*TB 9-6625-2329-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR SIGNAL GENERATOR RHODE AND SCHWARZ, MODEL 801.0001.43

Headquarters, Department of the Army, Washington, DC
1 July 2008

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 9-6625-2329-35, dated 5 May 2005, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Signal Generator, Rhode And Schwarz, Model 801.0001.43. 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 6 hours, using the dc and low frequency and microwave 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

Test instrument parameters	Performance specifications
Frequency	Range: 100 kHz to 1000 MHz Accuracy: RF > 31.25 MHz ($\pm$0.5 x 10^{-9}) + ref error Accuracy: RF < 31.25 MHz ($\pm$0.1 Hz + ref error) Time base stability: $\pm$1 x 10^{-9} per day
RF output	Range: 13 dBm Accuracy: $\pm$1.5 dB Flatness range: 100 kHz to 1000 MHz Accuracy: <1 dB at 0 dBm Attenuation (interrupted) [1] Range: 0 to 120 dB Accuracy: $\pm$1.5 dB Attenuation (non-interrupted) Range: 0 to 20 dB Accuracy: $\pm$0.2 dB at –5 dB $\pm$0.5 dB at –10 dB $\pm$0.5 dB at –15 dB $\pm$0.5 dB at –20 dB
Spectral purity	Harmonics Range: 100 kHz to 1000 MHz Accuracy: <-30 dBc Spurious signal range: — Accuracy 100 kHz to 31.25 MHz — <-70 dBc 31.25 MHz to 250 MHz — <-80 dBc 250 MHz to 1000 MHz — <-70 dBc

See footnotes at end of document.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Pulse modulation	Pulse rate: Dc to 10 MHz Pulse envelope on/off ratio: Pulse range: 100 kHz to 500 MHz Accuracy: >70 dB Pulse range: 500 MHz to 1000 MHz Accuracy: >50 dB
Amplitude modulation	Frequency range: 100 kHz to 1000 MHz Depth: 0 to 99% Accuracy: ±4% of setting +1% Distortion: <1%, 0 to 30% depth, 1 kHz rate <2%, 30 to 80% depth, 1 kHz rate Incidental PM: <0.20 Radians (30% AM depth at 1 kHz mod frequency) Modulated Frequency Response[2] Range: 30 Hz to 10 kHz Accuracy: < 0.4 dB 10 Hz to 50 kHz Accuracy: < 1.0 dB
Frequency modulation	Deviation range: Modulating rate[3] between 10 Hz and 100 kHz ≤400 kHz (.01 to 31.25 MHz) ≤100 kHz (31.25 to 62.5 MHz) ≤200 kHz (62.5 to 125 MHz) ≤400 kHz (125 to 250 MHz) ≤800 kHz (250 to 500 MHz) ≤1600 kHz (500 to 1000 MHz) ≤3200 kHz (1000 MHz and above) Accuracy: ±(5% of setting + 20 Hz) Incidental AM: <0.1% (>1 MHz carrier, 40 kHz deviation, 1 kHz rate) Distortion: ≤0.5% for 50% deviation at 1 kHz rate Modulation frequency response[4] Range: 20 Hz to 100 kHz Accuracy: < 0.5 dB
Phase modulation	Deviation range: 20 radians, 100 kHz to 31.25 MHz 5 radians, 31.25 to 62.5 MHz 10 radians, 62.5 to 125 MHz 20 radians, 125 to 250 MHz 40 radians, 250 to 500 MHz 80 radians, 500 to 1000 MHz Accuracy: +(5% of setting + 0.1 radians) Distortion: <0.5% at 1 kHz rate (50% maximum deviation) External modulation frequency response[5] Range: 10 Hz to 10 kHz Accuracy: <1.0 dB

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Modulation generator	Frequency range: 10 Hz to 100 kHz Accuracy: ±40 PPM Level range: 2 mV to 2 V Accuracy: ±1% + 1 mV Frequency response range: Accuracy: 10 Hz to 20 kHz ±2.5% 20 Hz to 100 kHz ±3.5% Distortion: >0.5 V level Accuracy: <0.1% (10 Hz to 100 kHz)

[1]Verified to -110 dB.
[2]Verified from 30 Hz to 50 kHz.
[2]Verified to 400 kHz dev.
[4]Verified from 30 Hz to 50 kHz.
[5]Verified from 300 Hz to 5 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-286, AN/GSM-287 and 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 provided 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	Frequency: 10 Hz to 100 kHz Distortion capability: ≤0.1%	Boonton, Model 1121 (1121)
FREQUENCY COUNTER	Frequency: 10 Hz to1000 MHz Accuracy: ±1.25 part in 10^{10}	Fluke, Model PM6681/656 (PM 6681/656)
FREQUENCY DIFFERENCE METER	Range capability: 1 part in 10^9	Tracor, Model 527E
MEASURING RECEIVER	Power measurement: Frequency: 100 kHz to 1000 MHz Level: +13 dB to -110 dB Accuracy: +0.375 dB Flatness measurement: Frequency: 100 kHz to 1000 MHz Level: 0 dBm Accuracy: ±0.25 dB	Measuring receiver system N5531S consisting of: Spectrum Analyzer, Agilent Model E4440A (E4440A), Power meter, Agilent Model E4419B (E4419B), and Sensor module, Agilent Model 504

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
MULTIMETER	Voltage measurement: Frequency: 10 Hz to 100 kHz Level: 2 V to 2 mV ac Accuracy: ±0.25%	Hewlett-Packard, Model 3458A (3458A)
PULSE GENERATOR	Amplitude: 5 V Period: 10 ms Width: 5 ms	LeCroy, Model 9210 (9210) w/plug-ins, LeCroy Models 9211 (9211) and 9215 (9215) (MIS 45839)
SPECTRUM ANALYZER	Harmonics measurement: Frequency: 100 kHz to 1000 MHz Level: 13 to -80 dB Accuracy: <-80 dB	(AN/USM-677)
TIME/FREQUENCY WORKSTATION	Frequency: 1 MHz Accuracy: ±2.5 part in 10^{11}	Datum, Model ET6000-75 (13589305)

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 manufacturer's manual 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.

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.

CAUTION

Before connecting TI to power source, make sure TI is set to the power source line voltage as shown on rear of TI.

a. Connect TI to a 115 V ac source.

b. Set **POWER** switch to **ON** and allow at least 1 hour for TI to warm-up and stabilize.

c. Connect equipment as shown in figure 1 below:

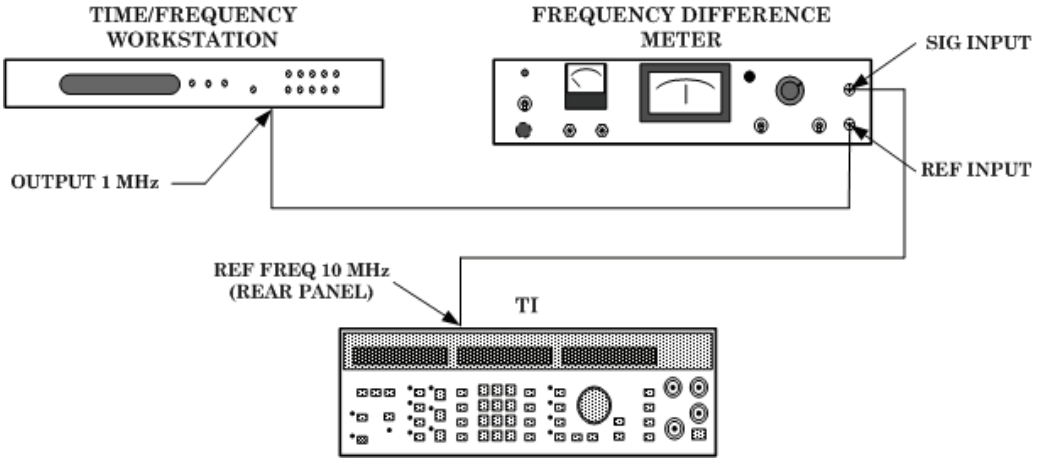

Figure 1. Internal oscillator stability.

d. In figure 2 adjust **REF FREQ 10 MHz** for minimum drift indication on the frequency difference meter.

e. Check frequency drift after 24 hours. The drift will be less than ±1 part in 10^9.

f. Disconnect frequency difference meter from TI and time/frequency workstation.

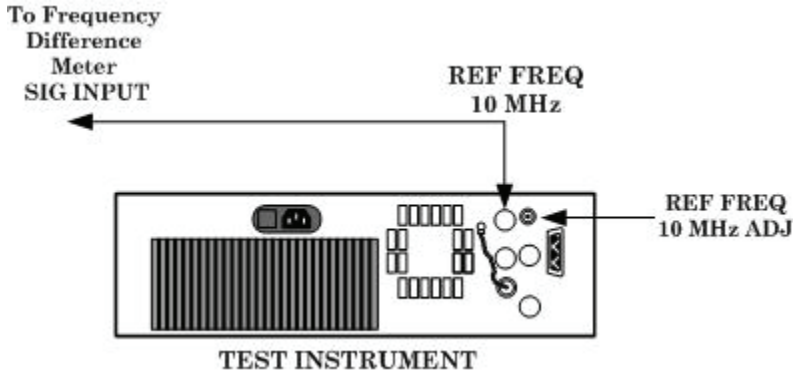

Figure 2. 10 MHz REF FREQ adjust.

8. Frequency Accuracy

a. Performance Check

(1) Connect equipment as shown in figure 3 below:

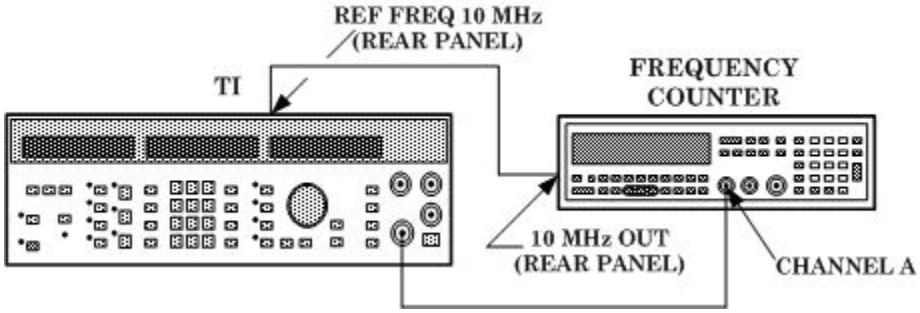

Figure 3. Frequency accuracy.

(2) Set up frequency counter controls to measure frequency with 50 Ω input.

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

(a) **SHIFT–INSTR PRESET**.
(b) **PARAMETER–RF**.
(c) **ON/OFF–EXT AC**.
(d) **PARAMETER–LEVEL**.
(e) **DATA–0**.
(f) **ENTER/UNITS–dBm**.

(4) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key for each row in table 3. Frequency counter will indicate within the limits specified.

Table 3. Frequency

Test instrument **DATA** and **ENTER/UNITS** (MHz)	Frequency counter indications (MHz)	
	Min	Max
10	9.999999	10.000001
60	59.999999	60.000001
90	89.999999	90.000001
150	149.999999	150.000001

(5) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF**–**OFF** key.

(6) Disconnect TI **RF 50Ω** output at frequency counter **A** input.

(7) Connect TI **RF 50Ω** output to frequency counter **C** input.

(8) Set frequency counter to **C** input.

(9) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF**–**INT ON** key.

(10) Press TI **PARAMETER**–**RF**, enter **DATA** numerical value, and **ENTER/UNITS MHz** key for each row in table 4. Frequency will indicate within limits specified.

Table 4. Frequency

Test instrument **DATA** and **ENTER/UNITS** (MHz)	Frequency counter indications (MHz)	
	Min	Max
400	399.999999	400.000001
700	699.999999	700.000001
1000	999.999999	1000.000001

(11) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF**–**OFF** key.

(12) Disconnect TI **RF 50Ω** from frequency counter.

b. Adjustments. No adjustments can be made.

9. RF Output and Flatness

a. Performance Check

NOTE

Zero, calibrate, and save sensor values as necessary

(1) Set measuring receiver to measure RF power:

(2) Connect sensor module input to TI RF 50Ω.

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

(a) **SHIFT–INSTR PRESET**.
(b) **PARAMETER**–**RF**.
(c) **DATA-100**.
(d) **ENTER/UNITS–MHz**.

(4) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS dBm** key for each row in table 5. Measure RF power using measuring receiver. If measuring receiver indications are not within limits specified in table 5, perform b below.

Table 5. RF Output

Test instrument **DATA** and **ENTER/UNITS** (dBm)	Measuring receiver indications (dBm)	
	Min	Max
13	11.5	14.5
0	-1.5	1.5

(5) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS** frequency key for each row in table 6. Measure and record the RF power using the measuring receiver.

(6) Calculate the flatness using the formula below. If calculated flatness is not less than the maximum limits listed in table 6, perform **b** below.

FORMULA

Flatness = (highest reading – lowest reading)/2

Table 6. Output Level Flatness

Test instrument **DATA** and **ENTER/UNITS MHz**	Measuring receiver indications	
	Reading (dB)	Maximum limit <(dB)
.1		1
.2		1
.3		1
.4		1
.5		1
.6		1
.7		1
.8		1
.9		1
1		1
2		1
3		1
4		1
5		1
6		1

Table 6. Output Level Flatness - Continued

Test instrument **DATA** and **ENTER/UNITS MHz**	Measuring receiver indications	
	Reading (dB)	Maximum limit <(dB)
7		1
8		1
9		1
10		1
20		1
30		1
40		1
50		1
60		1
70		1
80		1
90		1
100		1
200		1
300		1
400		1
500		1
600		1
700		1
800		1
900		1
1000		1

b. Adjustments

(1) Press **SHIFT–INSTR PRESET** pushbuttons, **PARAMETER–LEVEL** pushbutton, then press **ON/OFF**-**OFF** key.

(2) Remove top cover.

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

(a) **PARAMETER–RF**.
(b) **DATA–100**.
(c) **ENTER/UNITS–MHz**.
(d) **PARAMETER–LEVEL**.
(e) **DATA–0**.
(f) **ENTER/UNITS-dBm**.

(4) Adjust R514 (fig 4) for a 0 ±0.1 dBm power indication (R).

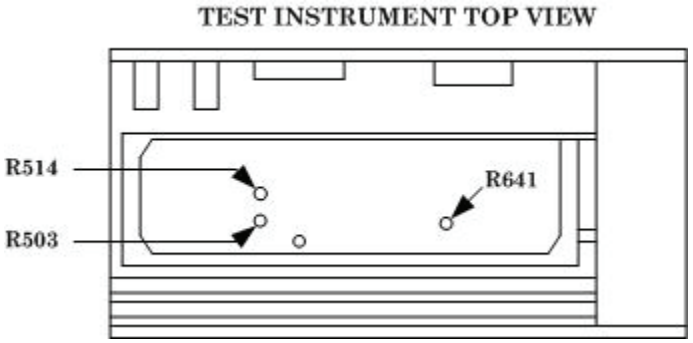

Figure 4. Adjustment locations.

(5) Press TI **PARAMETER–RF** pushbutton, enter **DATA 8** numerical value, and press **ENTER/UNITS MHz** key.

(6) Using measuring receiver RF power measurement techniques, measure RF power and set **RATIO** on.

(7) Press TI **PARAMETER–RF** pushbutton, enter **DATA 7.999** numerical value and press **ENTER/UNITS MHz** key**.**

(8) Set measuring receiver to measure RF power at 7.999 Mhz.

(9) Adjust R641 (fig. 4) for a 0.00 ±0.05 dBm power indication on measuring receiver. (R)

(10) Press **SHIFT-INSTR PRESET** pushbuttons, **PARAMETER–LEVEL** pushbutton, and press **ON/OFF–OFF** key.

(11) Replace top cover.

10. Attenuation

a. Performance Check

(1) Ensure measuring receiver, sensor module input is connected to TI **RF 50Ω**.

NOTE

On measuring receiver zero, calibrate, and save sensor values as necessary.

(2) Using measuring receiver with sensor module, press **PRESET** pushbutton.

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

(a) **SHIFT-INSTR PRESET**.
(b) **PARAMETER-RF**.
(c) **DATA-30**.
(d) **ENTER/UNTS-MHz**.

(4) Setup measuring receiver to measure RF power.

(5) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA** numerical value and press **ENTER/UNITS dBm** key for each row in table 7. Using measuring receiver and **RF power** measurement techniques, measured power will indicate within limits specified.

Table 7. RF Attenuator Accuracy

Test instrument **DATA** and **ENTER/UNITS** (dBm)	Measuring receiver indications (dBm)	
	Min	Max
0	-1.5	+1.5
10	8.5	11.5
13	11.5	14.5

(6) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA 0** numerical value and press **ENTER/UNITS dBm** key.

(7) Set measuring receiver to measure tuned RF level at 30 MHz.

(8) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS dBm** key for each row in table 8. Using measuring receiver and **RF power** measurement techniques, measured power will indicate within limits.

Table 8. RF Attenuator Accuracy (Interrupted)

Test instrument **DATA** and **ENTER/UNITS** (dBm)	Measuring receiver indications (dBm)	
	Min	Max
-10	-8	-12
-20	-18	-22
-30	-28	-32
-40	-38	-42
-50	-48	-52
-60	-58	-62
-70	-68	-72
-80	-78	-82
-90	-88	-92
-100	-98	-102
-110	-108	-112

(9) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA 0** numerical value and press **ENTER/UNITS dBm** key.

(10) Adjust controls as listed in (a) through (c) below:

(a) Press **SHIFT–PARAMETER–SPECIAL** pushbutton, enter **DATA 1** numerical value, and press **ENTER/UNITS dBm** key.

(b) Press **PARAMETER–LEVEL** pushbutton, **PARAMETER–STEP** pushbutton**,** enter **DATA 5** numerical value, and press **ENTER/UNITS dBm** key**.**

(c) Press **VARIATION–STEP** key.

(11) Press TI **VARIATION–STEP** ⇓ pushbutton for each row in table 9. Using measuring receiver and tuned RF power measurement techniques, measured power will indicate within limits specified.

Table 9. RF Attenuator Accuracy (Non-interrupted)

Test instrument **VARIATION STEP** (dBm)	Measuring receiver indications (dBm)	
	Min	Max
-5	-4.8	-5.2
-10	-9.5	-10.5
-15	-14.5	-15.5
-20	-19.5	-20.5

(12) Press **SHIFT–INSTR PRESET** pushbuttons, **PARAMETER–LEVEL** pushbutton, and press **ON/OFF–OFF** key.

(13) Disconnect measuring receiver **SENSOR MODULE** from TI **RF 50Ω**.

b. Adjustments. No adjustments can be made.

11. Spectral Purity

a. Performance Check

(1) Connect equipment as shown in figure 5.

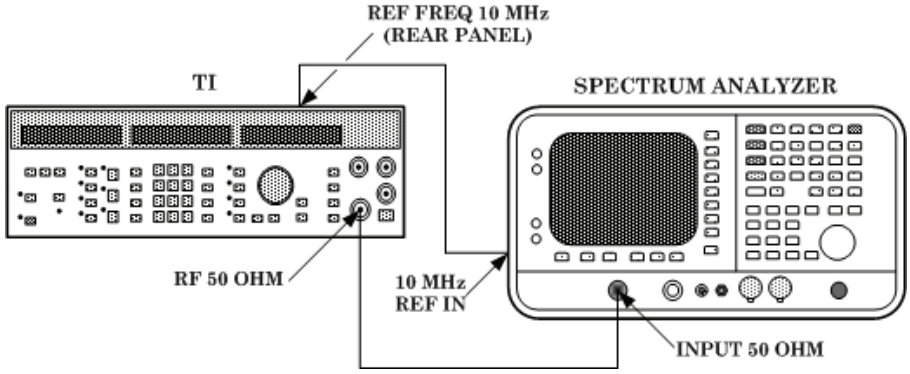

Figure 5. Spectral purity.

(2) Press **SHIFT–INSTR PRESET** pushbuttons.

(3) Adjust controls as listed in (a) through (c) below for each row in table 10 below.

(a) Press TI **PARAMETER**–**RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA** numerical value and press **ENTER/UNITS dBm** key**.**

(c) Set spectrum analyzer to TI frequency, set power reference then tune to harmonic frequency listed. Power amplitude will be less than dBc specified limit.

NOTE

Some spurious signals may be generated by the spectrum analyzer. If a spurious signal is present, change TI frequency. If it disappears, it most likely is from the TI. If the spurious signal moves with the TI frequency, it most likely is in the spectrum analyzer.

Table 10. Spectral Purity

Test instrument		Spectrum analyzer indications	
DATA and **ENTER/UNITS** (dBm)	**DATA** and **ENTER/UNITS** (MHz)	Harmonic frequency (MHz)	(dBc)
13	.1	.2	<-30
13	.500	1	<-30
13	1	2	<-30
13	2	4	<-30
13	4	8	<-30
13	10	20	<-30
13	32	64	<-30
13	125	250	<-30
13	375	750	<-30
13	500	1000	<-30
13	1000	2000	<-30

(4) Adjust controls as listed in (a) through (c) below for each row in table 11 below:

(a) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS dBm** key.

(c) Set spectrum analyzer to TI frequency; set power reference, then tune to harmonic frequency listed. Power amplitude will be less than dBc specified limit.

Table 11. Spurious Signals

Test instrument		Spectrum analyzer indications	
DATA and **ENTER/UNITS** (dBm)	**DATA** and **ENTER/UNITS** (MHz)	Harmonic frequency (MHz)	(dBc)
0	31	26	<-70
0	31	57	<-70
0	31	150	<-70
0	31	181	<-70
0	195	150	<-80
0	195	169	<-80
0	988	741	<-70
0	988	962	<-70
0	988	988.1	<-70

(5) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF–OFF** key.

(6) Disconnect all TI connections from spectrum analyzer.

b. Adjustments. No adjustments can be made.

12. Modulation Generator

a. Performance Check

(1) Connect equipment as shown in figure 6.

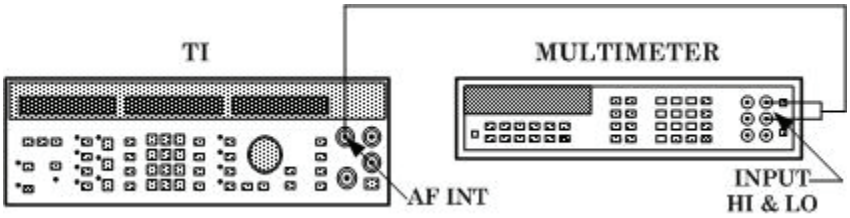

Figure 6. Modulation generator accuracy.

(2) Press **SHIFT–INSTR PRESET** pushbutton.

(3) Set up multimeter to measure ac voltage.

(4) Press **SHIFT–PARAMETER–SPECIAL** pushbutton, enter **DATA 5** numerical value, and press **ENTER/UNITS mV** key.

(5) Press **PARAMETER–LEVEL** pushbutton, enter **DATA 1000** numerical value, and press **ENTER/UNITS mV** key.

(6) Press TI **PARAMETER–AF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS Hz** key for each row in table 12. Using multimeter and ac voltage measurement techniques, multimeter will be between specified limits.

Table 12. Frequency Response

Test instrument **DATA** and **ENTER/UNITS** (Hz)	Multimeter indications (ac V)	
	Min	Max
10	.975	1.025
60	.975	1.025
150	.975	1.025
400	.975	1.025
1000	.975	1.025
7000	.975	1.025
10000	.975	1.025
19200	.975	1.025
25000	.965	1.035
76800	.965	1.035
99900	.965	1.035

(7) Press **PARAMETER–AF** pushbutton, enter **DATA 1** numerical value**,** and press **ENTER/UNITS kHz** key.

(8) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS mV** key for each row in table 13. Using multimeter and ac voltage measurement techniques, multimeter will be between specified limits.

Table 13. Level Accuracy

Test instrument **DATA** and **ENTER/UNITS** (mV)	Multimeter indications at 1 kHz (ac V)	
	Min	Max
2	.00098	.00302
6	.00494	.00706
18	.01682	.01918
36	.03464	.03736
64	.06236	.06564
100	.098	.102
130	.1277	.1323
290	.2861	.2939
550	.5435	.5565
1000	.989	1.011
1200	1.187	1.213
1500	1.484	1.516
1750	1.7315	1.7685
2000	1.979	2.021

(9) Press **PARAMETER**–**LEVEL** pushbutton and press **ON/OFF**–**OFF** key.

(10) Disconnect TI **AF INT** from multimeter.

(11) Connect TI **AF INT** to audio analyzer **INPUT HIGH**.

(12) Set up audio analyzer to measure distortion.

(13) Press **PARAMETER**–**LEVEL** pushbutton, enter **DATA 1000** numerical value, and press **ENTER/UNITS mV** key.

(14) Press TI **PARAMETER**–**AF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS kHz** for each row in table 14. Distortion analyzer will indicate within limits.

Table 14. Modulation Generator Distortion

Test instrument **DATA** and **ENTER/UNITS** (kHz)	Audio analyzer distortion indications (<%)
1	0.1
19.2	0.1
99.9	0.1

(15) Press **PARAMETER**–**LEVEL** pushbutton and press **ON/OFF**–**OFF** key.

(16) Disconnect TI **AF INT** audio analyzer **INPUT HIGH**.

(17) Connect TI **AF INT** to frequency counter **CHANNEL A** input.

(18) Set up frequency counter to measure frequency.

(19) Press **PARAMETER**–**LEVEL** pushbutton, enter **DATA 1000** numerical value, and press **ENTER/UNITS mV** level key.

(20) Press TI **PARAMETER–AF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS Hz** key for each row in table 15. Frequency counter will indicate within limits listed.

Table 15. Frequency Range

Test instrument **DATA** and **ENTER/UNITS** (Hz)	Frequency counter indications (Hz)	
	Min	Max
10	9.9996	10.0004
60	59.9976	60.0024
150	149.994	150.006
400	399.984	400.016
1000	999.96	1000.04
7000	6999.72	7000.28
10000	9999.6	10000.4
19200	19199.232	19200.768
25000	24999	25001
76800	76796.928	76803.072
99900	99896.004	99903.996

(21) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF–OFF** key.

(22) Disconnect TI from frequency counter.

b. Adjustments. No adjustments can be made.

13. Amplitude Modulation

a. Performance Check

(1) Connect **MEASURING RECEIVER SENSOR MODULE** to **TI RF 50 OHM** input.

(2) Press **SHIFT-INSTR PRESET pushbutton**.

(3) Connect **TI AM** to **AUDIO ANALYZER HIGH OUTPUT**.

(4) Set measuring receiver to **AM** peak positive with 300Hz high pass and 15kHz **filters** to on.

(5) Press TI **PARAMETER–AF** pushbutton, enter **DATA 1** numerical value, and press **ENTER/UNITS kHz** key.

(6) Press TI **PARAMETER–LEVEL** pushbutton, enter **DATA 0** numerical value, and press **ENTER/UNITS dBm** key.

(7) Adjust controls as listed in (a) through (c) below for each row in table 16 below:

(a) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–AM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS %** key.

(c) Using measuring receiver, measure AM modulation. If measuring receiver indications are not within limits specified in table 16, perform **b** below.

Table 16. AM Accuracy

Test instrument		Measuring receiver modulation indications (%)	
DATA and **ENTER/UNITS** (MHz)	**DATA** and **ENTER/UNITS** (%)	Min	Max
1	30	27.8	32.2
1	80	75.8	84.2
10	30	27.8	32.2
10	80	75.8	84.2
100	30	27.8	32.2
100	80	75.8	84.2
1000	30	27.8	32.2
1000	80	75.8	84.2

(8) Adjust controls as listed in (a) through (c) below for each row in table 17 below:

(a) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–AM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS %** key.

(c) Set measuring receiver to measure modulation distortion.

(9) Using measuring receiver and modulation distortion measurement techniques, modulation distortion will be between specified limits in table 17.

Table 17. Distortion Accuracy

Test instrument		Measuring receiver distortion indications (<%)
DATA and **ENTER/UNITS** (MHz)	**DATA** and **ENTER/UNITS** (%)	
1	30	1
1	80	2
10	30	1
10	80	2
100	30	1
100	80	2
1000	30	1
1000	80	2

(10) Press **PARAMETER–AM** pushbutton, enter **DATA 30** numerical value, and press **ENTER/UNITS %** key.

(11) Set measuring receiver to measure **ϕM**.

(12) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key for each row in table 18. Measuring receiver will indicate within limits specified.

Table 18. Incidental PM

Test instrument **DATA** and **ENTER/UNITS** (MHz)	Measuring receiver modulation indications (<rad)
4	0.2
100	0.2
400	0.2
1000	0.2

(13) Press pushbuttons as listed in (a) through (c) below:

(a) **PARAMETER**–**RF**, enter **DATA 100** numerical value, and press **ENTER/UNITS MHz** key.

(b) **PARAMETER–AM**, enter **DATA 80** numerical value, and press **ENTER/UNITS %** key.

(c) **PARAMETER–AM** and press **ON/OFF–EXT AC** key.

(14) Press measuring receiver push buttons to measure **AM** with all filters off, then set measuring receiver to **RATIO** mode**.**

(15) Press pushbuttons on audio analyzer as listed in (a) through (e) below:

(a) Source **FREQ** - **30 Hz**.

(b) Source **LEVEL** - **1 V**.

(c) Source–600Ω (SPCL 77).

(16) Set up audio analyzer source frequency for each row in table 19. Measuring receiver will indicate within limits specified.

Table 19. Ext Modulation Frequency Response

Audio analyzer source frequency (Hz)	Measuring Receiver indications (dB)	
	Min	Max
100	-0.4	+0.4
1000	-0.4	+0.4
2000	-0.4	+0.4
5000	-0.4	+0.4
10000	-0.4	+0.4
20000	-1	+1
50000	-1	+1

(17) Reduce output on audio analyzer.

b. Adjustments

(1) Remove TI top cover.

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

(a) **PARAMETER**–**RF**, enter **DATA 100** numerical value, and press **ENTER/UNITS MHz** key.

(b) **PARAMETER–LEVEL**, enter **DATA 0** numerical value, and press **ENTER/UNITS dBm** key.

(c) **PARAMETER–AF**, enter **DATA 1** numerical value, and press **ENTER/UNITS kHz** key.

(d) **PARAMETER–AM**, enter **DATA 80** numerical value, and press **ENTER/UNITS %** key.

(e) **PARAMETER–AM** and press **ON/OFF–INT/ON** key.

(3) Set measuring receiver to measure AM Peak positive, with 300Hz high and 15kHz low pass filters on.

(4) Adjust R503 (fig 4) for a 80 ±1% indication (R).

(5) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF–OFF** key.

14. Phase Modulation

a. Performance Check

(1) Connect **TI FM EXT** to **AUDIO ANALYZER HIGH OUTPUT**.

(2) Press-**SHIFT INSTR PRESET**.

(3) Set measuring receiver to measure PM deviation positive peak with 300Hz high pass and 15kHz low pass filters on.

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

(a) **PARAMETER**–**RF**, enter **DATA 15** numerical value, and press **ENTER/UNITS MHz** key.

(b) **PARAMETER–LEVEL**, enter **DATA 0** numerical value, and press **ENTER/UNITS dBm** key.

(c) **PARAMETER**–**AF**, enter **DATA 1** numerical value, and press **ENTER/UNITS kHz** key.

(5) Press TI **PARAMETER–ΦM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS rad** key for each row in table 20. Measuring receiver will indicate within limits specified.

Table 20. PM Accuracy

Test instrument **DATA** and **ENTER/UNITS** (rad)	Measuring receiver modulation indications (rad)	
	Min	Max
20	18.9	21.1
10	9.4	10.6
3	2.75	3.25
1	0.85	1.15
.3	0.185	0.415

(6) Press **PARAMETER–ΦM** pushbutton and press **ON/OFF-OFF** key.

(7) Press pushbuttons and adjust controls as listed in (a) through (c) below for each row in table 21 below:

(a) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–ΦM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS rad** key.

(c) Using measuring receiver and ΦM measurement techniques, modulation will be between specified limits.

Table 21. PM Accuracy

Test instrument		Measuring receiver modulation indications (rad)	
DATA and **ENTER/UNITS** (MHz)	**DATA** and **ENTER/UNITS** (rad)	Min	Max
46	5	4.65	5.35
46	2.5	2.275	2.725
93.5	10	9.4	10.6
93.5	5	4.65	5.35

Table 21. PM Accuracy - Continued

Test instrument		Measuring receiver modulation indications (rad)	
DATA and **ENTER/UNITS** (MHz)	**DATA** and **ENTER/UNITS** (rad)	Min	Max
187.5	20	18.9	21.1
187.5	10	9.4	10.6
375	40	37.9	42.1
375	20	18.9	21.1
750	80	75.9	84.1
750	40	37.9	42.1

(8) Press **PARAMETER–ΦM** pushbutton and press **ON/OFF–OFF** key.

(9) Adjust controls as listed in (a) through (b) below for each row in table 22 below:

(a) Press TI **PARAMETER**–**RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–ΦM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNIT rad** key.

(10) Using measuring receiver and distortion measurement techniques measure percent of distortion, distortion will be between specified limits in table 22.

Table 22. Distortion Accuracy

Test instrument		Measuring receiver analyzer distortion indications (<%)
DATA and **ENTER/UNITS** (MHz)	**DATA** and **ENTER/UNITS** (rad)	
15	10	0.5
46	2.5	0.5
93.5	5	0.5
187.5	10	0.5
375	20	0.5
750	40	0.5

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

(a) **PARAMETER–LEVEL** and press **ON/OFF–OFF** key.

(b) **PARAMETER–ΦM** and press **ON/OFF–OFF** key.

(c) **PARAMETER–RF**, enter **DATA 100** numerical value, and press **ENTER/UNITS MHz** key.

(d) **PARAMETER–ΦM**, enter **DATA 10** numerical value, and press **ENTER/UNIT rad** key.

(e) **ON/OFF–EXT AC** key.

(12) Using measuring receiver, ensure both 50 Hz high-pass filter and 15 kHz low-pass filter are on and set to ratio mode in dB.

(13) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF–ON** key.

(14) Press pushbuttons on audio analyzer as listed in (a) through (c) below:

(a) Source **FREQ**–**300 Hz**.

(b) Source **LEVEL**–**1 V**.

(c) Source–600Ω (SPCL 77).

(15) Set up audio analyzer source frequency for each row in table 23. Measuring receiver will indicate within limits specified.

Table 23. Ext Modulation Frequency Response

Audio analyzer source frequency (Hz)	Measuring receiver indications (dB)	
	Min	Max
500	-1	+1
1000	-1	+1
2000	-1	+1
5000	-1	+1

(16) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF–OFF** key.

(17) Reduce output on audio analyzer.

b. Adjustments. No adjustments can be made.

15. Frequency Modulation

a. Performance Check

(1) Press **SHIFT–INSTR PRESET** pushbutton.

(2) Set measuring receiver to measure FM deviation, with 50Hz high and 15kHz low pass filters on and PEAK + detector.

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

(a) **PARAMETER–RF**, enter **DATA 100** numerical value, and press **ENTER/UNITS MHz** key.

(b) **PARAMETER–LEVEL**, enter **DATA 0** numerical value, and press **ENTER/UNITS dBm** key.

(c) **PARAMETER–AF**, enter **DATA 1** numerical value, and press **ENTER/UNITS kHz** key.

(4) Press TI **PARAMETER–FM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS kHz** key for each row table 24. Using measuring receiver and FM measurement techniques, modulation will be between specified limits.

Table 24. FM Accuracy

Test instrument **DATA** and **ENTER/UNITS** (kHz)	Measuring receiver modulation indications FM (kHz)	
	Min	Max
1	0.93	1.07
3	2.83	3.17
10	9.48	10.52
30	28.48	31.52
100	94.98	105.02

(5) Press **PARAMETER–FM** pushbutton and press **ON/OFF–OFF** key.

(6) Setup measuring receiver to measure modulation distortion.

(7) Adjust controls as listed in (a) through (c) below for each row in table 25 below:

(a) Press TI **PARAMETER–RF** pushbutton, enter **DATA** numerical value and press **ENTER/UNITS MHz** key.

(b) Press TI **PARAMETER–FM** pushbutton, enter **DATA** numerical value, and press **ENTER/UNIT kHz** key.

(c) Using measuring receiver and distortion measurement techniques, distortion will be between specified limits.

Table 25. Distortion Accuracy

Test instrument		Measure receiver distortion indications (<%)
DATA and **ENTER/UNITS** (MHz)	**DATA** and **ENTER/UNITS** (kHz)	
15	100	0.5
15	25	0.5
46	25	0.5
93	25	0.5
93	50	0.5
187	100	0.5
375	200	0.5
900	400	0.5

(8) Press **PARAMETER**–**FM** pushbutton and press **ON/OFF**–**OFF** key.

(9) Press **PARAMETER–FM** pushbutton, enter **DATA 40** numerical value, and press **ENTER/UNIT kHz** key.

(10) Set up measuring receiver to measure AM with PEAK + detection, 300Hz high pass and 15kHz low pass filters on.

(11) Press TI **PARAMETER**–**RF** pushbutton, enter **DATA** numerical value, and press **ENTER/UNITS MHz** key for each row in table 26. Measuring receiver will indicate within limits specified.

Table 26. Incidental AM

Test instrument **DATA** and **ENTER/UNITS** (MHz)	Measuring receiver modulation indications (<%)
20	0.1
100	0.1
375	0.1
999	0.1

(12) Press **PARAMETER**–**FM** pushbutton and press **ON/OFF**–**OFF** key.

(13) Press pushbuttons as listed in (a) through (c) below:

(a) **PARAMETER**–**RF**, enter **DATA 100** numerical value, and press **ENTER/UNITS MHz** key.

(b) **PARAMETER–FM**, enter **DATA 100** numerical value, and press **ENTER/UNIT kHz** key.

(c) **PARAMETER**–**FM** and press **ON/OFF**–**EXT AC** key.

(14) Press pushbuttons on audio analyzer as listed in (a) through (c) below:

(a) Source **FREQ - 30 Hz**.
(b) Source **LEVEL - 1 V**.
(c) Source – 600Ω (SPCL 77).

(15) Set measuring receiver to measure **FM** and **PEAK +** with all filters off. After first FM measurement, set measuring receiver to RATIO and LOG mode.

(16) Set up audio analyzer source frequency for each row in table 27. Measuring receiver will indicate within limits specified in table 27.

Table 27. Ext Modulation Frequency Response

Audio analyzer source frequency (Hz)	Measuring Receiver indications (dB)	
	Min	Max
100	-0.5	+0.5
1000	-0.5	+0.5
2000	-0.5	+0.5
5000	-0.5	+0.5
10000	-0.5	+0.5
20000	-0.5	+0.5
50000	-0.5	+0.5

(17) Press **PARAMETER–LEVEL** pushbutton and press **ON/OFF–OFF** key.

(18) Reduce output on audio analyzer.

b. Adjustments. No adjustments can be made.

16. Pulse Modulation

a. Performance Check

(1) Connect equipment as shown in figure 7.

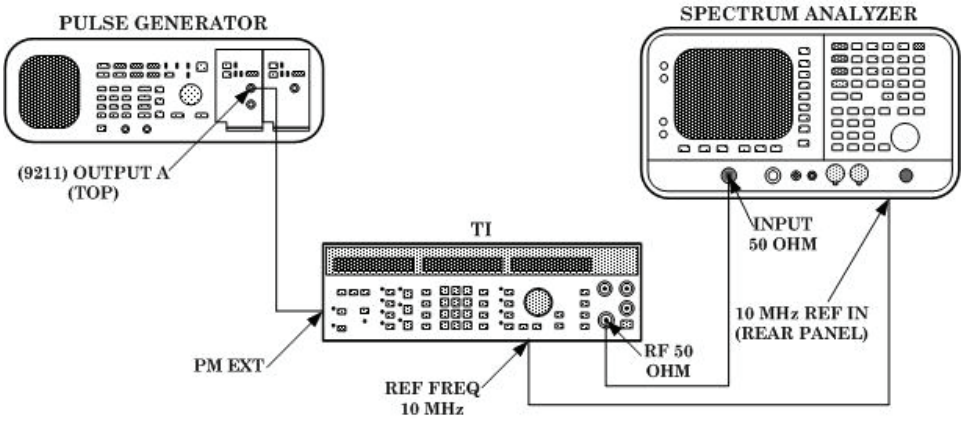

Figure 7. Pulse modulation.

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

(a) **CHANNEL A**.

(b) **Period** and enter **10 m/kHz**.
(c) **Width** and enter **5 m/kHz**.
(d) **Vhigh** and **5 ENTER/Hz**.
(e) **Vlow** and **0 ENTER/Hz**.
(f) **Delay** and enter **0 n/GHz**.
(g) **2 Pulse** and **OFF ENTER/Hz**.
(h) **DISABLE** red light (on) on the 9211 output module.

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

(a) **SHIFT–INSTR PRESET**.
(b) **PARAMETER–RF**, enter **DATA 150** numerical value, and press **ENTER/UNITS MHz** key.
(c) **PARAMETER–LEVEL**, enter **DATA 10** numerical value, and press **ENTER/UNITS dBm** key.

(4) Press **DISABLE** red light to off on pulse generator 9211 output module.

(5) Press spectrum analyzer pushbuttons as listed in (a) through (d) below:

(a) **Preset**.
(b) **AMPLITUDE**, **Ref Level**, **1**, **0**, **dBm**.
(c) **FREQUENCY**, **Center Freq**, **1**, **5**, **0**, **MHz**.
(d) **SPAN**, **1**, **MHz**.

(6) Press **SHIFT**, **PARAMETER–SPECIAL** pushbutton, enter **DATA 19** numerical value, and press **ENTER/UNITS mV** key.

(7) Press spectrum analyzer pushbuttons and adjust controls as listed in (a) through (j) below:

(a) **BW/Avg**, **Res BW**, **1**, **0**, **0**, **kHz**.
(b) **Video BW, 1, 0, 0, kHz**.
(c) **MARKER**.
(d) **SPAN**, **0**, **Hz**.
(e) **SWEEP**, **Sweep Time**, **5**, **0**, **mS**.
(f) **Trig**, **Video**, **1**, **0**, **–dBm**.
(g) **MARKER**.
(h) Adjust rotary control to place **Mkr1** at top of square wave.
(i) **MARKER, Delta**.
(j) Adjust rotary control to place **MkrΔ** at bottom of square wave.

(8) Using spectrum analyzer, measure top to bottom of square wave in dB. Pulse envelope on/off ratio will indicate within limits specified in table 28.

Table 28. Pulse Modulation On/Off Ratio

Spectrum analyzer (>dB)
70

(9) Press **SHIFT, PARAMETER–SPECIAL** pushbuttons, enter **DATA 20** numerical value, and press **ENTER/UNITS mV** key.

(10) Press **PARAMETER–RF** pushbutton, enter **DATA 300** numerical value, and press **ENTER/UNITS MHz** key.

(11) Press spectrum analyzer pushbuttons as listed in (a) through (d) below:

(a) **Preset**.
(b) **AMPLITUDE**, **Ref Level**, **1**, **0**, **dBm**.
(c) **FREQUENCY**, **Center Freq**, **3**, **0**, **0**, **MHz**.
(d) **SPAN**, **1**, **MHz**.

(12) Press **SHIFT, PARAMETER–SPECIAL** pushbutton, enter **DATA 19** numerical value, and press **ENTER/UNITS mV** key.

(13) Press spectrum analyzer pushbuttons and adjust controls as listed in (a) through (j) below:

(a) **BW/Avg**, **Res BW**, **1**, **0**, **0**, **kHz**.
(b) **Video BW, 1, 0, 0, kHz**.
(c) **MARKER**.
(d) **SPAN**, **0**, **Hz**.
(e) **SWEEP**, **Sweep Time**, **5**, **0**, **mS**.
(f) **Trig**, **Video**, **1**, **0**, **–dBm**.
(g) **MARKER**.
(h) Adjust rotary control to place **Mkr1** at top of square wave.
(i) **MARKER, Delta**.
(j) Adjust rotary control to place **MkrΔ** at bottom of square wave.

(14) Using spectrum analyzer, measure top to bottom of square wave in dB. Pulse envelope on/off ratio will indicate within limits specified in table 29.

Table 29. Pulse Modulation On/Off Ratio

Spectrum analyzer > dB
70

(15) Press **SHIFT**, **PARAMETER–SPECIAL** pushbuttons, enter **DATA 20** numerical value, and press **ENTER/UNITS mV** key.

(16) Press **PARAMETER–RF** pushbutton, enter **DATA 1000** numerical value, and press **ENTER/UNITS MHz** key.

(17) Press spectrum analyzer pushbuttons as listed in (a) through (d) below:

(a) **Preset**.
(b) **AMPLITUDE**, **Ref Level**, **1**, **0**, **dBm**.
(c) **FREQUENCY**, **Center Freq**, **1**, **GHz**.
(d) **SPAN**, **1**, **MHz**.

(18) Press **SHIFT**, **PARAMETER–SPECIAL** pushbuttons, enter **DATA 19** numerical value, and press **ENTER/UNITS mV** key.

(19) Press spectrum analyzer pushbuttons and adjust controls as listed in (a) through (j) below:

(a) **BW/Avg, Res BW, 1, 0, 0, kHz**.
(b) **Video BW, 1, 0, 0, kHz**.
(c) **MARKER**.
(d) **SPAN**, **0**, **Hz**.
(e) **SWEEP**, **Sweep Time**, **5**, **0**, **mS**.
(f) **Trig**, **Video**, **1**, **0**, **–dBm**.
(g) **MARKER**.
(h) Adjust rotary control to place **Mkr1** at top of square wave.
(i) **MARKER, Delta**.
(j) Adjust rotary control to place **MkrΔ** at bottom of square wave.

(20) Using spectrum analyzer, measure top to bottom of square wave in dB. Pulse envelope on/off ratio will indicate within limits specified in table 30.

Table 30. Pulse Modulation On/Off ratio

Spectrum analyzer **>** dB
50

(21) Press **SHIFT–INSTR PRESET** pushbutton.

(22) Press **PARAMETER**–**LEVEL** pushbutton and press **ON/OFF**–**OFF** key.

(23) Press **DISABLE** red light on pulse generator 9211 output module to on.

(24) Press spectrum analyzer **Preset** pushbutton.

b. Adjustments. No adjustments can be made.

17. 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

0719039

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344757, requirements for calibration procedure TB 9-6625-2329-35.

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.