RF TEST REPORT

Report No.:	20240617G10725X-W3
Product Name:	HOVERAir X1Smart
Model No.:	ZZ-H-1-002
FCC ID:	2AIDW-ZZ-H-1-003
IC:	21647-ZZH1003
Applicant:	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Address:	4th Floor,Qianhai E-metro Tower,Shenzhen-Hong Kong Cooperation Zone, Shenzhen,China
Dates of Testing:	06/18/2024 - 07/15/2024
Issued by:	CCIC Southern Testing Co., Ltd.
Lab Location:	Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China.
	Tel：86-755-26627338 **E-Mail**：manager@ccic-set.com

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Test Report

Product .....:	HOVERAir X1Smart
Trade Name .....:	ZERO ZERO ROBOTICS
Applicant.....:	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Applicant Address.....:	4th Floor,Qianhai E-metro Tower,Shenzhen-Hong Kong Cooperation Zone, Shenzhen,China
Manufacturer .....:	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Manufacturer Address .....:	4th Floor,Qianhai E-metro Tower,Shenzhen-Hong Kong Cooperation Zone, Shenzhen,China
Test Standards.....:	47 CFR Part 15 Subpart C 15.247 ANSI C63.10-2020 RSS-Gen Issue 5, Feb 2021 RSS-247 Issue 3, Aug 2023
Test Result.....:	Pass

Tested by .....: Kim Li 2024.07.19

Kim Li, Test Engineer

Reviewed by .....: Sun Jiaohui 2024.07.19

Sun Jiaohui, Senior Engineer

Approved by .....: Chris You 2024.07.19

Chris You, Manager

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Change History		
Issue	Date	Reason for change
1.0	2024.07.19	First edition

1. General Information

1.1. EUT Description

Product Name	HOVERAir X1Smart
Model No.	ZZ-H-1-002
Hardware Version	H130_HMB_V21
Software Version	ZZ_IMG_H121_V7.6.1/7.0.62
EUT supports Radios application	Bluetooth LE V5.0
Frequency Range	2402MHz~2480MHz
Channel Number	40
Bit Rate of Transmitter	1/2Mbps
Modulation Type	GFSK
Test Control Software	QRCT 4.0
Antenna Type	Internal Antenna
Antenna Gain	1.5dBi
Power supply	Rechargeable Li-ion Polymer Battery DC7.7V/690mAh

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 2: The information of antenna gain and cable loss is provided by the manufacturer and our lab is not responsible for the accuracy of the antenna gain and cable loss information.

1.2. Test Standards and Results

The purpose of the report is to conduct testing according to the following FCC/IC certification standards:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C	Radio Frequency Devices
2	ANSI C63.10-2020	American National Standard for Testing Unlicensed Wireless Devices
3	KDB 558074 D01 15.247 Meas Guidance v05r02	Cuidance for Compliance Measurement on Digital Transmission Systems, Frequency Hopping Spread Spectrum Systems, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules
4	RSS-Gen Issue 5, Feb 2021	General Requirements for Compliance of Radio Apparatus
5	RSS-247 Issue 3, Aug 2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test detailed items/section required by FCC/IC rules and results are as below:

No.	Section in CFR 47	IC Rules	Description	Result
1	15.203 15.247(c)	RSS-GEN, 6.8 RSS-247, 5.4(f)	Antenna Requirement	PASS
2	15.247(b)(3)	RSS-247, 5.4(d)	Peak Conducted Output Power	PASS
3	15.247(a)(2)	RSS-GEN, 6.7 RSS-247, 5.2(a)	6dB and 99% Bandwidth	PASS
4	15.247(d)	RSS-GEN, 6.13 RSS-247, 5.5	Conducted Band Edges and Spurious Emission	PASS
5	15.247(e)	RSS-247, 5.2(b)	Power spectral density (PSD)	PASS
6	15.207	RSS-GEN, 8.8	AC Power Line Conducted Emission	PASS
7	15.209 15.205 15.247(d)	RSS-GEN, 8.9 RSS-GEN, 8.10 RSS-247, 5.5	Radiated Band Edges and Spurious Emission	PASS

Note 1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10-2020.

Note 2: These RF tests were performed according to the method of measurements prescribed in KDB 558074 D01 15.247 Meas Guidance v05r02.

40 channels are provided for Bluetooth LE

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz
2	2406MHz	12	2426MHz	22	2446MHz	32	2466MHz
3	2408MHz	13	2428MHz	23	2448MHz	33	2468MHz
4	2410MHz	14	2430MHz	24	2450MHz	34	2470MHz
5	2412MHz	15	2432MHz	25	2452MHz	35	2472MHz
6	2414MHz	16	2434MHz	26	2454MHz	36	2474MHz
7	2416MHz	17	2436MHz	27	2456MHz	37	2476MHz
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz
Note: Channel 0, 19 &39 selected for GFSK.							

Test Items	Modulation Type	Data Rate	Channel
Peak Conducted Output Power Power Spectral Density 6dB and 99% Bandwidth Conducted Spurious Emission Radiated Spurious Emission	GFSK	1Mbps/2Mbps	0/19/39
Band Edge	GFSK	1Mbps/2Mbps	0/39

1.3. Table for Supporting Units

No.	Equipment	Brand Name	Model Name	Manufacturer	Serial No.	Note
1	Laptop	HP	TPN-Q221	HP	5CD14347QB	FCC DOC

1.4. EUT Operation Test Setup

For RF test items, an engineering test program was provided and enable to make EUT transmitting.

1.5. Test environment and mode

During the measurement, the environmental conditions were within the listed ranges:

Operating Environment	
Temperature	15°C - 35°C
Humidity	30% -60%
Atmospheric Pressure	86kPa-106kPa
Test mode:	
Continuously transmitting mode	Keep the EUT in continuous transmitting with modulation

1.6. Laboratory Facilities

FCC-Registration No.: 406086

CCIC Southern Testing 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 maintained in our files. Designation Number: CN1283, valid time is until Jun. 30th, 2025.

ISED Registration: 11185A

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A on Aug. 04, 2016, valid time is until Jun. 30th, 2025.

CAB number: CN0064

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.

2. Test Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

According to RSS GEN 6.8, The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

2.1.2. Antenna Information

Antenna Category: Internal Antenna

A internal Antenna was soldered to the antenna port of EUT via an adaptor cable, can’t be removed.

Antenna General Information:

No.	EUT	Operating frequency range	Ant. Type	Ant. Gain
1	HOVERAir X1Smart	2402-2480MHz	Internal	1.5dBi

2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Maximum Conducted Output Power

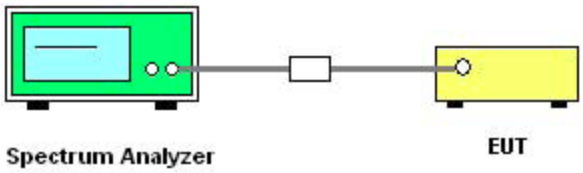
2.2.1. Limit of Maximum Conducted Output Power

For DTSs employing digital modulation techniques operating in the bands 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.9.1.1.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

   RBW ≥ DTS bandwidth / VBW ≥ 3*RBW / Sweep time: Auto couple / Detector mode: Peak / Trace mode: Max hold / Allow trace to fully stabilize / Use peak marker function to determine the peak amplitude level.
5. Record the measurement results in the test report.

2.2.5. Test Result of Maximum Conducted Output Power

Please refer to Appendix A for detail.

2.3. 6dB and 99% Bandwidth

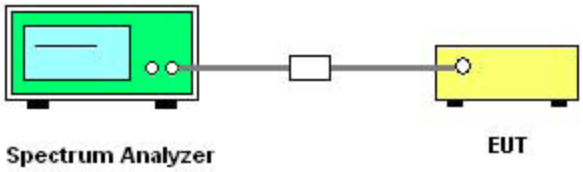
2.3.1. Limit of 6dB and 99% Bandwidth

The minimum 6 dB Occupied bandwidth shall be at least 500 kHz.

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.8.1.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the spectrum analyzer “Channel Bandwidth” function to easurement the 6dB EBW and 99% OBW.
5. For 6dB EBW Use the following spectrum analyzer settings:
   RBW: 100kHz / VBW: 300kHz / Detector: Peak / Trace mode: Max hold / Sweep time: Auto couple / Allow trace to fully stabilize.
6. For 99% OBW Use the following spectrum analyzer settings:
   Set RBW = approximately 1% EBW or 1.5 times to 5.0 times the OBW, VBW ≥ 3 × RBW.
7. Record the measurement results in the test report.

2.3.5. Test Results of 6dB and 99% Bandwidth

Please refer to Appendix A for detail.

2.4. Power spectral density (PSD)

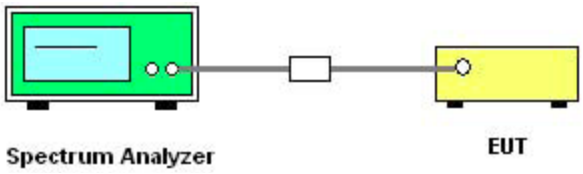
2.4.1. Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.10.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

   Set instrument center frequency to DTS channel center frequency / Set the span to 1.5 times the DTS bandwidth / RBW: 3kHz / VBW: 10kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum power level.
5. Record the measurement results in the test report.

2.4.5. Test Results of Power spectral density

Please refer to Appendix A for detail.

2.5. Conducted Band Edges and Spurious Emissions

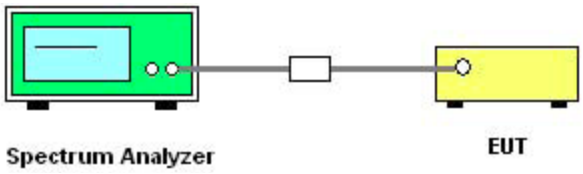
2.5.1. Limit of Conducted Band Edges and Spurious Emissions

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is perating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.11 and 11.13.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

   Reference level measurement: Set spectrum analyzer center frequency to DTS channel center frequency / Set the span to ≥1.5 times the DTS bandwidth / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum PSD level and attenuate it by 20dB.

   Emission level measurement: Set the center frequency and span to encompass frequency range to be measured / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum amplitude level.
5. Record the measurement results in the test report.

2.5.5. Test Results of Conducted Band Edges and Spurious Emissions

Please refer to Appendix A for detail.

2.6. Radiated Band Edge and Spurious Emission

2.6.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level. If the transmitter uses an RMS average conducted power limit, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the estricted bands, as defi ned in §15.205(a), must also comply with the radiated emission limits specifi ed in §15.209(a).

§15.209(a) Radiated emission limits:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Restricted bands of operation refer to §15.205 (a):

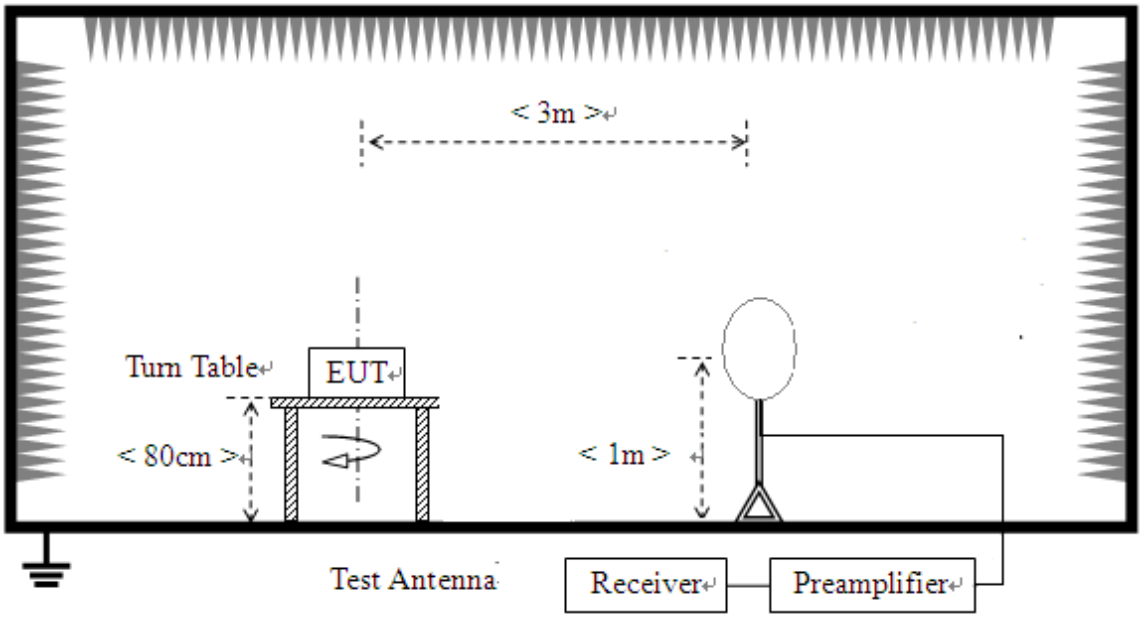
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41	/	/	/
Note: [1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz. [2]Above 38.6.			

2.6.2. Measuring Instruments

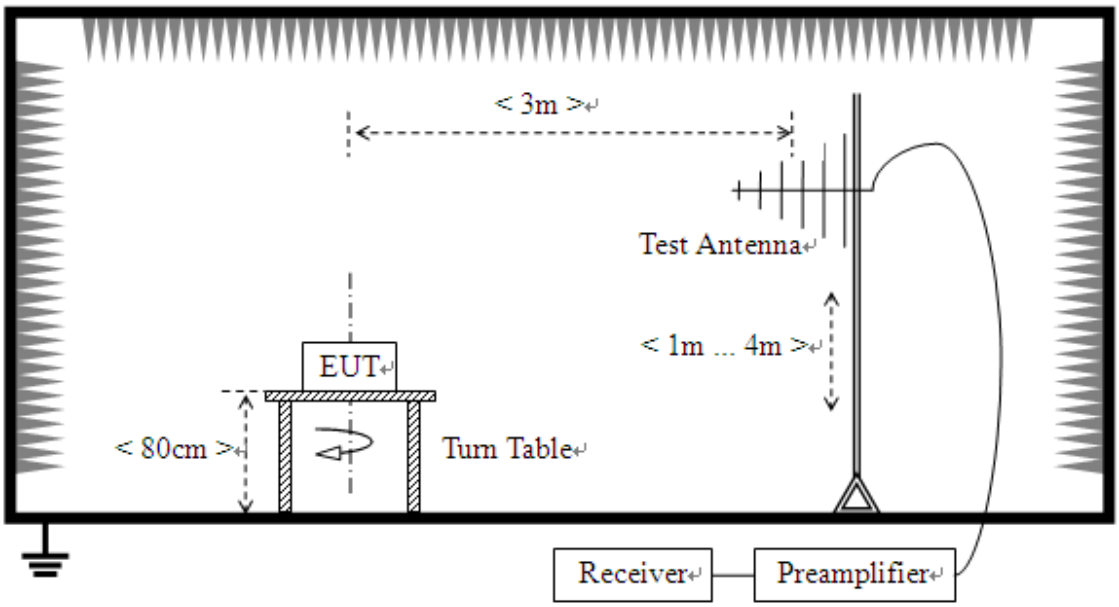
The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup

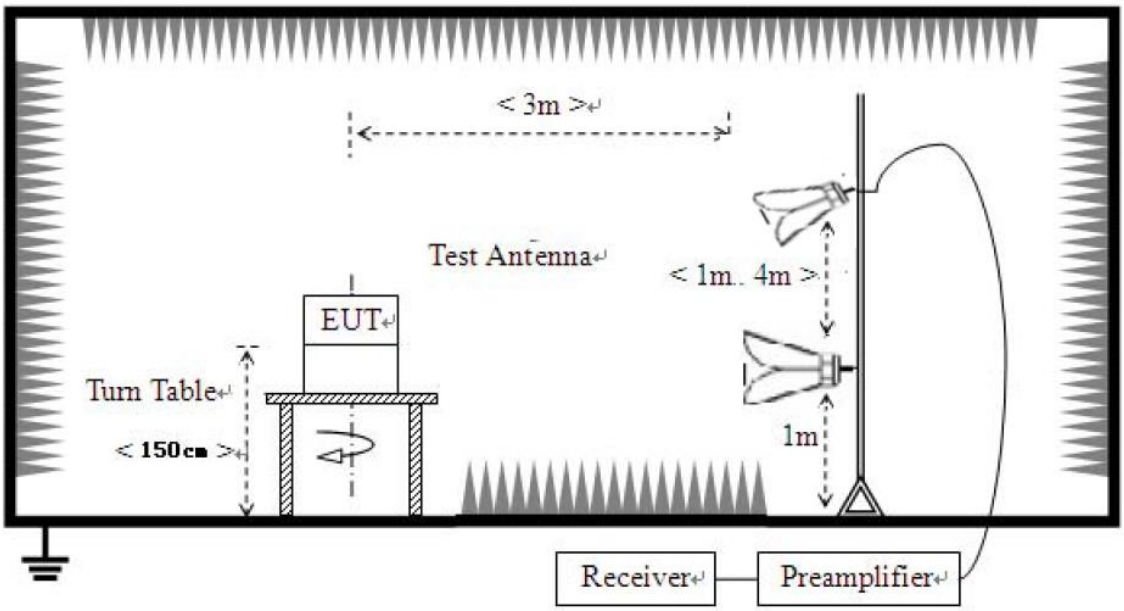
For radiated emissions from 9 kHz to 30 MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



2.6.4. Test Procedures

1. The EUT was placed on the top of a rotating table 0.8m for below 1GHz and 1.5m for above 1GHz above the ground at a 3 meters semi-anechoic chamber.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on thetop of a variable height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then

reported in a data sheet.

7. For the radiated emission test above 1GHz:

   Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T(Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

2.6.5. Test Results of Radiated Band Edge and Spurious Emission

For 9 kHz to 30MHz, The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

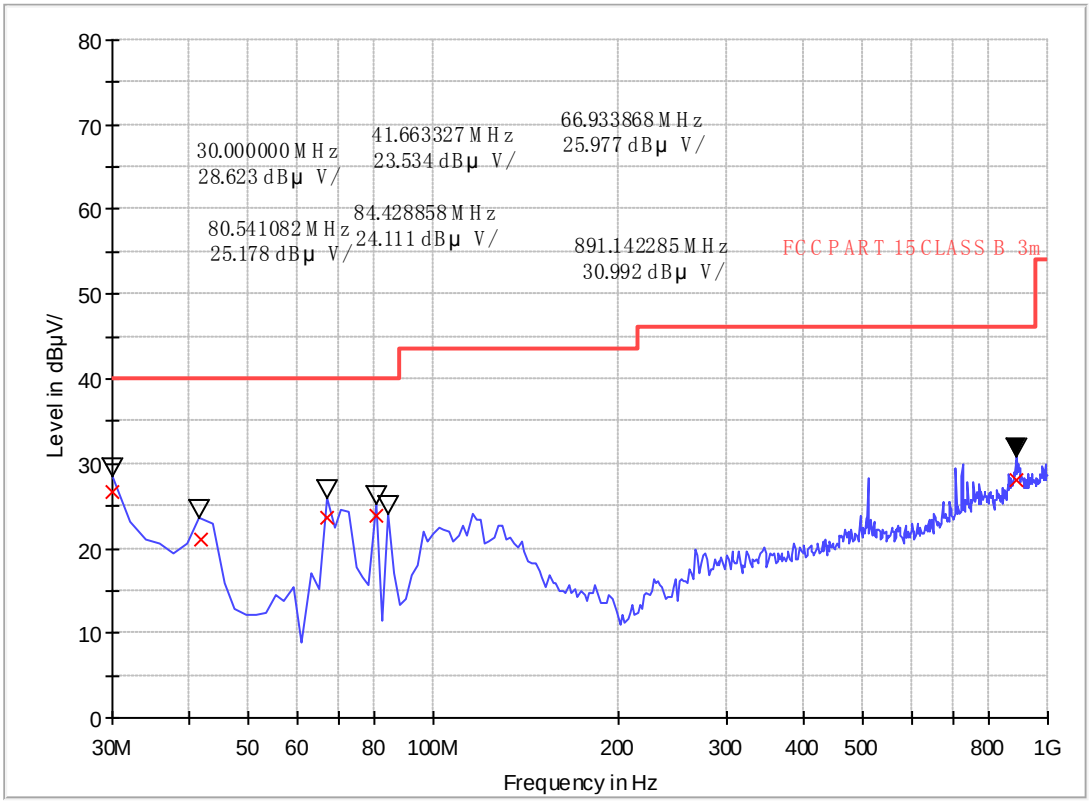
For 30MHz to 1GHz, All of the EUT Configure mode were tested and found 1Mbps_2440MHz channel is the worst mode, the worst case is recorded in this report.

For 1GHz to 25GHz, Only worst-case (1Mbps) data is reported.

For 30MHz to 1000MHz

Test site:	3M anechoic chamber	Environment:	Temp: 23℃; Humi:48%;101kPa
Operator:	Deng ShanFei	Test Date:	2024.07.05
Test Mode:	BLE - TX	Test Result:	Pass

EMI Sweep-3M(30-1G)



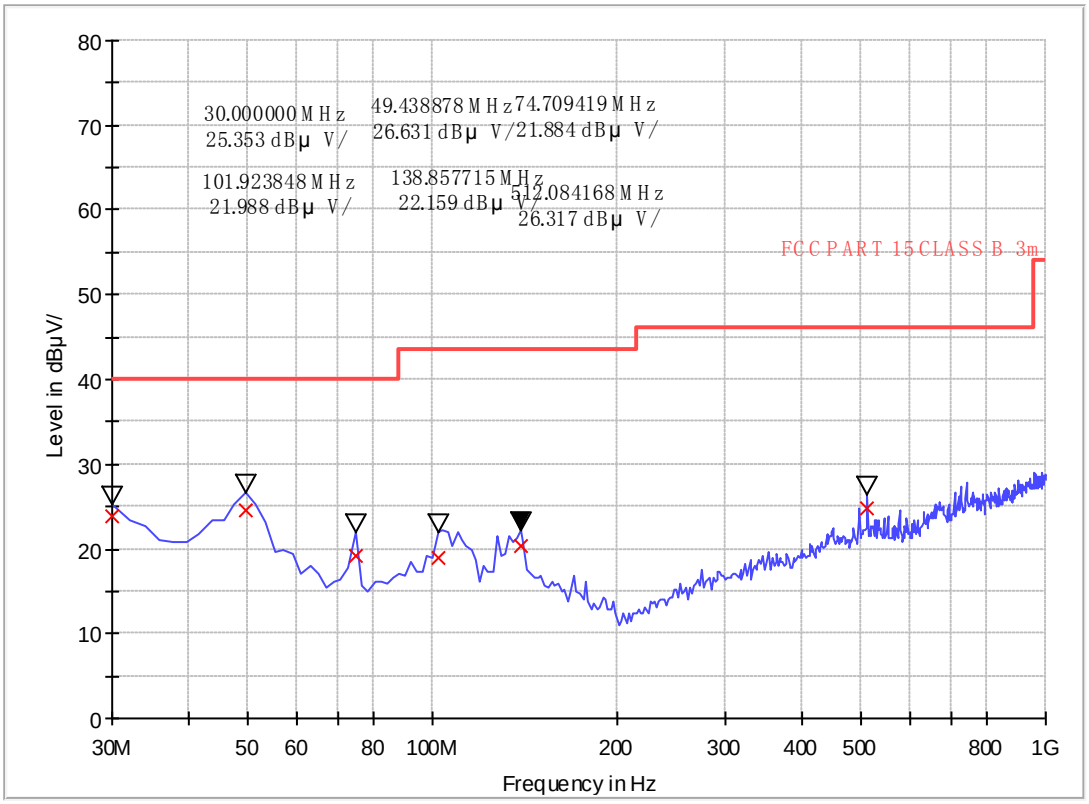
Frequency (MHz)	QuasiPeak (dBuV/m)	Bandwidth (kHz)	Height (cm)	Polarity	Corr. (dB/m)	Margin - QPK	Limit - QPK (dBuV/m)
30.000000	26.72	120.000	100.0	H	21.1	13.28	40.0
41.680000	21.10	120.000	100.0	H	15.6	18.90	40.0
66.920000	23.56	120.000	100.0	H	8.0	16.44	40.0
80.560000	23.94	120.000	100.0	H	9.7	16.06	40.0
891.160000	28.09	120.000	100.0	H	24.3	17.91	46.0

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value – Emission Level.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. Only the antenna height (from 1m to 4m) at maximum reading are recorded.

Test site:	3M anechoic chamber	Environment:	Temp: 23℃; Humi:48%;101kPa
Operator:	Deng ShanFei	Test Date:	2024.07.05
Test Mode:	BLE - TX	Test Result:	Pass

EMI Sweep-3M(30-1G)



Frequency (MHz)	QuasiPeak (dBuV/m)	Bandwidth (kHz)	Height (cm)	Polarity	Corr. (dB/m)	Margin - QPK	Limit - QPK (dBuV/m)
49.440000	24.56	120.000	100.0	V	10.5	15.44	40.0
74.720000	19.15	120.000	100.0	V	9.0	20.85	40.0
101.920000	19.04	120.000	100.0	V	12.3	24.46	43.5
138.840000	20.28	120.000	100.0	V	13.8	23.22	43.5
512.080000	24.90	120.000	100.0	V	20.2	21.10	46.0

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value – Emission Level.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. Only the antenna height (from 1m to 4m) at maximum reading are recorded.

For 1GHz to 25GHz

GFSK_2402MHz - 1Mbps									
Frequency (MHz)	Emssion Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	Polarity	Detector
2390.00	54.29	74.00	-19.71	1.60	190	57.38	-3.09	Horizontal	Peak
2390.00	42.52	54.00	-11.48	1.60	190	45.61	-3.09	Horizontal	Average
4804.00	46.26	74.00	-27.74	1.60	190	45.00	1.26	Horizontal	Peak
4804.00	36.65	54.00	-17.35	1.60	190	35.39	1.26	Horizontal	Average
7206.00	50.94	74.00	-23.06	1.60	190	44.77	6.17	Horizontal	Peak
7206.00	40.82	54.00	-13.18	1.60	190	34.65	6.17	Horizontal	Average
2390.00	53.71	74.00	-20.29	1.50	110	56.80	-3.09	Vertical	Peak
2390.00	42.87	54.00	-11.13	1.50	110	45.96	-3.09	Vertical	Average
4804.00	46.07	74.00	-27.93	1.50	110	44.81	1.26	Vertical	Peak
4804.00	36.87	54.00	-17.13	1.50	110	35.61	1.26	Vertical	Average
7206.00	50.80	74.00	-23.20	1.50	110	44.63	6.17	Vertical	Peak
7206.00	40.35	54.00	-13.65	1.50	110	34.18	6.17	Vertical	Average
GFSK_2440MHz - 1Mbps									
Frequency (MHz)	Emssion Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	Polarity	Detector
4880.00	46.03	74.00	-27.97	1.60	190	45.10	0.93	Horizontal	Peak
4880.00	37.02	54.00	-16.98	1.60	190	36.09	0.93	Horizontal	Average
7320.00	51.05	74.00	-22.95	1.60	190	45.46	5.59	Horizontal	Peak
7320.00	40.94	54.00	-13.06	1.60	190	35.35	5.59	Horizontal	Average
4880.00	45.84	74.00	-28.16	1.50	110	44.91	0.93	Vertical	Peak
4880.00	36.81	54.00	-17.19	1.50	110	35.88	0.93	Vertical	Average
7320.00	50.69	74.00	-23.31	1.50	110	45.10	5.59	Vertical	Peak
7320.00	40.83	54.00	-13.17	1.50	110	35.24	5.59	Vertical	Average

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) - Pre-Amplifier Factor(dB)

3. Margin value = Emission Level – Limit value

4.The emission levels of other frequencies are very lower than the limit and not show in test report.

5.Tnly the antenna height (from 1m to 4m) and turntable angle (from 0 degrees to 360 degrees) at maximum reading are recorded.

GFSK_2480MHz - 1Mbps									
Frequency (MHz)	Emssion Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	Polarity	Detector
2483.50	53.37	74.00	-20.63	1.60	190	58.12	-4.75	Horizontal	Peak
2483.50	43.68	54.00	-10.32	1.60	190	48.43	-4.75	Horizontal	Average
4960.00	44.75	74.00	-29.25	1.60	190	44.51	0.24	Horizontal	Peak
4960.00	35.86	54.00	-18.14	1.60	190	35.62	0.24	Horizontal	Average
7440.00	49.32	74.00	-24.68	1.60	190	43.50	5.82	Horizontal	Peak
7440.00	40.17	54.00	-13.83	1.60	190	34.35	5.82	Horizontal	Average
2483.50	53.58	74.00	-20.42	1.50	110	58.33	-4.75	Vertical	Peak
2483.50	43.60	54.00	-10.40	1.50	110	48.35	-4.75	Vertical	Average
4960.00	45.36	74.00	-28.64	1.50	110	45.12	0.24	Vertical	Peak
4960.00	35.99	54.00	-18.01	1.50	110	35.75	0.24	Vertical	Average
7440.00	49.80	74.00	-24.20	1.50	110	43.98	5.82	Vertical	Peak
7440.00	39.90	54.00	-14.10	1.50	110	34.08	5.82	Vertical	Average

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) - Pre-Amplifier Factor(dB)

3. Margin value = Emission Level – Limit value

4.The emission levels of other frequencies are very lower than the limit and not show in test report.

5.Tnly the antenna height (from 1m to 4m) and turntable angle (from 0 degrees to 360 degrees) at maximum reading are recorded.

2.7. AC Power Line Conducted Emission

2.7.1. Limit of AC Power Line Conducted Emission

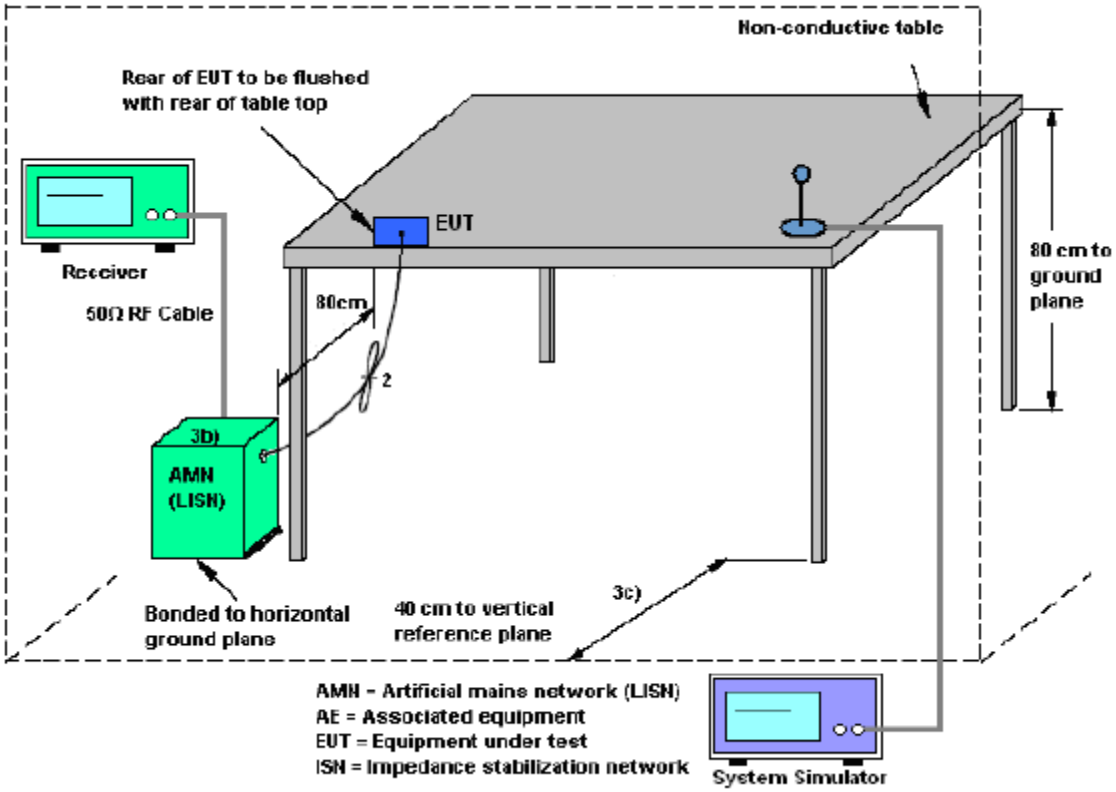
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup



2.7.4. Test Procedures

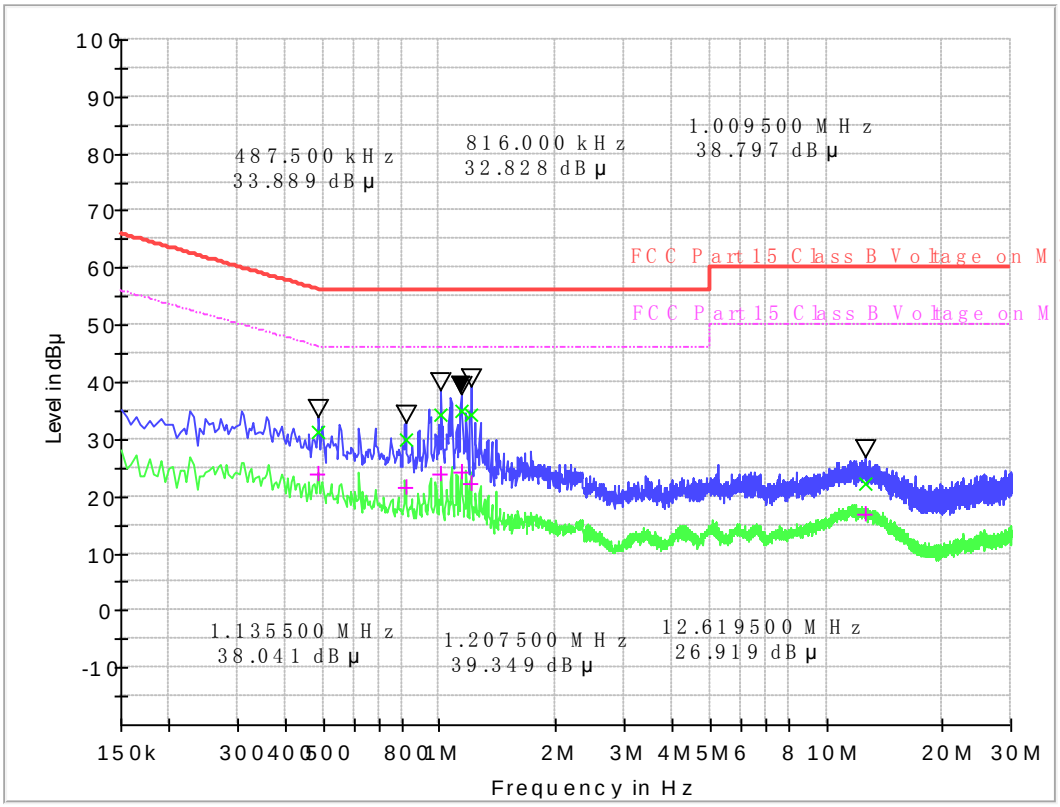
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

2.7.5. Test Results of Conducted Emission

The EUT configuration of the emission tests is Bluetooth LE Link + Charging from Adapter.

All of the EUT Configure mode were tested and found 1Mbps_2440MHz channel is the worst mode, the worst case is recorded in this report.

Test site:	Shield ROOM 1	Environment:	Temp: 23℃; Humi:53%;101kPa
Operator:	LIAOHONGTING	Test Date:	2024.07.04
Test Mode:	BLE - TX	Test Part:	L Line

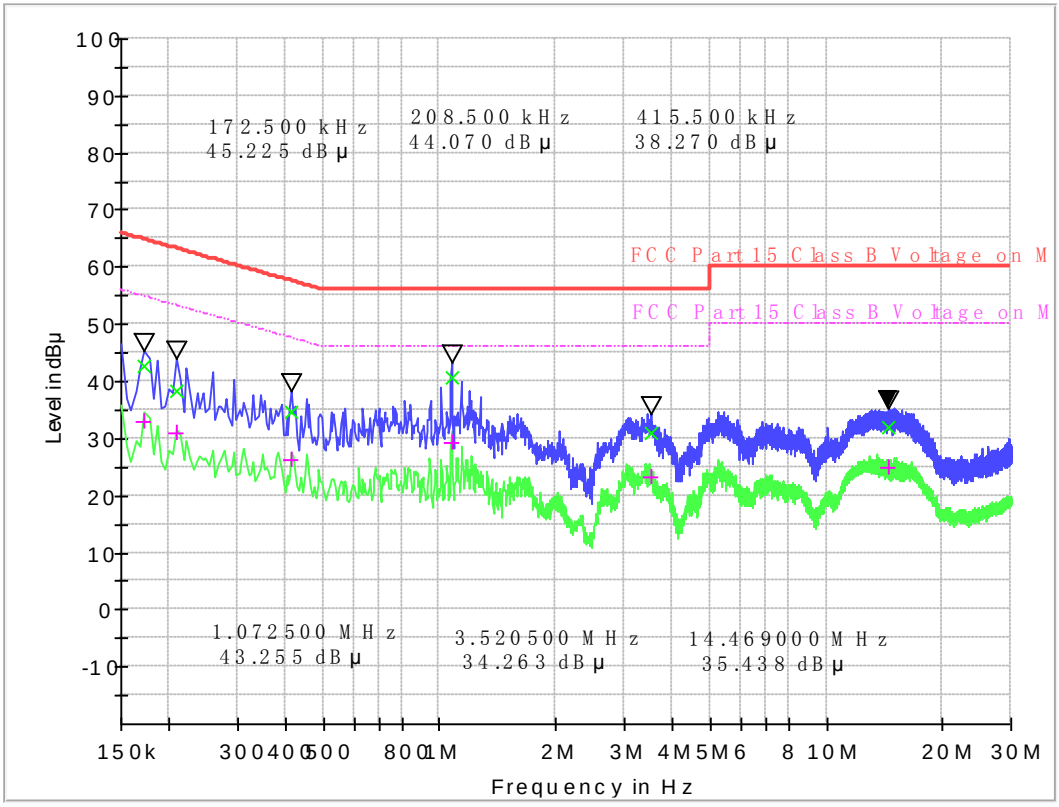


Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Corr.Factor (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - AV (dB)	Limit - AV (dBµV)
0.487500	31.32	23.76	19.9	24.89	56.2	22.45	46.2
0.816000	29.85	21.51	19.9	26.15	56.0	24.49	46.0
1.009500	34.14	23.90	19.8	21.86	56.0	22.10	46.0
1.135500	35.10	24.12	19.8	20.90	56.0	21.88	46.0
1.207500	34.20	22.27	19.8	21.80	56.0	23.73	46.0
12.619500	22.22	16.83	20.0	37.78	60.0	33.17	50.0

Test Result : Pass

Note: Final Level = Receiver Read level + Correction factor.

Test site:	Shield ROOM 2	Environment:	Temp: 23℃; Humi:53%;101kPa
Operator:	LIAOHONGTING	Test Date:	2024.07.04
Test Mode:	BLE - TX	Test Part:	N Line



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Corr.Factor (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - AV (dB)	Limit - AV (dBµV)
0.172500	42.72	33.04	19.9	22.12	64.8	21.80	54.8
0.208500	38.47	30.97	19.8	24.79	63.3	22.29	53.3
0.415500	34.59	26.37	19.8	22.95	57.5	21.17	47.5
1.072500	40.65	29.20	19.9	15.35	56.0	16.80	46.0
3.520500	31.03	23.26	19.8	24.97	56.0	22.74	46.0
14.469000	32.08	25.01	20.0	27.92	60.0	24.99	50.0

Test Result : Pass

Note: Final Level = Receiver Read level + Correction factor.

3. List of measuring equipment

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	5M Anechoic Chamber	Albatross	SAC-5MAC 12.8x6.8x6.4m	A0304210	2022.06.09	2025.06.08
2	EMI Test Receiver	ROHDE&SCHWARZ	ESW26	A180502935	2024.05.23	2025.05.22
3	Loop Antenna	Schwarz beck	HFH2-Z2	A0304220	2022.05.02	2025.05.01
4	Broadband antenna (30MHz~1GHz)	R&S	HL562	A0304224	2023.06.08	2026.06.07
5	EMI Horn Ant. (1-18G)	ETC	MCTD-1209	A150402241	2023.05.16	2026.05.15
6	Horn antenna (18GHz~26.5GHz)	AR	AT4510	A0804450	2023.06.01	2026.05.31
7	Amplifier 30M~1GHz	MILMEGA	80RF1000-10004	A140101634	2023.10.20	2024.10.19
8	Amplifier 1G~18GHz	MILMEGA	AS0104R-800/400	A160302517	2023.10.20	2024.10.19
9	Spectrum Analyzer	KEYSIGHT	N9030A	A160702554	2024.01.18	2025.01.17
10	Test Receiver	R&S	ESIB7	A0501375	2024.02.28	2025.02.27
11	Broadband Ant.	ETC	MCTD 2786	A150402240	2023.05.22	2026.05.21
12	3M Anechoic Chamber	Albatross	SAC-3MAC 9*6*6m	A0412375	2024.02.27	2027.02.26
13	Temperature chamber	ESPEC	SU-642	A150802409	2024.02.22	2025.02.21
14	Test Receiver	KEYSIGHT	N9038A	A141202036	2024.06.05	2025.06.04
15	LISN	ROHDE&SCHWARZ	ENV216	A140701847	2024.05.23	2025.05.22

4. Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2020. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence . The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of AC Power Line Conducted Emission Measurement (150kHz~30MHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	2.8dB

Uncertainty of Radiated Emission Measurement (9kHz~30MHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	3.5dB

Uncertainty of Radiated Emission Measurement (30MHz~1GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	3.91dB

Uncertainty of Radiated Emission Measurement (1GHz~18GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	4.5dB

Uncertainty of Radiated Emission Measurement (18GHz~40GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	4.9dB

Uncertainty of RF Conducted Measurement (9kHz~40GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	1.2dB

Uncertainty of Occupied Bandwidth Measurement

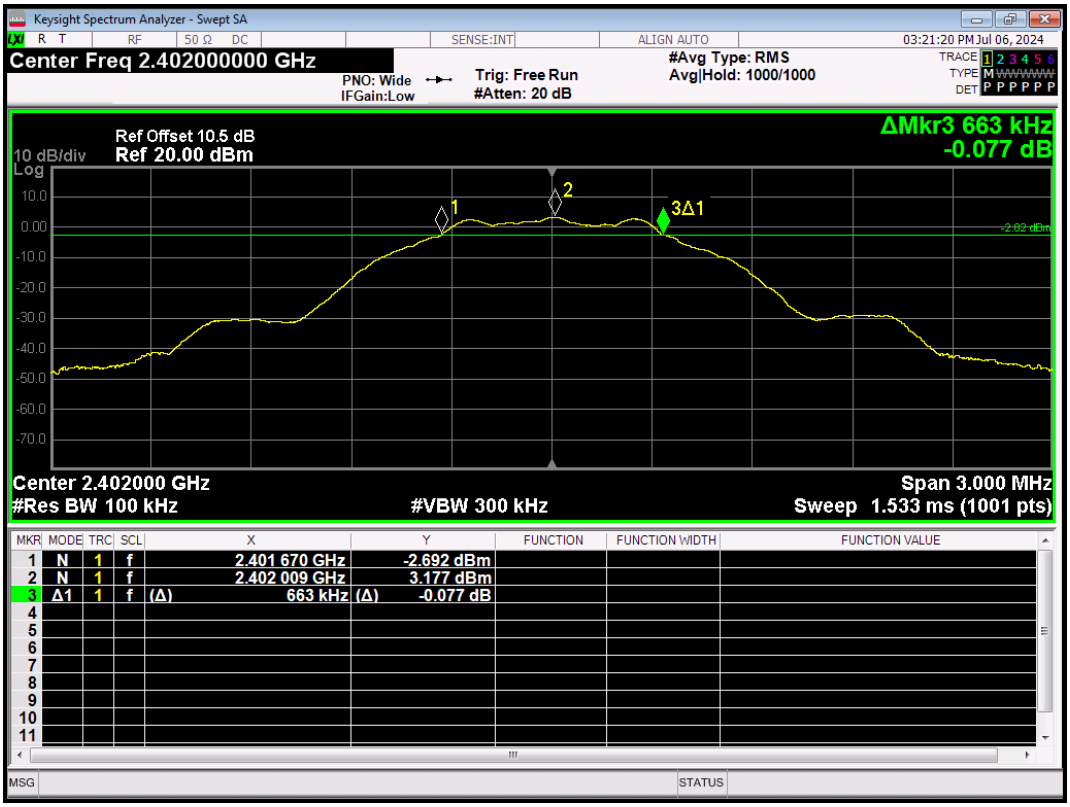
Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	1.2%

Appendix A

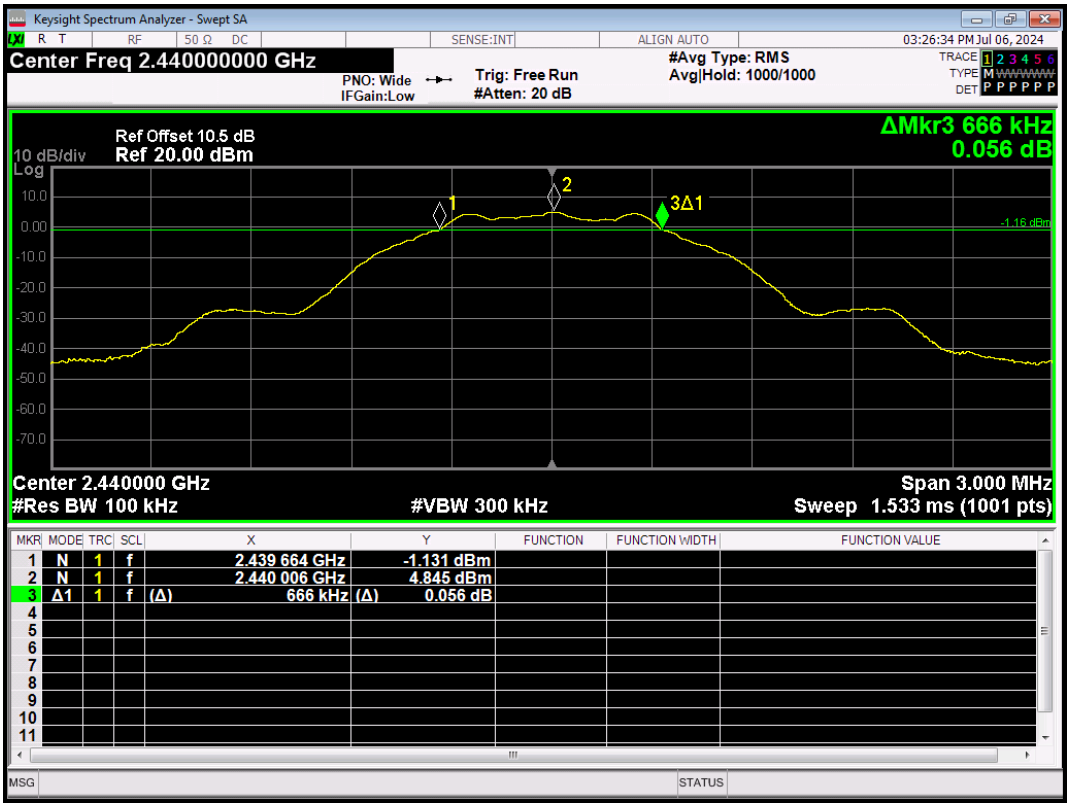
6dB Bandwidth

Test Result and Data

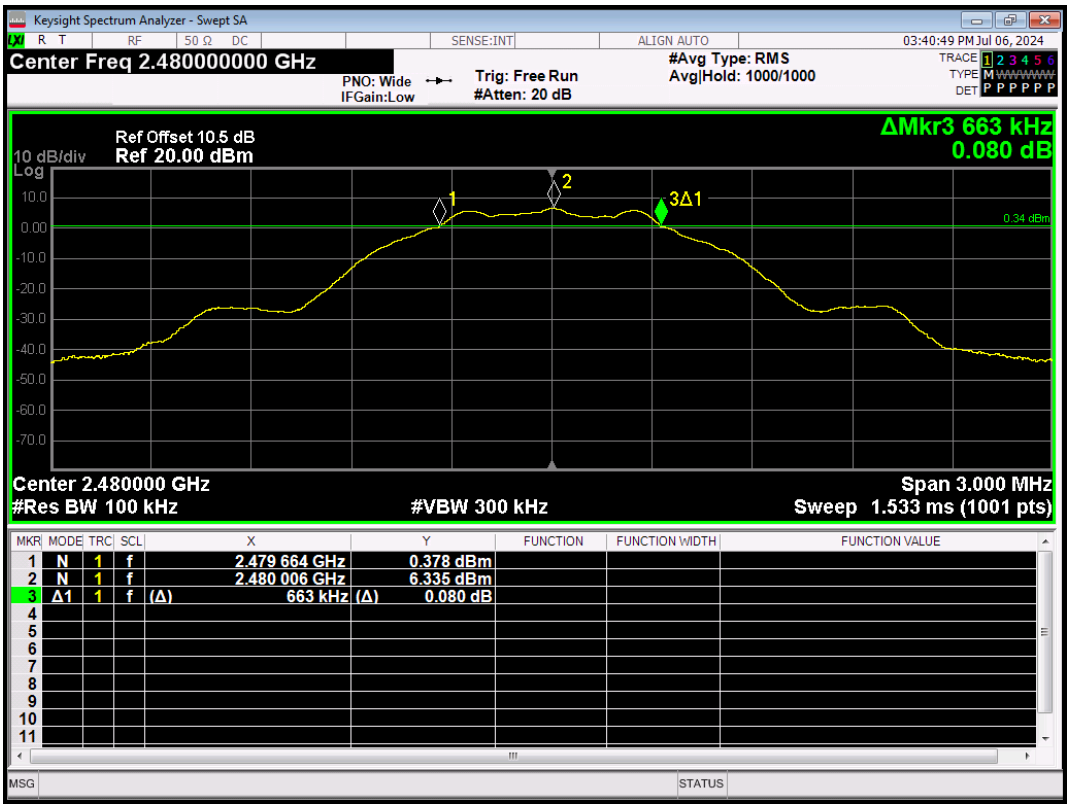
TestMode	Antenna	Frequency[MHz]	6dB BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.663	2401.670	2402.333	0.5	PASS
BLE_1M	Ant1	2440	0.666	2439.664	2440.330	0.5	PASS
BLE_1M	Ant1	2480	0.663	2479.664	2480.327	0.5	PASS
BLE_2M	Ant1	2402	1.130	2401.445	2402.575	0.5	PASS
BLE_2M	Ant1	2440	1.140	2439.435	2440.575	0.5	PASS
BLE_2M	Ant1	2480	1.130	2479.440	2480.570	0.5	PASS



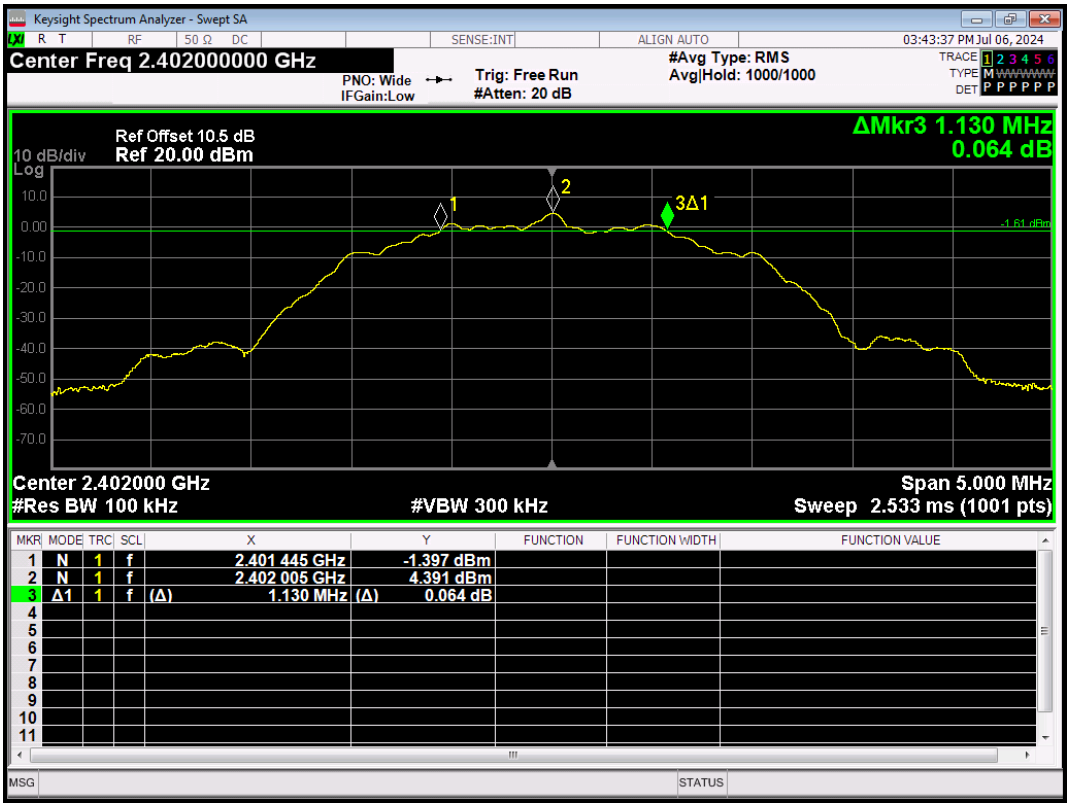
BLE_1M-Ant1-2402-PASS



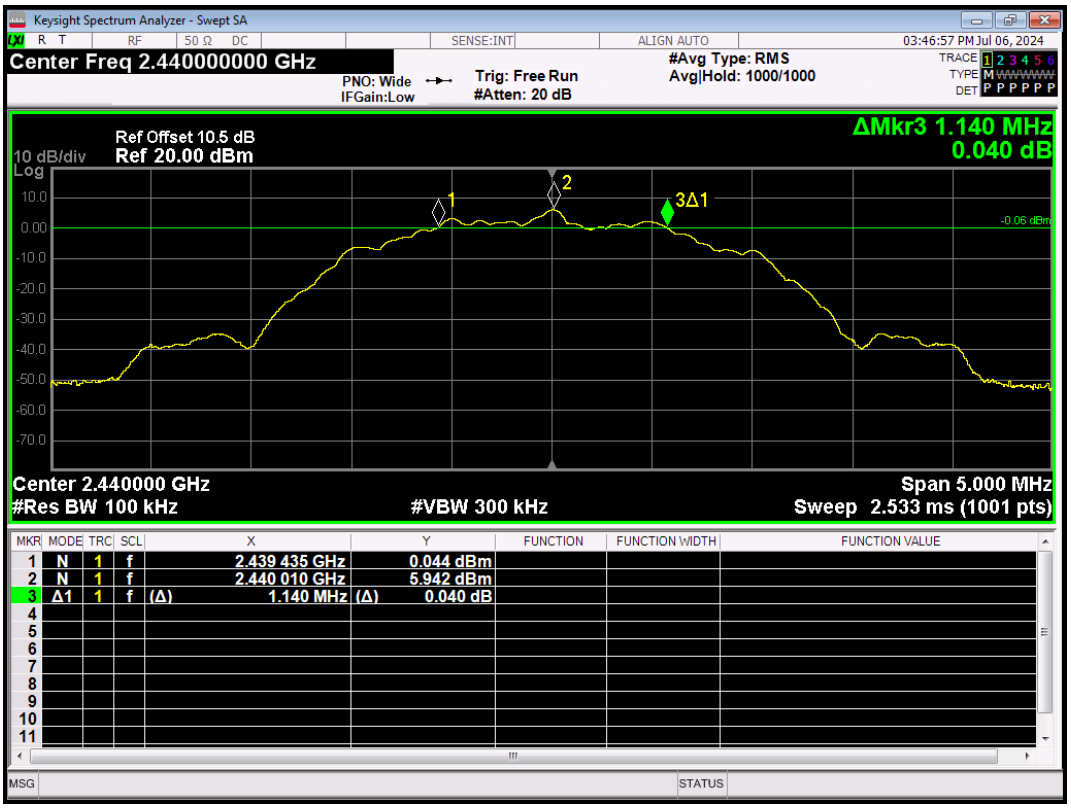
BLE_1M-Ant1-2440-PASS



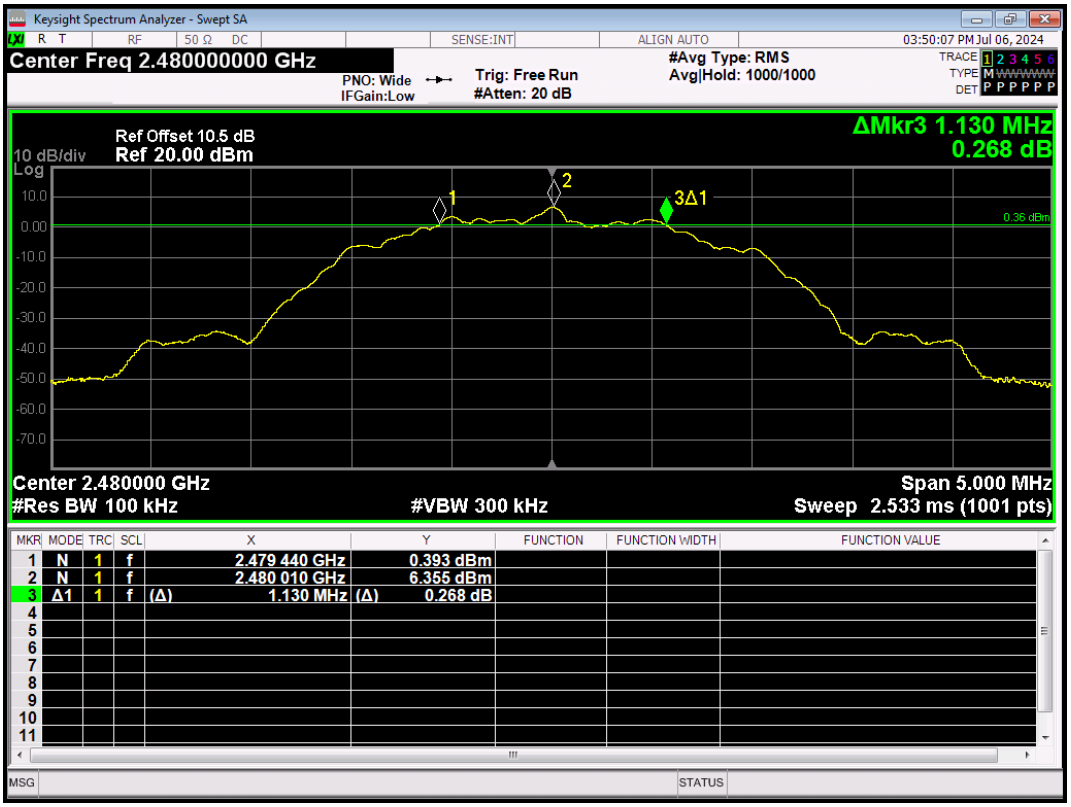
BLE_1M-Ant1-2480-PASS



BLE_2M-Ant1-2402-PASS



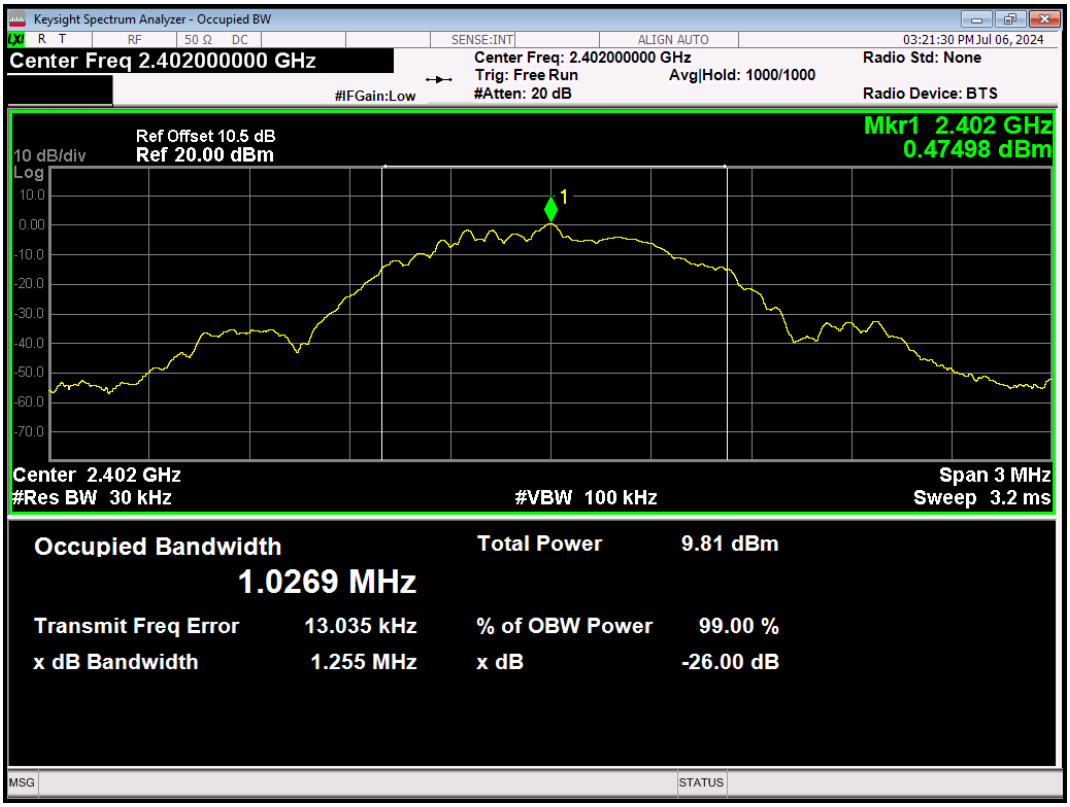
BLE_2M-Ant1-2440-PASS



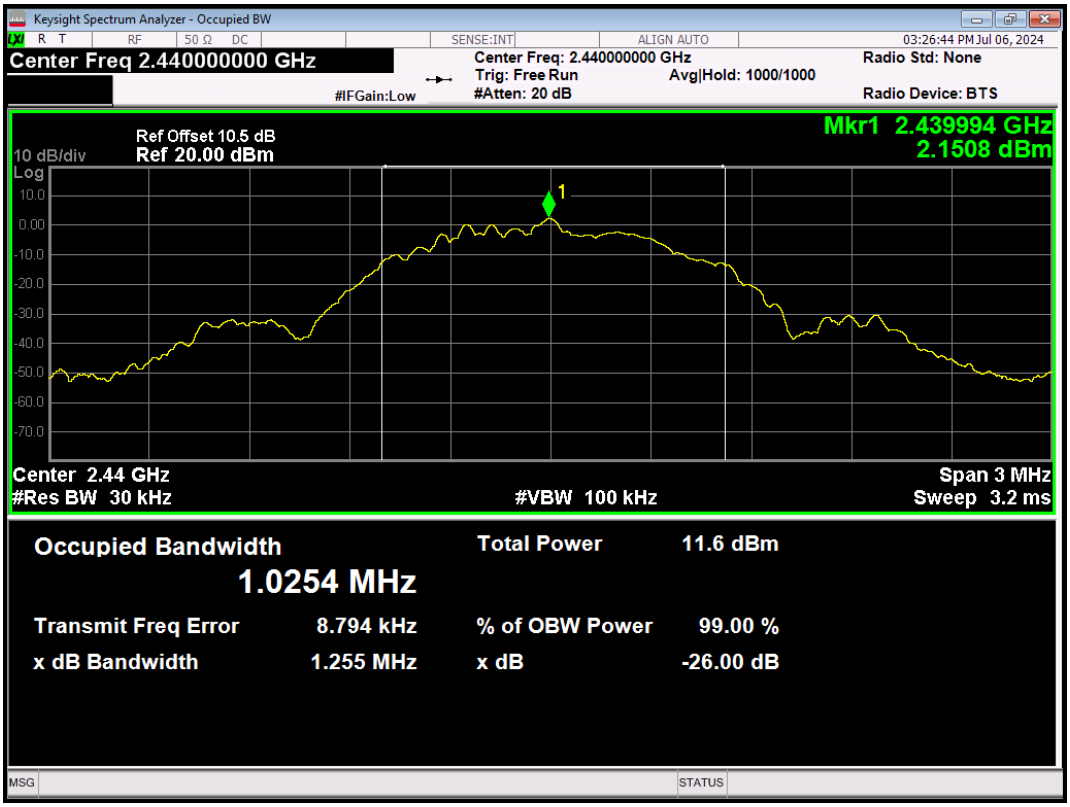
BLE_2M-Ant1-2480-PASS

99% Occupied Channel Bandwidth
Test Result and Data

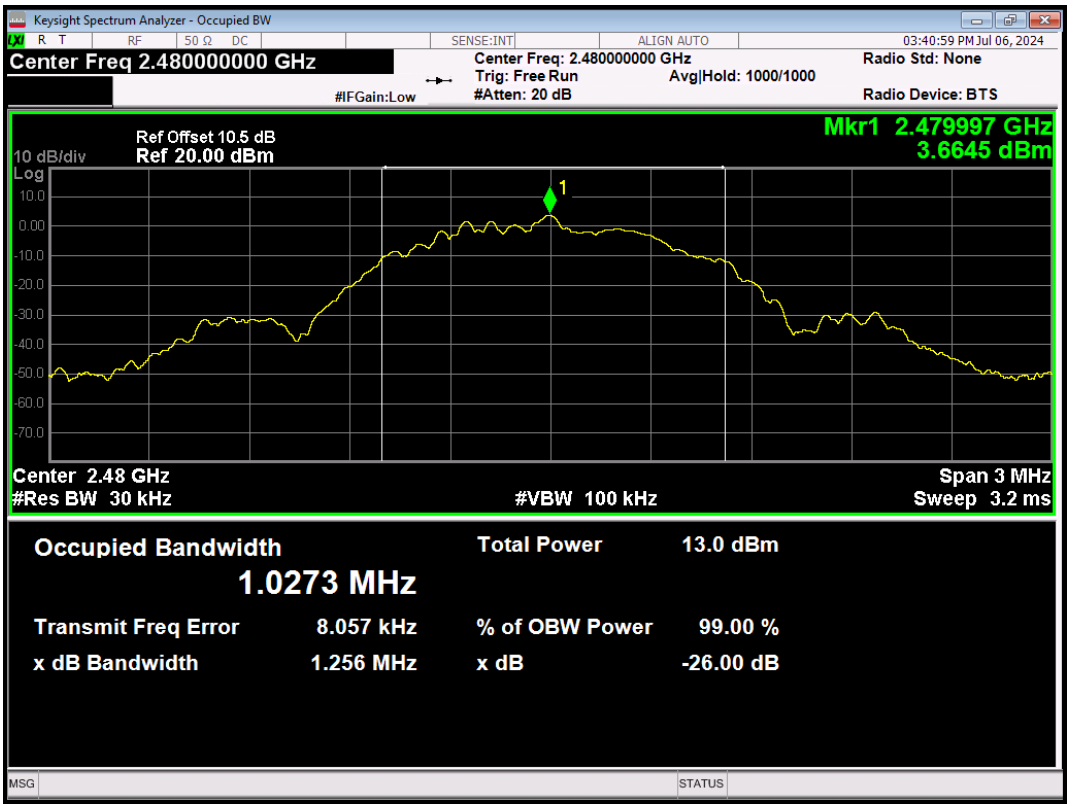
TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Verdict
BLE_1M	Ant1	2402	1.0269	2401.4996	2402.5265	PASS
BLE_1M	Ant1	2440	1.0254	2439.4961	2440.5215	PASS
BLE_1M	Ant1	2480	1.0273	2479.4944	2480.5217	PASS
BLE_2M	Ant1	2402	2.0313	2401.0122	2403.0435	PASS
BLE_2M	Ant1	2440	2.0276	2439.0054	2441.0330	PASS
BLE_2M	Ant1	2480	2.0276	2479.0070	2481.0346	PASS



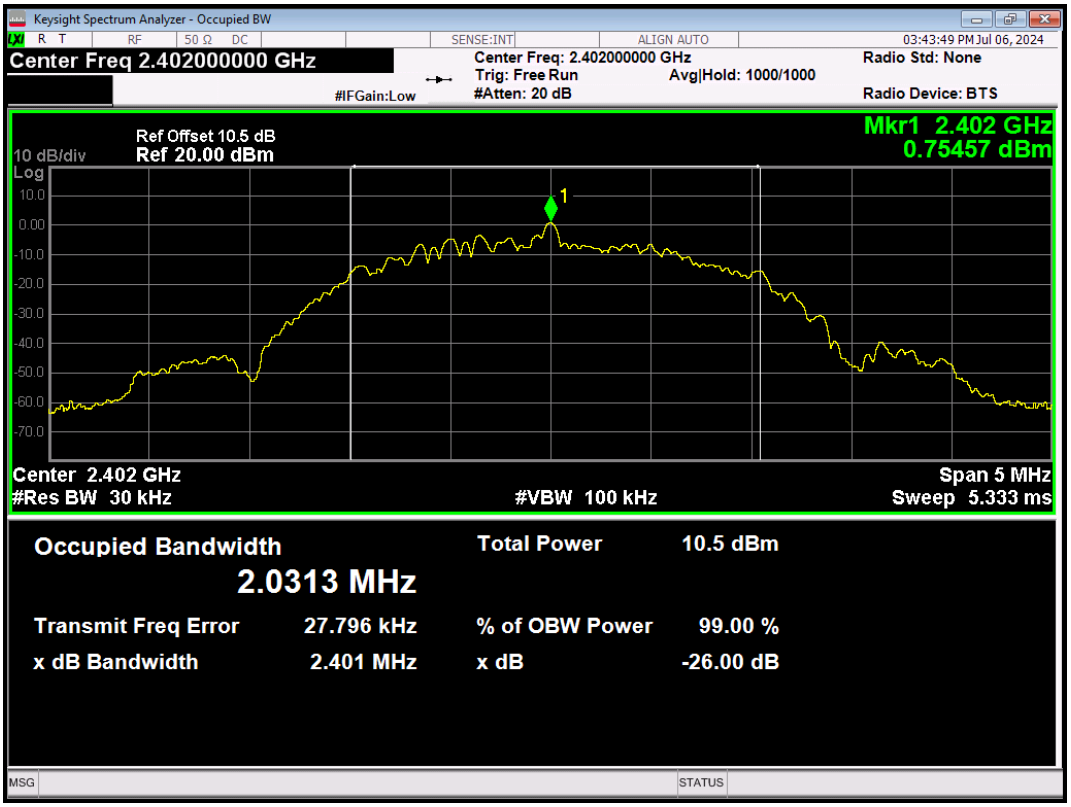
BLE_1M-Ant1-2402



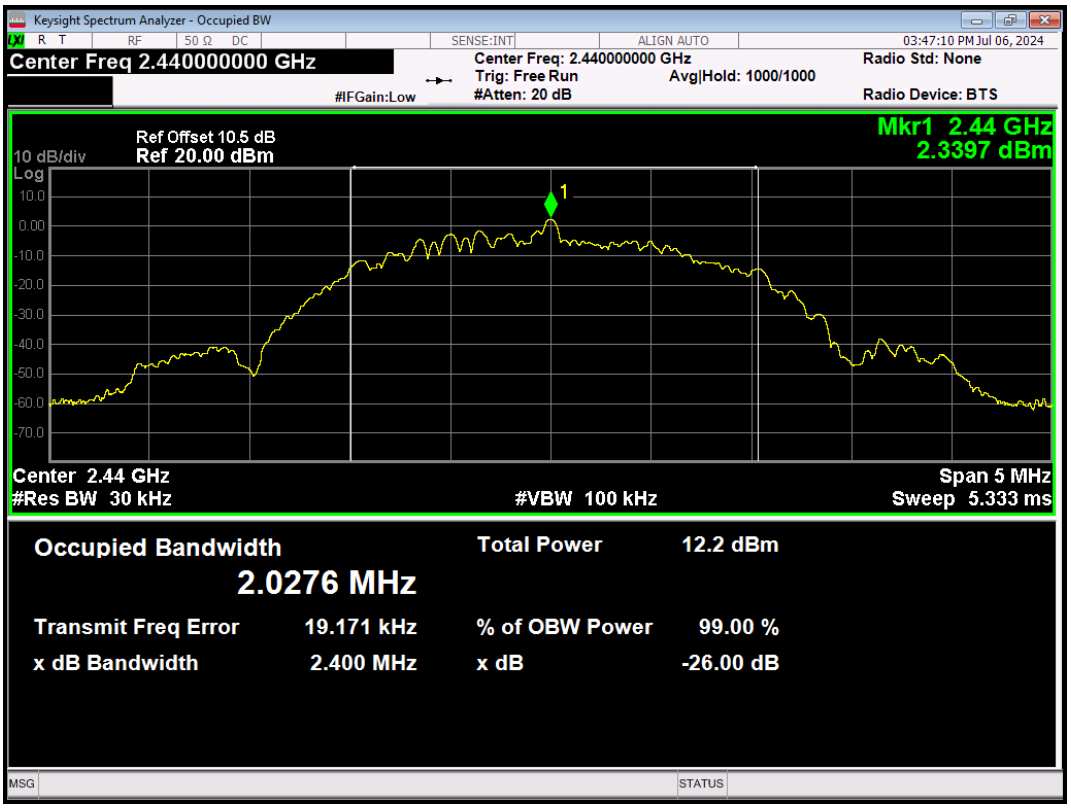
BLE_1M-Ant1-2440



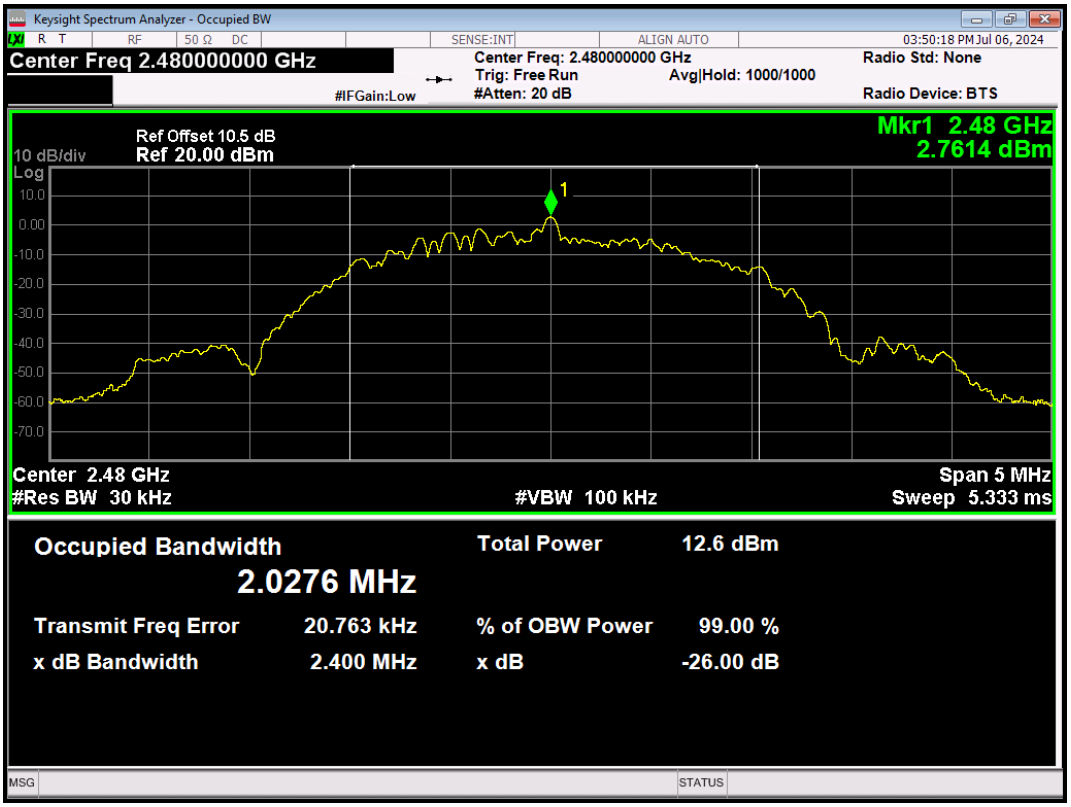
BLE_1M-Ant1-2480



BLE_2M-Ant1-2402



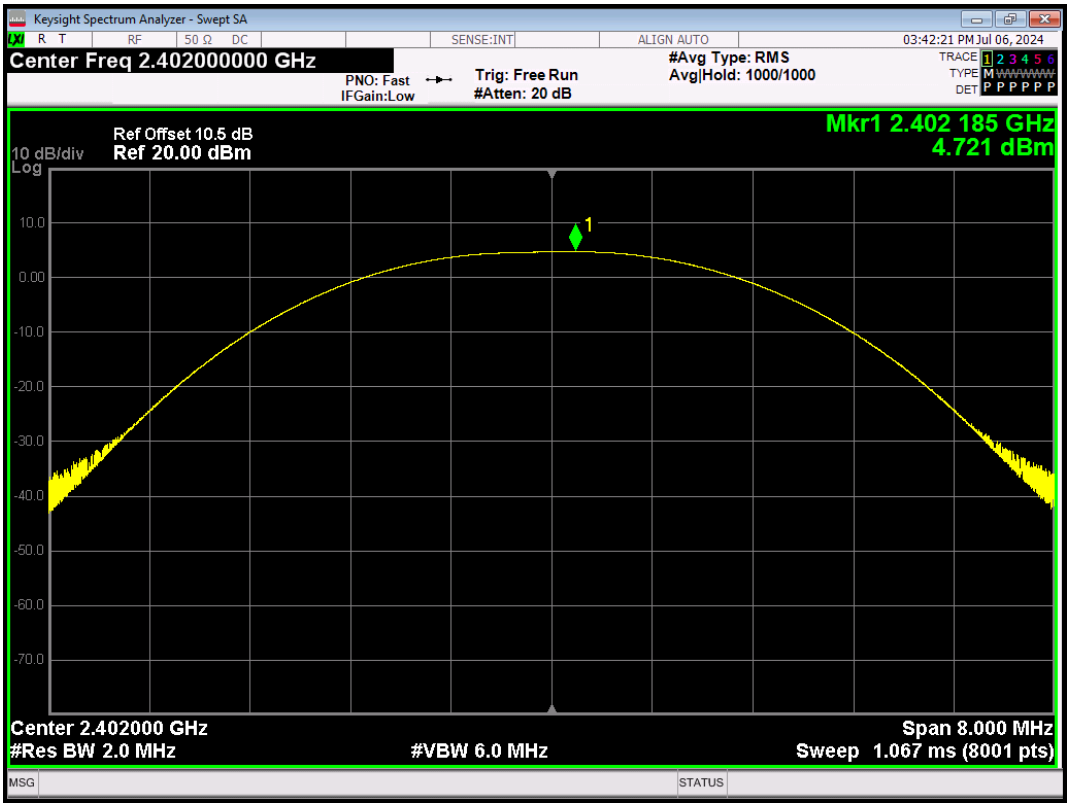
BLE_2M-Ant1-2440



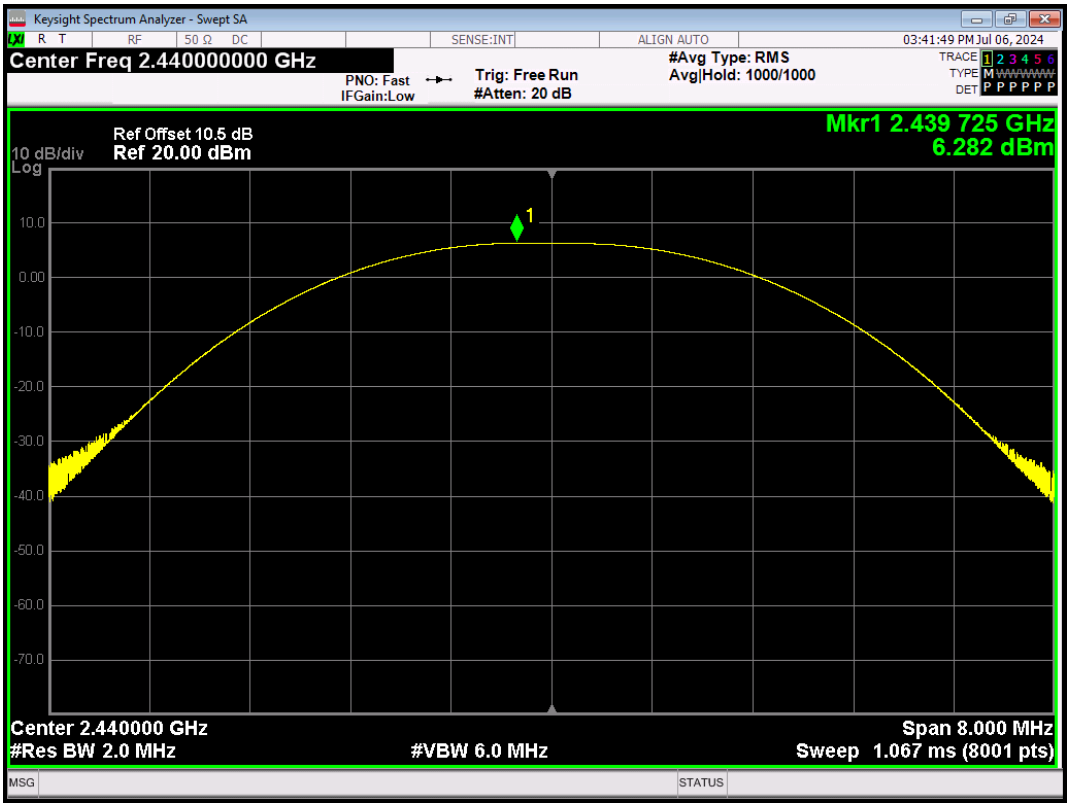
BLE_2M-Ant1-2480

Maximum conducted output power
Test Result and Data

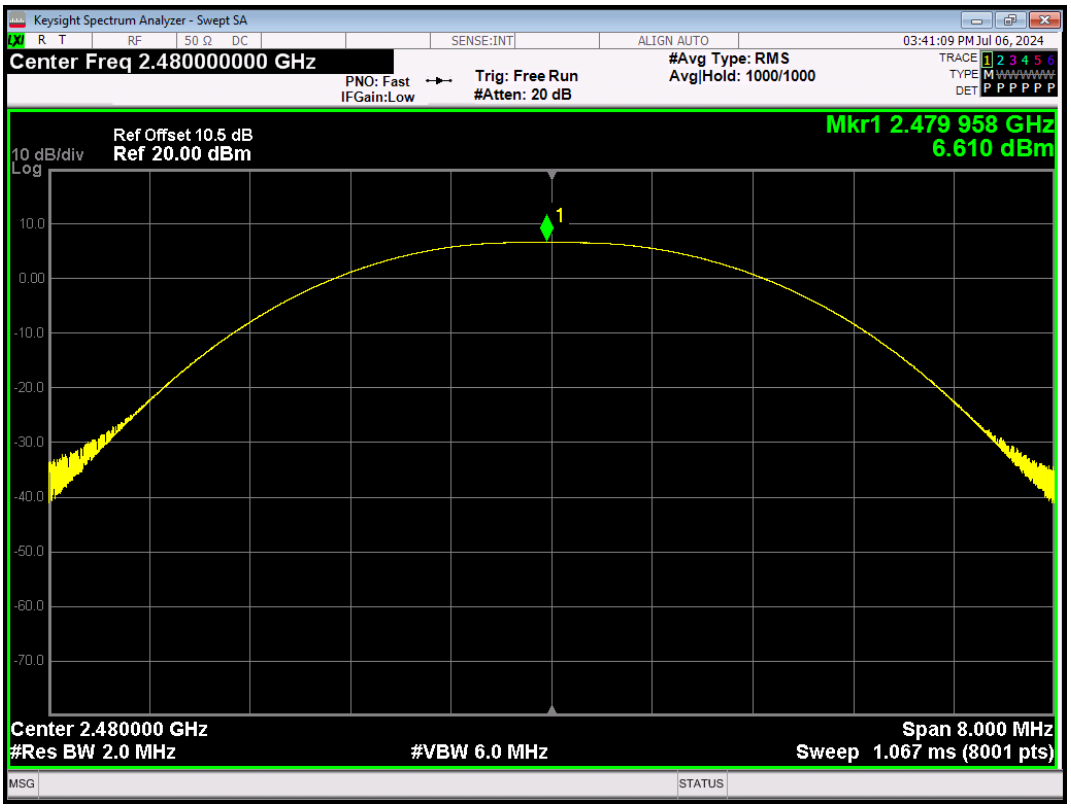
Test Mode	Antenna	Frequency [MHz]	Power [dBm]	Power Limit [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Verdict
BLE_1M	Ant1	2402	4.72	≤30	1.5	6.22	≤36	PASS
BLE_1M	Ant1	2440	6.28	≤30	1.5	7.78	≤36	PASS
BLE_1M	Ant1	2480	6.61	≤30	1.5	8.11	≤36	PASS
BLE_2M	Ant1	2402	4.83	≤30	1.5	6.33	≤36	PASS
BLE_2M	Ant1	2440	6.36	≤30	1.5	7.86	≤36	PASS
BLE_2M	Ant1	2480	6.69	≤30	1.5	8.19	≤36	PASS



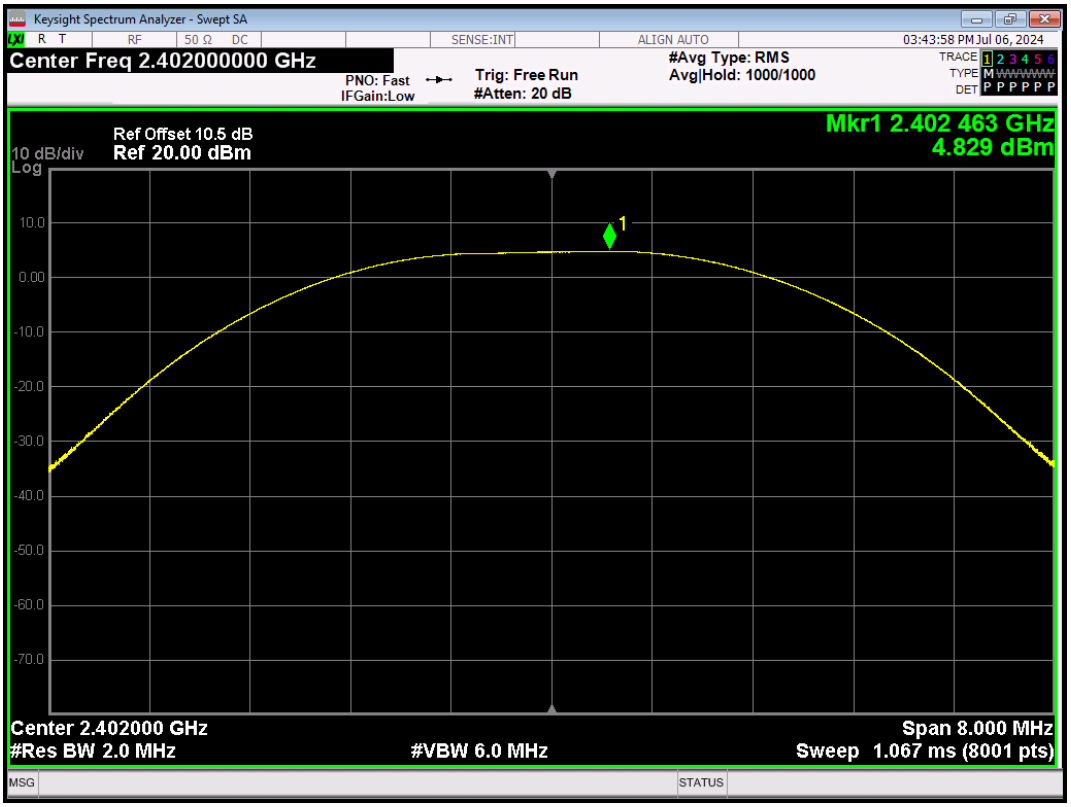
BLE_1M-Ant1-2402-PASS



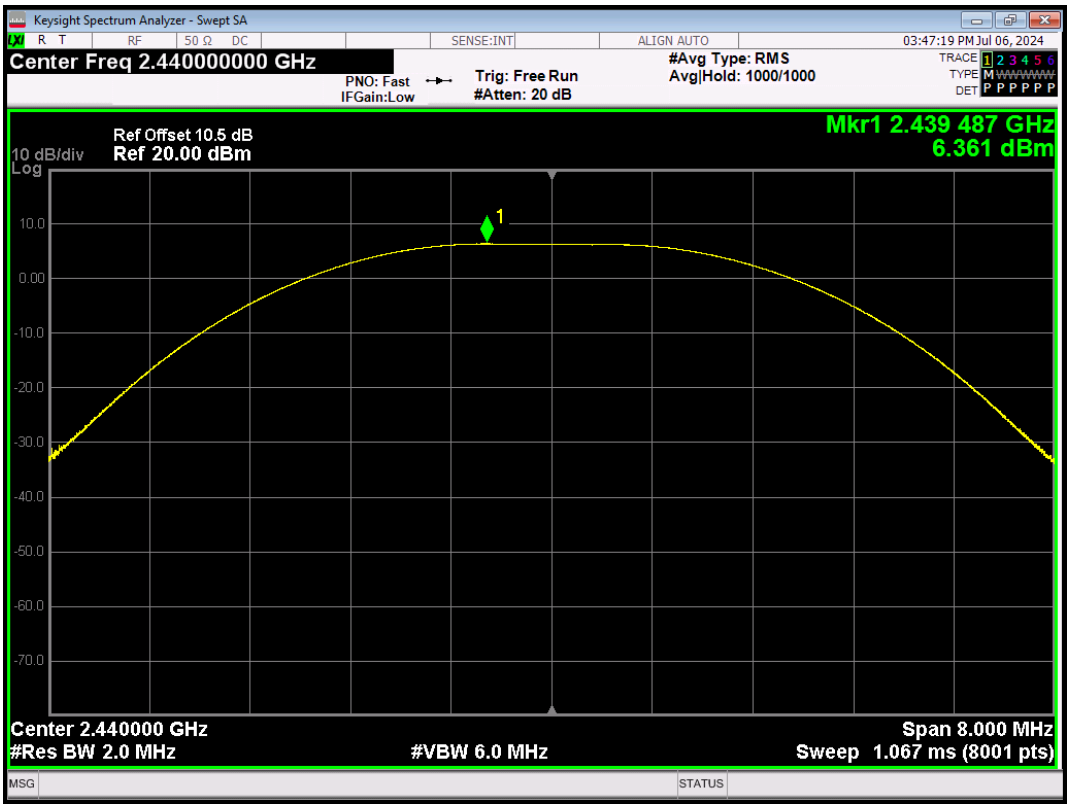
BLE_1M-Ant1-2440-PASS



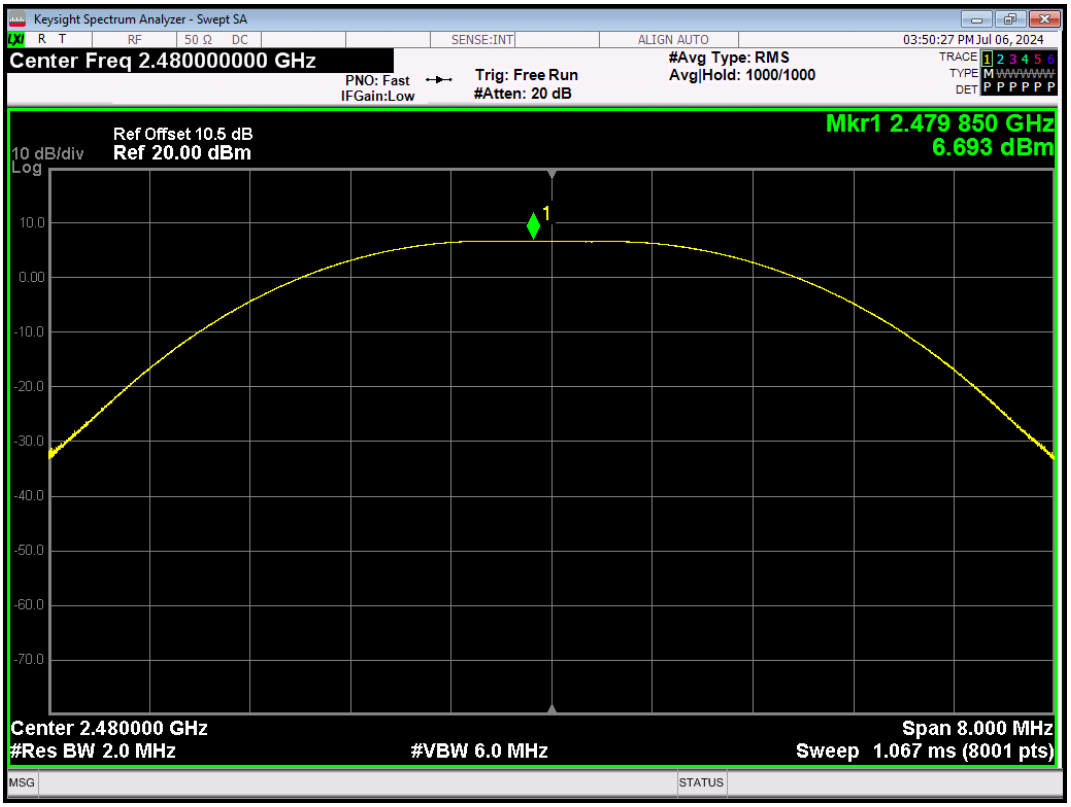
BLE_1M-Ant1-2480-PASS



BLE_2M-Ant1-2402-PASS



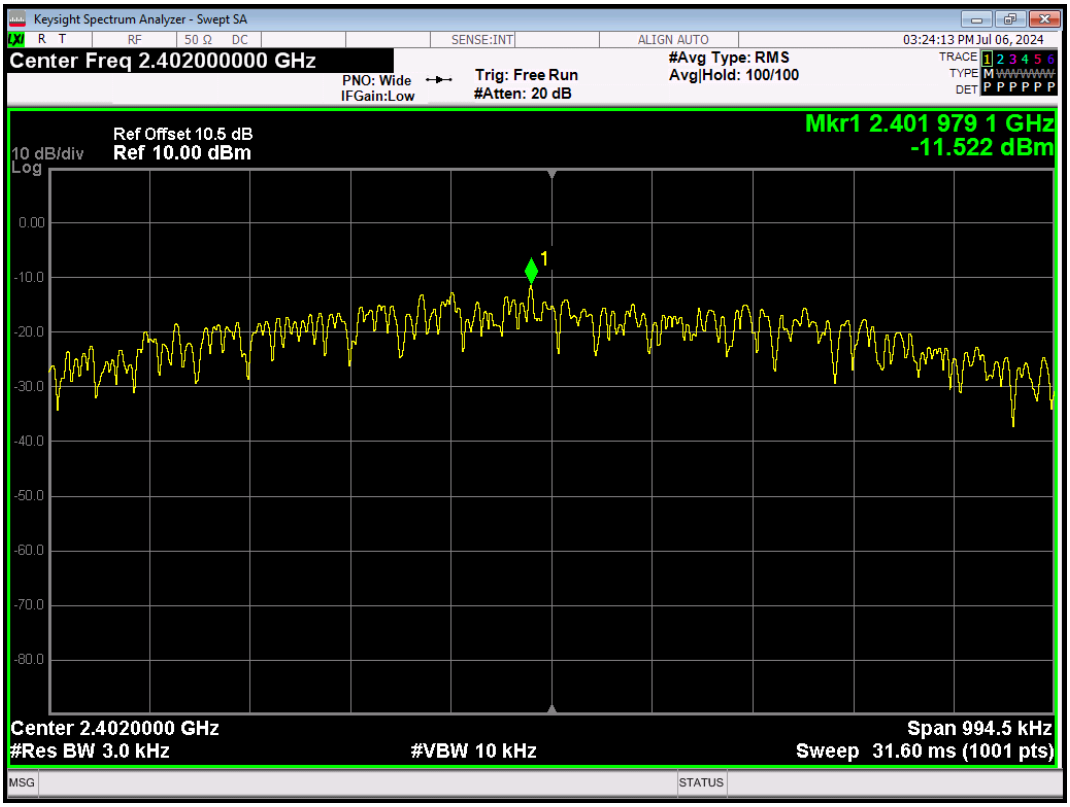
BLE_2M-Ant1-2440-PASS



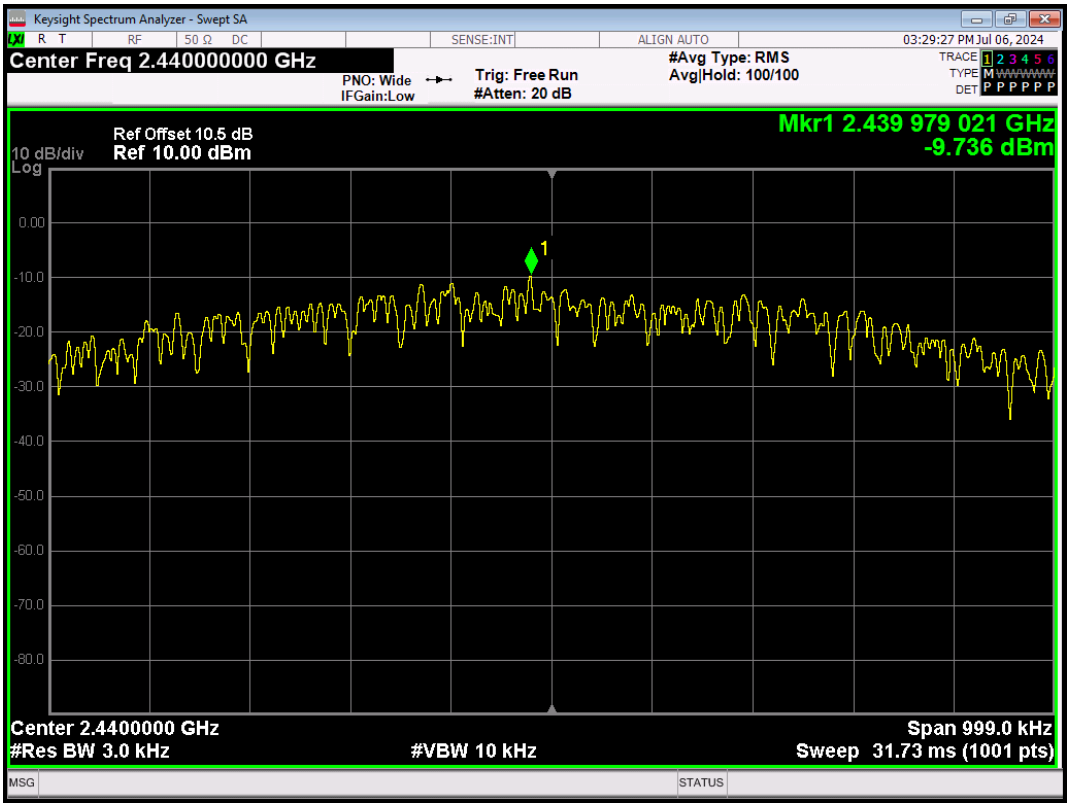
BLE_2M-Ant1-2480-PASS

Maximum power spectral density
Test Result and Data

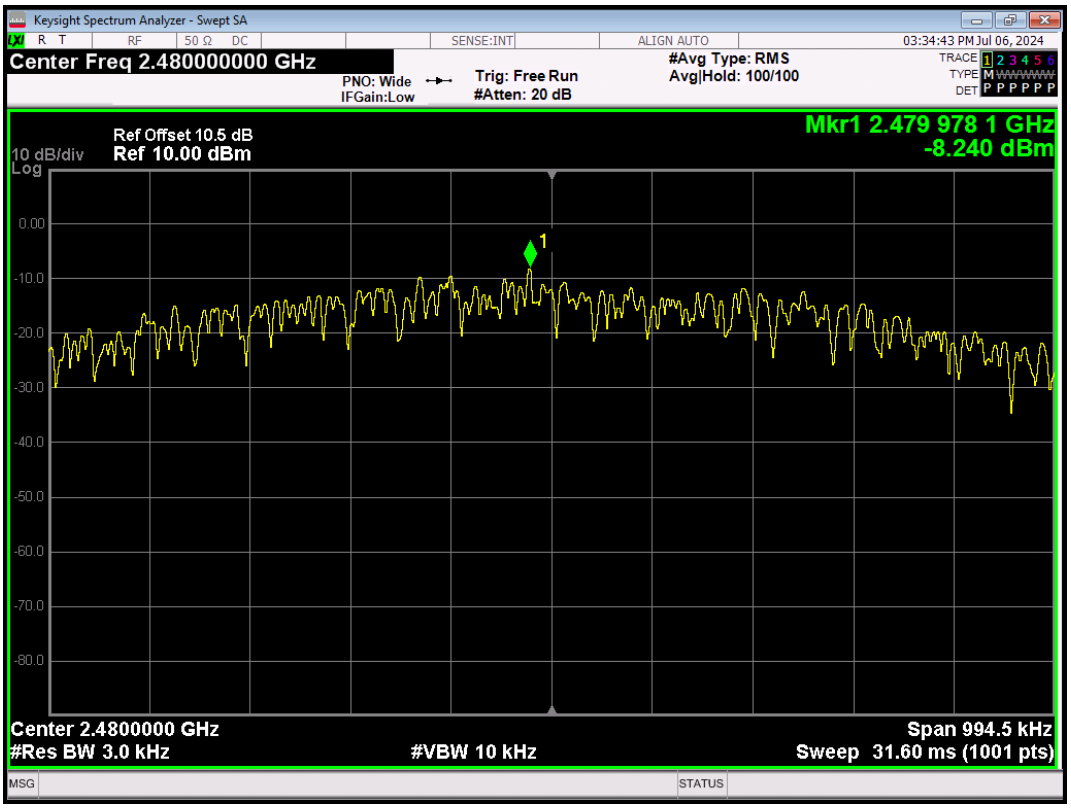
Test Mode	Antenna	Frequency [MHz]	Result [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-11.52	≤8.00	PASS
BLE_1M	Ant1	2440	-9.74	≤8.00	PASS
BLE_1M	Ant1	2480	-8.24	≤8.00	PASS
BLE_2M	Ant1	2402	-13.88	≤8.00	PASS
BLE_2M	Ant1	2440	-12.19	≤8.00	PASS
BLE_2M	Ant1	2480	-11.87	≤8.00	PASS



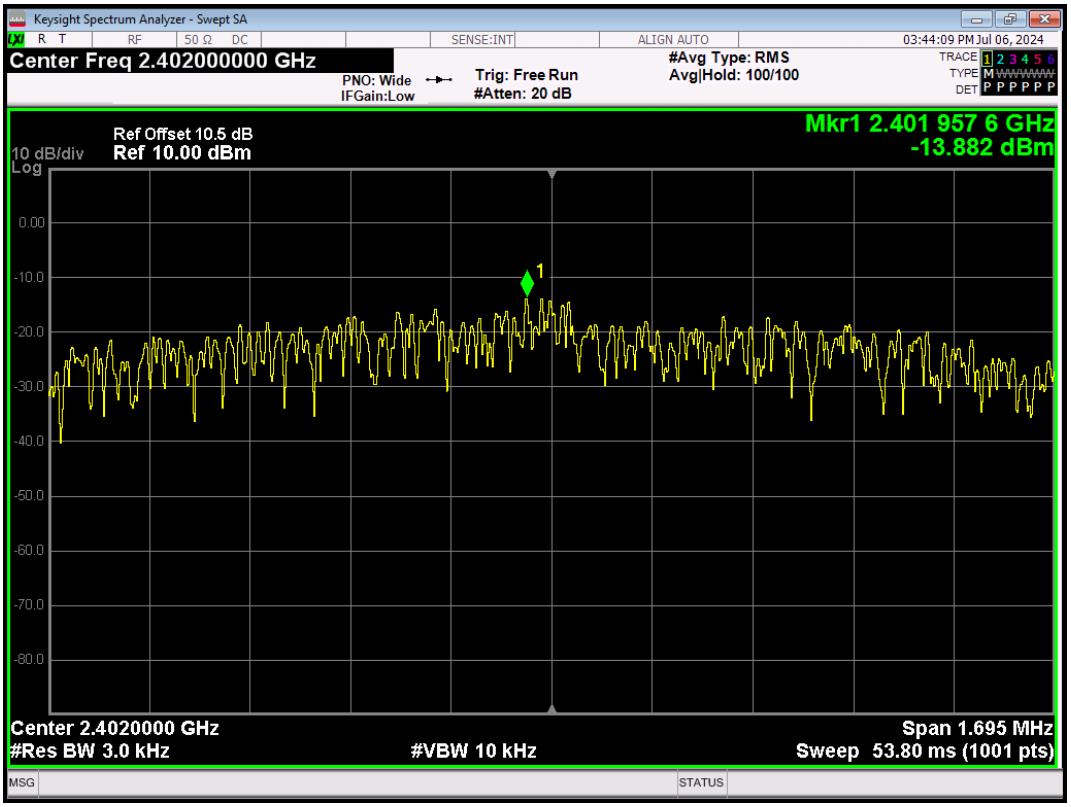
BLE_1M-Ant1-2402-PASS



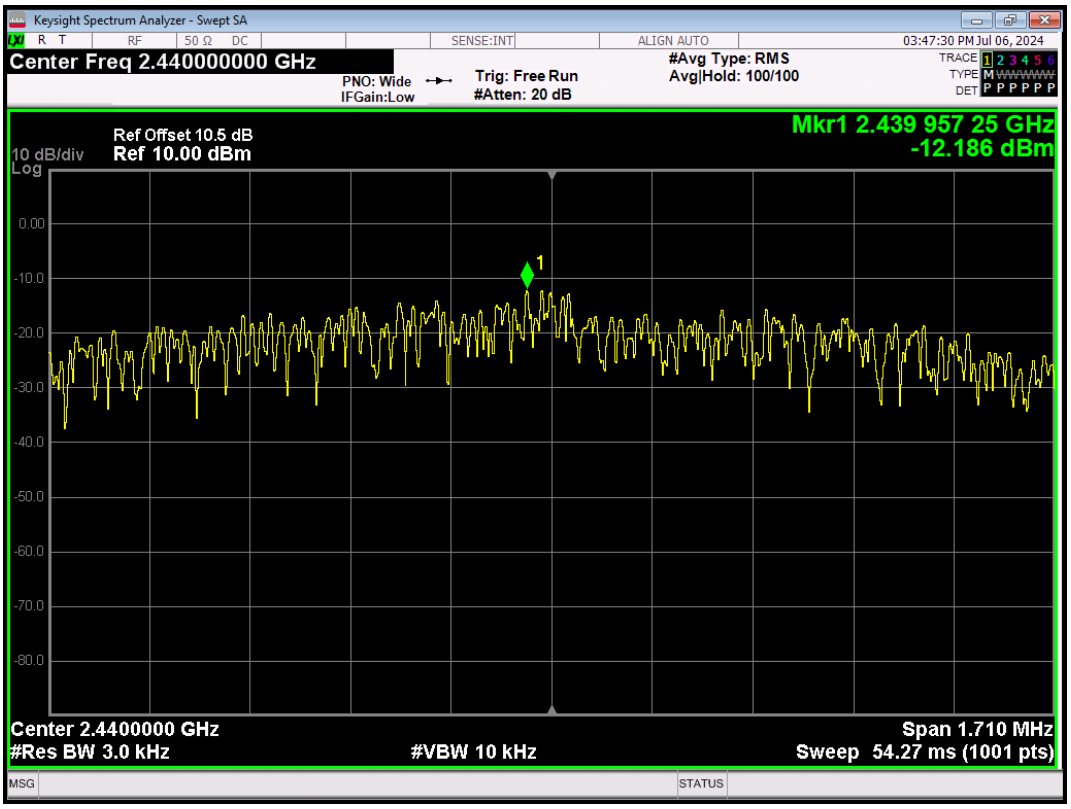
BLE_1M-Ant1-2440-PASS



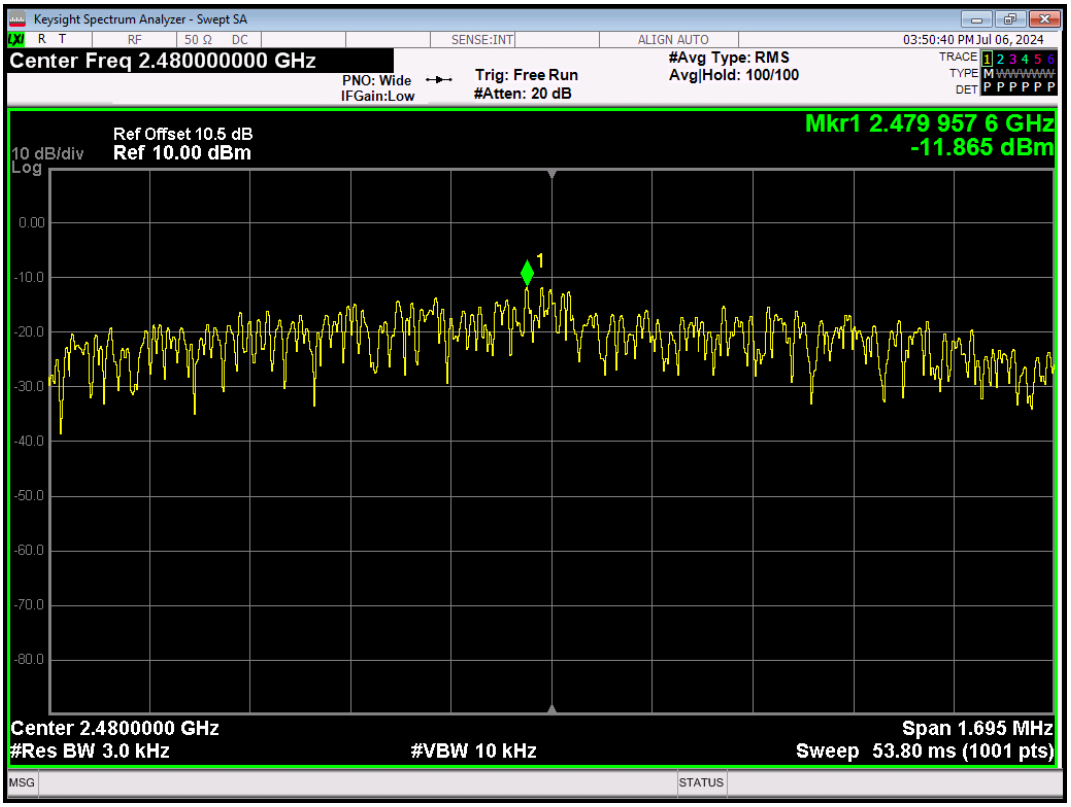
BLE_1M-Ant1-2480-PASS



BLE_2M-Ant1-2402-PASS

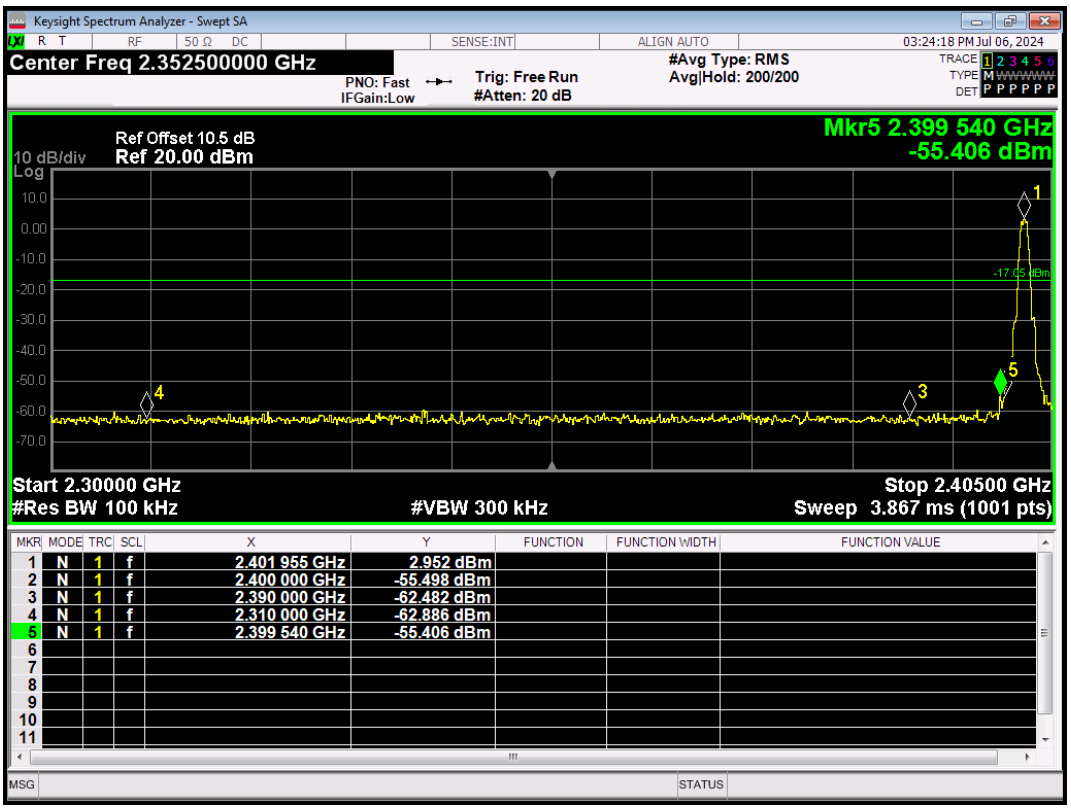


BLE_2M-Ant1-2440-PASS

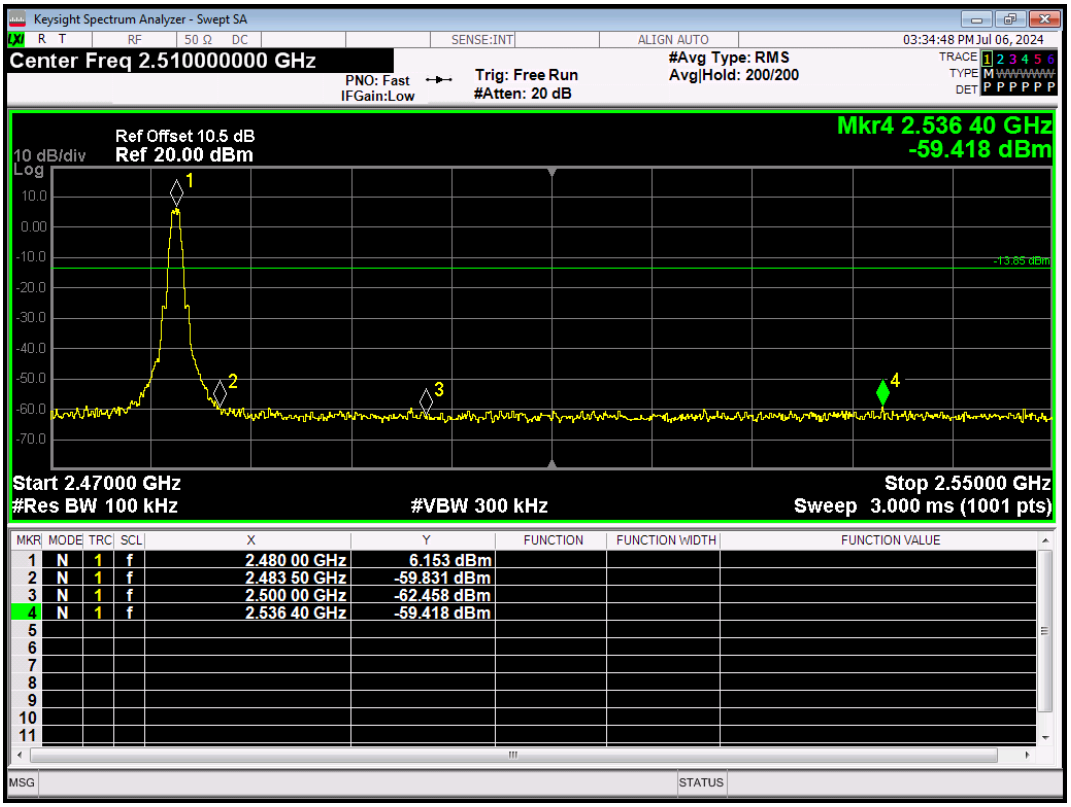


BLE_2M-Ant1-2480-PASS

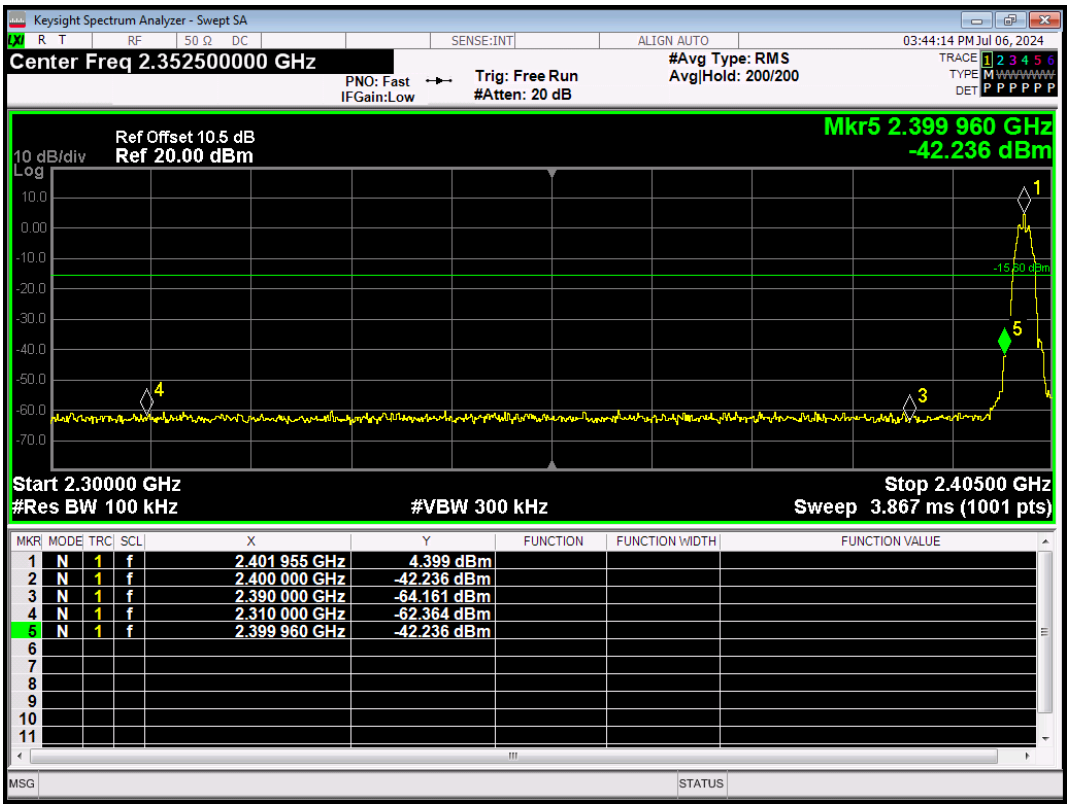
Band edge measurements
Test Result and Data



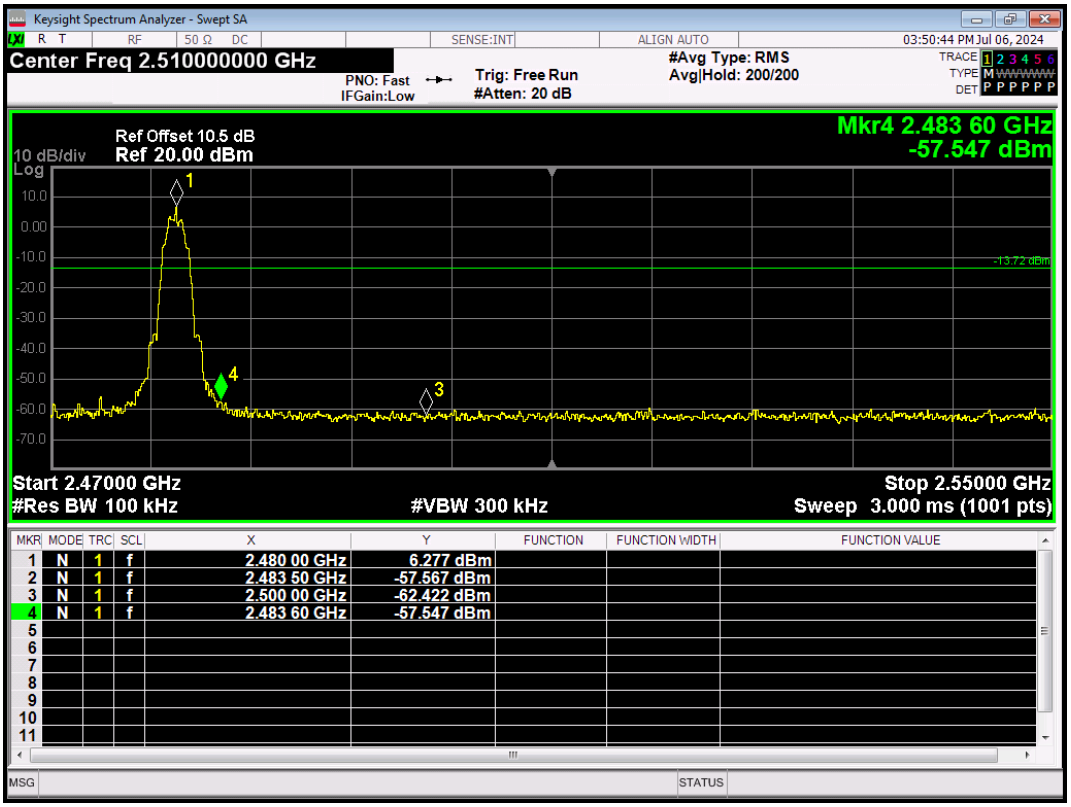
BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2480-PASS

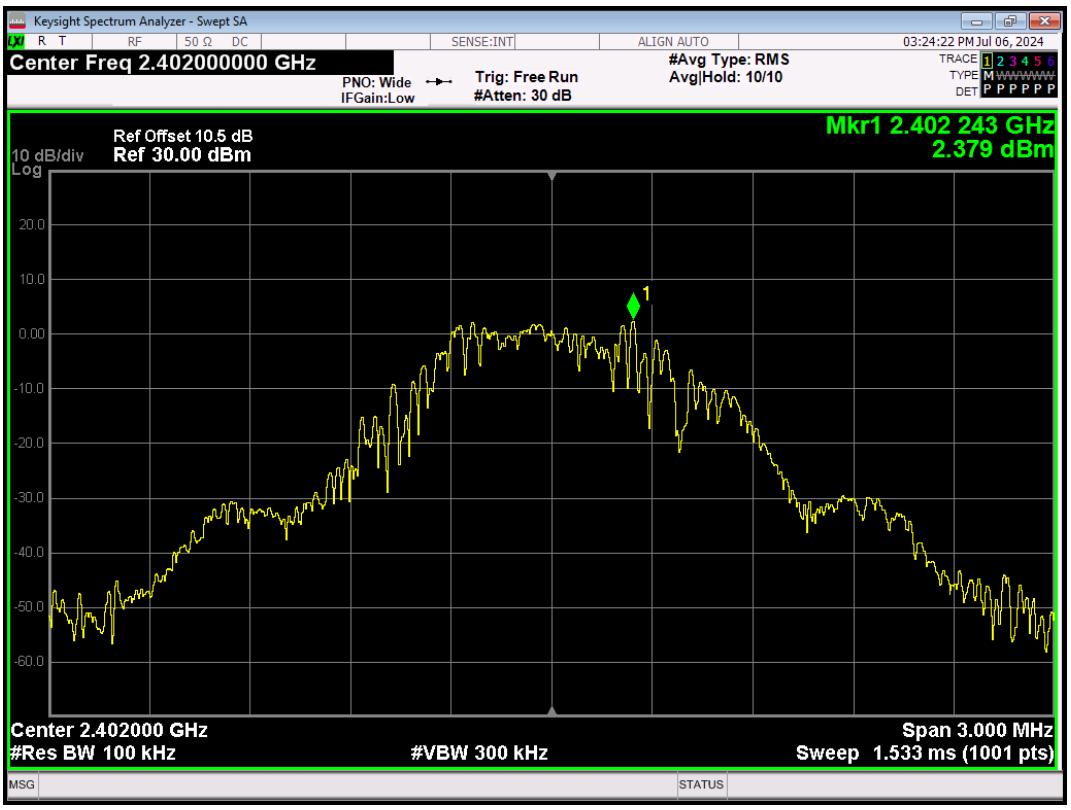


BLE_2M-Ant1-2402-PASS

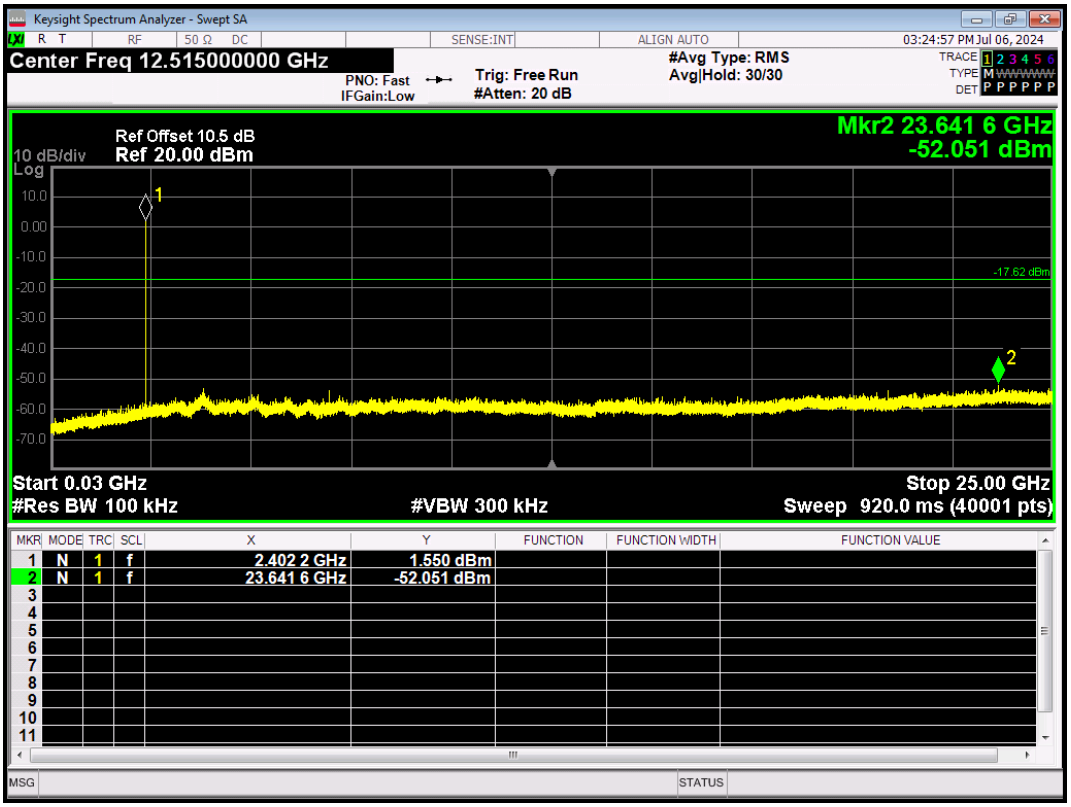


BLE_2M-Ant1-2480-PASS

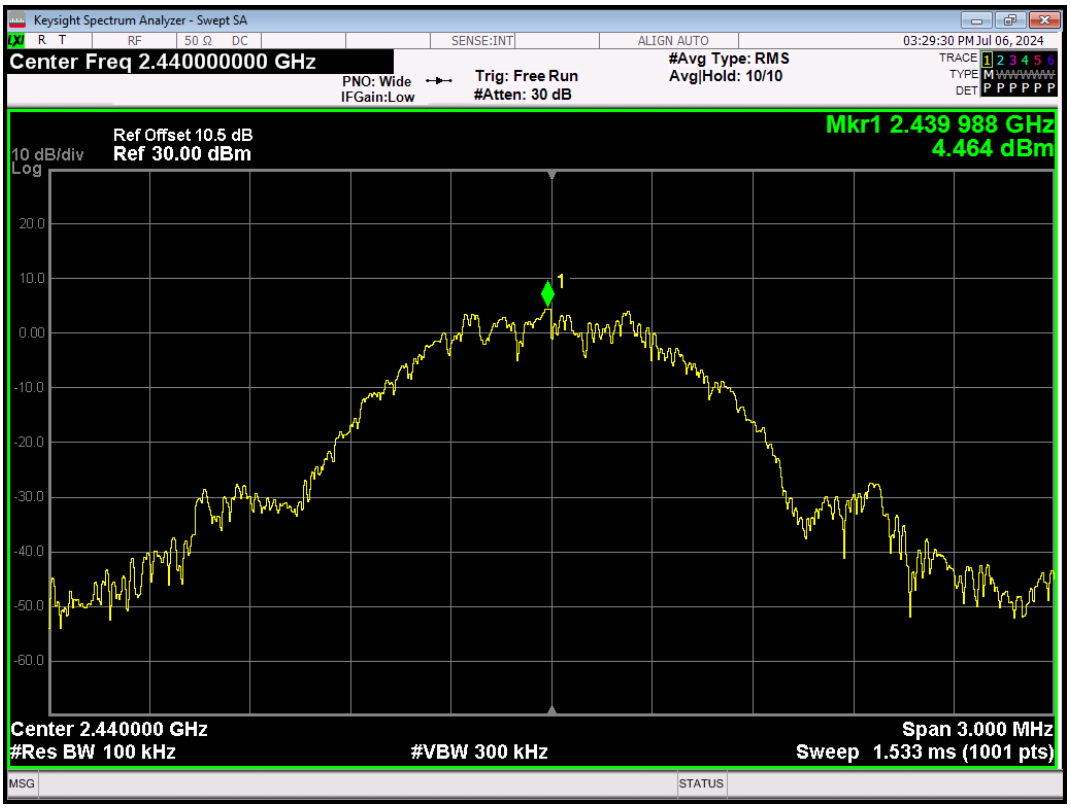
Conducted Spurious Emission
Test Result and Data



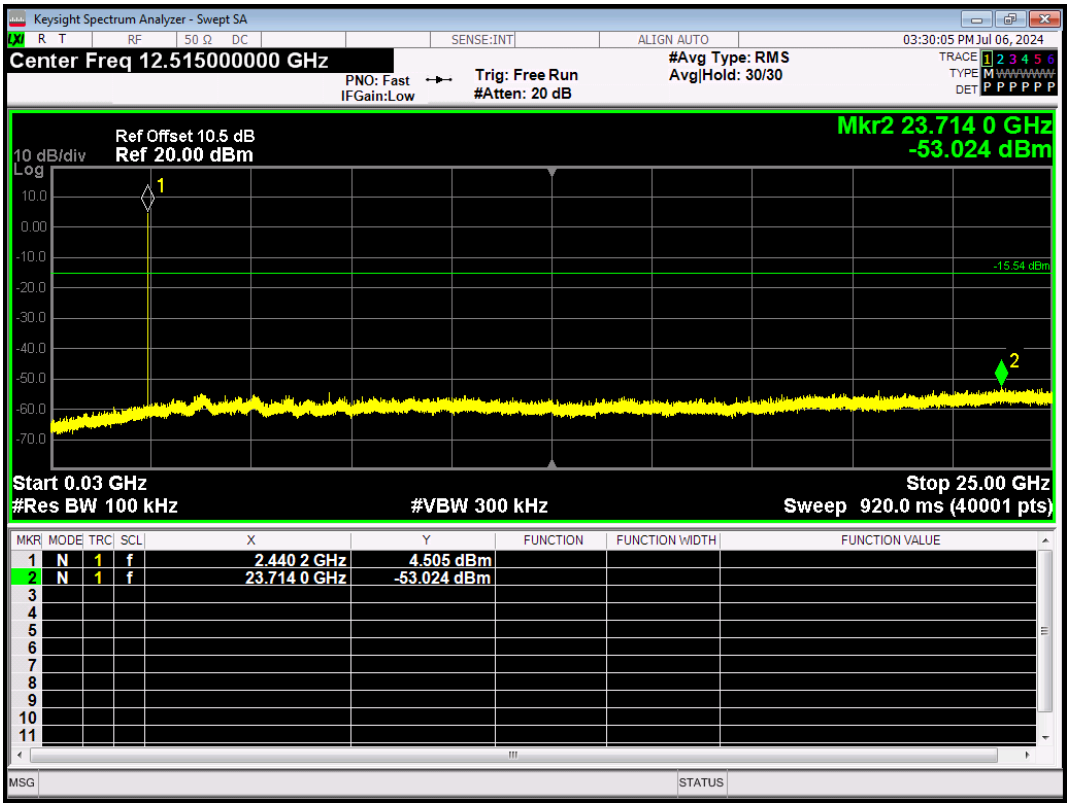
BLE_1M-Ant1-2402-0~Reference-PASS



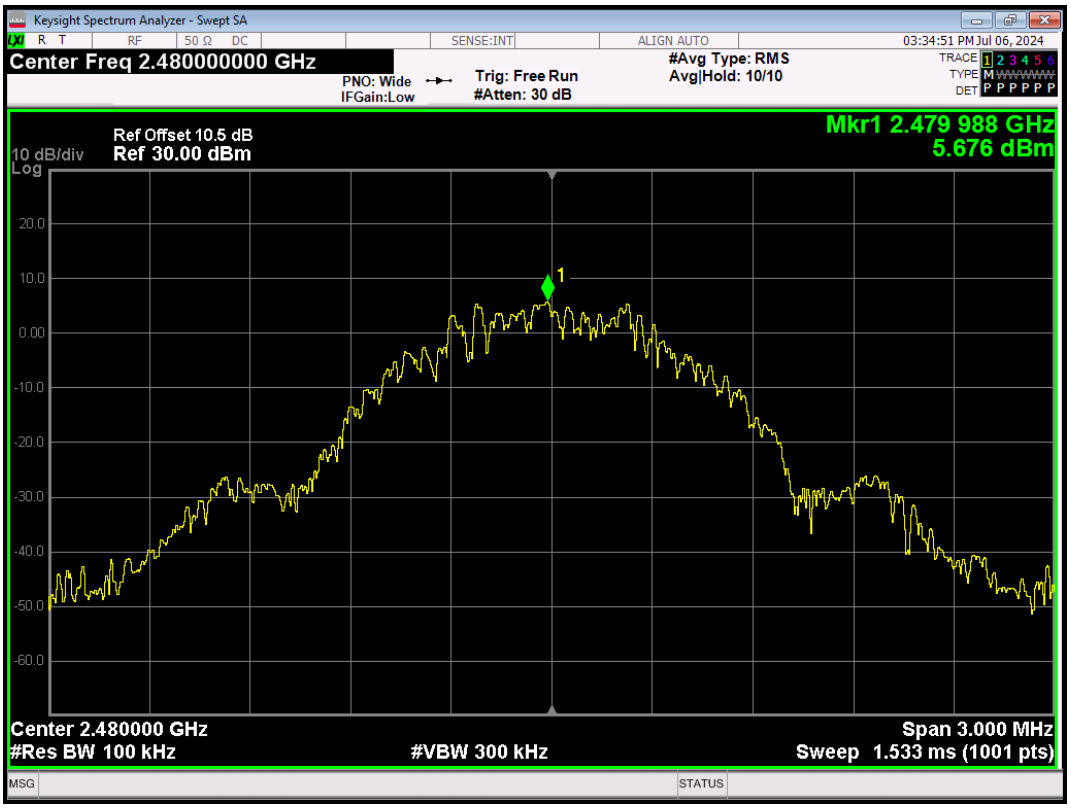
BLE_1M-Ant1-2402-30~25000-PASS



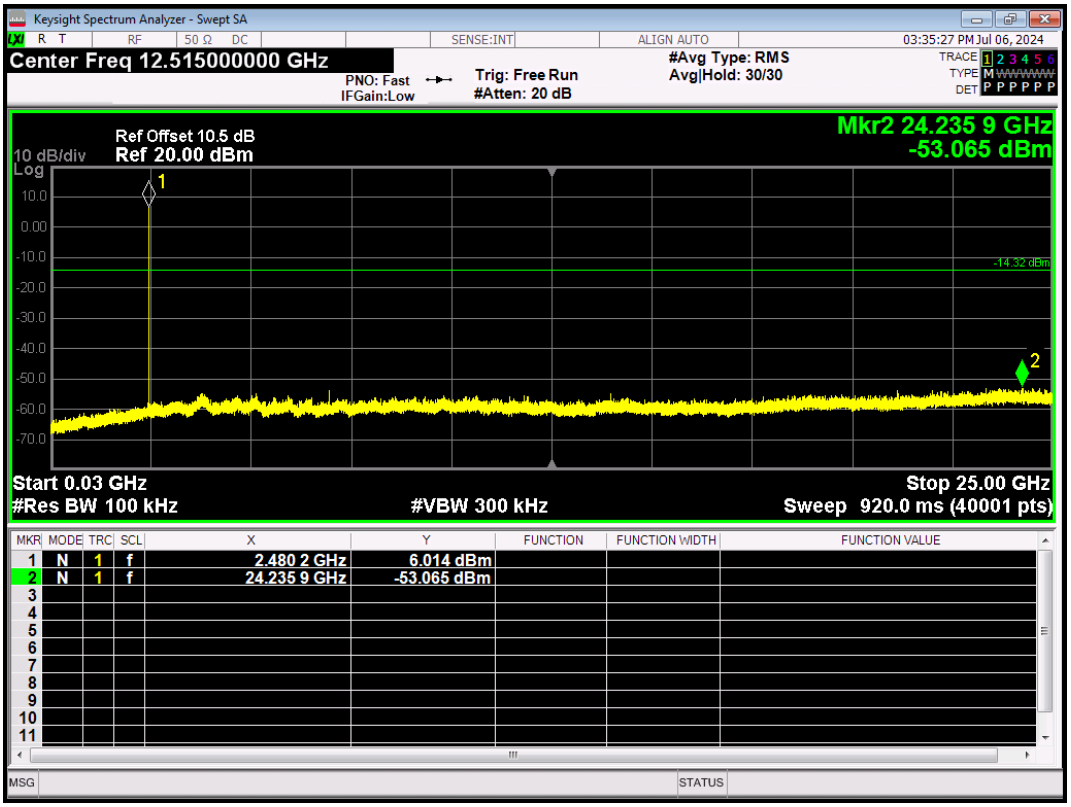
BLE_1M-Ant1-2440-0~Reference-PASS



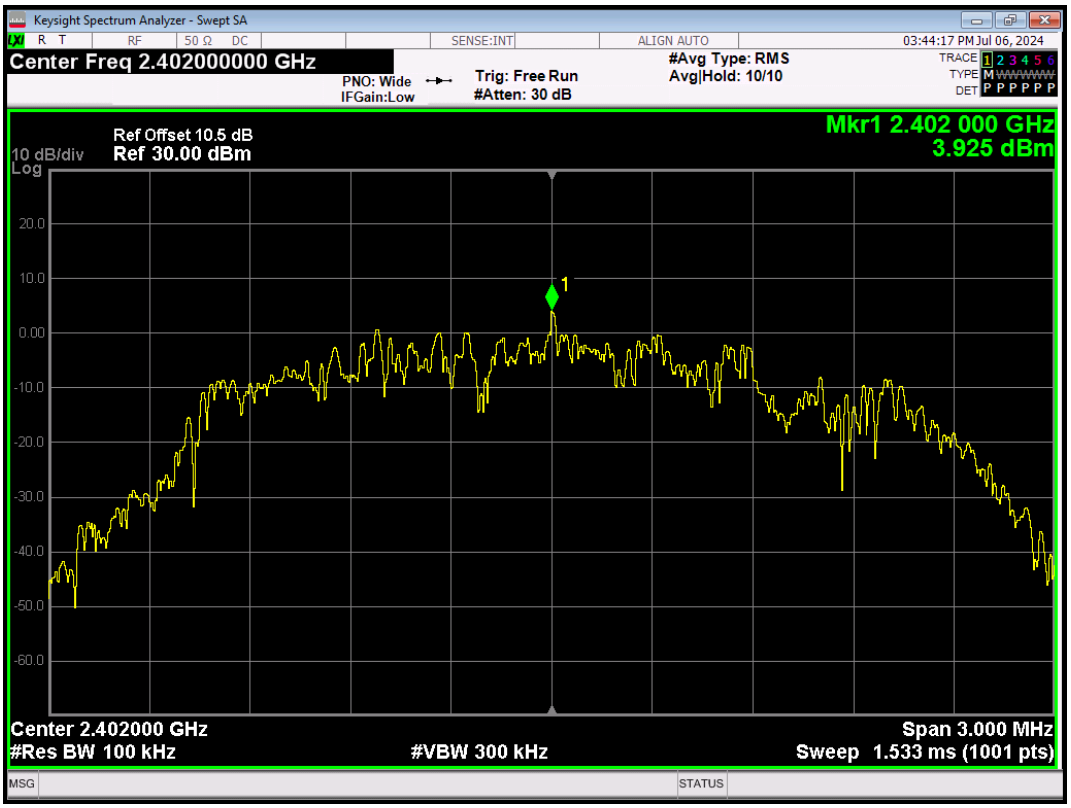
BLE_1M-Ant1-2440-30~25000-PASS



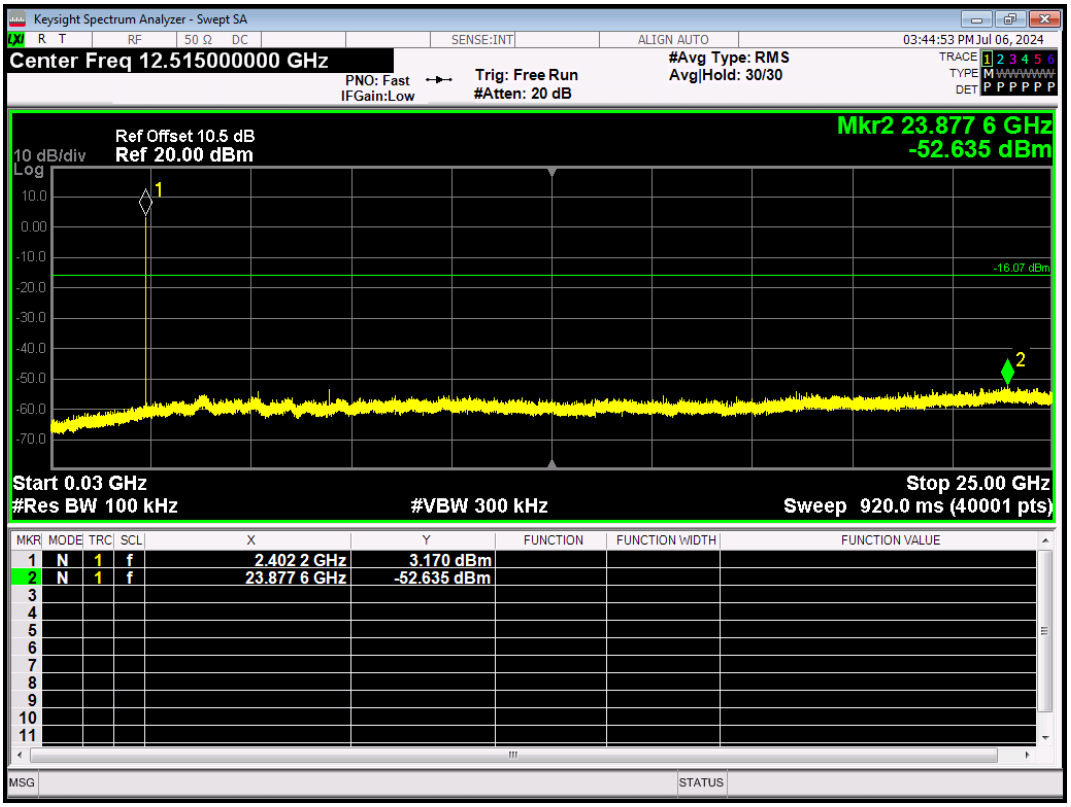
BLE_1M-Ant1-2480-0~Reference-PASS



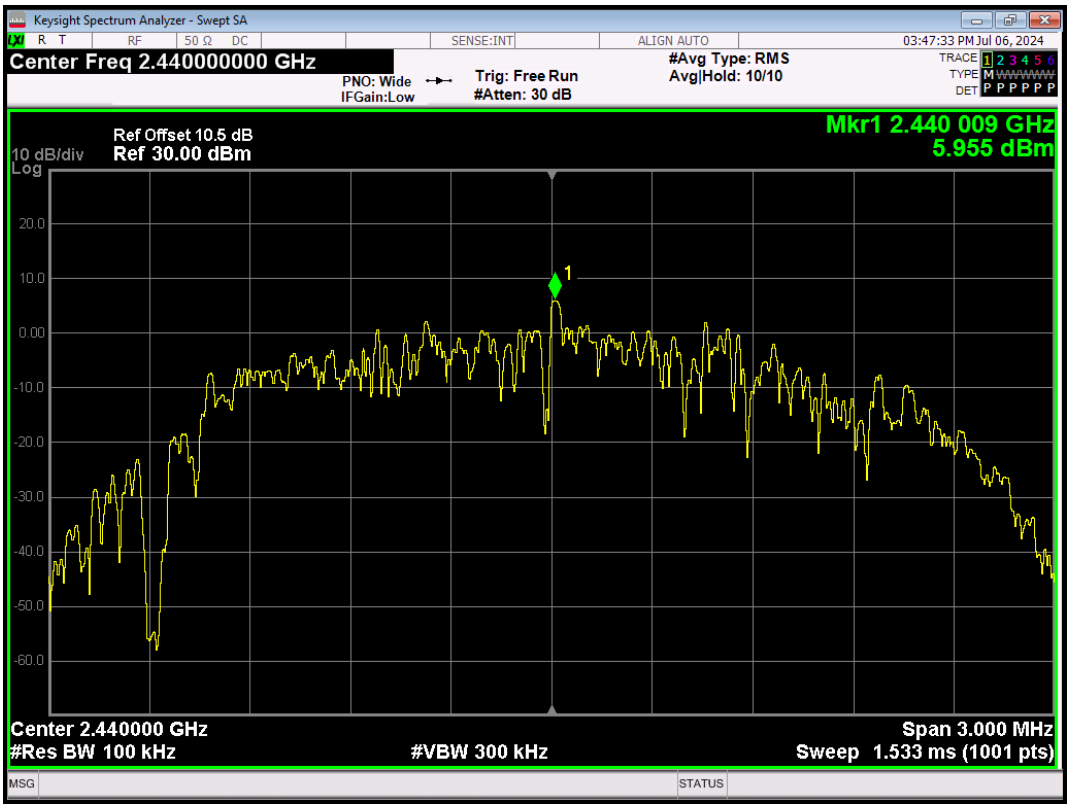
BLE_1M-Ant1-2480-30~25000-PASS



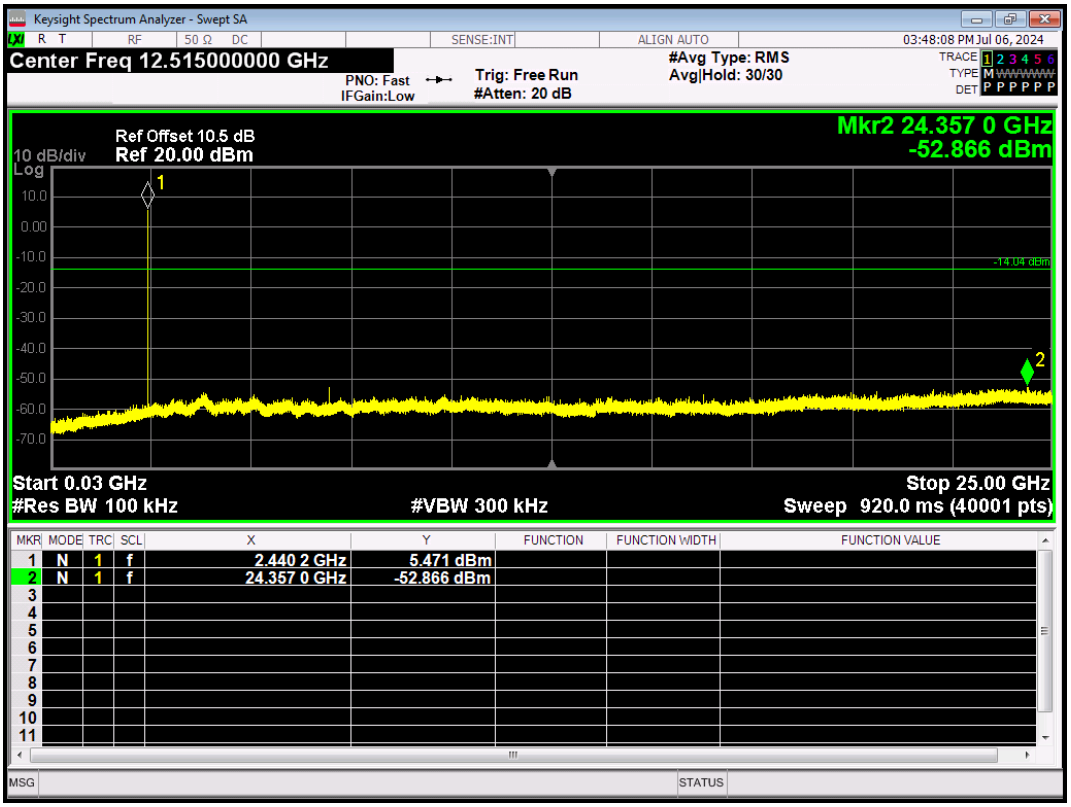
BLE_2M-Ant1-2402-0~Reference-PASS



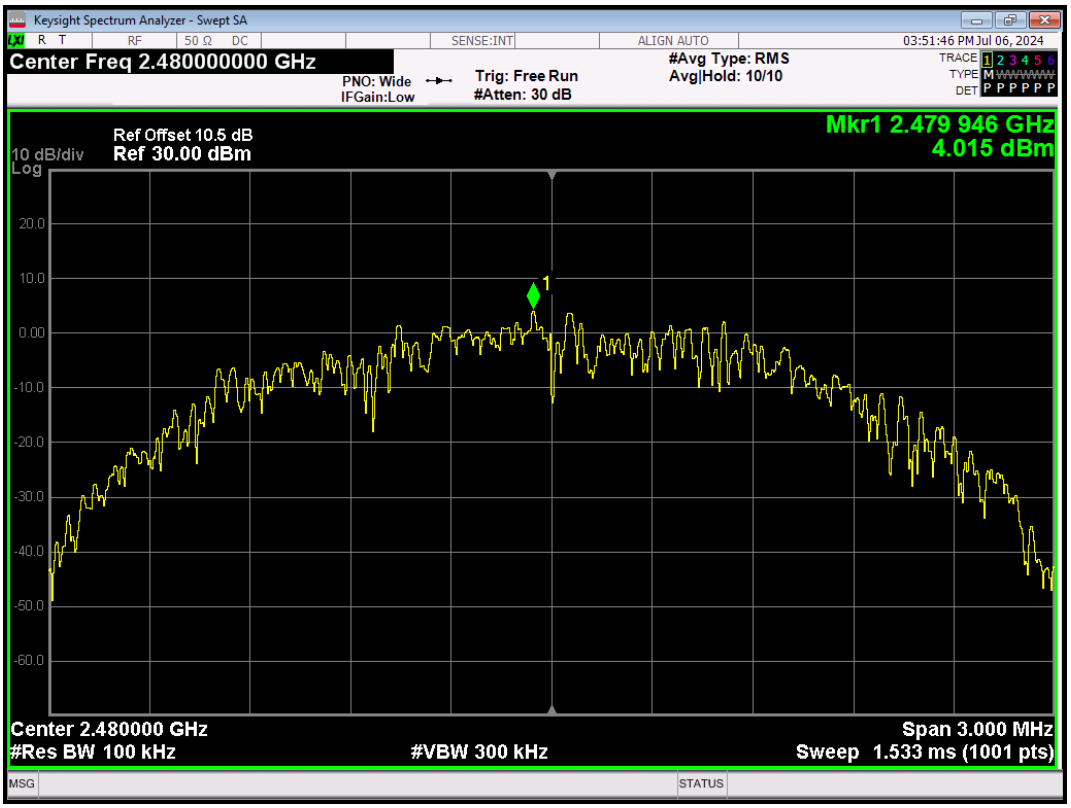
BLE_2M-Ant1-2402-30~25000-PASS



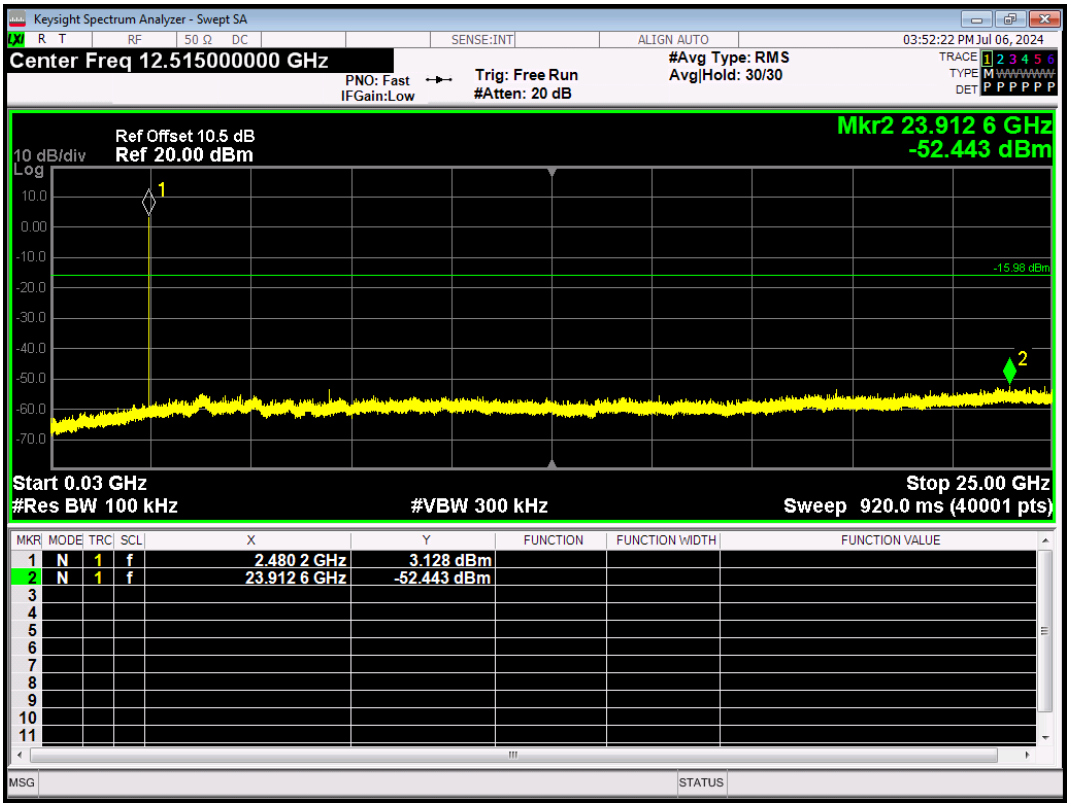
BLE_2M-Ant1-2440-0~Reference-PASS



BLE_2M-Ant1-2440-30~25000-PASS



BLE_2M-Ant1-2480-0~Reference-PASS



BLE_2M-Ant1-2480-30~25000-PASS

END OF REPORT