*TB 9-6625-2213-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR VECTOR VOLTMETER, ME-512/U AND HEWLETT-PACKARD, MODELS 8405A AND 8405A-H16

Headquarters, Department of the Army, Washington, DC
2 July 2009

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

*This bulletin supersedes TB 9-6625-2213-35, dated 17 May 1993.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Vector Voltmeter, ME-512/U and Hewlett-Packard, Models 8405A and 8405A-H16. The manufacturers' manuals and TM 11-6625-2856-14 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. Hewlett-Packard, Model 8405A, serial number 946 tolerances (if different) will be in parenthesis.

b. Time and Technique. The time required for this calibration is approximately 3 hours, using the microwave frequency technique.

2. Forms, Records, and Reports

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

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

<table>
<tr><th>Test instrument parameters</th><th>Performance specifications</th></tr>
<tr><td>Isolation between channels</td><td>Frequency range: 1 to 400 MHz: ≥100 dB
400 to 1000 MHz: ≥75 dB
(Frequency range: 1 to 300 MHz: ≥100 dB
300 to 1000 MHz: ≥80 dB)
Voltmeter residual noise: 10 μV or less as indicated on voltmeter</td></tr>
<tr><td>Voltmeter</td><td>Voltage range: 300 μV to 1 V rms[1]
<table>
<tr><th>Accuracy (± FS)</th><th>Frequency range (MHz)</th></tr>
<tr><td>2</td><td>1 to 100</td></tr>
<tr><td>4</td><td>100 MHz only</td></tr>
<tr><td>8</td><td>101 to 400</td></tr>
<tr><td>(6)</td><td>(100 to 300)</td></tr>
<tr><td>(12)</td><td>(300 to 800)</td></tr>
<tr><td>(12)</td><td>(800 to 1000)[1]</td></tr>
<tr><td>(17)</td><td>(800 to 1000)[2]</td></tr>
<tr><td>14</td><td>400 to 1000</td></tr>
</table>
Voltage ratio:
Attenuation range: 0 to 10 dB
Accuracy: ± 2% of full scale (± 0.2 dB)</td></tr>
</table>

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Phase	Phase accuracy checked at 400 MHz (including phase response versus frequency) Less than ± 1.5° + (± 3°) = ± 4.5°

[1]300 μV up 300 mVrms.
[2]300 and 1000 mVrms only.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standard Set AN/GSM-286; Set AN/GSM-287; or Set AN/GSM-705. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI. Where the four-to-one ratio cannot be met the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure. The following peculiar accessories are also required for this calibration: Accessories Kit, Hewlett-Packard, Model 11570A (must be furnished with TI) and Line Section Radio (adjustable airline), General Radio, Model 874LK20L.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUTOTRANSFORMER	Ac voltage range: 105 to 125 V ac Accuracy: ±1%	Ridge, Model 9020A (9020A) or Ridge, Model 9020F (9020F)
FREQUENCY COUNTER	Frequency range: 19.99 kHz to 400.000 MHz Accuracy: 2.5×10^{-7}	Fluke, Model PM6681/656 (PM6681/656)
LOW PASS FILTER NO. 1	Cut off frequency: 14 MHz Insertion loss: <1.0 dB Stopband attenuation: 24 to 28 MHz: 35 dB 20 to 24 MHz: 20 dB	Telonic, Model TLC14-3EF (TLC14-3EF)
LOW PASS FILTER NO. 2	Cut off frequency: 30 MHz Insertion loss: <1.0 dB Stopband attenuation: 40 to 45 MHz: 25 dB 45 to 60 MHz: 40 dB	Telonic, Model TLC30-4EF7 (TLC30-4EF7
LOW PASS FILTER NO. 3	Cut off frequency: 75 MHz Insertion loss: <1.0 dB Stopband attenuation: 90 to 95 MHz: 32 dB 95 to 105 MHz: 42 dB	Telonic, Model TLC75-6EF1 (TLC75-6EF1)
LOW PASS FILTER NO. 4	Cut off frequency: 125 MHz Insertion loss: <1.0 dB Stopband attenuation: 150 to 160 MHz: 32 dB 160 to 250 MHz: 42 dB	Telonic, Model TLC125-6EF1 (TLC125-6EF1)

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
LOW PASS FILTER NO. 5	Cut off frequency: 200 MHz Insertion loss: <1.0 dB Stopband attenuation: 250 to 255 MHz: 40 dB 255 to 400 MHz: 42 dB	Telonic. Model TLC200-6EF (TLC200-6EF)
LOW PASS FILTER NO. 6	Out off frequency: 316 MHz Insertion loss: <1.0 dB Stopband attenuation: 400 to 632 MHz: 42 dB	Telonic. Model TLC316-6EF1 (TLC316-6EF1)
LOW PASS FILTER NO. 7	Cut off frequency: 450 MHz Insertion loss: <1.0 dB Stopband attenuation: 632 to 900 MHz: 42 dB	Telonic, Model TLC450-6EF (TLC450-6EF)
LOW PASS FILTER NO. 8	Cut off frequency: 700 MHz Insertion loss: <1.0 dB Stopband attenuation: 900 to 1400 MHz 40 dB	Telonic, Model TLC700-6EF1 (TLC700-6EF1)
LOW PASS FILTER NO. 9	Cut off frequency: 1225 MHz Insertion loss: <1.0 dB Stopband Attenuation: 1400 to 1700 MHz: 10 dB 1700 to 2450 MHz: 42 dB	Telonic, Model TLS1225-5EF1 (TLS1225-5EF1)
MEASURING RECEIVER	Frequency range: 1 to 1000 MHz Measurement range: +13 to -70.5 dBm Accuracy: ± 0.025 dB/10 dB	Measuring receiver system N5530S consisting of: Spectrum Analyzer Agilent, Model E4440A (E4440A), Power Meter, Agilent, Model E4419B (E4419B), and Sensor Module Agilent, Model N5532A opt. 518 (518)
MULTIMETER	Dc mode: Range: -20.2 to +20.2 Accuracy: ± 25% Ac mode: Able to measure less than 1 mV rms	Hewlett-Packard, Model 3458A (3458A)
OSCILLOSCOPE	Able to measure 5 mV p-p	Agilent, OS-303/G (OS-303/G)
POWER SPLITTER	Frequency range: 10 to 1000 MHz Port-to-port tracking accuracy: 10 MHz to 1 GHz ± 0.15 dB	Weinschel, Model 1870A (7916839)
SIGNAL GENERATOR	Frequency range: 1 to 1000 MHz Power output range: +13 to -66.9 dBm Power accuracy of measuring receiver	Aeroflex, Model 2023B (2023B) or (SG-1207/U)
SYNTHESIZER/LEVEL GENERATOR	Frequency range: 20 kHz Accuracy: Accuracy of frequency counter	Hewlett-Packard Model 3335AOPT 001-K06 (MIS-35938)
VARIABLE ATTENUATOR	Frequency range: 30 and 100 MHz Attenuation range: 0 to 10 dB Accuracy of calibration test report	Weinschel, Model AF117A-69-34 (AF117A-69-34)

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in the procedure. Additional maintenance information is contained in the manufacturers' manuals for this TI.

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

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

NOTE

Ensure proper calibration factors for sensor module being used are loaded into measuring receiver

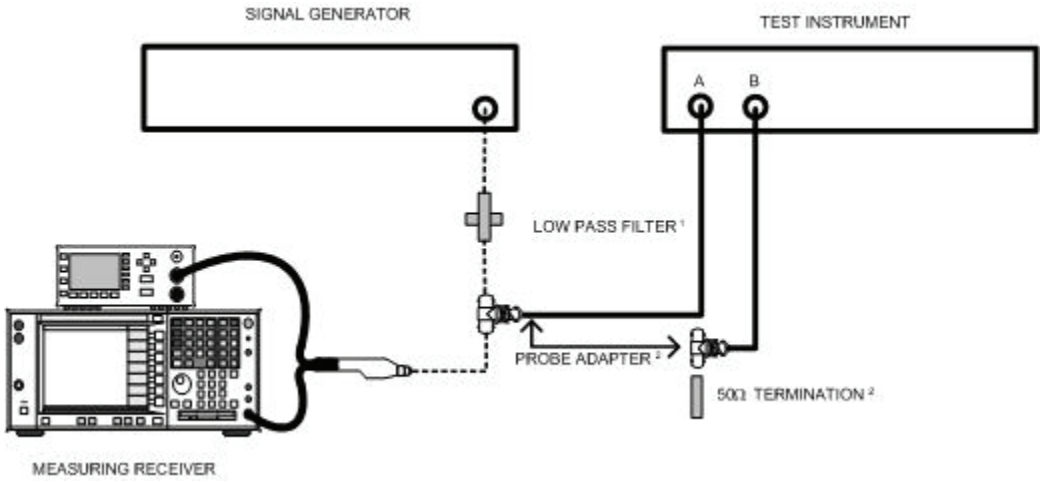
a. Mechanically zero TI meters.

b. Press **LINE PUSH ON/OFF** pushbutton to **ON** and allow TI to warm-up for 1 hour.

8. Channel Isolation

a. Performance Check

(1) Connect equipment as shown in figure 1.



[1]SELECT LOW PASS FILTER FROM TABLE 2.
[2]PART OF ACCESSORIES KIT, HEWLETT-PACKARD, MODEL 11570A.

Figure 1. Channel isolation - test equipment setup.

(2) Adjust signal generator frequency controls for **410** MHz and then adjust amplitude controls for 0 dBm indication on measuring receiver.

(3) Adjust TI **FREQ RANGE-MHz** switch so **APC UNLOCKED** light goes out and setting includes measurement frequency.

(4) Set **AMPLITUDE CHANNEL** switch to **A**.

(5) Adjust signal generator amplitude controls for a TI meter indication of 0 dB.

(6) Set **AMPLITUDE CHANNEL** switch to **B**. The channel **B** signal amplitude will not exceed -75 dBm (-80 dBm).

(7) Repeat (2) through (6) above for 600 and 1000 MHz.

(8) Adjust signal generator frequency controls for 1 MHz and amplitude controls for +13 dBm indication on measuring receiver.

(9) Set TI **FREQ RANGE-MHz** switch so **APC UNLOCKED** light goes out and setting includes measurement frequency.

(10) Set **AMPLITUDE CHANNEL** switch to **A**.

(11) Adjust signal generator amplitude controls for a TI meter indication of 1 V rms.

(12) Set **AMPLITUDE CHANNEL** switch to **B**. **CHANNEL B** vector voltmeter residual noise indication will be equal to or less than 10 μV.

(13) Repeat technique of (8) through (12) above for 100 and 300 MHz.

(14) Set **AMPLITUDE CHANNEL** switch to **A**.

(15) Adjust signal generator frequency controls to 1 MHz and amplitude controls for -47 dBm output indication on measuring receiver.

(16) Set **AMPLITUDE CHANNEL** switch to **B** and **AMPLITUDE MV-RANGE-DB** switch to **-70 dB**. **CHANNEL B** indication will be equal to or less than 10 μV.

b. Adjustments. No adjustments can be made.

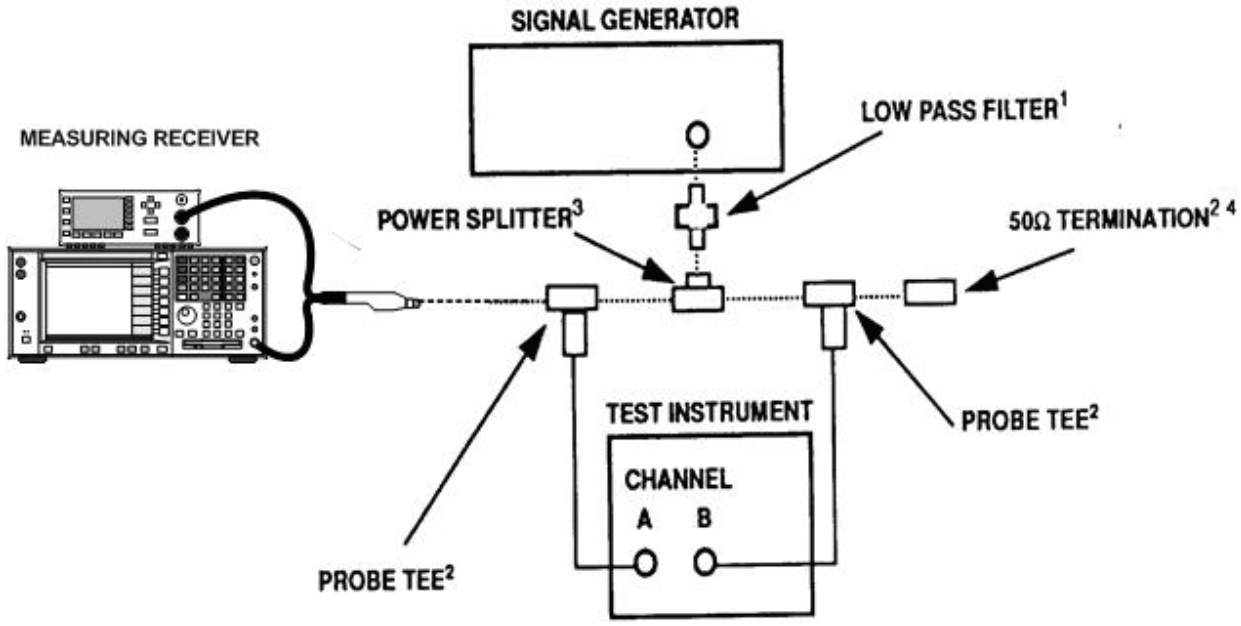
9. Voltmeter Accuracy

a. Performance Check

(1) Set TI **CHANNEL** switch to **A** position.

(2) Connect equipment as shown in figure 2.

(3) Adjust signal generator amplitude and frequency controls for frequency MHz settings and amplitude dBm settings listed in table 3.



[1]Select low pass filters from table 2 as needed.
[2]Part of Accessories Kit, Hewlett-Packard, Model 11570A.
[3]Use power splitter for frequencies from 10 to 1000 MHz and UHF "T: connector for frequencies from 1 to 10 MHz.
[4]If loading occurs, remove 50 Ω termination.

Figure 2. Voltmeter - test equipment setup.

Table 3. Voltmeter Test Setup

Signal generator		Test instrument **mV-RANGE-DB** switch settings (mV)	Measuring receiver indications (mV rms)	
Amplitude settings (dBm)	Frequency settings (MHz)		Min	Max
+13	10	1000	980	1020
+2.55	10	300	294	306
-6.9	10	100	98	102
-17.4	10	30	29.4	30.6
-26.9	10	10	9.8	10.2
-37.4	10	3	2.94	3.06
-46.9	10	1	0.98	1.02
-57.4	10	0.3	0.294	0.306
-66.9	10	0.1	0.098	0.102
+13	60	1000	980	1020
+2.55	60	300	294	306
-6.9	60	100	98	102
-17.4	60	30	29.4	30.6
-26.9	60	10	9.8	10.2
-37.4	60	3	2.94	3.06
-46.9	60	1	0.98	1.02
-57.4	60	0.3	0.294	0.306
-66.9	60	0.1	0.094	0.102
+13	100	1000	960	10401
+2.55	100	300	288	3121
-6.9	100	100	96.0	104.01
-17.4	100	30	28.8	31.21
-26.9	100	10	9.60	10.41
-37.4	100	3	2.88	3.121
-46.9	100	1	0.96	1.041
-57.4	100	0.3	0.288	0.3121
-66.9	100	0.1	0.096	0.1041
+13	200	1000	940	1062
+2.55	200	300	282	3182
-6.9	200	100	94	1062
-17.4	200	30	28.2	31.82
-26.9	200	10	9.4	10.62
-37.4	200	3	2.82	3. 182
-46.9	200	1	0.94	1.062
-57.4	200	0.3	0.282	0.3182
-66.9	200	0.1	0.094	0.1062
+13	375	1000	920 (880)	1080 (1120)
+2.55	375	300	276 (264)	324 (336)
-6.9	375	100	98.2 (88)	108 (112)
-17.4	375	30	27.6 (26.4)	32.4 (33.6)
-26.9	375	10	9.2 (8.8)	10.8 (11.2)
-37.4	375	3	2.76 (2.64)	3.24 (3.36)
-46.9	375	1	0.92 (0.88)	1.08 (1.12)
-57.4	375	0.3	0.276 (0.264)	0.324 (0.336)
-66.9	375	0.1	0.092 (0.088)	0.108 (0.112)

Table 3. Voltmeter Test Setup - Continued

Signal generator		Test instrument	Measuring receiver indications (mV rms)			
Amplitude settings (dBm)	Frequency settings (MHz)	**mV-RANGE-DB** switch settings (mV)	Min		Max	
+13	500	1000	860	(880)	1140	(1120)
+2.55	500	300	258	(264)	342	(336)
-6.9	500	100	86	(88)	114	(112)
-17.4	500	30	25.8	(26.4)	34.2	(33.6)
-26.9	500	10	8.6	(8.8)	11.4	(22.2)
-37.4	500	3	2.58	(2.64)	3.42	(3.36)
-46.9	500	1	0.86	(0.88)	1.14	(1.12)
-57.4	500	0.3	2.58	(0.264)	3.42	(0.336)
-66.9	500	0.1	0.086	(0.088)	0.114	(0.112)
+13	1000	1000	860	(830)	1140	(1170)
+2.55	1000	300	258	(264)	342	(336)
-6.9	1000	100	86	(88)	114	(112)
-17.4	1000	30	25.8	(26.4)	34.2	(33.6)
-26.9	1000	10	8.6	(8.8)	11.4	(11.2)
-37.4	1000	3	2.58	(2.64)	3.42	(3.36)
-46.9	1000	1	0.86	(0.88)	1.14	(1.12)
-57.4	1000	0.3	2.58	(0.264)	3.42	(0.336)
-66.9	1000	0.1	0.086	(0.088)	0.114	(0.112)

(4) Set **MV-RANGE-DB** switch to mV settings listed in table 3.

(5) Adjust signal generator amplitude controls for TI full scale **AMPLITUDE** meter indication (selected in (4) above).

(6) Configure measuring receiver to measure mV rms.

(7) Adjust **FREQ RANGE-MHz** control so that **APC UNLOCKED** light goes out with range setting including measurement frequency. If measuring receiver indications are not within limits listed in table 3, perform **b** below.

(8) Repeat (3) through (7) above for table 3 signal generator amplitude settings of +2.55 and -6.9 dBm settings.

NOTE

Perform (9) through (13) below for table 3 signal generator amplitude settings of -17.4 to -66.9 dBm.

(9) Adjust signal generator amplitude controls for amplitude dBm settings listed in table 3.

(10) Set **MV-RANGE-DB** switch to mV settings listed in table 3.

(11) Adjust signal generator amplitude controls for TI full scale meter indication (selected in (10) above).

(12) Configure measuring receiver to measure mV rms and set the RATIO function on. If measuring receiver indications are not within the limits listed in table 3, perform **b** below.

(13) Repeat (9) through (12) above for table 3 signal generator amplitude settings of -17.4 to -66.9 dBm.

(14) Set signal generator **RF** output switch to **OFF**.

(15) Replace TI channel A probe with channel B probe in figure 2 equipment setup.

(16) Set **AMPLITUDE CHANNEL** switch to **B** position.

(17) Set signal generator **RF** output switch to **ON**.

(18) Repeat (3) through (13) above for remaining signal generator amplitude and frequency settings listed in table 3 for **CHANNEL B.** If measuring receiver indications are not within the limits listed in table 3, perform **b** below.

(19) Repeat (1) through (18) above for remaining signal generator amplitude and frequency settings listed in table 3. If measuring receiver indications are not within the limits listed in table 3, perform **b** below.

(20) Connect equipment as shown in figure 3.

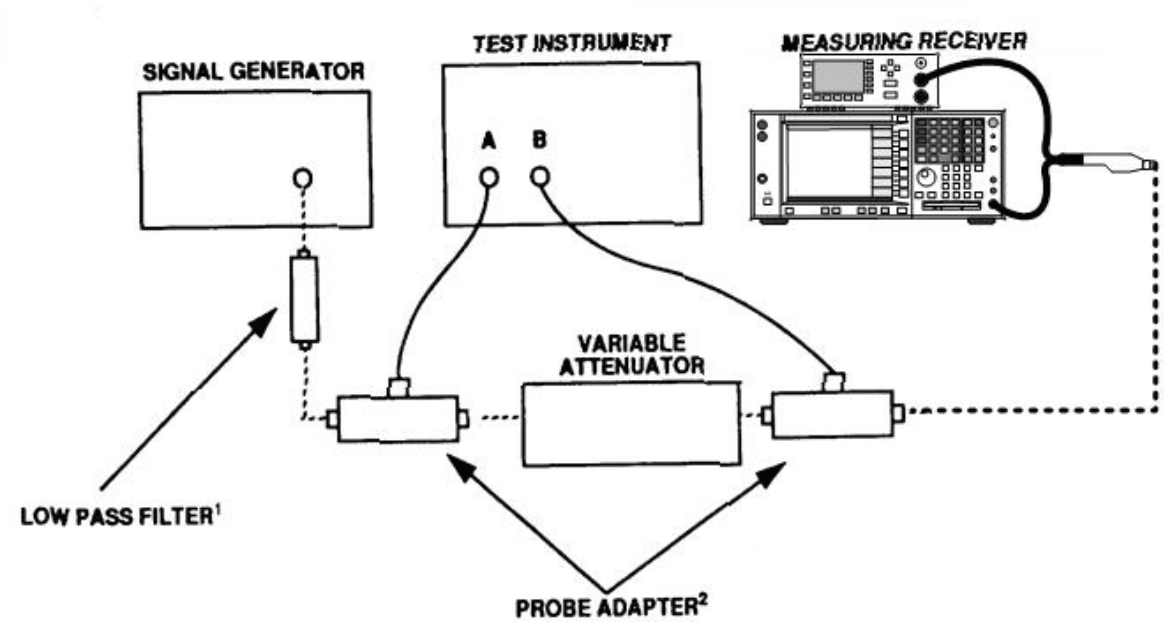


Figure 3. Voltage ratio accuracy - equipment setup.

CAUTION

Do not exceed +10 dBm input to TI during this performance check or damage to TI channel A probe may occur.

NOTE

Ensure **AMPLITUDE CHANNEL** switch is set to **B**.

(21) Set **AMPLITUDE MV-RANGE-DB** switch to 0 dB.

(22) Set variable attenuator to 0 dB.

(23) Set signal generator frequency controls to 30 MHz.

(24) Adjust **FREQ RANGE-MHz** control for a dial indication that includes 30 MHz.

(25) Adjust signal generator amplitude controls for an **AMPLITUDE** meter indication of **0 dB.**

(26) Set variable attenuator to dB setting listed in table 4. The **AMPLITUDE** meter will indicate within the limits listed in table 4.

Table 4. Voltage Ratio Accuracy

Variable attenuator settings (dB)	Test instrument **AMPLITUDE** meter indications[1]			
	Min		Max	
1	195.5	(193.0)	203.7	(205.0)
2	173.9	(172.0)	182.0	(183.0)
3	154.5	(152.0)	162.5	(164.0)
4	137.4	(135.0)	145.4	(147.0)
5	121.5	(120.0)	129.5	(132.5)
6	107.5	(106.0)	115.8	(118.0)
7	95.7	(93.8)	103.7	(106.0)

[1]Variable attenuator calibration error must be included in **AMPLITUDE** meter limits.

(27) Repeat (26) above for remaining variable attenuator settings listed in table 4.

(28) Set variable attenuator to **0 dB**.

(29) Set **AMPLITUDE MV-RANGE-DB** switch to **300 mV**.

(30) Adjust signal generator amplitude controls for a 0 dB indication on **AMPLITUDE** meter.

(31) Set variable attenuator to 10 dB.

NOTE

Add variable attenuator error, to **AMPLITUDE** meter indication in (32) below.

(32) Set **AMPLITUDE mV-RANGE-DB** switch to 100 **mV**. **AMPLITUDE** meter will indicate between 68.3 and 72.7 mV (68.7 and 72.7 mV).

(33) Set variable attenuator to **0 dB**.

(34) Adjust signal generator amplitude controls for an **AMPLITUDE** meter indication of 80 mV.

(35) Set variable attenuator to **10 dB**.

NOTE

Add variable attenuator error to **AMPLITUDE** meter indication in (36) below.

(36) Set **AMPLITUDE mV-RANGE-DB** switch to 30 mV. **AMPLITUDE** meter will indicate between 24.5 and 26.0 mV (24.7 and 25.0 mV).

(37) Decrease signal generator amplitude output and adjust frequency controls for 100 MHz.

(38) Repeat (21) through (36) for 100 MHz.

b. Adjustments

(1) Set **AMPLITUDE CHANNEL** switch to **A** and **AMPLITUDE mV-RANGE-DB** switch to **300 mV**.

NOTE

Ensure equipment is set up in the figure 1 configuration.

(2) Adjust signal generator controls to 100 MHz and adjust amplitude controls for a measuring receiver indication of 0.0 dB.

(3) Adjust **FREQ RANGE-MHz** control for a dial indication that includes 100 MHz and APC **UNLOCKED** indicator is extinguished.

(4) Adjust A3R5 (fig. 4) for a TI meter indication of 0 dB.

(5) Replace channel A probe with channel B probe in figure 1 equipment setup.

(6) Set **AMPLITUDE CHANNEL** switch to **B**.

(7) Adjust A4R5 (fig. 4) for a TI meter indication of 0 dB.

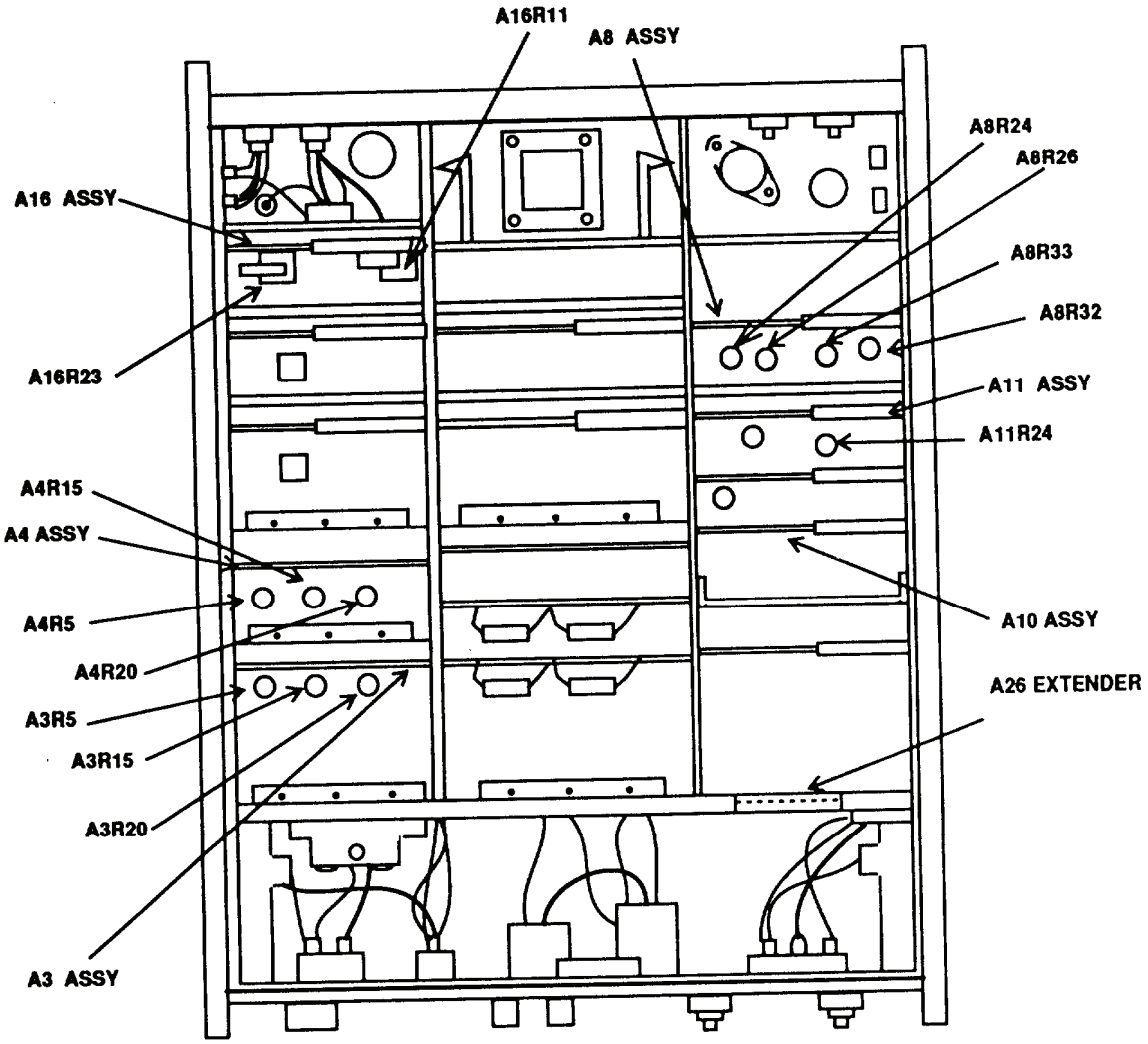


Figure 4. Test instrument - adjustments locations.

(8) Replace channel B probe with channel A probe in equipment setup.

(9) Repeat (1) through (8) above until both indications are within tolerance.

NOTE

If (1) through (9) above cannot be obtained, adjust A11R24 (fig. 4) for peak **AMPLITUDE** meter indication and perform the IF section adjustments as listed in TM 11-6625-2856-14 or the manufacturer's manual.

(10) Set **AMPLITUDE CHANNEL** switch to **A**.

(11) Adjust signal generator frequency to 1 MHz and amplitude controls for a measuring receiver indication of 0.0 dB.

(12) Adjust **FREQ RANGE-MHz** control for a dial indication that includes 1 MHz and **APC UNLOCKED** indicator is extinguished.

(13) Replace channel **A** probe with channel B probe in figure 1 equipment setup.

(14) Set **AMPLITUDE CHANNEL** switch to **B**.

(15) Adjust A4R5 (fig. 4) for an **AMPLITUDE** meter indication of approximately -0.2 dB.

(16) Replace channel **B** probe with channel **A** probe in equipment setup.

(17) Set **AMPLITUDE CHANNEL** switch to **A**.

(18) Adjust A3R5 (fig. 4) for an **AMPLITUDE** meter indication of approximately -0.2 dB.

(19) Repeat (1) through (9) above and allow a tolerance between -0.2 and +0.2 dB before making any adjustments.

NOTE

If adjustments were made in (19) above, then (10) through (18) above must be repeated.

(20) Adjust signal generator controls for 1000 MHz and adjust amplitude controls for a measuring receiver indication of 0.0 dBm.

(21) Set **AMPLITUDE CHANNEL** switch to **A** and **AMPLITUDE mV-RANGE-DB** switch to **300 mV**.

(22) Adjust **FREQ RANGE-MHz** control for a dial indication that includes 1000 MHz and **APC UNLOCKED** indicator is extinguished.

(23) If **AMPLITUDE** meter indication is not between 188 and 259 mV, adjust A3R20 (fig. 4) for an intolerance indication between 188 and 259 mV (R).

(24) Set **AMPLITUDE mV-RANGE-DB** switch to **+10 dB**.

(25) Adjust signal generator amplitude controls for a measuring receiver indication of +10.0 dBm.

(26) If **AMPLITUDE** meter indication is not between .537 and .877 V, adjust A3R20 (fig. 4) for an intolerance indication between .537 and .877 V dc (R).

(27) Repeat (20) through (26) above until both the 0 and +10 dBm indications are within tolerance.

(28) Replace channel A probe with channel B probe in figure 1 equipment setup.

(29) Set **AMPLITUDE CHANNEL** switch to **B** and **AMPLITUDE mV-RANGE-DB** switch to **300 mV**.

(30) Adjust signal generator amplitude controls for a measuring receiver indication of 0.0 dBm.

(31) If **AMPLITUDE** meter indication is not between 188 and 259 mV, adjust A4R20 (fig. 4) for an intolerance indication between 188 and 259 mV (R).

(32) Set **AMPLITUDE mV-RANGE-DB** switch to **+10 dB**.

(33) Adjust signal generator amplitude controls for a measuring receiver indication of +10.0 dBm.

(34) If **AMPLITUDE** meter indication is not between .537 and .877 V, adjust A3R20 (fig. 4) for an intolerance indication between .537 and .877 V dc (R).

(35) Repeat (29) through (34) above until both the 0 and +10 dBm indications are within tolerance.

(36) Repeat (20) through (34) above until no adjustments are required before proceeding to (37) below.

(37) Remove TI probes from equipment setup.

(38) Connect channel A probe to oscilloscope vertical input.

(39) Adjust A3Rl5 (fig. 4) for minimum peak-to-peak signal indication on oscilloscope. Peak-to-peak signal amplitude will not exceed 5 mV.

(40) Disconnect channel A probe from oscilloscope vertical input and connect channel B probe to oscilloscope vertical input.

(41) Adjust A4Rl5 (fig. 4) for minimum peak-to-peak signal indication on oscilloscope. Peak-to-peak signal amplitude will not exceed 5 mV.

(42) Disconnect channel B probe from oscilloscope vertical input.

10. Phase Accuracy

a. Performance Check

(1) Adjust signal generator frequency controls to 400 MHz and amplitude controls to -6.99 dBm.

(2) Connect equipment as shown in figure 5, CONNECTION A.

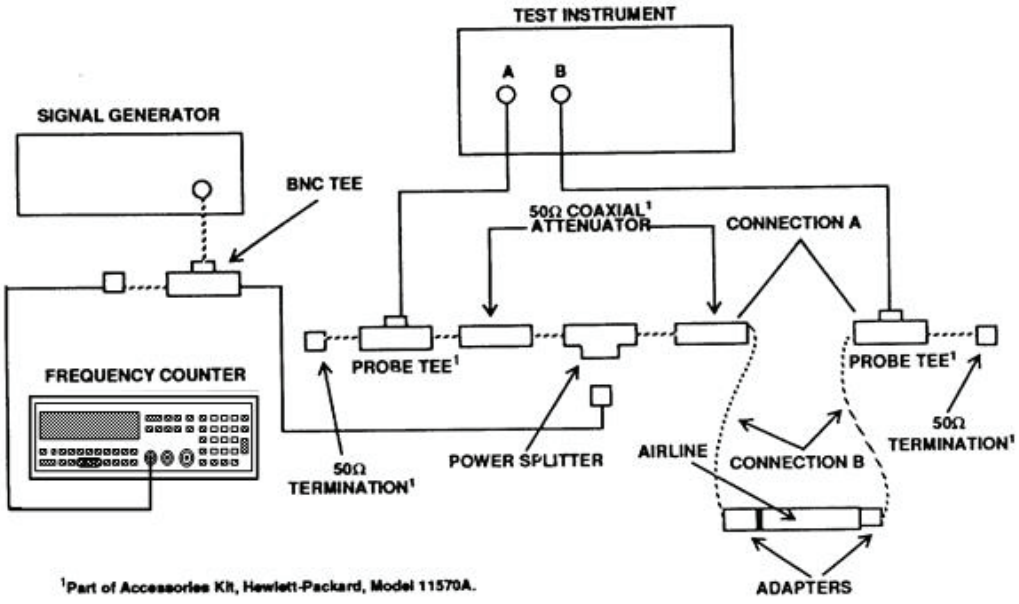


Figure 5. Phase accuracy - equipment setup.

(3) Adjust signal generator frequency controls for a 400.000 MHz indication on frequency counter.

(4) Set **AMPLITUDE CHANNEL** switch to **A** and **AMPLITUDE mV-RANGE-DB** switch to 300 mV.

(5) Adjust **FREQ RANGE-MHz** control so setting includes 400 MHz.

(6) Adjust signal generator amplitude controls for a TI **AMPLITUDE** meter indication of 100 mV.

(7) Set **PHASE RANGE** switch to ±180 and **PHASE METER OFFSET** switch to 0 degrees.

(8) Adjust **PHASE RANGE ZERO** control for a 0 degree indication on **PHASE** meter.

(9) Set **PHASE RANGE** switch to ±6 degrees and repeat (8) above.

(10) Connect equipment as shown in figure 5, CONNECTION B.

(11) Adjust airline length for a 0 degree indication on **PHASE** meter.

(12) Connect equipment as shown in figure 5, CONNECTION A.

(13) If needed, repeat (8) above.

(14) Connect equipment as shown in figure 5, CONNECTION B.

(15) If needed, repeat (11) above.

(16) Repeat (10) through (15) above until no further adjustments are required.

NOTE

Once conditions of (16) above have been met, lock airline.

(17) Adjust signal generator frequency controls for a frequency counter indication of 300.000 MHz.

(18) Position controls as listed in (a) through (c) below:

(a) **FREQ RANGE-MHz** control for a dial indication which includes 300 MHz.

(b) **PHASE METER OFFSET** switch to **90 degrees**.

(c) **PHASE METER OFFSET + -** switch to **+**.

(19) Adjust signal generator amplitude controls for a TI meter indication of 100 mV. If PHASE meter does not indicate between -4.5 and +4.5 degrees, perform **b** below.

(20) Adjust signal generator frequency controls for a frequency counter indication of 200.000 MHz.

(21) Set **PHASE METER OFFSET** switch to **180** and adjust **FREQ RANGE-MHz** control for a dial indication which includes 200.

(22) Set **PHASE METER OFFSET** switch to **90** and **PHASE METER OFFSET + -** switch to **+**.

(23) Adjust signal generator amplitude controls for a TI meter indication of 100 mV. If **PHASE** meter does not indicate between -4.5 and +4.5 degrees, perform **b** below.

(24) Disconnect signal generator from equipment setup and connect signal generator to frequency counter.

(25) Adjust signal generator frequency controls for a frequency counter indication of 100.000 MHz.

(26) Connect equipment as shown in figure 5, CONNECTION B.

(27) Set **PHASE METER OFFSET** switch to **90** and adjust **FREQ RANGE-MHz** control for a dial indication which includes 100.

(28) Set **PHASE METER OFFSET +** - switch to **-**.

(29) Adjust signal generator amplitude controls for a TI meter indication of 100 mV. If **PHASE** meter does not indicate between -4.5 and +4.5 degrees, repeat (12) through (19) above.

b. Adjustments

(1) Press and release **LINE PUSH ON/OFF** to **OFF**. Remove TI top cover.

(2) Remove A26 EXTENDER (fig. 4) and A8 ASSY boards (fig. 4). Plug A8 ASSY into extender board and plug extender board into A8 ASSY board slot in chassis.

(3) Unplug A3, A4, A10, and A11 ASSY boards (fig. 4).

(4) Connect equipment as shown in figure 6.

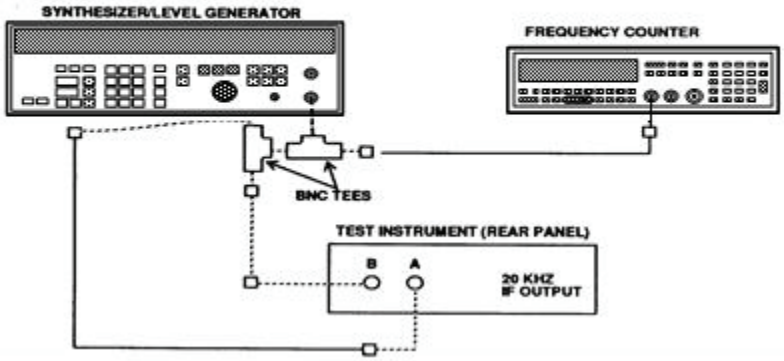


Figure 6. Phase meter adjustments - equipment setup.

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

(a) **PHASE METER OFFSET** switch to **0**.

(b) **PHASE RANGE** switch to **±60**.

(c) **AMPLITUDE mV-RANGE-DB** switch to **1000 mV**.

(d) **LINE PUSH ON/OFF** pushbutton to **ON**.

(6) Adjust synthesizer/level generator cw frequency controls for a frequency counter indication between 19.99 and 20.01 kHz.

(7) Adjust synthesizer/level generator amplitude controls for a 1000 mV indication on TI **AMPLITUDE** meter.

NOTE

Do not obtain more than 10 degree correction from any single adjustment.

(8) While observing **PHASE** meter adjust **PHASE RANGE ZERO** control fully cw. If **PHASE** meter does not indicate +18 degrees, adjust A8R32 (fig. 4) for a +18 degree indication (R).

(9) Adjust **PHASE RANGE ZERO** control fully ccw. If **PHASE** meter does not indicate -18 degrees, adjust A8R24 (fig. 4) for a -18 degree indication (R).

(10) Repeat (8) and (9) above until no further adjustments are required.

NOTE

If ±18 degree range cannot be obtained by adjusting A8R32 (fig. 4) and A8R24 (fig. 4), perform adjustments as listed in TM 11-6625-2856-14.

NOTE

If TI does not have adjustments A8R26 and A8R33 (fig. 4), proceed to (20) below.

(11) Connect multimeter (dc mode) black lead to chassis ground and red lead to junction of wiper arm of A8R33 (fig. 4) and base of A8Q16 (located on A8 ASSY (fig. 4)).

(12) Adjust A8R33 (fig. 4) for a multimeter indication of +7.4 V dc (R).

(13) Move multimeter red lead from junction of wiper arm of A8R26 (fig. 4) and base of A8Q12 (located on A8 ASSY (fig. 4)).

(14) Adjust A8R26 (fig. 4) for a multimeter indication of -7.4 V dc (R).

NOTE
Do not disconnect multimeter.

(15) Connect oscilloscope X10 probe to junction of A8CR1 and A8R20 (located on A8 ASSY (fig. 4) and chassis ground.

(16) Adjust oscilloscope controls as necessary to view TI square wave.

NOTE
Perform (17) below only if oscillations are present on square wave.

(17) Adjust A8R33 (fig. 4) and A8R26 (fig. 4) as necessary to eliminate oscillations (R).

(18) Multimeter will indicate between -6.0 and -7.5 V dc; if not, repeat (11) through (18).

(19) Repeat (11) and (12) above. Multimeter will indicate between +6.0 and +7.5 V dc; if not, repeat (11) through (18) above.

(20) Set **PHASE RANGE** switch to **±180** and **PHASE METER OFFSET** switch to **180**.

(21) Adjust **PHASE RANGE ZERO** control for maximum + (positive) indication on **PHASE** meter.

(22) Readjust A8R32 (fig. 4) for a +180 indication on **PHASE** meter (R).

(23) Adjust **PHASE RANGE ZERO** control for maximum - (negative) indication on PHASE meter.

(24) Readjust A8R24 (fig. 4) for a -180 indication on **PHASE** meter (R).

(25) Set **PHASE RANGE** switch to **±60** and **PHASE METER OFFSET** switch to **0**.

(26) Repeat (8) through (25) above until no further adjustments are required.

(27) Press and release **LINE PUSH ON/OFF** pushbutton to **OFF**.

(28) Disconnect multimeter and oscilloscope from TI.

(29) Remove A8 ASSY (fig. 4) board from extender board and reinstall all boards into their proper slot.

(30) Replace TI top cover.

(31) Press and release **LINE PUSH ON/OFF** pushbutton to **ON**.

11. Power Supply

NOTE

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

a. Performance Check

(1) Press and release **LINE PUSH ON/OFF** pushbutton to **OFF**.

(2) Remove TI top cover.

(3) Remove A26 EXTENDER (fig. 4) and A1 6 ASSY (power supply board (fig. 4)).

(4) Plug A16 ASSY into extender and then plug extender into A16 ASSY (fig. 4) slot in chassis.

(5) Connect TI to autotransformer and adjust autotransformer for 115 V ac output.

(6) Press **LINE PUSH ON/OFF** pushbutton to **ON**.

(7) Measure dc voltage between A16C6 (located on left end of large capacitor near bottom of board (fig. 4) and chassis ground. If multimeter does not indicate between -19.8 and -20.2 V dc, perform **b** (l) below.

(8) Vary autotransformer output between 105 and 125 V ac. Multimeter will indicate between -19.8 and -20.2 V dc.

(9) Measure ripple voltage between A16C6 (located on left end of large capacitor near bottom of board (fig. 4)) and chassis ground. Multimeter will indicate less than 1.0 mV.

(10) Measure dc voltage between A16C3 (located on right end of large capacitor near bottom of board (fig. 4)) and chassis ground. If multimeter does not indicate between +19.8 and +20.2 V dc, perform **b** (2) below.

(11) Measure ripple voltage between A16C3 (located on right end of large capacitor near bottom of board (fig. 4)) and chassis ground. Multimeter will indicate less than 1 mV.

(12) Press and release **LINE PUSH ON/OFF** pushbutton to **OFF**.

(13) Restore all assembly boards to original positions.

b. Adjustments

(1) Adjust A16R23 (fig. 4) for a multimeter indication between -19.8 and -20.2 V dc (R).

(2) Adjust A16R11 (fig. 4) for a multimeter indication between +19.8 and +20.2 V dc (R).

12. Final Procedure

a. Deenergize and disconnect all equipment.

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

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0912710

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 341164, requirements for calibration procedure TB 9-6625-2213-24.

Instructions for Submitting an Electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From:"Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028
1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.

PIN: 085500-000