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From: Bob Hunter
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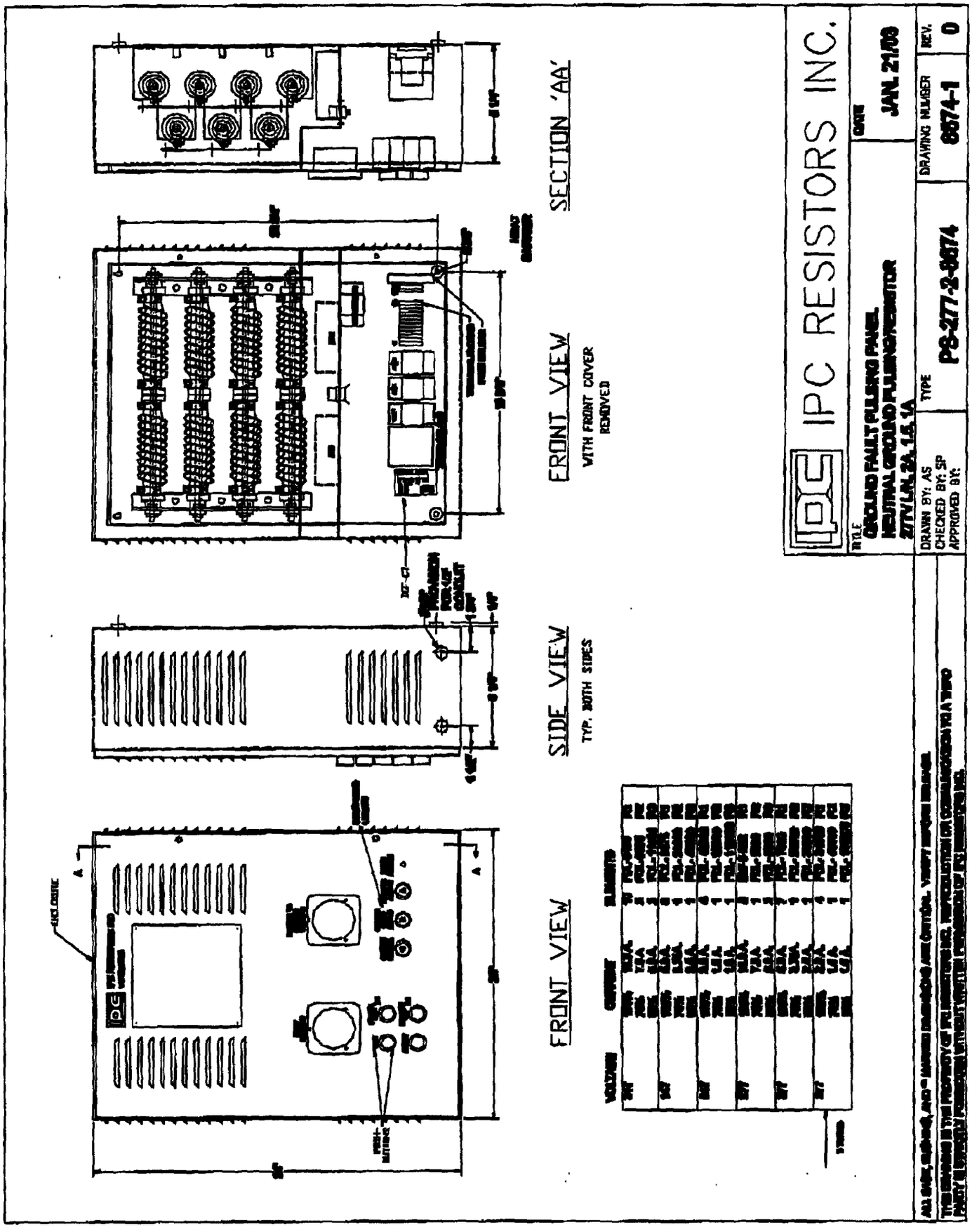
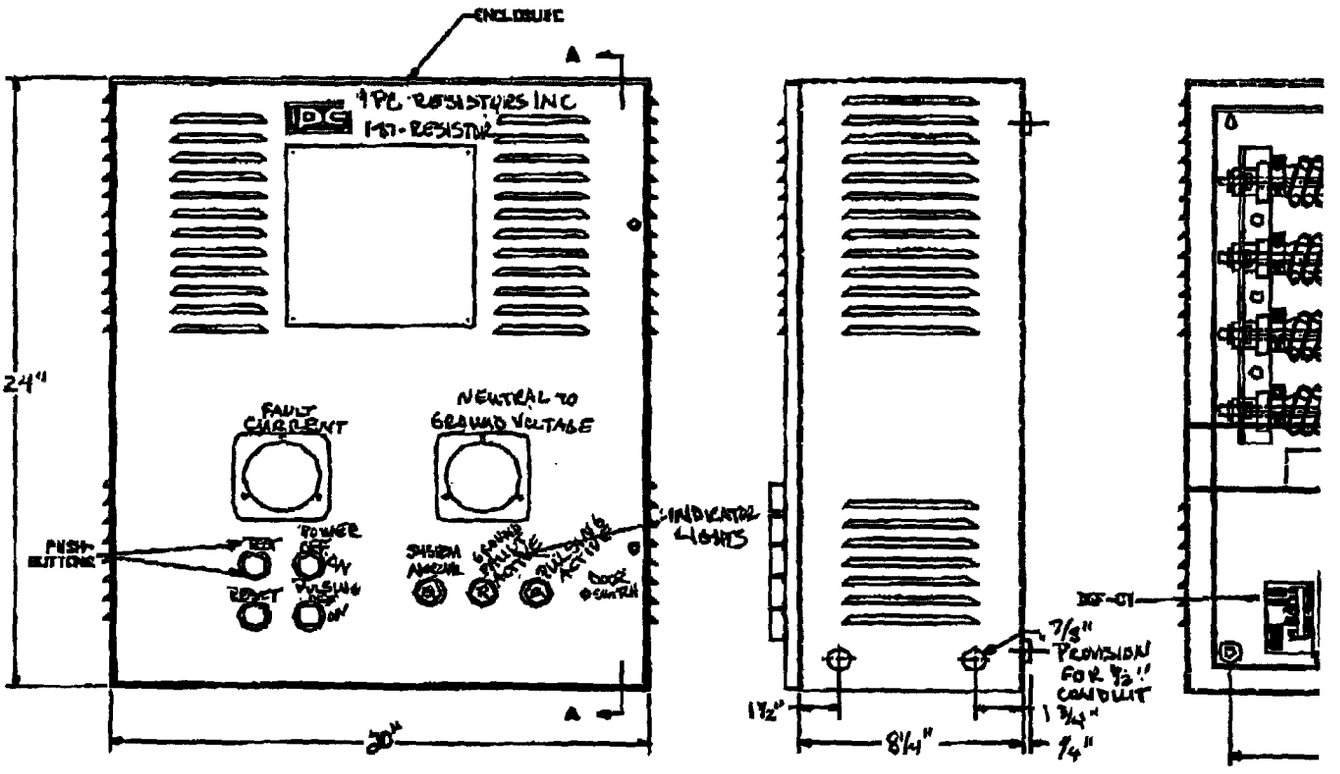
Specs on grounding resistor bank for cooling tower


SECTION 'AA'
FRONT VIEW
WITH FRONT COVER REMOVED
SIDE VIEW
TYP. BOTH SIDES
FRONT VIEW
IPC RESISTORS INC.
TITLE
GROUND FAULT PULSING PANEL
NEUTRAL GROUND PULSING RESISTOR
27V/LN, 2A, 1.5, 1A
DATE
JAN. 21/03
DRAWN BY: AS
CHECKED BY: SP
APPROVED BY:
TYPE
P8-277-2-8674
DRAWING NUMBER
8674-1
REV.
0



VOLTAGE	CURRENT		ELEMENTS		
24V	[illegible]	10.0A.	10	FOL-[illegible]	R1
	7.0A	7.0A	2	FOL-[illegible]	R2
	[illegible]	4.0A.	2	FOL-[illegible]	R3
30V	[illegible]	8.0A.	8	FOL-[illegible]	R1
	7.0A	4.0A.	1	FOL-[illegible]	R2
	[illegible]	2.0A.	1	FOL-[illegible]	R3
60V	[illegible]	2.0A.	4	FOL-[illegible]	R1
	7.0A	1.0A.	1	FOL-[illegible]	R2
	[illegible]	1.0A.	1	FOL-[illegible]	R3
120V	[illegible]	7.0A.	8	[illegible]	R1
	7.0A	7.0A	1	FOL-[illegible]	R2
	[illegible]	4.0A.	1	FOL-[illegible]	R3
277	[illegible]	2.0A.	7	FOL-[illegible]	R1
	7.0A	1.0A.	1	FOL-[illegible]	R2
	[illegible]	2.0A.	1	FOL-[illegible]	R3
347	[illegible]	2.0A.	4	FOL-[illegible]	R1
	7.0A	1.0A	1	FOL-[illegible]	R2
	[illegible]	1.0A.	1	FOL-[illegible]	R3

← See Attached

TITLE
GROUND
NEUTRAL
277V LN.

DRAWN BY: AS
CHECKED BY:
APPROVED BY:

ALL BASE, BUSHINGS & MARKED DIMENSIONS ARE CRITICAL. VERIFY BEFORE RELEASE

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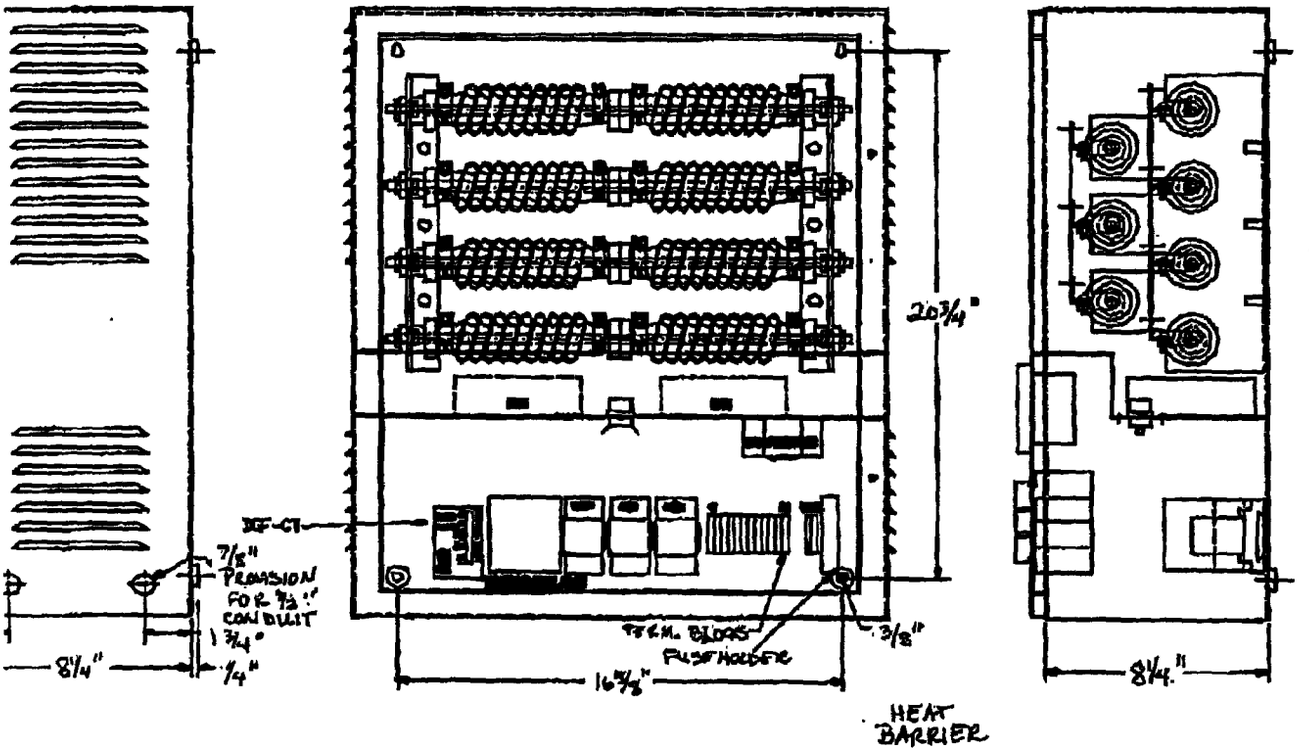

DE VIEW

P. BOTH SIDES

FRONT VIEW

WITH FRONT COVER REMOVED

SECTION 'AA'

See Attached

IPC RESISTORS INC.

TITLE GROUND FAULT PULSING PANEL NEUTRAL GROUND PULSING RESISTOR 277V LIN. 2A, 1.5, 1A			DATE JAN. 21/03
DRAWN BY: AS CHECKED BY: SF APPROVED BY:	TYPE PS-277-2-8674	DRAWING NUMBER 8674-1	REV. 0

ERASE
COMMUNICATION TO A
E IPC RESISTORS, INC.

VOLTAGE	CURRENT		ELEMENTS		
347	100%	10.0A	10	FDL-3400	R1
	75%	7.5A	2	FDL-6000	R2
	50%	5.0A	2	FDL-11500	R3
347	100%	5.0A	8	FDL-8675	R1
	75%	3.75A	1	FDL-23000	R2
	50%	2.5A	1	FDL-45000	R3
347	100%	2.5A	4	FDL-45000	R1
	75%	1.5A	1	FDL-62000	R2
	50%	1.0A	1	FDL-11300	R3
277	100%	10.0A	5	EW-5-652	R1
	75%	7.5A	1	FDL-5500	R2
	50%	5.0A	2	FDL-8600	R3
277	100%	5.0A	7	FDL-7500	R1
	75%	3.75A	1	FDL-23000	R2
	50%	2.5A	1	FDL-36000	R3
277	100%	2.0A	4	FDL-34600	R1
	75%	1.5A	1	FDL-45000	R2
	50%	1.0A	1	FDL-100000	R3

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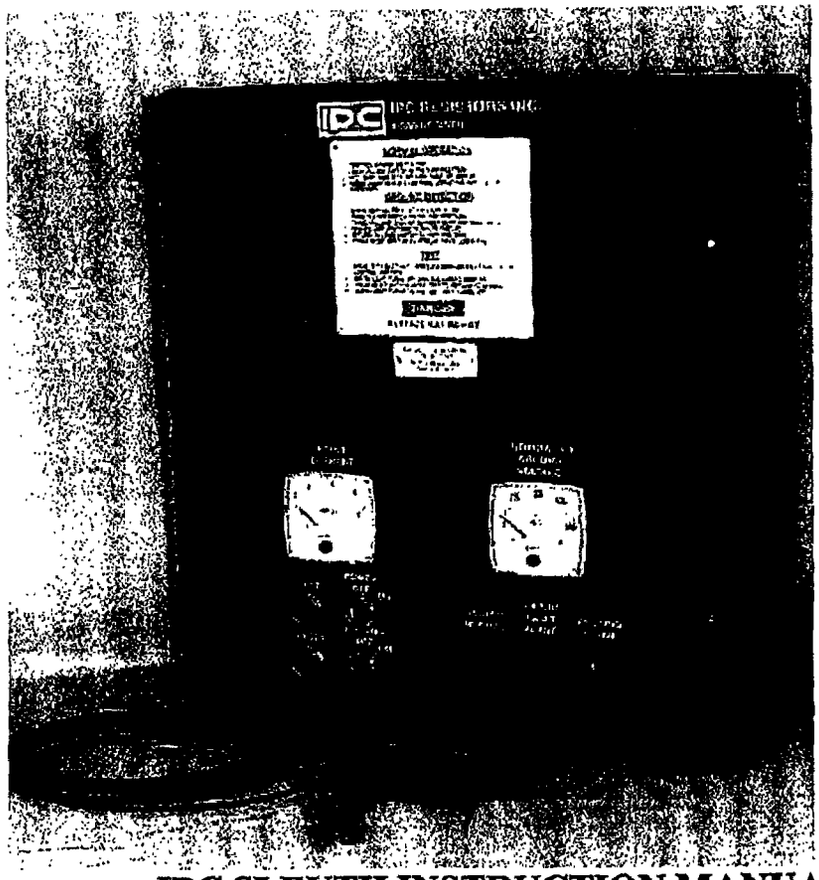
IPC RESISTORS INC.

SLEUTH

PULSING GROUND FAULT DETECTION SYSTEMS



IPC SLEUTH INSTRUCTION MANUAL

PUBLICATION NO. IM-PS REVISION 1

MARCH, 2000

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INSTRUCTION MANUAL

IPC RESISTORS INC.

SLEUTH

PULSING GROUND FAULT DETECTION SYSTEMS

INDEX:

1. **GENERAL DESCRIPTION**
2. **INSTALLATION**
3. **OPERATION**
4. **MAINTENANCE**
5. **STANDARDS AND DEFINITIONS**
6. **FOR ADDITIONAL INFORMATION**

1 GENERAL DESCRIPTION

IPC Sleuth is a neutral grounding device. The **IPC Sleuth** limits ground fault current to non-destructive levels allowing normal operations to continue and preventing over voltage damage.

IPC Sleuth is the ideal tool for sensing and locating ground faults quickly and easily. Ground faults are the most common form of electrical fault, accounting for a minimum of 85% of all electrical faults in a distribution system. When a ground fault occurs: **IPC Sleuth** controls and limits the fault current. Sleuth provides alarms that indicate an active fault, enabling plant electrical personnel to follow a simple sequence to locate and isolate the fault without interrupting or opening circuit breakers. This allows process equipment to continue operations uninterrupted.

IPC Sleuth announces the ground fault by means of lights on the panel front. In addition **IPC Sleuth** provides relay contacts which may be wired to a wide variety of alarm or annunciation devices.

IPC Sleuth is available in a variety of voltages. IPC Sleuth systems rated for 480 V. and 600 V. line to line systems are available for WYE or Delta systems. The latter make use of an artificial neutral. **IPC Sleuth** is also available for 2,400 V. and 4,160 V. systems. This manual is intended specifically for 277 V and 347 V systems.

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IPC Sleuth PS-277-2 through to PS-347-10 are wall mounted, high resistance, ground fault protection and location devices. PS-2400-5 and upwards are floor mounted units.

The numbers 277 and 347 in PS-277-2 and other part numbers refer to the system line-to-neutral voltage and correspond to the system voltages of 480 V. and 600 V. respectively. The last number in the part number refers to the maximum let through ground fault current. For instance a unit with the final number 2 will limit the ground fault current to less than 2 amps.

The **IPC Sleuth** pulsing system, when activated, will cyclically limit the ground fault current to 100%, 75%, and, 50% of the available ground 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 .

1.1 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 **IPC Sleuth** 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. **IPC Sleuth** 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.

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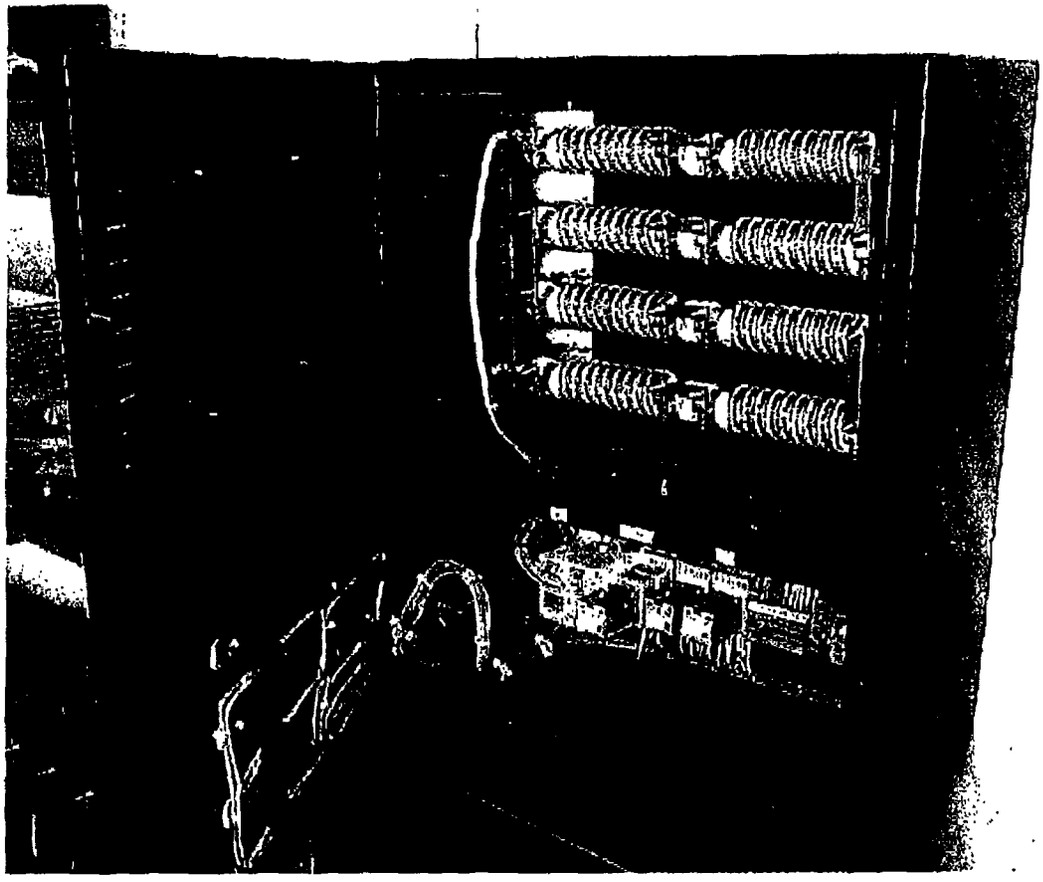
(4) To reduce arc blast or flash hazard to personnel who may have accidentally caused or who happen to be in close proximity to the ground fault.

(5) To reduce the momentary line-voltage dip occasioned by the occurrence and clearing of a ground fault.

(6) 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.



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2. INSTALLATION

IPC Sleuth is housed in a NEMA 2 indoor solid top drip proof enclosure and is to be mounted in accordance with local regulations.

Upon 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 IPC Resistors 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.

The mounting dimensions are indicated in this manual as well as in drawing #6090-1. Mounting dimensions for units utilizing an artificial neutral are indicated in drawing #6822-1.

The wall mounting holes are located in the rear corners of the cabinet 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.

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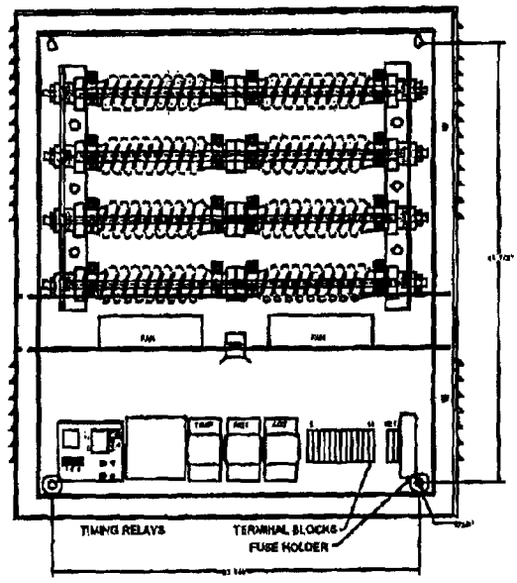

Mount the **IPC Sleuth** securely to the wall in accordance with local codes. Once the **IPC Sleuth** is securely mounted, proceed to the connections.

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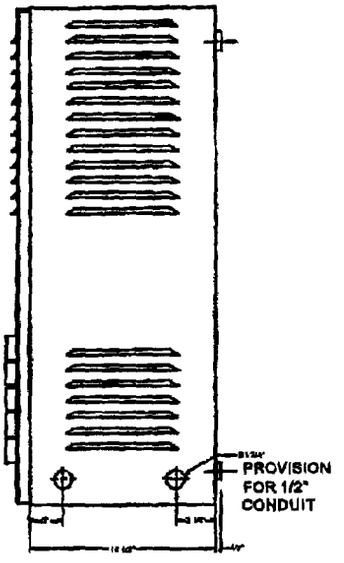

Electrical access to the interior is provided by means of eight knock out openings suitable for ½" conduit. Two are located near the bottom of each side and two are located in the bottom near each sidewall.

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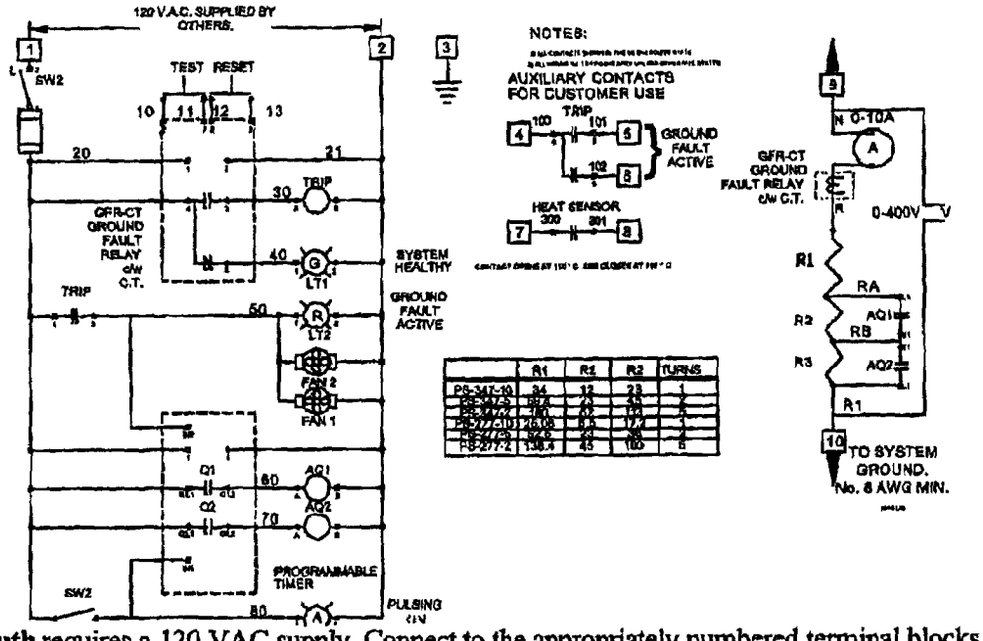

IPC Sleuth requires a 120 VAC supply. Connect to the appropriately numbered terminal blocks. Connect line to terminal 1, neutral to terminal 2 and ground to terminal 3. Recommended supply cable size is 14 or 12 AWG.

Connect the system neutral (neutral bushing of the transformer) to the point identified as N (#9 on terminal block) on drawing 6090 and the system ground to the point identified as G (#10 on terminal block) on the same drawing. 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 a single point only. All conductors must be insulated to the full system voltage.

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SLEUTH

PULSING GROUND FAULT DETECTION SYSTEMS

IPC Sleuth with an artificial neutral are connected differently. Four cables are required, three (3) phase connections and one ground connection as specified in drawing 6822-4.

Connect phase A to terminal #9
Connect phase B to terminal #10
Connect phase C to terminal #11
Connect ground to terminal #12.

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 ENEGIZE the **IPC Sleuth** unless the door is closed and secured by the two bolts provided.

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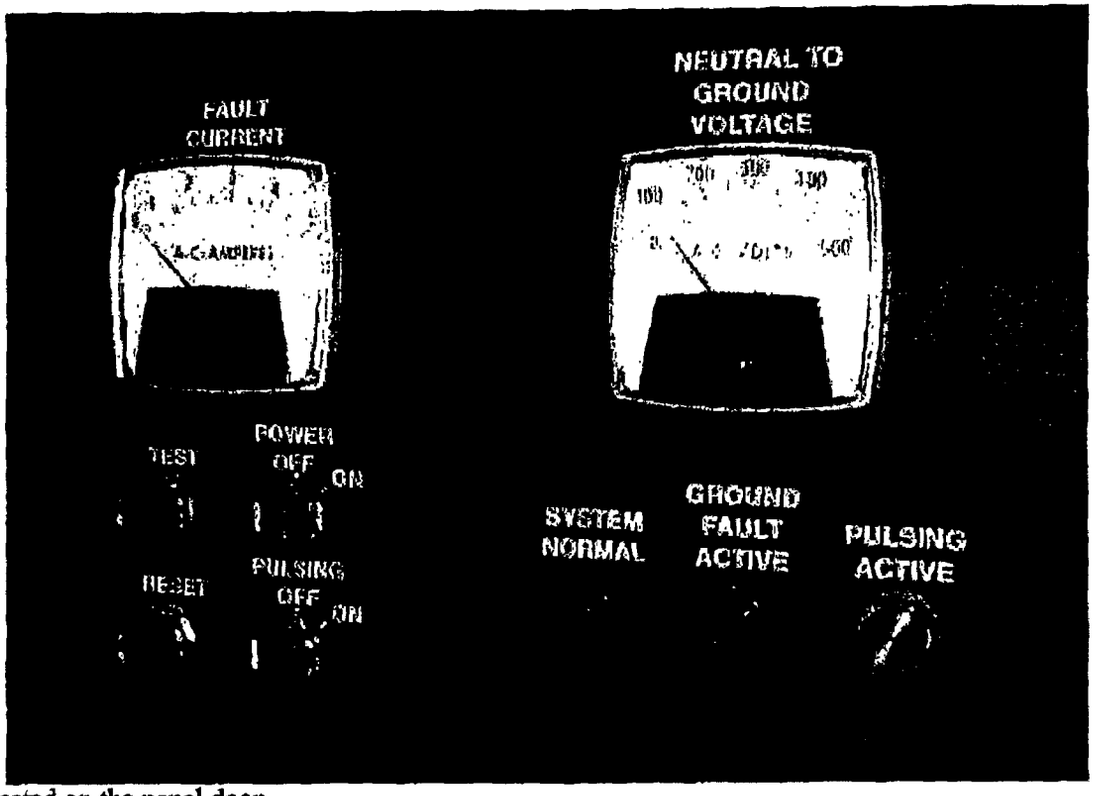
PULSING GROUND FAULT DETECTION SYSTEMS

3. OPERATION.

IPC Sleuth is energized by turning the rotary "POWER" switch to the ON position. The "POWER"



switch is located on the panel door.

Upon energizing the control panel the "SYSTEM HEALTHY", green light turns on signifying that no ground faults are on the system and the **IPC Sleuth** is receiving control voltage.

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

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Push the "RESET" button to reset the system to normal operational status. The red "GROUND FAULT ACTIVE" light goes off, the green "SYSTEM HEALTHY" light turns on and the fans stop. The **IPC Sleuth** is now ready to monitor the distribution system.

When a ground fault occurs the potential between the system neutral and ground elevates to the line to neutral voltage. This is reflected by the deflection of the voltmeter needle on the front door control panel. In addition to the voltage, the current is also being monitored. A deflection of the ammeter needle will indicate the magnitude of the fault current on the system. If the fault current magnitude is greater than the pick up setting of the GFR-CT and the duration is greater than the time delay setting on the GFR-CT, the GFR-CT will trip changing the state of the "TRIP" contacts. The green light turns off, the red light turns on and the fans activate.

The "GROUND FAULT ACTIVE" red light indicates the presence of a ground fault. Deflection on the voltmeter and ammeter on the **IPC Sleuth** indicate the magnitude of the neutral to ground voltage and the ground fault current available.

The ground fault pickup level can be set from 5% to 100% of the **IPC Sleuth** let through current. The time delay can be adjusted from 0.7s. to 10 s. this allows the user to adjust the IPC Sleuth settings to the unique requirements of his system in order to avoid nuisance tripping.

Both ground fault pickup level and time delay are adjusted using the knobs located on the front plate of he GFR-CT. The GFR-CT is located inside the **IPC Sleuth** enclosure. Rotating the controls in the clockwise direction increases the time delay or pick up level; counter-clockwise reduces these parameters.

IMPORTANT NOTE: Although the ground fault pickup level can be adjusted up to 100% of the let through current, this it is not recommended. Adjusting to a setting higher than 50% of the let through current may prevent the GFR-CT from detecting a fault.

IPC Sleuth can only pulse when tripped by an active ground fault. If ground fault current is available, pulses are visible on the ammeter

To initiate pulsing, rotate the "PULSING" switch to the "ON" position. The "PULSING ACTIVE" light turns on and the ground fault current changes from 100% to75% and 50% of available ground fault current.

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SAFETY NOTE: Tracing the ground fault signal involves working with live circuits. Additional care must be exercised whenever working in the proximity of live conductors.

IPC Sleuth creates a pattern of step pulses in the ground fault current. The pulses only appear in the faulted circuit. Use the I2000Flex current sensor and voltmeter to follow the pulse trail directly to the fault site.

Check for the presence of pulses by viewing the ammeter needle deflection. The needle will cycle between 100%, 75% and 50% of the available ground fault current. After confirming that the pulses are active, trace the source of the ground fault by:

a. Comparing readings of the front panel ammeter and the remote meter. Both meters will display the same step time pattern.
b. Attach the I2000Flex current sensor to a standard voltmeter as described below.
c. Use a single line diagram for the electrical distribution protected by the **IPC Sleuth**. Locate the pulsing ground fault current on the ground or neutral line as close to the **IPC Sleuth** as possible. Familiarize yourself with the values of the pulses on the hand held meter.
d. Check for the presence of pulses at branch points. Place the current sensor around the 3 phase conductors of each outgoing circuit. If you see no pulses this is not the faulted circuit. Move on to the next circuit
e. If current pulses are found, move down the circuit to the next branch point and repeat the procedure.
f. Follow the pulses. The pulsing ground fault signal will lead to the equipment or to the section of conductor containing the ground fault
g. Isolate the equipment or conductor from the circuit. Check the IPC Sleuth ammeter and voltmeter. If the voltage and current reads zero on these meters, the ground fault has been removed.
h. At this point the **IPC Sleuth** may be reset by rotating the "PULSING ACTIVE" switch to the "OFF" position and pushing the "RESET" button.
i. Repair or replace the equipment or conductor that was the source of the ground fault. The equipment or conductor may now be reconnected to the circuit.
j. Confirm that the ground fault has not returned by viewing the IPC Sleuth front panel.

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OPERATION OF THE I2000FLEX

IPC Sleuth comes complete with an I2000Flex current sensor loop. The I2000Flex loop is supplied with a dual banana to BNC adapter for easy connection to most standard meters. The I2000Flex will pick up and facilitate the display of the ground fault current pulses.

SAFETY NOTE: Read all safety and use information packaged with the I2000Flex before use.

Set the selector switch on the I2000Flex transducer to 10mV/A. The "POWER ON" light will flash on and off. A deflection of 0.25mV on the voltmeter with the transducer set to 10mV/A translates into a ground fault current of 2.5 Amps.

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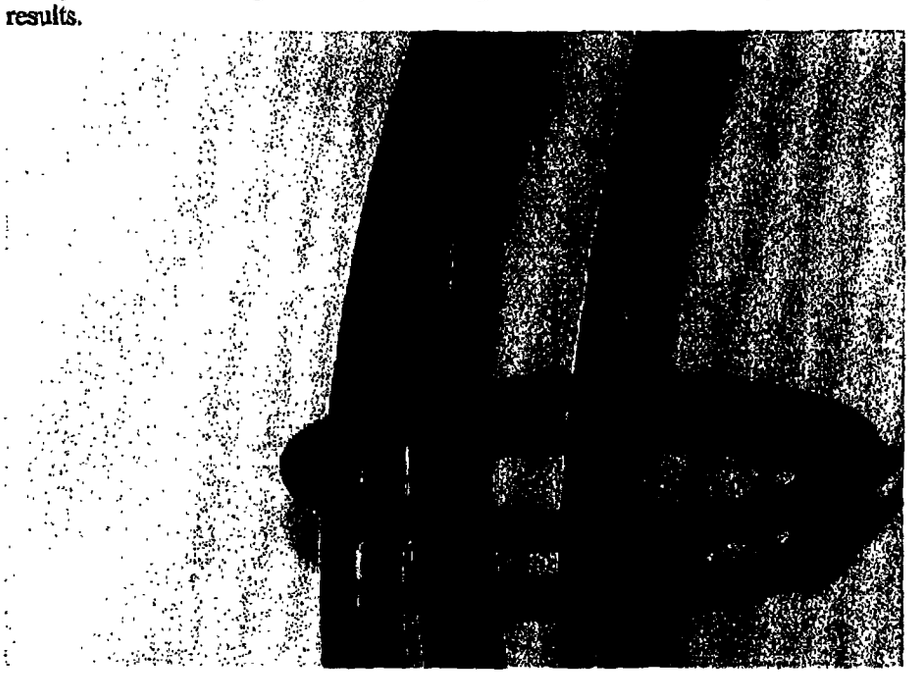
The I2000Flex requires a 9 Volt battery. Ensure that a fully charged battery is in place. The unit incorporates a flashing "Battery Low" light to indicate the battery is too low for correct measurement results.



Wrap the I2000Flex loop around all phases of the conductor. Any imbalance will be evident in meter deflection when the range is set to the appropriate setting. The ground fault current pulses will be visible in the meter deflection. Analogue meters provide easier reading during rapid pulsing. The pulse rate may be programmed to facilitate easier readings on digital meters.

When placing the sensor around the three phase conductors make sure that the arrow moulded into the sensor loop points downstream (toward the load) in order to provide proper readings.

Ensure that the junction point of the loop is held a minimum of 1" away from the conductors in order to minimize interference.

Additional information on the I2000Flex is available on the I2000Flex data sheet and at the address located at the end of this manual.

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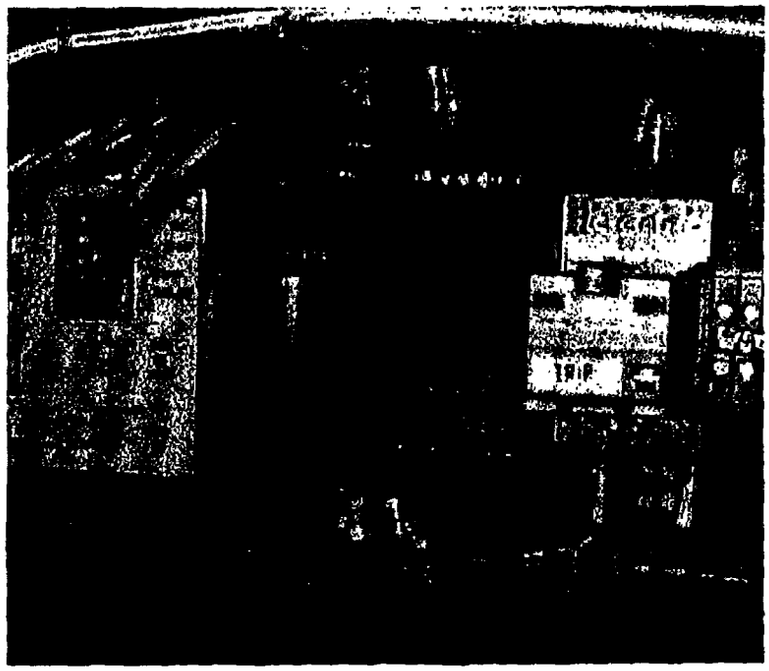
SLEUTH

PULSING GROUND FAULT DETECTION SYSTEMS



Pulse Duration

Pulse time duration may be varied by programming the LOGO logic controller located beside the GFR-CT. On the front of the LOGO are four arrow shaped buttons and two square buttons labelled "ESC" and "OK". Modify the pulse time settings by following this procedure.

a) Simultaneously press both the "ESC" and "OK" buttons
b) The display shows two choices "SET CLOCK" and "SET PARAM". Press the bottom arrow key to highlight "SET PARAM".
c) Confirm your choice by pressing the "OK" button twice.
d) The display will now show a cursor between available pulse delay settings. Determine which direction you wish the cursor to move in order to set the parameters of your choice.
e) There are three steps in one pulsing cycle. The entire cycle will take six times the number you program in seconds. If you program .5, the cycle will consist of three steps each 1 second long for a total of 3 seconds.

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HALMA GROUP COMPANY

f) Push the UP and DOWN arrow buttons to move the cursor. Continue to press the arrow buttons until you chosen parameter is reached.
g) Confirm your choice by pushing the "OK" key. The cursor disappears and **IPC Sleuth** will pulse using the newly set time duration.
h) Leave the programming mode by pushing the "ESC" button twice. **IPC Sleuth** will now return to normal operation.

IPC Sleuth will now remember and use the newly set pulsing times. In the event of a power failure to the control circuit, the **IPC Sleuth** will reset to the original factory set pulse times.

4. MAINTENANCE

IPC Sleuth is designed and constructed to reduce maintenance needs to a minimum. Test your **IPC Sleuth** every six months.

Test Procedure:
Push the "TEST" button located on the front of the panel. The following changes take place.

a) The red "GROUND FAULT ACTIVE" light turns on.
b) The green "SYSTEM NORMAL" light turns off.
c) The internal fans turn on.
d) Auxiliary contacts change state.

This change confirms that your **IPC Sleuth** is functioning normally. Return the **IPC Sleuth** to normal operating mode by pushing the "RESET" button.

If a lamp fails to function, check the bulb. If a bulb is blown, change it.

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.

To clean the **IPC Sleuth**, 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 IPC Sleuth 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. DEFINITIONS AND APPPLICABLE 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;

NEC 1999 pg. 70-87-88

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.

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 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 switchgear 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.

(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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4.5.2 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.

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(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, a service consultant is available through the following channels.

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