*TB 9-6695-265-40

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR VOLTAGE CALIBRATOR, FLUKE MODELS 5100B, 5100B0305, AND 5101B

Headquarters, Department of the Army, Washington, DC
15 November 2007

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

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*This bulletin supersedes TB 9-6695-265-50, dated 21 December 1981.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Voltage Calibrators, Fluke Models 5100B, 5100B0305, and 5101B. The manufacturer's manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. 5100B0305 has a wideband option.

b. Time and Technique. The time required for this calibration is approximately 6 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Dc voltage	Range: 0 to 1100 V in 6 ranges Accuracy: ± (0.005% of setting + 0.001% of range of + 5 μV)
Ac voltage	Range: 1 mV to 1100 V in 6 ranges at 50 Hz to 50 kHz Accuracy: 50 Hz to 10 kHz ± (0.05% of setting + 0.005% of range + 50 μV) 10 to 50 kHz ± (0.08% of setting + 0.008% of range + 50 μV)
	Frequency accuracy: Range: 50 Hz to 50 kHz Accuracy: ± 3%
Dc current	Range: 0 to 1.99999 A in 5 ranges Accuracy: ± (0.025% of setting + 0.0025% of range + 0.01 μA)
Ac current	Range: 0 to 1.99999 A in 5 ranges Accuracy: 50 Hz to 1 kHz ± (0.07% of setting + 0.01% of range + 0.02 μA)

Table 1. Calibration Description - Continued.

Test instrument parameters	Performance specifications
Ac voltage (Wideband OPT 03)	Range: 0 to 3.1623 V in 8 ranges 10 Hz to 10 MHz Accuracy: (1 kHz Ref) 1 to 3.1623 V ± (0.25% of setting +0.25% of range) 0.31624 to 0.99999 V ± (0.50% of setting +0.25% of range) 0.1 to 0.31623 V ± (0.75% of setting +0.25% of range) 31.624 to 99.999 mV ± (1.00% of setting +0.25% of range) 10 to 31.623 mV ± (1.25% of setting +0.25% of range) 3.1624 to 9.99999 mV ± (1.50% of setting +0.25% of range) 1 to 3.1623 mV ± (1.75% of setting +0.25% of range) 300 μV to 0.99999 mV ± (2.00% of setting +0.25% of range) Flatness: 10 to 30 Hz ± 0.3% 30 Hz to 1 MHz ± 0.25% 1 to 5 MHz ± 0.25% Above 1 mV or ± 0.6% 1 mV and below 5 to 10 MHz ± 0.6%
	Frequency accuracy: Range 10 Hz to 10 MHz Accuracy: ± 3%
Resistance	Range: 0 to 10 MΩ in 8 ranges Accuracy: 1 Ω ± 0.02% 10 Ω and 1 MΩ ranges ± 0.01% 100 Ω, and 1, 10 and 100 kΩ ranges ± 0.005% 10 MΩ range ± 0.05%

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Reference Calibration Standards Set, NSN 4931-00-621-7878. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AC MEASUREMENT STD (MEASUREMENT STANDARD)	Range: 2.0 mV to 1000 V ac Accuracy: Test report[1]	Fluke, Model 5790A (13534003)
AC SHUNT SET	Range: 18.9 mA to 1.91 A Accuracy: Test Report[1]	Holt Instrument Laboratories, Model HCS1 (MIS-10235)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ± 1%	Ridge, Model 9020A (9020A)
DC REFERENCE STANDARD	Range: 10 V dc Accuracy: Test report	Fluke, Model 732A (732A)
FREQUENCY COUNTER	Range: 10 Hz to 10 MHz Accuracy: ± 0.75%	Fluke, Model PM6681/656 (PM6681/656)
MULTIMETER	Range: 0 to 1000 V dc Accuracy: ± 0.0025% Range: 0 through 1 MΩ Accuracy: From ± 2.2 ppm @ 10 kΩ to ± 55 ppm at 10 MΩ [2]	Agilent, Model 3458A (3458A)
STANDARD RESISTOR NO. 1	Value: .10Ω Accuracy: Test report[3]	Leeds and Northrop, Model 4221B (8616294)
STANDARD RESISTOR NO. 2	Range: 10 kΩ Accuracy: Test report	General Radio, Type 1444A (MIS-10400)

[1]Combined accuracy of ac shunt set and ac measurement standard is: From ±50 ppm @ 10 mA, 1 kHz to ±.255% @ 2.0 A, 10 kHz.
[2]Utilizes manufacturer's 24-hour specification for dc voltage, resistance (0 through 1 MΩ), and dc current (100 μA to 100 mA).
[3]Combined accuracy of multimeter and standard resistor No. 1 is ±0.002%.

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturers' manuals for this TI.

d. Unless otherwise specified, all controls and control settings refer to the TI.

e. The technician should become familiar with the TI **DATA ENTRY** group controls before beginning calibration. These controls manually program the TI. The display above

the **DATA ENTRY** section indicates what has been programmed. The display above the **DC 50 HZ - 50 kHz** and **CONTROL** groups indicates what data has been entered and what is available at the **OUTPUT** connectors. An example to program a 1.00000 V dc output is described in (1) through (6) below:

(1) Press the **CONTROL** group **LOCAL** pushbutton.

(2) Press the **DATA ENTRY** group **CLEAR** pushbutton twice to clear and return the TI to its basic state.

NOTE

The TI basic clear state is 0.00000 mV dc.

(3) Press the **DATA ENTRY** group **1.0** pushbuttons. (The TI automatically sets the remaining four zeros for a total of 6 digits.)

(4) Press the **DATA ENTRY** group **ENTER** pushbutton to program volts and enter the above data into memory.

(5) Press the **CONTROL** group **OPR-STDBY OPR** pushbutton to program information at the output connectors.

(6) Press the **ERROR MODE** group **ENABLE** pushbutton to enable the **EDIT** adjust control.

f. Multimeter, Agilent, Model 3458A, Characterization

NOTE

The characterization is required to establish the manufacturer's 24-hour specifications. If ambient temperature drifts more than 1 degree Celsius prior to completing paragraphs **8** through **10** below, the characterization (and paragraph(s)) must be repeated.

NOTE

Control and control settings in this paragraph refer to the multimeter, unless otherwise specified.

(1) Remove all external input signals from the front and rear terminals.

(2) Select the **DCV FUNCTION** and the **100 mV RANGE**.

(3) Set front panel **TERMINALS** pushbutton to **FRONT** position.

(4) Ensure that at least a 4 hour warm-up has elapsed since power was applied.

(5) Front Terminal Offset:

(a) Connect a four-terminal short across the front panel terminals as shown in figure 1.

(b) After connecting the short, allow 5 minutes for thermal equilibrium.

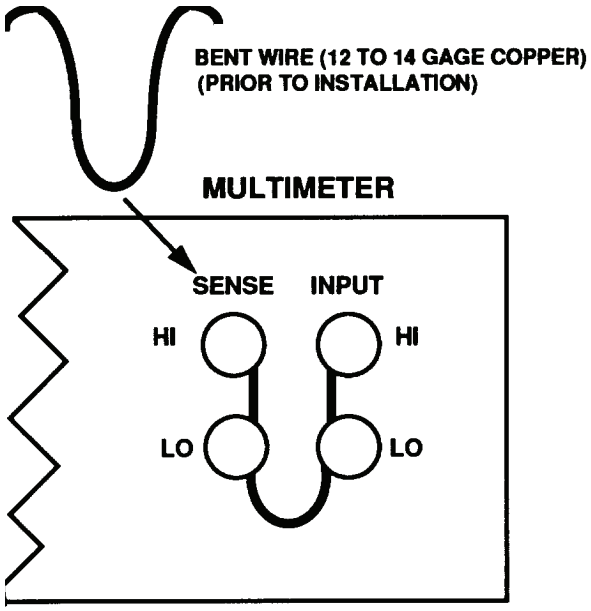

Figure 1. Four-terminal short.

NOTE

Take precautions to prevent thermal changes near four-wire short. Do not touch short after it is installed. If drafts exist, cover **INPUT** terminals/short to minimize thermal changes.

(c) Execute the **CAL 0** command by pressing: **Blue**, **AUTO CAL**, **0**, **,** , **3**, **4**, **5**, **8**, and **ENTER** keys. This adjustment takes about 5 minutes. When completed, the multimeter will return to displaying dc voltage measurements.

(d) Set to **10 V RANGE** and remove four-terminal short from front terminals.

(6) Dc Gain:

(a) Select **DCV FUNCTION** and set front panel **TERMINALS** pushbutton to **FRONT**.

(b) Connect dc reference standard 10 V output to **INPUT HI**, **LO**, and **GUARD** terminals.

(c) Execute the **CAL** command specifying the 10 V test report value of dc reference standard. For example, if the test report value is 10.000001 V press: **Blue, AUTO CAL**, **1**, **0**, **.**, **0**, **0**, **0**, **0**, **0**, **1**, **,** , **3**, **4**, **5**, **8** and **ENTER** keys. This adjustment takes about 2 minutes and, when completed, multimeter will display dc voltage measurements.

(d) Disconnect dc reference standard from multimeter.

(7) Resistance and Dc Current:

(a) Select the four-wire ohms measurement **FUNCTION** and enable the offset compensation by pressing: **Blue**, **OHMF/OHM**, **OFFSET COMPΩ**, ⇧ , and **ENTER** keys.

(b) Connect standard resistor No. 2 to multimeter using four-wire technique and set **GUARD** pushbutton to the **TO LO** position

(c) Execute the **CAL** command specifying the test report value of the standard resistor. For example, if the test report value is 10.00011 kΩ press: **Blue**, **AUTO CAL**, **1**, **0**, **.**, **0**, **0**, **0**, **1**, **1**, **E**, **3**, **,** , **3**, **4**, **5**, **8**, and **ENTER** keys. This adjustment takes about 12 minutes and, when completed, multimeter will return to displaying resistance readings.

(d) Disconnect standard resistor and execute **ACAL AC** by pressing: **AUTO CAL**, ⇩, ⇩, **3**, **4**, **5**, **8**, and **ENTER** keys.

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Remove protective cover from TI.

b. Connect TI to autotransformer.

c. Connect autotransformer to a 115 V ac power source and adjust for a 115 V ac output.

d. Press **POWER** pushbutton to **ON** and allow at least 30 minutes for warm-up.

e. Press **DATA ENTRY CLEAR** pushbutton twice.

f. Connect multimeter to **OUTPUT HI** and **LO** connectors.

g. Press **CONTROL OPR-STDBY** pushbutton to **OPR**.

h. If TI output voltage as indicated on multimeter is not 0 ± 5 μV dc, press **50 DIVIDER-OVERRIDE** to **OVERRIDE** and adjust A14R63 (fig. 2) for 0 (zero) μV indication on multimeter.

NOTE

When indications specified in paragraphs **8** through **13** are not within tolerance, perform the reference voltage and power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **8** through **13**. Do not perform power supply check if all other parameters are within tolerance.

8. Dc Voltage

a. Performance Check

NOTE

The characterization of the multimeter is required for this performance check. If ambient temperature drifts more than 1 degree Celsius (from time of characterization) prior to completing paragraph **8** below, the characterization (and paragraph **8**) must be repeated.

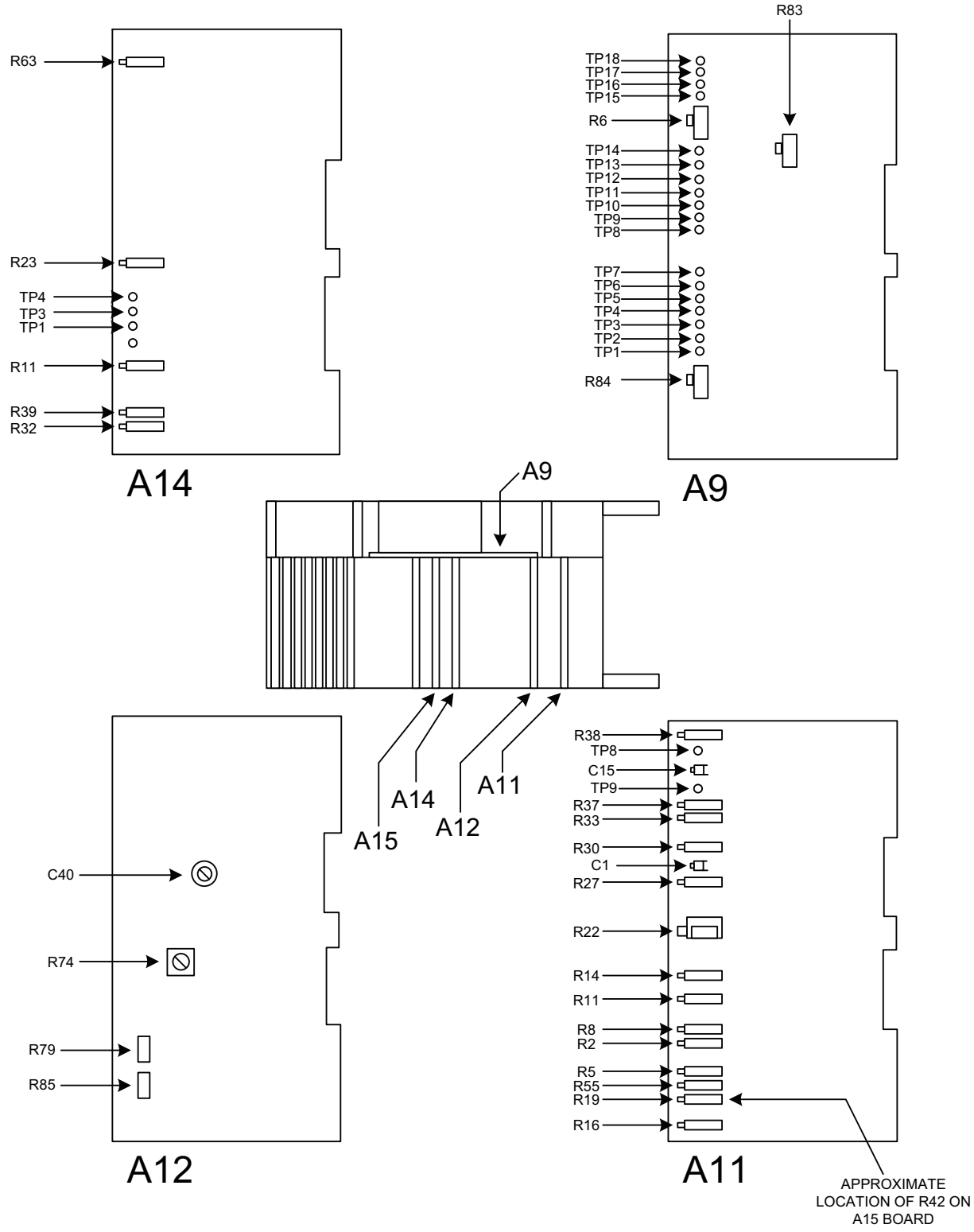

Figure 2. Test instrument - adjustment locations.

WARNING

The TI is capable of supplying lethal voltages. Do not make connections to the output terminals when any voltage is present. Placing the TI in **STANDBY** may not be enough to avoid shock hazard, since the **OPR/STBY** pushbutton could be pressed accidentally. Press the **RESET** pushbutton and verify that **STANDBY** is lit before making connections to the **OUTPUT** terminals.

b. Connect TI **OUTPUT HI**, **LO**, and **GUARD** terminals to multimeter **INPUT HI**, **LO**, and **GUARD** terminals. Ensure that TI **EX SENS** pushbutton is in the off position.

c. Set multimeter for most accurate dc voltage measurements and to the manual 100 mV range.

d. Set TI for a 19.9900 mV dc output. If multimeter does not indicate between 19.988006 and 19.991994 mV dc perform **f** (1) and (2) below.

e. Repeat **c** above for multimeter range settings and output voltages listed in table 3. Multimeter will indicate within the limits listed. When TI does not indicate within limits specified in table 3, perform appropriate adjustment in **f** below.

Table 3. Dc Voltage Linearity Test Multimeter Indications

Multimeter range setting (V dc)	Test instrument output (V dc)	Multimeter indications (V dc)		Adjustments[1]
		Min	Max	
100 mV	-19.9900 mV	-19.991994 mV	-19.988006 mV	A11R55 (fig. 1)
1	199.900 mV	0.19988006 mV	0.19991994 mV	A11R16 (fig. 1)
1	-199.900 mV	-0.19991994 mV	-0.19988006 mV	A11R16 (fig. 1)
10	1.99900	1.9988006	1.9991994	A11R19 (fig. 1)
10	-1.99900	-1.9991994	-1.9988006	A11R19 (fig. 1)
100	19.9900	19.988006	19.991994	A11R30 (fig. 1)
100	-19.9900	-19.991994	-19.988006	A11R33 (fig. 1)
1000	199.900	199.88006	199.91994	A11R27 (fig. 1)
1000	-199.900	-199.91994	-199.88006	
1000	1000.000	999.94	1000.06	A11R37 (fig. 1)
1000	-1000.000	-1000.06	-999.94	

[1] The adjustments between the + and – values interact. Adjust for best in-tolerance compromise.

f. Adjustments

(1) Adjust **EDIT** control for a +19.0000 mV dc indication on TI.

(2) Adjust A11R55 (fig. 2) for nominal value on multimeter (R).

(3) Adjust **EDIT** control for a -19.0000 mV dc indication on TI.

(4) Adjust A11R55 (fig. 2) for nominal value on multimeter.

(5) Repeat **b** (1) through (4) above, if necessary for best in-tolerance compromise for both +19.0000 and -19.0000 mV dc outputs.

(6) Adjust **EDIT** control for a +190.000 mV dc indication on TI.

(7) Adjust A11R16 (fig. 2) for nominal value on multimeter (R).

(8) Adjust **EDIT** control for a -190.000 mV dc indication on TI.

(9) Adjust A11R16 (fig. 2) for nominal value on multimeter.

(10) Repeat **b** (6) through (9) above, if necessary for best in-tolerance compromise for both +190.000 and -190.000 mV dc outputs.

(11) Adjust **EDIT** control for a +1.90000 V dc indication on TI.

(12) Adjust A11R19 (fig. 2) for nominal value on multimeter (R).

(13) Adjust **EDIT** control for a -1.90000 V dc indication on TI.

(14) Adjust A11R19 (fig. 2) for nominal value on multimeter.

(15) Repeat **b** (11) through (14) above, if necessary for best in-tolerance compromise for both +1.90000 and -1.90000 V dc output.

(16) Enter **EDIT** control for a 19.9900 V dc output.

(17) Adjust A11R30 and A11R33 (fig. 2) in equal amounts in opposite directions for optimal value on multimeter (R).

(18) Adjust **EDIT** control for a 199.900 V dc output indication on TI.

(19) Adjust A11R27 (fig. 2) for optimal value on multimeter (R).

(20) Adjust **EDIT** control for a 400.000 V dc output indication on TI.

(21) Adjust A11R37 (fig. 2) for optimal value on multimeter (R).

9. Dc Current

NOTE

The characterization of the multimeter is required for this performance check. If ambient temperature drifts more than 1 degree Celsius (from time of characterization) prior to completing paragraph **9** below, the characterization (and paragraph **9**) must be repeated.

a. Connect **OUTPUT HI**, **LO**, and **GUARD** terminals to multimeter **INPUT I**, **LO**, and **GUARD** terminals. Configure multimeter for most accurate dc current measurements.

b. Set TI for a 1.90000 mA output. Multimeter will indicate between 1.899468 and 1.900532 mA dc.

c. Repeat **b** above for multimeter range settings and output currents listed in table 4. Multimeter will indicate within the limits specified. If TI does not indicate within limits specified in table 4, perform **i** below.

Table 4. Dc Current

Multimeter range setting (A dc)	Test instrument output (A dc)	Multimeter indications (A dc)	
		Min	Max
10 mA	1.90000 mA	1.899468 mA	1.900532 mA
10 mA	-1.90000 mA	-1.900532 mA	-1.899468 mA
10 mA	2.10000 mA	2.0989647	2.1010353
10 mA	-2.10000 mA	-2.1010353	-2.0989647

d. Connect equipment as shown in figure 3.

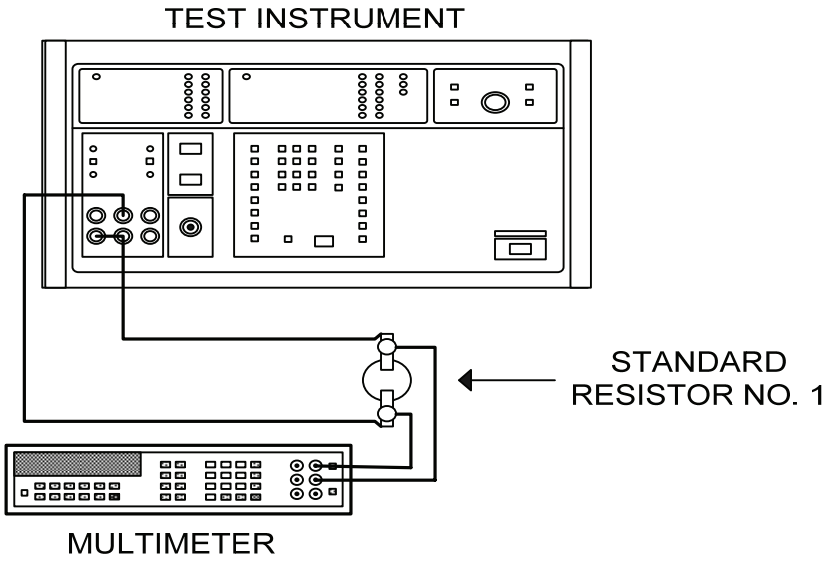

Figure 3. Dc current (1 A).

e. Configure multimeter for most accurate dc voltage measurements.

f. Set TI for a 1 A dc output and record multimeter indication.

g. Refer to test report for standard resistor No. 1 and divide test report value into multimeter indication recorded in **f** above. The calculated current will be between 0.9997000 and 1.0003000 A.

h. Repeat technique of **f** and **g** above for -1 A dc. The calculated current will be between -1.0003000 and -0.9997000 A.

i. Adjustments

(1) Adjust EDIT control for 1.90000 mA dc output.

(2) Adjust A15R42 (fig. 2) for 1.900000 mA dc indication on multimeter (R).

10. Resistance

NOTE

The characterization of the multimeter is required for this performance check. If ambient temperature drifts more than 1 degree Celsius (from time of characterization) prior to completing paragraph **10** below, the characterization (and paragraph **10**) must be repeated.

a. Connect equipment as shown in figure 4.

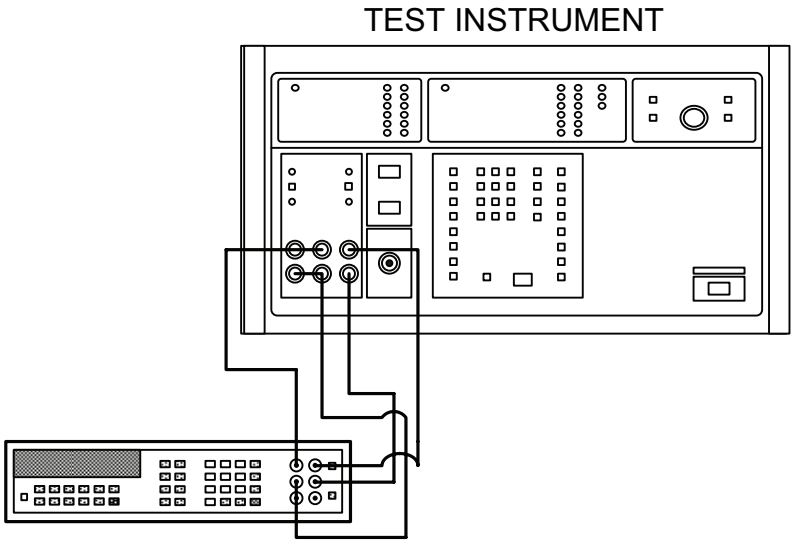

Figure 4. Resistance.

b. Configure multimeter for most accurate four-wire resistance measurements. (Configuration modifications will be required depending on value of input resistance; e.g., set **0COMP** to **ON** until **100 kΩ**, then set **0COMP** to **OFF**.)

c. Set TI for a 1 Ω output and set sense **INT/EXT** to **EXT**. If multimeter does not indicate between 0.99980 and 1.00020 perform **b** (1) below (R).

d. Repeat technique of **c** above for settings listed in table 5. If multimeter does not indicate within the listed limits, perform the appropriate adjustment.

Table 5. Resistance

Test instrument output	Multimeter indication ±(Ω)	Adjustments
10 Ω	± 1 mΩ	A11R5 (fig. 2) (R)
100 Ω	± 5 mΩ	A11R8 (fig. 2) (R)
1 k Ω	± 50 mΩ	A11R11 (fig. 2) (R)
10 k Ω	± 500 mΩ	A11R14 (fig. 2) (R)
100 k Ω	± 5 Ω	[1,2]
1 M Ω	± 100 Ω	
10 M Ω	± 5 kΩ	A11R22 (fig. 2) (R)

[1]Connect multimeter between A11TP8 (HD) (fig. 2) and A11TP9 (LO) (fig. 2). Adjust A11R38 (fig. 2) for nominal indication on multimeter (R).
[2]Adjust A11R30 and A11R33 (fig. 2) equal amounts in same direction for nominal indication on multimeter(R).

e. Set TI to **STANDBY**.

NOTE

If A11R30 and A11R33 are adjusted, repeat paragraph **8**.

11. Ac Voltage

a. Frequency Accuracy

(1) Connect **OUTPUT HI** and **LO** terminals to frequency counter.

(2) Set TI for a 1 V, 50 Hz output. Frequency counter will indicate between 48.5 Hz and 51.5 Hz.

(3) Repeat technique of (2) above for the frequencies listed in table 6. Frequency counter will indicate within the listed limits.

Table 6. Ac Voltage, Frequency Accuracy

Test instrument frequency	Frequency counter indications	
	Min	Max
400 Hz	388 Hz	412 Hz
2 kHz	1.94 kHz	2.06 kHz
3 kHz	2.91 kHz	3.09 kHz
4 kHz	3.88 kHz	4.12 kHz
5 kHz	4.85 kHz	5.15 kHz
6 kHz	5.82 kHz	6.18 kHz
7 kHz	6.79 kHz	7.21 kHz
8 kHz	7.76 kHz	8.24 kHz
9 kHz	8.73 kHz	9.27 kHz
10 kHz	9.7 kHz	10.3 kHz
50 kHz	48.5 kHz	51.5 kHz

b. Ac Voltage (1 mV through 600 V)

(1) Place ac measurement standard on top of TI and connect equipment as shown in figure 5. Press **INPUT 2** pushbutton on ac measurement standard.

(2) On the ac measurement standard, press the **UTIL MENUS** pushbutton then the **MEAS CONTROL** soft key. Set **DIGITAL FILTER MODE** to **FAST** and **RESTART** to **MEDIUM**. Push the **DONE** soft key twice to return to the measurement display and set to **AUTO** range.

(3) Program TI for a 2.10 V ac output at 1 kHz and press **ENTER**, **EXT SENSE**, and **OPR** pushbuttons.

(4) Measure TI output. If ac measurement standard does not indicate between 2.0979 and 2.1021 V ac, perform **c** (1) below.

(5) Press TI **STDBY** pushbutton.

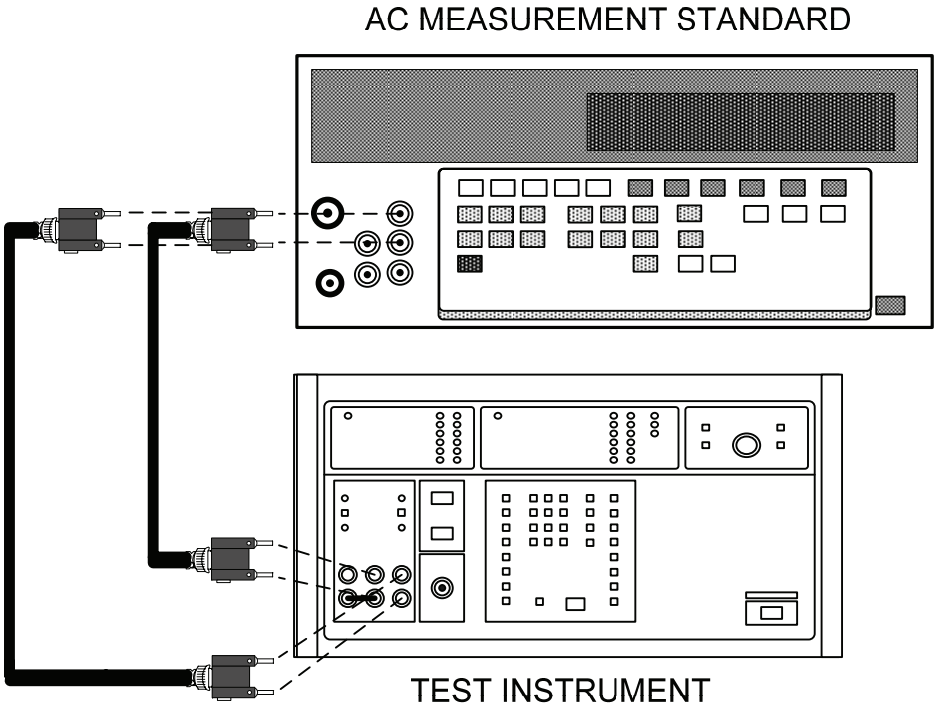

Figure 5. Ac voltage (2 mV through 1000 V).

(6) Program TI for a 19.9900 V ac output at 1 kHz and press **ENTER** and **OPR** pushbuttons.

(7) Measure TI output. If ac measurement standard does not indicate between 19.9790 and 20.0010 V ac, perform **c** (2) through (4) below.

(8) Press TI **STDBY** pushbutton.

(9) Program TI for a 19.9900 V ac output at 50 kHz and press **ENTER** and **OPR** pushbuttons.

(10)Measure TI output. If ac measurement standard does not indicate between 19.9723 and 20.0077 V ac, perform **c** (5) below.

(11) Press TI **STDBY** pushbutton.

(12) Program TI for a 100.000 V ac output at 20 kHz and press **ENTER** and **OPR** pushbuttons.

(13) Measure TI output. If ac measurement standard does not indicate between 99.905 and 100.095 V ac, perform **c** (5) below.

(14) Press TI **STDBY** pushbutton.

(15) Program TI for a 19.9900 V ac output at 400 Hz and press **ENTER** and **OPR** pushbuttons.

(16) Measure TI output. Ac measurement standard will indicate between 19.9790 and 20.0010 V ac.

(17) Press TI **STDBY** pushbutton.

(18) Repeat technique of (15) through (17) above for voltage outputs and frequencies listed in table 7. Ac measurement standard will indicate within limits specified.

Table 7. Ac Voltage Accuracy

Test instrument		Ac measurement standard indications (V Ac)	
Voltage (ac)	Frequency	Min	Max
19.9900	10 kHz	19.9790	20.0010
19.9900	50 Hz	19.9790	20.0010
2.1000	50 Hz	2.0979	2.1021
2.1000	10 kHz	2.0979	2.1021
2.1000	50 kHz	2.0966	2.1034
199.900	1 kHz	199.790	200.010
105.000	10 kHz	104.900	105.100
600.00	1 kHz	596.64	603.36
600.00	400 Hz	596.64	603.36
600.00	50 Hz	596.64	603.36

(19) Program TI for 1.0 V ac at 400 Hz and press **ENTER**, **OPR**, and **ENABLE** pushbuttons.

(20) Adjust TI **EDIT** control for nominal on ac measurement standard. TI **ERROR** indication will be within ± 0.065 percent.

(21) Press TI **STDBY** pushbutton.

(22) Program TI for 100.0 mV ac at 400 Hz and press **ENTER**, **OPR**, and **ENABLE** pushbuttons.

(23) Adjust TI **EDIT** control for nominal on ac measurement standard. TI **ERROR** indication will be within ± 0.11 percent.

(24) Press TI **STDBY** pushbutton.

(25) Program TI for 10.0 mV ac at 400 Hz and press **ENTER**, **OPR**, and **ENABLE** pushbuttons.

(26) Adjust TI **EDIT** control for nominal on ac measurement standard. TI **ERROR** indication will be within ± 0.56 percent.

(27) Press TI **STDBY** pushbutton.

c. Adjustments

(1) Adjust A14R39 (fig. 2) for a measured 2.1000 V ac on ac measurement standard (R).

(2) Adjust A14R32 (fig. 2) for a measured 19.9900 V ac on ac measurement standard (R).

(3) Repeat **b (**3) through (7) above and if necessary **c** (1) and (2) above until TI is within tolerance in both **b** (4) and (7) above.

(4) Adjust A11C15 (fig. 2) for a measured 19.9900 V ac on ac measurement standard (R).

(5) Adjust A11C1 (fig. 2) for a measured 100.000 V ac on ac measurement standard (R).

12. Ac Current

a. 10 mA to 2.0 A

(1) Connect equipment as shown in figure 6. Press **INPUT 1** pushbutton on ac measurement standard.

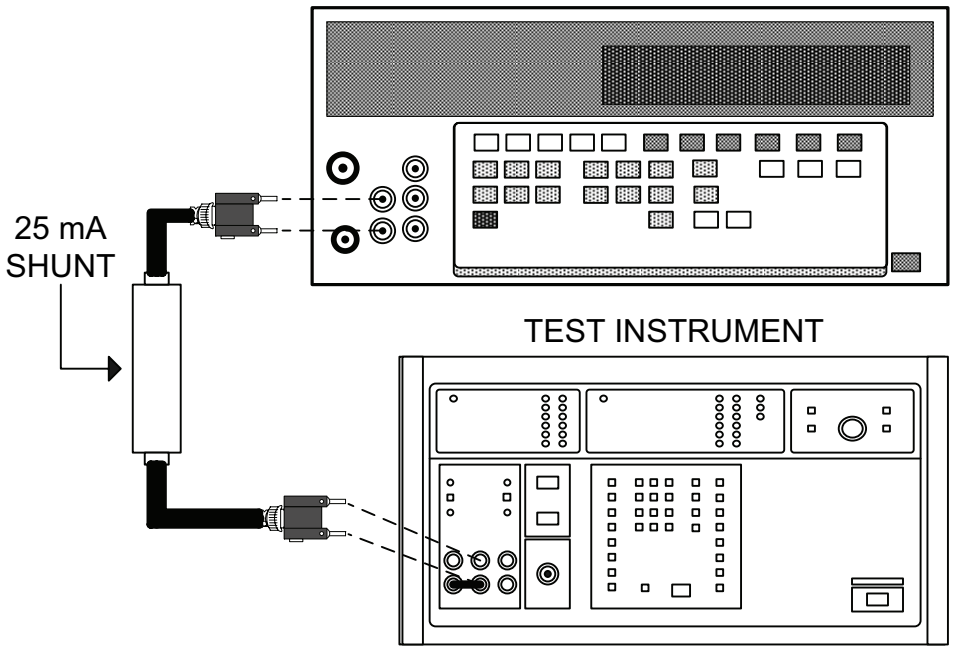

Figure 6. Ac current (19 mA to 1.9 A)

(2) Enter the ac-to-dc difference corrections for each shunt at each frequency in the appropriate column of table 8.

(3) Program TI for 19.0000 mA dc output and press **ENTER** and **OPR** pushbuttons. Allow at least 10 minutes for shunt stabilization.

NOTE

The 10 minute stabilization may only be required for the first measurement after ac shunt values are changed. Afterwards allow at least 1 minute after each TI output change before noting TI or ac measurement standard indications.

(4) When the reading has settled, press **SET REF** soft key on ac measurement standard and set display to indicate **PCT** units.

NOTE

When **SET REF** is engaged the display shows the difference between an applied input and the stored reference, or average of references. The difference can be displayed in units of V (or mV), ppm, percent, or ratio. Once a reference has been established you can cycle through each choice by pressing any of the three softkeys below the display. The display will cycle through **PPM** (power on state), **PCT**, **VOLTS**, and **RATIO**, and displays the equation used in each case.

(5) Set TI for 19.000 mA, 1.0 kHz ac output. Record ac measurement standard displayed error indication in appropriate column of table 8.

(6) Return to 19.000 mA dc output that was set in (3) above and verify that the ac measurement standard error display returns to a zero reading ± 0.0010 PCT; if not, repeat technique of (3) through (5) above.

(7) Algebraically add the resulting error indication to the test reported ac-to-dc difference of the ac shunt. The result will be within the limits specified.

(8) Repeat technique of (5) through (7) above for 50 Hz.

(9) Repeat technique of (2) through (8) above for 190 mA and 1.9 A using the appropriate ac shunts.

Table 8. Ac Current

Ac shunt	Test instrument indications		Ac measurement standard	Ac shunt ac-dc	Calculated error	Error limits
	Ac Current	Frequency	error display	difference	(± %)	(± %)
25 mA	19.000 mA	1 kHz				0.0805
25 mA	19.000 mA	50 Hz				0.0805
250 mA	190.000 mA	50 Hz				0.0805
250 mA	190.000 mA	1 kHz				0.0805
2.5 A	1.90000 A	1 kHz				0.0805
2.5 A	1.90000 A	50 Hz				0.0805

13. Ac High Frequency Voltage (Wideband Option 03)

a. Frequency Accuracy

(1) Connect TI **WIDEBAND** output connector to frequency counter, using cable and termination supplied with TI.

(2) Set TI for 1 V rms, 10 Hz wideband output.

(3) TI will indicate within limits specified in table 9. Repeat (2) above for frequencies listed in table 9.

Table 9. Wideband Frequency Accuracy

Test instrument frequency	Frequency counter indication	
	Min	Max
10 Hz	9.7 Hz	10.3 Hz
20 Hz	19.4 Hz	20.6 Hz
50 Hz	48.5 Hz	51.5 Hz
100 Hz	97 Hz	103 Hz
1 kHz	970 Hz	1.030 kHz
10 kHz	9.7 kHz	10.3 kHz
50 kHz	48.5 kHz	51.5 kHz
100 kHz	97 kHz	103 kHz
500 kHz	485 kHz	515 kHz
1 MHz	0.97 MHz	1.03 MHz
3 MHz	2.91 MHz	3.09 MHz
5 MHz	4.85 MHz	5.15 MHz
10 MHz	9.7 MHz	10.3 MHz

b. 1 kHz Wideband Accuracy

(1) Set ac measurement standard as specified in (a) through (g) below:

(a) Press **WIDEBAND** pushbutton.

(b) Press **7 V RANGE** pushbutton.

(c) Press **UTIL MENUS** pushbutton.

(d) Select **MEAS CONTROL** soft key.

(e) Select **FAST DIGITAL FILTER** mode.

(f) Select **MEDIUM RESTART**.

(g) Press the **DONE** soft key twice to return to measurement mode.

(2) Press **WIDEBAND** pushbutton and program TI for a 3.0000 V ac output at 1 kHz. Press **ENTER** and **OPR** pushbuttons. If ac measurement standard does not indicate between 2.9850 and 3.0150 V ac, perform **c** (1) below.

(3) Press TI **STDBY** pushbutton.

(4) Program TI for a 1.0000 V ac output at 1 kHz and press **ENTER** and **OPR** pushbuttons.

(5) Set ac measurement standard to **2.2 V RANGE**. If ac measurement standard does not indicate between 0.990 and 1.010 V ac, perform **b** (2) and (3) below.

(6) Program TI for a 0.99999 V ac output at 1 kHz and press **ENTER** and **OPR** pushbuttons. If ac measurement standard does not indicate between 0.99249 and 1.00749, perform **c** (4) below.

(7) Repeat technique of (3) and (4) above at TI **WIDEBAND** output voltages listed in table 10, using the appropriate Ac measurement standard range. Ac measurement standard will indicate within limits specified.

Table 10. WIDEBAND Ac Voltage

Test instrument **WIDEBAND** output voltage[1]	Ac measurement standard indication (V Ac)	
	Min	Max
2.0000 V	1.9875	2.0125
0.31623 V	0.31307	0.31939
99.999 mV	0.98749	0.101249
31.623 mV	0.031149	0.032097
9.999 mV	0.009824	0.010174

[1]At 1 kHz reference frequency.

(8) Press TI **STDBY** pushbutton.

(9) Press **CLEAR** pushbutton twice.

(10) Press **WIDEBAND** pushbutton.

(11) Program TI for 2.900 V ac at 1 kHz and press **ENTER**, **OPR** and **ENABLE** pushbuttons. Adjust **EDIT** control for a 0 (zero) percent error indication.

(12) Record ac measurement standard indication.

(13) Program TI for 2.900 V ac at 100 kHz and press **ENTER**, **OPR** and **ENABLE** pushbuttons.

(14) Adjust **EDIT** control for the same ac measurement standard indication as recorded in (12) above. TI indication will be within ± 0.25 percent.

(15) Repeat technique of (13) and (14) above for frequencies listed in table 11. If indications are not within limits specified, perform indicated adjustment.

Table 11. WIDEBAND Flatness

Test instrument		
Frequency (MHz)	Error indications ± ( ) %	Adjustments
1	0.25	- - -
3	0.25	- - -
5	0.25	**c** (5) through (8) below
7	0.6	- - -
10	0.6	- - -

c. Adjustments

(1) Adjust A12R79 (fig. 2) for a 3.0000 V ac indication on ac measurement standard (R).

(2) Adjust A12R74 (fig. 2) for a 1.0000 V ac indication on ac measurement standard (R).

(3) Repeat **b** (2) through (6) above and if necessary **c** (1) and (2) above until stated indications are obtained on both (1) and (2) above without further adjustment.

(4) Adjust A12R85 (fig. 2) for a 0.99999 V ac indication on ac measurement standard (R).

(5) Program TI for 2.900 V ac at 5 MHz and press **ENTER**, **OPR** and **ENABLE** pushbuttons.

(6) Adjust **EDIT** control for 0 percent **ERROR** indication.

(7) Adjust A12C40 (fig. 2) for the same ac measurement standard indication as recorded in **b** (12) above (R).

(8) Repeat **b** (8) through (15) above. If TI is out of tolerance, no further adjustments can be made.

14. Reference Voltage and Power Supply

a. Performance Check

NOTE

Do not perform supply check if all other parameters are- in tolerance.

(1) Connect multimeter to dc reference standard + output – terminals.

(2) Set dc reference standard for a + (positive) 10 V output.

(3) Measure dc reference standard output and record multimeter indication. Add 0.0005 V to recorded indication and record as + (positive) total value.

(4) Reverse leads at dc reference standard.

(5) Measure the - (negative) 10 V output and record multimeter indication. Add -0.0005 V to recorded indication and record as - (negative) total value.

(6) Connect multimeter between test points A14TP1 (HD and A14TP3 (LO) (fig. 2).

(7) Measure dc voltage. If multimeter indication is not within ± 0.00001 V of + (positive) total value recorded in (3) above, perform **b** (1) and (2) below. (8) Connect multimeter between test points A14TP4 (HI) and A14TP3 (LO) (fig. 2).

(9) Measure dc voltage. If multimeter indication is not within ± 0.00001 V of - (negative) total value recorded in (5) above, perform **b** (3) and (4) below.

(10) Connect multimeter between A9TP17 (HI) and A9TP18 (LO).

(11) Measure dc voltage. If measured dc voltage is not between 4.9 and 5.3 V dc, perform **b** (5) below.

(12) Repeat techniques of (1) and (2) above for test points (A9TP's) and voltage indications listed in table 12. If required, perform adjustments listed in table 12.

Table 12. Power Supply Voltages

Test points (fig. 1)		Multimeter indications (V dc)		Adjustments
HI	LO	Min	Max	(fig. 2)
TP16	TP18	11.25	12.75	- - -
TP15	TP18	-12.75	-11.25	- - -
TP14	TP13	14.99	15.01	A9R6
TP12	TP13	-15.15	-14.85	- - -
TP12	TP1	4.9	5.3	A9R84
TP4	TP6	60.0	64.0	- - -
TP2	TP6	-64.0	-60.0	- - -
TP3	TP6	37.5	40.5	- - -
TP5	TP6	-40.5	-37.5	- - -
TP11	TP10	14.25	15.75	- - -
TP7	TP10	-15.75	-14.25	- - -
TP8	TP9	4.75	5.25	- - -

b. Adjustments

(1) Set up multimeter to measure recorded total value in **a** (3) above.

(2) Adjust A14R11 (fig. 2) for a null on multimeter (R).

(3) Set up multimeter to measure recorded total value in **a** (5) above.

(4) Adjust A14R23 (fig. 2) for nominal on multimeter (R).

(5) Adjust A9R83 (fig. 2) for a 5.00 V dc indication on multimeter (R).

(6) Adjust A9R6 (fig. 2) for a 15.000 V dc indication on multimeter (R).

(7) Adjust A9R84 (fig. 2) for a 5.00 V dc indication on multimeter (R).

15. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army

0726004

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500, 2 January 2003, requirements for calibration procedure TB 9-6695-265-40.

Instructions for Submitting an Electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.