LT3000 - PORTABLE TEST SET

GROUND FAULT LEAKAGE CURRENT MEASURING DEVICE

USER
MANUAL

TABLE OF CONTENTS

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1. LT3000 – Operator Interaction

Establish compliance with NFPA99. Apply a 5 mA fault and confirm that the LIM goes into alarm. The LT3000 meter is in series with a variable resistor used to set the 5mA current. The LIM should read slightly above 5 mA.

Confirm that the trip point lies between 3.7 and 5.0 mA. Again, the LT3000 meter is used to read the trip current.

Let's assume that the LT3000 current measurement accuracy is 2% of the reading +/- 0.03 mA. This means that a 5 mA reading on the LCD screen could actually be a current of 4.87 mA. Will this current be sufficient to cause the LIM to go into alarm?

Calibration of the LT3000 really means to check on the accuracy of the meter.

- **UL 1022**

  Alarm signal shall be obtained when the THC reaches a threshold value of not more than 5.0 mA.

  The LIM shall not alarm for a FHC of 3.7 mA or less.

  Note: FHC is leakage contributed by fault impedance only.

  All LIM meter readings shall be within 10% of the test meter at the alarm threshold. Above this value, the meter may be read in the red alarm zone.

- **NFPA 99 – Chapter 6**

  The LIM circuit shall be tested by successively grounding[1] each line of the energized distribution system through a resistor of 200 x V ohms, where V = measured line voltage. The visual and audible alarms shall be activated.

[1] This procedures a 5mA resistive component of FHC. The THC includes the LIM and panel (including transformer) contribution.

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2. Important Leakage Current Definitions

Monitor Hazard Current

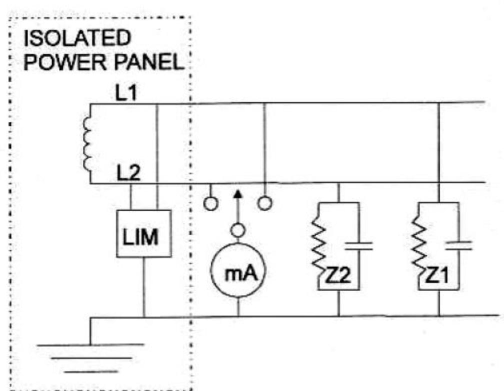
The Monitor Hazard Current (MHC) is the leakage current contributed only by the monitor (LIM) and indicators (remote and/or local). The MHC shall not exceed 1.0 mA.

Fault Hazard Current

The Fault Hazard Current (FHC) is the leakage current contributed by the connected fault impedance only.

Comment:
Each device that is plugged or wired into the Isolated Power supply contributes to the FHC. The current level is generally small and is normally due to capacitive coupling to ground. Nevertheless, even though it may only be in the microampere level, it is thought of as a fault that contributes to the make-up of FHC.

The fault load as seen by the Isolated Power supply (and the LIM) can be thought of as made up of two impedances each connected between a power conductor (L1 and L2) and ground. Each impedance is made up of a resistive and capacitive component. In the real world, the impedance is mostly capacitive. The FHC component can be determined by taking a reading while switching the millimeter between L1 and L2. The LIM shall not alarm for a FHC of 3.7 mA or less.



Total Hazard Current

The Total Hazard Current (THC) is the leakage current contributed by the monitor, remote and local indicators, field wiring, fixed and plugged-in medical apparatus. An alarm signal shall be obtained when the THC reaches a threshold value of not more than 5.0 mA. At the threshold value, the alarm condition shall be continuous.

3. QUICK USER CHART – Isolated Power

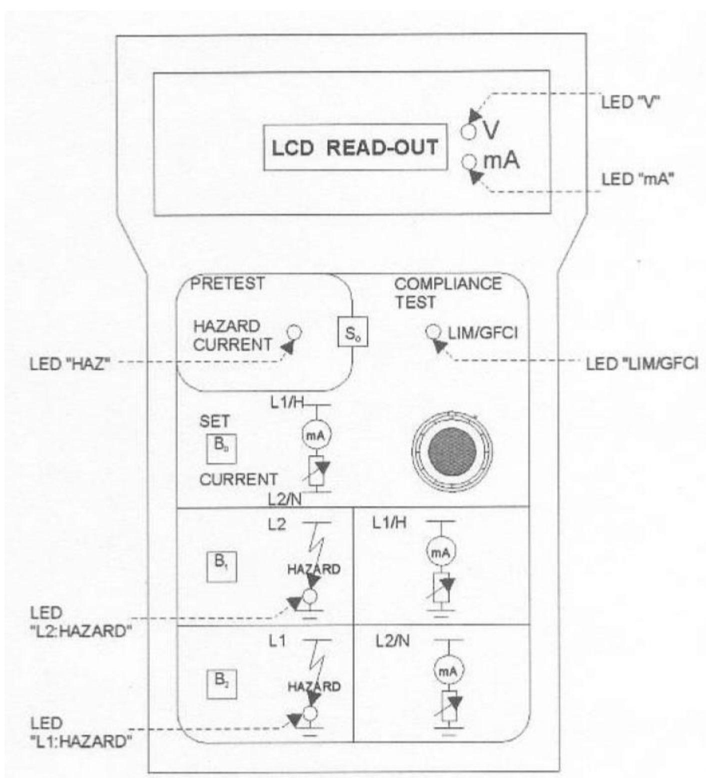
There are two modes of operation: the PRE-TEST mode, and the COMPLIANCE TEST mode.

PRE-TEST mode

It is first necessary to run the PRETEST mode to find out if there is any single fault that exists and that might not have been detected because of a faulty LIM. A 1st fault causes an Isolated Power supply to behave like a grounded system. This fault should be cleared as soon as possible before a 2nd fault occurs. A 2nd fault creates a short-circuit in the ground loop which, depending on its magnitude, may or may not be cleared by the branch circuit protection equipment. If undetected, it is a source of hazard for personnel and property alike. Additional details in page 6.

LIM COMPLIANCE TEST mode

NFPA 99 requires that the LIM circuit be tested after installation on a regular basis. The LT3000, when used in the COMPLIANCE TEST mode, simplifies this procedure and is equally easy to use regardless of the magnitude of the system voltage. Plug the LT3000 displays the line voltage. If the LCD display is BLANK: 1. Check that the associated circuit breaker is ON and operational, 2. Check for a faulty receptacle, and 3. Check for an open in one of the two Isolated Power conductors. Additional details in page 6.



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PRE-TEST

PRELIMINARY → PUSH SELECTOR BUTTOM **S0** UNTIL **"HAZARD CURRENT"** LED ILLUMINATES

Test Sequence	Action	Outcome	LCD Read-Out
Step #1	Press and hold B1 Note: Disregard LIM alarm	A. "L2 Hazard" LED is OFF B. "L2 Hazard" LED is ON Note: Outcome B indicates systems fault or excessive leakage on L2. Check LIM and system before proceeding any further.	< 5 mA > 5 mA Note: current is limited to 12 mA
Step #2	Press and hold B2 Note: Disregard LIM alarm	A. "L1 Hazard" LED is OFF B. "L1 Hazard" LED is ON Note: Outcome B indicates system fault or excessive leakage on L2. Check LIM and system before proceeding any further.	< 5 mA > 5 mA Note: current is limited to 12 mA

LIM COMPLIANCE TEST

PRELIMINARY → PUSH SELECTOR BUTTOM **S0** UNTIL **"LIM/GFCI"** LED ILLUMINATES

Test Sequence	Action	Outcome	LCD Read-Out
Step #1	Press and hold **B0** while turning the 10-turn potentiometer	Adjust the potentiometer unit 5 mA is displayed on the LCD read-out	5 mA as per NFPA 99
Step #2	Press and hold **B1**	The LIM meter will rise somewhat above 5 mA and there shall be both a visual and audible alarms	DISREGARD the LCD display
Step #3	Press and hold **B2**	The LIM meter will rise somewhat above 5 mA and there shall be both a visual and audible alarms	DISREGARD the LCD display

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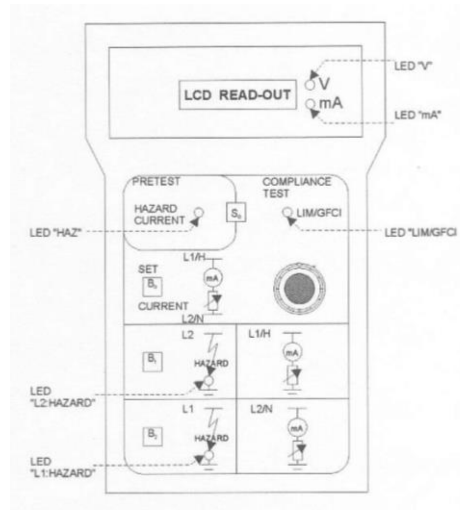
4. QUICK USER CHART – Measuring the LIM Trip Current (Isolated Power)

This procedure can be used to establish the LIM trip current. As indicated in section 3 – 4.3.3.2 of NFPA 99, "**The line isolation monitor shall not alarm for a fault of hazard current of less than 3.7 milliamperes**."



Preliminary

Step #1:

Pretest the system to be sure that there are no gross faults. This procedure is outlined on the **QUICK USER CHART – ISOLATED POWER.**

Step #2:

Open all branch circuit breakers except the one for the receptacle that the LT3000 is plugged into. Unplug all cord-connected apparatus on this branch circuit.

Step #3:

Using the **PRETEST** procedure, measure and record the L1 and L2 leakage currents. Try another branch circuit if the leakage current on either line exceeds 0.20 mA. It is always best to use a branch circuit with minimum leakage to reduce measurement errors due to inherent leakage from capacitive coupling to ground.

Record these currents while alternately pressing and holding **B1** and **B2** while in the **PRETEST** mode.

Trip Current Procedure

Step #1:

Operate the LT3000 in the **COMPLIANCE TEST** mode.

Step #2:

Press and hold **B0** while turning the 10-turn potentiometer until the LCD reads 3.7 mA. The LIM should not alarm when **B1** is pressed. While holding and pressing **B1**, **SLOWLY** advance the pot until the LIM alarms (disregard the LCD display while performing this action). Now release **B1** and press **B0**. The reading from the LCD display should be between 3.7 and 5 mA. The actual value is the LIM trip point.

Step #3:

This step is similar to STEP #2. Use **B2** instead of **B1**. Otherwise, the procedure is identical. In both cases the LIM trip point should be about the same.

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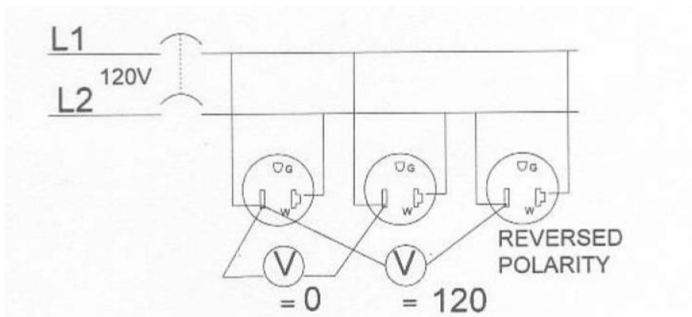
5. QUICK USER CHART – Receptacles check for reversed polarity (Isolated Power)

This procedure can be carried out without turning the power OFF. Three methods are presented here:

Method 1

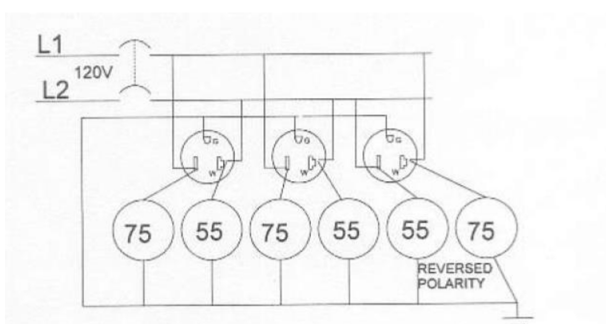
Connect a voltmeter between "like" blades on the receptacles. The wiring is consistent and proper if the voltmeter reads zero. Otherwise, there is a polarity reversal which should be corrected.



The disadvantage with this procedure is that two people are required to carry it out because of long distances between receptacles.

Method 2

This procedure involves measuring the voltage between each isolated conductor and ground. The voltage between each "like" blade and ground should be the same unless some of the receptacles have reversed polarity.



When measuring voltage to ground with a high impedance meter, it is usually not possible to add the L1 and L2 voltages to obtain line voltage. A typical voltage to ground might be around 75 volts. A gross unbalance usually indicates a faulty system. This method will generally work because the voltages between L1 and L2 to ground are seldom equal.

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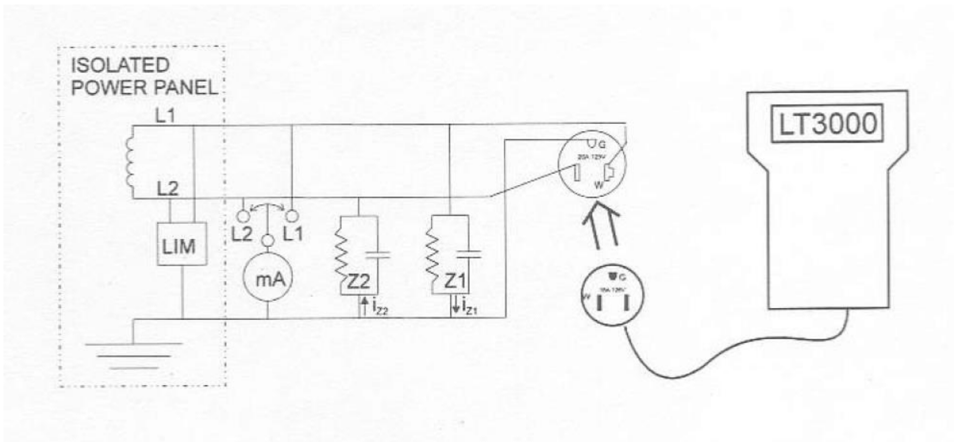
Method 3

The LT3000 can be used with this method. Consider the sketch below. When the switch is thrown to L1 the millimeter reading will be i_{z2}, and when thrown to L2 it will be i_{z1}. This method relies on the high likelihood that these currents will be unequal for reasons given in the section titled: "**APPLICATION NOTE 1- WHAT THE LIM DOES**", the LIM reads the higher of these two values.



The LT3000 is used in the **PRETEST** mode. Plug the LT3000 into the Isolated Power receptacle associated with a particular branch circuit. When first plugged in, the LT3000 displays the line voltage. Push selector button **S0** until "**HAZARD CURRENT**" LED illuminates. Press and hold **B1** and note the current reading on the LCD display. Repeat this action with push-button **B2**. **THE RECEPTACLES ARE WIRED CONSISTENTLY IF THE CURRENT READINGS PAIRS MATCH – FOR EACH RECEPTACLE – WHEN B1 AND B2 ARE DEPRESSED.**

The table below illustrates the approach:

RECEPTACLE	B1	B2	LCD	CONDITION
#1	ON	OFF	1.10	OK
	OFF	ON	1.40	
#2	ON	OFF	1.10	OK
	OFF	ON	1.40	
#3	ON	OFF	1.40	POLARITY REVERSED
	OFF	ON	1.10	

If the current readings are too close then plug or unplug medical apparatus so that a difference can be seen.

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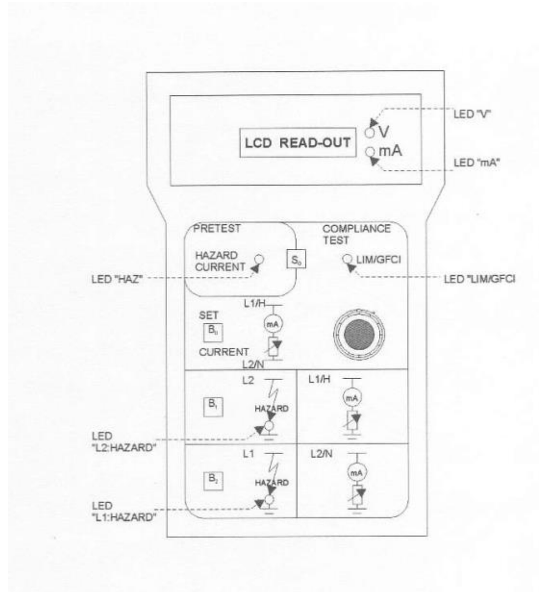
6. QUICK USER CHART – Grounded Power

NFPA 99 states that “If GFCIs are use, a device or component that causes 6 mA to flow to ground shall be momentarily connected between the energized conductor of the power distribution circuit being protected and ground to verify that the GFCI does indeed interrupt the power. If the test is performed when the system is in use on a patient, it must not endanger the patient even if the grounding circuit being tested is faulty”.



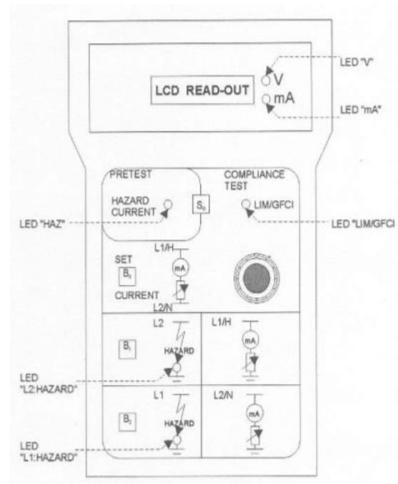
NFPA 99 requires that GFCIs be tested at regular intervals. The LT3000 simplifies this procedure and is equally easy to use regardless of the magnitude of the system voltage. As a side benefit, it detects an “open” ground wire and a reversal of the “H” and “N” wires.

It is only necessary to plug the LT3000 into the GFCI receptacle or any receptacle supplied by a GFI circuit breaker. When first plugged in, the LT3000 displays the line voltage. If the LCD display is blank: 1. Check that the associated branch circuit breaker is ON, and 2. Check that the GFCI is RESET.

GFCI COMPLIANCE TEST			
PRELIMINARY → PUSH SELECTOR BUTTON **S0** UNTIL”**LIM/GFCI**” LED ILLUMINATES			
TEST SEQUENCE	ACTION	OUTCOME	LCD READ-OUT
Step #1	Press and hold **B0** while turning the 10-turn potentiometer	Adjust the potentiometer until 6mA is displayed on the LCD read-out	6 mA as per NFPA 99
Step #2	Press and hold **B1**	**The LCD read-out becomes BLANK** Depending on the design of the GFCI, as much as 7 seconds can elapse before it trips.	BLANK
		The LCD display reads 0 mA This can happen if: 1. The ground wire is open, and/or 2. The “H” and “N” wires are reversed. The latter can be confirmed by pressing and holding B2 and observing the LCD display. It will be BLANK if “H” and “N” are reversed.	0 mA

7. QUICK USER CHART – Receptacle Check for Reversed Polarity and Open Ground (Grounded Power)

This procedure can be applied to standard and GFCI-type receptacles:



Step #1:

- Plug the LT3000 into the receptacle to be tested.
- When first plugged in, the LT3000 displays the line voltage. If the LCD display is BLANK:
  1. Check that the associated branch circuit breaker is ON.
  2. If a GFCI receptacle, check that it is RESET.
  3. The receptacle could be defective.
  4. There could be an OPEN in the “Hot” or “Neutral” wire.

Step #2:

- Push selector button **S0** until “**LIM/GFCI**” LED illuminates.

Step #3:

- Press and hold **B0** while turning the 10-turn potentiometer until 3.5 mA is displayed on the LCD read-out.

Step #4:

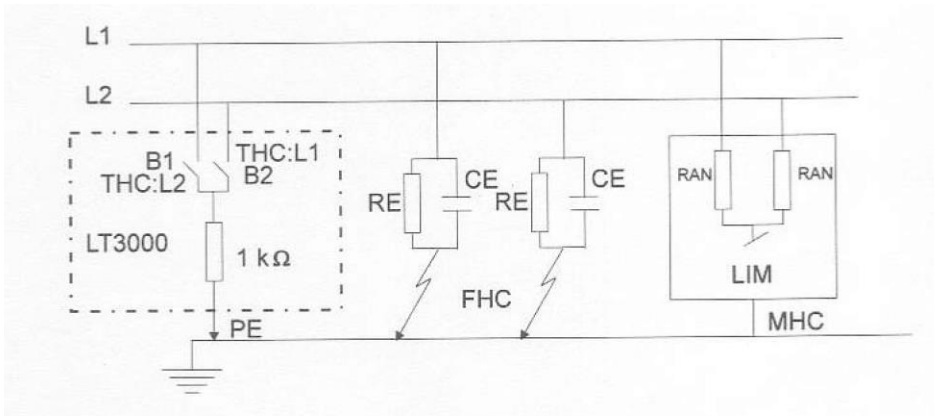
- Alternately press and hold **B1** and **B2**. Compare the LCD read-out with that in the table below which also gives an assessment of the condition of the receptacle.

BUTTON ACTION		**CONDITION OF RECEPTACLE**					
B1	**B2**	**LCD**	**STATUS**	**LCD**	**STATUS**	**LCD**	**STATUS**
ON	OFF	3.5	OK	0.00	POLARITY REVERSED	0.00	OPEN GROUND
OFF	ON	0.00		3.5		0.00	

8. LT3000 – Technical Information

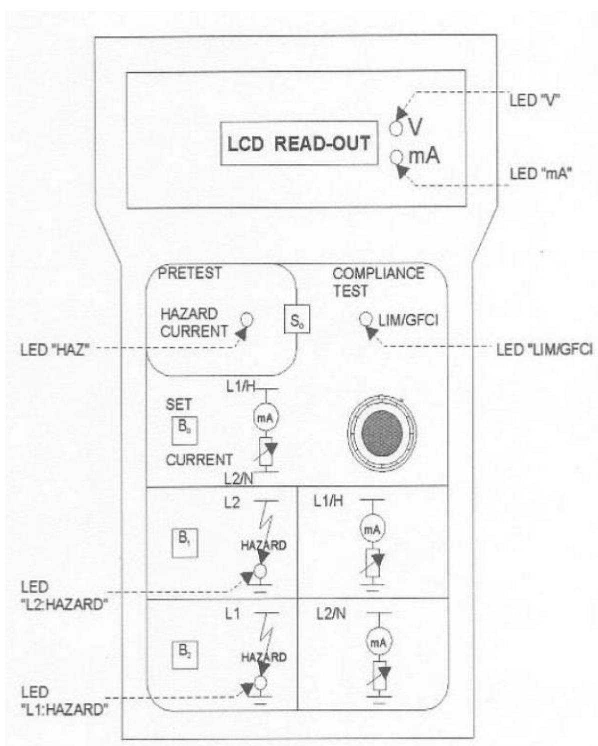
PRE-TEST Mode

A functional schematic is shown below:



The impedance between each isolated power conductor and ground is comprised of the parallel combination of R_E and C_E. Generally the values will be different for L1 and L2.

Alternately depressing **B1** and **B2** causes the connection to be made between L1 and L2 as shown on the diagram. There is a built-in electronic element which automatically limits the current to 12 mA for a severe external fault.



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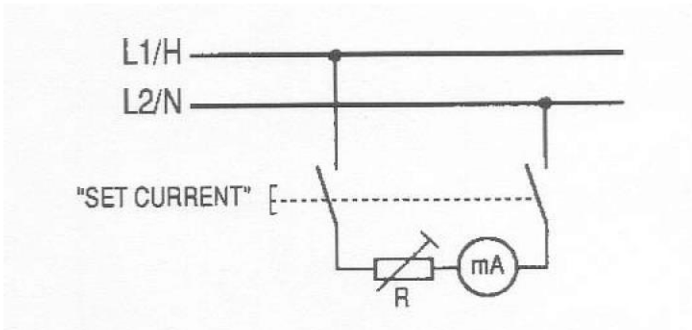
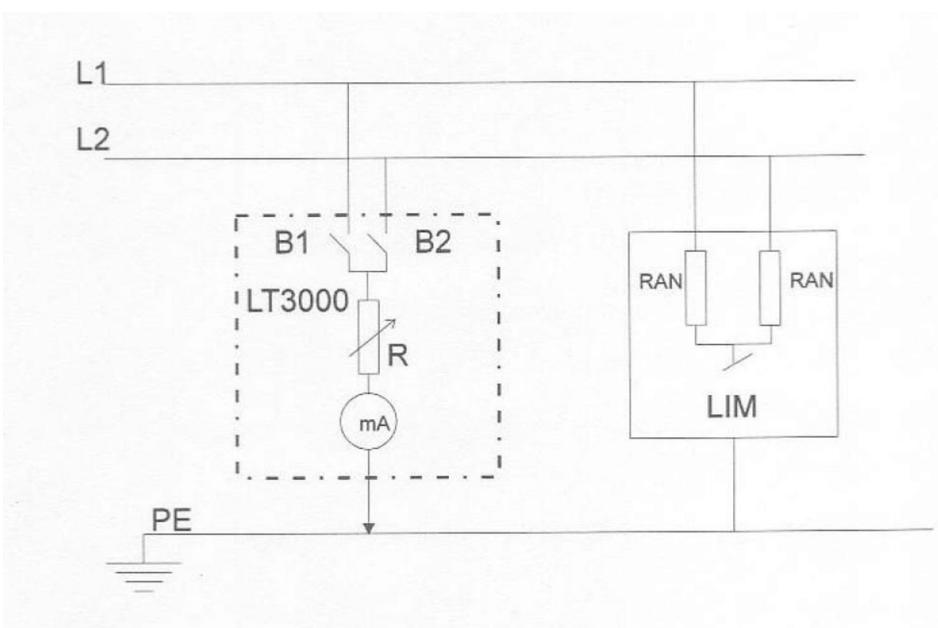
LIM COMPLIANCE TEST Mode

Schematically, setting the current level to, say, 5 mA involves the circuit shown below:



The push-button **B0** is depressed while turning the 10-turn potentiometer. It is easy to set the 5 mA for any voltage. This approach complies fully with section 3 – 5.2.4.2 of NFPA 99 which states: “The LIM circuits shall be tested after installation, and prior to being placed in service, by successively grounding each line of the energized distribution system through a resistor of 200 x V ohms, where V = measured line voltage. The visual and audible alarms (see 3 - 4.3.3.2 of NFPA 99) shall be activated.”

The functional drawing shown below illustrates the internal workings of the LT3000 when the COMPLIANCE TEST is conducted.



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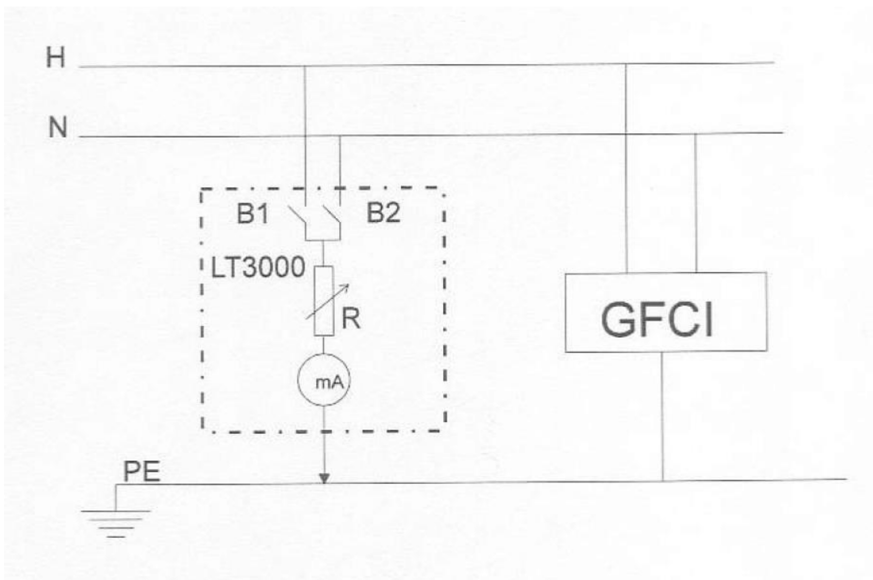
GFCI COMPLIANCE TEST Mode

The arrangement is similar to what is done in the LIM COMPIANCE TEST MODE. It is first necessary to set the current to 6 mA as required by section 3 – 5.2.3.1 of NFPA 99 which states: "If GFCIs are used, a device or component that causes 6 mA to flow to ground shall be momentarily connected between the energized conductor of the power distribution circuit being protected, and ground, to verify that the GFCI does indeed interrupt the power. If the test is performed when the system is in use on a patient, it must not endanger the patient even if the grounding circuit being tested is faulty."

The test circuit is shown below. See **QUICK USER CHART** for more details on the actual procedure.



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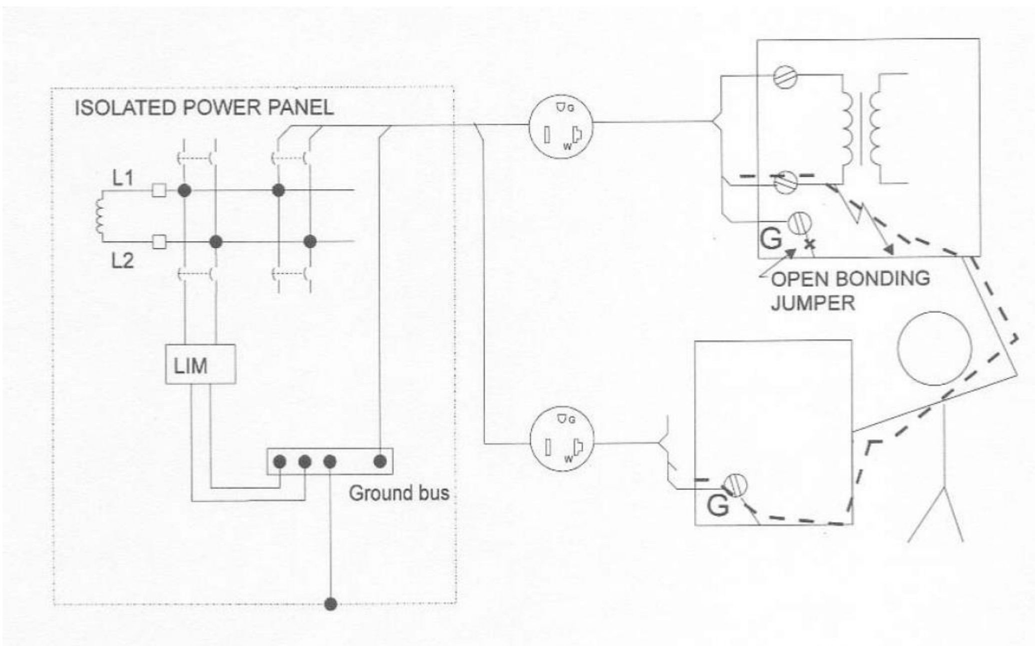
9. APPLICATION NOTE 1 – What the LIM Does

The essentials of an Isolated Power panel include:

1. An isolation transformer with grounded shield between primary and secondary,
2. A load center with circuit breakers for as many as 16 branch circuits,
3. A LIM which continuously monitors the power distribution system for ground faults
4. A reference grounding bus.

Let us first examine the diagram below. There are many ways that hazards can be created. One possible hazard is illustrated in the diagram.

Two pieces of medical apparatus are shown. A fault is shown occurring in the upper device. This could be excessive capacitive coupling to the enclosure or a resistive type fault. In either case, the current would normally flow back to the supply via the bonding jumper.



At worse, only a small current would be diverted through the person that comes in contact with the two devices. The situation becomes more hazardous, however, if there is an open in the bonding jumper. As will be seen presently, even in this worst case scenario, the use of Isolated Power SIGNIFICANTLY reduces the risk to the person over what it would be if the power system was grounded. In essence, the current that can flow through the person is dependent on the amount of line-to-ground capacitive coupling that exists in the system.

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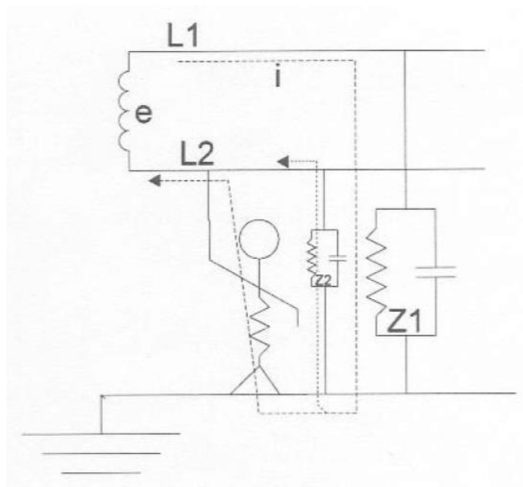
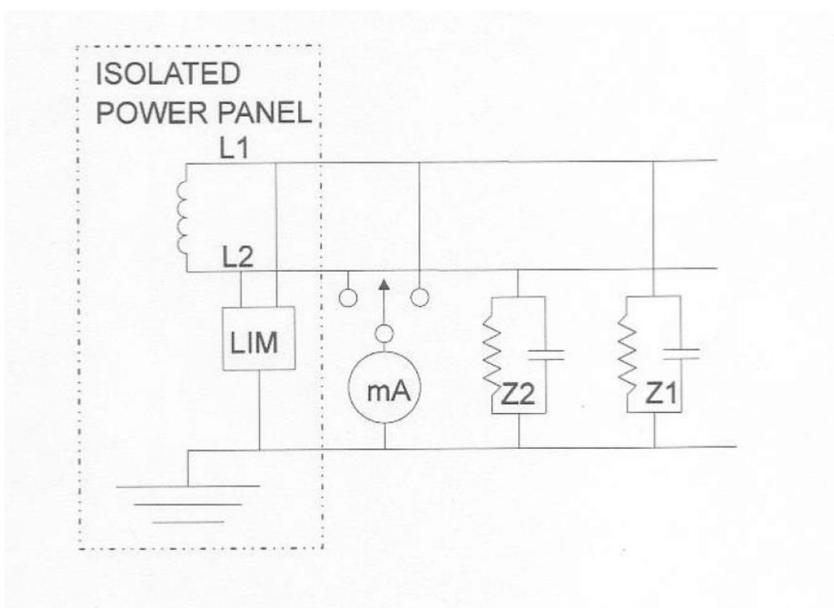
The current that will flow through the person can be calculated from the sketch shown below.



The impedance between L1 and ground will generally be capacitive even though it is shown as also having a resistive component. The maximum current in this instance is: $i_{max} = e/Z1$

From this background information, we can now proceed to explain the function of the LIM. Let us examine the sketch shown below,



The LIM calculates the magnitude of the impedance between EACH Isolated Power conductor and ground. One of these will generally be smaller than the other. For this discussion, let us say that Z1 is smallest of the two impedances Z1 and Z2. The current displayed on the LIM meter is e/Z1. This is a worse-case situation and represents the maximum current that could flow through a zero ohm person that might come in contact with – in this example – the L2 isolated power conductor. The current would, of course, be less if the person made contact with the L1 conductor.

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The LIM is a predictive device. In the above example with the two pieces of medical apparatus and the open ground bonding jumper, the LIM will correctly predict the current that would flow through the person making contact with the two devices **BEFORE** contact is actually made.

To further illustrate the function of the **LIM**, consider the "mA" meter in the diagram. Two meter readings are possible by alternately switching the LIM between L1 and L2. The LIM displays the larger of these two readings.

See the SIDEBAR for additional information concerning Isolated Power and the LIM.

SIDEBAR:

Section3-4.3.3.1of NFPA 99 is misleading. The "NOTE" reads:
"Protection for the patient is provided primarily by a grounding system."

Comments:

i. Protection is provided by the ISOLATED POWER supply which feeds the various medical devices. Equipment grounding requirements are similar to those for a solidly grounded system (NOT isolated). The supply however is NOT grounded. The ungrounded secondary of the isolation transformer reduces the maximum current in the grounding system in case of a single fault between both isolated power conductor and ground.

ii. Even a SOLIDLY grounded 1st fault will generally result in a "…maximum current in the grounding system..." that is less than 5 mA. The line isolation monitor provides warning when a single fault occurs, or when excessively low impedance to ground develops, which may expose the patient to an unsafe condition should an additional fault occur.

iii. Consider the example given earlier involving the two pieces of medical apparatus. Because of the "open" bonding jumper, the LIM read-out did not marginally change when the 1st fault occurred. In fact, the 1st fault is consummated ONLY after the person bridges the two medical devices. Even so, the LIM still accurately predicts the current that flows through the person. Excessive current in the grounding conductors will not result from a first fault.

iv. This is a gross understatement! A hazard exists if a second fault occurs before the first fault is cleared.

v. This is true. It helps to remember two things: 1. In addition to providing substantial increased hazard protection, Isolated Power also provides continuity of power subsequent to the occurrence of a 1st fault, and 2. A 1st fault in an OR Isolated Power application generally means an increase in the line-to-ground capacitance due to the addition of medical devices so that there is considerable leeway available before the 1st fault needs to be cleared.

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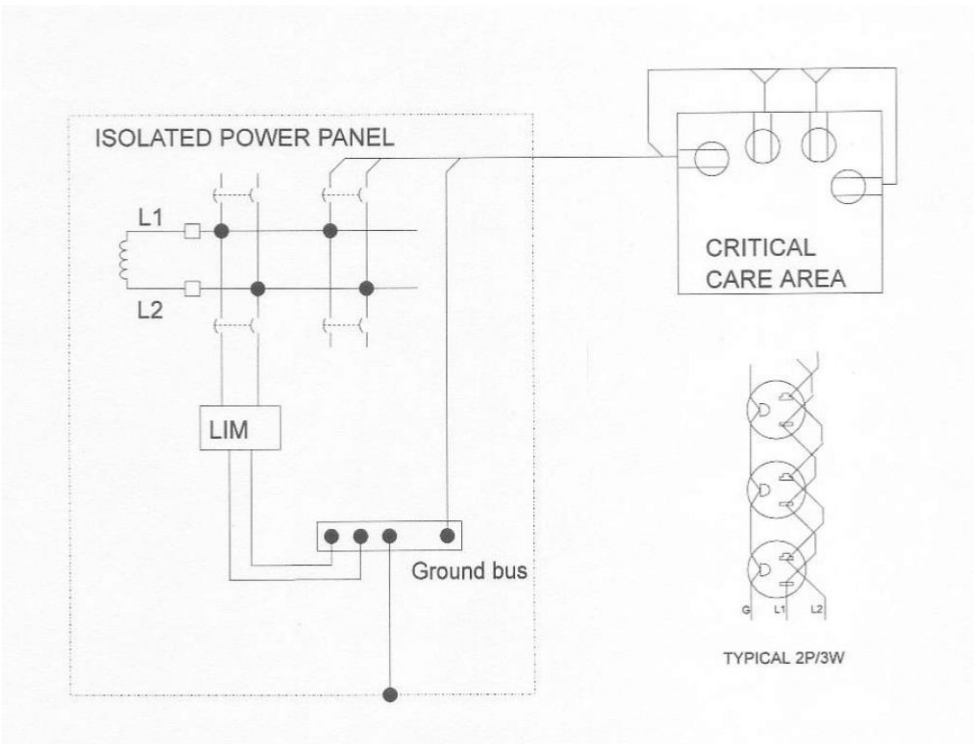
10. APPLICATION NOTE 2 – Nuisance Alarms - Diagnostic Program to Keeping Nuisance Alarms under Control

A typical Isolated Power distribution circuit is shown below. Branch circuits normally total between eight and sixteen. The majority of Isolated Power panels have a 5 or 7.5 KVA rating. The sample panel shows 4 duplex receptacles connected to one of the branch circuits.

Wiring is one of the contributors to system leakage current. A medical device plugged into a receptacle also contributes to the leakage current. A heart lung machine for example, can contribute as much as 350-450 µA of leakage current.



A systematic approach is required to assess the significance of a nuisance alarm. The questions that must be answered are: ***Is it legitimate? Was the system operating near full allowed leakage current limit of 5 mA before the alarm?*** Nuisances still occur when current draw of the transformer is less than 100% of the design load.

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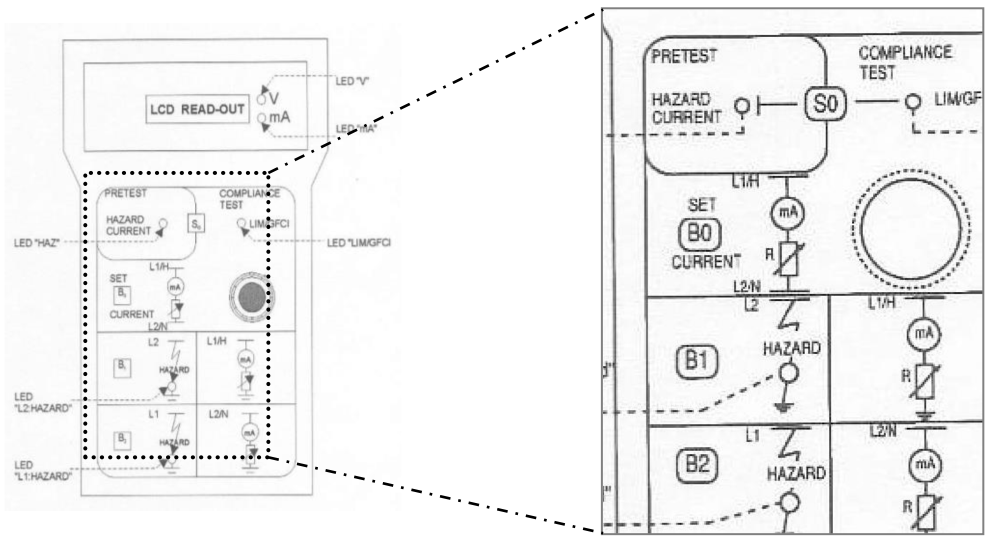
The LT3000 is a powerful tool that can be used to understand the cause of nuisance alarms. Here is what needs to be done:

Step #1:

Unplug all cord-connected apparatus from the receptacles that are supplied by this panel. Determine the leakage current contribution of the Isolated Power panel and the wiring of one of its branch circuits. Do this by disconnecting the LIM ground connection and opening all but one branch circuit breakers. Plug the LT3000 onto one of the receptacles supplied by this branch circuit. When first plugged in, the LCD display will read the transformer secondary voltage.

Step #2:

Push selector button **S0** until "**HAZARD CURRENT**" LED illuminates.



Step #3:

Press and hold **B1**. Jot down the mA value read from the LCD display. Repeat by pressing and holding **B2** and jotting down the mA value read from the LCD display. U.L. 1047 lists the following maximum allowable leakage current values for different panel sizes:

Maximum Panel Rating kVA	Maximum Panel Leakage Current Microamperes	
	Secondary Volts	
	120	208, 240, and 277
5	40	60
10	50	75
25	70	100
Wall Modular Units	100	100

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Step #4:

Re-connect the LIM ground and repeat **Step #3**. The higher readings constitute the LIM contribution to the leakage current.

Step #5:

Close one circuit at the time and repeat Step #3. Continue doing so until all circuits are evaluated. If any, have a significant change in the current readings, note the circuits. This will allow you to identify the circuit(s) causing the problem.

Note: *Most apparatus have a single pole switch. Therefore, it will not be possible to identify the leakage current contribution of fixed-mounted equipment unless the other conductor (normally the "neutral" wire) is temporarily disconnected.*

Step #6:

Make a record of the leakage current contributed by various medical apparatus that draw their power from this panel. This information will be valuable when assessing the significance of nuisance alarms, especially when the LIM reading is near the "alarm zone".

Tables 1, 2, and 3 have been prepared as possible guides for collecting leakage current data on Isolated Power panels, associated distribution circuits, and medical apparatus. Possessing this data should significantly reduce the task of assessing the significance of nuisance alarms. Partially filled-in samples are also included as an aid to the first time user.

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11. TABLE 1
GENERAL ISOLATED POWER PANEL DATA

ISOLATED POWER PANEL LOCATION	
ISOLATED POWER PANEL ELECTRICAL DATA:	
KVA	
PRIMARY/SECONDARY VOLTAGE	
# OF BRANCH CIRCUITS	
GENERAL LEAKAGE CURRENT DATA:	
MONITOR HAZARD CURRENT (MHC)	
TOTAL HAZARD CURRENT (THC)	
❖ ALL CIRCUIT BREAKERS OFF	
❖ ALL CIRCUIT BREAKERS ON	
LEAKAGE CURRENT CONTRIBUTION OF PANEL & TRANSFORMER[2]	

[2] This current should roughly equal (THC – MHC)

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12. TABLE 2
BRANCH CIRCUIT RECEPTACLE/APPARATUS SCHEDULE

BRANCH CIRCUIT	A1	A2	A3	A4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	B1	B2	B3	B4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	C1	C2	C3	C4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	D1	D2	D3	D4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	E1	E2	E3	E4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	F1	F2	F3	F4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	G1	G2	G3	G4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	H1	H2	H3	H4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	I1	I2	I3	I4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	J1	J2	J3	J4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	K1	K2	K3	K4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	L1	L2	L3	L4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	M1	M2	M3	M4	TOTAL µA
APPARATUS TYPE					

CODE:

- A, B, C…. REFERS TO THE BRANCH CIRCUIT
- A1, A2, A3… B1, B2, B3… REFERS TO A PARTICULAR RECEPTACLE ON BRANCH CIRCUITS “A”, “B”, etc.
- “TOTAL” = TOTAL LEAKAGE CURRENT ON THAT PARTICULAR BRANCH CIRCUIT

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13. TABLE 3
APPARATUS LEAKAGE CURRENT DATA

TYPE OF DEVICE	DESIGNATION	SERIAL #	LEAKAGE CURRENT - µA

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14. TABLE 1
GENERAL ISOLATED POWER PANEL DATA

SAMPLE

ISOLATED POWER PANEL LOCATION	**OR #5**
ISOLATED POWER PANEL ELECTRICAL DATA:	
KVA	**7.5**
PRIMARY/SECONDARY VOLTAGE	**208/120 Single phase**
# OF BRANCH CIRCUITS	**12**
GENERAL LEAKAGE CURRENT DATA:	
MONITOR HAZARD CURRENT (MHC)	**35 μA**
TOTAL HAZARD CURRENT (THC)	
❖ ALL CIRCUIT BREAKERS OFF	**50 μA**
❖ ALL CIRCUIT BREAKERS ON	**2.10 mA**
LEAKAGE CURRENT CONTRIBUTION OF PANEL & TRANSFORMER[3]	**15 μA**

[3] This current should roughly equal (THC – MHC)

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15. TABLE 2
BRANCH CIRCUIT RECEPTACLE/APPARATUS SCHEDULE

SAMPLE

BRANCH CIRCUIT	A1	A2	A3	A4	TOTAL µA
APPARATUS TYPE		**M3**			**150**
BRANCH CIRCUIT	B1	B2	B3	B4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	C1	C2	C3	C4	TOTAL µA
APPARATUS TYPE	**M7**			**M1**	**272**
BRANCH CIRCUIT	D1	D2	D3	D4	TOTAL µA
APPARATUS TYPE			**M4**		
BRANCH CIRCUIT	E1	E2	E3	E4	TOTAL µA
APPARATUS TYPE	**M4**	**M5**	**M1**		**585**
BRANCH CIRCUIT	F1	F2	F3	F4	TOTAL µA
APPARATUS TYPE				**M2**	**210**
BRANCH CIRCUIT	G1	G2	G3	G4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	H1	H2	H3	H4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	I1	I2	I3	I4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	J1	J2	J3	J4	TOTAL µA
APPARATUS TYPE	**M2**				**210**
BRANCH CIRCUIT	K1	K2	K3	K4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	L1	L2	L3	L4	TOTAL µA
APPARATUS TYPE					
BRANCH CIRCUIT	M1	M2	M3	M4	TOTAL µA
APPARATUS TYPE					

CODE:

- A, B, C…. REFERS TO THE BRANCH CIRCUIT
- A1, A2, A3… B1, B2, B3… REFERS TO A PARTICULAR RECEPTACLE ON BRANCHH CIRCUITS “A”, “B”, etc.
- “TOTAL” = TOTAL LEAKAGE CURRENT ON THAT PARTICULAR BRANCH CIRCUIT

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16. TABLE 3
APPARATUS LEAKAGE CURRENT DATA

SAMPLE

Type of Device	Designation	Serial #	Leakage Current - µA
Vacuum Pump	M1	37329	110
Electro-surgery Machine	M2	38732	210
Physiological Monitor	M3	39435	150
Heart Lung Machine	M4	40675	400
Defibrillator	M5	51900	75
Respirator	M6	67432	110
Hyperthermia Unit	M7	35896	162

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17. ADDITIONAL INFORMATION - LIM Test function

The TEST function is specified in UL1022. Highlights of this Standard that specifically apply to the TEST function are reproduced below:

Equipment Grounding Connection

7.9 A line isolation monitor shall be provided with a properly identified separate equipment grounding terminal or lead. The grounding terminal or lead shall be reliably connected to all exposed dead-metal parts as described in paragraph 9.1.

7.10 A terminal solely for connection of an equipment grounding conductor shall be capable of securing a conductor of the gage size equivalent to that of the conductors supplying the unit.

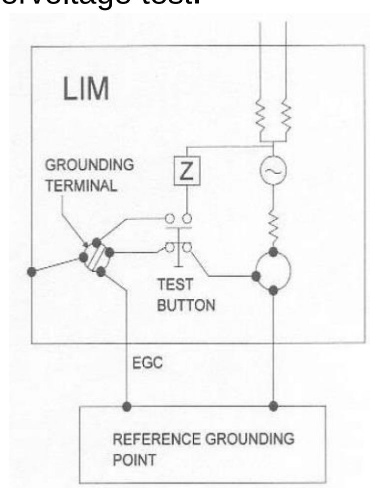
7.11 A terminal screw intended for the connection of an equipment grounding conductor shall have a green colored head that is hexagonal, slotted or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified, such as being marked G, GR, GROUND, GROUNDING, or the equivalent, or by a marking on a wiring diagram provided on the device. The grounding terminal shall be located so that it is unlikely to be removed during normal servicing of the device.

7.12 The surface of an insulated lead intended solely for the connection of an equipment grounding conductor shall be green, with or without one or more yellow stripes. No other lead visible to the installer, other than grounding conductors, shall be so identified.

PERFORMANCE

14. Normal Operation Test

14.6 Operation of the test switch with the unit in a normal standby condition shall result in de-energization of the red signal lamp and audible signal. The switch shall transfer the grounding terminal of the line isolation monitor from the reference grounding point to a test impedance arrangement having a magnitude sufficient to produce a monitor meter reading of a least 2 mA at rated line voltage. The operation of this switch shall not add to the risk of electric shock within the system in actual use, nor will the test include the effect of the line-to-ground stray impedance of the system. It shall be impossible to inadvertently leave the test switch in the test position. The same results are to be obtained when the device is subjected to the Overvoltage and Undervoltage test.



***COMMENT**:*
AS SHOWN IN THE DIAGRAM, PERFORMING THE TEST FUNCTION DOES NOT NECESSARILY DISCONNECT THE LIM FROM THE REFERENCE GROUNDING POINT. APPLYING THE IMPEDANCE Z ACROSS THE INTERNAL MEASURING VOLTAGE SOURCE CAUSES AN ARTIFICIAL FAULT CURRENT WHICH EXCEEDS 2 mA. THIS CAUSES THE LIM TO GO INTO ALARM.

18. LT3000 - Technical Specification

System Voltage...	100V…240V
Frequency…………………………………………………………..	50Hz…60Hz
Current set range (potentiometer)…………………………..	1.10…9 mA @ 120VAC 1.75…9 mA @ 240VAC
LCD Display……………………………………………………….	3 ½ digit 0…12.00 mA
Display resolution …………………………………………….	0.01 mA
Leakage current range …………………………………….........	0…12 mA

Note: *The current through the LT3000 is internally limited to 12 mA. A 5kΩ resistive fault in a 120V system would produce a LIM current of 24 mA. The LT3000, however, limits this current to 12 mA.*

Current magnitude required to activate "HAZARD" 'LEDS: 2 or 5 mA internally set prior to shipment

Current accuracy……………………………………………....	2% of reading ± 0.03 mA
Voltage accuracy…………………………………………..…….	2% of reading ± 3V
Operating temperature range…………………………….….	-5ºC…+50ºC
Power consumption…………………………………………...	1W @ 120V 2W @ 240V
Operation…………………………………………………….….	Continuous @ 120V *15-minute intermittent operation for voltages ≥ 208V*

Note: *At voltages ≥ 208V, the LT3000 will shut OFF for sustained operation > 15 minutes. It can be used again after some cooling-off period*

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