Test Report

Prepared for: Transducers Direct

Model: TDWLB5

Serial Number: 993

Project No: p2440018

Test Results: Pass

To

FCC Part 15.247: 2024
and
RSS-247: Issue 3 (August 2023)

Date of Issue: November 11, 2024

On the behalf of the applicant:

Transducers Direct
12115 Ellington Court
Cincinnati, Ohio, 45249

Attention of:

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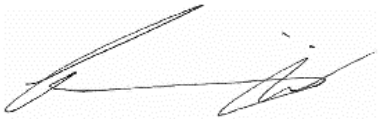
FCC Site Reg. #US2901
ISED Site Reg. #2044A-2

Reviewed / Authorized By:



John Michalowicz, Test Engineer

Test Results Summary

Test Date Range: November 3rd, 2024

Specification		Test Name	Pass, Fail, N/A	Comments
FCC	**RSS**			
15.247(b)	Section 5.4(d)	Output Power	Pass	
15.247(d)	Section 5.5	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5 / RSS-GEN Section 8.9	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Emissions At Band Edges	Pass	
15.247(a)(2)	Sections 5.2(a)	Occupied Bandwidth	Pass	
15.247(e)	Section 5.2(b)	Transmitter Power Spectral Density	Pass	
15.247(a)	Section 5.1 (c)	Dwell Time	N/A	EUT is a DTS device
15.247(a)	Section 5.1 (c)	Number of Hopping Channels	N/A	EUT is a DTS device
15.247(a)	Section 5.1 (b)	Channel Separation	N/A	EUT is a DTS device
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	Pass	
Method Deviations/Additions: No				

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*.

References/Methods	Description
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ANSI C63.10:2020	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 15.247 Meas Guidance v05r02	Guidance for Compliance Measurements on DTS, FHSS, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
ISO/IEC 17025:2017	General requirements for the Competence of Testing and Calibrations Laboratories

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	November 11, 2024	John Michalowicz	Original Document
2.0	January 13, 2025	John Michalowicz	Updated typo on page 36 Removed blank tables from RSE section
3.0	February 3, 2025	John Michalowicz	Updated test summary table Updated radiated emissions frequency units Updated mid channel radiated emissions data.

Current revision of the test report replaces any prior versions. Only the current version of the test report is valid.

EUT Description

Model:	**TDWLB5**
Serial:	**993**
Firmware:	**V1.19**
Software:	**NA**
Description:	**Wireless pressure and temperature transducer**
Additional Information:	**Radio Frequency Range and Operational Info: 2402 – 2480 MHz, BLE** **Usage: Fixed-Use/Mobile**
Receipt of Sample(s):	**May 10th, 2024**
EUT Condition:	**Visual Damage** No **State of Development** Production/Production Equivalent

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Authorization Requirements

Intentional Radios may require authorization covered under the following rule parts or standards:

-47 CFR Part 2 Subpart J

-RSS-Gen — General Requirements for Compliance of Radio Apparatus

Note: These notices are specific to the methods and standards related to the testing within this report. Customers should also consider and review additional legal regulations for import/export documentation and labeling for the countries and geographies under consideration by the manufacturer.

Test and Measurement Data

Subpart 2.1033(b)

All tests and measurement data shown were performed in accordance with FCC Rule Parts: 15.247.

All tests and measurement data shown are deemed satisfactory evidence of compliance with Industry Canada Radio Standards Specification RSS-Gen and RSS-247.

Standard Engineering Practices

Unless otherwise indicated, the procedures contained in ANSI C63.10 and ANSI C63.4 were observed during testing.

Prior to testing, the EUT was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing. Measurement results, unless otherwise noted, are worst case measurement.

Standard Test Conditions and Engineering Practices

Unless otherwise indicated in the specific measurement results, the ambient temperature was maintained within the range of 10º to 40ºC (50º to 104ºF) and the relative humidity levels were in the range of 10% to 90%.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Barometric Pressure (mbar)**
23.6 – 24.4	28.3 – 30.1	960.2 – 963.8

Test Setup and Modes of Operation

EUT Operation during Tests

The EUT was set to transmit at a power setting of -5. This was a constant transmit modulated emission. The EUT has a SMA connector for a conducted test port. The EUT is capable of transmitting in 1M PHY, 2M PHY and S8 coded PHY (128Kbps). All modes were investigated, and the worst case was determined to be 1M PHY and 2M PHY. The results are contained within this test report.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Test Laptop	ASUS	Vivobook	NA
1	AC/DC Adapter		GFD18-1201500UL	NA
1	Communication box	Spectrum Digital	XDS200	NA

Cables:

Qty	Description	Length (M)	Ferrites (Y/N)	Shielding Y/N	Shielded Hood Y/N	Termination / Connection
1	USB	1	N	N	N	NA

Modifications to EUT(s) (N):

15.203: Antenna Requirement:

Mark the option that is applicable.

X	The antenna is permanently attached to the EUT
	The antenna uses a unique coupling
	The EUT must be professionally installed
	The antenna requirement does not apply

The antenna gain stated by the manufacturer is Peak 2.1 dBi

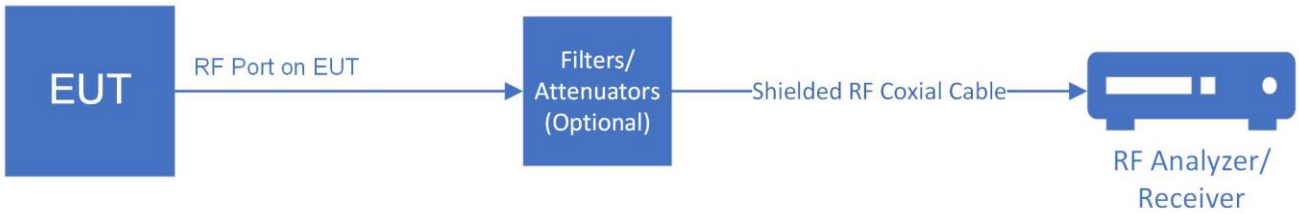
Output Power

Engineer: John Michalowicz
Test Date: 11/3/24

Test Procedure

CONDUCTED METHOD
A spectrum analyzer was directly connected to the EUT's RF port. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Output Power.

Test Setup



The Spectrum Analyzer was set to the following:

RBW ≥ DTS Bandwidth
VBW ≥ 3 x RBW
Span ≥ 3 x RBW
Sweep time = auto couple
Detector = peak
Trace Mode = max hold

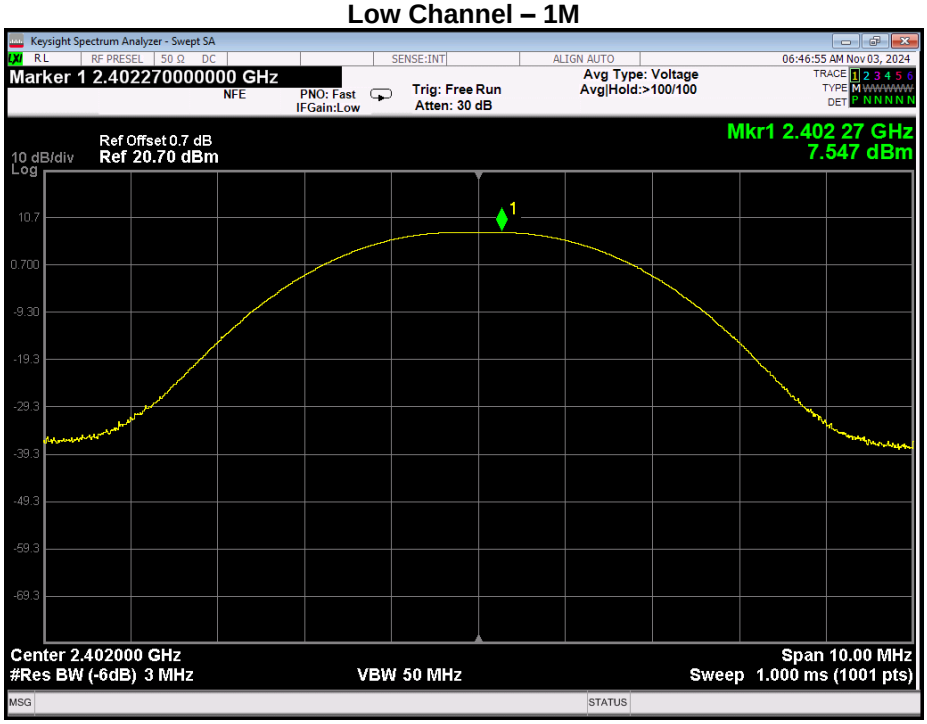
The RF output power was measured using the spectrum analyzer's marker peak function

Transmitter Output Power Summary Table

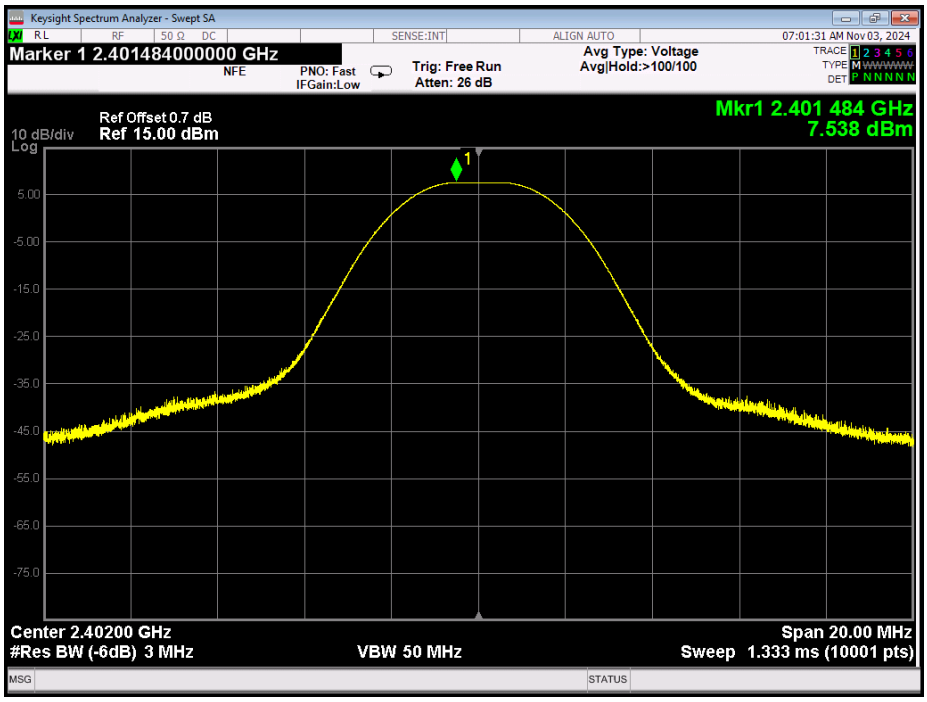
Tuned Frequency (MHz)	Mode of Operation	Measured Value (dBm)	Specification Limit	Result
2402	1M	7.55	1 W (30 dBm)	Pass
	2M	7.54	1 W (30 dBm)	Pass
2440	1M	7.22	1 W (30 dBm)	Pass
	2M	7.25	1 W (30 dBm)	Pass
2480	1M	6.85	1 W (30 dBm)	Pass
	2M	6.85	1 W (30 dBm)	Pass

Output Power Plots

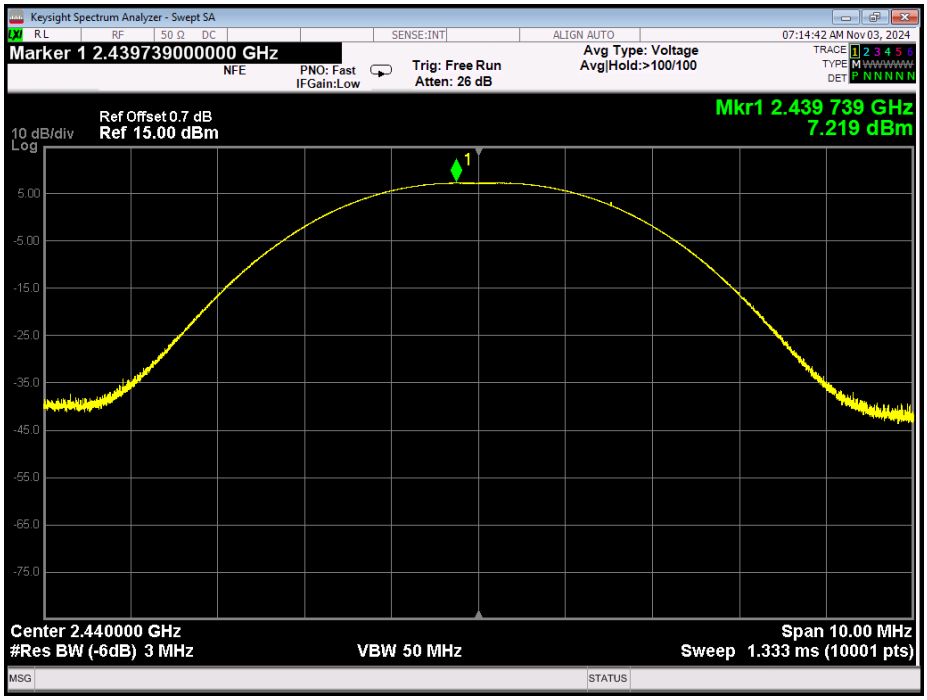
Low Channel – 1M



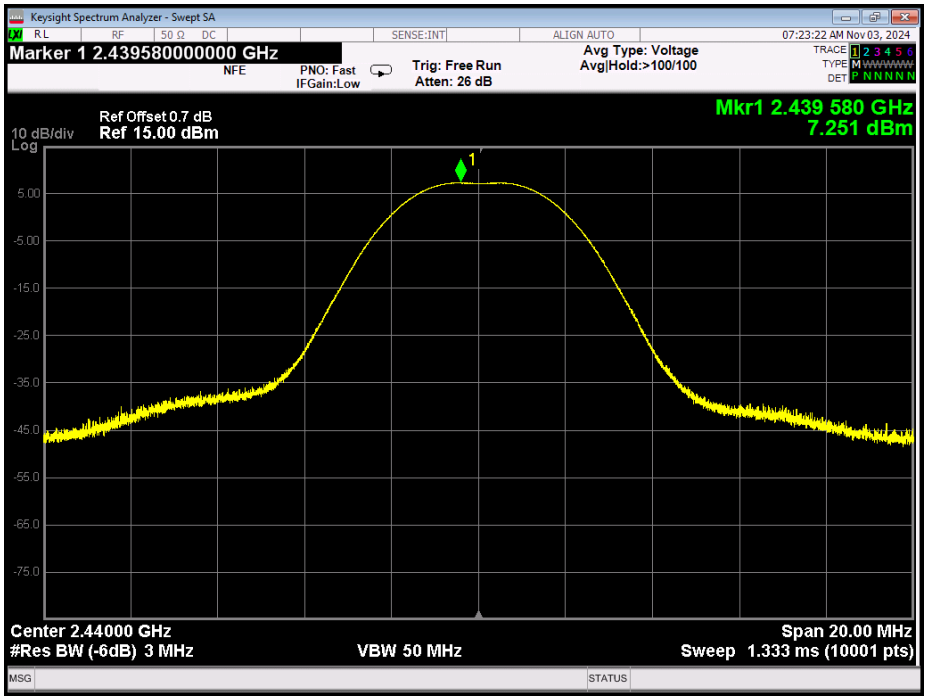
Low Channel – 2M



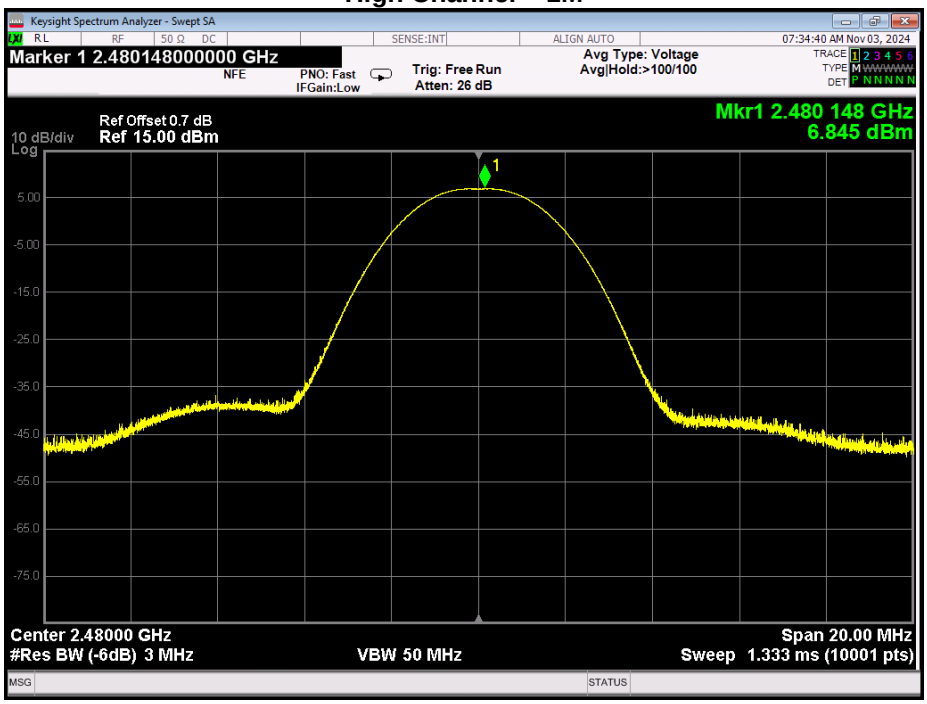
Mid Channel – 1M



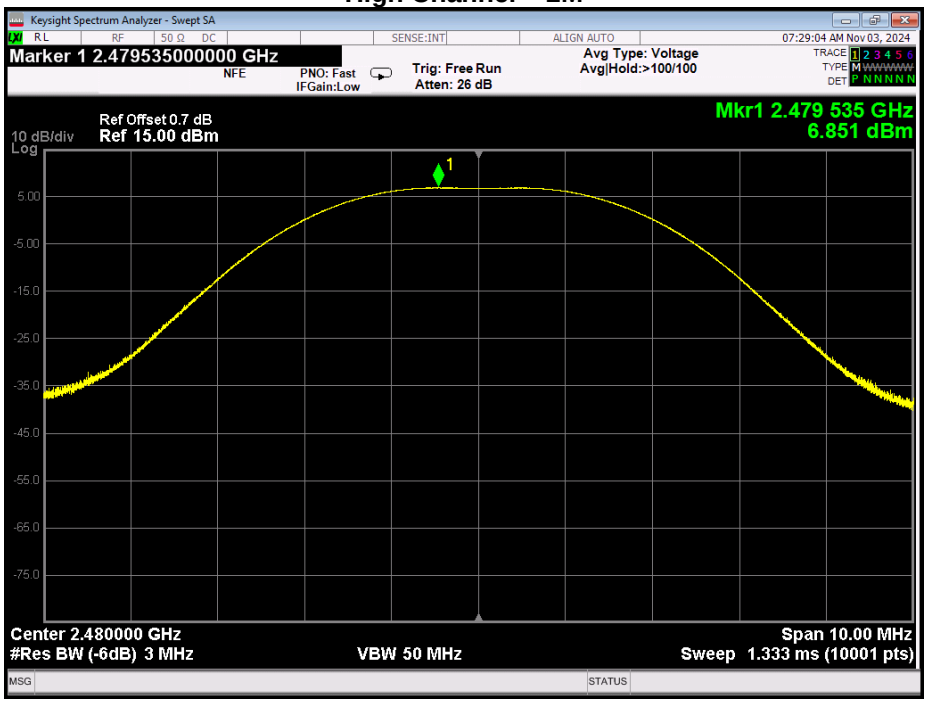
Mid Channel – 2M



High Channel – 1M



High Channel – 2M



Radiated Spurious Emissions

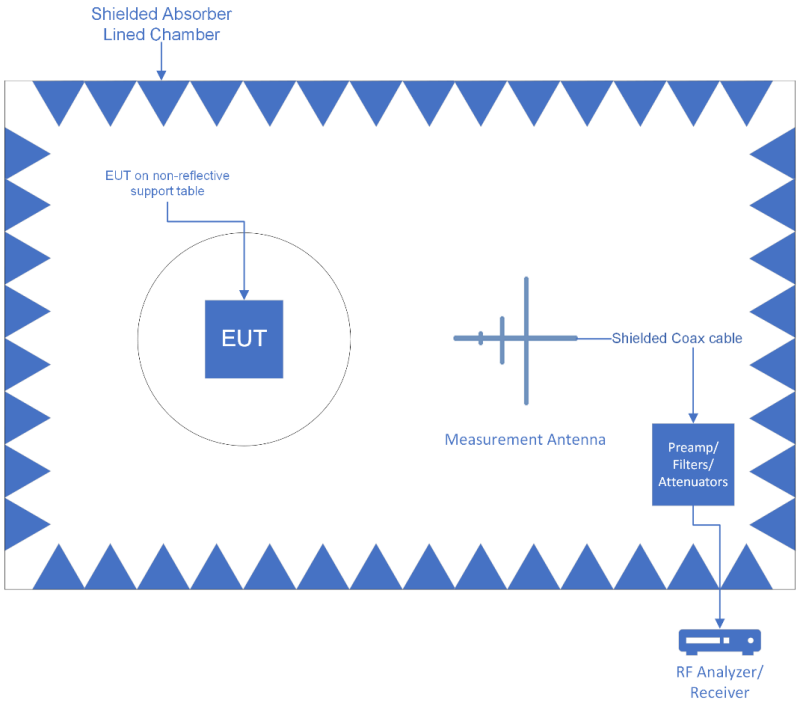
Engineer: John Michalowicz

Test Date: 11/3/24

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz and Above 1GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequency of operation at the maximum power level. The EUT was tested, in 3 orthogonal axis, by rotating it 360° with the receive antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the TX signal levels were maximized. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. All emissions across the required range were evaluated. The fundamental emissions in the plots on p21, p25 and p29 exceeding the limits are not applicable to the RSE limits.

Basic Test Setup



	Settings Below 1GHz	Settings Above 1GHz
RBW	120 kHz	1 MHz
VBW	300 kHz	3 MHz
Detector	Quasi Peak	Peak / Average

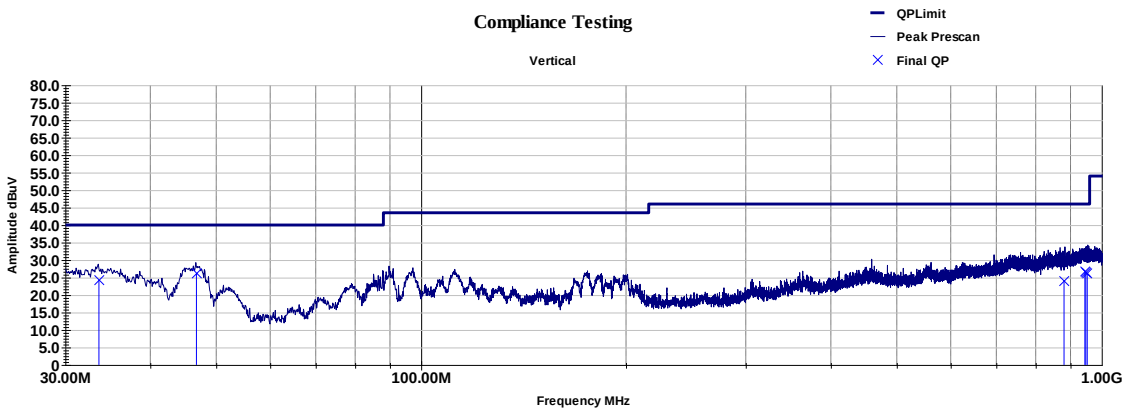
Sample Calculations

Corrected Value = Measured Value + Correction factor

Correction factor = Antenna Correction Factor + Cable loss + Preamp/Attenuator Factor

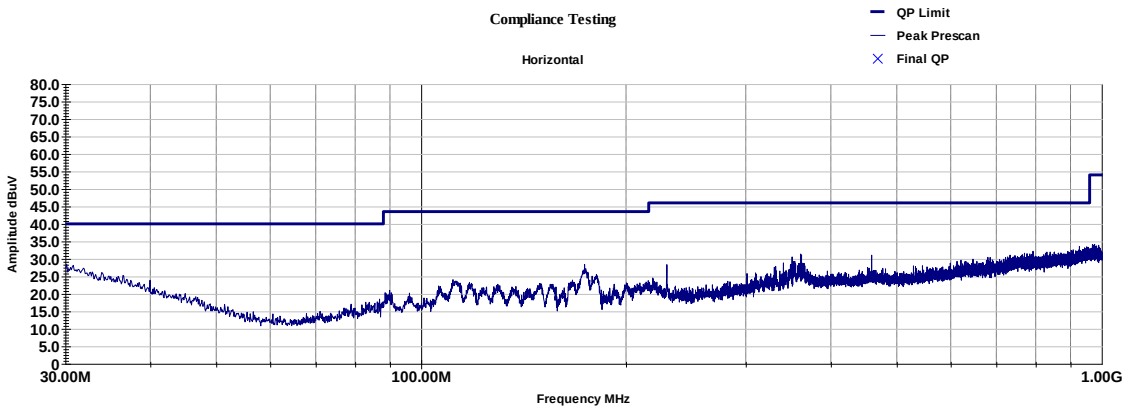
Radiated Emissions 30-1000MHz

Low Channel_30 - 1000

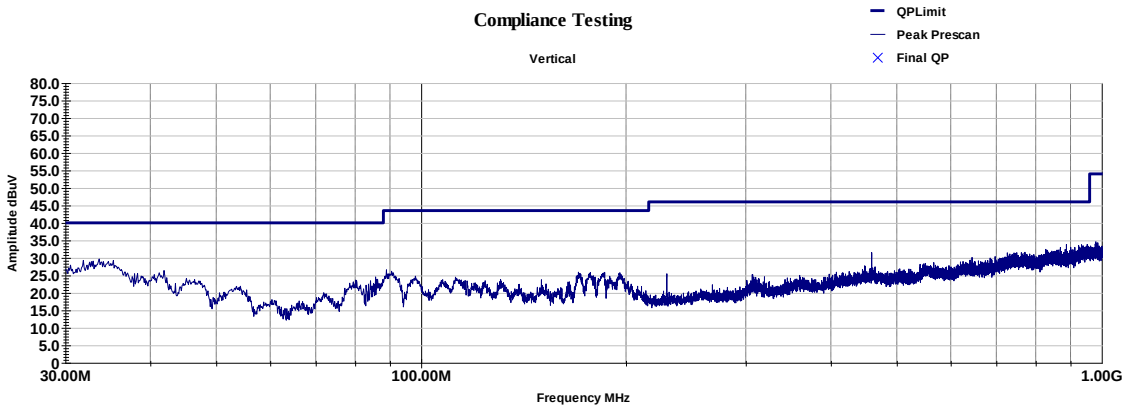


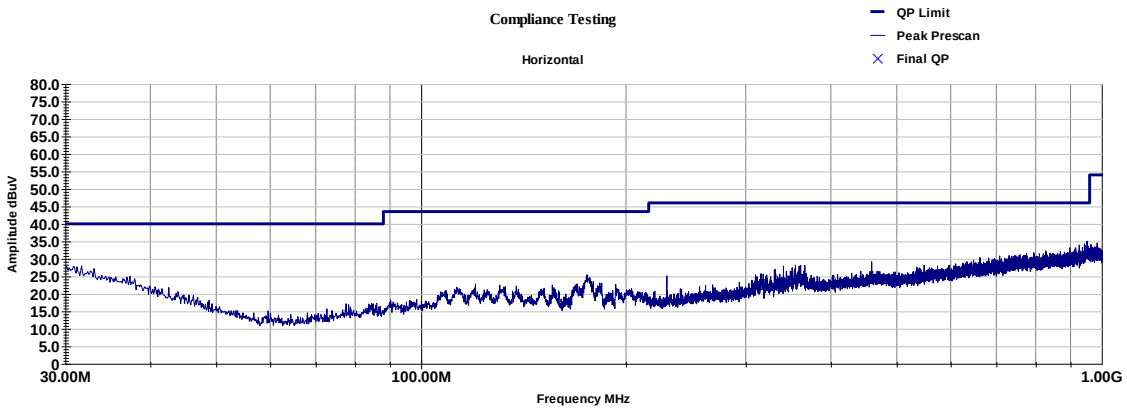
Frequency	Azimuth	Height	Raw QP	Correction	Final QP	Limit	QP Margin
MHz	deg	cm	dBuV	dB	dBuV/m	dBuV/m	dB
33.618	125.00	113.00	43.13	-18.86	24.30	40.00	-15.70
46.752	10.00	100.00	51.89	-25.65	26.20	40.00	-13.80
880.361	80.00	171.00	33.07	-8.96	24.10	46.00	-21.90
944.722	199.00	251.00	33.82	-7.10	26.70	46.00	-19.30
947.673	144.00	100.00	33.51	-7.07	26.40	46.00	-19.60
947.673	144.00	100.00	33.51	-7.07	26.40	46.00	-19.60
952.249	278.00	325.00	33.25	-7.17	26.10	46.00	-19.90
947.673	144.00	100.00	33.51	-7.07	26.40	46.00	-19.60
Final = Raw + Path Loss							

Margin = Final - Limit

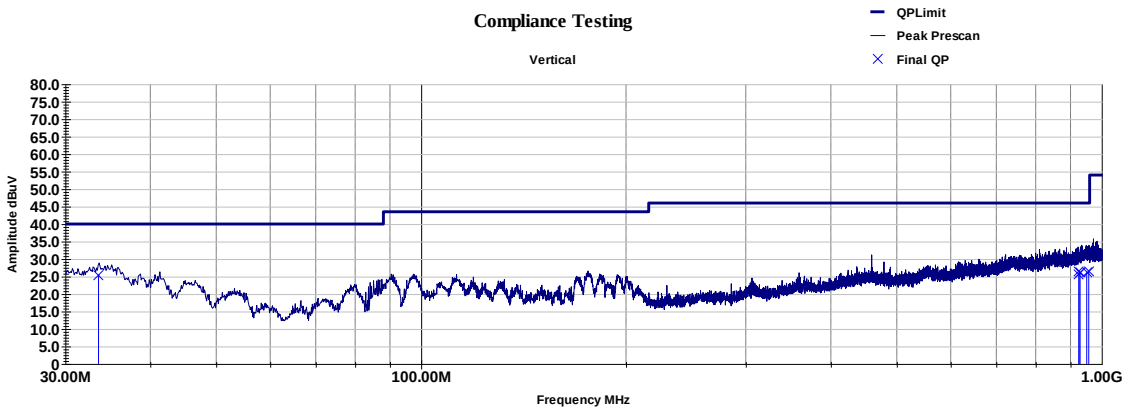

Compliance Testing
Horizontal
QP Limit
Peak Prescan
Final QP
Amplitude dBuV
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
30.00M
100.00M
1.00G
Frequency MHz

Mid Channel_30 - 1000



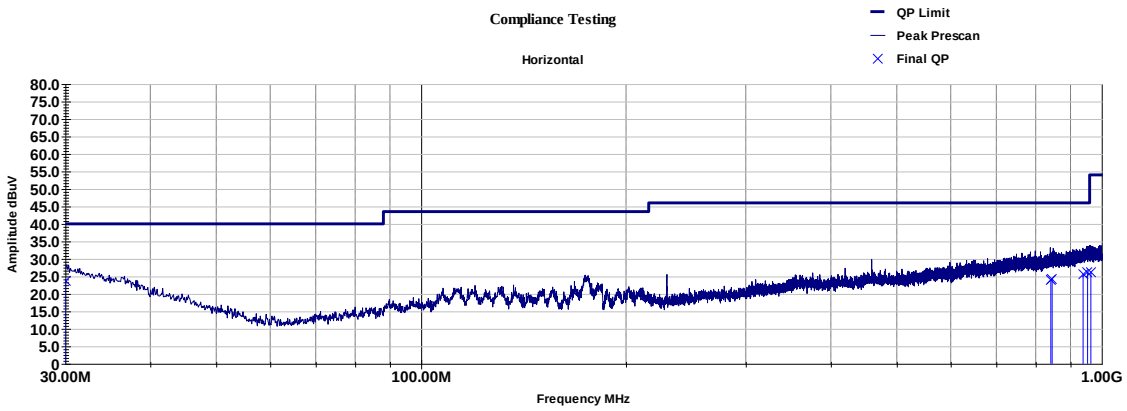


High Channel_30 - 1000



Frequency	Azimuth	Height	Raw QP	Correction	Final QP	Limit	QP Margin
MHz	deg	cm	dBuV	dB	dBuV/m	dBuV/m	dB
33.575	80.00	100.00	44.32	-18.84	25.50	40.00	-14.50
925.839	160.00	355.00	33.37	-7.67	25.70	46.00	-20.30
925.839	160.00	355.00	33.37	-7.67	25.70	46.00	-20.30
926.053	174.00	187.00	34.10	-7.65	26.40	46.00	-19.60
925.839	160.00	355.00	33.37	-7.67	25.70	46.00	-20.30
929.333	143.00	100.00	33.68	-7.52	26.20	46.00	-19.80
950.664	331.00	148.00	33.21	-7.07	26.10	46.00	-19.90
956.881	56.00	200.00	33.53	-7.18	26.40	46.00	-19.60
Final = Raw + Path Loss							

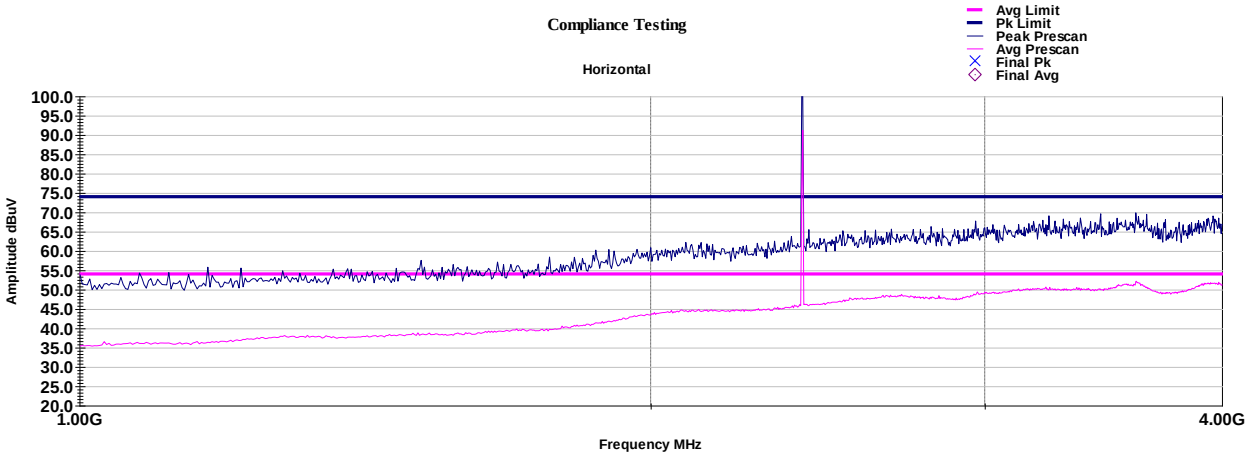
Margin = Final - Limit

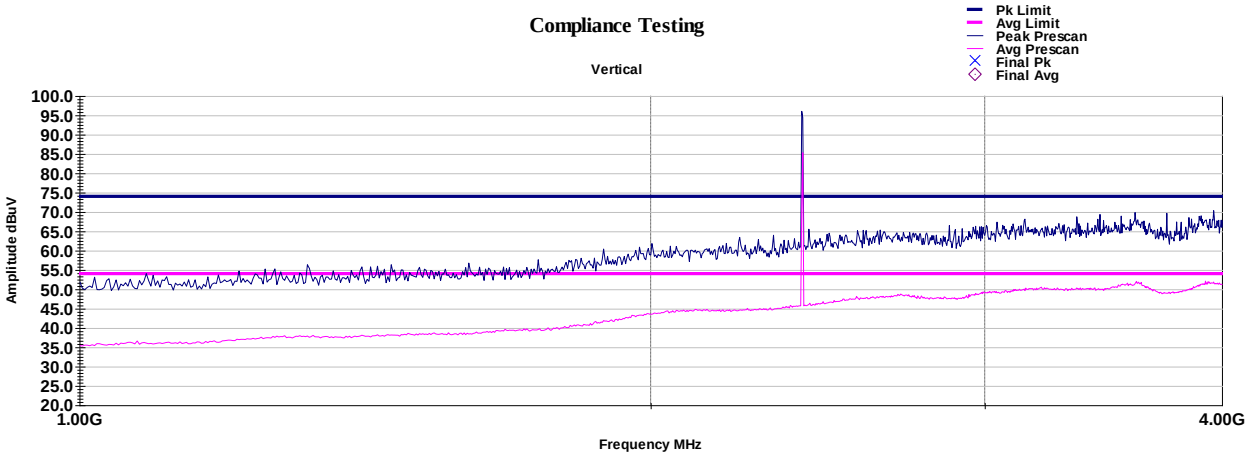


Frequency	Azimuth	Height	Raw QP	Correction	Final QP	Limit	QP Margin
MHz	deg	cm	dBuV	dB	dBuV/m	dBuV/m	dB
30.013	305.00	121.00	38.84	-15.17	23.70	40.00	-16.30
841.749	198.00	400.00	33.24	-9.15	24.10	46.00	-21.90
845.546	278.00	364.00	33.19	-9.04	24.20	46.00	-21.80
939.086	41.00	151.00	33.21	-7.56	25.70	46.00	-20.30
953.328	297.00	140.00	33.31	-7.17	26.10	46.00	-19.90
964.01	0.00	400.00	33.32	-7.26	26.10	54.00	-27.90
Final = Raw + Path Loss							
Margin = Final - Limit							

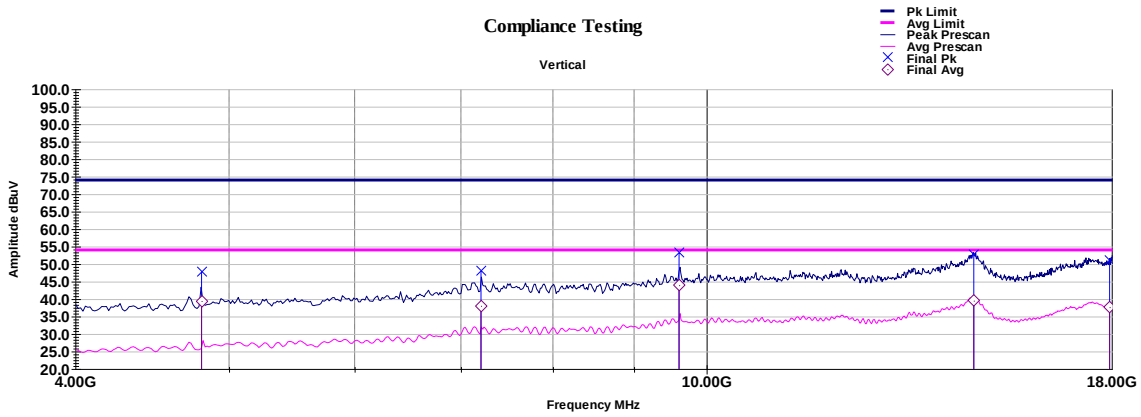
Radiated Emissions Above 1000MHz

Low Channel

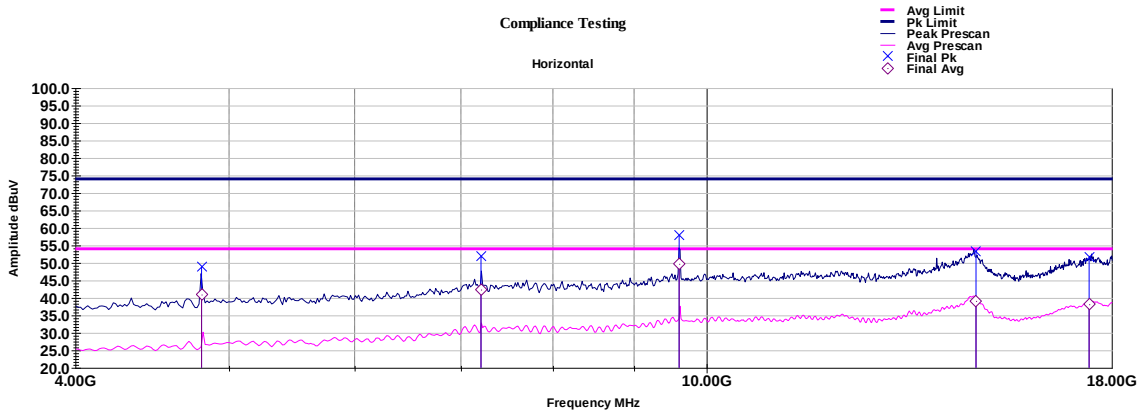




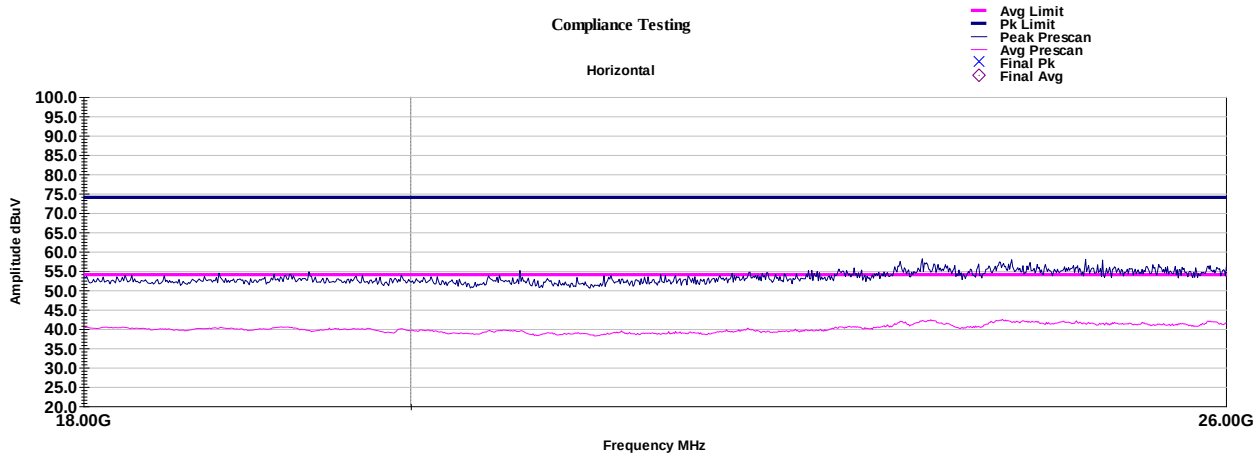
Low Channel_4 - 18 GHz

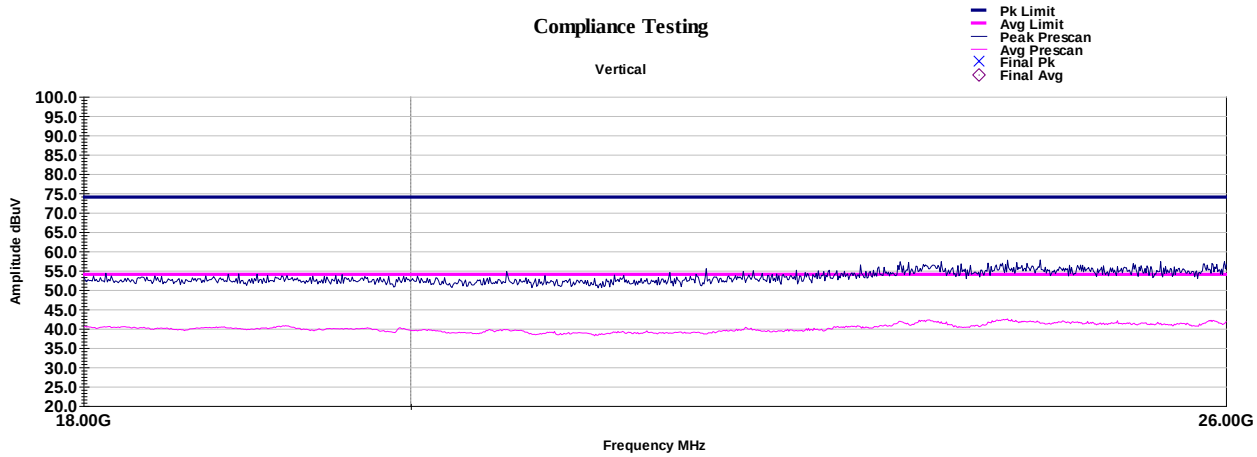


Frequency	Azimuth	Height	Raw Pk	Raw Avg	Correction	Final Pk	Pk Limit	Pk Margin	Final Avg	Avg Limit	Avg Margin
Hz	deg	cm	dBuV	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
4804682000	177.00	290.00	54.37	45.95	-6.54	47.83	74.00	-26.17	39.41	54	-14.60
7206883000	299.00	252.00	47.24	37.20	0.82	48.06	74.00	-25.94	38.02	54	-15.98
9607132000	273.00	175.00	52.58	43.38	0.56	53.14	74.00	-20.86	43.95	54	-10.06
14735040000	350.00	100.00	45.19	32.04	7.48	52.66	74.00	-21.34	39.52	54	-14.48
17944590000	0.00	140.00	42.12	28.63	9.03	51.15	74.00	-22.85	37.66	54	-16.34
Final = Raw + Path Loss											
Margin = Final - Limit											

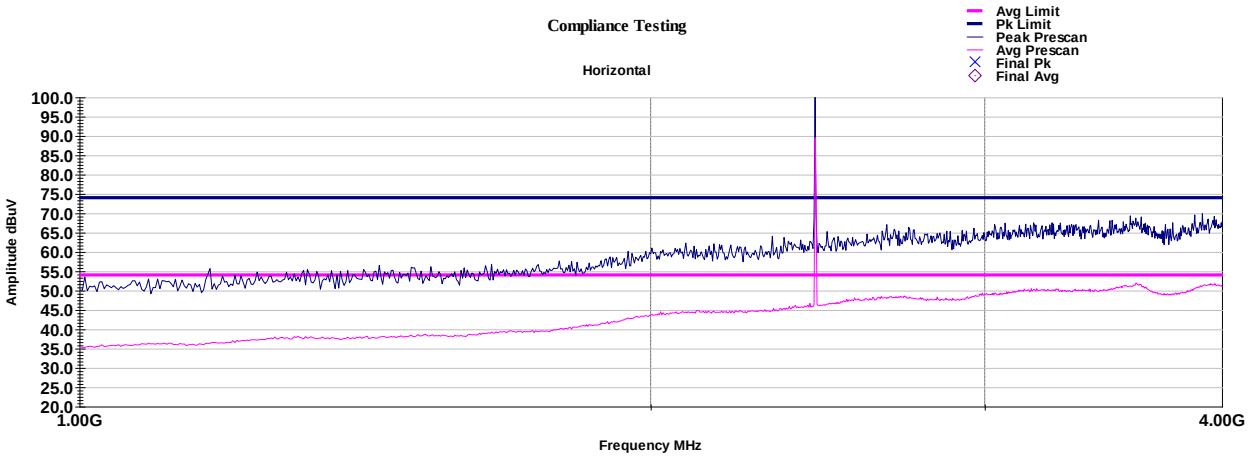


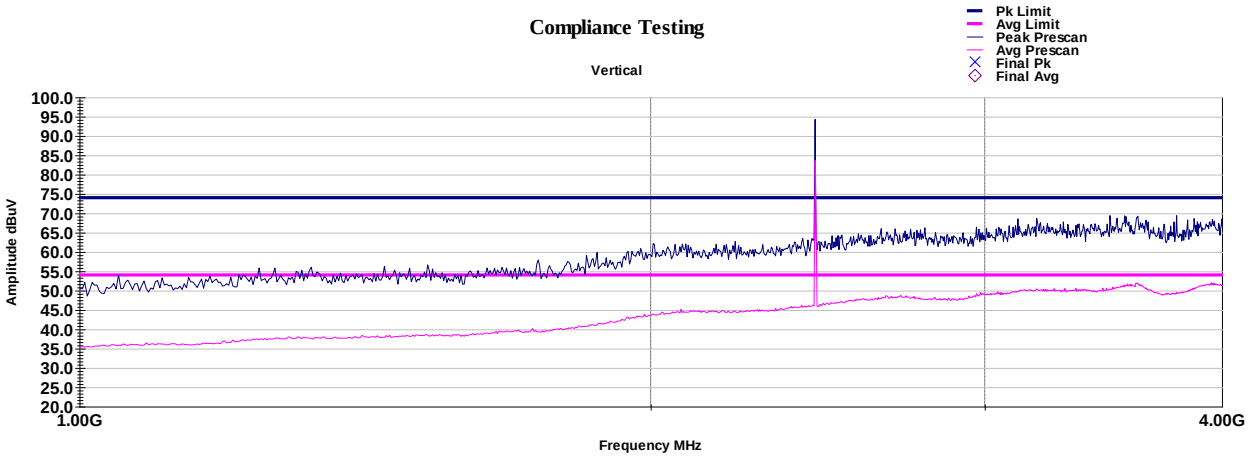
Frequency	Azimuth	Height	Raw Pk	Raw Avg	Correction	Final Pk	Pk Limit	Pk Margin	Final Avg	Avg Limit	Avg Margin
Hz	deg	cm	dBuV	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
4804496000	108.00	100.00	55.48	47.49	-6.54	48.93	74.00	-25.07	40.95	54	-13.06
7206763000	65.00	175.00	50.95	41.55	0.82	51.78	74.00	-22.22	42.37	54	-11.63
9609072000	65.00	175.00	57.27	49.16	0.56	57.83	74.00	-16.17	49.72	54	-4.28
14782650000	61.00	113.00	46.18	31.99	7.12	53.31	74.00	-20.69	39.11	54	-14.89
17420050000	273.00	179.00	42.39	28.99	9.17	51.56	74.00	-22.44	38.16	54	-15.84
Final = Raw + Path Loss											
Margin = Final - Limit											


Compliance Testing
Horizontal
Avg Limit
Pk Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
Amplitude dBuV
18.00G
26.00G
Frequency MHz

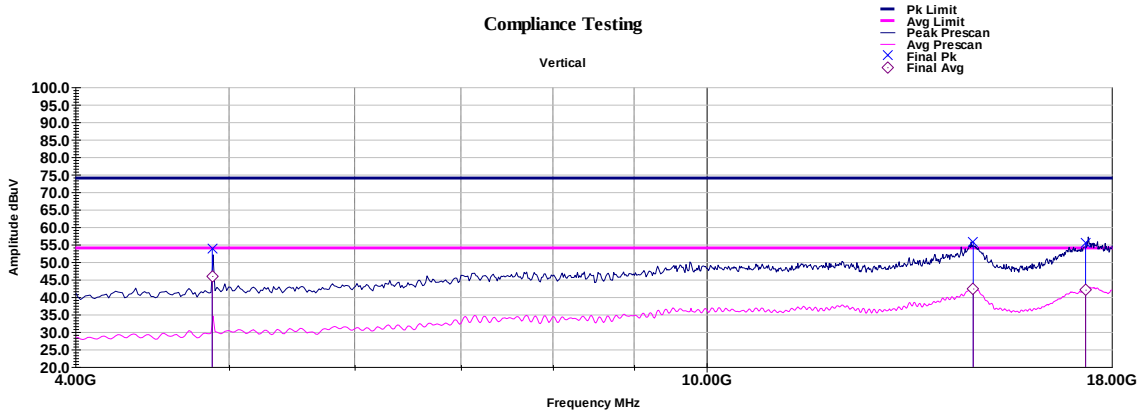

Compliance Testing
Vertical
Pk Limit
Avg Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
Amplitude dBuV
18.00G
26.00G
Frequency MHz

Mid Channel

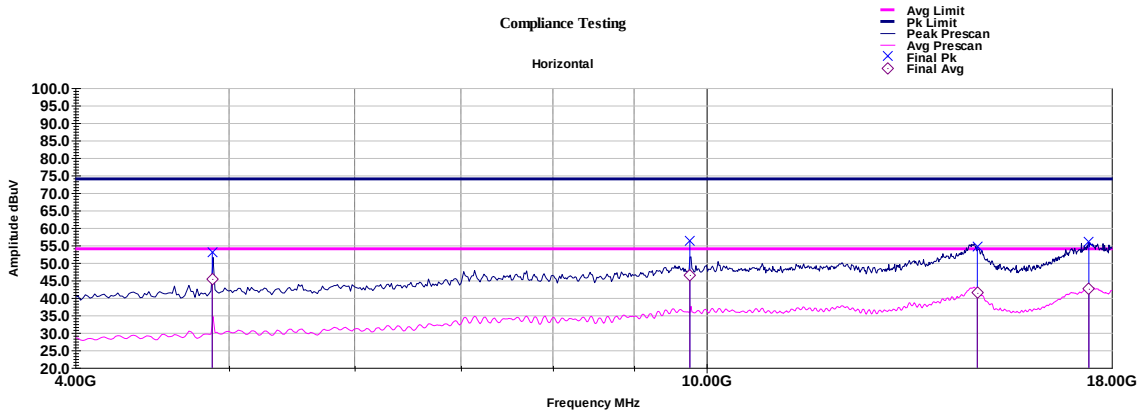

Compliance Testing
Horizontal
Avg Limit
Pk Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
Amplitude dBuV
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
1.00G
4.00G
Frequency MHz


Compliance Testing
Vertical
Pk Limit
Avg Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
Amplitude dBuV
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
1.00G
4.00G
Frequency MHz

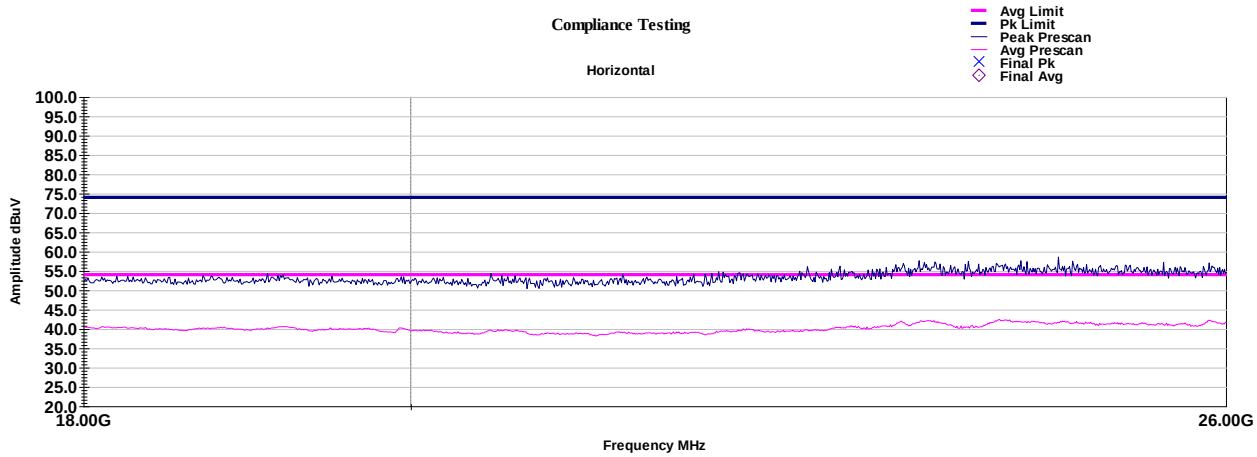
Mid Channel_4 - 18 GHz

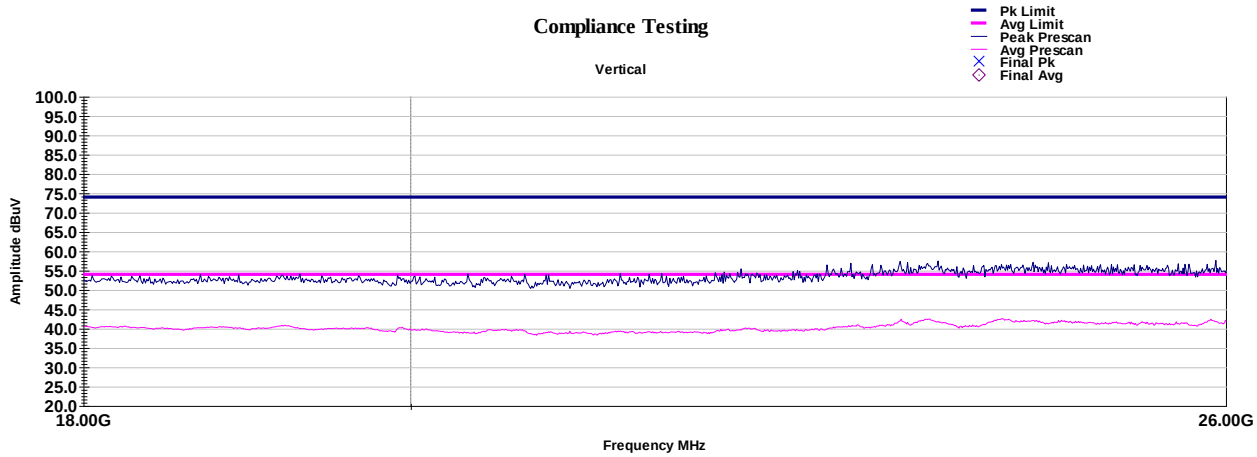


Frequency	Azimuth	Height	Raw Pk	Raw Avg	Correction	Final Pk	Pk Limit	Pk Margin	Final Avg	Avg Limit	Avg Margin
Hz	deg	cm	dBuV	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
4879594000	89.00	230.00	57.33	49.42	-6.38	53.90	74.00	-20.11	45.98	54	-8.02
14723780000	200.00	395.00	45.75	32.45	7.53	55.71	74.00	-18.29	42.40	54	-11.60
17330710000	137.00	148.00	42.78	29.48	8.56	55.35	74.00	-18.65	42.05	54	-11.95
Final = Raw + Path Loss											
Margin = Final - Limit											

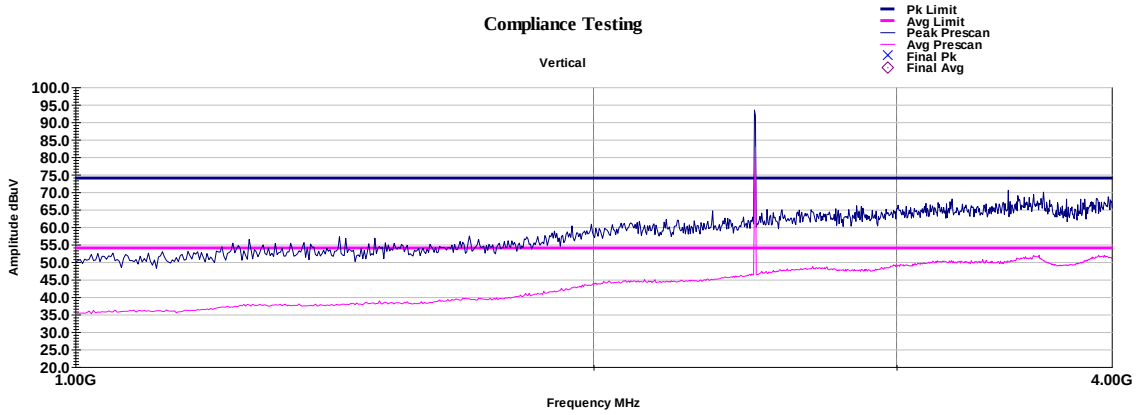


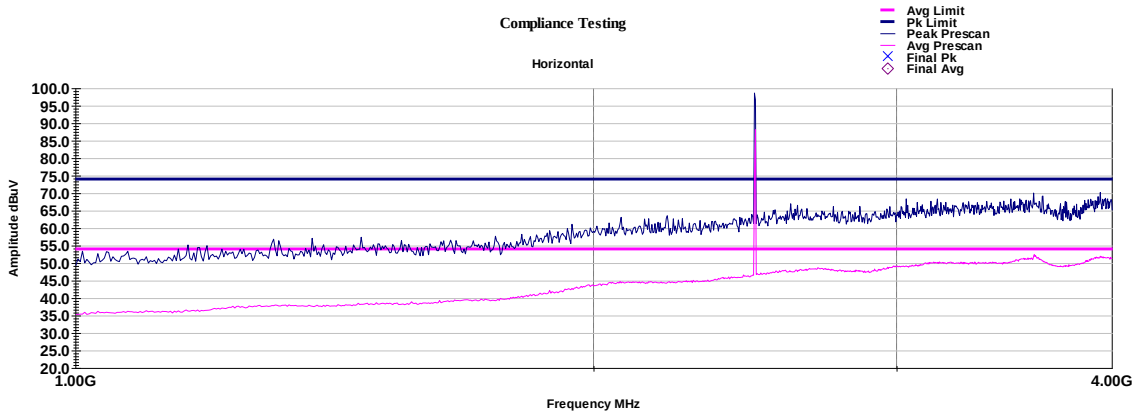
Frequency	Azimuth	Height	Raw Pk	Raw Avg	Correction	Final Pk	Pk Limit	Pk Margin	Final Avg	Avg Limit	Avg Margin
Hz	deg	cm	dBuV	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
4879587000	233.00	105.00	56.55	48.83	-6.38	53.11	74.00	-20.89	45.40	54	-8.60
9759062000	89.00	183.00	53.14	43.37	0.60	56.27	74.00	-17.73	46.51	54	-7.49
14810520000	179.00	152.00	45.32	32.16	6.82	54.54	74.00	-19.46	41.38	54	-12.62
17414310000	315.00	100.00	42.85	29.49	9.14	55.95	74.00	-18.06	42.58	54	-11.42
Final = Raw + Path Loss											
Margin = Final - Limit											


Compliance Testing
Horizontal
Avg Limit
Pk Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
Amplitude dBuV
18.00G
26.00G
Frequency MHz


Compliance Testing
Vertical
Pk Limit
Avg Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
Amplitude dBuV
18.00G
26.00G
Frequency MHz

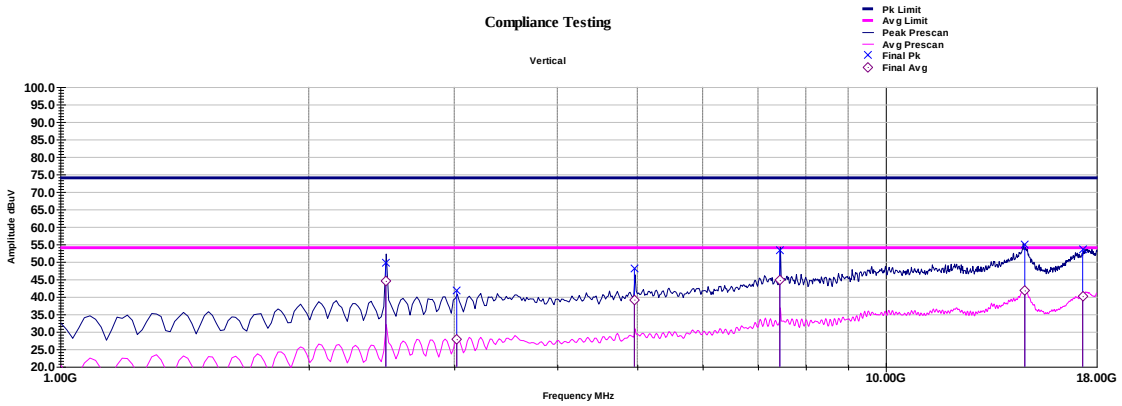
High Channel_1 - 4 GHz



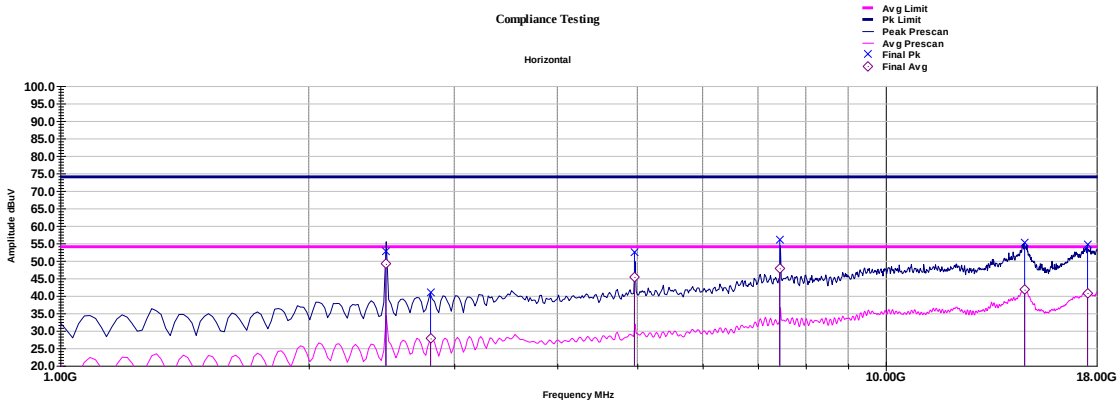


High Channel_4 - 18 GHz

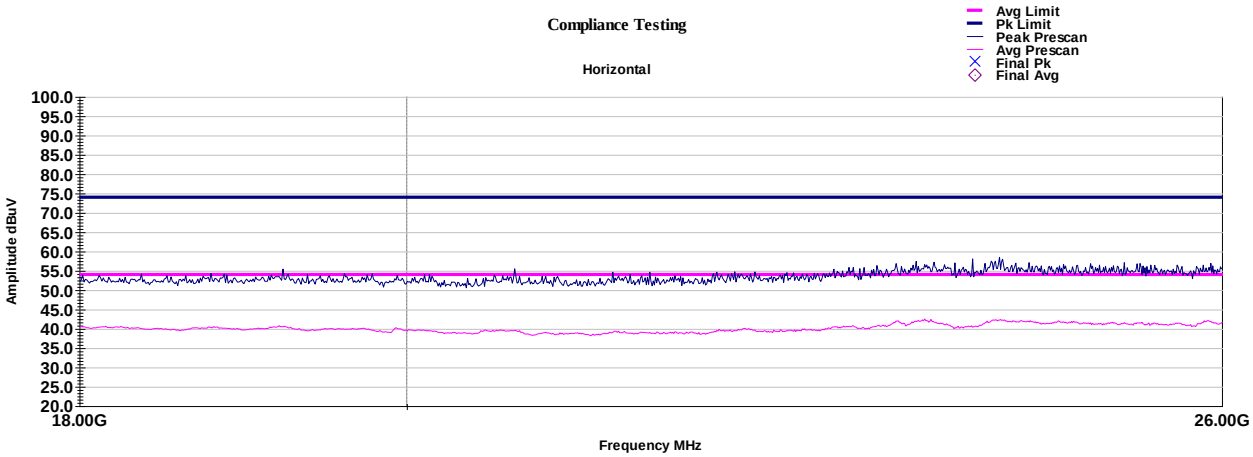
Results below 4 GHz on this and the following page are attenuated via a filter and are for reference only.

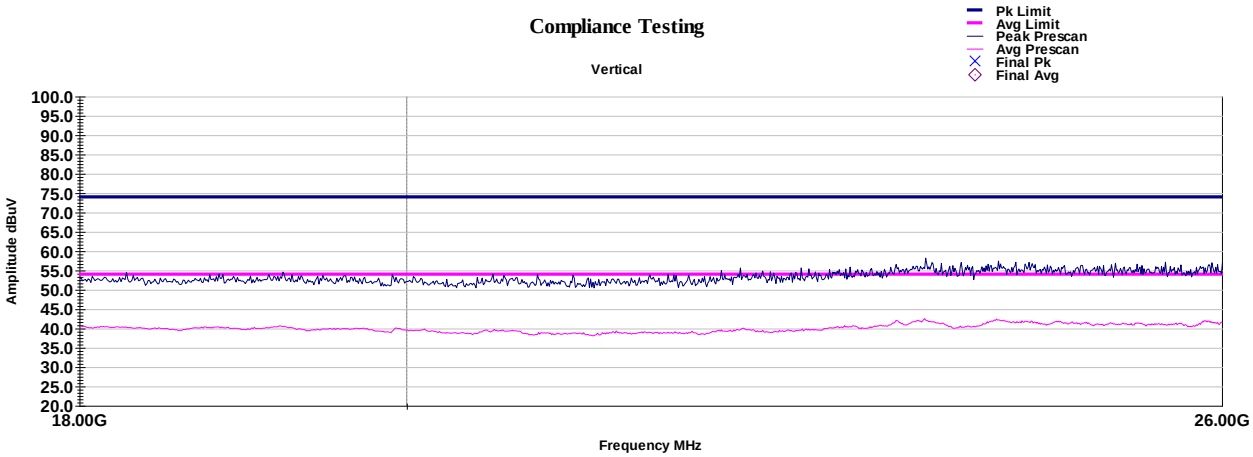


Frequency	Azimuth	Height	Raw Pk	Raw Avg	Correction	Final Pk	Pk Limit	Pk Margin	Final Avg	Avg Limit	Avg Margin
Hz	deg	cm	dBuV	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
2479719000	204.00	325.00	61.03	55.90	-11.39	49.64	74.00	-24.36	44.51	54	-9.49
3021778000	8.00	389.00	51.47	37.57	-9.71	41.76	74.00	-32.24	27.86	54	-26.14
4959441000	203.00	325.00	54.57	45.52	-6.38	48.19	74.00	-25.81	39.15	54	-14.85
7440733000	320.00	325.00	53.52	45.05	-0.30	53.22	74.00	-20.78	44.76	54	-9.24
14734250000	231.00	100.00	47.49	34.31	7.48	54.97	74.00	-19.03	41.80	54	-12.20
17315710000	208.00	389.00	45.08	31.70	8.46	53.53	74.00	-20.47	40.16	54	-13.84
Final = Raw + Path Loss											
Margin = Final - Limit											



Frequency	Azimuth	Height	Raw Pk	Raw Avg	Correction	Final Pk	Pk Limit	Pk Margin	Final Avg	Avg Limit	Avg Margin
Hz	deg	cm	dBuV	dBuV	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
2479849513	138.00	325.00	64.15	60.48	-11.39	52.76	74.00	-21.24	49.09	54	-4.91
2809313000	24.00	400.00	51.21	37.98	-10.21	41.00	74.00	-33.00	27.77	54	-26.23
4960585000	112.00	192.00	58.95	51.70	-6.37	52.58	74.00	-21.42	45.34	54	-8.67
7439237000	358.00	226.00	56.28	48.14	-0.29	55.98	74.00	-18.02	47.85	54	-6.15
14727020000	204.00	121.00	47.69	34.21	7.51	55.20	74.00	-18.80	41.72	54	-12.28
17549680000	359.00	136.00	45.37	31.37	9.40	54.76	74.00	-19.24	40.77	54	-13.23
Final = Raw + Path Loss											
Margin = Final - Limit											


Compliance Testing
Horizontal
Avg Limit
Pk Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
Amplitude dBuV
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
18.00G
26.00G
Frequency MHz


Compliance Testing
Vertical
Pk Limit
Avg Limit
Peak Prescan
Avg Prescan
Final Pk
Final Avg
Amplitude dBuV
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
18.00G
26.00G
Frequency MHz

Conducted RF Measurements (15.247)

Engineer: John Michalowicz

Test Date: 11/3/24

Test Procedure

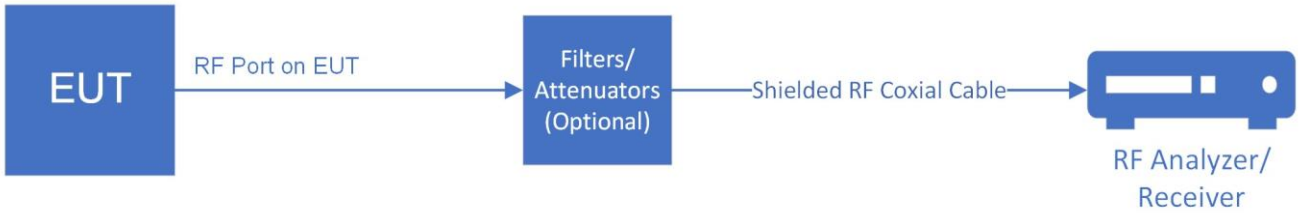
Antenna-port conducted measurements were performed as an alternative to radiated measurements for demonstrating compliance for 15.247(d)

Spectrum Analyzer settings were as follows:

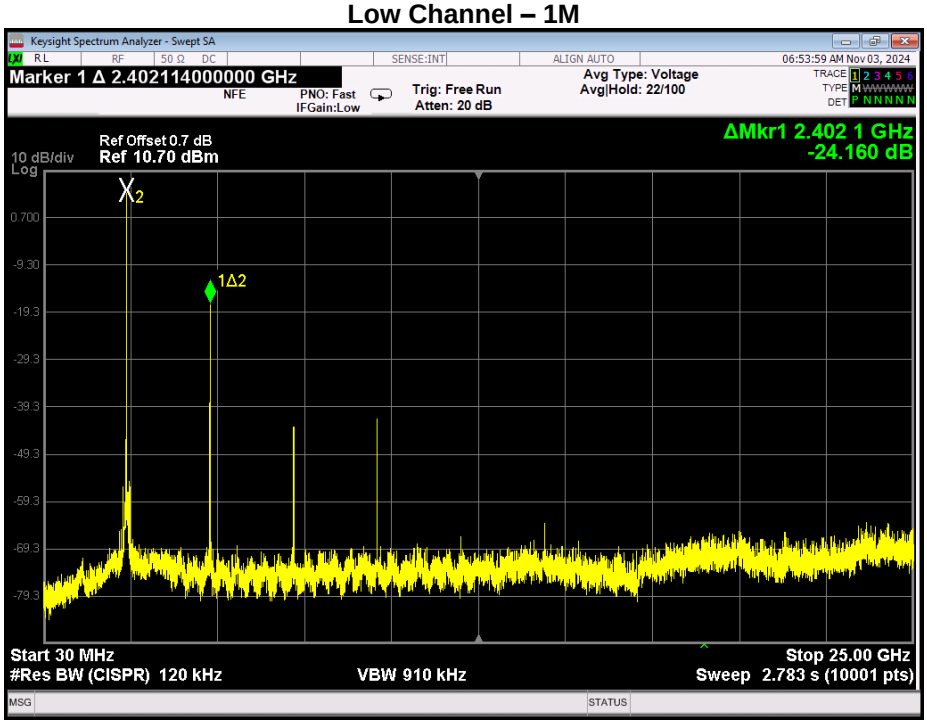
a. RBW = 100 kHz
b. VBW ≥ 300 kHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was investigated. required range were evaluated.

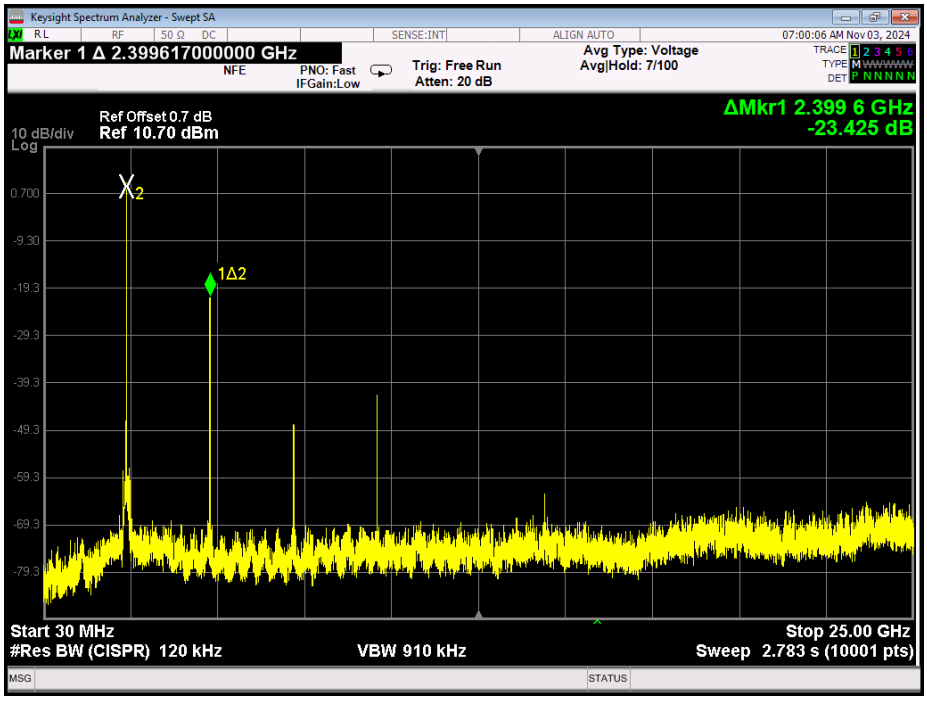
Basic Test Setup



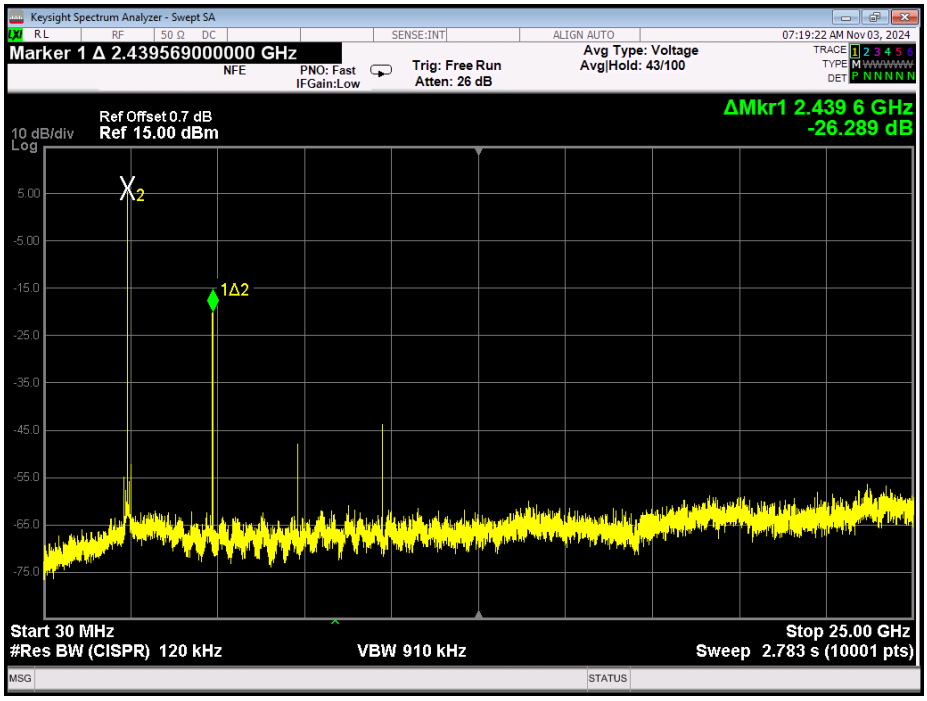
Low Channel – 1M



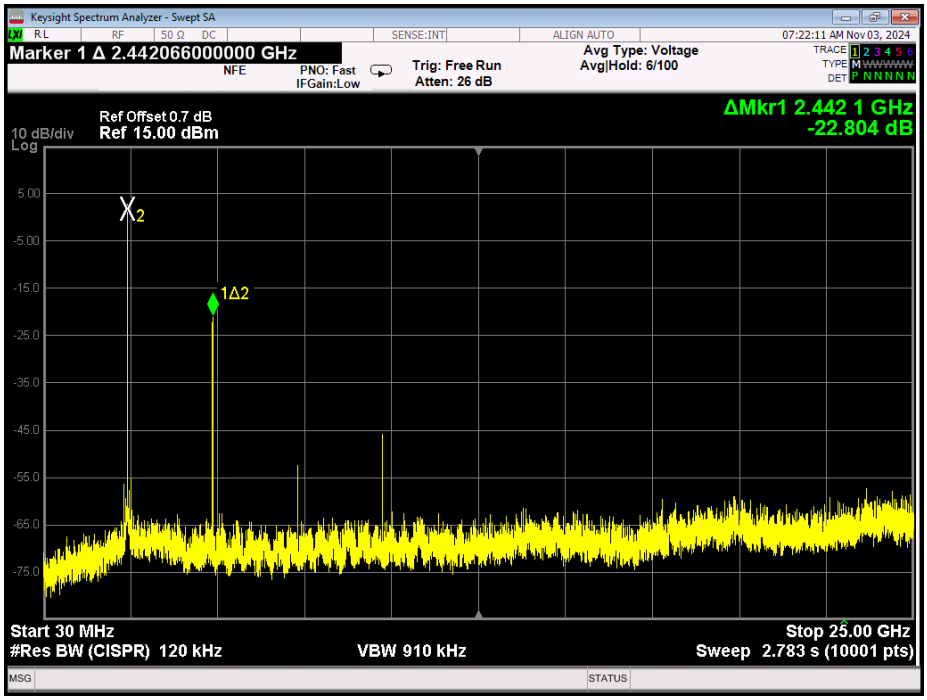
Low Channel – 2M



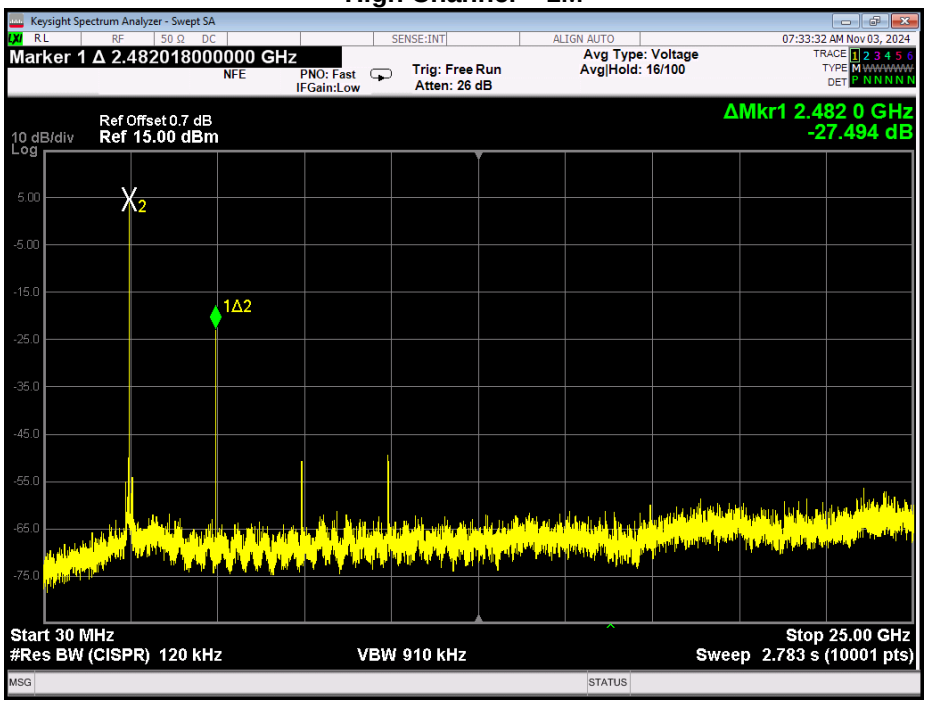
Mid Channel – 1M



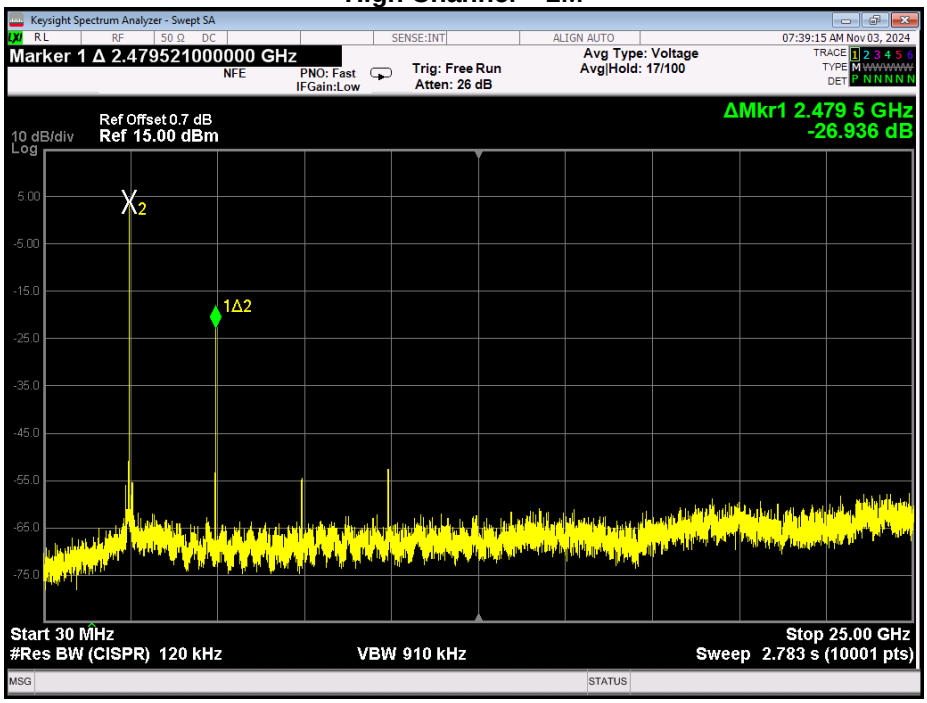
Mid Channel – 2M



High Channel – 1M



High Channel – 2M



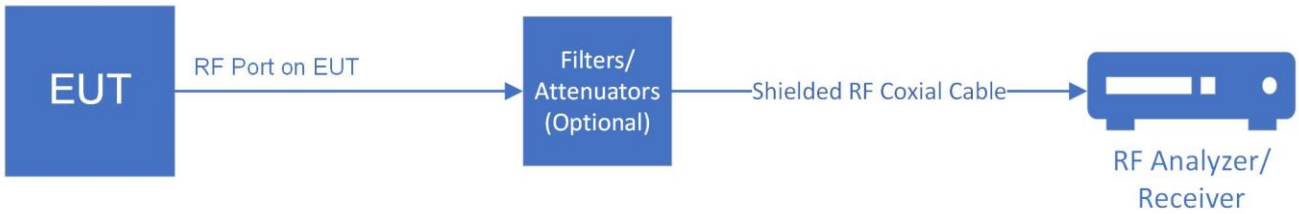
Emissions at Band Edges

Engineer: John Michalowicz
Test Date: 11/3/24

Test Procedure

CONDUCTED METHOD
A spectrum analyzer was directly connected to the EUT's RF port. The EUT was set to transmit on the lowest an highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for band edges.

Test Setup

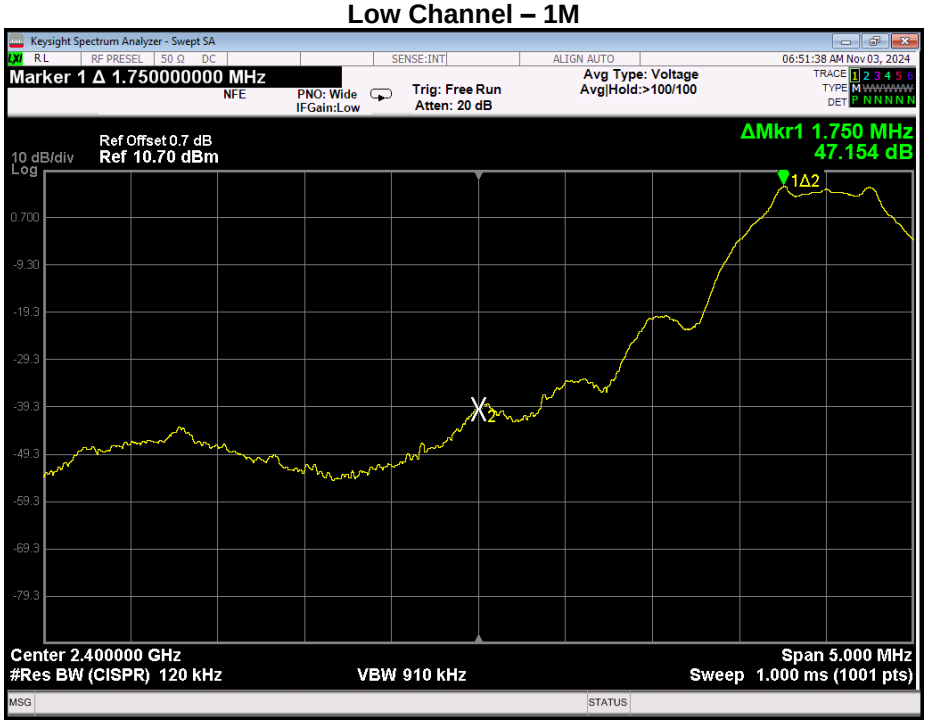


Band Edge Emissions Summary

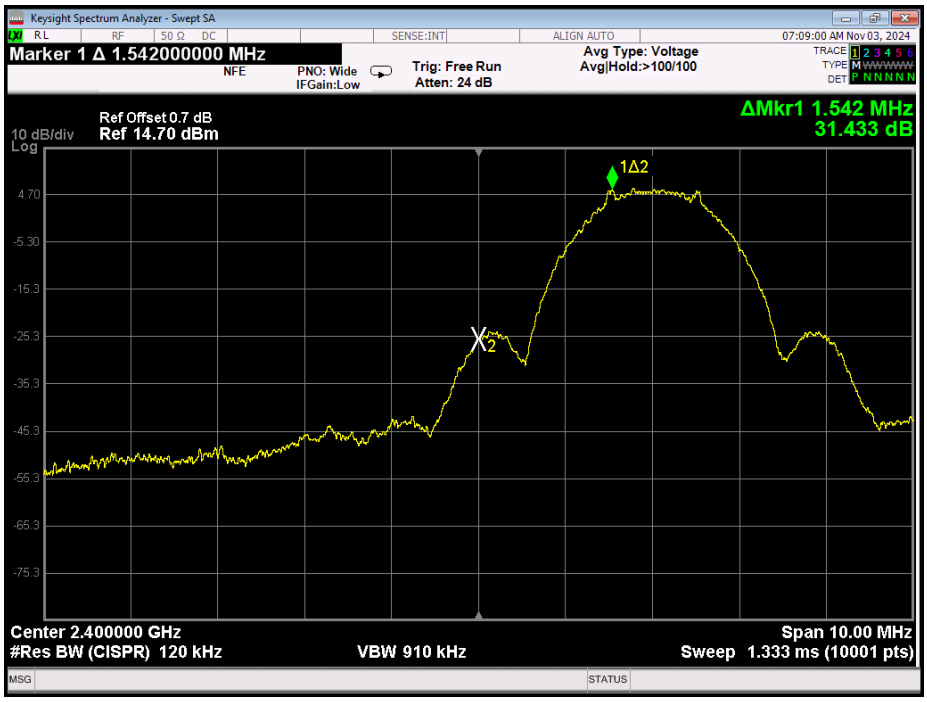
Tuned Frequency (MHz)	Mode	Emission Frequency (MHz)	Monitored Level	Detector	Limit	Result
2402	1M	2400	-47.2	Peak	-20 dBc	Pass
2402	2M	2400	-31.4	Peak	-20 dBc	Pass
2480	1M	2483.5	-60.8	Peak	-20 dBc	Pass
2480	2M	2483.5	-59.5	Peak	-20 dBc	Pass

Band Edge Plots

Low Channel – 1M



Low Channel – 2M



High Channel – 1M

High Channel – 2M

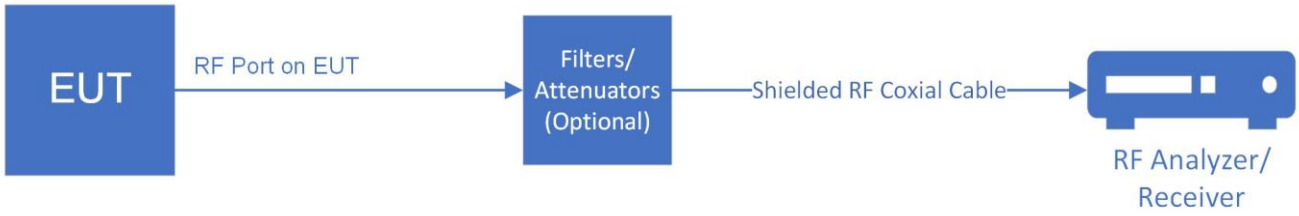
DTS Bandwidth

Engineer: John Michalowicz
Test Date: 11/3/24

Test Procedure

CONDUCTED METHOD
A spectrum analyzer was directly connected to the EUT's RF port. The EUT was set to transmit on the low, mid and high frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the Bandwidth requirements.

Test Setup



The Spectrum Analyzer was set to the following:
RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

6 dB Occupied Bandwidth Summary

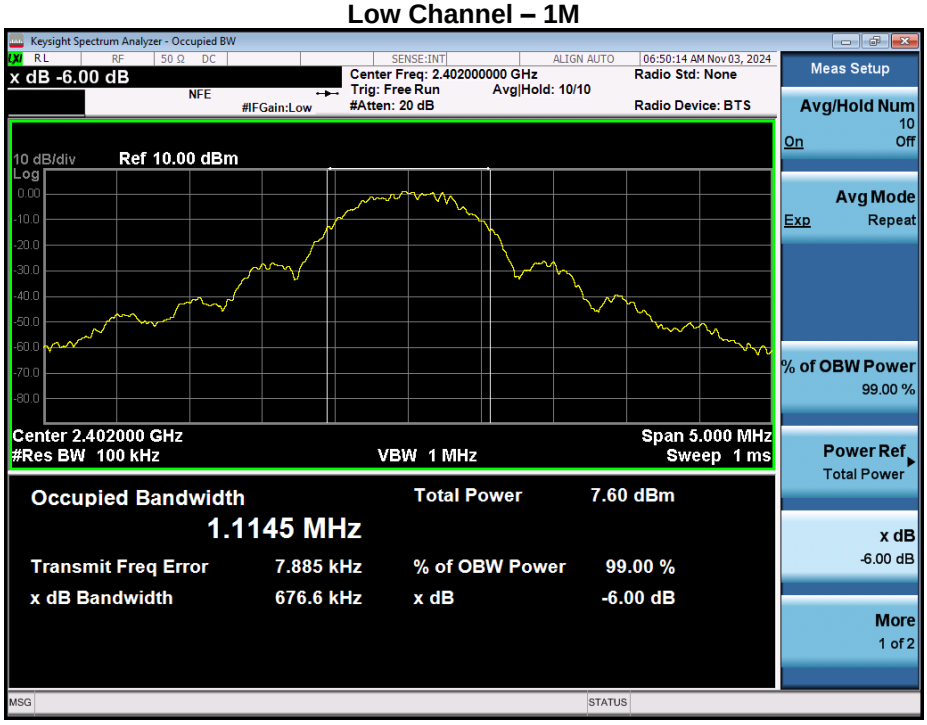
Frequency (MHz)	Mode of Operation	Measured Bandwidth (kHz)	Specification Limit (kHz)	Result
2402	1M	676.6	≥ 500	Pass
	2M	1325	≥ 500	Pass
2440	1M	694	≥ 500	Pass
	2M	1362	≥ 500	Pass
2480	1M	648.2	≥ 500	Pass
	2M	1070	≥ 500	Pass

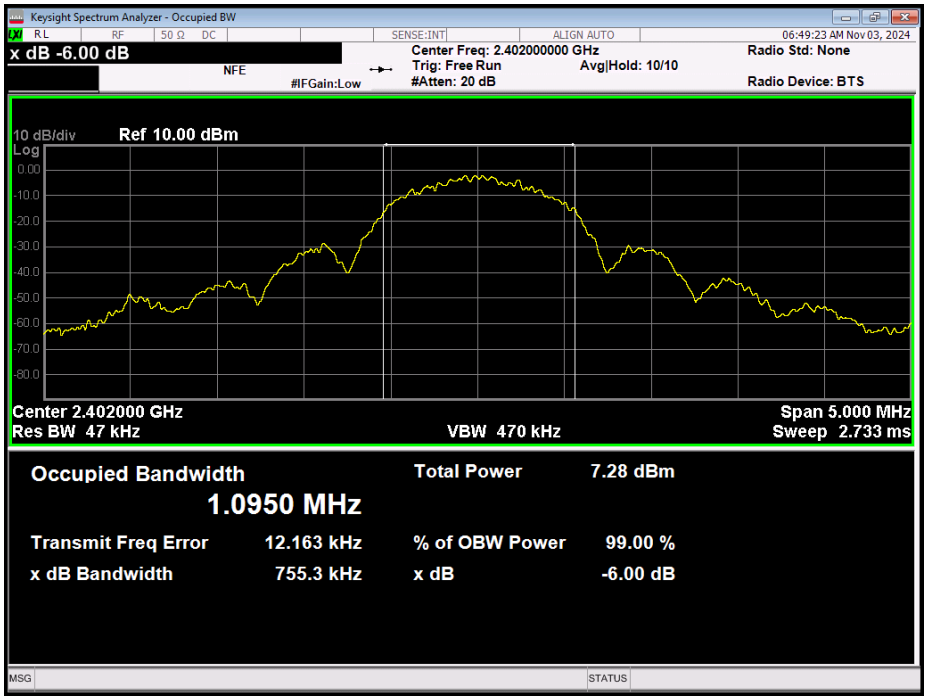
99% Bandwidth Summary

Frequency (MHz)	Mode of Operation	Measured Bandwidth (kHz)	Result
2402	1M	1095	Pass
	2M	2092	Pass
2440	1M	1099	Pass
	2M	2073	Pass
2480	1M	1087	Pass
	2M	2087	Pass

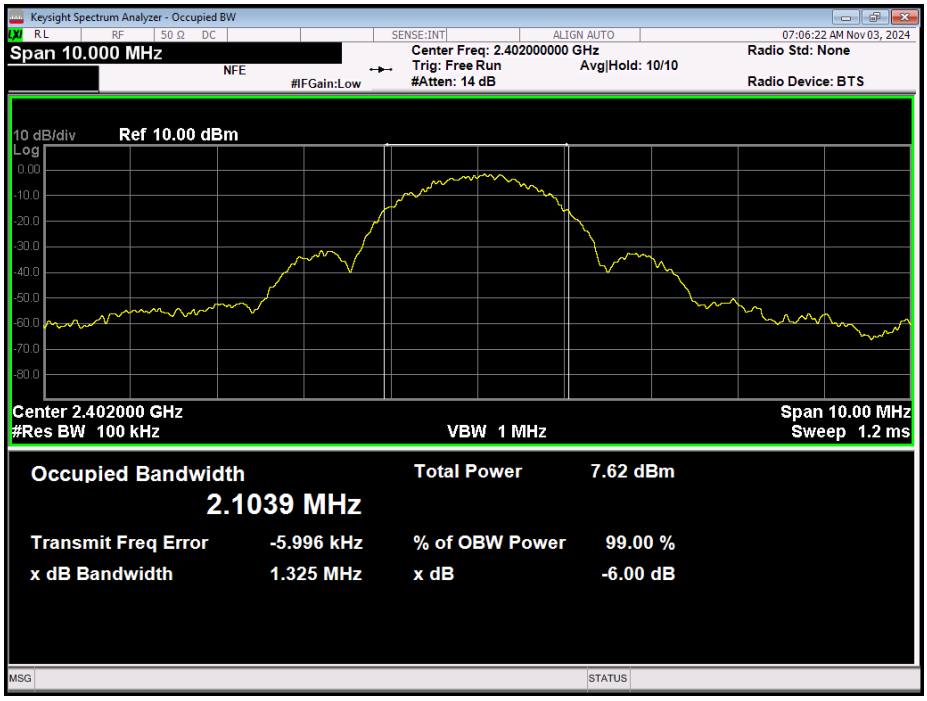
6 dB and 99% Bandwidth Plots

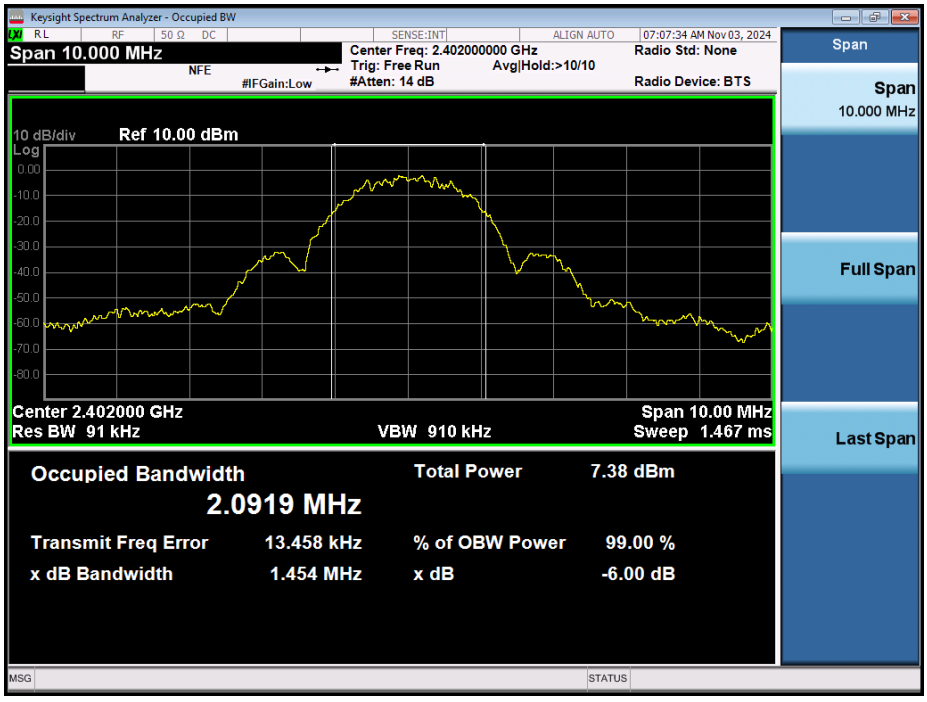
Low Channel – 1M



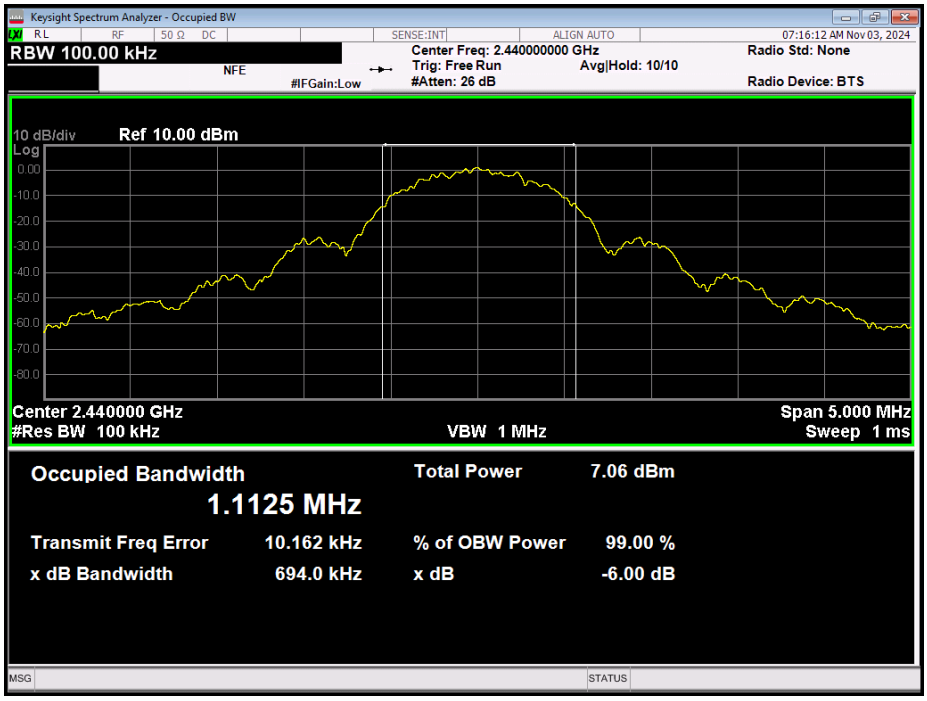


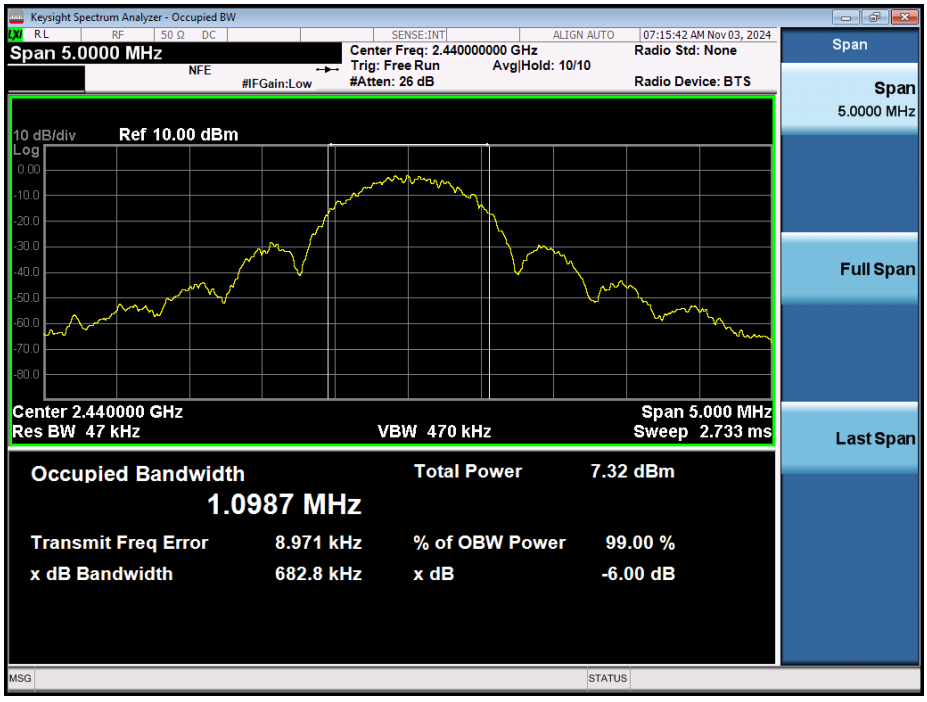
Low Channel – 2M



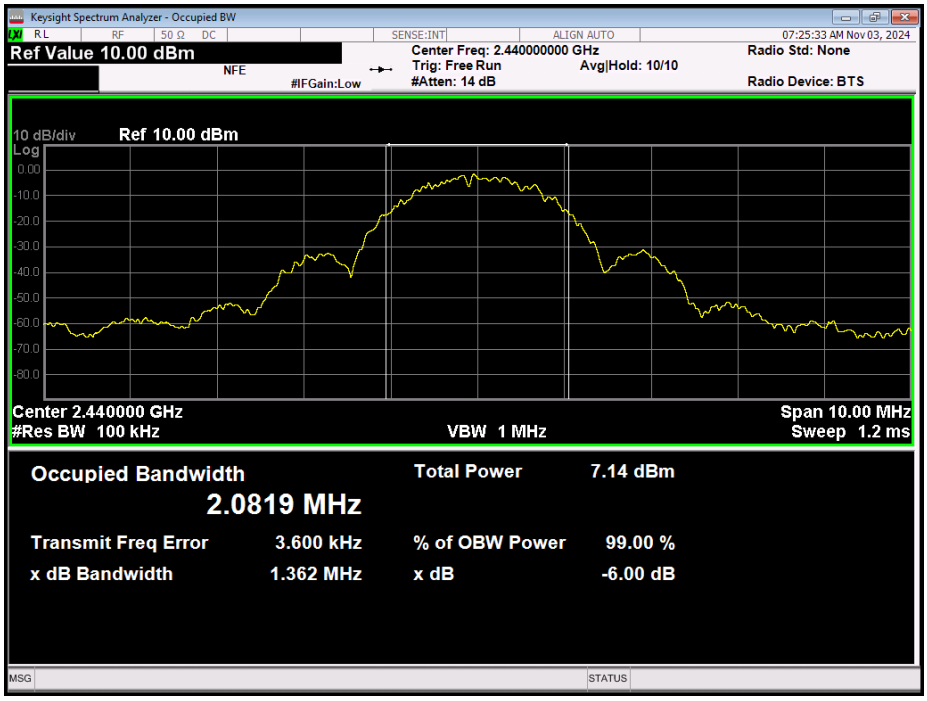


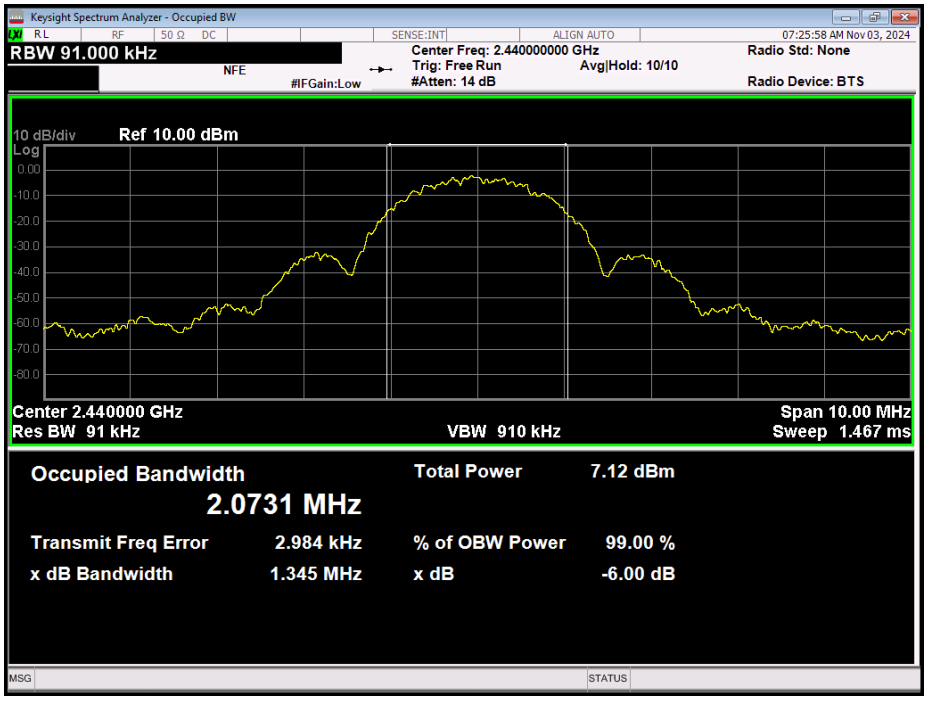
Mid Channel – 1M



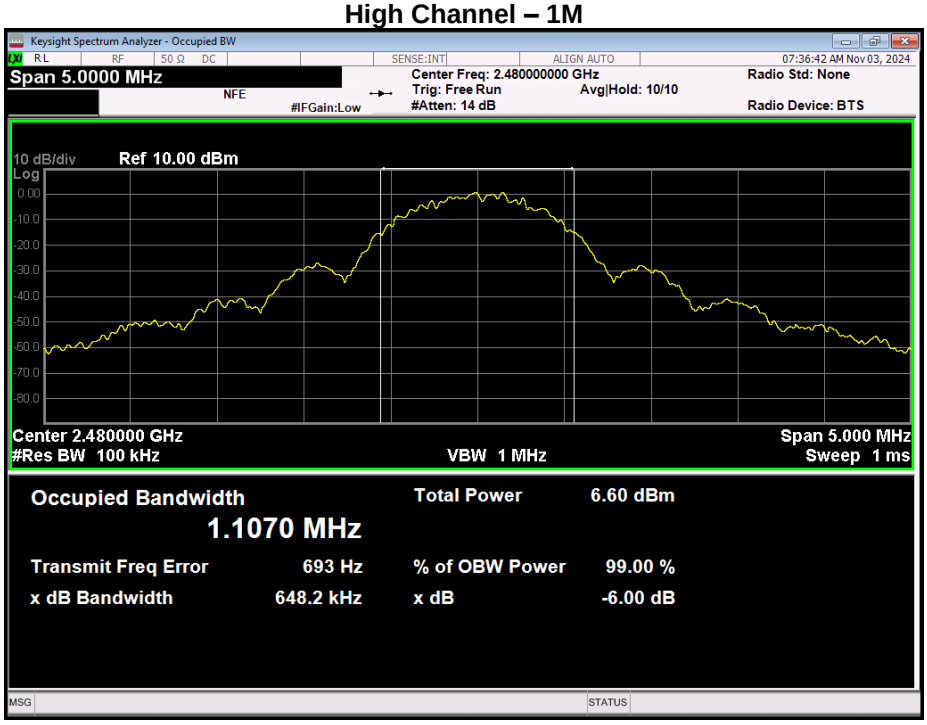


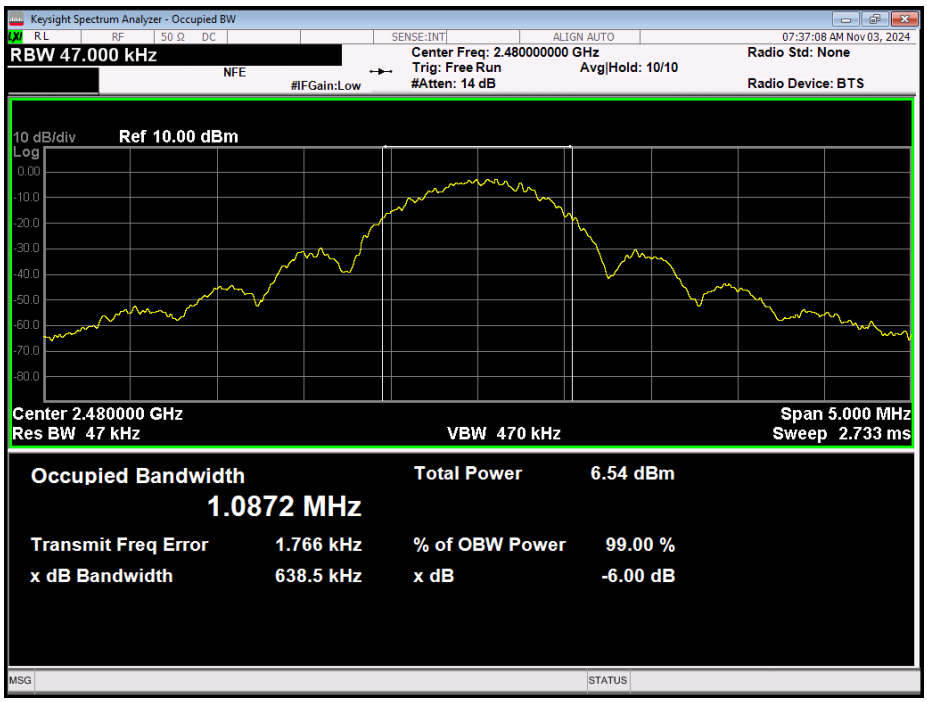
Mid Channel – 2M



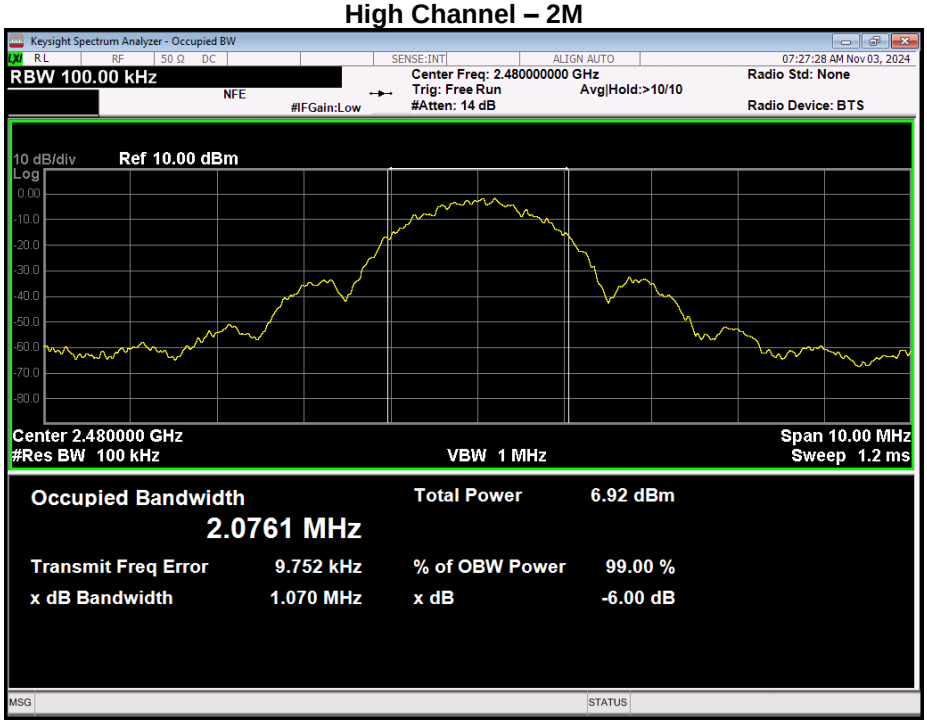


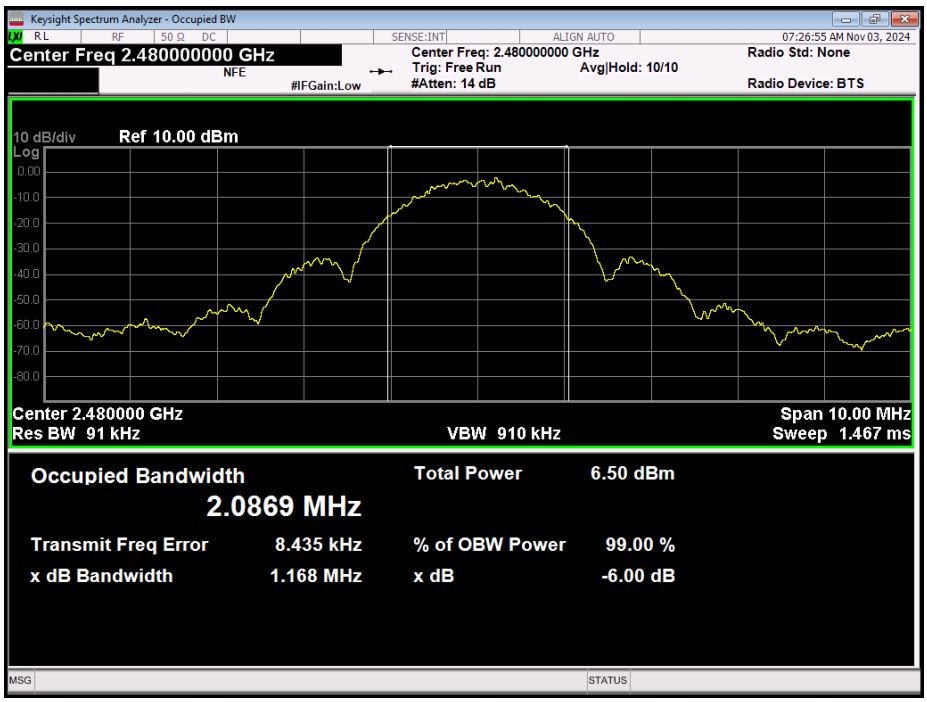
High Channel – 1M





High Channel – 2M





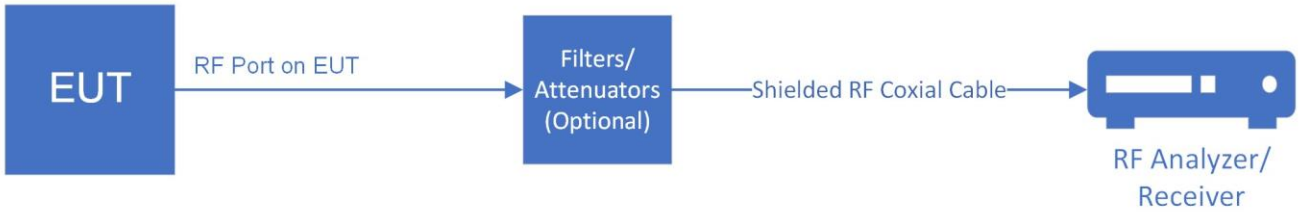
Transmitter Power Spectral Density (PSD)

Engineer: John Michalowicz
Test Date: 11/3/24

Test Procedure

CONDUCTED METHOD
A spectrum analyzer was directly connected to the EUT's RF port. The EUT was set to transmit on the lowest, middle and highest frequency of operation at the maximum power level. A spectrum analyzer was used to verify that the EUT met the power spectral density requirements.

Test Setup



The Spectrum Analyzer was set to the following:

DTS channel center frequency
Span 1.5 x DTS bandwidth
RBW =3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Sweep time = auto couple
Trace mode = max hold

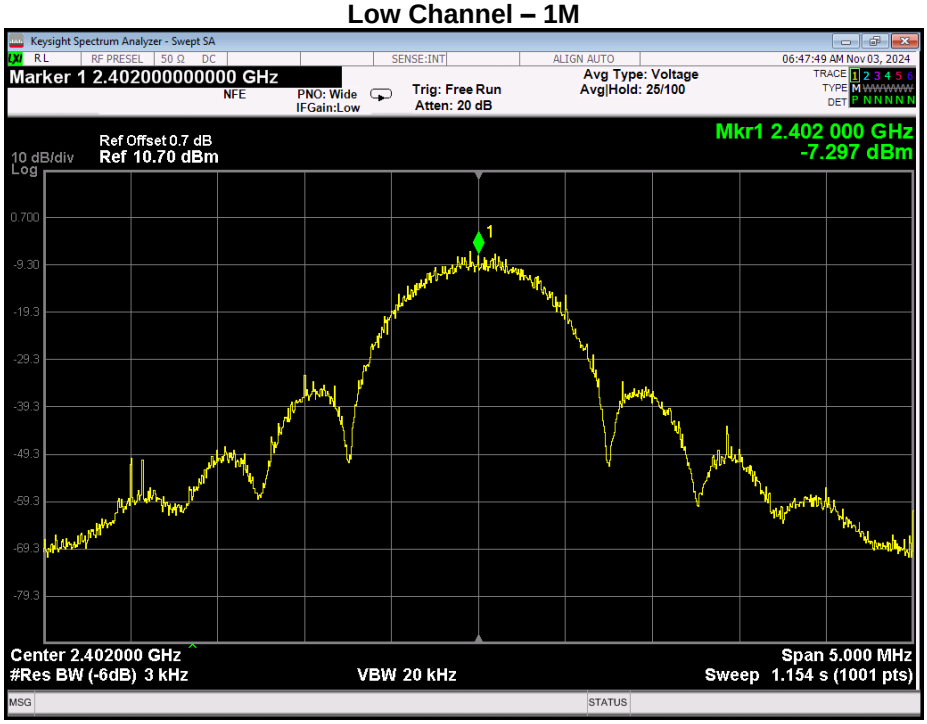
Once the trace has stabilized the peak marker was used to determine the power spectral density.

PSD Summary

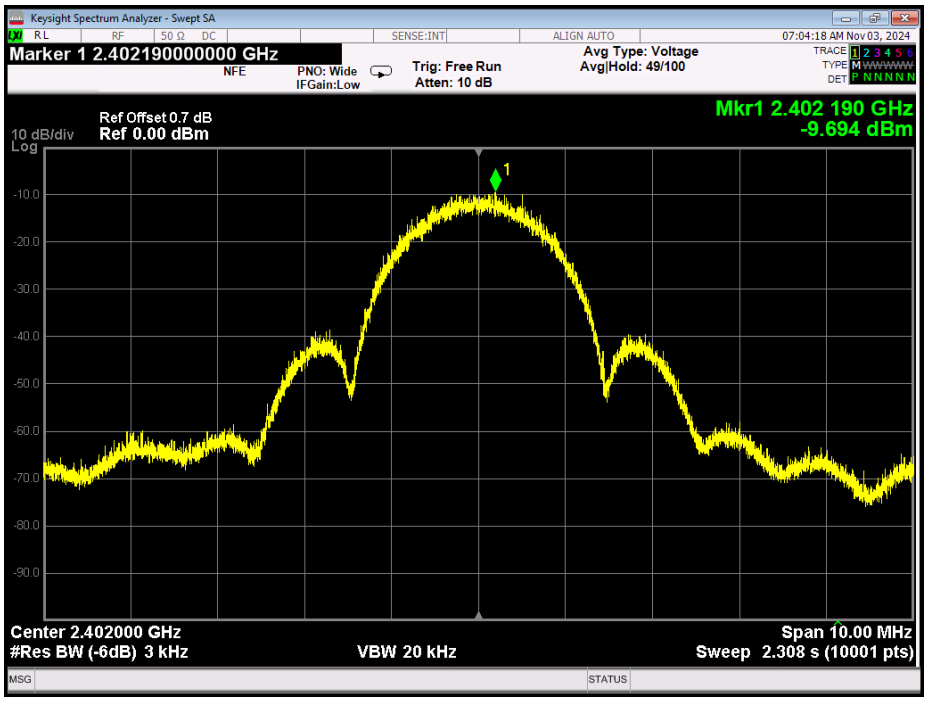
Frequency (MHz)	Mode of Operation	Measured Data (dBm)	Specification Limit (dBm)	Result
2402	1M	-7.29	8	Pass
	2M	-9.69	8	Pass
2440	1M	-5.70	8	Pass
	2M	-10.11	8	Pass
2480	1M	-6.22	8	Pass
	2M	-9.13	8	Pass

PSD Plots

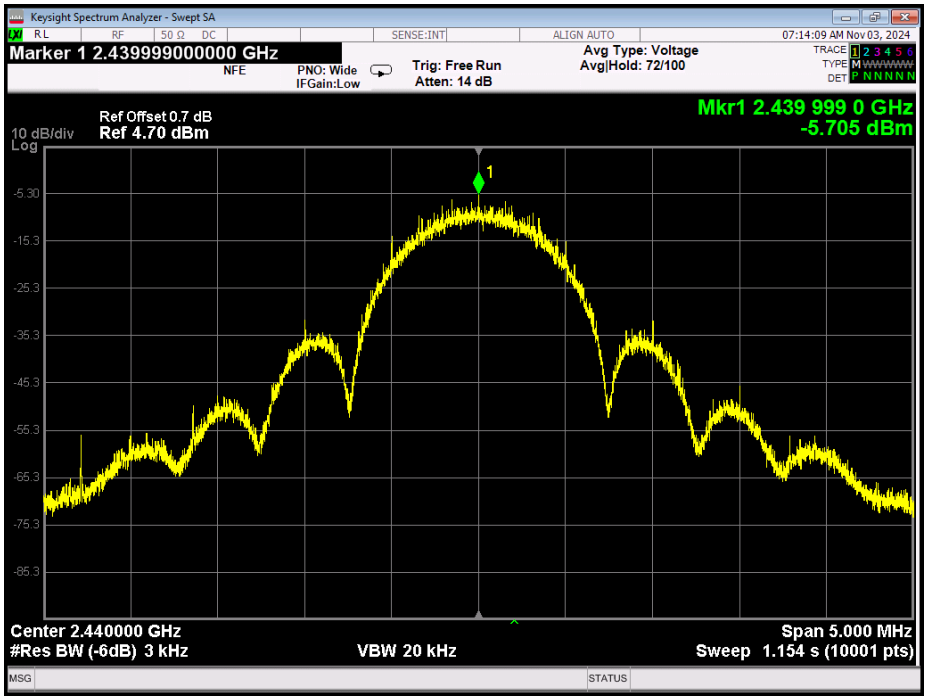
Low Channel – 1M



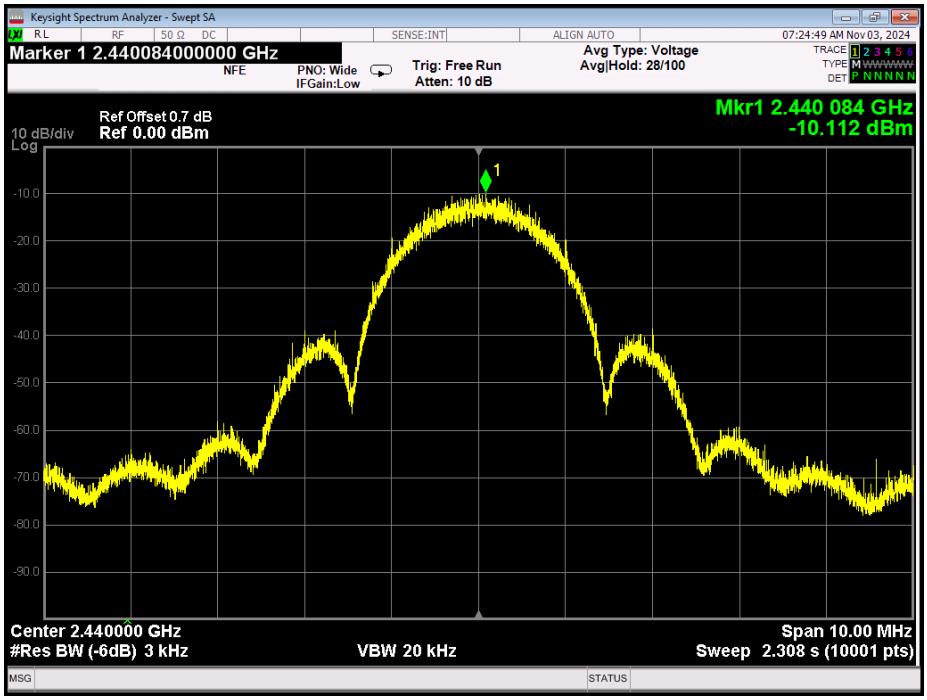
Low Channel – 2M



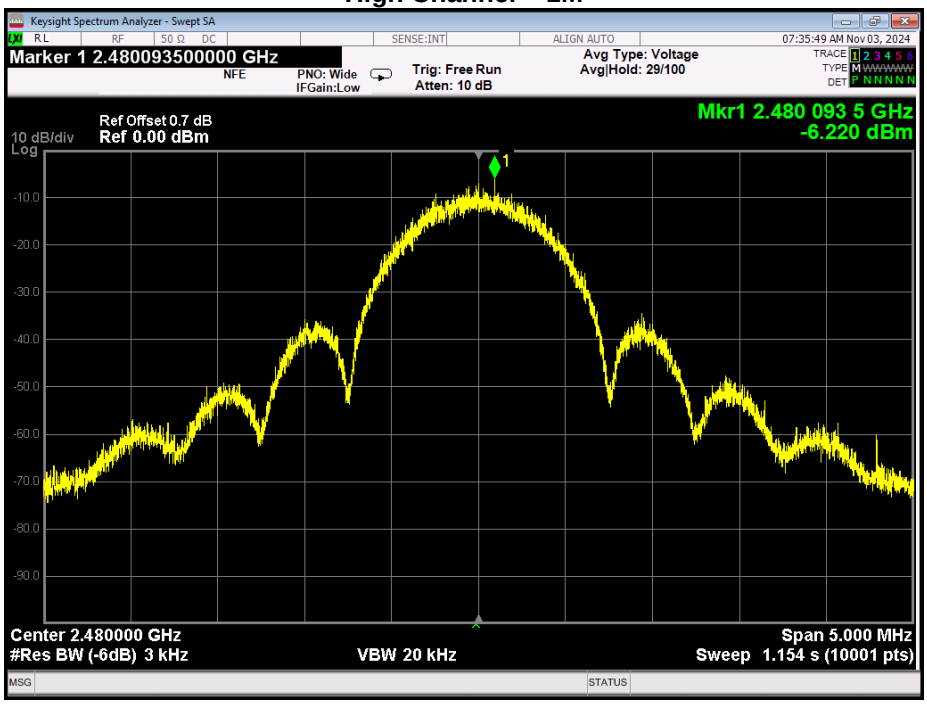
Mid Channel – 1M



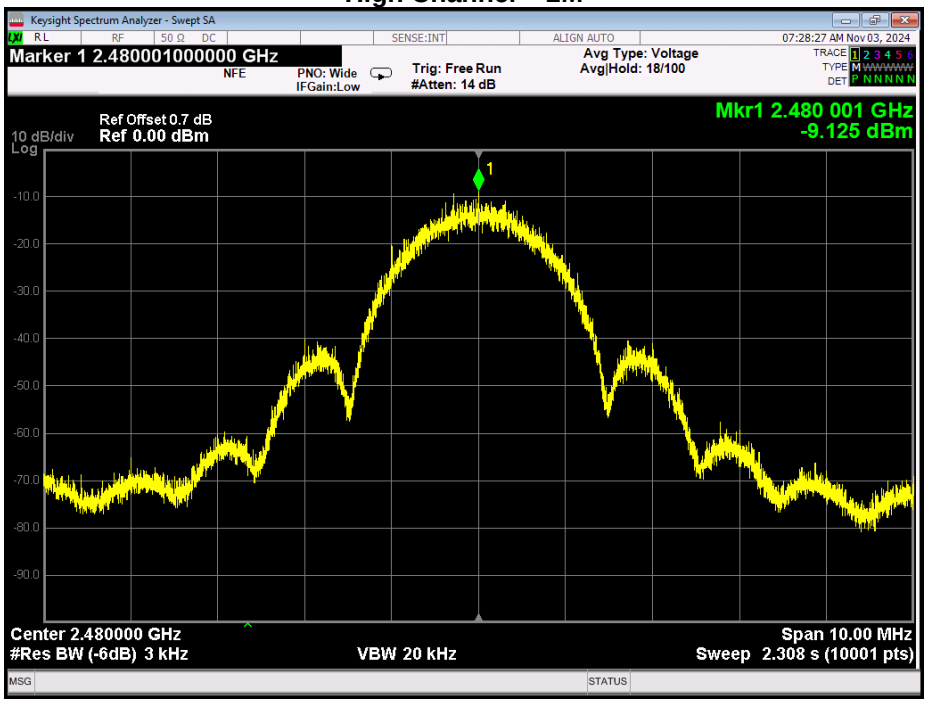
Mid Channel – 2M



High Channel – 1M



High Channel – 2M



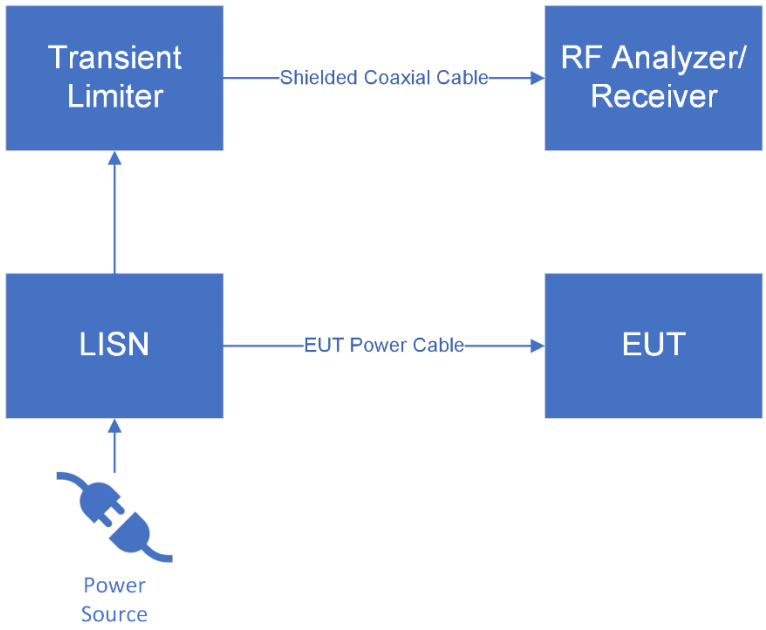
A/C Powerline Conducted Emissions

Engineer: John Michalowicz
Test Date: 11/11/24

Test Procedure

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Basic Test Setup



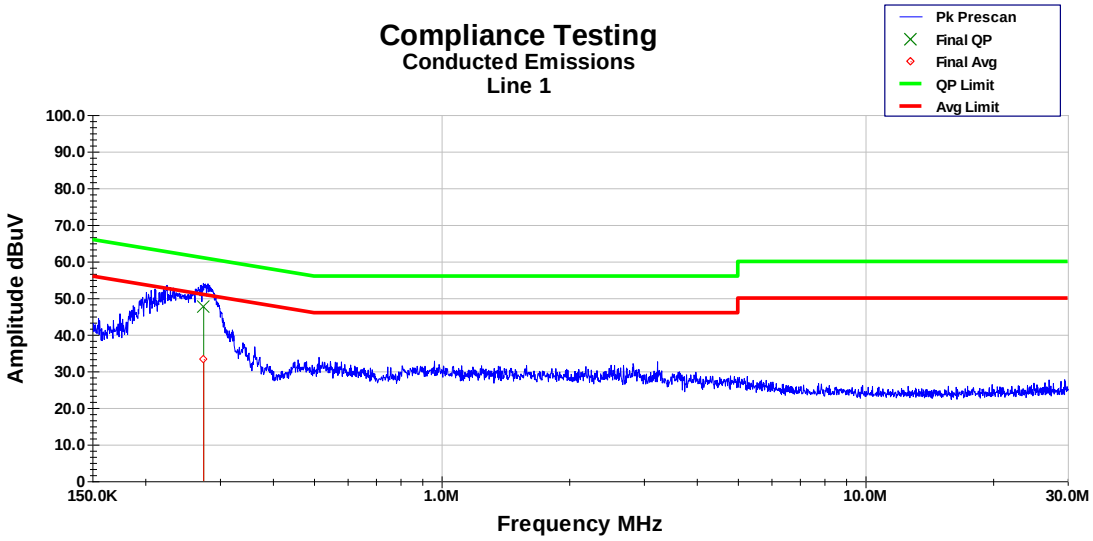
	Settings 150kHz-30MHz
RBW	9kHz
VBW	30kHz
Detector	QP/AV or PK

Sample Calculations

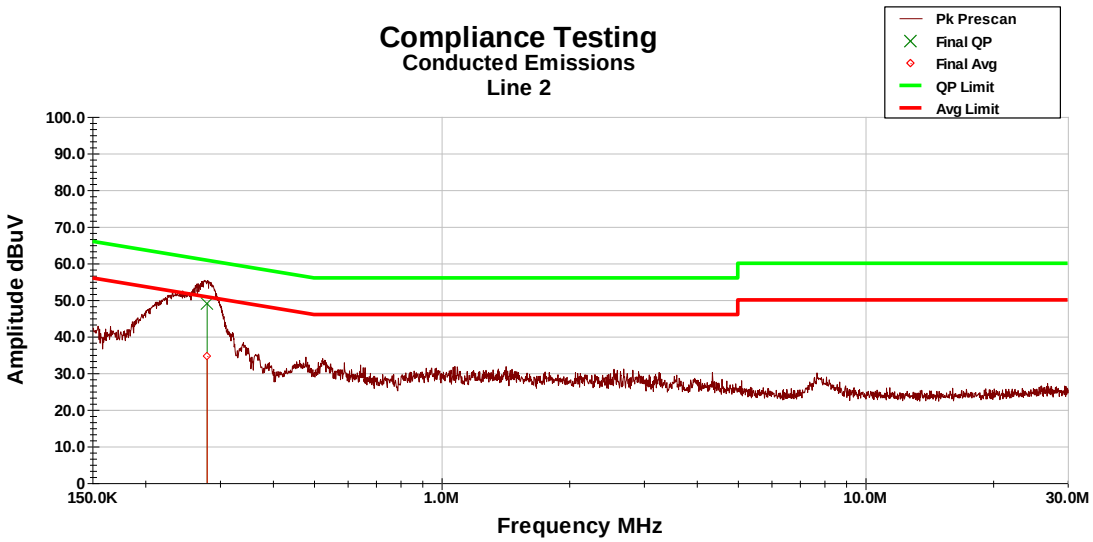
Corrected Value = Measured Value + Correction factor

Correction factor = Cable loss + Attenuator Factor

CE_120 VAC



Frequency	Raw QP	Raw Avg	Path Loss	Final QP	Final Avg	QP Limit	QP Margin	Avg Limit	Avg Margin
(MHz)	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dB	dBuV	dB
274.76 KHz	37.60	23.30	10.00	47.60	33.30	62.40	-14.80	52.40	-19.10
Final = Raw + Path Loss									
Margin = Final - Limit									



Frequency	Raw QP	Raw Avg	Path Loss	Final QP	Final Avg	QP Limit	QP Margin	Avg Limit	Avg Margin
(MHz)	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dB	dBuV	dB
280.04 KHz	39.06	24.70	10.00	49.00	34.70	62.30	-13.20	52.30	-17.60
Final = Raw + Path Loss									
Margin = Final - Limit									

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	Hewlett Packard	85462A	i00033	6/25/24	6/25/25
Bilog Antenna 0.030-1.0GHz	Schaffner	CBL6111C	i00349	02/07/23	02/06/25
LISN	COM-Power	LI-125A	i00446	3/18/24	3/18/26
LISN	COM-Power	LI-125A	i00448	3/18/24	3/18/26
ultra wideband LNA 10MHz-45GHz	RF-Lambda USA	RLNA00M45GA	i00555	02/19/24	02/19/25
9kHz-44GHz CISPR comp. receiver	Keysight	N9038A	i00552	03/01/24	03/01/25
Preamplifier	COM-Power	PAM-103	i00734	Verified on: 6/27/24	
1-18GHz Horn Antenna	Antenna Research Assoc	DRG-118/A	i00271	08/09/24	08/09/26
MXE EMI receiver	Keysight	N9038A	i00552	3/1/24	3/1/25
temperature/humidity/pressure probe	Omega Engineering, Inc.	iBTHX-W-5	i00629	01/25/23	01/24/25

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.

Measurement Uncertainty

Measurement Uncertainty for Compliance Testing is listed in the table below.

Measurement	U_{lab}
Radio Frequency	± 3.3 x 10^{-8}
RF Power, conducted	± 1.5 dB
RF Power Density, conducted	± 1.0 dB
Conducted Emissions	± 1.8 dB
Radiated Emissions 9kHz-30MHz	± 3.6 dB
Radiated Emissions 30MHz-1000MHz	± 4.25 dB
Radiated Emissions – 1GHz-18GHz	± 4.5 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_{EMC} 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.

END OF TEST REPORT