TECHNICAL MANUAL

CALIBRATION PROCEDURE

FOR

SIGNAL GENERATOR

3412, 3413, 3414, 3416

(IFR)

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SIGNAL GENERATOR

3412, 3413, 3414, 3416

(IFR)

1 CALIBRATION DESCRIPTION:

Table 1.

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Frequency Accuracy		
Reference Oscillator	Range: 10 MHz Accuracy: Accuracy: ±8 X 10^{-8}; *[1] Aging/year: <±8 X 10^{-8} after 30 days continuous use; Temperature: <±5 X 10^{-8} (0 to 50 °C) *[2]	Compared to a Frequency Standard
Display	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 Accuracy: ±1 count of LSD	Compared to a Universal Counter
RF Output (OPT 003)	Range: 3412: 250 kHz to 2 GHz, -140 to +13 dBm, ≤10 MHz; -140 to +16 dBm, >10 MHz to ≤2 GHz Accuracy: (at 23 ±5 °C) ≤2 GHz: -127 to -24 dBm, ±0.75 dB; >-24 dBm, ±0.5 dB Range: 3413: 250 kHz to 3 GHz, -140 to +13 dBm, ≤10 MHz; -140 to +16 dBm, >10 MHz to ≤3 GHz Accuracy: (at 23 ±5 °C) ≤2 GHz: -127 to -24 dBm, ±0.75 dB; >-24 dBm, ±0.5 dB ≤3 GHz: -127 to -24 dBm, ±1 dB; >-24 dBm, ±0.75 dB	Measured with a Microwave Measurement Receiver (MMR)

See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
RF Output (OPT 003) *(Cont.)*	Range: 3414: 250 kHz to 4 GHz, -140 to +13 dBm, ≤10 MHz; -140 to +16 dBm, >10 MHz to ≤3 GHz; -140 to +13 dBm, >3 to ≤3.75 GHz; -140 to +10 dBm, >3.75 to ≤4 GHz Accuracy: (at 23 ±5 °C) ≤2 GHz: -127 to -24 dBm, ±0.75 dB; >-24 dBm, ±0.5 dB ≤3 GHz: -127 to -24 dBm, ±1 dB; >-24 dBm, ±0.75 dB ≤4 GHz: -110 to -24 dBm, ±1.25 dB; >-24 dBm, ±1 dB Range: 3416: 250 kHz to 6 GHz, -140 to +13 dBm, ≤10 MHz; -140 to +16 dBm, >10 MHz to ≤3 GHz; -140 to +13 dBm, >3 to ≤3.75 GHz; -140 to +10 dBm, >3.75 to ≤4 GHz; -140 to +8 dBm, >4 to ≤6 GHz Accuracy: (at 23 ±5 °C) ≤2 GHz: -127 to -30 dBm, ±0.75 dB; >-30 dBm, ±0.5 dB ≤3 GHz: -127 to -30 dBm, ±1 dB; >-30 dBm, ±0.75 dB ≤6 GHz: -110 to -30 dBm, ±1.25 dB; >-30 dBm, ±1 dB	Measured with a MMR
Spectral Purity		Measured with a MMR Spectrum Analyzer
Harmonics	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 Accuracy: (≤+7 dBm in Noise and ACP RF modes) <-30 dBc	

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Spectral Purity *(Cont.)*		Measured with a MMR Spectrum Analyzer
Subharmonics and Nonharmonics	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414 Accuracy: (≤+7 dBm in Noise and ACP RF modes, >10 kHz offset) ≤375 MHz, <-60 dBc; ≤3 GHz, <-70 dBc; ≤4 GHz, <-60 dBc Range: 250 kHz to 6 GHz, 3416 Accuracy: (≤+7 dBm in Noise and ACP RF modes, >10 kHz offset) ≤3 GHz, <-70 dBc; ≤6 GHz, <-60 dBc	
Single Sideband Phase Noise	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 Accuracy: (at 20 kHz offset, Noise Optimized mode, CW) ≤375 MHz, <-115 dBc/Hz; 500 MHz, <-124 dBc/Hz; 1 GHz, <-118 dBc/Hz; 2 GHz, <-112 dBc/Hz; 3 GHz, <-108 dBc/Hz; 4 GHz, <-106 dBc/Hz; 6 GHz, <-102 dBc/Hz	Measured with a Phase Noise Measurement System
Residual FM	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 Accuracy: (at 1 GHz, 300 Hz to 3.4 kHz unweighted bandwidth) <4.5 Hz rms (3416, <2.5 Hz rms)	

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Wideband Noise	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 Accuracy: (at offsets >5 and <50 MHz excluding Thermal Noise) Power Mode: ≤375 MHz, <-138 dBc/Hz; ≤3 GHz, <-142 dBc/Hz; >3 to ≤6 GHz, <-136 dBc/Hz, 3416 Noise Mode: ≤375 MHz, <-138 dBc/Hz; ≤3 GHz, <-142 dBc/Hz; >3 to ≤6 GHz, <-136 dBc/Hz, 3416 ACP Mode: ≤375 MHz, <-135 dBc/Hz; ≤3 GHz, <-140 dBc/Hz; >3 to ≤6 GHz, <-134 dBc/Hz, 3416	Measured with a Phase Noise Measurement System
Amplitude Modulation		Measured with a MMR
Depth	Range: 2 MHz to 2 GHz, 0 to 99.9% Accuracy: (at 1 kHz rate) ±(4% of set depth + 1% AM excluding Residual AM)	
Distortion	Range: 2 MHz to 2 GHz, 0 to 99.9% Accuracy: (at 1 kHz rate) <1% THD for depths up to 30%; <2% THD for depths up to 80%	

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Frequency Modulation		Measured with a MMR
Deviation	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416, Maximum Peak Deviation: 250 kHz to 375 MHz, 7.5 MHz; 375 to 750 MHz, 3.75 MHz; 750 MHz to 1.5 GHz, 7.5 MHz; 1.5 to 3 GHz, 15 MHz; 3 to 6 GHz, 30 MHz Accuracy: (at 1 kHz rate) ±(4% of set deviation excluding Residual FM); 3416, ±(3% of set deviation excluding Residual FM)	
Distortion	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414 Accuracy (at 1 kHz rate) <0.2% THD for deviations up to 2% of maximum allowed deviation; <1% THD for deviations up to 20% of maximum allowed deviation; <3% THD at maximum deviation *[3] Range: 250 kHz to 6 GHz, 3416 Accuracy (at 1 kHz rate) <0.15% THD for deviations up to 2% of maximum allowed deviation; <0.6% THD for deviations up to 20% of maximum allowed deviation; <1.5% THD at maximum deviation *[3]	

See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Phase Modulation		
Deviation	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416, 0 to 10 rad Accuracy: (at 1 kHz rate) ±(4% of set deviation excluding Residual ϕM)	Measured with a MMR
Distortion	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 0 to 10 rad Accuracy: (at 1 kHz rate) <1% THD at 10 rad; 3416, <0.5% THD at 10 rad	
Internal Modulation Oscillator		
Frequency	Range: Sine: 0.1 Hz to 50 kHz (0.1 Hz to 16 MHz for TIs with OPT 005); Triangle: 0.1 Hz to 10 kHz (0.1 Hz to 2 MHz, 3416 OPT 005); Ramp: 0.1 Hz to 10 kHz (0.1 Hz to 2 MHz, 3416 OPT 005); Square: 0.1 Hz to 5 kHz (0.1 Hz to 1 MHz, 3416 OPT 005); Accuracy: Same as Reference Oscillator accuracy	Verified implicitly during Reference Oscillator calibration
Distortion	Range: Sine: 0.1 Hz to 50 kHz (0.1 Hz to 16 MHz for TIs with OPT 005) Accuracy: (Sinewave at 1 kHz) <0.1% THD	Measured with a MMR

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
IQ Modulation Bandwidth	Range: 250 kHz to 2 GHz, 3412; 250 kHz to 3 GHz, 3413; 250 kHz to 4 GHz, 3414; 250 kHz to 6 GHz, 3416 Accuracy: *[4] (in either ACP or Noise mode) DC to 5 MHz: ±0.5 dB; DC to 10 MHz: ±1 dB	Output measured with a MMR Spectrum Analyzer while a Signal Generator provides a known input

*[1] The accuracy is the manufacturers calculated specification after one year. The accuracy specification is found by multiplying the longest term aging rate by the appropriate time interval to obtain one year.

*[2] Typical or operational specification, not calibrated.

*[3] See step 3.6.

*[4] See step 3.7.

2 EQUIPMENT REQUIREMENTS:

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1 FREQUENCY STANDARD	Range: 10 MHz Accuracy: <2 X 10^{-8}	Arbiter 1083B	Austron 2100F
2.2 UNIVERSAL COUNTER	Range: 9.9 MHz to 1.1 GHz Accuracy: ±1 count of LSD	Agilent 53132A Opt 124	
2.3 MICROWAVE MEASUREMENT RECEIVER (MMR)	Range: -128 to 17 dB, 250 kHz to 6 GHz Accuracy: *[1] Relative Tuned RF Level: Residual Noise to Max power, ±(0.015 dB + 0.005 dB/10 dB); Minimum Power to Residual Noise Threshold, ±(Cumulative Error + 0.0012 X (Input Power - Residual Noise Threshold Power)^2); Range 2, ±0.031 dB; *[2] Range 3, ±0.031 dB *[3]	Agilent N5530SE26	

See footnotes at end of Equipment Requirements.

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.3 MICROWAVE MEASUREMENT RECEIVER (MMR) *(Cont.)*	Range: (Amplitude Modulation) 10.1 to 2 GHz 27 to 95% AM, 1 kHz rate Accuracy: AM: ±1.27% of rdg Distortion: <0.40% THD Range: (Frequency Modulation) 10.1 MHz to 6 GHz, 9 to 396 kHz, 1 kHz rate Accuracy: FM: ±1.0% of rdg 3416, TAR 3:1 Distortion: <0.10% THD Range: (Phase Modulation) 10.1 MHz to 6 GHz, 0.9 to 10.4 rad, 1 kHz rate Accuracy: PM: ±1.0% of rdg Distortion: <0.10% THD Range: (Audio Distortion) 1 kHz, 30% Accuracy: ±1 dB	Agilent N5530SE26	
2.3.1 POWER METER	Range: -1 to 17 dBm Accuracy: *[1, *4]	Agilent N1911A	
2.3.2 SENSOR MODULE	Range: 250 kHz to 4 GHz Accuracy: (all % are of charted value) ±2.4%, 250 to 300 kHz; ±2.1%, 300 kHz to 1 MHz; ±2.0%, 1 to 10 MHz; ±2.7%, 10 to 50 MHz; ±2.5%, 50 MHz to 2 GHz; ±2.6%, 2 to 4 GHz	Agilent N5532A-504	
2.3.3 SENSOR MODULE	Range: 4 to 6 GHz Accuracy: ±2.5% of charted value	Agilent N5532A-518	

See footnotes at end of Equipment Requirements.

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.3.4 SPECTRUM ANALYZER	Range: -128 to 17 dB, 250 kHz to 24 GHz Accuracy: Scale Fidelity: ±1.6 dB; Flatness: 375 MHz to 6 GHz, 1.5 dB relative *[5]	Agilent E4440A	
2.4 ATTENUATOR	Range: 250 kHz to 6 GHz, 20 dB Accuracy: N/A	Hewlett-Packard 8493C OPT 020	
2.5 PHASE NOISE MEASUREMENT SYSTEM	Range: 375 MHz to 6 GHz Accuracy: (Phase Noise) 20 kHz Offset, ±2 dB; 5 to 50 MHz Offset, ±4 dB; (Residual FM) ±2 dB TAR (worst case, Residual FM) 3.9:1	Hewlett-Packard E5504B	
2.6 SIGNAL GENERATOR	Range: 500 kHz to 10 MHz, 500 mV AC Accuracy: Flatness: *[5] 500 kHz to 5 MHz, ±0.15 dB; 5 to 10 MHz, ±0.3 dB	Agilent 33220A	

*[1] The worst case TAR of 1.3:1 is the result of the Microwave Measurement Receiver used to calibrate the TI RF Output Power for frequencies less than 3001 MHz.

*[2] This specification applies when the MMR enters Range 2. Range 2 is entered when the Range 1 Signal to Noise Ratio (SNR) falls between 50 and 28 dB. The SNR value is tuning dependent. Range 2 will be displayed on the MMR when the range is entered.

*[3] This specification, in addition to the Range 2 error, applies when the MMR enters Range 3. Range 3 is entered when the Range 2 SNR falls between 50 and 28 dB. The SNR value is tuning dependent. Range 3 will be displayed on the MMR when the range is entered.

*[4] MMR Power Meter Accuracy included in MMR Sensor Module Accuracy.

*[5] The TAR is the RSS (Root Sum Square) result of the MMR Spectrum Analyzer and Signal Generator accuracies. The worst case TAR for IQ Modulation Bandwidth is 1:1.

3 PRELIMINARY OPERATIONS:

3.1 Review and become familiar with the entire procedure before beginning the Calibration Process.

WARNING

Unless otherwise designated, and prior to beginning the Calibration Process, ensure that all test equipment voltage and /or current outputs are set to zero (0) or turned off, where applicable. Ensure that all equipment switches are set to the proper position before making connections or applying power. If not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

3.2 Connect test equipment to appropriate power source. Set all POWER switches to ON and allow warm-up as required by the manufacturer.

3.3 Connect TI to appropriate power source. Set TI O/I switch (rear panel) to I. Set the On/Off switch to On and allow a 20 minutes warm-up period except as noted below:

NOTE

The TI must have a 24 hour warm-up if it has been disconnected from the power source for less than 24 hours. If TI has been disconnected from the power source for 24 hours or more, the TI technically should be warmed up for 30 days. This may not be practical. Experience has shown that about 85% of new units and 95% of older units will be within specifications after a 24 hour warm-up. If TI fails the Frequency Accuracy and Display Calibration, the TI may be checked at 24 hour intervals up to the manufacturers stated warm-up time. If the TI passes the Frequency Accuracy and Display Calibration at any of these intermediate warm-up times, commence with the calibration. If the TI fails all intermediate intervals and after the manufacturers stated warm-up time, then perform the applicable maintenance actions for failure.

3.4 Throughout the procedure the Hardkeys will be in bold and upper case. The Softkeys (display keys) will be in Italics and upper case. Values shall be entered by use of the DATA key pad. For example: Press TI **SIG GEN**, then touch *LEV* and set to -10 dBm. The **SIG GEN** key is a Hardkey, the *LEV* is a Softkey (display key), the 1 and 0 are entries using the DATA key pad, and then push the MHz, -dBm key.

3.5 Press the TI **UTIL** key, then using the ↑ and ↓ keys, highlight SYSTEM. Press **4** on the keypad. Touch the *PRESET* tab at the bottom of the screen. Touch the *PRESET INSTRUMENT* , then press the **ENTER** key. Press the TI **MOD ON/OFF** to turn off the TI modulation. Press the TI **SOURCE ON/OFF** to turn off the TI source.

3.6 Due to the lack of standards, the Frequency Modulation Distortion at maximum deviation (<3% THD or <1.5% THD for 3416) is not calibrated. The maximum deviation verified is 380 kHz. Annotate and attach a Limited Certification Label accordingly.

3.7 Due to the lack of standards, the IQ Modulation Bandwidth is calibrated to an accuracy of ±1.55 dB. Annotate and attach a Limited Certification Label accordingly.

NOTE

Whenever a measurement is made with MMR at a carrier frequency of <20 MHz, the RF coupling must be set to DC. The 50 GHz MMR RF coupling is always DC. The 26.5 GHz MMR RF coupling must be set to DC.

3.8 When entering keystrokes and changing functions with the MMR, allow sufficient time for the unit to register the entries.

3.8.1 Set the MMR for the Factory Preset. Preset the MMR. Perform Align All Now.

3.8.2 On the MMR, press **INPUT/OUTPUT**, *RF Input,* and set *RF Coupling AC/DC* to *DC*.

3.9 Multiple firmware versions may exist for TIs covered by this Calibration Procedure. This may require variations of softkeys, menus, keystrokes, pathways, steps or etc. to achieve setting of the TI to the required state/configuration. These variations are permitted provided the required state/configuration is maintained. Technicians may need to consult the commercial data and become familiar with the softkeys, menus, keystrokes, pathways, steps or etc. to activate the exact TI state/configuration required by each respective step in the Calibration Procedure prior to performing the Calibration Process. These variations do not constitute changes required to the Calibration Procedure.

3.10 Perform only those portions of the Calibration Process that pertain to the TI being verified. The options covered in this Calibration Process are as follows:

OPT 003: Adds an Electronic Attenuator.

OPT 005: Adds a Dual-channel Arbitrary Waveform Generator.

4 CALIBRATION PROCESS:

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met, before proceeding.

4.1 FREQUENCY ACCURACY AND DISPLAY CALIBRATION:

NOTE

Adjustment of the Time Base Oscillator is normal due to the Aging Rate of the crystal. This is common to all Quartz Oscillators. The adjustment actions taken during this calibration will ensure the greatest reliability of the TI by adjusting the time base reference to the nominal value each time it is calibrated.

4.1.1 Connect Frequency Standard 10 MHz REF OUT to the Universal Counter REF IN.

4.1.2 Connect TI FREQ STD IN/OUT to the Universal Counter CHANNEL 1 input. Set Universal Counter for a 50 Ω input impedance. Ensure the Universal Counter is set for an external reference. Set Universal Counter for a frequency measurement and resolution to 0.1 Hz.

4.1.3 Press the TI **UTIL** key, then using the ↑ and ↓ keys, highlight SYSTEM, then touch *Ref. Oscillator* and *10 MHz Out* to turn on the Reference Oscillator.

NOTE

The values in the following step are derived from multiplication of the Aging Rate to determine the offset at one year. Use these calculated twelve month values regardless of the length of the calibration interval for this TI in T.O. 33K-1-100-1/2.

4.1.4 Adjust Universal Counter controls as required for a stable display indication. Verify Universal Counter indication is 9 999 999.2 to 10 000 000.8 Hz.

4.1.5 Disconnect test setup.

4.1.6 Connect equipment as shown in Figure 1. Set the Universal Counter resolution to 1 Hz.

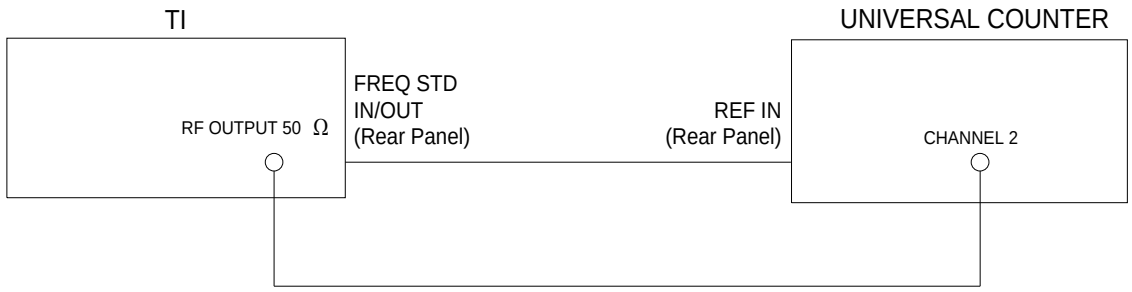


Figure 1.

4.1.7 Press the TI **SIG GEN** key, then touch *LEV* on the TI display and set to 0 dBm.

4.1.8 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied column of Table 2.

4.1.9 Verify the Universal Counter indication is within the values listed in the Limits column of Table 2.

4.1.10 Repeat steps 4.1.8 and 4.1.9 for the remaining corresponding values listed in Table 2.

Table 2.

Applied (Hz)	Limits (Hz)
111.111 111 M	111.111 110 to 111.111 112 M
222.222 222 M	222.222 221 to 222.222 223 M
333.333 333 M *	333.333 332 to 333.333 334 M
444.444 444 M	444.444 443 to 444.444 445 M
555.555 555 M	555.555 554 to 555.555 556 M
666.666 666 M	666.666 665 to 666.666 667 M
777.777 777 M	777.777 776 to 777.777 778 M
888.888 888 M	888.888 887 to 888.888 889 M
999.999 999 M	999.999998 M to 1.000000000 G
1.000 000 000 G	999.999999 M to 1.000000001 G

* Connect the TI RF OUTPUT 50 Ω to the Universal Counter CHANNEL 3 input.

4.1.11 Set TI **RF ON/OFF** to OFF and disconnect test setup.

4.1.12 To ensure reliability of the TI, the following action will be taken: If TI passed the above steps, perform the applicable adjustment steps in the Commercial Data and enter the applicable code into the Maintenance Data Collection System. If TI failed, perform the applicable steps listed in Commercial Data and enter the applicable code into the Maintenance Data Collection System.

4.2 RF OUTPUT CALIBRATION:

4.2.1 Connect the MMR Sensor Module (2.3.2) to the MMR Power Meter REF connector.

4.2.2 Connect the MMR Spectrum Analyzer 10 MHz OUT (SWITCHED) to the TI FREQ STD IN/OUT (rear panel).

4.2.3 Press the TI **UTIL** key, then using the ↑ and ↓ keys, highlight SYSTEM, then touch *Ref. Oscillator* and *Ext Ref.* Press *10 MHz Indirect* to use an external reference.

4.2.4 Set the MMR controls, as required, to provide a 10 MHz Timebase output.

4.2.5 Set the MMR to Measuring Receiver mode. Load the MMR Sensor Module (2.3.2) Cal Factors into the MMR and standardize the MMR for power measurements.

4.2.6 Connect MMR Sensor Module (2.3.2) to the TI RF OUTPUT 50 Ω connector.

4.2.7 Press the TI **SIG GEN** key. Set the TI **RF ON/OFF** to ON.

4.2.8 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied Frequency column of Table 3.

4.2.9 Touch the TI *LEV* on the TI display and set to the first value listed in the Applied Level column of Table 3 for the frequency being verified.

4.2.10 Set the MMR to measure RF Power at the TI Frequency. Allow the MMR indication to settle. Verify the MMR RF Power indication is within the corresponding values listed in the Limits column of Table 3.

4.2.11 Touch the TI *LEV* on the TI display and set to the next value listed in the Applied Level column of Table 3 for the frequency being verified.

4.2.12 Allow the MMR indication to settle. Verify the MMR RF Power indication is within the values listed in the Limits column of Table 3.

4.2.13 Repeat steps 4.2.11 and 4.2.12 for the remaining values listed in the Applied Level column of Table 3 for the frequency being verified. Record the MMR RF Power indication at 0.0 dBm, where indicated.

4.2.14 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied Frequency column of Table 3.

4.2.15 Repeat steps 4.2.9 through 4.2.13.

4.2.16 Repeat step 4.2.14 and 4.2.15, as required, for the remaining frequencies in Table 3 up to and including 4000 MHz.

4.2.17 Set the TI **RF ON/OFF** to OFF.

4.2.18 Disconnect the MMR Sensor Module (2.3.2) from the TI RF OUTPUT 50 Ω connector.

4.2.19 Connect the MMR Sensor Module (2.3.3) to the MMR Power Meter REF Connector. Load the MMR Sensor Module (2.3.3) Cal Factors into the MMR and standardize the MMR for power measurements.

4.2.20 Connect MMR Sensor Module (2.3.3) to the TI RF OUTPUT 50 Ω connector.

4.2.21 Set the TI **RF ON/OFF** to ON. Touch the TI *FREQ* on the TI display and set to 6000 MHz. Repeat steps 4.2.9 through 4.2.13 for the remaining values of Table 3.

Table 3.

Applied Frequency (Hz)	Level (dBm)	Limits (dBm)
250 k	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0	-0.5 to +0.5
1 M	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0	-0.5 to +0.5
10.1 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5
137.5 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5
237.5 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5

See footnotes at end of Table.

Table 3. (Cont.)

Applied Frequency (Hz)	Level (dBm)	Limits (dBm)
562.5 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5
1012.5 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5
1537.5 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5
2000 M	+16	+15.5 to +16.5
	+13	+12.5 to +13.5
	+10	+9.5 to +10.5
	+7	+6.5 to +7.5
	0 *[1]	-0.5 to +0.5
2001 M *[2]	+16	+15.25 to +16.75
	+13	+12.25 to +13.75
	+10	+9.25 to +10.75
	+7	+6.25 to +7.75
	0 *[1]	-0.75 to +0.75

See footnotes at end of Table.

Table 3. (Cont.)

Applied Frequency (Hz)	Level (dBm)	Limits (dBm)
2512.5 M *2	+16	+15.25 to +16.75
	+13	+12.25 to +13.75
	+10	+9.25 to +10.75
	+7	+6.25 to +7.75
	0 *1	-0.75 to +0.75
3000 M *2	+16	+15.25 to +16.75
	+13	+12.25 to +13.75
	+10	+9.25 to +10.75
	+7	+6.25 to +7.75
	0 *1	-0.75 to +0.75
3001 M *3	+13	+12 to +14
	+10	+9 to +11
	+7	+6 to +8
	0 *1	-1 to +1
3755 M *3	+10	+9 to +11
	+7	+6 to +8
	0 *1	-1 to +1
4000 M *3	+10	+9 to +11
	+7	+6 to +8
	0 *1	-1 to +1
6000 M *4	+8	+7 to +9
	0 *1	-1 to +1

*1 Record MMR RF Power indication.

*2 Disregard for 3412.

*3 For 3414 and 3416 only.

*4 For 3416 only.

4.2.22 Set the TI **RF ON/OFF** to OFF and disconnect test setup.

4.2.23 Connect TI RF OUTPUT 50 Ω to the MMR RF INPUT 50 Ω.

4.2.24 Set the TI **RF ON/OFF** to ON. Touch the TI *FREQ* on the TI display and set to 10.1 MHz.

4.2.25 Touch the TI *LEV* on the TI display and set to 0.0 dBm.

4.2.26 Set the MMR to make a Tuned RF Level measurement in High Accuracy mode at TI frequency.

NOTE

For Tuned RF Level measurements do not change the signal level during the Range 2 Switch Level Cal Factor and Range 3 Switch Level Cal Factor calibration. Wait for the red calibrating message to disappear before continuing. Use this method throughout the Calibration Process when making Tuned RF Level measurements.

4.2.27 Set the MMR to Set Ref. Allow the MMR Spectrum Analyzer indication to settle. Set the MMR Ext RF Atten to the value recorded in step 4.2.13 for the frequency being verified.

4.2.28 Touch the TI *LEV* and set to the next value listed in the Applied column of Table 4.

4.2.29 Allow the MMR indication to settle. Verify the MMR RF Power indication is within the corresponding values listed in the Limits column of Table 4.

4.2.30 Repeat steps 4.2.28 and 4.2.29 for the remaining values listed in Table 4.

Table 4.

Applied (dBm)	Limits (dBm)
0.0	Reference
-10.0	-10.5 to -9.5
-20.0	-20.5 to -19.5
-30.0	-30.75 to -29.25
-40.0	-40.75 to -39.25
-50.0	-50.75 to -49.25
-60.0	-60.75 to -59.25
-70.0	-70.75 to -69.25
-80.0	-80.75 to -79.25
-90.0	-90.75 to -89.25
-100.0	-100.75 to -99.25

Table 4. (Cont.)

Applied (dBm)	Limits (dBm)
-110.0	-110.75 to -109.25
-120.0	-120.75 to -119.25
-127.0	-127.75 to -126.25

4.2.31 Set the MMR Ext RF Atten to 0.0 dB.

4.2.32 Repeat steps 4.2.24 through 4.2.31, as required, for frequencies of 137.5, 237.5, 562.5, 1012.5, 1537.5 and 2000 MHz.

4.2.33 If TI is 3412 proceed to step 4.2.46. Otherwise continue with step 4.2.34.

4.2.34 Touch the TI *FREQ* on the TI display and set to 2001 MHz.

4.2.35 Touch the TI *LEV* on the TI display and set to 0.0 dBm.

4.2.36 Set the MMR to Set Ref. Allow the MMR Spectrum Analyzer indication to settle. Set the MMR Ext RF Atten to the value recorded in step 4.2.13 for the frequency being verified.

4.2.37 Touch the TI *LEV* and set to the next value listed in the Applied column of Table 5.

4.2.38 Allow the MMR indication to settle. Verify the MMR RF Power indication is within the corresponding values listed in the appropriate Limits column of Table 5 for the frequency and TI being verified.

4.2.39 Repeat steps 4.2.37 and 4.2.38 for the remaining values listed in Table 5.

Table 5.

	Limits (dBm)	
Applied (dBm)	**2001 to 3000 GHz**	**3001 to 6000 GHz**
0.0	Reference	Reference
-10.0	-10.75 to -9.25	-11 to -9
-20.0	-20.75 to -19.25	-21 to -19
-30.0	-31.0 to -29.0	-31.25 to -28.75
-40.0	-41.0 to -39.0	-41.25 to -38.75
-50.0	-51.0 to -49.0	-51.25 to -48.75
-60.0	-61.0 to -59.0	-61.25 to -58.75
-70.0	-71.0 to -69.0	-71.25 to -68.75
-80.0	-81.0 to -79.0	-81.25 to -78.75
-90.0	-91.0 to -89.0	-91.25 to -88.75
-100.0	-101.0 to -99.0	-101.25 to -98.75

Table 5 (Cont.)

Applied (dBm)	Limits (dBm) 2001 to 3000 GHz	3001 to 6000 GHz
-110.0	-111.0 to -109.0	-111.25 to -108.75
-120.0	-121.0 to -119.0	N/A
-127.0	-128.0 to -126.0	N/A

4.2.40 Set the MMR Ext RF Atten to 0.0 dB.

4.2.41 Repeat steps 4.2.34 through 4.2.40 at 2512.5 and 3000 MHz.

4.2.42 If TI is 3413, proceed to step 4.2.46. Otherwise continue with step 4.2.43.

4.2.43 Repeat steps 4.2.34 through 4.2.40 at 3001, 3755 and 4000 MHz.

4.2.44 If TI is 3414, proceed to step 4.2.46. Otherwise continue with step 4.2.45.

4.2.45 Repeat steps 4.2.34 through 4.2.40 at 6000 MHz.

4.2.46 Press the TI **UTIL** key, then using the ↑ and ↓ keys, highlight SYSTEM, then touch *Ref. Oscillator* and *10 MHz Out* to turn on the Reference Oscillator.

4.2.47 Set TI **RF ON/OFF** to OFF and disconnect test setup.

4.3 SPECTRAL PURITY CALIBRATION:

4.3.1 Connect the TI RF OUTPUT 50 Ω through the Attenuator to the MMR Spectrum Analyzer RF INPUT 50 Ω.

4.3.2 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied column of Table 6.

4.3.3 Touch the TI *LEV* on the TI display and set to +7 dBm. Touch the TI *RF MODE* on the TI display and set to *NOISE*. Set the TI **RF ON/OFF** to ON.

4.3.4 Set the MMR Spectrum Analyzer controls to view the carrier. Set the MMR Spectrum Analyzer control to place the peak of the carrier at a convenient reference level.

4.3.5 Set the MMR Spectrum Analyzer controls as required to measure four harmonics.

4.3.6 Verify the amplitude of any harmonic signal level is within the value listed in the Limits column of Table 6.

4.3.7 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied column of Table 6. Repeat steps 4.3.4 through 4.3.6.

4.3.8 Repeat step 4.3.7 for the remaining corresponding values listed in Table 6, depending on the TI being verified.

Table 6.

Applied (Hz)	Limits (dBc)
250 k	<-30
11 M	<-30

Table 6. (Cont.)

Applied (Hz)	Limits (dBc)
137.5 M	<-30
237.5 M	<-30
562.5 M	<-30
1012.5 M	<-30
1537.5 M	<-30
2000 M	<-30
2512.5 M *[1]	<-30
3000 M *[1]	<-30
3750 M *[2]	<-30
4000 M *[2]	<-30
6000 M *[3]	<-30

*[1] Disregard for 3412.

*[2] For 3414 and 3416 only.

*[3] For 3416 only.

4.3.9 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied column of Table 7.

4.3.10 Set the MMR Spectrum Analyzer controls to view the carrier. Set the MMR Spectrum Analyzer control to place the peak of the carrier at a convenient reference level.

4.3.11 Set the MMR Spectrum Analyzer controls as required to measure any nonharmonic signal level >10 kHz offset from carrier.

4.3.12 Verify the amplitude of any nonharmonic signal level is within the value listed in the Limits column of Table 7.

4.3.13 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied column of Table 7. Repeat steps 4.3.10 through 4.3.12.

4.3.14 Repeat step 4.3.13 for the remaining corresponding values listed in Table 7, depending on TI being verified.

Table 7.

Applied (Hz)	Limits (dBc) *[1]
250 k	<-60 (<-70)
11 M	<-60 (<-70)
137.5 M	<-60 (<-70)
237.5 M	<-60 (<-70)
562.5 M	<-70
1012.5 M	<-70
1537.5 M	<-70
2000 M	<-70
2512.5 M *[2]	<-70
3000 M *[2]	<-70
3750 M *[3]	<-60
4000 M *[3]	<-60
6000 M *[4]	<-60

*[1] Values in parenthesis for 3416 only.

*[2] Disregard for 3412.

*[3] For 3414 and 3416 only.

*[4] For 3416 only.

4.3.15 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied column of Table 8.

4.3.16 Set the MMR Spectrum Analyzer controls to view the carrier. Set the MMR Spectrum Analyzer control to place the peak of the carrier at a convenient reference level.

4.3.17 Set the MMR Spectrum Analyzer controls as required to measure any subharmonic signal level.

4.3.18 Verify the amplitude of any subharmonic signal level is within the value listed in the Limits column of Table 8.

4.3.19 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied column of Table 8. Repeat steps 4.3.16 through 4.3.18.

4.3.20 Repeat step 4.3.19 for the remaining corresponding values listed in Table 8, depending on TI being verified.

Table 8.

Applied (Hz)	Limits (dBc) *[1]
250 k	<-60 (<-70)
11 M	<-60 (<-70)
137.5 M	<-60 (<-70)
237.5 M	<-60 (<-70)
562.5 M	<-70
1012.5 M	<-70
1537.5 M	<-70
2000 M	<-70
2512.5 M *[2]	<-70
3000 M *[2]	<-70
3750 M *[3]	<-60
4000 M *[3]	<-60
6000 M *[4]	<-60

*[1] Values in parenthesis for 3416 only.

*[2] Disregard for 3412.

*[3] For 3414 and 3416 only.

*[4] For 3416 only.

4.3.21 Set the TI **RF ON/OFF** to OFF and disconnect test setup.

4.4 SINGLE SIDEBAND PHASE NOISE, RESIDUAL FM AND WIDEBAND NOISE CALIBRATION:

CAUTION

Do not connect outputs of Phase Noise Measurement System Reference Source or TI to the Inputs of the Phase Noise Measurement System until instructed to do so. Damage to the Phase Noise Measurement System can result if Reference Source or TI output power is applied to the system before the internal attenuators are set. If not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

4.4.1 Touch the TI *FREQ* on the TI display and set to 375 MHz.

4.4.2 Touch the TI *LEV* on the TI display and set to +7 dBm.

4.4.3 Verify the Phase Noise Measurement System is using the current Software Package CPIN number 88M-E5504B/NOISE-F001-01A, with the latest revision, as per ACPINS. The Desktop should be present on the screen when the computer is turned on.

4.4.4 Access the Phase Noise Calibration Program.

4.4.5 Select Define, then select Measurement.

4.4.6 On Phase Noise Measurement System select Preset. Select Yes. Set Offset Frequency Range Start Offset to 10 Hz and Stop Offset to 100 E+3.

4.4.7 On Phase Noise Measurement System select Sources. Select Preset. Select Yes. Set the following:

Carrier Source	
Frequency	375E+6 Hz
Power	7 dBm
Reference Source	
Power	16 dBm
VCO Tuning Parameters	
Nominal Tune Constant	10E+3
Tune Range +/-	5 Volts
Input Resistance	600 Ohms

4.4.8 On Phase Noise Measurement System select Cal. Select Preset. Select Yes. Select VCO Tune Constant Calculate from expected VCO tune constant using tune port resistance. De-select Verify calculated phase locked loop suppression.

4.4.9 On Phase Noise Measurement System select Block Diagram. Select Preset. Select Yes. Select Downconverter System Control. Select VCO Tune Mode DC FM and Reference Source Agilent/HP 8664A.

4.4.10 On Phase Noise Measurement System select Test Set. Select Preset. Select Yes. Set LNA Low Pass Filter to 200 kHz and de-select Auto.

4.4.11 On Phase Noise Measurement System select Graph. Select Preset. Select Yes. Enter graph title as appropriate for the set-up. Set X Scale Minimum to 10 Hz. Select Close.

4.4.12 On Phase Noise Measurement System select Measure. Select New Measurement. Select Yes when prompted to perform a new calibration and measurement.

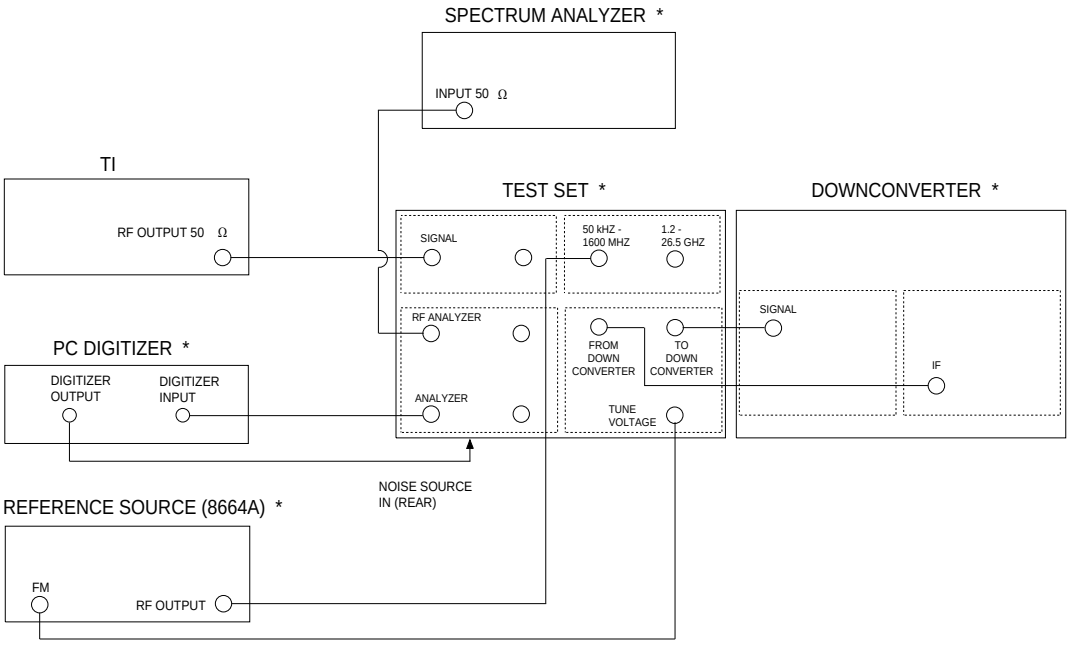
CAUTION

PC Digitizer (P/O Phase Noise Measurement System) INPUT and OUTPUT connectors are fragile. Damage can occur to the PC Digitizer INPUT and OUTPUT connectors and cables while connected if tension is applied. If not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

4.4.13 Connect equipment as shown in Figure 2. Set the TI **RF ON/OFF** to ON.

4.4.14 When Verify Connections diagram appears on screen, ignore on-screen diagram and select Continue.

4.4.15 The Phase Noise Plot at 20 kHz offset must be within the specifications in Table 1 for Single Sideband Phase Noise. If desired, the Marker icon may be used to obtain specific offset frequencies and corresponding phase noise measurements on the graph.



* P/O Phase Noise Measurement System.

Figure 2.

4.4.16 On Phase Noise Measurement System select Define, then select Measurement.

4.4.17 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 500E+6.

4.4.18 Touch the TI *FREQ* on the TI display and set to 500 MHz.

4.4.19 Repeat steps 4.4.11 through 4.4.15 for 500 MHz.

4.4.20 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 1.0E+9.

4.4.21 Touch the TI *FREQ* on the TI display and set to 1.0 GHz.

4.4.22 Repeat steps 4.4.11 through 4.4.15 for 1.0 GHz.

4.4.23 On Phase Noise Measurement System select Analyze, then select Trace Integration.

4.4.24 From the Trace Integration screen, set the Data Type to Snu(f) (Spectral density of frequency fluctuations). Set the Data to Integrate to Noise. Set the Start Offset to 300 Hz and Stop Offset to 3.4E+3. Select Integrate.

4.4.25 Verify the Value of Definite Integral is <4.5 Hz rms or <2.5 Hz rms for 3416.

4.4.26 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 2.0E+9.

4.4.27 Touch the TI *FREQ* on the TI display and set to 2.0 GHz.

4.4.28 Repeat steps 4.4.11 through 4.4.15 for 2.0 GHz.

4.4.29 If TI is 3412, proceed to step 4.4.41. Otherwise continue with step 4.4.30.

4.4.30 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 3.0E+9.

4.4.31 Touch the TI *FREQ* on the TI display and set to 3.0 GHz.

4.4.32 Repeat steps 4.4.11 through 4.4.15 for 3.0 GHz.

4.4.33 If TI is 3413, proceed to step 4.4.41. Otherwise continue with step 4.4.34.

4.4.34 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 4.0E+9.

4.4.35 Touch the TI *FREQ* on the TI display and set to 4.0 GHz.

4.4.36 Repeat steps 4.4.11 through 4.4.15 for 4.0 GHz.

4.4.37 If TI is 3414, proceed to step 4.4.41. Otherwise continue with step 4.4.38.

4.4.38 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 6.0E+9.

4.4.39 Touch the TI *FREQ* on the TI display and set to 6.0 GHz.

4.4.40 Repeat steps 4.4.11 through 4.4.15 for 6.0 GHz.

4.4.41 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 375E+6.

4.4.42 Touch the TI *FREQ* on the TI display and set to 375 MHz.

4.4.43 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *POWER*.

4.4.44 On Phase Noise Measurement System select Test Set. Set LNA Low Pass Filter to 100 MHz.

4.4.45 On Phase Noise Measurement System select Range and Type. Set the Offset Frequency Start Offset to 5.1E+6 and Stop Offset to 49.9E+6.

4.4.46 On Phase Noise Measurement System select Graph. Select Preset. Select Yes. Enter graph title as appropriate. Set X Scale Minimum to 5.1 MHz and Maximum to 49.9E+6. Select Close.

4.4.47 Repeat steps 4.4.12 through 4.4.14.

4.4.48 The Phase Noise Plot at offsets >5 and <50 MHz must <-138 dBc/Hz. If desired, the Marker icon may be used to obtain specific offset frequencies and corresponding phase noise measurements on the graph.

4.4.49 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *NOISE*. Repeat steps 4.4.47 and 4.4.48.

4.4.50 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *ACP*. Repeat step 4.4.47 and 4.4.48 except in step 4.4.48, the Phase Noise Plot at offsets >5 and <50 MHz must <-135 dBc/Hz.

4.4.51 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 2.0E+9.

4.4.52 Touch the TI *FREQ* on the TI display and set to 2.0 GHz.

4.4.53 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *POWER*.

4.4.54 Repeat steps 4.4.12 through 4.4.14.

4.4.55 The Phase Noise Plot at offsets >5 and <50 MHz must <-142 dBc/Hz. If desired, the Marker icon may be used to obtain specific offset frequencies and corresponding phase noise measurements on the graph.

4.4.56 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *NOISE*. Repeat steps 4.4.54 and 4.4.55.

4.4.57 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *ACP*. Repeat step 4.4.54 and 4.4.55 except in step 4.4.55, the Phase Noise Plot at offsets >5 and <50 MHz must <-140 dBc/Hz.

4.4.58 If TI is 3412, 3413 or 3414, proceed to step 4.4.66. Otherwise continue with step 4.4.59.

4.4.59 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to 5.0E+9.

4.4.60 Touch the TI *FREQ* on the TI display and set to 5.0 GHz.

4.4.61 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *POWER*.

4.4.62 Repeat steps 4.4.12 through 4.4.14.

4.4.63 The Phase Noise Plot at offsets >5 and <50 MHz must <-136 dBc/Hz. If desired, the Marker icon may be used to obtain specific offset frequencies and corresponding phase noise measurements on the graph.

4.4.64 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *NOISE*. Repeat steps 4.4.62 and 4.4.63.

4.4.65 Touch the TI *LEV* on the TI display , then touch the TI *RF MODE* on the TI display and set to *ACP*. Repeat step 4.4.62 and 4.4.63 except in step 4.4.63, the Phase Noise Plot at offsets >5 and <50 MHz must <-134 dBc/Hz.

4.4.66 Set the TI **RF ON/OFF** to OFF and disconnect test setup.

4.5 AMPLITUDE MODULATION CALIBRATION:

4.5.1 Connect TI RF OUTPUT 50 Ω to the MMR RF INPUT 50 Ω.

4.5.2 Touch the TI *LEV* on the TI display and set to +7 dBm. Touch the TI *RF MODE* on the TI display and set to *NOISE*. Set the TI **RF ON/OFF** to ON.

4.5.3 Press the TI **ANALOG MOD** key. Touch *AM*, then touch *INT AM1*. Press the **SIG GEN** key. Touch *INT* and set to 1 kHz. Press the TI  key.

4.5.4 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied Frequency column of Table 9.

4.5.5 Touch TI *AM1* and set to the first value listed in the Applied Depth column of Table 9 for the frequency being verified.

4.5.6 Set MMR to Measuring Receiver mode at the TI Frequency.

4.5.7 Set the MMR controls, as required, to measure AM Depth. Set High Pass Filter to 300 Hz, Low Pass Filter to 3 kHz and the Detector to Peak +-/2.

4.5.8 Allow the MMR AM Depth indication to settle. Verify the MMR AM Depth indication is within the corresponding values listed in the Limits Depth column of Table 9.

4.5.9 Set the MMR High Pass Filter and Low Pass Filter to None.

4.5.10 Verify the MMR AM Mod Distortion indication is within the corresponding value listed in the Limits Distortion column of Table 9, if applicable.

4.5.11 Set the TI Depth to the next value listed in the Applied Depth column of Table 9.

4.5.12 Repeat steps 4.5.7 through 4.5.11, as required, for the remaining values listed in Table 9 for the frequency being verified.

4.5.13 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied Frequency column of Table 9.

4.5.14 Touch TI *AM1* and set to the first value listed in the Applied Depth column of Table 9 for the frequency being verified.

4.5.15 Set the MMR Frequency to the TI carrier frequency. Restart the MMR.

4.5.16 Repeat steps 4.5.7 through 4.5.12.

4.5.17 Repeat steps 4.5.13 through 4.5.16 for the remaining values of Table 9.

Table 9.

Applied		Limits	
Frequency (MHz)	**Depth (%)**	**Depth (%)**	**Distortion (%)**
10.1	30.0	27.8 to 32.2	<1
	50.0	47.0 to 53.0	<2
	90.0	85.4 to 94.6	N/A
100	30.0	27.8 to 32.2	<1
	50.0	47.0 to 53.0	<2
	90.0	85.4 to 94.6	N/A
500	30.0	27.8 to 32.2	<1
	50.0	47.0 to 53.0	<2
	90.0	85.4 to 94.6	N/A
1000	30.0	27.8 to 32.2	<1
	50.0	47.0 to 53.0	<2
	90.0	85.4 to 94.6	N/A
2000	30.0	27.8 to 32.2	<1
	50.0	47.0 to 53.0	<2
	90.0	85.4 to 94.6	N/A

4.5.17 Press the TI **ANALOG MOD** key, then touch *NO AM*.

4.5.18 Set the TI **RF ON/OFF** to OFF and leave test setup connected.

4.6 FREQUENCY MODULATION CALIBRATION:

4.6.1 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied Frequency column of Table 10.

4.6.2 Touch the TI *LEV* on the TI display and set to +7 dBm. Set the TI **RF ON/OFF** to ON.

4.6.3 Press the TI **ANALOG MOD** key. Touch *FM*, then touch *INT FM1*. Press the **SIG GEN** key. Touch *INT* and set to 1 kHz. Press the TI key.

4.6.4 Touch the TI *FM1* and set to the first value listed in the Applied Deviation column of Table 10.

4.6.5 Set the MMR Frequency to the TI frequency.

4.6.6 Set the MMR controls, as required, to measure FM Deviation. Set High Pass Filter to 300 Hz, Low Pass Filter to 3 kHz and Detector to Peak +.

4.6.7 Verify the MMR FM Deviation indication is within the corresponding values listed in the Limits Deviation column of Table 10.

4.6.8 Set the MMR High Pass Filter and Low Pass Filter to None.

4.6.9 Verify the MMR FM Mod Distortion indication is within the corresponding value listed in the Limits Distortion column of Table 10.

4.6.10 Touch the TI *FM1* and set to the next value listed in the Applied Deviation column of Table 10.

4.6.11 Repeat steps 4.6.6. through 4.6.10, as required, for the remaining values in the Applied Deviation column of Table 10 for the frequency being verified.

4.6.12 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied Frequency column of Table 10.

4.6.13 Touch the TI *FM1* and set to the first value listed in the Applied Deviation column of Table 10 for the frequency being verified.

4.6.14 Set the MMR Frequency to the TI carrier frequency. Restart the MMR.

4.6.15 Repeat steps 4.6.6 through 4.6.11.

4.6.16 Repeat steps 4.6.12 through 4.6.15 for the remaining values of Table 10.

Table 10.

Applied		Limits	
Frequency (MHz)	**Deviation (kHz)**	**Deviation (kHz) *[1]**	**Distortion (%) *[1]**
10.1	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<0.2 (<0.15)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<1.0 (<0.6)

See footnotes at end of Table.

Table 10. (Cont.)

Applied		Limits	
Frequency (MHz)	**Deviation (kHz)**	**Deviation (kHz) *[1]**	**Distortion (%) *[1]**
100	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<0.2 (<0.15)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<1.0 (<0.6)
500	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<1.0 (<0.6)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<1.0 (<0.6)
1000	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<0.2 (<0.15)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<1.0 (<0.6)
2000	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<0.2 (<0.15)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<1.0 (<0.6)
3000 *[2]	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<0.2 (<0.15)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<1.0 (<0.15)
4000 *[3]	10.0	9.60 to 10.40 (9.70 to 10.30)	<0.2 (<0.15)
	100.0	96.0 to 104.0 (97.0 to 103.0)	<0.2 (<0.15)
	380.0	364.8 to 395.2 (368.6 to 391.4)	<0.2 (<0.15)
6000 *[4]	10.0	N/A (9.70 to 10.30)	N/A (<0.15)
	100.0	N/A (97.0 to 103.0)	N/A (<0.15)
	380.0	N/A (368.6 to 391.4)	N/A (<0.15)

*[1] Values in parenthesis for 3416 only.

*[2] Disregard for 3412.

*[3] For 3414 and 3416 only.

*[4] For 3416 only.

4.6.17 Press the TI **ANALOG MOD** key, then touch *NO FM*.

4.6.18 Set the TI **RF ON/OFF** to OFF and leave test setup connected.

4.7 PHASE MODULATION CALIBRATION:

4.7.1 Set the MMR to Measuring Receiver mode.

4.7.2 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied Frequency column of Table 11. Touch the TI *LEV* on the TI display and set to +7 dBm. Set the TI **RF ON/OFF** to ON. Press the TI **ANALOG MOD** key. Touch ϕ*M*, then touch *INT* ϕ*M1*. Press the **SIG GEN** key. Touch *INT* and set to 1 kHz. Press the TI ⊠ key.

4.7.3 Touch the TI ϕ*M1* and set to the first value listed in the Applied Deviation column of Table 11.

4.7.4 Set the MMR Frequency to the TI frequency.

4.7.5 Set the MMR controls, as required to measure PM Deviation. Set High Pass Filter to 300 Hz, Low Pass Filter to 3 kHz, and Detector to Peak +.

4.7.6 Verify the MMR PM Deviation indication is within the corresponding values listed in the Limits Depth column of Table 11.

4.7.7 Set the MMR High Pass Filter and Low Pass Filter to None.

4.7.8 Verify the MMR PM Mod Distortion indication is within the corresponding value listed in the Limits Distortion column of Table 11, if applicable.

4.7.9 Touch the TI ϕ*M1* and set to the next value listed in the Applied Deviation column of Table 11 for the frequency being verified.

4.7.10 Repeat steps 4.7.5 through 4.7.9, as required, for the remaining values listed in the Applied Deviation column of Table 11 for the frequency being verified.

4.7.11 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied Frequency column of Table 11.

4.7.12 Touch the TI ϕ*M1* and set to the first value listed in the Applied Deviation column of Table 11 for the frequency being verified.

4.7.13 Set the MMR Frequency to the TI frequency. Restart the MMR.

4.7.14 Repeat steps 4.7.5 through 4.7.10.

4.7.15 Repeat steps 4.7.11 through 4.7.14 for the remaining values of Table 11.

Table 11.

Applied Frequency (MHz)	Deviation (rad)	Limits Deviation (rad)	Distortion (%) *[1]
10.1	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
100	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
500	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
1000	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
2000	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
3000 *[2]	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
4000 *[3]	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	<1.0 (<0.5)
6000 *[4]	1.0	0.96 to 1.04	N/A
	5.0	4.80 to 5.20	N/A
	10.0	9.60 to 10.40	N/A (<0.5)

*[1] Values in parenthesis for 3416 only.

*[2] Disregard for 3412.

*[3] For 3414 and 3416 only.

*[4] For 3416 only.

4.7.16 Press the TI **ANALOG MOD** key, then touch *NO ϕM*.

4.7.17 Set the TI **RF ON/OFF** to OFF and disconnect test setup.

4.8 INTERNAL MODULATION OSCILLATOR DISTORTION CALIBRATION:

4.8.1 Connect the TI I/AM OUT to the MMR AUDIO INPUT 100 kΩ.

4.8.2 Touch the TI *FREQ* on the TI display and set to 10 MHz.

4.8.3 Touch the TI *LEV* on the TI display and set to +7 dBm. Set the TI **RF ON/OFF** to ON.

4.8.4 Press the TI **ANALOG MOD** key. Touch *AM*, then touch *INT AM1*. Press the **SIG GEN** key. Touch *INT* and set to 1 kHz. Press the TI ⊿ key.

4.8.5 Touch *AM1* and set to 30%.

4.8.6 Set the MMR controls for a distortion measurement.

4.8.7 Verify the MMR Audio Distortion indication is <0.1%.

4.8.8 Set the TI **RF ON/OFF** to OFF and disconnect the test setup.

4.9 IQ MODULATION BANDWIDTH CALIBRATION:

4.9.1 Press the TI **UTIL** key, then using the ↑ and ↓ keys, highlight SYSTEM. Press **4** on the keypad. Touch the *PRESET* tab at the bottom of the screen. Touch the *PRESET INSTRUMENT* , then press the **ENTER** key. Press the TI **MOD ON/OFF** to turn off the TI modulation.

4.9.2 Connect the Signal Generator Output to the TI EXT I EXT AM.

4.9.3 Connect the TI RF OUTPUT 50Ω to the MMR Spectrum Analyzer RF INPUT 50 Ω.

4.9.4 Touch the TI *LEV* on the TI display, ⊿ key, then touch the TI *RF MODE* on the TI display and set to *NOISE*. Press the TI **SIG GEN** key.

4.9.5 Touch the TI *FREQ* on the TI display and set to the first value listed in the Applied Carrier Frequency column of Table 12.

4.9.6 Touch the TI *LEV* on the TI display and set to 0 dBm. Set the TI **RF ON/OFF** to ON.

4.9.7 Press the TI **IQ MOD** key, then press **1** on the keypad.

4.9.8 Press the TI **SIG GEN** key, *IQ*, ⊿ key, <*Self-Cal*>, then press **0** on the keypad.

4.9.9 Verify the IQ cal successfully completes.

4.9.10 Set the Signal Generator for 500 kHz at 500 mV.

4.9.11 Set the MMR Spectrum Analyzer center frequency to the TI carrier frequency, span to 22 MHz, ref level to 0 dB and for 1 dB/div vertical display resolution.

4.9.12 Press the TI **MOD ON/OFF** to turn on the TI modulation.

4.9.13 Note and record the amplitude of both the lower and upper sidebands displayed on the Spectrum Analyzer.

4.9.14 Increase the Signal Generator frequency by 500 kHz.

4.9.15 Repeat step 4.9.13.

4.9.16 Repeat steps 4.9.14 and 4.9.15 up to a Signal Generator frequency of 5 MHz.

4.9.17 Determine the lower and upper sideband maximum and minimum values recorded in step 4.9.13.

4.9.18 Algebraically subtract the lower sideband minimum value determined in step 4.9.17 from the lower sideband maximum value determined in step 4.9.17. Algebraically subtract the upper sideband minimum value determined in step 4.9.17 from the upper sideband maximum value determined in step 4.9.17.

4.9.19 Verify each of the results of the calculations in step 4.9.18 is within the corresponding value listed in the Limits column of Table 12 for the TI carrier frequency and Signal Generator modulation frequency range being verified.

4.9.20 Repeat steps 4.9.14 through 4.9.19 up to a Signal Generator frequency of 10 MHz.

Table 12.

Applied Carrier Frequency (Hz)	Modulation Frequency (Hz)	Limits (dB)
375 M	≤5 M	≤3.1
	≤10 M	≤3.1
750 M	≤5 M	≤3.1
	≤10 M	≤3.1
1500 M	≤5 M	≤3.1
	≤10 M	≤3.1
2 G	≤5 M	≤3.1
	≤10 M	≤3.1
3 G *[1]	≤5 M	≤3.1
	≤10 M	≤3.1
4 G *[2]	≤5 M	≤3.1
	≤10 M	≤3.1

See footnotes at end of Table.

Table 12. (Cont.)

Applied Carrier Frequency (Hz)	Modulation Frequency (Hz)	Limits (dB)
5 G *[3]	≤5 M	≤3.1
	≤10 M	≤3.1
6 G *[3]	≤5 M	≤3.1
	≤10 M	≤3.1

*[1] Disregard for 3412.

*[2] For 3414 and 3416 only.

*[3] For 3416 only.

4.9.21 Touch the TI *FREQ* on the TI display and set to the next value listed in the Applied Carrier Frequency column of Table 12.

4.9.22 Press the TI **SIG GEN** key, *IQ*, ⊡ key, <*Self-Cal*>, then press **0** on the keypad.

4.9.23 Verify the IQ cal successfully completes.

4.9.24 Repeat steps 4.9.10 through 4.9.20, as required.

4.9.25 Repeat steps 4.9.21 through 4.9.24 for the remaining values listed in Table 12.

4.9.26 Set the TI **RF ON/OFF** to OFF.

4.9.27 Set the Signal Generator output to minimum.

4.9.28 Disconnect the Signal Generator Output from the TI EXT I EXT AM.

4.9.29 Connect the Signal Generator Output to the TI EXT Q EXT FM.

4.9.30 Repeat steps 4.9.5 through 4.9.25.

4.9.31 Set the TI **RF ON/OFF** to OFF and **MOD ON/OFF** to OFF.

4.9.32 Set all POWER switches to OFF or STBY. Disconnect and secure all equipment.

4.9.33 Annotate and attach a Limited Certification Label per steps 3.6 and 3.7.

CALIBRATION PERFORMANCE TABLE

4.1 FREQUENCY ACCURACY AND DISPLAY CALIBRATION:

Reference Oscillator

Range	Applied	Limits
10 MHz	10 MHz	9 999 999.2 to 10 000 000.8 Hz

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.1 FREQUENCY ACCURACY AND DISPLAY CALIBRATION: *(Cont.)*

Display

Range	Applied	Limits
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz; 3416, 250 kHz to 6 GHz	111.111 111 MHz	111.111 110 to 111.111 112 MHz
	222.222 222 MHz	222.222 221 to 222.222 223 MHz
	333.333 333 MHz	333.333 332 to 333.333 334 MHz
	444.444 444 MHz	444.444 443 to 444.444 445 MHz
	555.555 555 MHz	555.555 554 to 555.555 556 MHz
	666.666 666 MHz	666.666 665 to 666.666 667 MHz
	777.777 777 MHz	777.777 776 to 777.777 778 MHz
	888.888 888 MHz	888.888 887 to 888.888 889 MHz
	999.999 999 MHz	999.999998 MHz to 1.000000000 GHz
	1.000 000 000 GHz	999.999999 MHz to 1.000000001 GHz

4.2 RF OUTPUT CALIBRATION:

Range	Applied	Limits
3412, 250 kHz to ≤2 GHz	>-24 dBm	-0.5 to 0.5 dB
	-127 to -24 dBm	-0.75 to 0.75 dB
3413, 250 kHz to ≤2 GHz	>-24 dBm	-0.5 to 0.5 dB
	-127 to -24 dBm	-0.75 to 0.75 dB
3413, >2 to ≤3 GHz	>-24 dBm	-0.75 to 0.75 dB
	-127 to -24 dBm	-1 to 1 dB
3414, 250 kHz to ≤2 GHz	>-24 dBm	-0.5 to 0.5 dB
	-127 to -24 dBm	-0.75 to 0.75 dB
>2 to ≤3 GHz	>-24 dBm	-0.75 to 0.75 dB
	-127 to -24 dBm	-1 to 1 dB
>3 to ≤4 GHz	>-24 dBm	-1 to 1 dB
	-127 to -24 dBm	-1.25 to 1.25 dB

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.2 RF OUTPUT CALIBRATION: *(Cont.)*

3416, 250 kHz to ≤2 GHz	>-30 dBm	-0.5 to 0.5 dB
	-127 to -30 dBm	-0.75 to 0.75 dB
>2 to ≤3 GHz	>-30 dBm	-0.75 to 0.75 dB
	-127 to -30 dBm	-1 to 1 dB
>3 to ≤4 GHz	>-30 dBm	-1 to 1 dB
	-110 to -30 dBm	-1.25 to 1.25 dB
> 4 to ≤6 GHz	>-30 dBm	-1 to 1 dB
	-110 to -30 dBm	-1.25 to 1.25 dB

4.3 SPECTRAL PURITY CALIBRATION:

Harmonics

Range	Applied	Limits
3412, 250 kHz to 2 GHz	250 kHz to 2 GHz, ≤+7 dBm	<-30 dBc
3413, 250 kHz to 3 GHz	250 kHz to 3 GHz, ≤+7 dBm	<-30 dBc
3414, 250 kHz to 4 GHz	250 kHz to 4 GHz, ≤+7 dBm	<-30 dBc
3416, 250 kHz to 6 GHz	250 kHz to 6 GHz, ≤+7 dBm	<-30 dBc

Subharmonics and Nonharmonics

Range	Applied	Limits
3412, 250 kHz to 2 GHz	250 kHz to ≤375 MHz, ≤+7 dBm, >10 kHz offset	<-60 dBc
	>375 MHz to ≤2 GHz, ≤+7 dBm, >10 kHz offset	<-70 dBc
3413, 250 kHz to 3 GHz	250 kHz to ≤375 MHz, ≤+7 dBm, >10 kHz offset	<-60 dBc
	>375 MHz to ≤3 GHz, ≤+7 dBm, >10 kHz offset	<-70 dBc
3414, 250 kHz to 4 GHz	250 kHz to ≤375 MHz, ≤+7 dBm, >10 kHz offset	<-60 dBc
	>375 MHz to ≤3 GHz, ≤+7 dBm, >10 kHz offset	<-70 dBc
	>3 to ≤4 GHz, ≤+7 dBm, >10 kHz offset	<-60 dBc

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.3 SPECTRAL PURITY CALIBRATION: *(Cont.)*

Subharmonics and Nonharmonics (Cont.)

Range	Applied	Limits
3416, 250 kHz to 6 GHz	250 kHz to ≤3 GHz, ≤+7 dBm, >10 kHz offset	<-70 dBc
	>3 to ≤6 GHz, ≤+7 dBm, >10 kHz offset	<-60 dBc

4.4 SINGLE SIDEBAND PHASE NOISE, RESIDUAL FM AND WIDEBAND NOISE CALIBRATION:

Single Sideband Phase Noise

Range	Applied	Limits (20 kHz offset)
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz; 3416, 250 kHz to 6 GHz	250 kHz to ≤375 MHz	<-115 dBc/Hz
	500 MHz	<-124 dBc/Hz
	1 GHz	<-118 dBc/Hz
	2 GHz	<-112 dBc/Hz
	3 GHz	<-108 dBc/Hz
	4 GHz	<-106 dBc/Hz
	6 GHz	<-102 dBc/Hz

Residual FM

Range	Applied	Limits (300 Hz to 3.4 kHz unweighted BW)
1 GHz	1 GHz	<4.5 Hz rms
		<2.5 Hz rms, 3416

Wideband Noise

Range	Applied	Limits (>5 and <50 MHz offset)
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz; 3416, 250 kHz to 6 GHz	375 MHz (Power Mode)	<-138 dBc/Hz
	2 GHz (Power Mode)	<-142 dBc/Hz
	5 GHz (Power Mode)	<-136 dBc/Hz
	375 MHz (Noise Mode)	<-138 dBc/Hz
	2 GHz (Noise Mode)	<-142 dBc/Hz
	5 GHz (Noise Mode)	<-136 dBc/Hz

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.4 SINGLE SIDEBAND PHASE NOISE, RESIDUAL FM AND WIDEBAND NOISE CALIBRATION: *(Cont.)*

Wideband Noise *(Cont.)*

Range	Applied	Limits (>5 and <50 MHz offset)
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz; 3416, 250 kHz to 6 GHz	375 MHz (ACP Mode)	<-135 dBc/Hz
	2 GHz (ACP Mode)	<-140 dBc/Hz
	5 GHz (ACP Mode)	<-134 dBc/Hz

4.5 AMPLITUDE MODULATION CALIBRATION:

Depth

Range	Applied (at 1 kHz rate)	Limits
250 kHz to 2 GHz	30%	27.8 to 32.2%
	50%	47.0 to 53.0%
	90%	85.4 to 94.6%

Distortion

Range	Applied (at 1 kHz rate)	Limits
250 kHz to 2 GHz	Up to 30%	<1%
	Up to 80%	<2%

4.6 FREQUENCY MODULATION CALIBRATION:

Deviation

Range	Applied (at 1 kHz rate)	Limits
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz	10.0 kHz	9.60 to 10.40 kHz
	100.0 kHz	96.0 to 104.0 kHz
	380.0 kHz	364.8 to 395.2 kHz
3416, 250 kHz to 6 GHz	10.0 kHz	9.70 to 10.30 kHz
	100.0 kHz	97.0 to 103.0 kHz
	380.0 kHz	368.6 to 391.4 kHz

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.6 FREQUENCY MODULATION CALIBRATION: *(Cont.)*

Distortion

Range	Applied (at 1 kHz rate)	Limits
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz	Up to 2% of max deviation	<0.2%
	Up to 20% of max deviation	<1%
3416, 250 kHz to 6 GHz	Up to 2% of max deviation	<0.15%
	Up to 20% of max deviation	<0.6%

4.7 PHASE MODULATION CALIBRATION:

Deviation

Range	Applied (at 1 kHz rate)	Limits
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz; 3416, 250 kHz to 6 GHz	1.0 rad	0.96 to 1.04 rad
	5.0 rad	4.80 to 5.20 rad
	10.0 rad	9.60 to 10.40 rad

Distortion

Range	Applied (at 1 kHz rate)	Limits
3412, 250 kHz to 2 GHz; 3413, 250 kHz to 3 GHz; 3414, 250 kHz to 4 GHz	10 rad	<1%
3416, 250 kHz to 6 GHz	10 rad	<0.5%

4.8 INTERNAL MODULATION OSCILLATOR DISTORTION CALIBRATION:

Range	Applied	Limits
1 kHz	1 kHz	<0.1%

4.9 IQ MODULATION BANDWIDTH CALIBRATION:

Carrier Frequency (Hz)	Applied Modulation Frequency (Hz)	Limits (dB) *[1]
375 M	≤5 M	≤3.1
	≤10 M	≤3.1

See footnotes at end of Table.

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.9 IQ MODULATION BANDWIDTH CALIBRATION: *(Cont.)*

Carrier Frequency (Hz)	Applied Modulation Frequency (Hz)	Limits (dB) *[1]
750 M	≤5 M	≤3.1
	≤10 M	≤3.1
1500 M	≤5 M	≤3.1
	≤10 M	≤3.1
2 G	≤5 M	≤3.1
	≤10 M	≤3.1
3 G *[2]	≤5 M	≤3.1
	≤10 M	≤3.1
4 G *[3]	≤5 M	≤3.1
	≤10 M	≤3.1
5 G *[4]	≤5 M	≤3.1
	≤10 M	≤3.1
6 G *[4]	≤5 M	≤3.1
	≤10 M	≤3.1

*[1] For I and Q modulation separately modulated and for both lower and upper sidebands, independent of each other.

*[2] Disregard for 3412.

*[3] For 3414 and 3416 only.

*[4] For 3416 only.