*TB 9-6625-2023-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL VOLTMETER HEWLETT-PACKARD MODEL 3455A

Headquarters, Department of the Army, Washington, DC
20 May 2002

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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedure, please let us know. Mail your letter or DA Form 2028 to: Commander, U. S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5230. 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 FAX 256-842-6546/DSN 788-6546.

*This bulletin supersedes TB 9-6625-2023-35, dated 1 June 1981, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Voltmeter, Hewlett-Packard Model 3455A. 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. None.

b. Time and Technique. The time required for this calibration is approximately 2 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 ± 1000 V in 5 ranges Accuracy (high resolution off): 0.1 V range: ±(0.010% of reading + 5 digits) 1 V range: ±(0.009% of reading + 1 digit) 10 V range: ±(0.008% of reading + 1 digit) 100 and 1000 V range: ±(0.010% of reading + 1 digit) Accuracy (high resolution on): 1 V range: ±(0.009% of reading + 5 digits) 10 V range: ±(0.008% of reading + 3 digits) 100 and 1000 V range: ±(0.010% of reading + 3 digits)
Ac voltage	Range: 0 to 1000 V in 4 ranges[1] Accuracy: ± (0.06% of reading + 60 digits) 30 Hz to 20 kHz ± (0.6 % of reading + 130 digits) 20 to 100 kHz ± (2.1 % of reading + 300 digits) 100 to 250 kHz ± (5.1 % of reading + 600 digits) 250 to 500 kHz ± (6.3 % of reading + 3500 digits) 500 kHz to 1 MHz Inputs above 500 V multiply tolerance by $\frac{1500 + \lvert Vin \rvert}{1000}$

See footnotes at end of table.

Table 1. Calibration Description - Continued.

Test instrument parameters	Performance specifications		
Ohms	Range: 0 to 10,000 kΩ in 6 ranges[2]		
	Accuracy (high resolution off):	0.1 kΩ range:	± (0.005% of reading + 6 digits)
		1 kΩ range:	± (0.005% of reading + 1 digit)
		10 kΩ range:	± (0.007% of reading + 2 digits)
		100 kΩ range:	± (0.004% of reading + 3 digits)
		1000 kΩ range:	± (0.014% of reading + 5 digits)
		10,000 kΩ range:	± (0. 100% of reading + 5 digits)
	Accuracy (high resolution on):	1 kΩ range:	±(0.0040% of reading + 6 digits)
		10 kΩ range:	±(0.0065% of reading + 6 digits)
		100 kΩ range:	±(0.0040% of reading + 7 digits)
		1000 kΩrange:	±(0.0140% of reading + 6 digits)
		10,000 kΩ range:	±(0.1000% of reading + 6 digits)

[1]Frequencies > 100 kHz are specified for 1V and 10V ranges only.

[2]Accuracies specified are for the 4-wire kΩ function. Add 0.0004 kΩ to all readings for the 2-wire kΩ function.

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 Transfer Calibration Standards Set, AN/GSM-286. Alternate items may be used by the calibrating activity. 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.

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)
CALIBRATOR	Range: -10 V to 1000 V dc Accuracy: 100 mV ±0.00375% 1 V ±0.002375% 10 V ±0.002075% 100 V ±0.002575% 1000 V ±0.002575% Range: 100 Ω to 10 MΩ Accuracy: 100 Ω ±27.5 ppm 1 kΩ ±15 ppm 10 kΩ ±17.75 ppm 100 kΩ ±16 ppm 1 MΩ ±36.5 ppm 10 MΩ ±0.02515 %	John Fluke, Model 5700A/CT (p/o MIS-35947); w/power amplifier, John Fluke Model 5725A (5725A)

Table 2. Minimum Specifications of Equipment Required - Continued.

Common name	Minimum use specifications								
	Range: 1 to 1000 V ac Frequency: 30 Hz to 100 kHz Accuracy: (±%)								
	Volts	Frequency (Hz)							
		30	40	100	10 k	40 k	100 k	200 k	400 k	1 M
	.1	- - -	- - -	0.05	- - -	- - -	- - -	- - -	- - -	- - -
	1	0.03	- - -	0.03	- - -	0.1825	- - -	0.6	1.425	2.45
	10	0.03	- - -	0.03	- - -	0.1825	- - -	0.6	1.425	2.45
	100	0.03	- - -	0.03	- - -	0.1825	0.1825	- - -	- - -	- - -
	1000	- - -	0.075	- - -	0.075	- - -	- - -	- - -	- - -	- - -
MULTIMETER	Capability to measure ±10 µV dc and 1 V ±10 µV ac at 100 Hz						Hewlett-Packard, Model 3458A (3458A)			

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instruction 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 result 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 manufacturer's manual for this TI.

d. Most controls on the TI are of the light emitting diode (LED) type and are generally referred to as keys. The center of each key contains an LED which illuminates to indicate the control has been selected. The keys will be referred to as controls because they do not function like pushbuttons (press and release). In addition, some of the controls will be duplicated in a following check because there are cases when the controls are automatically voided during operation.

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

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. Set **INPUT SELECT FRONT/REAR** switch (rear panel) to **FRONT**.

b. Set **VOLTAGE SELECT** switches (rear panel) to **120 V** and **SAMPLE LENGTH 50 Hz/60 Hz** switch (rear panel) to power source line frequency.

c. Connect TI to a 115 V ac power source.

d. Press **LINE OFF/ON** pushbutton to **ON** and allow at least 1 hour for warm up and stabilization.

e. Press **FUNCTION TEST** key to on. All front panel indicators will light except **REAR TERMINAL** indicator and TI will indicate +8888888 with all decimal points lit.

f. Set **FUNCTION TEST** key to off by pressing any other **FUNCTION** key.

8. Dc Voltage

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **INPUT (2 WIRE) HI** and **LO**.

(2) Set controls as listed in (a) through (g) below:

(a) **FUNCTION =V** key to on.

(b) **HIGH RESOLN** key to off.

(c) **RANGE .1** key to on.

(d) **TRIGGER INTERNAL** key to on.

(e) **MATH OFF** key to on.

(f) **AUTO CAL** key to on.

(g) **GUARD** pushbutton pressed to on.

(3) Set TI and calibrator for settings listed in table 3. If TI does not indicate within limits specified, perform **b** below.

Table 3. Dc voltage

Test instrument		Calibrator output settings (dc)	Test instrument indications	
RANGE settings	**HIGH RESOLN** settings		Min	Max
.1	off	100 mV	0.099985	0.100015
1	off	1 V	0.99990	1.00010
1	on	1 V	0.999905	1.000095
1	on	-1 V	-0.999905	-1.000095
10	on	10 V	9.99917	10.00083
10	on	-10 V	-9.99917	-10.00083
10	off	10 V	9.9991	10.0009
100	off	100 V	99.989	100.011
100	on	100 V	99.9897	100.0103
1k	on	1000 V	999.897	1000.103
1k	off	1000 V	999.89	1000.11

(4) Press calibrator **RESET** key.

b. Adjustments.

(1) Set calibrator to **STANDBY** and disconnect from TI.

(2) Remove TI top outer cover and top inner cover to gain access to circuit board A10.

(3) Set controls as listed in (a) through (e) below:

(a) **RANGE 10** key to on.

(b) **HIGH RESOLN** key to on.

(c) **TRIGGER INTERNAL** key to on.

(d) **MATH OFF** key to on.

(e) **AUTO CAL** key to off.

(4) Connect multimeter (V dc mode) **INPUT LO** to TI **INPUT (2 WIRE) LO** (inguard chassis) and multimeter **INPUT HI** to A10 TP1 (fig. 1).

(5) Adjust A10 R66 (fig. 1) until multimeter indicates 0 V dc ±50 µV.

(6) Disconnect multimeter.

(7) Press **RANGE 100** and **AUTO CAL** keys to on.

(8) If TI does not indicate 0.0000 V ±1 count, repeat (3) through (7) above.

(9) Replace TI protective covers.

(10) Press **RANGE 1** key to on.

(11) Short **INPUT (2 WIRE) HI** and **LO** using copper wire or shorting bar.

(12) Allow TI to operate at room temperature for at least 30 minutes.

(13) TI will indicate 0.000000 V ±4 counts.

(14) Remove short from **INPUT (2 WIRE) HI** and **LO**.

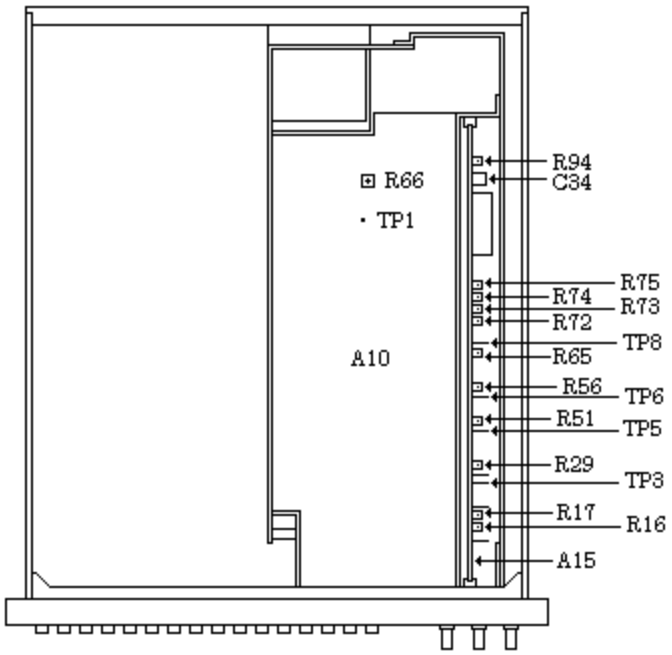

Figure 1. Test instrument - top view.

(15) Connect calibrator **OUTPUT HI** and **LO** to TI **INPUT (2 WIRE) HI** and **LO**.

(16) Press TI **RANGE 10** key to on.

(17) Set calibrator for a 10 V output.

NOTE

The following adjustments are accessible through holes in rear panel of TI. Adjustment designators are marked on panel.

(18) Adjust **10V** (A11R9) for a TI indication of 10.00000 V (R).

(19) Set calibrator for a 1 V output.

(20) Press TI **RANGE 1** key to on.

(21) Adjust **10:1** (A11R6) to obtain TI indication of 1.000000 V ±1 count (R).

(22) Repeat (16) through (21) above to obtain optimum adjustment.

9. Ohms

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **INPUT (2 WIRE) HI** and **LO**.

(2) Connect calibrator **SENSE HI** and **LO** to TI W **SIGNAL (4 WIRE) HI** and **LO**.

(3) Set controls as listed in (a) through (g) below:

(a) **FUNCTION 4 WIRE k**W key to on.

(b) **RANGE 1** key to on.

(c) **HIGH RESOLN** key to on.

(d) **TRIGGER INTERNAL** key to on.

(e) **MATH OFF** key to on.

(f) **AUTO CAL** key to on.

(g) **GUARD** pushbutton pressed to on.

(4) Set calibrator for a 1 kΩ output, **EX SNS** on, and **2 wire Comp** off then, using output adjustment controls, set calibrator control display **Reading** equal to TI indication. If calibrator control display **Error** indication is not within ±0.0046%, perform **b** below.

(5) Press **RANGE 100** key to on.

(6) Set calibrator for a 100 kΩ output then, using output adjustment controls, set calibrator control display **Reading** equal to TI indication. If calibrator control display **Error** indication is not within ±0.0047%, perform **b** below.

(7) Repeat technique of (5) and (6) above using settings and indications in table 4.

Table 4. Four Wire Ohms

Test instrument		Calibrator	
RANGE settings	**HIGH RESOLN** settings	Output settings	Control display **Error** indications (±%)
100	off	100 kΩ	0.007
1	off	1 kΩ	0.006
.1	off	100 Ω	0.011
10	on	10 kΩ	0.0071
10	off	10 kΩ	0.009
1 k	off	1 MΩ	0.019
1 k	on	1 MΩ	0.0146
10 k	on	10 MΩ	0.1006
10 k	off	10 MΩ	0.105

(8) Set calibrator for a 100 Ω output, **EX SNS** off, and **2 wire Comp** on.

(9) Press TI **FUNCTION 2 WIRE k**W key to on and repeat technique of (5) and (6) above using settings and indications in table 5.

Table 5. Two-Wire Ohms

Test instrument		Calibrator	
RANGE settings	**HIGH RESOLN** settings	Output settings	Control display **Error** indications (±%)
.1	off	100 Ω	0.411
1	off	1 kΩ	0.046
1	on	1 kΩ	0.0446
10	on	10 kΩ	0.0111
10	off	10 kΩ	0.013
100	off	100 kΩ[1]	0.0074
100	on	100 kΩ	0.0051
1 k	on	1 MΩ	0.0146
1 k	off	1 MΩ	0.019
10 k	off	10 MΩ	0.105
10 k	on	10 MΩ	0.1006

[1]Set calibrator **2 wire Comp** off before setting output to 100 kΩ.

b. Adjustments

NOTE

The following adjustments are accessible through holes in rear panel of TI. Adjustment designators are marked on panel.

(1) Press **RANGE 1** key to on.

(2) Set calibrator for a 1 kΩ output.

(3) Adjust **1k**W until TI indication is equal to calibrator output display indication rounded to TI digits of resolution (R).

(4) Press **RANGE 100** key to on.

(5) Set calibrator for a 100 kΩ output.

(6) Adjust **1M**W until TI indication is within ±1 count of calibrator output display indication rounded to TI digits of resolution (R).

(7) Repeat (1) through (6) above to obtain optimum adjustment.

10. Ac Voltage

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **INPUT (2 WIRE) HI** and **LO**.

(2) Set controls as listed in (a) through (g) below:

(a) **FUNCTION ~V** key to on.

(b) **RANGE 1** key to on.

(c) **TRIGGER INTERNAL** key to on.

(d) **MATH OFF** key to on.

(e) **AUTO CAL** key to on.

(f) **GUARD** pushbutton pressed to on.

(g) **AC-AC/DC** switch (rear panel) to **AC**.

(3) Set TI and calibrator to settings listed in table 6. If TI indications are not within limits specified, perform **b** below.

Table 6. Ac Voltage

Test instrument **RANGE** settings	Calibrator output settings		Test instrument indications	
	Voltage (V)	Frequency (Hz)	Min	Max
1	1	30	0.9988	1.0012
1	1	100	0.9988	1.0012
1	1	40 k	0.9927	1.0073
1	1	200 k	0.976	1.024
1	1	400 k	0.943	1.057
1	1	1 M	0.902	1.098
10	10	30	9.988	10.012
10	10	100	9.988	10.012
10	10	40 k	9.927	10.073
10	10	200 k	9.76	10.24
10	10	400 k	9.43	10.57
10	10	1 M	9.02	10.98
100	100	30	99.88	100.12
100	100	100	99.88	100.12
100	100	40 k	99.27	100.73
100	100	100 k	99.27	100.73
1000	1000	40	997	1003
1000	1000	10 k	997	1003

b. Adjustments

NOTE

Adjustments are labeled on top inner cover. Top inner cover must be removed to gain access to test points on circuit boards.

(1) Set calibrator to **STANDBY** and disconnect from TI.

(2) Press TI **RANGE 10** key to on.

(3) Short **INPUT (2 WIRE) HI** and **LO** using copper wire or shorting bar.

(4) Connect multimeter (V dc mode) **INPUT HI** to A15 TP8 (fig.1) and **LO** to A15 TP6 (fig. 1). Adjust A15 R65 (fig. 1) until multimeter indicates 0 V dc ±10 μV (R).

(5) Connect multimeter **INPUT HI** to A15TP5 (fig. 1). Adjust A15R56 (fig. 1) until multimeter indicates 0 V dc ±10 μV (R).

(6) Disconnect multimeter.

(7) Connect A15 TP3 (fig. 1) to A15TP6 (fig. 1). Adjust A15 R16 (fig. 1) until TI indicates 0 V ±1 count (R).

(8) Disconnect A15TP3 from A15TP6 and short from **INPUT (2 WIRE) HI** and **LO**.

(9) Connect calibrator **OUTPUT HI** and **LO** to TI **INPUT (2 WIRE) HI** and **LO**.

(10) Set calibrator for a 100 mV, 100 Hz output. Adjust A15R29 (fig. 1) until TI indicates between 0.0998 and 0.1002 V (R).

(11) Set TI rear panel **AC-AC/DC** switch to **AC/DC**.

(12) Set calibrator for a –10 V dc output. Record TI indication.

(13) Set calibrator for a +10 V dc output. Record TI indication.

(14) Adjust A15 R51 (fig. 1) so that indications recorded in (12) and (13) above are equal ±0.0005 V (R).

(15) Repeat (12) through (14) above as necessary.

(16) Set calibrator to **STANDBY**.

(17) Set TI rear panel **AC-AC/DC** switch to **AC**.

(18) Press TI **RANGE 1** key to on.

(19) Connect multimeter (V ac mode) **INPUT HI** to A15TP8 (fig. 1) and **LO** to A15 TP6 (fig. 1).

(20) Set calibrator for a 1 V, 100 Hz output. Adjust A15R74 (fig. 1) until multimeter indicates 1.00000 V ac ±1 count (R).

(21) Disconnect multimeter.

(22) Adjust A15R17 (fig. 1) until TI indicates 1.00000 V ±5 counts (R).

(23) Set calibrator for a 1 V, 40 kHz output. Adjust A15 R75 (fig. 1) until TI indicates 1.00010 V (R).

(24) Press TI **RANGE 10** key to on.

(25) Set calibrator for a 10 V, 100 Hz output. Adjust A15R73 (fig. 1) until TI indicates 10.0000 V ±5 counts (R).

(26) Set calibrator for a 10 V, 40 kHz output. Adjust A15A72 (fig. 1) until TI indicates 10.0010 V (R).

(27) Press TI **RANGE 100** key to on.

(28) Set calibrator for a 100 V, 100 Hz output. Adjust A15R94 (fig. 1) until TI indicates 100.000 V ±5 counts (R).

(29) Set calibrator for a 100 V, 40 kHz output. Adjust A15C34 (fig. 1) until TI indicates 100.010 V (R).

(30) Set calibrator to **STANDBY**.

(31) Repeat (18) through (30) above until optimum adjustment is obtained.

11. Final Procedure

a. Deenergize and disconnect all equipment.

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

THESE ARE THE INSTRUCTIONS FOR SENDING 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@avma27.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**: TB 9-6625-xxxx-35
9. **Pub Title**: Calibration Procedure for ...
10. **Publication Date**:
11. Change Number:
12. **Submitted Rank**: MSG
13. **Sumitter 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.

TB 9-6625-2023-35

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

OFFICIAL:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0209304

Distribution:

To be distributed in accordance with IDN 342185, requirements for calibration procedure TB 9-6625-2023-35.

PIN: 049005-000