# TEST REPORT

| | | |
|---|---|---|
| **Reference No.** | : | WTS17S0476038E |
| **FCC ID** | : | 2AJNYMP3451 |
| **Applicant** | : | SHENZHEN GRAND CREATIVE TECHNOLOGY CO., LTD. |
| **Address** | : | Building No. 2, Baoxianghe Industrial Park, Hexiuxi Road, Fuyong Street, Baoan District, Shenzhen, China |
| **Manufacturer** | : | The same as above |
| **Address** | : | The same as above |
| **Product Name** | : | Bluetooth CD Boombox |
| **Model No.** | : | MP3451 |
| **Brand Name** | : | memorex |
| **Standards** | : | FCC CFR47 Part 15 Section 15.247:2016 |
| **Date of Receipt sample** | : | Apr. 11, 2017 |
| **Date of Test** | : | Apr. 12 - 16, 2017 |
| **Date of Issue** | : | Apr. 17, 2017 |
| **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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# 3 Report Revision History

| Test report No. | Date of Receipt sample | Date of Test | Date of Issue | Purpose | Comment | Approved |
|---|---|---|---|---|---|---|
| WTS17S0476038E | Apr. 11, 2017 | Apr. 12 - 16, 2017 | Apr. 17, 2017 | original | - | Valid |

# 4 General Information

## 4.1 General Description of E.U.T.

Product Name: Bluetooth CD Boombox

Model No.: MP3451

Model Description: N/A

Operation Frequency: 2402MHz ~ 2480MHz, 79 channels in total

Type of Modulation: GFSK, Pi/4DQPSK, 8DPSK

The lowest oscillator: 32.768KHz

Antenna installation: PCB printed antenna

Antenna Gain: 0 dBi

## 4.2 Details of E.U.T.

Technical Data: AC120V~, 60Hz 13W or DC 9V⎓(6*1.5V ”C” size, UM-2 batteries)

## 4.3 Channel List

| Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) |
|---|---|---|---|---|---|---|---|
| 0 | 2402 | 1 | 2403 | 2 | 2404 | 3 | 2405 |
| 4 | 2406 | 5 | 2407 | 6 | 2408 | 7 | 2409 |
| 8 | 2410 | 9 | 2411 | 10 | 2412 | 11 | 2413 |
| 12 | 2414 | 13 | 2415 | 14 | 2416 | 15 | 2417 |
| 16 | 2418 | 17 | 2419 | 18 | 2420 | 19 | 2421 |
| 20 | 2422 | 21 | 2423 | 22 | 2424 | 23 | 2425 |
| 24 | 2426 | 25 | 2427 | 26 | 2428 | 27 | 2429 |
| 28 | 2430 | 29 | 2431 | 30 | 2432 | 31 | 2433 |
| 32 | 2434 | 33 | 2435 | 34 | 2436 | 35 | 2437 |
| 36 | 2438 | 37 | 2439 | 38 | 2440 | 39 | 2441 |
| 40 | 2442 | 41 | 2443 | 42 | 2444 | 43 | 2445 |
| 44 | 2446 | 45 | 2447 | 46 | 2448 | 47 | 2449 |
| 48 | 2450 | 49 | 2451 | 50 | 2452 | 51 | 2453 |
| 52 | 2454 | 53 | 2455 | 54 | 2456 | 55 | 2457 |
| 56 | 2458 | 57 | 2459 | 58 | 2460 | 59 | 2461 |
| 60 | 2462 | 61 | 2463 | 62 | 2464 | 63 | 2465 |
| 64 | 2466 | 65 | 2467 | 66 | 2468 | 67 | 2469 |
| 68 | 2470 | 69 | 2471 | 70 | 2472 | 71 | 2473 |
| 72 | 2474 | 73 | 2475 | 74 | 2476 | 75 | 2477 |
| 76 | 2478 | 77 | 2479 | 78 | 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 |

## 4.5 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

  Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A-1, October 15, 2015

- **FCC Test Site 1#– Registration No.: 880581**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, April 29, 2014.

- **FCC Test Site 2#– Registration No.: 328995**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 328995, December 3, 2014.

# 5 Equipment Used during Test

## 5.1 Equipments List

| Conducted Emissions Test Site 1# | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1. | EMI Test Receiver | R&S | ESCI | 100947 | Sep.12, 2016 | Sep.11, 2017 |
| 2. | LISN | R&S | ENV216 | 101215 | Sep.12, 2016 | Sep.11, 2017 |
| 3. | Cable | Top | TYPE16(3.5M) | - | Sep.12, 2016 | Sep.11, 2017 |
| **Conducted Emissions Test Site 2#** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1. | EMI Test Receiver | R&S | ESCI | 101155 | Sep.12, 2016 | Sep.11, 2017 |
| 2. | LISN | SCHWARZBECK | NSLK 8128 | 8128-289 | Sep.12, 2016 | Sep.11, 2017 |
| 3. | Limiter | York | MTS-IMP-136 | 261115-001-0024 | Sep.12, 2016 | Sep.11, 2017 |
| 4. | Cable | LARGE | RF300 | - | Sep.12, 2016 | Sep.11, 2017 |
| **3m Semi-anechoic Chamber for Radiation Emissions Test site 1#** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1 | Spectrum Analyzer | R&S | FSP | 100091 | Apr. 29, 2016 | Apr. 28, 2017 |
| 2 | Amplifier | Agilent | 8447D | 2944A10178 | Jan. 12, 2017 | Jan. 11, 2018 |
| 3 | Active Loop Antenna | Beijing Dazhi | ZN30900A | 0703 | Oct. 17, 2016 | Oct. 16, 2017 |
| 4 | Trilog Broadband Antenna | SCHWARZBECK | VULB9163 | 336 | Apr. 07, 2017 | Apr. 06, 2018 |
| 5 | Coaxial Cable (below 1GHz) | Top | TYPE16(13M) | - | Sep.12, 2016 | Sep.11, 2017 |
| 6 | Broad-band Horn Antenna | SCHWARZBECK | BBHA 9120 D | 667 | Apr. 07, 2017 | Apr. 06, 2018 |
| 7 | Broadband Preamplifier | COMPLIANCE DIRECTION | PAP-1G18 | 2004 | Apr. 07, 2017 | Apr. 06, 2018 |
| 8 | Coaxial Cable (above 1GHz) | Top | 1GHz-18GHz | EW02014-7 | Apr. 07, 2017 | Apr. 06, 2018 |
| **3m Semi-anechoic Chamber for Radiation Emissions Test site 2#** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No** | **Last Calibration Date** | **Calibration Due Date** |
| 1 | Test Receiver | R&S | ESCI | 101296 | Apr. 06, 2017 | Apr. 05, 2018 |
| 2 | Trilog Broadband Antenna | SCHWARZBECK | VULB9160 | 9160-3325 | Apr. 07, 2017 | Apr. 06, 2018 |
| 3 | Amplifier | ANRITSU | MH648A | M43381 | Apr. 07, 2017 | Apr. 06, 2018 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Cable | HUBER+SUHNER | CBL2 | 525178 | Apr. 07, 2017 | Apr. 06, 2018 |
| **RF Conducted Testing** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1. | EMC Analyzer (9k~26.5GHz) | Agilent | E7405A | MY45114943 | Sep.15,2016 | Sep.14,2017 |
| 2. | Spectrum Analyzer (9k-6GHz) | R&S | FSL6 | 100959 | Sep.15,2016 | Sep.14,2017 |
| 3. | Signal Analyzer (9k~26.5GHz) | Agilent | N9010A | MY50520207 | Sep.15,2016 | Sep.14,2017 |

## 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 (Bilog antenna 30M~1000MHz) |
| | ± 5.47 dB (Horn antenna 1000M~25000MHz) |
| Conducted Spurious Emissions test | ± 3.64 dB (AC mains 150KHz~30MHz) |

## 5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

# 6 Test Summary

| Test Items | Test Requirement | Result |
|---|---|---|
| Radiated Spurious Emissions | 15.205(a)<br>15.209<br>15.247(d) | C |
| Band edge | 15.247(d)<br>15.205(a) | C |
| Conduct Emission | 15.207 | C |
| Bandwidth | 15.247(a)(1) | C |
| Maximum Peak Output Power | 15.247(b)(1) | C |
| Frequency Separation | 15.247(a)(1) | C |
| Number of Hopping Frequency | 15.247(a)(1)(iii) | C |
| Dwell time | 15.247(a)(1)(iii) | C |
| Maximum Permissible Exposure<br>(Exposure of Humans to RF Fields) | 1.1307(b)(1) | C |
| Antenna Requirement | 15.203 | C |
| Note: C=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&ANSI C63.4:2014 |
| Test Result: | PASS |
| Frequency Range: | 150kHz to 30MHz |
| Class/Severity: | Class B |
| Limit: | 66-56 dBμV between 0.15MHz & 0.5MHz |
| | 56 dBμV between 0.5MHz & 5MHz |
| | 60 dBμV between 5MHz & 30MHz |
| Detector: | Peak for pre-scan (9kHz Resolution Bandwidth) |

## 7.1 E.U.T. Operation

Operating Environment **:**

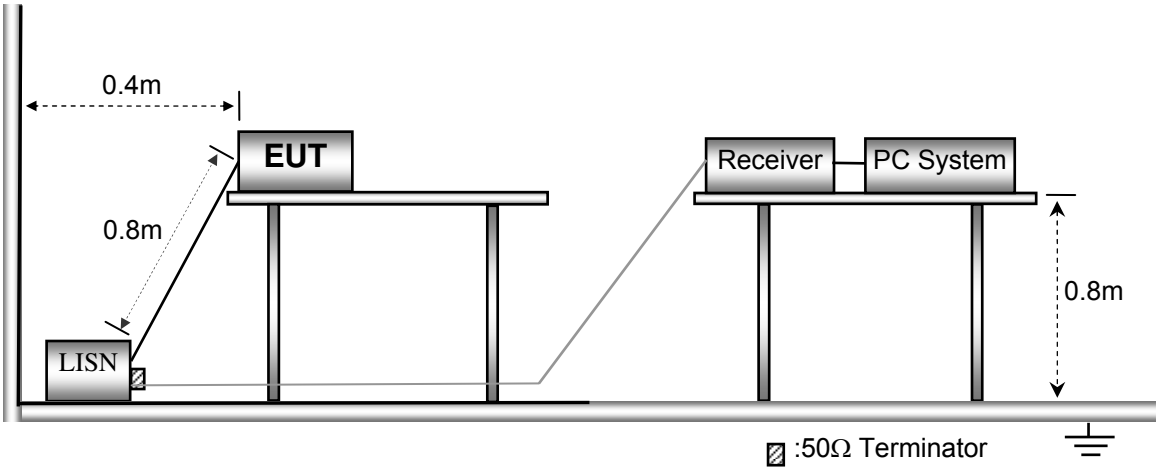
| | |
|---|---|
| Temperature: | 25.5 °C |
| Humidity: | 51 % RH |
| Atmospheric Pressure: | 101.2kPa |

EUT Operation **:**

The test was performed in BT transmitting mode, the test data 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.

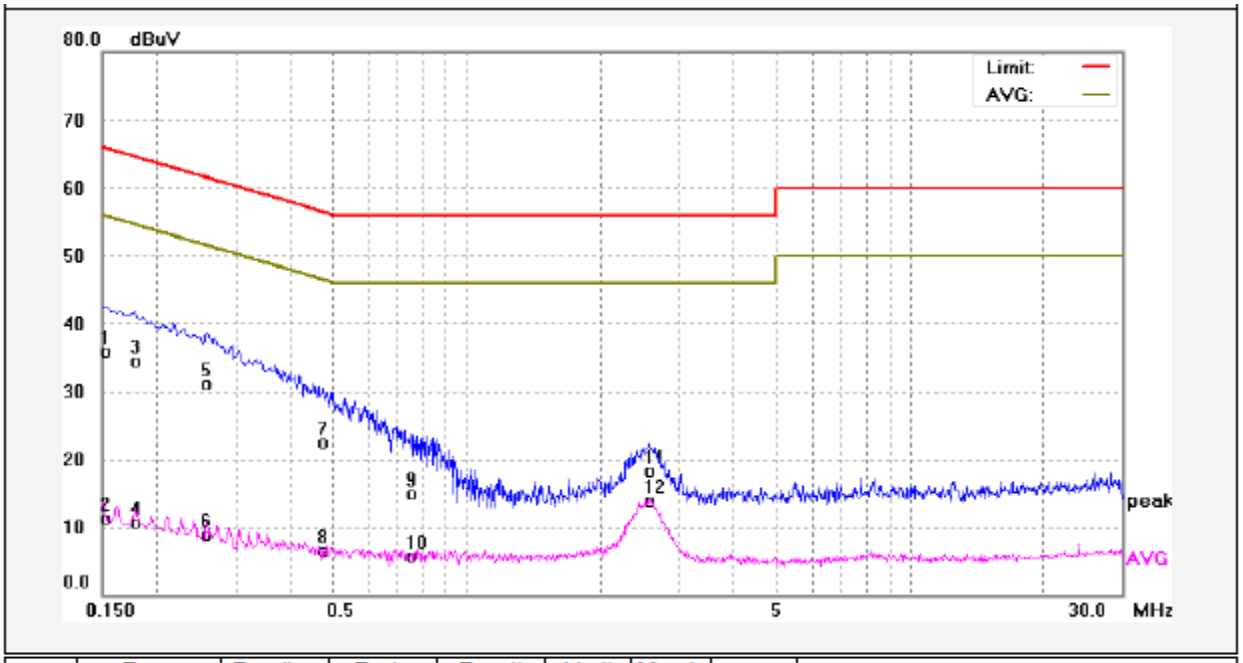



## 7.3 Measurement Description

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.

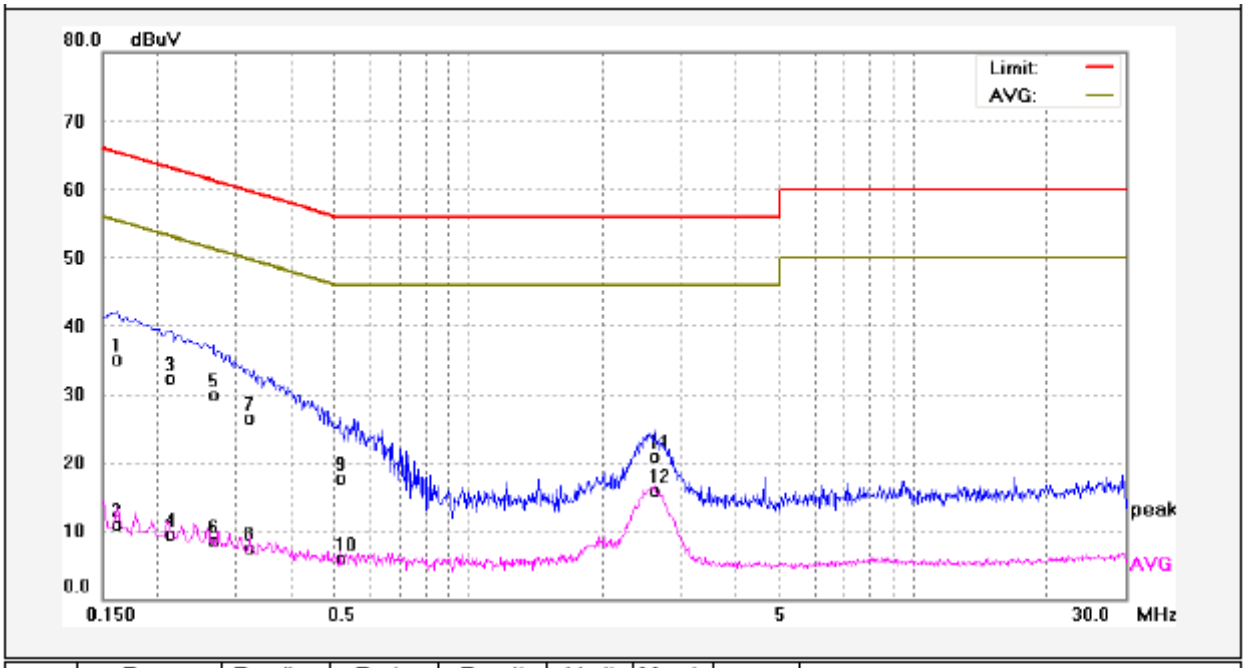
## 7.4 Conducted Emission Test Result

Live line:




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Margin (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1539 | 26.33 | 9.64 | 35.97 | 65.78 | -29.81 | QP | |
| 2 | 0.1539 | 1.75 | 9.64 | 11.39 | 55.78 | -44.39 | AVG | |
| 3 | 0.1780 | 24.97 | 9.63 | 34.60 | 64.57 | -29.97 | QP | |
| 4 | 0.1780 | 1.09 | 9.63 | 10.72 | 54.57 | -43.85 | AVG | |
| 5 | 0.2580 | 21.43 | 9.64 | 31.07 | 61.49 | -30.42 | QP | |
| 6 | 0.2580 | -0.68 | 9.64 | 8.96 | 51.49 | -42.53 | AVG | |
| 7 | 0.4740 | 12.77 | 9.65 | 22.42 | 56.44 | -34.02 | QP | |
| 8 | 0.4740 | -3.15 | 9.65 | 6.50 | 46.44 | -39.94 | AVG | |
| 9 | 0.7500 | 5.24 | 9.75 | 14.99 | 56.00 | -41.01 | QP | |
| 10 | 0.7500 | -4.14 | 9.75 | 5.61 | 46.00 | -40.39 | AVG | |
| 11 | 2.5700 | 8.45 | 9.94 | 18.39 | 56.00 | -37.61 | QP | |
| 12 | 2.5700 | 3.87 | 9.94 | 13.81 | 46.00 | -32.19 | AVG | |

Neutral line:




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Margin (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1620 | 25.42 | 9.64 | 35.06 | 65.36 | -30.30 | QP | |
| 2 | 0.1620 | 1.31 | 9.64 | 10.95 | 55.36 | -44.41 | AVG | |
| 3 | 0.2140 | 22.72 | 9.63 | 32.35 | 63.04 | -30.69 | QP | |
| 4 | 0.2140 | -0.08 | 9.63 | 9.55 | 53.04 | -43.49 | AVG | |
| 5 | 0.2660 | 20.25 | 9.64 | 29.89 | 61.24 | -31.35 | QP | |
| 6 | 0.2660 | -1.08 | 9.64 | 8.56 | 51.24 | -42.68 | AVG | |
| 7 | 0.3180 | 16.88 | 9.64 | 26.52 | 59.76 | -33.24 | QP | |
| 8 | 0.3180 | -2.17 | 9.64 | 7.47 | 49.76 | -42.29 | AVG | |
| 9 | 0.5140 | 7.98 | 9.66 | 17.64 | 56.00 | -38.36 | QP | |
| 10 | 0.5140 | -3.71 | 9.66 | 5.95 | 46.00 | -40.05 | AVG | |
| 11 | 2.6180 | 10.88 | 9.94 | 20.82 | 56.00 | -35.18 | QP | |
| 12 | 2.6180 | 5.96 | 9.94 | 15.90 | 46.00 | -30.10 | AVG | |

# 8 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013&ANSI C63.4:2014

Test Result: PASS

Measurement Distance: 3m

Limit:

| Frequency (MHz) | Field Strength | | Field Strength Limit at 3m Measurement Distance | |
|---|---|---|---|---|
| | 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: 51.1 % RH

Atmospheric Pressure: 101.2kPa

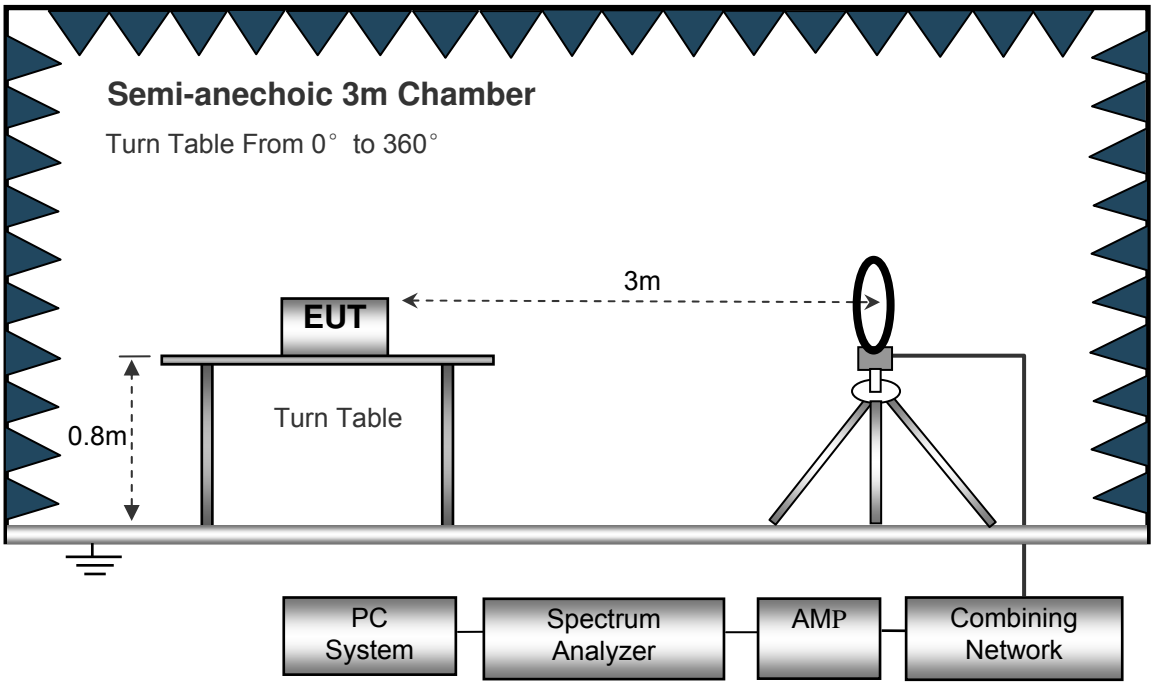
EUT Operation :

The test was performed in BT transmitting mode, the test data were shown in the report.

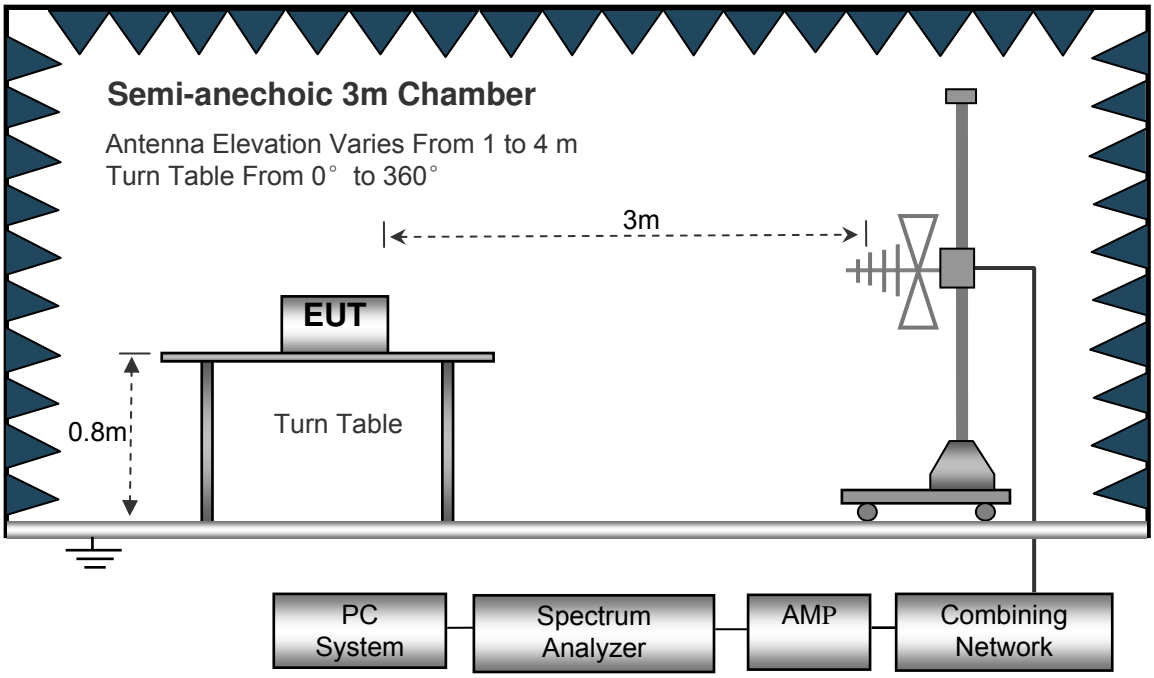
## 8.2 Test Setup

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

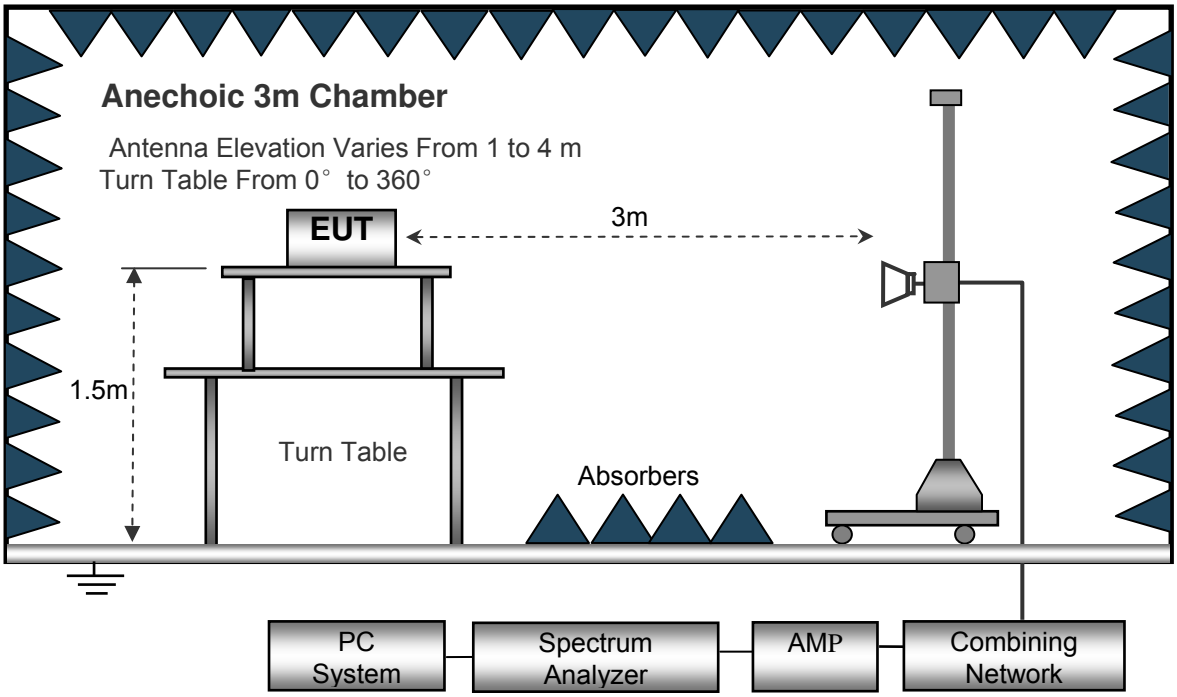
The test setup for emission measurement below 30MHz.




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 above ground plane.
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.

## 8.5 Summary of Test Results

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

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

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

| Frequency | Receiver Reading | Detector | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude | Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Height | Polar | | | | |
| (MHz) | (dBμV) | (PK/QP/Ave) | Degree | (m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK Low Channel | | | | | | | | | |
| 252.68 | 35.23 | QP | 155 | 1.5 | H | -13.35 | 21.88 | 46.00 | -24.12 |
| 252.06 | 40.28 | QP | 71 | 1.8 | V | -13.35 | 26.93 | 46.00 | -19.07 |
| 4804.00 | 43.66 | PK | 53 | 1.3 | V | -1.06 | 42.60 | 74.00 | -31.40 |
| 4804.00 | 36.65 | Ave | 53 | 1.3 | V | -1.06 | 35.59 | 54.00 | -18.41 |
| 7206.00 | 43.99 | PK | 241 | 1.5 | H | 1.33 | 45.32 | 74.00 | -28.68 |
| 7206.00 | 36.42 | Ave | 241 | 1.5 | H | 1.33 | 37.75 | 54.00 | -16.25 |
| 2332.08 | 46.13 | PK | 321 | 1.5 | V | -13.19 | 32.94 | 74.00 | -41.06 |
| 2332.08 | 39.85 | Ave | 321 | 1.5 | V | -13.19 | 26.66 | 54.00 | -27.34 |
| 2365.42 | 44.69 | PK | 32 | 2.0 | H | -13.14 | 31.55 | 74.00 | -42.45 |
| 2365.42 | 36.46 | Ave | 32 | 2.0 | H | -13.14 | 23.32 | 54.00 | -30.68 |
| 2487.57 | 43.25 | PK | 279 | 1.3 | V | -13.08 | 30.17 | 74.00 | -43.83 |
| 2487.57 | 37.70 | Ave | 279 | 1.3 | V | -13.08 | 24.62 | 54.00 | -29.38 |

| Frequency | Receiver Reading | Detector | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude | Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Height | Polar | | | | |
| (MHz) | (dBμV) | (PK/QP/Ave) | Degree | (m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK Middle Channel | | | | | | | | | |
| 252.68 | 37.09 | QP | 61 | 1.8 | H | -13.35 | 23.74 | 46.00 | -22.26 |
| 252.06 | 42.45 | QP | 301 | 1.8 | V | -13.35 | 29.10 | 46.00 | -16.90 |
| 4882.00 | 46.20 | PK | 69 | 1.5 | V | -0.62 | 45.58 | 74.00 | -28.42 |
| 4882.00 | 42.23 | Ave | 69 | 1.5 | V | -0.62 | 41.61 | 54.00 | -12.39 |
| 7323.00 | 38.90 | PK | 198 | 1.9 | H | 2.21 | 41.11 | 74.00 | -32.89 |
| 7323.00 | 34.56 | Ave | 198 | 1.9 | H | 2.21 | 36.77 | 54.00 | -17.23 |
| 2321.62 | 46.32 | PK | 132 | 1.8 | V | -13.19 | 33.13 | 74.00 | -40.87 |
| 2321.62 | 39.39 | Ave | 132 | 1.8 | V | -13.19 | 26.20 | 54.00 | -27.80 |
| 2383.58 | 43.21 | PK | 119 | 1.1 | H | -13.14 | 30.07 | 74.00 | -43.93 |
| 2383.58 | 37.47 | Ave | 119 | 1.1 | H | -13.14 | 24.33 | 54.00 | -29.67 |
| 2494.04 | 42.50 | PK | 188 | 1.7 | V | -13.08 | 29.42 | 74.00 | -44.58 |
| 2494.04 | 38.89 | Ave | 188 | 1.7 | V | -13.08 | 25.81 | 54.00 | -28.19 |

| Frequency | Receiver Reading | Detector | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude | Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Height | Polar | | | | |
| (MHz) | (dBμV) | (PK/QP/Ave) | Degree | (m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK High Channel | | | | | | | | | |
| 252.68 | 38.22 | QP | 126 | 1.4 | H | -13.35 | 24.87 | 46.00 | -21.13 |
| 252.06 | 42.56 | QP | 229 | 1.5 | V | -13.35 | 29.21 | 46.00 | -16.79 |
| 4960.00 | 43.89 | PK | 67 | 2.0 | V | -0.24 | 43.65 | 74.00 | -30.35 |
| 4960.00 | 40.39 | Ave | 67 | 2.0 | V | -0.24 | 40.15 | 54.00 | -13.85 |
| 7440.00 | 39.26 | PK | 133 | 1.0 | H | 2.84 | 42.10 | 74.00 | -31.90 |
| 7440.00 | 36.23 | Ave | 133 | 1.0 | H | 2.84 | 39.07 | 54.00 | -14.93 |
| 2318.75 | 46.88 | PK | 276 | 1.3 | V | -13.19 | 33.69 | 74.00 | -40.31 |
| 2318.75 | 38.93 | Ave | 276 | 1.3 | V | -13.19 | 25.74 | 54.00 | -28.26 |
| 2369.51 | 42.38 | PK | 132 | 1.1 | H | -13.14 | 29.24 | 74.00 | -44.76 |
| 2369.51 | 37.58 | Ave | 132 | 1.1 | H | -13.14 | 24.44 | 54.00 | -29.56 |
| 2483.81 | 43.66 | PK | 224 | 1.9 | V | -13.08 | 30.58 | 74.00 | -43.42 |
| 2483.81 | 38.55 | Ave | 224 | 1.9 | V | -13.08 | 25.47 | 54.00 | -28.53 |

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

**Test Frequency: Above 18GHz**

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 and Hopping |

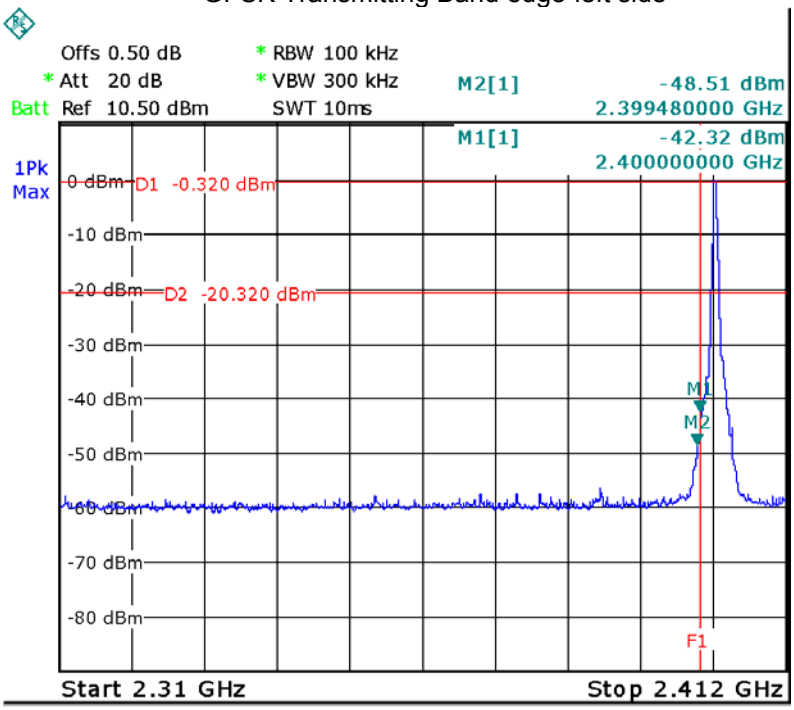
## 9.1 Test Procedure

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 analyser: RBW = 100 kHz, VBW = 300 kHz, Sweep = auto
   Detector function = peak, Trace = max hold

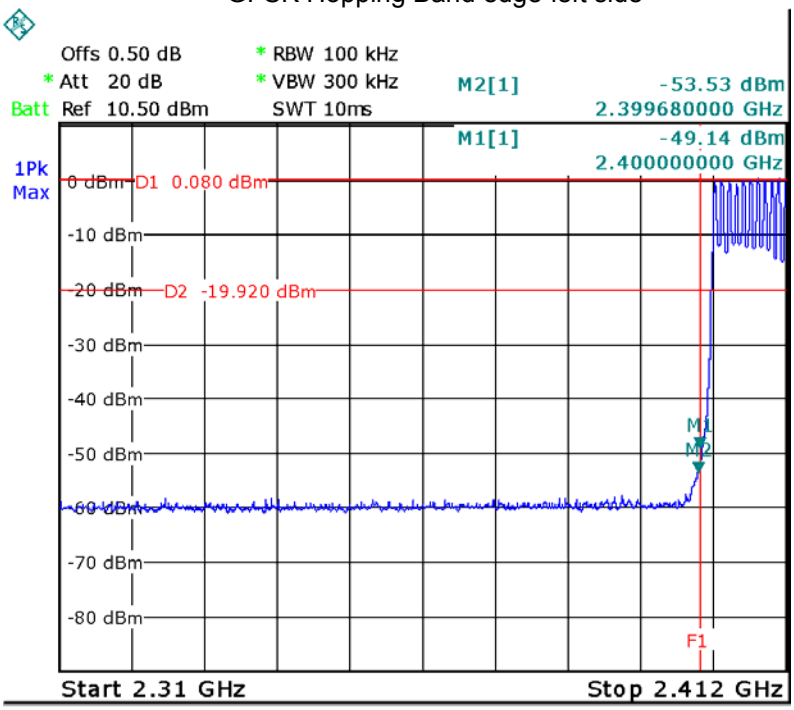
## 9.2 Test Result

Test plots

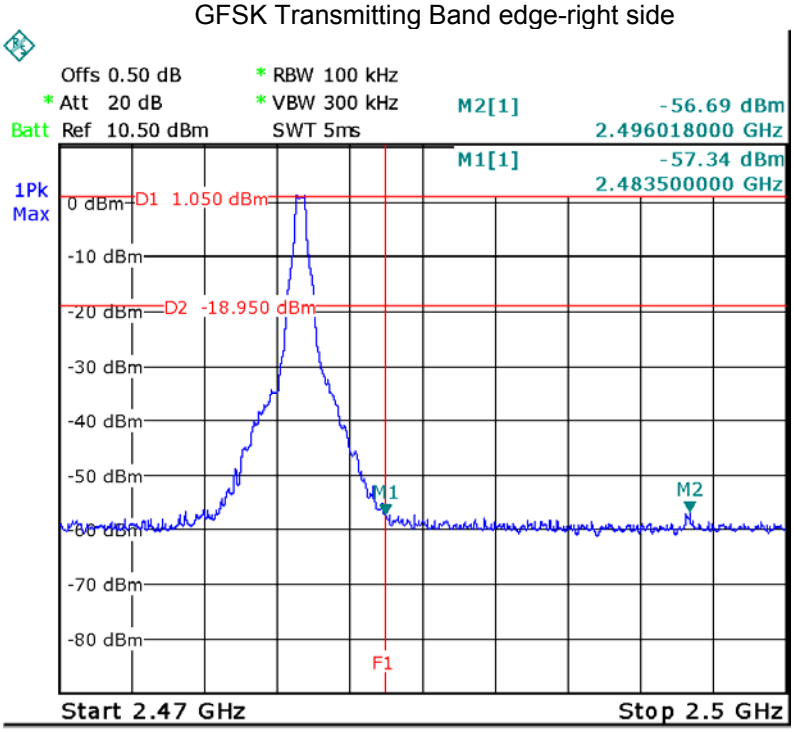
GFSK Transmitting Band edge-left side



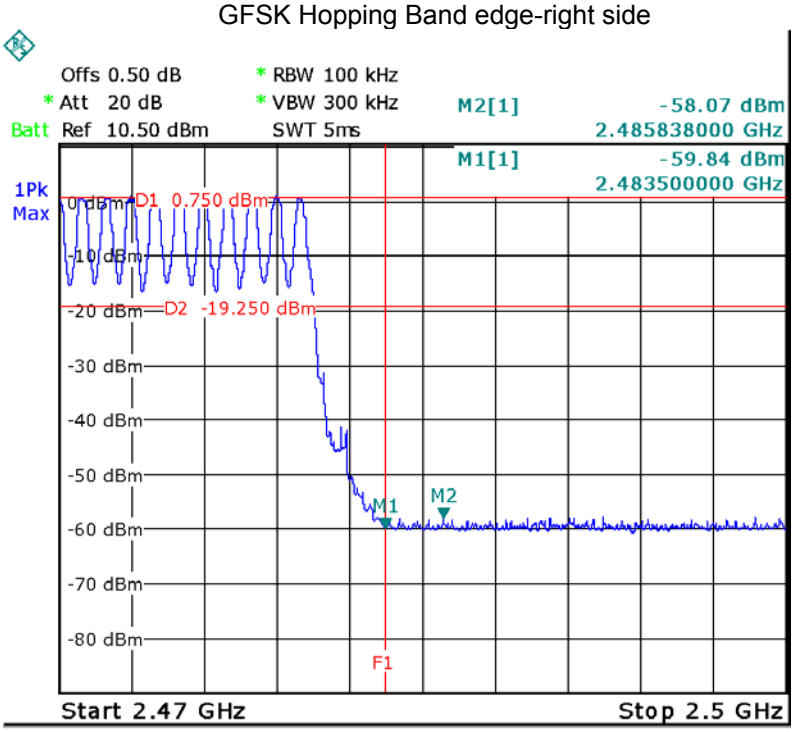

GFSK Hopping Band edge-left side



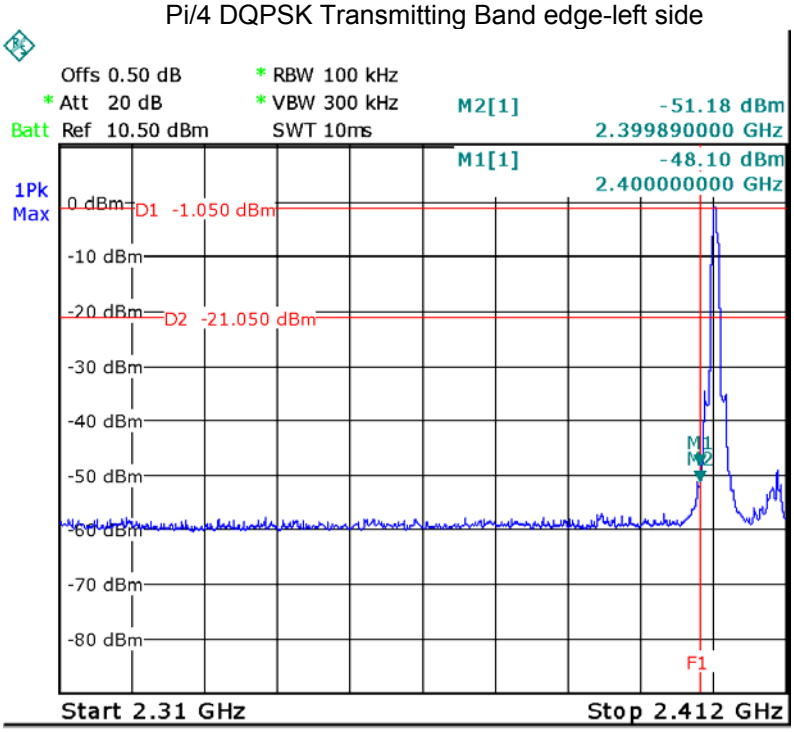
GFSK Transmitting Band edge-right side



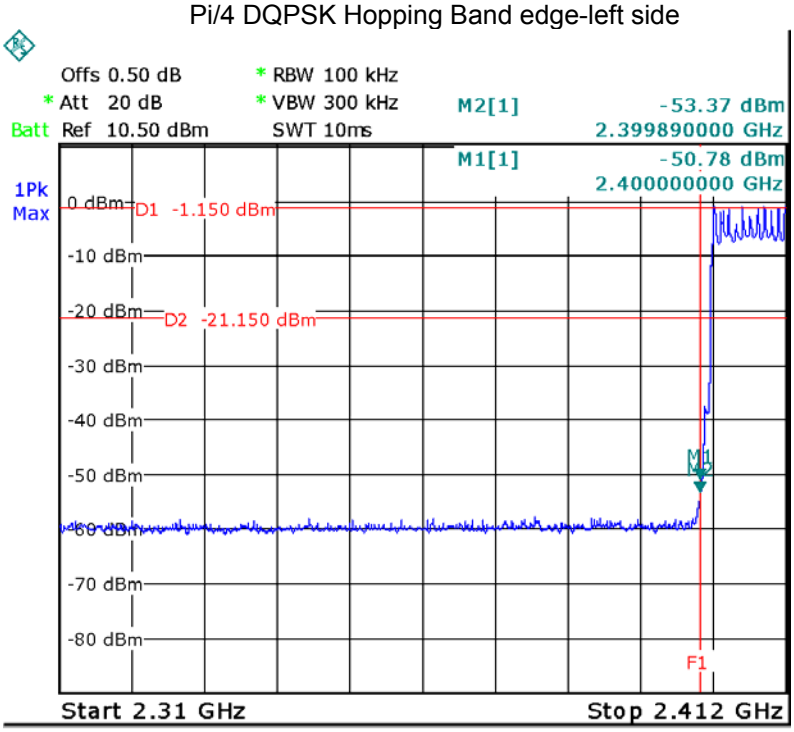

GFSK Hopping Band edge-right side



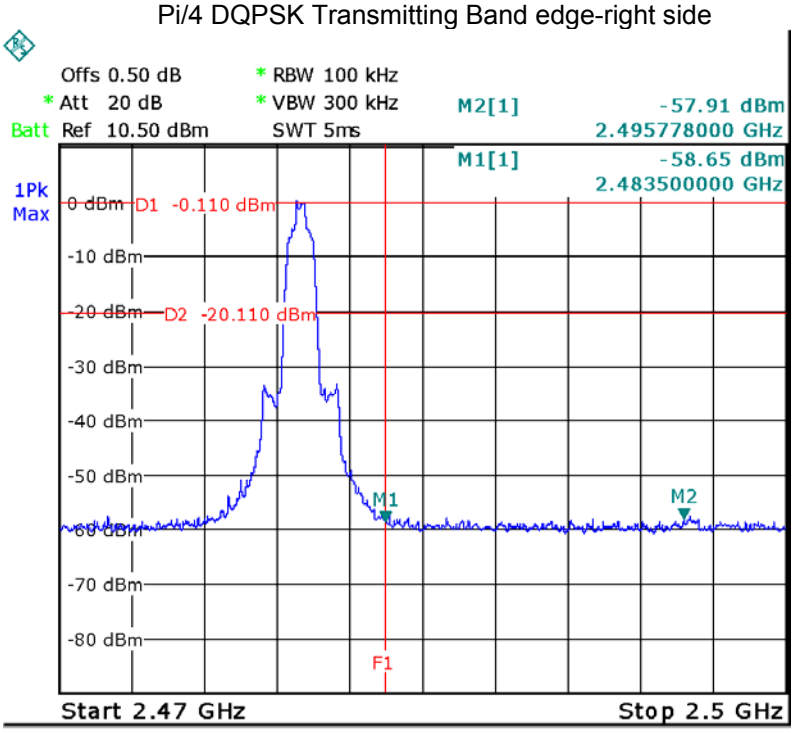
Pi/4 DQPSK Transmitting Band edge-left side



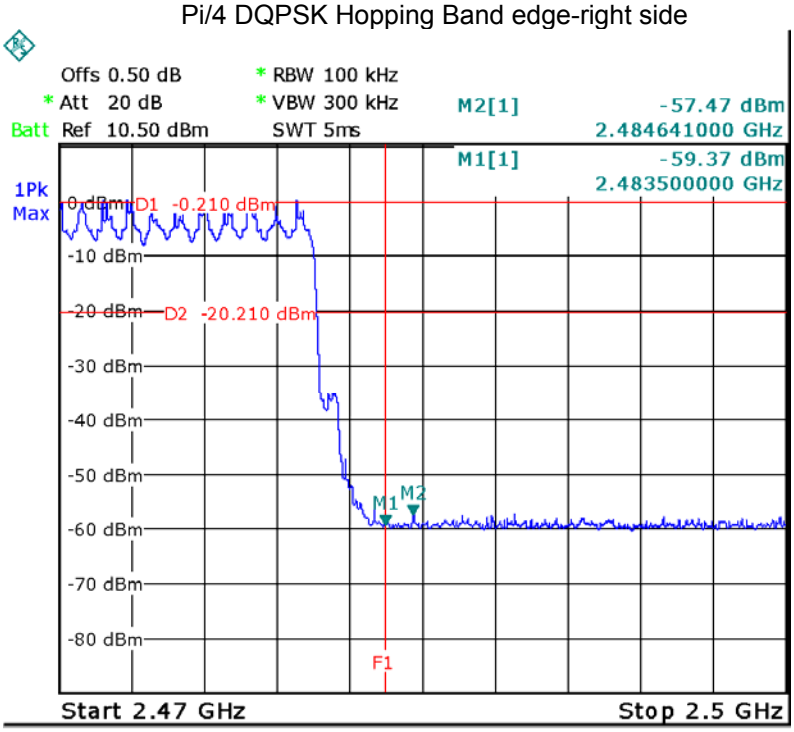

Pi/4 DQPSK Hopping Band edge-left side



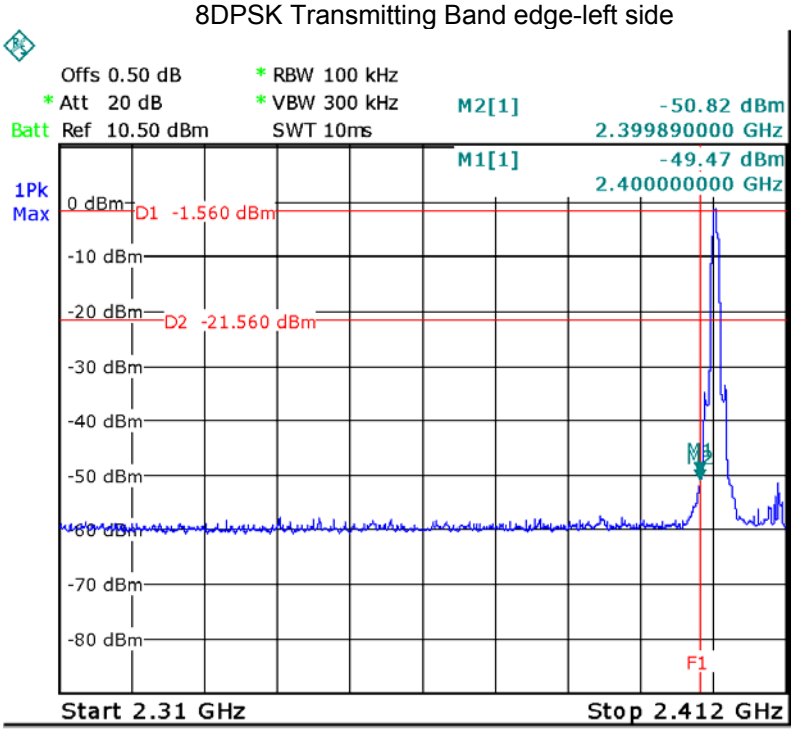
Pi/4 DQPSK Transmitting Band edge-right side



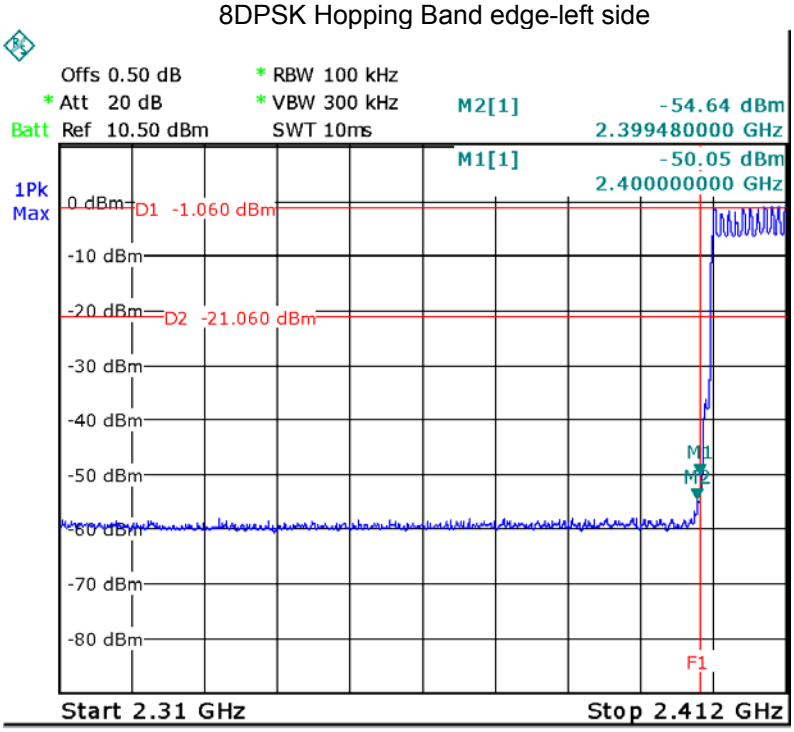

Pi/4 DQPSK Hopping Band edge-right side



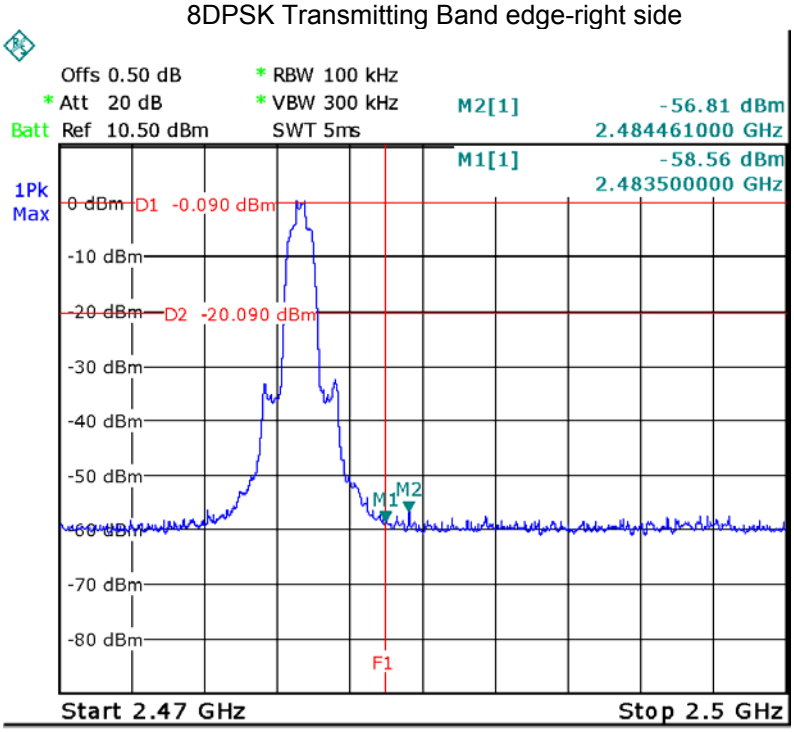
8DPSK Transmitting Band edge-left side



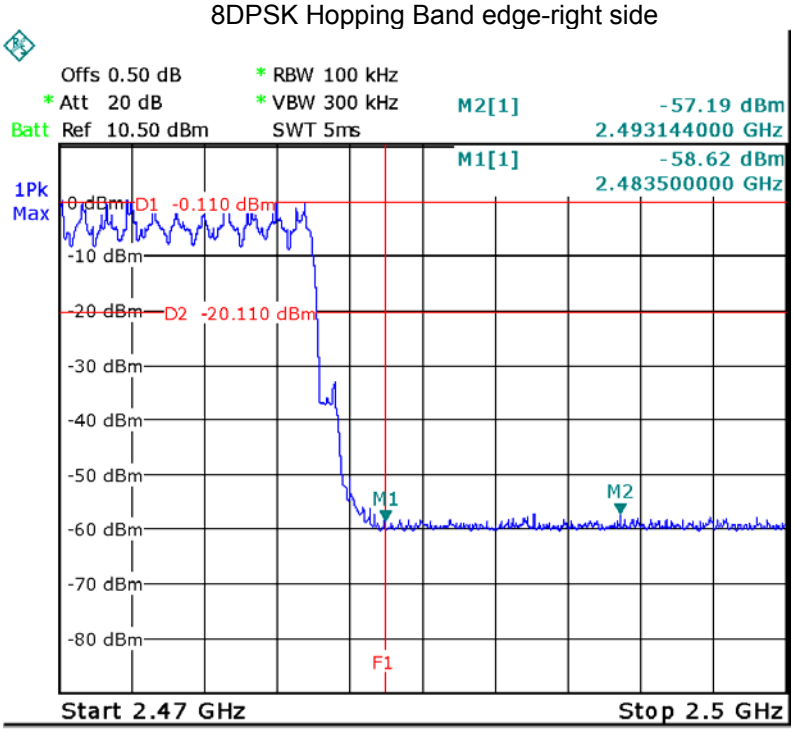

8DPSK Hopping Band edge-left side



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: ANSI C63.10:2013

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

## 10.1 Test Procedure

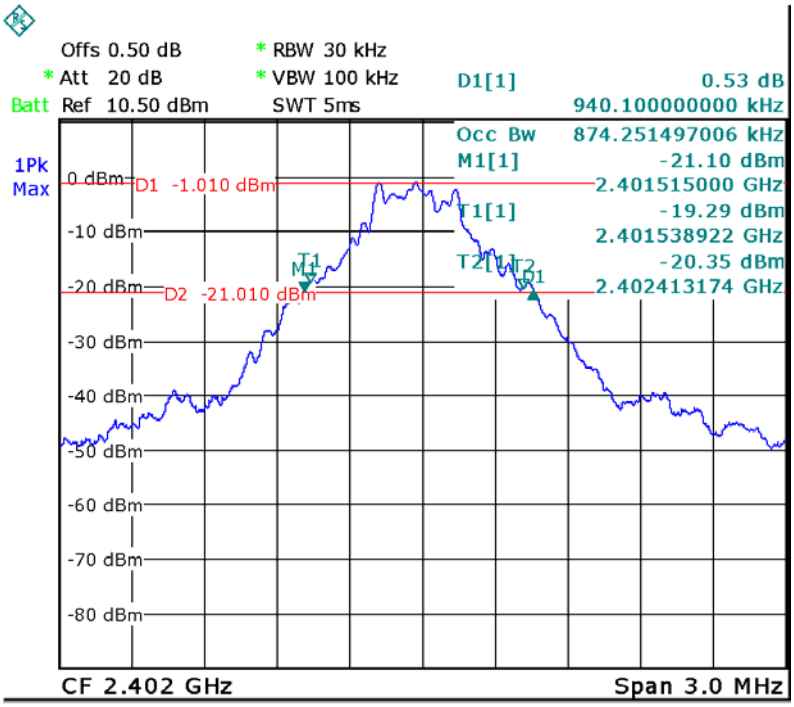
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyser: RBW = 30 kHz, VBW = 100 kHz

## 10.2 Test Result

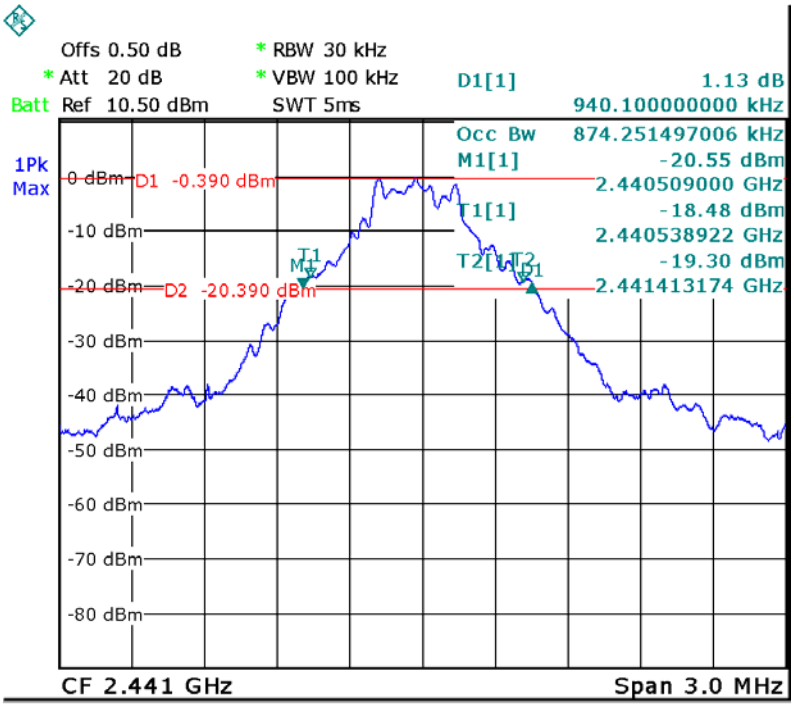
| Modulation | Test Channel | 20 dB Bandwidth | 99% Bandwidth |
|---|---|---|---|
| GFSK | Low | 0.940MHz | 0.874MHz |
| GFSK | Middle | 0.940MHz | 0.874MHz |
| GFSK | High | 0.940MHz | 0.874MHz |
| Pi/4 DQPSK | Low | 1.240MHz | 1.156MHz |
| Pi/4 DQPSK | Middle | 1.240MHz | 1.162MHz |
| Pi/4 DQPSK | High | 1.240MHz | 1.156MHz |
| 8DPSK | Low | 1.258 MHz | 1.162MHz |
| 8DPSK | Middle | 1.258 MHz | 1.174MHz |
| 8DPSK | High | 1.258 MHz | 1.168MHz |

Test plots

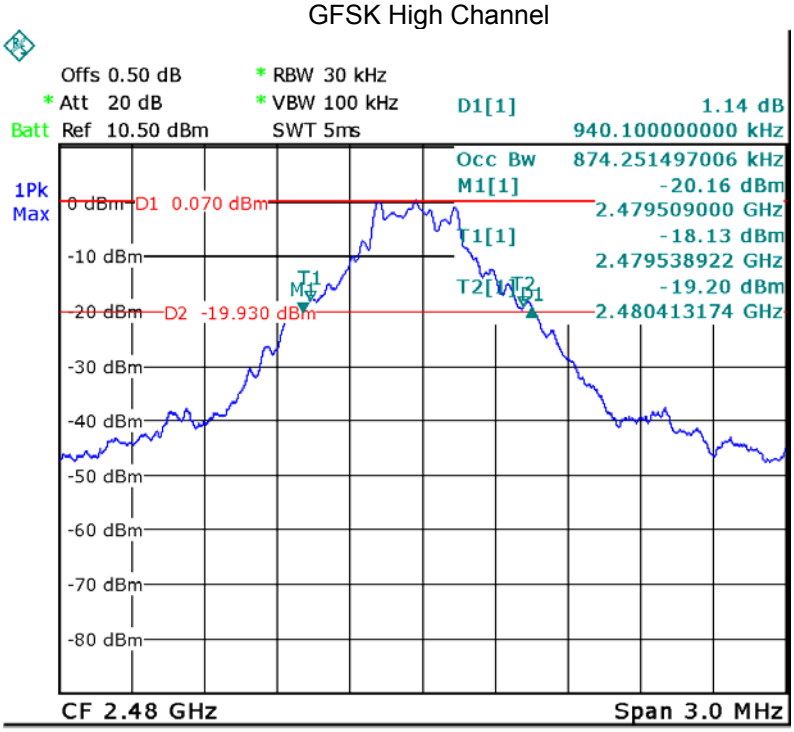
GFSK Low Channel



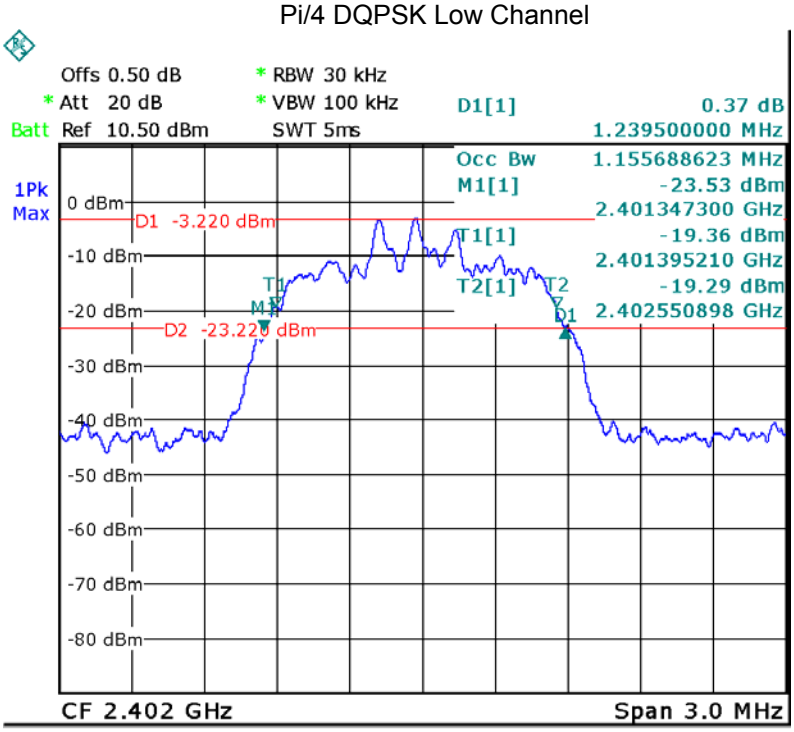

GFSK Middle Channel



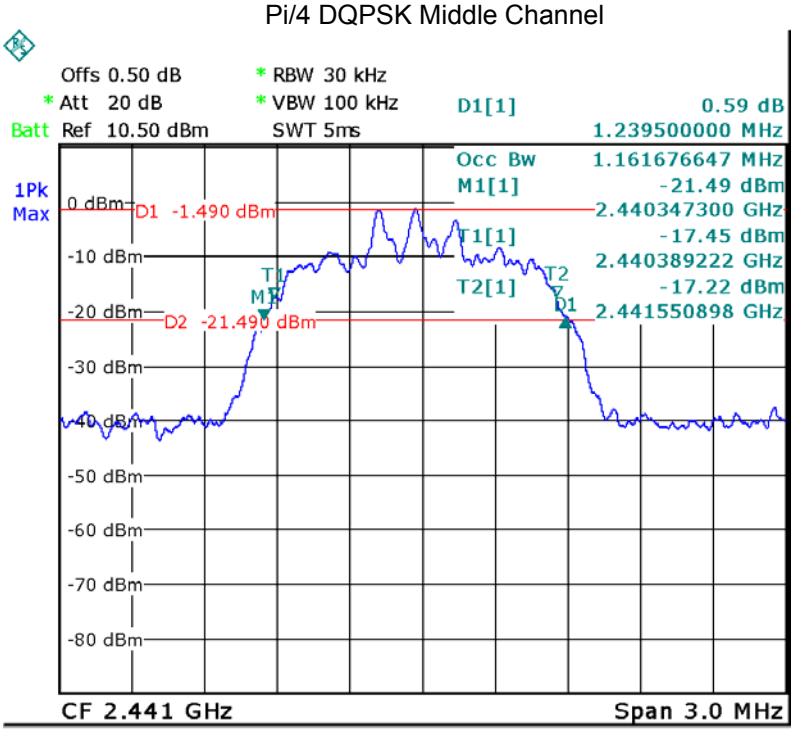
GFSK High Channel



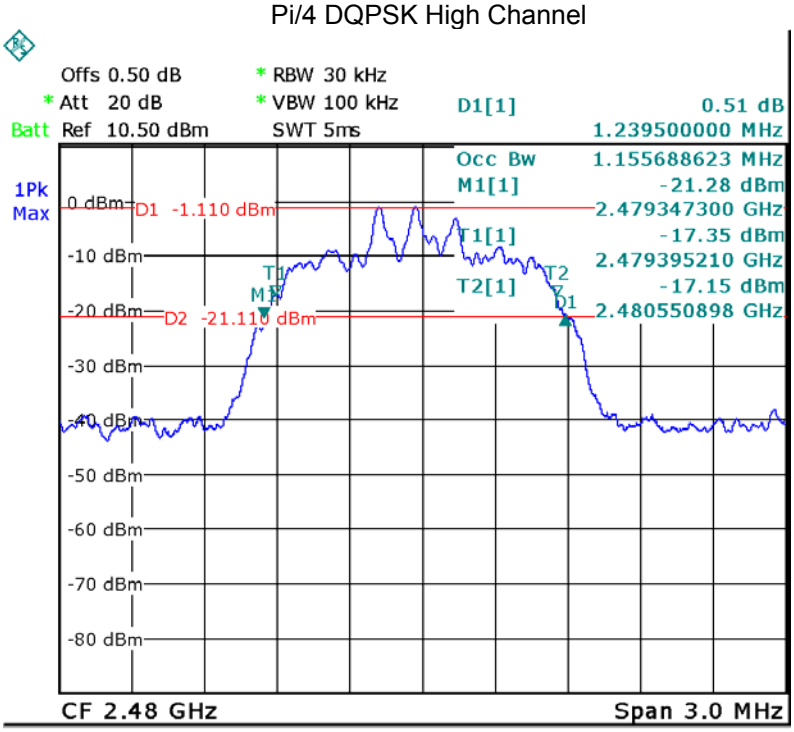

Pi/4 DQPSK Low Channel



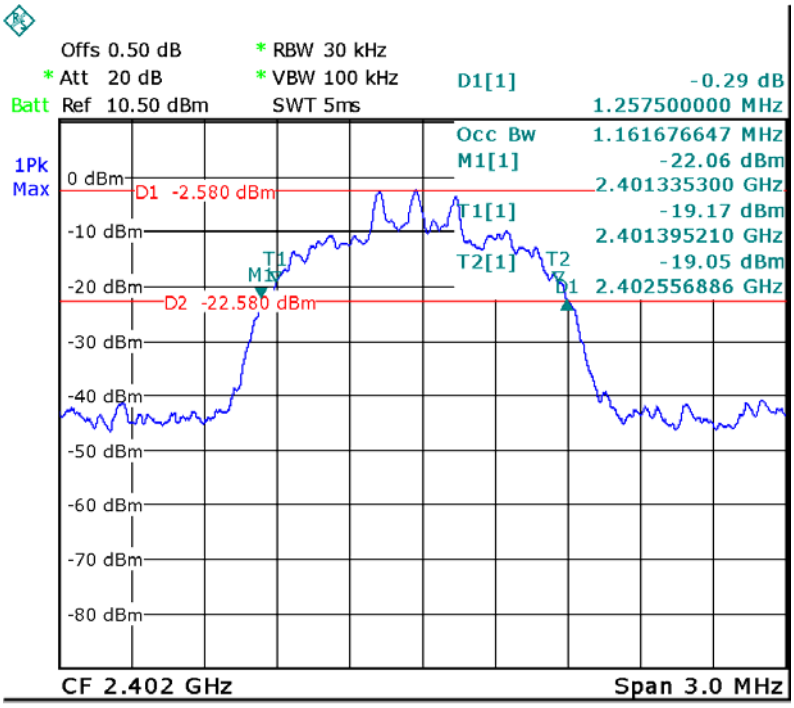
Pi/4 DQPSK Middle Channel



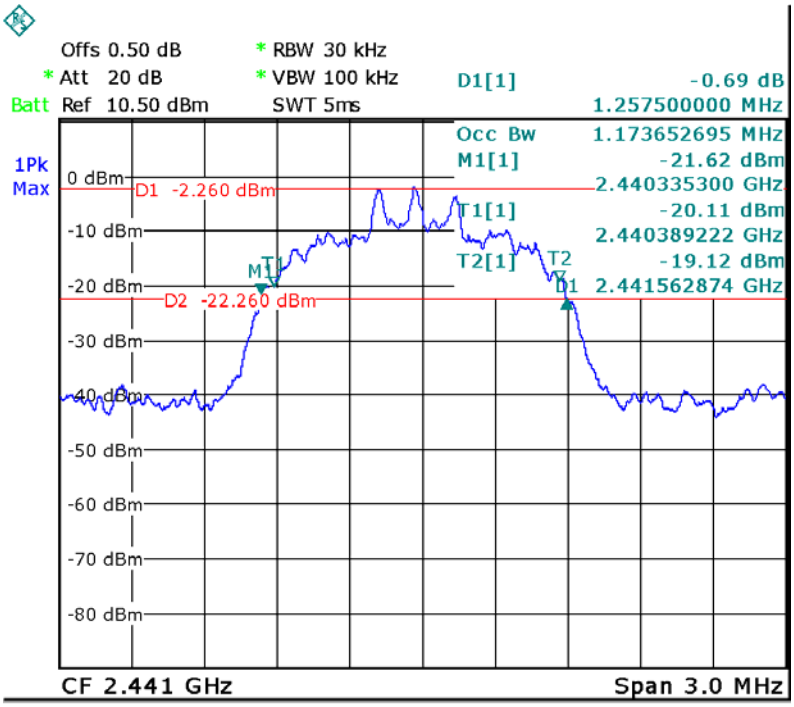

Pi/4 DQPSK High Channel



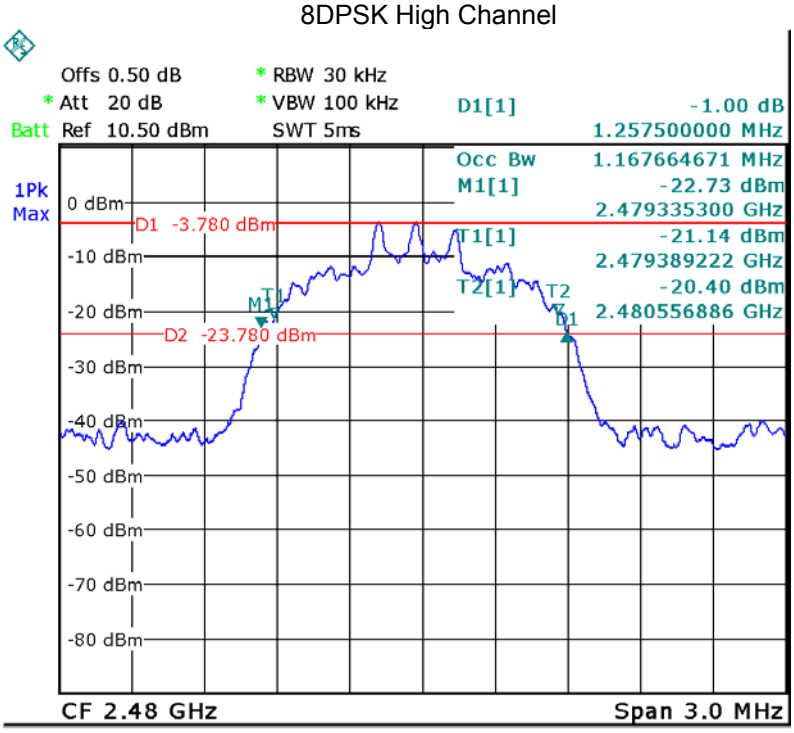
8DPSK Low Channel




8DPSK Middle Channel



8DPSK High Channel



# 11 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI 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 0.125watts (20.97 dBm) limit applies.

Test mode: Test in fixing frequency transmitting mode.

## 11.1 Test Procedure

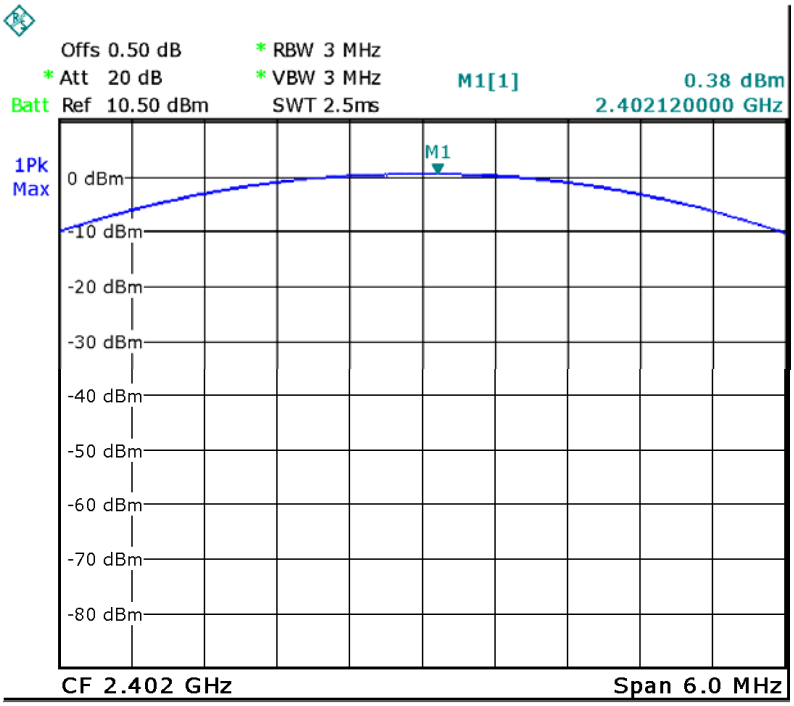
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 3 MHz VBW =3 MHz Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

## 11.2 Test Result

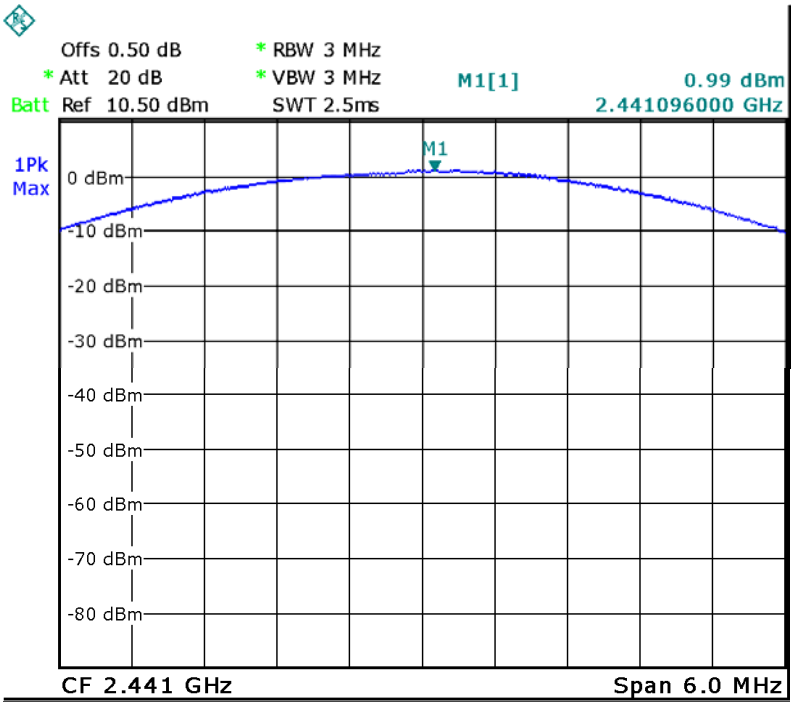
| Test Mode | Data Rate | Peak Power(dBm) | | | Limit (dBm) |
|---|---|---|---|---|---|
| | | Low Channel | Middle Channel | High Channel | |
| GFSK | 1Mbps | 0.38 | 0.99 | -1.11 | 20.97 |
| 4*π4DQPSK | 2Mbps | -0.53 | -0.73 | -2.12 | 20.97 |
| 8DPSK | 3Mbps | -0.24 | -0.70 | -1.91 | 20.97 |

Test plots

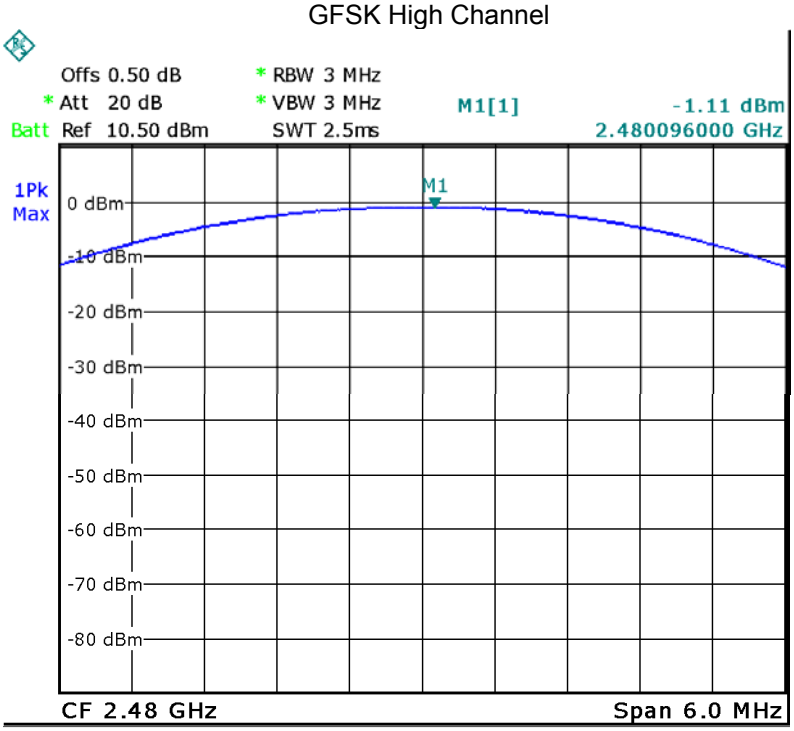
GFSK Low Channel



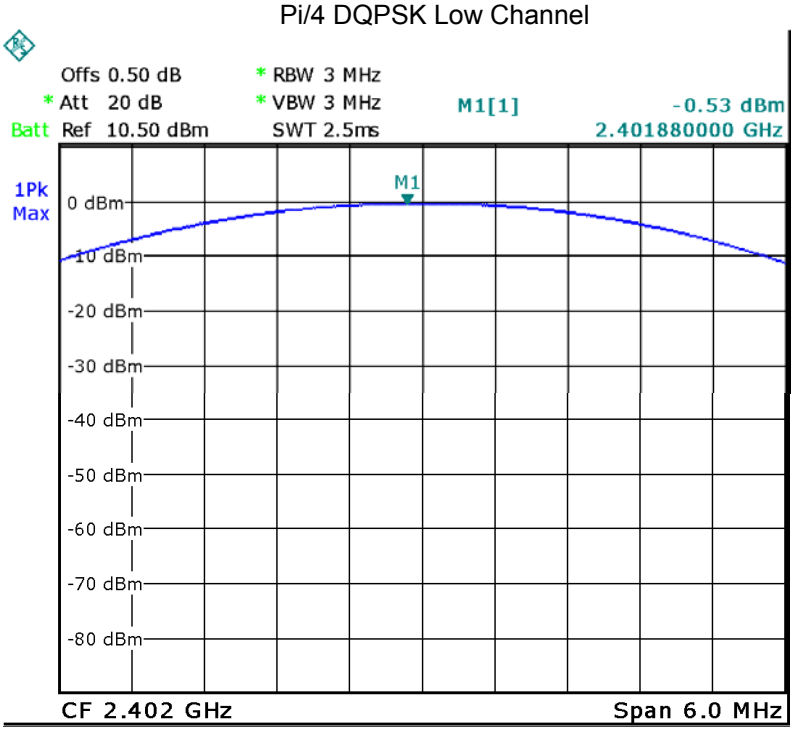

GFSK Middle Channel



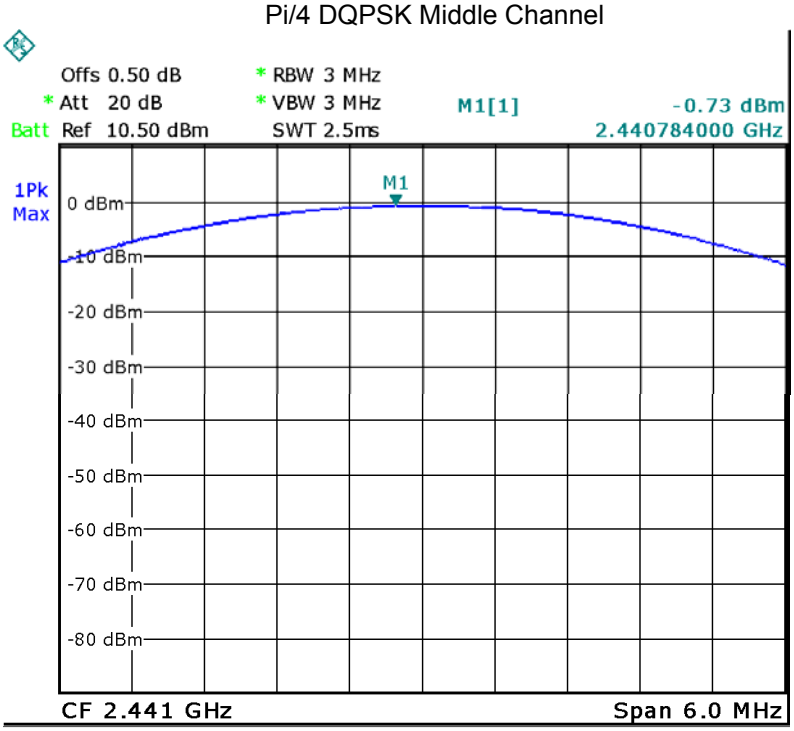
GFSK High Channel



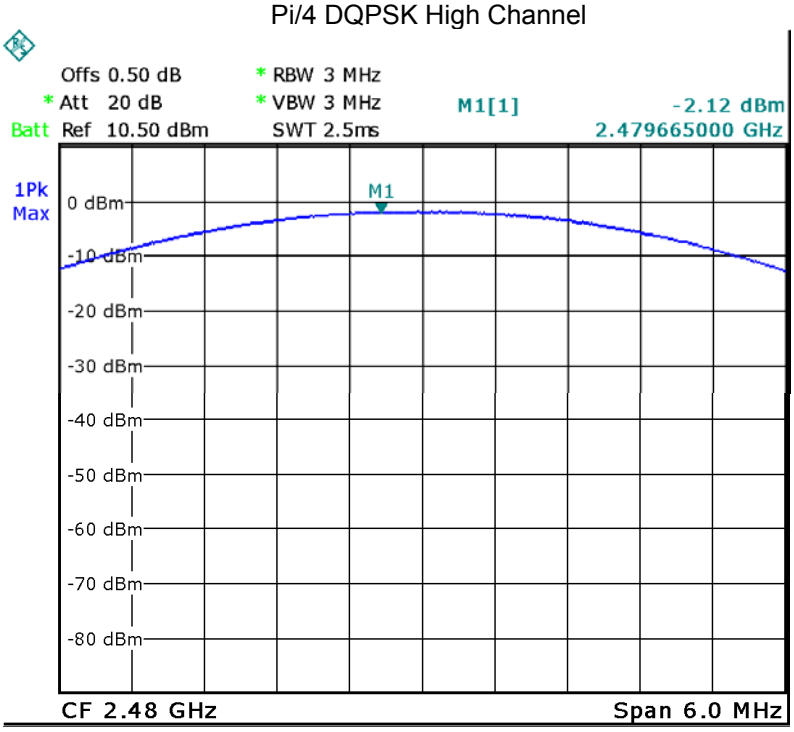

Pi/4 DQPSK Low Channel



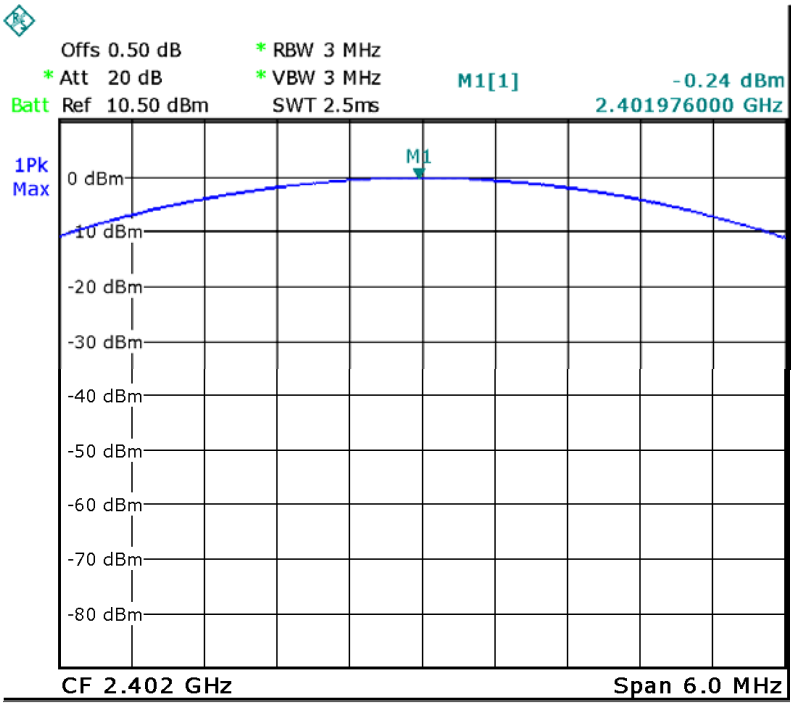
Pi/4 DQPSK Middle Channel



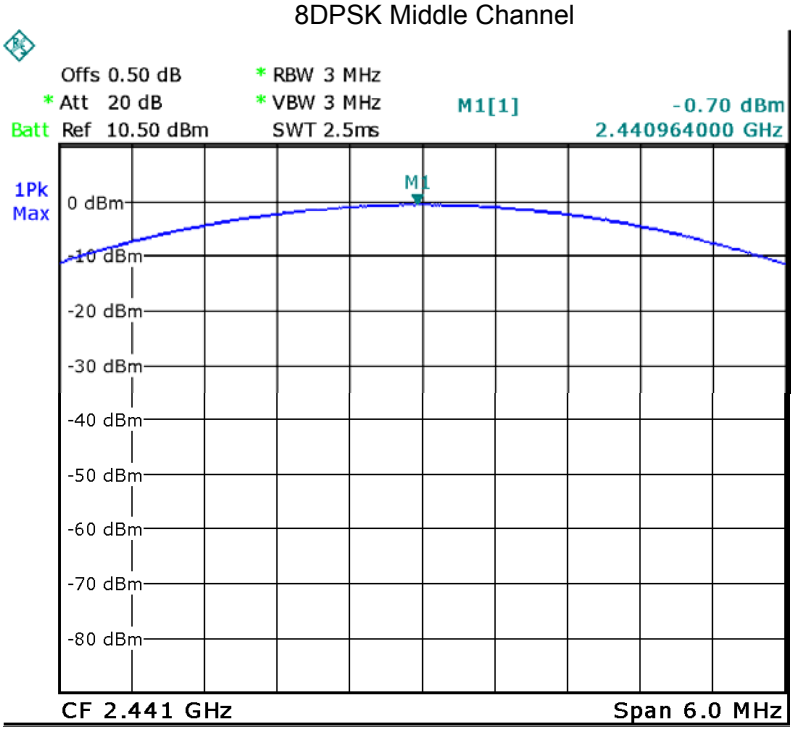

Pi/4 DQPSK High Channel



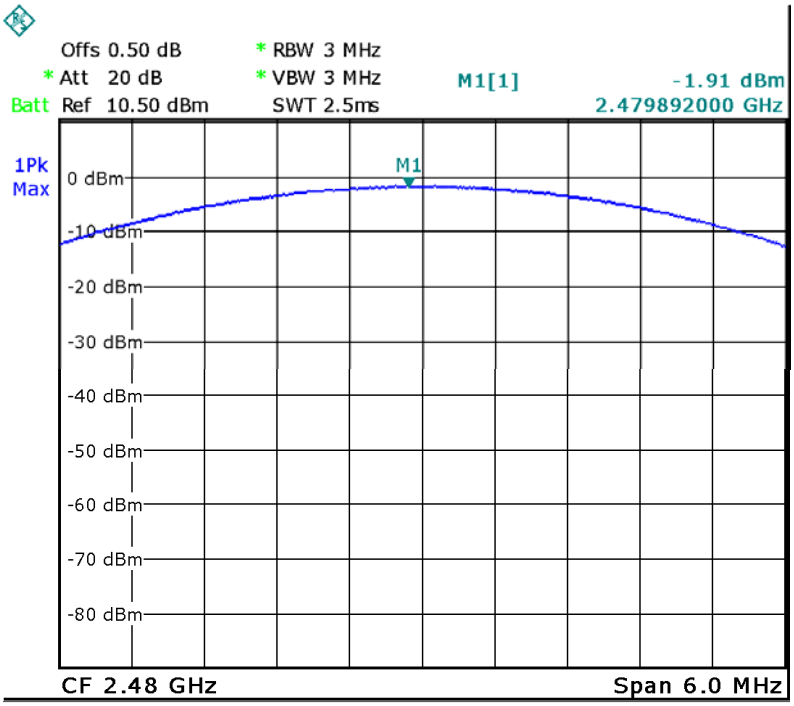
8DPSK Low Channel




8DPSK Middle Channel



8DPSK High Channel



# 12 Hopping Channel Separation

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI 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 2400-2483.5MHz 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

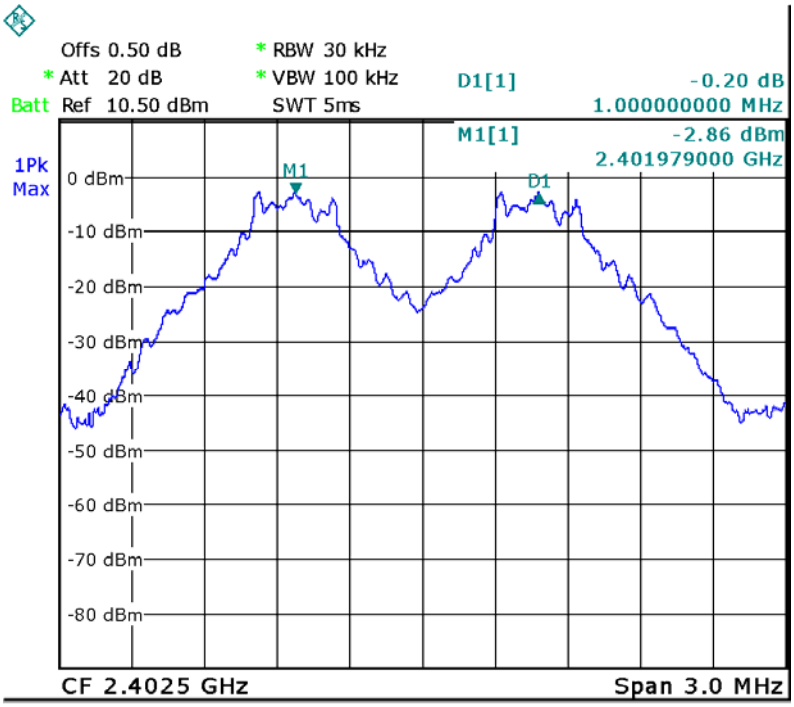
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 30KHz. VBW = 100 KHz, Span = 3MHz Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine 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 Result

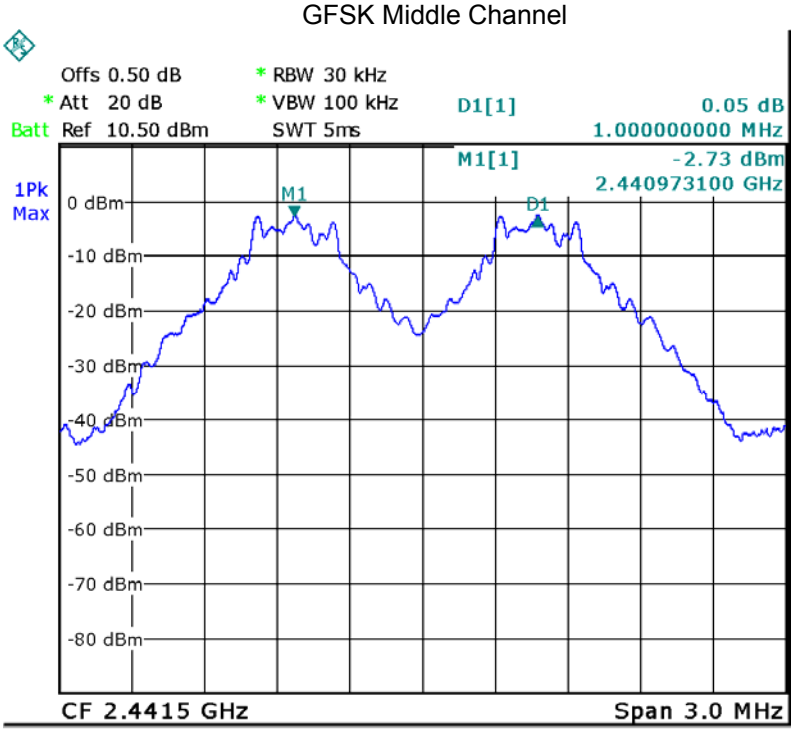
| Modulation | Test Channel | Separation (MHz) | Result |
|---|---|---|---|
| GFSK | Low | 1 MHz | PASS |
| GFSK | Middle | 1 MHz | PASS |
| GFSK | High | 1 MHz | PASS |
| Pi/4 DQPSK | Low | 1 MHz | PASS |
| Pi/4 DQPSK | Middle | 1 MHz | PASS |
| Pi/4 DQPSK | High | 1 MHz | PASS |
| 8DPSK | Low | 1 MHz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

Test plots

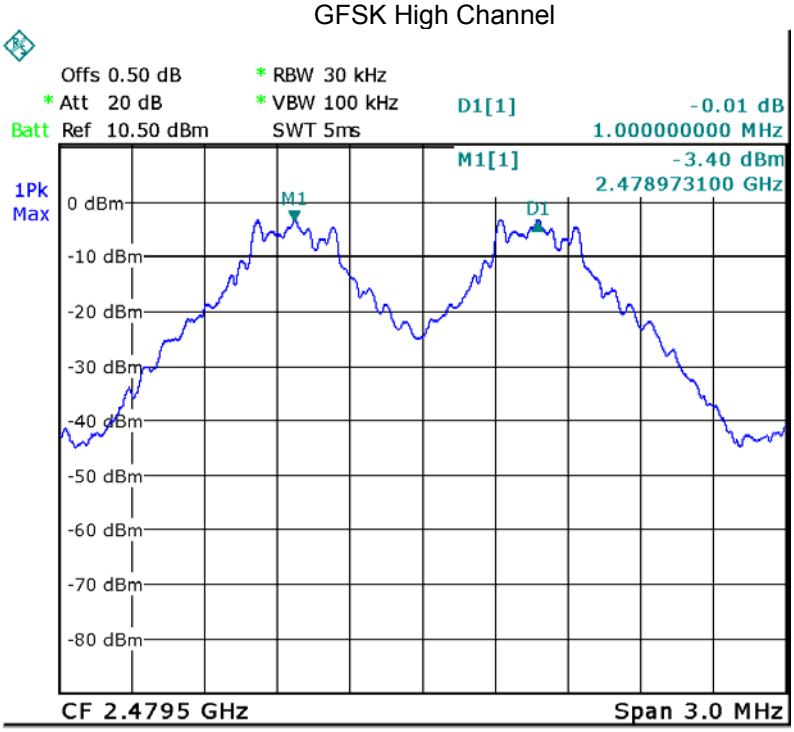
GFSK Low Channel



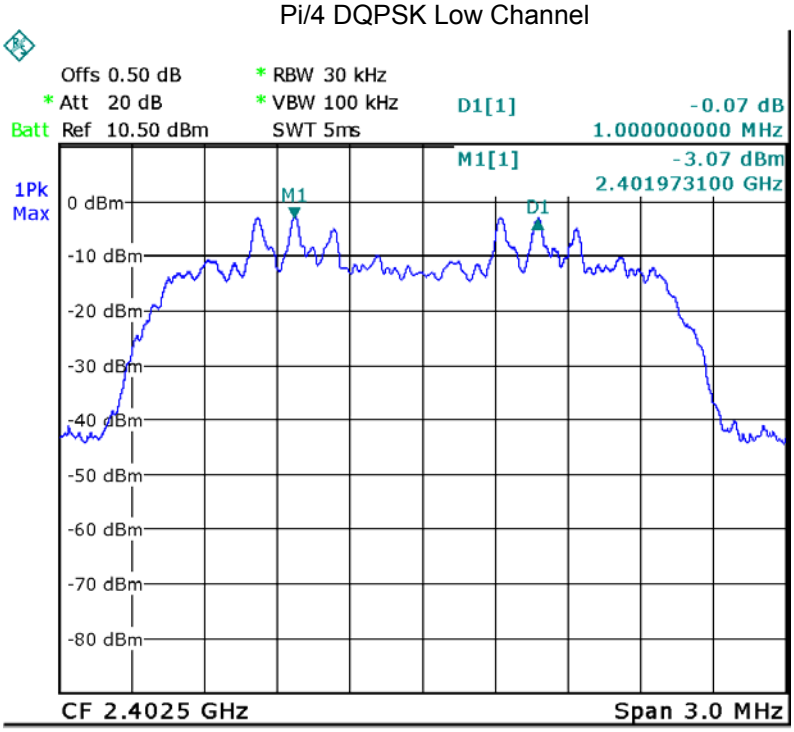

GFSK Middle Channel



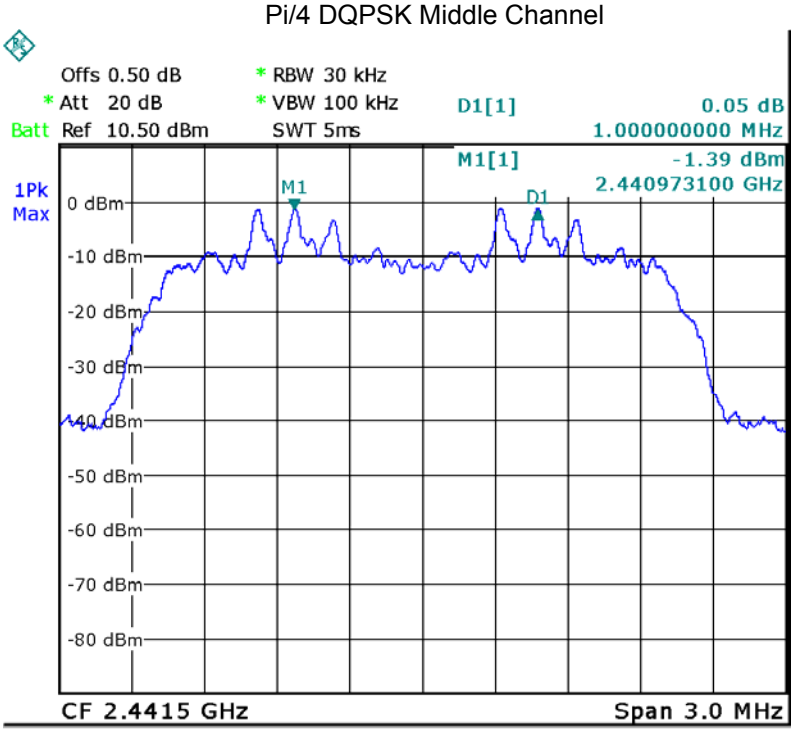
GFSK High Channel



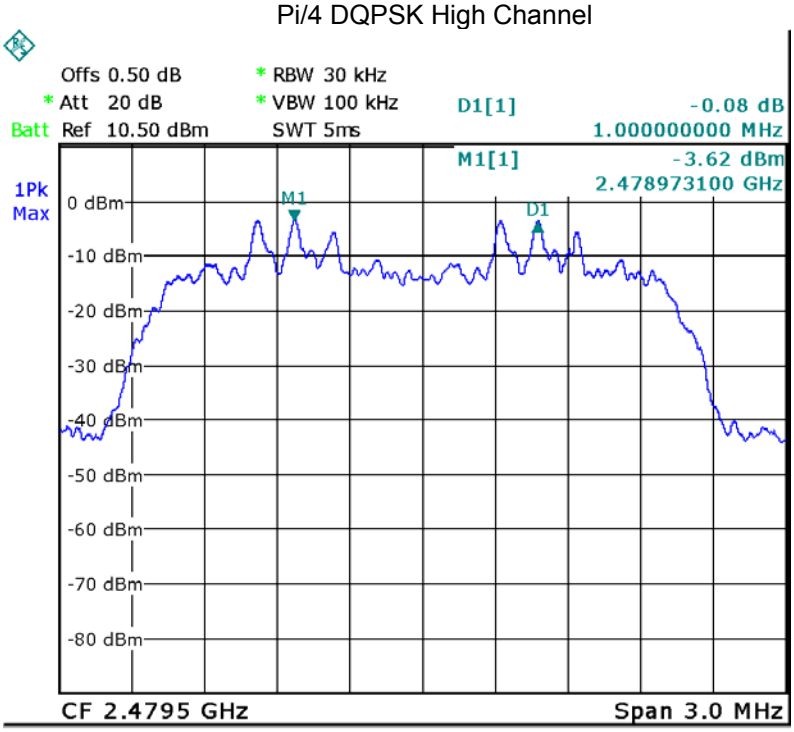

Pi/4 DQPSK Low Channel



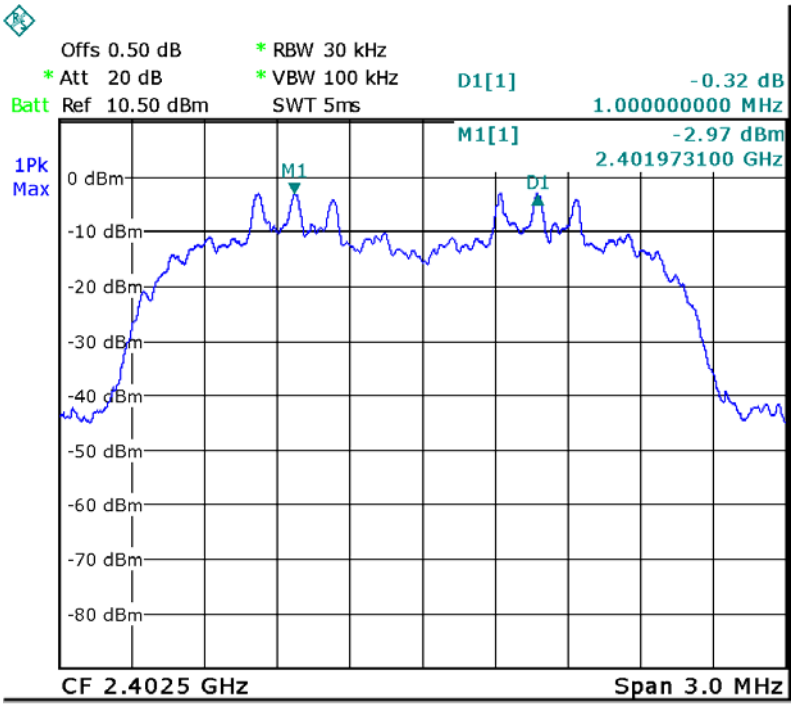
Pi/4 DQPSK Middle Channel



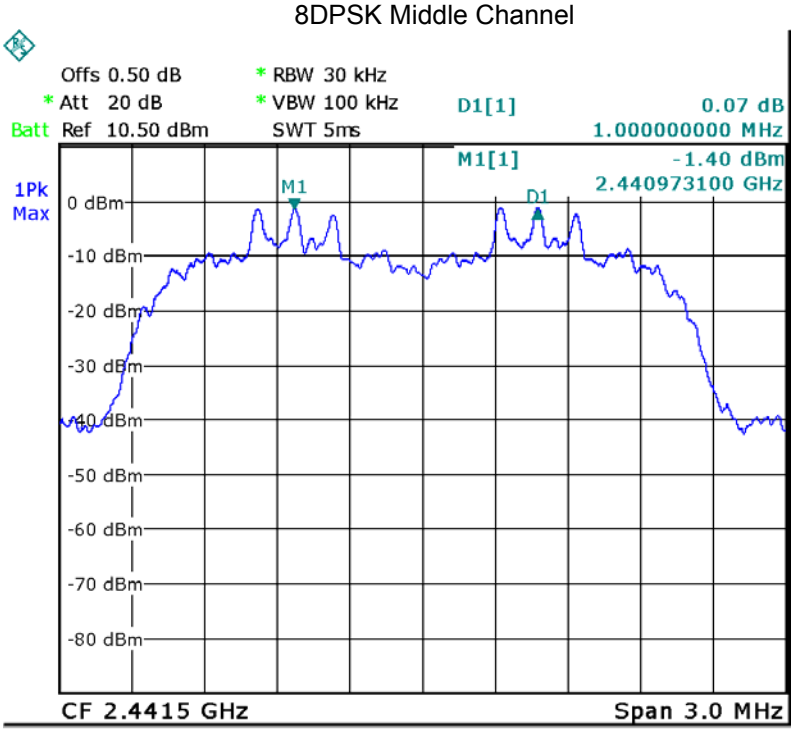

Pi/4 DQPSK High Channel



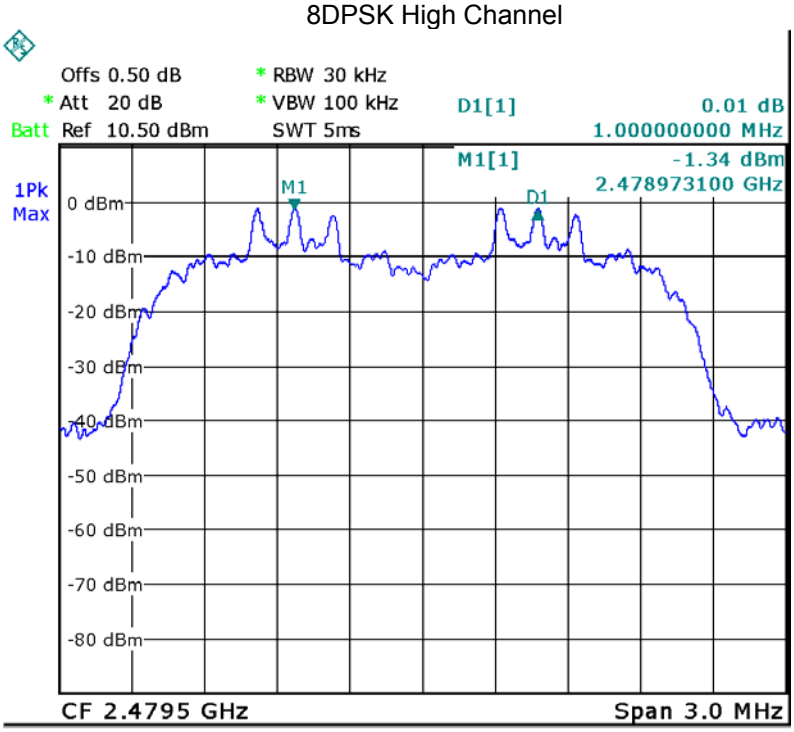
8DPSK Low Channel




8DPSK Middle Channel



8DPSK High Channel



# 13 Number of Hopping Frequency

| | |
|---|---|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247 |
| Test Method: | ANSI 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. |

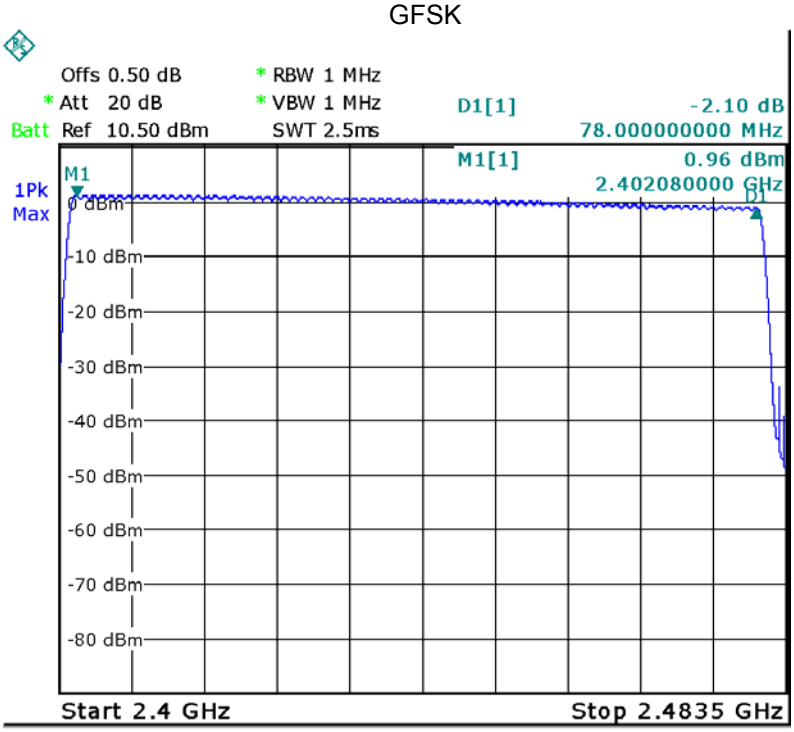
## 13.1 Test Procedure

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 analyser: RBW = 1MHz. VBW = 1MHz. 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 analyser: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

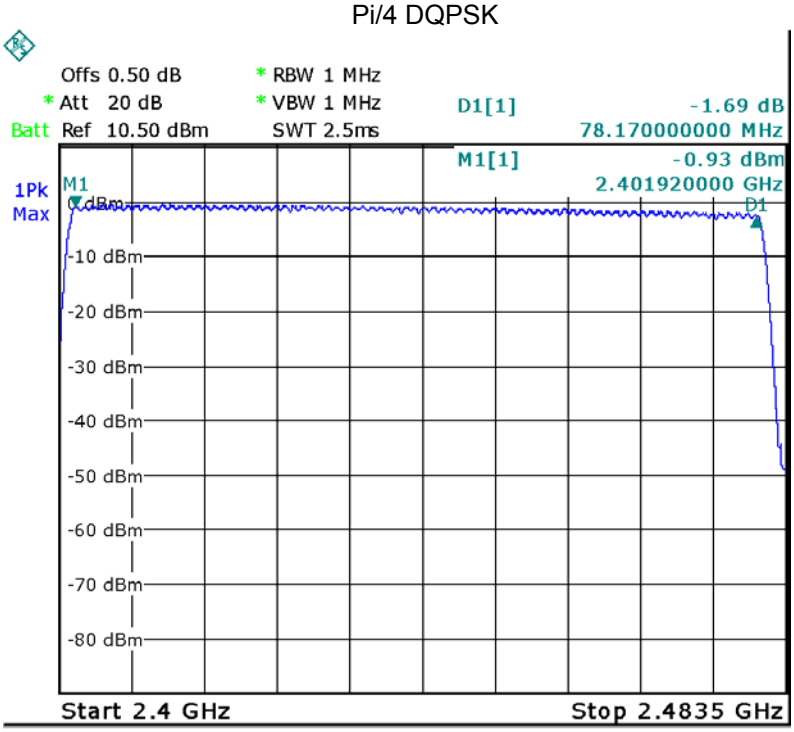
## 13.2 Test Result

Test Plots: 79 Channels in total

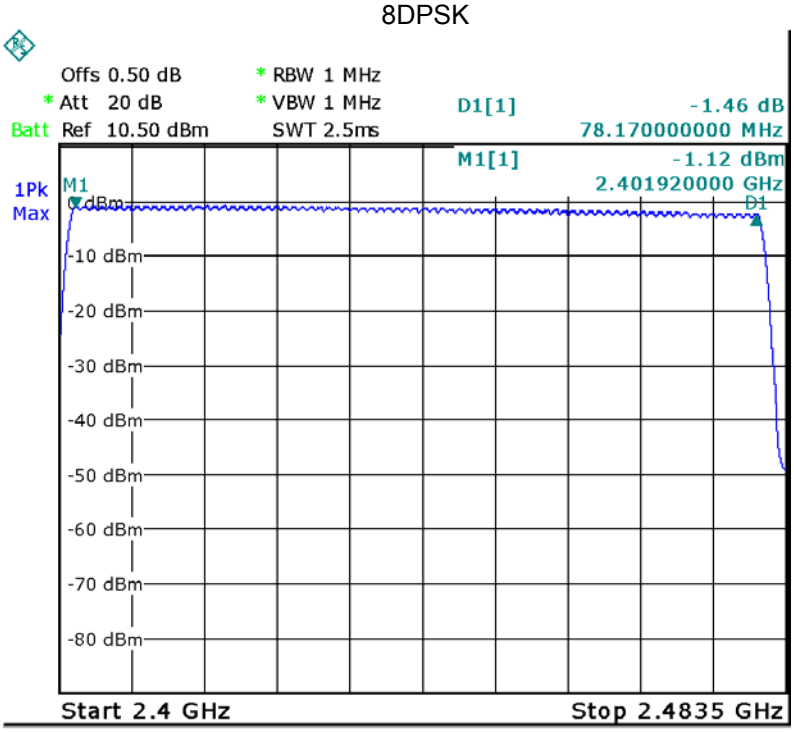
GFSK



Pi/4 DQPSK




8DPSK



# 14 Dwell Time

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI 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 analyser 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. Set the EUT for DH5, DH3 and DH1 packet transmitting.
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 Result

DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).

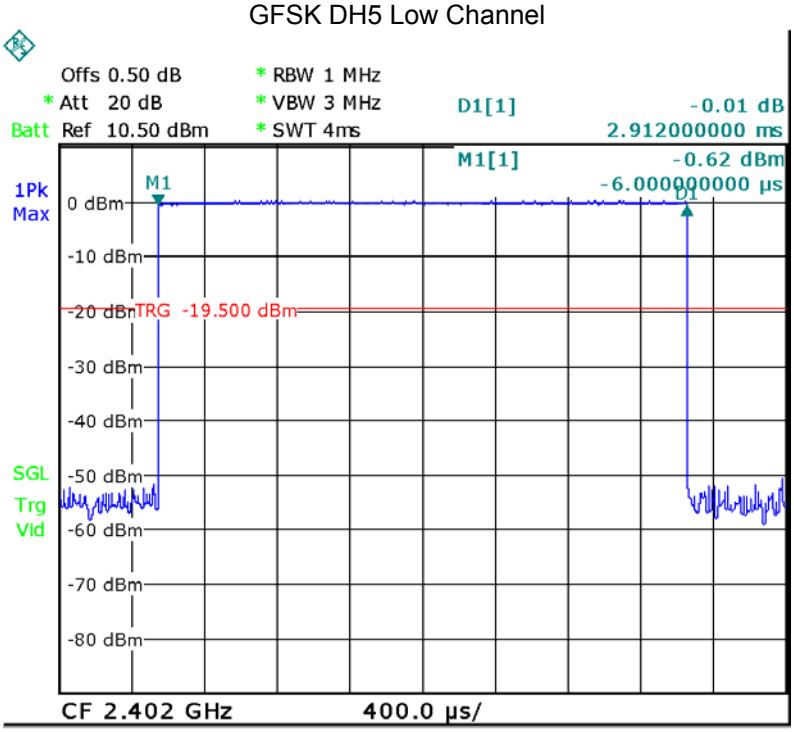
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

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:

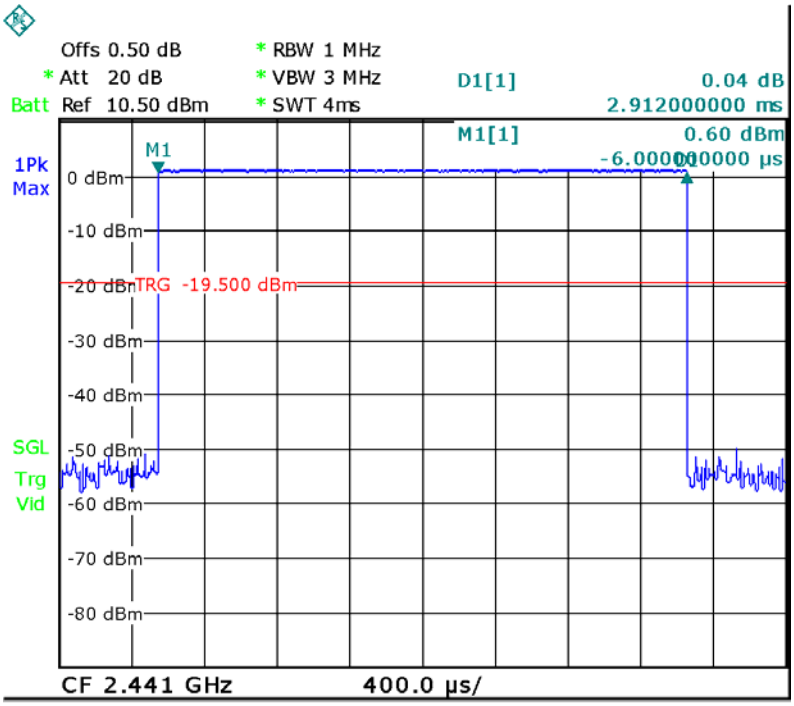
| Data Packet | Dwell Time(s) |
|---|---|
| DH5 | 1600/79/6*0.4*79*(MkrDelta)/1000 |
| DH3 | 1600/79/4*0.4*79*(MkrDelta)/1000 |
| DH1 | 1600/79/2*0.4*79*(MkrDelta)/1000 |
| Remark: Mkr Delta is once pulse time. Only the worst data (DH5) were show as follow. | |

| Modulation | Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|---|---|---|---|---|---|
| GFSK | DH5 | Low | 2.912 | 0.311 | 0.4 |
| | | middle | 2.912 | 0.311 | 0.4 |
| | | High | 2.912 | 0.311 | 0.4 |
| Pi/4DQPSK | DH5 | Low | 2.912 | 0.311 | 0.4 |
| | | middle | 2.912 | 0.311 | 0.4 |
| | | High | 2.912 | 0.311 | 0.4 |
| 8DPSK | DH5 | Low | 2.912 | 0.311 | 0.4 |
| | | middle | 2.912 | 0.311 | 0.4 |
| | | High | 2.912 | 0.311 | 0.4 |

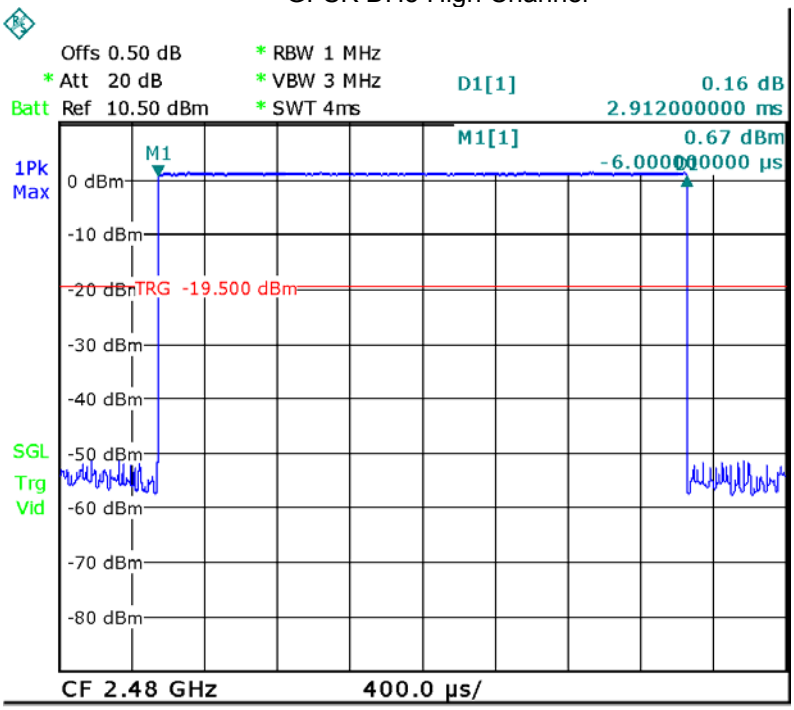
Test Plots
GFSK DH5 Low Channel



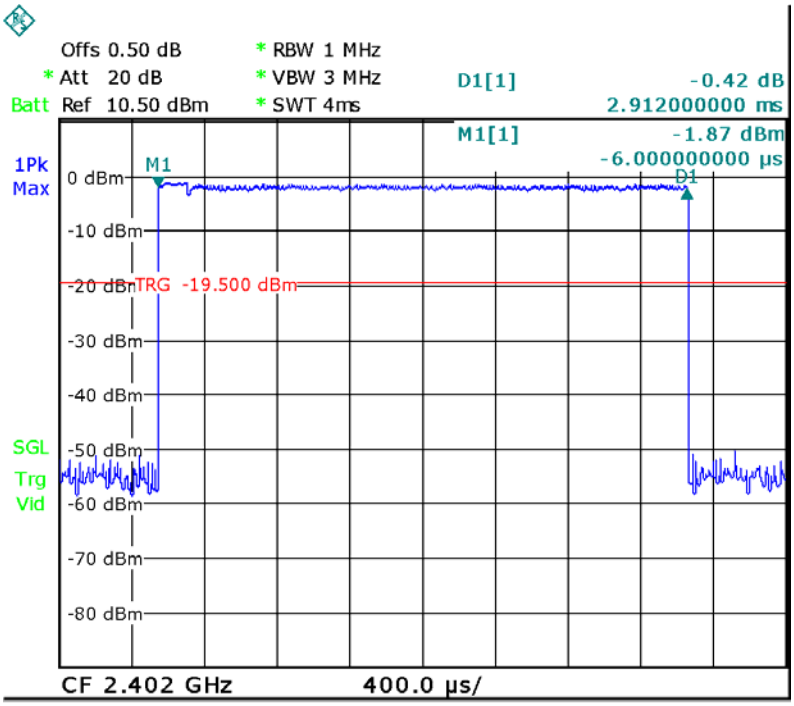
GFSK DH5 Middle Channel



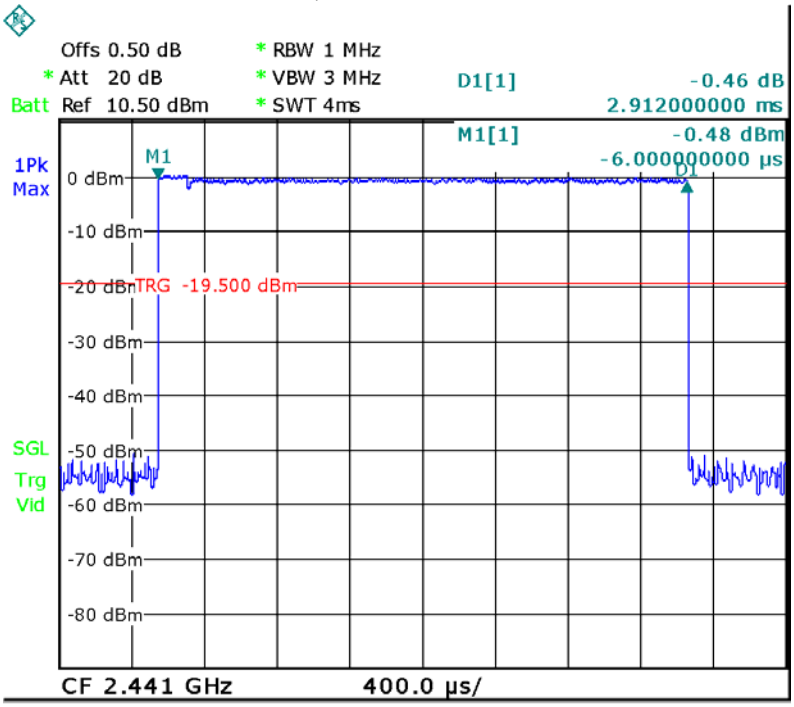

GFSK DH5 High Channel



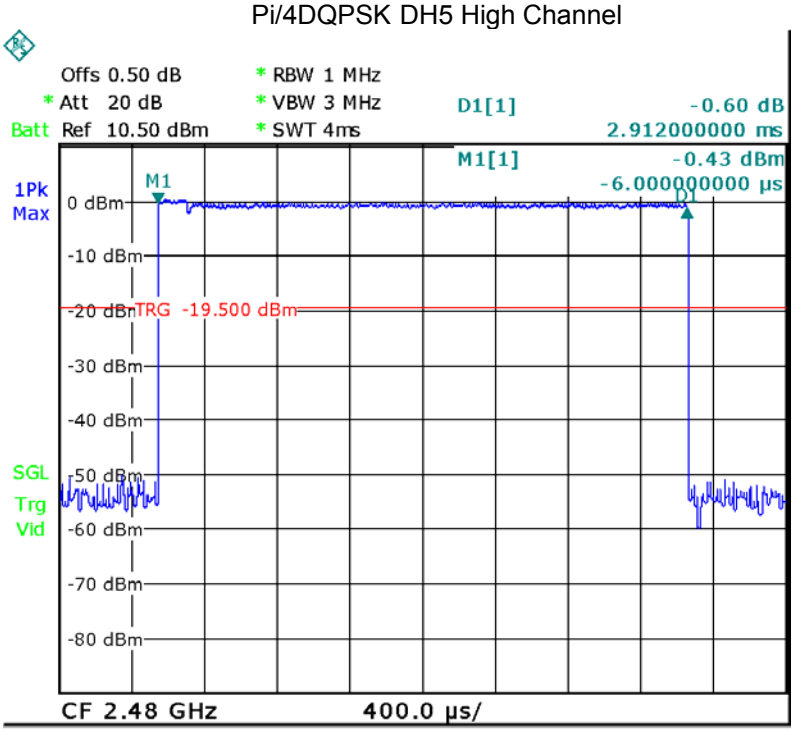
Pi/4DQPSK DH5 Low Channel



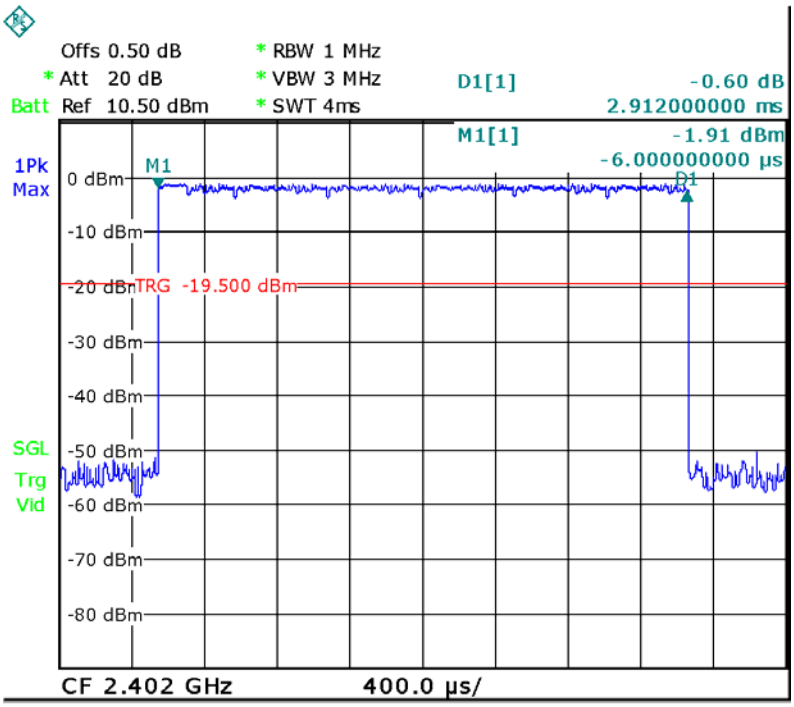

Pi/4DQPSK DH5 Middle Channel



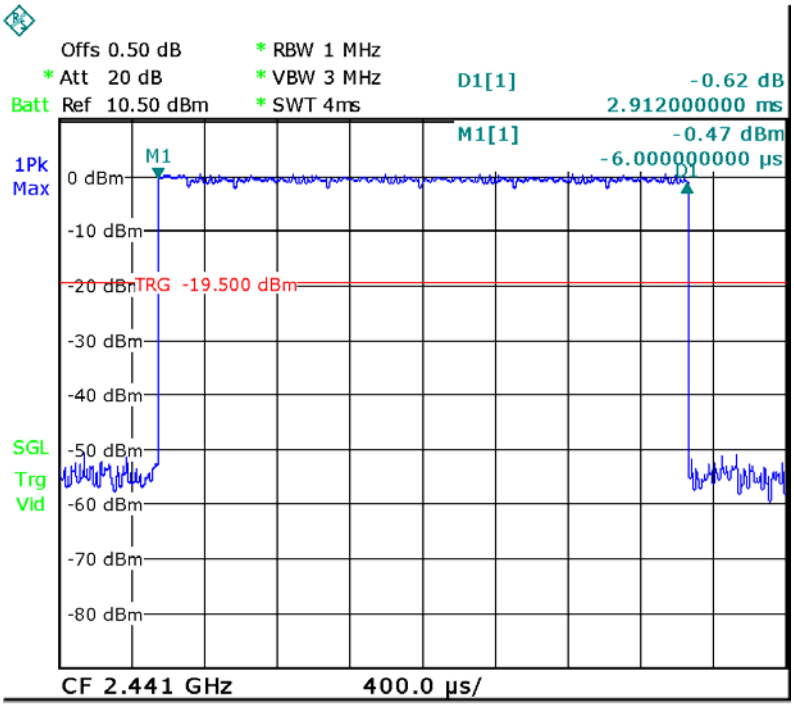
Pi/4DQPSK DH5 High Channel



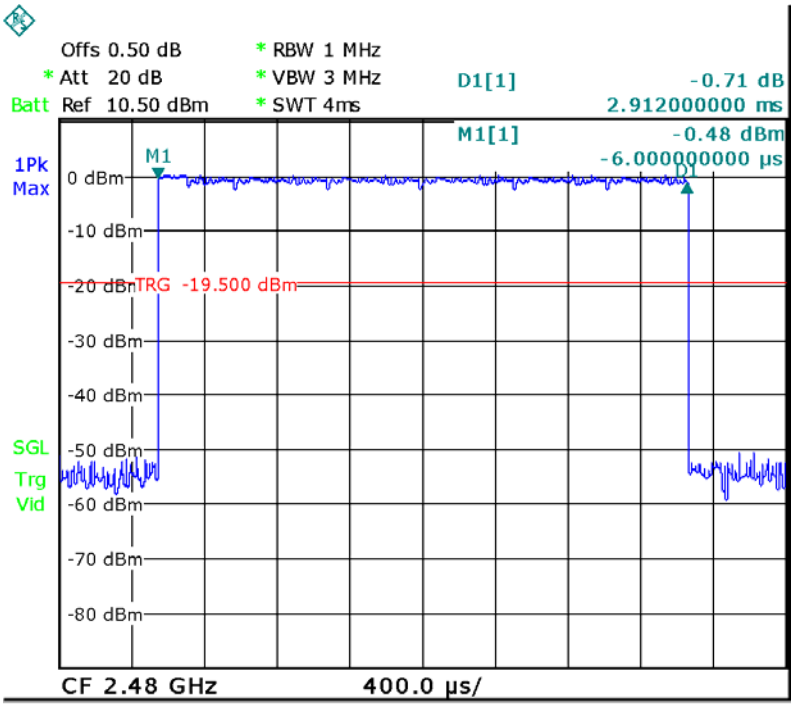

8DPSK DH5 Low Channel



8DPSK DH5 Middle Channel




8DPSK DH5 High Channel



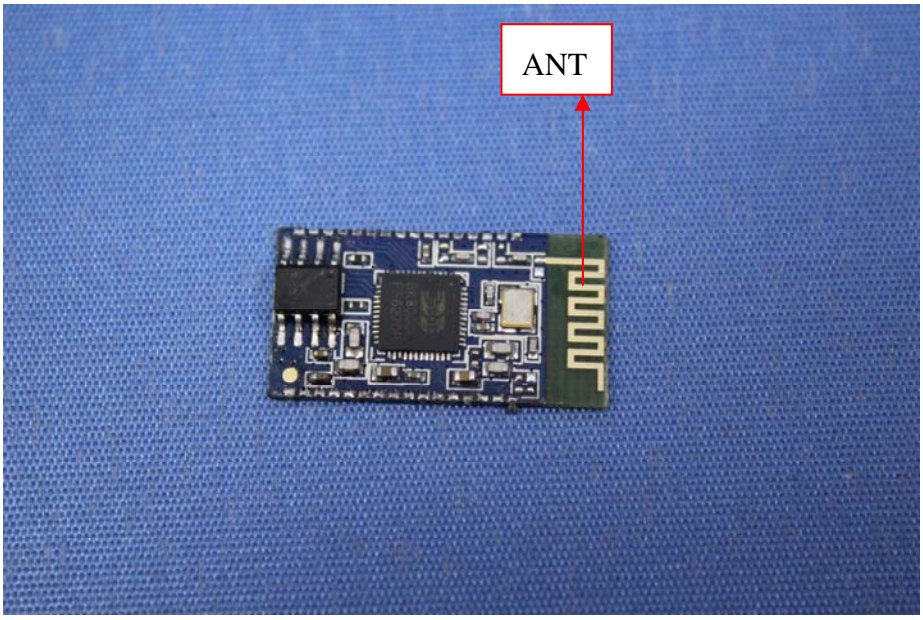
# 15 Antenna Requirement

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 one PCB Printed Antenna, the gain is 0 dBi. meets the requirements of FCC 15.203.



# 16 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part 2.1091 & KDB 447498 D01 General RF Exposure Guidance v06

## 16.1 Requirements

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

## 16.2 The procedures / limit

(A) Limits for Occupational / Controlled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ $cm^2$) | Averaging Time $\|E\|^2$,$\|H\|^2$or S (minutes) |
|---|---|---|---|---|
| 0.3-3.0 | 614 | 1.63 | (100)* | 6 |
| 3.0-30 | 1842 / f | 4.89 / f | (900 / f)* | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1500 | | | F/300 | 6 |
| 1500-100,000 | | | 5 | 6 |

(B) Limits for General Population / Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ $cm^2$) | Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes) |
|---|---|---|---|---|
| 0.3-1.34 | 614 | 1.63 | (100)* | 30 |
| 1.34-30 | 824/f | 2.19/f | (180/f)* | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | | | F/1500 | 30 |
| 1500-100,000 | | | 1.0 | 30 |

Note: f = frequency in MHz; *Plane-wave equivalent power density

## 16.3 MPE Calculation Method

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

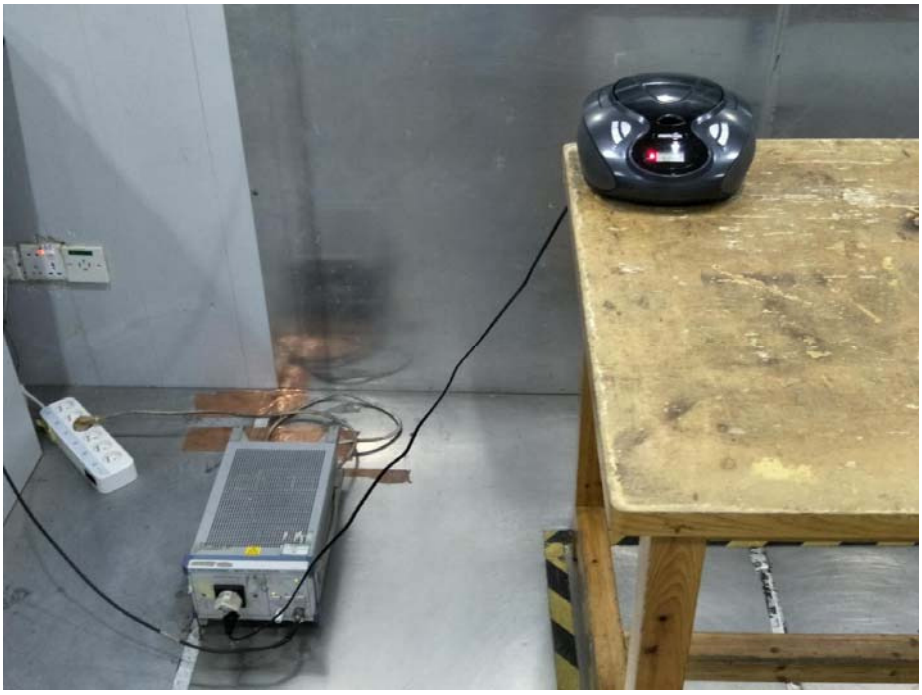
S = power density (in appropriate units, e.g. mW/cm$^2$)
P = output power to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

From the peak EUT RF output power, the minimum mobile separation distance, R=20cm, as well as the gain of the used antenna, the RF power density can be obtained

| Antenna Gain (dBi) | Antenna Gain (numeric) | Max. Peak Output Power (dBm) | Peak Output Power (mW) | Power Density (mW/cm$^2$) | Limit of Power Density (mW/cm$^2$) | Result |
|---|---|---|---|---|---|---|
| 0.00 | 1.000 | 0.99 | 1.26 | 0.000251 | 1 | Compliance |

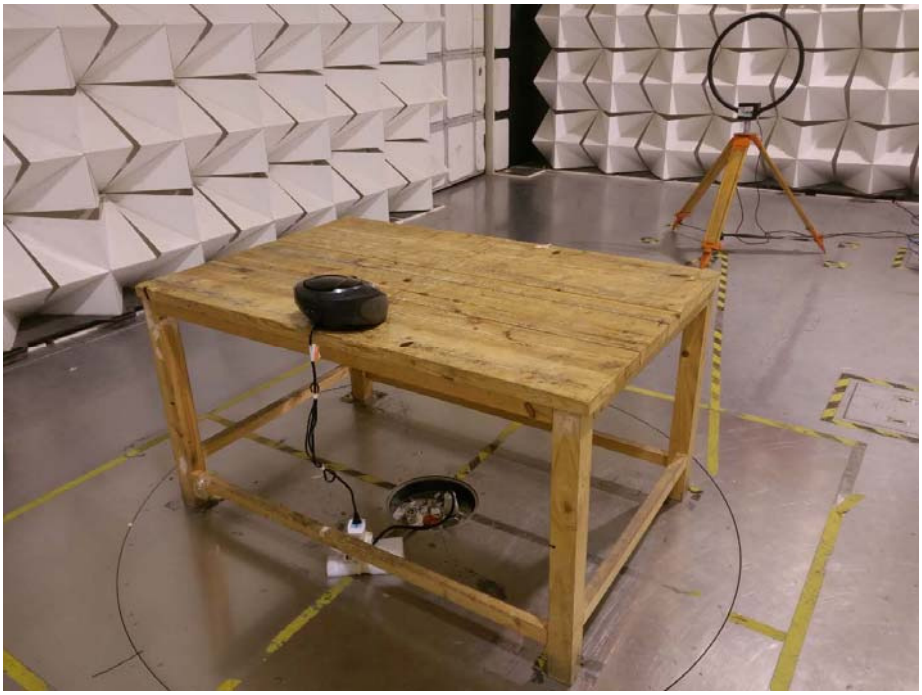
# 17 Photographs – Model MP3451 Test Setup

## 17.1 Photograph – Conducted Emission Test Setup at Test Site 1#

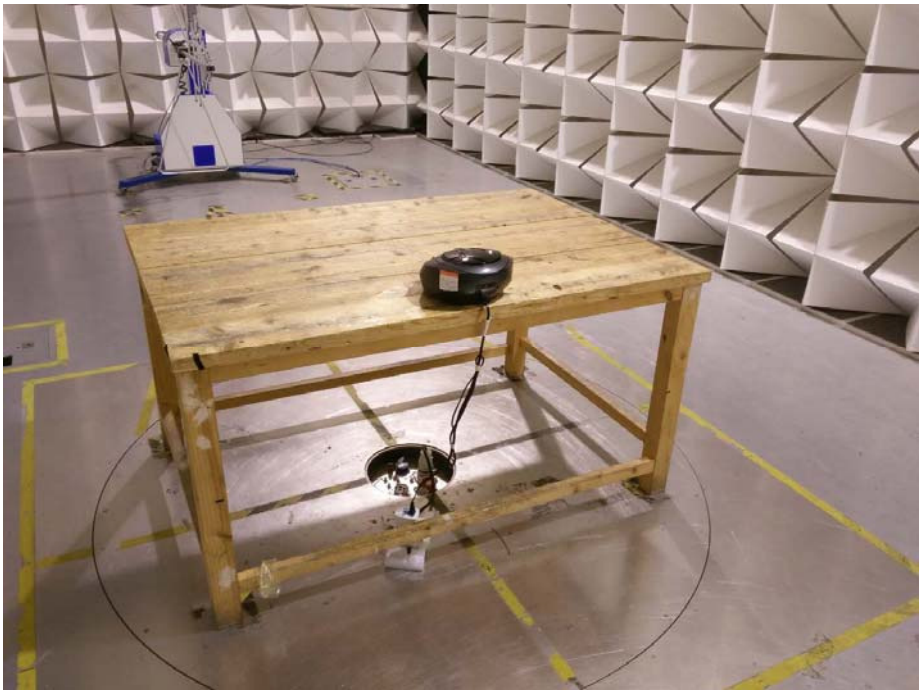


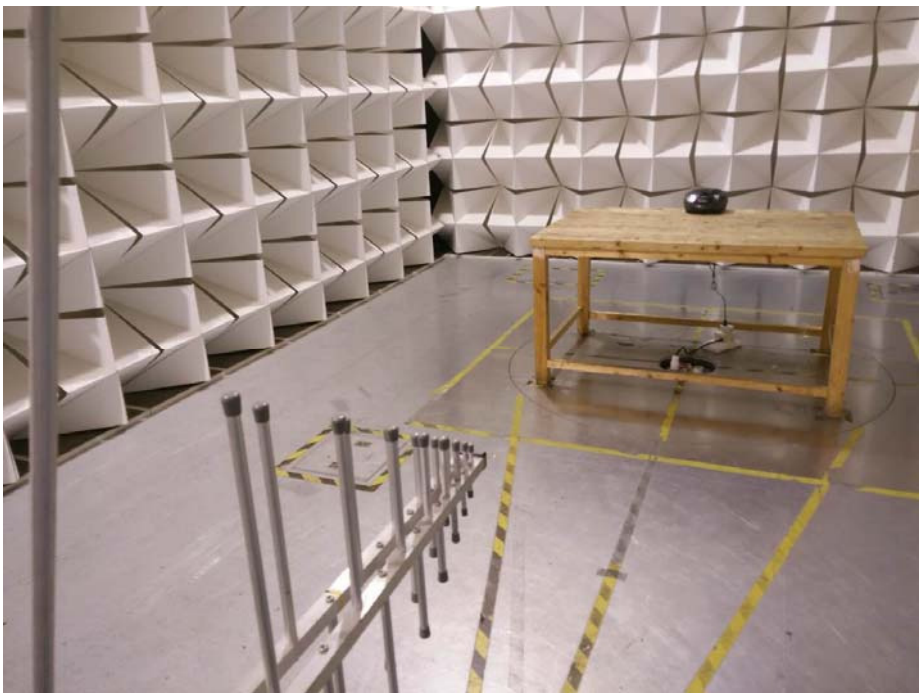
## 17.2 Photograph – Radiation Spurious Emission Test Setup

9 KHz to 30MHz at Test Site 2#



30MHz-1GHz at Test Site 2#

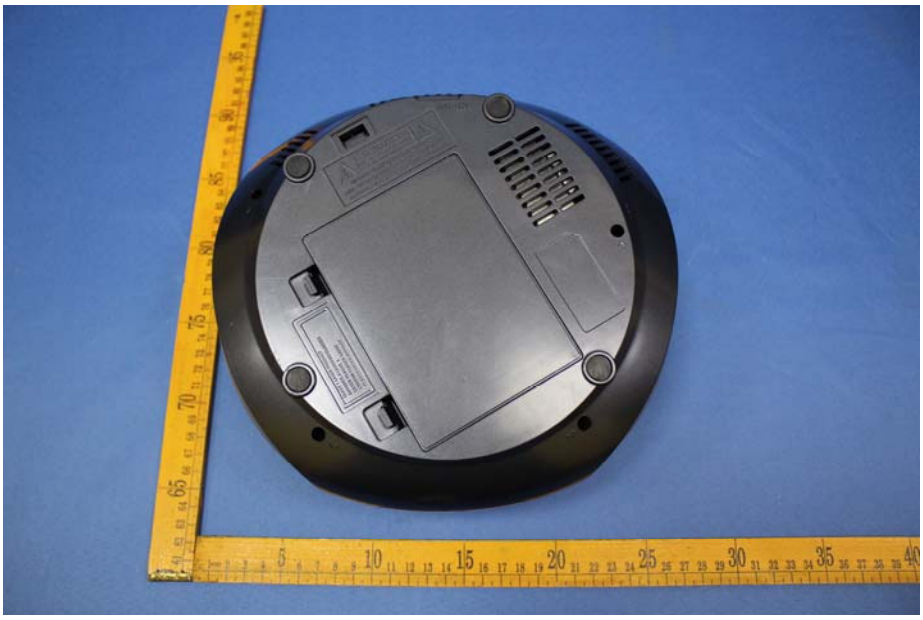




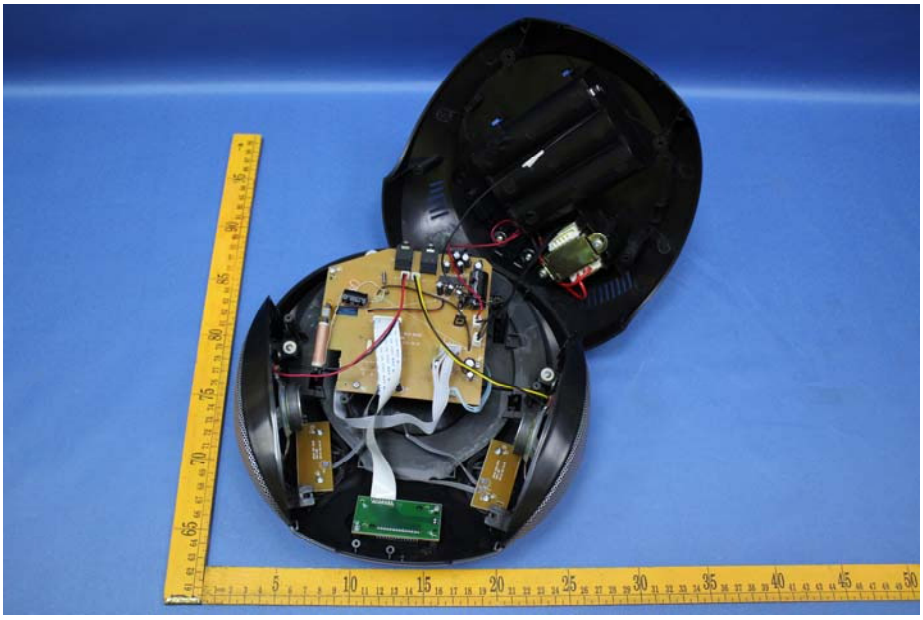
Above 1GHz at Test Site 1#

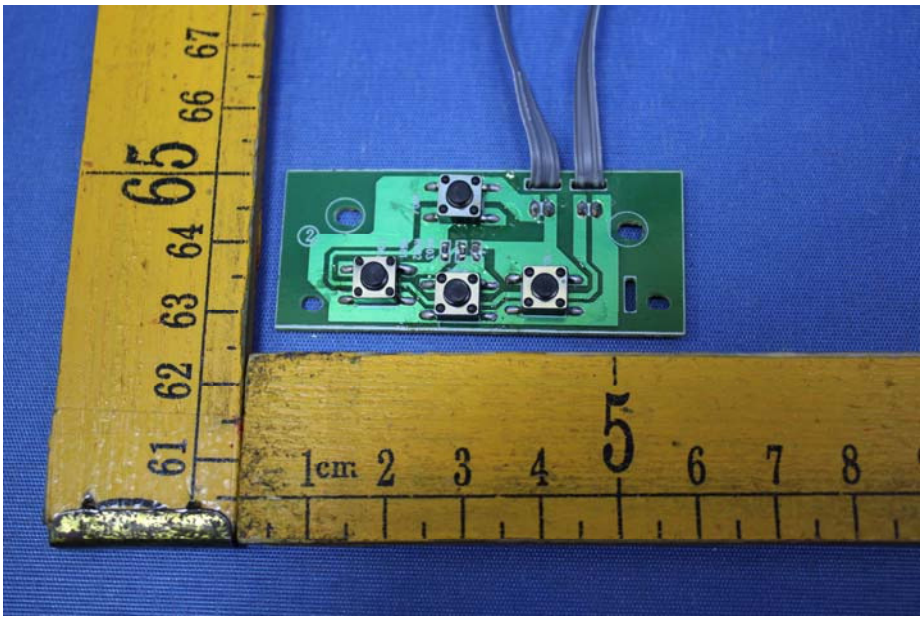
# 18 Photographs - Constructional Details

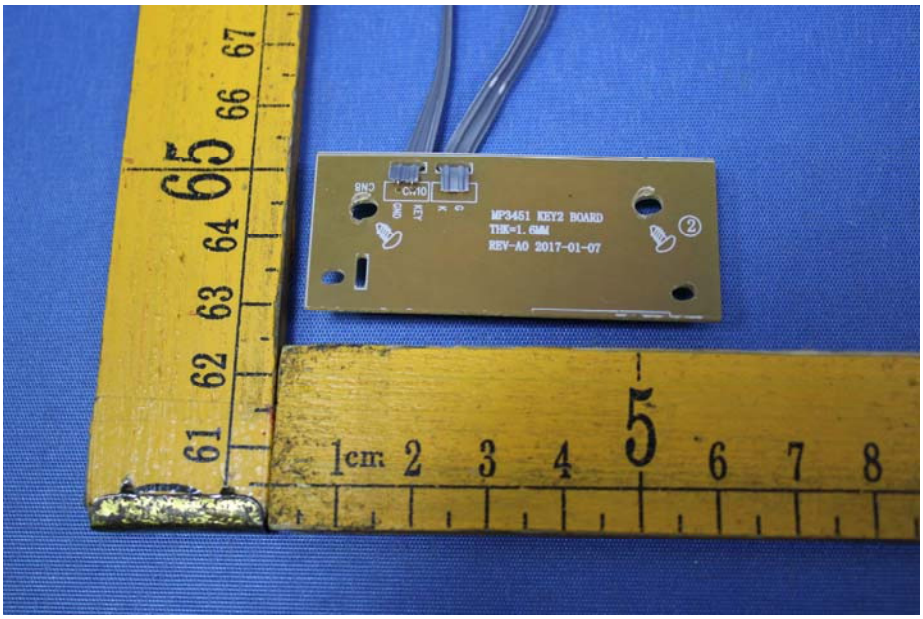
## 18.1 Model MP3451-External Photos

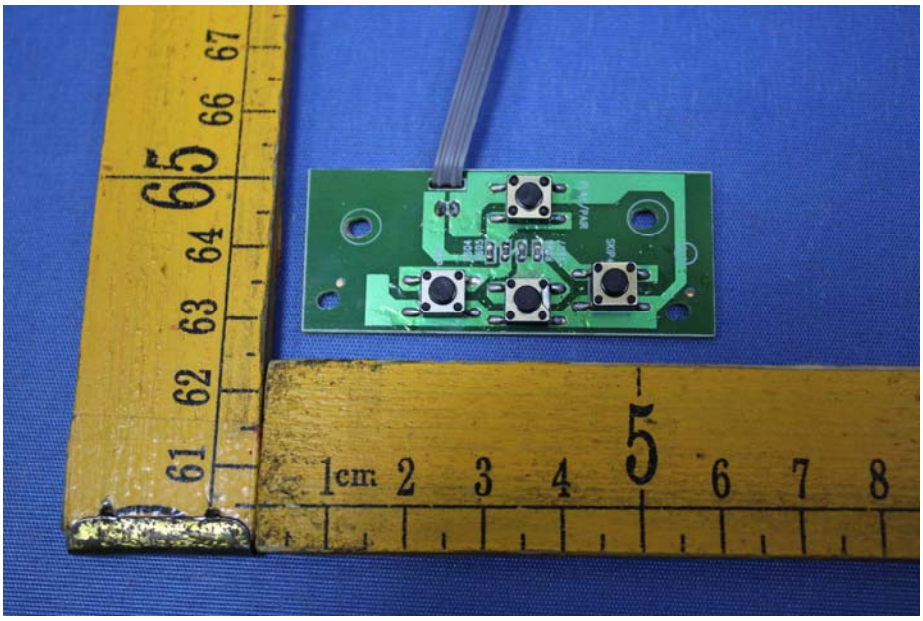


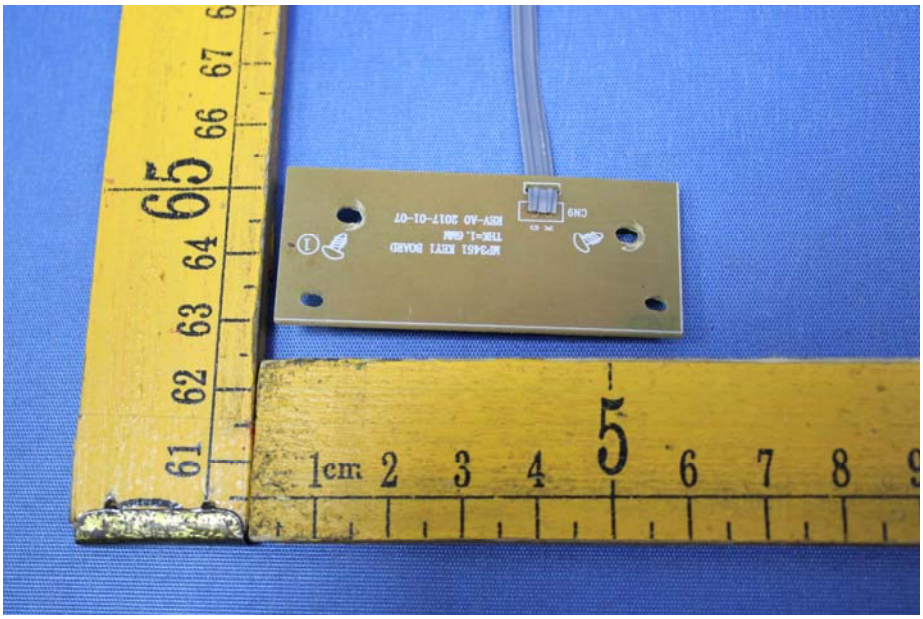
## 18.2 Model MP3451-Internal Photos

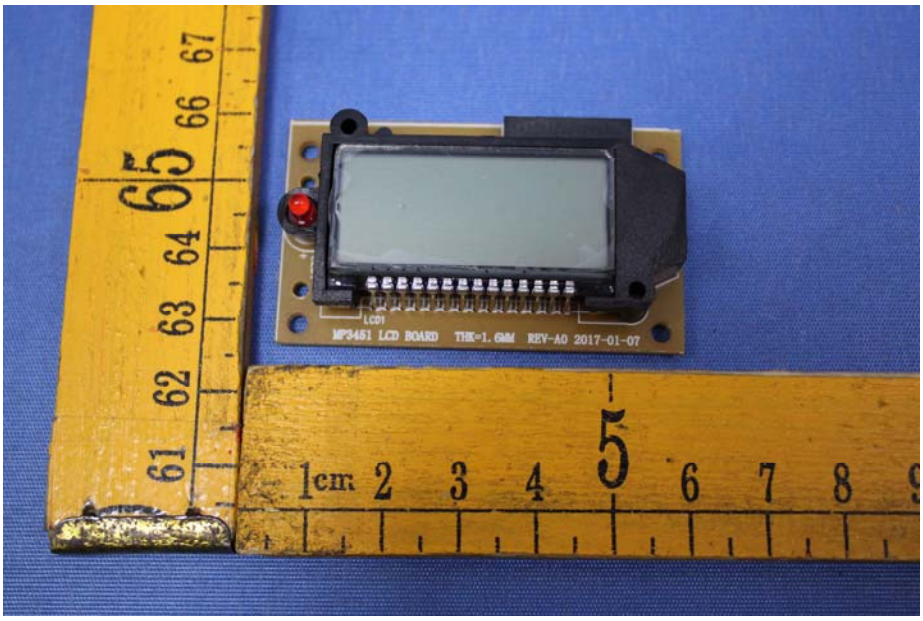


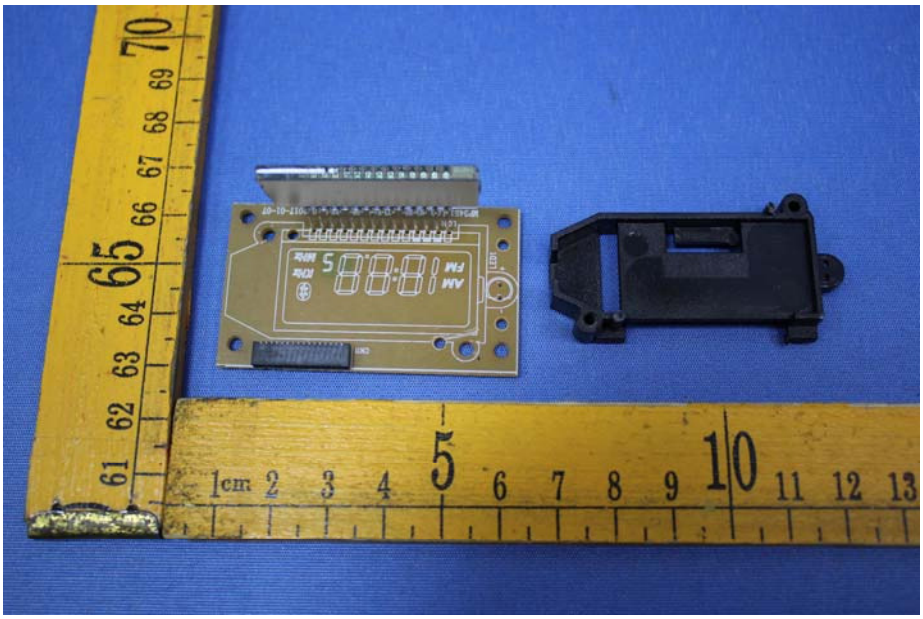


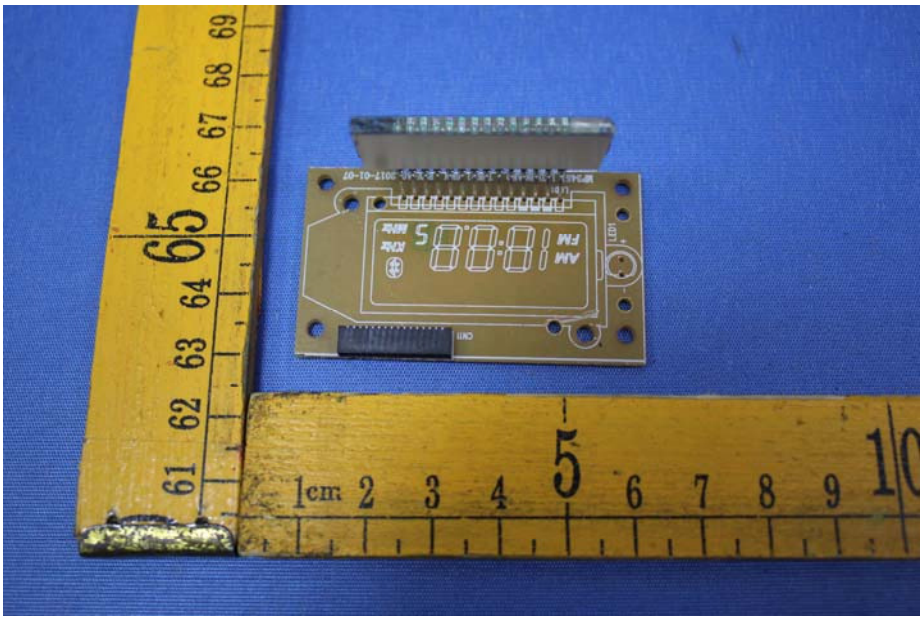

MF3451 KEY2 BOARD
THK=1.6MM
REV-A0 2017-01-07

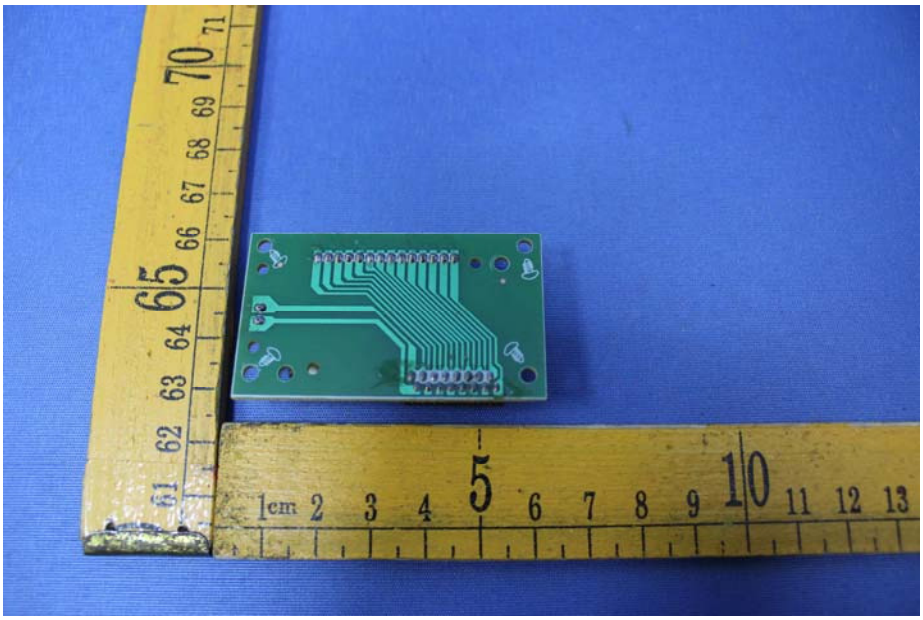


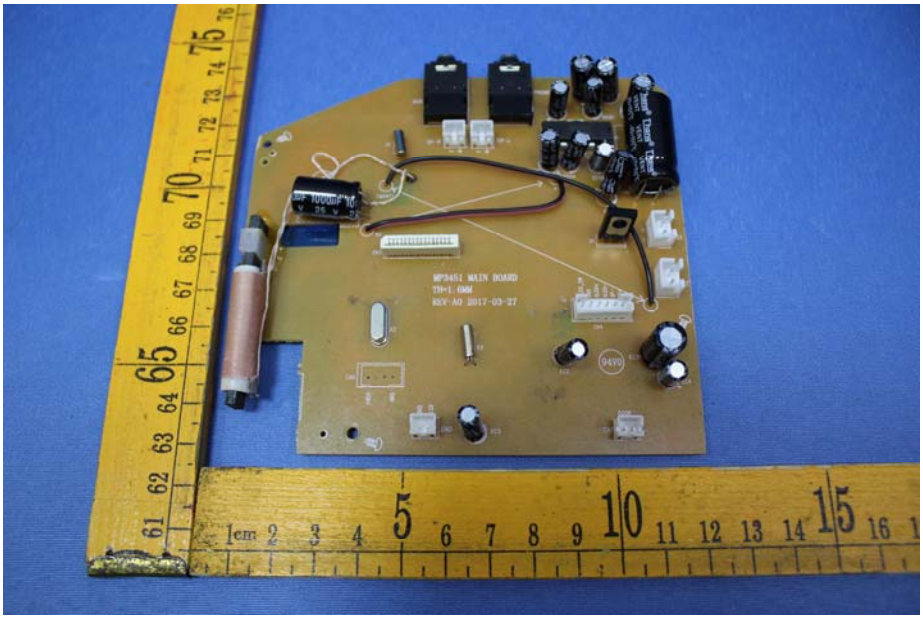

1cm 2 3 4 5 6 7 8
61 62 63 64 65 66 67

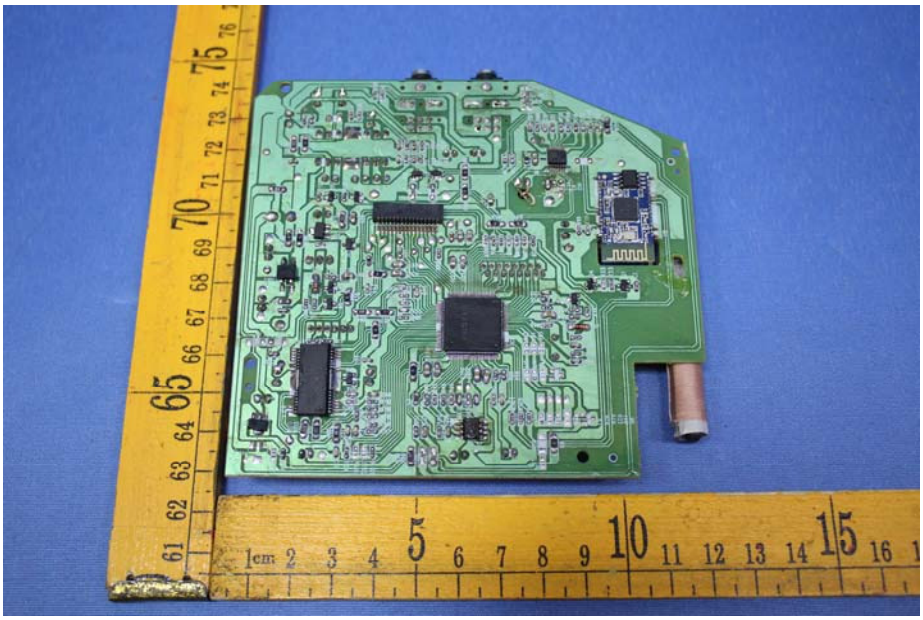

LCD1
MP3451 LCD BOARD THK=1.6MM REV-A0 2017-01-07
1cm 2 3 4 5 6 7 8
61 62 63 64 65 66 67

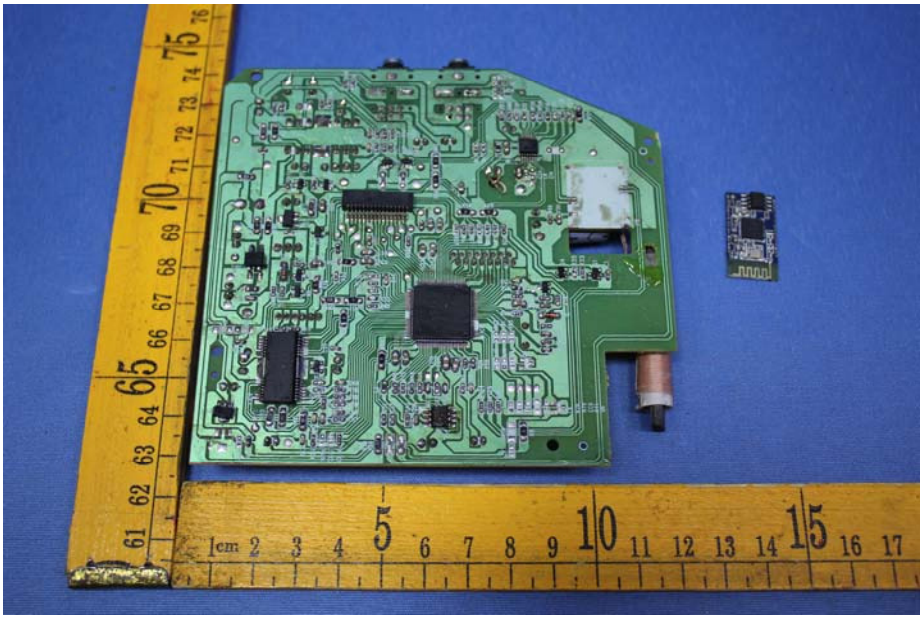


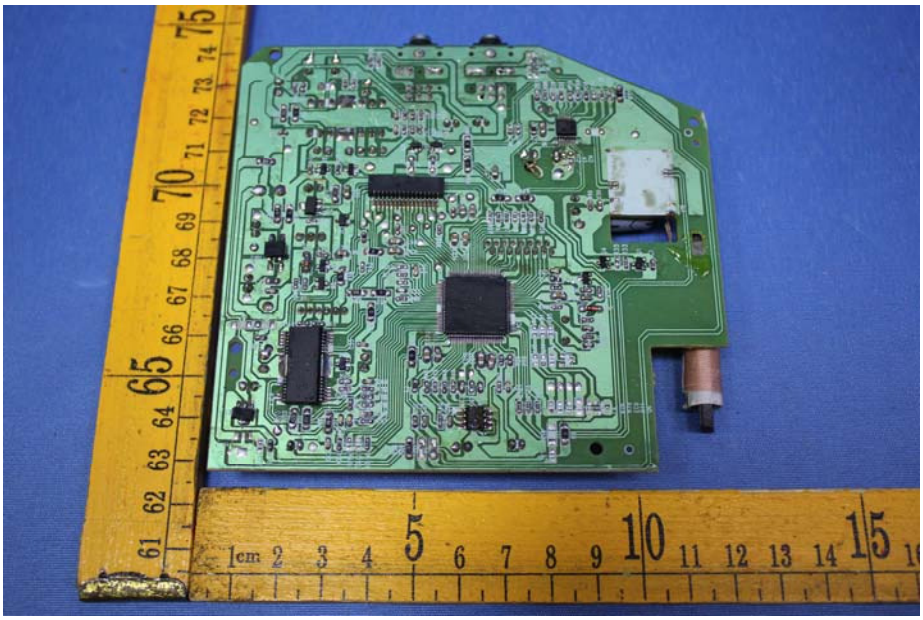


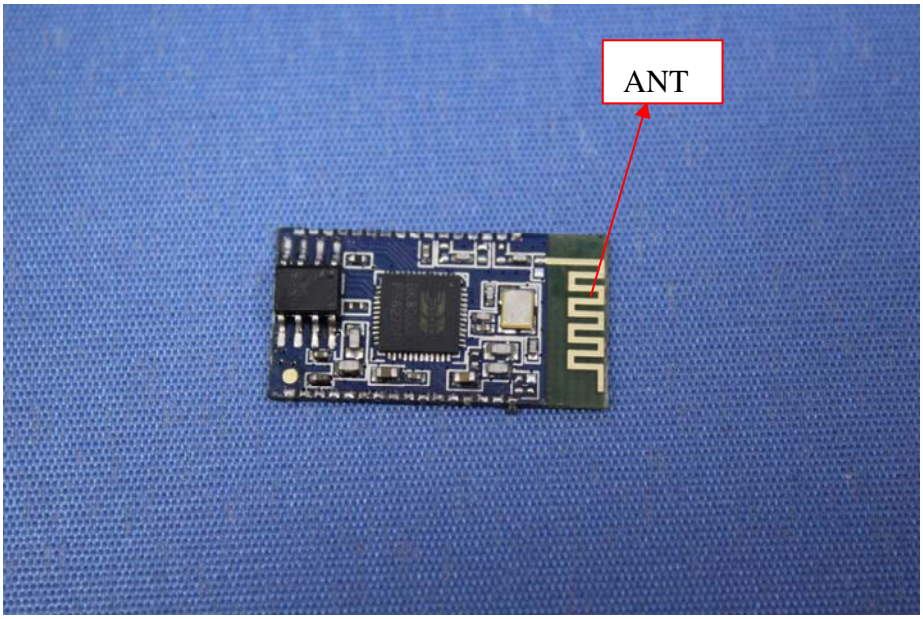








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====== End of Report ======