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CALIBRATION OF THE GUILDLINE 6500 TERRAOhmmETER

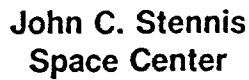
APRIL 19, 1995

DATE

**SAFETY
CRITICAL**

TSD-EL-5330-2004

NUMBER



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NASA Safety

Date _____



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SECTION 1

INTRODUCTION

SAFETY HAZARDS INVOLVED - YES NO

- 1.1 This procedure describes the calibration of the Guildline 6500 Terraohmmeter. The instrument being calibrated is referred to herein as the Test Instrument (TI).

TABLE 1. CALIBRATION PROCESS

Test Instrument Characteristics	Performance Specifications	Test Methods
Output Voltage	± 1000 ppm	Measured with DMM
<u>Resistance (Ohm)</u>	<u>Uncertainty $\pm$ (PPM)</u>	Standard Resistor traceable to NIST
1 M < R < 10 M	250	
10 M < R < 100 M	350	
100 M < R < 1 G	500	
1 G < R < 10 G	700	
10 G < R < 100 G	1000	
100 G < R < 1 T	2000	
1 T < R < 10 T	3000	
10 T < R < 100 T	5000	
100 T < R < 1 P	10000	
Capacitance	$\pm$ PPM	Standard Resistor traceable to NIST
27 pf	200000	
270 pf	80000	
2700 pf	20000	
Threshold Volts	± 10000 PPM	Measured with DMM



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SECTION 2

EQUIPMENT REQUIREMENTS¹

NOTE

Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment. Satisfactory performance of alternate items shall be verified prior to use. All applicable equipment must bear evidence of current calibration.

TABLE 2. EQUIPMENT REQUIREMENTS

Item	Minimum Use Specifications	Calibration Equipment
DMM Standard	+/- 0.002% Accuracy 100 Mohm input impedance	Solartron 7081
Resistance Standard	Range: 0 to 1 Meg Ohm Accuracy: +/- 0.1%	ESI SR1050-1M
Resistance Standard	Range: 10 Meg Ohm Accuracy: +/- 0.07%	ESI SR1050-10M
Reference Resistor	Range: 100 Meg Ohm Traceable	Guildline 65206
Short Circuit	0 Ohm	N/A

¹ The instruments utilized in this procedure were selected from those known to be available at the John C. Stennis Space Center, and the listing by make or model number carries no implication or preference, recommendation, or approval by the NASA or TSD for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance on the procedure.



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SECTION 3

PRELIMINARY OPERATIONS

- 3.1 Plug into proper power source. Turn unit ON and allow a minimum of 1/2 hour warm up time, before starting calibration or testing.

WARNING

HAZARDOUS STEPS FOLLOW

Voltages hazardous to life will be encountered during the following process. Personnel working with and around energized electrical circuits shall exercise due caution to protect themselves and co-workers, and shall not wear or have exposed metal zippers, buttons, buckles, rings, wrist watches, bracelets, earrings, metal framed eye-wear or similar items. The "Buddy System" shall be used with a person trained and currently certified in Cardiopulmonary Resuscitation (CPR), who shall be within eyesight at all times while the electrical hazard exists.

This warning applies to page 6, step 4.1 through page 7, step 4.2.6.



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SECTION 4

CALIBRATION PROCESS

4.0 Calibrate the TI, per the following approved procedure:

- Written procedure on the following pages.



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WARNING

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When TI TEST VOLTS are ON, voltages of up to 1000 V may be present between center pin of the source connector and ground.

WARNING HAZARDOUS STEPS FOLLOW !!

4.1 DC VOLTAGE CALIBRATION

- 4.1.1 Depress TI Ohms key; if the AUTO REVERSE LED is not already illuminated, depress the AUTO REVERSE key.
- 4.1.2 Depress the SET key; connect TI SOURCE and INPUT terminals to the Standard Resistor (SR1050-1M).
- 4.1.3 Set the Standard Resistor switches to obtain the first applied value listed in the applied column of Table 2.
- 4.1.4 Depress TI VOLTS ON key; TI must indicate within the corresponding limits listed in the limits column of Table 2.
- 4.1.5 Depress TI VOLTS ON key to turn off the test voltage.
- 4.1.6 Repeat steps 4.1.3 through 4.1.5 for each applied value listed in the applied column of Table 2.
- 4.1.7 Use Standard Resistor (SR1050-10M) for 10 Mohm to 100 Mohm steps.

4.2 OUTPUT VOLTAGE CALIBRATION

- 4.2.1 Connect the Digital Multimeter (SOLARTRON 7081) to the SOURCE connector of the 6500 under test.
- 4.2.2 Put the TI into the SOFTCAL DIAGNOSTIC MODE of operation by pressing the following key sequence: SOFTCAL, HIDDEN KEY S1, HIDDEN KEY S3, NUMERIC KEY # 3, ENTER.
- 4.2.3 The prompt OUTPUT TEST will appear in the display window. Press the numeric key # 0 to select the test voltage (key #0 will toggle + or - 1.0V).



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4.2.4 Press the ENTER key to turn the SOURCE output ON. Record the reading displayed by the DMM.

4.2.5 Press the UP key to select the next test voltage. Record each test voltage nominal value (Vnom) and the DMM reading (Vdmm) for each test voltage (+1.0 V through +1000.0 V, and -1.0 V through -1000.0 V).

4.2.6 Press the TEST VOLTS key to turn the SOURCE output OFF. Calculate the test voltage error from the following expression:

$$\text{ERROR (ppm)} = \frac{V_{dvm} - V_{nom}}{V_{nom}} \times 10^6$$

"HAZARDOUS STEPS COMPLETE"

4.2.7 For each test voltage, record the Error (ppm) voltage coefficient.

4.2.8 Press the set key to exit to the SELECT OHM/PA message.

4.2.9 Select the SOFTCAL CALIBRATION MODE of operation by: Pressing the SOFTCAL KEY, then the HIDDEN KEY S2, and the HIDDEN KEY S3.

4.2.10 Verify the message CALIBRATION MODE is momentarily displayed followed by the prompt SELECT FUNCTION.

4.2.11 Press the numeric key #0. Verify the prompt SERIAL NUMBER is displayed.

4.2.12 Press the ENTER KEY. Verify the Serial Number displayed matches the serial number printed on the rear of the instrument and on the Calibration Report. Press the +/- key to exit.

4.2.13 Press the numeric key #2. Verify the prompt OUTPUT ERRORS is displayed. Press the ENTER KEY.

4.2.14 Press the UP KEY until the message PLUS VOLTAGE is displayed. Press the ENTER KEY.

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- 4.2.15 Verify the display indicates the 1 Volt test voltage and its current error coefficient.
- 4.2.16 Press the ENTER KEY. The right most digit of the error coefficient will now flash. Use the numeric keys to enter the new test voltage coefficient (in ppm) calculated previously. Use the up ↑ key to enter - coefficients.
- 4.2.17 Carefully check the entered number, then press the ENTER KEY to accept and store the new coefficient.
- 4.2.18 Press the UP KEY to view the next test voltage and its stored error coefficient. Press the ENTER KEY to edit the displayed value.
- 4.2.19 Repeat the edit and re-entry of the test voltage error coefficients for all the test voltage values and polarities. Press the set key to exit to the prompt SELECT OHMS/PA.

4.3 **CAPACITOR CALIBRATION**

- 4.3.1 Connect the 100 Mohm reference resistor between the SOURCE and INPUT terminals of the instrument.
- 4.3.2 Select the SOFTCAL NORMAL MODE of operation by pressing the SOFTCAL KEY.
- 4.3.3 Press the numeric key #6. Verify the message REFERENCE RES is displayed.
- 4.3.4 Press the ENTER KEY to display the value stored for the reference resistor. Press the ENTER KEY again to cause the display to flash.
- 4.3.5 Using the numeric keys, enter the new value of the reference resistor. Press the enter key to accept/store the new value. Press the +/- key to exit to the REFERENCE RESISTOR prompt.
- 4.3.6 Press the numeric key #5. Verify the message CALIBRATION DATE is displayed. Press ENTER to view the previous calibration date.



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4.3.7 Press ENTER to edit/re-enter the new calibration date. Press the UP key to scroll day, month, and year. Press ENTER to accept the new calibration date. Press +/- to exit to the CALIBRATION DATE prompt.

4.3.8 Press the numeric key #3. Verify the message CAP ERROR is displayed.

4.3.9 Press the ENTER KEY to view the alternating message strings CONNECT REF RES and % ERROR.

4.3.10 Press the UP KEY until the % ERROR for the 2700 pf capacitor is displayed. Ensure that the 100 Mohm standard resistor is connected. Press the ENTER KEY to start the automatic capacitor calibration sequence.

4.3.11 When the calibration sequence is complete, the instrument will prompt with alternating messages CONNECT REF RES and % ERROR.

4.3.12 Use the UP KEY to select and calibrate the 270pf capacitor and 27pf capacitor in order. Once the last (27pf) capacitor error is known, press the +/- key to exit the CAP ERROR prompt.

4.4 THRESHOLD CALIBRATION

4.4.1 Press the numeric key #4. Verify the message THRESH ERROR is displayed. Press the ENTER KEY to display the error stored for the 1.0 V threshold.

4.4.2 Press the UP KEY until the 1.0V threshold error is displayed.

4.4.3 Ensure that the 100 Mohm standard resistor is connected. Press the ENTER KEY to start the error measurement cycle.

4.4.4 When the measurement is complete, select the 0.1V threshold value and repeat the measurement cycle.

4.4.5 Press the +/- key to exit the THRESH ERROR prompt when both threshold errors have been measured and (automatically) saved.



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4.5 **ERROR CALIBRATION**

- 4.5.1 Press the numeric key #2. Verify the message ZERO ERROR is displayed. Press the ENTER KEY to display the value stored for input resistance.
- 4.5.2 Remove the 100 Mohm standard resistor and replace with a short circuit to the INPUT terminal.
- 4.5.3 Press the ENTER KEY to initiate the measurement cycle. When the measurement is complete, press the +/- key to exit the ZERO ERROR prompt.
- 4.5.4 Press the SET KEY to accept all stored calibration coefficients. Verify the prompt SELECT OHMS/PA is displayed.
- 4.6 Prepare a data sheet using the data reported by the instrument during the calibration procedure.



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CALIBRATION PROCESS TABLES

TABLE 2

APPLIED	LIMITS
1 MOHM (10 X 10 EXP. 6)	.99975 TO 1.00025 X 10 EXP. 7
* 10 MOHM (1 X 10 EXP. 7)	9.99750 TO 10.00250 X 10 EXP. 6
* 20 MOHM (2 X 10 EXP. 7)	1.99950 TO 2.00050 X 10 EXP. 7
* 30 MOHM (3 X 10 EXP. 7)	2.99925 TO 3.00075 X 10 EXP. 7
* 40 MOHM (4 X 10 EXP. 7)	3.99900 TO 4.00100 X 10 EXP. 7
* 50 MOHM (5 X 10 EXP. 7)	4.99875 TO 5.00125 X 10 EXP. 7
* 60 MOHM (6 X 10 EXP. 7)	5.99850 TO 6.00150 X 10 EXP. 7
* 70 MOHM (7 X 10 EXP. 7)	6.99825 TO 7.00175 X 10 EXP. 7
* 80 MOHM (8 X 10 EXP. 7)	7.99800 TO 8.00200 X 10 EXP. 7
* 90 MOHM (9 X 10 EXP. 7)	8.99775 TO 9.00225 X 10 EXP. 7
* 100 MOHM (10 X 10 EXP. 7)	9.99750 TO 10.00250 X 10 EXP. 7

* USE STANDARD RESISTOR SR1050-10M.



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CALIBRATION-MAINTENANCE REPORT

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(See reverse side for calibration data.)

CALIBRATION NO.	WORK REQUEST NO.	RESP. LAB. EL	CAL. CYC: ☒ YR ☒ MON ☒ WKS	CAL. DUE	LOCATION	PROP. NO.
CALIBRATION DATE	TOLERANCE ☐ IN ☐ OUT ☐ OTHER	TECH. NAME	CLEAN REQ'D. ☐ YES ☒ NO	AREA 120	QUALITY	
ADMINISTRATIVE USE ONLY ☐ COUNT ☐ EDP INPUT ☐ TRACEABILITY ☐ QA BURDEN REVIEW		ACTION ADJUST ☐ REWORK ☐ ☐ NONE ☐ NONE		LAB TEMP _____ °F HUMIDITY _____ % BAR. PRESS. N/A "HG	HRS MAINT _____ CALIB _____ TOTAL _____	D&CR
EQUIPMENT NAME				TERRA OHMMETER		
MANUFACTURER GUILLOT	MODEL NO. 6500	SERIAL NO.	RANGE N/A	PROCEDURE NO. TSD-EL-5330-2004		

SPECIFICATIONS/ACCURACY

MANUFACTURER'S SPECIFICATIONS

ACCURACY RATIO:

CALIBRATION EQUIPMENT (List all equipment used in this calibration.)

MANUFACTURER & MODEL	C.C. NO.	CAL DUE DATE	MANUFACTURER & MODEL	C.C. NO.	CAL DUE DATE
SOLATRON 7081					
ESI SR1050-1M					
ESI SR1050-10M					

REPAIR INFORMATION

1. DESCRIPTION OF MALFUNCTION:

2. ACTION TAKEN (Parts replaced, etc.)

REMARKS

MODEL: GUILDLINE 6500

ECN:

PROCEDURE: TSD-EL-5330-2004

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TEST ID	FUNCTION TESTED	REFERENCE SIGNAL	NOMINAL VALUE	MEASURED VALUE		LIMITS OF ACCEPTANCE OR TOLERANCE	ERROR
				INITIAL	FINAL		
4.1	DC VOLTS	1 Mohm				.99975 to 1.000250 Mohm	
		10 " "				9.99975 to 10.0025 Mohm	
		20 " "				19.9950 to 20.0050 Mohm	
		30 " "				29.9929 to 30.0075 Mohm	
		40 " "				39.9900 to 40.0100 Mohm	
		50 " "				49.9875 to 50.0125 Mohm	
		60 " "				59.9850 to 60.0150 Mohm	
		70 " "				69.9825 to 70.0175 Mohm	
		80 " "				79.9800 to 80.0200 Mohm	
		90 " "				89.9775 to 90.0225 Mohm	
		100 " "				99.9750 to 100.025 Mohm	
2	OUTPUT VLT.	+1 VLT				+/- 1 mV	
		+2 VLT				+/- 2 mV	
		+5 VLT				+/- 5 mV	
		+10 VLT				+/- 10 mV	
		+20 VLT				+/- 20 mV	
		+50 VLT				+/- 50 mV	
		+100 VLT				+/- 100 mV	
		+200 VLT				+/- 200 mV	
		+500 VLT				+/- 500 mV	
		+1000 VLT				+/- 1 V	
		-1 VLT				+/- 1 mV	
		-2 VLT				+/- 2 mV	
		-5 VLT				+/- 5 mV	
		-10 VLT				+/- 10 mV	
		-20 VLT				+/- 20 mV	

MODEL: GUIDLINE 6500

SSC 671-4 (5/91) C, G, (B)