Compliance Testing, LLC
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Test Report

Prepared for: Honeywell International

Model: TR-86x VDR

Description: Aviation Radio

Serial Number: N/A

FCC ID: GB8TR865A

To

FCC Part 87

Date of Issue: September 12, 2018

On the behalf of the applicant:	**Honeywell International** **21111 N. 19th Avenue** **Phoenix, AZ 85027**
Attention of:	**Steve Jensen** **Ph: (928) 899-5883** **Email: Steve.Jensen2@Honeywell.com**

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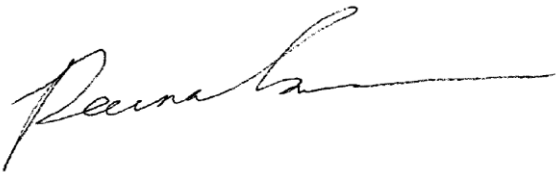

Poona Saber

Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	May 3, 2018	Poona Saber	Original Document
2.0	July 30, 2018	Poona Saber	Updated power table for AM transmitter on page 7 on extended frequency on 152 MHz
3.0	September 11,2018	Poona Saber	Removed the extended range frequency measurements for voice modulated Revised Annex A, B and C as well

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted in the table below

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

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FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II; Part 2, Sub-part J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1051, 2.1053, 2.1055, 2.1057 and the following individual Parts: FCC Part 87.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
23.3	28.9	967

EUT Description
Model: TR-86x VDR
Description: Aviation Radio
Firmware: N/A
Software: N/A
Serial Number: N/A
Additional Information:
EUT has 2 different modulation modes. AM voice and VDLM2 data with AM and D8PSK modulation. For testing of both modes unit is put on modulated carrier through control commands via telnet but, for modulation characteristic testing of the voice input unit was set to transmit unmodulated continuous wave and a 1 KHz signal was injected into Mic-Audio input to measure audio response and modulation limiting characteristic of the unit.

EUT Operation during Tests
Operating Frequency: 118MHz - 136.975MHz (Voice and Data Modes)

Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
2.1046, 87.131	Carrier Output Power (Conducted)	Pass	
2.1051, 87.139(i)(1)	Unwanted Emissions (Transmitter Conducted)	Pass	
2.1053	Field Strength of Spurious Radiation	Pass	
2.1049, 87.139(i)(3)	Emission Masks (Occupied Bandwidth)	Pass	
2.1047	Audio Low Pass Filter (Voice Input)	Pass	
2.1047	Audio Frequency Response	Pass	
2.1047	Modulation Limiting	Pass	
2.1055, 87.133(a)	Frequency Stability (Temperature Variation)	Pass	
2.1055, 87.133(a)	Frequency Stability (Voltage Variation)	Pass	

Carrier Output Power (Conducted)

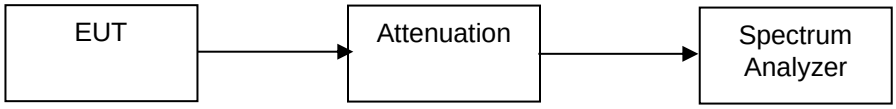
Engineer: Poona Saber

Test Date: 5/2/2018

Test Procedure

The Equipment Under Test (EUT) was connected to a 30 dB attenuation and to a spectrum analyzer with the RBW > OBW and the VBW set to 3 X RBW which set the RBW greater than the transmit signal ensuring there was no signal suppression while measuring a modulated signal. The peak readings were taken for each modulation type and the result was then compared to the limit.

Test Setup



D8PSK Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
118	46.73	47.09	55	Pass
127.5	46.68	46.55	55	Pass
136.97	46.60	45.7	55	Pass

AM Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
118	45.61	36.39	55	Pass
127.5	45.57	36.05	55	Pass
136.97	45.61	36.39	55	Pass

Conducted Spurious Emissions

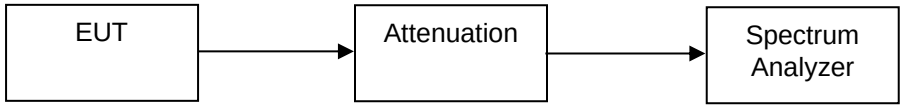
Engineer: Poona Saber

Test Date: 5/2/2018

Test Procedure

The EUT was connected through an attenuation to a spectrum analyzer to verify that the UUT met the requirements for spurious emissions based on requirements of 87.139 (d).

Test Setup



See Annex A for test plots

Field Strength of Spurious Radiation

Engineer: Poona Saber

Test Date: 5/3/2018

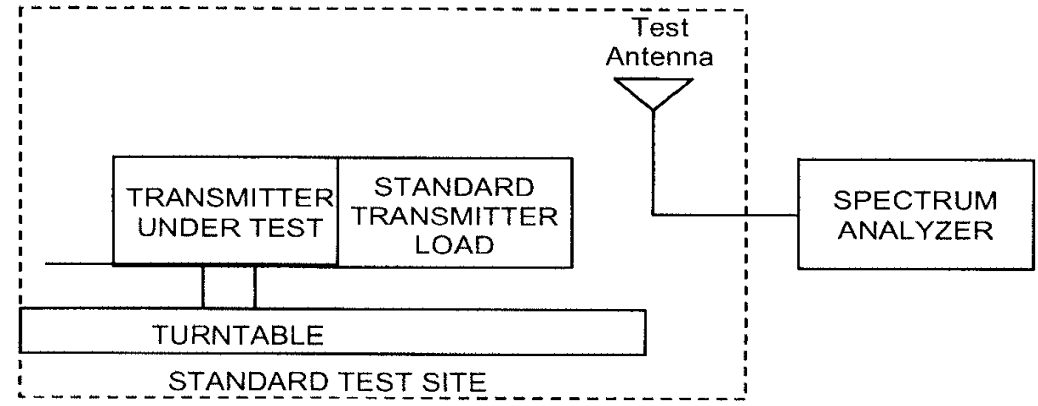
Test Procedure

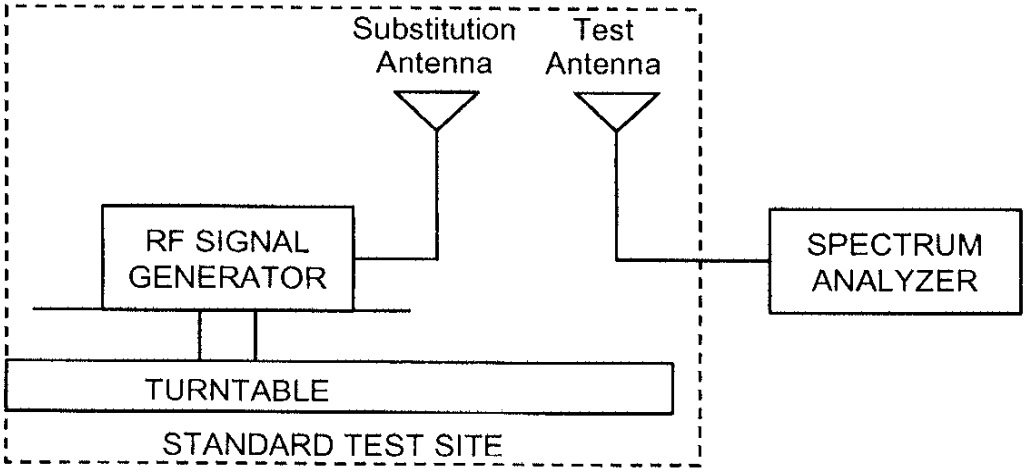
A. Connect the equipment as illustrated
B. Adjust the spectrum analyzer for the following settings:
    a. Resolution Bandwidth 100 kHz (<1 GHZ), 1 MHZ (> 1GHz).
    b. Video Bandwidth ≥ 3 times Resolution Bandwidth, or 30 kHz
    c. Sweep Speed ≤2000 Hz/second
    d. Detector Mode = Mean or Average Power
C. Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non-radiating load that is placed on the turntable. The RF cable to this load should be of minimum length.
D. For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ± the test bandwidth (see section 1.3.4.4).
E. For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
F. Repeat step E) for each spurious frequency with the test antenna polarized vertically.
G. Reconnect the equipment as illustrated.
H. Keep the spectrum analyzer adjusted as in step B).
I. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
J. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
K. Repeat step J) with both antennas vertically polarized for each spurious frequency.
L. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps J) and K) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.
M. The levels recorded in step L) are absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

Radiated spurious emissions dB = $10\log_{10}$(TX power in watts/0.001) – the levels in step l)

NOTE: It is permissible that other antennas provided can be referenced to a dipole.

Test Setup





See Annex B for test Results

Emission Masks (Occupied Bandwidth)

Engineer: Poona Saber

Test Date: 4/26/2018

Test Procedure

The EUT was connected through an attenuation to a spectrum analyzer. The occupied bandwidth of the emission is measured first based on the expected bandwidth with RBW set as close as possible to 1% of the occupied bandwidth to ensure accurate readings.

For digital modulation the requirements of the part 87.139 (k) has been tested for G1D emissions of VHF aeronautical stations per below:

1. The amount of power measured across either first adjacent 25 kHz channel shall not exceed 2 dBm.

2. For stations first installed on or after January 1, 2002,
   (i) The amount of power measured across either second adjacent 25 kHz channel shall be less than −28 dBm;
   (ii) The amount of power measured across either fourth adjacent 25 kHz channel shall be less than −38 dBm; and
   (iii) From there on the power measured in any other adjacent 25 kHz channel shall monotonically decrease at a rate of at least 5 dB per octave to a maximum value of −53 dBm.

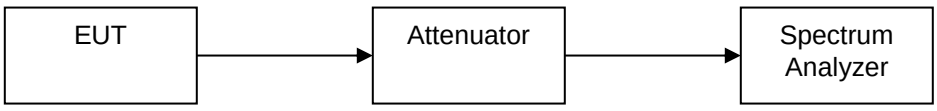
3. The amount of power measured over a 16 kHz channel bandwidth centered on the first adjacent 25 kHz channel shall not exceed −18 dBm.

For voice am modulated emissions the requirements of the part 87.139 (a) has been tested per below:

Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

1. When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;
2. When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.
3. When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10}$ pY dB.

Test Setup



See Annex C for test results

Frequency Stability (Temperature Variation)

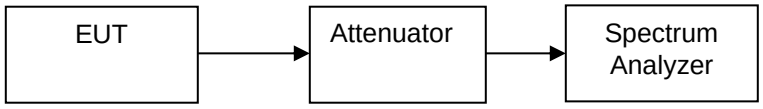
Engineer: Poona Saber

Test Date: 5/3/2018

Test Procedure

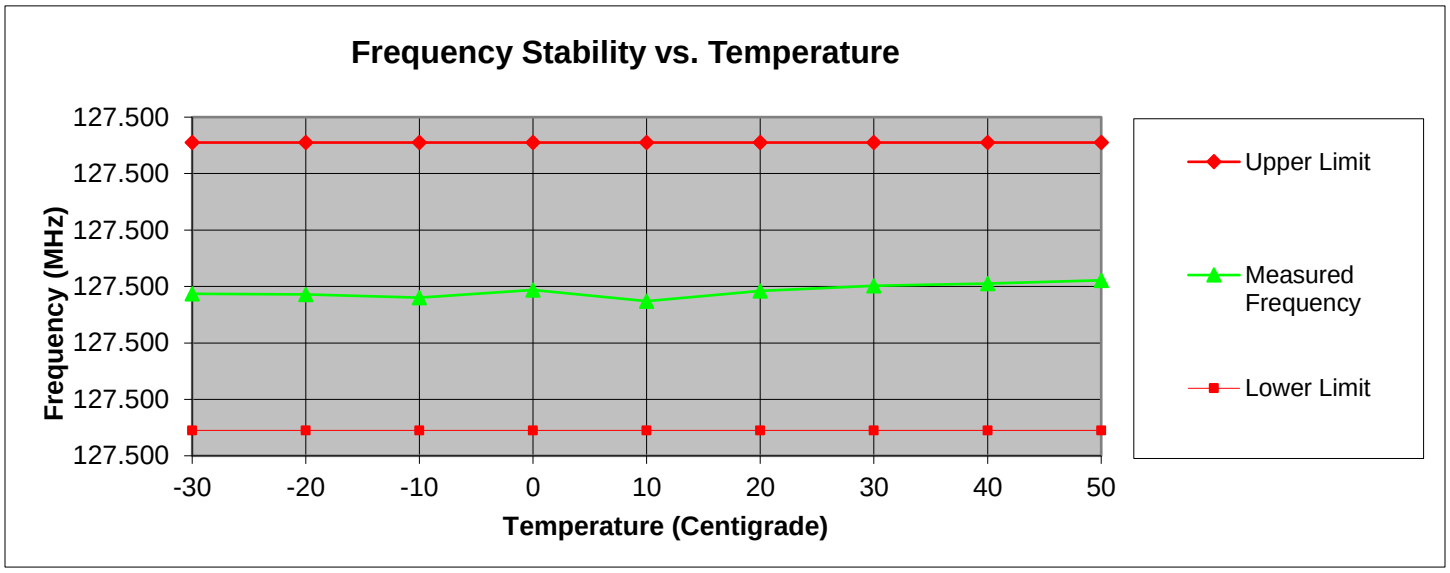
The EUT was placed in an environmental test chamber and the RF output was connected directly to a frequency counter. The temperature was varied from -30ºC to 50ºC in 10ºC increments. After a sufficient time for temperature stabilization the RF output frequency was measured.

Test Setup



Measurement Results

Tuned Frequency (MHz)	Frequency Tolerance PPM	Upper Limit (MHz)	Lower Limit (MHz)	Temperature centigrade	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
127.500	2.0	127.500255	127.499745	-30	127.499987	-0.000268	0.000242
		127.500255	127.499745	-20	127.499986	-0.000269	0.000241
		127.500255	127.499745	-10	127.499980	-0.000275	0.000235
		127.500255	127.499745	0	127.499994	-0.000261	0.000249
		127.500255	127.499745	10	127.499974	-0.000281	0.000229
		127.500255	127.499745	20	127.499992	-0.000263	0.000247
		127.500255	127.499745	30	127.500001	-0.000254	0.000256
		127.500255	127.499745	40	127.500005	-0.000250	0.000260
		127.500255	127.499745	50	127.500011	-0.000244	0.000266



Frequency Stability (Voltage Variation)

Engineer: Poona Saber

Test Date: 5/3/2018

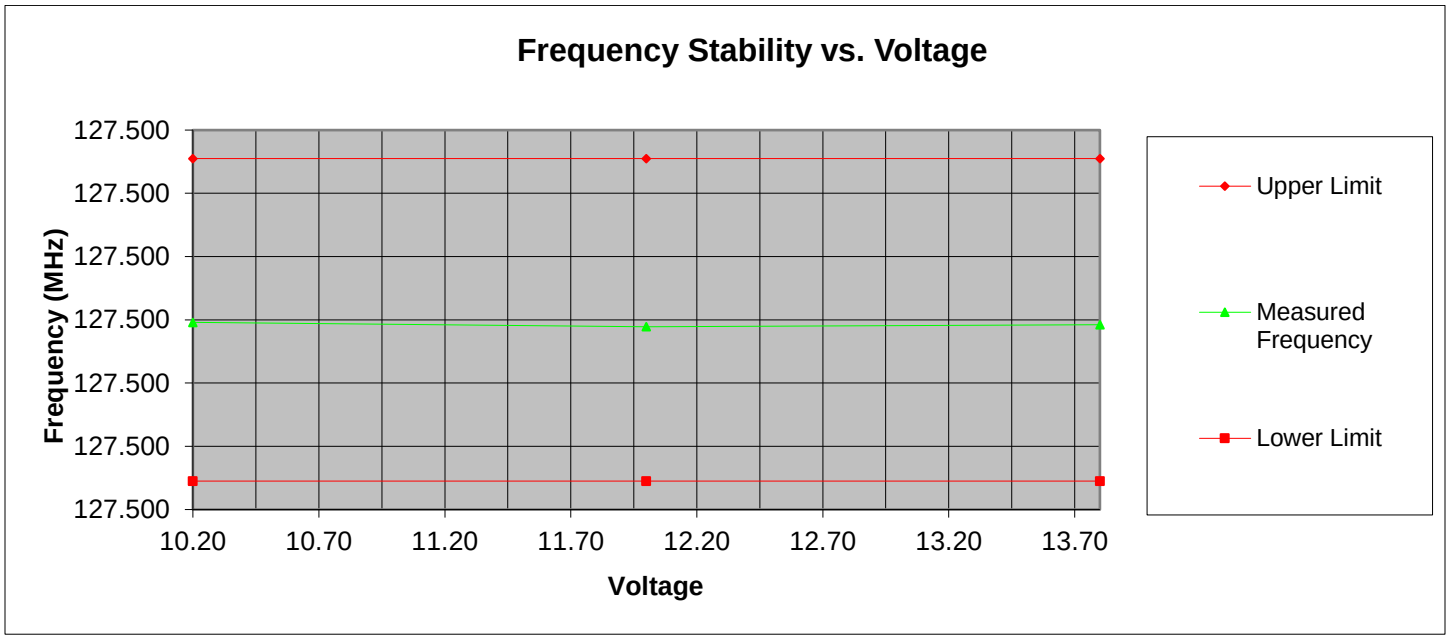
Test Procedure

The EUT was placed in a temperature chamber at 20±5°C and connected directly to a spectrum analyzer. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured. This was measured with both a 400 Hz 115 VAC supply and a variable DC voltage source.

Test Setup

Test Results

Tuned Frequency (MHz)	Frequency Tolerance PPM	Upper Limit (MHz)	Lower Limit (MHz)	Nominal Voltatge	Voltage	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
127.500	2.0	127.500255	127.499745	12.00	10.20	127.499996	-0.000259	0.000251
		127.500255	127.499745		12.00	127.499989	-0.000266	0.000244
		127.500255	127.499745		13.80	127.499992	-0.000263	0.000247



Modulation Characteristics

Engineer: Poona Saber

Test Date: 5/1/2018

Test Procedure

Based on part 2.1047 a curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Test Setup

Figure below displays the audio frequency response of the modulator. The frequency generator was set to 1 kHz frequency and injected into the audio input port of the EUT. The input voltage amplitude was adjusted to obtain 50% modulation at 1000 Hz. This level was then taken as the 0-dB reference. The frequency of the generator was then varied and the output voltage level was adjusted to maintain the 50% modulation. The output level required for 50% modulation was then recorded. This level was normalized to the level required for 50% modulation at 1000 Hz.

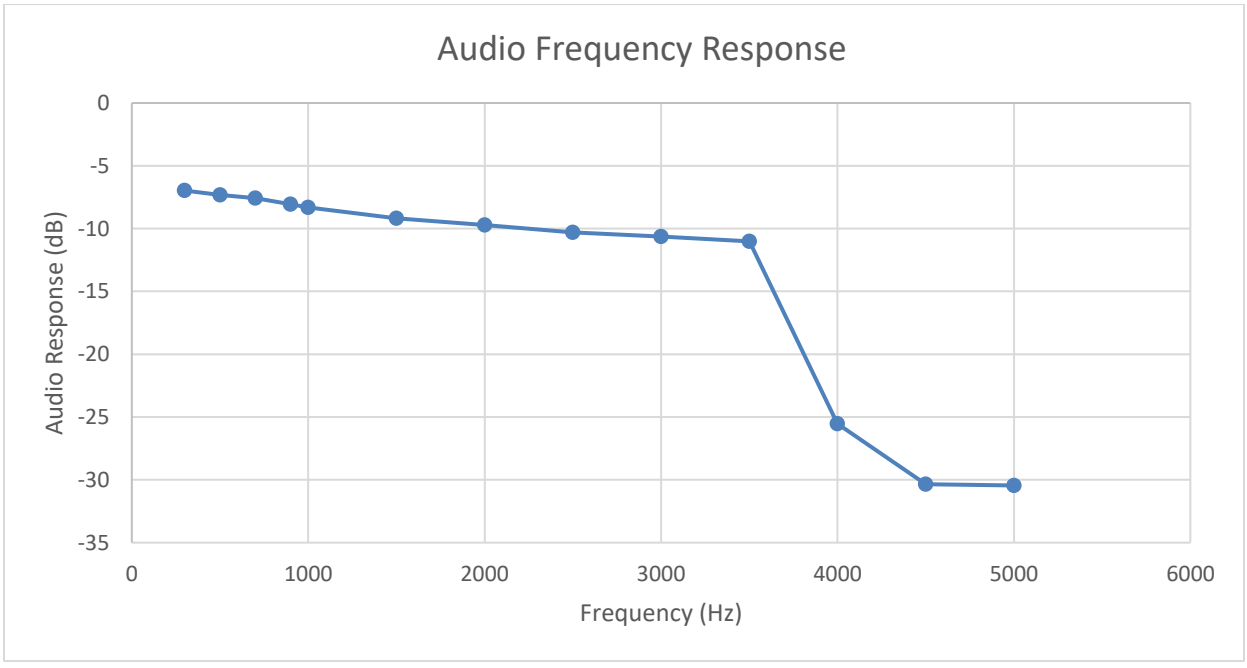
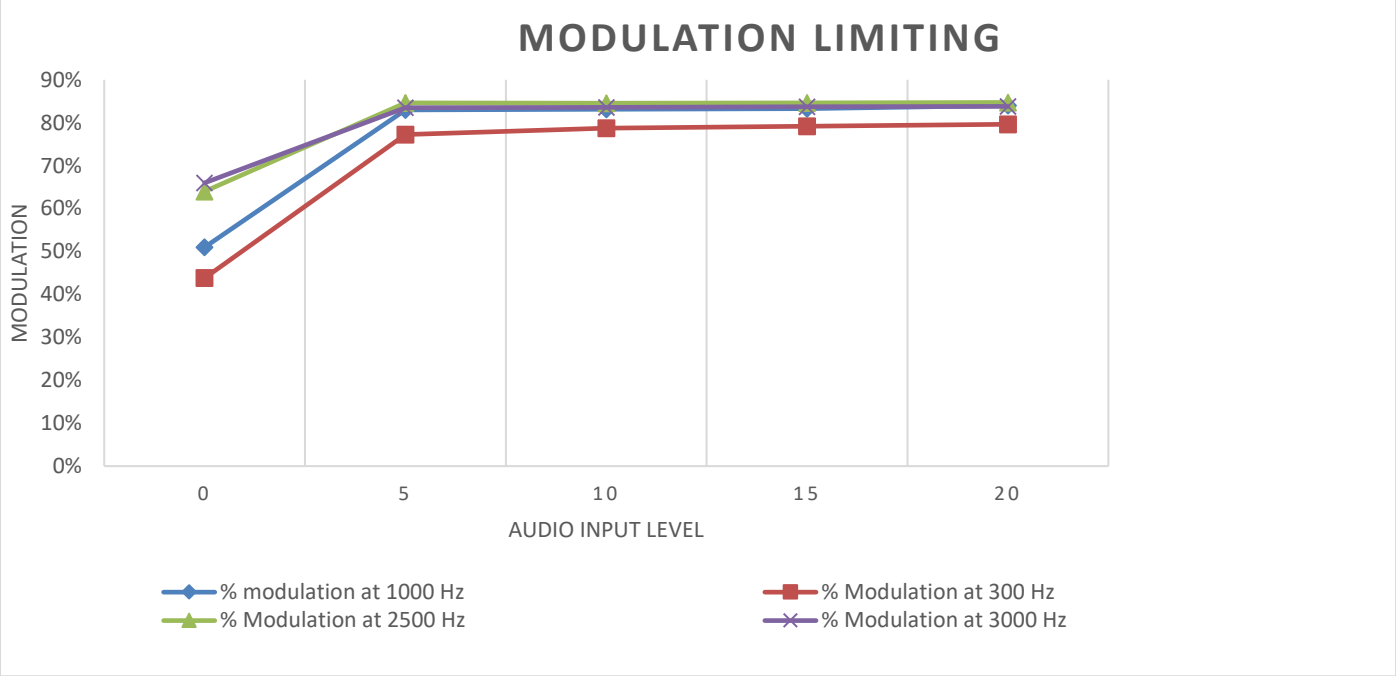
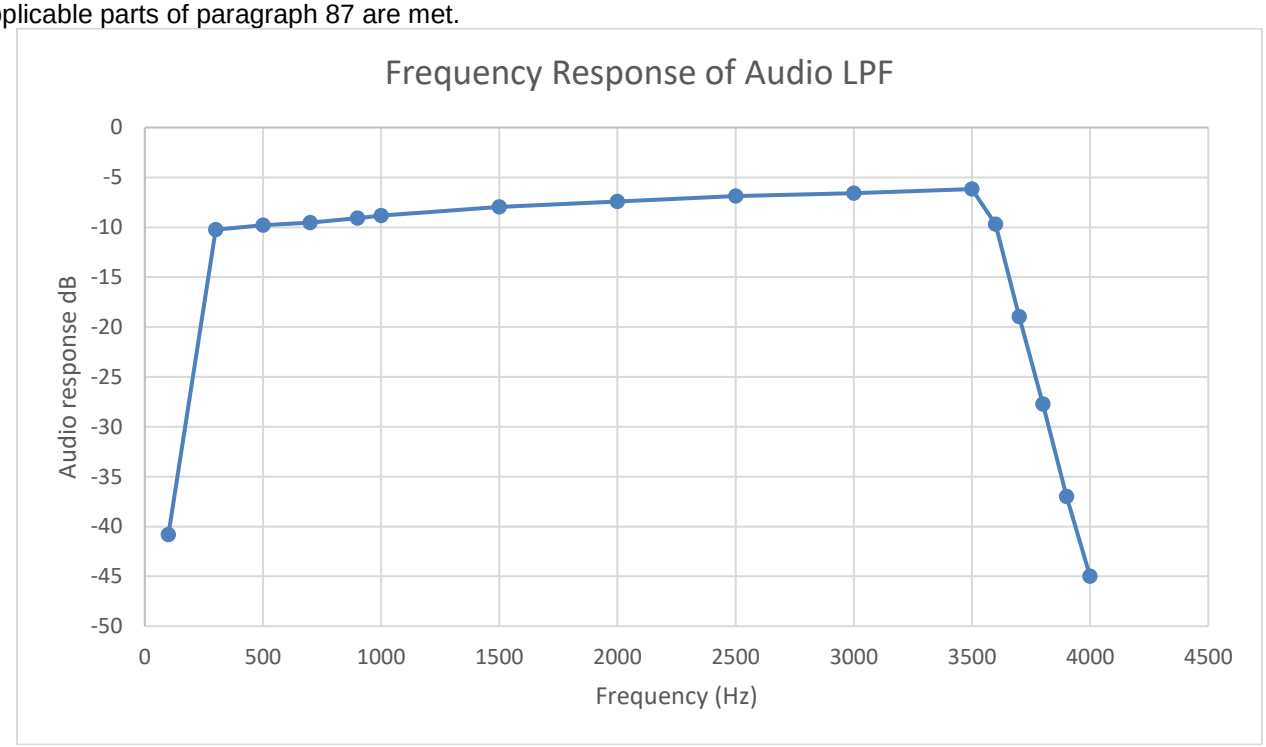


Figure Below shows the modulation characteristics of each different frequencies while the input voltage was varied. The frequency is held constant and the percent modulation is read from the modulation meter.



Next Figure shows the frequency response of the audio low pass filter. The specifications of Paragraph 47 CFR 2.1047 and applicable parts of paragraph 87 are met.



Necessary Bandwidth and Emission Bandwidth

Engineer: Poona Saber

Test Date: 5/1/2018

BPSK

Modulation = 14K0G1D
Necessary Bandwidth Calculation:

Signal States (S)	=		8
Data Rate (D)		=	31.5
Constant Factor (K)	=		0.667
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 6K00A3E
Necessary Bandwidth Calculation:

Maximum modulation frequency M, kHz	=	3
Necessary Bandwidth (B_N), kHz	=	2 x M

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Temperature Chamber	Tenney	Tenney Jr	i00027	NCR	NCR
Preamplifier	HP	8447D	i00055	NCR	NCR
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Spectrum Analyzer	Agilent	E4407B	i00331	11/21/17	11/21/18
Bi-Log Antenna	Teseq	CBL 6111D	i00349	8/3/16	8/3/18
AC Power Source	Behlman	BL 6000	i00362	Verified on: 1/16/2018	
spectrum analyzer	Agilent	E4445A	i00471	9/6/2017	9/6/2018
Signal Analyzer, 26.5 GHz Real Time	Tektronix	RSA5126A	i00424	5/3/2017	5/3/2018
Arbitrary Waveform Generator	HP	33120A	i00118	Verified on: 4/24/2018	
Sys. Dc Power Supply	HP	6673A	i00191	Verified on: 4/24/2018	

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT