T.O. 33K3-4-2586-1

TECHNICAL MANUAL

CALIBRATION PROCEDURE

FOR

COMMUNICATIONS SERVICE MONITOR

FM/AM 1200, FM/AM 1200A

(IFR INC.)

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COMMUNICATIONS SERVICE MONITOR

FM/AM 1200, FM/AM 1200A

(IFR INC.)

1 CALIBRATION DESCRIPTION:

Table 1.

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Receiver		
Modulation Meter	Range: AM 0 and 200%; FM Deviation 0 to 60 kHz Accuracy: AM: ±5.0% of Reading ±3.0% of FS; FM: ±5.0% of Reading ±3.0% of FS	Measure modulation from known source
Sensitivity	Range: 250 kHz to 999.9999 MHz Accuracy: 2 µV (-101 dBm)	Measured with Signal Generator
Bandwidth	Range: 6, 15, and 200 kHz from Center frequency Accuracy: 40 dB	Sensitivity checked 12, 27, and 300 kHz from tuned frequency
RF Frequency Error Meter	Range: up to 10 kHz Accuracy: ±3.0%	Measure error from known frequency
Audio Frequency Error Meter	Range: up to 10 kHz Accuracy: ±3.0%	Measure error from known frequency
RF Signal Generator		
Frequency	Range: 250 kHz to 999.9999 MHz Accuracy: ±5.0 Hz + Master Oscillator Accuracy	Measured on Electronic Counter
Power	Range: -127 to -20 dBm Accuracy: ±2.5 dB	Verified with a Power Meter and Attenuator

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
RF Signal Generator *(Cont.)*		
Function Generator	Range: 2.5 V, 10 Hz to 30 kHz Accuracy: Amplitude adjustable; Frequency: ±0.01%; Distortion: <2.0%	Measured with Digital Voltmeter, Distortion Analyzer and Electronic Counter
Oscilloscope	Range: Amplitude 10 mV to 10 V/Div, Sweep Time 10 Sec to 10 mSec/Div Accuracy: ±10%	Amplitude checked with Power Supply; Sweep Time checked with Signal Generator
Digital Voltmeter (OPT 10 Only)	Range: 0 to 100 V AC & DC Accuracy: ±10.0%	Compared to Standard Digital Voltmeter
Power Meter	Range: 0 to 15 and 0 to 150 W * Accuracy: ±7% of rdg ±3% FS, 1 to 600 MHz; ±20% of rdg ±3% FS, 600 to 1000 MHz	Measured using High Powered RF Standard

* 50 W continuous or 150 W, one minute ON, five minutes OFF.

2 EQUIPMENT REQUIREMENTS:

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1 SIGNAL GENERATOR	Range: 0.5 to 1024 MHz. Accuracy: ±0.1%	Hewlett-Packard 8640B Opt 004	
2.2 ELECTRONIC COUNTER	Range: 10 kHz to 1 GHz Accuracy: ±0.000001%	Hewlett-Packard 5345A w/5356A	
2.3 POWER METER	Range: Dependent upon Sensor Accuracy: ±2.0%	Hewlett-Packard 436A	

	Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.4	POWER SENSOR	Range: -20 to -40 dBm Accuracy: ±3.5%	Hewlett-Packard 8484A	
2.5	SPECTRUM ANALYZER	Range: up to 1 GHz Accuracy: ±1.0 dB	Hewlett-Packard 8569A	
2.6	RESISTOR	Range: 150 Ω, 1/2 W Accuracy: ±10%	Bench Stock	
2.7	DIGITAL VOLTMETER	Range: 100 V Accuracy: ±0.01%	Fluke 8506A	H-P 3455A
2.8	DISTORTION ANALYZER	Range: 110 kHz Accuracy: ±0.32%	Hewlett-Packard 339A	
2.9	FUNCTION GENERATOR	Range: 20 Hz to 2.0 MHz Accuracy: ±1.0%	Hewlett-Packard 3325A	
2.10	MODULATION ANALYZER	Range: FM Rates, 20 Hz to 200 kHz; Deviation Rates, 0 to 400 kHz; AM Rates, 20 Hz to 100 kHz; Depth to 99% Accuracy: Operational	Hewlett-Packard 8901A	
2.11	AC-DC VOLTAGE STANDARD	Range: 0 to 100 V AC & DC Accuracy: ±1.0%	John Fluke 5100A	
2.12	ATTENUATOR 20 dB	Range: 20 dB Accuracy: As Charted at 25.5 MHz	As Available	
2.13	HIGH POWER RF STANDARD	Range: 10 to 800 MHz Accuracy: AFPSL Charted	AGMC * 1852A	

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.14 POWER METER	Range: 0 to 10 mW Accuracy: ±1.0% FS	Hewlett-Packard 432B-H05	
2.15 RF POWER AMPLIFIER	Range: 10 to 800 MHz Accuracy: N/A	Microwave Products SSPA0240-22/6140	
2.16 RF POWER MEASUREMENT SET **	Range: 10 to 800 MHz, 0 to 150 W Accuracy: ±3.0% of rdg TAR: 3.33:1	Bird 4421A300	
2.17 HIGH POWER HIGH FREQUENCY RF AMPLIFIER SYSTEM **	Range: 10 to 800 MHz, 0 to 150 W Accuracy: N/A	PST Corp. BHED1719-1000/4006	

* Contact AFMETCAL DET 1 if item is not available.

** Used during Power Meter alternate procedure only.

3 PRELIMINARY OPERATIONS:

3.1 Review and become familiar with the 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.

WARNING

As long as the battery is installed or external AC or DC power is applied a voltage potential exists on various points in TI regardless of front panel power switch setting.

3.2 Connect TI and test equipment to appropriate power sources and allow sufficient warm-up. TI requires 30 minutes warm-up.

3.3 Until technician becomes familiar with this item, the TI Operators Manual should be on hand or close by as there are too many keyboard entries and/or controls on TI to be readily explained in the following calibration procedure.

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 RECEIVER MODULATION METER CALIBRATION:

4.1.1 Set TI controls as follows:

MODULATION	FM NAR
MODULATION METER	6 kHz/% X 10
PWR/OFF/BATT	PWR
HORIZONTAL	1 MHz/DIV
FREQ ERROR	RF 10 K
MODE	REC
SQUELCH	FULLY CCW

4.1.2 Set Signal Generator for 25.5 MHz at -20.0 dBm, FM signal modulated with a 1 kHz tone at 5 kHz deviation (monitored with Modulation Analyzer). Connect to TI ANT through the charted 20 dB Attenuator.

4.1.3 Using TI Keyboard enter RF 025.5000 MHz and 2nd FUNCTION-METER.

4.1.4 Verify the TI FREQUENCY ERROR meter indicates -3.0 to +3.0% of FS.

4.1.5 Set TI and Signal Generator to the settings of Table 2 and verify the TI indications are within the limits listed in Table 2.

Table 2.

Signal Generator Modulation	TI Modulation Selector	TI Range Selector	Limits Modulation Meter	Limits Display (MD)
5 kHz FM	FM NAR	6	4.57 to 5.43 kHz	4.57 to 5.43 kHz
5 kHz FM	FM MID	6	4.57 to 5.43 kHz	4.57 to 5.43 kHz
50 kHz FM	FM MID	60	45.7 to 54.3 kHz	45.7 to 54.3 kHz
50 kHz FM	FM WIDE	60	45.7 to 54.3 kHz	45.7 to 54.3 kHz

Table 2. (Cont.)

Signal Generator Modulation	TI Modulation Selector	TI Range Selector	Modulation Meter	Limits	Display (MD)
30% AM	AM NAR	6	2.67 to 3.33%	(1200A) (1200 or)	2.67 to 3.33% 26.7 to 33.3% 2.67 to 3.33%
30% AM	AM NORM	6	2.67 to 3.33%	(1200A) (1200 or)	2.67 to 3.33% 26.7 to 33.3% 2.67 to 3.33%

4.1.6 Set all outputs to minimum and disconnect the Signal Generator from the TI ANT connector.

4.2 RECEIVER SENSITIVITY CALIBRATION:

4.2.1 Set TI MODULATION to FM NAR position and slowly adjust TI SQUELCH control until TI is just silenced.

4.2.2 Set Signal Generator for no modulation and connect to TI ANT connector.

4.2.3 Set the TI and Signal Generator to the following frequencies and verify that TI sensitivity is -101 dB or better (TI breaks squelch), 255.5000, 455.5000, 855.5000 and 999.9999 MHz.

4.2.4 Set all outputs to minimum and disconnect the Signal Generator from the TI ANT connector.

4.3 RECEIVER BANDWIDTH CALIBRATION:

4.3.1 Select RF 151.0000 MHz on TI and set TI METER range select control to WATTS - PK 15 position and MODULATION to FM NAR.

4.3.2 Slowly adjust TI SQUELCH control until TI is just silenced.

4.3.3 Set the Signal Generator for a signal 151.0000 MHz at -90 dBm and connect to the TI ANT connector, verify TI breaks squelch.

4.3.4 Decrease the Signal Generator level until the TI squelches the signal. Record the level of this signal (level must be less than -101 dBm).

4.3.5 Set the Signal Generator to a frequency of 151.027 MHz and slowly increase Signal Generator level until TI breaks squelch (do not adjust TI SQUELCH control during this test), record this level.

4.3.6 The level required in step 4.3.5 to make the TI break squelch (produce noise) must be 40 dB greater than the level recorded in step 4.3.4 (example; level recorded in step 4.3.4 was -105 dBm, level recorded in step 4.3.5 must be -65 dB or greater, -64 passes, -66 fails).

4.3.7 Set TI MODULATION to FM MID and repeat steps 4.3.1 through 4.3.4. Set the Signal Generator to a frequency of 151.300 MHz and slowly increase Signal Generator level until TI breaks squelch (do not adjust TI SQUELCH control during this test), record this level.

4.3.8 The level required in step 4.3.7 to make the TI break squelch (produce noise) must be 40 dB greater than the level recorded in step 4.3.4 (example; level recorded in step 4.3.4 was -105 dBm, level recorded in step 4.3.7 must be -65 dB or greater, -64 passes, -66 fails).

4.3.9 Set TI MODULATION to AM NAR and the Signal Generator to a frequency of 151.015 MHz and slowly increase Signal Generator level until TI breaks squelch (do not adjust TI SQUELCH control during this test), record this level.

4.3.10 The level required in step 4.3.9 to make the TI break squelch (produce noise) must be 40 dB greater than the level recorded in step 4.3.4 (example; level recorded in step 4.3.4 was -105 dBm, level recorded in step 4.3.9 must be -65 dB or greater, -64 passes, -66 fails).

4.3.11 Set all outputs to minimum and disconnect Signal Generator from TI.

4.3.12 Set TI MODULATION to SSB and select TI RF 000.0010 MHz on TI keyboard then rotate TI VOLUME control CW as required to verify a 1 kHz tone is audible from TI speaker.

4.4 RECEIVER RF FREQUENCY ERROR METER CALIBRATION:

4.4.1 Set TI controls as follows:

MODULATION	FM NAR
VAR TONE	OFF
1 kHz TONE	OFF
1 kHz TONE LEVEL	FULLY CCW
KEYBOARD ENTRY	10.000 MHz

4.4.2 Connect a coax cable between the TI ANT connector and EXTERNAL REFERENCE connector.

4.4.3 Verify TI FREQ ERROR meter indicates zero.

4.4.4 Using TI keyboard and FREQ ERROR range selector controls, select each setting of Table 3 and verify the TI FREQ ERROR meter indicates within the limits listed in Table 3.

Table 3.

Freq Error Range Setting	Selected Frequency	Limits Freq Error Meter
RF 10 K	RF 010.0100 MHz	-0.97 to -1.03
RF 10 K	RF 009.9900 MHz	+0.97 to + 1.03

Table 3. (Cont.)

Freq Error Range Setting	Selected Frequency	Limits Freq Error Meter
RF 10 K	RF 009.9870 MHz	Pegged +
RF 1 K	RF 009.9970 MHz	Pegged +
RF 1 K	RF 009.9990 MHz	+0.97 to +1.03
RF 100	RF 009.9999 MHz	+0.97 to +1.03
RF 3 K	RF 010.0030 MHz	-2.91 to -3.09
RF 3 K	RF 009.9970 MHz	+2.91 to +3.09
RF 300	RF 009.9997 MHz	+2.91 to +3.09
RF 30	RF 010.0000 MHz	-0.09 to +0.09

4.4.5 Do not disconnect the coax cable between the TI ANT connector and EXTERNAL REFERENCE connector.

4.5 RECEIVER AUDIO FREQUENCY ERROR METER CALIBRATION:

4.5.1 Set TI controls as follows:

1 kHz TONE	ON
MODE	GEN
1 kHz TONE LEVEL	5 kHz Deviation
MODULATION METER	6 kHz/% X 10

4.5.2 Using TI keyboard and FREQ ERROR range selector controls, select each setting of Table 3 and verify the TI FREQ ERROR meter indicates within the limits listed in Table 4.

Table 4.

Freq Error Range Setting	Selected Frequency	Limits Freq Error Meter
AUDIO 300	TONE 01000.0 SINE	-0.03 to +0.03
AUDIO 300	TONE 01300.0 SINE	-2.91 to -3.09
AUDIO 300	TONE 00700.0 SINE	+2.91 to +3.09

Table 4. (Cont.)

Freq Error Range Setting	Selected Frequency	Limits Freq Error Meter
AUDIO 30	TONE 01030.0 SINE	-2.91 to -3.09
AUDIO 30	TONE 00970.0 SINE	+2.91 to +3.09
AUDIO 3	TONE 01003.0 SINE	-2.91 to -3.09
AUDIO 3	TONE 00997.0 SINE	+2.91 to +3.09

4.5.3 Disconnect the coax cable between the TI ANT connector and EXTERNAL REFERENCE connector.

4.6 RF SIGNAL GENERATOR FREQUENCY AND POWER CALIBRATION:

4.6.1 Set TI controls as follows:

MODULATION	FM WIDE
MODULATION METER	6 kHz/% X 10
VAR TONE	OFF
VAR TONE LEVEL	fully CCW
1 kHz TONE	OFF
1 kHz TONE LEVEL	fully CCW
RF LEVEL ATTENUATOR	-20 dBm
RF LEVEL ATTENUATOR vernier	fully CCW
GEN/LOCK	LOCK
MODE	GEN

4.6.2 Connect Electronic Counter set up for frequency measurement to TI T/R connector.

4.6.3 Using the TI Keyboard enter the frequencies listed under the Applied Freq column of Table 5. The TI must indicate within the limits listed in Table 5 for the Option being calibrated.

Table 5.

Applied Freq (MHz)	STD TCXO Limits (±Hz)	OPT 01 TCXO Limits (±Hz)	OPT 02 OVEN Limits (±Hz)
000.5000	0.25	0.10	0.025
002.5000	1.25	0.50	0.125
012.5000	6.25	2.50	0.625
042.5000	21.25	8.50	2.125
142.5000	71.25	28.50	7.125
342.5000	171.25	68.50	17.125
642.5000	321.25	128.50	32.125
999.9999	500.00	200.00	50.000

4.6.4 Disconnect Electronic Counter from TI T/R connector. Standardize Power Meter (2.3) and Power Sensor and connect Power Meter (2.3) and Sensor to TI T/R connector.

4.6.5 With TI set for an Output of -30 dBm and using the same frequencies that are listed in Table 5, check the TI power output at each frequency (change to low frequency Power Sensor below 10 MHz).

4.6.6 The power as measured on Power Meter (2.3) must be -32.5 to -27.5 dBm.

4.6.7 Set TI for a frequency of 500.0000 MHz. Rotate TI RF LEVEL attenuator vernier through its entire range and verify the power level as shown on Power Meter (2.3) changes at least 11 dB.

4.6.8 Adjust TI RF LEVEL control for an indication of -30 dBm as measured on Power Meter (2.3). Disconnect Power Meter (2.3) and Power Sensor from TI T/R connector and connect Spectrum Analyzer to TI T/R connector.

4.6.9 Set Spectrum Analyzer FREQUENCY to 500.0 MHz, REFERENCE LEVEL to -30 dB, display to LOG 10 dB/Div, BANDWIDTH and SCANWIDTH as required to display TI signal.

4.6.10 Without adjusting the TI controls, establish a reference on top graticule line of Spectrum Analyzer display.

4.6.11 Change the TI RF LEVEL Attenuator in 10 dB steps from -30 to -110 dB, at each step verify the Spectrum Analyzer display decreases 7.5 to 12.5 dB (change Spectrum Analyzer REFERENCE LEVEL and other controls as necessary to verify the above measurements).

4.6.12 Disconnect Spectrum Analyzer from TI T/R connector and connect Spectrum Analyzer to TI DUPLEX connector.

4.6.13 Select DUP on TI MODE selector and RF 150.0000 MHz and OFFSET 0.00 MHz on TI keyboard.

4.6.14 Verify TI DUPLEX output is -70 to -50 dBm at 150.0 MHz.

4.6.15 Disconnect Spectrum Analyzer from TI DUPLEX connector and connect Spectrum Analyzer to TI T/R connector.

4.6.16 Verify TI T/R level is -85 to -75 dBm.

4.6.17 Set all outputs to minimum and disconnect Spectrum Analyzer from TI.

4.7 RF SIGNAL GENERATOR FUNCTION GENERATOR CALIBRATION:

4.7.1 Set TI controls as follows:

VAR	OFF
VAR TONE	FULLY CCW
1 kHz TONE	OFF
1 kHz TONE LEVEL	FULLY CCW
PWR/OFF/BATT	PWR
MODE	REC
VOLUME	FULLY CCW
SQUELCH	FULLY CCW

4.7.2 Connect the Resistor across TI TONE OUT connector. Connect Digital Voltmeter across the Resistor.

4.7.3 Set TI 1 kHz TONE to INTL position and rotate 1 kHz TONE LEVEL control CW to obtain 2.5 V rms.

4.7.4 Disconnect Digital Voltmeter from across the Resistor connected to TI TONE OUT connector and connect Distortion Analyzer across the Resistor.

4.7.5 Measure distortion of the TI TONE OUT signal. Distortion must be ≤0.5%.

4.7.6 Disconnect the Distortion Analyzer from across the Resistor and connect Digital Voltmeter across the Resistor connected to TI TONE OUT connector.

4.7.7 Set TI 1 kHz TONE to OFF and VAR TONE to INTL position.

4.7.8 Using TI keyboard select TONE, 5000.0 Hz SINE.

4.7.9 Adjust TI VAR TONE LEVEL control until Digital Voltmeter indicates 2.5 V rms.

4.7.10 Disconnect Digital Voltmeter from across the resistor connected to TI TONE OUT connector and connect Distortion Analyzer across the Resistor.

4.7.11 Measure distortion of the TI TONE OUT signal. Distortion must be ≤2.0%.

4.7.12 Disconnect the Distortion Analyzer from across the Resistor and connect Electronic Counter set for a frequency measurement across the Resistor connected to TI TONE OUT connector.

4.7.13 Electronic Counter must indicate 4999.5 to 5000.5 Hz. Disconnect Electronic Counter from across the Resistor connected to TI TONE OUT connector.

4.7.14 Using TI keyboard select TONE, 1000.0 Hz SINE. Connect Digital Voltmeter to TI TONE OUT.

4.7.15 Adjust TI VAR TONE LEVEL control until Digital Voltmeter indicates 2.5 V rms.

4.7.16 Disconnect Digital Voltmeter from across the Resistor connected to TI TONE OUT connector and connect Distortion Analyzer across the Resistor.

4.7.17 Measure distortion of the TI TONE OUT signal. Distortion must be ≤2.0%.

4.7.18 Disconnect the Distortion Analyzer from across the Resistor and connect Electronic Counter set for a frequency measurement across the Resistor connected to TI TONE OUT connector.

4.7.19 Electronic Counter must indicate 999.9 to 1000.1 Hz. Disconnect Electronic Counter from across the Resistor connected to TI TONE OUT connector.

4.7.20 Disconnect Electronic Counter and Resistor from the TI TONE OUT connector.

4.7.21 Set TI controls as follows:

MODULATION	FM MID
VAR TONE	INTL
MODE	GEN
VAR TONE LEVEL	4 kHz DEVIATION
VERTICAL ATTENUATOR	2 kHz/DIV
HORIZONTAL SWEEP	100 µSEC/DIV (1200A)

4.7.22 Using TI keyboard select SINE, RAMP, SQUARE and TRIANGLE wave and verify each wave appears on both the TI digital display and CRT.

4.8 OSCILLOSCOPE CALIBRATION: (For 1200, 1200A Models)

4.8.1 Set TI controls as follows:

VERTICAL vernier	CAL
VERTICAL	1 V/DIV
HORIZONTAL vernier	CAL
HORIZONTAL	10 µSEC/DIV

MODE	REC
AC/GND/DC	DC

4.8.2 Adjust TI Oscilloscope VERT POS, INT, FOCUS and HORIZ POS controls until a clear sharp trace is centered over the center horizontal CRT graticule (trace should extend at least from the left most to right most vertical graticule).

4.8.3 Connect Power Supply to TI SCOPE/DVM connector.

4.8.4 Adjust Power Supply for 4 V (monitored with Digital Voltmeter as required). The Oscilloscope trace must move up 3.6 to 4.4 major divisions.

4.8.5 Adjust Power Supply to minimum.

4.8.6 Repeat step 4.8.4 setting TI VERTICAL V/DIV to 10 V/div and Power Supply to 40 V.

4.8.7 Repeat step 4.8.4 setting TI VERTICAL V/DIV to 100 mV/div and Power Supply to 400 mV.

4.8.8 Repeat step 4.8.4 setting TI VERTICAL V/DIV to 10 mV/div and Power Supply to 40 mV.

4.8.9 With TI VERTICAL V/DIV set to 10 mV/div and Power Supply set to 40 mV, turn TI VERTICAL VERNIER control fully CCW and verify that TI CRT display drops to ≤4 minor divisions. Set TI VERTICAL VERNIER to CAL position.

4.8.10 Set TI AC/GND/DC to AC and verify TI CRT trace returns to TI center horizontal graticule line.

4.8.11 Set TI AC/GND/DC to GND and verify TI CRT trace stays at the TI center horizontal graticule line. Return TI AC/GND/DC to DC.

4.8.12 Disconnect the Power Supply from TI and connect the TI TONE OUT to the TI SCOPE/DVM connector.

4.8.13 Set TI controls as follows:

HORIZONTAL	1 mS/DIV
VERTICAL	.1 V/DIV
AC/GND/DC	DC

4.8.14 Connect Function Generator set for a 1000 Hz output, to TI SCOPE/DVM connector.

4.8.15 Set Function Generator output amplitude for an approximate 4 divisions of vertical display on TI CRT.

4.8.16 Adjust TI HORIZ POS control to position first positive peak of signal on left most vertical TI CRT vertical graticule.

4.8.17 While keeping the first positive peak of the signal centered over the left most vertical graticule with TI HORIZ POS control, adjust Function Generator frequency control until each positive peak of signal is positioned over each major vertical graticule line of TI CRT.

4.8.18 The Function Generator frequency must indicate within 900 to 1100 Hz.

4.8.19 Set TI HORIZONTAL to 10 mS/DIV.

4.8.20 While keeping the first positive peak of the signal centered over the left most vertical graticule with TI HORIZ POS control, adjust Function Generator frequency control until each positive peak of signal is positioned over each major vertical graticule line of TI CRT.

4.8.21 The Function Generator frequency must indicate within 90 to 110 Hz.

4.8.22 Set TI HORIZONTAL to 100 µS/DIV.

4.8.23 While keeping the first positive peak of the signal centered over the left most vertical graticule with TI HORIZ POS control, adjust Function Generator frequency control until each positive peak of signal is positioned over each major vertical graticule line of TI CRT.

4.8.24 The Function Generator frequency must indicate within 9000 to 11000 Hz.

4.8.25 Set TI HORIZONTAL to 10 µS/DIV.

4.8.26 While keeping the first positive peak of the signal centered over the left most vertical graticule with TI HORIZ POS control, adjust Function Generator frequency control until each positive peak of signal is positioned over each major vertical graticule line of TI CRT.

4.8.27 The Function Generator frequency must indicate within 90.0 to 110.0 kHz.

4.8.28 Set TI HORIZONTAL to 1 µS/DIV.

4.8.29 While keeping the first positive peak of the signal centered over the left most vertical graticule with TI HORIZ POS control, adjust Function Generator frequency control until each positive peak of signal is positioned over each major vertical graticule line of TI CRT.

4.8.30 The Function Generator frequency must indicate within 900.0 to 1100.0 kHz.

4.8.31 With conditions as set in step 4.8.30, rotate the TI HORIZONTAL vernier fully CCW and verify 10 cycles per division or more on TI CRT display. Return TI HORIZONTAL vernier to the CAL (fully CW) position.

4.8.32 Set TI controls as follows:

MODULATION	FM NAR
MODULATION METER	6 kHz/DIV
VAR TONE	OFF
1 kHz TONE	INTL
KEYBOARD	RF 121.0000 MHz
VERTICAL vernier	CAL

VERTICAL	2 kHz/% X 10
HORIZONTAL vernier	CAL
HORIZONTAL	1 mS/DIV
MODE	GEN

4.8.33 Adjust TI 1 kHz TONE LEVEL control for 4 kHz deviation on TI MODULATION meter.

4.8.34 Verify the signal displayed on TI CRT is 3.6 to 4.4 major divisions peak to peak.

4.8.35 If calibrating the A model TI without the Digital Voltmeter (OPT 10) skip to step para 4.10. If TI is equipped with Digital Voltmeter (OPT 10) proceed to para 4.9.

4.9 DIGITAL VOLTMETER CALIBRATION: (OPT 10 Only)

4.9.1 Set TI controls as follows:

MODULATION	FM NAR
MODULATION METER	2 kHz/% X 10
VAR TONE	OFF
1 kHz TONE	OFF
PWR/OFF/BATT	PWR
FREQ ERROR	RF 10K
MODE	GEN
SQUELCH	FULLY CCW

4.9.2 Using TI keyboard select RF 151.0000 MHz and 2nd FUNCTION METER.

4.9.3 The TI Digital Display must indicate MD 00.00 ±2 counts.

4.9.4 Place TI MODULATION METER control to 6 kHz/% X 10 position and 1 kHz TONE SELECTOR to INTL position. Adjust TI 1 kHz TONE LEVEL control for 5 kHz deviation as indicated on TI MODULATION METER.

4.9.5 Verify TI Digital Display indicates MD 5.00 ±0.6 counts.

4.9.6 Set TI MODE selector control to REC position and using TI keyboard select RF 9.9950 MHz.

4.9.7 Connect TI ANT connector to the EXTERNAL REFERENCE connector.

4.9.8 Verify TI Digital Display indicates FE +05.00 ±0.30.

4.9.9 Set TI FREQ ERROR meter selector to 3 kHz position and verify TI Digital Display indicates 3.07 to 3.10.

4.9.10 Disconnect TI ANT connector from EXTERNAL REFERENCE connector.

4.9.11 Using a tee connector connect the Digital Voltmeter and Power Supply set to 0 VDC to TI SCOPE/DVM connector.

4.9.12 Using TI keyboard select DVM function and use the ± key to toggle to DC scale.

4.9.13 TI Digital Display indication must equal the Digital Voltmeter indication ±10% (if necessary adjust internal TI DVM ZERO ADJUST).

4.9.14 Set Power Supply for an indication on the Digital Voltmeter of 1.30 VDC. The TI Digital Display must indicate 1.17 to 1.43 VDC.

4.9.15 Set Power Supply for an indication on the Digital Voltmeter of 5.00 VDC. The TI Digital Display must indicate 4.50 to 5.50 VDC.

4.9.16 Set Power Supply for an indication on the Digital Voltmeter of 20.0 VDC. The TI Digital Display must indicate 18.00 to 22.00 VDC.

4.9.17 Set Power Supply output to minimum and disconnect Power Supply from TI SCOPE/DVM connector. Connect AC-DC Voltage Standard set to 1 kHz to TI SCOPE/DVM connector.

4.9.18 Using TI keyboard select DVM function and AC scale.

4.9.19 Repeat steps 4.9.14 through 4.9.16 using the AC-DC Voltage Standard and all indications must be VAC.

4.9.20 Set all outputs to minimum and disconnect and the test setup.

4.10 POWER METER CALIBRATION:

4.10.1 Set TI controls as follows:

METER	WATTS - AVG 15 W
MODE	REC

4.10.2 Connect equipment as shown in Figure 1.

4.10.3 On the Power Meter (2.14) set to 40 dB Coupler and CAL FACTOR/Vernier controls to the appropriate value.

4.10.4 On the RF Power Amplifier set the Filter Switching Unit BAND SELECT-MHz to 250-400 and POWER ADJUST controls fully CCW.

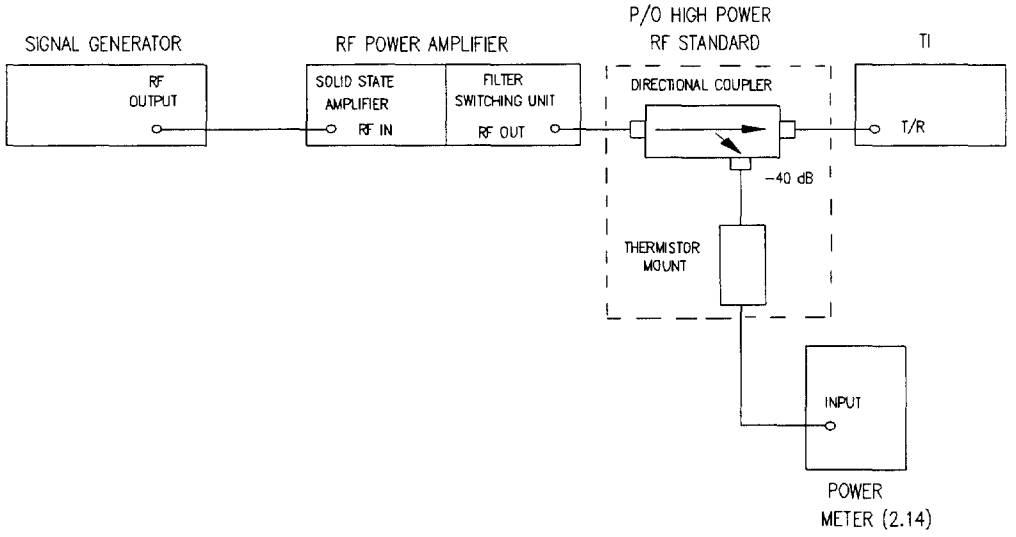

Figure 1.

4.10.5 Set Signal Generator as required for a 0 dBm output at 400 MHz.

4.10.6 On the RF Power Amplifier set the Filter Switching Unit 100-400 MHz POWER ADJUST controls for an indication of 10.00 W on Power Meter (2.14). (Set Power Meter CAL FACTOR/Vernier control as required).

4.10.7 TI digital and analog power meters must indicate 8.85 to 11.15 W.

4.10.8 Set TI METER control to WATTS - AVG 150 W and increase the RF Power Amplifier Switching Unit 100-400 MHz POWER ADJUST controls for an indication of 30.0 W on the Power Meter (2.14).

4.10.9 TI MODULATION meter and digital display must indicate 23.4 to 36.6 W.

4.10.10 Set Signal Generator output to minimum and set RF Power Amplifier Switching Unit BAND SELECT-MHz to 100-160 with POWER ADJUST controls fully CCW.

4.10.11 Set TI METER to WATTS - AVG 15 W and repeat steps 4.10.5 through 4.10.9 with Signal Generator set to 100 MHz as required.

4.10.12 Set Signal Generator output to minimum and set RF Power Amplifier Switching Unit BAND SELECT-MHz to 7.5 to 12 with POWER ADJUST controls fully CCW.

4.10.13 On the RF Power Amplifier change RF connections to Solid State Amplifiers and Filter Switching Unit as necessary for 10 MHz.

4.10.14 Set TI METER to WATTS - AVG 15 W and repeat steps 4.10.5 through 4.10.9 with Signal Generator set to 10 MHz as required.

4.10.15 Set Signal Generator output to minimum and set RF Power Amplifier Switching Unit BAND SELECT-MHz to 400 to 1000 with POWER ADJUST controls fully CCW.

4.10.16 On the RF Power Amplifier change RF connections to Solid State Amplifiers and Filter Switching Unit as necessary for 800 MHz.

4.10.17 Set Signal Generator as required for a 0 dBm output at 800 MHz.

4.10.18 On the RF Power Amplifier set the Filter Switching Unit 400-1000 MHz POWER ADJUST controls for an indication of 10.00 W on Power Meter (2.14). (Set Power Meter CAL FACTOR/Vernier control as required).

4.10.19 TI digital and analog power meters must indicate 7.55 to 12.45 W.

4.10.20 Set TI METER control to WATTS - AVG 150 W and increase the RF Power Amplifier Switching Unit 400-1000 MHz POWER ADJUST controls for an indication of 30.0 W on the Power Meter (2.14).

4.10.21 TI MODULATION meter and digital display must indicate 19.5 to 40.5 W.

4.10.22 Set all outputs to OFF or minimum and disconnect and secure all test equipment.

4.10A POWER METER CALIBRATION: (Alternate method)

4.10A.1 Connect equipment as shown in Figure 1A.

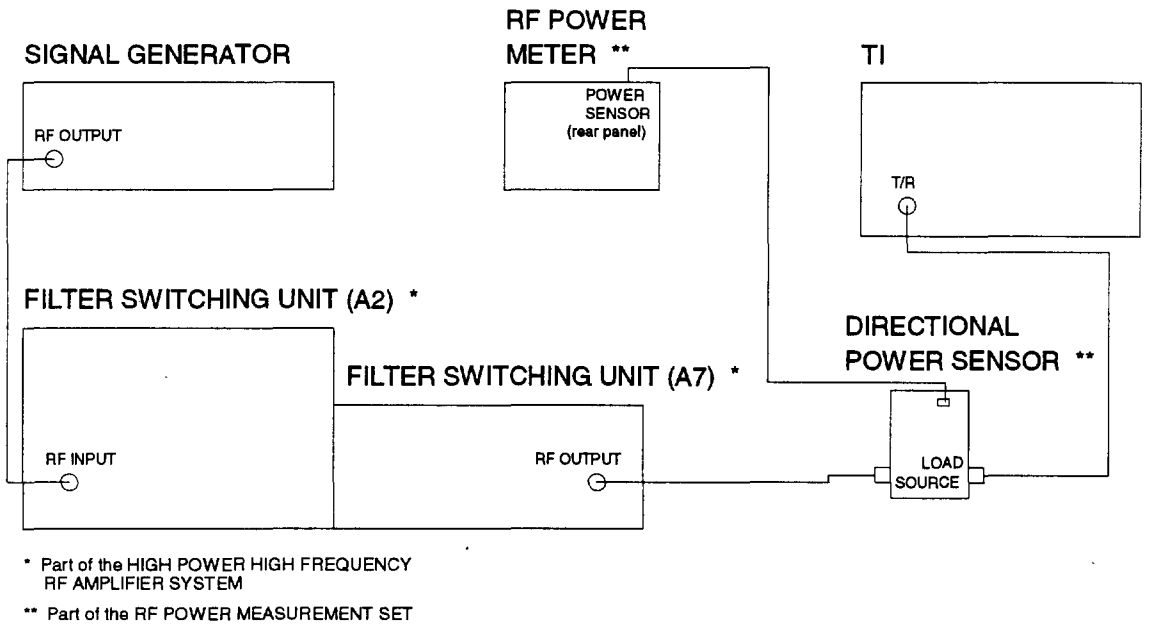

Figure 1A.

NOTE

Use the applicable Directional Power Sensor, as required, for the frequency being tested.

4.10A.2 Set the RF Power Meter, as required, to measure Watts.

4.10A.3 On the Filter Switching Unit (A2), set the RF OUTPUT LEVEL CONTROL fully CCW and press the OPER/STBY key until the OPERATE lamp illuminates.

NOTE

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

4.10A.4 Set the TI METER to the first value listed in the Range column of Table 2A. Set the MODE to REC.

4.10A.5 On the Filter Switching Unit (A2), press the Band listed in the Band column of Table 2A.

4.10A.6 Set the Signal Generator, as required, to 0.0 dBm at the first frequency listed in the Frequency column of Table 2A.

4.10A.7 Set the Filter Switching Unit (A2) RF OUTPUT LEVEL CONTROL for a RF Power Meter indication of the first value listed in the Applied column of Table 2A.

NOTE

It may not be possible to set the Filter Switching Unit (A2) RF OUTPUT LEVEL CONTROL for an exact indication of the value listed in the Applied column of Table 2A. If it is not, set the RF OUTPUT LEVEL CONTROL as close as possible and calculate the limits from the RF Power Meter displayed value.

4.10A.8 The TI digital and analog power meters must indicate within the values listed in the Limits column of Table 2A.

4.10A.9 Set the Filter Switching Unit (A2) RF OUTPUT LEVEL CONTROL fully CCW.

4.10A.10 Repeat steps 4.10A.4 through 4.10A.9 for the remaining corresponding values listed in Table 2A. Use the applicable Directional Power Sensor, as required, for the frequency being tested.

Table 2A.

Range (W)	Band (MHz)	Frequency (MHz)	Applied (W)	Limits (W)
15	10 - 16	10.00	10.00	8.85 to 11.15
150	10 - 16	10.00	30.0	23.4 to 36.6
15	64 - 100	100.0	10.0	8.85 to 11.15
150	64 - 100	100.0	30.0	23.4 to 36.6
15	348 - 500	400.0	10.0	8.85 to 11.15
150	348 - 500	400.0	30.0	23.4 to 36.6

Table 2A. (Cont.)

Range (W)	Band (MHz)	Frequency (MHz)	Applied (W)	Limits (W)
15	700 - 1000	800.0	10.0	7.55 to 12.45
150	700 - 1000	800.0	30.0	19.5 to 40.5

4.10A.11 Set all outputs to minimum. Disconnect and secure all test equipment.

CALIBRATION PERFORMANCE TABLE

4.1 RECEIVER MODULATION METER CALIBRATION:

Signal Generator Modulation	TI Modulation Selector	TI Range Selector	Modulation Meter	Limits	Display (MD)
5 kHz FM	FM NAR	6	4.57 to 5.43 kHz		4.57 to 5.43 kHz
5 kHz FM	FM MID	6	4.57 to 5.43 kHz		4.57 to 5.43 kHz
50 kHz FM	FM MID	60	45.7 to 54.3 kHz		45.7 to 54.3 kHz
50 kHz FM	FM WIDE	60	45.7 to 54.3 kHz		45.7 to 54.3 kHz
30% AM	AM NAR	6	2.67 to 3.33%	(1200A)	2.67 to 3.33%
				(1200	26.7 to 33.3%
				or)	2.67 to 3.33%
30% AM	AM NORM	6	2.67 to 3.33%	(1200A)	2.67 to 3.33%
				(1200	26.7 to 33.3%
				or)	2.67 to 3.33%

4.2 RECEIVER SENSITIVITY CALIBRATION:

TI MODULATION FM NAR	TI SQUELCH BREAKS	FREQUENCY	NO MODULATION	LEVEL
		255.5000		≤101 dBm
		455.5000		≤101 dBm
		855.5000		≤101 dBm
		999.9999		≤101 dBm

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.3 RECEIVER BANDWIDTH CALIBRATION:

TI INPUT FREQUENCY	TI Bandwidth	TI Meter	TI SQUELCH	Signal Generator
Carrier frequency	FM NARROW	WATTS-PK 15	Just silenced	Squelch (dBm)
CARRIER FREQ ±27 kHz			Not adjusted Break Squelch	Squelch (dBm) +40 dB
Carrier frequency	FM MIDDLE	WATTS-PK 15	Just silenced	Squelch (dBm)
CARRIER FREQ ±300 kHz			Not adjusted Break Squelch	Squelch (dBm) +40 dB
Carrier frequency	AM NARROW	WATTS-PK 15	Just silenced	Squelch (dBm)
CARRIER FREQ ±12 kHz			Not adjusted Break Squelch	Squelch (dBm) +40 dB

4.4 RECEIVER RF FREQUENCY ERROR METER CALIBRATION:

Freq Error Range Setting	Selected Frequency	Limits Freq Error Meter
RF 10 K	RF 010.0100 MHz	-0.97 to -1.03
RF 10 K	RF 009.9900 MHz	+0.97 to + 1.03
RF 10 K	RF 009.9870 MHz	Pegged +
RF 1 K	RF 009.9970 MHz	Pegged +
RF 1 K	RF 009.9990 MHz	+0.97 to +1.03
RF 100	RF 009.9999 MHz	+0.97 to +1.03
RF 3 K	RF 010.0030 MHz	-2.91 to -3.09
RF 3 K	RF 009.9970 MHz	+2.91 to +3.09
RF 300	RF 009.9997 MHz	+2.91 to +3.09
RF 30	RF 010.0000 MHz	-0.09 to +0.09

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.5 RECEIVER AUDIO FREQUENCY ERROR METER CALIBRATION:

Freq Error Range Setting	Selected Frequency	Limits Freq Error Meter
AUDIO 300	TONE 01000.0 SINE	-0.03 to +0.03
AUDIO 300	TONE 01300.0 SINE	-2.91 to -3.09
AUDIO 300	TONE 00700.0 SINE	+2.91 to +3.09
AUDIO 30	TONE 01030.0 SINE	-2.91 to -3.09
AUDIO 30	TONE 00970.0 SINE	+2.91 to +3.09
AUDIO 3	TONE 01003.0 SINE	-2.91 to -3.09
AUDIO 3	TONE 00997.0 SINE	+2.91 to +3.09

4.6 RF SIGNAL GENERATOR FREQUENCY AND POWER CALIBRATION:

Applied Freq (MHz)	STD TCXO Limits (±Hz)	OPT 01 TCXO Limits (±Hz)	OPT 02 OVEN Limits (±Hz)
000.5000	0.25	0.10	0.025
002.5000	1.25	0.50	0.125
012.5000	6.25	2.50	0.625
042.5000	21.25	8.50	2.125
142.5000	71.25	28.50	7.125
342.5000	171.25	68.50	17.125
642.5000	321.25	128.50	32.125
999.9999	500.00	200.00	50.000

4.7 RF SIGNAL GENERATOR FUNCTION GENERATOR CALIBRATION:

TONE OUT FREQUENCY	RESISTANCE	TONE LEVEL	DISTORTION (%)	FREQUENCY (Hz)
1 kHz INTL				
1 kHz	150 Ω	2.5 Vrms	≤0.5	
VAR TONE SELECTOR				
5000.0 Hz SINE	150 Ω	2.5 Vrms	≤2.0	4999.5 to 5000.5
1000.0 Hz SINE	150 Ω	2.5 Vrms	≤2.0	999.9 to 1000.1

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.8 OSCILLOSCOPE CALIBRATION: (for 1200, 1200A models)

Range	Accuracy
10 mV to 10 V/Div,	Set Value ±10%
Sweep Time	**Accuracy**
10 Sec to 10 mSec/Div	Set Value ±10%

4.9 DIGITAL VOLTMETER CALIBRATION: (OPT 10 Only)

Input VDC	Limits (VDC)
1.3	1.17 to 1.43
5.0	4.5 to 5.5
20.0	18.0 to 22.0
Input VAC 1 kHz	**Limits (VAC)**
1.3	1.17 to 1.43
5.0	4.5 to 5.5
20.0	18.0 to 22.0

4.10 POWER METER CALIBRATION:

Frequency (MHz)	Level (W)	Limits (W)
10.0	10.0	8.85 to 11.15
	30.0	23.4 to 36.6
100.0	10.0	8.85 to 11.15
	30.0	23.4 to 36.6
400.0	10.0	8.85 to 11.15
	30.0	23.4 to 36.6
800.0	10.0	7.55 to 12.45
	30.0	19.5 to 40.5

CALIBRATION PERFORMANCE TABLE *(Cont.)*

4.10A POWER METER CALIBRATION: (Alternate Method)

Frequency (MHz)	Level (W)	Limits (W)
10.0	10.0	8.85 to 11.15
	30.0	23.4 to 36.6
100.0	10.0	8.85 to 11.15
	30.0	23.4 to 36.6
400.0	10.0	8.85 to 11.15
	30.0	23.4 to 36.6
800.0	10.0	7.55 to 12.45
	30.0	19.5 to 40.5