# FCC PART 15.247

# TEST REPORT

For

# GEN3 Mobility LLC

110 110th Avenue NE, Suite 520, Bellevue, WA 98004 USA

## FCC ID: 2AZM4-ELV1004

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Electric Scooter |

**Report Number:** RTZ210319001-00A

**Report Date:** 2021-04-15

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Product | Electric Scooter |
| Trade | GEN3, GEN3 |
| Tested Model | ELV1004 |
| Frequency Range | BLE: 2402-2480MHz |
| Maximum Conducted Peak Output Power | 2.99dBm |
| Modulation Technique | BLE: GFSK |
| Antenna Specification* | PCB Antenna: 0dBi(provided by the applicant) |
| Voltage Range | DC 42V from adapter or DC 37V from battery. |
| Date of Test | 2021-04-06 to 2021-04-12 |
| Sample serial number | RTZ210319001-RF-S1(Assigned by ATC) |
| Received date | 2021-03-25 |
| Sample/EUT Status | Good condition |
| Adapter information | Model: XSL88-4200200<br>INPUT: 100-240V, 50/60Hz, 2A<br>OUTPUT: 42V, 2A |

## Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

## 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.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

| Parameter | | Uncertainty |
|---|---|---|
| AC Power Lines Conducted Emissions | | ±2.72dB |
| Emissions, Radiated | 30MHz - 1GHz | ±4.28dB |
| | 1GHz- 18GHz | ±4.98dB |
| | 18GHz- 26.5GHz | ±5.06dB |

*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.*

## Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A-2.

# SYSTEM TEST CONFIGURATION

## Description of Test Configuration

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with Channel 0, 19 and 39.

## Equipment Modifications

No modification was made to the EUT tested.

## EUT Exercise Software

"EMI-TOOL 1.8.1"software was used during test and power level is 5dBm.

## Duty cycle

Test Result: Compliant. Please refer to the Appendix BLE.

## Support Equipment List and Details

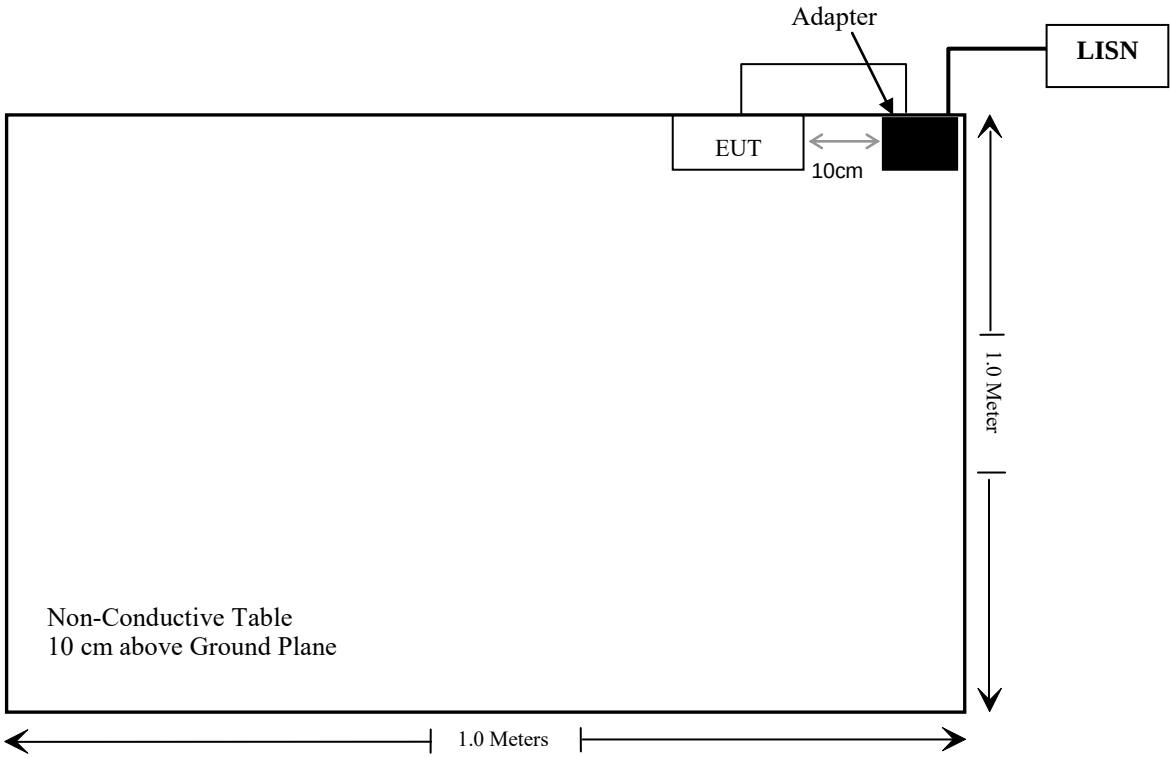
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| / | / | / | / |

## External I/O Cable

| Cable Description | Length (m) | From Port | To |
|---|---|---|---|
| Un-shielding Detachable DC Cable | 1.5 | Adapter | EUT |

## Block Diagram of Test Setup

For conducted emission:



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| §1.1307 (b) (1)& §2.1093 | 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 & Occupied Bandwidth | Compliance |
| §15.247(b)(3) | Maximum Conducted Output Power | Compliance |
| §15.247(d) | 100 kHz Bandwidth of Frequency Band Edge | Compliance |
| §15.247(e) | Power Spectral Density | Compliance |

# TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **Conducted Emissions Test** | | | | | |
| Rohde & Schwarz | Test Receiver | ESPI3 | 100396 | 2020/12/24 | 2021/12/23 |
| R & S | L.I.S.N. | ENV216 | 101314 | 2020/12/25 | 2021/12/24 |
| Rohde & Schwarz | Pulse Limiter | ESH3-Z2 | 100815 | 2020/12/25 | 2021/12/24 |
| Anritsu Corp | 50Ω Coaxial Switch | MP59B | 6200506474 | 2020/12/25 | 2021/12/24 |
| RF Coaxial Cable | Unknown | N-2m | No.2 | 2020/12/25 | 2021/12/24 |
| **Radiated Emissions Test** | | | | | |
| Rohde&Schwarz | Test Receiver | ESR | 101817 | 2020/12/24 | 2021/12/23 |
| Rohde & Schwarz | Spectrum Analyzer | FSV-40 | 101495 | 2020/12/24 | 2021/12/23 |
| A.H. Systems, inc. | Preamplifier | PAM-0118P | 531 | 2020/07/08 | 2021/07/07 |
| SONOMA INSTRUMENT | Amplifier | 310 N | 186131 | 2020/12/25 | 2021/12/24 |
| Schwarzbeck | Bilog Antenna | VULB9163 | 9163-323 | 2020/01/04 | 2023/01/03 |
| Schwarzbeck | Horn Antenna | BBHA9120D | 9120D-1067 | 2020/01/05 | 2023/01/04 |
| Schwarzbeck | Horn Antenna | BBHA9170 | 9170-359 | 2020/01/05 | 2023/01/04 |
| Quinstar | Amplifier | QLW-18405536-J0 | 15964001002 | 2020/11/28 | 2021/11/27 |
| RF Coaxial Cable | Unknown | N-5m | No.3 | 2020/12/25 | 2021/12/24 |
| RF Coaxial Cable | Unknown | N-5m | No.4 | 2020/12/25 | 2021/12/24 |
| RF Coaxial Cable | Unknown | N-1m | No.5 | 2020/12/25 | 2021/12/24 |
| RF Coaxial Cable | Unknown | N-1m | No.6 | 2020/12/25 | 2021/12/24 |
| **RF Conducted Test** | | | | | |
| Rohde & Schwarz | Spectrum Analyzer | FSV-40 | 101495 | 2020/12/24 | 2021/12/23 |
| WEINSCHEL | 10dB Attenuator | 5324 | AU 3842 | Each time | |

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

# FCC §15.247 (i), §1.1307 (b) (1) & §2.1093 – RF EXPOSURE

## Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

## Test Result:

**For worst case:**

| Mode | Frequency (MHz) | Maximum Tune-up power | | Calculated Distance (mm) | Calculated Value | Threshold (1-g SAR) | SAR Test Exclusion |
|---|---|---|---|---|---|---|---|
| | | (dBm) | (mW) | | | | |
| **BLE** | 2480 | 3 | 2.00 | 5 | 0.6 | 3.0 | Yes |

**Result: No Standalone SAR test is required**

# FCC §15.203 - ANTENNA REQUIREMENT

## 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. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
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 exceeds 6 dBi.

## Antenna Connector Construction

The EUT has one internal antenna arrangement which was permanently attached and the antenna gain is 0dBi, fulfill the requirement of this section. Please refer to the product photos.

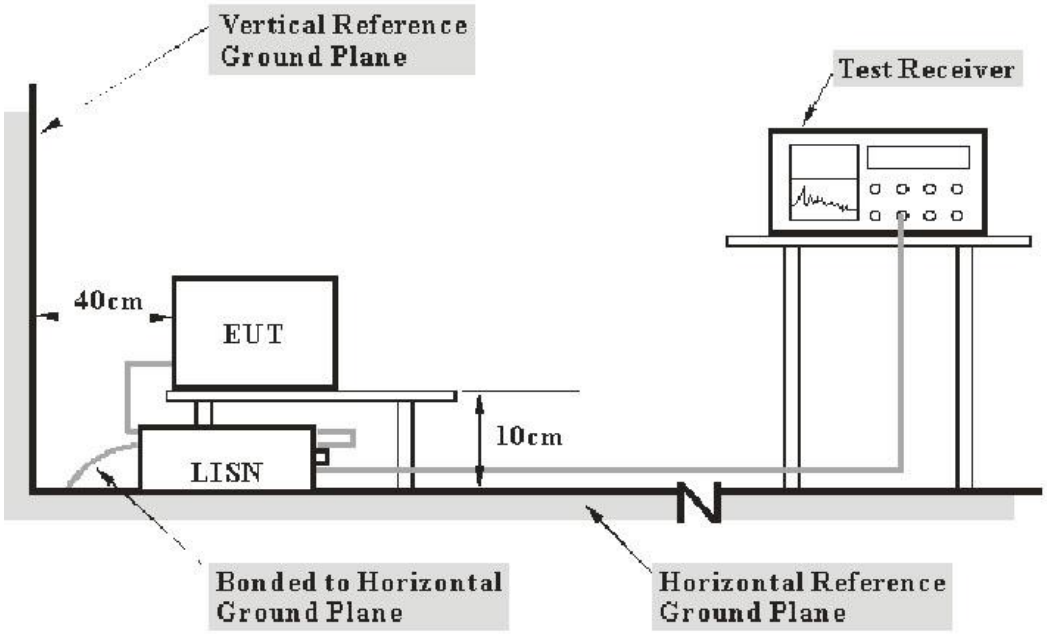
**Result:** Compliance.

# FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

## Applicable Standard

FCC§15.207

## EUT Setup




Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 10 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.

The spacing between the peripherals was 10 cm.

## EMI Test Receiver Setup

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

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

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

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

## Transd Factor & Margin Calculation

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

Transd Factor = LISN VDF + Cable Loss

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 = Limit – level
Level= reading level+ Transd Factor

## Test Data

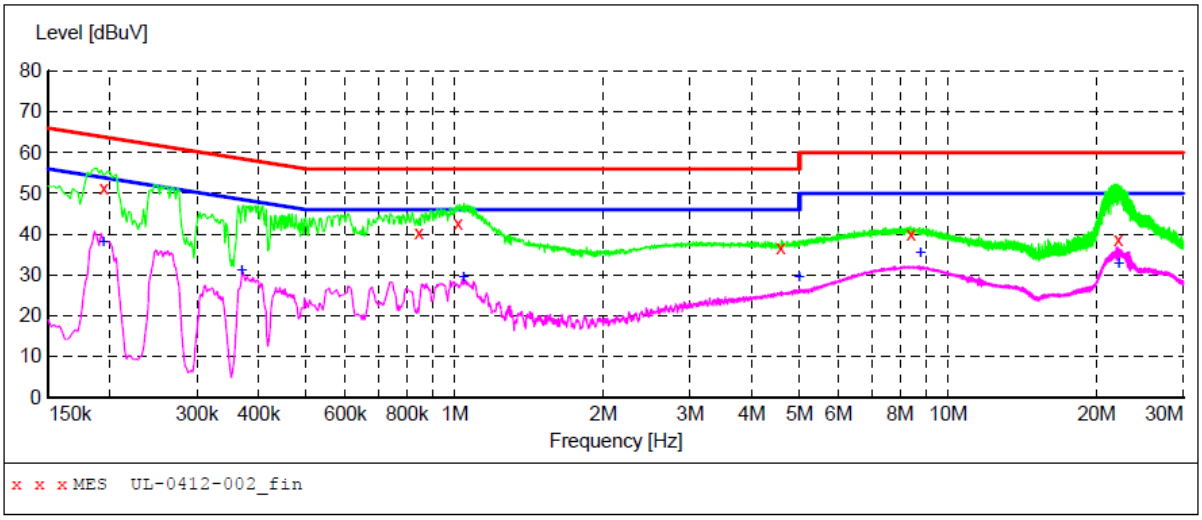
### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 48 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Ding on 2021-04-12.*

*EUT operation mode: Transmitting (Worst case as below)*

**AC 120V/60 Hz, Line**




***MEASUREMENT RESULT: "UL-0412-002_fin"***

4/12/2021 4:25PM

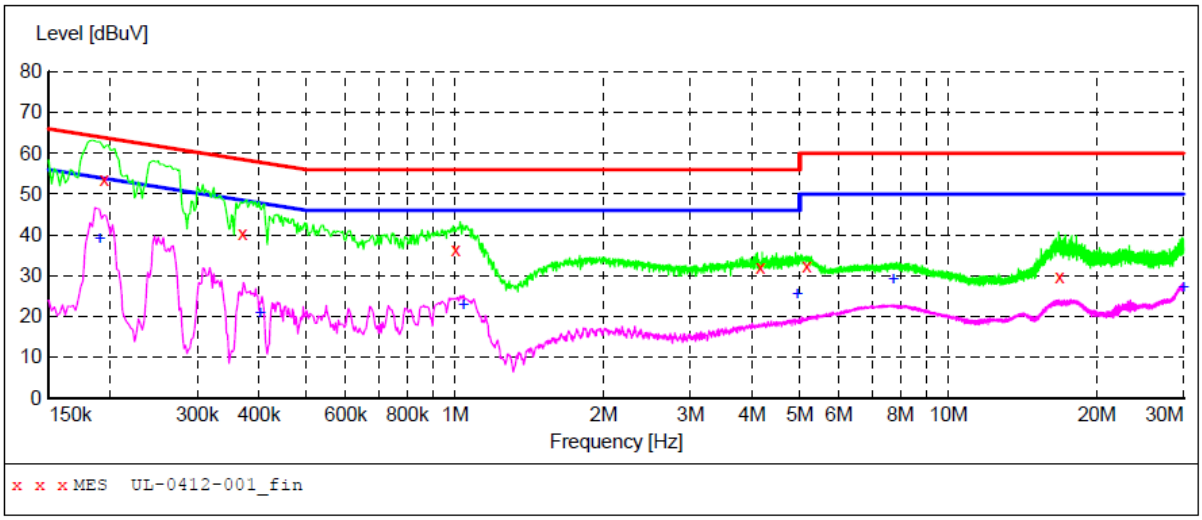
| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.194000 | 51.20 | 10.1 | 64 | 12.8 | QP | L1 | GND |
| 0.846000 | 40.50 | 10.1 | 56 | 15.5 | QP | L1 | GND |
| 1.014000 | 42.80 | 10.1 | 56 | 13.2 | QP | L1 | GND |
| 4.574000 | 36.50 | 10.1 | 56 | 19.5 | QP | L1 | GND |
| 8.402000 | 40.10 | 10.2 | 60 | 19.9 | QP | L1 | GND |
| 22.146000 | 38.50 | 10.3 | 60 | 21.5 | QP | L1 | GND |

***MEASUREMENT RESULT: "UL-0412-002_fin2"***

4/12/2021 4:25PM

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.194000 | 38.10 | 10.1 | 54 | 15.9 | AV | L1 | GND |
| 0.370000 | 30.90 | 10.1 | 49 | 18.1 | AV | L1 | GND |
| 1.042000 | 29.30 | 10.1 | 46 | 16.7 | AV | L1 | GND |
| 4.990000 | 29.30 | 10.1 | 46 | 16.7 | AV | L1 | GND |
| 8.794000 | 35.50 | 10.2 | 50 | 14.5 | AV | L1 | GND |
| 22.190000 | 32.70 | 10.3 | 50 | 17.3 | AV | L1 | GND |

**AC 120V/60 Hz, Neutral**




***MEASUREMENT RESULT: "UL-0412-001_fin"***

4/12/2021 4:00PM

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.194000 | 53.50 | 10.1 | 64 | 10.5 | QP | N | GND |
| 0.370000 | 40.30 | 10.1 | 59 | 18.7 | QP | N | GND |
| 1.002000 | 36.20 | 10.1 | 56 | 19.8 | QP | N | GND |
| 4.154000 | 32.10 | 10.1 | 56 | 23.9 | QP | N | GND |
| 5.162000 | 32.40 | 10.1 | 60 | 27.6 | QP | N | GND |
| 16.806000 | 29.60 | 10.3 | 60 | 30.4 | QP | N | GND |

***MEASUREMENT RESULT: "UL-0412-001_fin2"***

4/12/2021 4:00PM

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.190000 | 39.00 | 10.1 | 54 | 15.0 | AV | N | GND |
| 0.402000 | 20.80 | 10.1 | 48 | 27.2 | AV | N | GND |
| 1.038000 | 22.70 | 10.1 | 46 | 23.3 | AV | N | GND |
| 4.938000 | 25.30 | 10.1 | 46 | 20.7 | AV | N | GND |
| 7.726000 | 29.00 | 10.2 | 50 | 21.0 | AV | N | GND |
| 29.974000 | 27.10 | 10.2 | 50 | 22.9 | AV | N | GND |

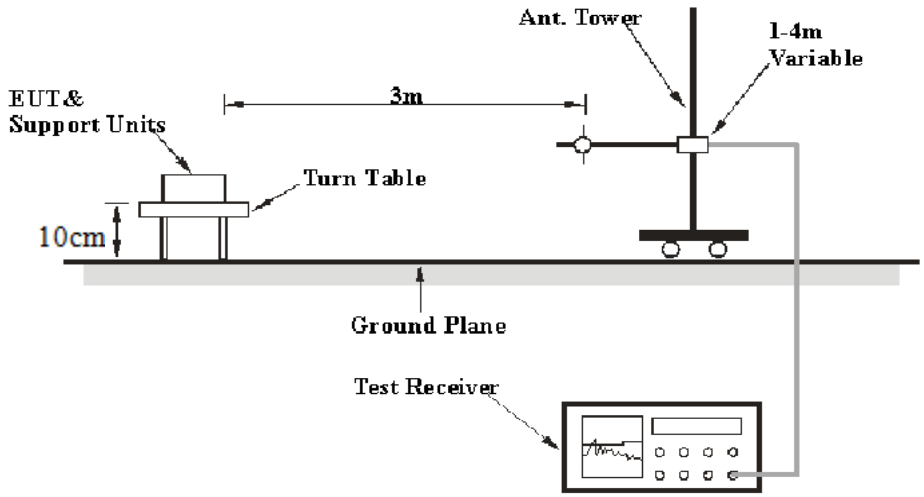
# FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

## Applicable Standard

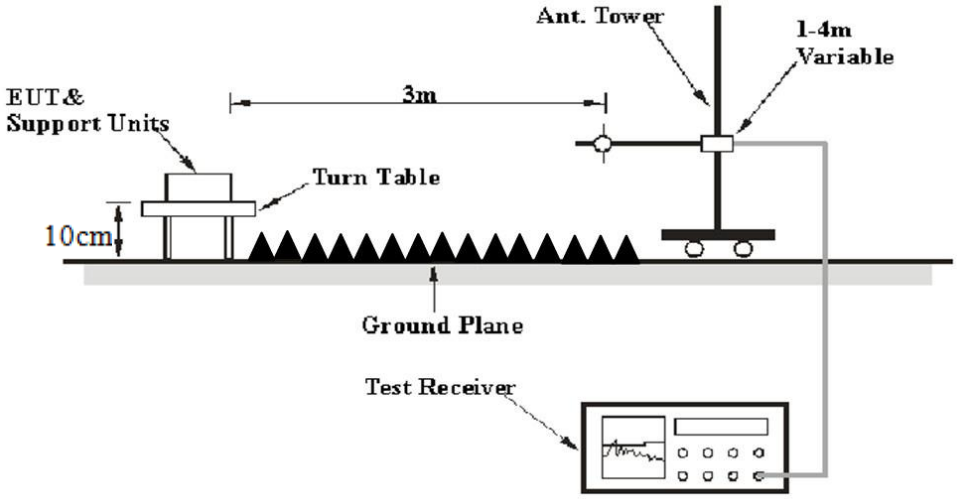
FCC §15.247 (d); §15.209; §15.205;

## EUT Setup

**Below 1 GHz:**




**Above 1GHz:**




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

## EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range | RBW | Video B/W | IF B/W | Measurement |
|---|---|---|---|---|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz | 120 kHz | QP |
| Above 1 GHz | 1MHz | 3 MHz | / | PK |
| | 1MHz | 10 Hz Note 1 | / | Average |
| | 1MHz | ＞1/T Note 2 | / | Average |

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

## Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

## Factor & Margin Calculation

The 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:

Factor = Meter Reading + 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 -7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Result-Limit
Result = Reading + Factor

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 48 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Ding on 2021-04-08.*

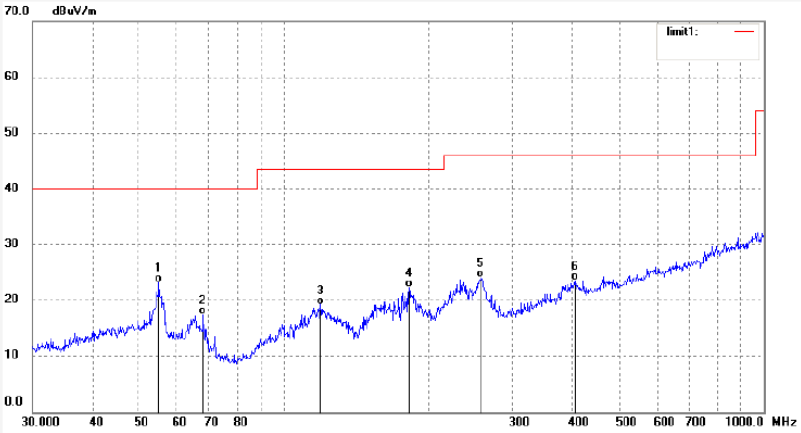
*EUT operation mode: Transmitting*
***18~25GHz**: The test values lower than the limits of 20dB or in the noise floor level, the test data were not recorded in the report.*

**BLE:**

**30 MHz~1 GHz:**

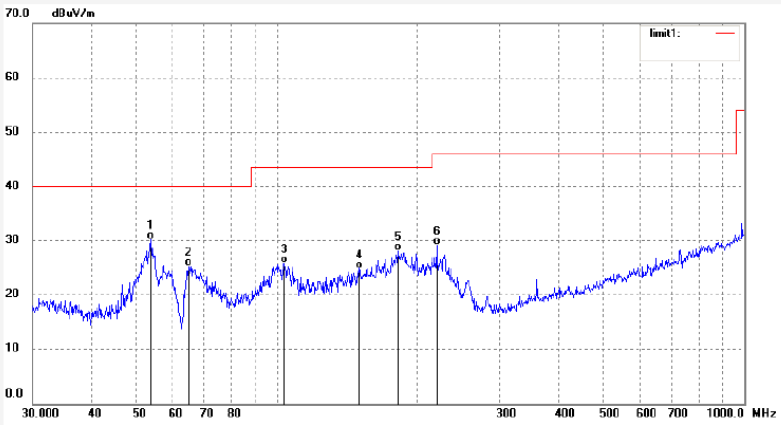
**TX 2402MHz (worst case):**

**Horizontal**




| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 55.0274 | 34.47 | -11.36 | 23.11 | 40.00 | -16.89 | QP | | | |
| 2 | 67.9129 | 31.55 | -14.17 | 17.38 | 40.00 | -22.62 | QP | | | |
| 3 | 119.4361 | 31.19 | -11.94 | 19.25 | 43.50 | -24.25 | QP | | | |
| 4 | 182.5592 | 34.37 | -12.07 | 22.30 | 43.50 | -21.20 | QP | | | |
| 5 | 257.4222 | 34.22 | -10.11 | 24.11 | 46.00 | -21.89 | QP | | | |
| 6 | 404.6665 | 29.19 | -5.70 | 23.49 | 46.00 | -22.51 | QP | | | |

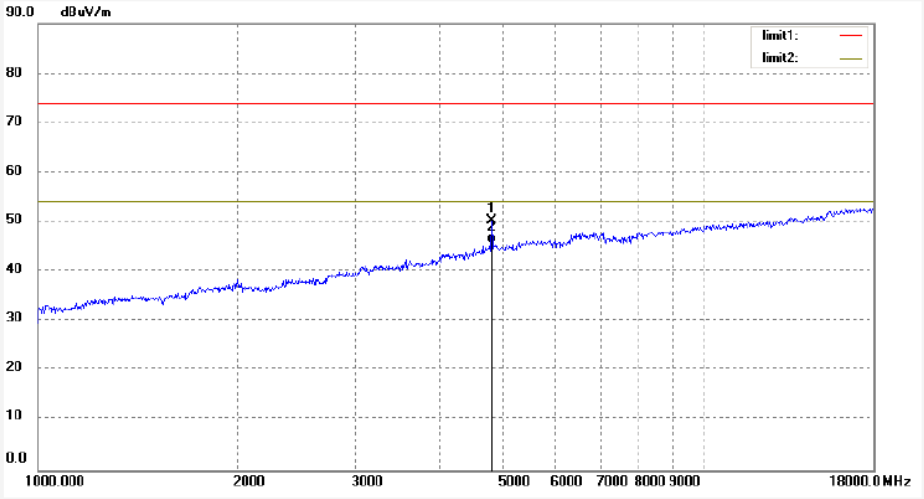
**Vertical**




| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 53.6932 | 41.74 | -11.54 | 30.20 | 40.00 | -9.80 | QP | | | |
| 2 | 64.6594 | 39.61 | -14.27 | 25.34 | 40.00 | -14.66 | QP | | | |
| 3 | 103.8055 | 38.24 | -12.43 | 25.81 | 43.50 | -17.69 | QP | | | |
| 4 | 150.0108 | 39.02 | -14.17 | 24.85 | 43.50 | -18.65 | QP | | | |
| 5 | 181.9202 | 40.21 | -12.16 | 28.05 | 43.50 | -15.45 | QP | | | |
| 6 | 219.8449 | 39.90 | -10.84 | 29.06 | 46.00 | -16.94 | QP | | | |

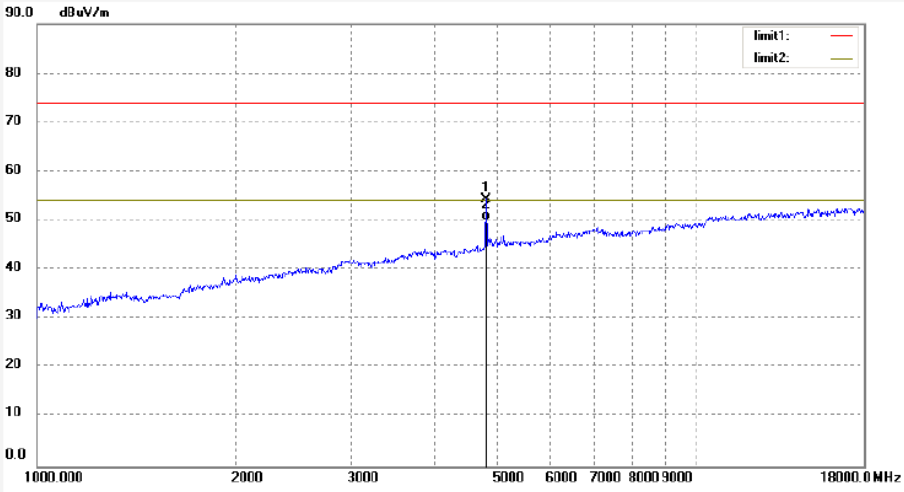
**Above 1 GHz:**

**2402MHz**
**Horizontal**



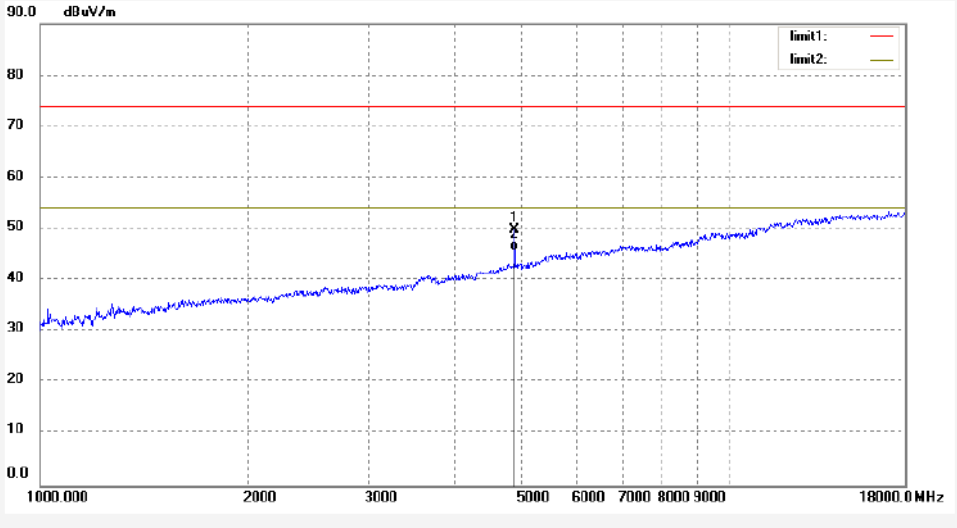

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4804.110 | 47.49 | 2.81 | 50.30 | 74.00 | -23.70 | peak | | | |
| 2 | 4804.110 | 42.96 | 2.81 | 45.77 | 54.00 | -8.23 | AVG | | | |

**Vertical**



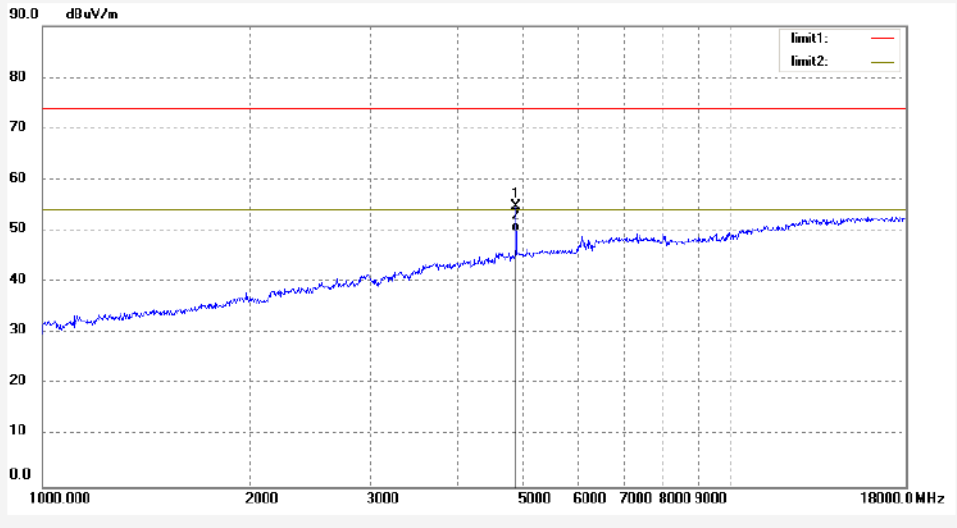

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4804.110 | 51.55 | 2.81 | 54.36 | 74.00 | -19.64 | peak | | | |
| 2 | 4804.110 | 47.26 | 2.81 | 50.07 | 54.00 | -3.93 | AVG | | | |

**2440MHz**
**Horizontal**



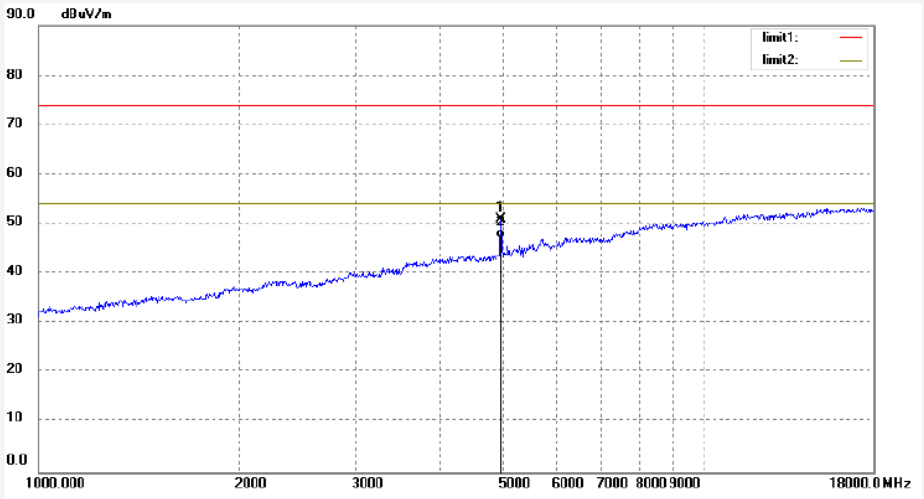

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4888.151 | 46.81 | 3.06 | 49.87 | 74.00 | -24.13 | peak | | | |
| 2 | 4888.151 | 42.76 | 3.06 | 45.82 | 54.00 | -8.18 | AVG | | | |

**Vertical**



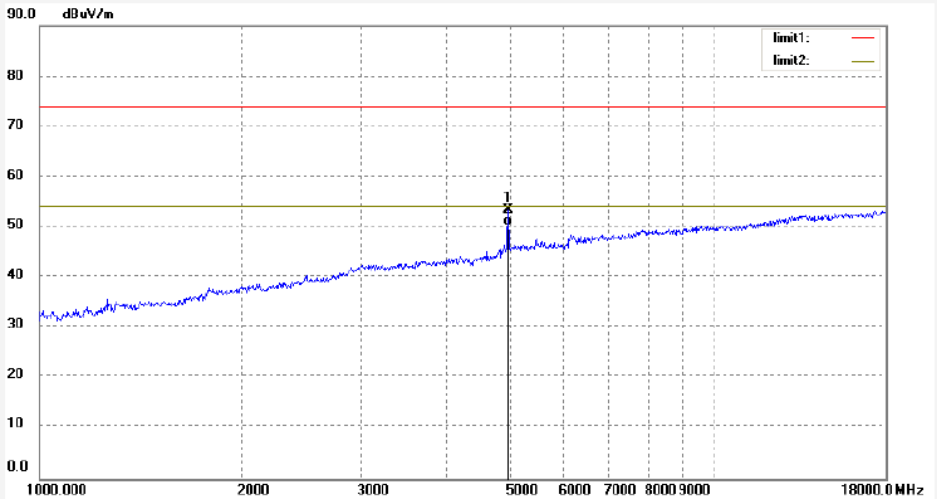

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4888.151 | 51.73 | 3.06 | 54.79 | 74.00 | -19.21 | peak | | | |
| 2 | 4888.151 | 46.87 | 3.06 | 49.93 | 54.00 | -4.07 | AVG | | | |

**2480MHz**
**Horizontal**



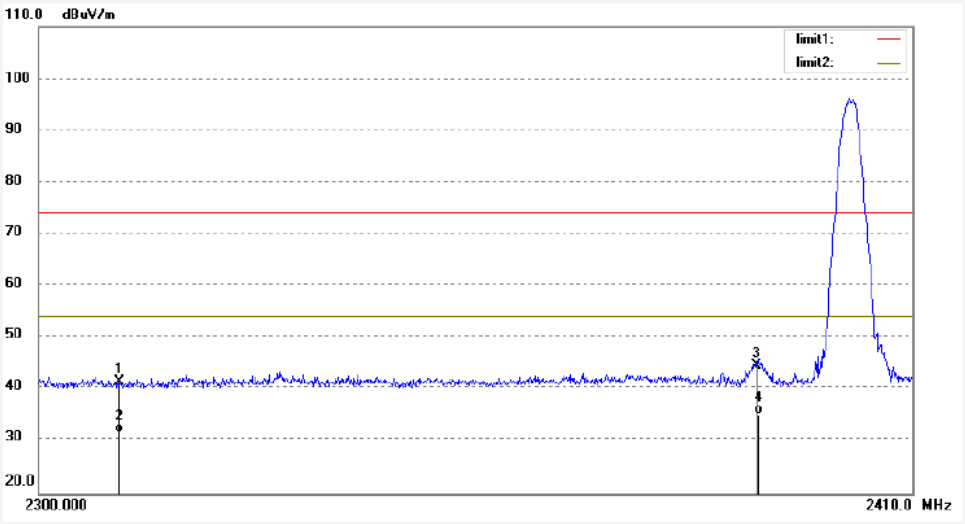

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4959.307 | 47.62 | 3.28 | 50.90 | 74.00 | -23.10 | peak | | | |
| 2 | 4959.307 | 43.75 | 3.28 | 47.03 | 54.00 | -6.97 | AVG | | | |

**Vertical**



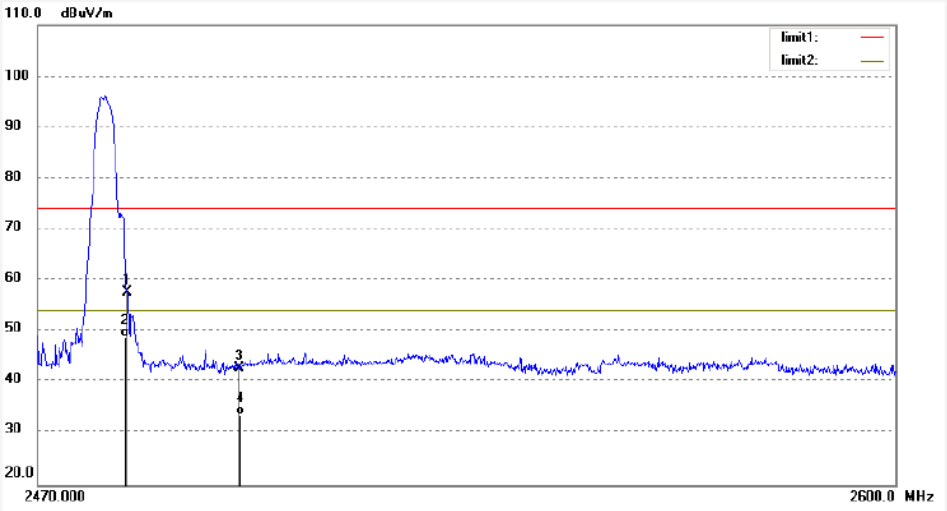

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4959.307 | 50.25 | 3.28 | 53.53 | 74.00 | -20.47 | peak | | | |
| 2 | 4959.307 | 46.92 | 3.28 | 50.20 | 54.00 | -3.80 | AVG | | | |

## Band Edge, Left Side




| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2310.000 | 48.30 | -6.84 | 41.46 | 74.00 | -32.54 | peak | | | |
| 2 | 2310.000 | 38.47 | -6.84 | 31.63 | 54.00 | -22.37 | AVG | | | |
| 3 | 2390.000 | 51.16 | -6.44 | 44.72 | 74.00 | -29.28 | peak | | | |
| 4 | 2390.000 | 41.63 | -6.44 | 35.19 | 54.00 | -18.81 | AVG | | | |

## Band Edge, Right Side




| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 63.73 | -5.96 | 57.77 | 74.00 | -16.23 | peak | | | |
| 2 | 2483.500 | 54.86 | -5.96 | 48.90 | 54.00 | -5.10 | AVG | | | |
| 3 | 2500.000 | 48.74 | -5.88 | 42.86 | 74.00 | -31.14 | peak | | | |
| 4 | 2500.000 | 39.45 | -5.88 | 33.57 | 54.00 | -20.43 | AVG | | | |

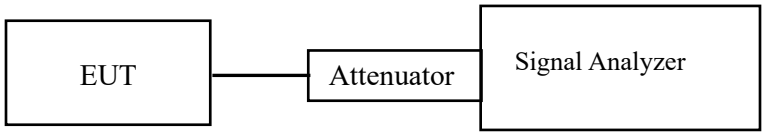
# FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

## Applicable Standard

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.

## Test Procedure

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 it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 48 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Ding on 2021-04-06.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix BLE.

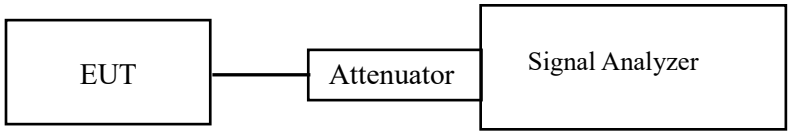
# FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

## Applicable Standard

According to FCC §15.247(b) (3), for 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.

## Test Procedure

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 one test equipment.
3. Add a correction factor to the display.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 48 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Ding on 2021-04-06.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix BLE.

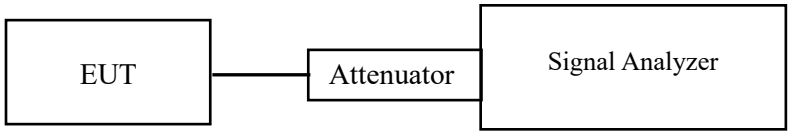
# FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

## Applicable Standard

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)).

## Test Procedure

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.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 48 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Ding on 2021-04-06.*

*EUT operation mode: Transmitting*

Test Result: Compliant.

### Conducted Band Edge Result:

Please refer to the Appendix BLE.

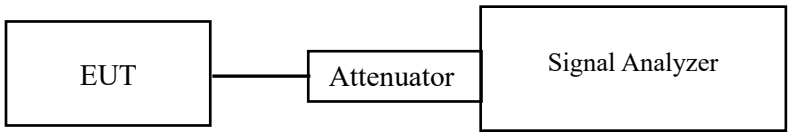
# FCC §15.247(e) - POWER SPECTRAL DENSITY

## Applicable Standard

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.

## Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
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 limit, reduce RBW (no less than 3 kHz) and repeat.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 48 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Ding on 2021-04-06.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix BLE.

# APPENDIX BLE

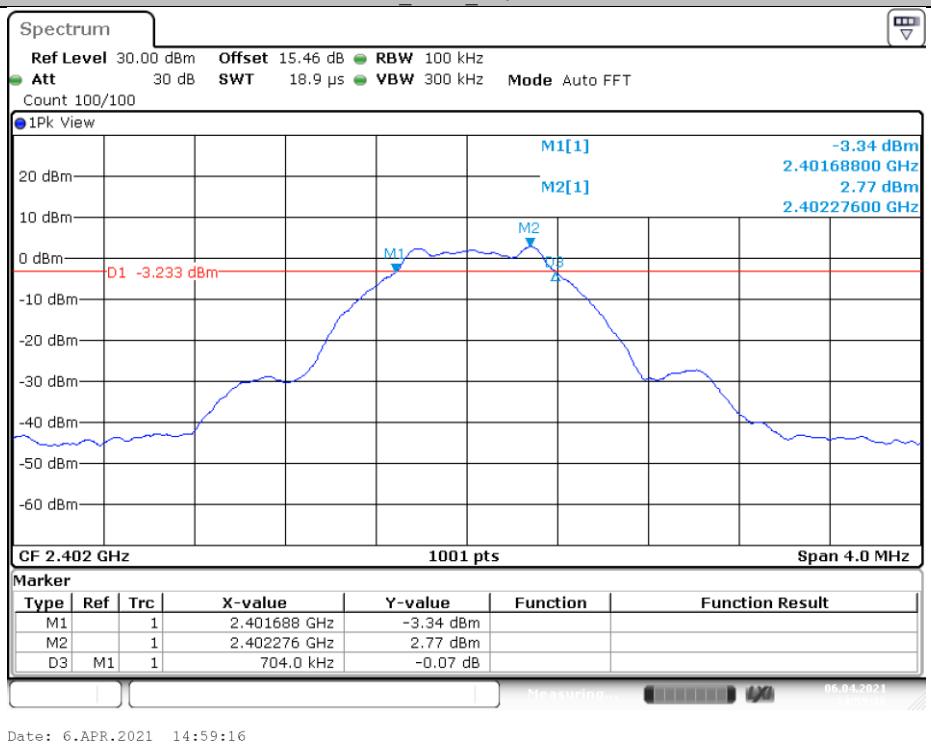
## Appendix A: 6dB Emission Bandwidth

### Test Result

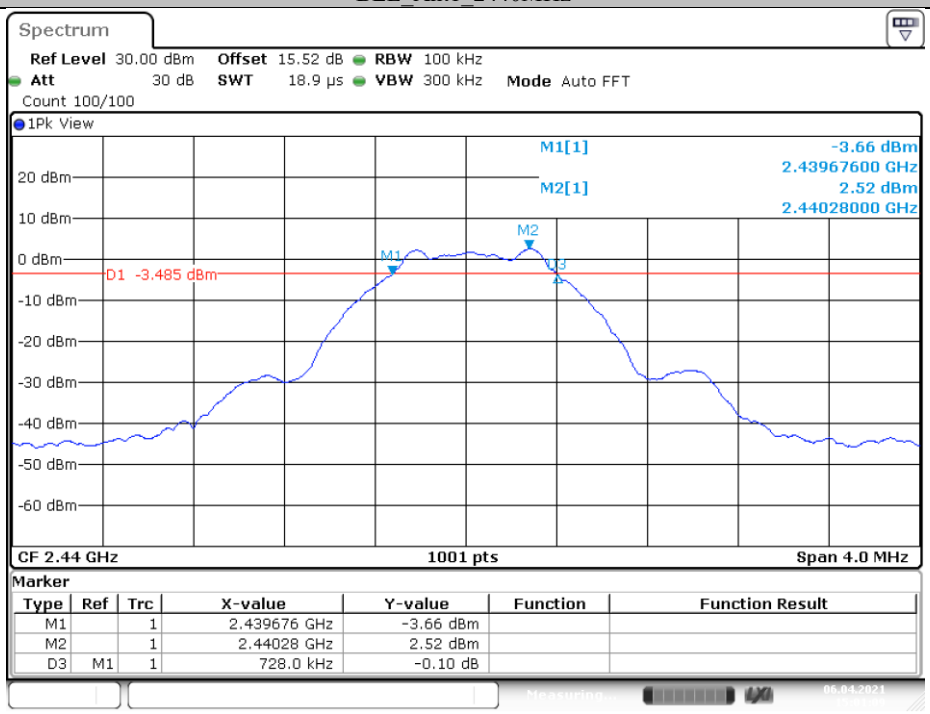
| Test Mode | Antenna | Channel [MHz] | DTS BW [MHz] | Limit[MHz] | Verdict |
|---|---|---|---|---|---|
| BLE_1M | Ant1 | 2402 | 0.704 | 0.5 | PASS |
| | | 2440 | 0.728 | 0.5 | PASS |
| | | 2480 | 0.712 | 0.5 | PASS |

### Test Graphs

BLE_ Ant1_2402MHz

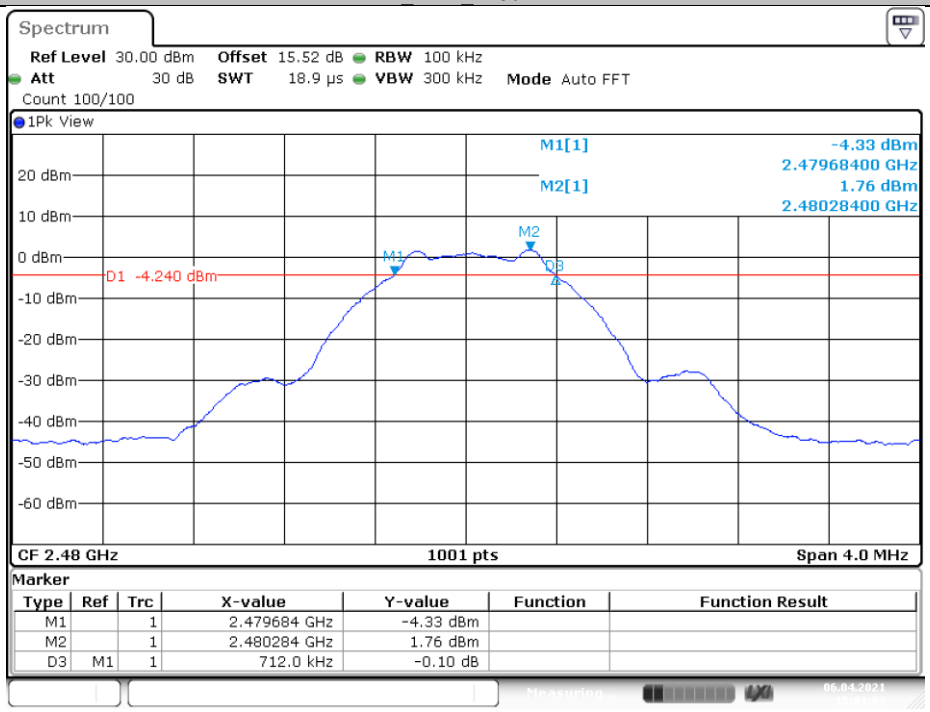


BLE_Ant1_2440MHz




Date: 6.APR.2021 15:01:10

BLE_Ant1_2480MHz




Date: 6.APR.2021 15:03:04

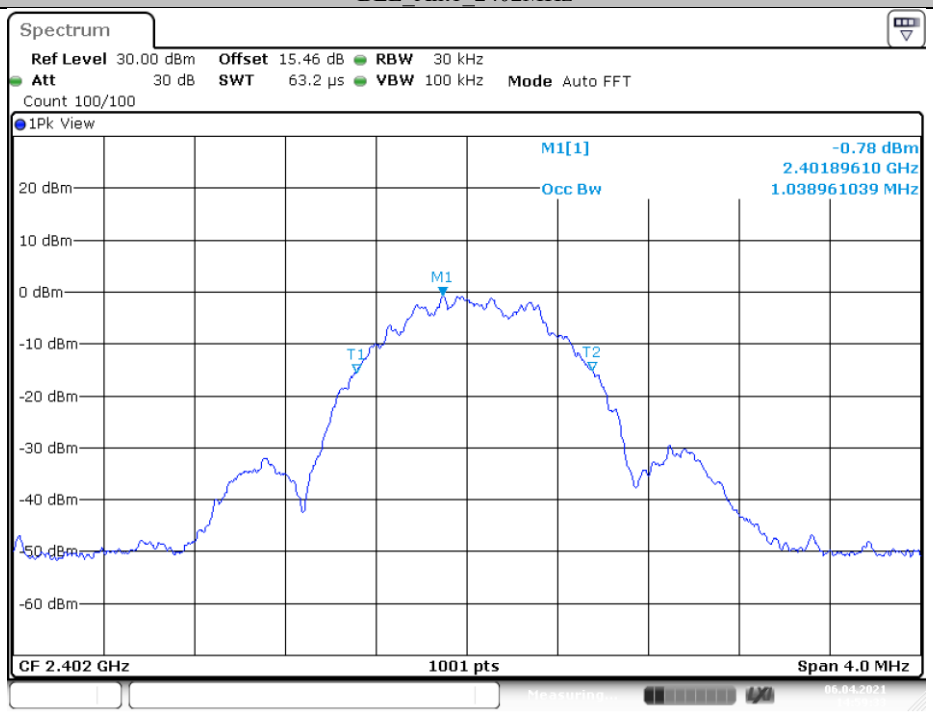
# Appendix B: Occupied Channel Bandwidth

## Test Result

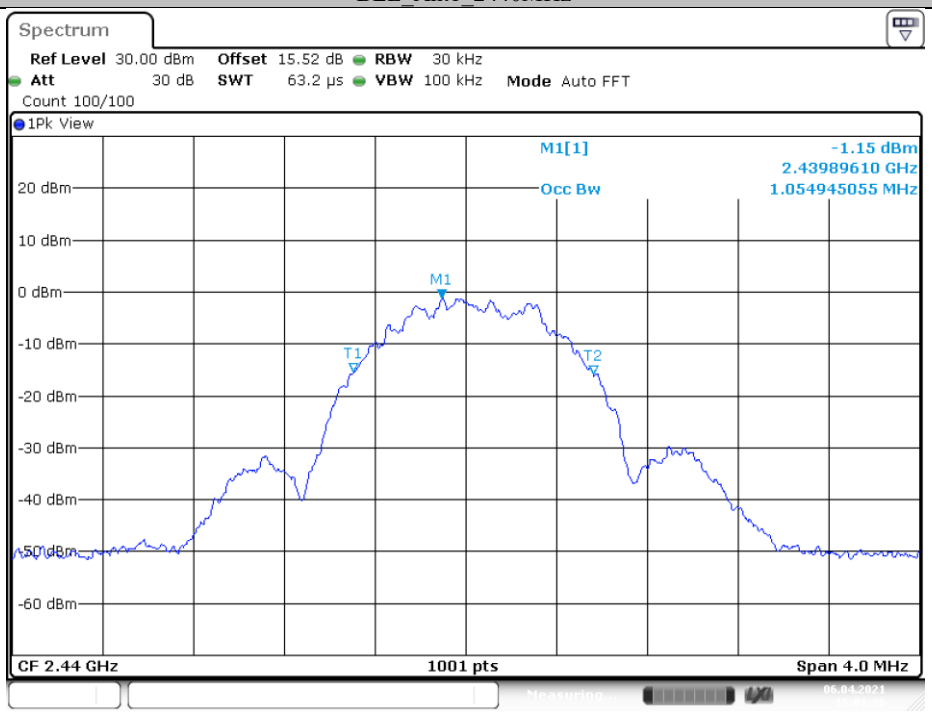
| TestMode | Antenna | Channel [MHz] | OCB [MHz] | Limit[dBm] | Verdict |
|---|---|---|---|---|---|
| BLE_1M | Ant1 | 2402 | 1.039 | --- | PASS |
| | | 2440 | 1.055 | --- | PASS |
| | | 2480 | 1.047 | --- | PASS |

## Test Graphs

BLE_Ant1_2402MHz

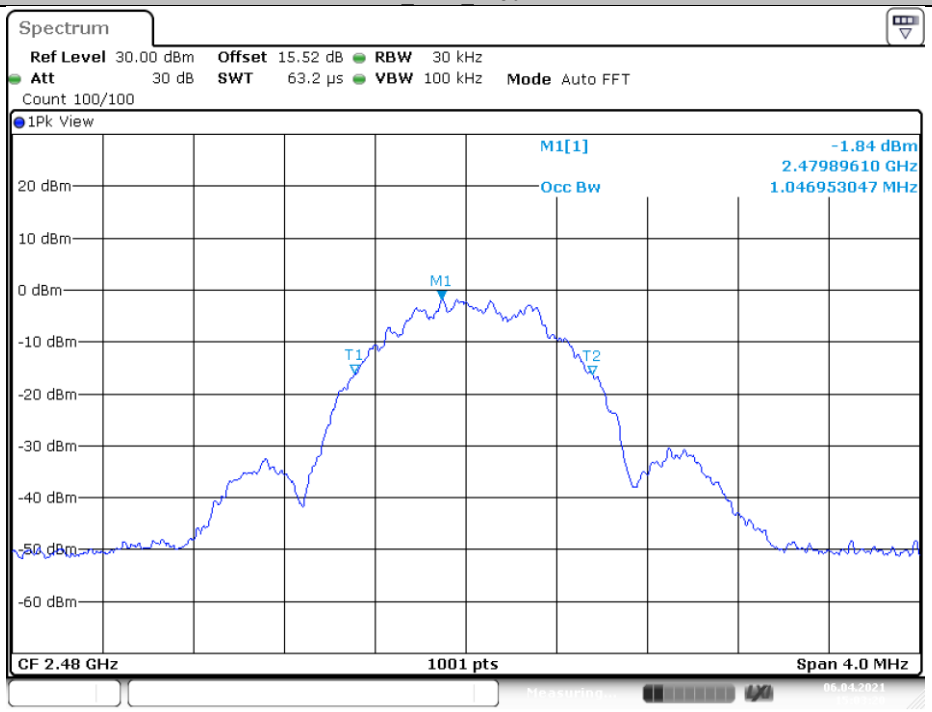


BLE_Ant1_2440MHz




Date: 6.APR.2021 15:01:27

BLE_Ant1_2480MHz




Date: 6.APR.2021 15:03:21

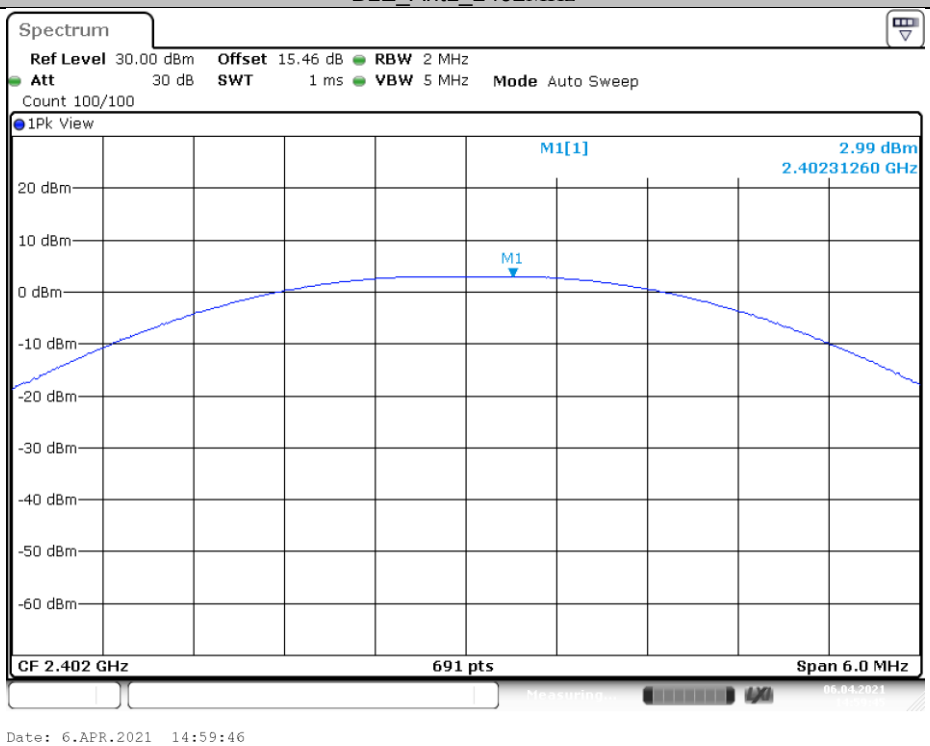
# Appendix C: Maximum conducted output power

## Test Result

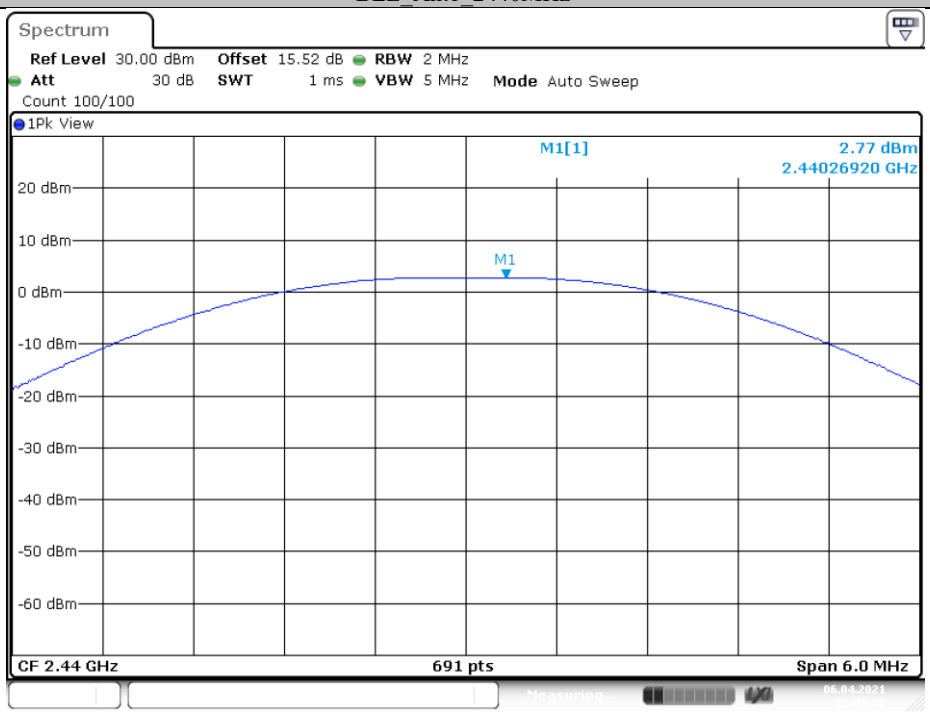
| Test Mode | Antenna | Channel [MHz] | Result[dBm] | Limit[dBm] | Verdict |
|---|---|---|---|---|---|
| BLE_1M | Ant1 | 2402 | 2.99 | <=30 | PASS |
| | | 2440 | 2.77 | <=30 | PASS |
| | | 2480 | 2.09 | <=30 | PASS |

## Test Graphs

BLE_Ant1_2402MHz

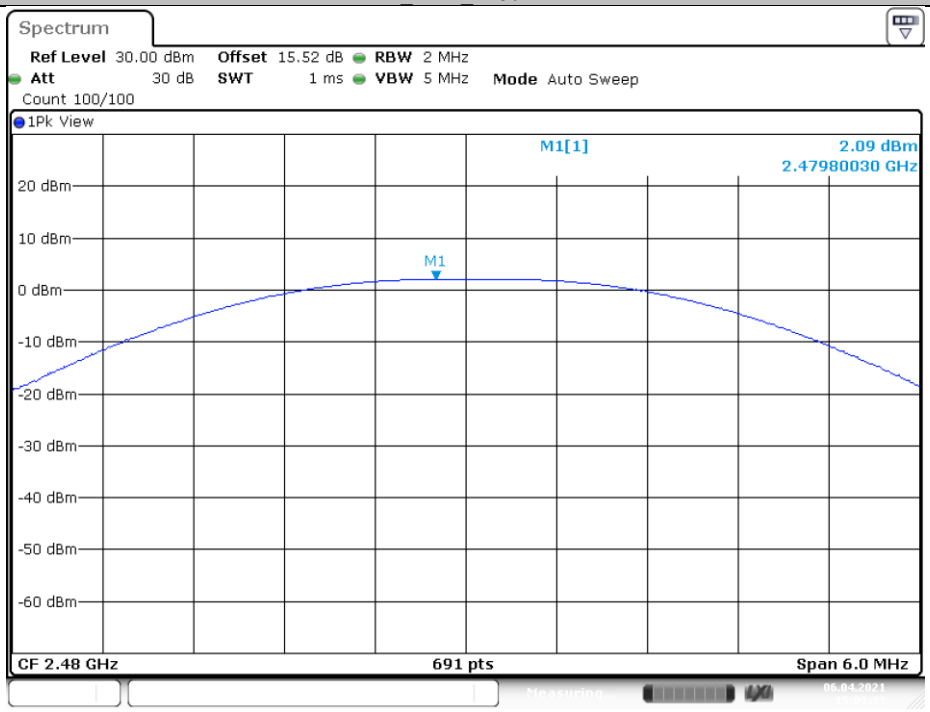


BLE_Ant1_2440MHz




Date: 6.APR.2021 15:01:39

BLE_Ant1_2480MHz




Date: 6.APR.2021 15:03:33

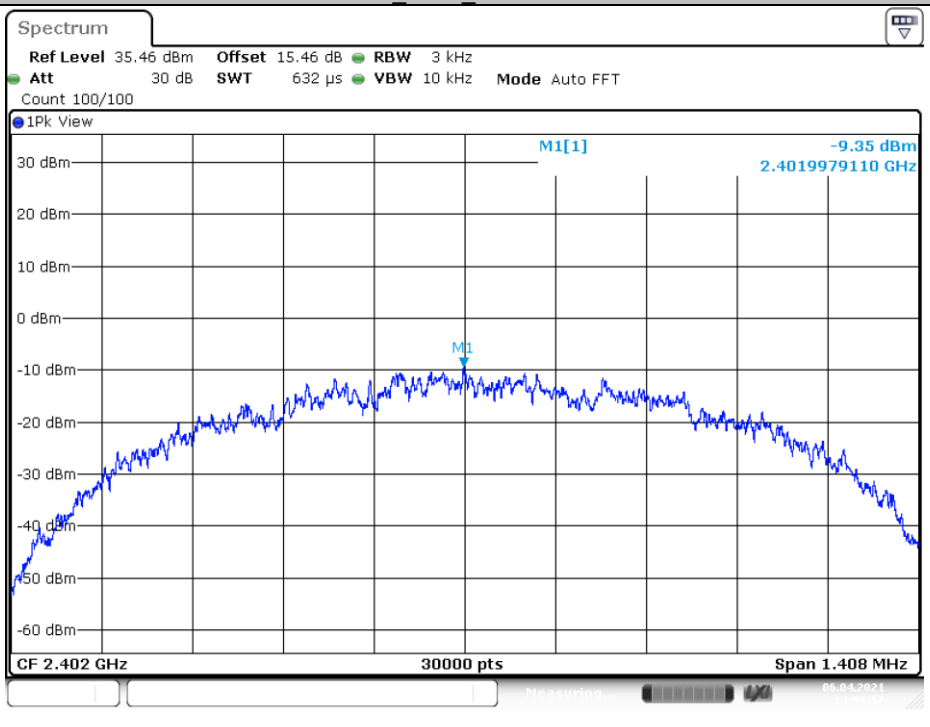
# Appendix D: Power spectral density

## Test Result

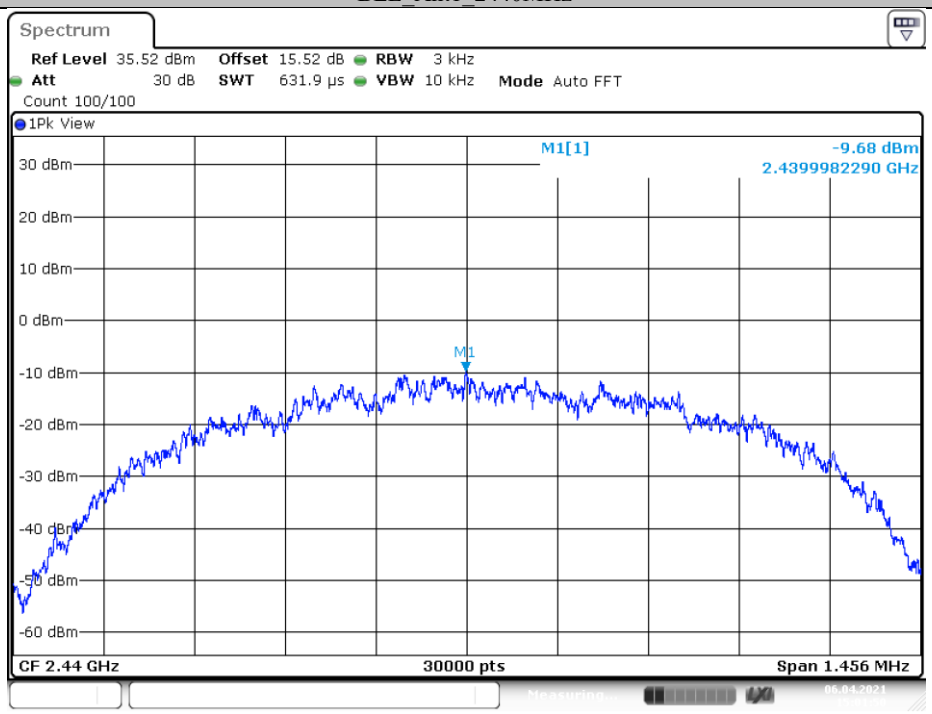
| Test Mode | Antenna | Channel[MHz] | Result[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|---|---|---|---|---|---|
| BLE_1M | Ant1 | 2402 | -9.35 | <=8 | PASS |
| | | 2440 | -9.68 | <=8 | PASS |
| | | 2480 | -10.35 | <=8 | PASS |

## Test Graphs

BLE_ Ant1_2402MHz



BLE_Ant1_2440MHz

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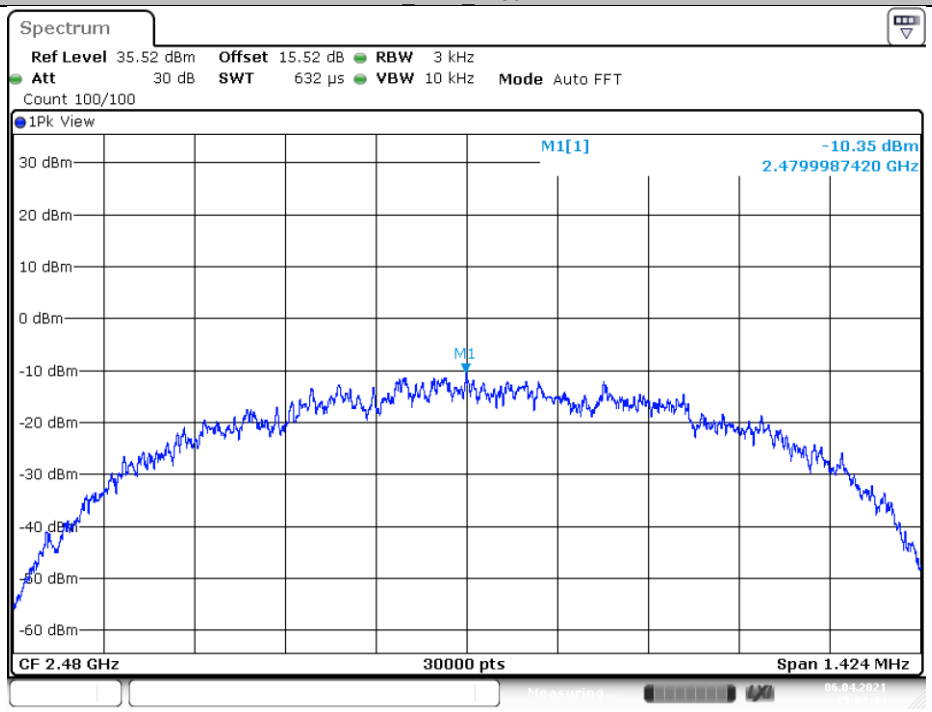
BLE_Ant1_2480MHz

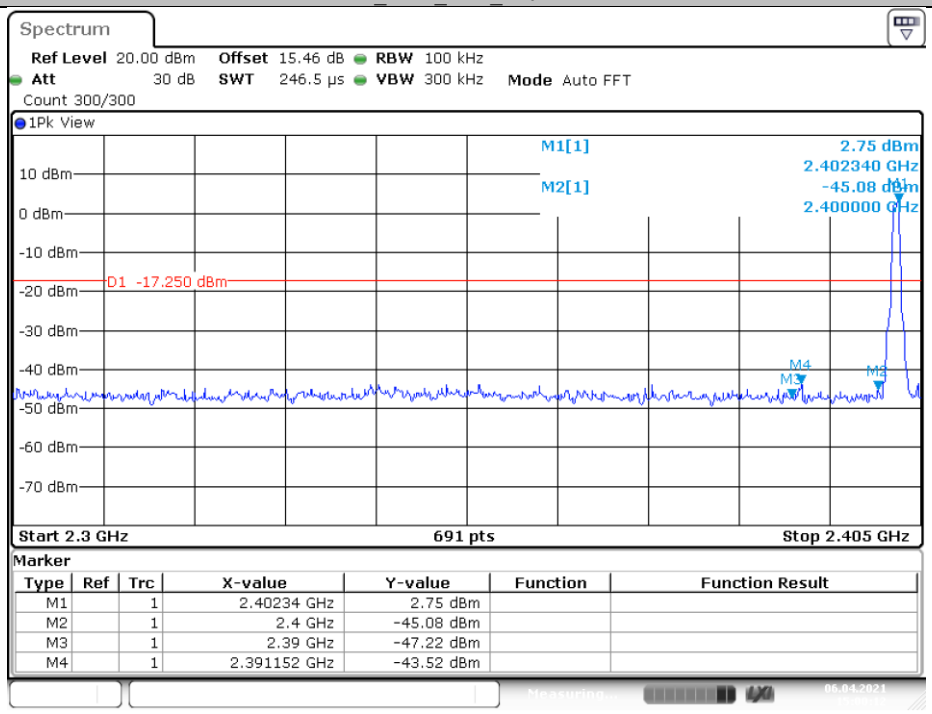



Date: 6.APR.2021 15:03:45

# Appendix E: Band edge measurements

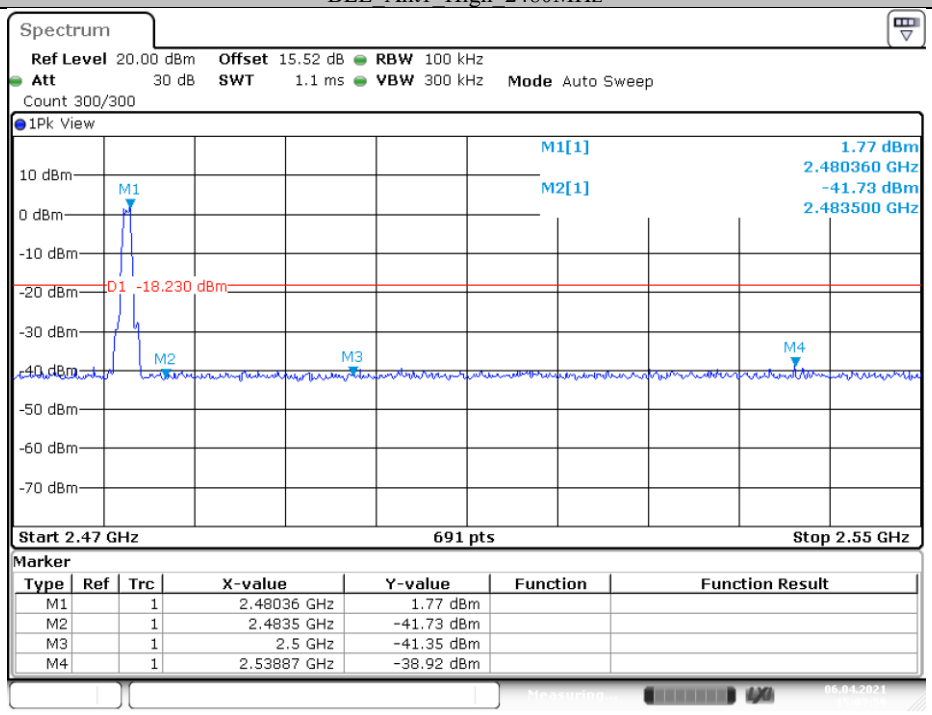
## Test Graphs

BLE_Ant1_Low_2402MHz




Date: 6.APR.2021 15:00:12

BLE_Ant1_High_2480MHz




Date: 6.APR.2021 15:04:00

# Appendix F: Duty Cycle

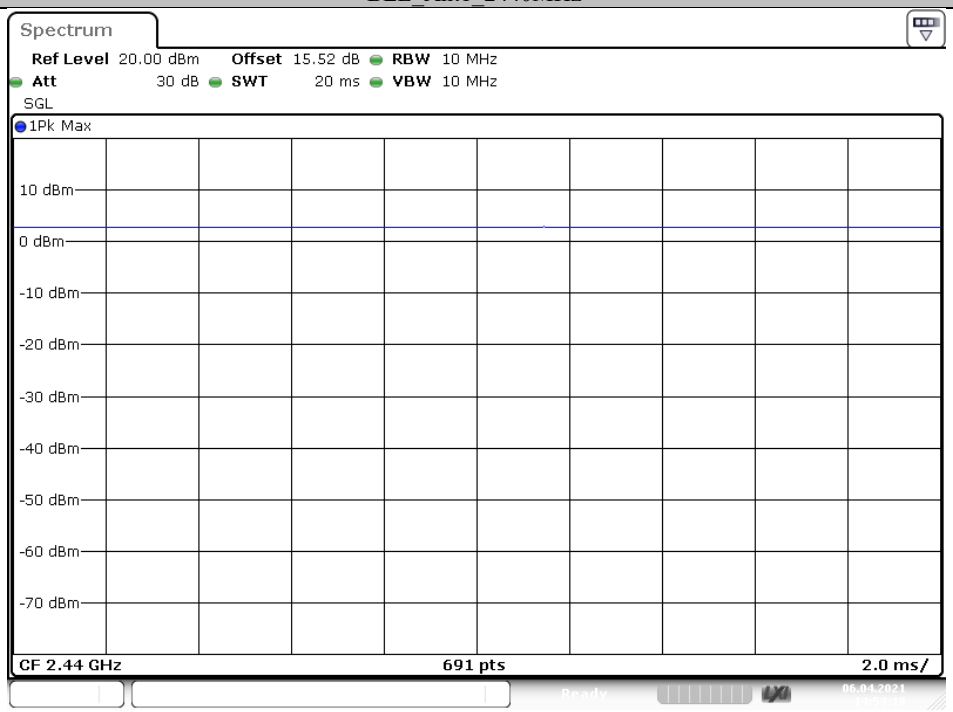
## Test Result

| Test Mode | Antenna | Channel [MHz] | Transmission Duration [ms] | Transmission Period [ms] | Duty Cycle [%] |
|---|---|---|---|---|---|
| BLE_1M | Ant1 | 2402 | 20.00 | 20.00 | 100.00 |
| | | 2440 | 20.00 | 20.00 | 100.00 |
| | | 2480 | 20.00 | 20.00 | 100.00 |

## Test Graphs

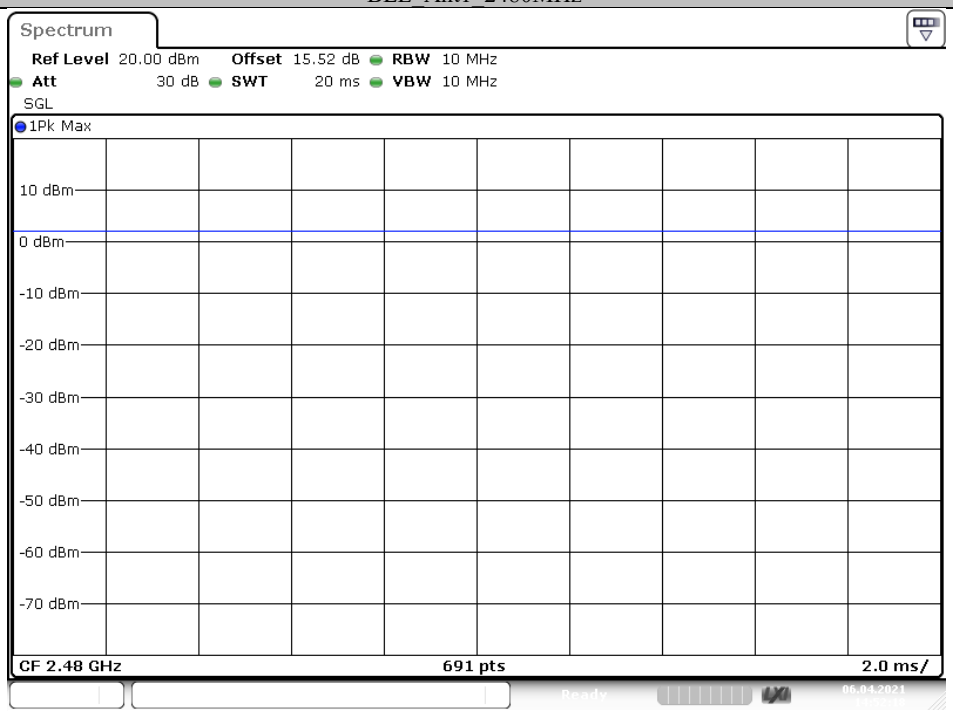
BLE_Ant1_2402MHz

BLE_Ant1_2440MHz




Date: 6.APR.2021 14:53:20

BLE_Ant1_2480MHz




Date: 6.APR.2021 14:52:18

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