*TB 9-6625-2288-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR ELECTRONIC VOLTMETERS AN/URM-145D (ME-247D/U) (MILLIVAC INSTRUMENTS, MODEL MV-828A)

Headquarters, Department of the Army, Washington, DC
18 February 2009

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 9-6625-2288-35, dated 16 October 2003.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Electronic Voltmeters, AN/URM-145D (ME-247D/U) (Millivac Instruments, Model MV-828A). TM 11-6625-524-14-4 and manufacturer's manual were used as the prime data sources 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 indicated in text.

b. Time and Technique. The time required for this calibration is approximately 4 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		
	Voltage ranges (V)	Range accuracy (FS)	Frequency response
AN/URM-145D (ME-247D/U)	0.003 to 3	±5% ±10%	20 kHz to 200 MHz 200 to 400 MHz
(Millivac Instruments, Model MV-828A)	0.001	±10% ±15%	20 kHz to 200 MHz 200 to 400 MHz

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-287 or AN/GSM-705 and Secondary Reference Calibration Standards Set, NSN 4931-00-621-7878. 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	Frequency range: 20 kHz to 1 MHz Voltage range: .2 mV to 3.15 V ac Accuracy: ±1.25%	Fluke, Model 5720A (p/o MIS-35947); w/ amplifier, Fluke, Model 5725A (5725A)
MEASURING RECEIVER	Frequency range: 10 to 400 MHz Range: 90 to 110 mV rms Accuracy: ±1.25%	Measuring receiver system N5530S consisting of: Spectrum Analyzer, Agilent Model E4440A (E4440A), Power meter, Agilent Model E4419B (E4419B), and Sensor module, Agilent Model N5532A opt. 504 (504)
MULTIMETER	Range: -13.5V to +15.5 V dc Accuracy: ±0.0167%	Hewlett Packard, Model 3458A (3458A)
POWER SPLITTER	Frequency range: 10 to 400 MHz Port-to-port tracking accuracy: ±0.15 dB	Weinschel, Model 1870A (7916839)
SIGNAL GENERATOR	Range: 3 to 400 MHz Output amplitude variable from 90 to 110 mV	(SG-1207/U)

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 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 the procedure.

d. When indications specified in paragraphs **8** and **9** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **8** and **9**. Do not perform power supply check if all other parameters are within tolerance.

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. Mechanically zero TI meter.

b. Connect RF probe to PROBE jack.

NOTE

The RF probe authorized for use with TI must have serial numbers matching the TI serial numbers. If a new RF probe is calibrated with TI, annotate new RF probe with TI serial number. Do not use any RF probe not calibrated with TI.

c. Connect TI to a 115 V ac source.

d. Set **OFF-ON** switch to **ON**.

e. Set **RANGE-FULL-SCALE** switch to **.001 -VOLTS**.

f. Adjust **SET-REF** until meter pointer is at **SET REF** mark.

g. Allow TI to warm-up for 1 hour.

h. Allow measuring receiver to warm-up for 30 minutes.

8. Accuracy and Linearity

a. Performance Check

(1) Adjust calibrator for wideband operation.

(2) Connect calibrator **WIDEBAND OUTPUT** (without 50 ohm pad) to TI RF probe using 50 ohm feedthrough termination supplied with TI.

(3) Adjust calibrator frequency controls for 500 kHz output.

(4) Adjust calibrator voltage output controls for a TI meter indication specified in table 3. If calibrator does not indicate within the limits specified in table 3, perform **b** below.

(5) Repeat technique of (4) above for remaining **RANGE-FULL-SCALE VOLTS** setting listed in table 3.

(6) Set calibrator to standby.

(7) Disconnect TI RF probe from calibrator output.

Table 3. Range Accuracy and Linearity

RANGE-FULL-SCALE VOLTS scale settings	Test instrument meter indications (V)	Calibrator indications	
		Min	Max
0.001	0.001	0.90 mV	1.1 mV
0.003	0.001	0.85 mV	1.15 mV
	0.002	1.85 mV	2.15 mV
	0.003	2.85 mV	3.15 mV
0.01	0.003	2.5 mV	3.5 mV
	0.006	5.5 mV	6.5 mV
	0.01	9.5 mV	10.5 mV
0.03	0.01	8.5 mV	11.5 mV
	0.02	18.5 mV	21.5 mV
	0.03	28.5 mV	31.5 mV
0.1	0.03	25.0 mV	35.0 mV
	0.06	55.0 mV	65.0 mV
	0.1	95.0 mV	105.0 mV
0.3	0.1	85.0 mV	115.0 mV
	0.2	185.0 mV	215.0 mV
	0.3	0.285 V	0.315 V
1	0.3	0.250 V	0.350 V
	0.6	0.550 V	0.650 V
	1	0.950 V	1.05 V
3	1	0.850 V	1.15 V
	2	1.95 V	2.15 V
	3	2.85 V	3.15 V

b. Adjustments

(1) Set **TI RANGE-FULL-SCALE** switch to **.001-VOLTS**.

(2) Short TI RF probe to chassis and adjust **SET REF** control until meter pointer is at **SET REF** mark.

NOTE

Operate calibrator in wideband operation.

(3) Connect TI RF probe to calibrator **WIDEBAND OUTPUT**.

(4) Adjust calibrator for 0.001 V ac output. Adjust **1MV HI** (fig. 1) for a meter indication between 0.0009 and 0.0011 mV (ideal 0.001) (R).

(5) Adjust calibrator for .0006 V ac output. Adjust **1MV MID** (fig. 1) for a meter indication between 0.0005 and 0.0007 V ac (ideal 0.0006) (R).

(6) Adjust calibrator for 0.0003 V ac output. Adjust **1MV LO** (fig. 1) for a meter indication between 0.0002 and 0.0004 V ac (ideal 0.0003) (R).

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

(8) Disconnect TI RF probe from calibrator output.

(9) Set TI **RANGE-FULL-SCALE** switch to **.003-VOLTS**.

(10) Short TI RF probe to chassis and adjust **SET REF** control until meter pointer is at **SET REF** mark**.**

(11) Connect TI RF probe to calibrator **WIDEBAND OUTPUT**.

(12) Adjust calibrator for 0.003 V ac output. Adjust **3MV HI** (fig. 1) for a meter indication between 0.00285 and 0.00315 V ac (ideal 0.003) (R).

(13) Adjust calibrator for 0.002 V ac output. Adjust **3MV MID** (fig. 1) for a meter indication between 0.00185 and 0.00215 V ac (ideal 0.002) (R).

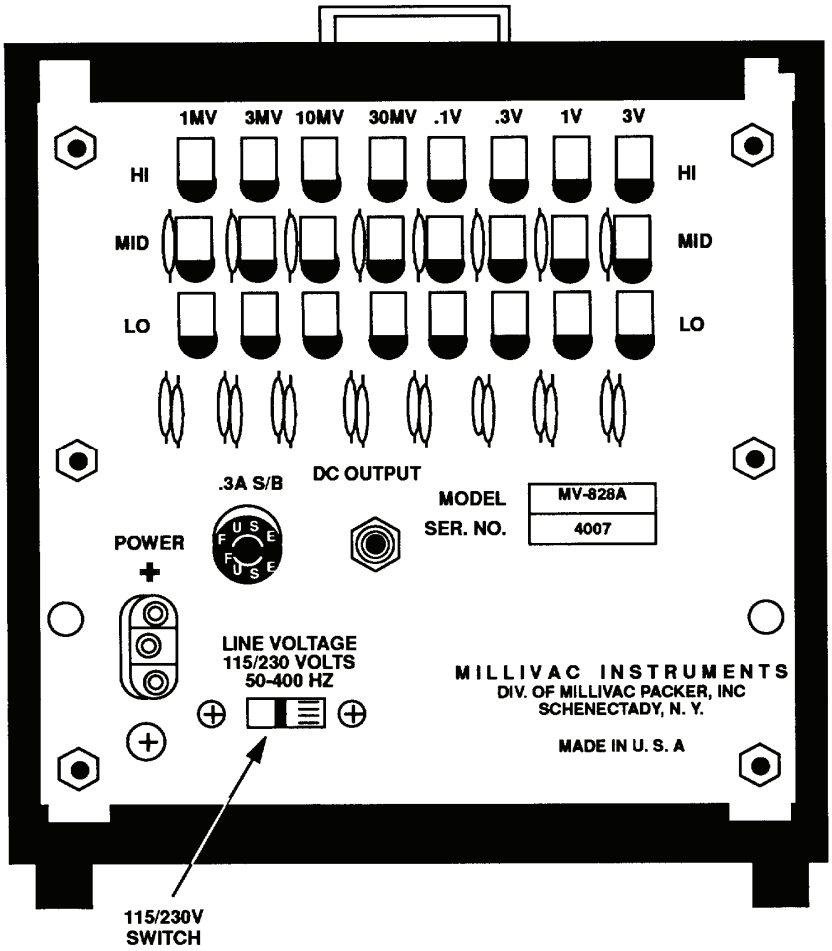

Figure 1. AN/URM-145D - adjustment locations.

(14) Adjust calibrator for 0.001 V ac output. Adjust **3MV LO** (fig. 1) for a meter indication between 0.00085 and 0.00115 V ac (ideal 0.001) (R).

(15) Repeat (12) through (14) above until no further adjustments are required.

(16) Set TI **RANGE-FULL-SCALE** switch to **.01-VOLTS**.

(17) Adjust calibrator for 0.01 V ac output. Adjust **10MV HI** (fig. 1) for a meter indication between 0.0095 and 0.0105 V ac (ideal 0.01) (R).

(18) Adjust calibrator for 0.006 V ac output. Adjust **10MV MID** (fig. 1) for a meter indication between 0.0055 and 0.0065 V ac (ideal 0.006).

(19) Adjust calibrator for 0.003 V ac output. Adjust **10MV LO** (fig. 1) for a meter indication between 0.0025 and 0.0035 V ac (ideal 0.003) (R).

(20) Repeat (17) through (19) above until no further adjustments are required.

(21) Set TI **RANGE-FULL-SCALE** switch to **.03-VOLTS**.

(22) Adjust calibrator for 0.03 V ac output. Adjust **30MV HI** (fig. 1) for a meter indication between 0.0285 and 0.0315 V ac (ideal 0.03) (R).

(23) Adjust calibrator for 0.02 V ac output. Adjust **30MV MID** (fig. 1) for a meter indication between 0.0185 and 0.0215 V ac (ideal 0.02) (R).

(24) Adjust calibrator for 0.01 V ac output. Adjust **30MV LO** (fig. 1) for a meter indication between 0.0085 and 0.0115 V ac (ideal 0.01) (R).

(25) Repeat (22) through (24) above until no further adjustments are required.

(26) Set TI **RANGE-FULL-SCALE** switch to **.1-VOLTS**.

(27) Adjust calibrator for 0.1V ac output. Adjust **.1V HI** (fig. 1) for a meter indication between 0.095 and 0.105 V ac (ideal 0.1) (R).

(28) Adjust calibrator for 0.06 V ac output. Adjust **.1V MID** (fig. 1) for a meter indication between 0.055 and 0.065 V ac (ideal 0.06) (R).

(29) Adjust calibrator for 0.03 V ac output. Adjust **.1V LO** (fig. 1) for a meter indication between 0.025 and 0.035 V ac (ideal 0.03) (R).

(30) Repeat (27) through (29) above until no further adjustments are required.

(31) Set TI **RANGE-FULL-SCALE** switch to **.3-VOLTS**.

(32) Adjust calibrator for 0.3 V ac output. Adjust **.3V HI** (fig. 1) for a meter indication between 0.285 and 0.315 V ac (ideal 0.3 V) (R).

(33) Adjust calibrator for 0.2 V ac output. Adjust **.3V MID** (fig. 1) for a meter indication between 0.185 and 0.215 V ac (ideal 0.2) (R).

(34) Adjust calibrator for 0.1V ac output. Adjust. .**3V LO** (fig. 1) for a meter indication between 0.085 and 0.115 V ac (ideal 0.1) (R).

(35) Repeat (32) through (34) above until no further adjustments are required.

(36) Set TI **RANGE-FULL-SCALE** switch to **1 -VOLTS**.

(37) Adjust calibrator for 1 V ac output. Adjust **1V HI** (fig. 1) for a meter indication between 0.950 and 1.05 V ac (ideal 1) (R).

(38) Adjust calibrator for 0.6 V ac output. Adjust **1V MID** (fig. 1) for a meter indication between 0.550 and 0.650 V ac (ideal 0.6) (R).

(39) Adjust calibrator for 0.3 V ac output. Adjust **1V LO** (fig. 1) for a meter indication between 0.250 and 0.350 V ac (ideal 0.3) (R).

(40) Repeat (37) through (39) above until no further adjustments are required.

(41) Set TI **RANGE-FULL-SCALE** switch to **3-VOLTS**.

(42) Adjust calibrator for 3 V ac output. Adjust **3V HI** (fig. 1) for a meter indication between 2.85 and 3.15 V ac (ideal 3) (R).

(43) Adjust calibrator for 2 V ac output. Adjust **3V MID** (fig. 1) for a meter indication between 1.85 and 2.15 V ac (ideal 2) (R).

(44) Adjust calibrator for 1 V ac output. Adjust **3V LO** (fig. 1) for a meter indication between 0.850 and 1.15 V ac (ideal 1) (R).

(45) Repeat (42) through (44) above until no further adjustments are required.

(46) Disconnect TI RF probe from calibrator.

9. Frequency Response

a. Performance Check

(1) Connect calibrator **WIDEBAND OUTPUT** (without 50 ohm pad) to TI RF probe using 50 ohm feed through termination supplied with TI.

(2) Set **RANGE-FULL-SCALE** switch to **.1-VOLTS**.

(3) Adjust calibrator frequency controls to value listed in table 4.

(4) Adjust calibrator output voltage controls for 0.1 V indication on TI meter. Calibrator voltage output will be within the limits specified in table 4.

(5) Repeat (3) and (4) above for remaining calibrator frequency settings listed in table 4.

Table 4. Frequency Response

Calibrator frequency settings (kHz)	Calibrator output voltage (mV)	
	Min	(Max)
20	95	105
50	95	105
100	95	105
500	95	105
1000	95	105

(6) Connect equipment as shown in figure 2.

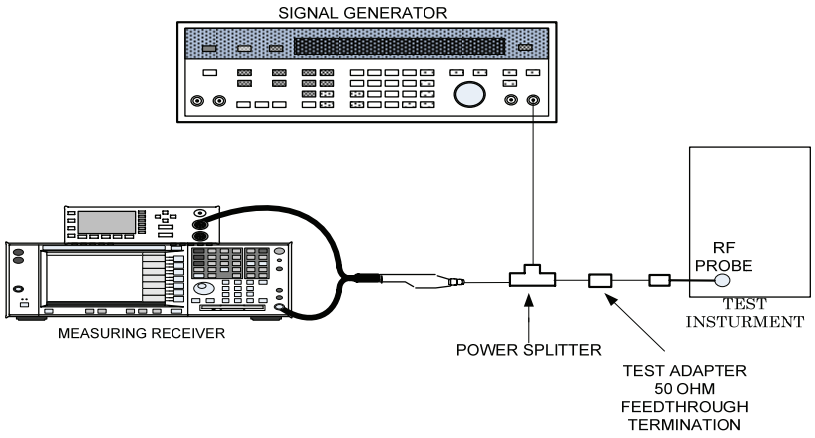

Figure 2. Frequency response - equipment setup.

(7) Set the measuring receiver to make an RF power measurement in mV.

(8) Adjust signal generator output to 100 mV and frequency controls to value listed in signal generator frequency settings listed in table 5.

(9) Measuring receiver indication will be within the limits listed in table 5.

Table 5. Frequency Response

Signal generator frequency settings (MHz)	Measuring receiver voltage indications	
	Min	Max
3	95	105
5	95	105
7	95	105
10	95	105
20	95	105
50	95	105
90	95	105
100	95	105
175	95	105
200	90	110
300	90	110
350	90	110
400	90	110

(10) Adjust signal generator for remaining frequency settings listed in table 5. Measuring receiver indication for remaining frequency settings will be within limits specified in table 5.

b. Adjustments. No adjustments can be made.

10. Power Supply

NOTE

Do not perform power supply check if all other parameters are within tolerance.

a. **Performance Check**. Connect multimeter positive lead to 3A1TP1 (fig. 3) and connect negative lead to 3A1TP2 (fig. 3). If the multimeter does not indicate between. +14.49 and +14.51 V dc, perform **b** (1) below.

b. Adjustments. Adjust 3A1R13 (fig. 3) for a multimeter indication between +14.49 and +14.51 V dc (ideal 14.50 V dc) (R).

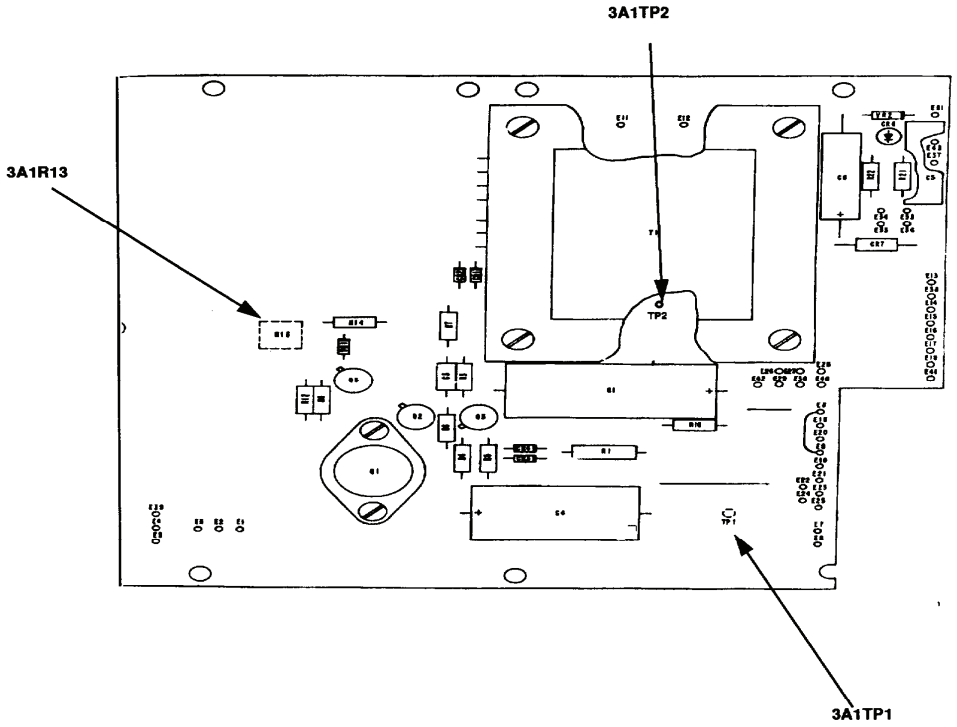

Figure 3. Regulated power supply 3A1 - location of parts.

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:

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

Official:

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

0835205

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344468, requirements for calibration procedure TB 9-6625-2288-24.

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.