DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR H-BAND MICROWAVE TEST SET HEWLETT-PACKARD, MODEL 5636

Headquarters, Department of the Army, Washington, DC
23 August 1988

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SECTION I

IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of H-Band Microwave Test Set, Hewlett-Packard, Model 5636. 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 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
Input power	Range: -6 to +3 dBm Accuracy:±1 dB
Output power	Range: -85 to +15 dBm Accuracy: ±2 dBm, +2% attenuator setting
Frequencuy meter	Range: 7.1 to 8.5 CHz Accuracy: ±0.03%
Sweep output	Range: 1 klHz Accuracy: ±5%

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.

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	DIGITAL VOLTMETER	Range: 3 V dc	Hewlett-Packard, Model 3490AOPT060 (3490AOPT060) Dana, Model 5000, or Dana, Model 5000, w/641
A2	FREQUENCY COUNTER	Range: 0.95 to 1.05 kHz Accuracy: ±1.25%	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1) w/5355A
A3	MICROWAVE MEASUREMENT SYSTEM	Range: 7.1 to 9.5 GHz Accuracy: ±0.0075%	Weinschel, Model 4312M16P-CA211 (4312M16P-CA211)
A4	OSCILLOSCOPE	Range: 23 V p-p Accuracy: ±3%	Tektronix, Type R5440 (MIS-28706/1 Type 1) w/5A48 (MIS-28706/3) and 5B42 (MIS-28706/4) and 5S14 (MIS-28706/5)
A5	POWER METER	Range: -17.2 to 7.2 dBm Accuracy: ±0.25 dB	Hewlett-Packard, Model E12-432A (MIS-30525) w/thermistor mount, Hewlett-Packard, Model H75-478A (7915907) or 8478B (8478B)
A6	POWER SPLITTER	Range: 7.1 to 8.5 GHz	Weinschel, Model 1870A (1870A)

Table 2. Minimum Specifications of Equipment Required

Item	Common name	Minimum use specifications	Manufacturer and model (part number)
A7	RECEIVER SYSTEM	Range: -58.1 to 0.0 dB Accuracy: ±0.5 dB	Weinschel, Model VM4-A (VM4-A)
A8	VARIABLE ATTENUATOR	- - -	Weinschel, Model AF117A-69-34 (AF117A-69-34)

Table 3. Accessories Required

Item	Common name	Description (part number)
B1	ADAPTER	N plug to N plug (MIS-10408-4)
B2	ADAPTER	N jack to N jack (10519455)
B3	ADAPTER	N jack to waveguide, 7.05 to 10.0 GHz, Maury Microwave, Model H213D2 (H213D2)
B4	ATTENUATOR	X5, Tektronix, Type 011-0059-02
B5	CABLE	30-in., RG-58/U; BNC plug terminations (7907467)
B6	CABLE	18-in., RC-9A/U; N plug terminations (10519072)
B7	LEAD	32-in., single banana plug to test hook (red)
		(7915941-1)
B8	LEAD	32-in., single banana plug to test hook (black)
		(7915941-2)

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. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

d. Unless otherwise specified all controls and controls settings refer to the TI.

7. Equipment Setup

WARNING

HIGEI VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

a. Remove TI protective cover as required for adjustment.

b. Connect TI to a 115-V ac source.

c. Position controls as listed in (1) through (4) below:

(1) **ATTENUATION DB** control for a **0**-indication on dial.

(2) **KLYSTRON FREQ** control for a 8.5-GHz indication on dial.

(3) **RF POWER** switch to monitor external power.

(4) **KLYSTRON EXT MOD-CW-INT FM** switch to **CW.**

d. Energize equipment and allow 15 minutes for warm up and stabilization.

8. Input Power

a. Performance Check

(1) **Adjust ZERO SET COARSE** and **FINE** controls for **ZERO SET** indication on T1 **POWER METER.**

(2) Connect equipment as shown in figure 1.

(3) Set microwave measurement system (A3) controls for a 7.1 GHz **CW** output.

(4) Adjust microwave measurement system level control and variable attenuator (A8) for a **POWER SET** indication on TI POWER METER. If power meter (A5) does not indicate 0 $\pm$1 dBm, perform **b** below.

(5) Repeat (4) above for microwave measurement system frequencies of 7.5, 8.0, and 8.5 GHz.

(6) Repeat (3) above.

(7) Adjust microwave measurement system level control and variable attenuator for a +3-dBm indication on TI **POWER METER.** Power meter will indicate between +2 and +4 dBm, if not perform **b** below.

(8) Adjust microwave measurement system level control and variable attenuator for a -6-dBm indication on TI **POWER METER.** Power meter will indicate between -5 and -7 dBm, if not perform **b** below.

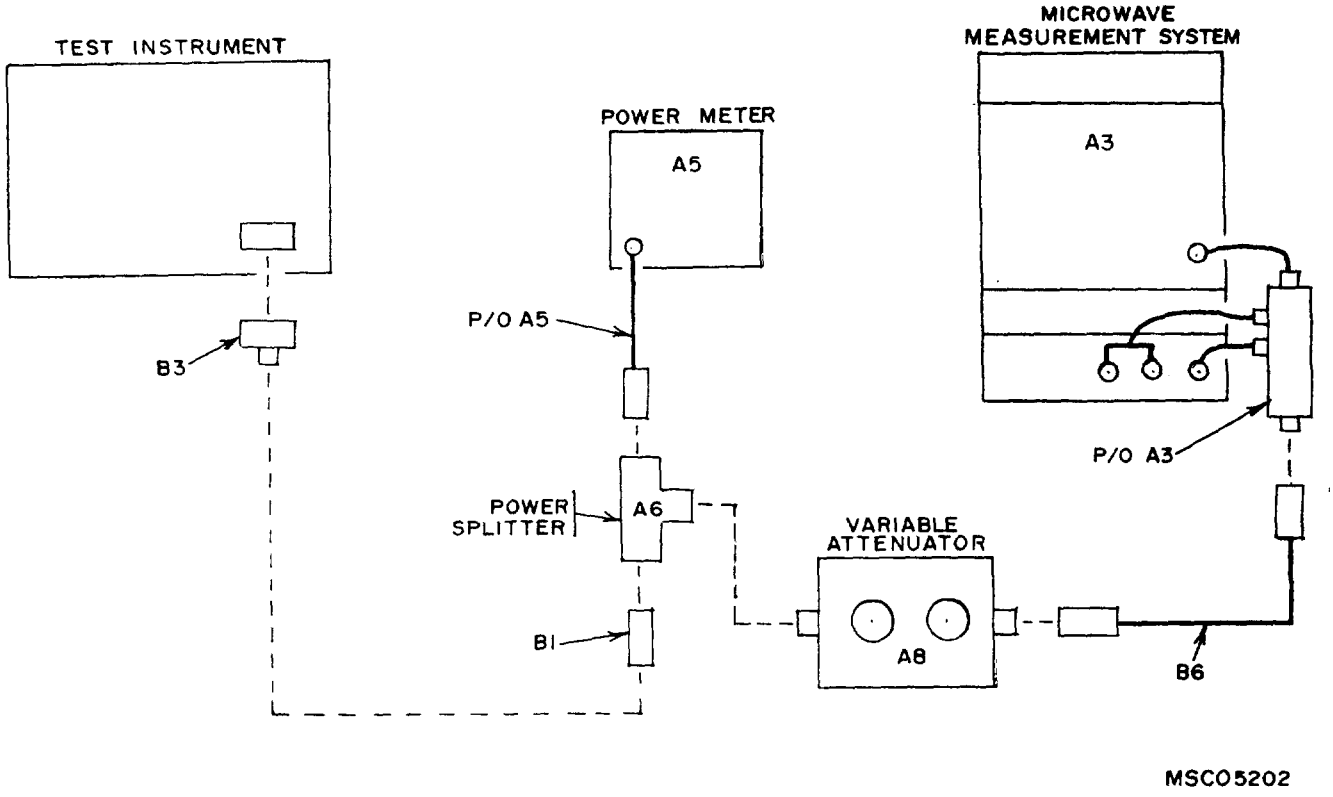

Figure 1. Input power - equipment setup.

b. Adjustments

(1) Disconnect cable (B6) from power splitter (A6).

(2) Connect digital voltmeter (Al) across R92 (fig. 2), using leads (B7 and B8).

(3) Adjust **ZERO SET COARSE** and **FINE** controls for a 3.0-V de digital voltmeter indication.

(4) Adjust R80 (fig. 2) for **ZERO SET** indication on TI **POWER METER** (R).

(5) Reconnect cable disconnected in (1) above.

(6) Set microwave measurement system (A3) controls for a 7.1 GHz **CW** output.

(7) Adjust microwave measurement system level control and variable attenuator (A8) for a 0.O-dBm indication on power meter (A5).

(8) Adjust R76 (fig. 2) for **POWER SET** indication on TI **POWER METER** (R).

(9) Repeat (7) above for microwave measurement system frequencies of 7.5, 8.0 and 8.5 GHz, while recording TI **POWER METER** indication at each frequency.

(10) Average TI **POWER METER** maximum and minimum indication recorded in (9) above. Algebraically, subtract this value from TI **POWER METER** indication at 8.5 GHz.

(11) Set microwave measurement system controls for a 8.5 GHz **CW** output and repeat (7) above.

(12) Readjust R76 until TI **POWER METER** indicates value computed in (10) above.

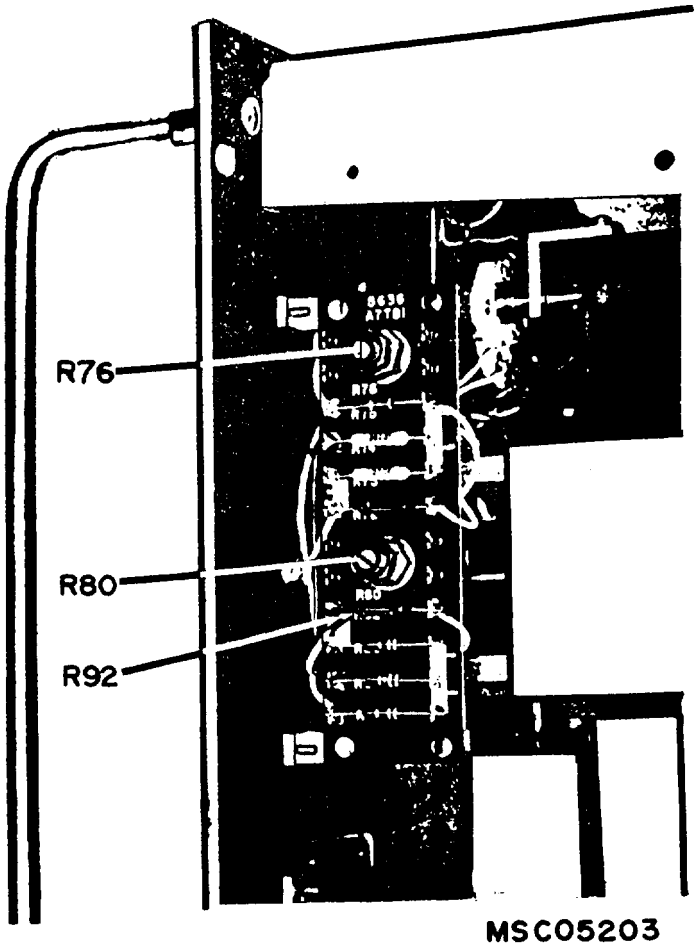

Figure 2. Test instrument - right side view

9. Output Power

a. Performance Check

(1) Connect power meter (A5) to TI RF output, using adapter (B3).

(2) Position controls as listed in (a) through (e) below:

(a) ATTENUATION DB control for a dial indication of **10.**

(b) ZERO SET COARSE and **FINE** controls for a **ZERO SET** indication on TI **POWER METER.**

(c) RF POWER switch to monitor internal power.

(d) KLYSTRON EXT MOD-CWINT FM switch to **CW.**

(e) KLYSTRON FREQ control for a 7.1-GHz indication on dial.

(3) Adjust **KLYSTRON REFLECTOR** control for peak indication on TI **POWER METER**.

(4) Adjust **POWER SET** control for **POWER SET** indication on TI **POWER METER.**

NOTE

If an out-of-tolerance condition is noted in (5) below. Complete (5) and (6) below then perform b below.

(5) Set **RF POWER** switch to output power position. Power meter will indicate between +2.8 and +7.2 dBm. Record power meter indication.

(6) Set **RF POWER** switch to monitor internal power and repeat (3) through (5) above for **KLYSTRON FREQ** control settings of 7.5, 8.0, and 8.5 GHz.

(7) Adjust **KLYSTRON FREQ** control for a 7.8-GHz indication on dial and set **RF POWER** switch to monitor internal power.

(8) Repeat (3) and (4) above.

(9) Adjust **ATTENUATION DB** control for a dial indication of 20.

(10) Set **RF POWER** switch to output power position. Power meter will indicate between -7.4 and -2.6 dBm.

(11) Adjust **ATTENUATION DB** control for a dial indication of 30.

(12) Power meter will indicate between -17.2 and -12.8 dBm. Adjust **ATTENUATION DB** control for a -15.0-dBm indication on power meter.

(13) Disconnect power meter from adapter (B3) connected to TI RF output.

(14) Connect variable attenuator (A8) to adapter connected to TI RF output, using cable (B5). Set variable attenuator to 20 dB.

(15) Connect receiver system (A7) **CHANNEL 1** high frequency probe to variable attenuator, using adapter (B1).

(16) Establish a 0.0-dB reference on receiver system.

(17) Adjust **ATTENUATION DB** control for a dial indication of 40. Receiver system will indicate between 7.8 and 10.2 dB.

(18) Repeat technique of (17) above for dial indications listed in table 4. Receiver system will indicate within limits specified.

Table 4. Test instrument attenuation dial settings

Test instrument dial indications	Receiver system indications (dB)	
	Min	Max
50	17.6	22.4
60	27.4	32.6
70	37.2	42.8
80	47.0	53.0
85	51.9	58.1

b. Adjustments

(1) Average the maximum and minimum power meter indications recorded in a(5) above.

WARNING

HIGH VOLTAGE exists on the ceramic wafer switch (fig. 3) in adjustment below. Exercise care to avoid touching or shorting switch.

(2) Adjust **KLYSTRON FREQ** control for a 8.5-GHz indication on dial and set **RF POWER** switch to monitor internal power.

(3) Repeat a(3) above.

(4) Set **RF POWER** switch to output power position and adjust **POWER SET** control until power meter indicates value computed in (1) above.

(5) Set **RF POWER** switch to monitor internal power.

(6) Loosen retaining screw (fig. 3) and adjust flap attenuator level (fig. 3) until TI **POWER METER** indicates **POWER SET.**

(7) Repeat (4) through (6) above until no further adjustment is required.

(8) Repeat paragraph **8** above.

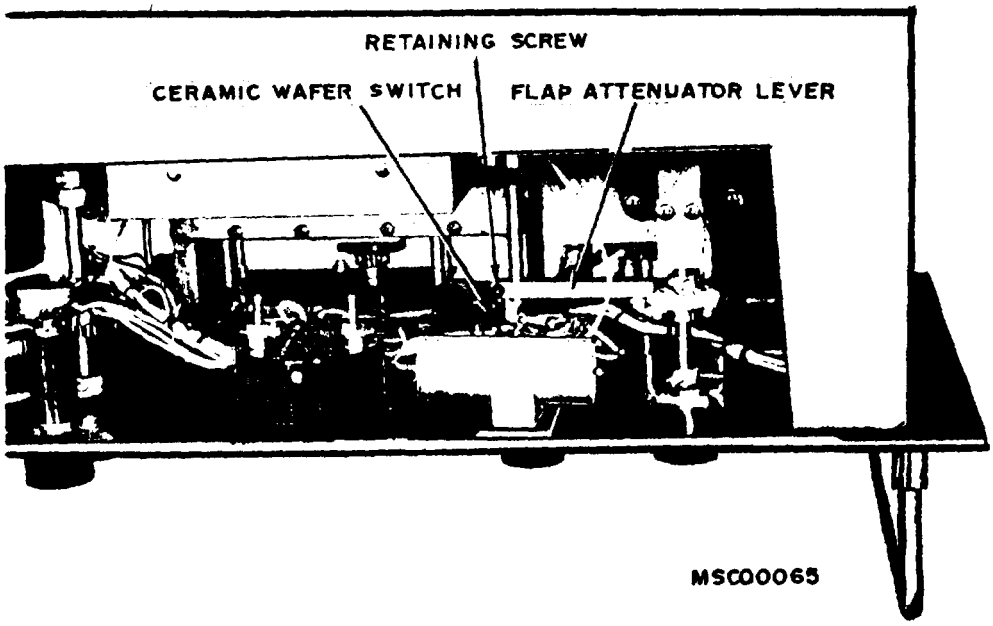

Figure 3. Test instrument - top view.

10. Frequency Meter Accuracy Meter Accuracy

a. Performance Check

(1) Connect microwave measurement system (A3) output to TI RF connector, using cable and adapter (B6 and B2).

(2) Set **RF POWER** switch to monitor external power.

(3) Set microwave measurement system controls for a 7.200 GHz CW im-put.

(4) Adjust microwave measurement system level control and TI **ATTENUATION DB** control for a **POWER SET** indication on TI **POWER METER**

NOTE

ON SERVE thermometer on front panel of TI. If temperature is not 44OC, the formula contained on TI FREQUENCY METER CALORATION CHART must be used in determining measured frequency in (5) through (7) below.

(5) Adjust **FREQUENCY METER** control for maximum dip as observed on TI **POWER METER.**

(6) Find the FREQUENCY METER micrometer indication on the TI **FREQUENCY METER CALIBRATION CHART.** The measured frequency will be between 7.19784 and 7.20216 GHz, if not perform b below.

(7) Repeat technique of (3) through (6) above for microwave measurement frequencies listed in table 5. Measured frequency will be within limits specified.

b. Adjustments. Prepare a new FREQUENCY METER CALIBRATION CHART for TI**.**

Table 5. Frequency Meter Accuracy

Microwave measurement frequency (GHz)	Measured frequency GHz)	
	Min	Max
7.400	7.39778	7.40222
7.600	7.59772	7.60228
7.800	7.79766	7.80234
8.000	7.99760	8.00240
8.200	8.19754	8.20246
8.400	8.39748	8.40252

11. Sweep Output

a. Performance Check

(1) **KLYSTRON EXT MOO-CW-INT FM** switch to **INT FM.**

(2) Connect frequency counter (A2) to **SWEEP OUTPUT**, using attenuator and cable (B4 and B5).. Frequency counter will indicate between 950 and 1050 Hz.

(3) Connect oscilloscope (A4) to **SWEEP OUTPUT**, using cable (B5). If signal as observed on oscilloscope display is not at least 23 V p-p in amplitude and undistorted, perform b below.

b. Adjustments. Adjust R52 (fig. 4) for minimum distortion and maximum amplitude as indicated on oscilloscope display (R).

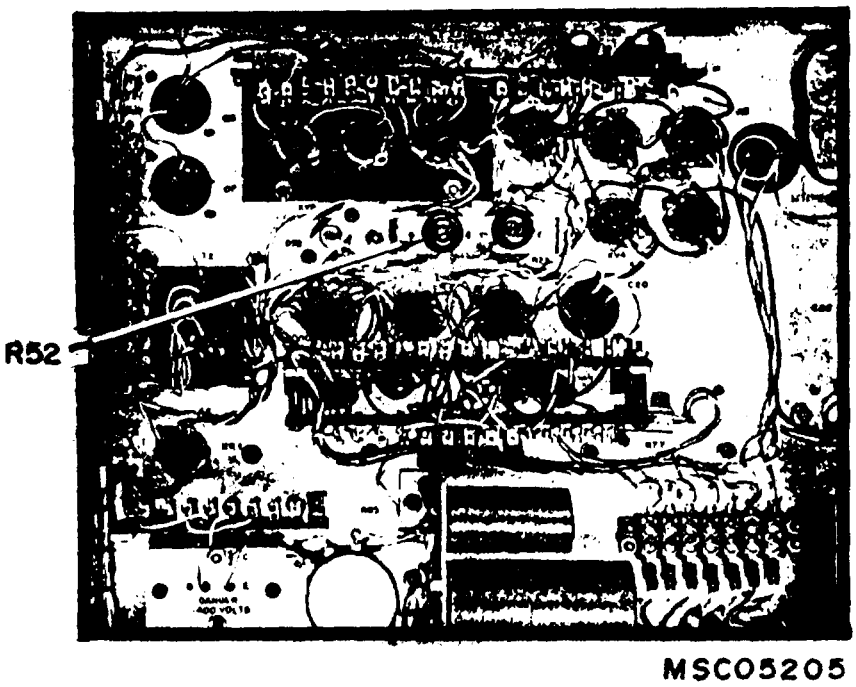

Figure 4. Test instrument - rear view.

12. Final Procedure

a. Deenergize and disconnect all equipment.

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

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