Sentry 50 Plus
Ground Bond Tester
Instruction Manual

Form 150743/A1

5 Clock Tower Place, 210 East
Maynard, Massachusetts, U.S.A. 01754
June 2004

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Sales	800-253-1230
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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.

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.

Contents

Contents (Continued)

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

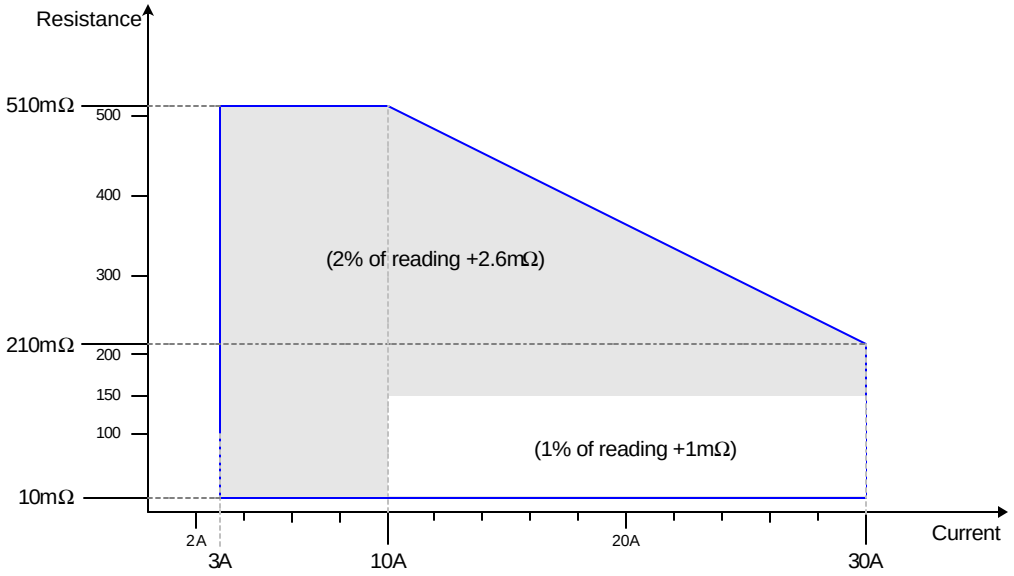
QuadTech's service policy is to maintain product repair capability for a period of at least five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.

Specifications

Output Current:
Range: 3.00 to 30.00A AC
Resolution: 0.01A/step
Accuracy: ± (1.5% of setting + 0.15A)
Frequency: 50 or 60Hz, ±0.1%

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

Resistance:
Range: 0.1mΩ - 510.0mΩ, 4 digits, Hi Limit
Accuracy: 10A - 30A, 10mΩ - 150mΩ: ±(1% of reading + 1mΩ)
Accuracy: All other ranges: ±(2% of reading + 2.6mΩ)



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

Offset Function:
0 to 100mohm offset, user selectable

Test Time:
0.5 - 999sec
Continuous operation mode

Indication:
Pass/Fail Display, LEDs and Audible Alarm

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

Specifications (Continued)

General Features

Setup Storage: 99 Memory Locations, 99 Steps, Maximum Block of 500

Standard Interfaces: Remote I/O

Optional Interfaces: None

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): 12.50 x 4.50 x 15.50 inches
312.5 x 112.5 x 387.5 mm

Weight: 34 lbs (15.4 kg) net, 40 lbs (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:
- 100V, 120V, 220V AC: ±10%
- 240V AC: -10%, +5%
- 50 or 60Hz
- 880W max

Supplied:
- Instruction Manual
- Power Cable
- Fuses
- Calibration Certificate
- G15 Test Leads

Ordering Information:

Description	Catalog No.
Ground Bond Tester	Sentry 50 Plus

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	150743
Calibration Certificate	1	N/A

Accessories/Options Available

Item	Quantity	QuadTech P/N
Foot Switch	1	S05
Interconnection Cable to Sentry Plus 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
Lead Set: Banana/Spade to Alligator clips (std with unit)	1	G15

Safety Precautions

WARNING

The Sentry 50 Plus Ground Bond Tester can provide an output current as high as 30A AC to the external device under test (DUT). Although the Sentry 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 Sentry 50 Plus 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 Sentry 50 Plus 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 test leads, test fixture or DUT in any manner (this includes insulation on all wires and clips) when the high current is applied and the red DANGER light is ON.
4. Before turning on the Sentry unit, make sure there is no device (DUT) or fixture connected to the test leads.
5. After each test, press the [STOP] (red) button for safety if there is any concern that high current may still be applied to the output terminals.
6. 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.
7. **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 Sentry 50 Plus INSTRUMENT.
8. 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 current is still being delivered regardless of the TEST ON/OFF control signal.
9. When the Sentry 50 Plus instrument is used in remote control mode, be extremely careful. The High Current Output is being turned on and off with an external signal.

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 Sentry 50 Plus 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 30A 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 0.1mΩ to 510mΩ 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 Sentry 50 Plus 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 Sentry 50 Plus unit is shipped from QuadTech with a 10A fuse in place for AC 100V or 120V operation. (A 5A fuse is included for 220V or 240V operation). The Sentry 50 Plus 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 Sentry 50 Plus unit AC power cord to the source of proper voltage. Operate the Sentry 50 Plus instrument with its chassis connected to earth ground. The Sentry 50 Plus 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 S50 Plus 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 S50 Plus 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 Sentry 50 Plus instrument can be zeroed.

Condensed Operating Instructions (Continued)

There are numerous menus within the Sentry 50 Plus 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.

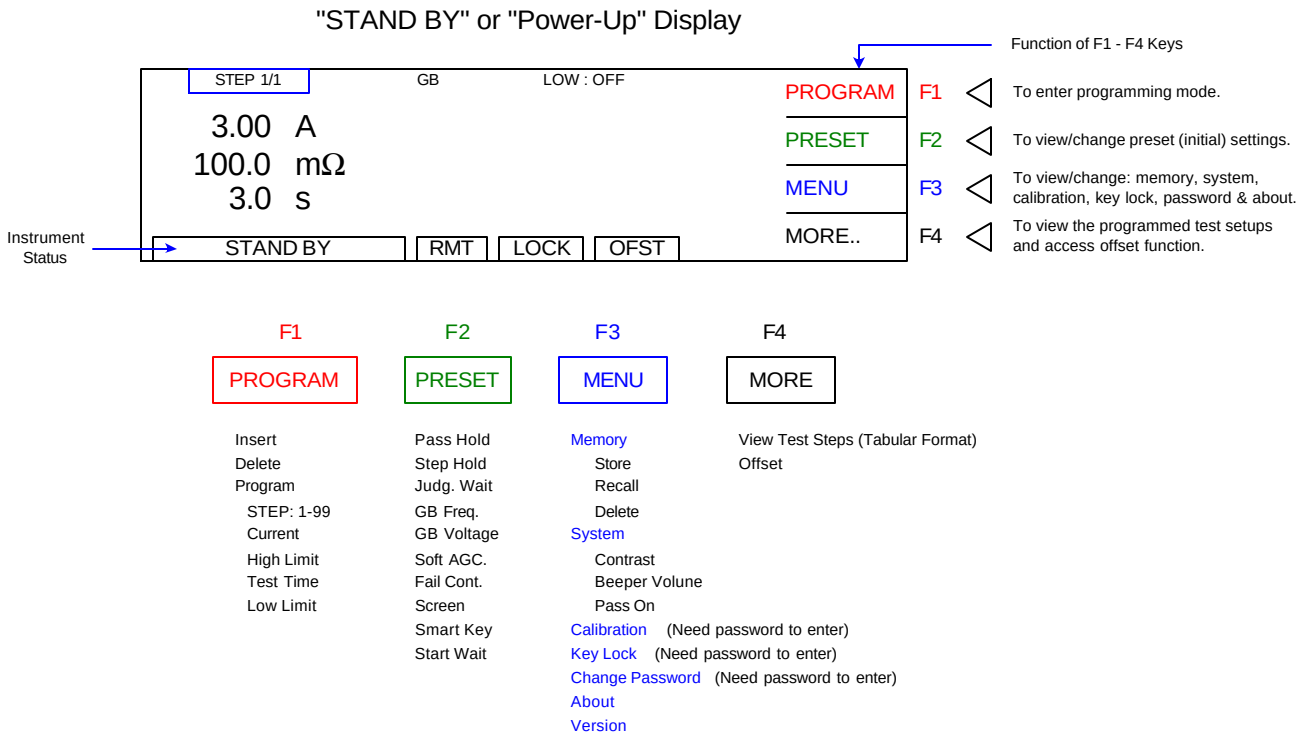


Figure COI-1: S50 Plus Menus

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.

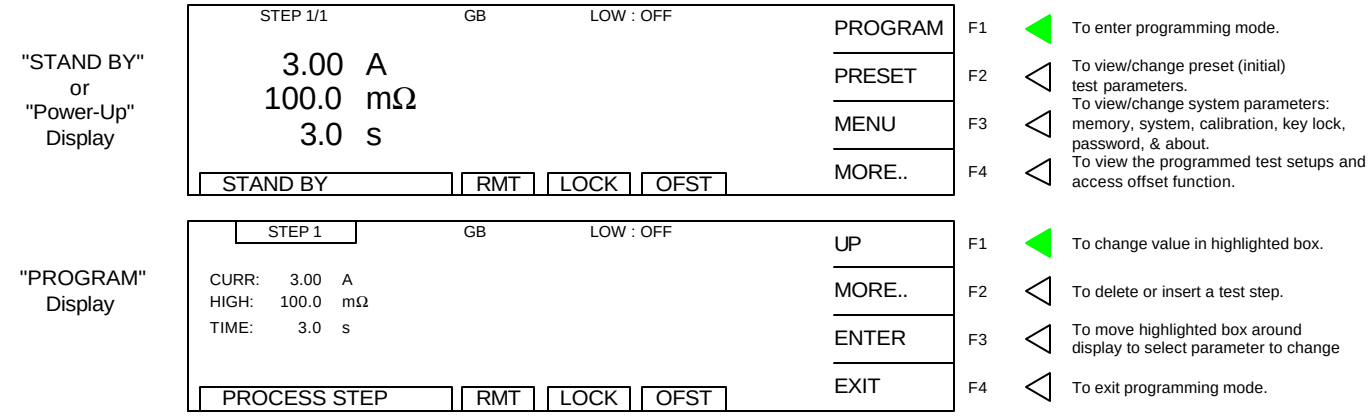


Figure COI-2: "STAND BY" and PROGRAM Displays

With the Sentry 50 Plus 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 – 30.00A)
- Press [F3] = ENTER to move highlighted box to HIGH
- Press [F1] = Up to select high resistance limit (0.1-510mΩ)
- Press [F3] = ENTER to move highlighted box to TIME
- Press [F1] = Up to select test time (0, 0.5 – 999s)
- 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 Sentry 50 Plus 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.

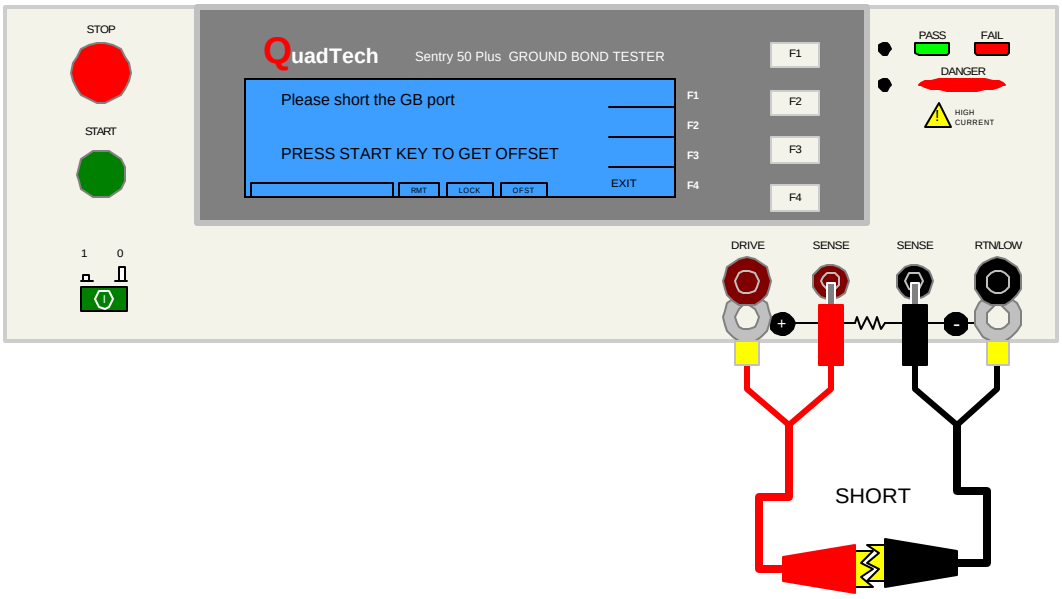
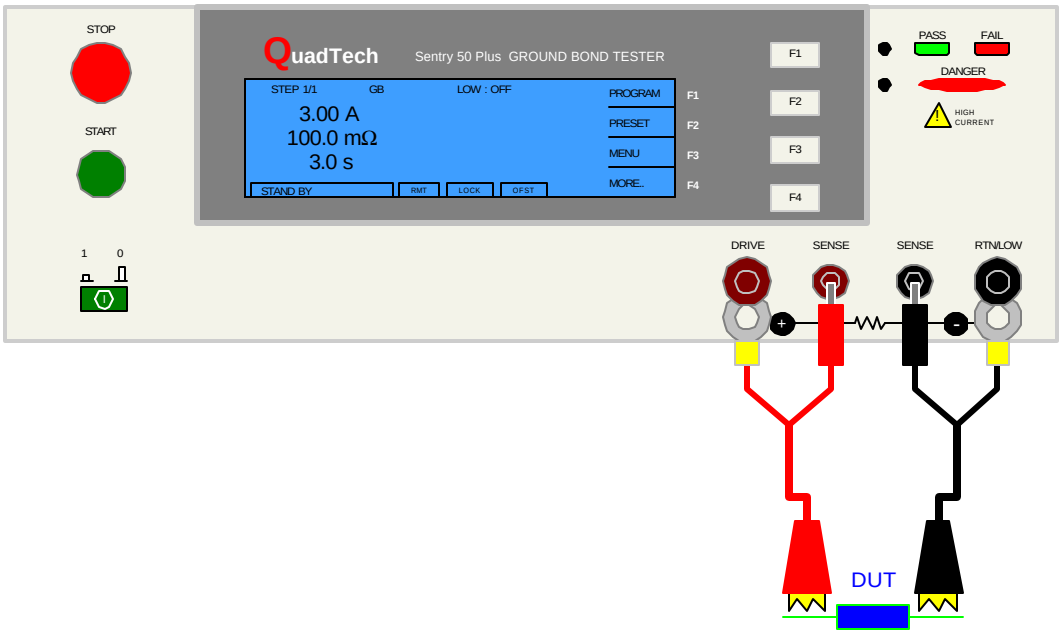


Figure COI-3: Shorted Test Leads for Offset

Condensed Operating Instructions (Continued)

Connection to Device under Test (DUT)

Figure COI-4 illustrates the connection of the Sentry 50 Plus 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 S50 Plus 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 S50 Plus unit to the low side of the DUT.



COI-4: Connection to Device under Test

Measurement Mode

1. Turn [POWER] ON.
2. Allow S50 Plus instrument a 15-minute warm up time.
3. Connect Red banana/spade cable to S50 Plus (+) terminals (DRIVE+, SENSE+)
4. Connect Black banana/spade cable to S50 Plus (-) 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 Sentry 50 Plus 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 Sentry 50 Plus instrument provides for verification of ground continuity connection (ground bond testing) between conductive surfaces and power cord ground on the product under test. The Sentry 50 Plus instrument can be programmed for an output current up to 30 amps and for high/low resistance measurement limits between 0.1mΩ and 510mΩ. The instrument also provides 99 memory locations, with up to 99-steps to a maximum memory block of 500. Each instrument comes standard with a remote interface with start/stop inputs & pass/fail outputs. The Sentry 50 Plus instrument can be connected to the Sentry Plus Series Hipot testers for a complete product test (hipot preceded by ground bond) with the push of one button.

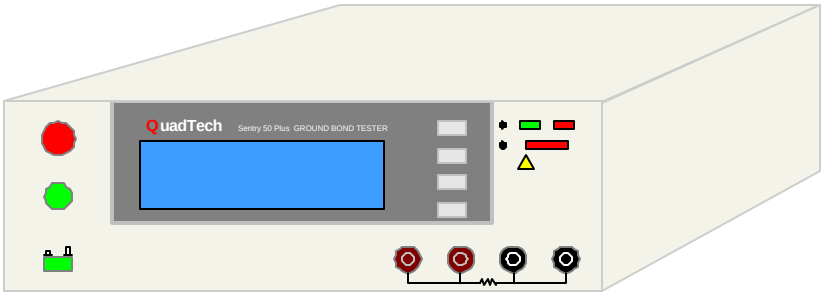


Figure 1-1: Sentry 50 Plus Ground Bond Tester

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 Sentry 50 Plus Ground Bond Tester. Table 1-1 identifies them with description and function.

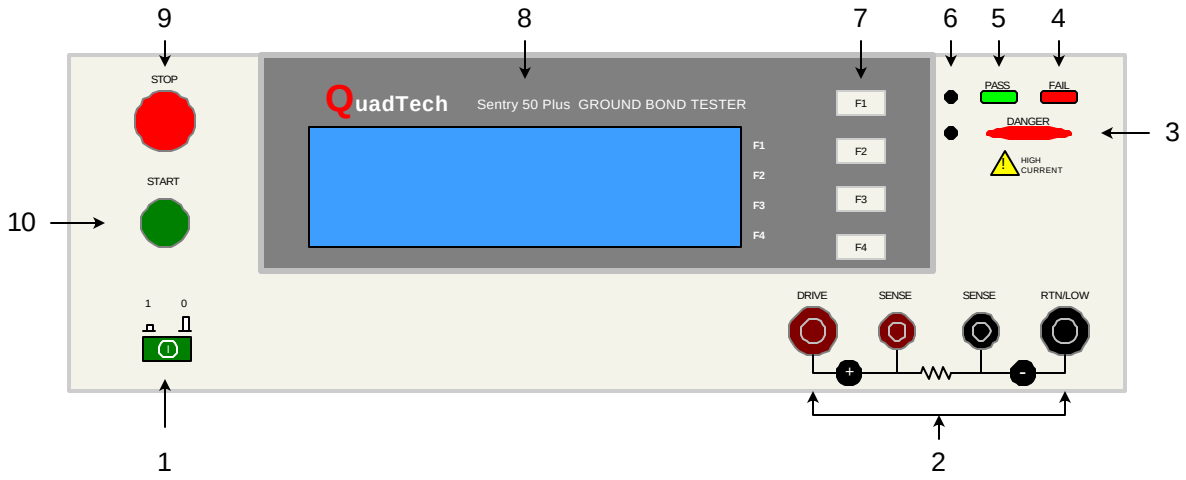


Figure 1-2: Sentry 50 Plus Front Panel Controls & Indicators

Table 1-1: Sentry 50 Plus 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 voltage is present at OUTPUT terminals
4	FAIL	Red LED	When lit, DUT judged as FAIL. Output voltage 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 Sentry 50 Plus Ground Bond Tester. Table 1-2 identifies them with description and function.

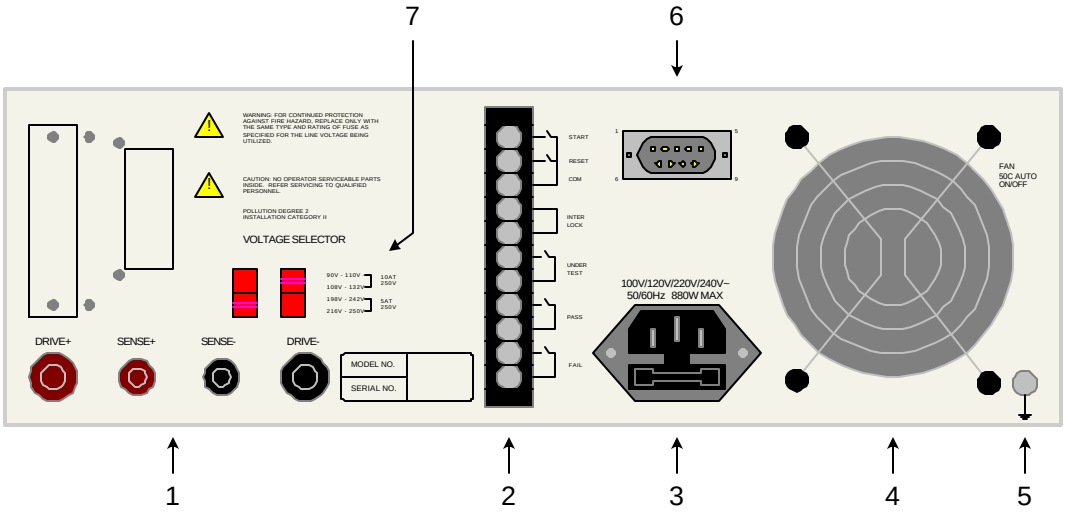


Figure 1-3: Rear Panel Sentry 50 Plus Instrument

Table 1-2: Sentry 50 Plus 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≥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

1.4 Installation

1.4.1 Dimensions

The Sentry 50 Plus 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 Sentry instrument can be tilted up for convenient operator viewing.

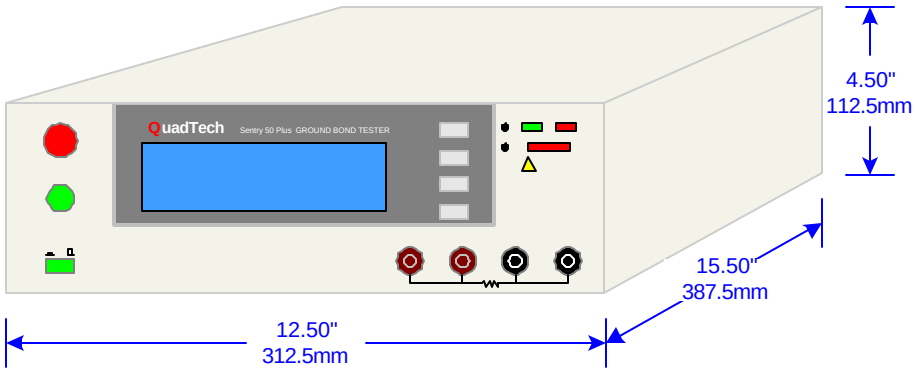


Figure 1-4: Sentry 50 Plus Instrument Dimensions

1.4.2 Instrument Positioning

The Sentry 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 Sentry 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 Sentry 50 Plus 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.

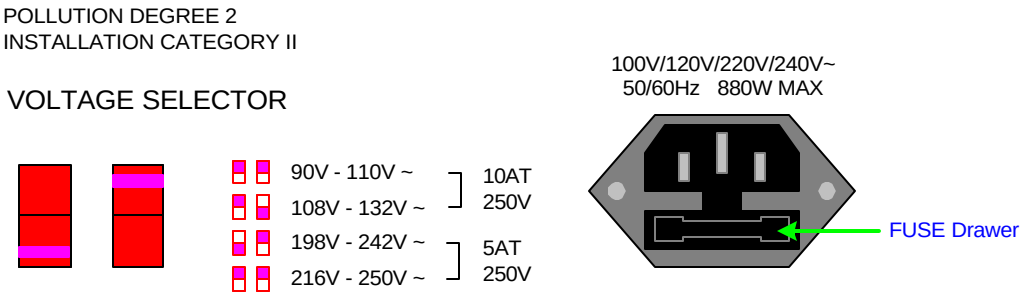


Figure 1-5: Close-Up of S50 Plus Rear Panel

1.4.4 Safety Inspection

Before operating the instrument inspect the power inlet module on the rear of the Sentry 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 Sentry 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 Sentry 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

Multiple	Scientific	Engineering	Symbol
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 30Amps. 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 <1Ω.

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 (AC), DC Hipot (DC), 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 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 S50 Plus 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 Sentry 50 Plus instrument by pressing the green [POWER] switch on the front panel to the ON (1 position). The Sentry 50 Plus 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 Sentry 50 Plus Ground Bond Tester

The Sentry 50 Plus 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.

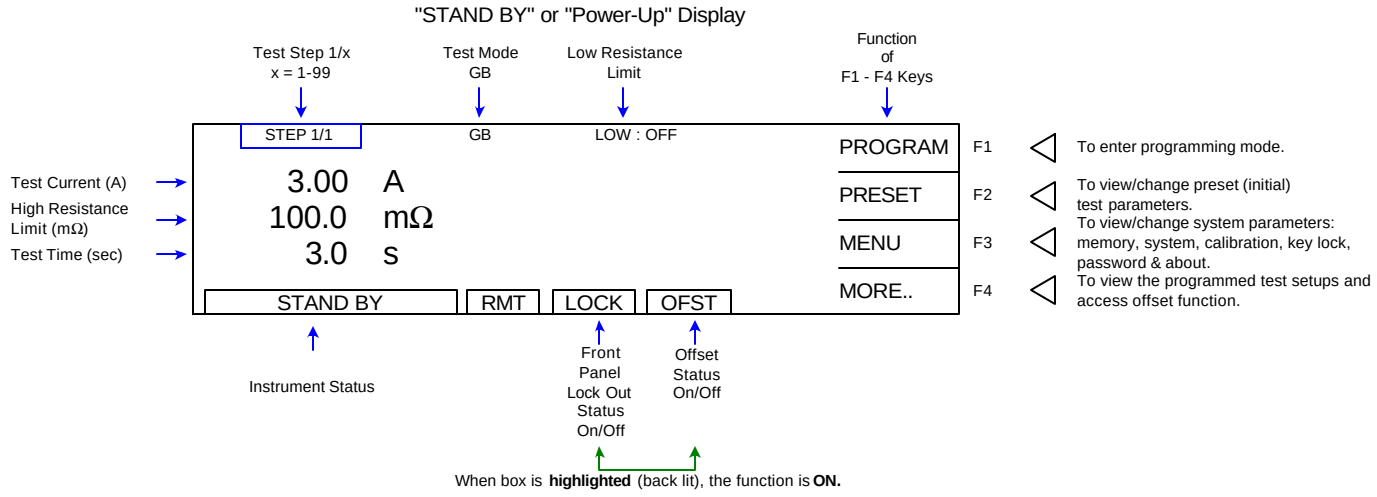


Figure 2-1: STAND BY Display

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 Sentry 50 Plus 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.

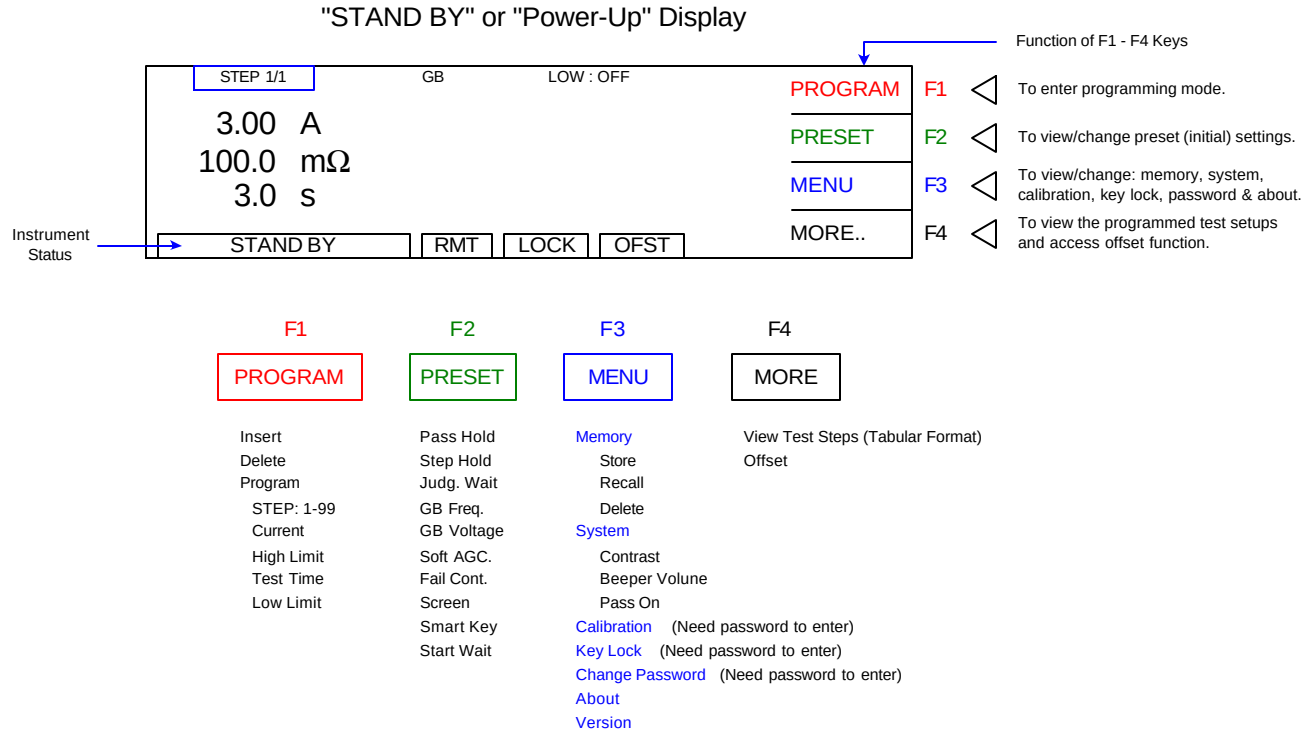
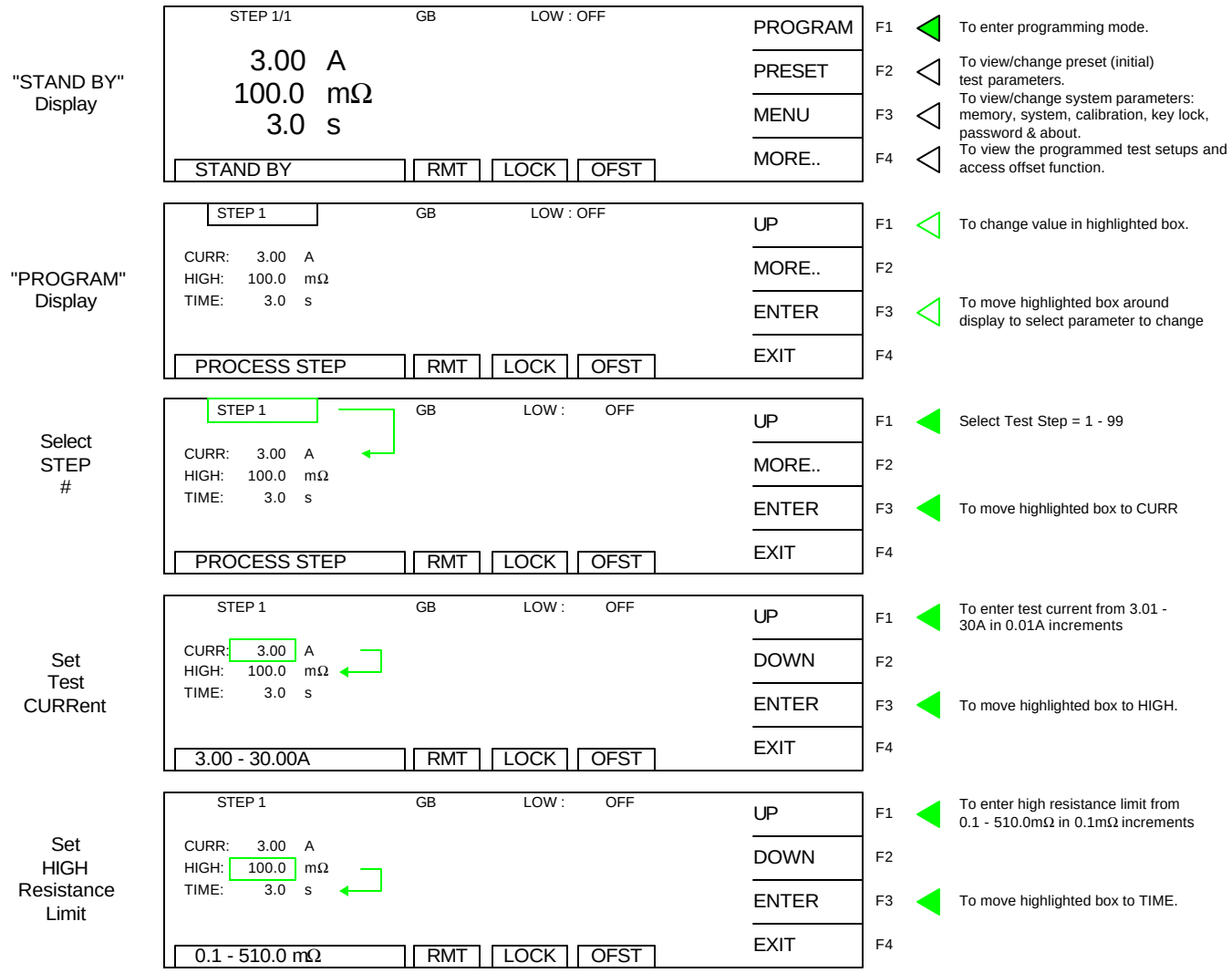


Figure 2-2: STAND BY Function Key Menus

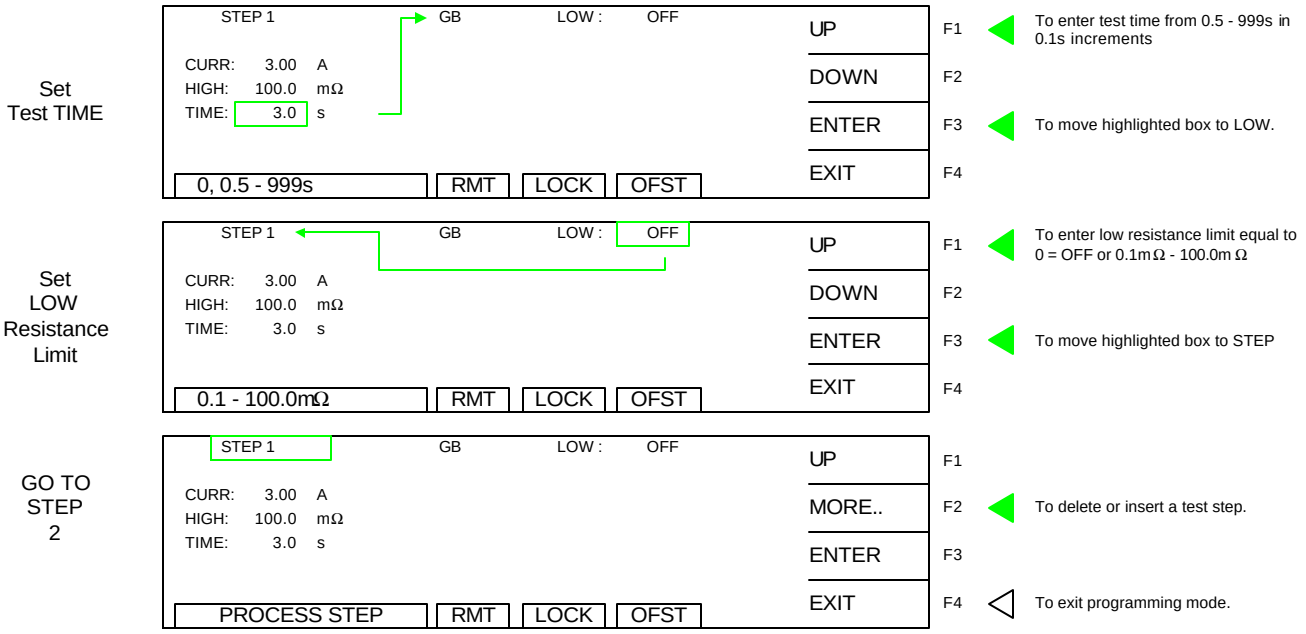
To access the programming function of the S50 Plus instrument in the STAND BY menu, press the [F1] key (PROGRAM). Once in the PROGRAM display, select the test step then the test mode (GB). From here you can program the individual parameters of each test.

2.3 Programming a Ground Bond Test

The Sentry 50 Plus instrument is capable of performing ground bond tests with a test current of 3-30A 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.



GB Programming continued on Next Page.



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 [F2] = MORE to insert a second step
- Press [F2] = INSERT or [F3] = DOWN to change STEP 1 to STEP 2.
- Continue programming Step 2 as illustrated in paragraph 2.3.
- After setting LOW limit, press [F3] = ENTER
- Press [F2] = More to insert a third step
- Or
- Press [F4] = EXIT to exit PROGRAM mode.
- Set instrument PRESET parameters (paragraph 2.5)
- Store 2-step test setup per paragraph 2.6.1.

2.5 PRESET Test Parameters

A number of initial parameters or default conditions may be programmed and stored as the 'power-up' conditions. On the Sentry 50 Plus instrument, this function is labeled PRESET and is accessible on the STAND BY display. Table 2-3 lists the Sentry 50 Plus 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	OFF, 0.1 – 99.9 sec	OFF	Set start delay time for current output

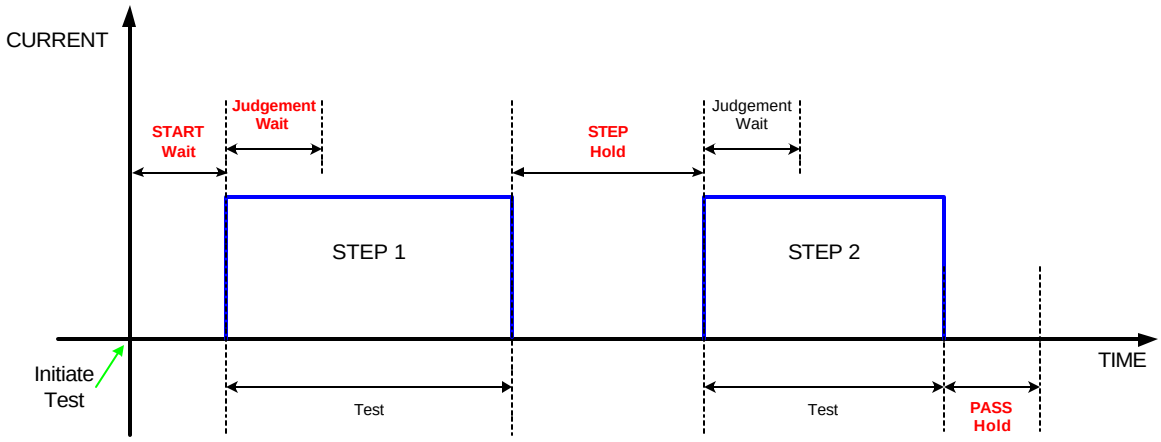


Figure 2-3: Hold Times

2.5.1 PASS HOLD

The Pass Hold setting allows the option of programming a hold time for the PASS relay (at 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 ON (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 DC 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 voltage (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 test 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.

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".

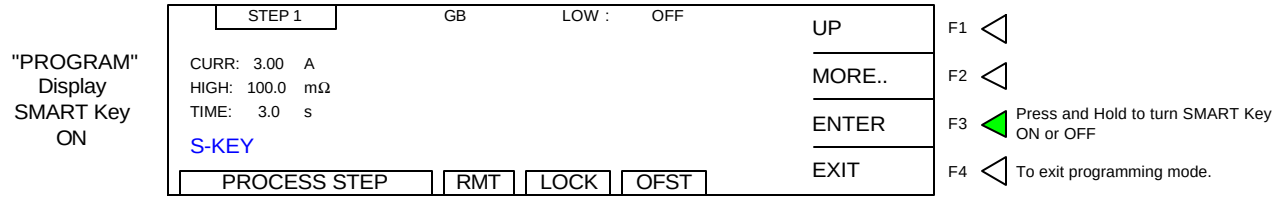


Figure 2.4: Smart Key Display

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 S50 Plus 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.

⎓ Direct Current present at output terminals

CAUTION
The START WAIT function is ACTIVE until the [STOP] button is pressed. When START WAIT is ON, the S50 Plus unit will start if contact is made with the test leads.

2.6 MENU Parameters

With the Sentry 50 Plus instrument in STAND BY status, press [F3] = MENU to access programmable instrument parameters. The MENU display contains the Memory, System, Calibration, Key Lock, Change Password, About and Version functions. Figure 2-5 illustrates the MENU display and Table 2-5 lists the MENU functions with description.

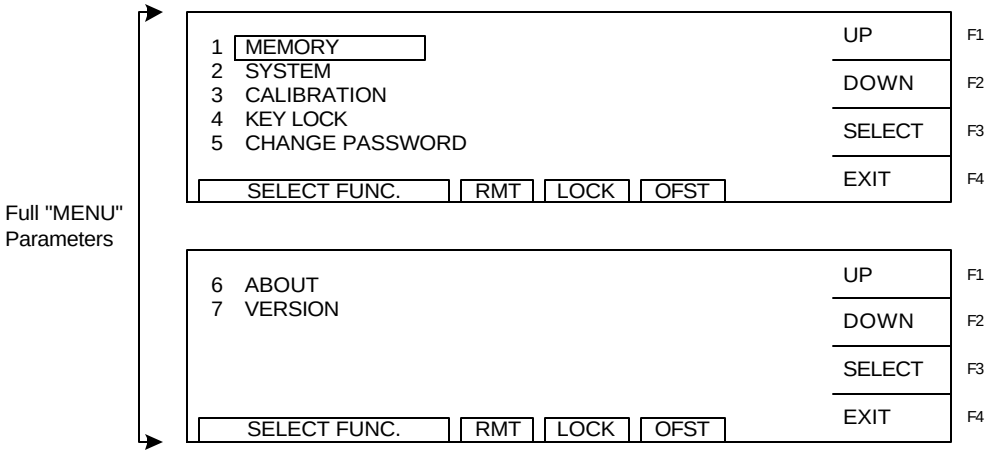


Figure 2-5: Contents of MENU

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	CALIBRATION	Enter instrument calibration routine Qualified service personnel only.
4	KEY LOCK	Lock out front panel program access.
5	CHANGE PASSWORD	Change key lock (user) password.
6	ABOUT	Instrument Manufacturer Information
7	VERSION	Instrument Software Information

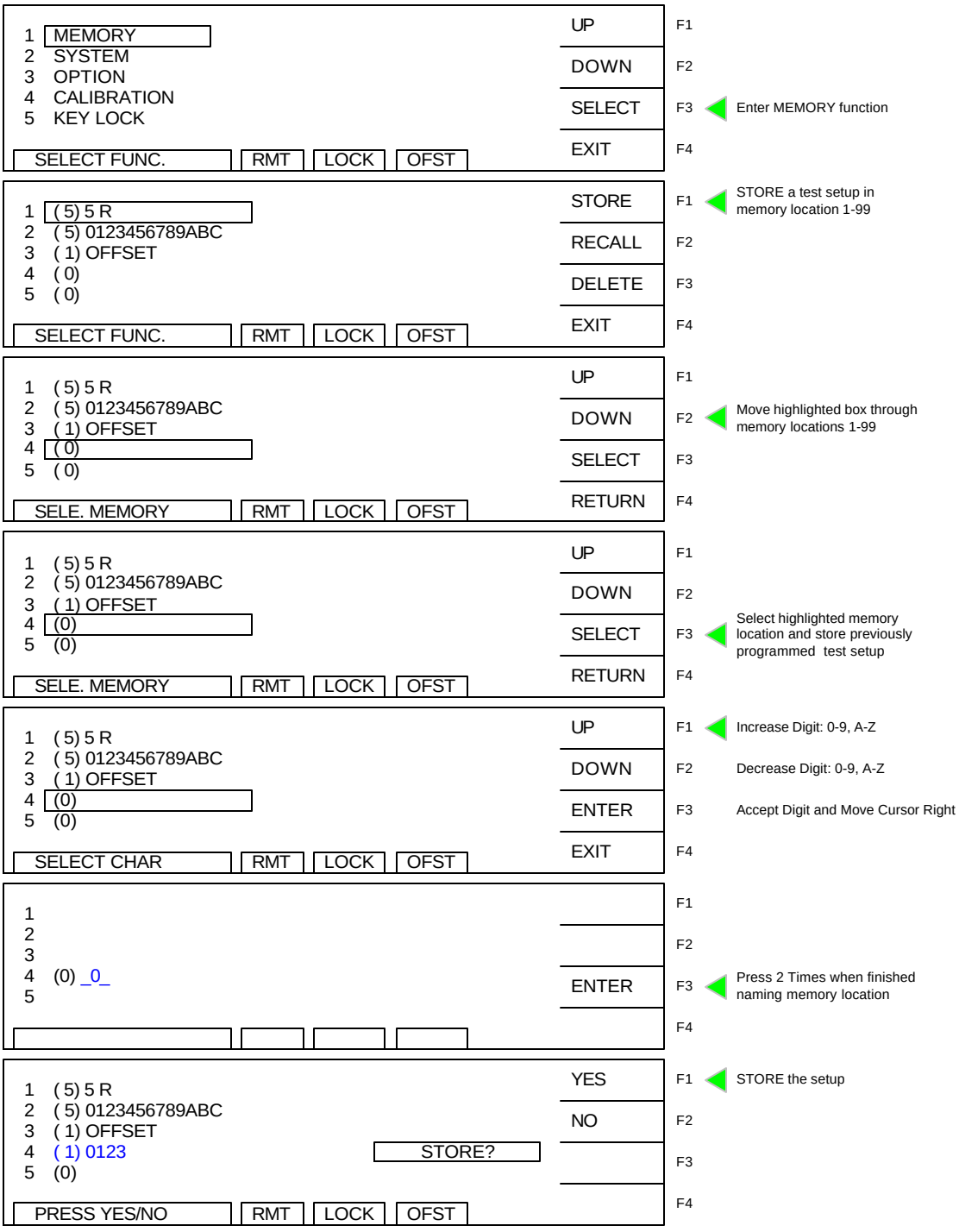
2.6.1 MEMORY

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 up to a maximum memory 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:



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.

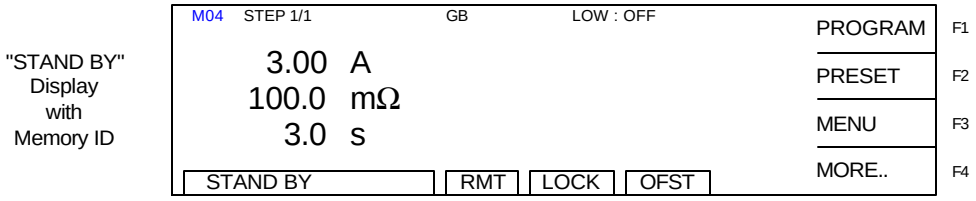


Figure 2-6: Memory Identification on STAND BY display

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.

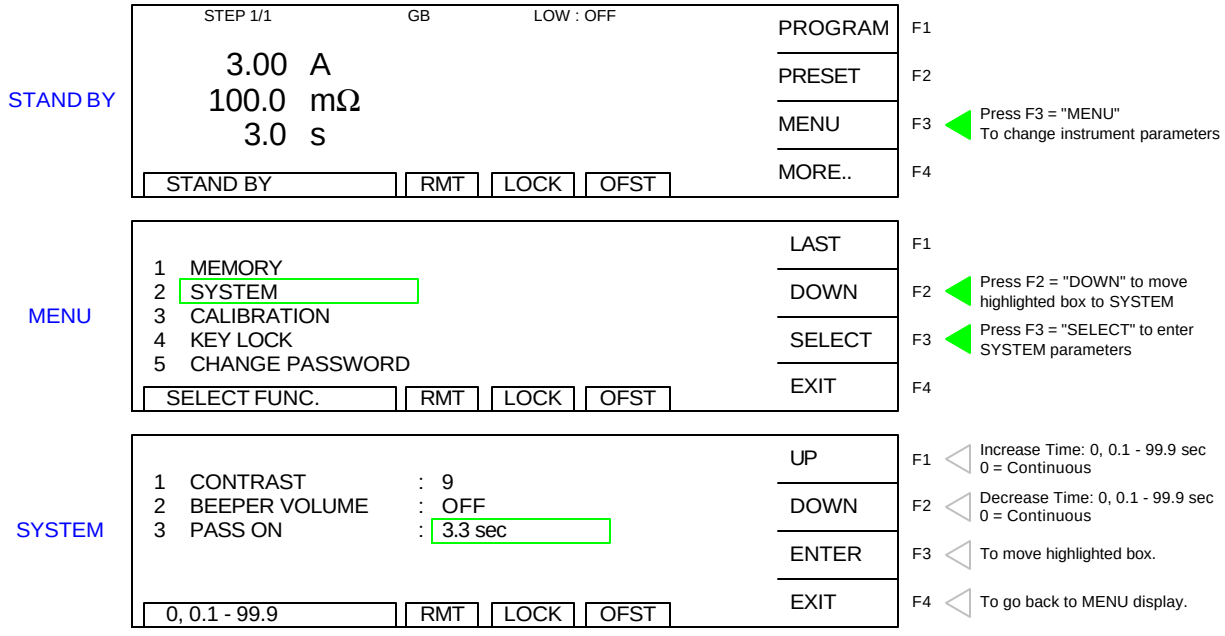


Figure 2-7: System Parameters

2.6.3 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 Sentry 50 Plus calibration procedure.

2.6.4 KEY LOCK

To lock out the PROGRAM and PRESET functions of the Sentry 50 Plus 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.

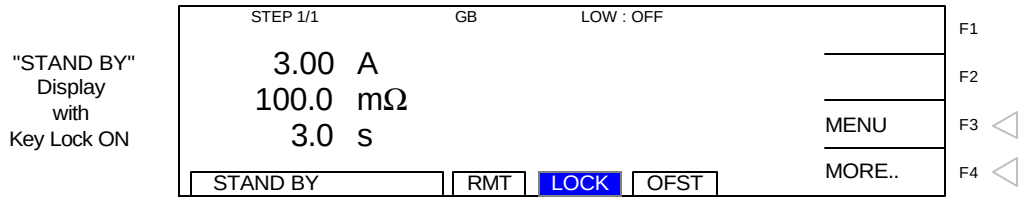


Figure 2-8: Key Lock Display

To disable the KEY LOCK function, repeat above steps.

2.6.5 CHANGE PASSWORD

The Sentry 50 Plus 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'.

2.6.6 ABOUT

The Sentry 50 Plus instrument includes 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] = MENU
- Press [F2] = DOWN until ABOUT is backlit.
- Press [F3] = SELECT
- Display lists the contents of ABOUT.

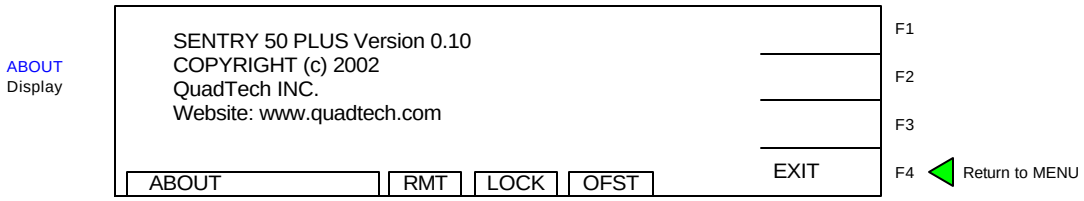


Figure 2-9: ABOUT Display

2.6.7 Version

The Sentry 50 Plus instrument includes 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.

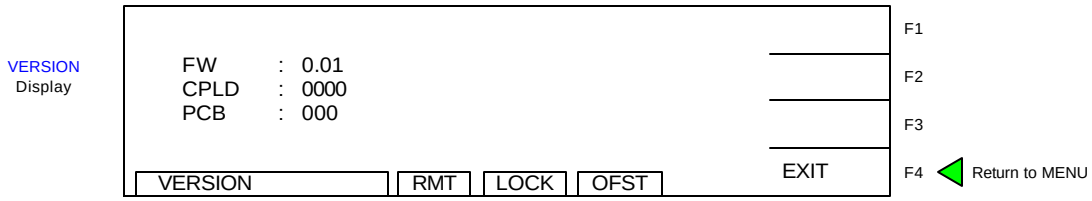


Figure 2-10: Version Display

2.7 Instrument Offset

The Sentry 50 Plus 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 S50 Plus 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:

Display Resistance = (Measured Resistance) – (Offset Resistance)

OFFSET Function – Illustrated

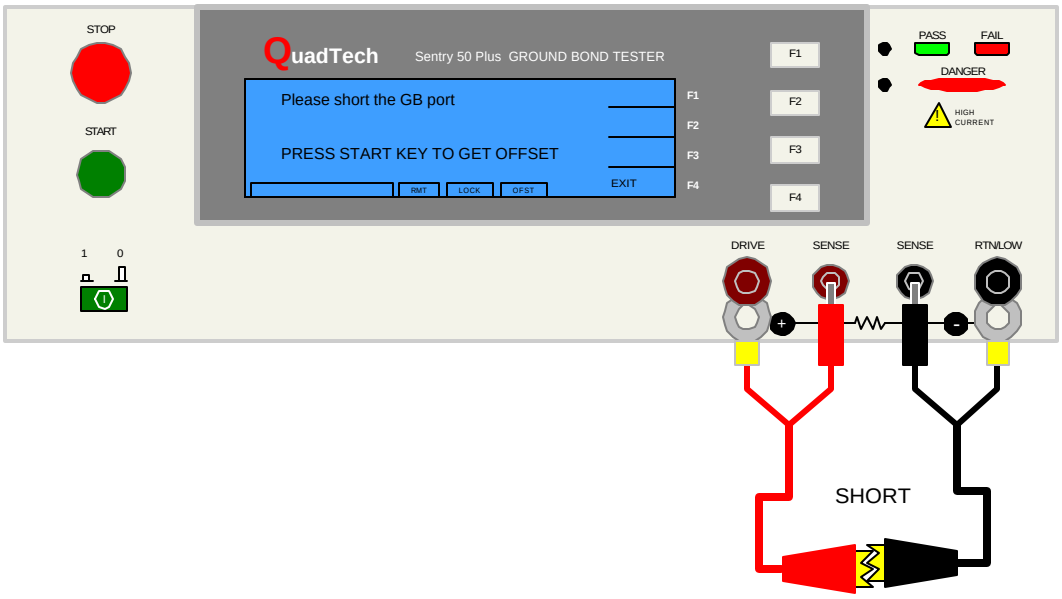
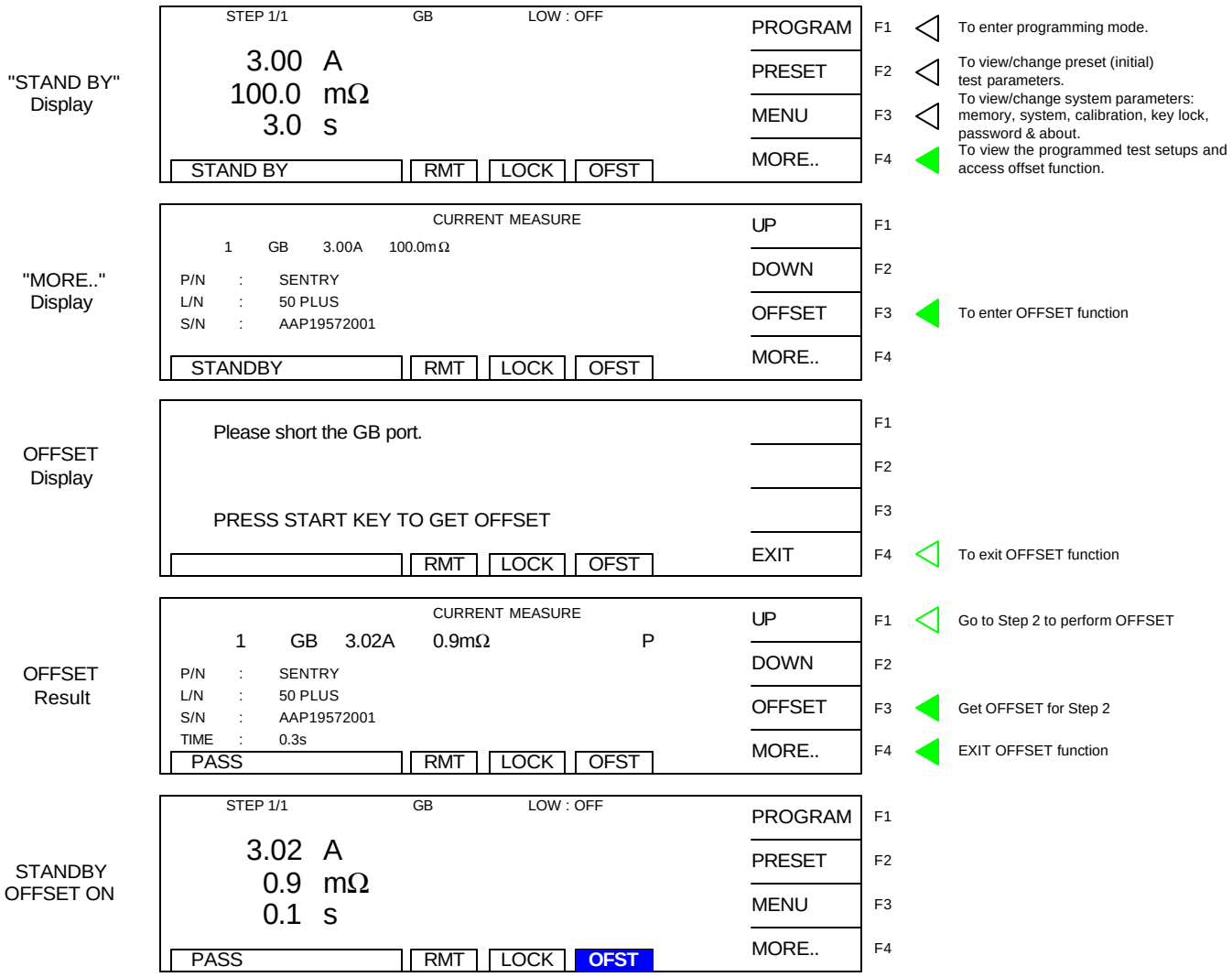


Figure 2-11: Test Leads Shorted for OFFSET function

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.



2.8 Connection to Device under Test

Figure 2-12 illustrates the connection of the Sentry 50 Plus 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 S50 Plus 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 S50 Plus unit to the low side of the DUT.

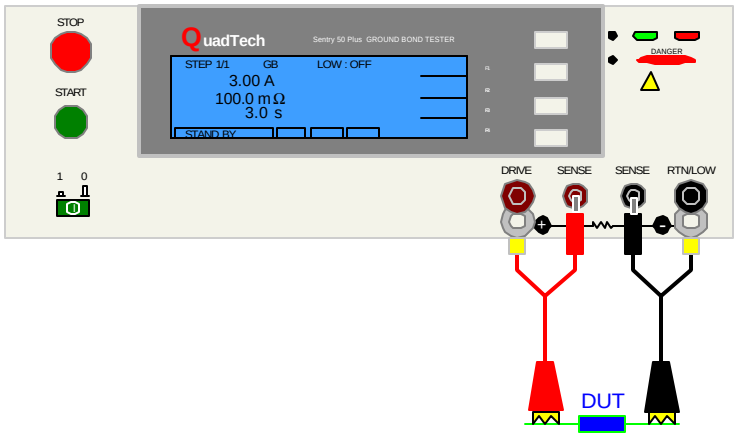


Figure 2-12: G15 Cable Connection

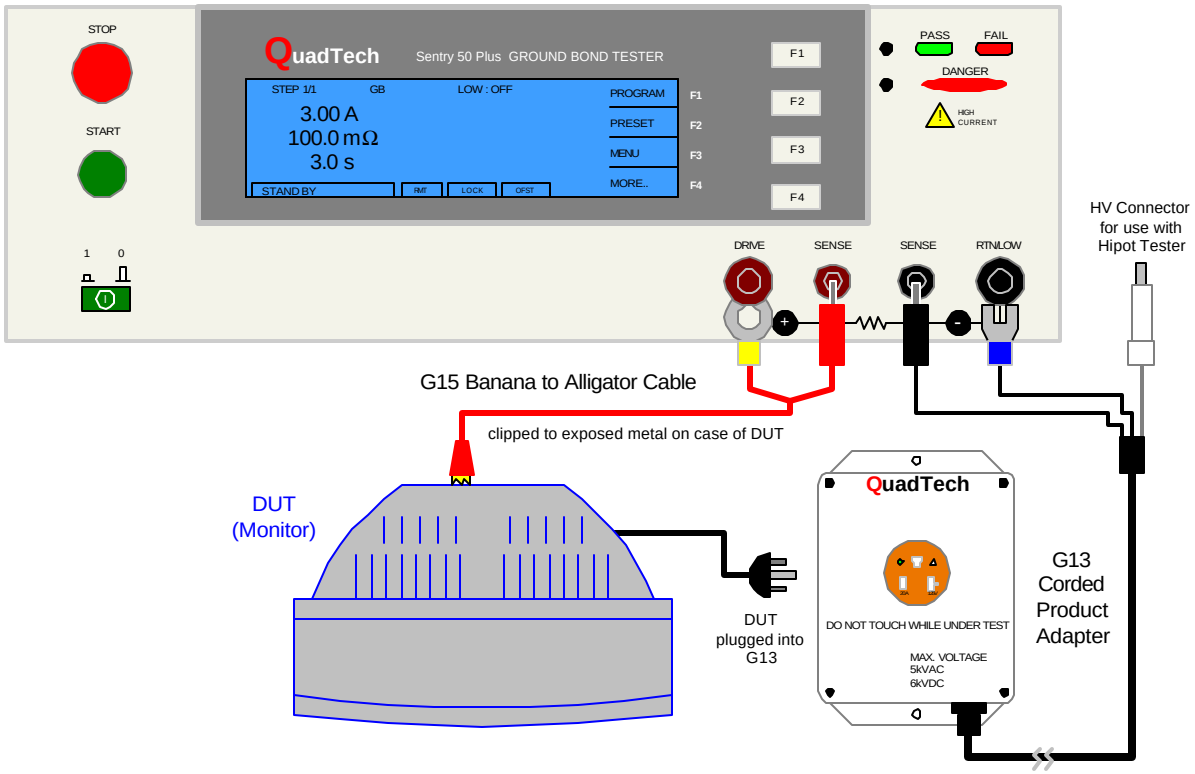


Figure 2-13: G13 Corded Product Adapter Connection

2.9 Measurement Procedure

Before a measurement is made verify the following:

1. Sentry 50 Plus 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 Sentry 50 Plus 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 Sentry 50 Plus 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.

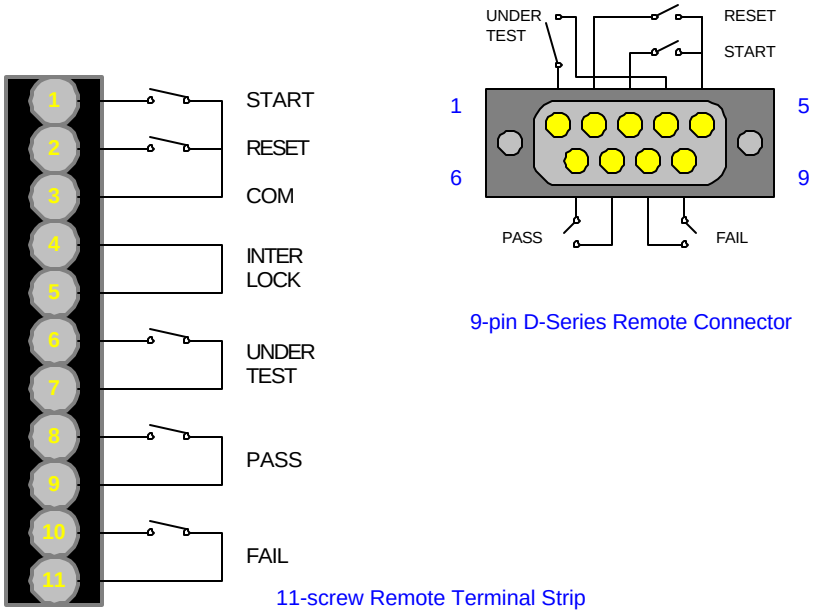


Figure 3-1: Sentry 50 Plus Remote Connectors

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 Sentry 50 Plus 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.

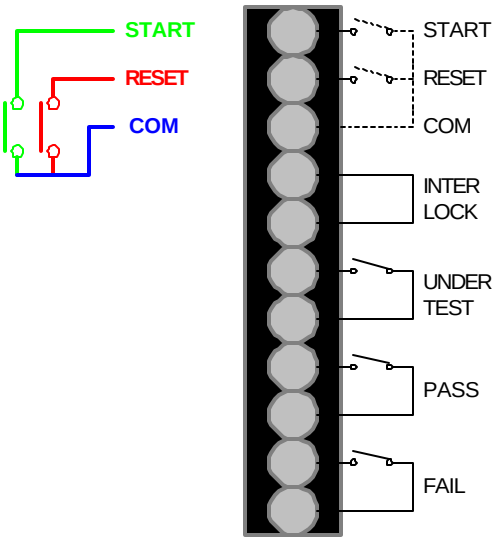


Figure 3-2: Single Control of START or RESET

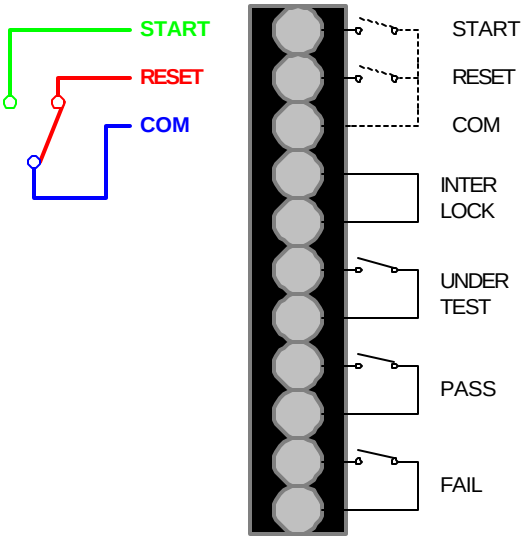


Figure 3-3: Continuous Control of RESET

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 20milliseconds. The above circuits are not isolated from other internal circuits. To terminate a test connect the RESET and COM terminals.

Figure 3-4 illustrates a logic component (such as a FET, photocoupler or transistor) as a control circuit. To use this system to control the circuit, the low signal current must be ≤2mA and the input signal's active time must be >20ms. The relay switch in Figure 3-2 or the coupler control in Figure 3-4 uses the component's contact for the control action, not both. This can effectively prevent operation interference however be observant of interference induced by measurement settings.

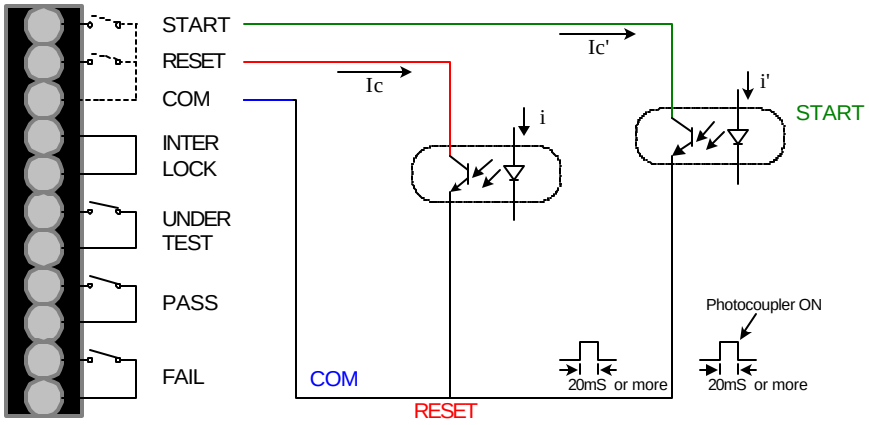


Figure 3-4: Connection for Logic Component as a Control Circuit

Figure 3-5 illustrates the timing diagram for the Sentry 50 Plus instrument under a PASS condition and a FAIL condition.

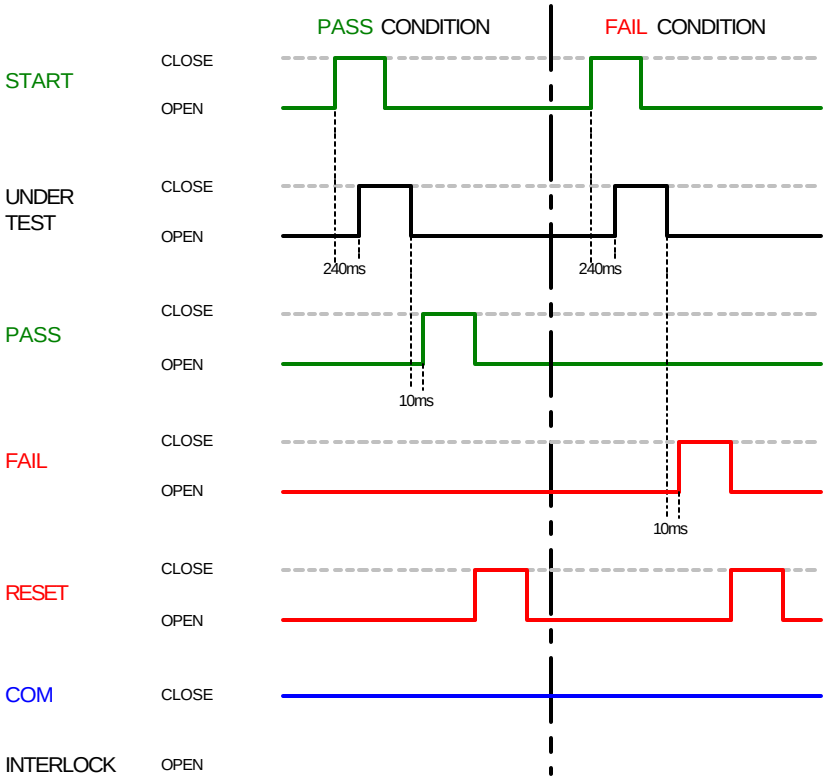


Figure 3-5: Sentry 50 Plus Timing Diagram

3.2 G16 International Power Strip

The Sentry 50 Plus instrument can be connected to the G16 International Power Strip as illustrated in Figure 3-6 for safety testing of many European corded products.

*Australia	*United Kingdom	*Denmark
*North America	*Norway	*Finland
*Sweden	*Germany	*Netherlands
*Austria	*Switzerland	*Italy

The three G-16 ground connectors are connected to the Sentry 50 Plus RTN/LOW terminal. There is a second RTN/LOW terminal on the rear of the Sentry 50 Plus Ground Bond Tester.

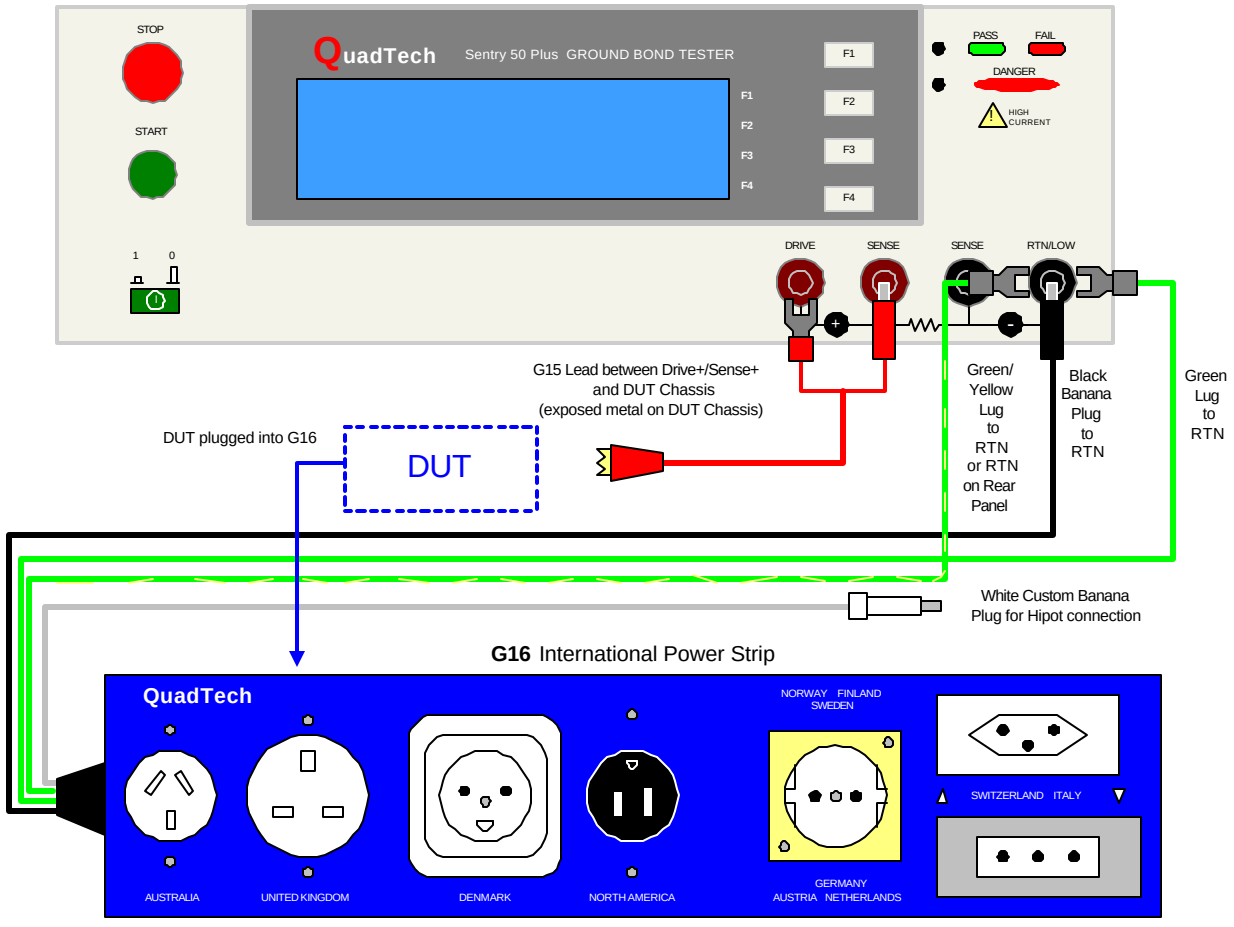


Figure 3-6: G16 International Power Strip Connection to Sentry 50 Plus Instrument

3.3 Connection to a Sentry Plus Series Hipot Tester

The Sentry 50 Plus instrument can be connected to the Sentry Plus 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 Sentry Plus Series instrument and Sentry 50 Plus instrument are connected via the S15 9-pin interconnection cable. Figure 3-7 illustrates the front panel connections of the two instruments.

NOTE: GFI must be set to OFF on the SPlus Hipot Tester when it is connected to the S50Plus.

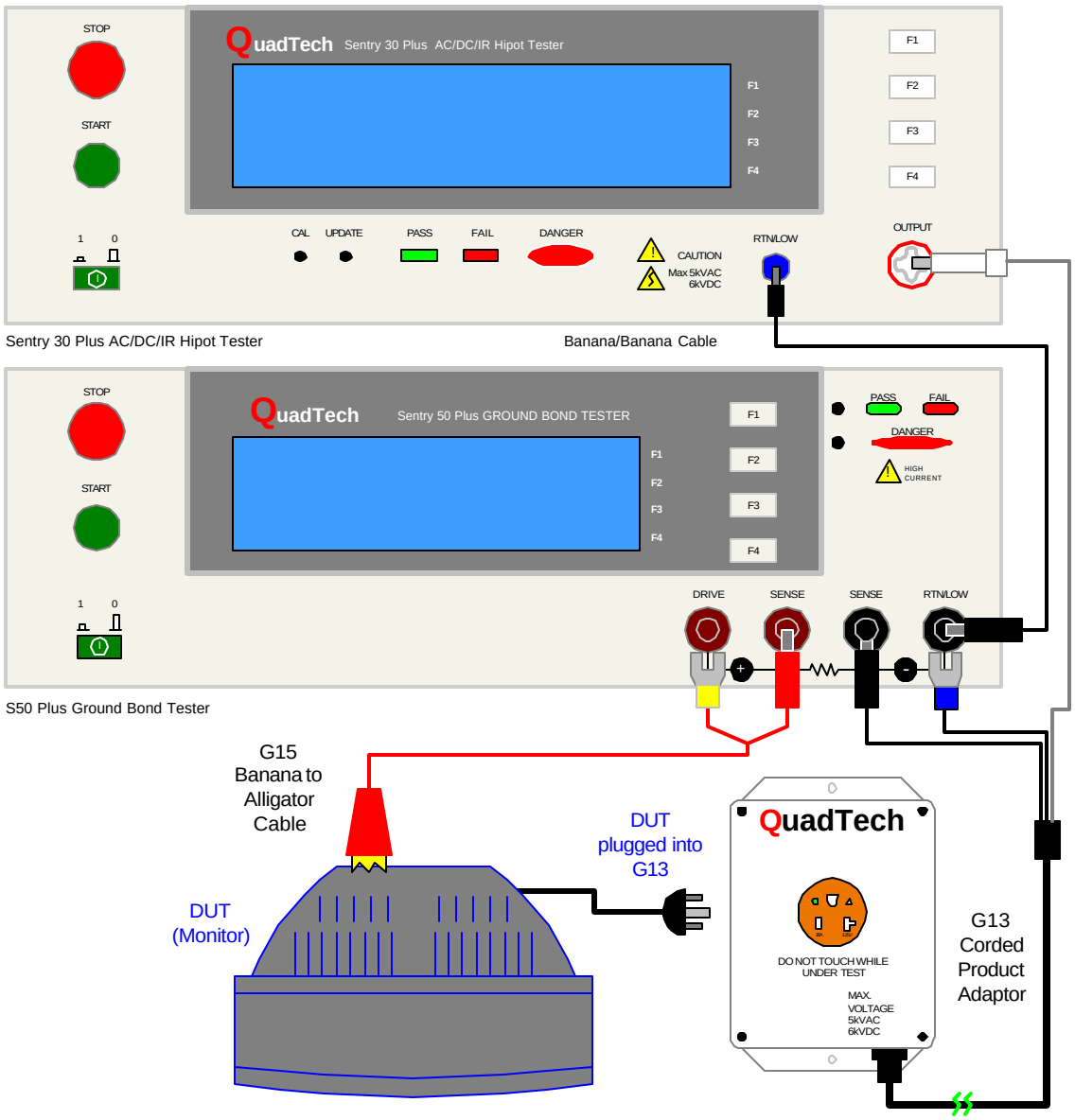


Figure 3-7: Sentry 50 Plus & Sentry 30 Plus

Section 4: Service & Calibration

4.1 General

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

4.2 Instrument Return

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

QuadTech, Inc.
5 Clock Tower Place, 210 East
Maynard, Massachusetts 01754

Attention: RMA#

Shipments sent collect cannot be accepted.

4.3 Calibration

Calibration of the Sentry 50 Plus 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 Sentry 50 Plus 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 Sentry 50 Plus Ground Bond Tester.

Table 4-2: Calibration Parameters

Test		Range		Load	
Current Calibration					
CAL	GBA	30A	OFST	3A	1mΩ
CAL	GBA	30A	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 Sentry 50 Plus 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 30A 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 Sentry 50 Plus instrument to the 1mΩ resistance standard. Connect the AC voltage meter to the Sense+ and Sense- terminals of the Guardian instrument.

Cal Step 1: 'GBA 30A 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 S50Plus 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 30A Full (30A)'. Attach the 100mΩ 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 S50Plus 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 100mΩ 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 S50Plus 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 S50Plus 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 S50Plus 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 S50Plus 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.