TECHNICAL MANUAL

CALIBRATION PROCEDURE

FOR

COMMUNICATION SERVICE MONITOR

TS-4317-1

(IFR)

This publication replaces T.O. 33K3-4-3211-1 dated 30 March 2015.

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Published under Authority of the Secretary of the Air Force

30 AUGUST 2015

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1 CALIBRATION DESCRIPTION:

Table 1.

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
Frequency		
Master Oscillator	Range: 10 MHz Accuracy: ±0.8 ppm; *[2] Accuracy: ±0.5 ppm; Aging Rate: ≤±0.3 ppm/year; Temperature: *[3] ≤±0.15 ppm, 0 to 50 °C	Verified with a Frequency Standard and Frequency Counter
Display	Range: 500.0 kHz to 999.9999 MHz Accuracy: ±1 count LSD	Verified with a Frequency Counter
RF Signal Generator		
Frequency	Range: 500.0 kHz to 999.9999 MHz Accuracy: Same as Master Oscillator	Verified during Master Oscillator and Display calibration
Level	Range: T/R connector: -137 to 0.0 dBm; Duplex connector: -120 to +7 dBm Accuracy: ±1.5 dB, ≥-110 dBm for both connectors; ±2.5 dB, -127 dBm to <-110 dBm for T/R connector; ±2.5 dB, <-110 dBm for Duplex connector	Measured with Microwave Measurement Receiver (MMR)

See footnotes at the end of the Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
RF Signal Generator *(Cont.)*		
Spectral Purity		
Residual FM	Range: 500.0 kHz to 999.9999 MHz Accuracy: Post detection BW: (50 Hz to 15 kHz bandwidth) <45 Hz rms	Measured with a MMR Spectrum Analyzer
Residual AM	Range: 500.0 kHz to 999.9999 MHz Accuracy: (50 Hz to 15 kHz bandwidth) <0.10% rms, >1 MHz; <0.20% rms, ≤1 MHz	
Harmonics	Range: 500.0 kHz to 999.9999 MHz Accuracy: <-26 dBc	
Non-harmonics	Range: 500.0 kHz to 999.9999 MHz Accuracy: <-50 dBc	
Single Sideband Phase Noise	Range: 500.0 kHz to 999.9999 MHz Accuracy: (at 20 kHz from carrier) <-80 dBc/Hz, ≤1 MHz; <-90 dBc/Hz, <930 MHz; <-85 dBc/Hz, ≥930 MHz	
RF Signal Modulation		
Internal FM	Range: 1 to 999.9999 MHz	
Deviation	Range: ±100.0 Hz to ±100.0 kHz Accuracy: ±5.0% of dev, ±1.0 to ±20.0 kHz; ±10.0% of dev, <±1.0 and >±20.0 kHz	Measured with Microwave Measuring Receiver or with Modulation Analyzer

See footnotes at the end of the Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
RF Signal Modulation *(Cont.)*		
Total Harmonic Distortion	Range: 1 to 999.9999 MHz, 30 Hz to 20 kHz rate Accuracy: (>6 to <25 kHz deviation) <0.7% THD, 700 Hz to 1.1 kHz; <1.0% THD, 30 Hz to 10.0 kHz; <2.0% THD, >10.0 to 20.0 kHz; <2.0% THD for all rates, >25 to <100 kHz deviation	Demodulated carrier measured on an MMR Spectrum Analyzer, then calculated or measured on an MMR Spectrum Analyzer
Internal AM	Range: 1 to 999.9999 MHz	
Amplitude Modulation	Range: 1.0 to 90.0% Accuracy: ±5.0% of actual mod, 30.0 to 90.0% modulation	Measured with Microwave Measuring Receiver or MMR
Total Harmonic Distortion	Range: 30.0 to 70.0% AM 100 Hz to 10 kHz rate Accuracy: <0.7% THD, 700 Hz to 1.1 kHz; <1.5% THD, 100 Hz to 6.0 kHz; <2.5% THD, >6.0 to 10.0 kHz	Demodulated carrier measured on an Audio Analyzer or measured with an MMR
Internal Phase Modulation	Range: 500.0 kHz to 999.9999 MHz	
Phase Modulation	Range: 0.1 to 10 rad Accuracy: ±10.0% of dev at 1 kHz rate, ≥0.3 rad	Measured with Microwave Measuring Receiver or MMR
Distortion	Range: ≥0.3 to 10 rad Accuracy: <2.0% THD at 1 kHz rate	Demodulated carrier measured on an Audio Analyzer or measured on an MMR
AF Generator		
Frequency	Range: 10.0 Hz to 40.0 kHz Accuracy: ±0.1% of setting	Measured with Frequency Counter

See footnotes at the end of the Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
AF Generator (*Cont.*)		
Level	Range: (150 Ω) 0.7 mV rms to 2.5 V rms; (600 Ω) 0.7 mV rms to 3.0 V rms Accuracy: (150 Ω) ±0.1 mV rms or ±3.0% of setting	Measured with Digital Multimeter using a Decade Resistor as a load
Total Harmonic Distortion	Range: 10.0 Hz to 40.0 kHz Accuracy: (≥100 mV to 3.0 V rms into 600 Ω) <0.7% THD, 700 Hz to 1.1 kHz; <1.0% THD, <700 Hz and >1.1 kHz	Measured on an MMR
Audio Frequency Counter	Range: 10.0 Hz to 40.00 kHz Accuracy: Same as Master Oscillator ±1 count	Verified during Master Oscillator and Display calibration
Radio Frequency Counter	Range: 500.0 kHz to 999.9999 MHz Accuracy: Same as Master Oscillator	Verified during Master Oscillator and Display calibration
Radio Frequency Error Counter/Meter	Range: (Counter) 0 Hz to ±150.0 kHz; (Meter) 0 to ±100.0 kHz Accuracy: Same as Master Oscillator	
RF Power Meter	Range: *[4] 1.5 to 999.9999 MHz, 0.2 mW to 200 W (1.5 to 30 MHz), 0.2 mW to 100 W (>30 to 200 MHz), 0.2 mW to 50 W (>200 to 999.9999 MHz) *[5] Accuracy: ±10.0% of rdg ±1 dgt (1 dgt is 1% or 0.1 mW)	Verified with an MMR Signal Generator and an RF Reference Source
FM Deviation Meter	Range: ±1.0 to ±100.0 kHz Accuracy: ±4.0% of rdg ±2 dgts + source residual, (1 dgt is 10 Hz for ≤20 kHz and 100 Hz for >20 kHz)	Verified with a MMR Signal Generator and MMR

See footnotes at the end of the Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
AM Depth Meter	Range: 1 to 95% (100 Hz to 10 kHz rates) Accuracy: ±5.0% FS ±1 dgt + source residual from 30.0 to 90.0% (1 dgt is 0.1%)	Verified with a MMR Signal Generator and MMR
PM Deviation Meter	Range: 0.0 to 10 rad (peak) Accuracy: ±5.0% FS ±1 dgt + source residual, at 1 kHz rate, >2 rad, (1 dgt is 0.01 rad at ≤5 rad or 0.1 rad at >5 rad)	
Distortion Meter	Range: 0.1 to 20.0% (600 Hz to 1.4 kHz) Accuracy: (Distortion levels 1.0 to ≤10.0%) ±0.5% distortion ±1 dgt (770 Hz and 1 kHz); ±1.0% distortion ±1 dgt (600 Hz to 1.4 kHz); (Distortions levels >10.0 to 20.0%) ±2.0 % distortion ±1 dgt (1 dgt is 0.1%)	Verified with a known signal inserted onto another known signal
SINAD Meter	Range: 3.0 to 30.0 dB (600 Hz to 1.4 kHz) Accuracy: ±1.0 dB ±1 dgt (1 dgt is 0.1 dB)	Verified with a known signal inserted onto another known signal
Digital Multimeter		
Voltmeter	Range: 0 to 1000.0 VDC, 0 to 500.0 VAC at 50 Hz to 20 kHz, Input Impedance 150, 600 Ω and 1 MΩ Accuracy: DC: ±1.0% FS ±1 dgt; AC: ±5.0% FS ±1 dgt *[6] Input Impedance: ±5% of setting (1 MΩ, nominal)	Verified with a Meter Calibrator Inherently calibrated during DC Voltage Calibration

See footnotes at the end of the Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
Digital Multimeter (*Cont.*)		
Current Meter	Range: 0 to 2.000 A (10.0 ADC or 5.0 AAC utilizing the External Shunt *[7] with the TI set to the Voltmeter 0.2 V rng) Accuracy: ±5.0% FS, or 0.1 mA, ±1 dgt, (1 dgt is 0.01 mA on the 20.00 mA rng); External Shunt: ±10.0% FS ±1 dgt	Verified with a Meter Calibrator
Ohmmeter	Range: 0 to 20.0 MΩ Accuracy: ±5.0% FS, or 0.1 Ω, ±1 dgt, (1 dgt is 0.1 Ω on the 200.0 Ω range)	
Oscilloscope	Range: DC to 1.0 MHz	
Vertical Bandwidth	Range: -3 dB bandwidth Accuracy: ≥1.0 MHz	Verified with an Oscilloscope Calibrator
Input Ranges	Range: 2 mV/div to 50 V/div (8 div) Accuracy: (2 mV/div) ±10% FS (±10% with X10 probe); (5 mV/div to 50 V/div) ±5% FS (±10% with X10 probe)	
Horizontal Sweep	Range: 1 μs/div to 100 ms/div (10 div) Accuracy: ±3% FS	
Spectrum Analyzer	Range: 500.0 kHz to 999.9999 MHz	
Frequency Span	Range: 1 kHz/div to 100 MHz/div, + zero scan (10 div) Accuracy: ±(5% of Span Width + 0.5 ppm)	Verified with a MMR Signal Generator

See footnotes at the end of the Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications *[1]	Test Method
Spectrum Analyzer (*Cont.*)	Range: 500.0 kHz to 999.9999 MHz	
Level	Range: Dynamic: -60 to 0 dB (at 0 dB Atten); Vertical: 0 to -85 dBm (<100.0 MHz); -30 to -85 dBm (>100.0 MHz) Accuracy: ±4.0 dB, 1 to 400.0 MHz (Normalized); ±6.0 dB, >400.0 to 999.9999 MHz (Normalized)	Verified with a MMR Signal Generator
AF Level Meter	Range: 0.5 to 9.99 V rms (100 Hz to 20 kHz) Accuracy: ±7.0% FS	Verified with Meter Calibrator

*[1] See step 3.10.

*[2] The accuracy is the manufacturers calculated specification plus the manufacturers aging rate after one year (±0.5 + ≤±0.3 ppm).

*[3] Typical or Operational specification. Not calibrated.

*[4] On/Off Times Operating Conditions: 0 to 50 W Continuous at 50 °C; >50 to 100 W On Maximum 30 seconds, Off 2 minutes at 50 °C; >100 to 200 W On Maximum 15 seconds, Off 2 minutes at 50 °C.

*[5] See step 3.11.

*[6] AC accuracy applies for AC Volts times kHz product <140.

*[7] The External Shunt is part of the accessory kit included with the TI.

2 EQUIPMENT REQUIREMENTS:

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1 FREQUENCY STANDARD	Range: 10 MHz Accuracy: ±7.5 X 10^{-8}	Arbiter 1083B	
2.2 FREQUENCY COUNTER	Range: 10 Hz to 500 MHz Accuracy: ±(0.025% of rdg + 1 count LSD)	Hewlett-Packard 53132A OPT012-030	

	Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.3	MICROWAVE MEASUREMENT RECEIVER (MMR)	Range: -130 to +8.5 dBm, 100 Hz to 500 MHz 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; Range 3, ±0.031 dB Range: (Residual FM) 500 kHz to 500 MHz Accuracy: <1.5 Hz rms Range: (FM) 10 to 500 MHz, 250 Hz to 100 kHz Deviation, 100 Hz to 10 kHz rate Accuracy: FM Deviation: ±1.0% of ind (β >0.45 *[2]); ±1.5% of ind (β >0.2 *[2]) Range: (Residual AM) 500 kHz to 500 MHz Accuracy: <0.01% rms Range: (AM) 10 to 500 MHz, 1 kHz rate, 27 to 95.5% AM Accuracy: ±1.4% of setting Range: (PM) 10 to 500 MHz, 1 kHz rate, 3.7 to 10 rad Accuracy: ±1.67% of rdg	Agilent N5530SE50	

See footnotes at the end of Equipment Requirements.

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.3.1 SPECTRUM ANALYZER	Range: -130 to +8.5 dBm, 500 kHz to 2500 MHz Accuracy: Scale Fidelity: ±1.6 dB Range: (Noise Sidebands) 10 to 500 MHz Accuracy: ≤-96 dBc/Hz at ≥20 kHz offset from carrier	Agilent E4448A	
2.3.2 POWER METER	Range: -1.5 to +1.5 dBm Accuracy: *[3]	Agilent N1911A	
2.3.3 SENSOR MODULE	Range: 0.5 to 500 MHz Accuracy: *[1] (all % are of Charted Value) ±2.1%, 500 kHz to 1 MHz; ±2.0%, 1 to 10 MHz; ±2.7%, 10 to 50 MHz; ±2.5%, 50 to 500 MHz	Agilent N5532A-504	
2.3.4 SIGNAL GENERATOR	Range: (CW) 500 kHz to 500 MHz, at -85 to +8 dBm Accuracy: Level: ±1 dB, Frequency: ±1.25% of setting Range: (FM) 1 to 90 kHz deviation at 1 kHz rate, 10 to 500 MHz (CW) Accuracy: N/A Range: (AM) 30 to 90% at 1 kHz rate, 10 to 500 MHz (CW) Accuracy: N/A	Agilent E8257D OPT 550	

See footnotes at the end of the Equipment Requirements.

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.3.4 SIGNAL GENERATOR (*Cont.*)	Range: (Phase Modulation) 4 to 9 rad at 1 kHz rate, 10 to 500 MHz (CW) Accuracy: N/A	Agilent E8257D OPT 550	
2.4 MICROWAVE MEASURING RECEIVER	Range: (FM) 10 to 500 MHz (CW); 90 Hz to 110 kHz deviation at 0.1 to 10.0 kHz rates Accuracy: ±1.25% of rdg Range: (Residual FM) 10 to 500 MHz (CW) Accuracy: <8 Hz rms at 1300 MHz decreasing linearly with frequency to <1 Hz rms for ≤100 MHz Range: (AM) 10 to 500 MHz (CW); 28.5 to 95% AM depth at 0.1 to 10.0 kHz rates Accuracy: ±1.25% of rdg Range: (Phase deviation) 10 to 500 MHz (CW); 0.9 to 11 rad at 1 kHz rate Accuracy: ±2.75% of rdg ±1 dgt TAR: 1.4:1 Range: (Audio Filters) 50 Hz to >20 kHz Accuracy: 50 Hz High-Pass Filter, <1.0% at rates ≥200 Hz; 300 Hz High-Pass Filter, <1.0% at rates ≥1 kHz; 3 kHz Low-Pass Filter, <1.0% at rates ≤1 kHz; 15 kHz Low-Pass Filter, <1.0% at rates ≤10 kHz; >20 kHz Low-Pass Filter, <1.0% at rates ≤10 kHz	Hewlett-Packard 8902MS	

	Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.5	FUNCTION GENERATOR	Range: 2 V at 1 kHz Accuracy: N/A	Hewlett-Packard 3325B	
2.6	DIGITAL MULTIMETER	Range: 0 to 10 V rms, 10 Hz to 25 kHz Accuracy: ±0.25% of rdg	Hewlett-Packard 3458A	
2.7	AUDIO ANALYZER	Range: (Distortion) 20 Hz to 40 kHz Accuracy: ±1 dB, 20 Hz to 20 kHz; ±2 dB, 20 to 40 kHz Range: (Output) 20.0 to 281.17 mV at 400 Hz Accuracy: ±2.0% of setting	Hewlett-Packard 8903B	
2.8	DECADE RESISTOR	Range: 150 Ω Accuracy: ±0.7% of setting	General Radio 1433-9714	
2.9	POWER SPLITTER	Range: 0.5 to 500 MHz Accuracy: ≤0.15 dB	Hewlett-Packard 11667A	
2.10	METER CALIBRATOR W/AMPLIFIER	Range: (DC Voltage) 0 to 1000 VDC Accuracy: ±0.25% of setting Range: (AC Voltage) 0 to 500 VAC, 50 Hz to 20 kHz Accuracy: ±0.25% of setting Range: (DC Current) 0 to 10.0 ADC Accuracy: ±1.25% of setting	Fluke 5700A w/5725A	

	Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.10	METER CALIBRATOR W/AMPLIFIER (*Cont.*)	Range: (AC Current) 0 to 5.0 AAC, 50 Hz to 10 kHz Accuracy: ±1.25% of setting Range: (Resistance) 100 Ω to 10 MΩ Accuracy: ±1.25% of setting	Fluke 5700A w/5725A	
2.11	OSCILLOSCOPE CALIBRATOR	Range: 50 kHz to >1 MHz, Sinewave Accuracy: ±5% of ref at 50 kHz Range: 10 mV to 200 V p-p, Square Wave Accuracy: ±2% of setting Range: 1 µs to 100 ms, Time Mark Accuracy: ±0.75% of setting	Fluke 9500B/3200AF	
2.12	POWER AMPLIFIER	Range: 2 to 100 W, 10 to 400 MHz Accuracy: N/A	Comtech Pst Corp BHED1758-1000/4006 *[4]	Comtech Pst Corp BHED1758-200/4006 or Microwave Products SSPA0240-22/6140 *[5]
2.13	RF POWER MEASUREMENT SET	Range: 10 to 50 W, 100 to 400 MHz Accuracy: ±3% of charted value Worst Case TAR: 3.4:1	Bird 4421A300	
2.14	LOCKOUT KEY	Range: N/A Accuracy: N/A	IFR 7005-7840-500	

See footnotes at end of Equipment Requirements.

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.15 HIGH POWER LOWPASS FILTER *[5]	Range: Cutoff >400 MHz; Rejection ≥40 dB @ 559 MHz Accuracy: Verify before use	Eagle CBL431NF	
2.16 HIGH POWER LOWPASS FILTER *[5]	Range: Cutoff >100 MHz; Rejection ≥40 dB @ 130 MHz Accuracy: Verify before use	Eagle CBL101NF	
2.17 OSCILLOSCOPE	Range: 10 MHz Accuracy: N/A	Tektronix 2465B	
2.18 ATTENUATOR	Range: 10 to 400 MHz Accuracy: N/A	Weinschel 82-10-34	
2.19 FEEDTHROUGH TERMINATION	Range: 50 Ω Accuracy: N/A	Tektronix 011-0049-01	
2.20 RF REFERENCE SOURCE	Range: 10 to 400 MHz, +10 dBm Accuracy: Power: ±2.75% of setting	Fluke 9640A	
2.21 MODULATION ANALYZER *[6]	Range: 10 to 500 MHz (CW); 90 Hz to 110 kHz deviation at 0.1 to 10.0 kHz rates Accuracy: ±1.25% of rdg	Rhode & Schwarz FMAV (p/o CIVS)	

*[1] A worst case TAR of 3.7:1 is achieved by the root sum squared (RSS) value of the MMR and Sensor Module for Level Calibration <0.0 dBm.

*[2] β = Deviation/Rate.

*[3] Power Meter Accuracy included in Sensor Module Accuracy.

*[4] See Caution in beginning of para 4.5.

*[5] May be used with Sub-Item for Power Amplifier to reduce harmonic content.

*[6] Used only in Alternate Internal FM Deviation and Total Harmonic Distortion Calibration.

3 PRELIMINARY OPERATIONS:

3.1 Review and become familiar with entire procedure before beginning 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 the test equipment to the appropriate power source. Set all POWER switches to On and allow warm-up as required by the manufacturer.

3.3 Connect the TI to the appropriate power source. Set the POWER switch to ON (ON annunciator will illuminate) and allow a 20 minute warm-up.

NOTE

Multiple firmware versions may exist for TIs covered by this Calibration Procedure. This may require variations of softkeys, menus, keystrokes, pathways, steps, 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, 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.

NOTE

When power is first applied to the TI, there is a series of beeps. The beeps verify the operation of several systems, as follows: Processor (1 beep), Memory Board (2 beeps) and Digital Bus (4 beeps).

3.4 Throughout this Calibration Process, Hardkeys will be designated with all capital letters. Softkeys will be designated by the function key with the title in parentheses (for example F6 (AUX)).

3.5 When required to select a specific function or value, utilize the FIELD SELECT keys to select the required field. Edit the field to the desired value by utilizing the DATA SCROLL knob or keys, or the DATA ENTRY keys. Press the ENTER key to execute the highlighted function or to enter the values edited by the DATA SCROLL or DATA ENTRY keys.

NOTE

Before implementing the self test, remove any leads that are connected to the coaxial connectors to prevent extraneous pick-up affecting the readings.

3.6 If applicable, perform the automated system self test procedure that starts at TS-4317/GRM power-up. Follow the onscreen instructions. If the triple banana to BNC is not available, use short banana cables and pin connectors for the connection. The positive (V/Ohm) is the male pin connector, the negative (COM) is the black female pin connector. There is no connection to the AMP input. The self test process may be terminated by pressing the ASTERISK key. Once pressed, the self test stops and another function may be selected, i.e. RF Gen.

3.7 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. Press F5 (AUX) from the Auxiliary Functions Menu, select 4 Self Test, select 1 Self Test, and then ENTER to execute all tests.

3.8 The results of all the self tests must indicate P (passed).

NOTE

Self Test 24 is the test to verify the Auxiliary Box. If the TI does not have an Auxiliary Box attached, Self Test 24 will indicate a failure. If this is the case, disregard the failure.

NOTE

The TI Deviation Meter screen indicator bar displays meter value in graphic form. The display is green when an over range condition exists and is red when conditions are outside the limits.

3.9 If the Current Shunt (P/O TI Accessory Kit) does not accompany the TI during calibration, annotate and attach a Limited Certification Label stating the TI Digital Multimeter Current Meter 20A Range is not certified. If the Current Shunt is available, annotate the S/N or the ID# of the TI which it was calibrated with in accordance with T.O. 00-20-14 requirements.

3.10 Air Force requirement is 500 MHz for all characteristics that currently are 999.9999 MHz. Annotate and attach a Limited Certification Label stating the TI is not calibrated >500 MHz, unless otherwise requested.

3.11 For RF Power Meter Calibration performed at 400 MHz, attach a Limited Certification Label stating not cal'd >406 MHz. 406 MHz is a user requirement that is inherently calibrated at 400 MHz.

3.12 Do only those portions of the procedure that pertains to the TI being calibrated.

3.13 Verify the Low Pass Filters in accordance with Appendix B.

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

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

NOTE

The Active Head (p/o Oscilloscope Calibrator) is an integral part of the Oscilloscope Calibrator. All connections are to be made through the Active Head.

4 CALIBRATION PROCESS:

NOTE

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

4.1 MASTER OSCILLATOR AND DISPLAY CALIBRATION:

NOTE

Overall TI accuracy depends upon the correct setting of the internal 10 MHz standard.

4.1.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults.

4.1.2 Connect the Frequency Standard 10 MHz REF OUT to Frequency Counter Ref In (rear panel).

4.1.3 Connect the TI T/R output connector to the Frequency Counter CHANNEL 1 Input. Set the Frequency Counter 50Ω/1MΩ switch to 50Ω.

4.1.4 Press the TI RF GEN, then F2 (Freq) and select a frequency of 10 MHz. Press F3 (Level) and select a level of 0.0 dBm.

NOTE

The values in the following step are derived from multiplication of the Aging Rate + the listed accuracy 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.

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.

4.1.5 Adjust the Frequency Counter controls as required for a stable display indication. Verify the Frequency Counter indication is 9 999 992 to 10 000 008 Hz ±1 count of LSD.

4.1.6 On the TI, select a minimum level.

4.1.7 Disconnect the Frequency Standard from the test setup.

4.1.8 Connect the Frequency Counter 10 MHz Out to the TI 10 MHz REF input (rear panel).

4.1.9 On the TI, select a level of 0.0 dBm and a frequency of 0.5000 MHz.

4.1.10 Set the Frequency Counter resolution, as required, to 1 Hz.

4.1.11 The Frequency Counter must indicate within 499 900 to 500 100 Hz.

4.1.12 Repeat steps 4.1.9 through 4.1.11 for the remaining values listed in Table 2.

NOTE

Set the Frequency Counter resolution as required for the TI frequency being measured.

Table 2.

TI Freq (MHz)	Limits (Hz)
0.500 0	499 900 to 500 100
111.111 1	111 111 000 to 111 111 200
122.222 2	122 222 100 to 122 222 300
133.333 3	133 333 200 to 133 333 400
144.444 4	144 444 300 to 144 444 500
155.555 5	155 555 400 to 155 555 600
166.666 6	166 666 500 to 166 666 700
177.777 7	177 777 600 to 177 777 800
188.888 8 *	188 888 700 to 188 888 900
500.000 0	499 999 900 to 500 000 100

* After making the measurement, select a minimum TI level and disconnect T/R output connector from the Frequency Counter CHANNEL 1 Input. Connect the TI T/R output connector to the Frequency Counter CHANNEL 3 Input.

4.1.13 On the TI, select a minimum level and disconnect the test setup.

4.1.14 To ensure the reliability of the TI, the following action shall be taken: If TI passes the above steps, perform the applicable adjustment steps in Appendix A, and enter the applicable code into the Maintenance Data Collection System. If the TI failed, perform the applicable steps listed in Appendix A and enter the applicable code into the Maintenance Data Collection System.

4.2 RF SIGNAL GENERATOR CALIBRATION:

4.2.1 LEVEL CALIBRATION:

4.2.1.1 Connect the MMR 10 MHz OUT (SWITCHED) to the TI 10 MHz REF input (rear panel) connector.

4.2.1.2 Set the MMR controls, as required, to provide a 10 MHz timebase output.

4.2.1.3 Connect the Sensor Module to the MMR. Set the MMR to Measuring Receiver mode. Load the Sensor Module Calibration Factors into the MMR and standardize the MMR for power measurements.

4.2.1.4 Connect the Sensor Module to the TI T/R connector.

4.2.1.5 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults.

4.2.1.6 Press TI RF GEN, then F2 (Freq) and select a frequency of .5 MHz. Press F3 (Level) and select a level of 0.0 dBm. Set the MMR to measure RF Power at the TI frequency.

NOTE

It may be necessary to increase the MMR IF Bandwidth to 75 Hz. This should be avoided unless TI fails to lock onto 10 Hz Bandwidth and may reduce dynamic range.

4.2.1.7 Allow the MMR Power indication to settle. Verify the MMR RF Power indication is within -1.5 to +1.5 dBm. Record the MMR RF Power indication at 10.1, 100 and 500 MHz.

4.2.1.8 Press the TI F3 (Level) and select a minimum level.

4.2.1.9 Repeat steps 4.2.1.6 through 4.2.1.8 at 1, 10.1, 100 and 500 MHz.

4.2.1.10 Disconnect the Sensor Module from the test setup.

4.2.1.11 Connect the TI T/R connector to the MMR RF INPUT 50 Ω.

4.2.1.12 Press TI RF GEN, then F2 (Freq) and select a frequency of 10.1 MHz.

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.

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

4.2.1.14 Press the TI F3 (Level) and select the first value listed in the Level column of Table 3.

4.2.1.15 Set the MMR to Set Ref.

4.2.1.16 Allow the MMR Tuned RF Level indication to settle.

4.2.1.17 Set the MMR Ext RF Atten to the value recorded, in dB, in step 4.2.1.7 for the frequency being verified.

4.2.1.18 Press the TI F3 (Level) and select the next value listed in the Level column of Table 3.

4.2.1.19 Allow the MMR Tuned RF Level indication to settle. Verify the MMR Tuned RF Level indication is within the corresponding values listed in the Limits column of Table 3.

4.2.1.20 Repeat steps 4.2.1.18 and 4.2.1.19, as required, for the remaining values listed in Table 3.

Table 3.

Level (dBm)	Limits (dBm)
0.0	Reference
-10.0	-11.5 to -8.5
-20.0	-21.5 to -18.5
-30.0	-31.5 to -28.5
-40.0	-41.5 to -38.5
-50.0	-51.5 to -48.5
-60.0	-61.5 to -58.5
-70.0	-71.5 to -68.5
-80.0	-81.5 to -78.5
-90.0	-91.5 to -88.5
-100.0	-101.5 to -98.5
-110.0	-111.5 to -108.5
-120.0	-122.5 to -117.5
-127.0	-129.5 to -124.5

4.2.1.21 Set the MMR Ext RF Atten to 0.0 dBm.

4.2.1.22 Repeat steps 4.2.1.12 through 4.2.1.21 for 100 and 500 MHz.

4.2.1.23 Disconnect the MMR from the TI T/R connector.

4.2.1.24 Connect the Sensor Module to the TI DUPLEX connector and press TI DPLX.

4.2.1.25 Select TI RX and enter a frequency of 10.1 MHz, then select OUT and DPLX, then enter a level of +7.0 dBm.

4.2.1.26 Set the MMR to measure RF Power at the TI frequency.

4.2.1.27 Allow the MMR Power indication to settle. Verify the MMR RF Power indication is within +5.5 to +8.5 dBm.

4.2.1.28 On the TI, enter a level of 0.0 dBm.

4.2.1.29 Allow the MMR Power indication to settle. Verify the MMR RF Power indication is within -1.5 to +1.5 dBm. Record the MMR RF Power indication.

4.2.1.30 Press the TI F3 (Level) and select a minimum level.

4.2.1.31 Repeat steps 4.2.1.25 through 4.2.1.30 at 100 and 500 MHz.

4.2.1.32 Disconnect the Sensor Module from the test setup.

4.2.1.33 Connect the MMR RF INPUT 50 Ω to the TI DUPLEX connector.

4.2.1.34 Press TI DPLX then select RX and enter a frequency of 10.1 MHz, then select OUT and DP.

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

4.2.1.36 Press the TI F3 (Level) and select the first value listed in the Level column of Table 4.

4.2.1.37 Set the MMR to Set Ref.

4.2.1.38 Allow the MMR Tuned RF Level indication to settle.

4.2.1.39 Set the MMR Ext RF Atten to the value recorded, in dB, in step 4.2.1.29 for the frequency being verified.

4.2.1.40 Press the TI F3 (Level) and select the next value listed in the Level column of Table 4.

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

4.2.1.42 Press the TI F3 (Level) and select the next value listed in the Level column of Table 4.

4.2.1.43 Repeat steps 4.2.1.41 and 4.2.1.42, as required, for the remaining values listed in Table 4.

Table 4.

Level (dBm)	Limits (dBm)
0.0	Reference
-10.0	-11.5 to -8.5
-20.0	-21.5 to -18.5
-30.0	-31.5 to -28.5
-40.0	-41.5 to -38.5
-50.0	-51.5 to -48.5
-60.0	-61.5 to -58.5
-70.0	-71.5 to -68.5
-80.0	-81.5 to -78.5
-90.0	-91.5 to -88.5

Table 4. (Cont.)

Level (dBm)	Limits (dBm)
-100.0	-101.5 to -98.5
-110.0	-111.5 to -108.5
-120.0	-122.5 to -117.5

4.2.1.44 Set the MMR Ext RF Atten to 0.0 dBm.

4.2.1.45 Repeat steps 4.2.1.34 through 4.2.1.44 at 100 and 500 MHz.

4.2.1.46 Press the TI F3 (Level) and select a minimum level.

4.2.1.47 Disconnect test setup. Ensure the TI and MMR Time bases are no longer connected.

4.2.2 SPECTRAL PURITY CALIBRATION:

4.2.2.1 RESIDUAL FM CALIBRATION:

4.2.2.1.1 Connect the MMR RF INPUT 50 Ω to the TI T/R input connector without the Sensor Module.

4.2.2.1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Ensure TI Modulation is Off.

4.2.2.1.3 Press the TI RF GEN, then F2 (Freq) and set to the first value listed in the Frequency column of Table 5. Press F3 (Level) and select a level of -10.0 dBm.

4.2.2.1.4 Set the MMR Frequency to the TI frequency.

4.2.2.1.5 Set the MMR to Measuring Receiver mode. Set the MMR controls, as required, to measure FM Deviation. Set the High Pass Filter to 50 Hz, Low Pass Filter to 15 kHz and Detector to RMS.

4.2.2.1.6 Verify the MMR FM Deviation indication is within the corresponding value listed in the Limits column of Table 5.

4.2.2.1.7 Press the TI RF GEN, then F2 (Freq) and set to the next value listed in the Frequency column of Table 5.

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

4.2.2.1.9 Repeat steps 4.2.2.1.6 through 4.2.2.1.8, as required, for the remaining values listed in Table 5.

Table 5.

Frequency (Hz)	Limits (Hz rms)
500.0 k	<45
1.00 M	<45
10.0 M	<45
100.0 M	<45
500.0 M	<45

4.2.2.1.10 Press the TI RF GEN, then F3 (Level). Select a minimum output. Do not disconnect the test setup.

4.2.2.2 RESIDUAL AM CALIBRATION:

4.2.2.2.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Ensure TI Modulation is Off.

4.2.2.2.2 Press the TI RF GEN, then F2 (Freq) and set to the first value listed in the Frequency column of Table 6. Press F3 (Level) and select a level of -20.0 dBm.

4.2.2.2.3 Set the MMR Frequency to the TI frequency.

4.2.2.2.4 Set the MMR for AM Depth measurements in the Measuring Receiver mode. Set the High Pass Filter to 50 Hz, Low Pass Filter to 15 kHz and Detector to RMS.

4.2.2.2.5 Verify the MMR AM Depth indication is within the corresponding value listed in the Limits column of Table 6.

Table 6.

Frequency (Hz)	Limits (%)
500 k	<0.20
1.01 M	<0.10
10.0 M	<0.10
100.0 M	<0.10
500.0 M	<0.10

4.2.2.2.6 Press the TI RF GEN, then F2 (Freq) and set to the next value listed in the Frequency column of Table 6.

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

4.2.2.2.8 Repeat steps 4.2.2.2.5 through 4.2.2.2.7, as required, for the remaining values listed in Table 6.

4.2.2.2.9 Press the TI F3 (Level) and select a minimum level. Do not disconnect the test setup.

4.2.2.3 HARMONICS AND NON-HARMONICS CALIBRATION:

4.2.2.3.1 Set the MMR to Spectrum Analysis mode. Set MMR input Attenuation to 30 dB.

4.2.2.3.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults.

4.2.2.3.3 Press the TI RF GEN, then F2 (Freq) and select a frequency of 125 MHz. Press F3 (Level) and select a level of 0.0 dBm.

4.2.2.3.4 Set the MMR for Harmonic Distortion measurements at 125 MHz.

4.2.2.3.5 Verify the MMR Amplitude indication of the first four Harmonic signals is within <-26 dBc.

4.2.2.3.6 Set the MMR controls to place the peak of the carrier at a convenient reference level.

4.2.2.3.7 Set the MMR controls as required to measure any Nonharmonic Signal.

4.2.2.3.8 Verify the amplitude of any Nonharmonic Signal is <-50 dBc.

Table 7.

[Deleted]

4.2.2.3.9 Press the TI F3 (Level) and select a minimum level. Do not disconnect the test setup.

4.2.2.4 SINGLE SIDEBAND PHASE NOISE CALIBRATION:

4.2.2.4.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press RF GEN, then F2 (Freq) and set to the first value listed in the Applied column of Table 8. Press F3 (Level) and select a level of 0.0 dBm.

4.2.2.4.2 Ensure the MMR Spectrum Analyzer is set to Spectrum Analysis Mode. Set the Center Frequency to the TI frequency, Span to 50 kHz and RBW to 300 Hz. Set the reference level as required to set the peak at a convenient level.

4.2.2.4.3 Set the MMR Spectrum Analyzer to do a peak search, set the Marker Delta to 20 kHz and set the Marker Noise to On.

4.2.2.4.4 Verify the MMR Spectrum Analyzer ΔMkr Noise Level is within the corresponding value listed in the Limits column in Table 8.

NOTE

The MMR Spectrum Analyzer will display the indication in dB/Hz vs dBc/Hz.

4.2.2.4.5 Set the MMR Spectrum Analyzer Markers to Off.

4.2.2.4.6 Press the TI RF GEN, then F2 (Freq) and set to the next value listed in the Applied column of Table 8.

4.2.2.4.7 Repeat step 4.2.2.4.2 through 4.2.2.4.6 for the remaining values in Table 8.

Table 8.

Applied (MHz)	Limits (dBc/Hz)
500	<-90
100	<-90
10	<-90

4.2.2.4.8 Press the TI F3 (Level) and set to minimum level. Disconnect the test setup.

4.3 RF SIGNAL MODULATION CALIBRATION:

4.3.1 INTERNAL FM DEVIATION AND TOTAL HARMONIC DISTORTION CALIBRATION:

4.3.1.1 Connect the TI DUPLEX connector to the Microwave Measuring Receiver INPUT 50 Ω.

4.3.1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI DPLX and then press F2 (RX).

4.3.1.3 Select TI RX and enter a frequency of 10.0 MHz, then select OUT and DPL, then enter a level of -10.0 dBm.

4.3.1.4 On the Microwave Measuring Receiver, press INSTR PRESET, FM key, 300 Hz HP FILTER, 3 kHz LP FILTER and ±PEAK/2 keys.

4.3.1.5 Record the Microwave Measuring Receiver indication as TI Residual FM.

4.3.1.6 Press F6 (MORE) until F1 indicates Source and select MOD TYPE of FM, press ENTER and then press F6 (More) until F2 indicates Dev, F3 indicates M Freq and F4 indicates Wave. Press F2 (Dev) and enter 0.1 kHz. Press F3 (M Freq) and enter 1000.0 Hz. Press F4 (Wave) and select Sine and press ENTER.

4.3.1.7 Subtract the value recorded in step 4.3.1.5 from the Microwave Measuring Receiver indication. The value obtained must be within 90.0 to 110.0 Hz.

4.3.1.8 Set TI FM Deviation to 0. Repeat steps 4.3.1.3 through 4.3.1.7 for the remaining values listed in Table 9.

NOTE

Set the Microwave Measuring Receiver LP and HP FILTERS as required to measure the modulation for the modulation frequencies applied.

Table 9.

Frequency (MHz)	Modulation Frequency (kHz)	Deviation (Hz)	Limits (Hz)
10.0	1.0	100	90.0 to 110.0
10.0	1.0	1.0 k	0.950 to 1.050 k
10.0	1.0	10.0 k	9.50 to 10.50 k
10.0	1.0	25.0 k	22.50 to 27.50 k
10.0	1.0	50.0 k	45.0 to 55.0 k
10.0	1.0	100.0 k	90.0 to 110.0 k
100.0	1.0	10.0 k	9.50 to 10.50 k
500.0	1.0	10.0 k	9.50 to 10.50 k
10.0	0.100	10.0 k	9.50 to 10.50 k
10.0	5.0	10.0 k	9.50 to 10.50 k
10.0	10.0	10.0 k	9.50 to 10.50 k

4.3.1.9 Press the TI F2 (Dev) and enter 10.0 kHz, press F3 (M Freq) and enter 1000.0 Hz and then press F4 (Wave) and select Sine and press ENTER.

4.3.1.10 On the Microwave Measuring Receiver, press the 300 Hz HP FILTER and the 15 kHz LP FILTER to on.

4.3.1.11 Connect the Microwave Measuring Receiver MODULATION OUTPUT to the MMR RF INPUT 50 Ω.

NOTE

Steps 4.3.1.12 through 4.3.1.15 can also be performed using the automated Total Harmonic Distortion function on the MMR.

4.3.1.12 Set the MMR controls to place the fundamental (1 kHz) at the top graticule line.

4.3.1.13 Set the MMR Center Frequency controls to view only the second harmonic (2 kHz) with the Frequency Span set to 1 kHz. Record the second harmonic amplitude.

4.3.1.14 Measure each individual harmonic up to and including the 5th harmonic by repeating step 4.3.1.13.

4.3.1.15 Determine the difference between the peak of the fundamental signal and the peak of each of the harmonics (this will be a negative number). Calculate Total Harmonic Distortion as follows:

$$THD = 100\sqrt{\left(LOG^{-1}\frac{2nd}{20}\right)^2 + \left(LOG^{-1}\frac{3rd}{20}\right)^2 + \left(LOG^{-1}\frac{4th}{20}\right)^2 + \left(LOG^{-1}\frac{5th}{20}\right)^2}$$

Where: THD = Total Harmonic Distortion

LOG^{-1} = Antilog

2nd, 3rd, 4th, 5th = Harmonics in dBc

4.3.1.16 Verify the Total Harmonic Distortion calculated in step 4.3.1.15 is <0.7%.

4.3.1.17 Press the TI F3 (M Freq) and enter 10.0 kHz.

4.3.1.18 On the Microwave Measuring Receiver, set the HP and LP FILTERs to off.

4.3.1.19 Repeat steps 4.3.1.12 through 4.3.1.15 for 10 kHz and verify the Total Harmonic Distortion calculated in step 4.3.1.15 is <1.0%.

4.3.1.20 Press the TI F3 (M Freq) and enter 20.0 kHz.

4.3.1.21 Repeat steps 4.3.1.12 through 4.3.1.15 for 20 kHz and verify the Total Harmonic Distortion calculated in step 4.3.1.15 is <2.0%.

4.3.1.22 On the TI, select a minimum output. Disconnect the MMR.

4.3.1A INTERNAL FM DEVIATION AND TOTAL HARMONIC DISTORTION CALIBRATION: (Alternate Method)

4.3.1A.1 Connect the TI DUPLEX connector to the Modulation Analyzer RF 50 Ω.

NOTE

Use an Attenuator as required.

4.3.1A.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI DPLX and then press F2 (RX).

4.3.1A.3 Select TI RX and enter a frequency of 10.0 MHz, then select OUT and DPL, then enter a level of -10.0 dBm.

4.3.1A.4 Set the Modulation Analyzer to measure FM. Set HP Filter to 300 Hz, LP Filter to 3 kHz and +/- PEAK/2.

4.3.1A.5 Record the Modulation Analyzer indication as TI Residual FM.

4.3.1A.6 Press the TI F6 (MORE) until F1 indicates Source and select MOD TYPE of FM, press ENTER and then press F6 (More) until F2 indicates Dev, F3 indicates M Freq and F4 indicates Wave. Press F2 (Dev) and enter 0.1 kHz. Press F3 (M Freq) and enter 1000.0 Hz. Press F4 (Wave) and select Sine and press ENTER.

4.3.1A.7 Subtract the value recorded in step 4.3.1A.5 from the Modulation Analyzer indication. The value obtained must be within 90.0 to 110.0 Hz.

4.3.1A.8 Repeat steps 4.3.1A.3 through 4.3.1A.7 for the remaining values listed in Table 2A.

NOTE

Set the Modulation Analyzer HP and LP filters as required to measure the modulation for the modulation frequencies applied.

Table 2A.

Frequency (MHz)	Modulation Frequency (kHz)	Deviation (Hz)	Limits (Hz)
10.0	1.0	100	90.0 to 110.0
10.0	1.0	1.0 k	0.950 to 1.050 k
10.0	1.0	10.0 k	9.50 to 10.50 k
10.0	1.0	25.0 k	22.50 to 27.50 k
10.0	1.0	50.0 k	45.0 to 55.0 k
10.0	1.0	100.0 k	90.0 to 110.0 k
100.0	1.0	10.0 k	9.50 to 10.50 k
500.0	1.0	10.0 k	9.50 to 10.50 k
10.0	0.100	10.0 k	9.50 to 10.50 k
10.0	5.0	10.0 k	9.50 to 10.50 k
10.0	10.0	10.0 k	9.50 to 10.50 k

4.3.1A.9 Press the TI F2 (Dev) and enter 10.0 kHz, press F3 (M Freq) and enter 1000.0 Hz and then press F4 (Wave) and select Sine and press ENTER.

4.3.1A.10 On the Modulation Analyzer, press the 300 Hz HP FILTER and the 23 kHz LP FILTER to on.

4.3.1A.11 Connect the Modulation Analyzer AF OUTPUT to the MMR RF INPUT 50 Ω. Set the MMR INPUT ATTEN to 30 dB and REF LEVEL to 13 dBm.

NOTE

Steps 4.3.1A.12 through 4.3.1A.15 can be performed using the Total Harmonic Distortion automated measurement function in the MMR.

4.3.1A.12 Set the MMR controls to place the fundamental (1 kHz) at the top graticule line.

4.3.1A.13 Set the MMR Center Frequency controls to view only the second harmonic (2 kHz) with the Frequency Span set to 1 kHz. Record the second harmonic amplitude.

4.3.1A.14 Measure each individual harmonic up to and including the 5th harmonic by repeating step 4.3.1A.13.

4.3.1A.15 Determine the difference between the peak of the fundamental signal and the peak of each of the harmonics (this will be a negative number). Calculate Total Harmonic Distortion as follows:

$$THD = 100\sqrt{\left(LOG^{-1}\frac{2nd}{20}\right)^2 + \left(LOG^{-1}\frac{3rd}{20}\right)^2 + \left(LOG^{-1}\frac{4th}{20}\right)^2 + \left(LOG^{-1}\frac{5th}{20}\right)^2}$$

Where: THD = Total Harmonic Distortion

LOG^{-1} = Antilog

2nd, 3rd, 4th, 5th = Harmonics in dBc

4.3.1A.16 Verify the Total Harmonic Distortion calculated in step 4.3.1A.15 is <0.7%.

4.3.1A.17 Press the TI F3 (M Freq) and enter 10.0 kHz.

4.3.1A.18 On the Modulation Analyzer, set the HP and LP FILTERs to off.

4.3.1A.19 Repeat steps 4.3.1A.12 through 4.3.1A.15 for 10 kHz and verify the Total Harmonic Distortion calculated in step 4.3.1A.15 is <1.0%.

4.3.1A.20 Press the TI F3 (M Freq) and enter 20.0 kHz.

4.3.1A.21 Repeat steps 4.3.1A.12 through 4.3.1A.15 for 20 kHz and verify the Total Harmonic Distortion calculated in step 4.3.1A.15 is <2.0%.

4.3.1A.22 On the TI, select a minimum output. Disconnect the test setup.

4.3.2 INTERNAL AM AMPLITUDE MODULATION AND TOTAL HARMONIC DISTORTION CALIBRATION:

4.3.2.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI DPLX and then press F2 (RX).

4.3.2.2 Select TI RX and enter a frequency of 10.0 MHz, then select OUT and DPL, then enter a level of -10.0 dBm.

4.3.2.3 Press F1 (Source) and select MOD TYPE of AM, press ENTER and then press F6 (More) until F2 indicates Mod, F3 indicates M Freq and F4 indicates Wave. Press F2 (Mod) and enter 30%. Press F3 (M Freq) and enter 1000.0 Hz. Press F4 (Wave) and select Sine and press ENTER.

4.3.2.4 On the Microwave Measuring Receiver, press INSTR PRESET and AM mode keys. Select the 300 Hz HP FILTER and the 3 kHz LP FILTER.

4.3.2.5 The Microwave Measuring Receiver must indicate within 28.5 to 31.5%.

Table 10.

Frequency (MHz)	Modulation Frequency (kHz)	Modulation Depth (%)	Limits (%)
10.0	1.0	30.0	28.5 to 31.5
10.0	1.0	50.0	47.5 to 52.5
10.0	1.0	70.0	66.5 to 73.5
10.0	1.0	90.0	85.5 to 94.5
10.0	0.100	50.0	47.5 to 52.5
10.0	5.0	50.0	47.5 to 52.5
10.0	10.0	50.0	47.5 to 52.5
50.0	1.0	50.0	47.5 to 52.5
250.0	1.0	50.0	47.5 to 52.5
500.0	1.0	50.0	47.5 to 52.5

4.3.2.6 Repeat steps 4.3.2.2 through 4.3.2.5 for the remaining values listed in Table 10.

NOTE

Set the Microwave Measuring Receiver LP and HP FILTERS as required to measure the modulation for the modulation frequencies applied.

4.3.2.7 Press the TI F2 (Mod) and enter 30.0%, press F3 (M Freq) and enter 1000.0 Hz and press F4 (Wave) and select Sine.

4.3.2.8 On the Microwave Measuring Receiver, press the 300 Hz HP FILTER and the 15 kHz LP FILTER to on.

4.3.2.9 Connect the Microwave Measuring Receiver Modulation Output to the Audio Analyzer input. Set the Audio Analyzer to measure distortion with the 80 kHz LP Filter on.

4.3.2.10 Verify the Audio Analyzer indication is <0.7%.

4.3.2.11 Press the TI F2 (Mod) and enter 50.0%.

4.3.2.12 Repeat step 4.3.2.10.

4.3.2.13 On the Microwave Measuring Receiver, press >20 kHz LP FILTER to on.

4.3.2.14 Press the TI F3 (M Freq) and enter 6.0 kHz.

4.3.2.15 Verify the Audio Analyzer indication is <1.5%.

4.3.2.16 Press the TI F3 (M Freq) and enter 10.0 kHz.

4.3.2.17 Verify the Audio Analyzer indication is <2.5%.

4.3.2.18 On the TI, select a minimum output. Do not disconnect the test setup.

4.3.2A INTERNAL AM AMPLITUDE MODULATION AND TOTAL HARMONIC DISTORTION CALIBRATION: (Alternate Method)

4.3.2A.1 Connect the MMR RF INPUT 50 Ω to the TI DUPLEX connector.

4.3.2A.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI DPLX and then press F2 (RX).

4.3.2A.3 Select TI RX and enter the first value listed in the Frequency column of Table 3A, then select OUT and DPL, then enter a level of -10.0 dBm.

4.3.2A.4 Press TI F1 (Source) and select MOD TYPE of AM, press ENTER and then press F6 (More) until F2 indicates Mod, F3 indicates M Freq and F4 indicates Wave.

4.3.2A.5 Press TI F2 (Mod) and enter the first value listed in the Modulation Depth column of Table 3A.

4.3.2A.6 Press TI F3 (M Freq) and enter the first value listed in the Modulation Frequency column of Table 3A. Press F4 (Wave) and select Sine and press ENTER.

4.3.2A.7 Set the MMR Frequency to the TI frequency.

4.3.2A.8 Set the MMR to Measuring Receiver mode. Set the MMR controls, as required, to measure Modulation Depth. Set the High Pass Filter to 300 Hz, Low Pass Filter to 3 kHz and Detector to Peak +-/2.

4.3.2A.9 Verify the MMR AM Depth indication is within the corresponding values listed in the Limits column of Table 3A.

4.3.2A.10 Select TI RX and enter the next value listed in the Frequency column of Table 3A.

4.3.2A.11 Set the MMR Frequency to the TI frequency.

4.3.2A.12 Press TI F2 (Mod) and enter the next corresponding value listed in the Modulation Depth column of Table 3A.

4.3.2A.13 Press TI F3 (M Freq) and enter the next corresponding value listed in the Modulation Frequency column of Table 3A. Press F4 (Wave) and select Sine and press ENTER.

4.3.2A.14 Repeat steps 4.3.2A.8 through 4.3.2A.13, as required, for the remaining values listed in Table 3A.

NOTE

Set the MMR Low Pass and High Pass Filters as required to measure the modulation for the modulation frequencies applied.

Table 3A.

Frequency (MHz)	Modulation Frequency (kHz)	Modulation Depth (%)	Limits (%)
10.0	1.0	30.0	28.5 to 31.5
10.0	1.0	50.0	47.5 to 52.5
10.0	1.0	70.0	66.5 to 73.5
10.0	1.0	90.0	85.5 to 94.5
10.0	0.100	50.0	47.5 to 52.5
10.0	5.0	50.0	47.5 to 52.5
10.0	10.0	50.0	47.5 to 52.5
50.0	1.0	50.0	47.5 to 52.5
250.0	1.0	50.0	47.5 to 52.5
500.0	1.0	50.0	47.5 to 52.5

4.3.2A.15 Press the TI F2 (Mod) and enter 30.0%, press F3 (M Freq) and enter 1000.0 Hz and press F4 (Wave) and select Sine.

4.3.2A.16 Set the MMR controls, as required, to measure AM Distortion. Set the MMR High Pass Filter to 300 Hz, Low Pass Filter to 15 kHz.

4.3.2A.17 Verify the MMR AM Mod Distortion indication is <0.7%.

4.3.2A.18 Press the TI F2 (Mod) and enter 50.0%.

4.3.2A.19 Repeat step 4.3.2A.17.

4.3.2A.20 Set the MMR Low Pass Filter to 30 kHz.

4.3.2A.21 Press the TI F3 (M Freq) and enter 6.0 kHz.

4.3.2A.22 Verify the MMR AM Mod Distortion indication is <1.5%.

4.3.2A.23 Press the TI F3 (M Freq) and enter 10.0 kHz.

4.3.2A.24 Verify the MMR AM Mod Distortion indication is <2.5%.

4.3.2A.25 On the TI, select a minimum output. Leave the test setup connected.

4.3.2A.26 Proceed to para 4.3.3A.

4.3.3 INTERNAL PHASE MODULATION AND DISTORTION CALIBRATION:

4.3.3.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI DPLX, then press F2 (RX).

4.3.3.2 Select TI RX and enter a frequency of 10.0 MHz, then select OUT and DPL, then enter a level of -10.0 dBm.

4.3.3.3 Press F1 (Source) and select MOD TYPE of PM, press ENTER, then press F6 (More) until F2 indicates Mod, F3 indicates M Freq and F4 indicates Wave. Press F2 (Mod) and enter 1.0 rad. Press F3 (M Freq) and enter 1000.0 Hz. Press F4 (Wave) and select Sine and press ENTER.

4.3.3.4 On the Microwave Measuring Receiver, press INSTR PRESET and the ΦM keys. Select the 300 Hz HP FILTER and the 3 kHz LP FILTER.

4.3.3.5 The Microwave Measuring Receiver must indicate within 0.9 to 1.1 rad.

Table 11.

Frequency (MHz)	Modulation Frequency (kHz)	Modulation Deviation (rad)	Limits (rad)
10.0	1.0	1.0	0.9 to 1.1
10.0	1.0	5.0	4.5 to 5.5
10.0	1.0	10.0	9.0 to 11.0
100.0	1.0	10.0	9.0 to 11.0
500.0	1.0	10.0	9.0 to 11.0

4.3.3.6 Repeat steps 4.3.3.2 through 4.3.3.5, as required, for the remaining values listed in Table 11.

NOTE

Set the Microwave Measuring Receiver LP and HP FILTERS as required to measure the modulation for the modulation frequencies applied.

4.3.3.7 On the Microwave Measuring Receiver, press the 300 Hz HP FILTER and the 15 kHz LP FILTER to on.

4.3.3.8 Set the Audio Analyzer to measure Distortion with the 30 kHz LP Filter on.

4.3.3.9 Verify the Audio Analyzer indication is <2.0%.

4.3.3.10 Press the TI F2 (Dev) and enter 5.0 rad.

4.3.3.11 Repeat step 4.3.3.9.

4.3.3.12 On the TI, select a minimum output. Disconnect the test setup.

4.3.3A INTERNAL PHASE MODULATION AND DISTORTION CALIBRATION: (Alternate Method)

4.3.3A.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI DPLX, then press F2 (RX).

4.3.3A.2 Select TI RX and enter the first value listed in the Frequency column of Table 4A, then select OUT and DPL, then enter a level of -10.0 dBm.

4.3.3A.3 Press TI F1 (Source) and select MOD TYPE of PM, press ENTER, then press F6 (More) until F2 indicates Mod, F3 indicates M Freq and F4 indicates Wave. Press F2 (Mod) and enter the first value listed in the Modulation Deviation column of Table 4A. Press F3 (M Freq) and enter 1000.0 Hz. Press F4 (Wave) and select Sine and press ENTER.

4.3.3A.4 Set the MMR to Measuring Receiver mode. Set the MMR frequency to the TI frequency.

NOTE

To stabilize reading on MMR, use IIR filter type. This can be set by pressing Detector Demod, More, Filter Type.

4.3.3A.5 Set the MMR controls, as required, to measure PM Deviation. Set the High Pass Filter to 300 Hz, the Low Pass Filter to 3 kHz and Detector to Peak+.

4.3.3A.6 Verify the MMR PM Deviation indication is within the corresponding values listed in the Limits column of Table 4A.

4.3.3A.7 Repeat steps 4.3.3A.2 through 4.3.3A.6, as required, for the remaining values listed in Table 4A.

Table 4A.

Frequency (MHz)	Modulation Frequency (kHz)	Modulation Deviation (rad)	Limits (rad)
10.0	1.0	1.0	0.9 to 1.1
10.0	1.0	5.0	4.5 to 5.5
10.0	1.0	10.0	9.0 to 11.0
100.0	1.0	10.0	9.0 to 11.0
500.0	1.0	10.0	9.0 to 11.0

4.3.3A.8 Verify the MMR PM Mod Distortion indication is <2.0%.

4.3.3A.9 Press the TI F2 (Dev) and enter 5.0 rad.

4.3.3A.10 Repeat step 4.3.3A.8.

4.3.3A.11 On the TI, select a minimum output. Disconnect the test setup.

4.4 AF GENERATOR CALIBRATION:

4.4.1 FREQUENCY CALIBRATION:

4.4.1.1 Connect the Frequency Counter CHANNEL 1 Input to the TI AUDIO OUT connector.

4.4.1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI AF GEN. The TI will display the AF Gen Menu. Press ENTER to set Gen #1 to On.

4.4.1.3 Select a Freq of 10.0 Hz and a Wave Form of Sine.

4.4.1.4 Select a Func Gen Out Level of 1.0000 V.

4.4.1.5 Set the Frequency Counter as required to read a stable and reliable frequency.

4.4.1.6 The Frequency Counter must indicate within 9.99 to 10.01 Hz.

Table 12.

Freq (Hz)	Limits (Hz)
10.0	9 99 to 10.01
100.0	99.9 to 100.1
1.000 k	0.999 to 1.001 k
10.00 k	9.99 to 10.01 k
40.00 k	39.96 to 40.04 k

4.4.1.7 Repeat steps 4.4.1.3 through 4.4.1.6 for the remaining values listed in Table 12.

4.4.1.8 On the TI, select a minimum Func Gen Out Level for AF Gen #1. Disconnect the Frequency Counter from TI.

4.4.2 LEVEL CALIBRATION:

4.4.2.1 Connect equipment as shown in Figure 1.

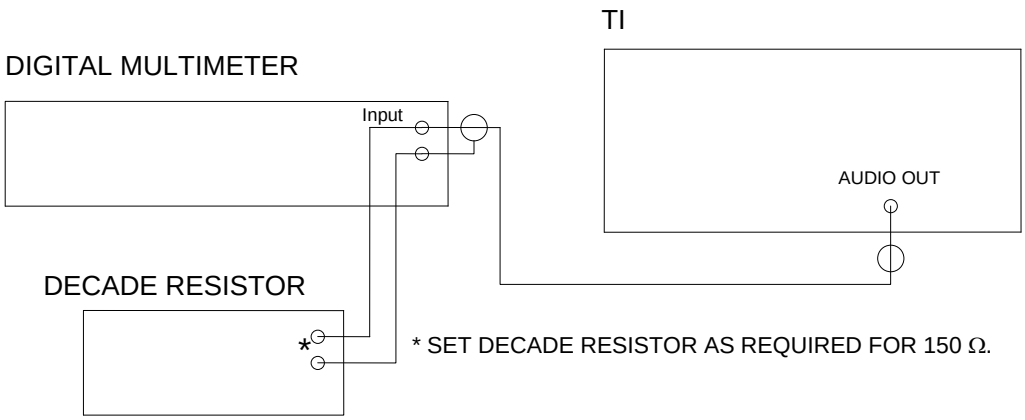

Figure 1.

4.4.2.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI AF GEN. The TI will display the AF Gen Menu. Press ENTER to set Gen #1 to On.

4.4.2.3 Select a Freq of 1.0 kHz and a Wave Form of Sine.

4.4.2.4 Select a Func Gen Out Level of 1.00 mV.

4.4.2.5 Set the Digital Multimeter as required to measure AC Volts. Ensure the Decade Resistor is set as required for 150 Ω.

4.4.2.6 The Digital Multimeter must indicate within 0.90 to 1.1 mV rms.

4.4.2.7 Repeat steps 4.4.2.3 through 4.4.2.6 for the remaining values listed in Table 13.

Table 13.

TI Freq (Hz)	TI Func Gen Out Level (V)	Limits (V rms)
1.0 k	1.00 m	0.90 to 1.10 m
1.0 k	10.0 m	9.70 to 10.3 m
1.0 k	0.100	97.0 to 103.0 m
10.0	1.000	0.970 to 1.030
100.0	1.000	0.970 to 1.030
1.0 k	1.000	0.970 to 1.030
10.0 k	1.000	0.970 to 1.030
25.0 k	1.000	0.950 to 1.050
1.0 k	2.500	2.425 to 2.575

4.4.2.8 On the TI, select a minimum Func Gen Out Level for AF Gen #1. Disconnect test equipment from TI.

4.4.3 TOTAL HARMONIC DISTORTION CALIBRATION:

4.4.3.1 Connect the MMR RF INPUT 50 Ω to the TI AUDIO OUT connector. Set the MMR INPUT ATTEN to 30 dB and REF LEVEL to 13 dBm.

4.4.3.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI AF GEN. The TI will display the AF Gen Menu. Press ENTER to set Gen #1 to On.

4.4.3.3 Select a Level of 1.0000 V.

4.4.3.4 Select TI frequency for the first value listed in the Frequency column of Table 14 and a Wave Form of Sine.

4.4.3.5 Set the MMR to measure Total Harmonic Distortion at 20 Hz. Measurements can be performed using the automated THD function of the MMR or performed manually using the equation as in step 4.3.1.15.

4.4.3.6 Verify the MMR THD indication is within the corresponding value listed in the Limits column of Table 14.

Table 14.

Frequency (Hz)	Func Gen Out Level (V)	Limits (%)
20.0	1.00	<1.0
100.0	1.00	<1.0
1.0 k	1.00	<0.7
10.0 k	1.00	<1.0
20.0 k	1.00	<1.0
40.0 k	1.00	<1.0

4.4.3.7 Select TI frequency for the next value listed in the Frequency column of Table 14.

4.4.3.8 Repeat steps 4.4.3.5 and 4.4.3.6 for the next values listed in Table 14.

4.4.3.9 Repeat step 4.4.3.7 and 4.4.3.8 for the remaining values listed in Table 14.

4.4.3.10 On the TI, select a minimum Func Gen Out Level for AF Gen #1. Disconnect test equipment from TI.

4.5 RF POWER METER CALIBRATION:

CAUTION

The TI Power Meter Detector Diode is extremely sensitive to overpowering. A single event of overpowering will damage the TI. If not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

CAUTION

The Power Amplifier may produce spikes when used at low power and care should be taken not to damage the TI by using the Attenuator in line with the amplified signal. The Attenuator must be used when using the Power Amplifier to avoid damage to the TI. If not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

NOTE

Use the applicable Directional Power Sensor (p/o the RF Power Measurement Set), as required, for the frequency being tested.

NOTE

If a Sub-Item Power Amplifier is used, ensure the following: If using the p/n BHED1758-200/4006 Power Amplifier, do not use the Attenuator; connect the RF Out of the Power Amplifier to the input of the Directional Power Sensor. If using the p/n SSPA0240-22/6140 Power Amplifier, do not use the Attenuator, but do use an appropriate High Power Lowpass Filter (2.15 or 2.16) between the output of the Power Amplifier and the input of the Directional Power Sensor.

4.5.1 Connect equipment as shown in Figure 2.

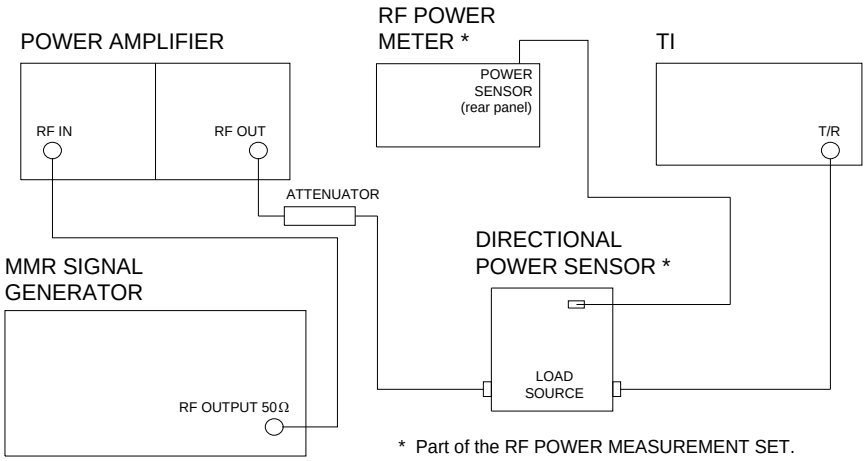

Figure 2.

4.5.2 Set the RF Power Meter, as required, to measure Watts.

4.5.3 Adjust the Power Amplifier RF OUTPUT LEVEL CONTROL fully CCW.

4.5.4 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI MTRS. The TI will display the Meter Menu. Select 3. Pwr Meter (Pulse/CW).

4.5.5 Press the TI F4 (Zero) and follow instructions on screen to zero the Power Meter.

4.5.6 Press the TI SETUP. The TI will display the Power Meter Menu. Select 1, Meter Range and select 20 W.

4.5.7 Select 2. Measurement Type. Select CW for the measurement type.

4.5.8 Press the TI MTRS, then select 3. Pwr Meter (Pulse/CW) to return to the Power Meter display.

4.5.9 Set the MMR Signal Generator to the first value listed in the Frequency column of Table 15 at 0.0 dBm.

CAUTION

When applying power to TI, technician must follow the On/Off Duty Cycle: ≤10 W, Continuous; >10 to ≤20 W, On: Max of 3 min, Off: Min of 2 min; >20 to ≤30 W, On: Max of 1 min, Off: Min of 2 min; >50 to 100 W, On: Max of 30 seconds, Off: Min of 2 min. If not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

4.5.10 On the Power Amplifier press the appropriate BAND, as required, for the first value listed in the Frequency column of Table 15. Adjust the Power Amplifier RF OUTPUT LEVEL CONTROL until the TI *TX PWR* = indicates the first value listed in the Applied column of Table 15.

NOTE

Ensure the RF Power Meter FWD lamp is illuminated. If not, press the RF PWR key.

4.5.11 Verify the RF Power Meter indicates within the corresponding values listed in the Limits column of Table 15.

4.5.12 Adjust the Power Amplifier RF OUTPUT LEVEL CONTROL fully CCW.

4.5.13 Repeat steps 4.5.9 through 4.5.12, as necessary, for the remaining values and TI Ranges listed in Table 15. Use the applicable Directional Power Sensor, as required, for the frequency being tested.

Table 15.

Frequency (MHz)	Applied (W)	TI Range (W)	Limits (W)
400.0	10.0	20	8.9 to 11.1
400.0	30.0	50 *	26.9 to 33.1
100.0	50.0	100 **	44 to 56

* Before measurement press the TI SETUP. The TI will display the Power Meter Menu. Select 1, Meter Range and select 50 W. Press MTRS (Meter Menu), select item 3 [(Pwr Meter (Pulse/CW)], then press ENTER.

** Before measurement press the TI SETUP. The TI will display the Power Meter Menu. Select 1, Meter Range and select 100 W. Press MTRS (Meter Menu), select item 3 [(Pwr Meter (Pulse/CW)], then press ENTER.

4.5.14 Set all outputs to minimum, as required. Disconnect the test setup.

NOTE

The 50 Ω Leveling Head (p/o RF Reference Source) is an integral part of the RF Reference Source. All connections are to be made through the 50 Ω Leveling Head.

4.5.15 Connect the RF Reference Source RF OUTPUT to the TI T/R connector.

4.5.16 Press the TI MTRS. The TI will display the Meter Menu. Select 3. Pwr Meter (Pulse/CW).

4.5.17 Press the TI SETUP. The TI will display the Power Meter Menu. Select 1. Meter Range and select Autorange.

4.5.18 On the TI, select 2. Measurement Type. Select CW for the measurement type.

4.5.19 Press the TI MTRS, then Select 3. Press Pwr Meter (Pulse/CW) to return to the Power Meter display.

4.5.20 Set the RF Reference Source for a +10 dBm at 10 MHz output and press OPER.

4.5.21 Verify the TI indicates within 8.9 to 11.1 mW.

4.5.22 Press the RF Reference Source STBY.

Table 16.

RF Reference Source		
Level (mW)	**Frequency (MHz)**	**TI Limits (mW)**
10.00	10	8.9 to 11.1
10.00	100	8.9 to 11.1
10.00	250	8.9 to 11.1
10.00	400	8.9 to 11.1

4.5.23 Repeat steps 4.5.20 through 4.5.22 for the remaining values listed in Table 16.

4.5.24 Disconnect the test setup.

4.6 FM DEVIATION METER CALIBRATION:

4.6.1 Connect the equipment as shown in Figure 3.

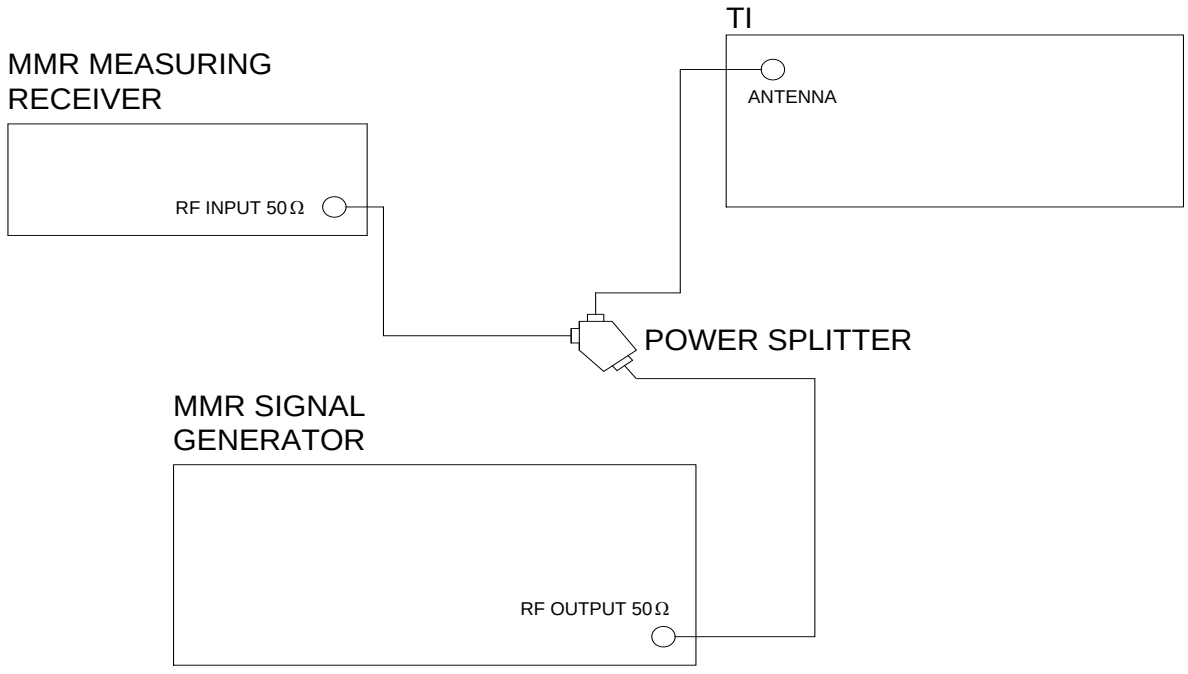

Figure 3.

4.6.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI RCVR, then press SETUP. The TI will display the Rcvr Menu.

4.6.3 From the TI Rcvr Setup Menu, select 1. Set Rcvr Freq and select the first value listed in the Applied Frequency column of Table 17.

4.6.4 From the TI Rcvr Setup Menu, select 2. Select Mod and select 11. User Defined. When User Defined is selected the TI will display the User Defined Menu.

4.6.5 From the TI User Defined Menu, select the following:

Modulation	FM
IF Filters	300 kHz
Post Detection	Low Pass

4.6.6 When Low Pass is selected the TI will display the Low Pass Menu. From the Low Pass Menu, select 15 kHz and press F6 (Esc) to return to the Rcvr Menu.

4.6.7 From the TI Rcvr Menu, select the following:

Rcvr In	Antenna
Input Atten	40 dB

4.6.8 Press the TI RCVR to return to the main receiver display.

4.6.9 Press the TI MTRS and select 4. Dev Meter. From the DEV METER (Peak) screen, select the following:

RANGE	2 kHz
PEAK HOLD	Off
AVERAGE	On
MODE	±Peak/2

4.6.10 Set the MMR Signal Generator to the first value listed in the Applied Frequency column of Table 17 at a level of -10 dBm. Set MMR Frequency to same frequency as the MMR Signal Generator.

4.6.11 Set the MMR for FM Deviation measurements in the Measuring Receiver mode. Set the MMR High Pass Filter to 300 Hz, the Low Pass Filter to 3 kHz and Detector to Peak+/-/2.

4.6.12 Set the MMR Signal Generator internal modulation, as required, to 1 kHz rate.

4.6.13 Record the value indicated on the MMR Measuring Receiver. This is the source residual FM.

NOTE

The MMR indication in step 4.6.14 must be compensated for residual FM. Set the MMR Signal Generator deviation until the MMR Measuring Receiver indicates the desired deviation + the residual FM (the value recorded in step 4.6.13). This compensation factors out the source residual effect on the TI accuracy.

4.6.14 Press the TI RCVR, then F3 (FMZ) to zero the TI display. Wait for both indications in the field DEV to stabilize.

4.6.15 On the MMR Signal Generator, set FM ON/OFF to ON and the deviation, as required, for the first value listed in the Applied Deviation column of Table 17 as indicated on the MMR.

4.6.16 Allow the MMR indication to settle.

NOTE

The MMR RESTART must be pressed after changing the MMR Signal Generator FM deviation.

4.6.17 Verify the TI DEV indicates within the corresponding values listed in the Limits column of Table 17.

4.6.18 Repeat steps 4.6.3 through 4.6.17, as necessary, for the remaining values listed in Table 17.

NOTE

Set TI Rcvr Freq as required to match the MMR Signal Generator frequency. After changing the MMR Signal Generator frequency, it may be necessary to reset the TI by pressing the RCVR in order to obtain the required resolution.

Table 17.

Frequency (MHz)	Applied Rate (kHz)	Deviation (kHz)	TI Range (kHz)	Limits (kHz)
10.0	1	1.0	2	0.94 to 1.06
10	1	4.0	5	3.82 to 4.18
10	1	9.0	10	8.62 to 9.38
10	1	15.0	20	14.2 to 15.8
10	1	40.0	50	38.2 to 41.8
10	1	90.0	100	86.2 to 93.8
20	1	9.0	10	8.62 to 9.38
50	1	9.0	10	8.62 to 9.38
100	1	9.0	10	8.62 to 9.38
500	1	9.0	10	8.62 to 9.38

4.6.19 Set the MMR Signal Generator output to minimum. Do not disconnect the test setup.

4.7 AM DEPTH METER CALIBRATION:

4.7.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI RCVR, then press SETUP. The TI will display the Rcvr Menu.

4.7.2 From the TI Rcvr Menu, select the following:

Rcvr Freq	10.0 MHz
Mod	AM2
Rcvr In	Antenna
Input Atten	40 dB
AGC Type	Auto

Set the remaining functions as desired or leave at default settings.

4.7.3 Press the TI RCVR to return to the main receiver display.

4.7.4 Press the TI MTRS and select 5. Modulation Meter.

4.7.5 From the TI Modulation Meter screen, select the following:

RANGE	40%
PEAK HOLD	Off

4.7.6 Press the TI RCVR to return to the main Receiver display.

4.7.7 On the MMR Measuring Receiver, press INSTR PRESET and AM mode keys. Set the High Pass Filter to 300 Hz, Low Pass Filter to 3 kHz and Detector to Peak+.

4.7.8 Set MMR Signal Generator to the first value listed in the Applied Frequency column of Table 18 at 0.0 dBm. Set the internal modulation to a 1 kHz rate. Ensure the modulation is Off, at this time.

4.7.9 Record the value indicated on the MMR Measuring Receiver. This is the source residual AM.

NOTE

The MMR indication in step 4.7.10 must be compensated for residual AM. Set the MMR Signal Generator depth until the MMR Measuring Receiver indicates the desired depth + the residual AM (the value recorded in step 4.7.9). This compensation factors out the source residual effect on the TI accuracy.

4.7.10 On the MMR Signal Generator, set the AM modulation to On and set the depth to the first value listed in the Applied Depth column of Table 18 as indicated on the MMR Measuring Receiver.

4.7.11 The TI must indicate within the corresponding values listed in the Limits column of Table 18.

NOTE

Set the TI Rcvr Freq as required to match the MMR Signal Generator frequency. After changing the MMR Signal Generator frequency, it may be necessary to reset the TI by pressing the RCVR in order to obtain the required resolution.

Table 18.

Frequency (MHz)	Applied Rate (kHz)	Depth (%)	TI Range (%)	Limits (%)
10.0	1	30.0	40	27.9 to 32.1
10	1	50	100	44.9 to 55.1
10	1	90	100	84.9 to 95.1
50	1	50	100	44.9 to 55.1
500	1	50	100	44.9 to 55.1

4.7.12 Repeat steps 4.7.8 through 4.7.11 for the remaining values listed in Table 18.

4.7.13 Set MMR Signal Generator output to minimum. Do not disconnect the test setup.

4.8 PM DEVIATION METER CALIBRATION:

4.8.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI RCVR, then press SETUP. The TI will display the Rcvr Menu.

4.8.2 Set the MMR to Measuring Receiver mode.

4.8.3 From the TI Rcvr Setup Menu, select 1. Set Rcvr Freq to the first value listed in the Applied Frequency column of Table 19 (if necessary, reset the TI by pressing the RCVR in order to obtain the required resolution).

4.8.4 From the TI Rcvr Setup Menu, select 2. Select Mod and select 10.PM.

4.8.5 From the TI Rcvr Menu, select the following:

Rcvr In	Antenna
Input Atten	40 dB

4.8.6 Press the TI RCVR to return to the main receiver display.

4.8.7 Press the TI MTRS and select 11 Phase Meter.

4.8.8 From the TI Phase Meter screen, select the following:

RANGE	first value listed in the TI Range column of Table 19
PEAK HOLD	Off

4.8.9 Press the TI F6 (Ret) to return to the Receiver operation screen.

4.8.10 Set the MMR Measuring Receiver controls as required to measure Phase Modulation. Set the High Pass Filter to 300 Hz, Low Pass Filter to 3 kHz and Detector to Peak +-/2.

4.8.11 Set MMR Signal Generator as required for the first value listed in the Applied Frequency column of Table 19 at 0.0 dBm. Set the internal modulation to a 1 kHz rate. Ensure the modulation is Off, at this time.

4.8.12 Record the value indicated on the MMR. This is the source residual PM.

NOTE

The MMR indication in step 4.8.13 must be compensated for residual PM. Set the MMR Signal Generator deviation until the MMR Measuring Receiver indicates the desired deviation + the residual PM (the value recorded in step 4.8.12). This compensation factors out the source residual effect on the TI accuracy.

4.8.13 On the MMR Signal Generator, set the Phase Modulation to On and set the deviation for the first value listed in the Applied Deviation column of Table 19 as indicated on the MMR Measuring Receiver.

4.8.14 The TI must indicate within the corresponding values listed in the Limits column of Table 19.

4.8.15 Repeat steps 4.8.3 through 4.8.14, as necessary, for the remaining values listed in Table 19.

NOTE

Set TI Rcvr Freq as required to match the MMR Signal Generator frequency. After changing the MMR Signal Generator frequency, it may be necessary to reset the TI by pressing the RCVR in order to obtain the required resolution.

Table 19.

Applied			TI	
Frequency (MHz)	**Rate (kHz)**	**Deviation (rad)**	**Range (rad)**	**Limits (rad)**
10	1	4.0	5	3.74 to 4.26
10	1	9.0	10	8.4 to 9.6
50	1	9.0	10	8.4 to 9.6
100	1	9.0	10	8.4 to 9.6
500	1	9.0	10	8.4 to 9.6

4.8.16 Set the MMR Signal Generator output to minimum. Disconnect the test setup.

4.9 DISTORTION METER CALIBRATION:

4.9.1 Connect equipment as shown in Figure 4.

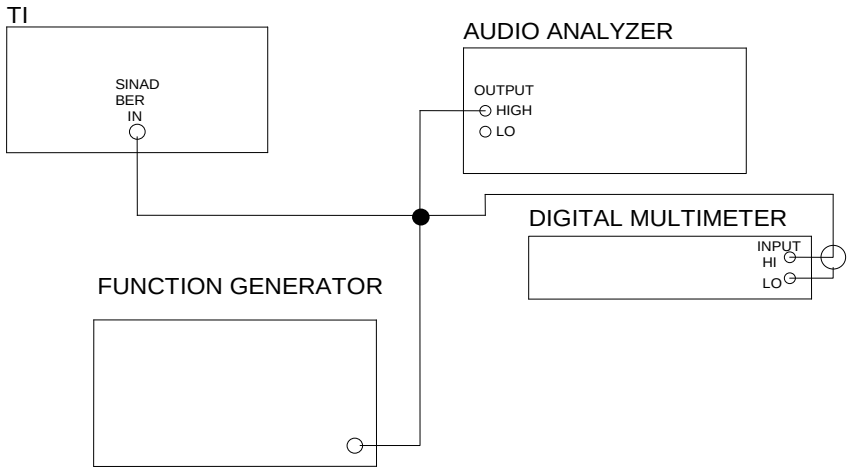

Figure 4.

4.9.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI MTRS, then select 6. Dist Meter.

4.9.3 Press the TI SETUP. The TI will display the Distortion Meter Menu.

4.9.4 From the Distortion Meter Menu, select the following:

Dist In	SINAD/BER
Filter Freq	1000 Hz
Peak Hold	Off
Average	On
Filter Select	Low Pass 15.000 kHz

4.9.5 Press the TI F5 (Ret) to return to the Distortion Meter display.

4.9.6 Set the Digital Multimeter as required to measure V rms.

4.9.7 Set Audio Analyzer for 50 Ω output operation by pressing 47.1 and SPCL keys.

4.9.8 Set Audio Analyzer output to minimum and set the Function Generator, as required, for 1.000 V at 1 kHz as indicated on the Digital Multimeter. Note Function Generator indicated output level.

4.9.9 Set Function Generator output to minimum and set the Audio Analyzer output, as required, for 20.0 mV at 400 Hz as indicated on the Digital Multimeter. Reset Function Generator output level as noted in step 4.9.8.

NOTE

Do not adjust the output level of the Function Generator after the level has been set using the Digital Multimeter.

NOTE

Do not adjust the output level of the Audio Analyzer after the level has been set using the Digital Multimeter.

NOTE

The indication on the Digital Multimeter does not represent anything when both the Audio Analyzer and Function Generator are set to the values in step 4.9.9.

4.9.10 The TI must indicate within 1.4 to 2.6%.

4.9.11 Repeat steps 4.9.6 through 4.9.10 for the remaining values listed in Table 20. The TI must indicate within the limits listed in the Limits column of Table 20.

Table 20.

Function Generator	Audio Analyzer	Limits (%)
1.000 V at 1.00 kHz	20.0 mV at 400 Hz	1.4 to 2.6
1.000 V at 1.00 kHz	50.0 mV at 400 Hz	4.4 to 5.6
1.000 V at 1.00 kHz	90 mV at 400 Hz	8.4 to 9.6
1.000 V at 1.00 kHz	150 mV at 400 Hz	12.9 to 17.1

4.9.12 Set the Function Generator and Audio Analyzer outputs to minimum.

4.9.13 Do not disconnect the test setup.

4.10 SINAD METER CALIBRATION:

4.10.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI MTRS, then select 7. SINAD Meter.

4.10.2 Press the TI SETUP. The TI will display the SINAD Meter Menu.

4.10.3 From the SINAD Meter Menu, select the following:

SINAD In	SINAD/BER
Notch Filter Freq	1000 Hz
Peak Hold	Off
Average	On
Filter Select	Low Pass 15.000 kHz
Readout Res.	0.1 dB

4.10.4 Press the TI F5 (Ret) to return to the SINAD Meter display.

4.10.5 Set Audio Analyzer for 50 Ω output operation by pressing 47.1 and SPCL keys.

4.10.6 Set Audio Analyzer output to minimum and set the Function Generator, as required, for 0.500 V at 1 kHz as indicated on the Digital Multimeter. Note Function Generator indicated output level.

4.10.7 Set Function Generator output to minimum and set the Audio Analyzer output, as required, as close as possible for 281.17 mV at 400 Hz as indicated on the Digital Multimeter. Reset the Function Generator output level as noted in step 4.10.6.

NOTE

Do not adjust the output level of the Function Generator after the level has been set using the Digital Multimeter.

NOTE

Do not adjust the output level of the Audio Analyzer after the level has been set using the Digital Multimeter.

NOTE

The indication on the Digital Multimeter does not represent anything when both the Audio Analyzer and Function Generator are set to the values in step 4.10.7.

4.10.8 The TI must indicate within 5.1 to 7.3 dB.

4.10.9 Repeat steps 4.10.6 through 4.10.8 for the remaining values listed in Table 21. The TI must indicate within the limits listed in the Limits column of Table 21.

Table 21.

Function Generator	Audio Analyzer	Limits (dB)
0.500 V at 1.00 kHz	281.17 mV at 400 Hz	5.1 to 7.3
0.500 V at 1.00 kHz	158.12 mV at 400 Hz	9.3 to 11.5
1.000 V at 1.00 kHz	100 mV at 400 Hz	18.9 to 21.1
1.000 V at 1.00 kHz	56.234 mV at 400 Hz	23.9 to 26.1

4.10.10 Set the Function Generator and Audio Analyzer outputs to minimum.

4.10.11 Disconnect the test setup.

4.11 DIGITAL MULTIMETER CALIBRATION:

4.11.1 VOLTMETER CALIBRATION:

4.11.1.1 Connect equipment as shown in Figure 5.

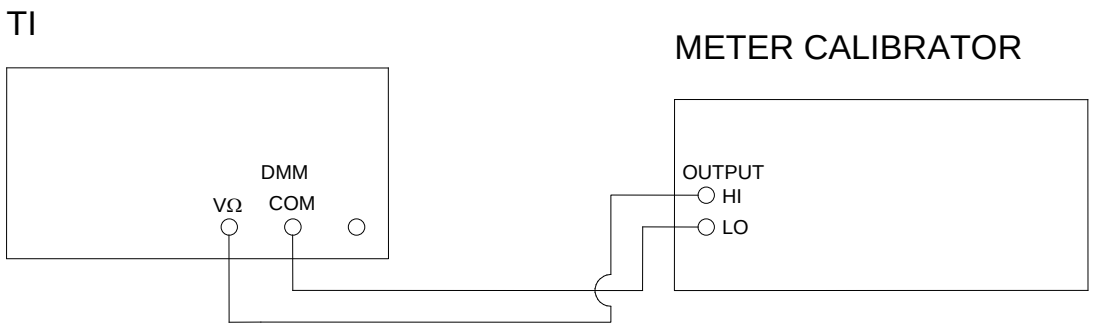

Figure 5.

4.11.1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI MTRS, then select 10. Digital Multimeter (DMM).

4.11.1.3 Press the TI SETUP. The TI will display the Multimeter Menu.

4.11.1.4 From the Multimeter Menu, select the following:

Multimeter Func	DCV
Set Range	200 mV
Select Peak Hold	Off

4.11.1.5 Press the TI F5 to return to the Digital Multimeter display.

4.11.1.6 Set the Meter Calibrator to +190.0 mV DC. Set the Meter Calibrator OPR/STBY to OPR.

4.11.1.7 The TI must indicate within 187.9 to 192.1 mV DC.

4.11.1.8 Set the Meter Calibrator OPR/STBY to STBY.

4.11.1.9 Repeat steps 4.11.1.3 through 4.11.1.8 for the remaining values listed in Table 22.

Table 22.

TI Range (VDC)	Applied (VDC)	Limits (VDC)
200 m	190.0 m	187.9 to 192.1 m
2.0	1.900	1.879 to 1.921
20	5.00	4.79 to 5.21
20	10.00	9.79 to 10.21
20	15.00	14.79 to 15.21
20	19.00	18.79 to 19.21

Table 22. (Cont.)

TI Range (VDC)	Applied (VDC)	Limits (VDC)
20	-5.00	-5.21 to -4.79
20	-10.00	-10.21 to -9.79
20	-15.00	-15.21 to -14.79
20	-19.00	-19.21 to -18.79
200	190.0	187.9 to 192.1
2000	900.0	879 to 921

4.11.1.10 Press the TI SETUP. The TI will display the Multimeter Menu.

4.11.1.11 From the Multimeter Menu, select the following:

Multimeter Func	ACV
Load Range	1 MEG
Press F6 (ESC), then Set Range	200 mV
Select Peak Hold	Off

4.11.1.12 Press the TI F5 (Ret) to return to the Digital Multimeter display.

4.11.1.13 Set the Meter Calibrator to 180.0 mV AC at 50 Hz. Set the Meter Calibrator OPR/STBY to OPR.

4.11.1.14 The TI must indicate within 169.9 to 190.1 mV AC.

4.11.1.15 Set the Meter Calibrator OPR/STBY to STBY.

4.11.1.16 Repeat steps 4.11.1.10 through 4.11.1.15 for the remaining values listed in Table 23.

Table 23.

	Meter Calibrator		
TI Range (VAC)	**Applied (VAC)**	**Frequency (Hz)**	**Limits (VAC)**
200 m	180.0 m	50.0	169.9 to 190.1 m
200 m	180.0 m	1.0 k	169.9 to 190.1 m
200 m	180.0 m	20.0 k	169.9 to 190.1 m

Table 23. (Cont.)

TI Range (VAC)	Meter Calibrator Applied (VAC)	Frequency (Hz)	Limits (VAC)
2.0	1.800	50.0	1.699 to 1.901
2.0	1.800	1.0 k	1.699 to 1.901
2.0	1.800	20.0 k	1.699 to 1.901
20	18.00	50.0	16.99 to 19.01
20	5.00	1 k	3.99 to 6.01
20	10.00	1 k	8.99 to 11.01
20	15.00	1 k	13.99 to 16.01
20	18.00	1 k	16.99 to 19.01
20	18.00	5.0 k	16.99 to 19.01
200	180.0	50.0	169.9 to 190.1
200	180.0	400.0	169.9 to 190.1
2000	450.0	50.0	349 to 551

4.11.1.17 On the Meter Calibrator, press RESET.

4.11.1.18 Disconnect the TI from the Meter Calibrator.

4.11.2 CURRENT METER CALIBRATION:

4.11.2.1 Connect equipment as shown in Figure 6.

NOTE

For TI inputs greater than 2 Amps, utilize the alternate connection as shown in Figure 6 and connect the Meter Calibrator OUTPUT to the Amplifier INPUT connectors, as required. Annotate on the Certification Label of the Current Shunt (P/O TI accessory kit) with the ID# and S/N of the TI which it was calibrated with.

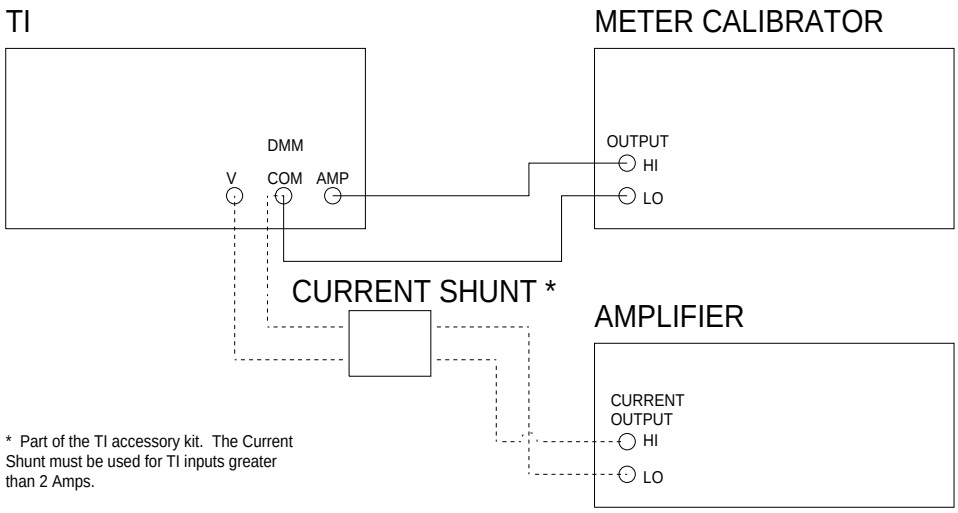

Figure 6.

4.11.2.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI MTRS, then select 10. Digital Multimeter (DMM).

4.11.2.3 Press the TI SETUP. The TI will display the Multimeter Menu.

4.11.2.4 From the Multimeter Menu, select the following:

Multimeter Func	DCC
Set Range	20 mA
Select Peak Hold	Off

4.11.2.5 Press the TI F5 (Ret) to return to the Digital Multimeter display.

4.11.2.6 Set the Meter Calibrator to +18.00 mA DC. Set the Meter Calibrator OPR/STBY to OPR.

4.11.2.7 The TI must indicate within 16.99 to 19.01 mA.

4.11.2.8 Set the Meter Calibrator OPR/STBY to STBY.

4.11.2.9 Repeat steps 4.11.2.3 through 4.11.2.8 for the remaining values listed in Table 24.

NOTE

If the External Shunt is not included, do not calibrate the TI at 10 ADC. Annotate a Limited Certification Label stating the TI 20A Range not calibrated.

Table 24.

TI Range (ADC)	Applied (ADC)	Limits (ADC)
20 m	18.00 m	16.99 to 19.01 m
200 m	180.0 m	169.9 to 190.1
2	1.80	1.699 to 1.901
20 *	10.00	8.99 to 11.01

* Move TI test leads from Meter Calibrator to Amplifier as shown in Figure 6. Set the Meter Calibrator, as required to produce 10.00 ADC at the Amplifier CURRENT OUTPUT.

4.11.2.10 Reconnect test equipment as originally shown in Figure 6.

4.11.2.11 Press the TI SETUP. The TI will display the Multimeter Menu.

4.11.2.12 From the Multimeter Menu, select the following:

Multimeter Func	ACC
Set Range	20 mA
Select Peak Hold	Off

4.11.2.13 Press the TI F5 (Ret) to return to the Digital Multimeter display.

4.11.2.14 Set the Meter Calibrator to 18.00 mA AC at 50.0 Hz. Set the Meter Calibrator OPR/STBY to OPR.

4.11.2.15 The TI must indicate within 16.99 to 19.01 mA AC.

4.11.2.16 Set the Meter Calibrator OPR/STBY to STBY.

4.11.2.17 Repeat steps 4.11.2.11 through 4.11.2.16 for the remaining values listed in Table 25.

NOTE

If the External Shunt is not included, do not calibrate the TI at 5.0 AAC. Annotate a Limited Certification Label stating the TI 20A Range not calibrated.

Table 25.

TI Range (AAC)	Meter Calibrator Applied (AAC)	Frequency (Hz)	Limits (AAC)
20 m	18.00 m	50.0	16.99 to 19.01 m
20 m	18.00 m	1.0 k	16.99 to 19.01 m
20 m	18.00 m	10.0 k	16.99 to 19.01 m
200 m	180.0 m	50.0	169.9 to 190.1 m
200 m	180.0 m	1.0 k	169.9 to 190.1 m
200 m	180.0 m	10.0 k	169.9 to 190.1 m
2.0	1.800	50.0	1.699 to 1.901
2.0	1.800	400.0	1.699 to 1.901
2.0	1.800	1 k	1.699 to 1.901
20 *	5.00	50.0	4.49 to 5.51
20 *	5.00	400.0	4.49 to 5.51

* Move TI test leads from Meter Calibrator to Amplifier as shown in Figure 6. Set the Meter Calibrator, as required to produce 5.00 AAC at the Amplifier CURRENT OUTPUT.

4.11.2.18 On the Meter Calibrator, press RESET.

4.11.2.19 Disconnect equipment from test setup.

4.11.3 OHMMETER CALIBRATION:

4.11.3.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI MTRS, then select 10. Digital Multimeter (DMM).

4.11.3.2 Press the TI SETUP. The TI will display the Multimeter Menu.

4.11.3.3 Connect the equipment as shown in Figure 5.

4.11.3.4 From the Multimeter Menu, select the following:

Multimeter Func	Ohm
Set Range	200 Ω
Select Peak Hold	Off

4.11.3.5 Press the TI F5 (Ret) to return to the Digital Multimeter display.

4.11.3.6 Set the Meter Calibrator to 100.0 Ω and set the 2 Wire Comp ON (for outputs greater than 19 kΩ, set the 2 Wire Comp to OFF). Set the Meter Calibrator OPR/STBY to OPR.

4.11.3.7 The TI must indicate within 89.9 to 110.1 Ω.

4.11.3.8 Set the Meter Calibrator OPR/STBY to STBY.

4.11.3.9 Repeat steps 4.11.3.4 through 4.11.3.8 for the remaining values listed in Table 26.

Table 26.

TI Range (Ω)	Applied (Ω)	Limits (Ω)
200	100.0	89.9 to 110.1
2.0 k	1 k	899 to 1101
20 k	10 k	8.99 to 11.01 k
200 k	100 k	89.9 to 110.1 k
2 M	1 M	899 to 1101 k
20 M	10 M	8.99 to 11.01 M

4.11.3.10 On the Meter Calibrator, press RESET.

4.11.3.11 Disconnect the test setup.

4.12 OSCILLOSCOPE CALIBRATION:

4.12.1 VERTICAL BANDWIDTH CALIBRATION:

4.12.1.1 Connect the Oscilloscope Calibrator through the Feedthrough Termination to the TI SCOPE IN connector.

4.12.1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI SCOPE/ANLZ.

4.12.1.3 Press the TI SETUP. The TI will display the Scope/Analyzer Menu.

4.12.1.4 From the Scope/Analyzer Menu, press 1. Scope and select On. Ensure the Analyzer indicates Off. If not, press 2. Analyzer and select Off.

4.12.1.5 From the Scope/Analyzer Menu, press 3. Setup Scope and select the following:

Input	AC
Trigger Source	Internal
Scale Factor	50 mV/div
Sweep Rate	10 µs

Trig Mode	Auto
Trig Lvl Setting	130
Vert Offset	160
Horiz Offset	0 div

4.12.1.6 Press the TI F5 (Ret) to return to the Oscilloscope display.

4.12.1.7 Set the Oscilloscope Calibrator for 50 kHz reference into 50 Ω, OUTPUT to ON and adjust the Amplitude until the TI indicates 6 divisions of vertical deflection.

NOTE

Set the TI Sweep Rate as required to obtain the best possible display for setting the 6 divisions of vertical deflection. Do not adjust the Oscilloscope Calibrator Amplitude or the TI Scale Factor.

4.12.1.8 Increase the frequency controls on the Oscilloscope Calibrator until the TI indicates 4.2 divisions of vertical deflection.

NOTE

Set the TI Sweep Rate as required to obtain the best possible display for setting the 4.2 divisions of vertical deflection. Do not adjust the Oscilloscope Calibrator Amplitude or the TI Scale Factor.

4.12.1.9 The Oscilloscope Calibrator Frequency display must indicate ≥1.0 MHz.

4.12.1.10 Set the Oscilloscope Calibrator OUTPUT to OFF.

4.12.1.11 Remove the Feedthrough Termination from the test setup.

4.12.2 INPUT RANGES CALIBRATION:

4.12.2.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI SCOPE/ANLZ.

4.12.2.2 Press the TI SETUP. The TI will display the Scope/Analyzer Menu.

4.12.2.3 From the Scope/Analyzer Menu, press 1. Scope and select On. Ensure Analyzer indicates Off. If not, press 2. Analyzer and select Off.

4.12.2.4 From the Scope/Analyzer Menu, press 3. Setup Scope and select the following:

Input	AC
Trigger Source	Internal
Scale Factor	2 mV/div
Sweep Rate	500 μs

Trig Mode	Auto
Trig Lvl Setting	130
Vert Offset	160
Horiz Offset	0 div

4.12.2.5 Press the TI F5 (Ret) to return to the Oscilloscope display.

4.12.2.6 Set the Oscilloscope Calibrator for a 10 mV p-p square wave signal into 1 MΩ. Set the OUTPUT to ON.

NOTE

Set the TI Sweep Rate and Vertical Offset as required to obtain the best possible display for verifying the correct number of divisions of vertical deflection.

4.12.2.7 The TI must indicate 4.2 to 5.8 divisions of vertical deflection.

4.12.2.8 Repeat steps 4.12.2.2 through 4.12.2.7 for the remaining values listed in Table 27.

Table 27.

Scale Factor (V/div)	Applied (V p-p)	Limits (divisions)
2 m	10 m	4.2 to 5.8
5 m	20 m	3.6 to 4.4
10 m	50 m	4.6 to 5.4
20 m	0.1	4.6 to 5.4
50 m	0.2	3.6 to 4.4
100 m	0.5	4.6 to 5.4
200 m	1.0	4.6 to 5.4
500 m	2.0	3.6 to 4.4
1	5.0	4.6 to 5.4
2	10.0	4.6 to 5.4
5	20.0	3.6 to 4.4
10	50.0	4.6 to 5.4
20	100.0	4.6 to 5.4
50	200.0	3.6 to 4.4

4.12.2.9 Set the Oscilloscope Calibrator OUTPUT to OFF.

4.12.2.10 Do not disconnect the test setup.

4.12.3 HORIZONTAL SWEEP CALIBRATION:

4.12.3.1 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI SCOPE/ANLZ.

4.12.3.2 Press the TI SETUP. The TI will display the Scope/Analyzer Menu.

4.12.3.3 From the TI Scope/Analyzer Menu, press 1. Scope and select On. Ensure Analyzer indicates Off. If not, press 2. Analyzer and select Off.

4.12.3.4 From the TI Scope/Analyzer Menu, press 3. Setup Scope and select the following:

Input	AC
Trigger Source	Internal
Scale Factor	As Required
Sweep Rate	1 μs
Trig Mode	Auto
Trig Lvl Setting	130
Vert Offset	160
Horiz Offset	0 div

4.12.3.5 Press the TI F5 (Ret) to return to the Oscilloscope display.

4.12.3.6 Set the Oscilloscope Calibrator for a 1 μs Time Marker into 1 MΩ at a convenient Amplitude. Set the OUTPUT to ON.

4.12.3.7 On the Oscilloscope Calibrator, adjust the Deviation control until the TI indicates one marker pulse on each horizontal division.

NOTE

Set the TI Scale Factor as required to obtain the best possible display for setting the marker pulses on the horizontal divisions.

4.12.3.8 The Oscilloscope Calibrator Deviation display must indicate within -3.00% to +3.00%.

4.12.3.9 Repeat steps 4.12.3.2 through 4.12.3.8 for the remaining values listed in Table 28.

Table 28.

TI Sweep Rate (sec)	Applied (sec)	Limits (%)
1 μ	1 μ	-3.00 to +3.00
2 μ	2 μ	-3.00 to +3.00
5 μ	5 μ	-3.00 to +3.00
10 μ	10 μ	-3.00 to +3.00
20 μ	20 μ	-3.00 to +3.00
50 μ	50 μ	-3.00 to +3.00
100 μ	100 μ	-3.00 to +3.00
200 μ	200 μ	-3.00 to +3.00
500 μ	500 μ	-3.00 to +3.00
1 m	1 m	-3.00 to +3.00
2 m	2 m	-3.00 to +3.00
5 m	5 m	-3.00 to +3.00
10 m	10 m	-3.00 to +3.00
20 m	20 m	-3.00 to +3.00
50 m	50 m	-3.00 to +3.00
100 m	100 m	-3.00 to +3.00

4.12.3.10 Set the Oscilloscope Calibrator OUTPUT to OFF.

4.12.3.11 Disconnect the equipment from the test setup.

4.13 SPECTRUM ANALYZER CALIBRATION:

4.13.1 FREQUENCY SPAN CALIBRATION:

4.13.1.1 Connect the MMR Signal Generator RF OUTPUT to the TI ANTENNA connector.

4.13.1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI SCOPE/ANLZ key until the Spectrum Analyzer display appears.

4.13.1.3 Press the TI SETUP. The TI will display the Scope/Analyzer Menu.

4.13.1.4 From the TI Scope/Analyzer Menu, press 1. Scope and select Off, then press 2. Analyzer and select On.

4.13.1.5 From the TI Scope/Analyzer Menu, press 4. Setup Analyzer and select the following:

Scale	dBm
Frequency	1.0 MHz
Rcvr Input	Antenna
Input Atten	40 dB
Range	10 dB
Scan Width	1 kHz
Track Gen	Off
Track Gen Lvl	-20.0 dBm
Gen Lvl Units	dBm
Velocity Factor	69.4%
Mode	Live
RF Mode	Direct

4.13.1.6 Press the TI F5 (Ret) to return to the Spectrum Analyzer display.

4.13.1.7 Set the MMR Signal Generator to 1.00 MHz at 0.0 dBm. Ensure all modulation outputs are Off.

NOTE

Normalize the TI Spectrum Analyzer for each frequency by removing the RF Signal, then press F6 (More) until F1 (Norm) softkey appears, press F1 and wait for normalizing action to complete before reconnecting the RF Signal to the TI.

4.13.1.8 Verify the TI displays the signal below the top grid line. If not, adjust the MMR Signal Generator until the signal displayed is 1 division below the top grid line.

4.13.1.9 Slowly set the MMR Signal Generator frequency until the signal on the TI display is at the second vertical grid line from the left. Press the MMR Signal Generator Freq ref set softkey.

4.13.1.10 Slowly set the MMR Signal Generator frequency until the signal on the TI display is at the second vertical grid line from the right.

4.13.1.11 The MMR Signal Generator must indicate a frequency within 7.499995 to 8.500005 kHz.

4.13.1.12 Set the MMR Signal Generator Freq ref to off.

4.13.1.13 Repeat steps 4.13.1.3 through 4.13.1.12 for the remaining values listed in Table 29.

Table 29.

TI Scan Width (Hz)	TI Frequency (MHz)	Applied CW Frequency (MHz)	Limits (Hz)
1 k	1.0	1.0	7.499995 to 8.500005 k
2 k	1.0	1.0	14.99999 to 17.00001 k
5 k	1.0	1.0	37.499975 to 42.500025 k
10 k	500.0	500.0	74.99995 to 85.00005 k
20 k	500.0	500.0	149.9999 to 170.0001 k
50 k	500.0	500.0	374.99975 to 425.00025 k
100 k	500.0	500.0	749.9995 to 850.0005 k
200 k	500.0	500.0	1.499999 to 1.700001 M
500 k	500.0	500.0	3.7499975 to 4.2500025 M
1 M	500.0	500.0	7.499995 to 8.500005 M
2 M	500.0	500.0	14.99999 to 17.00001 M
5 M	500.0	500.0	37.499975 to 42.500025 M
10 M	500.0	500.0	74.99995 to 85.00005 M
20 M	500.0	500.0	149.9999 to 170.0001 M
50 M	500.0	500.0	374.99975 to 425.00025 M
100 M	500.0	500.0	749.9995 to 850.0005 M

4.13.1.14 Set MMR Signal Generator output to minimum.

4.13.1.15 Disconnect the equipment from the test setup.

4.13.2 LEVEL CALIBRATION:

NOTE

It may be necessary to adjust the TI input attenuation and reference level if noise interferes with the measurement.

4.13.2.1 Connect the MMR Signal Generator RF OUTPUT 50 Ω to the TI ANTENNA connection.

4.13.2.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the TI SCOPE/ANLZ key until the Spectrum Analyzer display appears.

4.13.2.3 Press the TI SETUP. The TI will display the Scope/Analyzer Menu.

4.13.2.4 From the TI Scope/Analyzer Menu, press 4. Setup Analyzer and select the following:

Scale	dBm
Frequency	10.0 MHz
Rcvr Input	Antenna
Input Atten	40 dB
Range	10 dB
Scan Width	1 kHz
Track Gen	Off
Track Gen Lvl	-20.0 dBm
Gen Lvl Units	dBm
Velocity Factor	69.4%
Mode	Live
RF Mode	Direct

4.13.2.5 Press the TI F5 (Ret) to return to the Spectrum Analyzer display.

NOTE

Normalize the TI Spectrum Analyzer for each frequency by removing the RF Signal, then press F6 (More) until F1 (Norm) softkey appears, press F1 and wait for normalizing action to complete before reconnecting the RF Signal to the TI.

4.13.2.6 Set the MMR Signal Generator frequency to the first value listed in the Frequency column of Table 30.

4.13.2.7 Set the MMR Signal Generator amplitude to the first value listed in the Applied column of Table 30. Turn MMR Signal Generator RF Output to ON.

4.13.2.8 Press the TI F6 (More) until the Marker softkeys appear on the screen. Press F5 (Track) until Marker softkeys indicate F1 (Mkr Fc) and F3 (Mkr 1).

4.13.2.9 Set the TI Scan Width and Frequency as required to center the signal in the display. Press F3 (Mkr 1) and select the peak of the signal with the marker.

NOTE

There are two indications displayed under the Marker MHz display on the TI. The first (top) is the Marker frequency. For this test the Marker frequency reading is unimportant. The second (bottom) reading is the Level of the signal.

4.13.2.10 The TI Marker MHz display must indicate within the corresponding values listed in the Limits column of Table 30.

Table 30.

Frequency (MHz)	Applied (dBm)	Limits (dBm)
10.0	-10.0	-14.0 to -6.0
10.0	-20.0	-24.0 to -16.0
10.0	-30.0	-34.0 to -26.0
10.0	-40.0	-44.0 to -36.0
10.0	-50.0	-54.0 to -46.0
10.0	-60.0	-64.0 to -56.0
110.0 *	-30.0	-34.0 to -26.0
110.0 *	-40.0	-44.0 to -36.0
110.0 *	-50.0	-54.0 to -46.0
110.0 *	-60.0	-64.0 to -56.0
110.0 *	-70.0	-74.0 to -66.0
110.0 *	-80.0	-84.0 to -76.0
110.0 *	-85.0	-89.0 to -81.0
500.0 *	-30.0	-36.0 to -24.0
500.0 *	-40.0	-46.0 to -34.0
500.0 *	-50.0	-56.0 to -44.0
500.0 *	-60.0	-66.0 to -54.0
500.0 *	-70.0	-76.0 to -64.0
500.0 *	-80.0	-86.0 to -74.0
500.0 *	-83.0	-89.0 to -77.0

* Set the TI Input Atten to 20 dB.

4.13.2.11 Repeat steps 4.13.2.6 through 4.13.2.10 for the remaining values listed in Table 30.

4.13.2.12 Set the MMR Signal Generator output to minimum and disconnect the test setup.

4.14 AF LEVEL CALIBRATION:

4.14.1 Connect the Meter Calibrator to the TI SINAD/BER input.

4.14.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults. Press the MTRS MODE, SHIFT, 4 (E) key.

4.14.3 Set the Meter Calibrator to the first values listed in the Frequency and Applied columns of Table 31. Set Meter Calibrator to OPR.

4.14.4 Verify the TI indication is within the values listed in the Limits column of Table 31. Set Meter Calibrator to STBY.

Table 31.

Frequency (Hz)	Applied (V rms)	Limits (V rms)
100.0	1.0	0.3 to 1.7
100.0	2.0	1.3 to 2.7
100.0	3.0	2.3 to 3.7
100.0	4.0	3.3 to 4.7
100.0	5.0	4.3 to 5.7
100.0	6.0	5.3 to 6.7
100.0	7.0	6.3 to 7.7
100.0	8.0	7.3 to 8.7
100.0	9.0	8.3 to 9.7

4.14.5 Repeat steps 4.14.3 and 4.14.4 for the remaining values listed in Table 31.

4.14.6 Set all POWER switches to OFF and disconnect and secure all test equipment.

4.14.7 If applicable, annotate and attach a Limited Certification Label per steps 3.9, 3.10 and 3.11.

CALIBRATION PERFORMANCE TABLE

Not Required

APPENDIX A

A-1 TIME BASE ADJUSTMENT: (VCXO)

A-1.1 Connect the TI to the appropriate power source. Set the POWER switch to ON (ON annunciator will illuminate) and allow a 2 hour warm-up.

A-1.2 Press the TI MTRS MODE, F6 (AUX), RCL, SHIFT, 7 (A) and ENTER. This sets the TI to factory defaults.

A-1.3 Connect equipment as shown in Figure A-1.

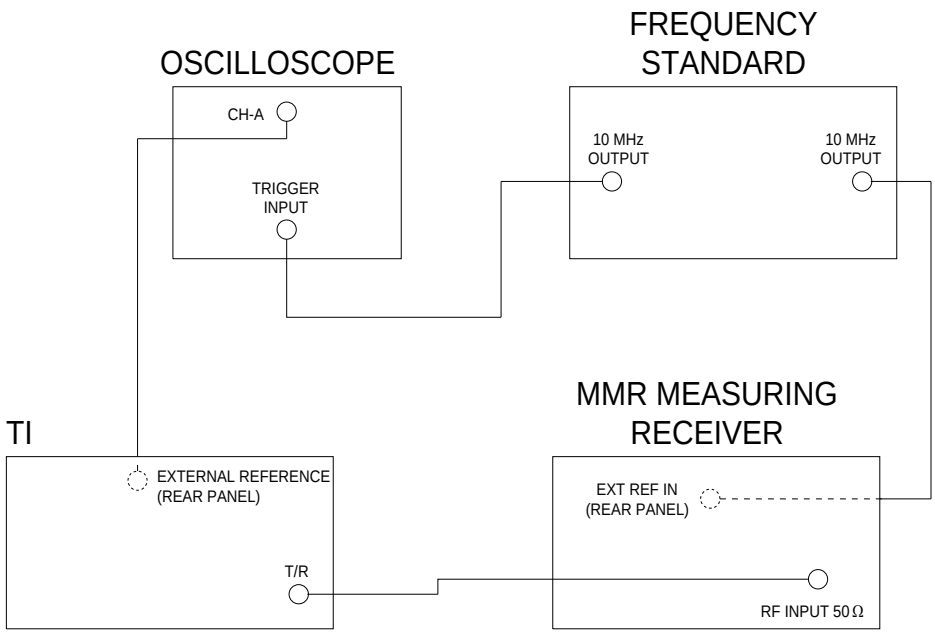

Figure A-1.

A-1.4 Press the TI RF GEN, then F2 (Freq) and select a frequency of 900.0000 MHz. Press F3 (Level) and select a level of 0.0 dBm.

A-1.5 Set the MMR Measuring Receiver, as required, to obtain 10 Hz frequency resolution and for an external time base.

NOTE

The TIs external reference outputs a periodic small signal (about 20 mV p) that is being used to perform the adjustment.

A-1.6 Set the Oscilloscope, as required, for a sweep time of 50 ns, external trigger and volts/div as necessary for a stable display.

A-1.7 Insert the Lockout Key in the TI MIC/ACC IN/OUT connector.

A-1.8 Press the TI SETUP key, then F6 (Aux) and select Calibrations. Select VCXO Calibration.

A-1.9 Verify the TI Select Attn submenu data field is highlighted. Select the least significant digit in the Select Attn field.

A-1.10 Observing the frequency on the MMR Measuring Receiver for coarse frequency reference, adjust the TI Select Attn to adjust the waveform on the Oscilloscope for minimum motion and/or rotation. Press the TI ENTER key. If adjustment range is <0 or >4095, set the Select Attn to 2048 and perform steps A-1.11 through A-1.13; otherwise continue to step A-1.14.

A-1.11 Remove the TI screw on top of the 10 MHz Frequency Standard to access coarse frequency adjustments.

A-1.12 Adjust the TI coarse frequency for minimum motion of the waveform on the Oscilloscope.

A-1.13 Replace screw in 10 MHz Frequency Standard and repeat steps A-1.8 through A-1.10.

A-1.14 Disconnect the test setup and continue with step 4.1.6.

APPENDIX B

B-1 LOW PASS FILTER VERIFICATION:

B-1.1 Connect the MMR Signal Generator through the Low Pass Filter being verified to the MMR RF INPUT 50 Ω.

B-1.2 Set the MMR Signal Generator amplitude to 0 dBm and to the CF frequency listed in the Equipment Requirements for the Low Pass Filter being verified.

B-1.3 On the MMR Spectrum Analyzer, set the FREQUENCY to the CF listed in the Equipment Requirements for the Low Pass Filter being verified.

B-1.4 Set the MMR Spectrum Analyzer SPAN as necessary to view the signal with a baseline ≥50 dB from the top graticule line.

B-1.5 Press the MMR Spectrum Analyzer PEAK SEARCH, MKR→ and MARKER→CF buttons.

B-1.6 Press the MMR Spectrum Analyzer PEAK SEARCH, MKR→, MARKER→REF LVL and MKR Δ buttons.

B-1.7 Ensure the signal displayed on the MMR Spectrum Analyzer is at the top graticule line with a baseline ≥50 dB down from the top graticule line. If the baseline is not ≥50 dB down from the top graticule line, set the MMR Spectrum Analyzer SPAN and RES BW controls as necessary and repeat steps B-1.5 and B-1.6.

B-1.8 Set the MMR Signal Generator frequency and the MMR Spectrum Analyzer FREQUENCY to the Rejection Frequency listed in the Equipment Requirements for the Low Pass Filter being verified.

B-1.9 Press the MMR Spectrum Analyzer PEAK SEARCH. Verify the MMR MKR Δ indication is > the rejection dB value listed in the Equipment Requirements for the Low Pass Filter being verified.