

TB 9-6625-2317-50

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR MODULATION METER

ME-523()/U

Headquarters, Department of the Army, Washington, DC
5 March 2001

Approved for public release; distribution is unlimited

TB 9-6625-2317-50, 26 May 1998, 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

1 and 2

7 and 8

Insert pages

1 and 2

7 and 8

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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General, United States Army
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OFFICIAL:



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Distribution:

To be distributed in accordance with Std IDS No. RLC-1500, 11 May 1992, requirements for calibration procedure TB 9-6625-2317-50.

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CALIBRATION PROCEDURE FOR MODULATION METER ME-523()/U

Headquarters, Department of the Army, Washington, DC
May 26, 1998

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REPORTING OF ERRORS AND RECOMMENDED 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: ls-lp@redstone.army.mil or by FAX (256) 842-6546/DSN 788-6546.

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CHANGE 1

*This bulletin supersedes TB 9-6625-2317-50, dated 4 April 1997.

SECTION I IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Modulation Meter, ME-523()/U. The manufacturer's manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None

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

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 table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Internal reference oscillator	Frequency: 10 MHz ¹ Accuracy stability: ± 1 PPM Aging rate: 10 MHz Accuracy: ²
Carrier frequency	Range: 150 kHz to 1.8 GHz Accuracy: Frequency standard accuracy ± 3 counts of the least significant digit Sensitivity: -25 dBm between 500 kHz to 500 MHz -20 dBm between 500 MHz to 1 GHz -10 dBm between 1 GHz to 1.8 GHz
Amplitude modulation	Range: 150 kHz to 10 MHz ³ Rate: 30 Hz to 10 kHz Range: 10 MHz to 1.8 GHz Rate: 30 Hz to 50 kHz Depth: 0% to 99% Accuracy: $\pm 2.5\%$ + one count above 5% modulation Distortion: $< 0.3\%$ between 5% to 49.9% modulation $< 0.6\%$ between 50% to 95% modulation
Frequency modulation	Range: 250 kHz to 10 MHz ³ Rate: 30 Hz to 10 kHz Peak deviation: 40 kHz Range: 10 MHz to 1.8 GHz Rate: 30 Hz to 200 kHz Peak deviation: 400 kHz Accuracy: $\pm 3\%$ of reading + one count Distortion: Range: 10 MHz to 1.8 GHz Rate: 30 Hz to 20 kHz Deviation: Up to 100 kHz Accuracy: $< 0.15\%$

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Phase modulation	Range: 10 MHz to 1.8 GHz Rate: 300 Hz to 4 kHz Peak deviation: 50 radians Accuracy: $\pm 3\%$ of reading $+3$ counts
Audio frequency	Demodulation range: 30 Hz to 100 kHz Accuracy: Frequency standard accuracy \pm one count
Power measurement	Range: $+10$ to $+30$ dBm ⁴ Accuracy: ± 3 dB

¹30 minute warm-up²0.3 ppm for 24-hour period after a 2-hour warm up at a constant ambient temperature.³Not verified with this procedure⁴ $+20$ dBm (100 mW) maximum without pad. $+30$ dBm (1 W) maximum with 10 dB pad.

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 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 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 four-to-one accuracy will be listed, and the actual accuracy of the equipment selected is shown parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph 4 above, and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUDIO ANALYZER	Source range: 1 kHz Range: 153 mV to 764 mV Analyzer distortion: $<0.15\%$	Boonton, Model 1120-S10 (MIS-35954/2)
CALIBRATION FIXTURE	No substitute	Hewlett-Packard Model 11715 (11715)
CALIBRATOR	Range: 1 kHz to 30 MHz Accuracy: $\pm 0.025\%$ Range: 114.5 mV to 890 mV ($+12$ dBm) Accuracy: ± 0.75 dBm	John Fluke, Model 5700A/CT (p/o MIS-35947); w/power amplifier, John Fluke, Model 5215A/CT (5215A/CT) w/transconductance amplifier, John Fluke, Model 5220A/CT (5220A/CT); w/ac divider, John Fluke, Model 7405A-4207 (7405A-4207)
FREQUENCY COUNTER	Range: 1 kHz and 4 kHz Accuracy: $\pm 0.025\%$	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1) w/converter, frequency plug-in, model 5355A (5355A)

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Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
MICROWAVE FREQUENCY COUNTER	Range: 50 kHz to 1.5 GHz Accuracy: ± 0.075 ppm	Hewlett-Packard, Model 5352BOPT001 (5352BOPT001)
POWER METER	Range: 160 kHz to 1.6 GHz Range: 0 to -25 dBm Accuracy: ± 0.25 dB	Hewlett-Packard, Model 437B (437B)
POWER SENSOR	Range: Frequency: 160 kHz to 1.6 GHz Accuracy: Part of power meter	Hewlett-Packard, Model 8482A (8482A)
POWER SPLITTER	Range: 150 kHz to 1.5 GHz Accuracy: ± 0.5 dB	Weinschel, Model 1870A (7916839)
RECEIVER	Range: 12.5 MHz to 100 MHz Rate: 1000 Hz Deviation: 30 to 100 kHz Accuracy: $\pm 0.75\%$ ($\pm 1\%$) Depth: 40% to 80% Accuracy: $\pm 0.625\%$ ($\pm 1\%$) Deviation: 20 to 30 radians Accuracy: $\pm 0.75\%$ ($\pm 1\%$)	Hewlett-Packard, Model 8902A (8902A)
SIGNAL GENERATOR	Carrier frequency: Range: 150 kHz to 1.5 GHz Amplitude: 0 and -25 dBm Accuracy: Not required	(SG-1207/U)

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 results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Additional maintenance information is contained in the manufacturer's manual for this TI.

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

7. Equipment Setup

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 with the performance check where applicable.

- a. Remove protective cover from TI only to make adjustments and replace upon completion.
- b. Connect TI to a 115 V ac source. Press **POWER** pushbutton to **ON** and allow at least 30 minutes for stabilization.
- c. TI will automatically do a self calibration; when done, you should see the word **SEARCHING** displayed on the screen.
- d. Press **#**, **0**, **1**, pushbuttons; all TI LEDs on front keys, the **FREQUENCY**, **LEVEL/DATA ENTRY**, and **Δ LEVEL** displays at top of front panel should be fully illuminated.
- e. Press **CLEAR/LOCAL**; pushbutton, the display should read **SEARCHING**. The TI is now ready for calibration.

8. Internal Reference Oscillator

a. Performance Check

(1) Connect microwave frequency counter **INPUT 2** ($1M\Omega$) to TI 10 MHz REF INPUT/OUTPUT (fig. 1), located on rear panel, using TI 10 dB ATTENUATOR (fig. 1.).

(2) The indication on the microwave frequency counter will be 10 MHz ± 1 PPM; if not, perform **b** below.

b. Adjustments. After a 2-hour warm up, adjust TI 10 MHZ FREQUENCY REFERENCE ADJ (fig. 1.) for ± 0.3 ppm. Wait 24 hours and re-check TI is within ± 0.3 ppm.

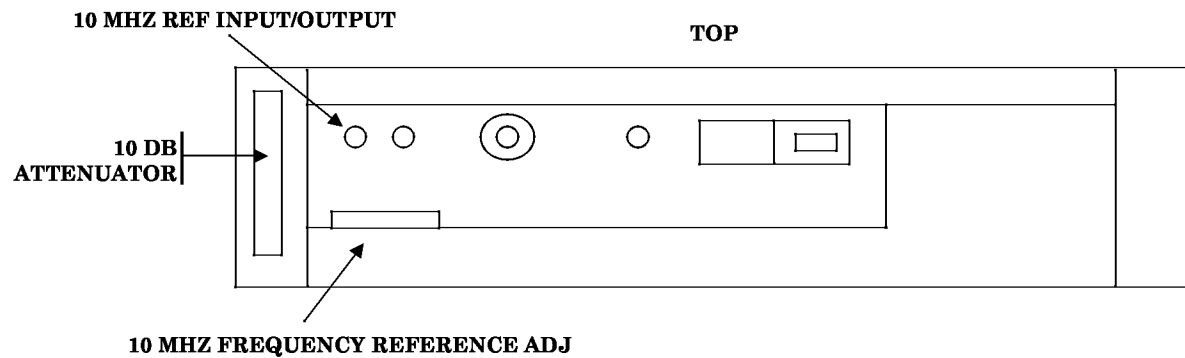


Figure 1. Rear panel.

9. Carrier Frequency

a. Performance Check

(1) Connect equipment as shown in figure 2.

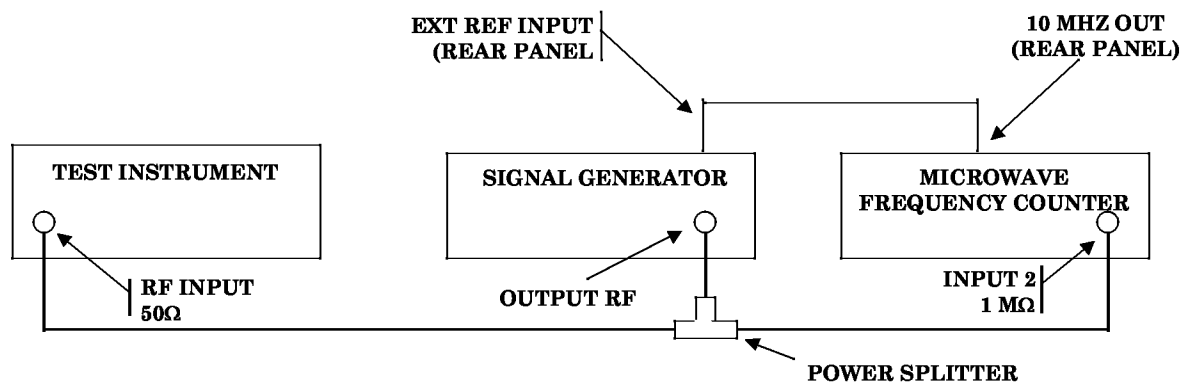


Figure 2. Carrier frequency.

(2) Ensure TI pushbuttons are pressed (on) as follows:

- (a) **LEVEL DISPLAY FM.**
- (b) **LEVEL DETECTOR MODE PK-PK/2.**
- (c) **FREQ DISP RF.**
- (d) **LEVEL UNITS ABS.**
- (e) **HIGH PASS FILTER 50 HZ.**
- (f) **LOW PASS FILTER 15 kHz.**

(3) Adjust signal generator frequency to 150 kHz at 0 dBm as indicated on microwave frequency counter.

(4) Press TI **CARR FREQ** then **., 1, 5, 0, MHz** pushbuttons.

(5) TI front panel **FREQUENCY** display will between 149.97 to 150.03 kHz RF.

(6) Repeat techniques (3) through (5) above, using settings in table 3. TI frequency will indicate within limits specified.

(7) On signal generator press **RF OFF/ON** pushbutton to **OFF**.

NOTE

TI may automatically select carrier frequency.

Table 3. Carrier Frequency

Signal Generator (0 dBm)	Test instrument indications			
	Min		Max	
500 kHz	499.97	kHz	500.03	kHz
1 MHz	999.97	kHz	1.00003	MHz
10 MHz	9.99996	MHz	10.00004	MHz
50 MHz	49.99992	MHz	50.00008	MHz
100 MHz ¹	99.99987	MHz	100.00013	MHz
200 MHz	199.99977	MHz	200.00023	MHz
500 MHz	499.99947	MHz	500.00053	MHz
1 GHz ²	999.9987	MHz	1000.0013	MHz
1.5 GHz	1499.9982	MHz	1500.0018	MHz

¹On microwave counter select 50Ω.

²On microwave counter, move coax cable to INPUT 1 (auto).

b. Adjustments. No adjustments can be made.

10. Input Power

a. Performance Check

(1) Connect equipment as shown in figure 3.

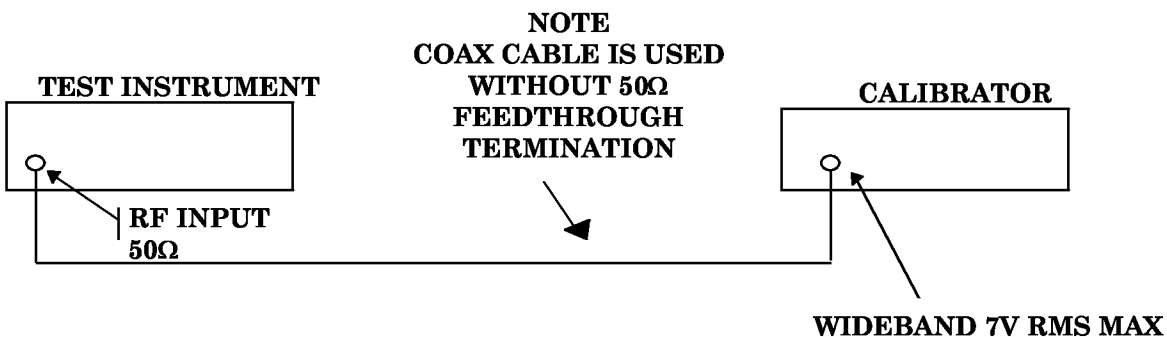


Figure 3. Input power.

(2) Set calibrator **WIDEBAND** output for 30 MHz frequency and amplitude of +12 dBm.

(3) On TI press **CARR FREQ** then **3, 0, MHz** pushbuttons.

(4) Press the TI **LEVEL DISPLAY RF POWER** pushbutton (on). TI **LEVEL/DATA ENTRY** display will indicate between 9 and 15 dBm.

(5) On calibrator press **OPR/STBY** pushbutton to **STBY**.

b. Adjustments. No adjustments can be made.

11. Carrier Level Sensitivity

a. Performance Check

(1) Connect equipment as shown in figure 4.

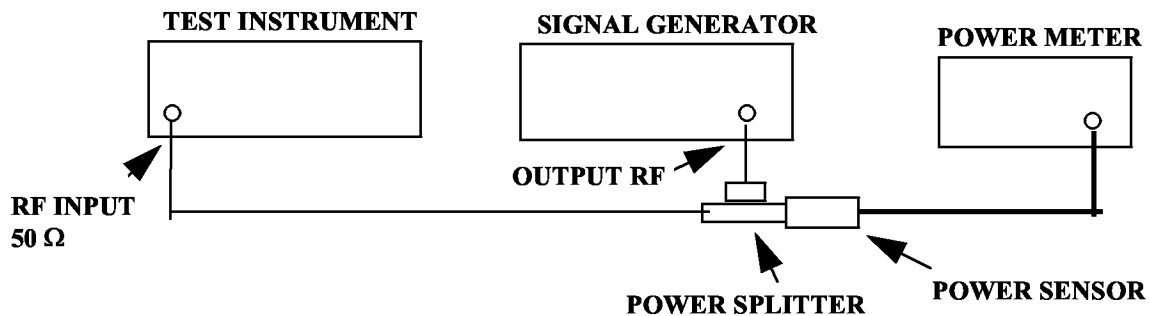


Figure 4. Input sensitivity.

(2) Set up power meter to measure power in dBm.

(3) Set signal generator output to 600 kHz and amplitude of -25 dBm as indicated on power meter.

NOTE

On power meter, set frequency and cal factors accordingly.

(4) On TI press **CARR FREQ** then, **., 6, 0, 0, MHz** pushbuttons.

(5) TI front panel **FREQUENCY LEVEL** display will indicate **600 kHz RF** and **LEVEL/DATA ENTRY** display will indicate **<-10 dBm RF**.

NOTE

If **FREQUENCY LEVEL** and **LEVEL/DATA ENTRY** display message "RF input level low or off tune," return to troubleshooting procedure.

(6) Repeat techniques of (3) through (5) above, using settings and indications in table 4. TI front panel **FREQUENCY** and **LEVEL/DATA ENTRY** displays will indicate frequency and RF level.

(7) On signal generator press **RF OFF/ON** pushbutton to **OFF**.

b. Adjustments. No adjustments can be made.

Table 4. Sensitivity

Signal generator frequency indication RF	Power meter indication	Test instrument CARR FREQ (pushbuttons)
1 MHz	- 25 dBm	1 MHz
10 MHz		10 MHz
50 MHz		50 MHz
100 MHz		100 MHz
200 MHz		200 MHz
400 MHz		400 MHz
600 MHz	-20 dBm	600 MHz
900 MHz		900 MHz
1.2 GHz	-10 dBm	1200 MHz
1.6 GHz		1600 MHz

12. AM Accuracy and Distortion

a. Performance Check

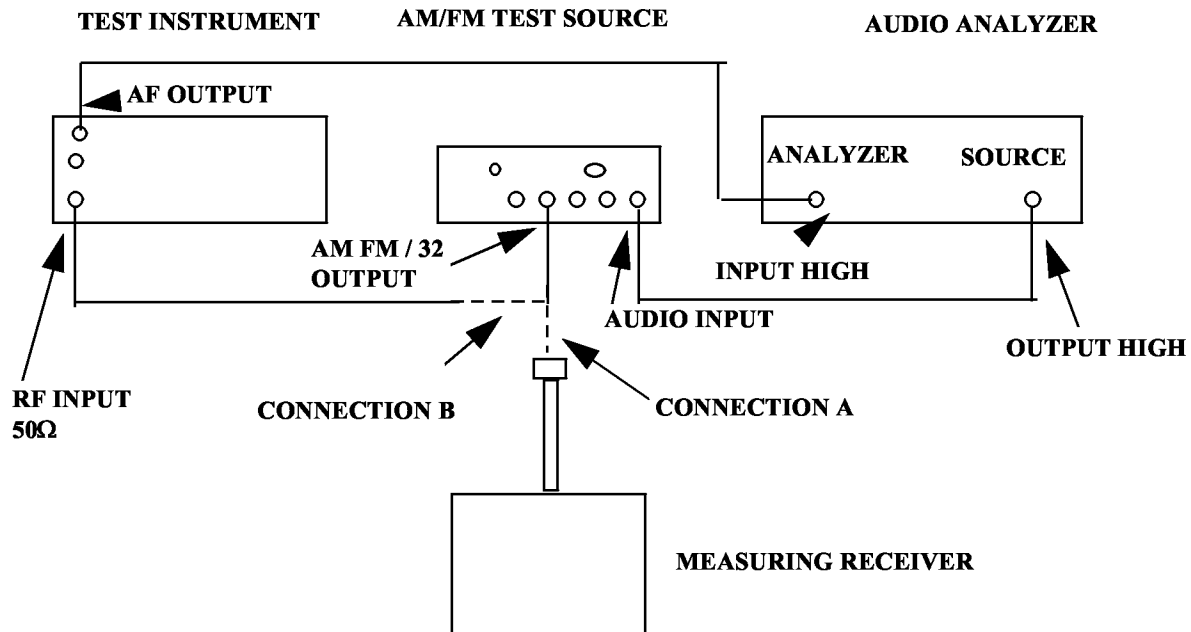


Figure 5. AM accuracy

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(1) On measuring receiver, calibrate the **AM** and **FM** by using the low frequency **SENSOR MODULE**.

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

(3) Ensure TI pushbuttons are pressed (on) as indicated in (a) through (h) below:

(a) **CARR FREQ** then **1, 2, ., 5 MHZ**

(b) **LEVEL DISPLAY** to **AM**.

(c) **LEVEL UNITS** to **ABS**.

(d) **LEVEL DETECTOR MODE** to **+ PEAK**.

(e) **HIGH PASS FILTER** to **50 Hz**.

(f) **LOW PASS FILTER** to **15 kHz**.

(g) **FREQ DISP** to **RF**.

(h) Data keyboard, press #, **0, 7** to perform self-calibration of **AM** and **FM** (this requires approximately 20 seconds).

(4) On audio generator, press pushbuttons as indicated in (a) through (d) below:

(a) **SOURCE FREQ** to **1000 Hz**.

(b) **SOURCE LEVEL** to **246 mV**.

(c) **SPCL 75**.

(d) **ANALYZER DIST** (on).

(5) On measuring receiver press **FREQ** pushbutton.

(6) On AM/FM test source, set **TEST MODE** switch to **AM** and adjust **CARRIER FREQUENCY TUNE** control for **12.5 MHz** display indication on measuring receiver.

(7) On measuring receiver, press **AM** pushbutton and record amplitude modulation displayed indication.

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

(9) TI **LEVEL/DATA ENTRY** display will indicate within $\pm 2.5\%$ + one count of the recorded value in (7) above.

- (10) Audio analyzer display will indicate $< .3\%$ distortion.
- (11) Connect equipment as shown in figure 5, CONNECTION A.
- (12) On audio generator, press **SOURCE LEVEL** pushbuttons to 492 mV.
- (13) On measuring receiver, record amplitude modulation displayed indication.
- (14) Connect equipment as shown in figure 5, CONNECTION B.
- (15) TI **LEVEL/DATA ENTRY** display will indicate within $\pm 2.5\%$ + one count of the recorded value in (13) above.
- (16) Audio analyzer display will indicate $< .6\%$ distortion.

b. Adjustments. No adjustments can be made.

13. FM Accuracy and Distortion

a. Performance Check

- (1) Connect equipment as shown in figure 6, CONNECTION A.

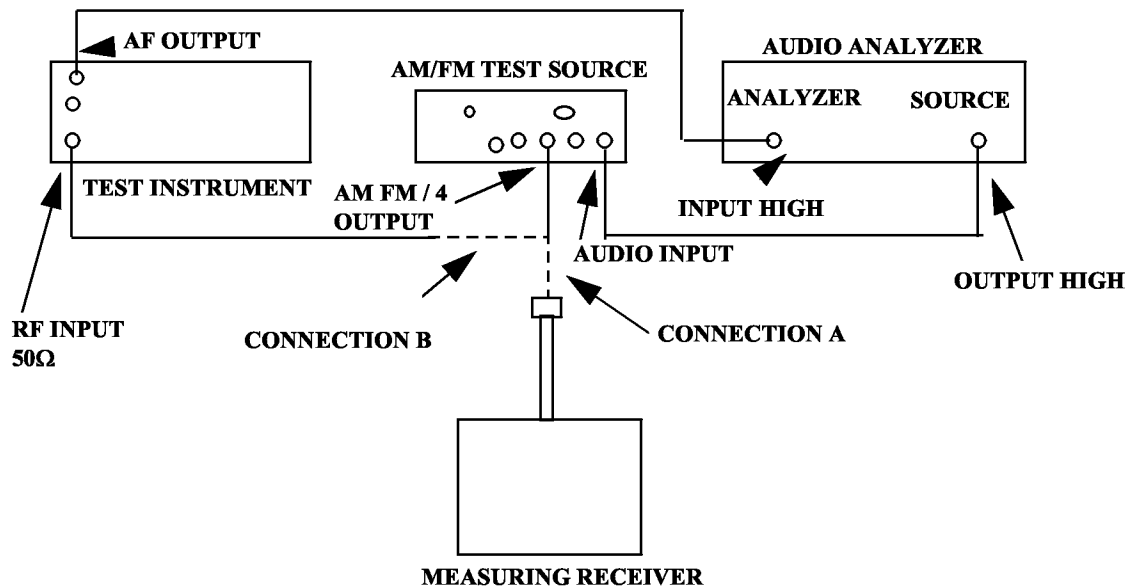


Figure 6. FM and PM accuracy.

- (2) On AM/FM test source, set **TEST MODE** switch to **FM**.
- (3) Set audio generator **SOURCE LEVEL** to 229 mV and **LP FILTER** to 80.
- (4) On measuring receiver, press **FREQ** pushbutton.

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(5) On AM/FM test source, set **TEST MODE** switch to **FM** and adjust **CARRIER FREQUENCY TUNE** control for **100 MHz** displayed indication on measuring receiver.

(6) On measuring receiver, press **FM** pushbutton and record frequency modulation displayed indication.

NOTE

Add filters on measuring receiver as necessary to indicate a stable reading.

(7) Connect equipment as shown in figure 6, CONNECTION B.

(8) Press TI pushbuttons as indicated in (a) through (d) below:

(a) **CARR FREQ** then **1, 0, 0, MHz**.

(b) **LEVEL DISPLAY** to **FM** (on).

(c) **LEVEL DETECTOR MODE** to **PK-PK/2** (on).

(d) **LOW PASS FILTER** to **300 kHz** (on).

(9) TI **LEVEL/DATA ENTRY** display will indicate within $\pm 3\%$ + one count of the recorded value in (6) above.

(10) Connect equipment as shown in figure 6, CONNECTION A.

(11) Press audio generator **SOURCE LEVEL** pushbuttons to 764 mV.

(12) On measuring receiver, record frequency modulation displayed indication.

(13) Connect equipment as shown in figure 6, CONNECTION B.

(14) TI **LEVEL/DATA ENTRY** display will indicate within $\pm 3\%$ + one count of the recorded value in (12) above.

(15) Audio analyzer display will indicate $<0.15\%$ distortion.

b. Adjustments. No adjustments can be made.

14. PM Deviation Accuracy

a. Performance Check

(1) Connect equipment as shown in figure 6, CONNECTION A.

(2) Press audio generator **SOURCE LEVEL** pushbuttons to 153 mV.

(3) On measuring receiver, press **PM** pushbutton and record phase modulation displayed indication.

NOTE

Add filters on measuring receiver as necessary to indicate a stable reading.

- (4) Connect equipment as shown in figure 6, CONNECTION B.
- (5) Press **TI LEVEL DISPLAY** to **PM** pushbutton (on).
- (6) **TI LEVEL/DATA ENTRY** display will indicate within $\pm 3\%$ + three counts of the recorded value in (3) above.
- (7) Connect equipment as shown in figure 6, CONNECTION A.
- (8) Press audio generator **SOURCE LEVEL** pushbuttons to **229 mV**.
- (9) On measuring receiver, record phase modulation displayed indication.
- (10) Connect equipment as shown in figure 6, CONNECTION B.
- (11) **TI LEVEL/DATA ENTRY** display will indicate within $\pm 3\%$ + three counts of the recorded value in (9) above.

b. Adjustments. No adjustments can be made.

15. AF Accuracy**a Performance Check**

- (1) Connect equipment as shown in figure 7.

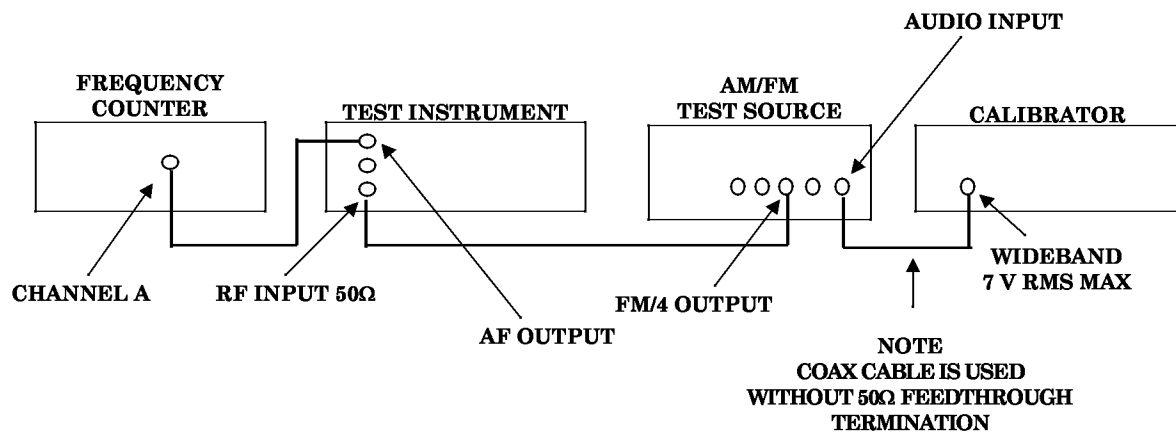


Figure 7. AF accuracy.

- (2) Set calibrator **WIDEBAND** output to 1 kHz at 114.5 mV.

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- (3) Set electronic counter to measure 1 kHz into a 50 Ω input.
- (4) Press TI pushbuttons (on) as indicated in (a) through (c) below:
 - (a) **LEVEL DISPLAY FM.**
 - (b) **LOW PASS FILTER 75 kHz.**
 - (c) **FREQ DISP AF.**
- (5) Frequency counter display will indicate between 999 to 1001 Hz.
- (6) Set calibrator **WIDEBAND** output to 4 kHz.
- (7) Frequency counter display will indicate between 3990 to 4010 Hz.
- (8) Press calibrator **OPR/STBY** pushbutton to **STBY**.

b. Adjustments. No adjustments can be made.

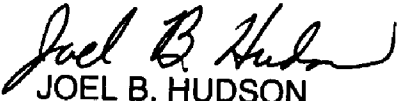
16. Final Procedure

- 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:

DENNIS J. REIMER
General, United States Army
Chief of Staff

Official:


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

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Distribution:

To be distributed in accordance with Std IDS No. RLC-1500, 11 May 1992, requirements for calibration procedure TB 9-6625-2317-50.