TB 9-6625-340-35

Change 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR RADIO FREQUENCY POWER TEST SET AN/USM-161( ) (TS1776)

Headquarters, Department of the Army, Washington, DC
25 May 1989

TB 9-6625-340-35, 23 June 1988, 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**
5 through 8	5 through 8

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

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

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			Paragraph	Page
SECTION	I.	IDENTIFICATION AND DESCRIPTION		
		Test instrument identification	1	2
		Forms, records, and reports	2	2
		Calibration description	3	2
	II.	EQUIPMENT REQUIREMENTS		
		Equipment required	4	2
		Accessories required	5	3
	III.	CALIBRATION PROCESS		
		Preliminary instructions	6	4
		Equipment Setup	7	4
		Automatic zero	8	5
		Power input	9	6
		Attenuation	10	10
		Power Supply	11	11
		Final procedure	12	12

*This bulletin supersedes TB 9-6625-340-35, 5 December 1986, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Radio Frequency Power Test Set, AN/USM-161( ) (TS1776). TM 11-6625-498-45 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 8 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	2 μW to 10 mW; to 5 W with external attenuators
Frequency[1]	10 MHz to 10 GHz without external attenuator 1 to 10 GHz with external attenuators
Power measurement[2]	± 2% FS

[1] Verify at 9.8 GHz, only, unless customer specifies differently.
[2] This specification verified to ± 5% of FS, excluding attenuators.

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	ATTENUATOR	Frequency range: 0.01 to 10 GHz Attenuation: 60 dB	Weinschel, Model 9918-60 (p/o WE9918 set) (7916817)
A2	ATTENUATOR	Frequency range: 0.01 to 10 GHz Attenuation: 10 dB	Weinschel, Model 9918-10 (p/o WE9918 set) (7916817)
A3	ATTENUATOR	Frequency range: 0.01 to 10 GHz Attenuation: 20 dB	Weinschel, Model 9918-20 (p/o WE9918 set) (7916817)
A4	AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ± 1%	General Radio, Model W10MT3AS3 (7910809)
A5	DIGITAL VOLTMETER	Range: -2.475 to +100 V dc Accuracy: ± 0.33%	Hewlett-Packard, Model 3490AOPT060 (3490AOPT060)
A6	DIRECTIONAL COUPLER	Must be calibrated w/test report for frequencies selected	Narda, Model 3095 (3095)
A7	MICROWAVE MEASUREMENT SYSTEM	Frequency: 1 to 10 GHz Power: 0.4 to 10 mW	Weinschel, Model 4312Ml6P-CA211 (4312Ml6P-CA211)
A8	POWER METER	Frequency range: .01 to 10 GHz Range: 0.095 to 3.15 mW Accuracy: ± 3%	Hewlett-Packard, Model E12-432A (MIS-30525) w/thermistor mount Hewlett-Packard, Model H75-478A (7915907) or 8478A (8478A)
A9	POWER SPLITTER	Range: 0.01 to 18 GHz Accuracy: See test report	Weinschel, Model 1870A (1870A)
A10	RECEIVER SYSTEM	Range: 30 dB Accuracy: ± .3 dB	Weinschel, Model VM4-A (VM4-A)

Table 3. Accessories Required

tem	Common name (official nomenclature)	Description (part number)
B1	ADAPTER[1]	APC7 N-J (18876 (7913349-5)
B2	ADAPTER	Double banana jack to phone plug (7907566)
B3	ADAPTER[1]	SMA female to N-male; Weinschel, P/N 1584-14
B4	ADAPTER	Phone plug WECO 310 (2798)
B5	CABLE	36-in., SMA plug terminations; Weinschel, P/N 1585-1000
B6	CLIP [1] (TEST LEAD)	32-in., single banana plug to test hook (red) (7915941-1)
B7	VARIABLE ATTENUATOR	Weinschel, Model AF117A69-34 (AF117A69-34)

[1] Two 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. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in TM 11-6625-498-45 for this TI.

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.

a. Remove TI protective cover.

b. Connect bolometer mount (supplied with TI) to input cable.

c. Center TI **NULL INDICATOR** meter by adjusting mechanical centering screw.

d. Connect TI to autotransformer (A4).

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

f. Set **LINE ON** switch to **ON** (up) and allow 15 minutes for warm-up.

8. Automatic Zero

a. Performance Check

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

(a) **POWER RANGE** switch to **1.0 MW, 0 DBM**.

(b) **COMP ATTENUATOR** control fully ccw.

(c) **POWER** control to **0** on 0 to 1.0 scale.

(d) **BIAS-READ** switch to **READ**.

(2) Connect adapter (B2) to J1 (fig. 1).

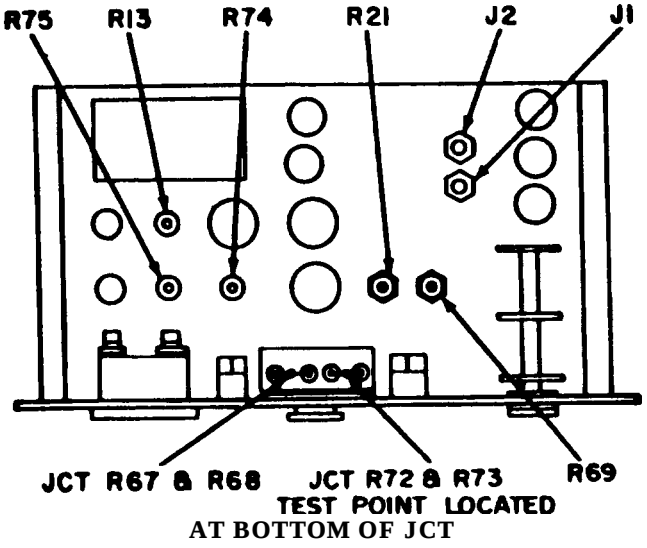

Figure 1. Test instrument - top view.

(3) Connect digital voltmeter (A5) between C22 (fig. 2) and chassis ground, using two clips (B6).

(4) Record digital voltmeter indication.

(5) Set **BIAS-READ** switch to **BIAS.** If digital voltmeter indication is not same as recorded in (4) above, perform **b** below.

(6) Remove adapter from J1 (fig. 1).

b. Adjustments. Adjust R75 (fig. 1) until digital voltmeter indicates value recorded in (4) above (R).

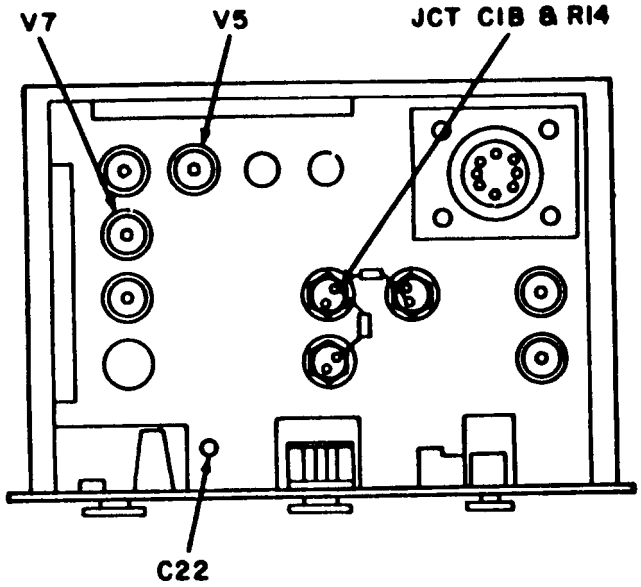

Figure 2. Test instrument - bottom view.

9. Power Input

a. Performance Check

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

(a) **POWER RANGE** switch to **3.0 MW +5 dBm**.

(b) **POWER** control to **0** on 0 to 3.0 scale.

(c) **BIAS-READ** switch to **BIAS**.

(d) **LINE ON** switch to **ON** (up).

(e) **COMP ATTENUATOR** control to **0 db**.

(2) Adjust **BIAS COARSE** and **FINE** controls for a null indication on TI **NULL INDICATOR** meter.

(3) Set **BIAS-READ** switch to **READ** and observe that null indication remains on TI **NULL INDICATOR** meter.

(4) Set **POWER RANGE** switch to **10 MW +10 DBM** and **BIAS-READ** switch to **BIAS**.

(5) Repeat (2) and (3) above.

(6) Connect equipment as shown in figure 3.

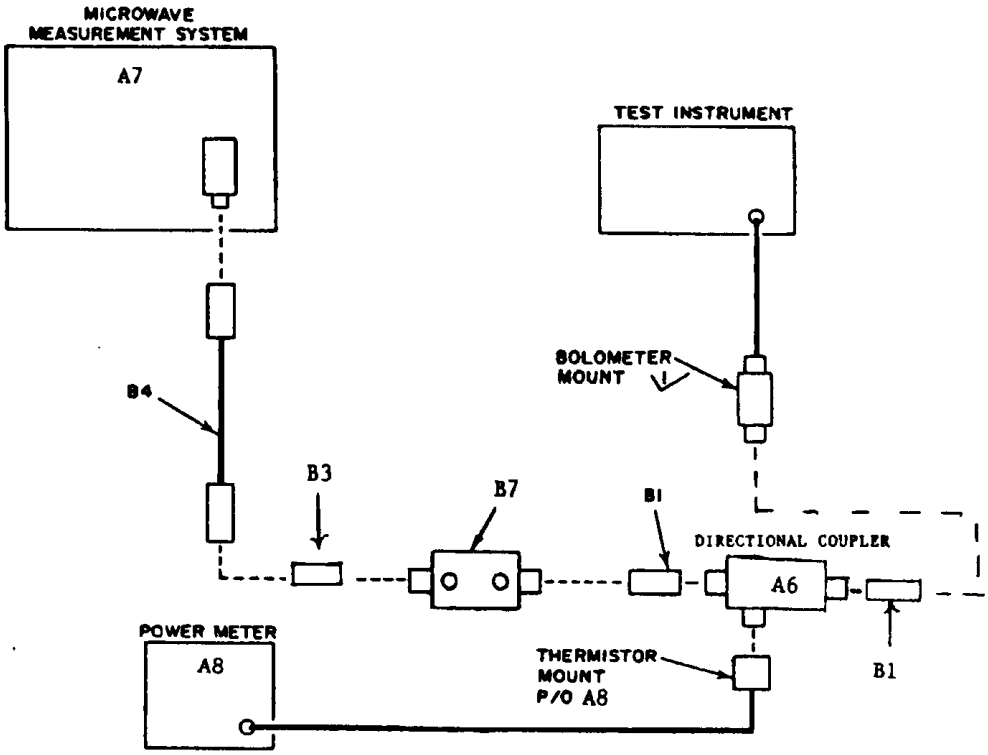

Figure 3. Power input - equipment setup.

(7) Adjust **POWER** control to **1.0** on **0** to **1.0** scale.

(8) Adjust microwave measurement system (A7) to upper frequency as indicated on TI bolometer mount efficiency chart. If chart is not available, adjust to 9.8 GHz.

NOTE

The output coupling factor for directional coupler (A6) must be considered during the performance of (9) through (23) below.

(9) Adjust microwave measurement system output and variable attenuator (B7) controls for a null indication on TI **NULL INDICATOR** meter. If power meter (A8) does not indicate between .95 and 1.05 mW, perform **b**(1) and (2) below.

(10) Reduce input level by adjusting variable attenuator controls by 10 dB.

(11) Adjust **POWER** control to **.10** on **0** to **1.0** scale.

(12) Adjust microwave measurement system output and variable attenuator for a null indication on TI **NULL INDICATOR** meter. If power meter does not indicate between .05 and .15 mW, perform **b**(3) through (5) below.

(13) Repeat technique of (7) through (9) above, using settings listed in table 4. Power meter will indicate within limits specified.

Table 4. Input Power

Test instrument		Power meter indications (mW)[1]	
POWER RANGE switch settings (mW)	**POWER** control settings (0 to 1.0 scale)	Min	Max
10	.25	0.20 (2.0)	0.30 (3.0)
10	.50	0.45 (4.5)	0.55 (5.5)
10	.75	0.70 (7.0)	0.80 (8.0)

[1]Readings in parenthesis are actual value after adding coupling factor for directional coupler.

(14) Set microwave measurement system **MULTIBAND CONTROL UNIT RF ON/OFF** switch to **OFF**.

(15) Position controls as listed in (a) through (f) below:

(a) **POWER RANGE** switch to **3.0 MW +5 DBM**.

(b) **POWER** control to **0** on 0 to 3.0 scale.

(c) **BIAS-READ** switch to **BIAS**.

(d) **BIAS COARSE** and **FINE** controls f or a null indication on TI **NULL INDICATOR** meter.

(e) **BIAS-READ** switch to **READ**.

(f) **POWER** control to **3.0** on **0** to **3.0** scale.

(16) Adjust microwave measurement system **MULTIBAND CONTROL UNIT RF ON/OFF** switch to **ON**.

(17) Adjust microwave measurement system output and variable attenuator controls for a null indication on TI **NULL INDICATOR** meter. Power meter will indicate between .285 and .315 m W.

(18) Set microwave measurement system **MULTIBAND CONTROL RF ON/OFF** switch to **OFF**.

(19) Position controls as listed in (a) through (f) below:

(a) **POWER RANGE** switch to **1.0 MW, 0 DBM**.

(b) **POWER** control to **0** on 0 to 1.0 scale.

(c) **BIAS-READ** switch to **BIAS**.

(d) **BIAS COARSE** and **FINE** controls for a null indication on TI **NULL INDICATOR** meter.

(e) **BIAS-READ** switch to **READ**.

(f) **POWER** control to **1.0** on **0** to **1.0** scale.

(20) Repeat (16) and (17) above. Power meter will indicate between .095 and .105 mW.

(21) Set microwave measurement system **MULTIBAND CONTROL UNIT RF ON/OFF** switch to **OFF**.

(22) Position controls as listed in (a) through (f) below:

(a) **POWER RANGE** switch to **.30 MW, -5 DBM**.

(b) **POWER** control to **0** on 0 to 3.0 scale.

(c) **BIAS/READ** switch to **BIAS**.

(d) **BIAS COARSE** and **FINE** controls for a null indication on TI **NULL INDICATOR** meter.

(e) **BIAS/READ** switch to **READ**.

(f) **POWER** control to **3.0** on **0** to **3.0** scale.

(23) Repeat (20) above. Power meter will indicate between 0.0285 and 0.0315 mW.

b. Adjustments

(1) Adjust variable attenuator for a 1.0-mW indication on power meter.

(2) Adjust R74 (fig. 1) for a null indication on TI **NULL INDICATOR** meter (R).

(3) Adjust variable attenuator for a 0.1-mW indication on power meter.

(4) Adjust R69 (fig. 1) for a null indication on TI **NULL INDICATOR** meter (R).

(5) Repeat **a**(7) through (12) above.

10. Attenuation

NOTE

This paragraph may be omitted for all systems codes except FOO.

a. Performance Check

(1) Connect attenuation measurement equipment as shown in figure 4.

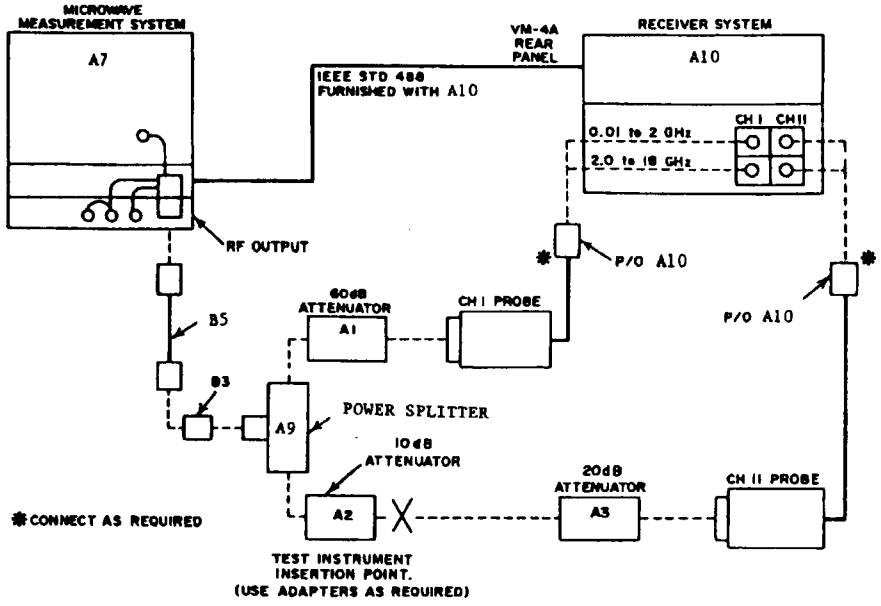

Figure 4. Attenuation measurement - equipment setup.

(2) Select one TI attenuator.

(3) Adjust equipment to measure attenuation at lowest frequency as indicated on calibration correction chart of TI attenuator selected in (2) above. Measured attenuation will be within ± 0.3 dB of attenuation value specified on calibration chart.

(4) Repeat technique of (2) and (3) above at remaining frequencies indicated on calibration chart of TI attenuator.

(5) Repeat (2) through (4) above for remaining TI attenuators.

b. Adjustments. No adjustments can be made. If necessary, correct calibration chart or prepare new calibration chart.

11. Power Supply

a. Performance Check

NOTE

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

CAUTION

Make sure there is no connection between chassis ground of digital voltmeter (A5) and TI.

(1) Adjust **COMP ATTENUATOR** control to **0**.

(2) Disconnect thermistor mount from TI.

(3) Set **POWER RANGE** switch to **1.0 MW, 0 DBM** and **THERM RES** switch to 100^.

(4) Insert adapter (B4) into J2 (fig. 1).

(5) Connect digital voltmeter negative terminal to TI chassis ground and positive terminal to junction of R72 and R73 (fig. 1). If digital voltmeter does not indicate between -2.475 and -2.525 V, perform **b** below.

b. Adjustments

(1) Remove adapter from J2 (fig. 1).

(2) Rotate **COMP ATTENUATOR** control fully ccw.

WARNING

There is a voltage of -225 V dc at junction of C1B and R14 (fig. 2). Exercise extreme caution when connecting digital voltmeter to TI in (3) below.

(3) Connect digital voltmeter positive terminal to pin 7 of V5 and negative terminal to junction of C1B and R14 (fig. 2).

(4) Adjust R13 (fig. 1) for a 50.0-V indication on digital voltmeter (R).

(5) Connect digital voltmeter positive terminal to pin 6 of V7 (fig. 2).

(6) Adjust R21 (fig. 1) for a 100.0-V indication on digital voltmeter (R).

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

(8) Adjust **COMP ATTENUATOR** control for a 69-V indication on digital voltmeter. If **COMP ATTENUATOR** control does not indicate 0, loosen control setscrews and adjust dial for proper indication. Tighten setscrews (R).

(9) Repeat **a** above.

12. Final Procedure

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

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

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