# TEST REPORT

| | |
|---|---|
| Applicant Name : | Dragino Technology Co., Limited. |
| Address : | Room 202,BaoChengTai industrial park,No.8 CaiYun, LongCheng Street, LongGang District,Shenzhen,China |
| Report Number : | RA230409-17769E-RF-00A |
| FCC ID: | ZHZPSLB |

**Test Standard (s)**

FCC PART 15.247

**Sample Description**

| | |
|---|---|
| Product Type: | LoRaWAN Analog Sensor |
| Model No.: | PS-LB-NA |
| Multiple Model(s) No.: | PS-LB; SDI-12; PS-LB-I5; PS-LB-TN4-A |
| Trade Mark: | DRAGINO |
| Date Received: | 2023/04/09 |
| Report Date: | 2023/05/26 |

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

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

**Prepared and Checked By:**

Dave Liang
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 "★ ".
Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.
This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

# TABLE OF CONTENTS

# DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|---|---|---|---|
| 0 | RA230409-17769E-RF-00A | Original Report | 2023/05/26 |

# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Product | LoRaWAN Analog Sensor |
| Tested model | PS-LB-NA |
| Multiple Model(s) | PS-LB; SDI-12; PS-LB-I5; PS-LB-TN4-A<br>(model difference see product declaration letter of similarity) |
| Frequency Range | BLE: 2402-2480MHz |
| Data rate | 1Mbps |
| Maximum Conducted Peak Output Power | BLE: -0.54dBm |
| Modulation Technique | BLE: GFSK |
| Antenna Specification* | 2.0dBi (provided by the applicant) |
| Voltage Range | DC 3.6V from battery |
| Sample serial number | 24CY-1 for Radiated Emissions Test<br>24CY-2 for RF Conducted Test (Assigned by ATC) |
| Sample/EUT Status | Good condition |

Note: Pre-scan with these models, the worst case is the PS-LB-NA which was recorded in the report.

## 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.

## 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 |
|---|---|---|
| Harmonic Current | | 0.512%, k=2 |
| Occupied Channel Bandwidth | | 5% |
| RF output power, conducted | | 0.71dB |
| Unwanted Emission, conducted | | 1.6dB |
| AC Power Lines Conducted Emissions | 9k-30MHz | 2.74dB, k=2 |
| | 150kHz-30MHz | 2.92dB, k=2 |
| Emissions, Radiated | 9kHz - 30MHz | 2.06dB |
| | 30MHz - 1GHz | 5.08dB |
| | 1GHz - 18GHz | 4.96dB |
| | 18GHz - 26.5GHz | 5.16dB |
| | 26.5GHz - 40GHz | 4.64dB |
| 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 Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, 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.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

# 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

"SerialPoriling; SmartSnippets Toolbox V5.0.12.exe *" software was used to test, the software and power level was provided by the applicant:

| Mode | Data rate | Power Level* | | |
|---|---|---|---|---|
| | | Low Channel | Middle Channel | High Channel |
| BLE | 1Mbps | 13 | 13 | 13 |

## Duty cycle

Test Result: Compliant. Please refer to the Appendix

## Support Equipment List and Details

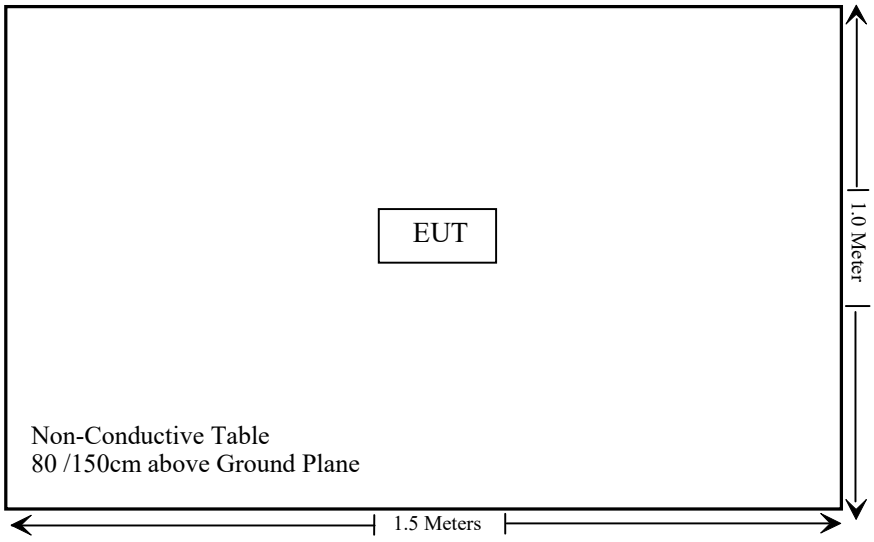
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| / | / | / | / |

## 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 |
|---|---|---|
| FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091 | MPE-Based Exemption | 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 | 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 device was powered by the battery.

# 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 | 2022/11/30 | 2025/11/29 |
| Schwarzbeck | HORN ANTENNA | BBHA9170 | 9170-359 | 2022/12/26 | 2025/12/25 |
| 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 | High Pass Filter | WHKX3.6/18G-10SS | 5 | 2022/11/25 | 2023/11/24 |
| **RF Conducted Test** | | | | | |
| SPECTRUM ANALYZER | Rohde & Schwarz | FSU26 | 200982 | 2022/07/04 | 2023/07/03 |
| WEINSCHEL | 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) & §2.1091- MPE-Based Exemption

## Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

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

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

Ris the minimum separation distance in meters
f = frequency in MHz

Simultaneous Transmission SAR Test Exemption:

$$\sum_{i=1}^{a}\frac{P_i}{P_{\text{th},i}}+\sum_{j=1}^{b}\frac{ERP_j}{ERP_{\text{th},j}}+\sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k}\leq 1 \qquad (C.1)$$

## Result

| Mode | Frequency (MHz) | Tune up conducted power | Antenna Gain | | ERP | | Evaluation Distance (m) | ERP Limit (mW) |
|---|---|---|---|---|---|---|---|---|
| | | (dBm) | (dBi) | (dBd) | (dBm) | (mW) | | |
| BLE | 2402-2480 | 0 | 2.0 | -0.15 | -0.15 | 0.97 | 0.2 | 768 |
| LoRa (Hybrid) | 902.3-914.9 | 5 | 2.0 | -0.15 | 4.85 | 3.05 | 0.2 | 462 |
| LoRa (DTS) | 903.0-914.2 | 14 | 2.0 | -0.15 | 13.85 | 24.27 | 0.2 | 462 |

Note: 1.The tune up conducted power and antenna gain was declared by the applicant.
2. 0dBd=2.15dBi
3. The BLE can transmit with the LoRa at the same time.

Simultaneous Transmission SAR Test Exemption:

The ratio=0.97/768+24.27/462=0.054<1

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliant**

# 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 PCB antenna for BLE which was permanently attached and the maximum antenna gain is 2.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliance.

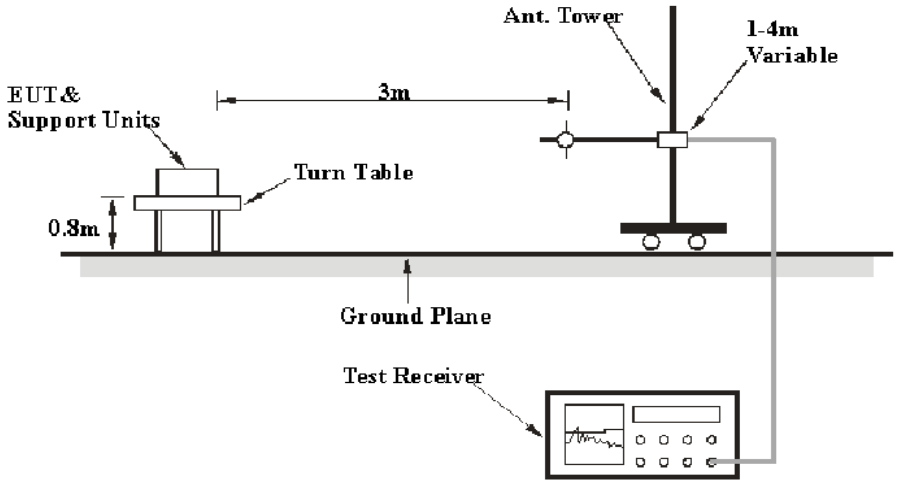
# FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

## Applicable Standard

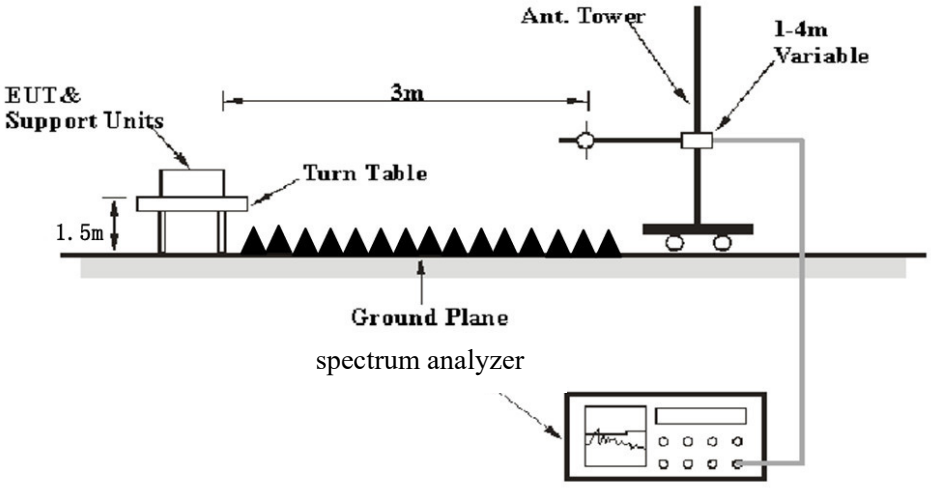
FCC §15.247 (d); §15.209; §15.205;

## 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:

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 = Corrected Amplitude / Absolute Level – Limit
Absolute Level / Corrected Amplitude = Read Level + Factor

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24~25.6 ℃ |
| **Relative Humidity:** | 50~56 % |
| **ATM Pressure:** | 101.0 kPa |

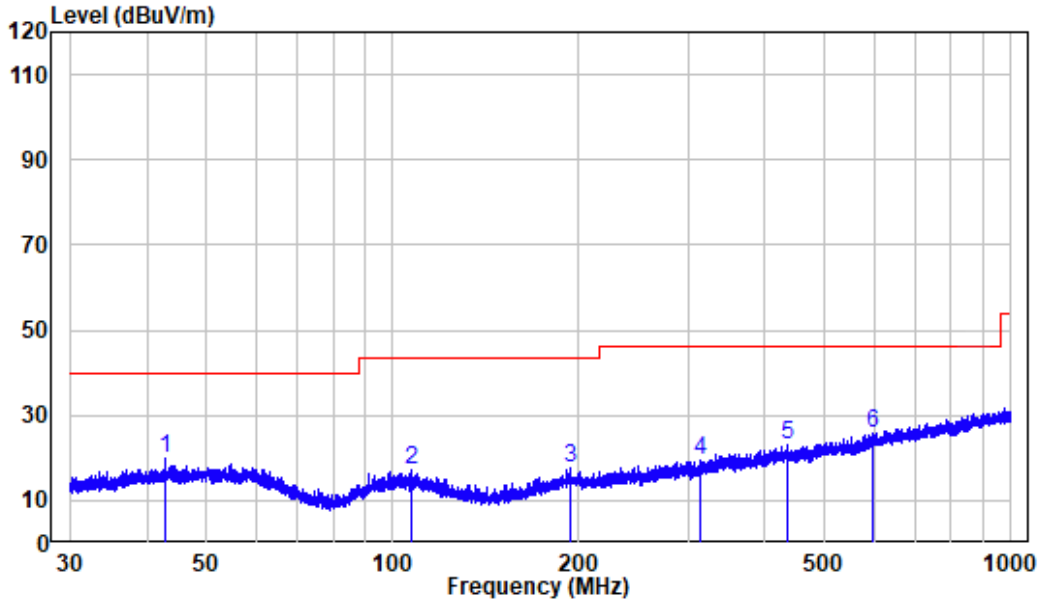
*The testing was performed by Jimi Zheng on 2023-04-26 for below 1GHz and Jason Liu on 2023-04-24 for above 1GHz*

*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 Low channel*)

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

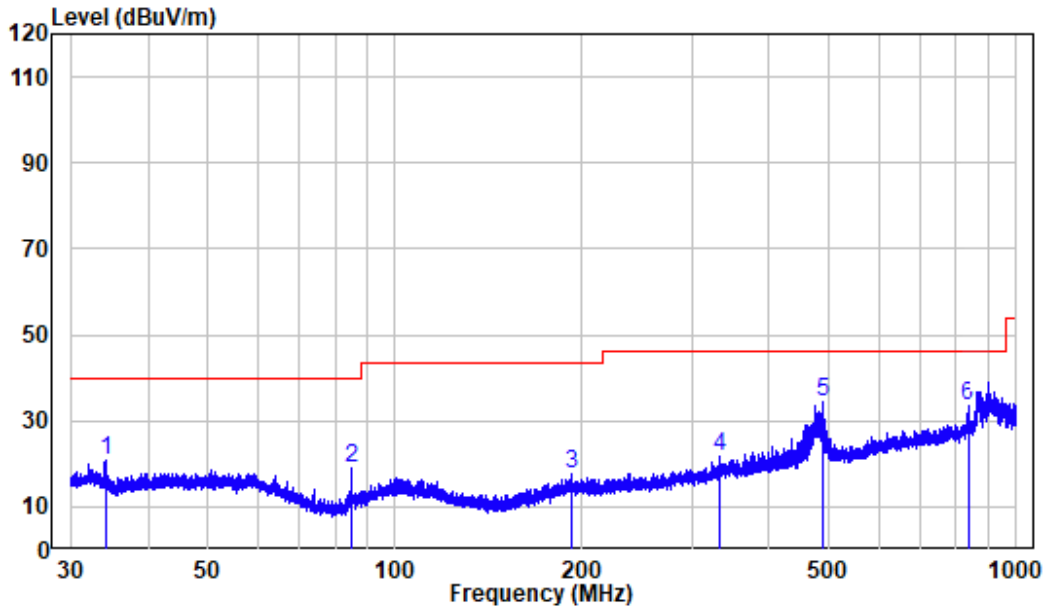
**Horizontal**




Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230409-17769E-RF
Test Mode: Transmitting

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 42.693 | -9.98 | 29.83 | 19.85 | 40.00 | -20.15 | Peak |
| 2 | 106.993 | -11.96 | 29.03 | 17.07 | 43.50 | -26.43 | Peak |
| 3 | 193.349 | -11.30 | 29.18 | 17.88 | 43.50 | -25.62 | Peak |
| 4 | 313.826 | -8.76 | 28.42 | 19.66 | 46.00 | -26.34 | Peak |
| 5 | 435.590 | -5.70 | 28.76 | 23.06 | 46.00 | -22.94 | Peak |
| 6 | 598.796 | -2.50 | 28.34 | 25.84 | 46.00 | -20.16 | Peak |

**Vertical**




Site : chamber
Condition: 3m VERTICAL
Job No. : RA230409-17769E-RF
Test Mode: Transmitting

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 34.276 | -11.77 | 32.49 | 20.72 | 40.00 | -19.28 | Peak |
| 2 | 84.776 | -15.72 | 34.79 | 19.07 | 40.00 | -20.93 | Peak |
| 3 | 192.841 | -11.27 | 28.87 | 17.60 | 43.50 | -25.90 | Peak |
| 4 | 332.956 | -7.77 | 29.66 | 21.89 | 46.00 | -24.11 | Peak |
| 5 | 487.743 | -4.78 | 39.36 | 34.58 | 46.00 | -11.42 | Peak |
| 6 | 836.244 | 0.21 | 33.21 | 33.42 | 46.00 | -12.58 | Peak |

**1-25 GHz:**

| Frequency (MHz) | Receiver | | Turntable Angle 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(2402MHz) | | | | | | | | | |
| 2316.4 | 67.21 | PK | 234 | 2.1 | H | -10.43 | 56.78 | 74 | -17.22 |
| 2316.4 | 52.25 | AV | 234 | 2.1 | H | -10.43 | 41.82 | 54 | -12.18 |
| 2388.7 | 68.41 | PK | 153 | 2 | V | -10.70 | 57.71 | 74 | -16.29 |
| 2388.7 | 53.33 | AV | 153 | 2 | V | -10.70 | 42.63 | 54 | -11.37 |
| 2390 | 66.20 | PK | 140 | 1.9 | H | -10.70 | 55.50 | 74 | -18.50 |
| 2390 | 53.30 | AV | 140 | 1.9 | H | -10.70 | 42.60 | 54 | -11.40 |
| 2390 | 64.63 | PK | 287 | 1.1 | V | -10.70 | 53.93 | 74 | -20.07 |
| 2390 | 53.31 | AV | 287 | 1.1 | V | -10.70 | 42.61 | 54 | -11.39 |
| 4804 | 64.02 | PK | 113 | 1.5 | H | -6.11 | 57.91 | 74 | -16.09 |
| 4804 | 57.40 | AV | 113 | 1.5 | H | -6.11 | 51.29 | 54 | -2.71 |
| 4804 | 63.01 | PK | 221 | 2.2 | V | -6.11 | 56.90 | 74 | -17.10 |
| 4804 | 55.37 | AV | 221 | 2.2 | V | -6.11 | 49.26 | 54 | -4.74 |
| Middle Channel(2440MHz) | | | | | | | | | |
| 4880 | 63.94 | PK | 157 | 1.7 | H | -5.91 | 58.03 | 74 | -15.97 |
| 4880 | 56.74 | AV | 157 | 1.7 | H | -5.91 | 50.83 | 54 | -3.17 |
| 4880 | 62.61 | PK | 117 | 1.1 | V | -5.91 | 56.7 | 74 | -17.30 |
| 4880 | 54.66 | AV | 117 | 1.1 | V | -5.91 | 48.75 | 54 | -5.25 |
| High Channel(2480MHz) | | | | | | | | | |
| 2483.5 | 65.49 | PK | 325 | 2.3 | H | -10.55 | 54.94 | 74 | -19.06 |
| 2483.5 | 53.58 | AV | 325 | 2.3 | H | -10.55 | 43.03 | 54 | -10.97 |
| 2483.5 | 65.95 | PK | 317 | 1.2 | V | -10.55 | 55.4 | 74 | -18.60 |
| 2483.5 | 53.63 | AV | 317 | 1.2 | V | -10.55 | 43.08 | 54 | -10.92 |
| 2495.02 | 67.95 | PK | 231 | 1.9 | H | -10.46 | 57.49 | 74 | -16.51 |
| 2495.02 | 53.71 | AV | 231 | 1.9 | H | -10.46 | 43.25 | 54 | -10.75 |
| 2485.66 | 68.58 | PK | 6 | 1.5 | V | -10.53 | 58.05 | 74 | -15.95 |
| 2485.66 | 53.78 | AV | 6 | 1.5 | V | -10.53 | 43.25 | 54 | -10.75 |
| 4960 | 63.46 | PK | 138 | 1.9 | H | -5.47 | 57.99 | 74 | -16.01 |
| 4960 | 57.45 | AV | 138 | 1.9 | H | -5.47 | 51.98 | 54 | -2.02 |
| 4960 | 61.83 | PK | 110 | 2 | V | -5.47 | 56.36 | 74 | -17.64 |
| 4960 | 52.46 | AV | 110 | 2 | V | -5.47 | 46.99 | 54 | -7.01 |

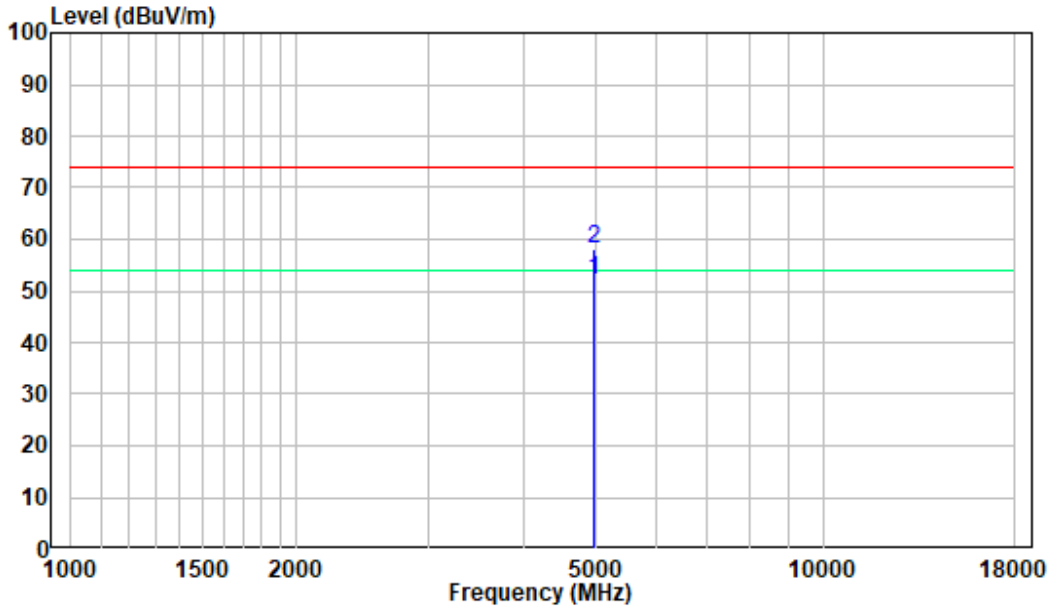
Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Absolute Level = Corrected Factor + Reading
Margin = Absolute Level - Limit
The other spurious emission which is in the noise floor level was not recorded.

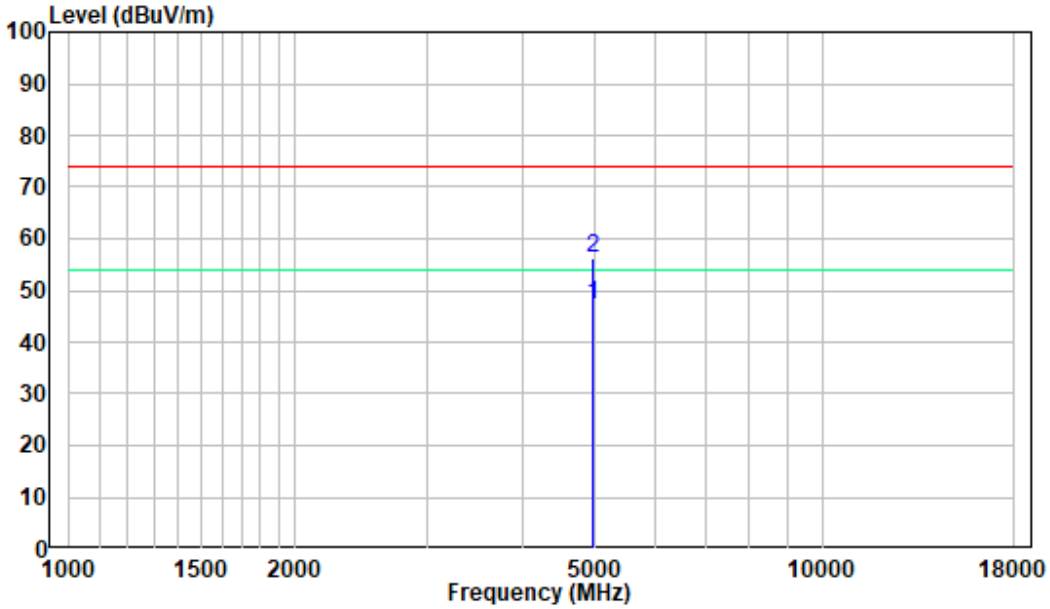
**1-18 GHz:**

**Pre-scan for BLE, High Channel**

**Horizontal**



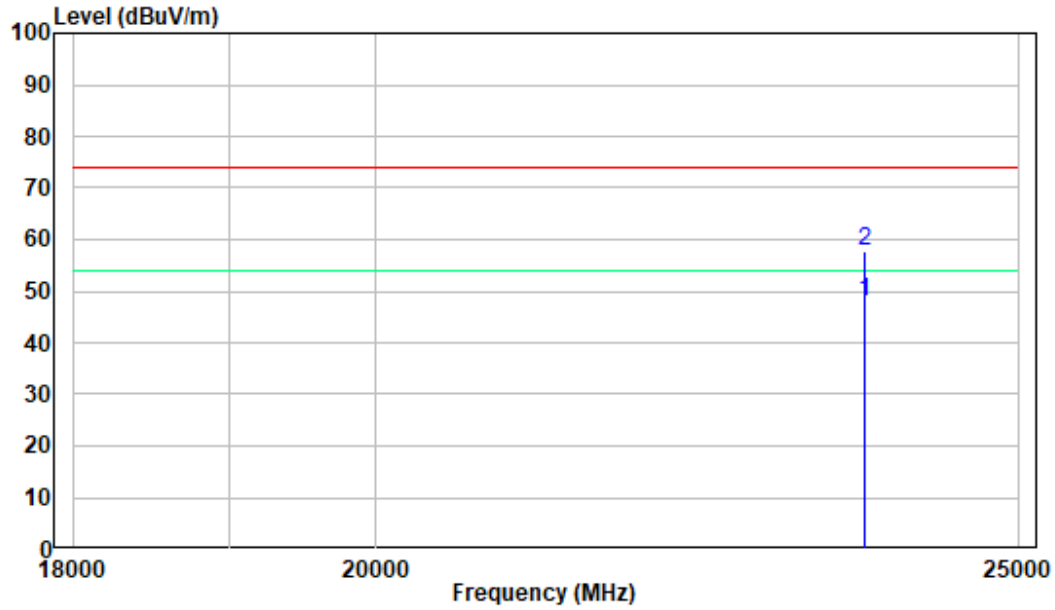

**Vertical**



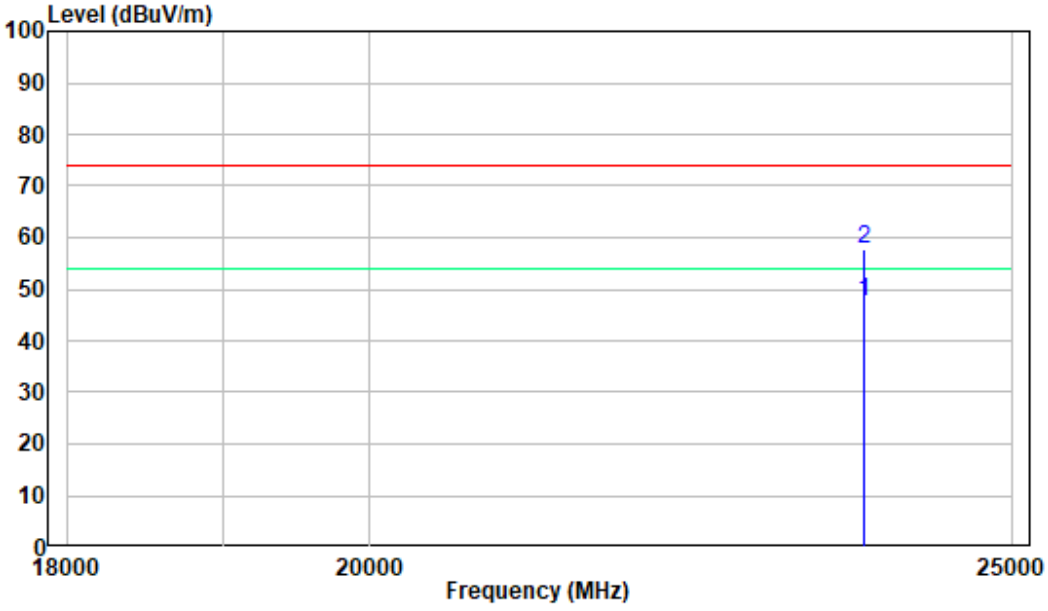
**18 -25GHz:**

**Pre-scan for BLE, High Channel**

**Horizontal**




**Vertical**



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

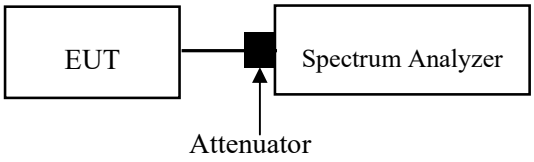
## Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 11.8.1 & Clause 6.9.3

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect 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:** | 25.5 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Jacob Huang on 2023-04-19.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

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

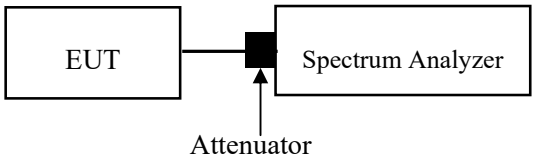
## Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 11.9.1.1

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:** | 25.5 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Jacob Huang on 2023-04-19.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

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

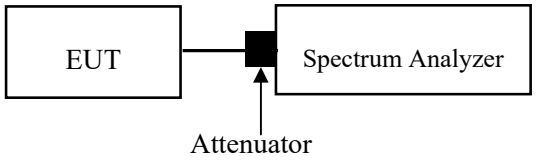
## Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 11.11

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:** | 25.5 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Jacob Huang on 2023-04-19.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

# FCC §15.247(e) - POWER SPECTRAL DENSITY

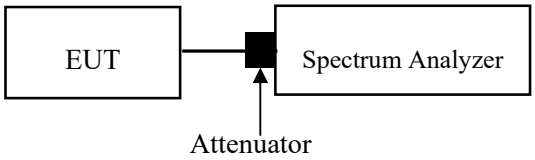
## Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 11.10.2

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:** | 25.5 ℃ |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Jacob Huang on 2023-04-19.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

# APPENDIX

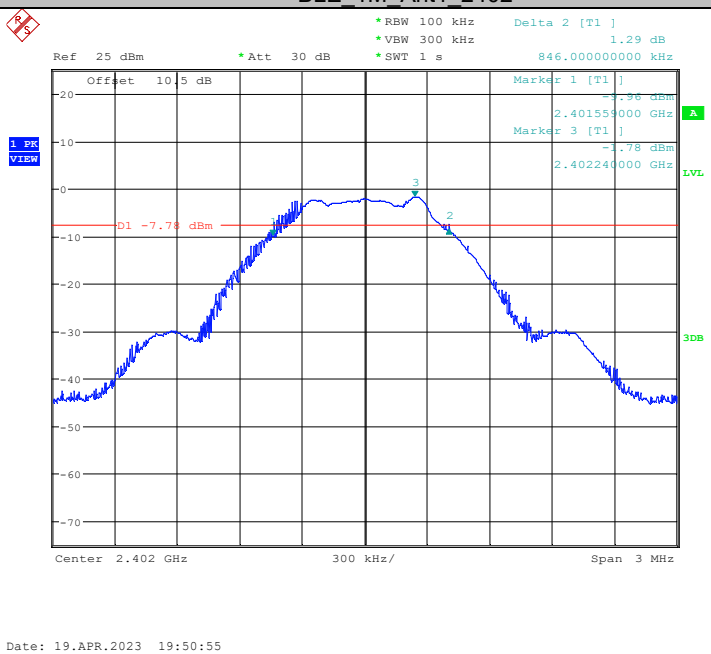
## Appendix A: 6 dB Bandwidth

### Test Result

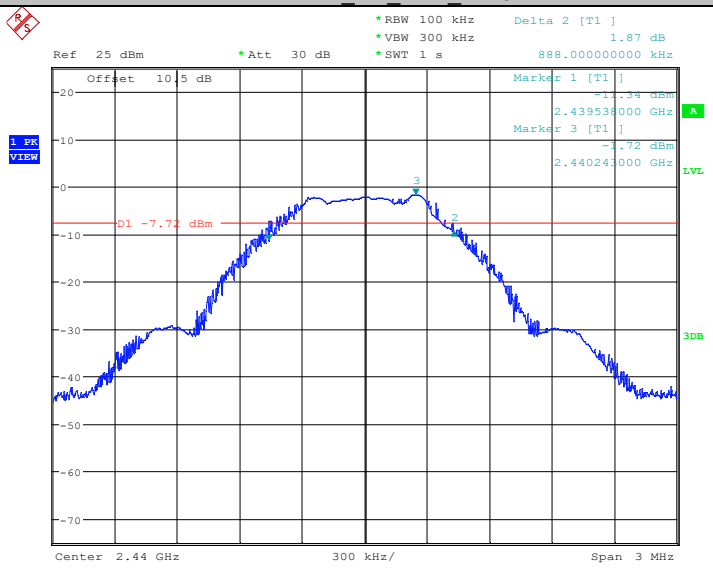
| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (MHz) | Limit (kHz) |
|---|---|---|---|
| BLE_1M | | | |
| Low | 2402 | 0.846 | ≥500 |
| Middle | 2440 | 0.888 | ≥500 |
| High | 2480 | 0.921 | ≥500 |

### Test Graphs

BLE_1M_Ant1_2402

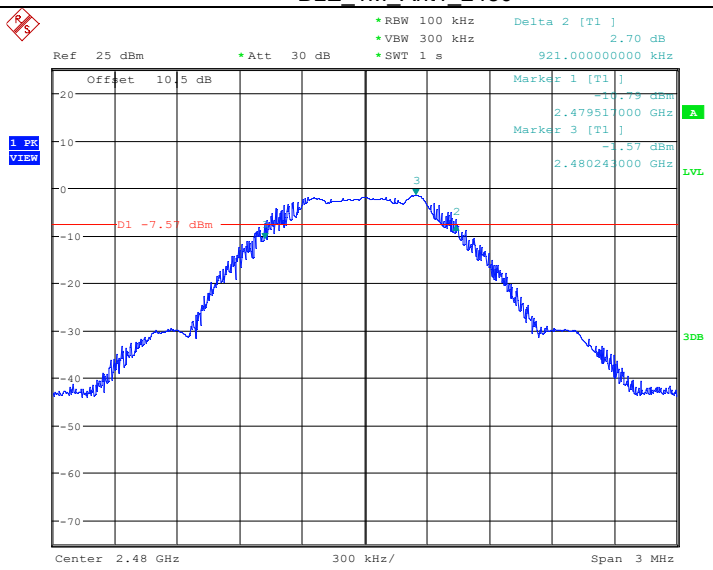


BLE_1M_Ant1_2440




Date: 19.APR.2023 19:57:23

BLE_1M_Ant1_2480




Date: 19.APR.2023 20:02:13

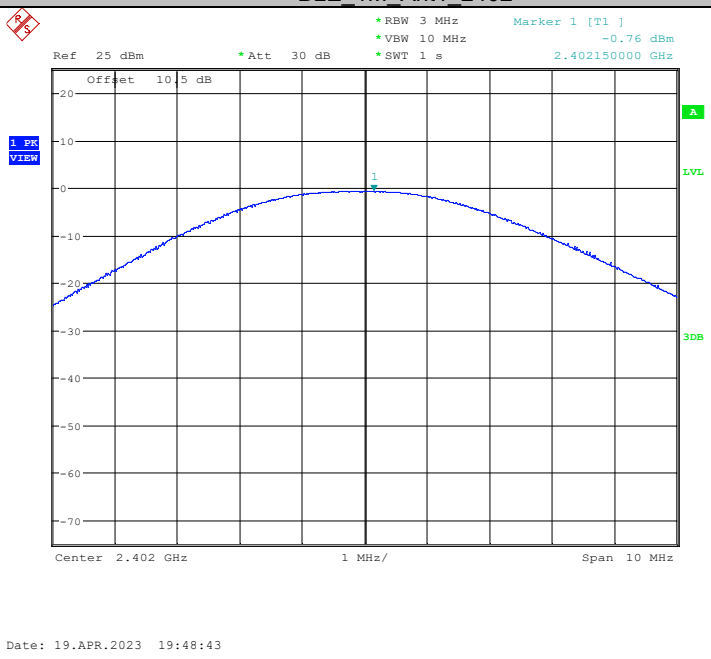
## Appendix B: Maximum conducted output power

### Test Result

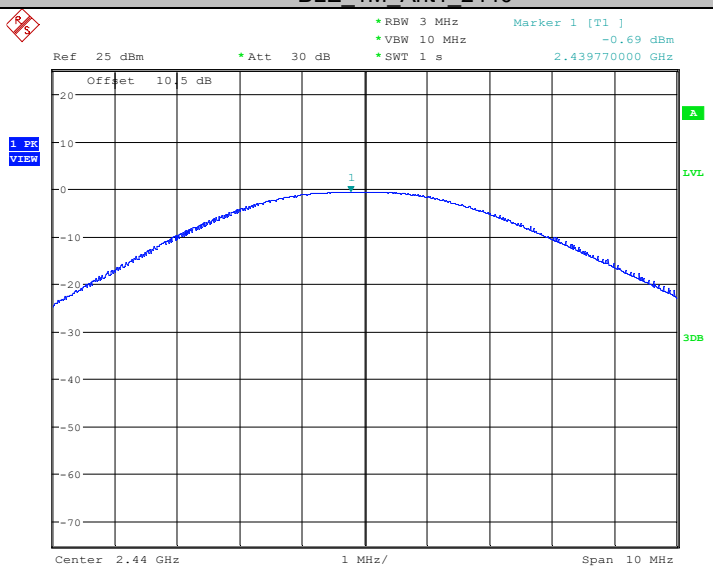
| Channel | Frequency (MHz) | Max Conducted Peak Output Power (dBm) | Limit (dBm) |
|---|---|---|---|
| Low | 2402 | -0.76 | 30 |
| Middle | 2440 | -0.69 | 30 |
| High | 2480 | -0.54 | 30 |

### Test Graphs Peak

BLE_1M_Ant1_2402

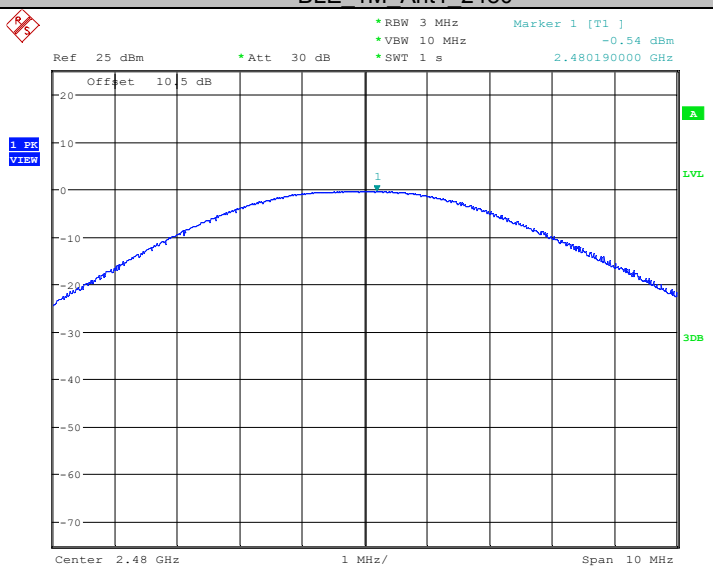


BLE_1M_Ant1_2440




Date: 19.APR.2023 19:54:46

BLE_1M_Ant1_2480




Date: 19.APR.2023 19:59:24

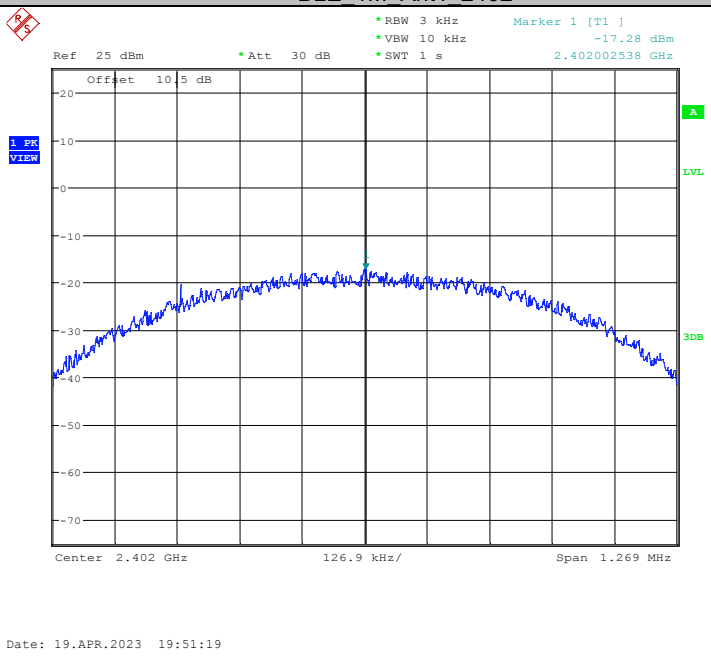
## Appendix C: Maximum power spectral density

## Test Result

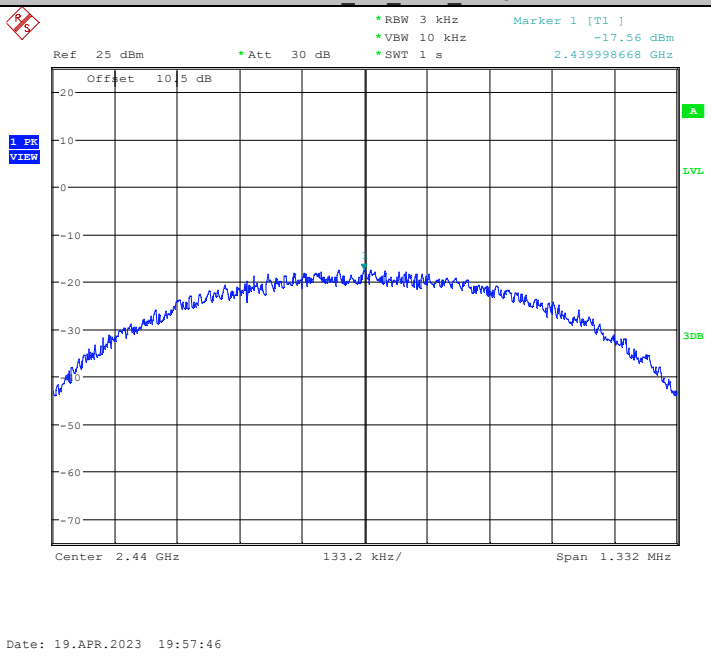
| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|---|
| BLE_1M | | | |
| Low | 2402 | -17.28 | ≤8 |
| Middle | 2440 | -17.56 | ≤8 |
| High | 2480 | -16.95 | ≤8 |

## Test Graphs

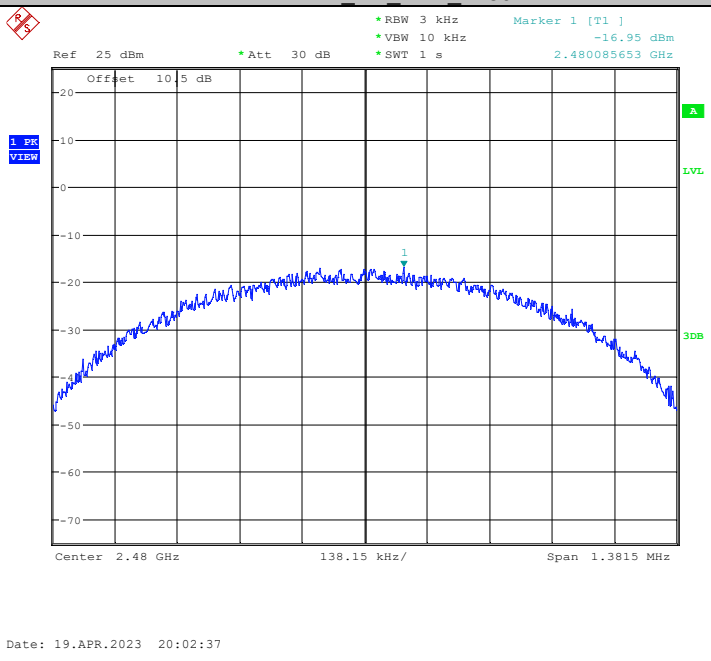
BLE_1M_Ant1_2402




BLE_1M_Ant1_2440



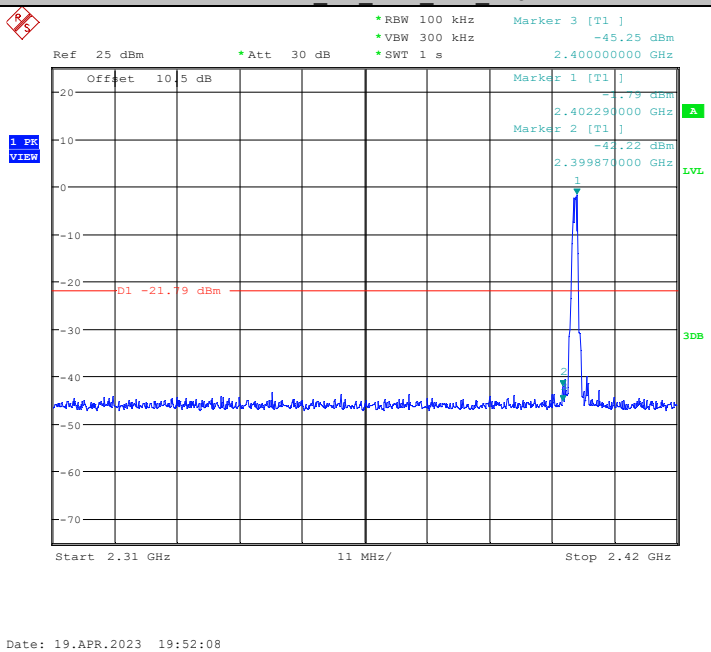
BLE_1M_Ant1_2480



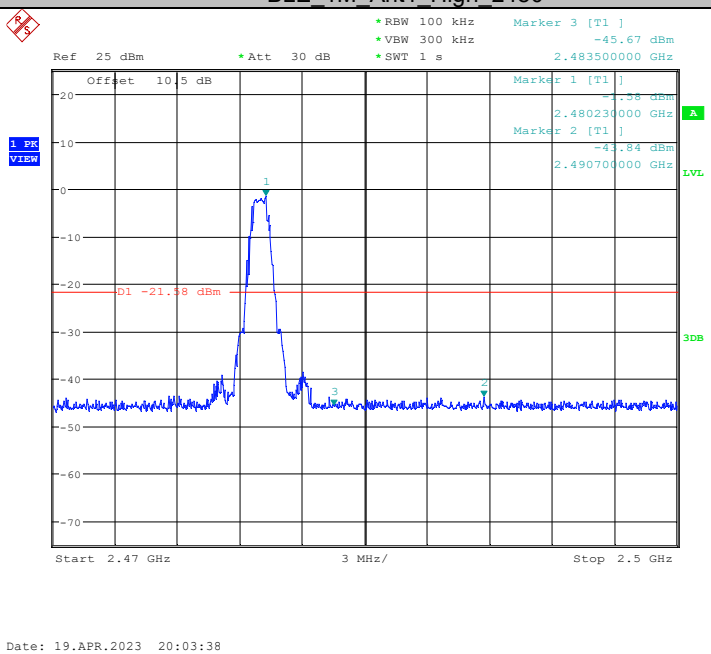
# Appendix D: Band edge measurements

## Test Graphs

BLE_1M_Ant1_Low_2402




BLE_1M_Ant1_High_2480



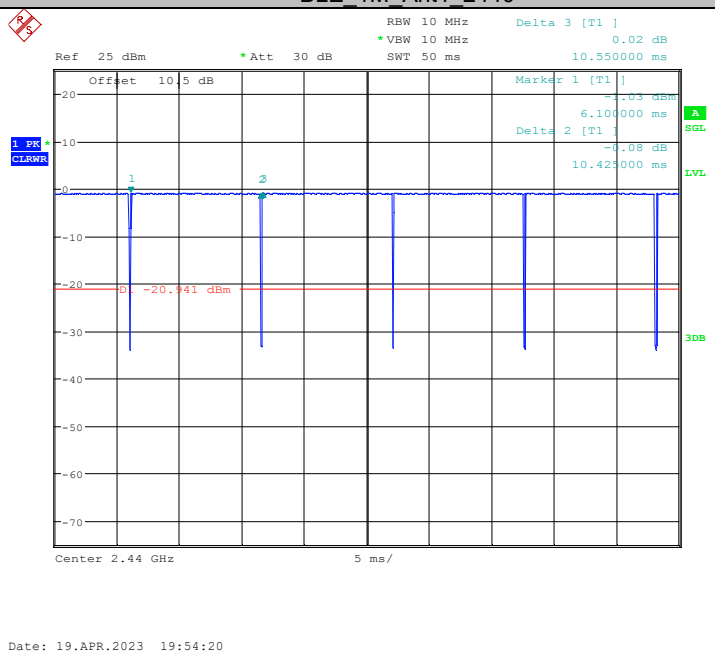
# Appendix E: Duty Cycle

## Test Result

| Mode | Ton (ms) | Ton+off (ms) | Duty Cycle (%) |
|---|---|---|---|
| BLE_1M | 10.425 | 10.550 | 98.8 |

## Test Graphs

BLE_1M_Ant1_2440

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