

# TEST REPORT

Reference No..... : WTF18S11128945W001  
FCC ID ..... : BRWIX20  
Applicant..... : Horizon Hobby, LLC  
Address..... : 2904 Research Rd. Champaign, Illinois 61821 United States  
Manufacturer ..... : The same as above  
Address..... : The same as above  
Product..... : iX20  
Model(s). ..... : iX20  
Brand Name..... : SPEKTRUM  
Standards..... : FCC CFR47 Part 15.247:2018  
Date of Receipt sample .... : 2019-05-25  
Date of Test ..... : 2019-05-26 to 2019-06-09  
Date of Issue..... : 2019-06-10  
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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## 2 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, the certification number is 4243.01) of USA, CNAS (China National Accreditation Service for Conformity Assessment, the registration number is L3110) of China. 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), ISED (Innovation, Science and Economic Development 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. Electro Magnetic 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.

**Test Facility:****A. Accreditations for Conformity Assessment (International)**

| Country/Region                                                      | Scope Covered By | Scope              | Note |
|---------------------------------------------------------------------|------------------|--------------------|------|
| USA                                                                 | ISO/IEC 17025    | 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                                                               |                  | WPC                | -    |
| Thailand                                                            |                  | NTC                | -    |
| Singapore                                                           |                  | IDA                | -    |
| Note:                                                               |                  |                    |      |
| 1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476. |                  |                    |      |
| 2. ISED CAB identifier: CN0013                                      |                  |                    |      |

**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               |

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#### 4 Revision History

| Test report No.        | Date of Receipt sample | Date of Test                | Date of Issue | Purpose  | Comment | Approved |
|------------------------|------------------------|-----------------------------|---------------|----------|---------|----------|
| WTF18S11128<br>945W001 | 2019-05-25             | 2019-05-26<br>to 2019-06-09 | 2019-06-10    | original | -       | Valid    |
|                        |                        |                             |               |          |         |          |

## 5 General Information

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

|                                       |                                                               |
|---------------------------------------|---------------------------------------------------------------|
| Product:                              | iX20                                                          |
| Model(s):                             | iX20                                                          |
| Model Description:                    | N/A                                                           |
| Wi-Fi Specification:                  | 2.4G-802.11b/g/n HT20<br>5G-802.11a/n(HT20/40)/ac(HT20/40/80) |
| Bluetooth Version:                    | Bluetooth v4.0 with BLE                                       |
| Hardware Version:                     | SW7883 Ver1.8                                                 |
| Software Version:                     | iX20.04251513                                                 |
| Highest frequency<br>(Exclude Radio): | 1.25GHz                                                       |
| Storage Location:                     | Internal Storage                                              |
| Note:                                 | N/A                                                           |

### 5.2 Details of E.U.T.

|                       |                                                         |
|-----------------------|---------------------------------------------------------|
| Operation Frequency:  | Bluetooth: 2402~2480MHz                                 |
| Max. RF output power: | Bluetooth: 8.68dBm                                      |
| Type of Modulation:   | Bluetooth: GFSK, Pi/4 DQPSK, 8DPSK                      |
| Antenna installation: | Bluetooth: internal permanent antenna                   |
| Antenna Gain:         | Bluetooth: -1.0dBi                                      |
| Ratings:              | DC 5V, 2A by charge Jack<br>DC 3.7V 10500mAh by battery |

### 5.3 Channel List

Normal

| 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            | -           | -               |

### 5.4 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      |



## 6 Test Summary

| Test Items                                                        | Test Requirement                 | Result   |
|-------------------------------------------------------------------|----------------------------------|----------|
| Radiated Spurious Emissions                                       | 15.205(a)<br>15.209<br>15.247(d) | PASS     |
| Conducted Spurious emissions                                      | 15.247(d)                        | PASS     |
| Band edge                                                         | 15.247(d)<br>15.205(a)           | PASS     |
| Conducted Emission                                                | 15.207                           | N/A      |
| 20dB 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     |
| Antenna Requirement                                               | 15.203                           | Complies |
| Maximum Permissible Exposure<br>(Exposure of Humans to RF Fields) | 1.1307(b)(1)                     | PASS     |

## 7 Equipment Used during Test

### 7.1 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          | 2018-09-12            | 2019-09-11           |
| 2.                                                            | LISN                       | R&S                              | ENV216       | 101215          | 2018-09-12            | 2019-09-11           |
| 3.                                                            | Cable                      | Top                              | TYPE16(3.5M) | -               | 2018-09-12            | 2019-09-11           |
| 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          | 2018-09-12            | 2019-09-11           |
| 2.                                                            | LISN                       | SCHWARZBECK                      | NSLK 8128    | 8128-289        | 2018-09-12            | 2019-09-11           |
| 3.                                                            | Limiter                    | York                             | MTS-IMP-136  | 261115-001-0024 | 2018-09-12            | 2019-09-11           |
| 4.                                                            | Cable                      | LARGE                            | RF300        | -               | 2018-09-12            | 2019-09-11           |
| 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          | 2019-04-29            | 2020-04-28           |
| 2                                                             | Active Loop Antenna        | Beijing Dazhi                    | ZN30900A     | -               | 2019-04-09            | 2020-04-08           |
| 3                                                             | Trilog Broadband Antenna   | SCHWARZBECK                      | VULB9163     | 336             | 2019-04-09            | 2020-04-08           |
| 4                                                             | Coaxial Cable (below 1GHz) | Top                              | TYPE16(13M)  | -               | 2018-09-12            | 2019-09-11           |
| 5                                                             | Broad-band Horn Antenna    | SCHWARZBECK                      | BBHA 9120 D  | 667             | 2019-04-09            | 2020-04-08           |
| 6                                                             | Broad-band Horn Antenna    | SCHWARZBECK                      | BBHA 9170    | 335             | 2019-04-09            | 2020-04-08           |
| 7                                                             | Broadband Preamplifier     | COMPLIANCE DIRECTION             | PAP-1G18     | 2004            | 2019-04-13            | 2020-04-12           |
| 8                                                             | Coaxial Cable (above 1GHz) | Top                              | 1GHz-25GHz   | EW02014-7       | 2019-04-13            | 2020-04-12           |
| 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          | 2019-04-13            | 2020-04-12           |
| 2                                                             | Trilog Broadband Antenna   | SCHWARZBECK                      | VULB9160     | 9160-3325       | 2019-04-09            | 2020-04-08           |
| 3                                                             | Amplifier                  | Compliance pirection systems inc | PAP-0203     | 22024           | 2019-04-13            | 2020-04-12           |
| 4                                                             | Cable                      | HUBER+SUHNER                     | CBL2         | 525178          | 2019-04-13            | 2020-04-12           |

| RF Conducted Testing |                                 |              |           |            |                       |                      |
|----------------------|---------------------------------|--------------|-----------|------------|-----------------------|----------------------|
| Item                 | Equipment                       | Manufacturer | Model No. | Serial No. | Last Calibration Date | Calibration Due Date |
| 1.                   | EMC Analyzer<br>(9k~26.5GHz)    | Agilent      | E7405A    | MY45114943 | 2018-09-12            | 2019-09-11           |
| 2.                   | Spectrum Analyzer<br>(9k-6GHz)  | R&S          | FSL6      | 100959     | 2018-09-12            | 2019-09-11           |
| 3.                   | Signal Analyzer<br>(9k~26.5GHz) | Agilent      | N9010A    | MY50520207 | 2018-09-12            | 2019-09-11           |

## 7.2 Description of Support Units

| Equipment | Manufacturer | Model No. | Series No. |
|-----------|--------------|-----------|------------|
| /         | /            | /         | /          |

## 7.3 Measurement Uncertainty

| Parameter                                       | Uncertainty                             |
|-------------------------------------------------|-----------------------------------------|
| Conducted Emission                              | ± 3.64 dB(AC mains 150KHz~30MHz)        |
| Radiated Spurious Emissions                     | ± 5.08 dB (Bilog antenna 30M~1000MHz)   |
|                                                 | ± 4.99 dB (Horn antenna 1000M~25000MHz) |
| Radio Frequency                                 | ± 1 x 10 <sup>-7</sup> Hz               |
| RF Power                                        | ± 0.42 dB                               |
| Dwell time                                      | 1.0%                                    |
| Conducted Spurious Emissions                    | ± 2.76 dB (9kHz~26500MHz)               |
| Confidence interval: 95%. Confidence factor:k=2 |                                         |

## 7.4 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.

## 8 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.205 & 15.209 & 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Measurement Distance: 3m

Limit:

| Frequency<br>(MHz) | Field Strength |                 | Field Strength Limit at 3m Measurement Dist |                                |
|--------------------|----------------|-----------------|---------------------------------------------|--------------------------------|
|                    | uV/m           | Distance<br>(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

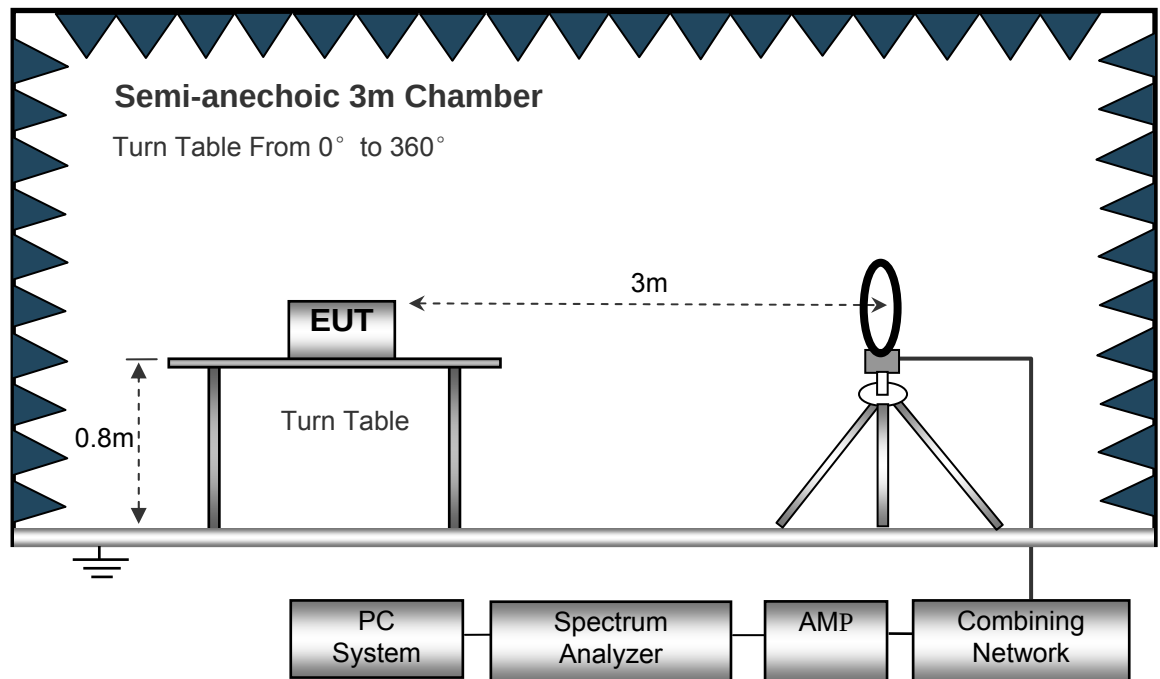
EUT Operation :

The test was performed in TX Transmitting mode, the test data were shown in the report.

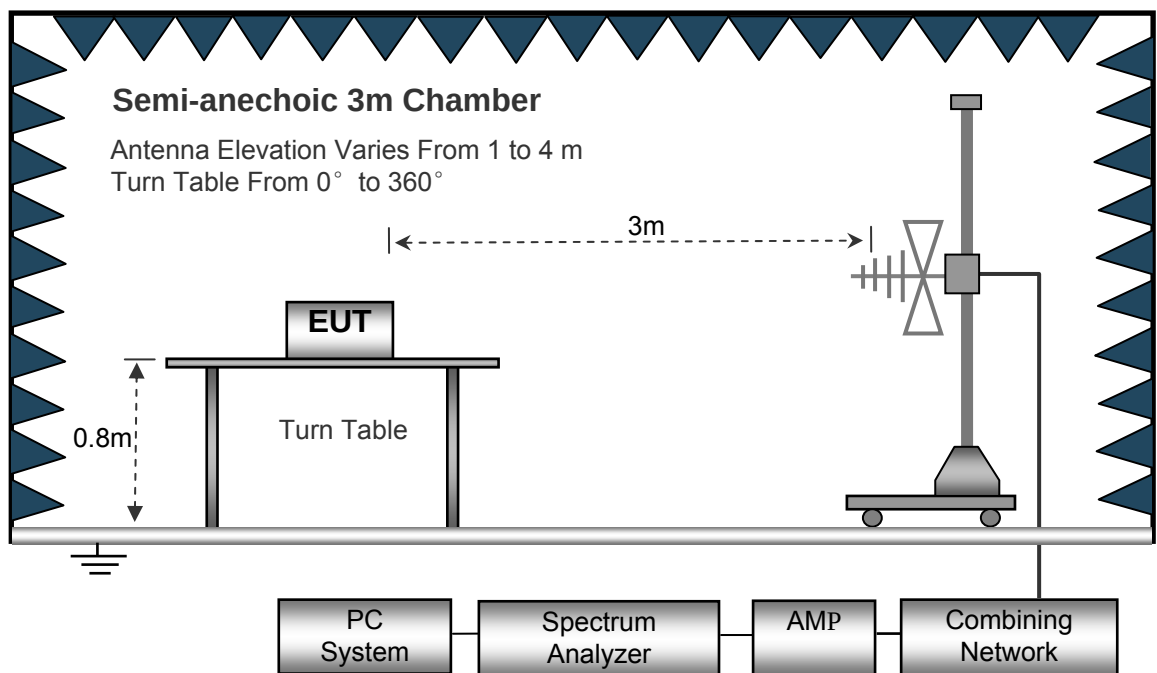
## 8.2 Test Setup

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

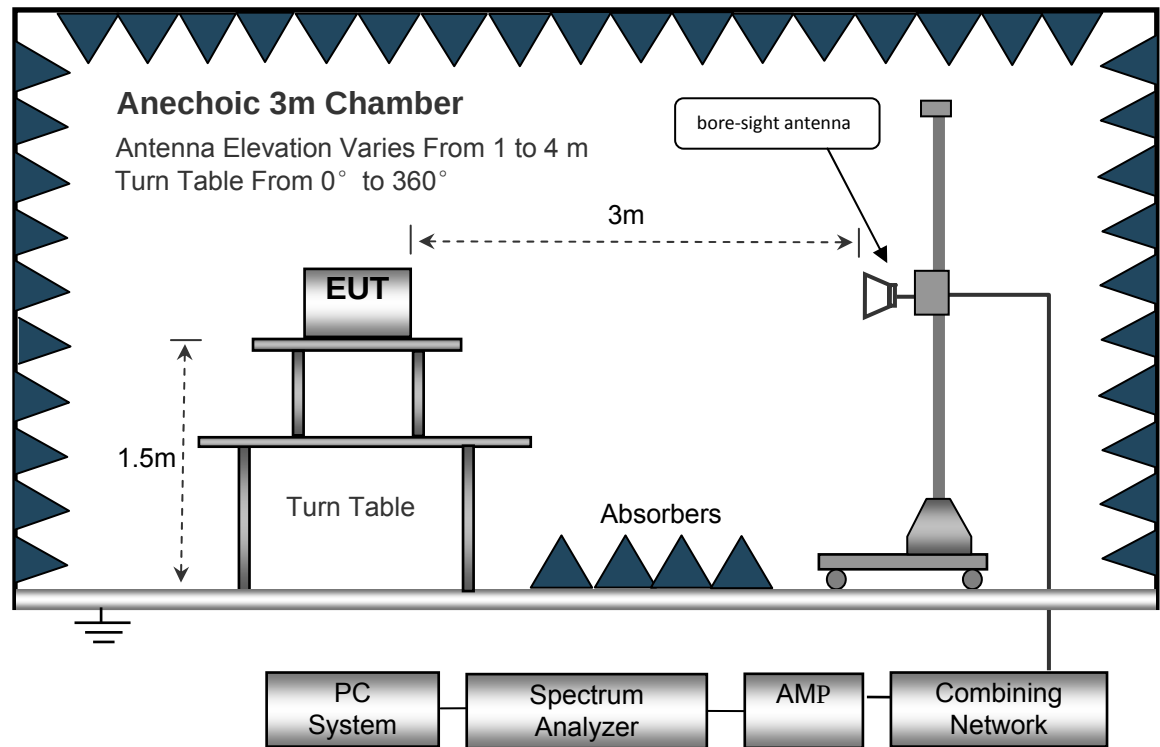
The test setup for emission measurement below 30MHz.



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 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 Z position. So the data shown was the Z position only.

## 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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

## 8.6 Summary of Test Results

### Test Frequency: 9KHz~30MHz

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

| Frequency | Measurement results dB $\mu$ V @3m | Detector PK/QP | Correct factor dB/m | Extrapolation factor dB | Measurement results (calculated) dB $\mu$ V/m @30m | Limits dB $\mu$ V/m @30m | Margin dB |
|-----------|------------------------------------|----------------|---------------------|-------------------------|----------------------------------------------------|--------------------------|-----------|
| (MHz)     | Measurement results                | Detector       | Correct factor      | Extrapolation factor    | Measurement results (calculated)                   | Limits                   | Margin    |
| 6.021     | 25.33                              | QP             | 21.84               | 40.00                   | 7.17                                               | 29.54                    | -22.37    |
| 15.730    | 24.89                              | QP             | 21.35               | 40.00                   | 6.24                                               | 29.54                    | -23.30    |
| 25.680    | 25.26                              | QP             | 20.67               | 40.00                   | 5.93                                               | 29.54                    | -23.61    |

### Test Frequency: 30MHz ~ 18GHz

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

| Frequency        | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | Limit          | Margin |
|------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|----------------|--------|
|                  |                  |             |                  | Height     | Polar |                  |                     |                |        |
| (MHz)            | (dB $\mu$ V)     | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB)             | (dB $\mu$ V/m)      | (dB $\mu$ V/m) | (dB)   |
| GFSK Low Channel |                  |             |                  |            |       |                  |                     |                |        |
| 268.32           | 36.93            | QP          | 137              | 2.0        | H     | -13.35           | 23.58               | 46.00          | -22.42 |
| 268.32           | 40.35            | QP          | 307              | 1.4        | V     | -13.35           | 27.00               | 46.00          | -19.00 |
| 4804.00          | 45.80            | PK          | 143              | 1.5        | V     | -1.06            | 44.74               | 74.00          | -29.26 |
| 4804.00          | 42.82            | Ave         | 143              | 1.5        | V     | -1.06            | 41.76               | 54.00          | -12.24 |
| 7206.00          | 40.08            | PK          | 192              | 1.9        | H     | 1.33             | 41.41               | 74.00          | -32.59 |
| 7206.00          | 34.57            | Ave         | 192              | 1.9        | H     | 1.33             | 35.90               | 54.00          | -18.10 |
| 2326.74          | 45.58            | PK          | 180              | 1.9        | V     | -13.19           | 32.39               | 74.00          | -41.61 |
| 2326.74          | 39.59            | Ave         | 180              | 1.9        | V     | -13.19           | 26.40               | 54.00          | -27.60 |
| 2380.54          | 42.63            | PK          | 132              | 1.1        | H     | -13.14           | 29.49               | 74.00          | -44.51 |
| 2380.54          | 37.95            | Ave         | 132              | 1.1        | H     | -13.14           | 24.81               | 54.00          | -29.19 |
| 2495.43          | 43.27            | PK          | 315              | 1.1        | V     | -13.08           | 30.19               | 74.00          | -43.81 |
| 2495.43          | 36.73            | Ave         | 315              | 1.1        | V     | -13.08           | 23.65               | 54.00          | -30.35 |



| 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 |                  |             |                  |            |       |                  |                     |          |        |
| 268.32              | 35.89            | QP          | 13               | 1.2        | H     | -13.35           | 22.54               | 46.00    | -23.46 |
| 268.32              | 41.15            | QP          | 75               | 1.6        | V     | -13.35           | 27.80               | 46.00    | -18.20 |
| 4882.00             | 45.76            | PK          | 197              | 1.6        | V     | -0.62            | 45.14               | 74.00    | -28.86 |
| 4882.00             | 42.15            | Ave         | 197              | 1.6        | V     | -0.62            | 41.53               | 54.00    | -12.47 |
| 7323.00             | 40.88            | PK          | 351              | 1.7        | H     | 2.21             | 43.09               | 74.00    | -30.91 |
| 7323.00             | 33.55            | Ave         | 351              | 1.7        | H     | 2.21             | 35.76               | 54.00    | -18.24 |
| 2347.50             | 45.76            | PK          | 2                | 1.9        | V     | -13.19           | 32.57               | 74.00    | -41.43 |
| 2347.50             | 39.14            | Ave         | 2                | 1.9        | V     | -13.19           | 25.95               | 54.00    | -28.05 |
| 2361.66             | 42.41            | PK          | 345              | 1.5        | H     | -13.14           | 29.27               | 74.00    | -44.73 |
| 2361.66             | 37.05            | Ave         | 345              | 1.5        | H     | -13.14           | 23.91               | 54.00    | -30.09 |
| 2493.39             | 42.81            | PK          | 209              | 1.8        | V     | -13.08           | 29.73               | 74.00    | -44.27 |
| 2493.39             | 38.66            | Ave         | 209              | 1.8        | V     | -13.08           | 25.58               | 54.00    | -28.42 |

| 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 |                  |             |                  |            |       |                  |                     |          |        |
| 268.32            | 35.12            | QP          | 328              | 1.7        | H     | -13.35           | 21.77               | 46.00    | -24.23 |
| 268.32            | 42.01            | QP          | 103              | 1.6        | V     | -13.35           | 28.66               | 46.00    | -17.34 |
| 4960.00           | 46.57            | PK          | 189              | 1.1        | V     | -0.24            | 46.33               | 74.00    | -27.67 |
| 4960.00           | 41.29            | Ave         | 189              | 1.1        | V     | -0.24            | 41.05               | 54.00    | -12.95 |
| 7440.00           | 40.83            | PK          | 293              | 1.2        | H     | 2.84             | 43.67               | 74.00    | -30.33 |
| 7440.00           | 33.83            | Ave         | 293              | 1.2        | H     | 2.84             | 36.67               | 54.00    | -17.33 |
| 2329.85           | 45.59            | PK          | 30               | 1.2        | V     | -13.19           | 32.40               | 74.00    | -41.60 |
| 2329.85           | 37.44            | Ave         | 30               | 1.2        | V     | -13.19           | 24.25               | 54.00    | -29.75 |
| 2366.13           | 44.38            | PK          | 138              | 1.1        | H     | -13.14           | 31.24               | 74.00    | -42.76 |
| 2366.13           | 36.15            | Ave         | 138              | 1.1        | H     | -13.14           | 23.01               | 54.00    | -30.99 |
| 2497.68           | 42.59            | PK          | 120              | 1.4        | V     | -13.08           | 29.51               | 74.00    | -44.49 |
| 2497.68           | 36.36            | Ave         | 120              | 1.4        | V     | -13.08           | 23.28               | 54.00    | -30.72 |

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

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

## 9 Conducted Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Limit:

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 Section 15.209(a) is not required. 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)).

### 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:

Below 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

Above 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

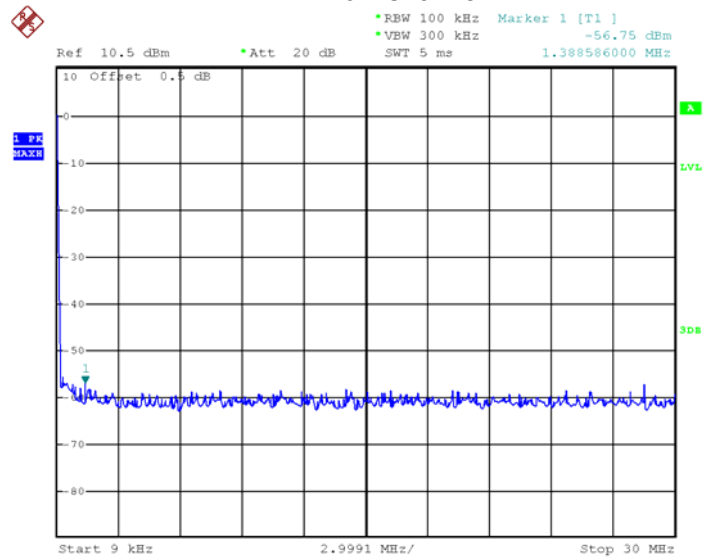
Detector function = peak, Trace = max hold

9.2 Test Result

9KHz - 30MHz

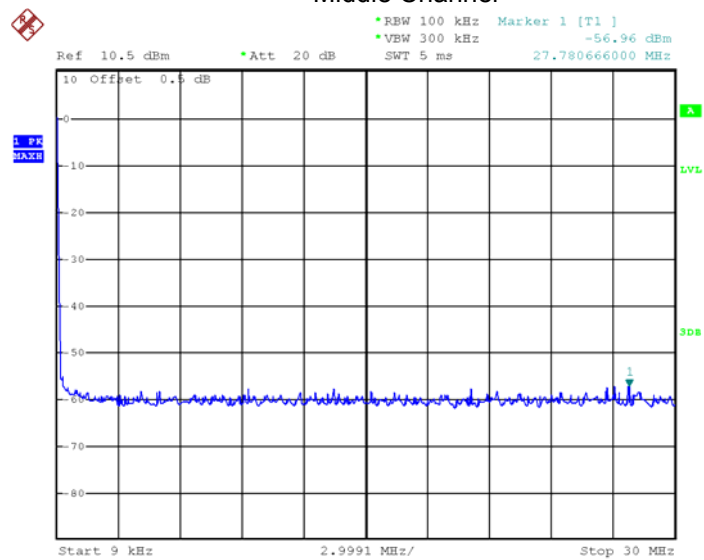
GFSK

Low Channel

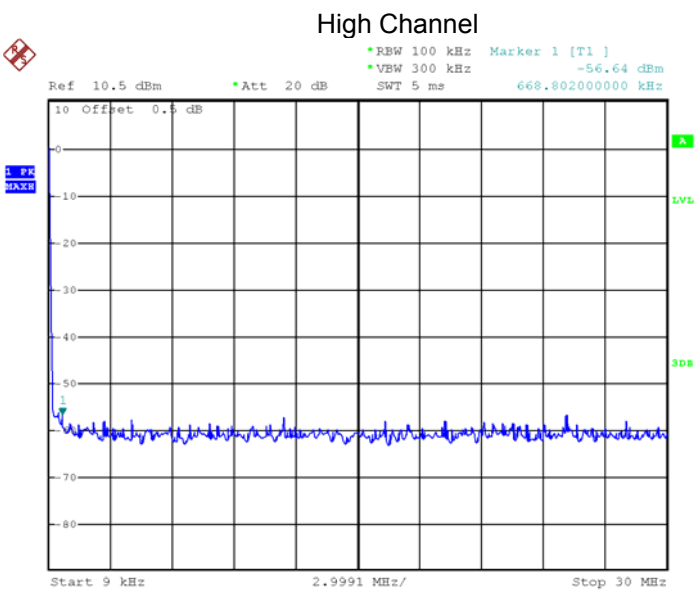


Date: 27.MAY.2019 04:04:45

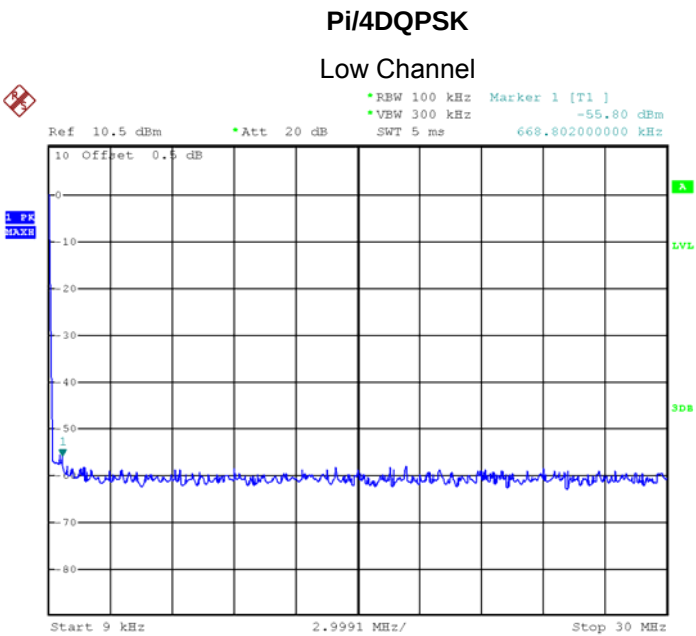
Middle Channel



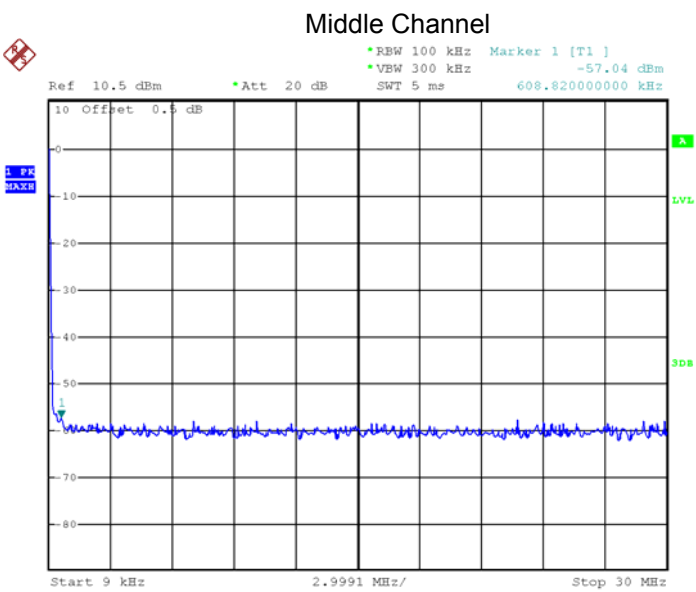
Date: 27.MAY.2019 04:04:56



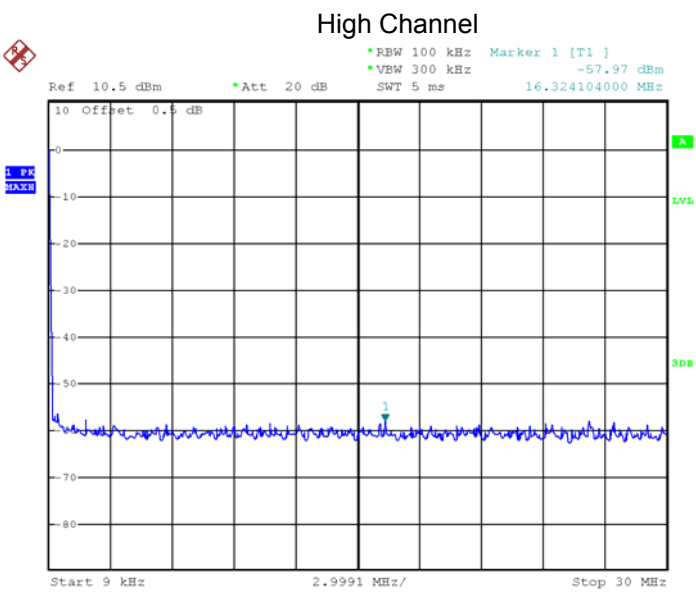
Date: 27.MAY.2019    04:05:03



Date: 27.MAY.2019    04:05:10



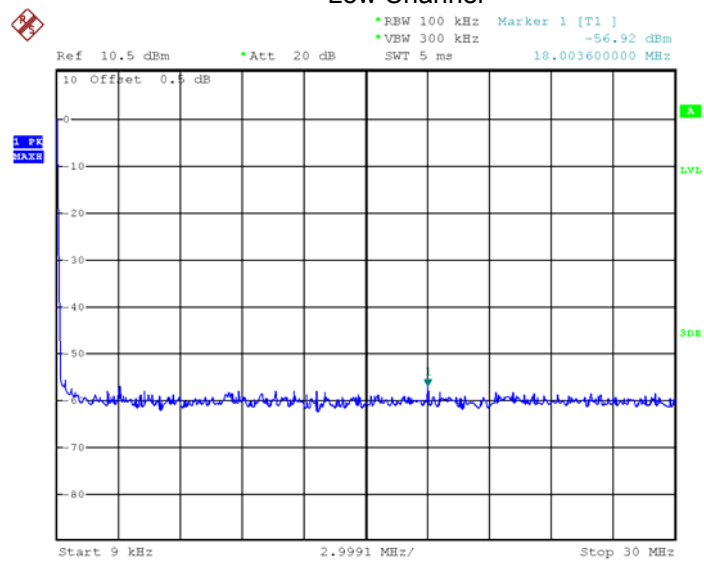
Date: 27.MAY.2019 04:05:21



Date: 27.MAY.2019 04:05:29

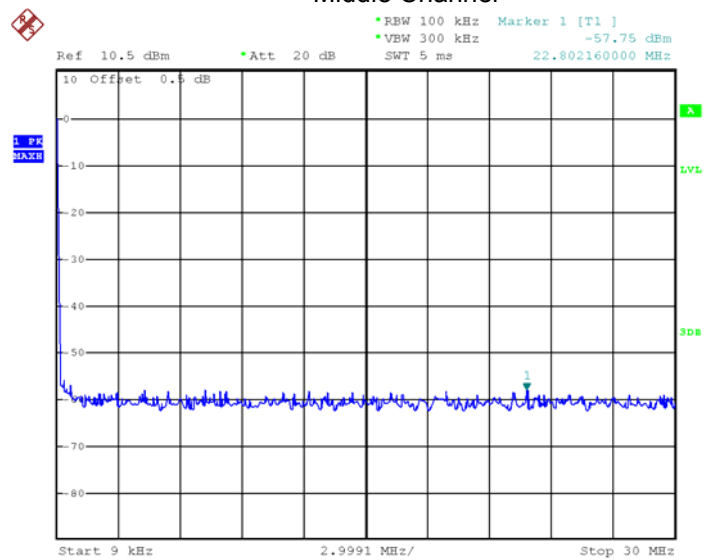
8DPSK

Low Channel

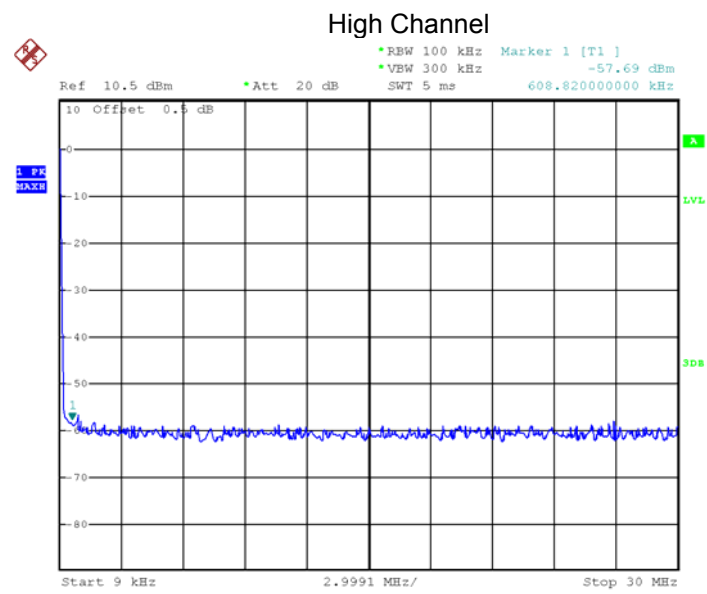


Date: 27.MAY.2019 04:05:41

Middle Channel



Date: 27.MAY.2019 04:05:49



Date: 27.MAY.2019 04:05:59



30MHz – 25GHz

GFSK Low Channel

Fundamental



GFSK Middle Channel

Fundamental



## GFSK High Channel

Fundamental



## Pi/4 DQPSK Low Channel

Fundamental



## Pi/4 DQPSK Middle Channel

Fundamental



## Pi/4 DQPSK High Channel

Fundamental



8DPSK Low Channel

Fundamental



8DPSK Middle Channel

Fundamental



## 8DPSK High Channel

Fundamental



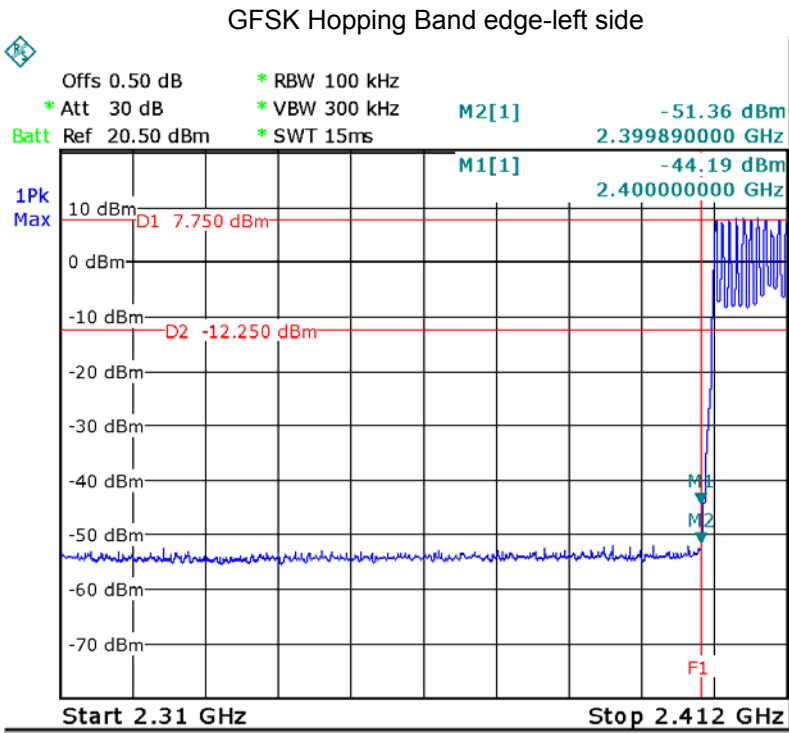
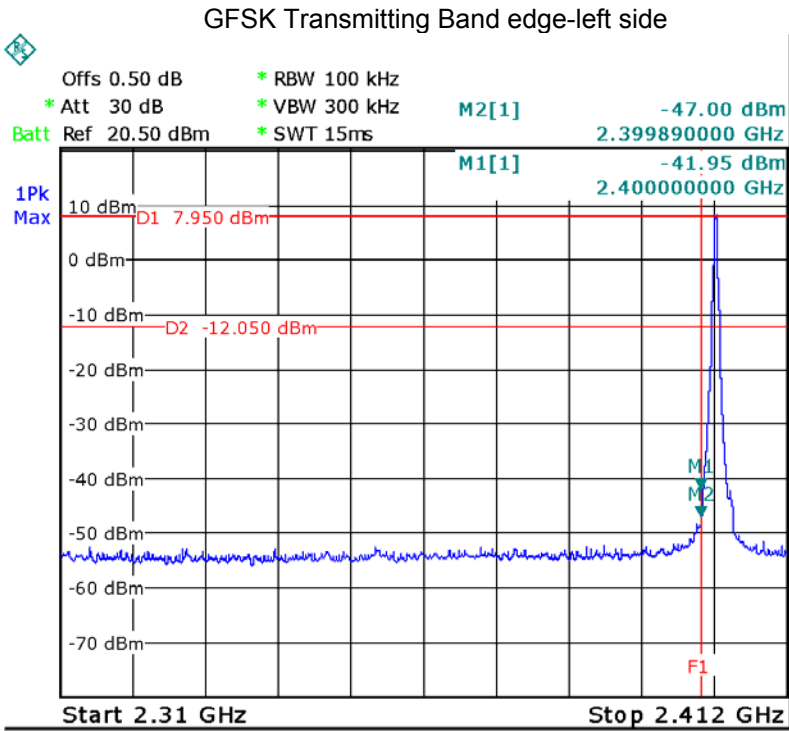
## 10 Band Edge Measurement

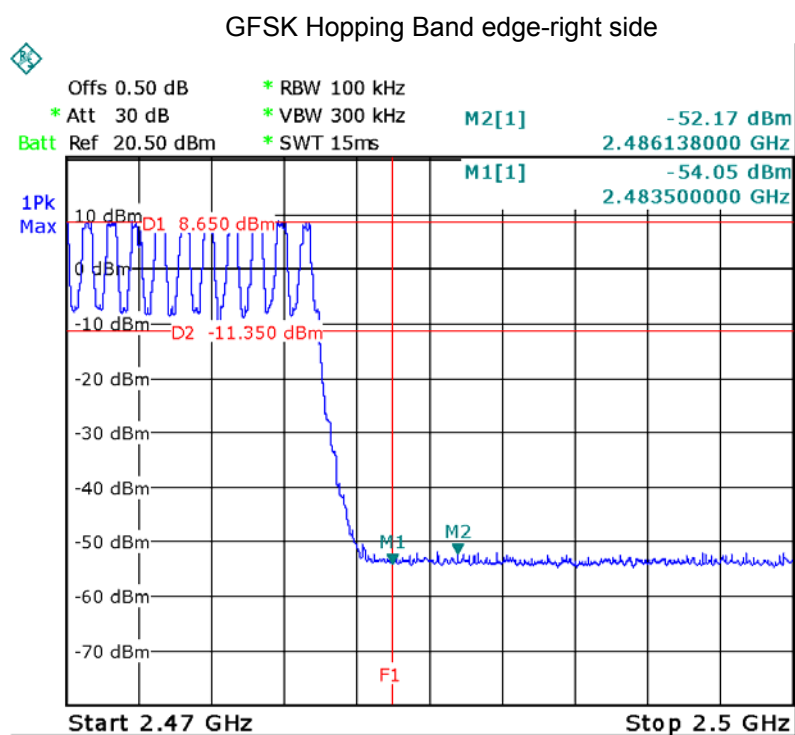
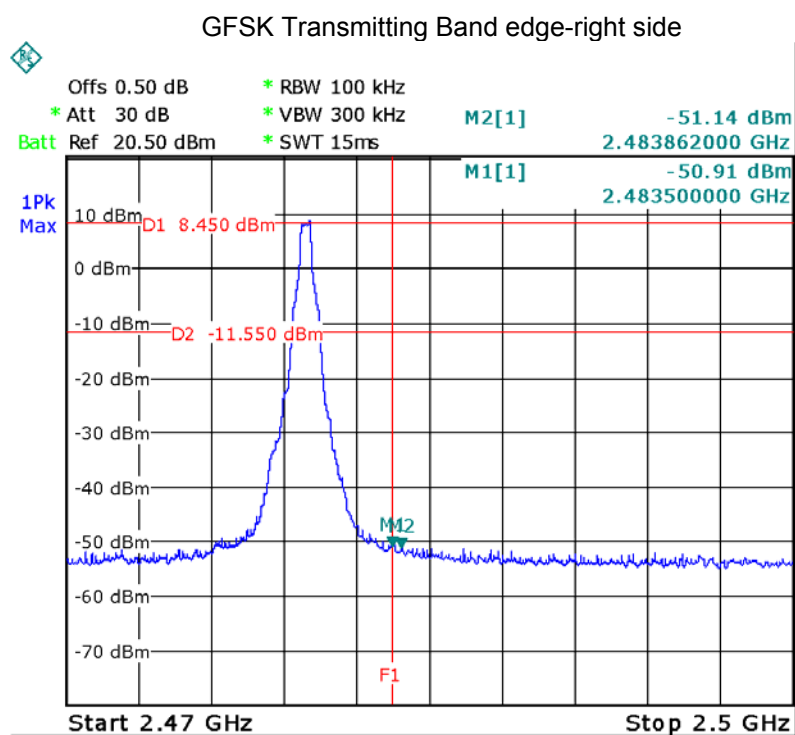
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

### 10.1 Test Procedure

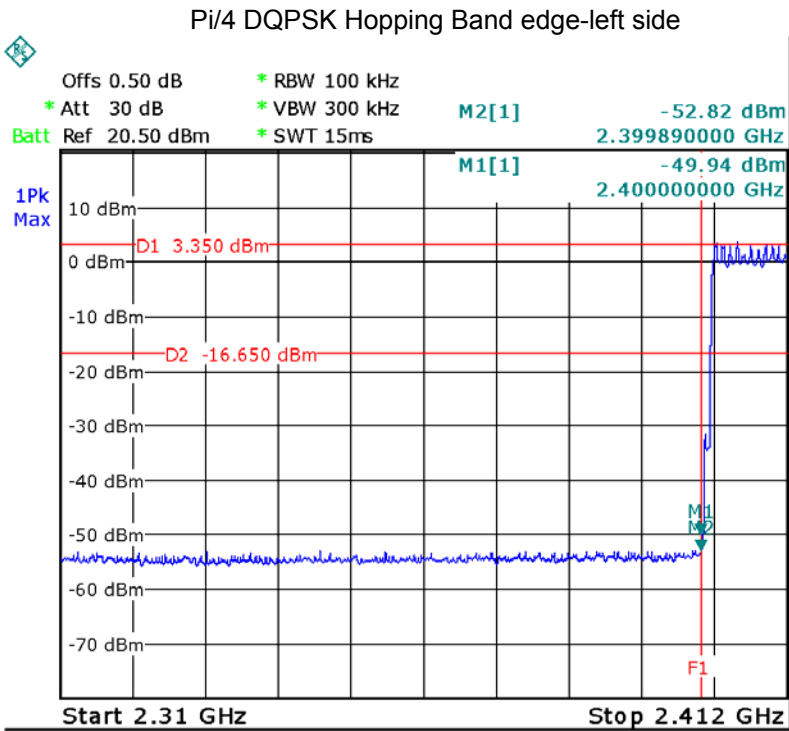
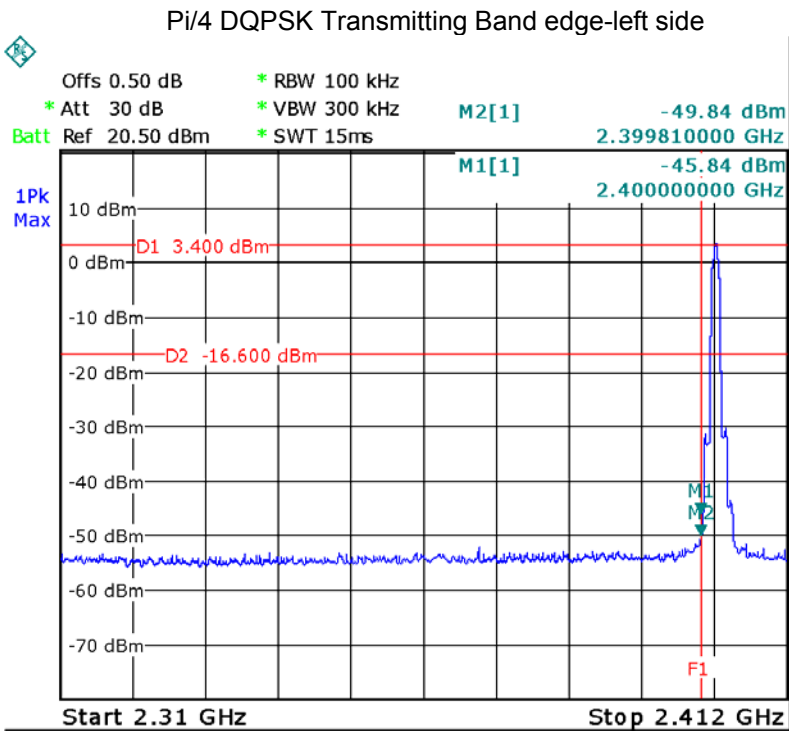
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto  
Detector function = peak, Trace = max hold

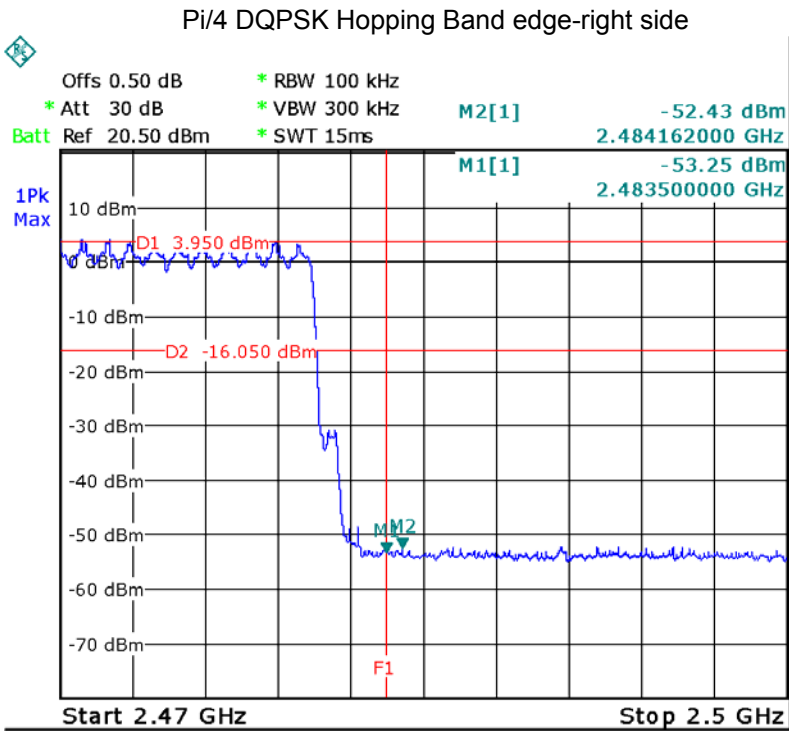
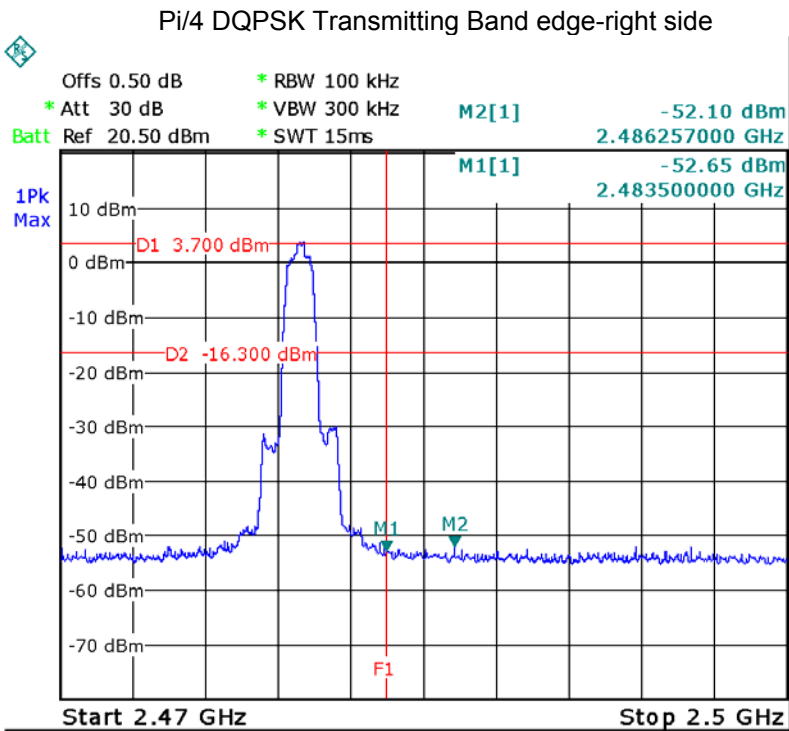
10.2 Test Result

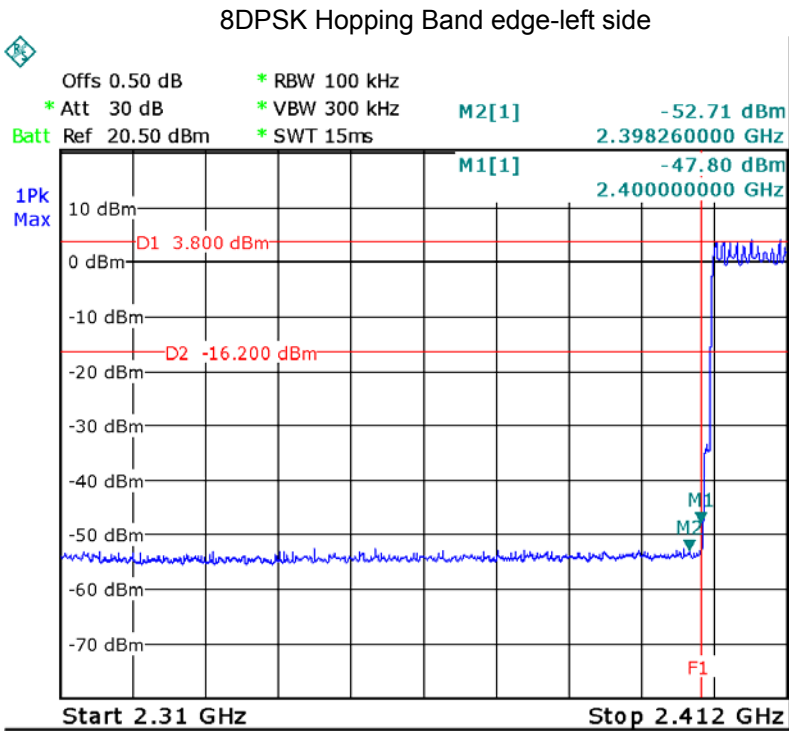
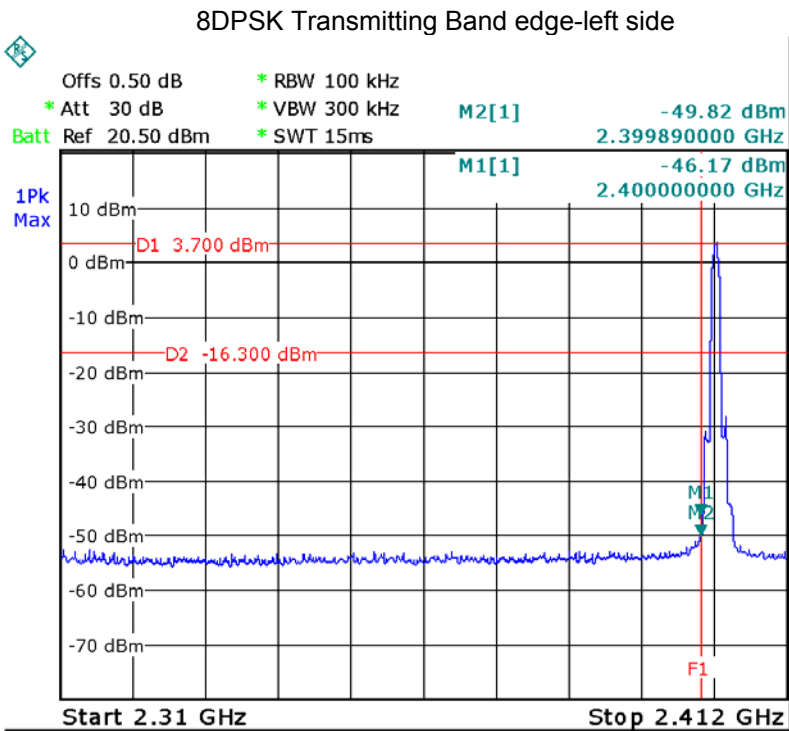


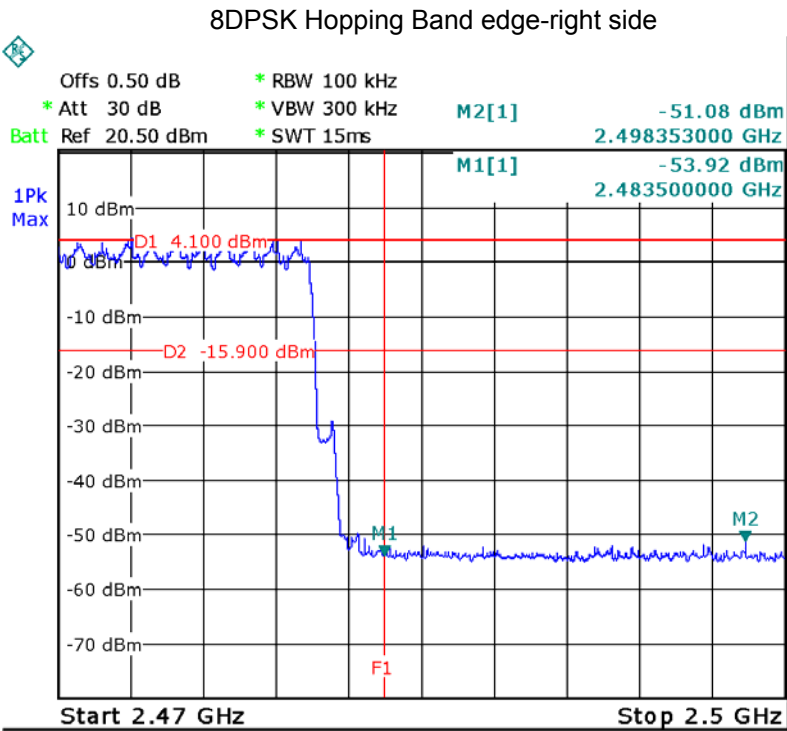
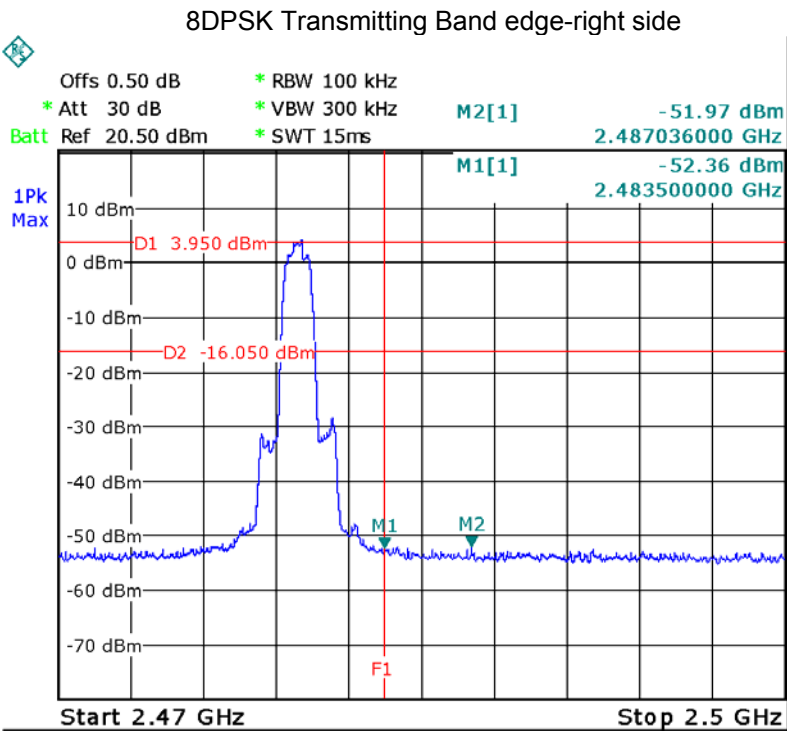












## 11 20 dB Bandwidth Measurement

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.

### 11.1 Test Procedure

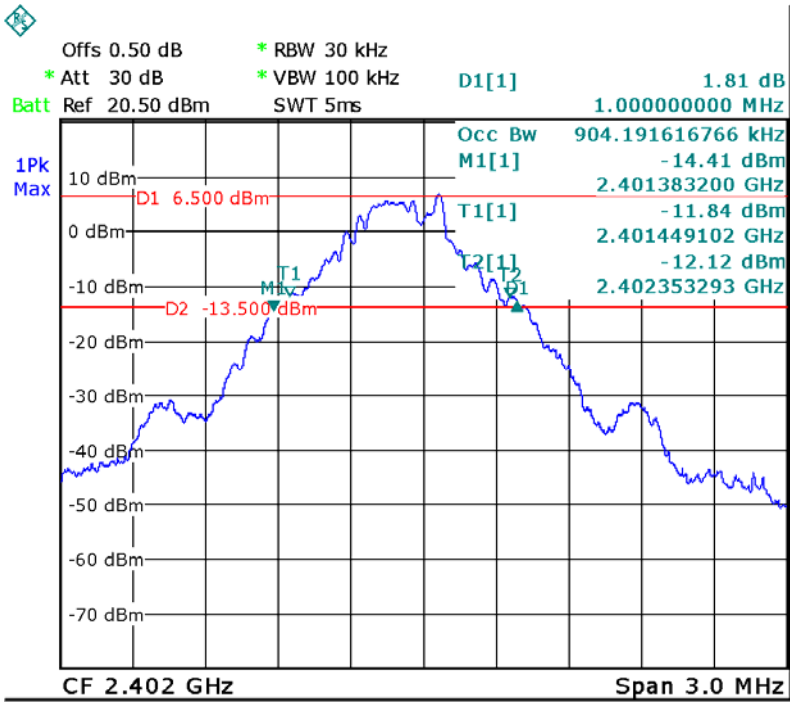
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

### 11.2 Test Result

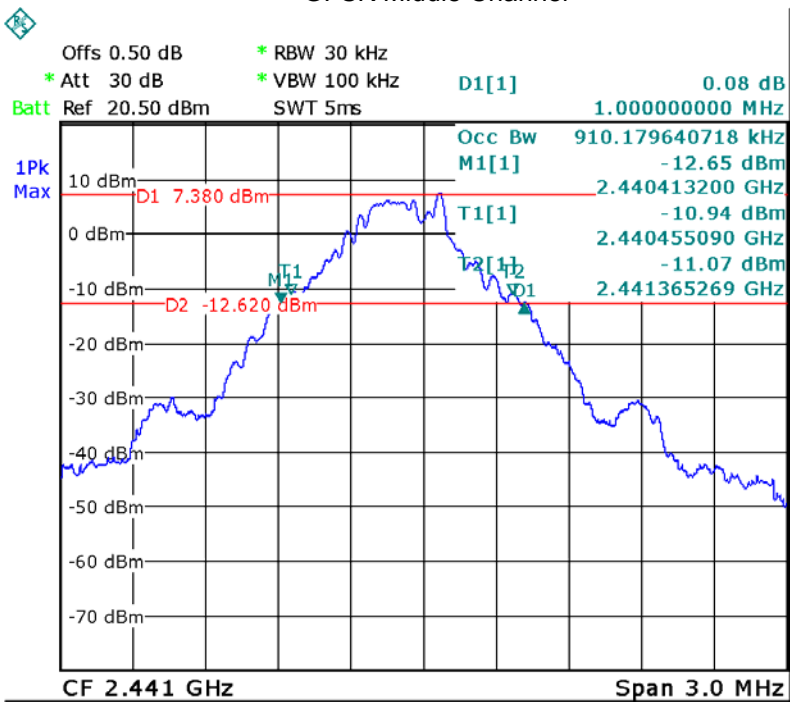
| Modulation | Test Channel | Bandwidth(MHz) |
|------------|--------------|----------------|
| GFSK       | Low          | 1.000          |
| GFSK       | Middle       | 1.000          |
| GFSK       | High         | 1.042          |
| Pi/4 DQPSK | Low          | 1.359          |
| Pi/4 DQPSK | Middle       | 1.359          |
| Pi/4 DQPSK | High         | 1.359          |
| 8DPSK      | Low          | 1.317          |
| 8DPSK      | Middle       | 1.329          |
| 8DPSK      | High         | 1.329          |

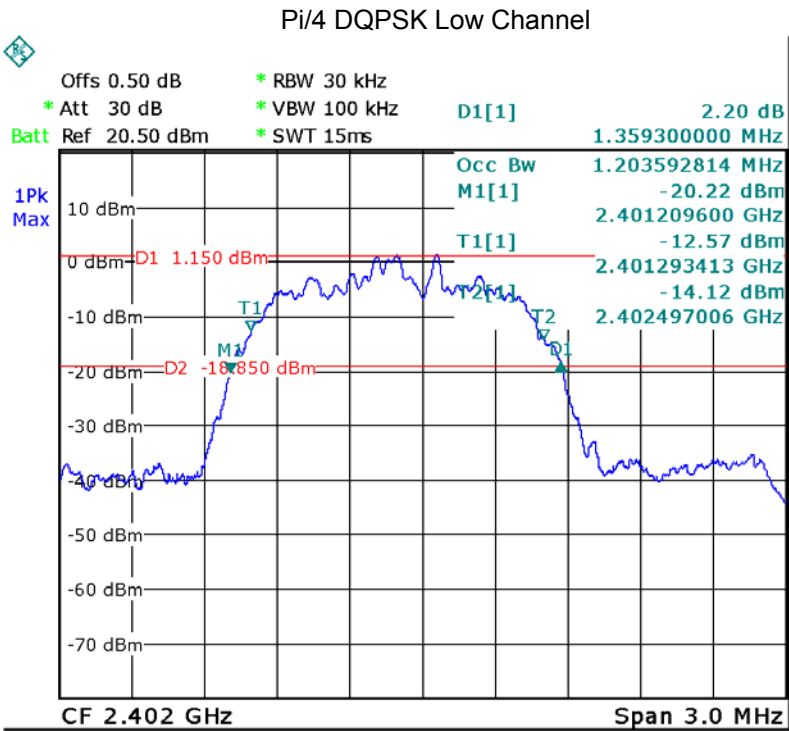
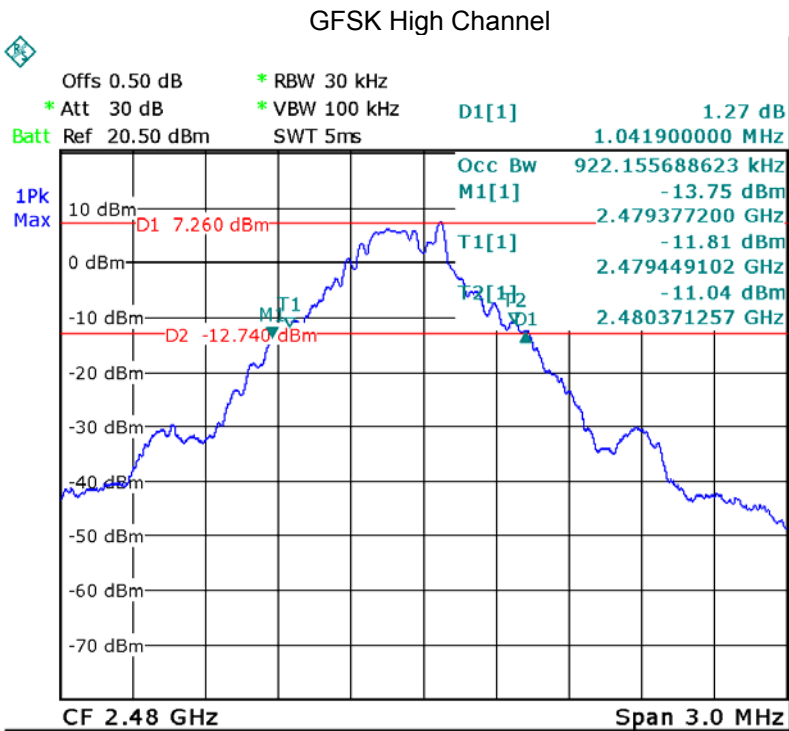
Test plots

GFSK Low Channel

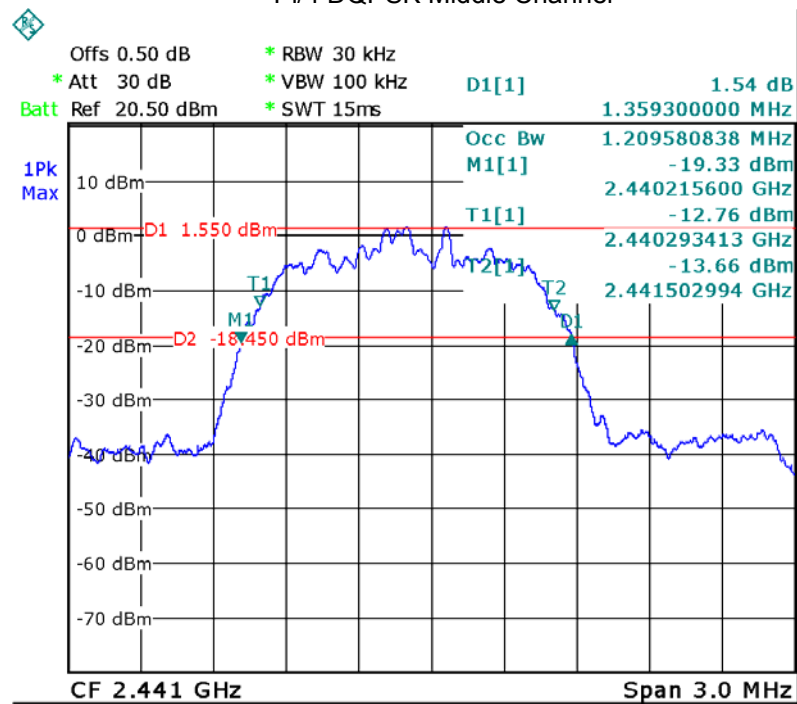


GFSK Middle Channel

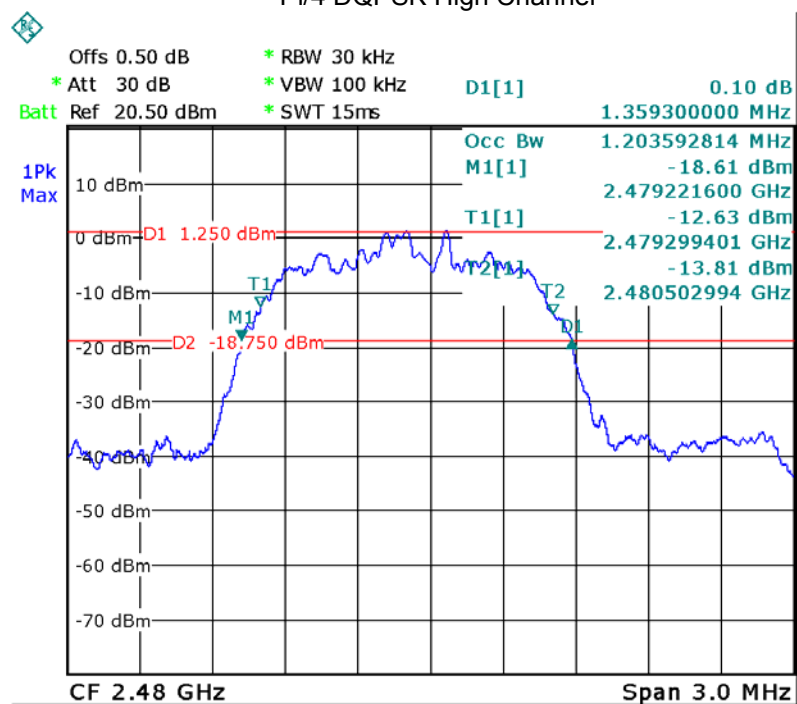




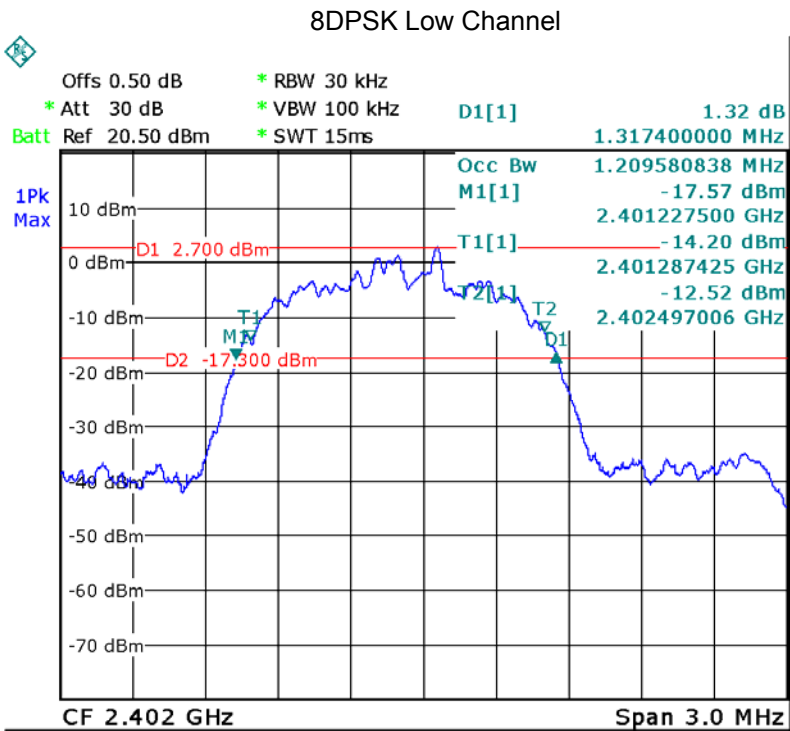
### Pi/4 DQPSK Middle Channel

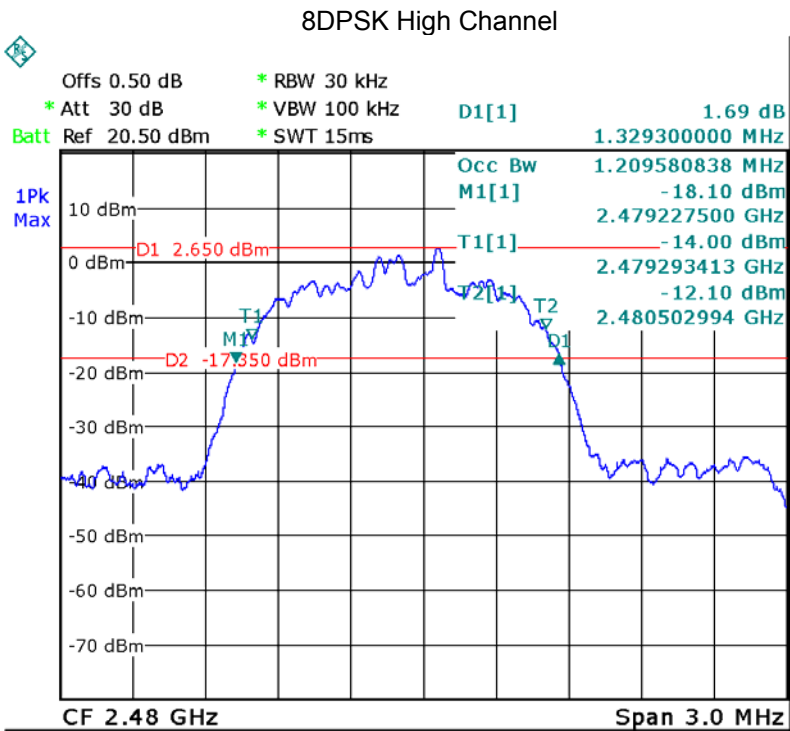


## Pi/4 DQPSK High Channel









## 12 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Limit: Regulation 15.247 (a)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater 0.125 watts..

Test mode: Test in fixing frequency transmitting mode.

### 12.1 Test Procedure

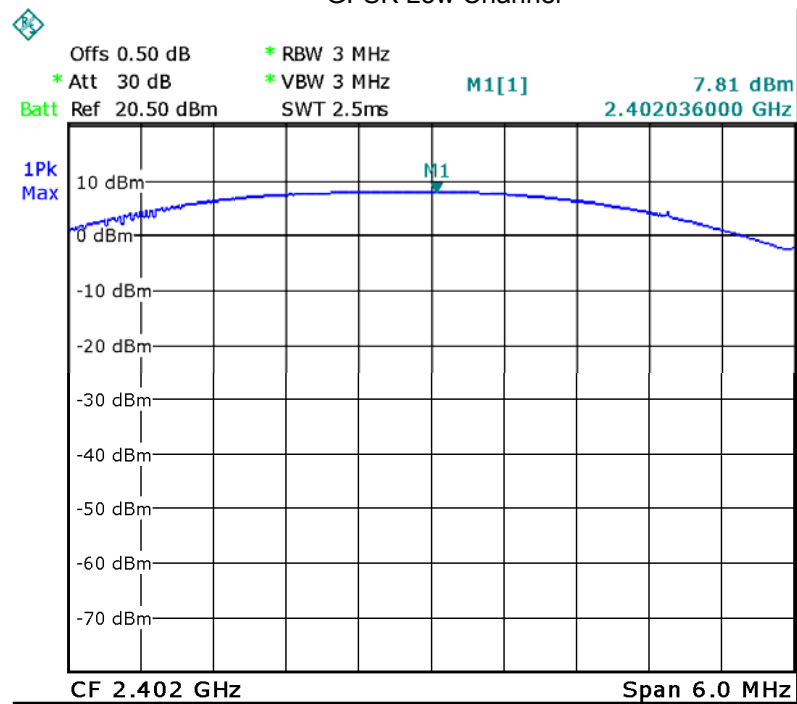
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer:
  - a) Use the following spectrum analyzer settings:
    - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
    - 2) RBW  $\geq$  20 dB bandwidth of the emission being measured.
    - 3) VBW  $\geq$  RBW.
    - 4) Sweep: Auto.
    - 5) Detector function: Peak.
    - 6) Trace: Max hold.
  - b) Allow trace to stabilize.
  - c) Use the marker-to-peak function to set the marker to the peak of the emission.
  - d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
  - e) A plot of the test results and setup description shall be included in the test report.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

## 12.2 Test Result

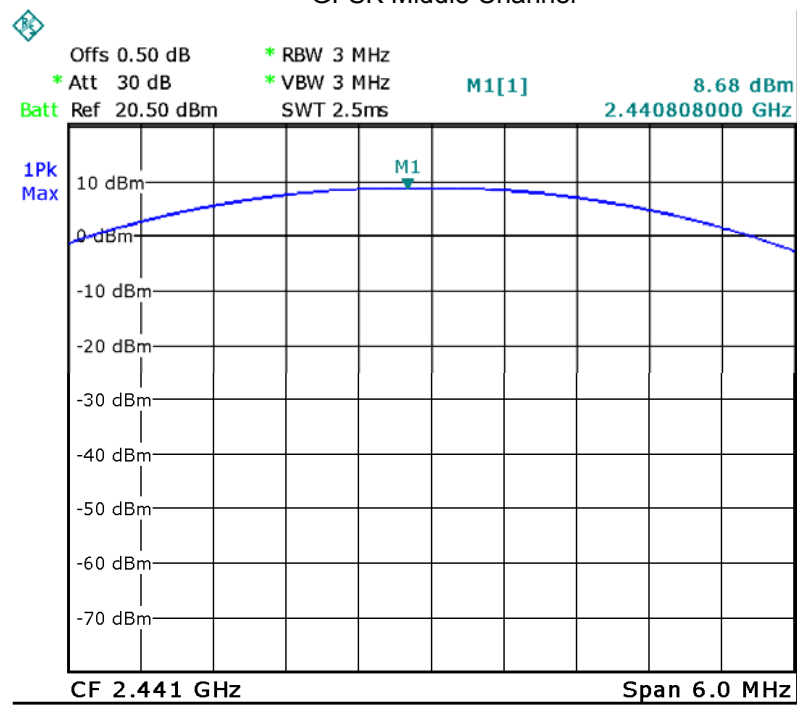
| Modulation | Test Channel | Output Power (dBm) | Limit (dBm) |
|------------|--------------|--------------------|-------------|
| GFSK       | Low          | 7.81               | 21          |
| GFSK       | Middle       | 8.68               | 21          |
| GFSK       | High         | 8.61               | 21          |
| Pi/4 DQPSK | Low          | 5.89               | 21          |
| Pi/4 DQPSK | Middle       | 6.49               | 21          |
| Pi/4 DQPSK | High         | 6.20               | 21          |
| 8DPSK      | Low          | 6.23               | 21          |
| 8DPSK      | Middle       | 6.81               | 21          |
| 8DPSK      | High         | 6.71               | 21          |

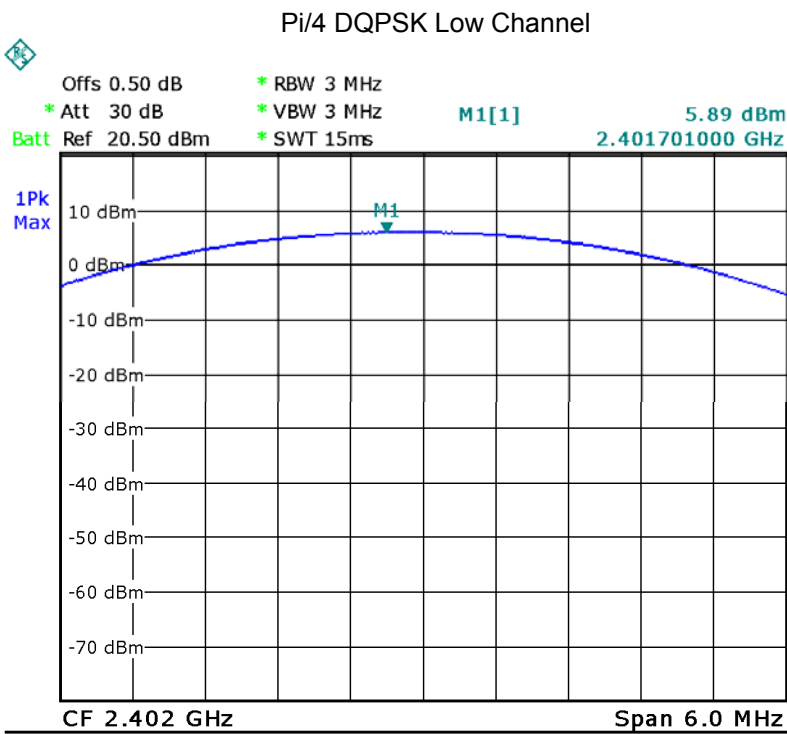
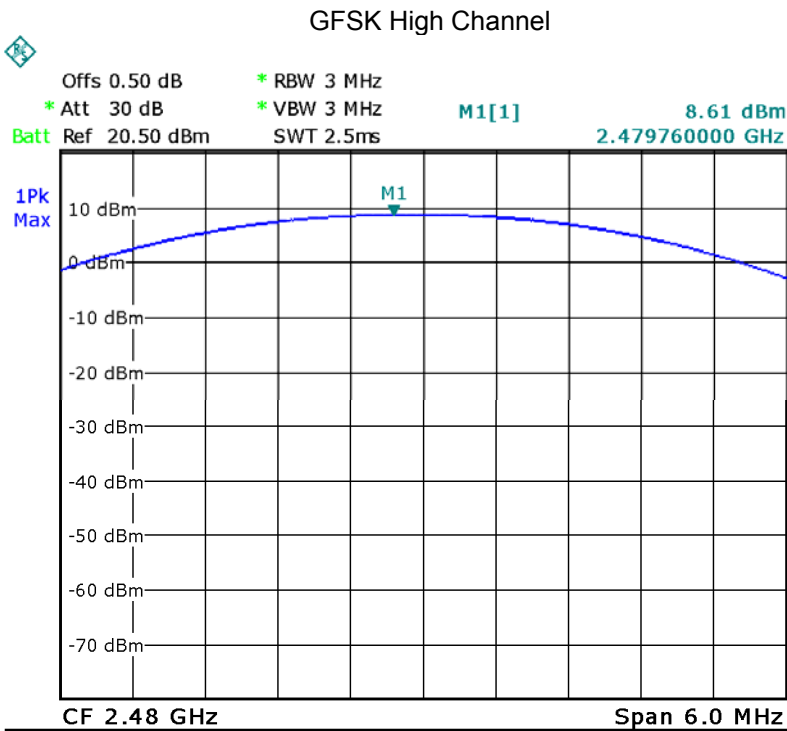
Test plots

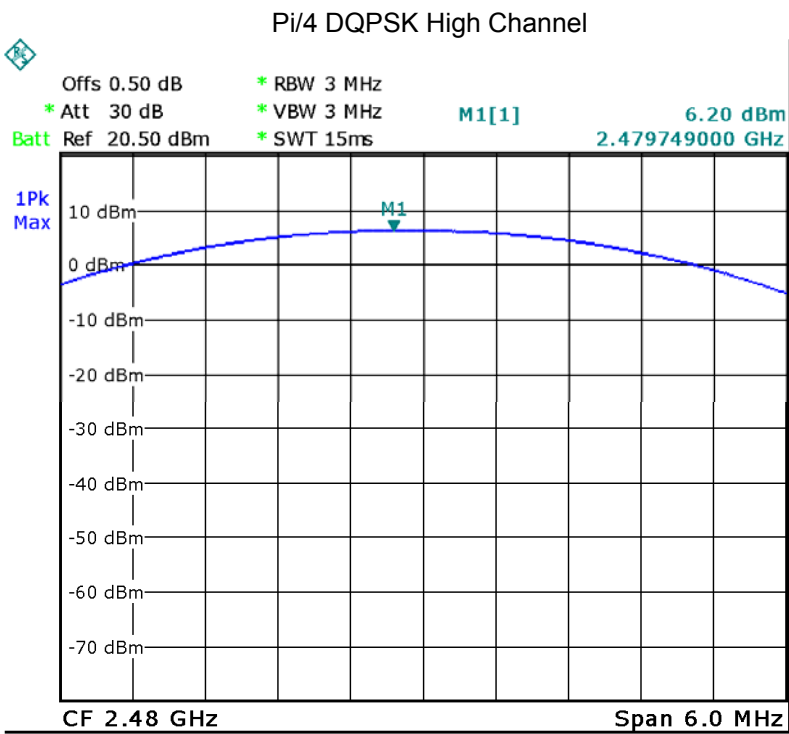
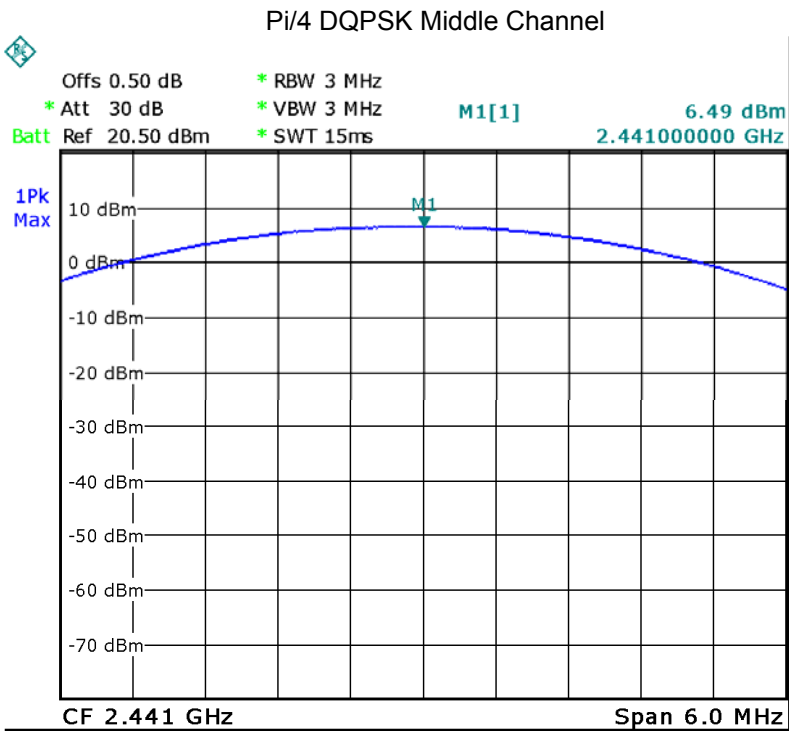
GFSK Low Channel

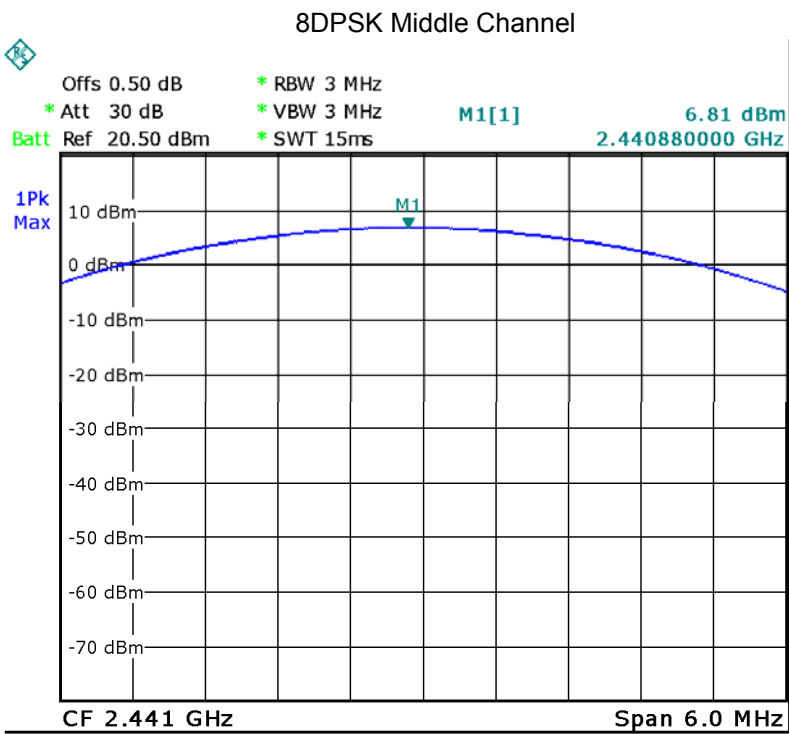
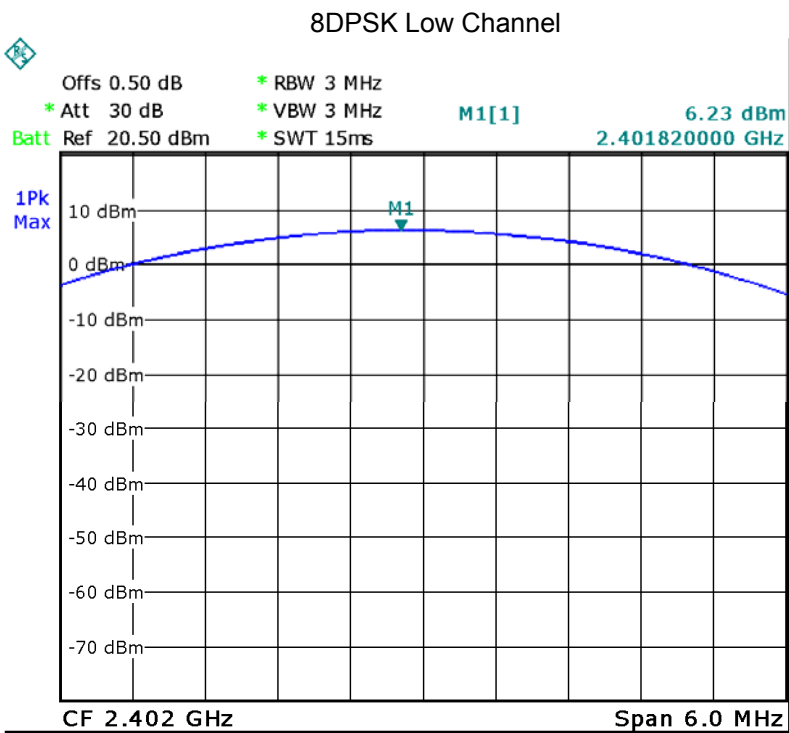


GFSK Middle Channel

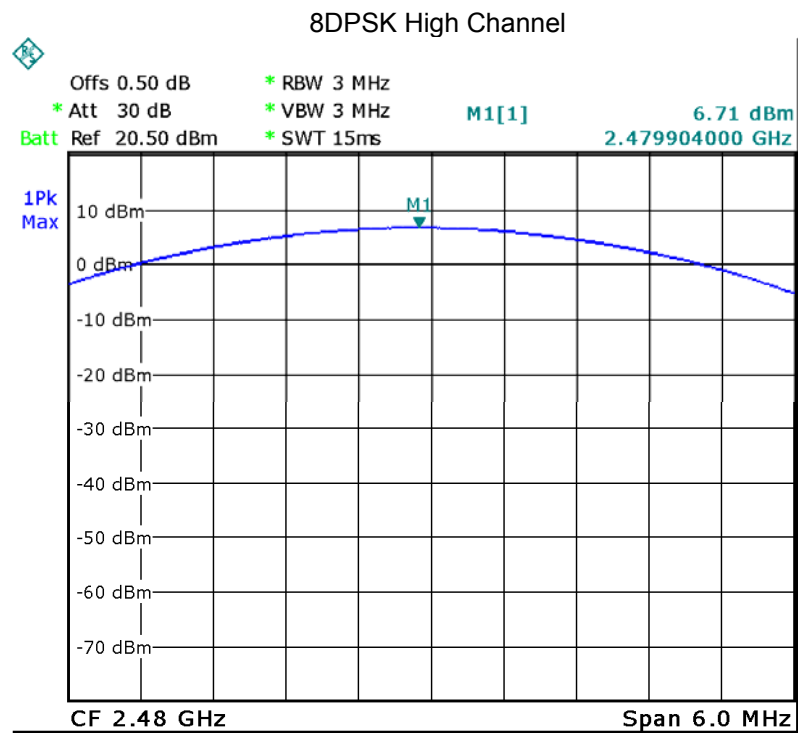












## 13 Hopping Channel Separation

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 2400-2483.5 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 power no greater than 0.125W.

Test Mode: Test in hopping transmitting operating mode.

### 13.1 Test Procedure

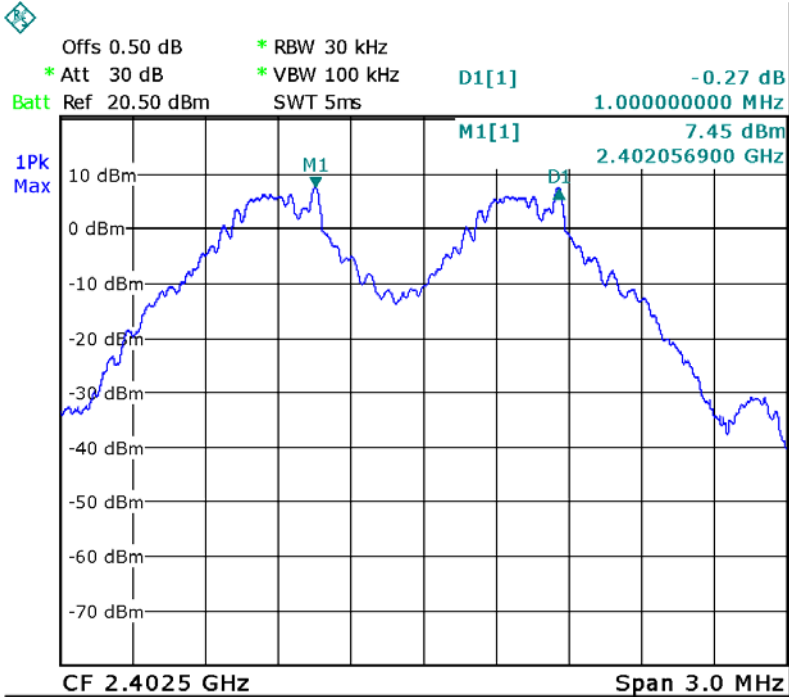
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer:
  - a) Span: Wide enough to capture the peaks of two adjacent channels.
  - b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
  - c) Video (or average) bandwidth (VBW)  $\geq$  RBW.
  - d) Sweep: Auto.
  - e) Detector function: Peak.
  - f) Trace: Max hold.
  - g) Allow the trace to stabilize.
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.

**13.2 Test Result**

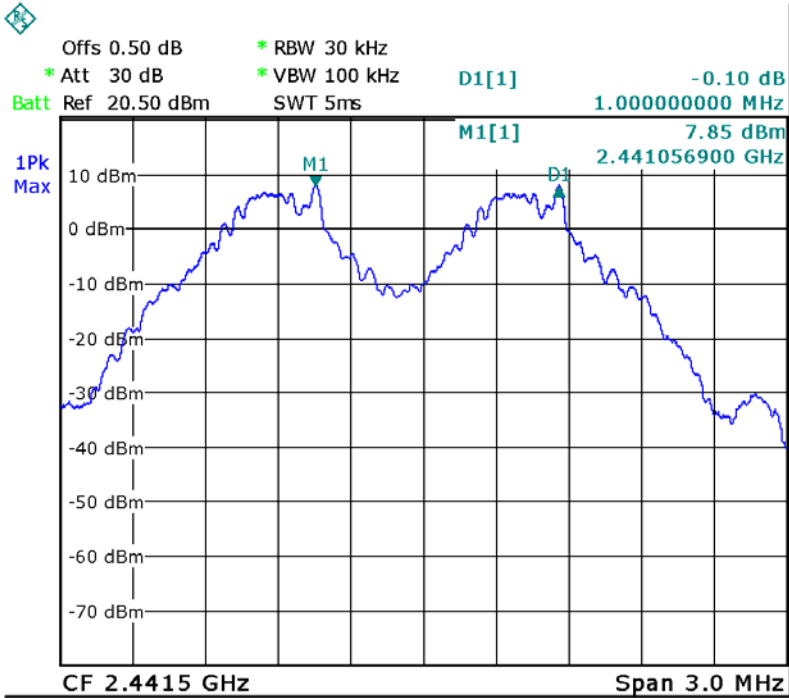
| Modulation | Test Channel | Separation<br>(MHz) | Limit(MHz) | Result |
|------------|--------------|---------------------|------------|--------|
| GFSK       | Low          | 1.000               | 0.667      | PASS   |
| GFSK       | Middle       | 1.000               | 0.667      | PASS   |
| GFSK       | High         | 1.000               | 0.695      | PASS   |
| Pi/4 DQPSK | Low          | 1.006               | 0.906      | PASS   |
| Pi/4 DQPSK | Middle       | 1.000               | 0.906      | PASS   |
| Pi/4 DQPSK | High         | 1.006               | 0.906      | PASS   |
| 8DPSK      | Low          | 1.006               | 0.878      | PASS   |
| 8DPSK      | Middle       | 1.000               | 0.886      | PASS   |
| 8DPSK      | High         | 1.000               | 0.886      | PASS   |

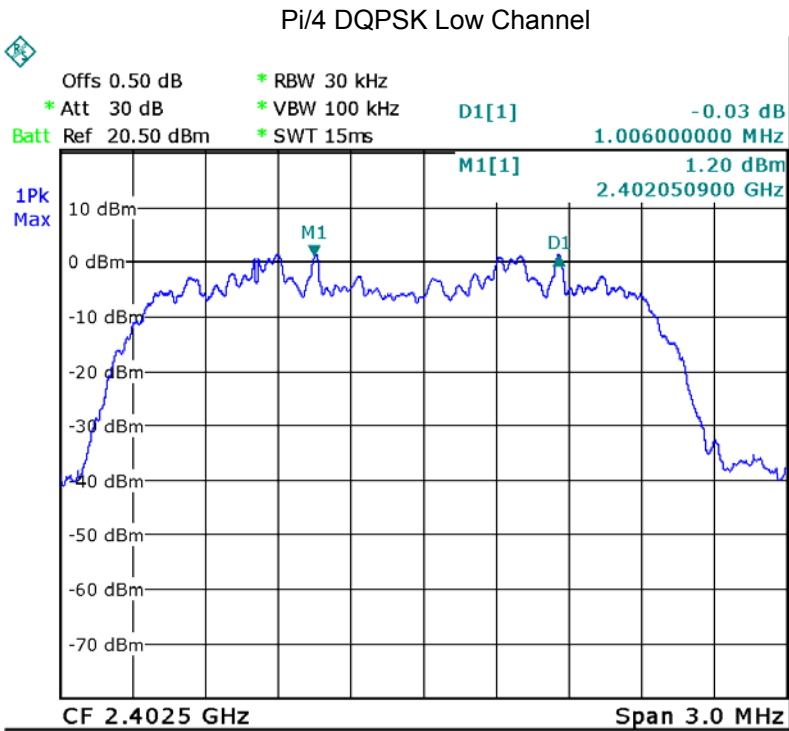
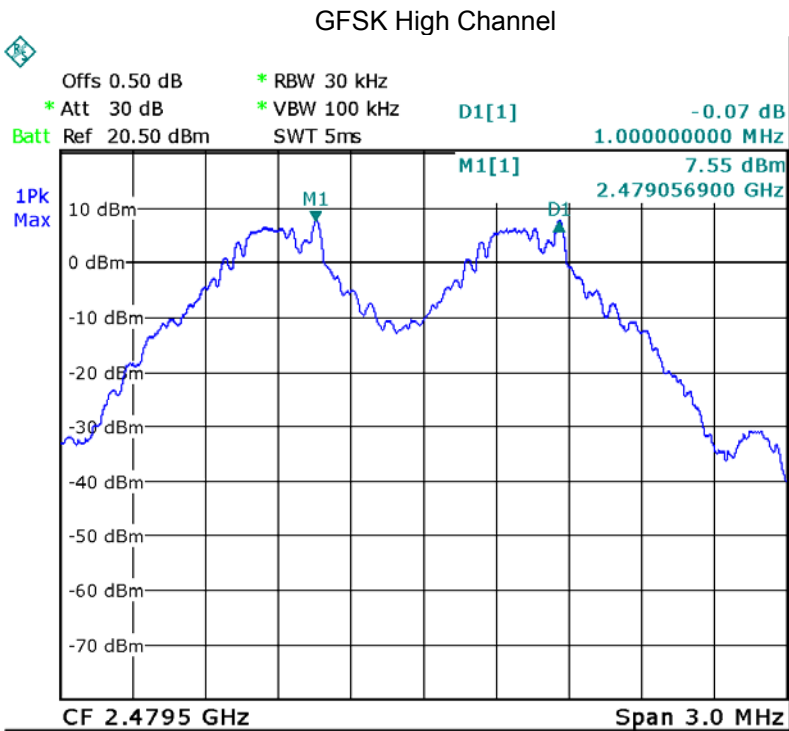
Test plots

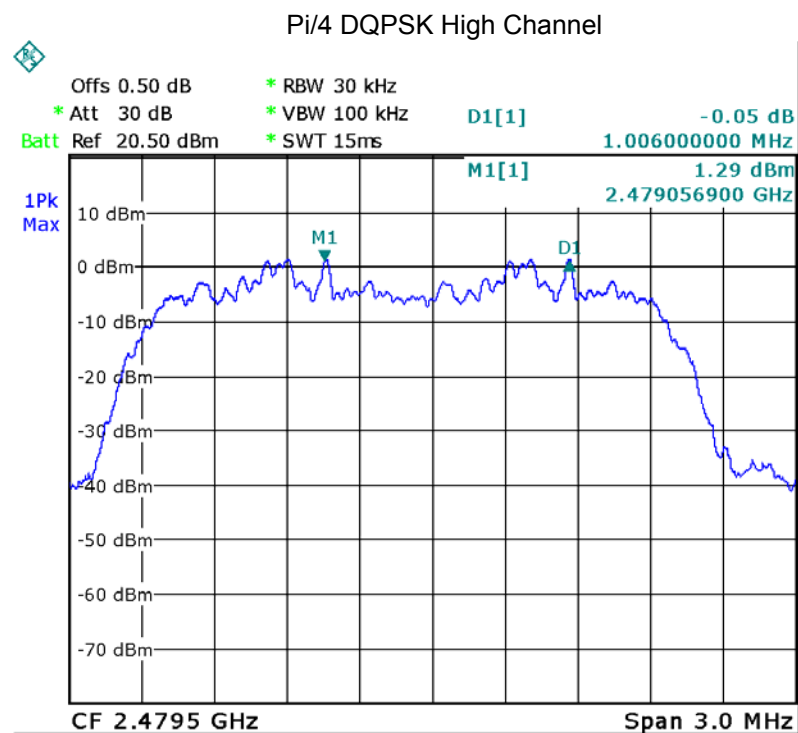
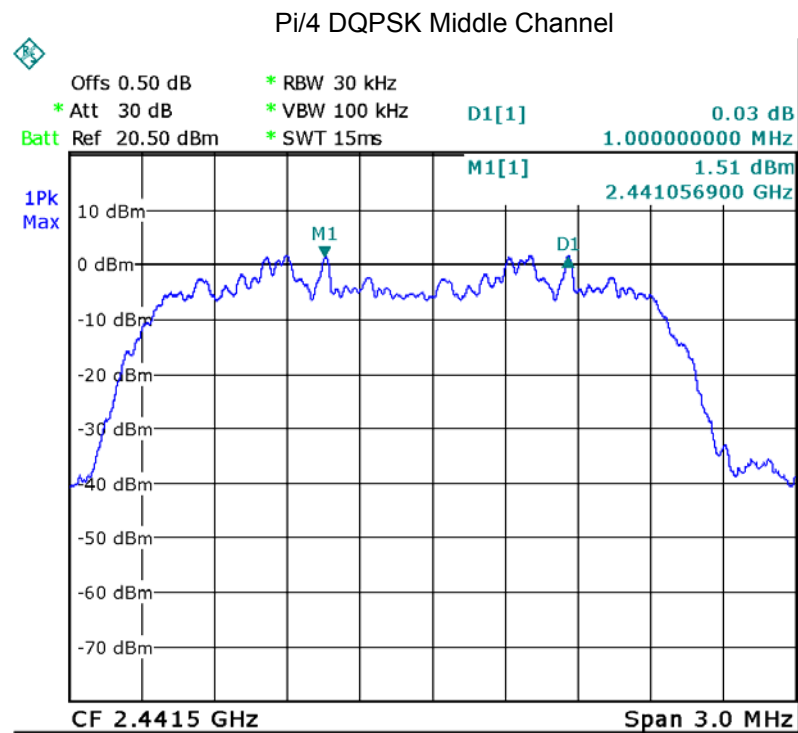
GFSK Low Channel

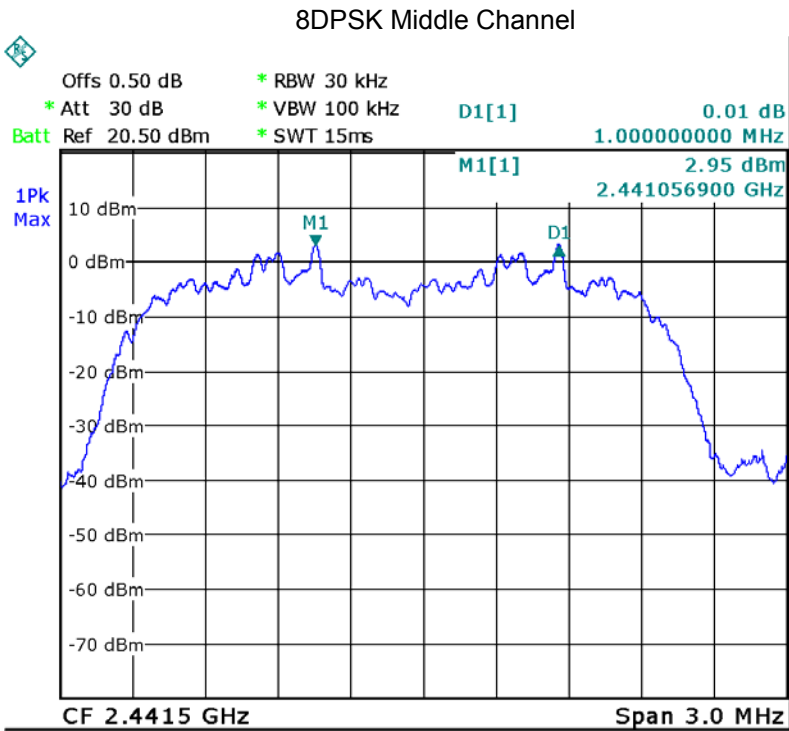
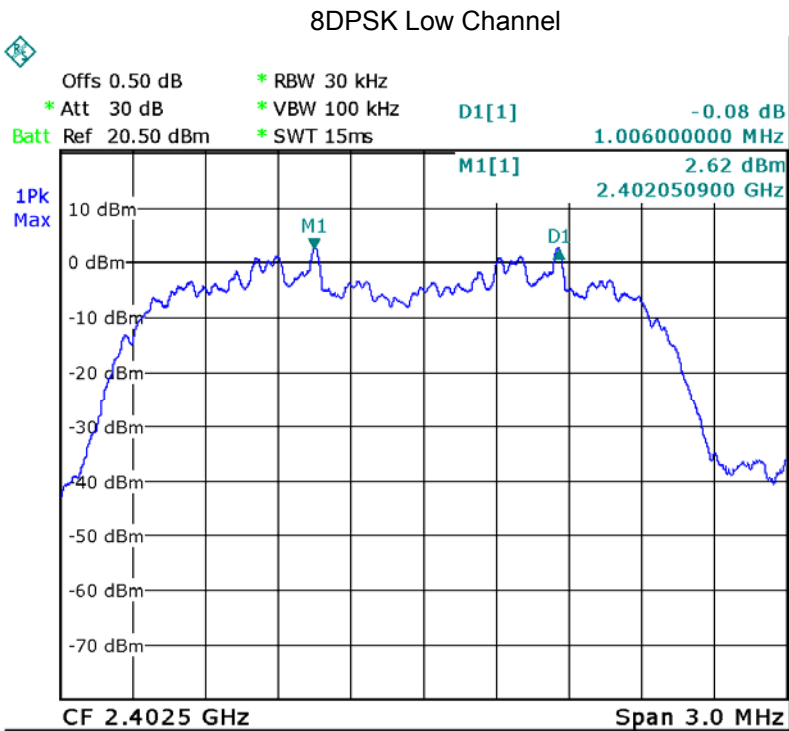


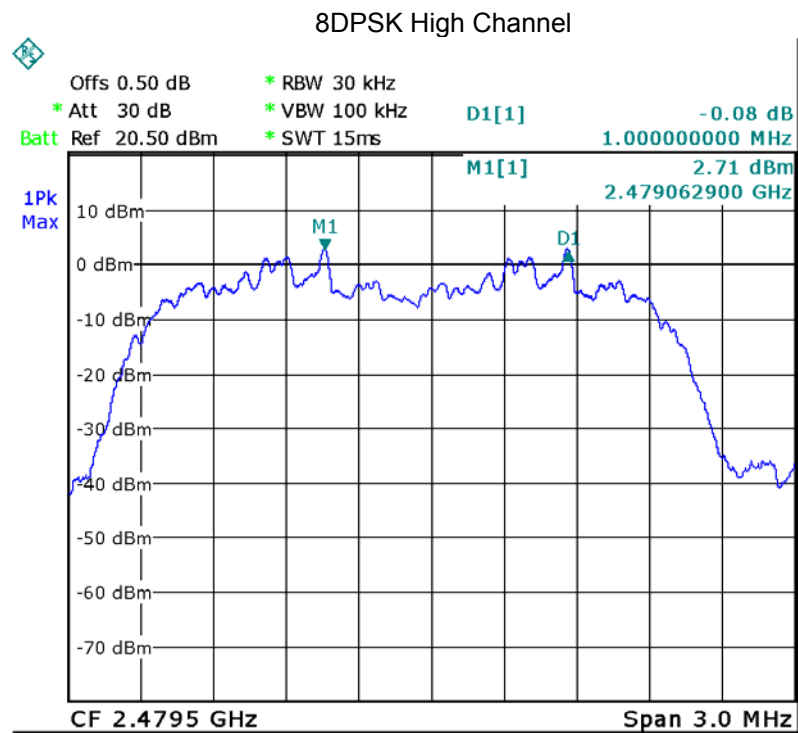
GFSK Middle Channel













## 14 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.

### 14.1 Test Procedure

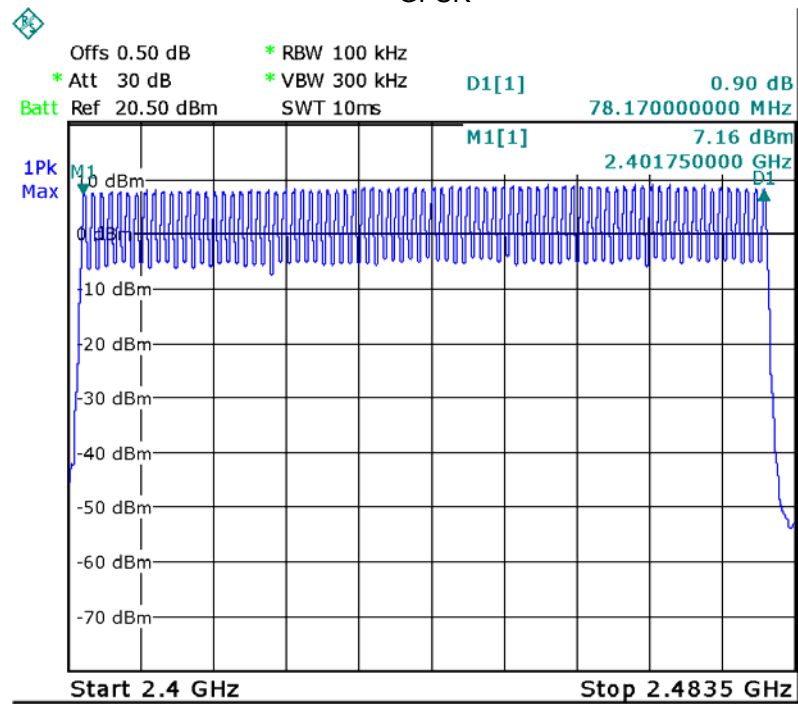
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer:
  - a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
  - b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
  - c) VBW  $\geq$  RBW.
  - d) Sweep: Auto.
  - e) Detector function: Peak.
  - f) Trace: Max hold.
  - g) Allow the trace to stabilize..
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;

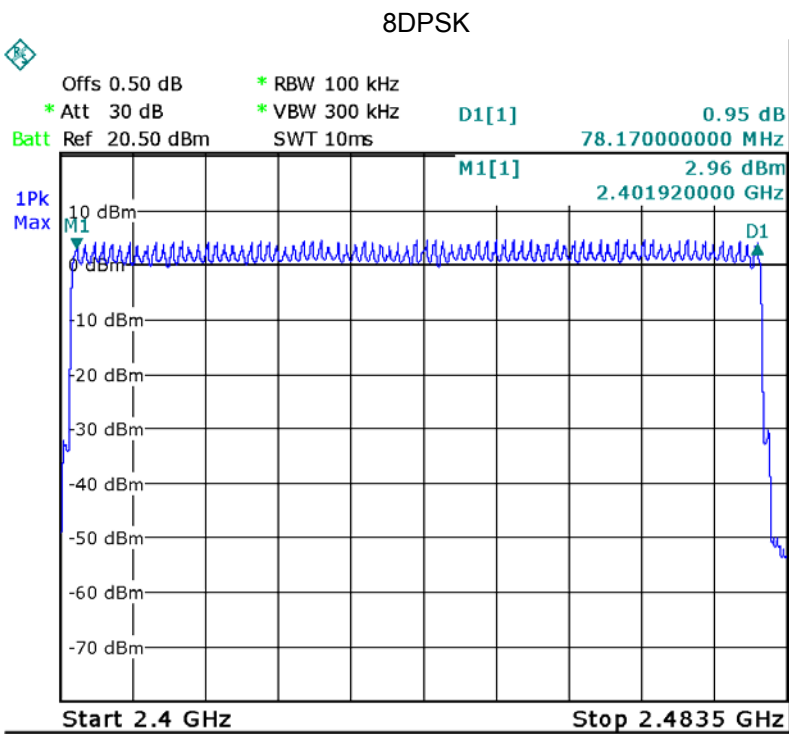
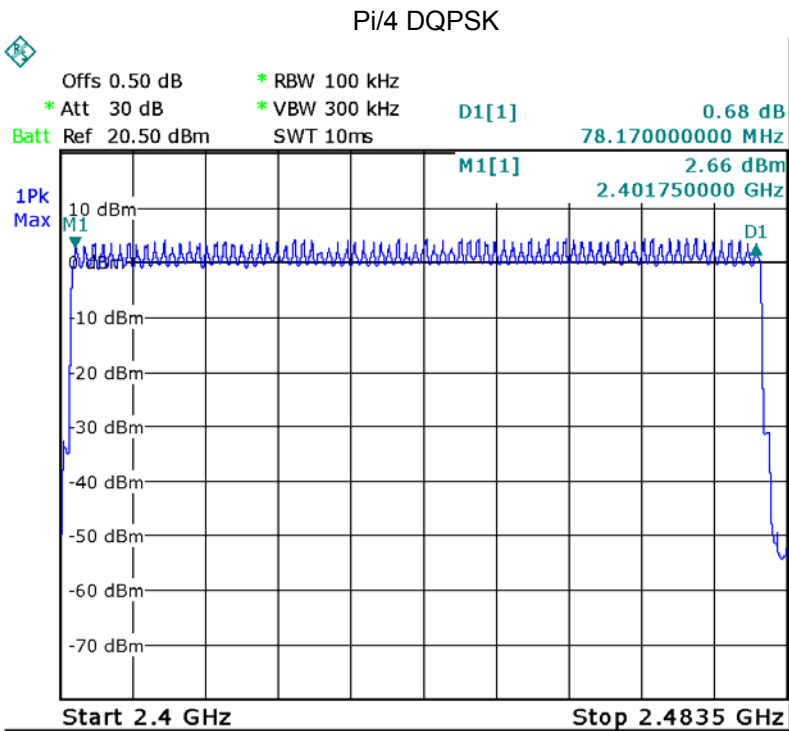
14.2 Test Result

Test Plots:

79 Channels in total

GFSK





## 15 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.

### 15.1 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. 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).

### 15.2 Test Result

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

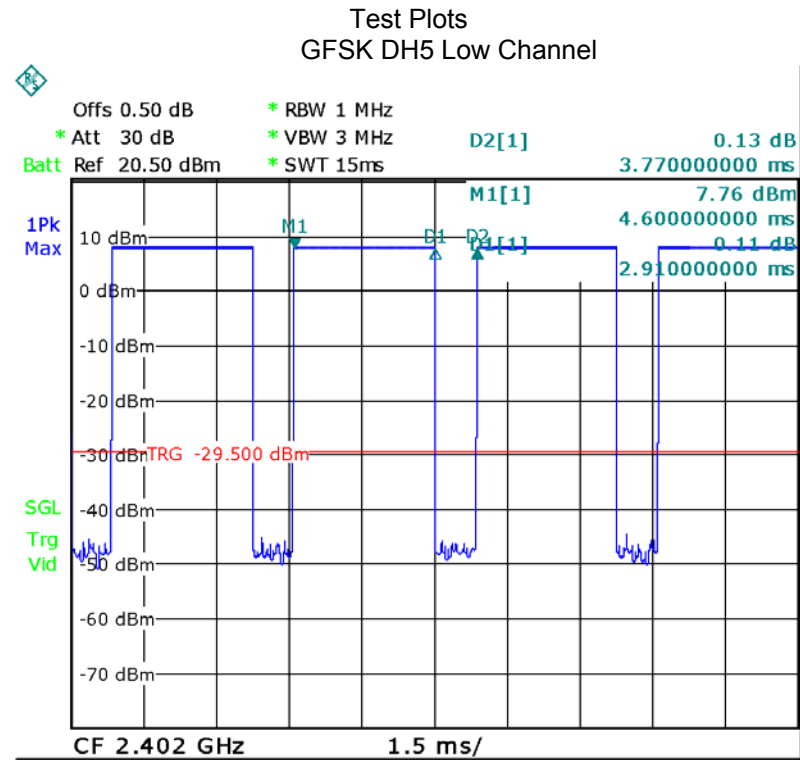
DH3 Packet permit maximum  $1600 / 79 / 4$  hops per second in each channel (3 time slots RX, 1 time slot TX).

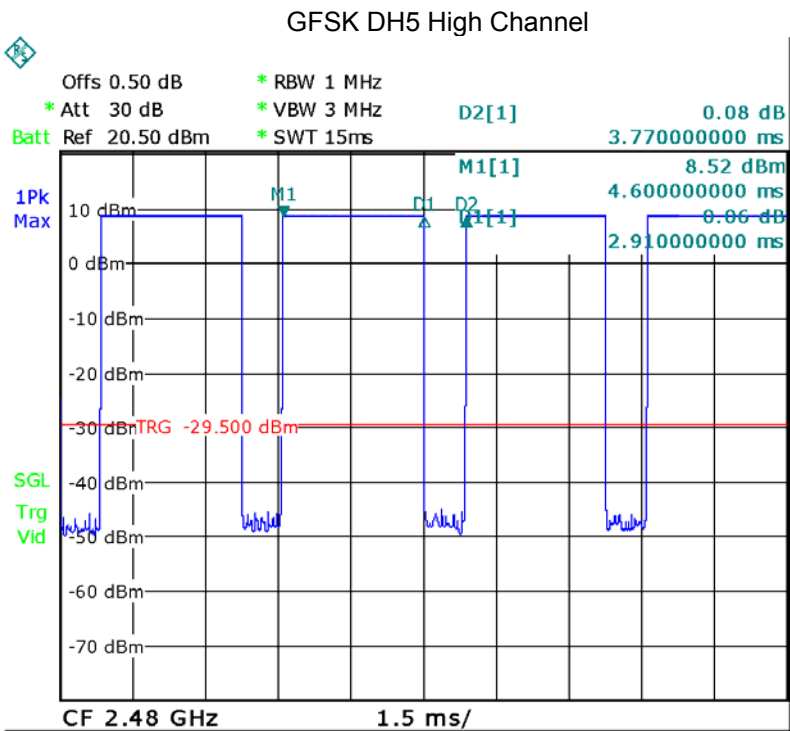
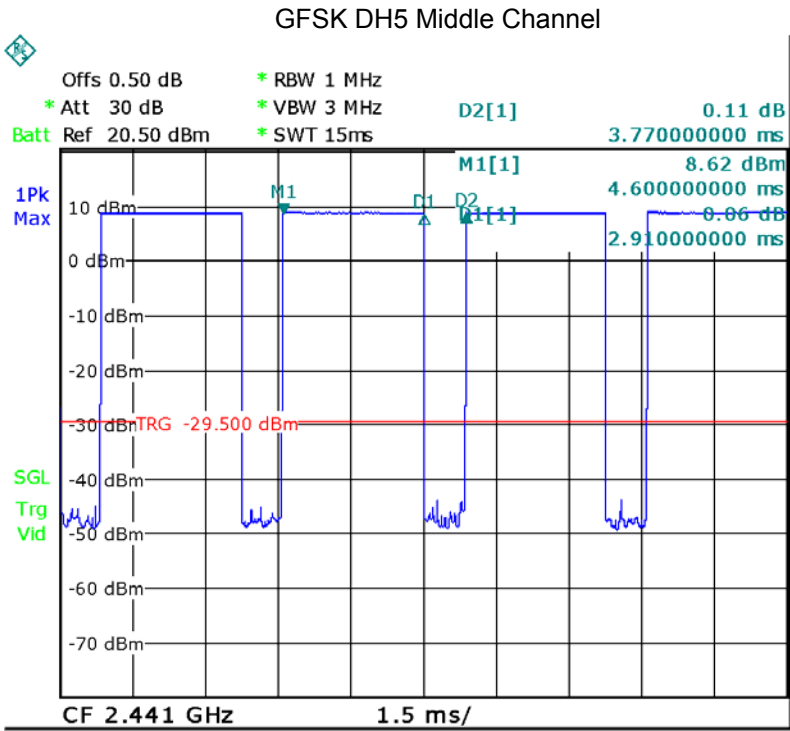
DH1 Packet permit maximum  $1600 / 79 / 2$  hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

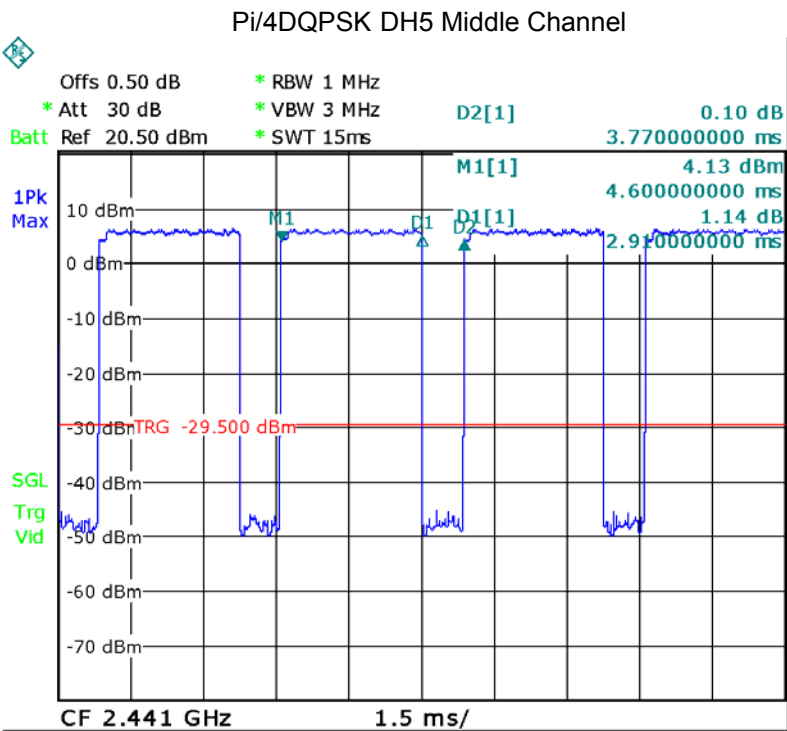
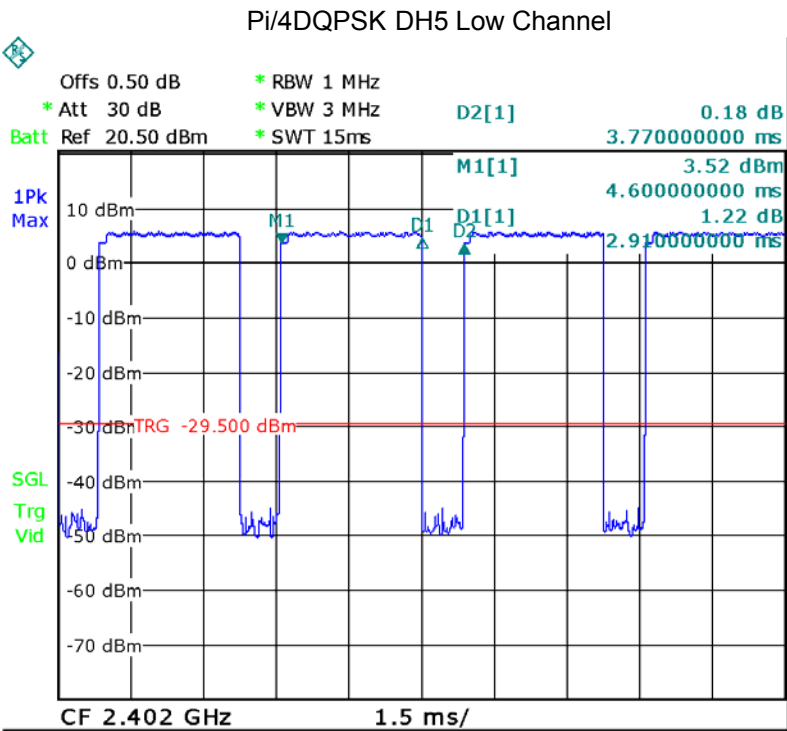
| Data Packet                           | Dwell Time(s)                      |
|---------------------------------------|------------------------------------|
| DH5                                   | $1600/79/6*0.4*79*(MkrDelta)/1000$ |
| DH3                                   | $1600/79/4*0.4*79*(MkrDelta)/1000$ |
| DH1                                   | $1600/79/2*0.4*79*(MkrDelta)/1000$ |
| Remark: Mkr Delta is once pulse time. |                                    |

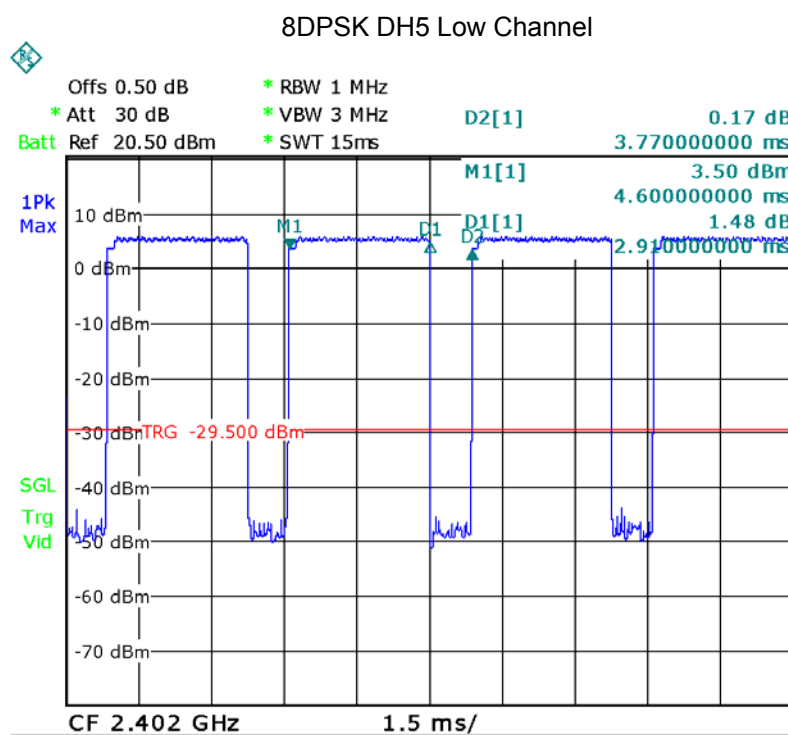
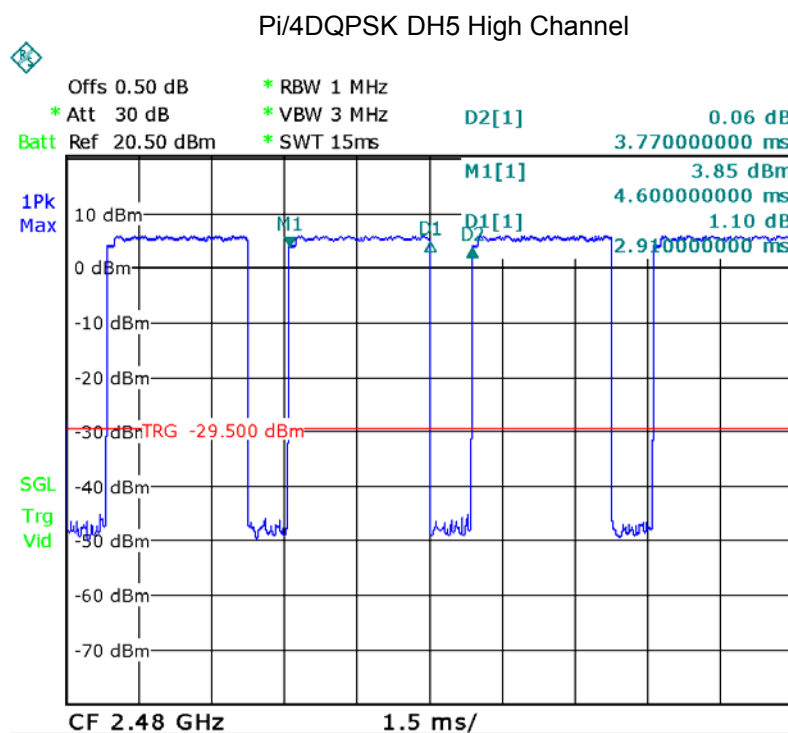
| Modulation | Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|------------|-------------|---------|----------------|---------------|-----------|
| GFSK       | DH5         | Low     | 2.910          | 0.310         | 0.4       |
|            |             | middle  | 2.910          | 0.310         | 0.4       |
|            |             | High    | 2.910          | 0.310         | 0.4       |
| Pi/4DQPSK  | DH5         | Low     | 2.910          | 0.310         | 0.4       |
|            |             | middle  | 2.910          | 0.310         | 0.4       |
|            |             | High    | 2.910          | 0.310         | 0.4       |
| 8DPSK      | DH5         | Low     | 2.910          | 0.310         | 0.4       |
|            |             | middle  | 2.910          | 0.310         | 0.4       |
|            |             | High    | 2.910          | 0.310         | 0.4       |

Remark: Only the worst-case mode DH5 is recorded.

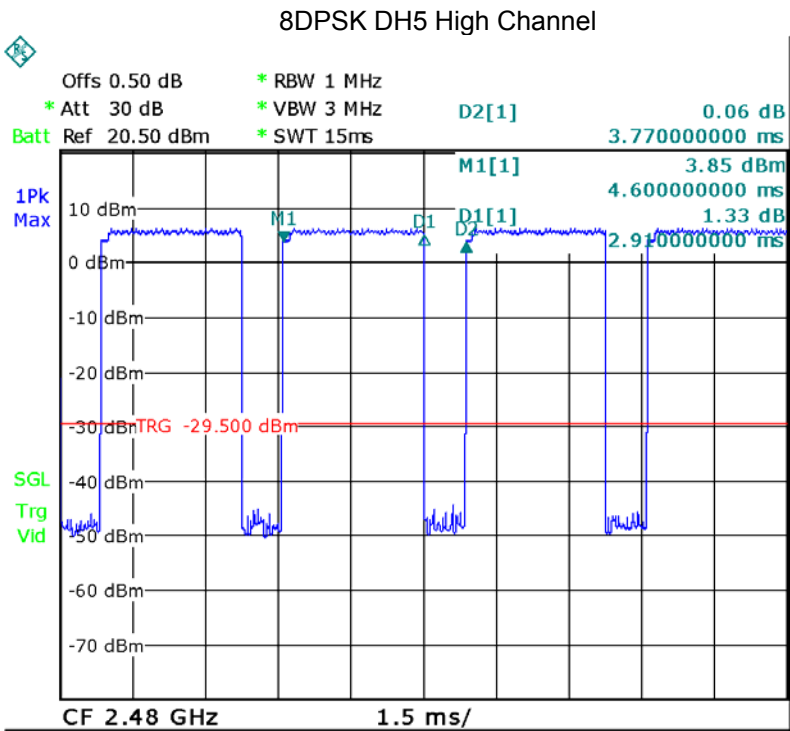
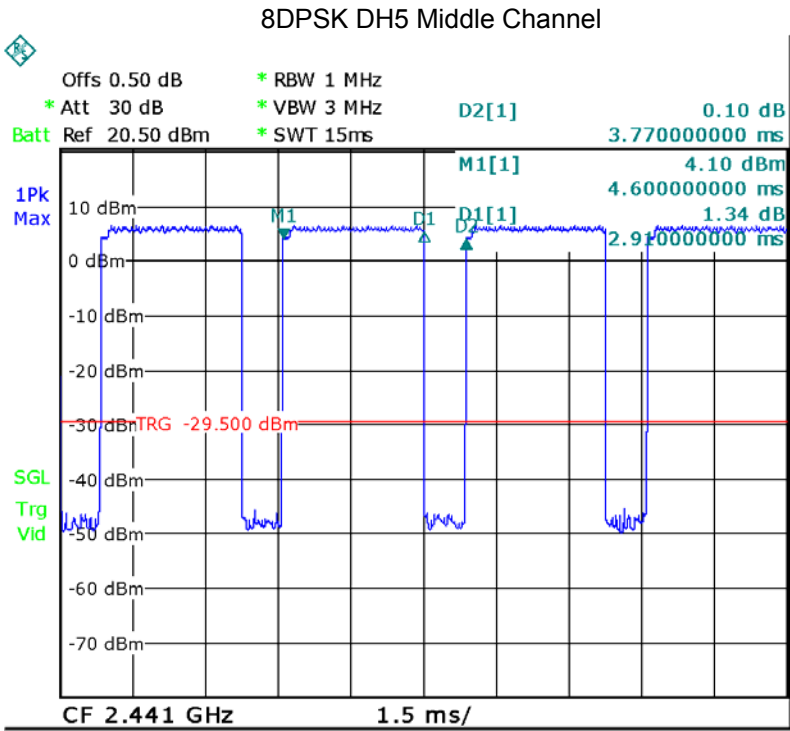












## **16 Antenna Requirement**

According to the FCC Part 15 Paragraph 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. This product has an integrated antenna, fulfil the requirement of this section.

## **17 RF Exposure**

Remark: refer to SAR test report: WTF18S11128953W.

## **18 Photographs of test setup and EUT.**

Note: Please refer to appendix: Appendix-iX20-Photos.

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