


**Guardian 5000**  
**AC/DC/IR/GC Safety Analyzer**  
**Instruction Manual**

Form 150206/B3

©QuadTech, Inc., 1996  
5 Clock Tower Place, 210 East  
Maynard, Massachusetts, U.S.A. 01754-2530  
November, 1999

Tel. 978-461-2100  
800-253-1230 (Sales & Service)  
Fax. 978-461-4295  
Email: sales@quadtech.com  
Web site: <http://www.quadtech.com>

The material in this manual is for informational purposes only and is subject to change, without notice. QuadTech assumes no responsibility for any error or for consequential damages that may result from the misinterpretation of any procedures in this publication.

**Symbol**  **IEC417** on equipment signifies that the manual contains information to prevent injury or equipment damage



---

# Contents

---

<b>Warranty</b> .....	v
<b>Specifications</b> .....	vii
<b>Introduction - Section 1</b>	
1.1 Unpacking and Inspection .....	1-1
1.1 Product Overview .....	1-1
1.3 Front Panel Description .....	1-2
1.4 Rear Panel Description .....	1-6
1.5 Accessories Included .....	1-7
1.6 Accessories/Options Available .....	1-7
1.7 Power Requirements .....	1-8
<b>Operation - Section 2</b>	
2.1 Startup .....	2-1
2.2 Instrument Zeroing/Offset .....	2-1
2.3 Connection to Device Under Test .....	2-3
2.4 Measurement Procedure .....	2-6
2.5 Programming Test Modes .....	2-8
2.6 Programming Hipot Test .....	2-10
2.7 Programming Insulation Resistance (IR) Test .....	2-12
2.8 Programming Ground Continuity Test .....	2-14
2.9 Initial Parameter Setting .....	2-16
2.10 Front Panel Lockout .....	2-18
2.11 Software Version Display .....	2-18
2.12 Clear Setup Memory .....	2-18
<b>Input/Output Interfaces - Section 3</b>	
3.1 Remote .....	3-1
3.2 IEEE-488 Interface .....	3-3
3.2.1 Description .....	3-3
3.2.2 Interface Commands .....	3-4
3.2.2.1 Listener Functions .....	3-5
3.2.2.2 Talker Functions .....	3-9
3.2.3 Sample QuickBASIC Program .....	3-11
3.3 Scanner Interface .....	3-14
3.3.1 Scanner Accessories .....	3-14
3.3.2 Scanner Card Installation .....	3-14
3.3.3 Scanner Connections .....	3-15
3.3.4 Scanner Programming .....	3-17
3.4 G16 International Power Strip .....	3-19

---

## Contents Continued

---

### Maintenance/Calibration - Section 4

4.1	General .....	4-1
4.2	Instrument Return .....	4-1
4.3	Calibration .....	4-1
4.3.1	Calibration Procedure .....	4-2
4.3.2	AC Voltage Calibration .....	4-3
4.3.3	DC Voltage Calibration .....	4-4
4.3.4	IR Voltage Calibration .....	4-4
4.3.5	AC Current Calibration .....	4-5
4.3.6	DC Current Calibration .....	4-6
4.3.7	GC Calibration.....	4-7
4.3.8	Finalize Calibration .....	4-8

---

## Warranty

---



QuadTech warrants that Products are free from defects in material and workmanship and, when properly used, will perform in accordance with QuadTech's applicable published specifications. If within one (1) year after original shipment it is found not to meet this standard, it will be repaired, or at the option of QuadTech, replaced at no charge when returned to a QuadTech service facility.

**Changes in the Product not approved by QuadTech shall void this warranty.**

**QuadTech shall not be liable for any indirect, special or consequential damages, even if notice has been given of the possibility of such damages.**

**This warranty is in lieu of all other warranties, expressed or implied, including, but not limited to any implied warranty or merchantability or fitness for a particular purpose.**

### **SERVICE POLICY**

QuadTech policy is to maintain product repair capability for a period of at least five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.

---

# Specifications

---

## Dielectric Strength

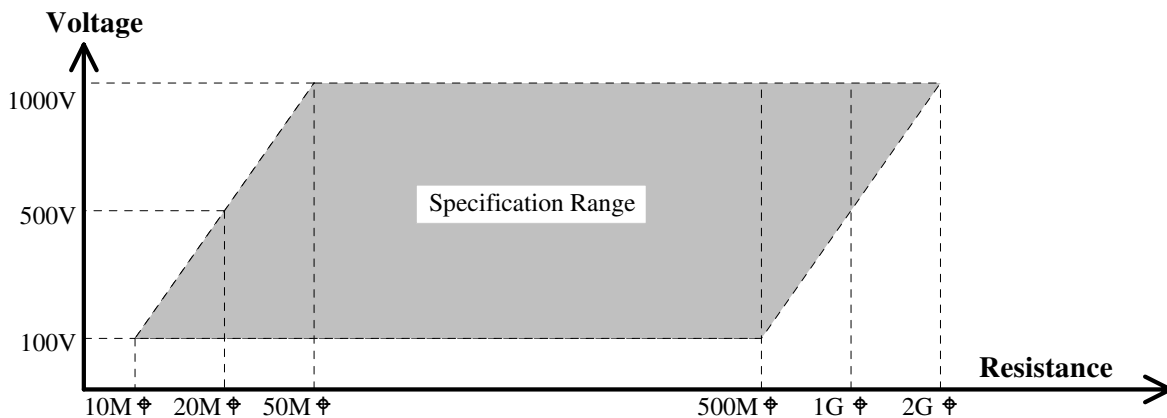
---

- Output Voltage:** Range:   • 0.1 to 5 KV AC, in 10V/steps, 50 - 600Hz  
                                  • 0.1 to 6 KV DC, in 10V/steps  
Accuracy: +/- (1% of reading + 5 counts)  
Regulation: <1% + 5V, rated load
- Breakdown:** Detection: • I<sub>max</sub>: 0.3 - 40mA AC, 0.3 - 20mA DC  
                                  • ΔI: 0.5 to 40mA, ≤ 20μsec
- Leakage Current:** Accuracy: +/- (1.5% + 5 counts), unspecified 0.01 - 0.3mA
- Test Time:** Ramp: 0.1 to 99.9sec (+/-20ms)  
                  Hold: 0.1 to 999sec (+/-20ms)

## Insulation Resistance

---

- Measurements:** Range: 10MΩ - 10GΩ  
                          Test Voltage: 100 - 1000V DC
- Accuracy:** Measurement: +/- 5% ≥ 500V, 10MΩ - 1GΩ  
                                  +/- 15% ≥ 500V, 1GΩ - 10GΩ  
                                  +/- 10% < 500V, 1 - 200MΩ  
                                  +/- 15% < 200V, 200MΩ - 1GΩ  
                          Voltage: +/- (1% of setting + 5 counts)
- Measure Time:** 0.1 - 999sec (+/-20ms)
- Limit Delay:** 0.3 - 99.9sec (+/-20ms)



## Specifications Continued

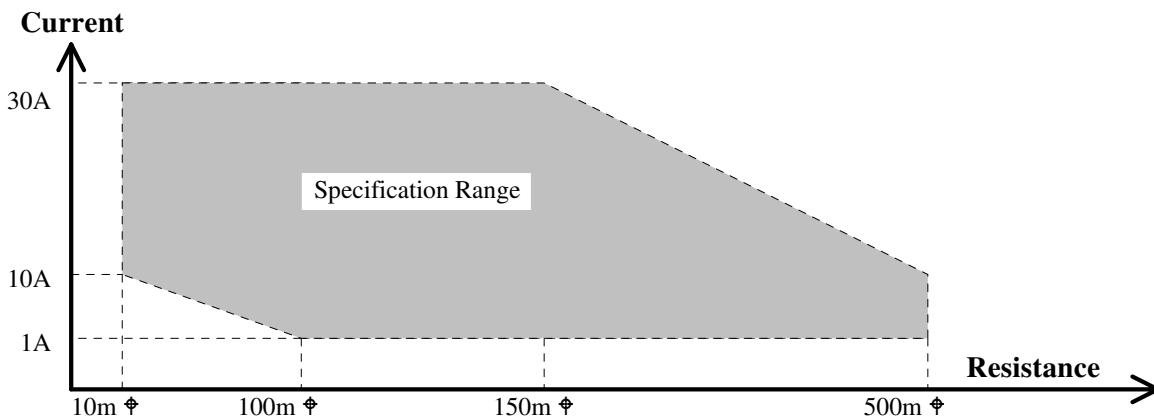
### Ground Continuity

**Output Current:** Range: 1.0 to 30.0A AC, setting 0.1A/step  
 Accuracy: +/- (1% of setting + 0.3A)  
 +/- (1% of reading + 3 counts)  
 Frequency: 50 or 60Hz, 6 to 15V

**Resistance:** Range: 0 - 500.0mΩ, 4 digits, Hi Limit  
 Accuracy: +/- (1% of reading + 3 counts)

**Offset Function:** 0 to 100mohm offset, user selectable

**Test Time:** 0.5 - 999sec (+/-20ms)



### General

**Safety Features:** Fast Cutoff (<0.4msec), Fast Discharge, Panel Lock

**Setup Storage:** 50 Memory Groups

**Remote Control:** Remote start & reset, Go/NoGo output, IEEE-488 Intf.

**Pass/Fail:** Display indication & alarm

**Mechanical:** Bench mount  
 Dimensions: (w x h x d): 17x8.5x22in (430x215x550mm)  
 Weight: 50 lbs (23kg) net, 60 lbs (27kg) shipping

**Environmental:** Meets MIL-T-28800E, Type 3, Class 5  
 Operating: 0 to + 45o C  
 Humidity: <75%  
 Storage: - 10 to + 60o C

**Power:** • 115 V/230V +/- 10%                      • 47 - 63Hz                      • 650W max

**Supplied:** • Instruction Manual                      • Power Cable  
 • Calibration Certificate                      • Test Leads

**Ordering Information:** Description                      Catalog No.  
 AC/DC/IR/GC Safety Analyzer                      Guardian 5000



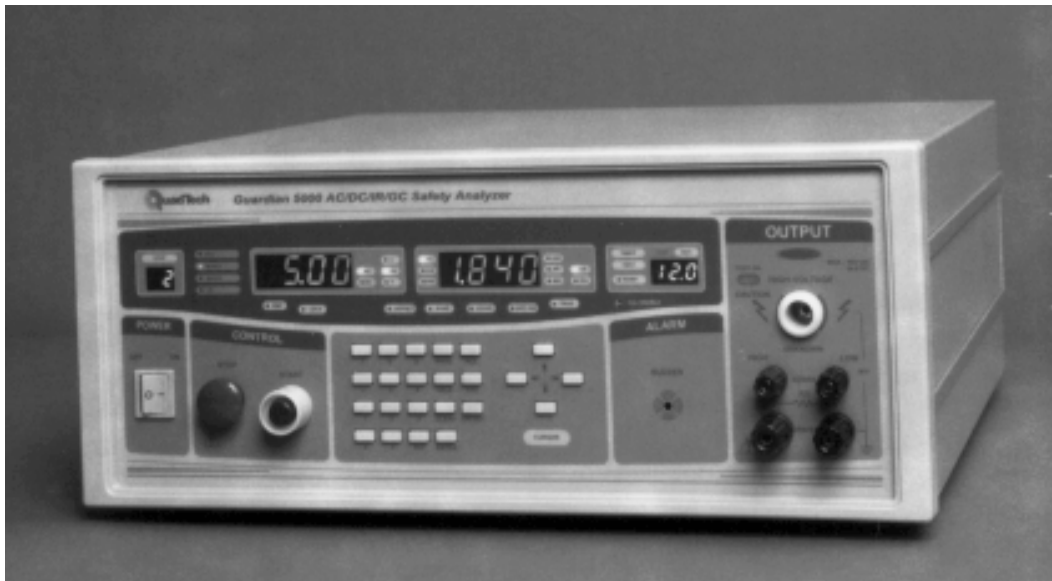


### 1.1 Unpacking and Inspection

Inspect the shipping carton before opening, if damaged contact the carriers agent immediately. Inspect the instrument for any damage. If the instrument appears damaged or fails to meet specifications notify QuadTech (refer to instruction manual front cover) or its local representative. Retain the shipping carton and packing material for future use such as returning for recalibration or service.

### 1.2 Product Overview

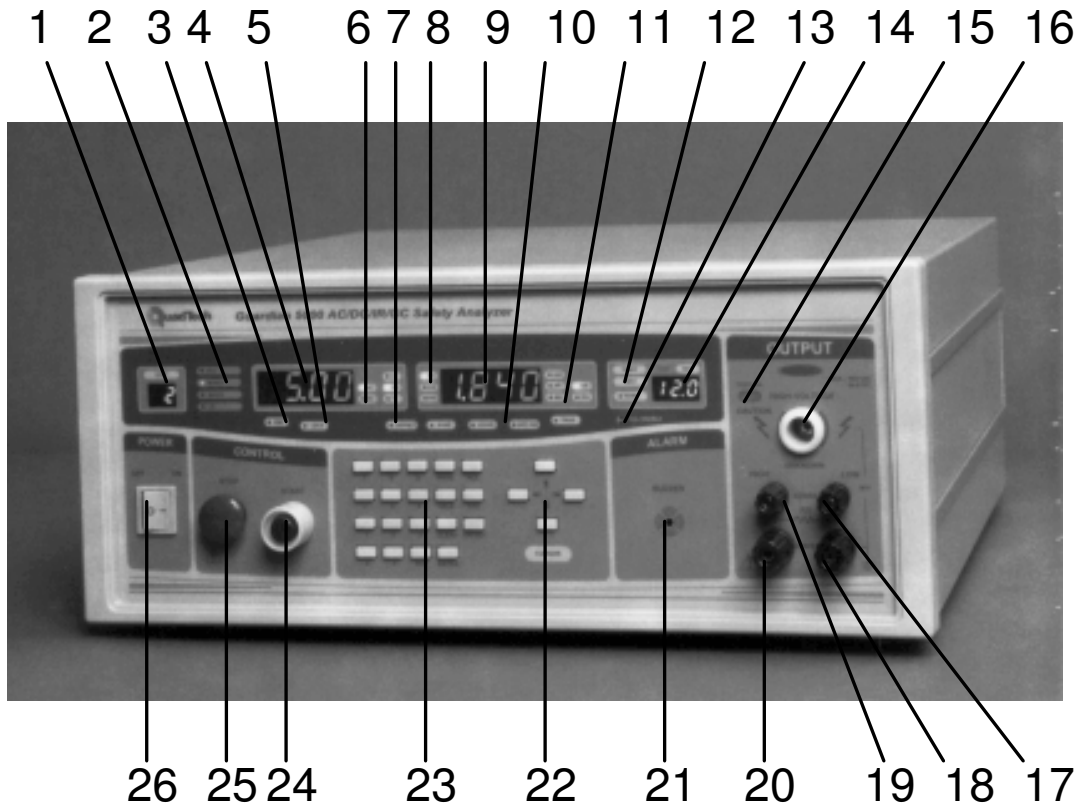
The Guardian 5000 Safety Analyzer combines four critical safety tests into a single instrument, these being **AC hipot, DC hipot, insulation resistance measurements and ground continuity test**. The hipot test can be programmed over a voltage range of 0.1 to 5KV AC and 0.5 to 6KV DC with a min/max leakage current detection range of 300 $\mu$ A to 40mA AC and 20mA DC. Insulation resistance measurements are possible to 10G $\Omega$  at programmable DC test voltages between 100 and 1000V. A ground continuity test to 30A AC is also possible. The instrument comes standard with internal storage of up to 50 memory groups and an IEEE-488.2 interface for remote control operation and communication with other instrumentation.



**Figure 1-1**  
**Guardian 5000**

### 1.3 Front Panel Description

Figure 1-2 shows the controls and indicators on the front panel of the Guardian 5000. Table 1-1 identifies them with descriptions and functions.



**Figure 1-2**  
**Front Panel Controls & Indicators**

**Table 1-1**  
**Front Panel Controls and Indicators**

**Fig 1-2**

<b>Ref. #</b>	<b>Item</b>	<b>Function</b>
1	Step	Display indicates step number selected in the auto test sequence (1 to 15). Indicates memory group number (1 to 50) when <b>RCL</b> (recall) or <b>STO</b> (store) is selected.
2	Mode RΩ/W-ACV W-DCV/IR	Light indicates that tester is in Ground Continuity, AC Hipot, DC Hipot or Insulation Resistance mode status.
3	RMT Indicator	Light indicates when instrument is in remote mode.
4	Voltage or Current Display	Display shows voltage/voltage setting value when test is not in process and shows output voltage/current when test is in process. 0.1 - 5KV for AC Hipot, 0.5 - 6KV for DC Hipot, 100 - 1000V for IR, and 1.0 - 30.0A for GC,
5	LOCK Indicator	Light indicates when instrument front panel keys are locked
6	Display Units	Indicates the units for the current/voltage display (AC or DC, A, KV for hipot, V for IR or A for GC)
7	OFFSET Indicator	Light indicates when instrument offset function is enabled.
8	Limit Indicator	Indicates the function of the limit shown on the Limit Display (HI, LO, or ARC)
9	Limit/Measure	Display shows limit setting when test is not in process and shows measured value when test is in process.
10	Result Indicators	Lights indicate test results based on set limits. <b>HI NG-</b> Measured value exceeded high limit <b>LO NG -</b> Measured value less than low limit <b>ARC NG -</b> Measured value exceeded arc limit <b>PASS -</b> Measured value is good based on all set limits

**Table 1-1**  
**Front Panel Controls and Indicators (continued)**

**Fig 1-2**

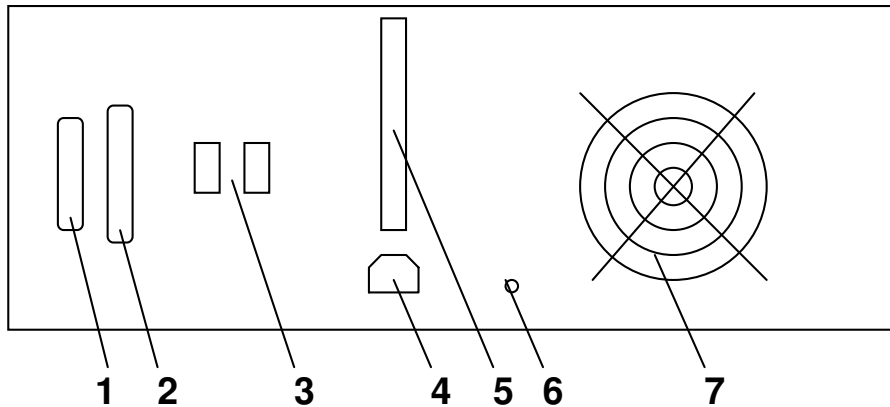
<b>Ref. #</b>	<b>Item</b>	<b>Function</b>
11	Limit/Measure Display Units	Indicates the units for the entered limits or the measured display (mA for hipot, MΩ for IR or mΩ for GC)
12	Timer Indicator	Indicates when test time shown is RAMP time
13	CAL ENABLE	For use by qualified service personnel during instrument calibration.
14	Timer Display	Display shows set time or time countdown when test is in process. A test time of 0 (zero) places the instrument in a continuous measure mode.
15	TEST ON Indicator	When indicator light is blinking high voltage is present on the output terminals.
16	HIGH VOLTAGE	High voltage output terminal (Hipot or Insulation Resistance tests)
17	LOW SENSE	Low potential terminal (SENSE) for Ground Continuity test.
18	LOW DRIVER	Ground reference terminal for all tests
19	HIGH SENSE	High potential terminal (SENSE) for Ground Continuity test.
20	HIGH DRIVER	High current terminals (DRIVER) for Ground Continuity test.
21	BUZZER	Audible output for pass/fail results.

**Table 1-1**  
**Front Panel Controls and Indicators (continued)**

**Fig 1-2**

<b>Ref. #</b>	<b>Item</b>	<b>Function</b>
22	CURSOR keys	<p><u>Under STOP status:</u>  <b>UP ▲</b> or <b>DOWN ▼</b> to examine 1 - 15 steps</p> <p><u>Under Hipot test On:</u>  <b>UP ▲</b> or <b>DOWN ▼</b> to increase or decrease test voltage in continuous mode</p> <p><u>Under PROG status:</u>  <b>LEFT ◀</b> or <b>RIGHT ▶</b> to select parameter for programming  <b>UP ▲</b> or <b>DOWN ▼</b> to change status status</p>
23	Data Entry Keys	<p><b>[0] [.] .....[9]</b> Numerical keys to input test parameters</p> <p><b>[OFF]</b> For turning off test parameters (limits, arc, etc.)</p> <p><b>[PROG]</b> To enter and exit parameter setting status</p> <p><b>[DELE]</b> To delete a test step, those below move up</p> <p><b>[CLEAR]</b> To cancel parameter number and input again</p> <p><b>[ENTER]</b> Press to confirm enter parameter</p> <p><b>[RCL]</b> Recalls stored parameters (1 - 50) from memory</p> <p><b>[STO]</b> Stores parameter (1 - 50) into memory</p> <p><b>[OFFSET]</b> Initiates zeroing offset function</p>
24	START button	Pressing this button starts a test and applies high voltage/current to the test terminals.
25	STOP button	Pressing this button stops a test in process and must be pressed as a reset function before a test can be started (after a failed test or after test conditions have been reprogrammed).
26	OFF/ON	Applies AC power to the tester, 0 is off, 1 is on.


## 1.4 Rear Panel Description



**Figure 1-3**  
**Rear Panel View**

**Table 1-2**  
**Rear Panel Connectors and Controls**

**Fig 1-3**

<b>Ref. #</b>	<b>Item</b>	<b>Function</b>
1	IEEE	Input/output connections according to IEEE STD-488.2. 24 pin socket for standard IEEE-488 cable. Refer to paragraph 3.2
2	SCAN	Input/output scanner interface for QuadTech 5000-01 or 5000-02 Multiport Scanner Matrix. Refer to Paragraph 3.3.
3	Voltage Selector	Switches for selecting range of AC power source - Set to 100V position for 90 - 100VAC operation - Set to 120V position for 110 - 130VAC operation - Set to 220V position for 200 - 240VAC operation - Set to 240V position for 220 - 250VAC operation
4	 AC Inlet	Fuse drawer and 3-wire connection for AC power source. Module Contains 7A, 250V, 5x20mm fuse for 90-130V operation or 3.5A, 250V, 5x20mm fuse for 200-250V operation
5	SIGNAL OUTPUT	Contact closures for test in process, test results good, and test results no good. Maximum contact rating is 115V at 0.3A.
6	Ground	Chassis ground connection
7	Fan	Temperature control fan - on for > 50°C - off for < 45°C

## 1.5 Accessories Included

**Table 1-3**

<u>Item</u>	<u>Quantity</u>
Instruction Manual	1
Calibration Certificate	1
Power Cord	1
Power Line Fuse, 7A	2
S02, Test Lead Set, Hipot (1 red, 1 black, with alligator clips)	1
G15, Test Lead Set, GC (1 red, 1 black, with spring clips)	1
G14, Test Lead Set, Hipot (115V Receptacle)	1

## 1.6 Accessories/Options Available

**Table 1-4**

<u>Item</u>	<u>Part Number</u>
Multiport Scanner Matrix (8 channel high V)	5000-01
Multiport Scanner Matrix (8 channel high V, 4 GC)	5000-02
Multiport Scanner Matrix, rack (8 channel high V)	5000-03
Multiport Scanner Matrix, rack (8 channel high V, 4 GC)	5000-04
High Voltage Lead Set, high & low, 1m (std w/unit)	S02
High Voltage Lead Set, high & low, 2m	S04
Foot Switch	S05
High Voltage Probe	S06
Gun Probe	S08
High Voltage Lead, 1 meter, unterminated	S09
High Voltage Lead, 2 meters, unterminated	S10
Gun Probe with remote start	S11
Load Box, resistive	S12
Load Box custom resistors	S14
Corded Product Adaptor	G13
Power Entry Adaptor Cable, GC (std w/unit)	G14
Ground Continuity Lead Set (std w/unit)	G15
International Power Strip	G16
Rear Panel Connection (factory installed)	G22
Rack Mount Flanges (factory installed)	G23
Corded Product Adaptor (240V)	G25
RS232 Interface	G26

## 1.7 Power Requirements



The Guardian 5000 can be operated from a power source of 90 to 130 VAC or 200 to 250 VAC. Power connection is via the rear panel through a standard receptacle. Before connecting the 3-wire power cord between the unit and AC power source make sure the voltage selection switches on the rear panel (as indicated) and fuses are in accordance with the power source being used. 7A, 250V, 5x20mm, for 90-130V source and 3.5A, 250V, 5x20mm, for 200-250V source. Always use an outlet which has a properly connected protection ground.

To change the fuse proceed as follows:

### **WARNING**

**MAKE SURE THE UNIT HAS BEEN DISCONNECTED FROM ITS AC POWER SOURCE FOR AT LEAST FIVE MINUTES BEFORE PROCEEDING.**

Remove the fuse drawer, by inserting a flat head screwdriver behind the small tab located just below the 3 prong receptacle, and force outward.

Once the fuse drawer has been removed from the instrument snap the fuse from the holder and replace. Make sure the new fuse is of the proper rating. Note that the fuse drawer can also be used to store a spare fuse.

Install the fuse drawer back in the inlet module (fuse down) by pushing in until it locks securely in place.



## 2.1 Startup

Check to make sure the Voltage Selector Switch on the rear panel agrees with the power source available (Depending on the power source the switch positions should be in the up or down positions as shown).

**WARNING**

**NEVER TOUCH THE TEST LEADS IN ANY MANNER (this includes insulation on all wires and clips) WHEN THE HIGH VOLTAGE IS APPLIED AND RED DANGER LIGHT ON.**

**USE ALL PRECAUTIONS NECESSARY TO AVOID TOUCHING THE DEVICE UNDER TEST WHEN THE RED DANGER LIGHT IS ON OR BLINKING.**

Connect the instrument power cord to the source of proper voltage. **The instrument is to be used only with three wire grounded outlets.**

Power is applied to the Guardian 5000 by pressing the front panel POWER switch to ON (1 position).

**WARNING**

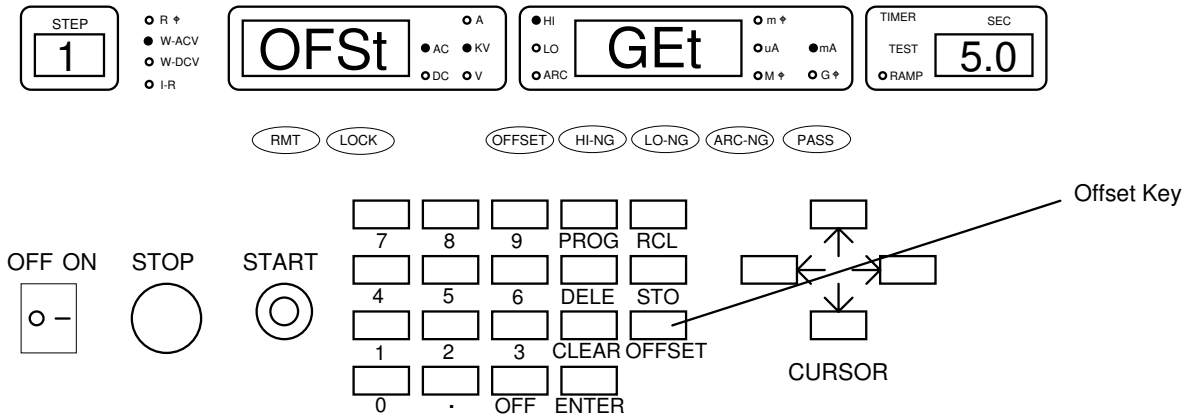
**DO NOT TURN INSTRUMENT POWER ON OR OFF WITH TEST DEVICES CONNECTED.**

## 2.2 Instrument Zeroing/Offset

The Guardian 5000 provides automatic zeroing/offset for lead or fixture effects. During the zeroing/offset process a correction is made (subtracted out) as the result of lead leakage current and stored in instrument memory to be applied to ongoing measurements. For maximum measurement accuracy it is recommended that the unit be zeroed after power-up and any time the test leads or fixture is changed (the offset is not saved under setup storage, 1 - 50 setups, but is saved on a power down and power back up. **The instrument should warm-up for at least 15 minutes before zeroing.**

Proceed as follows for automatic zeroing/offset:

- Plug the appropriate cable (or other fixture) into the front panel OUTPUT connectors, **with no device connected**. Refer to paragraph 2.3 for cable configurations based on test to be made. Test leads used for an AC Hipot, DC Hipot or Insulation Resistance measurement should be **open** and those leads used for the ground continuity measurement be **shorted** together before performing the zeroing offset.
- With the instrument in the power-up state (or in any other desired setup, refer to paragraph 2.4 for recalling setups) press the **OFFSET** key.



- Display should read **OFSt** and **GEt**. Push the **START** button to initiate the automatic storage of the offset value for all tests within a sequence.
- The offset will remain **on** until turned off by pressing the **OFFSET** key twice. If the instrument is powered down with the offset **on** it remains in effect when the unit is again powered up.

The following formulas apply to the offset function:

For AC offset current < 80µA:

$$\text{Display current} = \sqrt{(\text{current read})^2 - (\text{offset current})^2}$$

For DC offset or AC offset current ≥ 80µA:

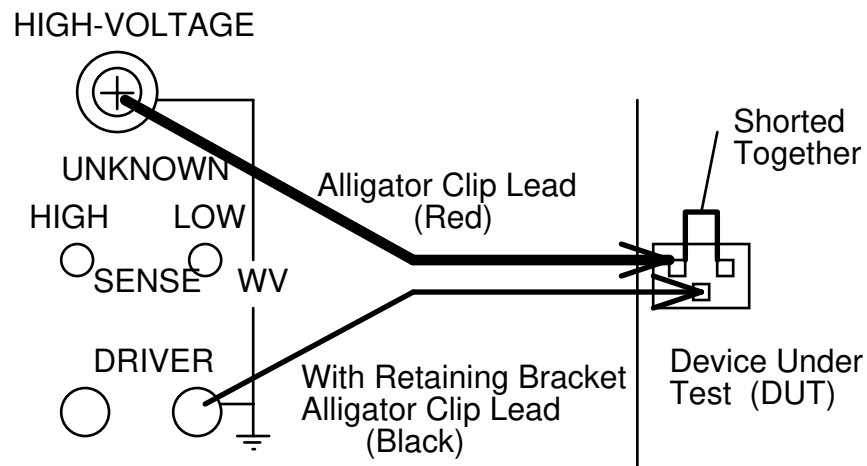
$$\text{Display current} = (\text{current read}) - (\text{offset current})$$

## 2.3 Connection to Device Under Test

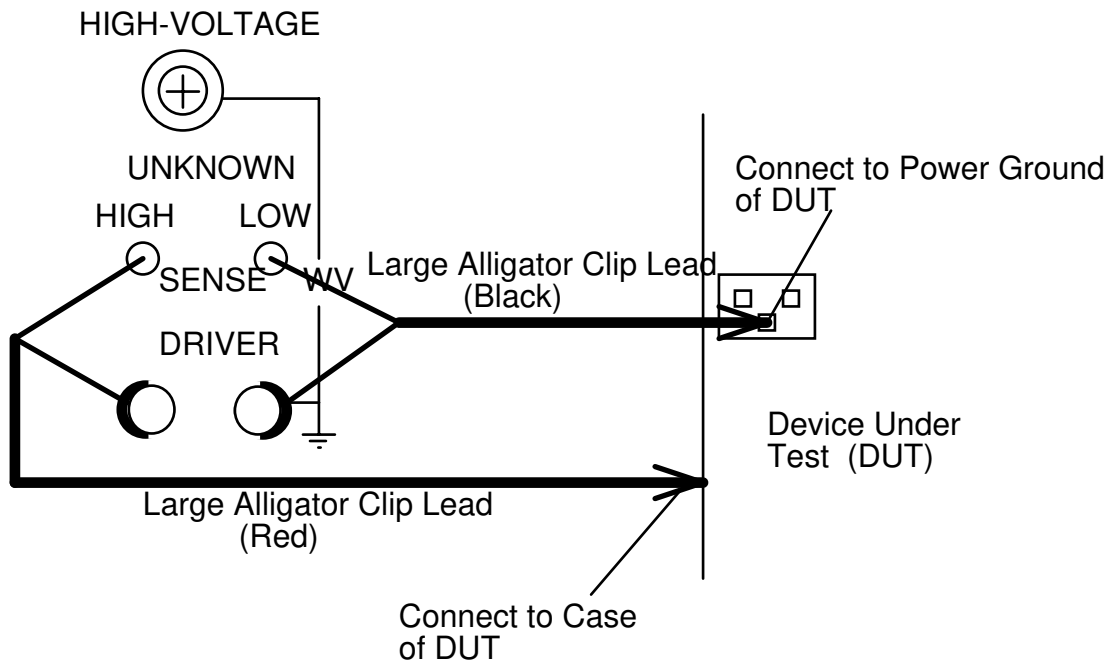
Before connecting the device for test Press the **STOP** key and make sure the red DANGER light is not on.

Depending on the test to be conducted (Hipot, IR or Ground Continuity) connect the test cables to the front panel OUTPUT connectors. Refer to the following figures to determine the correct configuration. When using the black cable, with the metal retaining bracket, make sure it is locked behind the connector to prevent this cable from accidentally coming loose.

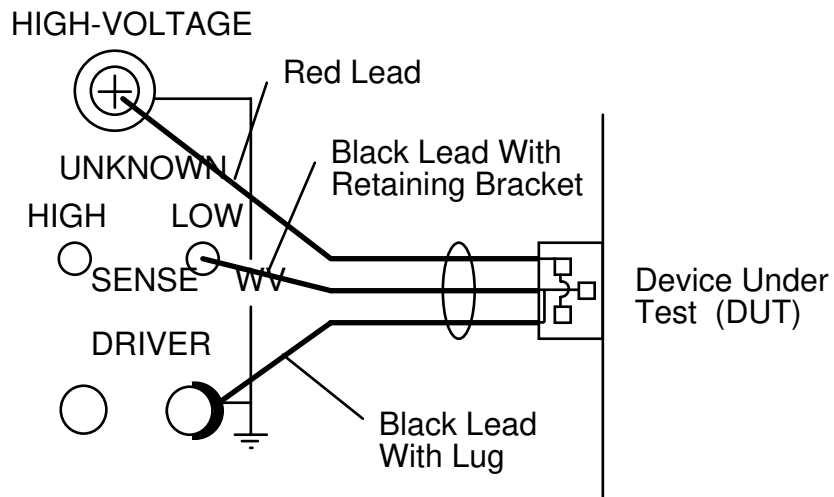
**WARNING**  
**NEVER TOUCH THE TEST LEADS OR THE DEVICE UNDER TEST WHEN THEY ARE CONNECTED TO THE INSTRUMENT AND THE RED DANGER LIGHT IS ON OR BLINKING.**



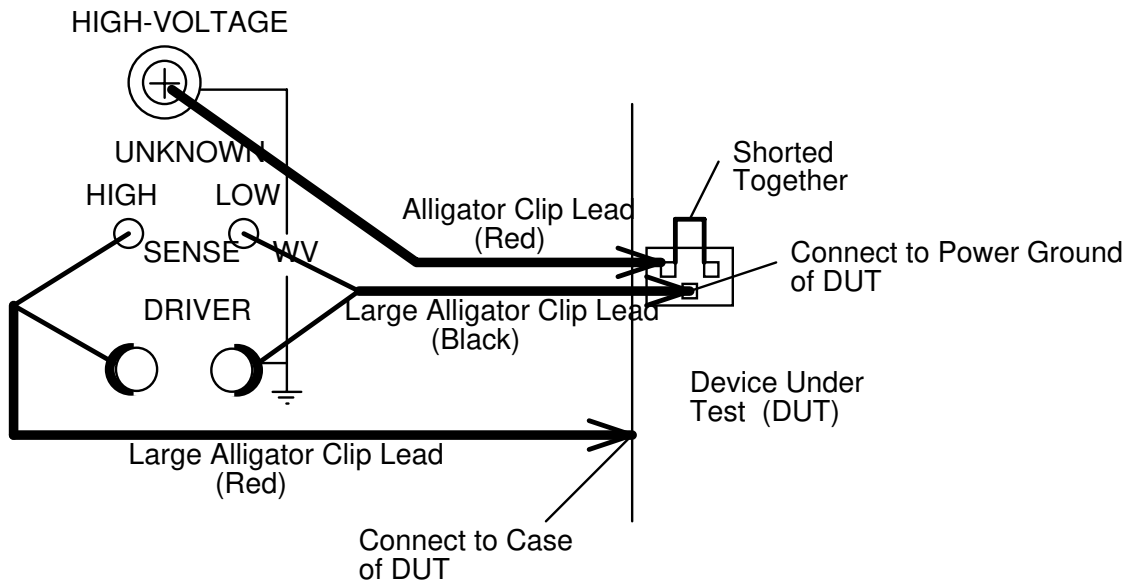
**Figure 2-1**  
**Connection for Hipot/IR Test**  
**(Using S02 Two Lead Test Set)**



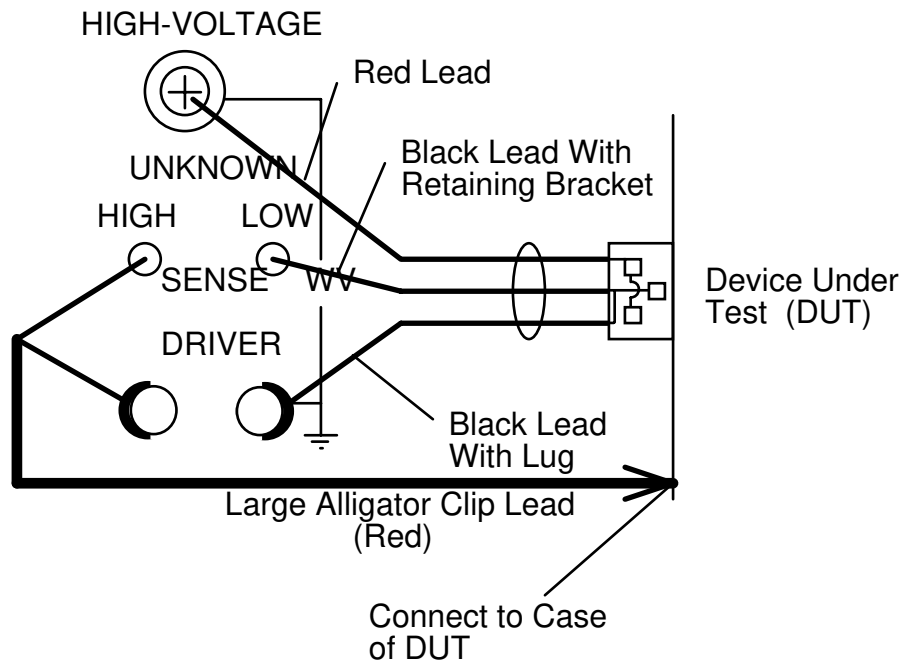
**Figure 2-2**  
**Connection for Ground Continuity Test**  
**(Using G15 Two Lead Set, Large Clips)**



**Figure 2-3**  
**Connection for Hipot Test**  
**(Using G14 Power Entry Cable)**



**Figure 2-4**  
**Connection for Hipot and Ground Continuity Test**  
**(Using S02 (HV cable) and G15 Clip Lead Sets)**



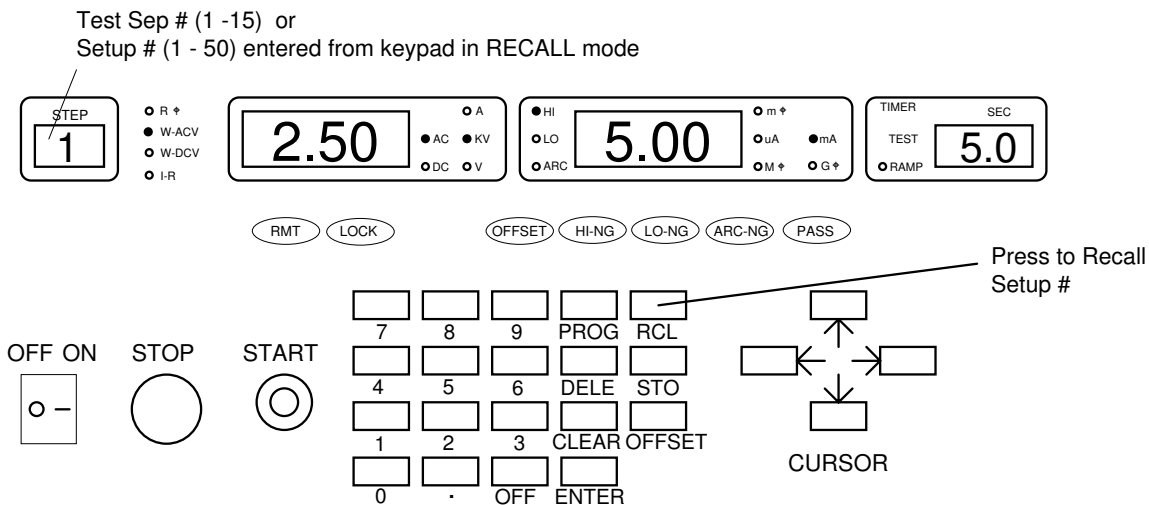
**Figure 2-5**  
**Connection for Hipot and Ground Continuity Test**  
**(Using G15 (one cable) & G14 Power Entry Cable)**

## 2.4 Measurement Procedure

Once the instrument has been powered up, the offset function implemented and the device under test connected, testing can begin. The operator has the choice of performing a test at **power-up conditions** (test conditions at which the instrument was last powered down), or recalling one of 50 possible **stored setups**. Refer to paragraph 2.5 thru 2.8 for instructions to change the test mode and/or test conditions.

**To initiate a test proceed as follows:**

- Press **STOP** (red button) to place the instrument in its standby ready-to-test state.



- Press **START** (green button) to start the test. When this button is pressed the high voltage is turned on. This is indicated by the DANGER light being on to warn the operator that high voltage or current is present at the test leads. The step display indicates the step # (1 - 15) within a sequence of tests, voltage/current display will indicate its value, the measure display will show current or resistance value and the timer will show ramp and test time countdown.
- Depending on the test conditions, the test voltage or current will cut off if a limit is exceeded or cut off when the test time has expired. In the case of a FAIL situation the **STOP** button must be pressed to stop the buzzer.
- The **STOP** button can be pressed at any time to stop the test.

**To recall one of the 50 setups proceed as follows:**

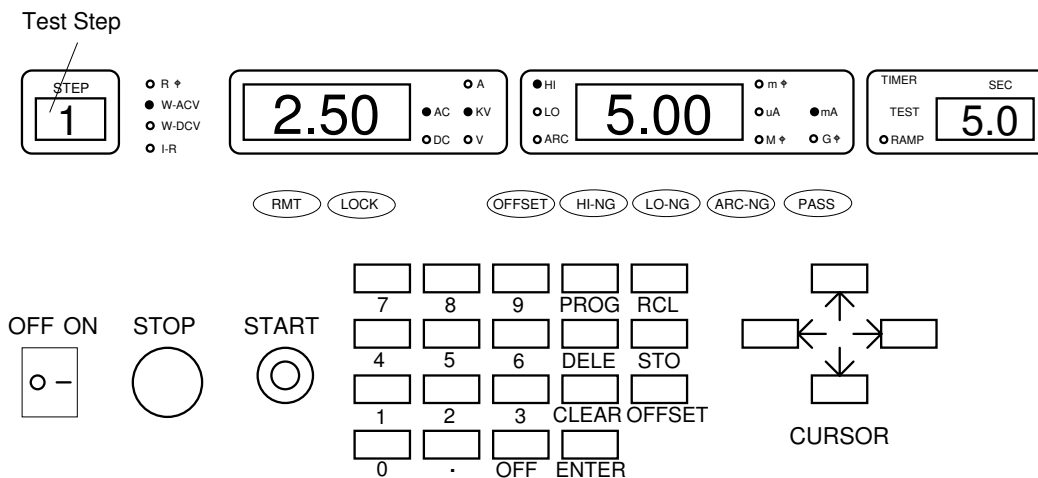
- Press the **RCL** key.
- The **STEP** display shows the current setup # selected. From the front panel keypad type in the setup number desired (1 - 50).
- Press **ENTER** to load the stored test conditions and then initiate a test as just described.

## 2.5 Programming Tests Mode

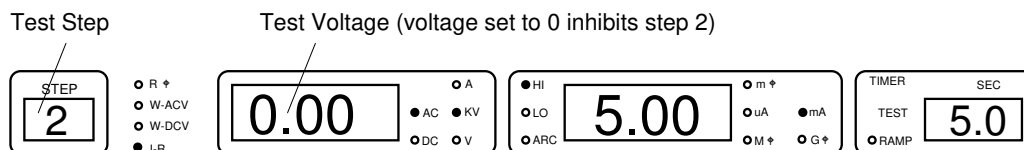
Each test can consist of 1 to 15 steps in sequence, for example, a typical three step test might be an AC hipot test followed by an IR test and followed by a Ground Continuity test. Each step may be programmed for any available function (ACV, DCV, IR or R-Ω for ground continuity) with programmed test conditions independent from the other step.

To change the test mode proceed as follows:

- With the instrument in standby status (Stop button previously pressed and no lights blinking) press the **UP ▲** cursor one or more times to select or examine steps 2 and higher. Note the test mode indicator light to the right of the step display, this light indicates if a particular step selected is AC/DC hipot, an insulation resistance test or ground continuity test. Press the **DOWN ▼** key to return to the lower steps. Remember, up to 15 steps within a single test are possible.



**For a single step test, the test voltage (or current for a ground continuity test) for step 2 must be set to 0.00. In a similar fashion, for a two step test the voltage or current for step 3 must be set to 0.00.**





- To change a test mode select the step to be changed (1 to 15) as described above and press **PROG** and then **ENTER** (the VAC/VDC /IR/R $\Omega$  light will be blinking).
- Arrow **UP ▲** or **DOWN ▼** to the newly desired test mode (VAC/VDC/IR/R $\Omega$ ) and press **ENTER** again.
- Once the desired test mode has been selected refer to paragraph 2.6 for changes to Hipot test conditions and paragraph 2.7 for changes to IR test conditions and paragraph 2.8 for changes to Ground Continuity test conditions.

**Example of test mode change (step 1 an AC Hipot and step 2 an IR test):**

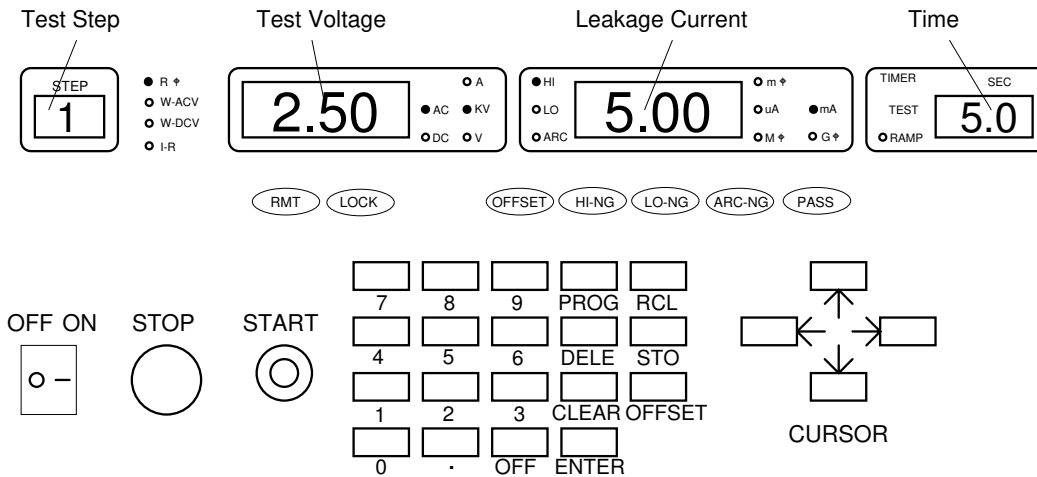
- In standby mode (with no light blinking), arrow **UP ▲** or arrow **DOWN ▼** to select **Step 1**. Press **PROG** and then **ENTER**. **UP ▲** or arrow **DOWN ▼** to select **W-ACV** for this step and then **ENTER**.

Starting with test voltage enter the test conditions for step 1 as discussed in paragraph 2.6 for Hipot test conditions. Return to standby mode (with no light blinking) by pressing **PROG** key

- In standby mode (with no light blinking), arrow **UP ▲** or arrow **DOWN ▼** to select **Step 2**. Press **PROG** and then **ENTER**. **UP ▲** or arrow **DOWN ▼** to select **I-R** for this step and then **ENTER**.

Starting with test voltage enter the test conditions for step 2 as discussed in paragraph 2.7 for IR test conditions. Return to standby mode (with no light blinking) by pressing **PROG** key

## 2.6 Programming Hipot Test



With the instrument in standby status (Stop button previously pressed and no lights blinking) press the arrow **UP** ▲ or arrow **DOWN** ▼ to select the test step # (1 - 15) to be programmed. If the desired selection is an AC or DC hipot test proceed as described below, if selection is an IR test refer to paragraph 2.7, if selection is ground continuity refer to paragraph 2.8.

Press **PROG** key and **ENTER** to begin the parameter change. The test mode indicator will blink, arrow **UP** ▲ or arrow **DOWN** ▼ to select **W-ACV** (AC Hipot) or **W-DCV** (DC Hipot) and press **ENTER**.

### Test Voltage

From the Data Entry Keys type the desired test voltage and then press **ENTER**. (0.10 to 5.00KV AC and 0.5 to 6.00KV DC are the allowable ranges)

### Hi Limit

From the Data Entry Keys type the desired high current limit and then press **ENTER**. (0.300 to 40.00mA AC, or 20.00mA DC is the allowable range). Any measured value of leakage current above this will result in a fail decision.

### Lo Limit

From the Data Entry Keys type the desired low current limit and then press **ENTER**. (0.100 to 1/2 the Hi Limit is the allowable range). Any measured value of leakage current below this will result in a fail decision. An entry of 0 disables the limit detection.

### Arc

From the Data Entry Keys type the desired arc current limit and then press **ENTER**. (0.500 to 40.00mA AC, or 20.00mA DC is the allowable range). Any measured value of arc current above this will result in a fail decision. An entry of 0 disables the limit detection.

### Test Time

From the Data Entry Keys type the desired test time and then press **ENTER**. (0.1 to 999s is the allowable range). A test time of 0 sets the instrument to continuous test mode.

## **WARNING**

**EXTREME CAUTION MUST BE USED BY THE OPERATOR, IN CONTINUOUS MODE, HIGH VOLTAGE IS APPLIED TO THE TEST TERMINALS UNTIL THE STOP BUTTON IS DEPRESSED OR A LEAKAGE CURRENT BREAKDOWN OCCURS.**

### Ramp Time

From the Data Entry Keys type the desired ramp time and then press **ENTER**. (0.1 to 99.9s is the allowable range). A test time of 0 for a display of [ - - - ] sets the ramp time to zero.

After the final test condition entry (ramp time) the instrument returns to the blinking test step #. Press **PROG** key to return to standby status in preparation for testing.

## **OR**

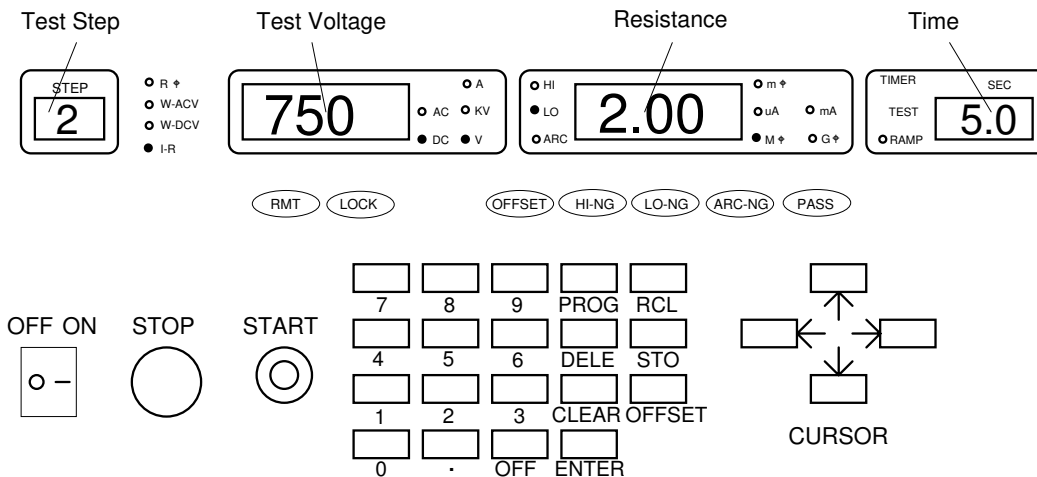
If test conditions are to be changed in another step, arrow **UP** ▲ or arrow **DOWN** ▼ to select the other step:

- if a hipot test, set the test conditions as described in this paragraph.
- if a insulation resistance test refer to paragraph 2.7 for setting test conditions.
- if a ground continuity test refer to paragraph 2.8 for setting test conditions.

To store the present set of test conditions proceed as follows:

- If the instrument is in programming mode (any lights blinking) press the **PROG** key.
- Press the **STO** key.
- From the Data Entry Keys type the setup number desired (1 - 50).
- Press **ENTER** to store the present test conditions.

## 2.7 Programming Insulation Resistance (IR) Test



With the instrument in standby status (Stop button previously pressed and no lights blinking) press the arrow **UP** ▲ or arrow **DOWN** ▼ to select the test step # (1 - 15) to be programmed. If the desired selection is an IR test proceed as described below, if selection is a Hipot test refer to paragraph 2.6, if selection is ground continuity refer to paragraph 2.8.

Press **PROG** key and **ENTER** to begin the parameter change. The test mode indicator will blink, arrow **UP** ▲ or arrow **DOWN** ▼ to select **I-R** and press **ENTER**.

### Test Voltage

From the Data Entry Keys type the desired test voltage and then press **ENTER**. (100 to 1000V DC are the allowable ranges, in 1 steps).

### Lo Limit

From the Data Entry Keys type the desired low resistance limit and then press **ENTER**. (10M $\Omega$  to 9999M $\Omega$  is the allowable range). Any measured resistance value below this will result in a fail decision.

### Hi Limit

From the Data Entry Keys type the desired high resistance limit and then press **ENTER**. (10M $\Omega$  to 9999M $\Omega$  is the allowable range and must be above the low limit). Any measured resistance value above this will result in a fail decision.

### Test Time

From the Data Entry Keys type the desired test time and then press **ENTER**. (0.1 to 999s is the allowable range). A test time of 0 with display of [ - - - ] sets the instrument to continuous test mode.

### **WARNING**

**EXTREME CAUTION MUST BE USED BY THE OPERATOR, IN CONTINUOUS MODE, HIGH VOLTAGE IS APPLIED TO THE TEST TERMINALS UNTIL THE STOP BUTTON IS DEPRESSED OR A FAILURE RESULTING FROM THE SET LIMIT OCCURS.**

After the final test condition entry (TEST time) the instrument returns to the blinking test step #. Press **PROG** key to return to standby status in preparation for testing.

**OR**

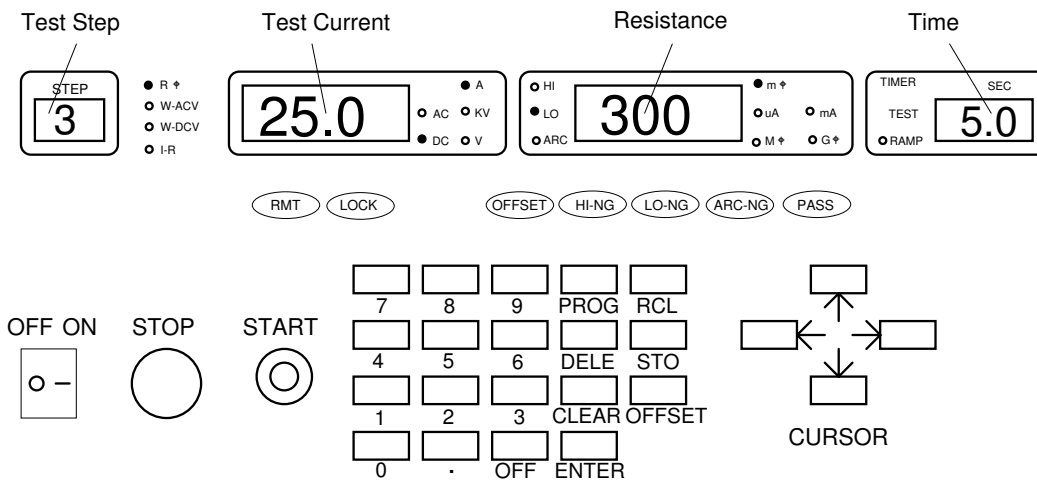
If test conditions are to be changed in another step, arrow **UP** ▲ or arrow **DOWN** ▼ to select the other step:

- if an insulation resistance test, set the test conditions as described in this paragraph.
- if a hipot test refer to paragraph 2.6 for setting test conditions.
- if a ground continuity test refer to paragraph 2.8 for setting test conditions.

**To store the present set of test conditions proceed as follows:**

- If the instrument is in programming mode (any lights blinking) press the **PROG** key.
- Press the **STO** key.
- From the Data Entry Keys type the setup number desired (1 - 50).
- Press **ENTER** to store the present test conditions.

## 2.8 Programming Ground Continuity Test



With the instrument in standby status (Stop button previously pressed and no lights blinking) press the arrow **UP** ▲ or arrow **DOWN** ▼ to select the test step # (1 - 15) to be programmed. If the desired selection is a ground continuity test proceed as described below, if selection is a Hipot test refer to paragraph 2.6, if selection is insulation resistance refer to paragraph 2.7.

Press **PROG** key and **ENTER** to begin the parameter change. The test mode indicator will blink, arrow **UP** ▲ or arrow **DOWN** ▼ to select **R-Ω** and press **ENTER**.

### Test Current

From the Data Entry Keys type the desired test current and then press **ENTER**. (1.0 to 30.0A AC are the allowable ranges, in 0.1A steps).

### Hi Limit

From the Data Entry Keys type the desired high resistance limit and then press **ENTER**. (0.1mΩ to 500mΩ is the allowable range). Any measured resistance value above this will result in a fail decision.

### Test Time

From the Data Entry Keys type the desired test time and then press **ENTER**. (0.1 to 999s is the allowable range). A test time of 0 sets the instrument to continuous test mode.

**WARNING**

**EXTREME CAUTION MUST BE USED BY THE OPERATOR, IN CONTINUOUS MODE, HIGH CURRENT IS APPLIED TO THE TEST TERMINALS UNTIL THE STOP BUTTON IS DEPRESSED OR A FAILURE RESULTING FROM THE SET LIMIT OCCURS.**

After the final test condition entry (TEST time) the instrument returns to the blinking test step #. Press **PROG** key to return to standby status in preparation for testing.

**OR**

If test conditions are to be changed in another step, arrow **UP ▲** or arrow **DOWN ▼** to select the other step:

- if a ground continuity test, set the test conditions as described in this paragraph.
- if a hipot test refer to paragraph 2.6 for setting test conditions.
- if an insulation resistance test refer to paragraph 2.7 for setting test conditions.

**To store the present set of test conditions proceed as follows:**

- If the instrument is in programming mode (any lights blinking) press the **PROG** key.
- Press the **STO** key.
- From the Data Entry Keys type the setup number desired (1 - 50).
- Press **ENTER** to store the present test conditions.

## 2.9 Initial Parameter Settings

The Guardian 5000 has a number of parameter setting that seldom require change, the instrument will power-up with default setting. Each of these parameters are listed in the table below and can be changed using the following procedure.

Parameter Name (on Limit display)	Selection Range (on Timer display)	Default Value	Function
St - 1	1 - 30	3	IEEE-488 address
St - 2	50 - 600	60	Hipot VAC freq.
St - 3	50/60	60	GC VAC freq.
St - 4	0.3 - 99.9sec	1	IR test delay
St - 5	0.2- 99.9sec	0.5	PASS hold time
St - 6	0.1- 99.9sec	1	STEP delay time
St - 7	6.0 - 15 volts	15.0 volts	GC voltage
St - 8	ON / OFF	ON	AGC control
St - 9	OFF / 1 / 2 / 3	3 (max)	Buzzer
St - A	ON / OFF	ON	PASS hold
ST-b	1 - 8	1	Scanner #
St - C	ON / OFF	OFF	Continue on FAIL

**Table 2-1  
Initial Parameter Setting**

### To select initial parameter setting mode:

With the instrument in standby status (Stop button previously pressed and no lights blinking) press **ENTER** and then **[5] [0] [0] [0]**. The limit display will indicate parameter St - 1, and others (Table 2-1) can be selected by arrow **UP ▲** or arrow **DOWN ▼**. Select the St # desired for change. Once a change is made and the ENTER key pressed the instrument moves to the next initial setting, if this is not the one desired, arrow **UP ▲** or arrow **DOWN ▼** to select another. **To exit the initial parameter setting mode press PROG.**

#### St - 1 (IEEE-488 Address)

The current address is shown on the Timer display. From the Data Entry Keys type the address number desired **[1 - 30]** and **ENTER**.

#### St - 2 (AC Hipot test frequency)

The current frequency is shown on the Timer display. From the Data Entry Keys type the frequency desired **[50 - 600]** and **ENTER**.



**St - 3 (Ground Continuity test frequency)**

The current frequency is shown on the Timer display. From the Data Entry Keys type the frequency desired [**50 or 60**] and **ENTER**.

**St - 4 (IR test delay time)**

The current delay time is shown on the Timer display. From the Data Entry Keys type the time desired [**.3 - 999**] and **ENTER**.

**St - 5 (Pass indicator hold time)**

The current Pass indicator hold time (time in which the Pass indicator remains on after test is complete) is shown on the Timer display. From the Data Entry Keys type the time desired [**.2 - 99.9**] and **ENTER**.

**St - 6 (step delay)**

The current delay time (delay time between steps) is shown on the Timer display. From the Data Entry Keys type the time desired [**.1 - 99.9**] and **ENTER**.

**St - 7 (Ground Continuity voltage)**

The current ground continuity test voltage is shown on the Timer display. From the Data Entry Keys type the test voltage desired [**6.0 - 15.0**] and **ENTER**.

**St - 8 (Hipot automatic gain control)**

The current AGC setting (on or off) is shown on the Timer display. From the Data Entry Keys press the **OFF** key to toggle the on/off.

**St - 9 (Buzzer)**

The current Buzzer setting (off or audible levels of 1, 2, or 3) is shown on the Timer display. From the Data Entry Keys press the **OFF** or **1, 2, or 3** key and **ENTER** to turn off or on. 1 is low volume, 2 is mid-range volume and 3 is high volume.

**St - A (Pass indicator hold)**

The current Pass indicator hold, on or off (with selection of on Pass indicator remains on until the next test is initiated) is shown on the Timer display. From the Data Entry Keys press the **OFF** key to toggle the on/off.

**St - b (# of scanner)**

The current # of scanner selected (1 - 8) is shown on the Timer display. From the Data Entry Keys type the number of scanners to be connected [**1 - 8**] and **ENTER**.

**St - C (Continue on fail)**

The current setting for continue on fail (on or off) is shown on the Timer display. From the Data Entry Keys press the **OFF** key to toggle the on/off.

## 2.10 Front Panel Lockout

With front panel lock in effect the ability to change test conditions is prohibited. Only the START and STOP buttons and the setup recall function (RCL) are functional.

### To activate the front panel lockout:

- With the instrument in standby status (Stop button previously pressed and no lights blinking) enter [5] [0] [0] [0] and [OFF] from the data entry keys. The LOCK indicator light will illuminate indicating the instrument is in the lockout state.

### To deactivate the front panel lockout:

- With the instrument in standby status (Stop button previously pressed and no lights blinking) enter [5] [0] [0] [0] and [OFF] from the data entry keys. The LOCK indicator light will go out indicating the instrument is no longer in the lockout state.

## 2.11 Software Version Display

The version of software, installed in the instrument, can be displayed on the front panel.

### To display software version:

- Press the front panel POWER switch to **ON** and **immediately** press the **ENTER** key. The year will be shown in the left display and the month and day in the right display as illustrated below. This software version display is only held for a couple of seconds.



## 2.12 Clear Setup Memory

All stored test conditions in instrument memory (50 setups) can be cleared with a few key strokes.

### To clear setup memory:

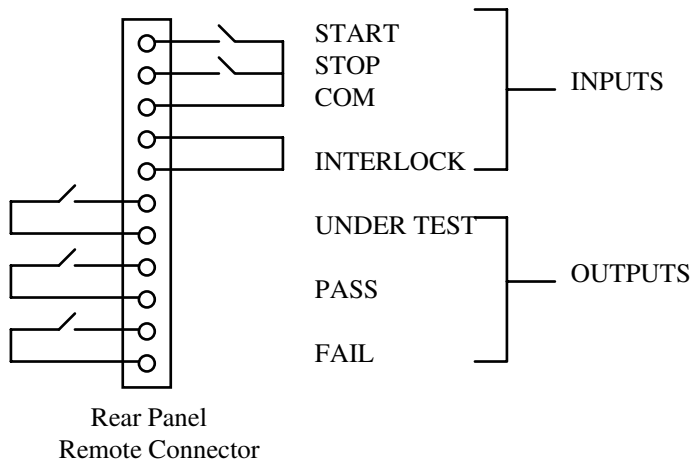
- With the instrument in standby status (Stop button previously pressed and no lights blinking) press **CLEAR** and then [5] [0] [0] [0] and **CLEAR** again.

### 3.1 Remote

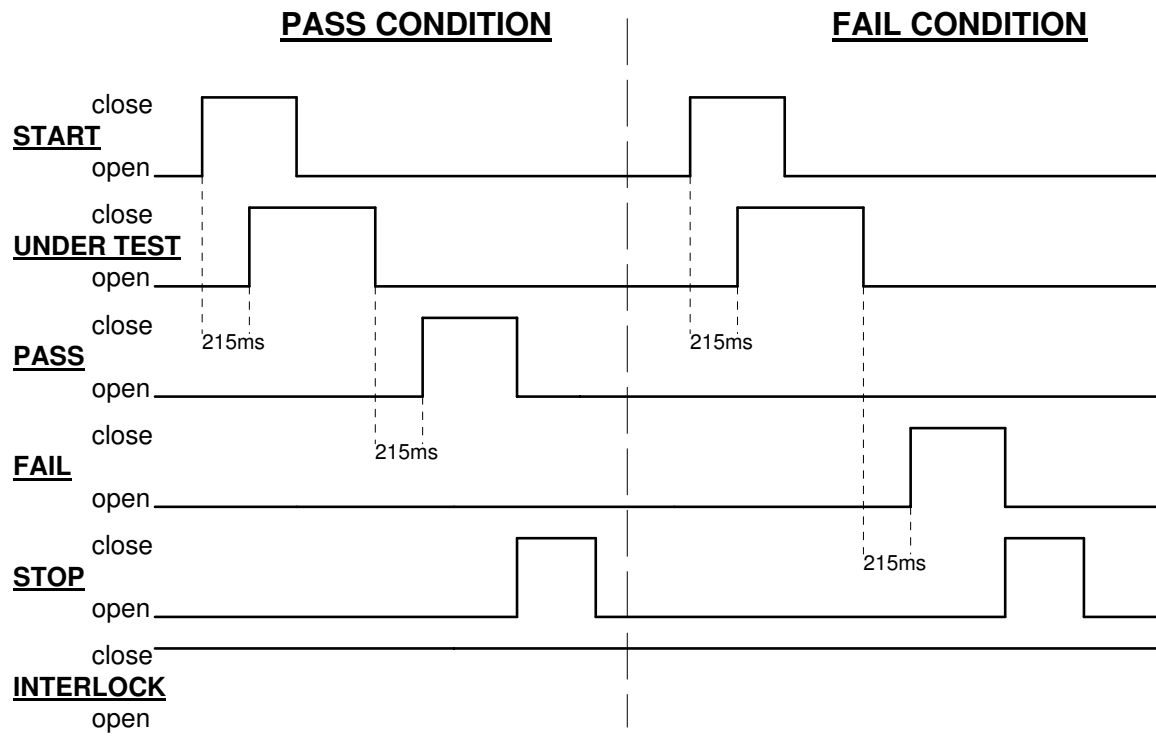
A remote control connector is located on the rear panel of the instrument with input connections for starting and stopping the unit externally and output connections indicating instrument status and a safety interlock connection.

Inputs require a contact closure and outputs provide a contact closure, as shown in the figure below.

Before connecting the instrument to its power source the **interlock function** on the rear panel remote connector must be properly utilized. **This is an important safety feature for the protection of the operator.** Turn on of the instrument's high voltage is inhibited with no interlock connection and is functional with the interlock jumper in place (as shipped from the factory).



**Figure 3-1**  
**Remote Control Connector**



## 3.2 IEEE-488 Interface

### 3.2.1 Description

The Guardian 5000 includes an IEEE-4888 interface with connection through a connector (24 pin) on the rear panel. This interface can be used to connect to a system containing a number of instruments and a controller in which each meets IEEE Standard 488.2 (Standard Digital Interface for Programmable Instrumentation).

The following functions have been implemented:

Code	Function
SH1	Source Handshake
AH1	Acceptor Handshake
T4	Basic Talker Function
L4	Basic Listener Function
SR0	No Service Request Function
RL1	All Remote/Local Function
PP0	No Parallel Poll Function
DC1	All Device Clear Function
DT0	Device Trigger Function
C0	No Controller Functions

The address is defined in the INITIAL setting for St-1, refer to paragraph 2.9

The instrument is in a remote control status when the RMT indicator is on.

To switch to Local from Remote press the [PROG] key, disabled by LLO message.

The only controls functional under Remote operation is [PROG], which switches to Local and STOP which resets the unit.

Intf Message	Function	Description
GET	Ground Execute Trigger	Response depends on the *DDT, setting to START or STOP
GTL	Go To Local	Switch unit to local
SDC	Selected Device Clear	Reset the unit
LLO	Local Lockout	Disables [PROG] switch to local
IFC	Interface Clear	Reset bus interface

### 3.2.2 Interface Commands

The interface function is controlled by ASCII commands which include:

{[command + parameter] ; [command + parameter] + ending code }

The length of the string is 128 characters. It is not necessary to input any sign or space between the command and parameter. Any two commands can be connected by "," and [Ending Code]. Ending Code can be any type of the following.

Ending Code
LF
CR + LF
EOI
LF + EOI
CR + LF + EOI

### 3.2.2.1 Listener Functions

Item	Command	Parameter	Function
1	STOP	X	stop test
2	TEST	X	start test
3	SHOW (?)	{c}	set testing value
4	STEP (?)	{n}	set Step
5	MODE (?)	{n   c}	set test mode
6	SOUR (?)	{f}	set output voltage or current
7	VOLT (?)	{f}	set output voltage
8	CURR (?)	{f}	set output current
9	HILI (?)	{f   *}	set High Limit
10	LOLI (?)	{f   *}	set Low Limit
11	SARC (?)	{f   *}	set ARC
12	HICH (?)	{n   *}	set High Channel
13	LOCH (?)	{n   *}	set Low Channel
14	TIME (?)	{f   *}	set the test time
15	RAMP (?)	{f   *}	set the voltage rise time
16	*SAV	{n}	save the setting value
17	*RCL	{n}	read the setting value
18	CLER	X	clear the memory
19	*IDN (?)	X	check the unit number
20	*DDT (?)	{n   c}	set the response to Trigger
21	*TRG	X	execute Trigger command
22	*RST	X	reset the unit

where x: no parameter required  
n: indicates integer  
f: indicates floating  
c: indicates memory mark  
\*: indicates the "\*" character of ASCII

### 1. STOP

Stop testing, same as STOP on front panel.

### 2. TEST

Start testing, same as START on front panel.

### 3. SHOW (?) {c}

Check the testing value, [STATUS] [STEP] [MODE] [SOURCE] [MEASURE] [TIMER] [CHAN] [SAVE]

The command can connect each parameter with "|". Each parameter can be abbreviated. Ex: STA=STATUS, STE=STEP

A delay  $\geq 150$  msec should be used between commands during measurements.

### 4. STEP (?) {n}

Step number (1 - 15). Set step number first before setting test conditions for that step.

### 5. MODE (?) {n | c}

Set test mode by number or memory sign.

Ground Continuity	0, G or GR
AC Hipot	1, A or WA
DC Hipot	2, D or WD
Insulation Resistance	3, I or IR

If testing mode is changed the test conditions will be cleared to the initial value.

### 6. SOUR (?) {f}

Set the output voltage of current according to mode selected.

Ground Continuity	f = 1 - 30 Amp
AC Hipot	f = 0.1 - 5.0 KV
DC Hipot	f = 0.5 - 6.0 KV
Insulation Resistance	f = 100 - 1000 V

The output voltage for current can be set by SOUR or VOLT or CURR directly.

**VOLT or CURR is the recommended method to avoid improper setting**

(5 Amp could be interchanged for 5 KV, depending on the MODE selected).

For Ground Continuity the high resistance limit is determined by the current setting.

The maximum high resistance limit is  $510\text{m}\Omega$  or  $R = 6.3 \text{ V/I}$  (i.e. if the current is 30 Amps the high limit could not exceed  $210\text{m}\Omega$ ).

### 7. VOLT (?) {f}

Set the output voltage (similar to SOUR). Indicates error 1 if mode is selected for Ground Continuity.

### 8. CURR (?) {f}

Set the output current (similar to SOUR). Indicates error 1 if mode is selected for anything other than Ground Continuity.



### 9. HILI (?) {f | \*}

Set the high limit value according to mode selected. \* disables the high limit.

Ground Continuity	f = 0.1 - 500.0 mΩ
AC Hipot	f = 0.01 - 40.00 mA
DC Hipot	f = 0.01 - 20.00 mA
Insulation Resistance	f = 1 - 9999 MΩ

In Hipot mode if the High Limit/2 is smaller than the Low Limit, the low limit is disabled.

In IR mode the value can not be smaller than the Low Limit, otherwise error 2 is indicated.

In Ground Continuity mode the maximum high resistance limit is 510mΩ or  $R = 6.3 \text{ V/I}$  (i.e. 210mΩ for 30 Amps).

### 10. LOLI (?) {f | \*}

Set the low limit value according to mode selected. \* disables the low limit.

Ground Continuity	f = 0.1 - 500.0 mΩ
AC Hipot	f = 0.01 - 40.00 mA
DC Hipot	f = 0.01 - 20.00 mA
Insulation Resistance	f = 1 - 9999 MΩ

In Hipot mode the limit is disabled if greater than High Limit/2.

In IR mode the limit is disabled if greater than the High Limit.

In Ground Continuity mode the limit can not be set.

### 11. SARC (?) {f | \*}

Set the arc limit value (Hipot mode only). \* disables the limit.

AC Hipot	f = 0.01 - 40.00 mA
DC Hipot	f = 0.01 - 20.00 mA

### 12. HICH (?) {n | \*}

Set the High Channel from 1 - 8. \* disables the limit. More than one channel is possible (Ex: HICH 1 3 5).

### 13. LOCH (?) {n | \*}

Set the Low Channel from 1 - 8. \* disables the limit. More than one channel is possible (Ex: LOCH 1 3 5). Can not be set in Ground Continuity mode.

### 14. TIME (?) {f | \*}

Set the Test Time from 0.1 - 99.9 sec. \* disables the time.

### 15. RAMP (?) {f | \*}

Set the voltage rise time from 0 - 99.9 sec for Hipot mode. \* disables the time.

**16. \*SAV {n}**

Save the test conditions for later recall (up to 15 steps each) in memory location: 1-50.

**17. \*RCL (?) {n}**

Recall the test conditions that have been saved (up to 15 steps each) in memory location 1 - 50.

**18. CLER**

Resets the instrument from interface control. The address function is still in effect.

**19. \*IDN**

Checks the instrument for identification.

**20. \*DDT (?) {n | c}**

Determines the response from the interface when the instrument receives TRG or GET command.

0 or S	Stop testing
1 or T	Start testing
2 or NS	Stops testing after receiving TRG or GET command and DDT will change to NT.
3 or NT	Starts testing after receiving TRG or GET command and DDT will change to NS.

**21. \*TRG**

Triggers the instrument and functions the same as interface message GET. This is dependent on the setting of DDT, see above.

**22. \*RST**

Resets the instrument and functions the same as interface message SDC

### 3.2.2.2 Talker Functions

The message of {string + ending code} will be sent when the instrument is assigned as TALKER. The ending code consists of CR+LF+EOI. The string is dependent on the present status.

There are several commands with the "?". These commands send the testing value by ASCII string.

Example:

1. Command : mode WD: mode?  
: MODE 2 : With Standing DC voltage test mode.
2. Command : high 1|3|5; high?  
:HICH 1|3|5 ; High Channel 1,3,5 is ON

All commands will feed back an error message except \*RST, \*TRG , show and "?". If the error code is not 0 the result will be displayed. Error messages are as follows:

Error Messages
Error 0: Save OK!
Error 1: The command is not valid
Error 2: The parameters are not valid
Error 3: Can not start test
Error 4: Scanner is not connected
Error 5: Channel can not set 0
Error 6: Channel invalid

The TALKER function is completed by SHOW(?) command. The instrument will send back the testing value for the parameter selected. It may check more than one test value by connecting the parameters with "|".

Status Messages
Status 0: Presently in STOP status
Status 1: Presently in TEST status
Status 2: Test complete, condition is PASS
Status 3: Test stop, condition is FAIL
Status 4: Test stop, Hipot arc limit FAIL
Status 5: Test stop, Hipot high limit FAIL
Status 6: Test stop, Hipot low limit FAIL
Status 7: Test stop, IR high limit FAIL
Status 8: Test stop, IR low limit FAIL
Status 9: Test stop, GC high limit FAIL

## 1. STATUS

To check the present status, with status code. Output form is:  
STATUS\_X--8 bytes

note: " \_" denotes a space

## 2. STEP

To check the present step. Output form is STEP\_XX--7 bytes

## 3. MODEL

To check the testing mode. Output form is MODE\_X--6 bytes

## 4. SOURCE

To check the output voltage or current. Output form is:

- 1) GC Mode AC\_XXX>XX\_A
- 2) AC Mode AC\_XX>XX\_KV
- 3) DC Mode DC\_XX>XX\_KV
- 4) IR Mode DC.XXXX\_\_V

total: 11 bytes

## 5. MEASURE

To check the tested resistance or current. Output form is:

MEASURE\_XXXXX\_UU

where XXXXX is the measured value and UU the units

total: 16 bytes

## 6. TIMER

To check the test time remaining. Output form is:

- 1) TIME\_XX.X
- 2) RAMP\_XX.X

total: 9 bytes

## 7. CHAN

To check the channel status. Output form is:

HICH\_X|X| .....|X, LOCH\_X|X|.....|X

total: 13 to 41 bytes

## 8. SAVE

To save the data of each test. The unit can read the data without the SHOW parameter.

Example: Write : SHOW Step|save

Read : STEP 1

Read : STEP 1

Write : SHOW mode

Read : MODE 1

Read : STEP 1 shows step by SHOW step|save

SAVE parameter can not be used alone

Example: SHOW SAVE will display Error 2

If the instrument is required to display saved item, just use SHOW? command  
If the instrument is required to display more than one testing value, no matter what the order of parameters, the output will display the following.

```
[STATUS],[STEP],[MODE],[SOURCE],[MESSAGE],[TIMER],[CHAN]
    any two parameters separated by a ","
```

Example: Write: SHOW STEP|STATUS|MODE  
Read: STATUS 2, STEP 1, MODE 1

The string length sent by SHOW may not be more than 106 bytes (including ending code)

### 3.2.3 Sample QuickBASIC Program

```
REM $INCLUDE: 'qbdecl.bas'
'declarations
ADAP$ = "GPIB0": G5000$ = "DEV3": V% = 1
W% = 0: C$ = SPACES$(50): d$ = SPACE$(50): C1$ = SPACE$(50): D1$ = SPACES$(50)
STAT$ = SPACES$(50)

'find IEEE card and G5000
CALL IBFIND(ADAP$, GPIB0%)
CALL IBFIND(G5000$, G5000%)

CLS 'clear screen

'read identification from g5000
CALL IBWRT(G5000%, "*IDN")
CALL IBRD(G5000%, D1$)
PRINT D1$

'open a file to store data and status to
20
PRINT "FILE NAME TO STORE RESULT (less than 8 characters)"
INPUT NAMES$
IF LEN(NAMES$) = 0 THEN NAMES$ = "DATA"
IF LEN(NAMES$) > 8 THEN GOTO 20
NAMES$ = NAMES$ + ".TXT"
OPEN NAMES$ FOR APPEND AS #1
```

```

'ask user for mode, voltage, current, ramp and test time
50
PRINT "MODE 1 = AC, 2 = DC"
INPUT MODE$
IF MODE$ = "" OR MODE$ > "2" OR MODE$ < "1" THEN GOTO 50 'check mode is
AC/DC hipot
100
PRINT "INPUT VOLTAGE IN kV"
INPUT VOLT$
IF VOLT$ = "" OR VOLT$ > "5" THEN GOTO 100 'check voltage is in range
200
PRINT "HIGH CURRENT LIMIT IN mA"
INPUT CURR$
IF CURR$ = "" OR CURR$ > "40" THEN GOTO 200 'check current is in range
PRINT "RAMP TIME IN seconds"
INPUT RAMP$
300
PRINT "TEST TIME IN seconds"
INPUT TIM$
IF TIM$ = "" OR TIM$ > "999.9" THEN GOTO 300 'check time is in range

'configure g5000
SET$ = "STEP1;MODE" + MODE$ + ";SOUR " + VOLT$ + ";HILI" + CURR$ + ";RAMP"
+ RAMP$ + ";TIME" + TIM$
CALL IBWRT(G5000%, SET$)           'send string to g5000
REM CALL IBRD(G5000%, C$)         'read status of g5000

'perform a measurement
CALL IBWRT(G5000%, "STOP") 'make sure unit is in stop mode
CALL IBRD(G5000%, C$)      'read status
PRINT C$
CALL IBWRT(G5000%, "TEST") 'start measurement
FOR I = 1 TO 500
NEXT I
CALL IBWRT(G5000%, "SHOW STATUS") 'check status of unit
CALL IBRD(G5000%, STAT$)
WHILE VAL(MID$(STAT$, 8, 1)) = 1 'loop while status is testing
    CALL IBWRT(G5000%, "SHOW STATUS")
    CALL IBRD(G5000%, STAT$)
    PRINT STAT$
WEND

```

```
'get data from G5000  
CALL IBWRT(G5000%, "SHOW SOURCE|MEASURE") 'ask for voltage and current levels  
CALL IBRD(G5000%, d$) 'read current and voltage levels  
PRINT "DATA IS: "; d$ 'output data to the screen  
PRINT #1, d$ + STAT$ + TIME$ + " " + DATE$ 'store data and status to open file  
CLOSE #1
```

```
END
```

### 3.3 Scanner Interface

#### 3.3.1 Scanner Accessories

**Table 3-1**  
**Guardian 5000 Scanner Accessories**

<u>Item</u>	<u>Quantity</u>
<b>G17</b> , 25 pin interconnect cable (Guardian 5000 to Scanner)	1
Test Lead Set, Hipot (Guardian Output to Scanner I/P)	
<b>G18</b> , HV plug to sheathed banana plug (red)	1
<b>G19</b> , Banana plug(w/retaining bracket) to sheathed banana plug (black)	1
<b>G21</b> , Scan Clip Leads, Hipot (Scanner front panel outputs to DUT) Sheathed banana (orange) to alligator clip (red)	8
* <b>G20</b> , Interconnect Cable, GC (Guardian Output to Scanner rear panel GC Input) Banana plug/lug, (red/black) to banana plug/lug (red/black)	1
* <b>G15</b> , Scan Clip Lead Set, GC (Scanner rear panel GC outputs to DUT) Large alligator clips (red/black) to banana plug/lug (red/black)	4
Scan Card for Guardian 5000	1

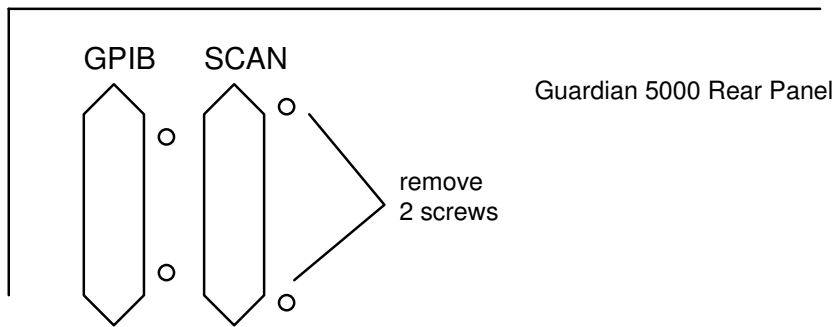
\* Only included with 5000-02 (GC scanner)

#### 3.3.2 Scanner Card Installation

The 5000-01 and 5000-02 Scanners are supplied with an interface card that must be installed in the Guardian 5000. Proceed as follows:

- Remove the three screws which secure the Guardian 5000 top cover to the rear panel. The top cover is removed by lifting up and back, out of the front panel groove.
- Remove the 2 screws (to the right of the rear panel SCAN connector hole) and remove the filler panel.





- Install the scanner card inside the rear panel using the two screws previously removed. On some of these cards **it may be necessary to bend the heatsink up** so that it does not hit the GPIB board (hot glue in the bent position is recommended).
- Plug the scanner card ribbon cable into the plug marked SCAN (adjacent to the GPIB ribbon cable connector). It will be necessary to first remove the GPIB board ribbon cable, plug in the scanner card ribbon cable, and then reconnect the GPIB cable. Note that the connectors are keyed with a notch to ensure proper orientation.
- Locate the loose cable (white wires) and plug into the 2-pin connector on the scanner board.
- Replace the instrument top cover by first sliding into the front panel groove, push down, and secure with the three screws.

### 3.3.3 Scanner Connections

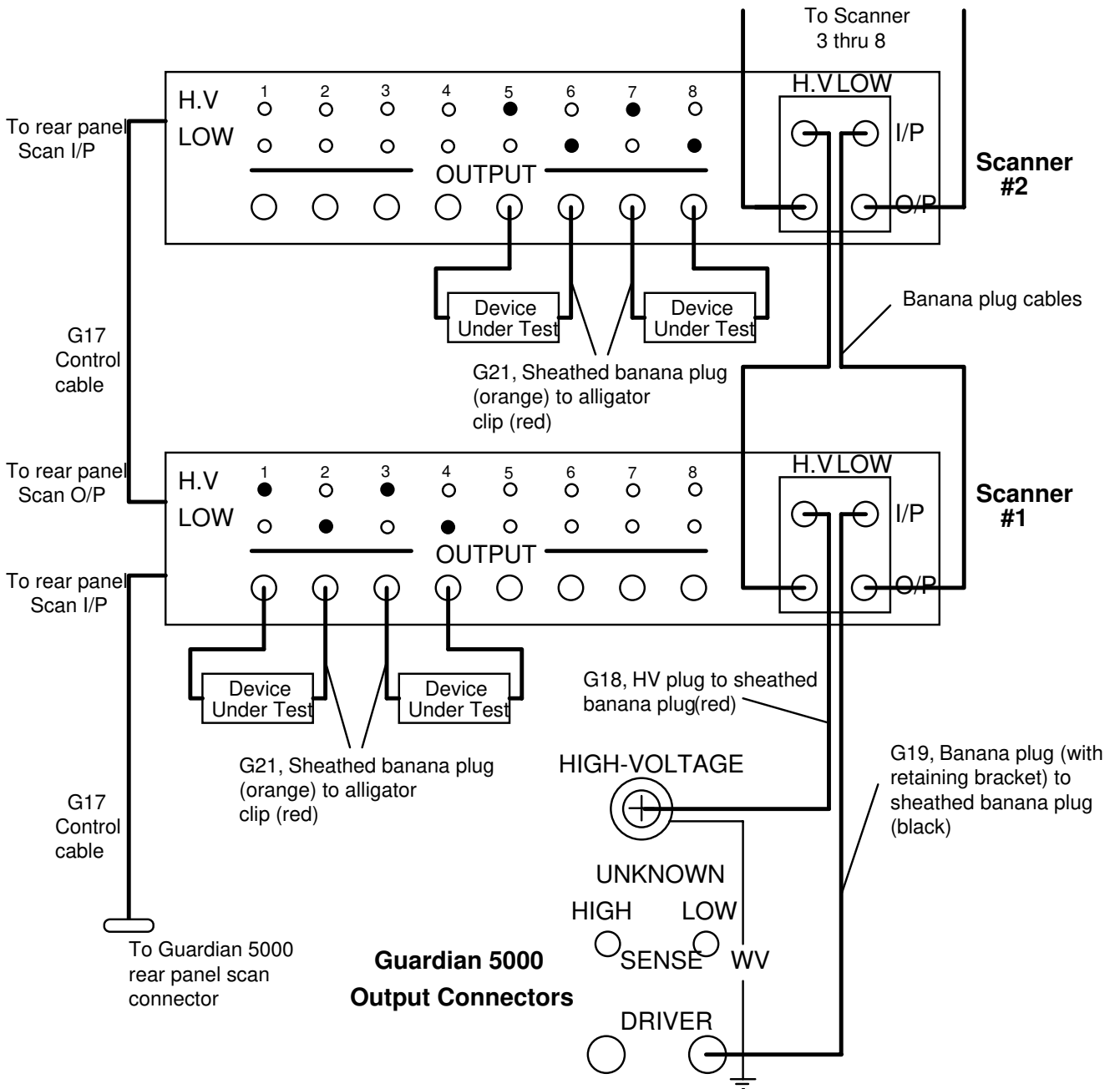
Before connecting the scanner to the Guardian 5000 or connecting devices for test **Press the STOP key** and make sure the red DANGER light is not on.

Refer to the diagrams that follow for a typical scanner connection. Figure 3-2 is connection to the 5000-01 for hipot or insulation resistance (IR) tests. Figure 3-3 is connection to the 5000-02 for ground continuity (GC) testing as well as Hipot or IR testing.

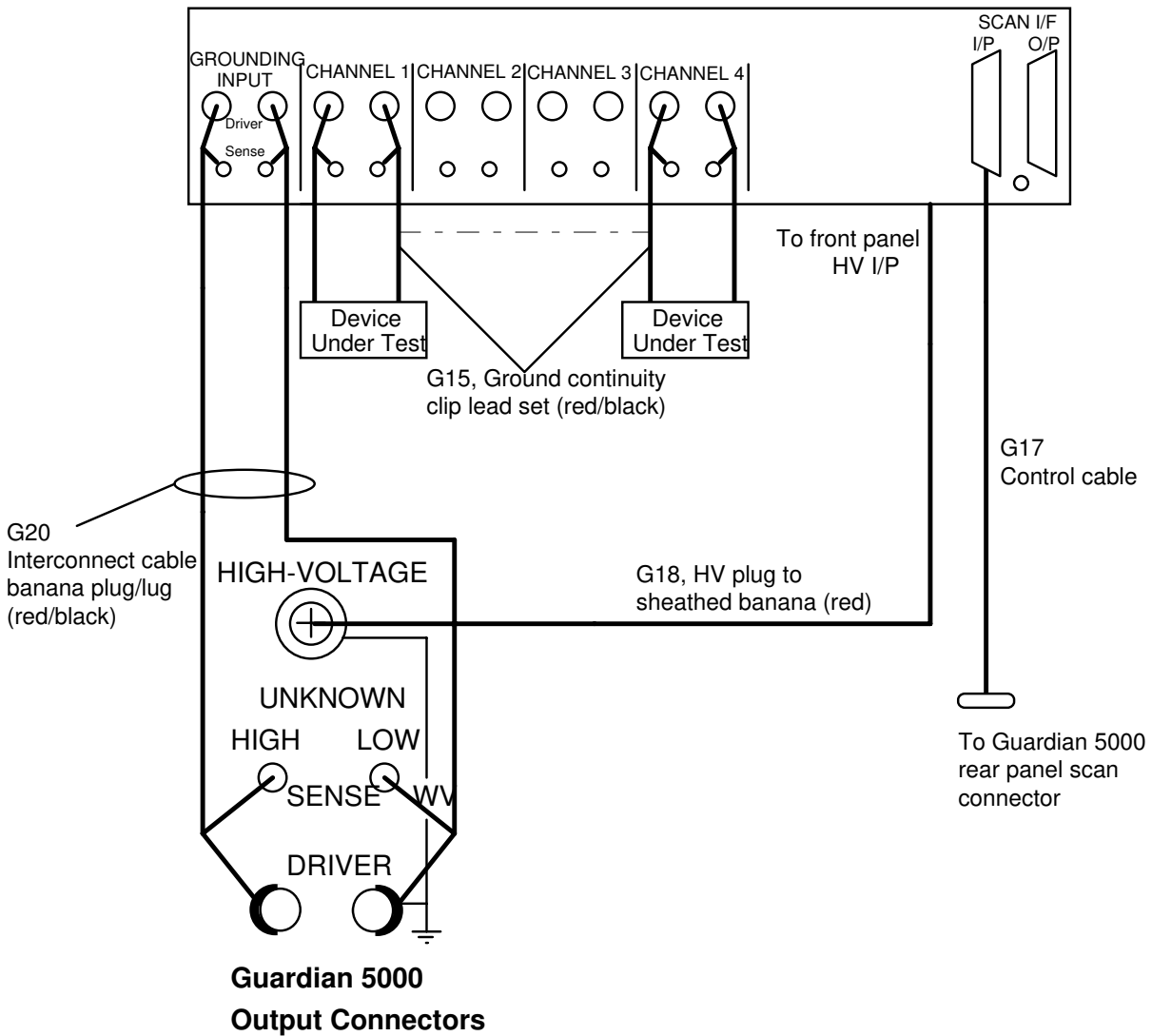
#### **WARNING**

**THE REAR PANEL GROUND LUGS ON ALL INSTRUMENTS (Guardian 5000 and Scanners) MUST BE INTERCONNECTED**

**NEVER TOUCH THE TEST LEADS OR THE DEVICE UNDER TEST WHEN THEY ARE CONNECTED TO THE INSTRUMENT AND THE RED DANGER LIGHT IS ON OR BLINKING.**



**Figure 3-2**  
**5000-01 Scanner Connection**  
**(one, two or more scanners)**



**Figure 3-3: 5000-02 Scanner Connection**

### 3.3.4 Scanner Programming

There are 16 indicators (8 high, 8 low) on the scanner front panel, during test these indicate which are programmed for the High Voltage or Low connections. Connections for high voltage are indicated in red and low in green. When the scanner and Guardian 5000 are connected (25 pin interconnect cable) the instrument will accept entry of scanner connections. A **Hi** or **Lo** entry (as shown below) is made during the programming process preceding the entry of a test voltage. It is possible to have one or multiple entries for scanner connections, i.e. if 1 2 and 3 are entered for the Hi connection all three outputs will be connected to the High Voltage terminal during the test. When making multiple entries for a scanner connection up to four will be shown on the Voltage display and those in excess of four shown on the Limit display.

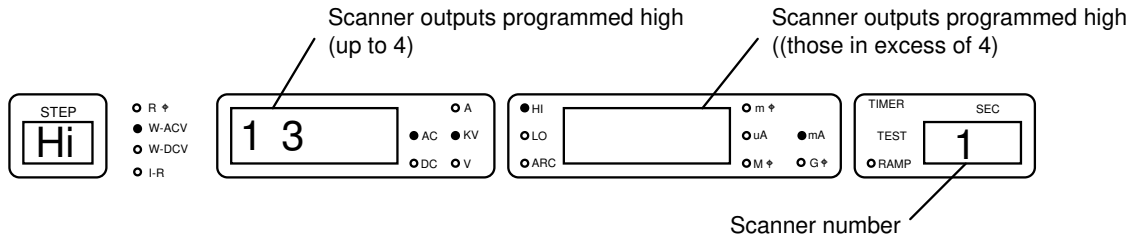
**Programmed Scanner Connections as Shown in Figure 3-2**

When using more than one scanner the **initial parameter setting, St-b** must be setup for the number of scanners connected. Refer to paragraph 2.9. Connection of up to 8 scanners (5000-01 thru 5000-04) for a total of 64 channels, hipot or IR testing or up to 8 scanners (5000-02 & 5000-04) for a total of 32 channels, ground continuity testing. When programming scanner connections the scanner number ( 1 thru 8) is shown on the timer display.

**Note**

When the scanner is programmed for multiple connections in the same test step the devices under test are connected in parallel (as shown in Figures 3-3 and 3-3). To test several devices independent from each other, requires an individual test step (1 to 15) for each. Refer to paragraph 2.5

**Scanner #1**



**Scanner #2**



**Programmed Scanner Connections as Shown in Figure 3-3**

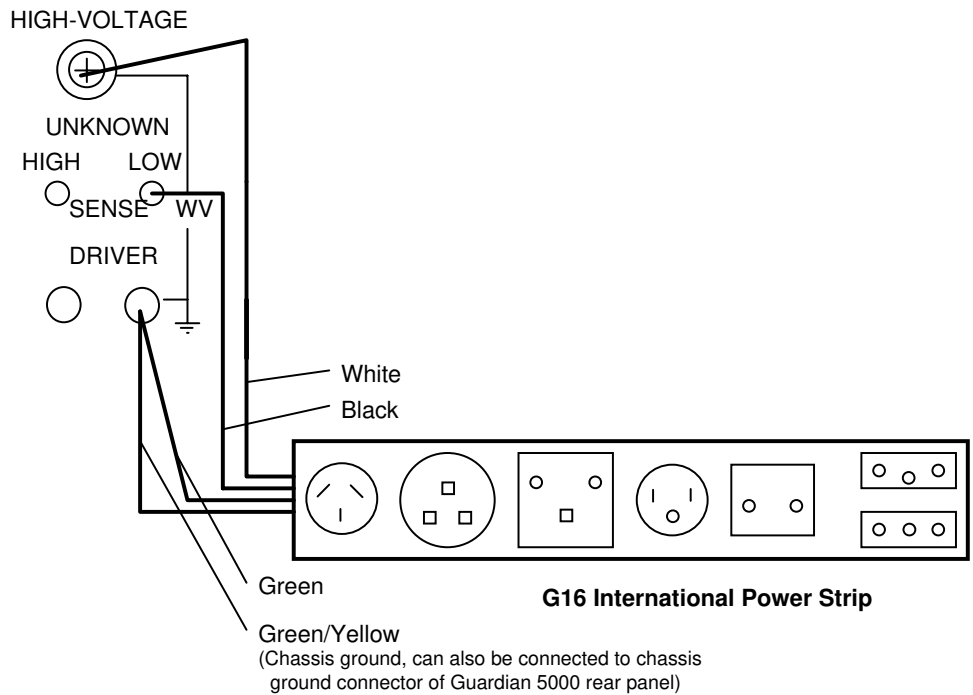


### 3.4 G16 International Power Strip

The G16 International Power Strip allows connection of standard corded products from several different countries. These being:

- Switzerland
- Italy
- Continental Europe
- United States
- Denmark
- United Kingdom
- Australia

Refer to Figure 3-4 for connection of the G16 International Power Strip to the Guardian 5000.



**Figure 3-4**  
**G16 International Power Strip Connection**



---

## Section 4

## Maintenance & Calibration

---

### 4.1 General

Our warranty (at the front of the manual) attests the quality of materials and workmanship in our products. If malfunction should be suspected, or other information be desired applications engineers are available for technical assistance. Application assistance is available in the U.S. by calling 978-461-2100 and asking for Applications Support. For support outside of the United States please contact your local QuadTech distributor.

### 4.2 Instrument Return

Before returning an instrument to QuadTech for service please call our Service Department at 800-253-1230 for return material authorization. It will be necessary to include a Purchase Order Number to insure expedient processing, although units found to be in warranty will be repaired at no-charge. For any questions on repair costs or shipment instructions please contact our Service Department at the above number. To safeguard an instrument during storage and shipping please use packaging that is adequate to protect it from damage, i.e., equivalent to the original packaging and mark the box "Delicate Electronic Instrument". Return material should be sent freight prepaid, to:

QuadTech, Inc.  
5 Clock Tower Place, 210 East  
Maynard, MA 01754-2530

Attention: Service Department

**Shipments sent collect can not be accepted.**

### 4.3 Calibration

Calibration of the Guardian 5000 is recommended on an annual basis. If the unit is returned to QuadTech for factory calibration refer to paragraph 4.2 for instructions. Using the calibration procedure below the instrument can be calibrated by a qualified service person if traceable calibration equipment and standards are available. **The instrument should be powered up for a minimum of 1 hour before calibration to ensure maximum stability.**

**Table 3-1  
Equipment for Calibration**

<u>Description</u>	<u>Requirements</u>
AC/DC Voltmeter	Measure range, 0 to 5KV, 0.1%.
AC/DC Current Meter	Measure range, 0 to 6KV, 0.1%.
10 MΩ Load Resistor	0.25W
420 kΩ Load Resistor	5W
80 kΩ Load Resistor	25W
50 kΩ Load Resistor	50W
0.1 Ω Load Resistor	100W
0.05 Ω Resistor	5W

#### **4.3.1 Calibration Procedure**

The following calibrations procedures are included:

##### **Voltage Calibration**

CL	50	OFST	ACV	; ACV 50 volts offset
CL	4000	FULL	ACV	; ACV 4000 volts full scale
CL	50	OFST	DCV	; DCV 50 volts offset
CL	4000	FULL	DCV	; DCV 4000 volts full scale
CL	50	OFST	IR	; IR 50 volts offset
CL	1000	FULL	IR	; IR 1000 volts full scale

##### **Current Calibration**

CL	OFST	2.99	ACV	; ACV 2.99 mA range offset
CL	FULL	2.99	ACV	; ACV 2.99 mA range full scale
CL	OFST	30.0	ACV	; ACV 30 mA range offset
CL	FULL	30.0	ACV	; ACV 30 mA range full scale
CL	OFST	2.99	DCV	; DCV 2.99 mA range offset
CL	FULL	2.99	DCV	; DCV 2.99 mA range full scale
CL	OFST	15.0	DCV	; DCV 15 mA range offset
CL	FULL	15.0	DCV	; DCV 15 mA range full scale

##### **Ground Continuity Calibration**

CL	3.0	OFST	GrA	; Grounding Current offset
CL	25.00	FULL	GrA	; Grounding Current full scale
CL	5.0	OFST	GrV	; Grounding Voltage offset
CL	30.0	FULL	GrV	; Grounding Voltage full scale



### To enable calibration:

With the instrument in standby status (Stop button previously pressed and no lights blinking) remove the front panel calibration seal and push (using pen or pencil point) the recessed switch through the hole in the front panel (to the in position).

Press	<b>ENTER</b> and then [7] [9] [3] [1]
Display	CAL OFF / CAL ON / CAL TEST
	CAL OFF : calibration data install zero
	CAL ON : calibration finished, in normal operation
	CAL TEST : into calibration procedure
Press	[OFF] key : to change CAL OFF / CAL ON / CAL TEST
Display	CAL TEST : ready to calibrate
Press	[PROG] key : ready for calibration

### 4.3.2 AC Voltage Calibration

Connect the AC voltmeter between the H.V. OUTPUT and the LOW DRIVER terminal.

Press	[UP] or [DOWN] key as necessary to display
Display	CL 50 OFST ACV
Press	[OFF] key to display
Display	1 0.05KV .500mA 0.0 sec
Press	[STOP] [START] ; read out the HV meter value ; example 0.062KV
Press	[0] [.] [0] [6] [2] [ENTER]
Press	[STOP]
Press	[DOWN] key to display
Display	CL 4000 FULL ACV
Press	[OFF] key to display
Display	1 4.00KV .500mA 0.0 sec
Press	[STOP] [START] ; read out the HV meter value ; example 4.052KV
Press	[4] [.] [0] [5] [2] [ENTER]
Press	[STOP] ; stop ACV full scale calibration

### 4.3.3 DC Voltage Calibration

Connect the DC voltmeter between the H.V. OUTPUT and the LOW DRIVER terminal.

Press [UP] or [DOWN] key as necessary to display  
Display CL 50 OFST DCV  
Press [OFF] key to display  
Display 1 0.05KV .500mA 0.0 sec  
Press [STOP] [START] ; read out the HV meter value  
; example 0.062KV  
Press [0] [.] [0] [6] [2] [ENTER]  
Press [STOP] ; stop DCV offset calibration  
Press [DOWN] key to display  
Display CL 4000 FULL DCV  
Press [OFF] key to display  
Display 1 4.00KV .500mA 0.0 sec  
Press [STOP] [START] ; read out the HV meter value  
; example 4.052KV  
Press [4] [.] [0] [5] [2] [ENTER]  
Press [STOP] ; stop DCV full scale calibration

### 4.3.4 IR Voltage Calibration

Connect the DC voltmeter between the H.V. OUTPUT and the LOW DRIVER terminal.

Press [UP] or [DOWN] key as necessary to display  
Display CL 50 OFST IR  
Press [OFF] key to display  
Display 1 50V 1M $\Omega$  0.0 sec  
Press [STOP] [START] ; read out the HV meter value  
; example 62V  
Press [6] [2] [ENTER]  
Press [STOP] ; stop IR voltage offset calibration  
Press [DOWN] key to display  
Display CL 1000 FULL IR  
Press [OFF] key to display  
Display 1 1000V 1M $\Omega$  0.0 sec  
Press [STOP] [START] ; read out the HV meter value  
; example 1052V  
Press [1] [0] [5] [2] [ENTER]  
Press [STOP] ; stop IR full scale calibration

### 4.3.5 AC Current Calibration

Connect a load resistor (10 Mohms) between the Hipot H.V. OUTPUT of the Guardian 5000 and the High terminal of the AC ammeter. Connect the Low terminal of the AC ammeter to the LOW DRIVER terminal (black) of the Guardian 5000.

Press [UP] or [DOWN] key as necessary to display  
Display CL OFST 2.99 ACA  
Press [OFF] key to display  
Display 1 1.2KV 2.999mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value  
; example 0.124mA

Press [0] [.] [1] [2] [4] [ENTER]  
Press [STOP] ; stop ACA 2.99mA range offset  
calibration and change the dummy load  
resistor to 420 kohms

Press [DOWN] key to display  
Display CL FULL 2.99 ACA  
Press [OFF] key to display  
Display 1 1.2KV 2.999mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value\*  
; example 2.903A

Press [2] [.] [9] [0] [3] [ENTER]  
Press [STOP] ; stop ACA 2.99mA range full scale  
calibration

Press [DOWN] key to display  
Display CL OFST 30.0 ACA  
Press [OFF] key to display  
Display 1 1.2KV 30.0mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value  
; example 2.903mA

Press [2] [.] [9] [0] [3] [ENTER]  
Press [STOP] ; stop ACA 30.0mA range offset  
calibration and change the dummy load  
resistor to 50 kohms

Press [DOWN] key to display  
Display CL FULL 30.0 ACA  
Press [OFF] key to display  
Display 1 1.2KV 30.0mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value\*  
; example 24.50mA

Press [2] [4] [.] [5] [0] [ENTER]  
Press [STOP] ; stop ACA 30mA range full scale  
calibration

\* it may be necessary to  
add resistance in series  
with the load to maintain  
current below the limit

### 4.3.6 DC Current Calibration

Connect a load resistor (10 Mohms) between the Hipot H.V. OUTPUT of the Guardian 5000 and the High terminal of the DC ammeter. Connect the Low terminal of the DC ammeter to the LOW DRIVER terminal (black) of the Guardian 5000.

Press [UP] or [DOWN] key as necessary to display  
Display CL OFST 2.999 DCA  
Press [OFF] key to display  
Display 1 1.2KV 2.999mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value  
; example 0.124mA

Press [0] [.] [1] [2] [4] [ENTER]  
Press [STOP] ; stop DCA 2.99mA range offset  
calibration and change the dummy load  
resistor to 420 kohms

Press [DOWN] key to display  
Display CL FULL 2.999 DCA  
Press [OFF] key to display  
Display 1 1.2KV 2.999mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value\*  
; example 2.903A

Press [2] [.] [9] [0] [3] [ENTER]  
Press [STOP] ; stop DCA 2.99mA range full scale  
calibration

Press [DOWN] key to display  
Display CL OFST 15.0 DCA  
Press [OFF] key to display  
Display 1 1.2KV 15.00mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value  
; example 2.903mA

Press [2] [.] [9] [0] [3] [ENTER]  
Press [STOP] ; stop DCA 15.0mA range offset  
calibration and change the dummy load  
resistor to 80 kohms

Press [DOWN] key to display  
Display CL FULL 15.0 DCA  
Press [OFF] key to display  
Display 1 1.2KV 15.00mA 0.0 sec  
Press [STOP] [START] ; read out the ammeter value\*  
; example 14.02mA

Press [1] [4] [.] [0] [2] [ENTER]  
Press [STOP] ; stop DCA 15mA range full scale  
calibration

### 4.3.7 GC Calibration

Connect a 4 terminal load resistor (0.1 ohms) between the HIGH/LOW DRIVER and HIGH/LOW SENSE of the Guardian 5000. Connect the 30 A AC ammeter in series with the HIGH DRIVER terminal.

Press [UP] or [DOWN] key as necessary to display  
Display CL 3.0 OFST GrA  
Press [OFF] key to display  
Display 1 3.0A 200.0 0.0 sec  
Press [STOP] [START] ; read out the ammeter value  
; example 2.87A

Press [2] [. ] [8] [7] [ENTER]  
Press [STOP] ; stop GrA offset calibration

Press [DOWN] key to display  
Display CL 25.0 FULL GrA  
Press [OFF] key to display  
Display 1 25.0A 200.0 0.0 sec  
Press [STOP] [START] ; read out the ammeter value  
; example 24.87A

Press [2] [4] [. ] [8] [7] [ENTER]  
Press [STOP] ; stop GrA full scale calibration

Change the load resistor to 50 mΩ and connect the AC voltmeter between HIGH and LOW SENSE.

Press [DOWN] key to display  
Display CL 5.0 OFST GrV ; 5.0A into 50mohm  
Press [OFF] key to display  
Display 1 5.0A 200.0 0.0 sec  
Press [STOP] [START] ; read out the voltmeter value  
; example 0.257 volts

Press [0] [. ] [2] [5] [7] [ENTER]  
Press [STOP] ; stop GrA offset calibration

Change the load resistor to 100 mΩ

Press [DOWN] key to display  
Display CL 30.0 FULL GrV ; 30A into 100mohm  
Press [OFF] key to display  
Display 1 30.0A 200.0 0.0 sec  
Press [STOP] [START] ; read out the voltmeter value  
; example 2.847 volts

Press [2] [. ] [8] [4] [7] [ENTER]  
Press [STOP] ; stop GrA full scale calibration

### 4.3.8 Finalize Calibration

Press	<b>ENTER</b> and then [7] [9] [3] [1]
Display	CAL OFF / CAL ON / CAL TEST
	CAL OFF : calibration data install zero
	CAL ON : calibration finished, in normal operation
	CAL TEST : into calibration procedure
Press	[OFF] key : to change CAL OFF / CAL ON / CAL TEST
Display	CAL ON : calibration finish, in normal operation
Press	[PROG] key : finish calibration

Press the lock switch (to the out position) and cover with a calibration label.