TB 9-4931-523-35

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR ATTENUATORS, FIXED AND VARIABLE (10 MHZ TO 40 GHZ) (GENERAL)

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

Approved for public release; distribution is unlimited.

TB 9-4931-523-35, 10 July 2000, 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
A-5 and A-6	A-5 and A-6
A-9 and A-10	A-9 and A-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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*TB 9-4931-523-35

CALIBRATION PROCEDURE FOR ATTENUATORS, FIXED AND VARIABLE (10 MHZ TO 40 GHZ) (GENERAL)

Headquarters, Department of the Army, Washington, DC
10 July 2000

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REPORTING OF ERRORS AND RECOMMENDING 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-LS-LP, 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.

*This bulletin supersedes TB 9-4931-523-35, dated 18 December 1991.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This procedure provides instructions for the calibration of Attenuators, Fixed and Variable (10 MHz to 40 GHz) (General). The manufacturers' manuals were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. Variations among models are described in appendix A.

b. Time and Technique. The time required for this calibration is approximately 2 hours for fixed and variable attenuators from 10 MHz to 18 GHz, and 5 hours for fixed and variable attenuators from 18 to 40 GHz.

2. Forms, Records, and Reports. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in appendix A. TIs other than those listed in the appendix may be checked using the techniques in this TB if the manufacturers' specifications are available.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 1 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-287 and Secondary Reference Calibration Standards Set NSN 4931-00-621-7878. 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 1. The accuracies listed in table 1 provide a four-to-one ratio between the standard and TI. Appendix A is footnoted where the four-to-one ratio may not be met.

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 accessories are also required for this calibration: Transformers Anzac Electronics, Models TP75 (7913106-2) and TP93 (7913106-2) and an 18-to-40 GHz kit.

Table 1. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
ATTENUATOR, (FIXED)	Range: 10 dB Frequency range: 10 MHz to 18 GHz Accuracy: ±0.5 dB Range: 20 dB Frequency range: 10 MHz to 18 GHz Accuracy: ±0.5 dB Range: 30 dB Frequency range: 0.7 and 1 GHz Accuracy: ±1.0 dB Range: 60 dB Frequency range: 10 MHz to 18 GHz Accuracy: ±1.5dB	Weinschel, Model 9918, 9918-10dB, 9918-20dB, 9918-30dB, and 9918-60dB (9918)
FREQUENCY EXTENSION KIT NO. 1 [1,2]	Frequency range: 18.0 to 26.5 GHz IF frequency: 700 MHz Combined accuracy w/receiver system: ±0.03 dB/10 dB	Weinschel, Model 1611 (1611)
FREQUENCY EXTENSION KIT NO. 2 [2,3]	Frequency range: 26.5 to 40 GHz IF frequency: 1 GHz Combined accuracy w/receiver system: ±0.03 dB/10 dB	Weinschel, Model 1612 (1612)
MEASURING RECEIVER	Frequency range: 10 MHz to 18 GHz Attenuation range: 0.0 to 100 dB Accuracy: ±0.02 dB/10 dB	Hewlett-Packard Model 8902A (13533996) with converter Hewlett-Packard Model 11793A, power sensor Hewlett-Packard Model 11722A, and power sensor Hewlett Packard Model 11792A
POWER METER	Frequency range: 10 MHz to 18 GHz Power range: 0 to -70 dBm Accuracy: ±dB/10 dB	Hewlett-Packard, Model 437B (13440045) with power sensor, Hewlett-Packard, Model 8482A (13440043), and power sensor, Hewlett-Packard, Model 8485D (8485D) with 30 dB attenuator, Hewlett-Packard, Model 11708A))

See footnotes at end of table.

Table 1. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
POWER SPLITTER	Frequency range: 10 MHz to 18 GHz Insertion loss: 6 dB -0.2 + 1.5 dB Output tracking between ports: 10 MHz to 2 GHz: ±0.15 dB 2 to 8 GHz: ±0.2 dB 8 to 18 GHz: ±0.25 dB	Weinschel, Model 1870A (7916839)
PROGRAMMABLE SWEEP GENERATOR	Frequency range: 13 to 26.5 GHz Power output: 0 to +3 dBm Power accuracy: 13 to 20 GHz: ±1.1 dB 20 to 26.5 GHz: ±1.4 dB	Wiltron, Model 6669M (6669M)
RECEIVER SYSTEM	Frequency range: 10 MHz to 18 GHz Attenuation range: 0.0 to 100 dB Accuracy: ±0.02 dB/10 dB	Weinschel, Model V M4A (VM4A)
SIGNAL GENERATOR NO. 1	Frequency range: 10 MHz to 2 GHz Power output: 0 dBm Accuracy: 10 to 500 MHz: ±1.5 dB 500 to 1 000 MHz: +9.0 dB 1000 to 2000 MHz: ±2.5 dB	(SG-1207/U)
SIGNAL GENERATOR NO. 2	Frequency range: 2 to 18 GHz Power output: 0 to +8 dBm Accuracy: ±2 dB	(SG-1219/U)
SIGNAL GENERATOR NO. 3	Frequency range: 2 to 18 GHz Power output: 0 to +8 dBm Accuracy: ±2 dB	(SG-1219/U)

[1]Part of microwave standards kit, 18 to 26.5 GHz (secondary reference).

[2]Accessories included.

[3]Part of microwave standards kit, 26.5 to 40 GHz, limited deployed (secondary reference) .

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 1.

c. This calibration bulletin contains information and techniques for the calibration of attenuators from 10 MHz to 40 GHz.

d. Attenuators with specifications below 10 MHz should use the techniques presented in TB 9-6625-2181-35.

7. Equipment Setup

a. Refer to TI as listed in appendix and evaluate TI for connector type, impedance, and frequency range. Determine and record at least 10 equally spaced frequency test points.

NOTE

The calibration frequencies attached to TI or test report furnished with TI may be used if desired.

b. Refer to TI type and frequency range for equipment setup figure and performance paragraph as listed in (1) through (6) below:

(1) Fixed attenuator with frequency range between 10 MHz and 18 GHz refer to **c** below.

(2) Variable attenuator with frequency range between 10 MHz and 18 GHz, refer to **d** below.

(3) Fixed attenuator with frequency range between 18 and 26.5 GHz, refer to **e** below.

(4) Variable attenuator with frequency range between 18 and 26.5 GHz, refer to **f** below.

(5) Fixed attenuator with frequency range between 26.5 and 40 GHz, refer to **g** below.

(6) Variable attenuator with frequency range between 26.5 and 40 GHz, refer to **h** below.

NOTE

For maximum accuracy, the RF input level to channel I should be approximately -60 dBm, and the RF input level to channel II should be approximately -30 dBm or less.

NOTE

The insertion loss measurements for attenuators listed in the appendix are considered adequate for determining their accuracy and serviceability. VSWR checks are not required.

NOTE

Unless otherwise specified, verify the results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration.

NOTE

When calibrating waveguide attenuators, use four clamps or screws for each connection to reduce losses.

c. Connect equipment as shown in figure 1 and allow equipment to warm up for 1 hour before performing paragraph **8** below (appendix B can be used as an alternate to paragraph **8** below.).

d. Connect equipment as shown in figure 1 and allow equipment to warm up 1 hour before performing paragraph **9** below (appendix C can be used as an alternate to paragraph **9** below.).

e. Connect equipment as shown in figure 2 and allow equipment to warm-up for 3 hours before performing paragraph **10** below.

f. Connect equipment as shown in figure 2 and allow equipment to warm-up for 3 hours performing paragraph **11** below.

g. Connect equipment as shown in figure 3 and allow equipment to warm-up for 3 hours before performing paragraph **12** below.

h. Connect equipment as shown in figure 3 and allow equipment to warm-up for 3 hours before performing paragraph **13** below.

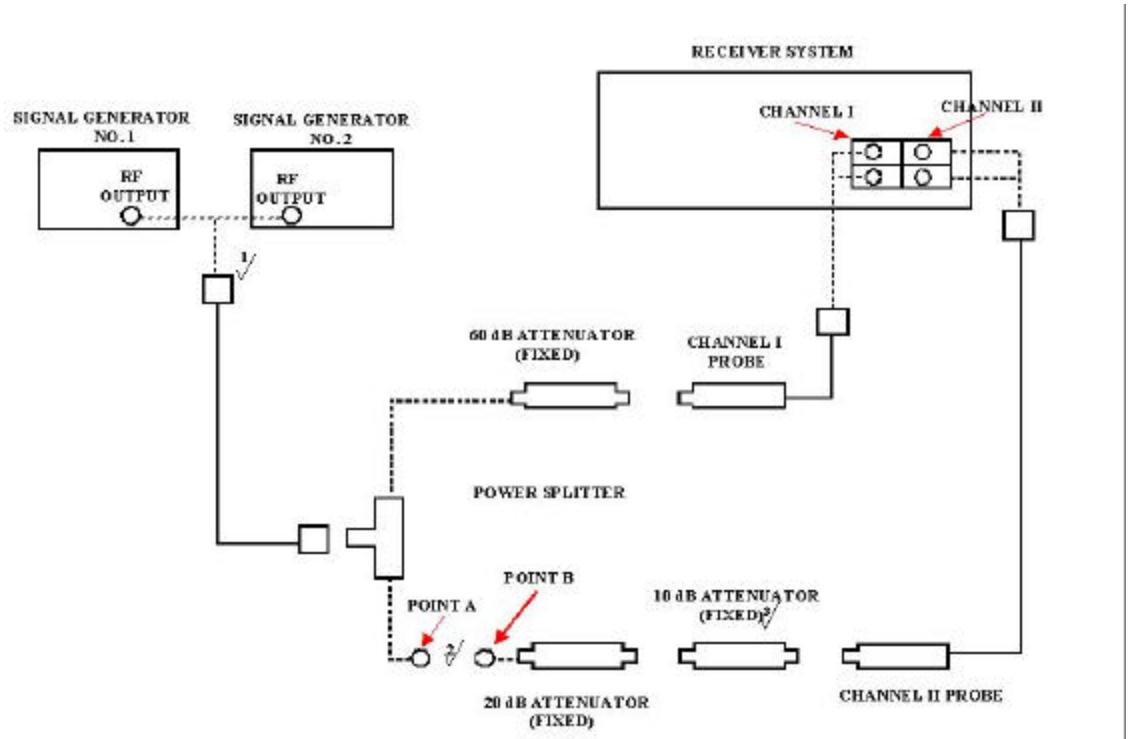

Figure 1. Attenuation measurement (10 MHz to 18 GHz) - equipment setup.

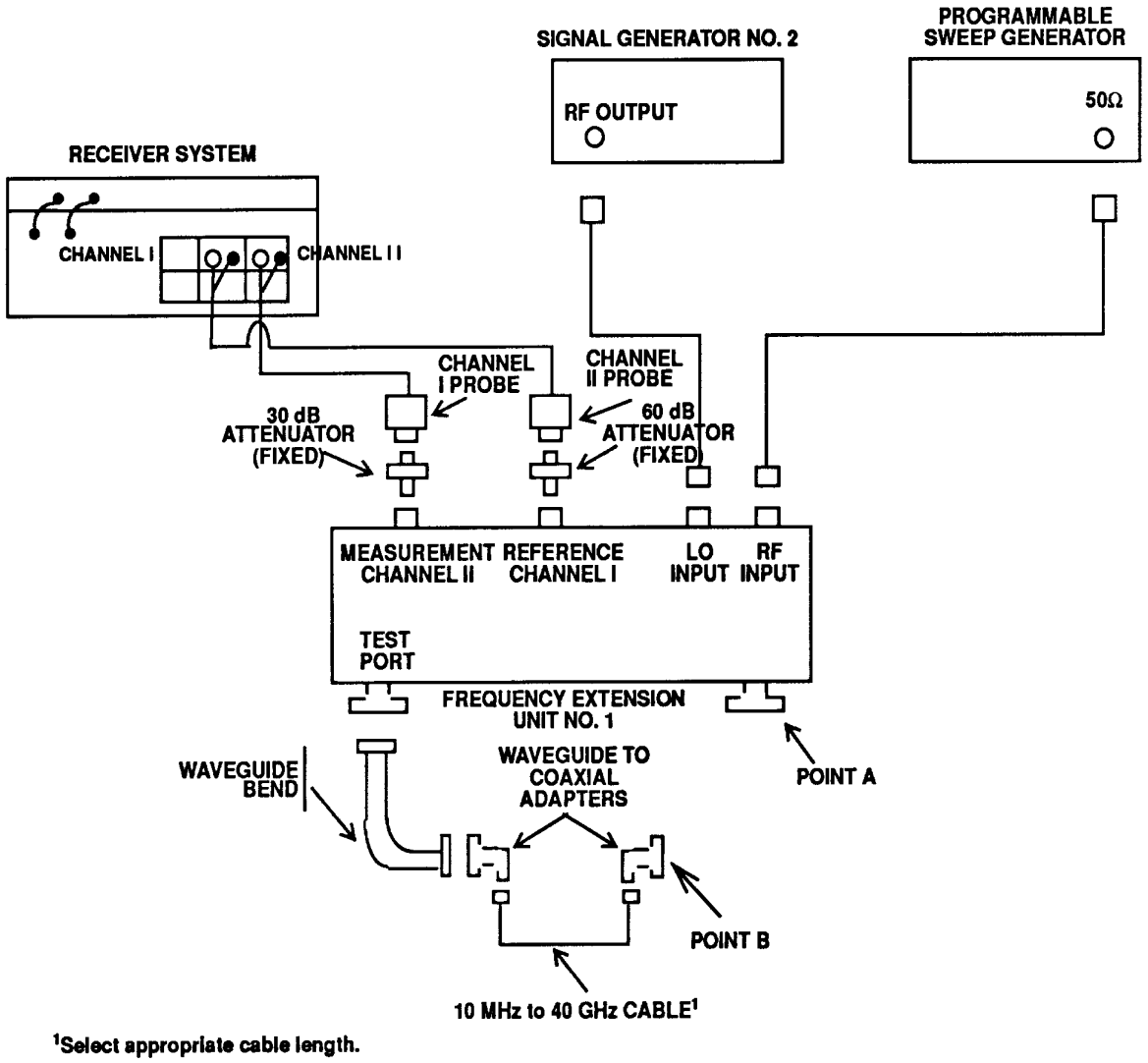

Figure 2. Attenuation measurement (18 to 26.5 GHz) - equipment setup.

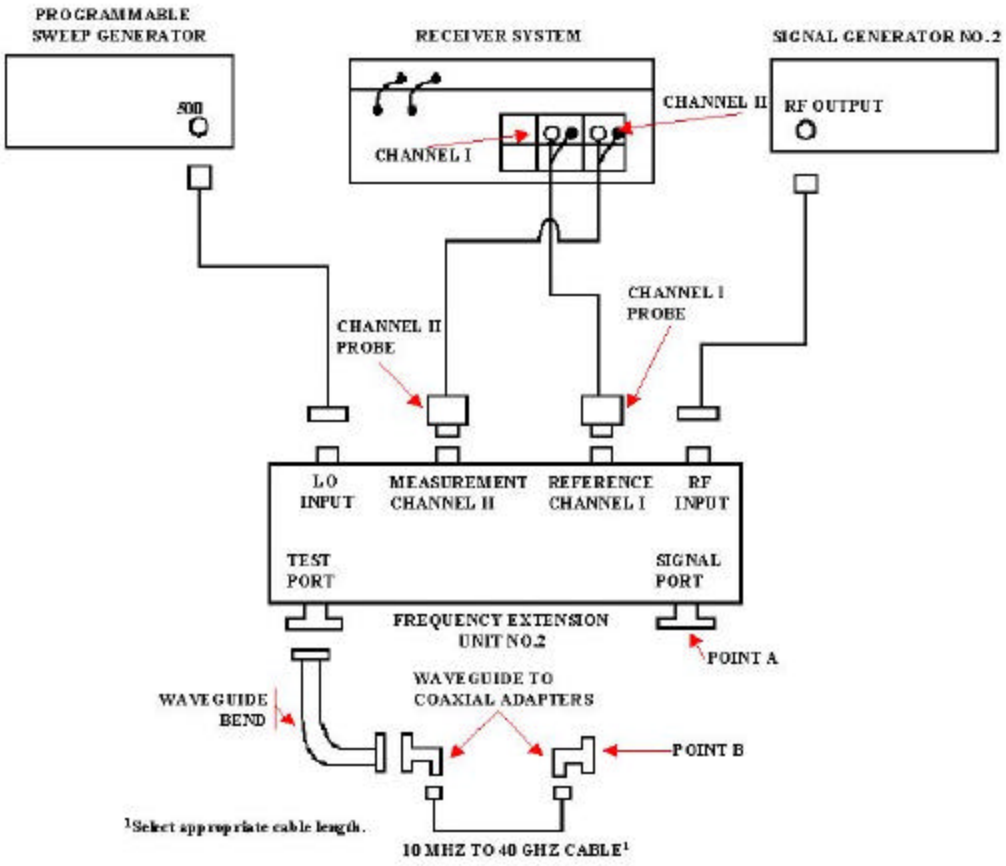

Figure 3. Attenuation measurement (26.5 to 40 GHz) - equipment setup.

8. Fixed Attenuation Measurement (10 MHz to 18 GHz)

a. Performance Check

NOTE

When performing the following steps, if TI frequency range extends above and below 2 GHz, it will be necessary to perform two separate tests - one below and one above 2 GHz.

(1) Adjust signal generator No. 1 (No. 2) frequency controls to test frequency recorded in **7a** above and adjust signal generator No. 1 (No. 2) RF output controls for +6 dBm.

(2) Connect POINT A to POINT B (fig. 1).

NOTE

Use adapters as needed.

NOTE

Use waveguide-to-coaxial adapters when TI is waveguide.

NOTE

Use 50Ω-to-75Ω or 50Ω-to-93Ω adapters when TI is 75Ω or 93Ω.

(3) Establish a reference on the receiver system at test frequency recorded in **7a** above.

(4) Connect TI between POINTS A and B (fig. 1).

NOTE

Ensure receiver system is in measurement mode.

(5) Measure and record receiver system indication. Measured attenuation will be within range and accuracies specified in appendix A for TI being calibrated.

(6) Disconnect TI from equipment setup and repeat (1) through (5) above for remaining test frequencies recorded in **7a** above.

b. Adjustments. No adjustments can be made; however, a correction chart may be prepared listing actual receiver system indications at frequencies of interest.

9. Variable Attenuation Measurement (10 MHz to 18 GHz)

a. Performance Check

NOTE

When performing the following steps, if TI frequency range extends above and below 2 GHz, it will be necessary to perform two separate tests - one below and one above 2 GHz.

NOTE

When calibrating step attenuators, check each step, record value, and add values. Sum should equal total value of attenuator plus or minus accuracies.

(1) Adjust signal generator No. 1 (No. 2) frequency controls to test frequency recorded in **7a** above and adjust signal generator No. 1 (No. 2) RF output controls for +6 dBm.

(2) Connect POINT A to POINT B (fig. 1).

NOTE

Use adapters as needed.

NOTE

Use waveguide to coaxial adapters when TI is waveguide.

NOTE

Use 50Ω-to-75Ω or 50Ω-to-93Ω adapters when TI is 75Ω or 93Ω.

(3) Establish a reference on the receiver system at test frequency recorded in **7a** above.

(4) Set TI for 0 dB or minimum attenuation and insert TI between POINTS A and B (fig. 1).

NOTE

Ensure receiver system is in measurement mode.

(5) Measure and record receiver system indication as insertion loss. This value will be within the tolerances listed in appendix A.

(6) Establish a new reference on receiver system.

(7) Increase TI attenuation setting in one step increments (or one cardinal point as desired).

(8) Measure and record attenuation change. Measured attenuation will be within range and accuracies specified in appendix A for TI being calibrated.

(9) Repeat (7) and (8) above for each setting on TI dial or other desired settings.

(10) Disconnect TI from equipment setup and repeat (1) through (9) above for remaining frequencies listed in **7a** above.

NOTE

Remove 10 dB attenuator (fixed) from figure 1 equipment setup and establish a new reference on receiver system when making measurements below -70 dB.

b. Adjustments. No adjustments can be made; however, a correction chart may be prepared listing actual receiver system indications at frequencies of interest.

10. Fixed Attenuation Measurement (18 to 26.5 GHz)

a. Performance Check

(1) Adjust programmable sweep generator frequency controls to value (RF) recorded in **7a** above and RF LEVEL output control for +3 dBm.

(2) Determine the signal generator No. 2 frequency (LO) required for the desired measurement by calculating the following equation:

LO = (RF -IF)/2

Where:
RF = frequency of programmable sweep generator (1) above
IF = intermediate frequency at which receiver system is to perform measurement (0.700 GHz).

EXAMPLE

Let IF = 0.700
Let RF = 18 GHz (1) above
Let LO = signal generator No. 2 frequency

LO = (RF -IF)/2
LO = (18 GHz -0.700 GHz)/2
LO = 17.3 GHz/2
LO = 8.65 GHz

Signal generator No. 2 frequency for this measurement would be set to 8.65 GHz.

(3) Adjust signal generator No. 2 frequency controls to value determined in (2) above and RF output controls to +8 dBm.

(4) Connect POINT A to POINT B (fig. 2).

NOTE

Use adapters as needed.

NOTE

Use waveguide-to-coaxial adapters when TI is coaxial.

(5) Establish a reference on receiver system at 0.700 GHz.

(6) Insert TI between POINTS A and B (fig. 2).

NOTE

Ensure receiver system is in measurement mode.

(7) Measure and record receiver system indication. Measured attenuation will be within the range and accuracies listed in appendix for TI being calibrated.

(8) Repeat (1) through (7) above for remaining test frequencies recorded in **7a** above.

b. Adjustments. No adjustments can be made; however, a corrective chart may be prepared showing actual attenuation value at frequencies of interest.

11. Variable Attenuation Measurement (18 to 26.5 GHz)

a. Performance Check

(1) Adjust programmable sweep generator frequency controls to value (RF) recorded in **7a** above and **RF LEVEL** output control for +3 dBm.

(2) Determine signal generator No. 2 frequency (LO) required for the desired measurement by calculating the following equation:

LO = (RF -IF)/2

Where:
RF = Frequency of programmable sweep generator (1) above,
IF = Intermediate frequency at which receiver system is to perform measurement (0.700 GHz)

EXAMPLE:

Let IF = 0.700 GHz
Let RF = 18 GHz (1) above
Let LO = signal generator No. 2 frequency

LO = (RF -IF)/2
LO = (1 8 GHz-0.700 GHz)/2
LO = 17.3 GHz/2
LO = 8.65 GHz

Signal generator No. 2 frequency for this measurement would be set to 8.65 GHz.

(3) Adjust signal generator No. 2 frequency controls to value determined in (2) above and RF output to controls +8 dBm.

(4) Connect POINT A to POINT B (fig. 2).

NOTE

Use adapters as needed.

NOTE

Use waveguide to coaxial adapters when TI is coaxial.

(5) Establish a reference on receiver system at 0.700 GHz.

(6) Set TI for 0 dB or minimum attenuation and insert TI between POINTS A and B (fig. 2).

NOTE

Ensure TI is in measurement mode.

(7) Measure and record receiver system indication as insertion loss. This value will be within the tolerances listed in appendix A.

(8) Establish a new reference on receiver system.

(9) Increase TI attenuation setting in one-step increments (or one cardinal point as desired).

(10) Measure and record receiver system indication. Measured attenuation will be within the range and accuracies listed in appendix A for TI being calibrated.

(11) Repeat (9) and (10) above for each setting on TI dial or other desired setting.

(12) Disconnect TI from equipment setup and repeat (1) through (11) above for remaining test frequencies of interest.

b. Adjustments. No adjustments can be made; however, a corrective chart may be prepared showing actual attenuation value at frequencies recorded in **7a** above.

12. Fixed Attenuation Measurement (26.5 to 40 GHz)

a. Performance Check

(1) Determine and record the signal generator No. 2 frequency (RF) required for the desired measurement by calculating the following equation:

RF = Test frequency in GHz (**7a** above) / 3
EXAMPLE A
If first test frequency recorded in **7a** above is 27 GHz:
RF = 27/3
RF = 9 or 9 GHz

(2) Determine and record programmable sweep generator frequency (LO) required for the desired measurement by calculating the following equation:

LO =((3 X RF) -IF)/ 2
EXAMPLE B
Where:

RF	=	signal generator No. 2 frequency in GHz recorded in (1) above
IF	=	1 (operating frequency of receiver system in GHz)
LO	=	programmable sweep generator frequency

Where:

LO	=	((3X9)-l)/2
LO	=	(27 - 1) / 2
LO	=	26/2
LO	=	13 or 13 GHz

(3) Adjust signal generator No. 2 frequency controls to value determined in (1) above and RF output controls to +3 dBm.

(4) Adjust programmable sweep generator frequency controls to value determined in (2) above and RF LEVEL output controls to 0 dBm.

(5) Connect POINT A to POINT B (fig. 3)

NOTE
Use adapters as needed.

(6) Establish a reference on receiver system at 1 GHz.

(7) Insert TI between POINTS A and B (fig. 3).

NOTE

Ensure receiver system is in measurement mode.

(8) Measure and record receiver indication. Measured attenuation will be within range and accuracies specified in appendix A for TI being calibrated.

(9) Disconnect TI from equipment setup.

(10) Repeat (1) through (9) above for remaining frequencies recorded in **7a** above.

b. Adjustments. No adjustments can be made; however, a correction chart may be prepared listing actual receiver system indications at frequencies of interest.

13. Variable Attenuation Measurement (26.5 to 40 GHz)

a. Performance Check

(1) Determine and record the signal generator No. 2 frequency (RF) required for the desired measurement by calculating the following equation:

RF = Test frequency in GHz (**7a** above)/3

EXAMPLE A
If first test frequency recorded in **7a** above is 27 GHz:
RF = 27/3
RF = 9 or 9 GHz

(2) Determine and record programmable sweep generator frequency (LO) required for the desired measurement by calculating the following equation:

LO - ((3 X RF) -IF) / 2

EXAMPLE B

Where:

RF	=	signal generator No. 2 frequency in GHz recorded in (1) above.
IF	=	1 (operating frequency of receiver system in GHz)
LO	=	programmable sweep generator frequency
LO	=	((3 X 9) -1) /2
LO	=	(27 - 1) / 2
LO	=	26 /2
LO	=	13 or 13 GHz

(3) Adjust signal generator No. 2 frequency controls to value determined in (1) above and RF output controls to +3 dBm.

(4) Adjust programmable sweep generator frequency controls to value determined in (2) above and **RF LEVEL** output controls to 0 dBm.

(5) Connect POINT A to POINT B (fig. 3)

NOTE

Use adapters as needed.

(6) Establish a reference on receiver system at 1 GHz.

(7) Set TI for 0 dB or minimum attenuation and insert TI between POINTS A and B (fig. 3).

NOTE

Ensure receiver system is in measurement mode.

(8) Measure and record receiver system indication as insertion loss. This value will be within the tolerance listed in appendix A.

(9) Establish a new reference on receiver system.

(10) Increase TI attenuation setting in one-step increments (or one cardinal point as desired).

(11) Measure and record attenuation change. Measured attenuation will be within range and accuracies specified in appendix A for TI being calibrated.

(12) Repeat (10) and (11) above for each setting on TI dial or other desired settings.

(13) Disconnect TI from equipment setup and repeat (1) through (12) above for remaining frequencies recorded in **7a** above.

b. Adjustments. No adjustments can be made; however, a correction chart may be prepared listing actual receiver system indications at frequencies of interest.

14. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

APPENDIX A

TEST INSTRUMENT IDENTIFICATION

Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
A2648B[2] (MIS-10263)	RLC Electronics	0 to 120[3]	DC to 1 DC to 0.1 0.1 to 0.5 0.5 to 1		≤0.25 ≤0.75 ≤1.5
		0 to 60	DC to 0.01	±0.15[4]	
		60 to 1203		±0.30	
		0 to 60	0.01 to 0.1	±0.35[5]	
		60 to 120[3]		±0.70[5]	
		0 to 120[3]	0.1 to 1	±3.0	
AB20B	Microlab/FXR	20	DC to 4.5 DC to 3 3 to 4.5	 ±0.7 ±1.0	
AC20N	Microlab/FXR	20	4.5 to 10	±1.0	
AD06N	Microlab/FXR	6	DC to 4	±0.6	
AD10N	Microlab/FXR	10	DC to 4	±0.8	
AD30N	Microlab/FXR	30	DC to 4	±1.0	
AF117A69-34[2]	Weinschel	0 to 69	DC to 18		≤1.2
		1 to 9	DC to 18	±0.5	
		10 to 19	DC to 18	±1.0	
		20 to 29	DC to 18	±1.2	
		30 to 39	DC to 18	±1.4	
		40 to 49	DC to 18	±1.5	
		50 to 59	DC to 18	±1.7	
		60 to 69	DC to 18	±1.8	
AS1	Weinschel	See Weinschel 50-3, 50-6, 50-10, 50-20, and 210-3, 210-6, 210-10, 210-20			
AS4	Weinschel	See Weinschel 50-3, 50-6, 50-10, 50-20, and 530A-3, 530A-6, 530A-10, 530A-20			
AS5A	Weinschel				
AS6A	Weinschel	See Weinschel 2-3 dB, 2-6 dB, 2-10 dB, 2-20 dB			
AS9146	Weinschel	See Weinschel 50-1, 50-2, 50-3, 50-6, 50-20			
AT201SR	RLC Electronics	0 to 120[3]	DC to 1 DC to 0.25	2% or ±0.5 dB whichever is greater	

See footnotes at end of table.

APPENDIX A

TEST INSTRUMENT IDENTIFICATION

Model number	Manufacturer	Nominal Attenuation (dB)	Frequency range (GHz)1	Accuracy (dB)	Insertion loss at 0 dB (dB)
AV-50-2	Jerrold	0 to 82 (each pad)	Dc to 0.5 At DC		
		Two or more pads	At DC	±2% of pad value ±0.1 dB	
			At 0.6	±2% of value +0.1 dB	
			At 0.23	±4% of value +0.1 dB	≤0.3
			At 0.5	±12% of value +0.1 dB	≤0.6
CN1096G	See Kay Elemetrics 31-0				
CN533U	PRD Electronics	0 to 40	7.0 to 10.0	±0.5	≤0.5
CN713U		0 to 20	8.2 to 12.4		
		0 to 10		±1.0	
		10 to 20		±2.0	
CN797U					
CN895		20	DC to 1	±0.5	
CN908U	Hewlett-Packard	See Hewlett-Packard G382A			
CN970U					
FP-50-1	Texscan	1	DC to 2.0 DC to 0.5 0.5 to 1.0 1.0 to 2.0	±0.3 ±0.5 ±1.0	
FP-50-2	Texscan	2	DC to 2.0 DC to 0.5 0.5 to 1.0 1.0 to 2.0	±0.3 ±0.5 ±1.0	
FP-50-3	Texscan	3	DC to 2.0 DC to 0.5 0.5 to 1.0 1.0 to 2.0	±0.3 ±0.5 ±1.0	
FP-50-6	Texscan	6	DC to 2.0 DC to 0.5 0.5 to 1.0 1.0 to 2.0	±0.3 ±0.5 ±1.0	
FP-50-10	Texscan	10	DC to 2.0 DC to 0.5 0.5 to 1.0 1.0 to 2.0	±0.3 ±0.5 ±1.0	

See footnotes at end of table.

APPENDIX A

TEST INSTRUMENT IDENTIFICATION

Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB	Insertion loss at 0 dB (dB)
FP-50-20	Texscan	20	DC to 2.0 DC to 0.5 0.5 to 1.0 1.0 to 2.0	±0.3 ±0.5 ±1.0	
FP-50-30	Texscan	30	DC to 0.5	±3%	
FP-50-40	Texscan	40	DC to 0.5	±3%	
FP-50-50	Texscan	50	DC to 0.5	±3%	
FP-50-60	Texscan	60	DC to 0.5	±3%	
G382A	Hewlett-Packard	0 to 50	3.95 to 5.85	±2% of setting or ±0.1 dB whichever is greater	
GGLFHN100	PRD Electronics	20	6	±1.0	
H101	PRD Electronics	0 to 60	7.05 to 10		≤0.5
		0 to 50		±0 1 dB or ±2% whichever is greater	
		50 to 60		±3%	
H101SH	PRD Electronics See Hl0l				
H175Al0DB	Microlab/FXR	10	3.95 to 5.85	±0.3	
H175A20DB	Microlab/FXR	20	3.95 to 5.85	±0.5	
H382A	Hewlett-Packard	0 to 50	7.05 to 10.0	±2% of setting or. ±0.1 dB whichever is greater	≤1.0
K175AFl0DB	Microlab/FXR	10	18 to 26.5	±0.3	
K375A	Hewlett-Packard	0 to 20	18 to 26.5		
		0 to 10		±1.0	
		10 to 20		±2.0	
K382A	Hewlett-Packard	0 to 50	18 to 26.5	+2% of setting or ±0.1 dB whichever is greater	≤1
M1042	Mitec Corp	30	12.4 to 18	±0.25	
MDC5078S10		10	DC to 18	±0.6	
MDCC88014-10	Microwave Distribution Company	10	DC to 12.4 DC to 6 6 to 12.4	±0.2 ±0.4	
MIS-10263	See RLC Electronics A2648B				

See footnotes at end of table.

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TEST INSTRUMENT IDENTIFICATION

Model number	Manufacturer	Nominal attenuation (dB0	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
MIS-38936	Flatness	0 to 120[3]	DC to 1		≤3.0
		0 to 120	DC to 0.01	±0.3	
		0 to 60	0.01 to 0.1	±0.35[5]	
		60 to 120		±0.7[5]	
		0 to 120	0.1 to 1	±3.0	
		0 to 60	DC to 0.01 0.01 to 0.1 0.1 to 1	±0.05 ±0.1 ±0.75	
N9412-10	Arra Inc	10	DC to 18 DC to 12 12 to 18	 ±1.0 ±2.0	
N9412-20	Arra Inc	20	DC to 18 DC to 12 12 to 18	 ±1.5 ±2.0	
P382A	Hewlett-Packard	0 to 50	12.4 to 18	±2% of setting or ±0.1 dB whichever is greater	<1.0
R382A	Hewlett-Packard	0 to 50	26.5 to 40	±2% of setting or ±0.1 dB whichever is greater	<1.0
TAD50A	Telonic	0 to 110[3]	DC to 0.9		
		0 to 10	0.03 0.4 0.9	±0.15 ±0.3 ±0.5	≤0.1 ≤0.5 ≤0.7
		11 to 110	0.03 0.4 0.9	±3% + 0.15 dB. ±5% + 0.3 dB ±8% + 0.5 dB	
TG950A	Telonic	0 to 102[3]	DC to 0.3		≤0.8 dB/100 MHz
			DC to 0.05	±1% or 0.05 dB whichever is greater	
			0.05 to 0.2	±1% or 0.2 dB whichever is greater	
			0.2 to 0.3	±0.5/step	
U175AFl0DB	Microlab/FXR	10	26.5 to 40	±0.3	
U175AF20DB	Microlab/FXR	20	26.5 to 40	±0.5	
V727	Narda	0 to 20	26.5 to 40		≤0.5
		0 to 10		±1.0	
		10 to 20		±1.5	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
WC-20-20 (7913121-3)		20	DC to 12.4	±5%	
W175A20DB	Microlab/FXR	20	7.05 to 10	±0.5	
X175A10DB	Microlab/FXR	10	8.2 to 12.4	±0.3	
Xl75A20DB	Microlab/FXR	20	8.2 to 12.4	±0.5	
X370B	Hewlett-Packard	6	8.2 to 12.4	±20%	
X370C	Hewlett-Packard	10	8.2 to 12.4	±20%	
X382A (7909033)	Hewlett-Packard	10 to 50	8.2 to 12.4	±12.4% of setting or ±0.1 dB whichever is greater	≤1.0
Y175A10DB	Microlab/FXR	10	12.4 to 18	±0.3	
Y175A20DB	Microlab/FXR	20	12.4 to 18	±0.5	
0880-3100 (7913358-1-2)	General Radio	6	DC to 12.5 At DC DC to 5 5 to 12.5	 ±0.04 ±0.3 ±0.4	
0880-3110 (7913358-2-2)	See General Radio 0880-3100				
1 A-20	Weinschel	20	DC to 12.4	±0.5	
1 A-3	Weinschel	3	DC to 12.4	±0.3	
1 A-6	Weinschel	6	DC to 12.4	±0.3	
1	Weinschel	See 1-10, 1-20, 1-3,1-30, and 1-6			
1-10N (7911956)	Weinschel	10	DC to 12.4	±0.5	
1-10	Weinschel	10	DC to 12.4	±0.5	
1-20N	Weinschel	20	DC to 12.4	±0.5	
1-20	Weinschel	20	DC to 12.4	±0.5	
1-3N	Weinschel	3	DC to 12.4	±0.3	
1-3	Weinschel	3	DC to 12.4	±0.3	
1-30	Weinschel	30	DC to 12.4	±0.75	
l-6N	Weinschel	6	DC to 12.4	±0.3	
1-6	Weinschel	6	DC to 12.4	±0.3	
1/432A	Kay Elemetrics	0 to 22.1 At 22.1	DC to 0.250 DC to 0.1 0.1 to 0.250	 ±5% ±10%	≤0.1
1100A	PRD Electronics	3	0 to 4.0	±1.0	
1100C (8520731)	PRD Electronics	10	0 to 4.0	±1.0	
11708A	Hewlett-Packard	30	At 50 MHz	±0.05	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
118A4	Narda	See 777C-3, 777C-6, 777C-10, and 777C-20			
119A4	Narda	See 757C-3, 757C-6, 757C-10, and 757C-20			
130C	PRD Electronics	10	7.05 to 10	±1.2	
130D	PRD Electronics	20	2.4 to 10	±1.2 at 4 GHz ±2.0 at all other frequencies	
13534006	Weinschel	40	DC to 4 4 to 8.5	±0.4 ±0.75	
190-599	Weinschel	50	DC to 18	±1.0	
2-10DB	Weinschel	10	DC to 18	±0.5	
2-20DB	Weinschel	20	DC to 18	±0.5	
2-3DB	Weinschel	3	DC to 18	±0.3	
2-30DB	Weinschel	30	DC to 18	±1.0	
2-6DB	Weinschel	6	DC to 18	±0.3	
20-0	Kay Elemetrics	0 to 41	DC to 0.5 DC to 0.25 0.25 to 0.5	 ±0.5 ±1.2	 ≤0.1 ≤0.2
210-10	Weinschel	10	1 to 12.4 4 1 10	 ±0.1[7] -1.1[8] ±0.5[8]	
210-20	Weinschel	20	2 to 12.4 4 2 10	 ±0.2[7] -1.3[8] +1.0[8]	
210-3	Weinschel	3	0.6 to 12.4 4 1 10	 ±0.1[7] -0.2[8] +0.2[8]	
210-6	Weinschel	6	1 to 12.4 4 1 10	 ±0.1[7] -0.5[8] +0.3[8]	
212-1	Weinschel	1	0.4 to 12.4 4 1 10	 ±0.1[7] -0.2[8] +0.2[8]	
212-2	Weinschel	2	0.5 to 12.4 4 1 10	 ±0.1[7] -0.2[8] +0.2[8]	
212-3	Weinschel	3	0.6 to 12.4 4 1 10	 ±0.1[7] -0.2[8] +0.2[8]	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
212-4	Weinschel	4	1 to 12.4 4 1 10	 ±0.1[7] -0.3[8] +0.3[8]	
212-5	Weinschel	5	1 to 12.4 4 1 10	 ±0.1[7] -0.4[8] +0.3[8]	
212-6	Weinschel	6	1 to 12.4 4 1 10	 ±0.1[7] -0.5[8] +0.3[8]	
212-7	Weinschel	7	1 to 12.4 4 1 10	 ±0.1[7] -0.6[8] +0.4[8]	
212-8	Weinschel	8	1 to 12.4 4 1 10	 ±0.1[7] -0.8[8] +0.5[8]	
212-9	Weinschel	9	1 to 12.4 4 1 10	 ±0.1[7] -1.0[8] +0.5[8]	
212-10	Weinschel	10	1 to 12.4 4 1 10	±0.1[7] -1.1[8] +0.5[8]	
212-20	Weinschel	20	2 to 12.4 4 2 10	 ±0.2[7] -1.3[8] +1.0[8]	
2701	Tektronix	0 to 79	DC to 1		≤-(0.5 + 0.14 dB/100 MHz)
		Units error		+0.1 to -0.5	
		Max error		+0.1 to -0.7	
		1	0.01 to 1	+0.31 -0.71	
		2		+032 -0.72	
		4		+033 -1.02	
		8		+0.36 -1.34	
		10		±0.58	
		20		±0.66	
		30		±0.74	
		40		±0.92	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
2936 (7913175)	Narda	5 to 90	.950 to 1.25	9	
		5 to 20		±0.5	
		20 to 40		±0.3	
		40 to 70		±0.5	
		70 to 90		±0.75	
30-0	Kay Elemetrics	0 to 101[3]	DC to 0.5 DC to 0.25 0.25 to 0.5	 ±1.0 ±2.0	 ≤0.1 ≤0.2
31-0	Kay Elemetrics	(70Ω) See Kay Elemetrics 30-0			
32-0	Kay Elemetrics	(70W) See Kay Elemetrics 30-0			
3282-6173-10	Omni Spectra	10	Dc to 4	±0.3	
33321A	Hewlett-Packard	0 to 70	DC to 4	±1.7% of setting or ±0.4 dB whichever is greater	≤0.4 dB +0.07 dB/GHz
33322A	Hewlett-Packard	0 to 110[3]	DC to 4	±1.7% of setting or whichever is greater	≤0.6 dB +0.09 dB/GHz
354A	Hewlett-Packard	0 to 60	DC to 12.4	±2	≤1.5
355A	Hewlett-Packard	0 to 12	DC to 0.5 At DC At 0.06 At 0.25 At 0.5 At 1 kHz DC to 0.5	 ±0.1 ±0.25	 0 ≤0.4 ≤1.0 ≤1.5
355B	Hewlett-Packard	0 to 120[3]	DC to 0.5 At DC At 0.06 At 0.25 At 0.5 At 1 kHz DC to 0.5	 ±0.3	 ≤0.4 ≤1.0 ≤1.5
		0 to 60	DC to 025	±1.0	
		0 to 120[3]	DC to 0.5	±2.0	
355C[2]	Hewlett-Packard	0 to 12	DC to 1 At 1kHz DC to 0.5 0.5 to 1	 ±0.1 ±0.25 ±0.35	≤0.11 dB +1.39 dB/GHz
355D[2]	Hewlett-Packard	0 to 90	< 1GHz	±1.5	<0.11 dB +1.39 dB/GHz

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		90 to 120[3]	< 1GHz	±3.0	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
3750A	Hewlett-Packard (75Ω)	0 to 99	DC to 0.4 At 0.01 At 0.5 At 0.1		 ≤0.1 ≤0.04 ≤0.6
	Cumulative	Units Tens 0 to 79 0 to 89 0 to 99	DC to 0.1	±0.1 ±0.2 ±0.5[5] ±1.0 ±2.0	
	Cumulative	Units Tens 0 to 89	0.1 to 0.2	±0.2 ±1.0 ±2.0	
	Cumulative	Units Tens 0 to 79	0.2 to 0.4	±0.2 ±1.0 ±2.0	
4108-3DB	ITT Electronics	3	DC to 8	±0.5	
4108-6DB	ITT Electronics	6	DC to 8	±0.5	
4108-10DB	ITT Electronics	10	DC to 8	±0.5	
4108-20DB	ITT Electronics	20	DC to 8	±0.5	
432D	Kay Elemetrics	0 to 101[3]	DC to 1 DC to 0.25 0.25 to 0.5 0.5 to 1	 ±0.65 ±1.2 ±2.0	 <0.1 <0.2 <0.4
44-6	Weinschel	6	DC to 18	±0.3	
44-60	Weinschel	60	DC to 18	±1.5	
442D	Kay Elemetrics[3] (75Ω)	0 to 101[3]	DC to 1 DC to 0.25 0.25 to 0.5 0.5 to 1	 ±1.0 ±1.2 ±2.0	 <0.1 <0.2 <0.4
464A (MIS-10263)	Kay Elemetrics	See RLC Electronics A2648B			
467A	Kay Elemetrics	0 to 12	DC to 1.5 DC to 1 1 to 1.5	 ±0.3 ±0.5	≤0.05 dB/100 MHz
50-1	Weinschel	1	DC to 3.0	±0.2	
50-10	Weinschel	10	DC to 3.0	±0.2	
50-2	Weinschel	2	DC to 3.0	±0.2	
50-20	Weinschel	20	DC to 3.0	±0.2	
50-3	Weinschel	3	DC to 3.0	±0.2	
50-6	Weinschel	6	DC to 3.0	±0.2	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
50CV120-726	Alan Inc	0 to 120[3]	DC to 1 DC to 0.1 0.1 to 0.5 0.5 to 1	±0.5 or ±1% whichever is greater	 ≤0.2 ≤0.75 ≤1.5
50MP30-864 (7916821-5)	Alan Inc	30	DC to 18	±1.0	
50TA101-377	Alan Inc	Limited	DC to 1 At 0.5		±1.0
		1 to 10 At 20	DC to 1	±0.25 ±2.0	
512	Waveline	0 to 40	7.05 to 10	±0.2[5]	≤0.5
530A-10	Weinschel	10	1 to 12.4 4 1 10	 ±0.1[7] -0.8[8] +0.4 -0.1[8]	
530A-20	Weinschel	20	2 to 12.4 4 1 10	 ±0.2[7] -0.9[7] +0.4 -0.1[8]	
530A-3	Weinschel	3	0.6 to 10 4 1 10	 ±0.1[7] -0.2[8] +0.2 -0.1[8]	
530A-6	Weinschel	6	1 to 10 4 1 10	 ±0.1[7] -0.4[8] +0.2 -0.1[8]	
530-3	Weinschel	3	0.6 to 12.4 4 1 10	 ±0.1[7] -0.2[8] +0.2 -0.1[8]	
530-7	Weinschel	7	1 to 12.4 4 1 10	 ±0.1[7] -0.6[8] +0.3 -0.1[8]	
60562	Waveline	0 to 60	8.2 to 12.4		1 dB maximum 0.5 dB typical
		0 to 50		±2% of setting or 0.1 dB whichever is greater	
		50 to 60		REF only	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
611	Waveline	0 to 30	8.2 to 12.4	±0.5	≤0.5
612DR	Telonic	0 to 40	8.2 to 12.4	±0.5	≤0.5
702	Narda	0 to 90	DC to 12.4		
		0		±0.4	
		10		±0.5	
		20		±0.7	
		30		±0.9	
		40		±1.0	
		50		±1.2	
		60		±1.3	
		70		±1.5	
		80		±1.5	
		90		±1.5	
711	Waveline	0 to 30	12.4 to 18	±0.5	≤0.5
749B	Narda	0 to 40	12.4 to 18	±0.3	≤0.5
757-10	Narda	10	1 to 12.4 At 1 At 2 At 3 At 7 At 12.4	±0.17 +0 -1.1 +0 -0.7 ±1.0 +0.6 -0.1 +1.3 -0	
757-20	Narda	20	2 to 12.4 At 2 At 3 At 7 At 12.4	±0.27 +0 -1.2 ±0.2 +1.3 -0.2 +1.9 -0	
757-3	Narda	3	.6 to 12.4 At 1 At 2 At 3 At 7 At 12.4	±0.17 +0 -0.3 +0 -0.2 1.0 +0.2 -0.1 +0.5 -0	
757-6	Narda	6	1 to 12.4 At 1 At 2 At 3 At 7 At 12.4	±0.17 +0 -0.6 +0 -0.5 ±0.1 +0.4 -0.1 +0.7 -0	
757B-6	Narda	6	DC to 12.4 DC to 3 3 to 6 6 to 12.4	 ±0.3 ±0.5 ±1.0	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
757C10	Narda	10	DC to 12.4		
			DC to 6	±0.3	
			6 to 12.4	±0.5	
757C20	Narda	20	DC to 12.4		
			DC to 6	±0.3	
			6 to 12.4	±0.5	
757C3	Narda	3	DC to 12.4	±0.3	
757C40	Narda	40	DC to 12.4		
			DC to 6	±1.0	
			6 to 12.4	±1.25	
757C6	Narda	6	DC to 12.4	±0.3	
765-10	Narda	10	DC to 5		
			DC to 3	±0.30	
			3 to 5	±0.50	
765-20	Narda	20	DC to 5		
			DC to 3	±0.30	
			3 to 5	±0.50	
766-10	Narda	10	DC to 4		
			DC to 3	±0.25	
			3 to 4	±0.50	
766-20	Narda	20	DC to 4		
			DC to 3	±0.25	
			3 to 4	±0.50	
766-3	Narda	3	DC to 4		
			DC to 3	±0.25	
			3 to 4	±0.50	
768-10	Narda	10	DC to 11		
			DC to 3	±0.25	
			3 to 6	±0.50	
			6 to 11	±0.75	
768-20	Narda	20	DC to 11		
			DC to 3	±0.25	
			3 to 6	±0.50	
			6 to 11	±0.75	
768-3	Narda	3	DC to 11		
			DC to 3	±0.25	
			3 to 6	±0.50	
			6 to 11	±0.75	
768-30	Narda	30	DC to 11		
			DC to 3	±0.25	
			3 to 6	±0.50	
			6 to 11	±0.75	
769-30	Narda	30	DC to 6		
			DC to 2	±0.4	
			2 to 6	±0.75	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
773-20	Narda	20	DC to 6 DC to 2 2 to 6	 ±0.3 ±0.5	
773-3	Narda	3	DC to 6 DC to 3 3 to 6	 ±0.3 ±0.5	
773-6	Narda	6	DC to 6 DC to 2 2 to 6	 ±0.3 ±0.5	
777-40	Narda	40	DC to 12.4 DC to 3 3 to 10 10 to 12.4	 ±0.40 ±0.75 ±0.75	
777C10	Narda	10	DC to 12.4 DC to 6 6 to 12.4	 ±0.2 ±0.4	
777C20	Narda	20	DC to 12.4 DC to 6 6 to 12.4	 ±0.2 ±0.3	
777C3	Narda	3	DC to 12.4	±0.2	
777C6	Narda	6	DC to 12.4 DC to 6 6 to 12.4	 ±0.2 ±0.3	
779-20	Narda	20	DC to 18 DC to 12.4 12.4 to 18	 ±0.5 ±0.7	
779-3	Narda	3	DC to 18	±0.3	
779-6	Narda	6	DC to 18	±0.3	
7909033	See Hewlett-Packard X382A				
7911956	See Weinschel 1-10N				
7913121-3		20	DC to 12.4	±5%	
7913122-1-4	See Microlab X175A20dB				
7913122-2-4	See Microlab Y175A20dB				
7913175	See Narda 2936				
7913358-1-2	See General Radio 0880-3100				
7913358-2-2	See General Radio 0880-3110				
7916821-1		3	DC to 18	±0.3	
7916821-2		6	DC to 18	±0.3	
7916821-3		10	DC to 18	±0.5	
7916821-4		20	DC to 18	±0.5	
7916821-5		30	DC to 18	±1.0	
7916821-6		40	DC to 18	±1.0	
7916821-7		50	DC to 18	±1.25	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
7916821-8		60	DC to 18	±1.5	
794FM	Narda	0 to 40	6 to 10	±1.5	≤1.5
8144A-102	Telonic	See MIS-38936			
8322	Bird Electronics		DC to 0.5	±0.5	
8323	Bird Electronics	30	DC to 0.5	±0.5	
8325	Bird Electronics	30	DC to 0.5	±0.5	
8329	Bird Electronics	30	DC to 0.5	±0.5	
839	Kay Electronics	0 to 101[3]	DC to 3		
		1.0 to 20 dB steps	DC to .25	±0.1	≤0.2
		1.0 to 20 dB steps	DC to .25	±0.1	≤0.2
		1.0 to 10 dB steps	.25 to 1	±0.2	≤0.4
		20 dB steps	.25 to 1	±0.3	
		1.0 to 10 dB steps	1 to 2	±0.3	≤0.7
		20 dB steps	1 to 2	±0.5	
		1.0 to 10 dB steps	2 to 3	±0.6	≤1.0
		20 dB steps	2 to 3	±0.8	
8491B10	Hewlett-Packard	10	DC to 18	±0.6	
8491B20	Hewlett-Packard	20	DC to 18 DC to 12.4 12.4 to 18	 ±0.6 ±1.0	
8492B3	Hewlett-Packard	3	DC to 18 DC to 12.4 12.4 to 18	 ±0.3 ±0.4	
8491B30	Hewlett-Packard	30	DC to 18	±1.0	
8491B6	Hewlett-Packard	6	DC to 18 DC to 12.4 12.4 to 18	 ±0.4 ±0.5	
8492A003	3		DC to 18 DC to 12.4 12.4 to 18	 ±0.3 ±0.4	
8492A006	Hewlett-Packard	6	DC to 18 DC to 12.4 12.4 to 18	 ±0.4 ±0.5	
8492A010	Hewlett-Packard	10	DC to 18	±0.6	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
8492A020	Hewlett-Packard	20	DC to 18 DC to 12.4 12.4 to 18	 ±0.6 ±1.0	
8494A-OPT002	Hewlett-Packard	0 to 11	DC to 4.0		
		1		±0.2	<0.6 dB + 0.09 dB/ GHz
		2		±0.2	
		3		±0.3	
		4		±0.3	
		5		±0.3	
		6		±0.3	
		7		±0.4	
		8		±0.4	
		9		±0.4	
		10		±0.4	
		11		±0.5	
8494B	Hewlett-Packard	0 to 11	DC to 18		<0.6 dB + 0.09 dB/GHz
		1	DC to 12.4 12.4 to 18	±0.3 ±0.7	
		2	DC to 12.4 12.4 to 18	±0.3 ±0.7	
		3	DC to 12.4 12.4 to 18	±0.4 ±0.7	
		4	DC to 12.4 12.4 to 18	±0.4 ±0.7	
		5	DC to 12.4 12.4 to 18	±0.5 ±0.7	
		6	DC to 12.4 12.4 to 18	±0.5 ±0.8	
		7	DC to 12.4 12.4 to 18	±0.6 ±0.8	
		8	DC to 12.4 12.4 to 18	±0.6 ±0.8	
		9	DC to 12.4 12.4 to 18	±0.6 ±0.8	
		10	DC to 12.4 12.4 to 18	±0.6 ±0.9	
		11	DC to 12.4 12.4 to 18	±0.7 ±0.9	

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Model number	Manufacturer	Nominal attenuation (dB)	Frequency range (GHz)[1]	Accuracy (dB)	Insertion loss at 0 dB (dB)
8494B001	Hewlett-Packard	See 8494B			
8495B001	Hewlett-Packard	0 to 70	DC to 12.4 12.4 to 18	±3% of setting ±4% of setting	±0.4 dB +0.07 dB/GHz
8495D	Hewlett-Packard	0 to 70	DC to 26.5 DC to 12.4 12.4 to 18 18 to 26.5	 ±3% of setting ±4% of setting ±7% of setting	±0.5 dB +0.13 dB/GHz
8496A001	Hewlett-Packard	0 to 110[3]	DC to 4	±1.7% of setting or ± 0.4 dB whichever is greater	±0.6 dB +0.9 dB/GHz
8496B	Hewlett-Packard	0 to 110[3]	DC to 18 DC to 12.4 12.4 to 18	 ±3% of setting ±4% of setting	±0.6 dB +0.9 dB/GHz
8420731	See PRD Electronics 1100C				
9918-3[2]	Weinschel	3	DC to 18	±0.3	
9918-6[2]	Weinschel	6	DC to 18	±0.3	
9918-10[2]	Weinschel	10	DC to 18	±0.5	
9918-20[2]	Weinschel	20	DC to 18	±0.5	
9918-30[2]	Weinschel	30	DC to 18	±1.0	
9918-60[2]	Weinschel	60	DC to 18	±1.5	

[1]Not calibrated below 10 MHz using this TB.

[2]Prepare test report for this item using receiver system indications for system codes: U04, U06, U10, U11, Ul2, and F00

[3]Not checked below -100 dB.

[4]Accuracy of receiver system (Weinschel, Model VM4) must be considered as well as losses associated with any adapter used.

[5]Some attenuation settings ($\geq$30 dB) will result in accuracy ratios between standard and TI to be < <4:1.

[6]The frequency of this item is Code A ±124 MHz. The actual frequency is classified.

[7]From value on body or shown on correctional chart.

[8]Deviation from value measured at 4 GHz.

[9]Provide calibration chart at 1 GHz giving attenuation every 1 dB up to 20 dB and every 5 dB from 20 to 70 dB. Accuracy of calibration chart will not be less than ±0.05 dB/10 dB.

APPENDIX B

NOTE

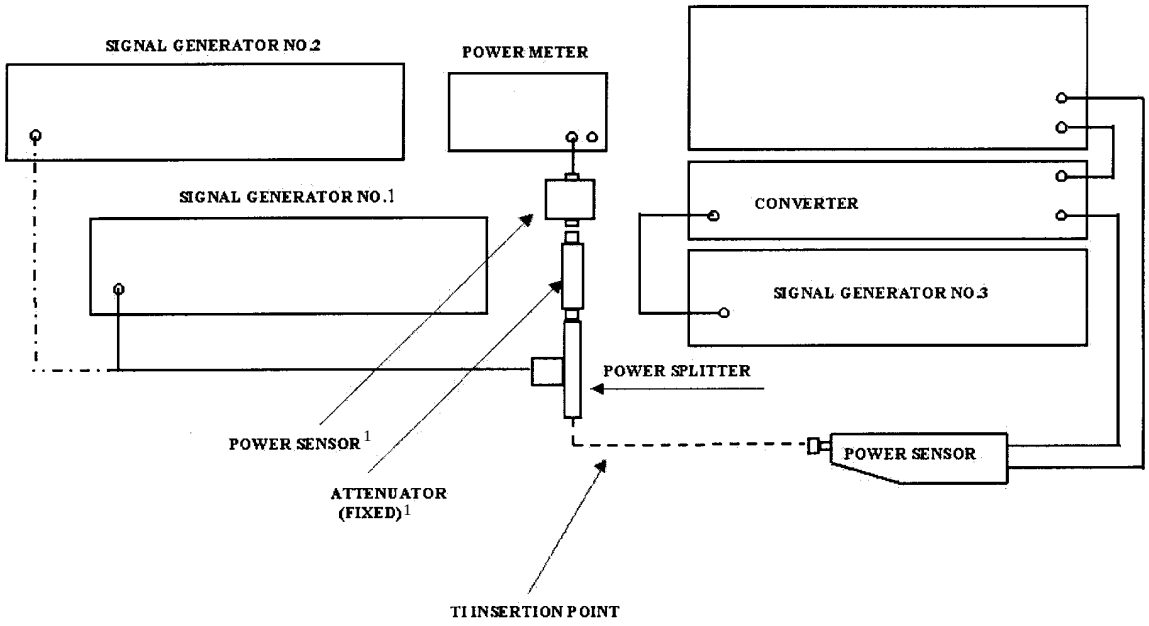
Software package USATA 001-PDMAT (V) can be used in place of steps **1a**(1) through **1a**(31) below, verifying that the TI meets or exceeds accuracies listed in appendix A. Copies of the software package are available from Commander, U. S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-LW, Redstone Arsenal, AL 35898-5000.

1. Alternate Fixed Attenuation Measurement (10 MHz to 18 GHz)

a. Performance Check

NOTE

When performing the following steps, if TI frequency range extends above and below 2 GHz, it will be necessary to perform two separate tests - one below and one above 2 GHz.



[1]For frequencies below 50 MHz, use power sensor 8482A and a 10 dB attenuator. For frequencies above 50 MHz, use power sensor 8485D and a 30 dB attenuator.

Figure 4. Alternate attenuation measurement (10 MHz to 18 GHz equipment setup.

APPENDIX B

(1) Zero and calibrate power meter and measuring receiver RF POWER, then connect equipment as shown in figure 4.

(2) Record the 10 test frequencies selected in paragraph **7a** in to the test frequencies column of table B1.

(3) Adjust signal generator No. 1 (No. 2) frequency controls to test frequency recorded in table B1 and adjust signal generator No. 1 (No. 2) RF output controls for +6 dBm.

NOTE
Use adapters as needed.

NOTE
Use waveguide to coaxial adapters when TI is waveguide.

NOTE
Use 50Ω to 75Ω or 50Ω to 93Ω adapters when TI is 75Ω or 93Ω.

(4) Press **4.0 SPCL** keys and, if the **AUTO TUNING** indicator light is off, press the measuring receiver **FREQ** and **BLUE** (**SHIFT**) **AUTO TUNING** keys.

NOTE
For frequencies below 2 GHz proceed to step (8).

NOTE
For frequencies 2 GHz and above, proceed to step (6) below. For frequencies from 1.3 to 2 GHz the offset frequency should be 620.53 MHz above that of signal generator No. 2. For frequencies above 2 GHZ the offset frequency should be 120.53 MHz above that of signal generator No. 2.

(5) Enter the test frequency into the measuring receiver and press the **MHz** key.

(6) Calculate and record the proper offset frequency and record it as the 'Offset Frequency' in table B1 alongside the appropriate test frequency. Set signal generator No. 3 to produce a +8 dB output at offset frequency.

APPENDIX B

Table B1

Test frequency	Offset frequency	Power meter reading	Init dB reading	First cal point	Second cal point	First RF cal fac (%)	Second RF cal fac (%)	Set ref cal fac (%)

(7) Press measuring receiver **27.3 SPCL** keys, enter the offset frequency from table B1, and press the **MHz** key.

(8) Press the **GOLD** (**S**) **TUNED RF LEVEL**, **39.9**, **SPCL**, **3.7 SPCL**, and **1.9 SPCL** keys then press the **LOG/LIN** key for dBm units.

(9) Note the power meter reading and record it as 'Power Meter Reading' in table B1 alongside the appropriate test frequency.

(10) Note the measuring receiver reading and record it as 'Init dB' reading in table B1 alongside the appropriate test frequency.

(11) Press the TI **BLUE** (**SHIFT**) key, then the **SET REF** (**ZERO**) key.

(12) Calculate the first cal point using the formula -40 + signal generator No.1 (No.2) output level - Init dB reading. (Example -40 dBm + (6 dBm) - (-1 dBm) = -33 dBm). Record this value, as 'First Cal Point' in table B1 alongside the appropriate test frequency.

(13) Set signal generator No. 1 (No.2) to the level calculated in (12) above and press the **CALIBRATE** key.

(14) Calculate the second cal point using the formula -80 + signal generator No. 1 (No. 2) output level -40 dBm to result of step (12). (Example -80 dBm + (6 dBm) - (-1 dBm) = -73 dBm). Record this value, as 'Second Cal Point' in table B1 alongside the appropriate test frequency.

(15) Set signal generator No. 1 (No. 2) to the level calculated in (14) above and press the **CALIBRATE** key.

(16) Set signal generator No. 1 (No. 2) to the initial level of +6 dBm.

(17) Press **38.2** and **SPCL** keys and record the displayed value as 'First RF CAL FAC' in table B1 alongside the appropriate test frequency.

(18) Press **38.3** and **SPCL** keys and record the displayed value as 'Second RF CAL FAC' in table B1 alongside the appropriate test frequency.

(19) Press **38.4** and **SPCL** keys and record the displayed value as 'Set Ref CAL FAC' in table B1 alongside the appropriate test frequency.

(20) Repeat steps (3) through (19) for each of the test frequencies in table B1.

(21) Press the **FREQ** and **BLUE** (**SHIFT**) **AUTO TUNING** keys.

(22) Set signal generator No. 1 (No. 2) to appropriate test frequency listed in table B1.

(23) Press the **GOLD** (**S**) and **TUNED RF LEVEL**, **26.1** and **SPCL** keys.

NOTE

For frequencies below 2 GHz proceed to step (25) below.

(24) Press **27.3 SPCL**, enter the appropriate offset frequency from table B1 and press the **MHz** key. (Ignore the displayed frequency reading.)

(25) Set signal generator No. 3 for an output of +8 dBm and the appropriate offset frequency from table B1.

(26) Connect the attenuator at the INSERTION POINT as shown in figure 4.

(27) Adjust signal generator No. 1 (No. 2) for a power meter indication as recorded in table B1 as 'Power Meter Reading'.

(28) Press **39.2 SPCL** and enter the 'First RF Cal Fac' from table B1 for the appropriate frequency, and press the **BLUE** (**SHIFT**) **% CAL FACTOR B** (**MHz**) keys.

(29) Press **39.3 SPCL** and enter the 'Second RF Cal Fac' from table B1 for the appropriate frequency, and press the **BLUE** (**SHIFT**) **% CAL FACTOR** (**MHz**) keys.

(30) Press **39.4 SPCL**, enter the 'Set Ref Cal Fac' from table B1 for the appropriate frequency, and press the **BLUE** (**SHIFT**) **% CAL FACTOR** (**MHz**) keys.

(31) Measure and record receiver system indication. Measured attenuation will be within range and accuracies specified in appendix A for TI being calibrated.

(32) Repeat (21) through (24) and (26) through (30) above for remaining test frequencies recorded in table B1 above.

b. Adjustments. No adjustments can be made; however, a correction chart may be prepared listing actual receiver system indications at frequencies of interest.

APPENDIX C

NOTE

Software package USATA 001-PDMAT (V) can be used in place of steps **1a**(1) through **1a**(35) below, verifying that the TI meets or exceeds accuracies listed in appendix A. Copies of the software package are available from Commander, U. S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-LW, Redstone Arsenal, AL 35898-5000.

1. Alternate Variable Attenuation Measurement (10 MHz to 18 GHz).

a. Performance Check

NOTE

When performing the following steps, if TI frequency range extends above and below 2 GHz, it will be necessary to perform two separate tests - one below and one above 2 GHz.

(1) Zero and calibrate power meter and measuring receiver RF POWER, then connect equipment as shown in figure 4.

(2) Record the 10 test frequencies selected in paragraph **7a** in to the test frequencies column of table C1.

(3) Adjust signal generator No. 1 (No. 2) frequency controls to test frequency recorded in table C1 and adjust signal generator No. 1 (No. 2) RF output controls for +6 dBm.

NOTE

Use adapters as needed.

NOTE

Use waveguide to coaxial adapters when TI is waveguide.

NOTE

Use 50Ω to 75Ω or 50Ω to 93Ω adapters when TI is 75Ω or 93Ω.

(4) If the **AUTO TUNING** indicator light is off, press the measuring receiver **FREQ** and **BLUE** (**SHIFT**) **AUTO TUNING** keys on the measuring receiver.

NOTE

For frequencies below 2 GHz proceed to step (8) below.

APPENDIX C

NOTE

For frequencies 2 GHz and above proceed to step (6) below. For a frequency of 2 GHz the offset frequency should be 620.53 MHz above that of signal generator No. 2. For frequencies above 2 GHZ the offset frequency should be 120.53 MHz above that of signal generator No. 2.

(5) Calculate and record the proper offset frequency and record it as the 'Offset Frequency' in table C1 alongside the appropriate test frequency. Set signal generator No. 3 to produce a +8 dB output at offset frequency.

Table C1

Test frequency	Offset frequency	Power meter reading	Init dB feeding	First cal point	Second cal point	First RF cal fac (%)	Second RF cal fac (%)	Set ref cal fac (%)

(6) Press measuring receiver **27.3 SPCL** key, enter the offset frequency from table C1, and press the **MHz** key.

(7) Press measuring receiver **RF POWER** key. Verify that the RF power mode has been properly calibrated, press **Log/Lin** key for a dB display, and press TI **RATIO** key.

(8) Set the TI to 0 dB or minimum level and connect to the TI INSERTION POINT (figure 4).

(9) Verify that the measuring receiver indication is within the insertion loss specification for the appropriate TI as listed in appendix A.

APPENDIX C

(10) Press the **RATIO** key to deactivate, then press the **GOLD** (**S**) **TUNED RF LEVEL**, **39.9 SPCL**, **3.7 SPCL**, and **1.9 SPCL** keys.

(11) Note the power meter reading and record it as 'Power Meter Reading' in table C1 alongside the appropriate test frequency.

(12) Note the measuring receiver reading and record it as 'Init dB' reading in table C1 alongside the appropriate test frequency.

(13) Press the TI **BLUE** (**SHIFT**) key and then the **SET REF** (**ZERO**) key.

(14) Calculate the first cal point using the formula -40 + signal generator No. 1 (No. 2) output level –Init dB reading. (Example -40 dBm + (6 dBm) - (-3 dBm) = -31 dBm). Record this value, as 'First Cal Point' in table C1 alongside the appropriate test frequency.

(15) Set signal generator No. 1 (No. 2) to the level calculated in (14) above and press the **CALIBRATE** key.

(16) Calculate the second cal point using the formula -80 + signal generator No.1 (No.2) output level –40 dBm to result of step (14). (Example -80 dBm + (6 dBm) - (-3 dBm) = -71 dBm). Record this value, as 'Second Cal Point' in table C1 alongside the appropriate test frequency.

(17) Set signal generator No. 1 (No. 2) to the level calculated in (16) above and press the **CALIBRATE** key.

(18) Set signal generator No. 1 (No. 2) to the initial level of +6 dBm.

(19) Press **38.2** and **SPCL** keys and record the displayed value as 'First RF CAL FAC' in table C1 alongside the appropriate test frequency.

(20) Press **38.3** and **SPCL** keys and record the displayed value as 'Second RF CAL FAC' in table C1 alongside the appropriate test frequency.

(21) Press **38.4** and **SPCL** keys and record the displayed value as 'Set Ref CAL FAC' in table C1 alongside the appropriate test frequency.

(22) Remove TI from setup and repeat steps (4) through (21) for each of the test frequencies in table C1.

(23) Press the **FREQ** and **BLUE** (**SHIFT**) **AUTO TUNING** keys.

(24) Set signal generator No. 1 (No. 2) to appropriate test frequency listed in table C1.

NOTE

For frequencies below 2 GHz proceed to step (27) below.

(25) Press **27.3 SPCL**, enter the appropriate offset frequency from table C1, and press the **MHz** key. (Ignore the displayed frequency reading.)

(26) Set signal generator No. 3 for an output of +8 dBm and the appropriate offset frequency from table C1.

(27) Press the **GOLD** (**S**) and **TUNED RF LEVEL**, **26.1** and **SPCL** keys.

(28) Adjust signal generator No. 1 (No. 2) for a power meter indication as recorded in table C1 as 'Power Meter Reading.'

(29) Press **39.2 SPCL** and enter the First RF Cal Fac from table C1 for the appropriate frequency, and press the **BLUE** (**SHIFT**) **% CAL FACTOR** (**MHz**) keys.

(30) Press **39.3 SPCL** and enter the Second RF Cal Fac from table C1 for the appropriate frequency, and press the **BLUE** (**SHIFT**) **% CAL FACTOR** (**MHz**) keys.

(31) Press **39.4 SPCL** and enter the Set Ref Cal Fac from table C1 for the appropriate frequency, and press the **BLUE** (**SHIFT**) **% CAL FACTOR** (**MHz**) keys.

(32) Increase TI attenuation setting in one step increments (or one cardinal point as desired.)

(33) Measure and record receiver system indication. Measured attenuation will be within range and accuracies specified in appendix A for TI being calibrated.

(34) Repeat (32) and (33) above for remaining TI step increments.

(35) Repeat (23) through (34) above for remaining test frequencies recorded in table C1 above.

b. Adjustments. No adjustments can be made; however, a correction chart may be prepared listing actual receiver system indications at frequencies of interest.

By Order of the Secretary of the Army:

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