TB 9-6625-2144-35

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR RADAR TEST SEST AN/UPM-29C, TS-147B/UP, TS-147D/UP AND TS-147F/UP

Headquarters, Department of the Army, Washington, DC
1 June 1988

TB 9-6625-2144-35, 10 July 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	***Insert pages***
1 and 2	1 and 2
5 and 6	5 and 6
9 and 10	9 and 10

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

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CALIBRATION PROCEDURE FOR RADAR TEST SET AN/UPM-29C, TS-147B/UP, TS-147D/UP AND TS-147F/UP

Headquarters, Department of the Army, Washington, DC
10 July 1987

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You can help improve this publication by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028, Recommended Changes to Publications, should be mailed directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-EP, Redstone Arsenal, AL 35898-5000. FAX to DSN 788-2313 (commercial 256-842-2313). A reply will be furnished directly to you.

*This bulletin supersedes TB 9-6625-2144-35, 18 December 1985, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Radar Test Set, AN/UPM-29C and TS-147B/UP, TS-147D/UP, and TS147F/UP. The manufacturers' manuals TM's 11-6625-917-15 and 11-1247 (Series) were 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. Differences among models are described in text.

b. Time and Technique. The time required for this calibration is approximately 3 hours,. using the microwave 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	
	TS-147 ( )/UP	AN/UPM-29 ( )
Frequency meter	Range: 8470 to 9630 MHz Accuracy: ± 2.5 MHz absolute ± 1 MHz relative for increments of less than 60 MHz ± 1 MHz at 9310	Range: 15.7 to 17.0 GHz Accuracy: ±8 MHz absolute ± 1.5 MHz/60 MHz increment relative
Signal generator	Range: 8500 to 9600 MHz	Range: 15.7 to 17.0 GHz
RF output power	Range: -7 to -85 dBm Accuracy: ± 1.5 dB	Range: -43 to -90 dBm Accuracy: ± 2 dB
RF input power[1]	Range: +7 to +30 dBm Accuracy: ± 1.5 dB	Range: +3 to +30 dBm Accuracy: ± 1.5 dB

[1]Item should be calibrated to highest cardinal point allowed by standard (Example: +7, +10, +20, +30).

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 when the equipment listed in table 2 is not available. 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 listed in table 3 are issued as indicated in paragraph 4 above and are used in this calibration procedure. When necessary, these items may be substituted by equivalent items, unless specifically prohibited.

Table 2. Minimum Specifications of Equipment Required

Item	Common name	Minimum use specifications	Manufacturer and model (part number)
A1	AUTOTRANSFORMER	Range: 105 to 125 V ac, 60 Hz Accuracy: ± 1%	General Radio, Model W10MT3AS3 or Ridge Model 9020F (7910809)
A2	MICROWAVE MEASUREMENT SYSTEM	Frequency: 8.5 to 9.6 GHz (15.7 to 17.0 GHz, 5 mW max)[1]	Weinschel, Model 4312M16P-CA211 (4312M16P-CA211)
A3	POWER METER	Range: 0.1 to 10 mW (+ 3 to -30 dBm)[1] Accuracy: ± 0.5 dB (15.7 to 17 GHz)[1]	Hewlett-Packard, Model E12-432A (MIS-30525) w/thermistor mount, Hewlett-Packard, Model 8478A (8478A)
A4	VM4-A	Range: 0 to 50 dB Accuracy: ±0.375 dB	Weinschel, Model VM4-A

[1]Reading in parenthesis pertains to AN/UPM-29 ( ).

Table 3. Accessories Required

Item	Common name	Description (part number)
B1	ADAPTER	P band waveguide to N Jack (P281BOption 013)[2] or N Jack to X band waveguide (10519423)[1]
B2	ADAPTER	N jack to N jack (10519455)
B3	ATTENUATOR	20 dB coaxial
B4	CABLE	18-in., RG-9A/U; N plug terminations (10519072)
B5	ISOLATOR	Waveguide 8.2 to 12.4 GHz, 20 dB isolation, PRD, Model 1203B (7923167) Microlab/FXR, Model X157A or Waveguide 12.4 to 18.0 GHz PRD Model 1208B (7923168)

[1]Two required.
[2]Three required.

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 and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

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. Additional maintenance information is contained in the manufacturer's manuals, TM's 11-6625-917-15 and 11-1247 (Series) 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.

a. Connect TI to autotransformer (A1).

b. Connect autotransformer to a 115-V ac source and adjust for a 115-V output.

c. Set **POWER** switch to **ON** and allow 45 minutes for equipment to warm up and stabilize**.**

NOTE

Knobs and dials may vary on some models.

d. Position controls as listed in (1) through (7) below:

(1) **DBM** dial to maximum attenuation.

(2) **SIGNAL WIDTH** control to **MIN**.

(3) **PHASE** control to **MIN**.

(4) **POWER SET** control fully ccw.

(5) **SIGNAL FREQ** control to midrange.

(6) **TEST/TRAN/RECV** switch to **TRAN.**

(7) Adjust **ZERO/FINE** control **(METER BALANCE/FINE** control on some models) for **SET ZERO** indication on **SET POWER** meter **(METER BALANCE** control on some models).

NOTE

It may be necessary to adjust R124 (fig. 1) to obtain **SET ZERO** indication in (7) above for the TS- 147 ( ).

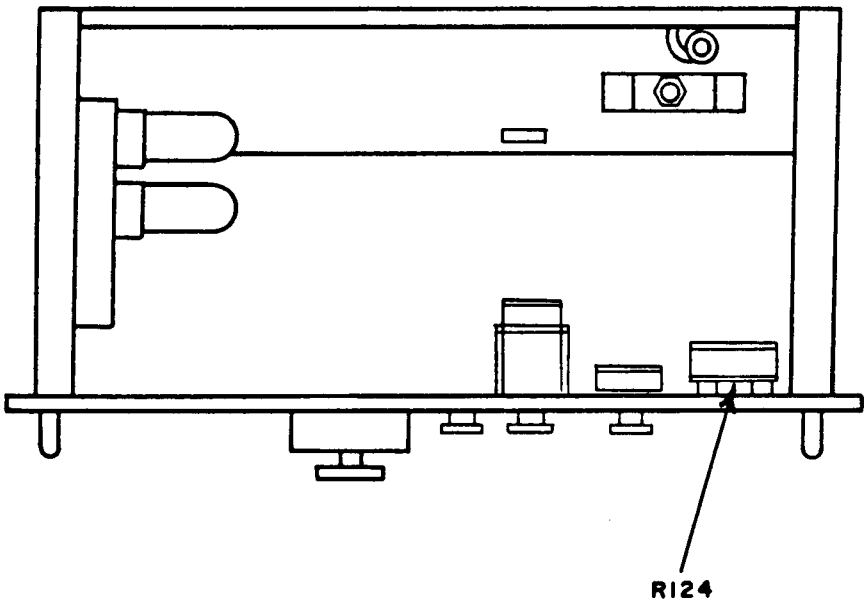

Figure 1. Radar test set - bottom view.

NOTE

Turn function selector switch to **TRAN** to ensure the power meter pointer is at **SET ZERO** prior to each performance check: if not, adjust **ZERO SET** control.

NOTE

Throughout this procedure, when adjusting **FREQUENCY** control, always approach desired frequency in a ccw direction to eliminate effects of backlash.

8. Frequency Meter Accuracy

NOTE

Readings in parenthesis pertain to AN/UPMP-29A, AN/UPM-29B, AN/UPM-29C, or TS-1335A**.**

a. Performance Check

(1) Position controls as listed in (a) and (b) below:

(a) **FREQUENCY** control to 850 (15.8 GHz) on **FREQUENCY MC/10** dial.

(b) Adjust **DBM** dial as necessary to obtain best usable indication.

(2) Connect microwave measurement system (A2) to RF input, using adapter and cable (B1 and B4).

(3) Adjust microwave measurement system for an output frequency of 8.5 GHz (15.8 GHz) and power level for an on-scale indication on **SET POWER** meter.

(4) Slowly readjust microwave measurement system frequency until SET **POWER** meter indication dips sharply.

(5) Microwave measurement system frequency indicated on frequency counter will be between 8.4975 and 8.5025 GHz (15.792 and 15.808 GHz).

(6) Repeat technique of (1) through (4) above, substituting frequencies and tolerances listed in table 4 (table 5).

Table 4. Frequency Meter

Test instrument FREQUENCY MC/10 dial settings	Frequency counter indications (GHz)	
	Min	Max
860	8.5975	8.6025
880	8.7975	8.8025
890	8.8975	8.9025
900	8.9975	9.0025
910	9.0975	9.1025
920	9.1975	9.2025
930	9.2975	9.3025
940	9.3975	9.4025
950	9.4975	9.5025
960	9.5975	9.6025

Table 5. Frequency Meter AN/UPM-29

Test instrument frequency MC/10 dial settings	Frequency counter indications (GHz)	
	Min	Max
1580	15.792	15.808
1590	15.892	15.908
1600	15.992	16.008
1610	16.092	16.108
1620	16.192	16.208
1630	16.292	16.308
1640	16.392	16.408
1650	16.492	16.508
1660	16.592	16.608
1670	16.692	16.708
1680	16.792	16.808
1690	16.892	16.908
1700	16.992	17.008

b. **Adjustments.** No adjustments can be made.

9. Signal Generator Range

a. Performance Check

(1) Set **TRAN/TEST/RECV** switch to **TEST** (red dot) position and adjust **PHASE** control for maximum peak indication of **SET POWER** meter. Adjust **POWER SET** control as necessary to maintain on-scale indication.

NOTE

The **PHASE** control has several settings at which peak deflection can be obtained on the power meter. Select the setting that provides the most stable operation.

(2) Adjust TI signal generator output frequency to 8.5 GHz (15.8 GHz), using technique of (a) through (d) below:

(a) Slowly adjust **FREQUENCY** control until **SET POWER** meter indication dips sharply. Note **FREQUENCY MC/10** dial indication.

(b) Slightly increase or decrease toward 8.5 GHz (15.8 GHz) **SIGNAL FREQ** control setting and readjust **PHASE** control to maintain peak indication of power meter.

(c) Continue process of (a) and (b) above until a sharp dip occurs when **FREQUENCY MC/10** dial indicates 850 (1580).

(d) When TI signal generator frequency is set at desired point, turn **FREQUENCY MC/10** dial to a point at least 100 MHz away from TI signal generator frequency and adjust **POWER SET** control for indication of **SET POWER** on **SET POWER** meter.

(3) Repeat technique of (1) and (2) above for frequency of 9.6 GHz (16.9 GHz). TI signal generator will operate at 1 mW output level (power set indication) between 8.5 and 9.6 GHz (15.8 and 16.9 GHz).

b. Adjustments. No adjustments can be made. Failure to operate between 8.5 and 9.6 GHz (15.8 and 16.9 GHz) indicates TI klystron may need replacement.

10. Output Power Accuracy

a. Performance Check

(1) Set **TRAN/TEST/RECV** switch to **TEST** (red dot) position and **DBM** dial to +10 dBm.

(2) Adjust TI controls as described in **9a**(1) and (2) above to set TI signal generator to 8.5 GHz (15.8 GHz).

(3) Connect power meter (A3) to **RF OUTPUT** connector, using adapter (B2) for AN/UPM-29 (*) and adapter (B1) for TS-147.

(4) Power meter indication will be between -8.5 and -11.5 dBm. Record power meter indication for use in paragraph **12a** below.

(5) Repeat (1) through (4) above for frequencies of 9.05 and 9.60 GHz (16.35 and 16.90 GHz).

NOTE

The value of attenuation on output cable assembly CG-92A/U (supplied with TI) is accurate to ±0.3 dB at 8.5, 9.080, and 9.6 GHz and is stamped on a metal tag which is attached to each unit. Since attenuation of this cable may change with time, actual attenuation of this cable should be confirmed by the following method to insure accurate calibration.

(6) Set up output power accuracy performance check as outlined in **a** above.

(7) Note power meter indication.

(8) Connect output cable assembly CG-92A/U between TI **RF OUTPUT** connector and power meter, using adapter (B2).

(9) Repeat power test and note new power indication.

(10) The difference between the two readings will indicate actual cable attenuation loss ±0.3 dB.

b. Adjustments. No adjustments can be made, however, a new correction chart may be prepared and attached to TI if necessary.

11. Input Power Accuracy

a. Performance Check

(1) Set **TRAN/TEST/RECV** switch to **TRAN** and adjust **SET ZERO COARSE** and **FINE** controls to obtain **SET ZERO** indication on **SET POWER** meter.

(2) Connect equipment as shown in figure 2, connection A.

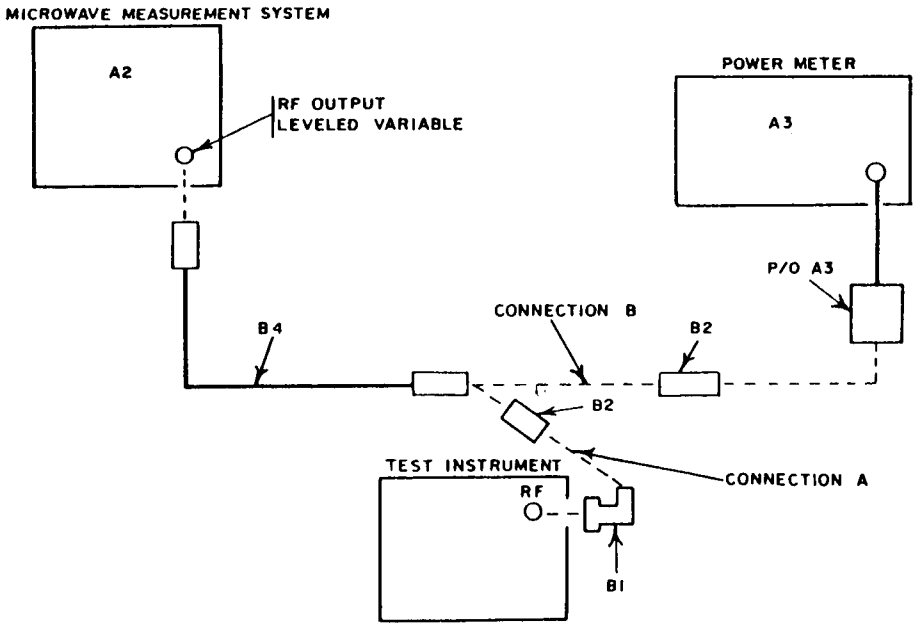

Figure 2. Input - equipment setup.

(3) Adjust controls of microwave measurement system (A2) for CW operation at 8.5 GHz (15.8 GHz) and power level for an on-scale Indication on **SET POWER** meter.

(4) Set **DBM** control to +7 dBm and adjust microwave measurement system power output until **SET POWER** meter indicates **SET POWER**.

(5) Connect equipment as shown in figure 2, connection B. Power meter (A3) indication will be between +5.5 and +8.5 dBm.

(6) Repeat technique (1) through (5) for highest possible level allowed by microwave measurement system or cardinal point on dBm dial (whichever is possible).

(7) Repeat technique of (1) through (6) above at frequencies of 9.05 and 9.60 GHz (16.35 and 16.9 GHz).

b. Adjustments. No adjustments can be made, however, a new calibration chart will be prepared and attached to TI if necessary.

12. Attenuation Dial Accuracy

a. Performance Check

(1) Connect equipment as shown in figure 3.

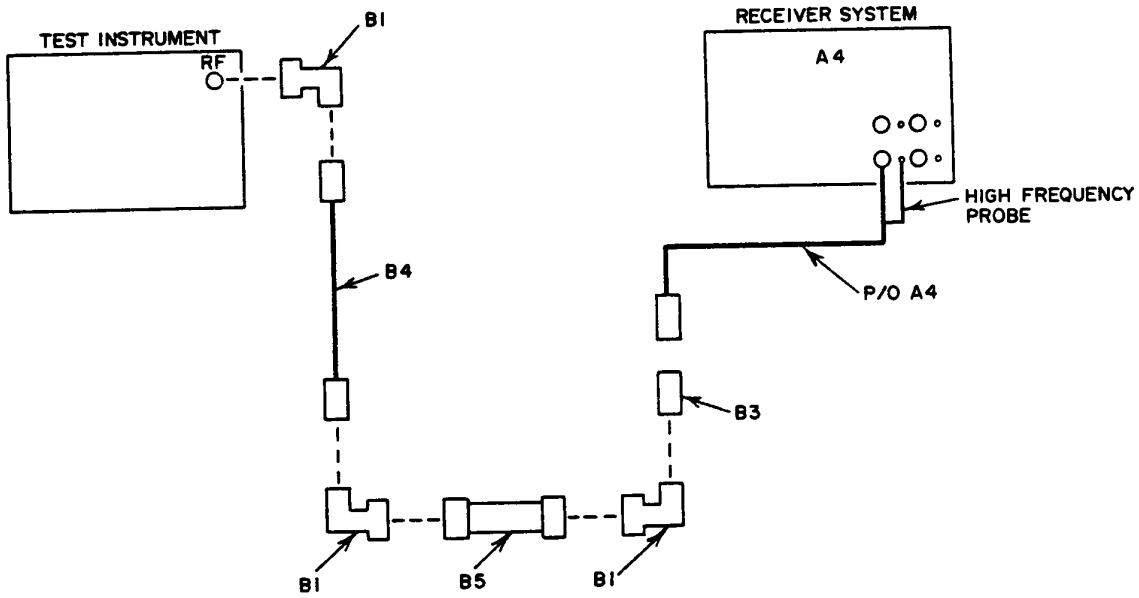

Figure 3. Attenuation - equipment setup.

(2) Set **dBm** dial to +10 dBm.

(3) Set **TRAN/TEST/RECV** switch to **TEST** (red dot) position and adjust **PHASE** control for maximum peak indication of **SET POWER** meter. Adjust **POWER SET** control as necessary to maintain on-scale indication.

NOTE

The **PHASE** control has several settings at which peak deflection can be obtained on the power meter. Select the setting that provides the most stable operation.

(4) Adjust TI signal generator output frequency to 8.5 GHz (15.8 GHz), using technique of (a) through (d) below:

(a) Slowly adjust **FREQUENCY** control until **SET POWER** meter indication dips sharply. Note **FREQUENCY MC/10** dial indication.

(b) Slightly increase or decrease toward 8.5 GHz (15.8 GHz) **SIGNAL FREQ** control setting and readjust **PHASE** control to maintain peak indication of power meter.

(c) Continue process of (a) and (b) above until a sharp dip occurs when **FREQUENCY MC/10** dial indicates 850 (1580).

(d) When TI signal generator frequency is set at displayed point, turn **FREQUENCY MC/10** dial to a point at least 100 MHz away from TI signal generator frequency and adjust **POWER SET** control for indication of **SET POWER** on **SET POWER** meter.

(5) Set receiver system (A4) controls to establish a reference at 8.5 GHz (15.8 GHz).

(6) Set **TRAN/TEST/RECV** switch to **RECV** and adjust **DBM** control to -45.

(7) Measure attenuation with receiver system. The receiver system will display an indication between 33.5 to 36.5 dB, add power meter Indication recorded in **10a**(3) above and total value will be between -43.5 to -46.5 dBm and record value (if making a new correction chart, value recorded in this step will be expressed as a negative number example: -46.5 dBm).

(8) Adjust receiver system controls to establish a new reference.

(9) Adjust **DBM** control to -50 and measure attenuation. receiver system display will indicate a reading between 3.5 and 6.5 dB. Add power meter indication recorded in **10a**(3) and receiver system indication recorded in **12a**(7) above, total value will be between 48.5 to 51.5 dBm (if making a new correction chart, value recorded in this step will be expressed as a negative number example -51.5) and record value.

(10) Repeat technique of (9) above for settings listed in table 6. Total recorded value will be within limits specified.

Table 6. Attenuation Dial Accuracy

Test instrument DBM control indications	Total recorded value	
	Min	Max
-55	8.5	11.5
-60	13.5	16.5
-65	18.5	21.5
-70	23.5	26.5
-75	28.5	31.5
-80	33.5	36.5
-85	38.5	41.5

[1]Total recorded values are derived by adding power meter recorded indications in **10a(3),** receiver system recorded indications in **12a(7),** and receiver system recorded indications in **12a(10)** (Example -10 -35 -10 = -55 dB).

b. Adjustments. No adjustments can be made, however, a new correction chart will be prepared and attached to TI if necessary.

13. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

b. Annotate and affix DA Label/Form in accordance with TB 750-25.

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