

TECHNICAL MANUAL
CALIBRATION PROCEDURE
FOR
VOR/ILS SIGNAL GENERATOR
NAV2000R

(JCAIR)

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VOR/ILS SIGNAL GENERATOR**NAV2000R****(JCAIR)****1 CALIBRATION DESCRIPTION:***Table 1.*

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Internal Reference Output	Range: 10 MHz Accuracy: $\pm 1 \times 10^{-6}$; * ¹ Aging/year: $\pm 1 \times 10^{-6}$	Compared to a Frequency Standard
Frequency Readout	Range: 150 kHz to 450 MHz Accuracy: ± 1 count of LSD	Compared to a Frequency Counter
Audio Frequency	Range: 10 Hz to 18 kHz Accuracy: $\pm 0.005\%$ of setting	
RF Output Level	Range: -127 to 0 dBm Accuracy: ± 1.0 dB, -64 to 0 dBm; ± 2.0 dB, -110 to -64 dBm; ± 3.0 dB, -127 to -110 dBm	Measured with a Power Meter, Power Sensor and Measuring Receiver
Spectral Purity		
Harmonics	Range: 150 kHz to 450 MHz Accuracy: < -30 dBc	Measured with a Spectrum Analyzer
Non-harmonics	Range: 150 kHz to 450 MHz Accuracy: < -60 dBc at > 5 kHz from carrier	
Single-Sideband (SSB) Phase Noise	Range: 150 kHz to 450 MHz Accuracy: < -115 dBc/Hz at > 25 kHz from carrier (CW only)	Measured with a Phase Noise Measurement System

See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Residual FM	Range: 150 kHz to 450 MHz Accuracy: (0.05 to 15 kHz) <25 Hz, 0.15 to 56.25 MHz; <10 Hz, 56.25 to 112.50 MHz; <16 Hz, 112.50 to 225.00 MHz; <25 Hz, 225.00 to 450.00 MHz	Measured with a Phase Noise Measurement System
Residual AM	Range: 150 kHz to 450 MHz Accuracy: <0.1% (0.05 to 15 kHz)	Measured with a Measuring Receiver
VOR		
Total Harmonic Distortion	Range: 30, 1020 and 9960 Hz Accuracy: <0.1% THD * ²	Measured with a Distortion Analyzer
FM Deviation	Range: 480 Hz at default frequencies Accuracy: ± 1 Hz * ³	Measured with an ILS/VOR Signal Calibrator
Phase Difference	Range: 0 to 360° Accuracy: $\pm 0.05^\circ$ relative to standard used during calibration * ⁴	
Amplitude Modulation	Range: 30, 1020 and 9960 Hz, 0 to 99% Accuracy: $\pm 2\%$ of setting for 10 to 95%	
Localizer		
Total Harmonic Distortion	Range: 90, 150 and 1020 Hz Accuracy: <0.1% THD	Measured with a Distortion Analyzer
Amplitude Modulation	Range: 90, 150 and 1020 Hz, 0 to 99% Accuracy: $\pm 2\%$ of setting for 10 to 95%	Measured with an ILS/VOR Signal Calibrator

See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Localizer (<i>Cont.</i>)		
DDM	Range: 0.000 to ± 0.200 DDM Accuracy: ± 0.0003 at 0.000 DDM; ± 0.0012 at 0.046 DDM; ± 0.0021 at 0.093 DDM; ± 0.0034 at 0.155 DDM; ± 0.0053 at 0.200 DDM	Measured with an ILS/VOR Signal Calibrator
Glideslope		
Total Harmonic Distortion	Range: 90 and 150 Hz Accuracy: $<0.1\%$ THD	Measured with a Distortion Analyzer
Amplitude Modulation	Range: 90 and 150 Hz, 0 to 99% Accuracy: $\pm 2\%$ of setting for 10 to 95%	Measured with an ILS/VOR Signal Calibrator
DDM	Range: 0.000 to ± 0.400 DDM Accuracy: ± 0.0003 at 0.000 DDM; * ⁵ ± 0.0012 at 0.045 DDM; ± 0.0021 at 0.091 DDM; ± 0.0038 at 0.175 DDM; ± 0.0083 at 0.400 DDM	
ADF		
Total Harmonic Distortion	Range: 10 Hz to 18 kHz Accuracy: $<0.1\%$ THD (10 Hz to 10 kHz)	Measured with a Distortion Analyzer
Amplitude Modulation	Range: 10 Hz to 18 kHz, 0 to 99% Accuracy: $\pm 2\%$ of setting for 10 to 95%	Measured with an ILS/VOR Signal Calibrator
Marker Beacon		
Total Harmonic Distortion	Range: 400, 1300 and 3000 Hz Accuracy: $<0.1\%$ THD	Measured with a Distortion Analyzer

See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
COMM		
Total Harmonic Distortion	Range: 10 Hz to 18 kHz Accuracy: <0.1% THD (10 Hz to 10 kHz)	Measured with a Distortion Analyzer
Amplitude Modulation	Range: 10 Hz to 18 kHz, 0 to 99% Accuracy: ±2% of setting for 10 to 95%	Measured with an ILS/VOR Signal Calibrator

*¹ The accuracy is the manufacturers calculated specification after one year. The accuracy specification is found by multiplying the longest term aging rate by the appropriate time interval to obtain one year. For a TI with a setability specification, the accuracy specification is found by adding the setability specification to the one year aging specification.

*² The TI VOR Total Harmonic Distortion at 9960 Hz is not verified as per manufacturer.

*³ Limited to ±3 Hz p.

*⁴ The TI will be verified to ±0.08° which is calculated by combining the uncertainty of the relative specification and the uncertainty of the ILS/VOR Signal Calibrator.

*⁵ Limited to ±0.0008 at 0.000 DDM.

2 EQUIPMENT REQUIREMENTS:

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1 FREQUENCY STANDARD	Range: 10 MHz Accuracy: ±2.5 × 10 ⁻⁷	Arbiter 1083B	Austron 2100F
2.2 FREQUENCY COUNTER	Range: 10 Hz to 450 MHz Accuracy: N/A	Hewlett-Packard 5345A	
2.3 MICROWAVE MEASUREMENT SYSTEM	Range: -127 to 0 dB, 15 to 330 MHz Accuracy: ±0.25 dB; Residual AM: <0.025% AM	Hewlett-Packard 8902MS	
2.4 DISTORTION ANALYZER	Range: 0 to 100%, 10 Hz to 10 kHz Accuracy: ±3% of FS	Hewlett-Packard 334A	

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.5 SPECTRUM ANALYZER	Range: 150 kHz to 1.8 GHz Accuracy: (Scale Fidelity) ± 1.6 dB	Hewlett-Packard 8563E	
2.6 ATTENUATOR	Range: 10 dB, 0.150 to 450 MHz Accuracy: N/A	As Available	
2.7 ILS/VOR SIGNAL CALIBRATOR	Range: 0.000 to 0.400 DDM; 0 to 359.99°, AM: 0 to 99%; FM: 477 to 483 Hz pk Accuracy: Localizer: $\pm(0.0002 + 0.1\%$ of rdg); Glide Slope: $\pm(0.0005 + 0.1\%$ of rdg); VOR: $\pm 0.03^\circ$ AM: $m \leq 80\%$, $\leq 0.8\%$ of rdg; $m \leq 95\%$, $\leq 1.0\%$ of rdg FM Deviation: $\leq 0.5\%$ of rdg TAR 1.3:1, VOR FM Deviation; TAR 2.7:1, VOR Phase Difference; TAR 1.5:1, Localizer at 0.000 DDM; TAR 1.6:1, Glideslope (worst case); TAR 1.3:1, FM Deviation; TAR 2:1, AM (worst case)	Rohde-Schwartz CIVS	
2.8 PHASE NOISE MEASUREMENT SYSTEM	Range: 0.15 to 450 MHz Accuracy: (Phase Noise) Offsets, 25 kHz to 1 MHz, ± 2 dB; Residual FM ± 2 dB TAR 3.9:1, Residual FM	Hewlett-Packard E5504B	
2.9 FEEDTHROUGH TERMINATION	Range: 600 Ω Accuracy: N/A	As Available	
2.10 POWER METER	Range: -1 to +1 dBm Accuracy: $\pm 2\%$ of rdg	Hewlett-Packard 436A	
2.11 POWER SENSOR	Range: 50 MHz Accuracy: $\pm 2.5\%$ of Charted Cal Factor	Hewlett-Packard 8481A	

3 PRELIMINARY OPERATIONS:

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

WARNING

Unless otherwise designated, and prior to beginning the Calibration Process, ensure that all test equipment voltage and/or current outputs are set to zero (0) or turned off, where applicable. Ensure that all equipment switches are set to the proper position before making connections or applying power.

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

3.3 Connect the TI to appropriate power source. Set TI POWER switch to ON and verify that the system diagnostics indicate a pass condition on the display for the CPU ROM, CPU RAM, DSP BOARD, RF GENERATOR and RF MODULATOR. Allow the TI a 30 minute warm-up.

3.4 On the TI, press and hold the VOR MODE key, select option 6 EXECUTE DISPLAY TEST and verify all elements of the display illuminate. Then press any key to stop the test.

3.5 Due to lack of standards, annotate and attach a Limited Certification Label stating: VOR FM Deviation is certified to ± 3 Hz p and Glideslope at 0.000 DDM is certified to ± 0.0008 DDM.

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 INTERNAL REFERENCE OUTPUT AND FREQUENCY READOUT CALIBRATION:

4.1.1 Connect the Frequency Standard 10 MHz REF OUT to the Electronic Counter EXT FREQ STD INPUT (1-10 MHz).

4.1.2 Set the Electronic Counter INT STD/EXT STD switch to EXT STD.

4.1.3 Connect the TI 10 MHz OUT connector (rear panel) to the Electronic Counter CHANNEL A input.

4.1.4 Set the Electronic Counter for a frequency measurement.

4.1.5 The Electronic Counter must indicate within 9 999 990 to 10 000 010 Hz.

4.1.6 Disconnect the test setup.

4.1.7 Connect equipment as shown in Figure 1.

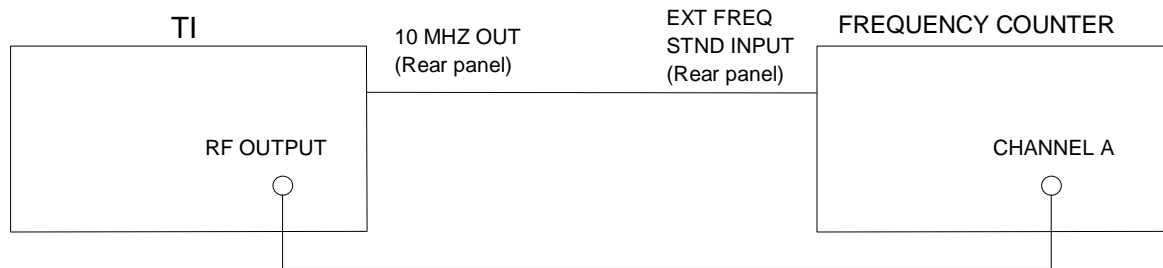


Figure 1.

4.1.8 On the TI, press COM and using the CURSOR CONTROL keys select Freq.MHz, set frequency to the first value listed in the Applied column of Table 2, ENT, ◀, 0.0, (dBm), ▼, ▶, 0, ENT for TONE #1 MODULATION and ▼, 0, ENT for TONE #2 MODULATION.

4.1.9 Verify the Frequency Counter indicates within the values listed in the Limits column of Table 2.

4.1.10 Using the TI CURSOR CONTROL keys select Freq.MHz, set frequency to the next value listed in the Applied column of Table 2 and ENT.

4.1.11 Verify the Frequency Counter indicates within the values listed in the Limits column of Table 2.

4.1.12 Repeat steps 4.1.10 and 4.1.11 for the remaining values listed in Table 2.

Table 2.

Applied (MHz)	Limits (MHz)
11.11111	11.11110 to 11.11112
22.22222	22.22221 to 22.22223
33.33333	33.33332 to 33.33334
44.44444	44.44443 to 44.44445
55.55555	55.55554 to 55.55556
66.66666	66.66665 to 66.66667
77.77777	77.77776 to 77.77778
88.88888	88.88887 to 88.88889
99.99999	99.99998 to 100.00000
100.00000	99.99999 to 100.00001
450.00000	449.99999 to 450.00001

4.1.13 Set all outputs to minimum and disconnect test setup.

4.2 AUDIO FREQUENCY CALIBRATION:

4.2.1 Connect equipment as shown in Figure 2.

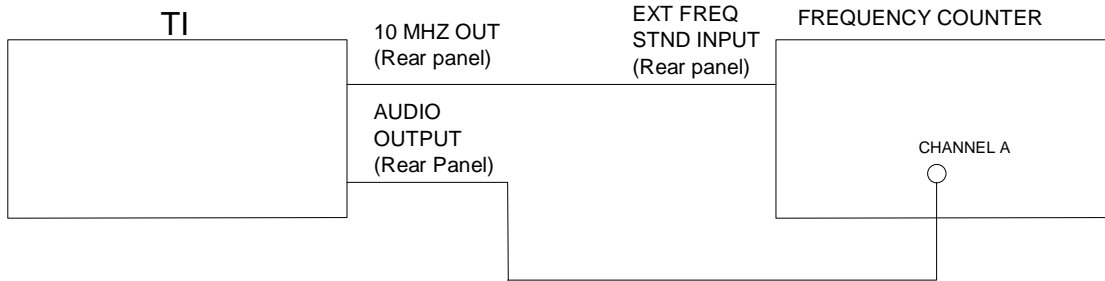


Figure 2.

4.2.2 On the TI, press COM and using the CURSOR CONTROL keys select Freq.MHz, set frequency to 100 MHz, press ENT, ◀, 0.0, (dBm), ▼, 10000, ENT, ▶, 50, ENT for TONE #1 MODULATION and ▼, 0 and ENT for TONE #2 MODULATION.

4.2.3 Verify the Frequency Counter indicates between 9999.5 and 10000.5 Hz

4.2.4 Using the TI CURSOR CONTROL keys select TONE #1 FREQUENCY, enter the first value listed in the Audio Frequency column of Table 3 and press ENT.

4.2.5 Verify the Frequency Counter indication is within the values listed in the Limits column of Table 3.

4.2.6 Repeat steps 4.2.4 and 4.2.5 for the remaining values in Table 3.

Table 3.

Audio Frequency (Hz)	Limits (Hz)
10.0	9.9995 to 10.0005
1000.0	999.95 to 1000.05
18000.0	17999.1 to 18000.9

4.2.7 Set all outputs to minimum and disconnect test setup.

4.3 RF OUTPUT LEVEL CALIBRATION:

4.3.1 Using the TI CURSOR CONTROL keys select Freq.MHz, set frequency to 50 MHz, press ENT, ▼, 0, ENT for TONE #1 MODULATION and ▼, 0 and ENT for TONE #2 MODULATION.

4.3.2 Standardize the Power Meter with the Power Sensor. Connect the Power Sensor to TI RF OUTPUT.

4.3.3 Set Power Meter CAL FACTOR control to appropriate value. The Power Meter must indicate between -1.0 and +1.0 dBm. Record the Power Meter indication.

4.3.4 Disconnect the Power Sensor from the TI RF OUTPUT.

4.3.5 Connect the TI RF OUTPUT to the Measuring Receiver (P/O Microwave Measurement System) INPUT 50 Ω.

4.3.6 On the Measuring Receiver, press INSTR PRESET, FREQ, enter the 50 and MHz.

4.3.7 On the Measuring Receiver, select TUNED RF LEVEL and press LOG/LIN key to select dB scale. Press Blue (Shift) and SET REF keys to establish a zero reference. Verify the Measuring Receiver display indicates 0.00 \pm 0.02 dB.

4.3.8 Using the TI CURSOR CONTROL keys select RF Level, enter the first value listed in the Applied column of Table 4 and press ENT.

4.3.9 Algebraically add the value recorded in step 4.3.3 to the Measuring Receiver indication. Verify the value is within the values listed in the Limits column of Table 4.

4.3.10 Repeat steps 4.3.8 and 4.3.9 for the remaining values in Table 4.

Table 4.

Applied (dBm)	Limits (dB)
-10	-11 to -9
-20	-21 to -19
-30	-31 to -29
-40	-41 to -39
-50	-51 to -49
-60	-61 to -59
-70	-72 to -68
-80	-82 to -78
-90	-92 to -88
-100	-102 to -98
-110	-112 to -108
-120	-123 to -117
-124	-127 to -121

4.3.11 Set all outputs to minimum and disconnect test setup.

4.4 SPECTRAL PURITY CALIBRATION:

4.4.1 On the TI, press COM and using the CURSOR CONTROL keys select Freq.MHz, set frequency to 0.150 MHz, press ENT, ◀, 0.0, (dBm), ▼, ▶, 0, ENT for TONE #1 MODULATION and ▼, 0 and ENT for TONE #2 MODULATION.

4.4.2 Connect equipment as shown in Figure 3.

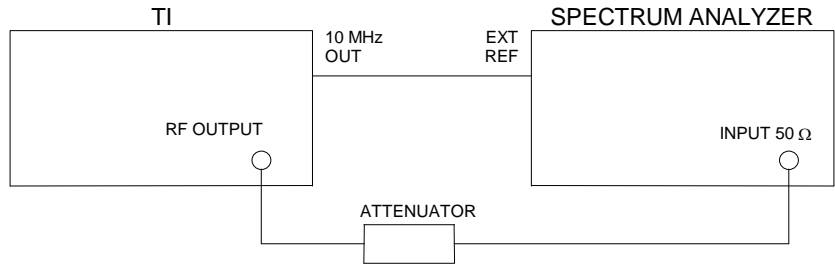


Figure 3.

4.4.3 Set the Spectrum Analyzer Center Frequency to the frequency listed in the Applied column of Table 5. Set the controls as required to establish a reference level for the fundamental frequency.

4.4.4 Set the Spectrum Analyzer controls to view at least four harmonics.

4.4.5 Verify any Harmonic amplitude is within the values listed in the Limits column of Table 5.

Table 5.

Applied (MHz)	Limits (dBc)
0.150	<-30
0.200	<-30
0.400	<-30
0.700	<-30
1.000	<-30
2.000	<-30
4.000	<-30
7.000	<-30
10.000	<-30
25.000	<-30
75.000	<-30
100.000	<-30
125.000	<-30
200.000	<-30
250.000	<-30
350.000	<-30

Table 5. (Cont.)

Applied (MHz)	Limits (dBc)
400.000	<-30
450.000	<-30

4.4.6 Using the TI CURSOR CONTROL keys select Freq.MHz, enter the next value listed in the Applied column of Table 5 and ENT.

4.4.7 Repeat steps 4.4.3 through 4.4.6 for each remaining corresponding value listed in the Applied column of Table 5.

4.4.8 On the TI, press 0.150, ENT, ◀, 0.0, (dBm), ▼, ▶, 0, ENT for TONE #1 MODULATION and ▼, 0 and ENT for TONE #2 MODULATION.

4.4.9 Set the Spectrum Analyzer Center Frequency to the first value listed in the Applied column of Table 6. Set the Spectrum Analyzer controls as required to establish a reference level for the fundamental frequency.

4.4.10 Set the Spectrum Analyzer controls to observe Non-harmonics signals >5 kHz from the carrier. Verify any Non-harmonic amplitude is within the values listed in the Limits column of Table 6.

Table 6.

Applied (MHz)	Limits (dBc)
0.150	<-60
0.200	<-60
0.400	<-60
0.700	<-60
1.000	<-60
2.000	<-60
4.000	<-60
7.000	<-60
10.000	<-60
25.000	<-60
75.000	<-60
100.000	<-60
125.000	<-60

Table 6. (Cont.)

Applied (MHz)	Limits (dBc)
200.000	<-60
250.000	<-60
350.000	<-60
400.000	<-60
450.000	<-60

4.4.11 Using the TI CURSOR CONTROL keys select Freq.MHz, enter the next value listed in the Applied column of Table 6 and ENT.

4.4.12 Repeat steps 4.4.9 through 4.4.11 for each value listed in the Applied column of Table 6.

4.4.13 Set all outputs to minimum and disconnect test setup.

4.5 SINGLE-SIDEBAND (SSB) PHASE NOISE AND RESIDUAL FM CALIBRATION:

4.5.1 On the TI, press COM and using the CURSOR CONTROL keys select Freq.MHz, set frequency to 65.0 MHz, press ENT, ◀, 0.0, (dBm), ▼, ▶, 0, ENT for TONE #1 MODULATION and ▼, 0 and ENT for TONE #2 MODULATION.

CAUTION

Do not connect outputs of Phase Noise Measurement System Reference Source or TI to the Inputs of the Phase Noise Measurement System until instructed to do so. Damage to the Phase Noise Measurement System can result if Reference Source or TI output power is applied to the system before the internal attenuators are set.

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

4.5.3 Access the Phase Noise Calibration Program.

4.5.4 Select Define, then select Measurement.

4.5.5 On Phase Noise Measurement System select Preset. Select Yes. Set Offset Frequency Range Start Offset to 20E+3 Hz and Stop Offset to 1E+6 Hz.

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

Carrier Source	
Frequency	65E+6 Hz
Power	0 dBm

Reference Source

Power	+13 dBm
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VCO Tuning Parameters

Nominal Tune Constant	325E-3
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Tune Range +/-	10 Volts
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Input Resistance	1E+6 Ohms
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NOTE

The VCO Tune Constant is obtained by the following formula:

$$\text{VCO Tune Constant} = 5 \text{ E-9} \times \text{Carrier Frequency}$$

$$\text{Example: } 65 \text{ E+6} \times 5 \text{ E-9} = 0.325 \text{ Hz/Volt}$$

4.5.7 On Phase Noise Measurement System select Cal. Select Preset. Select Yes. Select Measure VCO tune constant. De-select Verify calculated phase locked loop suppression.

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

4.5.9 On Phase Noise Measurement System select Test Set. Select Preset. Select Yes. Set LNA Low Pass Filter to Auto.

4.5.10 On Phase Noise Measurement System select Downconverter. Select Preset. Select Yes. Set Input Frequency to 65E+6.

4.5.11 On Phase Noise Measurement System select Graph. Select Preset. Select Yes. Enter graph title as appropriate. Set X Scale Minimum to 20E+3 Hz and Maximum to 1E+6. Select Close.

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

CAUTION

PC Digitizer (P/O Phase Noise Measurement System) INPUT and OUTPUT connectors are fragile. Damage can occur to the PC Digitizer INPUT and OUTPUT connectors and cables while connected if tension is applied.

4.5.13 Connect equipment as shown in Figure 4.

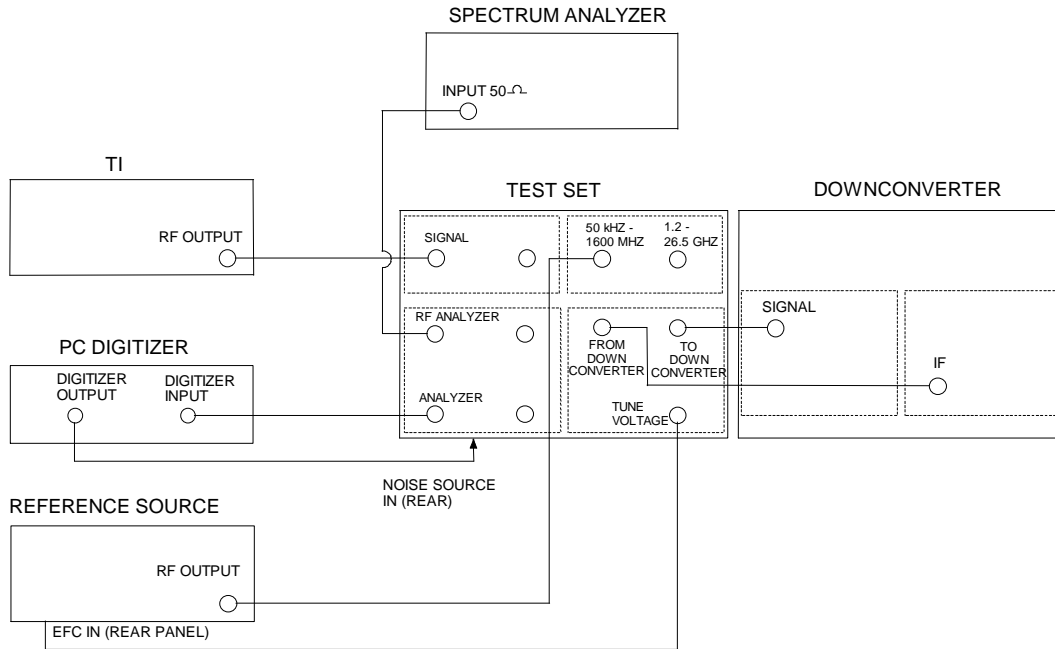


Figure 4.

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

4.5.15 Verify the Phase Noise Plot at a >25 kHz to 1 MHz offset is within the values listed in the Limits column of Table 7. If desired, the Marker function may be used to obtain specific offset frequencies and phase noise measurements on the graph. Press M to obtain the Marker function and use the arrow keys to obtain an offset frequency.

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

4.5.17 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to the next value listed in the Applied column of Table 7.

4.5.18 On Phase Noise Measurement System select Downconverter. Set Input Frequency to the next value listed in the Applied column of Table 7.

4.5.19 Using the TI CURSOR CONTROL keys select Freq.MHz, enter the next value listed in the Applied column of Table 7 and ENT.

4.5.20 Repeat steps 4.5.6 through 4.5.19 for the remaining corresponding values listed in Table 7.

Table 7.

Applied (MHz)	Limits (dBc/Hz)
65	<-115
100	<-115
450	<-115

4.5.21 On Phase Noise Measurement System select Define, then select Measurement. Set Offset Frequency Range Start Offset to 10 Hz and Stop Offset to 100E+3 Hz.

4.5.22 On Phase Noise Measurement System select Sources to change Carrier Source Frequency to the first value listed in the Applied column of Table 8.

4.5.23 On Phase Noise Measurement System select Downconverter. Set Input Frequency to the first value listed in the Applied column of Table 8.

4.5.24 Using the TI CURSOR CONTROL keys select Freq.MHz, enter the first value listed in the Applied column of Table 8 and ENT.

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

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

4.5.27 From the Trace Integration screen, set the Data Type to Snu(f) (Spectral density of frequency fluctuations). Set the Data to Integrate to Noise. Set the Start Offset to 50 Hz and Stop Offset to 15E+3.

4.5.28 Verify the Value of Definite Integral is within the values listed in the Limits column of Table 8 for Residual FM (50 Hz to 15 kHz Bandwidth).

4.5.29 Repeat steps 4.5.21 through 4.5.28 for the remaining values listed in the Applied column of Table 8.

Table 8.

Applied (MHz)	Limit (Hz)
15.000	<25
100.000	<10
150.000	<16
330.000	<25

4.5.30 Set outputs to minimum and disconnect test setup.

4.6 RESIDUAL AM CALIBRATION:

4.6.1 Using the TI CURSOR CONTROL keys select Freq.MHz, set frequency to the first value listed in the Applied column of Table 9 and press ENT.

4.6.2 Set the Measuring Receiver to measure AM at the first carrier frequency value listed in the Applied column of Table 9, with AM Detector to AVG, 50 Hz HP FILTER to ON and 15 kHz LP FILTER to ON.

4.6.3 Verify that the Measuring Receiver % AM indication is within the values listed in the Limits column of Table 9.

4.6.4 Repeat steps 4.6.1 through 4.6.3 for the remaining values listed in the Applied column of Table 9.

Table 9.

Applied (MHz)	Limit (%)
15.000	<0.1
100.000	<0.1
150.000	<0.1
330.000	<0.1

4.6.5 Set all outputs to minimum and disconnect test setup.

4.7 VOR TOTAL HARMONIC DISTORTION CALIBRATION:

4.7.1 Connect the Distortion Analyzer through the Feedthrough Termination to the TI AUDIO OUTPUT (rear panel).

4.7.2 On the TI, press VOR and using the CURSOR CONTROL keys select Freq.MHz, set frequency to 108.0 MHz, press ENT, ◀, -10.0 and (dBm).

4.7.3 Using the TI CURSOR CONTROL keys select PAGE 1 and press ENT.

4.7.4 Using the TI CURSOR CONTROL keys select 9960 Hz % MOD, enter 0% and press ENT.

4.7.5 Using the TI CURSOR CONTROL keys select 30 Hz % MOD, enter the first value listed in the 30 Hz % MOD column of Table 10 and press ENT.

4.7.6 Using the TI CURSOR CONTROL keys select 1020 Hz % MOD, enter the first value listed in the 1020 Hz % MOD column of Table 10 and press ENT. Verify that TONE is selected for the 1020 Hz IDENT MODE.

4.7.7 Adjust the Distortion Analyzer as necessary to verify the distortion is within the values listed in the Limits column of Table 10.

4.7.8 Repeat steps 4.7.5 through 4.7.7 for the remaining frequency value listed in the Applied Tone column of Table 10 setting the % MOD as required.

Table 10.

Applied Tone (Hz)	30 Hz % MOD	1020 Hz % MOD	Limits (%)
30 Hz	30	0	<0.1
1020 Hz	0	30	<0.1

4.7.9 Using the TI CURSOR CONTROL keys select PAGE 2, press ENT and ENT to return to PAGE 1.

4.7.10 Set outputs to minimum and disconnect test setup.

4.8 VOR FM DEVIATION CALIBRATION:

4.8.1 Using the TI CURSOR CONTROL keys select Freq.MHz, set frequency to 108.0 MHz, press ENT, ◀, -10.0 and (dBm).

4.8.2 Using the TI CURSOR CONTROL keys select 9960 Hz MOD and press SEL.

4.8.3 Using the TI CURSOR CONTROL keys select PAGE 1, press ENT and verify the TI displays 0% MOD for 30 Hz TONE and 30% MOD for 9960 Hz TONE.

4.8.4 Connect the TI RF OUTPUT to the ILS/VOR Signal Calibrator RF 50 Ω input.

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

4.8.6 Verify the ILS/VOR Signal Calibrator indicates between 477 and 483 Hz pk.

4.8.7 Using the TI CURSOR CONTROL keys select PAGE 2, press ENT and ENT to return to PAGE 1.

4.8.8 Set outputs to minimum.

4.9 VOR PHASE DIFFERENCE CALIBRATION:

4.9.1 Set the ILS/VOR Signal Calibrator for a VOR phase measurement.

4.9.2 Using the TI CURSOR CONTROL keys select Freq.MHz, set frequency to 108.00 MHz, press ENT, ◀, 0.0, (dBm), ▼, ▼, ENT and set TO/FROM to FROM.

4.9.3 Using the TI CURSOR CONTROL keys select PAGE 1 and press ENT.

4.9.4 Using the TI CURSOR CONTROL keys select 30 Hz % MOD, enter 30 in the 30 Hz % MOD field and press ENT.

4.9.5 Using the TI CURSOR CONTROL keys select 9960 Hz % MOD, enter 30 in the 9960 Hz % MOD field and press ENT.

4.9.6 Using the TI CURSOR CONTROL keys select 1020 Hz % MOD, enter 30 in the 1020 Hz % MOD field and press ENT.

4.9.7 Using the TI CURSOR CONTROL keys select PAGE 2, press ENT and ENT to return to PAGE 1.

4.9.8 Using the TI CURSOR CONTROL keys select BEARING, press 000.00 and ENT for BEARING.

4.9.9 Verify the ILS/VOR Signal Calibrator indicates between the values listed in the Limits column of Table 11.

4.9.10 Repeat steps 4.9.8 and 4.9.9 for the remaining values listed in the Bearing column of Table 11.

Table 11.

Bearing (°)	Limits (°)
000.00	359.92 to 000.08
30.00	29.92 to 30.08
60.00	59.92 to 60.08

Table 11. (Cont.)

Bearing (°)	Limits (°)
90.00	89.92 to 90.08
120.00	119.92 to 120.08
150.00	149.92 to 150.08
180.00	179.92 to 180.08
210.00	209.92 to 210.08
240.00	239.92 to 240.08
270.00	269.92 to 270.08
300.00	299.92 to 300.08
330.00	329.92 to 330.08

4.9.11 Set outputs to minimum.

4.10 VOR AMPLITUDE MODULATION CALIBRATION:

4.10.1 Set up the ILS/VOR Signal Calibrator as a receiver for a VOR Amplitude Modulation measurement.

4.10.2 Set the ILS/VOR Signal Calibrator to measure AM depth and select \pm Peak/2 Detector.

4.10.3 Using the TI CURSOR CONTROL keys select Freq.MHz, set frequency to 113.70 MHz, press ENT, ◀, -10.0 and (dBm).

4.10.4 Using the TI CURSOR CONTROL keys select PAGE 1, press ENT.

4.10.5 Using the TI CURSOR CONTROL keys select 1020 Hz % MOD, enter 0 and press ENT.

4.10.6 Using the TI CURSOR CONTROL keys select 30 Hz % MOD, enter the first value listed in the Tone 1 column of Table 12 and press ENT.

4.10.7 Using the TI CURSOR CONTROL keys select 9960 Hz % MOD, enter the first value listed in the Tone 2 column of Table 12 and press ENT.

4.10.8 Verify the ILS/VOR Signal Calibrator indicates between the values listed in the Limits column of Table 12.

4.10.9 Repeat steps 4.10.6 through 4.10.8 for the remaining values listed in Table 12.

Table 12.

Tone 1 (%)	Tone 2 (%)	Limits (%)
10	0	9.80 to 10.20
25	0	24.50 to 25.50
50	0	49.00 to 51.00

Table 12. (Cont.)

Tone 1 (%)	Tone 2 (%)	Limits (%)
75	0	73.50 to 76.50
95	0	93.10 to 96.90
0	10	9.80 to 10.20
0	25	24.50 to 25.50
0	50	49.00 to 51.00
0	75	73.50 to 76.50
0	95	93.10 to 96.90

4.10.10 Using the TI CURSOR CONTROL keys select PAGE 2, press ENT and ENT to return to PAGE 1.

4.10.11 Set outputs to minimum and disconnect test setup.

4.11 LOCALIZER TOTAL HARMONIC DISTORTION CALIBRATION:

4.11.1 On the TI, press MODE LOC G/S to select Localizer.

4.11.2 Connect the Distortion Analyzer through the Feedthrough Termination to the TI AUDIO OUTPUT (rear panel).

4.11.3 Using the TI CURSOR CONTROL keys select LEFT/RIGHT and set to RIGHT 90.

4.11.4 Using the TI CURSOR CONTROL keys select PAGE 1 and press ENT.

4.11.5 Using the TI CURSOR CONTROL keys select 90 Hz % MOD, enter the first value listed in the 90 Hz % MOD column of Table 13 and press ENT.

4.11.6 Using the TI CURSOR CONTROL keys select 150 Hz % MOD, enter the first value listed in the 150 Hz % MOD column of Table 13 and press ENT.

4.11.7 Using the TI CURSOR CONTROL keys select 1020 Hz % MOD, enter the first value listed in the 1020 Hz % MOD column of Table 13 and press ENT. Verify that TONE is selected for the 1020 Hz IDENT MODE.

4.11.8 Adjust the Distortion Analyzer as necessary to verify the distortion is within the values listed in the Limits column of Table 13.

4.11.9 Repeat steps 4.11.5 through 4.11.8 for the remaining frequency values listed in the Applied Tone column of Table 13 setting the % MOD as required.

Table 13.

Applied Tone (Hz)	90 Hz % MOD	1020 Hz % MOD	150 Hz % MOD	Limits (%)
90 Hz	30	0	0	<0.1
150 Hz	0	0	30	<0.1
1020 Hz	0	30	0	<0.1

4.11.10 Using the TI CURSOR CONTROL keys select PAGE 2, press ENT and ENT to return to PAGE 1.

4.11.11 Set outputs to minimum and disconnect test setup.

4.12 LOCALIZER AMPLITUDE MODULATION CALIBRATION:

4.12.1 Set up the ILS/VOR Signal Calibrator as a receiver for Localizer Amplitude Modulation measurements.

4.12.2 Set the ILS/VOR Signal Calibrator to measure AM depth and select \pm Peak/2 Detector.

4.12.3 Connect the TI RF OUTPUT to the ILS/VOR Signal Calibrator RF 50 Ω input.

4.12.4 On the TI using the CURSOR CONTROL keys select Freq.MHz, set frequency to 108.10 MHz, press ENT, \blacktriangleleft , -10.0 and (dBm).

4.12.5 Using the TI CURSOR CONTROL keys select PAGE 1 and press ENT.

4.12.6 Using the TI CURSOR CONTROL keys select 1020 Hz % MOD, enter 0 and press ENT.

4.12.7 Using the TI CURSOR CONTROL keys select 90 Hz % MOD, enter the first value listed in the Tone 1 column of Table 14 and press ENT.

4.12.8 Using the TI CURSOR CONTROL keys select 150 Hz % MOD, enter the first value listed in the Tone 2 column of Table 14 and press ENT.

4.12.9 Verify the ILS/VOR Signal Calibrator indicates between the values listed in the Limits column of Table 14.

4.12.10 Repeat steps 4.12.7 through 4.12.9 for the remaining values listed in Table 14.

Table 14.

Tone 1 (%)	Tone 2 (%)	Limits (%)
10	0	9.80 to 10.20
25	0	24.50 to 25.50
50	0	49.00 to 51.00
75	0	73.50 to 76.50
95	0	93.10 to 96.90
0	10	9.80 to 10.20
0	25	24.50 to 25.50
0	50	49.00 to 51.00

Table 14. (Cont.)

Tone 1 (%)	Tone 2 (%)	Limits (%)
0	75	73.50 to 76.50
0	95	93.10 to 96.90

4.12.11 Using the TI CURSOR CONTROL keys select PAGE 2, press ENT and ENT to return to PAGE 1.

4.12.12 Set outputs to minimum.

4.13 LOCALIZER DDM CALIBRATION:

4.13.1 On the TI, using the CURSOR CONTROL keys select Freq.MHz, set frequency to 108.10 MHz, press ENT, ◀, -13.0 and (dBm), select LEFT/RIGHT and set to LEFT 150.

4.13.2 Using TI CURSOR CONTROL keys select PAGE 1 and press ENT.

4.13.3 Using TI CURSOR CONTROL keys select 150 Hz % MOD and enter 20%.

4.13.4 Using TI CURSOR CONTROL keys select 90 Hz % MOD and enter 20%.

4.13.5 Using TI CURSOR CONTROL keys select PAGE 2 and press ENT until PAGE 1 is shown.

4.13.6 Set the ILS/VOR Signal Calibrator to measure Localizer DDM.

4.13.7 Using the TI CURSOR CONTROL keys select DDM, enter 0.000 and press ENT for a 0.000 DDM indication.

4.13.8 Verify the ILS/VOR Signal Calibrator indicates within the values listed in the Limits column of Table 15.

4.13.9 Repeat steps 4.13.7 and 4.13.8 for the remaining DDM values listed in Table 15.

Table 15.

DDM	Limits (DDM)
0.000	-0.0003 to +0.0003
0.046	-0.0448 to -0.0472
0.093	-0.0909 to -0.0951
0.155	-0.1516 to -0.1584
0.200	-0.1947 to -0.2053

4.13.10 Set outputs to minimum and disconnect test setup.

4.14 GLIDESLOPE TOTAL HARMONIC DISTORTION CALIBRATION:

- 4.14.1 On the TI, press MODE LOC G/S to select Glideslope.
- 4.14.2 Connect the Distortion Analyzer through the Feedthrough Termination to the TI AUDIO OUTPUT (rear panel).
- 4.14.3 Using the TI CURSOR CONTROL keys select UP/DOWN, press ENT to select DOWN 90.
- 4.14.4 Using the TI CURSOR CONTROL keys select PAGE 1 and press ENT.
- 4.14.5 Using the TI CURSOR CONTROL keys select 90 Hz % MOD, enter the first value listed in the 90 Hz % MOD column of Table 16 and press ENT.
- 4.14.6 Using the TI CURSOR CONTROL keys select 150 Hz % MOD, enter the first value listed in the 150 Hz % MOD column of Table 16 and press ENT.
- 4.14.7 Adjust the Distortion Analyzer as necessary to verify the distortion is within the values listed in the Limits column of Table 16.
- 4.14.8 Repeat steps 4.14.5 through 4.14.7 for the remaining frequency values listed in the Applied Tone column of Table 16 setting the % MOD as required.

Table 16.

Applied Tone (Hz)	90 Hz % MOD	150 Hz % MOD	Limits (%)
150 Hz	0	40	<0.1
90 Hz	40	0	<0.1

- 4.14.9 On the TI, press 4, 0, ENT, using the TI CURSOR CONTROL keys select PAGE 2 and press ENT.
 - 4.14.10 Set outputs to minimum and disconnect test setup.
- 4.15 GLIDESLOPE AMPLITUDE MODULATION CALIBRATION:**
- 4.15.1 Set up the ILS/VOR Signal Calibrator as a receiver for a Glideslope Amplitude Modulation measurements.
 - 4.15.2 Set the ILS/VOR Signal Calibrator to measure AM depth and select \pm Peak/2 Detector.
 - 4.15.3 Connect the TI RF OUTPUT to the ILS/VOR Signal Calibrator RF 50 Ω input.
 - 4.15.4 On the TI using the CURSOR CONTROL keys select Freq.MHz, set frequency to 329.15 MHz, press ENT, \blacktriangleleft , -10.0 and (dBm).
 - 4.15.5 Using the TI CURSOR CONTROL keys select PAGE 1, press ENT.
 - 4.15.6 Using the TI CURSOR CONTROL keys select 90 Hz % MOD, enter the first value listed in the Tone 1 column of Table 17 and press ENT.
 - 4.15.7 Using the TI CURSOR CONTROL keys select 150 Hz % MOD, enter the first value listed in the Tone 2 column of Table 17 and press ENT.

4.15.8 Verify the ILS/VOR Signal Calibrator indicates between the values listed in the Limits column of Table 17.

4.15.9 Repeat steps 4.15.6 through 4.15.8 for the remaining values listed in Table 17.

Table 17.

Tone 1 (%)	Tone 2 (%)	Limits (%)
10	0	9.80 to 10.20
25	0	24.50 to 25.50
50	0	49.00 to 51.00
75	0	73.50 to 76.50
95	0	93.10 to 96.90
0	10	9.80 to 10.20
0	25	24.50 to 25.50
0	50	49.00 to 51.00
0	75	73.50 to 76.50
0	95	93.10 to 96.90

4.15.10 Using the TI CURSOR CONTROL keys select PAGE 2 and press ENT to return to PAGE 1.

4.15.11 Set outputs to minimum.

4.16 GLIDESLOPE DDM CALIBRATION:

4.16.1 On the TI, using the CURSOR CONTROL keys select Freq.MHz, set frequency to 329.15 MHz, press ENT, ◀, -13.0 and (dBm), select UP/DOWN, press ENT to select UP 150.

4.16.2 Using TI CURSOR CONTROL keys select PAGE 1 and press ENT.

4.16.3 Using TI CURSOR CONTROL keys select 150 Hz % MOD and enter 40%.

4.16.4 Using TI CURSOR CONTROL keys select 90 Hz % MOD and enter 40%.

4.16.5 Using TI CURSOR CONTROL keys select PAGE 2 and press ENT until PAGE 1 is shown.

4.16.6 Using the TI CURSOR CONTROL keys select DDM, enter 0.000 and press ENT for a 0.000 DDM indication.

4.16.7 Verify the ILS/VOR Signal Calibrator indicates within the values listed in the Limits column of Table 18.

4.16.8 Repeat steps 4.16.6 and 4.16.7 for the remaining DDM values listed in Table 18.

Table 18.

DDM	Limits (DDM)
0.000	-0.0008 to +0.0008
0.045	-0.0438 to -0.0462
0.091	-0.0889 to -0.0931
0.175	-0.1712 to -0.1788
0.400	-0.3917 to -0.4083

4.16.9 Set outputs to minimum and disconnect test setup.

4.17 ADF TOTAL HARMONIC DISTORTION CALIBRATION:

4.17.1 On the TI, press ADF, using the CURSOR CONTROL keys select Freq.MHz, set frequency to 1.0 MHz, press ENT, ◀, -13.0 and (dBm).

4.17.2 Connect the Distortion Analyzer through the Feedthrough Termination to the TI AUDIO OUTPUT (rear panel).

4.17.3 Using the TI CURSOR CONTROL keys select TONE FREQ and enter the first frequency listed in the Applied Tone column of Table 19, then press ENT.

4.17.4 Adjust the Distortion Analyzer as necessary to verify the distortion is within the values listed in the Limits column of Table 19.

Table 19.

Applied Tone (Hz)	Limits (%)
10	<0.1
200	<0.1
500	<0.1
1000	<0.1
5000	<0.1
10000	<0.1

4.17.5 Repeat steps 4.17.3 and 4.17.4 for the remaining frequency values listed in the Applied Tone column of Table 19.

4.17.6 Set outputs to minimum and disconnect test setup.

4.18 ADF AMPLITUDE MODULATION CALIBRATION:

- 4.18.1 Set up the ILS/VOR Signal Calibrator as a receiver for ADF Amplitude Modulation measurements.
- 4.18.2 Set the ILS/VOR Signal Calibrator to measure AM depth and select \pm Peak/2 Detector.
- 4.18.3 Connect the TI RF OUTPUT to the ILS/VOR Signal Calibrator RF 50 Ω input.
- 4.18.4 Using the TI CURSOR CONTROL keys select RF LEVEL, set level to -10.0 and press ENT.
- 4.18.5 Using the TI CURSOR CONTROL keys select TONE FREQ, enter 1000 and press ENT.
- 4.18.6 Using the TI CURSOR CONTROL keys select MODULATION and enter the value listed in the Modulation column of Table 20, then press ENT.
- 4.18.7 Verify the ILS/VOR Signal Calibrator indicates between the values listed in the Limits column of Table 20.
- 4.18.8 Repeat steps 4.18.6 and 4.18.7 for the remaining values listed in Modulation column of Table 20.

Table 20.

MODULATION (%)	Limits (%)
10	9.80 to 10.20
25	24.50 to 25.50
50	49.00 to 51.00
75	73.50 to 76.50
95	93.10 to 96.90

- 4.18.9 Set all outputs to minimum and disconnect test setup.

4.19 MARKER BEACON TOTAL HARMONIC DISTORTION CALIBRATION:

- 4.19.1 Connect the Distortion Analyzer through the Feedthrough Termination to the TI AUDIO OUTPUT (rear panel).
- 4.19.2 On the TI, press MKR, using the CURSOR CONTROL keys select Freq.MHz, set frequency to 75 MHz, press ENT, \blacktriangleleft , -10.0 and (dBm).
- 4.19.3 Using the TI CURSOR CONTROL keys select TONE FREQ and enter the first frequency listed in the Applied Tone column of Table 21, then press ENT.
- 4.19.4 Adjust the Distortion Analyzer as necessary to verify the distortion is within the values listed in the Limits column of Table 21.

Table 21.

Applied Tone (Hz)	Limits (%)
400 Hz	<0.1
1300 Hz	<0.1
3000 Hz	<0.1

4.19.5 Repeat steps 4.19.3 and 4.19.4 for the remaining frequency values listed in the Applied Tone column of Table 21.

4.20 COMM TOTAL HARMONIC DISTORTION CALIBRATION:

4.20.1 On the TI, press COM and using the CURSOR CONTROL keys select Freq.MHz, set frequency to 100.0 MHz, press ENT, ◀, 0.0, (dBm), ▼, ▶, 90, ENT for TONE #1 MODULATION and ▼, 0 and ENT for TONE #2 MODULATION.

4.20.2 Using the TI CURSOR CONTROL keys select TONE #1 FREQUENCY, enter the first frequency listed in the Applied Tone column of Table 22 and press ENT.

4.20.3 Adjust the Distortion Analyzer as necessary to verify the distortion is within the values listed in the Limits column of Table 22.

Table 22.

Applied Tone (Hz)	Limits (%)
10	<0.1
200	<0.1
500	<0.1
1000	<0.1
5000	<0.1
10000	<0.1

4.20.4 Repeat steps 4.20.2 and 4.20.3 for the remaining frequency values listed in the Applied Tone column of Table 22.

4.20.5 Set outputs to minimum and disconnect test setup.

4.21 COMM AMPLITUDE MODULATION CALIBRATION:

4.21.1 Set up the ILS/VOR Signal Calibrator as a receiver for COMM Amplitude Modulation measurements.

4.21.2 Set the ILS/VOR Signal Calibrator to measure AM depth and select \pm Peak/2 Detector.

4.21.3 Connect the TI RF OUTPUT to the ILS/VOR Signal Calibrator RF 50 Ω input.

4.21.4 On the TI, press COM and using the CURSOR CONTROL keys select Freq.MHz, set frequency to 100.0 MHz, press ENT, \blacktriangleleft , 0.0 and (dBm).

4.21.5 Using the TI CURSOR CONTROL keys select TONE #1 FREQUENCY, enter 2000 and press ENT.

4.21.6 Using the TI CURSOR CONTROL keys select TONE #1 MODULATION, enter the first value listed in the Tone #1 column of Table 23 and press ENT.

4.21.7 Using the TI CURSOR CONTROL keys select TONE #2 MODULATION, enter the first value listed in the Tone #2 column of Table 23 and press ENT.

4.21.8 Verify the ILS/VOR Signal Calibrator indicates between the values listed in the Limits column of Table 23.

4.21.9 Repeat steps 4.21.6 through 4.21.8 for the remaining values listed in the Tone #1 and Tone #2 columns of Table 23.

Table 23.

Tone #1 (%)	Tone #2 (%)	Limits (%)
10	0	9.80 to 10.20
25	0	24.50 to 25.50
50	0	49.00 to 51.00
75	0	73.50 to 76.50
95	0	93.10 to 96.90
0	10	9.80 to 10.20
0	25	24.50 to 25.50
0	50	49.00 to 51.00
0	75	73.50 to 76.50
0	95	93.10 to 96.90

4.21.10 Set outputs to minimum. Set all POWER switches to OFF. Disconnect and secure all equipment.

4.21.11 Annotate and attach a Limited Certification Label as per step 3.5.

CALIBRATION PERFORMANCE TABLE

Not Required