

**FCC Part 15.247**  
**RSS-247, ISSUE 3, August 2023**  
**RSS-GEN, ISSUE 5, February 2021 Amendment 2**  
**TEST REPORT**

For

**YOFREE TECHNOLOGY CO., LTD.**

5 F., No. 753, Zhongzheng Rd., Zhonghe Dist., New Taipei City 23552, Taiwan (R.O.C.)

**FCC ID: 2BFPDYFBT30M**  
**IC: 32421-YFBT30M**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Bluetooth Module
<b>Report Producer :</b> <u>Coco Lin</u>	
<b>Report Number :</b> <u>RXZ240403016RF03</u>	
<b>Report Date :</b> <u>2024-06-05</u>	
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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RXZ240403016	RXZ240403016RF03	2024-06-05	Original Report	Coco Lin

## **TABLE OF CONTENTS**

<b>1</b>	<b>General Information .....</b>	<b>5</b>
1.1	Product Description for Equipment under Test (EUT) .....	5
1.2	Objective .....	6
1.3	Test Methodology.....	6
1.4	Statement.....	6
1.5	Measurement Uncertainty .....	7
1.6	Environmental Conditions.....	7
1.7	Test Facility .....	7
<b>2</b>	<b>System Test Configuration.....</b>	<b>8</b>
2.1	Description of Test Configuration.....	8
2.2	Equipment Modifications .....	8
2.3	EUT Exercise Software .....	8
2.4	Support Equipment List and Details.....	8
2.5	External Cable List and Details .....	8
2.6	Block Diagram of Test Setup .....	9
2.7	Duty Cycle.....	10
<b>3</b>	<b>Summary of Test Results.....</b>	<b>12</b>
<b>4</b>	<b>Test Equipment List and Details .....</b>	<b>13</b>
<b>5</b>	<b>FCC §15.247(i), §1.1307(b)(3) - RF Exposure .....</b>	<b>14</b>
5.1	Applicable Standard .....	14
5.2	RF Exposure Evaluation Result .....	15
<b>6</b>	<b>RSS-102 §2.5.2 - EXEMPTION FROM ROUTINE EVALUATION LIMITS – RF EXPOSURE EVALUATION .....</b>	<b>16</b>
6.1	Applicable Standard .....	16
6.2	RF Exposure Evaluation Result .....	16
<b>7</b>	<b>FCC §15.203 &amp; RSS-GEN §6.8– Antenna Requirements .....</b>	<b>17</b>
7.1	Applicable Standard .....	17
7.2	Antenna Information .....	17
<b>8</b>	<b>FCC §15.207(a) &amp; RSS-GEN §8.8– AC Line Conducted Emissions.....</b>	<b>18</b>
8.1	Applicable Standard.....	18
8.2	EUT Setup.....	19
8.3	EMI Test Receiver Setup .....	19
8.4	Test Procedure .....	19
8.5	Corrected Factor & Over Limit Calculation .....	19
8.6	Test Results .....	20
<b>9</b>	<b>FCC §15.209, §15.205, §15.247(d) &amp; RSS-247 §5.5, RSS-GEN §8.9, §8.10 – Spurious Emissions.....</b>	<b>21</b>
9.1	Applicable Standard.....	21
9.2	EUT Setup.....	23
9.3	EMI Test Receiver & Spectrum Analyzer Setup.....	24
9.4	Test Procedure.....	24
9.5	Corrected Factor & Margin Calculation .....	25
9.6	Test Results .....	25
<b>10</b>	<b>FCC §15.247(a)(2) &amp; RSS-247 §5.2(a), RSS-GEN §6.7 – 6 dB Emission Bandwidth &amp; Occupied Bandwidth.....</b>	<b>37</b>

10.1	Applicable Standard.....	37
10.2	Test Procedure.....	37
10.3	Test Results .....	38
11	FCC §15.247(b)(3) & RSS-247 §5.4(d) – Maximum Output Power.....	45
11.1	Applicable Standard.....	45
11.2	Test Procedure.....	45
11.3	Test Results .....	46
12	FCC §15.247(d) & RSS-247 §5.5 – 100 kHz Bandwidth of Frequency Band Edge	47
12.1	Applicable Standard.....	47
12.2	Test Procedure.....	47
12.3	Test Results .....	48
13	FCC §15.247(e) & RSS-247 §5.2(b) – Power Spectral Density .....	51
13.1	Applicable Standard.....	51
13.2	Test Procedure.....	51
13.3	Test Results .....	52

1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	YOFREE TECHNOLOGY CO., LTD.
	5 F., No. 753, Zhongzheng Rd., Zhonghe Dist., New Taipei City 23552, Taiwan (R.O.C.)
Brand(Trade) Name	Yofree
Product (Equipment) / PMN	Bluetooth Module
Main Model Name / HVIN	YFBT30M
Frequency Range	BLE(1M) / BLE(2M) : 2402 ~ 2480 MHz
Maximum Conducted Peak Output Power	BLE(1M) Mode : 1.35 dBm BLE(2M) Mode : 1.37 dBm
Modulation Technique	BLE(1M) / BLE(2M) : GFSK
Transmit Data Rate	BLE(1M) Mode : 1 Mbps BLE(2M) Mode : 2 Mbps
Power Operation (Voltage Range)	<input checked="" type="checkbox"/> DC 3.3V <input type="checkbox"/> Battery <input checked="" type="checkbox"/> DC Power Supply <input type="checkbox"/> External from USB Cable <input type="checkbox"/> External DC Adapter
Received Date	2024/04/03
Date of Test	2024/04/03 ~ 2024/04/23

\*All measurement and test data in this report was gathered from production sample serial number:  
RXZ240403016-1 (Assigned by BACL, New Taipei Laboratory).

## 1.2 Objective

This report is prepared on behalf of *YOFREE TECHNOLOGY CO., LTD.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules and RSS-247, Issue 3, August 2023, RSS-Gen, Issue 5, February 2021 Amendment 2 of the Innovation, Science and Economic Development Canada.

## 1.3 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 and KDB 558074 D01 15.247 Meas Guidance v05r02. And RSS-247, Issue 3, August 2023, RSS-Gen, Issue 5, February 2021 Amendment 2 of the Innovation, Science and Economic Development Canada.

## 1.4 Statement

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

It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory).

Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

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.

### 1.5 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 3.02 dB
RF output power, conducted		+/- 0.57 dB
Power Spectral Density, conducted		+/- 0.60 dB
Occupied Bandwidth		+/- 0.09 %
Unwanted Emissions, conducted		+/- 1.09 dB
Emissions, radiated	9 kHz~30 MHz	+/- 3.20 dB
	30 MHz~1 GHz	+/- 3.30 dB
	1 GHz~18 GHz	+/- 5.14 dB
	18 GHz~40 GHz	+/- 4.75 dB
Temperature		+/- 0.76 °C
Humidity		+/- 0.41 %

*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.*

### 1.6 Environmental Conditions

Test Site	Test Date	Temperature (°C)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2024/04/11	23.1	55	1010	Jing Chang
Radiation Spurious Emissions	2024/04/23	24.5	65	1010	Jim Chen
Conducted Spurious Emissions	2024/04/23	24.8	51	1010	Jim Chen
Emission Bandwidth	2024/04/23	24.8	51	1010	Jim Chen
Maximum Output Power	2024/04/23	24.8	51	1010	Jim Chen
100 kHz Bandwidth of Frequency Band Edge	2024/04/23	24.8	51	1010	Jim Chen
Power Spectral Density	2024/04/23	24.8	51	1010	Jim Chen

### 1.7 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 221, 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 lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: TW3732.

## 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.

### 2.2 Equipment Modifications

No modification was made to the EUT.

### 2.3 EUT Exercise Software

The test software was used “nRF\_DTM v0.10.2”

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

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

### 2.4 Support Equipment List and Details

Description	Manufacturer	Model Number
NB	DELL	E6410
Fixture	Waveshare	FT232
Fixture Board	Nordic Semiconductor	1 90658A_Y322

### 2.5 External Cable List and Details

Description	Manufacturer	Cable length
Micro USB	BACL	1M

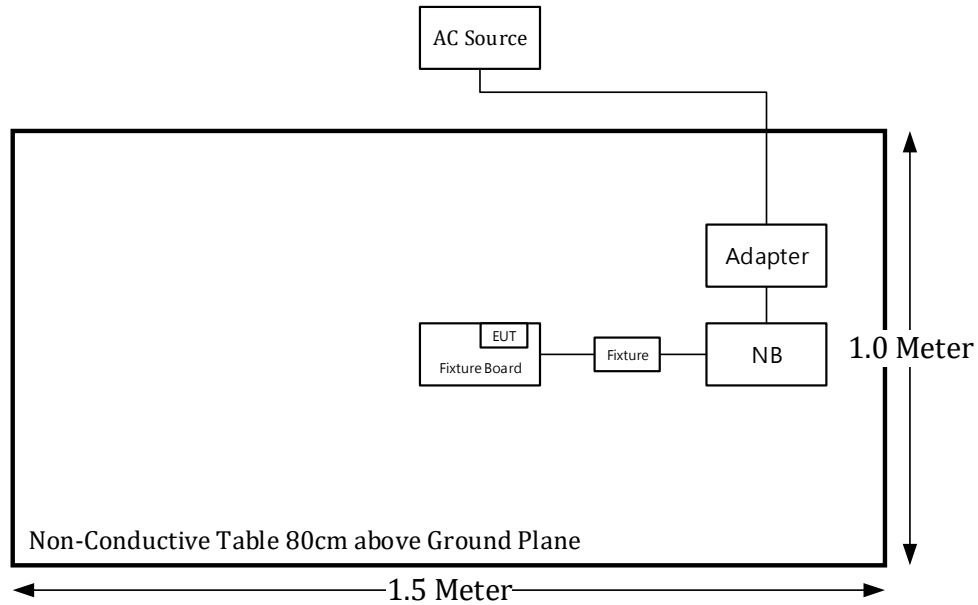


## 2.6 Block Diagram of Test Setup

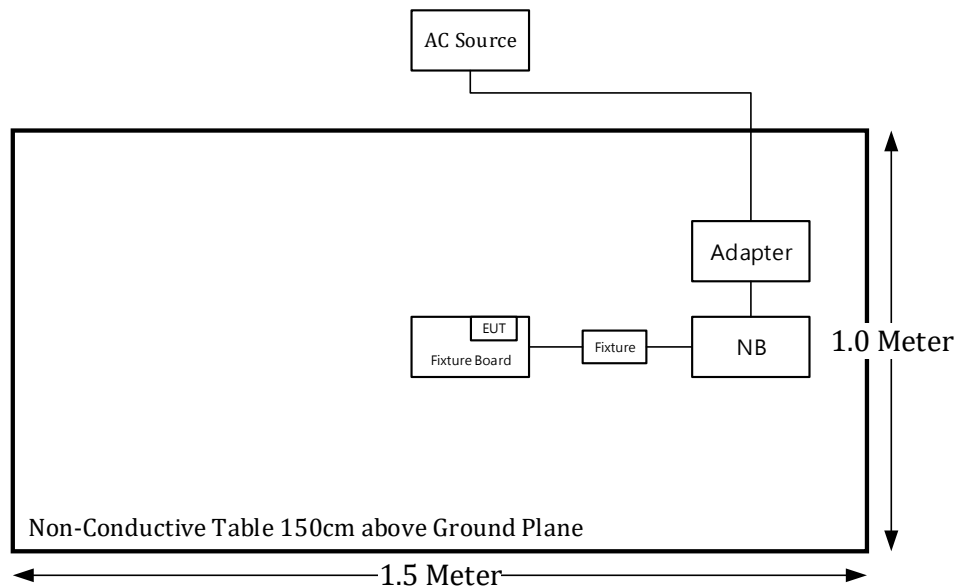
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

### Radiation:

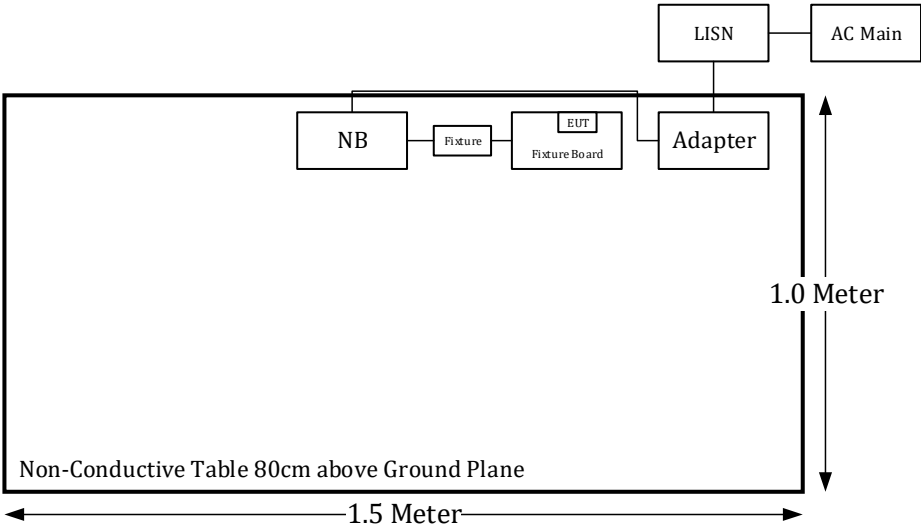
Below 1GHz



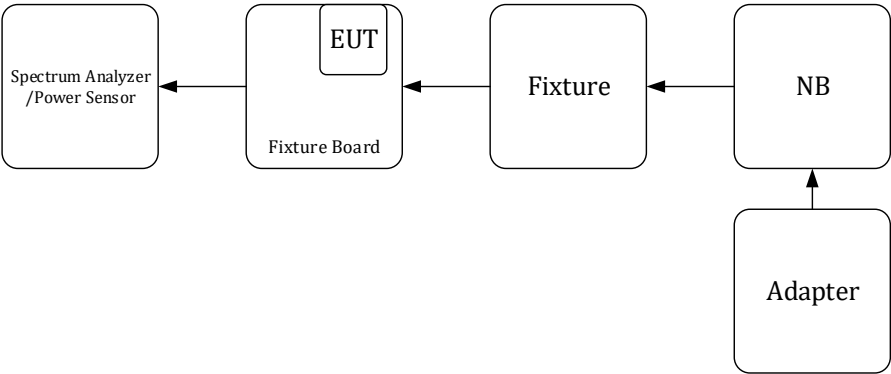
Above 1GHz:



Conduction:



Conducted:



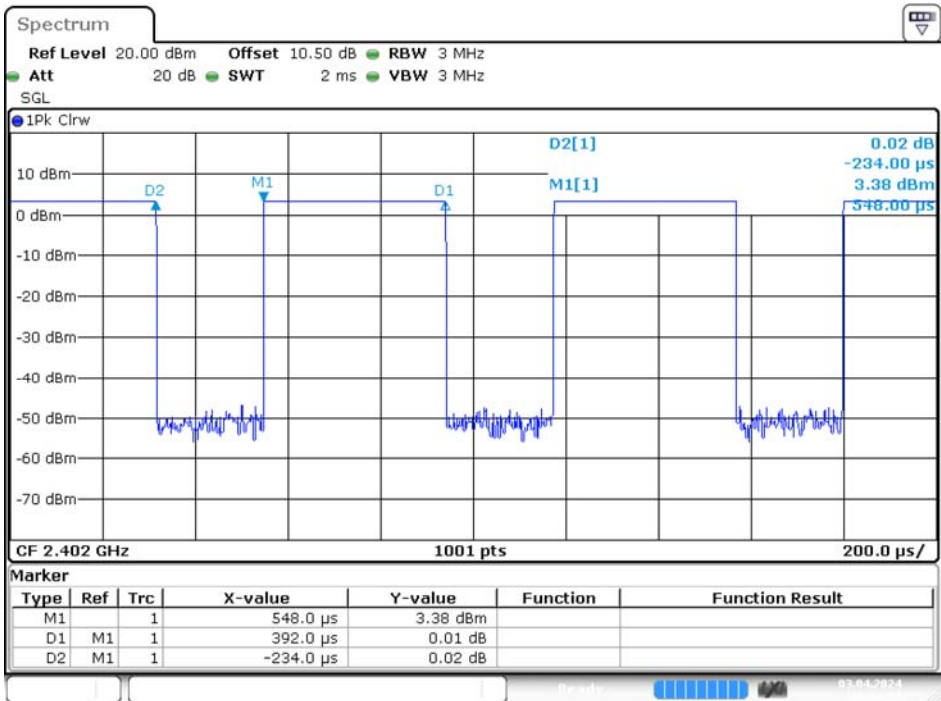
2.7 Duty Cycle

The duty cycle as below:

Radio Mode	On Time (ms)	Off Time (ms)	Duty Cycle (%)	1/T (kHz)	VBW Setting (kHz)
BLE(1M)	0.392	0.234	0.63	2.55	3
BLE(2M)	0.308	0.316	0.49	3.25	5

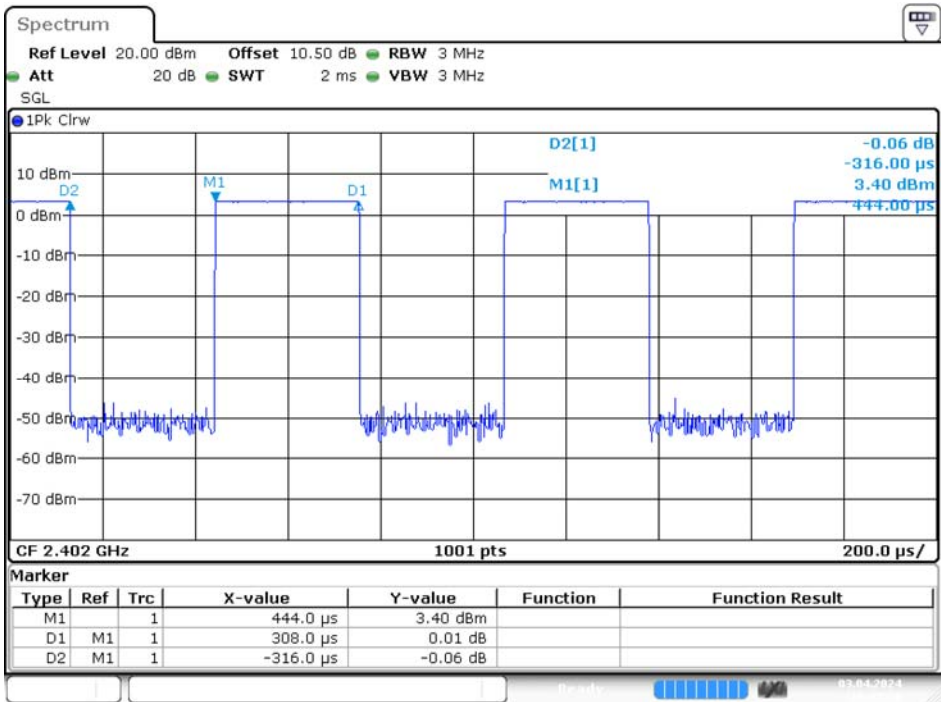
Please refer to the following plots.

BLE(1M) Mode



Date: 3.APR.2024 18:44:27

BLE(2M) Mode



Date: 3.APR.2024 18:45:30

### 3 Summary of Test Results

Rules	Description of Test	Results
FCC §15.247(i), §1.1307(b)(3)	RF Exposure	Compliance
RSS-102 §2.5.2	Exemption From Routine Evaluation Limits – RF Exposure Evaluation	Compliance
FCC §15.203 RSS-Gen §6.8	Antenna Requirement	Compliance
FCC §15.207(a) RSS-Gen §8.8	AC Line Conducted Emissions	Compliance
FCC §15.205, §15.209, §15.247(d) RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Spurious Emissions	Compliance
FCC §15.247(a)(2) RSS-247 §5.2(a) RSS-Gen §6.7	Emission Bandwidth	Compliance
FCC §15.247(b)(3) RSS-247 §5.4(d)	Maximum Peak Output Power	Compliance
FCC §15.247(d) RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliance
FCC §15.247(e) RSS-247 §5.2(b)	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	101612	2024/2/16	2025/2/14
EMI Test Receiver	Rohde & Schwarz	ESW8	100947	2023/5/22	2024/5/21
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2023/5/18	2024/5/16
RF Cable	EMEC	EM-CB5D	001	2023/6/6	2024/6/6
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiation Room (966-A)					
Active Loop Antenna	ETS-Lindgren	6502	35796	2024/3/27	2025/3/26
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/1554_2_01	2024/1/19	2025/1/17
Horn Antenna	EMCO	SAS-571	1020	2023/5/18	2024/5/16
Horn Antenna	ETS-Lindgren	3116	62638	2023/8/25	2024/8/23
Preamplifier	Sonoma	310N	130602	2023/6/16	2024/6/14
Preamplifier	Channel	ERA-100M-18G-01D1748	EC2300051	2024/3/29	2025/3/28
Preamplifier	EM Electronics Corporation	EM18G40G	60656	2024/1/8	2025/1/6
Spectrum Analyzer	Rohde & Schwarz	FSV40	101939	2024/3/27	2025/3/26
EMI Test Receiver	Rohde & Schwarz	ESR3	102099	2023/6/16	2024/6/14
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2024/1/23	2025/1/21
Coaxial Cable	COMMATE	PEWC	8Dr	2023/12/23	2024/12/22
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2024/1/23	2025/1/21
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2023/12/23	2024/12/22
Cable	EMC	EMC105-SM-SM-10000	201003	2024/1/23	2025/1/21
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2024/1/23	2025/1/21
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2024/1/23	2025/1/21
Band-stop filter	Woken	STI15-9831	STI15-9831-1	2023/10/20	2024/10/19
High-pass filter	XINGBOKEJI	XBLBQ-GTA54	200108-3-2	2023/10/20	2024/10/19
Software	AUDIX	E3	18621a	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101204	2023/5/30	2024/5/28
Cable	UTIFLEX	UFA210A	9435	2023/10/2	2024/9/30
Power Sensor	Boonton	RTP5006	11037	2023/5/23	2024/5/21
Attenuator	MCL	BW-S10W5+	1419	2024/2/23	2025/2/21

**\*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.

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

## 5 FCC §15.247(i), §1.1307(b)(3) - RF Exposure

### 5.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1307(b)(3), 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  $P_{th}$  (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).  $P_{th}$  is given by:

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

Where

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

and

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

(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  $\lambda/2\pi$ , where  $\lambda$  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  $\lambda/4$  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	$0.0128 R^2 f$ .
1,500-100,000	$19.2 R^2$ .

## 5.2 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)
BLE	2402	1.5	-0.209	200	1.41	-0.859	0.82

§ 1.1307(b)(3)(i)(A) method is not applicable.

Band	Freq (MHz)	$\lambda/2\pi$ (mm)	Distances applies	ERP Limit (mW)	Result Option C
BLE	2402	19.88	apply	768.00	exempt

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.

ERP (watts) is no more than the calculated value prescribed for that frequency

R must be at least  $\lambda/2\pi$

$\lambda$  is the free-space operating wavelength in meters

**Result: The device compliant the exemption at 20cm distances.**

## 6 RSS-102 §2.5.2 - EXEMPTION FROM ROUTINE EVALUATION LIMITS – RF EXPOSURE EVALUATION

### 6.1 Applicable Standard

According to RSS-102 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz<sup>Footnote6</sup> and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $4.49/f^{0.5}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f^{0.6834}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

### 6.2 RF Exposure Evaluation Result

Tune-up power = 1.5 dBm

EIRP Tune-up power = 1.291 dBm = 0.001 W

Exemption from Routine Evaluation Limit is:

$$1.31 \times 10^{-2} f^{0.6834} = 1.31 \times 10^{-2} 2402^{0.6834} = 2.68\text{W} > 0.001 \text{ W}$$

**Result: The device meets the exemption requirement.**



## 7 FCC §15.203 & RSS-GEN §6.8– 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.

According to RSS-Gen 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list. For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type

### 7.2 Antenna Information

Manufacturer	Model	Type	Antenna Gain	Impedance
ONEWAVE	WAN3216F245W36	Chip Antenna	-0.209 dBi	50Ω

The antenna is permanently attached to the device.

### Result: Compliance

## 8 FCC §15.207(a) & RSS-GEN §8.8– 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  $\mu$ H/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.

According to RSS-GEN §8.8

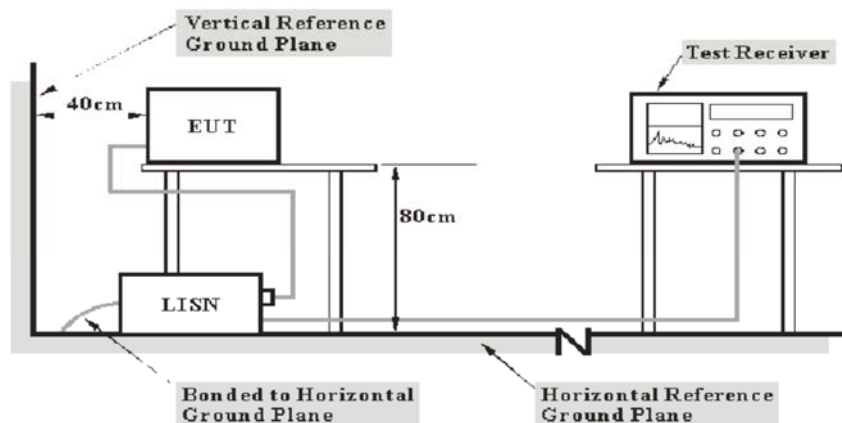
Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50  $\mu$ H / 50  $\Omega$  line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

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

*Note 1: Decreases with the logarithm of the frequency.*

## 8.2 EUT Setup



Note: 1. Support units were connected to second LISN.  
2. Both of LISNs (AMIN) 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 and RSS-GEN 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

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 & Over Limit 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:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

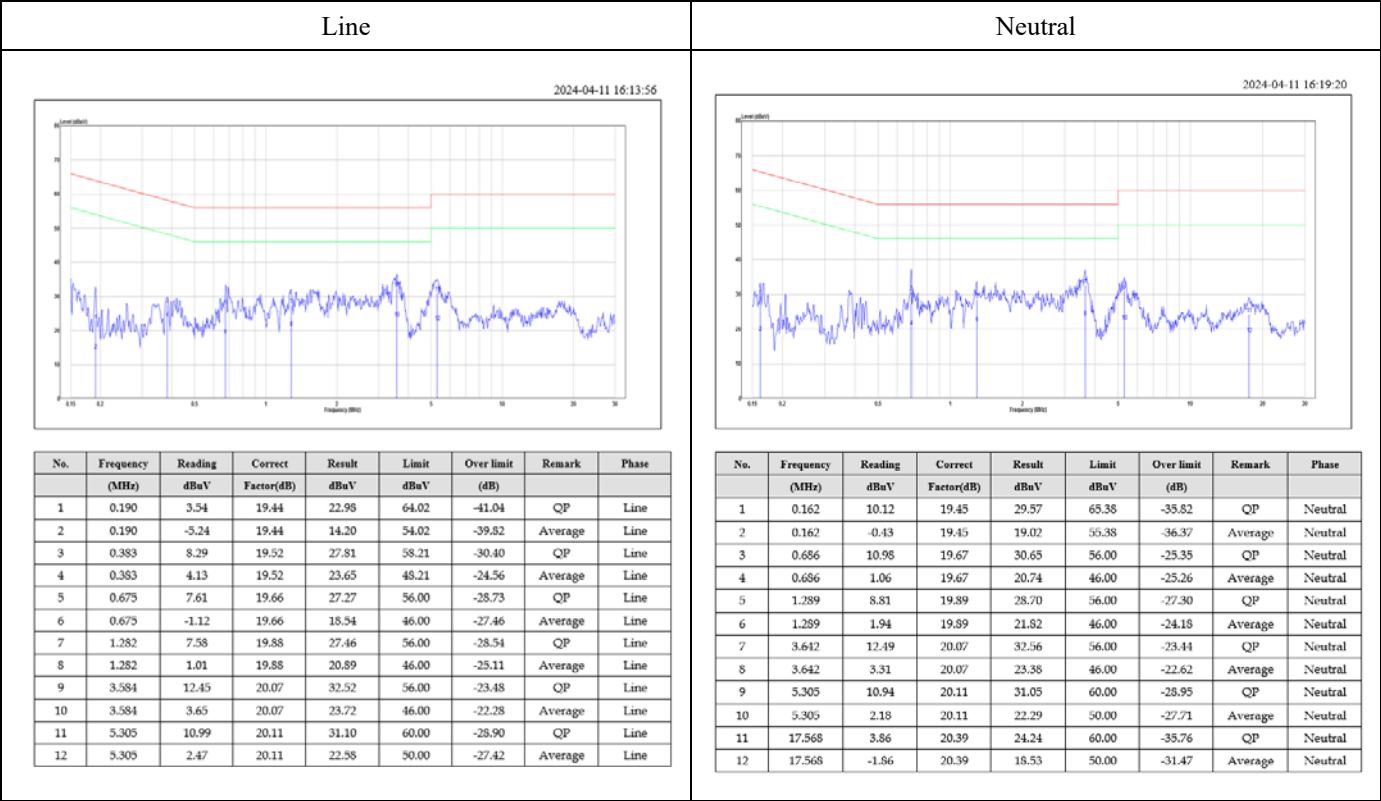
$$\text{Over Limit} = \text{Result} - \text{Limit Line}$$

8.6 Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz

(Worst case is BLE 1M mode High channel)



Note:

Result = Reading + Factor

Over Limit = Result – Limit Line

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

## 9 FCC §15.209, §15.205, §15.247(d) & RSS-247 §5.5, RSS-GEN §8.9, §8.10 – 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 RSS-Gen 8.10,

Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:

(a)The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD).

(b)Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6.

(c)Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

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 (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

\*\* 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 RSS-GEN §8.9: Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

**Table 5 – General field strength limits at frequencies above 30 MHz**

Frequency (MHz)	Field Strength (μV/m at 3 m)
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

**Table 6 – General field strength limits at frequencies below 30 MHz**

Frequency (MHz)	Field Strength (H-Field) (μA/m)	Measurement distance (m)
9 - 490 kHz <sup>Note 1</sup>	6.37/F (F in kHz)	300
490 - 1705 kHz	63.7/F (F in kHz)	30
1.705 - 30 MHz	0.08	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

Note 2: The limit was added 51.5dB to convert the limit from dBuA/m to dBuV/m.

According to ANSI C63.10-2013, section 5.3.3

Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field, and the emissions to be measured can be detected by the measurement equipment (see 4.3.4).

Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. Measurements from 18 GHz to 40 GHz are typically made at distances significantly less than 3 m from the EUT. When performing

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measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements or inverse of linear distance-squared for power-density measurements).

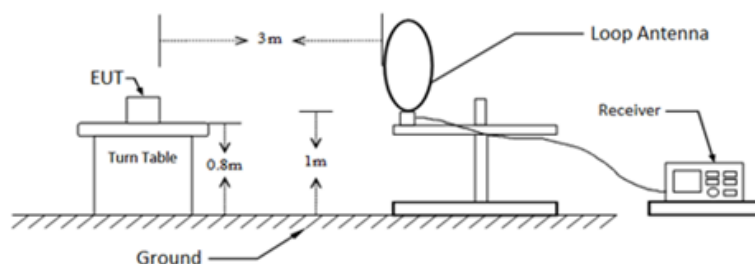
As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the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

As per RSS-247 5.5,

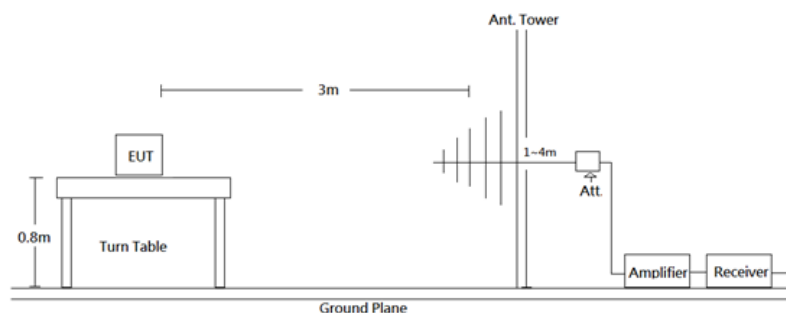
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## 9.2 EUT Setup

9kHz-30MHz:

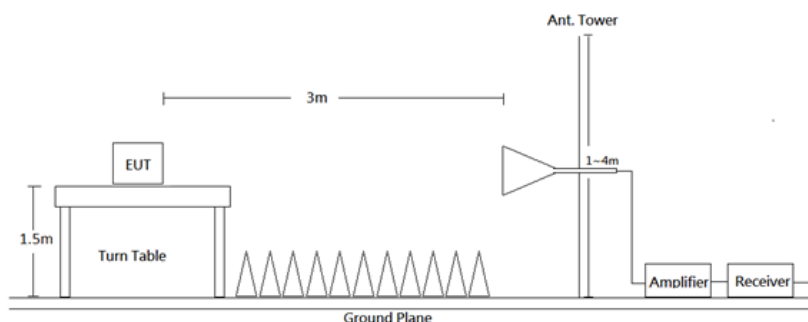


30MHz-1GHz:

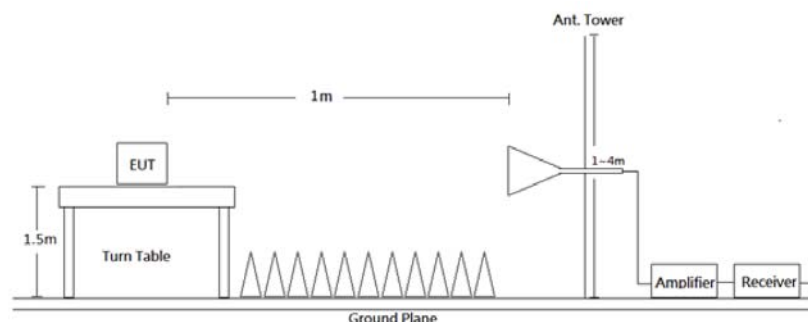


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1-18 GHz:



18-26.5 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, FCC 15.247 and RSS-Gen, RSS-247 Limits.

### 9.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz 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
9 kHz - 150 kHz	200 Hz/300 Hz	1 kHz	/	QP/AV
150 kHz - 30 MHz	9 kHz/10 kHz	30 kHz	/	QP/AV
30-1000 MHz	120 kHz	300 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

### 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 Quasi-peak and average detector mode from 9 kHz to 30 MHz, 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

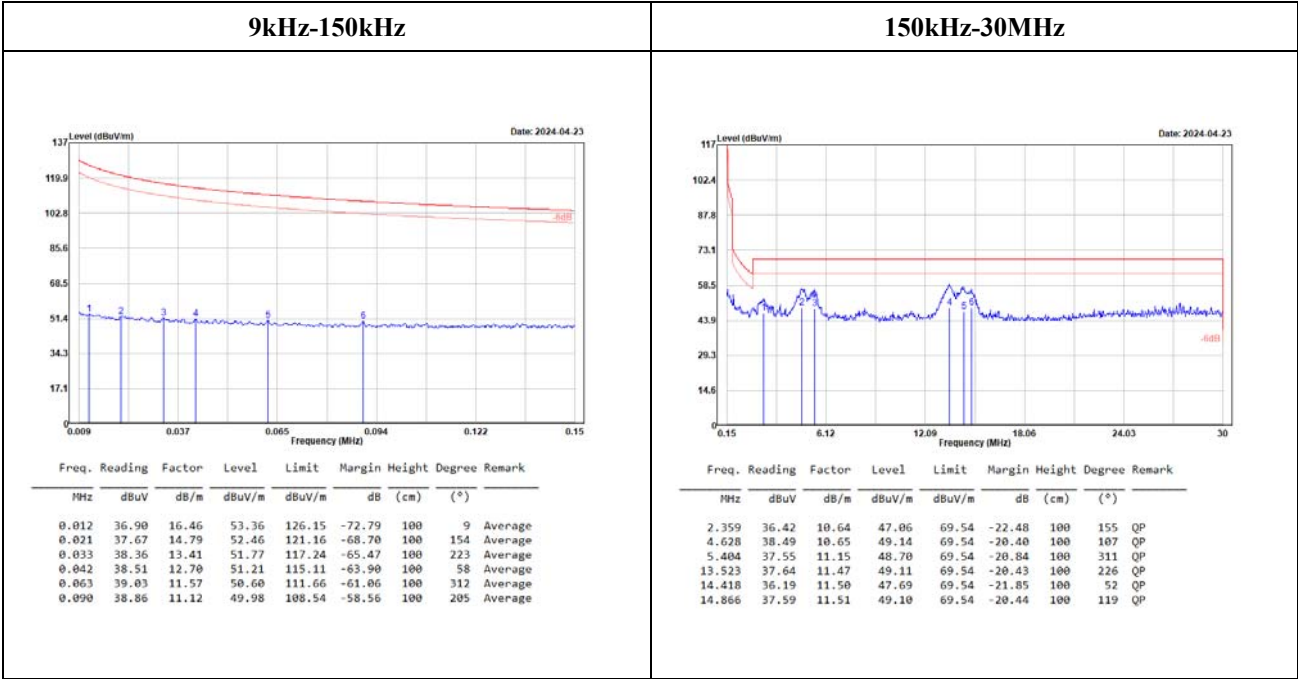
The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Level – Limit

9.6 Test Results

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

9kHz-30MHz:  
(worst case is BLE(1M) Mode high channel)  
(Pre-scan using three directional polarities, worst case as parallel.)

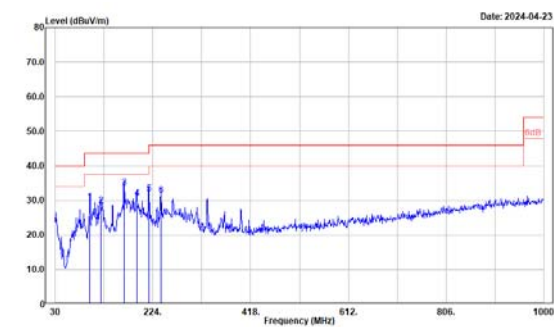


30MHz-1GHz:

(worst case is BLE(1M) Mode)

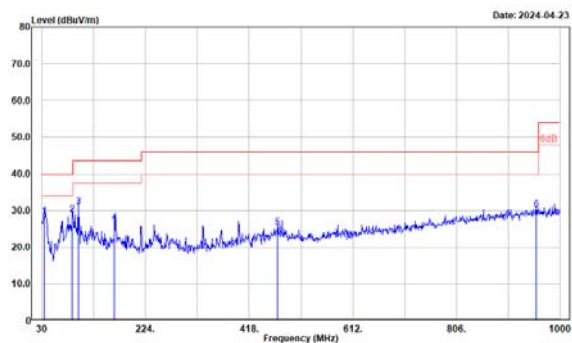
## Low channel

## Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
98.870	43.27	-13.72	29.55	43.50	-13.95	100	91	QP
120.210	38.05	-9.74	28.31	43.50	-15.19	100	102	QP
167.740	44.78	-11.22	33.56	43.50	-9.94	100	114	QP
191.990	42.25	-11.66	30.59	43.50	-12.91	100	117	QP
216.240	44.32	-12.38	31.94	46.00	-14.06	100	121	QP
239.520	42.93	-11.44	31.49	46.00	-14.51	100	127	QP

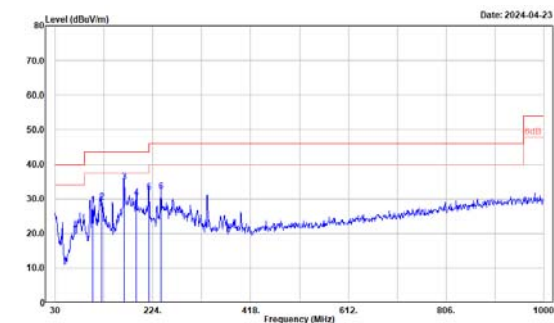
## Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
33.880	34.09	-5.70	28.39	40.00	-11.61	100	69	QP
87.230	45.04	-16.20	28.84	40.00	-11.16	100	100	QP
97.900	44.96	-14.00	30.96	43.50	-12.54	100	265	QP
165.800	37.82	-11.05	26.77	43.50	-16.73	100	160	QP
471.350	30.73	-5.35	25.38	46.00	-20.62	100	81	QP
955.380	27.67	2.50	30.17	46.00	-15.83	100	120	QP

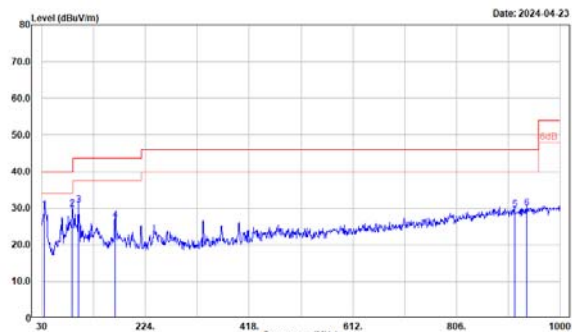
## Middle channel

## Horizontal

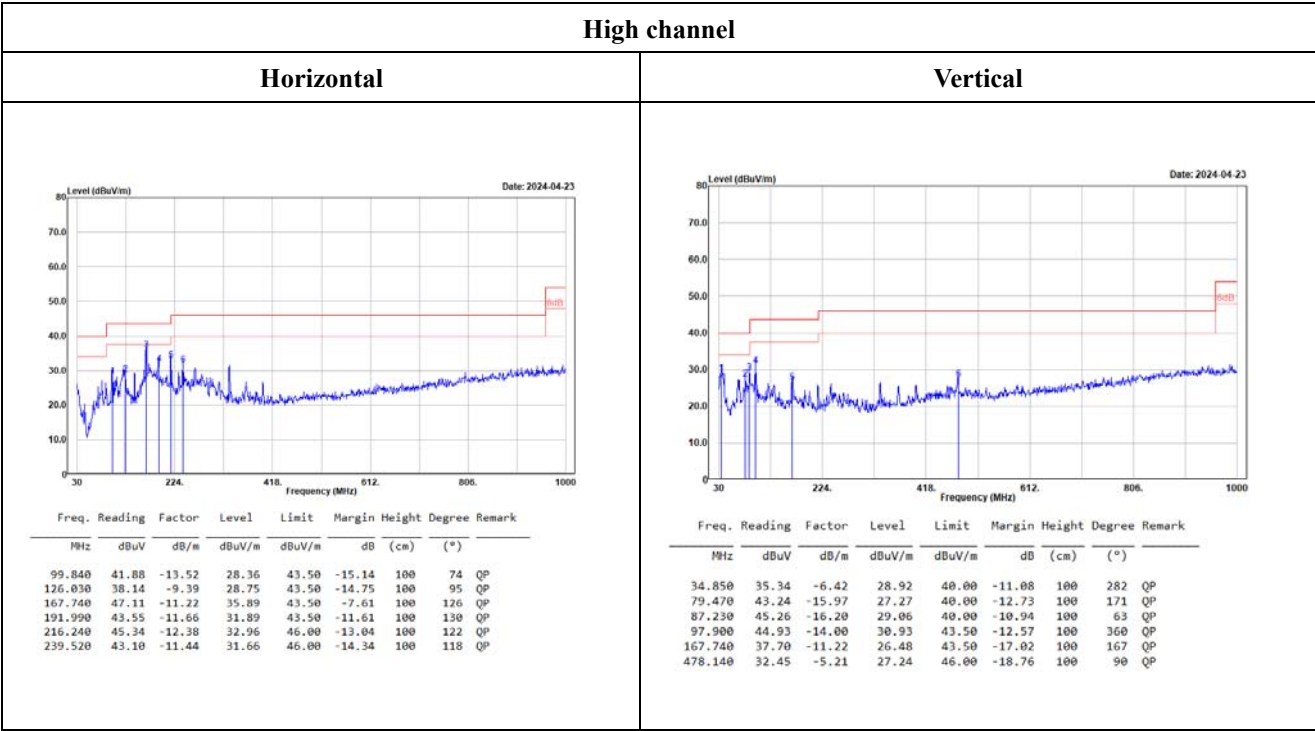


Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
104.690	40.33	-12.06	28.27	43.50	-15.23	100	100	QP
122.150	38.63	-9.63	29.00	43.50	-14.50	100	116	QP
166.770	46.01	-11.13	34.88	43.50	-8.62	100	124	QP
191.020	42.13	-11.77	30.36	43.50	-13.14	100	124	QP
216.240	44.32	-12.38	31.94	46.00	-14.06	100	127	QP
239.520	43.58	-11.44	32.14	46.00	-13.86	100	120	QP

## Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
34.850	35.93	-6.42	29.51	40.00	-10.49	100	156	QP
87.230	45.84	-16.20	29.64	40.00	-10.36	100	258	QP
97.900	44.80	-14.00	30.80	43.50	-12.70	100	141	QP
167.740	37.82	-11.22	26.60	43.50	-16.90	100	164	QP
914.640	27.49	2.00	29.57	46.00	-16.43	100	47	QP
936.950	27.49	2.45	29.94	46.00	-16.06	100	2	QP



Level = Reading + Factor.

Margin = Level – Limit.

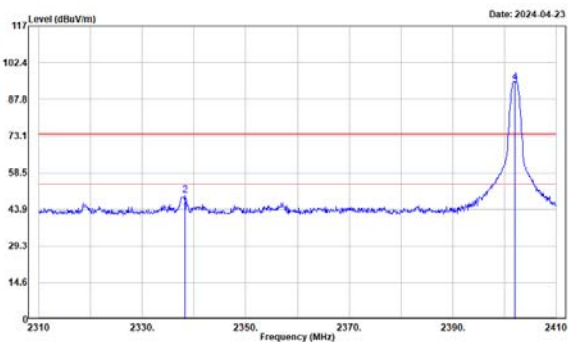
Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Band-Edge:

BLE(1M) Mode

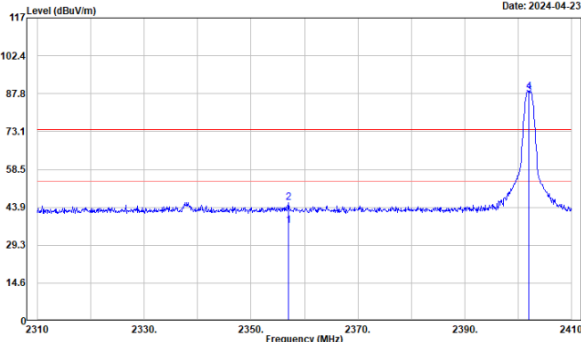
Low channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2338.200	53.76	-10.98	42.78	54.00	-11.22	147	262	Average
2338.200	60.38	-10.98	49.40	74.00	-24.60	147	262	Peak
2402.000	104.06	-10.61	93.45			147	262	Average
2402.000	105.03	-10.61	94.42				262	Peak

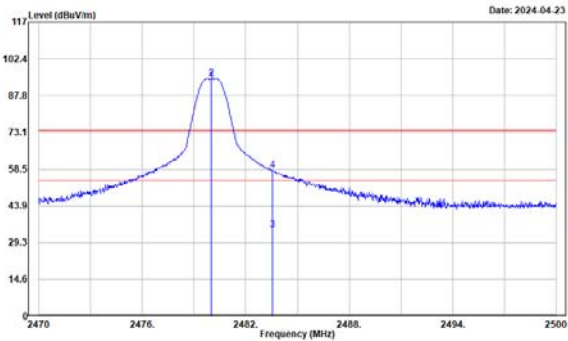
Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2357.000	47.74	-10.86	36.88	54.00	-17.12	171	210	Average
2357.000	56.56	-10.86	45.70	74.00	-28.30	171	210	Peak
2402.000	98.27	-10.61	87.66			171	210	Average
2402.000	99.01	-10.61	88.40				210	Peak

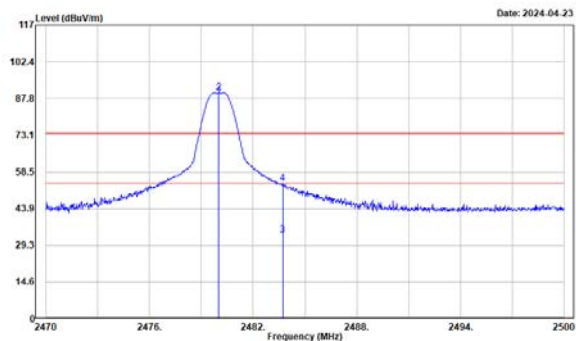
High channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	103.68	-10.25	93.43			104	253	Average
2480.000	104.67	-10.25	94.42				253	Peak
2483.560	44.35	-10.20	34.15	54.00	-19.85	104	253	Average
2483.560	68.11	-10.20	57.91	74.00	-16.09	104	253	Peak

Vertical

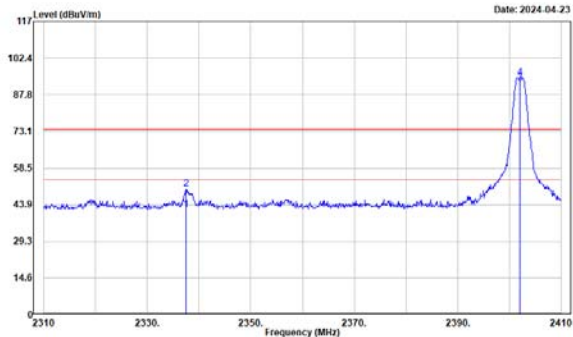


Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	99.18	-10.25	88.93			188	208	Average
2480.000	100.18	-10.25	89.93				208	Peak
2483.710	43.55	-10.20	33.35	54.00	-20.65	188	208	Average
2483.710	64.19	-10.20	53.99	74.00	-20.01	188	208	Peak

BLE(2M) Mode

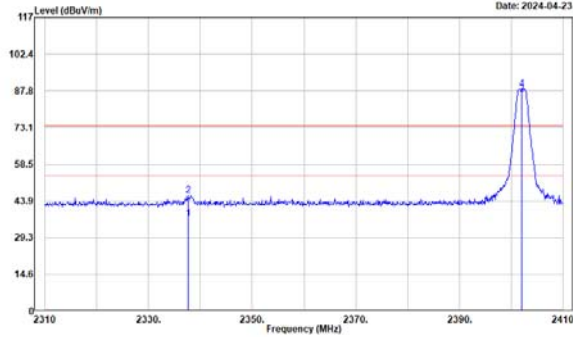
Low channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2337.500	52.89	-10.99	41.90	54.00	-12.10	147	260	Average
2337.500	61.19	-10.99	50.20	74.00	-23.80	147	260	Peak
2402.000	102.81	-10.61	92.20			147	260	Average
2402.000	105.22	-10.61	94.61			147	260	Peak

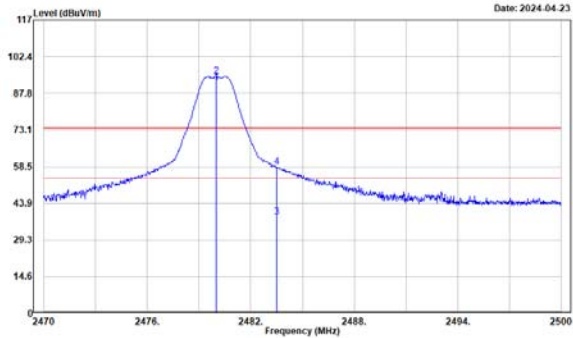
Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2337.700	47.68	-10.98	36.70	54.00	-17.30	173	212	Average
2337.700	57.05	-10.98	46.07	74.00	-27.93	173	212	Peak
2402.000	96.80	-10.61	86.19			173	212	Average
2402.000	99.23	-10.61	88.62			173	212	Peak

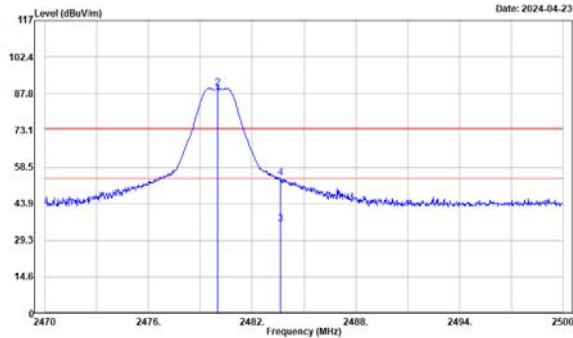
High channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	102.19	-10.25	91.94			105	255	Average
2480.000	104.67	-10.25	94.42			105	255	Peak
2483.500	48.52	-10.20	38.32	54.00	-15.68	105	255	Average
2483.500	68.52	-10.20	58.32	74.00	-15.68	105	255	Peak

Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	97.67	-10.25	87.42			188	208	Average
2480.000	100.16	-10.25	89.91			188	208	Peak
2483.650	46.02	-10.20	35.82	54.00	-18.18	188	208	Average
2483.650	64.40	-10.20	54.20	74.00	-19.80	188	208	Peak

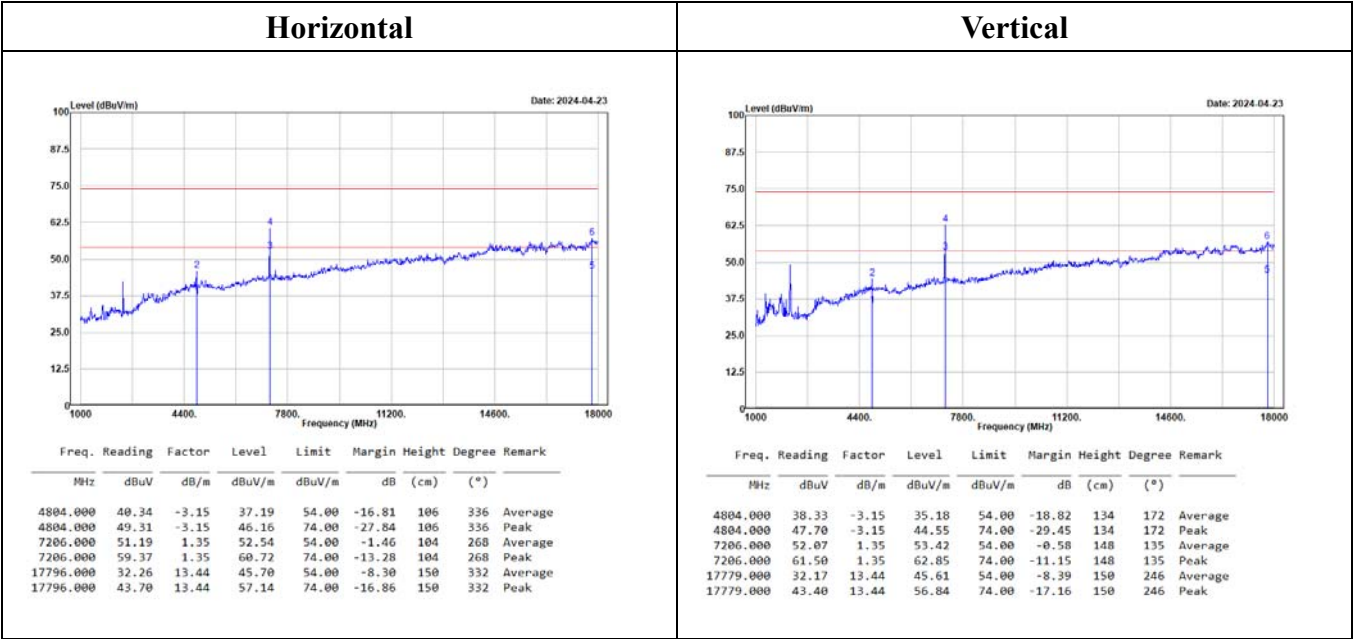
Level = Reading + Factor.

Margin = Level – Limit.

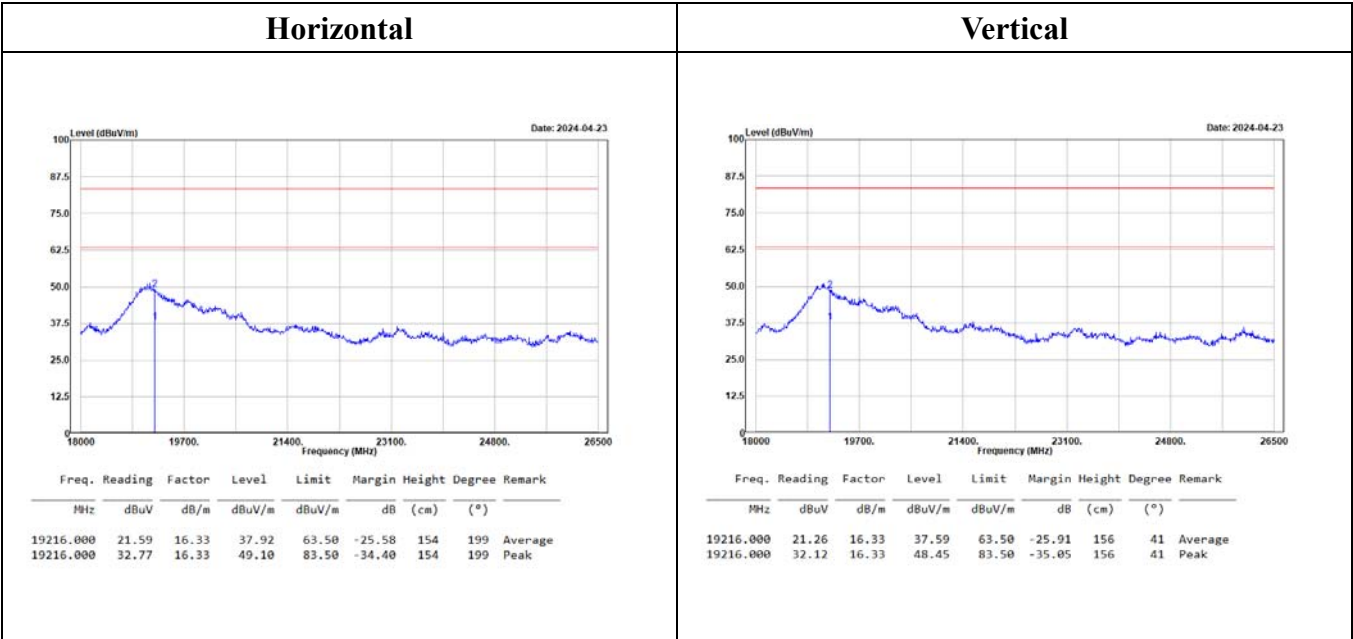
Factor = Antenna Factor + Cable Loss – Amplifier Gain.

(worst case is BLE(1M) Mode low channel)

1GHz-18GHz:



18GHz-26.5GHz:



Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

For 18-26.5GHz Convert the test distance limit of 3 meters to a limit of 1 meter:

Conversion factor = 20 log (1m/3m) = 9.5 dB , Limit = 54+9.5 = 63.50 dBuV/m @ 1m



# Above 1GHz

## BLE(1M) Mode

Low channel																	
Horizontal									Vertical								
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark	Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4804.000	40.34	-3.15	37.19	54.00	-16.81	106	336	Average	4804.000	38.33	-3.15	35.18	54.00	-18.82	134	172	Average
4804.000	49.31	-3.15	46.16	74.00	-27.84	106	336	Peak	4804.000	47.70	-3.15	44.55	74.00	-29.45	134	172	Peak
7206.000	51.19	1.35	52.54	54.00	-1.46	104	268	Average	7206.000	52.07	1.35	53.42	54.00	-0.58	148	135	Average
7206.000	59.37	1.35	60.72	74.00	-13.28	104	268	Peak	7206.000	61.50	1.35	62.85	74.00	-11.15	148	135	Peak
17796.000	32.26	13.44	45.70	54.00	-8.30	150	332	Average	17779.000	32.17	13.44	45.61	54.00	-8.39	150	246	Average
17796.000	43.70	13.44	57.14	74.00	-16.86	150	332	Peak	17779.000	43.40	13.44	56.84	74.00	-17.16	150	246	Peak

Middle channel																	
Horizontal									Vertical								
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark	Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	40.61	-2.97	37.64	54.00	-16.36	130	337	Average	4880.000	40.92	-2.97	37.95	54.00	-16.05	106	310	Average
4880.000	49.70	-2.97	46.73	74.00	-27.27	130	337	Peak	4880.000	48.73	-2.97	45.76	74.00	-28.24	106	310	Peak
7320.000	45.22	1.44	46.66	54.00	-7.34	129	260	Average	7320.000	49.05	1.44	50.49	54.00	-3.51	139	152	Average
7320.000	53.91	1.44	55.35	74.00	-18.65	129	260	Peak	7320.000	57.32	1.44	58.76	74.00	-15.24	139	152	Peak

High channel																	
Horizontal									Vertical								
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark	Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4960.000	44.09	-2.62	41.47	54.00	-12.53	111	294	Average	4960.000	41.07	-2.62	38.45	54.00	-15.55	121	322	Average
4960.000	51.36	-2.62	48.74	74.00	-25.26	111	294	Peak	4960.000	49.64	-2.62	47.02	74.00	-26.98	121	322	Peak
7440.000	45.38	1.48	46.86	54.00	-7.14	129	228	Average	7440.000	48.74	1.48	50.22	54.00	-3.78	132	129	Average
7440.000	53.95	1.48	55.43	74.00	-18.57	129	228	Peak	7440.000	57.00	1.48	58.48	74.00	-15.52	132	129	Peak

Note:

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

# BLE(2M) Mode

Low channel																	
Horizontal									Vertical								
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark	Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4804.000	41.12	-3.15	37.97	54.00	-16.03	153	333	Average	4804.000	38.93	-3.15	35.78	54.00	-18.22	189	207	Average
4804.000	49.13	-3.15	45.98	74.00	-28.02	153	333	Peak	4804.000	47.27	-3.15	44.12	74.00	-29.88	189	207	Peak
7206.000	51.47	1.35	52.82	54.00	-1.18	107	264	Average	7206.000	52.04	1.35	53.39	54.00	-0.61	136	144	Average
7206.000	59.58	1.35	60.93	74.00	-13.07	107	264	Peak	7206.000	61.15	1.35	62.50	74.00	-11.50	136	144	Peak

Middle channel																	
Horizontal									Vertical								
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark	Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	42.35	-2.97	39.38	54.00	-14.62	123	351	Average	4880.000	41.96	-2.97	38.99	54.00	-15.01	121	309	Average
4880.000	49.93	-2.97	46.96	74.00	-27.04	123	351	Peak	4880.000	48.80	-2.97	45.83	74.00	-28.17	121	309	Peak
7320.000	45.29	1.44	46.73	54.00	-7.27	130	255	Average	7320.000	49.23	1.44	50.67	54.00	-3.33	119	134	Average
7320.000	54.03	1.44	55.47	74.00	-18.53	130	255	Peak	7320.000	57.61	1.44	59.05	74.00	-14.95	119	134	Peak

High channel																	
Horizontal									Vertical								
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark	Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4960.000	44.85	-2.62	42.23	54.00	-11.77	112	317	Average	4960.000	43.97	-2.62	41.35	54.00	-12.65	244	133	Average
4960.000	51.35	-2.62	48.73	74.00	-25.27	112	317	Peak	4960.000	49.47	-2.62	46.85	74.00	-27.15	244	133	Peak
7440.000	47.13	1.48	48.61	54.00	-5.39	129	236	Average	7440.000	50.86	1.48	52.34	54.00	-1.66	132	137	Average
7440.000	55.51	1.48	56.99	74.00	-17.01	129	236	Peak	7440.000	58.96	1.48	60.44	74.00	-13.56	132	137	Peak

Note:

Level = Reading + Factor.

Margin = Level – Limit.

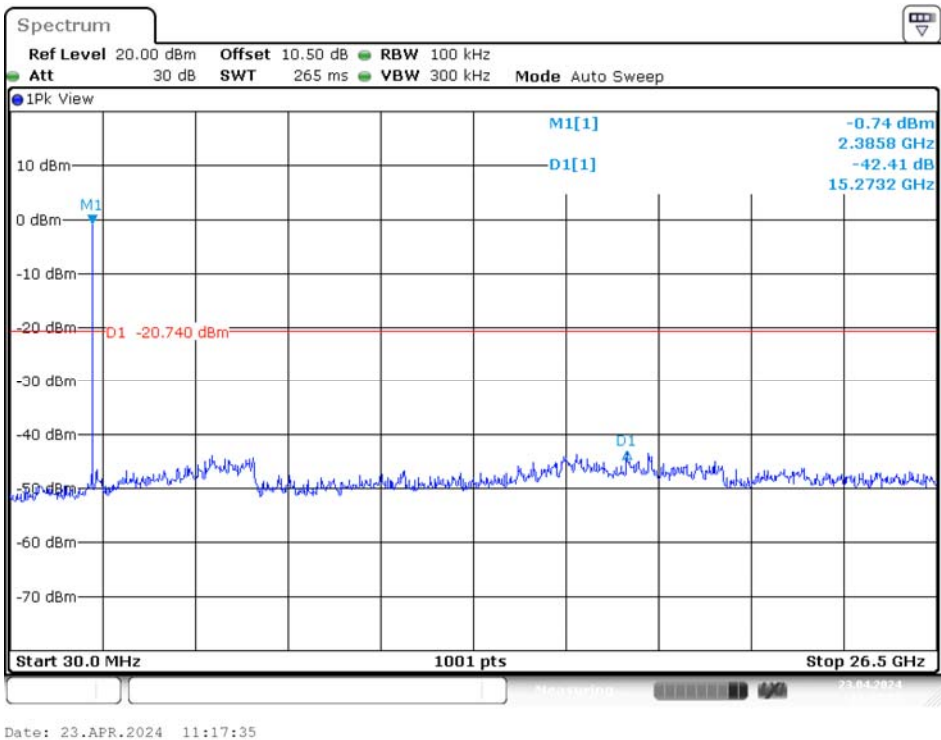
Factor = Antenna Factor + Cable Loss – Amplifier Gain.



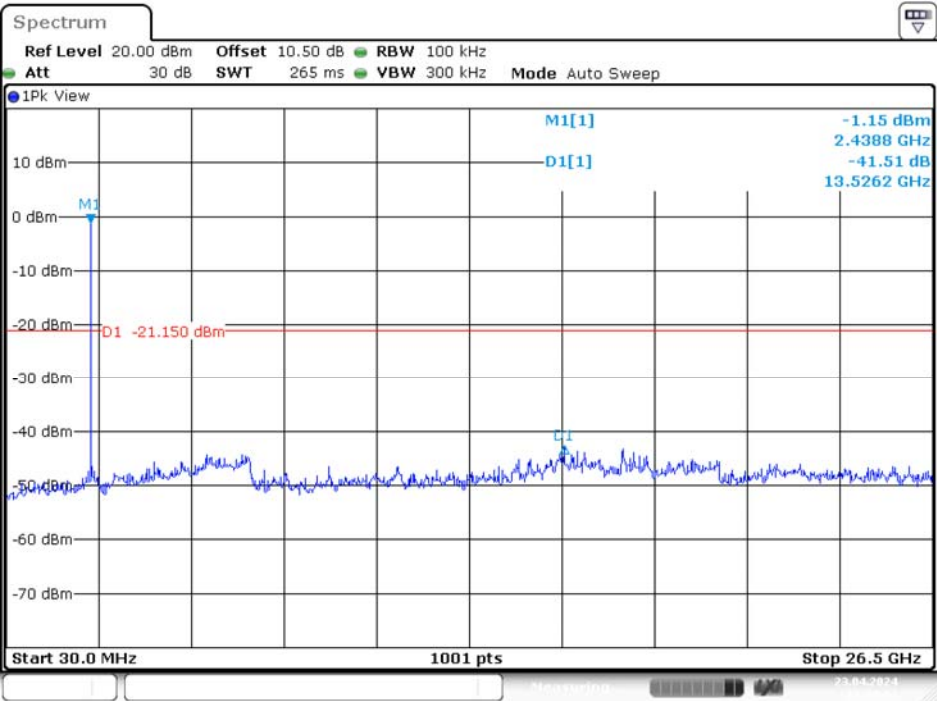
Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE(1M) Mode				
Low	2402	42.41	≥ 20	PASS
Middle	2440	41.51	≥ 20	PASS
High	2480	43.19	≥ 20	PASS
BLE(2M) Mode				
Low	2402	42.47	≥ 20	PASS
Middle	2440	41.51	≥ 20	PASS
High	2480	36.81	≥ 20	PASS

BLE(1M) Mode  
Low Channel

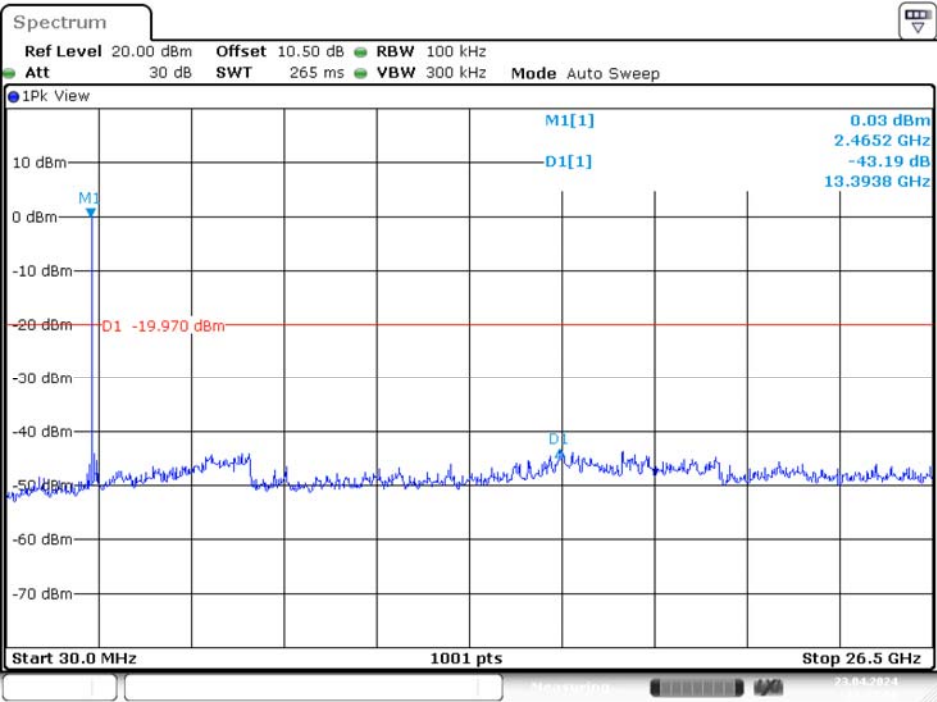


Middle Channel



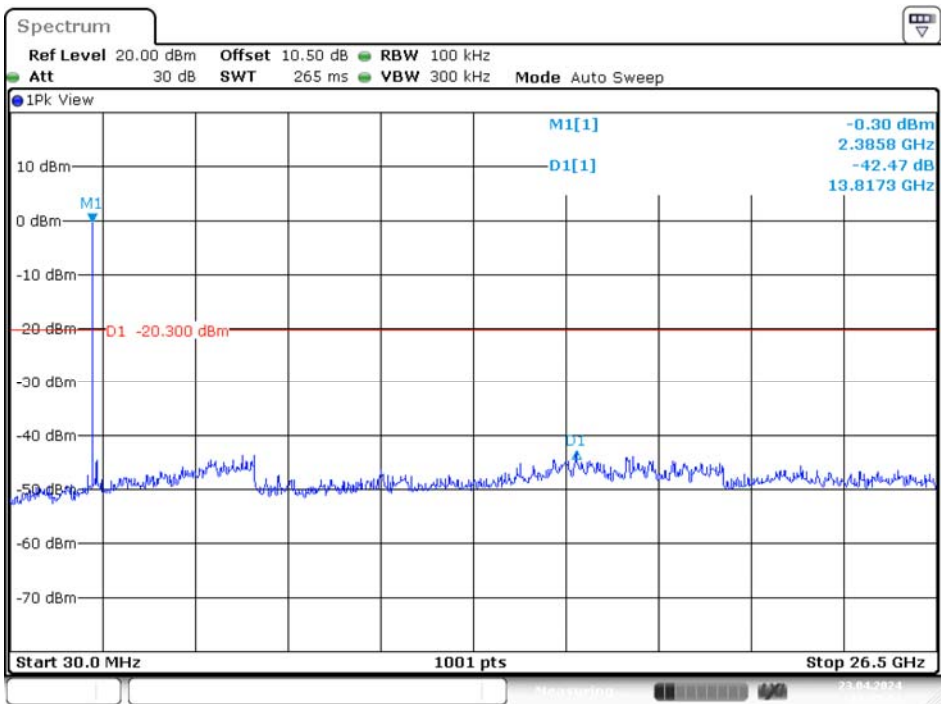
Date: 23.APR.2024 11:20:41

High Channel

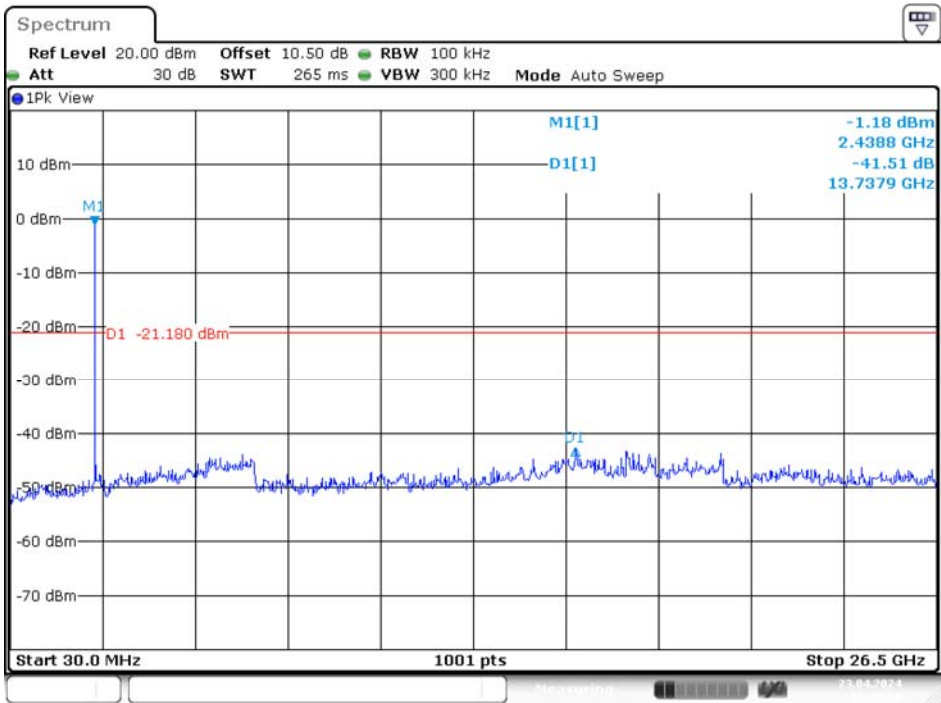


Date: 23.APR.2024 11:23:00

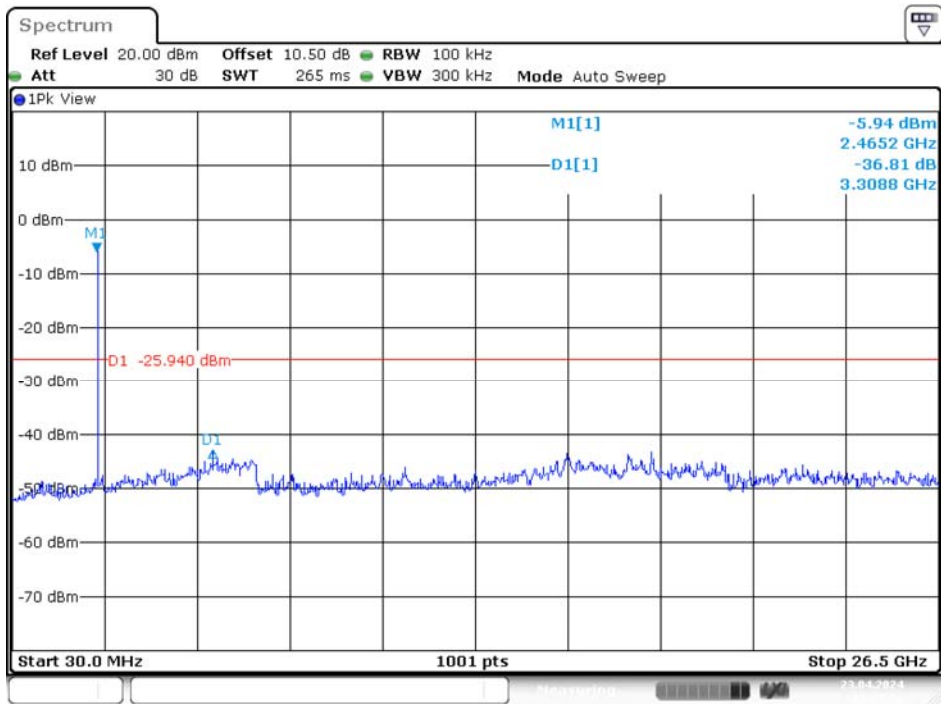
BLE(2M) Mode  
Low Channel



Middle Channel



High Channel



Date: 23.APR.2024 11:31:12

## **10 FCC §15.247(a)(2) & RSS-247 §5.2(a), RSS-GEN §6.7 – 6 dB Emission Bandwidth & Occupied 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.

According to RSS-247 §5.2 (a)

The minimum 6 dB bandwidth shall be 500 kHz.

According to RSS-GEN §6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

### **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  $\geq [3 \times \text{RBW}]$ .
- 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.

According to ANSI C63.10-2013 Section 6.9.3

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

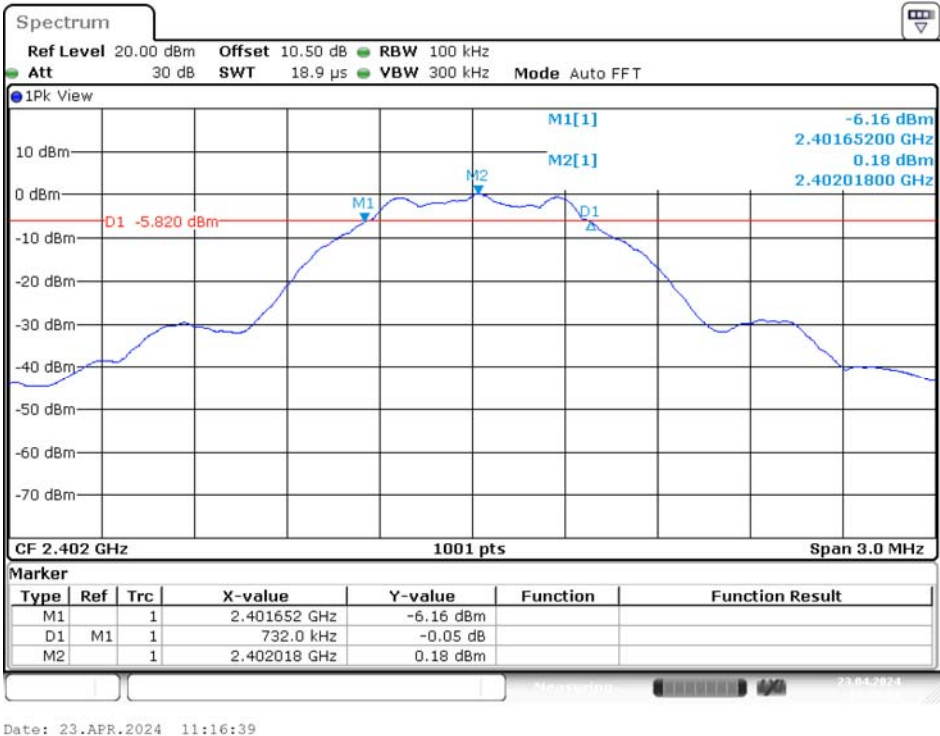
10.3 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (kHz)	Result
BLE(1M) Mode					
Low	2402	0.73	1.04	> 500	PASS
Middle	2440	0.74	1.04	> 500	PASS
High	2480	0.73	1.04	> 500	PASS
BLE(2M) Mode					
Low	2402	1.16	2.03	> 500	PASS
Middle	2440	1.16	2.03	> 500	PASS
High	2480	1.16	2.03	> 500	PASS

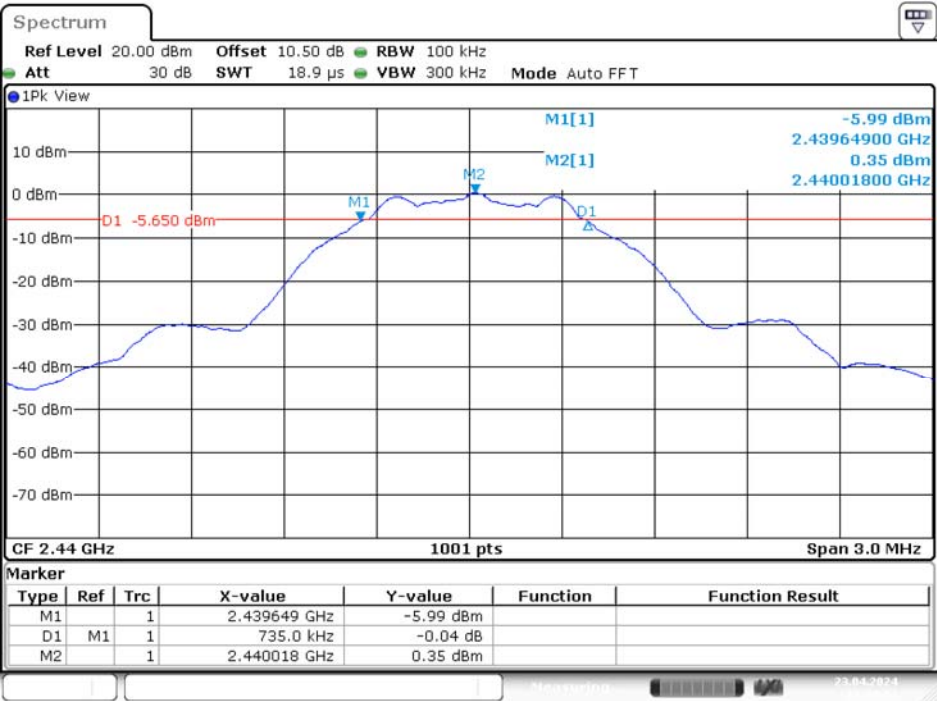
Please refer to the following plots

6 dB Emission Bandwidth

BLE(1M) Mode  
Low Channel

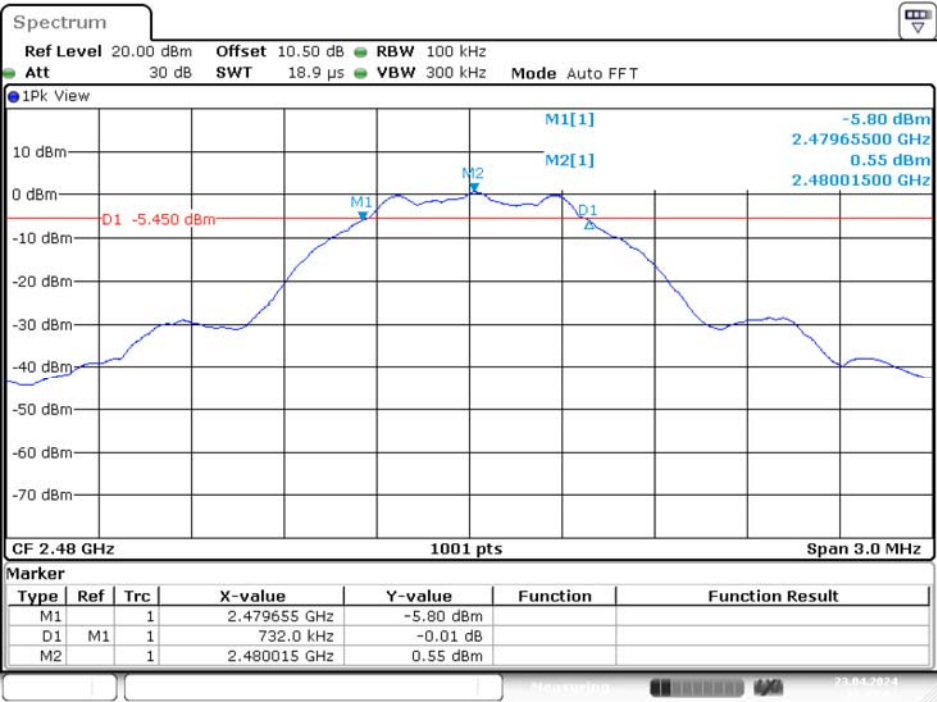


Middle Channel



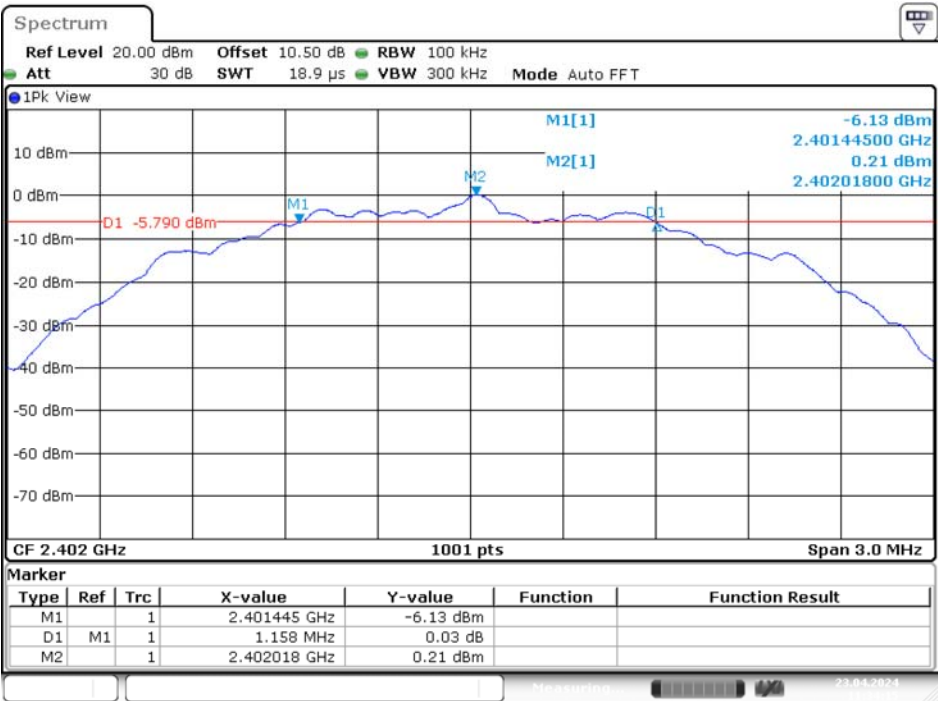
Date: 23.APR.2024 11:20:01

High Channel



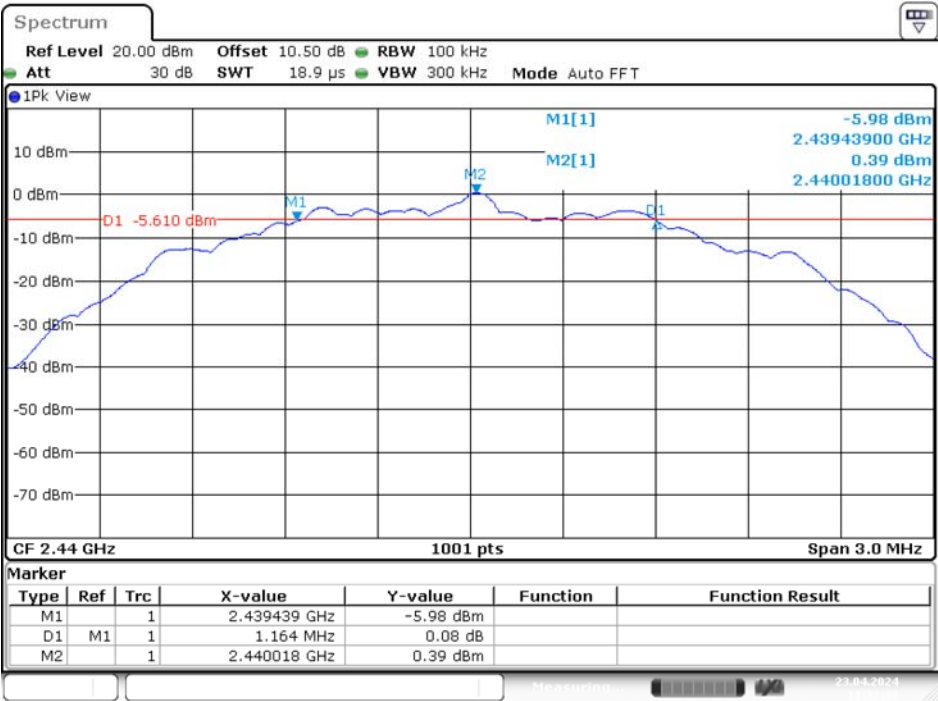
Date: 23.APR.2024 11:22:04

BLE(2M) Mode  
Low Channel



Date: 23.APR.2024 11:34:16

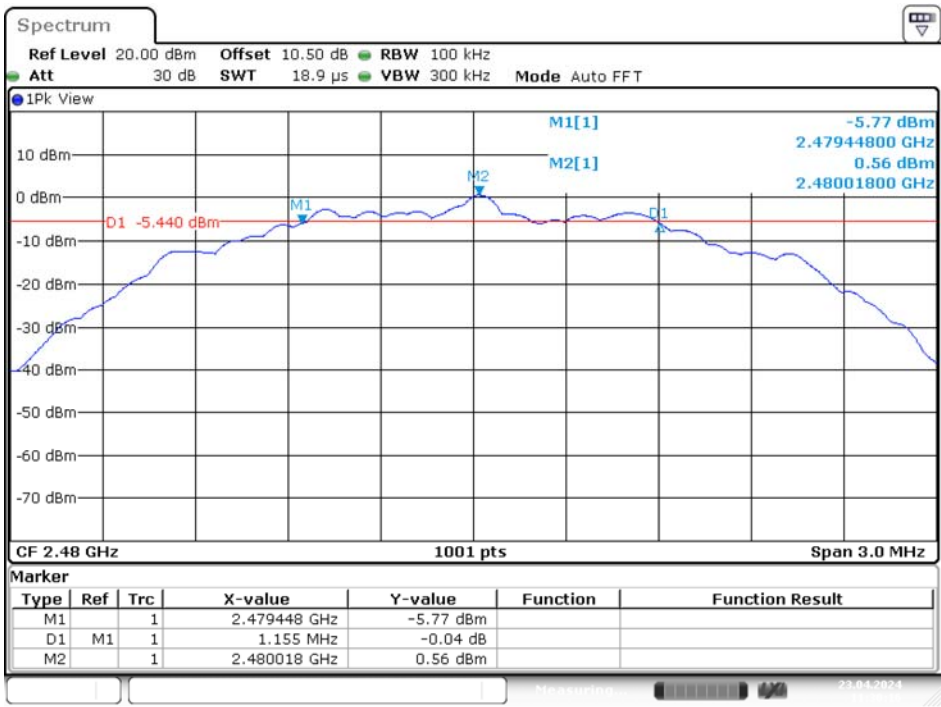
Middle Channel



Date: 23.APR.2024 11:32:39



High Channel



99% Bandwidth

BLE(1M) Mode  
Low Channel



Middle Channel



Date: 23.APR.2024 11:20:25

High Channel



Date: 23.APR.2024 11:22:29

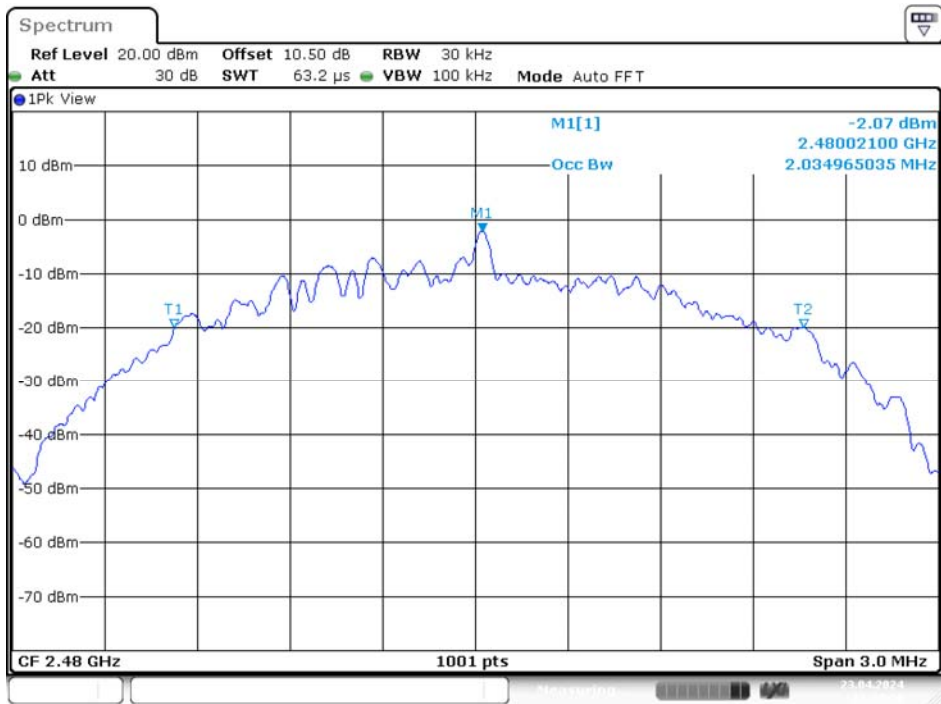
BLE(2M) Mode  
Low Channel



Middle Channel



High Channel



Date: 23.APR.2024 11:30:41

## **11 FCC §15.247(b)(3) & RSS-247 §5.4(d) – 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.

According to RSS-247 §5.4(d).

For DTSSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling 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 transmitting at a reduced power level. If multiple modes of operation are implemented, 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 11.9.1.3

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

#### Conducted Peak Output Power

Channel	Frequency (MHz)	Conducted Peak Output Power (dBm)	Limit (dBm)	Antenna Gain (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)
BLE(1M) Mode						
Low	2402	0.97	30	-0.209	0.761	36
Middle	2440	1.18	30	-0.209	0.971	36
High	2480	1.35	30	-0.209	1.141	36
BLE(2M) Mode						
Low	2402	0.98	30	-0.209	0.771	36
Middle	2440	1.20	30	-0.209	0.991	36
High	2480	1.37	30	-0.209	1.161	36

## 12 FCC §15.247(d) & RSS-247 §5.5 – 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)).

According to RSS-247 §5.5.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### 12.2 Test Procedure

According to ANSI C63.10-2013 Section 11.11

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW  $\geq [3 \times \text{RBW}]$ .
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level.

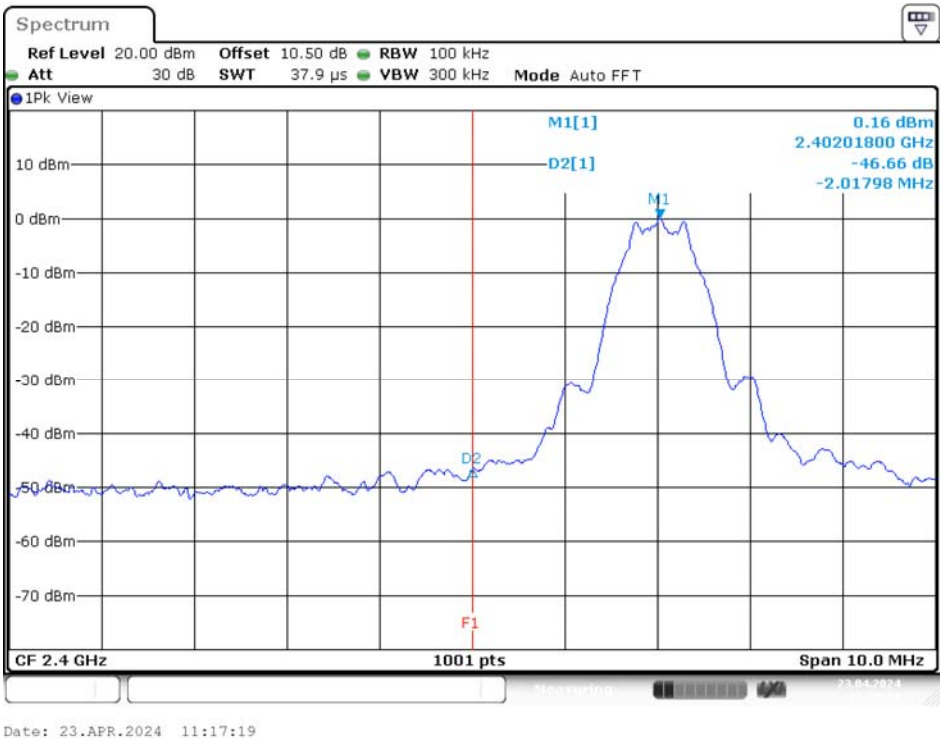
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

12.3 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE(1M) Mode				
Low	2402	46.66	$\geq 20$	PASS
High	2480	48.24	$\geq 20$	PASS
BLE(2M) Mode				
Low	2402	35.83	$\geq 20$	PASS
High	2480	48.45	$\geq 20$	PASS

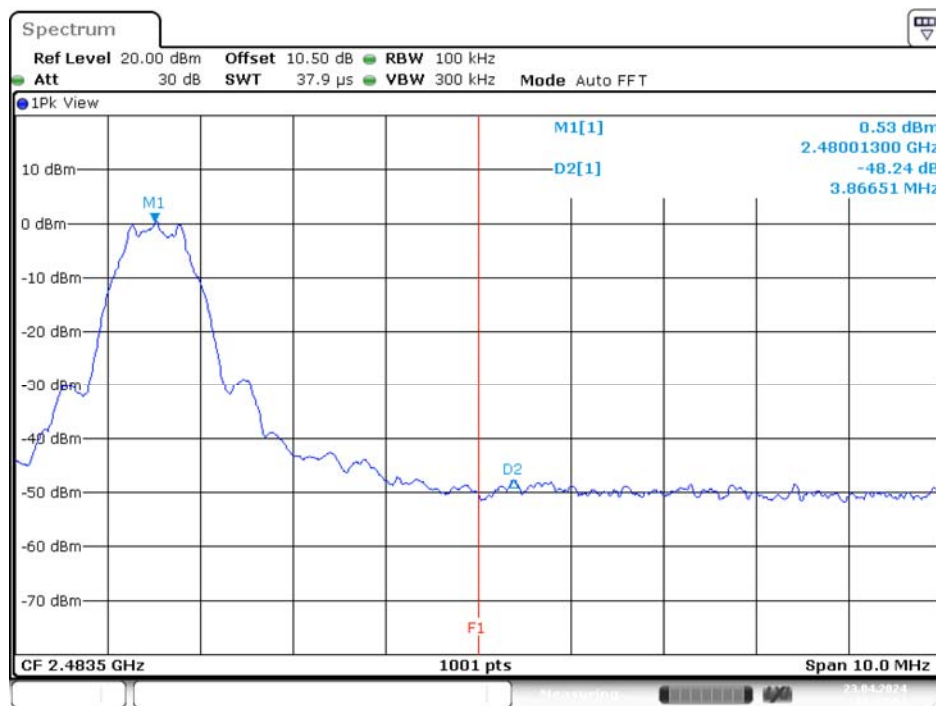
Please refer to the following plots

BLE(1M) Mode  
Band Edge, Left Side



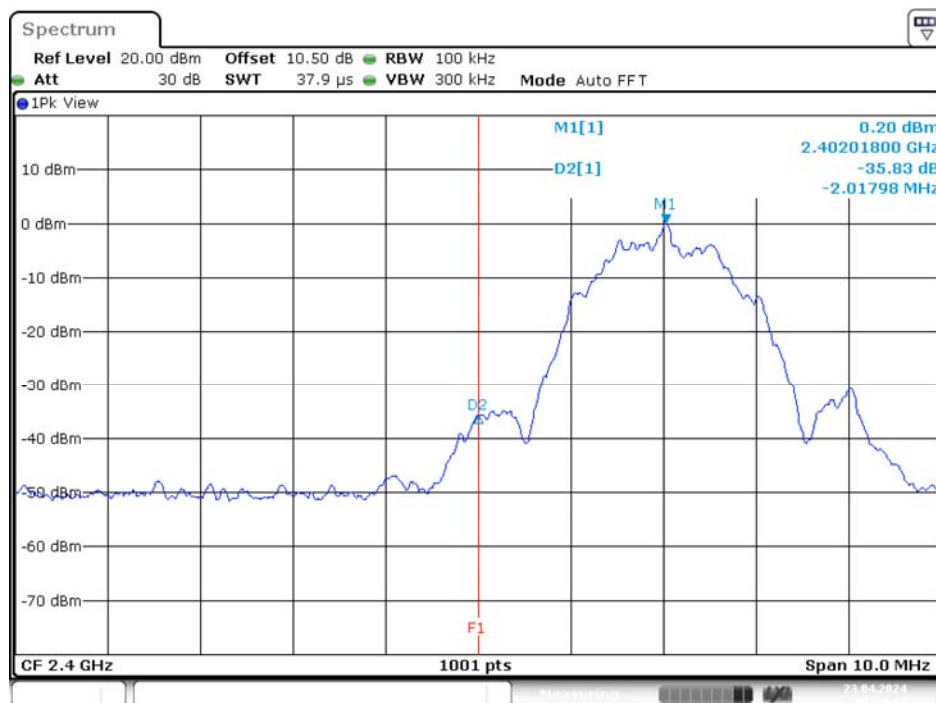


### Band Edge, Right Side



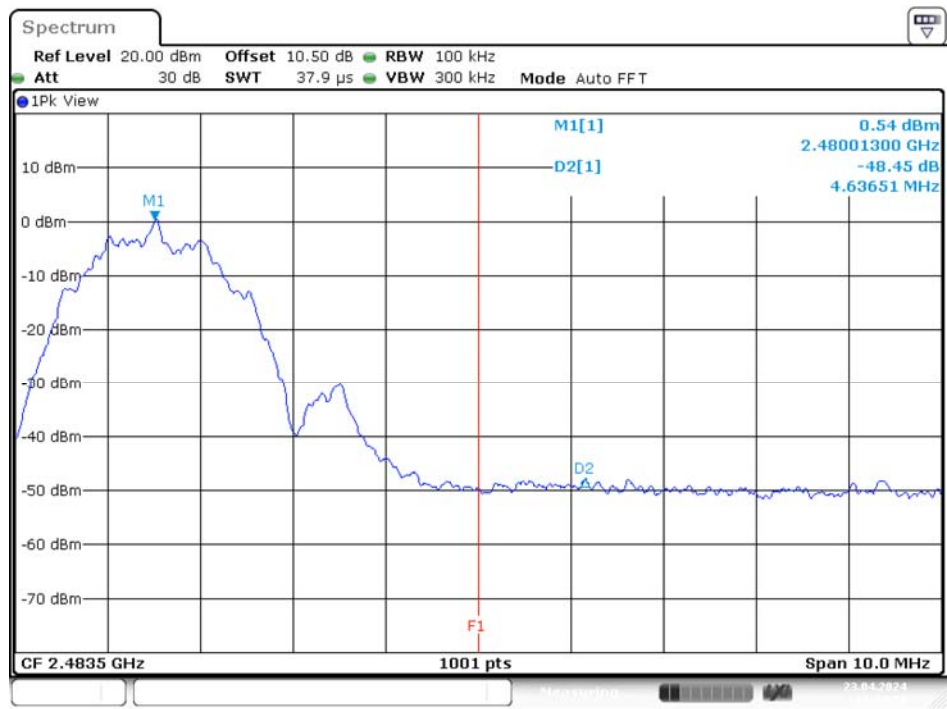
Date: 23.APR.2024 11:22:44

**BLE(2M) Mode**  
**Band Edge, Left Side**



Date: 23.APR.2024 11:34:56

Band Edge, Right Side



Date: 23.APR.2024 11:30:57

## 13 FCC §15.247(e) & RSS-247 §5.2(b) – 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.

According to RSS-247 §5.2(b).

The transmitter power spectral density conducted from the transmitter 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 section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

### 13.2 Test Procedure

According to ANSI C63.10-2013, section 11.10.2

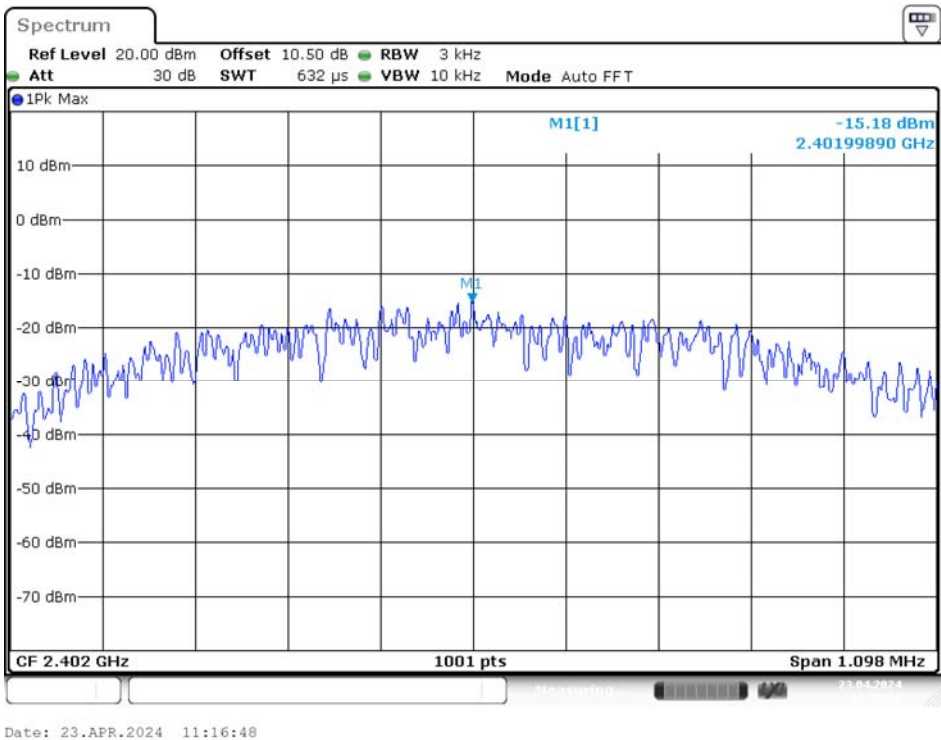
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
4. Set the VBW  $\geq [3 \times \text{RBW}]$ .
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

13.3 Test Results

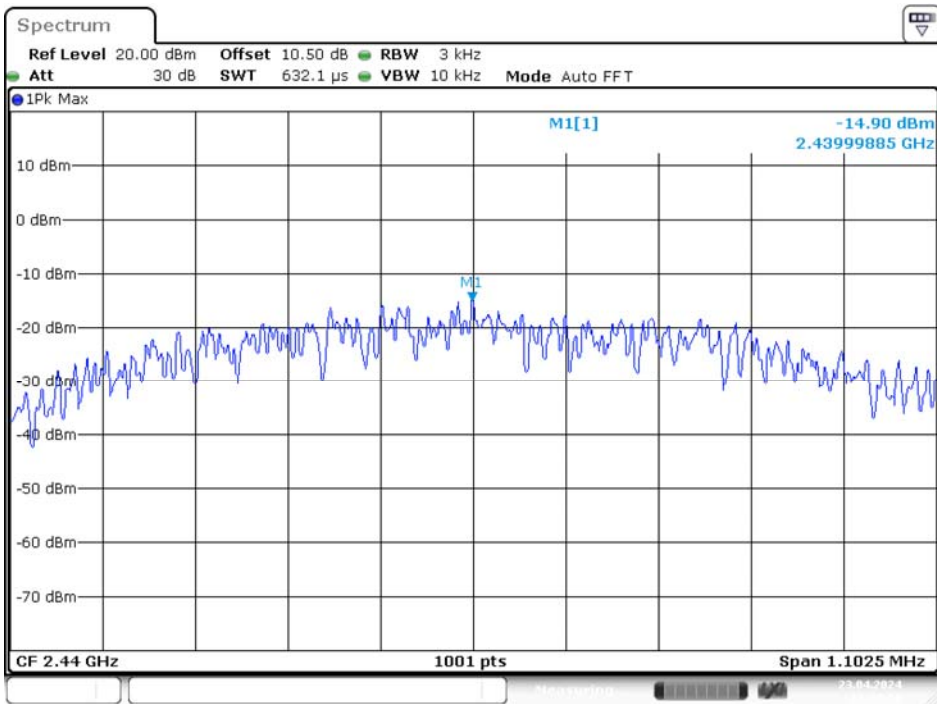
Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
BLE(1M) Mode				
Low	2402	-15.18	8	PASS
Middle	2440	-14.90	8	PASS
High	2480	-14.67	8	PASS
BLE(2M) Mode				
Low	2402	-17.66	8	PASS
Middle	2440	-17.48	8	PASS
High	2480	-17.24	8	PASS

Please refer to the following plots

BLE(1M) Mode  
Low Channel

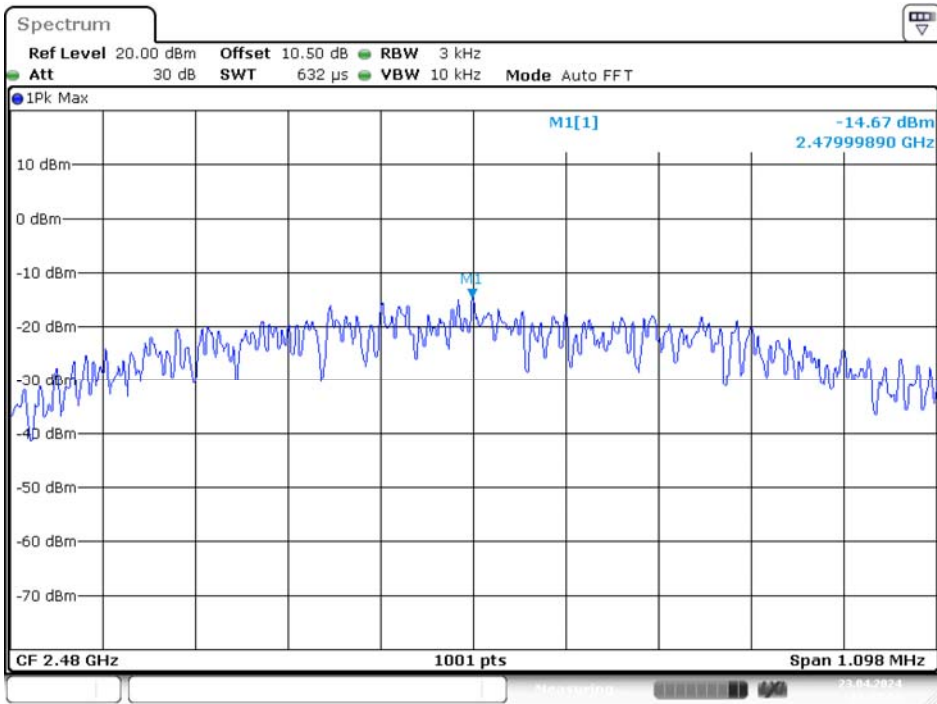


Middle Channel



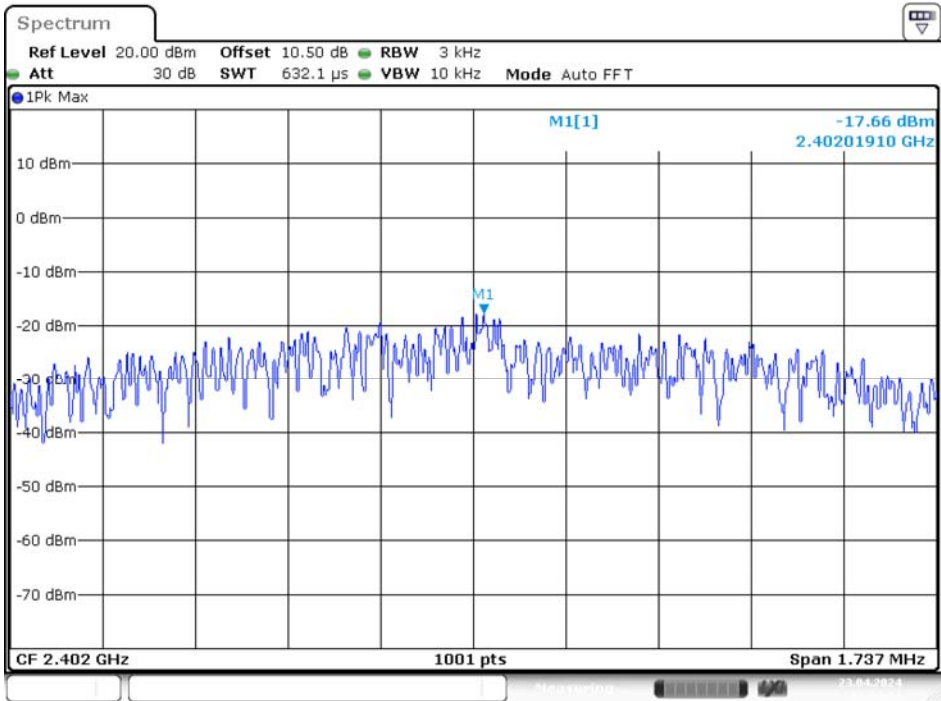
Date: 23.APR.2024 11:20:10

High Channel

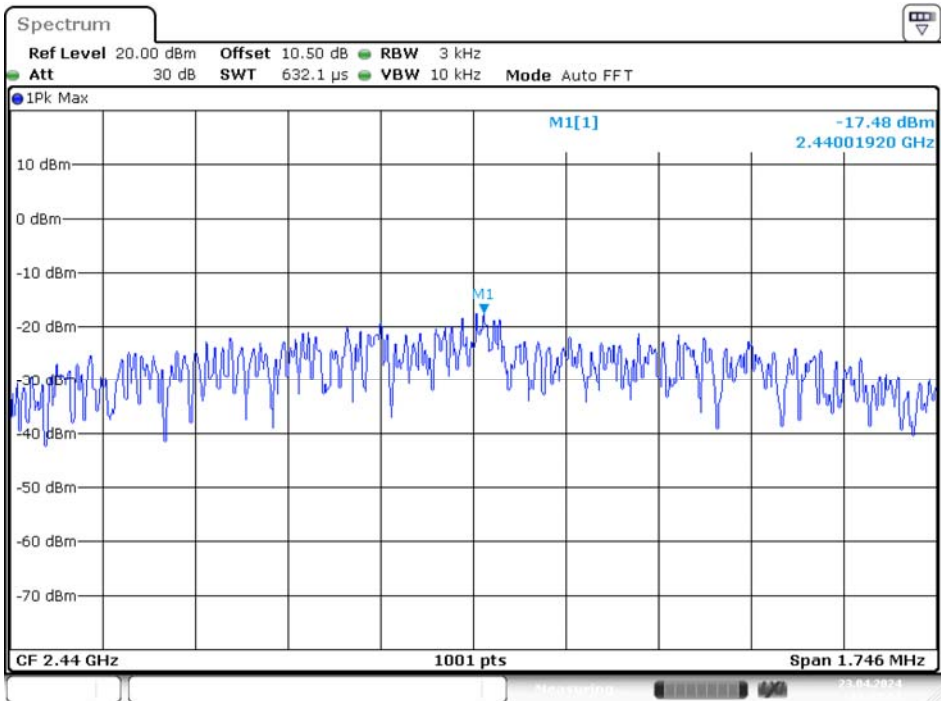


Date: 23.APR.2024 11:22:13

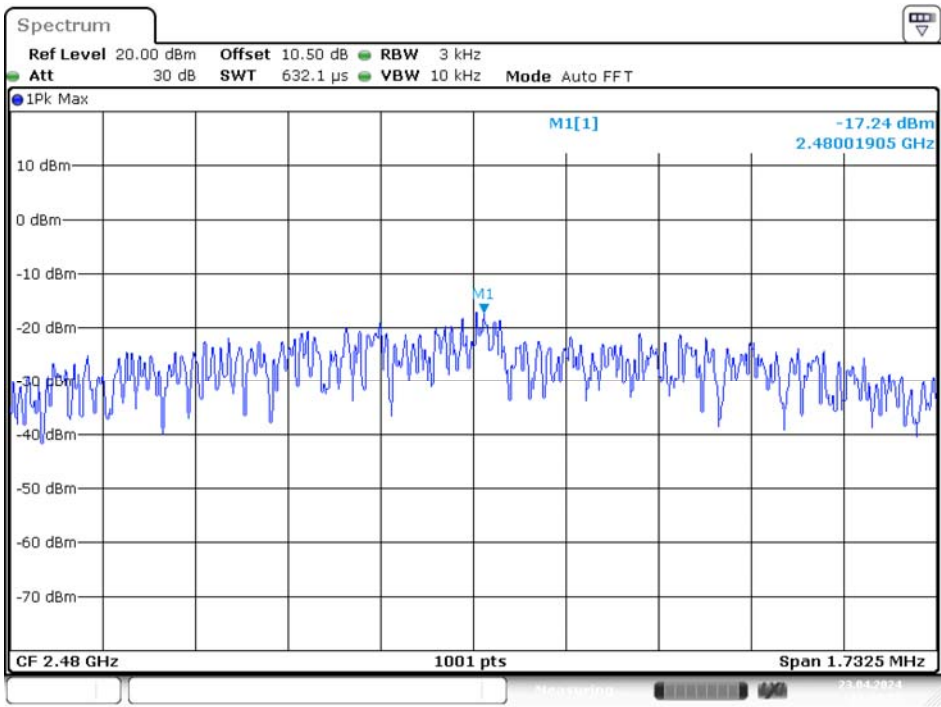
BLE(2M) Mode  
Low Channel



Middle Channel



High Channel



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