Test Report

Prepared for: Etherstack, Inc

Model: XBR5110D5VI

Description: XBR Base Station Transceiver

FCC ID: 2ADAKXBR5110D5VI

ISED ID: 9487A-XBR5110D5VI

Serial Number: 240400054

Project No: p2540016.3

Test Results: Pass

To

FCC Part 22, 74, 80, 90

ISED RSS-119 (issue 12)

Date of Issue: August 29, 2025

On the behalf of the applicant:	**Etherstack Inc** **16 Madison Square W. FL12 Suite 1200** **New York, NY 10010**
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Reviewed / Authorized By:

Greg Corbin,
Project Test Engineer

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All results contained herein relate only to the sample tested.

Test Result Summary

Specification		Test Name	Pass, Fail, N/A	Comments
FCC	ISED			
2.1046 22.565 (a) 74.461(b) 80.215 (f)(g) 90.205(s)	RSS-119 (5.4)	Carrier Output Power (Conducted)	Pass	
2.1051 22.359 (a) 74.462(c) 80.211 (f) 90.210(b)(d)	RSS-119 (5.8)	Unwanted Emissions (Transmitter Conducted)	Pass	
2.1053 22.359 (a) 74.462(c) 80.211 (f) 90.210(b)(d)	RSS-119 (5.8)	Field Strength of Spurious Radiation	Pass	
2.1049(c) 74.462(c) 80.211 (f) 90.210(b)(d)	RSS-119 (5.5)	Emission Masks (Occupied Bandwidth)	Pass	
2.1047(a) 80.213(e)	N/A	Audio Low Pass Filter (Voice Input)	Pass	
2.1047(a) 80.213(e)	N/A	Audio Frequency Response	Pass	
2.1047(b) 74.463(c) 80.213(b)(d)	N/A	Modulation Limiting	Pass	
2.1055 22.355 74.464 80.209 (a)(5) 90.213(a)	RSS-119 (5.3)	Frequency Stability (Temperature Variation)	Pass	
2.1055 90.213(a) 22.355 74.464 80.209 (a)(5)	RSS-119 (5.3)	Frequency Stability (Voltage Variation)	Pass	
90.214	RSS-119 (5.9)	Transient Frequency Behavior	Pass	
2.202 (g)	TRC-43 (issue 3)	Necessary Bandwidth Calculation	Pass	

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit*.
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit*.

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	8/29/2025	Madhava Gooduru	Original Document
2.0	9/17/2025	Madhava Gooduru	Updated PMN, Updated FM Narrowband Table, and Updated Radiated Spurious Emissions Summary Test Table.

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ANAB

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

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

FCC Site Reg. #750616

IC Site Reg. #2044A-2

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II, Part 2, Subpart J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, ANSI C63.26-2015, FCC Part 22, 74, 80, 90, RSS-GEN, RSS-119.

Standard Test Conditions and Engineering Practices

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

In accordance with ANSI/TIA 603C, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Environmental Conditions		
Temp (ºC)	**Humidity (%)**	**Pressure (mbar)**
25.2 - 30.2	33.8 - 43.6	965.0 - 971.2

Measurement results, unless otherwise noted, are worse case measurements.

EUT Description

Model:	XBR5110D5VI
Serial:	240400054
Firmware:	0.2.05_0
Software:	N/A
HVIN	XBR5110D5VI
PMN	XBR5110
UPN	XBR5110D5VI
FVIN	0.2.05_0
Description:	XBR Base Station Transceiver
Additional Information:	The EUT is a 100-watt base station transceiver with an external reference, using FM and C4FM modulation, operating in the VHF band as noted in Table 1.
Power	13.8 vdc
Receipt of Sample(s):	8/19/2025
EUT Condition:	**Visual Damage** No **State of Development** Production/Production Equivalent

EUT Operation during Tests

The transmitter is powered by 13.8 vdc.

The base station transceiver operates with NB (12.5 kHz Channel), C4FM, and WB (25 kHz) where allowed.

For output power, the minimum (1 watt) and maximum (50 watts) were recorded for test frequencies ,156.0125MHz and 161.9875MHz which covers FCC part 80.215(f)(g). The minimum (1 watt) and maximum (100 watts) were recorded for the remaining test frequencies.

All tests were performed with the 10MHz reference set to external except for radiated spurious emissions.

For frequency stability, the measurements were recorded with both external and internal reference.

Table 1 Frequency Allocation

Frequency Range (138 - 174 MHz)		
Rule Part	**Frequency Range (MHz)**	**Emission Designator**
FCC Part 90 Narrowband	150.8 - 173.4	8K10F1D, 8K10F1E, 8K10F1W, 8K10F7D, 8K10F7E, 8K10F7W, 11K0F3E
FCC Part 90 Wideband	150.8 - 173.4	16K0F3E
FCC Part 22	150.8 – 161.775	8K10F1D, 8K10F1E, 8K10F1W, 8K10F7D, 8K10F7E, 8K10F7W, 11K0F3E, 16K0F3E
FCC Part 74	152.855 – 173.2	8K10F1D, 8K10F1E, 8K10F1W, 8K10F7D, 8K10F7E, 8K10F7W, 11K0F3E, 16K0F3E
FCC Part 80	156 - 162	8K10F1D, 8K10F1E, 8K10F1W, 8K10F7D, 8K10F7E, 8K10F7W, 11K0F3E, 16K0F3E
RSS 119	138 - 174	8K10F1D, 8K10F1E, 8K10F1W, 8K10F7D, 8K10F7E, 8K10F7W, 11K0F3E, 16K0F3E

Table 2 - FCC Test Frequencies

Test Frequency (MHz)	FCC Rule Part
138.0125	RSS-119
150.8125	22, 90, RSS-119
153.11	22, 74, 90, RSS-119
156.0125	80, 90, RSS-119
161.5625	22, 80, 90, RSS-119
161,9875	80, RSS-119
173.3875	90, RSS-119

Accessories:

Qty	Description	Length	Model	S/N
1	Ethernet cable from transmitter to PC	3m	N/A	N/A
1	2 wire power cable from transmitter to power supply	2m	N/A	N/A
1	Multi-pin connector to 3 BNC cables from transmitter Audio input and output	1m	N/A	N/A

Modifications: None

Carrier Output Power (Conducted)

Engineer: Madhava Gooduru
Test Date: 8/19/2025

Measurement Procedure

The Equipment Under Test (EUT) was connected to a spectrum analyzer through a 30 dB Power attenuator.

All cable and attenuator losses were input into the spectrum analyzer as a reference level offset to ensure accurate readings were obtained.

For narrowband and wideband signals, a CW signal and peak detector was used for performing output power measurements.

For digital signals a C4FM signal and average detector was used for performing output power measurements.

Output power was recorded for both the lowest and highest power setting

The output power limits are as follows for each FCC rule part.

Manufacturer Rated Power = 100 watts (50 dBm)

Part 22: 22.565(a) = 150 watts

Part 74: 74.461(b) = 100 watts

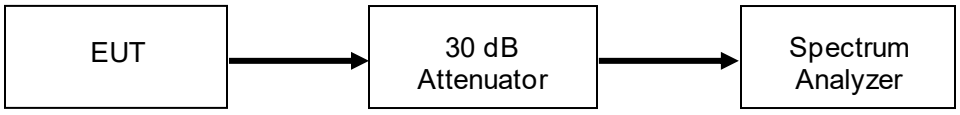
Part 80: 80.215(f)(g) 156-172 MHz The maximum power must not exceed 50W (F3E emission)

Part 90: 90.205(d) 150-174 MHz. (1) =100W. The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 1 in part 90.205(d).

90.205(s) FCC Output Power Limit = 120W (120% of manufacturer rated power)

RSS-119 Limit:
The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications

Test Setup



Transmitter Peak Output Power CW - Narrowband

Tuned Frequency	Power Level Setting	Output Power		Result
MHz	watts	dBm	watts	
138.0125	1	30.75	1.19	Pass
150.8125	1	30.34	1.08	Pass
153.11	1	30.66	1.16	Pass
156.0125	1	30.32	1.08	Pass
161.5625	1	30.27	1.06	Pass
161.9875	1	30.19	1.04	Pass
173.3875	1	30.14	1.03	Pass
138.0125	100	49.81	95.72	Pass
150.8125	100	49.75	94.41	Pass
153.11	100	49.75	94.41	Pass
156.0125	50	47.1	51.29	Pass
161.5625	100	49.8	95.50	Pass
161.9875	50	47.07	50.93	Pass
173.3875	100	49.86	96.83	Pass

Transmitter Peak Output Power CW - Wideband

Tuned Frequency	Power Level Setting	Output Power		Result
MHz	watts	dBm	watts	
138.0125	1	30.44	1.11	Pass
150.8125	1	30.37	1.09	Pass
153.11	1	30.62	1.15	Pass
156.0125	1	30.27	1.06	Pass
161.5625	1	30.24	1.06	Pass
161.9875	1	30.16	1.04	Pass
173.3875	1	30.1	1.02	Pass
138.0125	100	49.8	95.50	Pass
150.8125	100	49.75	94.41	Pass
153.11	100	49.75	94.41	Pass
156.0125	50	47.08	51.05	Pass
161.5625	100	49.81	95.72	Pass
161.9875	50	47.07	50.93	Pass
173.3875	100	49.85	96.61	Pass

Transmitter Average Output Power for C4FM modulation

Tuned Frequency	Power Level Setting	Output Power		Result
MHz	watts	dBm	watts	
138.0125	1	30.12	1.03	Pass
150.8125	1	30.44	1.11	Pass
153.11	1	30.38	1.09	Pass
156.0125	1	30.14	1.03	Pass
161.5625	1	30.09	1.02	Pass
161.9875	1	30.25	1.06	Pass
173.3875	1	30.33	1.08	Pass
138.0125	100	50.08	101.86	Pass
150.8125	100	49.75	94.41	Pass
153.11	100	49.62	91.62	Pass
156.0125	50	47.17	52.12	Pass
161.5625	100	49.64	92.04	Pass
161.9875	50	46.94	49.43	Pass
173.3875	100	49.56	90.36	Pass

Annex A Output Power

Refer to Annex A for Output Power plots.

Conducted Spurious Emissions

Engineer: Madhava Gooduru

Test Date: 8/19/2025

Test Procedure

The EUT was connected directly to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions.

The resolution bandwidth was set for 100 kHz or 1 MHz as required per the rule section and the reference level was adjusted to ensure the system had sufficient dynamic range to measure spurious emissions.

A tunable notch filter was utilized for 30 MHz to 1 GHz to ensure the fundamental did not put the spectrum analyzer into compression. The notch filter was replaced with a 1 GHz high pass filter that was used for measurements above 1 GHz.

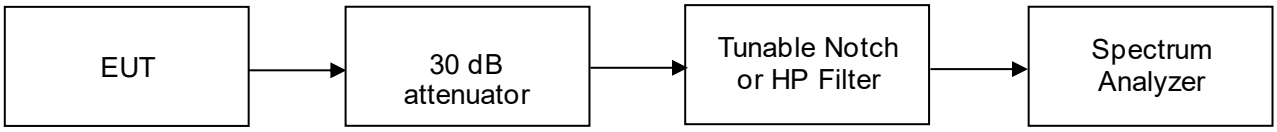
The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was observed and plotted. In this case, it was measured up to 2GHz.

The conducted spurious emissions were recorded using FM and C4FM modulation.
The specification limit was set for -20 dBm for comparison to the emission mask “D” limit.

Note: A marker was placed on the fundamental frequency and the highest spurious emission in 30-1000 MHz. Only the fundamental TX signal exceeded the limit as shown in the spectrum analyzer screenshots.

The output power was set to maximum power for all conducted spurious measurements.

Test Setup



Conducted Spurious Emissions Summary Test Table FM - Narrowband

Frequency Span	Tuned Frequency	Conducted Spurious		Limit	Margin	Result
		Frequency	Level			
MHz	MHz	MHz	dBm	dBm	dB	
30 - 1000	138.0125	52.07	-43.27	-20	-23.27	Pass
30 - 1000	150.8125	205.08	-42.65	-20	-22.65	Pass
30 - 1000	153.11	162.28	-38.68	-20	-18.68	Pass
30 - 1000	156.0125	52.07	-36.03	-20	-16.03	Pass
30 - 1000	161.5625	177.92	-41.7	-20	-21.7	Pass
30 - 1000	161.9875	52.07	-37.49	-20	-17.49	Pass
30 - 1000	173.3875	193.81	-42.22	-20	-22.22	Pass
1000 - 2000	138.0125	1563.75	-41.52	-20	-21.52	Pass
1000 - 2000	150.8125	1151.375	-42.28	-20	-22.28	Pass
1000 - 2000	153.11	1091.125	-41.17	-20	-21.17	Pass
1000 - 2000	156.0125	1724.875	-41.58	-20	-21.58	Pass
1000 - 2000	161.5625	1628.625	-41.9	-20	-21.9	Pass
1000 - 2000	161.9875	1279.125	-41.25	-20	-21.25	Pass
1000 - 2000	173.3875	1802.75	-41.5	-20	-21.5	Pass

Conducted Spurious Emissions Summary Test Table FM – Wideband

Frequency Span	Tuned Frequency	Conducted Spurious		Limit	Margin	Result
		Frequency	Level			
MHz	MHz	MHz	dBm	dBm	dB	
30 - 1000	138.0125	51.95	-44.11	-20	-24.11	Pass
30 - 1000	150.8125	203.87	-43.89	-20	-23.89	Pass
30 - 1000	153.11	163.98	-38.89	-20	-18.89	Pass
30 - 1000	156.0125	51.95	-36.69	-20	-16.69	Pass
30 - 1000	161.5625	177.2	-40.79	-20	-20.79	Pass
30 - 1000	161.9875	51.95	-39.9	-20	-19.9	Pass
30 - 1000	173.3875	192.35	-41.34	-20	-21.34	Pass
1000 - 2000	138.0125	1451.625	-42.01	-20	-22.01	Pass
1000 - 2000	150.8125	1683.125	-42.01	-20	-22.01	Pass
1000 - 2000	153.11	1275.5	-41.85	-20	-21.85	Pass
1000 - 2000	156.0125	1102.125	-41.34	-20	-21.34	Pass
1000 - 2000	161.5625	1513.25	-42.01	-20	-22.01	Pass
1000 - 2000	161.9875	1591.625	-42.03	-20	-22.03	Pass
1000 - 2000	173.3875	1119.125	-41.8	-20	-21.8	Pass

Conducted Spurious Emissions Summary Test Table C4FM

Frequency Span	Tuned Frequency	Conducted Spurious		Limit	Margin	Result
		Frequency	Level			
MHz	MHz	MHz	dBm	dBm	dB	
30 - 1000	138.0125	52.07	-44.23	-20	-24.23	Pass
30 - 1000	150.8125	202.78	-42.31	-20	-22.31	Pass
30 - 1000	153.11	163.98	-38.97	-20	-18.97	Pass
30 - 1000	156.0125	51.95	-36.05	-20	-16.05	Pass
30 - 1000	161.5625	181.32	-42.35	-20	-22.35	Pass
30 - 1000	161.9875	52.07	-39.88	-20	-19.88	Pass
30 - 1000	173.3875	192.72	-41.6	-20	-21.6	Pass
1000 - 2000	138.0125	1207.375	-41.55	-20	-21.55	Pass
1000 - 2000	150.8125	1654.375	-41.4	-20	-21.4	Pass
1000 - 2000	153.11	1968.125	-41.78	-20	-21.78	Pass
1000 - 2000	156.0125	1993.875	-41.81	-20	-21.81	Pass
1000 - 2000	161.5625	1911.625	-41.83	-20	-21.83	Pass
1000 - 2000	161.9875	1352.5	-41.38	-20	-21.38	Pass
1000 - 2000	173.3875	1629.25	-42.18	-20	-22.18	Pass

Annex B Conducted Spurious Emission

Refer to Annex B for Conducted Spurious Emission plots.

Field Strength of Spurious Radiation

Engineer: Madhava Gooduru

Test Date: 8/21/2025

Test Procedure

The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna.

A spectrum analyzer was used to verify that the EUT met the requirements for radiated emissions.

The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that the signal levels were maximized.

All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm.

The EUT was set to transmit at maximum power with the RF output terminated with a 150-watt 50 ohm load.

Radiated spurious emissions were recorded with the EUT using CW and C4FM.

The RBW was set to 100 kHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz.

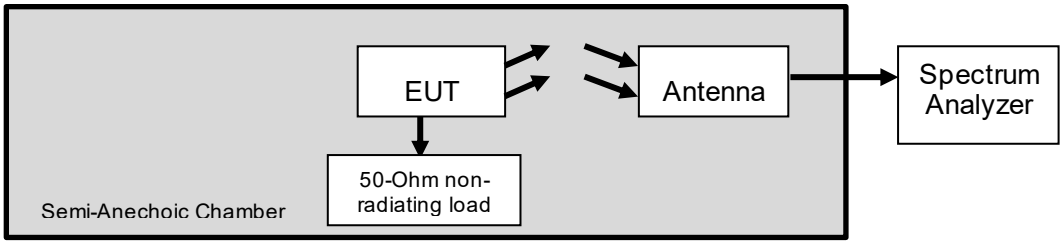
The VBW was set to 3 times the RBW.

The following formula was used for calculating the limits:

The worst case radiated spurious limit = P1 – (50+ 10Log(P2)) = -20 dBm

On the 30 – 1000 MHz plots, marker 1 is the fundamental transmit frequency and is not subject to the -20 dBm limit.

Test Setup



Radiated Spurious Emissions Summary Test Table CW-NB

Frequency Span	Tuned Frequency	Radiated Spurious		Limit	Margin	Result
		Frequency	Level			
MHz	MHz	MHz	dBm	dBm	dB	
30 - 1000	138.0125	828.116	-52.84	-20	-32.84	Pass
30 - 1000	150.8125	754.105	-47.94	-20	-27.94	Pass
30 - 1000	161.5625	969.348	-45.87	-20	-25.87	Pass
30 - 1000	173.3875	693.577	-47.98	-20	-27.98	Pass
1000 - 2000	138.0125	1104	-48.72	-20	-28.72	Pass
1000 - 2000	150.8125	1055.5	-50.81	-20	-30.81	Pass
1000 - 2000	161.5625	1130.875	-46.89	-20	-26.89	Pass
1000 - 2000	173.3875	1040.25	-43.93	-20	-23.93	Pass

Radiated Spurious Emissions Summary Test Table C4FM

Frequency Span	Tuned Frequency	Radiated Spurious		Limit	Margin	Result
		Frequency	Level			
MHz	MHz	MHz	dBm	dBm	dB	
30 - 1000	138.0125	966.05	-50.72	-20	-30.72	Pass
30 - 1000	150.8125	754.105	-48.01	-20	-28.01	Pass
30 - 1000	161.5625	969.348	-46.83	-20	-26.83	Pass
30 - 1000	173.3875	234.088	-51.18	-20	-31.18	Pass
1000 - 2000	138.0125	1104.125	-49.50	-20	-29.50	Pass
1000 - 2000	150.8125	1055.625	-51.80	-20	-31.80	Pass
1000 - 2000	161.5625	1130.875	-50.68	-20	-30.68	Pass
1000 - 2000	173.3875	1040.25	-44.59	-20	-24.59	Pass

Annex C Radiated Spurious Emission
Refer to Annex C for Radiated Spurious Emission plots

Emission Masks

Engineer: Madhava Gooduru

Test Date: 8/20/2025

Measurement Procedure

The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask.

The reference level was set to the maximum power recorded previously.

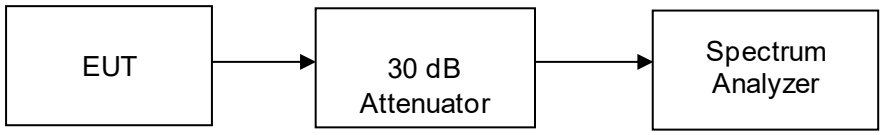
Mask B was used for wideband FM.

Mask D was used for narrowband FM and C4FM

For FM modulation, the transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation.

For C4FM modulation the internal C4FM standard test pattern was used.

Test Setup



Annex D Emission Mask

Refer to Annex D for Emission Mask plots.

Occupied Bandwidth

Engineer: Madhava Gooduru

Test Date: 8/19/2025

Measurement Procedure

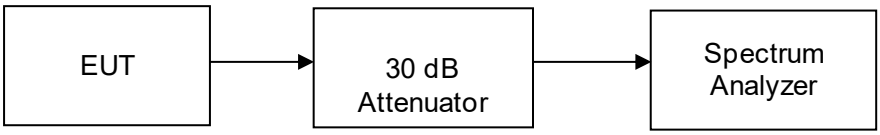
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required occupied bandwidth.

The internal occupied bandwidth tool built into the spectrum analyzer was used to record the -26 dB and 99% occupied bandwidth.

For FM modulation, the transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation.

For C4FM modulation the internal C4FM standard test pattern was used.

Test Setup



Occupied Bandwidth Summary Table

Tuned Frequency	Modulation	99%	-26 dB
MHz	NB, WB, C4FM	kHz	kHz
138.0125	NB	5.2823	10.170
150.8125	NB	5.5179	10.189
153.11	NB	5.2041	10.140
161.5625	NB	5.2622	10.164
173.3875	NB	5.5728	10.195
138.0125	WB	10.2118	15.230
150.8125	WB	10.2230	15.257
153.11	WB	10.1474	15.180
161.5625	WB	10.2057	15.206
173.3875	WB	10.2055	15.220
138.0125	C4FM	6.4053	8.060
150.8125	C4FM	6.7333	8.395
153.11	C4FM	6.7507	8.913
161.5625	C4FM	6.2669	8.278
173.3875	C4FM	7.2004	9.371

Annex E Occupied Bandwidth

Refer to Annex E for Occupied Bandwidth plots.

Transient Frequency Behavior

Engineer: Madhava Gooduru

Test Date: 8/20/2025

Measurement Procedure

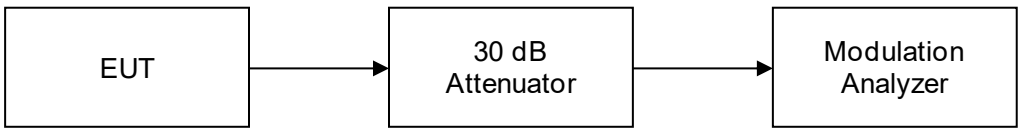
The EUT was connected directly to a modulation analyzer through a 30 dB attenuator to verify that the EUT meets the required Transient Frequency Behavior response per the specification. The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.
The turn on and turn off transient timing was measured and recorded.

Part 90.214 transient frequency behavior requirements.

Time Intervals [1,2]	Maximum Frequency Difference[3]	All Equipment	
		150 – 174 MHz	421 – 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{off} is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

Test Setup



Transient Frequency Test Results

Tuned Frequency = 161.5625 MHz				Tuned Frequency = 161.5625			
Channel Bandwidth = 12.5 kHz				Channel Bandwidth = 25 kHz			
Time Interval	Frequency Error (kHz)	Limit (kHz)	Pass / Fail	Time Interval	Frequency Error (kHz)	Limit (kHz)	Pass / Fail
t1	9.734	± 12.5	Pass	t1	8.164	± 25	Pass
t2	0.1725	± 6.25	Pass	t2	0.22	± 12.5	Pass
t3	1.327	± 12.5	Pass	t3	1.348	± 25	Pass

Annex F Transient Frequency Behavior

Refer to Annex F for Transient Frequency Behavior plots.

Audio Low Pass Filter (Voice Input)

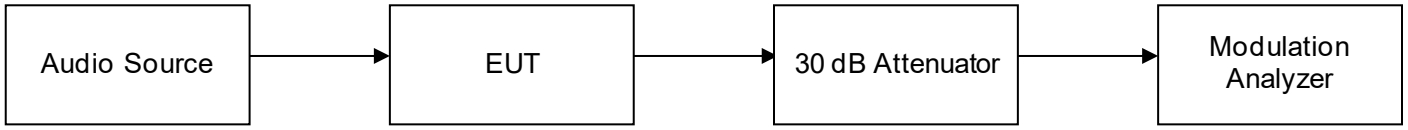
Engineer: Madhava Gooduru

Test Date: 8/20/2025

Measurement Procedure

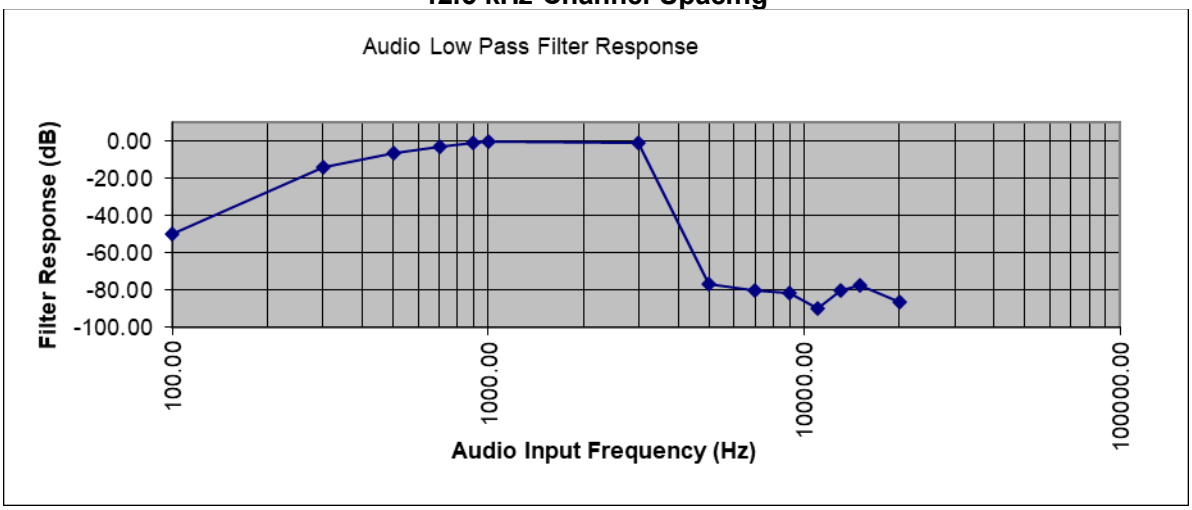
The EUT was connected directly to a modulation analyzer through an attenuator.
Set the audio frequency generator to 1 kHz and adjust the level for 60% deviation per manufacturer's specifications.
The audio source was tuned from 100 Hz to 20 kHz and the audio frequency response was measured and plotted.
The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.
The Audio Low Pass Filter test data was recorded for 12.5 kHz and 25 kHz channel spacing.

Test Setup

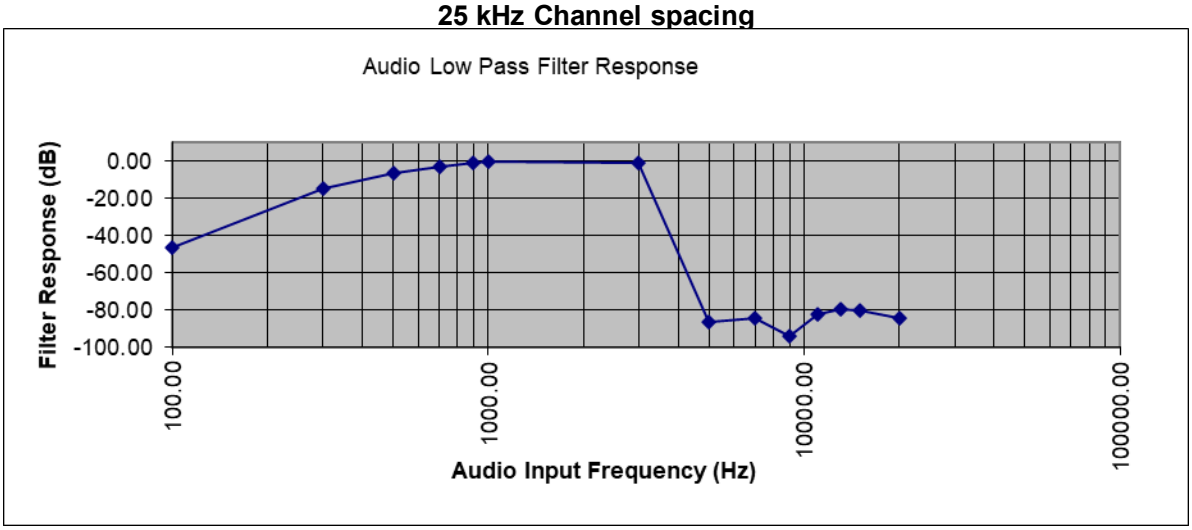


Test Results

12.5 kHz Channel Spacing



25 kHz Channel spacing



Audio Frequency Response

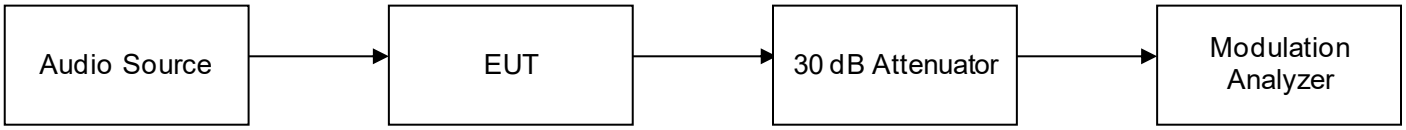
Engineer: Madhava Gooduru

Test Date: 8/20/2025

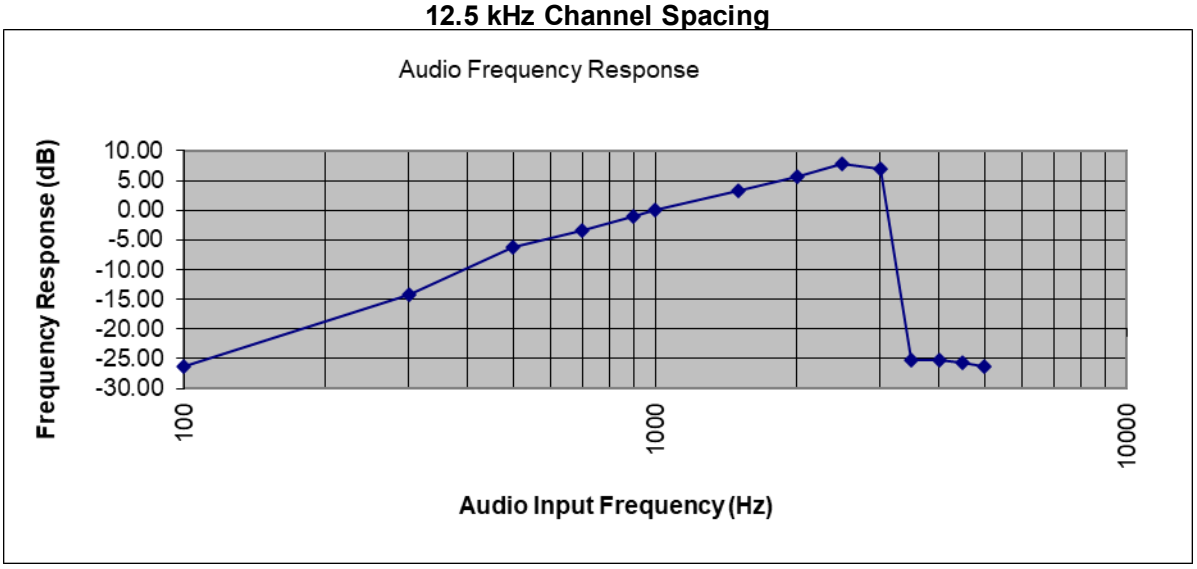
Measurement Procedure

The EUT was connected directly to a modulation analyzer through an attenuator.
The audio frequency was set to 1 kHz and the level was adjusted for 20% deviation according to the manufacturer's instructions.
The audio source was tuned from 100 Hz to 5000 Hz and the audio frequency response was measured and plotted.
The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.
The Audio Frequency Response test data was recorded for 12.5 kHz and 25 kHz channel spacing.

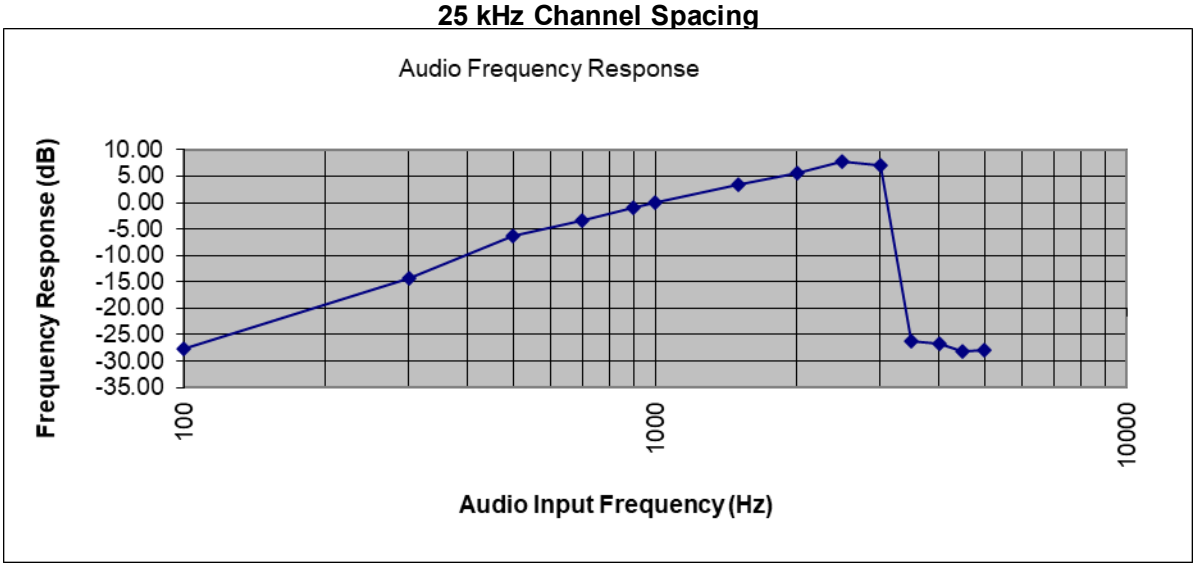
Test Setup



12.5 kHz Channel Spacing



25 kHz Channel Spacing



Modulation Limiting

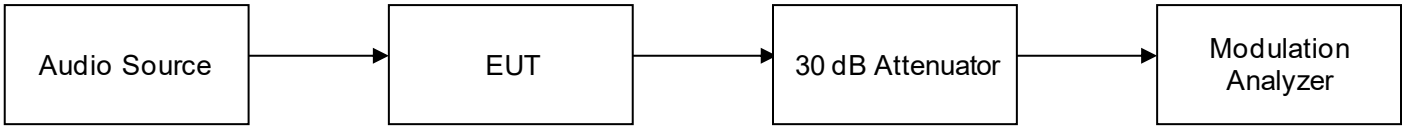
Engineer: Madhava Gooduru

Test Date: 8/20/2025

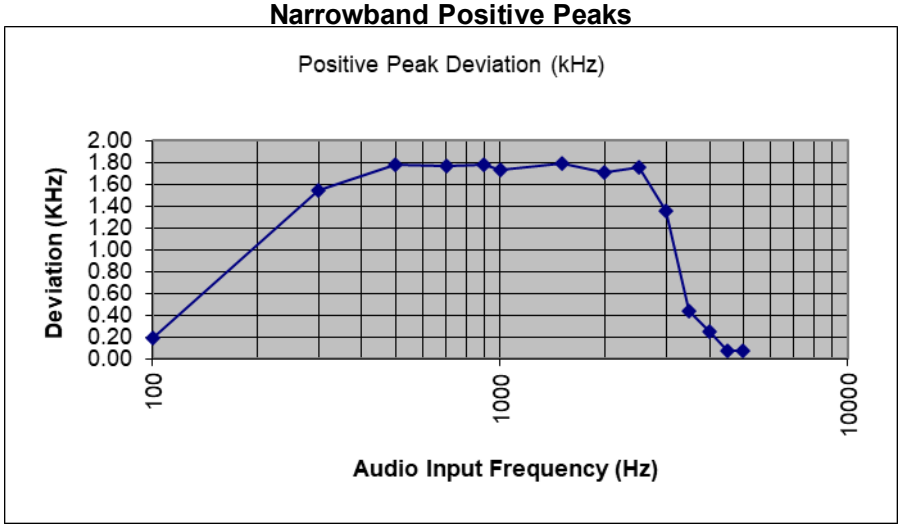
Measurement Procedure

The EUT was connected directly to a modulation analyzer through an attenuator.
The audio frequency was set to 1 kHz and the level was adjusted for 60% deviation according to the manufacturer's instructions. The input level was then set to 20 dB above the level used for 60 % modulation.
The audio source was tuned from 100 Hz to 5000 Hz and the audio frequency response was measured and plotted.
The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.
The Modulation Limiting test data was recorded for 12.5 kHz and 25 kHz channel spacing.

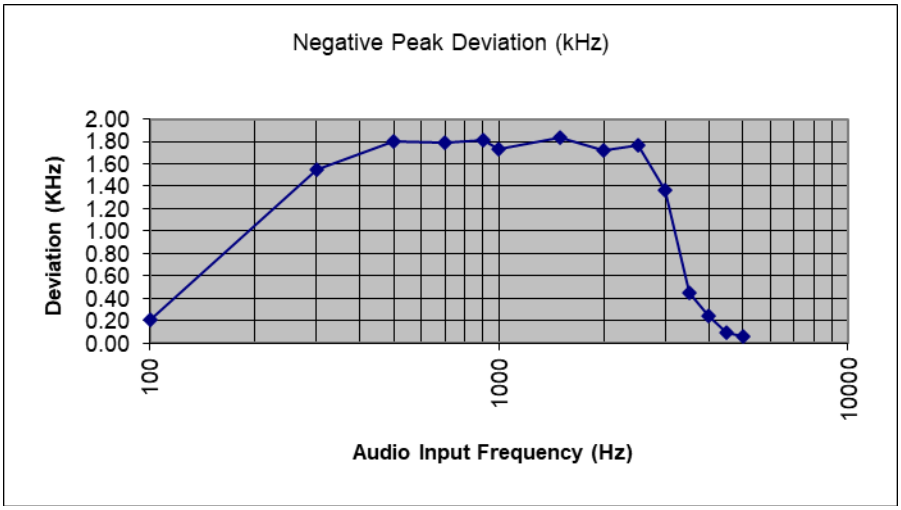
Test Setup



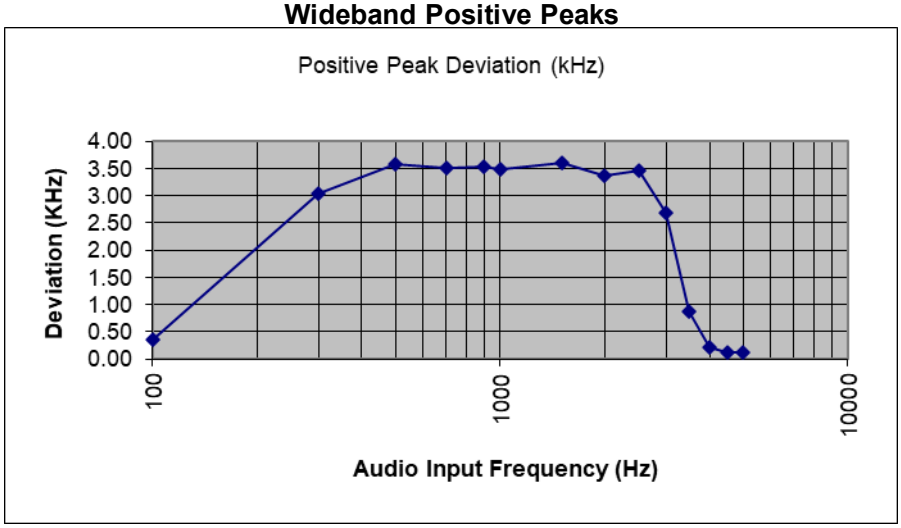
Narrowband Positive Peaks



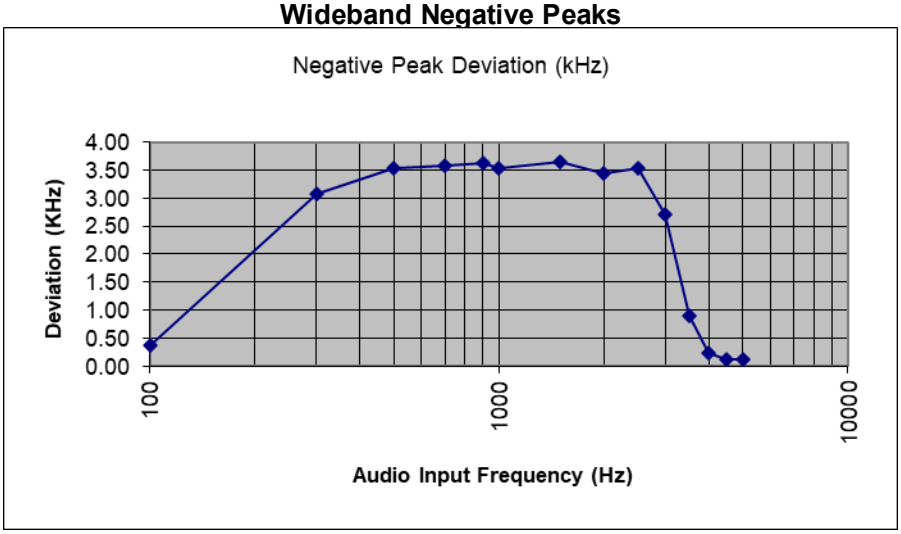
Narrowband Negative Peaks



Wideband Positive Peaks



Wideband Negative Peaks



Frequency Stability (Temperature Variation)

Engineer: Madhava Gooduru

Test Date: 8/22/2025

Measurement Procedure

The EUT was placed in an environmental test chamber and the RF output was connected directly to a spectrum analyzer.

The temperature was varied from -30°C to 50°C in 10°C increments.

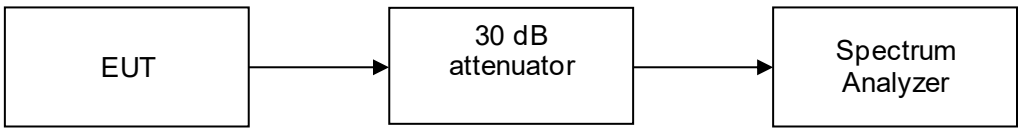
After a sufficient time for temperature stabilization the RF output frequency was measured.

The measurements were taken for internal and external reference.

At 20°C the power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured.

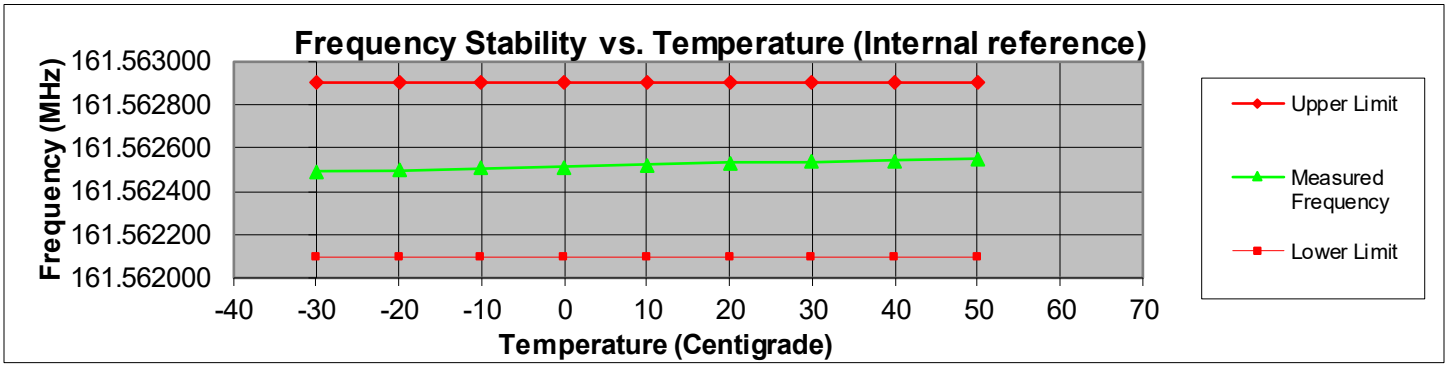
The transmitter DC input = 13.8 vdc.

Measurement Setup



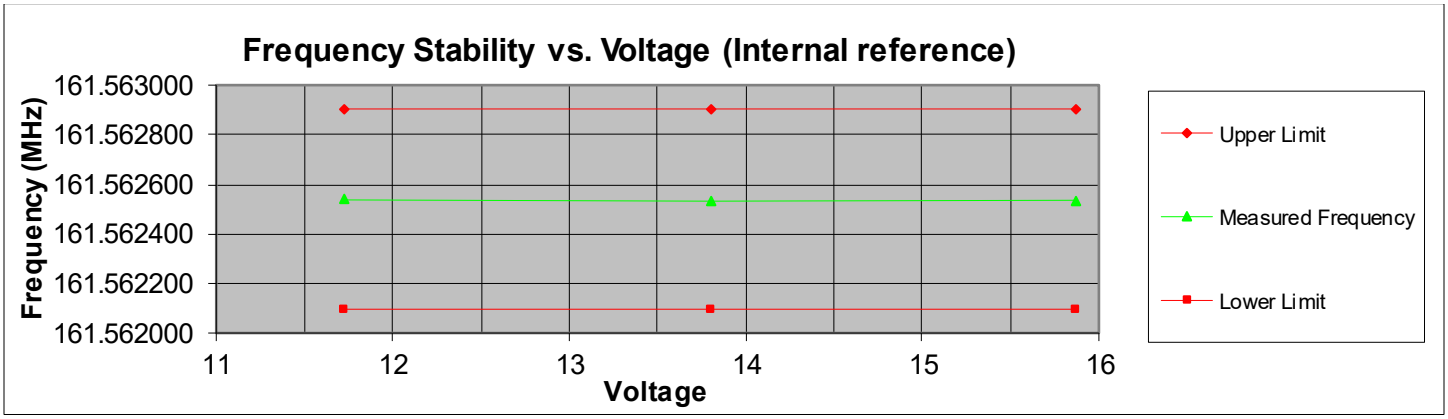
Frequency Stability vs Temperature (Internal reference)

Tuned Frequency	Temperature	Tolerance	Measured Frequency	Upper Limit	Lower Limit	Upper Margin	Lower Margin
(MHz)	(deg C)	(PPM)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
161.5625	-30	2.5	161.562494	161.562904	161.562096	-0.000410	0.000398
161.5625	-20	2.5	161.562496	161.562904	161.562096	-0.000408	0.000400
161.5625	-10	2.5	161.5625065	161.562904	161.562096	-0.000397	0.000410
161.5625	0	2.5	161.562512	161.562904	161.562096	-0.000392	0.000416
161.5625	10	2.5	161.5625217	161.562904	161.562096	-0.000382	0.000426
161.5625	20	2.5	161.562532	161.562904	161.562096	-0.000372	0.000436
161.5625	30	2.5	161.56254	161.562904	161.562096	-0.000364	0.000444
161.5625	40	2.5	161.562543	161.562904	161.562096	-0.000361	0.000447
161.5625	50	2.5	161.562552	161.562904	161.562096	-0.000352	0.000456



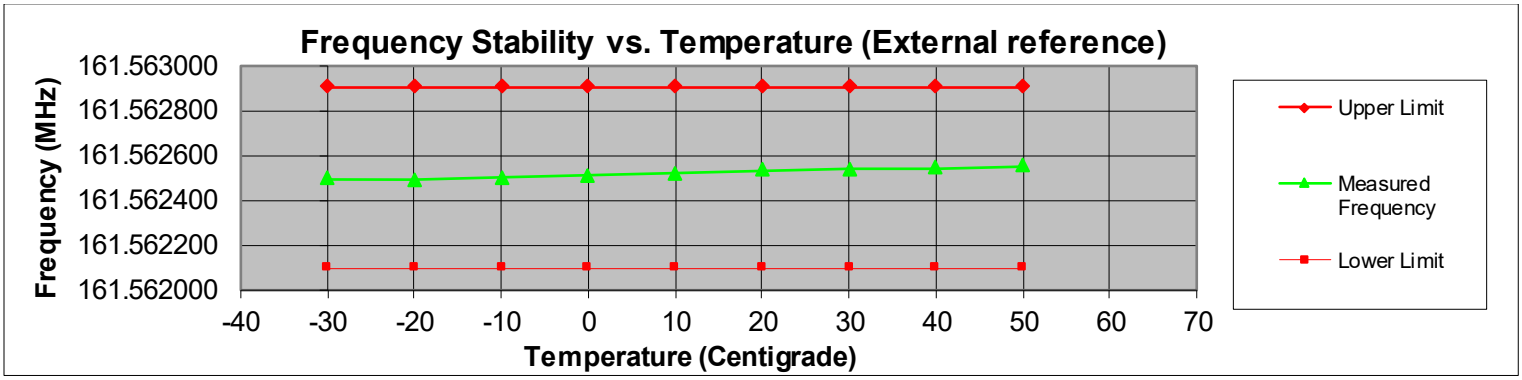
Frequency Stability vs Voltage (Internal reference)

Tuned Frequency	Tolerance	Voltage	Measured Frequency	Upper Limit	Lower Limit	Upper Margin	Lower Margin
(MHz)	(PPM)	(PPM)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
161.5625	2.5	11.73	161.562537	161.562904	161.562096	-0.000367	0.000441
161.5625	2.5	13.80	161.562532	161.562904	161.562096	-0.000372	0.000436
161.5625	2.5	15.87	161.562535	161.562904	161.562096	-0.000369	0.000439



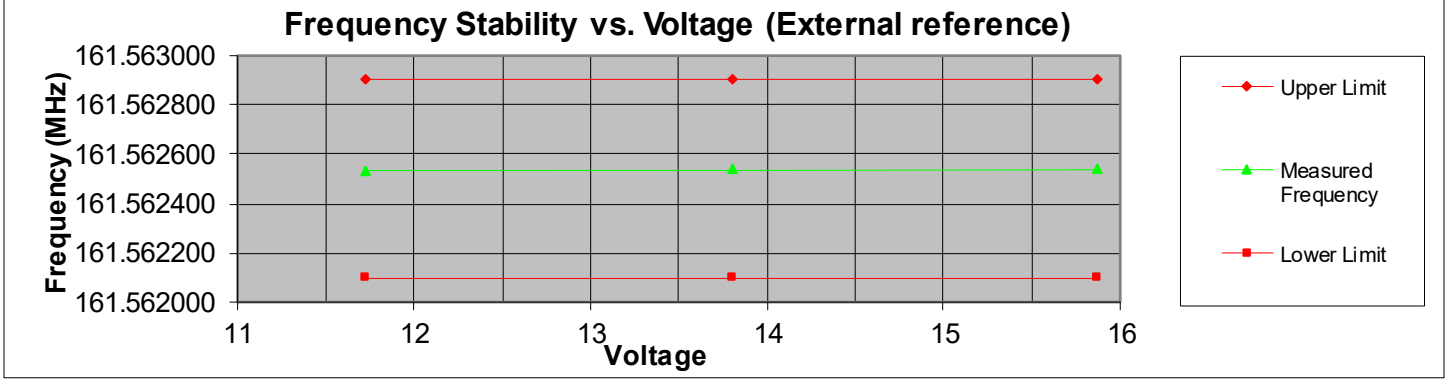
Frequency Stability vs Temperature (External reference)

Tuned Frequency	Temperature	Tolerance	Measured Frequency	Upper Limit	Lower Limit	Upper Margin	Lower Margin
(MHz)	(deg C)	(PPM)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
161.5625	-30	2.5	161.562495	161.562904	161.562096	-0.000409	0.000399
161.5625	-20	2.5	161.562493	161.562904	161.562096	-0.000411	0.000397
161.5625	-10	2.5	161.562503	161.562904	161.562096	-0.000401	0.000407
161.5625	0	2.5	161.562511	161.562904	161.562096	-0.000393	0.000415
161.5625	10	2.5	161.5625221	161.562904	161.562096	-0.000382	0.000426
161.5625	20	2.5	161.562536	161.562904	161.562096	-0.000368	0.000440
161.5625	30	2.5	161.562541	161.562904	161.562096	-0.000363	0.000445
161.5625	40	2.5	161.562544	161.562904	161.562096	-0.000360	0.000448
161.5625	50	2.5	161.562551	161.562904	161.562096	-0.000353	0.000455



Frequency Stability vs Voltage (External reference)

Tuned Frequency	Tolerance	Voltage	Measured Frequency	Upper Limit	Lower Limit	Upper Margin	Lower Margin
(MHz)	(PPM)	(PPM)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
161.5625	2.5	11.73	161.562537	161.562904	161.562096	-0.000367	0.000441
161.5625	2.5	13.80	161.562532	161.562904	161.562096	-0.000372	0.000436
161.5625	2.5	15.87	161.562535	161.562904	161.562096	-0.000369	0.000439



Necessary Bandwidth Calculations

Engineer: Madhava Gooduru

Test Date: 8/25/2025

Modulation = 11K0F3E		
Necessary Bandwidth Calculation:		
Maximum Modulation (M), kHz	=	3
Maximum Deviation (D), kHz	=	2.5
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	(2xM)+(2xDxK)
	=	11.0

Modulation = 16K0F3E		
Necessary Bandwidth Calculation:		
Maximum Modulation (M) kHz	=	3
Maximum Deviation (D), kHz	=	5
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	(2xM)+(2xDxK)
	=	16.0

Modulation = 8K10F1E, 8K10F1W, 8K10F7D, 8K10F7E, 8K10F7W, 8K10F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	9.6
Maximum Deviation (D), kHz	=	3.111
Signaling States	=	4
Constant Factor (K)	=	0.531
Necessary Bandwidth (B_N), kHz	=	($R/\log_2 S$)+2DK
	=	8.1

Measurement Uncertainty

Measurement Uncertainty (U_{lab}) for Compliance Testing is listed in the table below.

Measurement	U_{lab}
Radio Frequency	± 3.3 x 10^{-8}
RF Power, conducted	± .54 dB
RF Power Density, conducted	± 1.0 dB
Conducted Emissions	± 0.94 dB
Radiated Emissions 9kHz-30MHz	± 2.76 dB
Radiated Emissions 30MHz-1000MHz	± 4.25 dB
Radiated Emissions – 1GHz-18GHz	± 4..49 dB
Temperature	± 1.5 deg C
Humidity	± 4.3 %
DC voltage	± 0.20 VDC
AC Voltage	± 1.2 VAC

The reported expanded uncertainty +/- U_{lab}(dB) has been estimated at a 95% confidence level (k=2)

U_{lab} is less than or equal to U_{ETSI} therefore

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit
- Non-Compliance is deemed to occur if any measured disturbance exceeds the disturbance limit

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Signal Generator	Agilent	E4438C	I00457	12/14/2024	12/14/2025
Digital Radio Test Set	Aeroflex	3920B	I00524	Verified on: 8/19/25	
Tunable Notch Filter	Eagle	TNF-1-(118-200MHz)	i00124	Verified on: 8/20/25	
Horn Antenna	ARA	DRG-118/A	i00271	8/9/2024	8/9/2026
Temp./humidity/pressure monitor (Main Lab)	Omega Engineering	iBTHX-W-5	i00686	1/25/2025	1/25/2026
Data Logger	Fluke	Hydra Data Bucket	i00343	7/1/2025	7/1/2026
Attenuator, 30 dB, 150W	Narda	769-30	i00347	Verified on: 8/19/25	
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	2/27/25	2/27/27
Spectrum Analyzer	Textronix	RSA5126A	i00424	7/1/2025	7/1/2026
Spectrum Analyzer	Agilent	E4445A	I00471	1/25/2025	1/25/2026
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/13/23	7/13/26
Highpass Filter (1 GHz)	K&L	7IH40-980/T6000-O/O	i00432	Verified on: 8/20/25	
Voltmeter	Fluke	79iii	i00499	10/15/24	10/15/25
MXE EMI receiver	Keysight	N9038A	i00552	3/17/2025	3/17/2026
Temperature Chamber	Thermotron	SE-1000-3-3	i00557	Verified on: 8/22/25	
DC Power Supply	Keysight	N7973A	i00565	Verified on: 8/19/25	
Preamplifier	Eravant	SBB-0115034018-2F2F-E3	i00646	Verified on: 12/4/24	

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

END OF TEST REPORT