*TB 9-6625-011-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR TRUE RMS VOLTMETER HEWLETT-PACKARD, MODEL 3400A

Headquarters, Department of the Army, Washington, DC
19 June 2008

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.

*This bulletin supersedes TB 9-6625-011-35, dated 24 February 2006.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of True RMS Voltmeter Hewlett-Packard, Model 3400A. TM 11-6625-1541-15 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.** Variations among models are described in text.

b. **Time and Technique**. The time required for this calibration is approximately 1.5 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
Ac voltage	Range: 1.0 mV to 300 V rms in 12 ranges Frequency: 10 Hz to 10 MHz Accuracy: ±(%) FS Frequency: 10 Hz to 50 Hz ..... 5.0 50 Hz to 1.0 MHz..... 1.0 1.0 to 2.0 MHz..... 2.0 2.0 to 3.0 MHz..... 3.0 3.0 to 10 MHz..... 5.0

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, 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. 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)
CALIBRATOR	Ac voltage: Range: 3 mV to 300 V Frequency: 400 Hz and 1 kHz Accuracy: ±0.25% Wideband voltage: Voltage: 900 μV to 0.9 V Frequency: 20 Hz to 10 MHz (1 kHz reference) Amplitude flatness: ± (%) Frequency: 20 Hz 1.25 400 Hz to 1 MHz 0.25 2 MHz 0.50 3 MHz 0.75 10 MHz 1.25	Fluke, Model 5720A (5700A/EP) (p/o MIS-35947); w amplifier, Fluke 5725A/AR (5725A/AR); w/ac divider, Fluke, Model 7405A-4207 (7405A-4207)
MULTIMETER	Range: -1.0 V dc: Accuracy: ±0.25%	Hewlett Packard, Model 3458A (3458A)

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 TM 11-6625-1541-15.

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. Remove protective cover from TI only when necessary to make adjustments. Replace cover after completing the adjustments; then repeat the check.

b. Mechanically zero meter using front panel adjustment and set **RANGE** switch to **300 VOLTS**.

c Connect to an appropriate ac voltage source and press **LINE** switch to **ON**. Allow at least 30 minutes for warm-up.

8. Voltage Accuracy

a. Performance Check

(1) Connect calibrator **OUTPUT** to TI **INPUT** terminal and connect multimeter to TI rear panel **DC OUT** terminal.

(2) Set TI **RANGE** switch to **.01 VOLTS** and set calibrator for a 10 mV, 400 Hz output. If multimeter does not indicate -1**.**0 (± **.**01) V, perform **b** (1) and (2) below.

(3) Adjust calibrator for a TI indication of 1 on the 0-to-1 scale. Calibrator **Error** display will be ≤ ± 1.0%; if not, perform **b** (3) through (7) below.

(4) Set TI **RANGE** switch to **1 VOLTS** and set calibrator for a 1.0 V, 400 Hz output, then adjust calibrator for a TI indication of 1 on the 0-to-1 scale. Calibrator **Error** display will be ≤ ± 1.0%; if not, perform **b** (8) below.

(5) Reset calibrator and remove multimeter from equipment set-up.

(6) Connect ac divider **INPUT** (p/o calibrator) to calibrator **OUTPUT** terminals and ac divider **OUTPUT** to TI **INPUT** terminal.

(7) Set TI **RANGE** switch and calibrator initial output as indicated in table 3. Adjust calibrator for the TI meter indication specified. Calibrator **Error** display will indicate within the specified limits.

Table 3. Range Accuracy

Test instrument			Calibrator		
RANGE switch settings (**VOLTS**)	Meter indication scale		Initial output		**ERROR** display indications ≤ ± (%)
	0-to-1	0-to-3	Voltage	Frequency (Hz)	
0.001	1	---	1.0 V	400	1.0[1]
0.003	---	3	3.0 V	400	1.0
Reset calibrator and remove ac divider from setup.					
0.03	---	3	30 mV	400	1.0
0.1	1	---	100 mV	400	1.0
0.3	---	3	0.3 V	400	1.0[2]
1	1	---	1.0 V	400	1.0[3]
1	.8	---	0.8 V	400	1.25
1	.6	---	0.6 V	400	1.7
1	.4	---	0.4 V	400	2.5
1	.2	---	200 mV	400	5.0
3	---	3	3.0 V	400	1.0
10	1	---	10 V	400	1.0
30	---	3	30 V	400	1.0
100	1	---	100 V	400	1.0
300	---	3	300 V	400	1.0

[1]Record this value for use in table 4 as ERR_{ref1} (include the sign)
[2]Record this value for use in table 4 as ERR_{ref2} (include the sign)
[3]Record this value for use in table 4 as ERR_{ref3} (include the sign)

(8) Connect TI **INPUT** to calibrator **WIDEBAND** output and press calibrator **WBND** pushbutton.

(9) Set TI **RANGE** switch to .**001 VOLTS**.

(10) Set calibrator output for an initial 0.001V @ 400 Hz. Adjust the calibrator output amplitude for precisely '1' on the TI meter. Press calibrator **NEW REF** pushbutton.

(11) Set calibrator frequency to 20 Hz, then readjust the calibrator output amplitude for precisely '1' on the TI meter. Record calibrator **Error** display indication as ERR_{meas1} (include the sign). Algebraically calculate TI frequency response error using the formula below. The TI error will be < ± 5.0 percent.

$$\text{TI frequency response error} = ERR_{meas1} - ERR_{ref1}$$

Example:

$ERR_{meas1} = -2.3\%$ $ERR_{ref1} = 0.4\%$

$-2.3-0.4=-2.7\%$

(12) Repeat technique of (11) above for remaining frequencies listed for the **.001 VOLTS RANGE** switch settings in table 4. TI frequency response error will be within specified limits; if not, perform **b** (9) through (11) below.

(13) Repeat technique of (9) through (12) above for TI **1 VOLTS RANGE** switch settings and calibrator initial voltage listed in table 4. Substitute ERR_{meas3} and ERR_{ref3} in formula. TI frequency response error will be within the limits specified; if not, perform **b** (12) through (14).

(14) Repeat technique of (9) through (12) above for TI **0.3 VOLTS RANGE** switch settings and calibrator initial voltage listed in table 4. Substitute ERR_{meas2} and ERR_{ref2} in formula. TI frequency response error will be within the limits specified; if not, perform **b** 15) through (17).

Table 4. Frequency Response

Test instrument **RANGE** switch settings	Calibrator				Limits ±(%)
	Output				
	Initial setting (Volts)	Frequency			
0.001	0.001	400	Hz		N/A
0.001	0.001	20	Hz		5.0
0.001	0.001	10	kHz		1.0
0.001	0.001	50	kHz		1.0
0.001	0.001	100	kHz		1.0
0.001	0.001	500	kHz		1.0
0.001	0.001	1.0	MHz		1.0
0.001	0.001	2.0	MHz		2.0
0.001	0.001	3.0	MHz		3.0
0.001	0.001	10	MHz		5.0
1	1	400	Hz		N/A
1	1	20	Hz		5.0
1	1	10	kHz		1.0
1	1	50	kHz		1.0
1	1	100	kHz		1.0
1	1	500	kHz		1.0
1	1	1.0	MHz		1.0
1	1	2.0	MHz		2.0
1	1	3.0	MHz		3.0
1	1	10	MHz		5.0
0.3	0.3	400	Hz		N/A
0.3	0.3	20	Hz		5.0
0.3	0.3	10	kHz		1.0
0.3	0.3	50	kHz		1.0
0.3	0.3	100	kHz		1.0
0.3	0.3	500	kHz		1.0
0.3	0.3	1.0	MHz		1.0
0.3	0.3	2.0	MHz		2.0
0.3	0.3	3.0	MHz		3.0
0.3	0.3	10	MHz		5.0

b. Adjustments

(1) Adjust R4 (R627 for TIs with amplifier board A6, P/N 03400-66512) (fig.1) until multimeter indicates -1.00 V.

(2) If necessary, adjust R6 (fig. 1) for full-scale indication on TI.

(3) Set calibrator for a 10 mV, 400 Hz output. Adjust R6 (fig.1) until TI indicates full scale (R).

(4) Set **RANGE** switch to **.1 VOLTS**.

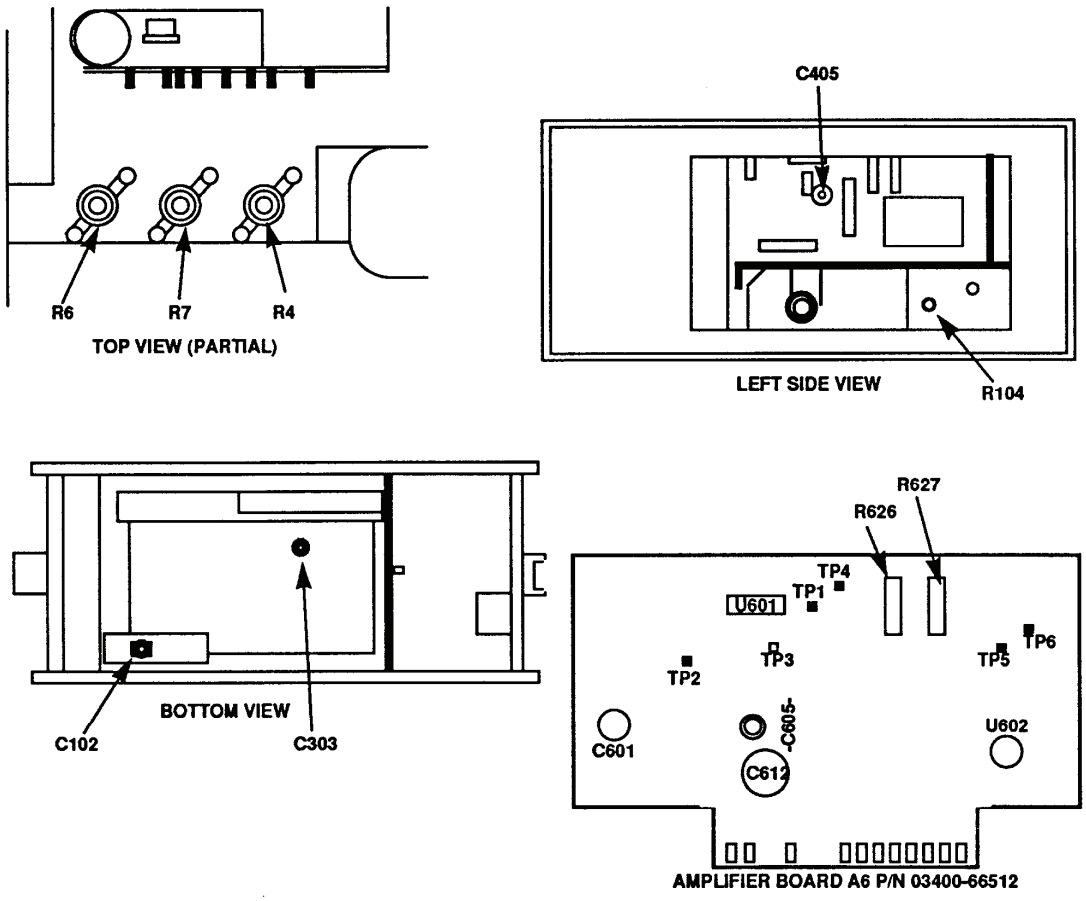

Figure 1. Test instrument - top, left side, bottom view, and A6 board, P/N 03400-66512.

(5) Adjust R7 (R626 for TIs with amplifier board A6, P/N 03400-66512) (fig. 1) until TI indicates 0.01 V (1 /10 scale) (R).

(6) Set **RANGE** switch to **.01 VOLTS**.

(7) Repeat (3) through (6) above until no further adjustment is necessary.

(8) Set calibrator for a 1.0 V, 400 Hz output. Adjust R104 (fig. 1) until TI indicates 1 (R).

(9) Set TI **RANGE** switch to **.001 VOLTS**. Set calibrator wideband output to 400 Hz and adjust amplitude for a full scale reference indication. Press **NEW REF** on calibrator.

(10) Set calibrator frequency to 10 MHz. Adjust C405 (fig. 1) for the 400 Hz full scale reference established in **b** (9) above (R).

(11) Vary calibrator frequency between 3 and 10 MHz and if required, readjust C405 (fig. 1) for best in-tolerance condition.

(12) Set TI **RANGE** switch to **1 VOLTS**. Set calibrator wideband output to 400 Hz and adjust amplitude for a full scale reference indication. Press **NEW REF** on calibrator.

(13) Set calibrator frequency to 100 kHz. Adjust C102 (fig. 1) for the 400 Hz full scale reference established in **b (**12) above (R).

(14) Vary calibrator frequency between 100 kHz and 10 MHz and, if required, readjust C102 (fig. 1) for best in-tolerance condition.

(15) Set TI **RANGE** switch to **.3 VOLTS**. Set calibrator wideband output to 400 Hz and adjust amplitude for a 0.3 Volt reference indication. Press **NEW REF** on calibrator.

(16) Set calibrator frequency to 3.0 MHz. Adjust C303 (fig. 1) for the 400 Hz 0.3 V reference established in **b** (15) above (R).

(17) Vary calibrator frequency between 3 and 10 MHz and, if required, readjust C303 (fig. 1) for best in-tolerance condition.

9. 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:

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

Official:

JOYCE E. MORROW
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Secretary of the Army

0811210

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342091, requirements for calibration procedure TB9-6625-011-24.

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.