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DESCRIPTION

Procedures for performing grounding and leakage current checks on the system.

1- GROUND RESISTANCE CHECKS

Ensure that all pre-installation and wiring is complete prior to starting these checks. This includes, but may not be limited to:

- Any required electrical code inspection
- Installation of the facility disconnect device
- EMERGENCY OFF wiring
- PDU primary wiring
- PDU subsystem power cables

If required, arrange for electrical code inspection when complete.

Initial Conditions

- Direction 2128854, Signa Horizon System Installation, Tab 1: POWER CABLE INSTALLATION INSTRUCTIONS.
- No hard wired signal cables connected to any subsystem cabinets. Fiber Optic cables may be connected and not impact this check.

Tools Required

- Bio-design MG5 meter (Microguard) with Milliohm Adapter.
- Dale 600 (120VAC) or Dale 600E (220VAC) Safety Analyzer
- Digital voltmeter (optional)

Note - Dale 600 or 600E Safety Analyzer
For those sites equipped with a Dale 600 or 600E Safety Analyzer, perform Section 1-2, otherwise perform section 1-1 using the Bio-design MG5 meter (Microguard) with Milliohm Adapter.

1-1 Ground Resistance Checks Using Microguard

Procedure

LIKELY FATAL PERSONAL INJURY!! LETHAL VOLTAGES ARE PRESENT WITHIN THE PDU EVEN WHEN ALL PDU BREAKERS ARE OFF. CHECK THAT POWER AT THE MAIN DISCONNECT IS OFF, LOCKED, AND TAGGED BEFORE PROCEEDING.

1. Ensure that **no** power is applied to PDU.

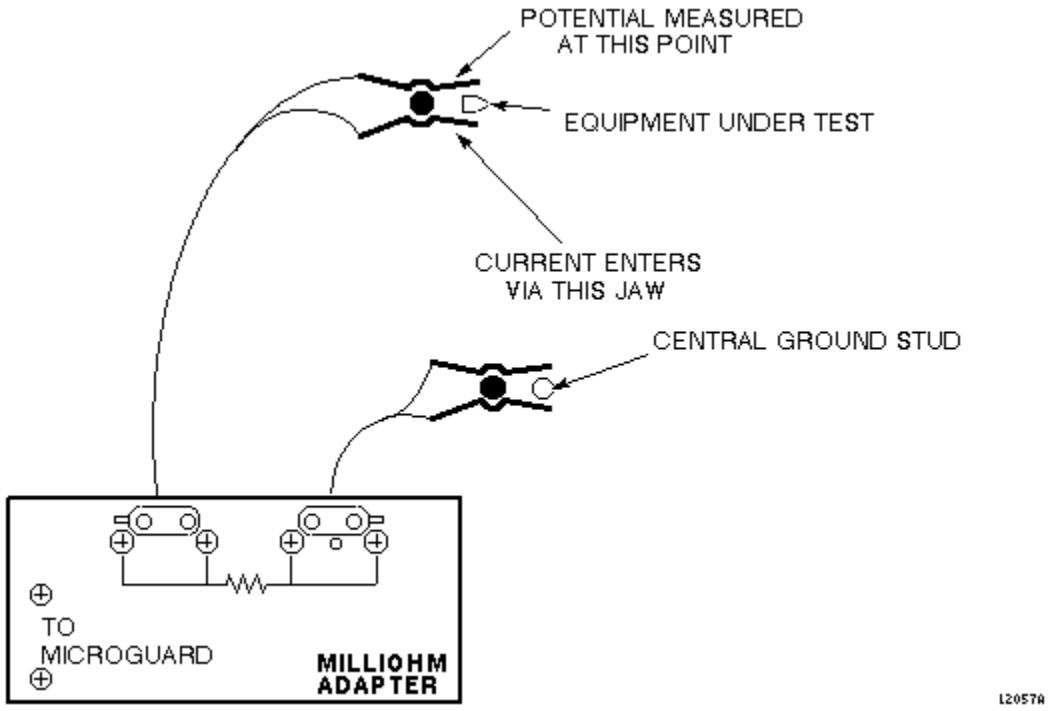
2. Notify all Field Service Engineers working at the site that PDU Main Disconnect will be shut off and locked out.

3. Locate and shut off the Main Disconnect supplying power to the PDU.

4. Lock out and tag the Main Disconnect using appropriate OSHA procedure. (Refer to CD-ROM *Dir. 2187583-3 [or -2], MR Release Signa 5x/8x Service Methods, Renewal Parts and Service Tools*, Procedure for Safety, Section 6, OSHA LOCKOUT/TAGOUT REQUIREMENTS.)

5. Verify that the Main Disconnect and PDU indicator lights are off, and that power switches are inactive.

6. Plug milliohm adapter module into power outlet of the Microguard. See Illustration 1-1.



MICROGUARD CONNECTIONS
ILLUSTRATION 1-1

Note

Since the Microguard is being used solely as a voltmeter in this application, any other meter capable of resolving 0.1 millivolts can be substituted in the next step. Meters other than the Microguard are currently in use. Refer to the appropriate tool catalog for further information.

7. Attach Microguard red and black leads to meter posts of milliohm module.

8. Set Microguard Patient Lead Tester switch to "All Other Tests."

9. Set Microguard Selector switch to "20 Microamps/Millivolts."

10. Set Microguard Input switch to "Red and Black Probes."

11. Attach the Kelvin leads as shown in Illustration 1-1. (Connect one lead to PDU ground bus bar, and the other lead to frame of subsystem cabinet under test.)

12. The meter reads voltage across ground resistance in millivolts. To obtain resistance in milliohms, multiply meter reading by 2.

13. Verify that measured resistance is less than 100 milliohms (corresponding to a meter reading of 50 millivolts).

14. Perform steps 11 through 13 for each subsystem cabinet.

System Restoration

1. Turn Microguard power off.

2. Remove leads and milliohm adapter from Microguard.

3. Close all subsystem cabinets and PDU cabinet.

1-2 Ground Resistance Checks Using Dale

Procedure

DANGER!!

LIKELY FATAL PERSONAL INJURY!! LETHAL VOLTAGES ARE PRESENT WITHIN THE PDU EVEN WHEN ALL PDU BREAKERS ARE OFF. CHECK THAT POWER AT THE MAIN DISCONNECT IS OFF, LOCKED, AND TAGGED BEFORE PROCEEDING.

1. Ensure that **no** power is applied to PDU.

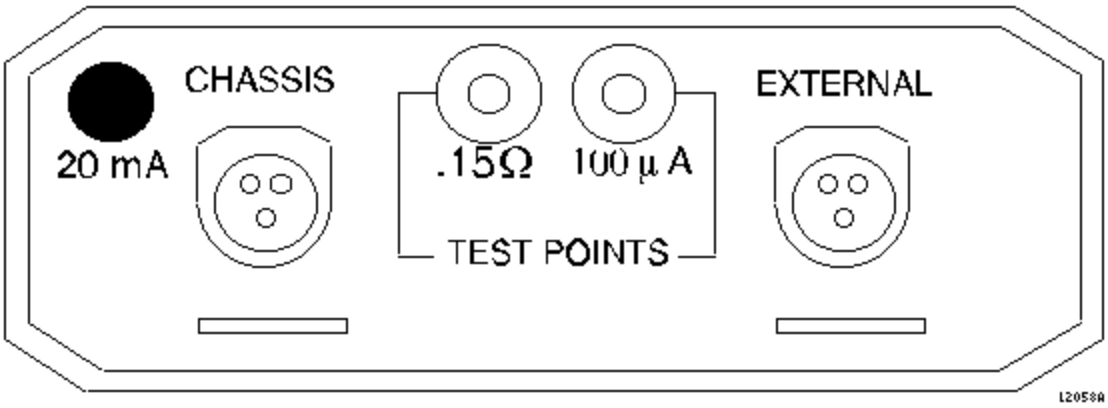
2. Notify all Field Service Engineers working at the site that PDU Main Disconnect will be shut off and locked out.

3. Locate and shut off the Main Disconnect supplying power to the PDU.

4. Lock out and tag the Main Disconnect using appropriate OSHA procedure. (Refer to CD-ROM *Dir. 2187583-3 [or -2], MR Release Signa 5x/8x Service Methods, Renewal Parts and Service Tools*, Procedure for Safety, Section 6, OSHA LOCKOUT/TAGOUT REQUIREMENTS.)

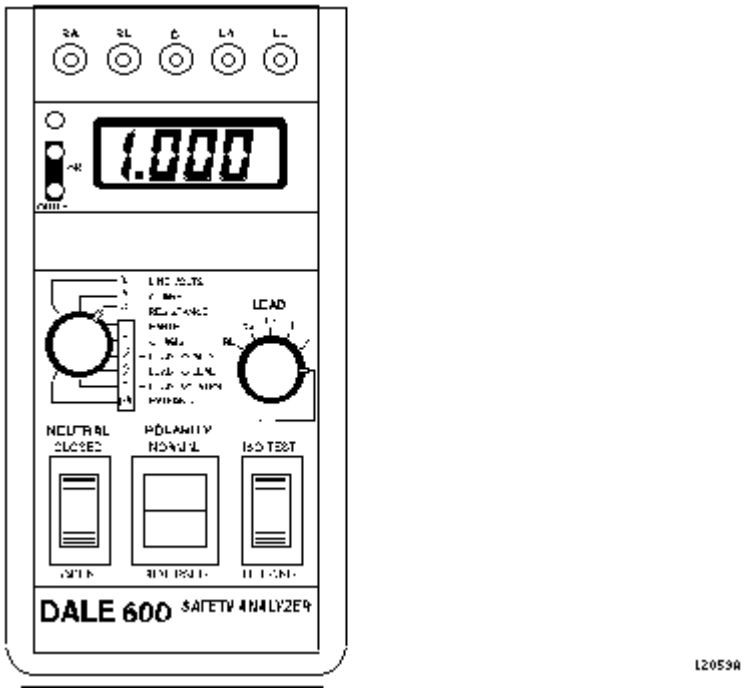
5. Verify that Main Disconnect and PDU indicators lights are off and power switches are inactive.

6. Connect one clamp-type lead to the External jack on the top of the Dale 600/600E. Connect the other clamp-type lead to the Chassis jack on the top of the Dale 600/600E. See Illustration 1-2.



TOP OF DALE 600/600E ANALYZER
ILLUSTRATION 1-2

7. On the Dale 600/600E, set the main selector switch to Ω - Resistance. See Illustration 1-3.



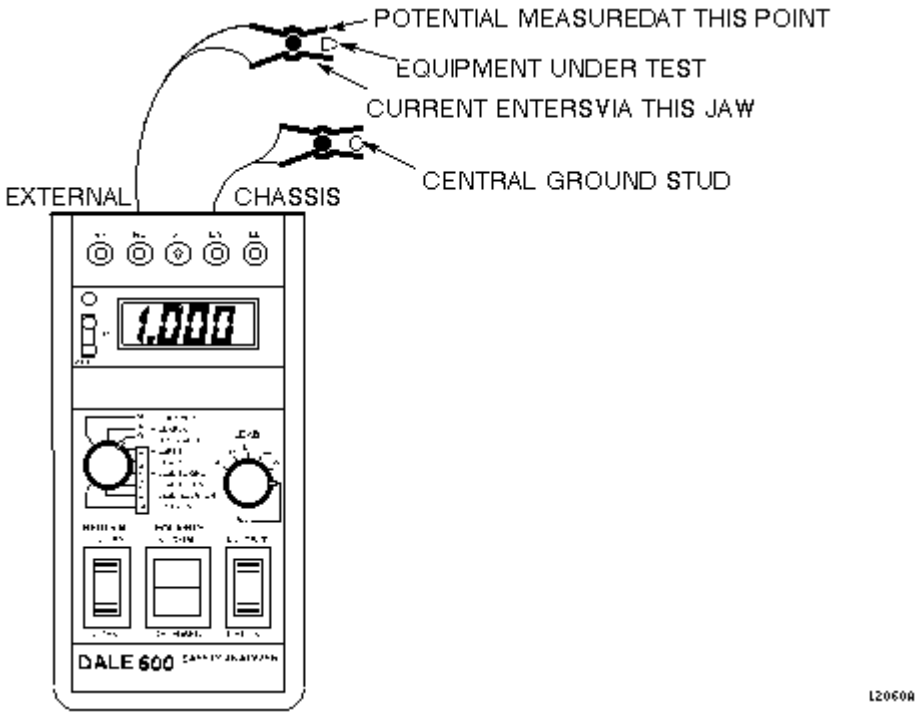
DALE 600/600E ANALYZER
ILLUSTRATION 1-3

8. Plug the Dale into an AC outlet.

9. On the Dale 600/600E, verify that the two OK LEDs light up, indicating proper wiring of the AC outlet. See Illustration 1-3.

10. With leads not touching each other, the display should read *1.00*. With the leads touching (copper to copper) the display should read *0.00* to *0.02*.

11. Attach the leads as shown in Illustration 1-4. (Connect one lead to PDU ground bus bar and the other lead to bare frame of subsystem cabinet under test.)



DALE 600/600E ANALYZER
ILLUSTRATION 1-4

12. The Dale 600/600E reads resistance in ohms. For example, a reading of *0.50* equals 500 milliohms.

13. Verify that measured resistance is less than 100 milliohms. If this fails, add an additional ground wire.

14. Perform steps 11 through 13 for each subsystem cabinet.

System Restoration

1. Unplug Dale from the ac outlet.

2. Remove leads from the Dale.

3. Close all subsystem cabinets and PDU cabinet.

2- GROUND LEAKAGE CURRENT TEST

Initial Conditions

- Section 1- Ground Resistance Checks (previous section) completed.
- All cable installation complete.
- Facility disconnect off.
- PDU secondary power circuit breakers off.
- Standard PDU only: CB18 (400A) in PDU is on.
- All subsystem cabinet circuit breakers and subsystem power switches are on.

Equipment Required

- One 1kOhm precision resistor
- Digital voltmeter
- Dale 600 (120VAC) or Dale 600E (220Vac) Safety Analyzer
- One set of jumper leads

Note - Sites with Dale 600 or 600E Safety Analyzer
For those sites equipped with a Dale 600 or 600E Safety Analyzer, perform Section 2-2, otherwise perform Section 2-1 using the 1kohm precision resistor and digital voltmeter.

2-1 Ground Leakage Current Test Using DVM and 1kOhm Resistor

Procedure

LIKELY FATAL PERSONAL INJURY!! LETHAL VOLTAGES ARE PRESENT WITHIN THE PDU EVEN WHEN ALL PDU BREAKERS ARE OFF. CHECK THAT POWER AT THE MAIN DISCONNECT IS OFF, LOCKED, AND TAGGED BEFORE PROCEEDING.

1. Ensure that **no** power is applied to PDU.

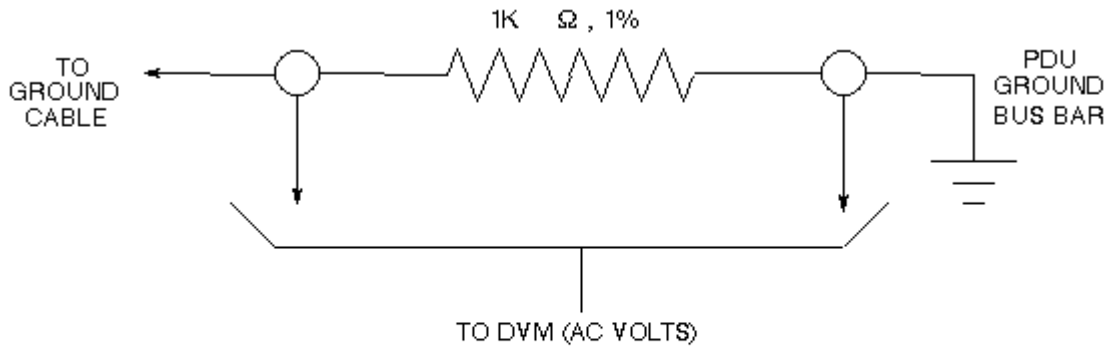
2. Notify all Field Service Engineers working at the site that PDU Main Disconnect will be shut off and locked out.

3. Locate and shut off Main Disconnect supplying power to the PDU.

4. Lock out and tag the Main Disconnect using appropriate OSHA procedure. (Refer to CD-ROM *Dir. 2187583-3 [or -2], MR Release Signa 5x/8x Service Methods, Renewal Parts and Service Tools*, Procedure for Safety, Section 6, OSHA LOCKOUT/TAGOUT REQUIREMENTS.)

5. Verify that Main Disconnect and PDU indicators lights are off, and that power switches are inactive.

6. Connect 1-kOhm resistor to PDU ground bus bar. See Illustration 2-1



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LEAKAGE CURRENT RESISTOR HOOKUP
ILLUSTRATION 2-1

Note

Some subsystem cabinets have one ground connection at the PDU bus bar, while other subsystem cabinets have two. If two ground connections exist, be sure that both are disconnected in the following step.

Note

Most subsystem cabinet grounds are incorporated within power cables. Refer to the "System Interconnects" illustration provided in the Signa installation manual for locating subsystem cabinet grounds.

7. At PDU bus bar, disconnect ground connection(s) of subsystem cabinet under test.

Note

In the following step, only one ground cable should be connected to the 1k ohm resistor. If a second ground cable exists, leave it disconnected during test.

8. Using jumper, connect one of the ground cables disconnected in step 7 to unconnected end of 1-kOhm resistor. See Illustration 2-1.

9. Connect DVM across 1-kOhm resistor (to measure AC volts).

10. Turn on facility disconnect.

11. Turn on PDU power (CB10 for standard PDU, Main Circuit Breaker for compact PDU).

12. Standard PDU only: Select FULL ON mode on PDU Control Board.

13. When mode sequencing finishes, (when all relays stop clicking on standard PDU), turn on CB6 (applies to both standard PDU and compact PDU).

14. Measure voltage across 1kOhm resistor.

Note

500mV corresponds to 500 μA of leakage current.

a. If subsystem cabinet under test only had one ground connection at PDU ground bus bar, verify that less than 500 mV (500 μA) is measured. If more than 500 mV (500 μA) is measured, a second ground cable must be added between subsystem cabinet under test and PDU ground bus bar. Furthermore, if more than 5000 mV (5000 μA) is measured, a serious leakage current problem exists which must be corrected. Use appropriate procedures to troubleshoot system.

b. If subsystem cabinet under test had two ground connections at PDU ground bus bar, verify that less than 5000 mV (5000 μA) is measured. If more than 5000 mV (5000 μA) is measured, a serious leakage current problem exists which must be corrected. Use appropriate procedures to troubleshoot system.

15. Turn CB6 off (applies to both standard PDU and compact PDU).

16. Standard PDU only: Select Full Off mode on PDU Control Board.

17. Turn off PDU power (CB10 for standard PDU, Main Circuit Breaker for Compact PDU).

18. Turn off facility disconnect.

Note

Some subsystem cabinets have one ground connection at the PDU bus bar, while other subsystem cabinets have two. If two ground connections exist, be sure that both are reconnected in the following step.

19. At PDU ground bus bar, reconnect ground connection(s) of subsystem cabinet under test.

20. Perform steps 1 through 19 for each subsystem cabinet.

System Restoration

1. Remove DVM leads.

2. Remove 1-kOhm resistor and jumper.

3. Turn on all PDU secondary power circuit breakers (CB1 through CB17).

4. Close PDU cabinet.

2-2 Ground Leakage Current Test Using Dale

Procedure

DANGER!!

LIKELY FATAL PERSONAL INJURY!! LETHAL VOLTAGES ARE PRESENT WITHIN THE PDU EVEN WHEN ALL PDU BREAKERS ARE OFF. CHECK THAT POWER AT THE MAIN DISCONNECT IS OFF, LOCKED, AND TAGGED BEFORE PROCEEDING.

1. Ensure that **no** power is applied to PDU from main disconnect.

2. Notify all Field Service Engineers working at the site that PDU Main Disconnect will be shut off and locked out.

3. Locate and shut off Main Disconnect supplying power to the PDU.

4. Lock out and tag the Main Disconnect using appropriate OSHA procedure. (Refer to CD-ROM *Dir. 2187583-3 [or -2], MR Release Signa 5x/8x Service Methods, Renewal Parts and Service Tools,* Procedure for Safety, Section 6, OSHA LOCKOUT/TAGOUT REQUIREMENTS.)

5. Verify that Main Disconnect and PDU indicators lights are off, and that power switches are inactive.

6. Connect one clamp-type lead to the External jack on the top of the Dale 600/600E. Connect the other clamp-type lead to the Chassis jack on the top of the Dale 600/600E. See Illustration 1-2.

7. On the Dale 600/600E set the main selector switch to Leakage μA - External.

8. Connect the Chassis clamp-type lead to PDU ground bus bar.

Note

Some subsystem cabinets have one ground connection at the PDU bus bar, while other subsystem cabinets have two. If two ground connections exist, be sure that both are disconnected in the following step.

Note

Most subsystem cabinet grounds are incorporated within power cables. To locate the PDU or Compact PDU interconnects, select Interconnects from the Topics screen, then select PDU, and then choose either Compact PDU Locations/Connections or PDU Locations/Connections, for locating subsystem cabinet grounds.

Note

In the following step, only one ground cable should be connected to the External clamp-type lead. If a second ground cable exists, leave it disconnected during test.

9. At PDU bus bar, disconnect ground connection(s) of subsystem cabinet under test. See Table 2-1. (Ground leads on the PDU bus can best be reached by opening the front cover of the PDU. The ground leads can be removed using appropriate deep sockets.)

TABLE 2-1
PDU GROUND LEAD AND CIRCUIT BREAKER CONNECTIONS

Subsystem Cabinet	Ground Leads	Circuit Breaker	Output Voltage	Output Phases
GRADIENT AMPLIFIER CABINET	1, 2, 3	CB 6 WITH SHUNT	208	3
BROADBAND RF AMPLIFIER CABINET (OPTION)	4, 5, 6	CB 7 WITH SHUNT	208	3
SPARE (OPTION)	7, 8, 9,	CB 13 WITH SHUNT	208	3
RF AMPLIFIER CABINET	10, 11, 12	CB 17 WITH SHUNT	208	3
OPERATOR CONSOLE	13, 14, 15	CB1	208	3
SYSTEM/COMPUTER CABINETS	16, 17, 18	CB 11	208	3
MULTI-FORMAT CAMERA	19	CB 2	120	1
SPARE (OPTION)	20	CB 3	120	1
SPARE (OPTION)	21	CB 4	120	1
INDEPENDENT CONSOLE	22, 23, 24	CB 5	208	3
SPARE (OPTION)	25	CB 12	120	1
RESISTIVE SHIM POWER SUPPLY (OPTION)	26, 27	CB 18 WITH SHUNT	208	2
PENETRATION CABINET	31	CB 8 WITH SHUNT	120	1
SERVICE OUTLETS	32	CB 9	120	1
SUPERCONDUCTING SHIM SERVICE RECEPTACLE	33, 34, 35	CB 16	208	3
MAGNET SERVICE RECEPTACLE	36, 37, 38	CB 15	208	3

10. Connect one of the ground cables disconnected in the previous step to External clamp-type lead.

11. Turn on facility disconnect.

12. Turn on PDU power (CB10 for standard PDU, main circuit breaker for compact PDU).

13. Standard PDU only: Select Full On mode on PDU Control Board.

14. When mode sequencing has completed (when all relays stop clicking on standard PDU), turn on CB6 for gradient cabinet (applies to both standard PDU and compact PDU).

15. Measure leakage current.

a. If subsystem cabinet under test had only one ground connection at PDU ground bus bar, verify that less than 500 μA is observed. If more than 500 μA is measured, a second ground cable must be added between subsystem cabinet under test and PDU ground bus bar. Furthermore, if more than 5000 μA is measured, a serious leakage current problem exists which must be corrected. Use appropriate procedures to troubleshoot system.
b. If subsystem cabinet under test had two ground connections at PDU ground bus bar, verify that less than 5000 μA is measured. If more than 5000 μA is measured, a serious leakage current problem exists which must be corrected. Use appropriate procedures to troubleshoot system.

16. Turn CB6 (for gradient) off (applies to both standard PDU and compact PDU).

17. Standard PDU only: Select Full Off mode on PDU Control Board.

18. Turn off PDU power (CB10 for standard PDU, Main Circuit Breaker for compact PDU).

19. Turn off facility disconnect.

Note

Some subsystem cabinets have one ground connection at the PDU bus bar, while other subsystem cabinets have two. If two ground connections exist, be sure that both are reconnected in the following step.

20. At PDU ground bus bar, reconnect ground connection(s) of subsystem cabinet under test.

21. Perform steps 1 through 20 turning on appropriate circuit breakers for each subsystem cabinet under test per Table 1.

System Restoration

1. Remove leads from Dale 600/600E Safety Analyzer.

2. Turn on all PDU secondary power circuit breakers (CB1 through CB17).

3. Close PDU cabinet.

3- PAC ASSEMBLY LEAKAGE CURRENT TEST

Initial Conditions

Same as for Section 2, Ground Leakage Current Test.

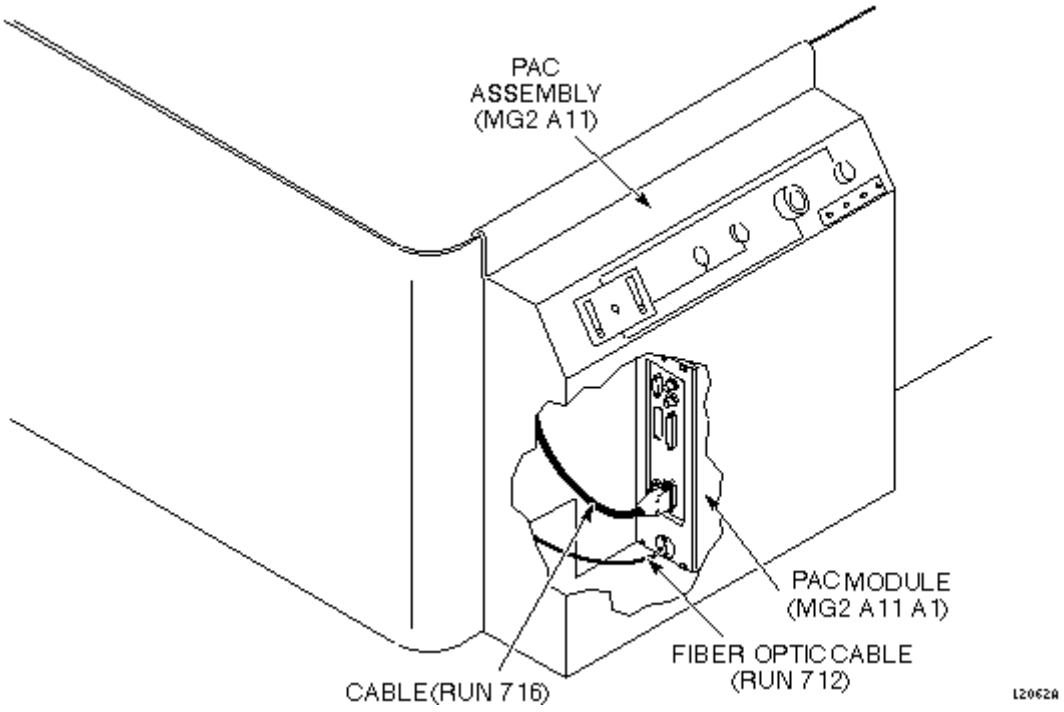
Equipment required:

- Microguard MG-5 with adapter cables for cardiac leads. Meters other than the Microguard are currently also in use. Refer to the appropriate tool catalog for further information.
- Dale 600 (120VAC) or Dale 600E (220VAC) Safety Analyzer
  Note - Dale 600/600E Safety Analyzer

3-1 PAC Assembly Leakage Current Test Using Microguard

Procedure

1. At physiological acquisition controller (PAC) assembly (MG2 A11), disconnect cables from PAC module (MG2 A11 A1): (Run 712) J9/J10 and (Run 716) J2. See Illustration 3-1.



PAC ASSEMBLY
ILLUSTRATION 3-1

2. Remove PAC assembly from front trim skirt of magnet enclosure and move it into equipment room, near penetration panel (PP1).

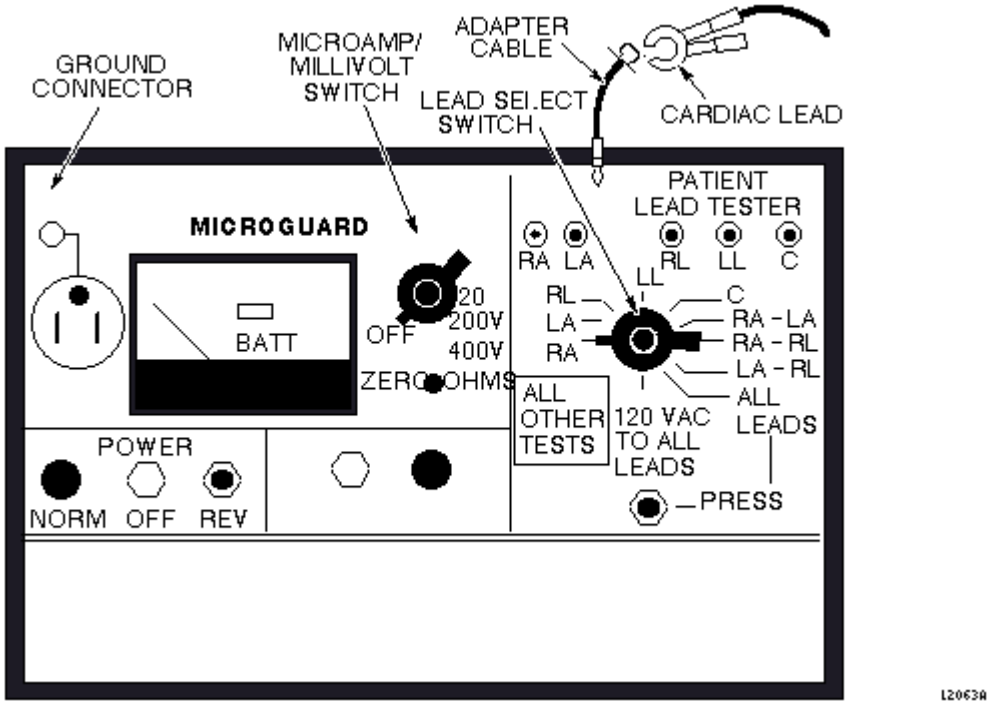
3. Disconnect cable (Run 714) from J89 of PP1 (equipment room side).

4. Connect cable (Run 714) to J2 of PAC module.

5. Connect cardiac lead set to PAC assembly.

6. Plug Microguard meter into an outlet and place power switch in Norm position.

7. Install adapter cables into Microguard meter. See Illustration 3-2.



MICROGUARD BOX
ILLUSTRATION 3-2

8. Connect cardiac leads to adapter cables. The leads and plugs are color-coded. See Illustration 3-2.

9. Check batteries in meter by turning Microamp/Millivolt switch to BATT- position. Meter needle should move into the BATT box. Turn Microamp/Millivolt switch to BATT+ position. Again, meter needle should move into the BATT box. See Illustration 3-2.

10. Connect a lead from ground connector on meter to any of four ECG Leads Test Points on PAC Aassembly.

11. Turn Microamp/Millivolt switch to 20 microamp position.

12. Move Lead Select switch through the positions shown in Table 3-1 and verify that leakage current displayed on meter is less than 10 microamps.

TABLE 3-1
LEAKAGE CURRENT MEASUREMENTS

LEAD SELECT POSITION
RA
LA
RL
RR
RA - LA
RA - RL
LA - RL

Record data for steps 12 to 17 in Data Sheet in Appendix A.

13. Move Lead Select switch to 120 Vac To All Leads position.

14. Coil up leads and place them approximately eight inches from a grounded surface such as a system cabinet.

15. Press button Lead Select switch and record the meter reading in Data Sheet.

16. Remove all leads from meter (including ground lead) and press the same button. Record meter reading in Data Sheet.

17. Subtract step 15 reading from step 16 reading. This must be less than 10 microamps. Record in Data Sheet.

Repeat steps 13–17 with power switch in the Reverse position.

System Restoration

1. Disconnect cardiac lead set from PAC assembly.

2. Disconnect cable (Run 714) from J2 of PAC module.

3. Connect cable (Run 714) to J89 of PP1 (equipment room side).

4. Install PAC assembly on front trim skirt of magnet enclosure. See Illustration 3-1.

5. Connect cables to PAC Module (MG2 A11 A1); (Run 712) J9/J10 and (Run 716) J2. See Illustration 3-1.

3-2 PAC Assembly Leakage Current Test Using Dale

Procedure

1. At physiological acquisition controller (PAC) assembly (MG2 A11), disconnect cables from PAC module (MG2 A11 A1): (Run 712) J9/J10 and (Run 716) J2. See Illustration 3-1.

2. Remove PAC assembly from front trim skirt of magnet enclosure and move it into equipment room.

3. Connect cardiac lead set into PAC assembly.

4. Connect cardiac leads to Dale 600/600E.

5. Connect a lead from C connector on Dale 600/600E to any of four ECG Leads Test Points on PAC assembly.

6. On the Dale 600/600E set the main selector switch to Leakage-Lead-Gnd.

7. Move Lead switch through positions shown in Table 3-1 and verify that leakage current displayed on meter is less than 10 microamps. Record data in Data Sheet in Appendix A.

8. On the Dale 600/600E, set the main selector switch to Leakage-Lead-Lead.

9. Move Lead switch through positions shown in Table 3-1 and verify that leakage current displayed on meter is less than 10 microamps.

10. On the Dale 600/600E, set the main selector switch to Leakage-Lead-ISO.

11. Coil up leads and place them approxi-mately eight inches from a grounded surface such as a system cabinet.

12. Press button ISO Test switch and record the meter reading in Data Sheet.

13. Remove all leads from meter (inclu-ding ground lead) and press the same button. Record meter reading in Data Sheet.

14. Subtract step 13 reading from step 12 reading. This reading must be less than 10 microamps. Record in Data Sheet.

Repeat steps 10–14 with Polarity switch in the Reversed position.

System Restoration

1. Disconnect cardiac lead set from PAC assembly.

2. Install PAC assembly on front trim skirt of magnet enclosure. See Illustration 3-1.

3. Connect cables to PAC module (MG2 A11 A1); (Run 712) J9/J10 and (Run 716) J2. See Illustration 3-1.

APPENDIX A - DATA SHEETS

PHYSIOLOGICAL ACQUISITION CONTROLLER ASSEMBLY LEAKAGE CURRENT MEASUREMENTS

LEAD SELECT POSITION	METER READING NORMAL POSITION (microamps)	METER READING REVERSE POSITION (microamps)
Right Arm (RA)		
Left Arm (LA)		
Right Leg (RL)		
Left Leg (LL)		
RA to LA		
RA to RL		
LA to RL		
Coiled Leads		
Leads Removed		
Leads Removed (Coiled Leads)		

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
0	Jun 30, 1998	L. Loehrer	Converted Toolbook document to MS Word 7.0
1	Nov 10, 1998	M. Keber	Added data sheet; style guide cleanup.