FCC RF Test Report

APPLICANT	:	Quectel Wireless Solutions Co., Ltd.
EQUIPMENT	:	Wi-Fi & Bluetooth Module
BRAND NAME	:	Quectel
MODEL NAME	:	FCE863R
FCC ID	:	XMR2024FCE863R
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System
TEST DATE(S)	:	Apr. 06, 2024 ~ May 15, 2024

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR430102B	Rev. 01	Initial issue of report	May 16, 2024

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Report only	-
3.2	15.247(b)(3)	Peak Output Power	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 8.34 dB at 30.00 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 15.33 dB at 0.402 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

1 General Description

1.1 Applicant

Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

1.2 Manufacturer

Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Wi-Fi & Bluetooth Module
Brand Name	Quectel
Model Name	FCE863R
FCC ID	XMR2024FCE863R
SN Code	Conducted: E1C23H816000098 Conduction: E1823L01P000037 Radiation: E1C23H816000097
HW Version	R1.0
SW Version	NA
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	<ANT0> BLE 1Mbps: 6.97 dBm (0.0050 W) BLE 2Mbps: 7.03 dBm (0.0050 W) BLE 125kbps: 6.91 dBm (0.0049 W) BLE 500kbps: 6.95 dBm (0.0050 W) <ANT1> BLE 1Mbps: 8.68 dBm (0.0074 W) BLE 2Mbps: 8.78 dBm (0.0076 W) BLE 125kbps: 8.53 dBm (0.0071 W) BLE 500kbps: 8.54 dBm (0.0071 W)
99% Occupied Bandwidth	<ANT0> BLE 1Mbps:1.027MHz

	BLE 2Mbps:2.046MHz BLE 125kbps:1.047MHz BLE 500kbps:1.023MHz <ANT1> BLE 1Mbps:1.027MHz BLE 2Mbps:2.046MHz BLE 125kbps:1.043MHz BLE 500kbps:1.027MHz
Antenna Type / Gain	<ANT0>: Diopole Antenna type with gain 0.2 dBi <ANT1>: Diopole Antenna type with gain 0.2 dBi
Type of Modulation	Bluetooth LE : GFSK

Note:

1. For BLE 1Mbps & 2Mbps & 125Kbps & 500Kbps mode, the whole testing has assessed BLE 1Mbps/2Mbps mode by referring to the higher conducted power.
2. BLE 2Mbps does not support three primary advertising channels (CH00/CH12/CH39).
3. The device supports Bluetooth LE SISO mode only.

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH08-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	TH01-KS	Tonscend	JS1120-3 test system China_210602	3.3.10
2.	03CH08-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
	20	2442	-	-

2.2 Test Mode

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X-plane) were recorded in this report.

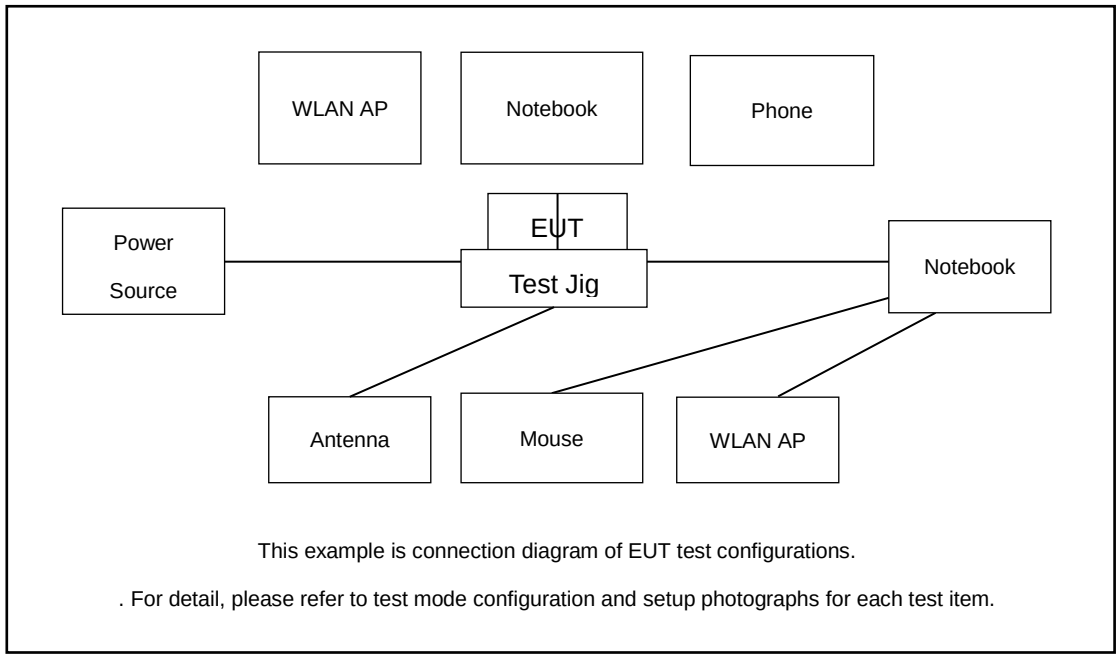
b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	**Data Rate / Modulation**
	Bluetooth – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps Mode 4: Bluetooth Tx CH01_2404 MHz_BLE 2Mbps Mode 5: Bluetooth Tx CH19_2440 MHz_BLE 2Mbps Mode 6: Bluetooth Tx CH38_2478 MHz_BLE 2Mbps
Radiated TCs	Mode 4/13: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps Mode 5/14: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps Mode 6/15: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps Mode 7/16: Bluetooth Tx CH01_2404 MHz_BLE 2Mbps Mode 8/17: Bluetooth Tx CH19_2440 MHz_BLE 2Mbps Mode 9/18: Bluetooth Tx CH38_2478 MHz_BLE 2Mbps
AC Conducted Emission	Mode 1: Bluetooth Link + WLAN Link (2.4G) + USB Cable (Charging from EVB Adapter)
Remark: For Radiated Test Cases, The tests were performed with Adapter.	

2.3 Connection Diagram of Test System

For AC conduction emission:



This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each test item.

For radiated emission:

This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-Link	DIR-628	KA2DIR628A2	N/A	Unshielded, 1.8 m
2.	WLAN AP	D-Link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
3.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
4.	Test Jig	N/A	N/A	N/A	N/A	N/A
5.	Adapter	N/A	N/A	N/A	N/A	N/A
6.	Antenna	N/A	N/A	N/A	N/A	N/A
7.	USB cable	N/A	N/A	N/A	N/A	N/A
8.	Mouse	N/A	N/A	N/A	N/A	N/A
9.	Phone	N/A	N/A	N/A	N/A	N/A

2.5 EUT Operation Test Setup

For BLE function, the engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 1.89 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 1.89 + 10 = 11.89 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

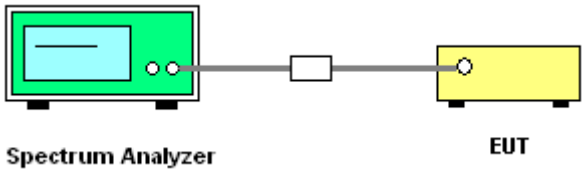
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1% to 5% of the 99% OBW and the VBW is set to 3 times of the RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

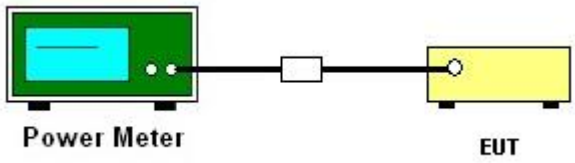
3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
2. The RF output of EUT was connected to the power meter 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. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 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.

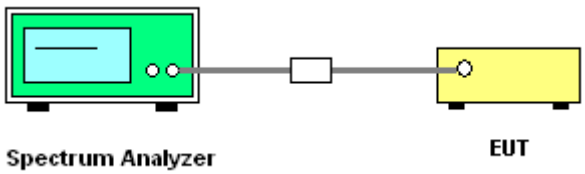
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. 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.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 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. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup

3.4.5 Test Result of Conducted Band Edges Plots

Please refer to Appendix A.

3.4.6 Test Result of Conducted Spurious Emission Plots

Please refer to Appendix A.

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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

3.5.2 Measuring Instruments

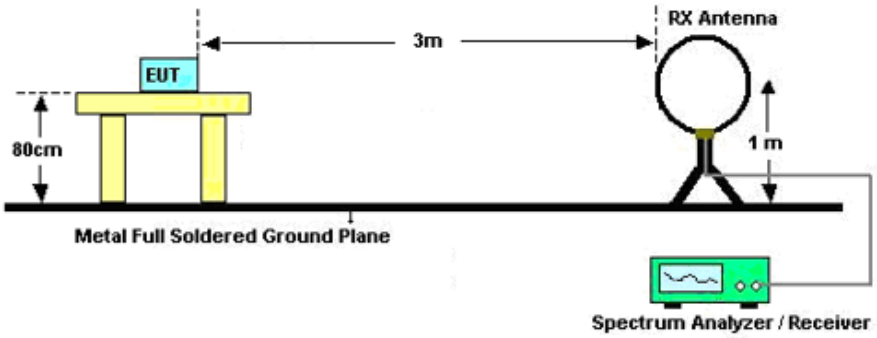
The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.5.3 Test Procedures

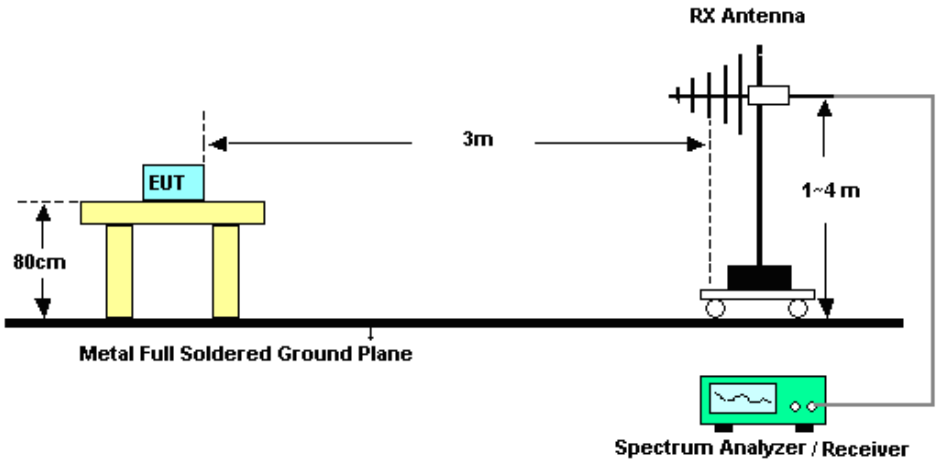
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

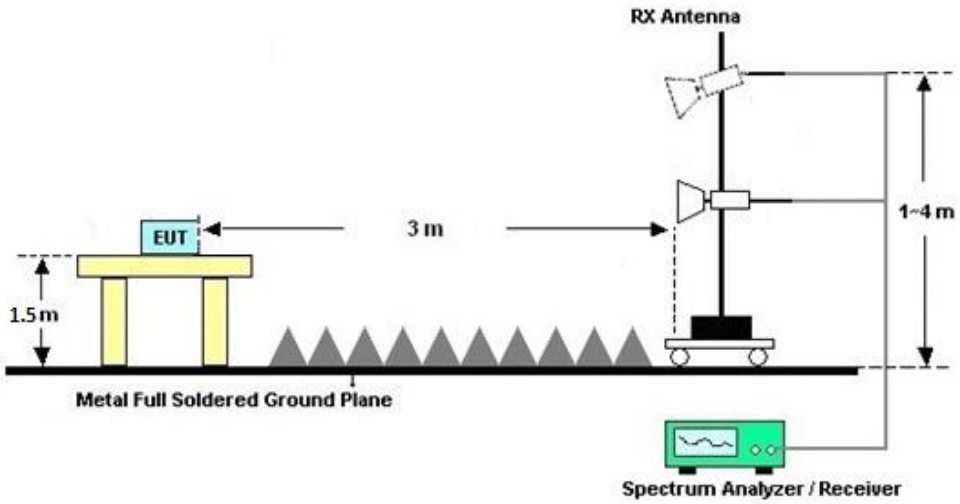
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC 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 of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

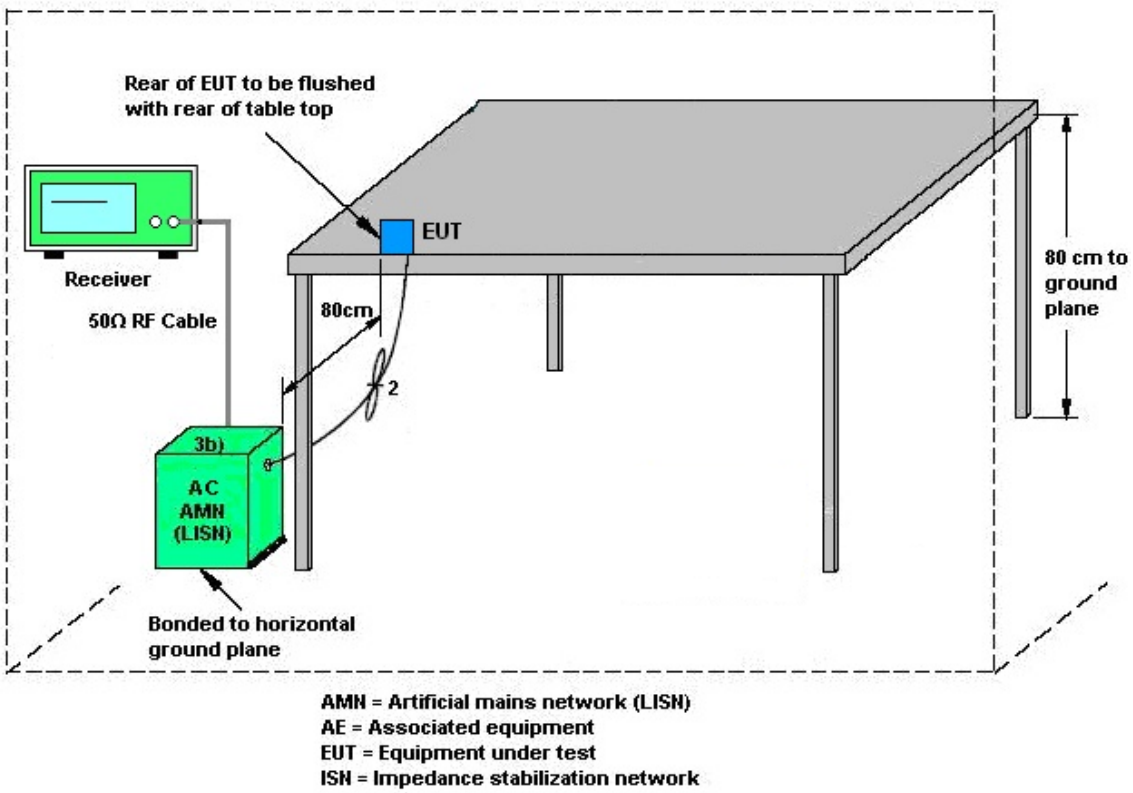
3.6.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.6.3 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 microhenry 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.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.7.2 Antenna Anti-Replacement Construction

Non-standard antenna connector is used.

3.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Apr. 06, 2024~ May 15, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Apr. 06, 2024~ May 15, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Apr. 06, 2024~ May 15, 2024	Jan. 01, 2025	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400023	3Hz~8.5GHz;Max 30dBm	Jan. 04, 2024	Apr. 21, 2024	Jan. 03, 2025	Radiation (03CH08-KS)
Spectrum Analyzer	R&S	FSV40	101932	10kHz~40GHz; Max 30dBm	Oct. 10, 2023	Apr. 21, 2024	Oct. 09, 2024	Radiation (03CH08-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Oct. 10, 2023	Apr. 21, 2024	Oct. 09, 2024	Radiation (03CH08-KS)
Bilog Antenna	TESEQ& VGT	CBL 61110	59915	30MHz-1GHz	Aug. 12, 2023	Apr. 21, 2024	Aug. 11, 2024	Radiation (03CH08-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Mar. 01, 2024	Apr. 21, 2024	Feb. 28, 2025	Radiation (03CH08-KS)
high gain Amplifier	EM	EM01G18GA	060845	1Ghz-18Ghz	Jan. 05, 2024	Apr. 21, 2024	Jan. 04, 2025	Radiation (03CH08-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 05, 2024	Apr. 21, 2024	Jan. 04, 2025	Radiation (03CH08-KS)
Amplifier	SONOMA	310N	413741	9KHz-1GHz	Jan. 05, 2024	Apr. 21, 2024	Jan. 04, 2025	Radiation (03CH08-KS)
Amplifier	EM	EM01G18GA	060834	1Ghz-18Ghz	Oct. 10, 2023	Apr. 21, 2024	Oct. 09, 2024	Radiation (03CH08-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 04, 2024	Apr. 21, 2024	Jan. 03, 2025	Radiation (03CH08-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Apr. 21, 2024	NCR	Radiation (03CH08-KS)
Turn Table	EM	EM 1000-T	N/A	0~360 degree	NCR	Apr. 21, 2024	NCR	Radiation (03CH08-KS)
Antenna Mast	EM	EM 1000-A	N/A	1 m~4 m	NCR	Apr. 21, 2024	NCR	Radiation (03CH08-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 16, 2023	Apr. 24, 2024	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 11, 2023	Apr. 24, 2024	Oct. 10, 2024	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Apr. 24, 2024	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 11, 2023	Apr. 24, 2024	Oct. 10, 2024	Conduction (CO01-KS)

NCR: No Calibration Required

5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. 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 Conducted Measurement

Conducted Spurious Emission & Bandedge	**±2.26 dB**
Occupied Channel Bandwidth	**±0.1%**
Conducted Power	**±0.46 dB**
Conducted Power Spectral Density	**±0.88 dB**
Frequency	**±0.4 ppm**

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.84 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.32 dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.28 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.90 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.26 dB**

---------- THE END ----------

Appendix A. Conducted Test Results

Ambient Condition: 25 ℃, 45 %RH	
Test Date: 2024.4.6~5.15	**Test Engineer:** Jiang Jun

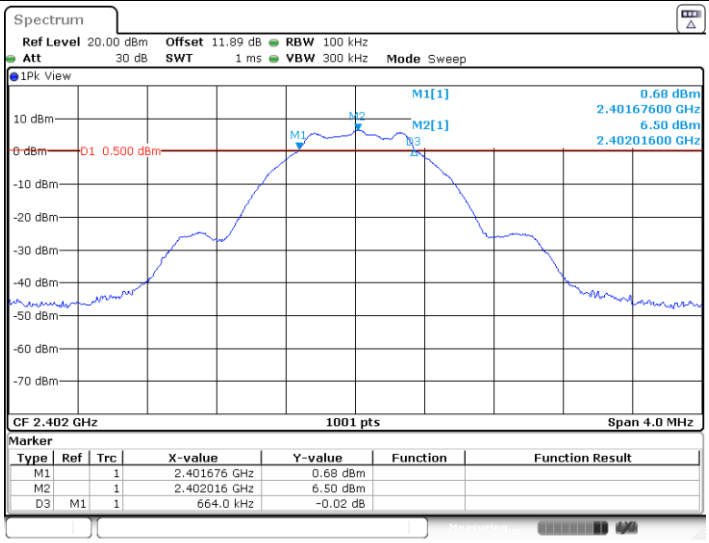
DTS Bandwidth

Test Result

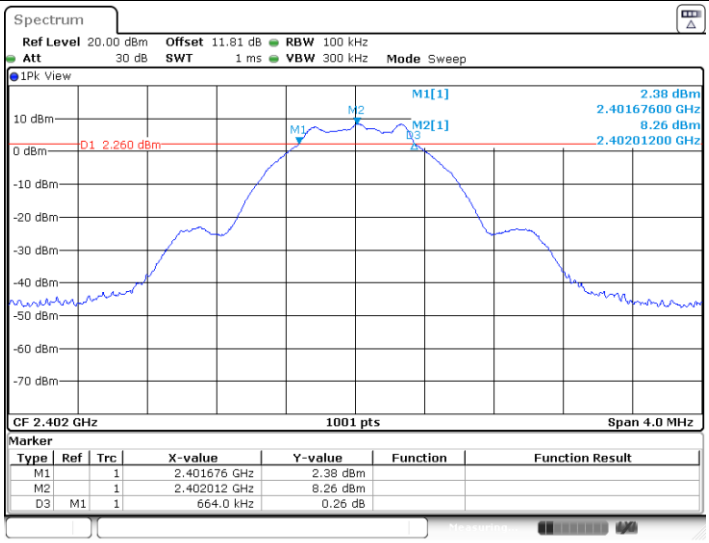
TestMode	Antenna	Freq(MHz)	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant0	2402	0.66	2401.68	2402.34	0.5	PASS
	Ant1	2402	0.66	2401.68	2402.34	0.5	PASS
	Ant0	2440	0.67	2439.68	2440.34	0.5	PASS
	Ant1	2440	0.66	2439.68	2440.34	0.5	PASS
	Ant0	2480	0.67	2479.67	2480.34	0.5	PASS
	Ant1	2480	0.67	2479.68	2480.34	0.5	PASS
BLE_2M	Ant0	2404	1.13	2403.46	2404.59	0.5	PASS
	Ant1	2404	1.14	2403.46	2404.59	0.5	PASS
	Ant0	2440	1.17	2439.46	2440.63	0.5	PASS
	Ant1	2440	1.14	2439.46	2440.60	0.5	PASS
	Ant0	2478	1.13	2477.46	2478.59	0.5	PASS
	Ant1	2478	1.14	2477.46	2478.60	0.5	PASS

Test Graphs

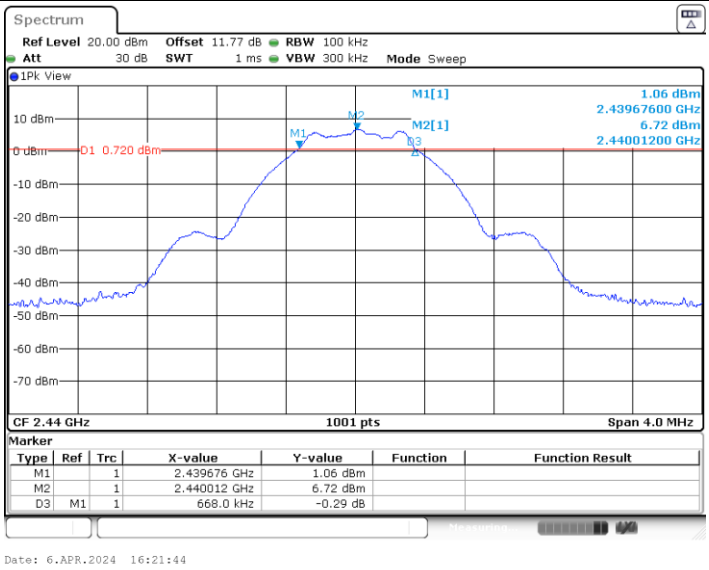
BLE_1M_Ant0_2402



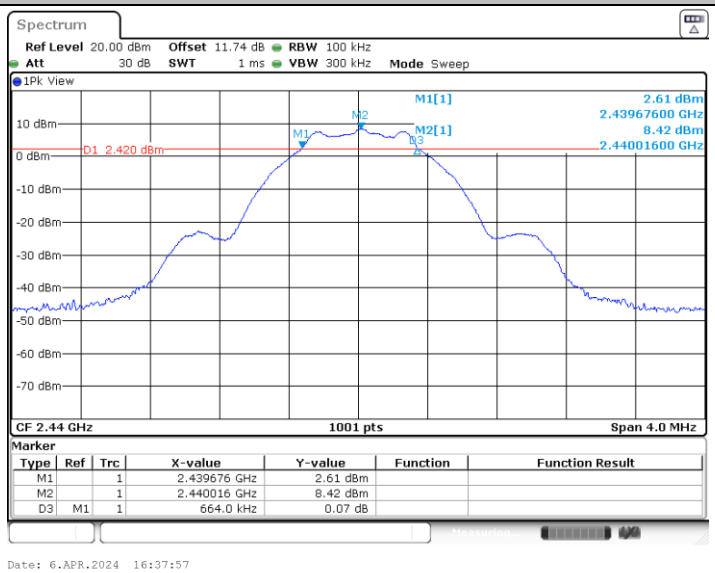
BLE_1M_Ant1_2402

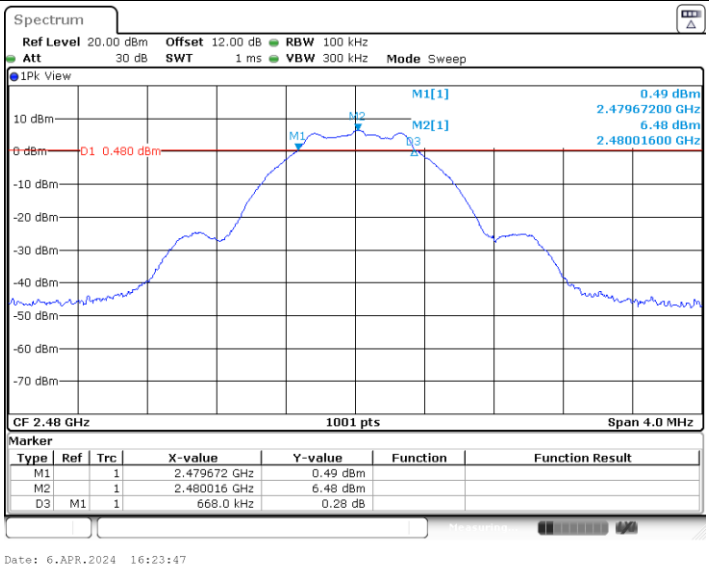


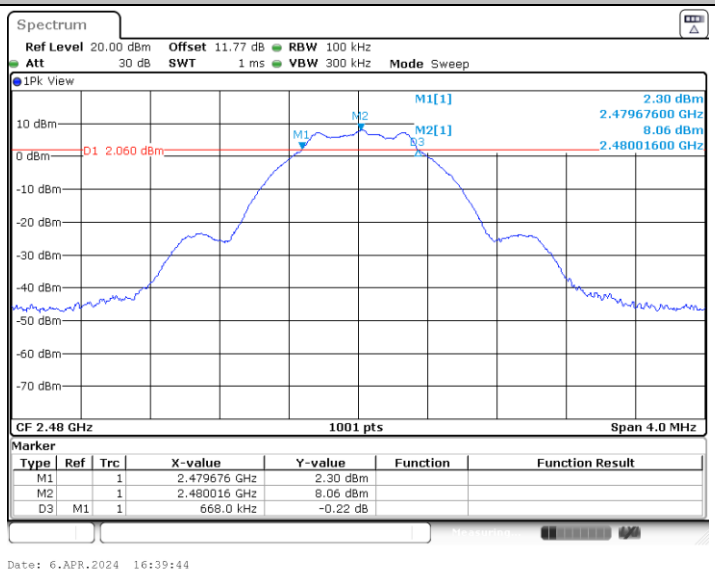
BLE_1M_Ant0_2440



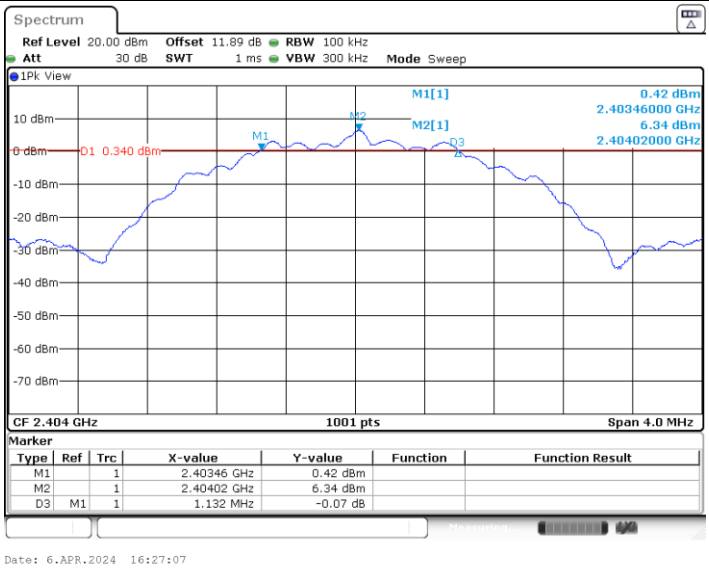
BLE_1M_Ant1_2440



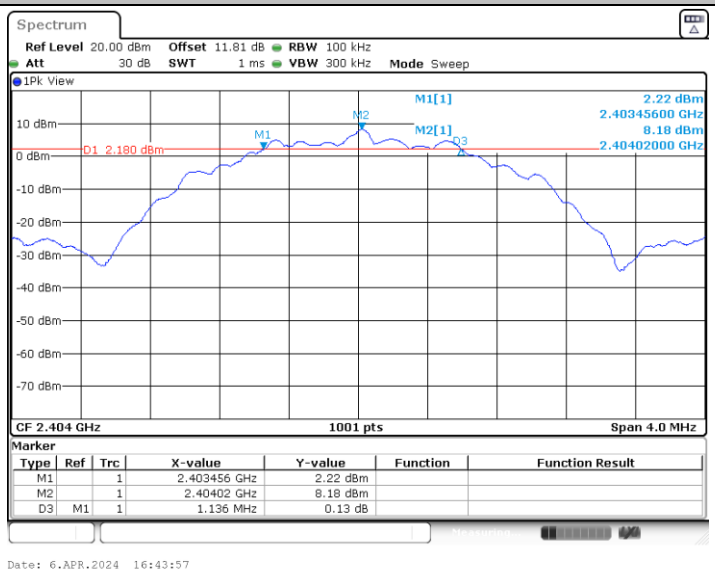
BLE_1M_Ant0_2480


BLE_1M_Ant1_2480


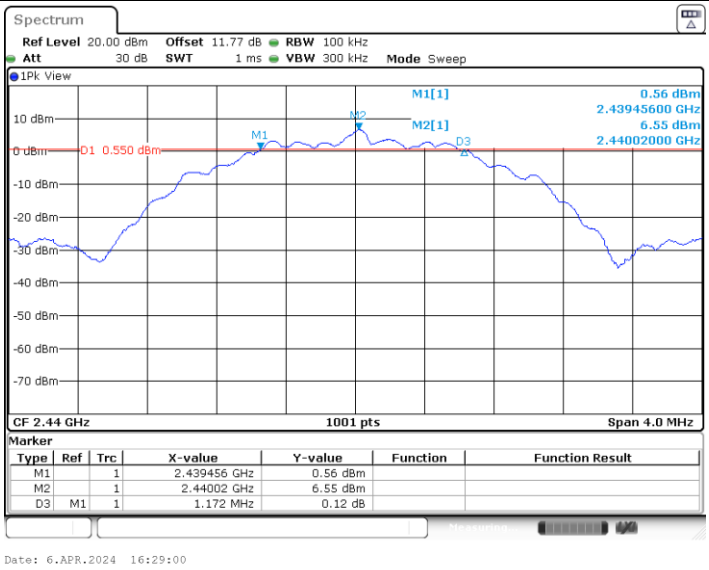
BLE_2M_Ant0_2404



BLE_2M_Ant1_2404

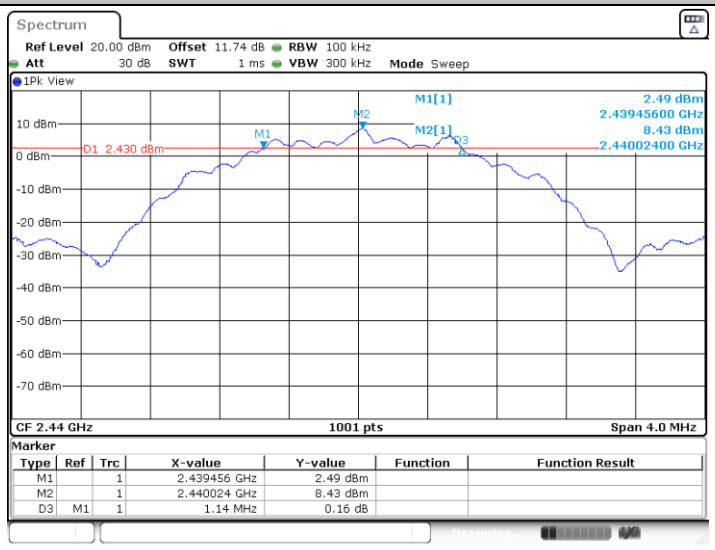


BLE_2M_Ant0_2440



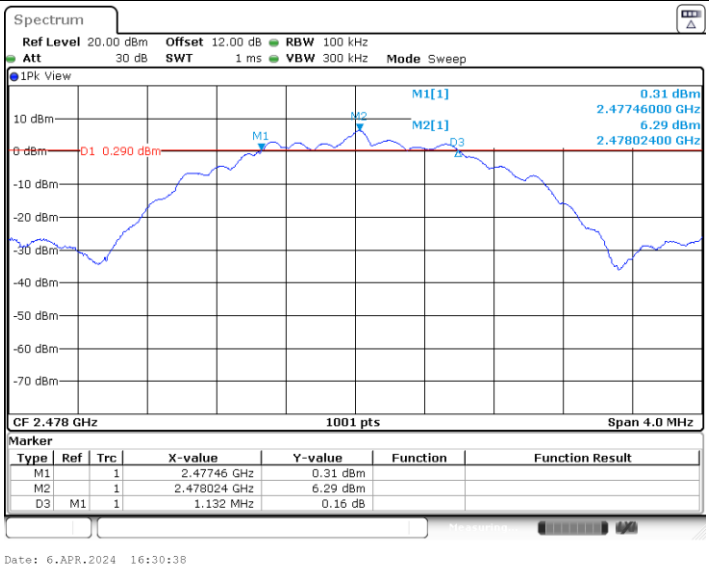
Date: 6.APR.2024 16:29:00

BLE_2M_Ant1_2440

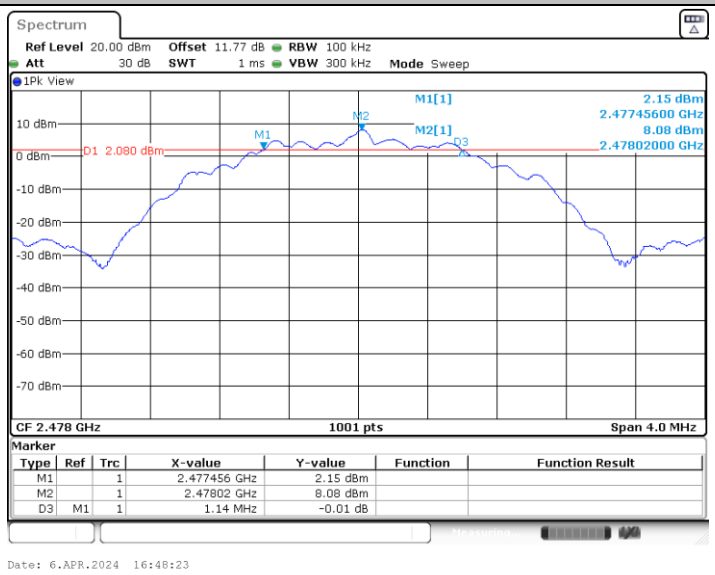


Date: 6.APR.2024 16:46:05

BLE_2M_Ant0_2478



BLE_2M_Ant1_2478



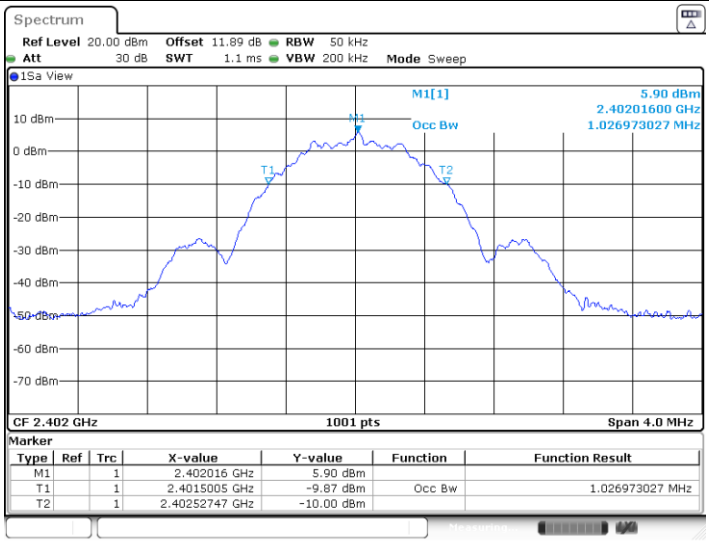
Occupied Channel Bandwidth

Test Result

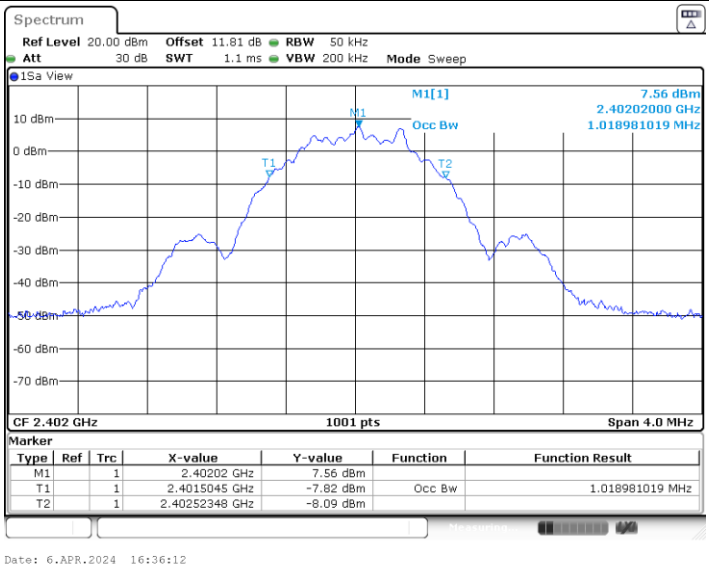
TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant0	2402	1.027	2401.5005	2402.5275	---	---
	Ant1	2402	1.019	2401.5045	2402.5235	---	---
	Ant0	2440	1.027	2439.5005	2440.5275	---	---
	Ant1	2440	1.027	2439.5005	2440.5275	---	---
	Ant0	2480	1.027	2479.5005	2480.5275	---	---
	Ant1	2480	1.027	2479.5005	2480.5275	---	---
BLE_2M	Ant0	2404	2.042	2403.0130	2405.0549	---	---
	Ant1	2404	2.046	2403.0130	2405.0589	---	---
	Ant0	2440	2.046	2439.0130	2441.0589	---	---
	Ant1	2440	2.038	2439.0170	2441.0549	---	---
	Ant0	2478	2.046	2477.0130	2479.0589	---	---
	Ant1	2478	2.046	2477.0130	2479.0589	---	---
BLE_125K	Ant0	2402	1.047	2401.4885	2402.5355	---	---
	Ant1	2402	1.043	2401.4885	2402.5315	---	---
	Ant0	2440	1.039	2439.4925	2440.5315	---	---
	Ant1	2440	1.043	2439.4885	2440.5315	---	---
	Ant0	2480	1.043	2479.4885	2480.5315	---	---
	Ant1	2480	1.043	2479.4885	2480.5315	---	---
BLE_500K	Ant0	2402	1.023	2401.5005	2402.5235	---	---
	Ant1	2402	1.023	2401.5005	2402.5235	---	---
	Ant0	2440	1.023	2439.5005	2440.5235	---	---
	Ant1	2440	1.023	2439.5005	2440.5235	---	---
	Ant0	2480	1.023	2479.5005	2480.5235	---	---
	Ant1	2480	1.027	2479.4965	2480.5235	---	---

Test Graphs

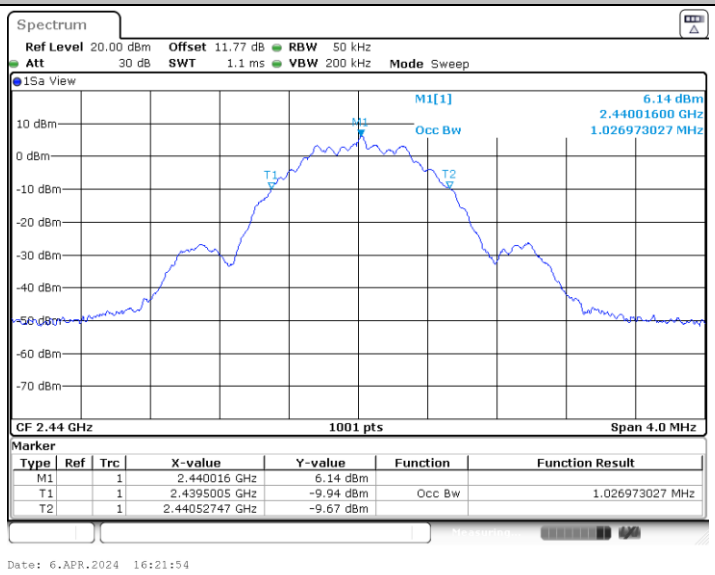
BLE_1M_Ant0_2402



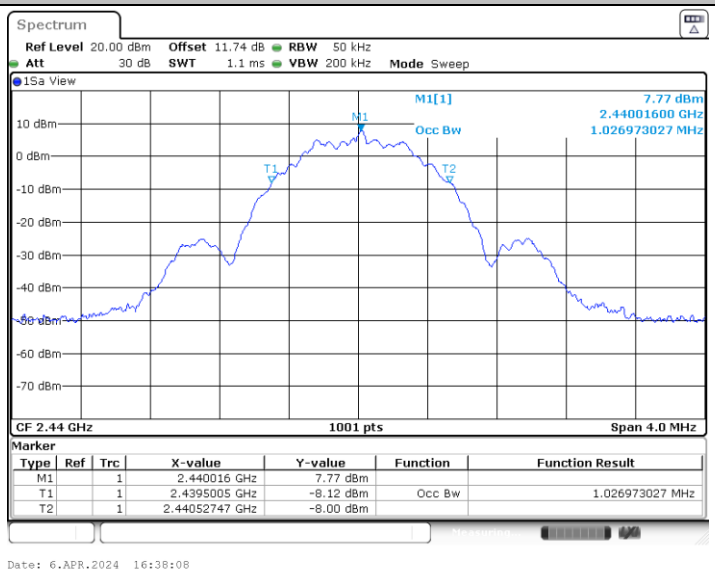
BLE_1M_Ant1_2402

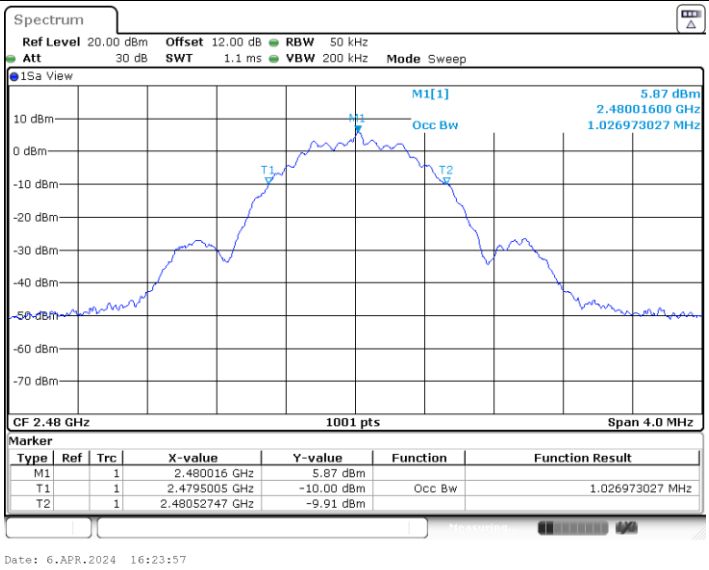


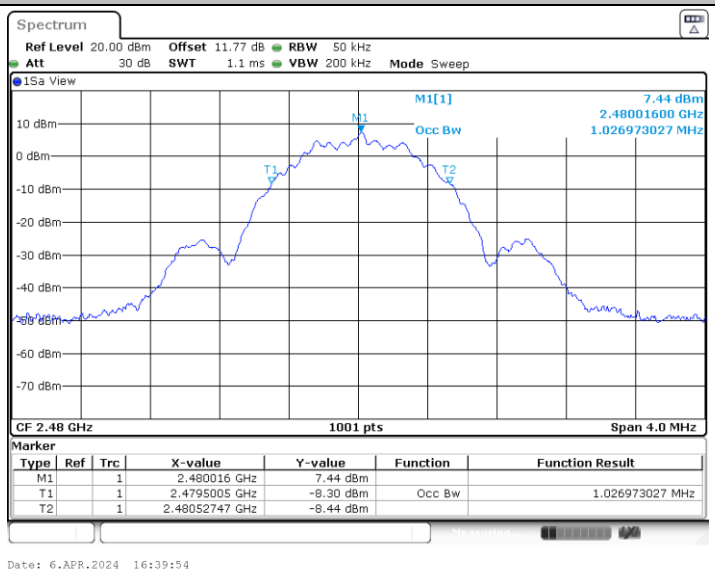
BLE_1M_Ant0_2440

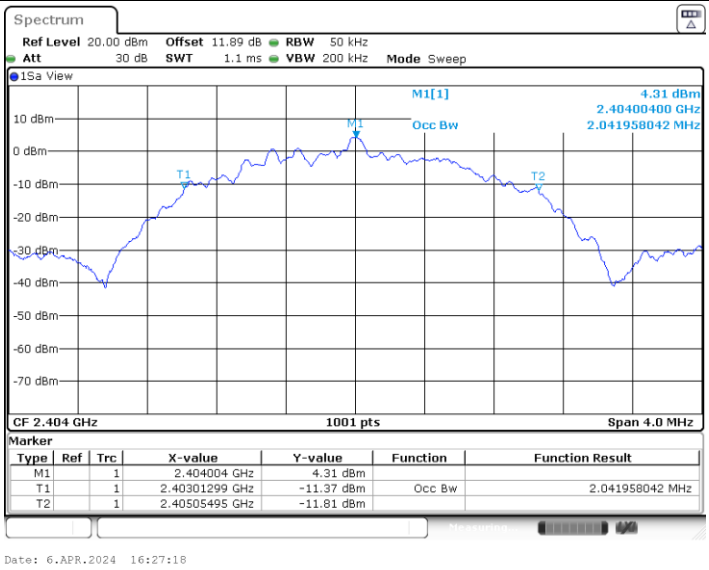


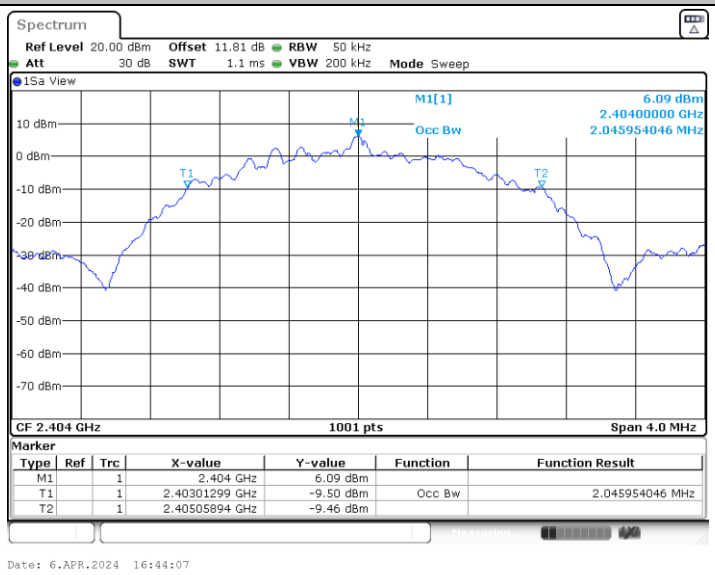
BLE_1M_Ant1_2440

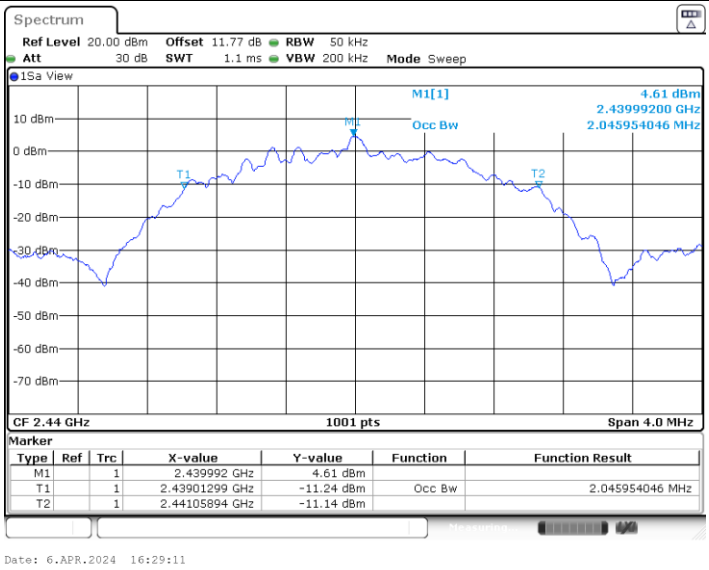


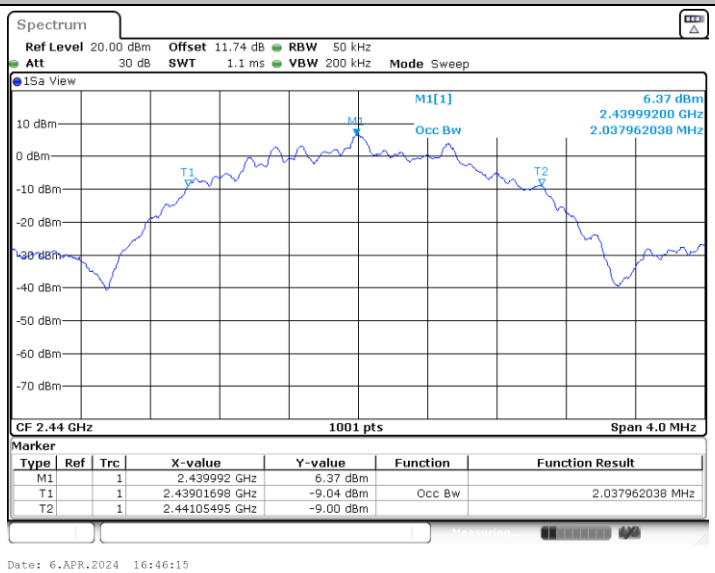
BLE_1M_Ant0_2480


BLE_1M_Ant1_2480


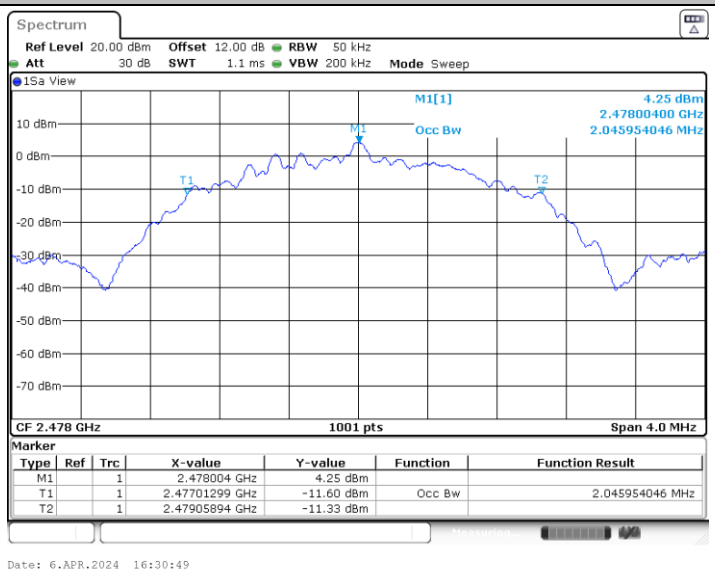
BLE_2M_Ant0_2404


BLE_2M_Ant1_2404


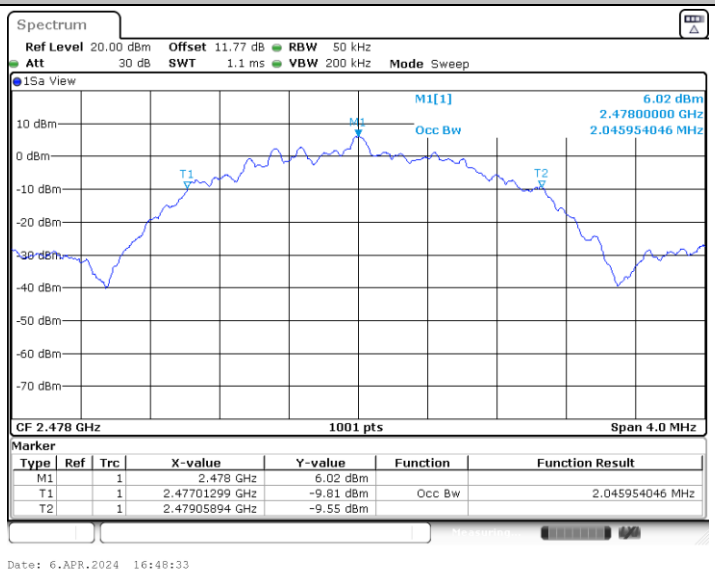
BLE_2M_Ant0_2440


BLE_2M_Ant1_2440


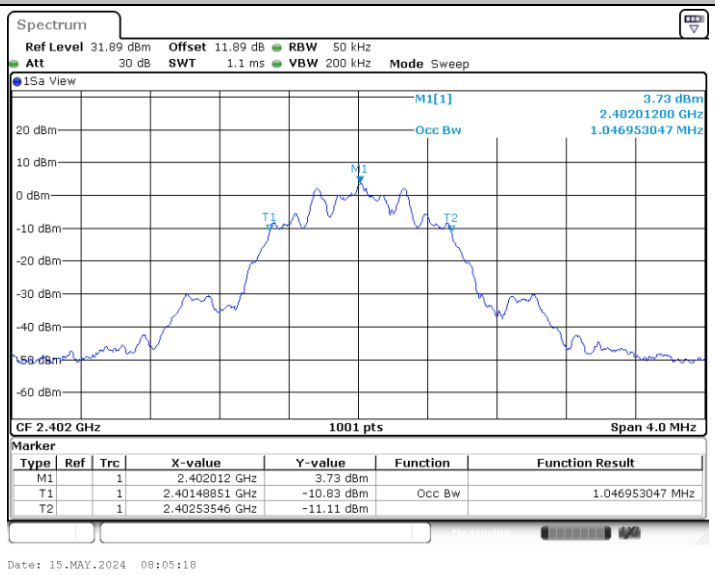
BLE_2M_Ant0_2478



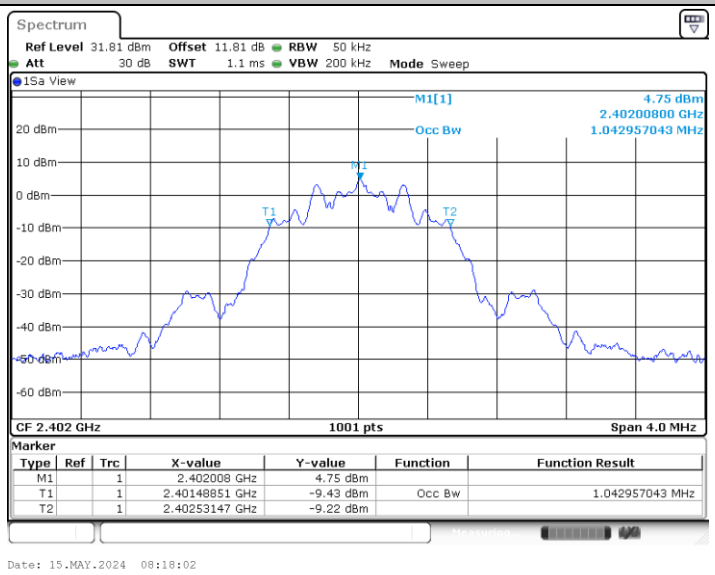
BLE_2M_Ant1_2478



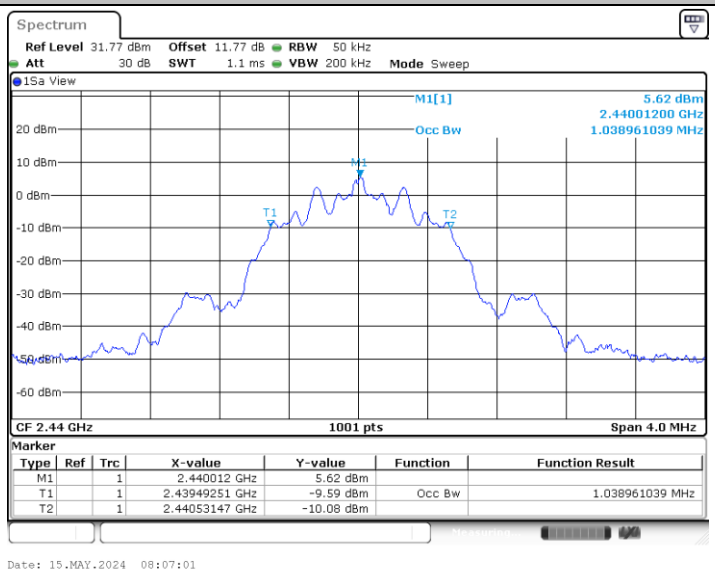
BLE_125K_Ant0_2402



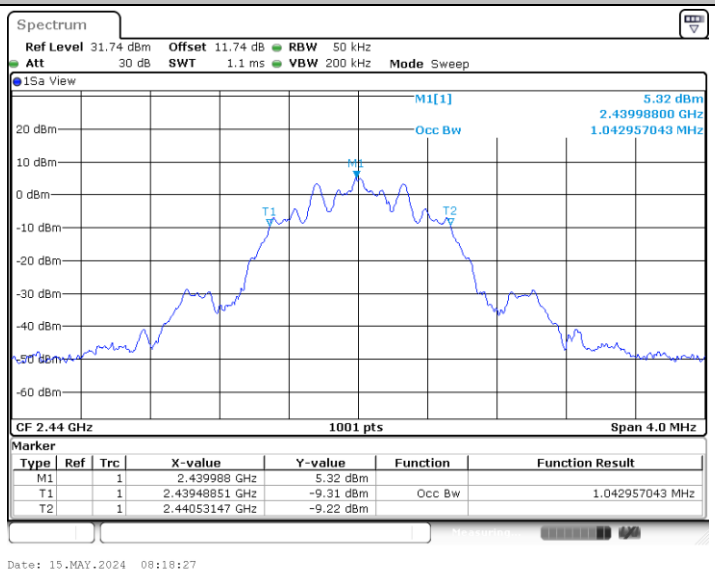
BLE_125K_Ant1_2402



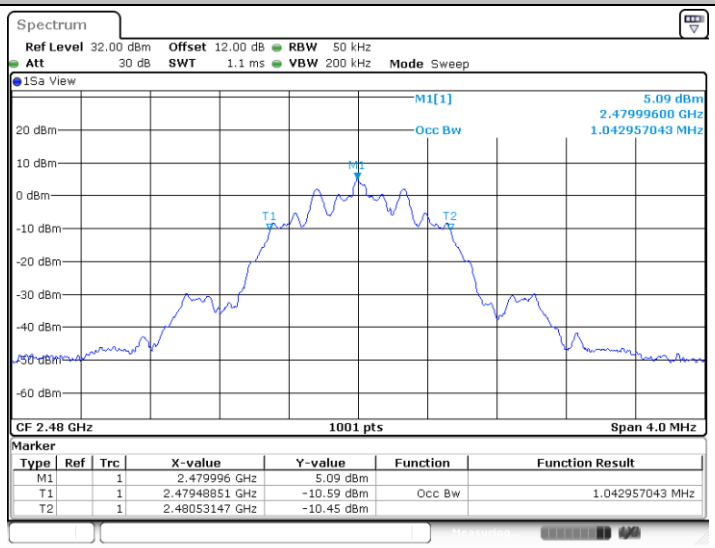
BLE_125K_Ant0_2440



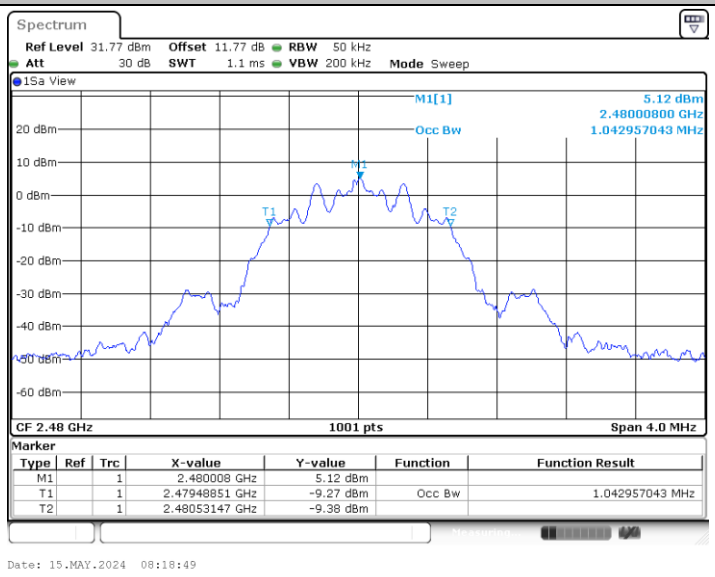
BLE_125K_Ant1_2440



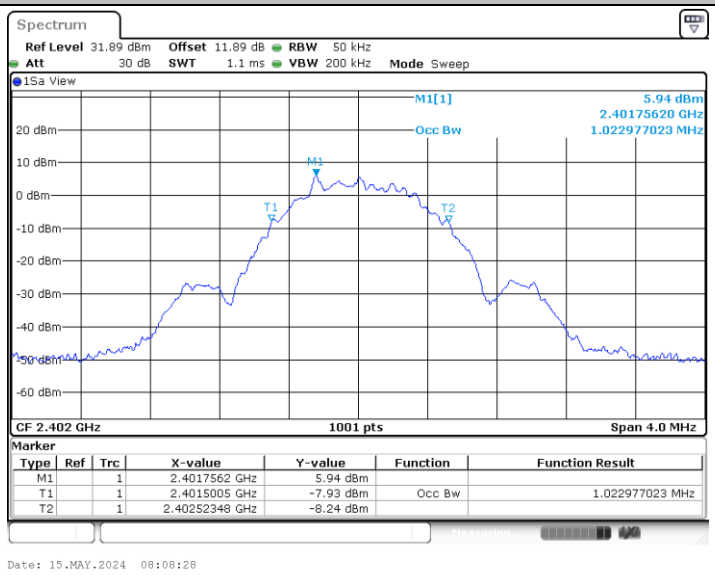
BLE_125K_Ant0_2480



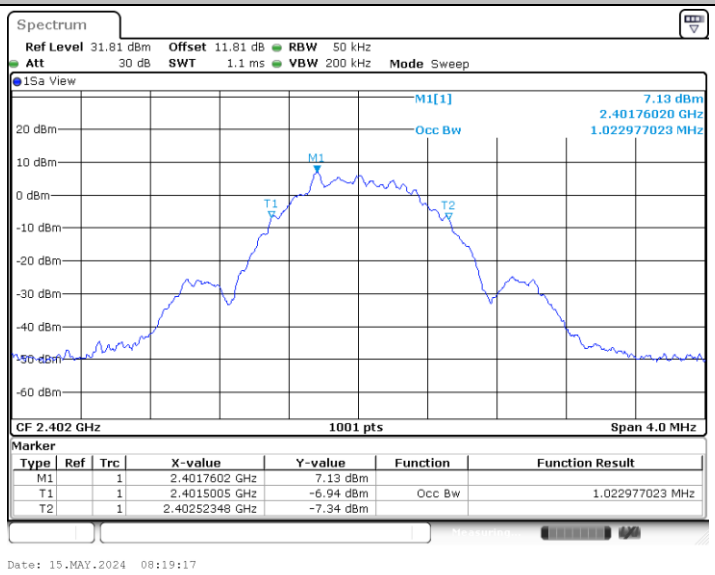
BLE_125K_Ant1_2480

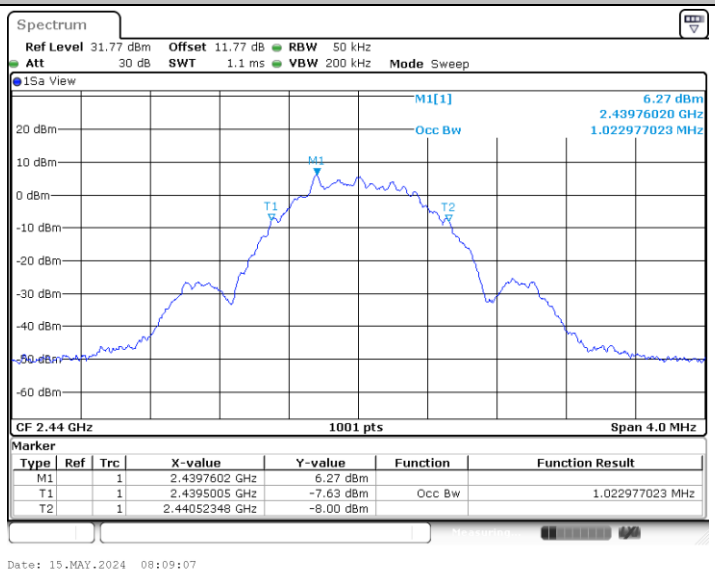


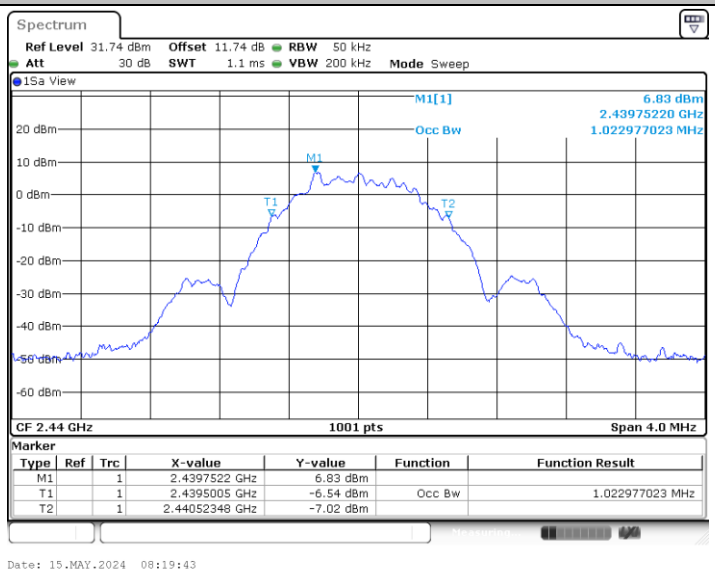
BLE_500K_Ant0_2402

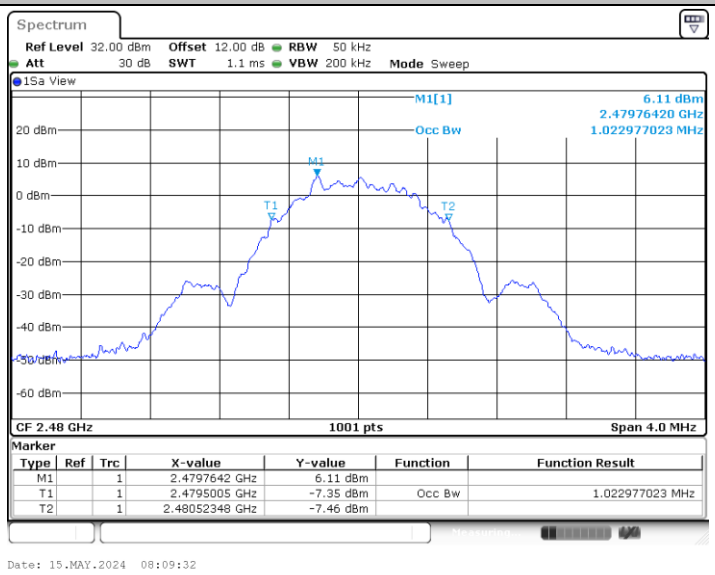


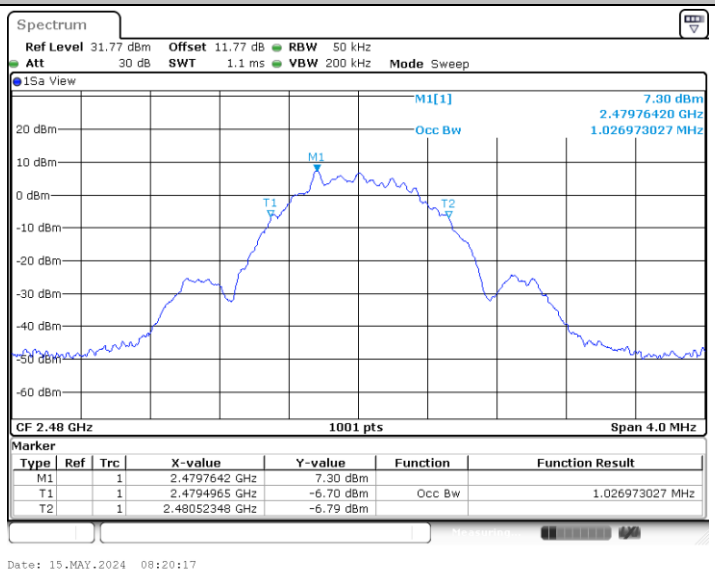
BLE_500K_Ant1_2402



BLE_500K_Ant0_2440


BLE_500K_Ant1_2440


BLE_500K_Ant0_2480


BLE_500K_Ant1_2480


Maximum conducted output power

Test Result Peak

TestMode	Antenna	CH.	Peak Conducted Power (dBm)	Conducted Power Limit	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit	Pass/Fail
BLE1M	Ant0	0	6.94	30.00	0.2	7.14	36.00	Pass
		19	**6.97**	30.00	0.2	7.17	36.00	Pass
		39	6.70	30.00	0.2	6.90	36.00	Pass
BLE2M	Ant0	1	6.95	30.00	0.2	7.15	36.00	Pass
		19	**7.03**	30.00	0.2	7.23	36.00	Pass
		38	6.77	30.00	0.2	6.97	36.00	Pass
BLE1M	Ant1	0	7.90	30.00	0.2	8.10	36.00	Pass
		19	**8.68**	30.00	0.2	8.88	36.00	Pass
		39	8.56	30.00	0.2	8.76	36.00	Pass
BLE2M	Ant1	1	8.08	30.00	0.2	8.28	36.00	Pass
		19	**8.78**	30.00	0.2	8.98	36.00	Pass
		38	8.75	30.00	0.2	8.95	36.00	Pass
BLE125K	Ant0	0	6.87	30.00	0.2	7.07	36.00	Pass
		19	**6.91**	30.00	0.2	7.11	36.00	Pass
		39	6.68	30.00	0.2	6.88	36.00	Pass
BLE500K	Ant0	0	6.91	30.00	0.2	7.11	36.00	Pass
		19	**6.95**	30.00	0.2	7.15	36.00	Pass
		39	6.65	30.00	0.2	6.85	36.00	Pass
BLE125K	Ant1	0	7.91	30.00	0.2	8.11	36.00	Pass
		19	8.49	30.00	0.2	8.69	36.00	Pass
		39	**8.53**	30.00	0.2	8.73	36.00	Pass
BLE500K	Ant1	0	7.82	30.00	0.2	8.02	36.00	Pass
		19	8.51	30.00	0.2	8.71	36.00	Pass
		39	**8.54**	30.00	0.2	8.74	36.00	Pass

Test Result Average

TestMode	Antenna	CH.	Duty Factor (dB)	Average Conducted Power (dBm)
BLE1M	Ant0	0	0.68	6.83
		19	0.68	**6.86**
		39	0.68	6.49
BLE2M	Ant0	1	2.40	6.92
		19	2.40	**6.95**
		38	2.40	6.73
BLE1M	Ant1	0	0.68	7.64
		19	0.68	**8.40**
		39	0.68	8.34
BLE2M	Ant1	1	2.41	7.68
		19	2.41	**8.43**
		38	2.41	8.40
BLE125K	Ant0	0	0.10	6.81
		19	0.10	**6.85**
		39	0.10	6.37
BLE500K	Ant0	0	0.39	6.76
		19	0.39	**6.83**
		39	0.39	6.47
BLE125K	Ant1	0	0.11	7.46
		19	0.11	8.16
		39	0.11	**8.29**
BLE500K	Ant1	0	0.39	7.55
		19	0.39	**8.31**
		39	0.39	8.34

Power Setting is default.

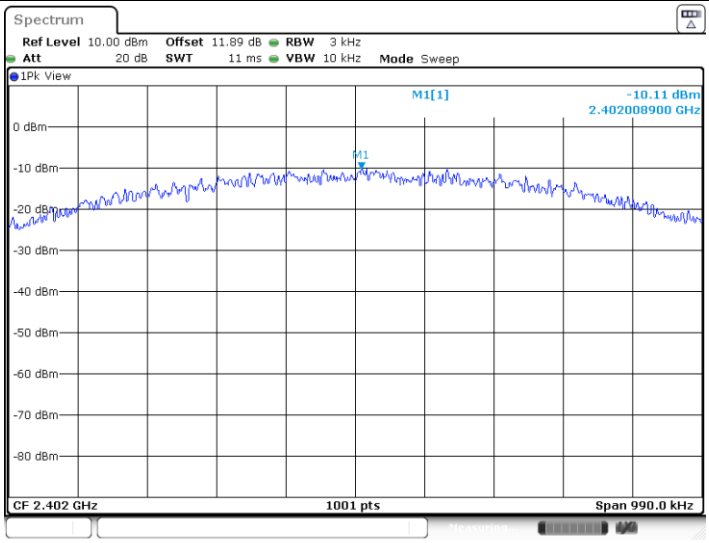
Maximum power spectral density

Test Result

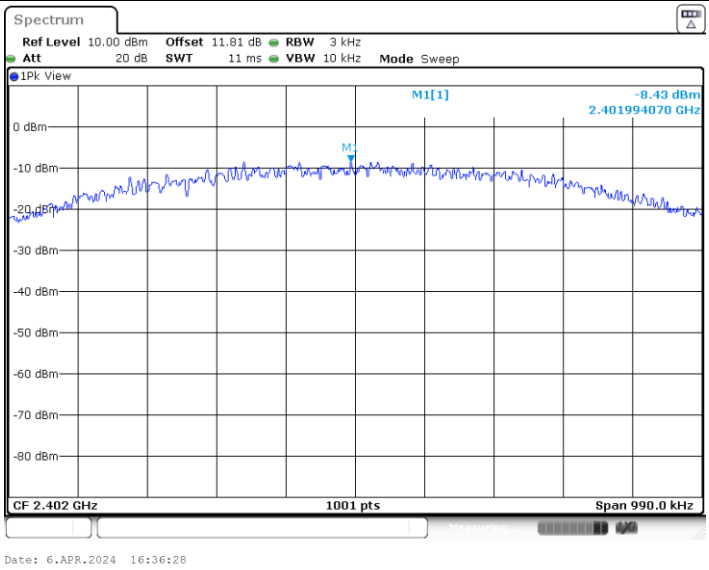
TestMode	Antenna	Freq(MHz)	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant0	2402	-10.11	≤8.00	PASS
	Ant1	2402	-8.43	≤8.00	PASS
	Ant0	2440	-9.27	≤8.00	PASS
	Ant1	2440	-7.91	≤8.00	PASS
	Ant0	2480	-9.50	≤8.00	PASS
	Ant1	2480	-7.32	≤8.00	PASS
BLE_2M	Ant0	2404	-11.91	≤8.00	PASS
	Ant1	2404	-9.16	≤8.00	PASS
	Ant0	2440	-10.68	≤8.00	PASS
	Ant1	2440	-8.41	≤8.00	PASS
	Ant0	2478	-11.30	≤8.00	PASS
	Ant1	2478	-9.82	≤8.00	PASS

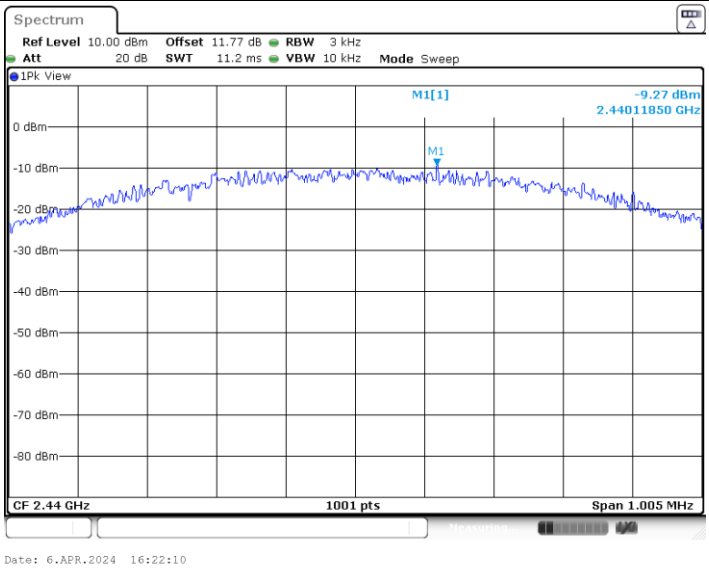
Test Graphs

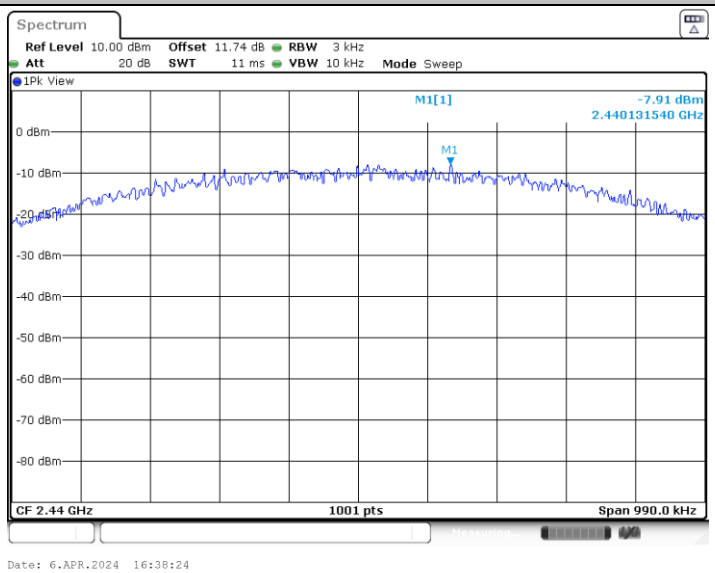
BLE_1M_Ant0_2402

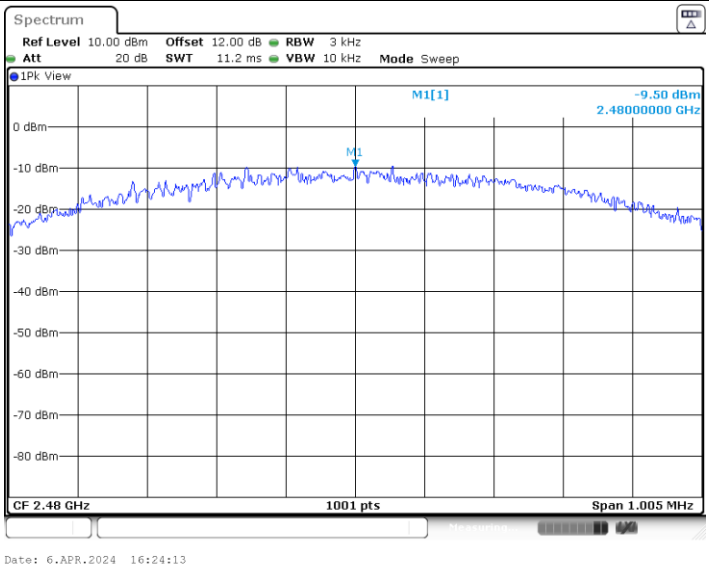


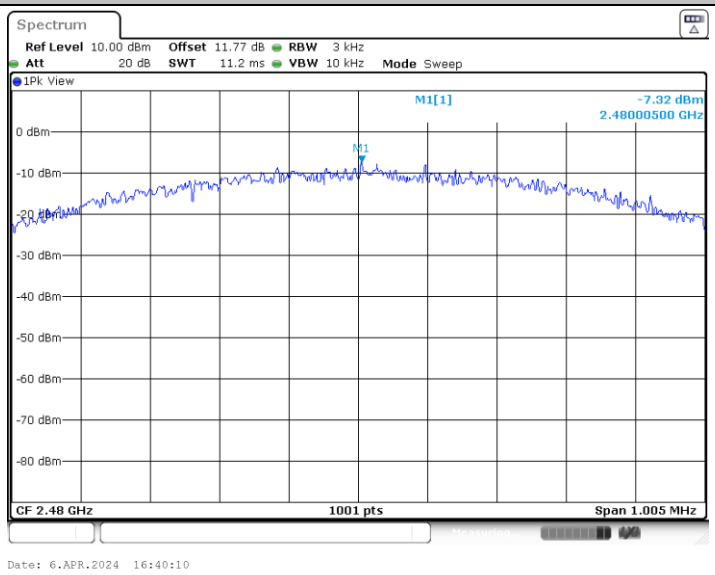
BLE_1M_Ant1_2402

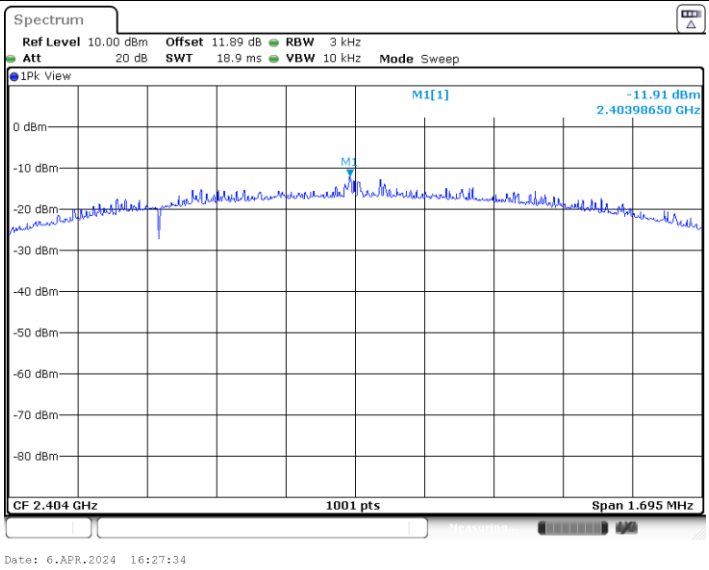


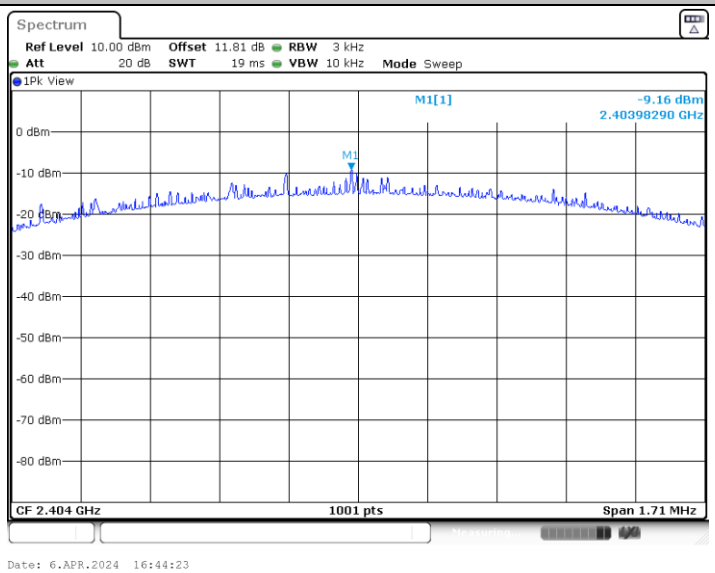
BLE_1M_Ant0_2440


BLE_1M_Ant1_2440


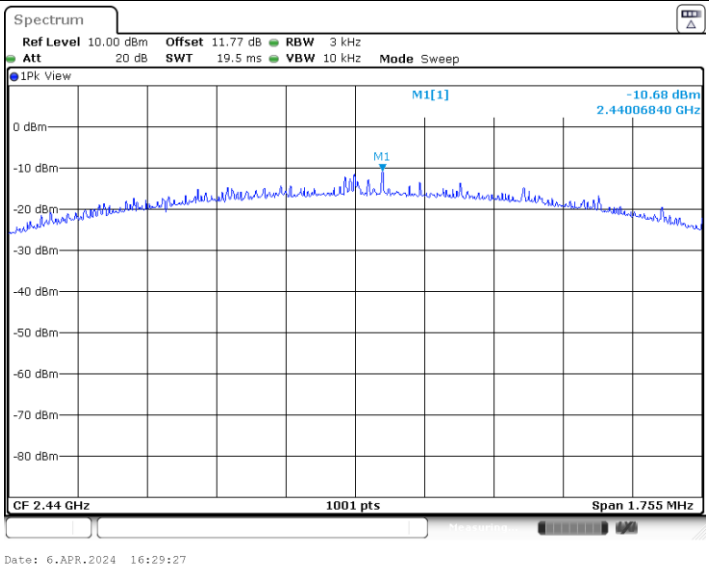
BLE_1M_Ant0_2480


BLE_1M_Ant1_2480


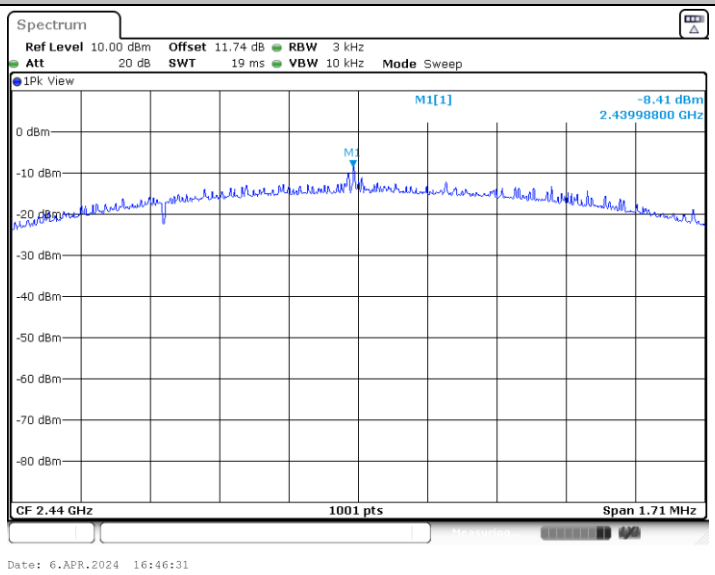
BLE_2M_Ant0_2404


BLE_2M_Ant1_2404


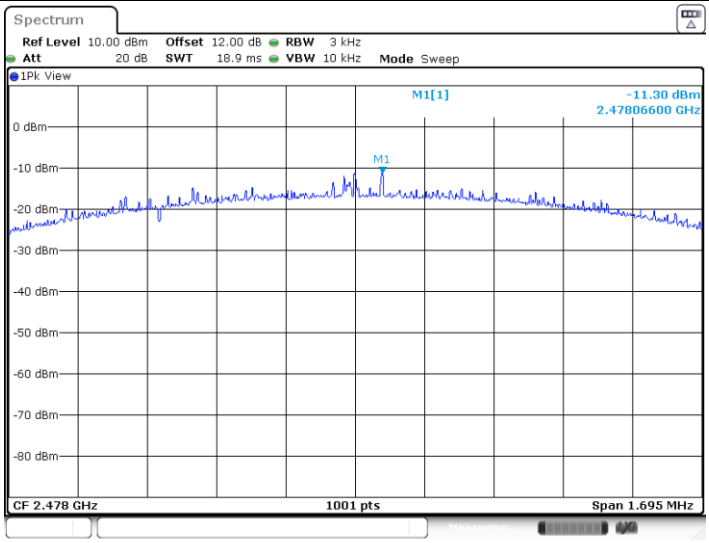
BLE_2M_Ant0_2440



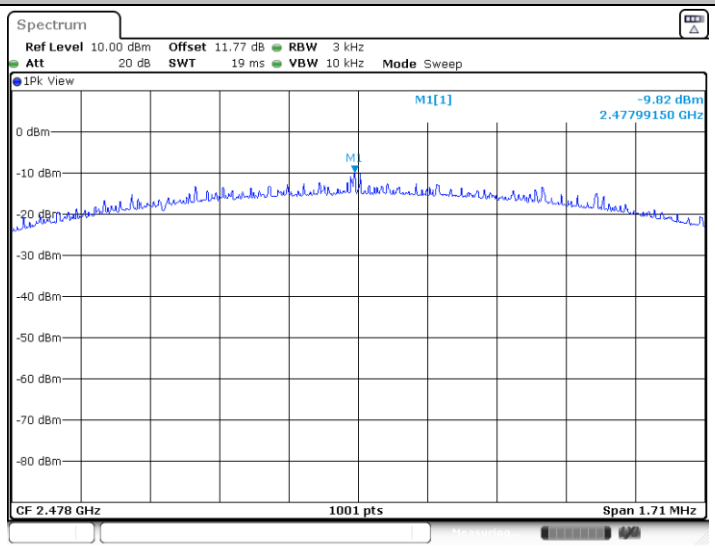
BLE_2M_Ant1_2440



BLE_2M_Ant0_2478



BLE_2M_Ant1_2478



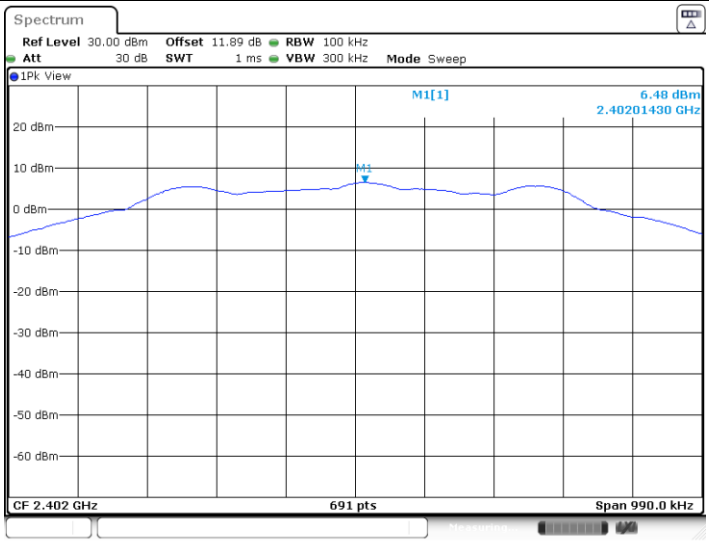
Reference level measurement

Test Result

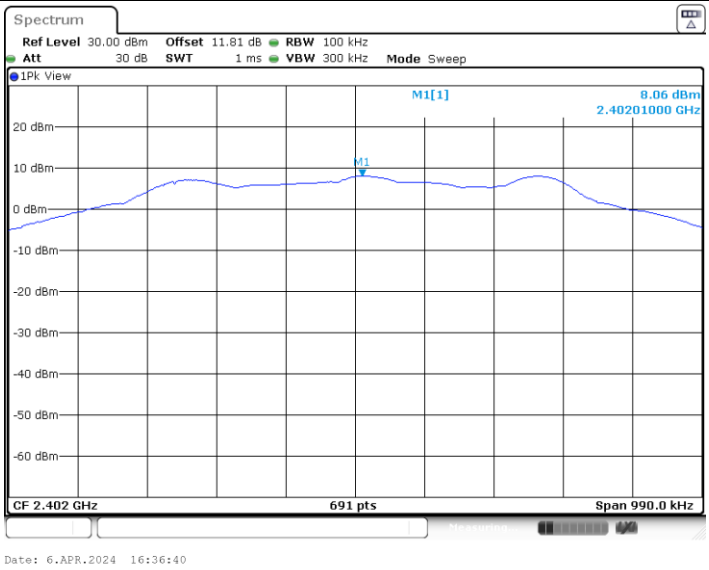
TestMode	Antenna	Freq(MHz)	Max.Point[MHz]	Result[dBm/100KHz]
BLE_1M	Ant0	2402	2402.01	6.48
	Ant1	2402	2402.01	8.06
	Ant0	2440	2440.01	6.67
	Ant1	2440	2440.01	8.32
	Ant0	2480	2480.01	6.43
	Ant1	2480	2480.01	8.02
BLE_2M	Ant0	2404	2404.02	6.32
	Ant1	2404	2404.02	8.08
	Ant0	2440	2440.02	6.55
	Ant1	2440	2440.02	8.38
	Ant0	2478	2478.02	6.28
	Ant1	2478	2478.02	8.02

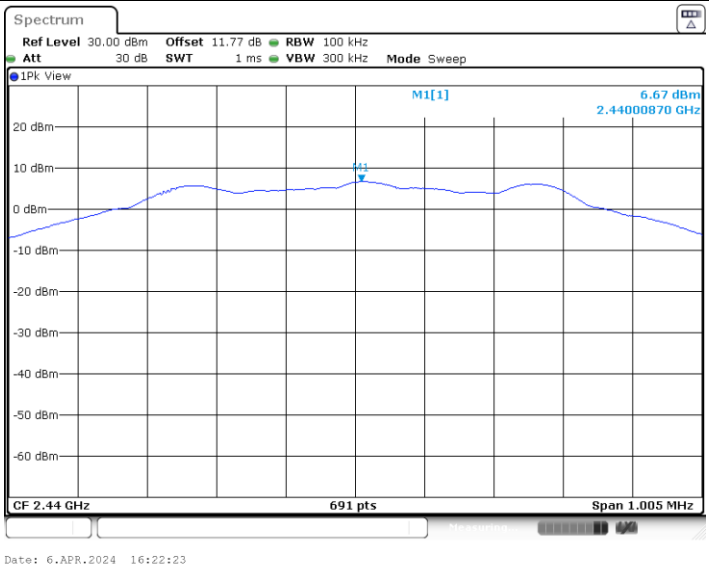
Test Graphs

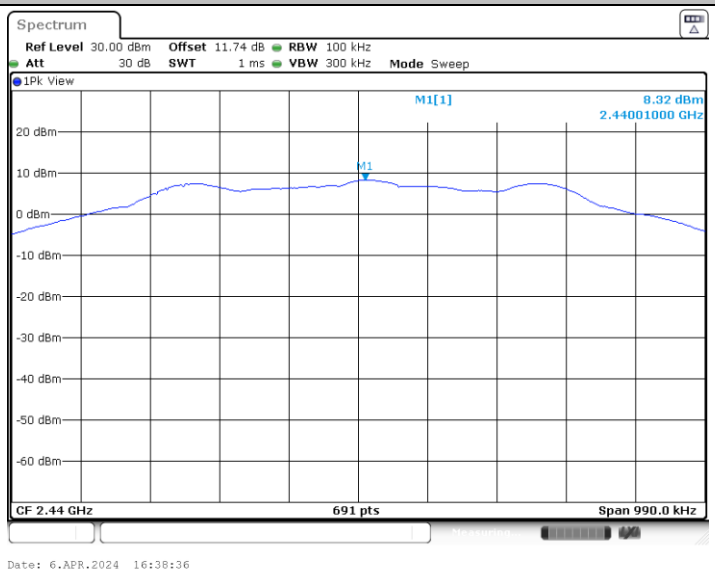
BLE_1M_Ant0_2402

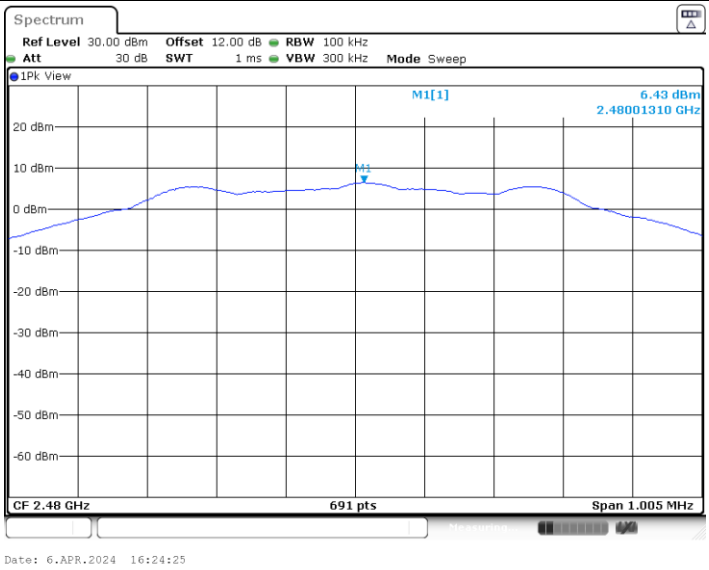


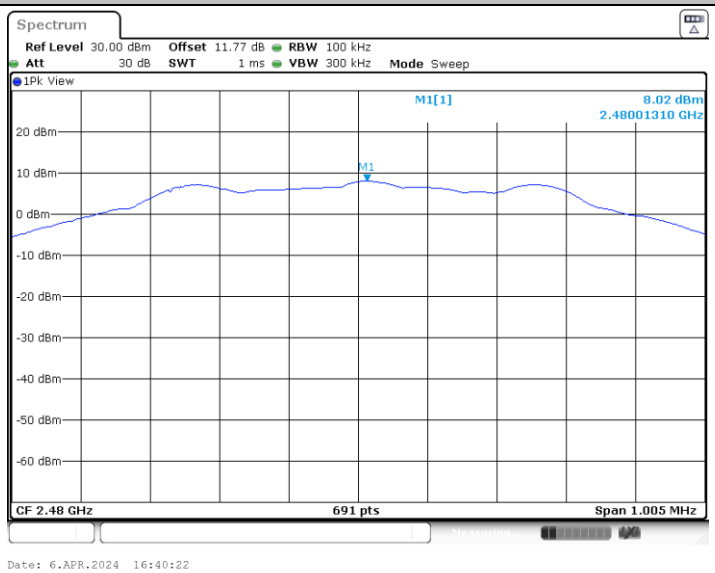
BLE_1M_Ant1_2402

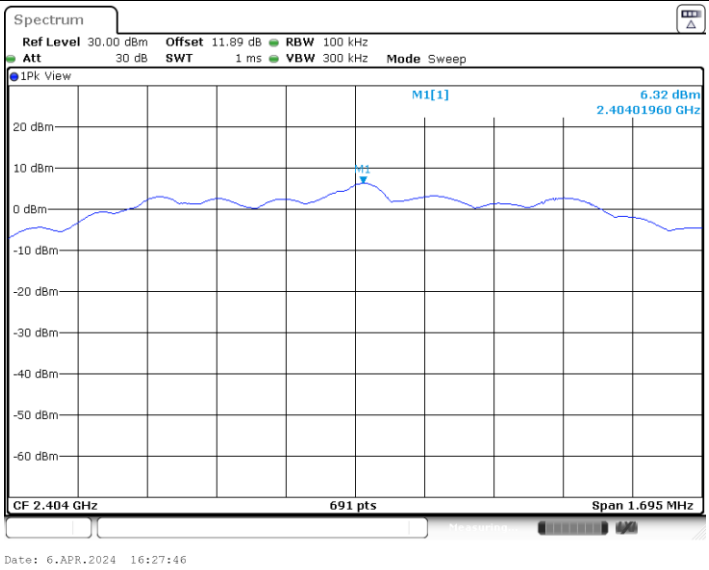


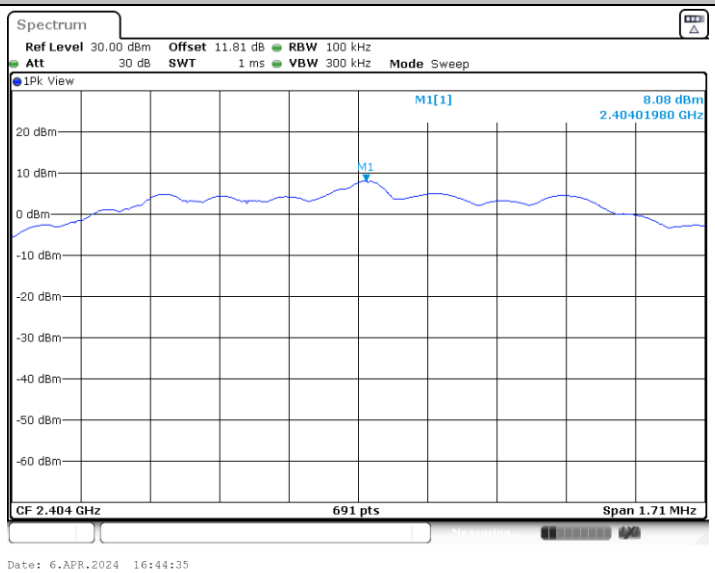
BLE_1M_Ant0_2440


BLE_1M_Ant1_2440


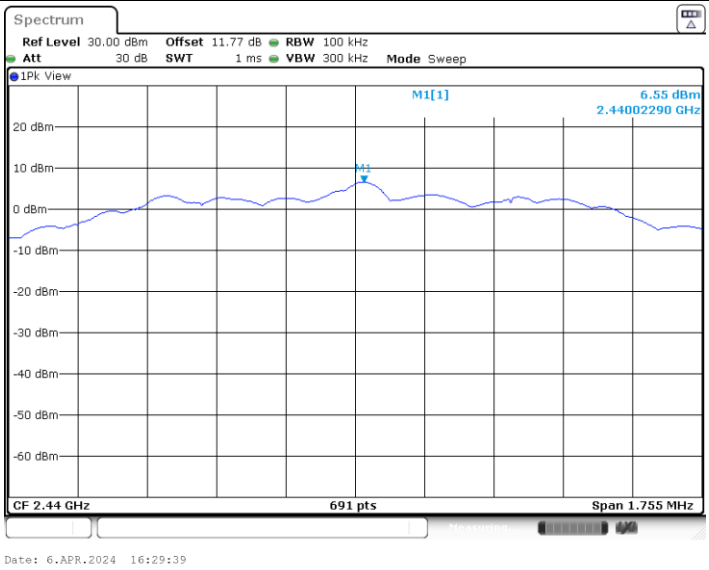
BLE_1M_Ant0_2480


BLE_1M_Ant1_2480


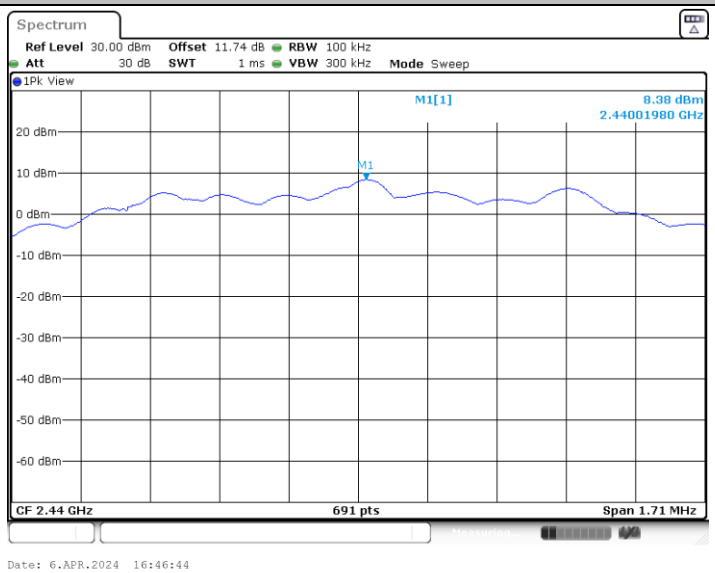
BLE_2M_Ant0_2404


BLE_2M_Ant1_2404


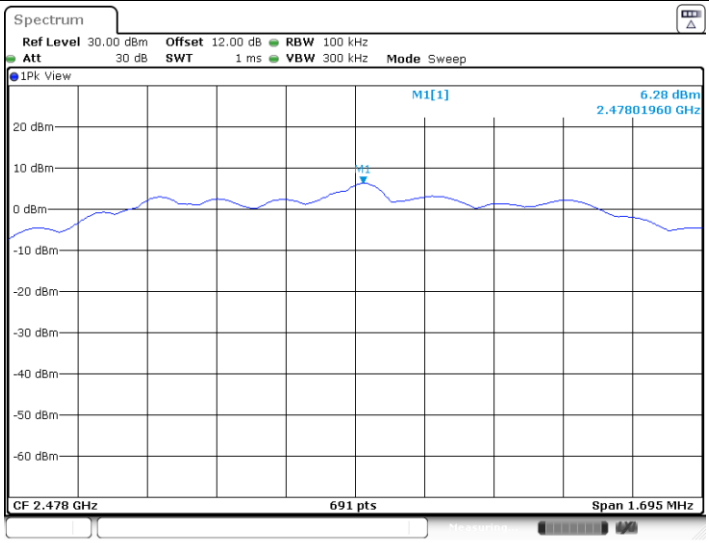
BLE_2M_Ant0_2440



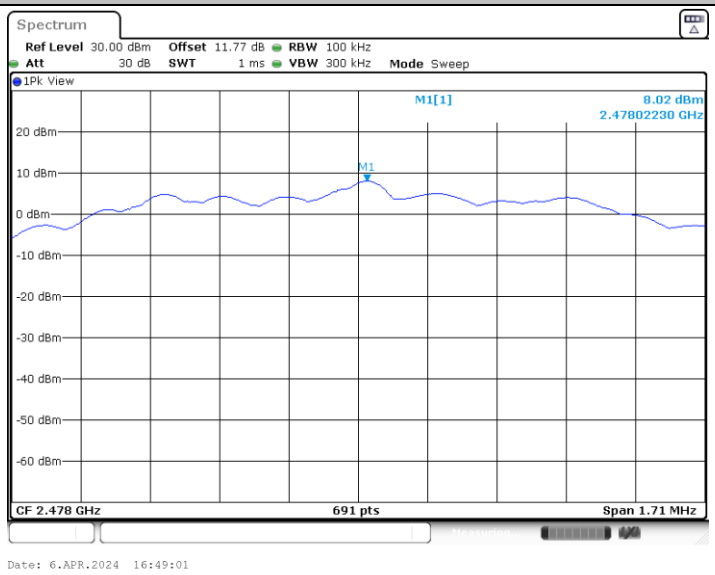
BLE_2M_Ant1_2440



BLE_2M_Ant0_2478



BLE_2M_Ant1_2478



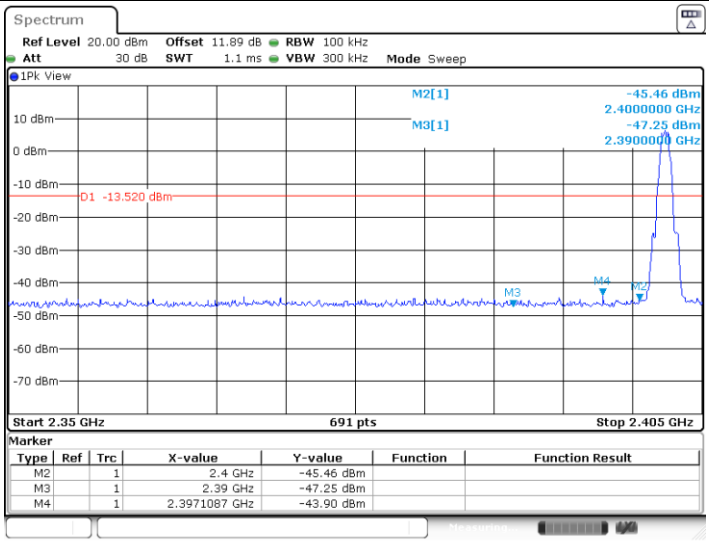
Band edge measurements

Test Result

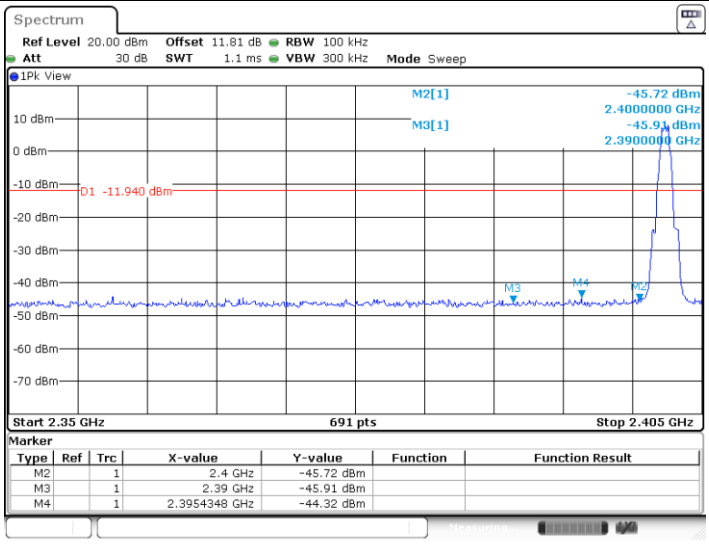
TestMode	Antenna	ChName	Freq(MHz)	RefLevel[dBm /100KHz]	Result[dBm /100KHz]	Limit[dBm /100KHz]	Verdict
BLE_1M	Ant0	Low	2402	6.48	-43.9	≤-13.52	PASS
	Ant1	Low	2402	8.06	-44.32	≤-11.94	PASS
	Ant0	High	2480	6.43	-43.42	≤-13.57	PASS
	Ant1	High	2480	8.02	-43.72	≤-11.98	PASS
BLE_2M	Ant0	Low	2404	6.32	-44.03	≤-13.68	PASS
	Ant1	Low	2404	8.08	-44.26	≤-11.92	PASS
	Ant0	High	2478	6.28	-43.64	≤-13.72	PASS
	Ant1	High	2478	8.02	-43.67	≤-11.98	PASS

Test Graphs

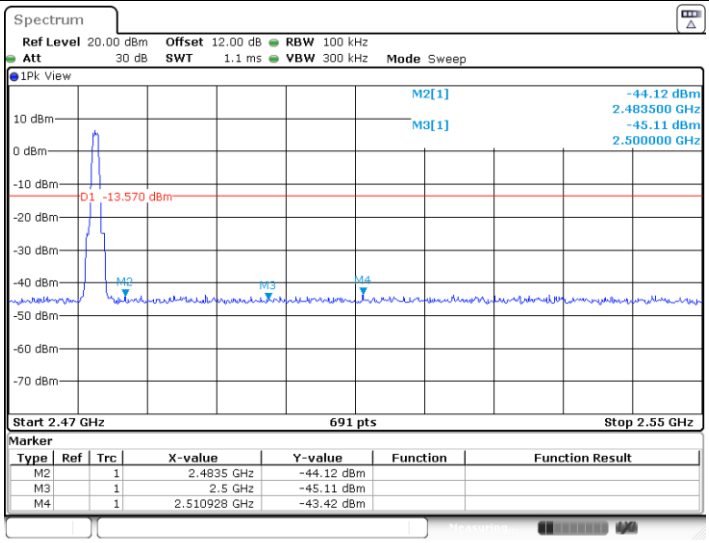
BLE_1M_Ant0_Low_2402



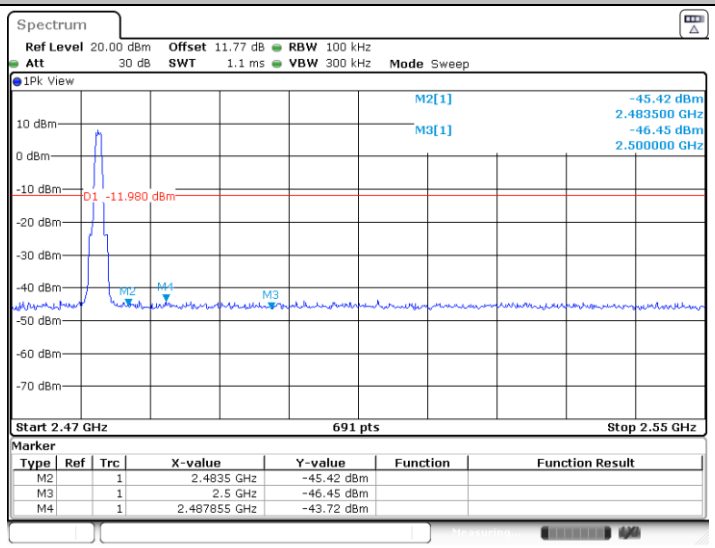
BLE_1M_Ant1_Low_2402



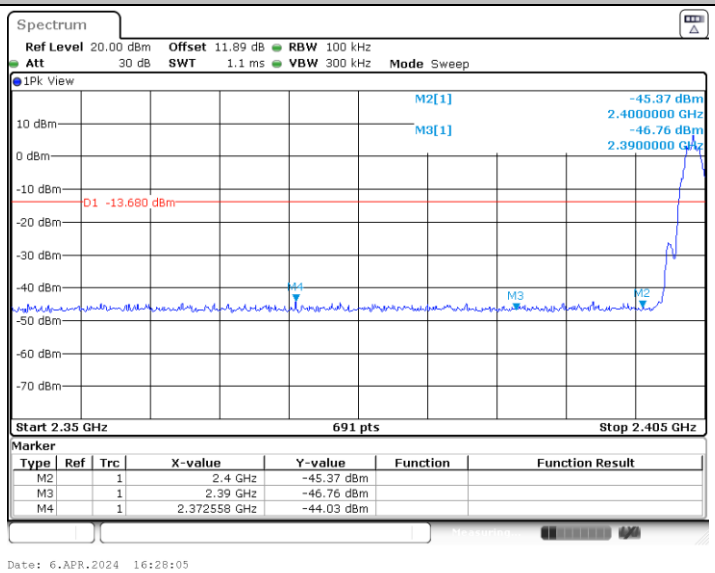
BLE_1M_Ant0_High_2480



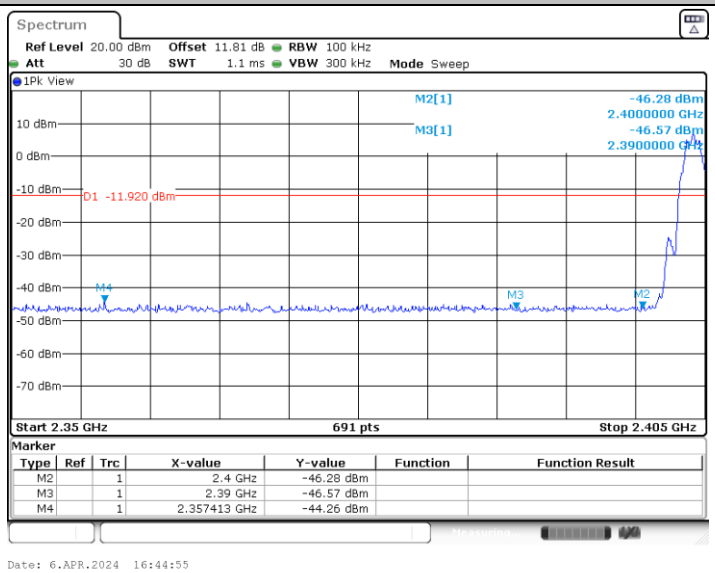
BLE_1M_Ant1_High_2480



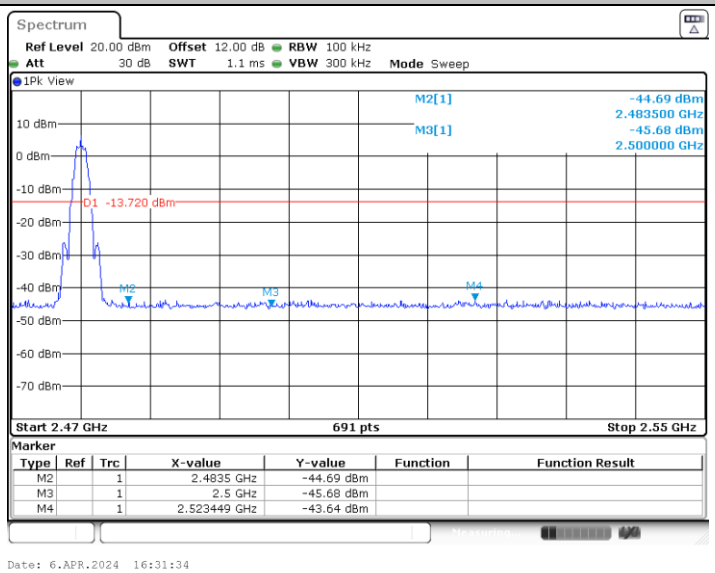
BLE_2M_Ant0_Low_2404



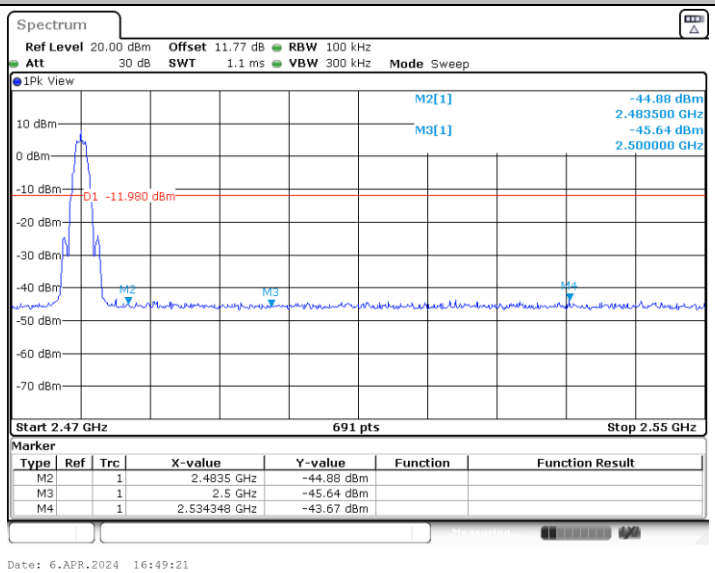
BLE_2M_Ant1_Low_2404



BLE_2M_Ant0_High_2478



BLE_2M_Ant1_High_2478



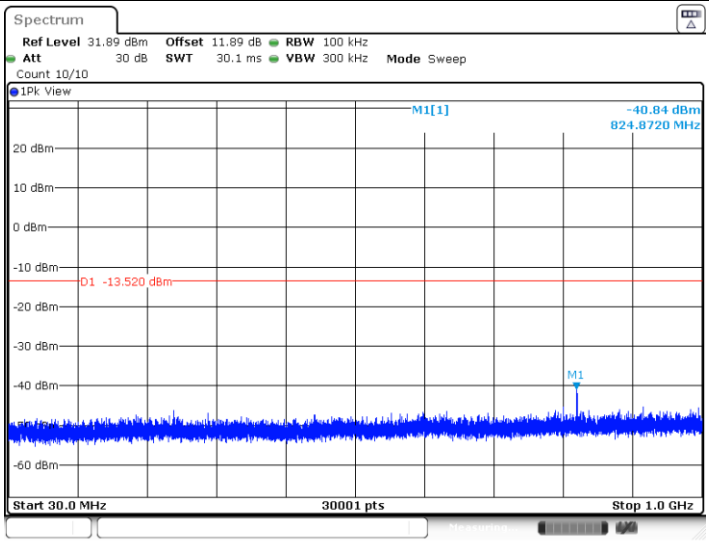
Conducted Spurious Emission

Test Result

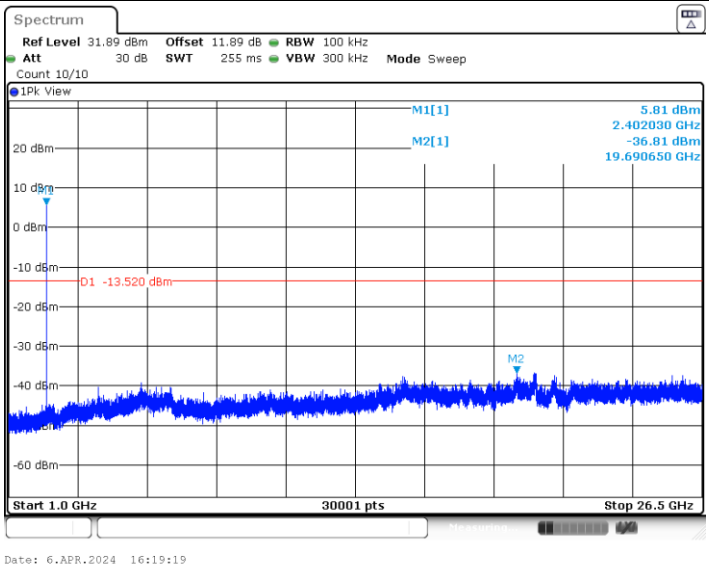
TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm/100KHz]	Result [dBm/100KHz]	Limit [dBm/100KHz]	Verdict
BLE_1M	Ant0	2402	30~1000	6.48	-40.84	≤-13.52	PASS
			1000~26500	6.48	-36.81	≤-13.52	PASS
	Ant1	2402	30~1000	8.06	-43.18	≤-11.94	PASS
			1000~26500	8.06	-36.17	≤-11.94	PASS
	Ant0	2440	30~1000	6.67	-45.9	≤-13.33	PASS
			1000~26500	6.67	-36.8	≤-13.33	PASS
	Ant1	2440	30~1000	8.32	-45.68	≤-11.68	PASS
			1000~26500	8.32	-36.78	≤-11.68	PASS
	Ant0	2480	30~1000	6.43	-44.89	≤-13.57	PASS
			1000~26500	6.43	-36.22	≤-13.57	PASS
	Ant1	2480	30~1000	8.02	-44.77	≤-11.98	PASS
			1000~26500	8.02	-36.93	≤-11.98	PASS
BLE_2M	Ant0	2404	30~1000	6.32	-45.46	≤-13.68	PASS
			1000~26500	6.32	-35.58	≤-13.68	PASS
	Ant1	2404	30~1000	8.08	-46.15	≤-11.92	PASS
			1000~26500	8.08	-36.26	≤-11.92	PASS
	Ant0	2440	30~1000	6.55	-43.17	≤-13.45	PASS
			1000~26500	6.55	-35.91	≤-13.45	PASS
	Ant1	2440	30~1000	8.38	-46.25	≤-11.62	PASS
			1000~26500	8.38	-36.24	≤-11.62	PASS
	Ant0	2478	30~1000	6.28	-43.67	≤-13.72	PASS
			1000~26500	6.28	-36.35	≤-13.72	PASS
	Ant1	2478	30~1000	8.02	-45.96	≤-11.98	PASS
			1000~26500	8.02	-37.47	≤-11.98	PASS

Test Graphs

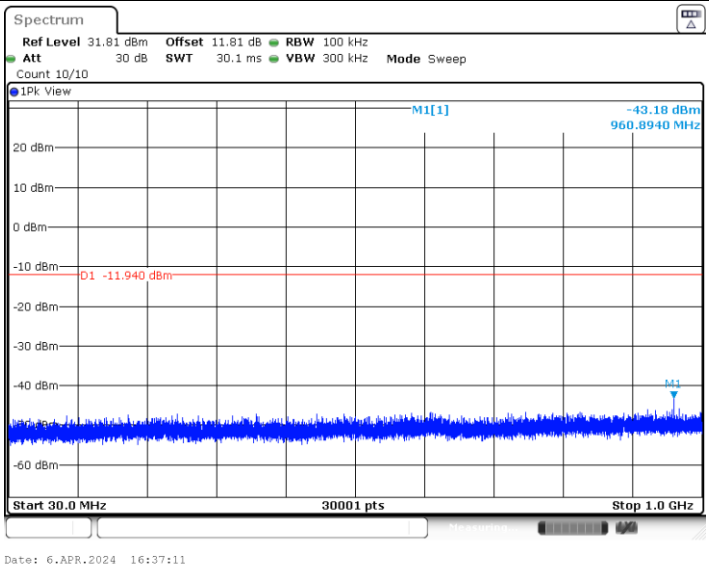
BLE_1M_Ant0_2402_30~1000



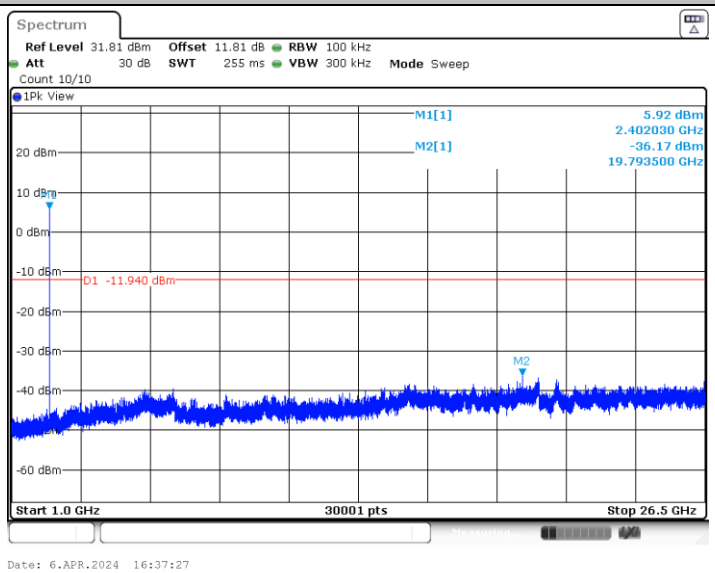
BLE_1M_Ant0_2402_1000~26500

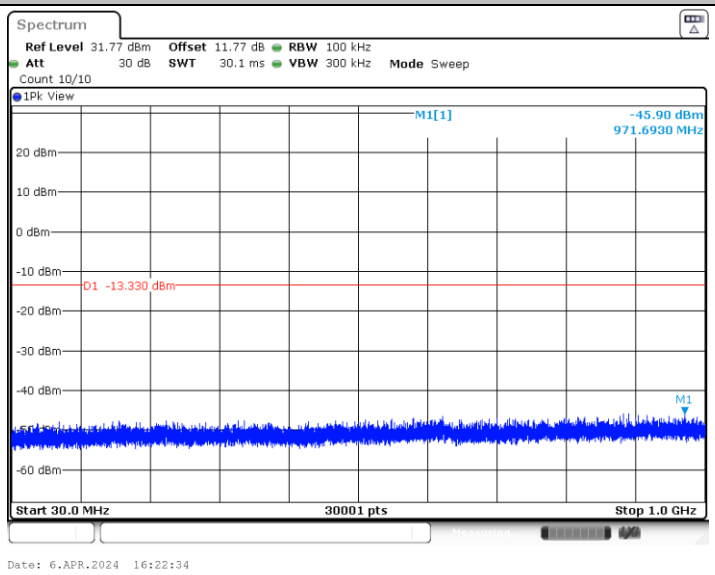
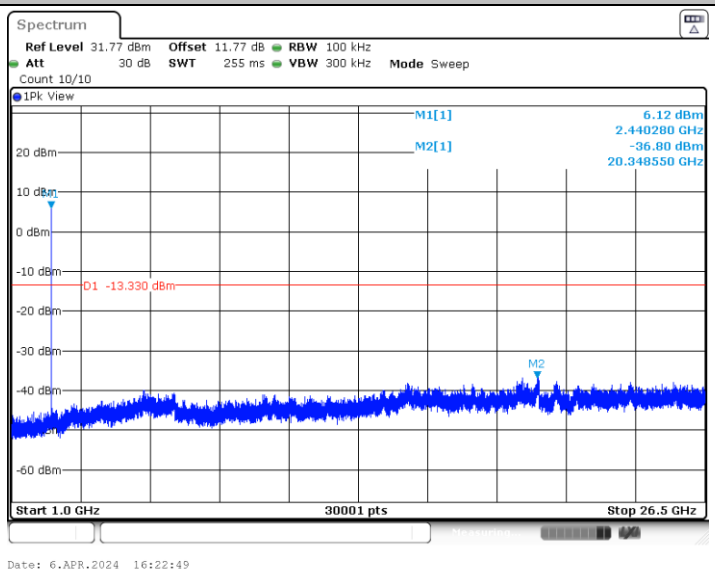


BLE_1M_Ant1_2402_30~1000

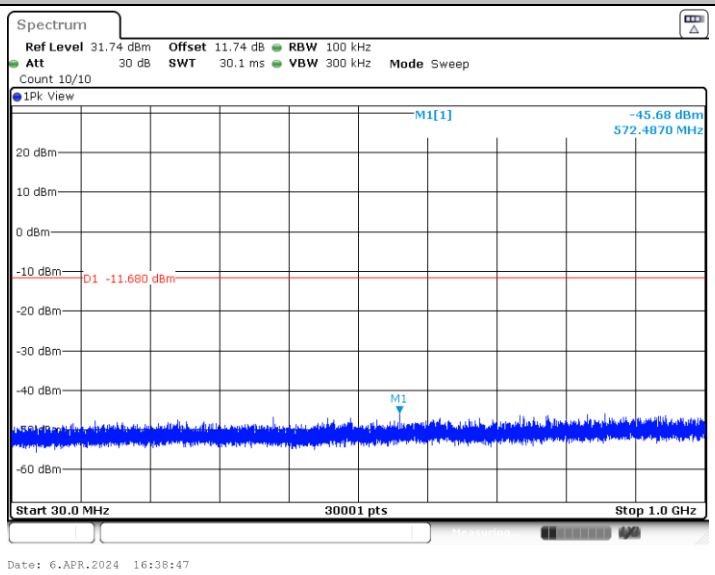


BLE_1M_Ant1_2402_1000~26500

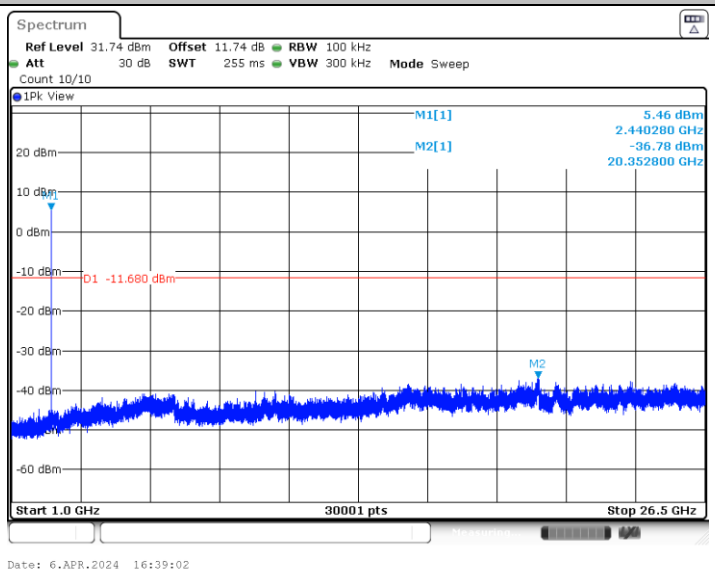


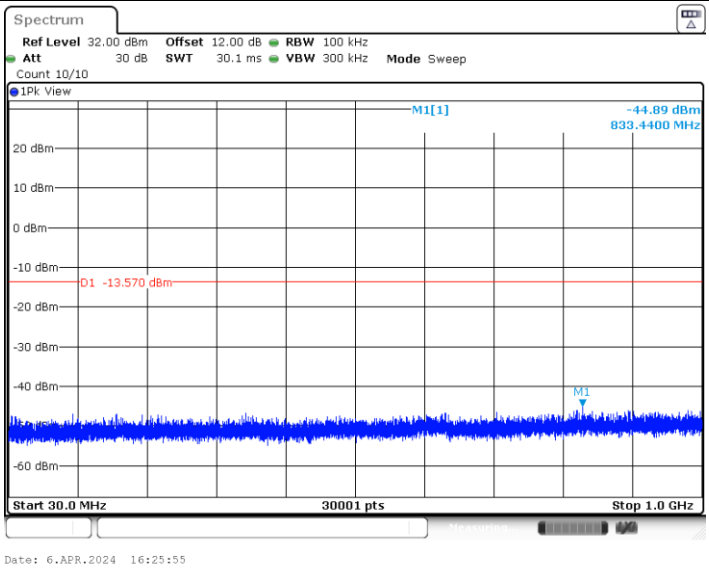
BLE_1M_Ant0_2440_30~1000

BLE_1M_Ant0_2440_1000~26500


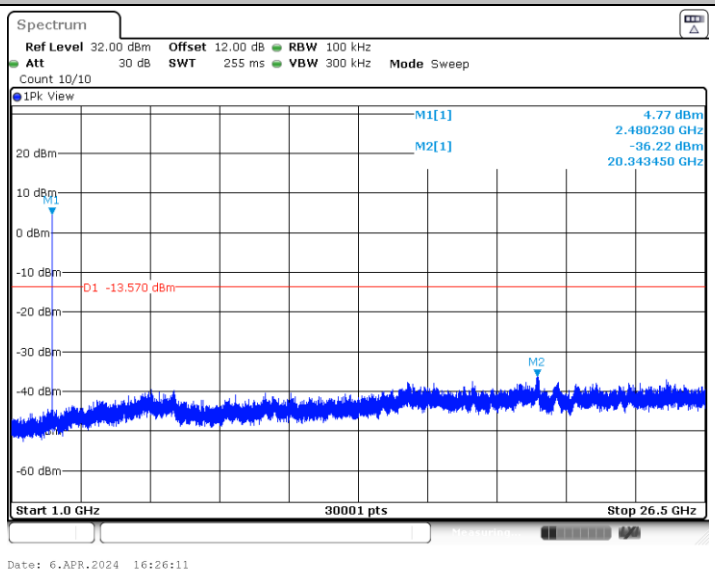
BLE_1M_Ant1_2440_30~1000



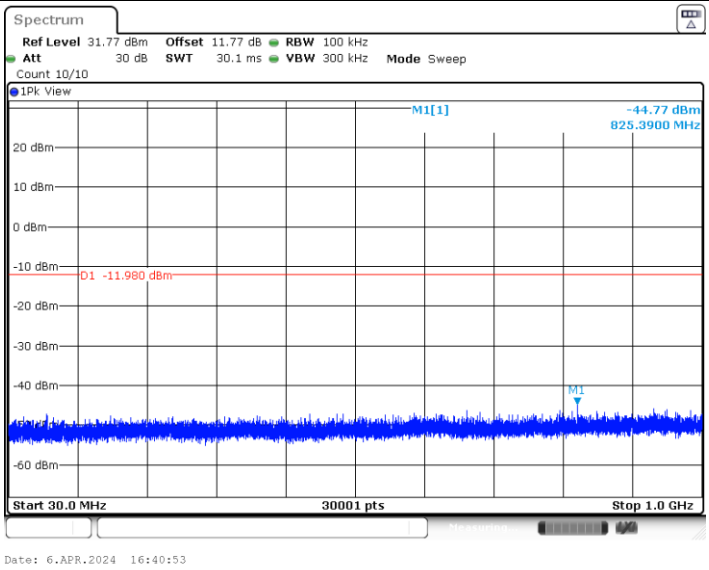
BLE_1M_Ant1_2440_1000~26500



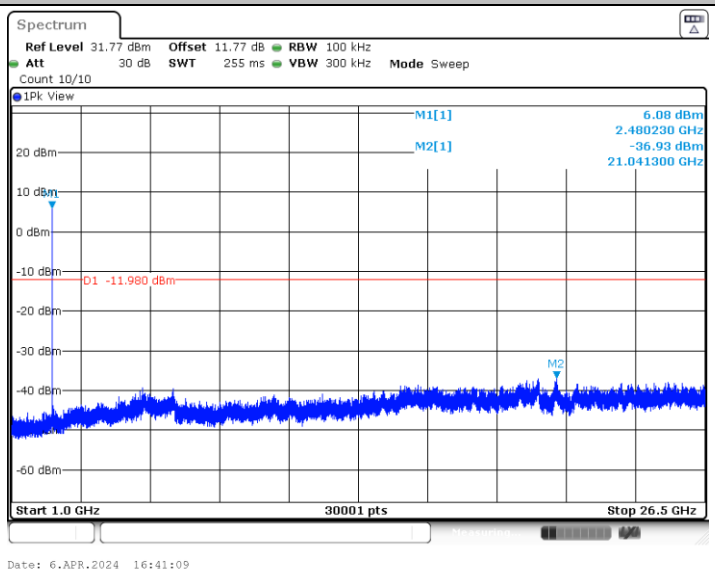
BLE_1M_Ant0_2480_30~1000


BLE_1M_Ant0_2480_1000~26500


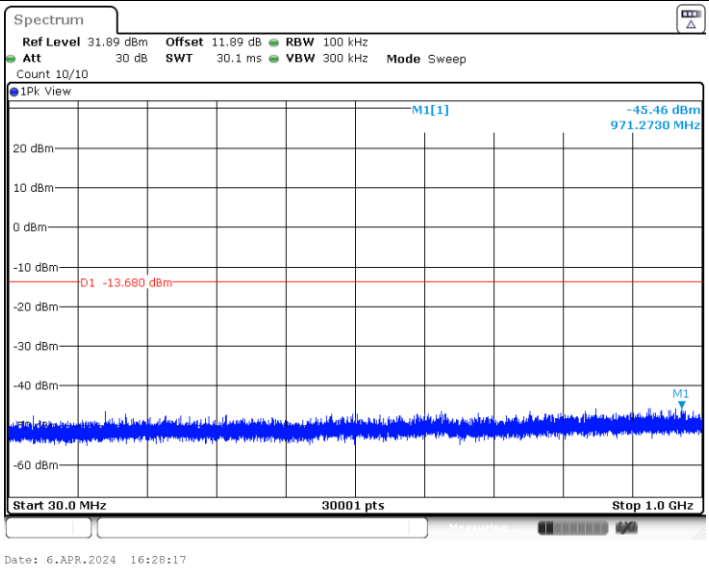
BLE_1M_Ant1_2480_30~1000



BLE_1M_Ant1_2480_1000~26500



BLE_2M_Ant0_2404_30~1000



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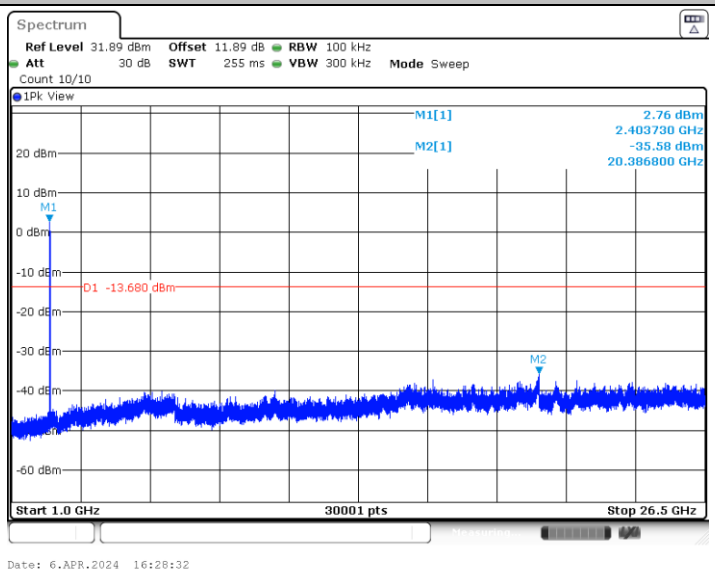

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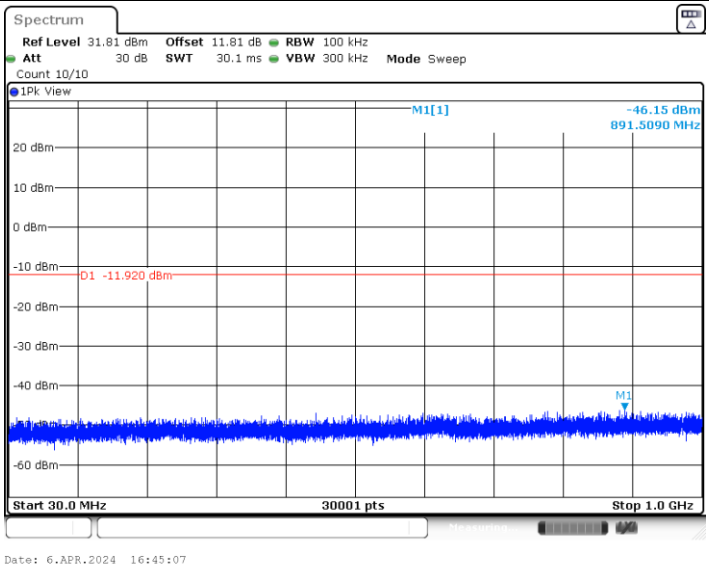

BLE_2M_Ant1_2404_1000~26500