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
5 August 2004

TB 9-4931-523-35, 14 May 2003, 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
A7 and A8	A7 and A8
A17 and A18	A17 and A18

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

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Headquarters, Department of the Army, Washington, DC
14 May 2003

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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, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 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 provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use https://amcom2028.redstone.army.mil.

			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
		Fixed attenuation measurement (10 MHz to 18 GHz)	8	8
		Variable attenuation measurement (10 MHz to 18 GHz)	9	9
		Fixed attenuation measurement (18 to 26.5 GHz)	10	10
		Variable attenuation measurement (18 to 26.5 GHz)	11	11

*This bulletin supersedes TB 9-4931-523-35, dated 10 July 2000, including all changes.

			Paragraph	Page
		Fixed attenuation measurement (26.5 to 40 GHz)	12	13
		Variable attenuation measurement (26.5 to 40 GHz)	13	14
		Final procedure	14	15
Appendix	A	Test instrument identification		A-1
Appendix	B	Alternate fixed attenuation measurements (10 MHz to 18 GHz)		B-1
Appendix	C	Alternate variable attenuation measurement (10 MHz to 18 GHz)		C-1

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 that 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, AN/GSM-705 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 Frequency Extension Kit (Secondary Reference only).

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 (11793A), power sensor Hewlett-Packard Model 11722A (11722A), and power sensor Hewlett Packard Model 11792A (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 (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)
RECEIVER SYSTEM	Frequency range: 10 MHz to 18 GHz Attenuation range: 0.0 to 100 dB Accuracy: ±0.02 dB/10 dB	Weinschel, Model VM4A (VM4A)
SIGNAL GENERATOR NO. 1	Frequency range: 0.01 to 40 GHz[4] Power output: +8 dBm, ±1dB Flatness: 10 to 50 MHz: ±2 dB .05 to 18 GHz: ±0.8 dB	Wiltron/Anritsu, Model 68369NV (68369NV)
SIGNAL GENERATOR NO. 2	Frequency range: 0.01 to 18 GHz Power output: +11 dBm, ±1dB Flatness: 10 to 50 MHz: ±2 dB .05 to 18 GHz: ±0.8 dB	Wiltron/Anritsu, Model 68347M (68347M)

[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).
[4]Not calibrated above 18 GHz.

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.).

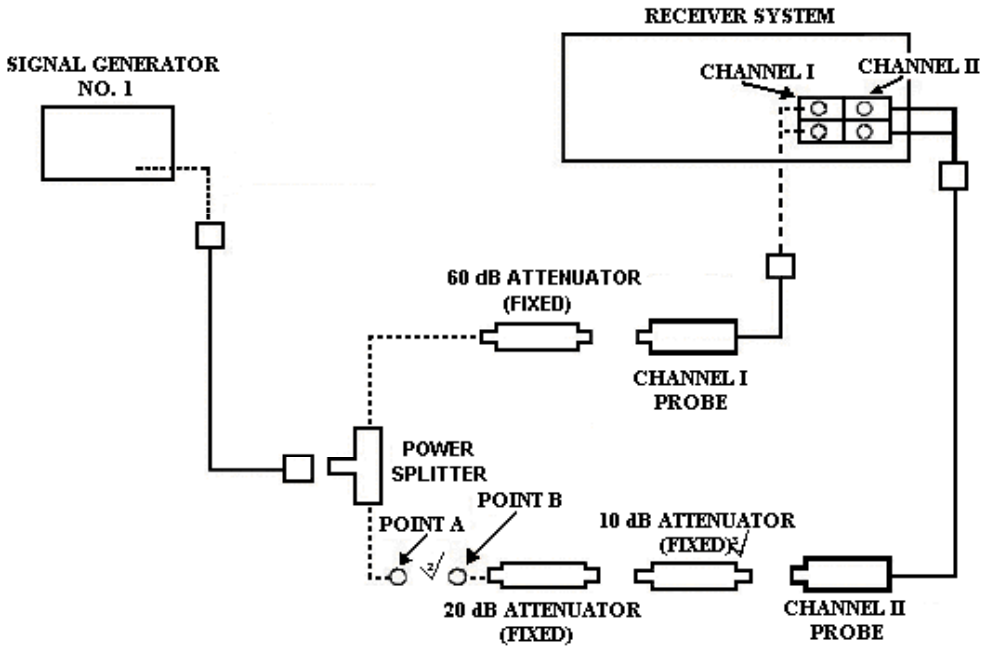
d. Connect equipment as shown in figure 1 and allow equipment to warm up 1 hour before performing paragraph **9** below (appendix C can be used as an alternate to paragraph **9** below.).

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.



[2]Use adapters as needed.

[3]Remove 10 dB attenuator (fixed) from equipment setup when making measurements below -70 dB.

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

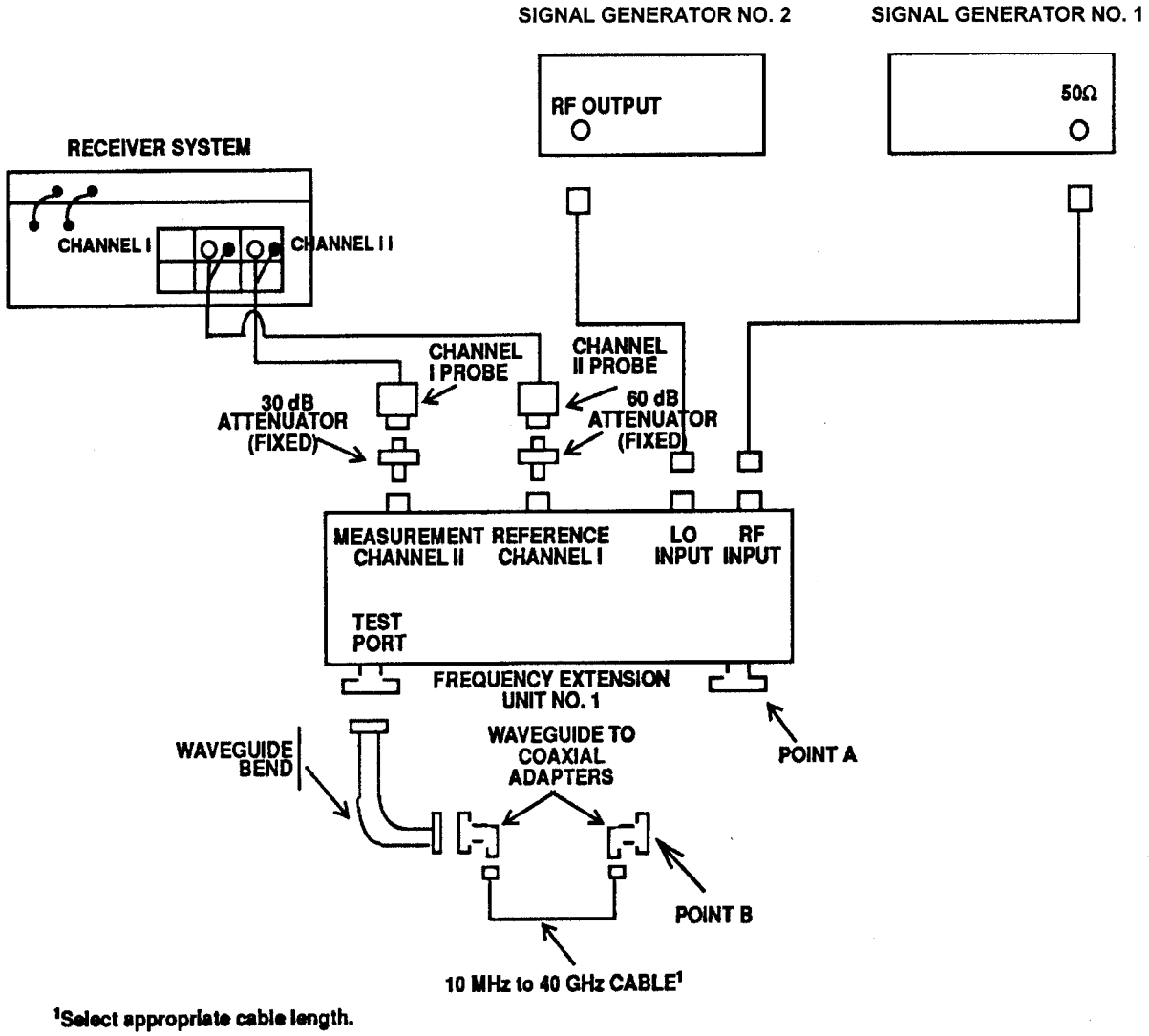


Figure 2. Attenuation measurement (18 to 26.5 GHz) - equipment setup.

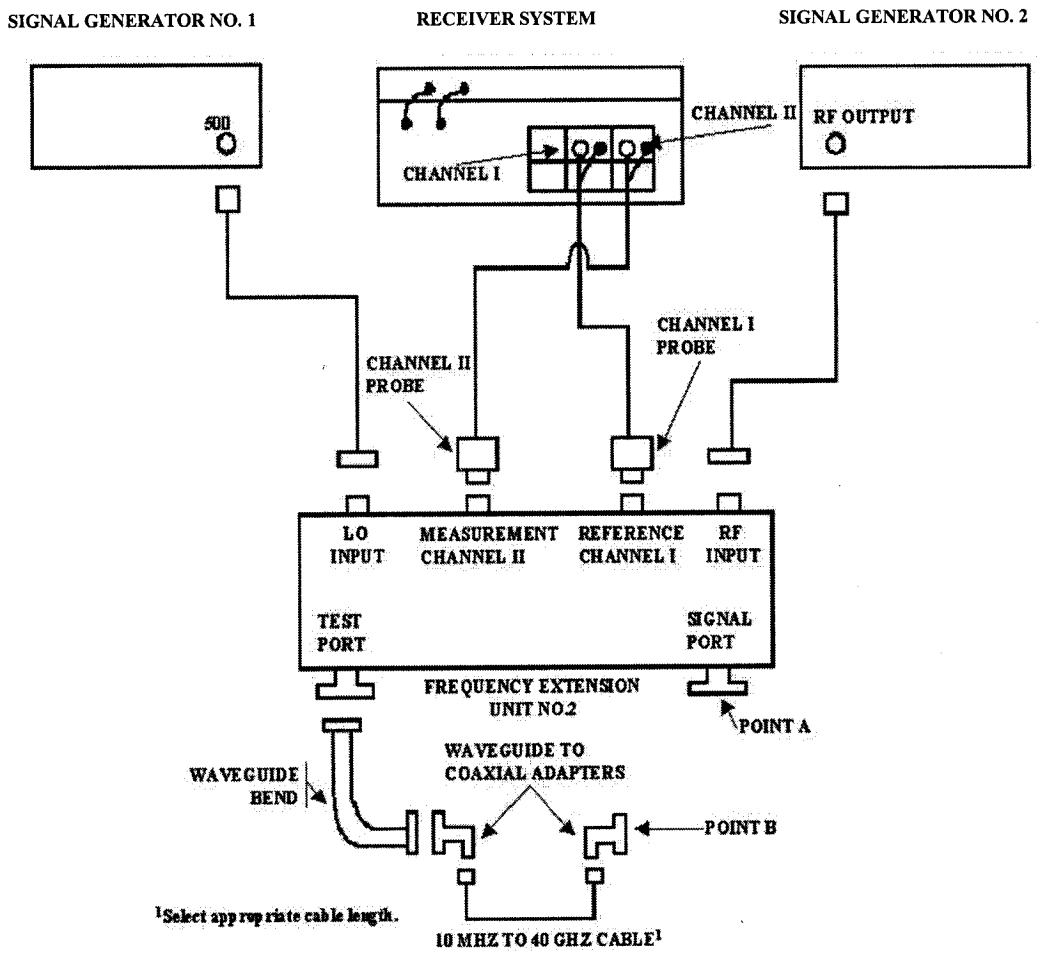


Figure 3. Attenuation measurement (26.5 to 40 GHz) - equipment setup.

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 1.3 GHz, it will be necessary to perform two separate tests - one below and one above 1.3 GHz.

(1) Adjust signal generator No. 1 frequency controls to test frequency recorded in **7a** above and adjust 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 1.3 GHz, it will be necessary to perform two separate tests - one below and one above 1.3 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 frequency controls to test frequency recorded in **7a** above and adjust 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 signal generator No. 1 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 signal generator No. 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 signal generator No. 1 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 signal generator No. 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
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 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 signal generator No. 1 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 = signal generator No. 1 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 signal generator No. 1 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 signal generator No. 1 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	=	signal generator No. 1 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 signal generator No. 1 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)
A200302	Weinschel	10	DC to 18		
			DC to 12.4	±0.3	
			12.4 to 18	±0.5	
A2648B[2] (MIS-10263)	RLC Electronics	0 to 120[3]	DC to 1		
			DC to 0.1		≤0.25
			0.1 to 0.5		≤0.75
			0.5 to 1		≤1.50
		0 to 60	DC to 0.01	±0.15[4]	
		60 to 120[3]		±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	±0.7	
			3 to 4.5	±1.0	
AB30N	Microlab/FXR	30	DC to 4.5		
			DC to 3	±0.7	
			3 to 4.5	±1.0	
AC20N	Microlab/FXR	20	DC to 3	±1.2	
AD06N	Microlab/FXR	6	3 to 4.5	±0.6	
AD10N	Microlab/FXR	10	DC to 4	±0.8	
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	
AN9444-3	Arra	3	DC to 18	±0.3	
AN9444-6	Arra	6	DC to 18	±0.3	
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			
AS5	Weinschel	See Weinschel 1-3, 1-6, 1-10, 1-20			
AS5A	Weinschel	See Weinschel 1-3, 1-6, 1-10, 1-20			
AS6	Weinschel	See Weinschel 2-3, 2-6, 2-10, 2-20			
AS6A	Weinschel	See Weinschel 2-3, 2-6, 2-10, 2-20			

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)
AT201SR[2]	RLC Electronics	0 to 120[3]	DC to 1		
			DC to 0.2	±2% or ±0.5 dB whichever is greater	
			0.25 to 0.5	±3% or ±0.5 dB whichever is greater	
			0.5 to 1.0	±5% or ±0.5 dB whichever is greater	
CN713U		0 to 20	4.4 to 5	±2.0	
CN797U	PRD Electronics	10	2.0 to 10	±0.12	
CN895	Cessna Aircraft	20	DC to 1	±0.5	
CN908U	Hewlett-Packard	See Hewlett-Packard G382A			
CN970U	Hewlett-Packard	See Hewlett-Packard 355C			
FP-50-1	Texscan	1	DC to 2.0		
			DC to 0.5	±0.3	
			0.5 to 1.0	±0.5	
			1.0 to 2.0	±1.0	
FP-50-2	Texscan	2	DC to 2.0		
			DC to 0.5	±0.3	
			0.5 to 1.0	±0.5	
			1.0 to 2.0	±1.0	
FP-50-3	Texscan	3	DC to 2.0		
			DC to 0.5	±0.3	
			0.5 to 1.0	±0.5	
			1.0 to 2.0	±1.0	
FP-50-6	Texscan	6	DC to 2.0		
			DC to 0.5	±0.3	
			0.5 to 1.0	±0.5	
			1.0 to 2.0	±1.0	
FP-50-10	Texscan	10	DC to 2.0		
			DC to 0.5	±0.3	
			0.5 to 1.0	±0.5	
			1.0 to 2.0	±1.0	
FP-50-20	Texscan	20	DC to 2.0		
			DC to 0.5	±0.3	
			0.5 to 1.0	±0.5	
			1.0 to 2.0	±1.0	
FP-50-30	Texscan	30	DC to 0.5	±0.9	

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-50-40	Texscan	40	DC to 0.5	±1.2	
FP-50-50	Texscan	50	DC to 0.5	±1.5	
FP-50-60	Texscan	60	DC to 0.5	±1.8	
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	□1.0
MDC1078B-20	Midisco	20	DC to 4.5		
			4.5	±1.0	
MDC1078B-30	Midisco	30	DC to 12.4		
			12.4	±1.0	
MDC1078S-3	Midisco	3	DC to 3		
			3	±0.3	
MDC1078S-6	Midisco	6	DC to 18	±0.3	
MDC5078S-10	Midisco	10	DC to 18	±0.5	
MDC5078S-20	Midisco	20	DC to 18	±0.7	
MDC5078S-3	Midisco	3	DC to 18	±0.3	
MDC5078S-6	Midisco	6	DC to 18	±0.3	

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)
MDC88014-10	Midisco	10	DC to 12.4		
			DC to 6	±0.2	
			6 to 12.4	±0.4	
MDC89076-10	Midisco	10	DC to 12.4		
			DC to 8	±0.5	
			8 to 12.4	±1.0	
MIS-10263	See RLC Electronics A2648B				
MIS-38936	Telonic Berkeley	0 to 120[3]	DC to 1		≤3.0
		0 to 120	DC to 0.01	±0.30	
		0 to 60	0.01 to 0.1	±0.35[5]	
		60 to 120		±0.70[5]	
		0 to 120	0.1 to 1	±3.00	
		0 to 60	DC to 0.01	±0.05	
			0.01 to 0.1	±0.10	
			0.1 to 1	±0.75	
N9412-10	Arra Inc	10	DC to 18		
			DC to 12	±1.0	
			12 to 18	±2.0	
N9412-20	Arra Inc	20	DC to 18		
			DC to 12	±1.5	
			12 to 18	±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
RFB551-50	Meggitt Avionics	0 to 80	DC to 0.225	±1.6	
TAD50A	Telonic	0 to 110[3]	DC to 0.9		
		0 to10	0.03	±0.15	≤0.1
			0.4	±0.3	≤0.5
			0.9	±0.5	≤0.7
		11 to 110	0.03	±3% + 0.15 dB	
			0.4	±5% + 0.3 dB	
			0.9	±8% + 0.5 dB	

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)
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	
TG950X9	Telonic	See TG950A			
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	26.5to 40		≤0.5
		0 to 10		±1.0	
		10 to 20		±1.5	
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	
011-0085-00	Tektronix	10	DC to 12.4	±1.0	
011-0086-00	Tektronix	20	DC to 12.4	±1.0	
011-0087-00	Tektronix	40	DC to 12.4	±1.5	
0880-3100 (7913358-1-2)	General Radio	6	DC to 12.5		
			At DC	±0.04	
			DC to 5	±0.3	
			5 to 12.5	±0.4	
0880-3110 (7913358-2-2)	General Radio	See 0880-3100			
1	Weinschel	See 1-10, 1-20, 1-3,1-30, and 1-6			
1-10	Weinschel	10	DC to 12.4	±0.5	
1-10N(7911956)	Weinschel	10	DC to 12.4	±0.5	
1-20	Weinschel	20	DC to 12.4	±0.5	
1-20N	Weinschel	20	DC to 12.4	±0.5	
1-3	Weinschel	3	DC to 12.4	±0.3	
1-3N	Weinschel	3	DC to 12.4	±0.3	

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)
1-30	Weinschel	30	DC to 12.4	±0.75	
1044-18N	Midwest Mwave	0 to 69	DC to 18		
			DC to 4		≤0.7
			4 to 12.4		≤1.0
			12.4 to 18		≤1.5
		1 to 9	DC to 18	±0.5	
		10 to 19		±1.0	
		20 to 29		±1.2	
		30 to 39		±1.4	
		40 to 49		±1.5	
		50 to 59		±1.6	
		60 to 69		±1.8	
1100A	PRD Electronics	3	DC to 4.0	±0.3 @ 1.2 GHz	
1100B	PRD Electronics	6	DC to 6.0	±0.5	
1100C (8520731)	PRD Electronics	10	DC to 4.0	±1.0 @ 1.2 GHz	
11708A	Hewlett-Packard	30	At 50 MHz	±0.05	
118A4	Narda	See 777C-3, 777C-6, 777C-10, and 777C-20			
119A4	Narda	See 757C-3, 757C-6, 757C-10, and 757C-20			
12N-10	Inmet Corp	10	DC to 12.4	±0.5	
12N-20	Inmet Corp	20	DC to 12.4	±0.75	
12N-3	Inmet Corp	3	DC to 12.4	±0.3	
12N-6	Inmet Corp	6	DC to 12.4	±0.3	
13534006	Weinschel	40	DC to 4	±0.4	
			4 to 8.5	±0.75	
18N-10	Inmet Corp	10	DC to 18	±0.75	
18N-10S	Inmet Corp	10	DC to 18	±0.75	
18N-20	Inmet Corp	20	DC to 18	±0.75	
18N-30	Inmet Corp	30	DC to 18	±0.75	
18N-6	Inmet Corp	6	DC to 18	±0.3	
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	

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)
20-0	Kay Elemetrics	0 to 41	DC to 0.5		
			DC to 0.25	±0.5	≤0.1
			0.25 to 0.5	±1.2	≤0.2
20-20	Weinschel	20	DC to 18	±0.5	
219-10	Midwest Mwave	10	DC to 18	±0.5	
219-20	Midwest Mwave	20	DC to 18	±0.5	
219-3	Midwest Mwave	3	DC to 18	±0.3	
219-6	Midwest Mwave	6	DC to 18	±0.3	
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 to -0.71	
		2		+032 to -0.72	
		4		+033 to -1.02	
		8		+0.36 to -1.34	
		10		±0.58	
		20		±0.66	
		30		±0.74	
		40		±0.92	
2936 (7913175)	Narda	5 to 90	.95 to 1.25		±9.0
		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	±1.0	≤0.10
			0.25 to 0.5	±2.0	≤0.20
	Kay Elemetrics	See 30-0			
32-0	Kay Elemetrics	See 30-0			
355C[2]	Hewlett-Packard	0 to 12	DC to 1		≤.20 dB+2.30 dB/GHz
			0.0001	±0.1	
			DC to 0.5	±0.25	
			0.5 to 1	±0.35	
355D[2]	Hewlett-Packard	0 to 120[3]	DC to 1		≤.20 dB+2.30 dB/GHz
			0.0001	±0.3	
		0 to 90	< 1GHz	±1.5	
		90 to 120[3]	< 1GHz	±3.0	

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)
3750A	Hewlett-Packard (75Ω)	0 to 99	Dc to 0.1		
			0.05		≤0.1
			0.1		≤0.04
	Cumulative	Units	DC to 0.1	±0.1	
		Tens		±0.2	
		0 to 79		±0.5[5]	
		0 to 89		±1.0	
		0 to 99		±2.0	
389-10	Midwest Mwave	10	DC to 18	±0.5	
389-3	Midwest Mwave	3	DC to 18	±0.3	
3M	Weinschel	1 to 10	DC to 12.4	±0.3	
		20		±0.5	
		30 and 40		±0.75	
		50 and 60		±1.0	
4108-10DB	ITT Electronics	10	DC to 8	±0.5	
4108-20DB	ITT Electronics	20	DC to 8	±0.5	
4108-3DB	ITT Electronics	3	DC to 8	±0.5	
4108-6DB	ITT Electronics	6	DC to 8	±0.5	
432D	Kay Elemetrics	0 to 101[3]	DC to 1		
			DC to 0.25	±0.6	≤0.1
			0.25 to 0.5	±1.2	≤0.2
			0.5 to 1	±2.0	≤0.6
44-20	Weinschel	20	DC to 18	±0.5	
44-30	Weinschel	30	DC to 18	±1.0	
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	±1.0	≤.1
			0.25 to 0.5	±1.2	≤.
			0.5 to 1	±2.0	≤.4
464A (MIS-10263)	Kay Elemetrics	See RLC Electronics A2648B			
467A	Kay Elemetrics	0 to 12	DC to 1.5		≤0.05dB/100 MHz
			DC to 1	±0.3	
			1 to 1.5	±0.5	
49-20-33	Weinschel	20	DC to 8.5		
			DC to 4	±0.4	
			4 to 8.5	±0.7	
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	

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)
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	
50CV120-726	Alan Inc	0 to 120[3]	DC to 1	±0.5 or ±2% whichever is greater	≤1.0
50MP10-1100	Alan Inc	10	DC to 18	±0.5	
50MP30-864	Alan Inc	30	DC to 18	±1.0	
50TA101-377	Alan Inc	0 101	DC to 1	±2.0	≤1.0
50TA102-261	Alan Inc	0 to 102	DC to 0.3		
			DC to 0.1		≤1.0
			0.1 to 0.2		≤1.5
			0.2 to 0.3		≤2.0
			DC to 0.05	±0.05 or 1%	
			0.05 to 0.2	±0.2 or 1%	
			0.2 to 0.3	±0.5	
530-10	Weinschel	10	1 to 12.4		
			4	±0.1	
			1	0, -0.8[8]	
			10	+0.5, -0.1[8]	
530-20	Weinschel	20	2 to 12.4		
			4	±0.2	
			2	0, -0.9[8]	
			10	+0.4, -0.1[8]	
530-3	Weinschel	3	0.6 to 12.4		
			4	±0.1	
			1	0, -0.2[8]	
			10	+0.2 -0.1[8]	
530-7	Weinschel	7	1 to 12.4		
			4	±0.1	
			1	0, -0.6[8]	
			10	+0.3, -0.1[8]	
5729-30	See 44-30				
60562	Waveline	0 to 60	8.2 to 12.4		1 dB max 0.5 dB typical
		0 to 50		±2% of setting or 0.1 dB whichever is greater	
		50 to 60		REF only	
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

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)
64A	Weinschel	0 to 64	DC to 2		
			1		≤0.4
			2		≤0.5
		Range A: 3 to 3.9	1 and 2	±0.7	
		Range B: 1 to 5	1 and 2	±0.12	
		Range B: 6 to 10	1 and 2	±0.15	
		Range C 10 to 50	1 and 2	±0.15 for the 10dB step, ±0.1/10dB +0.1 for 20 to 50dB step	
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	±0.17	
			1	+0 to -1.1	
			2	+0 to -0.7	
			3	±1.0	
			7	+0.6 to -0.1	
			12.4	+1.3 to -0	
757-20	Narda	20	1 to 12.4	±0.27	
			2	+0 to -1.2	
			3	±0.2	
			7	+1.3 to -0.2	
			12.4	+1.9 to -0	
757-3	Narda	3	0.6 to 12.4	±0.17	
			1	+0 to -0.3	
			2	+0 to -0.2	
			3	1.0	
			7	+0.2 to -0.1	
			12.4	+0.5 to -0	
757-6	Narda	6	1 to 12.4	±0.17	
			1	+0 to -0.6	
			2	+0 to -0.5	
			3	±0.1	
			7	+0.4 to -0.1	
			12.4	+0.7 to -0	
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	

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)
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	±0.25	
			3 to 5	±0.5	
765-20	Narda	20	DC to 5		
			DC to 3	±0.25	
			3 to 5	±0.5	
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	
766-30	Narda	30	DC to 4	±0.75	
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	±0.5	
			2 to 6	±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)
773-20	Narda	20	DC to 6		
			DC to 3	±0.3	
			3 to 6	±0.5	
773-3	Narda	3	DC to 6		
			DC to 3	±0.3	
			3 to 6	±0.5	
773-6	Narda	6	DC to 6		
			DC to 3	±0.3	
			3 to 6	±0.5	
777-40	Narda	40	DC to 12.4		
			DC to 3	±0.40	
			3 to 10	±0.75	
			10 to 12.4	±0.75	
777C10	Narda	10	DC to 12.4	±0.3	
777C20	Narda	20	DC to 12.4	±0.3	
777C3	Narda	3	DC to 12.4	±0.3	
777C6	Narda	6	DC to 12.4	±0.3	
779-10	Narda	10	DC to 18		
			DC to 12.4	±0.3	
			12.4 to 18	±0.5	
779-20	Narda	20	DC to 18		
			DC to 12.4	±0.5	
			12.4 to 18	±0.7	
779-3	Narda	3	DC to 18	±0.3	
779-6	Narda	6	DC to 18	±0.3	
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	
7916821-4		20	DC to 18	±0.5	
7916821-5		30	DC to 18	±1.0	
7916821-8		60	DC to 18	±1.5	
793FM	Narda	0 to 20	4 to 8	±1.5	≤1.5
794FM	Narda	0 to 40	4 to 8	±1.5	≤1.5
8144A-102	Telonic	See MIS-38936			
8322	Bird Electronics	30	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	

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)
8329-300	Bird Electronics	30	DC to 0.5	±0.5	
839	Kay Elemetrics	0 to 101[3]	DC to 3		
		1.0 to 20 dB steps	DC to .25	±0.1	≤0.2
		1.0 to 10 dB steps	0.25 to 1	±0.2	≤0.4
		20 dB steps	0.25 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	
84904K	Agilent	0 to 11	DC to 26.5		≤0.8 + .04/GHz
		1	DC to 18	±0.35	
		2		±0.45	
		3 to 6		±0.55	
		7 to 8		±0.60	
		9		±0.65	
		10		±0.70	
		11		±0.80	
		1	18 to 26.5	±0.40	
		2		±0.50	
		3 to 6		±0.70	
		7 to 8		±0.80	
		9		±0.85	
		10		±0.90	
		11		±1.10	
84904L	Agilent	0 to11	DC to 26.5		≤0.8 + 0.04/GHz
		1	DC to 18	±0.35	
		2		±0.45	
		3 to 6		±0.55	
		7 to 8		±0.6	
		9		±0.65	
		10		±0.7	
		11		±0.8	
		1	18 to 26.5	±0.4	
		2		±0.5	
		3 to 6		±0.7	
		7 to 8		±0.8	
		9		±0.85	
		10		±0.9	
		11		±1.1	

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)
84906K	Agilent	0 to 90	DC to 40		≤0.8 + 0.04/GHz
		10		±0.5	
		20		±0.6	
		30		±0.7	
		40		±1.0	
		50		±1.2	
		60		±1.6	
		70		±1.8	
		80		±2.7	
		90		±2.9	
84906L	Agilent	0 to 90	DC to 40		≤0.8 + 0.04/GHz
		10		±0.5	
		20		±0.6	
		30		±0.7	
		40		±1.0	
		50		±1.2	
		60		±1.6	
		70		±1.8	
		80		±2.7	
		90		±2.9	
8490D10DB	Hewlett-Packard	10	DC to 50		
			DC to 26.5	-0.6 to +0.9	
			26.5 to 50	-0.6 to +1.3	
8490D20DB	Hewlett-Packard	20	DC to 50		
			DC to 26.5	-0.8 to+1.3	
			26.5 to 50	-0.8 to +1.7	
8490D3DB	Hewlett-Packard	3	DC to 50		
			DC to 26.5	-0.5 to +0.9	
			26.5 to 50	-0.8 to +1.8	
8490D6DB	Hewlett-Packard	6	DC to 50		
			DC to 26.5	-0.6 to +0.9	
			26.5 to 50	-0.6 to +1.8	
8491A10DB	Hewlett-Packard	10	DC to 12.4	±0.5	
8491A20DB	Hewlett-Packard	20	DC to 12.4	±0.5	
8491A30DB	Hewlett-Packard	30	DC to 12.4	±1.0	
8491A3DB	Hewlett-Packard	3	DC to 12.4	±0.3	
8491A40DB	Hewlett-Packard	40	DC to 12.4	±1.5	

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)
8491A6DB	Hewlett-Packard	6	DC to 12.4	±0.3	
8491B010	Hewlett-Packard	10	See 8491B10		
8491B020	Hewlett-Packard	20	See 8491B20		
8491B030	Hewlett-Packard	30	See 8491B30		
8491B050	Hewlett-Packard	50	DC to 18	±1.5	
8491B10	Hewlett-Packard	10	DC to 18	±0.6	
8491B20	Hewlett-Packard	20	DC to 18		
			DC to 12.4	±0.6	
			12.4 to 18	±1.0	
8491B30	Hewlett-Packard	30	DC to 18	±1.0	
8491B3	Hewlett-Packard	3	DC to 18	±0.3	
8491B40	Hewlett-Packard	40	DC to 18	±1.5	
8491B50	Hewlett-Packard	50	DC to 18	±1.5	
8491B60	Hewlett-Packard	60	DC to 18	±2.0	
8491B6	Hewlett-Packard	6	DC to 18		
			DC to 12.4	±0.3	
			12.4 to 18	±0.54	
8492A003	Hewlett-Packard	3	DC to 18	±0.3	
8492A006	Hewlett-Packard	6	DC to 18		
			DC to 12.4	±0.3	
			12.4 to 18	±0.54	
8492A010	Hewlett-Packard	10	DC to 18	±0.6	
8492A020	Hewlett-Packard	20	DC to 18		
			DC to 12.4	±0.6	
			12.4 to 18	±1.0	
8492A030	Hewlett-Packard	30	DC to 18	±1.0	
8492A040	Hewlett-Packard	40	DC to 18	±1.5	
8492A050	Hewlett-Packard	50	DC to 18	±1.5	

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)
8493A30DB	Hewlett-Packard	30	DC to 12.4	±1.0	
8493B003	Hewlett-Packard	3	DC to 18	±0.3	
8493B006	Hewlett-Packard	6	DC to 18		
			DC to 12.4	±0.3	
			12.4 to 18	±0.4	
8493B010	Hewlett-Packard	10	DC to 18	±0.6	
8493B020	Hewlett-Packard	20	DC to 18		
			DC to 12.4	±0.6	
			12.4 to 18	±1.0	
8493C10	Hewlett-Packard	10	DC to 26.5		
			DC to 12.4	±0.3	
			12.4 to 18	±0.5	
8493C20	Hewlett-Packard	20	DC to 26.5		
			DC to 12.4	±0.5	
			12.4 to 18	±0.6	
8493C3	Hewlett-Packard	3	DC to 26.5		
			DC to 12.4	±0.5	
			12.4 to 18	±1.0	
8493C6	Hewlett-Packard	6	DC to 26.5	±0.6	
8494A	Hewlett-Packard	0 to 11	DC to 4.0	±2%	<0.6 dB +0.09 dB/ GHz
8494A-OPT002	Hewlett-Packard	0 to 11	DC to 4.0		<0.6 dB +0.09 dB/ GHz
				±0.2	
				±0.2	
				±0.3	
				±0.3	
				±0.3	
				±0.3	
				±0.4	
				±0.4	
				±0.4	
				±0.4	
				±0.5	

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)
8494B	Hewlett-Packard	0 to 11	DC to 18		≤0.6 dB +0.09 dB/ GHz
		1	DC to 12.4	±0.3	
			12.4 to 18	±0.7	
		2	DC to 12.4	±0.3	
			12.4 to 18	±0.7	
		3	DC to 12.4	±0.4	
			12.4 to 18	±0.7	
		4	DC to 12.4	±0.4	
			12.4 to 18	±0.7	
		5	DC to 12.4	±0.5	
			12.4 to 18	±0.7	
		6	DC to 12.4	±0.5	
			12.4 to 18	±0.8	
		7	DC to 12.4	±0.6	
			12.4 to 18	±0.8	
		8	DC to 12.48	±0.6	
			12.4 to 18	±0.8	
		9	DC to 12.4	±0.6	
			12.4 to 18	±0.8	
		10	DC to 12.4	±0.6	
			12.4 to 18	±0.9	
		11	DC to 12.4	±0.7	
			12.4 to 18	±0.9	
8494B001	Hewlett-Packard	See 8494B			
8495B001	Hewlett-Packard	0 to 70	DC to 18		±0.4 dB +0.07 dB/GHz
			DC to 12.4	±3% of setting	
			12.4 to 18	±4% of setting	
8495D	Hewlett-Packard	0 to 70	DC to 26.5		±0.5 dB+0.13 dB/GHz
			DC to 12.4	±3% of setting	
			12.4 to 18	±4% of setting	
			18 to 26.5	±7% of setting	
8496A001	Hewlett-Packard	0 to 110[3]	DC to 4	±1.7% of setting or ± 0.4 dB whichever is greater	±0.6 dB +0.09 dB/GHz
8496B	Hewlett-Packard	0 to 110[3]	DC to 18		±0.6 dB +0.09 dB/GHz
			DC to 12.4	±±3% of setting	
			12.4 to 18	±4% of setting	
8420731	See PRD Electronics 1100C				

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)
9918-30[2]	Weinschel	30	DC to 18	±1.0	
9918-60[2]	Weinschel	60	DC to 18	±1.5	
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	

[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, F00 and W05.

[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 (≥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

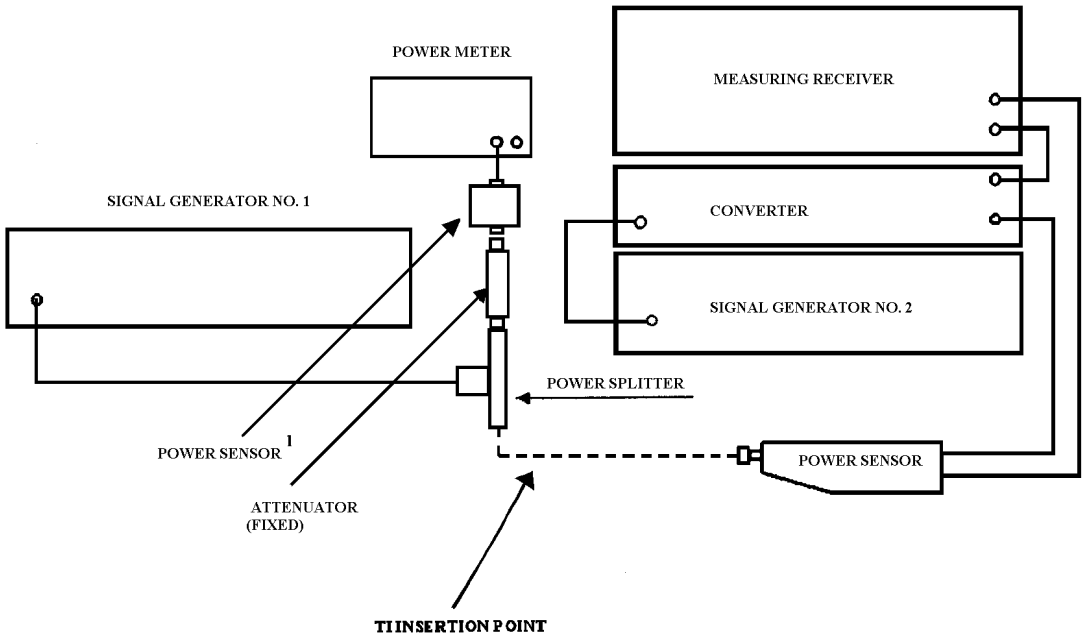
Software package USATA PD-MAT () can be used in place of steps **1a**(1) through **1a**(31) below, verifying that the TI meets or exceeds accuracies listed in appendix A. Copies of the software package are available from Commander, U. S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-LW, Redstone 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 above and below 1.3 GHz, it will be necessary to perform two separate tests - one below and one above 1.3 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** into the test frequencies column of table B1.

(3) Adjust signal generator No. 1 frequency controls to test frequency recorded in table B1 and adjust signal generator No. 1 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 1.3 GHz proceed to step (8).

NOTE
For frequencies 1.3 GHz and above, proceed to step (6) below.
For frequencies above 1.3 GHZ, the offset frequency should be 120.53 MHz above that of signal generator No. 1.

(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. 2 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 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 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 to the level calculated in (14) above and press the **CALIBRATE** key.

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

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

NOTE

For frequencies below 1.3 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. 2 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 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** (**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 PDMAT () 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 1.3 GHz, it will be necessary to perform two separate tests - one below and one above 1.3 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 frequency controls to test frequency recorded in table C1 and adjust signal generator No. 1 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 1.3 GHz proceed to step (8) below.

APPENDIX C

NOTE

For frequencies 1.3 GHz and above proceed to step (6) below.
For frequencies above 1.3 GHZ, the offset frequency should be 120.53 MHz above that of signal generator No. 1.

(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. 2 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 (fig. 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 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 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 to the level calculated in (16) above and press the **CALIBRATE** key.

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

NOTE

For frequencies below 1.3 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. 2 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 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:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

OFFICIAL:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army

0307704

Distribution:

To be distributed in accordance with IDN 342070, requirements for calibration procedure TB 9-4931-523-35.

THESE ARE THE INSTRUCTIONS FOR SENDING 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@avma27.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**: TB 9-6625-xxxx-35
9. **Pub Title**: Calibration Procedure for …
10. **Publication Date**:
11. Change Number:
12. **Submitted 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.

PIN: 050521-000