*TB 9-6625-2333-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR SPECTRUM ANALYZER AGILENT MODELS 8562EC AND 8562EC-104

Headquarters, Department of the Army, Washington, DC

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SECTION I
IDENTIFICATION AND DESCRIPTION

1. **Test Instrument Identification.** This bulletin provides instructions for the calibration of Spectrum Analyzer, Agilent Models 8562EC and 8562EC-104. 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. Option 104 deletes the module used to expand user memory which allows storage and execution of downloadable programs (DLPs) and limit lines.

    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[1]
Calibrator output accuracy	Amplitude range: -10 dBm Accuracy: <±0.3 dB

    See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications[1]	
Resolution bandwidth accuracy and selectivity	Range: 1 Hz to 1 MHz (selectable in 1, 3, 10 sequence) and 2 MHz (3 MHz at -6 dB) RES BW range: Accuracy: 10 Hz to 300 kHz <±10% 1 MHz <±25% 2 MHz <+50%, -25% Selectivity (60 dB/3 dB bandwidth ratio): RES BW ≥300 Hz: <15:1	
Input attenuator accuracy	Range: 20 to 70 dB, referenced to 10 dB input attenuation Frequency range: 30 Hz to 2.9 GHz Accuracy: <±0.6 dB/10 dB step, 1.8 dB maximum	
IF gain uncertainty	Range: 0 to -80 dBm reference level, 10 dB input attenuation Accuracy: <±1.0 dB	
Residual FM (zero span, 10 Hz RES BW)	<1.0 Hz X N^2 peak-to-peak in 20 ms	

Frequency readout
 	
   SPAN > 2 MHz X N^2
 	
   SPAN ≤ 2 MHz X N^2
	Frequency range: 30 Hz to 13.2 GHz, dc coupled
	Accuracy:
	  <±(center frequency X frequency reference accuracy + 5% of frequency span + 15% of RES BW + 10 Hz)
	  <±(center frequency X frequency reference accuracy + 1% of frequency span + 15% of RES BW + 10 Hz)	

Frequency count marker	Resolution: Selectable from 1 Hz to 1 MHz Accuracy: <±(marker frequency X frequency reference accuracy + 2 Hz X N^2 + 1 LSD)	

Frequency span	Range: 0 Hz, 100 Hz to 13.2 GHz over the 10-division display
	          horizontal axis, variable in approximately 1%
	          increments or in a 1,2,5, sequence
	Accuracy:
	SPAN > 2 MHz X N^2 <±5%
	SPAN ≤ 2 MHz X N^2 <±1%	

Frequency response (Referenced to 300 MHz cal output, dc coupled)	Frequency range: 30 Hz to 13.2 GHz
	Accuracy: 30 Hz to 2.9 GHz, <±1.8 dB
	          2.9 to 6.46 GHz, <±2.5 dB
	          6.46 to 13.2 GHz, <±2.9 dB	

Displayed average noise level (no signal at input, 1 Hz video BW, 0 dB input attenuation, tracking generator off)	Frequency range	1 Hz RES BW
	30 Hz	<-90 dBm
	1 kHz	<-105 dBm
	10 kHz	<-120 dBm
	100 kHz	<-120 dBm
	1 to10 MHz	<-140 dBm
	10 MHz to 2.9 GHz	<-151 dBm
	2.9 to 6.46 GHz	<-148 dBm
	6.46 to 13.2 GHz	<-145 dBm
Residual responses (no signal at input, 0 dB input attenuation, N^2)	Range: >200 kHz Responses: <-90 dBm	

[1]Specifications are for a standard 8562EC.
[2]N is the harmonic mixing mode.

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.

5. Accessories Required. The accessories required for this calibration are common usage accessories issued as indicated in **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)
ATTENUATOR	Range: 0 to 12 dB Frequency: 50 MHz	Hewlett-Packard, Model 355C (7910807)
ATTENUATOR (FIXED)	10 dB: Frequency range: 50 MHz and 2.9 GHz Accuracy: ±0.3 dB 20 dB: Frequency range: 50 MHz Accuracy: ±0.5 dB	Weinschel, Model 9918-10dB and Model 9918-20dB
MEASURING RECEIVER	Range: 10 MHz to 13.2 GHz at -10 dBm Accuracy:[1] Range: -9.7 to -10.3 at 300 MHz Accuracy: ±0.075 dBm	Hewlett-Packard, Model 8902A, w/sensor modules, Hewlett-Packard Model 11722A and Model 11792A, microwave converter, Model 11793A , and signal generator SG-1219/U
POWER SPLITTER	Range: 10 MHz to 13.2 GHz Accuracy:[1]	Weinschel, Model 1870A (7916839)
SIGNAL GENERATOR	Frequency range: 10 MHz to 13.2 GHz Power range: 0 to -15 dBm	Wiltron, Model 68369NV
SYNTHESIZER/LEVEL GENERATOR	Frequency range: 200 Hz to 50 MHz Amplitude range: -80 to +10 dBm Accuracy: ±0.02 dB per 10 dB step	Hewlett-Packard, Model 3335AOPT 001-KO6 (MIS-35938)

[1]Combined accuracy of measuring receiver and power splitter is ±0.45 dBm.

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, refer to the manufacturer's manual and perform appropriate adjustment(s) or 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 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.

    a. Connect TI to 115 V ac power source.

    b. Press **LINE** pushbutton to on and allow at least 30 minutes for TI to warm-up and stabilize.

NOTE

[ ] Denotes softkey on display. Softkeys and keys will be referred to as keys in this procedure.

8. **Calibrator Output Accuracy Test**

    a. **Performance Check**

NOTE

    If necessary, perform measuring receiver and sensor module (11722A) ZERO and CALIBRATE.

    (1) Connect measuring receiver sensor module input to TI **CAL OUTPUT.**

    (2) Setup measuring receiver to measure power in dBm at 300 MHz. Measuring receiver will indicate between -9.7 and -10.3 dBm.

    b. **Adjustments** Refer to paragraph **6. c.** above.

9. **Displayed Average Noise Level Test**

    a. **Performance Check**

    (1) Connect TI **CAL OUTPUT** to **INPUT 50 Ω.**

    (2) Press TI keys and enter values using the **DATA** keys as listed in (a) through (k) below:

        (a) **INSTRUMENT STATE PRESET**.
        (b) **FREQUENCY** then **[CENTER FREQ]** to **300 MHz**.
        (c) **SPAN** then **[SPAN]** to **100 Hz**.
        (d) **AMPLITUDE** then **[REF LVL]** to **-10 dBm**.
        (e) **[ATTEN]** to **0 dB**.
        (f) **[MORE 1 OF 3]** then **[COUPLING AC DC]** to select **DC**.
        (g) **CONTROL BW** then **[RES BW]** to **1 Hz**.
        (h) **[VIDEO BW]** to **1 Hz**.
        (i) **MARKER PEAK SEARCH**.
        (j) **INSTRUMENT STATE CAL**.
        (k) **[REF LVL ADJ]**.

    (3) Slowly adjust TI knob until **MKR** indication is between -9.83 and -10.17 dBm. Press **[STORE REF LVL]** key.

    (4) Disconnect **CAL OUTPUT** from **INPUT 50 Ω** and connect a 50 Ω termination to **INPUT 50 Ω**.

    (5) Press TI keys and enter values using **DATA** keys as listed in (a) through (e) below:

        (a) **AMPLITUDE** then **[REF LVL]** to **-50 dBm**.
        (b) **SPAN** then **[SPAN]** to **375 Hz**.

(c) **CONTROL BW** then **[RES BW]** to **1 Hz**.

(d) **FREQUENCY** then **[CENTER FREQ]** to **150 Hz**.

(e) **MARKER MKR** then **[MARKERS OFF]**.

(6) Press TI keys and enter values using **DATA** keys as listed in (a) through (e) below:

(a) **CONTROL BW** then **[VID AVG ON]** to **5 Hz**.

(b) **CONTROL TRACE** then **[CLEAR WRITE A]** and wait until **VAVG 5** is displayed above the graticule.

(c) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

(d) **MARKER MKR** to **30 Hz**.

(e) [**MKRNOISE ON OFF**] to select **ON**.

NOTE

-2.27 dB amplitude correction is added for normalization to a 1 Hz noise bandwidth, Log amplifier response, and envelope detector response.

(7) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be ≤-90 dBm.

NOTE

If any of the displayed average noise level indications are within 1.10 dB of the appropriate specification, repeat (6) and (7) above setting the number of video averages to 100 in (6) (a) above.

(8) Press TI keys and enter values using **DATA** keys as listed in (a) through (h) below:

(a) **FREQUENCY** then **[CENTER FREQ]** to **1 kHz**.

(b) **MARKER MKR** then **[MARKERS OFF]**.

(c) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

(d) **CONTROL BW** then **[VID AVG ON]** to **5 Hz**.

(e) **CONTROL TRACE** then **[CLEAR WRITE A]** and wait until **VAVG 5** is displayed above the graticule.

(f) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

(g) **MARKER MKR** to **1 kHz**.

(h) [**MKRNOISE ON OFF**] to select **ON**.

(9) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be ≤-105 dBm.

(10) Press TI keys and enter values using **DATA** keys as listed in (a) through (h) below:

    (a) **FREQUENCY** then **[CENTER FREQ]** to **10 kHz**.

    (b) **AMPLITUDE** then **[REF LVL]** to **-70 dBm**.

    (c) **MARKER MKR [MARKERS OFF]**.

    (d) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

    (e) **CONTROL TRACE** then **[CLEAR WRITE A]** and wait until **VAVG 5** is displayed above the graticule.

    (f) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

    (g) **MARKER MKR** to **10 kHz**.

    (h) **[MKRNOISE ON OFF]** to select **ON**.

(11) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be ≤-120 dBm.

(12) Press TI keys and enter values using **DATA** keys as listed in (a) through (g) below:

    (a) **FREQUENCY** then **[CENTER FREQ]** to **99 kHz**.

    (b) **MARKER MKR [MARKERS OFF]**.

    (c) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

    (d) **CONTROL TRACE** then **[CLEAR WRITE A]** and wait until **VAVG 5** is displayed above the graticule.

    (e) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

    (f) **MARKER MKR** to **99 kHz**.

    (g) **[MKRNOISE ON OFF]** to select **ON**.

NOTE

There is a residual response at 100 kHz. Tuning to 99 kHz to avoid displaying the response will yield a displayed average noise indication worse than the actual noise at 100 kHz.

(13) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be <-120 dBm.

(14) Press TI keys and enter values using **DATA** keys as listed in (a) through (g) below:

    (a) **FREQUENCY** then **[CENTER FREQ]** to **1.02 MHz**.

    (b) **MARKER MKR [MARKERS OFF]**.

    (c) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

    (d) **CONTROL TRACE** then **[CLEAR WRITE A]** and wait until **VAVG 5** is displayed above the graticule.

    (e) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

    (f) **MARKER MKR** to **1.02 MHz**.

    (g) **[MKRNOISE ON]**.

NOTE
There is a residual response at 1 MHz. Tuning to 1.02 MHz to avoid displaying the response will yield a displayed average noise indication worse than the actual noise at 1 MHz.

(15) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be <-140 dBm.

(16) Press TI keys and enter values using **DATA** keys as listed in (a) through (g) below:

    (a) **FREQUENCY** and then **[START FREQ]** to **10 MHz**.

    (b) **[STOP FREQ]** to **2.9 GHz**.

    (c) **MARKER MKR [MARKERS OFF]**.

    (d) **CONTROL BW** then **[RES BW]** to **1 MHz**.

    (e) **[VIDEO BW]** to **10 kHz**.

    (f) **[VID AVG ON OFF]** to select **OFF**.

    (g) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

(17) Press TI keys and enter values using **DATA** keys as listed in (a) through (j) below:

    (a) **MARKER MKR** then **[MKRNOISE ON OFF]** to select **ON**.

    (b) **MARKER PEAK SEARCH**.

    (c) **[MARKER → CF]**.

    (d) **SPAN** then **[SPAN]** to **375 Hz**.

    (e) **CONTROL BW** then **[RES BW]** to **1 Hz**.

    (f) **[VIDEO BW]** to **1 Hz**.

    (g) **[VID AVG ON OFF]** to select **ON**.

    (h) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

    (i) **CONTROL TRACE** then **[CLEAR WRITE A]** and wait until **VAVG 5** is displayed above the gradicule.

    (j) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

(18) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be <-151 dBm.

(19) Press TI keys and enter values using **DATA** keys as listed in (a) through (f) below:

    (a) **FREQUENCY** then **[START FREQ]** to **2.9 GHz**.

    (b) **[STOP FREQ]** to **6.46 GHz**.

    (c) **MARKER MKR** then **[MARKERS OFF]**.

    (d) **CONTROL BW** then **[RES BW]** to **1 MHz**.

    (e) **[VIDEO BW]** to **10 kHz**.

    (f) **[VID AVG ON OFF]** to select **OFF**.

(20) Repeat (17) above.

(21) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be <-148 dBm.

(22) Press TI keys and enter values using **DATA** keys as listed in (a) through (f) below:

    (a) **FREQUENCY** then **[START FREQ]** to **6.46 GHz**.

    (b) **[STOP FREQ]** to **13.2 GHz**.

    (c) **MARKER MKR** then **[MARKERS OFF]**.

    (d) **CONTROL BW** then **[RES BW]** to **1 MHz**.

    (e) **[VIDEO BW]** to **10 kHz**.

    (f) **[VID AVG ON OFF]** to select **OFF**.

(23) Repeat (17) above.

(24) Add -2.27 dB to TI **MKR** amplitude indication. Calculated displayed average noise level will be <-145 dBm.

  b. Adjustments. Refer to paragraph **6. c.** above.

10. Resolution Bandwidth Accuracy and Selectivity Test

  a. Performance Check

(1) Connect TI **10 MHz REF IN/OUT** to synthesizer/level generator **40/N MHz REF INPUT**.

(2) Connect synthesizer/level generator **OUTPUT 50 Ω** to TI **INPUT 50 Ω**.

(3) Press synthesizer/level generator keys to values as listed in (a) through (c) below:

    (a) **FREQUENCY** to **40 MHz**.

    (b) **AMPLITUDE** to **-5 dBm**.

    (c) **AMPTD INCR** to **1 dB**.

(4) Press TI keys enter values using **DATA** keys as listed in (a) through (k) below:

    (a) **INSTRUMENT STATE PRESET**.

    (b) **INSTRUMENT STATE SAVE**.

    (c) **[SAVELOCK ON OFF]** to select **OFF**.

    (d) **INSTRUMENT STATE CAL**.

    (e) **[FULL IF ADJ]** and wait for **IF ADJUST STATUS:** message to disappear.

    (f) **[IF ADJ ON OFF]** to select **OFF**.

    (g) **FREQUENCY** then **[CENTER FREQ]** to **40 MHz**.

    (h) **SPAN** then **[SPAN]** to **4 MHz**.

    (i) **AMPLITUDE** then **[LOG dB/DIV]** to **1 dB**.

    (j) **CONTROL BW** then **[RES BW]** to **2 MHz**.

    (k) **[VIDEO BW]** to **300 Hz**.

(5) Adjust synthesizer/level generator amplitude to position the signal 2 to 3 divisions (2 to 3 dB) below TI reference level.

(6) Set synthesizer/level generator **AMPTD INCR** to **3 dB.**

(7) Press TI **INSTRUMENT STATE CAL** key then **[ADJ CURR IF STATE]** key and wait for **IF ADJUST STATUS:** messages to disappear.

(8) If TI **RES BW** setting is 3 kHz or less, proceed to (15) below.

(9) Set synthesizer/level generator frequency to F1 in table 3 for the current TI **RES BW** setting.

Table 3. -3 dB Resolution Bandwidth Settings

Test instrument settings		Synthesizer/level generator frequency settings	
RES BW	**SPAN**	F1 (MHz)	F2 (MHz)
2 MHz	4 MHz	39.0	41.0
1 MHz	2 MHz	39.5	40.5
300 kHz	500 kHz	39.85	40.15
100 kHz	200 kHz	39.95	40.05
30 kHz	50 kHz	39.985	40.015
10 kHz	20 kHz	39.995	40.005
3 kHz	5 kHz	N/A	N/A
1 kHz	2 kHz	N/A	N/A
300 Hz	600 Hz	N/A	N/A

(10) Press TI keys as listed in (a) through (g) below:

    (a) **INSTRUMENT STATE SAVE**.

    (b) **[SAVE STATE]**.

    (c) **[SAVE 0]**.

    (d) **CONTROL AUTO COUPLE**.

    (e) **[ALL]**.

    (f) **MARKER PEAK SEARCH**.

    (g) **[MARKER DELTA]**.

(11) Set synthesizer/level generator frequency to F2 in table 3 for the current TI **RES BW** setting.

(12) Press TI **MARKER PEAK SEARCH** key. Record Δ **MKR** frequency indication as actual span in table 4 for the current TI **RES BW** setting.

Table 4. -3 dB Resolution Bandwidth Accuracy

Test instrument RES BW settings	Span		-3 dB bandwidth		- 3 dB BW error limits (%)
	Ideal	Actual	Measured	Corrected	
2 MHz	2 MHz	MHz			-25, +50
1 MHz	1 MHz	MHz			±25
300 kHz	300 kHz	kHz			±10
100 kHz	100 kHz	kHz			±10
30 kHz	30 kHz	kHz			±10
10 kHz	10 kHz	kHz			±10
3 kHz	N/A	N/A			±10
1 kHz	N/A	N/A			±10
300 Hz	N/A	N/A			±10

(13) Press TI **INSTRUMENT STATE RECALL** key then **[RECALL STATE]** key and then **[STATE 0]** key.

(14) Set synthesizer/level generator frequency to 40 MHz.

(15) Press synthesizer/level generator **AMPLITUDE** key then **INCR** ⇓ key.

(16) Press TI **MARKER PEAK SEARCH** key then **[MARKER DELTA]** key.

(17) Press synthesizer/level generator **INCR** ⇑ key.

(18) Press TI **INSTRUMENT STATE SGL SWP** key and wait for the completion of new sweep.

(19) Press TI **MARKER MKR** key. Adjust TI knob ccw until Δ **MKR** indicates 0 dB ±0.017 dB. The marker should be on the left-hand skirt of the signal. If the marker cannot be set exactly to 0 dB, note whether the marker is just above or just below the actual -3 dB point.

(20) Press TI **[DELTA MARKER]** key. Adjust TI knob cw until Δ **MKR** indicates 0 dB ±0.017 dB. The active marker should be on the right-hand skirt of the signal. If the marker was just above the -3 dB point in (19) above, set the marker just below the -3 dB point. If the marker was just below the -3 dB point in (19) above, set the marker just above the -3 dB point.

(21) If TI **RES BW** setting is 3 kHz or less, record TI Δ **MKR** frequency indication as corrected -3 dB bandwidth in table 4 and proceed to (24) below.

(22) Record TI Δ **MKR** frequency indication as the measured -3 dB bandwidth in table 4 for the current TI **RES BW** setting.

(23) Calculate corrected -3 dB bandwidth using formula below and record the result in table 4 for the current TI **RES BW** setting.

Corrected -3 dB BW = (Actual Span/Ideal Span) x Measured -3 dB BW

Example: **RES BW** setting = 1 MHz

Ideal Span = 1.0 MHz

Actual Span = 1.05 MHz

Measured -3 dB BW = 913 kHz

Corrected -3 dB BW = (1.05/1.00) x 913 kHz = 958.65 kHz

(24) Calculate -3 dB bandwidth using formula below. Result will be within limits listed in table 4 for the current TI **RES BW** setting.

-3 dB BW = 100 x (corrected -3 dB BW - **RES BW** setting)/**RES BW** setting

Example: **RES BW** setting = 1 MHz

Corrected -3 dB BW = 958.65 kHz

-3 dB BW = 100 x (0.95865 MHz - 1.0 MHz)/1.0 MHz = -4.135%

(25) Press TI keys as listed in (a) through (d) below:

(a) **MARKER MKR**.
(b) **[MARKERS OFF]**.
(c) **CONTROL TRIG**.
(d) **[SWEEP CONT SGL]** to select **CONT**.

(26) Repeat technique of (4)(h), (j), and (7) through (25) above for remaining TI settings in table 3 and table 4.

(27) Press TI keys and enter values using **DATA** keys as listed in (a) through (d) below:

(a) **SPAN** then **[SPAN]** to **20 MHz**.
(b) **CONTROL BW** then **[RES BW]** to **2 MHz**.
(c) **[VIDEO BW]** to **300 Hz**.
(d) **AMPLITUDE** then **[LOG dB/DIV]** to **10 dB**.

(28) Set synthesizer/level generator **AMPLITUDE** to **-3 dBm** and **AMPTD INCR** to **1 dB**.

(29) Press TI keys as listed in (a) through (c) below:

(a) **INSTRUMENT STATE CAL**.
(b) **[ADJ CURR IF STATE]** wait for **IF ADJUST STATUS** messages to disappear.
(c) **MARKER PEAK SEARCH**.

(30) Adjust synthesizer/level generator amplitude until TI **MKR** indicates 0 dBm ±1.00 dB.

(31) Set synthesizer/level generator **AMPTD INCR** to **60 dB**.

(32) Set synthesizer/level generator frequency to F1 listed in table 5 for the current TI **RES BW** setting.

Table 5. -60 dB Resolution Bandwidth Settings

Test instrument settings		Synthesizer/level generator frequency settings	
RES BW	**SPAN**	F1 (MHz)	F2 (MHz)
2 MHz	20 MHz	35.0	45.0
1 MHz	20 MHz	32.0	48.0
300 kHz	5 MHz	38.0	42.0
100 kHz	2 MHz	39.2	40.8
30 kHz	500 kHz	39.8	40.2
10 kHz	200 kHz	39.92	40.08
3 kHz	50 kHz	39.98	40.02
1 kHz	20 kHz	39.992	40.008
300 Hz	5 kHz	39.998	40.002

(33) Press TI keys as listed in (a) through (e) below:

(a) **INSTRUMENT STATE SAVE**.

(b) **[SAVE STATE]**.

(c) **[STATE 0]**.

(d) **CONTROL AUTO COUPLE**.

(e) **[ALL]**.

(34) If TI **RES BW** setting is now less than 300 Hz, press TI **CONTROL BW** key then **[RES BW]** key and enter **300 Hz** using **DATA** keys.

(35) Press TI **MARKER PEAK SEARCH** key then **[MARKER DELTA]** key.

(36) Set synthesizer/level generator frequency to F2 listed in table 5 for the current TI **RES BW** setting.

(37) Press TI **MARKER PEAK SEARCH** key. Record TI Δ **MKR** frequency indication as the actual span in table 6 for the current TI **RES BW** setting.

Table 6. -60 dB Resolution Bandwidth Accuracy

Test instrument **RES BW** settings	Span		-60 dB bandwidth		Selectivity limits (ratio)
	Ideal	Actual	Measured	Corrected	
2 MHz	10 MHz	MHz			<15:1
1 MHz	16 MHz	MHz			<15:1
300 kHz	4 MHz	MHz			<15:1
100 kHz	1.6 MHz	MHz			<15:1
30 kHz	400 kHz	kHz			<15:1
10 kHz	160 kHz	kHz			<15:1
3 kHz	40 kHz	kHz			<15:1
1 kHz	16 kHz	kHz			<15:1
300 Hz	4 kHz	kHz			<15:1

(38) Press TI **INSTRUMENT STATE RECALL** key then **[RECALL STATE]** key and then **[STATE 0]** key.

(39) Set synthesizer/level generator frequency to 40 MHz.

(40) Press synthesizer/level generator **INCR** ⇓ key.

(41) Press TI **MARKER PEAK SEARCH** key then **[MARKER DELTA]** key.

(42) Press synthesizer/level generator **INCR ⇑** key.

(43) Press TI **INSTRUMENT STATE SGL SWP** key and wait for completion of new sweep.

(44) Press TI **MARKER MKR** key. Adjust TI knob ccw until Δ **MKR** indicates 0 dB ±0.5 dB. The marker should be on the left-hand skirt of the signal. If the marker cannot be set exactly to 0 dB, note whether the marker is just above or just below the actual -60 dB point.

(45) Press TI **[DELTA MARKER]** key. Adjust TI knob cw until Δ **MKR** indicates 0 dB ±0.5 dB. The active marker should be on the right-hand skirt of the signal. If the marker was just above the -60 dB point in (44) above, set the marker just below the -60 dB point. If the marker was just below the -60 dB point in (44) above, set the marker just above the -60 dB point.

(46) Record TI Δ **MKR** frequency indication as the measured -60 dB bandwidth in table 6 for the current TI **RES BW** setting.

(47) Press TI **MARKER PEAK SEARCH** key. Record TI Δ **MKR** frequency indication as the actual span in table 6 for the current TI **RES BW** setting.

(48) Calculate corrected -60 dB bandwidth using formula below and record the result in table 6 for the current TI **RES BW** setting.

Corrected -60 dB BW = (Actual Span/Ideal Span) x Measured -60 dB BW

Example: **RES BW** setting = 1 MHz

    Ideal Span = 16 MHz

    Actual Span = 17 MHz

    Measured -60 dB BW = 9.82 MHz

Corrected -60 dB BW = (17/16) x 9.82 MHz = 10.43 MHz

(49) Calculate selectivity by dividing the corrected -60 dB bandwidth by the corrected -3 dB bandwidth (from table 4) for the current TI **RES BW** setting. The result will be <15.

Selectivity = corrected -60 dB BW / corrected -3 dB BW

Example: Selectivity = 10.43 MHz / 0.9415 MHz = 11.08

(50) Press TI keys as listed in (a) through (d) below:
    (a) **MARKER MKR**.
    (b) **[MARKERS OFF]**.
    (c) **CONTROL TRIG**.
    (d) **[SWEEP CONT SGL]** to select **CONT**.

(51) Repeat technique of (27)(a), (b), and (29) through (50) above for remaining TI settings in table 5 and table 6.

b. Adjustments. No adjustments can be made.

11. Input Attenuator Accuracy

a. Performance Check
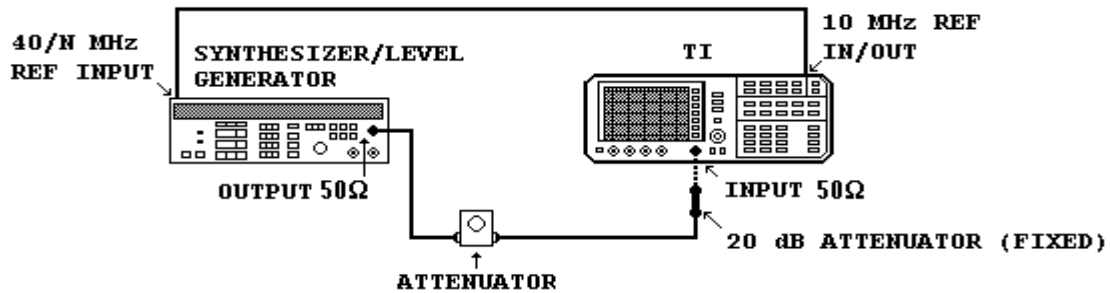
(1) Connect equipment as shown in figure 1.

Figure 1. Input attenuator accuracy (50 MHz) - equipment setup.

(2) Press synthesizer/level generator keys to values as listed in (a) through (c) below:

(a) **FREQUENCY** to **50 MHz**.

(b) **AMPLITUDE** to **-50 dBm**.

(c) **AMPTD INCR** to **10 dB**.

(3) Press TI keys and enter values using **DATA** keys as listed in (a) through (i) below:

(a) **INSTRUMENT STATE PRESET**.

(b) **INSTRUMENT STATE CAL**.

(c) **[REALIGN LO & IF]** wait for **ADJUST STATUS** messages to disappear.

(d) **FREQUENCY** then **[CENTER FREQ]** to **50 MHz**.

(e) **SPAN** then **[ZERO SPAN]**.

(f) **AMPLITUDE** then **[REF LVL]** to **-70 dBm**.

(g) **[LOG dB/DIV]** to **1 dB**.

(h) **CONTROL BW** then **[RES BW]** to **3 kHz**.

(i) **[VIDEO BW]** to **1 Hz**.

(4) Set attenuator to 0 dB.

(5) Adjust attenuator to position signal peak 2 to 3 divisions below TI reference level.

(6) Press TI keys as listed in (a) through (d) below:

   (a) **INSTRUMENT STATE SGL SWP**.

   (b) **INSTRUMENT STATE SGL SWP** and wait for completion of new sweep.

   (c) **MARKER MKR**.

   (d) **[MARKER DELTA]**.

(7) Press synthesizer/level generator **AMPLITUDE** key.

(8) Press synthesizer/level generator **INCR ⇑** key.

(9) Press TI **AMPLITUDE** key then **[REF LVL]** to **-60 dBm** and **[ATTEN]** to **20 dB**.

(10) Press TI **INSTRUMENT STATE SGL SWP** key and wait for completion of sweep. TI **Δ MKR** indication will be within limits specified in table 7. Record **Δ MKR** indication as actual **Δ MKR** indication in table 7.

Table 7. Input Attenuator Accuracy (50 MHz)

| Synthesizer/level generator amplitude settings (dBm) | Test instrument | | | | |
| | REF LVL settings (dBm) | ATTEN settings (dB) | Δ MKR indications (dB) | | |
			Min	Max	Actual
-40	-60	20	+9.4	+10.6	
-30	-50	30	+18.8	+21.2	
-20	-40	40	+28.2	+31.8	
-10	-30	50	+38.2	+41.8	
0	-20	60	+48.2	+51.8	
+10	-10	70	+58.2	+61.8	

(11) Repeat (8) through (10) above for remaining synthesizer/level generator and TI settings listed in table 7.

(12) Calculate the step-to-step accuracy for TI **ATTEN** 20 dB setting by subtracting 10 dB from the actual **Δ MKR** indication recorded in table 7 for **ATTEN** 20 dB setting. Difference will be between -0.6 and +0.6 dB.

(13) Calculate the step-to-step accuracy for TI **ATTEN** 30, 40, 50, 60 and 70 dB settings by subtracting previous **ATTEN** setting actual **Δ MKR** indication recorded in table 7 from the current **ATTEN** setting actual **Δ MKR** indication recorded in table 7 and then subtract 10 dB from the results. Difference will be between -0.6 and +0.6 dB for each setting.

   EXAMPLE:

		(Current)		(Previous)
30 dB step-to-step		TI **ATTEN** 30 dB		TI **ATTEN** 20 dB
accuracy	=	(actual **Δ MKR** indication	–	actual **Δ MKR** indication) - 10 dB

(14) Set synthesizer/level generator **AMPLITUDE** to **+5 dBm** and **AMPTD INCR** to **10 dB.**

(15) Press TI keys and enter values using **DATA** keys as listed in (a) through (j) below:

   (a) **INSTRUMENT STATE PRESET**.

   (b) **INSTRUMENT STATE CAL**.

> (c) **[REALIGN LO & IF]** wait for **ADJUST STATUS** messages to disappear.
>
> (d) **FREQUENCY** then **[CENTER FREQ]** to **50 MHz**.
>
> (e) **SPAN** then **[ZERO SPAN]**.
>
> (f) **AMPLITUDE** then **[REF LVL]** to **-10 dBm**.
>
> (g) **[LOG dB/DIV]** to **1 dB**.
>
> (h) **[ATTEN]** to **0 dB**.
>
> (i) **CONTROL BW** then **[RES BW]** to **1 kHz**.
>
> (j) **[VIDEO BW]** to **1 Hz**.

(16) Set attenuator to 5 dB and replace 20 dB attenuator (fixed) in equipment setup with 10 dB attenuator (fixed).

(17) Adjust attenuator to position trace 2 to 3 divisions below TI reference level.

(18) Press TI **MARKER MKR** key then **[MARKER DELTA]** key.

(19) Press synthesizer/level generator **AMPLITUDE** key.

(20) Press synthesizer/level generator **INCR ⇓** key.

(21) Press TI **AMPLITUDE** key then **[REF LVL]** key to and enter **-20 dBm** using **DATA** keys. Record actual Δ **MKR** indication for TI **REF LVL** –20 dBm setting in table 8.

(22) Subtract ideal Δ **MKR** value from actual Δ **MKR** indication listed in table 8 and record difference as **IF GAIN DEVIATION** in table 8.

Table 8. IF Gain Deviation

Synthesizer/level generator amplitude settings (dBm)	Test instrument			IF GAIN DEVIATION (dB)
	REF LVL settings (dBm)	Δ MKR indications		
		Actual (dB)	Ideal (dB)	
+5	-10	0 (ref)	0 (ref)	0 (ref)
-5	-20		-10	
-15	-30		-20	
-25	-40		-30	
-35	-50		-40	
-45	-60		-50	
-55	-70		-60	
-65	-80		-70	

(23) Repeat (20) through (22) above for remaining synthesizer/level generator and TI settings listed in table 8.

(24) Calculate the **IF GAIN CORRECTION** for **ATTEN** 20 dB setting in table 9 by subtracting the **IF GAIN DEVIATION** value recorded for **REF LVL** –20 dBm setting in table 8 from the **IF GAIN DEVIATION** value recorded for **REF LVL** –30 dBm setting in table 8 as in EXAMPLE below. Record difference as **IF GAIN CORRECTION** in table 9.

EXAMPLE:

- (a) If the **IF GAIN DEVIATION** values in table 8 are: **REF LVL** -30 dBm = +0.2 dB
       REF LVL -20 dBm = -0.3 dB
- (b)   **IF GAIN CORRECTION** formula listed in table 9 is: [(-30)-(-20)] =
- (c)   Substitute table 8 **IF GAIN DEVIATION** values for **REF LVL** settings into formula:
       [(-30)-(-20)] = [(+0.2)-(-0.3)] = **+0.5**
- (d)   Then +0.5 would be recorded as **IF GAIN CORRECTION** (dB) factor in table 9 for
       ATTEN 20 dB setting. **NOTE:** Do not record EXAMPLE in table 9.

Table 9. Input Attenuator Accuracy (2.9 GHz)

ATTEN settings (dB)	Δ MKR indications (dB)	IF GAIN CORRECTION (dB)	Δ MKR	
			Corrected indications (dB)	Limits (±dB)
10	0 (ref)	0 (ref)	0 (ref)	0 (ref)
20		[(-30) - (-20)] =		0.6
30		[(-40) - (-20)] =		1.2
40		[(-50) - (-20)] =		1.8
50		[(-60) - (-20)] =		1.8
60		[(-70) - (-20)] =		1.8
70		[(-80) - (-20)] =		1.8

(25) Repeat (24) above for each remaining **IF GAIN CORRECTION** listed in table 9.

(26) Connect equipment as shown in figure 2.

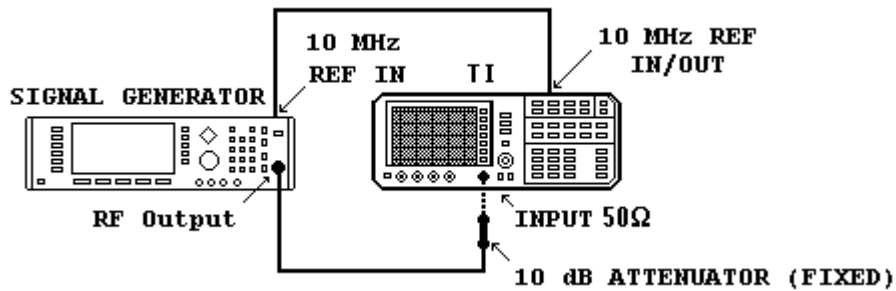Figure 2. Input attenuator accuracy (2.9 GHz) - equipment setup.

(27) Press TI keys and enter values using **DATA** keys as listed in (a) through (d) below:

- (a) **FREQUENCY** then **[CENTER FREQ]** to **2.9 GHz**.

(b) **AMPLITUDE** then **[REF LVL]** to **-10 dBm**.

(c) **AMPLITUDE** then **[ATTEN]** to **10 dB**.

(d) **MARKER MKR [MARKERS OFF]**.

(28) Set signal generator frequency to 2.9 GHz and level output to 0 dBm.

(29) Press TI **MARKER MKR** key.

(30) Adjust signal generator level output for a TI **MKR** indication between -12.95 and -13.05 dBm.

(31) Press TI keys and enter values using **DATA** keys as listed in (a) through (c) below:

(a) **MARKER MKR**.

(b) **[MARKER DELTA]**.

(c) **AMPLITUDE** then **[ATTEN]** to **20 dB**.

(32) Wait for completion of sweep. Record Δ **MKR** indication for TI **ATTEN** 20 dB setting in table 9.

(33) Repeat technique of (31)(c) and (32) above for remaining TI **ATTEN** settings listed in table 9.

(34) Subtract **IF GAIN CORRECTION** from Δ **MKR** indication and record results as corrected Δ **MKR** indication for each **ATTEN** setting listed in table 9. The corrected Δ **MKR** indications will be within limits specified for each setting.

(35) The step-to-step accuracy for TI **ATTEN** 20 dB setting is equal to the **ATTEN** 20 dB setting corrected Δ **MKR** indication recorded in table 9. The corrected Δ **MKR** indication will be between -0.6 and +0.6 dB.

(36) Calculate the step-to-step accuracy for TI **ATTEN** 30, 40, 50, 60 and 70 dB settings by subtracting previous **ATTEN** setting corrected Δ **MKR** indication recorded in table 9 from the current **ATTEN** setting corrected Δ **MKR** indication recorded in table 9. Difference will be between -0.6 and +0.6 dB for each setting.

EXAMPLE:

	(Current)	(Previous)
30 dB step-to-step	TI **ATTEN** 30 dB	TI **ATTEN** 20 dB
accuracy =	corrected Δ **MKR** indication –	corrected Δ **MKR** indication

b. Adjustments. Refer to paragraph **6. c.** above.

12. IF Gain Uncertainty

a. Performance Check
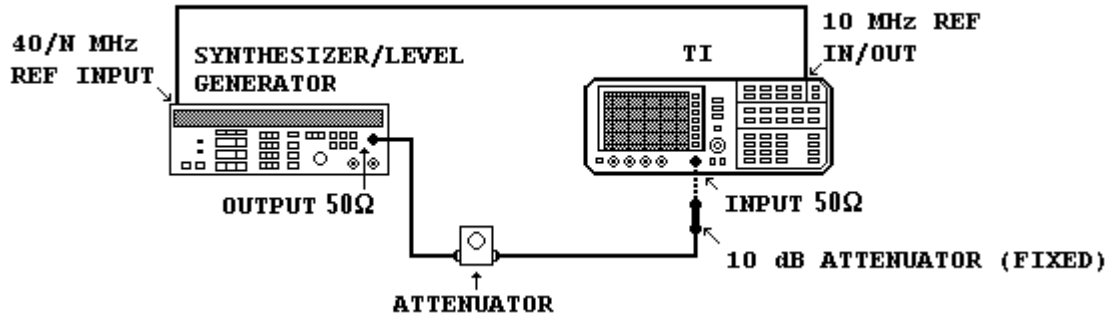
(1) Connect equipment as shown in figure 3.

Figure 3. IF gain uncertainty - equipment setup.

(2) Press synthesizer/level generator keys to values listed in (a) through (c) below:

    (a) **FREQUENCY** to **50 MHz**.

    (b) **AMPLITUDE** to **+10 dBm**.

    (c) **AMPTD INCR** to **10 dB**.

(3) Press TI keys and enter values using **DATA** keys as listed in (a) through (h) below:

    (a) **INSTRUMENT STATE PRESET**.

    (b) **INSTRUMENT STATE CAL**.

    (c) **[REALIGN LO & IF]** wait for **ADJUST STATUS** messages to disappear.

    (d) **FREQUENCY** then **[CENTER FREQ]** to **50 MHz**.

    (e) **SPAN** then **[ZERO SPAN]**.

    (f) **AMPLITUDE** then **[LOG dB/DIV]** to **1 dB**.

    (g) **CONTROL BW** then **[RES BW]** to **1 kHz**.

    (h) **[VIDEO BW]** to **1 Hz**.

(4) Set attenuator to 0 dB.

(5) Press TI **MARKER MKR** key.

(6) Adjust attenuator to position signal peak 2 to 3 dB (2 to 3 divisions) below TI reference level.

(7) Press TI keys as listed in (a) through (d) below:

    (a) **INSTRUMENT STATE SGL SWP**.

    (b) **INSTRUMENT STATE SGL SWP**.

    (c) **MARKER MKR**

    (d) **[MARKER DELTA]**.

(8) Press synthesizer/level generator **AMPLITUDE** key.

(9) Press synthesizer/level generator **INCR ⇓** key.

(10) Press TI **AMPLITUDE** key then **[REF LVL]** key and enter **-10 dBm** using **DATA** keys.

(11) Press TI **INSTRUMENT STATE SGL SWP** key and wait for completion of sweep.

(12) TI Δ **MKR** indication will be between -9 and -11 dB.

(13) Repeat technique of (9) through (11) above for synthesizer/level generator and TI settings listed in table 10. TI Δ **MKR** indications will be within limits specified in table 10.

Table 10. Log Gain Uncertainty (10 dB Steps)

Synthesizer/level generator amplitude settings (dBm)	Test instrument		
	REF LVL settings (dBm)	Δ MKR indications (dB)	
		Min	Max
-10	-20	-21	-19
-20	-30	-31	-29
-30	-40	-41	-39
-40	-50	-51	-49
-50	-60	-61	-59
-60	-70	-71	-69
-70	-80	-81	-79

(14) Set synthesizer/level generator **AMPLITUDE** to **+10 dBm** and **AMPTD INCR** to **1 dB**.

(15) Press TI keys and enter values using **DATA** keys as listed in (a) though (d) below:

    (a) **MARKER MKR** then **[MARKER NORMAL]**.

    (b) **AMPLITUDE** then **[REF LVL]** to **0 dBm**.

    (c) **[LOG dB/DIV]** to **1 dB**.

    (d) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

(16) Adjust attenuator to position signal peak 2 to 3 dB (2 to 3 divisions) below TI reference level.

(17) Press TI keys as listed in (a) through (d) below:

    (a) **INSTRUMENT STATE SGL SWP**.

    (b) **INSTRUMENT STATE SGL SWP**.

    (c) **MARKER MKR**

    (d) **[MARKER DELTA]**.

(18) Press synthesizer/level generator **AMPLITUDE** key.

(19) Press synthesizer/level generator **INCR ⇓** key.

(20) Press TI **AMPLITUDE** key then **[REF LVL]** key and enter **-1 dBm** using **DATA** keys.

(21) Press TI **INSTRUMENT STATE SGL SWP** key and wait for completion of sweep.

(22) TI Δ **MKR** indication will be between 0 and -2 dB.

(23) Repeat technique of (19) through (21) above for synthesizer/level generator and TI settings listed in table 11. TI Δ **MKR** indications will be within limits specified in table 11.

Table 11. Log Gain Uncertainty (1 dB Steps)

Synthesizer/level generator amplitude settings (dBm)	Test instrument		
	REF LVL settings (dBm)	**Δ MKR** indications (dB)	
		Min	Max
+8	-2	-3	-1
+7	-3	-4	-2
+6	-4	-5	-3
+5	-5	-6	-4
+4	-6	-7	-5
+3	-7	-8	-6
+2	-8	-9	-7
+1	-9	-10	-8
0	-10	-11	-9
-1	-11	-12	-10
-2	-12	-13	-11

(24) Set synthesizer/level generator **AMPLITUDE** to **+10 dBm** and **AMPTD INCR** to **10 dB**.

(25) Press TI keys to values using **DATA** keys as listed in (a) through (f) below:

(a) **MARKER MKR** then **[MARKER NORMAL]**.

(b) **AMPLITUDE** then **[REF LVL]** to **0 dBm**.

(c) **[LINEAR]**.

(d) **[MORE 1 of 3]**.

(e) **[AMPTD UNITS]** then **[dBm]**.

(f) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

(26) Adjust attenuator to position signal peak 2 to 3 dB (2 to 3 divisions) below TI reference level.

(27) Press TI keys as listed in (a) through (d) below:

(a) **INSTRUMENT STATE SGL SWP**.

(b) **INSTRUMENT STATE SGL SWP**.

(c) **MARKER MKR**

(d) **[MARKER DELTA]**.

(28) Press synthesizer/level generator **AMPLITUDE** key.

(29) Press synthesizer/level generator **INCR ⇓** key.

(30) Press TI **AMPLITUDE** key then **[REF LVL]** key and enter **-10 dBm** using **DATA** keys.

(31) Press TI **INSTRUMENT STATE SGL SWP** key and wait for completion of sweep.

(32) TI **Δ MKR** indication will be between -9 and -11 dB.

(33) Repeat technique of (29) through (31) above for synthesizer/level generator and TI settings listed in table 12. TI **Δ MKR** indications will be within limits specified in table 12.

Table 12. Linear IF Gain Uncertainty

Synthesizer/level generator amplitude settings (dBm)	Test instrument		
	REF LVL settings (dBm)	ΔMKR indications (dB)	
		Min	Max
-10	-20	-21	-19
-20	-30	-31	-29
-30	-40	-41	-39
-40	-50	-51	-49
-50	-60	-61	-59
-60	-70	-71	-69
-70	-80	-81	-79

b. **Adjustments.** Refer to paragraph **6. c.** above.

13. Residual FM

a. Performance Check

(1) Connect signal generator **RF Output** to TI **INPUT 50 Ω**.

(2) Set signal generator frequency to 2.5 GHz and level output to 0 dBm.

(3) Press TI keys and enter values using **DATA** keys listed in (a) through (q) below:

(a) **INSTRUMENT STATE PRESET**.

(b) **FREQUENCY** then **[CENTER FREQ]** to **2.5 GHz**.

(c) **SPAN** then **[SPAN]** to **1 MHz**.

(d) **MARKER PEAK SEARCH**.

(e) **MARKER MKR**.

(f) **[SIG TRK ON OFF]** to select **ON**.

(g) **SPAN** then **[SPAN]** to **5 kHz** wait for signal to be centered in a 5 kHz span.

(h) **CONTROL BW** then **[RES BW]** to **10 Hz**.

(i) **SPAN** then **[SPAN]** to **100 Hz** wait for signal to be centered in a 100 Hz span.

(j) **MARKER MKR**.

(k) **[SIG TRK ON OFF]** to select **OFF**.

(l) **AMPLITUDE** then **[LOG dB/DIV]** to **2 dB**.

(m) **MARKER PEAK SEARCH**.

(n) **MARKER MKR→**.

(o) **[MARKER→ REF LVL]**.

(p) **MARKER PEAK SEARCH**.

(q) **[MARKER DELTA]**

(4) Adjust TI knob ccw for a Δ **MKR** indication between -9.5 and -10.5 dB.

(5) Press TI keys as listed in (a) through (d) below:

(a) **[MARKER NORMAL]**.

(b) **[MARKER → CF]**.

(c) **SPAN** then **[ZERO SPAN]**.

(d) **CONTROL SWEEP** then **[SWP TIME MAN]** to **200 ms**.

(6) If TI trace is not about **5** divisions below reference level, press TI **FREQUENCY** key and adjust TI knob to adjust center frequency until trace is approximately 5 divisions below reference level.

(7) Press TI **INSTRUMENT STATE SGL SWP** key and **MARKER MKR** key.

(8) Locate the horizontal division with the greatest amplitude deviation. Adjust TI knob to place marker at highest point in the horizontal division with the greatest amplitude deviation.

(9) Press TI **[MARKER DELTA]** key. Adjust TI knob to place marker at lowest point within the same division. Record TI Δ **MKR** amplitude indication.

(10) Multiply TI Δ **MKR** amplitude indication recorded in (9) above by 0.457 Hz/dB. Calculated value will be <1 Hz/dB.

<div align="center">NOTE</div>

The 0.457Hz/dB is the slope of the 10 RES BW filter at 10 dB below the peak of the filter.

b. Adjustments. No adjustments can be made.

14. Frequency Readout and Frequency Count Marker Accuracy

a. Performance Check

(1) Connect TI **10 MHz REF IN/OUT** to signal generator **10 MHz REF IN**.

(2) Connect signal generator **RF Output** to TI **INPUT 50Ω.**

(3) Set signal generator frequency to 1.5 GHz and level output to -10 dBm.

(4) Press TI keys and enter values using **DATA** keys as listed in (a) through (f) below:

(a) **INSTRUMENT STATE PRESET**.

(b) **FREQUENCY** then **[CENTER FREQ]** to **1.5 GHz**.

(c) **SPAN** then **[SPAN]** to **1 MHz**.

(d) **INSTRUMENT STATE RECALL**.

(e) **[MORE 1 OF 2]**.

(f) **[FACTORY PRSEL PK]**.

(5) Press TI **MARKER PEAK SEARCH** key. TI **MKR** frequency indication will be between 1.499988 and 1.500012 GHz.

(6) Repeat technique of (4)(c) and (5) above for remaining TI **SPAN** settings listed in table 13. TI **MKR** frequency indications will be within the limits specified in table 13.

Table 13. Frequency Readout Accuracy – 1.5 GHz

Signal generator frequency setting (GHz)	Test instrument			
	CENTER FREQ setting (GHz)	**SPAN** settings	**MKR** frequency indications (GHz)	
			Min	Max
1.5	1.5	10 MHz	1.49948	1.50052
1.5	1.5	20 MHz	1.49895	1.50105
1.5	1.5	50 MHz	1.49745	1.50255
1.5	1.5	100 MHz	1.4948	1.5052
1.5	1.5	1 GHz	1.450	1.550

(7) Set signal generator frequency to 4 GHz.

(8) Press TI keys and enter values using **DATA** keys as listed in (a) through (f) below:

    (a) **FREQUENCY** then **[CENTER FREQ]** to **4 GHz**.

    (b) **MARKER PEAK SEARCH**.

    (c) **INSTRUMENT STATE AUX CTRL**.

    (d) **[INTERNAL MIXER]**.

    (e) **[PRESEL AUTO PK]** wait for **PEAKING** message to disappear.

    (f) **SPAN** then **[SPAN]** to **1 MHz**.

(9) Press TI **MARKER PEAK SEARCH** key. TI **MKR** frequency indication will be between 3.999988 and 4.000012 GHz.

(10) Press TI **SPAN** key then **[SPAN]** key and enter **10 MHz** using **DATA** keys.

(11) Press TI **MARKER PEAK SEARCH** key. TI **MKR** frequency indication will be between 3.99948 and 4.00052 GHz.

(12) Repeat technique of (10) and (11) above for remaining TI **SPAN** settings listed in table 14. TI **MKR** frequency indications will be within limits specified in table 14.

Table 14. Frequency Readout Accuracy – 4 GHz

Signal generator frequency setting (GHz)	Test instrument			
	CENTER FREQ setting (GHz)	**SPAN** settings	**MKR** frequency indications (GHz)	
			Min	Max
4	4	20 MHz	3.99895	4.00105
4	4	50 MHz	3.99745	4.00255
4	4	100 MHz	3.9948	4.0052
4	4	1 GHz	3.950	4.050

(13) Set signal generator frequency to 9 GHz.

(14) Press TI keys and enter values using **DATA** keys as listed in (a) through (f) below:

    (a) **FREQUENCY** then **[CENTER FREQ]** to **9 GHz**.

    (b) **MARKER PEAK SEARCH**.

    (c) **INSTRUMENT STATE AUX CTRL**.

    (d) **[INTERNAL MIXER]**.

(e) **[PRESEL AUTO PK]** and wait for **PEAKING** message to disappear.

(f) **SPAN** then **[SPAN]** to **1 MHz**.

(15) Press TI **MARKER PEAK SEARCH** key. TI **MKR** frequency indication will be between 8.999988 and 9.000012 GHz.

(16) Press TI **SPAN** key then **[SPAN]** key and enter **10 MHz** using **DATA** keys.

(17) Press TI **MARKER PEAK SEARCH** key. TI **MKR** frequency indication will be between 8.99948 and 9.00052 GHz.

(18) Repeat technique of (16) and (17) above for remaining TI **SPAN** settings listed in table 15. TI **MKR** frequency indications will be within limits specified in table 15.

Table 15. Frequency Readout Accuracy – 9 GHz

Signal generator frequency setting (GHz)	Test instrument		
	CENTER FREQ setting (GHz)	**SPAN** settings	**MKR** frequency indications (GHz)
			Min	Max
9	9	20 MHz	8.99895	9.00105
9	9	50 MHz	8.99745	9.00255
9	9	100 MHz	8.9948	9.0052
9	9	1 GHz	8.950	9.050

(19) Set signal generator frequency to 1.5 GHz.

(20) Press TI keys and enter values using **DATA** keys as listed in (a) through (c) below:

(a) **FREQUENCY** then **[CENTER FREQ]** to **1.5 GHz**.

(b) **SPAN** then **[SPAN]** to **1 MHz**.

(c) **MARKER FREQ COUNT** then **[COUNTER RES]** to **1 Hz**.

(21) Press **MARKER PEAK SEARCH** key. TI **MKR** frequency indication will be between 1.499999997 and 1.500000003 GHz.

(22) Repeat technique of (19) through (21) above for signal generator and TI settings listed in table 16. TI **MKR** frequency indication will be within limits specified in table 16.

Table 16. Frequency Count Marker Accuracy

Signal generator frequency settings (GHz)	Test instrument **CENTER FREQ** settings (GHz)	Test instrument **MKR** frequency indications (GHz)	
		Min	Max
4	4	3.999999997	4.000000003
9	9	8.999999995	9.000000005

b. Adjustments. Refer to paragraph **6. c.** above.

15. Frequency Span Accuracy

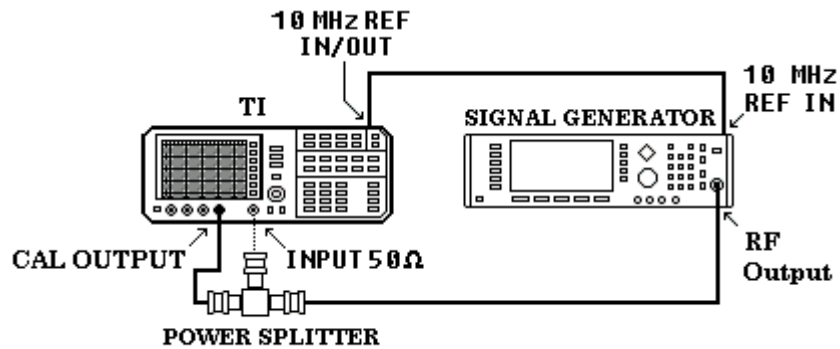**a. Performance Check**

(1) Connect equipment as shown in figure 4.

Figure 4. Frequency span accuracy - equipment setup.

(2) Press TI **INSTRUMENT STATE PRESET** key.

(3) Set signal generator frequency to 300.0008 MHz and level output to -15 dBm.

(4) Press TI keys and enter values using **DATA** keys as listed in (a) through (g) below:

    (a) **FREQUENCY** then **[CENTER FREQ]** to **300.0004 MHz**.

    (b) **SPAN** then **[SPAN]** to **1 kHz**.

    (c) **AMPLITUDE** then **[REF LEVEL]** to **-10 dBm**.

    (d) **INSTRUMENT STATE SGL SWP** wait for completion of new sweep.

    (e) **MARKER PEAK SEARCH**.

    (f) **[MARKER DELTA]**.

    (g) **[NEXT PEAK]**.

NOTE

The active and anchor markers should be on the signals near the second and tenth graticule lines (the left most graticule is the first graticule line on the display).

(5) TI Δ **MKR** indication will be between 792 and 808 Hz.

(6) Press TI **MARKER MKR** key then **[MARKERS OFF]** key.

(7) Repeat technique of (3) through (6) above for signal generator and TI settings listed in table 17. TI Δ **MKR** indications will be within limits specified in table 17.

Table 17. Frequency Span Accuracy

Signal generator	Test instrument			
Frequency settings (MHz)	CENTER FREQ settings (MHz)	SPAN settings	Δ MKR indications	
			Min	Max
300.0016	300.0008	2 kHz	1.584 kHz	1.616 kHz
300.004	300.002	5 kHz	3.96 kHz	4.04 kHz
300.008	300.004	10 kHz	7.92 kHz	8.08 kHz
300.016	300.008	20 kHz	15.84 kHz	16.16 kHz
300.04	300.02	50 kHz	39.6 kHz	40.4 kHz
300.08	300.04	100 kHz	79.2 kHz	80.8 kHz
300.16	300.08	200 kHz	158.4 kHz	161.6 kHz
300.4	300.2	500 kHz	396 kHz	404 kHz
300.8	300.4	1 MHz	792 kHz	808 kHz
301.6	300.8	2 MHz	1.584 MHz	1.616 MHz
304	302	5 MHz	3.8 MHz	4.2 MHz
308	304	10 MHz	7.6 MHz	8.4 MHz
316	308	20 MHz	15.2 MHz	16.8 MHz
340	320	50 MHz	38 MHz	42 MHz
380	340	100 MHz	76 MHz	84 MHz
460	380	200 MHz	152 MHz	168 MHz
700	500	500 MHz	380 MHz	420 MHz
1100	700	1 GHz	760 MHz	840 MHz
1900	1100	2 GHz	1.52 GHz	1.68 GHz

b. **Adjustments**. Refer to paragraph **6. c.** above.

16. **Frequency Response**

a. **Performance Check**

NOTE

Perform measuring receiver and sensor module (11792A) ZERO and CALIBRATE.
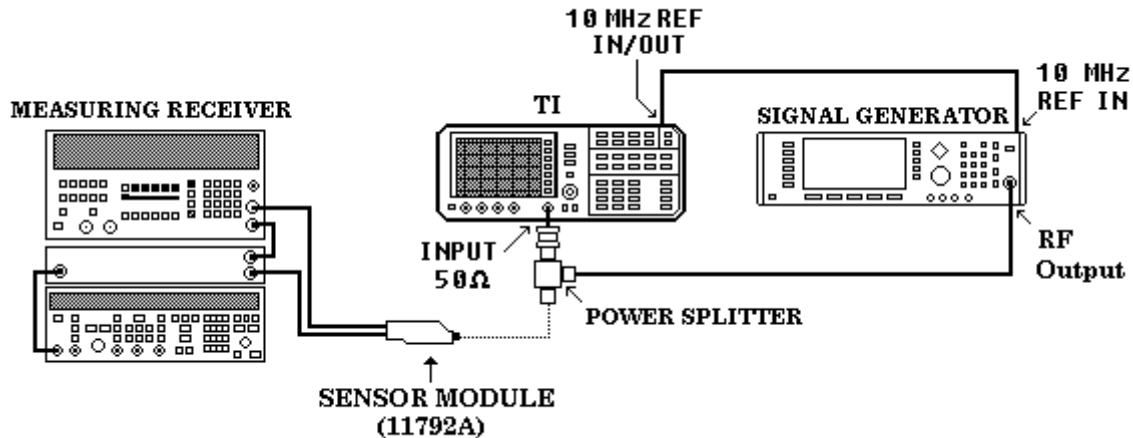
(1) Connect equipment as shown in figure 5.

Figure 5. Frequency response - equipment setup.

(2) Press TI keys and enter values using **DATA** keys as listed in (a) through (e) below:

(a) **INSTRUMENT STATE PRESET**.

(b) **FREQUENCY** then **[CENTER FREQ]** to **300 MHz**.

(c) **SPAN** then **[SPAN]** to **1 MHz**.

(d) **AMPLITUDE** then **[LOG dB/DIV]** to **2 dB/DIV**.

(e) **[MORE 1 OF 3]** then **[COUPLING AC DC]** to select **DC**.

(3) Set signal generator frequency to 300 MHz and level output to -5 dBm.

(4) Press TI **MARKER PEAK SEARCH** key.

(5) Set measuring receiver to measure RF power in dBm at 300 MHz.

(6) Adjust signal generator level output for a TI **MKR** amplitude indication between -9.95 and -10.05 dBm.

(7) Record measuring receiver indication.

(8) Set signal generator frequency to 13.2 GHz.

(9) Set measuring receiver to measure RF power in dBm at signal generator frequency.

(10) Press TI **FREQUENCY** key then **[CENTER FREQ]** key and enter **13.2 GHz** using **DATA** keys.

(11) Press **MARKER PEAK SEARCH** key.

(12) Adjust signal generator level output for a TI **MKR** amplitude indication between -9.95 and -10.05 dBm.

(13) Measuring receiver indication will be within ±2.9 dB of indication recorded in (7) above.

(14) Repeat (8) through (13) above for signal generator frequency and TI **CENTER FREQ** 12.5 GHz to 6.5 GHz settings listed in table 18.

(15) Repeat (8) through (12) above for signal generator frequency and TI **CENTER FREQ** 6.0 GHz to 3.0 GHz settings listed in table 18. Measuring receiver indication will be within ±2.5 dB of indication recorded in (7) above.

(16) Repeat (8) through (12) above for signal generator frequency and TI **CENTER FREQ** 2.5 GHz to 20.0 MHz settings listed in table 18. Measuring receiver indication will be within ±1.8 dB of indication recorded in (7) above.

Table 18. Frequency Response

Signal generator frequency and test instrument **CENTER FREQ** settings	
12.5	GHz
12.0	GHz
11.5	GHz
11.0	GHz
10.5	GHz
10.0	GHz
9.5	GHz
9.0	GHz
8.5	GHz
8.0	GHz
7.5	GHz
7.0	GHz
6.5	GHz
6.0	GHz
5.5	GHz
5.0	GHz
4.5	GHz
4.0	GHz
3.5	GHz
3.0	GHz
2.5	GHz
2.0	GHz
1.5	GHz
1.0	GHz
500	MHz
100	MHz
50	MHz
20	MHz

(17) Set signal generator frequency to 10 MHz.

(18) Set measuring receiver to measure RF power in dBm at 10 MHz.

(19) Press TI **FREQUENCY** key then **[CENTER FREQ]** key and enter **10 MHz** using **DATA** keys.

(20) Press TI **SPAN** key then **[SPAN]** key and enter **10 kHz** using **DATA** keys.

(21) Press **MARKER PEAK SEARCH** key.

(22) Adjust signal generator level output for a TI **MKR** amplitude indication between -9.95 and -10.05 dBm. Measuring receiver indication will be within ±1.8 dB of indication recorded in (7) above.

(23) Record measuring receiver indication.

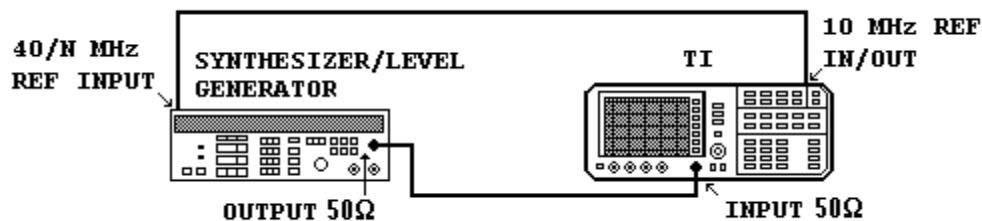(24) Connect equipment as shown in figure 6.

Figure 6. Frequency response - equipment setup.

(25) Press synthesizer/level generator keys to values as listed in (a) through (c) below:

    (a) **FREQUENCY** to **10 MHz**.

    (b) **AMPLITUDE** to **-4 dBm**.

    (c) **AMPTD INCR** to **0.1 dB**.

(26) Press TI **MARKER PEAK SEARCH** key.

(27) Slowly adjust synthesizer/level generator amplitude until TI **MKR** indication is as close as possible to measuring receiver indication recorded in (23) above.

(28) Set synthesizer/level generator frequency to 1 MHz.

(29) Press **FREQUENCY** key then **[CENTER FREQ]** key and enter **1 MHz** using **DATA** keys.

(30) Press **MARKER PEAK SEARCH** key.

(31) TI **MKR** indication will be within ±1.8 dB of measuring receiver indication recorded in (7) above.

(32) Repeat (28) through (31) above for synthesizer/level generator frequency and TI **CENTER FREQ** 100 kHz, 10 kHz, 1 kHz, 500 Hz and 200 Hz settings.

  b. Adjustments. Refer to paragraph **6. c.** above.

17. Residual Responses

  a. Performance Check

  (1) Connect TI **CAL OUTPUT** to **INPUT 50 Ω**.

  (2) Press TI keys and enter values using **DATA** keys as listed in (a) through (i) below:

    (a) **INSTRUMENT STATE PRESET**.

    (b) **FREQUENCY** then **[CENTER FREQ]** to **300 MHz**.

(c) **SPAN** then **[SPAN]** to **10 kHz**.

(d) **CONTROL BW** then **[RES BW]** to **300 Hz**.

(e) **AMPLITUDE** then **[REF LVL]** to **-10 dBm**.

(f) **[ATTEN]** to **0 dB**.

(g) **MARKER PEAK SEARCH**.

(h) **INSTRUMENT STATE CAL**.

(i) **[REF LVL ADJ]**.

(3) Slowly adjust TI knob until **MKR** amplitude indication is between -9.83 and -10.17 dBm.

(4) Press **[STORE REF LVL]** key.

(5) Disconnect TI **CAL OUTPUT** from **INPUT 50 Ω** and connect a 50 Ω termination to **INPUT 50 Ω.**

(6) Press TI keys and enter values using **DATA** keys as listed in (a) through (i) below:

(a) **INSTRUMENT STATE PRESET**.

(b) **FREQUENCY** then **[CENTER FREQ]** to **15.2 MHz**.

(c) **[CF STEP]** to **28.5 MHz**.

(d) **SPAN** then **[SPAN]** to **30 MHz**.

(e) **AMPLITUDE** then **[REF LVL]** to **-50 dBm**.

(f) **[ATTEN]** to **0 dB**.

(g) **CONTROL BW** then **[RES BW]** to **10 kHz**.

(h) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **SGL**.

(i) **CONTROL DISPLAY** then **[DISPLAY LINE]** to **-90 dBm**.

(7) Press TI **INSTRUMENT STATE SWP SGL** key and wait for completion of new sweep. The noise level will be at least 6 dB below the display line; if not, reduce **SPAN** and **RES BW** values to reduce noise level.

<div align="center">NOTE</div>

If **SPAN** is reduced, **CF STEP** reduction must be no more than 95 percent of the **SPAN**.

(8) If a residual is not present proceed to (13) below. If residual is suspected, press **INSTRUMENT STATE SWP SGL** key. Record the amplitude and frequency of any response above the display line.

<div align="center">NOTE</div>

Noise peak will not persist when **INSTRUMENT STATE SWP SGL** key is pressed. However a residual response will persist.

(9) If response is marginal, press TI keys as listed in (a) through (d) below:

(a) **INSTRUMENT STATE SAVE**.

(b) **[SAVE STATE]**.

      (c) **[STATE 0]**.

      (d) **MARKER MKR**.

(10) Position marker on peak of response in question and press TI keys as listed in (a) through (f) below:

      (a) **MARKER MKR→** then **[MARKER→ CF]**.

      (b) **SPAN** then **[SPAN]**.

      (c) **STEP ⇓** four times**.**

      (d) **CONTROL TRIG** then **[SWEEP CONT SGL]** to select **CONT**.

      (e) **MARKER PEAK SEARCH** then **[MARKER→ CF]**.

      (f) **CONTROL BW** then **[RES BW AUTO]**.

(11) Reduce **SPAN** and **RES BW** until **RES BW** is **300 Hz**. Record the frequency and amplitude of any residual response above the display line. Residual responses will be <-90 dBm.

(12) Press TI keys as listed in (a) through (c) below:

      (a) **INSTRUMENT STATE RECALL**.

      (b) **[RECALL STATE]**.

      (c) **[STATE 0]**.

(13) Press TI **FREQUENCY** key then **[CENTER FREQ]** key.

(14) Press **STEP ⇑** key.

(15) Repeat (7) through (14) above to check for residuals up to 2.9 GHz.

(16) Press TI **FREQUENCY** key then **[CENTER FREQ]** key and enter **2.915 GHz** using **DATA** keys and repeat (7) through (14) above to check residuals up to 6.46 GHz.

  b. Adjustments. No adjustments can be made.

18. 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:

Official:

                                  PETER J. SCHOOMAKER
                                  General, United States Army
                                  Chief of Staff

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

0332403

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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.