# FCC TEST REPORT

## FCC ID: 2BD7X-RLM1000

| | | |
|---|---|---|
| **Report No.** | : | SSP24010121-1E |
| **Prepared For** | : | Hongling smart link LLC |
| **Product Name** | : | Robotic Lawn Mower |
| **Model Name** | : | RLM1000 |
| **FCC Rule** | : | FCC Part 15.247 |
| **Date of Issue** | : | 2024-02-01 |
| **Prepared By** | : | Shenzhen CCUT Quality Technology Co., Ltd. |

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This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen CCUT Quality Technology Co., Ltd.

## Test Report Basic Information

| | |
|---|---|
| **Applicant**.....: | Hongling smart link LLC |
| Address of Applicant.....: | Baoneng Park, Qinghu Industrial, Bantian Street, Longgang District, Shenzhen, China |
| **Manufacturer**.....: | Hongling smart link LLC |
| Address of Manufacturer.....: | Baoneng Park, Qinghu Industrial, Bantian Street, Longgang District, Shenzhen, China |
| **Product Name**.....: | Robotic Lawn Mower |
| **Brand Name**.....: | Smonet |
| **Main Model**.....: | RLM1000 |
| **Series Models**.....: | See section 1.1 (Page 5) |
| **Test Standard**.....: | FCC Part 15 Subpart C<br>ANSI C63.10-2013 |
| **Date of Test** .....: | 2024-01-25 to 2024-01-27 |
| **Test Result**.....: | PASSED |
| **Tested Engineer** .....: | Walker Wu (Walker Wu) |
| **Project Manager**.....: | Lieber Ouyang (Lieber Ouyang) |
| **Authorized Signatory**.....: | Lahm Peng (Lahm Peng) |

Shenzhen CCUT Quality Technology Co., Ltd. APPROVED

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# Revision History

| Revision | Issue Date | Description | Revised By |
|---|---|---|---|
| V1.0 | 2024-02-01 | Initial Release | Lahm Peng |
| | | | |
| | | | |
| | | | |
| | | | |

# 1. General Information

## 1.1 Product Information

| | |
|---|---|
| Product Name: | Robotic Lawn Mower |
| Trade Name: | Smonet |
| Main Model: | RLM1000 |
| Series Models: | RLM1000W, RLM1000A, RLM1000AW, RLM1000B, RLM1000BW, RLM500, RLM500W, RLM500A, RLM500AW, RLM500B, RLM500BW, RLM700, RLM700W, RLM700A, RLM700AW, RLM700B, RLM700BW, RLM800, RLM800W, RLM800A, RLM800AW, RLM800B, RLM800BW, RLM1200, RLM1200W, RLM1200A, RLM1200AW, RLM1200B, RLM1200BW, RLM1500, RLM1500W, RLM1500A, RLM1500AW, RLM1500B, RLM1500BW, RLM2000AW, RLM2000BW, RLM001, RLM002 |
| Rated Voltage: | DC 18V |
| Battery: | DC 18V, 2500mAh |
| Power Adaptor: | Input: 100-240V~50/60Hz 1.5A; Output: 24.0V⎓2.0A 48.0V |
| Hardware Version: | V1.7 |
| Software Version: | V1.7.4 |
| Note 1: The test data is gathered from a production sample, provided by the manufacturer.<br>Note 2: The color of appearance and model name of series models listed are different from the main model, but the circuit and the electronic construction are the same, declared by the manufacturer. | |

| **Wireless Specification** | |
|---|---|
| Wireless Standard: | Bluetooth BLE |
| Operating Frequency: | 2402MHz ~ 2480MHz |
| RF Output Power: | 3.2dBm (Conducted) |
| Number of Channel: | 40 |
| Channel Separation: | 2MHz |
| Modulation: | GFSK |
| Antenna Gain: | 3.26dBi |
| Type of Antenna: | PCB Antenna |
| Type of Device: | ☐ Portable Device ☒ Mobile Device ☐ Modular Device |

## 1.2 Test Setup Information

| List of Test Modes | | |
|---|---|---|
| Test Mode | Description | Remark |
| TM1 | Lowest Channel | 2402MHz |
| TM2 | Middle Channel | 2440MHz |
| TM3 | Highest Channel | 2480MHz |
| TM4 | Operating | Bluetooth connecting |

| List and Details of Auxiliary Cable | | | |
|---|---|---|---|
| Description | Length (cm) | Shielded/Unshielded | With/Without Ferrite |
| - | - | - | - |
| - | - | - | - |

| List and Details of Auxiliary Equipment | | | |
|---|---|---|---|
| Description | Manufacturer | Model | Serial Number |
| - | - | - | - |
| - | - | - | - |

| List of Channels | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. of Channel | Frequency (MHz) | No. of Channel | Frequency (MHz) | No. of Channel | Frequency (MHz) | No. of Channel | Frequency (MHz) |
| 01 | 2402 | 11 | 2422 | 21 | 2442 | 31 | 2462 |
| 02 | 2404 | 12 | 2424 | 22 | 2444 | 32 | 2464 |
| 03 | 2406 | 13 | 2426 | 23 | 2446 | 33 | 2466 |
| 04 | 2408 | 14 | 2428 | 24 | 2448 | 34 | 2468 |
| 05 | 2410 | 15 | 2430 | 25 | 2450 | 35 | 2470 |
| 06 | 2412 | 16 | 2432 | 26 | 2452 | 36 | 2472 |
| 07 | 2414 | 17 | 2434 | 27 | 2454 | 37 | 2474 |
| 08 | 2416 | 18 | 2436 | 28 | 2456 | 38 | 2476 |
| 09 | 2418 | 19 | 2438 | 29 | 2458 | 39 | 2478 |
| 10 | 2420 | 20 | 2440 | 30 | 2460 | 40 | 2480 |

## 1.3 Compliance Standards

| Compliance Standards | |
|---|---|
| FCC Part 15 Subpart C | FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators |
| All measurements contained in this report were conducted with all above standards | |
| According to standards for test methodology | |
| FCC Part 15 Subpart C | FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators |
| ANSI C63.4-2014 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. |
| ANSI C63.10-2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained. | |

## 1.4 Test Facilities

| | |
|---|---|
| Laboratory Name: | **Shenzhen CCUT Quality Technology Co., Ltd.**<br>1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China |
| CNAS Laboratory No.: | L18863 |
| A2LA Certificate No.: | 6893.01 |
| FCC Registration No: | 583813 |
| ISED Registration No.: | CN0164 |
| All measurement facilities used to collect the measurement data are located at 1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China. | |

## 1.5 List of Measurement Instruments

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| **Conducted Emissions** | | | | | |
| AMN | ROHDE&SCHWARZ | ENV216 | 101097 | 2023-10-21 | 2024-10-20 |
| EMI Test Receiver | ROHDE&SCHWARZ | ESPI | 100242 | 2023-07-31 | 2024-07-30 |
| **Radiated Emissions** | | | | | |
| EMI Test Receiver | ROHDE&SCHWARZ | ESPI | 100154 | 2023-07-31 | 2024-07-30 |
| Spectrum Analyzer | KEYSIGHT | N9020A | MY48030972 | 2023-07-31 | 2024-07-30 |
| Spectrum Analyzer | ROHDE&SCHWARZ | FSV40-N | 101692 | 2023-07-31 | 2024-07-30 |
| Amplifier | SCHWARZBECK | BBV 9743B | 00251 | 2023-07-31 | 2024-07-30 |
| Amplifier | HUABO | YXL0518-2.5-45 | -- | 2023-07-31 | 2024-07-30 |
| Amplifier | COM-MW | DLAN-18G-4G-02 | 10229104 | 2023-07-31 | 2024-07-30 |
| Loop Antenna | DAZE | ZN30900C | 21104 | 2023-08-07 | 2024-08-06 |
| Broadband Antenna | SCHWARZBECK | VULB 9168 | 01320 | 2023-08-07 | 2024-08-06 |
| Horn Antenna | SCHWARZBECK | BBHA 9120D | 02553 | 2023-08-07 | 2024-08-06 |
| Horn Antenna | COM-MW | ZLB7-18-40G-950 | 12221225 | 2023-08-07 | 2024-08-06 |
| **Conducted RF Testing** | | | | | |
| RF Test System | MWRFTest | MW100-RFCB | 220418SQS-37 | 2023-07-31 | 2024-07-30 |
| Spectrum Analyzer | KEYSIGHT | N9020A | ATO-90521 | 2023-07-31 | 2024-07-30 |

## 1.6 Measurement Uncertainty

| Test Item | Conditions | Uncertainty |
|---|---|---|
| Conducted Emissions | 9kHz ~ 30MHz | ±1.64 dB |
| Radiated Emissions | 9kHz ~ 30MHz | ±2.88 dB |
| | 30MHz ~ 1GHz | ±3.32 dB |
| | 1GHz ~ 18GHz | ±3.50 dB |
| | 18GHz ~ 40GHz | ±3.66 dB |
| Conducted Output Power | 9kHz ~ 26GHz | ±0.50 dB |
| Occupied Bandwidth | 9kHz ~ 26GHz | ±4.0 % |
| Conducted Spurious Emission | 9kHz ~ 26GHz | ±1.32 dB |
| Power Spectrum Density | 9kHz ~ 26GHz | ±0.62 dB |

## 2. Summary of Test Results

| FCC Rule | Description of Test Item | Result |
|---|---|---|
| FCC Part 15.203 | Antenna Requirement | Passed |
| FCC Part 15.247(i) | RF Exposure(see the RF exposure report) | Passed |
| FCC Part 15.207 | Conducted Emissions | Passed |
| FCC Part 15.209, 15.247(d) | Radiated Emissions | Passed |
| FCC Part 15.247(d) | Band-edge Emissions(Radiated) | Passed |
| FCC Part 15.247(b)(3) | Maximum Peak Conducted Output Power | Passed |
| FCC Part 15.247(a)(2) | Occupied Bandwidth(-6dB) | Passed |
| FCC Part 15.247(e) | Maximum Power Spectral Density | Passed |
| FCC Part 15.247(d) | Band-edge Emissions(Conducted) | Passed |
| FCC Part 15.247(d) | Conducted RF Spurious Emissions | Passed |
| Passed: The EUT complies with the essential requirements in the standard<br>Failed: The EUT does not comply with the essential requirements in the standard<br>N/A: Not applicable | | |

# 3. Antenna Requirement

## 3.1 Standard and Limit

According to FCC Part 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.

## 3.2 Test Result

This product has an PCB antenna, fulfill the requirement of this section.

# 4. Conducted Emissions

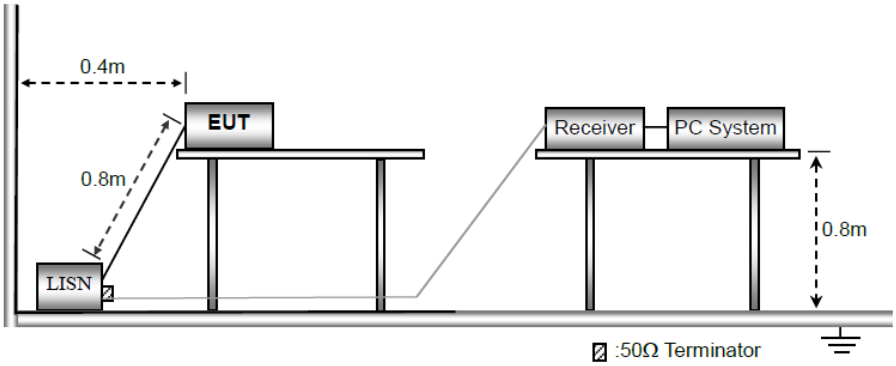
## 4.1 Standard and Limit

According to the rule FCC Part 15.207, Conducted emissions limit for AC power lines as below:

| Frequency of Emission (MHz) | Conducted emissions (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 | 56 to 46 |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |
| Note 1: Decreases with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz<br>Note 2: The lower limit applies at the band edges | | |

## 4.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.2.




Test Setup Block Diagram

a) The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

b) The following is the setting of the receiver
Attenuation: 10dB
Start Frequency: 0.15MHz
Stop Frequency: 30MHz
IF Bandwidth: 9kHz

c) The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

d) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
e) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

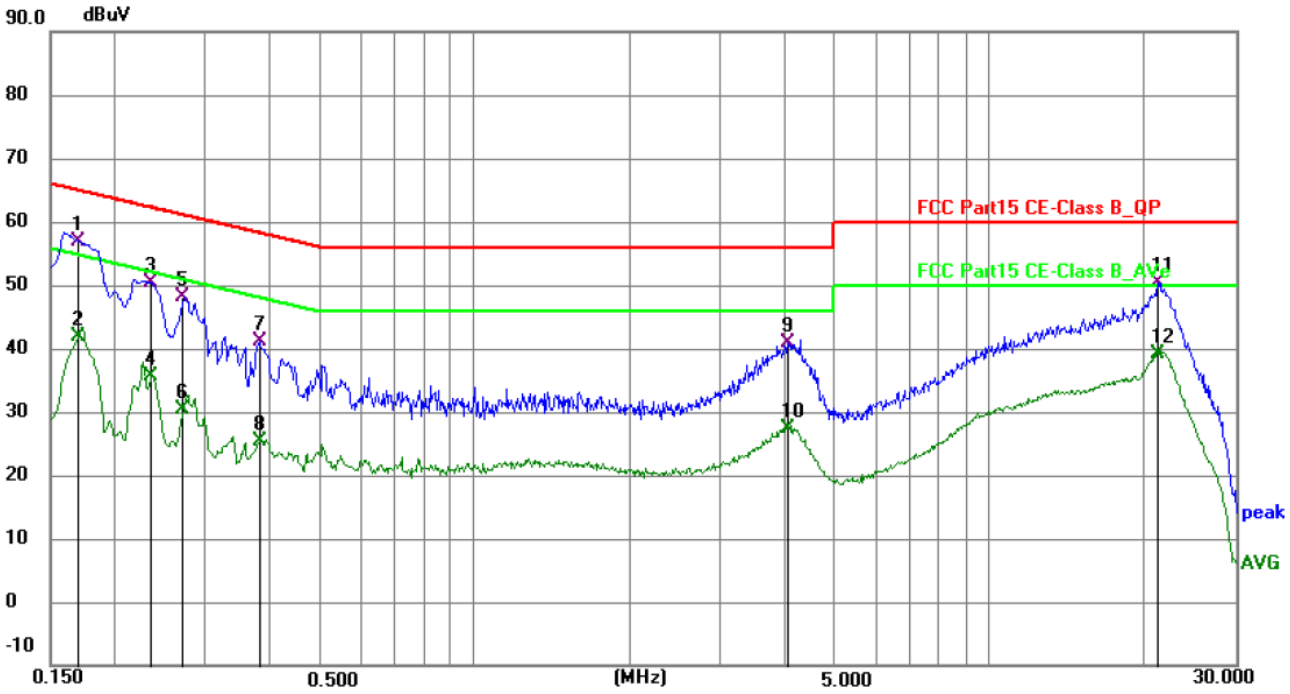
f) LISN is at least 80 cm from nearest part of EUT chassis.

g) For the actual test configuration, please refer to the related Item - photographs of the test setup.

## 4.3 Test Data and Results

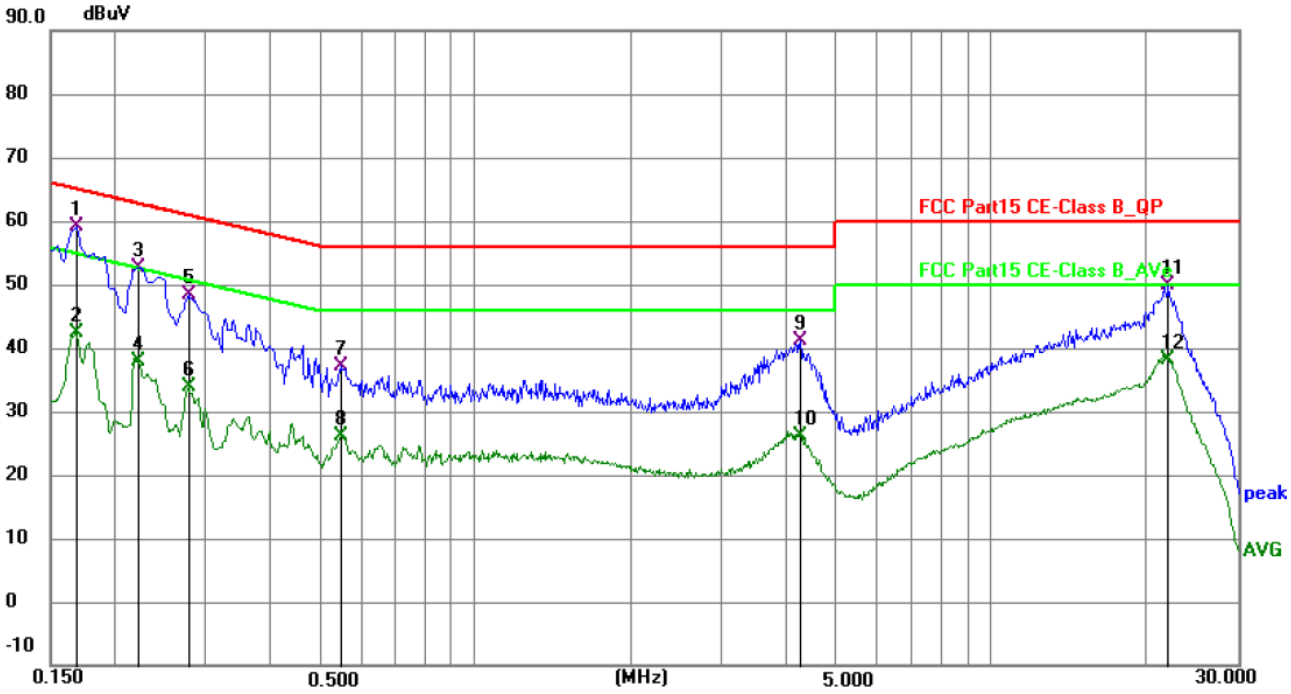
Based on all tested data, the EUT complied with the FCC Part 15.207 standard limit for a wireless device, and with the worst case as below:
Remark: Level = Reading + Factor, Margin = Level - Limit

| Test Plots and Data of Conducted Emissions | |
|---|---|
| Tested Mode: | TM4 |
| Test Voltage: | AC 120V/60Hz |
| Test Power Line: | Neutral |
| Remark: | |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 * | 0.1694 | 47.77 | 9.16 | 56.93 | 64.99 | -8.06 | QP | P | |
| 2 | 0.1694 | 32.60 | 9.16 | 41.76 | 54.99 | -13.23 | AVG | P | |
| 3 | 0.2353 | 40.77 | 9.65 | 50.42 | 62.26 | -11.84 | QP | P | |
| 4 | 0.2353 | 26.04 | 9.65 | 35.69 | 52.26 | -16.57 | AVG | P | |
| 5 | 0.2714 | 38.39 | 9.68 | 48.07 | 61.07 | -13.00 | QP | P | |
| 6 | 0.2714 | 20.62 | 9.68 | 30.30 | 51.07 | -20.77 | AVG | P | |
| 7 | 0.3795 | 31.44 | 9.70 | 41.14 | 58.29 | -17.15 | QP | P | |
| 8 | 0.3795 | 15.62 | 9.70 | 25.32 | 48.29 | -22.97 | AVG | P | |
| 9 | 4.0650 | 30.81 | 10.16 | 40.97 | 56.00 | -15.03 | QP | P | |
| 10 | 4.0650 | 17.19 | 10.16 | 27.35 | 46.00 | -18.65 | AVG | P | |
| 11 | 21.2010 | 39.89 | 10.40 | 50.29 | 60.00 | -9.71 | QP | P | |
| 12 | 21.2010 | 28.82 | 10.40 | 39.22 | 50.00 | -10.78 | AVG | P | |

| Test Plots and Data of Conducted Emissions | |
|---|---|
| Tested Mode: | TM4 |
| Test Voltage: | AC 120V/60Hz |
| Test Power Line: | Live |
| Remark: | |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 * | 0.1680 | 49.98 | 9.09 | 59.07 | 65.06 | -5.99 | QP | P | |
| 2 | 0.1680 | 33.29 | 9.09 | 42.38 | 55.06 | -12.68 | AVG | P | |
| 3 | 0.2220 | 43.42 | 9.20 | 52.62 | 62.74 | -10.12 | QP | P | |
| 4 | 0.2220 | 28.58 | 9.20 | 37.78 | 52.74 | -14.96 | AVG | P | |
| 5 | 0.2760 | 38.60 | 9.66 | 48.26 | 60.94 | -12.68 | QP | P | |
| 6 | 0.2760 | 24.10 | 9.66 | 33.76 | 50.94 | -17.18 | AVG | P | |
| 7 | 0.5460 | 27.20 | 9.94 | 37.14 | 56.00 | -18.86 | QP | P | |
| 8 | 0.5460 | 16.29 | 9.94 | 26.23 | 46.00 | -19.77 | AVG | P | |
| 9 | 4.2540 | 30.85 | 10.16 | 41.01 | 56.00 | -14.99 | QP | P | |
| 10 | 4.2540 | 16.03 | 10.16 | 26.19 | 46.00 | -19.81 | AVG | P | |
| 11 | 22.0200 | 39.33 | 10.44 | 49.77 | 60.00 | -10.23 | QP | P | |
| 12 | 22.0200 | 27.69 | 10.44 | 38.13 | 50.00 | -11.87 | AVG | P | |

# 5. Radiated Emissions

## 5.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

According to the rule FCC Part 15.209, Radiated emission limit for a wireless device as below:

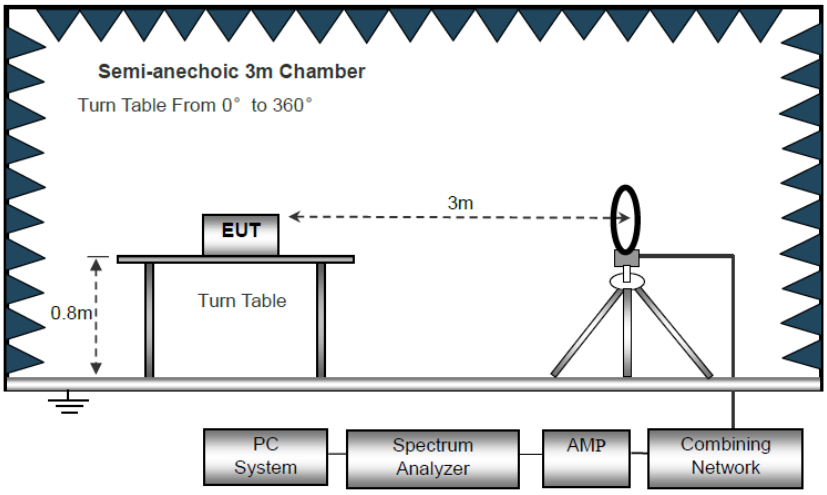
| Frequency of emission (MHz) | Radiated emissions (3m) |
|---|---|
| | Quasi-peak (dBuV/m) |
| 30-88 | 40 |
| 88-216 | 43.5 |
| 216-960 | 46 |
| Above 960 | 54 |
| Note: The more stringent limit applies at transition frequencies. | |

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

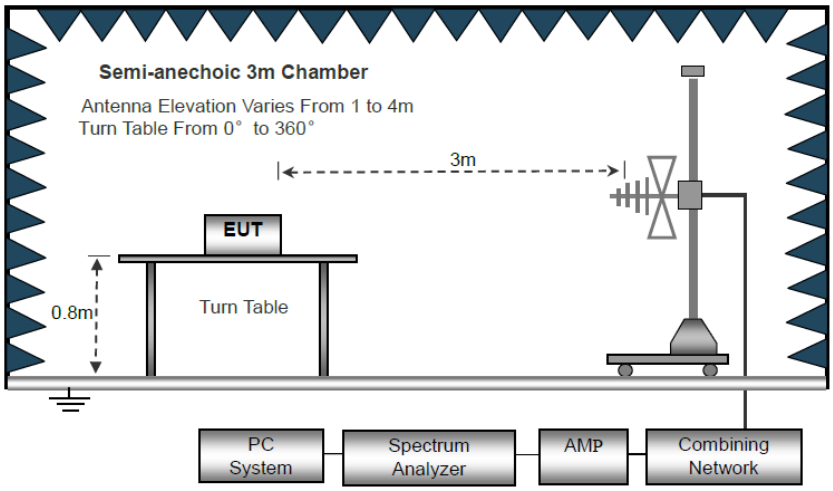
*Note: Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.*

## 5.2 Test Procedure

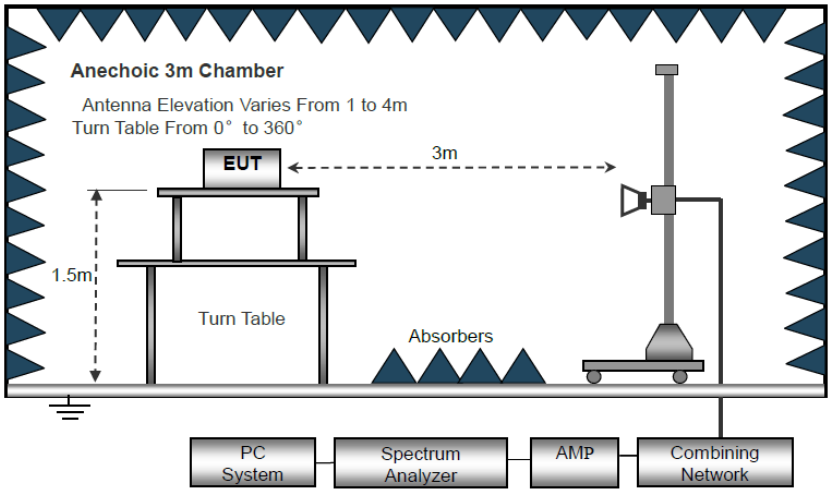
Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6.




Block Diagram of Radiated Emission Below 30MHz




Block Diagram of Radiated Emission From 30MHz to 1GHz




Block Diagram of Radiated Emission Above 1GHz

a) The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range blew 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.

b) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.

c) Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1GHz, 100 kHz for f < 1 GHz, 10kHz for f < 30MHz
VBW ≥ RBW, Sweep = auto
Detector function = peak
Trace = max hold

d) Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

e) The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = PK for AV value, while maintaining all of the other instrument settings.

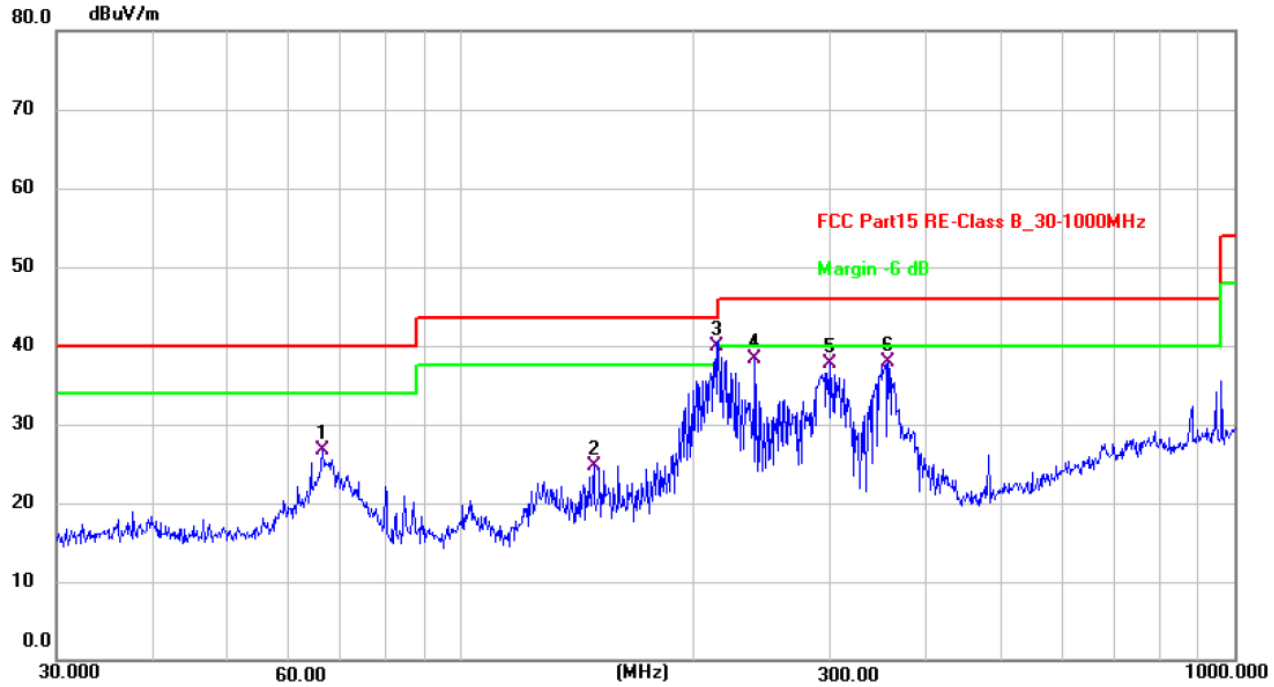
f) For the actual test configuration, please refer to the related item - EUT test photos.

## 5.3 Test Data and Results

Based on all tested data, the EUT complied with the FCC Part 15.247 standard limit for a wireless device, and with the worst case as below:

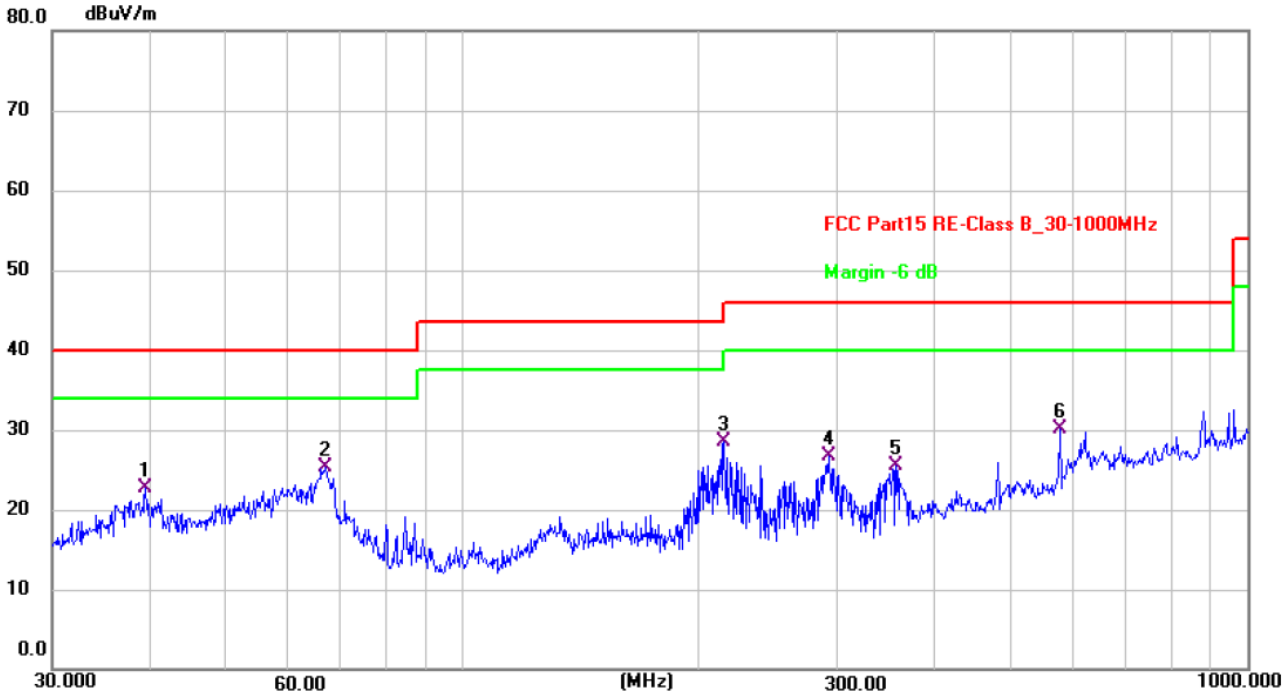
Remark: Level = Reading + Factor, Margin = Level - Limit

| Radiated Emission Test Data (30MHz to 1GHz) | |
|---|---|
| Tested Mode: | TM1 |
| Test Antenna Polarization: | Horizontal |
| Remark: | |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Azimuth (deg.) | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 66.2662 | 37.18 | -10.52 | 26.66 | 40.00 | -13.34 | QP | 100 | 348 | P | |
| 2 | 148.4410 | 33.41 | -8.75 | 24.66 | 43.50 | -18.84 | QP | 100 | 348 | P | |
| 3 * | 214.8478 | 51.30 | -11.46 | 39.84 | 43.50 | -3.66 | QP | 100 | 348 | P | |
| 4 | 239.9874 | 48.23 | -9.92 | 38.31 | 46.00 | -7.69 | QP | 100 | 348 | P | |
| 5 | 299.3158 | 46.08 | -8.31 | 37.77 | 46.00 | -8.23 | QP | 100 | 217 | P | |
| 6 | 356.6758 | 45.29 | -7.36 | 37.93 | 46.00 | -8.07 | QP | 100 | 217 | P | |

| Radiated Emission Test Data (30MHz to 1GHz) | |
|---|---|
| Tested Mode: | TM1 |
| Test Antenna Polarization: | Vertical |
| Remark: | |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Azimuth (deg.) | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.4371 | 30.66 | -8.04 | 22.62 | 40.00 | -17.38 | QP | 100 | 196 | P | |
| 2 * | 66.7325 | 35.78 | -10.57 | 25.21 | 40.00 | -14.79 | QP | 100 | 73 | P | |
| 3 | 215.2678 | 40.01 | -11.44 | 28.57 | 43.50 | -14.93 | QP | 100 | 288 | P | |
| 4 | 293.0842 | 35.09 | -8.47 | 26.62 | 46.00 | -19.38 | QP | 100 | 277 | P | |
| 5 | 356.6758 | 32.94 | -7.36 | 25.58 | 46.00 | -20.42 | QP | 100 | 247 | P | |
| 6 | 576.6443 | 31.96 | -1.90 | 30.06 | 46.00 | -15.94 | QP | 100 | 298 | P | |

| Radiated Emission Test Data (Above 1GHz) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Frequency | Reading | Correct | Result | Limit | Margin | Polar | Detector |
| MHz | dBuV/m | dB/m | dBuV/m | dBuV/m | dB | H/V | PK/AV |
| Lowest Channel (GFSK 2402MHz) | | | | | | | |
| 4804 | 76.19 | -14.72 | 61.47 | 74 | -12.53 | H | PK |
| 4804 | 61.49 | -14.72 | 46.77 | 54 | -7.23 | H | AV |
| 7206 | 62.11 | -8.41 | 53.7 | 74 | -20.3 | H | PK |
| 7206 | 50.36 | -8.41 | 41.95 | 54 | -12.05 | H | AV |
| 4804 | 76.24 | -14.72 | 61.52 | 74 | -12.48 | V | PK |
| 4804 | 57.76 | -14.72 | 43.04 | 54 | -10.96 | V | AV |
| 7206 | 65.61 | -8.41 | 57.2 | 74 | -16.8 | V | PK |
| 7206 | 50.59 | -8.41 | 42.18 | 54 | -11.82 | V | AV |
| Middle Channel (GFSK 2440MHz) | | | | | | | |
| 4880 | 78.76 | -14.64 | 64.12 | 74 | -9.88 | H | PK |
| 4880 | 60.09 | -14.64 | 45.45 | 54 | -8.55 | H | AV |
| 7320 | 62.33 | -8.28 | 54.05 | 74 | -19.95 | H | PK |
| 7320 | 47.48 | -8.28 | 39.2 | 54 | -14.8 | H | AV |
| 4880 | 74.03 | -14.64 | 59.39 | 74 | -14.61 | V | PK |
| 4880 | 58.08 | -14.64 | 43.44 | 54 | -10.56 | V | AV |
| 7320 | 64.21 | -8.28 | 55.93 | 74 | -18.07 | V | PK |
| 7320 | 48.01 | -8.28 | 39.73 | 54 | -14.27 | V | AV |
| Highest Channel (GFSK 2480MHz) | | | | | | | |
| 4960 | 75.29 | -14.53 | 60.76 | 74 | -13.24 | H | PK |
| 4960 | 61.86 | -14.53 | 47.33 | 54 | -6.67 | H | AV |
| 7440 | 64.32 | -8.13 | 56.19 | 74 | -17.81 | H | PK |
| 7440 | 46.42 | -8.13 | 38.29 | 54 | -15.71 | H | AV |
| 4960 | 74.01 | -14.53 | 59.48 | 74 | -14.52 | V | PK |
| 4960 | 60.81 | -14.53 | 46.28 | 54 | -7.72 | V | AV |
| 7440 | 64.38 | -8.13 | 56.25 | 74 | -17.75 | V | PK |
| 7440 | 49.41 | -8.13 | 41.28 | 54 | -12.72 | V | AV |

*Note 1: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

*Note 2: Testing is carried out with frequency rang 9kHz to the tenth harmonics. The measurements greater than 20dB below the limit from 9kHz to 30MHz.*

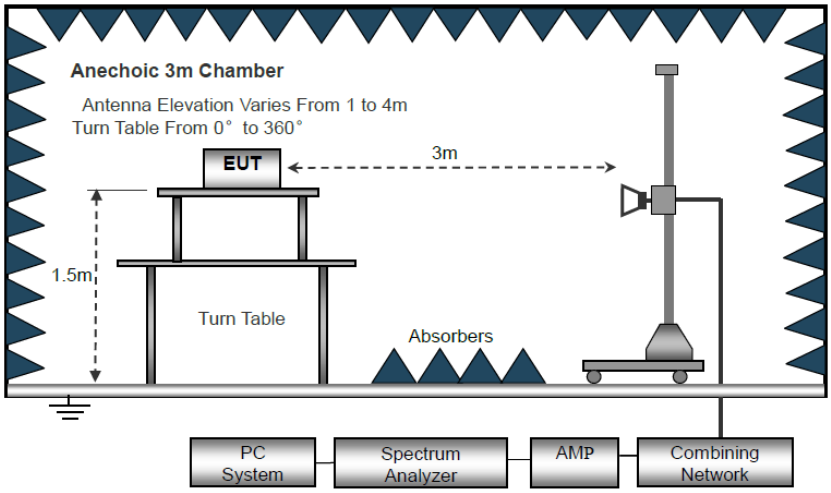
# 6. Band-edge Emissions(Radiated)

## 6.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

## 6.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6 and section 6.10.




Test Setup Block Diagram

As the radiated emissions testing, set the Lowest and Highest Transmitting Channel, observed the outside band of 2310MHz to 2400MHz and 2483.5MHz to 2500MHz, than mark the higher-level emission for comparing with the FCC rules.

## 6.3 Test Data and Results

Based on all tested data, the EUT complied with the FCC Part 15.247 standard limit, and with the worst case as below:

| Test Mode | Frequency | Limit | Result |
|---|---|---|---|
| | MHz | dBuV/dBc | |
| Lowest | 2310.00 | <54 dBuV | Pass |
| | 2390.00 | <54 dBuV | Pass |
| | 2400.00 | >30 dBc | Pass |
| Highest | 2483.50 | <54 dBuV | Pass |
| | 2500.00 | <54 dBuV | Pass |

| Radiated Emission Test Data (Band edge emissions) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Frequency | Reading | Correct | Result | Limit | Margin | Polar | Detector |
| MHz | dBuV/m | dB/m | dBuV/m | dBuV/m | dB | H/V | PK/AV |
| Lowest Channel (GFSK 2402MHz) | | | | | | | |
| 2310 | 64.64 | -21.34 | 43.3 | 74 | -30.7 | H | PK |
| 2310 | 52.13 | -21.34 | 30.79 | 54 | -23.21 | H | AV |
| 2390 | 65.52 | -20.96 | 44.56 | 74 | -29.44 | H | PK |
| 2390 | 50.41 | -20.96 | 29.45 | 54 | -24.55 | H | AV |
| 2400 | 68.54 | -20.91 | 47.63 | 74 | -26.37 | H | PK |
| 2400 | 53.32 | -20.91 | 32.41 | 54 | -21.59 | H | AV |
| 2310 | 66.37 | -21.34 | 45.03 | 74 | -28.97 | V | PK |
| 2310 | 52.26 | -21.34 | 30.92 | 54 | -23.08 | V | AV |
| 2390 | 66.6 | -20.96 | 45.64 | 74 | -28.36 | V | PK |
| 2390 | 50.55 | -20.96 | 29.59 | 54 | -24.41 | V | AV |
| 2400 | 71.01 | -20.91 | 50.1 | 74 | -23.9 | V | PK |
| 2400 | 52.85 | -20.91 | 31.94 | 54 | -22.06 | V | AV |
| Highest Channel (GFSK 2480MHz) | | | | | | | |
| 2483.50 | 64.58 | -20.51 | 44.07 | 74 | -29.93 | H | PK |
| 2483.50 | 50.7 | -20.51 | 30.19 | 54 | -23.81 | H | AV |
| 2500 | 65.02 | -20.43 | 44.59 | 74 | -29.41 | H | PK |
| 2500 | 52.61 | -20.43 | 32.18 | 54 | -21.82 | H | AV |
| 2483.50 | 64.12 | -20.51 | 43.61 | 74 | -30.39 | V | PK |
| 2483.50 | 51.32 | -20.51 | 30.81 | 54 | -23.19 | V | AV |
| 2500 | 67.63 | -20.43 | 47.2 | 74 | -26.8 | V | PK |
| 2500 | 52.73 | -20.43 | 32.3 | 54 | -21.7 | V | AV |

Remark: Level = Reading + Factor, Margin = Level - Limit

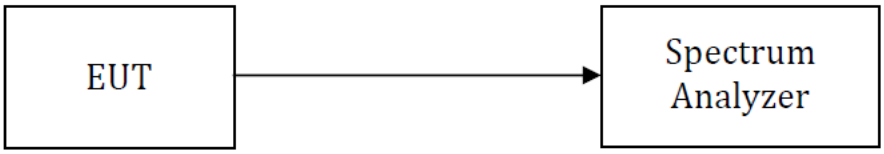
# 7. Maximum Peak Conducted Output Power

## 7.1 Standard and Limit

According to 15.247(b)(1). For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

## 7.2 Test Procedure

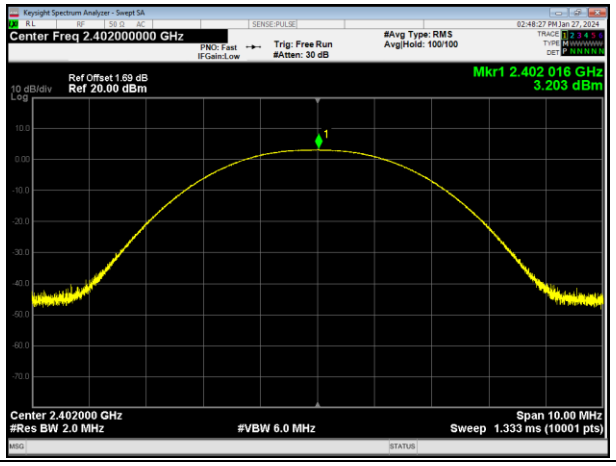
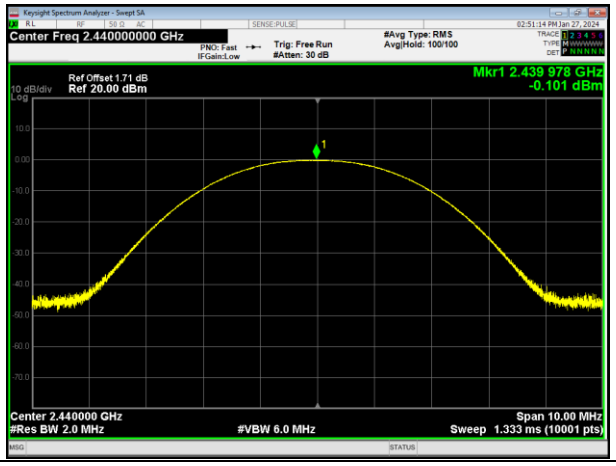
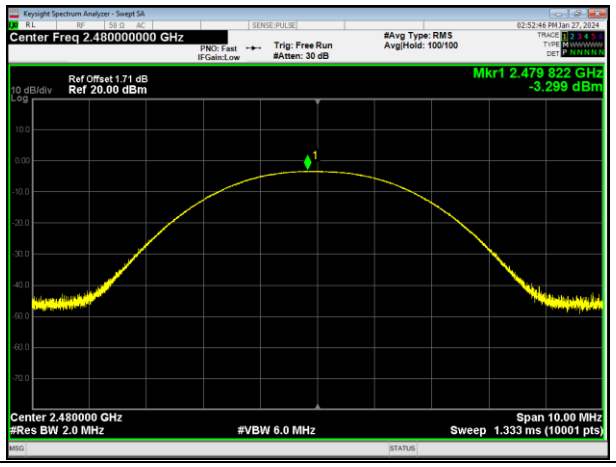
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 2MHz, VBW = 6MHz, Sweep = Auto, Detector = RMS.
4) Measure the highest amplitude appearing on spectral display and mark the value.
5) Repeat the above procedures until all frequencies measured were complete.




Test Setup Block Diagram

## 7.3 Test Data and Results

| Test Mode | Test Channel MHz | Conducted Output Power (dBm) | Limit (dBm) | Test Result |
|---|---|---|---|---|
| BLE_GFSK | 2402 | 3.2 | 30 | Pass |
| | 2440 | -0.1 | 30 | Pass |
| | 2480 | -3.3 | 30 | Pass |

| BLE_GFSK |
|---|
| 2402MHz<br>  <br> |
| |
| 2440MHz<br>  <br> |
| |
| 2480MHz<br>  <br> |

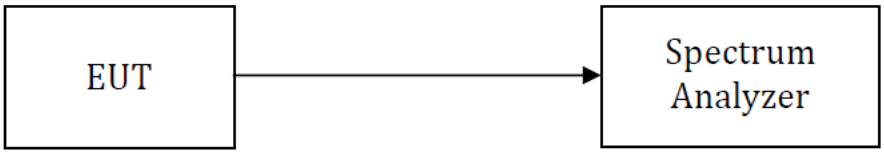
# 8. Occupied Bandwidth(-6dB)

## 8.1 Standard and Limit

According to 15.247(a)(2), Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## 8.2 Test Procedure

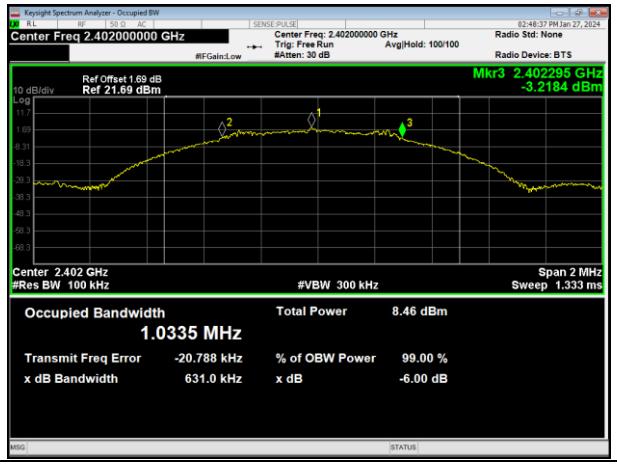
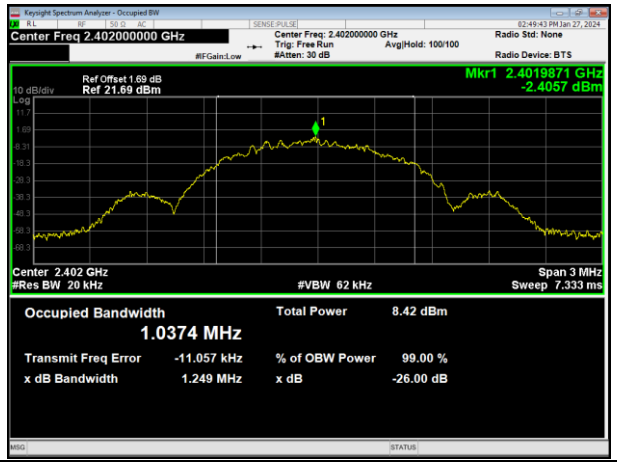
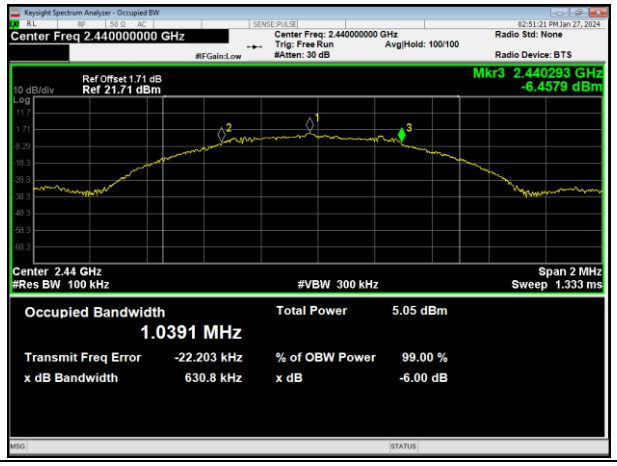
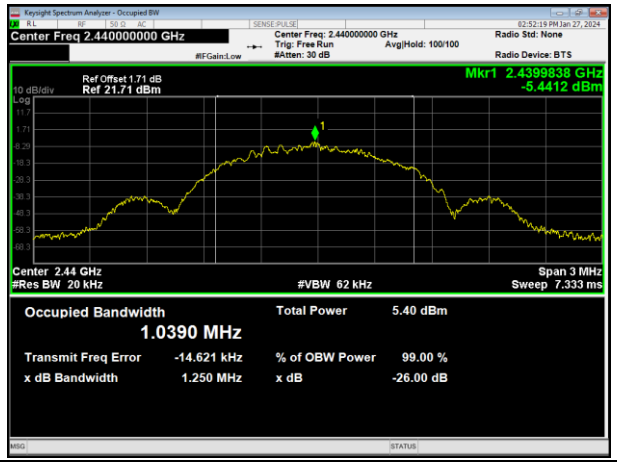
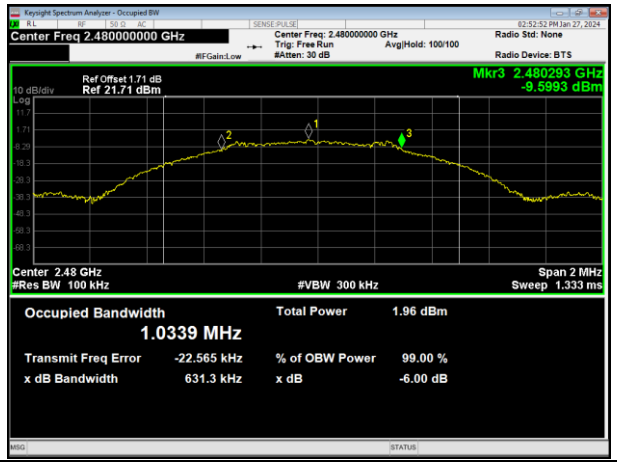
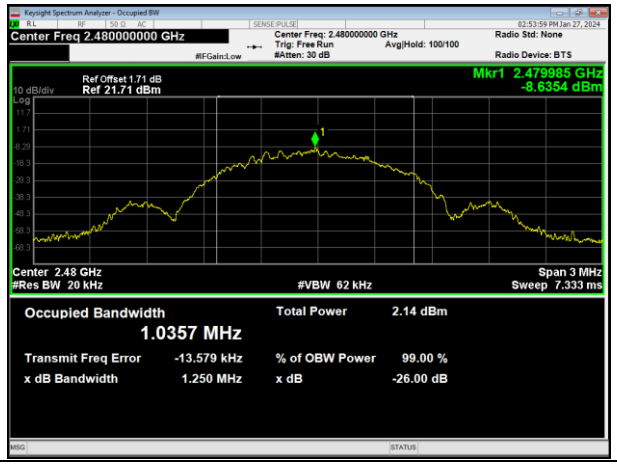
According to the ANSI 63.10-2013, section 6.9, the emission bandwidth test method as follows.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto.
4) Set a reference level on the measuring instrument equal to the highest peak value.
5) Measure the frequency difference of two frequencies that were attenuated 6dB from the reference level. Record the frequency difference as the emission bandwidth.
6) Repeat the above procedures until all frequencies measured were complete.




Test Setup Block Diagram

## 8.3 Test Data and Results

| Test Mode | Test Channel (MHz) | 6dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Limit 6 dB Bandwidth (MHz) | Test Result |
|---|---|---|---|---|---|
| BLE_GFSK | 2402 | 0.631 | 1.0374 | 0.5 | Pass |
| | 2440 | 0.6308 | 1.0390 | 0.5 | Pass |
| | 2480 | 0.6313 | 1.0357 | 0.5 | Pass |

| BLE_GFSK | |
|---|---|
| 6dB bandwidth | 99% bandwidth |
| 2402MHz | 2402MHz |
|  |  |
| 2440MHz | 2440MHz |
|  |  |
| 2480MHz | 2480MHz |
|  |  |

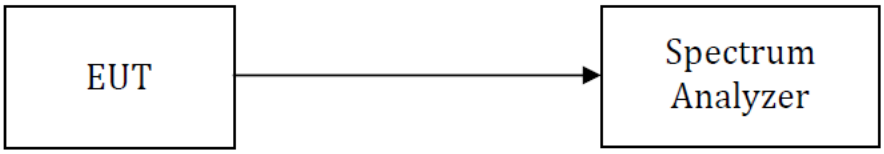
# 9. Maximum Power Spectral Density

## 9.1 Standard and Limit

According to FCC 15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm 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.

## 9.2 Test Procedure

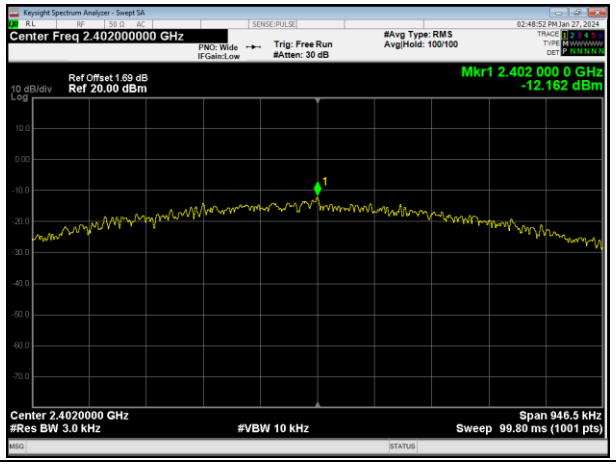
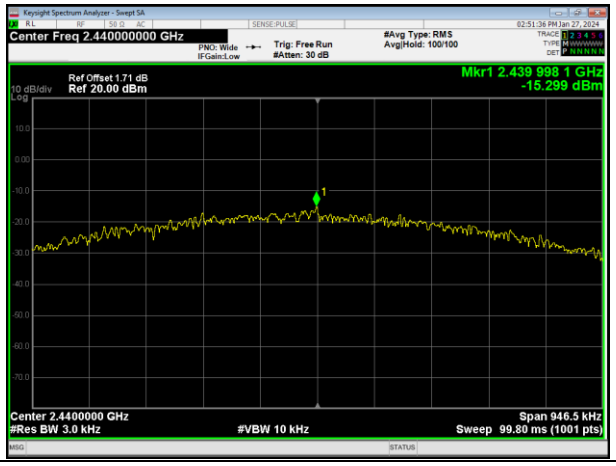
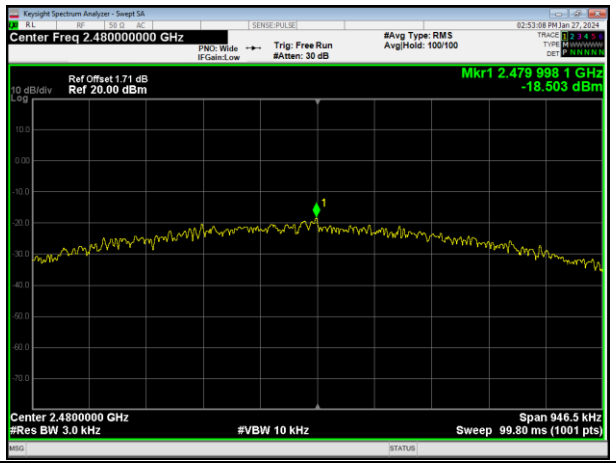
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 3kHz, VBW = 10kHz, Sweep = Auto, Detector = RMS.
4) Measure the highest amplitude appearing on spectral display and mark the value.
5) Repeat above procedures until all frequencies measured were complete.




Test Setup Block Diagram

## 9.3 Test Data and Results

| Test Mode | Test Channel MHz | Power Spectral Density (dBm/3kHz) | Limit (dBm/3kHz) | Test Result |
|---|---|---|---|---|
| BLE-GFSK | 2402 | -12.16 | 8 | Pass |
| | 2440 | -15.3 | 8 | Pass |
| | 2480 | -18.5 | 8 | Pass |

| BLE_GFSK |
|---|
| 2402MHz<br>  <br> |
| |
| 2440MHz<br>  <br> |
| |
| 2480MHz<br>  <br> |

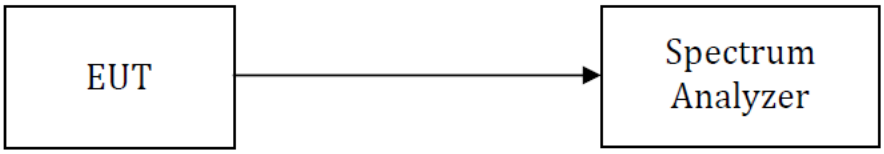
# 10. Band-edge Emission(Conducted)

## 10.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

## 10.2 Test Procedure

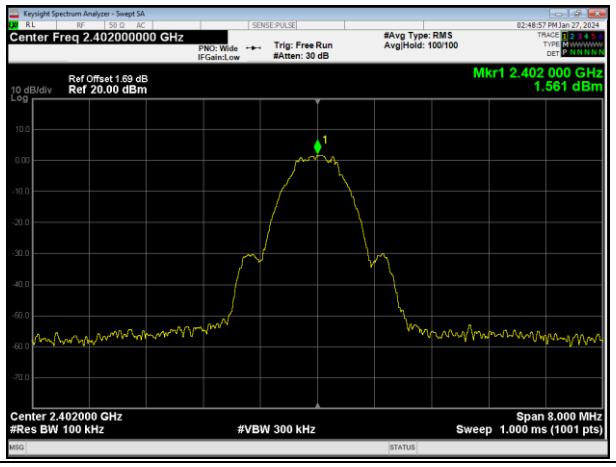
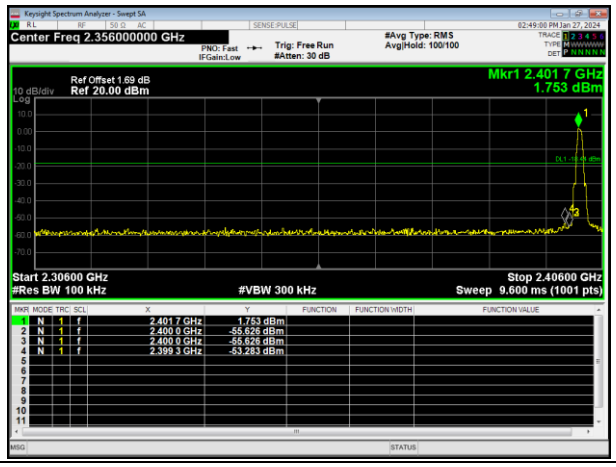
Test is conducting under the description of ANSI C63.10 - 2013 section 6.10.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = RMS.
4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
5) Set a convenient frequency span including 100 kHz bandwidth from band edge.
6) Measure the emission and marking the edge frequency.
7) Repeat above procedures until all frequencies measured were complete.

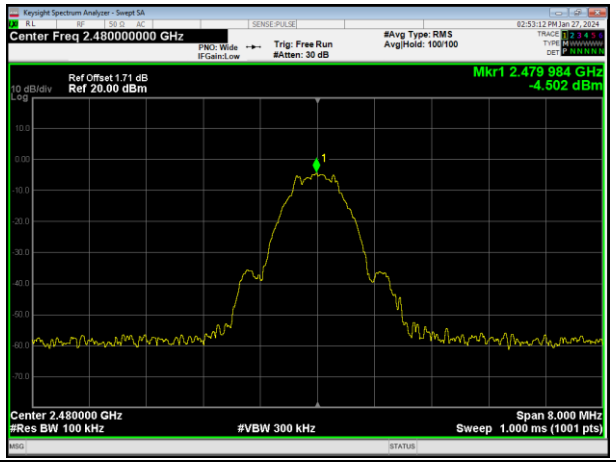
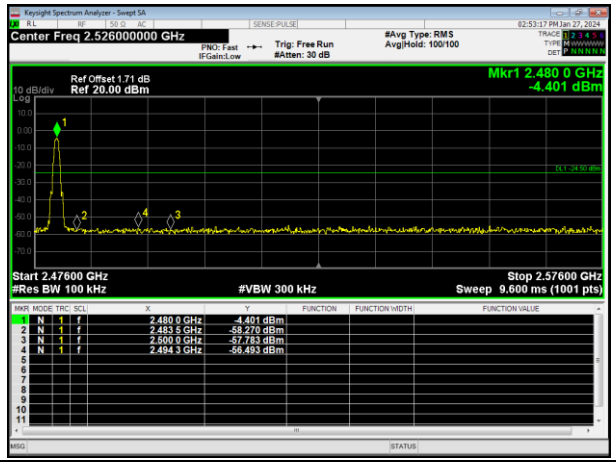



Test Setup Block Diagram

## 10.3 Test Data and Results

| Test Mode | Band-edge | Test Channel (MHz) | Max. Value (dBc) | Limit (dBc) | Test Result |
|---|---|---|---|---|---|
| GFSK | Lowest | -54.84 | -50.82 | -20 | Pass |
| | Highest | -51.99 | -39.32 | -20 | Pass |

| BLE_GFSK Lowest | |
|---|---|
| Reference Power | Band-edge Emission |
|  |  |

| BLE_GFSK Highest | |
|---|---|
| Reference Power | Band-edge Emission |
|  |  |

# 11. Conducted RF Spurious Emissions

## 11.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

## 11.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.7.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = RMS.
4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
5) Measure the spurious emissions with frequency range from 9kHz to 26.5GHz.
6) Repeat above procedures until all measured frequencies were complete.

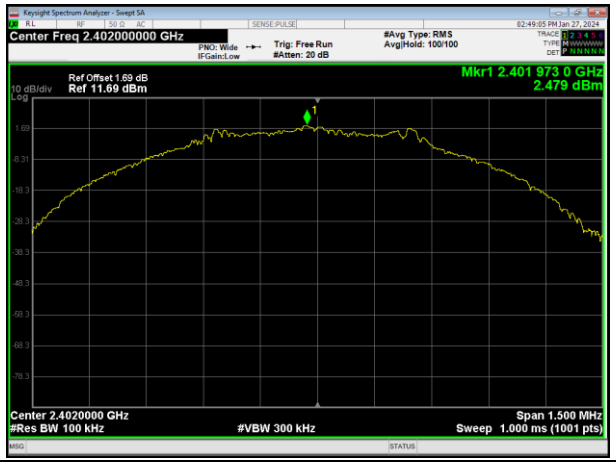
Test Setup Block Diagram

## 11.3 Test Data and Results

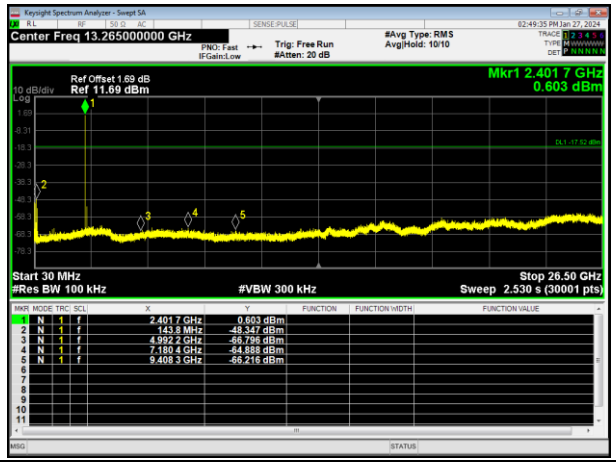
*Note: The measurement frequency range is from 9kHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions measurement data.*

BLE_GFSK Lowest

Reference Power

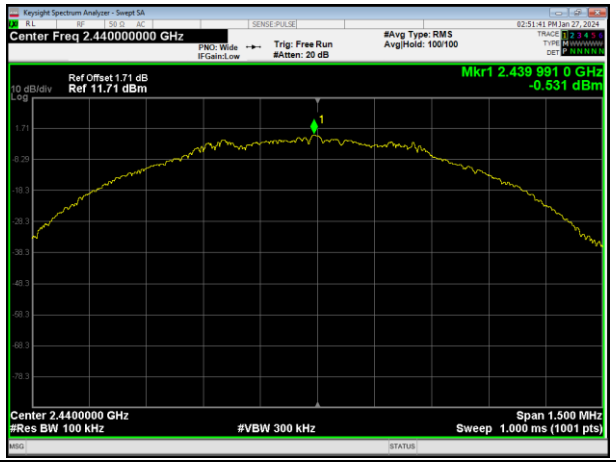



Spurious Emissions

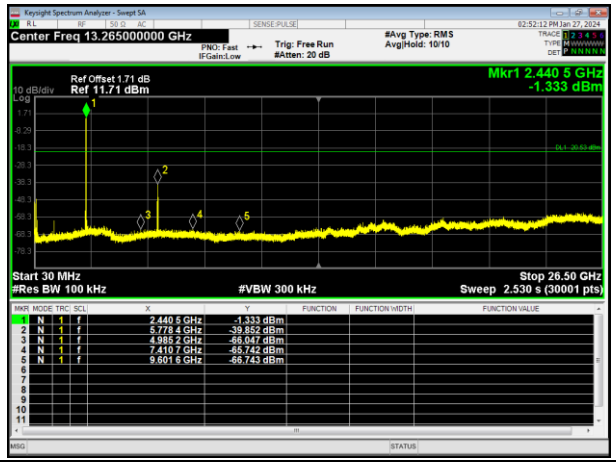



BLE_GFSK Middle

Reference Power

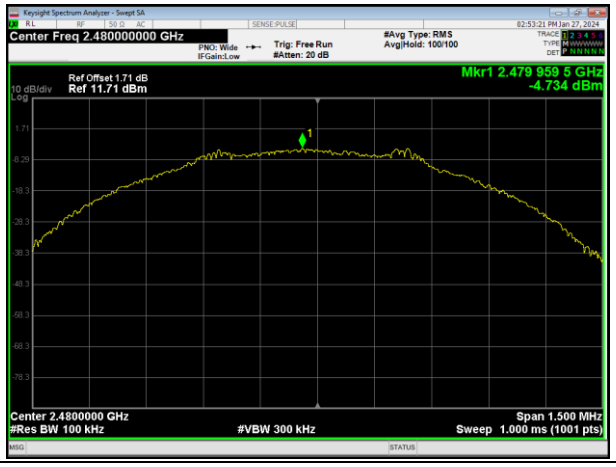



Spurious Emissions

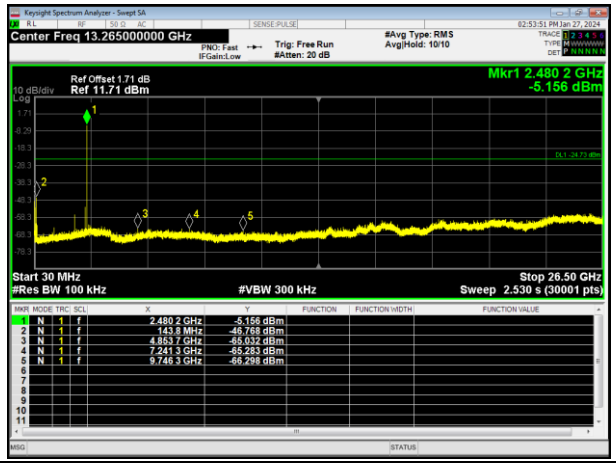



BLE_GFSK Highest

Reference Power




Spurious Emissions




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