Hybrid 2000
AC/DC/IR/DCR Analyzer
Instruction Manual

Form 150827/A1

5 Clock Tower Place, 210 East
Maynard, Massachusetts, U.S.A. 01754
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Telephone	978-461-2100
Sales	800-253-1230
Facsimile	978-461-4295
Website	www.quadtech.com

WARNING

Potentially dangerous voltages 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 voltage 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.


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

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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

AC Dielectric Withstand Voltage (WVAC)

AC Output Voltage:	Range:	0.05 to 5kV AC, in 1V steps
	Regulation:	± (1% of setting +5V)
	Frequency:	50/60Hz selectable
Voltage Display:	Accuracy:	± (1% of reading +5V)
	Resolution:	1V steps
AC Current Display:	Total & Real current	
	Range:	0.001mA to 30mA AC, in 1μA steps
	Accuracy:	± (1% of reading + 5 counts) (Total)
	Accuracy:	± (5% of reading + 20 counts) (Real)

DC Dielectric Withstand Voltage (WVDC)

DC Output Voltage:	Range:	0.05 to 6kV DC, in 1V steps
Voltage Display:	Accuracy:	± (1% of reading +5V)
	Resolution:	1V steps
DC Current Display:	Range:	0.0001mA to 10mA DC
	3 Ranges:	.0001mA - .2999mA, 0.3mA-2.999mA, 3mA-10mA
	Accuracy:	± (1% of reading + 5 counts)

Insulation Resistance (IR)

Insulation Resistance:	Voltage:	50 - 5000V DC in 1V steps
	Accuracy:	± (1.5% of reading + 5V)
	Range:	1MΩ - 50GΩ (voltage dependent)
	Accuracy:	1MΩ - 1GΩ, ± (3% + 10counts) ≥ 500V
		1GΩ - 10GΩ, ± (7% + 10counts) ≥ 500V
		10GΩ - 50GΩ, ± (10% + 10counts) ≥ 500V

DC Resistance (DCR)

DC Resistance:	Range:	50mΩ - 100kΩ
	Accuracy:	.01Ω - 10Ω: ± (2% of reading + 0.5% of range)
		10.01Ω - 100Ω, ± (2% of reading + 0.5% of range)
		100.0Ω - 1kΩ, ± (2% of reading + 0.5% of range)
		1.001kΩ - 10kΩ, ± (2% of reading + 0.5% of range)
		10.01kΩ - 100kΩ, ± (2% of reading + 0.5% of range)

Open/Short Check (OSC)

Open/Short:	Detection mode to verify proper connection of DUT	
	Voltage:	< 100V
	Frequency:	600Hz
	Open:	programmable: 10% - 100%, default: 50%
	Short:	programmable: 100% - 500%, default: 300%

Specifications (Continued)

General Features

ARC Detection:	Detection Current:	Range: 0.1mA – 15mA AC and 10mA DC
	Pulse Width:	Minimum: 10µs
Ground Fault Interrupt (GFI):	Instrument Shutdown when current imbalance > 0.5mA	
Fast Output Cutoff:	HV output voltage terminated <0.4mS after NG (Fail) result	
Fast Discharge:	<0.2s (Typical) Discharge of DUT upon termination of HV.	
Time:	Ramp:	0.1sec – 999 sec, OFF
	Dwell:	0.1sec – 999 sec, OFF (DC only)
	Test*:	0.3sec – 999 sec, Continuous
	Fall:	0.1sec – 999 sec, OFF
	*Test Time ≤ 60seconds when the voltage and high current limit is > 100VA	
Limits:	HI/LO programmable during Test Time LO can be set to OFF during Hipot Test HI can be set to OFF during IR Test	
Indication:	Pass/fail LEDs, audible alarm	
Setup Storage:	50 Memory Locations, 20 Steps each	
Interlock:	Safety Mechanism Terminal Strip	
Standard Interfaces:	RS232, 9-pin male D-Series	
Scanner:	8 Channel HV Internal Scanner, Front Panel access	
Connectors:	Front Panel Connection HV OUTPUT: Custom Banana Sockets (8) RTN/LOW: Banana Socket (1)	
Front Panel Lockout:	11 Digit Password with or without setup recall LED Display: LOCK	
Display:	240x300 LCD with status LEDs: LOCK, ERR, RMT, CORR View as single step or list of all programmed steps in a test setup.	

Specifications (Continued)

General Features

Mechanical: Bench Mount
Dimensions: (w x h x d): 17 x 6.8 x 17.7 inches; 430 x 175 x 450 mm

Weight: 44 lbs (20 kg) net, 50 lbs (22 kg) shipping

Environmental:

Operating:	0°C to + 40°C
Humidity:	<70% RH
Storage:	-10°C to + 60°C
Warm-up Time:	15 minutes

Power:
- 90 - 130V AC
- 200 - 250V AC
- 50 or 60Hz
- 500W max

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

Ordering Information:

Description	Catalog No.
AC/DC/IR/DCR Analyzer	Hybrid 2000

Accessories

Accessories Included

Item	Quantity	QuadTech P/N
AC Power Cord	1	4200-0300
Power Line Fuse 5A 250V SB	1	520068
Power Line Fuse 2.5A 250V SB	1	520134
High Voltage Lead Set, 1m with alligator clips	1	S02
Ground Continuity Lead	1	700100
HV Lead Set (8), Banana to non-terminated ends	1	G40
Instruction Manual	1	150827
Calibration Certificate	1	N/A

Accessories/Options Available

Item	Quantity	QuadTech P/N
High Voltage Lead Set, high & low, 1m (std. with unit)	1	S02
Corded Product Adaptor, 115V	1	S03
High Voltage Lead Set, high & low, 2m	1	S04
Foot Switch	1	S05
High Voltage Probe	1	S06
Power Entry Adaptor Cable	1	S07
Gun Probe	1	S08
High Voltage Lead, 1m, unterminated	1	S09
High Voltage Lead, 2m, unterminated	1	S10
Gun Probe with Remote Start	1	S11
Load Box, resistive	1	S12
Load Box, custom resistors	1	S14
Pass/Fail Load Box	1	S14-01
Load Box, Power Entry Adapter, Pass/Fail	1	S14-03
Ground Continuity Lead (standard with unit)	1	700100
International Power Strip	1	G16
Corded Product Adaptor, 240V	1	G25
HV Lead Set (8) with clips (G1030S)	1	G40
RS-232 Cable (9-pin male to female), 10’ length	1	630157

Safety Precautions

WARNING

The Hybrid 2000 Analyzer can provide an output voltage as high as 6000V DC (5000V AC) to the external device under test (DUT). Although the Hybrid 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. The Hybrid 2000 unit is designed to be operated 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 Hybrid 2000 is not connected to earth ground.
2. Tightly connect cable(s) to the (blue) RTN/LOW terminal. If this is not done, the DUT's casing can be charged to the high voltage 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 Hybrid 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 if there is any concern that HV may still be 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 Hybrid 2000 INSTRUMENT.
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 Hybrid 2000 instrument is used in remote control mode, be extremely careful. The High Voltage Output is being turned on and off with an external signal.

    <u>While Under Remote Control</u>:

    The operator or service personnel must NOT touch the device under test, the test leads or the test probes in any manner when the instrument is under test.

    Caution must be used to ensure that the unintentional access to the rear panel remote start control (via gun probe, foot switch or other means) can NOT occur.

Condensed Operating Instructions

WARNING

High Voltage is applied to the white HV Output Terminal 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 Hybrid 2000 AC/DC/IR/DCR Analyzer is a measuring instrument for direct readout of dielectric withstand voltage and leakage current; insulation resistance and DC resistance. The voltage applied to the device under test is adjustable from 50V – 5kV AC and 50V to 6kV DC. The trip current limit is programmable from 1uA to 30mA AC and from 0.1uA to 10mA DC (range dependent). The output voltage for Insulation Resistance tests is 50V to 5000V DC over a measurement range of 1MΩ to 50GΩ. DC Resistance (DCR) is measurable from 50mΩ to 100kΩ. The Open/Short Circuit (OS) detection mode verifies the proper connection of the DUT by comparing the test reading to a standard capacitance value, Cs.

Start-Up

The Hybrid 2000 unit can be operated from a power source between 90 and 250VAC at a power line frequency of 50 or 60Hz. The standard Hybrid 2000 unit is shipped from QuadTech with a 5A fuse in place for AC 90-130V operation. (A 2.5A fuse is included for 200-250V operation). The Hybrid 2000 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 Hybrid 2000 unit AC power cord to the source of proper voltage. Operate the Hybrid 2000 instrument with its chassis connected to earth ground. The Hybrid 2000 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 Hybrid 2000 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 Hybrid 2000 instrument should warm up for 15 minutes prior to use.

NOTE

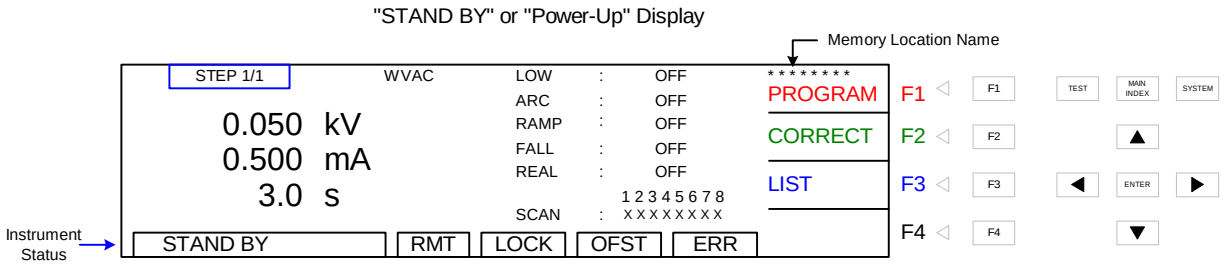
Please read this instruction manual in its entirety before operating this instrument. These condensed operating instructions are not a substitute for all the information provided in the remainder of this manual.

NOTE

Refer to paragraphs 2.3 through 2.11 for a full description of programming test parameters and instruction on how to store the test setup. Test parameters must be set before the Hybrid 2000 instrument can be zeroed.

Condensed Operating Instructions (Continued)

There are several menus within the Hybrid 2000 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.



F1 PROGRAM — Program a Test

Insert
Delete
Program
  STEP: 1-20
  MODE: WVAC/WVDC/IR/DCR/OS/PA

WVAC:	WVDC:
Voltage	Voltage
High Limit	High Limit
Test Time	Test Time
Low Limit	Low Limit
ARC Limit	ARC Limit
Ramp Time	Ramp Time
Fall Time	Dwell Time
REAL Limit	Fall Time
Channel 1-8	Channel 1-8

IR:	DCR:
Voltage	High Limit
Low Limit	Low Limit
Test Time	Test Time
High Limit	Range
Ramp Time	Dwell Time
Fall Time	Channel 1-8
Range	
Channel 1-8	

OSC:	PA:
Open %	Message
Short %	Time
Channel 1-8	

F2 CORRECT — Run Lead Correction

Open Correction
  Current Offset: WV, IR Modes
  Stray Capacitance: OSC Mode
Short Correction
  Short Circuit: DCR Mode
Sample Test

F3 LIST — Change Display

Display:
  List (Tabular) Format
  Step Format

TEST — Standby Display

MAIN INDEX — Memory

Store
Recall
Delete

SYSTEM — Change System Parameters

Test Control
  Pass Hold
  ACV Frequency
  Software AGC
  WV Auto Range
  GFI
  Fail Continuity
  Ramp Judgment
System Config
  Contrast
  Beeper
  GPIB
  Handler
  RS232 #1
  RS232 #2
Key Lock
Calibration
Error Log
About

Figure COI-1: Hybrid 2000 Menus

Condensed Operating Instructions (Continued)

With the Hybrid 2000 instrument in "STAND BY" (or power-up display) status, follow the steps in Table COI-1 to program an OSC, WVAC, WVDC, IR and/or DCR test. A pause (PA) can be inserted between tests.

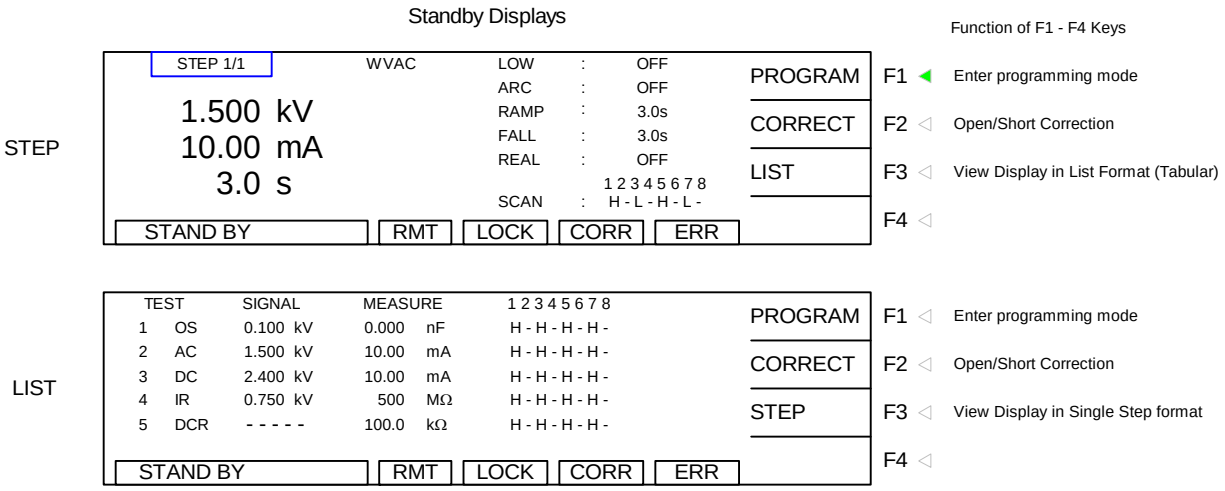


Figure COI-2: STAND BY Displays: STEP and LIST

Table COI-1: Test Parameter Setup

	OSC	AC Hipot	DC Hipot	IR	DCR	PA
1	Test Step	Test Step	Test Step	Test Step	Test Step	Test Step
	1-20	1-20	1-20	1-20	1-20	1-20
2	Test Mode	Test Mode	Test Mode	Test Mode	Test Mode	Test Mode
	OSC	WVAC	WVDC	IR	DCR	PA
3	Open Check	Voltage	Voltage	Voltage	High Limit	Message
	10-100%	0.05-5kV	0.05-6kV	0.05-5kV	0.1Ω-100kΩ	15 characters
4	Short Check	High Limit	High Limit	Low Limit	Low Limit	Time
	0, 100-500%	0.001-30mA	0.0001-10mA	1-50000MΩ	0.1Ω-100kΩ	0, 0.1-999s
5	Output CH	Test Time	Test Time	Test Time	Test Time	
	1-8: H, L, -	0, 0.3-999s	0, 0.3-999s	0, 0.3-999s	0, 0.1-999s	
6		Low Limit	Low Limit	High Limit	Range	
		0 - High	0 - High	0, Low-50GΩ	A, 10k, 100k	
7		Arc Limit	Arc Limit	Ramp Time	Dwell Time	
		1-15mA	1-10mA	0-999s	0, 0.1-999s	
8		Ramp Time	Ramp Time	Fall Time	Output CH	
		0-999s	0-999s	0-999s	1-8: H, L, -	
9		Fall Time	Dwell Time	Range		
		0-999s	0-999s	A, 3mA, 10mA		
10		Real Current	Fall Time	Output CH		
		0 - High	0-999s	1-8: H, L, -		
11		Output CH	Output CH			
		1-8: H, L, -	1-8: H, L, -			

Offset Correction

After setting your test parameters, zero the Hybrid 2000 instrument by using the automatic offset correction. With no device connected, connect the appropriate cable (or other fixture) into the front panel output connectors. Refer to paragraph 2.15 cable connections based on test to be performed. Test leads for WVAC, WVDC and OSC should be open.

Prior to performing the Offset Correction:

- Allow the instrument to warm up for 15 minutes
- Connect the test cables (fixture) to the front panel output (CH_) and/or RTN/LOW connectors
- Program the test steps

With the instrument in STAND BY status:

- Press [F2] = CORRECT
- Press [F1] = OPEN
- Follow instructions on display: i.e.: Remove DUT from test fixture
- Press green [START] button
- Wait while instrument gets correction value
- The CORR block at the bottom of the display is now highlighted (back lit)
- Press [F4] = ABORT to return to STAND BY status

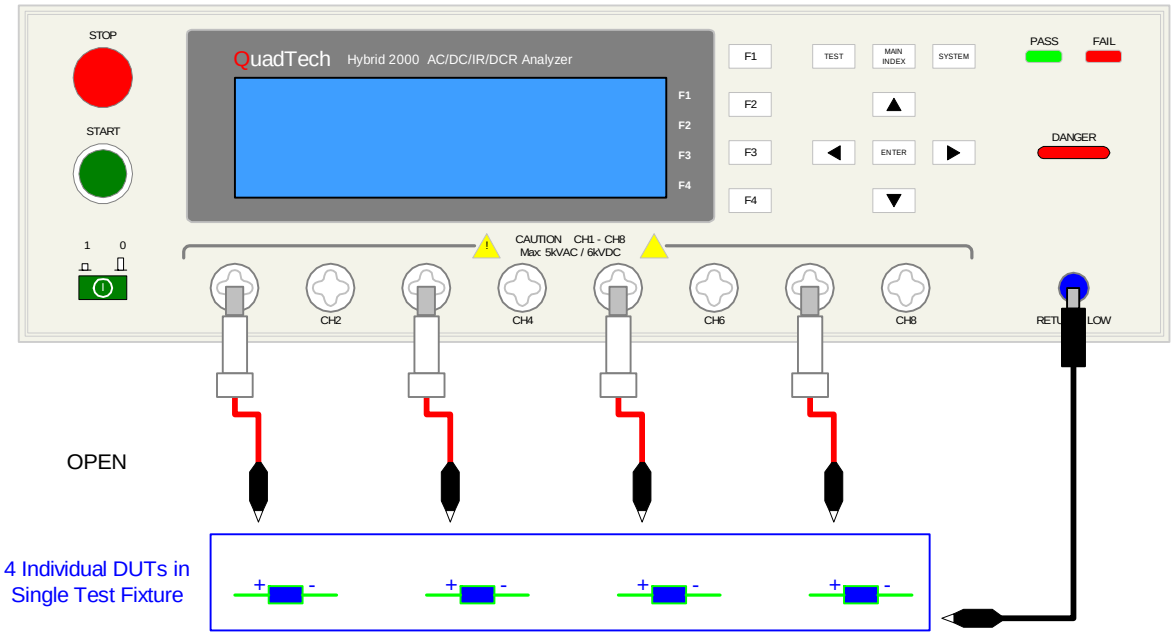


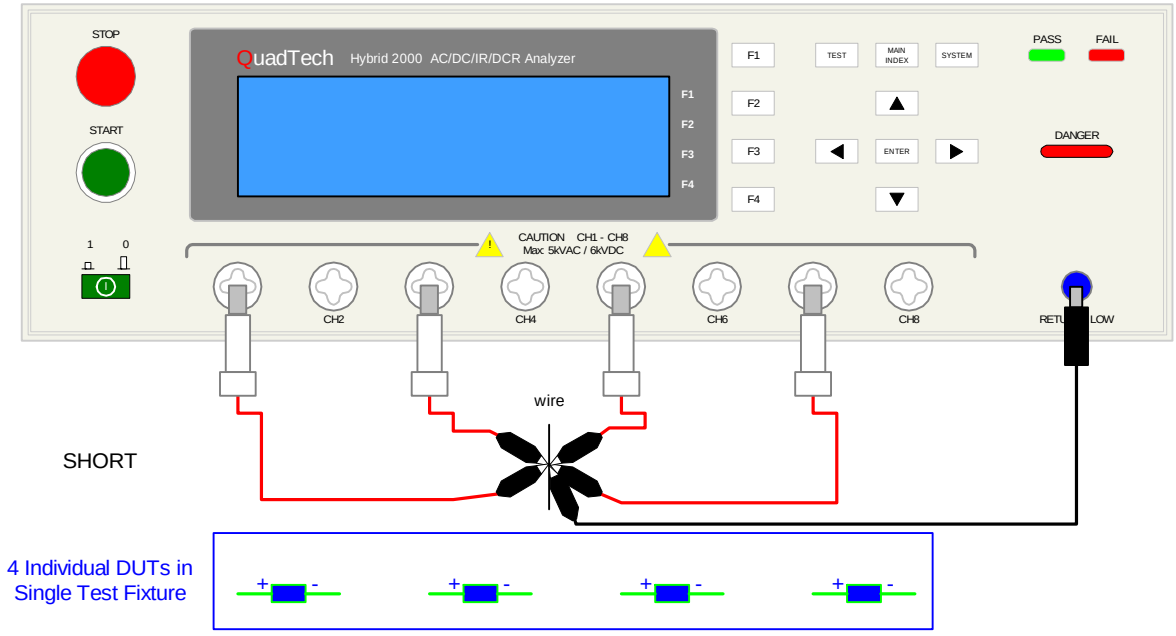
Figure COI-3: Offset Correction OPEN Configuration

Condensed Operating Instructions (Continued)

NOTE:
To obtain consistent results, the Offset Correction must be performed when using OSC mode. The Offset Correction is performed prior to the Get Cs function.

For DCR Mode run the Short correction:

- Press [F2] = CORRECT
- Press [F2] = SHORT CIRCUIT
- Follow instructions on display: i.e.: Place Short Circuit Kit
- Press green [START] button
- Wait while instrument gets correction value
- The CORR block at the bottom of the display is now highlighted (back lit)
- Press [F4] = ABORT to return to STAND BY status



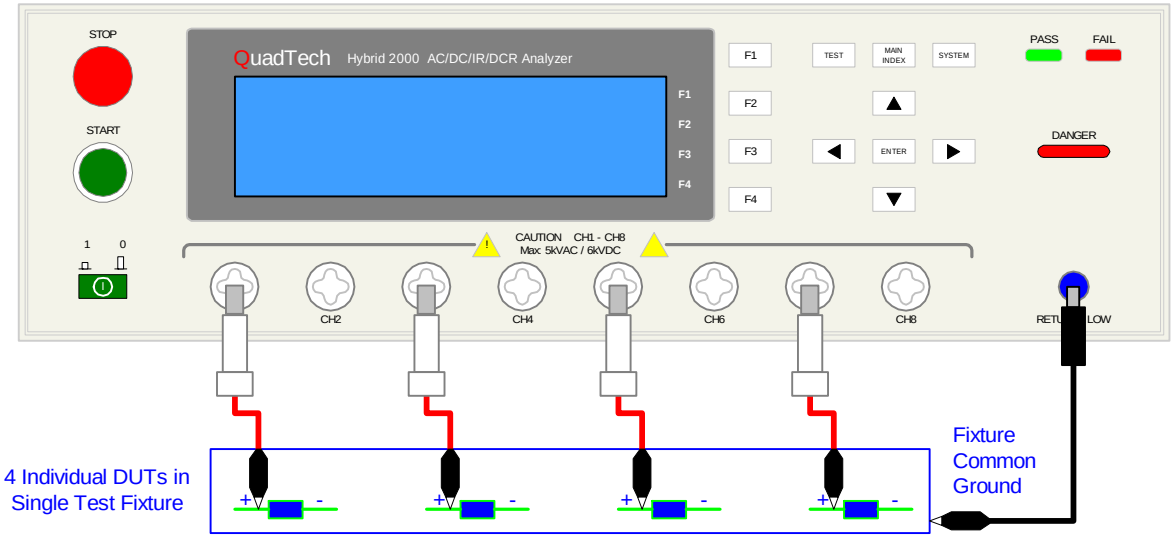
For OSC Mode run the Get Cs correction:

- Press [F2] = CORRECT
- Press [F3] = SAMPLE TEST
- Follow instructions on display: i.e.: Get C Nominal (OSC); Place Sample DUT
- Press green [START] button
- Wait while instrument gets correction value
- The CORR block at the bottom of the display is now highlighted (back lit)
- Press [F4] = ABORT to return to STAND BY status

Condensed Operating Instructions (Continued)

Connection to Device under Test (DUT)

Figure COI-4 illustrates the connection of the Hybrid 2000 unit to four DUTs in a test fixture using the lead set that comes standard with the instrument. The custom white banana plug/red alligator clip is connected between the output terminal (CH_) on the Hybrid 2000 unit and the high side of the device under test. The black banana plug/alligator clip is connected between the RTN/LOW terminal on the Hybrid 2000 unit to the low side of the DUT.



COI-4: Connection to Device under Test

Measurement Mode

1. Turn [POWER] ON. Allow Hybrid 2000 instrument a 15-minute warm up time.
2. Connect Black ground cable to Hybrid 2000 unit RTN/LOW terminal
3. Connect White/red HV cable to Hybrid 2000 unit HV output terminal(s) = CH_.
4. Press [F1] = PROGRAM and enter test parameters. When finished programming, press [TEST] to return to Stand By status.
5. Press [F2] = CORRECT to access Correction function. Press [F1] = OPEN CIRCUIT. Follow instructions. Press [F2] = SHORT CIRCUIT. Follow instructions. When Offset is complete, press [F4] = EXIT to go to Stand By.
6. Press [F2] = CORRECT to access GET Cs function. Press [F3] = SAMPLE TEST. Follow Get Cs instructions. When Get Cs is done press [F4] = EXIT to go to Stand By.
7. Connect device under test (DUT) to test leads.
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 Hybrid 2000 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 recalibration or service.

1.2 Product Overview

The Hybrid 2000 provides AC Dielectric Withstand, DC Dielectric Withstand, Insulation Resistance and DC Resistance testing capability. The dielectric withstand test can be programmed over a voltage range of 0.05 to 5kV AC and 0.05 to 6kV DC with a min/max leakage current detection range of 0.001 to 30mA AC and 0.0001 to 10mA DC. Insulation resistance measurements are possible to 50GΩ at programmable DC test voltages between 50 and 5000V. DC Resistance (DCR) is measurable from 50mΩ to 100kΩ. The Hybrid 2000 also provides open/short circuit detection mode to ensure proper connection of the DUT and pause mode for adding a hold time between tests. The Hybrid 2000 instrument has automatic offset correction to zero out stray capacitance and resistance of the test leads/fixture.

The Hybrid 2000 incorporates multiple safety features including GFI, fast HV output cutoff and quick DUT discharge. Danger LED indicates high voltage and Pass/Fail LEDs accompanied by audible warnings indicate test result. The instrument provides internal storage of 50 test setups with 20 steps each. The enhanced LCD has two viewing modes - Step and List - to view the programmed test as a single step or view all the steps of a single test in list format. The display also has status indicators for Remote, Lock, Correction and Error functions. The Key Lock function provides password-protected front panel lockout. The RS232 interface is standard equipment as is the internal 8 channel HV scanner for multi-point and multi-device testing.

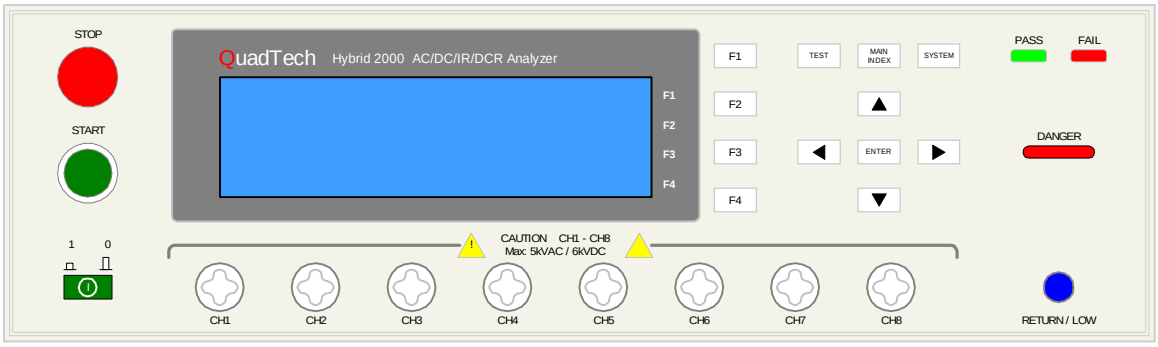


Figure 1-1: Hybrid 2000 AC/DC/IR/DCR Analyzer

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 Hybrid 2000 AC/DC/IR/DCR Analyzer. Table 1-1 identifies them with description and function.

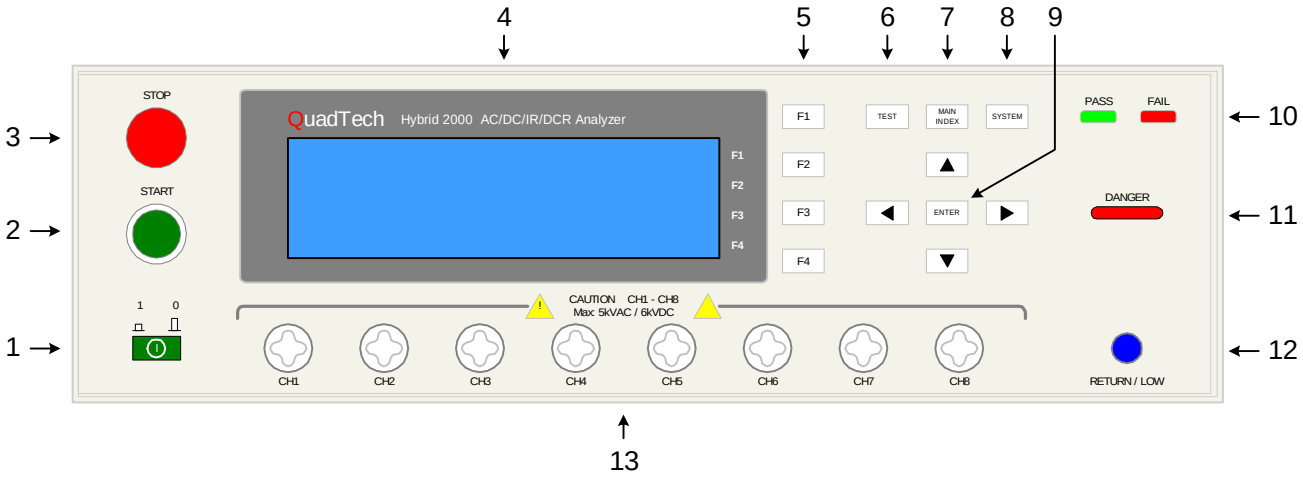


Figure 1-2: Hybrid 2000 Front Panel Controls & Indicators

Table 1-1: Hybrid 2000 Front Panel Controls & Indicators

Ref # Fig 1-2	Name	Type	Function
1	Power	Green Push Button	Apply AC Power: 1=ON, 0=OFF
2	START	Green Push Button	Initiate Test: HV applied to OUTPUT terminal
3	STOP	Red Push Button	Stop Test: HV terminated at OUTPUT terminal
4	Display	LCD	Program Menu, Test Setup, Measurement Results, Memory Contents, Calibration STEP = View Single Step of Test with parameters LIST = View all Steps of Test in list format
5	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.
6	TEST	Gray Push Button	Select Standby Menu: Program, Correct, DSP (Display)
7	MAIN INDEX	Gray Push Button	Select Memory Menu: Store, Recall, Delete Test Setups
8	SYSTEM	Gray Push Button	System Setup: Test Control, System Configuration, Key Lock, Calibration, Error Log and About Functions
9	▲ ▼ ◀ ▶	Gray Push Buttons	Move backlit box (highlighted parameter) UP, DOWN, LEFT and RIGHT within Program Mode.
	ENTER	Gray Push Button	In Program Mode: Accept Value in backlit box
10	PASS	Green LED	When lit, DUT judged as PASS
	FAIL	Red LED	When lit, DUT judged as FAIL. Output voltage is immediately cut off. Press [STOP] to disable FAIL LED
11	DANGER	Red LED	When lit, high voltage is present at OUTPUT terminals
12	RTN/LOW	Blue Banana Socket	RTN: Low voltage reference terminal LOW: Common ground reference terminal
13	CH1-8	8 White Custom Banana Sockets	High Voltage Output Channels Programmed: H (High); L (Low) or – (unused)

1.3.2 Rear Panel Controls and Connectors

Figure 1-3 illustrates the controls and connectors on the rear panel of the Hybrid 2000 AC/DC/IR/DCR Analyzer. Table 1-2 identifies them with description and function.

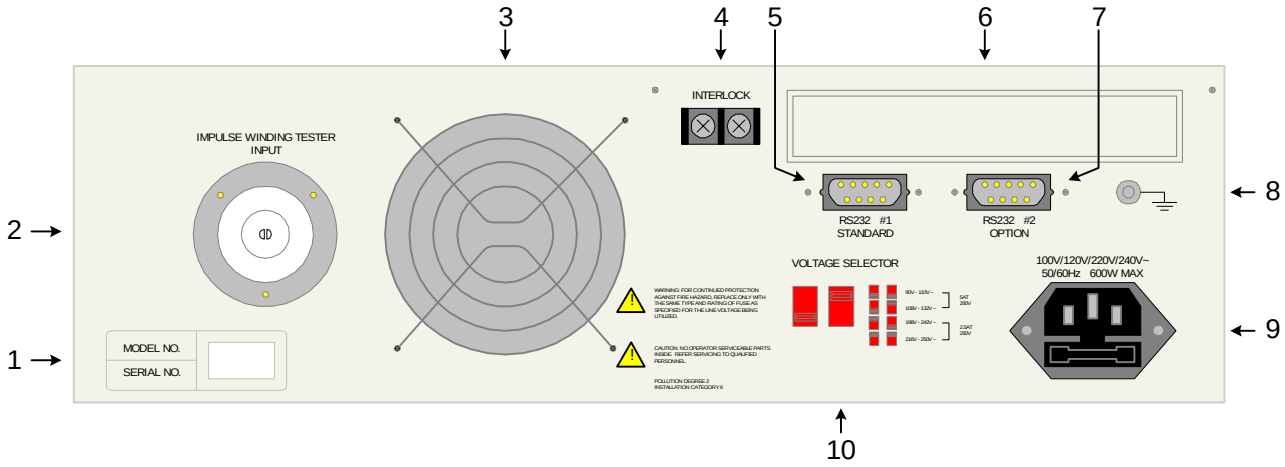


Figure 1-3: Rear Panel Hybrid 2000 Instrument

Table 1-2: Hybrid 2000 Rear Panel Controls & Connectors

Reference # Figure 1-3	Name	Type	Function
1	Model No. Serial No.	White Barcode Sticker	Instrument Identifiers Model No. Hybrid 2000; Serial No. Unique ID
2	IWT Input	Black 11-screw	Remote Connection to Impulse Winding Tester
3	Fan	# AD0824HB A70GL DC 24V 0.16A	Temperature Control Fan to cool unit: ON ≥50°C, OFF <50°C
4	INTERLOCK	Black 2-screw Terminal Strip	Safety Function: Control HV output to front channels Jumper in place: HV is available at front channels
5	RS232 #1	Silver 9-pin Male	RS232 Interface connector
6			Future expansion: IEEE-488 and Handler
7	RS232 #2	Silver 9-pin Male	Optional 2nd RS232 Interface connector
8	Chassis Ground	Silver Banana, Screw	Chassis Ground Connection
9	AC Line Input	Black 3-wire inlet module & fuse holder	Connection to AC power source Fuse Drawer: 5A 250V or 2.5A 250V (see #10)
10	VOLTAGE SELECTOR	2 Red 2-position Slide Switches	Select Voltage Level corresponding to AC Source 90V – 110V: 5A 250V Slow Blow 110V – 130V: 5A 250V Slow Blow 200V – 240V: 2.5A 250V Slow Blow 220V – 250V: 2.5A 250V Slow Blow

1.4 Installation

1.4.1 Dimensions

The Hybrid 2000 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 Hybrid 2000 instrument can be tilted up for convenient operator viewing.

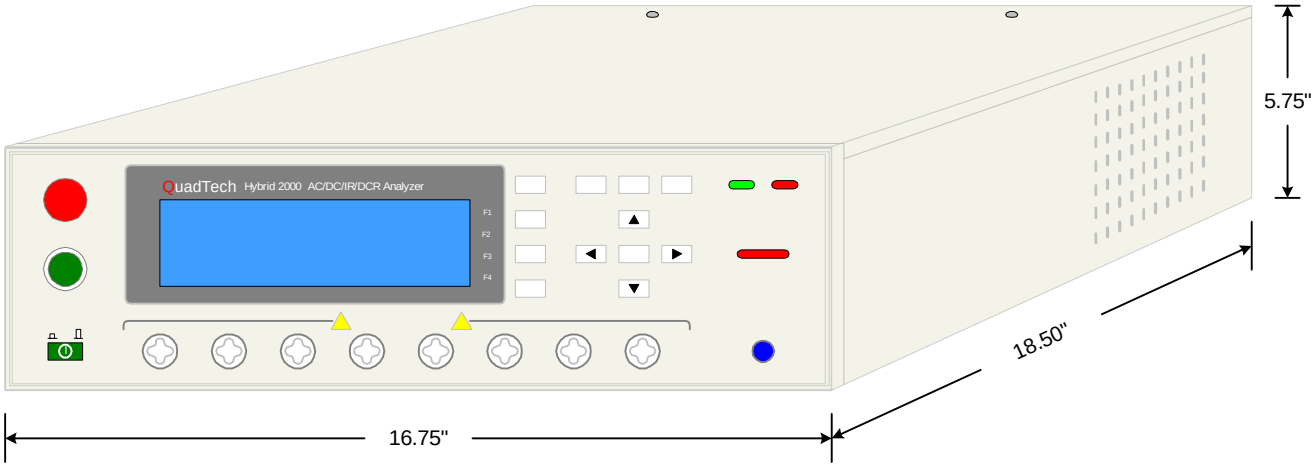


Figure 1-4: Hybrid 2000 Instrument Dimensions

1.4.2 Instrument Positioning

The Hybrid 2000 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 Hybrid 2000 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 5A 250V fuse. For a 198-250V source, use a 2.5A 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 Hybrid 2000 Instrument 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.

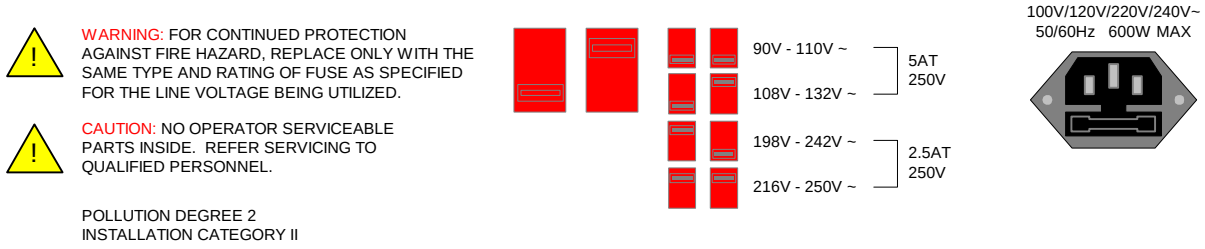


Figure 1-5: Close-Up of Hybrid 2000 Rear Panel

1.4.4 Safety Inspection

Before operating the instrument inspect the power inlet module on the rear of the Hybrid 2000 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 Hybrid 2000 instrument is shipped with a standard U.S. power cord, QuadTech P/N 4200-0300 (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 Hybrid 2000 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.

DC Resistance (DCR): The electrical characteristic that impedes the flow of current through a circuit to which voltage has been applied. DCR = V_{DC}/I.

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 tests.
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.

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 dielectric withstand (hipot), leakage current and ground bond test modes 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. In insulation resistance test mode a low limit is required. In an AC or DC hipot test, the low limit FAIL decision occurs at the end of the programmed test time.

Mode: The test which is to be performed such as AC Dielectric Withstand Voltage (WVAC), DC Dielectric Withstand Voltage (WVDC), Insulation Resistance (IR) or DC Resistance (DCR)

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

Step: The Hybrid 2000 instrument can perform up to 20 steps in one test setup. The step number indicates the order in which the tests will be performed. If step 1 is an OSC test, step 2 a WVAC test and step 3 an IR measurement then when a test is started the Hybrid 2000 will perform an Open/Short Circuit check, followed by an AC hipot test then an insulation resistance test.

Test Current:

Real Current: The real current test is a measure of the resistive current component of the device under test. The resistive component is attributed to the resistance of the device's insulation.

Total Current: The total current test is a measure of the resistive and reactive current components of the device under test. The reactive component is attributed to the capacitive or inductive components of the circuit

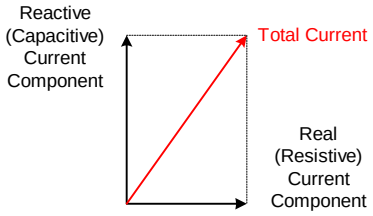


Figure 2-1: Total Current

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 Hybrid 2000 Rear Panel).

WARNING
NEVER TOUCH THE TEST LEADS IN ANY MANNER (this includes insulation on all wires and clips) when HIGH VOLTAGE 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 Hybrid 2000 instrument by pressing the green [POWER] switch on the front panel to the ON (1 position). The Hybrid 2000 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.

2.3 Programming Electrical Safety Tests

The Hybrid 2000 instrument is capable of performing the tests listed in Table 2-2. A single-step test can be performed on a device and is programmed as described in paragraphs 2.4 – 2.7 respectively. When the device under test requires a multi-step test the order of test precedence is important. Refer to paragraph 2.10 for programming a multi-step test.

Table 2-2: Hybrid 2000 Electrical Safety Tests

Test	Software Designation	Program Instructions Paragraph
Open/Short Circuit	OSC	2.4
AC Hipot	WVAC	2.5
DC Hipot	WVDC	2.6
Insulation Resistance	IR	2.7
DC Resistance	DCR	2.8
Pause	PA	2.9
Multi-Step	--	2.10

The output channels are programmed in the last step of an OSC, WVAC, WVDC, IR and DCR test setup. Channels (CH) 1-8 can be programmed to H (High), L (Low) or – (unused). At least one of the 8 channels must be programmed for output.

Function keys of the STAND BY Display

The function keys on the right hand side of the display allow the operator to access the various menus imbedded within the Hybrid 2000 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.

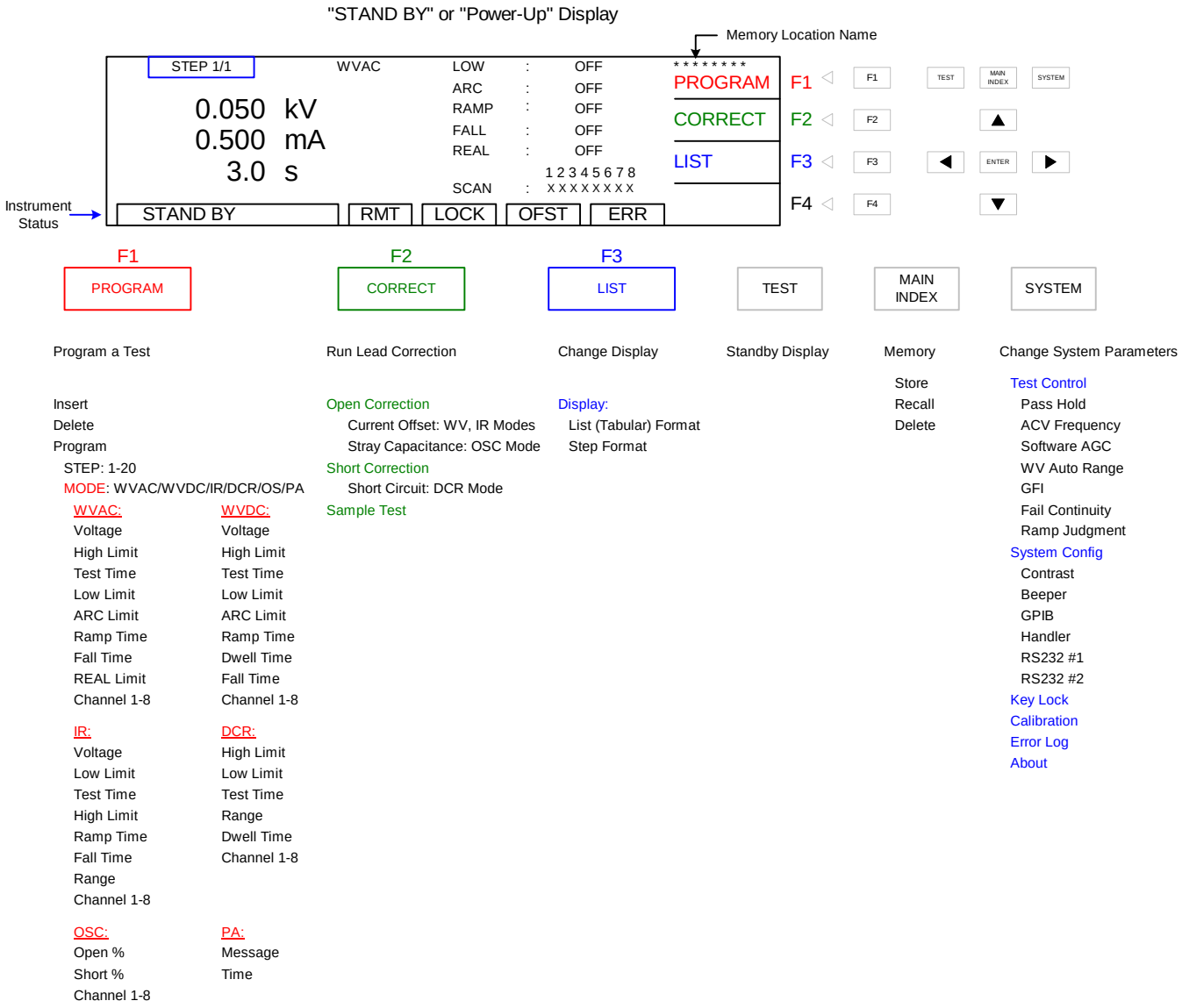


Figure 2-2: STAND BY Function Key Menus

To clarify the various functions of the Hybrid 2000 software, this instruction manual will illustrate the menu 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 2-4 illustrates the Standby STEP display and LIST display shown upon instrument 'power-up'.

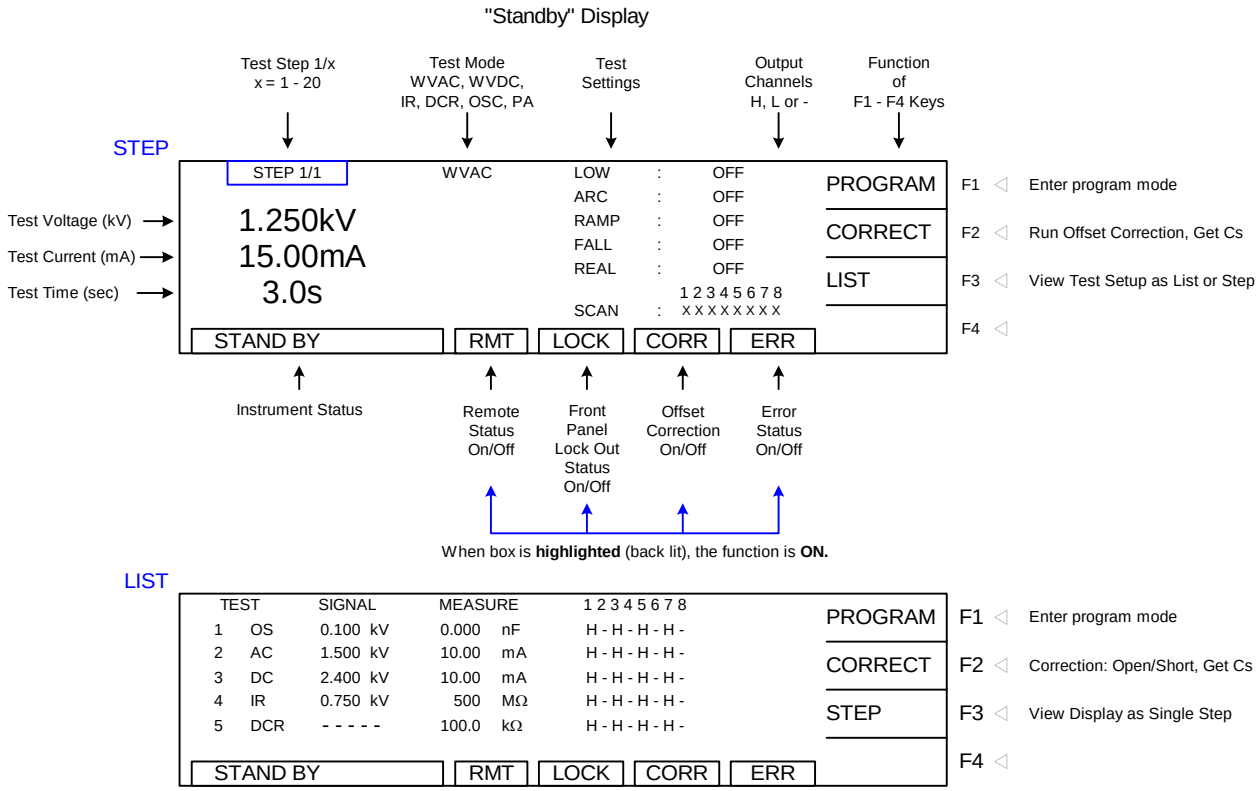


Figure 2-3: Standby Display

To access the programming function of the Hybrid 2000 instrument in the Standby menu, press the [F1] key (PROGRAM). Once in the PROGRAM display, select the test step.

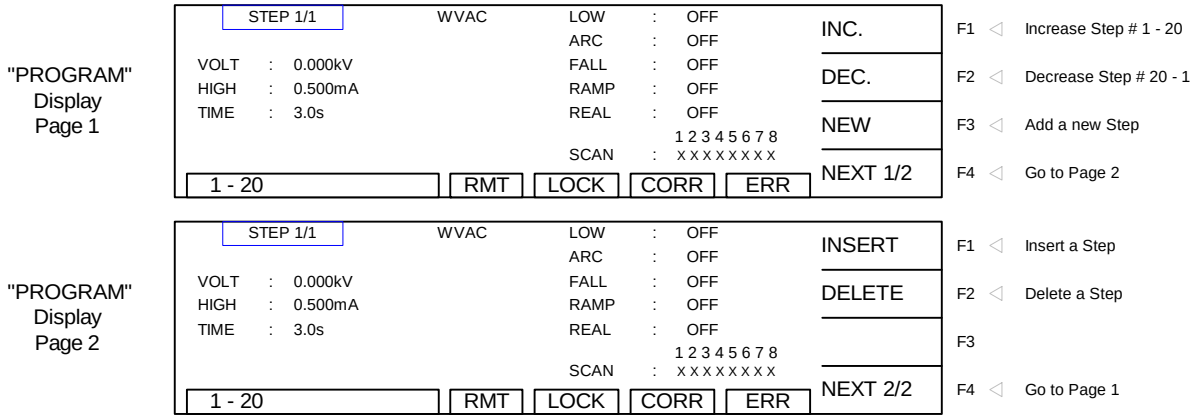


Figure 2-4: Program Display: Setting the Step Number

NOTE: To navigate the menus use the UP, DOWN, RIGHT and LEFT arrow keys to move the highlighted (backlit) box around the display. Use the [ENTER] key to select the parameter to modify. Use the F1 – F4 keys (or arrows) to modify selected parameter. Press [ENTER] again to accept modified value.

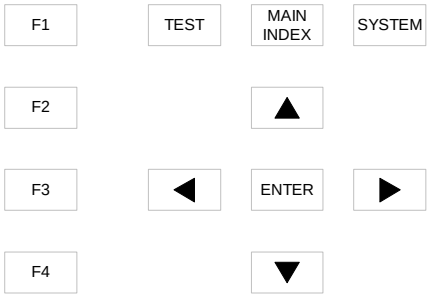


Figure 2-5: Keys for Menu Navigation

Next: Select the test mode (OSC, WVAC, WVDC, IR, DCR or PA). Figure 2-6 illustrates the "Standby" display and the test mode displays. Paragraphs 2.4, 2.5, 2.6, 2.7, 2.8 and 2.9 illustrate how to program the specific parameters of each of the 6 modes. For clarity, a **green** arrow (◀) is used to denote which function key (F1 – F4) is pressed to get to the next display screen.

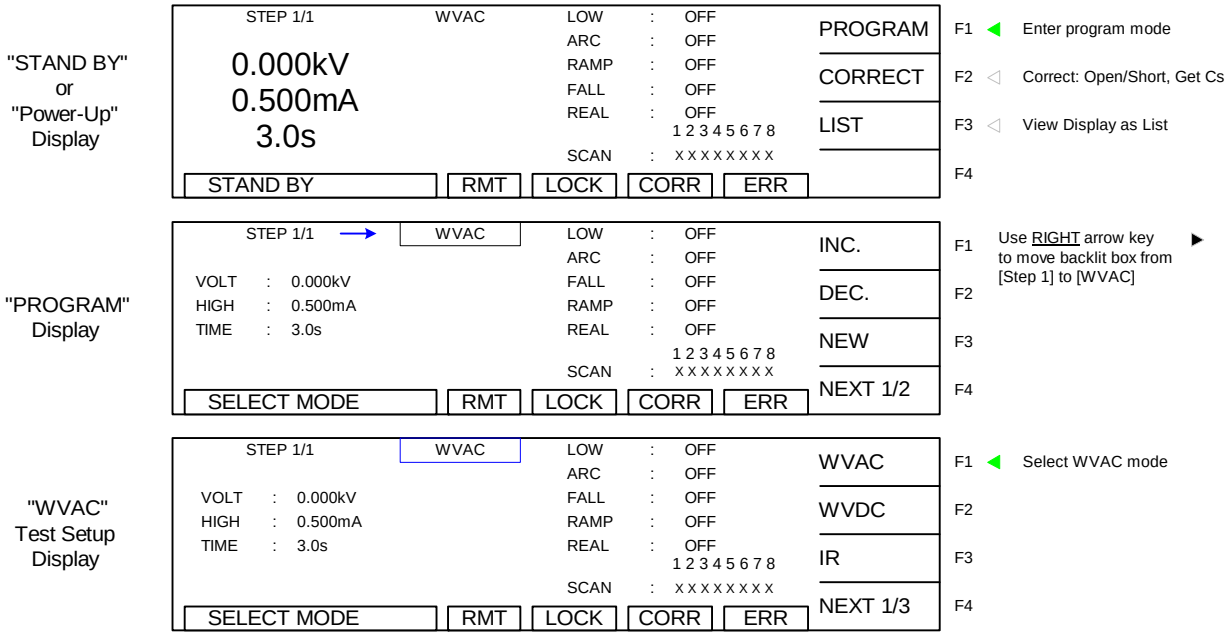


Figure 2-6a: STAND BY, PROGRAM & Test Mode Displays

Mode Displays continued on next page.

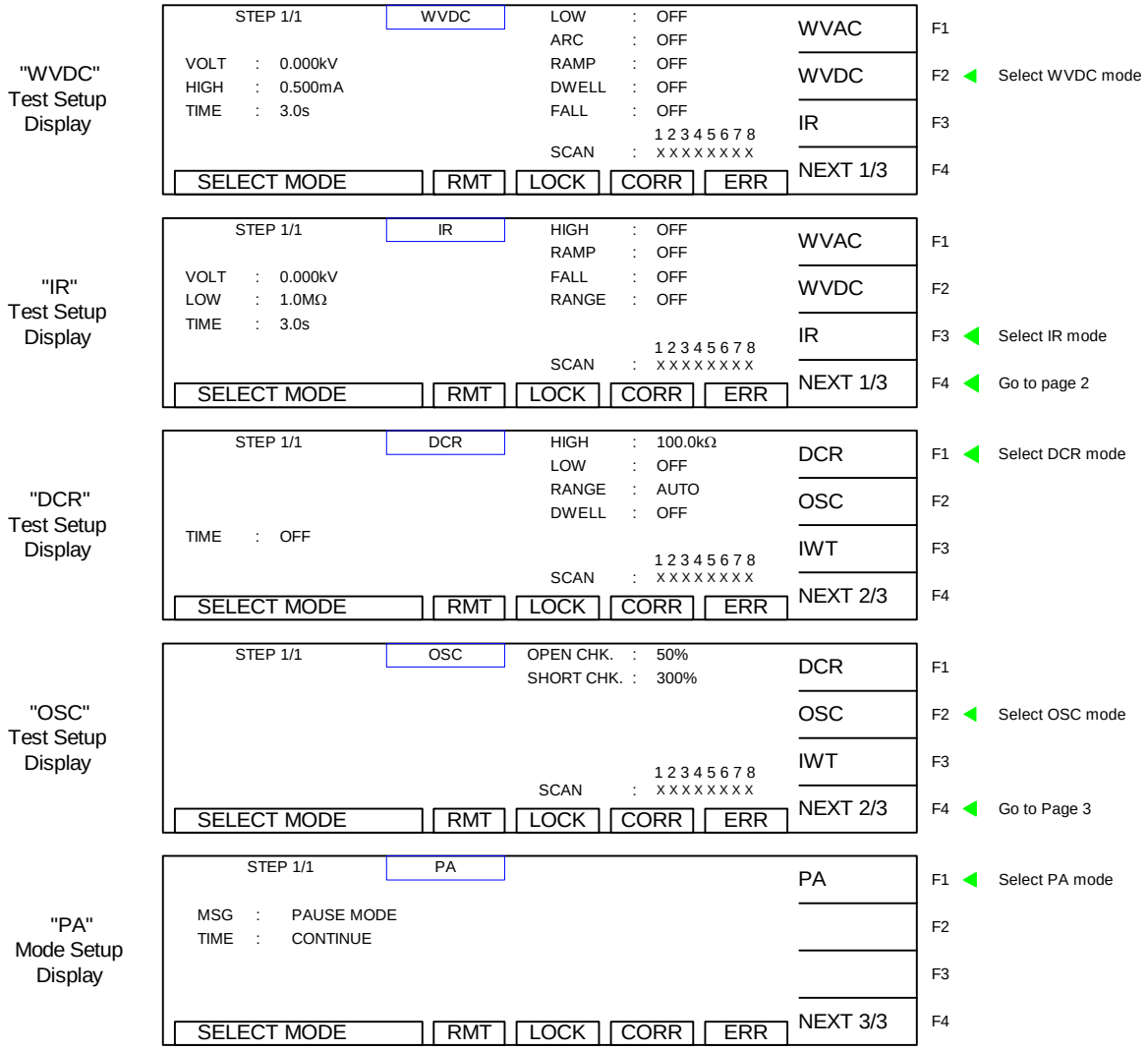


Figure 2-6b: Mode Displays

2.4 Programming an Open/Short Circuit (OSC) Check

The Open/Short Circuit Detection Mode will ensure the Device under Test is connected properly and does not have a short circuit. In Program mode OSC can be selected as one of the steps within the test. There are two programmable parameters Open % and Short %. Open % is equivalent to a low limit. Short % would be considered a high limit. Once programming is finalized, an offset should be performed and the Get Cs function must be ran to learn the Capacitance of the device under test. This learned Capacitance value will then be compared to the Open % and Short % for Pass/Fail judgment. This function is typically programmed prior to a hipot test to check the connection to the device under test before applying high voltage.

Open Check: In hipot testing, a low leakage current may generate a PASS. If the connection is faulty between the hipot and the DUT, the test could pass even if the DUT was not tested. Open Check is similar to using a low limit in an AC hipot test to ensure the connection of the DUT. In some cases, such as DC Hipot, a low limit is not feasible. Open Check will ensure that the DUT is connected.

The Open Check sets the judgment test result (Pass/Fail) to open circuit condition and compares the test reading with the standard capacitance value (Cs). If the test reading is within the programmed % then the judgment is Pass. The Open Check can be programmed from 10% - 100% and the default 50%.

Short Check: In some cases, the DUT is shorted prior to testing. If the product is shorted, there is no need to perform hipot.

The Short Check sets the judgment test result (Pass/Fail) to short circuit condition and compares the test reading to the standard capacitance value (Cs). If the test reading is within the programmed % then the judgment is Pass. The Short Check can be set to Off or programmed from 100% - 500%. The default value is 300%.

When using OSC mode, program the test, attach the DUT, press [F2] = CORRECT and then [F3] = SAMPLE TEST to obtain the DUT's nominal capacitance value. The Cs value is saved with the test program in instrument memory. The Cs value is applicable to that product only.

To illustrate this function: for a particular DUT, the Hybrid instrument learned Cs = 0.241nF and the Open Check is set to 50%. If the measured Cs is within 50% of the learned Cs, then the OSC result is a PASS. If the measured Cs is greater than 0.121nF (50% of .241nF), then the OSC result is a PASS. If the measured Cs is less than 0.121nF, then the OSC result is an OPEN.

If the Short Check is set to 300%. If the measured Cs is less than 300% of the learned Cs, then the OSC result is a PASS. If the measured Cs is greater than 300% of the learned Cs, then the OSC result is a FAIL. If the measured Cs is greater than 0.723nF (300% of .241nF), then the OSC result is a SHORT.

NOTE:
To obtain consistent results, the Offset correction must be performed when using OSC mode. The Offset correction is performed prior to the Get Cs function.

Open/Short Circuit (OSC) Check

Follow the **green** arrows (◀) on the right side of this diagram to program the individual OSC parameters. With the instrument in 'stand-by' status:
Press [F1] = PROGRAM.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F4] = NEXT 1/3 to got to page 2.
Press [F2] = OSC to select Open/Short Circuit mode.
Press RIGHT [▸] arrow key to move backlit box from OSC to 50%
Press [F1] – [F4] keys to set Open % value. Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 50% to 300%
Press [F1] – [F4] keys to set Short % value. Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 300% to XXXXXXXX
Press [F1] – [F4] keys to set Output Channels. Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from XXXXXXXX to STEP
Press [TEST] to EXIT program mode
OR
Press [F3] = NEW to program the next test step.

End OSC programming. Press [F3] = ENTER to start programming STEP 2-20 OR press [TEST] to exit program mode and return to STAND BY status.

2.5 Programming an AC Dielectric Withstand Voltage (WVAC) Test

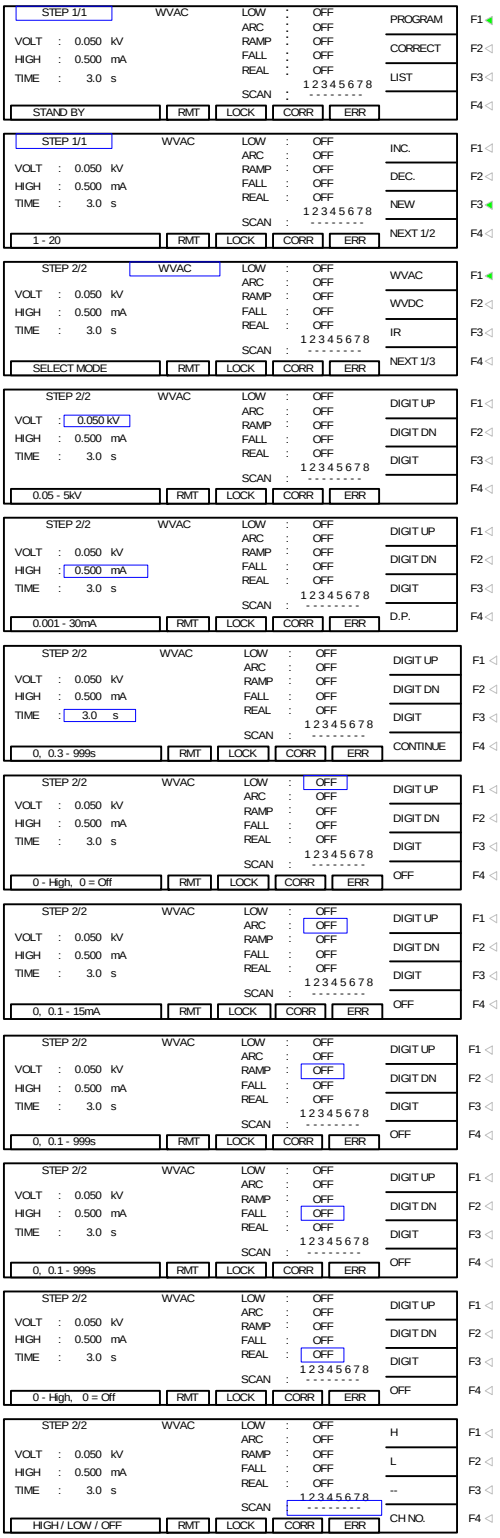
If programming a single WVAC test with the instrument in 'stand-by' status: press [F1] = PROGRAM. Select Step # then press RIGHT [▸] arrow key to move backlit box from STEP to WVAC. Follow instructions below starting with setting AC output voltage.

If continuing the multi-step example (OSC = Step 1) here is how to program an AC test in Step 2:

Press [F3] = NEW.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press DOWN [▾] arrow key to move backlit box from WVAC to 0.050kV
Press [F1] – [F3] keys to set AC output voltage (50V – 5kV).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 0.050kV to 0.500mA
Press [F1] – [F4] keys to set high current limit (0.001 – 30mA).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 0.500mA to 3.0s
Press [F1] – [F4] keys to set test time (0, 0.3 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F4] keys to set low current limit (0 - high limit).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set arc limit (0.1 – 15mA).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set ramp time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set fall time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set real current limit (0 – high limit).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to XXXXXXXX
Press [F1] – [F4] keys to set output channel 1 (H, L, -).
Press [F4] to move backlit cursor right to next channel.
Press [F1] – [F3] keys to set output channels 2-8 (H, L, -).
Press [ENTER] when finished entering all Channel Settings.
Press DOWN [▾] arrow key to move backlit box from H-H-H-H- to STEP

Continue on next page.

Programming a WVAC Test (illustrated)



End WVAC programming. Press [F3] = NEW to start programming STEP 3-20 OR press [TEST] to exit program mode and return to STAND BY status.

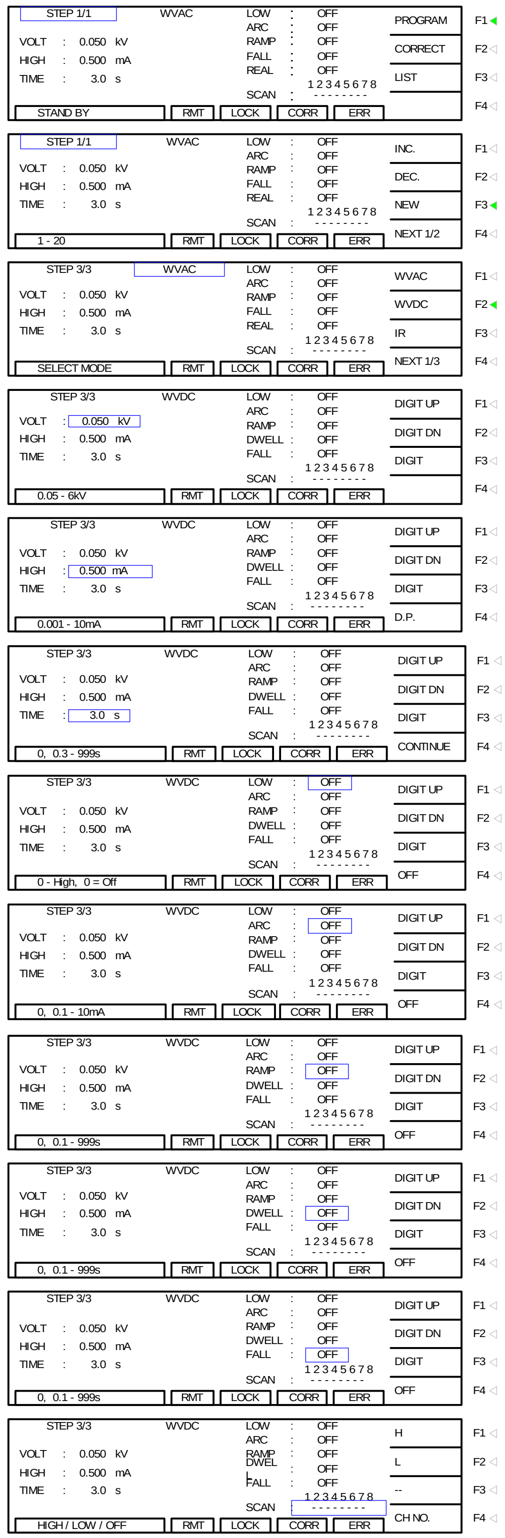
2.6 Programming a DC Dielectric Withstand Voltage (WVDC) Test

If programming a single WVDC test, with the instrument in 'stand-by' status, press [F1] = PROGRAM. Select Step # then press RIGHT [▸] arrow key to move backlit box from STEP to WVAC. Press [F2] = WVDC. Follow instructions below starting with setting DC output voltage.

If continuing the multi-step example (OSC = Step 1, WVAC = Step 2) here is how to program a WVDC test in Step 3:

Press [F3] = NEW.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F2] = WVDC
Press DOWN [▾] arrow key to move backlit box from WVDC to 0.050kV
Press [F1] – [F3] keys to set DC output voltage (50V – 6kV).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 0.050kV to 0.500mA
Press [F1] – [F4] keys to set high current limit (0.0001 – 10mA).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 0.500mA to 3.0s
Press [F1] – [F4] keys to set test time (0, 0.3 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F4] keys to set low current limit (0 - high limit).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set arc limit (0.1 – 10mA).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set ramp time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set dwell time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set fall time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to XXXXXXXX
Press [F1] – [F4] keys to set output channel 1 (H, L, -).
Press [F4] to move backlit cursor right to next channel.
Press [F1] – [F3] keys to set output channels 2-8 (H, L, -).
Press [ENTER] when finished entering all Channel Settings.
Press DOWN [▾] arrow key to move backlit box from H-H-H-H- to STEP
Continue on next page.

Programming a WVDC Test (illustrated)



End WVDC programming. Press [F3] = ENTER to start programming STEP 4-20 OR press [TEST] to exit program mode and return to STAND BY status.

2.7 Programming an Insulation Resistance (IR) Test

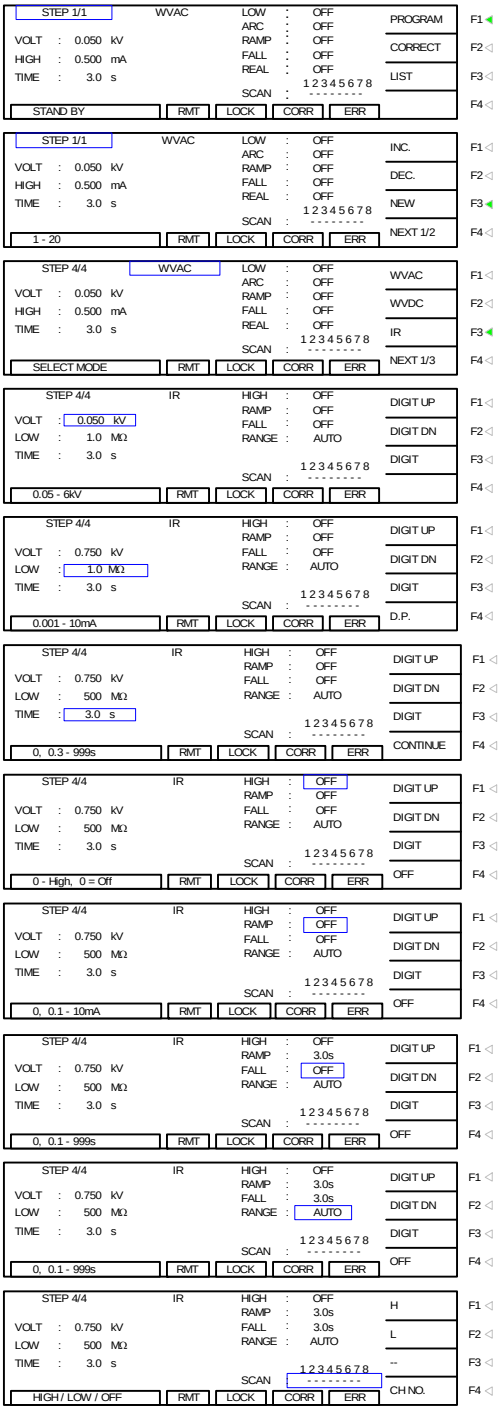
If programming a single IR test, with the instrument in 'stand-by' status, press [F1] = PROGRAM. Select Step # then press RIGHT [▸] arrow key to move backlit box from STEP to WVAC. Press [F3] = IR. Follow instructions below starting with setting IR output voltage.

If continuing the multi-step example (OSC = Step 1, WVAC = Step 2, WVDC = Step 3) here is how to program an IR test in Step 4:

Press [F3] = NEW.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F3] = IR
Press RIGHT [▾] arrow key to move backlit box from IR to 0.050kV
Press [F1] – [F3] keys to set IR output voltage (50V – 5kV).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 0.050kV to 1.0MΩ
Press [F1] – [F4] keys to set low resistance limit (1MΩ – 50GΩ).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 1.0MΩ to 3.0s
Press [F1] – [F4] keys to set test time (0, 0.3 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F4] keys to set high resistance limit (0, Low – 50GΩ).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set ramp time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set fall time (0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F4] keys to set resistance range (Auto, 30nA - 10mA, 7 ranges).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from OFF to XXXXXXXX
Press [F1] – [F4] keys to set output channel 1 (H, L, -).
Press [F4] to move backlit cursor right to next channel.
Press [F1] – [F3] keys to set output channels 2-8 (H, L, -).
Press [ENTER] when finished entering all Channel Settings.
Press DOWN [▾] arrow key to move backlit box from H-H-H-H- to STEP

Continue on next page.

Programming an IR Test (illustrated)



End IR programming. Press [F3] = NEW to start programming STEP 5-20 OR press [TEST] to exit program mode and return to STAND BY status.

2.8 Programming a DC Resistance (DCR) Test

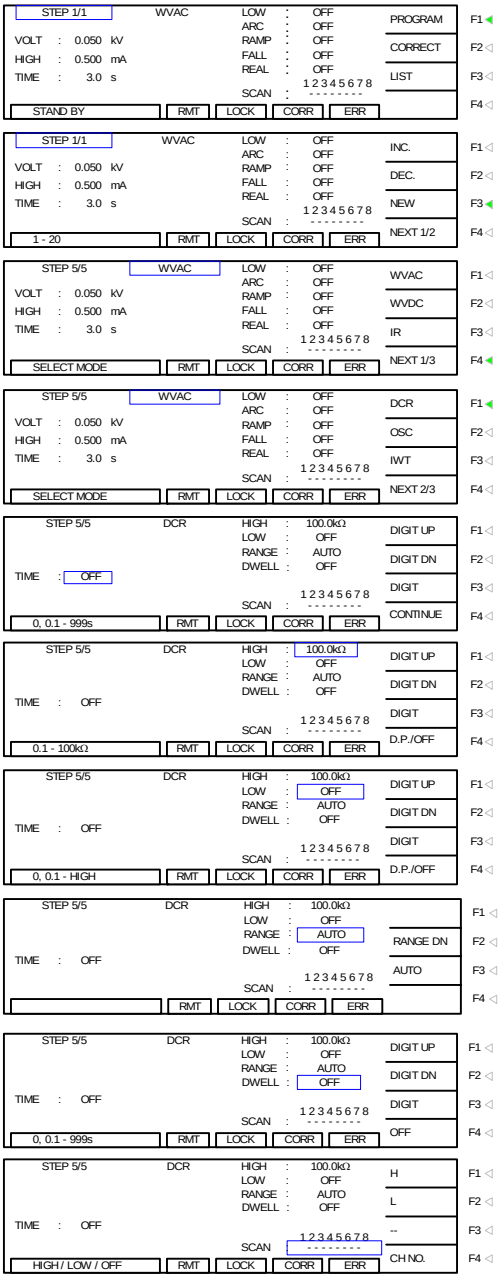
If programming a single DCR test, with the instrument in 'stand-by' status, press [F1] = PROGRAM. Select Step # then press RIGHT [▶] arrow key to move backlit box from STEP to WVAC. Press [F4] = NEXT 1/3. Press [F1] = DCR. Follow instructions below starting with setting high resistance limit.

If continuing multi-step example (OSC = Step 1, WVAC = Step 2, WVDC = Step 3, IR = Step 4) here is how to program a DCR test in Step 5:

Press [F3] = NEW.
Press RIGHT [▶] arrow key to move backlit box from STEP to WVAC
Press [F4] = NEXT 1/3
Press [F1] = DCR
Press DOWN [▼] arrow key to move backlit box from DCR to OFF
Press [F1] – [F4] keys to set test time (0, 0.1 – 999s).
Press [ENTER] to accept value.
Press UP [▲] and RIGHT [▶] arrow key to move backlit box from OFF to 100.0 kΩ
Press [F1] – [F4] keys to set high resistance limit (0.1Ω – 100kΩ).
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from 100.0kΩ to OFF
Press [F1] – [F4] keys to set low resistance limit (0, 0.1Ω - HIGH).
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from OFF to AUTO
Press [F1] – [F3] keys to set resistance range (Auto, 5 ranges: 10Ω – 100kΩ).
Press DOWN [▼] arrow key to move backlit box from AUTO to OFF
Press [F1] – [F4] keys to set dwell time (0, 0.1 – 999s).
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from OFF to XXXXXXXX
Press [F1] – [F3] keys to set output channel 1 (H, L, -).
Press [F4] to move backlit cursor right to next channel.
Press [F1] – [F3] keys to set output channels 2-8 (H, L, -).
Press [ENTER] when finished entering all Channel Settings.
Press DOWN [▼] arrow key to move backlit box from H-H-H-H- to STEP

Continued on next page

Programming a DCR Test (illustrated):



End DCR programming. Press [F3] = ENTER to start programming STEP 6-20 OR press [TEST] to exit program mode and return to STAND BY status.

2.9 Programming a Pause (PA)

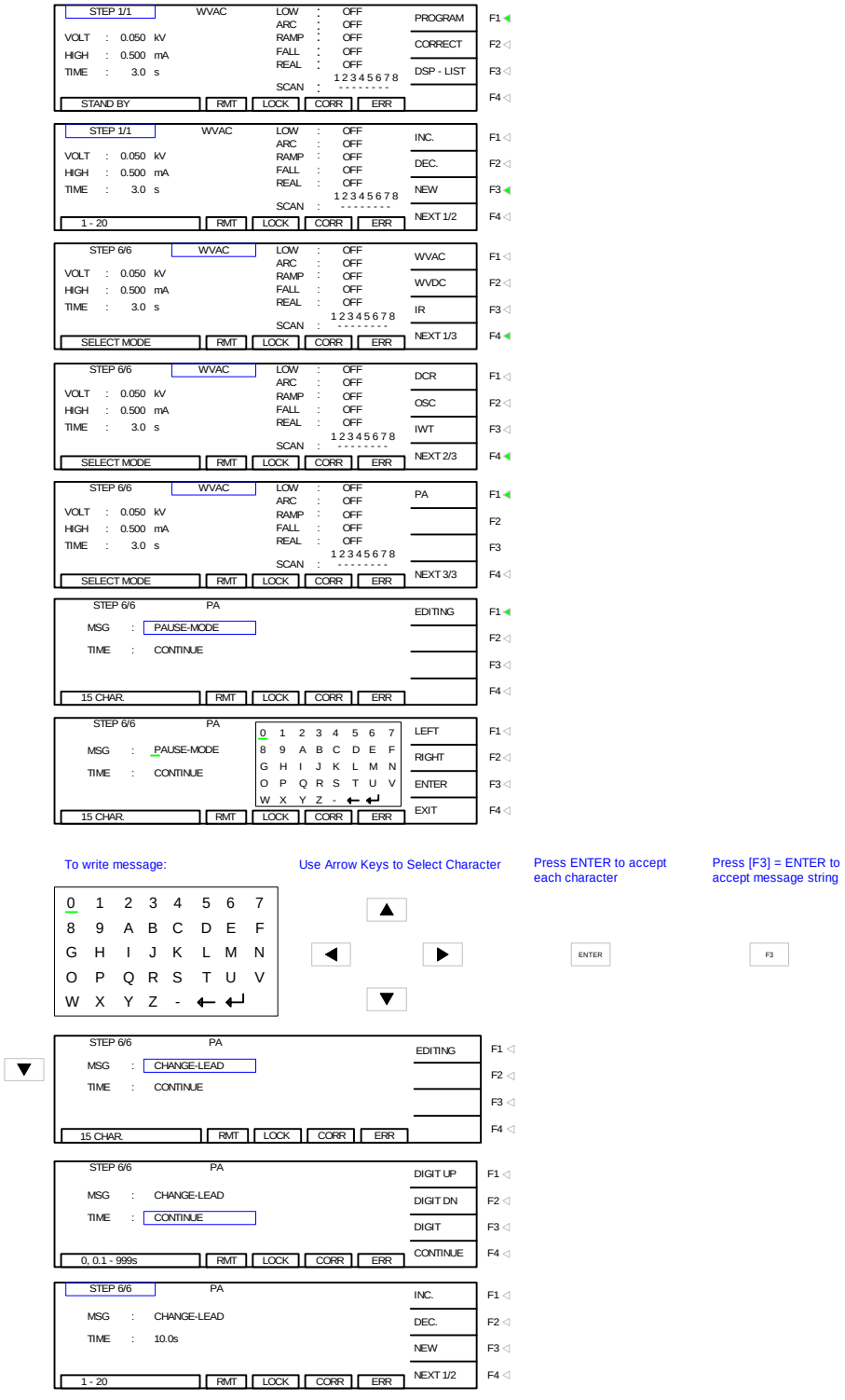
If programming a PAUSE in the test setup, with the instrument in 'stand-by' status, press [F1] = PROGRAM. Select Step # then press RIGHT [▸] arrow key to move backlit box from STEP to WVAC. Press [F4] = NEXT 1/3. Press [F4] = NEXT 2/3. Press [F1] = PA. Follow instructions below starting with entering pause message.

If continuing multi-step example (OSC = Step 1, WVAC = Step 2, WVDC = Step 3, IR = Step 4, DCR = Step 5) here is how to program a PA in Step 6:

Press [F3] = NEW
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F4] = NEXT 1/3
Press [F4] = NEXT 2/3
Press [F1] = PA
Press DOWN [▾] arrow key to move backlit box from PA to PAUSE-MODE
Press [F1] – [F3] keys to enter message (15 character alpha-numeric: 0-9; A-Z; -).
Press [ENTER] to accept message.
Press DOWN [▾] arrow key to move backlit box from PAUSE-MODE to CONTINUE
Press [F1] – [F3] keys to set pause time (0, 0.1 – 999sec).
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from CONTINUE to STEP

Continued on next page.

Programming a PAUSE (illustrated):



End PA programming. Press [F3] = ENTER to start programming STEP 7-20 OR press [TEST] to exit program mode and return to STAND BY status.

2.10 Programming a Multi-Step Test

Paragraphs 2.4, 2.5, 2.6, 2.7, 2.8 and 2.9 illustrate the programming of a 6-step test (OSC, WVAC, WVDC, IR, DCR & PA). To program a multiple step test, power-up the Hybrid 2000 instrument so the 'Stand By' display is shown (Figure 2-7). Use the parameters in Table 2-3 and follow the instructions to program a 6-step test and save it as "EXAMPLE" to memory location 01.

Table 2-3: Parameter Settings for 6-Step Example

	OSC	WVAC	WVDC	IR	DCR	PA
1	Test Step #	Test Step #	Test Step #	Test Step #	Test Step #	Test Step #
	1	2	3	4	5	6
2	Test Mode	Test Mode	Test Mode	Test Mode	Test Mode	Test Mode
	OSC	WVAC	WVDC	IR	DCR	PA
3	Open Check	Voltage	Voltage	Voltage	High Limit	Message
	50%	1.250kV	2.400kV	0.750kV	100.0kΩ	CHANGE LEAD
4	Short Check	High Limit	High Limit	Low Limit	Low Limit	Time
	300%	15mA	10mA	500MΩ	OFF	10.0s
5	Output CH	Test Time	Test Time	Test Time	Test Time	
	1, 3, 5, 7 = H	3.0s	3.0s	3.0s	3.0s	
6		Low Limit	Low Limit	High Limit	Range	
		OFF	OFF	OFF	Auto	
7		Arc Limit	Arc Limit	Ramp Time	Dwell Time	
		OFF	OFF	3.0s	3.0s	
8		Ramp Time	Ramp Time	Fall Time	Output CH	
		3.0s	3.0s	3.0s	1, 3, 5, 7 = H	
9		Fall Time	Dwell Time	Range		
		3.0s	3.0s	Auto		
10		Real Limit	Fall Time	Output CH		
		OFF	3.0s	1, 3, 5, 7 = H		
11		Output CH	Output CH			
		1, 3, 5, 7 = H	1, 3, 5, 7 = H			

From the Standby Menu:

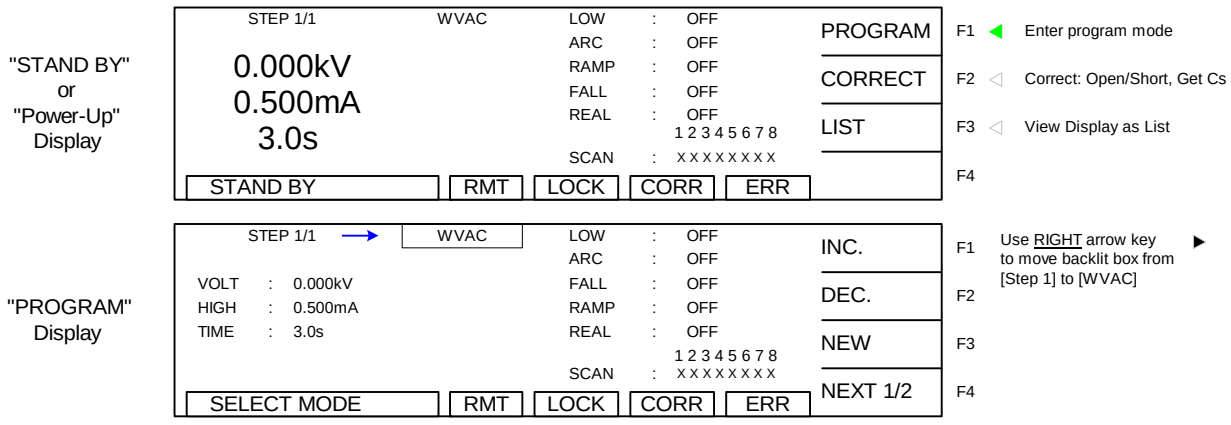


Figure 2-7: Hybrid 2000 Standby Menu & Program Menu

Press [F1] = PROGRAM.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F4] = NEXT 1/3 to got to page 2.
Press [F2] = OSC to select Open/Short Circuit mode.
Press [ENTER] to accept Open % = 50%.
Press DOWN [▾] arrow key to move backlit box from 50% to 300%
Press [ENTER] to accept Short % = 300%.
Press DOWN [▾] arrow key to move backlit box from 300% to XXXXXXXX
Press [F1] – [F4] keys to set Output Channels 1, 3, 5, & 7=H. Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from H-H-H-H- to STEP

Press [F3] = NEW to program the next test step.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press DOWN [▾] arrow key to move backlit box from WVAC to 0.050kV
Press [F1] – [F3] keys to set AC output voltage to 1.250kV.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 1.250kV to 0.500mA
Press [F1] – [F3] keys to set high current limit = 15.00mA.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 15.00mA to 3.0s
Press [ENTER] to accept test time = 3.0sec.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [ENTER] to accept low current limit = Off.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [ENTER] to accept arc limit = Off.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F3] keys to set ramp time = 3.0sec.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F3] keys to set fall time = 3.0sec.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [ENTER] to accept real current limit = Off.
Press DOWN [▾] arrow key to move backlit box from OFF to XXXXXXXX
Press [F1] – [F3] keys to set output channels 1, 3, 5 & 7 = H.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from H-H-H-H- to STEP

Press [F3] = NEW to program the next test step.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F2] = WVDC
Press DOWN [▾] arrow key to move backlit box from WVDC to 0.050kV
Press [F1] – [F3] keys to set DC output voltage = 2.400kV.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 2.400kV to 0.500mA
Press [F1] – [F3] keys to set high current limit = 10.00mA.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 10.00mA to 3.0s
Press [ENTER] to accept test time = 3.0sec.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [ENTER] to accept low current limit = Off.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [ENTER] to accept arc limit = Off.
Press DOWN [▾] arrow key to move backlit box from OFF to OFF
Press [F1] – [F3] keys to set ramp time = 3.0sec.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F3] keys to set dwell time = 3.0sec.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F3] keys to set fall time = 3.0sec.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 3.0s to XXXXXXXX
Press [F1] – [F3] keys to set output channels1, 3, 5, & 7 = H.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from H-H-H-H- to STEP

Press [F3] = NEW to program the next test step.
Press RIGHT [▸] arrow key to move backlit box from STEP to WVAC
Press [F3] = IR
Press [ENTER]
Press RIGHT [▾] arrow key to move backlit box from IR to 0.050kV
Press [F1] – [F3] keys to set IR output voltage = 0.750kV.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 0.750kV to 1.0MΩ
Press [F1] – [F3] keys to set low resistance limit = 500MΩ.
Press [ENTER] to accept value.
Press DOWN [▾] arrow key to move backlit box from 500MΩ to 3.0s
Press [ENTER] to accept test time 3.0sec.
Press DOWN [▾] arrow key to move backlit box from 3.0s to OFF
Press [ENTER] to accept high resistance limit = Off.

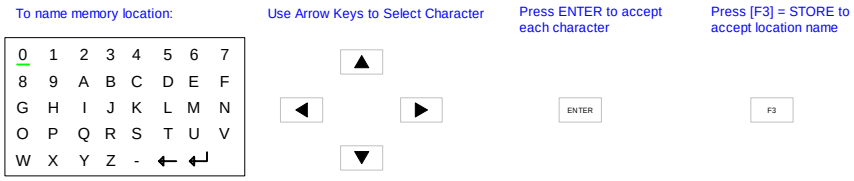
Press DOWN [▼] arrow key to move backlit box from OFF to OFF
Press [F1] – [F3] keys to set ramp time = 3.0 sec
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from 3.0s to OFF
Press [F1] – [F3] keys to set fall time = 3.0 sec.
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from 3.0s to OFF
Press [ENTER] to accept resistance range = Auto.
Press DOWN [▼] arrow key to move backlit box from Auto to XXXXXXXX
Press [F1] – [F3] keys to set output channels1, 3, 5, & 7 = H.
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from H-H-H-H- to STEP

Press [F3] = NEW to program the next test step.
Press RIGHT [▶] arrow key to move backlit box from STEP to WVAC
Press [F4] = NEXT 1/3
Press [F1] = DCR
Press [ENTER]
Press DOWN [▼] arrow key to move backlit box from DCR to OFF
Press [F1] – [F4] keys to set test time = 3.0s.
Press [ENTER] to accept value.
Press RIGHT [▶] arrow key to move backlit box from 3.0s to 100.0 kΩ
Press [ENTER] to accept high resistance limit = 100kΩ.
Press DOWN [▼] arrow key to move backlit box from 100.0kΩ to OFF
Press [ENTER] to accept low resistance limit = Off.
Press DOWN [▼] arrow key to move backlit box from OFF to AUTO
Press [ENTER] to accept resistance range = Auto.
Press DOWN [▼] arrow key to move backlit box from AUTO to OFF
Press [F1] – [F4] keys to set dwell time 3.0s.
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from 3.0s to XXXXXXXX
Press [F1] – [F3] keys to set output channels1, 3, 5, & 7 = H.
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from H-H-H-H- to STEP

Press [F3] = NEW to program the next test step.
Press RIGHT [▶] arrow key to move backlit box from STEP to WVAC
Press [F4] = NEXT 1/3
Press [F4] = NEXT 2/3
Press [F1] = PA
Press DOWN [▼] arrow key to move backlit box from PA to _
Press [F1] – [F3] keys to enter message (15 character alpha-numeric: 0-9; A-Z; -).
Press [ENTER] to accept message = CHANGE-LEAD.
Press DOWN [▼] arrow key to move backlit box from CHANGE-LEAD to CONTINUE
Press [F1] – [F3] keys to set pause time = 10.0sec.
Press [ENTER] to accept value.
Press DOWN [▼] arrow key to move backlit box from 10.0s to STEP

Press [MAIN INDEX] to access to Store/Recall Menu. Follow the next instructions to save the 6-Step Test to Memory Location 1 and give it the label "EXAMPLE".

Press [F1] = STORE/RECALL
Display shows memory location 01 backlit: 01. (00)
Press [F1] = STORE



Press the [▶], [◀], [▼], [▲] arrows to move the backlit cursor around alpha-numeric box and select character. Press [ENTER] after each character is selected:
[E] [ENTER]
[X] [ENTER]
[A] [ENTER]
[M] [ENTER]
[P] [ENTER]
[L] [ENTER]
[E] [ENTER]
Press [F3] = STORE
Press [F1] = YES

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.

Store “EXAMPLE” test (illustrated):

Press [TEST] to return to Standby Menu. The test setup name ‘EXAMPLE’ is in the upper right hand corner above [PROGRAM].

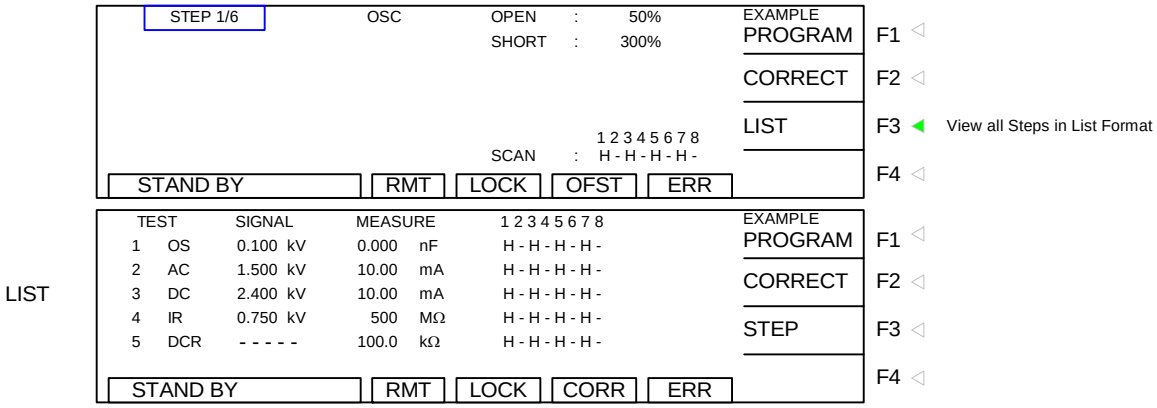


Figure 2-8: Programmed “EXAMPLE’ Display

2.11 SYSTEM Setup

Under [SYSTEM] setup there are 6 functions. The Test Control function applies to each test setup. The System Configuration function applies to the instrument setup. The Key Lock function provides password-protected front panel lockout capability. Calibration provides instrument verification. The Error Log function returns RS232 communication errors. The About function is a list of the manufacturer and firmware version of the Hybrid 2000 instrument.

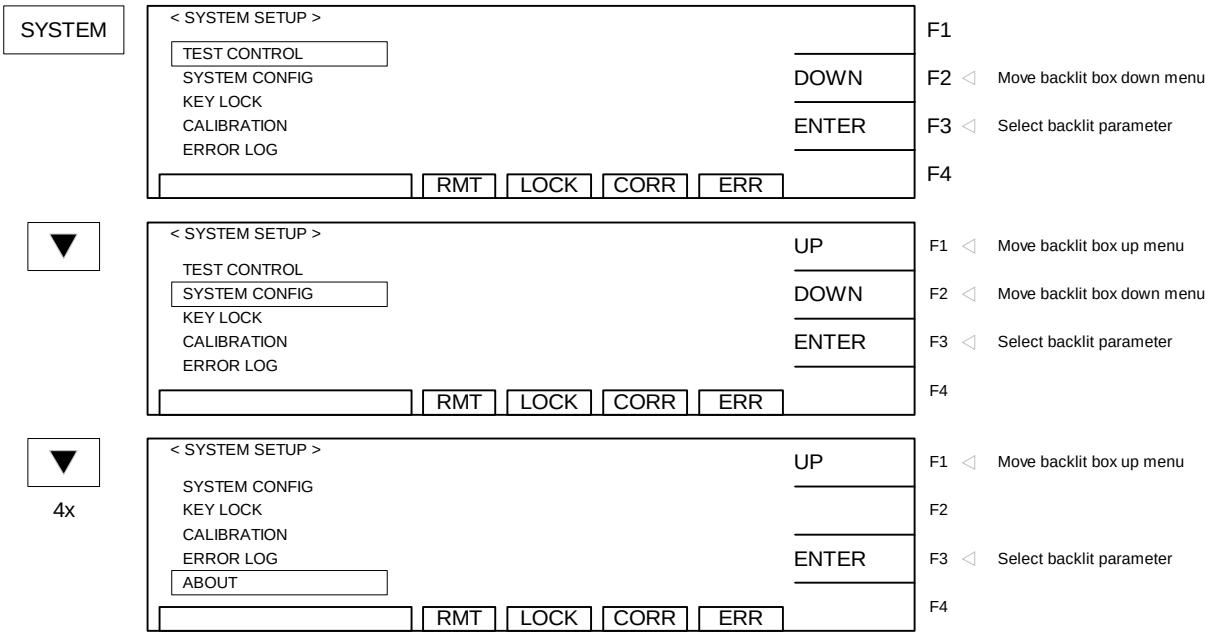


Figure 2-9: System Setup Menu

Table 2-4: System Setup Parameters

Parameter	Description
Test Control	Set initial parameters for test setups; saved with setup
System Config	Set instrument parameters
Key Lock	Lockout front panel access (Disable Program & Correct functions)
Calibration	Enter instrument calibration routine
Error Log	View status of error queue
About	View instrument manufacturer, firmware version & date

2.11.1 Test Control Parameters

A number of initial parameters or default conditions may be programmed and stored as the 'power-up' conditions. On the Hybrid 2000 instrument, this function is labeled Test Control and is accessible in the [SYSTEM] menu. Table 2-5 lists the Hybrid 2000 Test Control parameters including parameter range and initial (default) value.

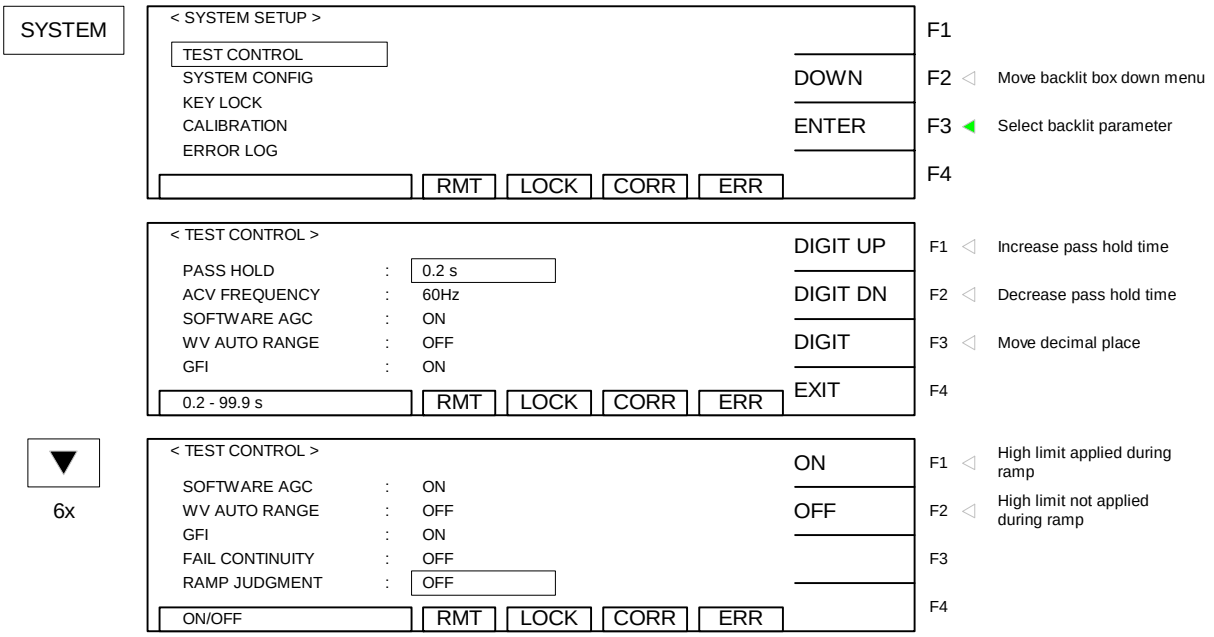


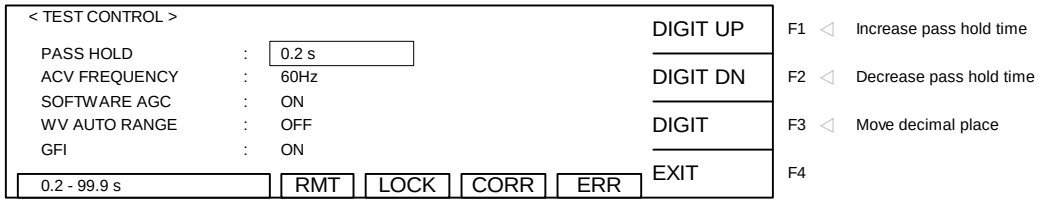
Figure 2-10: Test Control Menu

Table 2-5: Test Control Parameters

Parameter	Range	Initial (Default) Value	Description
Pass Hold	0.2 – 99.9 sec	0.5	Set hold time for a PASS result
AC-V Frequency	50 or 60Hz	60	Set frequency for WVAC test
Software AGC	ON or OFF	ON	Set software automatic gain control function ON or OFF
WV Auto Range	ON or OFF	OFF	Set auto range function ON or OFF
GFI	ON or OFF	ON	Set ground fault interrupt to trip if current imbalance >0.5mA
Fail Continuity	ON or OFF	ON	Set instrument to continue test if a step fails
Ramp Judgment	ON or OFF	OFF	Set ON/OFF to have high limit applied during ramp or not

2.11.1.1 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 2-11.



To access Pass Hold:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press [F1] = UP or [F2] = DOWN to increase or decrease the Pass Hold time
Press [ENTER] to accept Pass Hold Time
or
Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

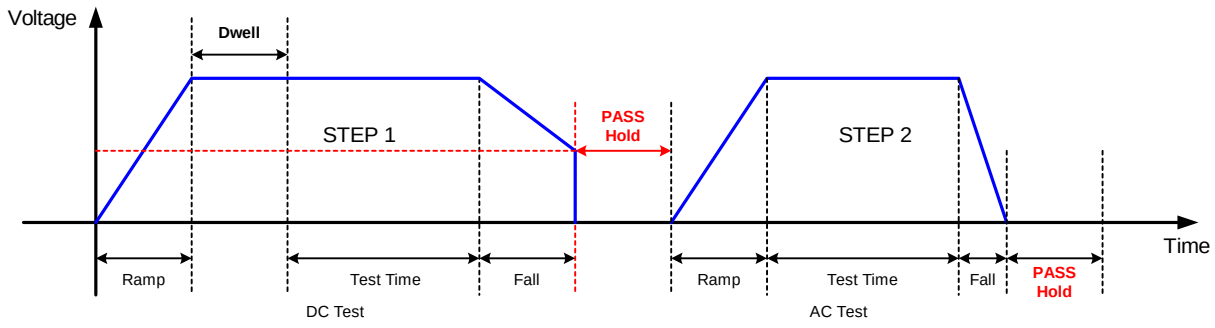
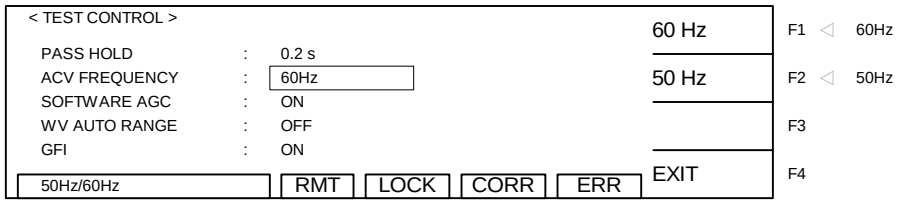


Figure 2-11: Pass Hold

2.11.1.2 ACV Frequency

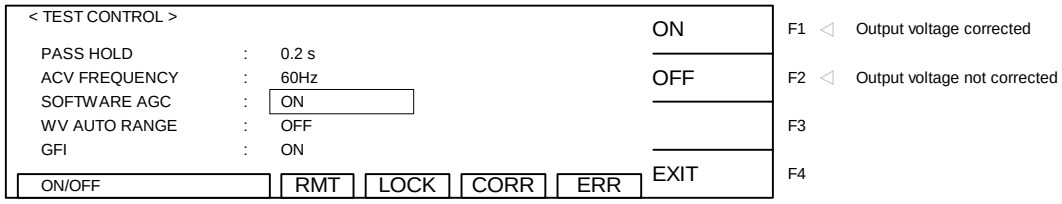
The AC V Frequency setting allows the option of selecting the frequency for the WVAC dielectric withstand voltage test. The range of AC-V Freq. is 50 or 60Hz and the instrument default setting is 60Hz.



To access AC-V FREQ:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press DOWN [▼] arrow key so that backlit box is next to: AC-V FREQ: 60Hz
Press [F1] = 60Hz or [F2] = 50Hz to change the AC-V Frequency
Press [ENTER] to accept ACV Frequency
or
Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

2.11.1.3 Software AGC

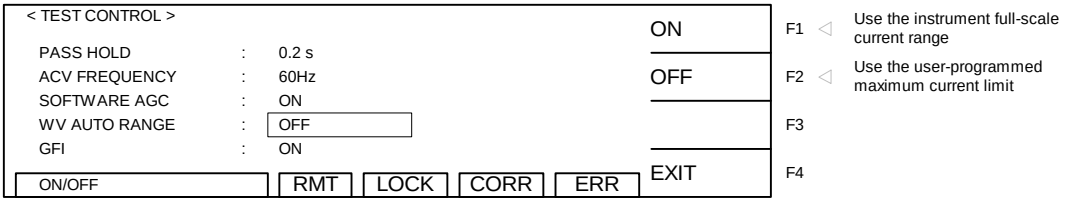
The Software Automatic Gain Control (SOFTWARE AGC) setting allows the option of correcting the output voltage (ON). This is satisfactory when measuring resistors but under special circumstances when measuring large capacitive devices it is best to select Software AGC OFF. The default value is ON.



To access SOFT AGC:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press DOWN [▼] arrow key so that backlit box is next to: SOFTWARE AGC: ON
Press [F1] = ON or [F2] = OFF to change Software AGC to ON/OFF
Press [ENTER] to accept Software AGC setting.
or
Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

2.11.1.4 WV Auto Range

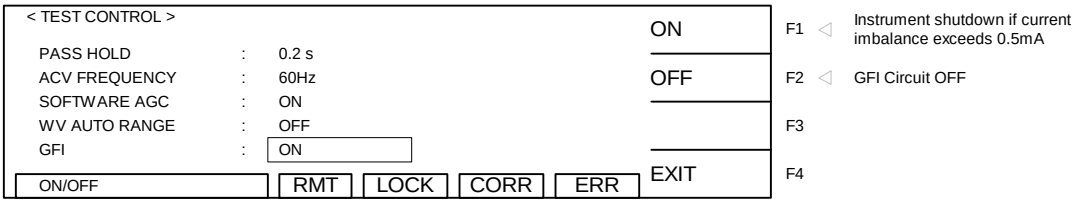
The WV Auto Range setting allows the option of using the full scale current range (ON) or using the user programmed maximum current limit (OFF) in the WVAC and WVDC tests. The low current range (3mA full scale) results in increased measurement resolution. The default value of WV Auto Range is OFF.



To access WV AUTO RANGE:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press DOWN [▼] arrow key so that backlit box is next to: WV AUTO RANGE: OFF
Press [F1] = ON or [F2] = OFF to change WV Auto Range to ON/OFF
Press [ENTER] to accept WV Auto Range setting
or
Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

2.11.1.5 GFI

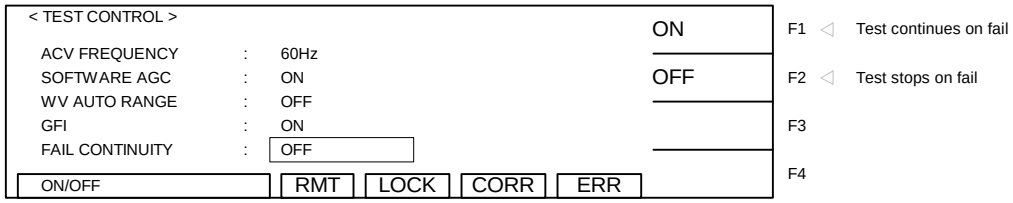
The Ground Fault Interrupt (GFI) function can be programmed ON or OFF. The instrument default setting is ON. When GFI is activated, the ground fault interrupt circuit will trip when a current imbalance >0.5mA occurs. The high voltage output is immediately shutdown.



To access GFI:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press DOWN [▼] arrow key so that backlit box is next to: GFI: ON
Press [F1] = ON or [F2] = OFF to change the Ground Fault Interrupt to ON/OFF
Press [ENTER] to accept GFI setting
or
Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

2.11.1.6 Fail Continuity

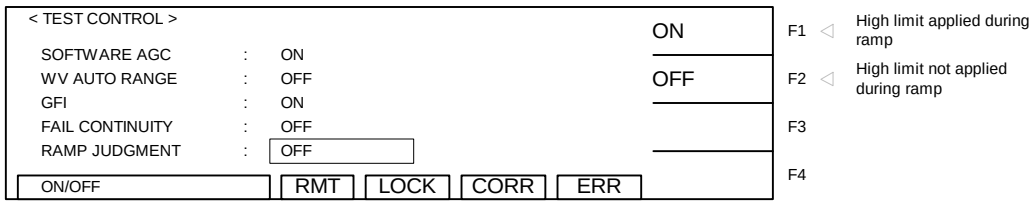
The Fail Continuity function can be programmed ON or OFF and the default setting is OFF. This selection determines if the unit will stop testing or proceed to the next test on fail during a multi-step test. When ON is selected if a test fails, then the instrument proceeds to the next step in the program. The exception to this: if Ground Fault Interrupt (GFI) is ON and a GFI failure occurs, the instrument will not proceed to the next step but will shut down.



To access FAIL CONT:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press DOWN [▼] arrow key so that backlit box is next to: FAIL CONTINUITY: OFF
Press [F1] = ON or [F2] = OFF to change Fail Continuity to ON/OFF
Press [ENTER] to accept Fail Continuity setting.
OR Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

2.11.1.7 Ramp Judgment

The Ramp Judgment setting allows the option of applying the high current limit during the ramp time of a WVAC or WVDC test or just having the high limit applied during test time. Applying the high current limit before the device is fully charged can give a better indication of breakdown prior to the voltage being applied. The range for Ramp Judgment is ON or OFF and the instrument default setting is OFF.



To access Ramp Judgment:
Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press [F3] = ENTRY
The backlit box is next to: PASS HOLD: 0.2sec
Press DOWN [▼] arrow key so that backlit box is next to: RAMP JUDGMENT: OFF
Press [F1] = ON or [F2] = OFF to change the Ramp Judgment setting
Press [ENTER] to accept Ramp Judgment setting
OR Press [F4] = EXIT to exit Test Control Menu and return to System Setup Menu.

2.11.2 System Configuration

A number of system parameters may be programmed and stored as the 'power-up' conditions. On the Hybrid 2000 instrument, this function is labeled SYSTEM CONFIG and is accessible in the [SYSTEM] menu. Table 2-6 lists the Hybrid 2000 System Configuration parameters including parameter range and initial (default) value.

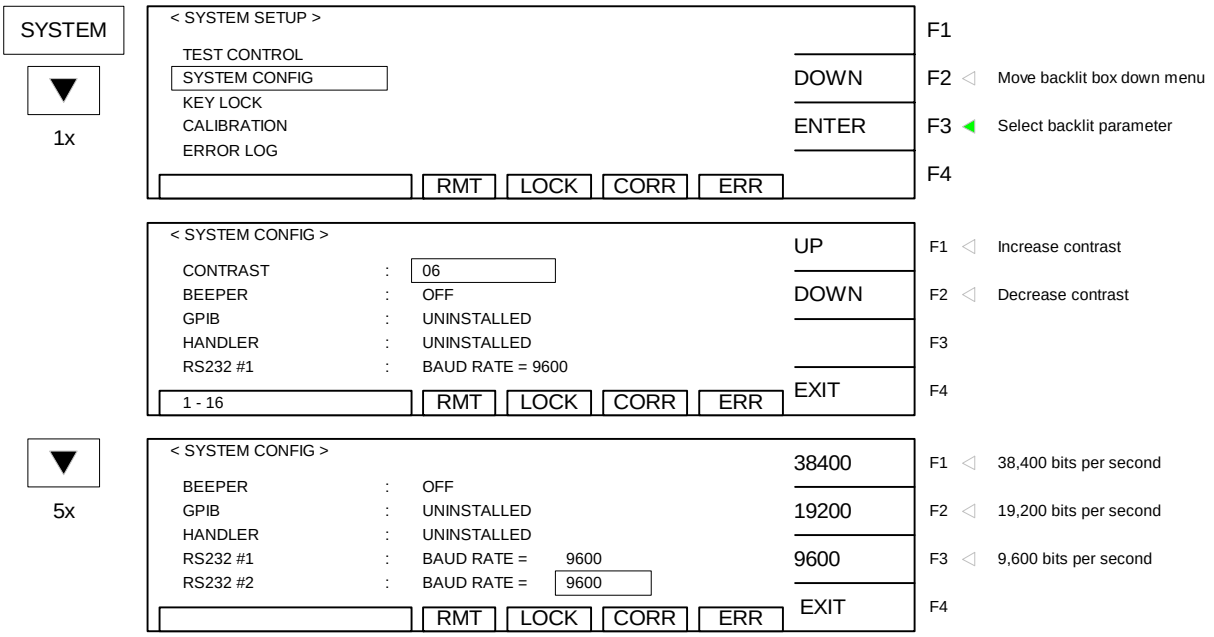


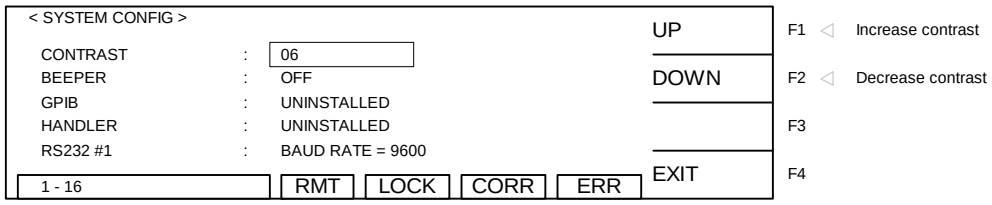
Figure 2-12: System Config Menu

Table 2-6: System Configuration Parameters

Parameter	Range	Default Value	Description
Contrast	1 – 16	06	Change Display Contrast: 0=Lightest; 16=Darkest
Beeper	Large, Small, Off	LARGE	Set loudness of beeper: High, Low or Off
GPIB	Currently Unavailable	03	Set address of IEEE interface: 00 - 30
Handler	Currently Unavailable		Set trigger of Handler interface:
RS232 #1	9600 - 38400	9600	Set Baud Rate: 9600, 19200 or 38400
RS232 #2	9600 - 38400	9600	Optional interface: Set Baud Rate: 9600, 19200 or 38400

2.11.2.1 Contrast

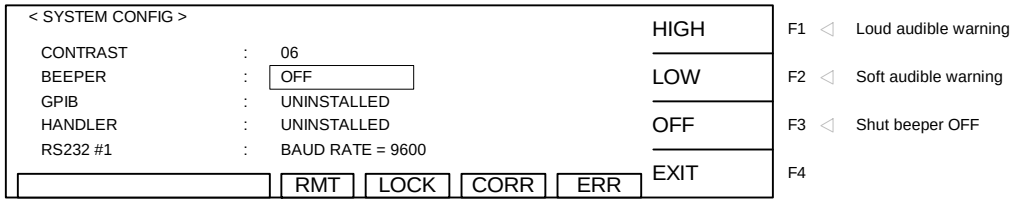
The contrast parameter adjusts the brightness of the LCD display. The range is 1-16 with 16 being the darkest. The initial default setting is 6.



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: SYSTEM CONFIG
Press [ENTER]
The backlit box is next to: CONTRAST: 06
Press [F1] = UP or [F2] = DOWN to increase/decrease the contrast of the display.
Press [ENTER] to accept contrast setting.
Press [F4] = EXIT to exit SYSTEM CONFIG and return to SYSTEM SETUP.

2.11.2.2 Beeper

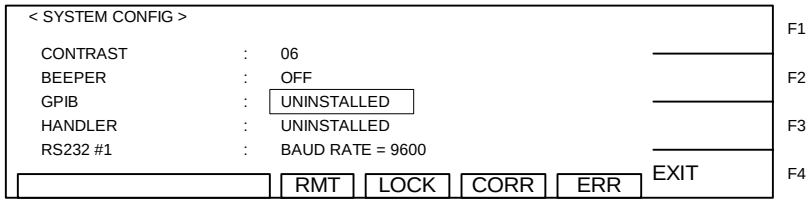
The beeper volume can be adjusted from low to high or it can be turned OFF. The initial default setting is high.



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: SYSTEM CONFIG
Press [ENTER]
The backlit box is next to: CONTRAST: 06
Press DOWN [▼] arrow key so that backlit box is next to: BEEPER: HIGH
Press [F1] = HIGH, [F2] = LOW or [F3] = OFF to set the loudness of the beeper.
Press [ENTER] to accept beeper setting.
Press [F4] = EXIT to exit SYSTEM CONFIG and return to SYSTEM SETUP.

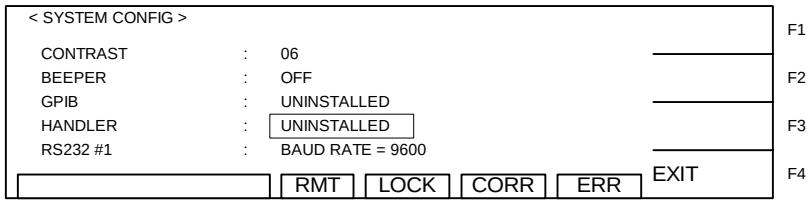
2.11.2.3 GPIB

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



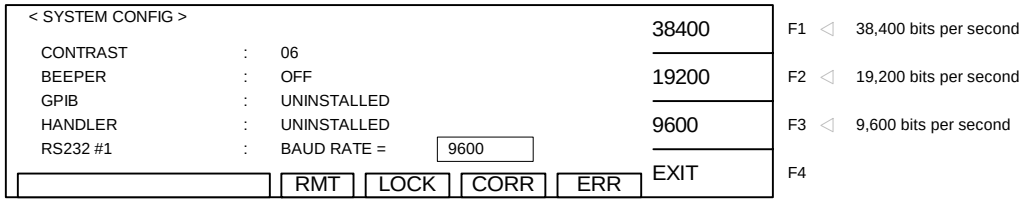
2.11.2.4 Handler

Function currently unavailable.



2.11.2.5 RS232 #1

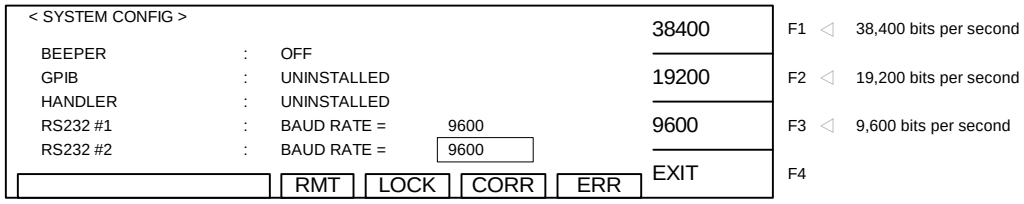
Within the RS232 menu there is one programmable parameter: baud rate. The baud rate is adjustable as 9600, 19200 or 38400 bps. The initial setting is 9600.



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: SYSTEM CONFIG
Press [ENTER]
The backlit box is next to: CONTRAST: 06
Press DOWN [▼] arrow key so that backlit box is next to: RS232 #1: BAUD RATE = 9600
Press [F1] = 38400, [F2] = 19200 or [F3] = 9600 to set the baud rate.
Press [ENTER] to accept baud rate setting.
Press [F4] = EXIT to exit SYSTEM CONFIG and return to SYSTEM SETUP.

2.11.2.6 RS232 #2

An optional 2nd RS232 interface is available for the Hybrid 2000 instrument. The baud rate is adjustable as 9600, 19200 or 38400 bps. The initial setting is 9600.



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: SYSTEM CONFIG
Press [ENTER]
The backlit box is next to: CONTRAST: 06
Press DOWN [▼] arrow key so that backlit box is next to: RS232 #2: BAUD RATE = 9600
Press [F1] = 38400, [F2] = 19200 or [F3] = 9600 to set the baud rate.
Press [ENTER] to accept baud rate setting.
Press [F4] = EXIT to exit SYSTEM CONFIG and return to SYSTEM SETUP.

2.11.3 Key Lock

To lock out the Program and Test Control functions of the Hybrid 2000 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:

Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: KEY LOCK
Press [ENTER]
Display prompts 'LOCK KEY: NEW PASSWORD _'
Press [A] [A] [A] [A] [ENTER]
Display prompts 'LOCK KEY: CONFIRM PASSWORD _'
Press [A] [A] [A] [A] [ENTER] again
NOTE: AAAA is the default password. If password has been changed use the new password.
The LOCK block at bottom of display is backlit.
PROGRAM and CORRECT functions are no longer visible or functional.

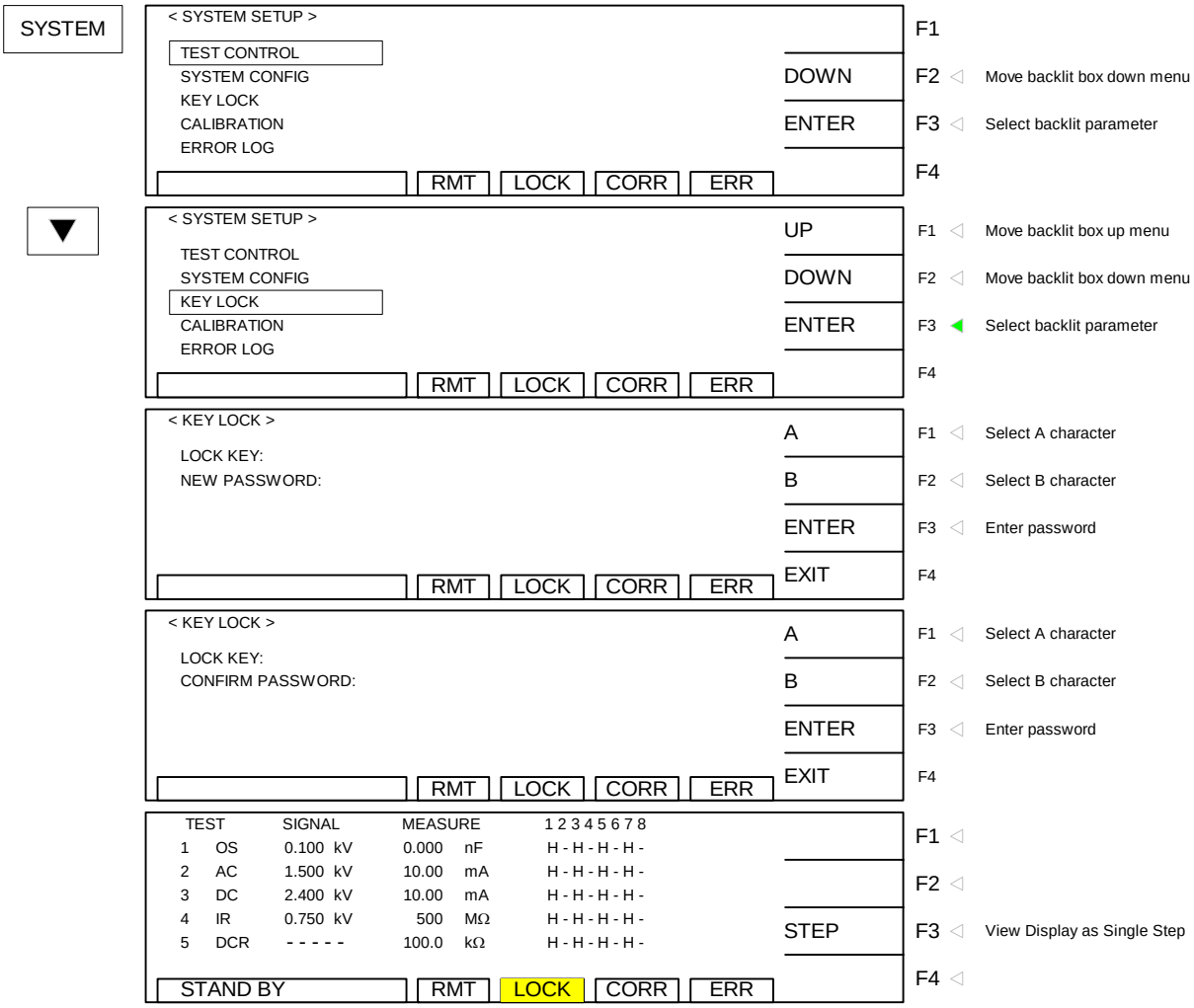


Figure 2-13: Key Lock Display

To disable the KEY LOCK function:

Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: KEY LOCK
Press [ENTER]
Display prompts 'UNLOCK KEY: NEW PASSWORD ▯'
Press [A] [A] [A] [A] [ENTER]
Display prompts 'UNLOCK KEY: CONFIRM PASSWORD ▯'
Press [A] [A] [A] [A] [ENTER] again
NOTE: AAAA is the default password. If password has been changed use the new password.
The LOCK block at bottom of display is OFF.
PROGRAM and CORRECT functions are now visible and functional.

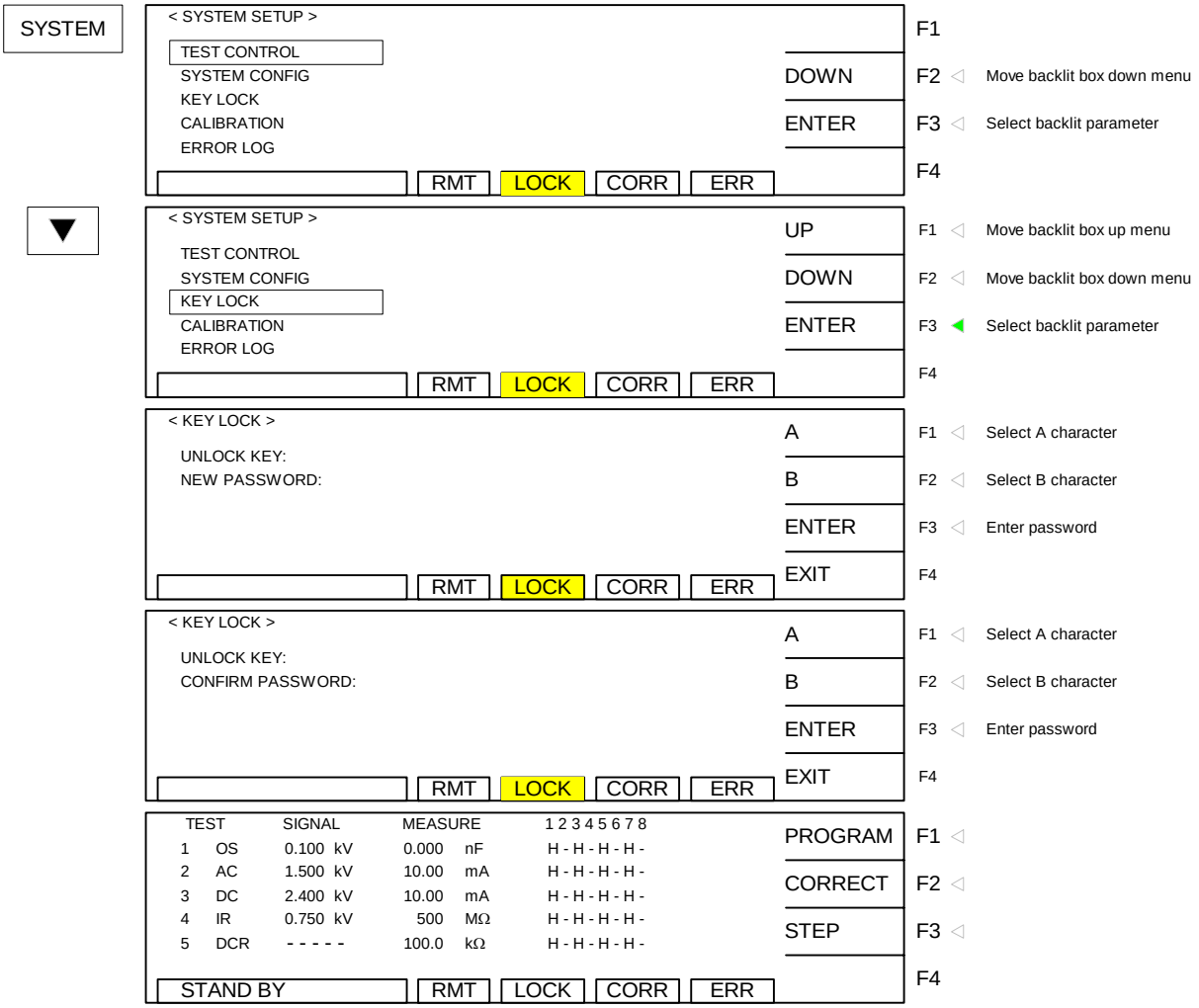
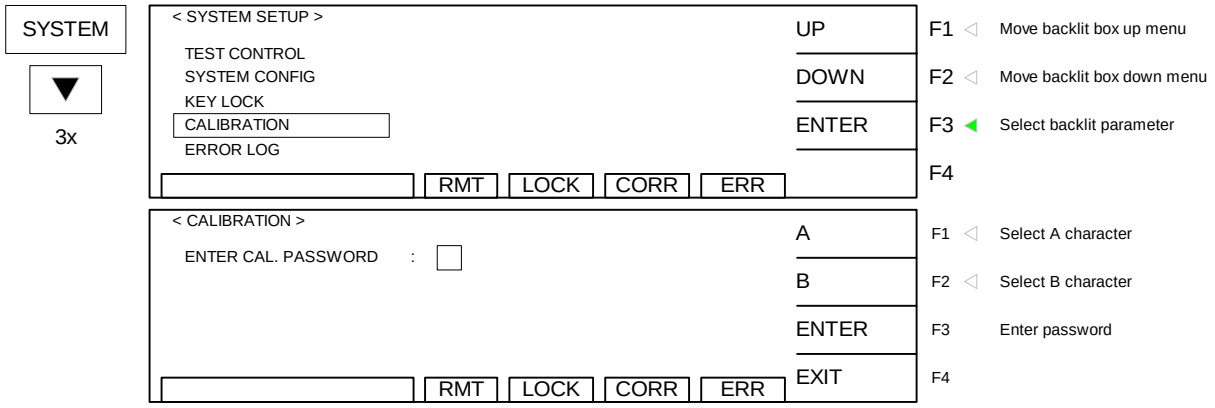


Figure 2-14: Disabling Key Lock

2.11.4 Calibration

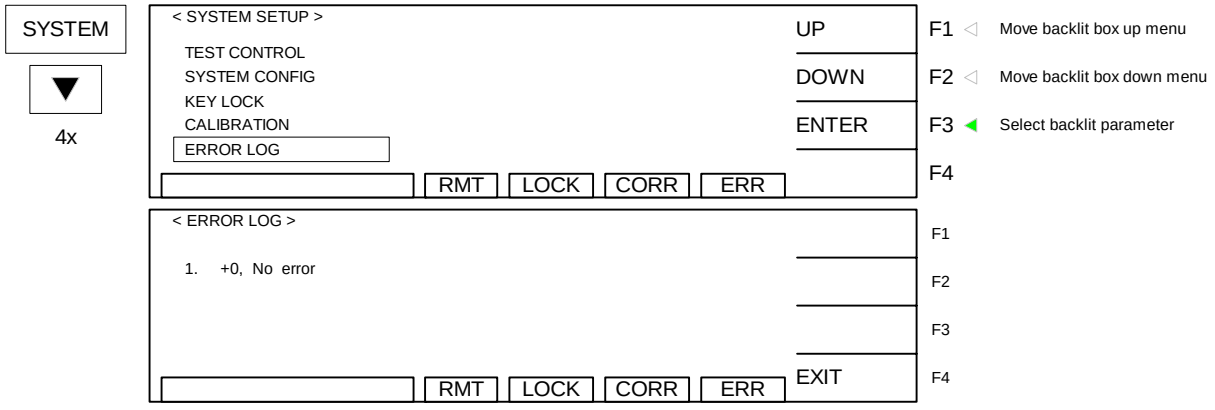
The CALIBRATION function requires a password to enter the instrument routine. Only qualified service personnel with NIST traceable standards should perform instrument calibration. Refer to paragraph 4.3 for the Hybrid 2000 calibration procedure.



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: CALIBRATION
Press [ENTER]
Refer to paragraph 4.3 for the Hybrid 2000 calibration procedure.

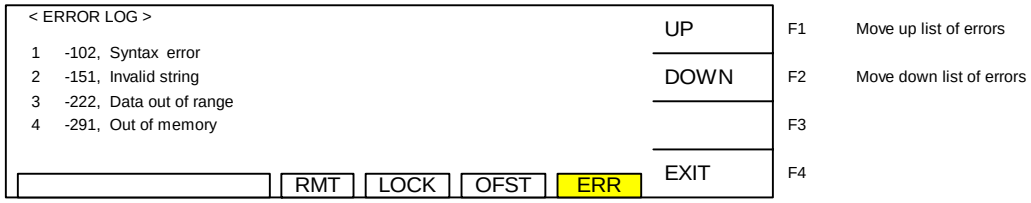
2.11.5 Error Log

The Hybrid 2000 instrument has an Error Log to track communication errors when the RS232 interface is being used. Refer to paragraph 3.2.4 and Table 3-2 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 in the queue. To view the contents of the error log:



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: ERROR LOG
Press [ENTER]
Display lists the contents of the Error Log.

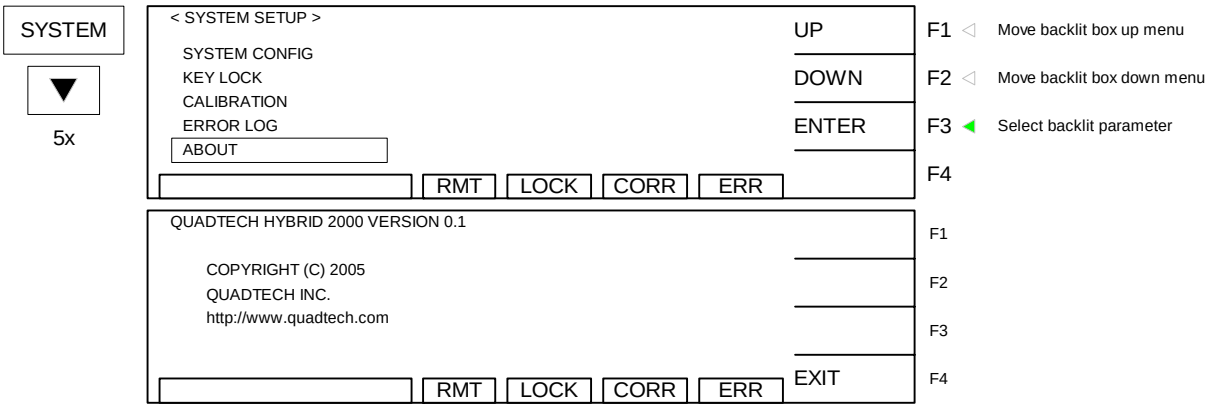
If there were errors in the queue:



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

2.11.6 About

The Hybrid 2000 instrument has a parameter labeled 'About' which lists the instrument manufacturer, software version and date. To view the contents of ABOUT:



Press [SYSTEM]
The backlit box is on: TEST CONTROL
Press DOWN [▼] arrow key so that backlit box is on: ABOUT
Press [ENTER]
Display lists the contents of ABOUT.

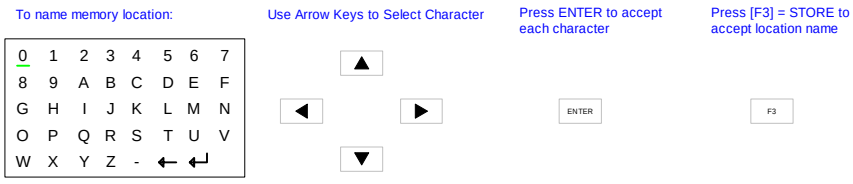
2.12 MAIN INDEX

Within the [MAIN INDEX] menu is the STORE/RECALL function. There are 50 memory locations, each of which can store a test setup that has up to 20 steps.

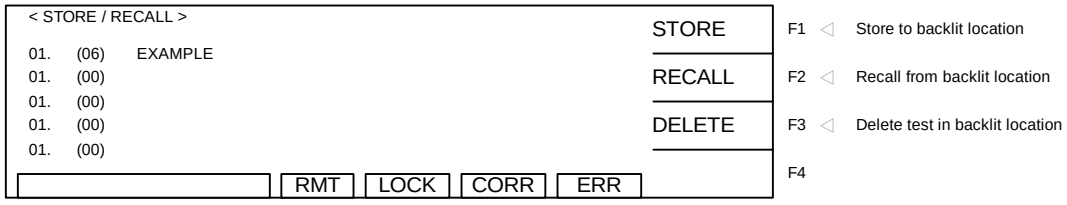
2.12.1 Storing a Test Setup

To store the previous example of the programmed 6-step test, put the instrument in 'Standby' status and:

Press [MAIN INDEX] to access the memory function.
Press [F1] = STORE/RECALL to enter the memory function.
Press [F1] = STORE to access the store function.
The backlit box is next to memory location 01: 01. (00)
Press [ENTER] to select memory location 01



Press the [▶], [◀], [▼], [▲] arrow keys to move the backlit cursor around alpha-numeric box to select each character. Press [ENTER] after each character is selected:
[E] [ENTER]
[X] [ENTER]
[A] [ENTER]
[M] [ENTER]
[P] [ENTER]
[L] [ENTER]
[E] [ENTER]
Press [F3] = STORE
Press [F1] = YES



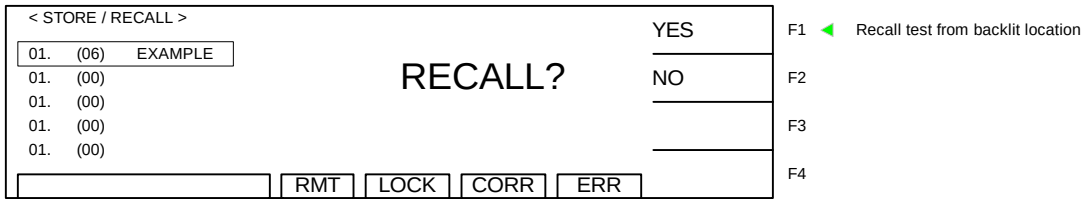
Press [TEST] to return to the Standby menu.

NOTE: If you tell the instrument to store a setup to a location that already has a setup stored in it, the Hybrid 2000 will write-over the first setup with the new setup.

2.12.2 Recalling a Test Setup

To recall a test from one of the 50 memory locations, put the instrument in ‘Standby’ status and:

Press [MAIN INDEX] to access the memory menu.
Press [F1] = STORE/RECALL to enter the memory function.
Press [F2] = RECALL to access the recall function.
The backlit box is next to memory location 01: 01. (06) EXAMPLE
Press DOWN [▼] arrow to move backlit box to the desired memory location
Press [ENTER] to select that memory location
Display prompts ‘RECALL?’
Press [F1] = YES

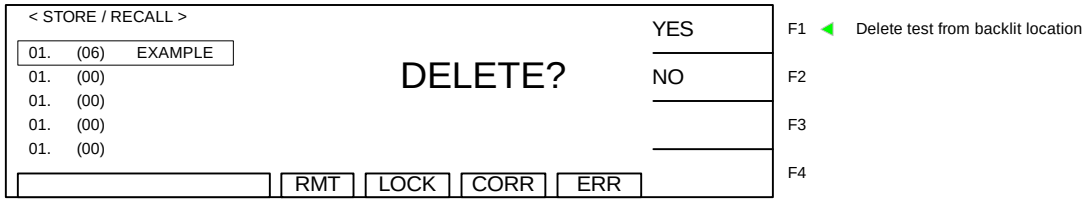


Press [TEST] to return to Standby menu.

2.12.3 Deleting a Test Setup

To delete a test from one of the 50 memory locations, put the instrument in ‘Standby’ status and:

Press [MAIN INDEX] to access the memory menu.
Press [F1] = STORE/RECALL to enter the memory function.
The backlit box is next to memory location 01: 01. (06) EXAMPLE
Press DOWN [▼] arrow to move backlit box to the desired memory location
Press [ENTER] to select that memory location
Press [F3] = DELETE to access the delete function.
Display prompts ‘DELETE?’
Press [F1] = YES



Press [TEST] to return to Standby menu.

2.13 Instrument Offset Correction

The Hybrid 2000 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 leakage current and stored in instrument memory to be applied to ongoing measurements. For maximum measurement accuracy it is recommended that the Offset Correction be performed on the Hybrid 2000 instrument after power up, any time the test parameters are changed and any time the test leads or fixture is changed.

Prior to performing the Offset Correction:

Allow the instrument to warm up for 15 minutes.
Connect the Test cables (or fixture) to the OUTPUT and RTN/LOW connectors.
Program the test steps.

With the instrument in STAND BY status:

Press [F2] = CORRECT
Press [F1] = OPEN
Follow instructions on display: i.e.: "Open Circuit Correction – Current Offset (WV & IR)".
Press green [START] button.
Wait while instrument gets Offset Correction value.
The CORR block at the bottom of the display is now highlighted (back lit).

OR

To undo the Offset Correction:

Press [F2] = CORRECT
Press [F1] = OPEN CIRCUIT
Press [F2] = OFF to turn **off** Offset Correction.
The CORR block at the bottom of the display is **OFF** now.

The following formulas apply to the offset function:

For Total Offset Current ≤ 100μA:

$$\text{Display Current} = \sqrt{(\text{Measured total current})^2 - (\text{Offset total current})^2}$$

For Real Current & Total Current > 100μA:

$$\text{Display Current} = (\text{Measured real current}) - (\text{Offset real current})$$

NOTE:
To obtain consistent results, the Offset Correction must be performed when using OSC mode. The Offset Correction is performed prior to the Get Cs function.

Offset Correction

Using the pre-programmed example from paragraphs 2.4-2.9 of the OSC, WVAC, WVDC, IR, DCR and PA 6-step test the offset correction is illustrated herein. There is an open correction for WVAC, WVDC and IR; a short correction for DCR and a Get Cs correction for OSC mode.

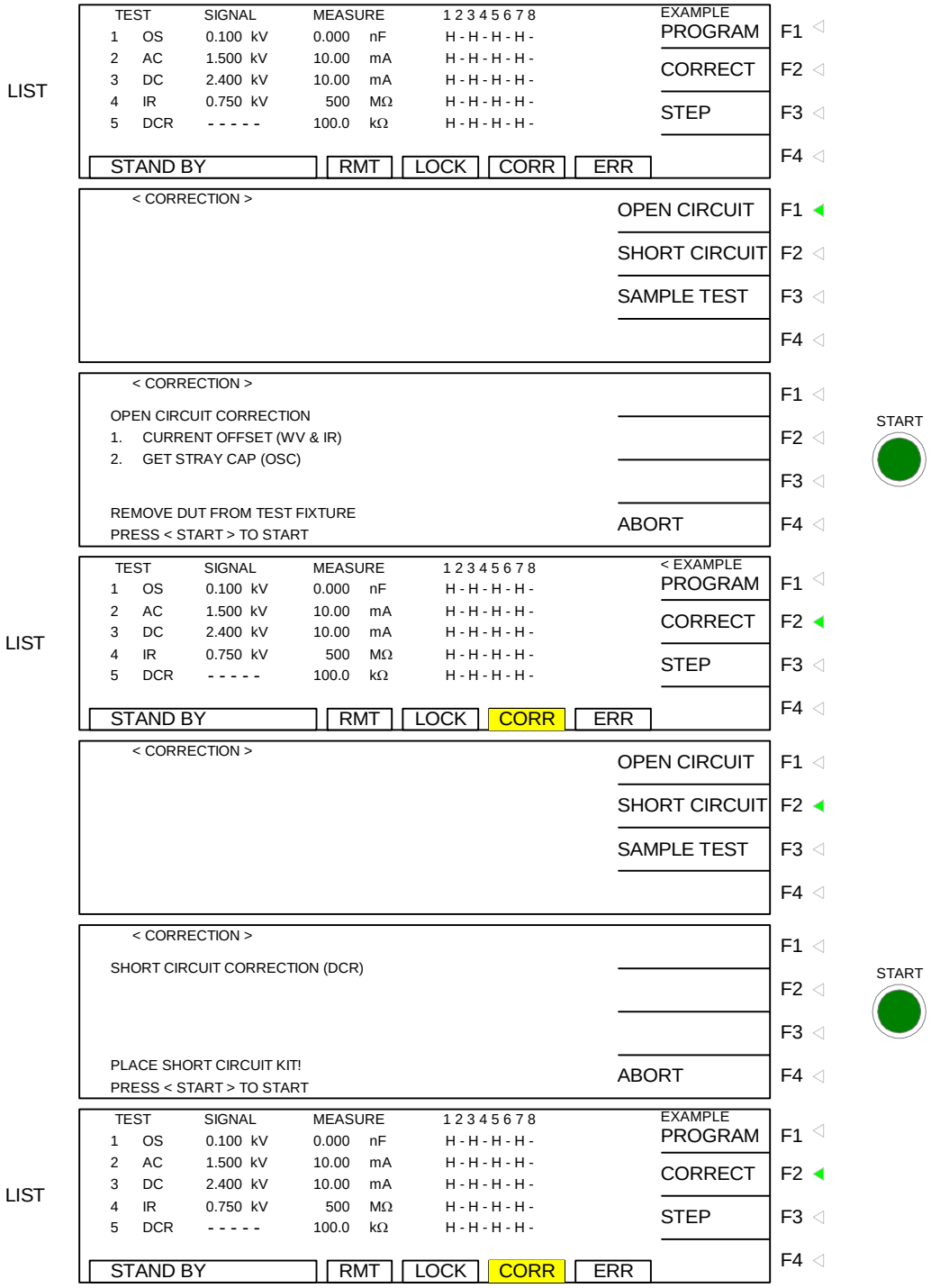


Figure 2-15: Correction

2.14 GET Cs

GET Cs is applicable to the OSC mode only. OSC is normally programmed prior to a WVAC or WVDC test to ensure the DUT is properly connected before the high voltage is applied. Refer to ¶2.4 for full explanation of the Open/Short Circuit check. The GET Cs function is illustrated herein using the pre-programmed example from ¶2.4-2.9 of the OSC, WVAC, WVDC, IR, DCR and PA 6-step test.

After performing the OFFSET Correction, attach the known good DUT and press [F2] = CORRECT.

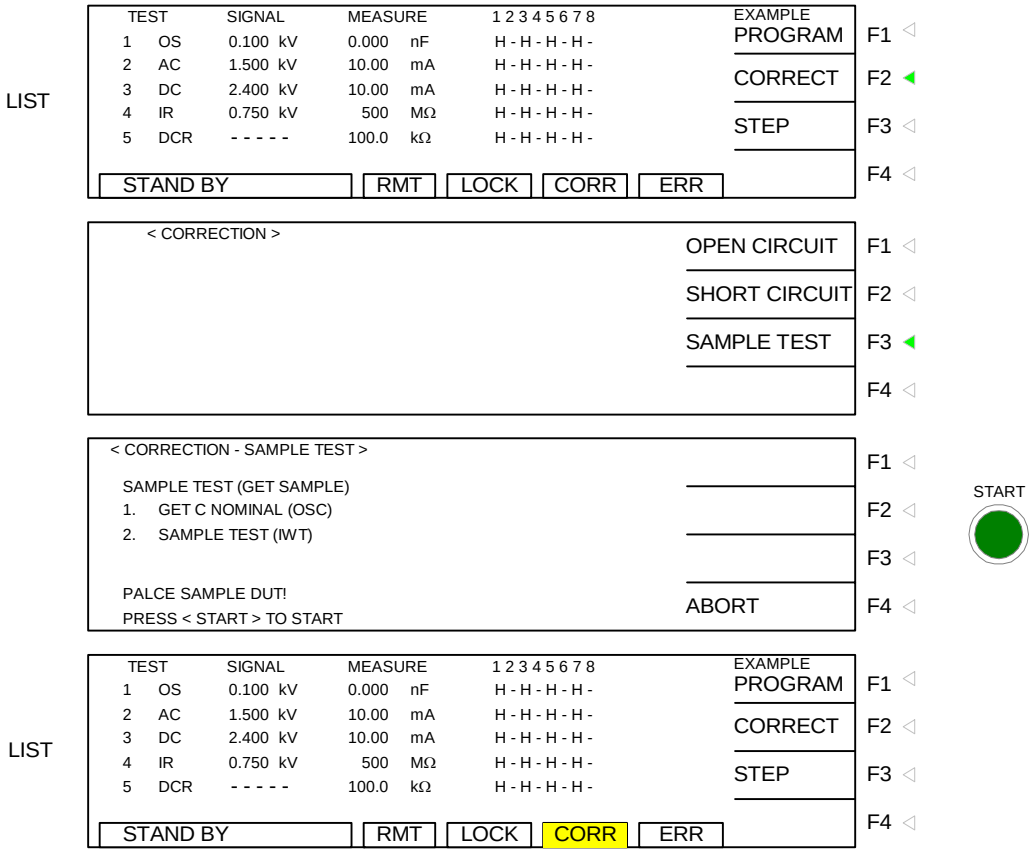


Figure 2-16: Get Cs

The Get Cs value is saved with the test setup. To delete the Get Cs correction value, press [F2] = CORRECT. Press [F3] = SAMPLE TEST. Press [F2] = OFF. The CORR led will turn off.

2.15 Connection to Device under Test

Figure 2-17 illustrates the connection of the Hybrid 2000 unit to a single DUT using the S02 1-meter HV cable set that comes standard with the instrument. The custom white banana plug/red alligator clip is connected between one output channel on the Hybrid 2000 unit and the high side of the device under test. The black banana plug/alligator clip is connected between the RTN/LOW terminal on the Hybrid 2000 unit to the low side of the DUT.

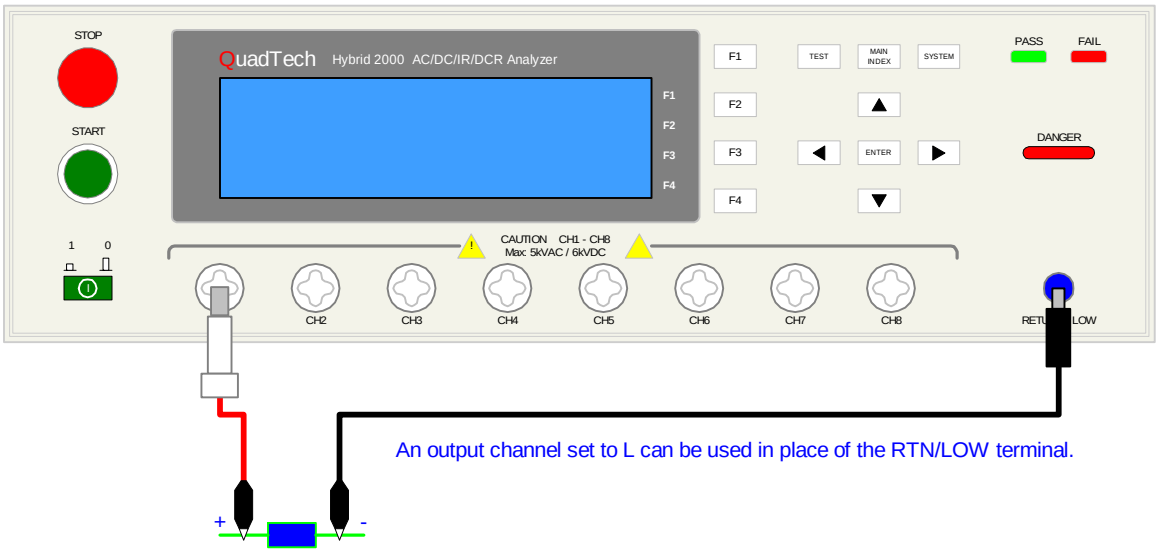


Figure 2-17: S02 Cable Connection

Figure 2-18 illustrates the connection of the Hybrid 2000 unit for a multi-device/multi-point test. The custom white banana plug/white wires are connected between the output channels (CH1-8) designated as H (high) and the high side of the device under test. The black banana plug/alligator clip is connected between the RTN/LOW terminal on the Hybrid 2000 unit to a common ground on the test fixture.

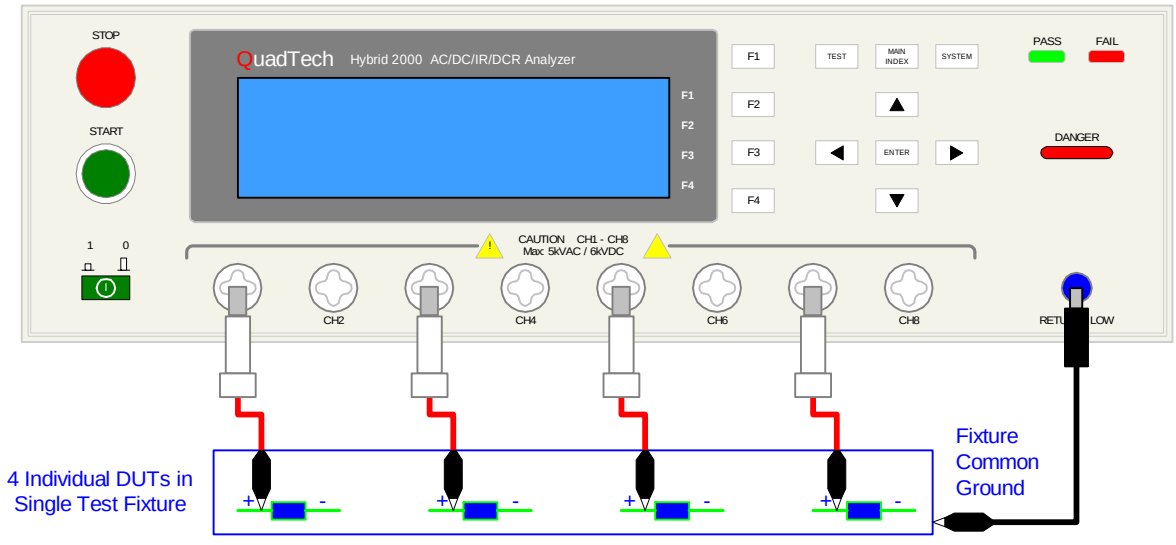


Figure 2-18: Multi-Cable Connection

With the test fixture as shown in Figure 2-18, Channels 1, 3, 5 & 7 are designated H (high) and a common ground is connected between the RTN/LOW terminal on the Hybrid 2000 and ground on the test fixture. In this case the Channels 2, 4, 6 & 8 would be designated X (not used). Another configuration for the multi-point test illustrated in Figure 2-18 is to assign Channels 2, 4, 6 & 8 as L (low) and connect these channels to the low side of each of the four DUTs.

Refer to paragraphs 3.2 through 3.7 for the description and illustration of the connection of several QuadTech accessories to the Hybrid 2000 instrument.

2.14 Measurement Procedure

Before a measurement is made verify the following:

1. Hybrid 2000 instrument [POWER] ON.
2. 15-minute warm-up.
3. Test parameters programmed and shown on Standby display.
4. Test cables or fixture connected.
5. Offset Correction 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 50 stored test setups. Refer to paragraphs 2.4 – 2.10 for test programming and storage/recall instructions.

To initiate a test:

Press [STOP] to make sure instrument is in Standby status.
Press [START]. DANGER led flashes.
The test voltage 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 voltage and stop the test.

To view the test results, press [F3] = LIST to go to the tabular display. Use the UP/DOWN [▲] [▼] arrow keys to scroll to the next page. When "UUUU" is displayed as the result, it indicates that the unit has exceeded the upper measurement limit for leakage current or insulation resistance.

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

The Hybrid 2000 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.

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.

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 2-7 lists the possible error messages for a NO GOOD/FAIL judgment.

Table 2-7: Error Messages

Error Message	Description
HIGH	Measured value (current or resistance) is over the programmed high limit.
OUTPUT FAIL	Unit's output voltage is unable to reach 95%
LOW FAIL	Measured value (current or resistance) is below the programmed low limit.
ARC FAIL	Current arc is over the programmed high limit.
SHORT	Current/Resistance reading is greater than the allowable # of digits.
GFI FAIL	Ground Fault Interrupt failed.
REAL FAIL	Measured Real Current value is over the programmed high limit.

Section 3: Interface

3.1 Interlock

On the rear panel of the Hybrid 2000 instrument is a black 2-screw terminal strip labeled INTERLOCK. The Interlock is an important safety feature for protection of the operator and instrument.

Before connecting the instrument to its power source, the interlock function on the rear panel remote connector (terminal strip) must be properly utilized. When the INTERLOCK jumper is removed, there is **no** high voltage at the output channels. Therefore, to initiate a test make sure the interlock jumper is in place.

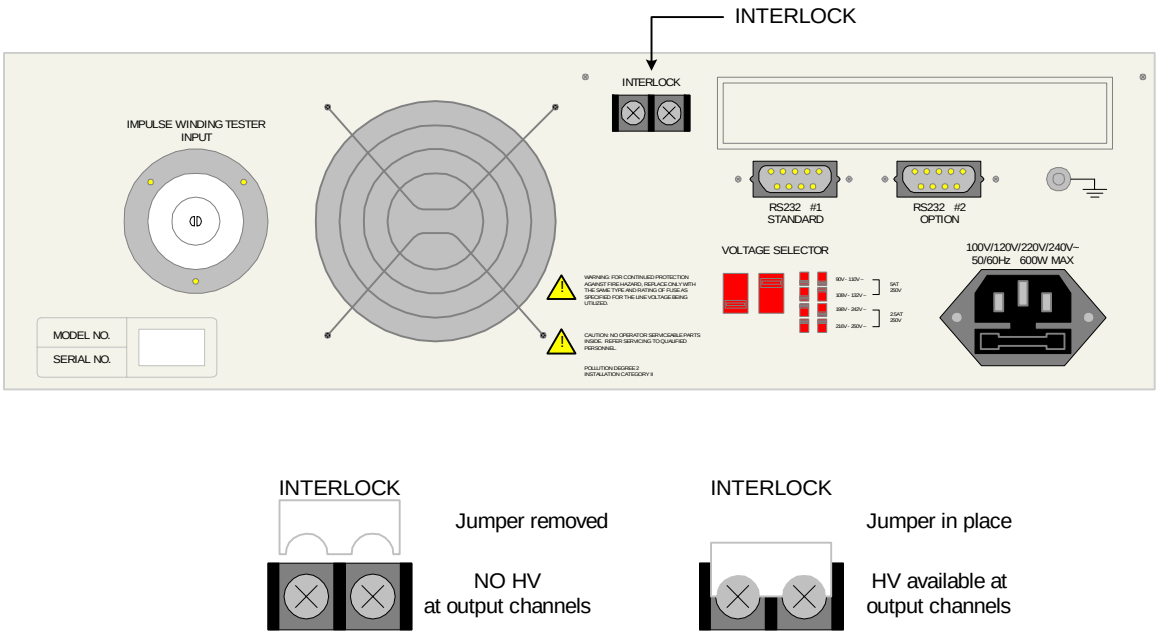


Figure 3-1: Hybrid 2000 Interlock Connector

3.2 RS232 Interface

3.2.1 Pin Configuration

The Hybrid 2000 instrument comes standard with an RS232 Interface for remote operation. A second RS232 interface is available as an option. Connection is through the silver 9-pin connector labeled 'RS232 #1' on the rear panel of the Hybrid 2000 instrument. Figure 3-2 illustrates the designation of the pins on the RS232 connector. The connection cable must be a 'straight through' cable for the Hybrid 2000 unit to communicate.

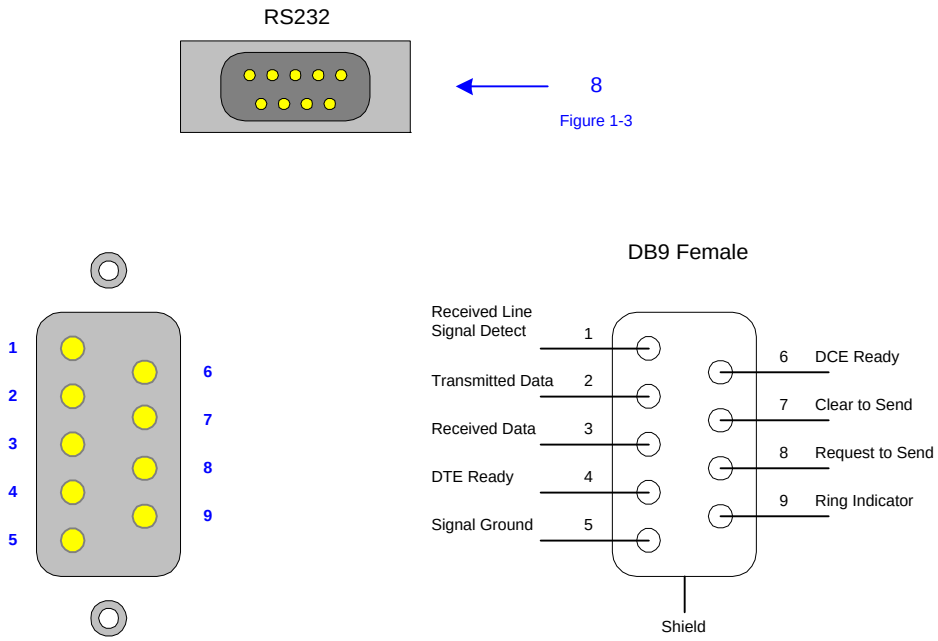


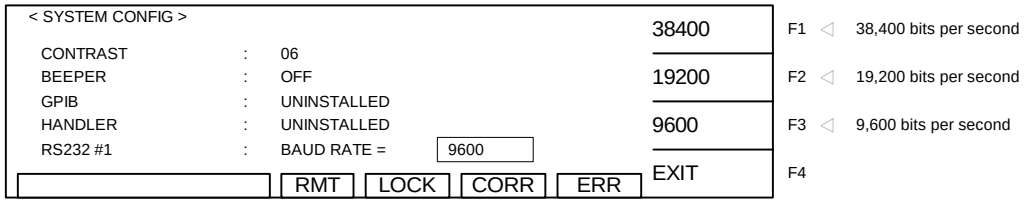
Figure 3-2: RS232 Pin Configuration

When the ERR box is backlit on the bottom of the display, there are error messages in the queue. Refer to paragraph 3.2.4, Table 3-2 for explanation of error messages. Refer to paragraph 2.11.5 for instructions on how to access and clear the error log.

3.2.2 RS232 Specifications

Data Bits:	8
Stop Bits:	1
Parity:	None, Odd, Even
Baud Rate:	9600, 19200 or 38400 bps, Software selectable
EOS:	LF or CR + LF
Echo:	Off

Setting the Baud Rate is done in the SYSTEM CONFIG function in the SYSTEM SETUP menu:



From the Standby display, press [SYSTEM]
Press the DOWN [▼] arrow key to highlight SYSTEM CONFIG.
Press [ENTER]
Press the DOWN [▼] arrow key until the box next to RS232 #1: BAUD RATE = 9600 is backlit
Press [ENTER]
Press [F1] = 38400 or [F2] = 19200 or [F3] = 9600 to select Baud Rate
Press [F4] to EXIT

3.2.3 RS232 Commands

The command set for the RS232 interface is listed on the following pages. NOTE: CR + LF is the necessary end code for the RS232 commands. There are additional RS232-only commands listed herein.

RS232-Only Commands

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

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

The Hybrid 2000 unit is in a remote control status when the RMT block on the bottom right hand side of display is backlit.

RS232 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 is CR + LF.

Table 3-1: RS232 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 – 50
*RCL	Recall	Recall saved status from memory.	1 – 50

3.2.4 SCPI Command Summary

The SCPI (Standard Commands for Programmable Instruments) parameter syntax format is listed on the following pages. To illustrate the order of precedence the entire command list is scrolled through. 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 Hybrid 2000 unit a decimal number it is necessary to have a zero before the decimal point. Example: DC: LIMit: HIGH: 0.004

:CALibration
| :REQuest?
| :RELease
| :SAFety
| | :DCR
| | | :SHORt
| | | :RRANge? MAXimum | MINimum
| | | :RESistance<n>
| | | | :OFFSet
| | | | | :BEST?
| | | | :FULL
| | | | | :BEST?
| | :IR
| | | :OPEN
| | | :RRANge? MAXimum | MINimum
| | | :RESistance<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | :OSC
| | | :VRANge? MAXimum | MINimum
| | | :VOLTage<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?

| | :STARt
| | :STOP
| | :WVAC
| | | :ARANge? MAXimum | MINimum
| | | :ARC<n>
| | | | :SLOPe
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | :CRANge? MAXimum | MINimum
| | | :CURRent<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | :RCRange? MAXimum | MINimum
| | | :RCURrent<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | :VRANge? MAXimum | MINimum
| | | :VOLTage<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?

| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | :WVDC
| | | :ARANge? MAXimum | MINimum
| | | :ARC<n>
| | | | :SLOPe
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | :CRANge? MAXimum | MINimum
| | | :CURRent<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | :VRANge? MAXimum | MINimum
| | | :VOLTage<n>
| | | | :OFFSet
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?
| | | | :FULL
| | | | | [:SOURce]
| | | | | | [:VOLTage] <number value>
| | | | | | [:VOLTage]?
| | | | | :BEST?

```
|  :STATe <boolean> | ON | OFF
|  :VALue <number value>
:MEMory
|  :DELete
|  |  [:NAME] <name>
|  |  :LOCation <register number>
|  :STATe
|  |  :DEFine <name>,<register number>
|  |  :DEFine? <name>
|  :FREE
|  |  :STATe?
|  :NSTates?
[:SOURce]
|  :SAFety
|  |  :FETCh? [<item>][,<item>]
|  |  :RESult
|  |  |  :ALL
|  |  |  |  [:JUDGment]?
|  |  |  |  :MMETerage?
|  |  |  |  :MODE?
|  |  |  |  :OMETerage?
|  |  |  |  :TIME
|  |  |  |  |  [:ELAPsed]
|  |  |  |  |  |  :DWELl?
|  |  |  |  |  |  :FALL?
|  |  |  |  |  |  :RAMP?
|  |  |  |  |  |  [:TEST]?
|  |  |  :AREPort <boolean> | ON | OFF      (RS232 only)
|  |  |  :AREPort?                          (RS232 only)
|  |  |  :COMPleted?
|  |  |  [:LAST]
|  |  |  |  [:JUDGment]
|  |  |  :STEP<n>
|  |  |  |  [:JUDGment]?
|  |  |  |  :MMETerage?
|  |  |  |  :MODE?
|  |  |  |  :OMETerage?
|  |  |  |  :TIME
|  |  |  |  |  [:ELAPsed]
|  |  |  |  |  |  :DWELl?
|  |  |  |  |  |  :FALL?
|  |  |  |  |  |  :RAMP?
|  |  |  |  |  |  [:TEST]?
```

| | :SNUMber?
| | :STARt
| | | [:ONCE]
| | | :CORRection
| | | | :OPEN GET | OFF
| | | | :OPEN?
| | | | :SHORt GET | OFF
| | | | :SHORt?
| | | | :SAMPle GET
| | | | :SAMPle?
| | :STATus?
| | :STEP<n>
| | | :DCR
| | | | :CHANnel
| | | | | [:HIGH] <channel list>
| | | | | [:HIGH]?
| | | | | :LOW <channel list>
| | | | | :LOW?
| | | | :LIMit
| | | | | [:HIGH] <number value>
| | | | | [:HIGH]?
| | | | | :LOW <number value>
| | | | | :LOW?
| | | | :RANGe
| | | | | [:UPPer] <number value>
| | | | | [:UPPer]?
| | | | | :LOWer <number value>
| | | | | :LOWer?
| | | | | :AUTO <boolean> | ON | OFF
| | | | | :AUTO?
| | | | :TIME
| | | | | :TEST <number value>
| | | | | :TEST?
| | | | | :DWELl <number value>
| | | | | :DWELl?
| | | :DELete

| | | :IR
| | | | :CHANnel
| | | | | [:HIGH] <channel list>
| | | | | [:HIGH]?
| | | | | :LOW <channel list>
| | | | | :LOW?
| | | | [:LEVel] <number value>
| | | | [:LEVel]?
| | | | :LIMit
| | | | | :HIGH <number value>
| | | | | :HIGH?
| | | | | [:LOW] <number value>
| | | | | [:LOW]?
| | | | :RANGe
| | | | | [:UPPer] <number value>
| | | | | [:UPPer?]
| | | | | :LOWer <number value>
| | | | | :LOWer?
| | | | | :AUTO <boolean> | ON | OFF
| | | | | :AUTO?
| | | | :TIME
| | | | | :FALL <number value>
| | | | | :FALL?
| | | | | :RAMP <number value>
| | | | | :RAMP?
| | | | | [:TEST] <number value>
| | | | | [:TEST]?
| | | :IWT
| | | | :CHANnel
| | | | | [:HIGH] <channel list>
| | | | | [:HIGH]?
| | | | | :LOW <channel list>
| | | | | :LOW?
| | | :OSC
| | | | :CHANnel
| | | | | [:HIGH] <channel list>
| | | | | [:HIGH]?
| | | | | :LOW <channel list>
| | | | | :LOW?
| | | | :LIMit
| | | | | [:OPEN] <number value>
| | | | | [:OPEN]?
| | | | | :SHORt <number value>
| | | | | :SHORt?

```
| | | :PAuse
| | | | [:MESSage] <string data>
| | | | [:MESSage]?
| | | | :TIME
| | | | | [:TEST] <number value>
| | | | | [:TEST]?
| | | :MODE?
| | | :SET?
| | | :WVAC
| | | | :CHANnel
| | | | | [:HIGH] <channel list>
| | | | | [:HIGH]?
| | | | | :LOW <channel list>
| | | | | :LOW?
| | | | [:LEVel] <number value>
| | | | [:LEVel]?
| | | | :LIMit
| | | | | :ARC <number value>
| | | | | :ARC?
| | | | | [:HIGH] <number value>
| | | | | [:HIGH]?
| | | | | :LOW <number value>
| | | | | :LOW?
| | | | | :REAL <number value>
| | | | | :REAL?
| | | | :TIME
| | | | | :FALL <number value>
| | | | | :FALL?
| | | | | :RAMP <number value>
| | | | | :RAMP?
| | | | | [:TEST] <number value>
| | | | | [:TEST]?
| | | :WVDC
| | | | :CHANnel
| | | | | [:HIGH] <channel list>
| | | | | [:HIGH]?
| | | | | :LOW <channel list>
| | | | | :LOW?
| | | | [:LEVel] <number value>
| | | | [:LEVel]?
```

```
|  |  |  |  :LIMit
|  |  |  |  |  :ARC <number value>
|  |  |  |  |  :ARC?
|  |  |  |  |  [:HIGH] <number value>
|  |  |  |  |  [:HIGH]?
|  |  |  |  |  :LOW <number value>
|  |  |  |  |  :LOW?
|  |  |  |  :TIME
|  |  |  |  |  :DWELl <number value>
|  |  |  |  |  :DWELl?
|  |  |  |  |  :FALL <number value>
|  |  |  |  |  :FALL?
|  |  |  |  |  :RAMP <number value>
|  |  |  |  |  :RAMP?
|  |  |  |  |  [:TEST] <number value>
|  |  |  |  |  [:TEST]?
|  |  :STOP
:SYSTem
|  :ERRor
|  |  [:NEXT]?
|  :KLOCk <boolean> | ON | OFF              (RS232 only)
|  :KLOCk?
|  :LOCK
|  |  :OWNer?
|  |  :RELease                             (RS232 only)
|  |  :REQuest?                            (RS232 only)
|  :TCONtrol
|  |  :AGC
|  |  |  [:SOFTware] <boolean> | ON | OFF
|  |  |  [:SOFTware]?
|  |  :FCONtinuity <number value>
|  |  :FCONtinuity?
|  |  :GFI <boolean> | ON | OFF
|  |  :GFI?
|  |  :RJUDgment <boolean> | ON | OFF
|  |  :RJUDgment?
|  |  :TIME
|  |  |  :PASS <number value>
|  |  |  :PASS?
|  |  :WVAC
|  |  |  :FREQuency <boolean> | ON | OFF
|  |  |  :FREQuency?
|  |  :WRANge
|  |  |  [:AUTO] <boolean> | ON | OFF
|  |  |  [:AUTO]?
|  :VERSion?
```

3.2.5 Command Descriptions

:MEMory:DELete[:Name] **< *name* >**
Delete the parameter data specified by <name> in main memory. < name > is a string.

:MEMory:DELete:LOCAtion **< *register number* >**
Delete the parameter data specified by < register number > in main memory.
< register number > is an integer.

:MEMory:STATe:DEFine **< *"name"* >, < *register number* >**
Set a name for memory specified by <register number >.

:MEMory:STATe:DEFine? **< *name* >**
Query the memory's < register number > specified by < name >.

:MEMory:FREE:STATe?
Query the unused capacity in main memory.

:MEMory:NSTates?
Query the capacity of main memory. The value returned is one greater than the maximum that can be sent as a parameter to the *SAV and *RCL commands.

:SYSTem:ERRor[:NEXT]?
This command reads the messages in Error Queue. See paragraph 3.2.6 Error Messages for the returned messages.

:SYSTem:KLOCk **< *boolean* > | *ON* | *OFF***
Lock the panel control. The command does not affect the Remote/Local state of GPIB.

:SYSTem:KLOCk?
Query if the panel is locked.

:SYSTem:OWNer?
Query if the tester is in panel control or remote control state.

:SYSTem: LOCK:RELease
Switch back to panel control state.

:SYSTem:LOCK:REQuest?
Switch to remote control state. It returns 1 if success or it returns 0.

:SYSTem:TCONtrol: AGC[:SOFTware] **< *boolean* > | *ON* | *OFF***
Set the software AGC function ON or OFF.

:SYSTem:TCONtrol: AGC[:SOFTware]?
Query if the software AGC function is ON or OFF.

:SYSTem:TCONtrol: FCONtimuity **< *boolean* > | *ON* | *OFF***
Set Continue on Fail ON or OFF.

:SYSTem:TCONtrol: FCONtimuity **< *boolean* > | *ON* | *OFF***
Query if FCONtinuity is enabled.

:SYSTem:TCONtrol: GFI **< *boolean* > | *ON* | *OFF***
Set GFI ON or OFF.

:SYSTem:TCONtrol: GFI?
Query if GFI is enabled with 0 or 1 returned. (0 = GFI is OFF, 1 = GFI is ON.)

:SYSTem:TCONtrol: RJUDgment **< *boolean* > | *ON* | *OFF***
Set RAMP JUDGMENT ON or OFF.

:SYSTem:TCONtrol: RJUDgment?
Query if RAMP JUDGMENT is enabled with 0 or 1 returned. (0 = OFF, 1 = ON.)

:SYSTem:TCONtrol: TIME:PASS **<*numeric_value*>**
Set the time (in sec) for PASS HOLD duration.

:SYSTem:TCONtrol: TIME:PASS?
Query the time (in sec) for PASS HOLD duration.

:SYSTem:TCONtrol: FREQuency **< *numeric value* >**
Set the output voltage frequency for AC withstand voltage test.

:SYSTem:TCONtrol: FREQuency?
Query the output voltage frequency for AC withstand voltage test.

:SYSTem:TCONtrol: WRANge **< *boolean* > | *ON* | *OFF***
Set the withstand voltage auto range function ON or OFF.

:SYSTem:TCONtrol: WRANge?
Query if the withstand voltage auto range function is enabled. (0 = OFF, 1 = ON.)

:SYSTem:VERSion?
Query the supported SCPI version of this device.

[:SOURce]:SAFEty:FETCh? ***[< item >] [, < item >]***

Query the measurement result of the tester. <item> is string as listed below:

String	Returned Data
STEP	The present STEP number.
MODE	The present MODE
OMETerage	The present reading of output meter
MMETerage	The present reading of measure meter
RMETerage	The present reading of real current meter
RELApsed	The time executed for RAMP
RLEAve	The time remained for RAMP
DELApsed	The time executed for DWELL
DLEAve	The time remained for DWELL
TELApsed	The time executed for TEST
TLEAve	The time remained for TEST
FELapsed	The time executed for FALL
FLEave	The time remained for FALL

[:SOURce]:SAFEty:RESult:ALL[:JUDGment]?

Query all judgment results. The return format is First Step Result, Second Step Result ..., Last Step Result. The hex and decimal code meaning are listed below:

Mode	WVAC		WVDC		IR		DCR		OSC		IWT		ALL	
Code	HEX	DEC	HEX	HEX	HEX	HEX	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC
UNCOMPLETED													70	112
ABORT													71	113
TESTING													73	115
PASS/SKIPPED /COMPLETED													74	116
HIGH FAIL	21	33	31	49	41	65	11	17						
LOW FAIL	22	34	32	50	42	66	12	18						
ARC FAIL	23	35	33	51										
REAL FAIL	2A	42												
OUTPUT FAIL	21	33	31	49	42	66								
GFI FAIL	24	36	34	52	44	68								
SHORT	24	36	34	52	44	68			61	97				
OPEN									62	98				
IWT FAIL											51	81		
DWX ERROR											54	84		

[:SOURce]:SAFEty:RESult:ALL:MMETerage?

Query the MEASURE METER readings of all STEPs.

[:SOURce]:SAFEty:RESult:ALL:RMETerage?

Query the REAL CURRENT METER readings of all STEPs.

[:SOURce]:SAFEty:RESult:ALL:MODE?

Query the MODE of all STEPs. Return is a string: WVAC|WVDC|IR|DCR|OSC|IWT|PA

[:SOURce]:SAFEty:RESult:ALL:OMETerage?

Query the OUTPUT METER readings of all STEPs.

[:SOURce]:SAFEty:RESult:ALL:TIME[:ELAPsed]:DWELl?
Query the DWELL time of all STEPs.

[:SOURce]:SAFEty:RESult:ALL:TIME[:ELAPsed]:FALL?
Query the voltage fall time of all STEPs.

[:SOURce]:SAFEty:RESult:ALL:TIME[:ELAPsed]:RAMP?
Query the voltage ramp time of all STEPs.

[:SOURce]:SAFEty:RESult:ALL:TIME[:ELAPsed][:TEST]?
Query the test time of all STEPs.

[:SOURce]:SAFEty:RESult:AREPort ***< boolean > | ON | OFF***
Set auto reporting of the test result ON or OFF. (RS232 interface only.)

[:SOURce]:SAFEty:RESult:AREPort?
Query if auto reporting is ON (1) or OFF (0). (RS232 interface only.)

[:SOURce]:SAFEty:RESult:COMPleted?
Query if the device has completed all test steps by returning 1 or 0.

[:SOURce]:SAFEty:RESult[:LAST][:JUDGment]?
Query the judgment code of the last executed STEP.

[:SOURce]:SAFEty:RESult: STEP<n> [:JUDGment]?
Query the judgment of selected STEP.

[:SOURce]:SAFEty:RESult:STEP<n>:MMETerage?
Query the MEASURE METER reading of selected STEP.

[:SOURce]:SAFEty:RESult: STEP<n>:RMETerage?
Query the REAL CURRENT METER reading of selected STEP.

[:SOURce]:SAFEty:RESult:STEP<n>:MODE?
Query the MODE of selected STEP> Return string: WVAC|WVDC|IR|DCR|OSC|IWT|PA

[:SOURce]:SAFEty:RESult: STEP<n>:OMETerage?
Query the OUTPUT METER reading of selected STEP.

[:SOURce]:SAFEty:RESult: STEP<n>:TIME[:ELAPsed]:DWELl?
Query the DWELL time of selected STEP.

[:SOURce]:SAFEty:RESult: STEP<n>:TIME[:ELAPsed]:FALL?
Query the voltage fall time of selected STEP.

[:SOURce]:SAFEty:RESult: STEP<n>:TIME[:ELAPsed]:RAMP?
Query the voltage ramp time of selected STEP.

[:SOURce]:SAFEty:RESult: STEP<n>:TIME[:ELAPsed][:TEST]?
Query the test time of selected STEP.

[:SOURce]:SAFEty:SNUMber?
Query the number of STEPs set in the active memory.

[:SOURce]:SAFEty:STARt[:ONCE]
Activate the test.

[:SOURce]:SAFEty:STARt:CORRection:OPEN ***GET | OFF***
When the parameter is set to GET, it executes open offset and the tester may output high voltage. It closes offset when the parameter is set to OFF.

[:SOURce]:SAFEty:STARt:CORRection:OPEN?
Query if open offset is performed.

[:SOURce]:SAFEty:STARt:CORRection:SHORt ***GET | OFF***
When the parameter is set to GET, it executes short offset and the tester may output high voltage. It closes offset when the parameter is set to OFF.

[:SOURce]:SAFEty:STARt:CORRection:SHORt?
Query if short offset is executed.

[:SOURce]:SAFEty:STARt:CORRection:SAMPle ***GET***
When the parameter is set to GET, it executes the sample correction and the tester may output high voltage.

[:SOURce]:SAFEty:STARt:CORRection:SAMPle?
Query if sample correction is executed.

[:SOURce]:SAFEty:STOP
Stop the test.

[:SOURce]:SAFEty:STATus?
Query the execution status of current device. Return string: RUNNING|STOPPED.

[:SOURce]:SAFEty:STEP<n>:DELete
Delete the STEP specified by <n> and the STEP after <n> will replace it.

[:SOURce]:SAFEty:STEP<n>:MODE?
Query the MODE of selected STEP. Return: WVAC, WVDC, IR, DCR, OSC, IWT, PA.

[:SOURce]:SAFEty:STEP<n>:SET?
Query the settings of selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:CHANnel[: HIGH] <***channel_list***>
Set the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:CHANnel[: HIGH]?
Query the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:CHANnel: LOW <***channel_list***>
Set the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:CHANnel: LOW?
Query the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC[:LEVel] < ***numeric value*** >
Set the voltage (in volts) for AC withstand voltage test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC[:LEVel]?
Query the voltage (in volts) for AC withstand voltage test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit:ARC < ***numeric value*** >
Set the ARC inspection value for selected STEP. The unit is amperes.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit:ARC?
Query the ARC inspection value for selected STEP. The unit is amperes.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit[:HIGH] < ***numeric value*** >
Set the leakage current high limit (in amps) for WVAC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit[:HIGH]?
Query the leakage current high limit (in amps) for WVAC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit:LOW < ***numeric value*** >
Set the leakage current low limit (in amps) for WVAC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit:LOW?
Query the leakage current low limit (in amps) for WVAC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit:REAL < ***numeric value*** >
Set the real current high limit (in amps) for WVAC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:LIMit:REAL?
Query the real current high limit (amps) for WVAC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:TIME:FALL **< *numeric value* >**
Set the time required (in sec) for set voltage to fall to low voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:TIME:FALL?
Query the time required (in sec) for set voltage to fall to low voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:TIME:RAMP **< *numeric value* >**
Set the time required (in sec) for ramping to the set voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:TIME:RAMP?
Query the time required (in sec) for ramping to the set voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVAC:TIME[:TEST] **< *numeric value* >**
Set the time required for test for selected STEP. The unit is seconds.

[:SOURce]:SAFEty:STEP<n>:WVAC:TIME[:TEST]?
Query the time required for test for selected STEP. The unit is seconds.

[:SOURce]:SAFEty:STEP<n>:WVDC:CHANnel[: HIGH] **<*channel_list*>**
Set the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:CHANnel[: HIGH]?
Query the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:CHANnel: LOW **<*channel_list*>**
Set the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:CHANnel: LOW?
Query the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC[:LEVel] **< *numeric value* >**
Set the voltage (in volts) for DC withstand voltage test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC[:LEVel]?
Query the voltage (in volts) for DC withstand voltage test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:LIMit:ARC **< *numeric value* >**
Set the ARC inspection value for selected STEP. The unit is amperes.

[:SOURce]:SAFEty:STEP<n>:WVDC:LIMit:ARC?
Query the ARC inspection value for selected STEP. The unit is amperes.

[:SOURce:]SAFEty:STEP<n>:WVDC:LIMit[:HIGH] **< *numeric value* >**
Set the leakage current high limit (in amps) for WVDC test for selected STEP.

[:SOURce:]SAFEty:STEP<n>:WVDC:LIMit[:HIGH]?
Query the leakage current high limit (in amps) for WVDC test for selected STEP.

[:SOURce:]SAFEty:STEP<n>:WVDC:LIMit:LOW **< *numeric value* >**
Set the leakage current low limit (in amps) for WVDC test for selected STEP.

[:SOURce:]SAFEty:STEP<n>:WVDC:LIMit:LOW?
Query the leakage current low limit (in amps) for WVDC test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME:DWELl **< *numeric value* >**
Set the time (in sec) required for DWELL for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME:DWELl?
Query the time (in sec) required for DWELL for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME:FALL **< *numeric value* >**
Set the time (in sec) for set voltage to fall to low voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME:FALL?
Query the time (in sec) for set voltage to fall to low voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME:RAMP **< *numeric value* >**
Set the time (in sec) for ramping to the set voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME:RAMP?
Query the time (in sec) for ramping to the set voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME[:TEST] **< *numeric value* >**
Set the time (in sec) for test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:WVDC:TIME[:TEST]?
Query the time (in sec) for test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:CHANnel[: HIGH] ***<channel_list>***
Set the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:CHANnel[: HIGH]?
Query the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:CHANnel: LOW ***<channel_list>***
Set the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:CHANnel: LOW?
Query the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR[:LEVel] **< *numeric value* >**
Set the voltage (in volts) for IR test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR[:LEVel]?
Query the voltage (in volts) for IR test for selected STEP. The unit is Volt.

[:SOURce]:SAFEty:STEP<n>:IR:LIMit:HIGH **< *numeric value* >**
Set the insulation resistance high limit (in ohms) for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:LIMit:HIGH?
Query the insulation resistance high limit (in ohms) for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:LIMit[:LOW] **< *numeric value* >**
Set the insulation resistance low limit (in ohms) for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:LIMit[:LOW]?
Query the insulation resistance low limit (in ohms) for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe[:UPPer] **< *numeric value* >**
Set the test current range for selected STEP. The unit is amperes. The set current range should be larger than the input current.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe[:UPPer]?
Query the test current range for selected STEP. The unit is amperes.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:LOWer **< *numeric value* >**
Set the test current range for selected STEP. The unit is amperes. The set current range should be smaller than the input current.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:LOWer?
Query the test current range for selected STEP. The unit is amperes.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:AUTO **< *boolean* > | *ON* |*OFF***
Set the test current range to auto for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:AUTO?
Query if the test current range is set to auto for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:TIME:FALL **< *numeric value* >**
Set the time (in sec) required for set voltage to fall to low voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:TIME:FALL?
Query the time (in sec) required for set voltage to fall to low voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:TIME:RAMP **< *numeric value* >**
Set the time (in sec) required for ramping to the set voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:TIME:RAMP?
Query the time (in sec) required for ramping to the set voltage for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:TIME[:TEST] **< *numeric value* >**
Set the time required for test for selected STEP. The unit is seconds.

[:SOURce]:SAFEty:STEP<n>:IR:TIME[:TEST]?
Query the time required for test for selected STEP. The unit is seconds.

[:SOURce]:SAFEty:STEP<n>:DCR:CHANnel[: HIGH] ***<channel_list>***
Set the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:DCR:CHANnel[: HIGH]?
Query the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:DCR:CHANnel: LOW ***<channel_list>***
Set the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:DCR:CHANnel: LOW?
Query the RTN/LOW channel output state of scan for selected STEP.

[:SOURce:]SAFEty:STEP<n>:DCR:LIMit[:HIGH] **< *numeric value* >**
Set the DC resistance high limit (in ohms) for selected STEP.

[:SOURce:]SAFEty:STEP<n>:DCR:LIMit[:HIGH]?
Query the DC resistance high limit (in ohms) for selected STEP.

[:SOURce:]SAFEty:STEP<n>:DCR:LIMit:LOW **< *numeric value* >**
Set the DC resistance low limit (in ohms) for selected STEP.

[:SOURce:]SAFEty:STEP<n>:DCR:LIMit:LOW?
Query the DC resistance low limit (in ohms) for selected STEP.

[:SOURce]:SAFEty:STEP<n>:DCR:RANGe[:UPPer] **< *numeric value* >**
Set the DC resistance range (in ohms) for selected STEP. The set DC resistance range should be larger than the DC resistance to be input.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe[:UPPer]?
Query the DC resistance range for selected STEP. The unit is ohms.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:LOWer **< *numeric value* >**
Set the DC resistance range (in ohms) for selected STEP. The set DC resistance range should be smaller than the DC resistance to be input.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:LOWer?
Set the tested DC resistance range (in ohms) for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:AUTO ***< boolean > | ON |OFF***
Set the DC resistance range to auto for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IR:RANGe:AUTO?
Query if the tested DC resistance range is set to auto for selected STEP.

[:SOURce]:SAFEty:STEP<n>:OSC:CHANnel[: HIGH] ***<channel_list>***
Set the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:OSC:CHANnel[: HIGH]?
Query the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:OSC:CHANnel: LOW ***<channel_list>***
Set the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:OSC:CHANnel: LOW?
Query the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]: SAFEty: STEP<n>: OSC: LIMit[: OPEN] ***< numeric value >***
Set the percentage of Open when doing Open/Short Check for selected STEP.

[:SOURce]: SAFEty: STEP<n>: OSC: LIMit[: OPEN]?
Query the percentage of Open when doing Open/Short Check for selected STEP.

[:SOURce]: SAFEty: STEP<n>: OSC: LIMit: SHORt ***< numeric value >***
Set the percentage of Short when doing Open/Short Check for selected STEP.

[:SOURce]: SAFEty: STEP<n>: OSC: LIMit: SHORt?
Query the percentage of Short when doing Open/Short Check for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IWT:CHANnel[: HIGH] ***<channel_list>***
Set the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IWT:CHANnel[: HIGH]?
Query the high voltage output channel state of scan test for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IWT:CHANnel: LOW ***<channel_list>***
Set the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:IWT:CHANnel: LOW?
Query the RTN/LOW channel output state of scan for selected STEP.

[:SOURce]:SAFEty:STEP<n>:PA [:MESSage] <string>
Set the message string for PA MODE.

[:SOURce]:SAFEty:STEP<n>:PA [:MESSage]?
Query the message string for PA MODE.

[:SOURce]:SAFEty:STEP<n>:PA:TIME[:TEST] **< *numeric value* >**
Set the execution time (in sec) for PA MODE.

[:SOURce]:SAFEty:STEP<n>:PA:TIME[:TEST]?
Query the execution time (in sec) for PA MODE.

3.2.6 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 3-2 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 3-2: RS232 Error Messages

#	Type	Description
-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
-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
-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
-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 Terminated	Query terminated because the output queue data cannot be read when there is NO data in the queue.

3.3 G16 International Power Strip

The Hybrid 2000 instrument can be connected to the G16 International Power Strip as illustrated in Figure 3-3 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 Hybrid 2000 RTN/LOW terminal.

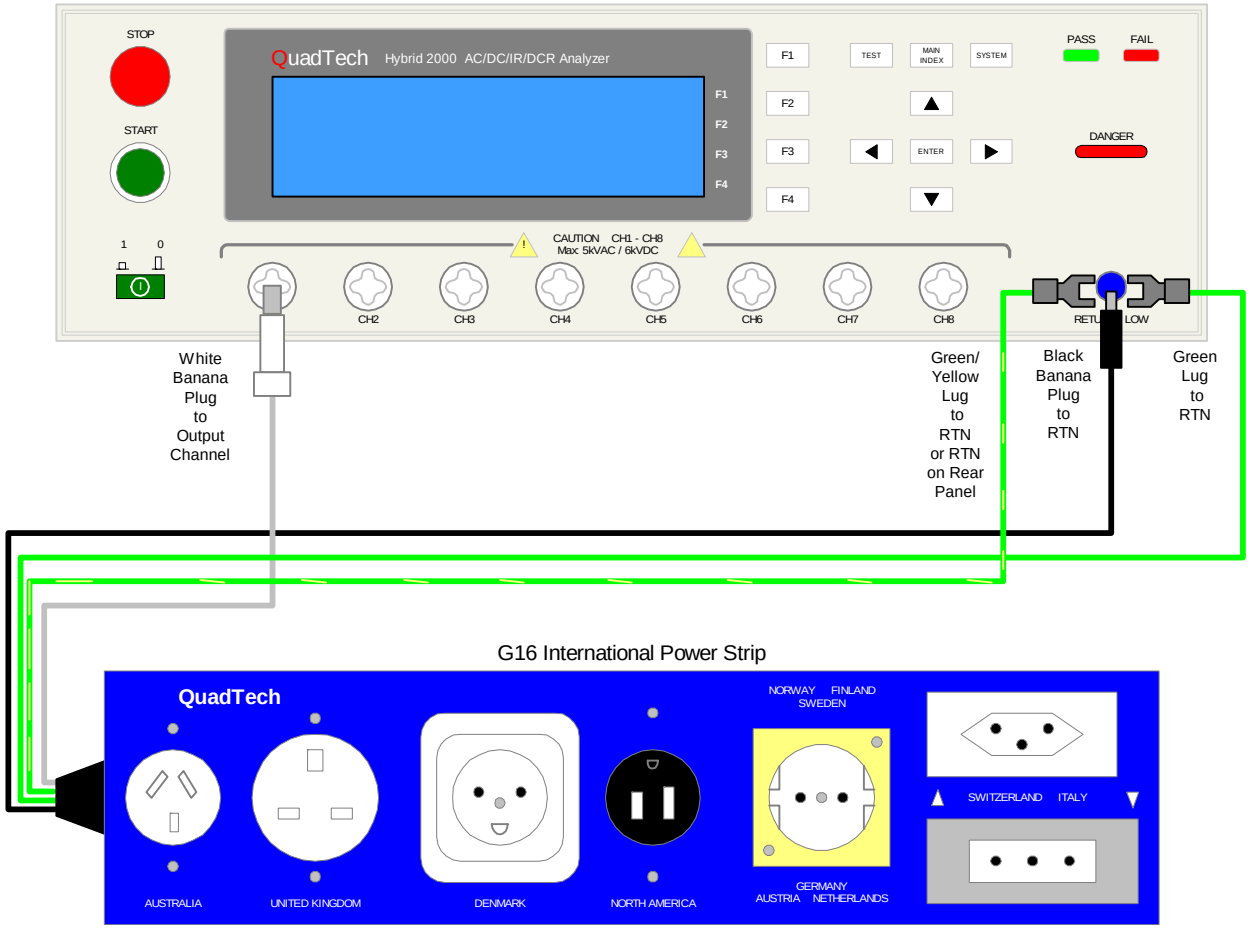


Figure 3-3: G16 International Power Strip Connection to Hybrid 2000 Instrument

3.4 S07 Power Entry Adaptor Cable

The S07 Power Entry Adaptor Cable is a 3-wire AC inlet receptacle for precise testing of corded products. The S07 cable is connected to the Hybrid 2000 instrument via a two-lead set. The white custom banana plug is connected to an output channel on the Hybrid 2000 unit. The black banana plug with retaining bracket is connected to the RTN/LOW terminal on the Hybrid 2000 unit. Figure 3-4 illustrates this connection of the S07 cable to a Hybrid 2000 instrument.

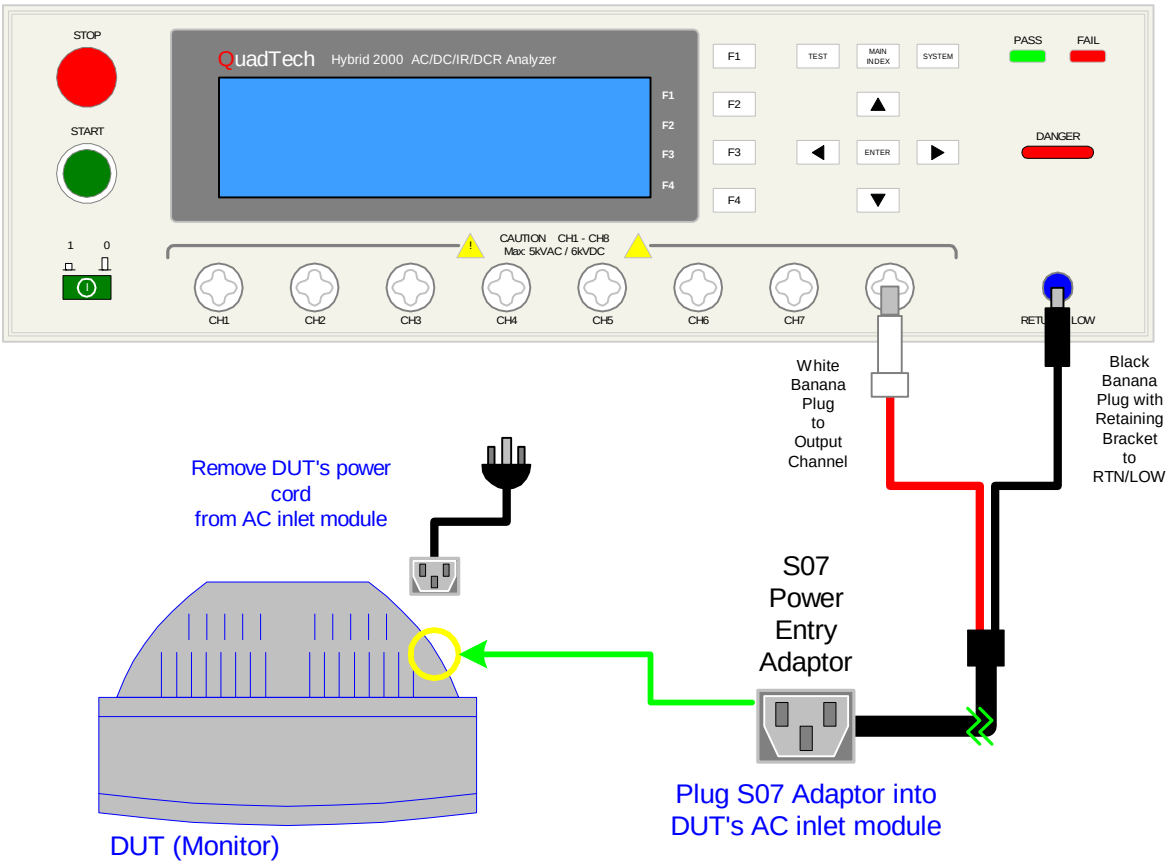


Figure 3-4: S07 Power Entry Adaptor Cable

3.5 S03 Corded Product Adaptor (115V)

The S03 Corded Product Adaptor is a 3-prong electrical outlet box to facilitate testing of corded products. The S03 cable is connected to the Hybrid 2000 instrument via a two-lead set. The white custom banana plug is connected to an output channel on the Hybrid 2000 unit. The black banana plug is connected to the RTN/LOW terminal on the Hybrid 2000 unit. Figure 3-5 illustrates this connection of the S03 cable to a Hybrid 2000 instrument.

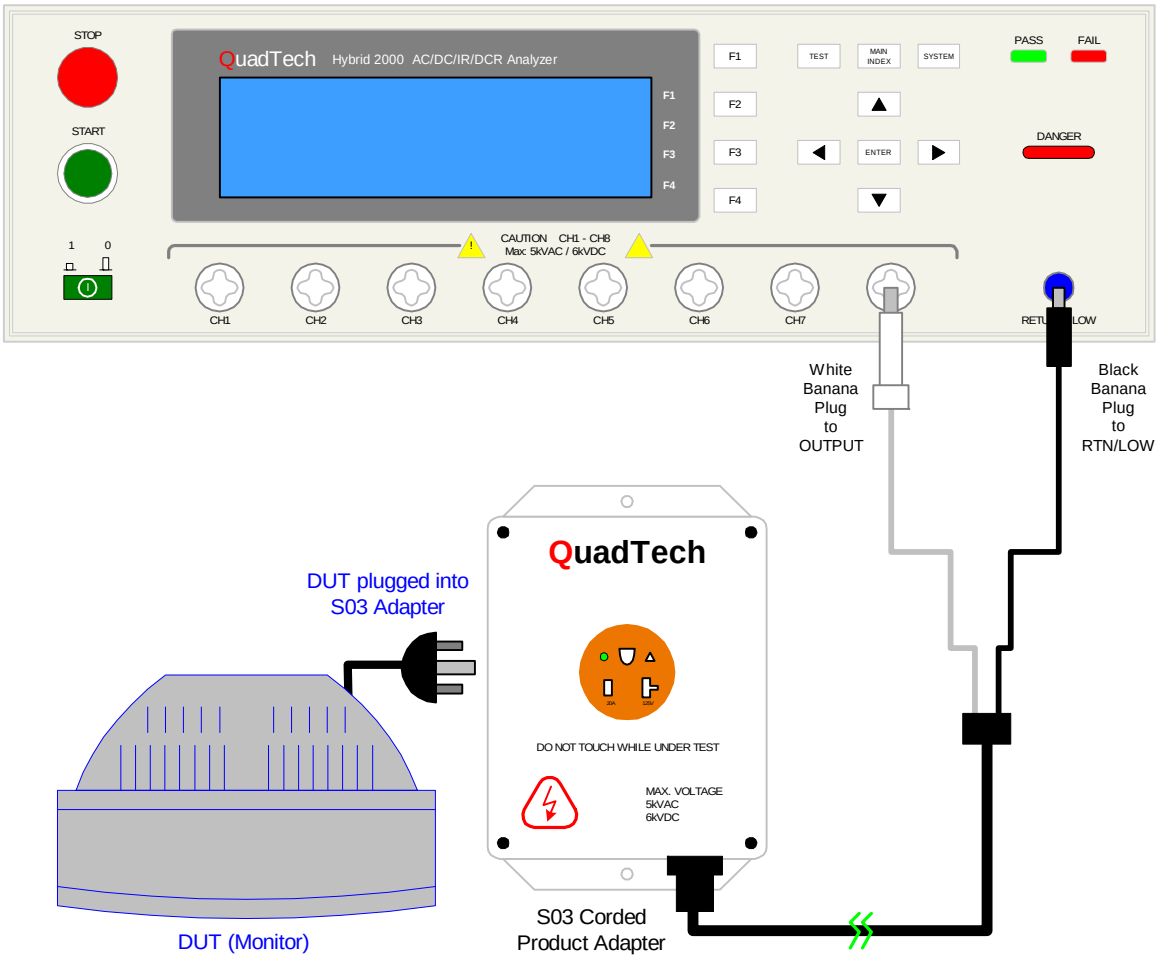


Figure 3-5: S03 Corded Product Adaptor

3.6 S08 Gun Probe

The S08 Gun Probe provides fast testing capability with pinpoint control. The custom white banana plug is connected to an output channel on the front panel of the Hybrid 2000 instrument. Figure 3-6 illustrates this connection of the S08 probe to the Hybrid 2000 instrument.

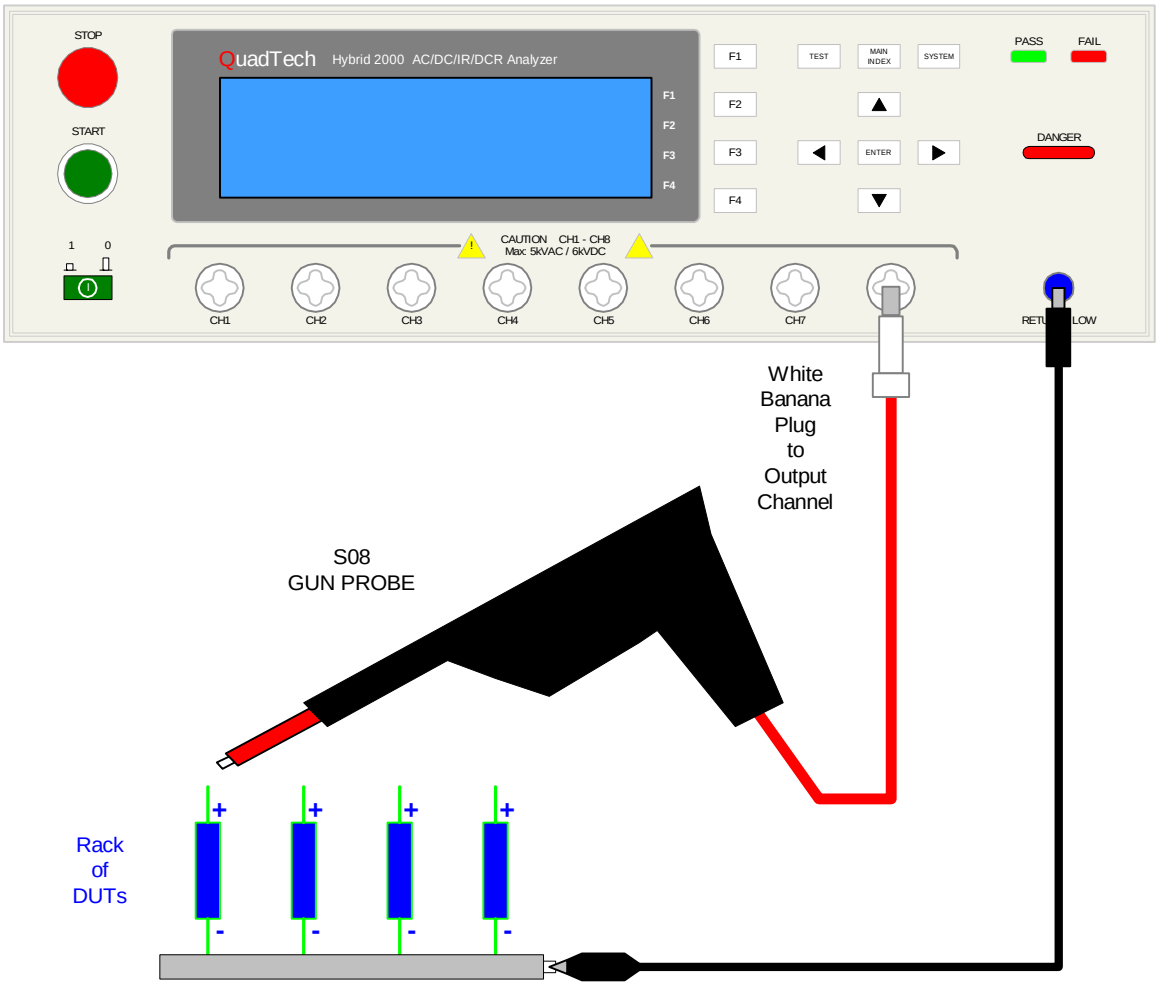


Figure 3-6: S08 Gun Probe

3.7 Guardian 1050 Ground Bond Tester

The Hybrid 2000 instrument can be connected to the Guardian 1050 Ground Bond Tester for high current ground testing between chassis and power cord ground. The output current is programmable from 1A to 30A AC in 0.01A increments and resistance can be measured over the range 0.1mΩ to 510mΩ. The rear panels of the Hybrid 2000 instrument and Guardian 1050 instrument are connected via the S15 9-pin interconnection cable. Figure 3-7 illustrates the front panel connections of the two instruments.

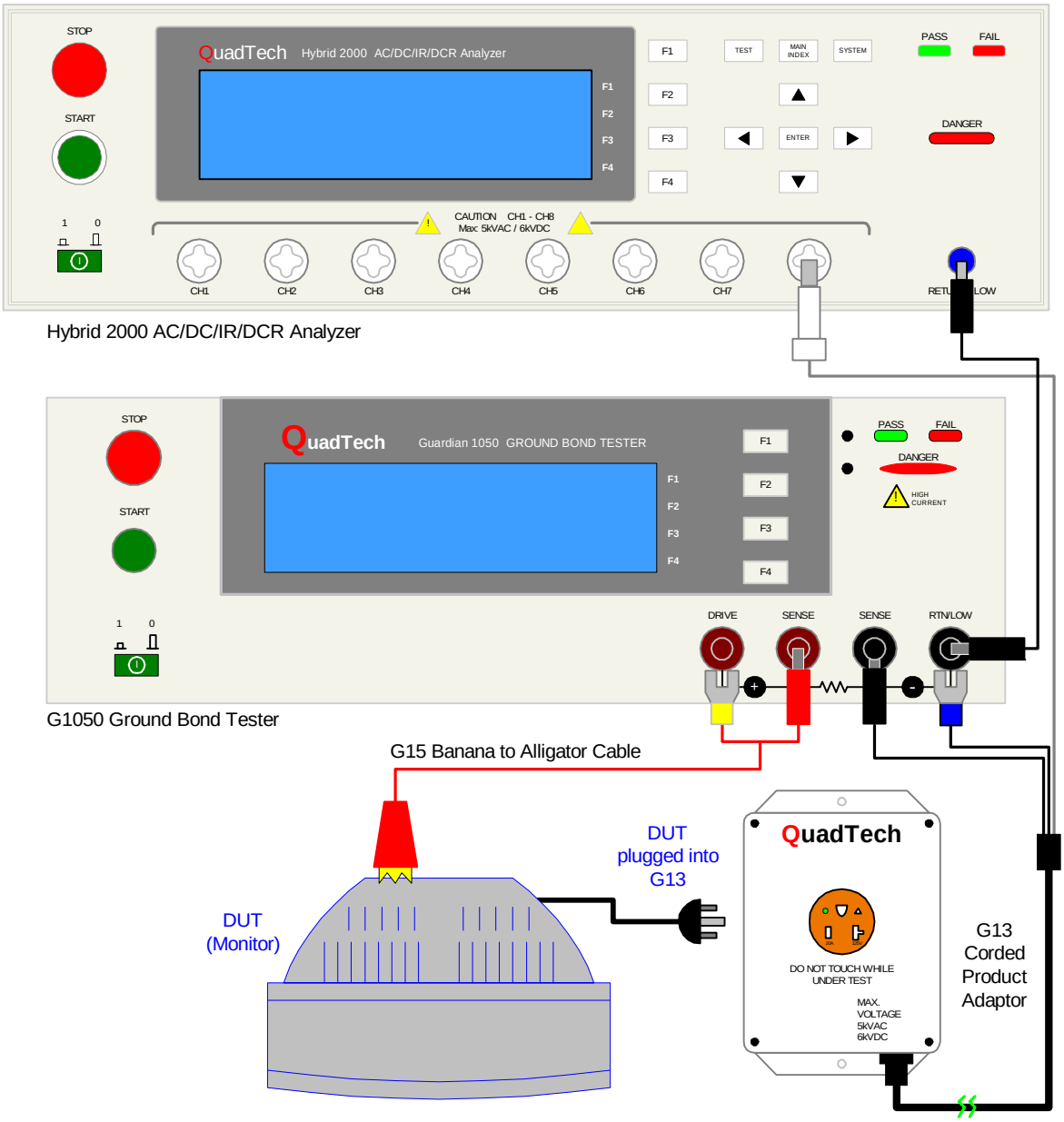


Figure 3-7: Hybrid 2000 & Guardian 1050 Connection

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 Hybrid 2000 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 Hybrid 2000 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
AC/DC High Voltage Voltmeter	ACV, DCV, IRV	Measure Range: 0 to 6kV, 0.1% accuracy
AC/DC Current Meter	ACA, RACA, DCA	Measure Range: 0 to 40mA, 0.1% accuracy
1GΩ Resistance Standard	IRR	250V
100MΩ Resistance Standard	IRR	500V
10MΩ Resistance Standard	IRR	500V, 1000V & 1200V
420kΩ Resistance Standard	ACA, DCA, RACA	1200V, 3mA, 50W
50kΩ Resistance Standard	ACA, RACA	1200V, 25mA, 200W
150kΩ Resistance Standard	DCA	1200V, 15mA, 100W
1Ω Resistance Standard	DCR	
9Ω Resistance Standard	DCR	
90Ω Resistance Standard	DCR	
900Ω Resistance Standard	DCR	
9kΩ Resistance Standard	DCR	
90kΩ Resistance Standard	DCR	

4.3.1 Calibration Parameters

Table 4-2 contains the calibration parameters for the Hybrid 2000 instrument.

Table 4-2: Calibration Parameters

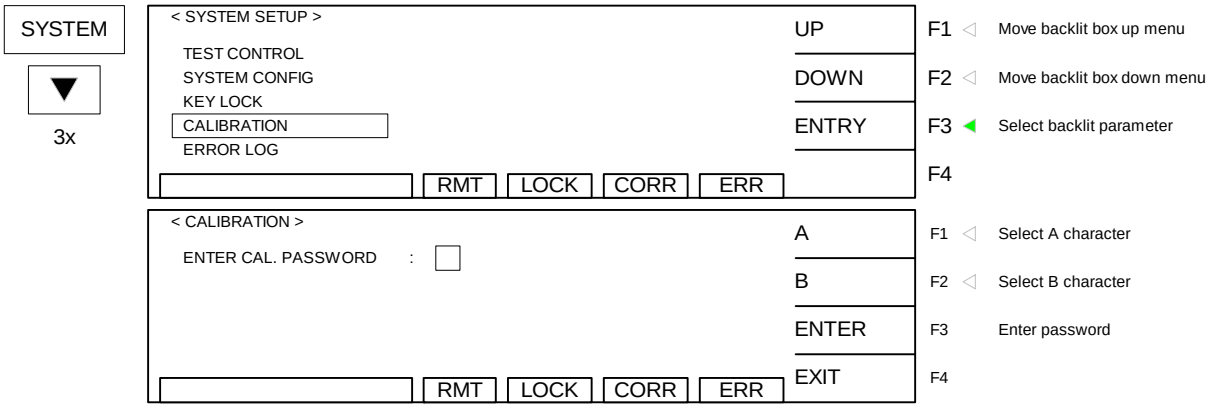
TEST		RANGE		CAL. POINT
Voltage Calibration				
1	ACV	5kV	OFST	0.100kV
2	ACV	5kV	FULL	4.000kV
3	OSCV	100V	OFST	50V
4	OSCV	100V	FULL	100V
5	DCV	6kV	OFST	0.100kV
6	DCV	6kV	FULL	4.000kV
Current Calibration				
7	ACA	3mA	OFST	0.120mA
8	RACA	3mA	OFST	0.120mA
9	ACA	3mA	FULL	2.400mA
10	RACA	3mA	FULL	2.400mA
11	ACA	30mA	OFST	2.40mA
12	RACA	30mA	OFST	2.40mA
13	ACA	30mA	FULL	12.00mA
14	RACA	30mA	FULL	12.00mA
15	DCA	3mA	OFST	0.120mA
16	DCA	3mA	FULL	2.400mA
17	DCA	10mA	OFST	2.40mA
18	DCA	10mA	FULL	4.80mA
IR Resistor Mode Calibration				
19	IRR	200MΩ	OFST	4MΩ
20	IRR	200MΩ	FULL	20MΩ
21	IRR	2GΩ	OFST	40MΩ
22	IRR	2GΩ	FULL	200MΩ

Table 4-2: Calibration Parameters – Continued

TEST		RANGE		CAL. POINT
IR Resistor Mode Calibration				
23	IRR	20GΩ	OFST	400MΩ
24	IRR	20GΩ	FULL	2GΩ
25	IRR	200GΩ	OFST	4GΩ
26	IRR	200GΩ	FULL	20GΩ
27	IRR	550GΩ	OFST	40GΩ
28	IRR	550GΩ	FULL	200GΩ
DC Resistance Calibration				
29	DCR	0Ω	GET SHORT	R1, R2, R3, R4, R5
30	DCR	10Ω	OFST	1Ω
31	DCR	10Ω	FULL	9Ω
32	DCR	100Ω	OFST	9Ω
33	DCR	100Ω	FULL	90Ω
34	DCR	1kΩ	OFST	0.090kΩ
35	DCR	1kΩ	FULL	0.9kΩ
36	DCR	10kΩ	OFST	0.9kΩ
37	DCR	10kΩ	FULL	9kΩ
38	DCR	100kΩ	OFST	9kΩ
39	DCR	100kΩ	FULL	90kΩ
ARC Calibration				
40	AC ARC	15mA	FULL	7mA
41	DC ARC	10mA	FULL	5mA

4.3.2 Enable Calibration

The instrument should be powered up for a minimum of 1 hour prior to calibration to ensure maximum stability. Enable Cal Switch which is located inside the unit on the display board.



The unit is in STAND BY status. Press [SYSTEM]
Press DOWN arrow key [▼] until the backlit box is on CALIBRATION. Press [ENTER]
Display will prompt for a password. Press [A] [A] [A] [B] [ENTER]
Cal Step 1: 'ACV 5kV Offset (0.05kV)' is displayed on the screen.

The UP and DOWN arrow keys [▲] [▼] will move one through the calibration steps. Press [F3] = SETUP to enter a calibration step.

4.3.3 Voltage Calibration (ACV, OSCV & DCV)

Connect output channel (CH1) of the Hybrid 2000 unit to the input terminal of the AC/DC high voltage meter. Connect the RTN/LOW terminal of the Hybrid 2000 to the GND terminal of the voltmeter. Set the voltmeter to AC and 2kV range.

Cal Step 1: 'ACV 5kV Offset (0.05kV)'

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the voltmeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 2: 'ACV 5kV Full (4kV)'. Change voltmeter range to 20kV.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the voltmeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 3: 'OSCV 100V Offset (50V)'. Change voltmeter range to 2kV.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the voltmeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 4: 'OSCV 100V Full (100V)'.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the voltmeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 5: 'DCV 6kV Offset (0.05kV)'.

Make sure the setting on the Valhalla voltmeter is set to DC and 2kV range.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the voltmeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 6: 'DCV 6kV Full (4kV)'. Change voltmeter range to 20kV.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the voltmeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 7: 'ACA 3mA Offset (0.12mA)'.

4.3.4 Current Calibration (ACA, RACA & DCA)

Connect the CH1 output terminal of the Hybrid 2000 instrument to a resistance box or resistance standard. Connect an AC/DC current meter in series between the resistance load (box/standard) and the RTN/LOW terminal of the Hybrid 2000 instrument. Table 4-4 lists the resistance loads necessary for the current calibration steps.

Table 4-4: Resistance Loads

Mode	Step #	Voltage	Calibration Point	Resistance (Load)
ACA	CAL 7	1200 V	0.12mA	10MΩ
RACA	CAL 8	1200 V	0.12mA	10MΩ
ACA	CAL 9	1200 V	2.4mA full	500kΩ
RACA	CAL 10	1200V	2.4mA full	500KΩ
ACA	CAL 11	1200 V	2.4mA offset	500kΩ
RACA	CAL 12	1200 V	2.4mA offset	500KΩ
ACA	CAL 13	1200 V	12mA	100kΩ
RACA	CAL 14	1200 V	12mA	100kΩ
DCA	CAL 15	1200 V	0.12mA	10MΩ
DCA	CAL 16	1200 V	2.4mA full	500kΩ
DCA	CAL 17	1200 V	2.4mA	500kΩ
DCA	CAL 18	1200 V	4.8mA	250kΩ

With the display on Cal Step 7: ‘ACA 3mA Offset (0.12mA)’:

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 8: ‘RACA 3mA Offset (0.12mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 9: ‘ACA 3mA Full (2.4mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 10: ‘RACA 3mA Full (2.4mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 11: ‘ACA 30mA Offset (2.4mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 12: ‘RACA 30mA Offset (2.4mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 13: ‘ACA 30mA Full (12mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 14: ‘RACA 30mA Full (12mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 15: ‘DCA 3mA Offset (0.12mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 16: ‘DCA 3mA Full (2.4mA)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 17: 'DCA 10mA Offset (2.4mA)'.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 18: 'DCA 10mA Full (4.8mA)'.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the ammeter.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

4.3.5 Insulation Resistance Calibration (IRR)

Connect the resistance load (per Table 4-5) between the Hybrid 2000 instrument's CH1 output terminal and RTN/LOW terminal.

Table 4-5: IRR Cal Resistance Loads

IRR Calibration				
Cal Step	Mode	Range	Voltage	Load
CAL 19	IRR	200MΩ	1.000kV	4MΩ
CAL 20	IRR	200MΩ	1.000kV	20MΩ
CAL 21	IRR	2GΩ	1.000kV	40MΩ
CAL 22	IRR	2GΩ	1.000kV	200MΩ
CAL 23	IRR	20GΩ	1.000kV	400MΩ
CAL 24	IRR	20GΩ	1.000kV	2GΩ
CAL 25	IRR	200GΩ	1.000kV	4GΩ
CAL 26	IRR	200GΩ	1.000kV	20GΩ
CAL 27	IRR	550GΩ	1.000kV	40GΩ
CAL 28	IRR	550GΩ	1.000kV	200GΩ

Press [F2] = DOWN to go to Cal Step 19: 'IRR 200MΩ Offset (4MΩ)'.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 20: ‘IRR 200MΩ Full (20MΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 21: ‘IRR 2GΩ Offset (40MΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 22: ‘IRR 2GΩ Full (200MΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 23: ‘IRR 20GΩ Offset (400MΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 24: ‘IRR 20GΩ Full (2GΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 25: ‘IRR 200GΩ Offset (4GΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 26: ‘IRR 200GΩ Full (20GΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 27: ‘IRR 550GΩ Offset (40GΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 28: 'IRR 550GΩ Full (200GΩ)'.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

4.3.6 DC Resistance Calibration (DCR)

Connect the resistance load (per Table 4-5) between the Hybrid 2000 instrument's CH1 output terminal and RTN/LOW terminal.

Table 4-5: DCR Cal Resistance Loads

Cal Step	Mode	Range	Function	Load
CAL 29	DCR	0Ω	Get Short	R1, R2, R3, R4, R5
CAL 30	DCR	10Ω	OFST	1Ω
CAL 31	DCR	10Ω	FULL	9Ω
CAL 32	DCR	100Ω	OFST	9Ω
CAL 33	DCR	100Ω	FULL	90Ω
CAL 34	DCR	1kΩ	OFST	0.090kΩ
CAL 35	DCR	1kΩ	FULL	0.9kΩ
CAL 36	DCR	10kΩ	OFST	0.9kΩ
CAL 37	DCR	10kΩ	FULL	9kΩ
CAL 38	DCR	100kΩ	OFST	9kΩ
CAL 39	DCR	100kΩ	FULL	90kΩ

Press [F2] = DOWN to go to Cal Step 29: 'DCR 0Ω Get Short (0Ω)'.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 30: ‘DCR 10Ω Offset (1Ω)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 31: ‘DCR 10Ω Full (9Ω)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 32: ‘DCR 100Ω Offset (9Ω)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 33: ‘DCR 100Ω Full (90Ω)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 34: ‘DCR 1kΩ Offset (0.090kΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 35: ‘DCR 1kΩ Full (0.9kΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 36: ‘DCR 10kΩ Offset (0.9kΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 37: ‘DCR 10kΩ Full (9kΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 38: ‘DCR 100kΩ Offset (9kΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

Press [F2] = DOWN to go to Cal Step 39: ‘DCR 100kΩ Full (90kΩ)’.

Press [F3] = SETUP to enter Cal Step.
Press [START] to output voltage.
Press [ENTER]
Press [F1] = UP or [F2] = DOWN until the Hybrid 2000 display reads the same as the certified load value.
Press [ENTER] to accept reading.
Press [STOP] to end voltage output.

4.3.7 ARC Calibration

NOTE: ARC calibration is part of the calibration routine but it is **not** performed on the Hybrid 2000 instrument. ARC Calibration is set at the factory.

Press [F2] = DOWN to go to Cal Step 40: ‘AC ARC 15mA (7mA)’. BY-PASS
Press [F2] = DOWN to go to Cal Step 41: ‘DC ARC 10mA (5mA)’. BY-PASS

4.3.8 Finalize Calibration

When all calibration steps are complete:

Press [F4] = EXIT