

TEST REPORT

Applicant Name : TECNO MOBILE LIMITED
Address : FLAT N 16/F BLOCK B UNIVERSAL INDUSTRIAL CENTRE 19-25
SHAN MEI STREET FOTAN NT HONGKONG
Report Number : RA221219-62429E-RF-00B
FCC ID: 2ADYY-TSP-WP01

Test Standard (s)

FCC PART 15.247

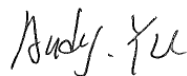
Sample Description

Product Type: Smart Watch
Model No.: TSP-WP01
Multiple Model(s) No.: N/A
Trade Mark: TECNO
Date Received: 2022/12/19
Report Date: 2023/01/04

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

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

Prepared and Checked By:



Andy Yu
EMC Engineer

Approved By:



Candy 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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DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|-----------------|------------------------|-------------------------|------------------|
| 0 | RA221219-62429E-RF-00B | Original Report | 2023/01/04 |

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

| | |
|-------------------------------------|--|
| Frequency Range | BLE: 2402-2480MHz |
| Maximum Conducted Peak Output Power | BLE: 1.93dBm |
| Modulation Technique | BLE: GFSK |
| Antenna Specification* | 0.17dBi (provided by the applicant) |
| Voltage Range | DC3.7V from battery or DC5V from Charging Port |
| Sample serial number | 1W15-1 for Radiated Emissions Test 1W16-2 for RF Conducted Test (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, 15.209 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 |
| Temperature | | 1°C |
| 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 (ISED), 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

“RTL8762X_RFTestTool v1.0.1.9”* software was used to test, and power level as below:

| Mode | Data rate | Power Level* | | |
|------|-------------|--------------|----------------|--------------|
| | | Low Channel | Middle Channel | High Channel |
| BLE | 1Mbps/2Mbps | Default | Default | Default |

Note: the software and power level was provided by manufacturer

Duty cycle

Test Result: Compliant. Please refer to the Appendix

Support Equipment List and Details

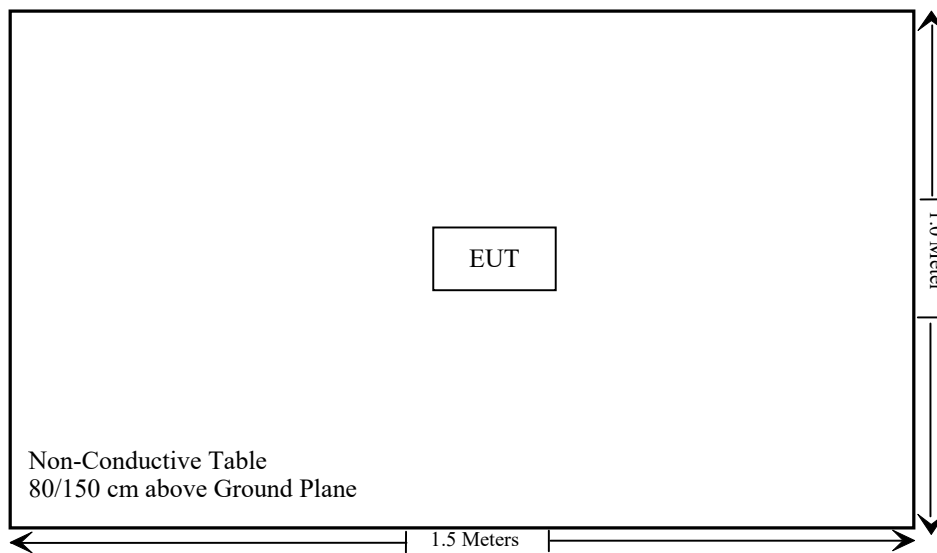
| Manufacturer | Description | Model | Serial Number |
|--------------|-------------|-------|---------------|
| / | / | / | / |

External I/O Cable

| Cable Description | Length (m) | From Port | To |
|-------------------|------------|-----------|----|
| / | / | / | / |

Block Diagram of Test Setup

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 | Not Applicable |
| §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 |

Not Applicable: The Bluetooth function cannot use when charging.

TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|--------------------|---|---------------|------------------|----------------------|
| Radiated emission test | | | | | |
| Rohde& Schwarz | Test Receiver | ESR | 102725 | 2022/11/25 | 2023/11/24 |
| Rohde&Schwarz | Spectrum Analyzer | FSV40 | 101949 | 2022/11/25 | 2023/11/24 |
| SONOMA INSTRUMENT | Amplifier | 310 N | 186131 | 2022/11/08 | 2023/11/07 |
| A.H. Systems, inc. | Preamplifier | PAM-0118P | 135 | 2022/11/08 | 2023/11/07 |
| Quinstar | Amplifier | QLW-18405536-J0 | 15964001002 | 2022/11/08 | 2023/11/07 |
| 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 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.11 | N1000 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.12 | N040 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.13 | N300 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.14 | N800 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.15 | N600 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.16 | N650 | 2022/11/25 | 2023/11/24 |
| Wainwright | Band Reject Filter | WRCG2400/2 485- 2375/2510- 60/11SS | 10 | 2022/11/25 | 2023/11/24 |
| RF conducted test | | | | | |
| Rohde&Schwarz | Spectrum Analyzer | FSV-40 | 101590 | 2022/11/25 | 2023/11/24 |
| Tonscend | RF Control Unit | JS0806-2 | 19G8060182 | 2022/10/24 | 2023/10/23 |
| WEINSCHHEL | 10dB Attenuator | 5324 | AU 3842 | 2022/11/25 | 2023/11/24 |
| Unknown | RF Coaxial Cable | No.31 | RF-01 | 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:

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

Where

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

and

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

d = the separation distance (cm);

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{\text{Evaluated}_k}{\text{Exposure Limit}_k} \leq 1$$

Result

For worst case:

| Mode | Frequency (MHz) | P _{th} | | Antenna Gain | | Maximum tune-up conducted power (dBm) | Exemption |
|-----------|-----------------|-----------------|-------|--------------|-------|---------------------------------------|-----------|
| | | (mW) | (dBm) | (dBi) | (dBd) | | |
| Bluetooth | 2402-2480 | 2.72 | 4.35 | 0.17 | -1.98 | 2.0 | Compliant |
| BLE | 2402-2480 | 2.72 | 4.35 | 0.17 | -1.98 | 2.0 | Compliant |

- Note: 1. The tune up conducted power was declared by the applicant.
 2. 0dBd=2.15dBi
 3. The antenna gain is -1.98dBd, so the maximum tune-up conducted power was used for evaluation.
 4. The Bluetooth and BLE can transmit simultaneously.
 5. To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 0.5cm from nearby persons.

Simultaneous transmitting consideration (worst case):

The ratio= $P_{BT}/P_{th} + P_{BLE}/P_{th} = 2.0/4.35 + 2.0/4.35 = 0.92 < 1.0$, so simultaneous exposure is compliant.

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 0.17dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

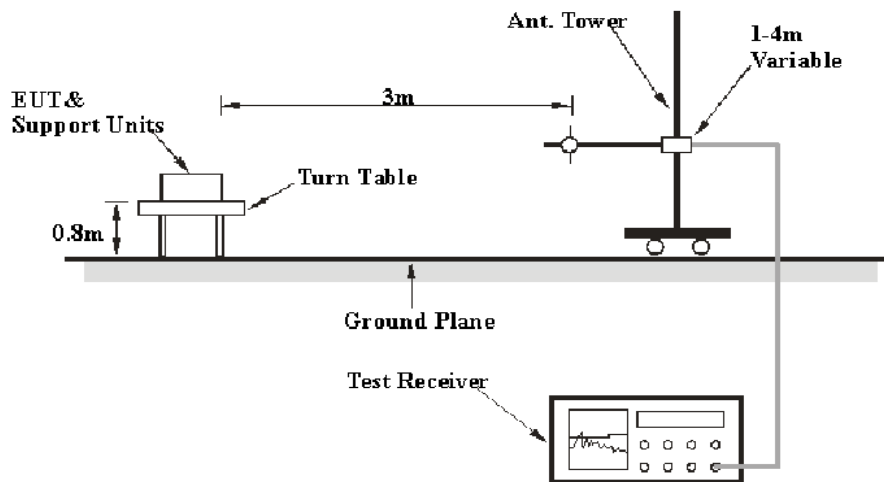
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

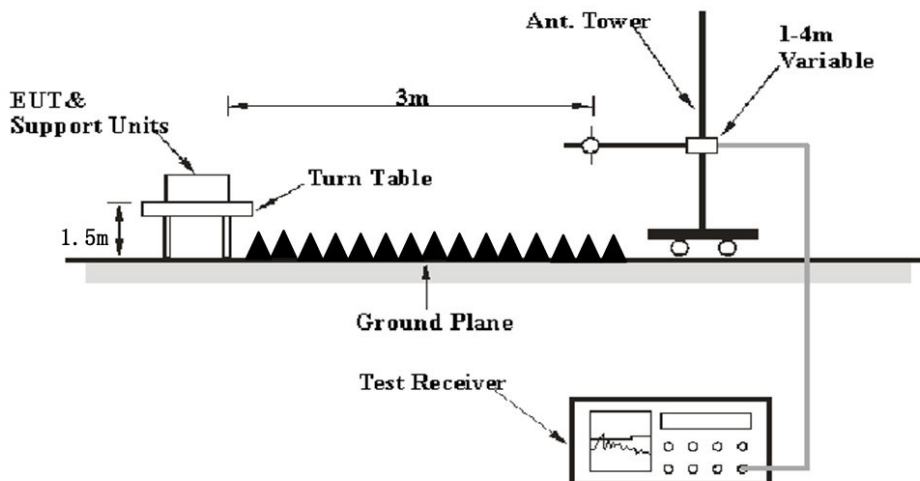
FCC §15.247 (d); §15.209; §15.205;

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:

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\begin{aligned} \text{Over Limit/Margin} &= \text{Level} / \text{Corrected Amplitude} - \text{Limit} \\ \text{Level} / \text{Corrected Amplitude} &= \text{Read Level} + \text{Factor} \end{aligned}$$

Test Data

Environmental Conditions

| | |
|---------------------------|------------|
| Temperature: | 22.6~23 °C |
| Relative Humidity: | 50~55 % |
| ATM Pressure: | 101.0 kPa |

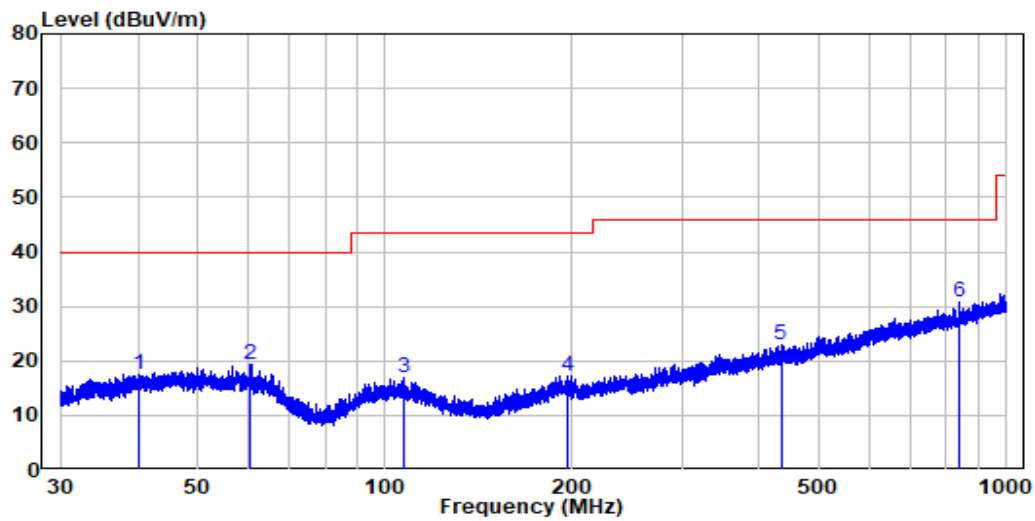
The testing was performed by Jaosn Liu on 2022-12-28 for below 1GHz and Tom Liu on 2022-12-29 for above 1GHz

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

30MHz-1GHz: (Worst case is BLE 1M, Middle channel)

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

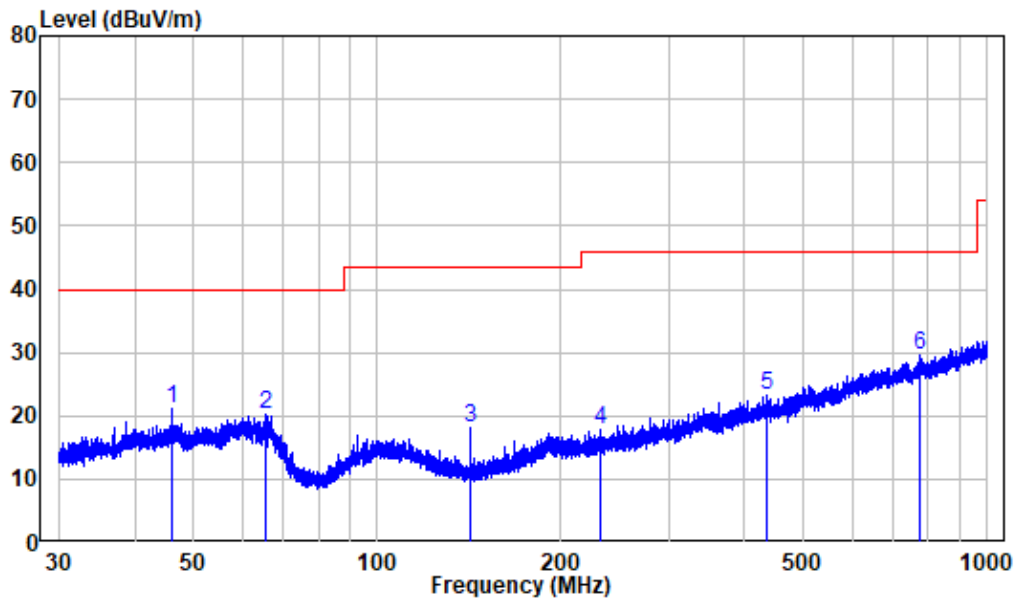
Horizontal:



Site : chamber
 Condition: 3m HORIZONTAL
 Job No. : RA221219-62429E-RF
 Test Mode: BLE Transmitting

| | Freq | Factor | Read Level | Limit Level | Limit Line | Over Limit | Remark |
|---|---------|--------|------------|-------------|------------|------------|--------|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 40.082 | -10.33 | 27.89 | 17.56 | 40.00 | -22.44 | Peak |
| 2 | 60.784 | -10.94 | 30.33 | 19.39 | 40.00 | -20.61 | Peak |
| 3 | 107.181 | -11.97 | 28.97 | 17.00 | 43.50 | -26.50 | Peak |
| 4 | 196.166 | -11.57 | 28.89 | 17.32 | 43.50 | -26.18 | Peak |
| 5 | 433.495 | -5.73 | 28.59 | 22.86 | 46.00 | -23.14 | Peak |
| 6 | 838.079 | 0.24 | 30.49 | 30.73 | 46.00 | -15.27 | Peak |

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : RA221219-62429E-RF
 Test Mode: BLE Transmitting

| | Freq | Factor | Read Level | Limit Level | Limit Line | Over Limit | Remark |
|---|---------|--------|------------|-------------|------------|------------|--------|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 45.956 | -9.99 | 31.02 | 21.03 | 40.00 | -18.97 | Peak |
| 2 | 65.774 | -12.79 | 33.06 | 20.27 | 40.00 | -19.73 | Peak |
| 3 | 141.951 | -15.54 | 33.72 | 18.18 | 43.50 | -25.32 | Peak |
| 4 | 231.820 | -11.06 | 29.01 | 17.95 | 46.00 | -28.05 | Peak |
| 5 | 434.827 | -5.71 | 28.86 | 23.15 | 46.00 | -22.85 | Peak |
| 6 | 774.837 | 0.03 | 29.45 | 29.48 | 46.00 | -16.52 | Peak |

1-25 GHz:

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Factor (dB/m) | Corrected. Amplitude (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) |
|------------------------|----------------------|--------|------------------|------------|-------------|---------------|-------------------------------------|----------------------|-------------|
| | Reading (dB μ V) | PK/Ave | | Height (m) | Polar (H/V) | | | | |
| BLE 1M | | | | | | | | | |
| Low Channel 2402MHz | | | | | | | | | |
| 2310 | 61.49 | PK | 162 | 1.5 | H | -7.24 | 54.25 | 74 | -19.75 |
| 2310 | 48.70 | AV | 162 | 1.5 | H | -7.24 | 41.46 | 54 | -12.54 |
| 2310 | 61.36 | PK | 299 | 2.4 | V | -7.24 | 54.12 | 74 | -19.88 |
| 2310 | 48.52 | AV | 299 | 2.4 | V | -7.24 | 41.28 | 54 | -12.72 |
| 2390 | 62.68 | PK | 111 | 1.5 | H | -7.22 | 55.46 | 74 | -18.54 |
| 2390 | 50.06 | AV | 111 | 1.5 | H | -7.22 | 42.84 | 54 | -11.16 |
| 2390 | 62.95 | PK | 56 | 1.3 | V | -7.22 | 55.73 | 74 | -18.27 |
| 2390 | 50.01 | AV | 56 | 1.3 | V | -7.22 | 42.79 | 54 | -11.21 |
| 4804 | 58.34 | PK | 229 | 1.6 | H | -3.51 | 54.83 | 74 | -19.17 |
| 4804 | 49.37 | AV | 229 | 1.6 | H | -3.51 | 45.86 | 54 | -8.14 |
| 4804 | 57.18 | PK | 158 | 1.1 | V | -3.51 | 53.67 | 74 | -20.33 |
| Middle Channel 2440MHz | | | | | | | | | |
| 4880 | 58.36 | PK | 349 | 1.5 | H | -3.38 | 54.98 | 74 | -19.02 |
| 4880 | 50.94 | AV | 349 | 1.5 | H | -3.38 | 47.56 | 54 | -6.44 |
| 4880 | 58.07 | PK | 6 | 1.2 | V | -3.38 | 54.69 | 74 | -19.31 |
| 4880 | 48.04 | AV | 6 | 1.2 | V | -3.38 | 44.66 | 54 | -9.34 |
| High Channel 2480MHz | | | | | | | | | |
| 2483.5 | 72.71 | PK | 215 | 2.1 | H | -7.20 | 65.51 | 74 | -8.49 |
| 2483.5 | 52.09 | AV | 215 | 2.1 | H | -7.20 | 44.89 | 54 | -9.11 |
| 2483.5 | 65.55 | PK | 181 | 2.2 | V | -7.20 | 58.35 | 74 | -15.65 |
| 2483.5 | 51.71 | AV | 181 | 2.2 | V | -7.20 | 44.51 | 54 | -9.49 |
| 2500 | 65.08 | PK | 70 | 2.3 | H | -7.18 | 57.9 | 74 | -16.10 |
| 2500 | 50.37 | AV | 70 | 2.3 | H | -7.18 | 43.19 | 54 | -10.81 |
| 2500 | 63.47 | PK | 252 | 1.2 | V | -7.18 | 56.29 | 74 | -17.71 |
| 2500 | 50.41 | AV | 252 | 1.2 | V | -7.18 | 43.23 | 54 | -10.77 |
| 4960 | 57.20 | PK | 2 | 1.2 | H | -3.01 | 54.19 | 74 | -19.81 |
| 4960 | 47.93 | AV | 2 | 1.2 | H | -3.01 | 44.92 | 54 | -9.08 |
| 4960 | 56.16 | PK | 194 | 1.3 | V | -3.01 | 53.15 | 74 | -20.85 |

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Factor (dB/m) | Corrected. Amplitude (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) |
|------------------------|----------------------|--------|------------------|------------|-------------|---------------|-------------------------------------|----------------------|-------------|
| | Reading (dB μ V) | PK/Ave | | Height (m) | Polar (H/V) | | | | |
| BLE 2M | | | | | | | | | |
| Low Channel 2402MHz | | | | | | | | | |
| 2310 | 61.93 | PK | 170 | 1.5 | H | -7.24 | 54.69 | 74 | -19.31 |
| 2310 | 49.27 | AV | 170 | 1.5 | H | -7.24 | 42.03 | 54 | -11.97 |
| 2310 | 61.80 | PK | 306 | 1.9 | V | -7.24 | 54.56 | 74 | -19.44 |
| 2310 | 48.95 | AV | 306 | 1.9 | V | -7.24 | 41.71 | 54 | -12.29 |
| 2390 | 62.55 | PK | 112 | 1.8 | H | -7.22 | 55.33 | 74 | -18.67 |
| 2390 | 50.52 | AV | 112 | 1.8 | H | -7.22 | 43.30 | 54 | -10.70 |
| 2390 | 62.19 | PK | 268 | 2 | V | -7.22 | 54.97 | 74 | -19.03 |
| 2390 | 50.13 | AV | 268 | 2 | V | -7.22 | 42.91 | 54 | -11.09 |
| 4804 | 58.20 | PK | 343 | 2.1 | H | -3.51 | 54.69 | 74 | -19.31 |
| 4804 | 50.63 | AV | 343 | 2.1 | H | -3.51 | 47.12 | 54 | -6.88 |
| 4804 | 58.76 | PK | 50 | 1.8 | V | -3.51 | 55.25 | 74 | -18.75 |
| 4804 | 48.64 | AV | 50 | 1.8 | V | -3.51 | 45.13 | 54 | -8.87 |
| Middle Channel 2440MHz | | | | | | | | | |
| 4880 | 58.36 | PK | 29 | 2.1 | H | -3.38 | 54.98 | 74 | -19.02 |
| 4880 | 52.36 | AV | 29 | 2.1 | H | -3.38 | 48.98 | 54 | -5.02 |
| 4880 | 57.30 | PK | 80 | 2.5 | V | -3.38 | 53.92 | 74 | -20.08 |
| High Channel 2480MHz | | | | | | | | | |
| 2483.5 | 73.22 | PK | 178 | 1.4 | H | -7.20 | 66.02 | 74 | -7.98 |
| 2483.5 | 58.24 | AV | 178 | 1.4 | H | -7.20 | 51.04 | 54 | -2.96 |
| 2483.5 | 65.00 | PK | 357 | 1.8 | V | -7.20 | 57.8 | 74 | -16.20 |
| 2483.5 | 52.20 | AV | 357 | 1.8 | V | -7.20 | 45 | 54 | -9.00 |
| 2500 | 64.10 | PK | 265 | 2.1 | H | -7.18 | 56.92 | 74 | -17.08 |
| 2500 | 50.82 | AV | 265 | 2.1 | H | -7.18 | 43.64 | 54 | -10.36 |
| 2500 | 63.92 | PK | 120 | 2.2 | V | -7.18 | 56.74 | 74 | -17.26 |
| 2500 | 50.67 | AV | 120 | 2.2 | V | -7.18 | 43.49 | 54 | -10.51 |
| 4960 | 57.34 | PK | 253 | 2.4 | H | -3.01 | 54.33 | 74 | -19.67 |
| 4960 | 49.08 | AV | 253 | 2.4 | H | -3.01 | 46.07 | 54 | -7.93 |
| 4960 | 56.46 | PK | 176 | 1.1 | V | -3.01 | 53.45 | 74 | -20.55 |

Note:

Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Factor + Reading

Margin = Corrected. Amplitude - Limit

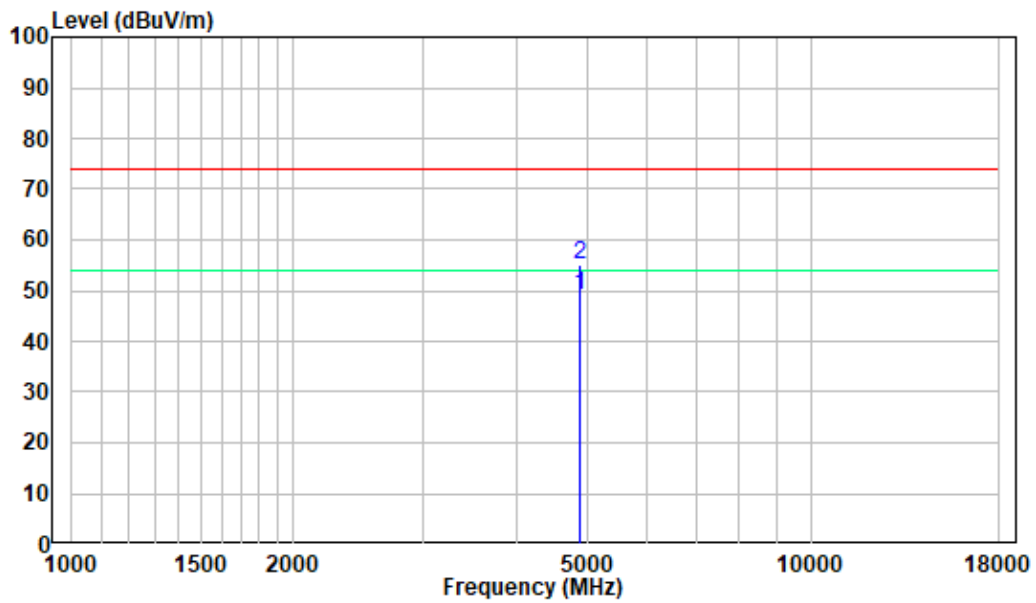
The other spurious emission which is in the noise floor level was not recorded.

When the test result of Peak was below the limit of average, just the Peak value was recorded.

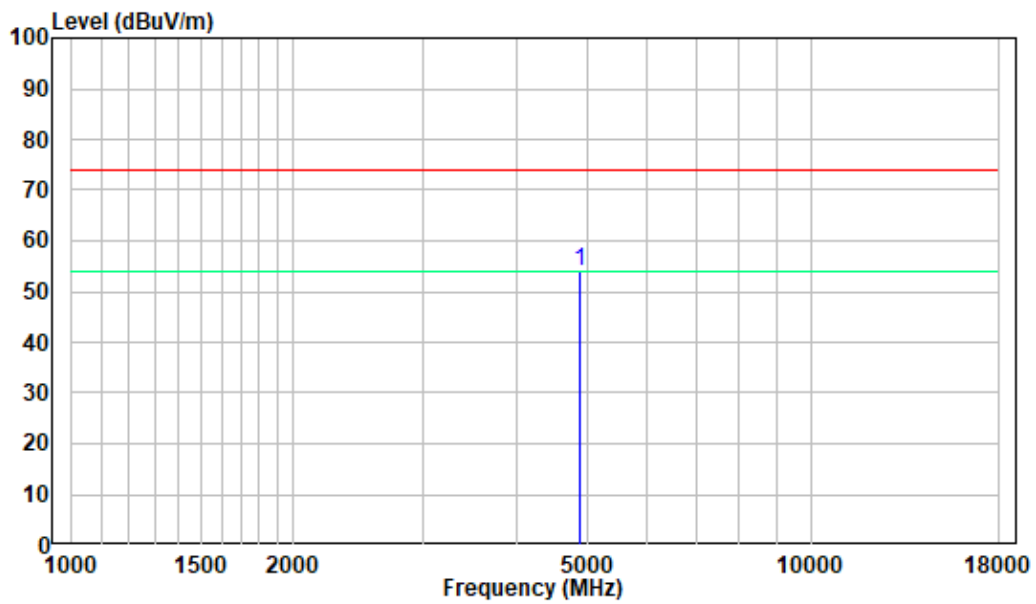
1-18 GHz:

Pre-scan for BLE 2M, Middle Channel

Horizontal



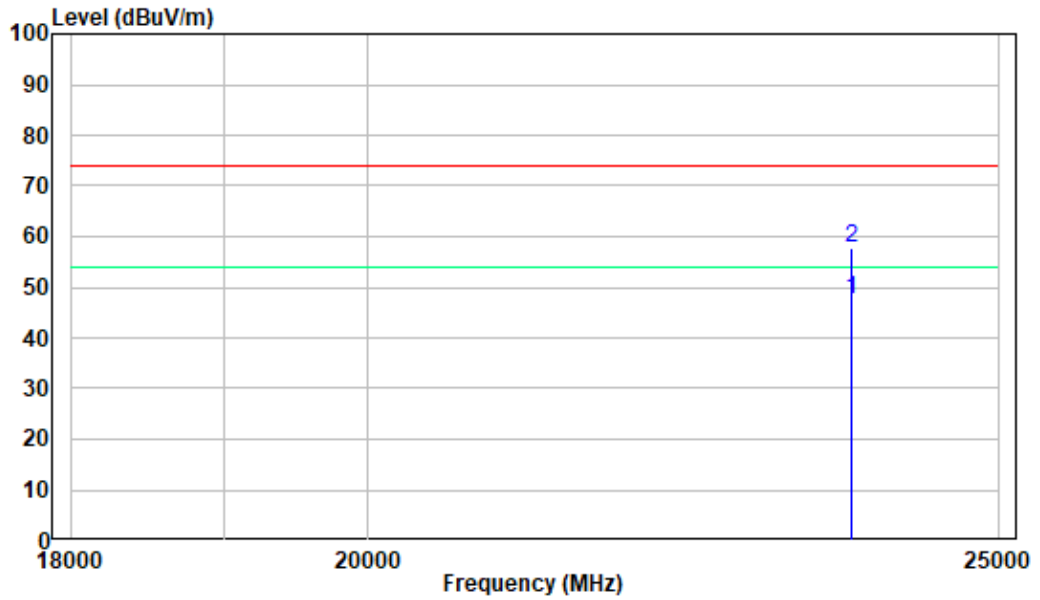
Vertical



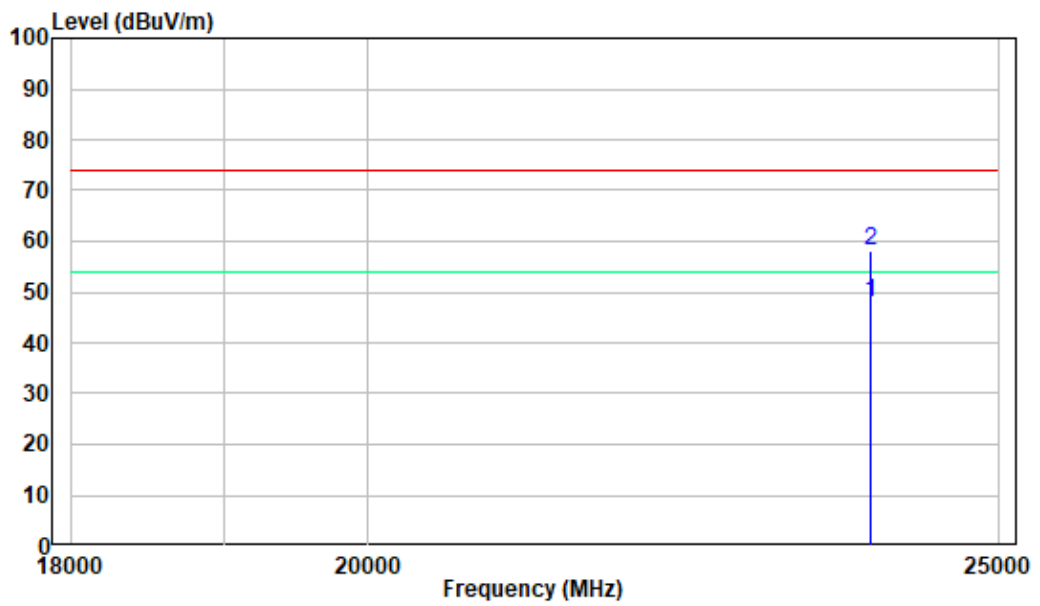
18 -25GHz:

Pre-scan for BLE 2M, Middle Channel

Horizontal



Vertical



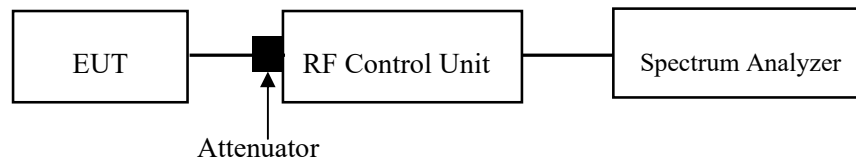
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

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 °C |
| Relative Humidity: | 65 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Andy Yu on 2022-12-30.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

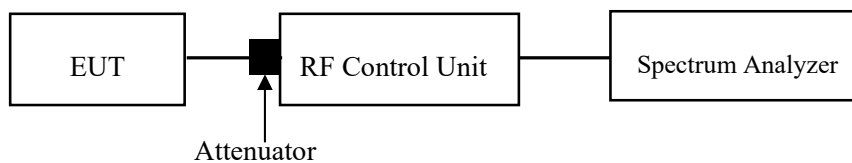
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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 °C |
| Relative Humidity: | 65 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Andy Yu on 2022-12-30.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

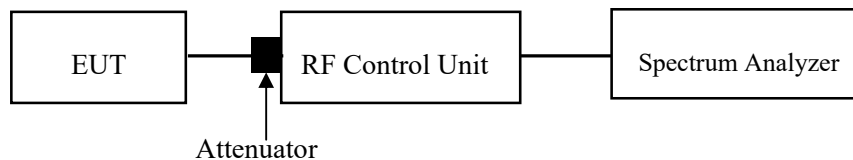
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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 °C |
| Relative Humidity: | 65 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Andy Yu on 2022-12-30.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

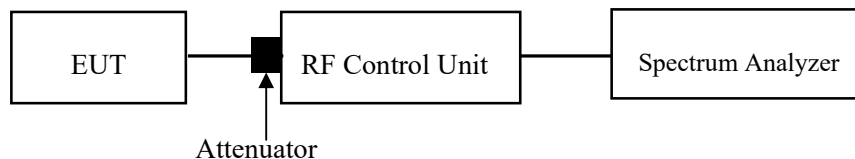
FCC §15.247(e) - POWER SPECTRAL DENSITY

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: $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
3. Set the VBW $\geq 3 \times \text{RBW}$.
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 °C |
| Relative Humidity: | 65 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Andy Yu on 2022-12-30.

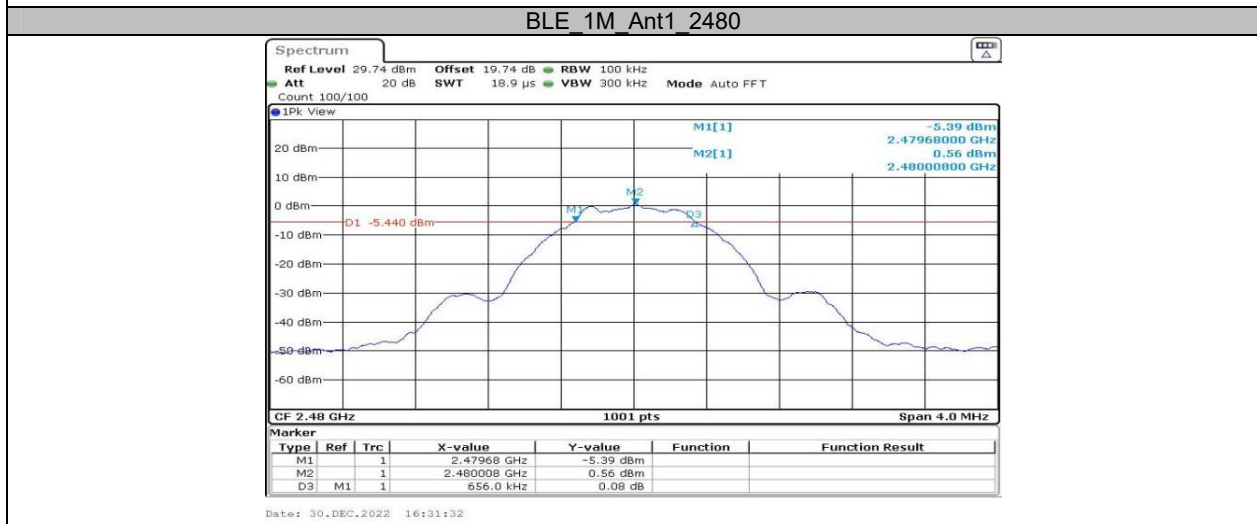
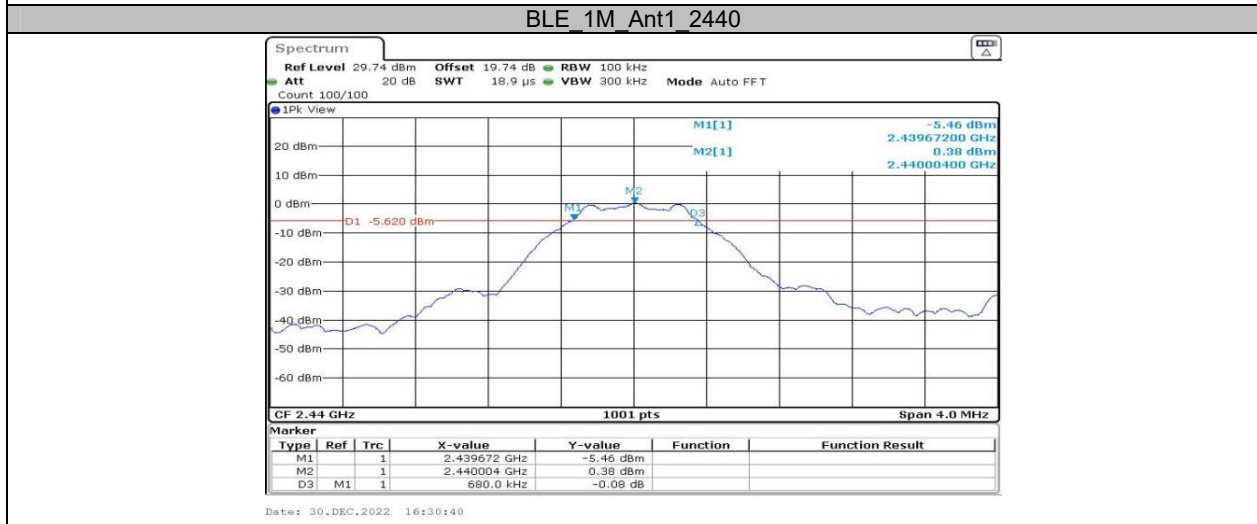
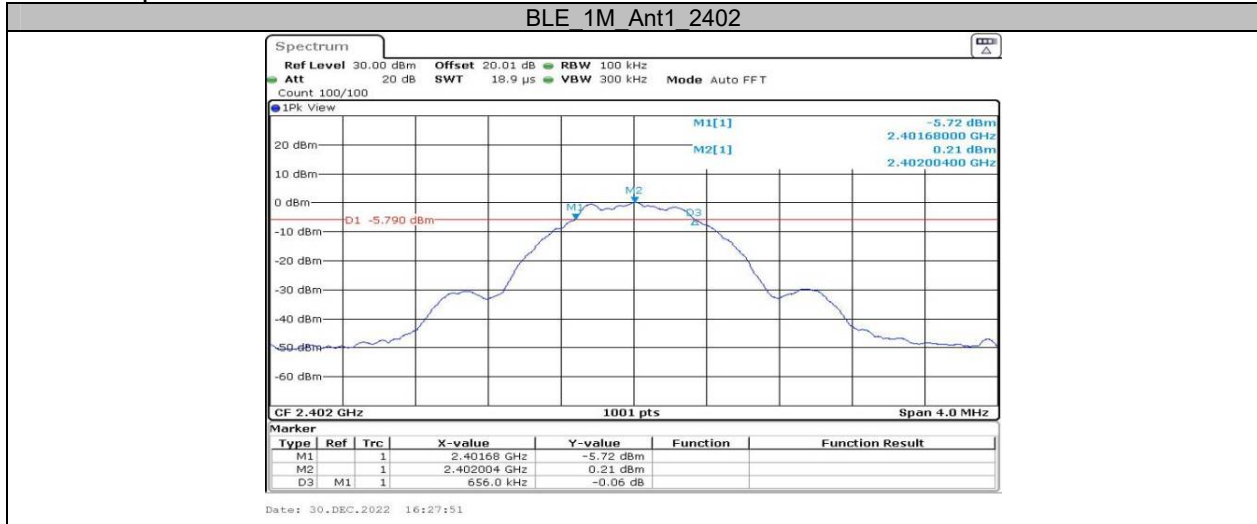
EUT operation mode: Transmitting

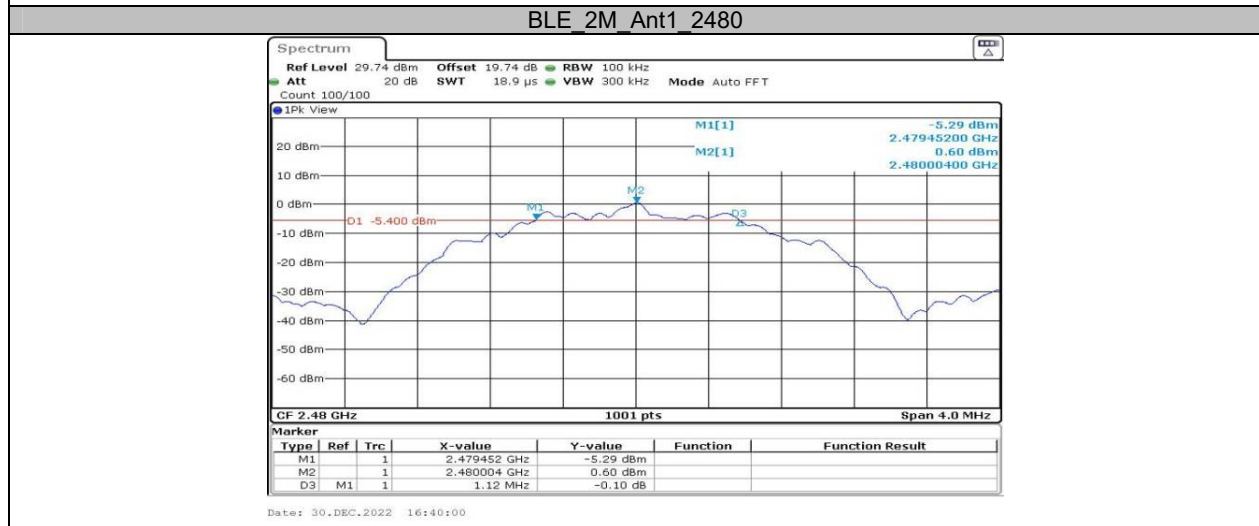
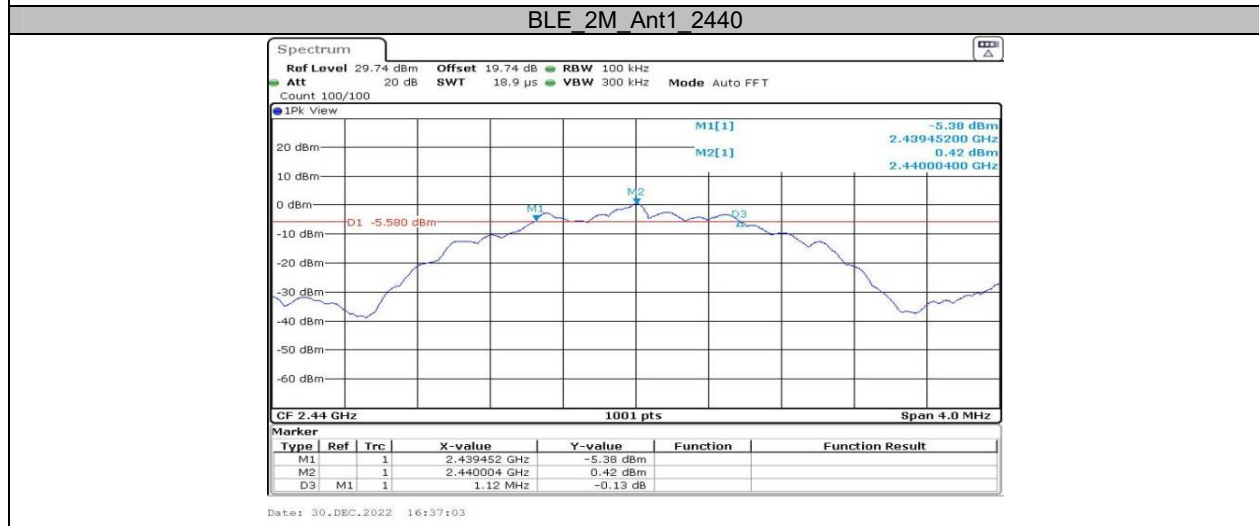
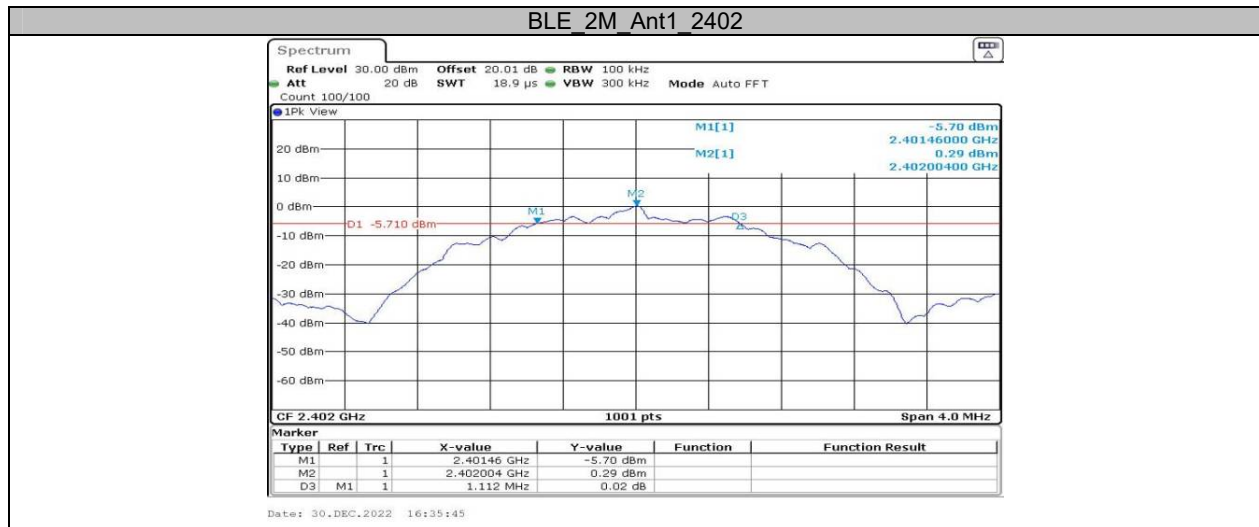
Test Result: Compliant. Please refer to the Appendix.

APPENDIX**Appendix A: DTS Bandwidth
Test Result**

| Test Mode | Antenna | Frequency[MHz] | DTS BW [MHz] | Limit[MHz] | Verdict |
|-----------|---------|----------------|--------------|------------|---------|
| BLE_1M | Ant1 | 2402 | 0.66 | 0.5 | PASS |
| | | 2440 | 0.68 | 0.5 | PASS |
| | | 2480 | 0.66 | 0.5 | PASS |
| BLE_2M | Ant1 | 2402 | 1.11 | 0.5 | PASS |
| | | 2440 | 1.12 | 0.5 | PASS |
| | | 2480 | 1.12 | 0.5 | PASS |

Test Graphs

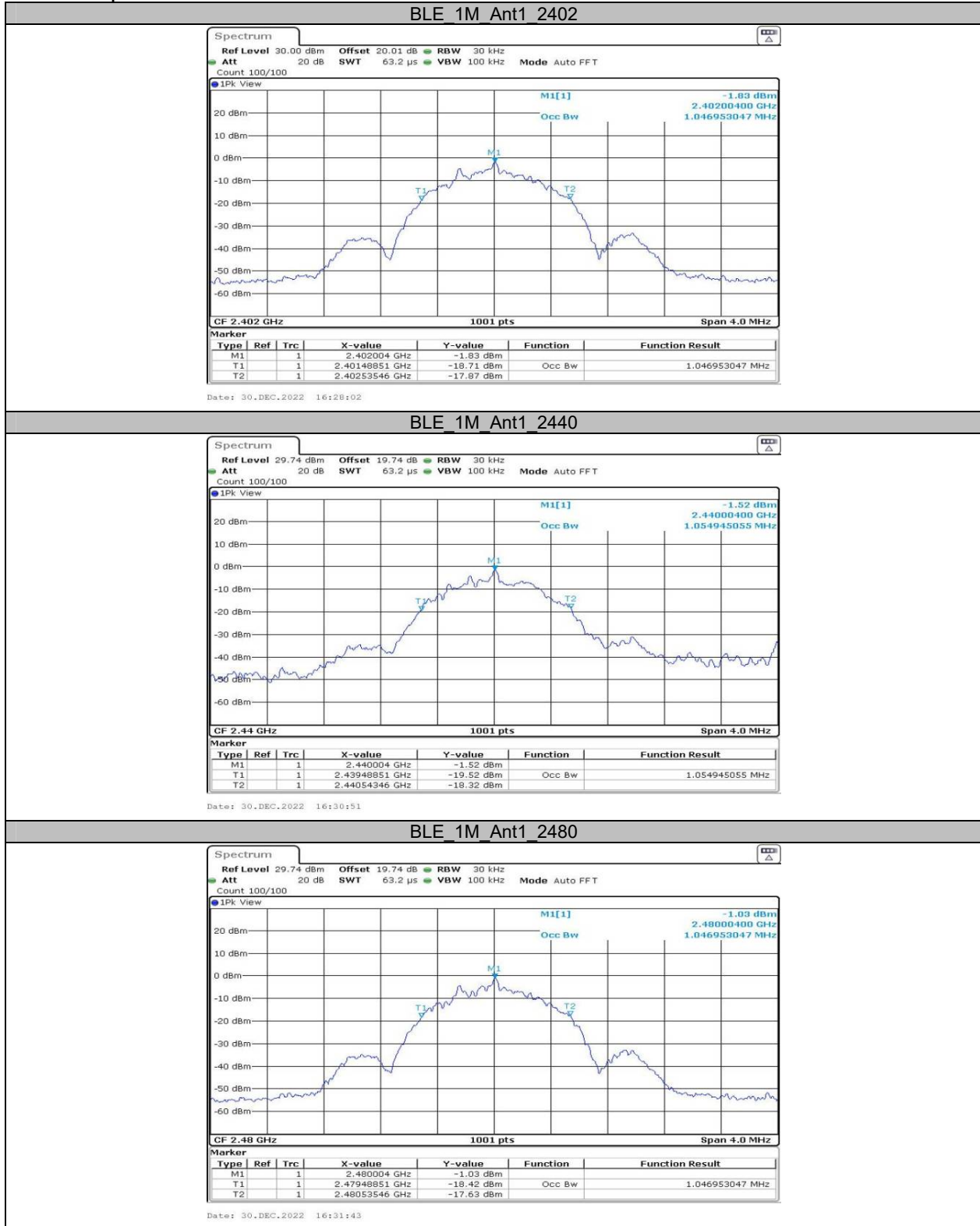


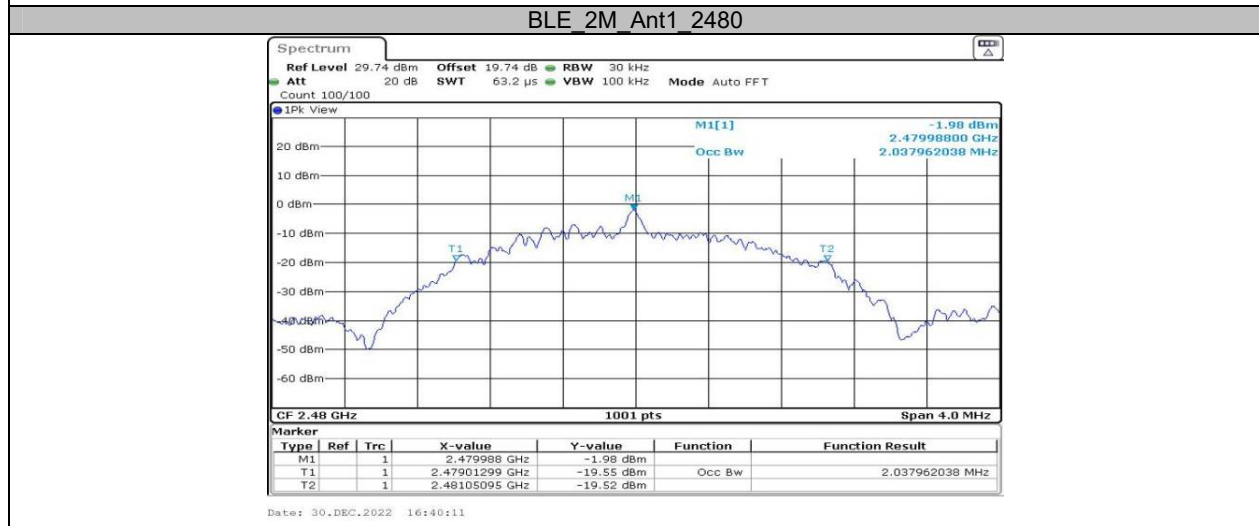
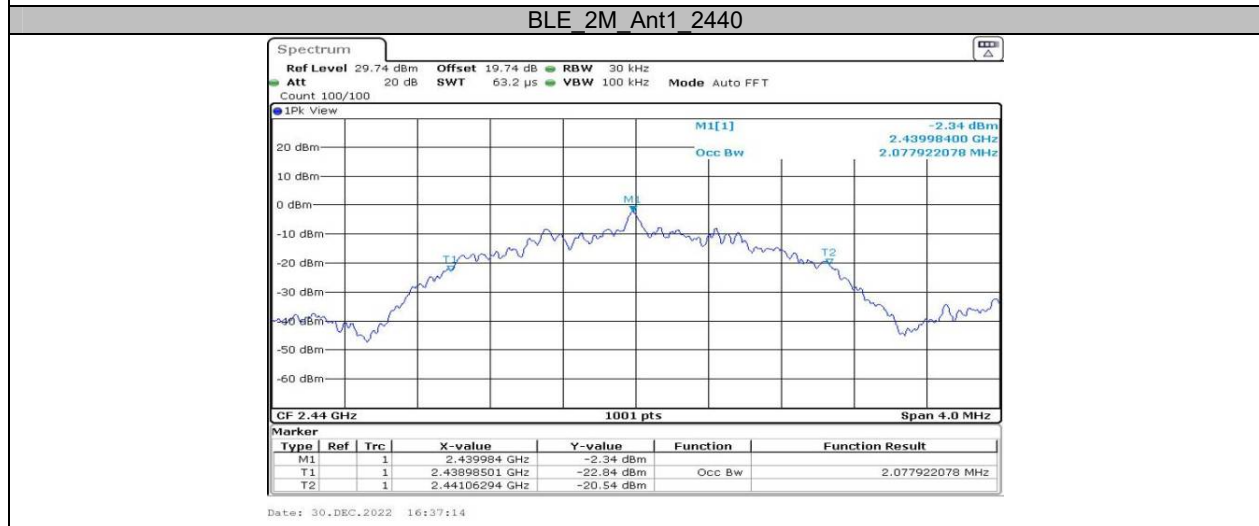
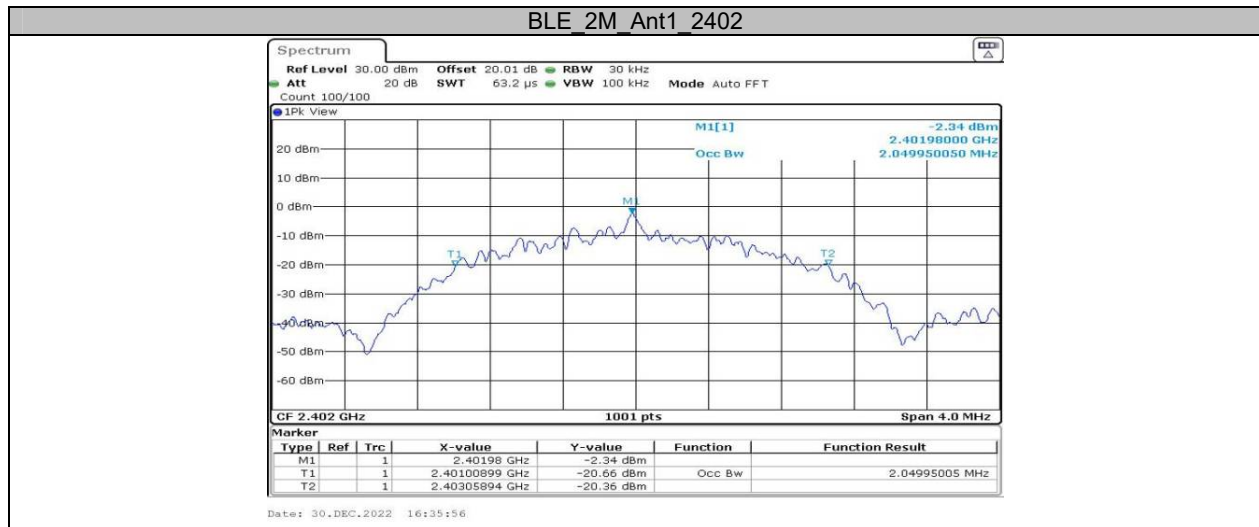


**Appendix B: Occupied Channel Bandwidth
Test Result**

| Test Mode | Antenna | Frequency[MHz] | OCB [MHz] | FL[MHz] | FH[MHz] | Limit[MHz] | Verdict |
|-----------|---------|----------------|-----------|----------|----------|------------|---------|
| BLE_1M | Ant1 | 2402 | 1.047 | 2401.489 | 2402.535 | --- | --- |
| | | 2440 | 1.055 | 2439.489 | 2440.543 | --- | --- |
| | | 2480 | 1.047 | 2479.489 | 2480.535 | --- | --- |
| BLE_2M | Ant1 | 2402 | 2.050 | 2401.009 | 2403.059 | --- | --- |
| | | 2440 | 2.078 | 2438.985 | 2441.063 | --- | --- |
| | | 2480 | 2.038 | 2479.013 | 2481.051 | --- | --- |

Test Graphs





**Appendix C: Maximum conducted output power
Test Result**

| Test Mode | Antenna | Frequency[MHz] | Conducted Peak Power [dBm] | Conducted Limit [dBm] | Verdict |
|-----------|---------|----------------|----------------------------|-----------------------|---------|
| BLE_1M | Ant1 | 2402 | 0.83 | ≤30 | PASS |
| | | 2440 | 1.93 | ≤30 | PASS |
| | | 2480 | 1.51 | ≤30 | PASS |
| BLE_2M | Ant1 | 2402 | 0.88 | ≤30 | PASS |
| | | 2440 | 1.85 | ≤30 | PASS |
| | | 2480 | 1.54 | ≤30 | PASS |

Test Graphs

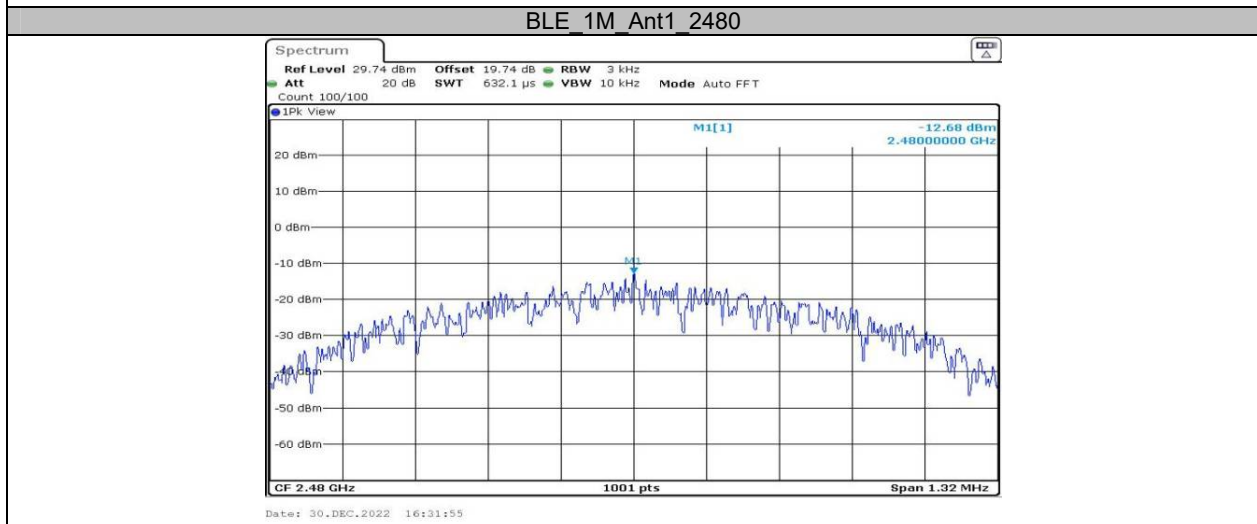
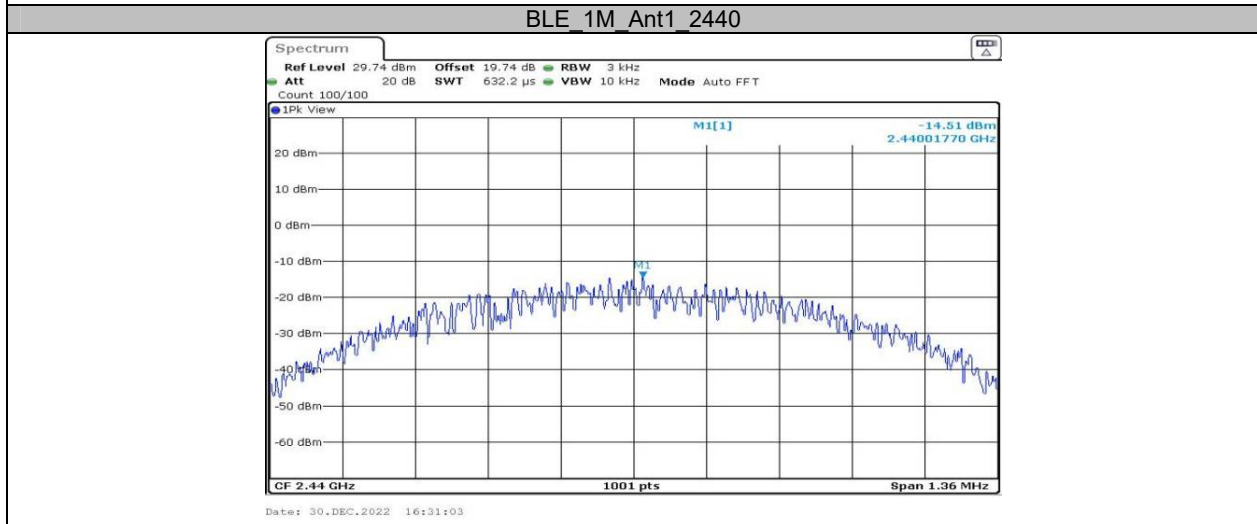
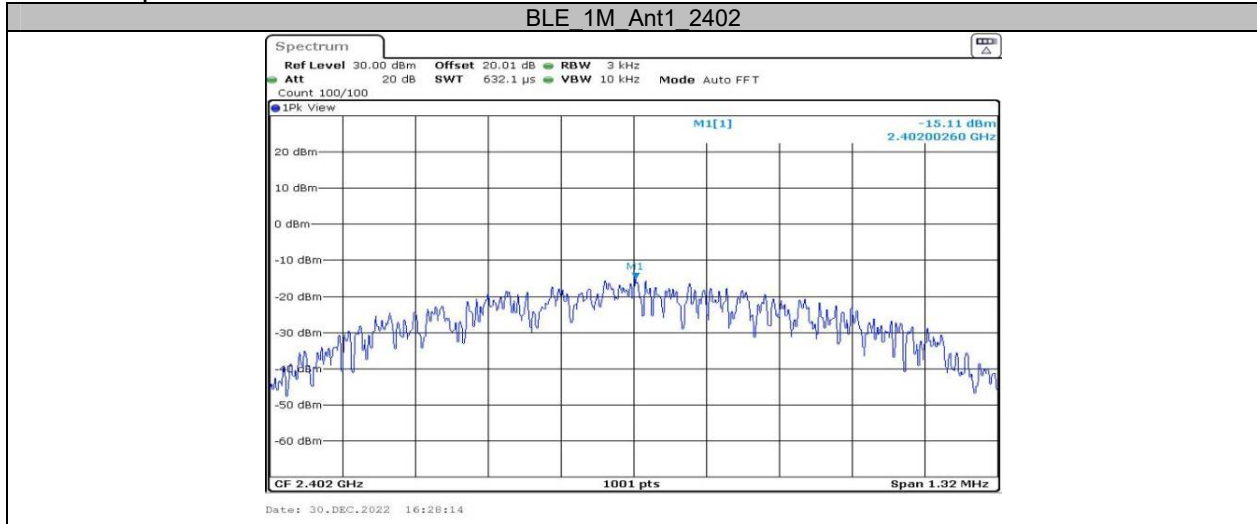


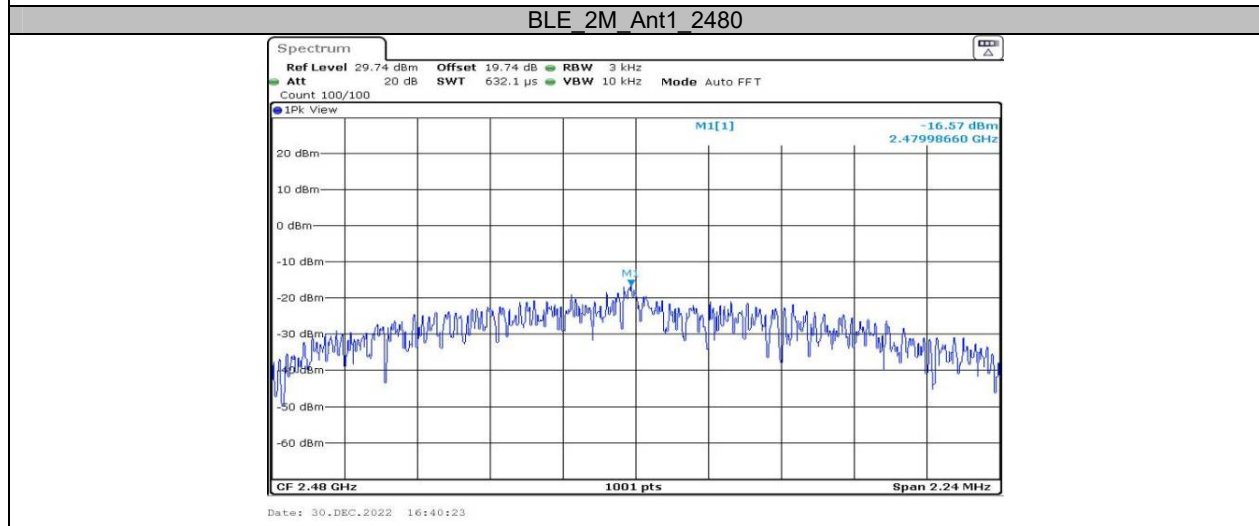
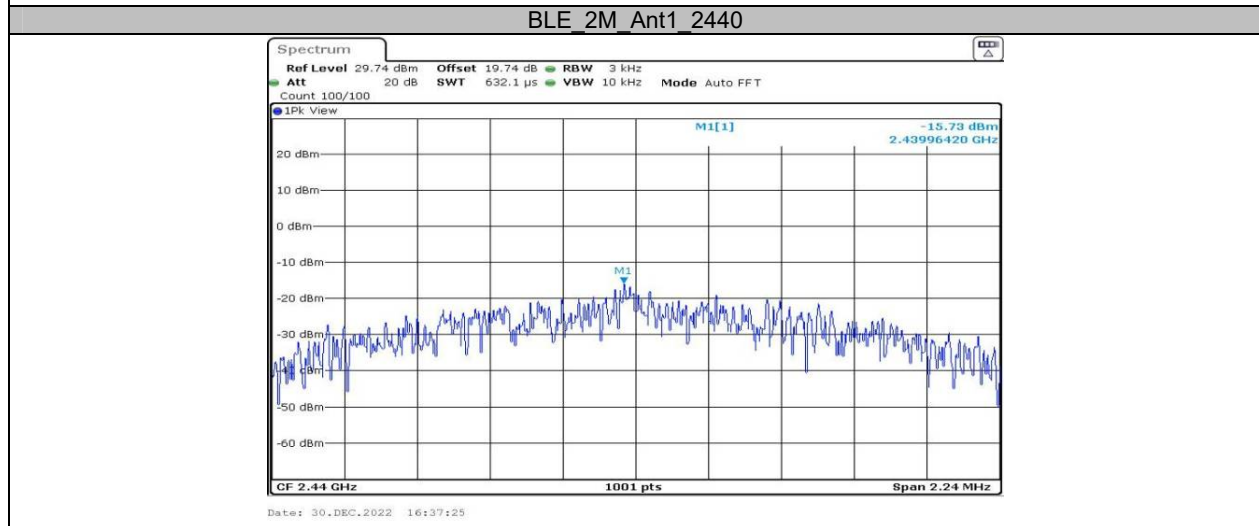
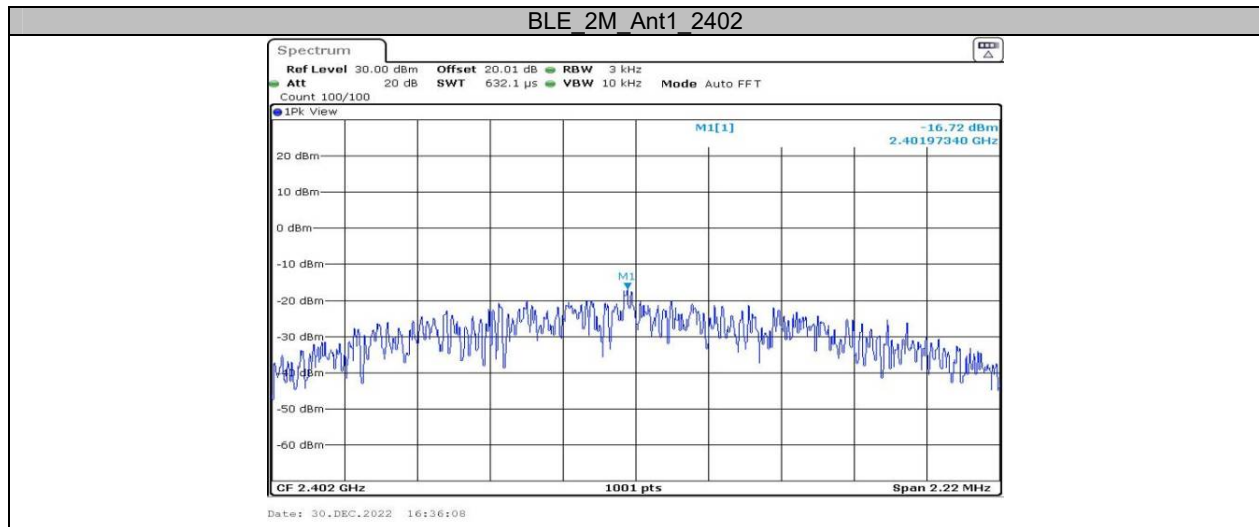


**Appendix D: Maximum power spectral density
Test Result**

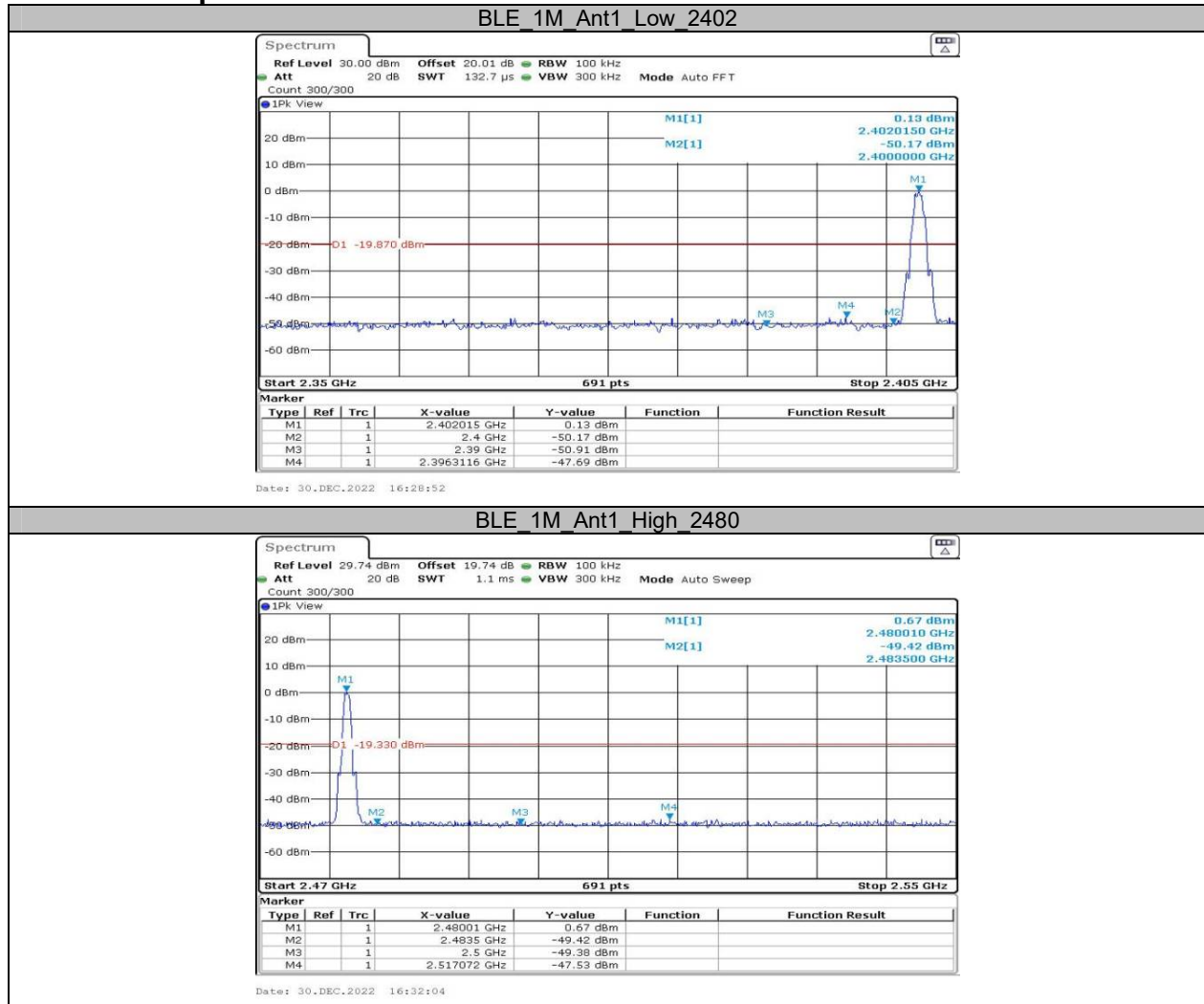
| Test Mode | Antenna | Frequency[MHz] | Result[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|-----------|---------|----------------|------------------|-----------------|---------|
| BLE_1M | Ant1 | 2402 | -15.11 | ≤8.00 | PASS |
| | | 2440 | -14.51 | ≤8.00 | PASS |
| | | 2480 | -12.68 | ≤8.00 | PASS |
| BLE_2M | Ant1 | 2402 | -16.72 | ≤8.00 | PASS |
| | | 2440 | -15.73 | ≤8.00 | PASS |
| | | 2480 | -16.57 | ≤8.00 | PASS |

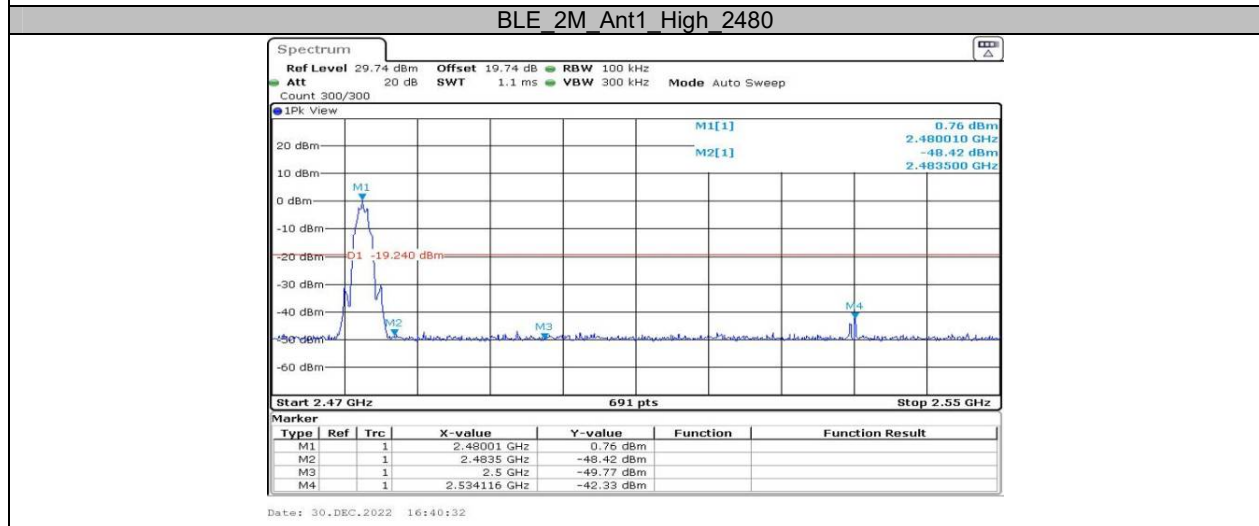
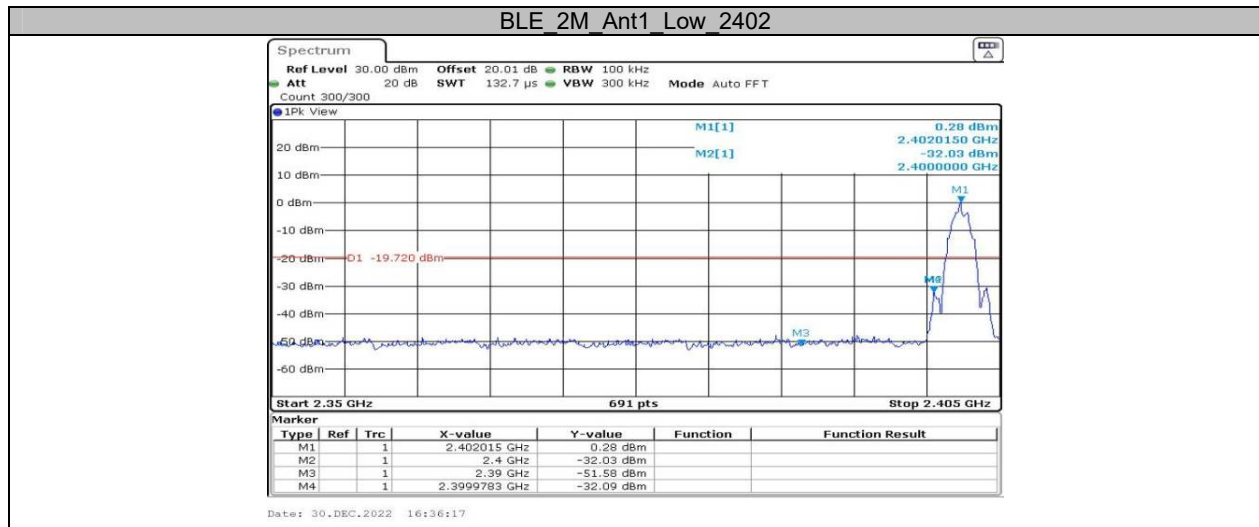
Test Graphs





Appendix E: Band edge measurements Test Graphs

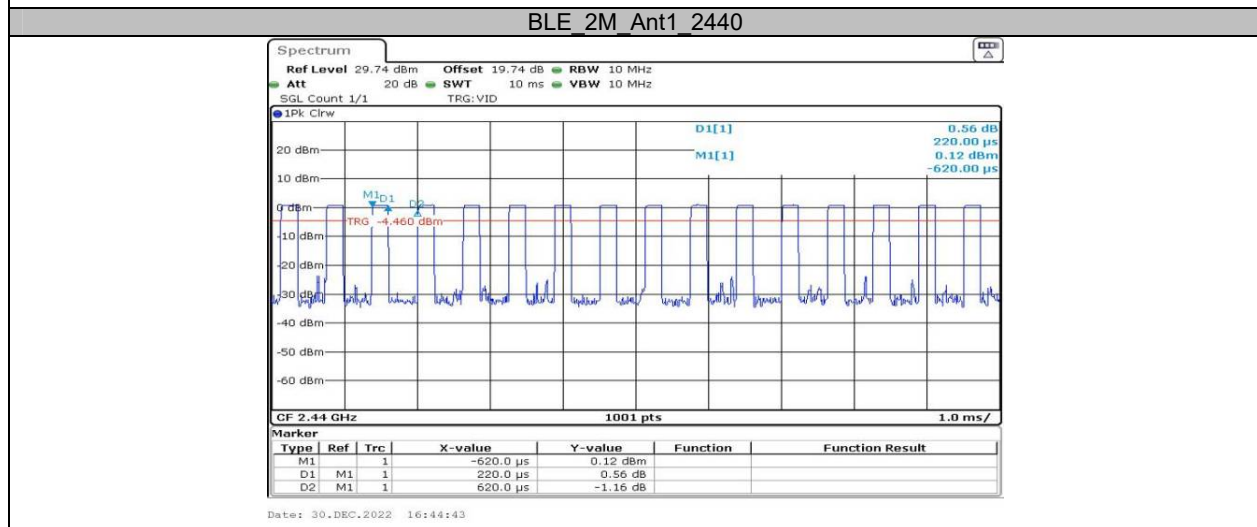
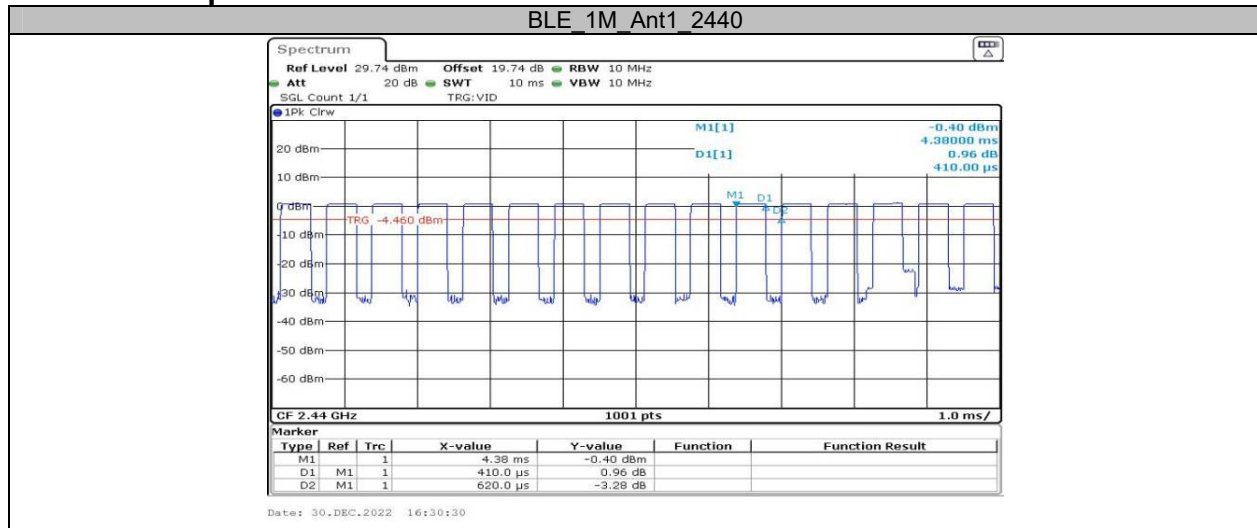




Appendix F: Duty Cycle Test Result

| Test Mode | Antenna | Frequency[MHz] | ON Time [ms] | Period [ms] | Duty Cycle [%] |
|-----------|---------|----------------|--------------|-------------|----------------|
| BLE_1M | Ant1 | 2440 | 0.41 | 0.62 | 66.13 |
| BLE_2M | Ant1 | 2440 | 0.22 | 0.62 | 35.48 |

Test Graphs



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