# TEST REPORT

| | | |
|---|---|---|
| **Reference No.** ..... | : | WTD18S07118156-1W |
| **FCC ID**..... | : | 2AJMW-MS500B |
| **Applicant** ..... | : | Edco Electronics Inc. |
| **Address** ..... | : | 8484 Avenue de l'Esplanade, Montreal, Quebec H2P 2R7, Canada |
| **Manufacturer** ..... | : | Edco Electronics Inc. |
| **Address** ..... | : | 8484 Avenue de l'Esplanade, Montreal, Quebec H2P 2R7, Canada |
| **Factory**..... | : | Dongguan Yihua Electrical Appliance Company Limited |
| **Address** ..... | : | Nanyu Industrial Park, Nanchang Road, Wangniudun Town, Dongguan City, Guangdong Province, China |
| **Product** ..... | : | Bluetooth CD AM/FM Micro System |
| **Model(s)**..... | : | MS500B, W-M029B |
| **Standards** ..... | : | FCC CFR47 Part 15 Section 15.247:2018 |
| **Date of Receipt sample**.... | : | 2018-07-16 |
| **Date of Test**..... | : | 2018-07-17 to 2018-07-31 |
| **Date of Issue** ..... | : | 2018-08-02 |
| **Test Result** ..... | : | **Pass** |

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.


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# 1 Laboratories Introduction

**Waltek Services (Shenzhen) Co., Ltd** is a professional third-party testing and certification laboratory with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by ILAC (International Laboratory Accreditation Cooperation) member. A2LA (American Association for Laboratory Accreditation) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.

Waltek Services (Shenzhen) Co., Ltd is one of the largest and the most comprehensive third party testing laboratory in China. Our test capability covered four large fields: safety test. ElectroMagnetic Compatibility(EMC), and energy performance, wireless radio. As a professional, comprehensive, justice international test organization, we still keep the scientific and rigorous work attitude to help each client satisfy the international standards and assist their product enter into globe market smoothly.

## 1.1 Test Facility

**A. Accreditations for Conformity Assessment (International)**

| Country/Region | Accreditation Body | Scope | Note |
|---|---|---|---|
| USA | **A2LA (Certificate No.: 4243.01)** | FCC ID \ DOC \ VOC | 1 |
| Canada | | IC ID \ VOC | 2 |
| Japan | | MIC-T \ MIC-R | - |
| Europe | | EMCD \ RED | - |
| Taiwan | | NCC | - |
| Hong Kong | | OFCA | - |
| Australia | | RCM | - |
| India | **International Services** | WPC | - |
| Thailand | | NTC | - |
| Singapore | | IDA | - |

Note:

1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.
2. IC Canada Registration No.: 7760A

**B.TCBs and Notify Bodies Recognized Testing Laboratory.**

| Recognized Testing Laboratory of … | Notify body number |
|---|---|
| TUV Rheinland | Optional. |
| Intertek | |
| TUV SUD | |
| SGS | |
| Phoenix Testlab GmbH | 0700 |
| Element Materials Technology Warwick Ltd | 0891 |
| Timco Engineering, Inc. | 1177 |
| Eurofins Product Service GmbH | 0681 |

# 2 Contents

**Page**


**COVER PAGE** ..... **1**

**1 LABORATORIES INTRODUCTION** ..... **2**

**1.1 TEST FACILITY** ..... 3

**2 CONTENTS** ..... **4**

**3 REVISION HISTORY** ..... **6**

**4 GENERAL INFORMATION** ..... **7**

4.1 GENERAL DESCRIPTION OF E.U.T ..... 7
4.2 DETAILS OF E.U.T ..... 8
4.3 CHANNEL LIST ..... 8
4.4 TEST MODE ..... 8

**5 EQUIPMENT USED DURING TEST** ..... **9**

5.1 EQUIPMENTS LIST ..... 9
5.2 MEASUREMENT UNCERTAINTY ..... 10
5.3 SUBCONTRACTED ..... 10

**6 TEST SUMMARY** ..... **11**

**7 CONDUCTED EMISSION** ..... **12**

7.1 E.U.T. OPERATION ..... 12
7.2 EUT SETUP ..... 12
7.3 MEASUREMENT DESCRIPTION ..... 13
7.4 CONDUCTED EMISSION TEST RESULT ..... 13

**8 RADIATED EMISSIONS** ..... **15**

8.1 EUT OPERATION ..... 15
8.2 TEST SETUP ..... 16
8.3 SPECTRUM ANALYZER SETUP ..... 17
8.4 TEST PROCEDURE ..... 18
8.5 CORRECTED AMPLITUDE & MARGIN CALCULATION ..... 18
8.6 SUMMARY OF TEST RESULTS ..... 19

**9 BAND EDGE MEASUREMENT** ..... **22**

9.1 TEST PROCEDURE ..... 22
9.2 TEST SETUP ..... 22
9.3 TEST RESULT: ..... 23

**10 BANDWIDTH MEASUREMENT** ..... **29**

10.1 TEST PROCEDURE: ..... 29
10.2 TEST SETUP ..... 29
10.3 TEST RESULT: ..... 29

**11 MAXIMUM PEAK OUTPUT POWER** ..... **35**

11.1 TEST PROCEDURE: ..... 35
11.2 TEST SETUP ..... 35
11.3 TEST RESULT: ..... 35

**12 HOPPING CHANNEL SEPARATION** ..... **41**

12.1 TEST PROCEDURE: ..... 41
12.2 TEST SETUP ..... 41
12.3 TEST RESULT: ..... 42

**13 NUMBER OF HOPPING FREQUENCY ..... 47**
13.1 TEST PROCEDURE: ..... 47
13.2 TEST SETUP ..... 47
13.3 TEST RESULT: ..... 48
**14 DWELL TIME ..... 50**
14.1 TEST PROCEDURE: ..... 50
14.2 TEST SETUP ..... 50
14.3 TEST RESULT: ..... 50
**15 ANTENNA REQUIREMENT ..... 56**
**16 FCC ID: 2AJMW-MS500B RF EXPOSURE REPORT ..... 57**
**17 PHOTOGRAPHS - MODEL MS500B TEST SETUP PHOTOS ..... 57**
**18 PHOTOGRAPHS - CONSTRUCTIONAL DETAILS ..... 57**
18.1 MODEL MS500B - EXTERNAL PHOTOS ..... 57
18.2 MODEL MS500B - INTERNAL PHOTOS ..... 57

# 3 Revision History

| Test report No. | Date of Receipt sample | Date of Test | Date of Issue | Purpose | Comment | Approved |
|---|---|---|---|---|---|---|
| WTD18S07118156-1W | 2018-07-16 | 2018-07-17 to 2018-07-31 | 2018-08-02 | original | - | Valid |

# 4 General Information

## 4.1 General Description of E.U.T

| | |
|---|---|
| **Product** | : Bluetooth CD AM/FM Micro System |
| **Model(s)** | : MS500B, W-M029B |
| **Model difference** | : Only the model name is different. The model MS500B is the tested sample. |
| **Operation Frequency** | : 2402-2480MHz, 79(EDR) Channels in total |
| **Antenna installation** | : PCB Printed Antenna |
| **Antenna Gain** | : 0dBi |
| **Type of Modulation** | : GFSK, π/4DQPSK, 8DPSK |

**Frequency hopping systems (FHS):**

This transmitter device is frequency hopping device, and complies with FCC Part15.247 Requirements.

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 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. The average time of occupancy on any channel is less than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels（79 channels）employed.

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 FCC Part15.247.

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 19, 56, 40, 18, 50, 09, 02, 23, 32, 41, 33, 31, 65, 73, 53, 69, 06, 22, 67, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 17, 60, 63, 54, 03, 00, 59, 64, 75, 35, 66, 43, 15, 45, 39, 77, 55, 71, 47, 61, 27, 30, 48, 72, 01, 14, 07, 25, 34, 12, 28, 44, 51, 16, 49, 74, 11, 05, 13, 37 , 62 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.

## 4.2 Details of E.U.T

**Ratings** AC 120V 60Hz 18W
DC 1.5V x 2 “AAA” Size Battery

## 4.3 Channel List

| Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) |
|---|---|---|---|---|---|---|---|
| 1 | 2402 | 2 | 2403 | 3 | 2404 | 4 | 2405 |
| 5 | 2406 | 6 | 2407 | 7 | 2408 | 8 | 2409 |
| 9 | 2410 | 10 | 2411 | 11 | 2412 | 12 | 2413 |
| 13 | 2414 | 14 | 2415 | 15 | 2416 | 16 | 2417 |
| 17 | 2418 | 18 | 2419 | 19 | 2420 | 20 | 2421 |
| 21 | 2422 | 22 | 2423 | 23 | 2424 | 24 | 2425 |
| 25 | 2426 | 26 | 2427 | 27 | 2428 | 28 | 2429 |
| 29 | 2430 | 30 | 2431 | 31 | 2432 | 32 | 2433 |
| 33 | 2434 | 34 | 2435 | 35 | 2436 | 36 | 2437 |
| 37 | 2438 | 38 | 2439 | 39 | 2440 | 40 | 2441 |
| 41 | 2442 | 42 | 2443 | 43 | 2444 | 44 | 2445 |
| 45 | 2446 | 46 | 2447 | 47 | 2448 | 48 | 2449 |
| 49 | 2450 | 50 | 2451 | 51 | 2452 | 52 | 2453 |
| 53 | 2454 | 54 | 2455 | 55 | 2456 | 56 | 2457 |
| 57 | 2458 | 58 | 2459 | 59 | 2460 | 60 | 2461 |
| 61 | 2462 | 62 | 2463 | 63 | 2464 | 64 | 2465 |
| 65 | 2466 | 66 | 2467 | 67 | 2468 | 68 | 2469 |
| 69 | 2470 | 70 | 2471 | 71 | 2472 | 72 | 2473 |
| 73 | 2474 | 74 | 2475 | 75 | 2476 | 76 | 2477 |
| 77 | 2478 | 78 | 2479 | 79 | 2480 | - | - |

## 4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

| Test mode | Low channel | Middle channel | High channel |
|---|---|---|---|
| Transmitting | 2402MHz | 2441MHz | 2480MHz |

Note: The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

# 5 Equipment Used during Test

## 5.1 Equipments List

| Conducted Emissions | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1. | EMI Test Receiver | R&S | ESCI | 101155 | 2017-09-12 | 2018-09-11 |
| 2. | LISN | SCHWARZBECK | NSLK 8128 | 8128-259 | 2017-09-12 | 2018-09-11 |
| 3. | Limiter | CYBERTEK | EM5010 | 261115-001-0024 | 2017-09-12 | 2018-09-11 |
| 4 | Cable | Laplace | RF300 | - | 2017-09-12 | 2018-09-11 |
| **3m Semi-anechoic Chamber for Radiation Emissions** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1 | Spectrum Analyzer | R&S | FSP30 | 100091 | 2018-04-29 | 2019-04-28 |
| 2 | Broad-band Horn Antenna(1-18GHz) | SCHWARZBECK | BBHA 9120 D | 667 | 2018-04-29 | 2019-04-28 |
| 3 | Broadband Preamplifier | COMPLIANCE DIRECTION | PAP-1G18 | 2004 | 2018-04-29 | 2019-04-28 |
| 4 | Coaxial Cable (above 1GHz) | Top | 1GHz-18GHz | EW02014-7 | 2018-04-29 | 2019-04-28 |
| 5 | Spectrum Analyzer | R&S | FSP40 | 100501 | 2017-10-20 | 2018-10-19 |
| 6 | Broad-band Horn Antenna(18-40GHz) | SCHWARZBECK | BBHA 9170 | BBHA9170651 | 2017-10-25 | 2018-10-24 |
| 7 | Microwave Broadband Preamplifier (18-40GHz) | SCHWARZBECK | BBV 9721 | 100472 | 2017-10-25 | 2018-10-24 |
| 8 | Cable | Top | 18-40GHz | - | 2017-10-25 | 2018-10-24 |
| **3m Semi-anechoic Chamber for Radiation Emissions** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No** | **Last Calibration Date** | **Calibration Due Date** |
| 1 | Test Receiver | R&S | ESCI | 101296 | 2018-04-29 | 2019-04-28 |
| 2 | Trilog Broadband Antenna | SCHWARZBECK | VULB9160 | 9160-3325 | 2018-04-29 | 2019-04-28 |
| 3 | Active Loop Antenna | Com-power | AL-130R | 10160007 | 2018-04-17 | 2019-04-16 |
| 4 | Amplifier | ANRITSU | MH648A | M43381 | 2018-04-29 | 2019-04-28 |
| 5 | Cable | HUBER+SUHNER | CBL2 | 525178 | 2018-04-29 | 2019-04-28 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Coaxial Cable (below 1GHz) | Top | TYPE16 (13M) | - | 2017-09-12 | 2018-09-11 |
| **RF Conducted Testing** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1. | Spectrum Analyzer | R&S | FSL6 | 100959 | 2017-09-12 | 2018-09-11 |
| 2 | Coaxial Cable | Top | 10Hz-30GHz | - | 2017-09-12 | 2018-09-11 |
| 3 | Antenna Connector* | Realacc | 45RSm | - | 2017-09-12 | 2018-09-11 |
| 4 | DC Block | Gwave | GDCB-3G-N-SMA | 140307001 | 2017-09-12 | 2018-09-11 |
| "*": The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list. | | | | | | |

## 5.2 Measurement Uncertainty

| Parameter | Uncertainty |
|---|---|
| Radio Frequency | ± 1 x $10^{-6}$ |
| RF Power | ± 1.0 dB |
| RF Power Density | ± 2.2 dB |
| Radiated Spurious Emissions test | ± 5.03 dB (30M~1000MHz) |
| | ± 5.47 dB (1000M~25000MHz) |
| Conducted Emissions test | ± 3.64 dB (AC mains 150KHz~30MHz) |
| Confidence interval：95%. Confidence factor:k=2 | |

## 5.3 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

Test items: N/A

# 6 Test Summary

| Test Items | Test Requirement | Result |
|---|---|---|
| Conduct Emission | 15.207 | Pass |
| Radiated Spurious Emissions | 15.205(a)<br>15.209<br>15.247(d) | Pass |
| Band edge | 15.247(d)<br>15.205(a) | Pass |
| Bandwidth | 15.247(a)(1) | Pass |
| Maximum Peak Output Power | 15.247(b)(1) | Pass |
| Frequency Separation | 15.247(a)(1) | Pass |
| Number of Hopping Frequency | 15.247(a)(1)(iii) | Pass |
| Dwell time | 15.247(a)(1)(iii) | Pass |
| RF exposure | 1.1307(b)(1) | Pass |
| Antenna Requirement | 15.203 | Pass |
| RF Exposure | 1.1307(b)(1) | Pass |
| Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable. | | |

# 7 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

| Frequency (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.5 | 66 to 56* | 56 to 46* |
| 0.5 to 5.0 | 56 | 46 |
| 5.0 to 30 | 60 | 50 |
| *Decreases with the logarithm of the frequency. | | |

## 7.1 E.U.T. Operation

Operating Environment **:**

Temperature: 22.8 °C

Humidity: 52.6 % RH

Atmospheric Pressure: 101.2kPa

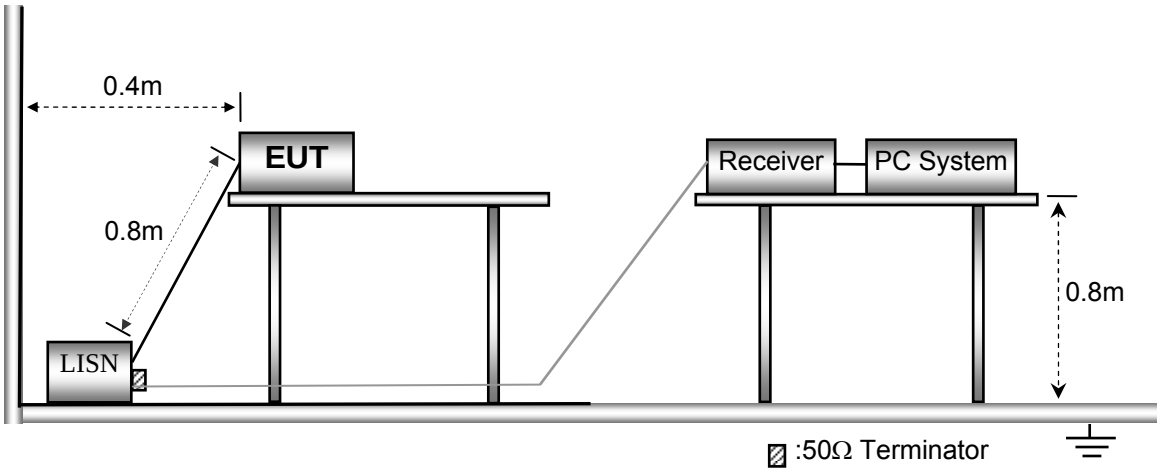
Test Voltage: AC 120V, 60Hz

EUT Operation **:**

The test was performed in Transmitting mode, the worst test data (GFSK modulation Low channel) were shown in the report.

## 7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



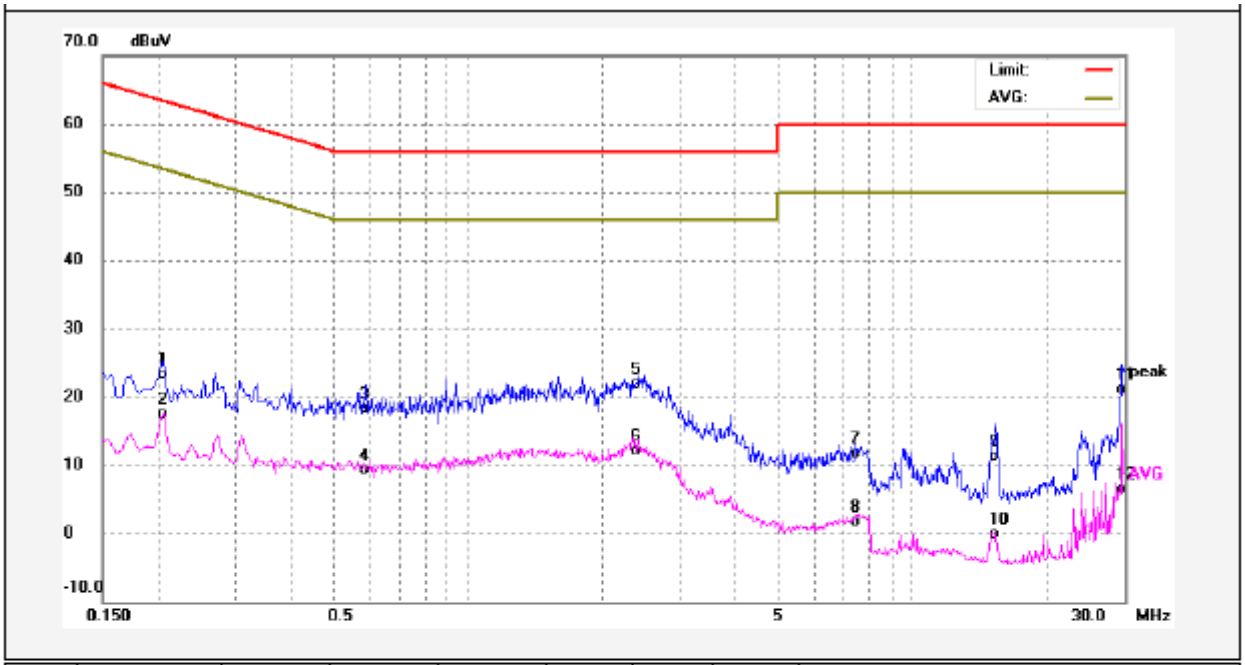
## 7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

## 7.4 Conducted Emission Test Result

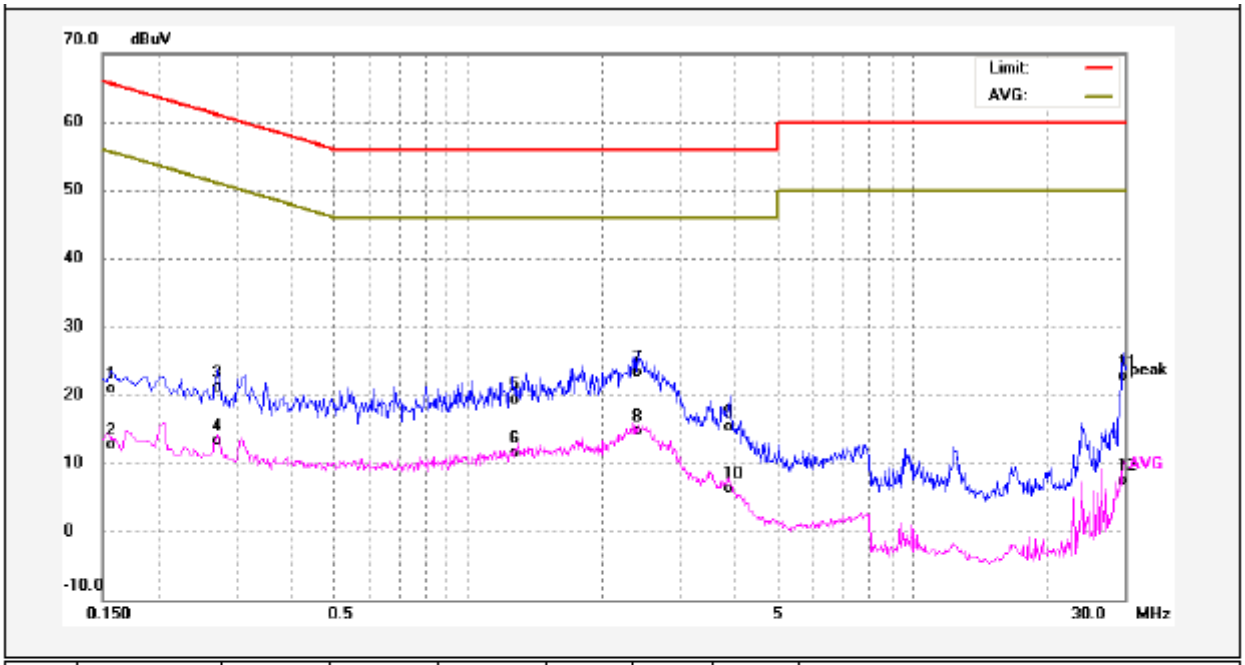
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Margin (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.2060 | 12.92 | 10.33 | 23.25 | 63.36 | -40.11 | QP | |
| 2 | 0.2060 | 7.08 | 10.33 | 17.41 | 53.36 | -35.95 | AVG | |
| 3 | 0.5899 | 7.77 | 10.48 | 18.25 | 56.00 | -37.75 | QP | |
| 4 | 0.5899 | -1.20 | 10.48 | 9.28 | 46.00 | -36.72 | AVG | |
| 5 | 2.4340 | 11.19 | 10.65 | 21.84 | 56.00 | -34.16 | QP | |
| 6 | 2.4340 | 1.43 | 10.65 | 12.08 | 46.00 | -33.92 | AVG | |
| 7 | 7.4620 | 0.61 | 11.04 | 11.65 | 60.00 | -48.35 | QP | |
| 8 | 7.4620 | -9.33 | 11.04 | 1.71 | 50.00 | -48.29 | AVG | |
| 9 | 15.4220 | 0.38 | 10.87 | 11.25 | 60.00 | -48.75 | QP | |
| 10 | 15.4220 | -10.87 | 10.87 | 0.00 | 50.00 | -50.00 | AVG | |
| 11 | 29.5900 | 10.74 | 10.29 | 21.03 | 60.00 | -38.97 | QP | |
| 12 | 29.5900 | -3.87 | 10.29 | 6.42 | 50.00 | -43.58 | AVG | |

Neutral line:




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Margin (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1580 | 10.60 | 10.27 | 20.87 | 65.56 | -44.69 | QP | |
| 2 | 0.1580 | 2.39 | 10.27 | 12.66 | 55.56 | -42.90 | AVG | |
| 3 | 0.2740 | 10.63 | 10.40 | 21.03 | 60.99 | -39.96 | QP | |
| 4 | 0.2740 | 2.84 | 10.40 | 13.24 | 50.99 | -37.75 | AVG | |
| 5 | 1.2579 | 8.78 | 10.45 | 19.23 | 56.00 | -36.77 | QP | |
| 6 | 1.2579 | 1.07 | 10.45 | 11.52 | 46.00 | -34.48 | AVG | |
| 7 | 2.4020 | 12.61 | 10.64 | 23.25 | 56.00 | -32.75 | QP | |
| 8 | 2.4020 | 4.01 | 10.64 | 14.65 | 46.00 | -31.35 | AVG | |
| 9 | 3.8860 | 4.59 | 10.77 | 15.36 | 56.00 | -40.64 | QP | |
| 10 | 3.8860 | -4.54 | 10.77 | 6.23 | 46.00 | -39.77 | AVG | |
| 11 | 29.7740 | 12.37 | 10.28 | 22.65 | 60.00 | -37.35 | QP | |
| 12 | 29.7740 | -2.83 | 10.28 | 7.45 | 50.00 | -42.55 | AVG | |

# 8 Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

| Frequency (MHz) | Field Strength | | Field Strength Limit at 3m Measurement Dist | |
|---|---|---|---|---|
| | uV/m | Distance (m) | uV/m | dBuV/m |
| 0.009 ~ 0.490 | 2400/F(kHz) | 300 | 10000 * 2400/F(kHz) | $20\log^{(2400/F(kHz))} + 80$ |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 | 100 * 24000/F(kHz) | $20\log^{(24000/F(kHz))} + 40$ |
| 1.705 ~ 30 | 30 | 30 | 100 * 30 | $20\log^{(30)} + 40$ |
| 30 ~ 88 | 100 | 3 | 100 | $20\log^{(100)}$ |
| 88 ~ 216 | 150 | 3 | 150 | $20\log^{(150)}$ |
| 216 ~ 960 | 200 | 3 | 200 | $20\log^{(200)}$ |
| Above 960 | 500 | 3 | 500 | $20\log^{(500)}$ |

## 8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 52.1 % RH

Atmospheric Pressure: 101.2kPa

Test Voltage: AC 120V, 60Hz

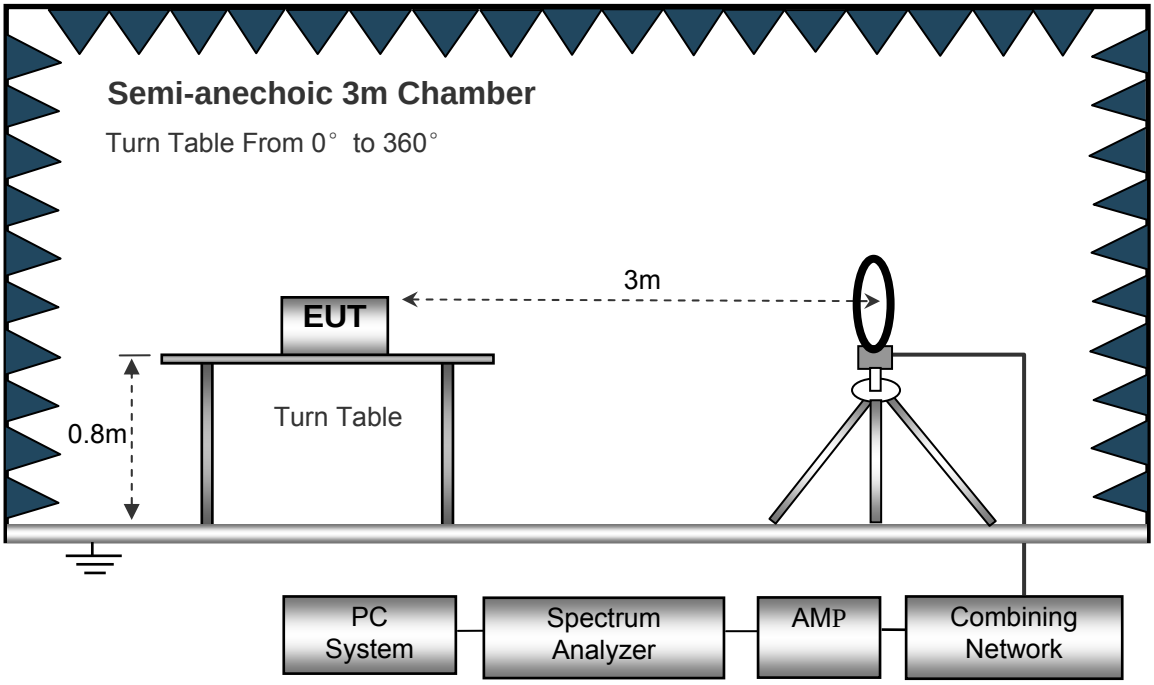
EUT Operation **:**

The test was performed in Transmitting mode, the worst test data (GFSK modulation) were shown in the report.

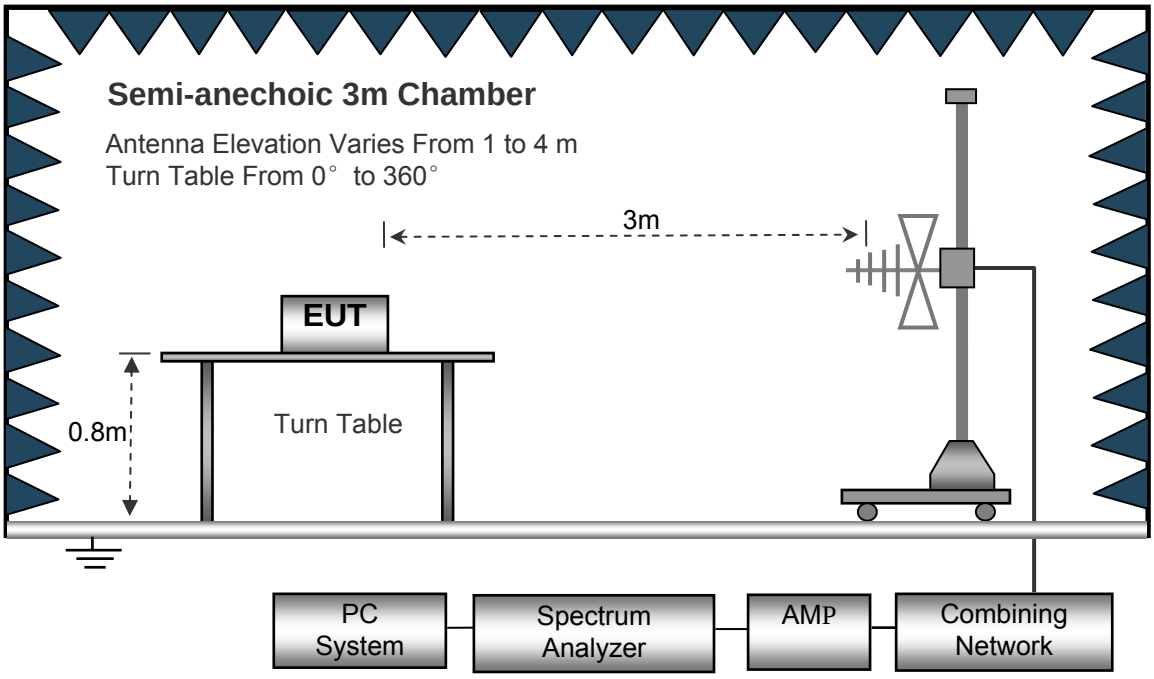
## 8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

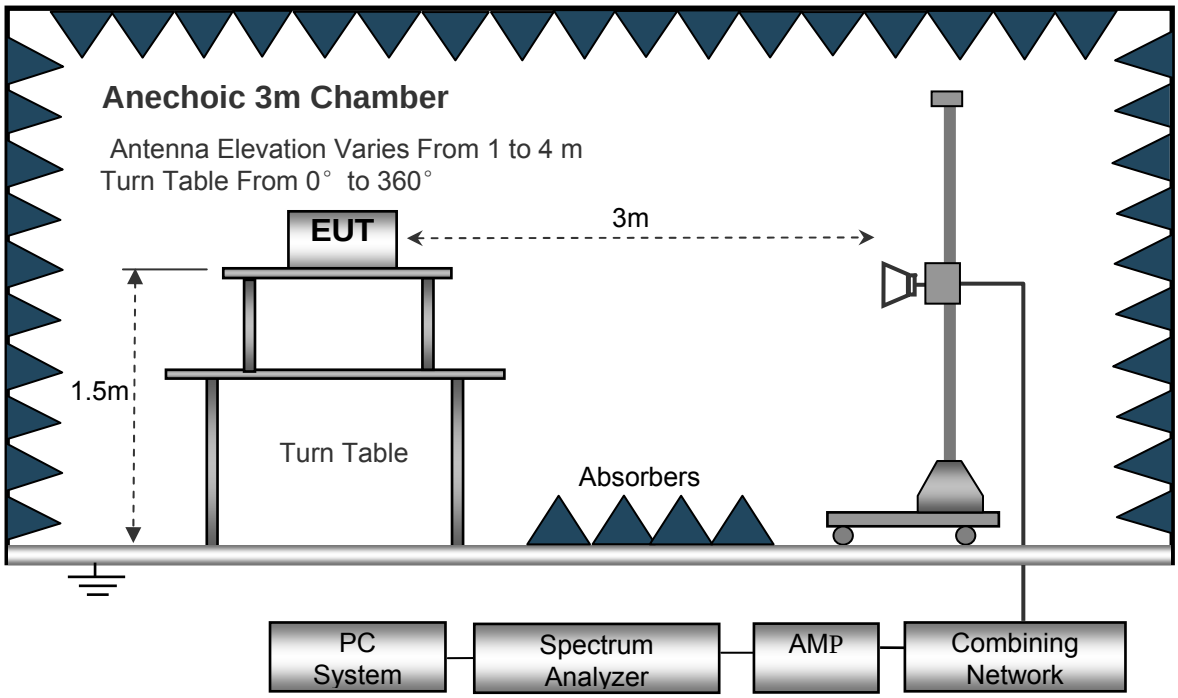
The test setup for emission measurement below 30MHz.




The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.




## 8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector ..... Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

## 8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X, Y, Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.
8. For the radiated emission test above 1GHz:

   Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

## 8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

## 8.6 Summary of Test Results

**Test Frequency: 9 kHz ~ 30 MHz**

The measurements were more than 20 dB below the limit and not reported.

**Test Frequency: 30 MHz ~ 18 GHz**

Only the worst case GFSK mode were record in the report.

| Frequency | Receiver Reading | Detector | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude | FCC Part 15.247/209/205 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Height | Polar | | | Limit | Margin |
| (MHz) | (dBμV) | (PK/QP/Ave) | Degree | (m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK Low Channel 2402MHz | | | | | | | | | |
| 670.49 | 35.61 | QP | 358 | 1.4 | H | -6.79 | 28.82 | 46.00 | -17.18 |
| 670.49 | 41.77 | QP | 67 | 1.6 | V | -6.79 | 34.98 | 46.00 | -11.02 |
| 4804.00 | 49.87 | PK | 8 | 1.5 | V | -1.06 | 48.81 | 74.00 | -25.19 |
| 4804.00 | 42.15 | Ave | 8 | 1.5 | V | -1.06 | 41.09 | 54.00 | -12.91 |
| 7206.00 | 40.62 | PK | 253 | 1.7 | H | 1.33 | 41.95 | 74.00 | -32.05 |
| 7206.00 | 35.37 | Ave | 253 | 1.7 | H | 1.33 | 36.70 | 54.00 | -17.30 |
| 2320.68 | 45.46 | PK | 50 | 1.6 | V | -13.19 | 32.27 | 74.00 | -41.73 |
| 2320.68 | 37.83 | Ave | 50 | 1.6 | V | -13.19 | 24.64 | 54.00 | -29.36 |
| 2362.87 | 43.84 | PK | 54 | 1.8 | H | -13.14 | 30.70 | 74.00 | -43.30 |
| 2362.87 | 36.71 | Ave | 54 | 1.8 | H | -13.14 | 23.57 | 54.00 | -30.43 |
| 2499.24 | 44.89 | PK | 219 | 1.9 | V | -13.08 | 31.81 | 74.00 | -42.19 |
| 2499.24 | 36.97 | Ave | 219 | 1.9 | V | -13.08 | 23.89 | 54.00 | -30.11 |

| Frequency | Receiver Reading | Detector | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude | FCC Part 15.247/209/205 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Height | Polar | | | Limit | Margin |
| (MHz) | (dBμV) | (PK/QP/Ave) | Degree | (m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK Middle Channel 2441MHz | | | | | | | | | |
| 670.49 | 35.35 | QP | 278 | 1.8 | H | -6.79 | 28.56 | 46.00 | -17.44 |
| 670.49 | 41.09 | QP | 271 | 1.5 | V | -6.79 | 34.30 | 46.00 | -11.70 |
| 4882.00 | 50.02 | PK | 126 | 1.1 | V | -0.62 | 49.40 | 74.00 | -24.60 |
| 4882.00 | 40.81 | Ave | 126 | 1.1 | V | -0.62 | 40.19 | 54.00 | -13.81 |
| 7323.00 | 41.18 | PK | 277 | 1.5 | H | 2.21 | 43.39 | 74.00 | -30.61 |
| 7323.00 | 35.60 | Ave | 277 | 1.5 | H | 2.21 | 37.81 | 54.00 | -16.19 |
| 2314.26 | 46.58 | PK | 357 | 1.5 | V | -13.19 | 33.39 | 74.00 | -40.61 |
| 2314.26 | 37.59 | Ave | 357 | 1.5 | V | -13.19 | 24.40 | 54.00 | -29.60 |
| 2380.12 | 44.24 | PK | 185 | 1.4 | H | -13.14 | 31.10 | 74.00 | -42.90 |
| 2380.12 | 36.35 | Ave | 185 | 1.4 | H | -13.14 | 23.21 | 54.00 | -30.79 |
| 2484.19 | 43.49 | PK | 177 | 2.0 | V | -13.08 | 30.41 | 74.00 | -43.59 |
| 2484.19 | 37.23 | Ave | 177 | 2.0 | V | -13.08 | 24.15 | 54.00 | -29.85 |

| Frequency | Receiver Reading | Detector | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude | FCC Part 15.247/209/205 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Height | Polar | | | Limit | Margin |
| (MHz) | (dBμV) | (PK/QP/Ave) | Degree | (m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK High Channel 2480MHz | | | | | | | | | |
| 670.49 | 35.73 | QP | 63 | 1.4 | H | -6.79 | 28.94 | 46.00 | -17.06 |
| 670.49 | 41.51 | QP | 314 | 1.4 | V | -6.79 | 34.72 | 46.00 | -11.28 |
| 4960.00 | 49.89 | PK | 216 | 1.0 | V | -0.24 | 49.65 | 74.00 | -24.35 |
| 4960.00 | 41.13 | Ave | 216 | 1.0 | V | -0.24 | 40.89 | 54.00 | -13.11 |
| 7440.00 | 42.16 | PK | 330 | 1.1 | H | 2.84 | 45.00 | 74.00 | -29.00 |
| 7440.00 | 36.60 | Ave | 330 | 1.1 | H | 2.84 | 39.44 | 54.00 | -14.56 |
| 2331.27 | 46.34 | PK | 355 | 1.9 | V | -13.19 | 33.15 | 74.00 | -40.85 |
| 2331.27 | 37.94 | Ave | 355 | 1.9 | V | -13.19 | 24.75 | 54.00 | -29.25 |
| 2367.95 | 44.03 | PK | 333 | 1.7 | H | -13.14 | 30.89 | 74.00 | -43.11 |
| 2367.95 | 37.89 | Ave | 333 | 1.7 | H | -13.14 | 24.75 | 54.00 | -29.25 |
| 2492.03 | 42.86 | PK | 210 | 1.4 | V | -13.08 | 29.78 | 74.00 | -44.22 |
| 2492.03 | 38.12 | Ave | 210 | 1.4 | V | -13.08 | 25.04 | 54.00 | -28.96 |

**Test Frequency: 18GHz~25GHz**

The measurements were more than 20 dB below the limit and not reported.

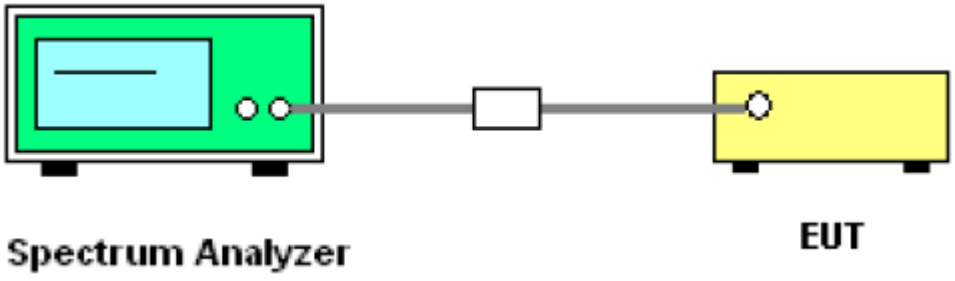
# 9 Band Edge Measurement

| | |
|---|---|
| Test Requirement: | Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)). |
| Test Method: | ANSI C63.10:2013 |
| Test Limit: | Regulation 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)). |
| Test Mode: | Transmitting |

## 9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
   Detector function = peak, Trace = max hold

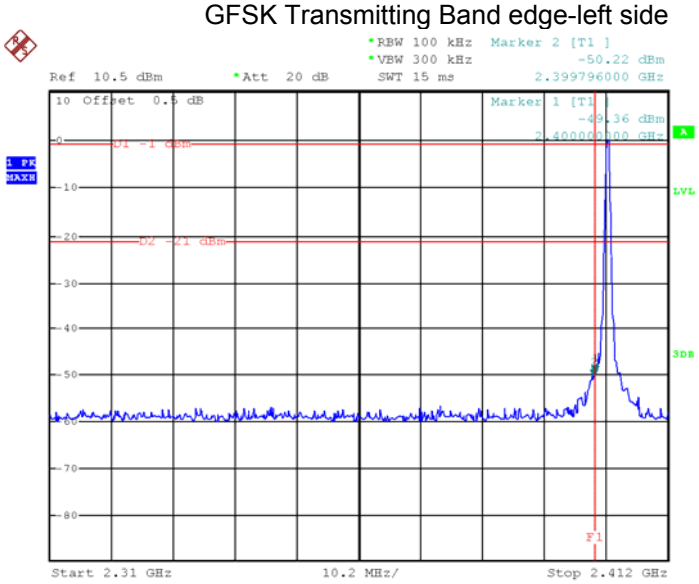
## 9.2 Test Setup



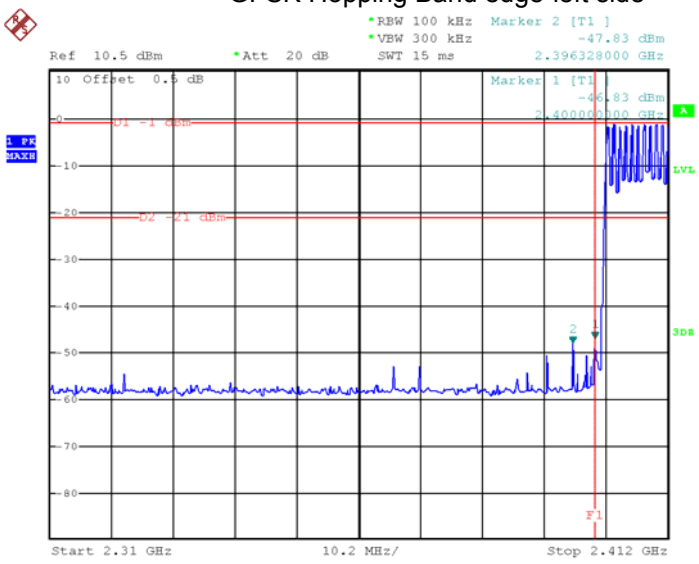
## 9.3 Test Result:

Test plots

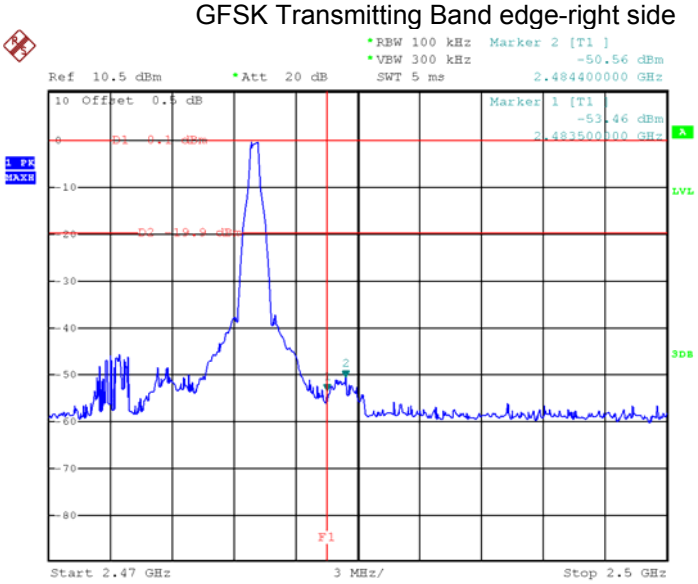
GFSK Transmitting Band edge-left side



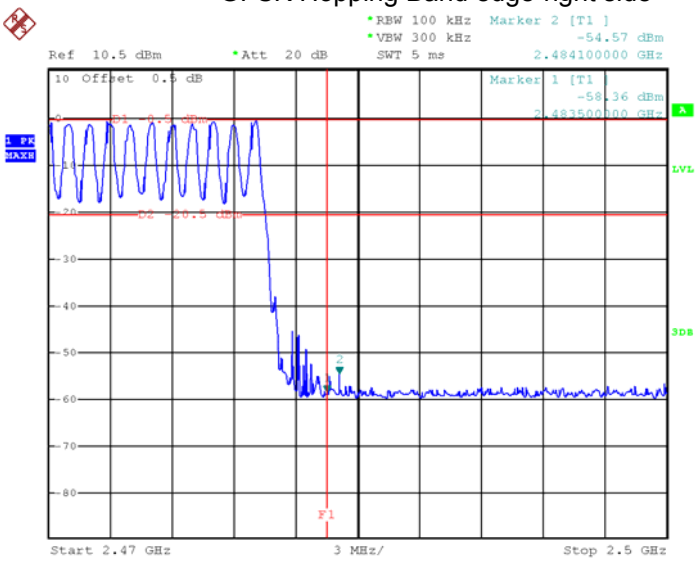

GFSK Hopping Band edge-left side



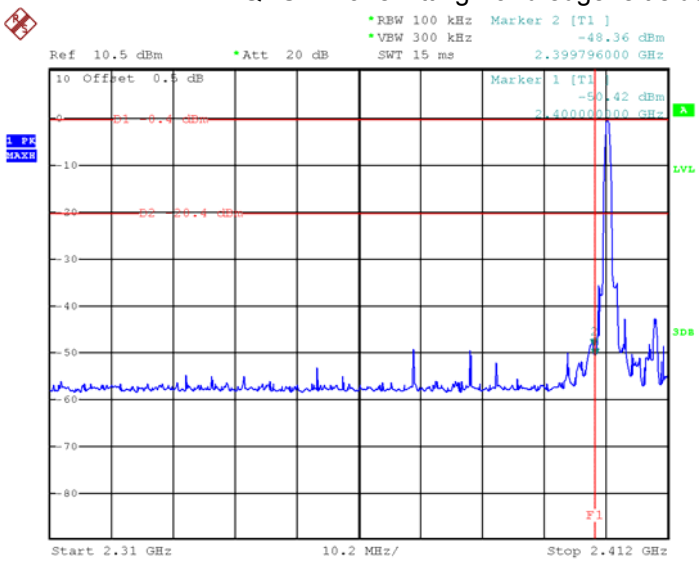
GFSK Transmitting Band edge-right side



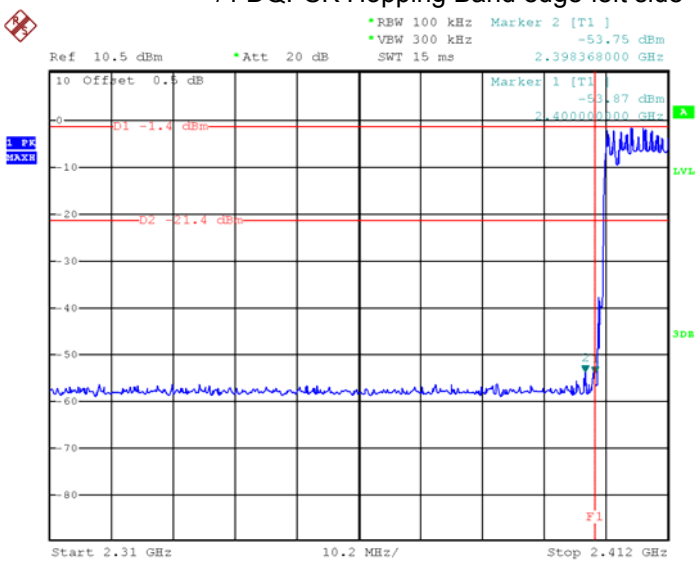

GFSK Hopping Band edge-right side



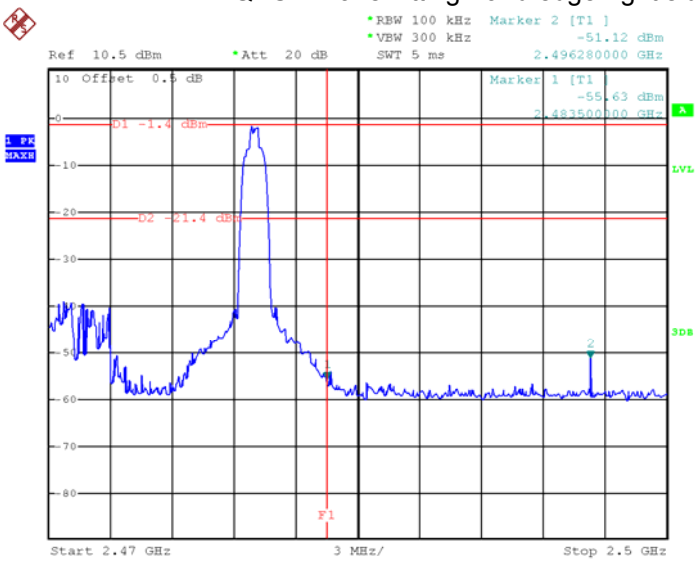
π /4 DQPSK Transmitting Band edge-left side



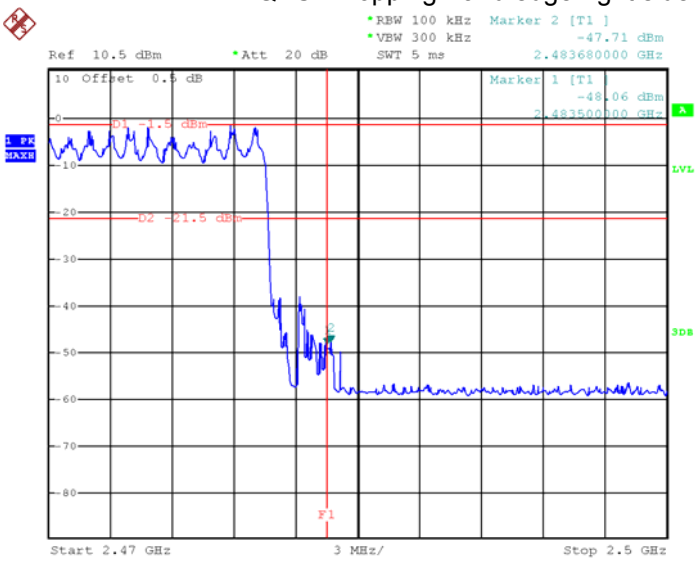

π /4 DQPSK Hopping Band edge-left side



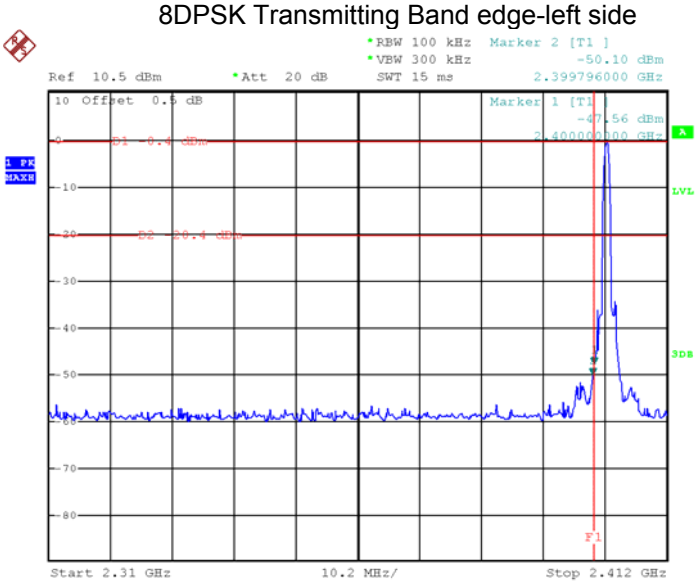
π /4 DQPSK Transmitting Band edge-right side



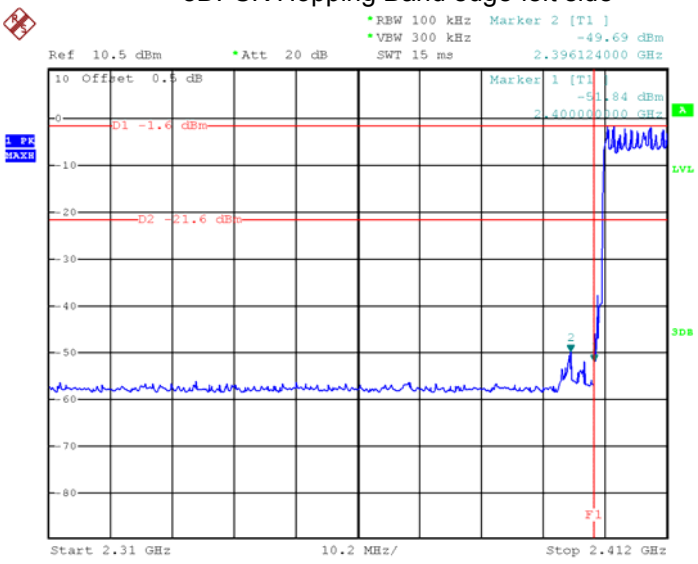

π /4 DQPSK Hopping Band edge-right side



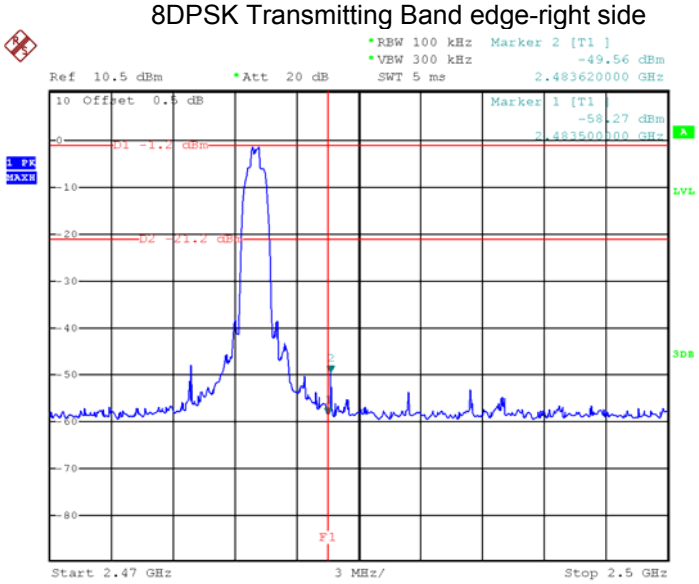
8DPSK Transmitting Band edge-left side



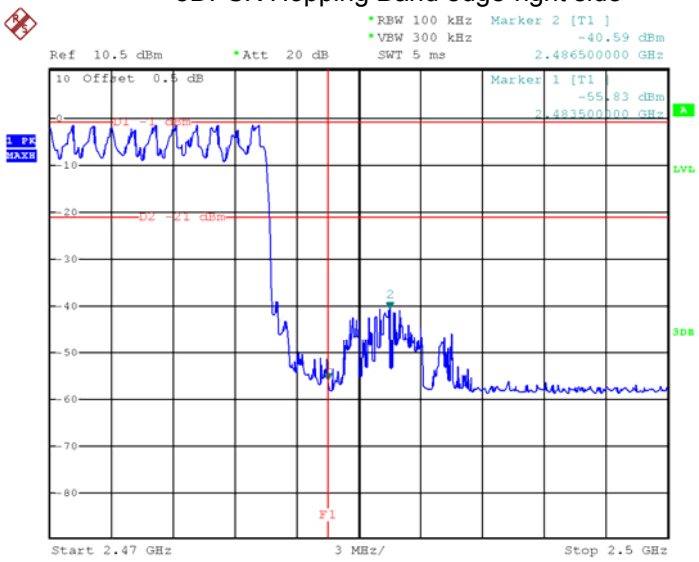

8DPSK Hopping Band edge-left side



8DPSK Transmitting Band edge-right side




8DPSK Hopping Band edge-right side



# 10 Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: C63.10: 2013

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

## 10.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

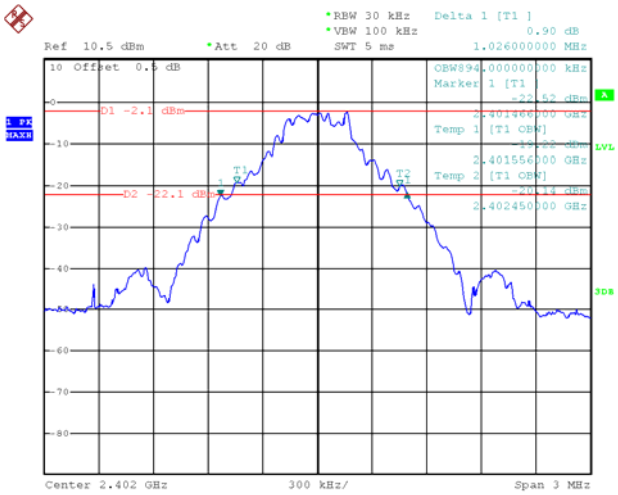
## 10.2 Test Setup

## 10.3 Test Result:

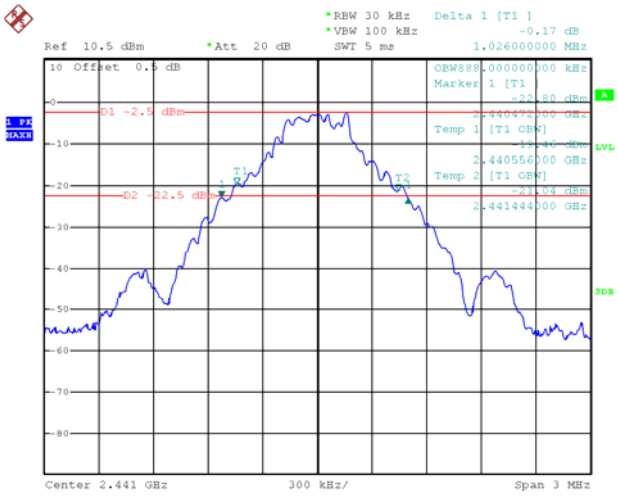
| Modulation | Test Channel | 20 dB Bandwidth | 99% Bandwidth |
|---|---|---|---|
| GFSK | Low | 1.026MHz | 0.894MHz |
| GFSK | Middle | 1.026MHz | 0.888MHz |
| GFSK | High | 1.026MHz | 0.888MHz |
| π /4 DQPSK | Low | 1.290MHz | 1.182MHz |
| π 4 DQPSK | Middle | 1.290MHz | 1.170MHz |
| π /4 DQPSK | High | 1.290MHz | 1.170MHz |
| 8DPSK | Low | 1.302MHz | 1.182MHz |
| 8DPSK | Middle | 1.302MHz | 1.176MHz |
| 8DPSK | High | 1.302MHz | 1.170MHz |

Test result plot as follows:

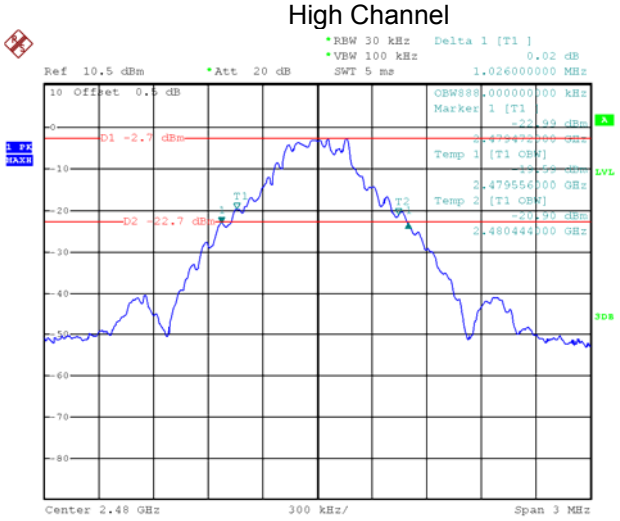
Modulation: GFSK Low Channel




Middle Channel

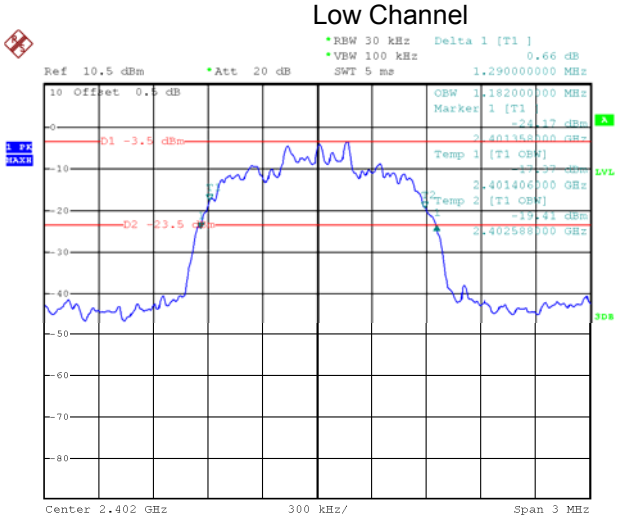


High Channel

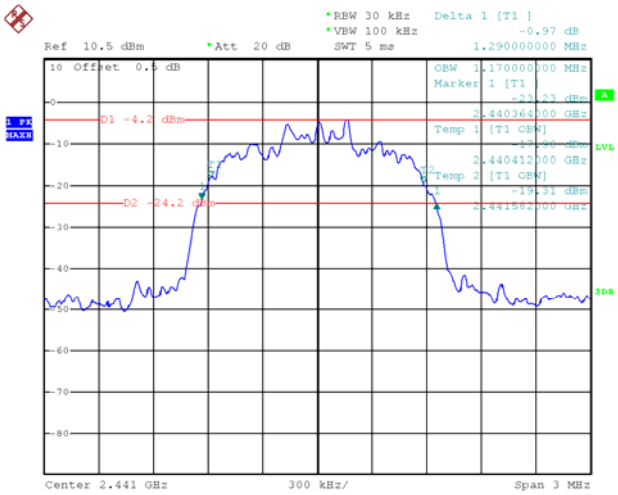



Modulation: π/4 DQPSK

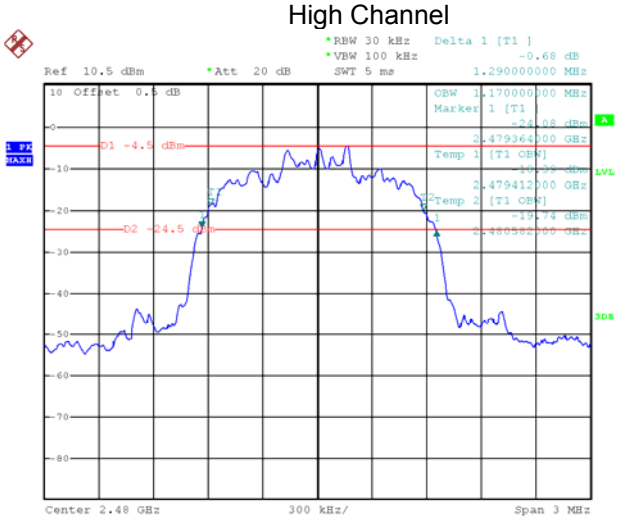
Low Channel



Middle Channel

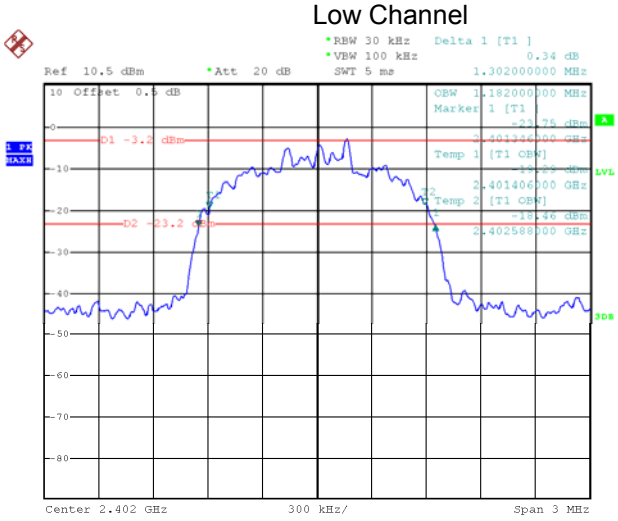



High Channel

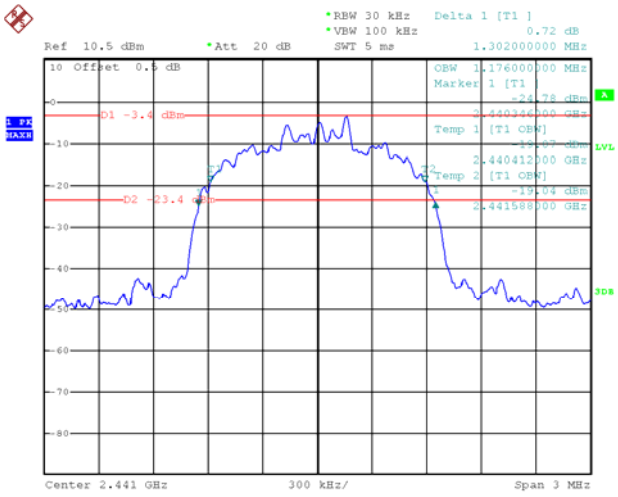


Modulation: 8DPSK

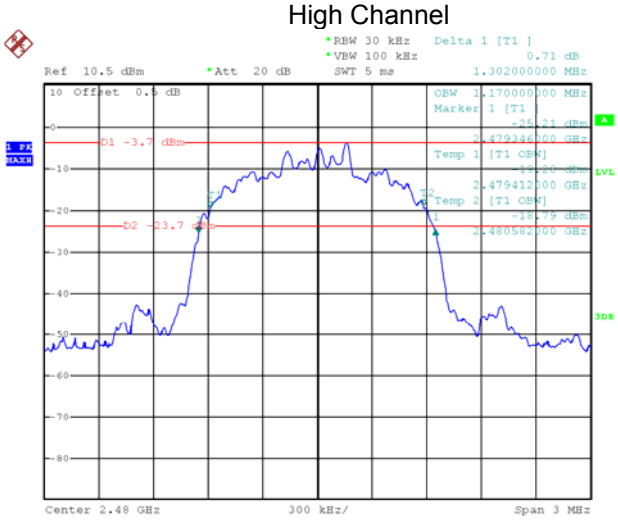
Low Channel




Middle Channel



High Channel



# 11 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: C63.10:2013

Test Limit: Regulation 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.

Refer to the result “Number of Hopping Frequency” of this document. The 1watts (30 dBm) limit applies.

Test mode: Test in fixing frequency transmitting mode.

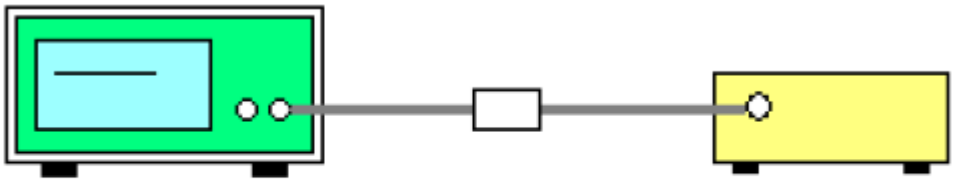
## 11.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 3 MHz. VBW =3 MHz. Sweep = auto; Detector Function = Peak.

3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

## 11.2 Test Setup



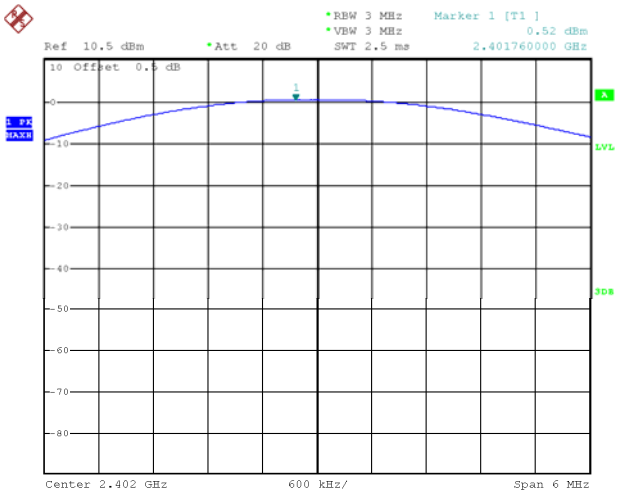

## 11.3 Test Result:

| Test Mode | Data Rate | Peak Power(dBm) | | | Limit (dBm) |
|---|---|---|---|---|---|
| | | Low Channel | Middle Channel | High Channel | |
| GFSK | 1Mbps | 0.52 | 0.18 | 0.09 | 20.97 |
| π/4 DQPSK | 2Mbps | 0.49 | -0.06 | -0.45 | 20.97 |
| 8DPSK | 3Mbps | **0.76** | 0.18 | 0.07 | 20.97 |

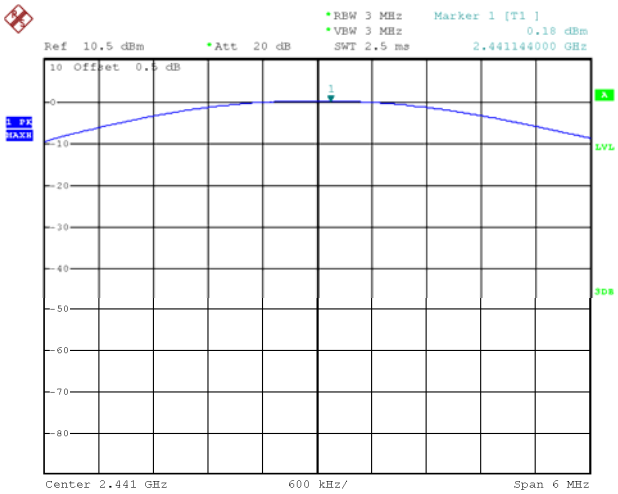
Test result plot as follows:

Modulation: GFSK

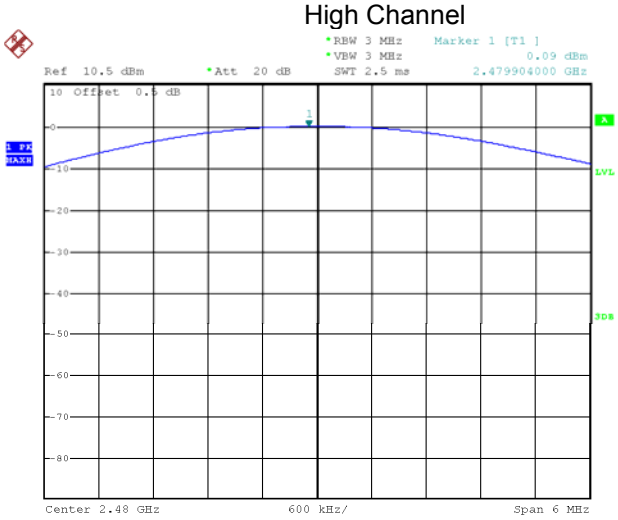
Low Channel




Middle Channel

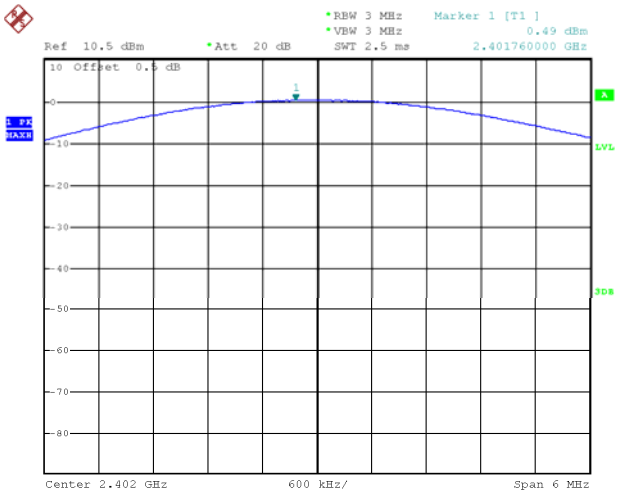


High Channel

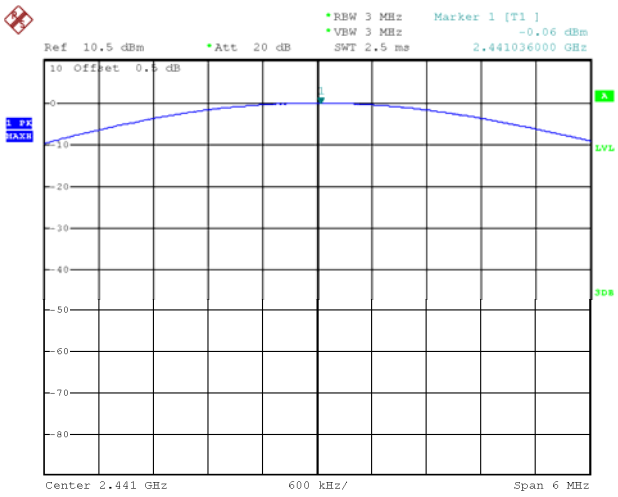



Modulation: π/4 DQPSK Low Channel

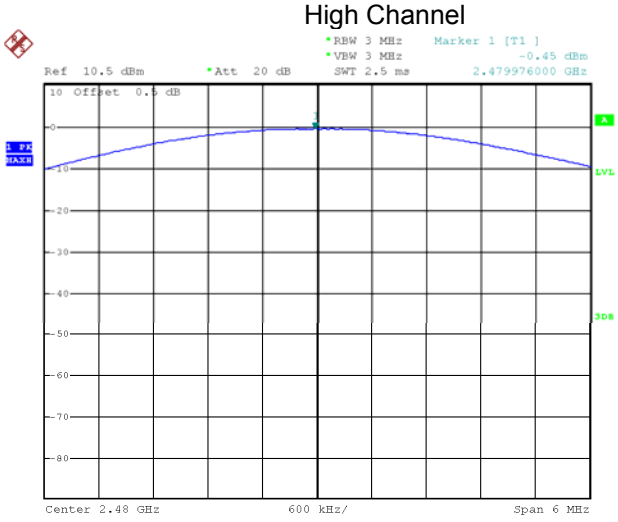
Low Channel



Middle Channel

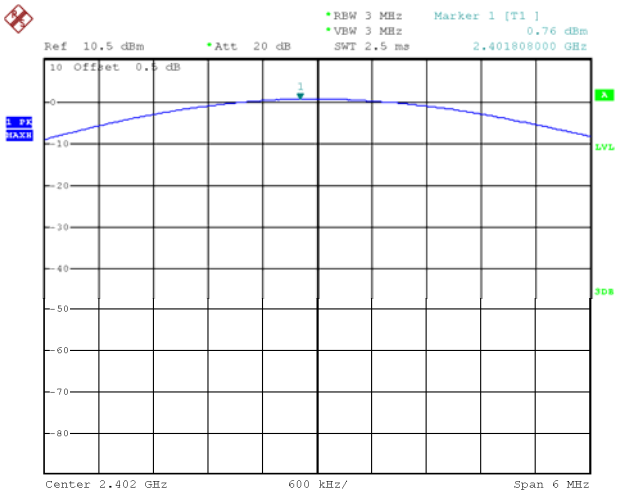



High Channel

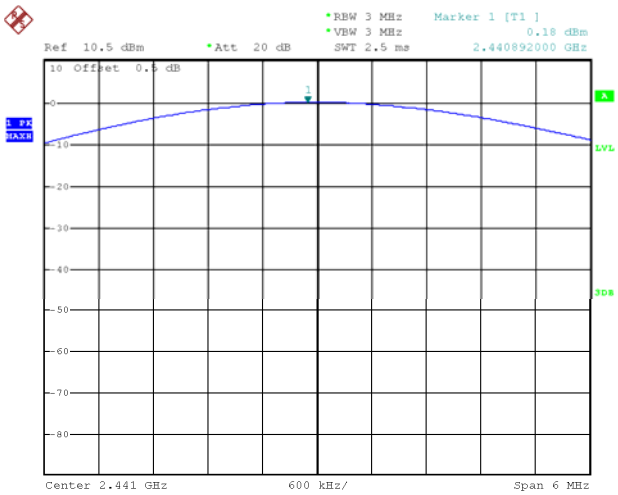


Modulation: 8DPSK Low Channel

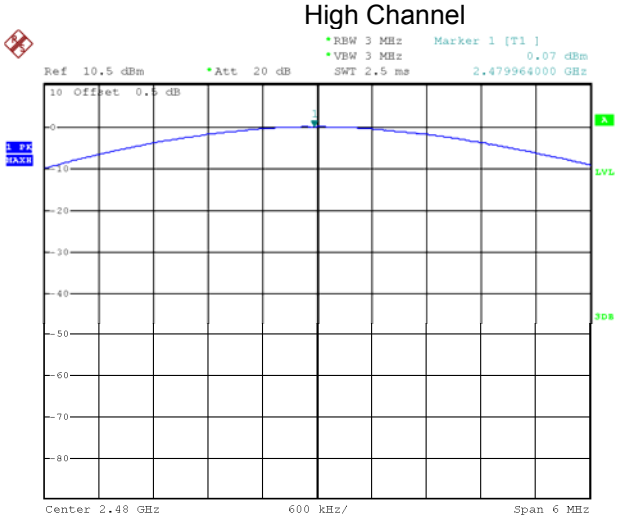
Low Channel




Middle Channel



High Channel



# 12 Hopping Channel Separation

| | |
|---|---|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247 |
| Test Method: | C63.10:2013 |
| Test Limit: | Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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, whichever is greater, provided the systems operate with an output power no greater than 1W. |
| Test Mode: | Test in hopping transmitting operating mode. |

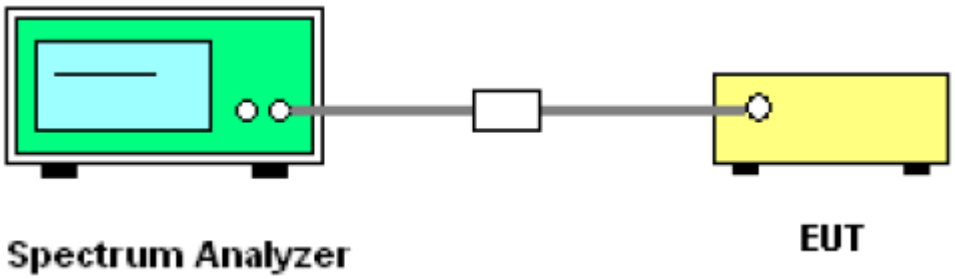
## 12.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

## 12.2 Test Setup



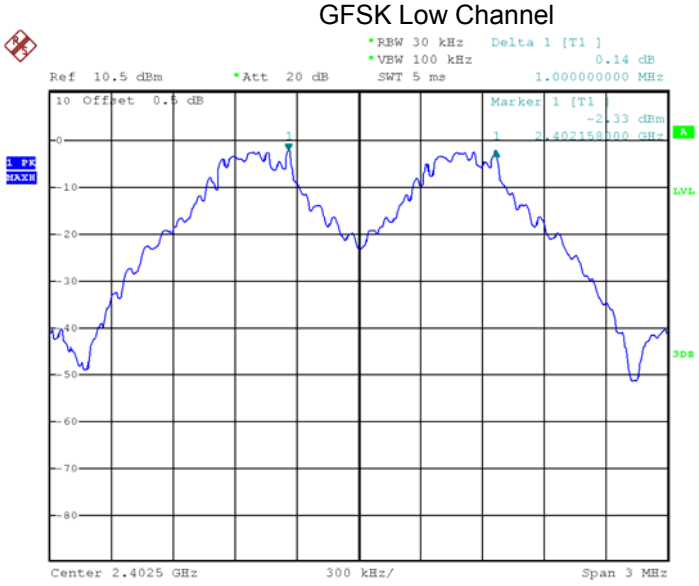
## 12.3 Test Result:

Test result plot as follows:

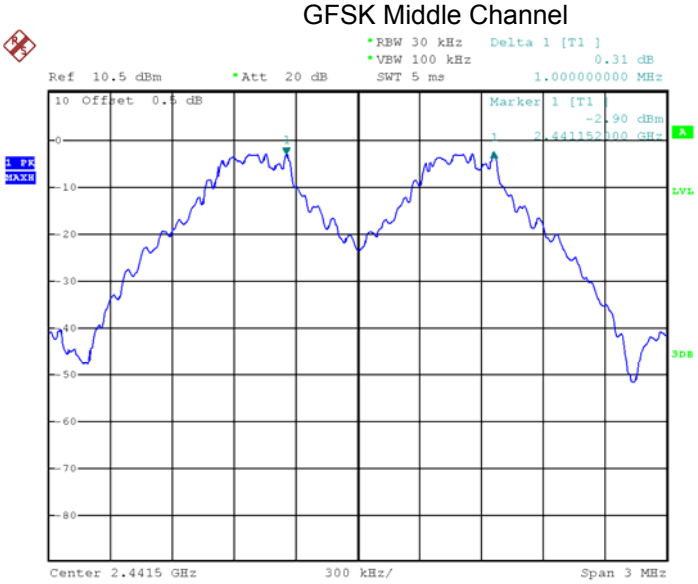
| Modulation | Test Channel | Separation (MHz) | Result |
|---|---|---|---|
| GFSK | Low | 1 MHz | PASS |
| GFSK | Middle | 1 MHz | PASS |
| GFSK | High | 1 MHz | PASS |
| π /4 DQPSK | Low | 1 MHz | PASS |
| π /4 DQPSK | Middle | 1 MHz | PASS |
| π /4 DQPSK | High | 1 MHz | PASS |
| 8DPSK | Low | 1 MHz | PASS |
| 8DPSK | Middle | 1 MHz | PASS |
| 8DPSK | High | 1 MHz | PASS |

Test plots

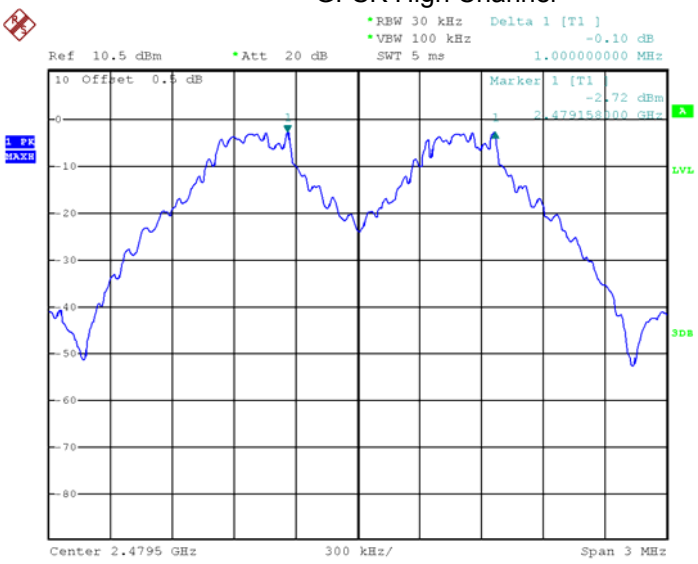
GFSK Low Channel



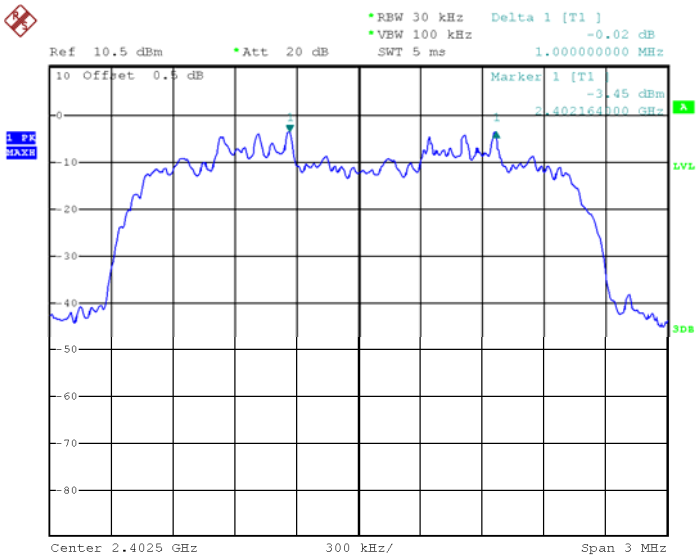
GFSK Middle Channel



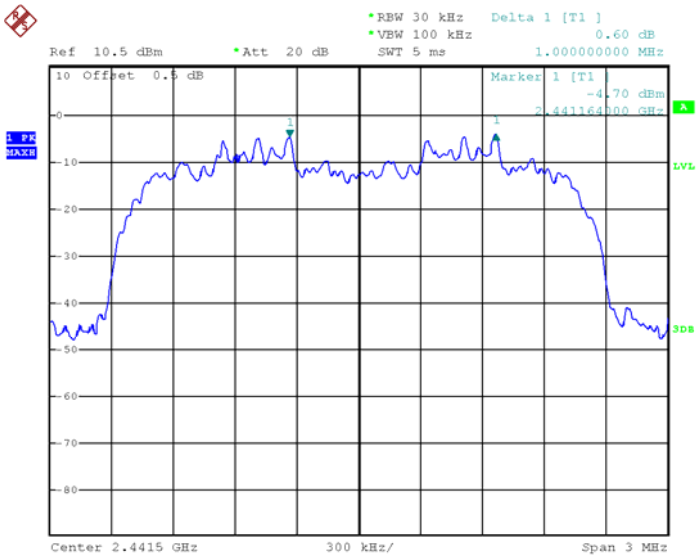

GFSK High Channel



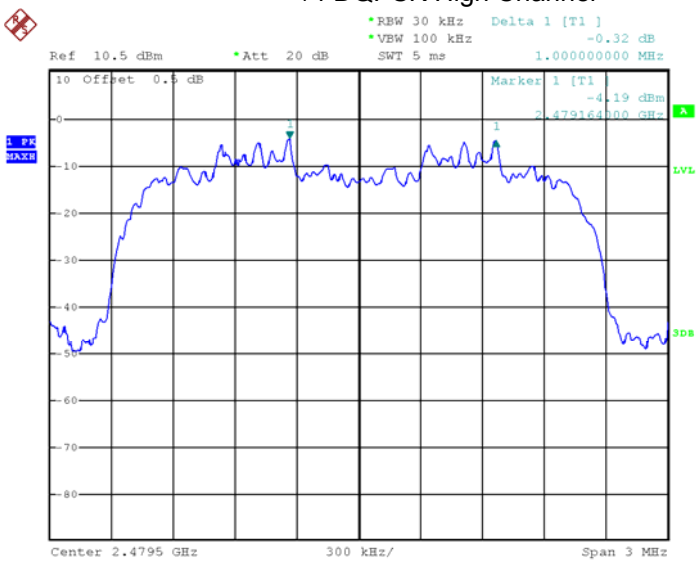
π /4 DQPSK Low Channel



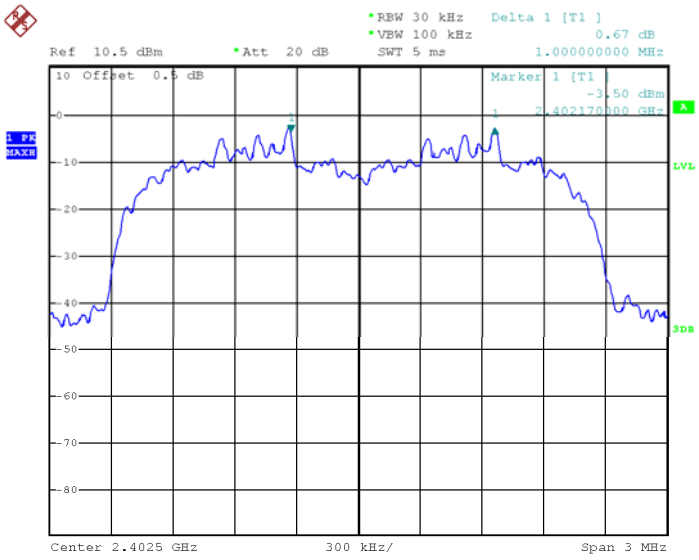

π /4 DQPSK Middle Channel



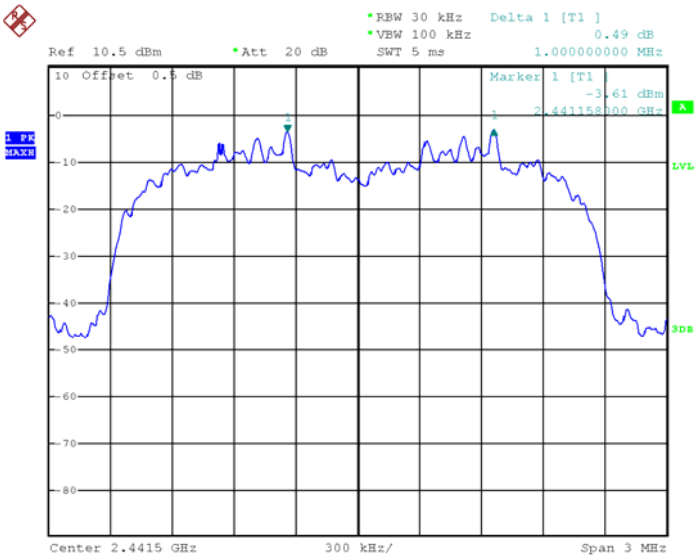
π /4 DQPSK High Channel



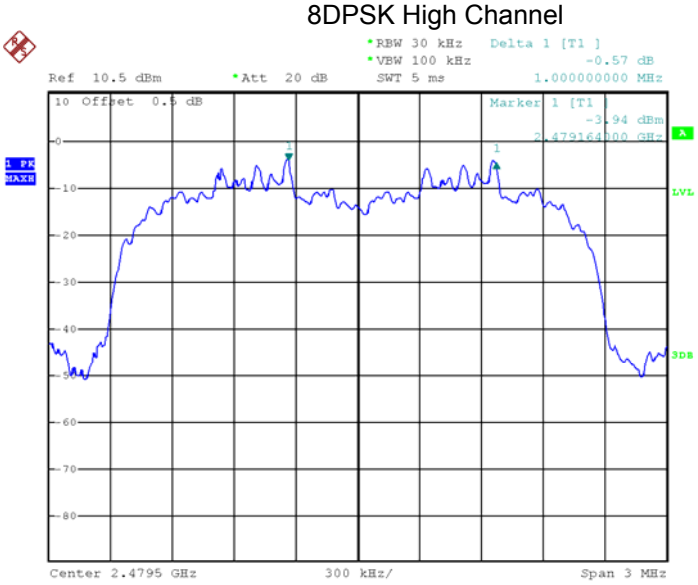

8DPSK Low Channel



8DPSK Middle Channel




8DPSK High Channel



# 13 Number of Hopping Frequency

| | |
|---|---|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247 |
| Test Method: | C63.10:2013 |
| Test Limit: | Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. |
| Test Mode: | Test in hopping transmitting operating mode. |

## 13.1 Test Procedure:

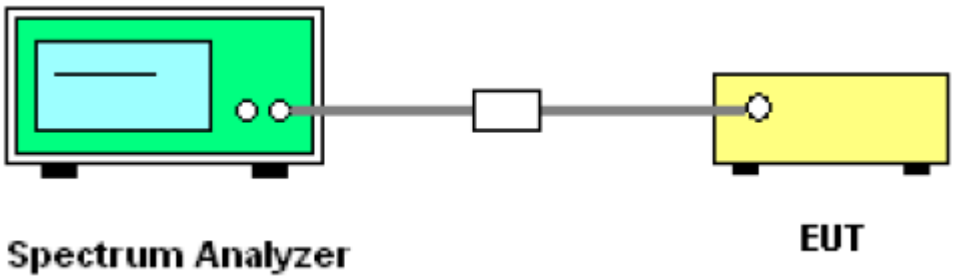
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 300 kHz. VBW = 300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

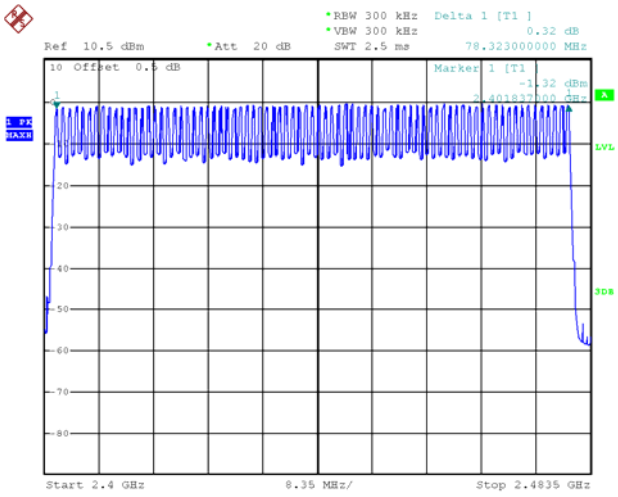
## 13.2 Test Setup



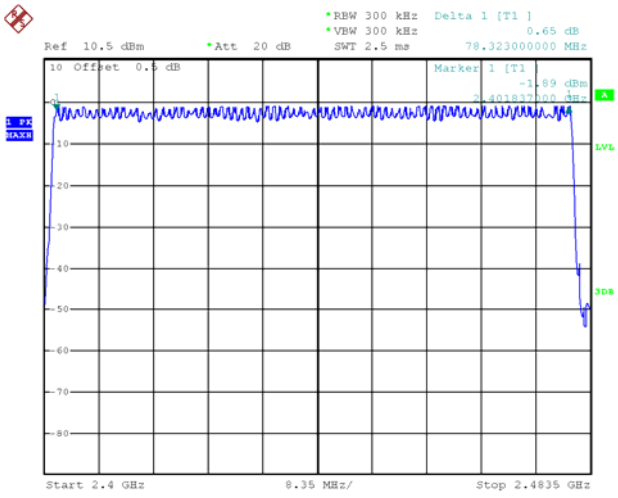
## 13.3 Test Result:

**Total Channels are 79 Channels.**

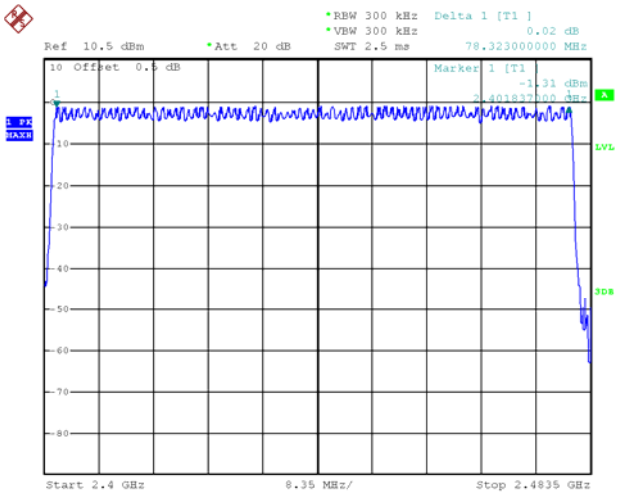
Modulation: GFSK




Modulation: π /4 DQPSK



Modulation: 8DPSK



# 14 Dwell Time

| | |
|---|---|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247 |
| Test Method: | C63.10:2013 |
| Test Limit: | Regulation 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Test Mode: | Test in hopping transmitting operating mode. |

## 14.1 Test Procedure:

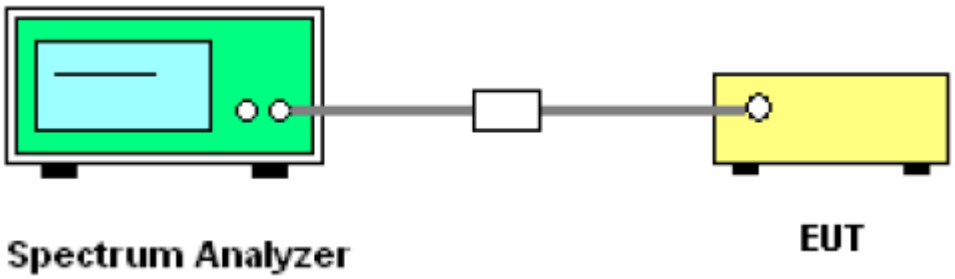
1.Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2.Set spectrum analyzer span = 0. centred on a hopping channel;

3.Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel.

4.Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

## 14.2 Test Setup




## 14.3 Test Result:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period
The test period: T= 0.4(s) * 79 = 31.6 (s)
DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

DH1 Packet permit maximum 1600 / 79 / 2 hops per second in each channel (1 time slot RX, 1 time slot TX).

So, the Dwell Time can be calculated as follows:

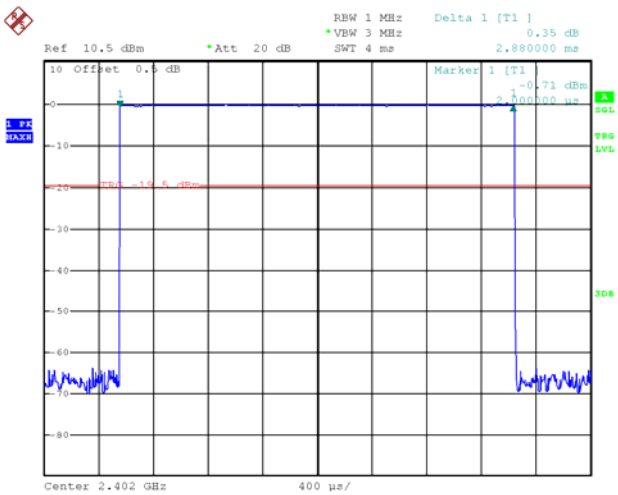
| Data Packet | Dwell Time(s) |
|---|---|
| DH5 | 1600/79/6*31.6*(MkrDelta)/1000 |
| DH3 | 1600/79/4*31.6*(MkrDelta)/1000 |
| DH1 | 1600/79/2*31.6*(MkrDelta)/1000 |
| Remark | Mkr Delta is single pulse time. |

| Modulation | Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|---|---|---|---|---|---|
| GFSK | DH5 | Low | 2.880 | 0.307 | 0.4 |
| | | middle | 2.880 | 0.307 | 0.4 |
| | | High | 2.880 | 0.307 | 0.4 |
| π /4 DQPSK | DH5 | Low | 2.880 | 0.307 | 0.4 |
| | | middle | 2.880 | 0.307 | 0.4 |
| | | High | 2.880 | 0.307 | 0.4 |
| 8DPSK | DH5 | Low | 2.880 | 0.307 | 0.4 |
| | | middle | 2.880 | 0.307 | 0.4 |
| | | High | 2.880 | 0.307 | 0.4 |

Modulation: GFSK

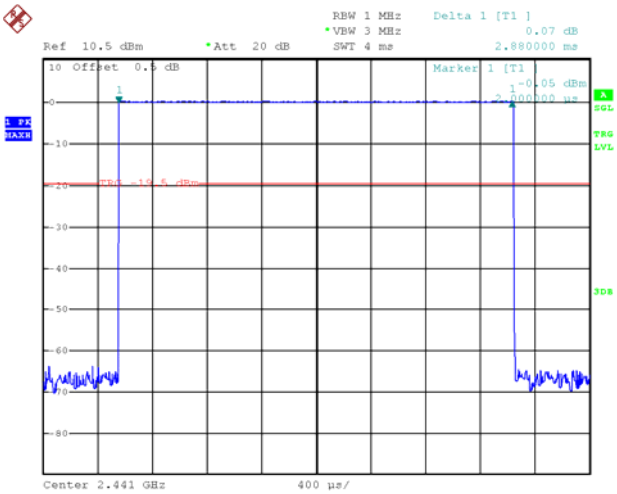
Data Packet:

DH5.Low channel



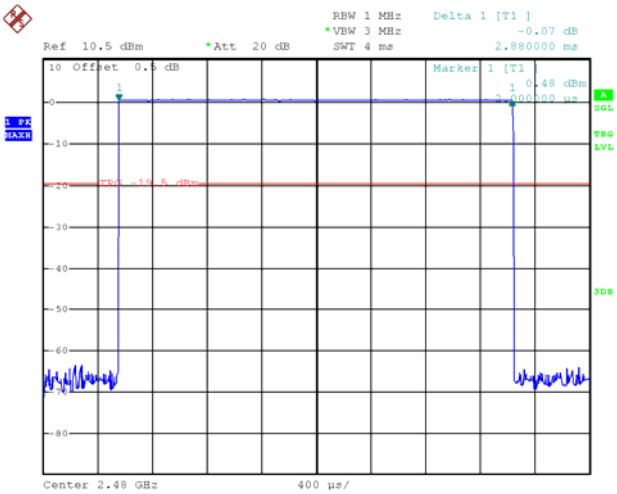
Data Packet:

DH5.Middle channel




Data Packet:

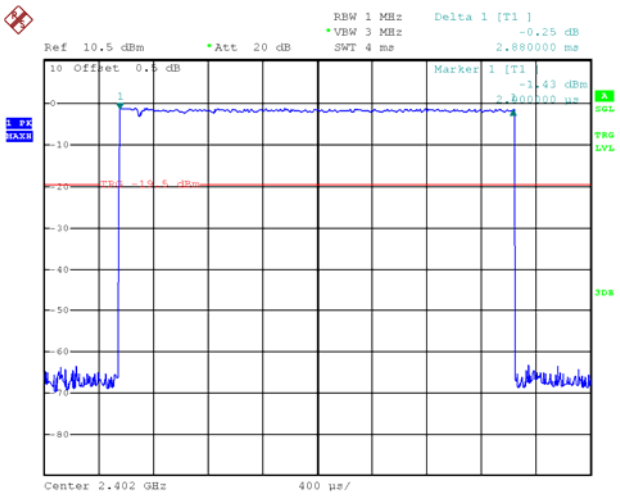
DH5, High channel



Modulation: π/4 DQPSK

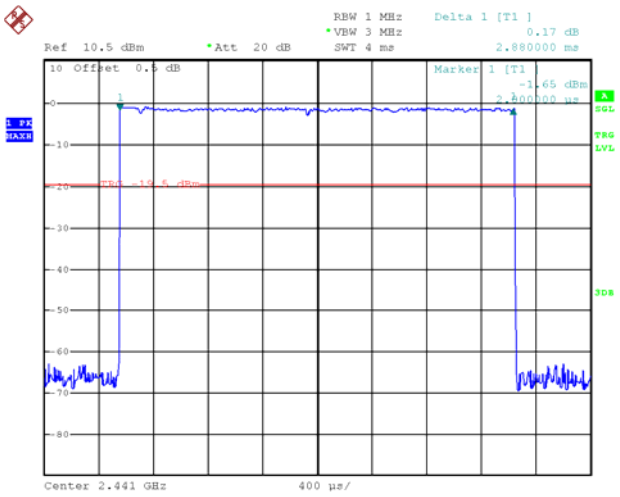
Data Packet:

2DH5 Low channel



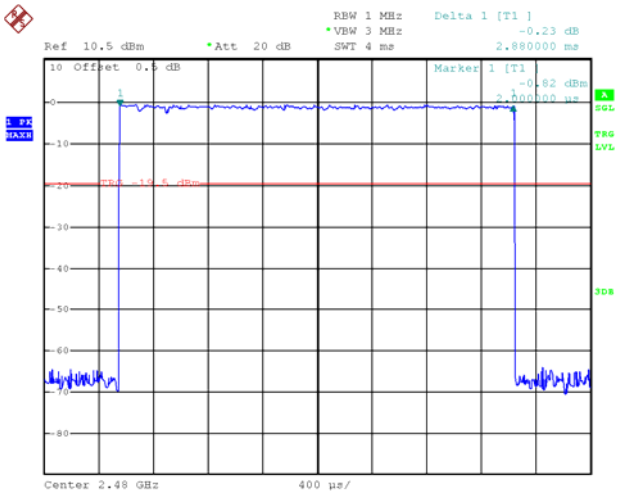

Data Packet:

2DH5.Middle channel



Data Packet:

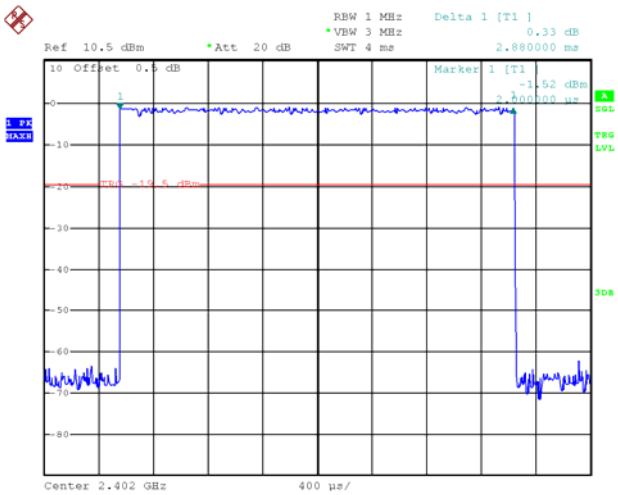
2DH5, High channel




Modulation: 8DPSK

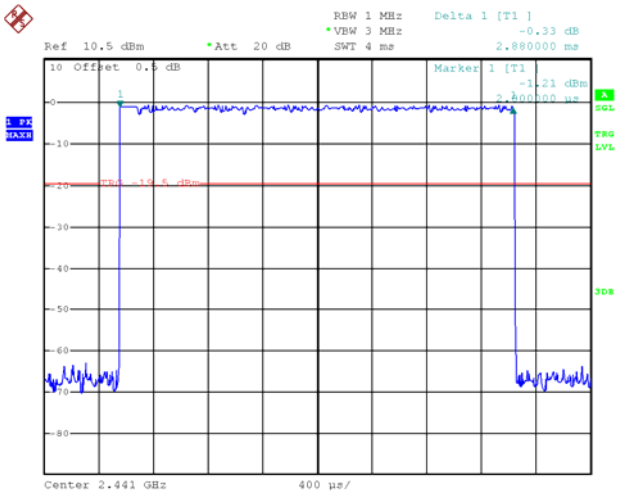
Data Packet:

3DH5.Low channel



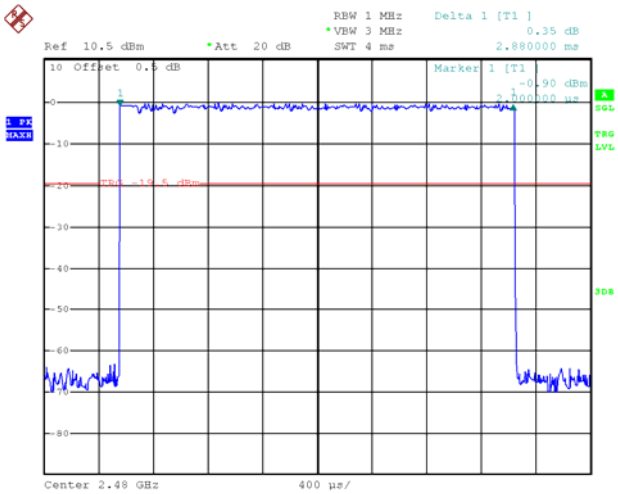
Data Packet:

3DH5.Middle channel




Data Packet:

3DH5, High channel



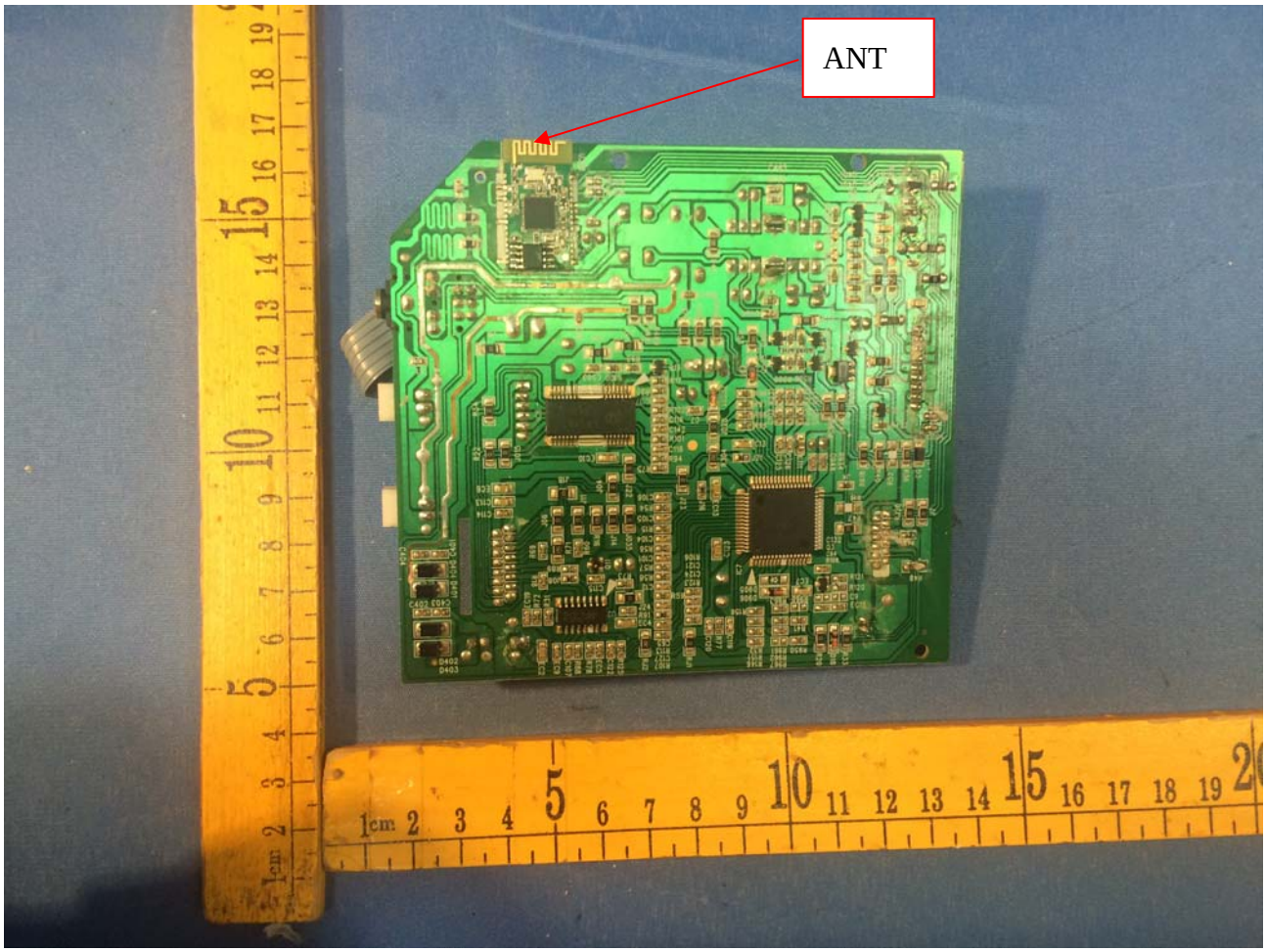
# 15 Antenna Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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.

Result:

The EUT has onePCB Printed Antenna, the gain is 0dBi for Bluetooth Antenna, meets the requirements of FCC 15.203.



# 16 FCC ID: 2AJMW-MS500B RF Exposure Report

Note: Please refer to RF Exposure Report: WTD18S07118156-2W.

# 17 Photographs - Model MS500B Test Setup Photos

Note: Please refer to Photos: WTD18S07118156-3W.

# 18 Photographs - Constructional Details

## 18.1 Model MS500B - External Photos

Note: Please refer to Photos: WTD18S07118156-3W.

## 18.2 Model MS500B - Internal Photos

Note: Please refer to Photos: WTD18S07118156-3W.

======End of Report======