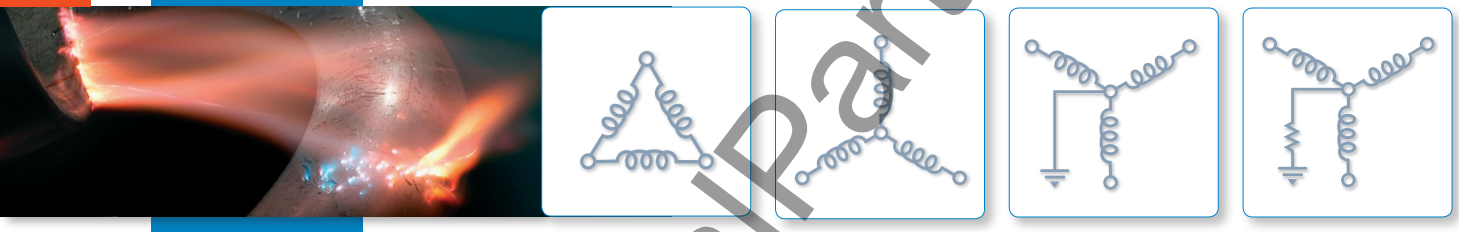
GARD

GEMINI

HIGH RESISTANCE GROUNDING SYSTEM



the power to protect

Instruction Manual C-102

IPC

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HIGH RESISTANCE GROUNDING SYSTEM

Gemini is a unique, fail safe, all-in-one neutral grounding system, combining 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 and 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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1 GENERAL DESCRIPTION

To increase reliability in High-Resistance-Grounded power systems, I-Gard has introduced the **Gemini** Grounding Resistor system, which you have purchased. The resistor provides a return path for hazardous capacitive currents, which can break down the system insulation under conditions of intermittent ground faults. The **Gemini** provides a dual resistor element to double the reliability of the resistor elements. Two separate elements are used to provide redundancy thus providing protection in the event of an open circuit failure of one of the elements.

A versatile ground fault relay I-Gard Type **GFR-RM** in the **Gemini** system indicates the presence of ground faults that may occur on the power system by current measurement within the Gemini unit itself, in addition to providing a monitor that will operate a local and remote Alarm if the value of the Grounding resistor elements changes to a lower or higher limit set by the user.

When a **single** ground fault occurs: **Gemini** controls and limits the fault current. **Gemini** provides alarms that indicate the presence of an active fault, and if equipped with the optional Pulsing relay, plant electrical personnel may follow a simple sequence to locate and isolate the fault without interrupting or opening circuit breakers. This allows for the uninterrupted operation of process equipment.

Faults are indicated by front panel lights. The TRIP lamp lights whenever a Ground Fault or a Resistor fault is detected. Separate lights for GROUND FAULT and RESISTOR FAULT indicate which condition caused the Trip lamp to turn on. Two form C contacts are available for the user's application - one for Ground Fault and the other for Resistor Fault. See Wiring Diagram Figure 1 for details.

A meter scaled from 0-100% is supplied on the front of the panel. This meter indicates the amount of ground fault current present relative to the let through current.

A TEST button on the front panel allows a confidence check of the Gemini unit. When pressed, the Gemini will go into the Alarm condition with SYSTEM HEALTHY lamp extinguishing and RESISTOR FAULT, GROUND FAULT, and TRIP lamps illuminating. The corresponding contacts will operate to energize the user's devices if connected.

If supplied, the **Gemini** pulsing system, when activated, will cyclically limit the ground fault current to 100% and 50% of the available round fault current. The user can modify the duration of this pulse to suit the requirements of his sensing device.

The cyclic pulsing, combined with the hand held current sensor and a single line diagram, can be used to rapidly locate a ground fault even in a very complex power distribution system.

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Figure 1 Close up of Front Panel

2 INSTALLATION

⚠ DANGER

Hazard of Electrical Shock, Burn or Explosion

Qualified personnel must perform all installation, servicing and testing referred to in this manual. All power should be disconnected prior to removing covers or enclosures and where live conductors may otherwise be exposed.

Failure to observe these precautions may result in death or severe personal injury.

Catalogue Numbers for the Gemini are GS-480-5 for 480V and GS-600-5 for 600V, 5A resistor units.

Please ensure before installation of the unit that the correct version has been supplied!

On receipt, carefully open the protective shipping carton, remove all packing material and visually inspect the unit. If the unit is damaged do not proceed with installation. Contact I-Gard at the numbers listed on the final page of this document.

Loosen the two door bolts and open the front door to access the mounting holes.

Gemini is housed in a NEMA 3R enclosure, see Figure 4 for installation details.

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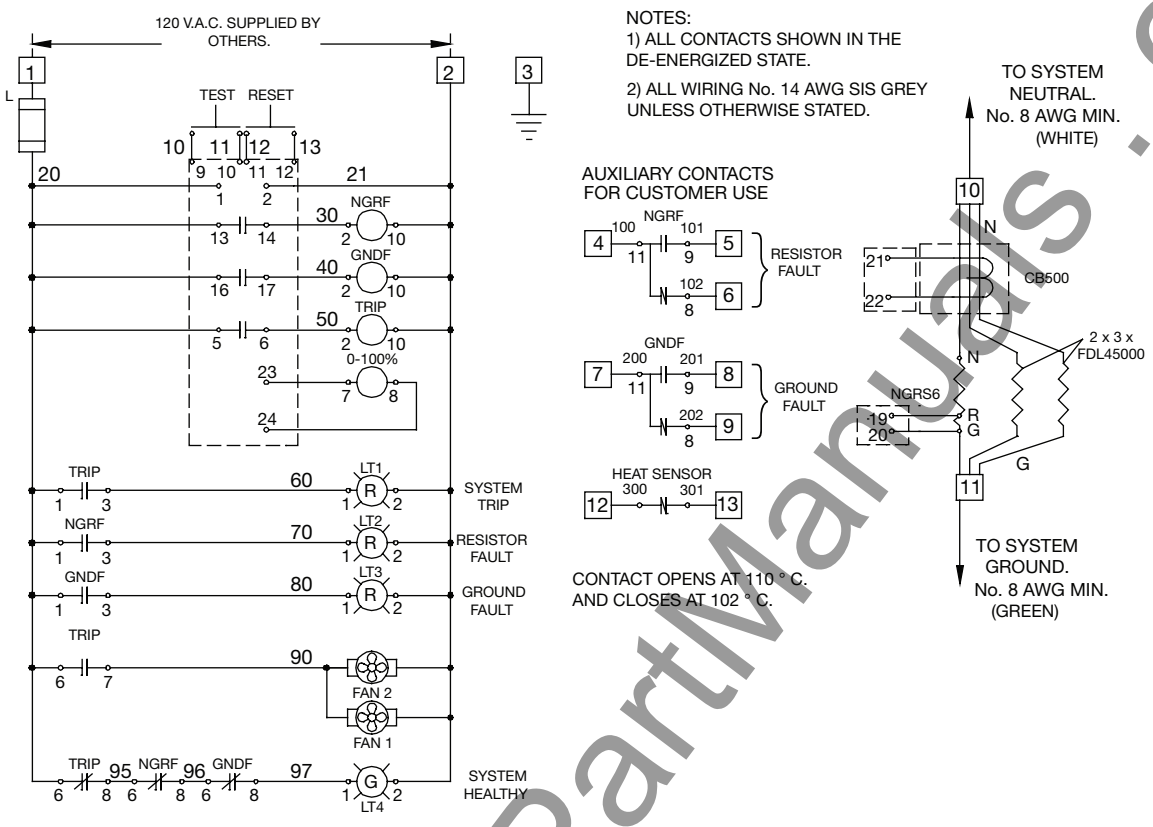

Figure 2 Wiring Diagram for Gemini

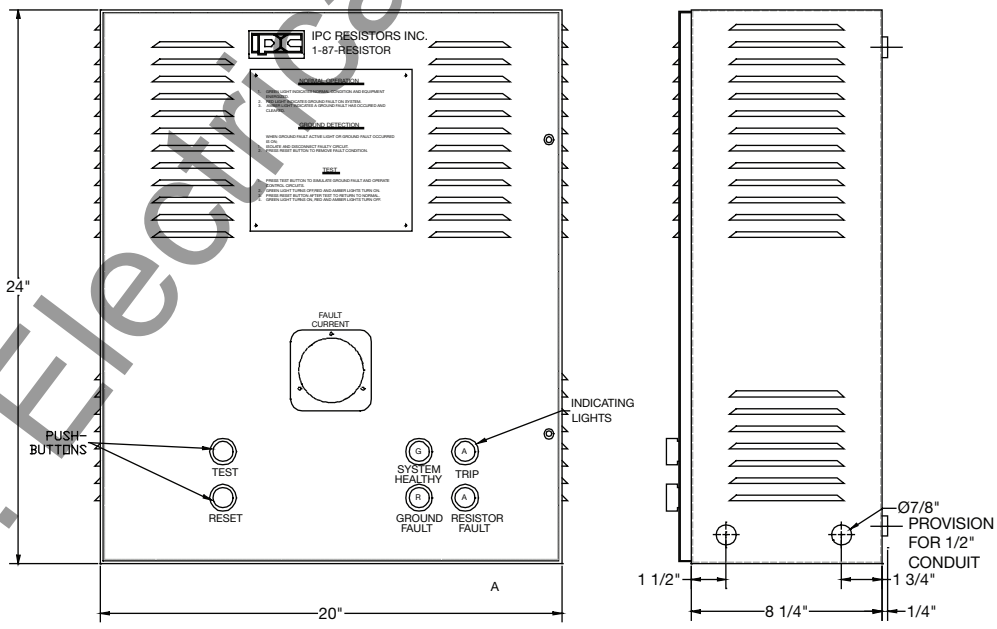

Figure 3 Outside Dimensions

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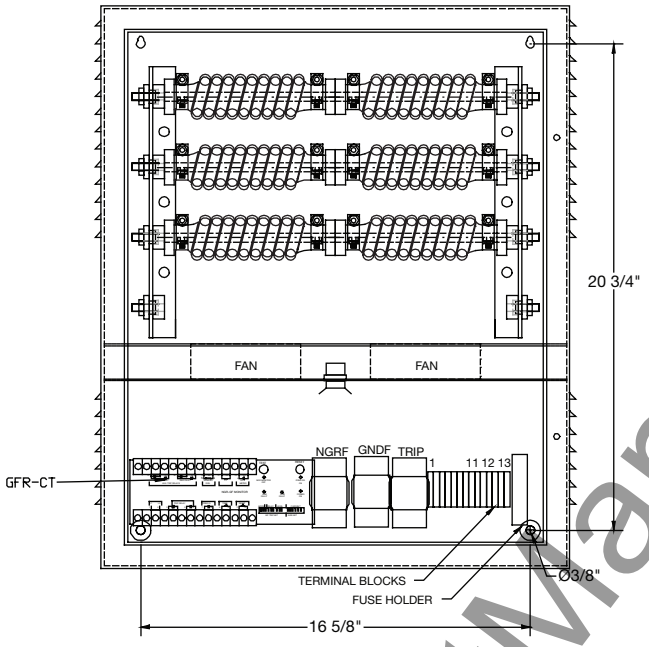

Figure 4 Outside Dimensions

The wall mounting holes are located in the rear corners of the cabinet (Figure 4). The distance between mounting holes is 20 3/4" or 527 mm. in the vertical direction and 16 5/8" or 422.3 mm. in the horizontal direction. Mounting holes are 3/8" or 9.5 mm. wide allowing for the use of 5/16" or 9 mm. diameter fasteners.

Mount the **Gemini** securely to the wall in accordance with local codes. Once the **Gemini** is securely mounted, proceed to the connections. Electrical access to the interior is provided by means of eight knock out openings (See Figure 3) suitable for 1/2" conduit. Two are located near the bottom of each side and two are located in the bottom near each sidewall. **Gemini** requires a 120 VAC supply. Proper connection for the 120 VAC supply is as follows. Connect line to terminal 1, neutral to terminal 2 and ground to terminal 3. Recommended supply cable size is 14 or 12 AWG. Connect the system neutral (neutral bushing of the transformer) to the point identified as N (#10 on terminal block) and the system ground to the point identified as G (#11 on terminal block).

Both the Canadian Electrical Code and the National Electrical Code require a minimum size of 8 AWG if conduit is used and size 6 AWG if exposed wiring is used.

IMPORTANT NOTE: System Neutral (N) must be connected to the X0 point of the main power transformer on wye systems or the X0 point of the zigzag transformer for delta systems. There should be no other connections to this point. All conductors must be insulated to the full system voltage.

Following installation, always perform a final inspection. All foreign objects must be removed. All conductors must be secured in the proper positions before closing the door and energizing the system. DO NOT ENERGIZE the **Gemini** unless the door is closed and secured by the two bolts provided.

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3 OPERATION

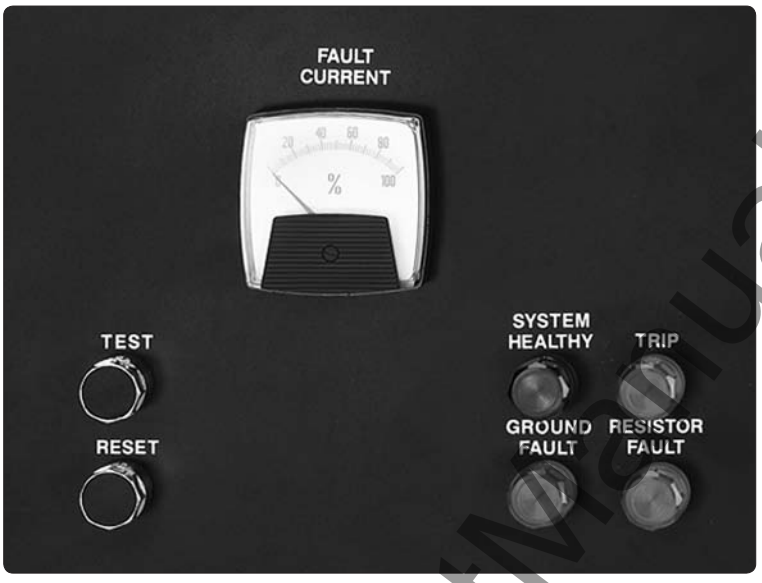

Figure 5 Gemini Control Panel

Upon energizing the control panel only the green SYSTEM HEALTHY light will turn ON signifying that no ground faults are on the system and the **Gemini** is receiving control voltage.

Verify the **Gemini** condition by pushing the TEST button and holding for the delay time set on the **GFR-RM.** This causes the **GFR-RM** to trip. The green light turns OFF, the red GROUND FAULT light turns ON and the fans activate. This confirms that control voltage is available, the **GFR-RM** is functioning and the fans are operational.

Push the RESET button to restore the system to normal operational status. The red GROUND FAULT, RESISTOR FAULT and TRIP lights will go OFF and the green SYSTEM HEALTHY light will turn ON, and the fans stop. (The meter may indicate a slight leakage). The **Gemini** is now ready to monitor the distribution system.

When a ground fault occurs the potential between the system neutral and ground will increase causing the meter to display the fault level which may be any value between 0 and 100% of 5A. This current is also being monitored by the FAULT CURRENT ammeter. If the fault current magnitude is greater than the pick up setting of the **GFR-RM** and the duration is greater than the time delay setting on the **GFR-RM**, the **GFR-RM** will trip, changing the state of the GROUND FAULT TRIP contacts. The green SYSTEM HEALTHY light turns OFF and the red GROUND FAULT and TRIP lights turn ON, and cooling fans activate.

By adjustment of the GFR-RM relay, the ground fault pickup level can be set from 5% to 50% of the 5A let-through current. The time delay can be adjusted from 60mS to 3.15s. This allows the **Gemini** settings to be adjusted for the unique requirements of each system in order to avoid nuisance tripping.

Both ground fault pickup level and time delay are adjusted using the bank of Dipswitches located on the front plate of the **GFR-RM** relay, which is located inside the **Gemini** enclosure. (Refer to I-Gard Manual IM-GFR-RM) for complete details of this relay).

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The factory default settings are as shown in Table 1.

TABLE 1 GFR-RM DEFAULT SETTINGS

FUNCTION	SETTING	SWITCH NO.	DIRECTION
MODE	NON FAILSAFE	1	DOWN
	MEMORY ON	2	DOWN
DELAY	60mS	3	DOWN
		4	DOWN
		5	DOWN
		6	DOWN
		7	DOWN
LEVEL	50% IGMAX	8	UP
		9	UP
		10	UP
CURRENT	5A, 1000:1 CT	1	DOWN
		2	DOWN
		3	DOWN
		4	DOWN
		5	DOWN
		6	DOWN

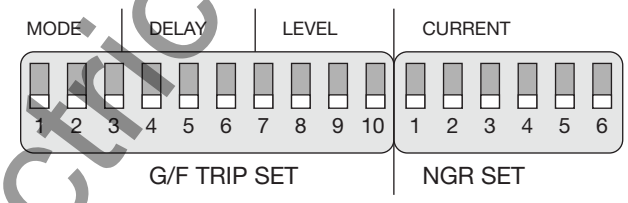

Figure 6 GFR-RM Dipswitch

4 MAINTENANCE

Gemini is designed and constructed to operate properly with minimal maintenance, however, it is recommended that it be tested on a regular basis at a **minimum** of once every six months. The self-test feature allows for a rapid and reliable test.

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Self-Test Procedure:

Push the TEST button located on the front of the panel. The following changes take place.

a) The red GROUND FAULT light turns ON.
b) The green SYSTEM HEALTHY light turns OFF
c) The TRIP light turns ON
d) The internal fans turn on.
e) Auxiliary contacts change state.

This change confirms that your Gemini is functioning normally. Return the Gemini to normal operating mode by pushing the RESET button.

Troubleshooting:

If a lamp fails to function, check the bulb. If a bulb is blown, replace with. (Cutler Hammer E22R2)
If the fans fail to start, remove power and check the electrical connections.
If all power fails, check the internal fuse and replace it if necessary. (Edison EDCC5 fuse (5A))
For complete testing it will be necessary to apply a short to the system.

⚠ DANGER
Hazard of Electrical Shock, Burn or Explosion
Qualified personnel must perform testing referred to in this manual. All power should be disconnected prior to making any connections or disconnection. All exposed metallic enclosures must be grounded.
Failure to observe these precautions may result in death or severe personal injury.

This should be done at a convenient downstream location (and not at the main substation for example) using a suitable low impedance protected by a HRC fuse mounted in a grounded enclosure for safety. This test should only be performed when there is no other fault indicated on the system.

Cleaning:

To clean the **Gemini**, first disconnect the electrical power. Using compressed air, blow away any accumulated dust and foreign material. The exterior may be cleaned using a slightly damp cloth. Ensure that the **Gemini** is completely dry before energizing. Close the front door and reconnect electrical power. Test the unit again before returning to normal service.

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5 APPENDIX 1

5.1 High-Resistance Grounding

Both the Canadian Electrical Code, Part 1, C22.1-98 and the National Electrical Code, NFPA 70 1999, approve the use of high-impedance grounding neutral systems up to 1000 V. A.C. where the ground fault current is limited to 5 amperes or less. These new changes to the electrical code allow users of the Gemini to maintain a ground fault current of 5 amperes or less on their electrical distribution system without shutting down because of a single ground fault, thereby avoiding unscheduled down times. Gemini users can locate, isolate and repair faulty equipment at convenient time.

The reason for limiting ground fault current by resistance grounding may be one or more of the following, as indicated in IEEE Std. 142-1991, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems, pp. 25-26.

1) To reduce burning and melting effects in faulted electric equipment, such as switchgear, transformers, cables, and rotating machines.
2) To reduce mechanical stresses in circuits and apparatus carrying fault currents.
3) To reduce electric-shock hazards to personnel caused by stray ground-fault currents in the ground return path.
4) To reduce arc blast or flash hazard to personnel who may have accidentally caused or who happen to be in close proximity to the ground fault.
5) To reduce the momentary line-voltage dip occasioned by the occurrence and clearing of a ground fault.

To secure control of transient over voltages while at the same time avoiding the shutdown of a faulty circuit on the occurrence of the first ground fault.

5.2 Definitions and Applicable Standards

Grounding means a permanent and continuous conductive path to the earth with sufficient ampacity to carry any fault current liable to be imposed on it, and of a sufficiently low impedance to limit the voltage rise above ground and to facilitate the operation of protective devices in the circuit;

Bonding means a low impedance path obtained by permanently joining all non-current-carrying metal parts to assure electrical continuity and having the capacity to conduct safely any current likely to be imposed on it;

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250-36. High-Impedance Grounded Neutral Systems

High-impedance grounded neutral systems in which a grounding impedance, usually a resistor, limits the ground-fault current to a low value shall be permitted for 3-phase ac systems of 480 volts to 1000 volts where all of the following conditions are met.

1) The conditions of maintenance and supervision ensure that only qualified persons will service the installation.

2) Continuity of power is required.

3) Ground detectors are installed on the system.

4) Line-to neutral loads are not served.

High-impedance grounded neutral systems shall comply with provisions (a) through (f).

a) ***Grounding Impedance Location*** The grounding impedance shall be installed between the grounding electrode conductor and the system neutral. Where a neutral is not available, the grounding impedance shall be installed between the grounding electrode conductor and the neutral derived from a grounding transformer.

b) ***Neutral Conductor*** The neutral conductor from the neutral point of the transformer or generator to its connection point to the grounding impedance shall be fully insulated.

The neutral conductor shall have an ampacity of not less than the maximum current rating of the grounding impedance. In no case shall the neutral conductor be smaller than No. 8 copper or No. 6 aluminum or copper-clad aluminum.

c) ***System Neutral Connection*** The system neutral connection shall not be connected to ground except through the grounding impedance.

d) ***Neutral Conductor Routing*** The conductor connecting the neutral point of the transformer or generator to the grounding impedance shall be permitted to be installed in a separate raceway. It shall not be required to run this conductor with the phase conductors to the first system disconnecting means or overcurrent device.

e) ***Equipment Bonding Jumper*** The Equipment bonding jumper (the connection between the equipment grounding conductors and the grounding impedance) shall be an unspliced conductor run from the first system disconnecting means or overcurrent device to the grounded side of the grounding impedance.

f) ***Grounding Electrode Conductor Location*** The grounding electrode conductor shall be attached at any point from the grounded side of the grounding impedance to the equipment grounding connection at the service equipment or first system disconnecting means.

CSA Canadian Electrical Code Part 1, C22.1-98 Pg. 105-106

10-1100 Scope.

Rules 10-1102 to 10-1108 apply to the use of neutral grounding devices used for the purpose of controlling the ground fault current or the voltage to ground of an alternating-current system.

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10-1102 Use.

1) Neutral grounding devices shall be permitted to be used only on a system involving a true neutral or an artificial neutral, where the line to neutral loads are not served.

2) Where a neutral grounding device is used on an electrical system operating above 5 kV, provision shall be made to automatically de-energize the system on the detection of ground fault.

3) Where a neutral grounding device is used on an electrical system operating at 5 kV or less, provision shall be made to automatically de-energize the system on the detection of ground fault, unless

a) The ground fault current is controlled at 5 A or less; and

b) A visual or audible alarm, or both, clearly identified to indicate the presence of a ground fault is provided.

10-1104 Neutral Grounding Devices.

1) Neutral grounding devices shall be specifically approved for the application.

2) Only neutral grounding devices with a continuous rating shall be permitted where provision is not made to de-energize the system on the detection of a ground fault.

3) Neutral grounding devices not having a continuous rating shall be permitted where:

a) Provision is made to automatically de-energize the system on the detection of a ground fault; and

b) The time rating of the device is coordinated with the time/current rating of the protective device on the system.

4) Neutral grounding devices shall have insulation voltages at least equal to the line-to-neutral voltage.

10-1106 Location of Neutral Grounding Devices and Warning Signs.

1) All live parts of neutral grounding devices shall be enclosed or guarded in compliance with Rule 2-202.

2) Neutral grounding devices shall be placed in a location that is accessible only to qualified persons to perform inspection, testing, and maintenance of the neutral grounding device.

3) Neutral grounding devices shall be placed in a location so that heat dissipation from the device under ground fault conditions will not damage or adversely affect the operation of the device or other equipment.

4) Where neutral grounding devices are used, warning signs indicating that the system is impedance grounded and the maximum voltage at which the neutral may be operating relative to ground shall be placed at the:

a)Transformer or generator, or both; and

b) Consumer's service switch gear or equivalent; and

c) Supply authority's metering equipment.

10-1108 Conductors Used with Neutral Grounding Devices.

(1) The conductor connecting the neutral grounding device to the neutral point of the transformer, generator, or grounding transformer shall be:

a) Insulated for the nominal system voltage; and

b) Identified white or natural grey; and

c) Sized to conduct the rated current of the neutral grounding device, and in no case less than No. 8 AWG; and

d) Installed in accordance with other appropriate Rules of this Code.

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2) The conductor connecting the neutral grounding device to the neutral point of the transformer, generator, or grounding transformer shall not be grounded.

3) The conductor connecting the neutral grounding device to the system grounding electrode shall be:

a) A copper conductor which shall be permitted to be insulated or bare; and

b) Identified green if insulated; and

c) Sized to conduct the rated current of the neutral grounding device, and in no case less than No. 8 AWG in size; and

d) Installed in accordance with other appropriate Rules in this Code

CAN/CSA M421-93 Use of Electricity in Mines

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Neutral-grounding Devices

The neutral grounding device shall be continuously monitored by a device that will trip the supply if an open circuit in the neutral grounding device occurs.

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4.7.3.4.1 Resistance Grounding

Where on-board three-phase, isolation power transformers larger than 20 kV•A and operating at voltages in excess of 300 V are used, the following requirements shall apply:

a) Except as permitted by item (g), either a direct or derived neutral shall be grounded through a resistor at the power source to limit the prospective ground-fault current to 25 A or less.

b) A grounding circuit shall originate at the grounded side of the resistor and extend along with the power conductors to ground the frames of all electrical apparatus supplied from the circuit, except where the steel structure provides the ground-return path as permitted by clause 4.7.5 (b).

c) The size of the grounding conductors may be reduced provided the ampacity exceeds the prospective ground-fault current.

d) Neutral-grounding resistors shall be isolated by elevation or guarded in accordance with Clause 4.7.4.1.

e) Neutral-grounding resistors shall be rated and protected in accordance with Clause 3.6.2.

f) Ground-fault protection with a minimum tripping ratio of 5 shall be provided, except as permitted by items (g) and (h).

g) Acceptable ungrounded systems with ground-fault detection may be used for specialized drive circuits.

h) Ground-fault detection, which alerts the operator to the ground fault, may be used instead of ground-fault protection where de-energizing a circuit can create a machine-operation hazard.

6 ADDITIONAL INFORMATION

If you require more information or experience problems with your equipment that persist after taking the steps identified in this manual, contact I-Gard customer service.

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7 INSTRUCTION MANUALS

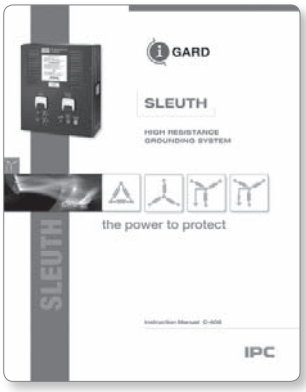
C-101 Stoplight
High Resistance Grounding
System Manual

C-102 Gemini
High Resistance Grounding
System Manual

C-105 Fusion
Ground Fault Protection
System Manual

C-322 MGFR
Ground Fault Relay Manual

C-407 GCHK-100 Mining Relay
Ground Fault Protection
System Manual



C-408 Sleuth
High Resistance
Grounding System Manual

C-409 DSP OHMNI
High Resistance
Grounding System Manual

C-403 GFR-RM SIGMA
Resistor Monitoring
and Ground Fault Relay

C-107 SENTINEL
High Resistance
Grounding System

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7615 Kimbel St., Unit 1
Mississauga, Ontario
Canada L5S 1A8

Phone 905-673-1553
Toll Free 1-800-737-4787
Fax 905-673-8472
e-mail: sales@i-gard.com
www.i-gard.com