

*TB 9-6625-2232-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL VOLTMETER AGILENT, MODEL 3456A

Headquarters, Department of the Army, Washington, DC
3 April 2008

Distribution Statement A: 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 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.

SECTION		Paragraph	Page
I.	IDENTIFICATION AND DESCRIPTION		
	Test instrument identification	1	2
	Forms, records, and reports.....	2	2
	Calibration description	3	2
II.	EQUIPMENT REQUIREMENTS		
	Equipment required.....	4	3
	Accessories required.....	5	3
III.	CALIBRATION PROCESS		
	Preliminary instructions	6	4
	Equipment setup	7	4
	Dc voltage	8	5
	Resistance	9	6
	Ac voltage.....	10	7
	Final procedure	11	9

*This bulletin supersedes TB 9-6625-2232-35, dated 15 November 2002, including all changes.

SECTION I IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Voltmeter, Agilent, 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

Test instrument parameters	Performance specifications																																				
Dc voltage	Range: 0 to 1000 V (in 5 ranges) Accuracy: \pm (% of reading + number of counts) ¹ <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: center;">Range</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0.1</td> <td style="text-align: center;">0.0112</td> <td style="text-align: center;">+</td> <td style="text-align: center;">24</td> </tr> <tr> <td style="text-align: center;">1.0</td> <td style="text-align: center;">0.0102</td> <td style="text-align: center;">+</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">10.0</td> <td style="text-align: center;">0.0101</td> <td style="text-align: center;">+</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;">100.0</td> <td style="text-align: center;">0.0104</td> <td style="text-align: center;">+</td> <td style="text-align: center;">3</td> </tr> <tr> <td style="text-align: center;">1000.0</td> <td style="text-align: center;">0.0222</td> <td style="text-align: center;">+</td> <td style="text-align: center;">2</td> </tr> </tbody> </table>	Range				0.1	0.0112	+	24	1.0	0.0102	+	4	10.0	0.0101	+	2	100.0	0.0104	+	3	1000.0	0.0222	+	2												
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10.0	0.0101	+	2																																		
100.0	0.0104	+	3																																		
1000.0	0.0222	+	2																																		
Resistance	Range: 0 Ω to 1 G Ω (in 8 ranges) Accuracy: \pm (% of reading + number of counts) ² <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: center;">Range</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">Ω</td> <td style="text-align: center;">0.0092</td> <td style="text-align: center;">+ 24</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">kΩ</td> <td style="text-align: center;">0.0082</td> <td style="text-align: center;">+ 4</td> </tr> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">kΩ</td> <td style="text-align: center;">0.0082</td> <td style="text-align: center;">+ 4</td> </tr> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">kΩ</td> <td style="text-align: center;">0.0082</td> <td style="text-align: center;">+ 2</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">MΩ</td> <td style="text-align: center;">0.0122</td> <td style="text-align: center;">+ 2</td> </tr> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">MΩ</td> <td style="text-align: center;">0.0472</td> <td style="text-align: center;">+ 2</td> </tr> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">MΩ</td> <td style="text-align: center;">1.8052</td> <td style="text-align: center;">+ 1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">GΩ</td> <td style="text-align: center;">16.0052</td> <td style="text-align: center;">+ 1</td> </tr> </tbody> </table>	Range				100	Ω	0.0092	+ 24	1	k Ω	0.0082	+ 4	10	k Ω	0.0082	+ 4	100	k Ω	0.0082	+ 2	1	M Ω	0.0122	+ 2	10	M Ω	0.0472	+ 2	100	M Ω	1.8052	+ 1	1	G Ω	16.0052	+ 1
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1	G Ω	16.0052	+ 1																																		

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: \pm (% 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	

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

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

³AUTO 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 Calibration Standards Sets AN/GSM-286, AN/GSM-287 or AN/GSM-705. 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: (\pm) 100 mV 0.0034 1 V 0.00265 10 V 0.002575 100 V 0.002675 1000 V 0.0056	Fluke, Model 5720A (5720A) (p/o MIS-35947); w amplifier, Fluke 5725A/AR (5725A/AR)
	Ac voltage range: 1 to 700 V Frequency: 25 Hz to 250 kHz Accuracy: (\pm)	
	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: ($\pm\%$)	Fluke, Model 5720A (5720A) (p/o MIS-35947); w amplifier, Fluke 5725A/AR (5725A/AR)
	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: ($\pm\%$)	Beckman, Model CR1000M (8579478)
	100 M Ω	0.4513	
	1000 M Ω	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 Ω/4WR Ω 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	999.776	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 ±1 count (R).
- (5) Set calibrator to **STANDBY** and disconnect from TI.
- (6) Press **RANGE ↓** key to 100 mV range.
- (7) Short **VOLTS/2WR Ω/4WR Ω 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 Ω /4WR Ω HI** and **LO**.
- (10) Connect calibrator **OUTPUT HI** and **LO** to **TI VOLTS/2WR Ω /4WR Ω HI** and **LO**.
- (11) Set calibrator for a 100 mV output.
- (12) Adjust **D** until TI indicates 100.0000 -3 \pm 5 counts (R).
- (13) Press keys as listed in (a) through (f) below:
 - (a) **MATH/REGISTERS MATH**.
 - (b) **MATH/REGISTERS 0/OFF**.
 - (c) **RANGE** \uparrow 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 \pm 1 count (R).

9. Resistance

a. Performance Check

- (1) Connect calibrator **OUTPUT HI** and **LO** to **TI VOLTS/2WR Ω /4WR Ω HI** and **LO**.
- (2) Connect calibrator **SENSE HI** and **LO** to **TI RATIO REF/4WR Ω 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 Ω** .
- (4) Set calibrator for a 0 Ω 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 ($\pm\%$)
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 Ω SENSE** and **VOLTS/2WR Ω /4WR Ω HI** and **LO** to resistance standard for 100 M Ω . TI will indicate between 98.1947 +6 and 101.8053 +6.

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

(9) Press TI **FUNCTION 2 Wr Ω** 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 k Ω 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 k Ω 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 k Ω 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 M Ω 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 M Ω 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 Ω /4WR Ω 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** \uparrow or \downarrow key to 100 V range. Adjust **K** until TI indicates 01.000 \pm 1 count (R).
- (5) Press TI **RANGE** \downarrow key to 1 V range. Adjust **L** until TI indicates 1.00000 \pm 3 counts (R).
- (6) Press TI **RANGE** \uparrow key to 1 kV range. Adjust either **M** or **N** until TI indicates 001.00 \pm 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** Ω /**4WR** Ω **HI** and **LO**.

(10) Press **FUNCTION** ~ + = key and **RANGE** \uparrow or \downarrow 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.

By Order of the Secretary of the Army:

Official:



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

0803810

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

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344753, requirements for calibration procedure TB 9-6625-2232-24.

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.

