TEST REPORT

Reference No.	:	WTX23X10231915W002
FCC ID	:	JFZTWX7L
Applicant	:	Audio-Technica Corporation
Address	:	2-46-1 Nishi-naruse, Machida, Tokyo 194-8666, Japan
Manufacturer	:	The same as Applicant
Address	:	The same as Applicant
Product Name	:	Wireless Headphones
Model No.	:	ATH-TWX7L
Standards	:	47 CFR Part 15 Subpart C
Date of Receipt sample	:	2023-10-30
Date of Test	:	2023-10-30 to 2023-11-01
Date of Issue	:	2023-11-01
Test Report Form No.	:	WTX_Part 15_247W
Test Result	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of approver.

Prepared By:

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TABLE OF CONTENTS

1. GENERAL INFORMATION 5
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 5
1.2 TEST STANDARDS 6
1.3 TEST METHODOLOGY 6
1.4 TEST FACILITY 6
1.5 EUT SETUP AND TEST MODE 7
1.6 MEASUREMENT UNCERTAINTY 8
1.7 TEST EQUIPMENT LIST AND DETAILS 9
2. SUMMARY OF TEST RESULTS 12
3. ANTENNA REQUIREMENT 13
3.1 STANDARD APPLICABLE 13
3.2 EVALUATION INFORMATION 13
4. DUTY CYCLE OF TEST SIGNAL 14
4.1 REQUIREMENT 14
4.2 SUMMARY OF TEST RESULTS/PLOTS 14
5. POWER SPECTRAL DENSITY 15
5.1 STANDARD APPLICABLE 15
5.2 TEST SETUP BLOCK DIAGRAM 15
5.3 TEST PROCEDURE 15
5.4 SUMMARY OF TEST RESULTS/PLOTS 15
6. DTS BANDWIDTH 16
6.1 STANDARD APPLICABLE 16
6.2 TEST SETUP BLOCK DIAGRAM 16
6.3 TEST PROCEDURE 16
6.4 SUMMARY OF TEST RESULTS/PLOTS 16
7. RF OUTPUT POWER 17
7.1 STANDARD APPLICABLE 17
7.2 TEST SETUP BLOCK DIAGRAM 17
7.3 TEST PROCEDURE 17
7.4 SUMMARY OF TEST RESULTS/PLOTS 17
7. FIELD STRENGTH OF SPURIOUS EMISSIONS 18
8.1 STANDARD APPLICABLE 18
8.2 TEST PROCEDURE 18
8.3 CORRECTED AMPLITUDE & MARGIN CALCULATION 20
8.4 SUMMARY OF TEST RESULTS/PLOTS 20
9. OUT OF BAND EMISSIONS 35
9.1 STANDARD APPLICABLE 35
9.2 TEST PROCEDURE 35
9.3 SUMMARY OF TEST RESULTS/PLOTS 36
10. CONDUCTED EMISSIONS 43
10.1 TEST PROCEDURE 43
10.2 BASIC TEST SETUP BLOCK DIAGRAM 43
10.3 TEST RECEIVER SETUP 43
10.4 SUMMARY OF TEST RESULTS/PLOTS 43
APPENDIX SUMMARY 44
APPENDIX A 45
APPENDIX B 49
APPENDIX C 53

APPENDIX D.....**57**
APPENDIX E.....**64**
APPENDIX PHOTOGRAPHS.....**75**

Report version

Version No.	Date of issue	Description
Rev.00	2023-11-01	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

General Description of EUT	
Product Name:	Wireless Headphones
Trade Name	audio-technica
Model No.:	ATH-TWX7L
Adding Model(s):	/
Rated Voltage:	Battery 3.85V
Battery Capacity:	72mAh
Adapter Model:	/
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Bluetooth Version:	V5.3(BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	1Mbps: 3.27dBm (Conducted) 2Mbps: 3.14dBm (Conducted)
Data Rate:	1Mbps, 2Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	LDS Antenna
Antenna Gain:	-2.1dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.
558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under section 15.247 of the Fcc rules.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02.
The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory
Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.
Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

FCC – Registration No.: 125990
Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is mai ntained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A
The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A and the CAB identifier is CN0057.

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low	2402MHz
TM2	Middle	2440MHz
TM3	High	2480MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	45~55 %
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB Cable	0.35	Unshielded	Without Ferrite

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB Extension Cable	1.0	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	TianYi 100-14IBD	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Power Spectral Density	Conducted	±1.8dB
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	9-150kHz ±3.74dB
		0.15-30MHz ±3.34dB
Transmitter Spurious Emissions	Radiated	30-200MHz ±4.52dB
		0.2-1GHz ±5.56dB
		1-6GHz ±3.84dB
		6-26GHz ±3.92dB

1.7 Test Equipment List and Details

Fixed asset Number	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
WTXE1041A1001	Communication Tester	Rohde & Schwarz	CMW500	148650	2023-02-25	2024-02-24
WTXE1005A1005	Spectrum Analyzer	Agilent	N9020A	US47140102	2023-02-25	2024-02-24
WTXE1084A1001	Spectrum Analyzer	Agilent	N9020A	MY54320548	2023-02-25	2024-02-24
WTXE1004A1-001	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2023-02-25	2024-02-24
☐Chamber A: Below 1GHz						
WTXE1005A1003	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2023-02-25	2024-02-24
WTXE1007A1001	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2023-02-25	2024-02-24
WTXE1007A1001	Amplifier	HP	8447F	2805A03475	2023-02-25	2024-02-24
WTXE1010A1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19
WTXE1010A1006	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2023-03-20	2026-03-19
☐Chamber A: Above 1GHz						
WTXE1005A1003	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2023-02-25	2024-02-24
WTXE1007A1001	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2023-02-25	2024-02-24
WTXE1065A1001	Amplifier	C&D	PAP-1G18	14918	2023-02-25	2024-02-24
WTXE1010A1005	Horn Antenna	ETS	3117	00086197	2021-03-19	2024-03-18
WTXE1010A1010	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2021-03-19	2024-03-18
WTXE1003A1001	Pre-amplifier	Schwarzbeck	BBV 9721	9721-031	2023-02-25	2024-02-24
☐Chamber B:Below 1GHz						
WTXE1010A1006	Trilog Broadband Antenna	Schwarz beck	VULB9163(B)	9163-635	2021-04-09	2024-04-08
WTXE1038A1001	Amplifier	Agilent	8447D	2944A10457	2023-02-25	2024-02-24

WTXE1001A 1002	EMI Test Receiver	Rohde & Schwarz	ESPI	101391	2023-02-25	2024-02-24
☒Chamber C:Below 1GHz						
WTXE1093A 1001	EMI Test Receiver	Rohde & Schwarz	ESIB 26	100401	2023-02-25	2024-02-24
WTXE1010A 1013-1	Trilog Broadband Antenna	Schwarz beck	VULB 9168	1194	2021-05-28	2024-05-27
WTXE1010A 1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19
WTXE1007A 1002	Amplifier	HP	8447F	2944A038 69	2023-02-25	2024-02-24
☒Chamber C: Above 1GHz						
WTXE1093A 1001	EMI Test Receiver	Rohde & Schwarz	ESIB 26	100401	2023-02-25	2024-02-24
WTXE1103A 1005	Horn Antenna	POAM	RTF-118A	1820	2023-03-10	2026-03-09
WTXE1103A 1006	Amplifier	Tonscend	TAP01018050	AP22E806 235	2023-02-25	2024-02-24
WTXE1010A 1010	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2021-03-19	2024-03-18
WTXE1003A 1001	Pre-amplifier	Schwarzbeck	BBV 9721	9721-031	2023-02-25	2024-02-24
☒Conducted Room 1#						
WTXE1001A 1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2023-02-25	2024-02-24
WTXE1002A 1001	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2023-02-25	2024-02-24
WTXE1003A 1001	AC LISN	Schwarz beck	NSLK8126	8126-279	2023-02-25	2024-02-24
☐Conducted Room 2#						
WTXE1001A 1004	EMI Test Receiver	Rohde & Schwarz	ESPI	101259	2023-02-25	2024-02-24
WTXE1003A 1003	LISN	Rohde & Schwarz	ENV 216	100097	2023-02-25	2024-02-24

Software List			
Description	**Manufacturer**	**Model**	**Version**
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission Room 1#)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission Room 2#)*	SKET	EMC-I	V2.0

*Remark: indicates software version used in the compliance certification testing.

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§15.203; §15.247(b)(4)(i)	Antenna Requirement	Compliant
/	Duty Cycle of Test Signal	Compliant
§15.205	Restricted Band of Operation	Compliant
§15.207(a)	Conducted Emission	N/A
§15.247(e)	Power Spectral Density	Compliant
§15.247(a)(2)	DTS Bandwidth	Compliant
§15.247(b)(3)	RF Output Power	Compliant
§15.209(a)	Radiated Emission	Compliant
§15.247(d)	Band Edge (Out of Band Emissions)	Compliant

N/A: Not applicable.

3. Antenna Requirement

3.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Evaluation Information

This product has a LDS antenna, fulfill the requirement of this section.

4. Duty Cycle of Test Signal

4.1 Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%).When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration(T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e.,no transmitter OFF-time is to be considered).
When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this sub clause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than ±2%; otherwise, the duty cycle is considered to be non constant.

4.2 Summary of Test Results/Plots

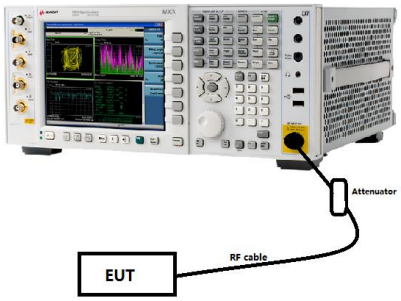
Please refer to Appendix A

5. Power Spectral Density

5.1 Standard Applicable

According to 15.247(a)(1)(iii), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

5.2 Test Setup Block Diagram



5.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3kHz ≤ RBW ≤ 100kHz.
d) Set the VBW ≥ 3 × RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3kHz) and repeat.

5.4 Summary of Test Results/Plots

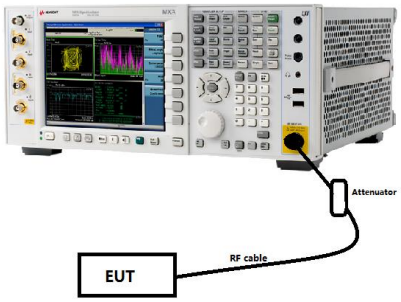
Please refer to Appendix B

6. DTS Bandwidth

6.1 Standard Applicable

According to 15.247(a)(2), systems using digital modulation techniques may operate in the 902–928MHz, 2400–2483.5MHz, and 5725–5850 MHz bands. The minimum 6dB bandwidth shall be at least 500kHz.

6.2 Test Setup Block Diagram



6.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

a) Set RBW = 100kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

6.4 Summary of Test Results/Plots

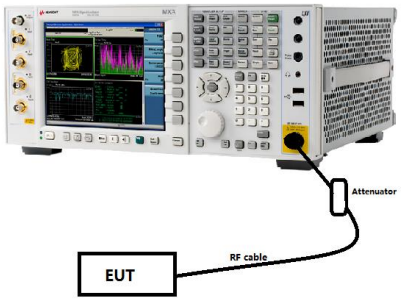
Please refer to Appendix C

7. RF Output Power

7.1 Standard Applicable

According to 15.247(b)(3), for systems using digital modulation in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands: 1 Watt.

7.2 Test Setup Block Diagram



7.3 Test Procedure

According to the KDB-558074 D01 v05r02 Subclause 8.3.1.1 and ANSI C63.10-2013 Subclause 11.9.1.1, this procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 × RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

7.4 Summary of Test Results/Plots

Please refer to Appendix D

7. Field Strength of Spurious Emissions

8.1 Standard Applicable

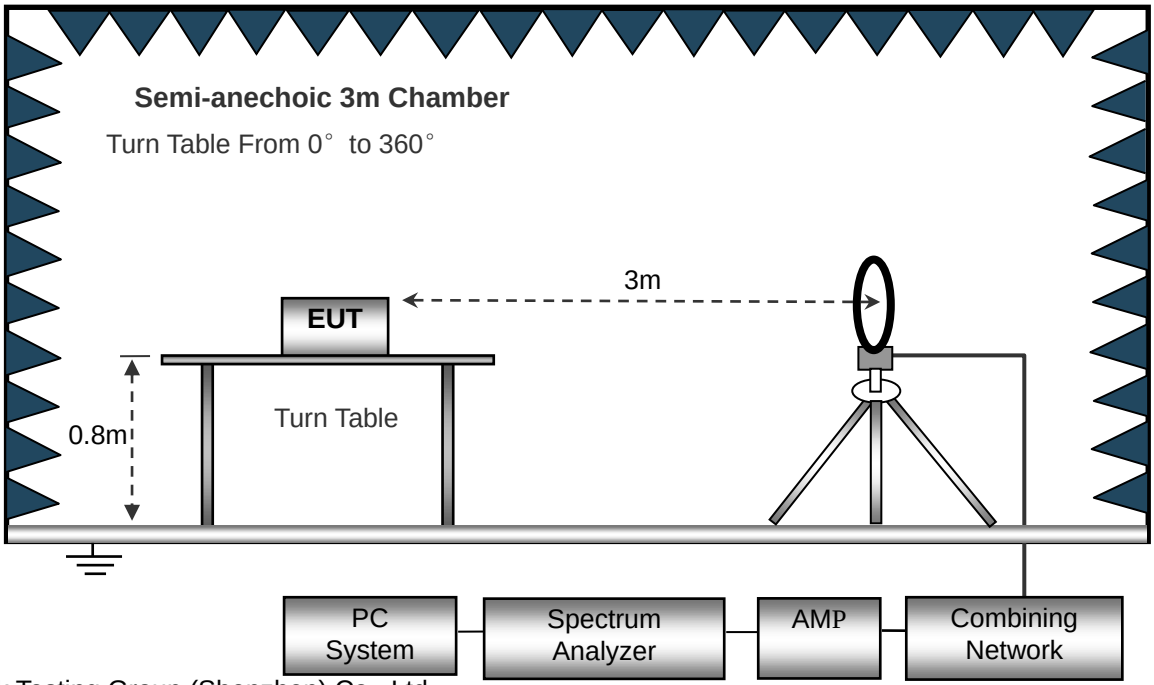
According to §15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

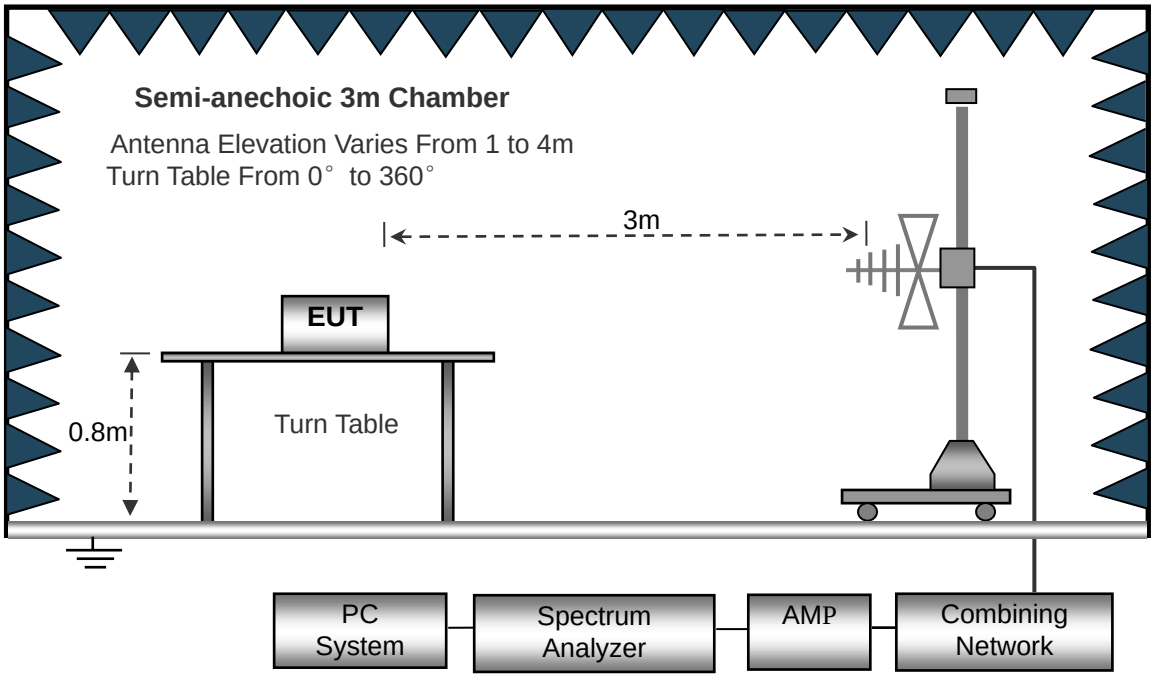
8.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle. The spacing between the peripherals was 10cm.

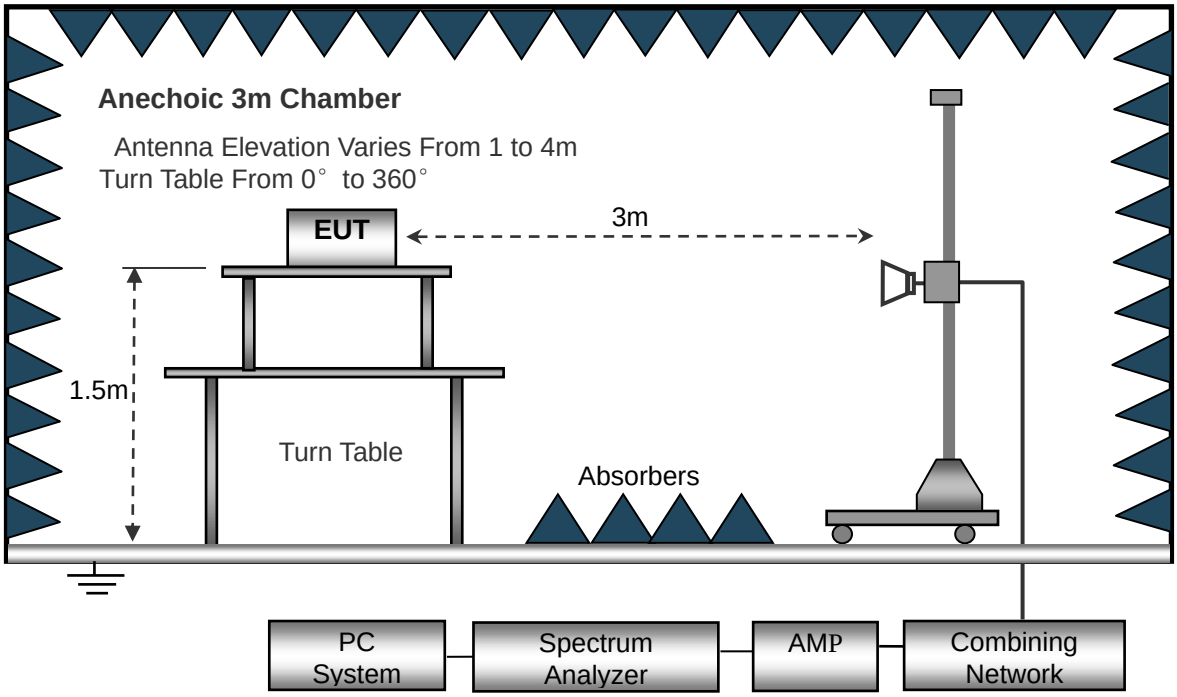
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1GHz.



Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold

Detector function = peak Detector function = peak, QP Detector function = peak, AV

8.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

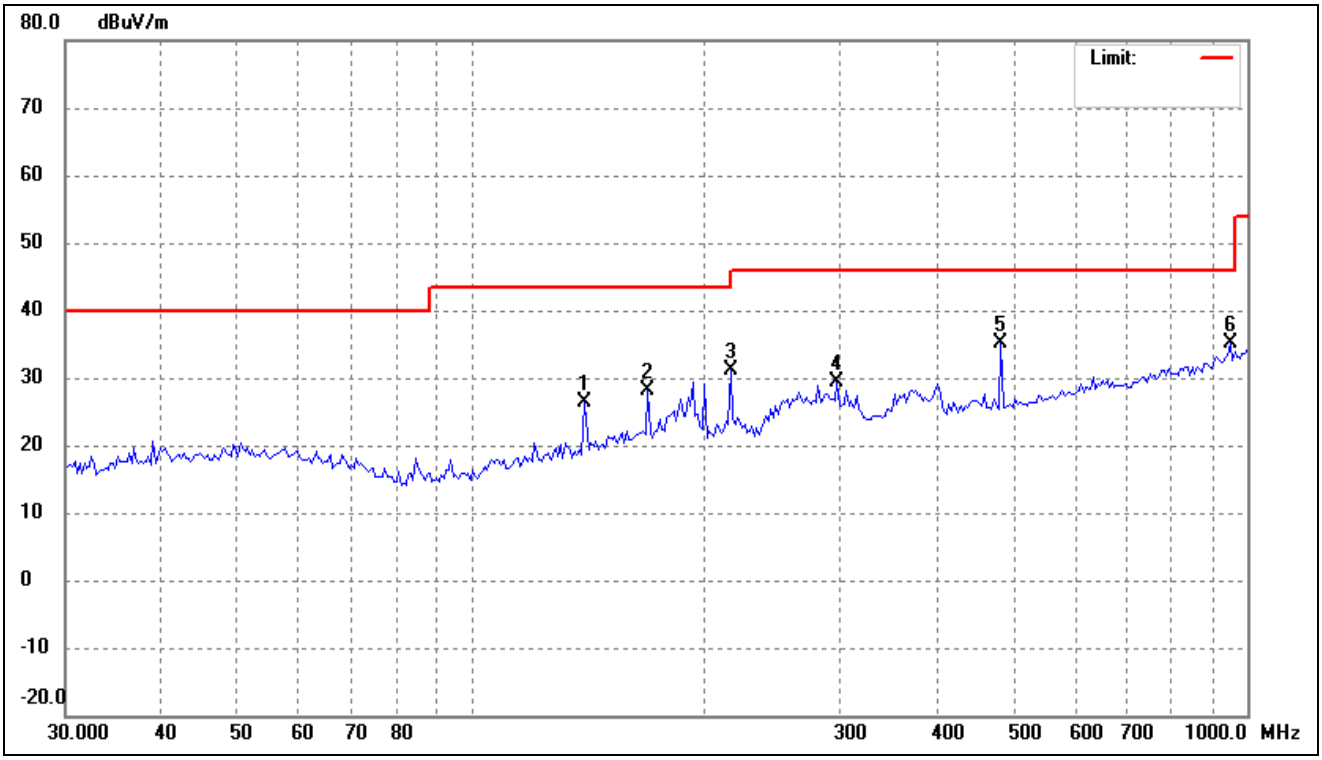
Margin = Corr. Ampl. – FCC Part 15 Limit

8.4 Summary of Test Results/Plots

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

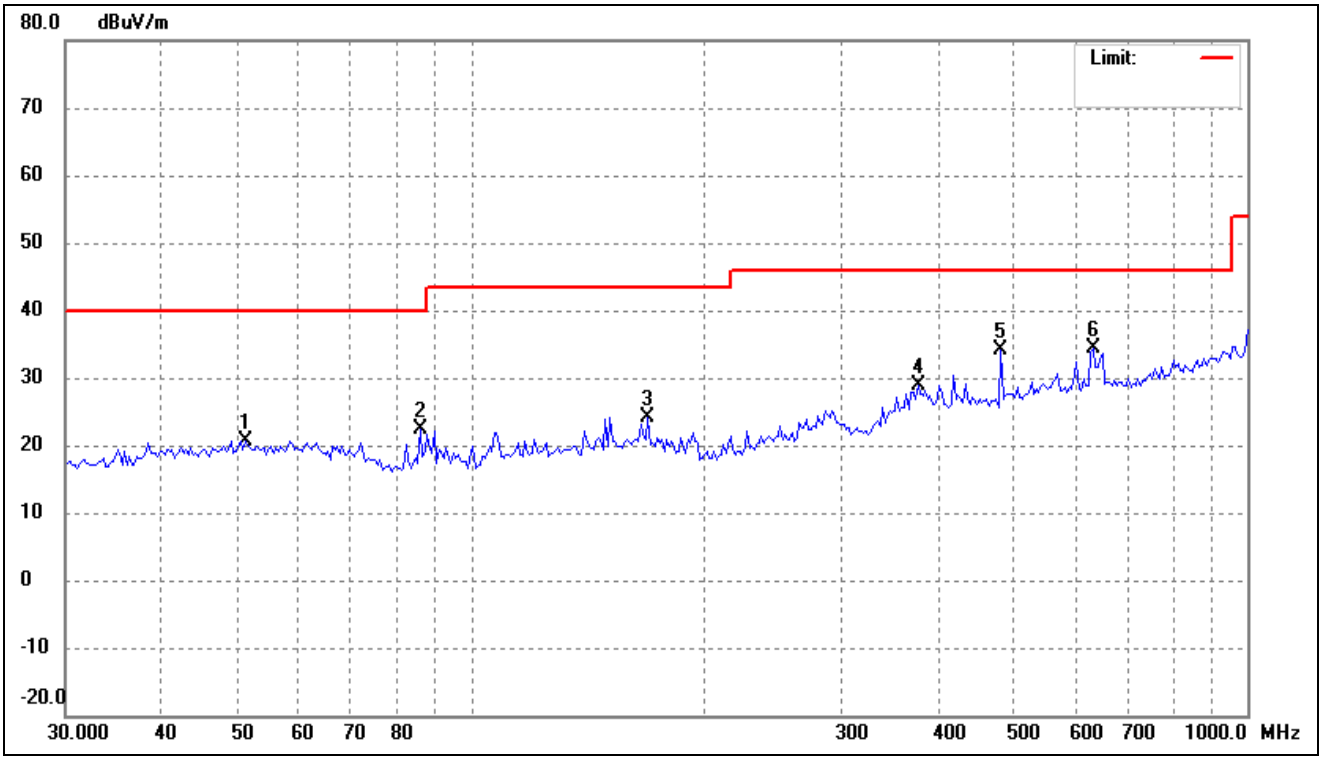
- Spurious Emissions Below 1GHz
- BLE 1Mbps

Test Channel	Low	Polarity:	Horizontal



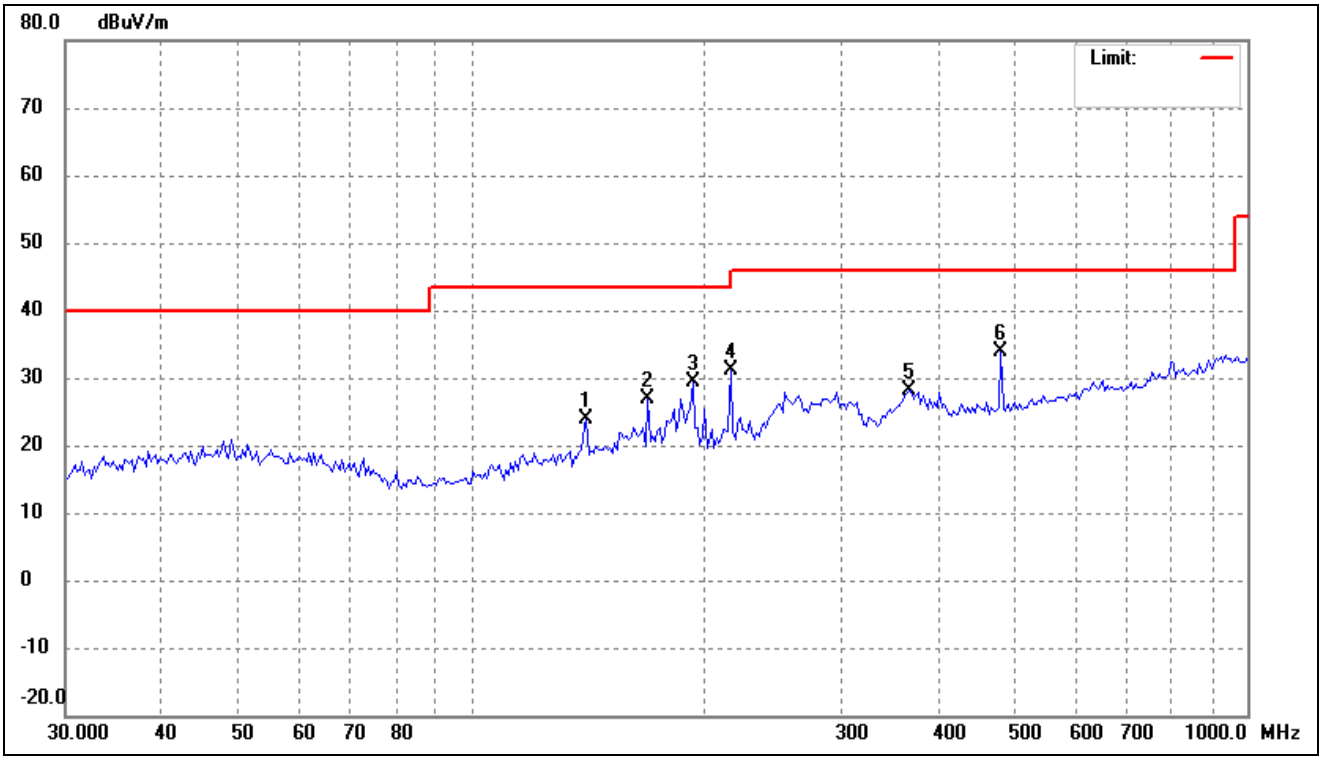
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	139.7909	35.78	-9.44	26.34	43.50	-17.16	-	-	peak
2	168.9970	37.06	-8.85	28.21	43.50	-15.29	-	-	peak
3	216.1197	43.13	-12.12	31.01	46.00	-14.99	-	-	peak
4	296.5023	37.75	-8.38	29.37	46.00	-16.63	-	-	peak
5	481.5112	39.26	-4.15	35.11	46.00	-10.89	-	-	peak
6	952.0001	32.77	2.25	35.02	46.00	-10.98	-	-	peak

Test Channel	Low	Polarity:	Vertical



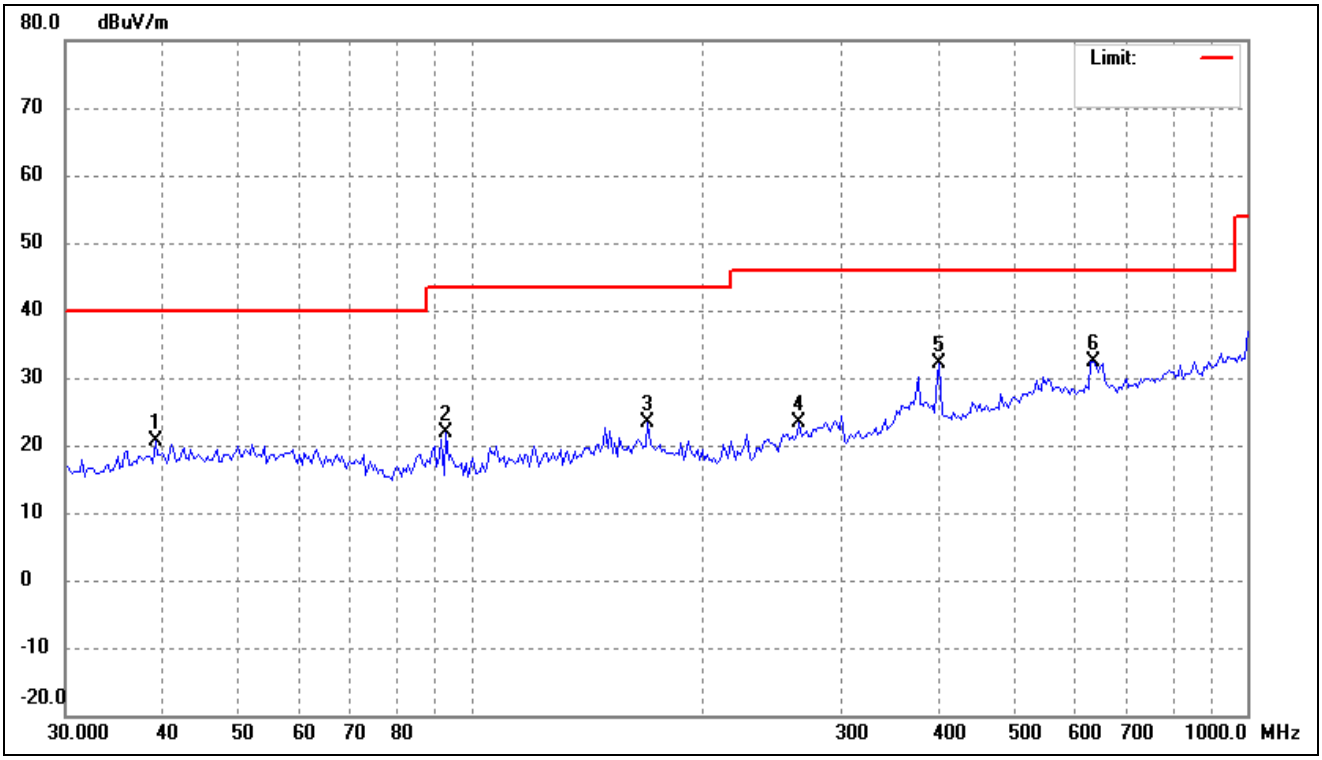
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	51.1756	28.88	-8.22	20.66	40.00	-19.34	-	-	peak
2	86.0796	35.46	-13.04	22.42	40.00	-17.58	-	-	peak
3	168.9970	33.10	-8.85	24.25	43.50	-19.25	-	-	peak
4	376.5228	35.25	-6.44	28.81	46.00	-17.19	-	-	peak
5	481.5112	38.20	-4.15	34.05	46.00	-11.95	-	-	peak
6	633.3285	35.79	-1.37	34.42	46.00	-11.58	-	-	peak

Test Channel	Middle	Polarity:	Horizontal



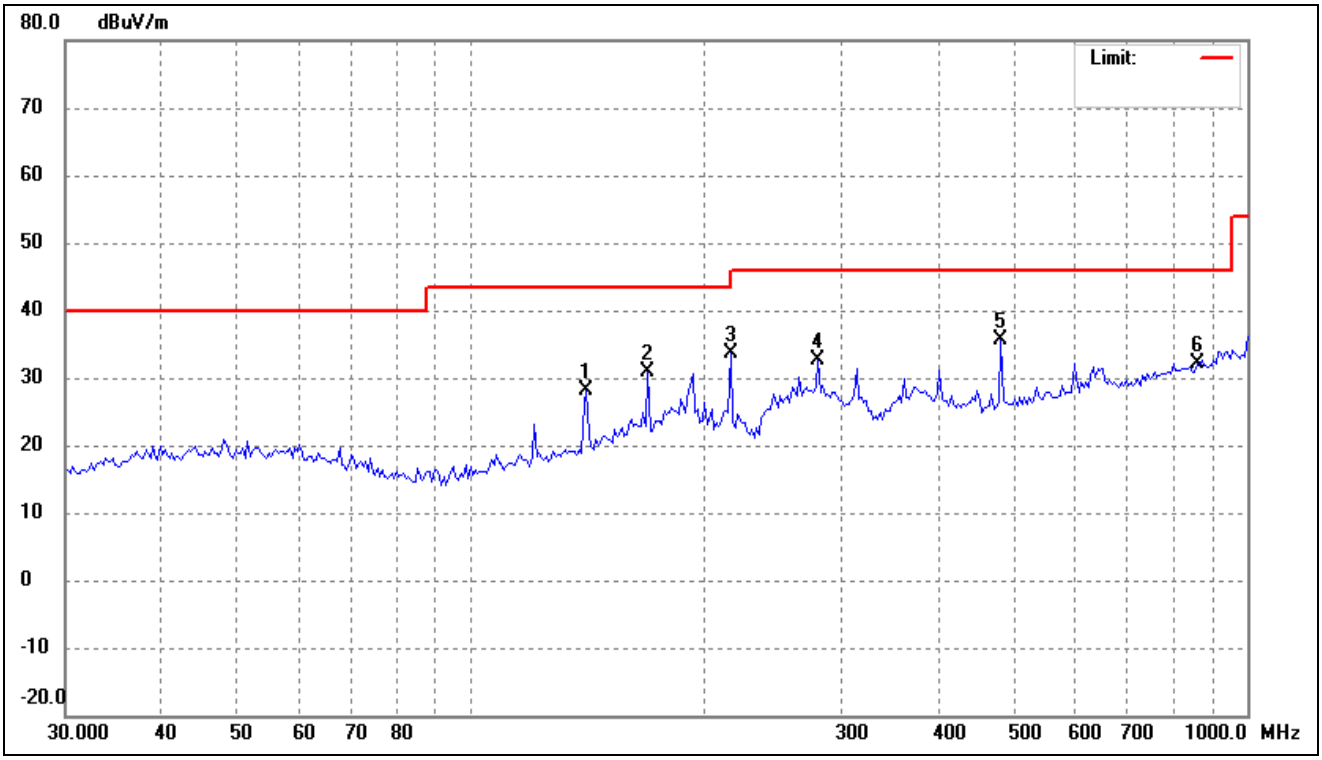
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	140.7767	33.17	-9.37	23.80	43.50	-19.70	-	-	peak
2	168.9970	35.64	-8.85	26.79	43.50	-16.71	-	-	peak
3	193.1366	41.07	-11.60	29.47	43.50	-14.03	-	-	peak
4	216.1197	43.21	-12.12	31.09	46.00	-14.91	-	-	peak
5	366.0866	34.87	-6.70	28.17	46.00	-17.83	-	-	peak
6	481.5112	38.03	-4.15	33.88	46.00	-12.12	-	-	peak

Test Channel	Middle	Polarity:	Vertical



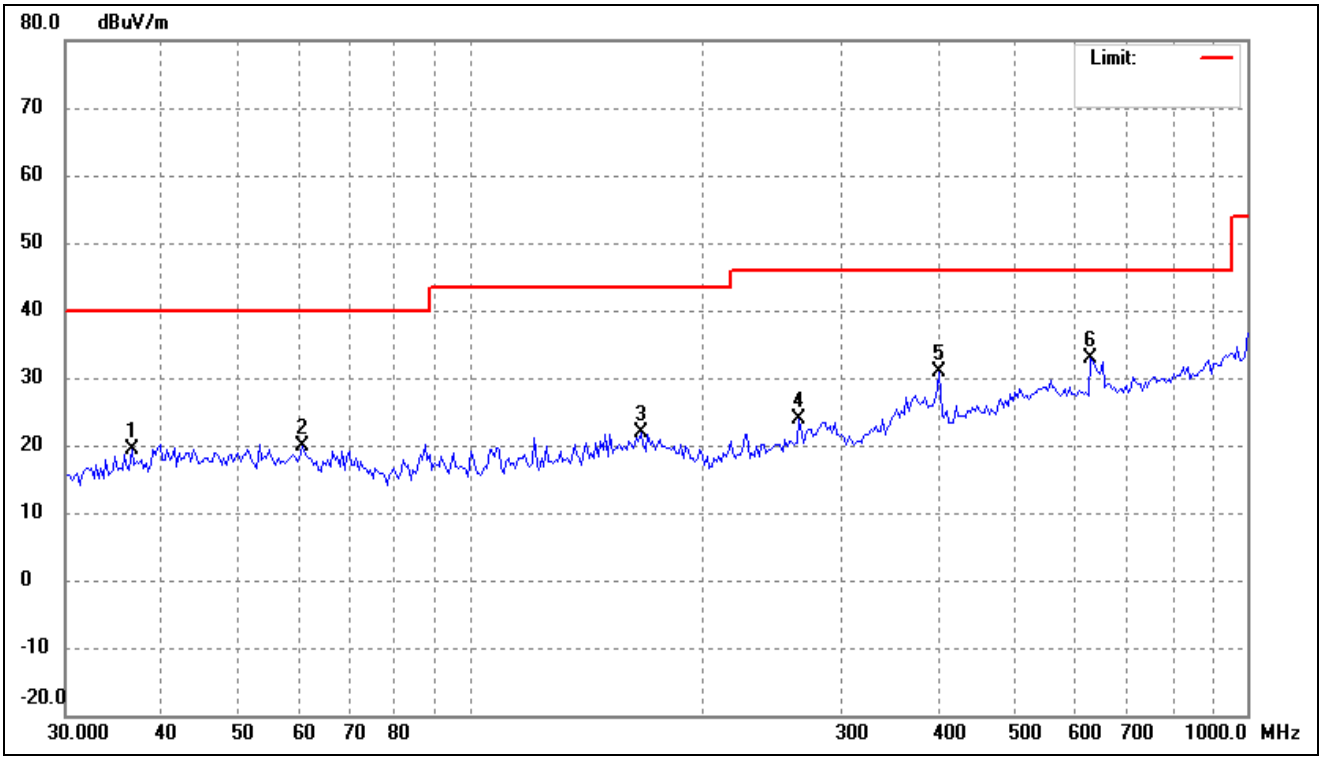
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	39.1825	29.39	-8.65	20.74	40.00	-19.26	-	-	peak
2	92.9974	34.85	-12.93	21.92	43.50	-21.58	-	-	peak
3	168.9970	32.14	-8.85	23.29	43.50	-20.21	-	-	peak
4	264.9709	32.86	-9.55	23.31	46.00	-22.69	-	-	peak
5	401.1050	38.05	-5.93	32.12	46.00	-13.88	-	-	peak
6	628.8936	33.84	-1.38	32.46	46.00	-13.54	-	-	peak

Test Channel	High	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	140.7767	37.45	-9.37	28.08	43.50	-15.42	-	-	peak
2	168.9970	39.62	-8.85	30.77	43.50	-12.73	-	-	peak
3	216.1197	45.76	-12.12	33.64	46.00	-12.36	-	-	peak
4	280.2936	41.53	-8.93	32.60	46.00	-13.40	-	-	peak
5	481.5112	39.69	-4.15	35.54	46.00	-10.46	-	-	peak
6	862.8015	31.29	0.85	32.14	46.00	-13.86	-	-	peak

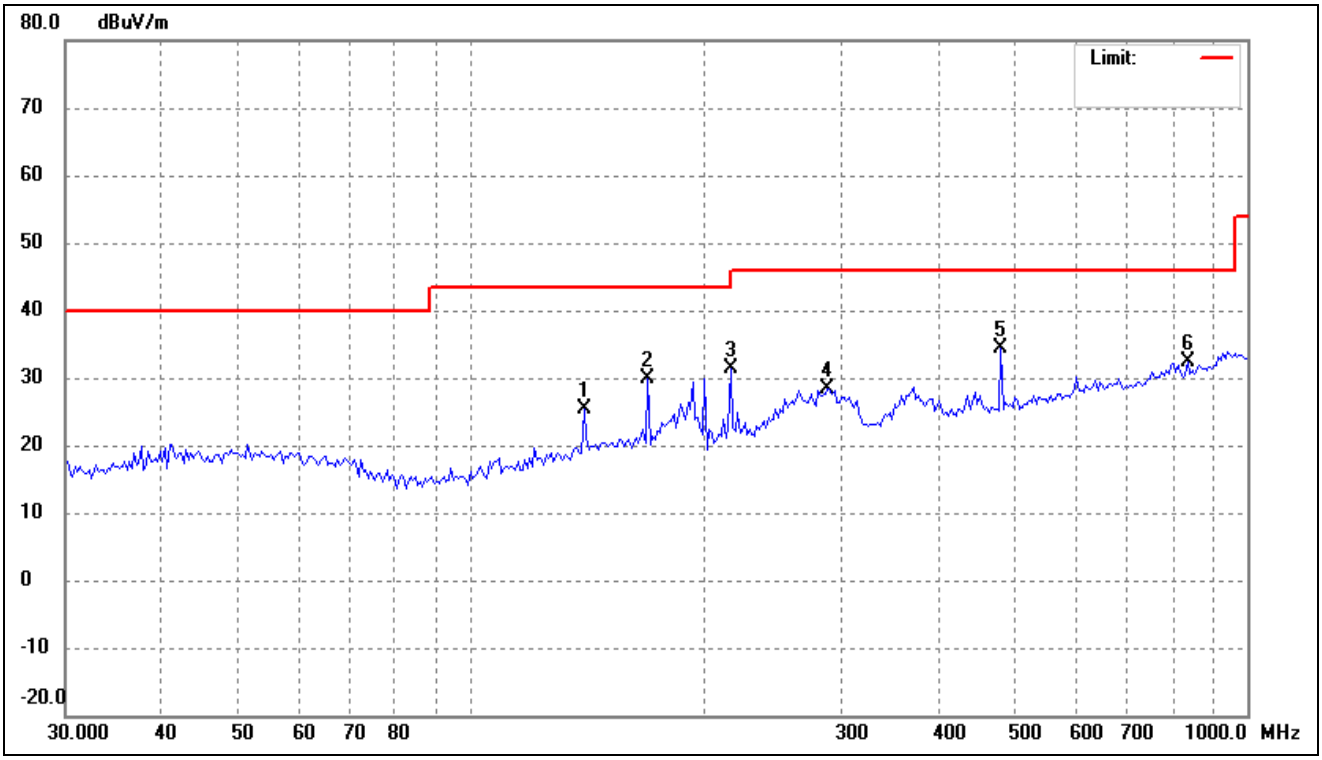
Test Channel	High	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	36.5236	28.67	-9.22	19.45	40.00	-20.55	-	-	peak
2	60.5769	28.86	-9.04	19.82	40.00	-20.18	-	-	peak
3	165.4716	30.59	-8.76	21.83	43.50	-21.67	-	-	peak
4	264.9709	33.37	-9.55	23.82	46.00	-22.18	-	-	peak
5	401.1050	36.81	-5.93	30.88	46.00	-15.12	-	-	peak
6	628.8936	34.33	-1.38	32.95	46.00	-13.05	-	-	peak

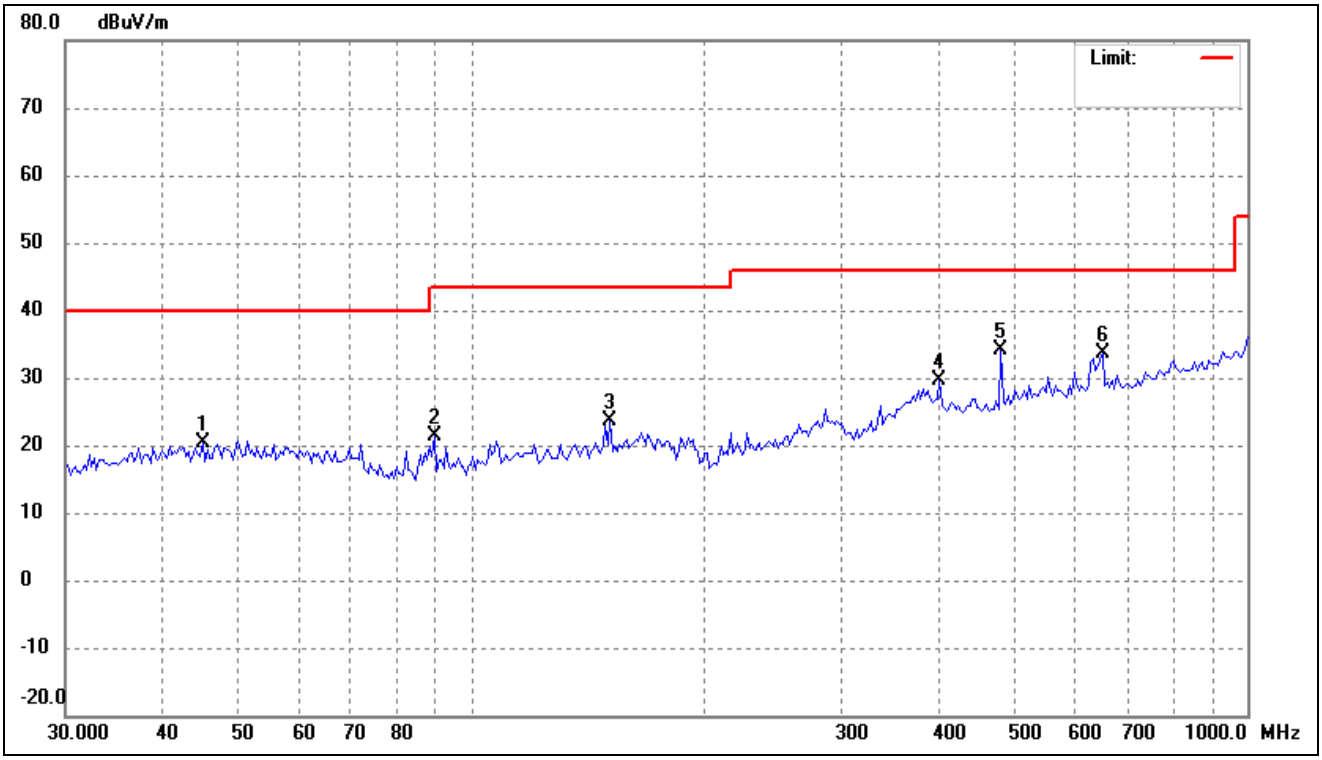
➢ BLE 2Mbps

Test Channel	Low	Polarity:	Horizontal



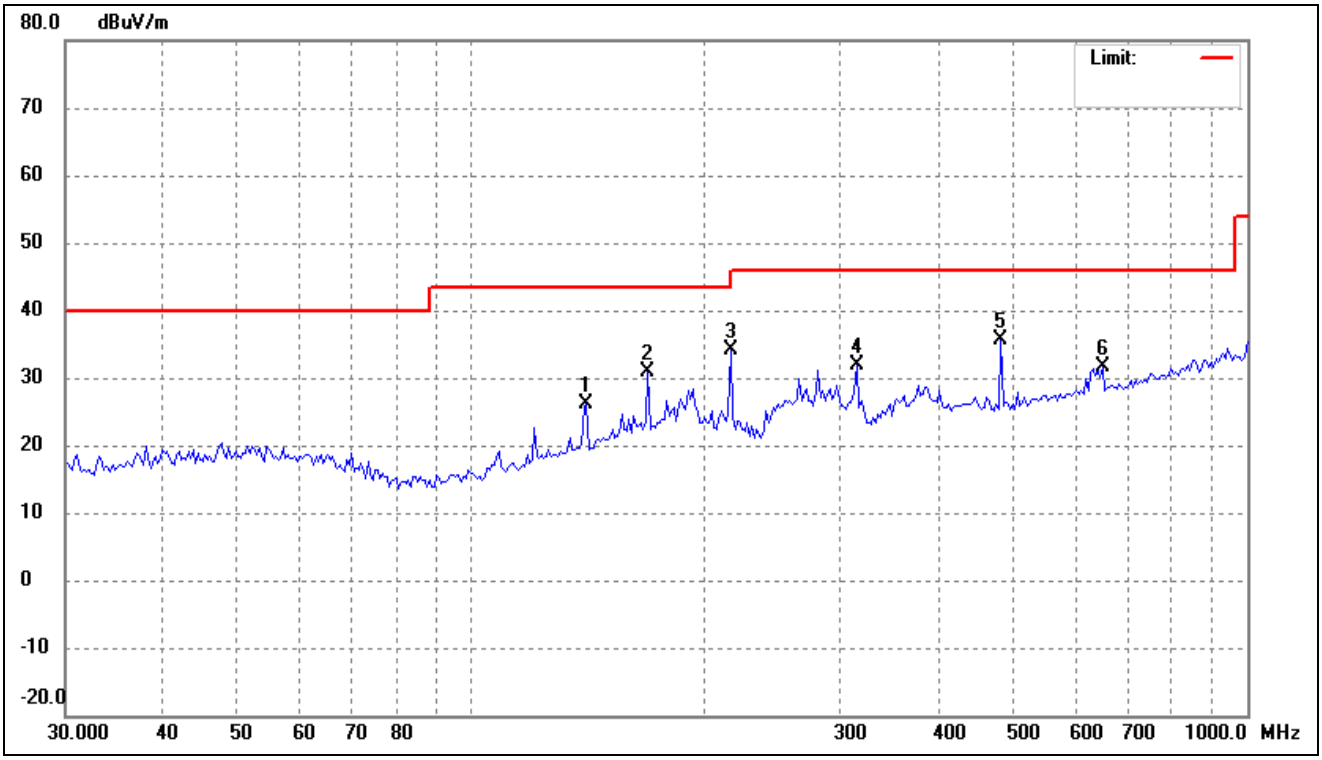
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	139.7909	34.89	-9.44	25.45	43.50	-18.05	-	-	peak
2	168.9970	38.68	-8.85	29.83	43.50	-13.67	-	-	peak
3	216.1197	43.43	-12.12	31.31	46.00	-14.69	-	-	peak
4	288.2840	36.97	-8.66	28.31	46.00	-17.69	-	-	peak
5	481.5112	38.59	-4.15	34.44	46.00	-11.56	-	-	peak
6	838.8870	31.74	0.64	32.38	46.00	-13.62	-	-	peak

Test Channel	Low	Polarity:	Vertical



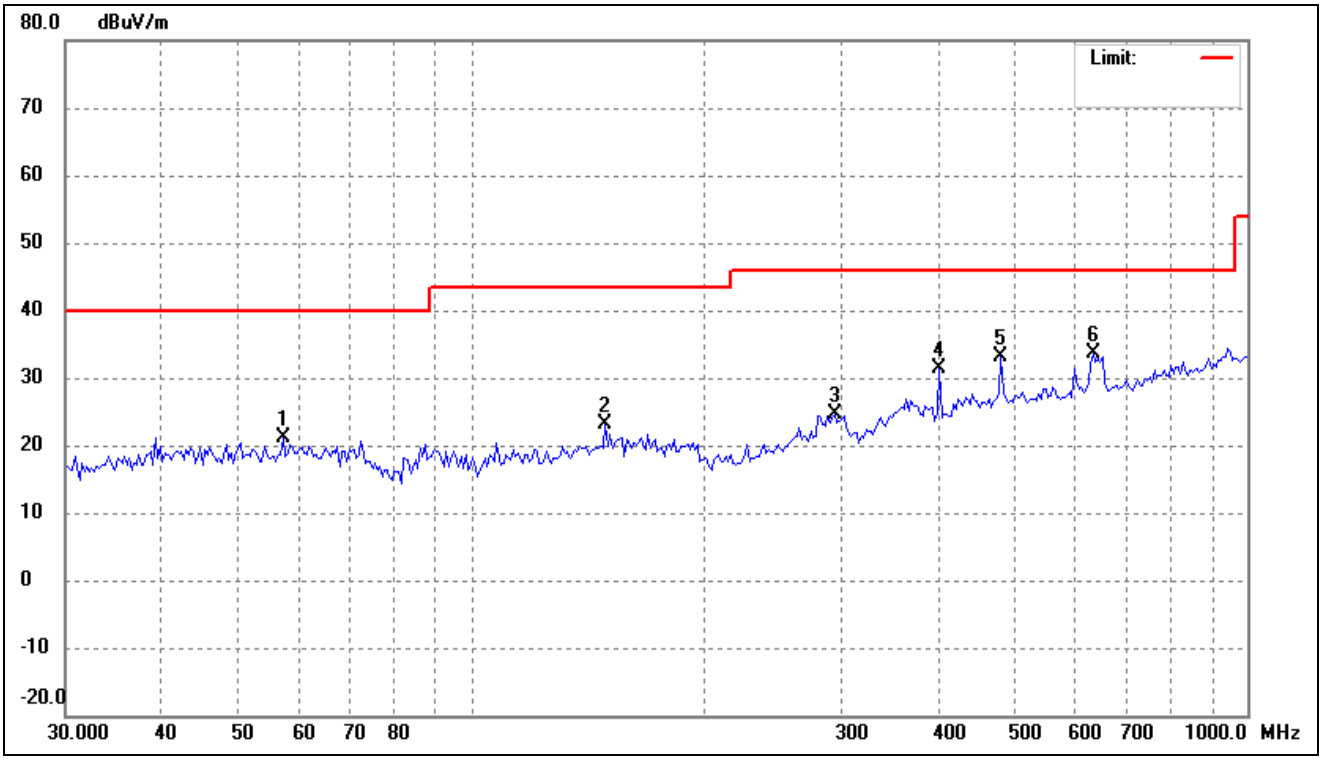
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	45.0951	28.89	-8.46	20.43	40.00	-19.57	-	-	peak
2	89.7866	34.47	-13.10	21.37	43.50	-22.13	-	-	peak
3	151.0252	32.16	-8.61	23.55	43.50	-19.95	-	-	peak
4	401.1050	35.54	-5.93	29.61	46.00	-16.39	-	-	peak
5	481.5112	38.30	-4.15	34.15	46.00	-11.85	-	-	peak
6	651.3831	34.91	-1.30	33.61	46.00	-12.39	-	-	peak

Test Channel	Middle	Polarity:	Horizontal



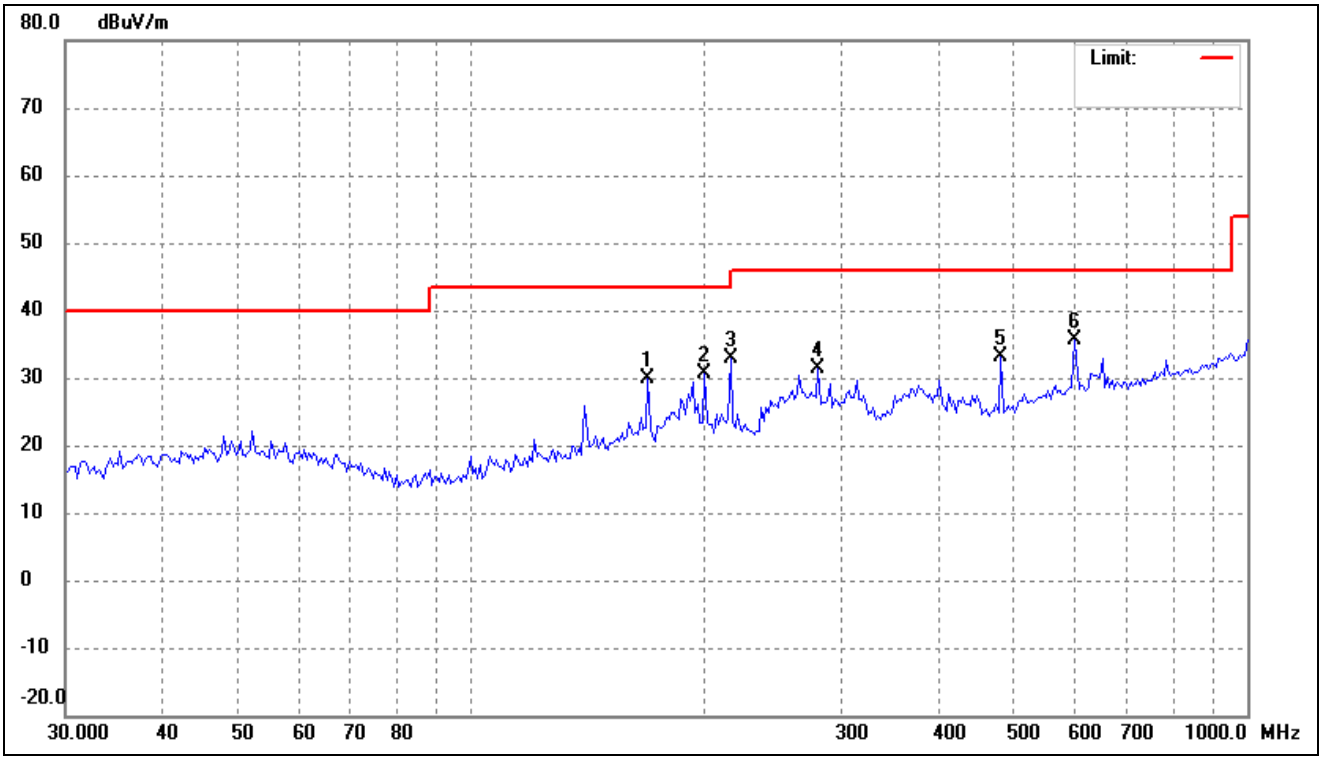
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	140.7767	35.52	-9.37	26.15	43.50	-17.35	-	-	peak
2	168.9970	39.66	-8.85	30.81	43.50	-12.69	-	-	peak
3	216.1197	46.15	-12.12	34.03	46.00	-11.97	-	-	peak
4	313.6483	39.86	-7.87	31.99	46.00	-14.01	-	-	peak
5	481.5112	39.86	-4.15	35.71	46.00	-10.29	-	-	peak
6	651.3831	33.02	-1.30	31.72	46.00	-14.28	-	-	peak

Test Channel	Middle	Polarity:	Vertical



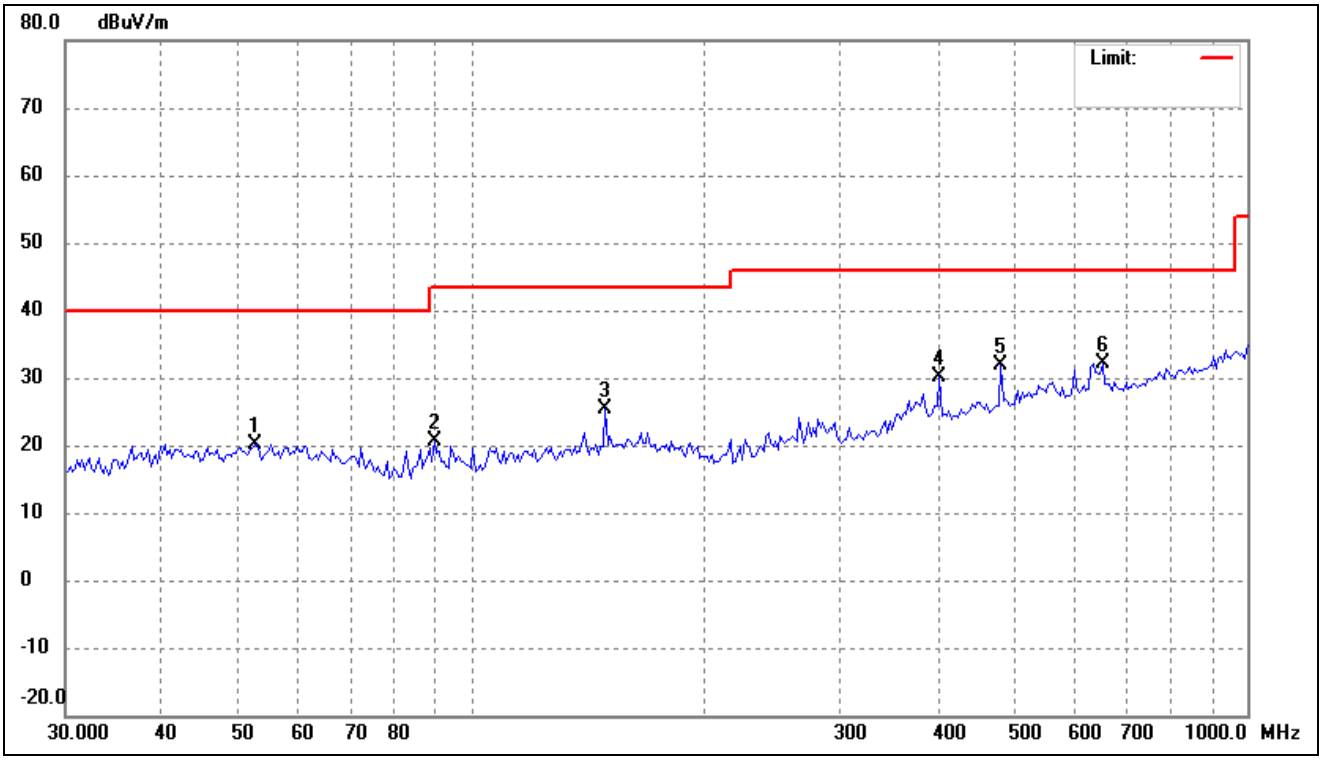
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	57.2654	29.97	-8.77	21.20	40.00	-18.80	-	-	peak
2	148.9175	31.69	-8.68	23.01	43.50	-20.49	-	-	peak
3	294.4260	33.08	-8.45	24.63	46.00	-21.37	-	-	peak
4	401.1050	37.39	-5.93	31.46	46.00	-14.54	-	-	peak
5	481.5112	37.17	-4.15	33.02	46.00	-12.98	-	-	peak
6	633.3285	35.01	-1.37	33.64	46.00	-12.36	-	-	peak

Test Channel	High	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	168.9970	38.69	-8.85	29.84	43.50	-13.66	-	-	peak
2	200.0432	42.70	-11.98	30.72	43.50	-12.78	-	-	peak
3	216.1197	44.91	-12.12	32.79	46.00	-13.21	-	-	peak
4	280.2936	40.24	-8.93	31.31	46.00	-14.69	-	-	peak
5	481.5112	37.38	-4.15	33.23	46.00	-12.77	-	-	peak
6	598.7067	37.32	-1.77	35.55	46.00	-10.45	-	-	peak

Test Channel	High	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	52.6345	28.52	-8.37	20.15	40.00	-19.85	-	-	peak
2	89.7866	33.68	-13.10	20.58	43.50	-22.92	-	-	peak
3	148.9175	33.96	-8.68	25.28	43.50	-18.22	-	-	peak
4	401.1050	36.00	-5.93	30.07	46.00	-15.93	-	-	peak
5	481.5112	36.09	-4.15	31.94	46.00	-14.06	-	-	peak
6	651.3831	33.46	-1.30	32.16	46.00	-13.84	-	-	peak

Remark: '-'Means' the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

- Spurious Emissions Above 1GHz

BLE 1Mbps

Frequency	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz					
1632.533	46.59	74.00	27.41	H	PK
2554.667	47.12	74.00	26.88	H	PK
1992.533	46.75	74.00	27.25	V	PK
2454.400	47.49	74.00	26.51	V	PK
Middle Channel-2440Hz					
1097.600	45.73	74.00	28.27	H	PK
2452.800	47.69	74.00	26.31	H	PK
1600.000	46.31	74.00	27.69	V	PK
2014.933	46.99	74.00	27.01	V	PK
Middle Channel-2480MHz					
1948.800	46.58	74.00	27.42	H	PK
2406.400	46.64	74.00	27.36	H	PK
1147.200	45.98	74.00	28.02	V	PK
2492.267	47.31	74.00	26.69	V	PK

BLE 2Mbps

Frequency	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz					
1218.133	45.74	74.00	28.26	H	PK
2489.600	47.51	74.00	26.49	H	PK
1466.667	46.52	74.00	27.48	V	PK
2411.200	48.22	74.00	25.78	V	PK
Middle Channel-2440Hz					
1991.467	46.41	74.00	27.59	H	PK
2409.067	46.90	74.00	27.10	H	PK
2048.000	46.34	74.00	27.66	V	PK
2414.933	47.47	74.00	26.53	V	PK
Middle Channel-2480MHz					
2029.867	46.91	74.00	27.09	H	PK
2406.400	47.96	74.00	26.04	H	PK
1162.133	47.39	74.00	26.61	V	PK
2410.667	47.73	74.00	26.27	V	PK

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

9. Out of Band Emissions

9.1 Standard Applicable

According to §15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

9.2 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r02 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

A. Radiated emission measurements:
Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)
RBW = 1MHz, VBW = 1MHz for peak value measured
RBW = 1MHz, VBW = 10Hz for average value measured
Sweep = auto; Detector function = peak/average; Trace = max hold
All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission

must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

B. Antenna-port conducted measurements

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 9.

b) VBW ≥ [3 × RBW].

c) Detector = peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

RBW as a function of frequency

Frequency	RBW
9kHz to 150kHz	200Hz to 300Hz
0.15MHz to 30MHz	9kHz to 10kHz
30MHz to 1000MHz	100kHz to 120kHz
>1000MHz	1MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

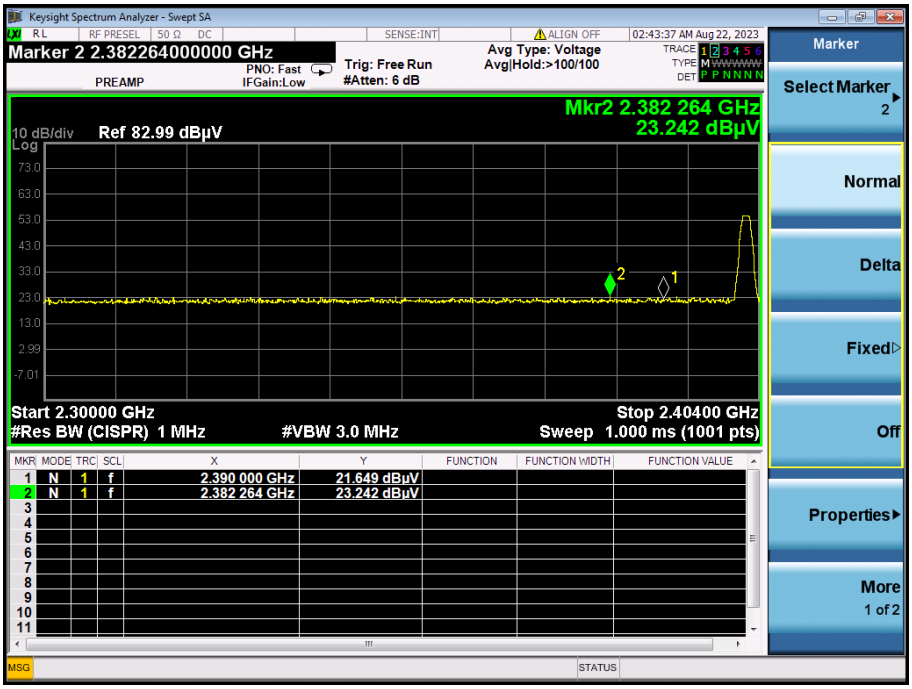
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

9.3 Summary of Test Results/Plots

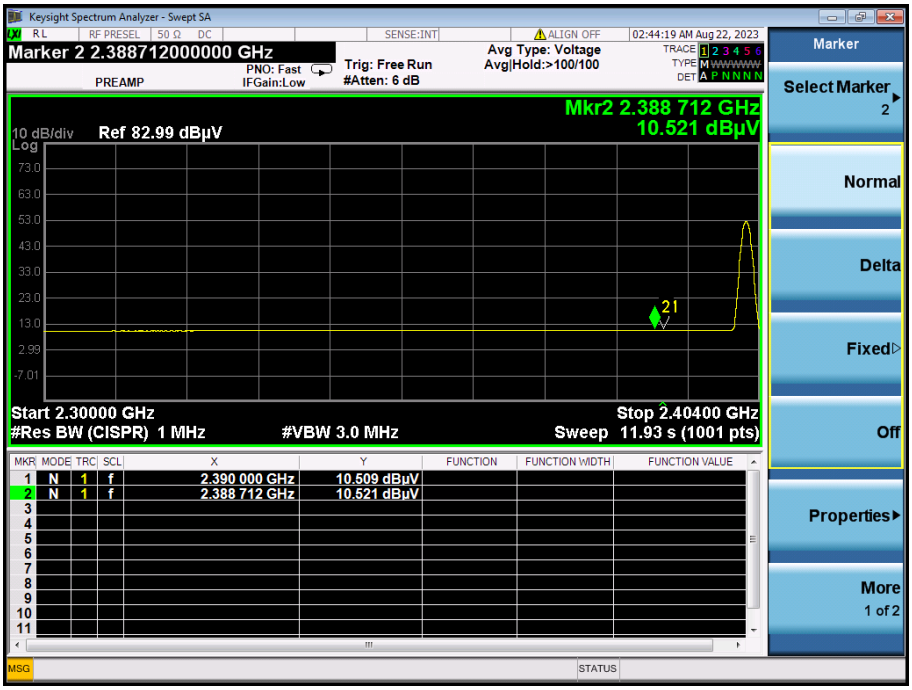
- Radiated test

BLE 1Mbps

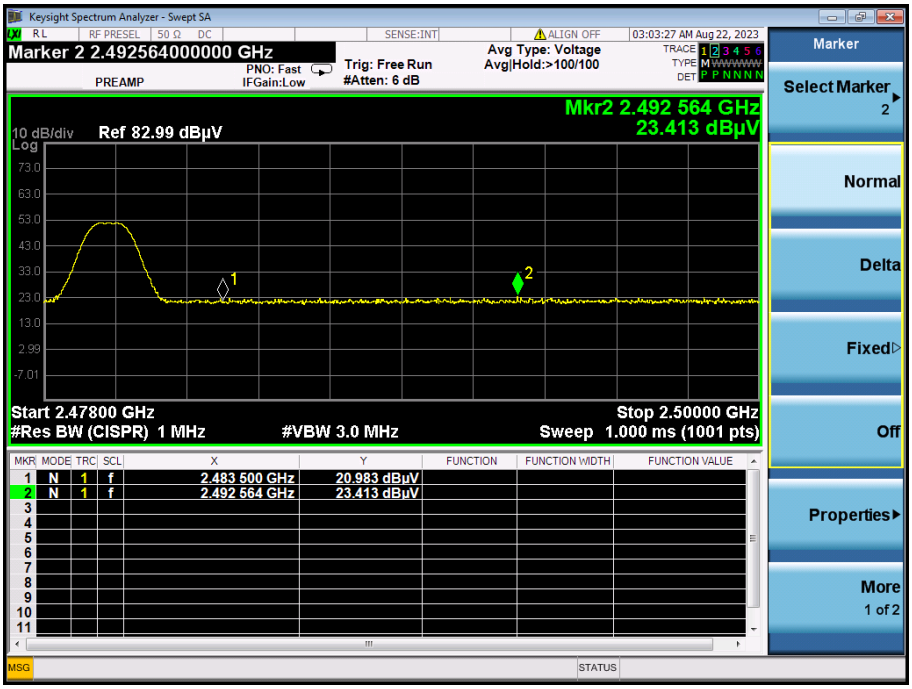
Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBμV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2382.26	PK	23.24	6.74	27.20	57.18	74	PASS
0	2388.71	AV	10.52	6.74	27.20	44.46	54	PASS
39	2492.56	PK	23.41	6.74	27.20	57.35	74	PASS
39	2493.16	AV	10.23	6.74	27.20	44.17	54	PASS



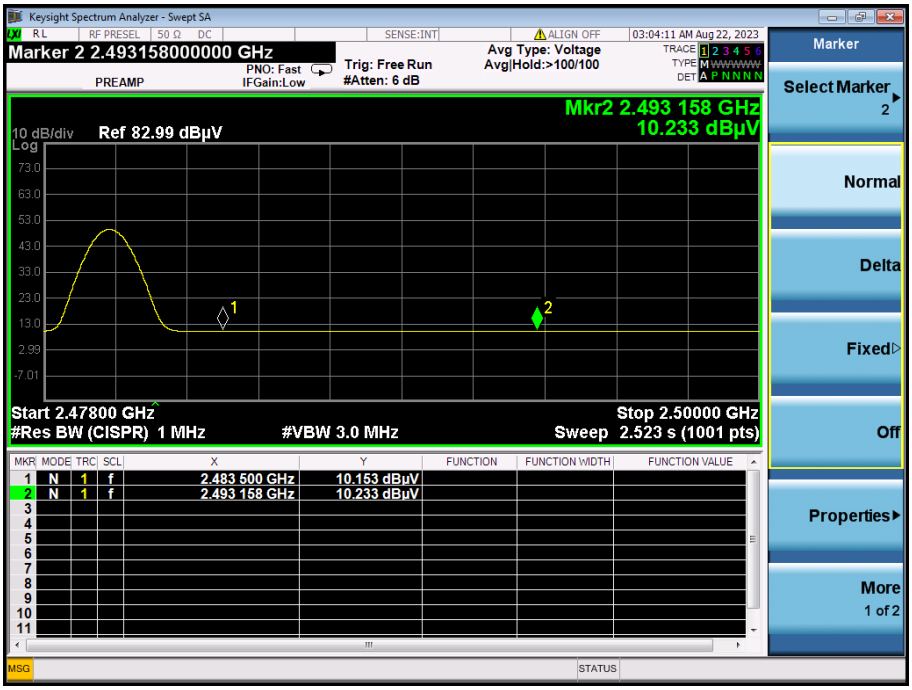
(PEAK, Channel 0)



(AVERAGE, Channel 0)



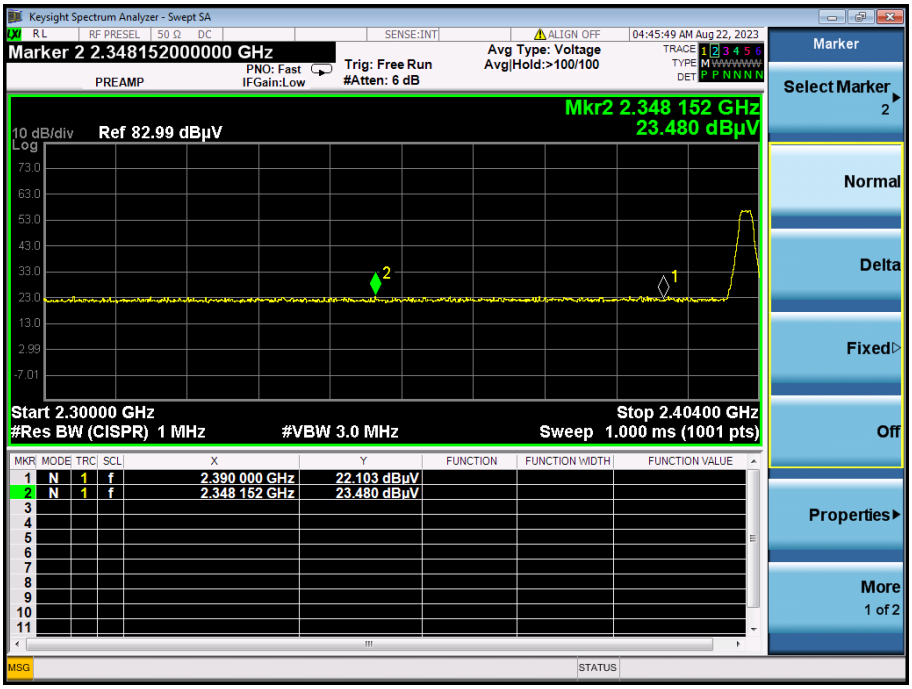
(PEAK, Channel 39)



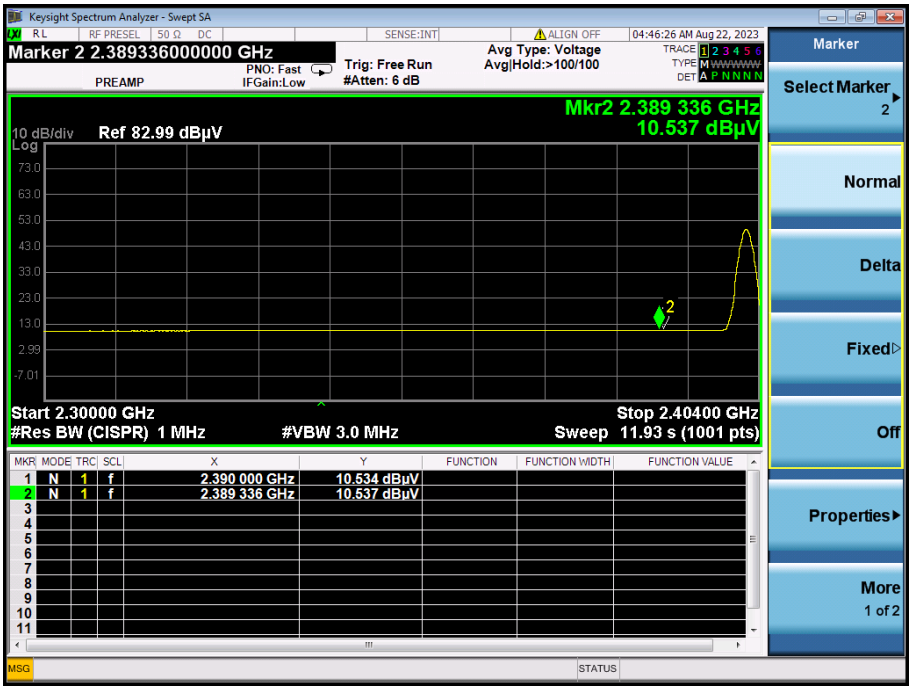
(AVERAGE, Channel 39)

BLE 2Mbps

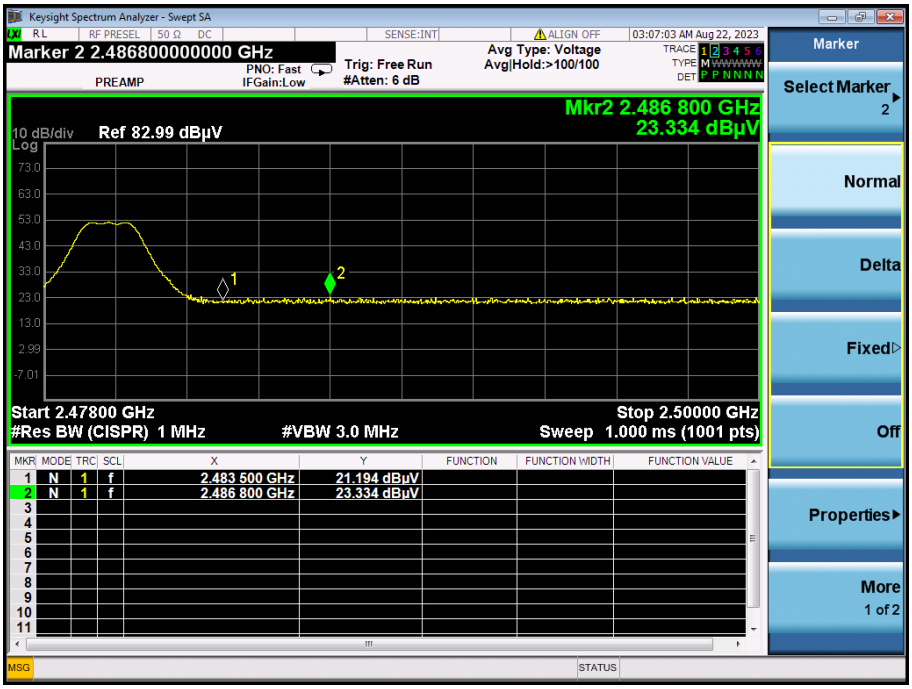
Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBμV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2348.15	PK	23.48	6.74	27.20	57.42	74	PASS
0	2389.34	AV	10.54	6.74	27.20	44.48	54	PASS
39	2486.80	PK	23.33	6.74	27.20	57.27	74	PASS
39	2492.83	AV	10.23	6.74	27.20	44.17	54	PASS



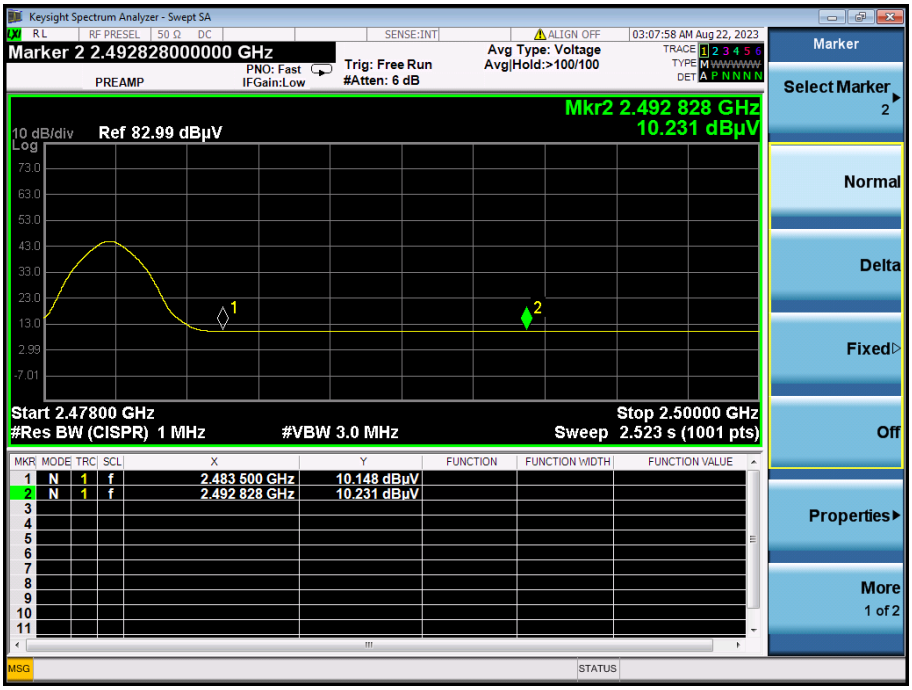
(PEAK, Channel 0)



(AVERAGE, Channel 0)



(PEAK, Channel 39)



(AVERAGE, Channel 39)

Note: Average measurement was not performed if peak level is lower than average limit(54dBuV/m) for above 1GHz.

➢ Conducted test

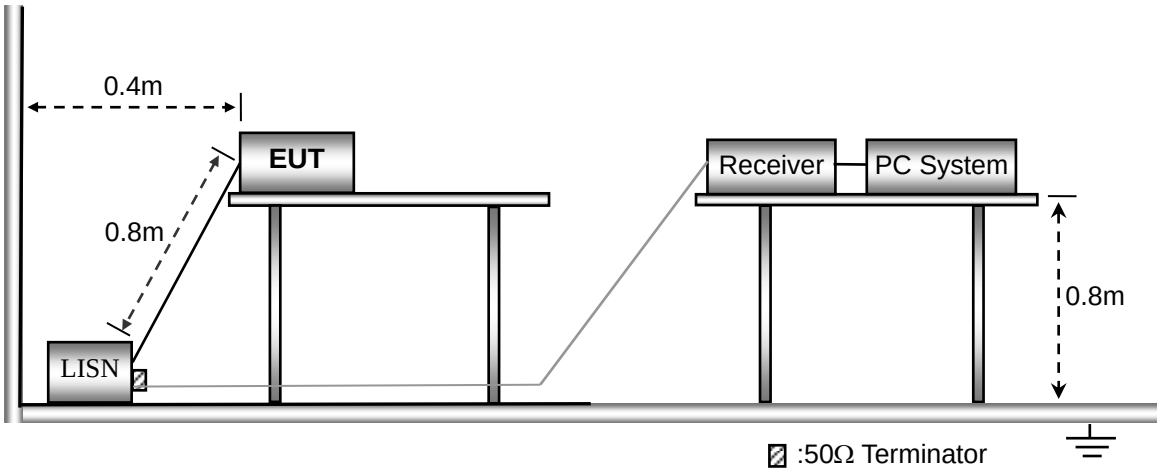
Please refer to Appendix E

10. Conducted Emissions

10.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle. The spacing between the peripherals was 10cm.

10.2 Basic Test Setup Block Diagram



10.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency 150kHz
Stop Frequency 30MHz
Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Quasi-Peak Adapter Bandwidth 9kHz
Quasi-Peak Adapter Mode ..... Normal

10.4 Summary of Test Results/Plots

Not applicable

APPENDIX SUMMARY

APPENDIX	Description of Test Item	Result
A	Duty Cycle of Test Signal	Compliant
B	Power Spectral Density	Compliant
C	DTS Bandwidth	Compliant
D	RF Output Power	Compliant
E	Conducted Out of Band Emissions	Compliant

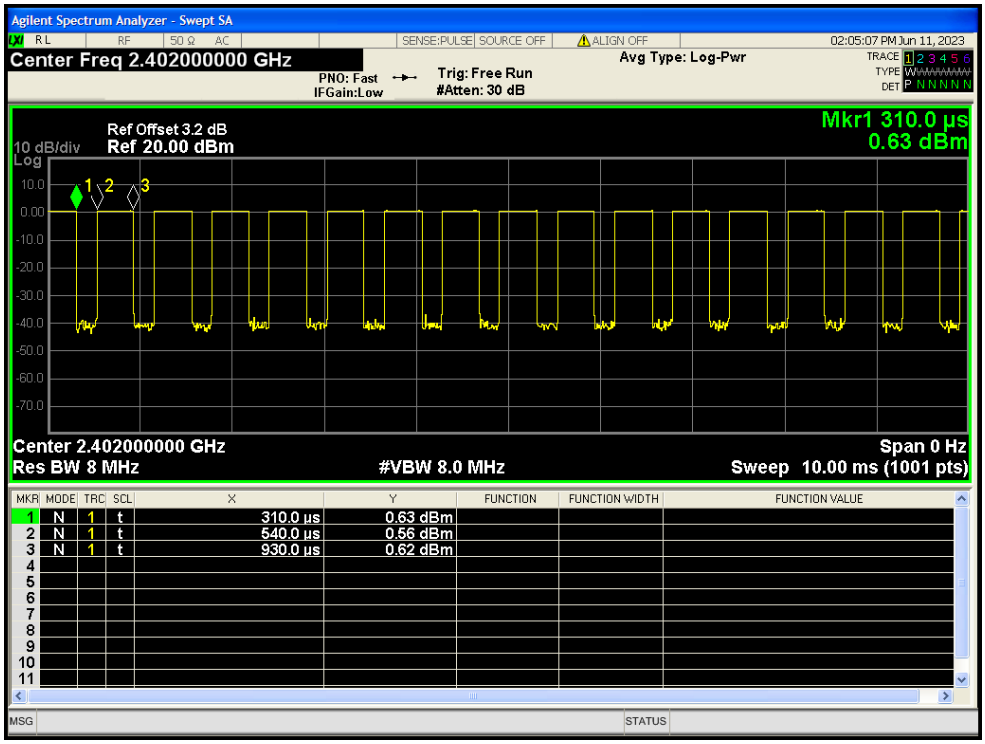
APPENDIX A

Duty Cycle

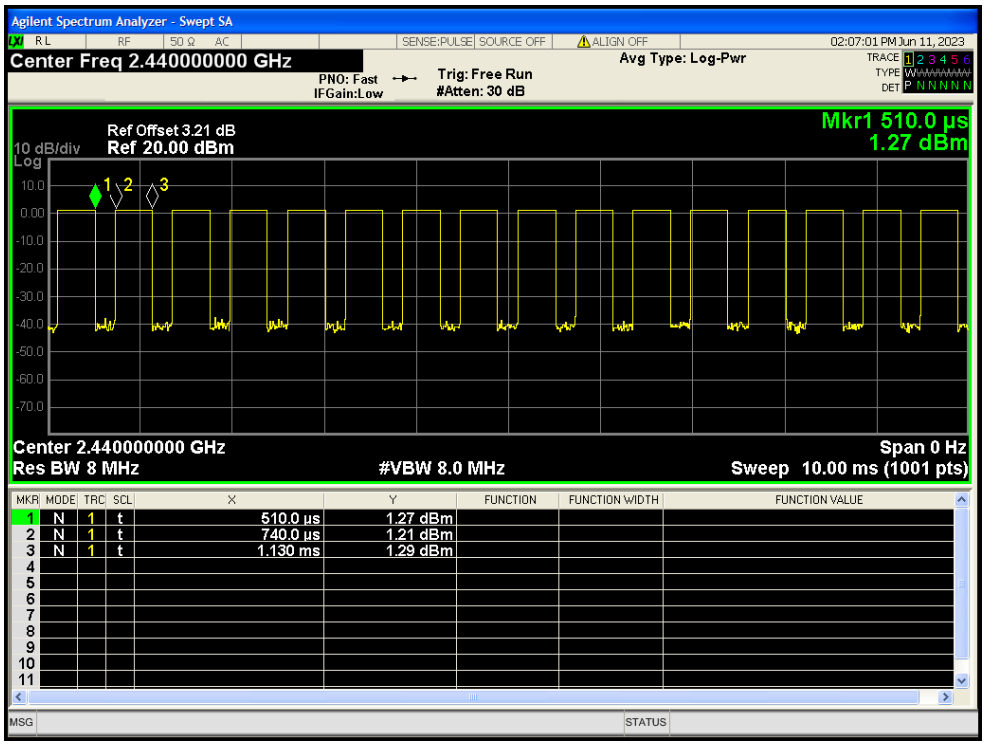
Condition	Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	BLE 1M	2402	Ant1	62.90	2.01	2.56
NVNT	BLE 1M	2440	Ant1	62.90	2.01	2.56
NVNT	BLE 1M	2480	Ant1	63.49	1.97	2.50
NVNT	BLE 2M	2402	Ant1	33.33	4.77	4.76
NVNT	BLE 2M	2440	Ant1	33.33	4.77	4.76
NVNT	BLE 2M	2480	Ant1	33.33	4.77	4.76

Test Graphs

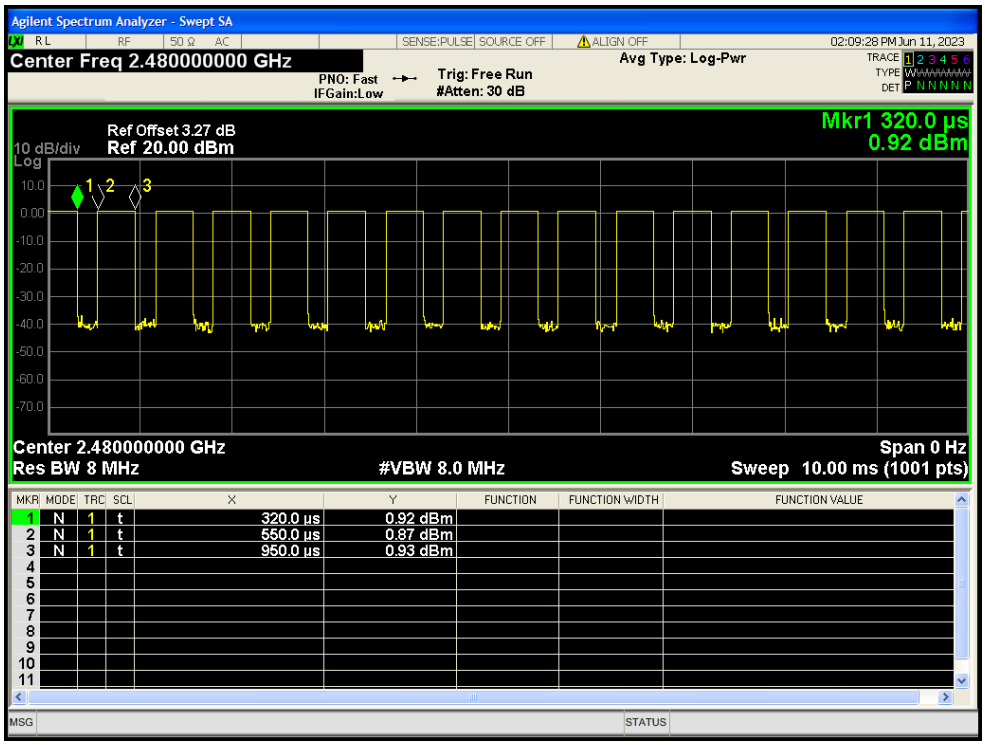
Duty Cycle NVNT BLE 1M 2402MHz Ant1 SISO



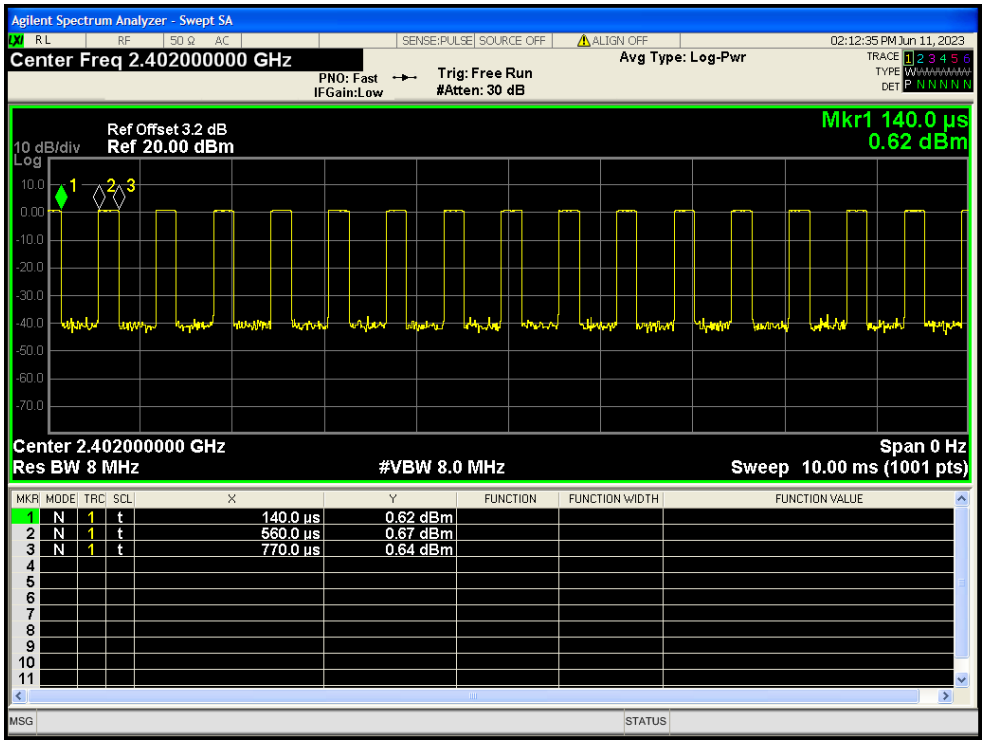
Duty Cycle NVNT BLE 1M 2440MHz Ant1 SISO



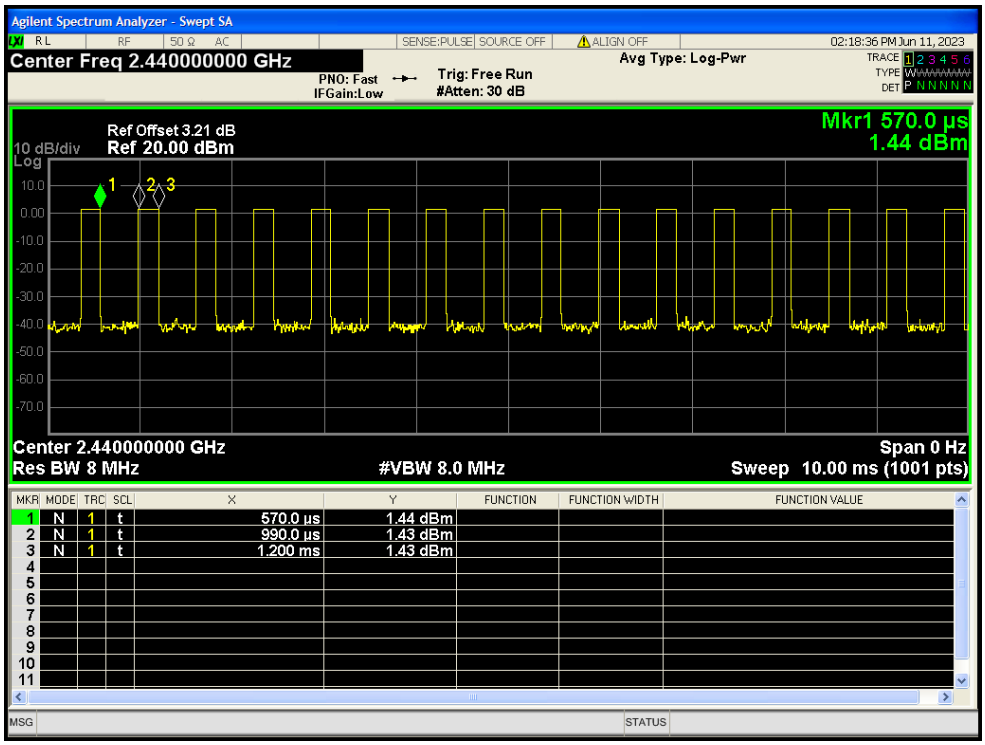
Duty Cycle NVNT BLE 1M 2480MHz Ant1 SISO



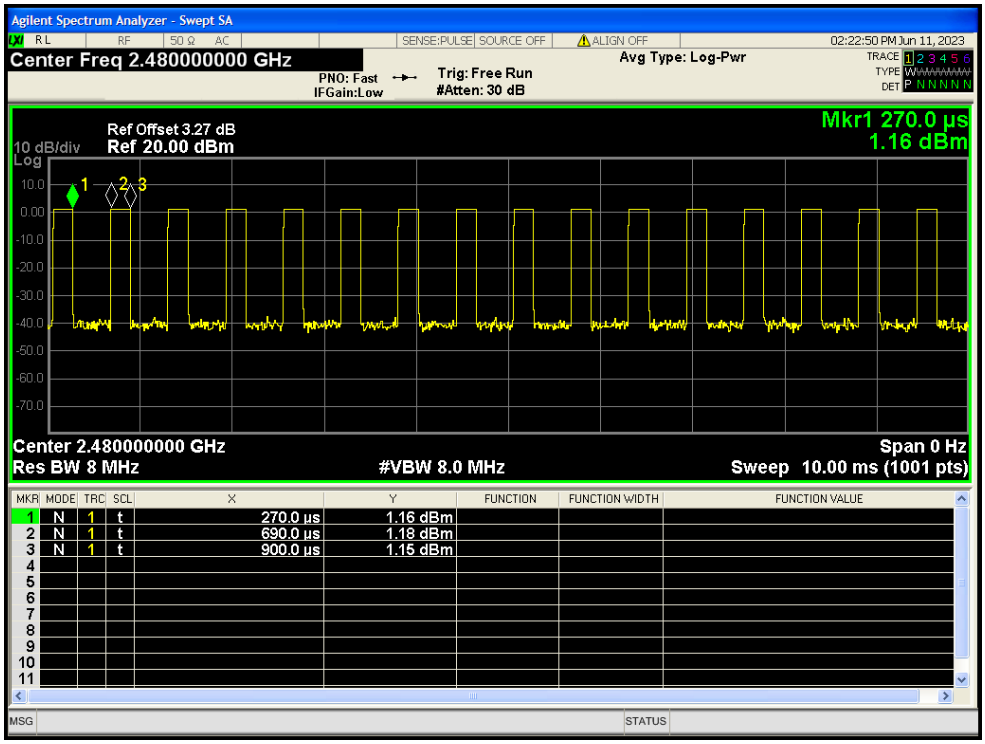
Duty Cycle NVNT BLE 2M 2402MHz Ant1 SISO



Duty Cycle NVNT BLE 2M 2440MHz Ant1 SISO



Duty Cycle NVNT BLE 2M 2480MHz Ant1 SISO



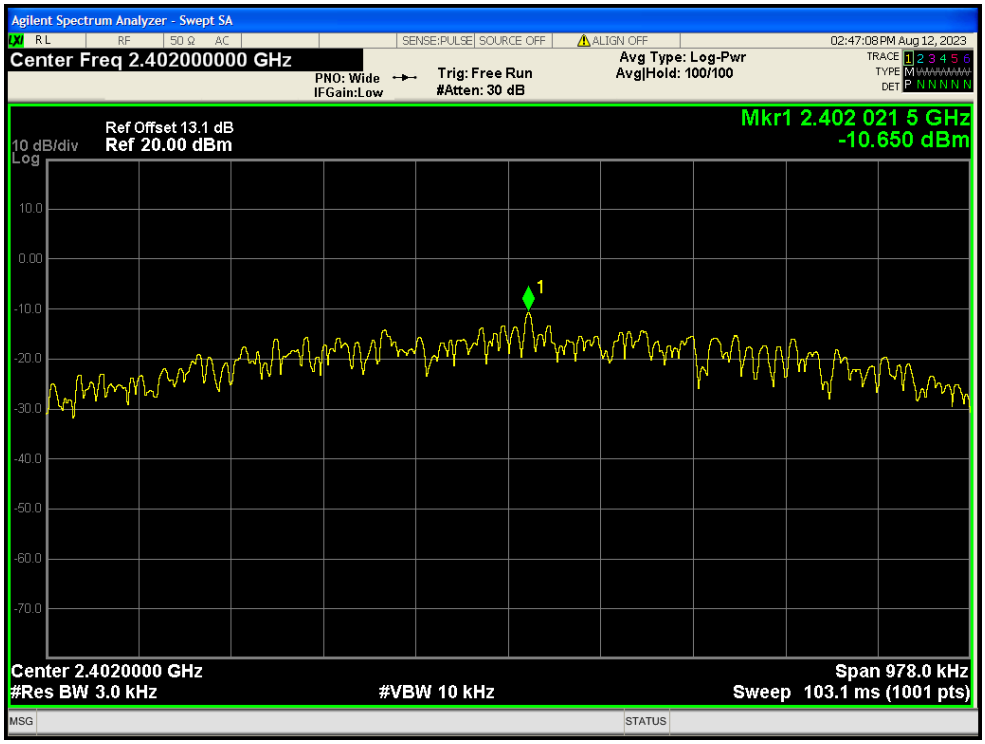
APPENDIX B

Maximum Power Spectral Density Level

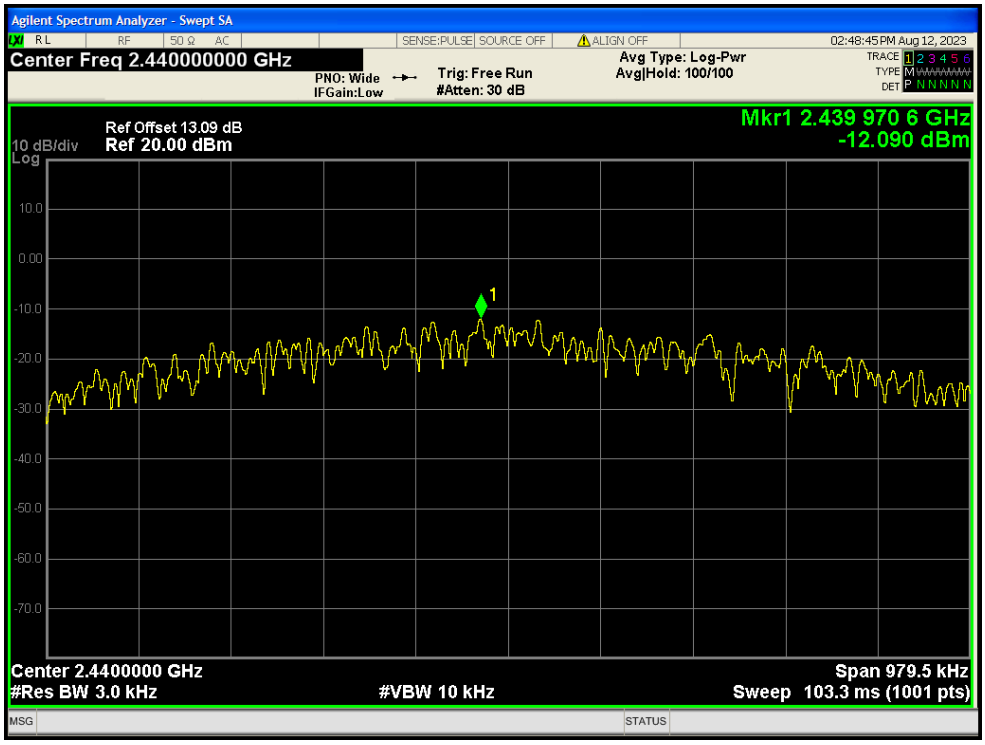
Condition	Mode	Frequency (MHz)	Antenna	Conducted PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE 1M	2402	Ant1	-10.65	0	-10.65	8	Pass
NVNT	BLE 1M	2440	Ant1	-12.09	0	-12.09	8	Pass
NVNT	BLE 1M	2480	Ant1	-11.9	0	-11.9	8	Pass
NVNT	BLE 2M	2402	Ant1	-15.32	0	-15.32	8	Pass
NVNT	BLE 2M	2440	Ant1	-14.36	0	-14.36	8	Pass
NVNT	BLE 2M	2480	Ant1	-13.88	0	-13.88	8	Pass

Test Graphs

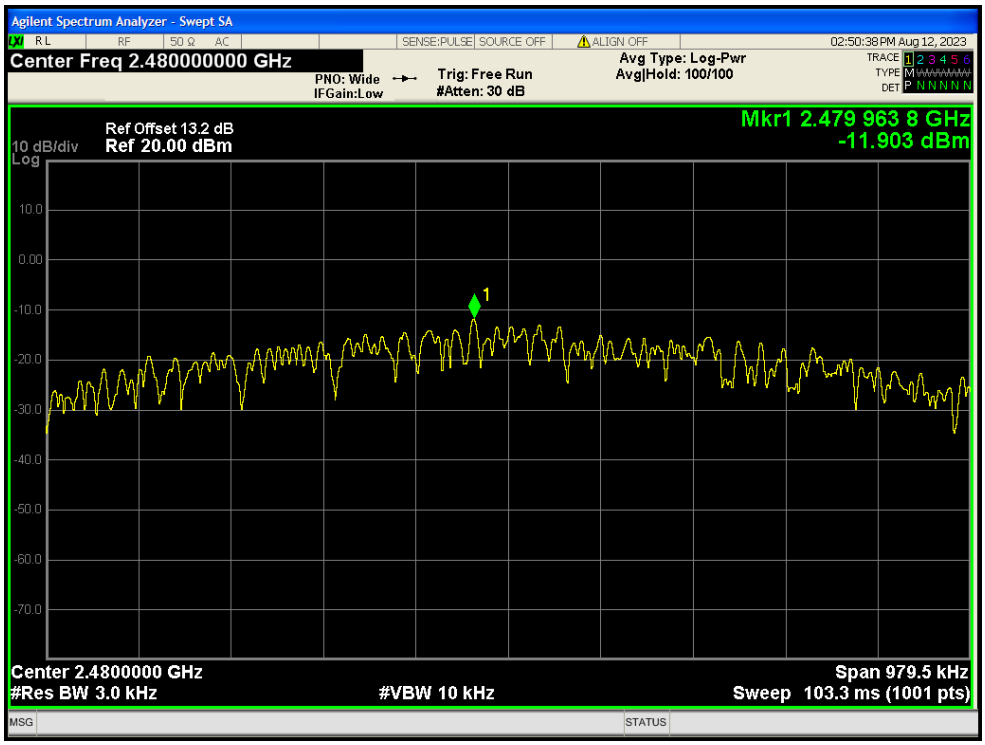
PSD NVNT BLE 1M 2402MHz Ant1 SISO



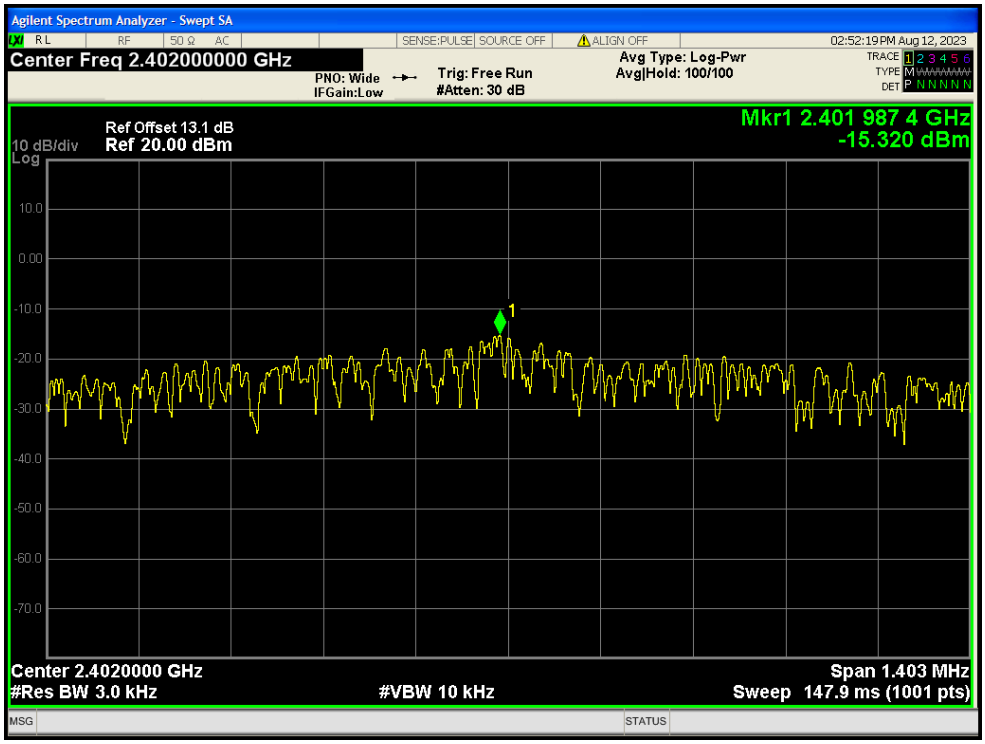
PSD NVNT BLE 1M 2440MHz Ant1 SISO



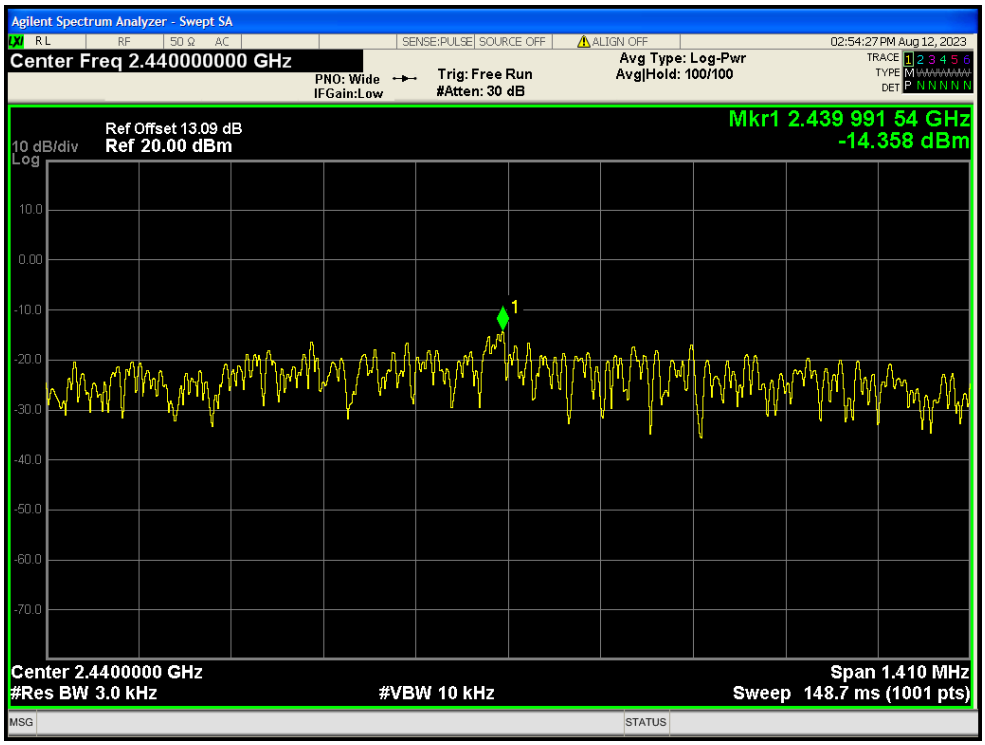
PSD NVNT BLE 1M 2480MHz Ant1 SISO



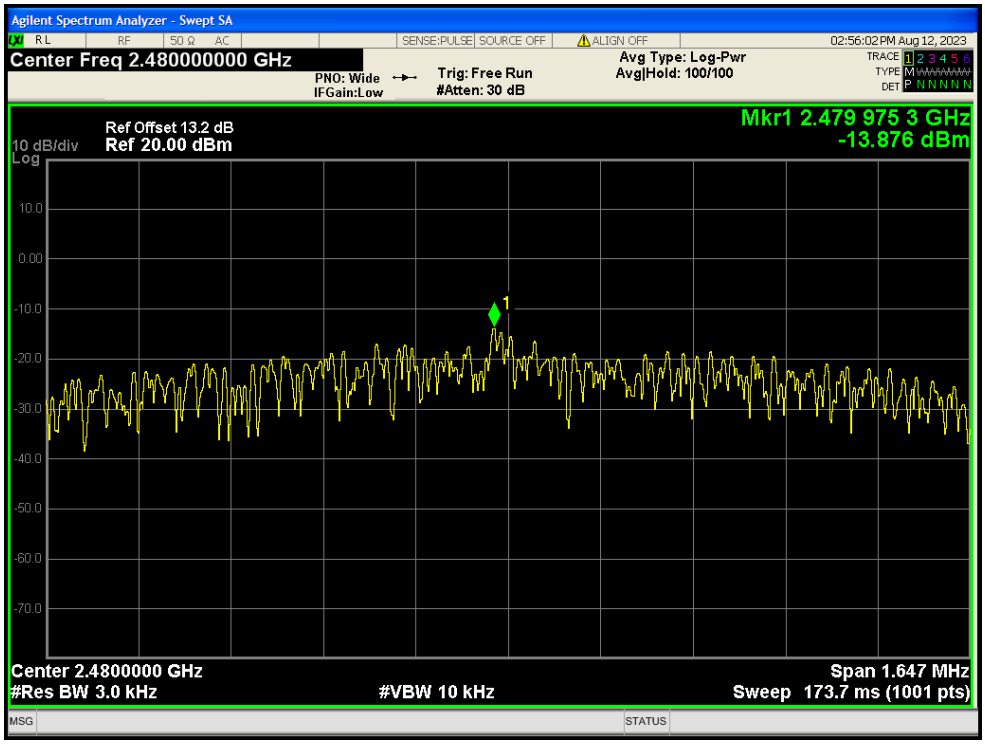
PSD NVNT BLE 2M 2402MHz Ant1 SISO



PSD NVNT BLE 2M 2440MHz Ant1 SISO



PSD NVNT BLE 2M 2480MHz Ant1 SISO



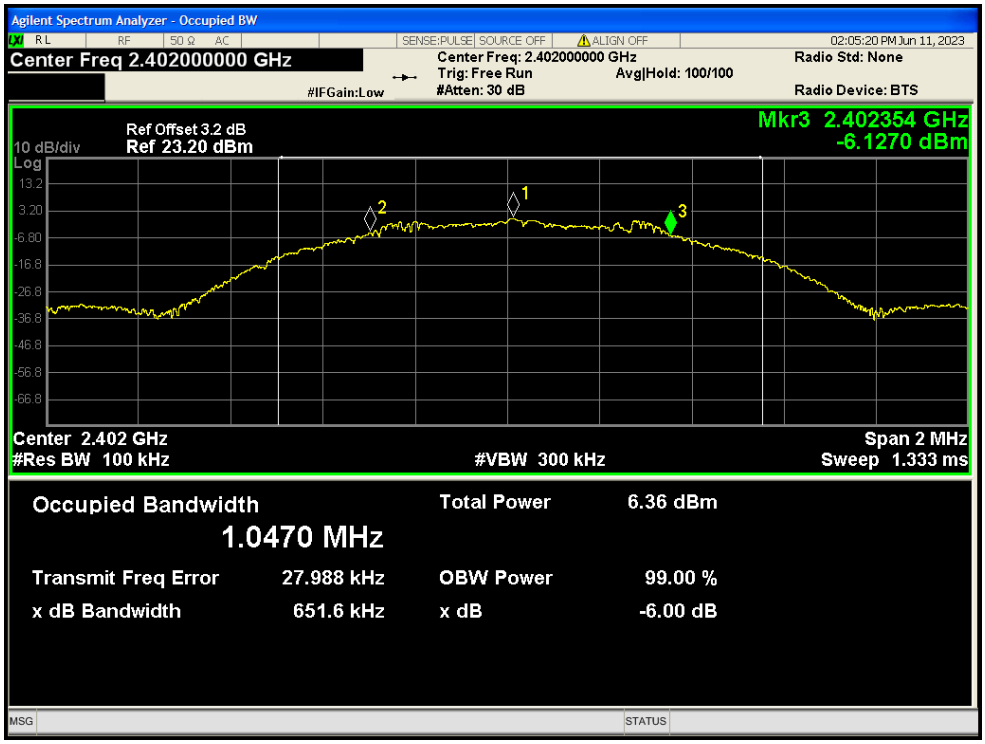
APPENDIX C

-6dB Bandwidth

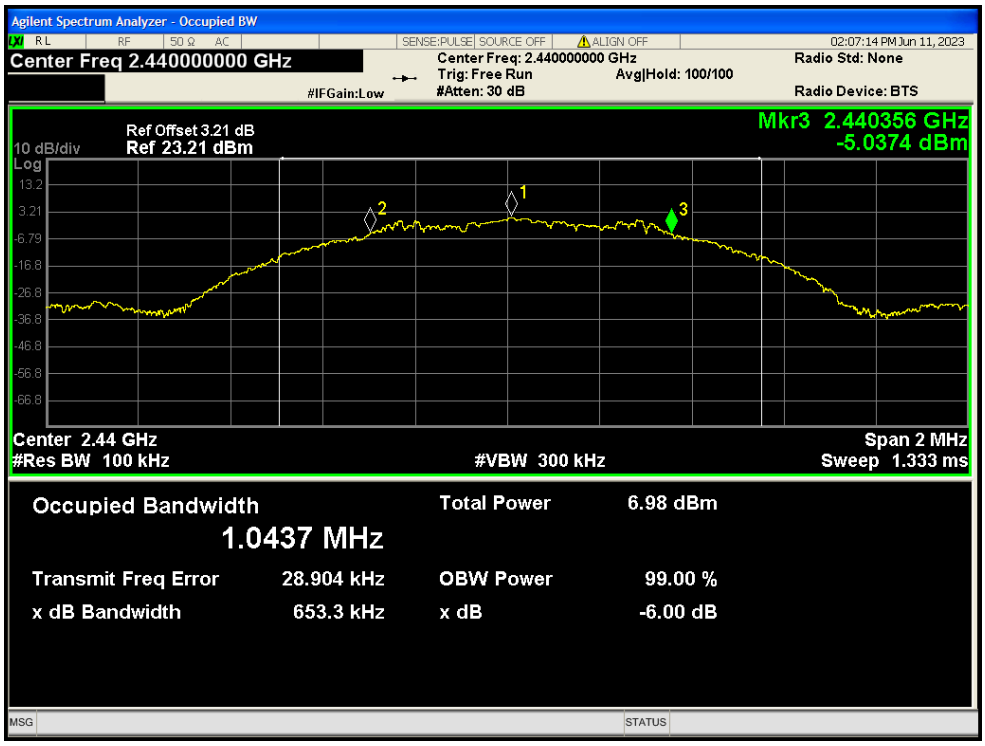
Condition	Mode	Frequency (MHz)	Antenna	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE 1M	2402	Ant1	0.652	0.5	Pass
NVNT	BLE 1M	2440	Ant1	0.653	0.5	Pass
NVNT	BLE 1M	2480	Ant1	0.653	0.5	Pass
NVNT	BLE 2M	2402	Ant1	1.115	0.5	Pass
NVNT	BLE 2M	2440	Ant1	1.092	0.5	Pass
NVNT	BLE 2M	2480	Ant1	1.033	0.5	Pass

Test Graphs

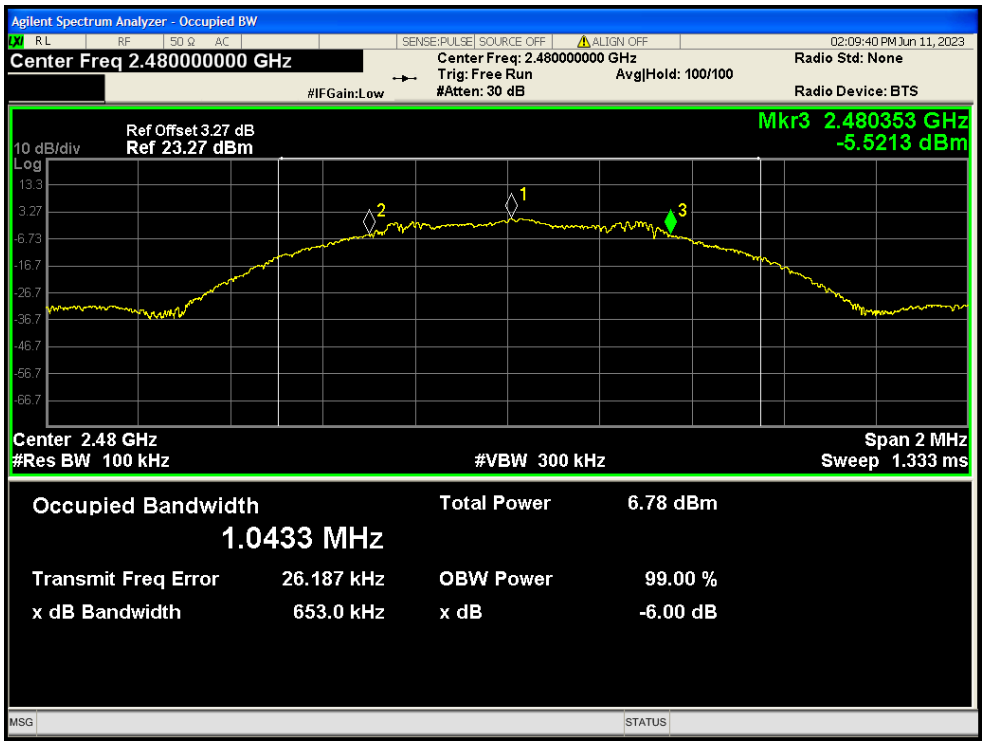
-6dB Bandwidth NVNT BLE 1M 2402MHz Ant1 SISO



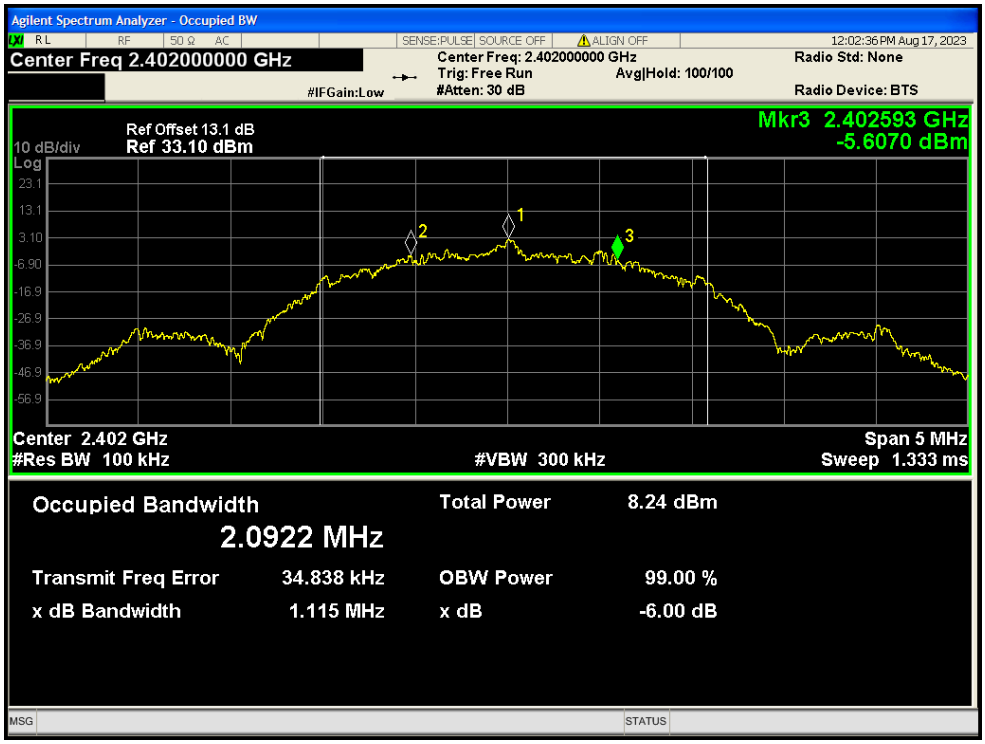
-6dB Bandwidth NVNT BLE 1M 2440MHz Ant1 SISO



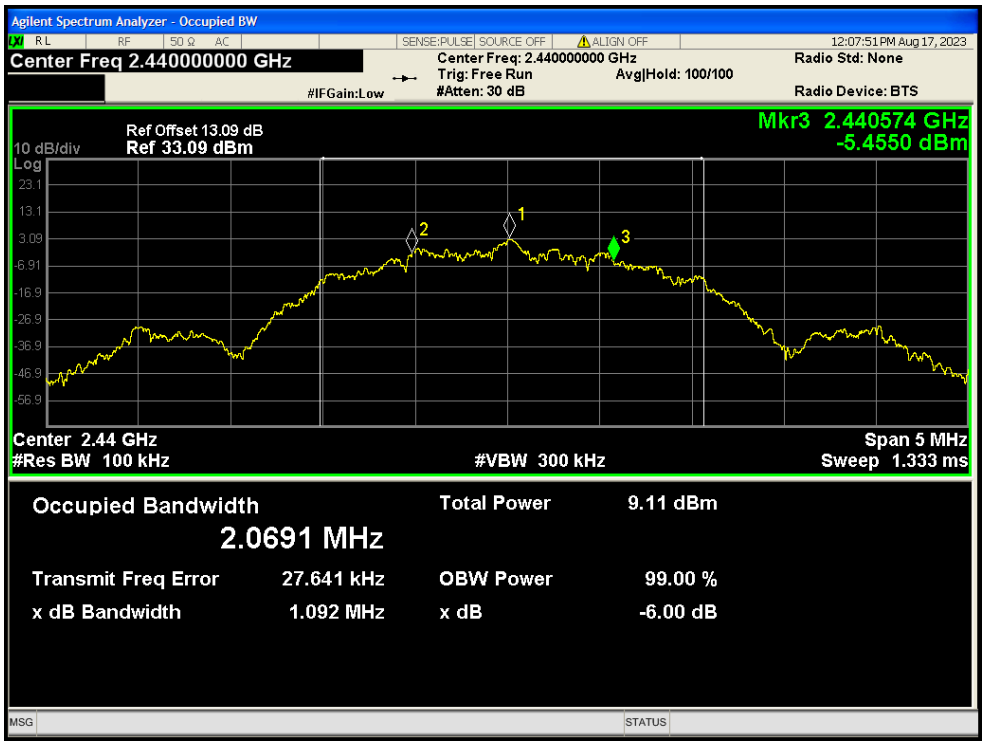
-6dB Bandwidth NVNT BLE 1M 2480MHz Ant1 SISO



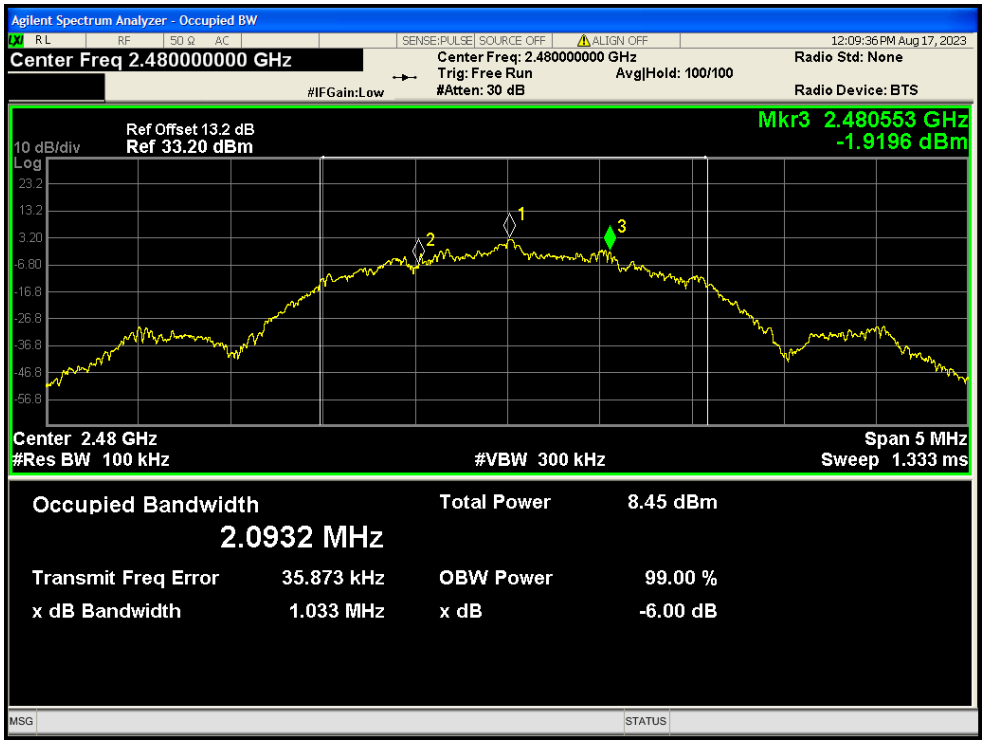
-6dB Bandwidth NVNT BLE 2M 2402MHz Ant1 SISO



-6dB Bandwidth NVNT BLE 2M 2440MHz Ant1 SISO



-6dB Bandwidth NVNT BLE 2M 2480MHz Ant1 SISO



APPENDIX D

Maximum Average Conducted Output Power

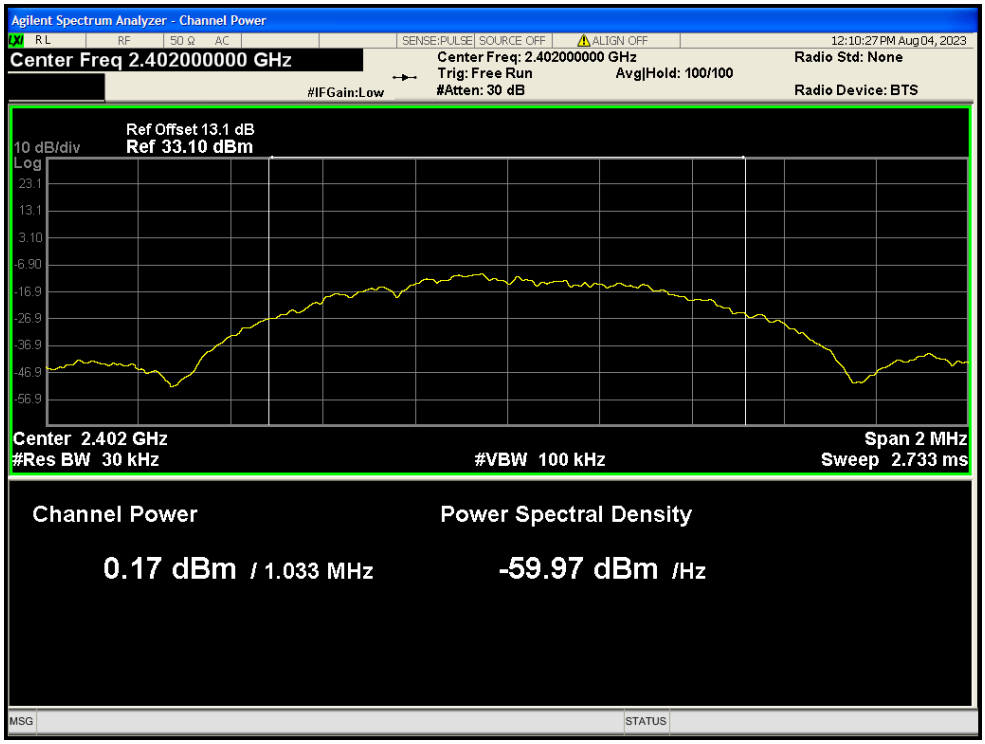
Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Conducted Power (dBm)	Total Conducted Power (mW)	Limit Conducted(dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	0.17	2.01	2.18	1.65	30	Pass
NVNT	BLE 1M	2440	Ant1	0.73	2.01	2.74	1.88	30	Pass
NVNT	BLE 1M	2480	Ant1	0.68	1.97	2.65	1.84	30	Pass
NVNT	BLE 2M	2402	Ant1	-2.58	4.77	2.19	1.66	30	Pass
NVNT	BLE 2M	2440	Ant1	-1.88	4.77	2.89	1.95	30	Pass
NVNT	BLE 2M	2480	Ant1	-1.97	4.77	2.8	1.91	30	Pass

Maximum Peak Conducted Output Power

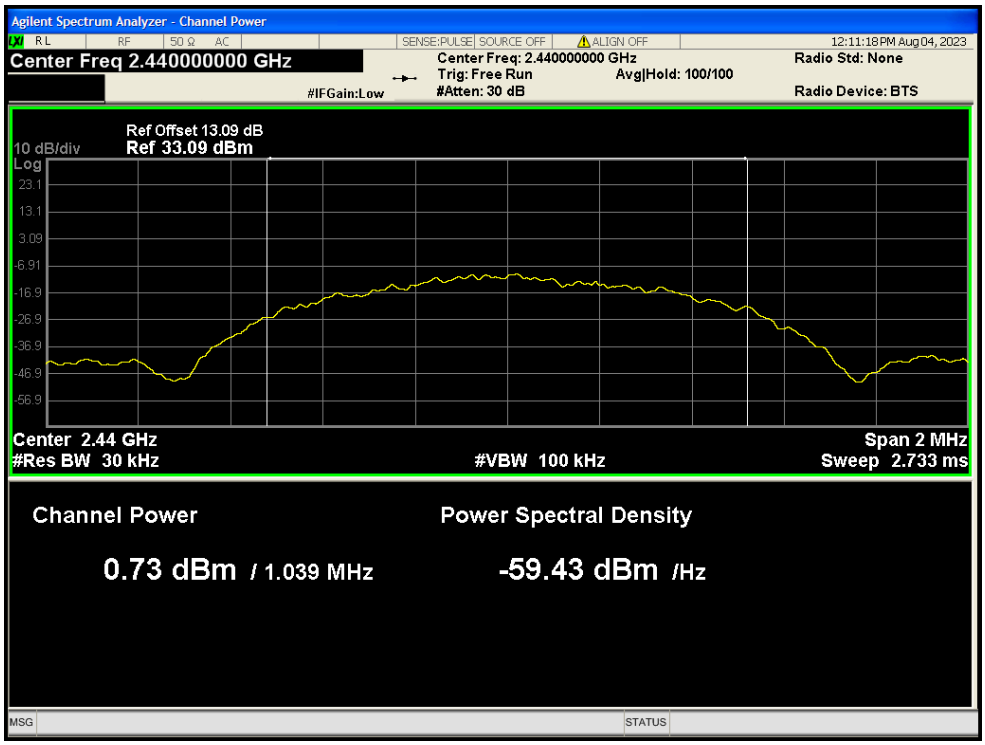
Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Conducted Power (dBm)	Total Conducted Power (mW)	Limit Conducted(dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	2.67	0	2.67	1.85	30	Pass
NVNT	BLE 1M	2440	Ant1	3.27	0	3.27	2.12	30	Pass
NVNT	BLE 1M	2480	Ant1	3.07	0	3.07	2.03	30	Pass
NVNT	BLE 2M	2402	Ant1	2.64	0	2.64	1.84	30	Pass
NVNT	BLE 2M	2440	Ant1	3.14	0	3.14	2.06	30	Pass
NVNT	BLE 2M	2480	Ant1	2.86	0	2.86	1.93	30	Pass

Maximum Average Conducted Output Power

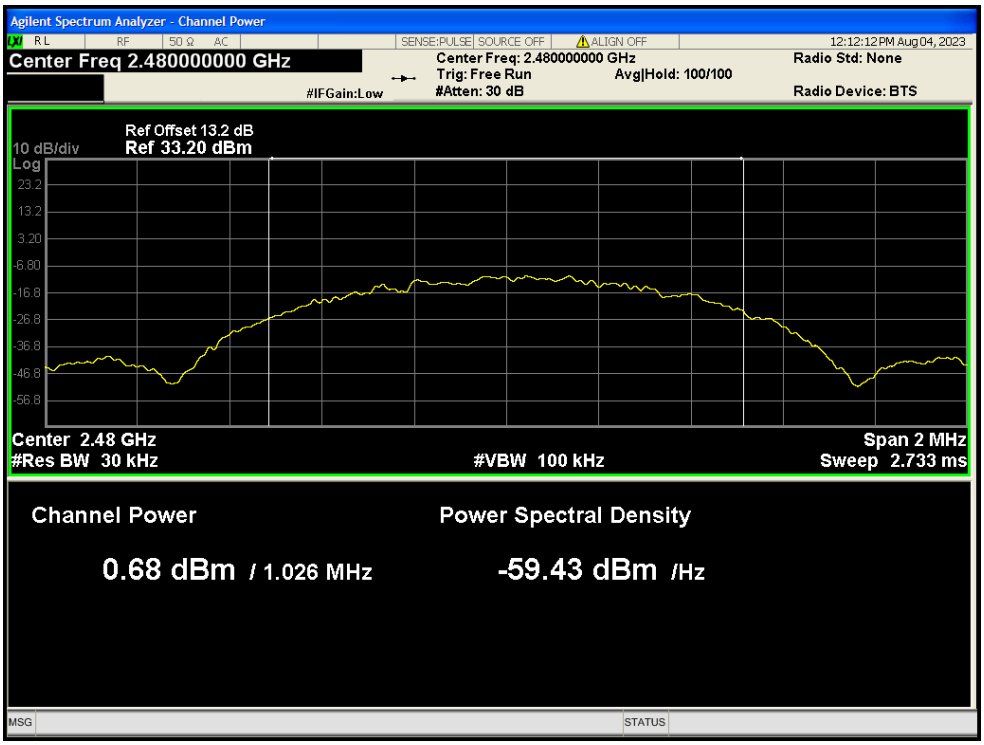
Test Graphs
Average Power NVNT BLE 1M 2402MHz Ant1 SISO



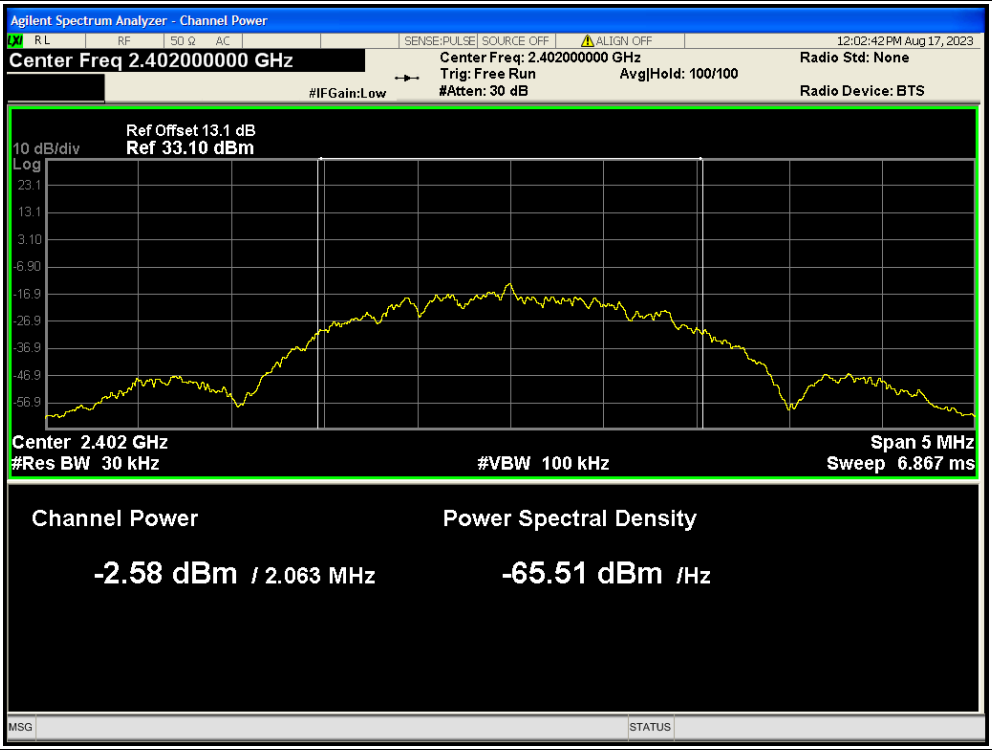
Average Power NVNT BLE 1M 2440MHz Ant1 SISO



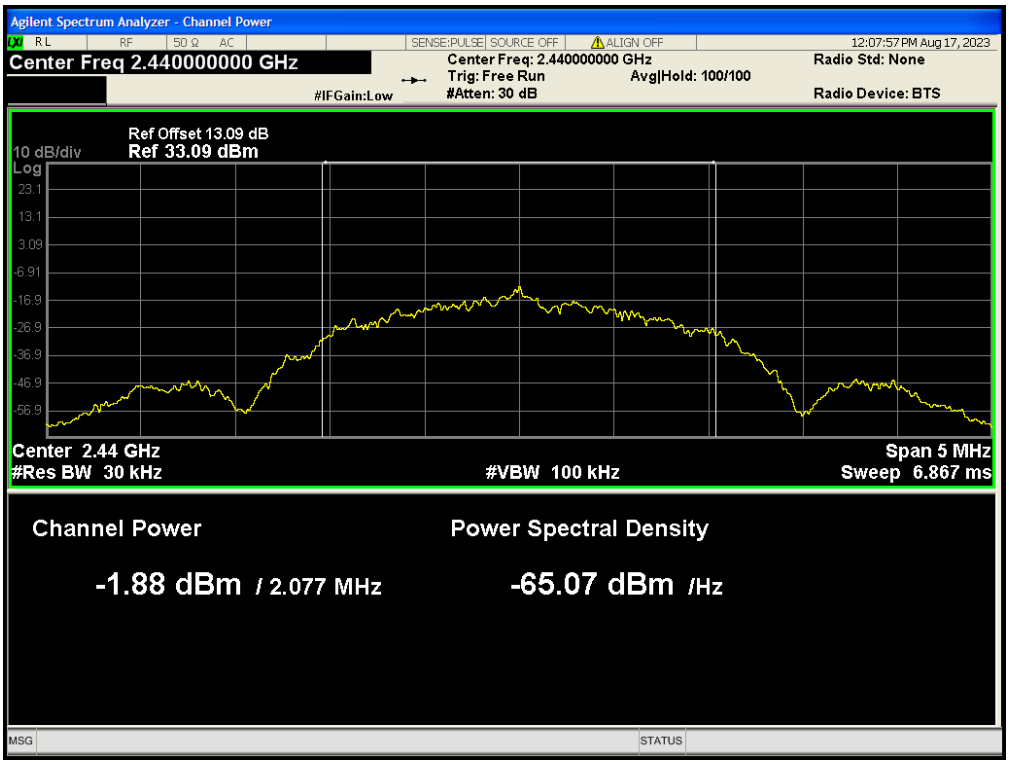
Average Power NVNT BLE 1M 2480MHz Ant1 SISO



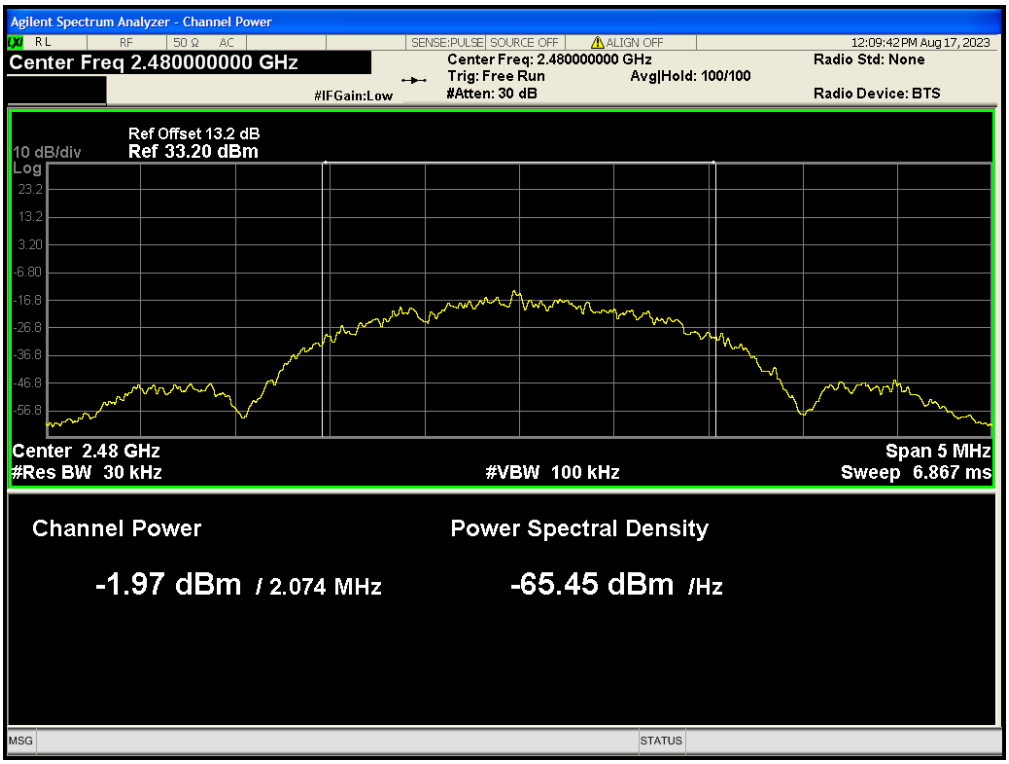
Average Power NVNT BLE 2M 2402MHz Ant1 SISO



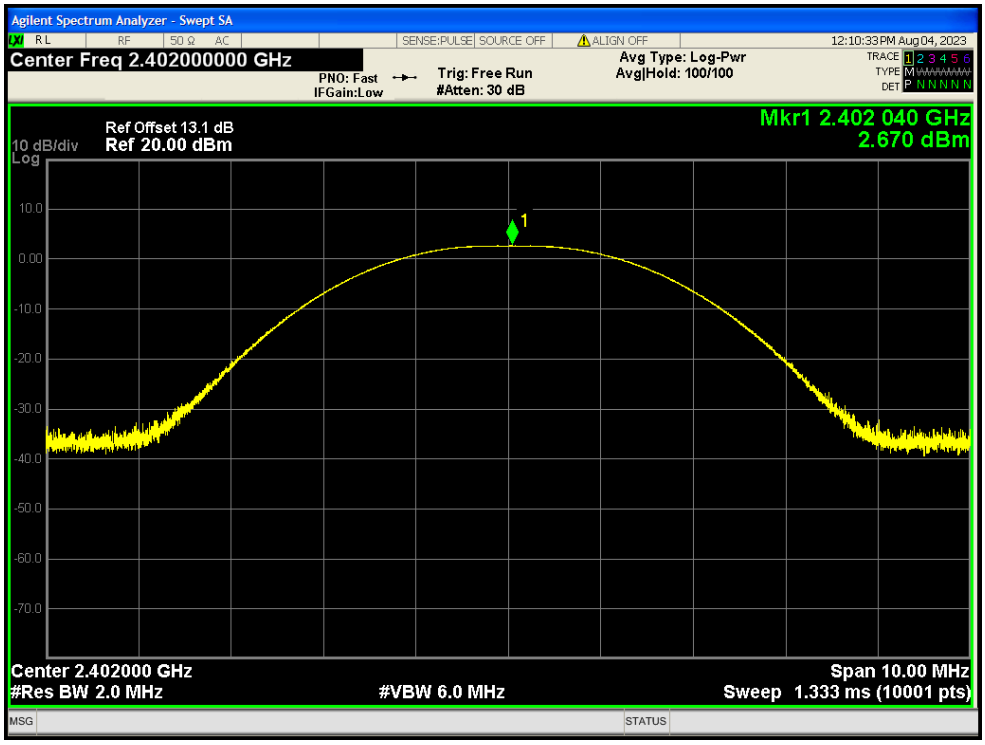
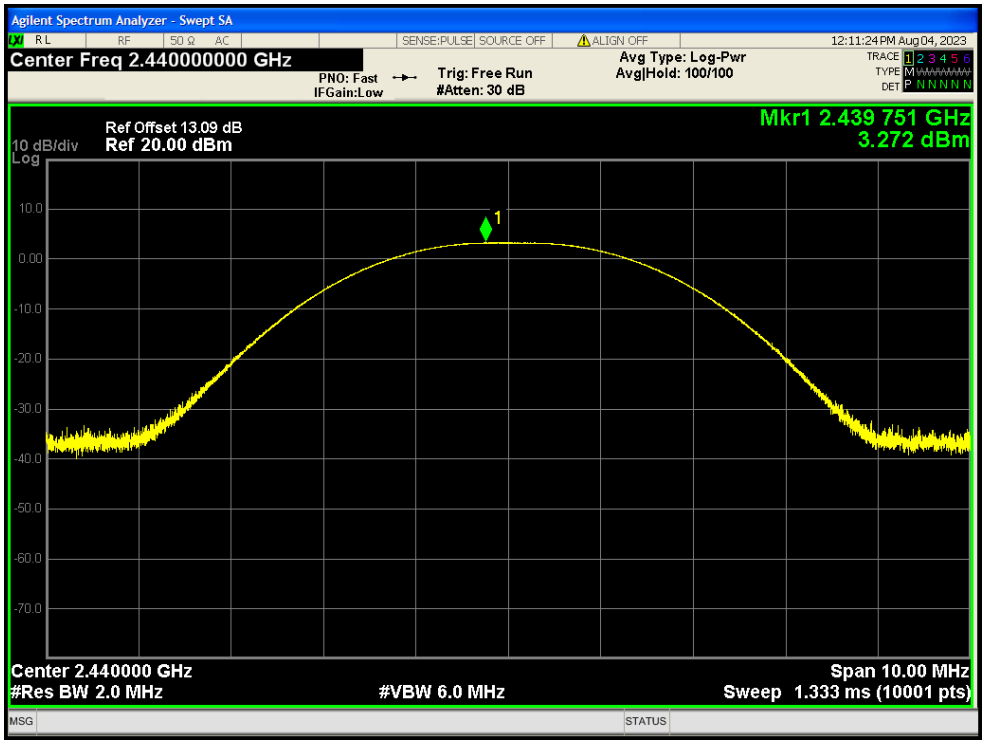
Average Power NVNT BLE 2M 2440MHz Ant1 SISO



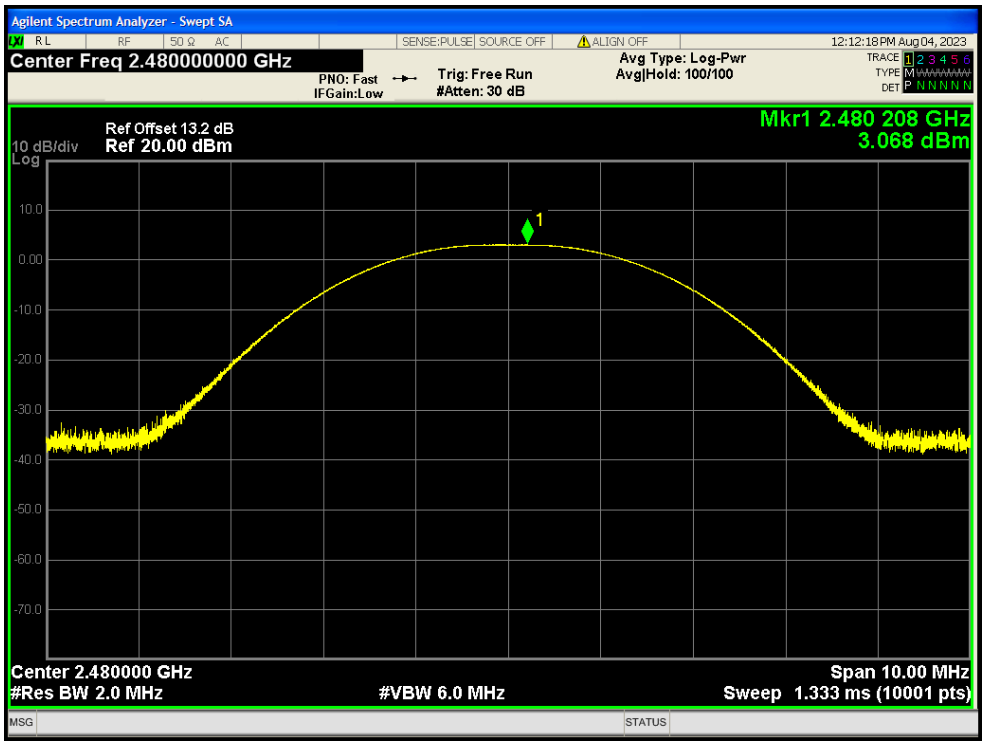
Average Power NVNT BLE 2M 2480MHz Ant1 SISO



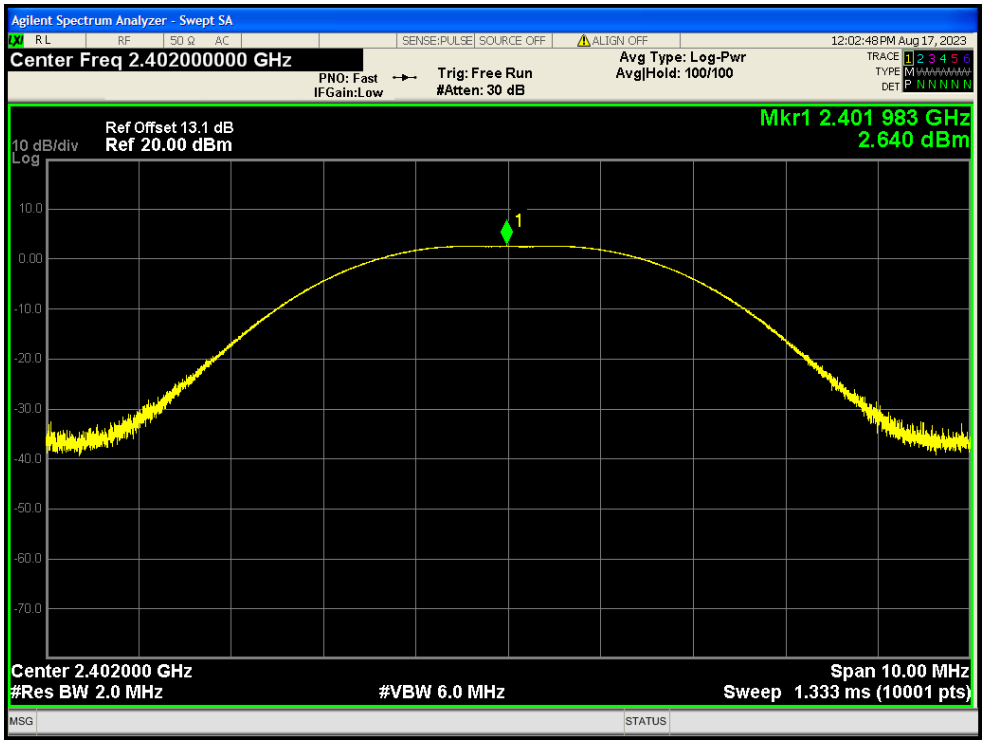
Maximum Peak Conducted Output Power

Test Graphs
Peak Power NVNT BLE 1M 2402MHz Ant1 SISO

Peak Power NVNT BLE 1M 2440MHz Ant1 SISO


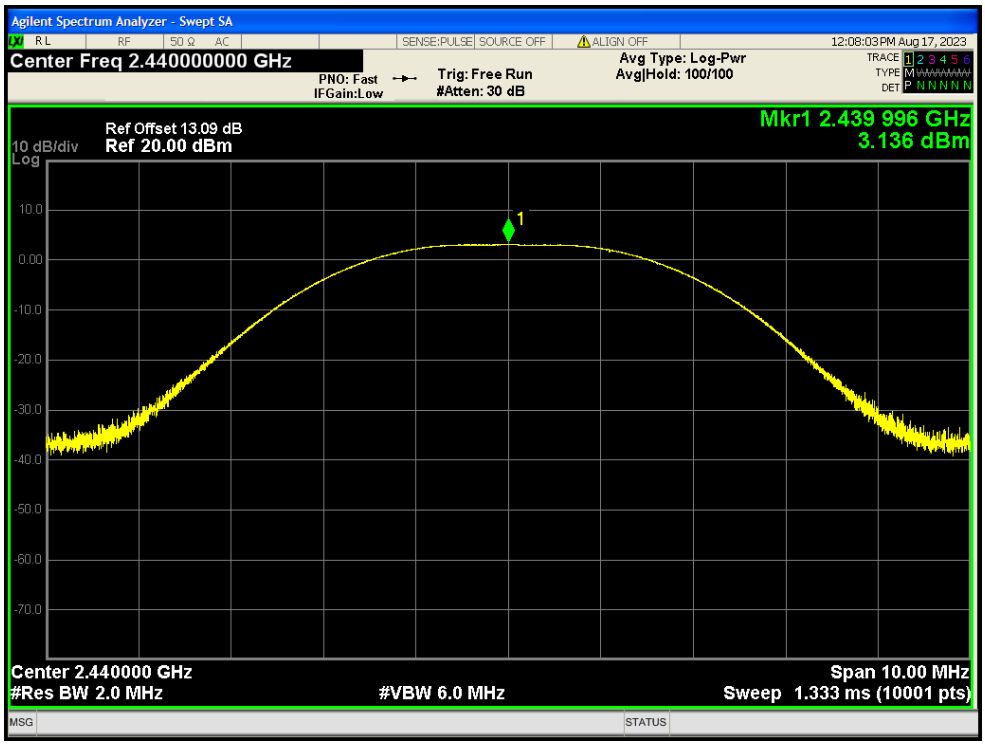
Peak Power NVNT BLE 1M 2480MHz Ant1 SISO



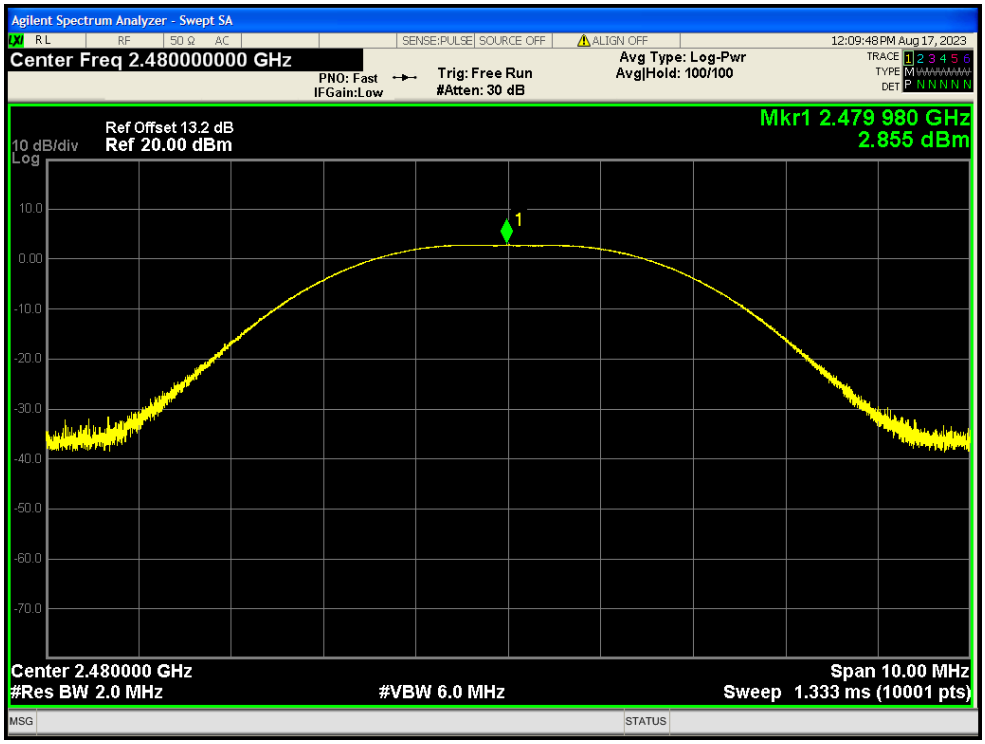
Peak Power NVNT BLE 2M 2402MHz Ant1 SISO



Peak Power NVNT BLE 2M 2440MHz Ant1 SISO



Peak Power NVNT BLE 2M 2480MHz Ant1 SISO



APPENDIX E

Band Edge

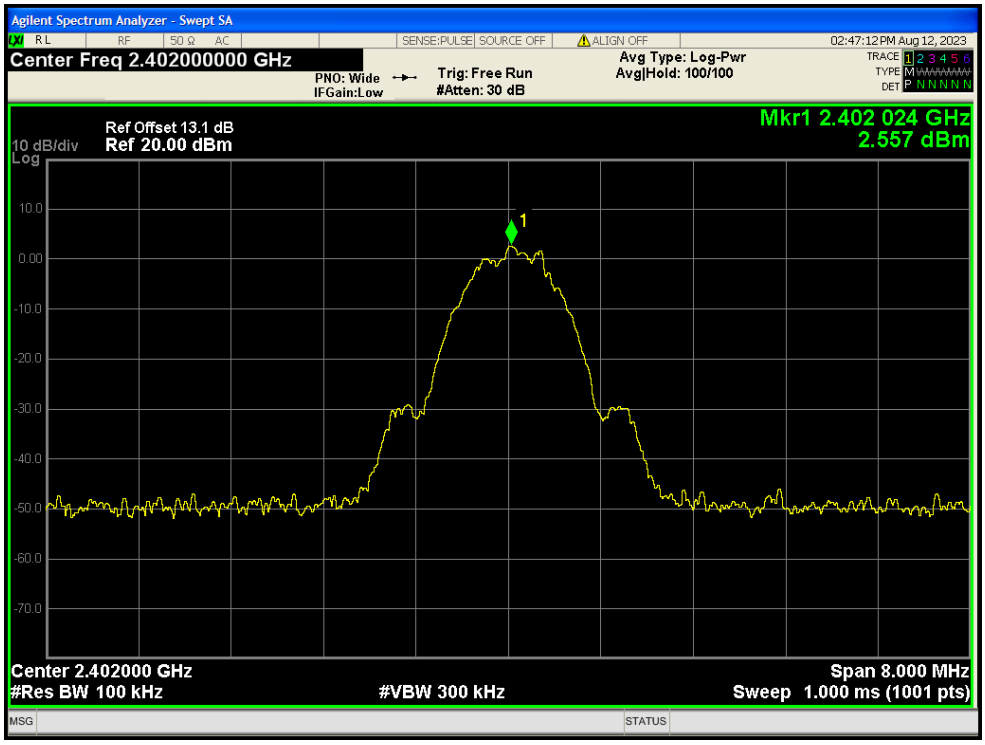
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-47.96	-20	Pass
NVNT	BLE 1M	2480	Ant1	-48.54	-20	Pass
NVNT	BLE 2M	2402	Ant1	-34.52	-20	Pass
NVNT	BLE 2M	2480	Ant1	-45.51	-20	Pass

Conducted RF Spurious Emission

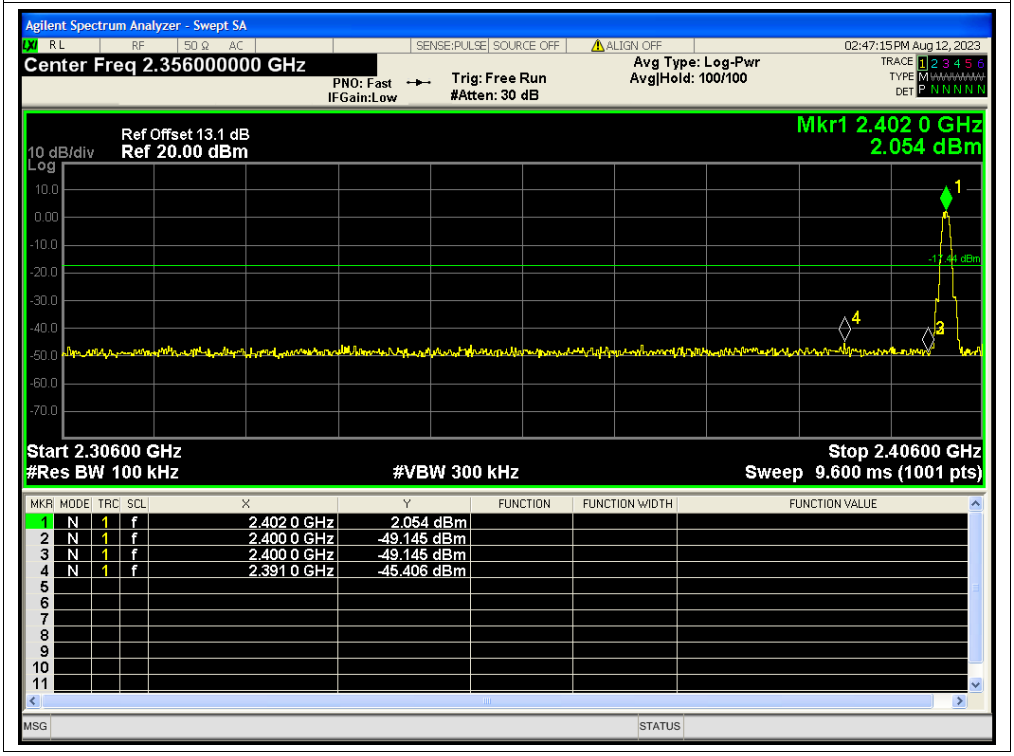
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-31.30	-20	Pass
NVNT	BLE 1M	2440	Ant1	-32.02	-20	Pass
NVNT	BLE 1M	2480	Ant1	-31.63	-20	Pass
NVNT	BLE 2M	2402	Ant1	-30.68	-20	Pass
NVNT	BLE 2M	2440	Ant1	-31.78	-20	Pass
NVNT	BLE 2M	2480	Ant1	-31.46	-20	Pass

Test Graphs

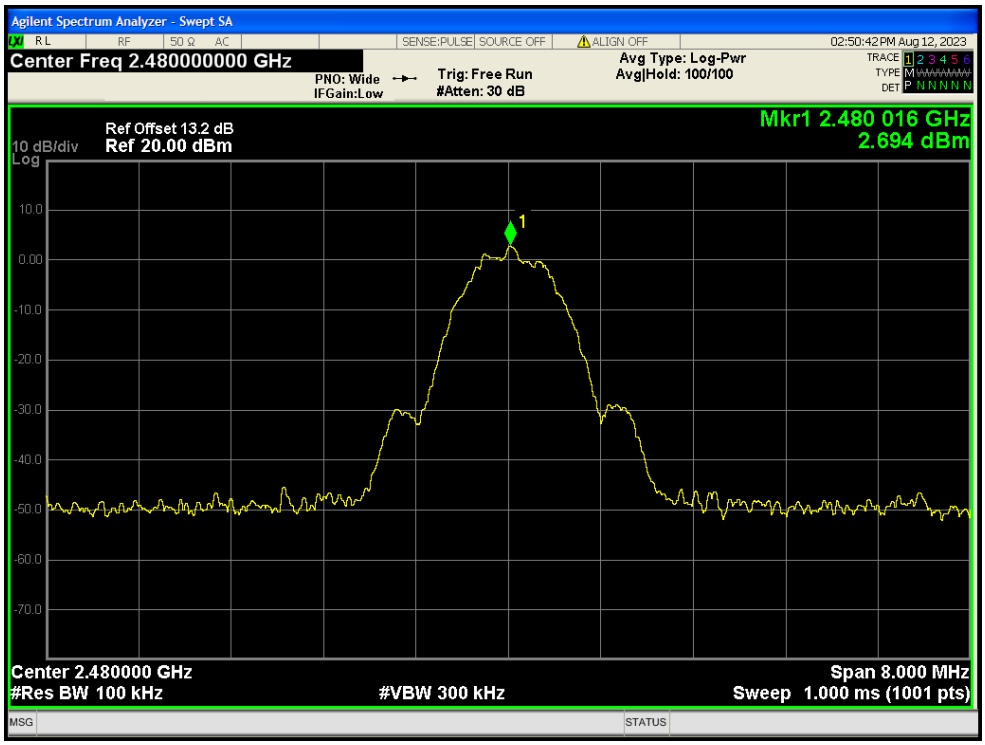
Band Edge NVNT BLE 1M 2402MHz Ant1 Ref SISO



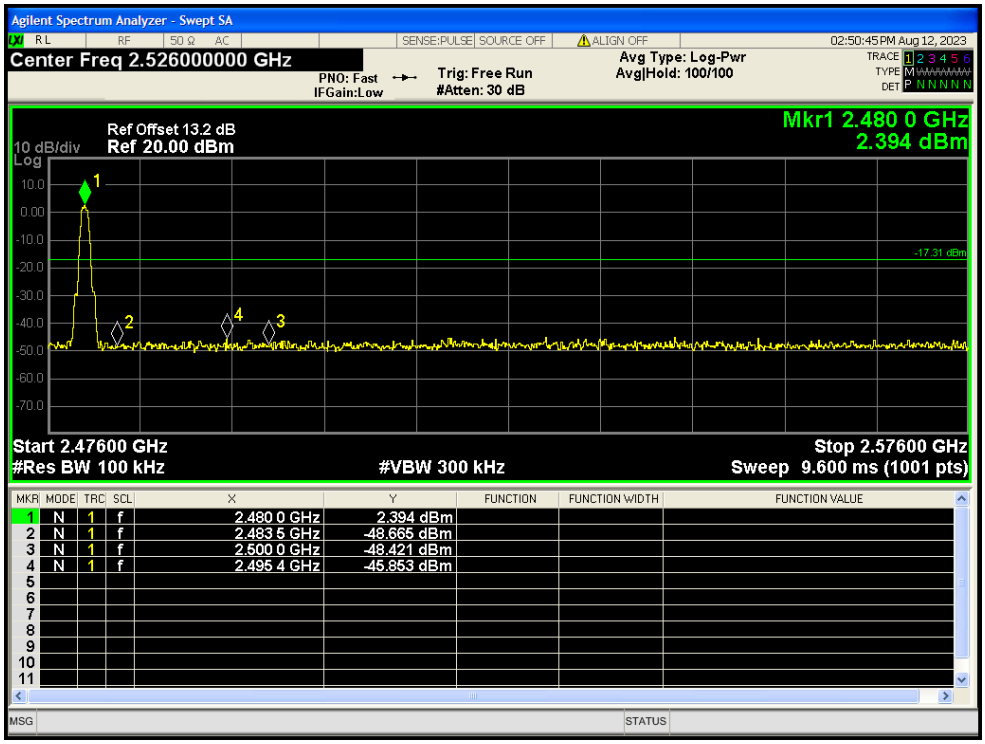
Band Edge NVNT BLE 1M 2402MHz Ant1 Emission SISO



Band Edge NVNT BLE 1M 2480MHz Ant1 Ref SISO

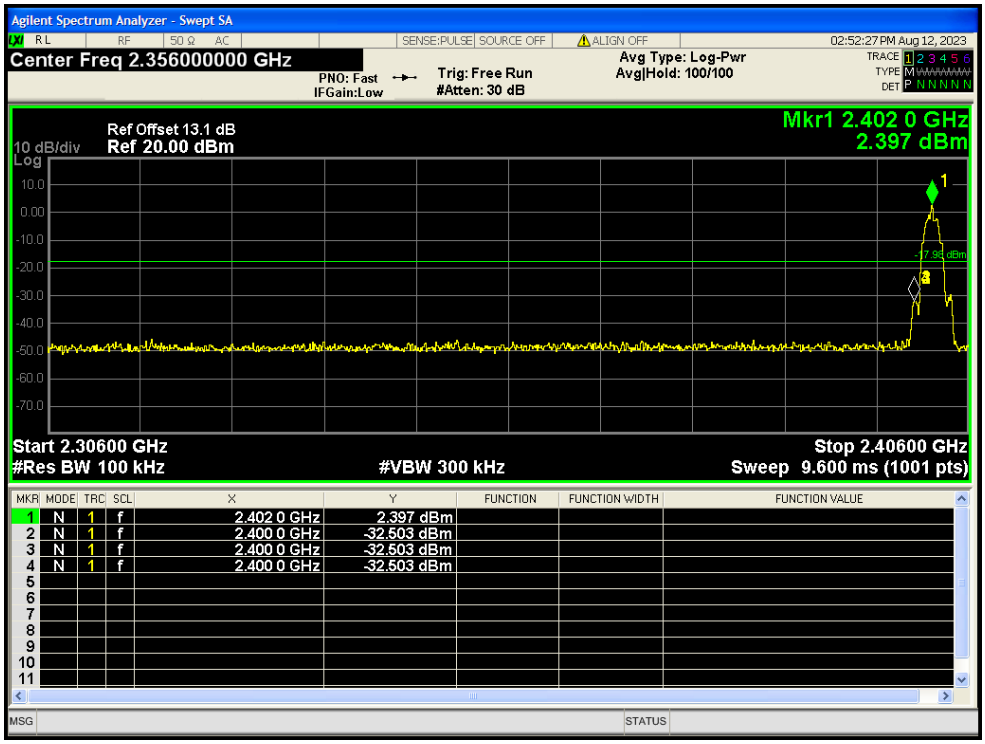


Band Edge NVNT BLE 1M 2480MHz Ant1 Emission SISO



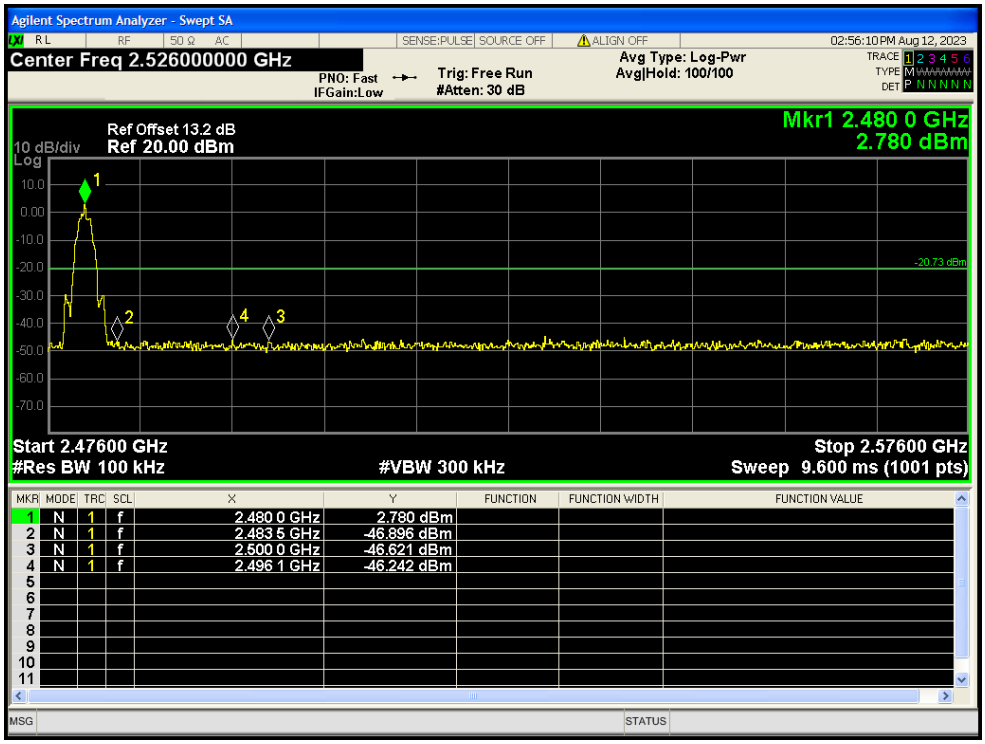
Band Edge NVNT BLE 2M 2402MHz Ant1 Ref SISO

Band Edge NVNT BLE 2M 2402MHz Ant1 Emission SISO



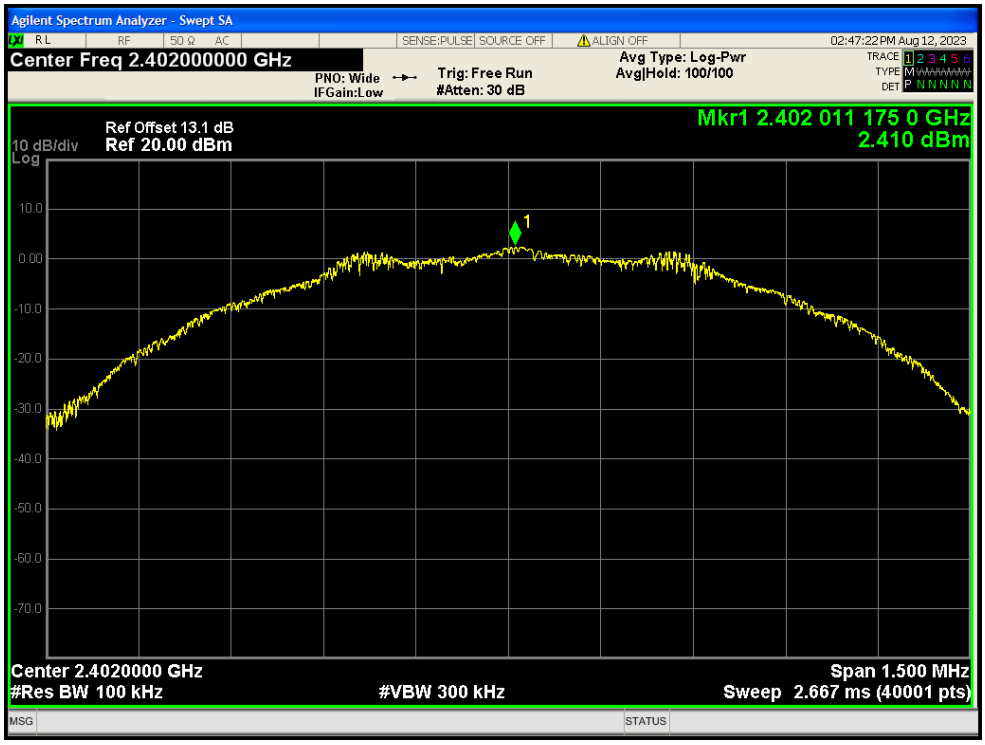
Band Edge NVNT BLE 2M 2480MHz Ant1 Ref SISO

Band Edge NVNT BLE 2M 2480MHz Ant1 Emission SISO

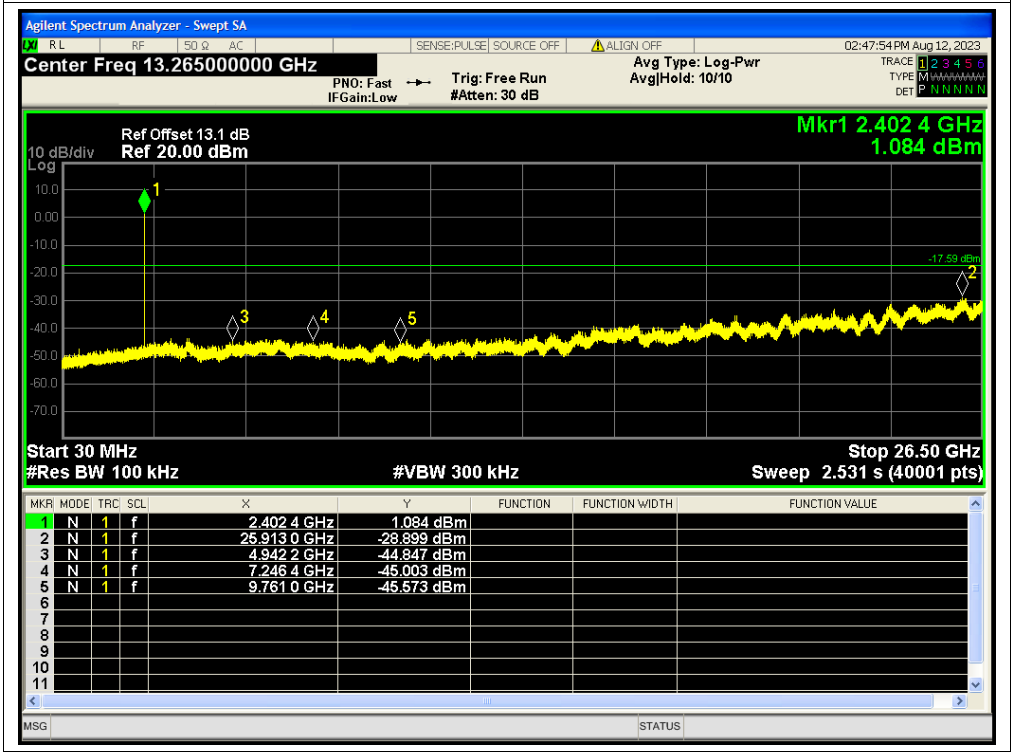


Conducted RF Spurious Emission

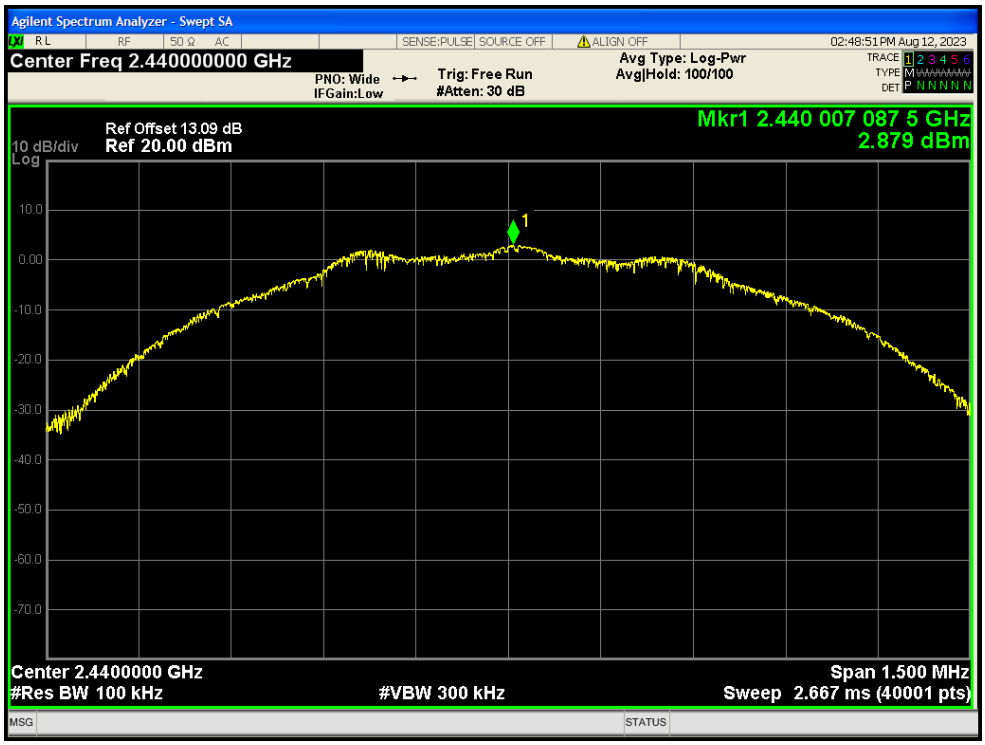
Test Graphs
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Ref SISO



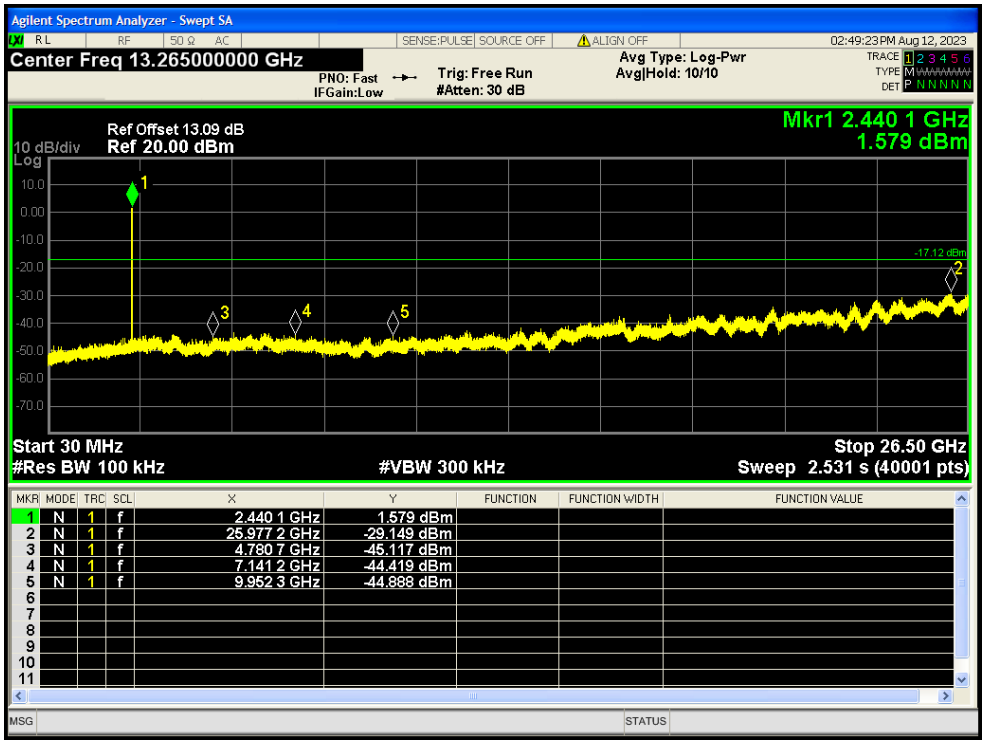
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Emission SISO



Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Ref SISO



Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Emission SISO



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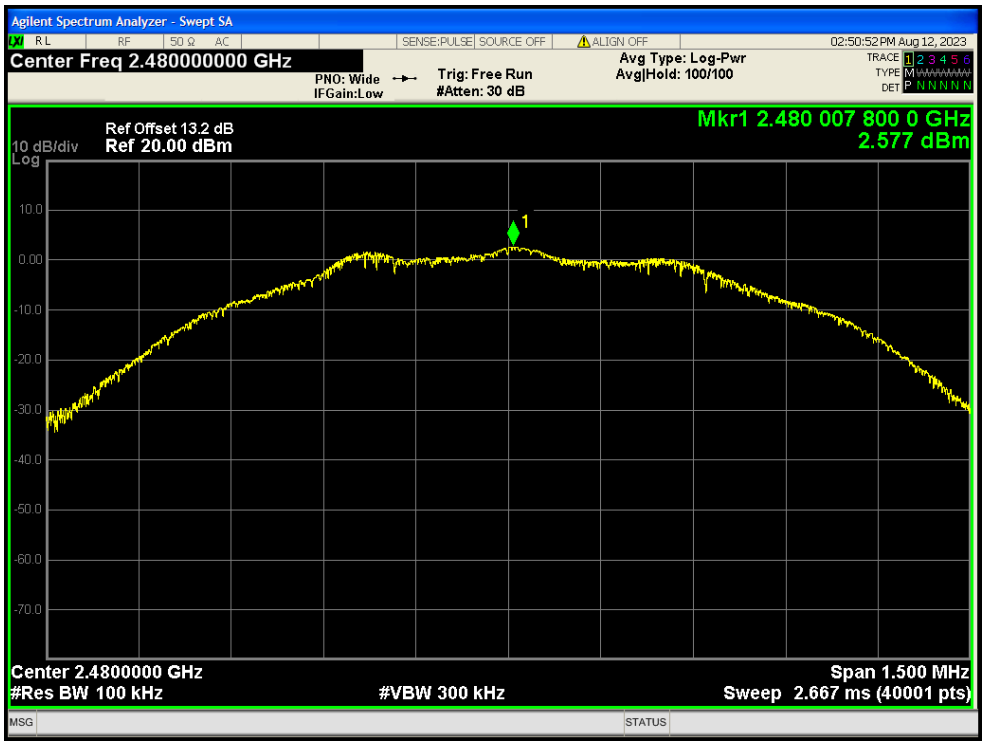

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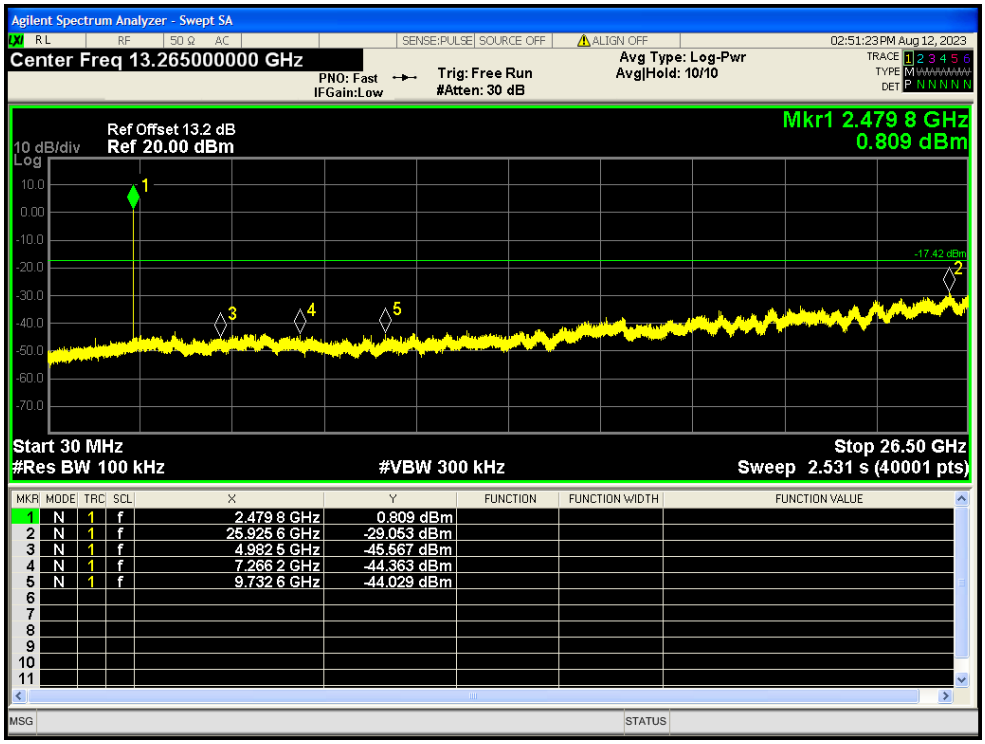
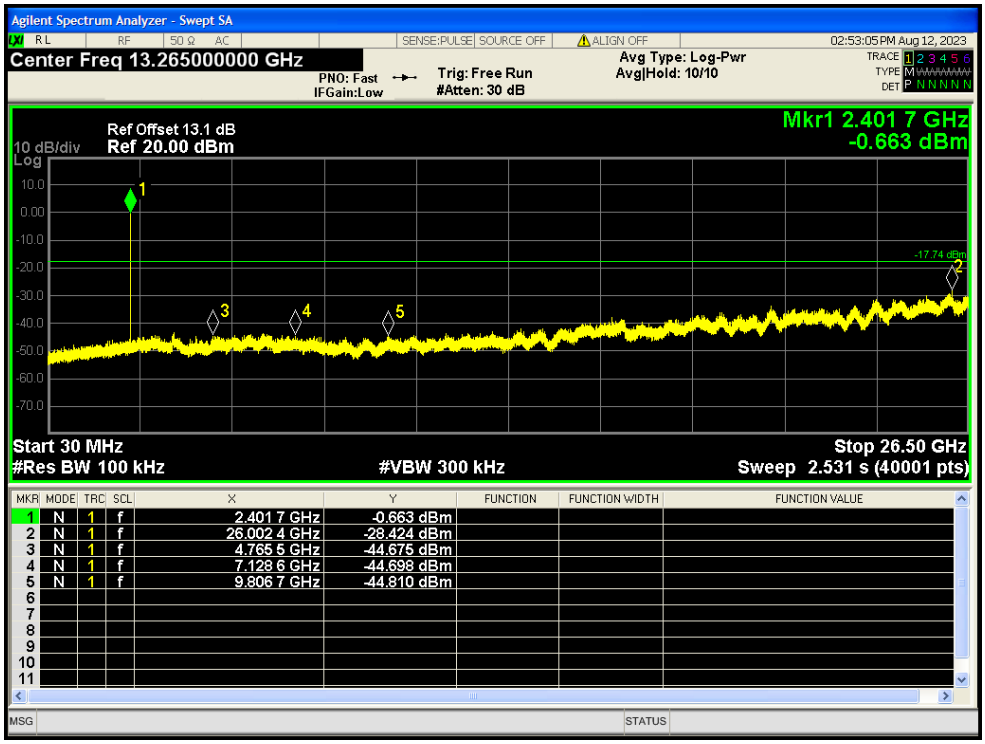
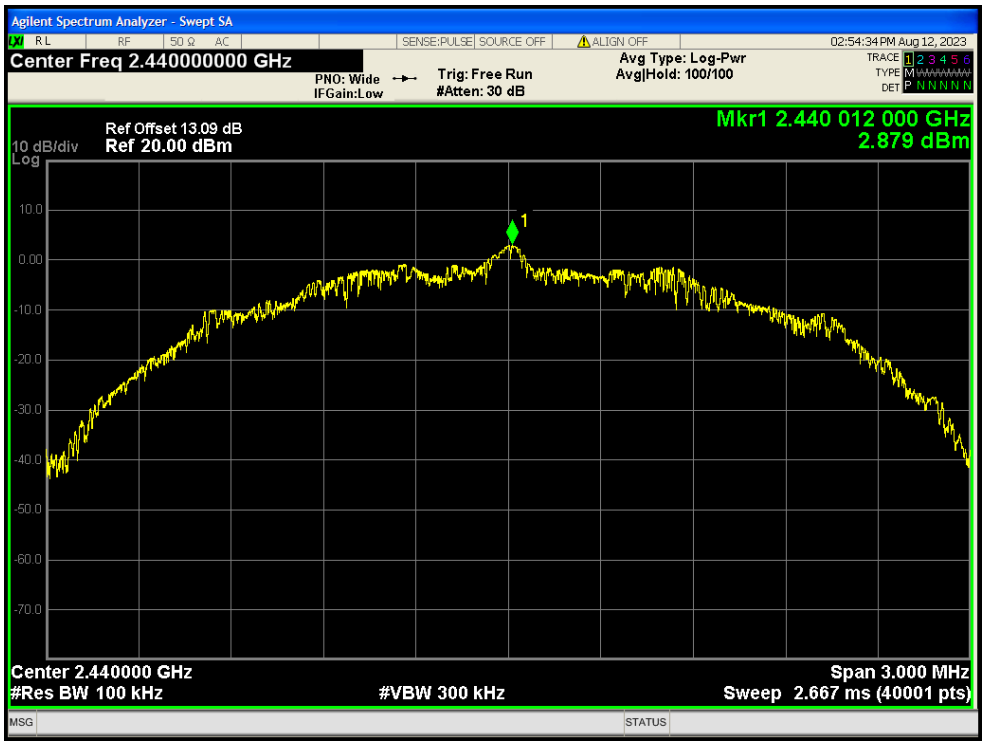


Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Ref SISO

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Emission SISO



Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Ref SISO



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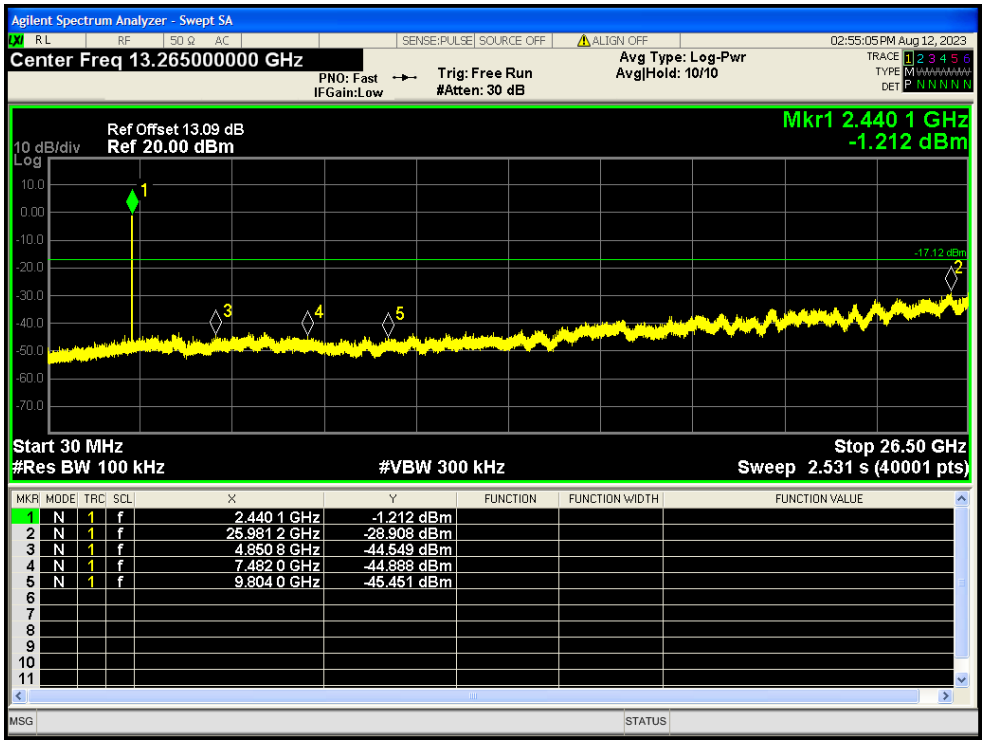
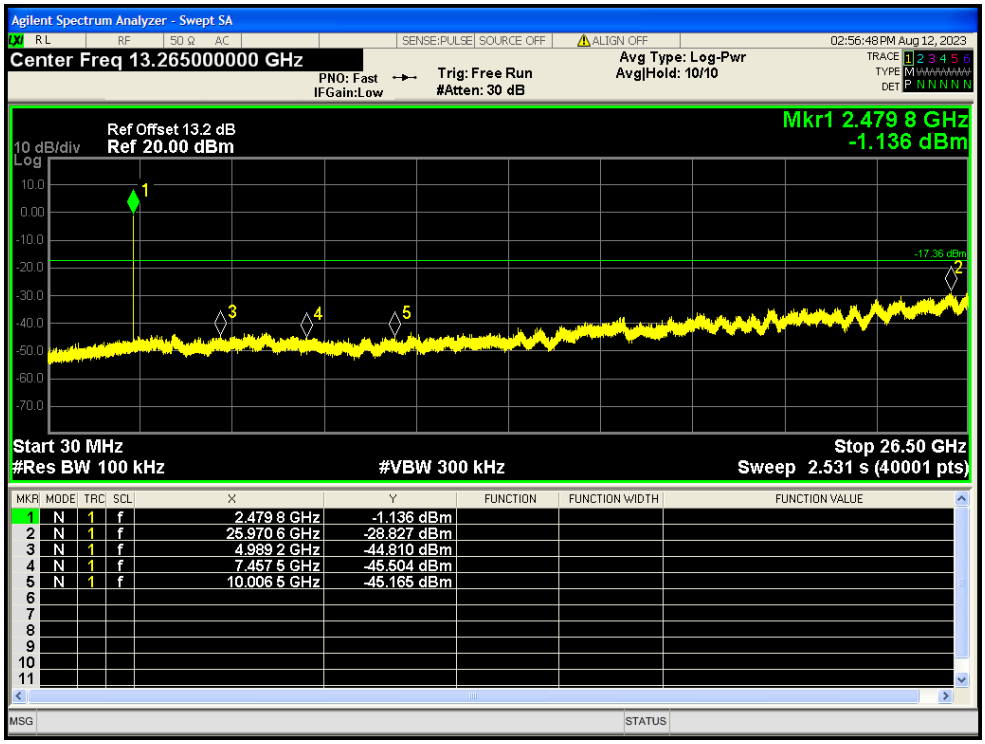


Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Ref SISO

Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Emission SISO



APPENDIX PHOTOGRAPHS

Please refer to “ANNEX”

******* END OF REPORT *******