

Instruction Bulletin

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GFL-1000 Analyzer for Hospital Ungrounded Isolated Power Systems Class 4825



SQUARE D

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SECTION 1—INTRODUCTION

The GFL-1000 analyzer was initially developed for Square D engineers to test hospital ungrounded isolated power systems. Now, this unit has been made available to users who have a thorough understanding of isolated power systems and are trained to maintain and test hospital equipment. These individuals also should have completed the Square D training on how to operate the GFL-1000 analyzer and interpret the measurements.

DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- Only specially trained personnel who thoroughly understand hospital ungrounded isolated power systems are to use the GFL-1000 analyzer.
- Perform all tests in accordance with Article 517 of The National Fire Protection Association® (NFPA®) 70, The National Electrical Code® (NEC®), and NFPA 99 Standard for Health Care Facilities.
- Never use this unit in patient-occupied areas.

Failure to observe these instructions will result in death or serious injury.

Using the GFL-1000 analyzer, you can perform a complete test of hospital ungrounded isolated power systems, including:

- Testing all types of line isolation monitors (LIMs)
The analyzer can test both dynamic and static LIMs, which have alarm levels of 5 milliamperes or less. It does not require special adaptors for different types of LIMs or different voltages. The analyzer also can test the Square D 3-phase LIM, which is commonly used for operating room surgical table motors, laser equipment used in ophthalmology surgeries, and certain laminar airflow systems.
- Testing the impedance of isolated wire as required by NFPA 99 and NEC
The analyzer measures the grounding system impedance as required in NFPA 99, 1996 edition, paragraph 3-3.2.2.2. NFPA 99 requires the impedance to ground of either conductor of the ungrounded isolated power system to exceed 200,000 ohms. The GFL-1000 analyzer is also capable of this measurement directly, without use of special adaptors or extra test equipment.
- Testing the grounding system in patient care areas
NFPA 99, 1996 edition, requires that the grounding system be tested by voltage and impedance measurements. The GFL-1000 analyzer contains a high current, low voltage metering section that performs that testing.
- Specific tests that can be performed include:
 - Measuring line-to-line voltage (AC) of the hospital ungrounded isolated power system.
 - Measuring line-to-ground impedance of the hospital ungrounded isolated power system.
 - Testing the grounding system, including all power receptacles, ground receptacles, and permanently installed equipment.
 - Testing the alarm level of all LIMs.

Square D Field Services

Complete testing services are available from Square D Field Services. Field Services can provide assistance in a variety of areas, from installation to comprehensive testing and verification of the new equipment. Contact Field Services at 1-800-634-2003, 24-hours a day.

Field Services technicians can perform the following tests and inspections:

- Operational check of all equipment.
- Inspection of the entire installation for applicable code conformance.
- Testing of the hospital ungrounded isolated power system:
 - Line-to-line voltage measurement
 - Line-to-ground impedance measurements
 - LIM alarm level test
 - 20 A equipment grounding system test
- Recording of initial system hazard current readings for hospital records.
- Testing of the ground network including:
 - Power receptacle equipment grounds
 - Ground receptacles
 - Permanently installed equipment
- Training of hospital personnel:
 - Concepts, benefits, and safe use of isolated power
 - Proper maintenance procedures that included periodic testing and record keeping
- Delivery of the final report.

SECTION 2—RECEIVING, HANDLING, AND STORING

The shipping carton contains three pieces of equipment. See Figure 1.

- Analyzer
- Power line cord
- Ground cord for 20 A ground test (with insulated alligator clips)

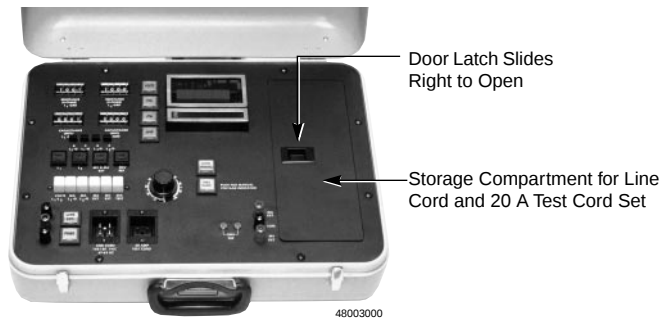


Figure 1: Locating the Line Cord

Before using or storing the GFL-1000 analyzer, inspect it for any possible shipping damage. Upon receipt, remove the unit from its packaging and inspect it for damage or signs of rough handling. If damage is apparent, notify the shipping agent and your Square D sales representative. If the damage necessitates returning the unit to the factory for service, first obtain a return material authorization (RMA) from the nearest Square D sales office or factory.

Always store the analyzer in a clean, dry location where the ambient temperature is between 5 °C (41 °F) and 30 °C (86 °F).

SECTION 3—PREPARATION

A full-size sample worksheet is provided in “Appendix A—Sample Worksheet” on page 12 to assist you in completing the test of the hospital ungrounded isolated power system. This form is supplied only as an example.

Inspecting the Equipment

Before performing any tests with the analyzer, inspect the equipment in the room following these guidelines.

Verify Equipment Operation

Inspect the electrical system equipment for physical damage such as cracked meters, scratches, and other potential damage. Record any physical or electrical deficiency and discuss with the appropriate people at the location to determine who is responsible for the repair. Have the equipment repaired at jobsite or note that it must be replaced.

Visually Examine the Wiring

1. Remove the isolation panel cover and circuit breaker deadfront. Examine the branch circuit wiring. Leave the cover off for testing later in this procedure.
2. Inspect the room ground and patient reference ground for damage, such as loose connections or frayed wires.
3. Verify that the circuit breakers are identified properly on the schedule.
4. Examine the receptacles, ground jacks, lights, switches, and other equipment for compliance to NEC Article 517. Ensure that they meet any other applicable electrical codes and have been installed using sound wiring practices.

SECTION 4—OPERATION

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE

- Before performing tests or measurements, make sure the unit is set to the appropriate corresponding power source, either from the line cord or an external power source.
- Do not change the line/external (LINE/EXT) setting while performing a test.
- Never perform tests or obtain measurements through the line cord when the GFL-1000 analyzer is plugged into a grounded power system.
- Do not connect 20 A test cord to grounded or isolated power source.

Failure to observe these instructions can result in injury or equipment damage.

Supplying Power to the GFL-1000 Analyzer

The GFL-1000 analyzer obtains supply power through the line cord and matching plug supplied with the unit. **Power to the unit must be 120 V, 50 or 60 Hz.** Do not attempt to use an adapter to supply another voltage. Because the analyzer is powered with 120 V, the unit can directly test 120 V hospital isolation systems through its power cord connection. See Figure 2.

If the isolation panel is not 120 V, for example 208 or 240 V, perform the isolation system tests and measurements through the external jacks on the analyzer. However, the GFL-1000 analyzer still requires power from a 120 V source. In this case, push down the LINE/EXT button to illuminate EXT and to set the unit for an external power source. See Figure 3.

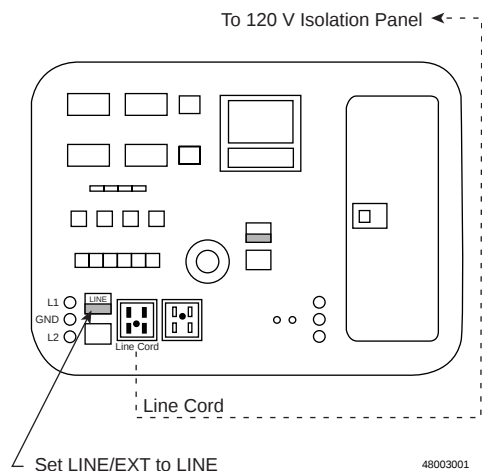


Figure 2: Direct Power Supply

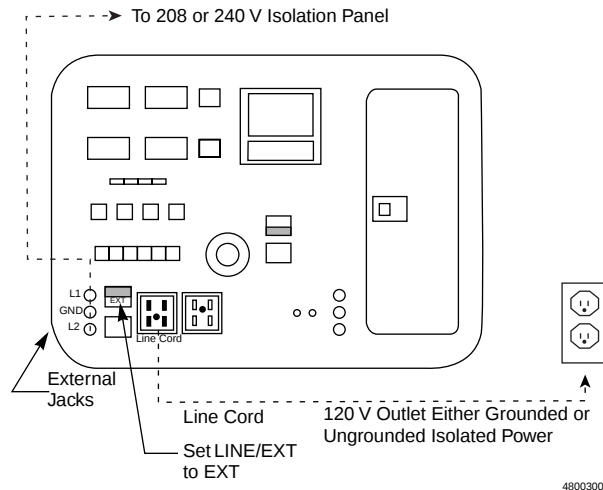


Figure 3: External Power Supply

The LINE/EXT button is the selector switch for the power supply. This button has two positions. The up position selects LINE and illuminates in yellow when the unit is powered by the 120 V isolation panel.

When pressed down for EXTERNAL, the button illuminates in green and takes readings from the external banana jacks. The jacks are labeled Line 1, Line 2, and Ground. When in the external position, faults and measurements will occur only on the external lines. Therefore, line-to-ground faults will not occur on the system supplying power to the GFL-1000.

Using the GFL-1000 Analyzer to Perform Measurements and Tests

Table 1 lists the measurements and tests described in this section that are to be performed with the GFL-1000 analyzer. The meter function buttons and corresponding meter display are detailed in Table 2.

Table 1: Uses of the GFL-1000 Analyzer

Measurements	Tests
Line-to-line (ac) voltage	Test the LIM alarm levels
Line-to-ground impedance	Test the performance of the 20 A equipment ground system

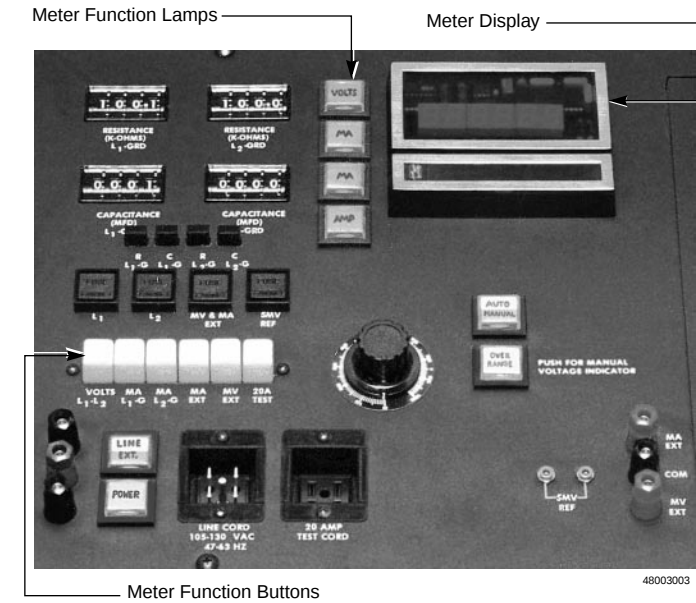


Figure 4: Meter Display Features

Table 2: Operation of the Meter Function Buttons

Button	Meter Function
VOLTS L1-L2	Selects voltmeter for line 1 and line 2. When selected, the top meter function lamp illuminates. Volts will be shown in the meter display.
MA L1-G	Selects ammeter for line 1 to ground. When selected, the 2nd meter function button illuminates. Milliamperes will be shown in the meter display.
MA L2-G	Selects ammeter for line 2 to ground. When selected, the 3rd meter function button illuminates. Milliamperes will be shown in the meter display.
Button	External Line Meter Function
MA EXT	Selects the ammeter for use with the external jacks, MA EXT, and COM.
MV EXT	Used with voltmeter and MV EXT jack and COM.
20 A TEST	Used for the 20 A ground test.

Measuring Line-to-Line Voltage (AC) Directly Through a 120 V Isolation Panel

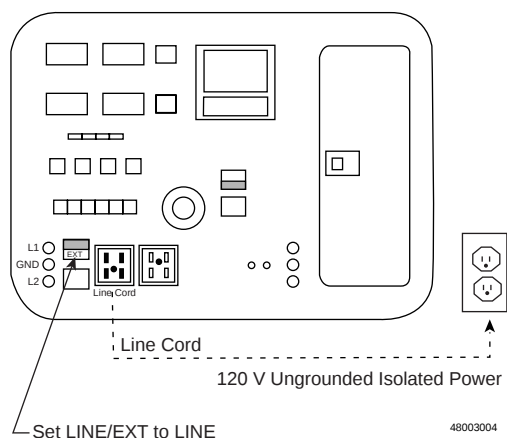


Figure 5: Reading Voltage Directly from 120 V Isolated Panel

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE

- On grounded power systems, do not press the MA L1-G or MA L2-G meter function switch to measure leakage current. Doing so can damage the GFL-1000, and thus void the warranty.
- Do not change the LINE/EXT setting while performing a test.
- Ensure that the LINE/EXT button is in the up position and that the yellow LINE is illuminated.

Failure to observe these instructions can result in injury or equipment damage.

1. Plug the line cord into the line cord receptacle. This connects to the secondary of the isolated transformer in the isolation panel. See Figure 5.
2. Press the POWER button on the GFL-1000 analyzer to turn on the power to the analyzer. See Figure 6.
3. Press LINE/EXT to the up position to select LINE. See Figure 6.
The meter display shows 0 (volts) and the VOLTS meter function indicator illuminates. The meter function buttons interlock so only one meter function can be selected at a time.

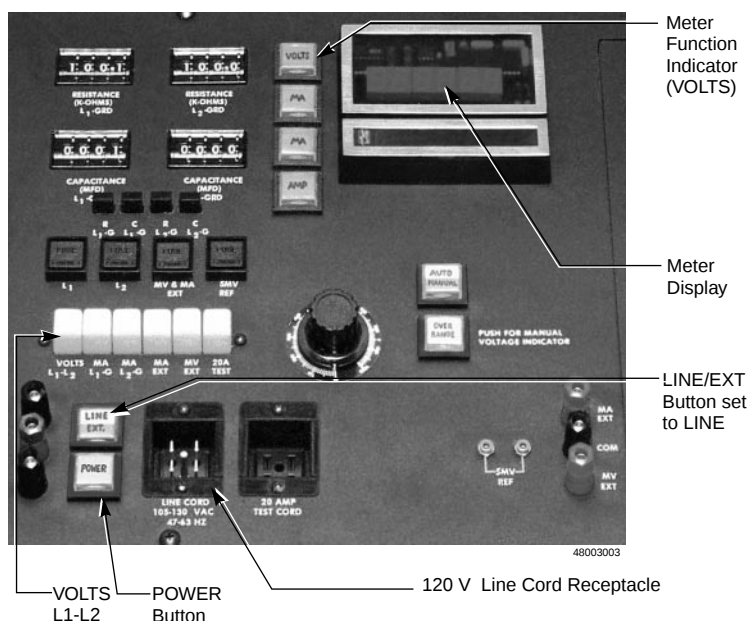


Figure 6: Setting for Line-to-Line Voltage (Direct)

NOTE: When making line voltage measurements only, do not apply faults between L1-Ground or L2-Ground.

4. Press the VOLTS L1-L2 meter function button. This measures the voltage across the two power conductors of the line cord. See Figure 6.
5. Record the voltage reading.
If using the worksheet, record under SYSTEM VOLTAGE (VAC).

Measuring Line-to-Line Voltage (AC) Through a 208 or 240 V External Power Source

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE

- On grounded power systems, do not press the MA L1-G or MA L2-G meter function switch to measure leakage current. Doing so can damage the GFL-1000, and thus void the warranty.
- Do not change the LINE/EXT setting while performing a test.
- Ensure that the LINE/EXT button is in the up position and that the yellow LINE is illuminated.

Failure to observe these instructions can result in injury or equipment damage.

1. Plug the line cord into a 120 V outlet.
2. Connect the L1, GND, and L2 external jacks from the GFL-1000 to the secondary of the isolated transformer in a 208 or 240 V isolation panel. See Figure 7.

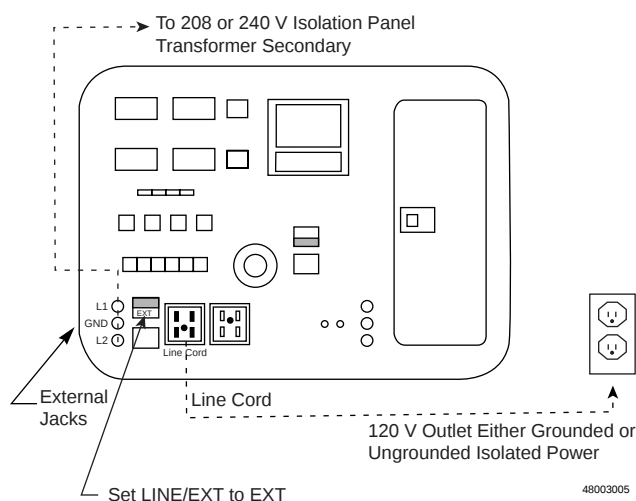


Figure 7: External Power Supply

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

Leads (exterior jacks) are energized. Always remove the leads from the power source first. Do not pull out the leads from the GFL while the leads are connected to the power source.

Failure to observe this instruction will result in death or serious injury.

3. Press the POWER button on the GFL-1000 analyzer to turn on the power to the analyzer. See Figure 8.
4. Press LINE/EXT to the down position to select EXT. See Figure 8.
The meter display shows 0 (volts) and the VOLTS meter function indicator illuminates. The meter function buttons interlock so only one meter function can be selected at a time.
5. Press the VOLTS L1-L2 meter function button. See Figure 8.
This measures the voltage across L1 and L2 external jacks.
6. Record the voltage reading.
If using the worksheet, record under SYSTEM VOLTAGE (VAC).

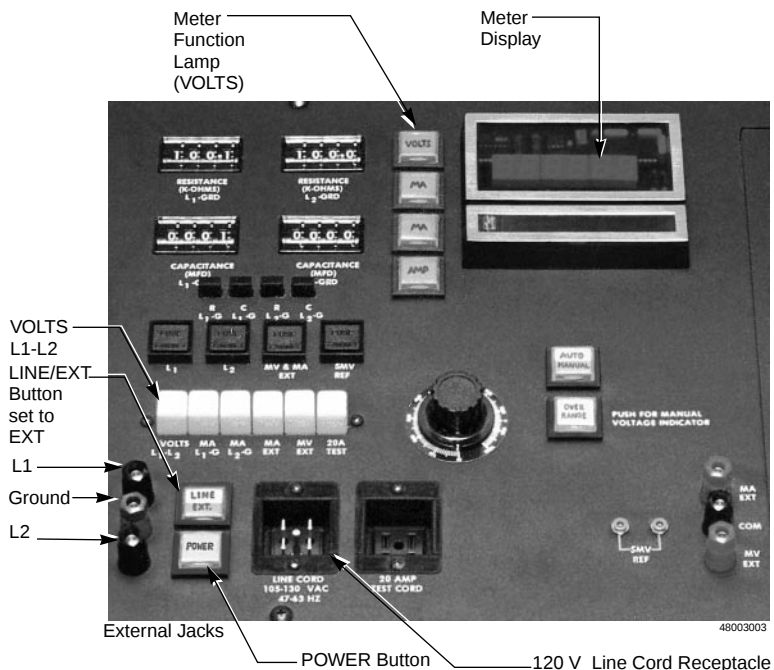


Figure 8: Setting for Line-to-Line Voltage (External)

Measuring Line-to-Ground Impedance

When measuring line-to-ground impedance, all branch circuits that originate from the isolation panel must be energized. For isolation panels with branch-circuit interlock systems, all branches must be measured individually.

Before making line-to-ground measurements:

1. Unplug all accessory equipment from the isolation system receptacles so that only the fixed wiring, which is connected to the isolation panel, is energized.
2. Turn off all permanently mounted equipment in the room, such as X-ray viewers and surgical lights.
3. Turn off all meter function switches on the GFL-1000 analyzer.

Both MA L1-G and MA L2-G measurements must be taken. These values, together with the VOLTS L1-L2, determine individual line impedance according to the formulas given in this procedure. See Figure 9.

To take the measurement:

1. Press the test button on the LIM and hold in for readings taken in step 2. Pressing the test button removes the ground from the LIM. This is in accordance with the NEC.
2. Alternately press the MA L1-G and MA L2-G meter function buttons.
3. Record the current reading (mA).

If using the worksheet, record under EXTERNAL FAULTS.

4. Calculate line impedance using the following formula:

$$\Omega \text{ Impedance (L1 to GND)} = \frac{\text{L1 to L2 Voltage}}{\text{AC mA (L2 to GND)}} \times 1000$$

$$\Omega \text{ Impedance (L2 to GND)} = \frac{\text{L1 to L2 Voltage}}{\text{AC mA (L1 to GND)}} \times 1000$$

The value of each line impedance must be above 200,000 Ω as described by NFPA 99-1996.

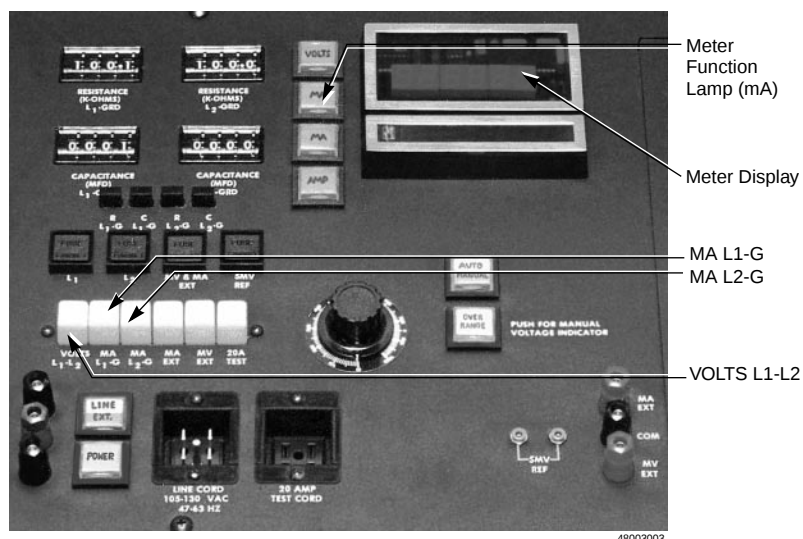


Figure 9: Settings for Line-to-Ground Impedance

Testing the LIM Alarm Levels

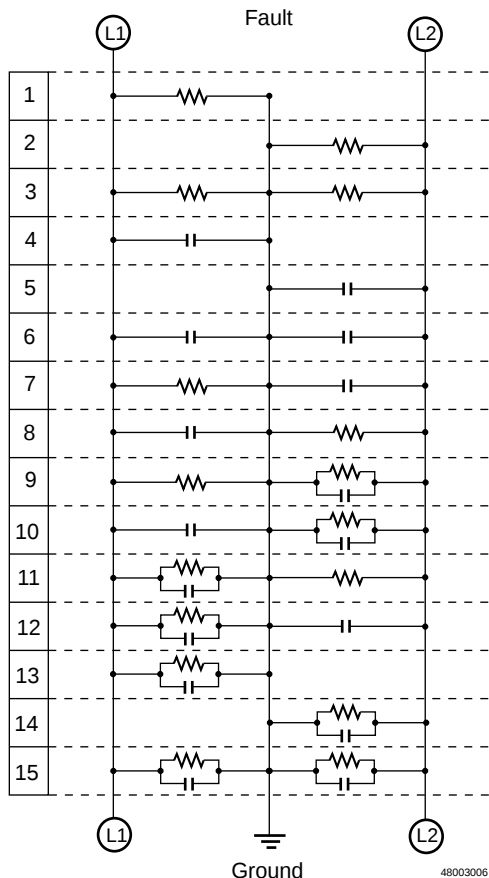


Figure 10: Fault Test Options

The 15 possible faults that the GFL-1000 analyzer can simulate are shown in Figure 10. Faults can be applied directly to the power line cord when the LINE/EXT pushbutton is in the LINE position. If checking higher voltage LIMs, move the LINE/EXT button to the EXT position and apply the faults to the external terminals. Plug the line cord only into a 120 V, 50–60 Hz source. See “Supplying Power to the GFL-1000 Analyzer” on page 4.

When applying the test faults, ensure that the meter function button is in the VOLTS L1-L2 position. To check the alarm level of a 120 V LIM, follow these steps. See Figure 11.

1. Press the appropriate meter function button to select the desired fault to ground.
You can apply resistance, capacitance, or both types of faults on one or two lines. Always apply a higher value of impedance than required to activate the trip level in the LIM.
To determine the nominal resistive value of the impedance that will cause the LIM to alarm, divide the line-to-line voltage by the alarm level of the LIM. For example: $120 \text{ V} \div 5 \text{ mA} (5 \times 10^{-3} \text{ A}) = 24,000 \Omega (24 \text{ k}\Omega)$.
2. Slowly lower the desired fault impedance until the LIM trips into alarm.
When applying the faults, pause several seconds between decrements of impedance because the LIM has a built-in time delay.
3. When the LIM trips into alarm, verify the trip point.
 - If the fault is placed on L2-G, press the MA L1-G meter function button.
 - If the fault is placed on L1-G, press the MA L2-G meter function button.
 - You can also alternate between the two switches.
 - If applying a balanced fault, choose the highest reading.

The reading is shown in the meter display. The correct trip point of a 2 mA ISO-GARD® LIM is between 1.95 and 2.00 mA. The correct trip point of a 5 mA ISO-GARD LIM is between 4.85 and 5.00 mA.

To perform LIM operational checks, refer to the manufacturers instructions that ship with the LIM.

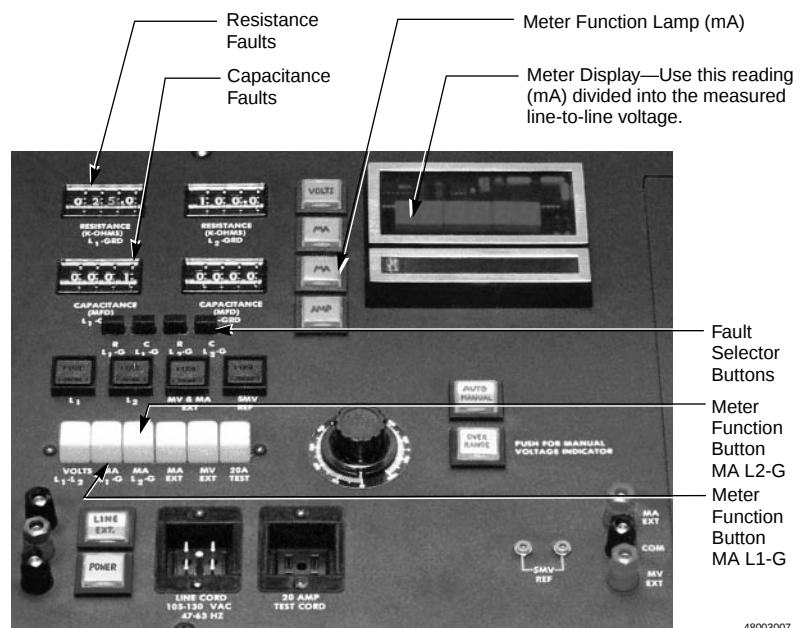


Figure 11: Settings for the LIM Alarm Level Test

Performing a 20 A Ground Test

- Square D recommends that all receptacle grounds measure below 0.1 Ω (2 V at 20 A) and are measured to the reference ground point. To perform the 20 A ground test, follow these steps. See Figure 12.
1. Plug the 20 A test cord set into the GFL-1000 analyzer.
 2. Place one end of the test cord on the reference ground bus.
 3. Attach the other end to the item being tested.
Plugs that have only a ground lead to which the test clip can be attached work well for testing receptacle grounds.
 4. Press down on the 20 A TEST meter function button.
 5. Turn the variac up slowly until a 20 A reading is shown in the meter display.
 - When in manual mode, press the OVERRANGE lighted pushbutton to obtain the correct voltage reading at 20 A.
 - In the 20 A AUTO mode, the meter reads volts automatically when 20 A are reached. The OVERRANGE light comes on when 20 A are exceeded.
 6. Divide the voltage reading by 20 to calculate the resistance.

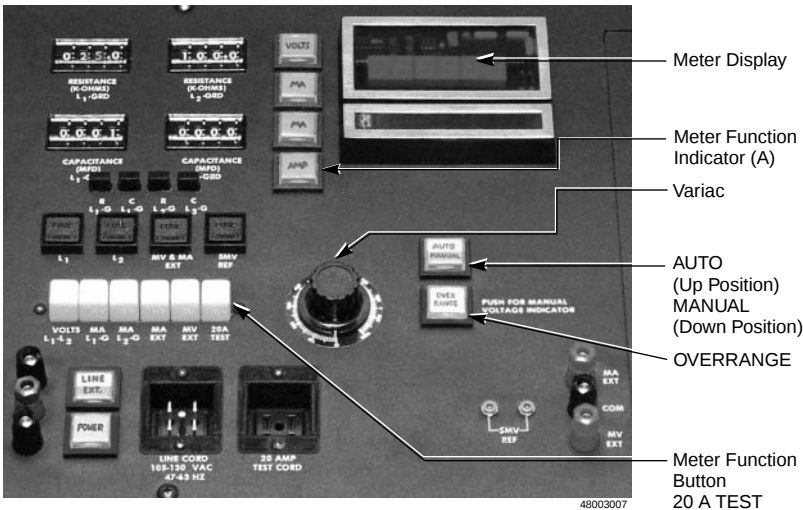


Figure 12: Settings for the 20 A Ground Test

SECTION 5—SPECIFICATIONS

Table 3: Specifications

Voltage Measurements	0 to 310.0 Vac, $\pm 2\%$
mA Measurements	0 to 31.00 mA, $\pm 1\%$
20 A Test	Manual Mode, $\pm 2\%$ accuracy; Auto Mode, $\pm 5\%$ accuracy
mV Measurements	9 to 310.0 mV, $\pm 0.5\%$
5 mV Calibration Source	5 mV, $\pm 0.5\%$

Spare Parts

Table 4: Spare Parts

Fuse	1/4 A, 3AGC
Bulb	Chicago Miniature #382, 12 Vac

APPENDIX A—SAMPLE WORKSHEET



SQUARE D COMPANY
TECHNICAL SERVICES DIVISION

HOSPITAL ISOLATION PANEL REPORT

JOB NAME	JOB NO.
LOCATION	DATE
EQUIP. DESIG.	

PANEL DATA

MFGR.	MODEL NO.	SERIAL NO.
TYPE		LOCATION

HAZARD CURRENT READINGS								SYSTEMS IMPEDANCE (ALL CKTS. ON)				
ALL SECONDARY CIRCUITS OFF:								mA				
ALL CIRCUITS ON:								L1-GROUND KOHM				
L2-GROUND KOHM												
CIRCUIT NO.	1	2	3	4	5	6	7	8	9	10	11	12
HAZARD CURRENT mA												
LEAKAGE CURRENT μ A	L1-GND											
	L2-GND											

LINE ISOLATION MONITOR/ALARMS

ITEM	MONITOR	ALARMS
SAFE		
HAZARD LIGHT		
AUDIBLE		
SILENCE		
PUSH TO TEST		
CALIBRATION		N/A

LIM TYPE (EDD - IGD - 120 - 208 - 240 - 277)

OTHER

LIM ALARM CONDITION TESTS

EXTERNAL FAULTS		SINGLE-R (K Ω)	SINGLE-C (μ A)	BAL-R (K Ω)	BAL-R (μ A)
L1-GRD	LIM MTR	mA	mA	mA	mA
	EXT MTR	mA @	mA @ .0	mA @	mA @ .0
L2-GRD	LIM MTR	mA	mA	mA	mA
	EXT MTR	mA @	mA @ .0	mA @	mA @ .0

LIM: ACCEPTABLE - UNACCEPTABLE BECAUSE:

SYSTEM PARAMETERS				REFERENCE POINT FOR GROUND TEST:
	L ₁ -L ₂	L ₁ -GND	L ₂ -GND	
SYSTEM VOLTAGE (VAC)				
SYSTEM LEAKAGE CURRENT (μ A)	N/A			
PUSH TO TEST (μ A)	N/A			

NOTES:

APPENDIX B—NOTES LOG

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