FCC Part 15.247

TEST REPORT

For

Targus International LLC

1211 North Miller Street, Anaheim, CA 92806 USA

FCC ID: OXM000147

Report Type: Original Report	**Product Type:** Bluetooth V5.3 Dual-Mode Dongle

Report Producer : Coco Lin

Report Number : RXZ221215001RF06

Report Date : 2023-05-11

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RXZ221215001	RXZ221215001RF06	2023-05-11	Original Report	Coco Lin

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Manufacturer	Targus International LLC
	1211 North Miller Street, Anaheim, CA 92806 USA
Brand(Trade) Name	Targus
Product (Equipment)	Bluetooth V5.3 Dual-Mode Dongle
Main Model Name	ACB75B
Frequency Range	BLE(1M) / BLE(2M) : 2402 ~ 2480 MHz
Conducted Peak Output Power	BLE(1M) Mode : 4.24 dBm BLE(2M) Mode : 4.25 dBm
Modulation Technique	BLE(1M) / BLE(2M) : GFSK
Transmit Data Rate	BLE(1M) : 1 Mbps BLE(2M) : 2 Mbps
Power Operation (Voltage Range)	☐ AC 120V/60Hz ☐ Adapter ☐ By AC Power Cord ☐ PoE
	☒ DC Type ☐ Battery ☐ DC Power Supply ☒ External from USB 5V. ☐ External DC Adapter
	☐ Host System via Sever power
Received Date	2022/12/22
Date of Test	2022/12/28~ 2023/2/8

*All measurement and test data in this report was gathered from production sample serial number: RXZ221215001-01 (Assigned by BACL, New Taipei Laboratory).

1.2 Objective

This report is prepared on behalf of Targus International LLC in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS submission with FCC ID: OXM000147

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
KDB 558074 D01 Meas Guidance v05

1.5 Statement

Decision Rule: No, (The test results do not include MU judgment)

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.
Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.6 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 2.36 dB
RF output power, conducted		+/- 1.69 dBm
Occupied Bandwidth		+/- 0.35 MHz
Unwanted Emissions, conducted		+/- 1.69 dBm
Emissions, radiated	30 MHz~1GHz	+/- 5.22 dB
	1 GHz~18 GHz	+/- 6.12 dB
	18 GHz~40 GHz	+/- 4.99 dB
Temperature		+/- 1.27 °C
Humidity		+/- 3 %

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

1.7 Environmental Conditions

Test Site	Test Date	Temperature (℃)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2022/12/28	20.1	71	1010	Andy Cheng
Radiation Spurious Emissions	2023/2/7~2023/2/8	20.2	79	1010	Jim Chen
Conducted Spurious Emissions	2023/2/3	25.3	55	1010	Andy Cheng
6 dB Emission Bandwidth	2023/2/3	25.3	55	1010	Andy Cheng
Occupied bandwidth	2023/2/3	25.3	55	1010	Andy Cheng
Maximum Output Power	2023/2/3	25.3	55	1010	Andy Cheng
100 kHz Bandwidth of Frequency Band Edge	2023/2/3	25.3	55	1010	Andy Cheng
Power Spectral Density	2023/2/3	25.3	55	1010	Andy Cheng

1.8 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp.(New Taipei Laboratory) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp.(New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10.

2 System Test Configuration

2.1 Description of Test Configuration

For BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	--	--
2	2406	--	--
3	2408	37	2476
--	--	38	2478
19	2440	39	2480

For BLE Modes were tested with channel 0, 19 and 39.

The system was configured for testing in engineering mode, which was provided by manufacturer.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The test software was used “Realtek Bluetooth MP Kit”.

Test Frequency		Low	Middle	High
Power Level Setting	BLE 1M	0x38	0x38	0x38
	BLE 2M	0x38	0x38	0x38

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number
NB	DELL	E6410

2.5 External Cable List and Details

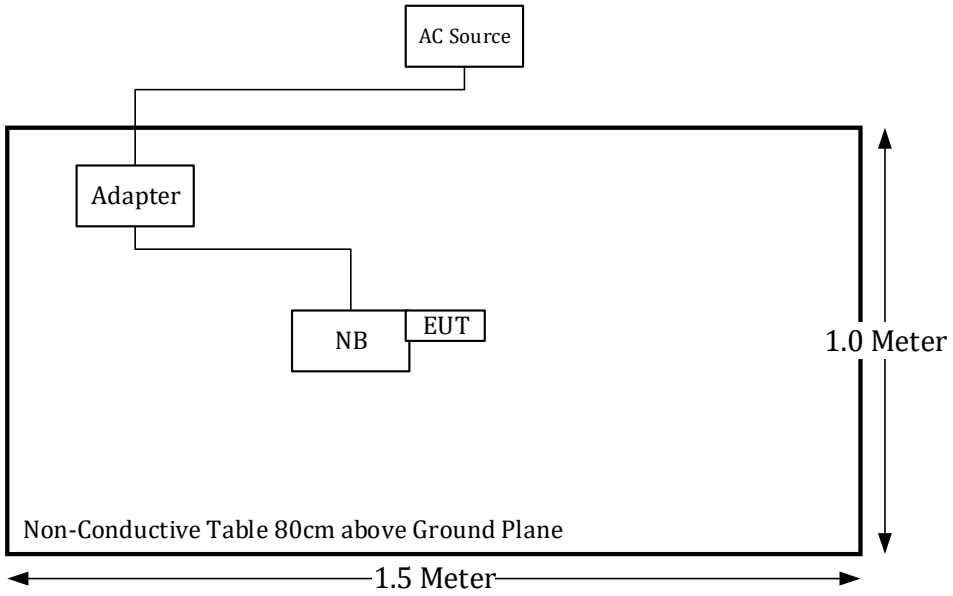
N/A

2.6 Block Diagram of Test Setup

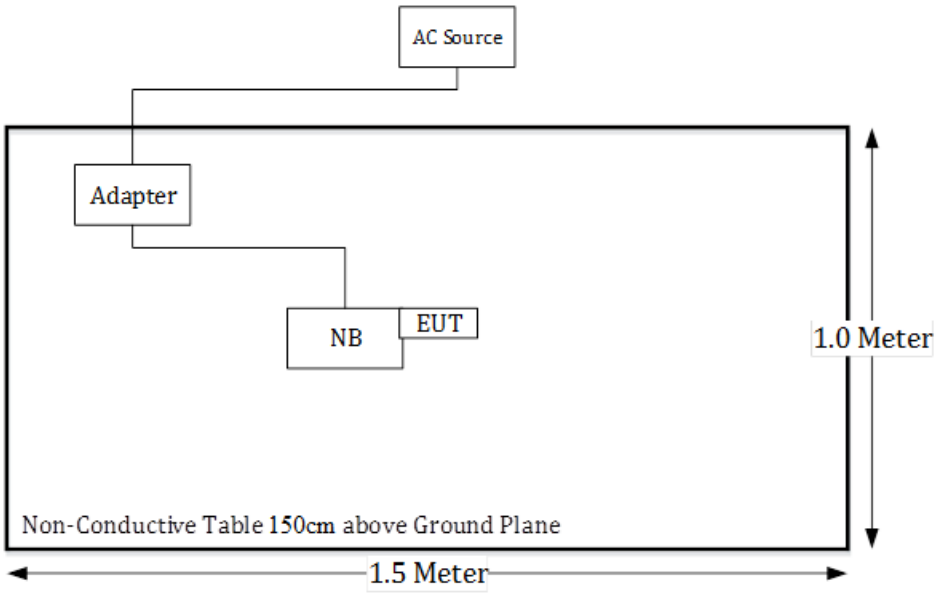
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

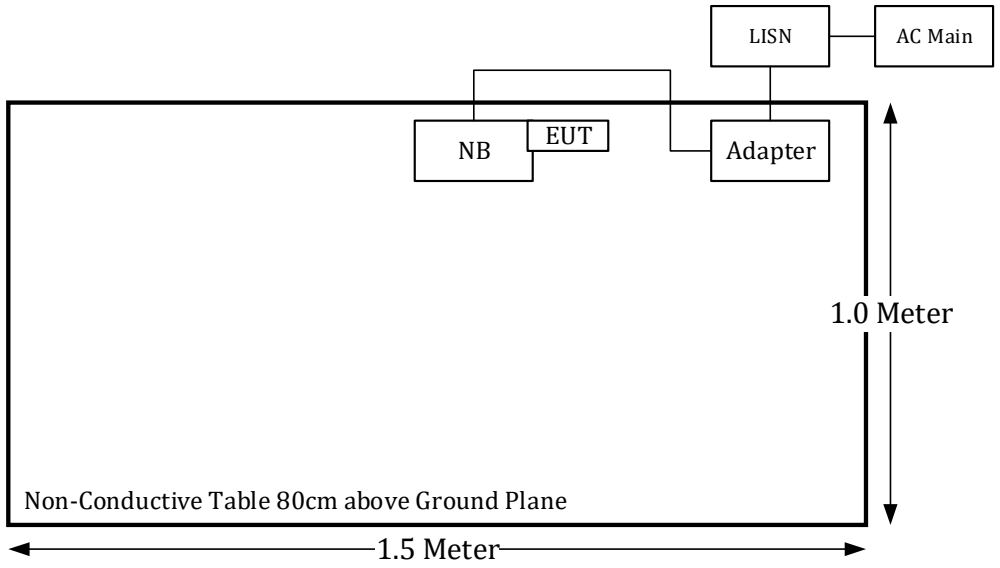
Below 1GHz:



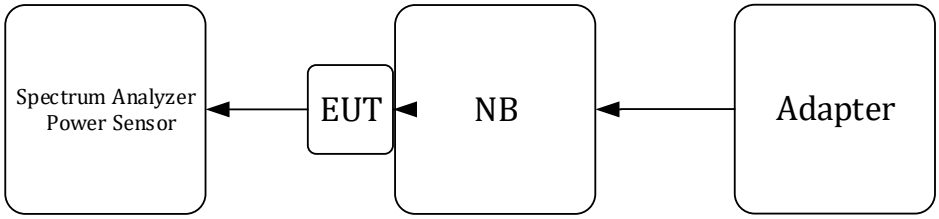
Above 1GHz:



Conduction:



Conducted:



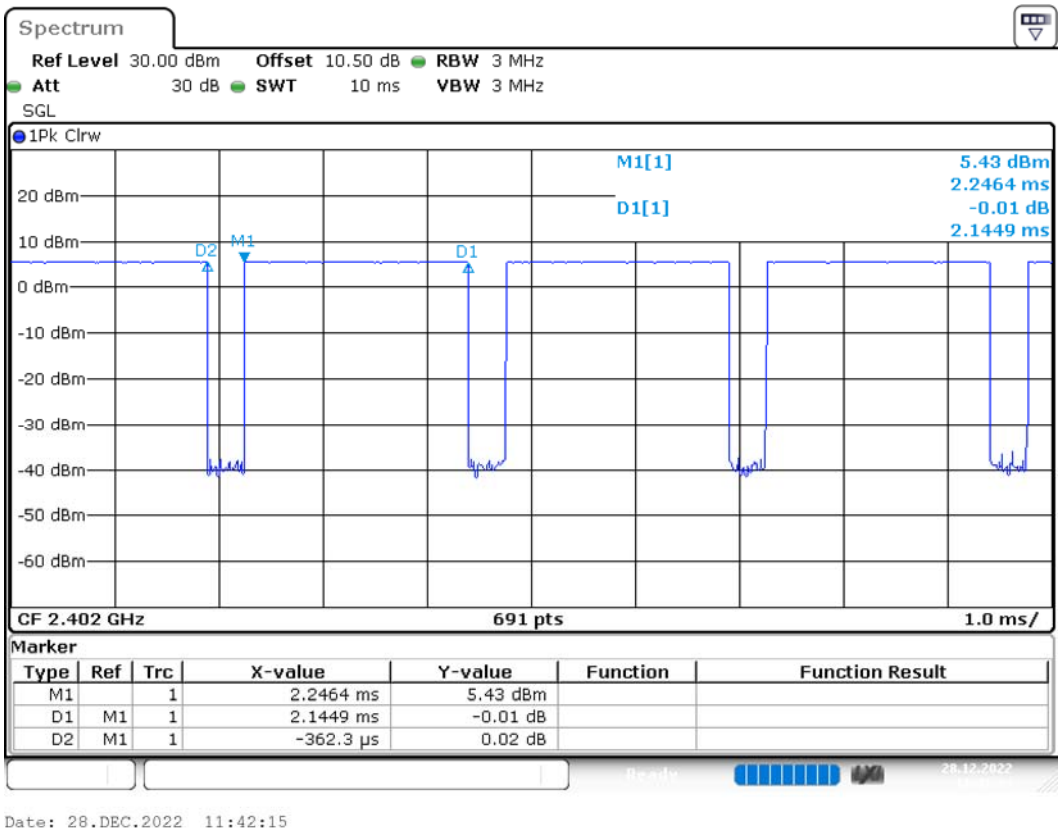
2.7 Duty Cycle

The duty cycle as below:

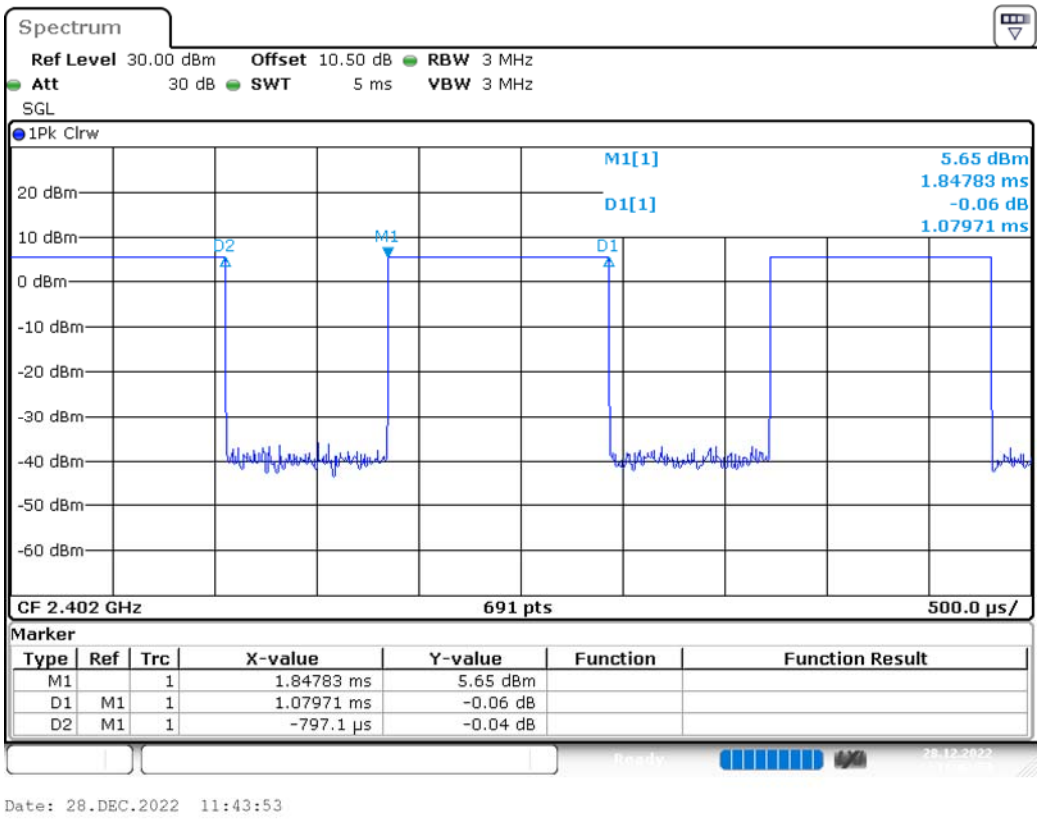
Radio Mode	T_{on} (ms)	$T_{on}+T_{off}$ (ms)	Duty Cycle (%)
BLE 1M	2.144	2.507	86
BLE 2M	1.079	1.877	58

Please refer to the following plots.

BLE(1M) Mode



BLE(2M) Mode


Spectrum
Ref Level 30.00 dBm Offset 10.50 dB RBW 3 MHz
Att 30 dB SWT 5 ms VBW 3 MHz
SGL
1Pk Clrw
M1[1] 5.65 dBm
1.84783 ms
D1[1] -0.06 dB
1.07971 ms
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
D2
M1
D1
CF 2.402 GHz
691 pts
500.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 1.84783 ms 5.65 dBm
D1 M1 1 1.07971 ms -0.06 dB
D2 M1 1 -797.1 µs -0.04 dB
Date: 28.DEC.2022 11:43:53

3 Summary of Test Results

FCC Part 15.247

FCC Rules	Description of Test	Results
§15.247(i), §1.1307(b)(3)(i)	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101248	2022/6/22	2023/6/21
EMI Test Receiver	Rohde & Schwarz	ESW8	100947	2022/7/27	2023/7/26
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2022/7/19	2023/7/18
RF Cable	EMEC	EM-CB5D	1	2022/6/7	2023/6/6
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiation 3M Room (966-A)					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2023/2/2	2024/2/1
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2022/11/2	2023/11/1
Horn Antenna	EMCO	SAS-571	1020	2022/5/25	2023/5/24
Horn Antenna	ETS-Lindgren	3116	62638	2022/8/18	2023/8/17
Preamplifier	Sonoma	310N	130602	2022/6/16	2023/6/15
Preamplifier	A.H. system Inc.	PAM-0118P	470	2022/3/28	2023/3/27
Microware Preamplifier	EM Electronics Corporation	EM18G40G	60656	2023/1/6	2024/1/5
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2023/2/1	2024/1/31
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2023/1/24	2024/1/23
Coaxial Cable	COMMATE	PEWC	8Dr	2022/12/24	2023/12/23
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2023/1/24	2024/1/23
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2022/12/24	2023/12/23
Cable	EMC	EMC105-SM-SM-10000	201003	2023/1/24	2024/1/23
Software	AUDIX	E3	18621a	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2022/2/18	2023/2/17
Cable	UTIFLEX	UFA210A	9435	2022/10/3	2023/10/2
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2023/2/2	2024/2/1
Attenuator	MINI-CIRCUITS	BW-S10W5+	1419	2023/2/2	2024/2/1

*Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.

6 FCC §15.247(i), §1.1307(b)(3)(i) – RF EXPOSURE

6.1 Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

For single RF sources (*i.e.,* any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold *Pth* (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). *Pth* is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

6.2 RF Exposure Evaluation Result

Project info

Band	Freq (MHz)	Tune-up Power (dBm)	Ant Gain (dBi)	Distances (mm)	Tune-up Power (mW)	ERP (dBm)	ERP (mW)
BT	2480	4.2	-4.1	5	2.63	-2.05	0.62
BLE	2480	4.3	-4.1	5	2.69	-1.95	0.64

§ 1.1307(b)(3)(i)(A) and (C) methid is not applicable.

§ 1.1307(b)(3)(i)(B)

Band	Freq (MHz)	Pth (mW)	X	ERP 20cm (mW)	Result Option B
BT	**2480**	**2.72**	**1.905**	**3060**	**exempt**
BLE	**2480**	**2.72**	**1.905**	**3060**	**exempt**

The available maximum time-averaged power or effective radiated power (ERP), whichever is greater. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive).

Result: The EUT meets exemption requirement.

7 FCC §15.203 – Antenna Requirements

7.1 Applicable Standard

According to § 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the 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 does not exceed 6dBi.

7.2 Antenna Information

Manufacturer	Model	Type	Antenna Gain
CC&C	BT-330S-V2	PCB Antenna	-4.10dBi

Result: Compliance

8 FCC §15.207(a) – AC Line Conducted Emissions

8.1 Applicable Standard

According to §15.207

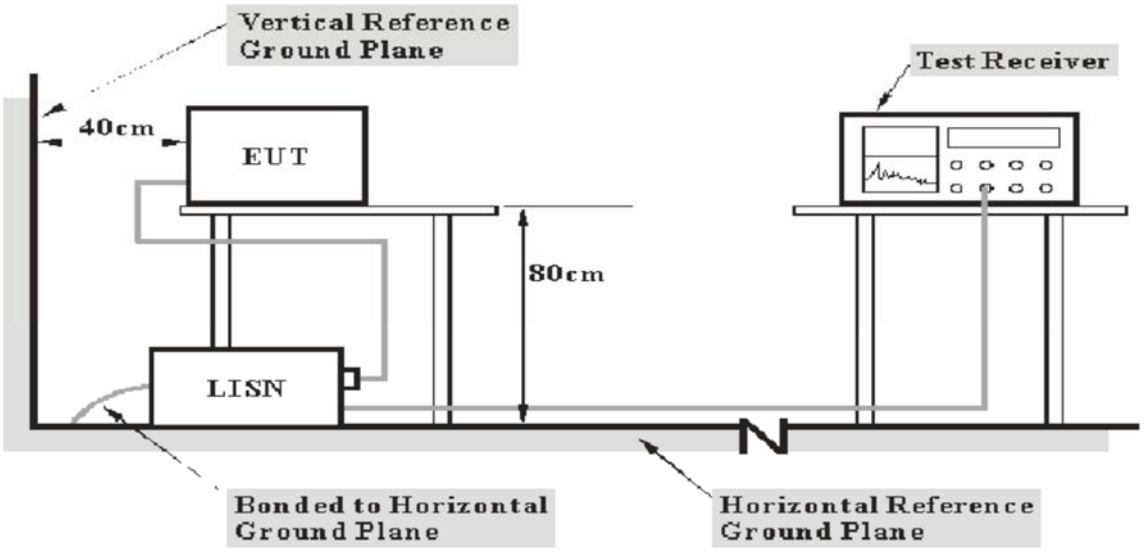
For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

Note 2: A linear average detector is required

8.2 EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

8.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

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

Frequency Range	IF B/W
150kHz – 30MHz	9kHz

8.4 Test Procedure

According to ANSI C63.10-2013, section 6.2

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

8.5 Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

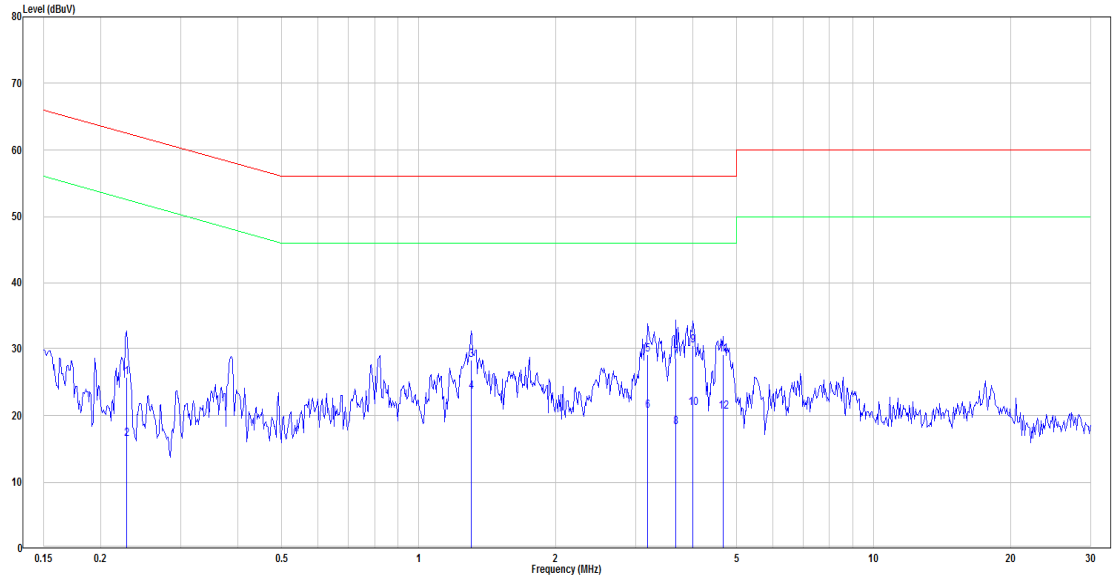
The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

8.6 Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz, Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBµV)	Factor(dB)	(dBµV)	(dBµV)	(dB)	
1	0.228	6.26	19.51	25.77	62.52	-36.75	QP
2	0.228	-3.10	19.51	16.41	52.52	-36.11	Average
3	1.303	8.79	19.55	28.34	56.00	-27.66	QP
4	1.303	4.00	19.55	23.55	46.00	-22.45	Average
5	3.190	9.53	19.61	29.14	56.00	-26.86	QP
6	3.190	1.08	19.61	20.69	46.00	-25.31	Average
7	3.681	8.89	19.62	28.51	56.00	-27.49	QP
8	3.681	-1.46	19.62	18.16	46.00	-27.84	Average
9	4.006	10.78	19.63	30.41	56.00	-25.59	QP
10	4.006	1.48	19.63	21.11	46.00	-24.89	Average
11	4.672	9.51	19.65	29.16	56.00	-26.84	QP
12	4.672	0.91	19.65	20.56	46.00	-25.44	Average

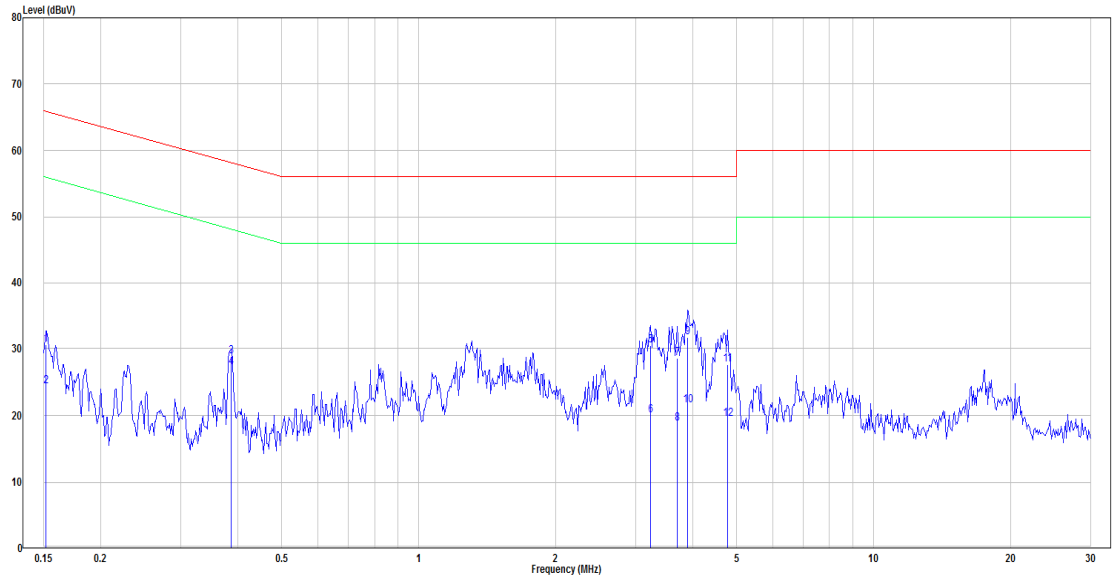
Note:

Result = Reading + Correct Factor

Over Limit = Result– Limit

Correct Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Main: AC120 V, 60 Hz, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBµV)	Factor(dB)	(dBµV)	(dBµV)	(dB)	
1	0.152	11.16	19.51	30.67	65.91	-35.24	QP
2	0.152	4.86	19.51	24.37	55.91	-31.54	Average
3	0.387	9.29	19.52	28.81	58.12	-29.31	QP
4	0.387	7.70	19.52	27.22	48.12	-20.90	Average
5	3.241	10.91	19.61	30.52	56.00	-25.48	QP
6	3.241	0.45	19.61	20.06	46.00	-25.94	Average
7	3.700	8.92	19.62	28.54	56.00	-27.46	QP
8	3.700	-0.79	19.62	18.83	46.00	-27.17	Average
9	3.901	12.01	19.63	31.64	56.00	-24.36	QP
10	3.901	1.81	19.63	21.44	46.00	-24.56	Average
11	4.772	7.95	19.66	27.61	56.00	-28.39	QP
12	4.772	-0.25	19.66	19.41	46.00	-26.59	Average

Note:

Result = Reading + Correct Factor

Over Limit = Result– Limit

Correct Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

9 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

9.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	608 – 614	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5. 35 – 5. 46
2.1735 – 2.1905	16.80425 – 16.80475	1300 – 1427	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1660 – 1710	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2310 – 2390	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	162.0125 –167.17	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3 3458 – 3 358	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4		Above 38.6
13.36 – 13.41	399.9 – 410		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/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

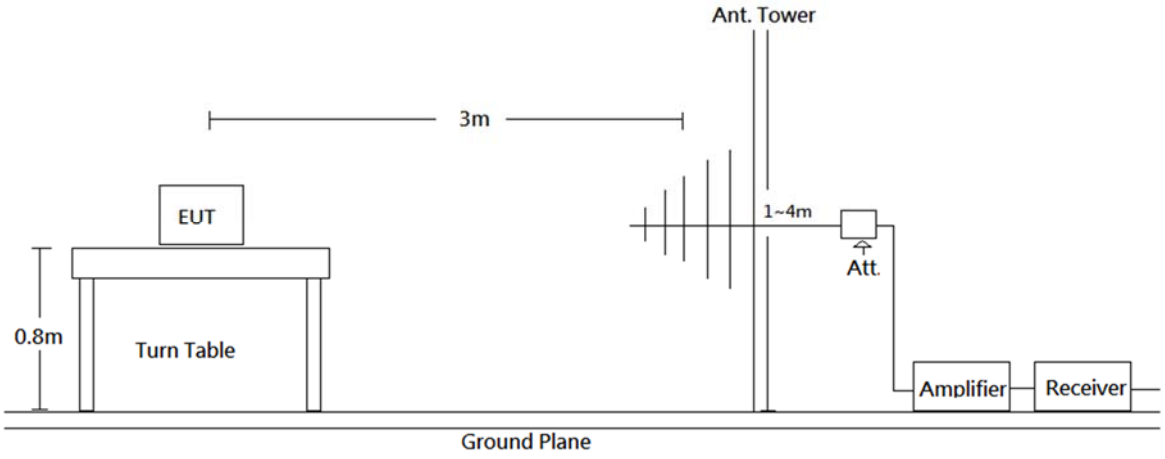
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains

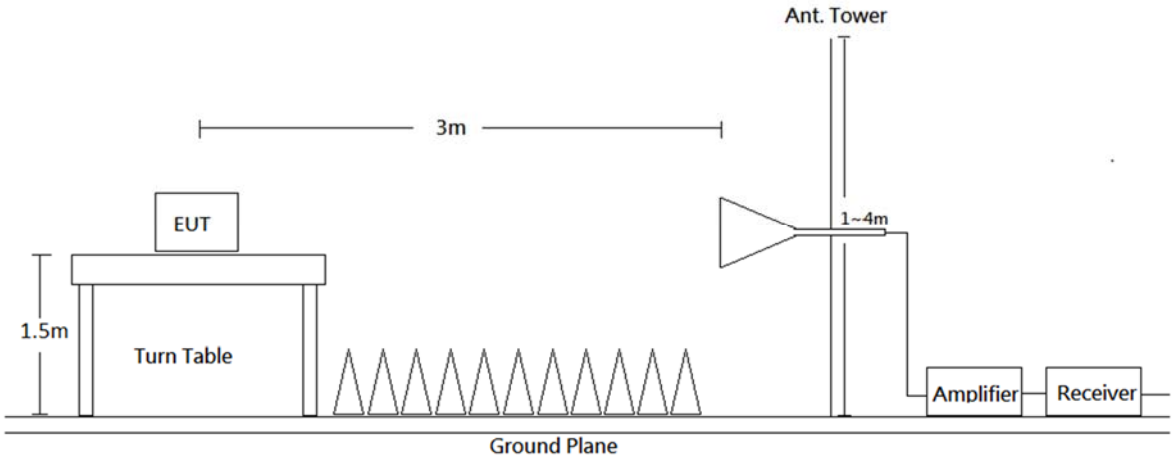
the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

9.2 EUT Setup

Below 1 GHz:



Above 1 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

9.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Duty cycle	Measurement method
30-1000 MHz	120 kHz	/	/	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	>98%	Ave
	1 MHz	1/T	<98%	Ave

Note: T is minimum transmission duration,
BLE (1M): 1/T= 1/2.144ms=0.466, => 0.5kHz
BLE (2M): 1/T= 1/1.079ms=0.927, => 1kHz

9.4 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

9.5 Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result – Limit

9.6 Test Results

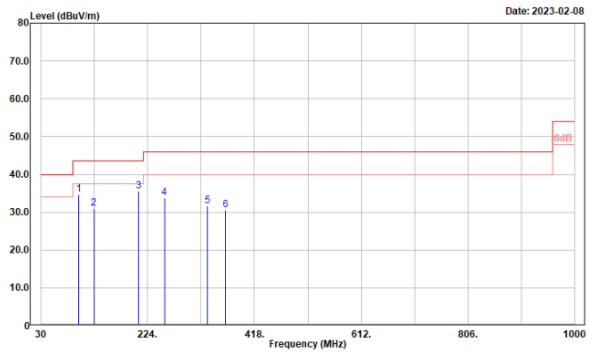
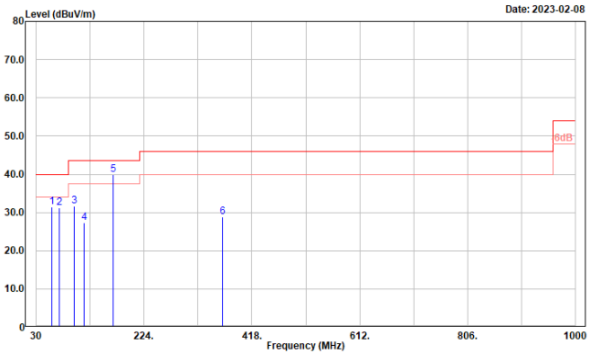
Test Mode: Transmitting

(Pre-scan with three orthogonal axis, and worse case as Z axis.)

(worst case is BLE 2M mode high channel)

30MHz-1GHz:

Horizontal

Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
98.939	46.85	-12.07	34.78	43.50	-8.72	100	105	QP
126.126	38.65	-7.67	30.98	43.50	-12.52	100	278	QP
206.717	46.08	-10.55	35.53	43.50	-7.97	100	305	QP
254.294	43.19	-9.39	33.80	46.00	-12.20	100	162	QP
332.943	38.02	-6.30	31.72	46.00	-14.28	100	298	QP
365.956	35.97	-5.33	30.64	46.00	-15.36	100	298	QP

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
58.158	46.70	-15.25	31.45	40.00	-8.55	100	71	QP
71.752	45.15	-14.04	31.11	40.00	-8.89	100	6	QP
98.939	43.66	-12.07	31.59	43.50	-11.91	100	28	QP
116.416	35.82	-8.50	27.32	43.50	-16.18	100	178	QP
167.878	49.47	-9.61	39.86	43.50	-3.64	100	320	QP
364.985	34.15	-5.34	28.81	46.00	-17.19	100	47	QP

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

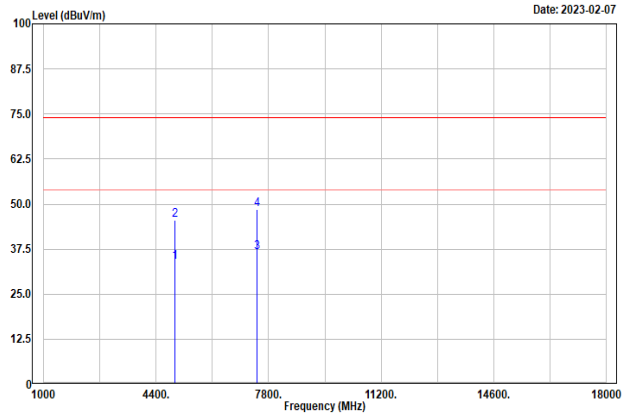
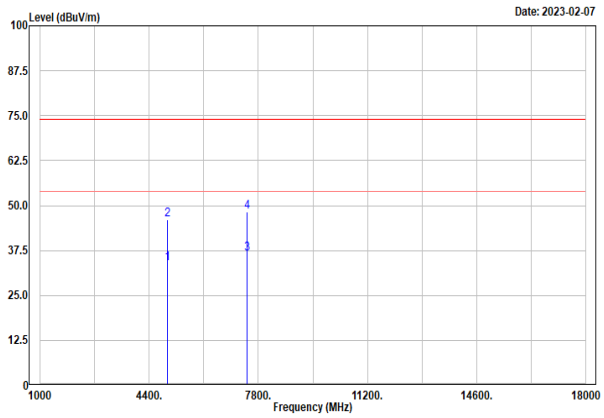
Spurious emissions more than 20 dB below the limit were not reported.

BLE(1M) Mode

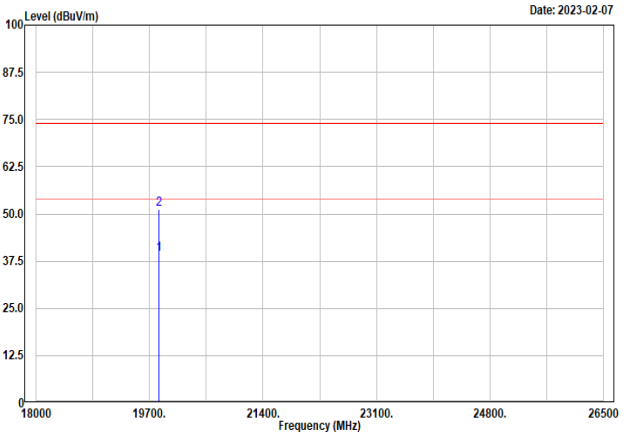
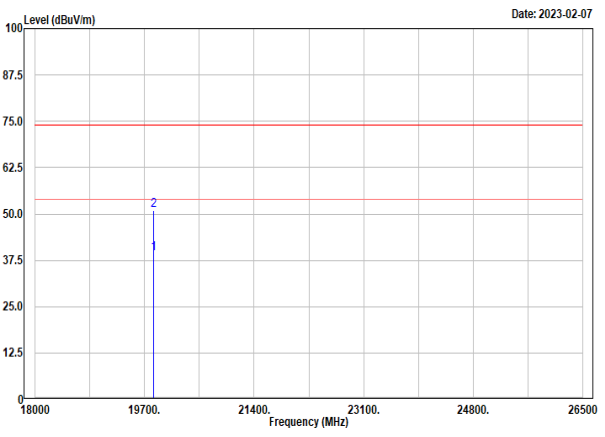
(Pre-scan with three orthogonal axis, and worse case as Z axis.)

(worst case is high channel)

1GHz-18GHz:

Horizontal	Vertical
	

18GHz-26.5GHz:

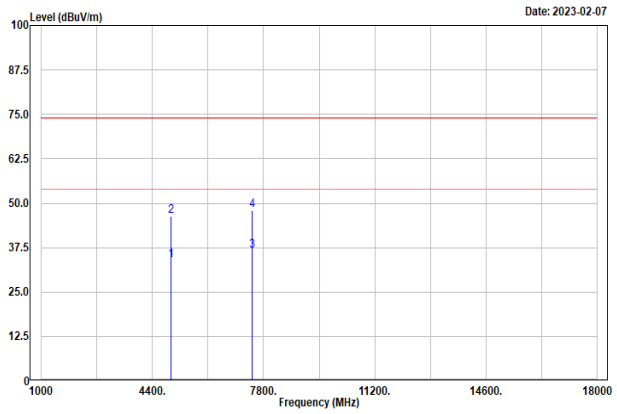
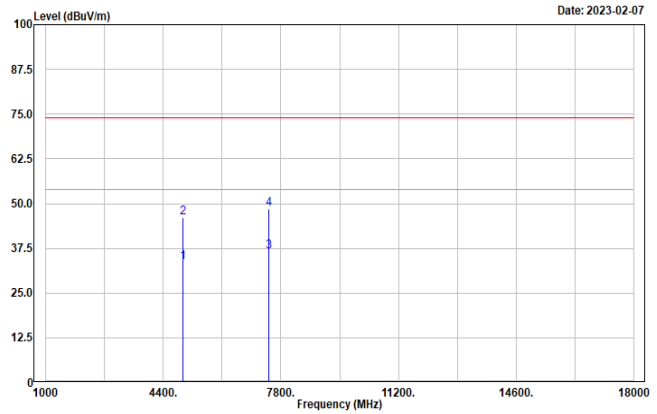
Horizontal	Vertical
	

BLE(2M) Mode

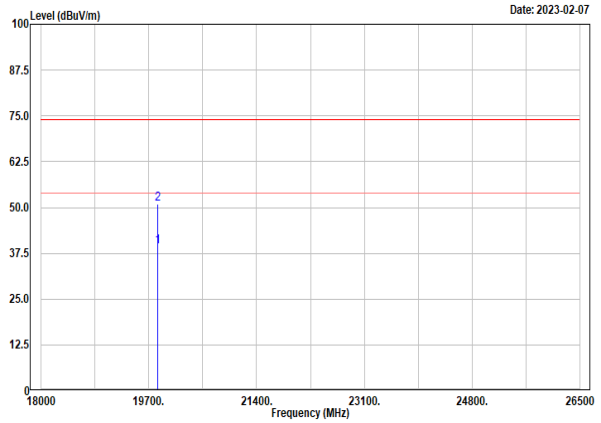
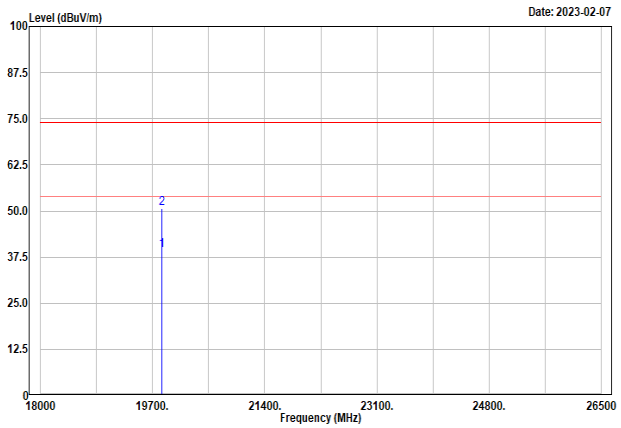
(Pre-scan with three orthogonal axis, and worse case as Z axis.)

(worst case is high channel)

1GHz-18GHz:

Horizontal	Vertical
	

18GHz-26.5GHz:

Horizontal	Vertical
	

BLE(1M) Mode

Above 1GHz

Horizontal

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2364.454	41.30	-4.82	36.48	54.00	-17.52	160	210	Average
2364.454	54.87	-4.82	50.05	74.00	-23.95	160	210	Peak
2402.000	93.71	-4.48	89.23			160	210	Average
2402.000	94.85	-4.48	90.37			160	210	Peak
4804.000	30.23	3.45	33.68	74.00	-40.32	155	119	Average
4804.000	43.09	3.45	46.54	74.00	-27.46	155	119	Peak
7206.000	27.57	9.05	36.62	54.00	-17.38	152	208	Average
7206.000	39.55	9.05	48.60	74.00	-25.40	152	208	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	91.99	-4.20	87.79			135	211	Average
2440.000	93.14	-4.20	88.94			135	211	Peak
4880.000	29.87	3.57	33.44	54.00	-20.56	154	329	Average
4880.000	41.89	3.57	45.46	74.00	-28.54	154	329	Peak
7320.000	28.08	9.25	37.33	54.00	-16.67	149	33	Average
7320.000	40.28	9.25	49.53	74.00	-24.47	149	33	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	92.01	-3.73	88.28			119	206	Average
2480.000	93.15	-3.73	89.42			119	206	Peak
2547.568	41.28	-3.04	38.24	54.00	-15.76	119	206	Average
2547.568	54.70	-3.04	51.66	74.00	-22.34	119	206	Peak
4960.000	30.04	3.92	33.96	54.00	-20.04	153	213	Average
4960.000	41.48	3.92	45.40	74.00	-28.60	153	213	Peak
7440.000	27.25	9.42	36.67	54.00	-17.33	148	51	Average
7440.000	39.00	9.42	48.42	74.00	-25.58	148	51	Peak

Level = Reading + Factor.
Margin = Level – Limit.
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2348.038	41.32	-4.96	36.36	54.00	-17.64	182	237	Average
2348.038	55.38	-4.96	50.42	74.00	-23.58	182	237	Peak
2402.000	88.11	-4.48	83.63			182	237	Average
2402.000	89.31	-4.48	84.83			182	237	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4804.000	30.14	3.45	33.59	54.00	-20.41	153	119	Average
4804.000	41.32	3.45	44.77	74.00	-29.23	153	119	Peak
7206.000	27.52	9.05	36.57	54.00	-17.43	148	29	Average
7206.000	38.64	9.05	47.69	74.00	-26.31	148	29	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	86.31	-4.20	82.11			186	234	Average
2440.000	87.48	-4.20	83.28			186	234	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	29.92	3.57	33.49	54.00	-20.51	156	64	Average
4880.000	41.30	3.57	44.87	74.00	-29.13	156	64	Peak
7320.000	28.00	9.25	37.25	54.00	-16.75	152	159	Average
7320.000	39.92	9.25	49.17	74.00	-24.83	152	159	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	85.45	-3.73	81.72			197	228	Average
2480.000	86.68	-3.73	82.95			197	228	Peak
2530.741	41.19	-3.18	38.01	54.00	-15.99	197	228	Average
2530.741	54.89	-3.18	51.71	74.00	-22.29	197	228	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4960.000	29.96	3.92	33.88	54.00	-20.12	155	136	Average
4960.000	42.12	3.92	46.04	74.00	-27.96	155	136	Peak
7440.000	27.16	9.42	36.58	54.00	-17.42	153	67	Average
7440.000	38.91	9.42	48.33	74.00	-25.67	153	67	Peak

Level = Reading + Factor.
Margin = Level – Limit.
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

BLE(2M) Mode

Above 1GHz

Horizontal

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2353.243	42.02	-4.93	37.09	54.00	-16.91	163	208	Average
2353.243	55.97	-4.93	51.04	74.00	-22.96	163	208	Peak
2402.000	91.81	-4.48	87.33			163	208	Average
2402.000	94.64	-4.48	90.16			163	208	Peak
4804.000	29.97	3.45	33.42	54.00	-20.58	148	250	Average
4804.000	41.45	3.45	44.90	74.00	-29.10	148	250	Peak
7206.000	27.42	9.05	36.47	54.00	-17.53	146	71	Average
7206.000	40.31	9.05	49.36	74.00	-24.64	146	71	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	89.86	-4.20	85.66			156	206	Average
2440.000	92.81	-4.20	88.61			156	206	Peak
4880.000	29.77	3.57	33.34	54.00	-20.66	152	221	Average
4880.000	41.28	3.57	44.85	74.00	-29.15	152	221	Peak
7320.000	27.90	9.25	37.15	54.00	-16.85	151	124	Average
7320.000	39.92	9.25	49.17	74.00	-24.83	151	124	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	89.83	-3.72	86.11			147	207	Average
2480.000	92.77	-3.72	89.05			147	207	Peak
2512.929	41.65	-3.35	38.30	54.00	-15.70	147	207	Average
2512.929	55.67	-3.35	52.32	74.00	-21.68	147	207	Peak
4960.000	29.97	3.92	33.89	54.00	-20.11	147	289	Average
4960.000	42.55	3.92	46.47	74.00	-27.53	147	289	Peak
7440.000	27.15	9.42	36.57	54.00	-17.43	155	236	Average
7440.000	38.62	9.42	48.04	74.00	-25.96	155	236	Peak

Level = Reading + Factor.
Margin = Level – Limit.
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2334.825	41.78	-4.98	36.80	54.00	-17.20	136	237	Average
2334.825	55.64	-4.98	50.66	74.00	-23.34	136	237	Peak
2402.000	86.52	-4.48	82.04			136	237	Average
2402.000	89.42	-4.48	84.94			136	237	Peak
4804.000	29.82	3.45	33.27	54.00	-20.73	147	313	Average
4804.000	41.14	3.45	44.59	74.00	-29.41	147	313	Peak
7206.000	27.43	9.05	36.48	54.00	-17.52	153	232	Average
7206.000	39.04	9.05	48.09	74.00	-25.91	153	232	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2334.825	41.78	-4.98	36.80	54.00	-17.20	136	237	Average
2334.825	55.64	-4.98	50.66	74.00	-23.34	136	237	Peak
2402.000	86.52	-4.48	82.04			136	237	Average
2402.000	89.42	-4.48	84.94			136	237	Peak
4880.000	29.70	3.57	33.27	54.00	-20.73	154	4	Average
4880.000	41.61	3.57	45.18	74.00	-28.82	154	4	Peak
7320.000	27.77	9.25	37.02	54.00	-16.98	147	69	Average
7320.000	39.92	9.25	49.17	74.00	-24.83	147	69	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	81.61	-3.73	77.88			217	232	Average
2480.000	84.62	-3.73	80.89			217	232	Peak
2498.400	41.72	-3.48	38.24	54.00	-15.76	217	232	Average
2498.400	55.88	-3.48	52.40	74.00	-21.60	217	232	Peak
4960.000	29.76	3.92	33.68	54.00	-20.32	149	278	Average
4960.000	42.20	3.92	46.12	74.00	-27.88	149	278	Peak
7440.000	27.12	9.42	36.54	54.00	-17.46	153	339	Average
7440.000	39.03	9.42	48.45	74.00	-25.55	153	339	Peak

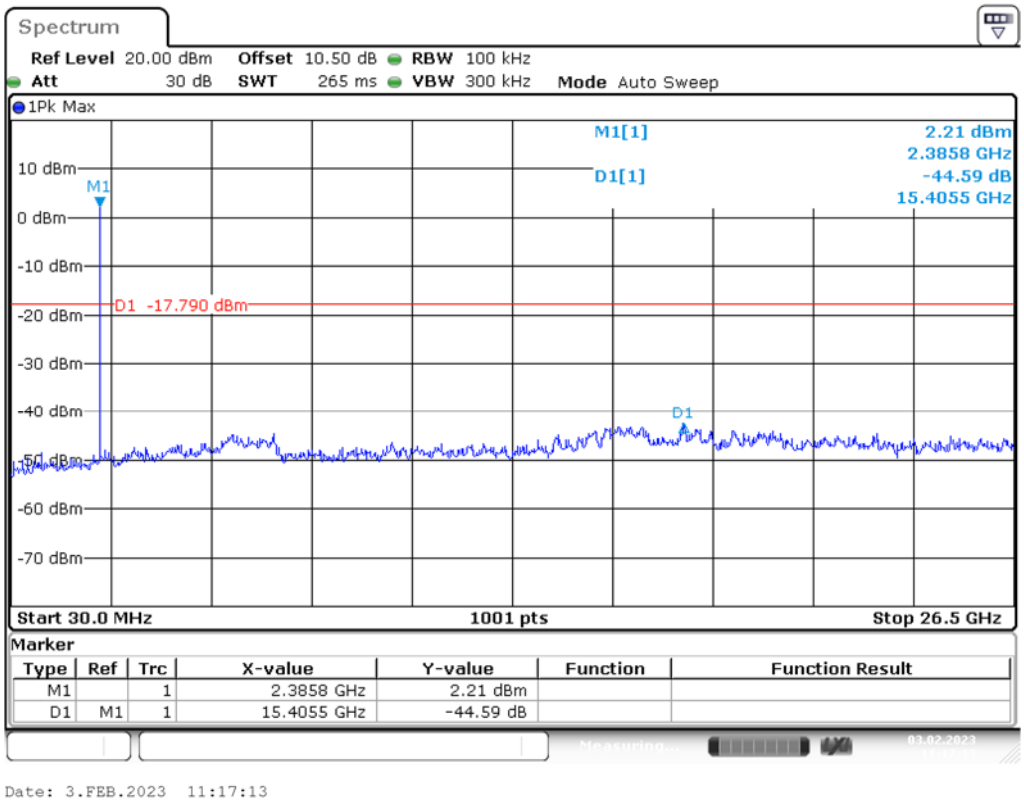
Level = Reading + Factor.
Margin = Level – Limit.
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

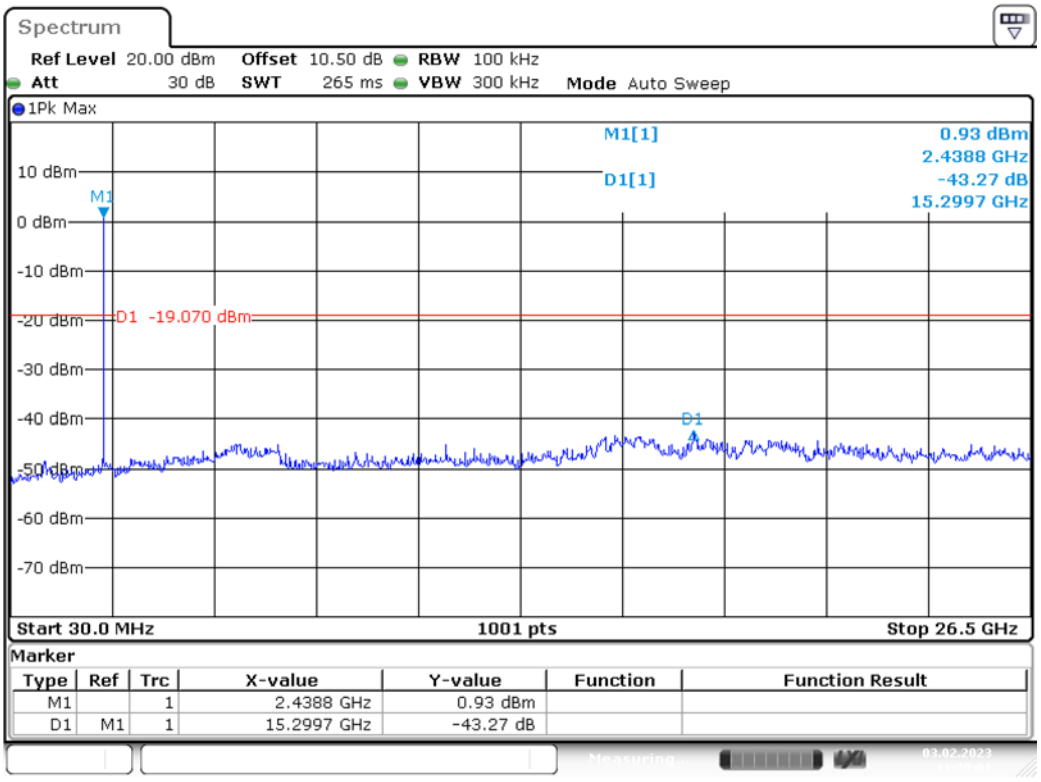
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE(1M) Mode				
Low	2402	44.59	≥ 20	PASS
Mid	2440	43.27	≥ 20	PASS
High	2480	44.54	≥ 20	PASS
BLE(2M) Mode				
Low	2402	41.73	≥ 20	PASS
Mid	2440	41.92	≥ 20	PASS
High	2480	41.37	≥ 20	PASS

Please refer to the following plots

BLE(1M) Mode
Low Channel

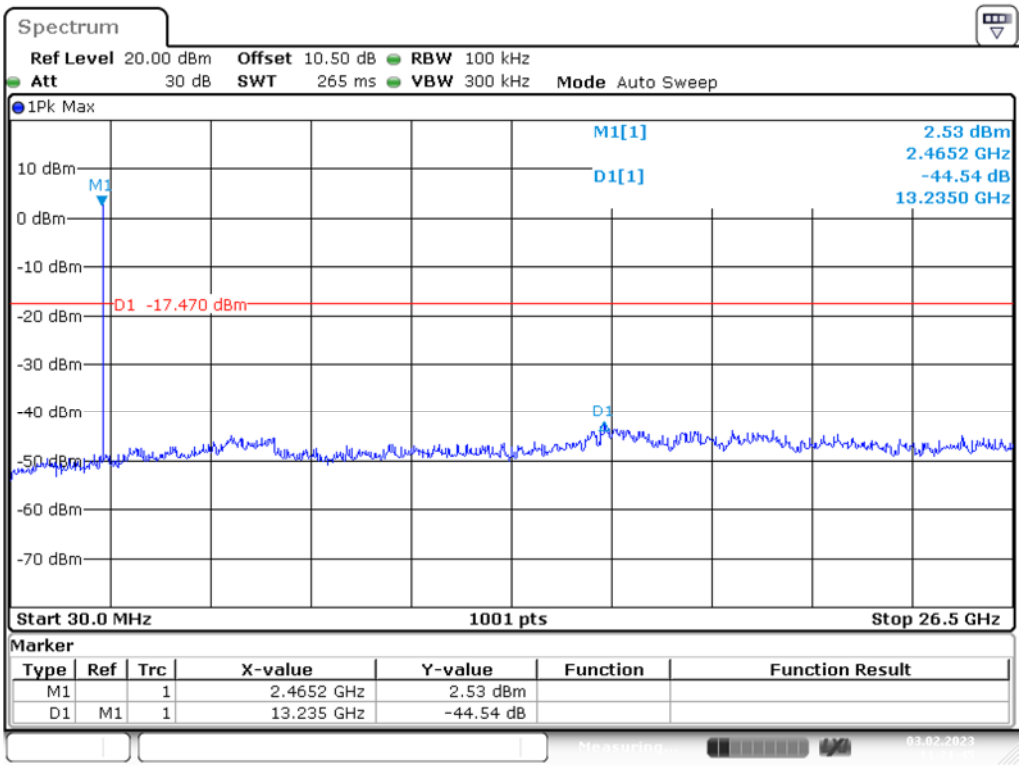


Middle Channel



Date: 3.FEB.2023 11:20:01

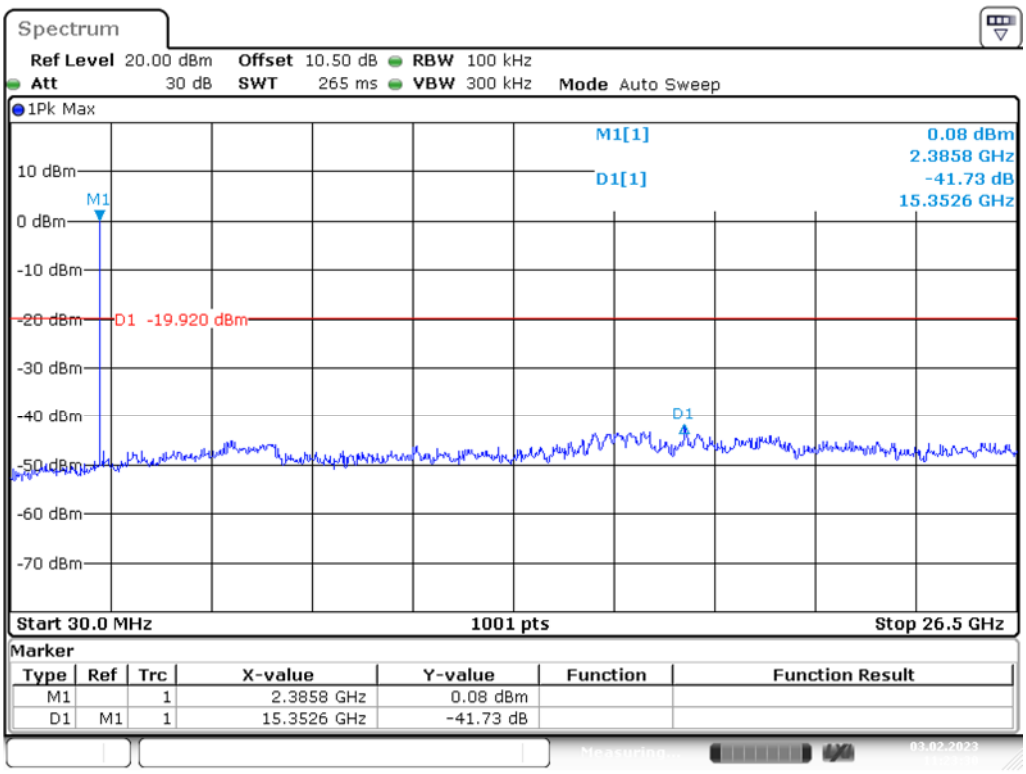
High Channel



Date: 3.FEB.2023 11:21:45

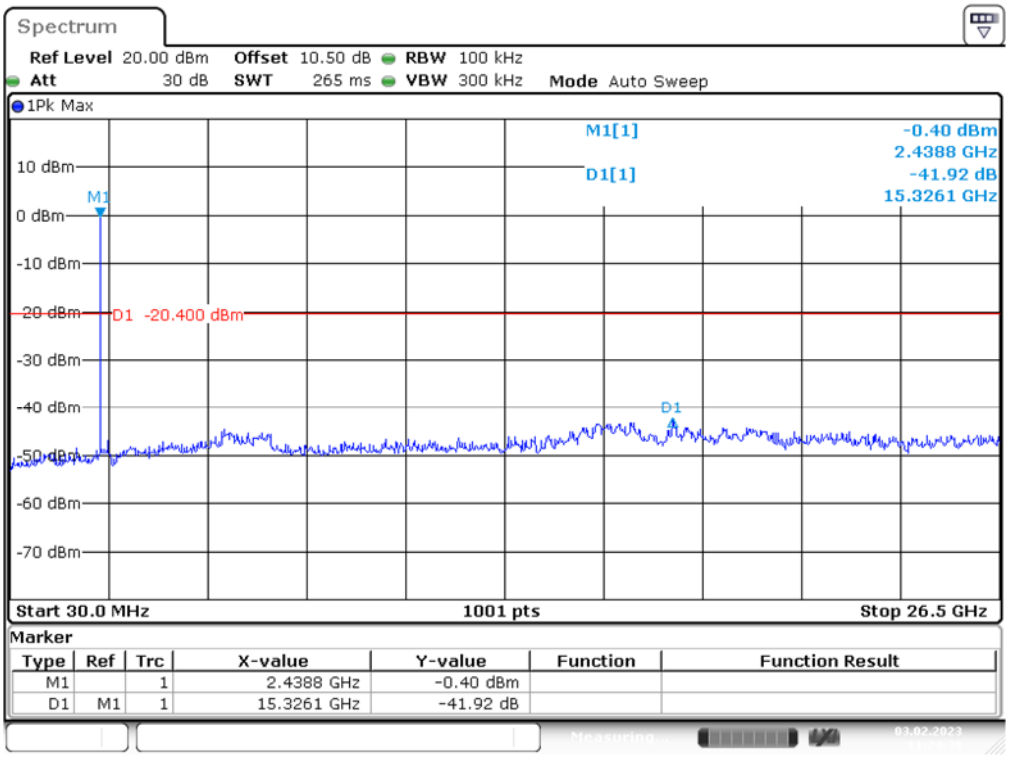
BLE(2M) Mode

Low Channel



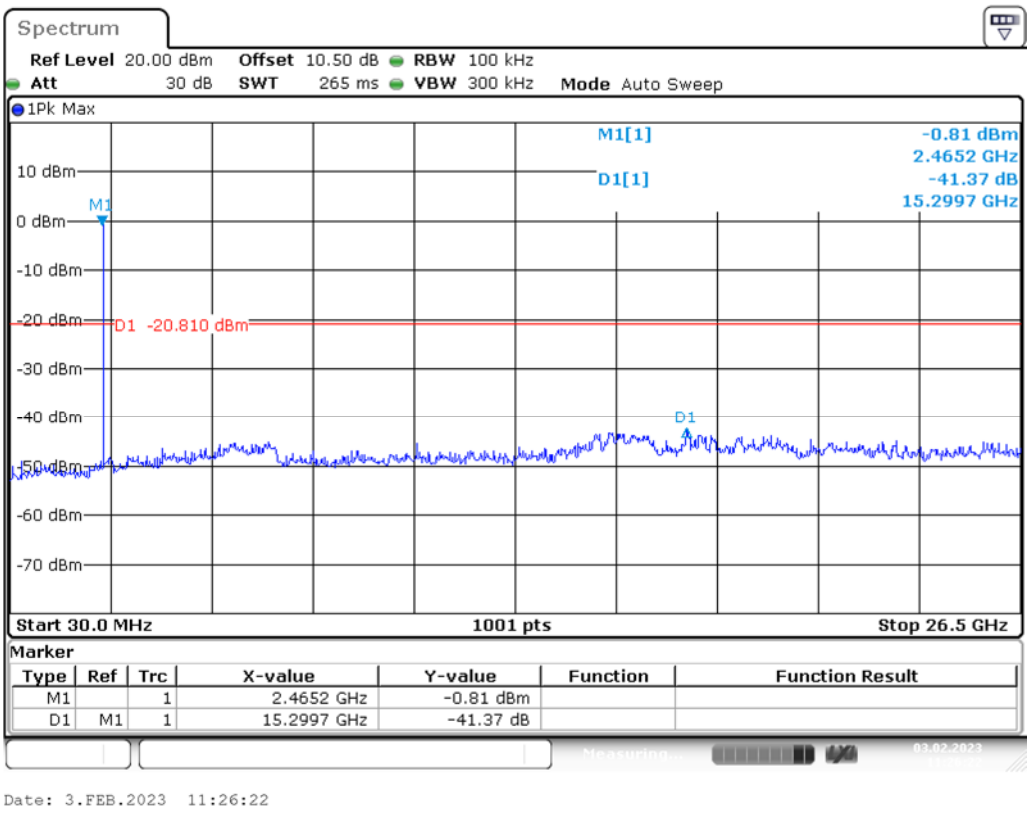
Date: 3.FEB.2023 11:23:30

Middle Channel



Date: 3.FEB.2023 11:24:38

High Channel



10 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

10.1 Applicable Standard

According to FCC §15.247(a)(2).

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

10.2 Test Procedure

According to ANSI C63.10-2013, section 11.8

The steps for the first option are as follows:

a) Set RBW = 100 kHz.

b) Set the VBW ≥ [3 × RBW].

c) Detector = peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

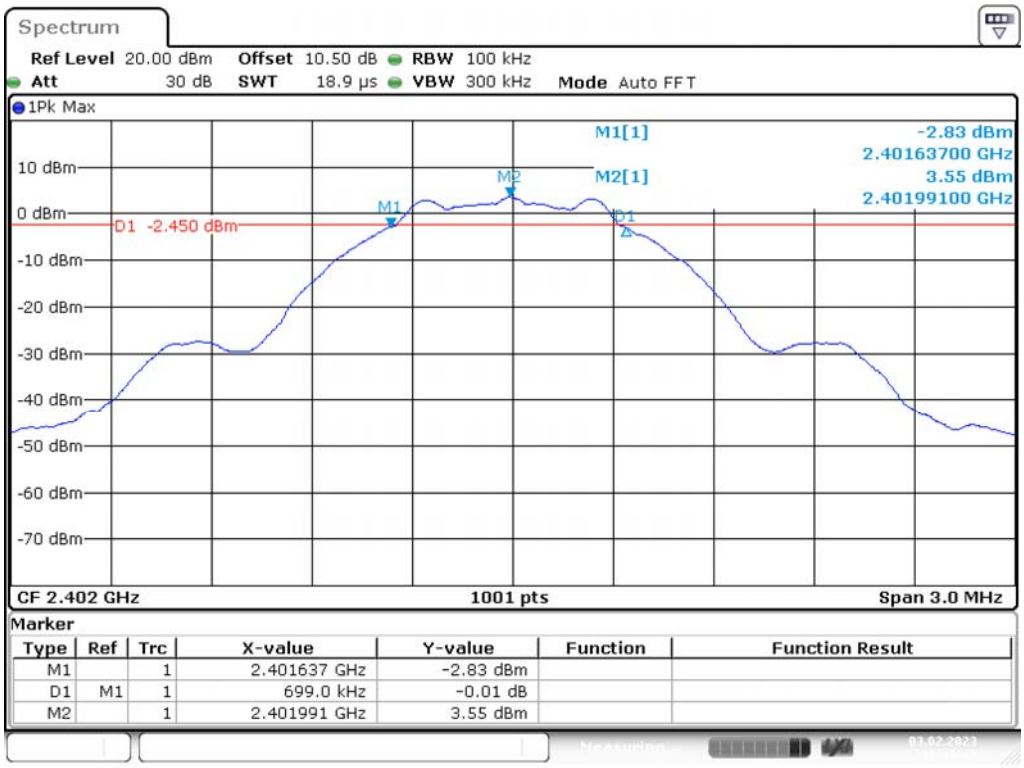
10.3 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	Limit (kHz)	Result
BLE(1M) Mode				
Low	2402	0.70	> 500	Compliance
Middle	2440	0.70	> 500	Compliance
High	2480	0.71	> 500	Compliance
BLE(2M) Mode				
Low	2402	1.19	> 500	Compliance
Middle	2440	1.16	> 500	Compliance
High	2480	1.16	> 500	Compliance

Please refer to the following plots

BLE(1M) Mode

Low Channel



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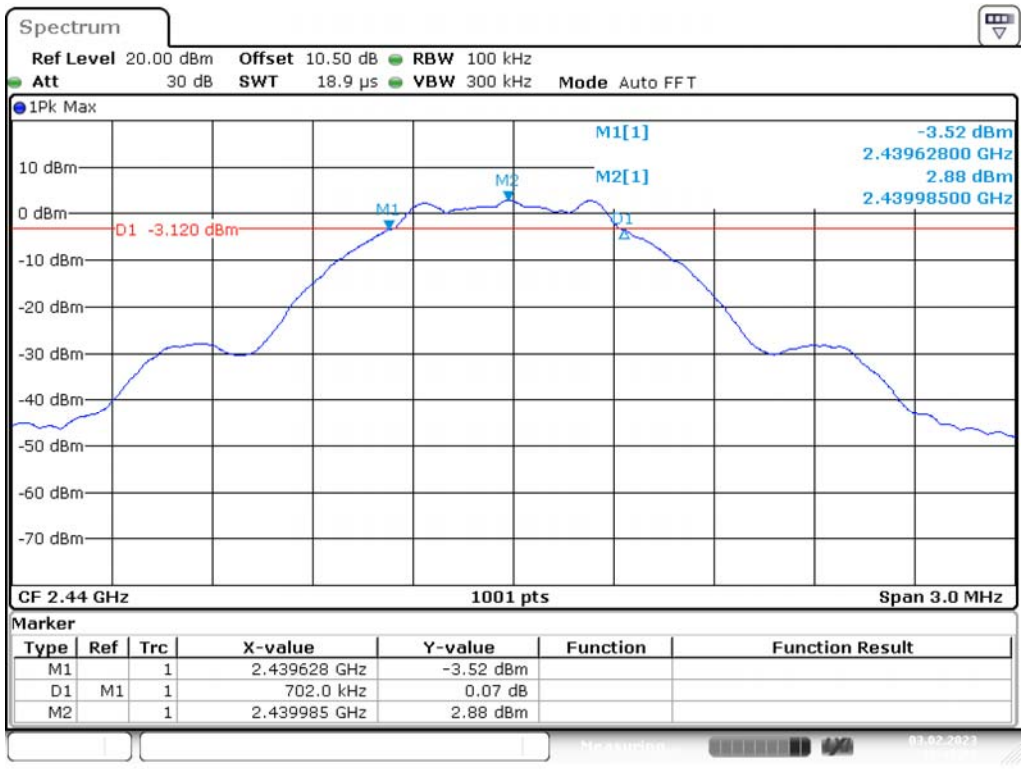
Middle Channel



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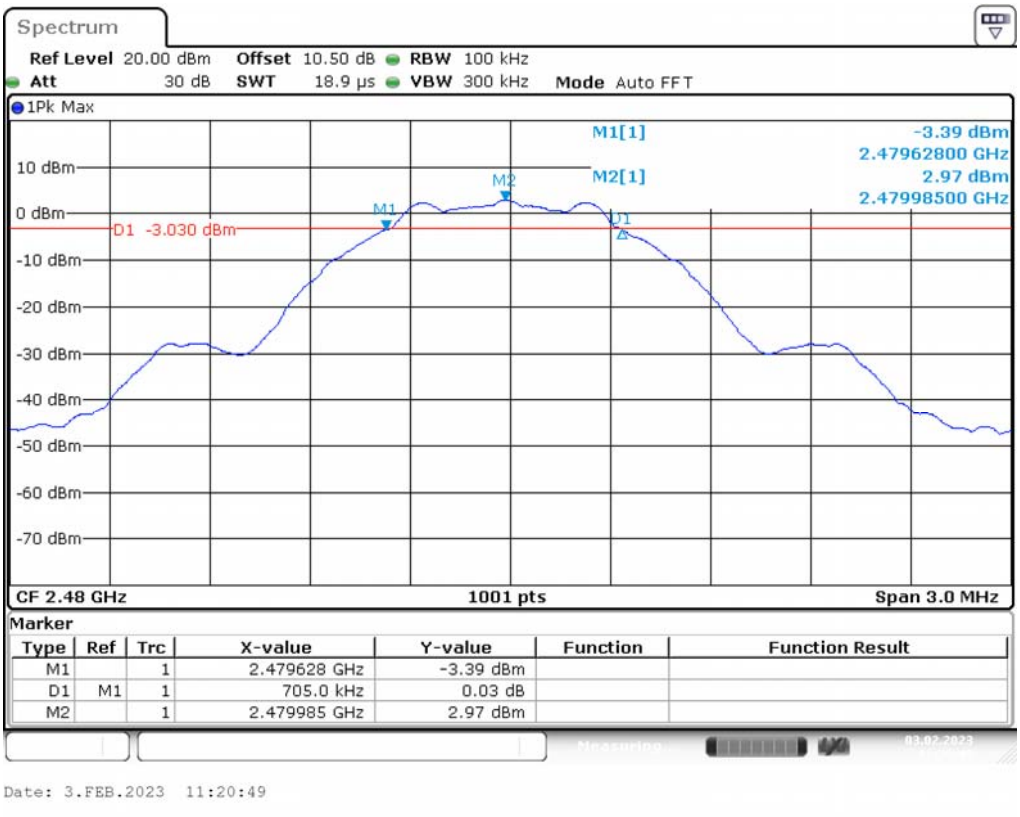
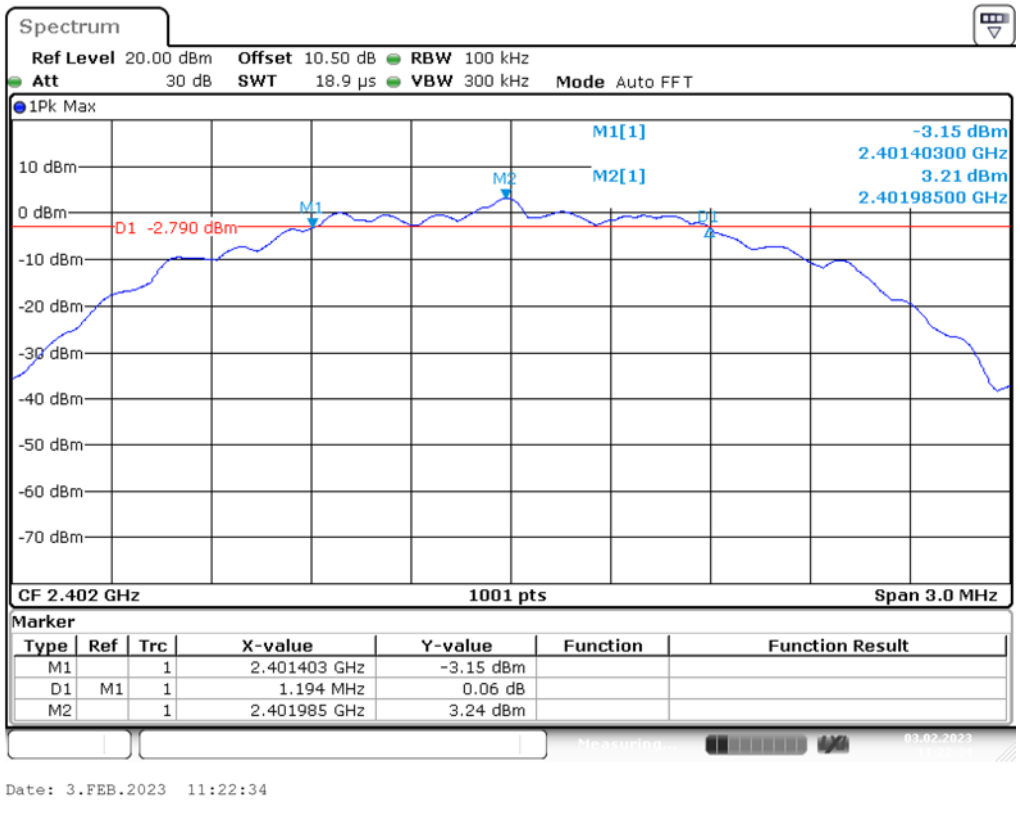
High Channel

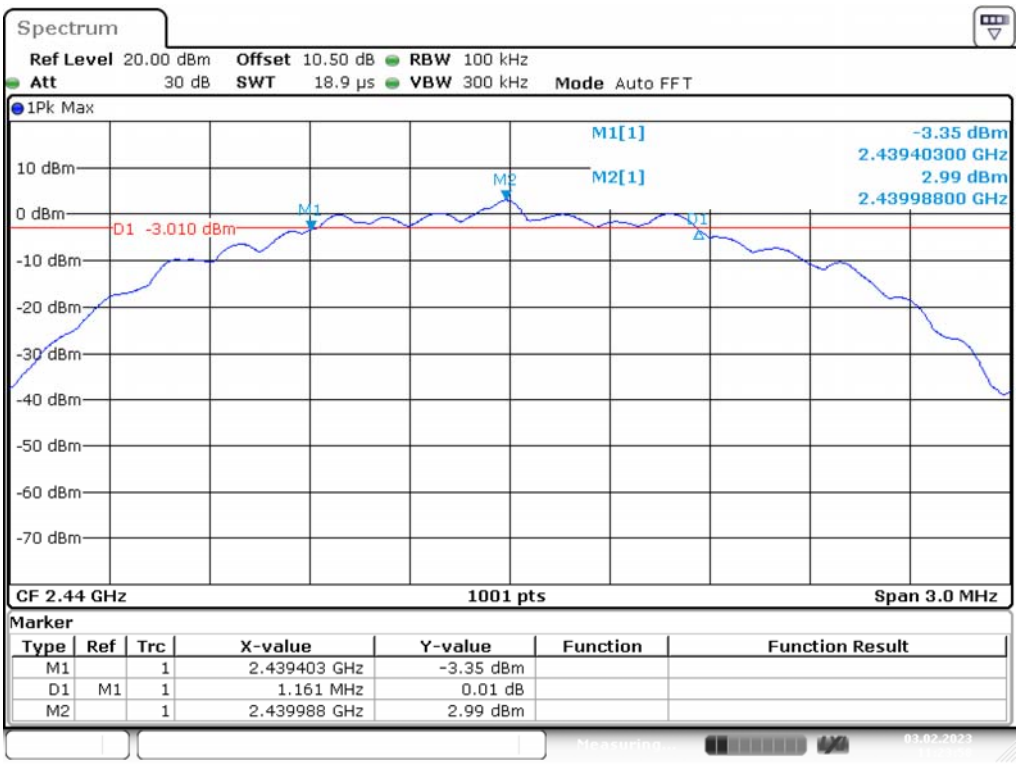


BLE(2M) Mode

Low Channel



Middle Channel



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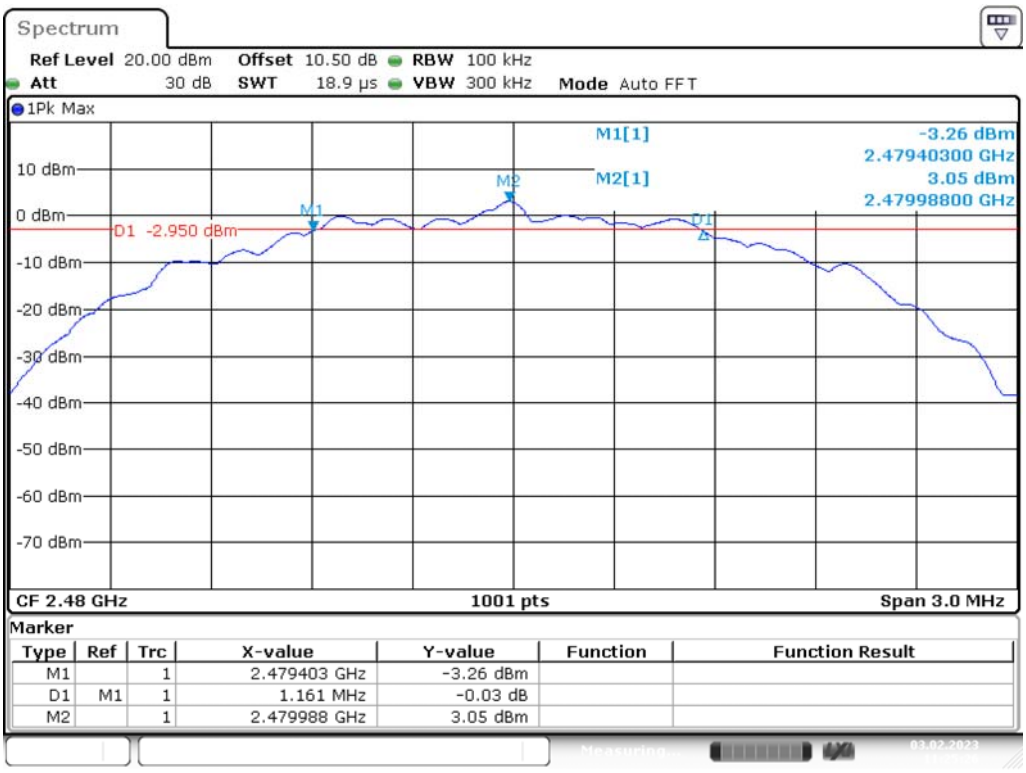
High Channel



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11 FCC §15.247(b)(3) – Maximum Output Power

11.1 Applicable Standard

According to FCC §15.247(b) (3).

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

11.2 Test Procedure

According to ANSI C63.10-2013, section 11.9

1. Place the EUT on a bench and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

11.3 Test Results

Channel	Frequency	Maximum peak Conducted Output Power		Limit	Result
	(MHz)	(dBm)	(W)	(W)	
BLE(1M) Mode					
Low	2402	4.24	0.003	1	PASS
Middle	2440	3.87	0.002	1	PASS
High	2480	3.92	0.002	1	PASS
BLE(2M) Mode					
Low	2402	4.25	0.003	1	PASS
Middle	2440	3.89	0.002	1	PASS
High	2480	3.92	0.002	1	PASS

12 FCC§15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

12.1 Applicable Standard

According to FCC §15.247(d).

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

12.2 Test Procedure

According to ANSI C63.10-2013, section 11.13.3

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.

3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.

4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.

5. Repeat above procedures until all measured frequencies were complete.

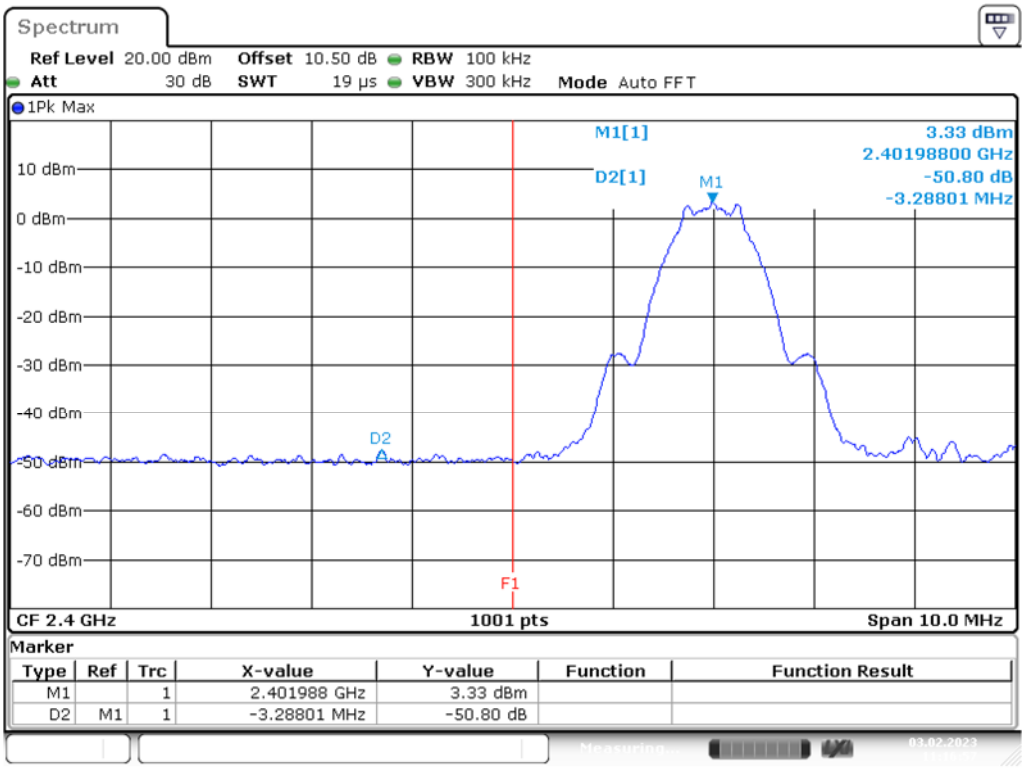
12.3 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE(1M) Mode				
Low	2402	50.80	≥ 20	PASS
High	2480	51.66	≥ 20	PASS
BLE(2M) Mode				
Low	2402	31.81	≥ 20	PASS
High	2480	51.21	≥ 20	PASS

Please refer to the following plots

BLE(1M) Mode

Band Edge, Left Side



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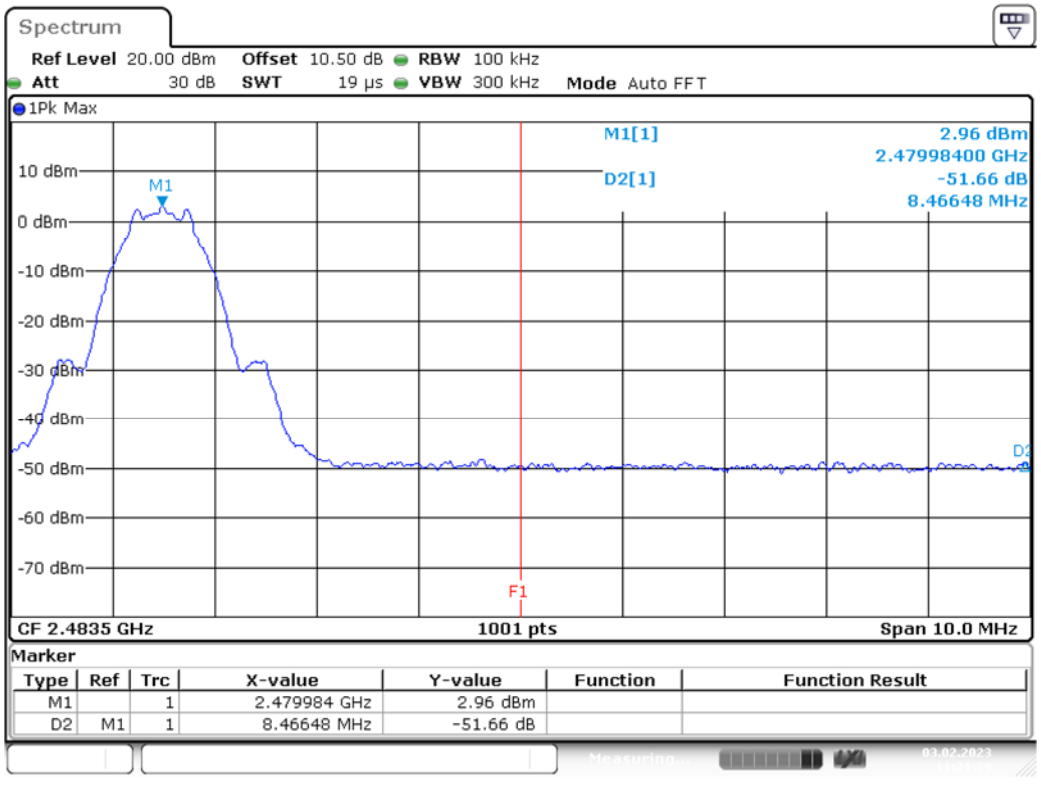
Band Edge, Right Side



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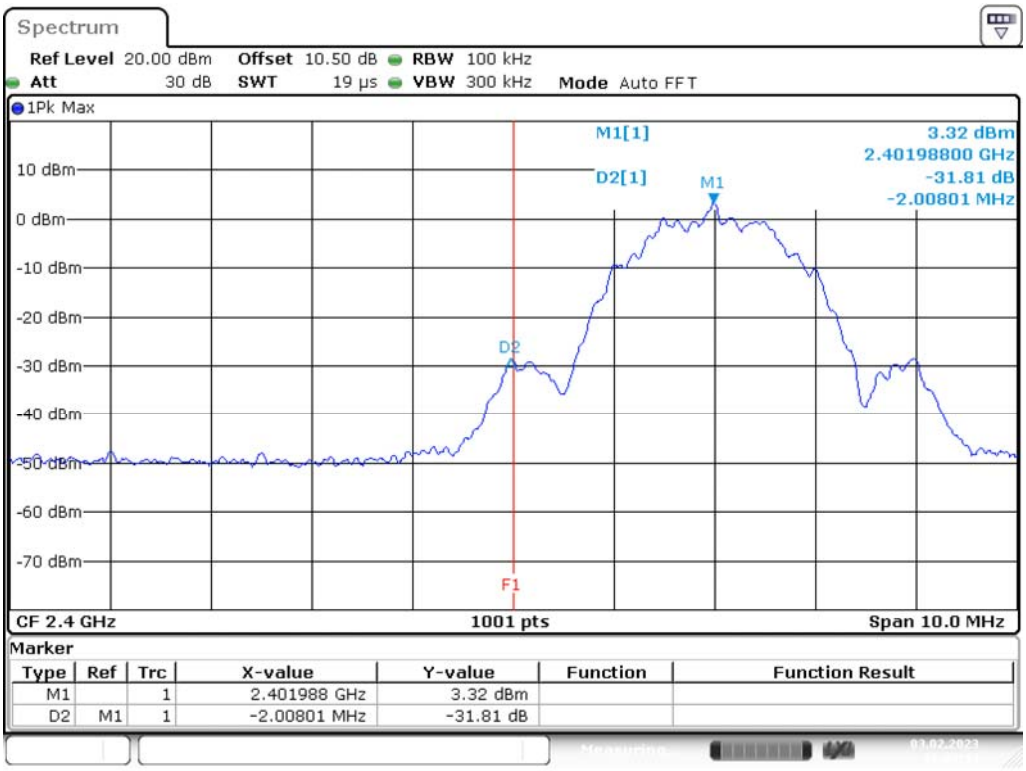
BLE(2M) Mode

Band Edge, Left Side



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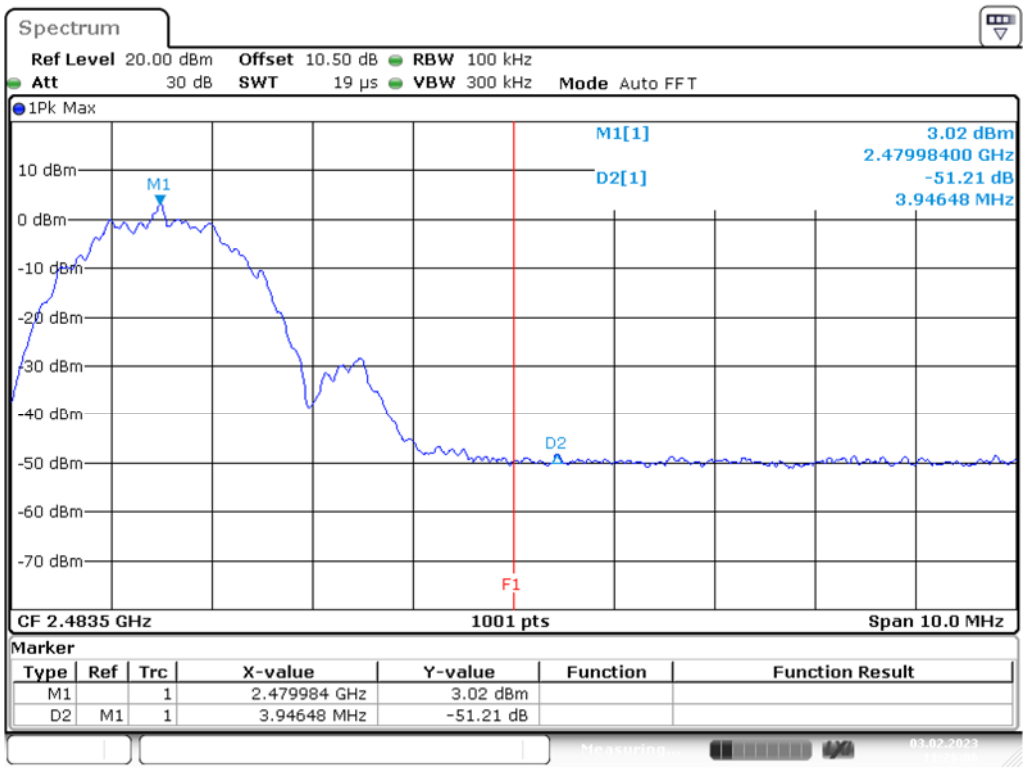
Band Edge, Right Side



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13 FCC §15.247(e) – Power Spectral Density

13.1 Applicable Standard

According to FCC §15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

13.2 Test Procedure

According to ANSI C63.10-2013, section 11.10

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

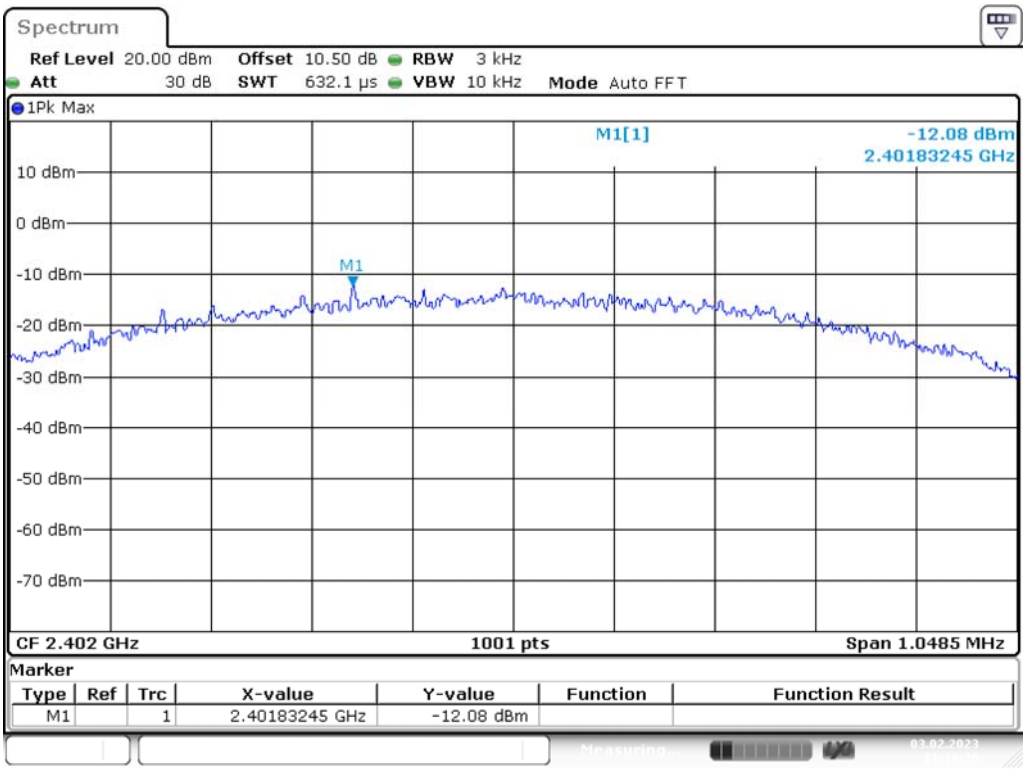
13.3 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
BLE(1M) Mode				
Low	2402	-12.08	8	Compliance
Middle	2440	-13.15	8	Compliance
High	2480	-11.11	8	Compliance
BLE(2M) Mode				
Low	2402	-14.56	8	Compliance
Middle	2440	-15.23	8	Compliance
High	2480	-15.31	8	Compliance

Please refer to the following plots

BLE(1M) Mode

Low Channel



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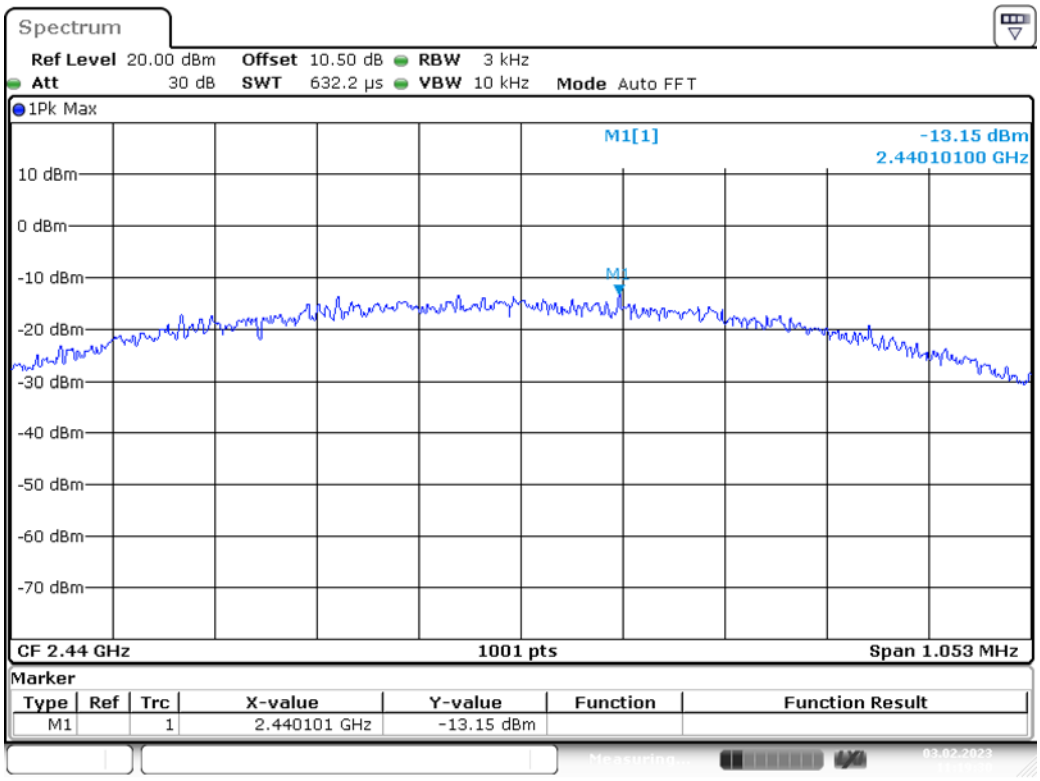
Middle Channel



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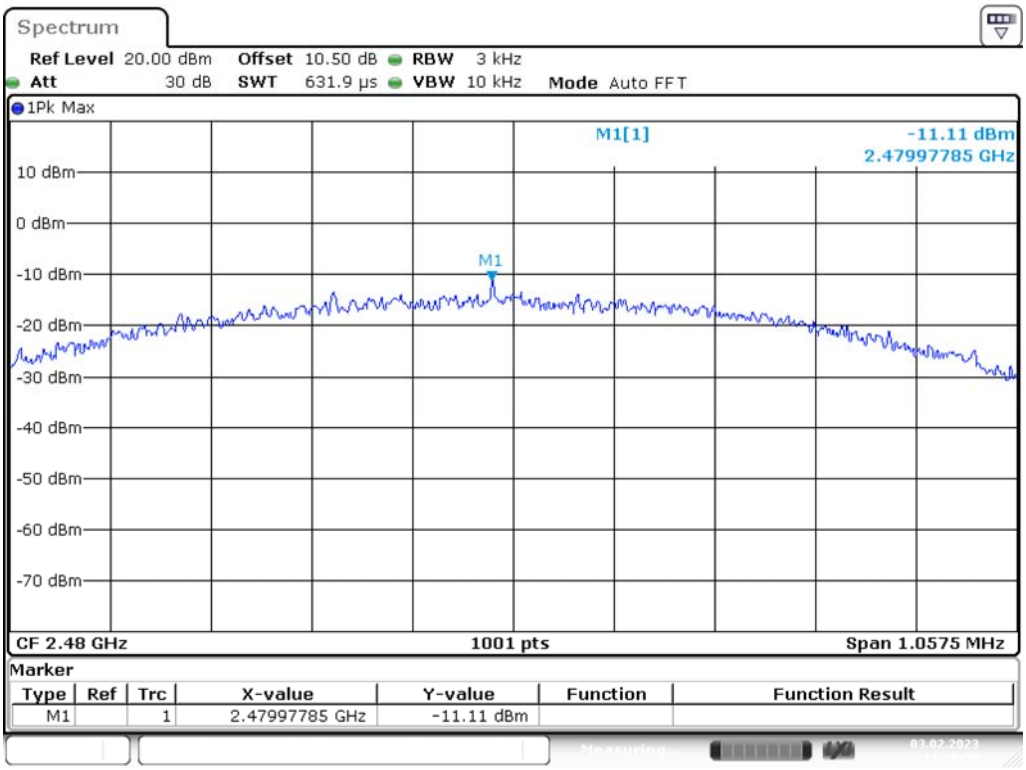
High Channel



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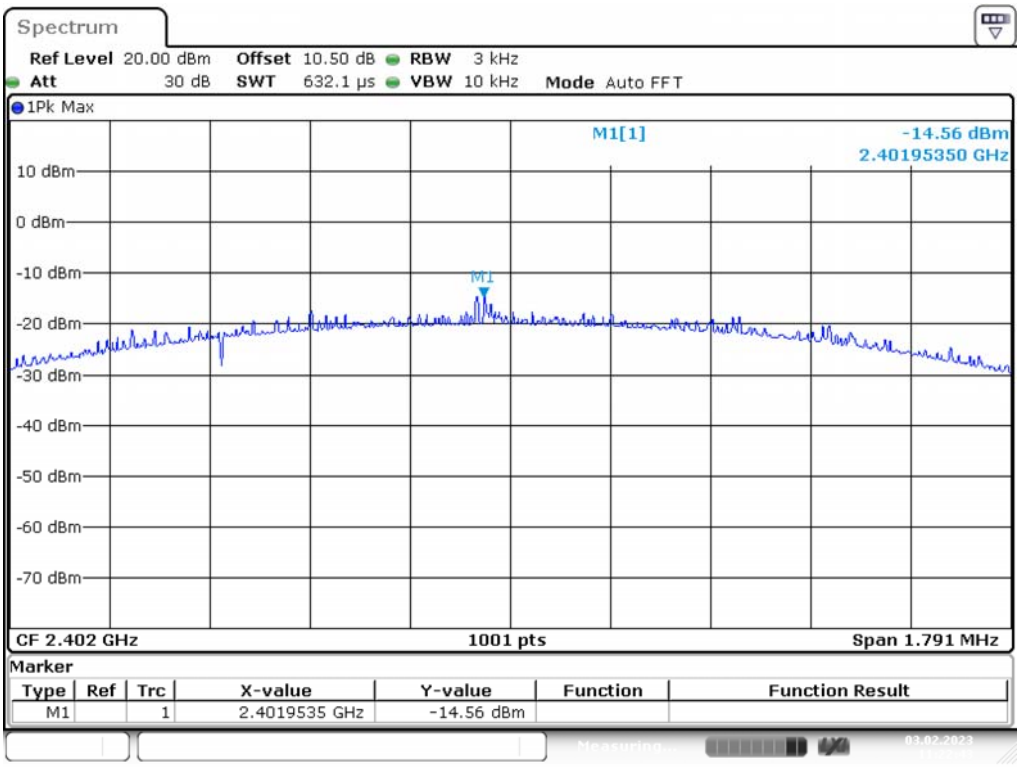
BLE(2M) Mode

Low Channel



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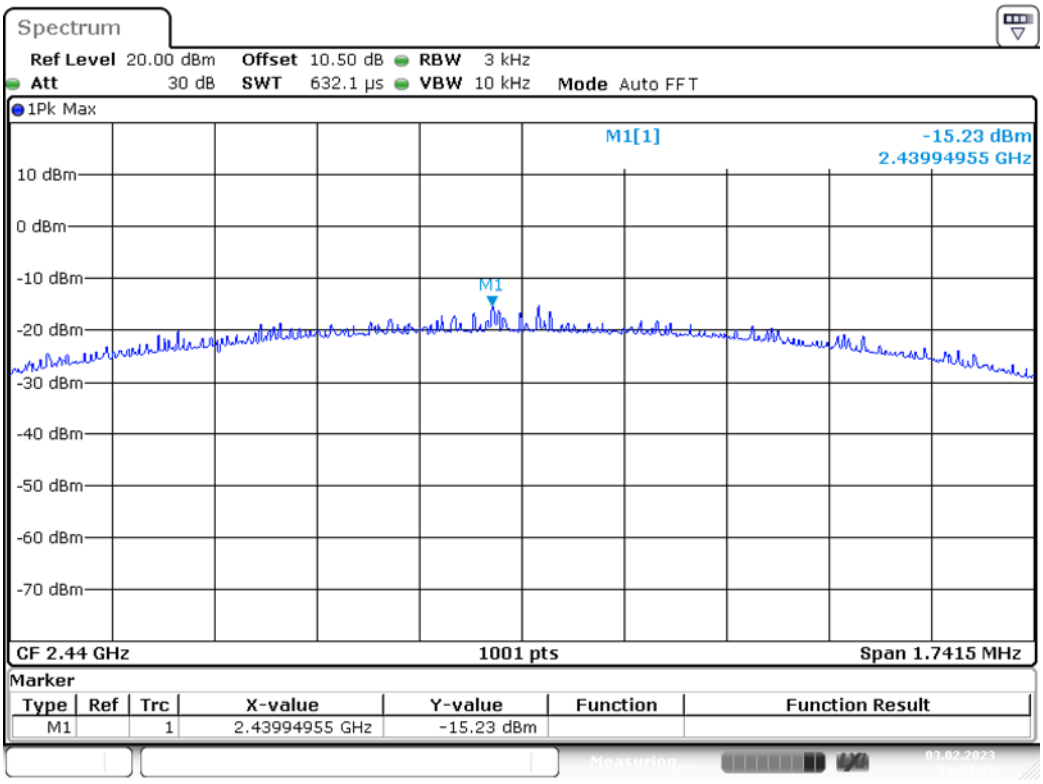
Middle Channel



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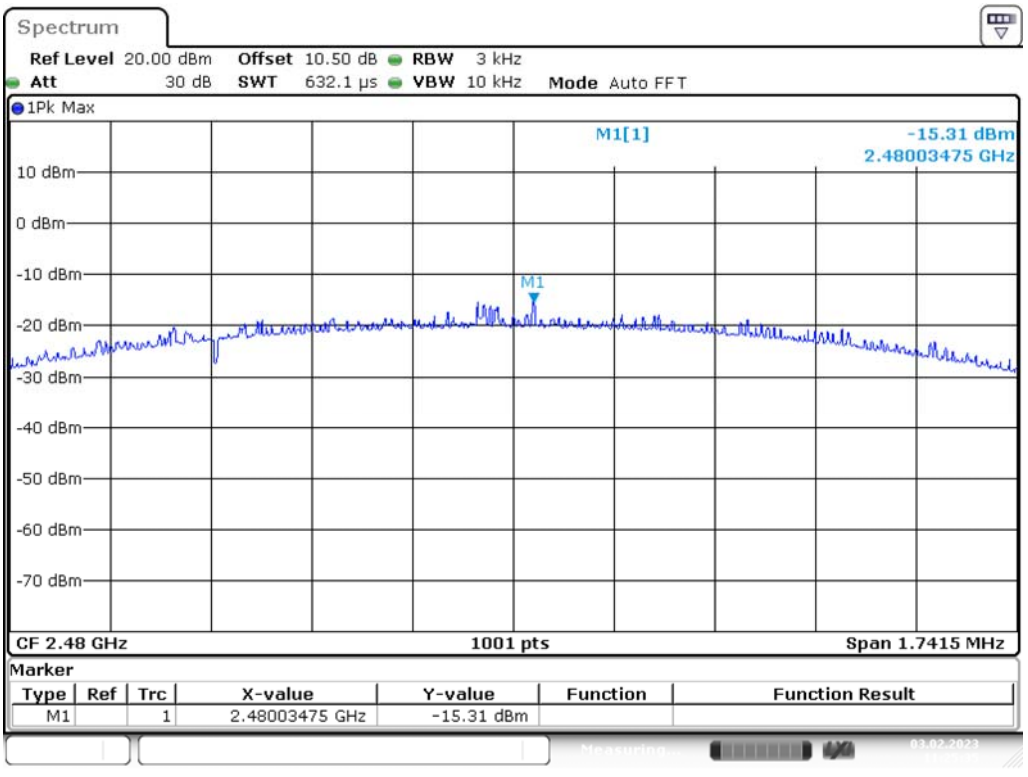
High Channel



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