# TEST REPORT

| | |
|---|---|
| Applicant Name : | ORAIMO TECHNOLOGY LIMITED |
| Address : | FLAT N 16/F BLOCK B UNIVERSAL INDUSTRIAL CENTRE 19-25 SHAN MEI STREET FOTAN NT HONGKONG |
| Report Number : | SZNS220617-27098E-RF-00B |
| FCC ID: | 2AXYP-OBS-40S |

**Test Standard (s)**

FCC PART 15.247

**Sample Description**

| | |
|---|---|
| Product Type: | Portable Wireless Speaker |
| Model No.: | OBS-40S |
| Multiple Model(s) No.: | N/A |
| Trade Mark: | oraimo |
| Date Received: | 2022/06/17 |
| Report Date: | 2022/07/15 |

| | |
|---|---|
| Test Result: | Pass* |

* In the configuration tested, the EUT complied with the standards above.

**Prepared and Checked By:**

Andy Yu
EMC Engineer

**Approved By:**

Robert Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Frequency Range | BLE 1M/2M: 2402-2480MHz |
| Maximum Conducted Peak Output Power | 1.20dBm |
| Modulation Technique | BLE: GFSK |
| Antenna Specification* | 0 dBi (provided by the applicant) |
| Voltage Range | DC 3.7V from battery |
| Sample serial number | SZNS220617-27098E-RF-S1 for Conducted and Radiated Emissions<br>SZNS220617-27098E-RF-S2 for RF Conducted Test<br>(Assigned by ATC) |
| Sample/EUT Status | Good condition |

## 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 |
|---|---|---|
| Occupied Channel Bandwidth | | 5% |
| RF Frequency | | $0.082*10^{-7}$ |
| RF output power, conducted | | 0.73dB |
| Unwanted Emission, conducted | | 1.6dB |
| AC Power Lines Conducted Emissions | | 2.72dB |
| Emissions, Radiated | 9kHz - 30MHz | 2.66dB |
| | 30MHz - 1GHz | 4.28dB |
| | 1GHz - 18GHz | 4.98dB |
| | 18GHz - 26.5GHz | 5.06dB |
| | 26.5GHz - 40GHz | 4.72dB |
| Temperature | | 1℃ |
| Humidity | | 6% |
| Supply voltages | | 0.4% |

*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.

# 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.

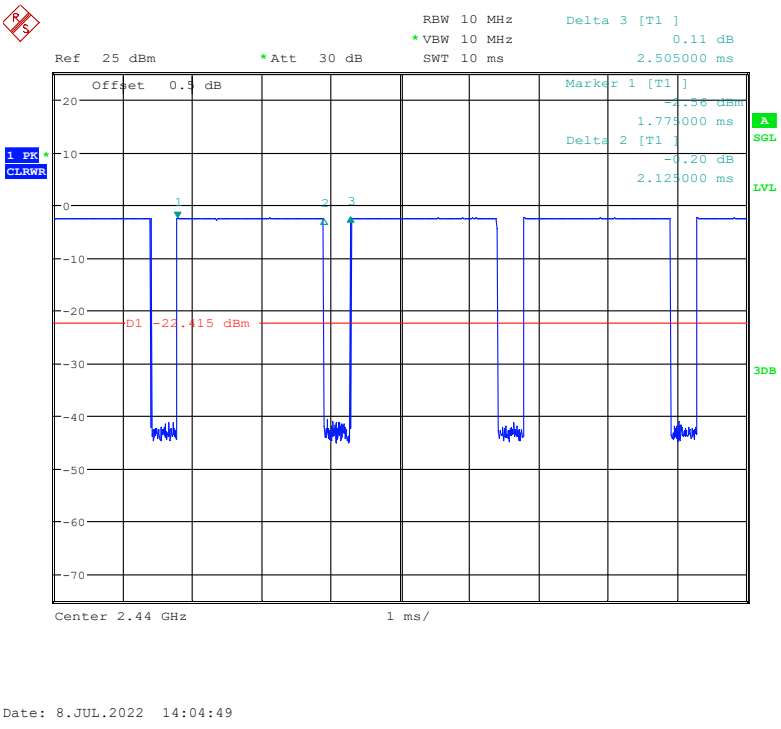
## EUT Exercise Software

"FCC_assisst"* exercise software was used and the power level is Deafult*. The software and power level was provided by the manufacturer.

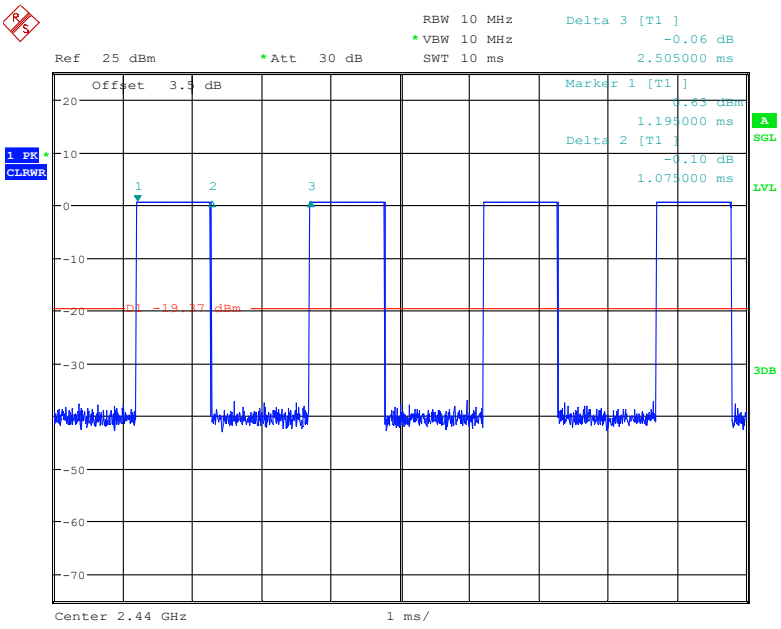
## Duty cycle

| Mode | Ton (ms) | Ton+off (ms) | Duty Cycle (%) |
|---|---|---|---|
| **BLE 1M** | 2.125 | 2.505 | 84.83 |
| **BLE 2M** | 1.075 | 2.505 | 42.91 |

**BLE-1M:**



**BLE-2M:**




Date: 8.JUL.2022 14:21:57

## Support Equipment List and Details

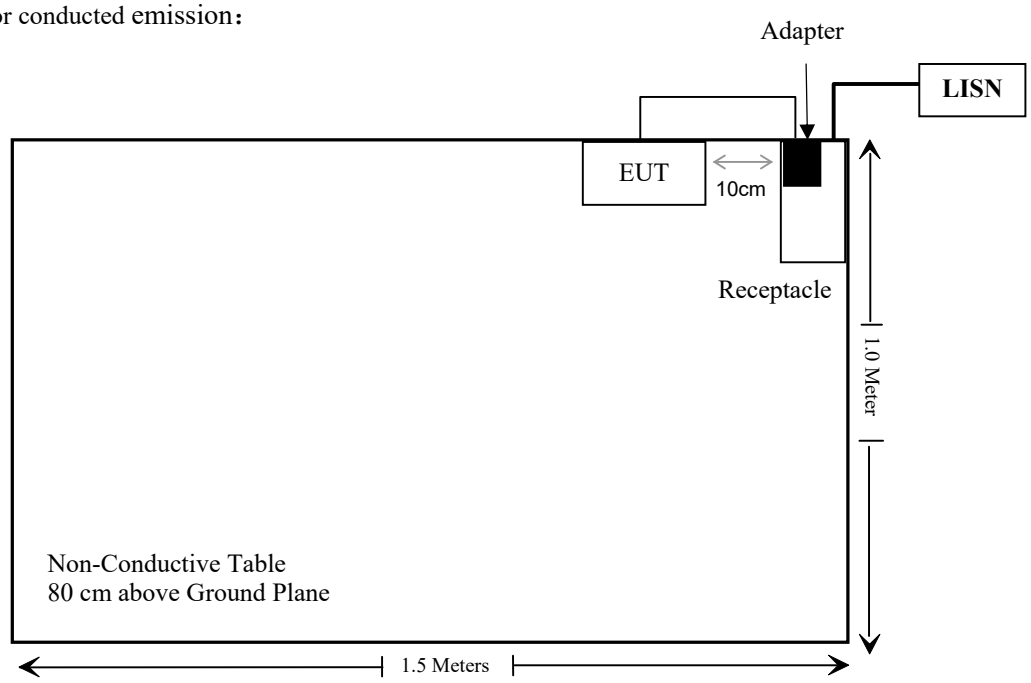
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| TECNO | Adapter | U180TSA | Unknown |

## External I/O Cable

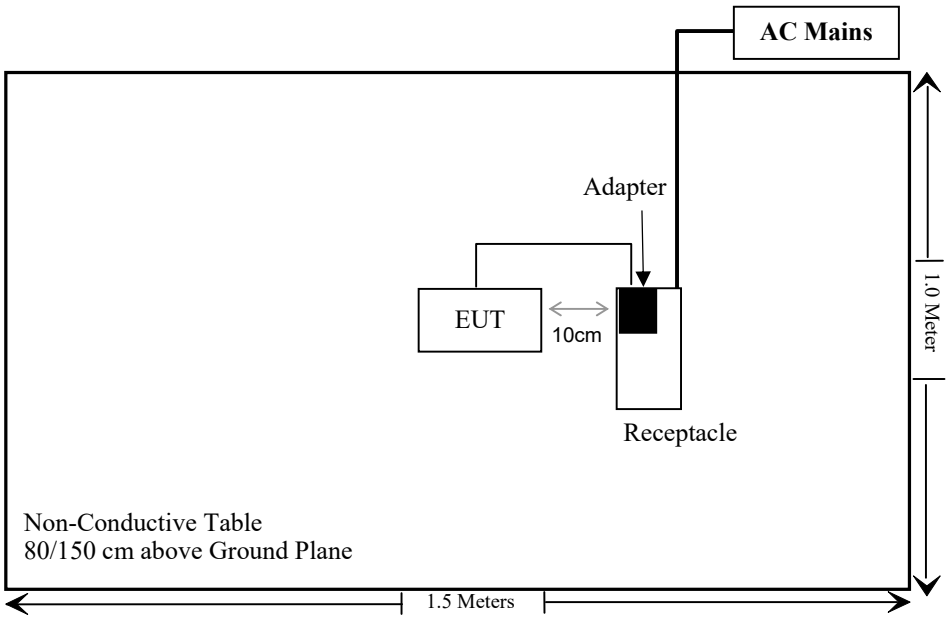
| Cable Description | Length (m) | From/Port | To |
|---|---|---|---|
| Un-shielding Detachable USB Cable | 0.5 | EUT | Adapter |

## Block Diagram of Test Setup

For conducted emission：




For Radiated Emissions:



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| §15.247 (i),§1.1307 (b) (3) &§2.1093 | RF Exposure | Compliant |
| §15.203 | Antenna Requirement | Compliant |
| §15.207 (a) | AC Line Conducted Emissions | Compliant |
| §15.205, §15.209, §15.247(d) | Spurious Emissions | Compliant |
| §15.247 (a)(2) | 6 dB Emission Bandwidth & Occupied Bandwidth | Compliant |
| §15.247(b)(3) | Maximum Conducted Output Power | Compliant |
| §15.247(d) | 100 kHz Bandwidth of Frequency Band Edge | Compliant |
| §15.247(e) | Power Spectral Density | Compliant |

# TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Conducted Emissions Test | | | | | |
| Rohde& Schwarz | EMI Test Receiver | ESCI | 100784 | 2021/12/13 | 2022/12/12 |
| Rohde & Schwarz | L.I.S.N. | ENV216 | 101314 | 2021/12/13 | 2022/12/12 |
| Anritsu Corp | 50 Coaxial Switch | MP59B | 6100237248 | 2021/12/13 | 2022/12/12 |
| Unknown | RF Coaxial Cable | No.17 | N0350 | 2021/12/14 | 2022/12/13 |
| Conducted Emission Test Software: e3 19821b (V9) | | | | | |
| Radiated Emissions Test | | | | | |
| Rohde& Schwarz | Test Receiver | ESR | 102725 | 2021/12/13 | 2022/12/12 |
| Rohde&Schwarz | Spectrum Analyzer | FSV40 | 101949 | 2021/12/13 | 2022/12/12 |
| SONOMA INSTRUMENT | Amplifier | 310 N | 186131 | 2021/11/09 | 2022/11/08 |
| A.H. Systems, inc. | Preamplifier | PAM-0118P | 135 | 2021/11/09 | 2022/11/08 |
| Quinstar | Amplifier | QLW-18405536-J0 | 15964001002 | 2021/11/11 | 2022/11/10 |
| Schwarzbeck | Bilog Antenna | VULB9163 | 9163-323 | 2021/07/06 | 2024/07/05 |
| Schwarzbeck | Horn Antenna | BBHA9120D | 9120D-1067 | 2020/01/05 | 2023/01/04 |
| Schwarzbeck | HORN ANTENNA | BBHA9170 | 9170-359 | 2020/01/05 | 2023/01/04 |
| Radiated Emission Test Software: e3 19821b (V9) | | | | | |
| Unknown | RF Coaxial Cable | No.10 | N050 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.11 | N1000 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.12 | N040 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.13 | N300 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.14 | N800 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.15 | N600 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.16 | N650 | 2021/12/14 | 2022/12/13 |
| Wainwright | High Pass Filter | WHKX3.6/18G-10SS | 5 | 2021/12/14 | 2022/12/13 |

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| RF Conducted Test | | | | | |
| SPECTRUM ANALYZER | Rohde & Schwarz | FSU26 | 200982 | 2022/04/01 | 2023/03/31 |
| Weinschel | 3dB Attenuator | Unknown | 1 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Cable | Unknown | 2 | 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) (3) &§2.1093 – RF EXPOSURE

## Applicable Standard

According to FCC §2.1093 and §1.1307(b) (3), 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 D04 Interim General RF Exposure Guidance

SAR-Based Exemption:

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum timeaveraged power or maximum time-averaged ERP, whichever is greater.

Per § 1.1307(b)(3)(i)(B), 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:

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:

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

Where

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

and

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

$d$ = the separation distance (cm);

**For worst case:**

exemption limit:

For $f$=2.48GHz, $d$=0.5cm, the $P_{th}$=2.72mW

The higher of the conducted time-averaged output power or effective radiated power (ERP):

The antenna gain is 0dBi(-2.15dBd), 0dBd=2.15dBi

The maximum tune-up conducted power is 1.5dBm (1.41mW), which less than 2.72 mW@2480MHz exemption limit

**So the stand-alone SAR evaluation can be exempted.**

# 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 which was permanently attached and the maximum antenna gain is 0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

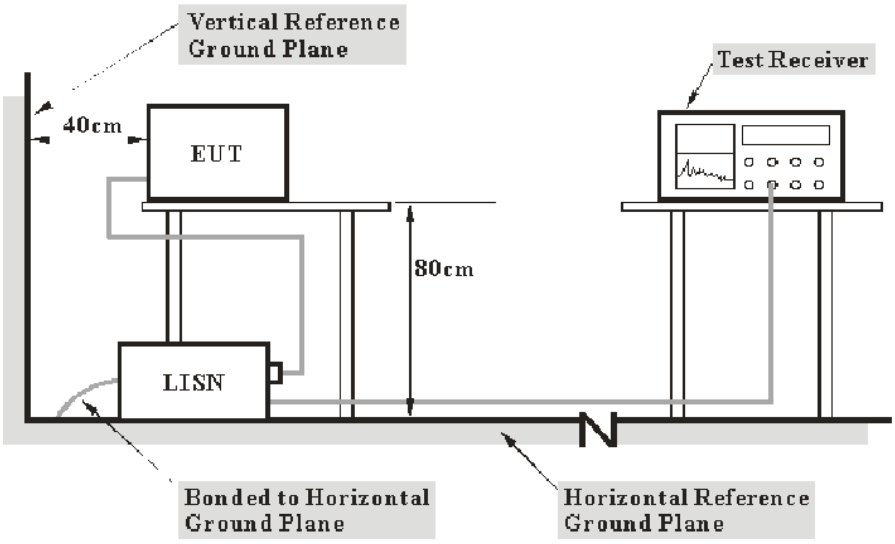
**Result:** Compliance.

# 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 80 cm from other units and other metal planes support units.

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

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

Over Limit = level – Limit
Level= reading level+ Transd Factor

## Test Data

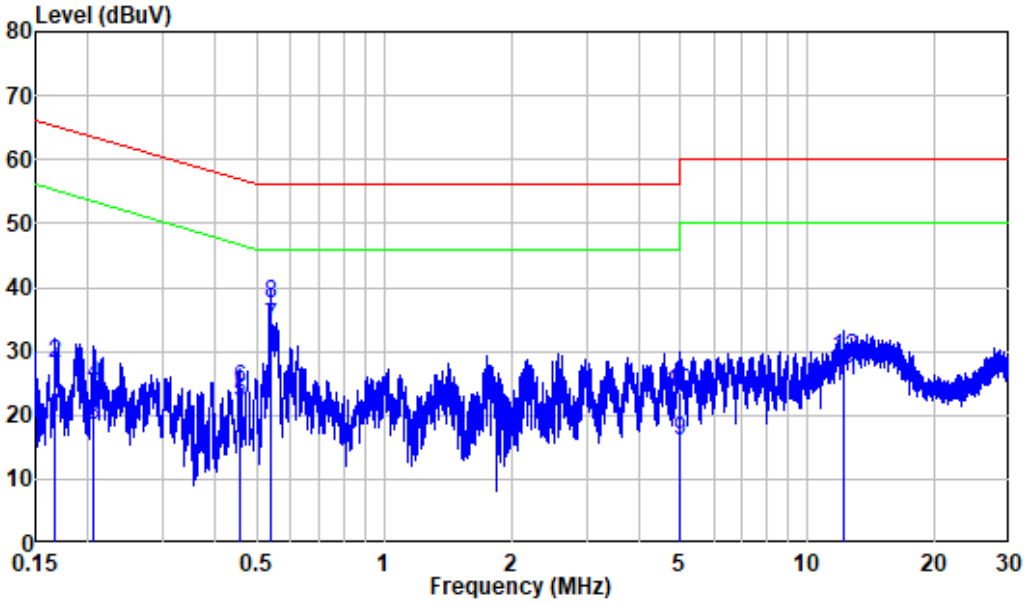
### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 52 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Jason on2022-06-30.*

*EUT operation mode: Transmitting (worst case is BLE 2M, Low channel)*

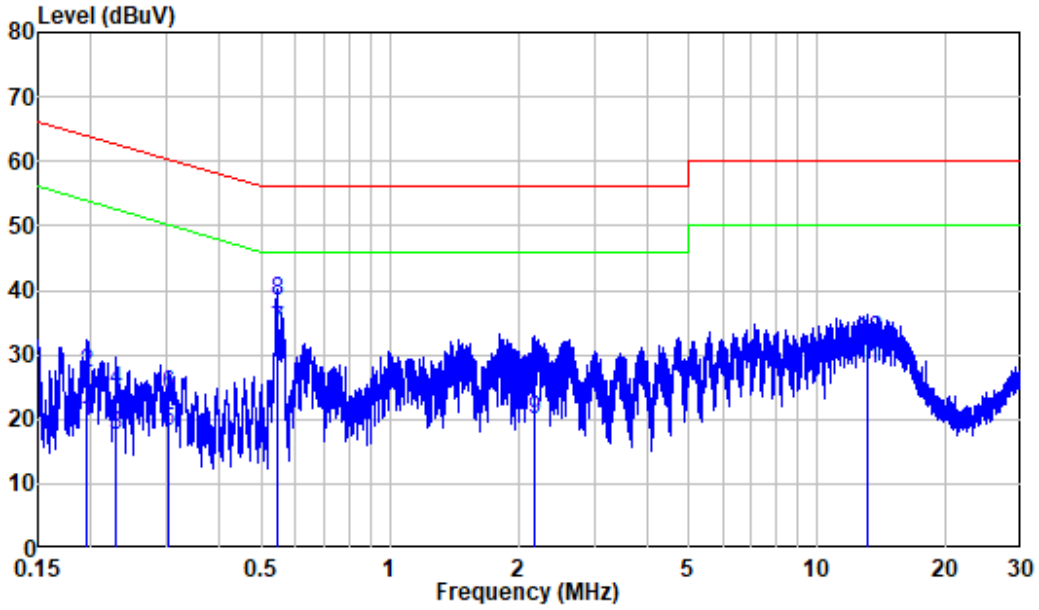
**AC 120V/60 Hz, Line**




Site : Shielding Room
Condition: Line
Mode : BLE
Model : OBS-40S
Power : AC 120V 60Hz

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|
| | MHz | dB | dBuV | dBuV | dBuV | dB | |
| 1 | 0.167 | 9.80 | 9.89 | 19.69 | 55.10 | -35.41 | Average |
| 2 | 0.167 | 9.80 | 18.27 | 28.07 | 65.10 | -37.03 | QP |
| 3 | 0.206 | 9.80 | 8.61 | 18.41 | 53.37 | -34.96 | Average |
| 4 | 0.206 | 9.80 | 15.09 | 24.89 | 63.37 | -38.48 | QP |
| 5 | 0.455 | 9.80 | 12.37 | 22.17 | 46.79 | -24.62 | Average |
| 6 | 0.455 | 9.80 | 14.29 | 24.09 | 56.79 | -32.70 | QP |
| 7 | 0.541 | 9.81 | 24.07 | 33.88 | 46.00 | -12.12 | Average |
| 8 | 0.541 | 9.81 | 27.52 | 37.33 | 56.00 | -18.67 | QP |
| 9 | 4.965 | 9.85 | 6.22 | 16.07 | 46.00 | -29.93 | Average |
| 10 | 4.965 | 9.85 | 13.66 | 23.51 | 56.00 | -32.49 | QP |
| 11 | 12.196 | 9.92 | 15.54 | 25.46 | 50.00 | -24.54 | Average |
| 12 | 12.196 | 9.92 | 19.03 | 28.95 | 60.00 | -31.05 | QP |

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




Site : Shielding Room
Condition: Neutral
Mode : BLE
Model : OBS-40S
Power : AC 120V 60Hz

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|
| | MHz | dB | dBuV | dBuV | dBuV | dB | |
| 1 | 0.196 | 9.80 | 9.74 | 19.54 | 53.78 | -34.24 | Average |
| 2 | 0.196 | 9.80 | 17.28 | 27.08 | 63.78 | -36.70 | QP |
| 3 | 0.229 | 9.80 | 7.79 | 17.59 | 52.50 | -34.91 | Average |
| 4 | 0.229 | 9.80 | 14.51 | 24.31 | 62.50 | -38.19 | QP |
| 5 | 0.304 | 9.80 | 8.42 | 18.22 | 50.14 | -31.92 | Average |
| 6 | 0.304 | 9.80 | 14.02 | 23.82 | 60.14 | -36.32 | QP |
| 7 | 0.546 | 9.81 | 24.04 | 33.85 | 46.00 | -12.15 | Average |
| 8 | 0.546 | 9.81 | 28.38 | 38.19 | 56.00 | -17.81 | QP |
| 9 | 2.184 | 9.82 | 10.12 | 19.94 | 46.00 | -26.06 | Average |
| 10 | 2.184 | 9.82 | 16.83 | 26.65 | 56.00 | -29.35 | QP |
| 11 | 13.101 | 10.03 | 17.72 | 27.75 | 50.00 | -22.25 | Average |
| 12 | 13.101 | 10.03 | 22.12 | 32.15 | 60.00 | -27.85 | QP |

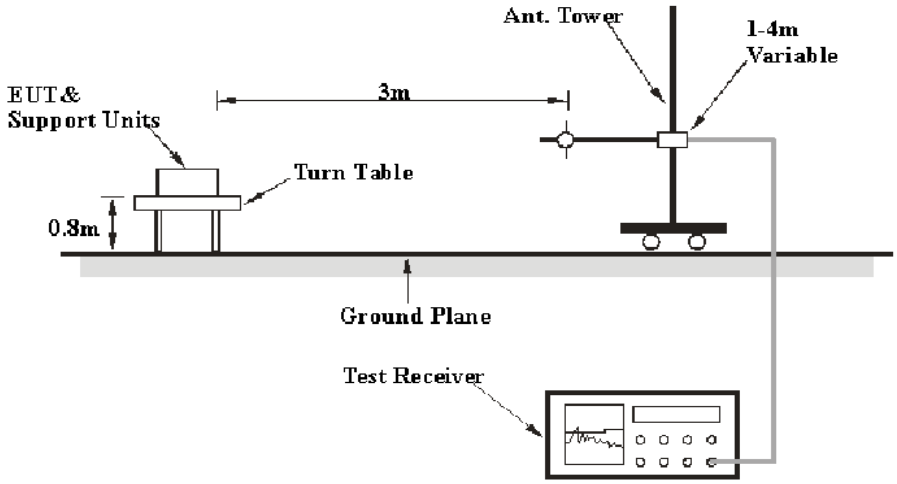
# FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

## Applicable Standard

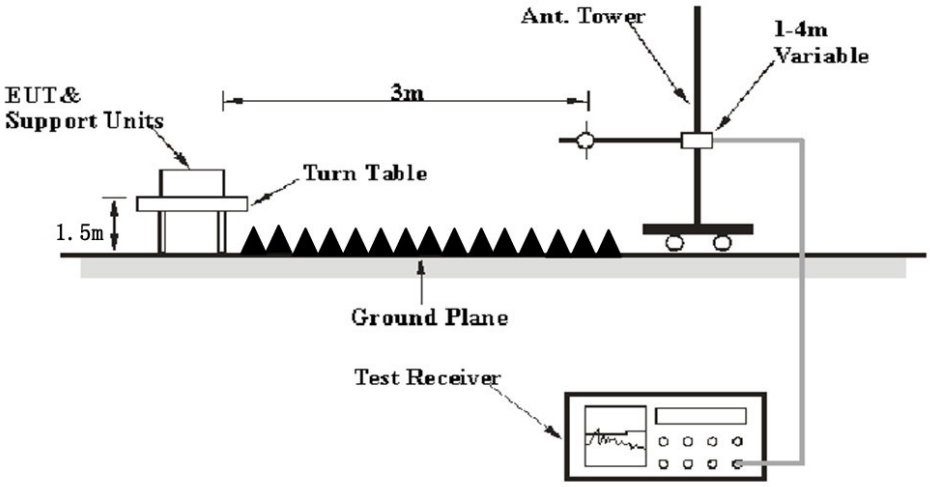
FCC §15.247 (d); §15.209; §15.205;

## 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. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24~26 ℃ |
| **Relative Humidity:** | 61~65 % |
| **ATM Pressure:** | 101.0 kPa |

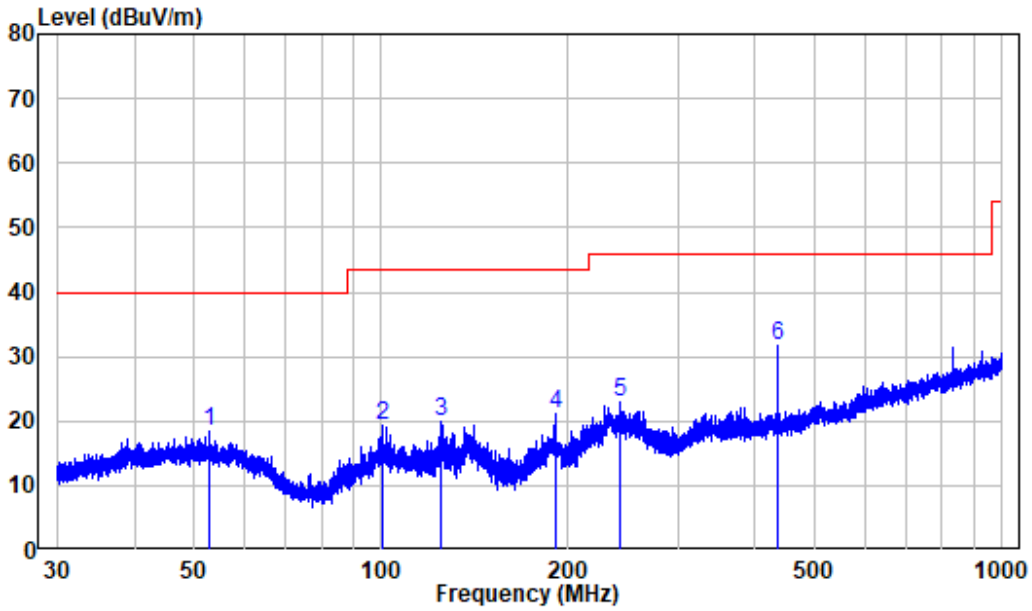
*The testing was performed by Level on 2022-06-30 for below 1GHz, Jimi and Level Li from 2022-06-30 to 2022-07-06 for above 1GHz.*

*EUT operation mode: Transmitting(Pre-scan in the X,Y and Z axes of orientation, the worst case X-axes orientation was recorded)*

**30MHz-1GHz:** *(worst case is BLE 2M, Low channel)*

*Note: When the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded.*

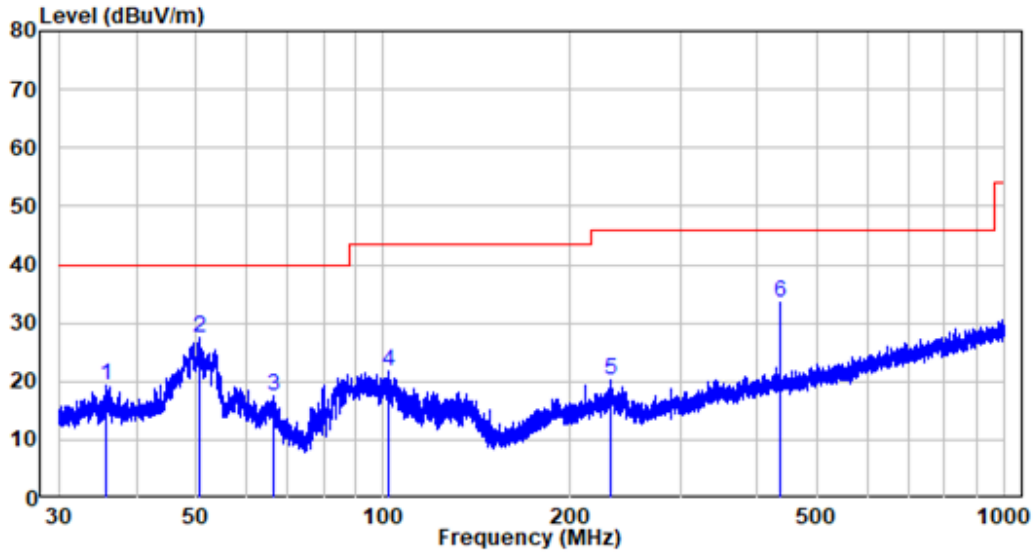
**Horizontal:**




Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220617-27098E-RF
Test Mode: BLE

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 52.969 | -10.16 | 28.58 | 18.42 | 40.00 | -21.58 | Peak |
| 2 | 100.185 | -11.78 | 31.00 | 19.22 | 43.50 | -24.28 | Peak |
| 3 | 124.842 | -14.29 | 34.12 | 19.83 | 43.50 | -23.67 | Peak |
| 4 | 191.493 | -11.34 | 32.44 | 21.10 | 43.50 | -22.40 | Peak |
| 5 | 241.676 | -10.79 | 33.67 | 22.88 | 46.00 | -23.12 | Peak |
| 6 | 434.065 | -5.72 | 37.34 | 31.62 | 46.00 | -14.38 | Peak |

**Vertical**




Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS220617-27098E-RF
Test Mode: BLE

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 35.749 | -11.29 | 30.53 | 19.24 | 40.00 | -20.76 | Peak |
| 2 | 50.520 | -9.93 | 37.31 | 27.38 | 40.00 | -12.62 | Peak |
| 3 | 66.353 | -13.05 | 30.66 | 17.61 | 40.00 | -22.39 | Peak |
| 4 | 101.867 | -11.58 | 33.39 | 21.81 | 43.50 | -21.69 | Peak |
| 5 | 232.838 | -11.03 | 31.30 | 20.27 | 46.00 | -25.73 | Peak |
| 6 | 434.065 | -5.72 | 39.29 | 33.57 | 46.00 | -12.43 | Peak |

**Above 1GHz:**

**BLE 1M:**

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Factor (dB/m) | Absolute Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/Ave | | Height (m) | Polar (H/V) | | | | |
| Low Channel | | | | | | | | | |
| 2310 | 68.47 | PK | 150 | 1.7 | H | -7.24 | 61.23 | 74 | -12.77 |
| 2310 | 56.51 | AV | 150 | 1.7 | H | -7.24 | 49.27 | 54 | -4.73 |
| 2310 | 68.36 | PK | 76 | 1.1 | V | -7.24 | 61.12 | 74 | -12.88 |
| 2310 | 56.40 | AV | 76 | 1.1 | V | -7.24 | 49.16 | 54 | -4.84 |
| 2390 | 69.54 | PK | 359 | 1.2 | H | -7.22 | 62.32 | 74 | -11.68 |
| 2390 | 57.66 | AV | 359 | 1.2 | H | -7.22 | 50.44 | 54 | -3.56 |
| 2390 | 69.45 | PK | 12 | 2.2 | V | -7.22 | 62.23 | 74 | -11.77 |
| 2390 | 57.58 | AV | 12 | 2.2 | V | -7.22 | 50.36 | 54 | -3.64 |
| 4804 | 55.68 | PK | 26 | 1.7 | H | -3.51 | 52.17 | 74 | -21.83 |
| 4804 | 54.93 | PK | 221 | 1.1 | V | -3.51 | 51.42 | 74 | -22.58 |
| Middle Channel | | | | | | | | | |
| 4880 | 55.82 | PK | 196 | 1.8 | H | -3.37 | 52.45 | 74 | -21.55 |
| 4880 | 55.4 | PK | 311 | 1.5 | V | -3.37 | 52.03 | 74 | -21.97 |
| High Channel | | | | | | | | | |
| 2483.5 | 70.25 | PK | 322 | 1.9 | H | -7.2 | 63.05 | 74 | -10.95 |
| 2483.5 | 58.20 | AV | 322 | 1.9 | H | -7.2 | 51 | 54 | -3 |
| 2483.5 | 70.16 | PK | 70 | 1.4 | V | -7.2 | 62.96 | 74 | -11.04 |
| 2483.5 | 58.08 | AV | 70 | 1.4 | V | -7.2 | 50.88 | 54 | -3.12 |
| 2500 | 69.27 | PK | 258 | 2 | H | -7.18 | 62.09 | 74 | -11.91 |
| 2500 | 57.39 | AV | 258 | 2 | H | -7.18 | 50.21 | 54 | -3.79 |
| 2500 | 69.15 | PK | 150 | 1.6 | V | -7.18 | 61.97 | 74 | -12.03 |
| 2500 | 57.30 | AV | 150 | 1.6 | V | -7.18 | 50.12 | 54 | -3.88 |
| 4960 | 54.86 | PK | 145 | 1.3 | H | -3.01 | 51.85 | 74 | -22.15 |
| 4960 | 54.59 | PK | 173 | 2.2 | V | -3.01 | 51.58 | 74 | -22.42 |

**BLE 2M:**

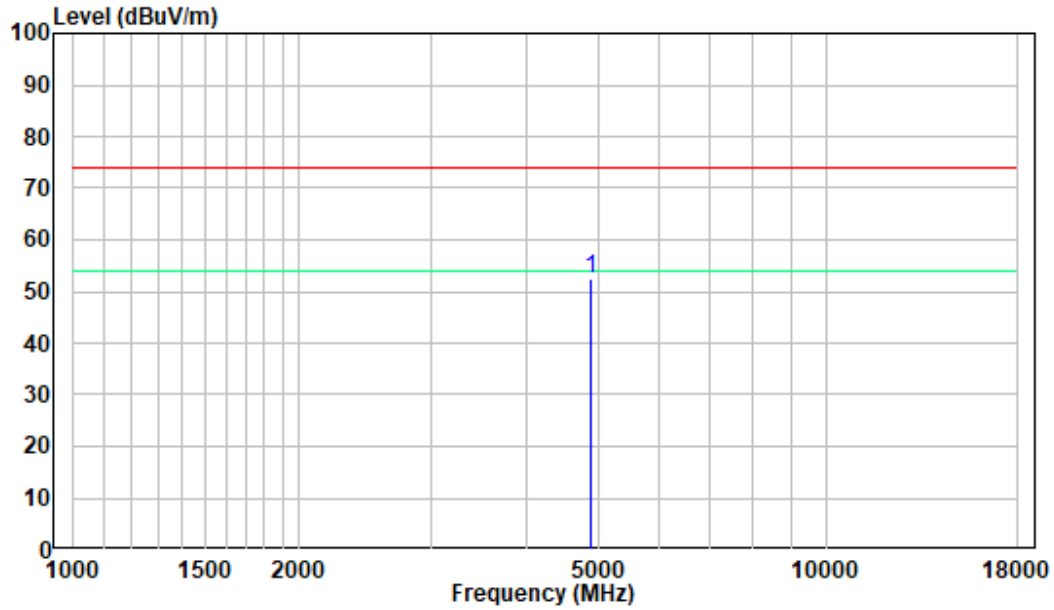
| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Factor (dB/m) | Absolute Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/Ave | | Height (m) | Polar (H/V) | | | | |
| Low Channel | | | | | | | | | |
| 2310 | 68.73 | PK | 202 | 2.1 | H | -7.24 | 61.49 | 74 | -12.51 |
| 2310 | 57.49 | AV | 202 | 2.1 | H | -7.24 | 50.25 | 54 | -3.75 |
| 2310 | 68.62 | PK | 341 | 2.2 | V | -7.24 | 61.38 | 74 | -12.62 |
| 2310 | 57.40 | AV | 341 | 2.2 | V | -7.24 | 50.16 | 54 | -3.84 |
| 2390 | 69.87 | PK | 157 | 1.8 | H | -7.22 | 62.65 | 74 | -11.35 |
| 2390 | 58.66 | AV | 157 | 1.8 | H | -7.22 | 51.44 | 54 | -2.56 |
| 2390 | 69.78 | PK | 117 | 2.2 | V | -7.22 | 62.56 | 74 | -11.44 |
| 2390 | 58.55 | AV | 117 | 2.2 | V | -7.22 | 51.33 | 54 | -2.67 |
| 4804 | 55.66 | PK | 18 | 2.5 | H | -3.51 | 52.15 | 74 | -21.85 |
| 4804 | 55.43 | PK | 118 | 1.6 | V | -3.51 | 51.92 | 74 | -22.08 |
| Middle Channel | | | | | | | | | |
| 4880 | 55.82 | PK | 98 | 1.4 | H | -3.37 | 52.45 | 74 | -21.55 |
| 4880 | 55.25 | PK | 20 | 1.9 | V | -3.37 | 51.88 | 74 | -22.12 |
| High Channel | | | | | | | | | |
| 2483.5 | 70.58 | PK | 205 | 2 | H | -7.2 | 63.38 | 74 | -10.62 |
| 2483.5 | 59.34 | AV | 205 | 2 | H | -7.2 | 52.14 | 54 | -1.86 |
| 2483.5 | 70.49 | PK | 31 | 1.7 | V | -7.2 | 63.29 | 74 | -10.71 |
| 2483.5 | 59.23 | AV | 31 | 1.7 | V | -7.2 | 52.03 | 54 | -1.97 |
| 2500 | 69.43 | PK | 113 | 2.3 | H | -7.18 | 62.25 | 74 | -11.75 |
| 2500 | 58.47 | AV | 113 | 2.3 | H | -7.18 | 51.29 | 54 | -2.71 |
| 2500 | 69.34 | PK | 125 | 1.6 | V | -7.18 | 62.16 | 74 | -11.84 |
| 2500 | 58.38 | AV | 125 | 1.6 | V | -7.18 | 51.2 | 54 | -2.8 |
| 4960 | 55.06 | PK | 187 | 2.4 | H | -3.01 | 52.05 | 74 | -21.95 |
| 4960 | 54.49 | PK | 54 | 1.4 | V | -3.01 | 51.48 | 74 | -22.52 |

**Note:**
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is 20dB to the limit or in noise floor was not recorded.
The test result of peak was less than the limit of average, so just peak value were recorded.

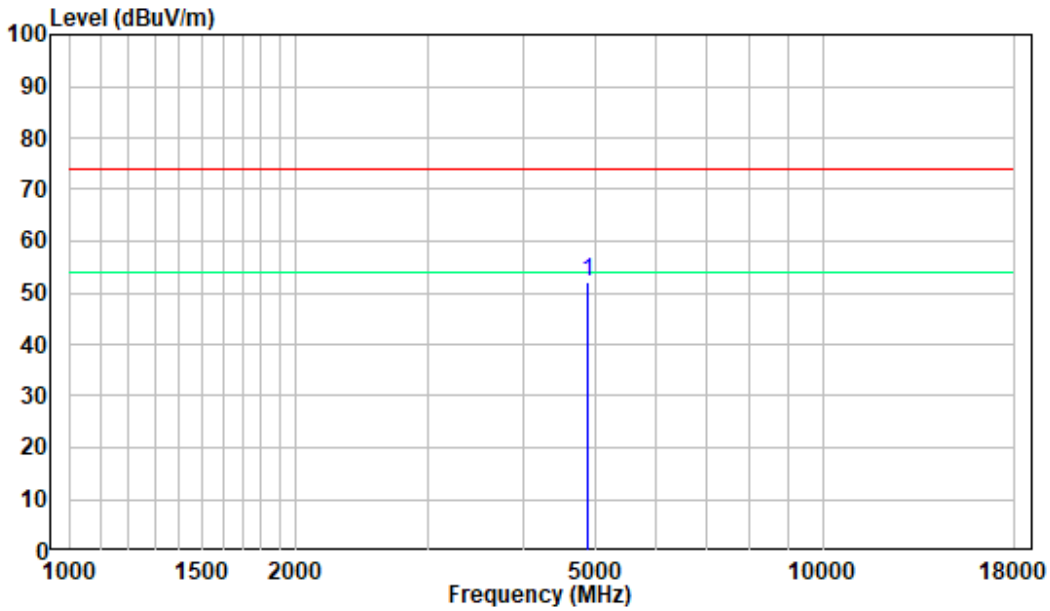
**Pre-scan for BLE 1M, Middle channel**

**1-18GHz**

**Horizontal:**

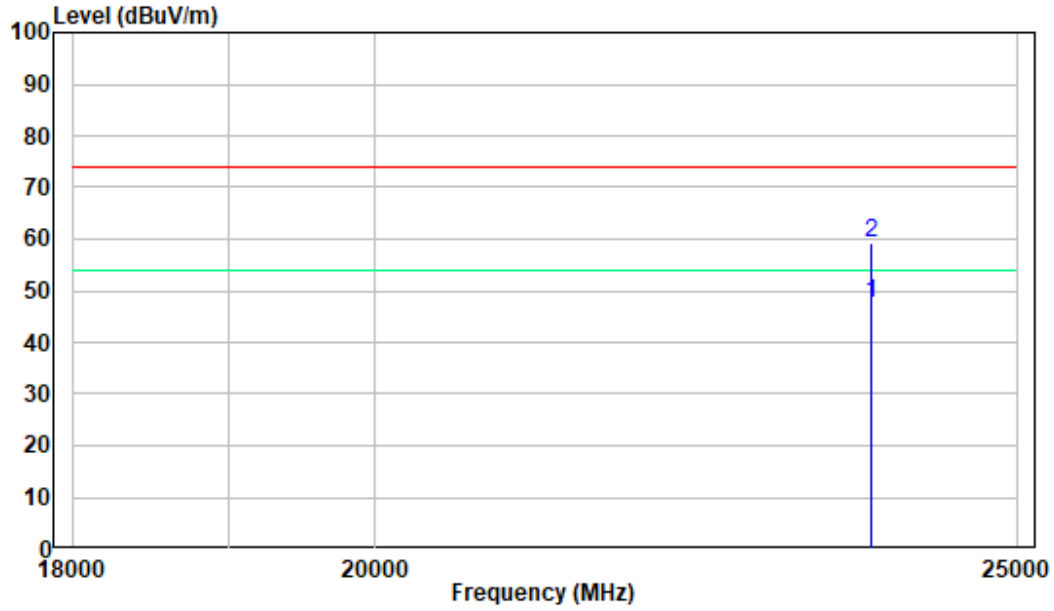



**Vertical:**

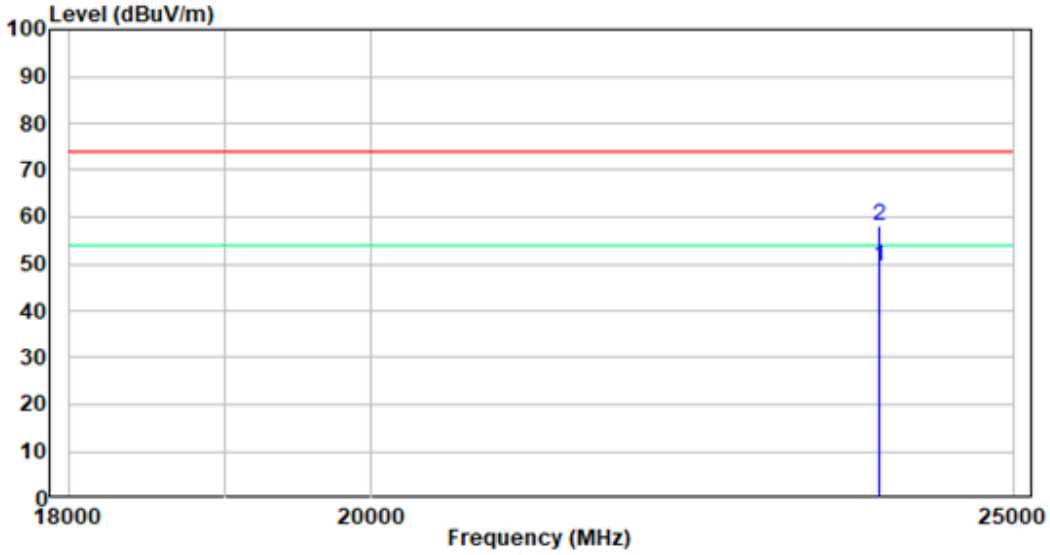


**18-25GHz:**

**Horizontal:**




**Vertical:**



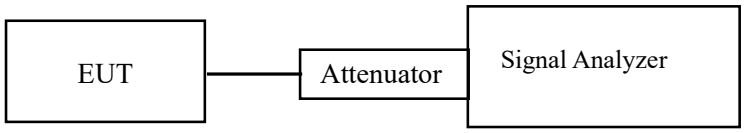
# FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

## 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:** | 25 ℃ |
| **Relative Humidity:** | 60 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Andy Yu on 2022-07-08.*

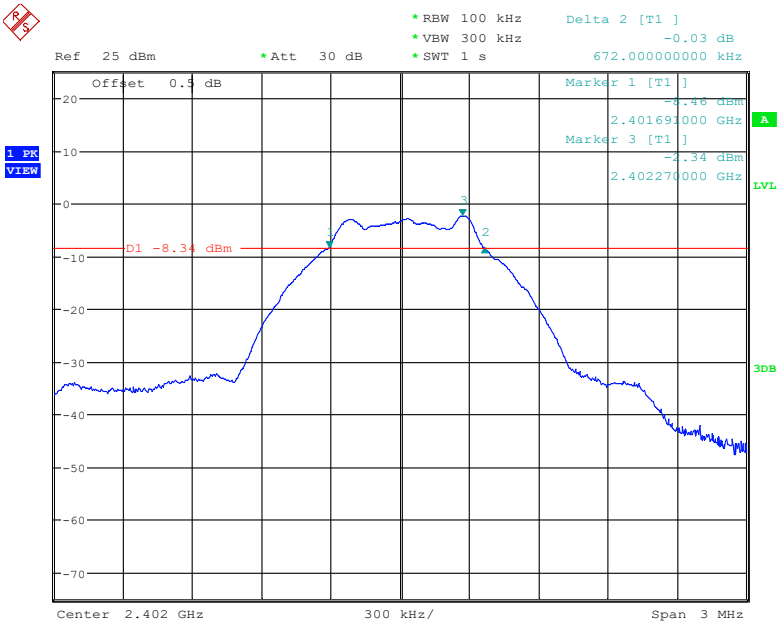
*EUT operation mode: Transmitting*

Test Result: Compliant.

| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (MHz) | 99% Emission Bandwidth (MHz) | Limit (kHz) |
|---|---|---|---|---|
| BLE 1M | | | | |
| Low | 2402 | 0.672 | 1.026 | ≥500 |
| Middle | 2440 | 0.669 | 1.026 | ≥500 |
| High | 2480 | 0.672 | 1.026 | ≥500 |
| BLE 2M | | | | |
| Low | 2402 | 1.224 | 2.058 | ≥500 |
| Middle | 2440 | 1.230 | 2.058 | ≥500 |
| High | 2480 | 1.224 | 2.064 | ≥500 |

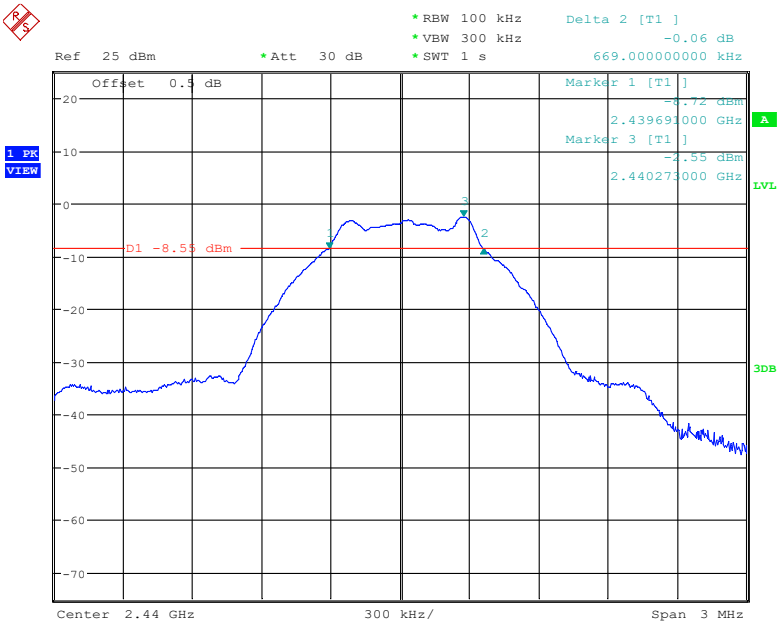
**BLE 1M:**

**6dB Bandwidth, Low Channel**



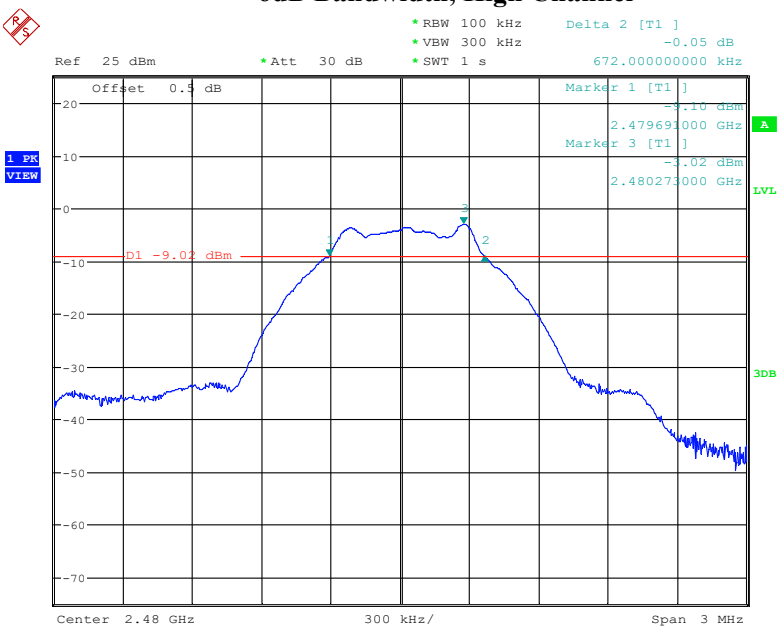

Date: 8.JUL.2022 14:02:54

**6dB Bandwidth, Middle Channel**



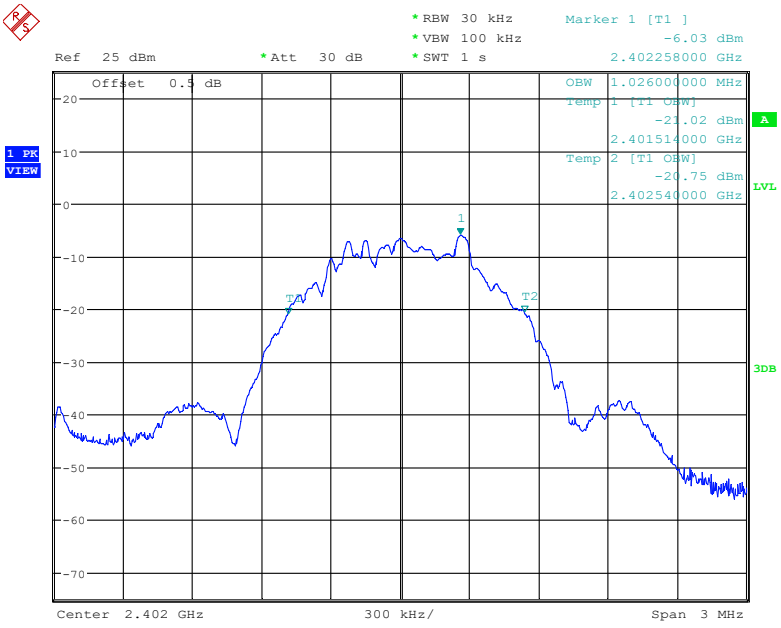

Date: 8.JUL.2022 14:06:13

## 6dB Bandwidth, High Channel



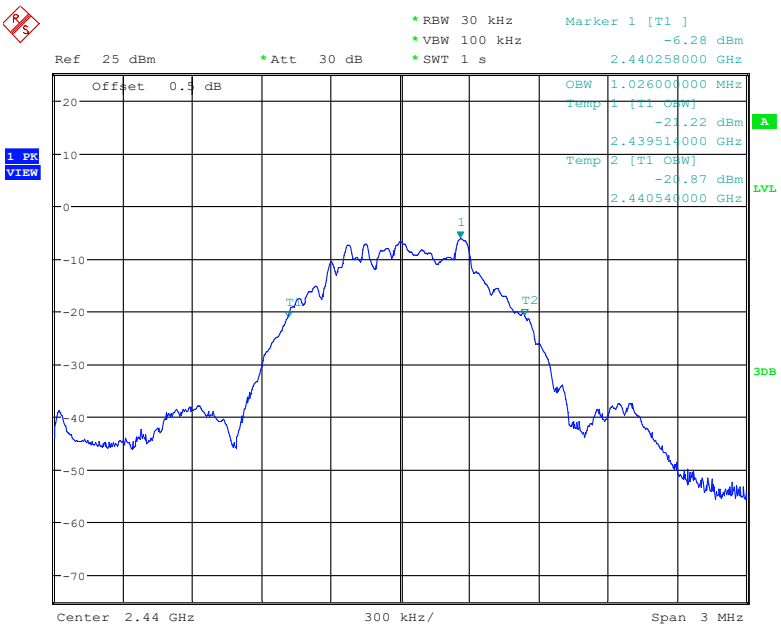

Date: 8.JUL.2022 14:09:09

## 99% Emission Bandwidth, Low Channel



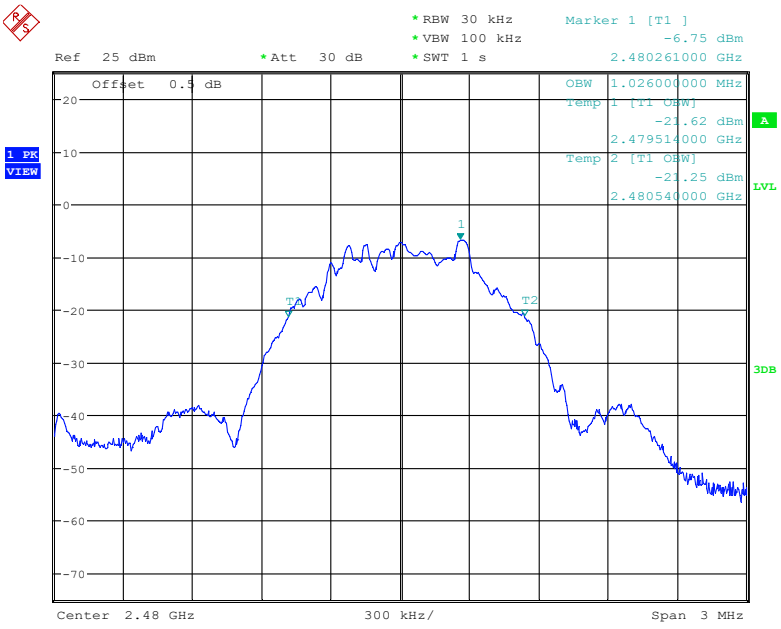

Date: 8.JUL.2022 14:02:27

## 99% Emission Bandwidth, Middle Channel




Date: 8.JUL.2022 14:05:46

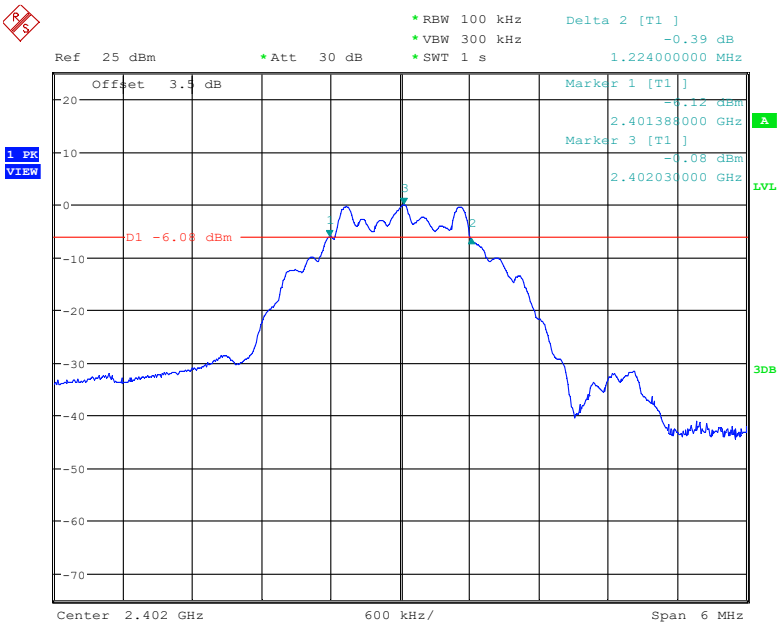
## 99% Emission Bandwidth, High Channel




Date: 8.JUL.2022 14:08:41

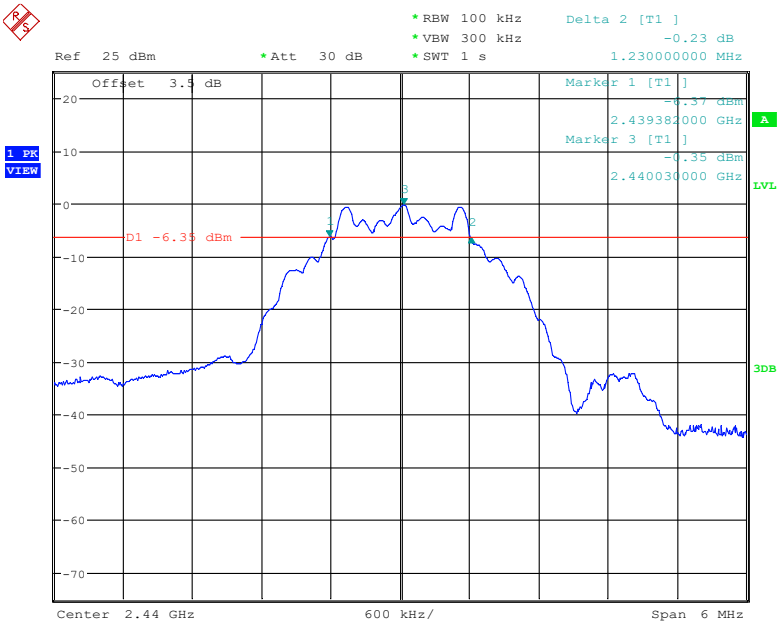
**BLE 2M:**

**6dB Bandwidth, Low Channel**



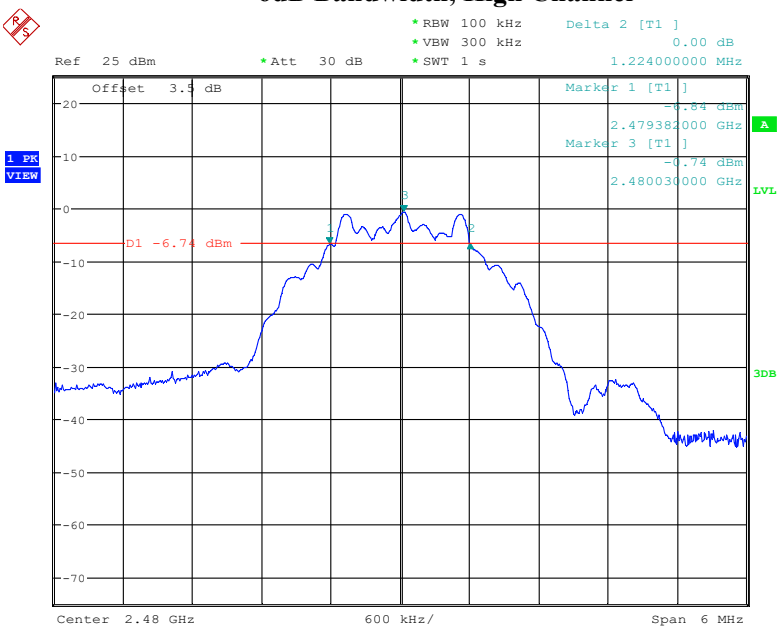

Date: 8.JUL.2022 14:25:49

**6dB Bandwidth, Middle Channel**



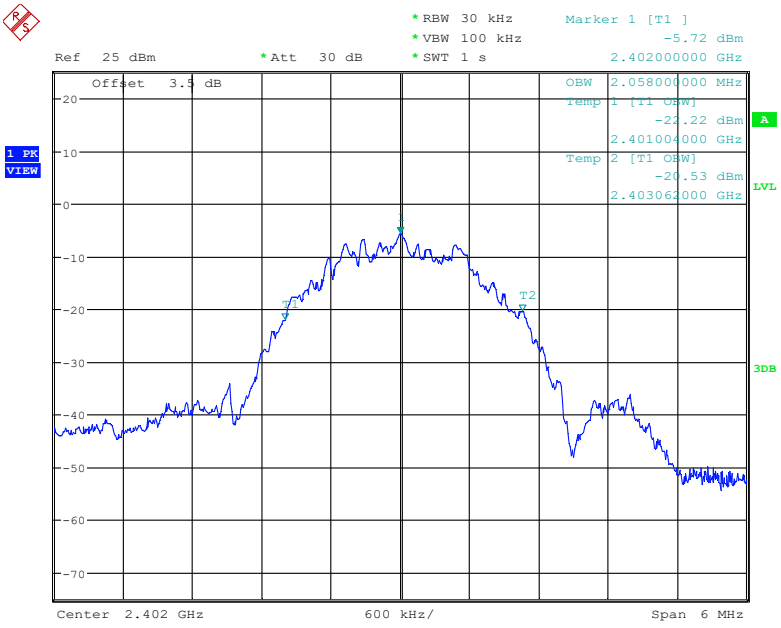

Date: 8.JUL.2022 14:23:24

## 6dB Bandwidth, High Channel



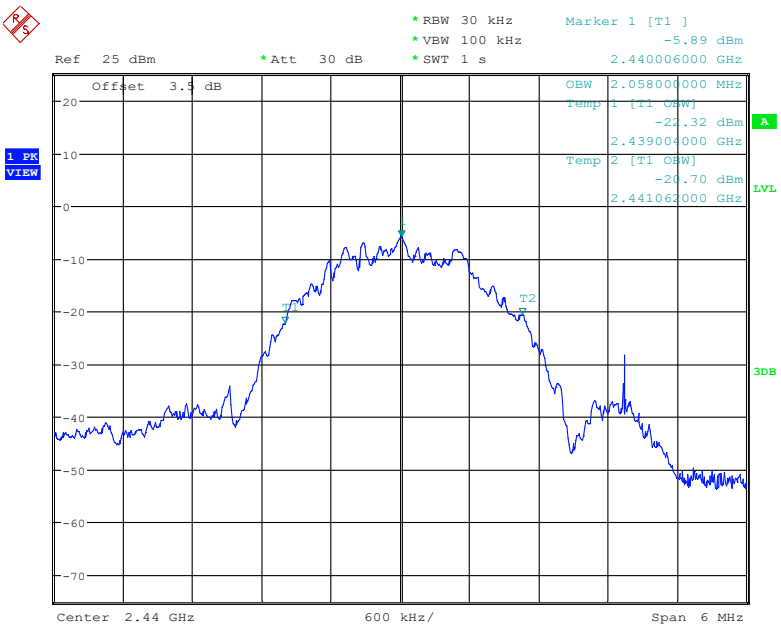

Date: 8.JUL.2022 14:19:31

## 99% Emission Bandwidth, Low Channel



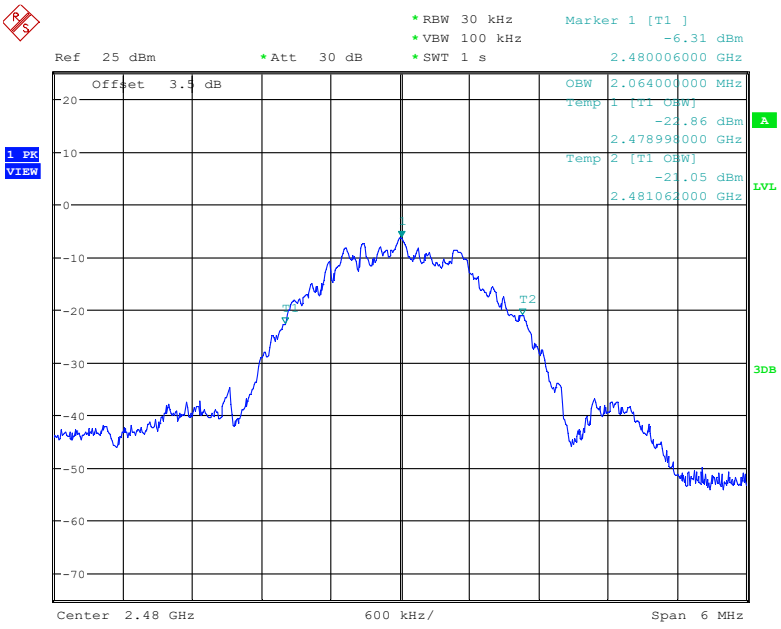

Date: 8.JUL.2022 14:25:21

## 99% Emission Bandwidth, Middle Channel




Date: 8.JUL.2022 14:22:55

## 99% Emission Bandwidth, High Channel




Date: 8.JUL.2022 14:19:02

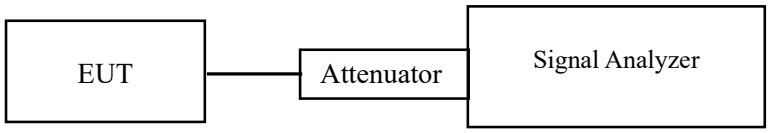
# FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

## 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:** | 25 ℃ |
| **Relative Humidity:** | 60 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Andy Yu on 2022-07-08.*

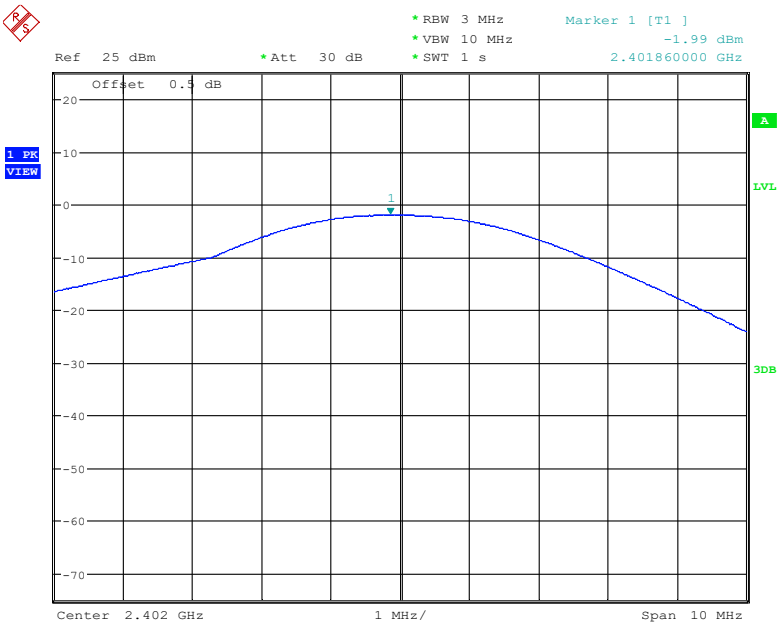
*EUT operation mode: Transmitting*

Test Result: Compliant.

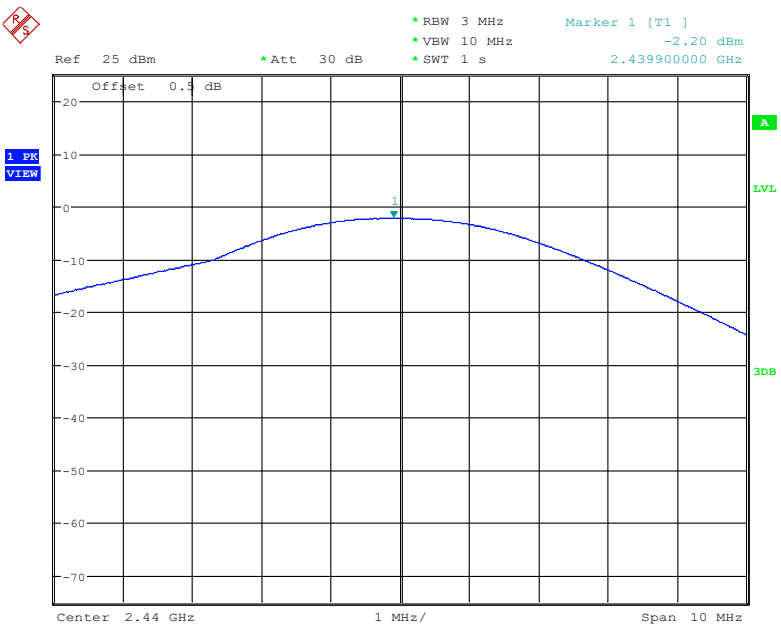
| Channel | Frequency (MHz) | Max Conducted Peak Output Power (dBm) | Limit (dBm) |
|---|---|---|---|
| BLE 1M | | | |
| Low | 2402 | -1.99 | 30 |
| Middle | 2440 | -2.20 | 30 |
| High | 2480 | -2.61 | 30 |
| BLE 2M | | | |
| Low | 2402 | 1.20 | 30 |
| Middle | 2440 | 0.79 | 30 |
| High | 2480 | 0.46 | 30 |

**BLE 1M:**

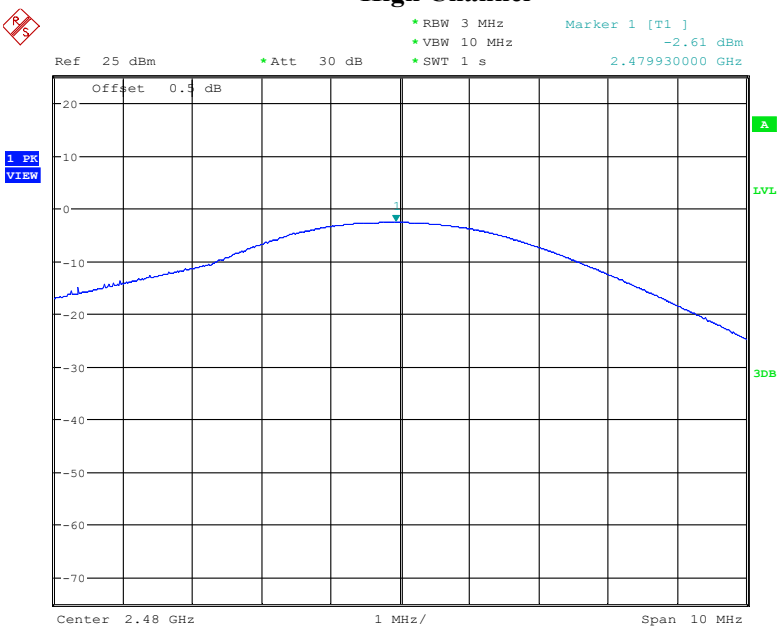
**Low Channel**




**Middle Channel**

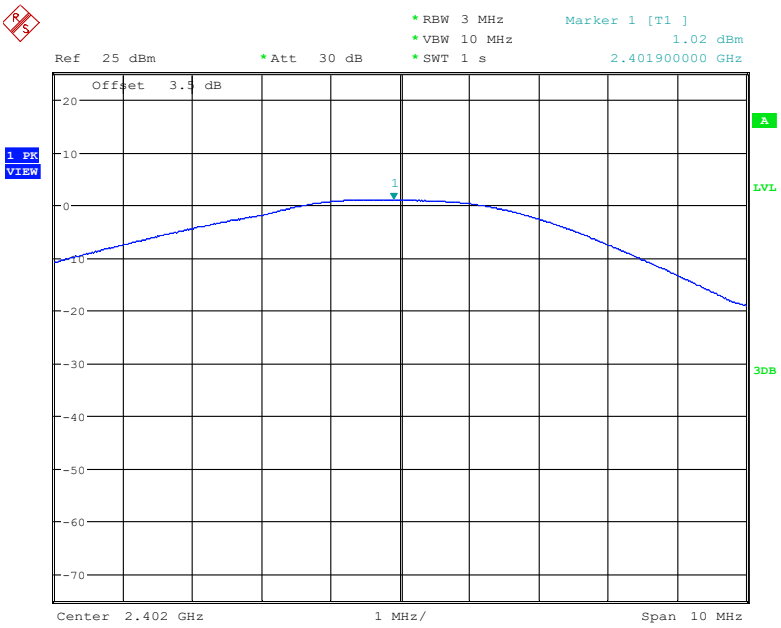


**High Channel**

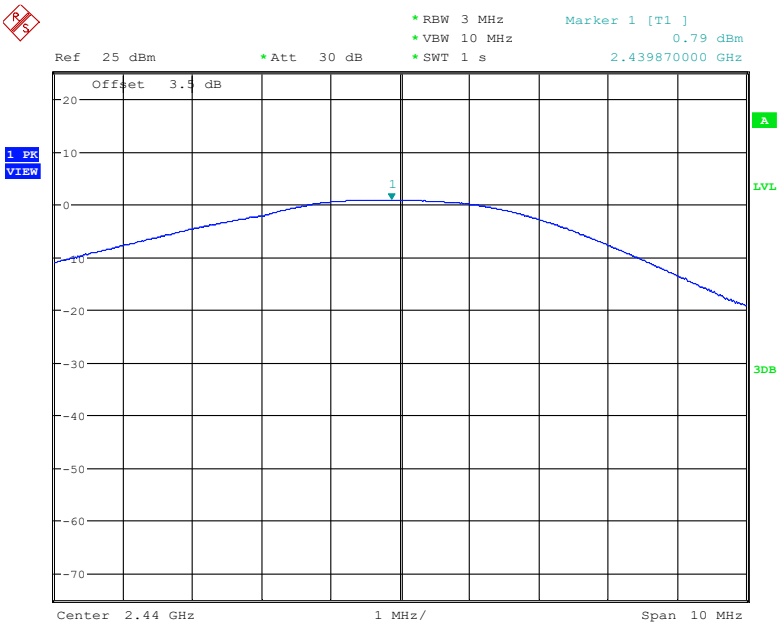



**BLE 2M:**

**Low Channel**

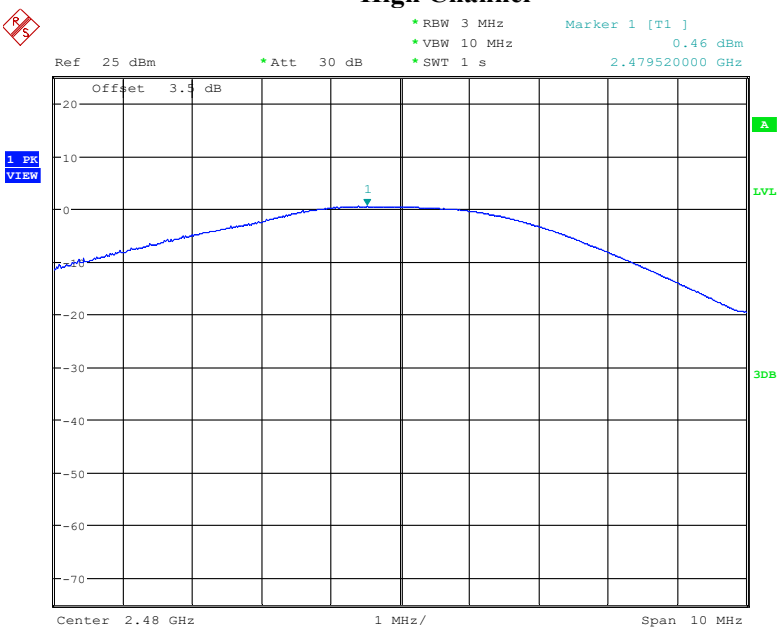


## Middle Channel




Date: 8.JUL.2022 14:22:27

## High Channel




Date: 8.JUL.2022 14:18:34

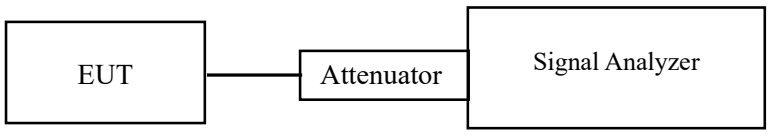
# FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

## 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:** | 25 ℃ |
| **Relative Humidity:** | 60 % |
| **ATM Pressure:** | 101.0 kPa |

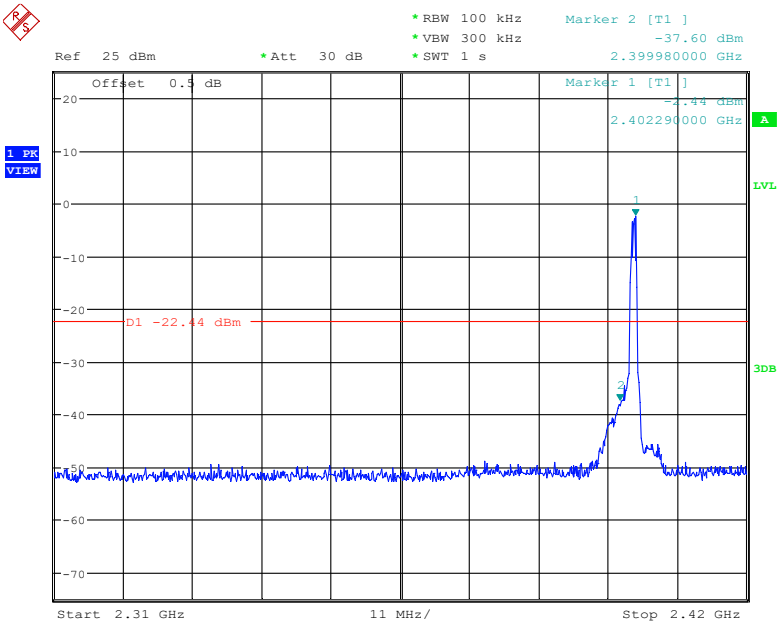
*The testing was performed by Andy Yu on 2022-07-08.*

*EUT operation mode: Transmitting*

Test Result: Compliant.

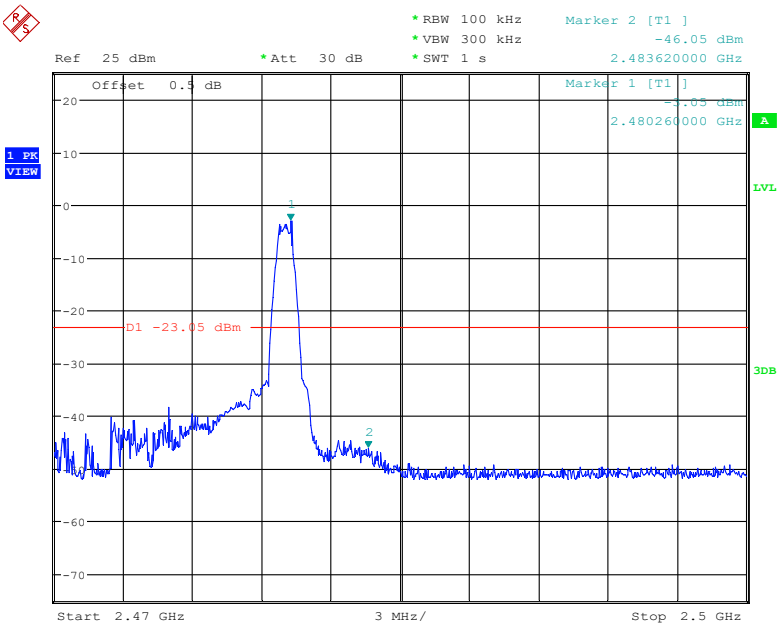
**BLE 1M:**

**Band Edge, Left Side**




Date: 8.JUL.2022 14:03:51

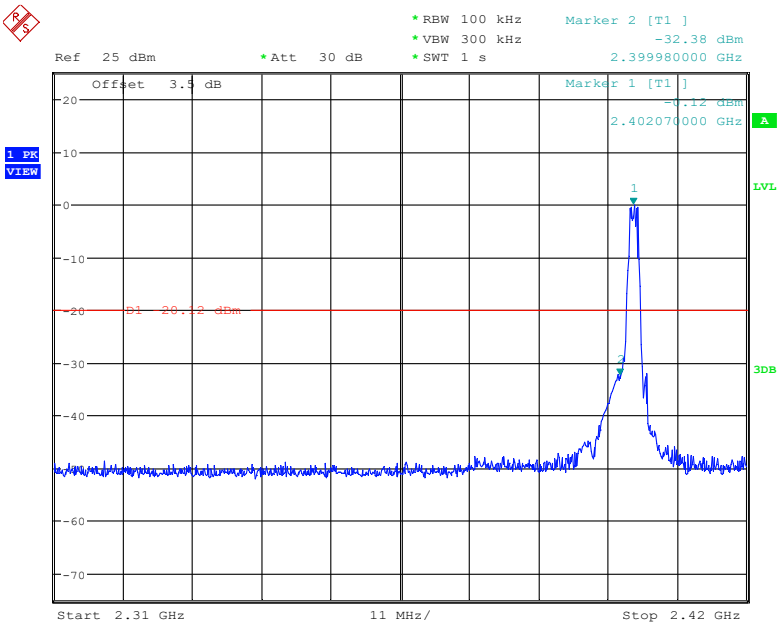
**Band Edge, Right Side**




Date: 8.JUL.2022 14:10:05

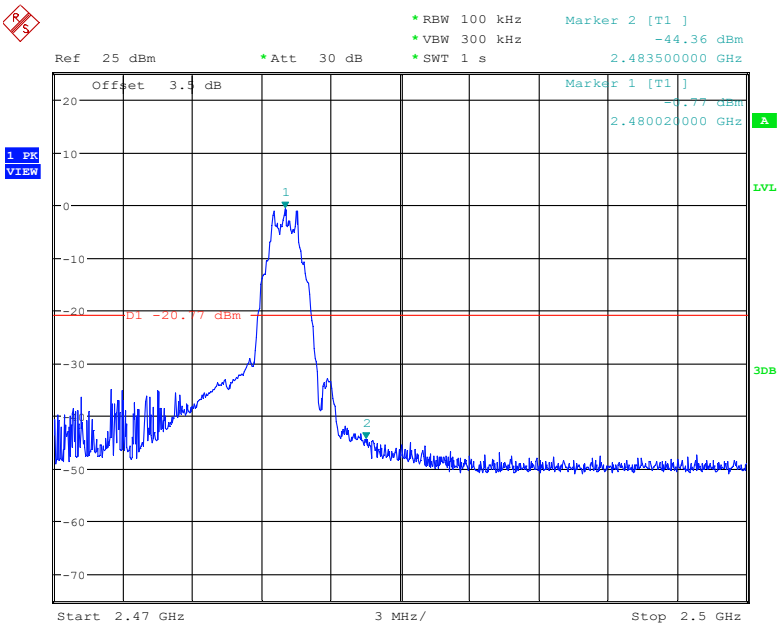
**BLE 2M:**

**Band Edge, Left Side**




Date: 8.JUL.2022 14:26:47

**Band Edge, Right Side**




Date: 8.JUL.2022 14:20:29

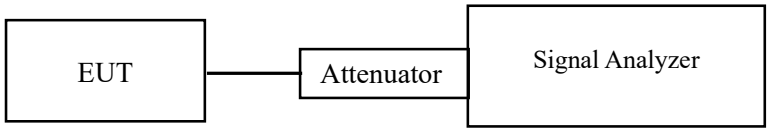
# FCC §15.247(e) - POWER SPECTRAL DENSITY

## 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:** | 25 ℃ |
| **Relative Humidity:** | 60 % |
| **ATM Pressure:** | 101.0 kPa |

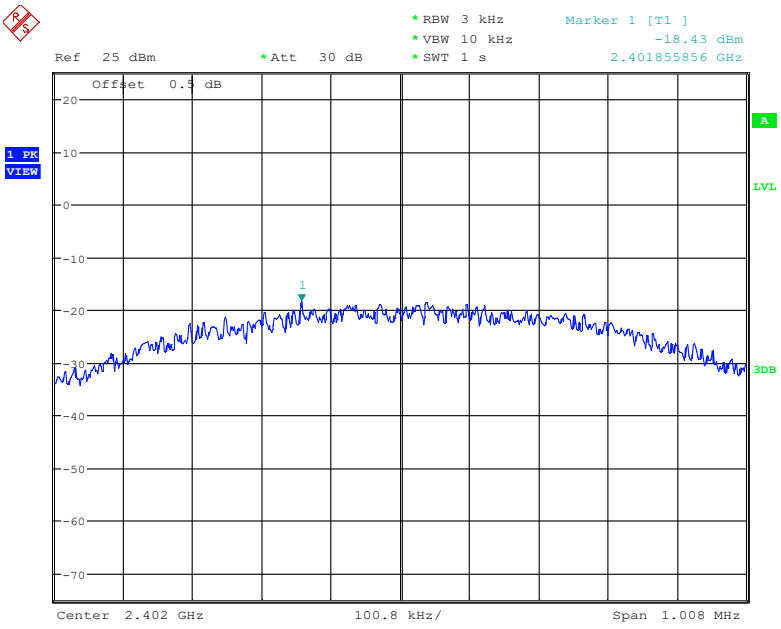
*The testing was performed by Andy Yu on 2022-07-08.*

*EUT operation mode: Transmitting*

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|---|
| BLE 1M | | | |
| Low | 2402 | -18.43 | ≤8 |
| Middle | 2440 | -18.66 | ≤8 |
| High | 2480 | -19.22 | ≤8 |
| BLE 2M | | | |
| Low | 2402 | -18.75 | ≤8 |
| Middle | 2440 | -18.97 | ≤8 |
| High | 2480 | -19.41 | ≤8 |

**BLE 1M:**

**Power Spectral Density, Low Channel**

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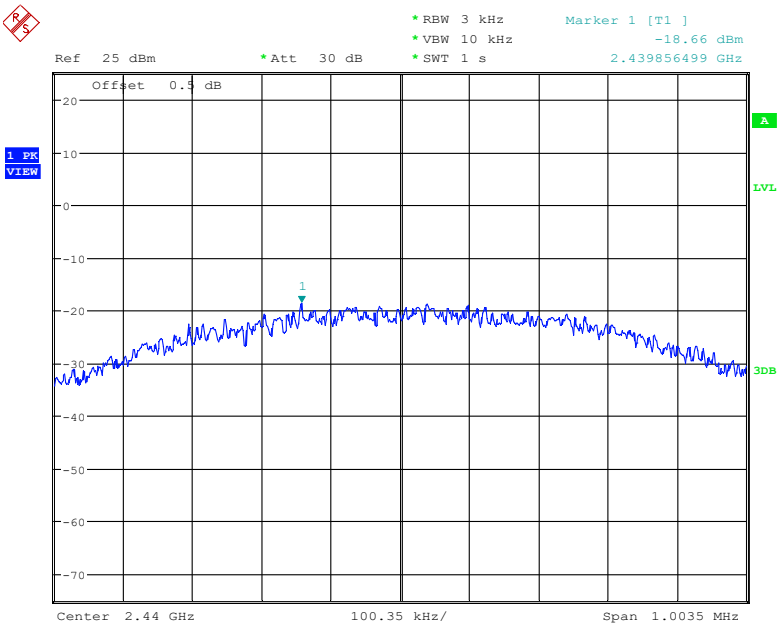
**Power Spectral Density, Middle Channel**

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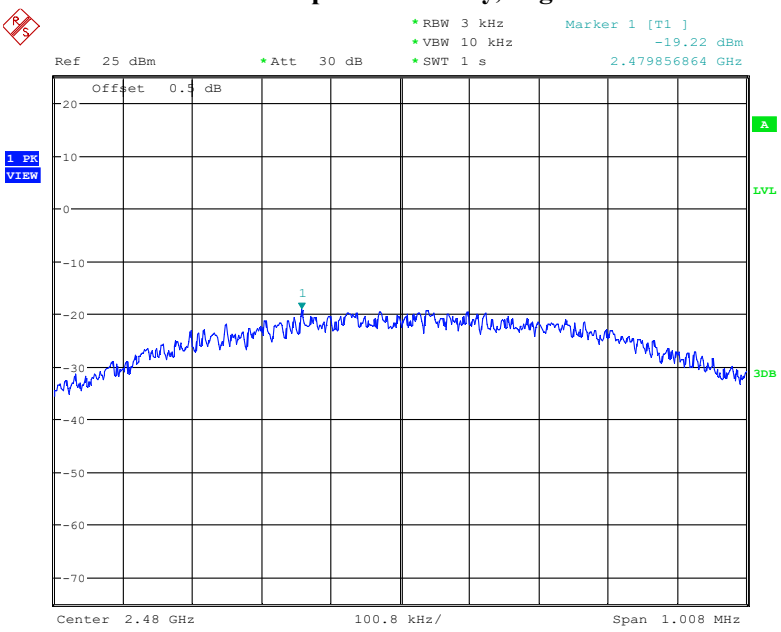
**Power Spectral Density, High Channel**

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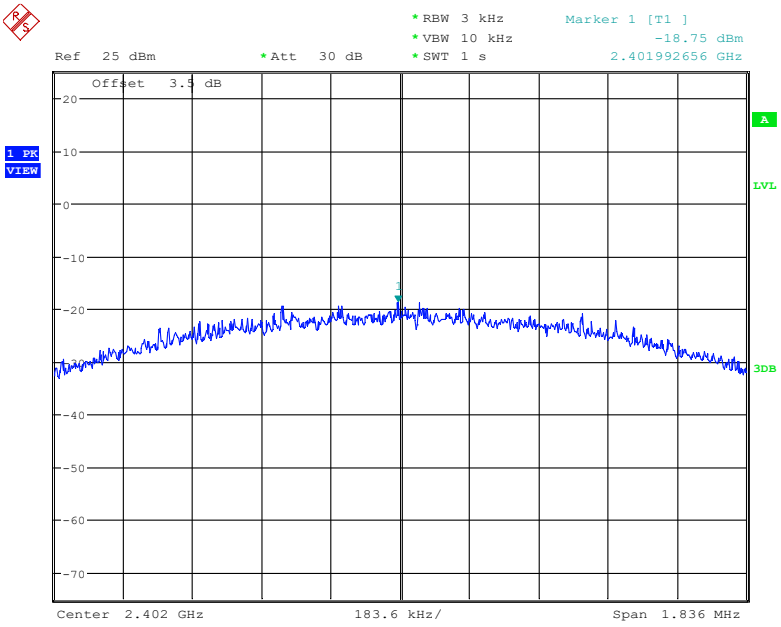
**BLE 2M:**

**Power Spectral Density, Low Channel**

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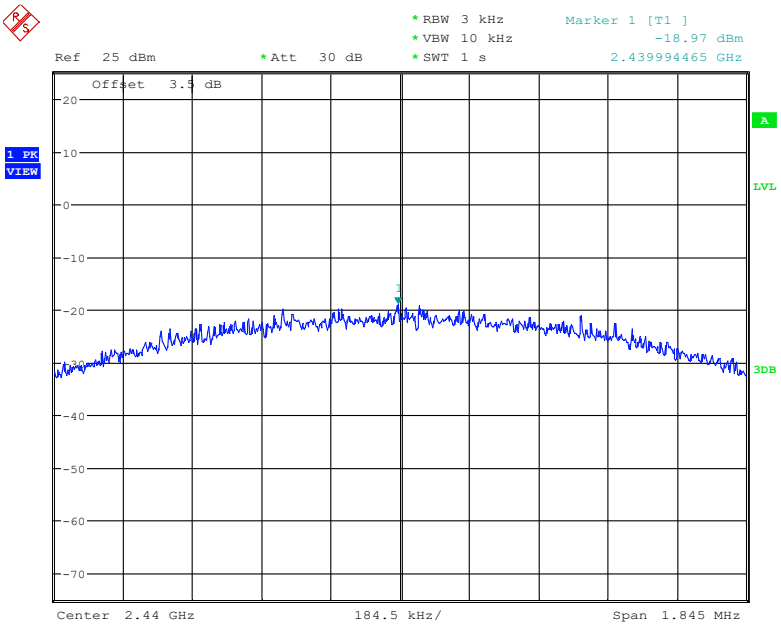
## Power Spectral Density, Middle Channel

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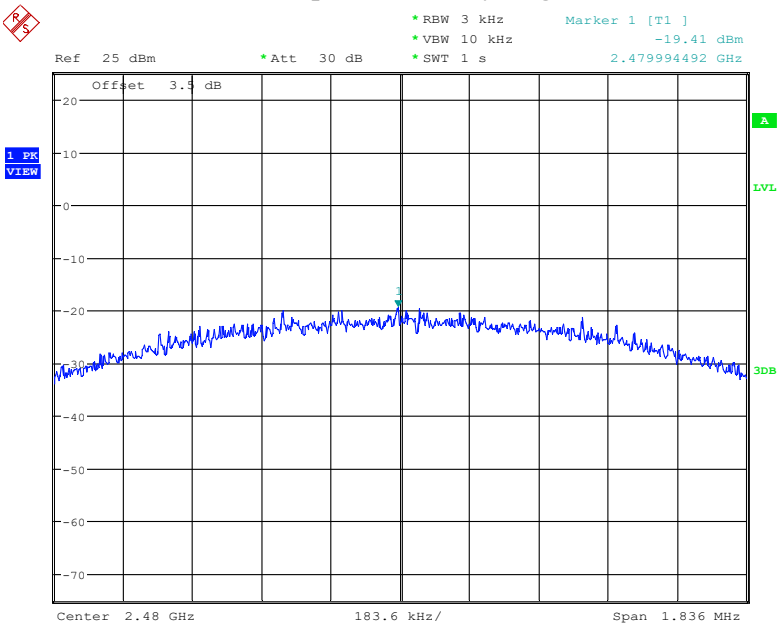
## Power Spectral Density, High Channel

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