# FCC TEST REPORT

## FCC ID: 2BKVG-E311

| | | |
|---|---|---|
| **Report No.** | : | SSP24080217-1E |
| **Applicant** | : | Dongguan Mingcheng Digital Company Limited |
| **Product Name** | : | bluetooth headset |
| **Model Name** | : | E311 |
| **Test Standard** | : | FCC Part 15.247 |
| **Date of Issue** | : | 2024-09-06 |

**Shenzhen CCUT Quality Technology Co., Ltd.**
1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China; (Tel.:+86-755-23406590 website: www.ccuttest.com)

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**.....: | Dongguan Mingcheng Digital Company Limited |
| Address of Applicant.....: | Room 302, No. 9 Shuixin Industrial Third Road, Fenggang, Guangdong province China |
| **Manufacturer**.....: | Dongguan Mingcheng Digital Company Limited |
| Address of Manufacturer.....: | Room 302, No. 9 Shuixin Industrial Third Road, Fenggang, Guangdong province China |
| **Product Name**.....: | bluetooth headset |
| **Brand Name**.....: | - |
| **Main Model**.....: | E311 |
| **Series Models**.....: | See section 1.1(page 5) |
| **Test Standard**.....: | FCC Part 15 Subpart C<br>ANSI C63.4-2014<br>ANSI C63.10-2013 |
| **Date of Test** .....: | 2024-09-04 to 2024-09-05 |
| **Test Result**.....: | PASS |
| **Tested By** .....: | Colin Chen (Colin Chen) |
| **Reviewed By**.....: | Lieber Ouyang (Lieber Ouyang) |
| **Authorized Signatory**.....: | Lahm Peng (Lahm Peng) |

Shenzhen CCUT Quality Technology Co., Ltd. APPROVED

Note : 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.. All test data presented in this test report is only applicable to presented test sample.

# CONTENTS

**1. General Information** ..... **5**
1.1 Product Information ..... 5
1.2 Test Setup Information ..... 6
1.3 Compliance Standards ..... 7
1.4 Test Facilities ..... 7
1.5 List of Measurement Instruments ..... 8
1.6 Measurement Uncertainty ..... 9
**2. Summary of Test Results** ..... **10**
**3. Antenna Requirement** ..... **11**
3.1 Standard and Limit ..... 11
3.2 Test Result ..... 11
**4. Conducted Emissions** ..... **12**
4.1 Standard and Limit ..... 12
4.2 Test Procedure ..... 12
4.3 Test Data and Results ..... 13
**5. Radiated Emissions** ..... **16**
5.1 Standard and Limit ..... 16
5.2 Test Procedure ..... 16
5.3 Test Data and Results ..... 18
**6. Band-edge Emissions(Radiated)** ..... **22**
6.1 Standard and Limit ..... 22
6.2 Test Procedure ..... 22
6.3 Test Data and Results ..... 22
**7. Frequency Hopping System** ..... **24**
7.1 Standard and Limit ..... 24
7.2 Test Procedure ..... 24
7.3 Test Data and Results ..... 25
**8. Dwell Time** ..... **26**
8.1 Standard and Limit ..... 26
8.2 Test Procedure ..... 26
8.3 Test Data and Results ..... 27
**9. Maximum Peak Conducted Output Power** ..... **31**
9.1 Standard and Limit ..... 31
9.2 Test Procedure ..... 31
9.3 Test Data and Results ..... 31
**10. Occupied Bandwidth(-20dB)** ..... **34**
10.1 Standard and Limit ..... 34
10.2 Test Procedure ..... 34
10.3 Test Data and Results ..... 34
**11. Carrier Frequencies Separation** ..... **38**
11.1 Standard and Limit ..... 38
11.2 Test Procedure ..... 38
11.3 Test Data and Results ..... 38
**12. Number of Hopping Channel** ..... **41**
12.1 Standard and Limit ..... 41
12.2 Test Procedure ..... 41
12.3 Test Data and Results ..... 41
**13. Band-edge Emission(Conducted)** ..... **43**
13.1 Standard and Limit ..... 43
13.2 Test Procedure ..... 43
13.3 Test Data and Results ..... 43
**14. Conducted RF Spurious Emissions** ..... **49**
14.1 Standard and Limit ..... 49
14.2 Test Procedure ..... 49
14.3 Test Data and Results ..... 49

# Revision History

| Revision | Issue Date | Description | Revised By |
|---|---|---|---|
| V1.0 | 2024-09-06 | Initial Release | Lahm Peng |
| | | | |
| | | | |
| | | | |
| | | | |

# 1. General Information

## 1.1 Product Information

| | |
|---|---|
| Product Name: | bluetooth headset |
| Trade Name: | - |
| Main Model: | E311 |
| Series Models: | E9S, E10, E5, E8, E8S, E9, E10, E10S, E11, M18, M21, M21S, M23, M25, M26, M31, M32, M318, M328, M316, E312, E310, E21, E23, E26, E28, E30, IM-01, T10, T20, SK18, SK19, A9pro, A39, P2-Pro, P2-Air, M20 |
| Rated Voltage: | DC 3.7V by battery, USB 5V charging |
| Battery: | DC3.7V, 35mAh, 0.125Wh |
| Hardware Version: | PADS |
| Software Version: | AB5656T2 |
| 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 BR/EDR |
| Operating Frequency: | 2402MHz ~ 2480MHz |
| RF Output Power: | -1.96dBm |
| Number of Channel: | 79 |
| Channel Separation: | 1MHz |
| Modulation: | GFSK, Pi/4 DQPSK, 8DPSK |
| Antenna Gain: | 2.78dBi |
| Type of Antenna: | SMD 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(DH5/2DH5/3DH5) |
| TM2 | Middle Channel | 2441MHz(DH5/2DH5/3DH5) |
| TM3 | Highest Channel | 2480MHz(DH5/2DH5/3DH5) |
| TM4 | Hopping | 2402MHz~2480MHz |
| TM5 | Charging | AC 120V/60Hz |

| List and Details of Auxiliary Cable | | | |
|---|---|---|---|
| Description | Length (cm) | Shielded/Unshielded | With/Without Ferrite |
| Type-C Cable | 100 | Unshielded | Without Ferrite |
| - | - | - | - |

| List and Details of Auxiliary Equipment | | | |
|---|---|---|---|
| Description | Manufacturer | Model | Serial Number |
| Adapter | Huawei | HW-100225C00 | HC78E2N6A23645 |
| - | - | - | - |

| 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 | 21 | 2422 | 41 | 2442 | 61 | 2462 |
| 02 | 2403 | 22 | 2423 | 42 | 2443 | 62 | 2463 |
| 03 | 2404 | 23 | 2424 | 43 | 2444 | 63 | 2464 |
| 04 | 2405 | 24 | 2425 | 44 | 2445 | 64 | 2465 |
| 05 | 2406 | 25 | 2426 | 45 | 2446 | 65 | 2466 |
| ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ |
| 16 | 2417 | 36 | 2437 | 56 | 2457 | 76 | 2477 |
| 17 | 2418 | 37 | 2438 | 57 | 2458 | 77 | 2478 |
| 18 | 2419 | 38 | 2439 | 58 | 2459 | 78 | 2479 |
| 19 | 2420 | 39 | 2440 | 59 | 2460 | 79 | 2480 |
| 20 | 2421 | 40 | 2441 | 60 | 2461 | | |

## 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 | 2024-08-07 | 2025-08-06 |
| EMI Test Receiver | ROHDE&SCHWARZ | ESPI | 100242 | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 5 | N/A | 2024-08-07 | 2025-08-06 |
| EMI Test Software | FARA | EZ-EMC | EMEC-3A1+ | N/A | N/A |
| **Radiated Emissions** | | | | | |
| EMI Test Receiver | ROHDE&SCHWARZ | ESPI | 100154 | 2024-08-07 | 2025-08-06 |
| Spectrum Analyzer | KEYSIGHT | N9020A | MY48030972 | 2024-08-07 | 2025-08-06 |
| Spectrum Analyzer | ROHDE&SCHWARZ | FSV40-N | 101692 | 2024-08-07 | 2025-08-06 |
| Amplifier | SCHWARZBECK | BBV 9743B | 00251 | 2024-08-07 | 2025-08-06 |
| Amplifier | HUABO | YXL0518-2.5-45 | -- | 2024-08-07 | 2025-08-06 |
| Amplifier | COM-MW | DLAN-18G-4G-02 | 10229104 | 2024-08-07 | 2025-08-06 |
| Loop Antenna | DAZE | ZN30900C | 21104 | 2024-08-03 | 2025-08-02 |
| Broadband Antenna | SCHWARZBECK | VULB 9168 | 01320 | 2024-08-03 | 2025-08-02 |
| Horn Antenna | SCHWARZBECK | BBHA 9120D | 02553 | 2024-08-03 | 2025-08-02 |
| Horn Antenna | COM-MW | ZLB7-18-40G-950 | 12221225 | 2024-08-03 | 2025-08-02 |
| Attenuator | QUANJUDA | 6dB | 220731 | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 1 | N/A | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 2 | N/A | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 3 | N/A | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 4 | N/A | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 8 | N/A | 2024-08-07 | 2025-08-06 |
| Test Cable | N/A | Cable 9 | N/A | 2024-08-07 | 2025-08-06 |
| EMI Test Software | FARA | EZ-EMC | FA-03A2 RE+ | N/A | N/A |
| **Conducted RF Testing** | | | | | |
| RF Test System | MWRFTest | MW100-RFCB | 220418SQS-37 | 2024-08-07 | 2025-08-06 |
| Spectrum Analyzer | KEYSIGHT | N9020A | ATO-90521 | 2024-08-07 | 2025-08-06 |
| RF Test Software | MWRFTest | MTS 8310 | N/A | N/A | N/A |
| Laptop | Lenovo | ThlnkPad E15 Gen 3 | SPPOZ22485 | N/A | N/A |

## 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 |

# 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(a)(1), (g), (h) | Frequency Hopping System | Passed |
| FCC Part 15.247(a)(1)(iii) | Dwell Time | Passed |
| FCC Part 15.247(b)(1) | Maximum Peak Conducted Output Power | Passed |
| FCC Part 15.215(c) | Occupied Bandwidth(-20dB) | Passed |
| FCC Part 15.247(a)(1) | Carrier Frequencies Separation | Passed |
| FCC Part 15.247(a)(1)(iii) | Number of Hopping Channel | 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 SMD antenna, fulfill the requirement of this section.

# 4. Conducted Emissions

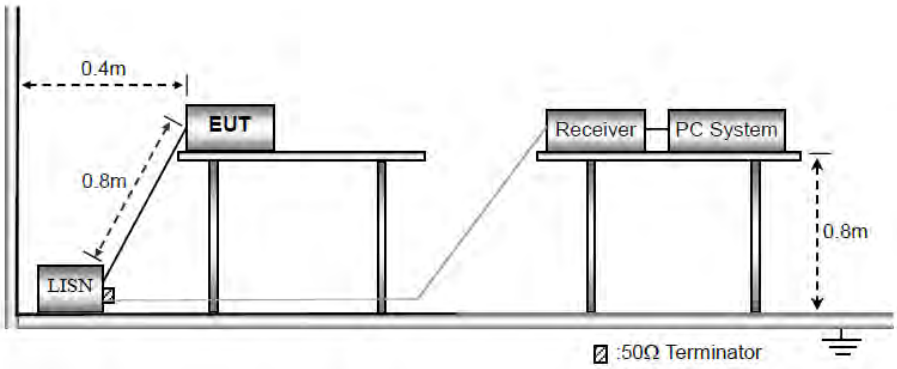
## 4.1 Standard and Limit

According to the rule FCC Part 15.207, Conducted emissions limit, the limit for a wireless device 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.

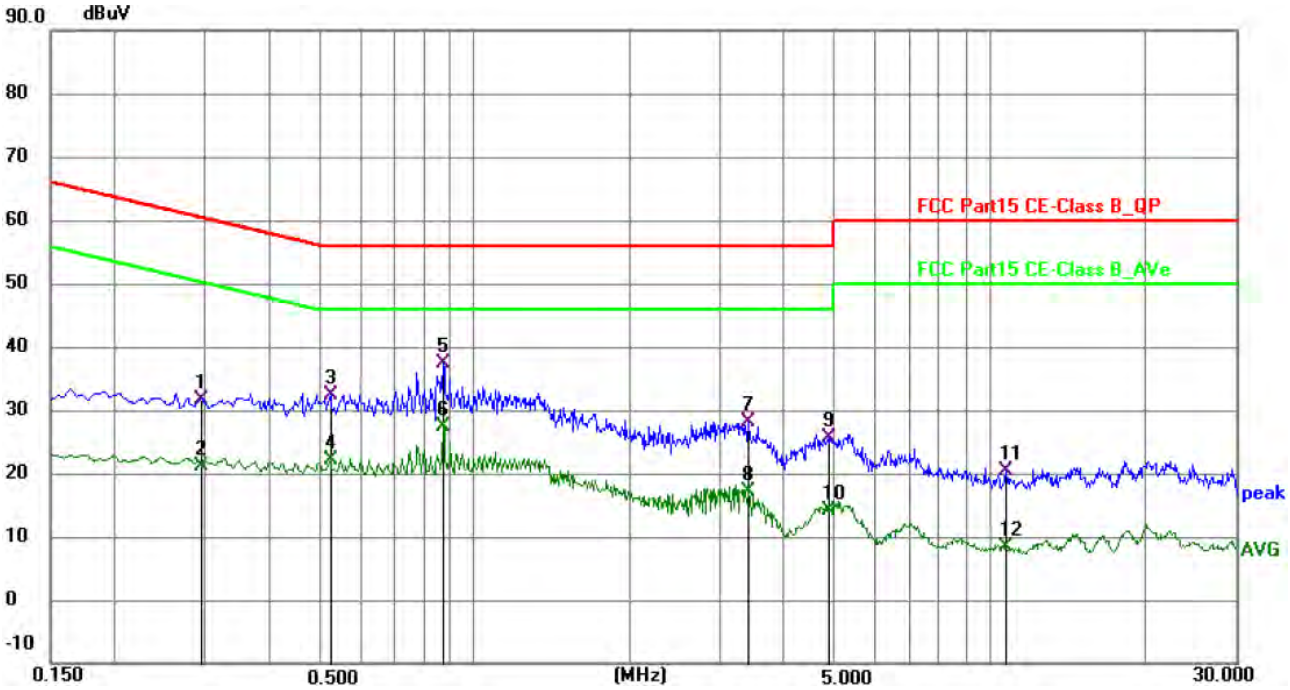
f) LISN is at least 80 cm from nearest part of EUT chassis.

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

## 4.3 Test Data and Results

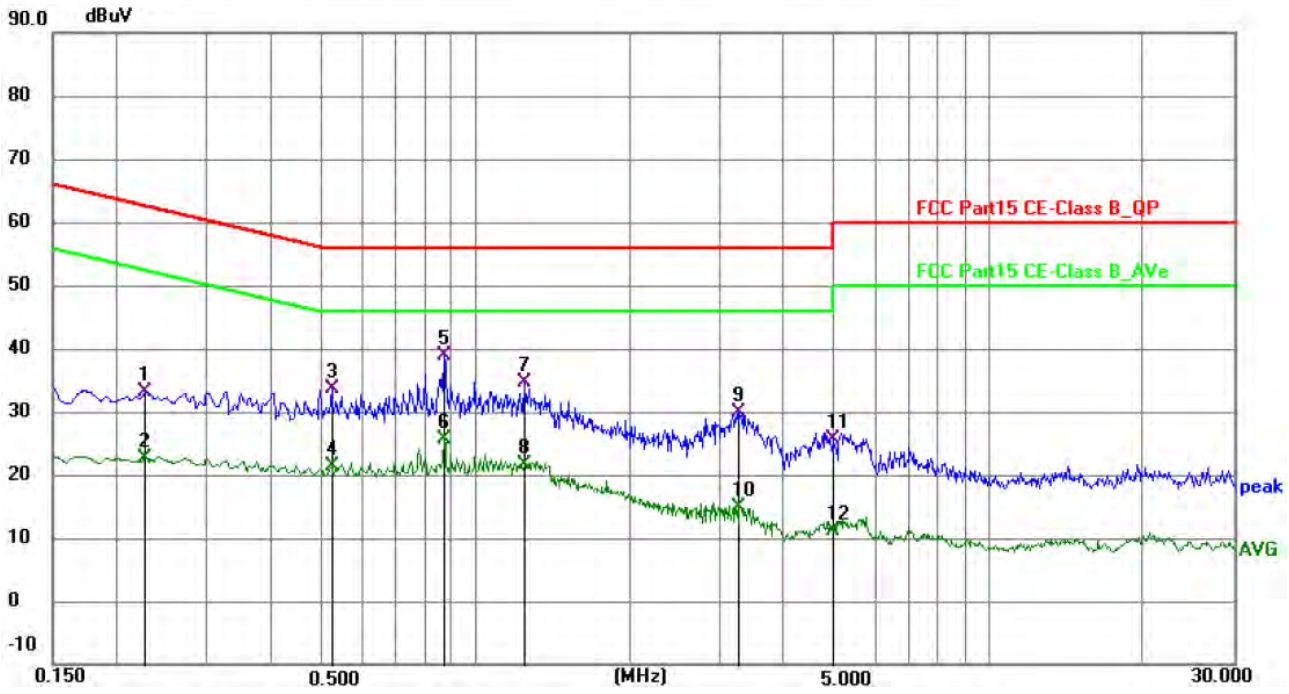
Based on all tested data, the EUT complied with the FCC Part 15.207 standard limit for a wireless device, and with the worst case as below:
Remark: Level = Reading + Factor, Margin = Level - Limit

| Test Plots and Data of Conducted Emissions | |
|---|---|
| Tested Mode: | TM5 |
| 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 | 0.2940 | 22.36 | 9.39 | 31.75 | 60.41 | -28.66 | QP | P | |
| 2 | 0.2940 | 11.71 | 9.39 | 21.10 | 50.41 | -29.31 | AVG | P | |
| 3 | 0.5235 | 23.04 | 9.39 | 32.43 | 56.00 | -23.57 | QP | P | |
| 4 | 0.5235 | 12.71 | 9.39 | 22.10 | 46.00 | -23.90 | AVG | P | |
| 5 | 0.8700 | 27.96 | 9.39 | 37.35 | 56.00 | -18.65 | QP | P | |
| 6 * | 0.8700 | 17.98 | 9.39 | 27.37 | 46.00 | -18.63 | AVG | P | |
| 7 | 3.3855 | 18.55 | 9.51 | 28.06 | 56.00 | -27.94 | QP | P | |
| 8 | 3.3855 | 7.69 | 9.51 | 17.20 | 46.00 | -28.80 | AVG | P | |
| 9 | 4.8525 | 15.99 | 9.57 | 25.56 | 56.00 | -30.44 | QP | P | |
| 10 | 4.8525 | 4.47 | 9.57 | 14.04 | 46.00 | -31.96 | AVG | P | |
| 11 | 10.7880 | 10.71 | 9.55 | 20.26 | 60.00 | -39.74 | QP | P | |
| 12 | 10.7880 | -1.20 | 9.55 | 8.35 | 50.00 | -41.65 | AVG | P | |

| Test Plots and Data of Conducted Emissions | |
|---|---|
| Tested Mode: | TM5 |
| 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 | 0.2265 | 23.66 | 9.44 | 33.10 | 62.58 | -29.48 | QP | P | |
| 2 | 0.2265 | 13.20 | 9.44 | 22.64 | 52.58 | -29.94 | AVG | P | |
| 3 | 0.5234 | 23.93 | 9.58 | 33.51 | 56.00 | -22.49 | QP | P | |
| 4 | 0.5234 | 11.89 | 9.58 | 21.47 | 46.00 | -24.53 | AVG | P | |
| 5 * | 0.8700 | 29.33 | 9.58 | 38.91 | 56.00 | -17.09 | QP | P | |
| 6 | 0.8700 | 16.06 | 9.58 | 25.64 | 46.00 | -20.36 | AVG | P | |
| 7 | 1.2435 | 24.96 | 9.63 | 34.59 | 56.00 | -21.41 | QP | P | |
| 8 | 1.2435 | 11.88 | 9.63 | 21.51 | 46.00 | -24.49 | AVG | P | |
| 9 | 3.2595 | 20.23 | 9.70 | 29.93 | 56.00 | -26.07 | QP | P | |
| 10 | 3.2595 | 5.27 | 9.70 | 14.97 | 46.00 | -31.03 | AVG | P | |
| 11 | 5.0010 | 15.90 | 9.76 | 25.66 | 60.00 | -34.34 | QP | P | |
| 12 | 5.0010 | 1.49 | 9.76 | 11.25 | 50.00 | -38.75 | 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:

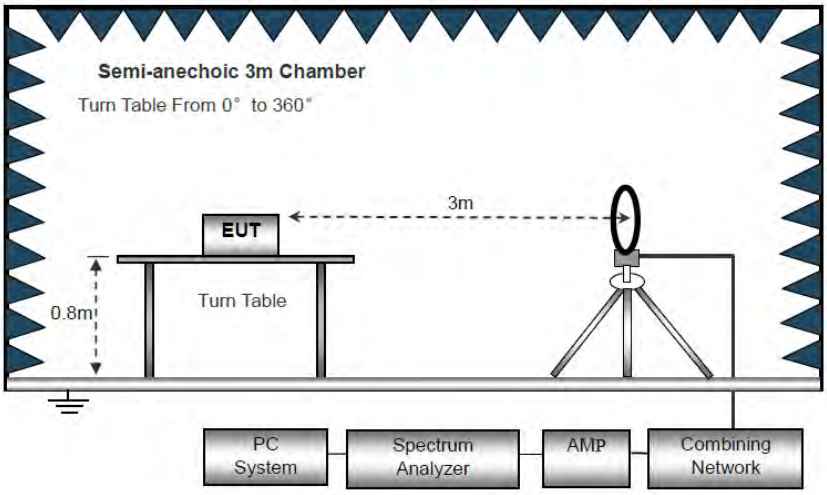
| Frequency of emission (MHz) | Radiated emissions (3m) |
|---|---|
| | Quasi-peak (dBuV/m) |
| 30-88 | 40 |
| 88-216 | 43.5 |
| 216-960 | 46 |
| Above 960 | 54 |
| Note: The more stringent limit applies at transition frequencies. | |

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.

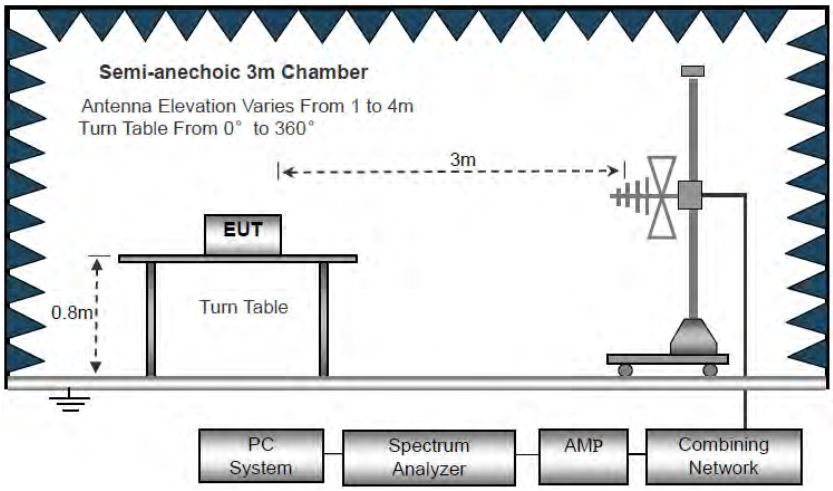
*Note: Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.*

## 5.2 Test Procedure

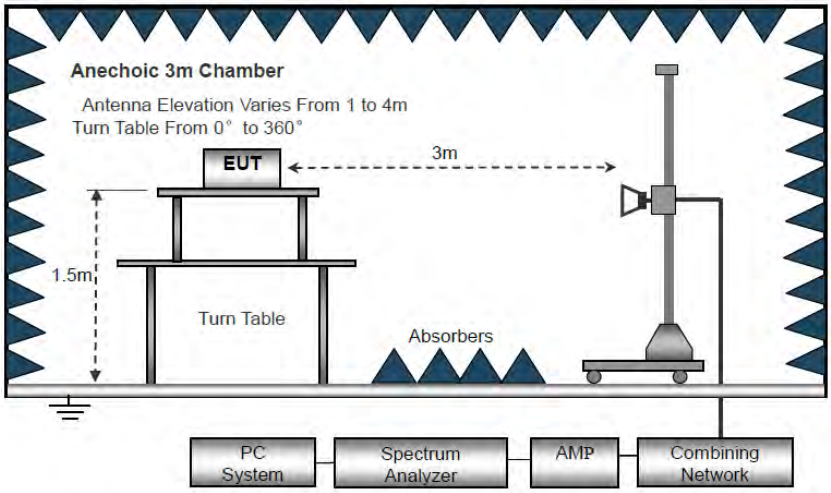
Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6.




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.

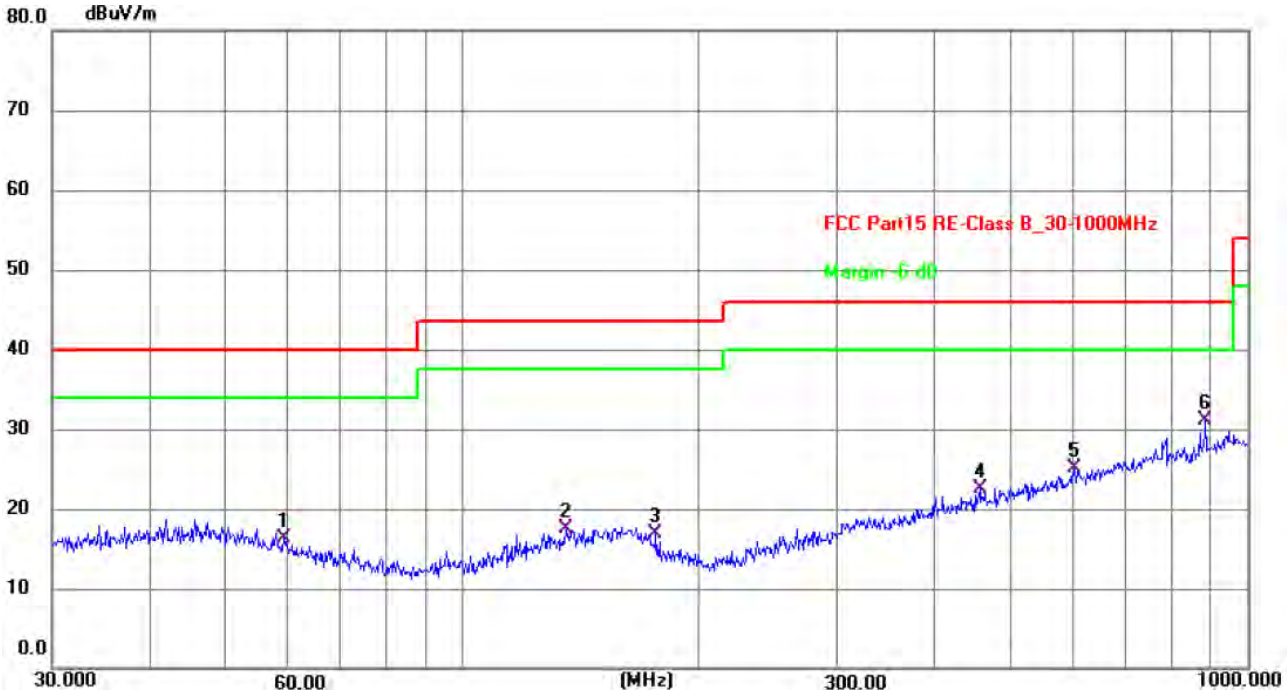
f) For the actual test configuration, please refer to the related item - EUT test photos.

## 5.3 Test Data and Results

All of the GFSK and π/4 DQPSK and 8DPSK modes have been tested, the EUT complied with the FCC Part 15.247 standard limit for a wireless device, and with the worst case GFSK_2402MHz as below:

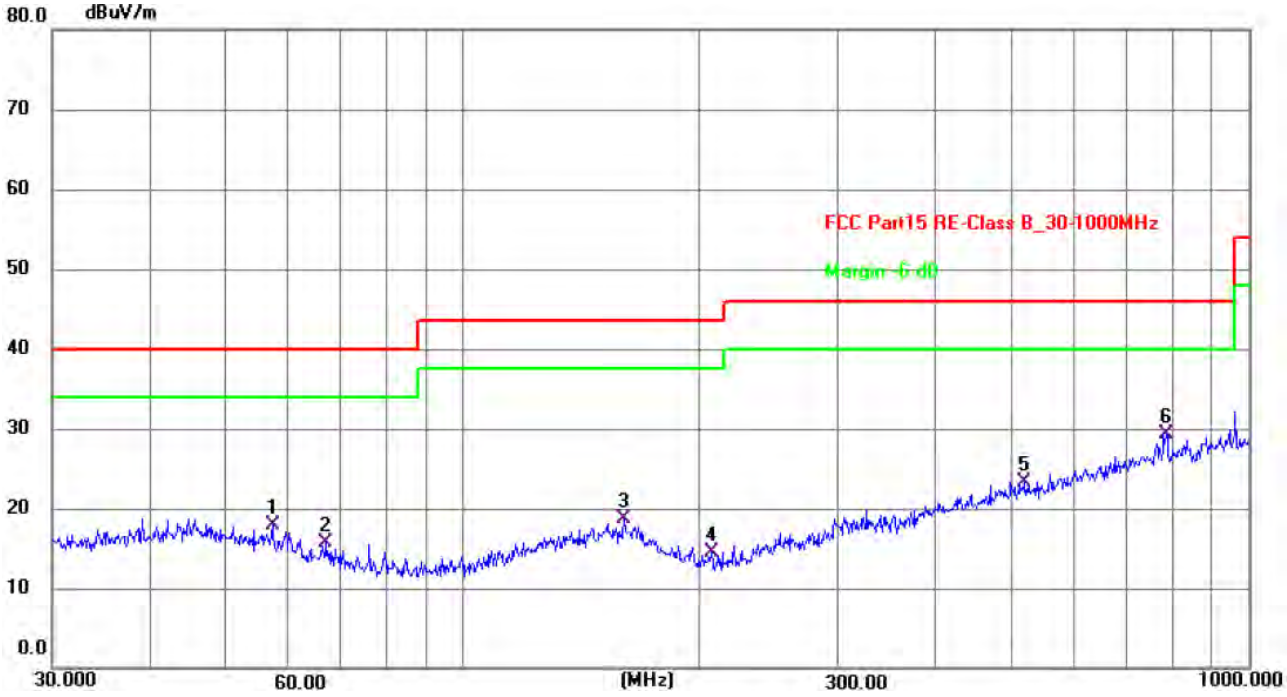
Remark: Level = Reading + Factor, Margin = Level - Limit

| 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 | 59.2325 | 26.05 | -9.84 | 16.21 | 40.00 | -23.79 | QP | 100 | 348 | P | |
| 2 | 135.5062 | 25.91 | -8.49 | 17.42 | 43.50 | -26.08 | QP | 100 | 48 | P | |
| 3 | 176.2686 | 26.82 | -9.88 | 16.94 | 43.50 | -26.56 | QP | 100 | 168 | P | |
| 4 | 455.9058 | 26.97 | -4.37 | 22.60 | 46.00 | -23.40 | QP | 100 | 88 | P | |
| 5 | 601.4265 | 26.65 | -1.59 | 25.06 | 46.00 | -20.94 | QP | 100 | 88 | P | |
| 6 * | 884.5029 | 28.82 | 2.29 | 31.11 | 46.00 | -14.89 | QP | 100 | 348 | 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 | 57.1914 | 27.36 | -9.50 | 17.86 | 40.00 | -22.14 | QP | 100 | 184 | P | |
| 2 | 66.9669 | 26.78 | -11.17 | 15.61 | 40.00 | -24.39 | QP | 100 | 304 | P | |
| 3 | 160.3456 | 26.56 | -7.90 | 18.66 | 43.50 | -24.84 | QP | 100 | 283 | P | |
| 4 | 207.1226 | 26.50 | -11.97 | 14.53 | 43.50 | -28.97 | QP | 100 | 355 | P | |
| 5 | 519.0649 | 26.30 | -3.07 | 23.23 | 46.00 | -22.77 | QP | 100 | 93 | P | |
| 6 * | 785.0935 | 28.04 | 1.33 | 29.37 | 46.00 | -16.63 | QP | 100 | 359 | 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 (2402MHz) | | | | | | | |
| 4804 | 79.94 | -14.72 | 65.22 | 74 | -8.78 | H | PK |
| 4804 | 61.31 | -14.72 | 46.59 | 54 | -7.41 | H | AV |
| 7206 | 64.75 | -8.41 | 56.34 | 74 | -17.66 | H | PK |
| 7206 | 48.15 | -8.41 | 39.74 | 54 | -14.26 | H | AV |
| 4804 | 77.14 | -14.72 | 62.42 | 74 | -11.58 | V | PK |
| 4804 | 60.22 | -14.72 | 45.5 | 54 | -8.5 | V | AV |
| 7206 | 62.95 | -8.41 | 54.54 | 74 | -19.46 | V | PK |
| 7206 | 47.16 | -8.41 | 38.75 | 54 | -15.25 | V | AV |
| Middle Channel (2441MHz) | | | | | | | |
| 4882 | 76.42 | -14.64 | 61.78 | 74 | -12.22 | H | PK |
| 4882 | 62.97 | -14.64 | 48.33 | 54 | -5.67 | H | AV |
| 7323 | 62.25 | -8.28 | 53.97 | 74 | -20.03 | H | PK |
| 7323 | 48.58 | -8.28 | 40.3 | 54 | -13.7 | H | AV |
| 4882 | 78.34 | -14.64 | 63.7 | 74 | -10.3 | V | PK |
| 4882 | 57.06 | -14.64 | 42.42 | 54 | -11.58 | V | AV |
| 7323 | 65.08 | -8.28 | 56.8 | 74 | -17.2 | V | PK |
| 7323 | 50.27 | -8.28 | 41.99 | 54 | -12.01 | V | AV |
| Highest Channel (2480MHz) | | | | | | | |
| 4960 | 77.7 | -14.53 | 63.17 | 74 | -10.83 | H | PK |
| 4960 | 61.66 | -14.53 | 47.13 | 54 | -6.87 | H | AV |
| 7440 | 63.94 | -8.13 | 55.81 | 74 | -18.19 | H | PK |
| 7440 | 47.61 | -8.13 | 39.48 | 54 | -14.52 | H | AV |
| 4960 | 78.48 | -14.53 | 63.95 | 74 | -10.05 | V | PK |
| 4960 | 57.52 | -14.53 | 42.99 | 54 | -11.01 | V | AV |
| 7440 | 63.38 | -8.13 | 55.25 | 74 | -18.75 | V | PK |
| 7440 | 48.3 | -8.13 | 40.17 | 54 | -13.83 | 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.*

*Note3: Other emissions are attenuated 20dB below the limits from 9kHz to 30MHz, so it does not recorded in report.18GHz-26GHz not recorded for no spurious point have a margin of less than 6 dB with respect to the limits.*

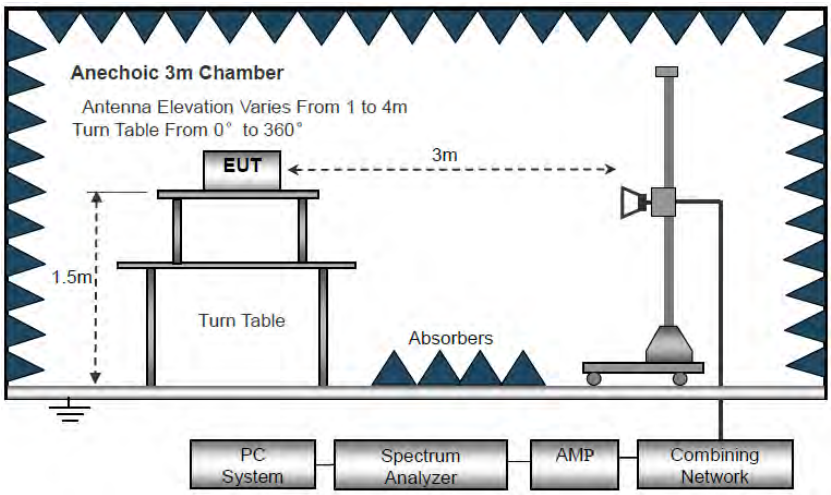
# 6. Band-edge Emissions(Radiated)

## 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

All of the GFSK and π/4 DQPSK and 8DPSK modes have been tested, 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 |
| 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 | 68.71 | -21.34 | 47.37 | 74 | -26.63 | H | PK |
| 2310 | 52.25 | -21.34 | 30.91 | 54 | -23.09 | H | AV |
| 2390 | 68.19 | -20.96 | 47.23 | 74 | -26.77 | H | PK |
| 2390 | 52.79 | -20.96 | 31.83 | 54 | -22.17 | H | AV |
| 2400 | 68.34 | -20.91 | 47.43 | 74 | -26.57 | H | PK |
| 2400 | 52.18 | -20.91 | 31.27 | 54 | -22.73 | H | AV |
| 2310 | 65.35 | -21.34 | 44.01 | 74 | -29.99 | V | PK |
| 2310 | 49.02 | -21.34 | 27.68 | 54 | -26.32 | V | AV |
| 2390 | 69.01 | -20.96 | 48.05 | 74 | -25.95 | V | PK |
| 2390 | 52.67 | -20.96 | 31.71 | 54 | -22.29 | V | AV |
| 2400 | 67.96 | -20.91 | 47.05 | 74 | -26.95 | V | PK |
| 2400 | 52.13 | -20.91 | 31.22 | 54 | -22.78 | V | AV |
| Highest Channel GFSK (2480MHz) | | | | | | | |
| 2483.50 | 69.71 | -20.51 | 49.2 | 74 | -24.8 | H | PK |
| 2483.50 | 56.6 | -20.51 | 36.09 | 54 | -17.91 | H | AV |
| 2500 | 69.75 | -20.43 | 49.32 | 74 | -24.68 | H | PK |
| 2500 | 49.05 | -20.43 | 28.62 | 54 | -25.38 | H | AV |
| 2483.50 | 69.29 | -20.51 | 48.78 | 74 | -25.22 | V | PK |
| 2483.50 | 56.14 | -20.51 | 35.63 | 54 | -18.37 | V | AV |
| 2500 | 64.66 | -20.43 | 44.23 | 74 | -29.77 | V | PK |
| 2500 | 51.7 | -20.43 | 31.27 | 54 | -22.73 | V | AV |

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

# 7. Frequency Hopping System

## 7.1 Standard and Limit

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

## 7.2 Test Procedure

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

## 7.3 Test Data and Results

Pseudorandom Frequency Hopping Sequence Table as below:
Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

# 8. Dwell Time

## 8.1 Standard and Limit

According to 15.247 (a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

## 8.2 Test Procedure

1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Spectrum Setting: RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak
3) Use video trigger with the trigger level set to enable triggering only on full pulses.
4) Sweep Time is more than once pulse time.
5) Set the center frequency on any frequency would be measure and set the frequency span to zero span.
6) Measure the maximum time duration of one single pulse.
7) Set the EUT for packet transmitting.
8) Measure the maximum time duration of one single pulse.
9) The EUT was set to the Hopping Mode for Dwell Time Test.

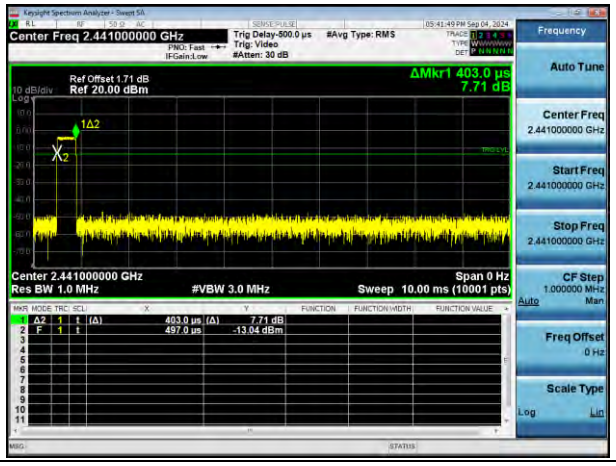
Test Setup Block Diagram

## 8.3 Test Data and Results

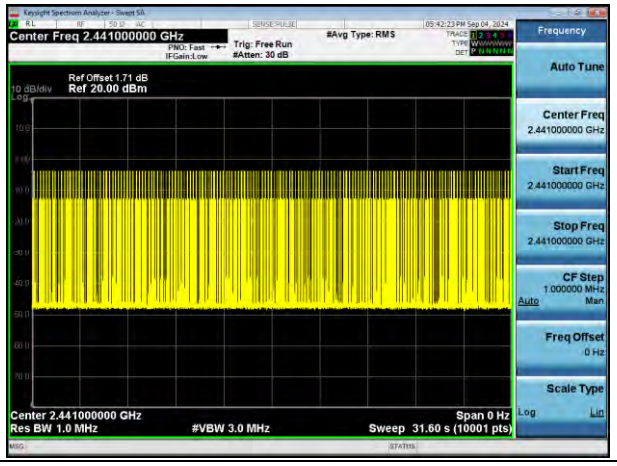
| Test Mode | Data Packet | Channel (MHz) | Pulse Duration (ms) | Dwell Time (ms) | Limit (ms) | Result |
|---|---|---|---|---|---|---|
| GFSK | DH1 | 2441 | 0.403 | 128.557 | <400 | Pass |
| | DH3 | 2441 | 1.66 | 253.98 | <400 | Pass |
| | DH5 | 2441 | 2.906 | 334.19 | <400 | Pass |
| Pi/4 DQPSK | 2DH1 | 2441 | 0.413 | 131.747 | <400 | Pass |
| | 2DH3 | 2441 | 1.665 | 274.725 | <400 | Pass |
| | 2DH5 | 2441 | 2.911 | 291.1 | <400 | Pass |
| 8DPSK | 3DH1 | 2441 | 0.414 | 132.066 | <400 | Pass |
| | 3DH3 | 2441 | 1.665 | 259.74 | <400 | Pass |
| | 3DH5 | 2441 | 2.915 | 306.075 | <400 | Pass |

**GFSK (2441MHz)**

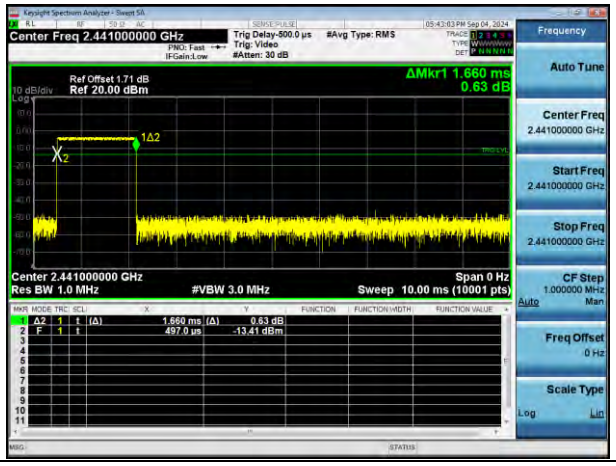
Burst(DH1)



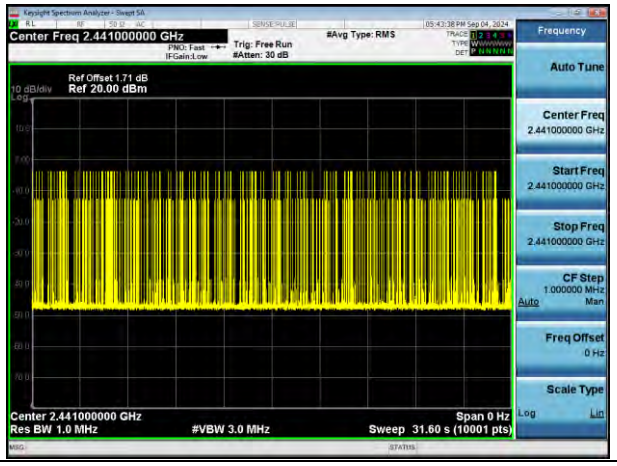

Accumulate(DH1)



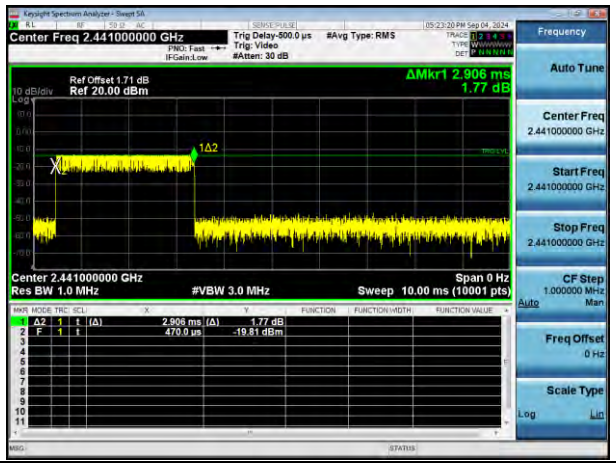

Burst(DH3)



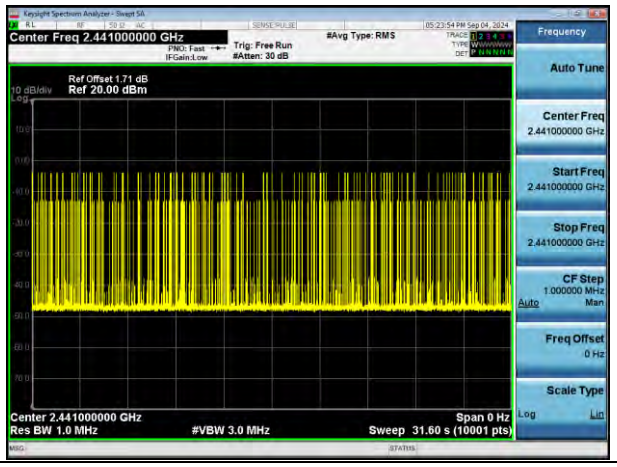

Accumulate(DH3)




Burst(DH5)

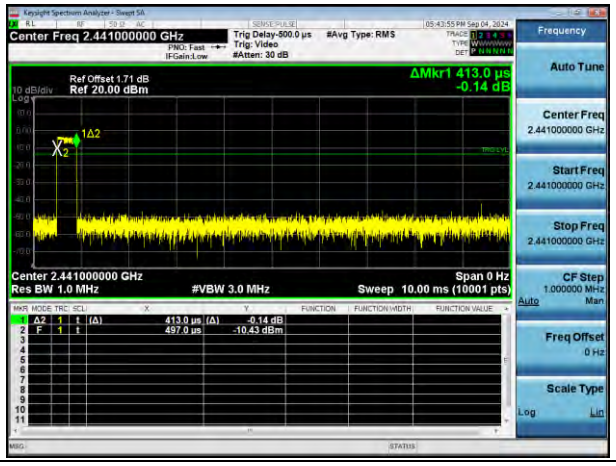



Accumulate(DH5)

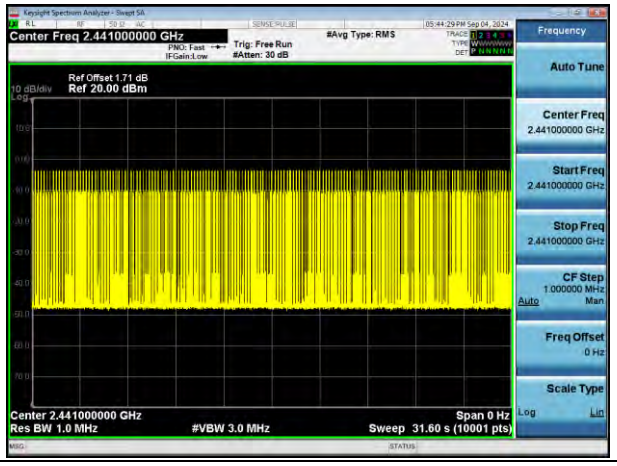


**Pi/4 DQPSK (2441MHz)**

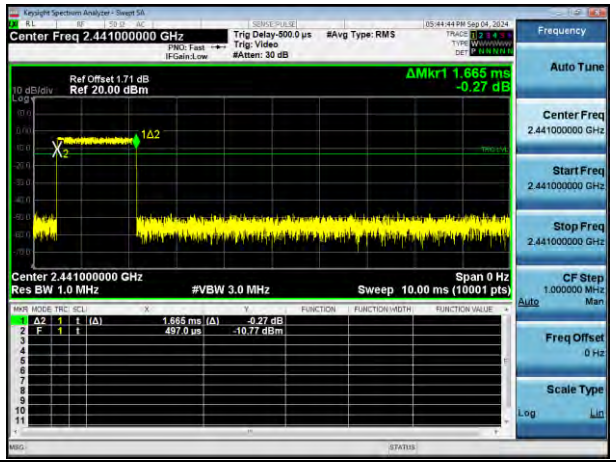
Burst(2DH1)



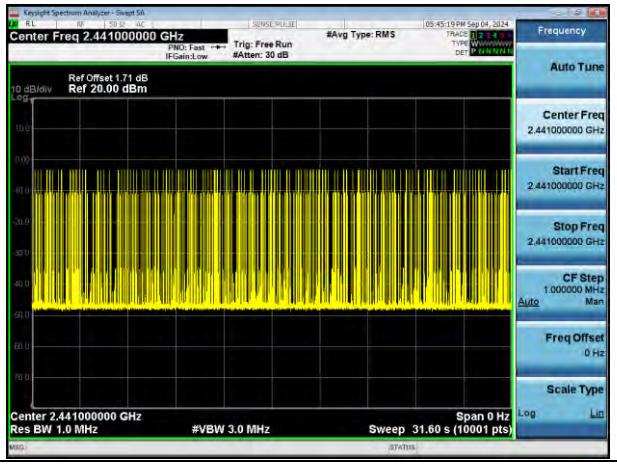

Accumulate(2DH1)



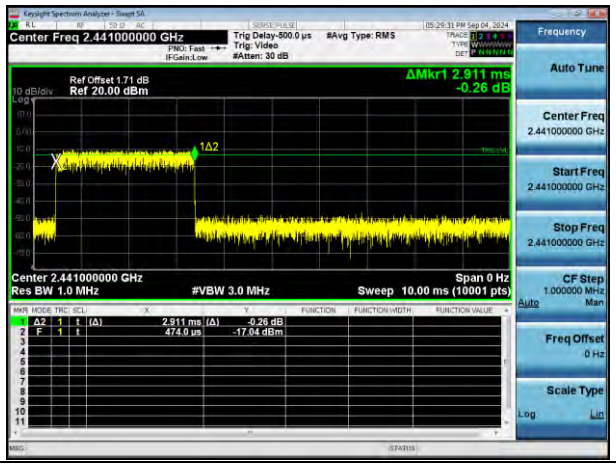

Burst(2DH3)



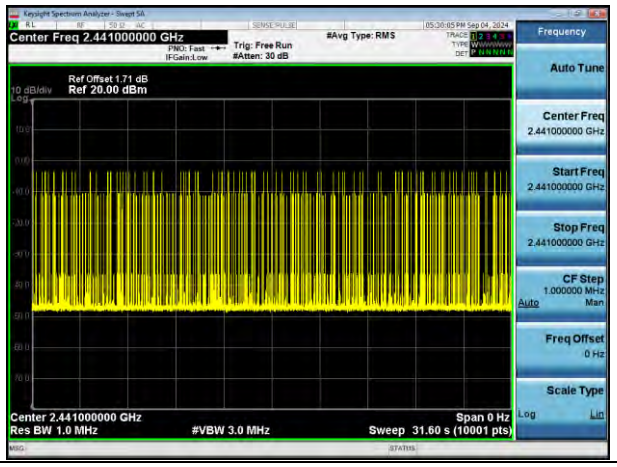

Accumulate(2DH3)




Burst(2DH5)

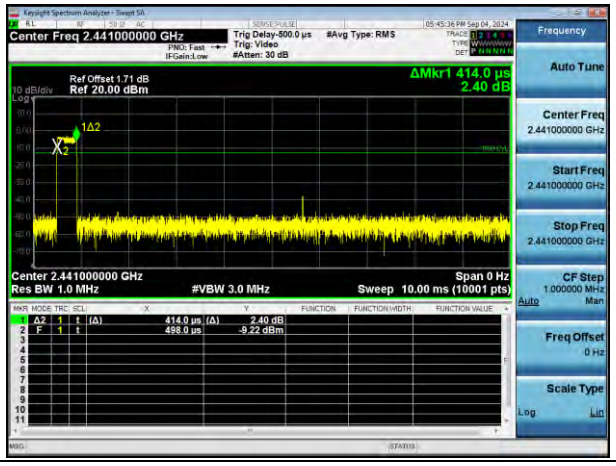



Accumulate(2DH5)

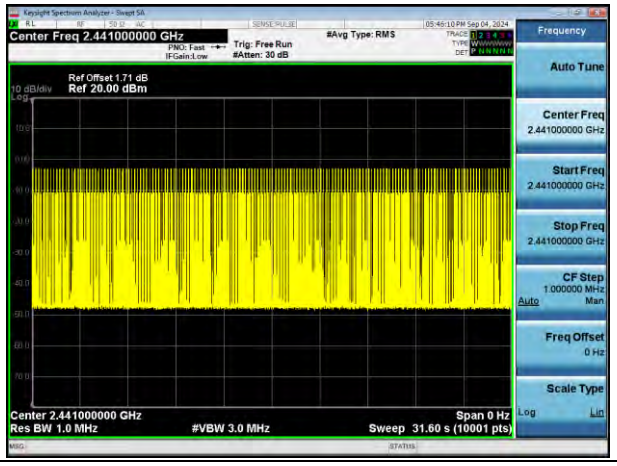


**8DPSK (2441MHz)**

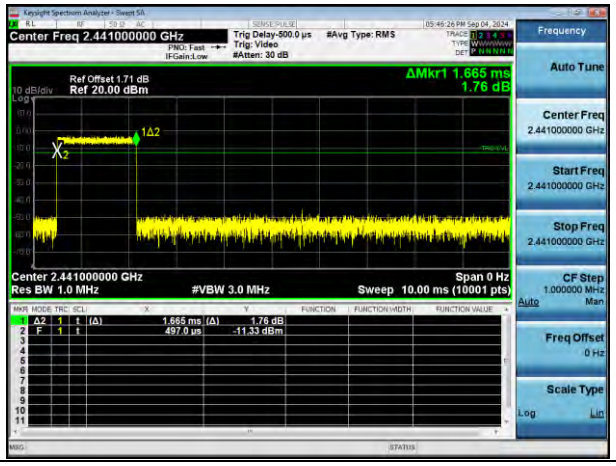
Burst(3DH1)



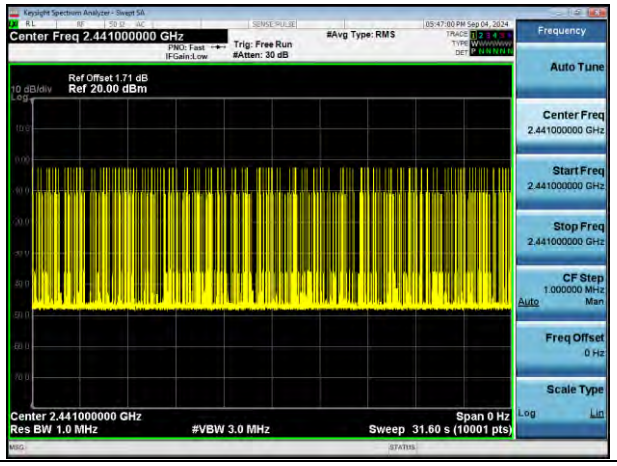

Accumulate(3DH1)



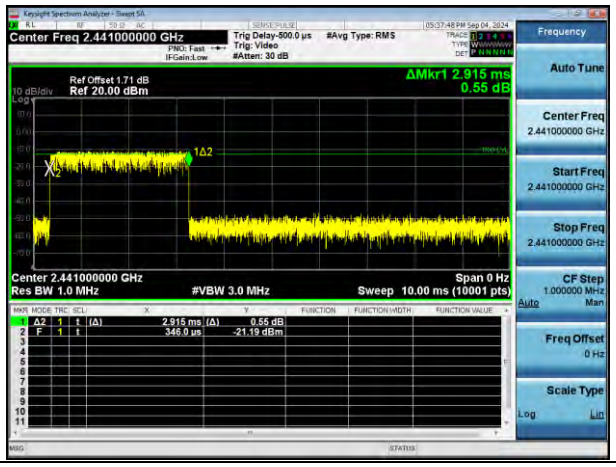

Burst(3DH3)



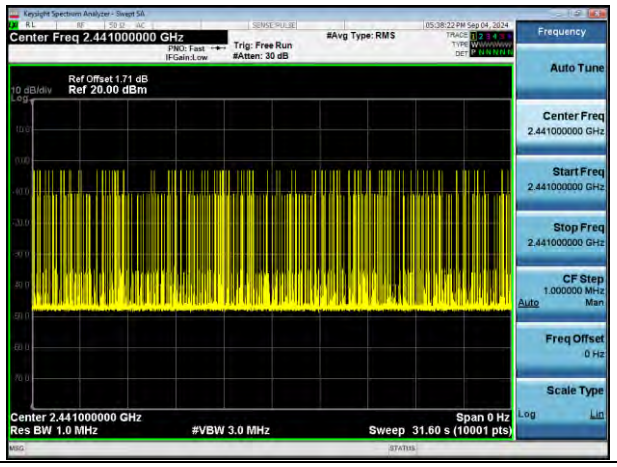

Accumulate(3DH3)




Burst(3DH5)




Accumulate(3DH5)



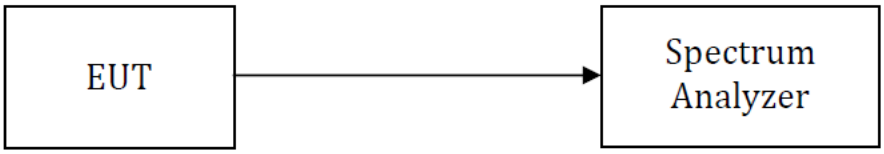
# 9. Maximum Peak Conducted Output Power

## 9.1 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.

## 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 = 2MHz, VBW = 6MHz, Sweep = Auto, Detector = Peak.
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

## 9.3 Test Data and Results

| Test Mode | Test Channel MHz | Conducted Output Power (dBm) | Limit (dBm) | Test Result |
|---|---|---|---|---|
| GFSK | 2402 | -2.93 | 21 | Pass |
| | 2441 | -3.77 | 21 | Pass |
| | 2480 | -4.43 | 21 | Pass |
| Pi/4 DQPSK | 2402 | -2.24 | 21 | Pass |
| | 2441 | -2.96 | 21 | Pass |
| | 2480 | -3.7 | 21 | Pass |
| 8DPSK | 2402 | -1.96 | 21 | Pass |
| | 2441 | -2.71 | 21 | Pass |
| | 2480 | -3.38 | 21 | Pass |

| GFSK | Pi/4 DQPSK |
|---|---|
| 2402MHz | 2402MHz |
| | |
| | |
| 2441MHz | 2441MHz |
| | |
| | |
| 2480MHz | 2480MHz |
| | |

| 8DPSK |
|---|
| 2402MHz<br> <br> |
| |
| 2441MHz<br> <br> |
| |
| 2480MHz<br> <br> |

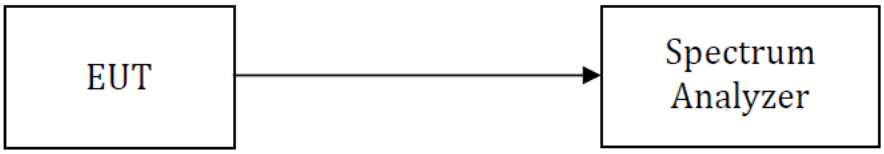
# 10. Occupied Bandwidth(-20dB)

## 10.1 Standard and Limit

According to 15.215 (c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

## 10.2 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 = 30kHz, VBW = 100kHz, 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 20dB 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

## 10.3 Test Data and Results

| Test Mode | Test Channel (MHz) | 20dB Bandwidth (MHz) | 99% Bandwidth (kHz) |
|---|---|---|---|
| GFSK | 2402 | 0.933 | 850.57 |
| | 2441 | 0.946 | 874.62 |
| | 2480 | 0.948 | 859.51 |
| Pi/4 DQPSK | 2402 | 1.242 | 1167.8 |
| | 2441 | 1.318 | 1183.6 |
| | 2480 | 1.217 | 1163.0 |
| 8DPSK | 2402 | 1.27 | 1176.0 |
| | 2441 | 1.25 | 1172.7 |
| | 2480 | 1.203 | 1150.8 |

| GFSK | Pi/4 DQPSK |
|---|---|
| 2402MHz<br> <br> | 2402MHz<br> <br> |
| 2441MHz<br> <br> | 2441MHz<br> <br> |
| 2480MHz<br> <br> | 2480MHz<br> <br> |

| 8DPSK |
|---|
| 2402MHz<br> <br> |
| |
| 2441MHz<br> <br> |
| |
| 2480MHz<br> <br> |

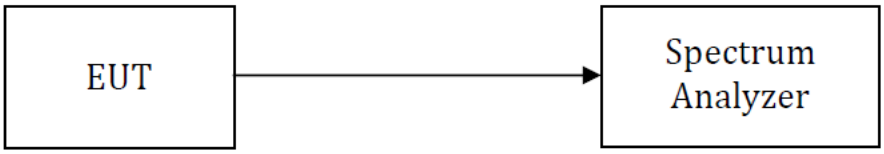
# 11. Carrier Frequencies Separation

## 11.1 Standard and Limit

According to FCC 15.247(a)(1), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

## 11.2 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 = 30kHz, VBW = 100kHz, Sweep = Auto, Detector = Peak.
4) By using the Max Hold function, record the separation of two adjacent channels.
5) Measure the frequency difference of these two adjacent channels by spectrum analyzer mark function. and then plot the result on the screen of the spectrum analyzer.
6) Repeat above procedures until all frequencies measured were complete.

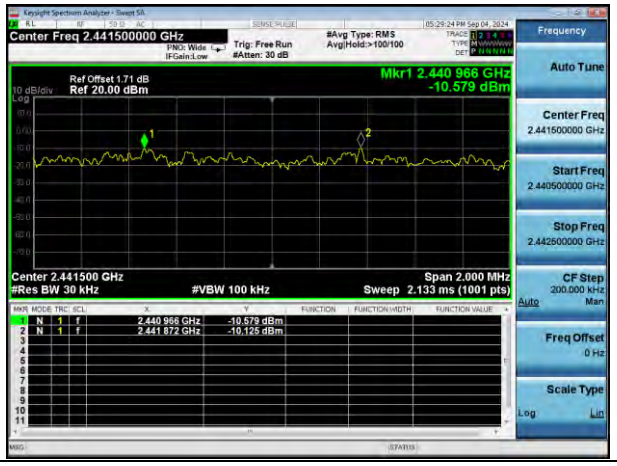
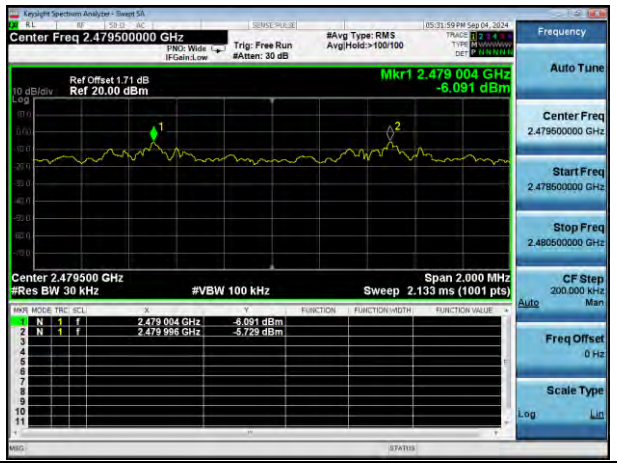


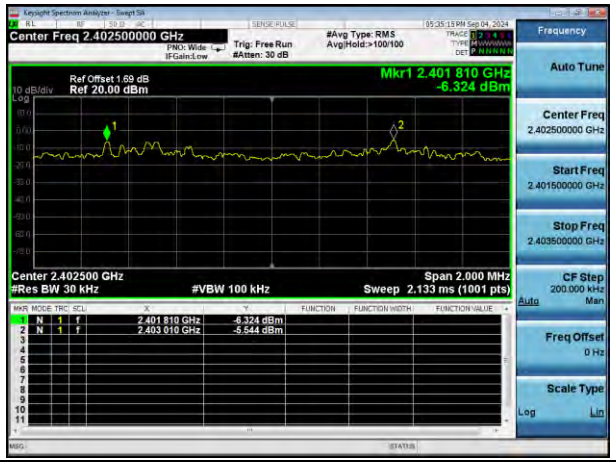
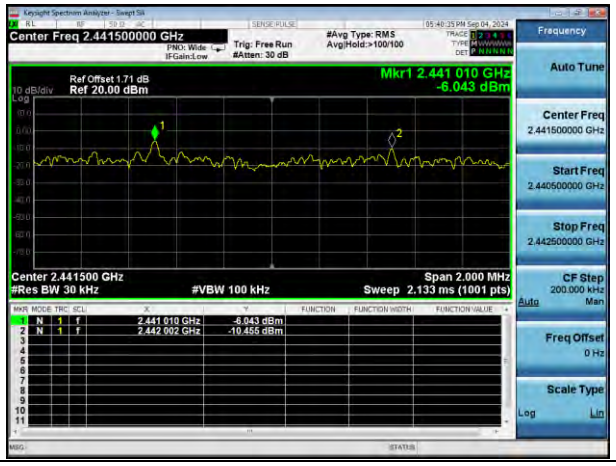
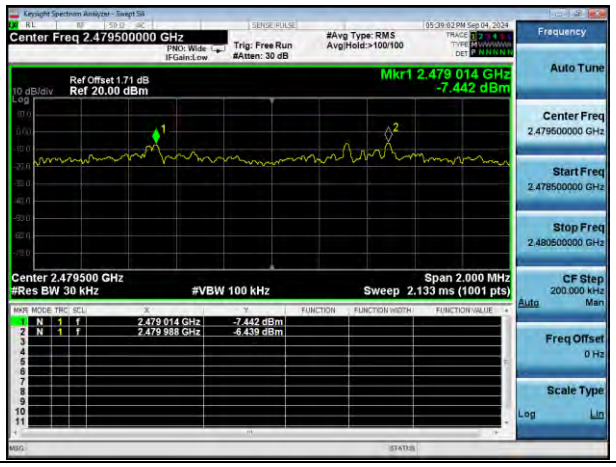

Test Setup Block Diagram

## 11.3 Test Data and Results

| Test Mode | Test Channel | Test Freq. 1 (MHz) | Test Freq. 2 (MHz) | CFS (MHz) | Limit (MHz) |
|---|---|---|---|---|---|
| GFSK | Lowest | 2401.99 | 2402.824 | 0.834 | 0.622 |
| | Middle | 2440.81 | 2441.978 | 1.168 | 0.631 |
| | Highest | 2478.81 | 2479.994 | 1.184 | 0.632 |
| Pi/4 DQPSK | Lowest | 2401.988 | 2402.822 | 0.834 | 0.828 |
| | Middle | 2440.966 | 2441.872 | 0.906 | 0.879 |
| | Highest | 2479.004 | 2479.996 | 0.992 | 0.811 |
| 8DPSK | Lowest | 2401.81 | 2403.01 | 1.2 | 0.847 |
| | Middle | 2441.01 | 2442.002 | 0.992 | 0.833 |
| | Highest | 2479.014 | 2479.988 | 0.974 | 0.802 |

*Note: CFS(Channel Frequency Separation) = Test Freq. 2 - Test Freq. 1*

| GFSK | Pi/4 DQPSK |
|---|---|
| Lowest | Lowest |
| | |
| Middle | Middle |
| |  |
| Highest | Highest |
| |  |

| 8DPSK |
|---|
| Lowest<br>  <br> |
| |
| Middle<br>  <br> |
| |
| Highest<br>  <br> |

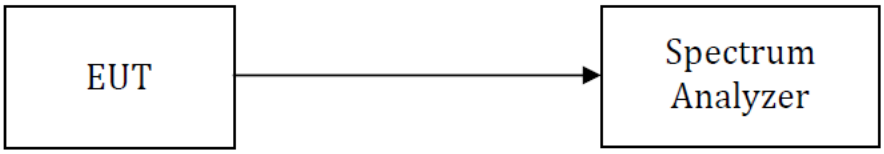
# 12. Number of Hopping Channel

## 12.1 Standard and Limit

According to FCC 15.247(a)(1), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

## 12.2 Test Procedure

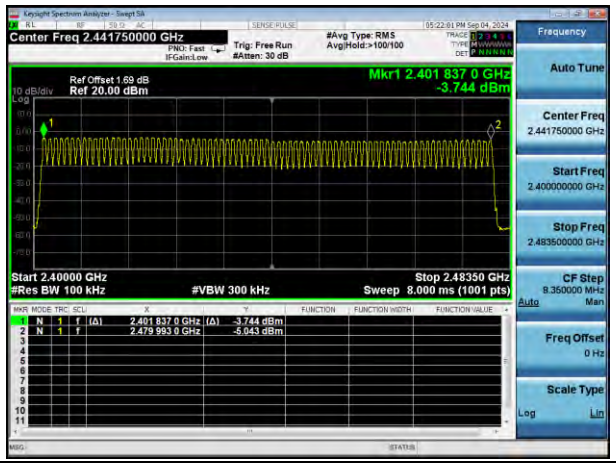
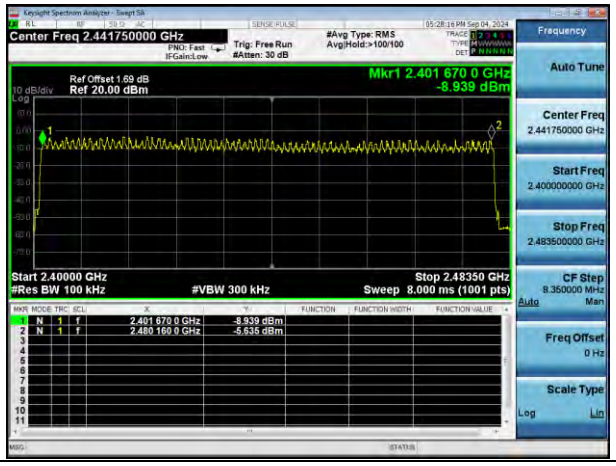
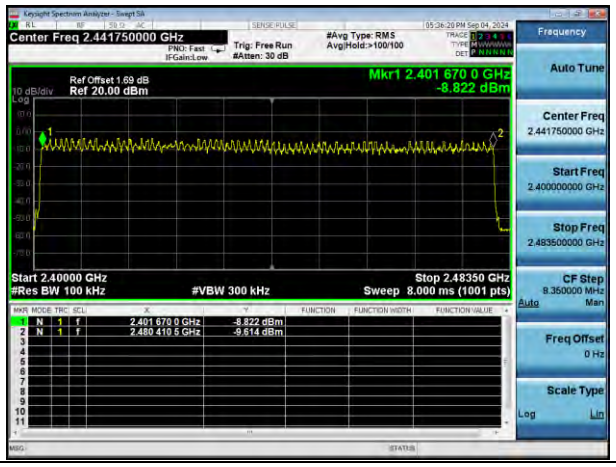
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
4) Set the spectrum analyzer on Max hold mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
5) Set the spectrum analyzer on View mode and then plot the result on the screen of the spectrum analyzer.
6) Repeat the above procedures until all frequencies measured were complete.




Test Setup Block Diagram

## 12.3 Test Data and Results

| Test Mode | Number of Hopping Channel | Limit | Test Result |
|---|---|---|---|
| GFSK | 79 | 15 | Pass |
| Pi/4 DQPSK | 79 | 15 | Pass |
| 8DPSK | 79 | 15 | Pass |

| Number of Hopping Channel |
|---|
| GFSK<br>  <br> |
| |
| Pi/4 DQPSK<br>  <br> |
| |
| 8DPSK<br>  <br> |

# 13. Band-edge Emission(Conducted)

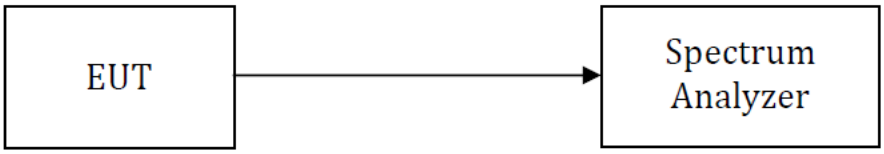
## 13.1 Standard and Limit

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)).

## 13.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.10.

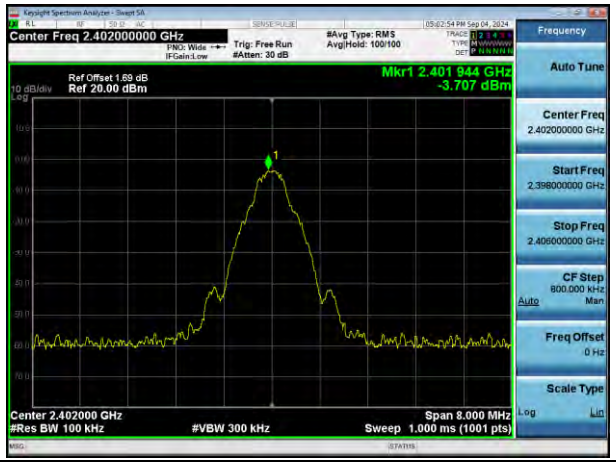
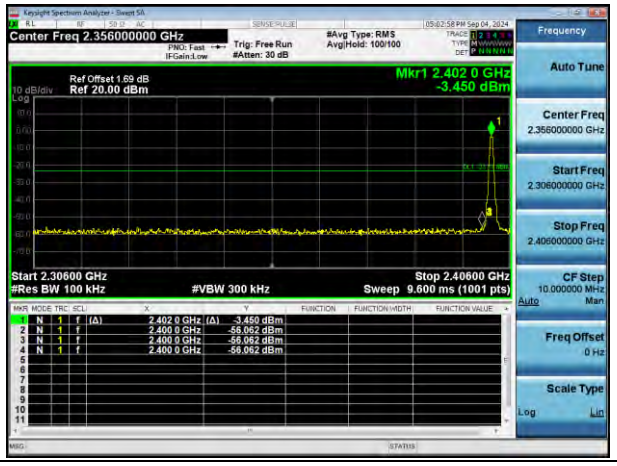
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral 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.

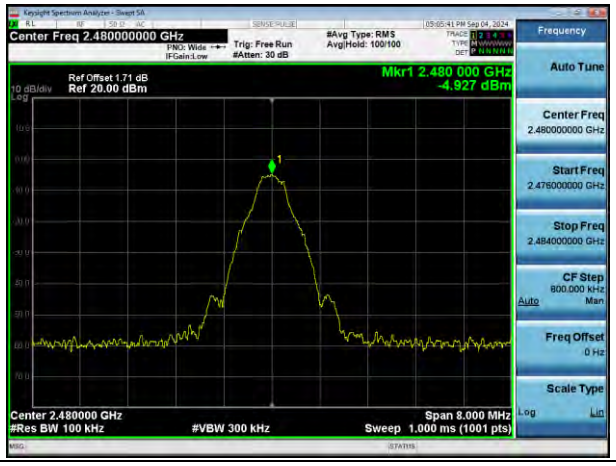
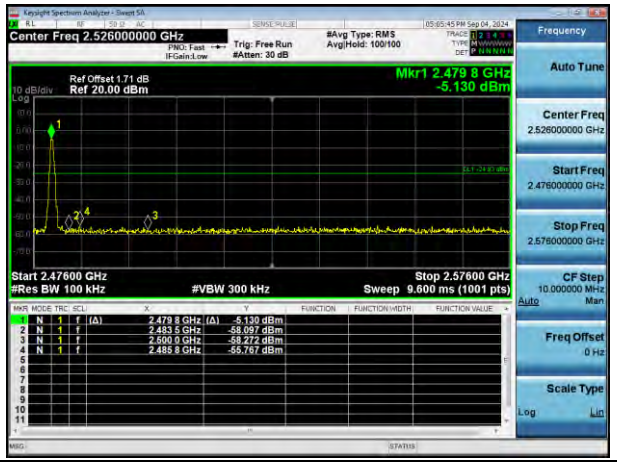


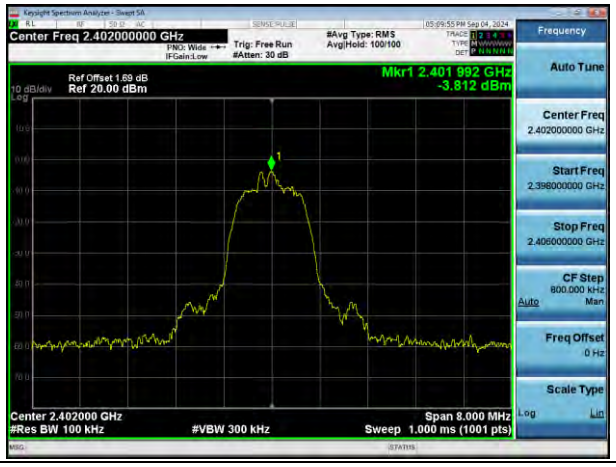
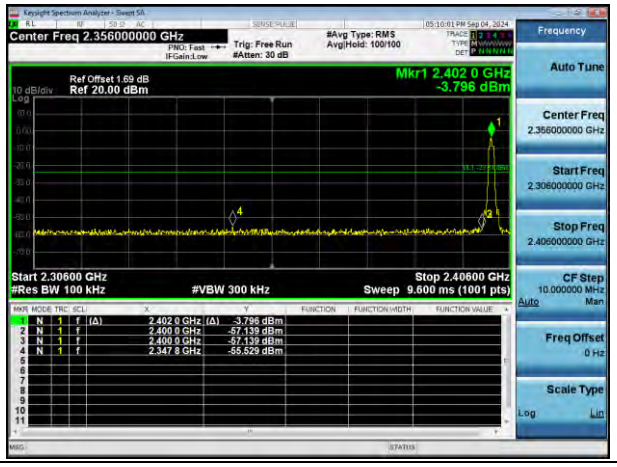

Test Setup Block Diagram

## 13.3 Test Data and Results

| Test Mode | Band-edge | Test Channel (MHz) | Max. Value (dBc) | Limit (dBc) | Test Result |
|---|---|---|---|---|---|
| No-Hopping | | | | | |
| GFSK | Lowest | 2402 | -52.35 | -20 | Pass |
| | Highest | 2480 | -50.83 | -20 | Pass |
| Pi/4 DQPSK | Lowest | 2402 | -51.71 | -20 | Pass |
| | Highest | 2480 | -50.24 | -20 | Pass |
| 8DPSK | Lowest | 2402 | -49.84 | -20 | Pass |
| | Highest | 2480 | -50.3 | -20 | Pass |
| Hopping | | | | | |
| GFSK | Lowest | 2402 | -50.8 | -20 | Pass |
| | Highest | 2480 | -49.54 | -20 | Pass |
| Pi/4 DQPSK | Lowest | 2402 | -50.15 | -20 | Pass |
| | Highest | 2480 | -47.83 | -20 | Pass |
| 8DPSK | Lowest | 2402 | -50.89 | -20 | Pass |
| | Highest | 2480 | -48.86 | -20 | Pass |

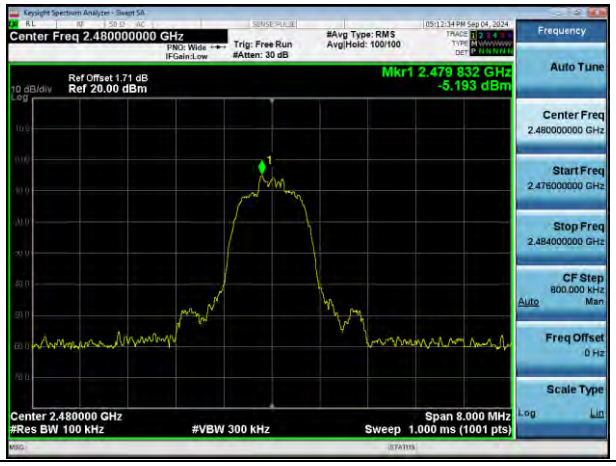
| No-Hopping GFSK Lowest | |
|---|---|
| Reference Power | Band-edge Emission |
|  |  |

| No-Hopping GFSK Highest | |
|---|---|
| Reference Power | Band-edge Emission |
|  |  |

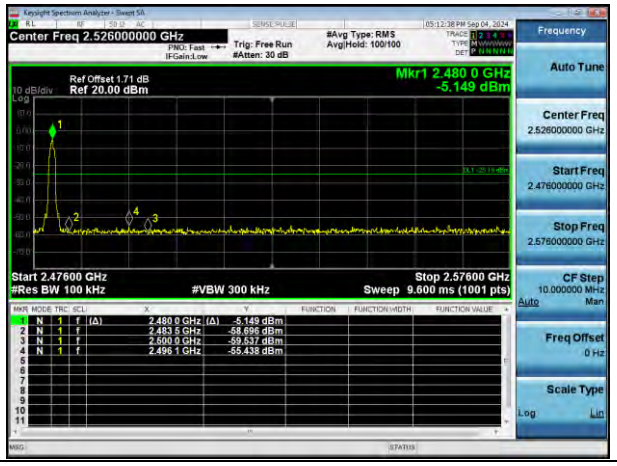
| No-Hopping Pi/4 DQPSK Lowest | |
|---|---|
| Reference Power | Band-edge Emission |
|  |  |

No-Hopping Pi/4 DQPSK Highest

Reference Power

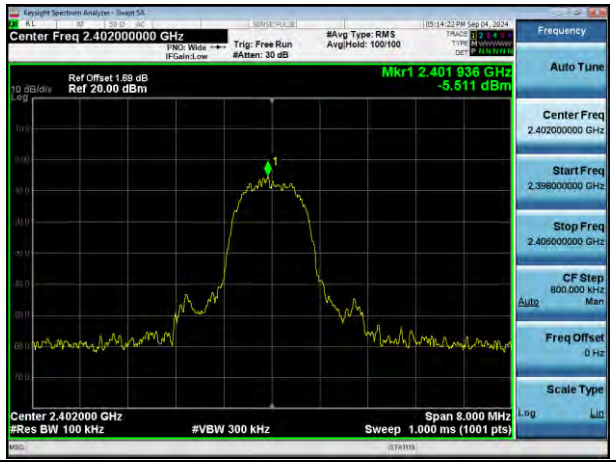



Band-edge Emission

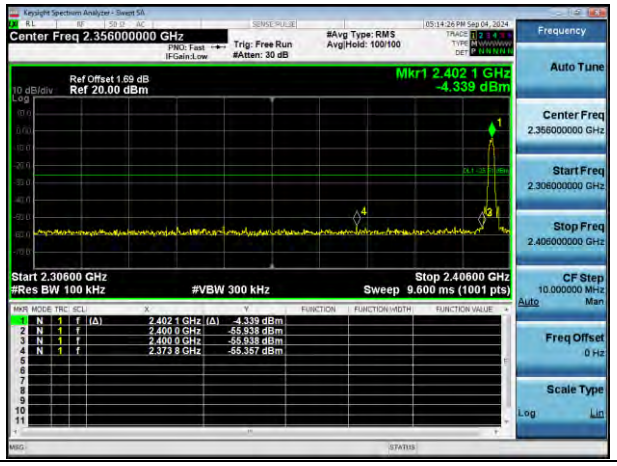



No-Hopping 8DPSK Lowest

Reference Power



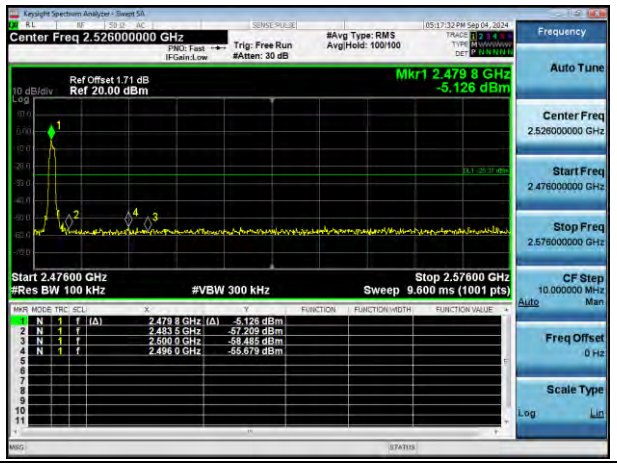

Band-edge Emission

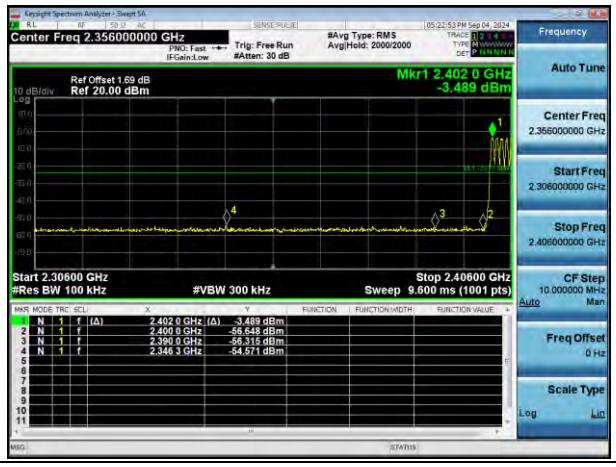


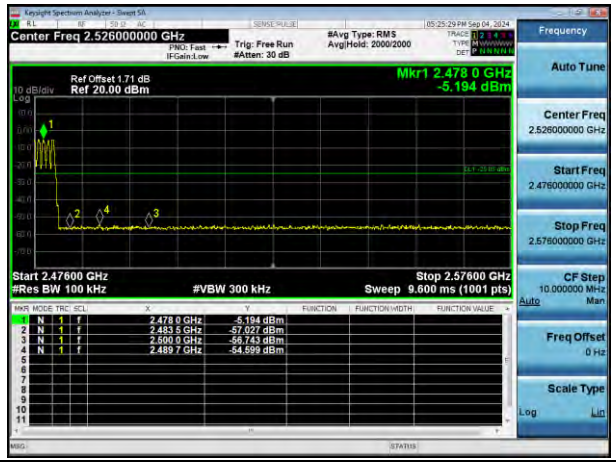

No-Hopping 8DPSK Highest

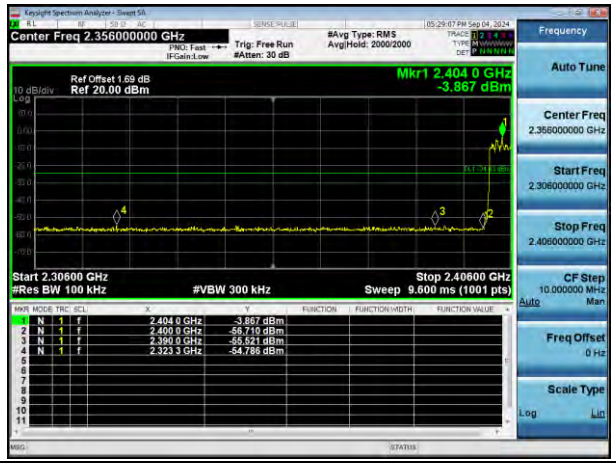
Reference Power

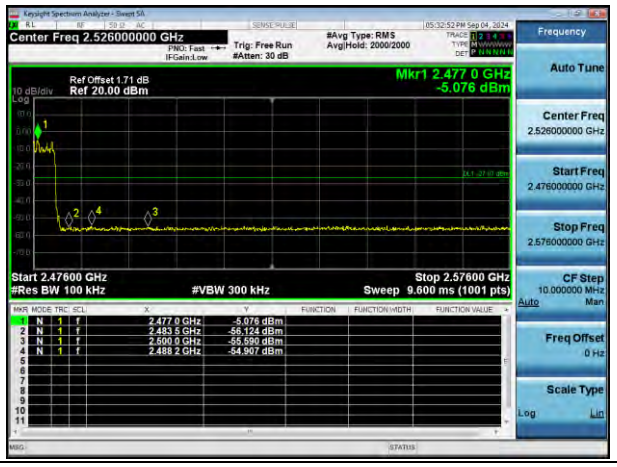
Band-edge Emission

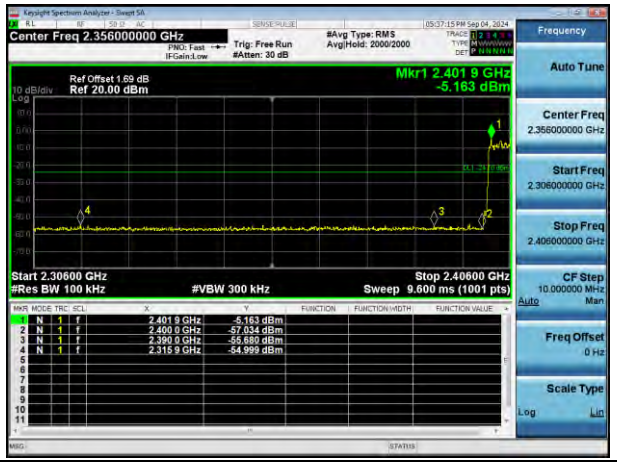


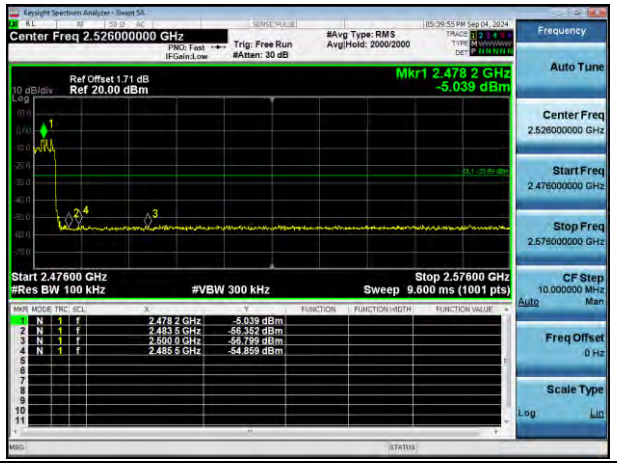
| Hopping GFSK Lowest | |
|---|---|
| Reference Power | Band-edge Emission |
| |  |

| Hopping GFSK Highest | |
|---|---|
| Reference Power | Band-edge Emission |
| |  |

| Hopping Pi/4 DQPSK Lowest | |
|---|---|
| Reference Power | Band-edge Emission |
| |  |

| Hopping Pi/4 DQPSK Highest | |
|---|---|
| Reference Power | Band-edge Emission |
| |  |

| Hopping 8DPSK Lowest | |
|---|---|
| Reference Power | Band-edge Emission |
| |  |

| Hopping 8DPSK Highest | |
|---|---|
| Reference Power | Band-edge Emission |
| |  |

# 14. Conducted RF Spurious Emissions

## 14.1 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)).

## 14.2 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

## 14.3 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.*

GFSK Lowest

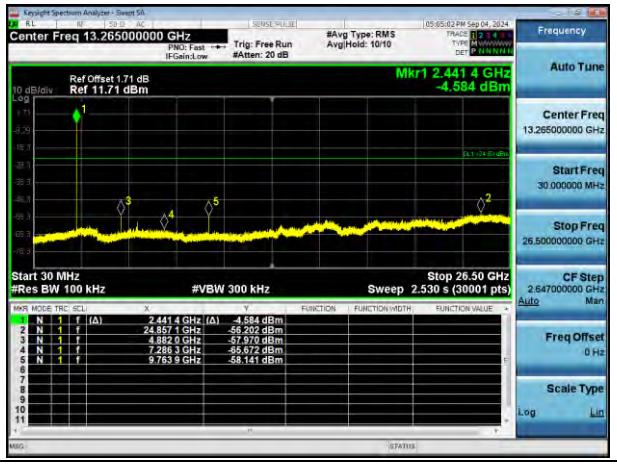
Reference Power

Spurious Emissions

GFSK Middle

Reference Power

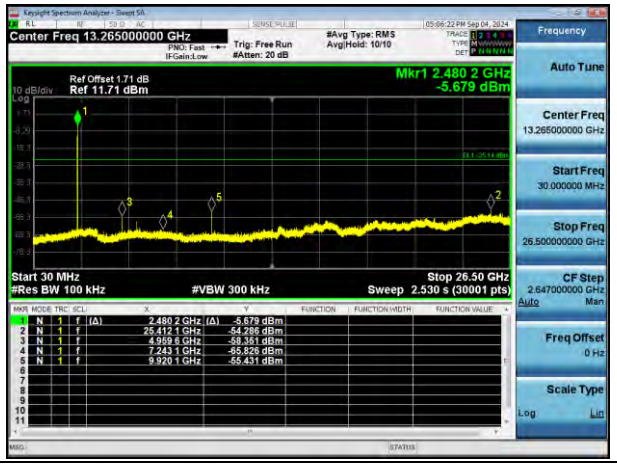
Spurious Emissions



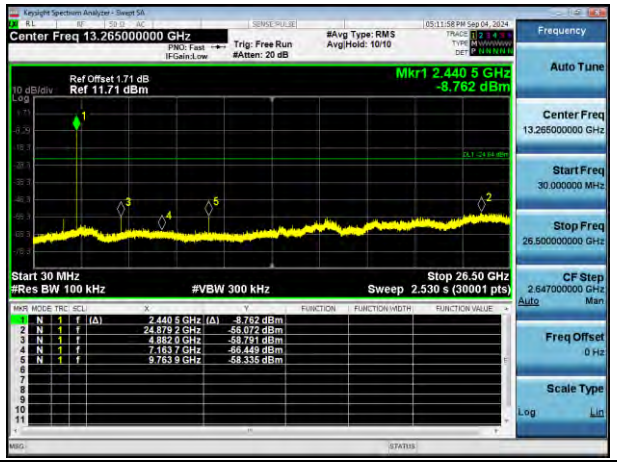

GFSK Highest

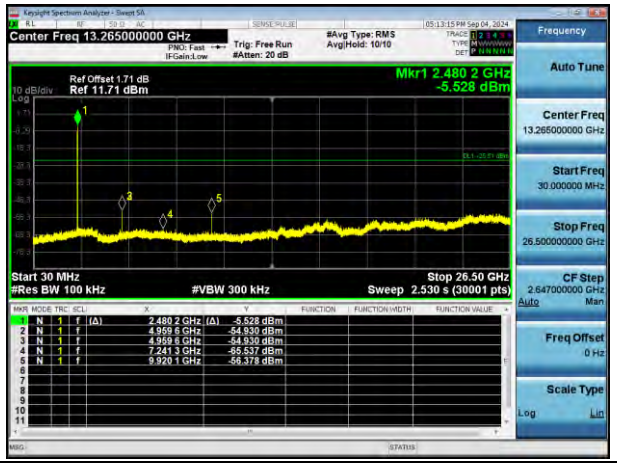
Reference Power

Spurious Emissions



| Pi/4 DQPSK Lowest | |
|---|---|
| Reference Power | Spurious Emissions |
| | |

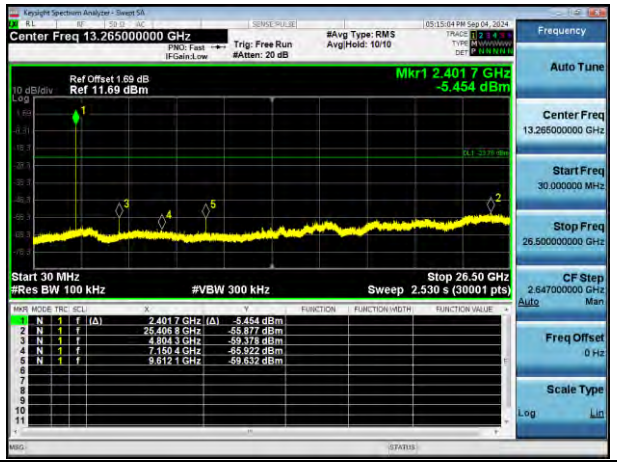
| Pi/4 DQPSK Middle | |
|---|---|
| Reference Power | Spurious Emissions |
| |  |

| Pi/4 DQPSK Highest | |
|---|---|
| Reference Power | Spurious Emissions |
| |  |

8DPSK Lowest

Reference Power

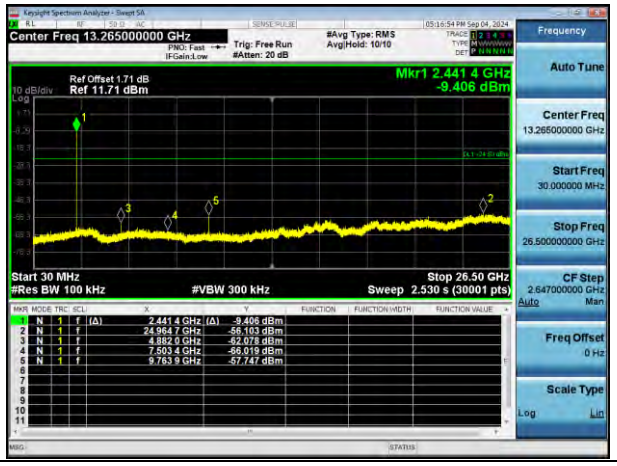
Spurious Emissions




8DPSK Middle

Reference Power

Spurious Emissions




8DPSK Highest

Reference Power

Spurious Emissions

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