

TECHNICAL MANUAL
CALIBRATION PROCEDURE
FOR
NAV/COMM TEST SET
IFR4000

(IFR AMERICAS INC)

This publication replaces T.O. 33K3-4-3457-1 dated 30 March 2005 and all subsequent changes.



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Page No.	* Change No.	Page No.	* Change No.	Page No.	* Change No.
Title	0				
A	0				
1 - 24.....	0				

*Zero in this column indicates an original page

NAV/COMM TEST SET

IFR4000

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1 CALIBRATION DESCRIPTION:*Table 1.*

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
RF Signal Generator		
Output Frequency	Range: VOR: 107 to 118 MHz; LOC: 107 to 113 MHz; Marker Beacon: 72 to 78 MHz; Comm VHF AM: 117 to 157 MHz; G/S: 327 to 337 MHz; Comm VHF FM: 155 to 175 MHz; Comm UHF: 224 to 401 MHz; SELCAL: 117 to 157 MHz Accuracy: time base ±1 ppm when Autocal is performed	Compared to a Frequency Standard
Output Level		
ANT Connector		Measured with a Power Meter, Power Sensor and Microwave Measurement System
Single Carrier	Range: -67 to +13 dBm Accuracy: ±3 dB	

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
RF Signal Generator (<i>Cont.</i>)		
Output Level (<i>Cont.</i>)		Measured with a Power Meter, Power Sensor and Microwave Measurement System
RF I/O Connector		
Single Carrier	Range: -130 to -12 dBm Accuracy: -120 to -95 dBm, ± 3 dB; -94.5 to -40 dBm, ± 2 dB; -39.5 to -12 dBm, ± 2.5 dB	
Spectral Purity		Measured with a Spectrum Analyzer
Harmonics	Range: 72 to 401 MHz Accuracy: < -20 dBc	
Non-Harmonics	Range: 75 to 400 MHz Accuracy: < -35 dBc	
VOR Mode		Measured with ILS/VOR Signal Calibrator, Universal Counter and Audio Analyzer
Tone Frequency	Range: 30 Hz Ref, 30 Hz Var, 1020 and 9960 Hz Accuracy: $\pm 0.02\%$ of setting	
AM Modulation	Range: 30%, 30, 1020 and 9960 Hz; 10%, 1020 Hz Morse Code Accuracy: In CAL position: Modulation: $\pm 2\%$ AM; Distortion: $< 2.5\%$ THD * ¹	
FM Modulation	Range: 30 Hz Ref @ ± 480 Hz Peak Deviation on 9960 Hz sub-carrier Accuracy: ± 25 Hz peak deviation	

See footnote at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
VOR Mode (<i>Cont.</i>)		Measured with ILS/VOR Signal Calibrator, Universal Counter and Audio Analyzer
Bearing	Range: 0.0° to 359.9° Accuracy: ±0.1°	
LOC Mode		
Tone Frequency	Range: 90, 150 and 1020 Hz Accuracy: ±0.02% of setting	
Modulation	Range: 20% AM, 90 and 150 Hz; 30% AM, 1020 audio tone; 10% AM, 1020 Morse Code Accuracy: In CAL position: Modulation: ±2% AM; Distortion: <2.5% THD	
DDM		
Fixed	Range: ±0, 0.093, 0.155 or 0.200 DDM and Tone Delete Accuracy: ≤+10 dBm output level, ±(0.0015 DDM +3% of setting)	
Variable	Range: ±0.4 DDM Accuracy: ≤+10 dBm output level, ±(0.0025 DDM +3% of setting)	
G/S Mode		
Tone Frequency	Range: 90 and 150 Hz Accuracy: ±0.02% of setting	

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
G/S Mode <i>(Cont.)</i>		Measured with ILS/VOR Signal Calibrator, Universal Counter and Audio Analyzer
Modulation	Range: 40% AM; 90 and 150 Hz Accuracy: In CAL position: Modulation: $\pm 2\%$ AM; Distortion: $< 2.5\%$ THD	
DDM		
Fixed	Range: $\pm 0, 0.091, 0.175$ or 0.400 DDM and Tone Delete Accuracy: $\leq +10$ dBm output level, $\pm(0.003$ DDM + 3% of setting)	
Variable	Range: ± 0.8 DDM Accuracy: $\leq +10$ dBm output level, $\pm(0.0048$ DDM + 3% of setting)	
Marker Mode		
Tone Frequency	Range: 400, 1300 and 3000 Hz Accuracy: $\pm 0.02\%$ of setting	
Modulation	Range: 95% AM; 400, 1300 and 3000 Hz Accuracy: In CAL position: Modulation: $\pm 5\%$ AM; Distortion: $< 2.5\%$ THD, single carrier	
COMM Mode		
Tone Frequency	Range: 1020 Hz Accuracy: $\pm 0.02\%$ of setting	

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
COMM Mode (Cont.)	Range: 30% AM, 1020 Hz Accuracy: In CAL position: Modulation: $\pm 2\%$ AM; Distortion: $< 2.5\%$ THD	Measured with ILS/VOR Signal Calibrator, Universal Counter and Audio Analyzer
Frequency Counter	Range: 10 to 400 MHz; Resolution: 100 Hz Accuracy: Same as time base, ± 1 dig	Verified during RF Signal Generator Frequency Output calibration
AUX I/O Connector	Range: 1 to 10 MHz; Resolution: 1 Hz Accuracy: Same as time base, ± 1 dig	
Power Meter	Range: * ² 118.0 to 400.0 MHz, 0.1 to 300 W; Resolution: 0.1 to < 1 W, 0.01 W; 1 to < 100 W, 0.1 W; 100 to 300 W, 1 W Accuracy: * ³ CW only (w/o ext attenuator), $\pm (8\% \text{ of rdg} + 1 \text{ dig})$	Measured on TI with known signal applied
AM Meter	Range: 50 to 3000 Hz, 10 to 99% mod Accuracy: $\pm 10\%$ of rdg	
FM Meter	Range: 50 to 3000 Hz, 1 to 15 kHz dev Accuracy: $\pm (0.4 \text{ kHz} + 8\% \text{ of rdg})$	

*¹ VOR Mode 1020 Hz Morse Code Distortion not calibrated due to instability of measurement.

*² 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.

*³ External Attenuator required for input power > 30 W.

2 EQUIPMENT REQUIREMENTS:

	Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1	FREQUENCY STANDARD	Range: 10 MHz Accuracy: $<2.5 \times 10^{-7}$	Arbiter 1083B	
2.2	UNIVERSAL COUNTER	Range: 29 Hz to 335 MHz Accuracy: $\pm 0.005\%$ of rdg	Hewlett-Packard 53132A OPT 124	
2.3	POWER METER	Range: 10.0 to 16.0 dBm Accuracy: $\pm 1.2\%$ of indication	Agilent E4418B	
2.4	POWER SENSOR	Range: 75 to 335 MHz Accuracy: (all of Charted Cal Factor) $\pm 2.4\%$ of charted Cal Factor	Agilent E4412A	
2.5	MICROWAVE MEASUREMENT SYSTEM	Range: (Tuned RF Level) 75 to 335 MHz, -127 to +13 dB Accuracy: $\pm(0.02 \text{ dB} + 0.01 \text{ dB}/10 \text{ dB} + 1 \text{ digit})$ 0 to -80 dB; $\pm(0.02 \text{ dB} + 0.02 \text{ dB}/10 \text{ dB} + 1 \text{ digit})$ -80 to -110 dB; $\pm(0.02 \text{ dB} + 0.05 \text{ dB}/10 \text{ dB} + 1 \text{ digit})$ -110 to -127 dB Range: (AM) 400 MHz, 30 to 90% AM, 1 kHz rate Accuracy: $\pm 2.5\%$ of indication Range: (FM) 165 MHz, 1 to 13 kHz deviation, 1 kHz rate Accuracy: $\pm 2.8\%$ of indication	Hewlett-Packard 8902MS	

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.6 SENSOR MODULE	Range: 75 to 335 MHz, Accuracy: (all % of Charted Cal Factor) 75 to 100 MHz, $\pm 3.2\%$; 100 to 335 MHz, $\pm 2.6\%$	Hewlett-Packard 11722A	
2.7 SPECTRUM ANALYZER	Range: 75 to 1.5 GHz, 0 to 50 dB Accuracy: (Scale Fidelity) ± 1.6 dB	Hewlett-Packard 8563E	
2.8 ILS/VOR SIGNAL CALIBRATOR	Range: CW Frequency: 75 to 335 MHz; Audio Frequency: 29 to 9962 Hz Bearing: 0.00 to 359.99°; AM: 8 to 100% AM; FM: ± 505 Peak Deviation; DDM: ± 0.415 DDM; Accuracy: AM: $\pm 0.5\%$ AM; Bearing: $\leq 0.025^\circ$; FM: 6.25 Hz Peak Deviation; DDM: ± 0.001 DDM	Rhode-Schwartz CIVS	
2.9 POWER AMPLIFIER	Range: 800 mW to 28 W, 118 to 400 MHz Accuracy: N/A	Microwave Products SSPA0240-22/6140	
2.10 COUPLER SET	Range: 118 to 400 MHz Accuracy: $\pm 3\%$ of charted value *	Premier Microwave 1852A	
2.11 POWER METER	Range: 1 to 10 mW Accuracy: $\pm 1\%$ of rdg *	Hewlett-Packard 432B-H05	

See footnote at end of Table.

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.12 SIGNAL GENERATOR	Range: (CW) 118 to 400 MHz, -5 to 0 dBm; (AM) 30 to 90% modulation, 1 kHz rate; (FM) 1 to 13 kHz deviation, 1 kHz rate Accuracy: N/A	Hewlett-Packard 8664A Opt H15 (P/O E5504B)	
2.13 AUDIO ANALYZER	Range: 0 to 100% Accuracy: ± 1 dB	Hewlett-Packard 8903B	

* A worst case TAR of 2.7:1 is achieved by the RSS value of the Power Meter and the Coupler Set for the calibration of the Power Meter Measurement.

3 PRELIMINARY OPERATIONS:


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



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.

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

3.3 Throughout the Calibration Procedure, all hard keys will be in all CAPS, soft keys will be underlined, submenus will be in **Bold**, and menu values will be in *Italics*.

3.4 Connect the TI Power Cord to appropriate power source. Press TI POWER  key to on. Allow a 15 min warm-up period.

3.5 Press the TI SETUP key, as necessary to display the SETUP menu, and press H/W TOOLS, DIAGS, SELF TEST and RUN to initiate Self Test. When complete, ensure all Self-Tests pass. Press RETURN 3 times.

3.6 Press the TI SETUP key, as necessary to display the SETUP menu, and press STORE/RECALL. Press PREV or NEXT, as necessary, to select *PRESET SETTINGS* and then press RECALL. Press RETURN.

3.7 Throughout the Calibration Procedure, when required to enter a value, utilize the \uparrow , \downarrow , \leftarrow and \rightarrow keys to enter the value.

3.8 TO 33K3-4-3457-1 was written for boot sw ver 1.00, main sw ver 1.01, 1.03 and 1.04, fpga ver 1.0 and cpld ver 1.0. If the TI has another boot sw, main sw, fpga or cpld version, contact the TCM at AFMETCAL.

4 CALIBRATION PROCESS:**NOTE**

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

4.1 RF SIGNAL GENERATOR OUTPUT FREQUENCY CALIBRATION:

- 4.1.1 Connect Frequency Standard 10 MHz REF OUT to the Universal Counter Ref In (rear panel).
- 4.1.2 Press the TI SETUP key, as necessary to display the SETUP menu, and press NEXT PARAM, as necessary, to select the **PORT** field and set to *ANT*.
- 4.1.3 Connect the TI ANT connector to the Universal Counter CHANNEL 1 input. Set the Universal Counter 50Ω/1MΩ switch to 50Ω.
- 4.1.4 Press the TI MODE key, as necessary, to display the VOR mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to *REF&VAR*. Press **FREQ** and set **FREQ** to *108.000 MHz*.
- 4.1.5 Press the TI RF LVL key and set **RF LVL** to *0.0 dBm*.
- 4.1.6 Adjust Universal Counter controls as required for a stable display indication. Verify the Universal Counter indication is within the appropriate values listed in the Limits column of Table 2.

Table 2.

MODE	Limits (Hz)
VOR	107999892.0 to 108000108.0
LOCALIZER	108099891.9 to 108100108.1
MARKER BEACON	74999925.0 to 75000075.0
COMM VHF AM	117999882.0 to 118000118.0

- 4.1.7 Press the TI MODE key, as necessary, to display the LOCALIZER mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to *90 & 150*. Press **FREQ** and set **FREQ** to *108.100 MHz*.
- 4.1.8 Repeat step 4.1.6.
- 4.1.9 Press the TI MODE key, as necessary, to display the MARKER BEACON mode screen. Press **FREQ** and set **FREQ** to *75.00 MHz*.
- 4.1.10 Repeat step 4.1.6.
- 4.1.11 Press the TI MODE key, as necessary, to display the COMM VHF AM mode screen. Press SWITCH GEN/RX, as necessary, to set to *GENERATING*. Press **FREQ** and set **FREQ** to *118.0000 MHz*. Press **TONE**, as necessary, and set **MOD TONE** to *OFF*.

4.1.12 Repeat step 4.1.6.

4.1.13 Disconnect the TI ANT connector from the Universal Counter CHANNEL 1 input and connect the TI ANT connector to the Universal Counter CHANNEL 3 input. Set the Universal Counter 50Ω/1MΩ switch to 50Ω.

4.1.14 Press the TI MODE key, as necessary, to display the GLIDE SLOPE mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to 90 & 150. Press **FREQ** and set **FREQ** to 334.700 MHz.

4.1.15 Repeat step 4.1.6 using Table 3.

4.1.16 Press the TI MODE key, as necessary, to display the COMM UHF mode screen. Press SWITCH GEN/RX, as necessary, to set to *GENERATING*. Press **FREQ** and set **FREQ** to 225.0000 MHz. Press **TONE**, as necessary, and set **MOD TONE** to *OFF*.

4.1.17 Repeat step 4.1.6 using Table 3.

Table 3.

MODE	Limits (Hz)
GLIDE SLOPE	334699665.3 to 334700334.7
COMM UHF	224999775.0 to 225000225.0

4.1.18 Press the TI RF LVL key and set **RF LVL** to -67.0 dBm. Disconnect the test setup.

4.2 RF SIGNAL GENERATOR OUTPUT LEVEL CALIBRATION:

4.2.1 Repeat step 3.6 to restore the TI factory presets.

4.2.2 Press the TI SETUP key, as necessary to display the SETUP menu, and press NEXT PARAM, as necessary, to select the **PORT** field and set to *ANT*.

4.2.3 Press the TI MODE key, as necessary, to display the VOR mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to *REF&VAR*. Press **FREQ** and set **FREQ** to 108.000 MHz.

4.2.4 Standardize Power Meter (2.3) and Power Sensor. Set the Power Meter (2.3) controls for a dBm measurement.

4.2.5 Connect the Power Sensor to the TI ANT connector.

4.2.6 Press the TI RF LVL key and set **RF LVL** to the first value listed in the Level column of Table 4.

4.2.7 Set the Power Meter (2.3) CAL FACTOR switch to the appropriate value for the frequency being verified.

4.2.8 Verify the Power Meter (2.3) indication is within the values listed in the Limits column of Table 4.

4.2.9 Press the TI RF LVL key and set **RF LVL** to -67.0 dBm.

4.2.10 Disconnect the Power Sensor from the TI ANT connector.

4.2.11 Standardize the Measuring Receiver and Sensor Module. Ensure the Sensor Module calibration data is loaded in the Measuring Receiver.

4.2.12 Connect the Sensor Module to the TI ANT connector.

4.2.13 Set the Measuring Receiver controls for a power measurement in the dBm mode.

4.2.14 Press the TI RF LVL key and set **RF LVL** to the next value listed in the Level column of Table 4.

4.2.15 Ensure the Measuring Receiver indicates a stable power measurement. Press the Measuring Receiver Gold **S** key and TUNED RF LEVEL key. Press the CALIBRATE key and wait for a new indication.

NOTE

When the Measuring Receiver RECAL light illuminates, press the CALIBRATE key and wait for a new indication.

NOTE

Do NOT press the Measuring Receiver Blue (shift) and SET REF keys. The TI specifications are absolute levels.

4.2.16 Verify the Measuring Receiver indication is within the values listed in the Limits column of Table 4.

4.2.17 Press the TI RF LVL key and set **RF LVL** to the next value listed in the Level column of Table 4.

4.2.18 Verify the Measuring Receiver indication is within the values listed in the Limits column of Table 4.

4.2.19 Repeat steps 4.2.17 and 4.2.18 for the remaining corresponding values listed in Table 4.

4.2.20 Disconnect the Sensor Module from the TI ANT connector.

Table 4.

Level (dBm)	Limits (dBm)
+13	10.0 to 16.0
0	-3.0 to +3.0
-10	-13.0 to -7.0
-20	-23.0 to -17.0
-30	-33.0 to -27.0
-40	-43.0 to -37.0
-50	-53.0 to -47.0
-60	-63.0 to -57.0
-67	-70.0 to -64.0

4.2.21 Press the TI SETUP key and press NEXT PARAM, as necessary, to select the **PORT** field and set to *RF I/O*. Press the MODE key.

4.2.22 Connect the Sensor Module to the TI RF I/O connector.

4.2.23 Press the TI RF LVL key and set **RF LVL** to the first value listed in the Level column of Table 5.

4.2.24 Repeat steps 4.2.15 through 4.2.19 for the remaining corresponding values listed in Table 5.

4.2.25 Disconnect the Sensor Module from the TI RF I/O connector.

4.2.26 Press the TI SETUP key, as necessary to display the SETUP menu, and press NEXT PARAM, as necessary, to select the **PORT** field and set to *ANT*.

Table 5.

Level (dBm)	Limits (dBm)
-12	-14.5 to -9.5
-20	-22.5 to -17.5
-30	-32.5 to -27.5
-40	-42.0 to -38.0
-50	-52.0 to -48.0
-60	-62.0 to -58.0
-70	-72.0 to -68.0
-80	-82.0 to -78.0
-90	-92.0 to -88.0
-100	-103.0 to -97.0
-110	-113.0 to -107.0
-120	-123.0 to -117.0

4.2.27 Press the TI MODE key, as necessary, to display the LOCALIZER mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to *90 & 150*. Press **FREQ** and set **FREQ** to *108.100 MHz*.

4.2.28 Repeat steps 4.2.5 through 4.2.26.

4.2.29 Press the TI MODE key, as necessary, to display the GLIDE SLOPE mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to *90 & 150*. Press **FREQ** and set **FREQ** to *334.250 MHz*.

4.2.30 Repeat steps 4.2.5 through 4.2.26.

4.2.31 Press the TI MODE key, as necessary, to display the MARKER BEACON mode screen. Press **FREQ** and set **FREQ** to *75.00 MHz*.

4.2.32 Repeat steps 4.2.5 through 4.2.26.

4.2.33 Press the TI MODE key, as necessary, to display the COMM VHF AM mode screen. Press SWITCH GEN/RX, as necessary, to set to *GENERATING*. Press **FREQ** and set **FREQ** to *118.0000 MHz*. Press **TONE**, as necessary, and set **MOD TONE** to *OFF*.

4.2.34 Repeat steps 4.2.5 through 4.2.26.

4.2.35 Press the TI MODE key, as necessary, to display the COMM UHF mode screen. Press SWITCH GEN/RX, as necessary, to set to *GENERATING*. Press **FREQ** and set **FREQ** to *225.0000 MHz*. Press **TONE**, as necessary, and set **MOD TONE** to *OFF*.

4.2.36 Repeat steps 4.2.5 through 4.2.26.

4.2.37 Disconnect the test setup.

4.3 RF SIGNAL GENERATOR SPECTRAL PURITY HARMONICS AND SPECTRAL PURITY NON-HARMONICS CALIBRATION:

4.3.1 Repeat step 3.6 to restore the TI factory presets.

4.3.2 Connect the TI RF I/O connector to the Spectrum Analyzer INPUT 50 Ω .

4.3.3 Press the TI MODE key, as necessary, to display the VOR mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to *REF&VAR*. Press **FREQ** and set **FREQ** to *108.000 MHz*.

4.3.4 Press the RF LVL key and set **RF LVL** to *-12.0 dBm*.

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

4.3.6 Set the Spectrum Analyzer controls as required to measure at least four harmonic signal levels.

4.3.7 Verify the amplitude of the Harmonic signals are within the first value listed in the Harmonics column of Table 6.

4.3.8 Verify the amplitude of the Non-Harmonic signals are within the first value listed in the Non-Harmonics column of Table 6.

Table 6.

MODE	Limits (dBc)	
	Harmonics	Non-Harmonics
VOR	<-20	<-35
LOCALIZER	<-20	<-35

Table 6. (Cont.)

MODE	Limits (dBc)	
	Harmonics	Non-Harmonics
GLIDE SLOPE	<-20	<-35
MARKER BEACON	<-20	<-35
COMM VHF AM	<-20	<-35
COMM UHF	<-20	<-35

4.3.9 Press the TI MODE key, as necessary, to display the LOCALIZER mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to 90 & 150. Press **FREQ** and set **FREQ** to 108.100 MHz.

■ 4.3.10 Repeat steps 4.3.4 through 4.3.8.

4.3.11 Press the TI MODE key, as necessary, to display the GLIDE SLOPE mode screen. Press TONE DEL, as necessary, to set **TONE DEL** to 90 & 150. Press **FREQ** and set **FREQ** to 334.250 MHz.

■ 4.3.12 Repeat steps 4.3.4 through 4.3.8.

4.3.13 Press the TI MODE key, as necessary, to display the MARKER BEACON mode screen. Press **FREQ** and set **FREQ** to 75.00 MHz.

■ 4.3.14 Repeat steps 4.3.4 through 4.3.8.

4.3.15 Press the TI MODE key, as necessary, to display the COMM VHF AM mode screen. Press SWITCH GEN/RX, as necessary, to set to *GENERATING*. Press **FREQ** and set **FREQ** to 118.0000 MHz. Press **TONE**, as necessary, and set **MOD TONE** to *OFF*.

■ 4.3.16 Repeat steps 4.3.4 through 4.3.8.

4.3.17 Press the TI MODE key, as necessary, to display the COMM UHF mode screen. Press SWITCH GEN/RX, as necessary, to set to *GENERATING*. Press **FREQ** and set **FREQ** to 225.0000 MHz. Press **TONE**, as necessary, and set **MOD TONE** to *OFF*.

■ 4.3.18 Repeat steps 4.3.4 through 4.3.8.

4.3.19 Press the RF LVL key and set **RF LVL** to -130.0 dBm. Disconnect the test setup.

4.4 VOR MODE CALIBRATION:

4.4.1 Repeat step 3.6 to restore the TI factory presets.

4.4.2 Connect the TI RF I/O to the ILS/VOR Signal Calibrator 50 Ω Input connector.

4.4.3 Press the TI MODE, as necessary, for the VOR mode screen. Press the TI RF LVL and set **RF LVL** to -20.0 dBm.

- 4.4.4 Press the TI TONE DEL, as necessary, to set **TONE DEL** to —. Press 9960 MOD and set **9960 Hz MOD** to 30%, set **30 Hz MOD** to 0%.
- 4.4.5 Set the ILS/VOR Signal Calibrator as a receiver for % AM modulation measurement.
- 4.4.6 Connect ILS/VOR Signal Calibrator AF output to the Universal Counter CHANNEL 1 input.
- 4.4.7 Verify the Universal Counter indication is within the values listed in the Frequency column of Table 7 for 9960 Hz Tone.
- 4.4.8 Verify the ILS/VOR Signal Calibrator indication is within the values listed in the AM Modulation column of Table 7 for the 9960 Hz Tone.
- 4.4.9 Disconnect Universal Counter from the ILS/VOR Signal Calibrator AF output.
- 4.4.10 Connect the ILS/VOR Signal Calibrator AF output to the Audio Analyzer HI input for distortion measurement.
- 4.4.11 Verify the Audio Analyzer indication is within the values listed in the Distortion column of Table 7 for the 9960 Hz Tone.
- 4.4.12 Disconnect Audio Analyzer from the ILS/VOR Signal Calibrator AF output.
- 4.4.13 Press the TI 9960 MOD and set **9960 Hz MOD** to 0%. Press 30 MOD and set **30 Hz MOD** to 30%. Repeat steps 4.4.6 through 4.4.12 for the 30 Hz Tone.
- 4.4.14 Press the TI 30 MOD and set **30 Hz MOD** to 0%. Press TONE, as necessary, to set **MOD TONE** to 1020 Hz. Repeat steps 4.4.6 through 4.4.12 for the 1020 Hz Tone.
- 4.4.15 Press the TI TONE, as necessary, to set **MOD TONE** to MORSE. Repeat steps 4.4.5 through 4.4.12, as applicable, for the 1020 Hz Morse Code Tone.

Table 7.

Tone (Hz)	Frequency (Hz)	Limits	
		AM Modulation (%)	Distortion (%)
9960	9958.008 to 9961.992	28 to 32	<2.5
30	29.994 to 30.006	28 to 32	<2.5
1020	1019.796 to 1020.204	28 to 32	<2.5
1020 Morse Code	N/A	8 to 12	N/A

4.4.16 Press the TI TONE, as necessary, to set **MOD TONE** to OFF. Press 30 MOD and set **30 Hz MOD** to 30%, then press 9960 MOD and set **9960 Hz MOD** to 30%. Press the TONE DEL, as necessary, to set **TONE DEL** to —.

4.4.17 On the ILS/VOR Signal Calibrator press DEMOD, AM Avion, VOR and DEV 9.96k.

4.4.18 Verify the ILS/VOR Signal Calibrator indicates within 455 to 505 Hz p.

4.4.19 Set up the ILS/VOR Signal Calibrator as a receiver for VOR measurements.

4.4.20 Press the TI **BRG** and set **BRG** to the first value listed in the Applied column of Table 8.

4.4.21 Verify the ILS/VOR Signal Calibrator indicates within the appropriate values listed in the Limits column of Table 8.

4.4.22 Repeat steps 4.4.20 and 4.4.21 for the remaining corresponding values listed in Table 8.

Table 8.

Applied (°)	Limits (°)
0.0	179.9 to 180.1
30	209.9 to 210.1
60	239.9 to 240.1
90	269.9 to 270.1
120	299.9 to 300.1
150	329.9 to 330.1
180	359.9 to 0.1
210	29.9 to 30.1
240	59.9 to 60.1
270	89.9 to 90.1
300	119.9 to 120.1
330	149.9 to 150.1

4.4.23 Leave test setup connected.

4.5 LOC MODE CALIBRATION:

4.5.1 Repeat step 3.6 to restore the TI factory presets.

4.5.2 Press the TI **MODE**, as necessary, for the LOCALIZER mode screen. Press the TI **RF LVL** and set **RF LVL** to **-20.0 dBm**.

4.5.3 Press the TI **TONE DEL**, as necessary, to set **TONE DEL** to **150**.

4.5.4 Set the ILS/VOR Signal Calibrator as a receiver for % AM modulation measurement.

- 4.5.5 Connect ILS/VOR Signal Calibrator AF output to the Universal Counter CHANNEL 1 input.
- 4.5.6 Verify the Universal Counter indication is within the values listed in the Frequency column of Table 9 for 90 Hz Tone.
- 4.5.7 Verify the ILS/VOR Signal Calibrator indication is within the values listed in the AM Modulation column of Table 9 for the 90 Hz Tone.
- 4.5.8 Disconnect Universal Counter from the ILS/VOR Signal Calibrator AF output.
- 4.5.9 Connect the ILS/VOR Signal Calibrator AF output to the Audio Analyzer HI input for distortion measurement.
- 4.5.10 Verify the Audio Analyzer indication is within the values listed in the Distortion column of Table 9 for the 90 Hz Tone.
- 4.4.11 Disconnect Audio Analyzer from the ILS/VOR Signal Calibrator AF output.
- 4.5.12 Press the TI TONE DEL, as necessary, to set **TONE DEL** to 90. Repeat steps 4.5.5 through 4.5.11 for the 150 Hz Tone.
- 4.5.13 Press the TI TONE DEL, as necessary, to set **TONE DEL** to 90&150, then press TONE, as necessary, to set **MOD TONE** to 1020 Hz. Repeat steps 4.5.5 through 4.5.11 for the 1020 Hz Tone.

Table 9.

Tone (Hz)	Frequency (Hz)	Limits	
		AM Modulation (%)	Distortion (%)
90	89.982 to 90.018	18 to 22	<2.5
150	149.970 to 150.030	18 to 22	<2.5
1020	1019.796 to 1020.204	28 to 32	<2.5

- 4.5.14 Press the TI TONE DEL, as necessary, to set **TONE DEL** to —, then press TONE, as necessary, to set **MOD TONE** to OFF.
- 4.5.15 Set the ILS/VOR Signal Calibrator for a DDM measurement.
- 4.5.16 Press the TI DDM/μA LOC ← and →, as necessary, to select the first value listed in the Applied column in Table 10.
- 4.5.17 Verify the ILS/VOR Signal Calibrator indication is within the values listed in the Limits column of Table 10.
- 4.5.18 Repeat steps 4.5.16 and 4.5.17 for the remaining corresponding values listed in Table 10.

Table 10.

Applied (DDM)	Limits (DDM)
0.200 LEFT	-0.2075 to -0.1925
0.155 LEFT	-0.1612 to -0.1488
0.093 LEFT	-0.0973 to -0.0887
0.000 CENTER	-0.0015 to +0.0015
0.093 RIGHT	0.0887 to 0.0973
0.155 RIGHT	0.1488 to 0.1612
0.200 RIGHT	0.1925 to 0.2075

4.5.19 Leave test setup connected.

4.6 G/S MODE CALIBRATION:

4.6.1 Repeat step 3.6 to restore the TI factory presets.

4.6.2 Press the TI MODE, as necessary, for a the GLIDE SLOPE mode screen. Press the TI RF LVL and set **RF LVL** to *-20 dBm*.

4.6.3 Press the TI TONE DEL, as necessary, to set **TONE DEL** to *150*.

4.6.4 Set the ILS/VOR Signal Calibrator as a receiver for % AM modulation measurement.

■ 4.6.5 Connect ILS/VOR Signal Calibrator AF output to the Universal Counter CHANNEL 1 input.

4.6.6 Verify the Universal Counter indication is within the values listed in the Frequency column of Table 11 for 90 Hz Tone.

4.6.7 Verify the ILS/VOR Signal Calibrator indication is within the values listed in the AM Modulation column of Table 11 for the 90 Hz Tone.

■ 4.6.8 Disconnect Universal Counter from the ILS/VOR Signal Calibrator AF output.

■ 4.6.9 Connect the ILS/VOR Signal Calibrator AF output to the Audio Analyzer HI input for distortion measurement.

■ 4.6.10 Verify the Audio Analyzer indication is within the values listed in the Distortion column of Table 11 for the 90 Hz Tone.

■ 4.6.11 Disconnect Audio Analyzer from the ILS/VOR Signal Calibrator AF output.

■ 4.6.12 Press the TI TONE DEL, as necessary, to set **TONE DEL** to *90*. Repeat steps 4.6.5 through 4.6.11 for the 150 Hz Tone.

Table 11.

Tone (Hz)	Frequency (Hz)	Limits	
		AM Modulation (%)	Distortion (%)
90	89.982 to 90.018	38 to 42	<2.5
150	149.970 to 150.030	38 to 42	<2.5

4.6.13 Press the TI TONE DEL, as necessary, to set **TONE DEL** to —.

4.6.14 Set the ILS/VOR Signal Calibrator for a DDM measurement.

4.6.15 Press the TI DDM/ μ A G/S \uparrow and \downarrow , as necessary, to select the first value listed in the Applied column in Table 12.

4.6.16 Verify the ILS/VOR Signal Calibrator indication is within the values listed in the Limits column of Table 12.

4.6.17 Repeat steps 4.6.15 and 4.6.16 for the remaining corresponding values listed in Table 12.

Table 12.

Applied (DDM)	Limits (DDM)
0.400 DOWN	+0.3850 to +0.4150
0.175 DOWN	+0.1667 to +0.1833
0.091 DOWN	+0.0853 to +0.0967
0.000 CENTER	-0.0030 to +0.0030
0.091 UP	-0.0967 to -0.0853
0.175 UP	-0.1833 to -0.1667
0.400 UP	-0.4150 to -0.3850

4.6.18 Leave test setup connected.

4.7 MARKER MODE CALIBRATION:

4.7.1 Repeat step 3.6 to restore the TI factory presets.

4.7.2 Press the TI MODE, as necessary, for a MARKER BEACON mode screen. Press the TI RF LVL and set **RF LVL** to *-20.0 dBm*.

4.7.3 Press the TI TONE, as necessary, to set **MOD TONE** to *400 Hz*.

4.7.4 Set the ILS/VOR Signal Calibrator as a receiver for % AM modulation measurement.

■ 4.7.5 Connect ILS/VOR Signal Calibrator AF output to the Universal Counter CHANNEL 1 input.

4.7.6 Verify the Universal Counter indication is within the values listed in the Frequency column of Table 13 for 400 Hz Tone.

4.7.7 Verify the ILS/VOR Signal Calibrator indication is within the values listed in the AM Modulation column of Table 13 for the 400 Hz Tone.

■ 4.7.8 Disconnect Universal Counter from the ILS/VOR Signal Calibrator AF output.

■ 4.7.9 Connect the ILS/VOR Signal Calibrator AF output to the Audio Analyzer HI input for distortion measurement.

■ 4.7.10 Verify the Audio Analyzer indication is within the values listed in the Distortion column of Table 13 for the 400 Hz Tone.

■ 4.7.11 Disconnect Audio Analyzer from the ILS/VOR Signal Calibrator AF output.

■ 4.7.12 Press the TI TONE, as necessary, to set **MOD TONE** to 1300 Hz. Repeat steps 4.7.5 through 4.7.11 for the 1300 Hz Tone.

■ 4.7.13 Press the TI TONE, as necessary, to set **MOD TONE** to 3000 Hz. Repeat steps 4.7.5 through 4.7.11 for the 3000 Hz Tone.

Table 13.

Tone (Hz)	Frequency (Hz)	Limits	
		AM Modulation (%)	Distortion (%)
400	399.92 to 400.08	90 to 100	<2.5
1300	1299.74 to 1300.26	90 to 100	<2.5
3000	2999.40 to 3000.60	90 to 100	<2.5

4.7.14 Leave test setup connected.

4.8 COMM MODE CALIBRATION:

4.8.1 Repeat step 3.6 to restore the TI factory presets.

4.8.2 Press the TI MODE, as necessary, for a the COMM VHF AM mode screen. Press the TI RF LVL and set **RF LVL** to -20.0 dBm, then press SWITCH GEN/RX, as necessary, to select *GENERATING*.

4.8.3 Set the ILS/VOR Signal Calibrator as a receiver for % AM modulation measurement.

■ 4.8.4 Connect ILS/VOR Signal Calibrator AF output to the Universal Counter CHANNEL 1 input.

4.8.5 Verify the Universal Counter indication is within the appropriate values listed in the Limits column of Table 14 for the Function being verified.

4.8.6 Verify the ILS/VOR Signal Calibrator modulation indication is within the appropriate values listed in the Limits column of Table 14 for the Function being verified.

4.8.7 Disconnect Universal Counter from the ILS/VOR Signal Calibrator AF output.

4.8.8 Connect the ILS/VOR Signal Calibrator AF output to the Audio Analyzer HI input for distortion measurement.

4.8.9 Verify the Audio Analyzer indication is within the appropriate values listed in the Limits column of Table 14 for the Function being verified.

Table 14.

Tone (Hz)	Function	Limits
1020	Frequency	1019.80 to 1020.20 Hz
	AM Modulation	28 to 32%
	Distortion	<2.5%

4.8.10 Set outputs to minimum and disconnect test setup.

4.9 POWER METER CALIBRATION:

4.9.1 Repeat step 3.6 to restore the TI factory presets.

4.9.2 Press the TI MODE, as necessary, for a the COMM VHF AM mode screen. Press the TI POWER METER, as necessary, to select AVG.

4.9.3 Press the TI ZERO, ensure to remove all cables from RF I/O connector then press NEXT.

4.9.4 Connect test equipment as shown in Figure 1.

CAUTION

The Thermistor Mount (P/O Coupler Set) is not capable of Direct Power Measurements above 10 mW. DO NOT attempt High Wattage Measurements without using the Directional Coupler (P/O Coupler Set). Damaging voltages to the equipment may be encountered during the sequence of these test procedures. All necessary precautions during the conduct of these tests must be observed.

NOTE

The Coupler Set will be used with this method of calibration for power measurements of 1 to 30 W.

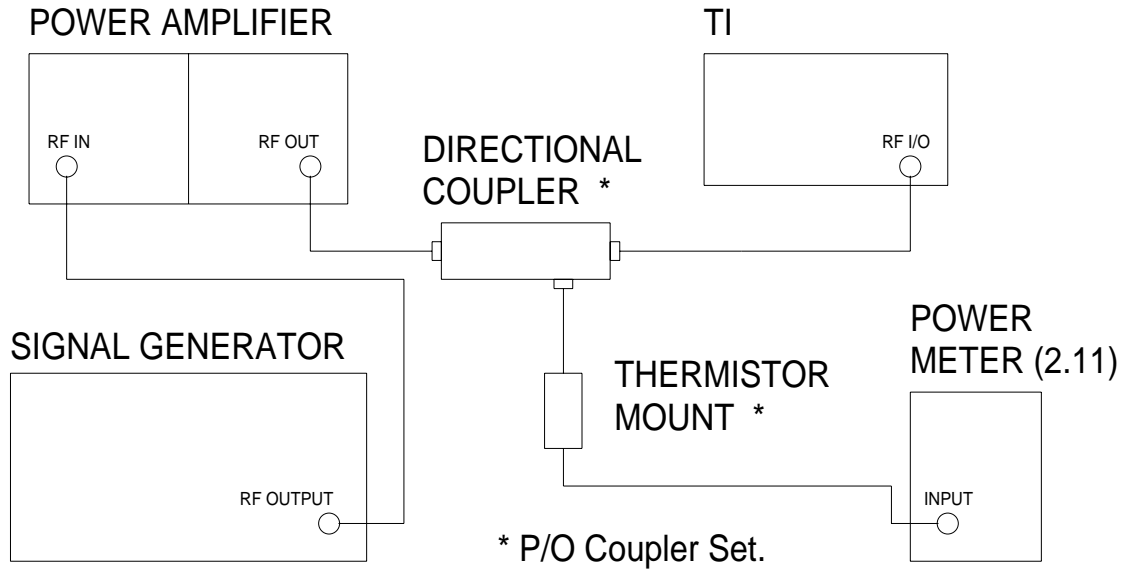


Figure 1.

4.9.5 Set the Power Meter (2.11) $\mu\text{W}/\text{mW}$ switch to 40 dB COUPLER and the CORRECTION FACTOR switch to the proper position for frequency being generated.

4.9.6 Set the Signal Generator frequency to 118 MHz.

4.9.7 Increase the Signal Generator output level until the TI TX PWR = indicates the first value listed in the Applied column of Table 15.

4.9.8 Verify the Power Meter (2.11) indicates within the values listed in the Limits column of Table 15.

4.9.9 Repeat steps 4.9.7 and 4.9.8 for the remaining values listed in the Applied column of Table 15.

Table 15.

Applied (W)	Limits (W)
1	0.820 to 1.180
10	9.100 to 10.900
20	18.300 to 21.700
25	22.900 to 27.100

4.9.10 Set the Signal Generator to minimum. Disconnect the Directional Coupler (P/O Coupler Set) from the TI RF I/O.

4.9.11 Press the TI MODE, as necessary, for the COMM UHF mode screen.

4.9.12 Repeat steps 4.9.3 through 4.9.10 at 250 MHz.

4.9.13 Repeat steps 4.9.3 through 4.9.10 at 400 MHz.

4.9.14 Set the Signal Generator to minimum and disconnect test setup.

4.10 AM METER CALIBRATION:

4.10.1 Repeat step 3.6 to restore the TI factory presets.

4.10.2 Press the TI SETUP key, as necessary to display the SETUP menu, and press NEXT PARAM, as necessary, to select the **PORT** field and set to *ANT*. Press MODE, as necessary, for the COMM UHF mode screen.

4.10.3 Connect the Signal Generator output to a BNC Tee. Connect one leg of the BNC Tee to the TI ANT and the other leg to the Measuring Receiver INPUT 50 Ω .

4.10.4 Press the Measuring Receiver INSTR PRESET. Adjust the Signal Generator frequency for a 400 MHz indication on the Measuring Receiver. Press the Measuring Receiver AM key and set HP Filter to 300 Hz and LP Filter to 3 kHz.

4.10.5 Press the TI FREQ and set **FREQ** to *400.000 MHz*.

4.10.6 Set the Signal Generator MODULATION AM to ON and the audio frequency to 1 kHz.

4.10.7 Set the Signal Generator AM modulation level, as required, for a Measuring Receiver indication of the first value listed in the Applied column of Table 16.

4.10.8 Verify the TI TX MOD = modulation indication is within the values listed in the appropriate Limits column of Table 16.

4.10.9 Repeat steps 4.10.7 and 4.10.8 for the remaining corresponding values listed in Table 16.

Table 16.

Applied (%)	Limits (%)
30.0	27 to 33
50.0	45 to 55
90.0	81 to 99

4.10.10 Set outputs to minimum.

4.11 FM METER CALIBRATION:

4.11.1 Repeat step 3.6 to restore the TI factory presets.

4.11.2 Press the TI SETUP key, as necessary to display the SETUP menu, and press NEXT PARAM, as necessary, to select the **PORT** field and set to *ANT*. Press the TI MODE, as necessary, for a the COMM VHF FM mode screen.

4.11.3 Set the Signal Generator MODULATION FM to ON and the audio frequency to 1 kHz.

4.11.4 Press the Measuring Receiver INSTR PRESET. Adjust the Signal Generator frequency for a 165 MHz indication on the Measuring Receiver. Press the Measuring Receiver FM key and set HP Filter to 300 Hz and LP Filter to 3 kHz.

4.11.5 Press the TI FREQ and set **FREQ** to *165.000 MHz*.

4.11.6 Set the Signal Generator FM deviation level, as required, for a Measuring Receiver indication of the first value listed in the Applied column of Table 17.

4.11.7 Verify the TI TX DEV = indication is within the values listed in the appropriate Limits column of Table 17.

4.11.8 Repeat steps 4.11.6 and 4.11.7 for the remaining corresponding values listed in Table 17.

Table 17.

Applied (kHz)	Limits (kHz)
4.5	3.74 to 5.26
10	8.80 to 11.20
13	11.56 to 14.44

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

CALIBRATION PERFORMANCE TABLE

Not Required