*TB 9-4931-533-40

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR ATTENUATOR AND SIGNAL GENERATOR CALIBRATOR, WEINSCHEL ENGINEERING, MODEL VM-4A

Headquarters, Department of the Army, Washington, DC
14 May 2008

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.

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*This-bulletin supersedes TB 9-4931-533-50, dated 15 May 1987, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Attenuator and Signal Generator Calibrator, Weinschel Engineering, Model VM-4A. 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 4 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
Attenuation: Dynamic range	Single channel: 90 dB 910 MHz to 9.0 GHz 85 dB (9 to 18 GHz) Dual channel: >100dB (10 MHz to 19 GHz)
System accuracy	±(0.02 dB/10dB)
Frequency range: Low band High bank	 10 MHz to 2.0 GHz 2 to 18 GHz

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with Secondary Reference Calibration Standards Set NSN 4931-00-621-7878 and is to be used in performing this procedure. 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)
ATTENUATOR	Range: 0.01 to 18 GHz Attenuation: 60 dB	Weinschel Model 44-60
ATTENUATOR	Range: 0.01 to 18 GHz Attenuation: 30 dB	Alan Ind. Model 50 MP-30-864
ATTENUATOR SET (FIXED)	Range: 0.01 to 18 Ghz Accuracy: test report	Weinschel, Model 9918, 9918-6dB, 9918-10dB, 9918-20dB, 9918-30dB, and 9918-60dB (9918)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ± 1%	Ridge, Model 9020A (9020A)
PRECISION IF ATTENUATOR	Range: 20 to 100 dB, 30 MHz Accuracy: (± 0.0005 dB/10) above 20 dB reading (from test report)	Weinschel Model PA-2 (7912047-1)
POWER METER	Range: -20 to +10 dBm Accuracy: ± 5%	Hewlett-Packard, Model E12-432A (MIS-30525) w/thermistor mount, Hewlett-Packard, Model478A-H75-(7915907) and 8478B (8478B)
POWER SPLITTER	Frequency: 0.01 to 18 GHz	Weinschel, Model 1870A (1870A)
SIGNAL GENERATOR NO.1	Range: 0.01 to 2.1 GHz Accuracy: ± 0.1%	(SG-1207U)
SIGNAL GENERATOR NO.2	Range: 2 to 18 GHz Accuracy: ± 0.1%	(SG-1219U)
VARIABLE ATTENUATOR	Range: 0 to 69 dB, 0.01 to 18 GHz Accuracy: ± 1.9 dB	Weinschel, Model AF117A69-34 (AF117A-69-34)

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 manual for this TI.

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

7. Equipment Setup

a. Connect the two semi-rigid links (front panel) between channel I and II of the **VM-4A** and **HO-2** oscillator.

b. Connect the low frequency probes to channel I and II low frequency connectors (front panel).

c. Connect the 10 MHz reference (coaxial link) on rear panel between the **VM4A** and **HO-**2 oscillator.

d. Connect the main **VM-4A INTERFACE** bus (rear panel) cable between the **VM-4A** and **HO-2** oscillator, and the **IEEESTD-488** bus between the **VM-4A** and signal generator No. 1.

e. Connect ac line cords to both **VM-4A** and **HO-2** oscillator, and connect to autotransformers. Adjust autotransformers for 115 V ac.

f. Energize equipment and allow approximately 30 minutes for equipment to warm-up and stabilize.

8. Attenuator Accuracy (30 MHz)

NOTE

This procedure should not be performed until TI self diagnostic test (microprocessor and 30 MHz self test) has been satisfactorily completed.

a. Performance Check

(1) Connect equipment as shown in figure 1, connection A.

NOTE

Insure that low frequency probes are connected.

(2) Set signal generator No. 1 for a frequency of **30 MHz** and an output of **0 dBm**.

(3) Ensure **RF OFF/ON** is set to **ON**.

(4) Press TI pushbuttons as listed in (a) through (g) below:

(a) **LOCAL (IEEE 488 BUS STATUS)**.
(b) **±% SRCH (VM-4A) 2**, and **ENTER**.
(c) **AUTO TUNE**, **(4312 GENERATOR)**.
(d) **TUNE (VM-4A** Group).
(e) **030 and ENTER**.
(f) **001 (RESOLUTION-dB)**.
(g) **II-I (CHANNEL)**.

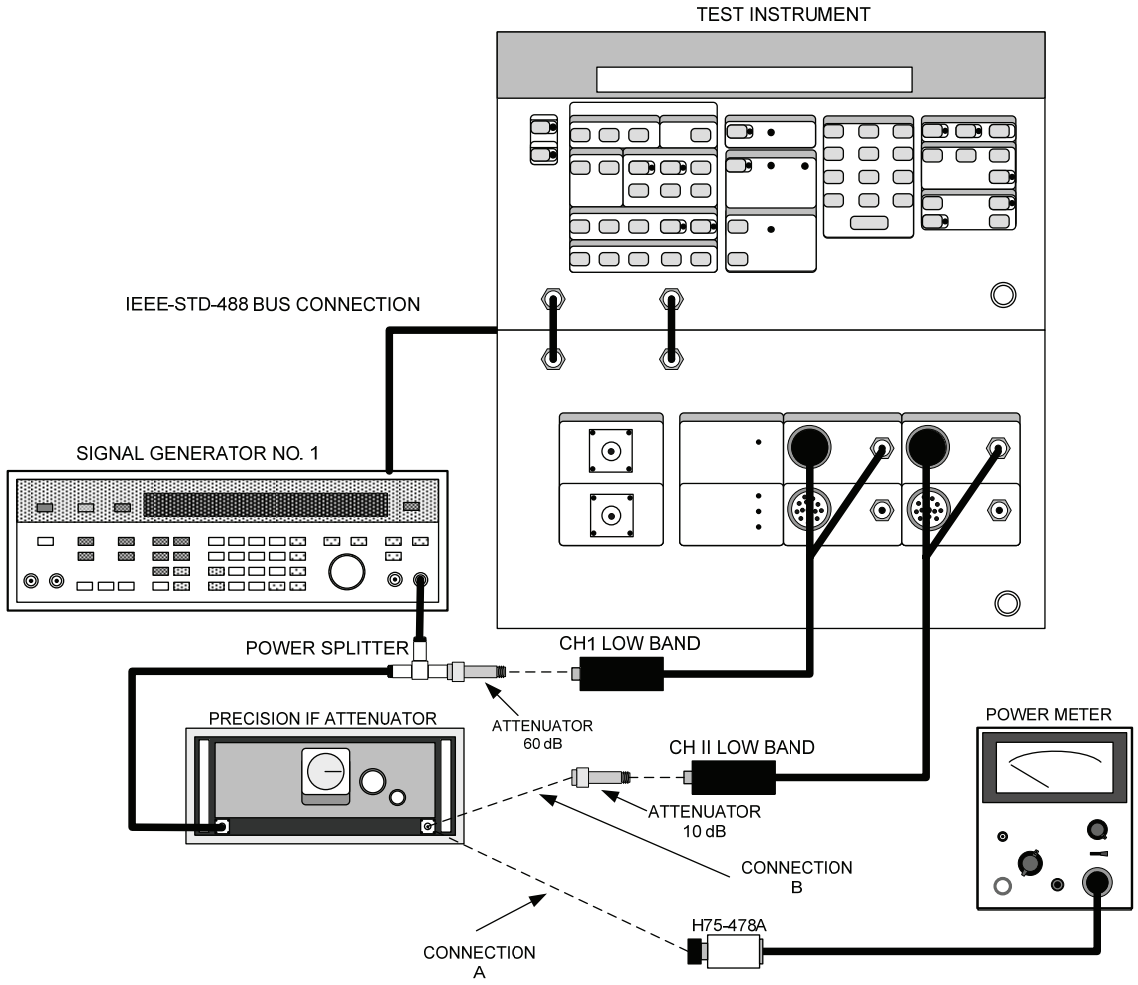

Figure 1. Attenuation accuracy (30 MHz) - equipment setup.

(5) Set precision IF attenuator to 20.00 dB and adjust signal generator No. 1 for a power level of -20 dBm or less as indicated on power meter. Do not readjust power level for remainder of this test.

(6) Connect equipment as shown in figure 1, connection B.

(7) Press TI **MEASUREMENT ON** and **REF** pushbuttons to establish, a TI reference.

(8) Adjust precision IF attenuator from 20 to 30 dB. Press TI **MEASUREMENT ON** pushbutton. TI display will indicate ± 0.02 dB/10dB of test report values for precision if attenuator. Press **MEASUREMENT STOP** pushbutton.

(9) Repeat (8) above in 10 dB increments to 100 dB. TI display will indicate within the tolerances specified in (8) above.

b. Adjustments. No adjustment can be made.

9. Attenuation Accuracy Dynamic Range (Auto Mode 0.01 to 18 GHz)

a. Performance Check

(1) Connect equipment as shown in figure 2, connection A, using high band probes.

(2) Adjust signal generator No. 2 for 0 dBm or less as indicated on power meter.

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

(4) Program TI, using data entry and **LOCAL PROGRAM** pushbuttons as listed in (a) through (o) below.

(a) **BAND A START FREQ - 3 GHz**.
(b) **BAND A STOP FREQ - 17 GHz**.
(c) **BAND A NUMBER OF TEST POINTS -15**.
(d) **BAND A FREQ SPACING - LIN**.
(e) **RESOLUTION DB 0.01**.
(f) **BAND B START FREQ - 5.6 GHz**.
(g) **BAND B STOP FREQ - 5.6 GHz**.
(h) **BAND B NUMBER OF TEST POINTS -1**.
(i) **BAND B FREQ SPACING - LIN**.
(j) **RESOLUTION dB 0.01**.
(k) **BAND C START FREQ - 9.7 GHz**.
(l) **BAND C STOP FREQ - 9.7 GHz**.
(m) **BAND C NUMBER OF TEST POINTS - 1**.
(n) **BAND C FREQ SPACING - LIN**.
(o) **RESOLUTION dB 0.01**.

(5) Press **REF** pushbutton **(MEASUREMENT CONTROL)** and press **FREQUENCY BAND A** pushbutton.

(6) Press **RUN** pushbutton **(MEASUREMENT CONTROL GP).** After **RUN COMPLETE** displayed proceed to (7) below.

(7) Press **MEAS** pushbutton **(MEASUREMENT CONTROL)** and **FREQUENCY BAND A** pushbutton.

(8) Insert 6 dB attenuator at attenuator insertion point as shown in figure 2.

(9) Press **RUN** pushbutton **(MEASUREMENT CONTROL)**.

(10) When TI indicates **RUN COMPLETE**, press **ALL** pushbutton **(DISPLAY CONTROL)**, step through test results by pressing **FWD** pushbutton while observing that TI display indicates the measured insertion loss ± maximum uncertainty as listed in test report for the attenuator (± 0.02 dB/10 dB).

NOTE

Verify results only at frequencies listed in the attenuator test report. If test report frequencies change, reprogram TI in (4) above for new frequencies.

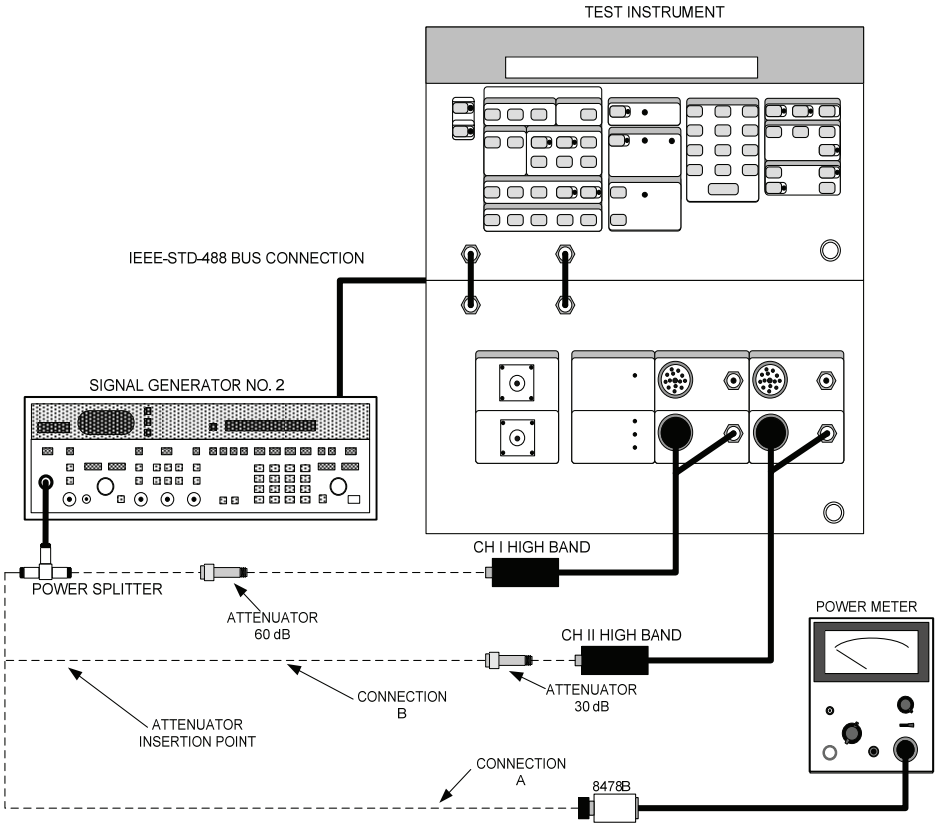

Figure 2. Attenuation accuracy and dynamic range (0.01 to 18 GHz) - equipment setup.

(11) Remove 6 dB attenuator and repeat (7) through (10) above substituting 20, 30, and 60 dB attenuators.

(12) Repeat (4) through (7) above changing **RESOLUTION** to **.1 dB**.

(13) Connect 30 and 60 dB attenuators in series and connect at attenuator insertion point. Press TI **RUN** pushbutton.

(14) Verify that TI display does, not display **OUT OF RANGE** and TI completes run.

NOTE

Step (14) is for dynamic range only, disregard tolerances. If TI displays **OUT OF RANGE** for any frequency, perform (1) and (2) above for that frequency and rerun.

(15) Substitute TI low band probes for high band probes, signal generator No. 1 for signal generator No. 2, and repeat technique of (1) through (14) above at start frequency of 0.6 GHz and stop frequency of 1.5 GHz and any other frequency points certified on attenuator test reports (below 2 GHz).

b. Adjustments. No adjustment can be made.

10. Single Channel Accuracy and Dynamic Range (0.01 to 18 GHz)

a. Performance Check

(1) Connect equipment as shown in figure 3, using low band probe (CH1).

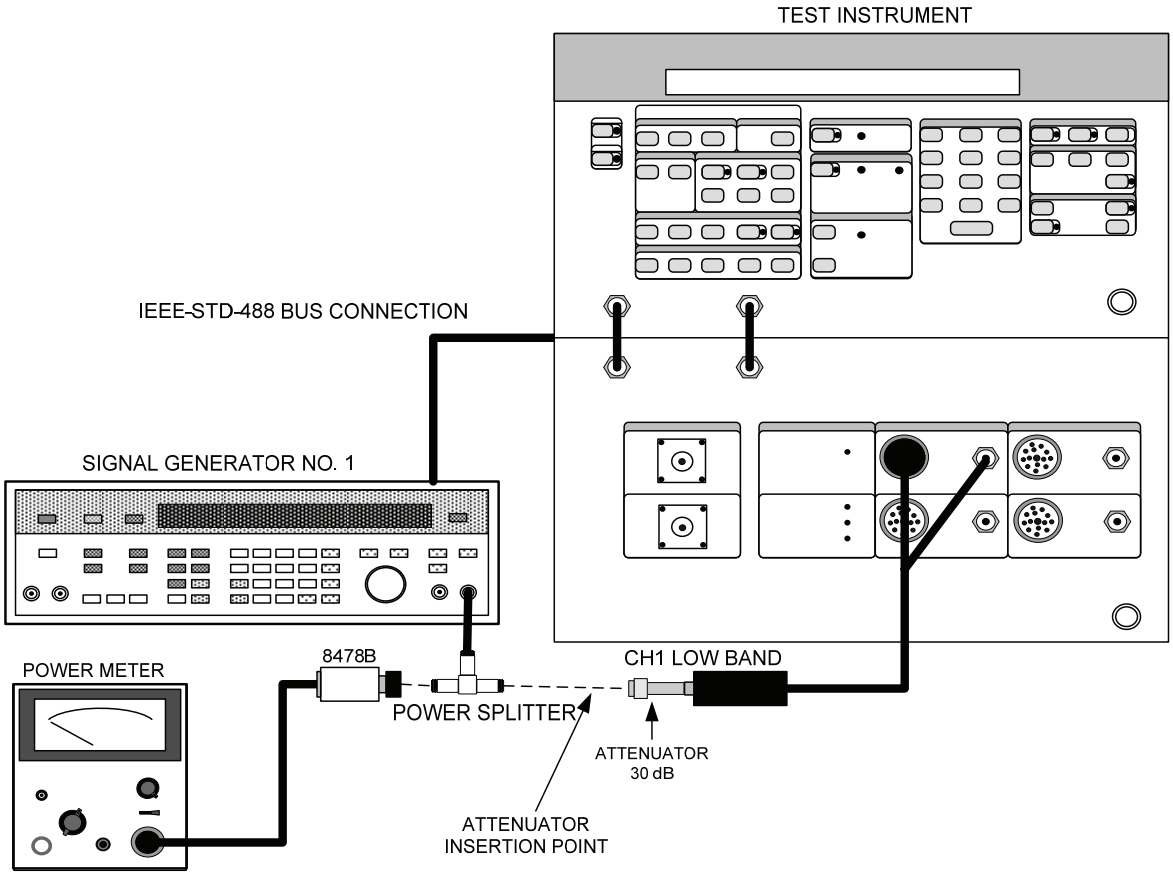

Figure 3. Single channel accuracy and dynamic range - equipment setup.

(2) Press TI pushbuttons as listed in (a) through (e) below:

(a) **TUNE (VM-4A Group)**.
(b) **.6** and **ENTER**.
(c) **MEASUREMENT – ON**.
(d) **.01 (RESOLUTION - dB)**.
(e) **1 (CHANNEL)**.

(3) Adjust signal generator No. 1 for a power level of 0 dBm indication on power meter. Maintain this power level throughout remaining checks.

(4) Press TI **MEASUREMENT ON** and **REF** pushbuttons to establish TI reference.

(5) Press **MEASUREMENT - STOP** pushbutton. Connect 6 dB attenuator at attenuation insertion point as shown in figure 3.

(6) Press **MEASUREMENT - ON** pushbutton. TI display will indicate the measured insertion loss (dB) ± maximum uncertainty as listed in test report for the attenuator.

NOTE

Small fluctuations in RF power level set in (3) above will cause out-of-tolerance reading.

(7) Repeat (5) and (6) above substituting 20 and 30 dB attenuator.

(8) Repeat (1) through (4) above changing **RESOLUTION** to **.1 dB**.

(9) Press **MEASUREMENT STOP pushbutton**. Connect variable attenuator and 30 dB attenuator in series and connect combination in attenuator insertion point (fig. 3).

(10) Set variable attenuator to **0.0 DB**. Press **MEASUREMENT ON** and observe TI **VM-4A LOCKED** light is on.

(11) Increase variable attenuator setting in 1 dB steps until **VM-4A LOCKED** light starts blinking, then decrease setting until light remains on.

(12) TI display reading must be greater than 60 dB (55 dB at frequencies above 9 GHz).

(13) Repeat (1) through (12) above at frequencies of 1.5, 3.0, 5.6, 9.7, 11.0, 15.0 and 17 GHz. Substitute high band probes for low band probes and signal generator No. 2 for signal generator No. 1 at frequencies above 2 GHz.

b. Adjustments. No adjustments can be made.

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:

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0807910

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500, 2 January 2003, requirements for calibration procedure TB 9-4931-533-40.

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.