*TB 9-6625-2232-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL VOLTMETER HEWLETT-PACKARD, MODEL 3456A

Headquarters, Department of the Army, Washington, DC
15 November 2002

Approved for public release; distribution is unlimited

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, 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 provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our FAX number is: DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use: https://amcom2028.redstone.army.mil.

*This bulletin supersedes TB 9-6625-2232-50, dated 26 March 1993.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Voltmeter, Hewlett-Packard, Model 3456A. 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

<table>
<tr><th>Test instrument parameters</th><th>Performance specifications</th></tr>
<tr><td>Dc voltage</td><td>Range: 0 to 1000 V (in 5 ranges)
Accuracy: ±(% of reading + number of counts)[1]
<table>
<tr><th colspan="4">Range</th></tr>
<tr><td>0.1</td><td>0.0112</td><td>+</td><td>24</td></tr>
<tr><td>1.0</td><td>0.0102</td><td>+</td><td>4</td></tr>
<tr><td>10.0</td><td>0.0101</td><td>+</td><td>2</td></tr>
<tr><td>100.0</td><td>0.0104</td><td>+</td><td>3</td></tr>
<tr><td>1000.0</td><td>0.0222</td><td>+</td><td>2</td></tr>
</table></td></tr>
<tr><td>Resistance</td><td>Range: 0Ω to 1 GΩ (in 8 ranges)
Accuracy: ±(% of reading + number of counts)[2]
<table>
<tr><th colspan="5">Range</th></tr>
<tr><td>100</td><td>Ω</td><td>0.0092</td><td>+</td><td>24</td></tr>
<tr><td>1</td><td>kΩ</td><td>0.0082</td><td>+</td><td>4</td></tr>
<tr><td>10</td><td>kΩ</td><td>0.0082</td><td>+</td><td>4</td></tr>
<tr><td>100</td><td>kΩ</td><td>0.0082</td><td>+</td><td>2</td></tr>
<tr><td>1</td><td>MΩ</td><td>0.0122</td><td>+</td><td>2</td></tr>
<tr><td>10</td><td>MΩ</td><td>0.0472</td><td>+</td><td>2</td></tr>
<tr><td>100</td><td>MΩ</td><td>1.8052</td><td>+</td><td>1</td></tr>
<tr><td>1</td><td>GΩ</td><td>16.0052</td><td>+</td><td>1</td></tr>
</table></td></tr>
</table>

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Ac voltage	Range: 0 to 700 V rms (in 4 ranges) Accuracy: ±(% of reading + number of counts)[3]

Frequencies								
20		to	30	Hz	0.402	+	656	
30	Hz	to	20	kHz	0.122	+	856	
20		to	50	kHz	0.222	+	1856	
50		to	100	kHz	0.602	+	3056	
100		to	250	kHz	5.052	+	6656	

[1]**AUTO ZERO** pushbutton on, **FILTER** off, and 10 PLC.

[2]**AUTO ZERO** pushbutton on, **FILTER** off, 10 PLC, and 4 WRΩ (add 0.2Ω offset for 2 WRΩ measurements).

[3]**AUTO ZERO** pushbutton on, **FILTER** on, 10 PLC, >1% of FS, and dc component <10% of ac (for inputs >500 V rms add 0.07% of reading). Frequencies >100 kHz are specified for 1 V and 10 V ranges only.

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 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	Dc voltage: Accuracy: (±%) 100 mV 0.0034 1 V 0.00265 10 V 0.002575 100 V 0.002675 1000 V 0.0056	John Fluke, Model 5720A (p/o MIS-35947); w/power amplifier, John Fluke Model 5725A (5725A)
	Ac voltage range: 1 to 700 V Frequency: 25 Hz to 250 kHz Accuracy: (±%)	

Ac voltage	Frequency (kHz)				
	0.025	1	45	95	250
1 V	0.1169	0.0519	0.1019	0.2269	1.4294
10 V	0.1169	0.0519	0.1019	0.2269	1.4294
100 V	0.1169	0.0519	0.1019	0.2269	- - -
700 V	---	0.0786	0.1393	0.2771	- - -

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications		Manufacturer and model (part number)
CALIBRATOR - continued	Resistance (Ω)	Accuracy: (±%)	John Fluke, Model 5720A (p/o MIS-35947); w/power amplifier, John Fluke Model 5725A (5725A)
	100	0.0029	
	1 k	0.00215	
	10 k	0.00215	
	100 k	0.0021	
	1 M	0.0031	
	10 M	0.0118	
RESISTANCE STANDARD	Resistance:	Accuracy: (±%)	Beckman, Model CR1000M (8579478)
	100 MΩ	0.4513	
	1000 MΩ	4	

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. Additional maintenance information is contained in the manufacturer's manual for this TI.

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

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

c. Ensure TI input terminals are not connected to any external circuitry.

d. Release **TERMINALS FRONT/REAR** pushbutton out to **FRONT** and press **GUARD (FRONT TERM) OPEN/TO LO** pushbutton in to **TO LO**.

e. Press **TEST** key.

NOTE

Once the test is completed, the display and LEDs go blank for a time and the operation starts again. If any of the internal checks do not pass, a negative integer corresponding to the check which did not pass is displayed. Refer to the manufacturer's manual if the internal test does not pass.

f. Press **TEST** key again upon completion of a test.

8. DC Voltage

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **VOLTS/2WR**W**/4WR**W **HI** and **LO**.

(2) Press keys as listed in (a) through (d) below:

(a) **RESET**.

(b) **MATH/REGISTERS 6**.

(c) **MATH/REGISTERS STORE**.

(d) **MATH/REGISTERS 9/N DIG DISP**.

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

Table 3. Dc Voltage

Calibrator output settings	Test instrument indications	
	Min	Max
100 mV	99.9864 -3	100.0136 -3
1 V	.999894	1.000106
10 V	9.99897	10.00103
100 V	99.9893	100.0107
1000 V	99.776	1000.224

b. Adjustments

NOTE

Adjustments are located behind a front panel section located at the front input terminals.

(1) Set calibrator for a 10 V output.

(2) Adjust **A** (coarse) and **B** (fine) until TI indicates 10.00000 ±1 count (R).

(3) Set calibrator for a 1 V output.

(4) Adjust **C** until TI indicates 1.000000 ±l count (R).

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

(6) Press **RANGE** ß key to 100 mV range.

(7) Short **VOLTS/2WR**W**/4WR**W **HI** and **LO** using copper wire or shorting bar.

(8) Press **MATH/REGISTERS MATH** key then press **MATH/REGISTERS 3/NULL** key.

(9) Remove short from **VOLTS/2WR**W**/4WR**W **HI** and **LO**.

(10) Connect calibrator **OUTPUT HI** and **LO** to TI **VOLTS/2WR**W**/4WR**W **HI** and **LO**.

(11) Set calibrator for a 100 mV output.

(12) Adjust **D** until TI indicates 100.0000 -3 ±5 counts (R).

(13) Press keys as listed in (a) through (f) below:

(a) **MATH/REGISTERS MATH**.

(b) **MATH/REGISTERS 0/OFF**.

(c) **RANGE** Ý to 100 V range.

(d) **MATH/REGISTERS 6**.

(e) **MATH/REGISTERS STORE**.

(f) **MATH/REGISTERS 9/N DIG DISP**.

(14) Set calibrator for a 100 V output.

(15) Adjust **E** until TI indicates 100.0000 ±1 count (R).

9. Resistance

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **VOLTS/2WR**W/**4WR**W **HI** and **LO**.

(2) Connect calibrator **SENSE HI** and **LO** to TI **RATIO REF/4WR**W **SENSE HI** and **LO**.

(3) Press keys as listed in (a) through (e) below:

(a) **RESET**.

(b) **MATH/REGISTERS 6**.

(c) **MATH/REGISTERS STORE**.

(d) **MATH/REGISTERS 9/N DIG DISP**.

(e) **FUNCTION 4 Wr**W.

(4) Set calibrator for a 0Ω output and **EX SNS** on. TI will indicate between –00.0024 and 00.0024.

(5) Set calibrator output for settings listed in table 4. At each output setting, use calibrator output adjustment controls to set calibrator control display **Reading** equal to TI indication. If calibrator control display **Error** indications are not within limits specified, perform **b** below.

Table 4. Resistance

Calibrator	
Output settings (Ω)	Control display **Error** indications (±%)
100	0.0116
1 k	0.0086
10 k	0.0086
100 k	0.0084
1 M	0.0124
10 M	0.0474

(6) Disconnect calibrator from TI.

(7) Connect TI **RATIO REF/4WR**W **SENSE** and **VOLTS/2WR**W/**4WR**W **HI** and **LO** to resistance standard for 100 MΩ. TI will indicate between 98.1947 +6 and 101.8053 +6.

(8) Connect TI **RATIO REF/4WR**W **SENSE** and **VOLTS/2WR**W/**4WR**W **HI** and **LO** to resistance standard for 1000 MΩ. TI will indicate between 839.947 +6 and 1160.053 +6.

(9) Press TI **FUNCTION 2 Wr**W key. TI will indicate between 839.947 +6 and 1160.053 +6.

b. Adjustments.

NOTE

Adjustments are located behind a front panel section located at the front input terminals.

(1) Set calibrator for a 10 kΩ output. Adjust **F** until TI indication is within ±1 count of calibrator output display indication rounded to TI digits of resolution.

(2) Set calibrator for a 1 kΩ output. Adjust **G** until TI indication is within ±1 count of calibrator output display indication rounded to TI digits of resolution.

(3) Set calibrator for a 100 kΩ output. Adjust **H** until TI indication is within ±1 count of calibrator output display indication rounded to TI digits of resolution.

(4) Set calibrator for a 1 MΩ output. Adjust **I** until TI indication is within ±1 count of calibrator output display indication rounded to TI digits of resolution.

(5) Set calibrator for a 10 MΩ output. Adjust **J** until TI indication is within ±4 counts of calibrator output display indication rounded to TI digits of resolution.

10. Ac Voltage

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **VOLTS/2WR**W**/4WR**W **HI** and **LO**.

(2) Press keys as listed in (a) through (f) below:

(a) **RESET**.

(b) **FUNCTION ~V**.

(c) **FILTER** to on.

(d) **MATH/REGISTERS 6**.

(e) **MATH/REGISTERS STORE**.

(f) **MATH/REGISTERS 9/N DIG DISP**.

(3) Set calibrator to settings listed in table 5. If TI indications are not within limits specified, perform **b** below.

Table 5. Ac Voltage

Calibrator output settings		Test instrument indications	
Voltage (V)	Frequency	Min	Max
1	25 Hz	0.995324	1.004676
1	1 kHz	0.997924	1.002076
1	45 kHz	0.995924	1.004076
1	95 kHz	0.990924	1.009076
1	250 kHz	0.942824	1.057176
10	25 Hz	9.95324	10.04676
10	1 kHz	9.97924	10.02076
10	45 kHz	9.95924	10.04076
10	95 kHz	9.90924	10.09076
10	250 kHz	9.42824	10.57176
100	25 Hz	99.5324	100.4676
100	1 kHz	99.7924	100.2076
100	45 kHz	99.5924	100.4076
100	95 kHz	99.0924	100.9076
700	1 kHz	697.8	702.2
700	45 kHz	696.1	703.9
700	95 kHz	692.24	707.76

b. Adjustments

NOTE

Adjustments are located behind a front panel section located at the front input terminals.

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

(2) Press TI **RESET** key then **FUNCTION ~V** key.

(3) Set calibrator for a 1 V, 1 kHz output.

(4) Press TI **RANGE** Ý or ß key to 100 V range. Adjust **K** until TI indicates 01.000 ±1 count (R).

(5) Press TI **RANGE** ß key to 1 V range. Adjust **L** until TI indicates 1.00000 ±3 counts (R).

(6) Press TI **RANGE** Ý key to 1 kV range. Adjust either **M** or **N** until TI indicates 001.00 ±2 counts (R).

(7) Repeat (4) through (6) above until no further adjustments are necessary.

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

(9) Short TI **VOLTS/2WR**W**/4WR**W **HI** and **LO**.

(10) Press **FUNCTION** ~ **+ =** key and **RANGE** Ý or ß key to 1 V range. Adjust **N** for a minimum TI indication.

(11) Press **FUNCTION ~V** key and perform (a) through (c) below:

(a) Record TI indication.

(b) Adjust **M** for a minimum TI indication.

(c) Continue adjusting **M** in the same direction until TI indication is within ±2 counts of indication recorded in (a) above.

(12) Repeat (10) and (11) above until both indications are within ±2 counts of each other.

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.

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
0227706

Distribution:

To be distributed in accordance with initial distribution number (IDN) 344753, requirement for calibration procedure TB 9-6625-2232-35.