*TB 9-6625-2297-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR POWER METER HEWLETT-PACKARD, MODEL 437B

Headquarters, Department of the Army, Washington, DC
18 March 2002

Approved for public release; distribution is unlimited

REPORTING OF ERRORS AND RECOMMENDED 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 by FAX (256) 842-6546/DSN 788-6546

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*This bulletin supersedes TB 9-6625-2297-35, dated 28 June 1993.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Power Meter, Hewlett-Packard, Model 437B. 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. 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
Zero set (digital set ability of zero)	±0.5% FS (Most sensitive range. Decrease percentage factor of 10 for each higher range ±1 count)
Instrument accuracy single channel mode	Range: 3 µW to 100 mW Accuracy:[1] ±0.5% or ±0.2 dB (within same calibration range)
Reference frequency oscillator	Frequency: 50 MHz Accuracy: ±0.5 MHz
Power reference	Range: 1 mW Accuracy: ±1.2% Frequency: 50 MHz

[1]Instrumentation includes sensor linearity. When operating in ranges 4 or 5 add the corresponding sensor power linearity percentage.

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. 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. The following peculiar accessory is also required for this calibration: Power sensor cable, Hewlett-Packard, Model 11730A.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
FREQUENCY COUNTER	Frequency range: 49.5 to 50.5 MHz Accuracy: ±0.25%	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1)
MULTIMETER	Ability to measure approximately 200Ω Ability to measure µV dc	Hewlett-Packard, Model 3458A (3458A)
POWER METER	Range: 0.988 to 1.012 mW Accuracy: ±0.7% Frequency range: 50 MHz Must have V_{COMP} and V_{RF} outputs	Hewlett-Packard, Model El2-432A (MIS-30525) w/thermistor mount, Hewlett-Packard, Model H75-478A (7915907)
RANGE CALIBRATOR	Range: 3 µW to 100 mW Accuracy: ±0.25%	Hewlett-Packard, Model 11683A (11683A)

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 this procedure. Additional maintenance information is contained in the manufacturer's manuals.

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 TI **LINE STBY/ON** pushbutton to **ON** and allow 30 minutes for warmup.

8. Zero Carryover

a. Performance Check

(1) Press TI **LINE STBY/ON** pushbutton to **STBY** and range calibrator **LINE OFF/ON** pushbutton to **OFF**.

(2) Connect TI **SENSOR** to range calibrator **POWER METER**.

(3) Press TI **LINE STBY/ON** pushbutton to **ON**.

(4) Position range calibrator controls as listed in (a) through (c) below:

(a) **FUNCTION CALIBRATE/STANDBY** switch to **STANDBY**.

(b) **RANGE** switch to **3** m**W**.

(c) **LINE OFF/ON** pushbutton to **ON**.

(5) Press **DATA ENTRY PRESET/LOCAL** key then **DATA ENTRY ENTER** key.

(6) Press **FUNCTION dBm/W** key for TI indications in watts.

(7) Press **FUNCTION ZERO** key and wait approximately 15 seconds for **ZEROING: ******* display to disappear. TI will indicate between -0.06 and +0.06 µW.

(8) Press **FUNCTION SET RANGE** key.

(9) Press **DATA ENTRY** Ý or ß key until **RNG1 -20 dBm** is displayed.

(10) Press **DATA ENTRY ENTER** key. TI will indicate between -0.05 and +0.05 µW.

(11) Repeat technique of (8) through (10) above for TI range settings and indications listed in table 3.

Table 3. Zero Carryover

Test instrument		
Range settings	Indications	
	Min	Max
RNG2 -10 dBm	-0.1 µW	+0.1 µW
RNG3 +00 dBm	-0.001 mW	+0.001 mW
RNG4 +10 dBm	-0.01 mW	+0.01 mW
RNG5 +20 dBm	-0.1 mW	+0.1 mW

b. Adjustments. No adjustments can be made.

9. Instrument Accuracy

a. Performance Check

NOTE

If TI **SENSOR** is not connected to range calibrator **POWER METER**, perform **8a** (1) through (4) above.

(1) Set range calibrator switches as listed in (a) through (c) below:

(a) **FUNCTION CALIBRATE/STANDBY** to **STANDBY**.

(b) **POLARITY NORMAL/REVERSE** to **NORMAL**.

(c) **RANGE** to **3 mW**.

(2) Press **DATA ENTRY PRESET/LOCAL** key then **DATA ENTRY ENTER** key.

(3) Press **FUNCTION dBm/W** key for TI indications in watts.

NOTE

When setting range calibrator **FUNCTION CALIBRATE/STANDBY** switch to **STANDBY**, allow sufficient time for range calibrator to settle before zeroing TI (typically less than 60 seconds).

(4) Press **FUNCTION ZERO** key and wait approximately 15 seconds for **ZEROING: ******* display to disappear. TI will indicate between -0.05 and +0.05 µW.

(5) Set range calibrator **RANGE** switch to **1 mW** and **FUNCTION CALIBRATE/STANDBY** switch to **CALIBRATE**.

(6) Press **FUNCTION SHIFT** key then **FUNCTION CAL/ZERO** key.

(7) Press **DATA ENTRY** Ý, ß, Ü, Þ keys until **REF CF 100.0%** is displayed.

(8) Press **DATA ENTRY ENTER** key. TI will display **CAL ******* for a few seconds.

(9) Press **FUNCTION SHIFT** key then **FUNCTION CAL FAC/FREQ** key.

(10) Press **DATA ENTRY** Ý, ß, Ü, Þ keys until **CALFAC 100.0%** is displayed.

(11) Press **DATA ENTRY ENTER** key. If TI does not indicate between 0.995 and 1.005 mW, perform **b** below.

(12) Set range calibrator **RANGE** switch to settings listed in table 4. If TI does not indicate within limits specified, perform **b** below.

Table 4. Test Instrument Accuracy

Range calibrator **RANGE** switch settings	Test instrument indications	
	Min	Max
3 µW	3.10 µW	3.23 µW
10 µW	9.90 µW	10.10 µW
30 µW	31.4 µW	31.8 µW
100 µW	99.5 µW	100.5 µW
300 µW	0.314 mW	0.318 mW
3 mW	3.14 mW	3.18 mW
10 mW	9.95 mW	10.05 mW
30 mW	31.4 mW	31.8 mW
100 mW	99.5 mW	100.5 mW

b. Adjustments

(1) Set range calibrator **FUNCTION CALIBRATE/STANDBY** switch to **STANDBY** and **RANGE** switch to **1 mW**.

(2) Press **DATA ENTRY PRESET/LOCAL** key then **DATA ENTRY ENTER** key.

(3) Press **FUNCTION dBm/W** key for TI indications in watts.

NOTE

When setting range calibrator **FUNCTION CALIBRATE/STANDBY** switch to **STANDBY**, allow sufficient time for range calibrator to settle before zeroing TI (typically less than 60 seconds).

(4) Press **FUNCTION ZERO** key and wait approximately 15 seconds for **ZEROING: ******* display to disappear.

(5) Set range calibrator **FUNCTION CALIBRATE/STANDBY** switch to **CALIBRATE.**

(6) Press **FUNCTION SHIFT** key then **FUNCTION CAL/ZERO** key.

(7) Press **DATA ENTRY** Ý, ß, Ü, Þ keys until **REF CF 100.0%** is displayed**.**

(8) Press **DATA ENTRY ENTER** key. TI will display **CAL ******* for a few seconds.

(9) Press **FUNCTION SHIFT** key then **FUNCTION CAL FAC/FREQ** key.

(10) Press **DATA ENTRY** Ý, ß, Ü, Þ keys until **CALFAC 100.0%** is displayed.

(11) Press **DATA ENTRY ENTER** key.

(12) Adjust R87 (fig. 1) for a maximum TI indication (R).

(13) Set range calibrator **RANGE** switch to **10 mW**.

(14) Adjust R111 (fig. 1) for a TI indication between 9.99 and 10.01 mW (R).

(15) Set range calibrator **RANGE** switch to **100 mW**.

(16) Adjust R112 (fig. 1) for a TI indication between 99.9 and 100.1 mW (R).

(17) Repeat (13) through (16) above until no further adjustments are required.

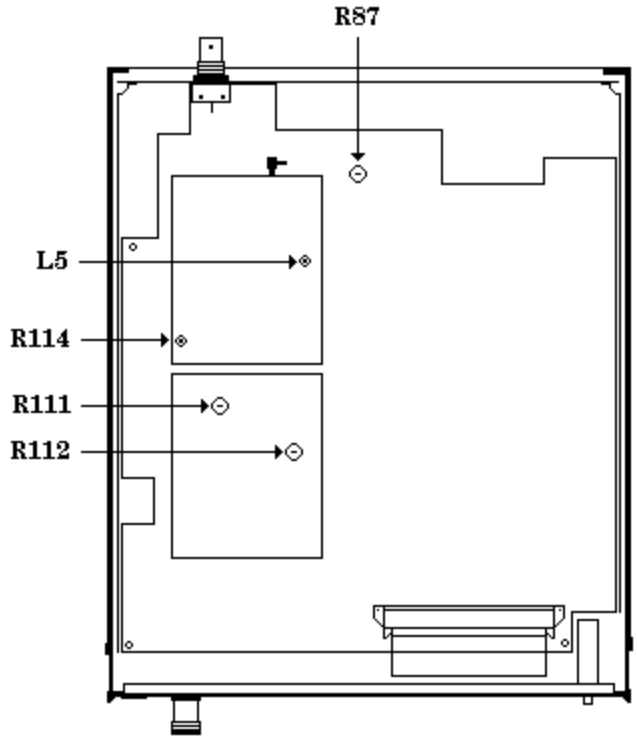

Figure 1. Adjustment locations - test instrument bottom view.

10. Reference Frequency Oscillator

a. Performance Check

(1) Set range calibrator **FUNCTION CALIBRATE/STANDBY** switch to **STANDBY** and disconnect range calibrator from TI.

(2) Connect TI **POWER REF** to frequency counter **CHANNEL A** input.

(3) Press **DATA ENTRY PRESET/LOCAL** key then **DATA ENTRY ENTER** key.

(4) Press **FUNCTION SHIFT** key then **DATA ENTRY PWR REF/**Þ key. If frequency counter does not indicate between 49.5 and 50.5 MHz, perform **b** below.

(5) Disconnect frequency counter from TI.

b. Adjustments

(1) Adjust L5 (fig. 1) for a frequency counter indication between 49.5 and 50.5 MHz (R).

11. Power Reference Level

a. Performance Check

(1) Press **DATA ENTRY PRESET/LOCAL** key then **DATA ENTRY ENTER** key.

(2) Set multimeter to measure resistance.

NOTE

Power meter is a standard used to calibrate the TI. Instructions in this text which refer to power meter setup or connections refer to the standard power meter.

(3) Set power meter **LINE** switch to **OFF** position.

(4) Connect multimeter between center conductor of power meter rear panel $\mathbf{V_{RF}}$ connector and pin 1 of thermistor mount end of power meter interconnect cable.

(5) Round off multimeter indication to two decimal places and record value as R (approximately 200Ω).

(6) Disconnect multimeter from power meter interconnect cable.

(7) Connect equipment as shown in figure 2.

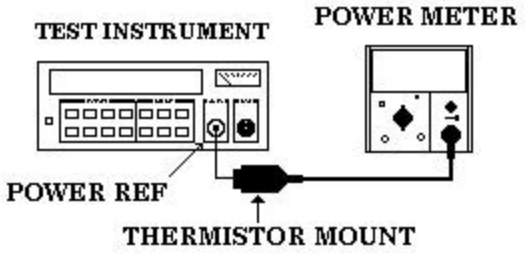

Figure 2. Power reference level test setup.

(8) Set power meter **LINE** switch to **ON** position.

(9) Allow equipment and thermistor mount to warm up for 30 minutes before proceeding to (10) below.

(10) Set power meter **RANGE** switch to **COURSE ZERO** and adjust power meter front panel **COURSE ZERO** control for a zero meter indication.

(11) Fine zero the power meter on the most sensitive range and then set the power meter **RANGE** switch to **1 mW.**

(12) Set multimeter to measure dc microvolts and ensure inputs are disconnected from chassis ground.

(13) Connect multimeter **Input HI** to center conductor of power meter rear panel **V_{COMP}** connector and **Input LO** to center conductor of power meter rear panel **V_{RF}** connector.

(14) If multimeter indication is between –400 and +400 μV, record multimeter indication and proceed to (16) below; if not, proceed to (15) below.

(15) Hold power meter **FINE ZERO** control and adjust **COURSE ZERO** control for a multimeter indication between –200 and +200 μV. Record multimeter indication.

(16) Round off indication recorded in (14) or (15) above to the nearest microvolt and record this value as V0.

(17) Press **FUNCTION SHIFT** key then **DATA ENTRY PWR REF/Þ** key. Record multimeter indication as V1.

(18) Move multimeter **Input LO** from power meter V_{RF} connector to power meter chassis ground.

(19) Record multimeter indication as V_{COMP}.

(20) Calculate the power reference oscillator output level using formula below. If calculated power reference oscillator output level is not between 0.988 and 1.012 mW, perform **b** below.

$$PRF = \frac{2\,V_{COMP}\,(Vl\text{-}V0) + V0^2 - V1^2}{4\,R\,(\text{Calibration Factor})}$$

WHERE: PRF = Power reference oscillator output level
V0 = Value recorded in (16) above
V1 = Value recorded in (17) above
V_{COMP} = Value recorded in (19) above
R = Value recorded in (5) above
Calibration Factor = Value for thermistor mount at 50 MHz

b. Adjustments

(1) Adjust R114 (fig. 1) slightly and repeat **11a** above until calculated power reference oscillator output level is between 0.988 and 1.012 mW (R).

12. 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

0202813

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