TB 9-6625-2330-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR SIGNAL GENERATOR SG-1207A/U (WAYNE-KERR, MODEL PSG2400L)

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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Signal Generator, SG-1207A/U (Wayne-Kerr, Model PSG2400L). TM 43-6625-911-14&P 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. There are at least two different SG-1207A/U versions fielded. While there are no operational differences between versions, there are internal differences that are maintenance significant. Therefore, the only adjustment included in this procedure is for the 10 MHz Ref Adj. Additional adjustments are contained in TM 43-6625-911-14&P.

b. Time and Technique. The time required for this calibration is approximately 6 hours, using the dc and low frequency and microwave 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 in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Frequency	Range: 100 kHz to 2000 MHz Accuracy: ±1 PPM Time stability: ±0.02 PPM/24hour Line stability: ±1 PPM, 10% line change[1]
RF output	Range: >15 to –125 dBm[2] Flatness: ±1.5 dB (100 kHz to 1000 MHz) ±2.5 dB (100 kHz to 2000 MHz) Attenuator accuracy: ±1.5 dB (100 kHz to 1000 MHz) ±2.5 dB (100 kHz to 2000 MHz)

See footnotes at end of table.

Table 1. . Calibration Description - Continued

Test instrument parameters	Performance specifications
Spectral purity	**Harmonics range:** **Accuracy:** 100 kHz to 2000 MHz <+13 dBm, <-25 dBc <+3 dBm, <-30 dBc **Sub harmonic range:** **Accuracy:** 100 kHz to 1200 MHz <+3 dBm, <-40 dBc 100 kHz to 2000 MHz <+3 dBm, <-30 dBc 100 kHz to 2000 MHz <+13 dBm, <-20 dBc **Spurious signal range** **Accuracy:** 100 kHz to 2000 MHz <+13 dBm, <-50 dBc = >5 kHz carrier offset
Pulse modulation	Pulse range: 100 kHz to 2000 MHz Pulse rate: 50 Hz to 10 MHz Pulse envelope on/off ratio: Accuracy (100 kHz to 2000 MHz) >60 dB Pulse envelope rise/falltime <25 nanoseconds (10% to 90%)
Amplitude modulation	Frequency range: 100 kHz to 2000 MHz Depth: 0 to 99.9% in .1% increments Accuracy: ±7% of setting at 1 kHz rate and modulation depth of 30% to 70% Distortion: <3%, (30% to 70% depth, 1 kHz rate) (3 dB bandwidth 300 Hz to 3 kHz) Incidental FM: <200 Hz (30% at 1 kHz) (3 dB bandwidth 300 Hz to 3 kHz)
Frequency modulation	Frequency response: 50 Hz to 100 kHz internal/external Deviation range: 10 Hz to 200 kHz Accuracy: ±5% at 1 kHz rate Incidental AM: < 1% (3 dB bandwidth 300 Hz to 3 kHz, 1 kHz rate) Distortion: ≤2% (3 dB bandwidth 300 Hz to 3 kHz 1 kHz rate and deviation > 8 kHz)
Phase modulation	Modulation bandwidth: 100 Hz to 10 kHz Deviation range: 0 to 10 radians ±10% of setting (1 kHz rate) Frequency response: ±2 dB relative to 1 kHz rate across modulation bandwidth Distortion: <2% (3 dB bandwidth 300 Hz to 3 kHz at 1 kHz rate and deviation > 8 kHz)

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Internal oscillator	Frequency range: .1 Hz to 500 kHz[3] Accuracy: Same as time base Distortion: <0.2%, (@ 1 kHz and 400 Hz) Output: 1 V rms into 50Ω nominal

[1]Line stability verified to 8.7% line change.

[2]Range verified to –110 dBm.

[3]Range verified to 100 kHz

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 Standards Set AN/GSM-287. 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 is shown in parenthesis.

5. Accessories Required. The accessories required for the 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	Distortion capability: ≤ .05% Range: 20 Hz to 100 kHz	Boonton, Model 1120-S/10 (MIS-35954/2)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ±1%	General Radio, Type W10MT3AS3 (7910809) or Ridge, Model 9020A (9020A) or Ridge, Model 9020F (9020F)
CRYSTAL DETECTOR	Range: 1 GHz	Hewlett-Packard Model 423A (423A)
ELECTRONIC COUNTER	Range: 20 Hz to 500 MHz Accuracy: ±2.5 ppm or .00025%	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1)
FEEDTHROUGH TERMINATION	Range: 1 V rms 1 kHz	Hewlett-Packard Model 11048C (11048C)
FREQUENCY DIFFERENCE METER	Range: 10 MHz Resolution: 1 part in 10^{-10} per day	Tracor, Model 527E (MIS-28754/1 Type 1)

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
MEASURING RECEIVER	Frequency measurement: Range: 200 kHz to 2000 MHz Accuracy: ±.25 ppm Power measurement: (+13 dB to -110 dB) ±.375 dB Flatness measurement: (100 kHz to 1000 MHz) ±.375 dB (100 kHz to 2000 MHz) ±.625 dB	Hewlett-Packard, Model 8902A (8902A) w/sensors, Hewlett-Packard, Models 11722A (11722A) and 11792A (11792A), and microwave converter, Hewlett-Packard, Model 11793A (11793A),).
MULTIMETER	Range: 50 to -15 V dc Accuracy: ±.25%	John Fluke, Model 8840A/A-05/09 (AN/GSM-64D)
OSCILLOSCOPE	Range: 50 kHz Accuracy: <25 ns risetime	(OS-291/G)
PULSE GENERATOR	Amplitude: 5 V Period: 10 ms to 20 µs Width: 5 ms to 6 µs	LeCroy, Model 9210 (9210) w/plug-ins, LeCroy Models 9211 (9211) and 9215 (9215)
SIGNAL GENERATOR	Range: Output level +8 dBm Frequency range: 2 GHz	(SG-1219)
SPECTRUM ANALYZER	Range: 100 kHz to 2 GHz (13 to -90 dB) Accuracy: ±1.0 dB/10 dB step, 1.0 dB maximum	Hewlett-Packard Model 8562A, (AN/USM-489(V)1)

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

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

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

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in TM 43-6625-911-14&P for this TI.

d. When indications specified in paragraphs **7** through **16** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **7** through **16**. Do not perform power supply check if all other parameters are within tolerance.

e. 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

Before connecting TI, the protective earth terminal of the instrument must be connected to the protective conductor of the line power cord. The line plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

NOTE

When indications specified in this procedure are not within tolerance, perform the power supply check prior to making adjustments.

a. Connect TI to autotransformer.

b. Connect autotransformer to a 115 V ac source and adjust autotransformer to 115 V ac.

c. Press **POWER** pushbutton to **ON** and allow at least 30 minutes for TI to stabilize.

d. Connect **REF IN/OUT** connector of TI to **SIG INPUT** of frequency difference meter.

e. Connect **1 MHz** output of time/frequency workstation to **REF INPUT** of the frequency difference meter.

f. Adjust **REF ADJ** (TI rear panel) for a minimum frequency difference meter indication.

g. Verify oscillator drift is less than 2 parts in 10^{-8} in 24 hours.

h. Disconnect frequency difference meter from TI and the time/frequency workstation.

8. Line Stability

a. Performance Check

(1) Connect electronic counter **CHANNEL A** to TI **RF OUTPUT**, using cable and adapter.

(2) Position electronic counter controls and switches as indicated in (a) thru (j) below.

(a) **FUNCTION FREQ A**.
(b) **GATE TIME 1S**.
(c) **DISPLAY POSITION AUTO**.
(d) **CHECK/COM A/SEP** to **SEP**.
(e) **CHANNEL A SLOPE** to **+**.
(f) **CHANNEL A AC/DC** switch to **AC**.
(g) **CHANNEL A 50**W **1 M**W switch to **50**W.
(h) **CHANNEL A X1 X10** switch to **X1**.
(i) **CHANNEL A –LEVEL+** as needed.
(j) **SAMPLE RATE** as needed.

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY-100 MHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY-0 dBm**.
(e) **FUNCTION-RF ON** to on (red light lit).

(4) Record electronic counter indication.

(5) Vary autotransformer to the voltage level indicated in the first row of table 3. Electronic counter will indicate within ±100 Hz of the recorded value in (4) above.

(6) Repeat (5) above for the remaining voltage levels listed in table 3.

Table 3. Line Stability

Autotransformer voltage indications	Electronic counter indication at 100 MHz ±100 Hz
125 V ac	
120 V ac	
110 V ac	
105 V ac	

(7) Adjust autotransformer to 115 V ac.

b. Adjustments. No adjustments can be made.

9. Frequency Accuracy

a. Performance Check

(1) Connect electronic counter **CHANNEL A** to TI **RF OUTPUT**, using cable and adapter.

(2) Position electronic counter controls and switches as indicated in (a) thru (j) below.

(a) **FUNCTION FREQ A**.
(b) **GATE TIME 1S**.
(c) **DISPLAY POSITION AUTO**.
(d) **CHECK/COM A/SEP** to **SEP**.
(e) **CHANNEL A SLOPE** to **+**.
(f) **CHANNEL A AC/DC** switch to **AC**.
(g) **CHANNEL A 50**W **1 M**W switch to **50**W.
(h) **CHANNEL A X1 X10** switch to **X1**.
(i) **CHANNEL A –LEVEL+** as needed.
(j) **SAMPLE RATE** as needed.

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY-100 kHz.**
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- -3 dBm**.
(e) **FUNCTION-RF ON** to on (red light lit).

(4) Verify that the electronic counter indicates within the limits listed in table 4.

(5) Set TI to the next frequency listed in table 4 using the TI **FUNCTION-CARR FREQ** and **DATA ENTRY** keys and repeat (4) above.

(6) Repeat (4) and (5) above for the remaining frequencies listed in table 4.

Table 4. Frequency

Test instrument **DATA ENTRY** frequency	Electronic counter indications	
	Min	Max
100 kHz	99.9999 kHz	100.0001 kHz
500 kHz	499.9995 kHz	500.0005 kHz
1 MHz	999.999 kHz	1.000001 MHz
5 MHz	4.999995 MHz	5.000005 MHz
10 MHz	9.999990 MHz	10.000010 MHz
50 MHz	49.999950 MHz	50.0000500 MHz
100 MHz	99.999900 MHz	100.000100 MHz
500 MHz	499.999500 MHz	500.000500 MHz

(7) Press TI **FUNCTION-RF ON** pushbutton to off (red light extinguished).

(8) Disconnect electronic counter, cable, and adapter from TI **RF OUTPUT**.

(9) Connect measuring receiver with sensor module (11792A) to TI **RF OUTPUT.**

(10) Press TI **RF ON** pushbutton to off (red light extinguished).

(11) Set TI to the first frequency listed in table 5 using the TI **FUNCTION-CARR FREQ** and **DATA–ENTRY** Keys.

(12) Verify that the measuring receiver indicates within the limits listed in table 5.

(13) Set TI to the second frequency listed in table 5.

(14) Set local oscillator and measuring receiver to measure 2 GHz, using the local oscillator and measuring receiver offset frequencies listed in table 5.

(15) Verify that the measuring receiver indicates within the limits listed in table 5.

Table 5. Frequency

Local (GHz) oscillator	Measuring receiver offset (MHz)	Test instrument **DATA ENTRY** frequency	Measuring receiver indications	
			Min	Max
N/A	N/A	1300 MHz	1299.998700 MHz	1300.001300 MHz
2	2000	2000 MHz	1999.998000 MHz	2000.002000 MHz

(16) Press TI **FUNCTION-RF ON** pushbutton to off (red light extinguished).

(17) Disconnect measuring receiver sensor module from TI **RF OUTPUT**.

b. Adjustments. No adjustments can be made.

10. RF Output

a. Performance Check

(1) Connect power sensor module (11722A) to measuring receiver **CALIBRATION RF POWER OUTPUT**.

(2) Calibrate and save the calibration of the power sensor.

(3) Disconnect the measuring receiver power sensor module from the **CALIBRATION RF POWER OUTPUT** and connect it to the TI **RF OUTPUT.**

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY-30 MHz.**
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 13 dBm**.
(e) **FUNCTION-RF ON** to on (red light lit).

(5) Using measuring receiver and RF power measurement techniques; measured power will indicated with in the limits specified in table 6 for the TI RF power level setting.

(6) Press TI **FUNCTION-CARR LEVEL** and **DATA ENTRY** keys to the next level listed in table 6. Measuring receiver will indicate within limits specified for TI RF power level setting.

(7) Repeat (6) above for the remaining levels listed in table 6.

Table 6. 30 MHz RF Output

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
13 dBm	11.5	14.5
10 dBm	8.5	11.5
5 dBm	3.5	6.5
0 dBm	-1.5	1.5

(8) Press TI **FUNCTION-CARR LEVEL** and **DATA ENTRY** keys to set TI output level to the first value listed in table 7.

(9) Using standard tuned level measurement techniques, verify the measuring receiver indicates within the limits specified in table 7 for the TI RF power level setting.

(10) Press TI **FUNCTION-CARR LEVEL** and **DATA ENTRY** keys to set TI output level to the next value listed in table 7. Measuring receiver indicates within limits listed in table 7 for the TI RF power level setting.

(11) Repeat (10) above for the remaining levels listed in table 7.

Table 7. 30 MHz RF Output

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
0 dBm	-1.5	1.5
-10 dBm	-11.5	-8.5
-20 dBm	-21.5	-18.5
-30 dBm	-31.5	-28.5
-40 dBm	-41.5	-38.5
-50 dBm	-51.5	-48.5
-60 dBm	-61.5	-58.5
-70 dBm	-71.5	-68.5
-80 dBm	-81.5	-78.5
-90 dBm	-91.5	-88.5
-100 dBm	-101.5	-98.5
-110 dBm	-111.5	-108.5

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY-1300 MHz.**

(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 13 dBm**
(e) **FUNCTION-RF ON** to on (red light lit).

(13) Using RF power measurement techniques, measured power will indicate within limits specified in table 8 for the TI RF power level setting.

(14) Press TI **FUNCTION-CARR LEVEL** and **DATA ENTRY** keys to set TI output level to the next value listed in table 8. Verify the measuring receiver indicates within minimum and maximum limits listed in table 8.

(15) Repeat (14) above for the remaining levels listed in table 8.

Table 8. 1300 MHz RF Output

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
13 dBm	11.5	14.5
10 dBm	8.5	11.5
5 dBm	3.5	6.5
0 dBm	-1.5	1.5

(16) Press TI **FUNCTION-CARR LEVEL** and **DATA ENTRY** keys to set TI output level to the first value listed in table 9. Verify the measuring receiver indicates within minimum and maximum limits listed in table 9 using standard tuned level measurement techniques.

(17) Using standard tuned level measurement techniques, measuring receiver will indicate within the limits specified in table 9 for the TI RF level setting.

(18) Press TI **FUNCTION-CARR LEVEL** and **DATA ENTRY** keys to set TI output level to the next value listed in table 9. Verify the measuring receiver indicates within minimum and maximum limits listed in table 9.

(19) Repeat (18) above for the remaining levels listed in table 9.

Table 9. 1300 MHz RF Output

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
0 dBm	-1.5	1.5
-10 dBm	-11.5	-8.5
-20 dBm	-21.5	-18.5
-30 dBm	-31.5	-28.5
-40 dBm	-41.5	-38.5

Table 9. 1300 MHz RF Output

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
-50 dBm	-51.5	-48.5
-60 dBm	-61.5	-58.5
-70 dBm	-71.5	-68.5
-80 dBm	-81.5	-78.5
-90 dBm	-91.5	-88.5
-100 dBm	-101.5	-98.5
-110 dBm	-111.5	-108.5

(20) Press TI **FUNCTION-RF ON** pushbutton to off (red light extinguished).

b. Adjustments. No adjustments can be made.

11. Output Level Flatness

a. Performance Check

(1) Connect power sensor module (11792A) to measuring receiver **CALIBRATION RF POWER OUTPUT**.

(2) Calibrate and save the calibration of the power sensor.

(3) Disconnect the measuring receiver power sensor module from the **CALIBRATION RF POWER OUTPUT** and connect it to the TI **RF OUTPUT.**

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

(a) **FUNCTION-CARR FREQ** and **DATA ENTRY** keys to the first TI frequency listed in table 10.

(b) **FUNCTION-CARR LEVEL**.

(c) **DATA ENTRY- 13 dBm.**

(d) **FUNCTION-RF ON** to on (red light lit).

(5) Manually tune measuring receiver to the first TI frequency listed in table 10.

(6) Set measuring receiver to measure RF power in **LOG** mode. Using measuring receiver and RF power measurement techniques, verify the measuring receiver indicates within minimum and maximum limits listed in table 10.

(7) Repeat **4a**(5) and (6) for the remaining frequencies listed in table 10.

Table 10. Output Level Flatness

Test instrument **DATA ENTRY** frequency		Measuring receiver indications (dB)	
		Min	Max
200	kHz	11.5	14.5
500	kHz	11.5	14.5
1	MHz	11.5	14.5
3	MHz	11.5	14.5
10	MHz	11.5	14.5
30	MHz	11.5	14.5
100	MHz	11.5	14.5
200	MHz	11.5	14.5
300	MHz	11.5	14.5
400	MHz	11.5	14.5
500	MHz	11.5	14.5
600	MHz	11.5	14.5
700	MHz	11.5	14.5
800	MHz	11.5	14.5
900	MHz	11.5	14.5
1	GHz	11.5	14.5
1.1	GHz	11.5	14.5
1.2	GHz	11.5	14.5
1.3	GHz	11.5	14.5
1.4	GHz	11.5	14.5
1.5	GHz	11.5	14.5
1.6	GHz	11.5	14.5
1.7	GHz	11.5	14.5
1.8	GHz	11.5	14.5
1.9	GHz	11.5	14.5
2.0	GHz	11.5	14.5

(8) Press TI **FUNCTION-RF ON** pushbutton to off (red light extinguished).

b. Adjustments. No adjustments can be made.

12. Attenuation

a. Performance Check

(1) Connect power sensor module (11722A) to measuring receiver **CALIBRATION RF POWER OUTPUT**.

(2) Calibrate and save the calibration of the power sensor.

(3) Disconnect the measuring receiver power sensor module from the **CALIBRATION RF POWER OUTPUT** and connect it to the TI **RF OUTPUT.**

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

(a) **FUNCTION-CARR FREQ.**
(b) **DATA ENTRY- 500 MHz**
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 0 dBm.**
(e) **FUNCTION-RF ON** to on (red light lit).

(5) Using measuring receiver and RF power measurement techniques, measured power will indicate within limits specified in table 11 for 0 dBM.

(6) Set measurement receiver to reference mode.

(7) Set TI to the next power level indicated in table 11.

(8) Using standard tuned level measurement techniques, verify the measuring receiver indicates within the minimum and maximum limits for TI output level listed in table 11.

(9) Repeat (7) and (8) above for the remaining output levels listed in table 11.

Table 11. 500 MHz Attenuation

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
0 dBm	-1.5	1.5
-10 dBm	-11.5	-8.5
-20 dBm	-21.5	-18.5
-30 dBm	-31.5	-28.5
-40 dBm	-41.5	-38.5
-50 dBm	-51.5	-48.5
-60 dBm	-61.5	-58.5
-70 dBm	-71.5	-68.5
-80 dBm	-81.5	-78.5
-90 dBm	-91.5	-88.5
-100 dBm	-101.5	-98.5
-110 dBm	-111.5	-108.5

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

FUNCTION-CARR FREQ.
DATA ENTRY-1300 MHz.
FUNCTION-CARR LEVEL.
DATA ENTRY- 0 dBm.
FUNCTION-RF ON to on (red light lit).

(11) Using measuring receiver and RF power measurement techniques, measured power will indicate within limits specified in table 12 for 0 dBM.

(12) Set measurement receiver to ratio mode.

(13) Set TI to the next power level indicated in table 12.

(14) Using standard tuned level measurement techniques, verify the measuring receiver indicates within the minimum and maximum limits for TI output level listed in table 11.

(15) Repeat (13) and (14) above for the remaining output levels listed in table 12.

Table 12. 1300 MHz Attenuation

Test instrument **DATA ENTRY** level	Measuring receiver indications (dB)	
	Min	Max
0 dBm	-1.5	1.5
-10 dBm	-11.5	-8.5
-20 dBm	-21.5	-18.5
-30 dBm	-31.5	-28.5
-40 dBm	-41.5	-38.5
-50 dBm	-51.5	-48.5
-60 dBm	-61.5	-58.5
-70 dBm	-71.5	-68.5
-80 dBm	-81.5	-78.5
-90 dBm	-91.5	-88.5
-100 dBm	-101.5	-98.5
-110 dBm	-111.5	-108.5

(16) Press TI **FUNCTION-RF ON** pushbutton to off (red light extinguished).

(17) Disconnect measuring receiver sensor module (11722A) from TI **RF OUTPUT.**

b. Adjustments. No adjustments can be made.

13. Spectral Purity

a. Performance Check

(1) Connect spectrum analyzer **INPUT 50**W to TI **RF OUTPUT**, using cable.

(2) Connect TI **EXT REF INPUT** (rear panel) to spectrum analyzer **10 MHz REF IN/OUT** (rear panel).

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

(a) **FUNCTION-CARR FREQ.**
(b) **DATA ENTRY- .450 MHz.**
(c) **FUNCTION-CARR LEVEL.**
(d) **DATA ENTRY- 13 dBm.**
(e) **FUNCTION-RF ON** to on (red light lit).

(4) Set spectrum analyzer controls as listed in (a) through (g) below:

(a) **PRESET**.
(b) **AMPLITUDE REF LVL** to **13 dBm**.
(c) **FREQUENCY-CENTER FREQ** to **.450 MHz**.
(d) **VIDEO BW** to **AUTO**.
(e) **RES BW** to **10 kHz**.
(f) **SPAN** to **1 MHz**.
(g) All markers off.

(5) Allow the display to sweep a few times then set spectrum analyzer controls as listed in (a) through (d).

(a) **PEAK SEARCH.**
(b) **MARKER CF.**
(c) **MARKER DELTA.**
(d) **FREQUENCY-CENTER FREQ**, to (harmonic frequency listed in table 13) **MHz**.

(6) The spectrum analyzer **?MKR** will indicate less than the dBc limit listed in table 13.

(7) Set TI frequency and spectrum analyzer center frequency to the next frequency listed in table 13 and repeat (4)(g) through (6) above.

(8) Repeat (7) above for remaining frequencies listed in table 13

Table 13. Spectral Purity

Test instrument		Spectrum analyzer		
DATA ENTRY level (dBm)	**DATA ENTRY** frequency (MHz)	Harmonic frequency (MHz)	Harmonic number	dBc
13	.450	.900	2nd	<-25
13	.450	1.350	3rd	<-25
13	1	2	2nd	<-25
13	1	3	3rd	<-25
13	166.666665	333.333330	2nd	<-25

Table 13. Spectral Purity - Continued

Test instrument		Spectrum analyzer		
DATA ENTRY level (dBm)	**DATA ENTRY** frequency (MHz)	Harmonic frequency (MHz)	Harmonic number	dBc
13	166.666665	499.999995	3rd	<-25
13	250	500	2nd	<-25
13	333.333335	666.666670	2nd	<-25
13	333.333335	1000.000005	3rd	<-25
13	500	1000	2nd	<-25
13	2000	1000	.5	<-20
13	2000	4000	2nd	<-25

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

(a) **FUNCTION-CARR FREQ 100**.
(b) **DATA ENTRY- 100 MHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 7 dBm**.
(e) **FUNCTION-RF ON** to on (red light lit).

(10) Set spectrum analyzer controls as listed in (a) through (g) below:

(a) **PRESET**.
(b) **FREQUENCY- CENTER FREQ to 101 MHz**.
(c) **AMPLITUDE REF LVL to 7 dBm**.
(d) **VIDEO BW to AUTO**.
(e) **RES BW to AUTO**.
(f) All markers off.
(g) **SPAN 2.5 kHz**.

(11) Set spectrum analyzer to single sweep mode and take one sweep.

(12) Set spectrum analyzer marker to normal.

(13) The spectrum analyzer **MKR** will indicate less than the dB limit listed in table 14.

Table 14. Noise Floor

Test Instrument		Spectrum Analyzer		
DATA ENTRY frequency	**DATA ENTRY** level	Center frequency	Span	dB indications
100 MHz	7 dBm	101 MHz	1 kHz	<-87 dBm

(14) Press TI pushbuttons as listed in (a) through (d) below:

(a) **FUNCTION-CARR FREQ** to the first TI frequency listed in table 15 below.

(b) **FUNCTION-CARR LEVEL**.
(c) **DATA ENTRY- 13 dBm.**
(d) **FUNCTION-RF ON** to on (red light lit).

(15) Using spectrum analyzer, verify that all non-harmonic spurious signals are less than the dBc limit listed in table 15.

(16) Repeat (14) and (15) for the remaining frequencies listed in table 15.

Table 15. Spurious Signals

Test instrument		Spectrum analyzer
DATA ENTRY level (dBm)	**DATA ENTRY** frequency (MHz)	Spurious signal level
13	25 MHz	<-50 dBc
13	50 MHz	<-50 dBc
13	100 MHz	<-50 dBc
13	225 MHz	<-50 dBc
13	450 MHz	<-50 dBc
13	750 MHz	<-50 dBc
13	1500 MHz	<-50 dBc

b. Adjustments. No adjustments can be made.

14. Pulse Modulation

a. Performance Check

(1) Connect equipment as shown in figure 1.

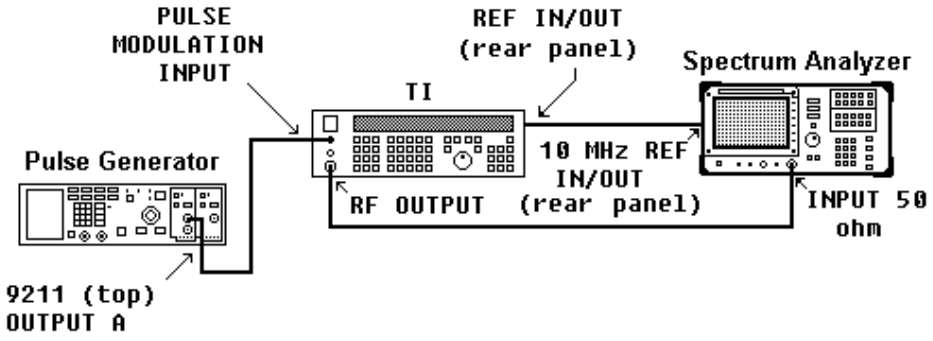

Figure 1. Pulse modulation on/off ratio hookup.

(2) Press pulse generator pushbuttons for a pulse output as listed in (a) through (h) below:

(a) **CHANNEL A**.
(b) **Period** and enter **10m/kHz** from data keyboard.
(c) **Width** and enter **5 m/kHz** from data keyboard.
(d) **Vhigh** and enter **5** from data keyboard.
(e) **Vlow** and enter **0** from data keyboard.
(f) **Delay** and enter **0 n/GHz** from data keyboard.
(g) **2 Pulse** and enter **OFF Enter/Hz** from data keyboard.
(h) On 9211 output module, disable (red light extinguished).

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY- 1 GHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 10 dBm.**
(e) **FUNCTION-RF ON** to on (red light lit).

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

(a) **INSTR PRESET**.
(b) **AMPLITUDE - REF LVL** to **+10 dBm**.
(c) **FREQUENCY - CENTER FREQ** to **1 GHz**.
(d) **SPAN 1.5 MHz**.

(5) Press TI **MODULATION/AUX-MOD SOURCE DISP** and **MODULATION /AUX-MOD ON EXT** to ext.

(6) Press spectrum analyzer pushbuttons as listed in (a) through (m) below:

(a) **RES BW** to **100 kHz**.
(b) **VIDEO BW** to **1 kHz**
(c) **MARKER - ON**.
(d) **SPAN 0 Hz**.
(e) **CONTROL – SWEEP** to **30 ms**.
(f) **CONTROL – TRIG VIDEO** to **–10 dBm**.
(g) **MARKER – ON**.
(h) Adjust **MARKER** control to top of squarewave.
(i) **MARKER DELTA**.
(j) Adjust **DELTA** control to bottom of squarewave.
(k) Adjust **MARKER** control to top of squarewave.
(l) **MARKER DELTA**.
(m) Adjust **DELTA** control to bottom of squarewave.

(7) Using spectrum analyzer, measure top to bottom of square wave in dB. Pulse envelope on/off ratio will indicate within limits specified in table 16.

Table 16. Pulse Modulation

Spectrum analyzer >dB
60

(8) Set TI **FUNCTION-RF ON** to off (red light extinguished).

(9) Connect equipment as shown in figure 2.

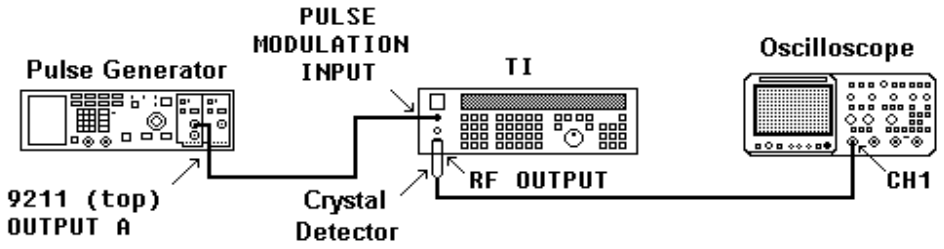

Figure 2. Pulse modulation risetime hookup.

(10) Adjust pulse generator output for a period of 20 µsec and a pulse width of 15 µsec.

(11) Set TI **FUNCTION-RF ON** to on (red light lit).

(12) Set oscilloscope input impedance to 50Ω.

(13) Using oscilloscope measurement techniques, verify that the risetime of displayed envelope is within the limits listed in table 17.

Table 17. Risetime

Oscilloscope < nS
25

(14) Using oscilloscope measurement techniques, verify that the falltime of displayed envelope is within the limits listed in table 18.

Table 18. Falltime

Oscilloscope < nS
25

(15) Set TI **FUNCTION-RF ON** to off (red light extinguished).

(16) Disconnect pulse generator and oscilloscope from circuit.

b. Adjustments. No adjustments can be made.

15. Internal Oscillator

a. Performance Check

(1) Connect TI **MODULATION IN/OUT** to audio analyzer **INPUT HIGH**.

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

(a) **FUNCTION-RF ON** to off (red light extinguished).
(b) **MODULATION/AUX-MOD SOURCE DISP** to **Source One**.
(c) **FUNCTION-MOD FREQ.**
(d) **DATA ENTRY- 1 kHz**
(e) **MODULATION/AUX-MOD ON ONE.**

(3) Using audio analyzer, measure the distortion. Audio analyzer distortion indication will be within the limits specified in table 19.

Table 19. Internal Oscillator Distortion

Test instrument **MOD FREQ** frequency	Audio analyzer distortion indications (%)
1 kHz	<0.2

(4) Using audio analyzer, measure frequency. Audio analyzer frequency indication will be within the limits specified for the first frequency listed in table 20.

(5) Set TI **FUNCTION-MOD FREQ** and **DATA ENTRY** keys to the next frequency listed in table 20.

(6) Audio analyzer frequency indication will be within the limits specified in table 20 for the frequency setting of the TI.

(7) Repeat (5) and (6) above for the remaining frequencies listed in table 20.

Table 20. Internal Oscillator Frequency

Test instrument **DATA ENTRY** mod frequency settings	Audio analyzer indications (Hz)	
	Min	Max
1 kHz	999	1001
100 Hz	99	101
500 Hz	499	501
5 kHz	4.999 k	5.001 k
10 kHz	9.999 k	10.001 k
50 kHz	49.999 k	50.001 k
100 kHz	99.999 k	100.001 k

(7) Disconnect TI **MODULATION IN/OUT** from audio analyzer **INPUT HIGH**. Connect TI **MODULATION IN/OUT** to electronic counter **CHANNEL A** input.

(8) Position electronic counter controls and switches as indicated in (a) through (j) below:

(a) **FUNCTION FREQ A**.
(b) **GATE TIME 1S**.
(c) **DISPLAY POSITION AUTO**.
(d) **CHECK/COM A/SEP** to **SEP**.
(e) **CHANNEL A SLOPE** to **+**.
(f) **CHANNEL A AC/DC** switch to **AC**.
(g) **CHANNEL** 50W **1 M**W switch to **50**W**.**
(h) **CHANNEL A X1 X10** switch to **X1**.
(i) **CHANNEL A –LEVEL+** as needed.
(j) **SAMPLE RATE** as needed.

(8) Set TI **FUNCTION-MOD FREQ** and **DATA ENTRY** keys to the first frequency listed in table 21.

(9) Using electronic counter, measure frequency. Electronic counter frequency indication will be within the limits specified for the frequency listed in table 21.

(10) Set TI **FUNCTION-MOD FREQ** and **DATA ENTRY** Keys to the next frequency listed in table 21.

(11) Electronic counter indication will be within the limits specified in table 21 for the frequency setting of the TI.

(12) Repeat (13) and (14) above for the remaining frequencies listed in table 21.

Table 21. Internal Oscillator Frequency

Test instrument **DATA ENTRY** mod frequency settings	Electronic counter indications (Hz)	
	Min	Max
200 kHz	199999	200001
300 kHz	299999	300001
400 kHz	399999	400001
500 kHz	499999	500001

(16) Disconnect **TI MODULATION IN/OUT** from electronic counter **CHANNEL A**.

(17) Connect **TI MODULATION IN/OUT** to **DMM INPUT HI LO** through feedthrough termination, Hewlett-Packard, Model 11048C, using appropriate adapters and cable.

(18) Set up **DMM** to measure V rms.

(19) Set TI **FUNCTION-MOD FREQ** and **DATA ENTRY** keys to the frequency listed in table 22.

(20) Using **DMM**, measure V rms. **DMM** indication will be within the limits specified in table 22.

Table 22. Internal Oscillator output voltage

Test instrument **DATA ENTRY** mod frequency setting	DMM indication (V rms)	
	Min	Max
1 kHz	0.950	1.050

b. Adjustments. No adjustments can be made.

16. Amplitude Modulation

a. Performance Check

(1) Connect equipment as shown in figure 3.

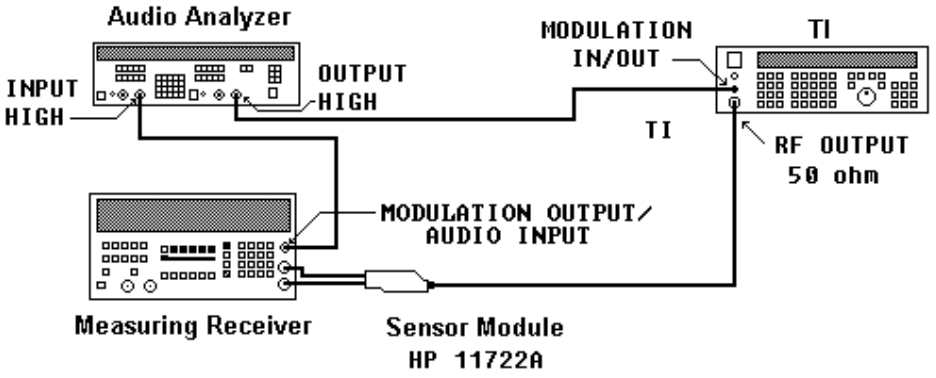

Figure 3. AM modulation hookup.

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY- 1 GHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 5 dBm**.
(e) **FUNCTION- RF ON** to on (red light lit).
(f) **FUNCTION-MOD FREQ**.
(g) **DATA ENTRY- 1 kHz**.
(h) **FUNCTION-MOD LEVEL**.
(i) **DATA ENTRY- 30% AM**.
(k) **MODULATION/AUX –MOD ON ONE**.

(3) Set measuring receiver to measure FM with a 3 kHz low-pass filter and a 300 Hz high-pass filter.

(4) Measuring receiver will indicate within limits specified in table 23.

Table 23. Incidental FM

Carrier frequency	**MOD FREQ**	Modulation %	Measuring receiver <Hz
1 GHz	1 kHz	30	200

(5) Set measuring receiver to measure AM with 15 kHz low-pass filter and a 300 Hz high-pass filter.

(6) Set audio analyzer to measure distortion.

(7) Press TI **FUNCTION-MOD LEVEL** and **DATA ENTRY** keys for the values listed in table 24. Using measuring receiver, measure the AM percent of modulation. Measuring receiver will indicate within the limits specified in table 24.

Table 24. Internal AM Modulation Accuracy

Test instrument **DATA ENTRY** percent of modulation	Measuring receiver modulation indications (%)	
	Min	Max
30%	23	27
60%	53	67
90%	83	97

(8) Press TI **FUNCTION-MOD LEVEL** and **DATA ENTRY** keys for the values listed in table 25. Using audio analyzer, measure the AM distortion. Audio analyzer will indicate within the limits specified in table 25.

Table 25. Internal AM Modulation Distortion

Test instrument **DATA ENTRY** percent of modulation	Audio analyzer distortion indications (<%)
30%	3
60%	3
90%	3

(9) Press TI **MODULATION/AUX-MOD SOURCE DISP** and **MODULATION /AUX-MOD ON EXT** keys.

(10) Press TI **FUNCTION-MOD LEVEL** and **DATA ENTRY- 90% AM** keys.

(11) Set audio analyzer to output a 1 kHz signal at 1.414 V rms with an output impedance of 50Ω.

(12) Set audio analyzer to measure level and set units to dB, then set audio analyzer to ratio mode.

(13) Set audio analyzer to output frequencies listed in table 26 and verify audio analyzer level indication is within limits listed in table 26.

Table 26. External AM Frequency Response

Test description	Audio analyzer frequency (Hz)	Audio analyzer indication	
		Min	Max
250 Hz Response	250	-1	1
400 Hz Response	400	-1	1
500 Hz Response	500	-1	1
2 kHz Response	2000	-1	1
5 kHz Response	5000	-1	1
10 kHz Response	10000	-1	1

b. Adjustments. No adjustments can be made.

17. Frequency Modulation

a. Performance Check

(1) Connect equipment as shown in figure 4.

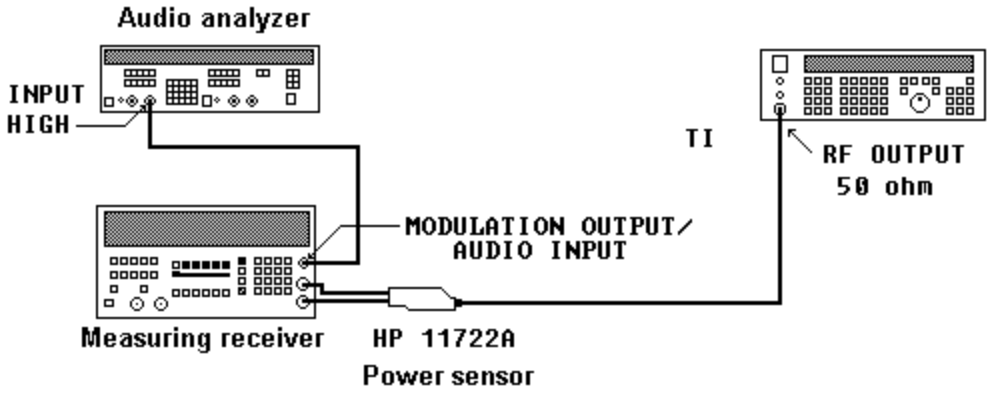

Figure 4. FM Modulation hookup

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY- 1 GHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 13 dBm**.
(e) **FUNCTION-RF ON** to on (red light lit).

(f) **MODULATION/AUX- MOD ON ONE**.
(g) **MODULATION/AUX- MOD ON EXT**.
(h) **MODULATION/AUX- MOD OFF**.

(3) Set measuring receiver to measure FM with an RMS detector, 3 kHz low-pass filter, and a 300 Hz high pass filter.

(4) Measuring receiver will indicate within limits specified in table 27.

Table 27. Residual Response

Audio analyzer distortion indication (%)
2%

(5) Press TI pushbuttons as listed in (a) through (j) below:

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY- 1 GHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 13 dBm**.
(e) **FUNCTION- MOD LEVEL**.
(f) **DATA ENTRY- 20 kHz**.
(g) **FUNCTION- MOD FREQ**.
(h) **DATA ENTRY- 1 kHz**.
(i) **MODULATION/AUX-MOD ON ONE** (mod off red light extinguished).
(j) **FUNCTION-RF ON** to on (red light lit).

(6) Set measuring receiver to measure AM with a + PEAK detector, 3 kHz low-pass filter and a 300 Hz high-pass filter.

(7) Measuring receiver will indicate within the limits specified in table 28.

Table 28. Incidental AM

Measuring receiver indication (%)
<1

(8) Press TI pushbuttons as listed in (a) through (f) below:

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY – 250 MHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY – 10 dBm**.
(e) **FUNCTION – MOD LEVEL**.
(f) **DATA ENTRY – 200 kHz**.

(9) Set up measuring receiver to measure FM with a + PEAK detector, no high pass filter and no low pass filter.

(10) Set up audio analyzer to measure distortion with a slow detecting noise rejecting filter.

(11) Audio analyzer will indicate within the limits specified in table 29.

Table 29. FM Audio Distortion

Audio analyzer distortion indication (%)
2%

(12) Press TI **FUNCTION-CARR FREQ, FUNCTION-MOD LEVEL**, and **DATA ENTRY** keys for the values listed in table 30. Using measuring receiver, measure the FM deviation. Measuring receiver will indicate within the limits specified in table 30.

Table 30. FM Deviation

Test instrument			Measuring receiver indications (kHz)	
DATA ENTRY carrier frequency (MHz)	**DATA ENTRY** modulation frequency (kHz)	**DATA ENTRY** frequency deviation (kHz)	Min	Max
1050	1	100	90	110
256	1	25	22.5	27.5
50	1	150	135	165
256	1	187	168.3	205.7

b. Adjustments. No adjustments can be made.

18. Phase Modulation

a. Performance Check

(1) Connect measuring receiver sensor module (11722A) to TI **RF OUTPUT**.

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

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY- 8 MHz**.
(c) **FUNCTION-CARR LEVEL**.
(d) **DATA ENTRY- 10 dBm**.
(e) **FUNCTION-MOD FREQ**.
(f) **DATA ENTRY- 1 kHz**.
(g) **FUNCTION-MOD LEVEL**.
(h) **DATA ENTRY- 10 RAD**.
(i) **MODULATION/AUX-MOD ON ONE**.
(j) **FUNCTION-RF ON** to on (red light lit).

(3) Set measuring receiver to measure PM with a + PEAK detector, 15 kHz low-pass filter and a 300 Hz high-pass filter.

(4) Using measuring receiver, measure phase modulation. Measuring receiver phase modulation indication will be within the limits specified for the first carrier frequency listed in table 31.

(5) Set TI **FUNCTION-CARR FREQ** and **DATA ENTRY** keys to the next frequency listed in table 31.

(6) Measuring receiver phase modulation indication will be within the limits specified in table 31 for the carrier frequency setting of the TI.

(7) Repeat (5) and (6) above for the remaining frequency listed in table 31.

Table 31. Phase Modulation

Test instrument carrier frequency (MHz)	Measuring receiver phase modulation indications (rad)	
	Min	Max
8	9	11
1050	9	11
.50	9	11

(8) Press TI pushbuttons as listed in (a) through (j) below:

(a) **FUNCTION-CARR FREQ**.
(b) **DATA ENTRY- 8 MHz**.
(c) **FUNCTION- CARR LEVEL**.
(d) **DATA ENTRY- 10 dBm**.
(e) **FUNCTION-MOD FREQ**.
(f) **DATA ENTRY- 1 kHz**.
(g) **FUNCTION-MOD LEVEL**.
(h) **DATA ENTRY- 10 RAD**.
(i) **MODULATION/AUX-MOD ON ONE**.
(j) **FUNCTION-RF ON** to on (red light lit).

(9) Set measuring receiver to measure 1 kHz audio distortion.

(10) Using measuring receiver, measure audio distortion. Measuring receiver audio distortion indication will be within the limits specified for the first carrier frquency listed in table 32.

(11) Set TI **FUNCTION-CARR FREQ** and **DATA ENTRY** keys to the next frequency listed in table 32.

(12) Measuring receiver audio distortion indication will be within the limits specified in table 32 for the carrier frequency setting of the TI.

(13) Repeat (11) and (12) above for the remaining frequency listed in table 32.

Table 32. Phase Modulation Audio Distortion

Test instrument carrier frequency (MHz)	Measuring receiver audio distortion indications (%)
8	2
1050	2
.50	2

b. **Adjustments**. No adjustments can be made.

19. Final Procedure

a. Deenergize and disconnect all equipment.

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

TB 9-6625-2330-35

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. **Sumitter 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.

TB 9-6625-2330-35

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

0202822

Distribution:

To be distributed in accordance with IDN 344734 requirements for calibration procedure TB 9-6625-2330-35.

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