



Guardian 1050 Ground Bond Tester Instruction Manual

Form 150744/A3

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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.

WARNING

Potentially dangerous current levels may be present on front and rear panel terminals. Follow all warnings in this manual when operating or servicing this instrument. Dangerous levels of energy may be stored in capacitive devices tested by this unit. Always make sure the high current indicator is **not** on when connecting or disconnecting the device under test.

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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 of fitness for a particular purpose.

SERVICE POLICY

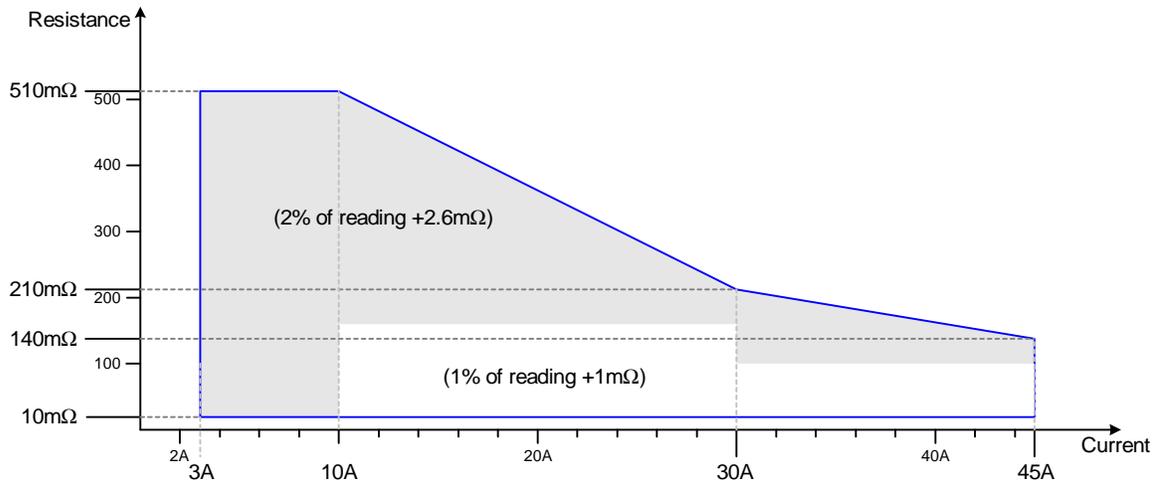
QuadTech's service policy is to maintain product repair capability for a period of at least five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.

Specifications

Output Current: Range: 3.00 to 45.00A AC
 Resolution: 0.01A, 3-30A; 0.1A 30-45A
 Accuracy: $\pm (1.5\% \text{ of setting} + 0.15A)$, for $I \leq 30A$
 $\pm (1.5\% \text{ of setting} + 0.2A)$, for $I > 30A$
 Frequency: 50 or 60Hz, $\pm 0.1\%$

Voltage Limit: Range: 1.0 to 8.0V AC, setting 0.1V/step

Resistance: Range: 0.1m Ω - 510.0m Ω , 4 digits, Hi Limit
 Accuracy: 10A - 30A, 10m Ω - 150m Ω : $\pm(1\% \text{ of reading} + 1m\Omega)$
 Accuracy: 30A - 45A, 10m Ω - 100m Ω : $\pm(1\% \text{ of reading} + 1m\Omega)$
 Accuracy: All other ranges: $\pm(2\% \text{ of reading} + 2.6m\Omega)$



Limits: High: 0.1m Ω - 510.0m Ω
 Low: 0.1m Ω - High Limit, Off
 HI/LO programmable during Test Time

Offset Function: 0 to 100mohm offset, ON/OFF

Test Time: 0.5 - 999sec for $I < 40A$ AC
 0.5 - 120sec for $I \geq 40A$ AC
 Continuous operation mode (For $I < 40A$ AC)

Indication: Pass/Fail Display, LEDs and Audible Alarm

Remote Control: Inputs: START, STOP
 Characteristics: 24V active low, Pulse width $\cong 20ms$
 Output: PASS, FAIL, UNDER TEST
 Characteristics: Dry contact relay, Closed if true
 30V AC, 60V DC, $< 0.3A$
 Connector: 9 pin male D-series & Terminal Strip

Specifications (Continued)

General Features

Setup Storage:	99 Memory Locations, 99 Steps, Maximum block 500		
Standard Interfaces:	Remote I/O		
Optional Interfaces:	RS232	IEEE-488	Printer (replaces IEEE)
Connectors:	4-Terminal Kelvin Connection 4 Binding Posts/Banana Sockets: Front and Rear 1 Chassis Ground Banana Socket		
Front Panel Lockout:	11 Digit Password with or without setup recall LED Display: LOCK		
Mechanical:	Bench Mount Dimensions: (w x h x d): 312.5 x 112.5 x 387.5 mm		
Weight:	15.4 kg net, 18.1 kg shipping		
Environmental:	Specifications:	18°C to 28°C, 70% RH	
	Operating:	0°C to + 40°C, 80% RH	
	Storage:	-10°C to + 60°C, 90% RH	
	Warm-up Time: 15 minutes		
Power:	<ul style="list-style-type: none">• 100V, 120V, 220V AC: ±10%• 240V AC: -10%, +5%• 50 or 60Hz• 880W max		
Supplied:	<ul style="list-style-type: none">• Instruction Manual• Calibration Certificate	<ul style="list-style-type: none">• Power Cable• G15 Test Leads	<ul style="list-style-type: none">• Fuses
Ordering Information:	<u>Description</u> Ground Bond Tester	<u>Catalog No.</u> Guardian 1050	

Accessories

Accessories Included

Item	Quantity	QuadTech P/N
AC Power Cord	1	700070
Power Line Fuse 10A 250V SB	1	520107
Power Line Fuse 5A 250V SB	1	520068
Lead Set: Banana/Spade to Alligator clips	1	G15
Instruction Manual	1	150744
Calibration Certificate	1	N/A

Accessories/Options Available

Item	Quantity	QuadTech P/N
Foot Switch	1	S05
Interconnection Cable to G1000 Series Hipot Testers	1	S15
Corded Product Adaptor, 115V	1	G13
Power Entry Adaptor Cable	1	G14
International Power Strip	1	G16
Corded Product Adaptor, 240V	1	G25
RS232 Interface	1	G36
Printer Interface (replaces IEEE-488)	1	G38
IEEE-488 ('GPIB') Interface	1	G39
Lead Set: Banana/Spade to Alligator clips (std with unit)	1	G15
RS232 Cable	1	630157

Safety Precautions

WARNING

The Guardian 1050 Ground Bond Tester can provide an output current as high as 45A AC to the external device under test (DUT). Although the Guardian unit is designed with full attention to operator safety, serious hazards could occur if the instrument is used improperly and these safety instructions are not followed.

1. Operate the Guardian 1050 unit with its chassis connected to earth ground. The instrument is shipped with a three-prong power cord to provide this connection to ground. This power cord should only be plugged in to a receptacle that provides earth ground. Serious injury can result if the Guardian 1050 is not connected to earth ground.
2. Tightly connect cable(s) to the RTN/LOW terminal. If this is not done, the DUT's casing can be charged to the high current test level and serious injury or electrical shock hazards could result if the DUT is touched.
3. Never touch the metal of the High Voltage probe directly. Touch only the insulated parts of the lead(s).
4. Never touch the test leads, test fixture or DUT in any manner (this includes insulation on all wires and clips) when the high voltage is applied and the red **DANGER** light is ON.
5. Before turning on the Guardian unit, make sure there is no device (DUT) or fixture connected to the test leads.
6. After each test, press the **[STOP]** (red) button for safety. This terminates the high voltage being applied to the output terminals.
7. When the red **DANGER** LED is lit or flashing, NEVER touch the device under test, the lead wires or the output terminals.
8. Before touching the test lead wires or output terminals make sure :
 - a) The red **[STOP]** button has been pressed
 - b) The red **DANGER** LED is OFF.
9. In the case of an emergency, turn OFF the POWER switch using a "hot stick" and disconnect the AC power cord from the wall. DO NOT TOUCH THE INSTRUMENT. Position the equipment so it is easy to disconnect. Always disconnect by means of the power plug or power connector.
10. If the **DANGER** LED does not go off when the **[STOP]** button is pressed, immediately stop using the tester. It is possible that the output voltage is still being delivered regardless of the TEST ON/OFF control signal.
11. When the instrument is remotely controlled, be extremely careful. The High Voltage Output is being turned On/Off with an external signal.

Safety Symbols

The product is marked with the following safety symbols.



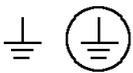
Product will be marked with this symbol (ISO#3864) when it is necessary for the user to refer to the instruction manual in order to prevent injury or equipment damage.



Product marked with this symbol (IEC417) indicates presence of direct current.



Product will be marked with this symbol (ISO#3864) when voltages in excess of 1000V are present.



Indicates the grounding protect terminal, which is used to prevent electric shock from the leakage on chassis. The ground terminal must connect to earth before using the product.

Warning Procedure can cause hazard to human if the warning is neglected.

Caution Avoid product misuse. It may cause damage to the product itself and the DUT if the caution is neglected.

Note Important information or tips for the procedures and applications.

Warning Signal During Testing

“DANGER – HIGH VOLTAGE TEST IN PROGRESS, UNAUTHORIZED PERSONS KEEP AWAY”

Disposal

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new one, the retailer is legally obligated to take back your



Condensed Operating Instructions

WARNING

High Current is applied to the Output Terminals anytime the red **DANGER** LED is ON or flashing. Always make sure the **DANGER** LED is OFF when connecting or disconnecting the device under test (DUT).

General Information

The Guardian 1050 Ground Bond Tester is a measuring instrument for direct readout of high current ground bond between chassis and power cord ground. It is an excellent choice for electrical safety testing on a wide variety of electrical products and appliances. The current applied to the device under test is adjustable from 3A to 45A AC in 0.01A steps. The voltage range is 1.0V to 8.0VAC with a 0.1V/step setting. The resistance range is from 0.1m Ω to 510m Ω with adjustable high and low limits. PASS and FAIL LEDs provide a visual display of test results based on preset limits. In FAIL mode, a buzzer gives an audible indication of test result based on preset limit.

Start-Up

The Guardian 1050 unit can be operated from a power source of 100V, 120V, 220V and 240V AC at a power line frequency of 50 or 60Hz. The standard Guardian 1050 unit is shipped from QuadTech with a 10A fuse in place for AC 100V or 120V operation. (A 5A fuse is included for 220 or 240V operation). The G1050 unit is shipped with the line voltage selector set for 120V. Refer to paragraph 1.4.3 for instructions on changing the fuse or line voltage selector.

Connect the Guardian 1050 unit AC power cord to the source of proper voltage. Operate the G1050 instrument with its chassis connected to earth ground. The Guardian 1050 instrument is shipped with a three-prong power cord to provide this connection to ground. This power cord should only be plugged into a receptacle that provides earth ground. Serious injury may result if the G1050 instrument is not connected to earth ground.

Press the [POWER] button on the front panel to apply power. To switch the power off, press the [POWER] button again or if measurements are to be made proceed with the Test Parameter Setup in Table COI-1. The G1050 instrument should warm up for 15 minutes prior to use.

NOTE

Please read this instruction manual in its entirety before operating this instrument. These condensed operating instructions are not a substitute for all the information provided in the remainder of this manual.

NOTE

Refer to paragraph 2.3 for a full description of programming test parameters. Test parameters must be set before the G1050 instrument can be zeroed.

Condensed Operating Instructions (Continued)

There are numerous menus within the Guardian 1050 instrument. Familiarize yourself with these menus prior to programming a test. Figure COI-1 illustrates the STAND BY display and lists the functions that can be accessed by pressing the [F1] through [F4] keys.

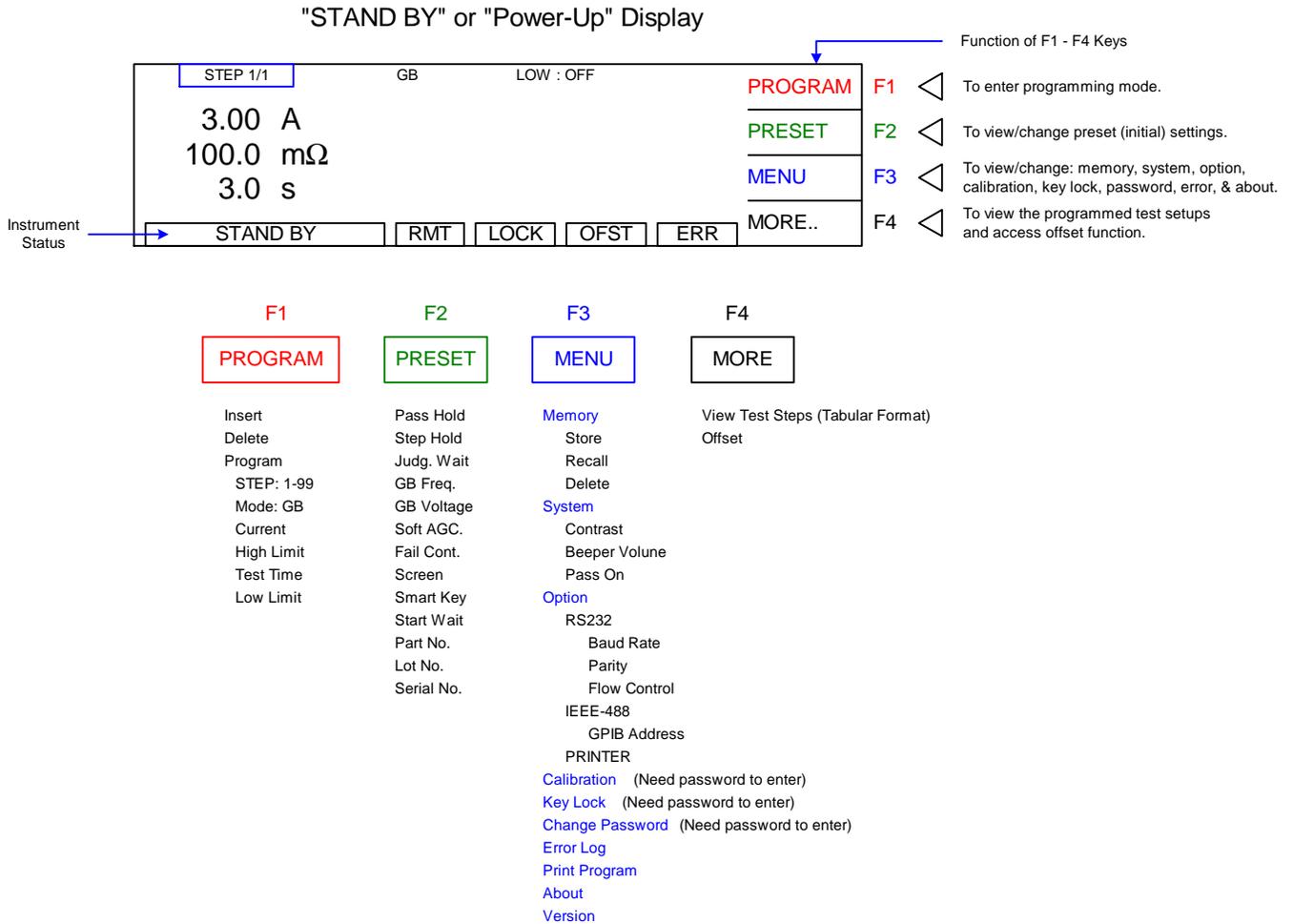


Figure COI-1: G1050 Menus

NOTE:

The function of UP/DOWN depends on the menu. When [F3] = ENTER, the UP/DOWN operation changes the highlighted value and the ENTER operation scrolls through the menu selections. When [F3] = SELECT, the UP/DOWN operation scrolls through the menu selections and the SELECT operation chooses (enters into) the highlighted parameter.

Condensed Operating Instructions (Continued)

<p>"STAND BY" or "Power-Up" Display</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: left; padding: 2px;">STEP 1/1</td> <td style="text-align: center; padding: 2px;">GB</td> <td style="text-align: right; padding: 2px;">LOW : OFF</td> <td style="text-align: right; padding: 2px;">PROGRAM</td> <td style="padding: 2px;">F1</td> <td style="padding: 2px;">▶ To enter programming mode.</td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 5px;"> <p>3.00 A 100.0 mΩ 3.0 s</p> </td> <td style="text-align: right; padding: 2px;">PRESET</td> <td style="padding: 2px;">F2</td> <td style="padding: 2px;">◀ To view/change preset (initial) test parameters.</td> </tr> <tr> <td colspan="3" style="padding: 2px;"></td> <td style="text-align: right; padding: 2px;">MENU</td> <td style="padding: 2px;">F3</td> <td style="padding: 2px;">◀ To view/change system parameters: memory, system, option, calibration, key lock, password, error, & about.</td> </tr> <tr> <td colspan="3" style="padding: 2px;"></td> <td style="text-align: right; padding: 2px;">MORE..</td> <td style="padding: 2px;">F4</td> <td style="padding: 2px;">◀ To view the programmed test setups and access offset function.</td> </tr> <tr> <td colspan="3" style="padding: 2px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">STAND BY</td> <td style="padding: 2px;">RMT</td> <td style="padding: 2px;">LOCK</td> <td style="padding: 2px;">OFST</td> <td style="padding: 2px;">ERR</td> </tr> </table> </td> <td colspan="2"></td> </tr> </table>	STEP 1/1	GB	LOW : OFF	PROGRAM	F1	▶ To enter programming mode.	<p>3.00 A 100.0 mΩ 3.0 s</p>			PRESET	F2	◀ To view/change preset (initial) test parameters.				MENU	F3	◀ To view/change system parameters: memory, system, option, calibration, key lock, password, error, & about.				MORE..	F4	◀ To view the programmed test setups and access offset function.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">STAND BY</td> <td style="padding: 2px;">RMT</td> <td style="padding: 2px;">LOCK</td> <td style="padding: 2px;">OFST</td> <td style="padding: 2px;">ERR</td> </tr> </table>			STAND BY	RMT	LOCK	OFST	ERR		
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PROCESS STEP	RMT	LOCK	OFST	ERR																															

Figure COI-2: "STAND BY" and PROGRAM Displays

With the Guardian 1050 instrument in "STAND BY" (or power-up display) status, follow these steps to program one GB test.

- Press [F1] = PROGRAM
- Press [F3] = ENTER to move highlighted box to CURR
- Press [F1] = Up to select test current (3.00 – 45.00A)
- Press [F3] = ENTER to move highlighted box to HIGH
- Press [F1] = Up to select high resistance limit (0, 0.1-510mΩ)
- Press [F3] = ENTER to move highlighted box to TIME
- Press [F1] = Up to select test time (0, 0.5 – 999s) (0.5 - 120s when I > 40A)
- Press [F3] = ENTER to move highlighted box to LOW
- Press [F1] = Up to select low resistance limit (OFF, 0.1mΩ - high limit)
- Press [F4] = EXIT to return to STANDBY status

Offset

After setting your test parameters, zero the Guardian 1050 instrument by using the automatic offset. With no device connected, connect the appropriate cable (or other test fixture) into the front panel OUTPUT connectors. Short the test leads. Figure COI-3.

Condensed Operating Instructions (Continued)

With the instrument in STAND BY status:

- Press [F4] = MORE
- Press [F3] = OFFSET
- Follow instructions on display: i.e.: 'please SHORT the GB port'.
- Press green [START] button.
- Wait while instrument gets OFFSET value.
- The **OFST** block at the bottom of the display is now highlighted (back lit).
- Press [F4] = MORE to return to STAND BY status.

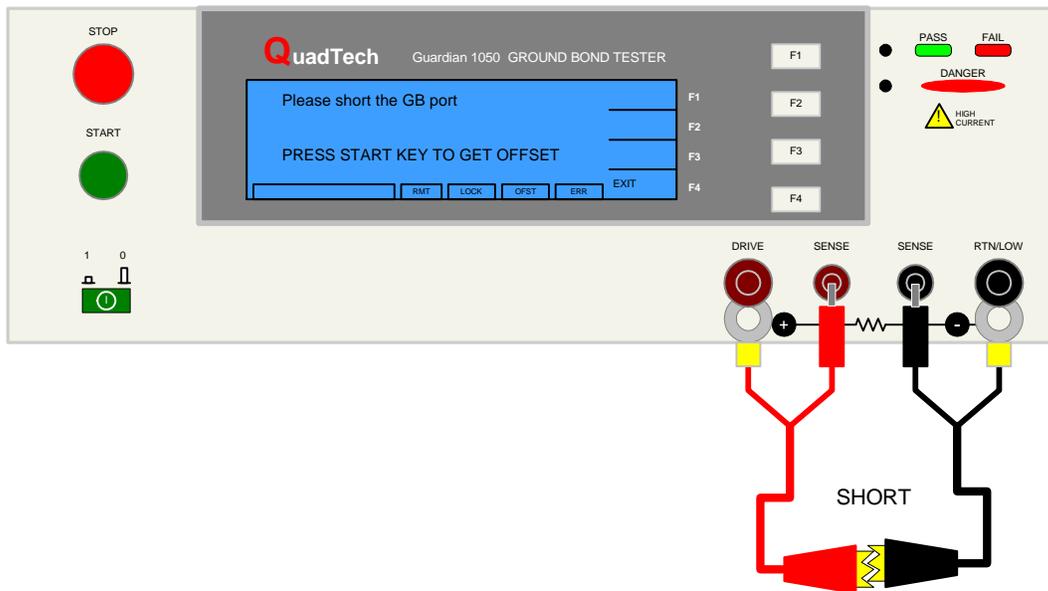
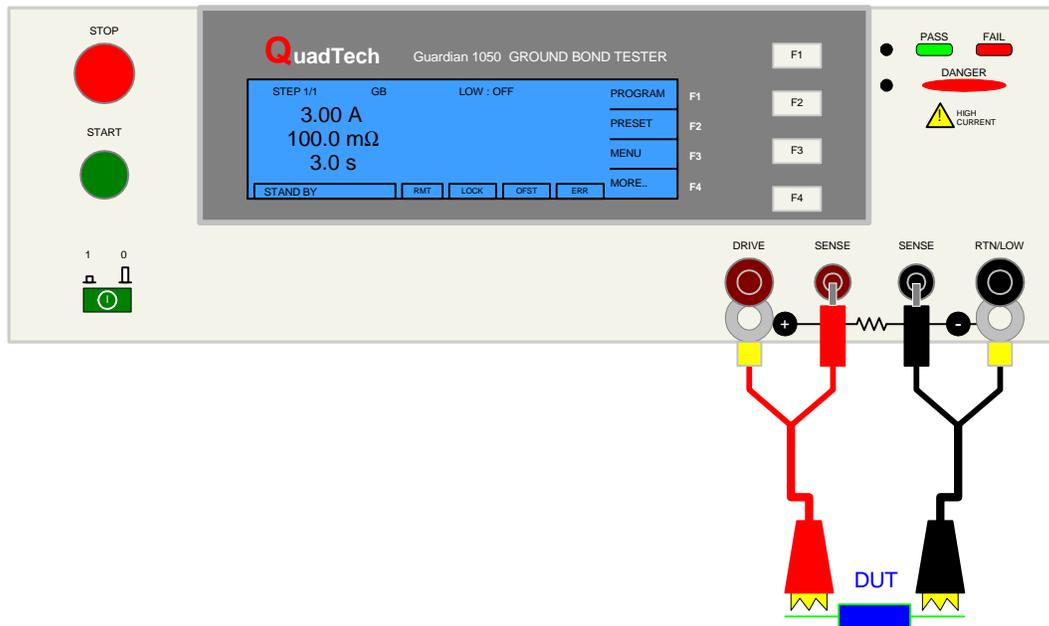


Figure COI-3: Shorted Test Leads for Offset

Condensed Operating Instructions (Continued)

Connection to Device under Test (DUT)

Figure COI-4 illustrates the connection of the Guardian 1050 Ground Bond Tester to a single DUT using the G15 cable set that comes standard with the instrument. The red banana plug/spade to alligator clip is connected from the DRIVE+/SENSE+ terminals on the G1050 unit to the high side of the device under test. The black banana plug/spade/alligator clip is connected between the SENSE-/RTN/LOW terminal on the G1050 unit to the low side of the DUT.



COI-4: Connection to Device under Test

Measurement Mode

1. Turn [POWER] ON.
2. Allow G1050 instrument a 15-minute warm up time.
3. Connect Red banana/spade cable to G1050 (+) terminals (DRIVE+, SENSE+)
4. Connect Black banana/spade cable to G1050 (-) terminals (SENSE-, RTN/LOW).
5. Press [F1] = PROGRAM and enter test parameters. When finished programming, press [F4] = EXIT to return to STAND BY status.
6. Press [F4] = MORE to access Offset function. Press [F3] = OFFSET. Follow Offset instructions. When Offset is complete, press [F4] = MORE to return to STAND BY.
7. Connect alligator clips to device under test (DUT).
8. Press [START].
9. Record measurement.
10. Press [STOP].

Section 1: Introduction

1.1 Unpacking and Inspection

Inspect the shipping carton before opening. If damaged, contact the carrier agent immediately. Inspect the Guardian 1050 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 original shipping carton and packing material for future use such as returning the instrument for calibration or service.

1.2 Product Overview

The Guardian 1050 instrument provides for verification of ground continuity connection (ground bond testing) between conductive surfaces and power cord ground on the product under test. The Guardian 1050 instrument can be programmed for an output current up to 45 amps and for high/low resistance measurement limits between 0.1m Ω and 510m Ω . The instrument also provides memory for internal storage of 99 test setups with 99-steps each. Each instrument comes standard with a remote interface with start/stop inputs & pass/fail outputs. Optional RS232, IEEE-488 and Printer Interfaces are available for the Guardian 1050 Ground Bond Tester. The Guardian 1050 instrument can be connected to the Guardian 1000 Series Hipot testers for a complete product test (hipot preceded by ground bond) with the push of one button.

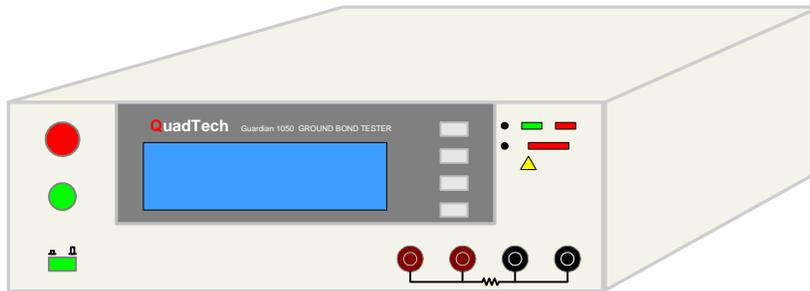


Figure 1-1: Guardian 1050 Ground Bond Tester

1.3 Controls and Indicators

1.3.1 Front Panel Controls and Indicators

Figure 1-2 illustrates the controls and indicators on the front panel of the Guardian 1050 Ground Bond Tester. Table 1-1 identifies them with description and function.

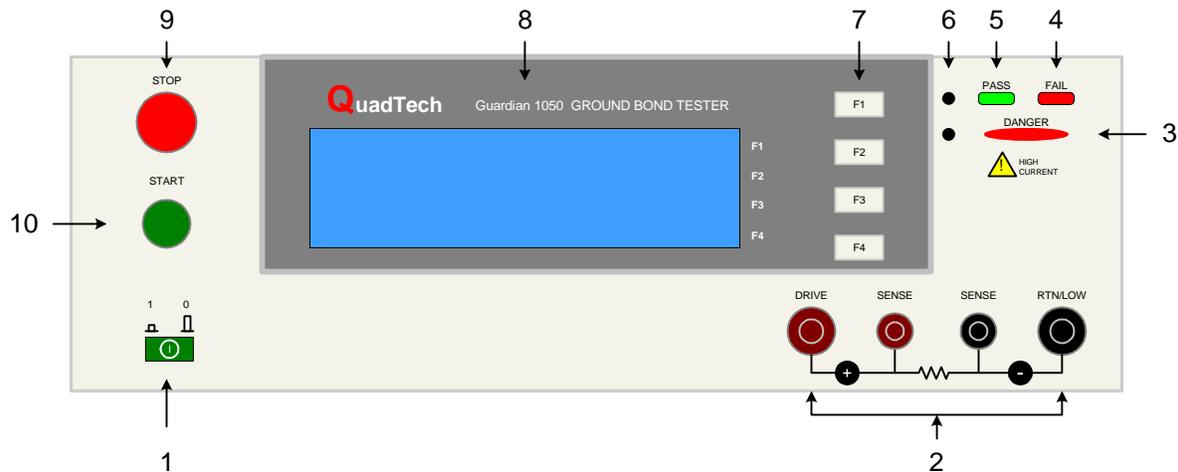


Figure 1-2: Guardian 1050 Front Panel Controls & Indicators

Table 1-1: Guardian 1050 Front Panel Controls & Indicators

Reference # Figure 1-2	Name	Type	Function
1	Power	Green Push Button	Apply AC Power: 1=ON, 0=OFF
2	Output	2 Maroon Binding Posts 2 Black Binding Posts	DRIVE +: High Current terminal (Driver) SENSE+: High Voltage terminal SENSE-: Low Voltage terminal RTN/LOW: Low Current terminal, Ground Reference
3	DANGER	Red LED	When lit, high current is present at OUTPUT terminals
4	FAIL	Red LED	When lit, DUT judged as FAIL. Output current is immediately cut off. Press [STOP] to disable FAIL LED
5	PASS	Green LED	When lit, DUT judged as PASS
6	CAL UPDATE	Recessed P-B Recessed P-B	Enable/Disable Instrument Calibration Qualified Service Personnel Only
7	F1, F2, F3 and F4	Gray Push Buttons	Select Instrument Functions Keys perform different functions under different menus. Right side of display shows corresponding key function.
8	Display	LCD	Program Menu, Test Setup, Measurement Results, Memory Contents, Calibration
9	STOP	Red Push Button	Stop Test: HV terminated at OUTPUT terminal
10	START	Green Push Button	Initiate Test: HV applied to OUTPUT terminal

1.3.2 Rear Panel Controls and Connectors

Figure 1-3 illustrates the controls and connectors on the rear panel of the Guardian 1050 Ground Bond Tester. Table 1-2 identifies them with description and function.

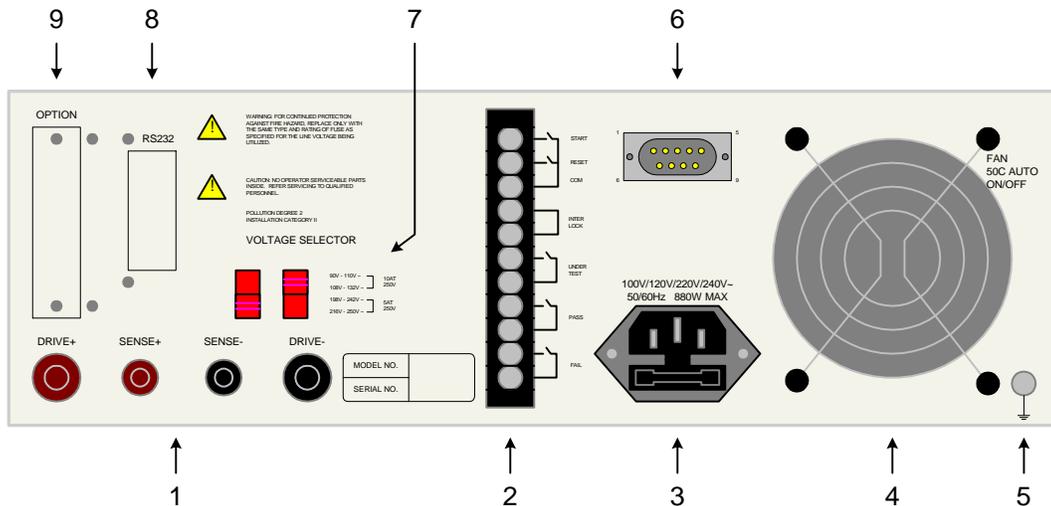


Figure 1-3: Rear Panel Guardian 1050 Instrument

Table 1-2: Guardian 1050 Rear Panel Controls & Connectors

Reference # Figure 1-3	Name	Type	Function
1	Output	2 Maroon Binding Posts 2 Black Binding Posts	DRIVE +: High Current terminal (Driver) SENSE+: High Voltage terminal SENSE-: Low Voltage terminal RTN/LOW: Low Current terminal, Ground Reference
2	Remote	Black 11-screw Terminal Strip	Remote Connection: Inputs: Start, Stop, Interlock Outputs: Pass, Fail, Under Test
3	AC Line Input	Black 3-wire inlet module & fuse holder	Connection to AC power source Fuse Drawer: 10A 250V or 5A 250V (see #7)
4	Fan	FFB0812VHE DC 12V 0.57A	Cool Unit: T \geq 50°C = ON, T<45°C = OFF
5	Ground	Silver banana plug/screw	Chassis Ground Connection
6	Remote	Silver 9-pin D-Type Connector	Remote Connection: Inputs: Start, Reset, Interlock Outputs: Pass, Fail, Under Test
7	VOLTAGE SELECTOR	2 Red 2-position Slide Switches	Select Voltage Level corresponding to AC Source 90V – 110V: 10AT 250V 108V – 132V: 10AT 250V 198V – 242V: 5AT 250V 216V – 250V: 5AT 250V
8	RS232	Silver 9-pin, D-Type	Optional RS232 Interface
9	OPTION	Blue 24-pin	Optional IEEE-488 Interface or Printer Interface

1.4 Installation

1.4.1 Dimensions

The Guardian 1050 unit is supplied in a bench configuration, i.e., in a cabinet with resilient feet for placement on a table. Flip feet are provided under the front feet so that the Guardian instrument can be tilted up for convenient operator viewing.

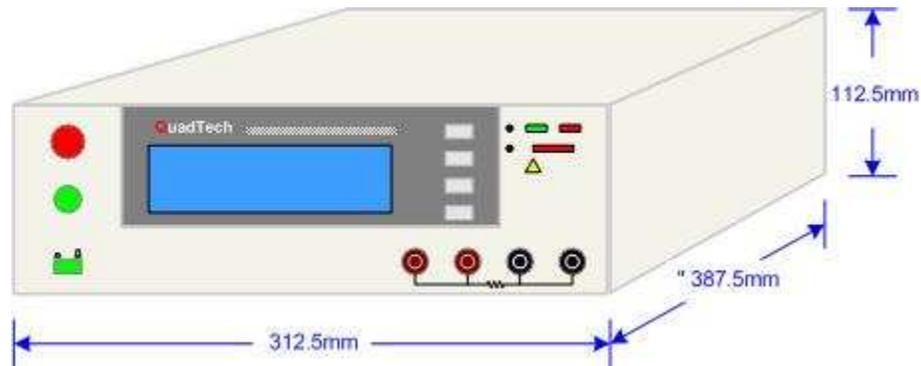


Figure 1-4: Guardian 1050 Instrument Dimensions

1.4.2 Instrument Positioning

The Guardian unit contains one (1) graphic display for direct readout of measured parameters. The optimum angle for viewing is slightly down and about 10 degrees either side of center. For bench operation the front flip feet should always be used to angle the instrument up. In bench or rack mount applications the instrument should be positioned with consideration for ample air flow around the rear panel fan ventilation hole. An open space of at least 3 inches (75mm) is recommended behind the rear panel. Testing should be performed on a non-conductive surface. An ESD mat is not a recommended test platform.

1.4.3 Power Requirements

The Guardian can be operated from a power source of 90 to 132V AC or 198 to 250V AC. 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 (Figure 1-5) are in accordance with the power source being used. For a 90-132V source, use a 10A 250V fuse. For a 198-250V source, use a 5A 250V fuse. Always use an outlet that has a properly connected protection ground.

WARNING

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

Procedure For Changing A Guardian 1050 Fuse

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.

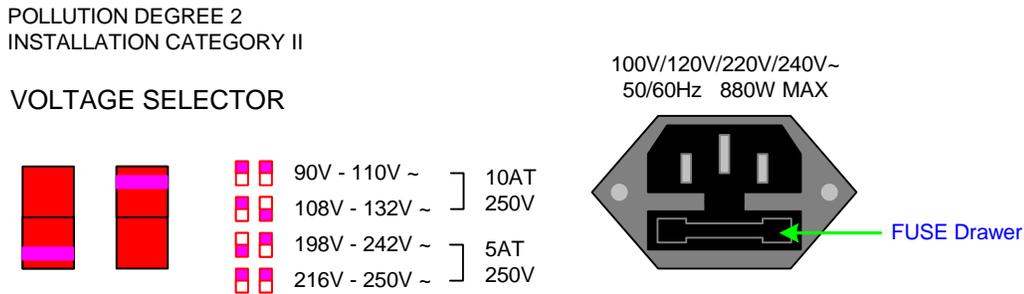


Figure 1-5: Close-Up of G1050 Rear Panel

1.4.4 Safety Inspection

Before operating the instrument inspect the power inlet module on the rear of the Guardian to ensure that the properly rated fuse is in place, otherwise damage to the unit is possible. Make sure that the voltage selector switches are set in accordance with the power source in use. Refer to paragraph 1.4.3 and Figure 1-5.

The Guardian instrument is shipped with a standard U.S. power cord, QuadTech P/N 700070 (with Belden SPH-386 socket or equivalent, and a 3-wire plug conforming to IEC 320). Make sure the instrument is only used with these cables (or other approved international cord set) to ensure that the instrument is provided with connection to protective earth ground.

The surrounding environment should be free from excessive dust to prevent contamination of electronic circuits. The surrounding environment should also be free from excessive vibration. Do not expose the Guardian instrument to direct sunlight, extreme temperature or humidity variations, or corrosive chemicals.

Section 2: Operation

2.1 Terms and Conventions

Table 2-1: Measurement Unit Prefixes

<u>Multiple</u>	<u>Scientific</u>	<u>Engineering</u>	<u>Symbol</u>
1000000000000000	10 ¹⁵	Peta	P
1000000000000	10 ¹²	Tera	T
1000000000	10 ⁹	Giga	G
1000000	10 ⁶	Mega	M
1000	10 ³	Kilo	k
.001	10 ⁻³	milli	m
.000001	10 ⁻⁶	micro	u
.000000001	10 ⁻⁹	nano	n
.000000000001	10 ⁻¹²	pico	p
.000000000000001	10 ⁻¹⁵	femto	f

ARcing: Sparking or ‘flashing over’ caused by a breakdown of electrical insulation.

Current:

AC: Alternating Current. AC is an electrical current that has one polarity during part of the cycle and the opposing polarity during the other part of the cycle. Residential electricity is AC.

DC: Direct Current. Non-reversing polarity. The movement of charge is in one direction. Used to describe both current and voltage. Batteries supply direct current (DC).

Charging Current: An insulated product exhibits the basic characteristics of a capacitor. Application of a voltage across the insulation causes a current to flow as the capacitor charges. This current instantaneously rises to a high value as voltage is applied then exponentially decays to zero as the DUT becomes fully charged. Charging current decays to zero much faster than dielectric absorption.

Dielectric Absorption:	The physical phenomenon in which insulation appears to absorb and retain an electrical charge slowly over time. Apply a voltage to a capacitor for an extended period of time. Then quickly discharge it to zero voltage. Leave the capacitor open circuited for a period of time then connect a voltmeter to it and measure the residual voltage. The residual voltage is caused by the dielectric absorption of the capacitor.
Dielectric Strength:	The ratio between the voltage at which breakdown of the insulating material occurs and the distance between the two points subject to the applied voltage.
Dielectric Withstand Test:	This is the most common electrical safety test performed. A high voltage (either AC or DC) is applied to determine if a breakdown will occur in the insulation of the DUT. Dielectric Withstand is also referred to as a hipot (high potential) test.
Discharge:	The act of draining off an electrical charge to ground. Devices that retain charge should be discharged after an IR test or DC hipot test.
DUT:	Device Under Test. (i.e. the product being tested).
Frequency:	The rate at which current or voltage reverses polarity and then back again completing a full cycle, measured in Hertz (Hz) or cycles/second. AC Line Frequency = 50/60 Hz.
Ground:	
Ground:	The base reference from which voltages are measured, nominally the same potential as the earth. Ground is also the side of a circuit that is at the same potential as the base reference.
Ground Bond Test:	Test to verify that all conductive parts of a product that are exposed to user contact are connected to the power line ground. The ground bond test verifies the integrity of the ground connection using a high current AC signal with current level as high as 45Amps. Ground bond provides a better simulation of how a product will perform under an actual fault condition.
Ground Continuity:	Test to verify that all conductive parts of a product that are exposed to user contact are connected to the power line ground. GC Test normally performed with a low current DC signal that checks to ensure the ground connection has a resistance of $<1\Omega$.

Insulation Resistance: Measures the total resistance between any two points separated by electrical insulation. The IR test determines how effective the dielectric (insulation) is in resisting the flow of electrical current.

Interface:

IEEE-488: General Purpose Interface Bus (GPIB). GPIB is an industry standard definition of a Parallel bus connection for the purpose of communicating data between devices.

RS232: An industry standard definition for a Serial line communication link or port.

Scanner: An electronic device designed to switch or matrix signals.

Leakage Current (LC):

Leakage Current: The residual flow of current that flows through the insulation after a high voltage has been applied for a period of time. The leakage current is equal to the applied voltage divided by the insulation resistance. Leakage current is the main measured value for AC hipot and DC hipot.

Applied Part LC Test: A line leakage current test that measures the current that would flow from, to or between applied parts such as sensor and patient leads. This test is the most complicated and time-consuming line leakage test.

Earth LC Test: The most important and most common of the line leakage tests. Earth leakage current is basically the current flowing back through the ground conductor on the power cord. It is measured by opening the ground conductor, inserting a circuit with the simulated impedance of the human body then measuring the voltage across part of the circuit with a true RMS voltmeter.

Enclosure LC Test: A line leakage test that measures the current that flows through the human body if the body had touched the enclosure of the DUT.

Line LC Test: A line voltage leakage current test simulates the effect of a person touching exposed metal parts of a product and detects whether or not the leakage current that flows through the person's body remains below a safe level. Apply power to the product being tested, then measure the leakage current from any exposed metal on the chassis of the product under a fault conditions such as "no ground". A special circuit is used to simulate the impedance of the human body.

Limits:

High Limit: The high limit is the upper value for a test to be considered a pass. If the measured value is higher than the high limit the test is considered a fail. In ground bond test mode a high limit is required.

Low Limit: The low limit is the lower value for a test to be considered a pass. If the measured value is lower than the low limit the test is considered a fail.

Mode: The test which is to be performed such as AC Hipot (WAC), DC Hipot (WDC), Insulation Resistance (IR), Ground Bond (GB) or Leakage Current (LC).

RAMPing: The gradual increase or decrease of voltage or current over a period of time (step).

Step: The Guardian 1050 instrument can perform up to 99 tests in a sequence. The step number indicates in which order the tests will be performed.

Test Time:

Ramp: The period of time for the voltage to climb to programmed level.

Dwell: The period of time for the voltage to settle at programmed level.

Test: The period of time that the voltage is applied to the DUT.

Fall: The period of time for the voltage to decrease back to 0.

2.2 Startup

Check to make sure the Red Voltage Selector Switches on the rear panel agree with the power source available. Depending on the power source the switch positions should be in the up or down positions as shown in Figure 1-5 (Close-Up of G1050 Rear Panel).

WARNING

NEVER TOUCH THE TEST LEADS IN ANY MANNER (this includes insulation on all wires and clips) when HIGH CURRENT IS APPLIED and red **DANGER** LED is ON.

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

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 1050 instrument by pressing the green [POWER] switch on the front panel to the ON (1 position). The Guardian 1050 unit should warm up for a period of at least 15 minutes prior to use.

WARNING

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

Before Programming the 1050 Ground Bond Tester

The Guardian 1050 instrument has multiple menus or displays that may seem confusing at first glance. In an attempt to clarify the numerous functions of the software, this instruction manual will illustrate these displays in a (hopefully) logical format. The function keys (F1, F2, F3 & F4) perform different tasks depending upon the menu currently shown on the display. Figure 2-1 illustrates the STAND BY display shown upon instrument 'power-up'. The box in the lower left hand corner denotes the instrument status. For clarity, a green arrow (⇨) is used to denote which function key (F1 – F4) is pressed to get to the next display screen.

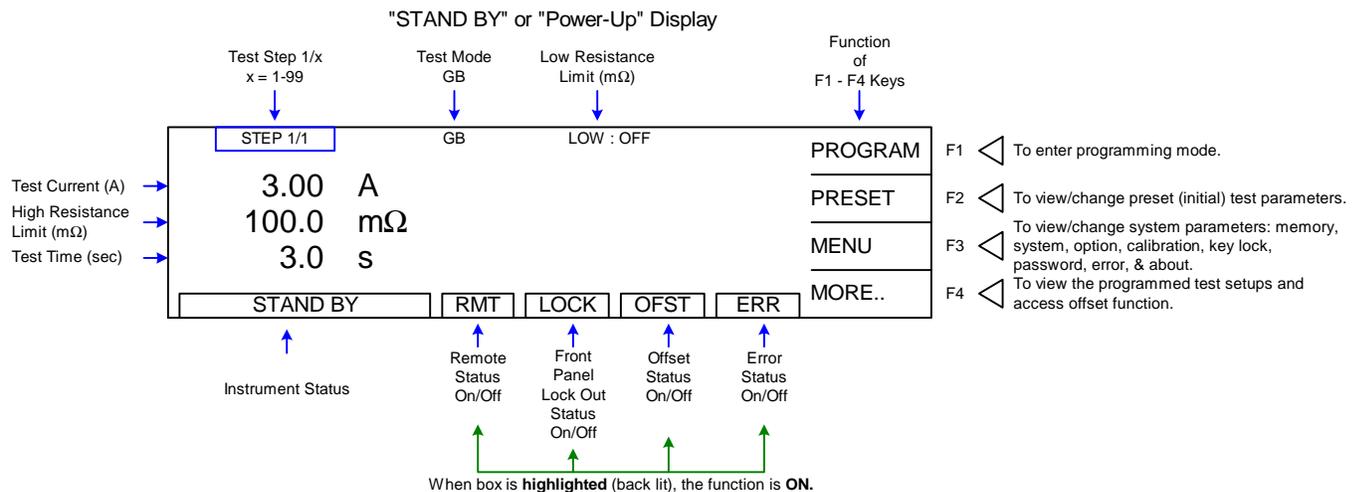


Figure 2-1: STAND BY Display

Function keys of the STAND BY Display

The function keys on the right hand side of the display allow the operator to access the numerous menus imbedded within the Guardian 1050 instrument software. Familiarize yourself with these menus prior to programming a test. Figure 2-2 illustrates the STAND BY display and lists the functions that can be accessed by pressing the [F1] through [F4] keys.

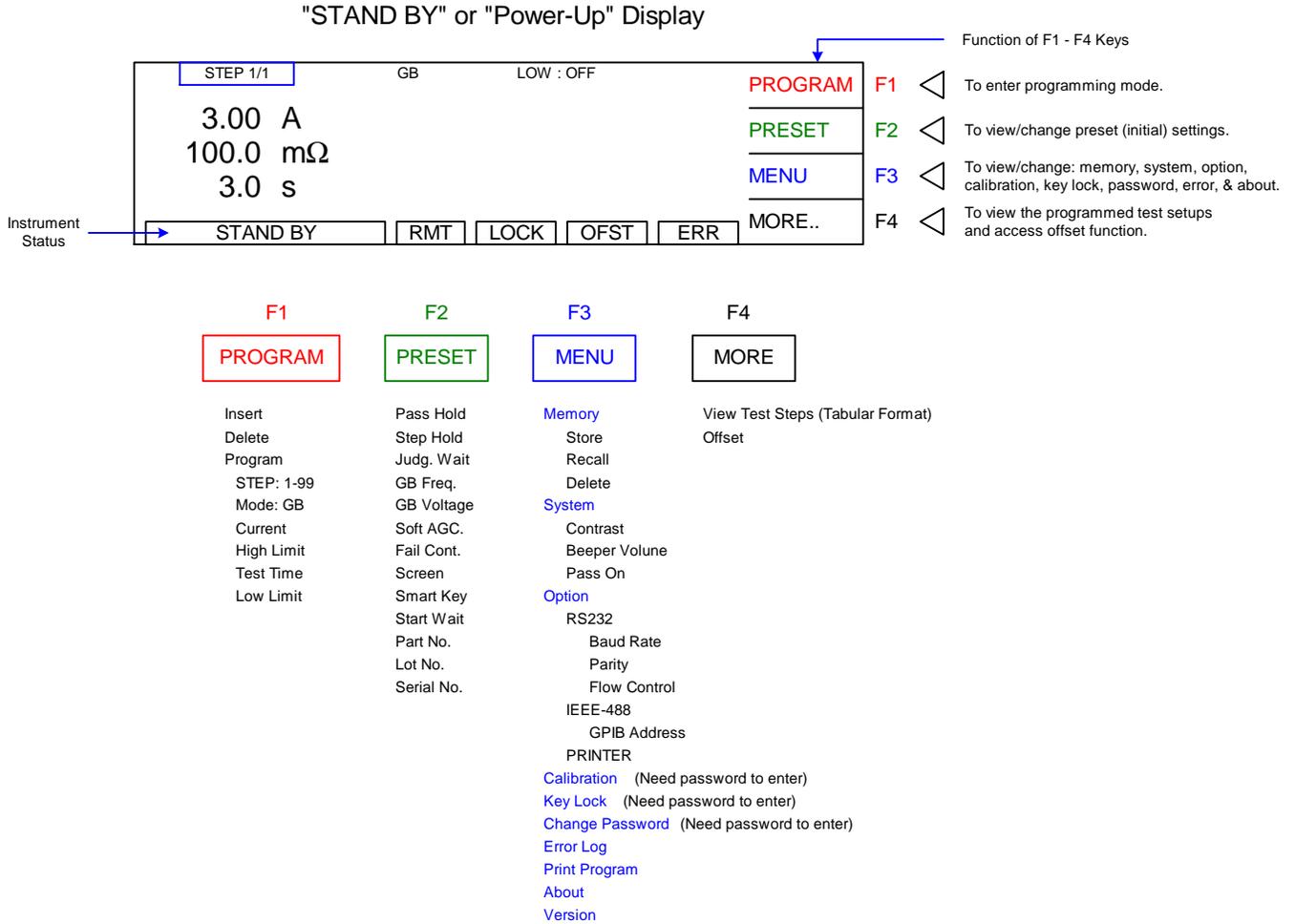


Figure 2-2: STAND BY Function Key Menus

To access the programming function of the G1050 instrument in the STAND BY menu, press the [F1] key (PROGRAM). Once in the PROGRAM display, select the test step then the test mode (GB). From here you can program the individual parameters of each test.

2.3 Programming a Ground Bond Test

The Guardian 1050 instrument is capable of performing ground bond tests with a test current of 3-45A and resistance range of 0.1-510mΩ. A single-step test or multi-step (up to 99) test can be performed on a device and stored to one of 99 memory locations.

"STAND BY" Display	<div style="border: 1px solid black; padding: 5px;"> <p>STEP 1/1 GB LOW : OFF</p> <p style="text-align: center;">3.00 A 100.0 mΩ 3.0 s</p> <p>STAND BY RMT LOCK OFST ERR</p> </div>	<p>F1 To enter programming mode.</p> <p>F2 To view/change preset (initial) test parameters.</p> <p>F3 To view/change system parameters: memory, system, option, calibration, key lock, password, error, & about.</p> <p>F4 To view the programmed test setups and access offset function.</p>
	<div style="border: 1px solid black; padding: 5px;"> <p>STEP 1 GB LOW : OFF</p> <p>CURR: 3.00 A HIGH: 100.0 mΩ TIME: 3.0 s</p> <p>PROCESS STEP RMT LOCK OFST ERR</p> </div>	<p>F1 To change value in highlighted box.</p> <p>F2 MORE..</p> <p>F3 To move highlighted box around display to select parameter to change</p> <p>F4 EXIT</p>
Select STEP #	<div style="border: 1px solid black; padding: 5px;"> <p>STEP 1 GB LOW : OFF</p> <p>CURR: 3.00 A HIGH: 100.0 mΩ TIME: 3.0 s</p> <p>PROCESS STEP RMT LOCK OFST ERR</p> </div>	<p>F1 Select Test Step = 1 - 99</p> <p>F2 MORE..</p> <p>F3 To move highlighted box to CURR</p> <p>F4 EXIT</p>
Set Test CURRent	<div style="border: 1px solid black; padding: 5px;"> <p>STEP 1 GB LOW : OFF</p> <p>CURR: 3.00 A HIGH: 100.0 mΩ TIME: 3.0 s</p> <p>3.00 - 45.00A RMT LOCK OFST ERR</p> </div>	<p>F1 To enter test current from 3.01 - 45A in 0.01A increments</p> <p>F2 DOWN</p> <p>F3 To move highlighted box to HIGH.</p> <p>F4 EXIT</p>
Set HIGH Resistance Limit	<div style="border: 1px solid black; padding: 5px;"> <p>STEP 1 GB LOW : OFF</p> <p>CURR: 3.00 A HIGH: 100.0 mΩ TIME: 3.0 s</p> <p>0.1 - 510.0 mΩ RMT LOCK OFST ERR</p> </div>	<p>F1 To enter high resistance limit from 0.1 - 510.0mΩ in 0.1mΩ increments</p> <p>F2 DOWN</p> <p>F3 To move highlighted box to TIME.</p> <p>F4 EXIT</p>

GB Programming continued on Next Page.

GB Programming – Continued

Set Test TIME	STEP 1	GB	LOW : OFF	UP	F1	◀ To enter test time from 0.5 - 999s in 0.1s increments
	CURR: 3.00 A			DOWN	F2	
	HIGH: 100.0 mΩ			ENTER	F3	◀ To move highlighted box to LOW.
	TIME: 3.0 s			EXIT	F4	
	0, 0.5 - 999s	RMT	LOCK	OFST	ERR	
Set LOW Resistance Limit	STEP 1	GB	LOW : OFF	UP	F1	◀ To enter low resistance limit equal to 0 = OFF or 0.1mΩ - 100.0mΩ
	CURR: 3.00 A			DOWN	F2	
	HIGH: 100.0 mΩ			ENTER	F3	◀ To move highlighted box to STEP
	TIME: 3.0 s			EXIT	F4	
	0.1 - 100.0mΩ	RMT	LOCK	OFST	ERR	
GO TO STEP 2	STEP 1	GB	LOW : OFF	UP	F1	
	CURR: 3.00 A			MORE..	F2	◀ To delete or insert a test step.
	HIGH: 100.0 mΩ			ENTER	F3	
	TIME: 3.0 s			EXIT	F4	◀ To exit programming mode.
	PROCESS STEP	RMT	LOCK	OFST	ERR	

NOTE:

Instrument **PRESET** values can be programmed and stored for your specific test setup. Therefore **before storing** your tests, program the preset values.

2.4 Programming a Multi-Step Test

To program a multi-step test, proceed as follows:

- Program Step 1 as illustrated in paragraph 2.3
- After setting LOW limit, press [F3] = ENTER so that the **STEP 1** box is highlighted.
- Press [F1] = UP to add a second step
- Continue programming Step 2 as illustrated in paragraph 2.3.
- After setting LOW limit, press [F3] = ENTER
- Press [F1] = UP to add a third step (and program as in ¶ 2.3)
- **OR**
- Press [F4] = EXIT to exit PROGRAM mode.
- Set instrument PRESET parameters (paragraph 2.5)
- Store multi-step test setup per paragraph 2.6.1.

2.5 PRESET Test Parameters

A number of parameters may be programmed and stored with each program. On the Guardian 1050 instrument, this function is labeled PRESET and is accessible on the STAND BY display. Table 2-3 lists the Guardian 1050 PRESET test parameters including parameter range and initial (default) value.

Table 2-3: PRESET Test Parameters

Parameter	Range	Initial (Default) Value	Description
PASS HOLD	0.2 – 99.9 sec	0.5	Set hold time for a PASS result
STEP HOLD	0.1 – 99.9 sec/KEY	0.2	Set interval time between test steps KEY=Tester will stop after each step and display PASS/FAIL results.
JUDG. WAIT	0.1 – 99.9 sec	0.3	Set the judgment time
GB FREQ.	50 or 60Hz	60	Set test frequency
GB VOLTAGE	1.0 – 8.0V AC	8.0	Set test voltage
SOFT. AGC	ON or OFF	ON	Set software automatic gain control ON (to correct output voltage) or OFF.
FAIL CONT.	ON or OFF	OFF	Set instrument to Continue on a Fail result
SCREEN	ON or OFF	ON	Turn display off to increase test speed
SMART KEY	ON or OFF	ON	Retain previous 10 test parameters
START WAIT	0.1 – 99.9 sec, OFF	OFF	Set delay time from initial start
PART NO.	0-13 characters	Blank	Assign a Part Number
LOT NO.	0-13 characters	Blank	Assign a Lot Number
SERIAL NO.	0/ 5-13 characters	Blank	Assign a Serial Number

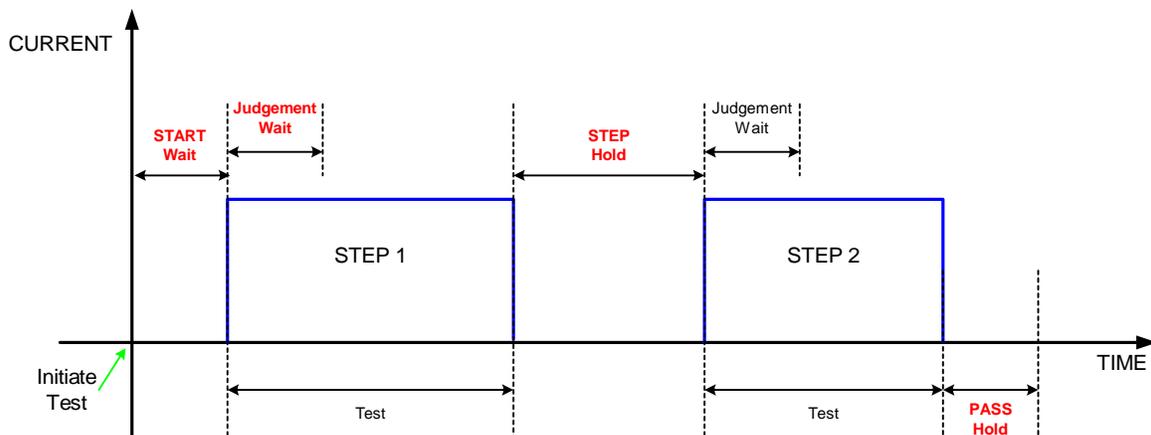


Figure 2-3: Hold Times

2.5.1 PASS HOLD

The Pass Hold setting allows the option of programming a hold time for the PASS relay (on the Remote Interface) after a single test or multiple step tests. The range for Pass Hold is 0.2 – 99.9 sec and the instrument default setting is 0.5sec. Refer to Figure 2-3.

2.5.2 STEP HOLD

The Step Hold setting allows the option of programming a hold time between steps. The range for Step Hold is set to KEY or 0.1 – 99.9seconds. The instrument default setting is 0.2sec. When Step Hold is set to KEY, the unit will stop after each step, display PASS/FAIL results and continue when [START] is pressed (or initiated remotely).

2.5.3 JUDG. WAIT

The Judgment Wait setting allows the option of programming a hold time. This allows the device to be fully charged prior to a measurement being made and then judged PASS/FAIL. The range for Judgment Wait is 0.1 – 99.9sec and the instrument default setting is 0.3sec. Refer to Figure 2-3.

2.5.4 GB FREQ.

The GB Frequency setting allows the option of selecting the frequency for the ground bond test. The range of GB Freq. is 50 or 60Hz and the instrument default setting is 60Hz.

2.5.5 GB VOLTAGE

The GB Voltage setting permits the operator to select the test voltage for the ground bond test from 1.0V to 8.0V AC in tenths of volts. The instrument default setting is 8.0V.

2.5.6 SOFT AGC

The Software Automatic Gain Control (SOFT AGC) setting allows the option of correcting the output current (ON). This is satisfactory when measuring resistors but under special circumstances when measuring large capacitive devices it is best to select Software AGC OFF. The default value is ON.

2.5.7 FAIL CONT

FAIL CONTINUE STEPS function can be programmed ON or OFF. The default setting is OFF. This selection determines if the unit will stop testing or proceed to the next step on fail during a multi-step test. When ON is selected if a test fails, then the instrument proceeds to the next step in the program. Use caution when FAIL CONT is ON.

2.5.8 SCREEN

The SCREEN function disables the display while testing. It can be set to ON or OFF. When set to OFF, the display is blank and the test time is increased by approximately 100millisec. The pass/fail LED indicators, DANGER LED and remote I/O inputs and outputs are operational.

2.5.9 SMART Key

The SMART Key programming function retains the last ten (10) test parameters previously run. When in program mode and SMART key is ON, the UP/DOWN function key will permit the user to scroll through the last ten parameters tested.

To enable SMART Key Programming:

In program menu, press and hold [ENTER = F3] until “S-KEY” is displayed in lower left hand corner. Refer to Figure 2.4. Smart Key must be set to ON in the Preset Menu first.

To turn SMART Key OFF:

Press and hold [ENTER = F3] for approximately 1 second until display no longer shows “SKey”.

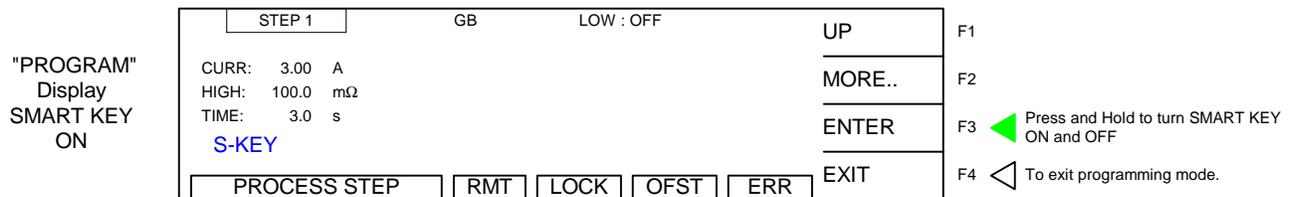


Figure 2.4: Smart Key Display

SMART Key retains the settings of the last 10 test parameters allowing the user to easily access those test conditions for fast programming. For example, if 3A, 30A and 45A are the only test currents that will be used for multiple programs, Smart Key will scroll through these 3 currents only when programming. This function is ideal for an R&D and lab environment.

2.5.10 START WAIT

The Start Wait time is a delay time – after connection to the device is made and before current is applied to begin the test. This feature is normally used in a probing application. For example: If a 2 second start wait time is programmed, once the operator connects the test probe to the device under test, the G1050 unit waits the 2sec programmed start time then applies current to the DUT. The range for Start Wait is OFF or 0.1 – 99.9sec and the instrument default setting is OFF.

CAUTION
 The START WAIT function is ACTIVE until the [STOP] button is pressed.
 When START WAIT is ON, the G1050 unit will start if contact is made with the test leads.

2.5.11 PART NO.

The PART NUMBER function allows the operator to assign a part number to the device under test. The part number can be made up of 0-13 alpha or numeric characters (0-9, A-Z).

2.5.12 LOT NO.

The LOT NUMBER function allows the operator to assign a lot number to the device under test. The lot number can be made up of 0-13 alpha or numeric characters (0-9, A-Z).

2.5.13 SERIAL NO.

The SERIAL NUMBER function allows the operator to assign a serial number to the device under test. The serial number can be made up of 0-13 alpha or numeric characters (0-9, A-Z).

2.6 MENU Parameters

With the Guardian 1050 instrument in STAND BY status, press [F3] = MENU to access programmable instrument parameters. The MENU display contains the Memory, System, Option, Calibration, Key Lock, Change Password, Error Log, About and Version functions. Figure 2-5 illustrates the MENU display and Table 2-5 lists the MENU functions with description.

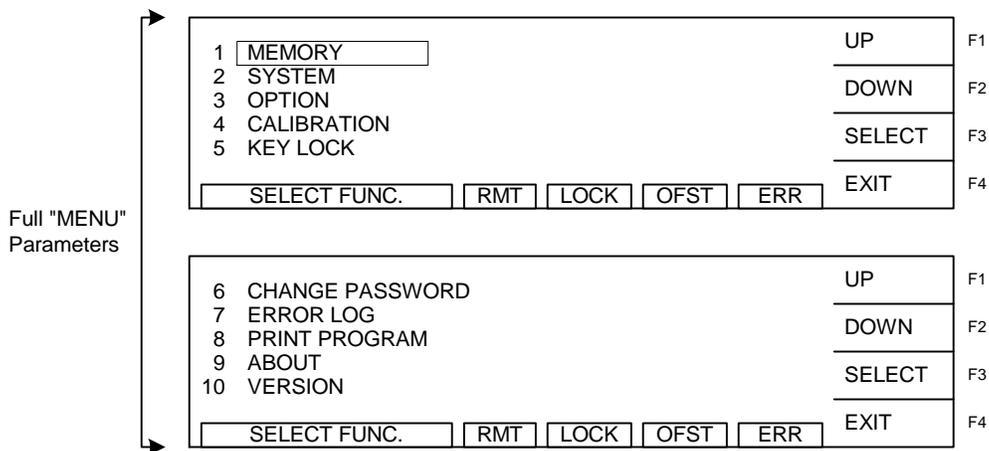


Figure 2-5: Contents of MENU

Table 2-5: MENU Parameters

MENU #	Parameter	Function
1	MEMORY	Store, Recall or Delete a test setup from instrument memory
2	SYSTEM	Change display contrast Change beeper volume Change PASS ON time
3	OPTION	Change RS232 settings Change IEEE-488 address Change Print Options
4	CALIBRATION	Enter instrument calibration routine Qualified service personnel only.
5	KEY LOCK	Lock out front panel program access.
6	CHANGE PASSWORD	Change key lock (user) password.
7	ERROR LOG	View status of remote errors.
8	PRINT PROGRAM	Prints programmed test setup
9	ABOUT	Instrument Manufacturer Information
10	VERSION	Instrument Software Information

2.6.1 MEMORY

Within the MEMORY function is the ability to STORE, RECALL or DELETE test setups to and from instrument memory. There are 99 memory locations available that may contain 1-99 steps each to a maximum block of 500. To access the MEMORY:

- Instrument in STAND BY status.
- Press [F3] = MENU
- **MEMORY** is backlit.
- Press [F3] = SELECT
- Display lists first 5 locations & respective contents of ‘MEMORY’
- Press [F1] = STORE to access the store function
- Press [F2] = DOWN to move highlighted box to the memory location (1-99) in which to store this test setup
- Press [F3] = SELECT to accept location number
- Press [F1] = UP to enter an alpha/numerical tag/name for this test step
- Press [F3] = ENTER after each digit to accept that digit and move on to the next. The tag can be up to 13 characters in length.
- When finished entering the numerical tag, press [F3] = ENTER two times.
- The display will prompt: STORE?
- Press [F1] = YES to accept storage or [F2] = NO to reject storage.
- Press [F4] = EXIT two times to return to “STAND BY” status.

NOTE:

With the front panel locked and lock recall OFF, the recall of memory locations can be performed directly from the STAND BY menu in place of [F1].

Example MEMORY and STORE Function:

1	MEMORY	UP	F1
2	SYSTEM	DOWN	F2
3	OPTION	SELECT	F3
4	CALIBRATION	EXIT	F4
5	KEY LOCK		
SELECT FUNC.		RMT	LOCK
		OFST	ERR

Enter MEMORY function

1	(5) 5 R	STORE	F1
2	(5) 0123456789ABC	RECALL	F2
3	(1) OFFSET	DELETE	F3
4	(0)	EXIT	F4
5	(0)		
SELECT FUNC.		RMT	LOCK
		OFST	ERR

STORE a test setup in memory location 1-99

1	(5) 5 R	UP	F1
2	(5) 0123456789ABC	DOWN	F2
3	(1) OFFSET	SELECT	F3
4	(0)	RETURN	F4
5	(0)		
SELE. MEMORY		RMT	LOCK
		OFST	ERR

Move highlighted box through memory locations 1-99

1	(5) 5 R	UP	F1
2	(5) 0123456789ABC	DOWN	F2
3	(1) OFFSET	SELECT	F3
4	(0)	RETURN	F4
5	(0)		
SELE. MEMORY		RMT	LOCK
		OFST	ERR

Select highlighted memory location and store previously programmed test setup

1	(5) 5 R	UP	F1
2	(5) 0123456789ABC	DOWN	F2
3	(1) OFFSET	SELECT	F3
4	(0)	ENTER	F4
5	(0)		
SELECT CHAR		RMT	LOCK
		OFST	ERR

Increase Digit: 0-9, A-Z
Decrease Digit: 0-9, A-Z
Accept Digit and Move Cursor Right

1			F1
2			F2
3			F3
4	(0) _0_	ENTER	F4
5			

Press 2 Times when finished naming memory location

1	(5) 5 R	YES	F1
2	(5) 0123456789ABC	NO	F2
3	(1) OFFSET	STORE?	F3
4	(1) 0123		F4
5	(0)		
PRESS YES/NO		RMT	LOCK
		OFST	ERR

STORE the setup

Press [F1] = YES to store the setup. Press [F4] = EXIT to return to Memory display. Press [F4] = EXIT to return to the STANDBY display. **Note:** the number in parenthesis (5) is the number of steps in that test setup.

The MEMORY RECALL and DELETE functions work the same way as STORE. When the instrument returns to STAND BY status there will be a tag “Mxx” in the upper left hand corner of the display to indicate which memory location is in use (displayed) as shown in Figure 2-6.

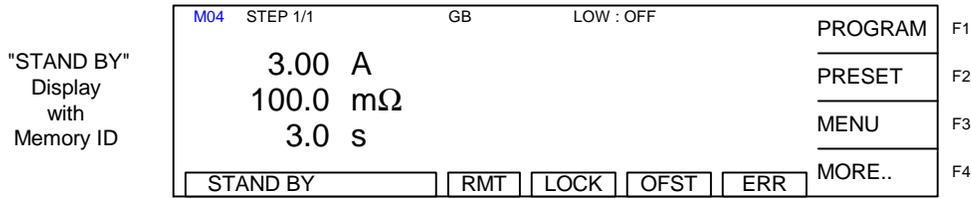


Figure 2-6: Memory Identification on STAND BY display

2.6.2 SYSTEM

Within the SYSTEM function are three programmable parameters: contrast, beeper volume and PASS ON. The contrast parameter adjusts the brightness of the LCD display. The range is 1-16 with 16 being the brightest and 1 the darkest. The initial default setting is 7. The beeper volume can be adjusted from low (soft) to medium (moderate) to high (loud) or it can be turned OFF. The initial default setting is high (loud). The time for PASS ON can be set to 0 for continuous operation or between 0.1 and 99.9 seconds for a halt time on a pass result.

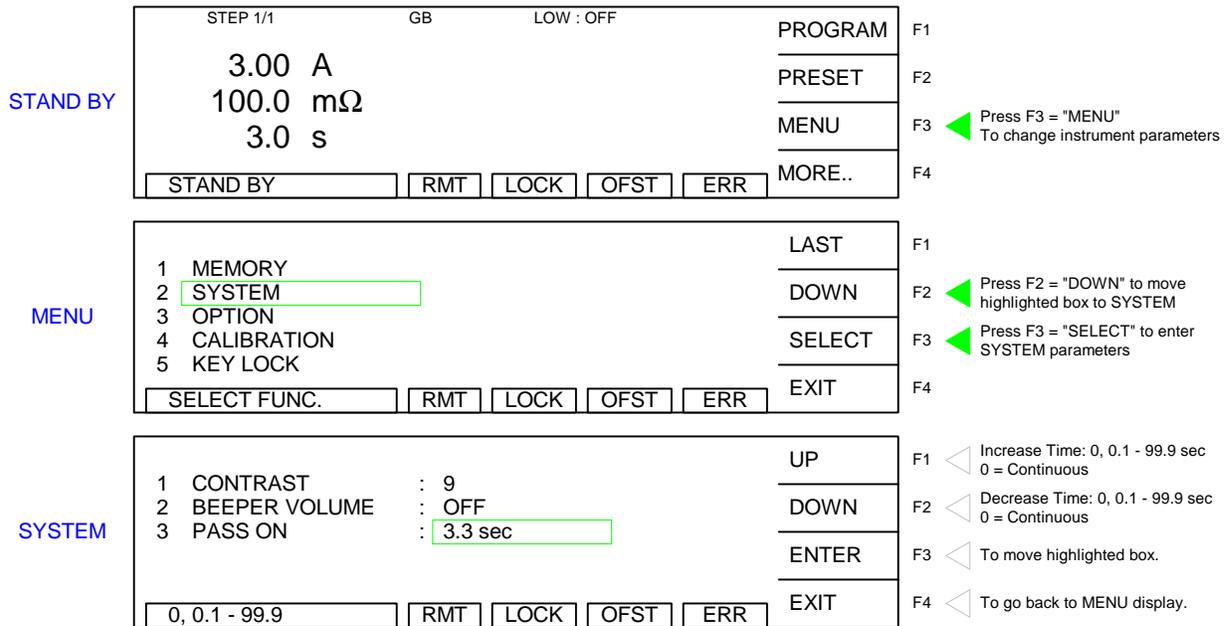


Figure 2-7: System Parameters

2.6.3 OPTION

Within the OPTION function are three programmable parameters: RS232, IEEE-488 and PRINTER. Within the RS232 function there are three programmable parameters: baud rate, parity and flow control. The baud rate is adjustable as 300, 600, 1200, 2400 4800, 9600 or 19200 bps. The initial setting is 9600. Refer to paragraph 3.2.2 for instructions on changing the RS232 parameters.

Within the IEEE-488 function there is one programmable function: GPIB address. The range for the IEEE-488 address is 0-30 and the initial instrument setting is 3.

Within the Print function there are seven programmable Parameters: Pass, Fail, Part No., Lot No., Serial No., Test Data, and Result. These parameters can be set to ON or OFF. The initial setting is OFF.

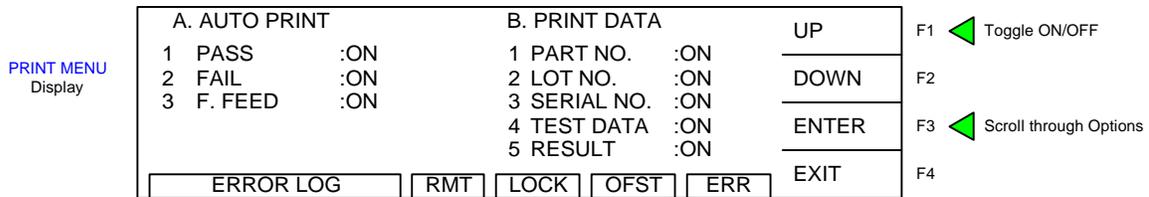


Figure 2-8: Print Option Menu

Print Option Detail

Auto Print

These two functions are used to determine when print data is desired. Both Pass and Fail can be turned ON to obtain data from all tests.

Pass: When selected ON, the G1050 will send data to the printer when the test result is a Pass.

Fail: When selected ON, the G1050 will send data to the printer when the test result is a Fail.

F. Feed: When selected ON, the printer paper will automatically form feed at the end of the print out.

This is used when one test result is desired per a page. If the printer is being used to log data and multiple tests are desired per a page, F. Feed should be set to OFF.

Print Data

These functions are used to determine what data is to be printed.

Part No.: When selected ON, the part number entered in the Preset section will print.

Lot No.: When selected ON, the lot number entered in the Preset section will print

Serial No.: When selected ON, the serial number entered in the Preset section will print

Test Data: When selected ON, the step #, mode, output voltage, measured current and result will print.

Result: When selected ON, the final Pass/Fail of all steps will print

Refer to paragraph “3.4 Printer Interface” for detail of print out.

2.6.4 CALIBRATION

The CALIBRATION function requires a password to enter the instrument routine. Only qualified service personnel with NIST traceable standards should perform instrument calibration. Refer to paragraph 4.3 for the Guardian 1050 calibration procedure.

2.6.5 KEY LOCK

To lock out the PROGRAM and PRESET functions of the Guardian 1050 instrument use the KEY LOCK function in the MENU parameters. The range of KEY LOCK is ON or OFF and the initial instrument setting is OFF. To activate the KEY LOCK function:

- Instrument in STAND BY status.
- Press [F3] = MENU
- Press [F2] = DOWN until **KEY LOCK** is backlit.
- Press [F3] = SELECT
- Display prompts 'PASSWORD'
- Press [A] [A] [A] [A] [ENTER]
- **NOTE: AAAA is the default password. If password has been changed use the new password.**
- Display prompts 'RECALL LOCK: YES'
- Press [F1] = YES to select KEY LOCK ON.
- **NOTE: Selecting YES means programmed tests cannot be recalled from memory.**
- The **LOCK** block at bottom of display is backlit.
- Press [F4] = EXIT to return to STAND BY status.
- PROGRAM and PRESET are no longer visible or functional.

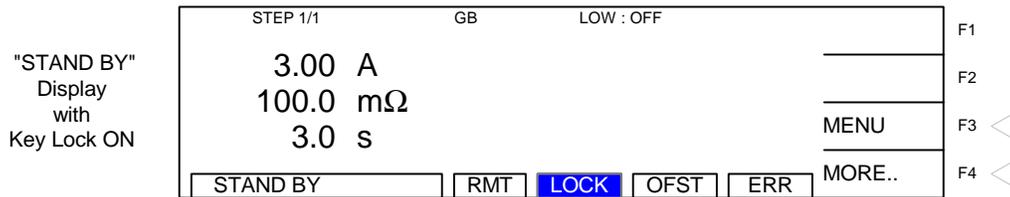


Figure 2-9: Key Lock Display

To disable the KEY LOCK function, repeat above steps.

2.6.6 CHANGE PASSWORD

The Guardian 1050 instrument has a password function for locking out the front panel so that the instrument PRESET settings and PROGRAM function are disabled. A separate password is used to perform instrument calibration. Refer to paragraph 4.3. The CHANGE PASSWORD function applies to the initial instrument password. To activate the CHANGE PASSWORD function:

- Instrument in STAND BY status.
- Press [F3] = MENU
- Press [F2] = DOWN until **CHANGE PASSWORD** is backlit.
- Press [F3] = SELECT
- Display prompts 'PASSWORD'
- Press [A] [A] [A] [A] [ENTER]
- Display prompts 'NEW PASSWORD'
- Press [B] [B] [B] [B] [ENTER]
- Display prompts 'CONFIRM'
- Press [B] [B] [B] [B] [ENTER]
- Display prompts 'CHANGE PASSWORD OK!! PRESS EXIT TO CONTINUE'.

2.6.7 ERROR LOG

The Guardian 1050 instrument has an Error Log to track communication errors when the IEEE-488 interface or RS232 interface is being used. Refer to paragraph 3.3.5 and Table 3-5 for a list of error message numbers and their respective description. When the **ERR** block on the bottom of the display is backlit, there is an error message. To view the contents of the error log:

- Instrument in STAND BY status.
- Press [F3] = MENU
- Press [F2] = DOWN until **ERROR LOG** is backlit.
- Press [F3] = SELECT
- Display lists the contents of the Error Log.

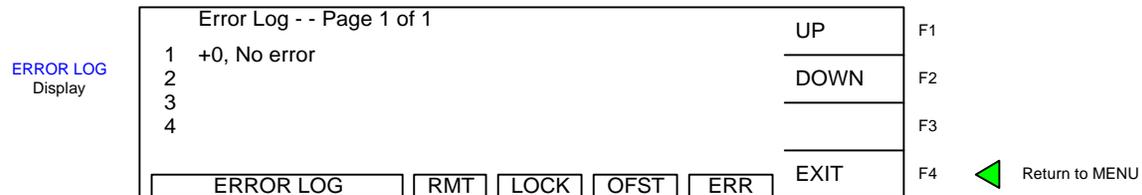


Figure 2-10: ERROR LOG Display

The queue will clear itself once the log has been viewed.

2.6.8 PRINT PROGRAM

When the G38 printer card is installed in the G1050 instrument, then this option can be selected. When F3 “Select” is pressed, the Guardian 1050 instrument will send the programmed test setup to the printer. Refer to paragraph 3.4 “Printer Interface” for detail of the print out.

- Instrument in STAND BY status.
- Press [F3] = MENU
- Press [F2] = DOWN until **PRINT PROGRAM** is backlit.
- Press [F3] = SELECT
- Display lists the Print Option Menu. Refer to paragraph 2.13.3.

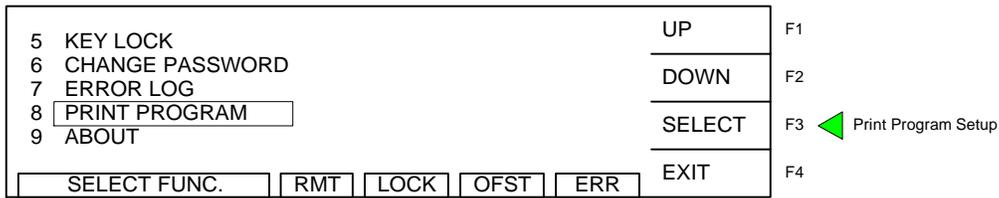


Figure 2-11: Select Print Program

2.6.9 ABOUT

The Guardian 1050 instrument has a parameter labeled ‘About’. This parameter lists the instrument manufacturer, software version and date. To view the contents of ABOUT:

- Instrument in STAND BY status.
- Press [F3] = LOCAL (appears when GPIB installed and in use)
- Press [F3] = MENU
- Press [F2] = DOWN until **ABOUT** is backlit.
- Press [F3] = SELECT
- Display lists the contents of ABOUT.

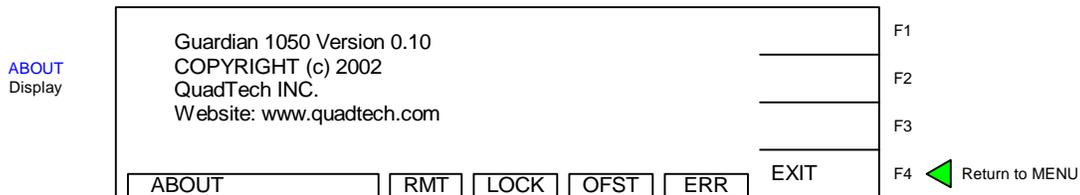


Figure 2-12: ABOUT Display

2.6.10 Version

The Guardian 1050 instrument has a parameter labeled 'Version'. This parameter lists the instrument software information to date. To view the contents of VERSION:

- Instrument in STAND BY status.
- Press [F3] = MENU
- Press [F2] = DOWN until **VERSION** is backlit.
- Press [F3] = SELECT
- Display lists the contents of VERSION.

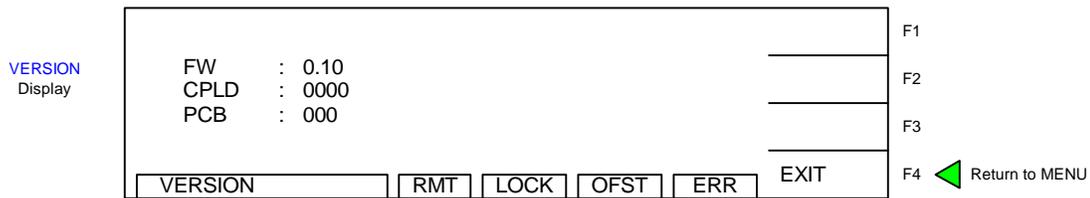


Figure 2-13: Version Display

2.7 Instrument Offset

The Guardian 1050 instrument provides automatic offset for lead and/or fixture effects. During the offset process a correction is made (subtracted out) as the result of lead resistance up to 100mΩ and is applied to ongoing measurements. For maximum measurement accuracy it is recommended that the OFFSET function be performed on the G1050 instrument after power up, any time the test parameters are changed and any time the test leads or fixture is changed. The offset will store in memory with each test program. Performing offset prior to saving a program in memory is recommended.

Prior to performing the OFFSET function:

- Allow the instrument to warm up for 15 minutes.
- Connect the Test cables (or fixture) to the output terminals.
- Program the test steps.

With the instrument in STAND BY status:

- Press [F4] = MORE
- Press [F3] = OFFSET
- Follow instructions on display: i.e.: connect SHORT across output terminals.
- Press green [START] button.
- Wait while instrument gets OFFSET value.
- The **OFST** block at the bottom of the display is now highlighted (back lit).
- Press [F4] = MORE to return to STAND BY status.

To undo the OFFSET function:

- Press [F3] = OFFSET
- Follow prompt on display: “Turn off the offset function?”
- Press [F3] = ENTER to turn **off** OFFSET function.
- The **OFST** block at the bottom of the display is **not** highlighted now.

The following formula applies to the offset function:

$$\text{Display Resistance} = (\text{Measured Resistance}) - (\text{Offset Resistance})$$

OFFSET Function - Illustrated

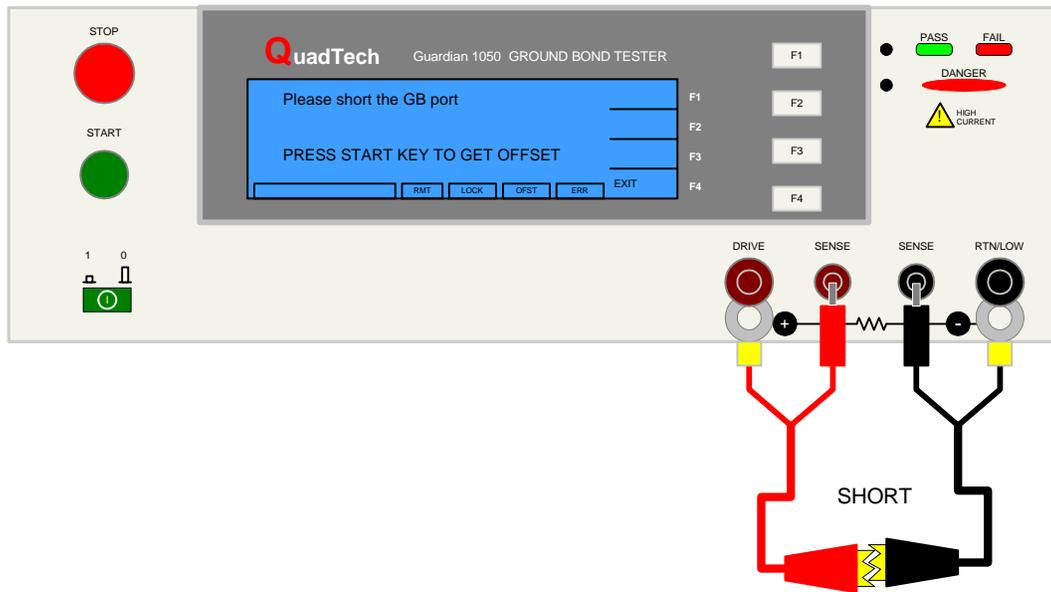


Figure 2-14: Test Leads Shorted for OFFSET function

The offset function menus are illustrated herein starting with the instrument in STANDBY display. Press [F4] = MORE. Press [F3] = OFFSET. Short the test cables. Press [START]. Press [F4] = MORE to exit the offset function and return to standby status.

"STAND BY" Display	STEP 1/1	GB	LOW : OFF	PROGRAM	F1	◁	To enter programming mode.
	3.00 A			PRESET	F2	◁	To view/change preset (initial) test parameters.
	100.0 mΩ			MENU	F3	◁	To view/change system parameters: memory, system, option, calibration, key lock, password, error, & about.
	3.0 s			MORE..	F4	▶	To view the programmed test setups and access offset function.
	STAND BY	RMT	LOCK	OFST	ERR		
"MORE.." Display	CURRENT MEASURE			UP	F1		
	1	GB	3.00A 100.0mΩ	DOWN	F2		
	P/N :	GUARDIAN		OFFSET	F3	▶	To enter OFFSET function
	L/N :	50		MORE..	F4		
	S/N :	AAP19572001					
	STANDBY	RMT	LOCK	OFST	ERR		
OFFSET Display	Please short the GB port.				F1		
	PRESS START KEY TO GET OFFSET				F2		
					F3		
	EXIT				F4	◁	To exit OFFSET function
		RMT	LOCK	OFST	ERR		
OFFSET Result	CURRENT MEASURE			UP	F1	◁	Go to Step 2 to perform OFFSET
	1	GB	3.02A 0.9mΩ P	DOWN	F2		
	P/N :	GUARDIAN		OFFSET	F3	▶	Get OFFSET for Step 2
	L/N :	50		MORE..	F4	▶	EXIT OFFSET function
	S/N :	AAP19572001					
	TIME :	0.3s					
	PASS	RMT	LOCK	OFST	ERR		
STANDBY OFFSET ON	STEP 1/1	GB	LOW : OFF	PROGRAM	F1		
	3.02 A			PRESET	F2		
	0.9 mΩ			MENU	F3		
	0.1 s			MORE..	F4		
	PASS	RMT	LOCK	OFST	ERR		

2.8 Connection to Device under Test

Figure 2-15 illustrates the connection of the Guardian 1050 unit to a single DUT using the G15 cable set that comes standard with the instrument. The red banana/spade/alligator clip is connected between the DRIVE+/SENSE+ terminals on the G1050 unit and the high side of the device under test. The black banana/spade/alligator clip is connected between the SENSE-/RTN/LOW terminals on the G1050 Series unit to the low side of the DUT.

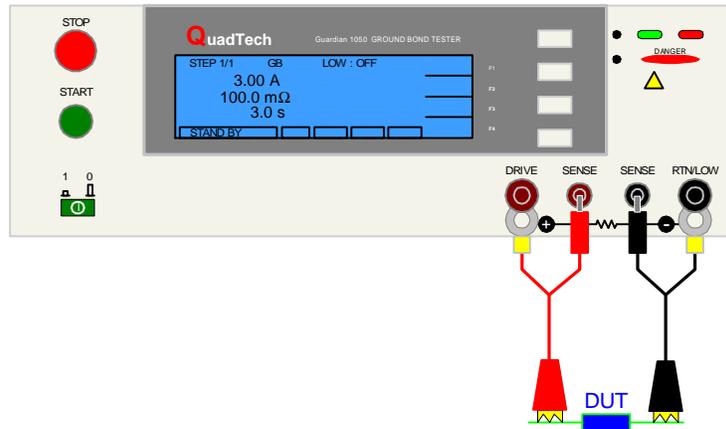


Figure 2-15: G15 Cable Connection

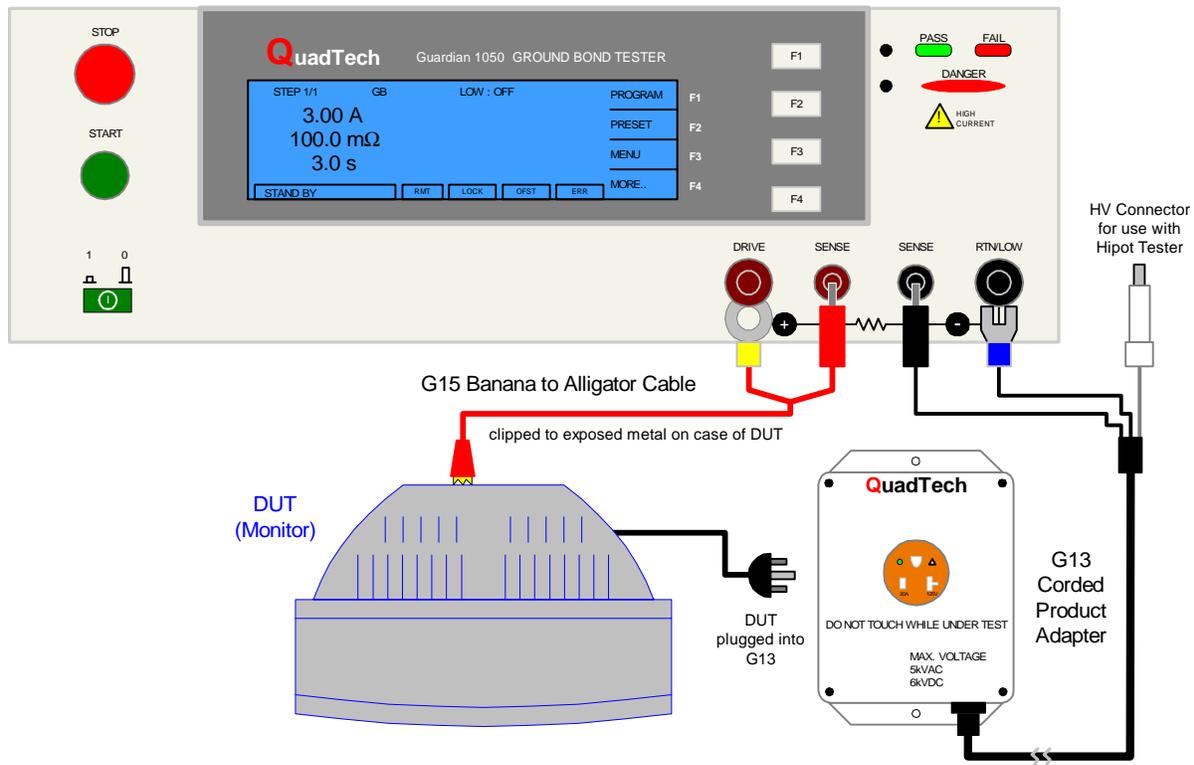


Figure 2-16: G13 Corded Product Adapter

2.9 Measurement Procedure

Before a measurement is made verify the following:

1. Guardian 1050 instrument [POWER] ON.
2. 15-minute warm-up.
3. Test parameters programmed and shown on STAND BY display.
4. Test cables or fixture connected.
5. Offset Function initiated.
6. Device under test connected.

The operator has the option of performing a test at power-up conditions (test conditions at which the instrument was last powered down) or recalling one of 99 stored test setups. Refer to paragraph 2.3 for programming instructions and paragraph 2.6.1 storage/recall instructions.

To initiate a test:

- Press [STOP] to make sure instrument is in STAND BY status.
- Press [START]. DANGER led flashes. Status window shows UNDER TEST.
- The test current is shut **off** when all test steps are completed,
- **OR** when a test result is judged a FAIL per programmed test limits,
- **OR** when the [STOP] button is pressed.
- Press [STOP] at any time to terminate the output current and stop the test.

To view the test results, press [F4] = MORE to go to the tabular display. Use the UP/DOWN key to scroll to the next page.

NOTE: Exiting the tabular display will clear your test results.

The Guardian 1050 instrument judges the measurement value as GOOD or NO GOOD. A GOOD judgment means the DUT passed all programmed steps. Upon completion of the test the output voltage is terminated and the display shows PASS. The rear panel PASS signal is functional and the buzzer sounds (if not turned OFF in SYSTEM parameters under MENU).

If the measurement value of the test (or any one step of the test) is abnormal, the DUT is judged as NO GOOD, the display will show FAIL and the buzzer will sound until the [STOP] button is pressed. Press [STOP] at any time to terminate the output voltage and stop the test.

NOTE: Pressing STOP twice will clear your test results.

Error Messages (FAIL result)

When the measurement value was judged NO GOOD and FAIL is shown on the display, an error message denoting the test result will be shown on the display also. Table 2-4 lists the possible error messages for a NO GOOD/FAIL judgment.

Table 2-4: Error Messages

Error Message	Description
HI	Measured resistance is over the programmed high limit.
LO	Measured resistance is below the programmed low limit.
IO	Hardware failure: cannot detect test signal.
ADV OVER	Voltage/Current reading is greater than the allowable # of digits.
ADI OVER	Current/Resistance reading is greater than the allowable # of digits.
SOME FAILS	At least 1 of the steps in the program failed.

Section 3: Interface

3.1 Remote

A 9-pin D-Series remote control connector is located on the rear panel of the Guardian 1050 instrument. There is a black 11 screw terminal strip for the remote output signals: UNDER TEST, PASS & FAIL and the remote inputs: START, RESET, COM AND INTERLOCK.

Inputs require a contact closure and outputs provide a contact closure. Figure 3-1 illustrates the Remote terminal strip connector and 9-pin D-Series connector.

Before connecting the instrument to its power source, the interlock function on the rear panel remote connector (terminal strip) must be properly utilized. This is an important safety feature for the protection of the operator. When the INTERLOCK jumper is removed, there is **no** high current at the OUTPUT. Therefore, to initiate a test make sure the interlock jumper is in place.

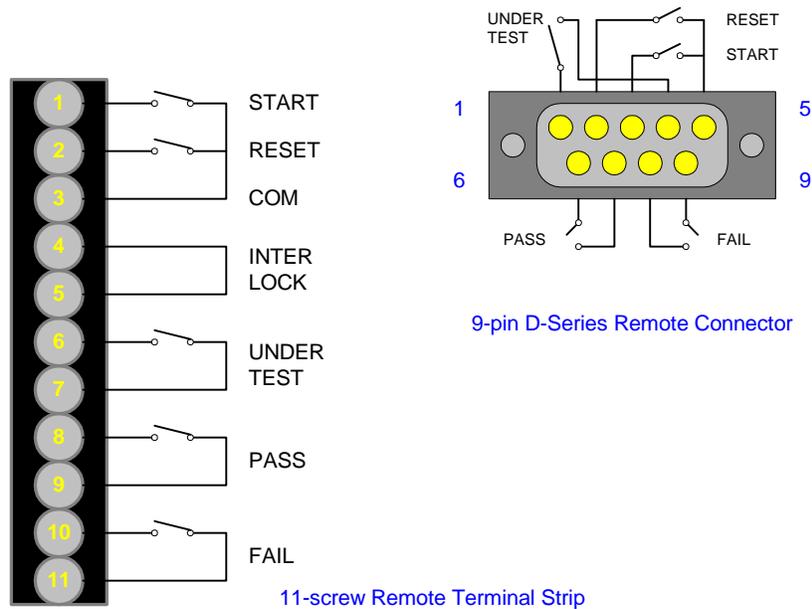


Figure 3-1: Guardian 1050 Remote Connectors

The Guardian 1050 instrument has three output signals on the rear panel. The UNDER TEST relay is closed during a test. The PASS relay is closed when the DUT is judged GOOD. The FAIL relay is closed when the DUT is judged NO GOOD. These relays are rated for voltage up to 30VAC and 60VDC and current <0.3A.

Figures 3-2 and 3-3 illustrate possible remote control connections to the Guardian 1050 terminal strip. Use extreme care when using a remote control connection as the high current output is being turned ON and OFF with an external signal.

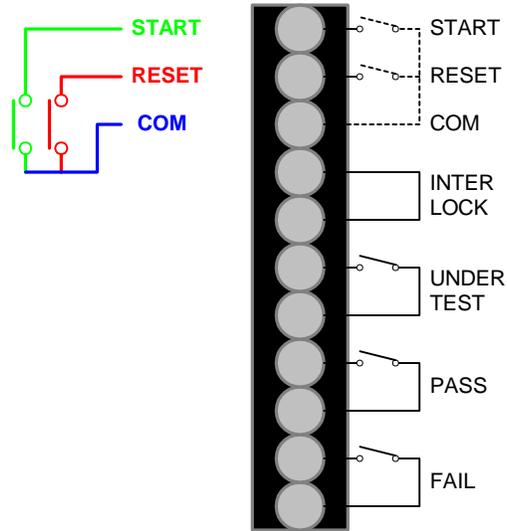


Figure 3-2: Single Control of START or RESET

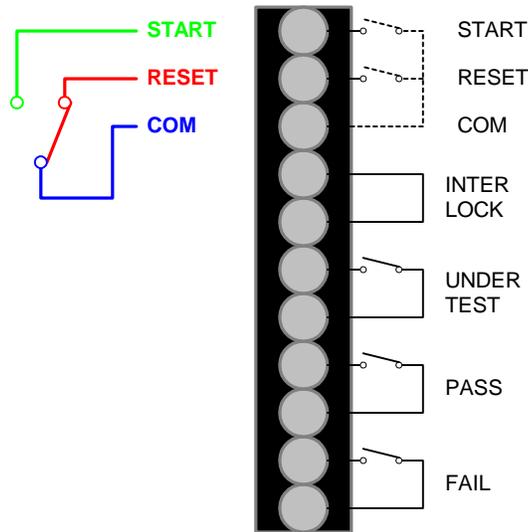


Figure 3-3: Continuous Control of RESET

START and RESET terminals have unregulated 24VDC present. To initiate a test connect the START and COM terminals. To terminate a test connect the RESET and COM terminals. The input time duration is approximately 20 milliseconds. The above circuits are not isolated from other internal circuits. To terminate a test connect the RESET and COM terminals.

Figure 3-4 illustrates the timing diagram for the Guardian 1050 instrument under a PASS condition and a FAIL condition.

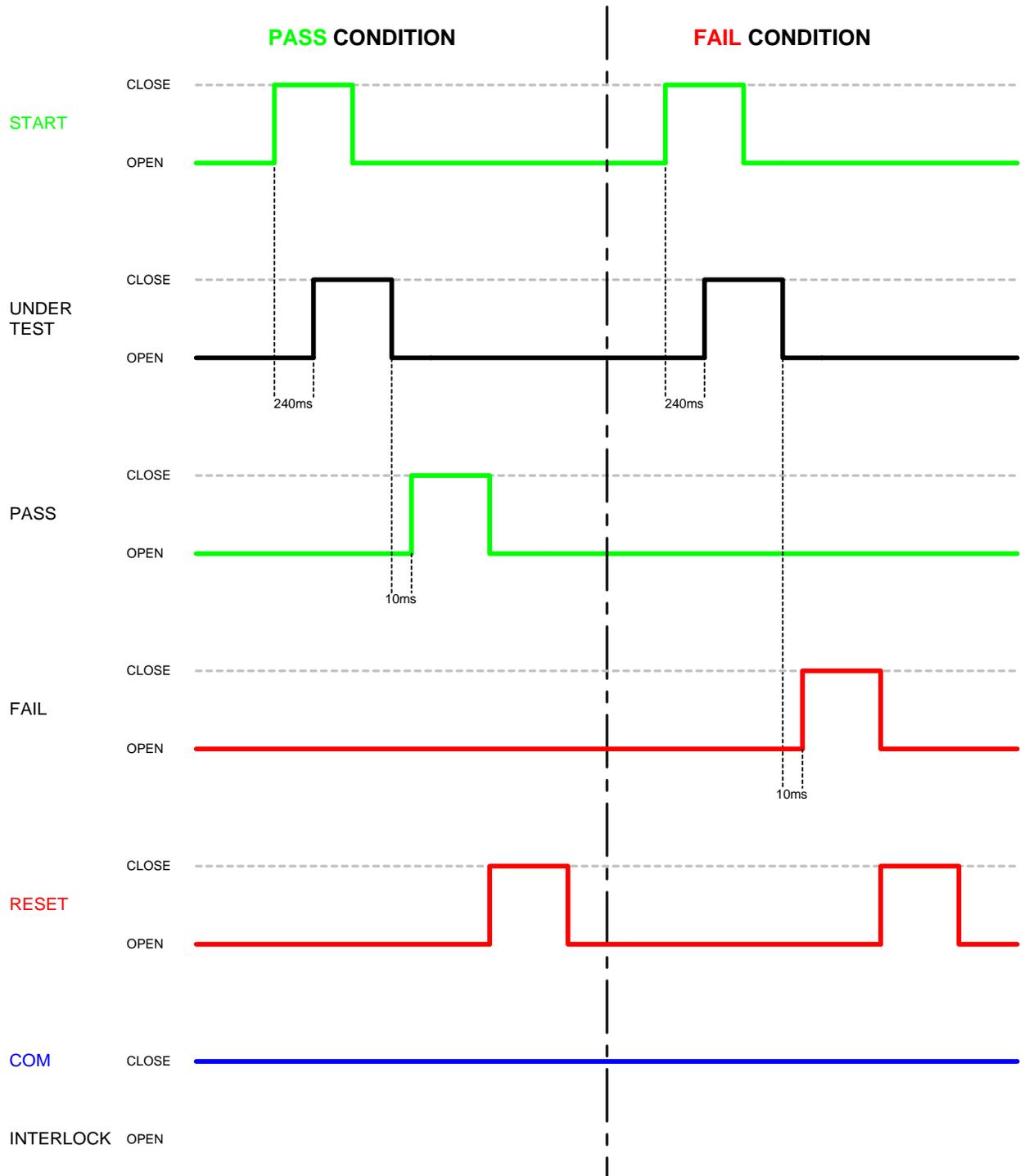


Figure 3-4: Guardian 1050 Timing Diagram

3.2 RS232 Interface

3.2.1 Pin Configuration

The Guardian 1050 instrument has an optional RS232 Interface for remote operation. Connection is through the silver 9-pin connector labeled 'RS232' on the rear panel of the Guardian 1050 instrument. Figure 3-5 illustrates the designation of the pins on the RS232 connector. The connection cable must be a **'straight through'** cable for the G1050 unit to communicate.

NOTE

When the RS232 Interface and the IEEE-488 Interface are both installed in a Guardian 1050 instrument, only **one** of the two interfaces may be activated at a time.

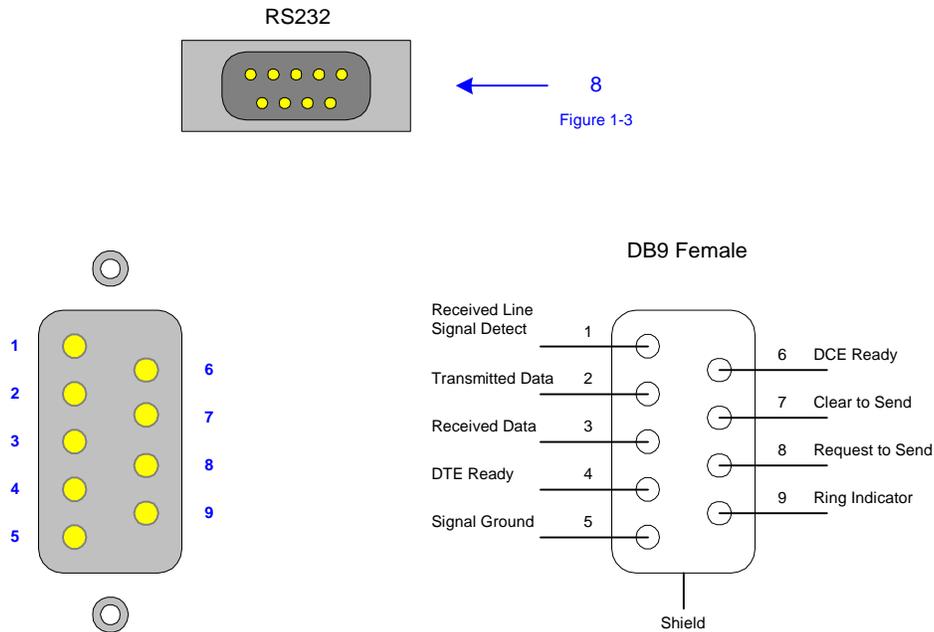


Figure 3-5: RS232 Pin Configuration

When the **ERR** box is backlit on the bottom of the display, there are error messages in the queue. Refer to paragraph 3.3.5, Table 3-7 for explanation of error messages.

3.2.2 RS232 Specifications

Data Bits:	8
Stop Bits:	1
Parity:	None, Odd, Even
Baud Rate:	0.3/0.6/1.2/2.4/4.8/9.6/19.2(k) Software selectable
EOS:	LF or CR + LF
Echo:	Off

Selecting the Baud Rate, Parity and Flow Control

Setting the Baud Rate is done in the OPTION function under MENU settings:

- From the STAND BY display, press [F3] = MENU.
- Press [F2] = DOWN two times to highlight **OPTION**.
- Press [F3] = SELECT to enter OPTION function.
- Press [F3] = SELECT to select RS232 function.
- Display shows “1. BAUD RATE : **9600**” with rate highlighted.
- Press [F1] = UP to select baud rate.
- Press [F4] to EXIT
- **OR**
- Press [F3] = ENTER to change the parity.
- Display shows “2. PARITY : **ODD**” with parity bit highlighted.
- Press [F1] = UP to select parity.
- Press [F4] to EXIT
- **OR**
- Press [F3] = ENTER to change the flow control.
- Display shows “3. FLOW CTRL. : **NONE**” with parity bit highlighted.
- Press [F1] = UP to select software flow control or no flow control.
- Press [F4] to EXIT

The software flow control allows the RS232 interface to control the intake of data so the amount of data will not overload the I/O. Flow control of an RS232 interface is similar to DAV (Data is available and valid on data lines) on an IEEE interface.

3.2.3 RS232 Commands

The command set for the RS232 interface is the same as the IEEE-488 interface command set listed in paragraphs 3.3.3 through 3.3.5 of this instruction manual.

NOTE

CR + LF are necessary end codes for the RS232 commands.

There are additional RS232 only commands on the following page.

Additional RS232 Commands

Some commands for RS232 use only are listed here. These commands follow the SCPI version 1999.0.

```
:SYSTem:LOCK:RELease ==> Change statue to local, as GPIB Go To Local.  
:SYSTem:LOCK:REQuest? ==> Change statue to Remote, return '1' if successful.  
:SYSTem:LOCK:OWNer? ==> Query the statue.  
:SYSTem:LOCK <Boolean> ==> As GPIB Local Lockout.  
:SYSTem:LOCK? ==> Query the Key Lock status.
```

3.2.4 Sample QuickBasic Program

Sample programs can also be located on <http://www.quadtech.com/resources>.

```
Rem This is a simple program for the Guardian 1050 GB Tester  
Rem This is for RS232 communication and reads *idn from G1050  
Rem You must use a straight through cable  
Rem You must enable RS232 interface in System Setup menu of G50  
Rem baud rate = 9600  
Rem to change com1, com2 in OPEN statement depending upon your computer
```

```
Print "Calculating Delay Loops ....."  
Rem delay correction routine  
q = 1  
Do While Environ$(q) <> ""  
  If Left$(Environ$(q), 7) = "MACHINE" Then  
    qq = q  
    mn = Val(Right$(Environ$(q), 1))  
    mn$ = Right$(Environ$(q), 1)  
  End If  
  q = q + 1  
Loop  
error1:  
t1 = Timer  
s = 0  
For i = 1 To 30000  
Next i  
t2 = Timer  
k = t2 - t1  
If k = 0 Then GoTo error1  
k2 = 40000 / k
```

```

Rem ask for com port number and open com port as #1
goodcom:
Cls
Print ""
Print ""
Print "Enter Com Port Number (1 or 2)"
INPUT com$
If Val(com$) < 1 Then GoTo goodcom
If Val(com$) > 2 Then GoTo goodcom

Open "COM" + com$ + ":9600,n,8,1,cs,ds" For Random As #1:

INPUT "filename"; ans3$           'get file name to store data
Open ans3$ For Output As #2       'open #3 as file to store data

Rem Get identification string from G50
For j = 1 To k2: Next j
Print #1, "*idn?"; Chr$(13); Chr$(10)
For j = 1 To k2: Next j
GoSub cget
r45$ = Input$(x, #1)
Print "Identification String is;"
Print r45$
Print ""
Print ""
Print "Enter number of measurements to make"
INPUT nummeas

For i = 1 To nummeas
Print #1, "source:safety:stop"; Chr$(13); Chr$(10)
For j = 1 To k2: Next j
Print #1, "source:safety:start"; Chr$(13); Chr$(10)
For j = 1 To k2: Next j

contmeas:

Print #1, ":Source:safety:result:complete?"; Chr$(13); Chr$(10)
GoSub cget
r45$ = Input$(x, #1)

If Val(r45$) = 0 Then GoTo contmeas

```

```

Print "Measurement" + Str$(i)

Print #1, ":Source:safety:result:all?"; Chr$(13); Chr$(10)
GoSub cget
jdg$ = Input$(x, #1)

Print #1, ":Source:safety:result:all:omet?"; Chr$(13); Chr$(10)
GoSub cget
omet$ = Input$(x, #1)

Print #1, ":Source:safety:result:all:mmet?"; Chr$(13); Chr$(10)
GoSub cget
mmet$ = Input$(x, #1)

Print mmet$
Print omet$
Print jdg$

Print #2, mmet$
Print #2, omet$
Print #2, jdg$

Next i

Close #1
Close #2
Print "End of Program"
End

cget:
' subroutine to get serial input loop until first character is received
Do While (Loc(1) = 0)
For j = 1 To k2: Next j
  Loop
' then get the rest of the string
y = x + Loc(1)
Do While (x <> y)
y = x
For j = 1 To k2 / 10: Next j
x = Loc(1)
Loop
'PRINT x
Return

```

3.3 IEEE-488 Interface

3.3.1 Pin Configuration

The Guardian 1050 instrument has an optional IEEE-488 interface that is factory installed when the instrument is ordered. Connection is through the blue 24-pin connector labeled 'OPTION' on the rear panel of the Guardian 1050 instrument. This interface can be used to connect a system containing a number of instruments and a controller in which each meets IEEE Standard 488.2 (Standard Digital Interface for Programmable Instrumentation). Figure 3-6 illustrates the designations of the pins on the IEEE-488 connector.

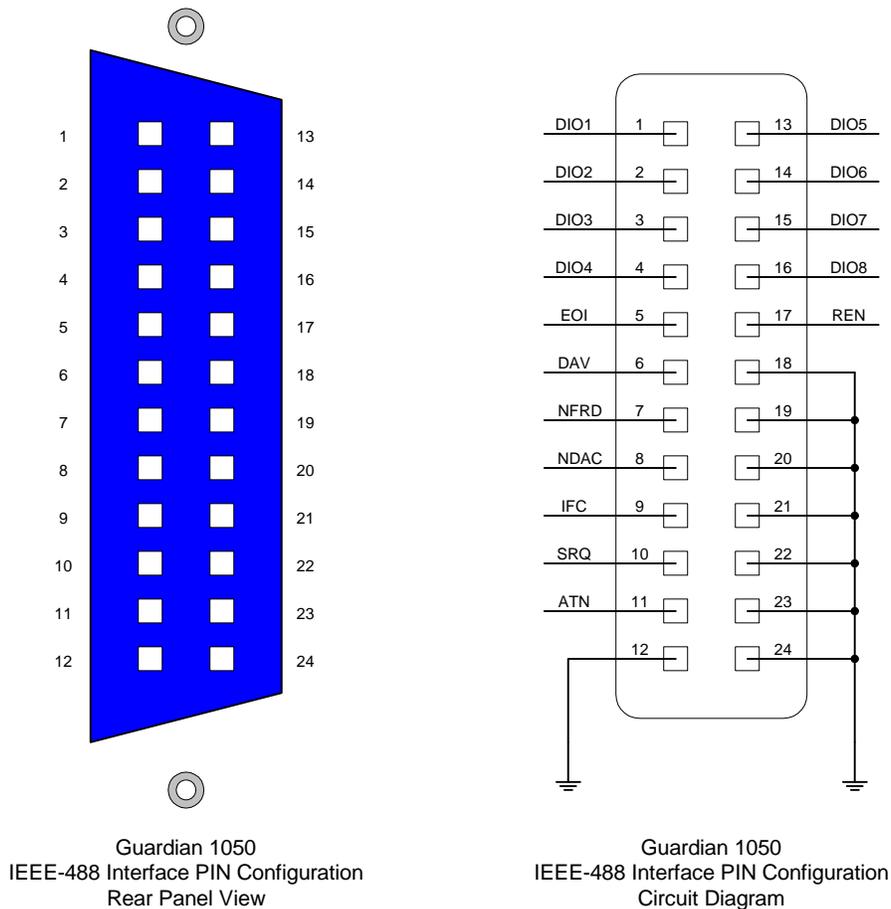


Figure 3-6: IEEE-488 Interface Pin Configuration

Table 3-1 lists the IEEE-488 Interface pin designations by pin number, signal name and pin function.

Table 3-1: IEEE-488 Interface Pin Designations

Signal Name	Pin Number	Function
DAV	6	Low State: "Data is Available" and valid on DI01 through DI08
NRFD	7	Low State: At least one Listener on the bus is "Not Ready For Data"
NDAC	8	Low State: At least one Listener on the bus is "Not Accepting Data"
ATN	11	"Attention" specifies 1 of 2 uses for the DI01 through DI08 lines: Low State: Controller command messages High State: Data bytes from the Talker device
IFC	9	"Interface Clear" Low State: Returns portion of interface system to a known quiescent state
SRQ	10	"Service Request" Low State: A Talker or Listener signals (to the controller) need for attention in the midst of the current sequence of events.
REN	17	"Remote Enable" Low State: Enables each device to enter remote mode when addressed to listen. High State: All devices revert to Local control.
EOI	5	"End of Identify" If ATN is in HIGH state, then EOI LOW state indicates the end of a multiple-byte data transfer sequence. If ATN is in LOW state, then EOI LOW state indicates a parallel poll.
DI01	1	The 8-Line Data Bus. If ATN is in LOW state, then the bus conveys interface messages. If ATN is in HIGH state, then the bus conveys device-dependent messages. (Example: carries remote control commands from the controller or from a talker device)
DI02	2	
DI03	3	
DI04	4	
DI05	13	
DI06	14	
DI07	15	
DI08	16	

3.3.2 IEEE-488 Interface Codes and Messages

The IEEE-488 (GPIB) address is defined under the MAIN MENU in the OPTION MENU. Press [MAIN MENU] then the numerical key [2] to enter the OPTION MENU. Press function key [F2] to enter the GPIB SETUP menu. To select a new IEEE-488 address, use the function keys

The Guardian 1050 unit is in a remote control status when the **RMT** block on the bottom right hand side of display is backlit.

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

Table 3-2 defines the IEEE-488 interface codes and their function. Table 3-3 defines the IEEE-488 interface messages and their function.

Table 3-2: IEEE-488 Interface Functions

Code	Function
SH1	Source Handshake
AH1	Acceptor Handshake
T4	Basic Talker Function
L4	Basic Listener Function
SR1	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

Table 3-3: IEEE-488 Interface Messages

Interface Message	Function	Description
GTL	Go To Local	Switch unit to local
SDC	Selected Device Clear	Reset the unit
LLO	Local Lockout	Disables [LOCAL] switch to local
IFC	Interface Clear	Reset IEEE-488 bus interface

3.3.3 IEEE-488 Interface Commands

The interface function is controlled by ASCII commands that include:

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

The maximum string length is consists of 1024 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 in Table 3-4.

Table 3-4: IEEE-488 Interface Ending Codes

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

NOTE

The data can be sent out by the IEEE-488 interface to achieve transfer function. The data command is {string message + ending code}. The ending codes are listed in Table 3-4.

NOTE

CR + LF are necessary ending codes for the RS232 Commands.

3.3.3.1 IEEE-488 Register Assignments

Table 3-5 lists the bit assignments for the Summary and Event registers. The configuration of these registers is illustrated in Figure 3-7.

Table 3-5: Summary Status & Event Status Registers

Summary Status Register			Event Status Register		
Bit	Decimal Value	Use	Bit	Decimal Value	Use
0	1	Not Used	0	1	Operation Complete
1	2	Has Result	1	2	Not Used
2	4	Error/Event Queue	2	4	Query Error
3	8	Not Used	3	8	Device Error (No device contact)
4	16	Message Available	4	16	Execution Error (Over Range, etc.)
5	32	Summary Standard Event Status Register	5	32	Command Error (Syntax)
6	64	Request Service	6	64	Not Used
7	128	Not Used	7	128	Power ON

3.3.3.2 IEEE-488 Register Configuration

Figure 3-7 illustrates the configuration of the Summary (Status), Event and Enable Registers for the Guardian 1050 IEEE-488 Interface.

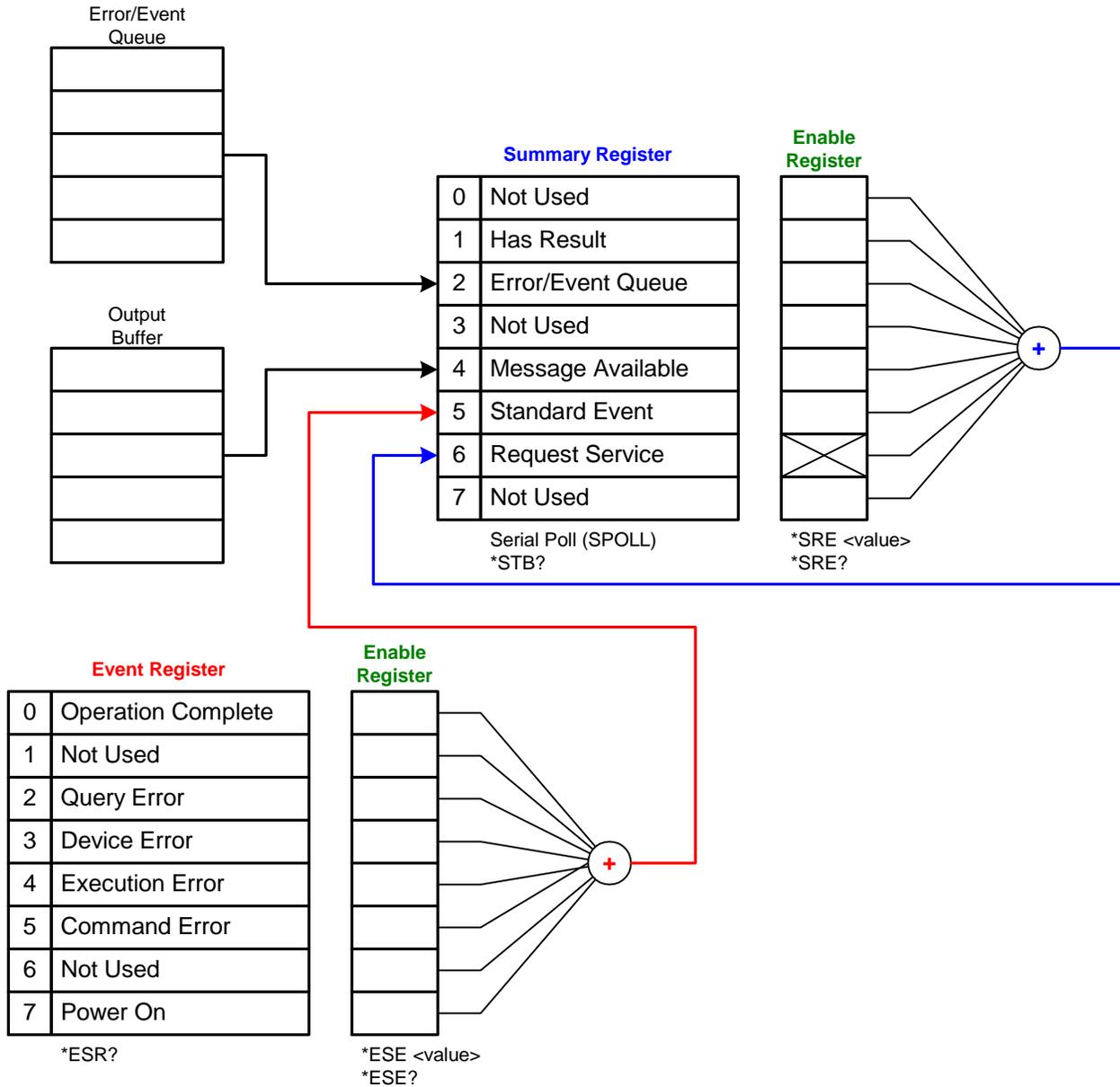


Figure 3-7: Guardian 1050 IEEE-488 Register Configuration

Table 3-6: IEEE-488 Commands

Command	Name	Function	Output Format
*CLS	Clear Status	Clear standard event status register. Clear status bit group register except for bit 4 (MAV)	
*ESE	Event Status Enable	Enable standard event status register value.	0 – 255
*ESE?	Event Status Enable	Query standard event status of device enable register	0 – 255
*ESR?	Event Status Register	Query standard event register value of device. After this command, the standard register is cleared to 0.	0 – 255
*SRE	Service Request Enable	Enable service request register value.	0 – 255
*SRE?	Service Request Enable	Query/Read service request register value.	0 – 255
*STB?	Status Byte Register	Query/Read status byte register value	0 – 255
*OPC	Operation Complete	Operation is complete.	
*OPC?	Operation Complete	Query operation complete.	1
*PSC 0 1	Power On	Clear status of Power On	
*PSC?	Power On	Query Power On.	1 or 0
*IDN?	Identification	Query/Read basic device data. (A comma separates the identification fields.)	4 ID: Manufacturer, Device Model, Serial Number, Firmware Version
*SAV	Save	Save current status to memory.	1 – 99
*RCL	Recall	Recall saved status from memory.	1 – 99
*RST	Reset	Reset instrument.	

3.3.4 IEEE-488 & SCPI Command Summary

The SCPI (Standard Commands for Programmable Instruments) parameter syntax format is listed in order of precedence. The dual arrow symbol “<>” denotes the defined parameter is a standard SCPI command. The symbol “<numerical value>” denotes the metric system value. The symbol “<boolean>” denotes the Boolean equation data and its value is 0 or 1. The vertical line “|” denotes the OR parameter. When sending the G1050 unit a decimal number it is necessary to have a zero before the decimal point. Example: DC: LIMit: HIGH: 0.004

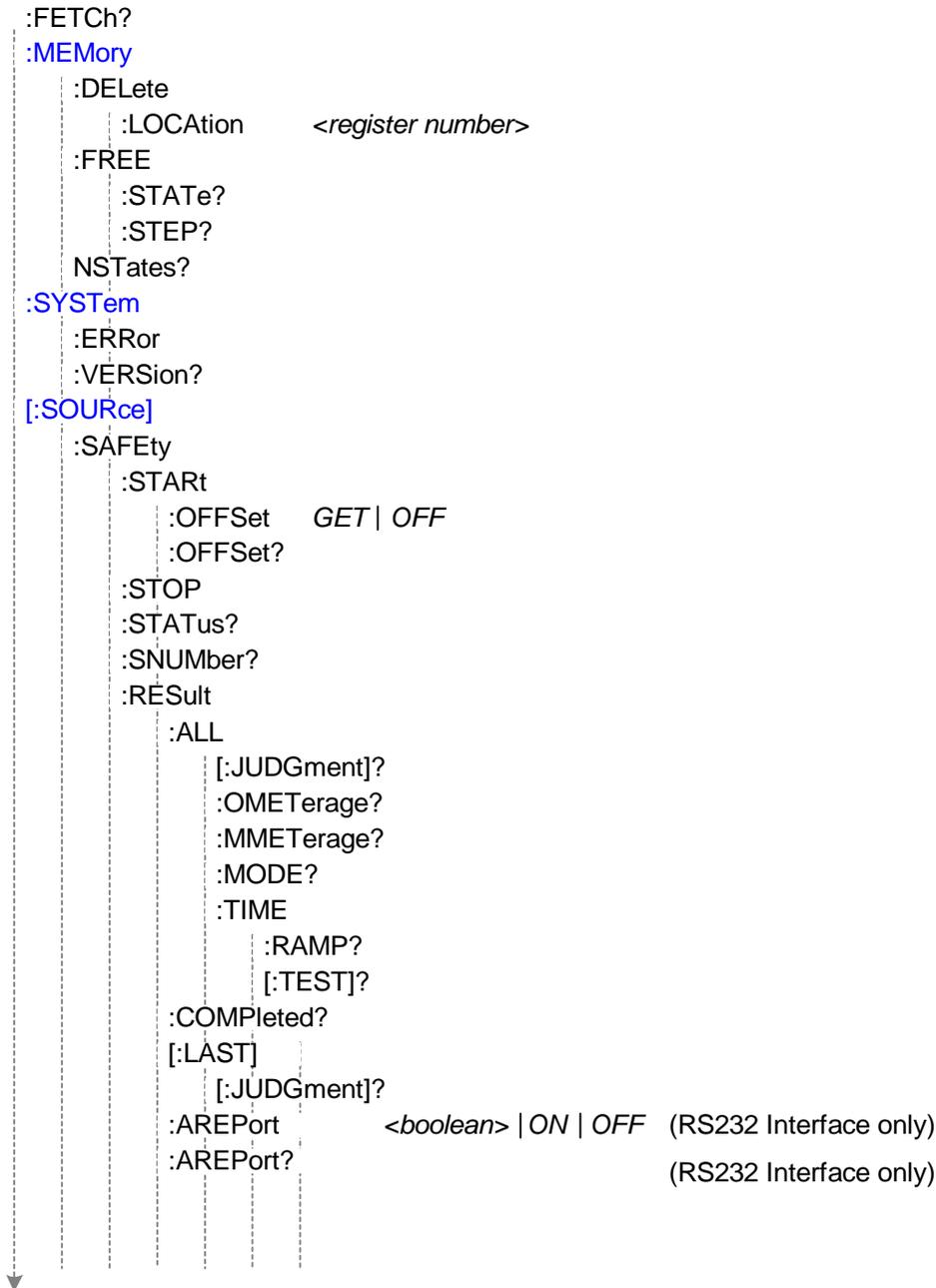


Figure 3-8a: SCPI Command Structure

SCPI Command Structure - continued

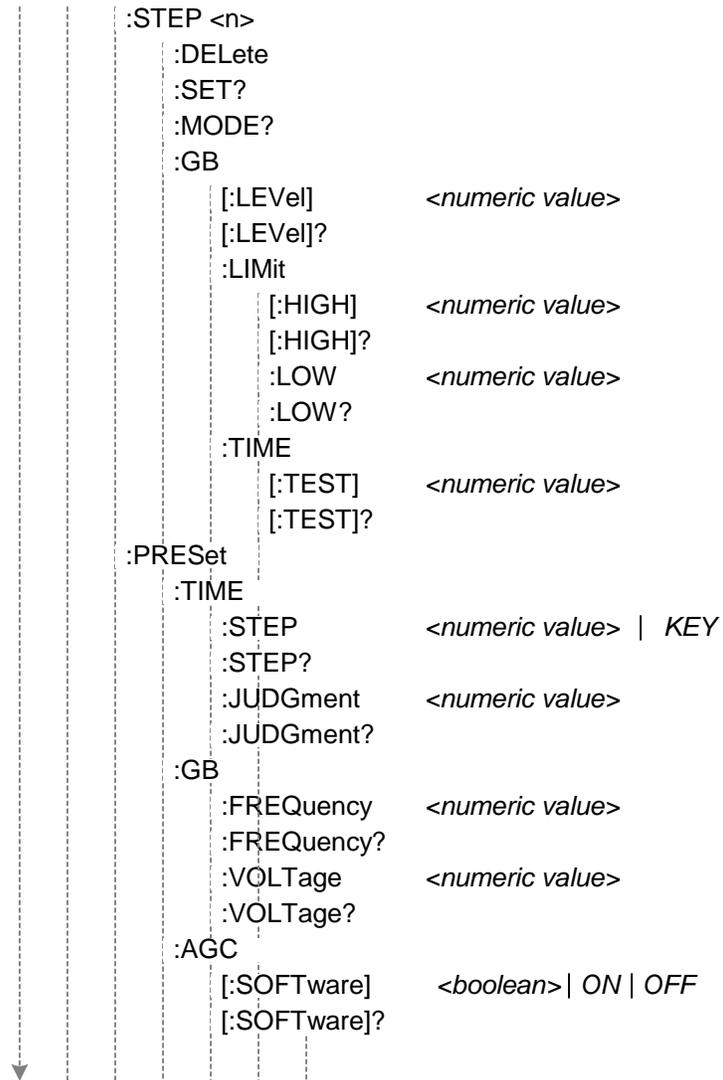


Figure 3-8b: SCPI Command Structure

:MEMory

:DELeTe

LOCAtion <register number>

Command: :MEMory:DELeTe:LOCAtion

This command deletes the data in the defined location.

:FRee

:STATe?

Command: :MEMory:FRee:STATe?

Return Value: 99,1

This command queries the availability of free memory.

:STEP?

Command: :MEMory:FRee:STATe:STEP?

Return Value: 499,1

This command queries the next free step in memory.

:NSTates?

Command: :MEMory:NSTates?

This command queries the maximum state in memory.

:SYSTem

:ERRor

Command: :SYSTem:ERRor?

Return Value: -410 “Query Interrupted”, -113 “Undefined Header”

This command reads the message in the Error Queue. Refer to ¶ 3.3.5 for Error Messages

:VERSion?

Command: :SYSTem:VERSion?

Return Value: 1990.0

This command queries the SCPI version of this device.

[:SOURce]

:SAFEty

:STARt

:OFFSet GET | OFF

Command: :SOURce:SAFEty:STARt:OFFSet GET

This command gets the offset value.

Command: :SOURce:SAFEty:STARt:OFFSet OFF

This command turns the offset function off.

:OFFSet?

Command: :SOURce:SAFEty:STARt:OFFSet?

Return Value: 1 (ON), 0 (OFF)

This command queries if the offset function is ON or OFF.

:STOP

Command: :SOURce:SAFEty:STOP

This command stops the test.

:STATus?

Command: :SOURce:SAFETy:STATus?

Return Value: RUNNING | STOPPED

This command queries the execution status of the current device under test.

:SNUMber?

Command: :SOURce:SAFETy:SNUMber?

Return Value: +2

This command queries the # of steps in the active program.

:RESult

:RESult:ALL:OMETerage?

Command: :SOURce:SAFETy:RESult:ALL:OMETerage?

Return Value: +3.000000E+01, +2.980000E+00

This command queries the Output Meter reading of all steps.

:RESult:ALL:MMETerage?

Command: :SOURce:SAFETy:RESult:ALL:MMETerage?

Return Value: +1.100000E-03, +8.000001E-04

This command queries the Measurement Meter reading of all steps.

:RESult:ALL:MODE?

Command: :SOURce:SAFETy:RESult:ALL:MODE?

Return Value: GB,GB

This command queries the mode of all steps.

:RESult:ALL:TIME:ELAPsed?

Command: :SOURce:SAFETy:RESult:ALL:TIME:ELAPsed?

Return Value: +4.600001E+00, +9.910000E+37

NOTE: +9.910000E+37 is the default value for “Not Tested”

This command queries how long the instrument tested for.

:RESult:ALL:JUDGment?

Command: :SOURce:SAFETy:RESult:ALL:JUDGment?

Return Value: 116,116

This command queries the judgment results of all steps.

The return format is First Step result, Second Step result...Last Step result.

Action/Result	Hex	Dec
STOP	70	112
USER STOP	71	113
CAN NOT TEST	72	114
PASS	74	116
HIGH FAIL	11	17
LOW FAIL	12	18
ADV OVER	16	22
ADI OVER	17	23

:RESult:COMPLeted?

Command: :SOURce:SAFETy:RESult:COMPLeted?

Return Value: 1, 0

This command queries the completion of all steps.

:RESult:LAST:JUDGment?

Command: :SOURce:SAFEty:RESult:LAST:JUDGment?

Return Value: 113

This command queries the judgment results of the last step.

:RESult:AREPort <boolean> | ON | OFF

Command: :SOURce:SAFEty:RESult:AREPort <boolean> | ON | OFF

This command sets the auto test report function ON or OFF. (RS232 interface only)

:RESult:AREPort?

Command: :SOURce:SAFEty:RESult:AREPort?

Return Value: 1, 0

This command queries if the auto test report is ON or OFF. (RS232 interface only)

:STEP <n>

:DELeTe

Command: :SOURce:SAFEty:STEP<n>:DELeTe

This command clears all setting values in selected step to the initial value.

<n> denotes the step number. Range: $1 \leq n \leq 99$.

:SET?

Command: :SOURce:SAFEty:STEP<n>:SET?

Return Value: 1,GB,+3.000000E+01, +1.600000E-03,+0.000000E+00,+8.300000E+00

This command queries all setting values in selected step.

:MODE?

Command: :SOURce:SAFEty:STEP<n>:MODE?

Return Value: GB

This command queries the test Mode of the selected step.

:GB

:LEVel <numeric value>

Command: :SOURce:SAFEty:STEP<n>:GB:LEVel <numeric value>

This command sets the DC voltage level for the selected step.

<numeric value> is 3 to 45 and the unit is amperes.

:LEVel?

Command: :SOURce:SAFEty:STEP<n>:GB:LEVel?

This command queries the current level for the selected step.

<numeric value> is 3 to 45 and the unit is amperes.

:LIMit

:LIMit:HIGH <numeric value>

Command: :SOURce:SAFEty:STEP<n>:GB:LIMit:HIGH <numeric value>

This command sets the high resistance limit for the selected step.

<numeric value> is 0 to 510 and the unit is milliohms

NOTE: must be in scientific notation, example: 10mohm is 10e-3

:LIMit:HIGH?

Command: :SOURce:SAFEty:STEP<n>:GB:LIMit:HIGH?

Return Value: +1.000000E-03

This command queries the high resistance limit for the selected step.

:LIMit:LOW <numeric value>

Command: :SOURce:SAFEty:STEP<n>:GB:LIMit:LOW <numeric value>

This command sets the low resistance limit for the selected step.

<numeric value> is 0 to 100 and the unit is milliohms.

NOTE: must be in scientific notation, example: 1milliohm is 1e-3

:LIMit:LOW?

Command: :SOURce:SAFEty:STEP<n>:GB:LIMit:LOW?

Return Value: +1.000000E-02

This command queries the low resistance limit for the selected step.

:TIME:TEST <numeric value>

Command: :SOURce:SAFEty:STEP <n>:GB:TIME:TEST <numeric value>

This command sets the test time for the selected step.

<numeric value> is 0 to 999 and the unit is seconds.

:TIME:TEST?

Command: :SOURce:SAFEty:STEP <n>:GB:TIME:TEST?

Return Value: +6.000000E+01 (for 60 second test)

This command queries the test time for the selected step.

:PRESet

:KEYboard:SMARt

Command: :SOURce:SAFEty:PRESet:KEYboard:SMARt <boolean> | ON | OFF

This command sets the keyboard function OFF or ON.

:KEYboard:SMARt?

Command: :SOURce:SAFEty:PRESet:KEYboard:SMARt?

Return Value: 1 (ON), 0 (OFF)

This command queries if the keyboard function is ON or OFF.

:TIME

:TIME:PASS <numeric value> | KEY

Command: :SOURce:SAFEty:PRESet:TIME:PASS <numeric value>

This command sets the pass hold time for the selected step.

<numeric value> is 0 to 999 and the unit is seconds.

:TIME:PASS?

Command: :SOURce:SAFEty:PRESet:TIME:PASS?

Return Value: +5.000000E-01 (example: 0.5sec pass hold time)

This command queries the pass hold time for the selected step.

:TIME:STEP <numeric value> | KEY

Command: :SOURce:SAFEty:PRESet:TIME:STEP <numeric value>

This command sets the step hold time for the selected step.

<numeric value> is 0 to 999 and the unit is seconds.

:TIME:STEP?

Command: :SOURce:SAFEty:PRESet:TIME:STEP?

Return Value: +5.000000E-01 (example: 0.5sec step hold time)

This command queries the step hold time for the selected step.

:TIME:JUDGment <numeric value>

Command: :SOURce:SAFEty:PRESet:TIME:JUDGment <numeric value>

This command sets the time between measurement and judgment.

<numeric value> is a value between 0.1 and 99.9 and the unit is seconds.

:TIME:JUDGment?

Command: :SOURce:SAFEty:PRESet:TIME:JUDGment?

Return Value: +1.100000E+00 (example: 1.1sec judgment wait time)

This command queries the time between measurement and judgment.

:GB

:GB:FREQuency <numeric value>

Command: :SOURce:SAFEty:PRESet:GB:FREQuency <numeric value>

This command sets the frequency for the GB test.

<numeric value> is 50 to 60 and the unit is hertz.

:GB:FREQuency?

Command: :SOURce:SAFEty:PRESet:GB:FREQuency?

Return Value: +6.000000E+01 (example: 60Hz selected)

This command queries the frequency for the GB test.

:GB:VOLTage <numeric value>

Command: :SOURce:SAFEty:PRESet:GB:VOLTage <numeric value>

This command sets the AC voltage for the GB test.

<numeric value> is a value between 1 and 8 and the unit is volts.

:GB:VOLTage?

Command: :SOURce:SAFEty:PRESet:GB:VOLTage?

Return Value: +1.500000E+00 (example: 1.5V test voltage)

This command queries the AC voltage for the GB test.

:AGC

:SOFTware <boolean> ON | OFF

Command: :SOURce:SAFEty:PRESet:AGC:SOFTware

This command sets the software Automatic Gain Control function ON or OFF.

:SOFTware?

Command: :SOURce:SAFEty:PRESet:AGC:SOFTware?

Return Value: 1 or 0

This command queries the status of the software Automatic Gain Control function.

:FCONtin

Command: :SOURce : SAFEty : PRESet : FCONtin ON

This command turns the Continue on Fail function ON.

Command: :SOURce : SAFEty : PRESet : FCONtin?

Return Value: 1 or 0, ON or OFF

This command queries the status of the Continue on Fail function.

:NUMBER

:PART <numerical value>

Command: :SOURce : SAFETy : PRESet : NUMber : PART
This command sets the part number for the device under test.
Send text string up to 13 characters.

:PART?

Command: :SOURce : SAFETy : PRESet : NUMber : PART?
Return Value: G1050 (example part #)
This command queries the part number of the device under test.

:LOT <numerical value>

Command: :SOURce : SAFETy : PRESet : NUMber : LOT
This command sets the lot number for the device under test.
Send text string up to 13 characters.

:LOT?

Command: :SOURce : SAFETy : PRESet : NUMber : LOT?
Return Value: S097856 (example lot #)
This command queries the lot number of the device under test.

:SERIAL <numerical value>

Command: :SOURce : SAFETy : PRESet : NUMber : SERIAL
This command sets the serial number format.
Send text string up to 13 characters.

:SERIAL?

Command: :SOURce : SAFETy : PRESet : NUMber : SERIAL?
Return Value: AAP10500012 (example serial #)
This command queries the serial number format.

:SCREEN

Command: :SOURce : SAFETy : PRESet : SCREEN ON
This command turns the display ON or OFF.

Command: :SOURce : SAFETy : PRESet : SCREEN?
Return Value: 1 or 0, ON or OFF
This command queries the status of the display.

3.3.5 Error Messages

Error messages are saved in an error queue that is accessed by the FIFO method. The first return error message is the first saved in the queue. When the error message queue is over 30 messages, the error message “Queue overflow” will be displayed. The error queue cannot save any more error messages until this queue is cleared. When there is no error in the queue, the first position in the queue displays “No error”. Table 3-7 lists the error messages by number and description. When the **ERR** box is backlit on the bottom of the display, there are error messages in the queue.

Table 3-7: IEEE-488 Error Messages

#	Type	Description
+0	No Error	
-102	Syntax Error	Command includes a prohibited character or symbol
-108	Parameter Not Allowed	Device received a prohibited parameter
-109	Missing Parameter	Parameter missing from programming
-112	Mnemonic Too Long	Command program header is > 12 characters
-113	Undefined Header	Device received undefined header.
-114	Header Suffix Out of Range	Header suffix is out of range
-141	Invalid Character Data	Sent an invalid character in data string
-151	Invalid String of Data	Invalid string (usually missing double quotation marks)
-158	String Not Allowed	Data string is not allowed
-170	Expression Error	Device received incomplete parameter data
-222	Data Out of Range	Data is out of range
-223	Too Much Data	Data string too long
-291	Out of Memory	No memory left
-292	Referenced Name	Queried a name that does not exist
-293	Referenced Name	Cannot save a name that already exists
-350	Queue Overflow	Error Queue is Full
-361	Parity Error	Wrong parity in program message
-363	Input Buffer Overrun	Device received over 1024 characters
-365	Time Out Error	Device did not receive end character within certain time
-400	Queue Error	Output queue data is > 256 characters
-410	Query Interrupted	Query interrupted because query result from previous query has not yet been read.
-420	Query Unterminated	Query terminated because the output queue data cannot be read when there is NO data in the queue.

3.3.6 Sample IEEE-488 Basic Programs

Included herein is a sample Basic program to program a GB test, save it to memory and recall it. Additional software resources can be located on <http://www.quadtech.com/resources>.

```
Rem -----
Rem G1050 IEEE Sample Program
Rem Please run the ULI file before this program
Rem G1000 GPIB address is 3
Rem -----
Rem This example will show you how to program a test and save it
Rem to memory. It will then show you how to recall a setup
Rem This program will set a one step test and save it to
Rem Memory location 1. It will then add an additional step and
Rem save it to Memory location 3. Finally it will recall Memory
Rem location 1.
Rem ****In order for this program to function the way it was
Rem ****intended be sure there are no steps present in the
Rem ****standby mode before running this program
Cls

Open "gpib0" For Output As #1
Open "gpib0" For Input As #2

Print #1, "abort"
Print #1, "GPIBEOS IN LF"
Print #1, "output 3;SOURce:SAFEty:STOP"
Rem Program 3A current
Print #1, "output 3;SOURce:SAFEty:STEP1:GB:LEVEl 3"
Rem Program 0.4mohm high limit
Print #1, "output 3;SOURce:SAFEty:STEP1:GB:LIMit:HIGH 0.0004"
Rem Program 5 second test time
Print #1, "output 3;SOURce:SAFEty:STEP1:GB:TIME:TEST 5"

Rem Save programmed steps to memory location 1 and label it 3A
Print #1, "output 3;*SAV 1"
Print #1, "output 3;MEMory:STATE:DEFine 3A,1"

Print #1, "output 3;SOURce:SAFEty:STEP2:GB:LEVEl 40"
Print #1, "output 3;SOURce:SAFEty:STEP2:GB:LIMit:HIGH 0.0001"

Rem Save 2 step test in location 3, label as 3A-40A
Print #1, "output 3;*SAV 3"
Print #1, "output 3;MEMory:state:DEFine 3A-40A,3"

Rem Recall 3A from memory location 1
Print #1, "output 3;*RCL 1"

Close: System
```

3.4 Printer Interface

An optional Printer Interface is available for the Guardian 1050 instrument. The Printer interface takes the place of the IEEE-488 interface and is factory installed when the unit is ordered. Connection is through the black 25-pin connector labeled 'OPTION' on the rear panel of the Guardian 1050 instrument. Figure 3-9 illustrates the Printer interface pin designation.

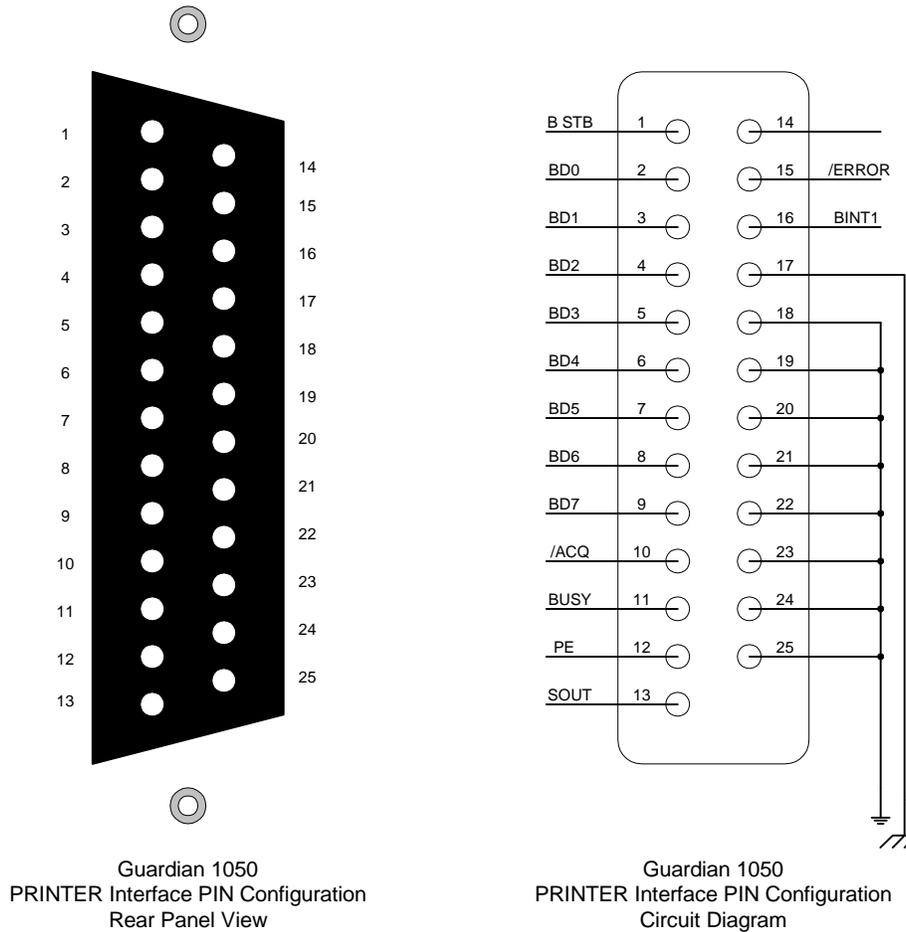


Figure 3-9: Printer Interface Pin Configuration

The following printers have been tested with the G38 printer interface: Epson Stylus Color 440, Epson Stylus Color 460, Epson Stylus Photo 720, Epson LQ570C+ dot matrix, Epson LX-300 and HP DeskJet 648C. Included are two sample printouts: "Print Program" and "Auto Print".

When **Print Program** is selected, the programmed test parameters will print:

```
STEP 1 GB
CURR: 3.00A
TIME: 3.0S
HIGH: 100.0mΩ
LOW : OFF
=====
STEP 2 GB
VOLT: 40.00A
TIME: 5.0s
HIGH: 150.0mΩ
LOW : OFF
=====
```

The following will print when **Auto Print**: Pass and Fail and all Print Data options are turned ON:

```
=====
P/N: 1050-GB
L/N:X1Y5
S/N:4240631
Step-01 GB 3.00A 0.6mΩ ----- PASS
Step-02 GB 40.00A 0.8mΩ ----- PASS
-----PASS -----
```

3.5 G16 International Power Strip

The Guardian 1050 instrument can be connected to the G16 International Power Strip as illustrated in Figure 3-10 for safety testing of many European corded products.

*Australia

*North America

*Sweden

*Austria

*United Kingdom

*Norway

*Germany

*Switzerland

*Denmark

*Finland

*Netherlands

*Italy

The three G-16 ground connectors are connected to the Guardian 1050 RTN/LOW terminal. There is a second RTN/LOW terminal on the rear of the Guardian 1050 Ground Bond Tester.

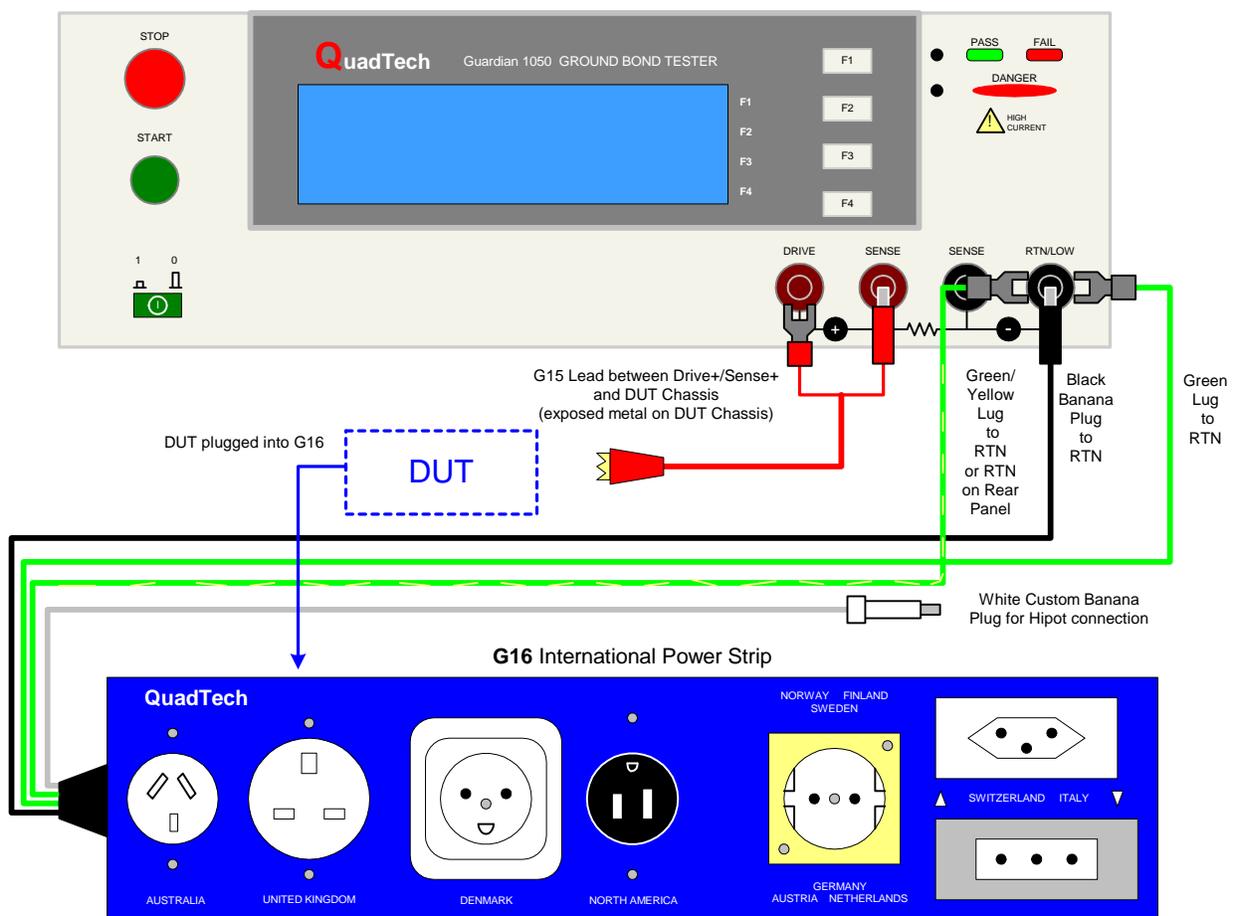


Figure 3-10: G16 International Power Strip Connection to Guardian 1050 Instrument

3.6 Guardian 1000 Series Hipot Tester

The Guardian 1050 instrument can be connected to the G1000 Series Hipot Testers for high current ground testing between chassis and power cord ground in addition to AC/DC hipot and IR testing. The rear panels of the Guardian 1000 Series instrument and Guardian 1050 instrument are connected via the S15 9-pin interconnection cable. Figure 3-11 illustrates the front panel connections of the two instruments.

NOTE: GFI must be set to OFF on the G1000 when it is connected to the G1050.

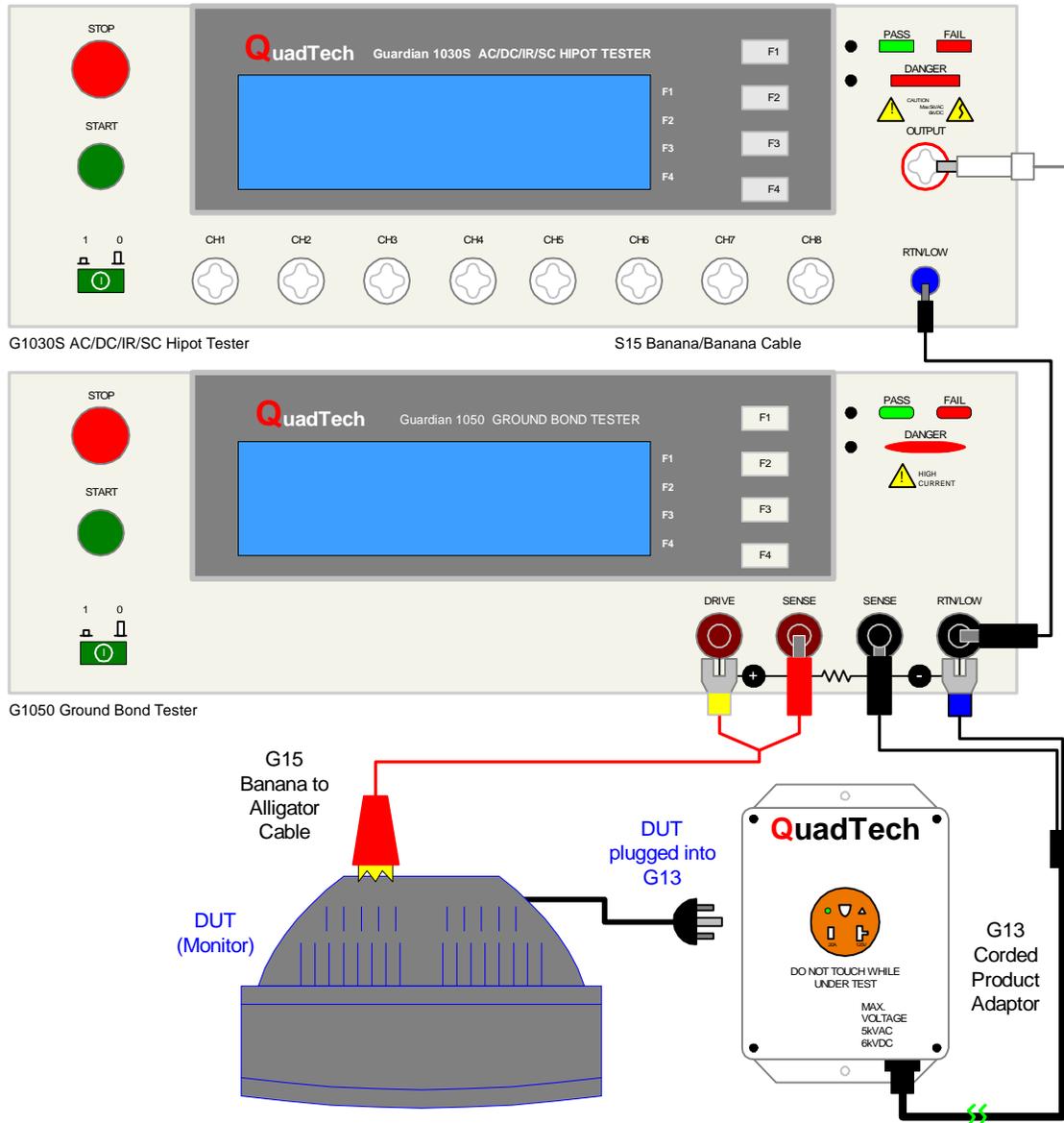


Figure 3-11: Guardian 1050 & Guardian 1030S

Section 4: Service & Calibration

4.1 General

Our warranty (at the front of this manual) attests to 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 800-253-1230 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 obtain an [online Return Materials Authorization Number \(RMA#\)](#). This number, when placed on the outside of the shipping package, will speed processing at our Service Lab and will serve as a reference number for the time your unit is at QuadTech. Please contact our **Customer Care Center (CCC)** at **800-253-1230** for additional support. The CCC phone line is staffed from 8:00am to 5:00pm (EST).

It will be necessary to include a Purchase Order Number and credit card information 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 CCC 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". Please follow online instructions for shipping materials back to QuadTech.

4.3 Calibration

Calibration of the Guardian 1050 instrument is recommended on an annual basis. If the unit is returned to QuadTech for factory calibration, refer to paragraph 4.2 for RMA and shipping instructions. Using the calibration procedure in paragraph 4.3.1, the Guardian 1050 instrument may 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 prior to calibration to ensure maximum stability.](#)

Table 4-1: Calibration Equipment

Equipment	Parameter	Requirements
Multimeter	GBA, GBV	Measure Range: 0 to 6kV, 1.2% accuracy
1mΩ Resistance Standard	GBA, GBV	30A, NIST Traceable
10mΩ Resistance Standard	GBA, GBV	30A, NIST Traceable
100mΩ Resistance Standard	GBA, GBV	30A, NIST Traceable

4.3.1 Calibration Parameters

Table 4-2 contains the calibration parameters for the Guardian 1050 Ground Bond Tester.

Table 4-2: Calibration Parameters

Test		Range		Load	
Current Calibration					
CAL	GBA	45A	OFST	3A	1mΩ
CAL	GBA	45A	FULL	30A	100mΩ
Voltage Calibration					
CAL	GB VX1	8V	OFST	0.3V	100mΩ
CAL	GB VX1	8V	FULL	3V	100mΩ
CAL	GB VX10	8V	OFST	0.03V	100mΩ
CAL	GB VX10	8V	FULL	0.3V	100mΩ

4.3.2 Enable Calibration

The instrument should be powered up for a minimum of 1 hour prior to calibration to ensure maximum stability. With the Guardian 1050 instrument in standby status ([STOP] button previously pressed and no warning lights flashing) remove the Calibration seal over the hole labeled “CAL” on the front panel and push the recessed switch to the IN position.

The unit is in STAND BY status.

Press [F3] = MENU.

Press [F2] = DOWN three times until **CALIBRATION** is highlighted (backlit).

Press [F3] = SELECT to choose calibration function.

Display will prompt for a password.

Press [A] [A] [A] [B] [ENTER]

Cal Step 1: ‘GBA 45A Offset (3A)’ is displayed on the screen.

NOTE

The ‘Calibration is OFF’ display may occur if the CAL recessed switch has not been pressed IN prior to entering Calibration function.

NOTE:

When in the Calibration Routine:

Pressing [UP] or [DOWN] scrolls through the calibration steps.

Pressing [START] initiates the calibration of the particular step

Pressing [INC.] or [DEC.] adjusts the Standard Value Pressing [ENTER] accepts the calibration value.

Pressing [STOP] completes calibration of the particular step

4.3.3 GB Current Calibration

Connect the Drive & Sense terminals of the Guardian 1050 instrument to the 1m Ω resistance standard. Connect the AC voltage meter to the Sense+ and Sense- terminals of the Guardian instrument.

Cal Step 1: 'GBA 45A Offset (3A)'

Press [STOP] to return instrument to steady state.

Press [START] to get offset value.

Calculate the current using Ohm's Law

Press [F1] = INC or [F2] = DEC until the G1050 display reads the same as the calculated current.

Press [ENTER] to accept reading.

Sentry Plus reverts to "GBA Offset" display (incorporating new cal value).

Press [F1] = UP to go to [Cal Step 2: 'GBA 45A Full \(30A\)'](#). Attach the 100m Ω standard.

Press [STOP] to return instrument to steady state.

Press [START] to get full value

Calculate the current using Ohm's Law

Press [F1] = INC or [F2] = DEC until the G1050 display reads the same as the calculated current.

Press [ENTER] to accept reading.

Sentry Plus reverts to "GBA Full" display (incorporating new cal value).

4.3.4 GB Voltage Calibration

NOTE: Use of a current meter is acceptable in place of the volt meter. Keep the 100m Ω standard attached.

Press [F1] = UP to go to [Cal Step 3: 'GBVX1 8V Offset \(0.3V\)'](#).

Press [STOP] to return instrument to steady state.

Press [START] to get offset value.

Press [F1] = INC or [F2] = DEC until the G1050 display reads the same as the voltmeter.

Press [ENTER] to accept reading.

Sentry Plus reverts to "GBVX1 Offset" display (incorporating new cal value).

Press [F1] = UP to go to [Cal Step 4: 'GBVX1 8V Full \(3V\)'](#).

Press [STOP] to return instrument to steady state.

Press [START] to get full value.

Press [F1] = INC or [F2] = DEC until the G1050 display reads the same as the voltmeter.

Press [ENTER] to accept reading.

Sentry Plus reverts to "GBVX1 Full" display (incorporating new cal value).

Voltage Calibration continued.

Press [F1] = UP to go to **Cal Step 5: 'GBVX10 8V Offset (0.03V)'**. Use 100mΩ standard.

Press [STOP] to return instrument to steady state.

Press [START] to get offset value.

Press [F1] = INC or [F2] = DEC until the G1050 display reads the same as the voltmeter.

Press [ENTER] to accept reading.

Sentry Plus reverts to "GBVX10 Offset" display (incorporating new cal value).

Press [F1] = UP to go to **Cal Step 6: 'GBVX10 8V Full (0.3V)'**. Use 100mΩ standard.

Press [STOP] to return instrument to steady state.

Press [START] to get full value.

Press [F1] = INC or [F2] = DEC until the G1050 display reads the same as the voltmeter.

Press [ENTER] to accept reading.

Sentry Plus reverts to "GBVX10 Full" display (incorporating new cal value).

Contrast Calibration

This calibration step is by-passed. If setup is selected, the display contrast will be set to a level of 7. Display contrast can be adjusted outside of the calibration routine in the SYSTEM menu. Refer to paragraph 2.6.2.

4.3.5 Finalize Calibration

When all calibration steps are complete:

Press [F4] = EXIT

Release the [CAL] enable switch to the **OUT** position using the tip of a small screwdriver.

1. Press [F2] = DOWN three times.
2. Press [F3] = SELECT
3. Display prompts: 'PASSWORD'.
4. Press [A] [A] [A] [A] [ENTER]
5. Display prompts: 'Select Software Calibration?'
6. Press [F1] = ON to set Calibration Values ON.