



# RF TEST REPORT

**Report No.:** SET2015-11556

**Product Name:** BT headset

**FCC ID:** 2AB2S-IAM5110

**IC:** 20547-IAM5110

**Model No. :** IAM5110

**Applicant:** I.am.plus electronics inc.

**Address:** 10960 Wilshire Blvd.,5th Floor Los Angeles California, 90024,  
the United States

**Dates of Testing:** 08/03/2015 — 08/14/2015

**Issued by:** CCIC-SET

**Lab Location:** Electronic Testing Building, Shahe Road, Xili, Nanshan District,  
Shenzhen, 518055, P. R. China

**Tel:** 86 755 26627338 **Fax:** 86 755 26627238

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**Test Report**

|                                   |                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product Name .....</b>         | BT headset                                                                                                                                                                                                                                                                                                             |
| <b>Brand Name .....</b>           | I.AM+                                                                                                                                                                                                                                                                                                                  |
| <b>Trade Name .....</b>           | DOTS                                                                                                                                                                                                                                                                                                                   |
| <b>Applicant .....</b>            | I.am.plus electronics inc.                                                                                                                                                                                                                                                                                             |
| <b>Applicant Address .....</b>    | 10960 Wilshire Blvd.,5th Floor Los Angeles California,<br>90024, the United States                                                                                                                                                                                                                                     |
| <b>Manufacturer .....</b>         | I.am.plus electronics inc.                                                                                                                                                                                                                                                                                             |
| <b>Manufacturer Address .....</b> | 10960 Wilshire Blvd.,5th Floor Los Angeles California,<br>90024, the United States                                                                                                                                                                                                                                     |
| <b>Factory .....</b>              | Shenzhen Grandsun Electronic Co., Ltd.                                                                                                                                                                                                                                                                                 |
| <b>Factory Address .....</b>      | Pingdi Gaoqiao Industry Zone , Longgang District ,<br>Shenzhen, China                                                                                                                                                                                                                                                  |
| <b>Test Standards.....</b>        | 47 CFR Part 15 Subpart C 2014: Radio Frequency Devices<br>ANSI C63.10:2013: American National Standard for<br>Testing Unlicensed Wireless Devices<br>RSS-247:Issue 1,December2015 / RSS-GEN Issue 4,<br>November 2014<br>DA 00-705: Filing and Measurement Guidelines<br>for Frequency Hopping Spread Spectrum Systems |
| <b>Test Result .....</b>          | PASS                                                                                                                                                                                                                                                                                                                   |
| <b>Tested by .....</b>            | <div>2015.08.14</div> <div>Lu Lei, Test Engineer</div>                                                                                                                                                                              |
| <b>Reviewed by .....</b>          | <div>2015.08.14</div> <div>Zhu Qi, Senior Engineer</div>                                                                                                                                                                            |
| <b>Approved by .....</b>          | <div>2015.08.14</div> <div>Wu Li'an, Manager</div>                                                                                                                                                                                  |

## Table of contents

|                                                       |           |
|-------------------------------------------------------|-----------|
| <b>1. GENERAL INFORMATION .....</b>                   | <b>4</b>  |
| 1.1. EUT Description .....                            | 4         |
| 1.2. Test Standards and Results.....                  | 5         |
| 1.3. Frequency Hopping System Requirements.....       | 6         |
| 1.4. Description of test environment test modes.....  | 7         |
| 1.5. Facilities and Accreditations .....              | 8         |
| <b>2. 47 CFR PART 15C REQUIREMENTS.....</b>           | <b>9</b>  |
| 2.1. Antenna requirement.....                         | 9         |
| 2.2. Number of Hopping Frequency .....                | 10        |
| 2.3. Peak Output Power.....                           | 13        |
| 2.4. Bandwidth.....                                   | 15        |
| 2.5. Carried Frequency Separation.....                | 26        |
| 2.6. Dwell time.....                                  | 29        |
| 2.7. Conducted Spurious Emissions.....                | 36        |
| 2.8. Conducted Band Edge.....                         | 46        |
| 2.9. Conducted Emission .....                         | 53        |
| 2.10. Radiated Band Edges and Spurious Emission ..... | 57        |
| <b>3. LIST OF MEASURING EQUIPMENT .....</b>           | <b>71</b> |

| Change History |            |                   |
|----------------|------------|-------------------|
| Issue          | Date       | Reason for change |
| 1.0            | 2015.08.14 | First edition     |
|                |            |                   |
|                |            |                   |

## 1. General Information

### 1.1. EUT Description

|                                 |                             |
|---------------------------------|-----------------------------|
| EUT Type                        | BT headset                  |
| Hardware Version                | 1.0                         |
| Software Version                | 1.0                         |
| EUT supports Radios application | Bluetooth EDR               |
| Frequency Range                 | 2402MHz~2480MHz             |
| Channel Number                  | 79                          |
| Bit Rate of Transmitter         | 1/2/3Mbps                   |
| Modulation Type                 | GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Antenna Type                    | Ceramic Antenna             |
| Antenna Gain                    | 2dBi                        |

Note 1: The EUT is a BT headset, it contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is  $F(\text{MHz})=2402+1*n$  ( $0 \leq n \leq 78$ ). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 3: a. When power on, the EUT will scan the whole frequency until a Connection command from the other BT devices.

b. When receiving the signal from the other BT devices, The EUT transmit are sponse signal.

c. The other devices receive the response signal and recognize it, then send a connection command to establish the connection.

d. After the connection establish successfully, the data transmission is beginning. At the same time, the both devices will shift frequencies in synchronization per a same pseudo randomly ordered list of hopping frequencies, the hopping rate is 1600 times per second. This device conforms to the criteria in FCC Public Notice DA 00-705.

e. The bandwidth of the receiver, which is set to a fixed width by the software.

Note 4: Bluetooth signal has 9 packages DH1, DH3, DH5, 3DH1, 3DH3, 3DH5, 5DH1, 5DH3, 5DH5, DH5 package is largest, we are testing DH5 in the document.

Note 5: The antenna of EUT is designed with permanent attachment and no consideration of replacement. It is a Ceramic Antenna with a maximum gain of 2dBi, and it is used to radiate the RF emissions.

## 1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC ID Certification:

| No. | Identity                            | Document Title                                                                                                                        |
|-----|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1   | 47 CFR Part 15<br>Subpart C 2013    | Radio Frequency Devices                                                                                                               |
| 2   | ANSI C63.10 2013                    | American National Standard for Testing<br>Unlicensed Wireless Devices                                                                 |
| 3   | RSS-GEN: Issue<br>4, November 2014  | General Requirements and Information<br>for the<br>Certification of Radio Apparatus                                                   |
| 4   | RSS-247: Issue<br>1, December 2015: | Digital Transmission Systems (DTSs),<br>Frequency Hopping Systems (FHSs) and<br>Licence-Exempt Local Area Network<br>(LE-LAN) Devices |

Test detailed items/section required by FCC rules and results are as below:

| No. | Standard(s) Section |                                   | Description                                  | Result |
|-----|---------------------|-----------------------------------|----------------------------------------------|--------|
|     | FCC                 | IC                                |                                              |        |
| 1   | 15.203              | 8.3                               | Antenna Requirement                          | PASS   |
| 2   | 15.247(a)           | RSS-247 Issue1 - 5.1              | Number of Hopping Frequency                  | PASS   |
| 3   | 15.247(b)           | RSS-247 Issue1 - 5.4              | Peak Output Power                            | PASS   |
| 4   | 15.247(a)           | RSS-247 Issue1 - 5.1              | Bandwidth                                    | PASS   |
| 5   | 15.247(a)           | RSS-247 Issue1 - 5.1              | Carrier Frequency Separation                 | PASS   |
| 6   | 15.247(a)           | RSS-247 Issue1 - 5.1              | Time of Occupancy (Dwell time)               | PASS   |
| 7   | 15.247(d)           | RSS-247 Issue1 - 5.5              | Conducted Spurious Emission                  | PASS   |
| 8   | 15.247(d)           | RSS-247 Issue1 - 5.5<br>RSS - Gen | Conducted Band Edge                          | PASS   |
| 9   | 15.207              | RSS-GEN                           | Conducted Emission                           | PASS   |
| 10  | 15.209<br>15.247(c) | RSS-247 Issue1 - 5.5<br>RSS - Gen | Radiated Band Edges and Spurious<br>Emission | PASS   |

Note 1: The tests were performed according to the method of measurements prescribed in DA-00-705.

Note 2: The test of Radiated Emission was performed according to the method of measurements prescribed in ANSI C63.10 2013.

### **1.3. Frequency Hopping System Requirements**

#### **1.3.1. Standard Applicable**

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

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

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

#### **1.3.2. Frequency Hopping System**

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

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

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

impact on the bandwidth used.

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

### 1.3.3. EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:

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

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

### 1.4. Description of test environment test modes

79 channels are provided for Bluetooth EDR

| Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---------|----------------|---------|----------------|
| 0       | 2402           | 40      | 2442           |
| 1       | 2403           | 41      | 2443           |
| 2       | 2404           | 42      | 2444           |
| 3       | 2405           | 43      | 2445           |
| 4       | 2406           | 44      | 2446           |
| 5       | 2407           | 45      | 2447           |
| 6       | 2408           | 46      | 2448           |
| 7       | 2409           | 47      | 2449           |
| 8       | 2410           | 48      | 2450           |
| 9       | 2411           | 49      | 2451           |
| 10      | 2412           | 50      | 2452           |
| 11      | 2413           | 51      | 2453           |
| 12      | 2414           | 52      | 2454           |
| 13      | 2415           | 53      | 2455           |
| 14      | 2416           | 54      | 2456           |
| 15      | 2417           | 55      | 2457           |
| 16      | 2418           | 56      | 2458           |
| 17      | 2419           | 57      | 2459           |
| 18      | 2420           | 58      | 2460           |
| 19      | 2421           | 59      | 2461           |
| 20      | 2422           | 60      | 2462           |
| 21      | 2423           | 61      | 2463           |
| 22      | 2424           | 62      | 2464           |
| 23      | 2425           | 63      | 2465           |
| 24      | 2426           | 64      | 2466           |
| 25      | 2427           | 65      | 2467           |
| 26      | 2428           | 66      | 2468           |
| 27      | 2429           | 67      | 2469           |
| 28      | 2430           | 68      | 2470           |

|    |      |    |      |
|----|------|----|------|
| 29 | 2431 | 69 | 2471 |
| 30 | 2432 | 70 | 2472 |
| 31 | 2433 | 71 | 2473 |
| 32 | 2434 | 72 | 2474 |
| 33 | 2435 | 73 | 2475 |
| 34 | 2436 | 74 | 2476 |
| 35 | 2437 | 75 | 2477 |
| 36 | 2438 | 76 | 2478 |
| 37 | 2439 | 77 | 2479 |
| 38 | 2440 | 78 | 2480 |
| 39 | 2441 |    |      |

## 1.5. Facilities and Accreditations

### 1.5.1. Facilities

#### CNAS-Lab Code: L1659

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. CCIC is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659. A 12.8\*6.8\*6.4 (m) fully anechoic chamber was used for the radiated spurious emissions test.

#### FCC-Registration No.: 406086

CCIC Southern Electronic Product Testing (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 406086, valid time is until October 28, 2017.

#### IC-Registration No.: 11185A-1

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on July. 15, 2013, valid time is until July. 15, 2016.

### 1.5.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

|                             |              |
|-----------------------------|--------------|
| Temperature (°C):           | 15 - 35      |
| Relative Humidity (%):      | 30 -60       |
| Atmospheric Pressure (kPa): | 86KPa-106KPa |

## 2. 47 CFR Part 15C Requirements

### 2.1. Antenna requirement

#### 2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

#### 2.1.2. Antenna Information

**Antenna Category:** Internal antenna

An External antenna was soldered to the antenna port of EUT via an adaptor cable, can't be removed.

**Antenna General Information:**

| No. | EUT        | Ant. Type | Gain(dBi) |
|-----|------------|-----------|-----------|
| 1   | BT headset | Ceramic   | 2         |

#### 2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

## 2.2. Number of Hopping Frequency

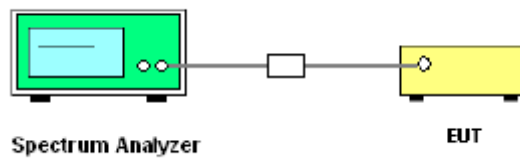
### 2.2.1. Limit of Number of Hopping Frequency

Frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

### 2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.2.3. Test Setup



### 2.2.4. Test Procedure

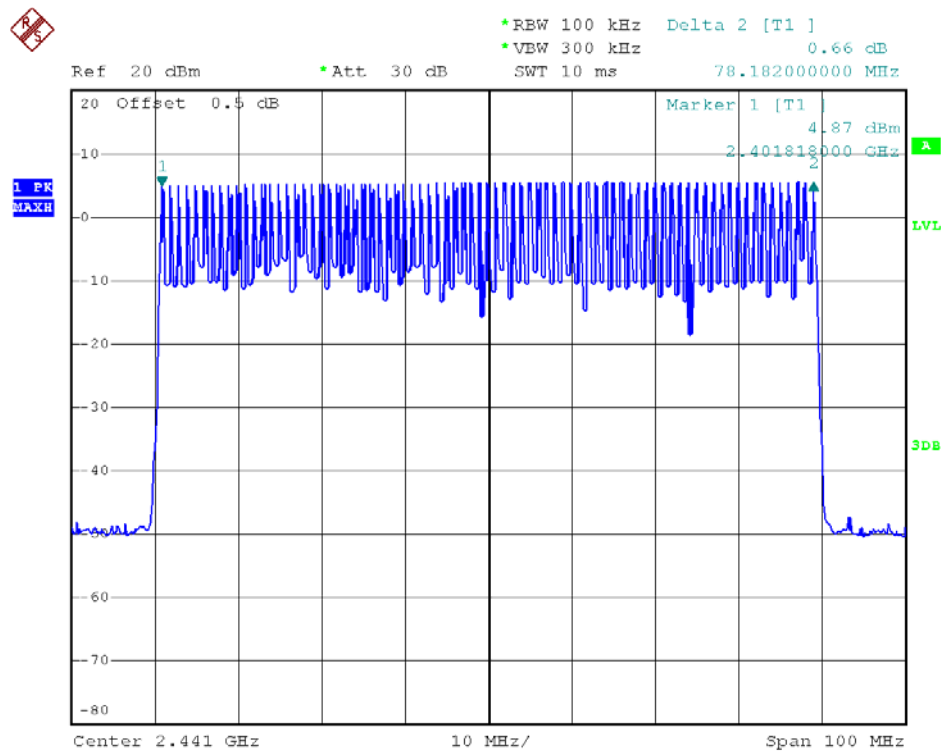
1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation;  
 $RBW \geq 1\%$  of the span;  $VBW \geq RBW$ ; Sweep = auto; Detector function = peak;  
 Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

### 2.2.5. Test Results of Number of Hopping Frequency

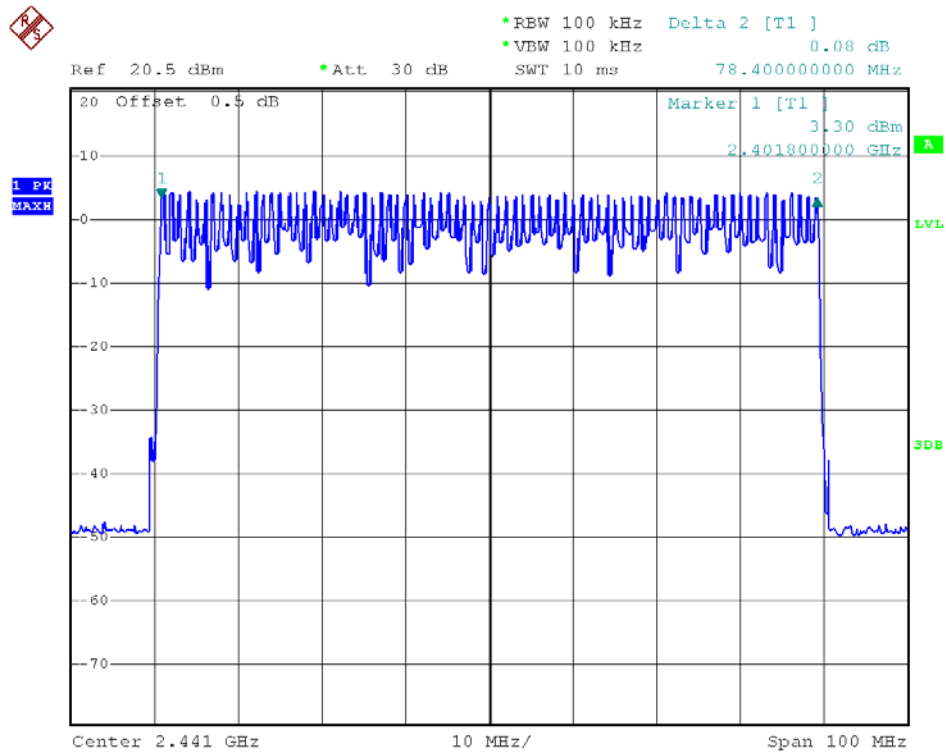
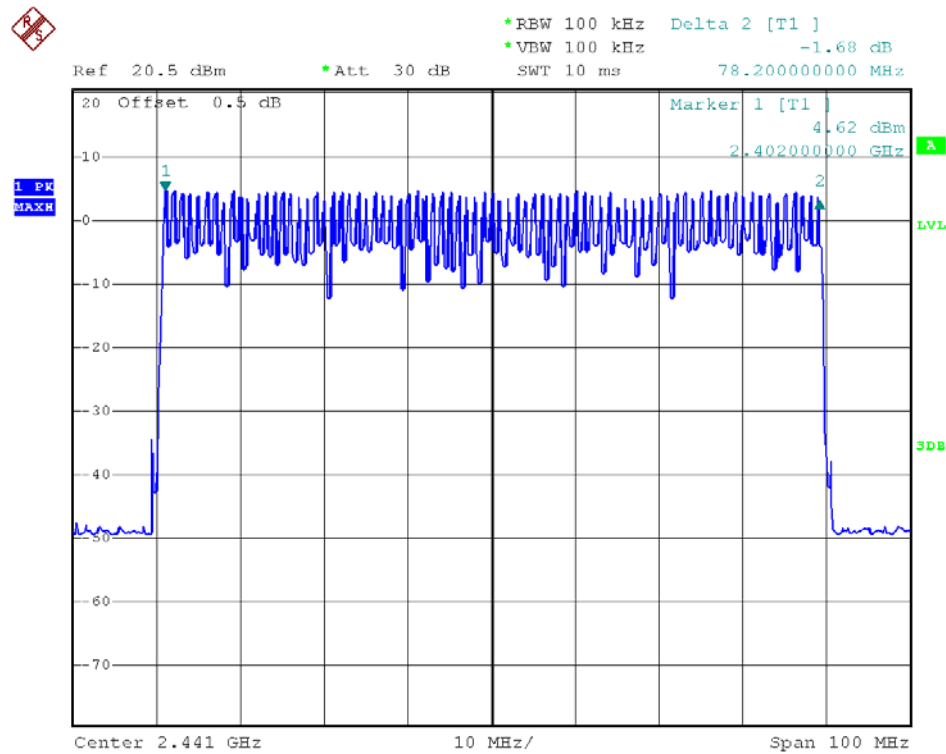
The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

| Test Mode      | Frequency Block (MHz) | Measured Channel Numbers | Min. Limit | Refer to Plot | Verdict |
|----------------|-----------------------|--------------------------|------------|---------------|---------|
| GFSK           | 2400 - 2483.5         | 79                       | 15         | Plot A        | PASS    |
| $\pi/4$ -DQPSK | 2400 - 2483.5         | 79                       | 15         | Plot B        | PASS    |
| 8-DPSK         | 2400 - 2483.5         | 79                       | 15         | Plot C        | PASS    |

### 2.2.6. Test Results (plots) of Number of Hopping Frequency



(Plot A: GFSK)


(Plot B:  $\pi/4$ -DQPSK)


(Plot C: 8- DPSK)

## 2.3. Output Power

### 2.3.1. Limit of Peak Output Power

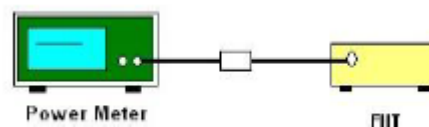
Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

### 2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.3.3. Test Setup



### 2.3.4. Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

### 2.3.5. Test Result

| Test Mode      | Channel | Frequency (MHz) | Conducted Peak Power (dBm) | Antenna Gain(dBi) | E.I.R.P (dBm) | Limit (dBm) |
|----------------|---------|-----------------|----------------------------|-------------------|---------------|-------------|
| GFSK           | 0       | 2402            | 3.16                       | 2.0               | 5.16          | 21          |
|                | 39      | 2441            | 3.02                       |                   | 5.02          |             |
|                | 78      | 2480            | 3.15                       |                   | 5.15          |             |
| $\pi/4$ -DQPSK | 0       | 2402            | 2.56                       |                   | 4.56          |             |
|                | 39      | 2441            | 2.71                       |                   | 4.71          |             |
|                | 78      | 2480            | 2.63                       |                   | 4.63          |             |
| 8- DPSK        | 0       | 2402            | 2.46                       |                   | 4.46          |             |
|                | 39      | 2441            | 2.54                       |                   | 4.54          |             |
|                | 78      | 2480            | 2.38                       |                   | 4.38          |             |

## 2.4. Bandwidth

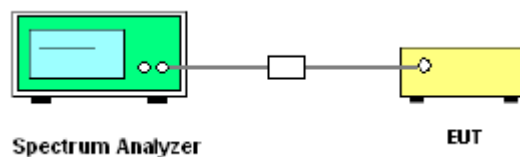
### 2.4.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth ( $10 \cdot \log 1\% = 20\text{dB}$ ) taking the total RF output power.

### 2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.4.3. Test Setup



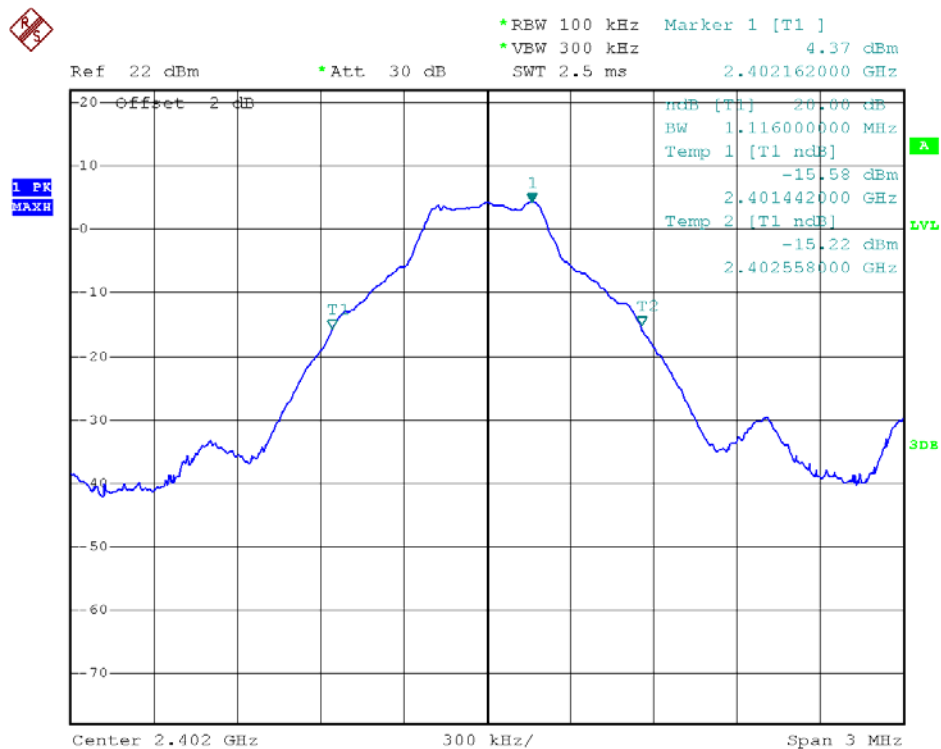
### 2.4.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.  
  
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel;  
  
 $\text{RBW} \geq 1\%$  of the 20 dB bandwidth;  $\text{VBW} \geq \text{RBW}$ ; Sweep = auto; Detector function = peak;  
  
Trace = max hold.
5. Use the following spectrum analyzer setting for 99% Bandwidth measurement.  
  
For 99% Bandwidth measurement, the  $\text{RBW}=30\text{kHz}$ , and  $\text{VBW}=100\text{kHz}$ , Sweep=auto  
  
Detector function=sample ,Trace = max. hold
6. Measure and record the results in the test report.

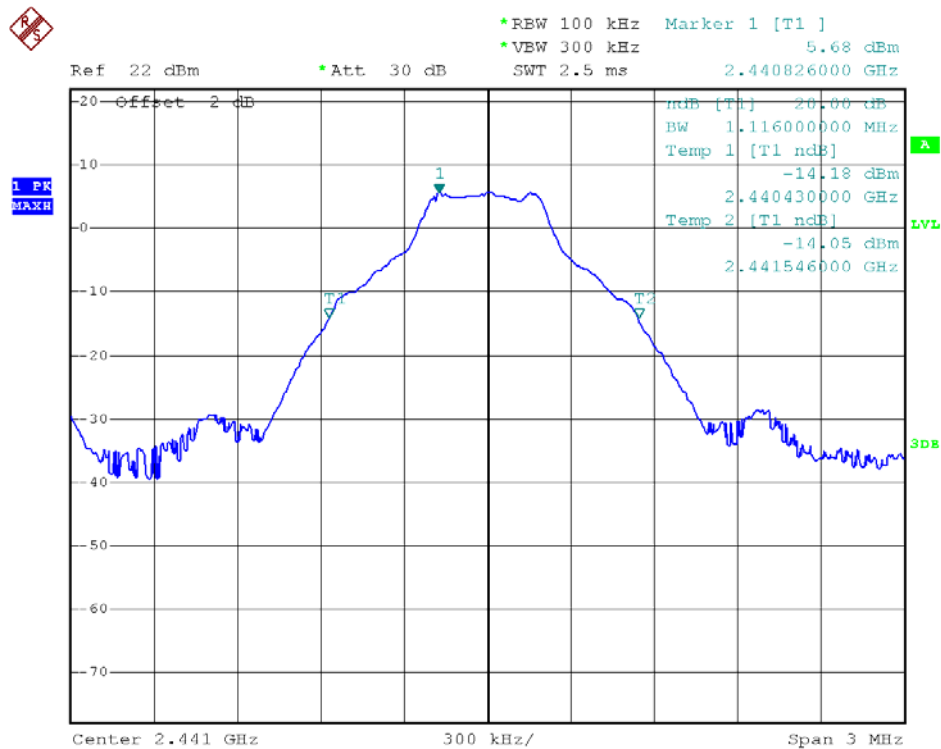
### 2.4.5. Test Results of Bandwidth

| Mode           | Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | 99% bandwidth (MHz) |
|----------------|---------|-----------------|----------------------|---------------------|
| GFSK           | 0       | 2402            | 1.116                | 0.954               |
|                | 39      | 2441            | 1.116                | 0.960               |
|                | 78      | 2480            | 1.116                | 0.960               |
| $\pi/4$ -DQPSK | 0       | 2402            | 1.380                | 1.206               |
|                | 39      | 2441            | 1.374                | 1.212               |
|                | 78      | 2480            | 1.380                | 1.212               |
| 8-DPSK         | 0       | 2402            | 1.368                | 1.218               |
|                | 39      | 2441            | 1.374                | 1.242               |
|                | 78      | 2480            | 1.374                | 1.254               |

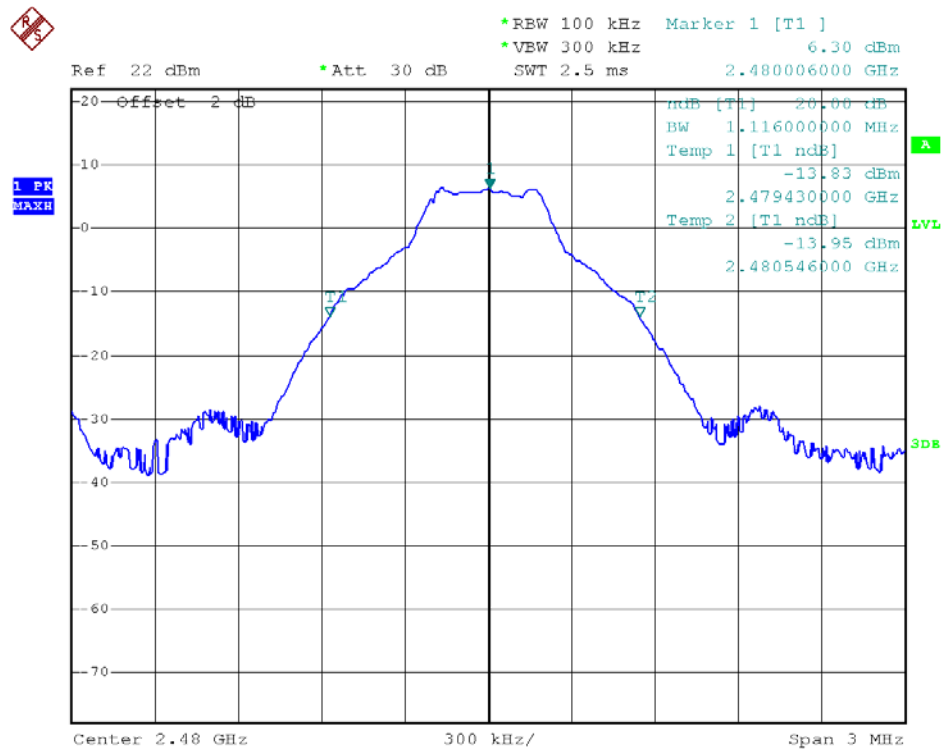
### 2.4.6. Test Results (plots) of 20dB Bandwidth



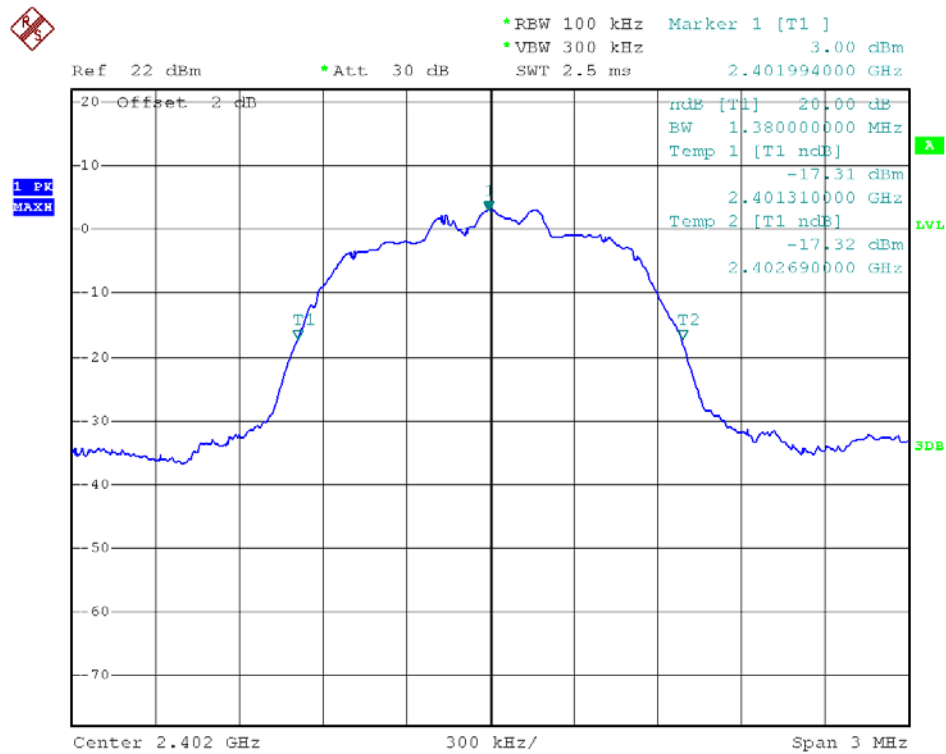
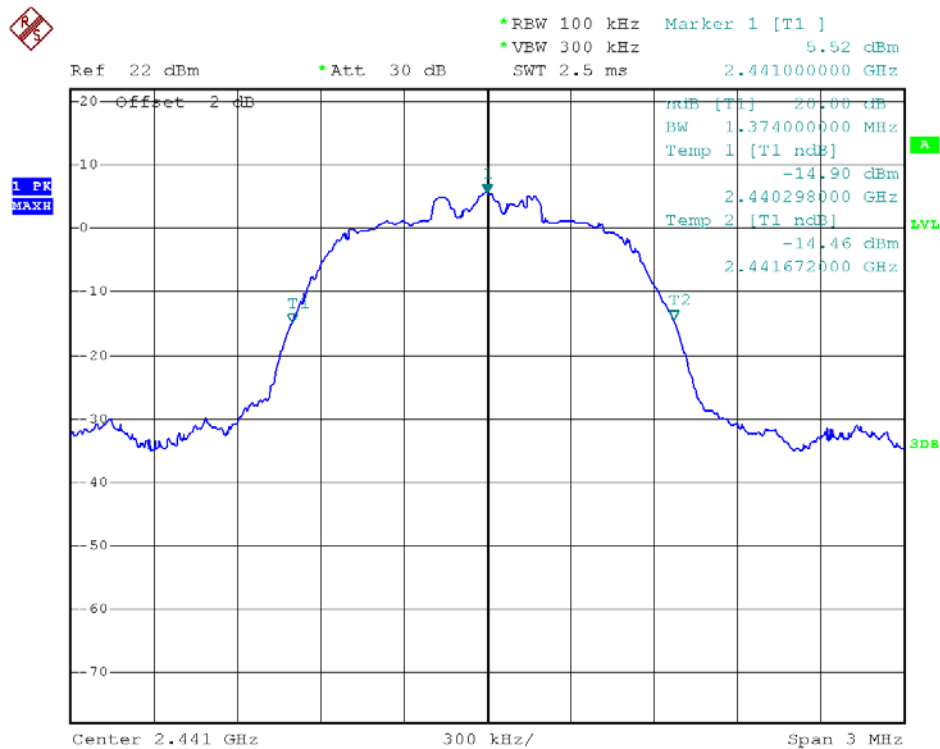
0 Channel @ GFSK

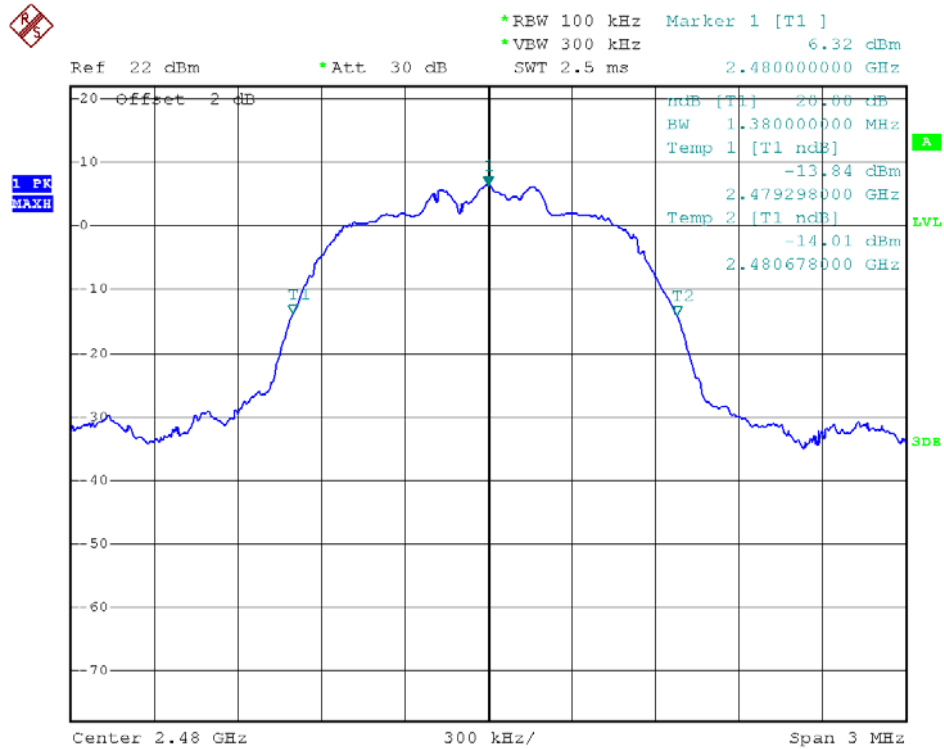
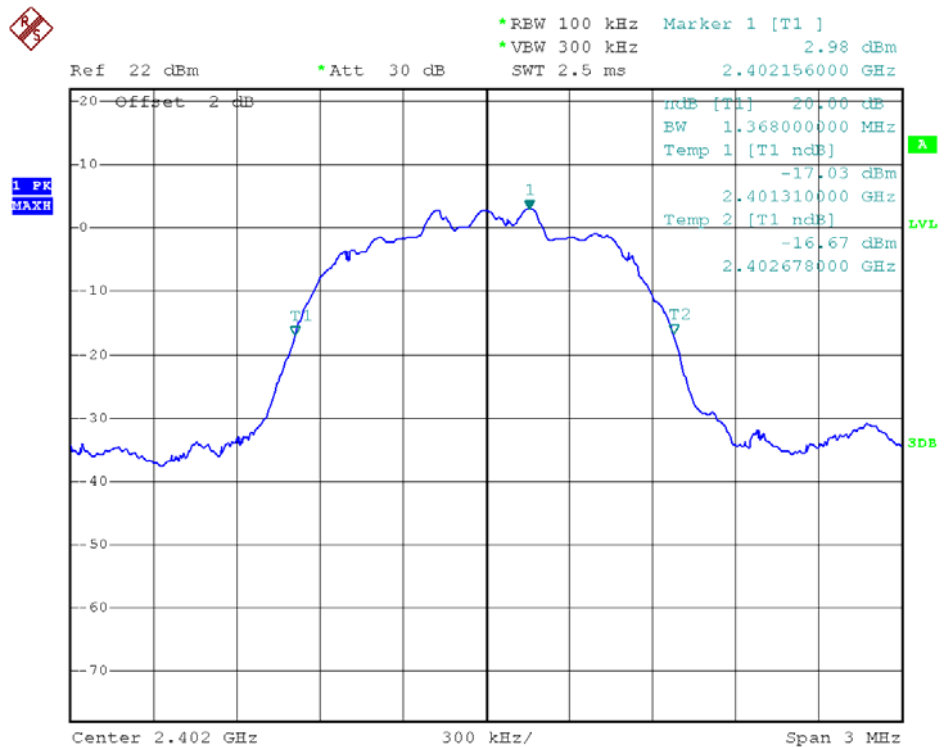


39 Channel @ GFSK

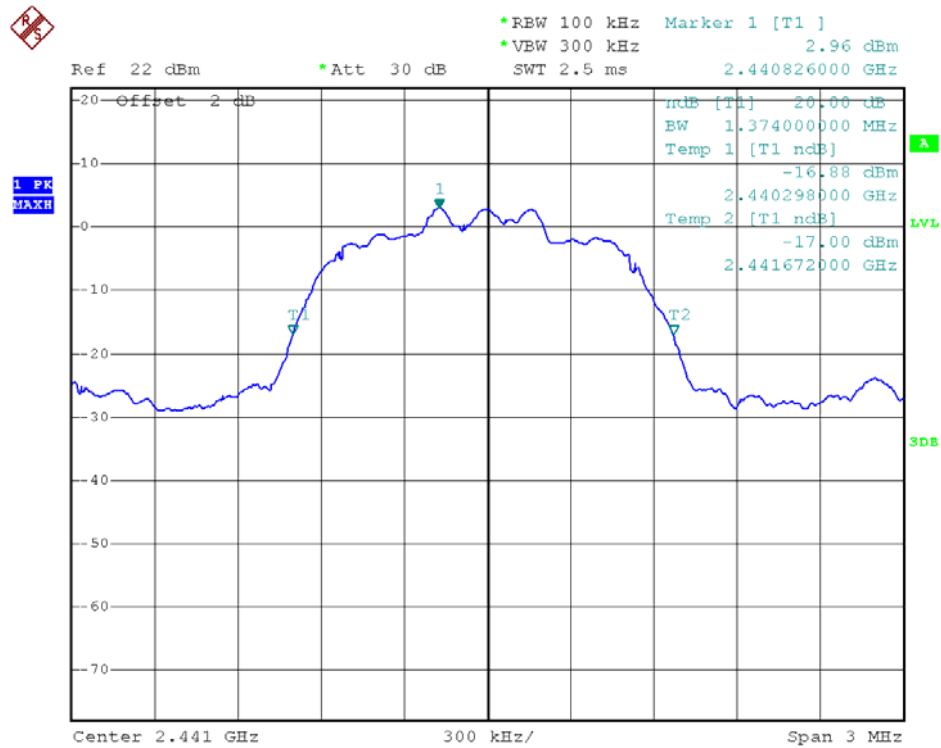


78 Channel @ GFSK

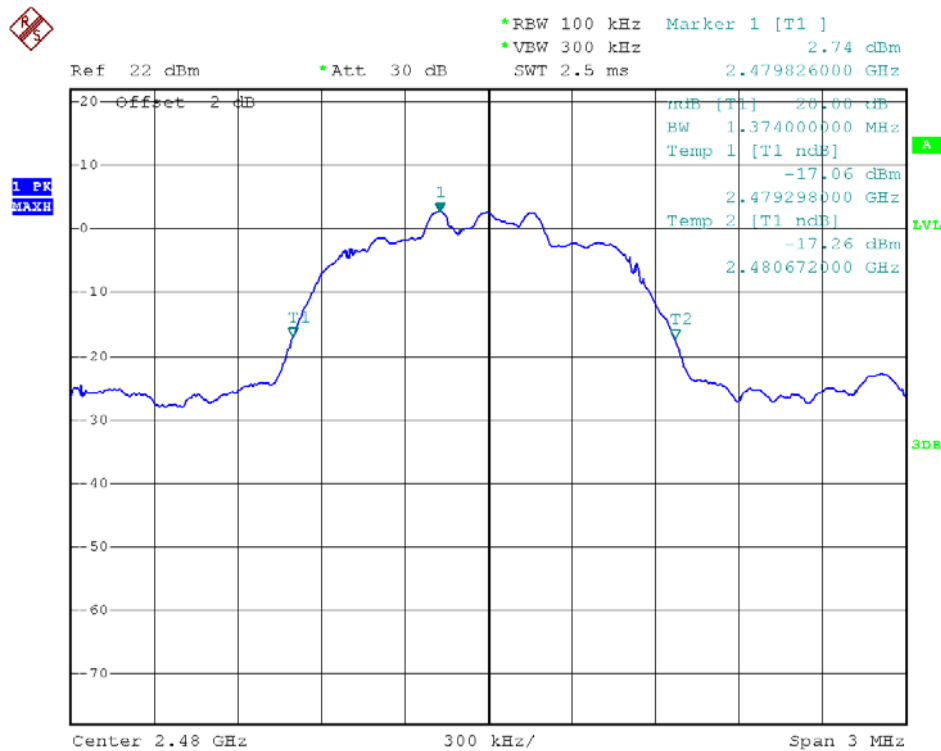

0 Channel @  $\pi/4$ -DQPSK

39 Channel @  $\pi/4$ -DQPSK


78 Channel @  $\pi/4$ -DQPSK


0 Channel @ 8-DPSK

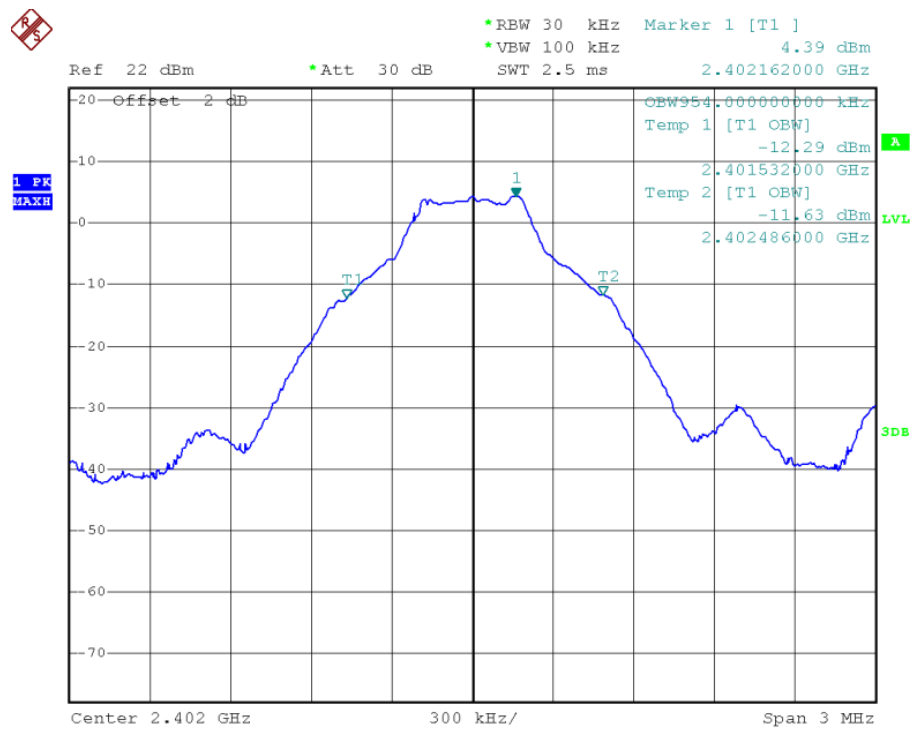


39 Channel @ 8-DPSK

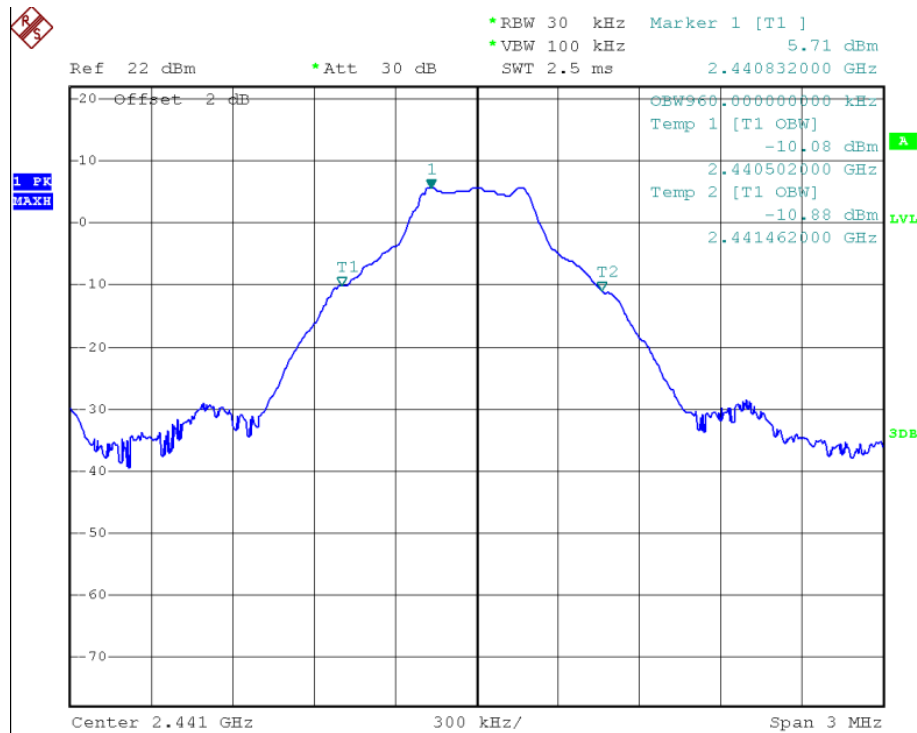


78 Channel @ 8-DPSK

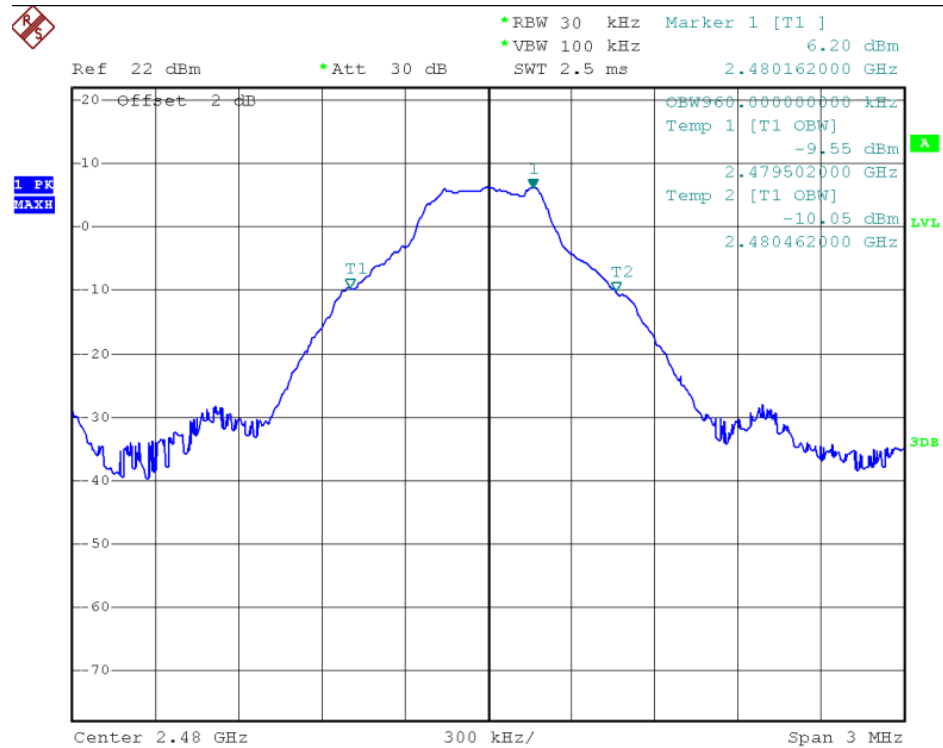
### 2.4.7. Test Results (plots) of 99% Bandwidth



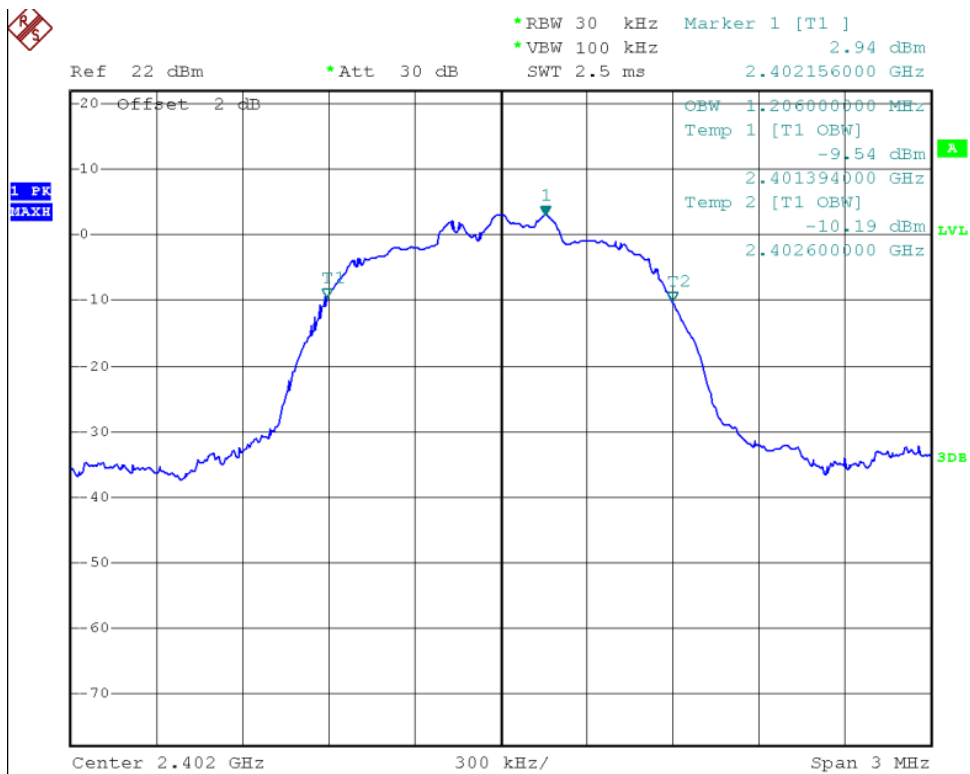
0 Channel @ GFSK

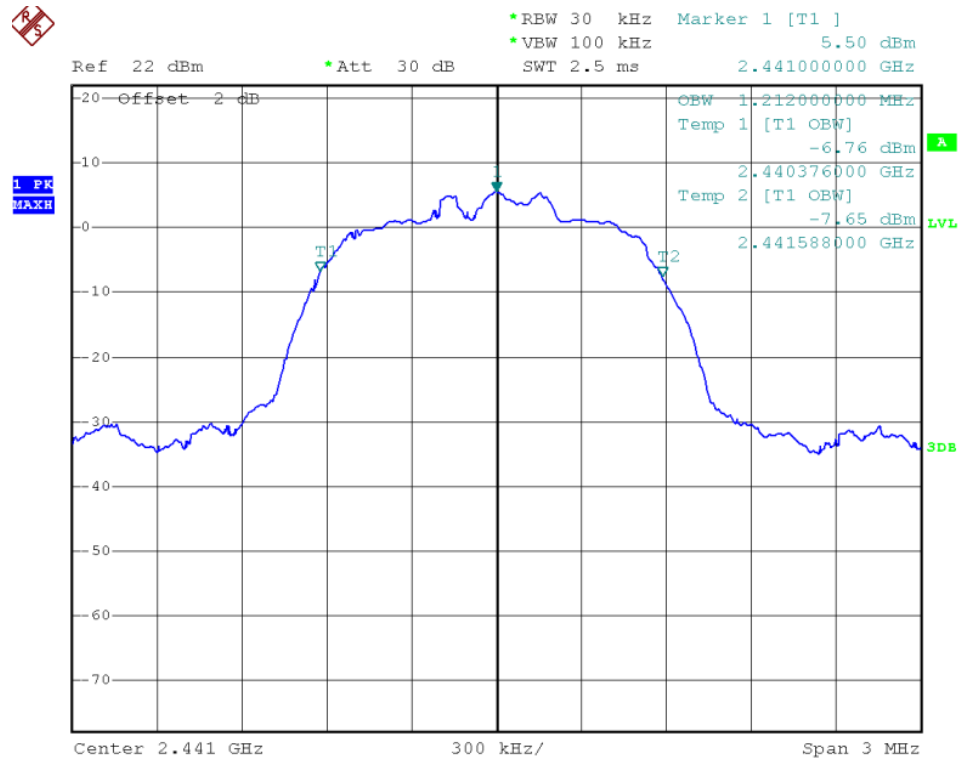


39 Channel @ GFSK

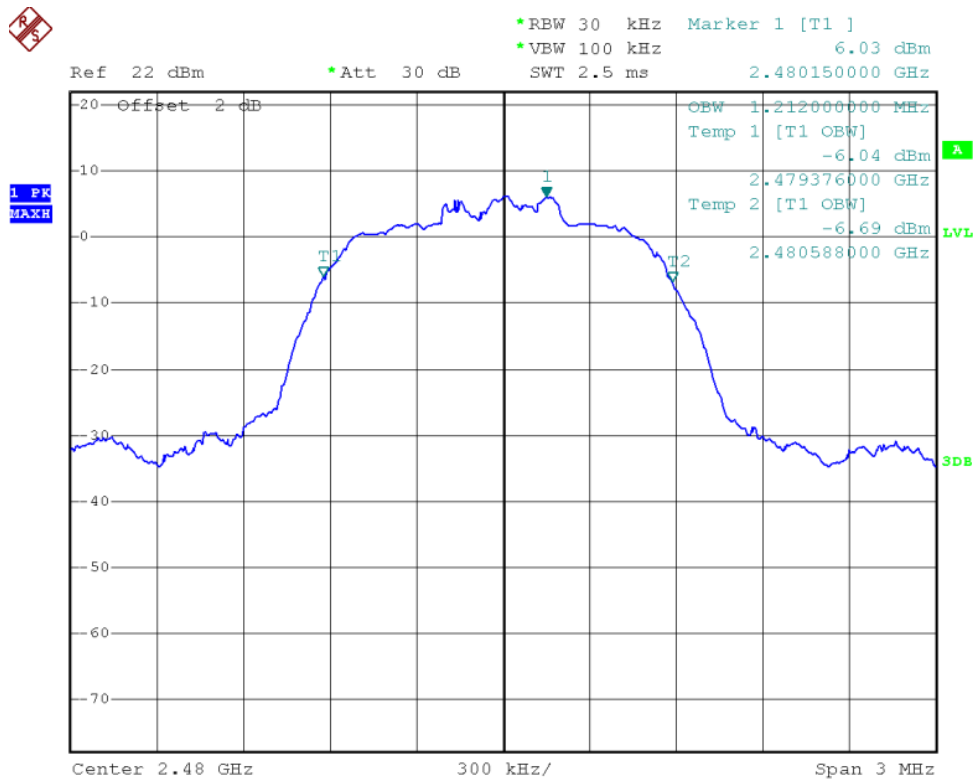


78 Channel @ GFSK

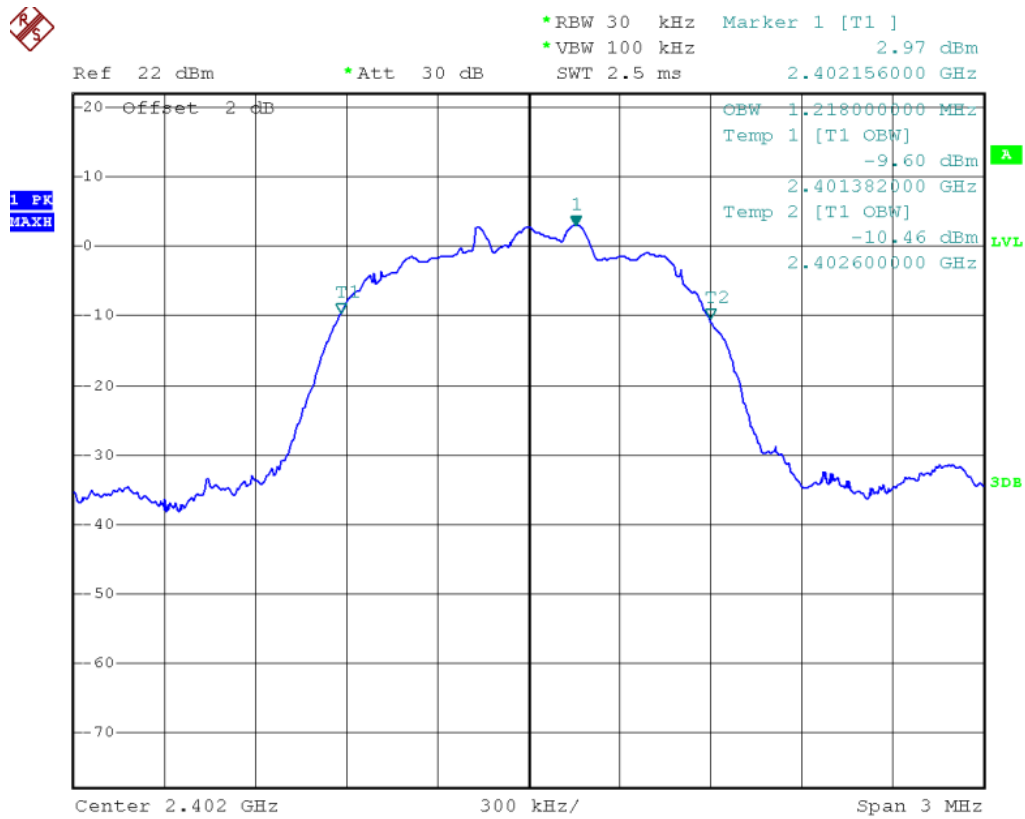

0 Channel @  $\pi/4$ -DQPSK



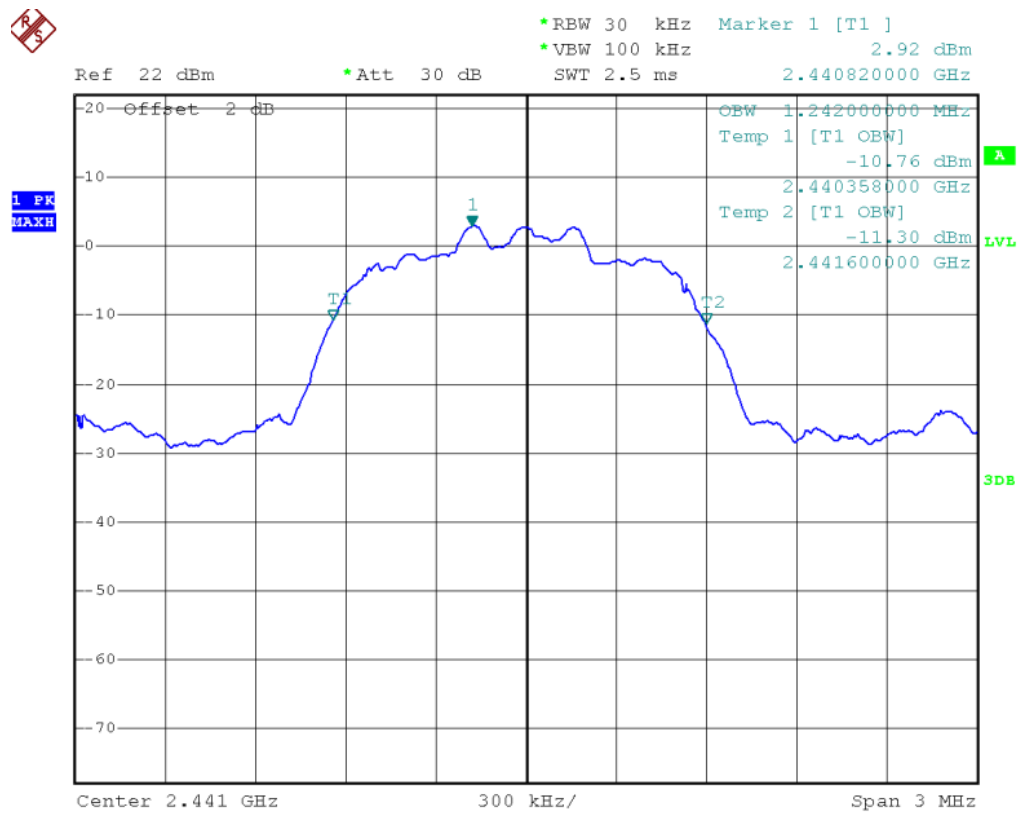
39 Channel @  $\pi/4$ -DQPSK



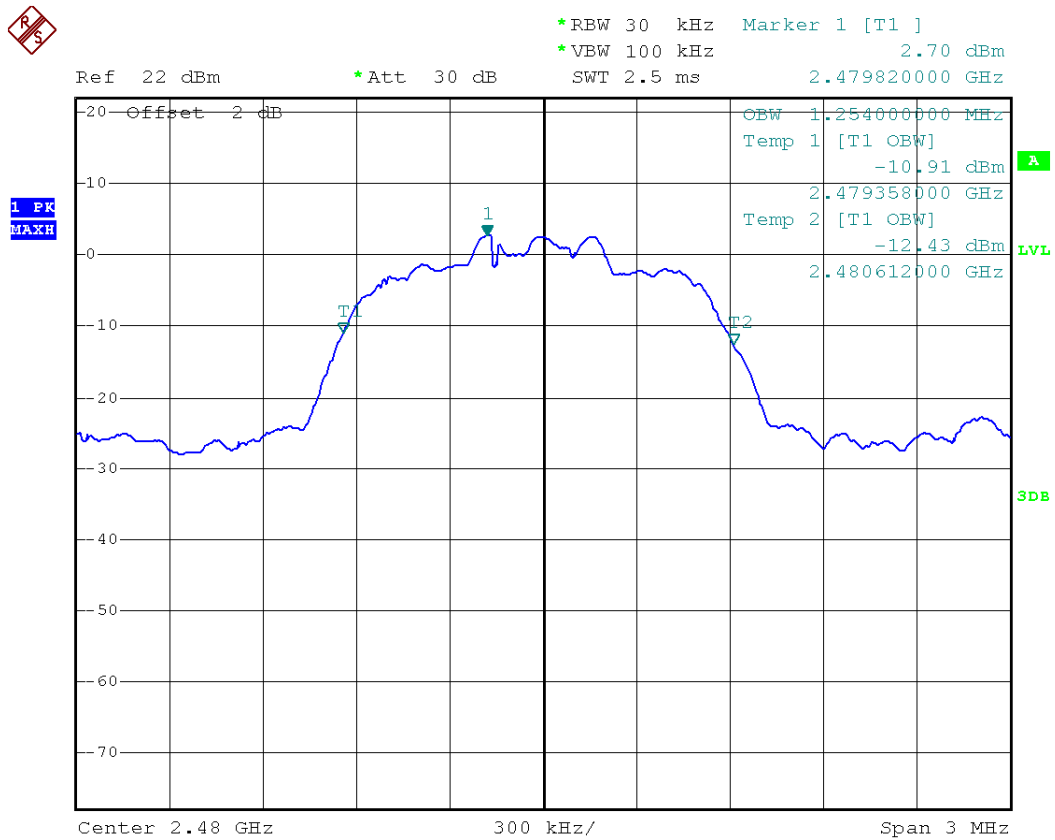
78 Channel @  $\pi/4$ -DQPSK



0 Channel @ 8-DPSK



39 Channel @ 8-DPSK



78 Channel @ 8-DPSK

## 2.5. Carried Frequency Separation

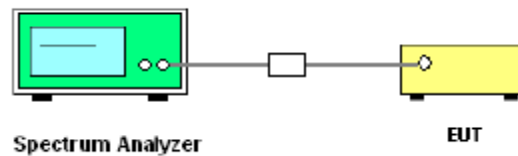
### 2.5.1. Limit of Carried Frequency Separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

### 2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.5.3. Test Setup



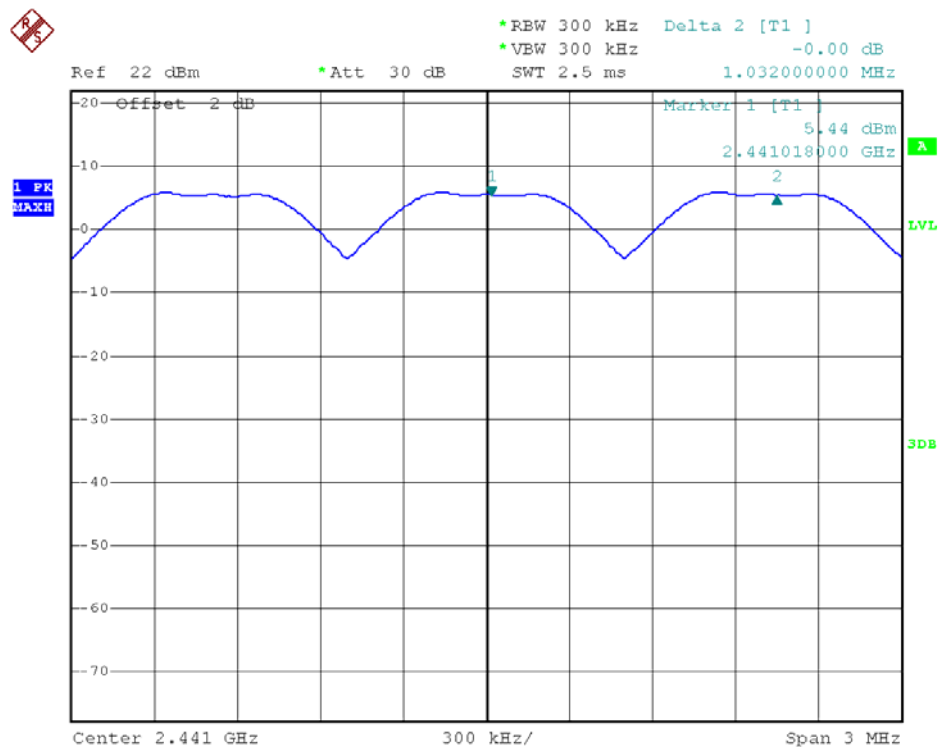
### 2.5.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.  
The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:  
  
Span = wide enough to capture the peaks of two adjacent channels;  $RBW \geq 1\%$  of the span;  
  
 $VBW \geq RBW$ ; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

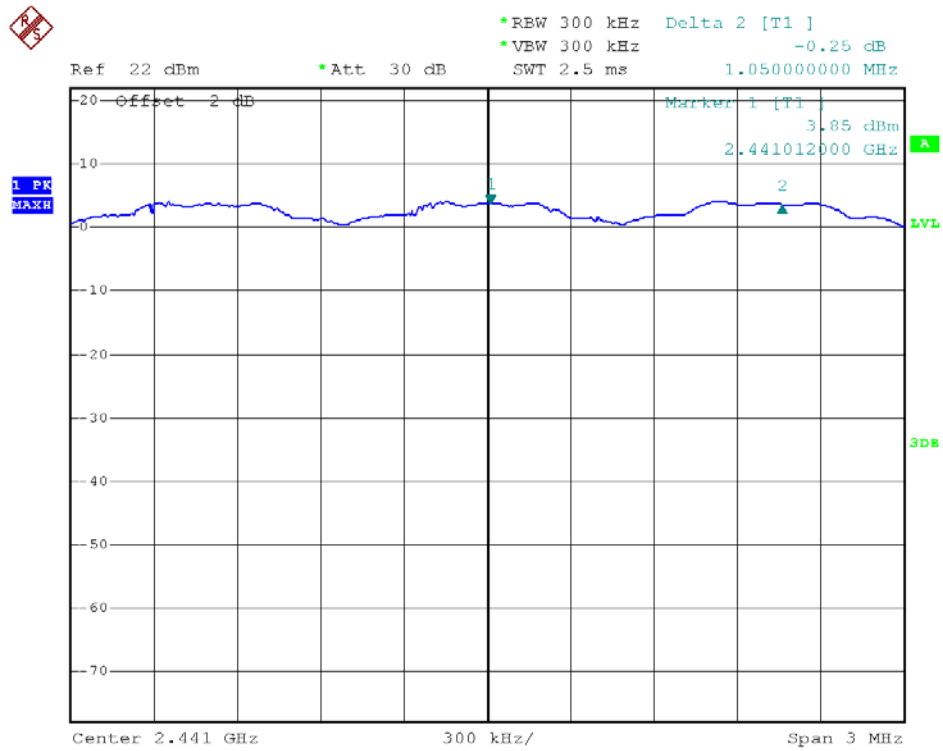
### 2.5.5. Test Results of Carried Frequency Separation

| Test mode      | Frequency Separation(MHz) | (2/3 of 20dB BW) Limits (MHz) | Verdict |
|----------------|---------------------------|-------------------------------|---------|
| GFSK           | 1.032                     | 0.744                         | PASS    |
| $\pi/4$ -DQPSK | 1.050                     | 0.920                         | PASS    |
| 8-DPSK         | 1.062                     | 0.916                         | PASS    |

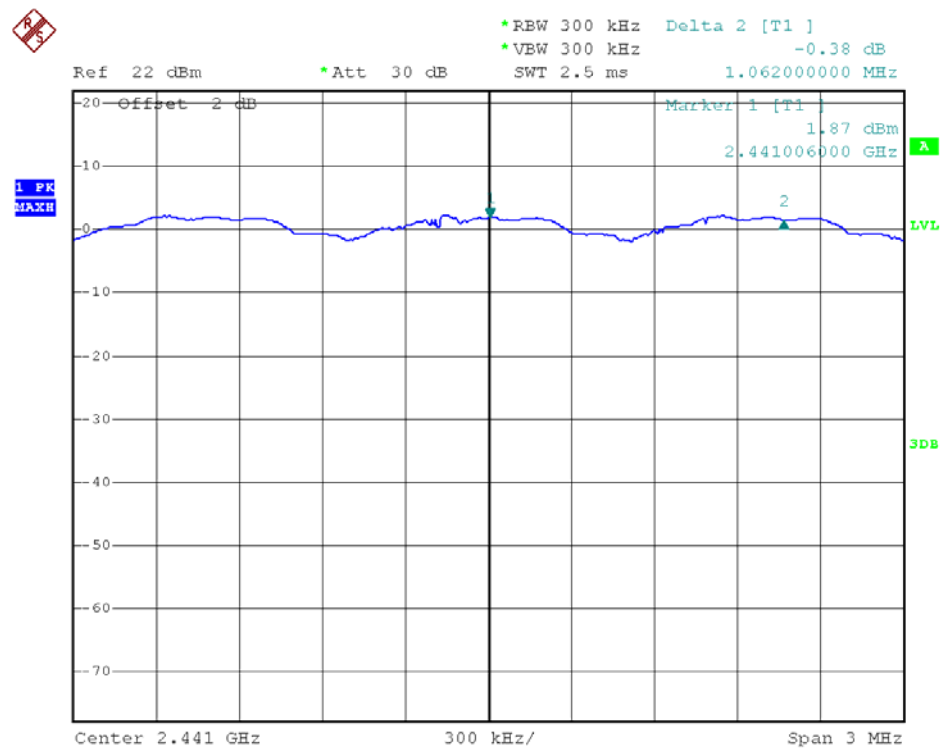
### 2.5.6. Test Results (plots) of Carried Frequency Separation



GFSK Mode



$\pi/4$ -DQPSK Mode



8-DPSK Mode

## 2.6. Dwell time

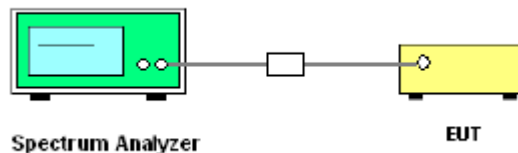
### 2.6.1. Limit of Dwell Time

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.

### 2.6.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.6.3. Test Setup



### 2.6.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.  
The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW  $\geq$  RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

### 2.6.5. Test Results of Dwell Time

For DH1 package type:

$$\{\text{Total of Dwell}\} = \{\text{Pulse Time}\} * (1600 / 2) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\}$$

$$\{\text{Period}\} = 0.4s * \{\text{Number of Hopping Frequency}\}$$

For DH3 package type:

$$\{\text{Total of Dwell}\} = \{\text{Pulse Time}\} * (1600 / 4) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\}$$

$$\{\text{Period}\} = 0.4s * \{\text{Number of Hopping Frequency}\}$$

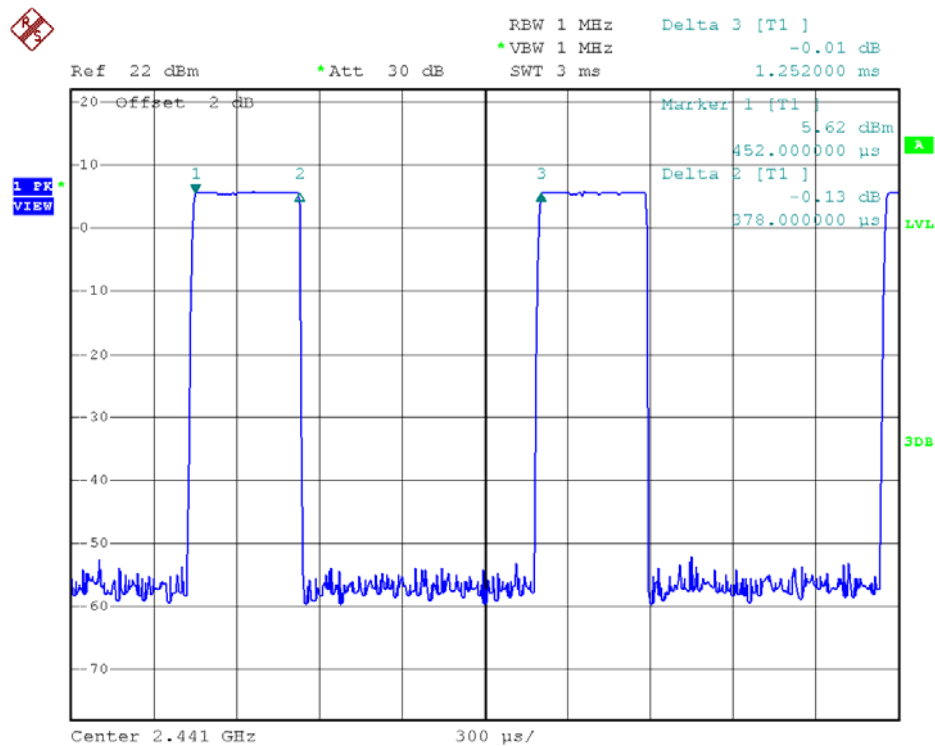
For DH3 package type:

$$\{\text{Total of Dwell}\} = \{\text{Pulse Time}\} * (1600 / 6) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\}$$

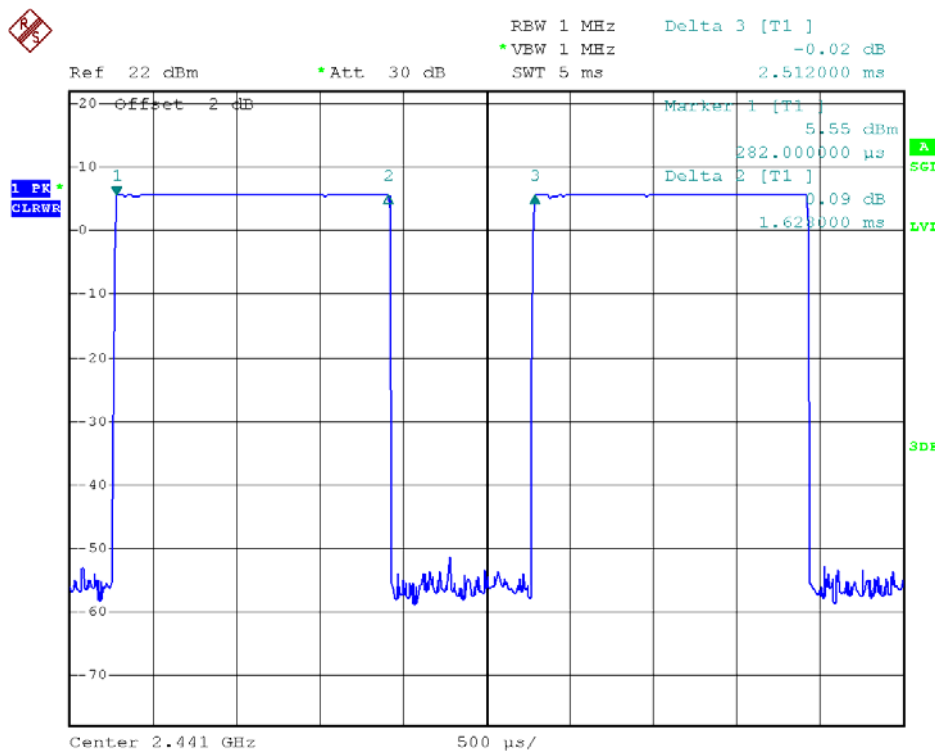
$$\{\text{Period}\} = 0.4s * \{\text{Number of Hopping Frequency}\}$$

| Modulation     | Packet Type | Channel | Pulse Time (ms) | Dwell Time (ms) | Limit (ms) | Verdict |
|----------------|-------------|---------|-----------------|-----------------|------------|---------|
| GFSK           | DH1         | 39      | 0.38            | 121.60          | 400        | PASS    |
|                | DH3         | 39      | 1.63            | 260.80          |            | PASS    |
|                | DH5         | 39      | 2.90            | 309.33          |            | PASS    |
| $\pi/4$ -DQPSK | DH1         | 39      | 0.38            | 121.60          |            | PASS    |
|                | DH3         | 39      | 1.63            | 260.80          |            | PASS    |
|                | DH5         | 39      | 2.89            | 305.07          |            | PASS    |
| 8-DPSK         | DH1         | 39      | 0.38            | 124.80          |            | PASS    |
|                | DH3         | 39      | 1.63            | 262.40          |            | PASS    |
|                | DH5         | 39      | 2.87            | 307.20          |            | PASS    |

## 2.6.6. Test Results (plots) of Dwell Time

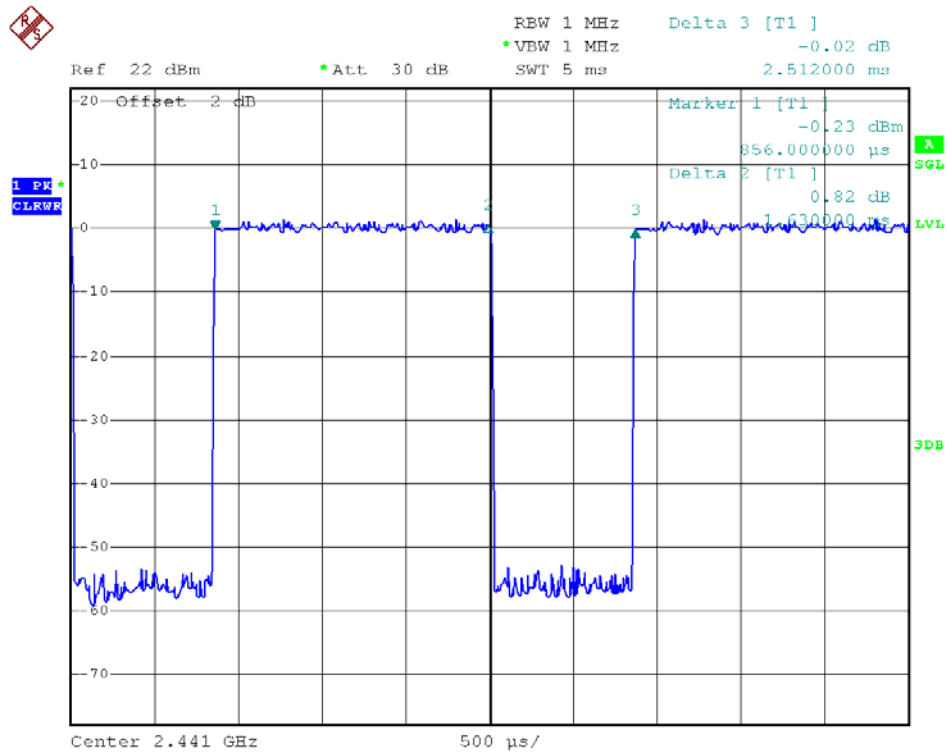


39 Channel @ DH1

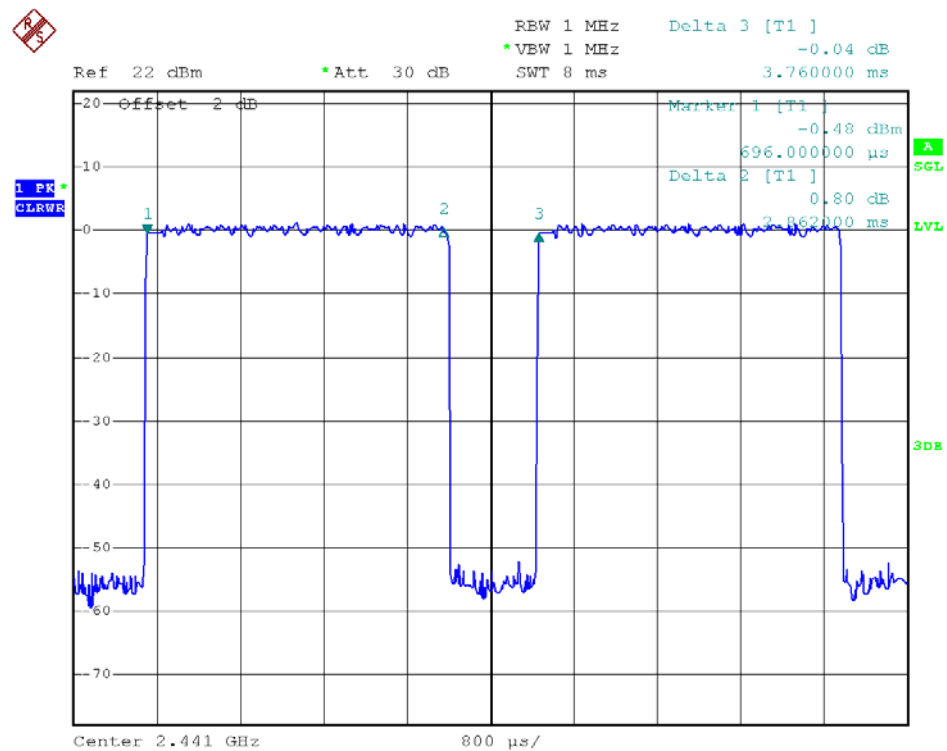


39 Channel @ DH3

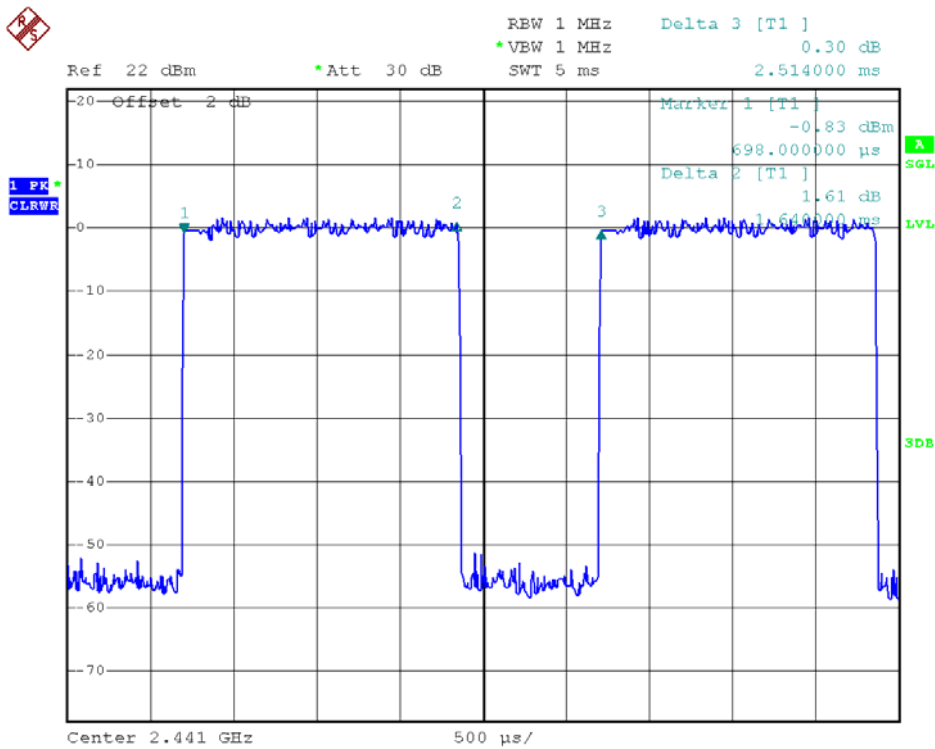
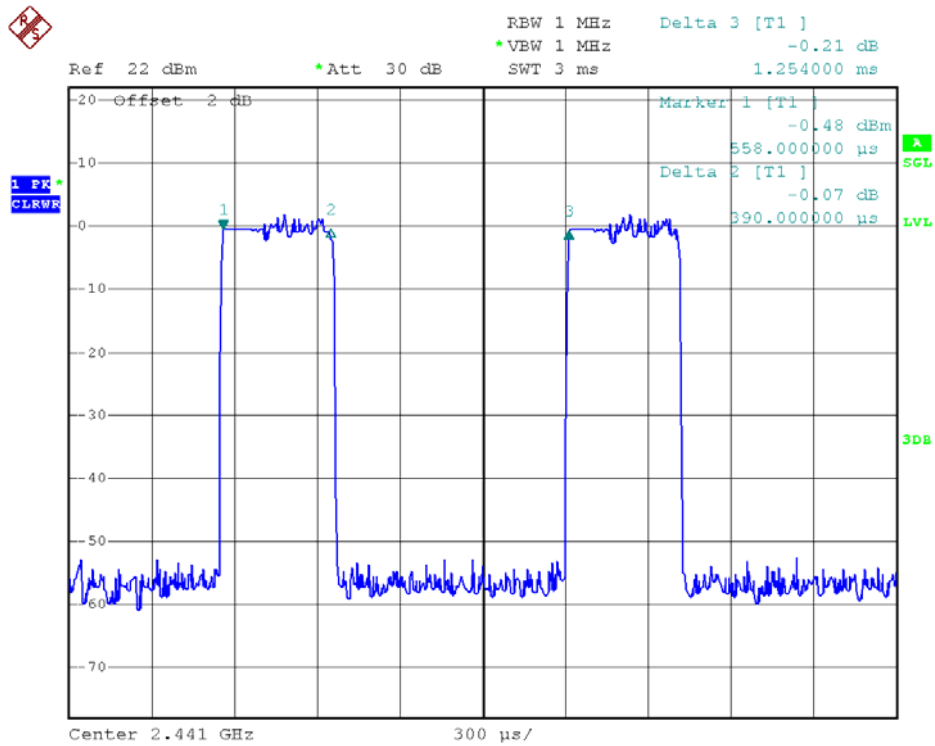


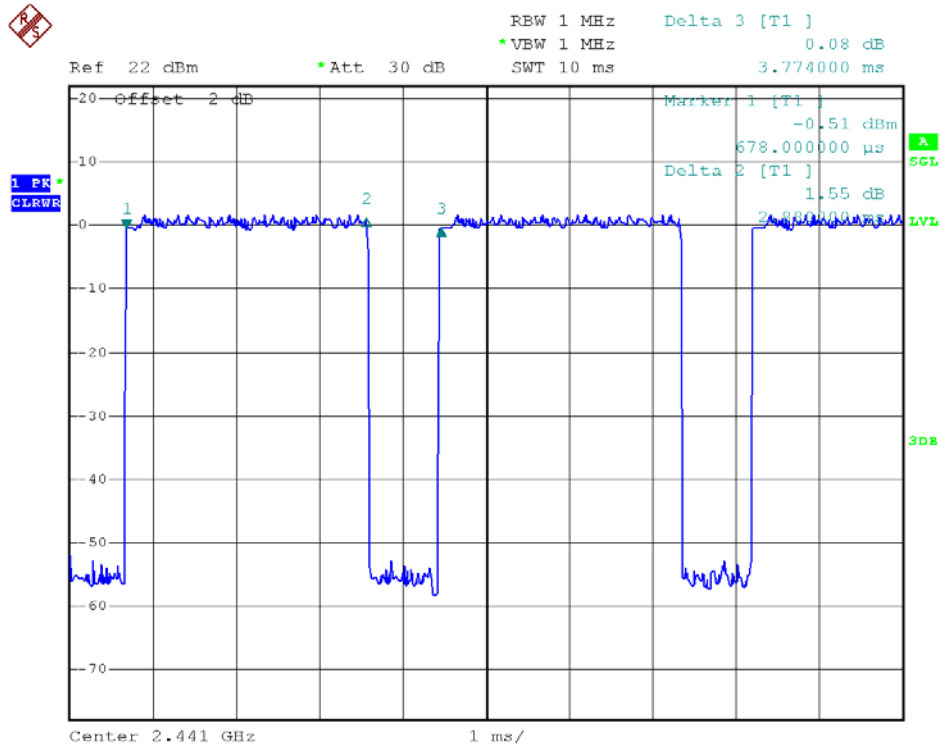


39 Channel @ 2DH3



39 Channel @ 2DH5





39 Channel @ 3DH5

## 2.7. Conducted Spurious Emissions

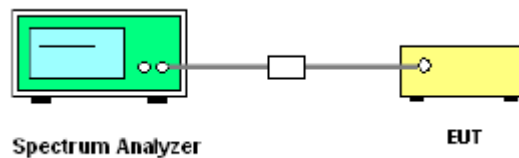
### 2.7.1. Limit of Spurious Emission

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

### 2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

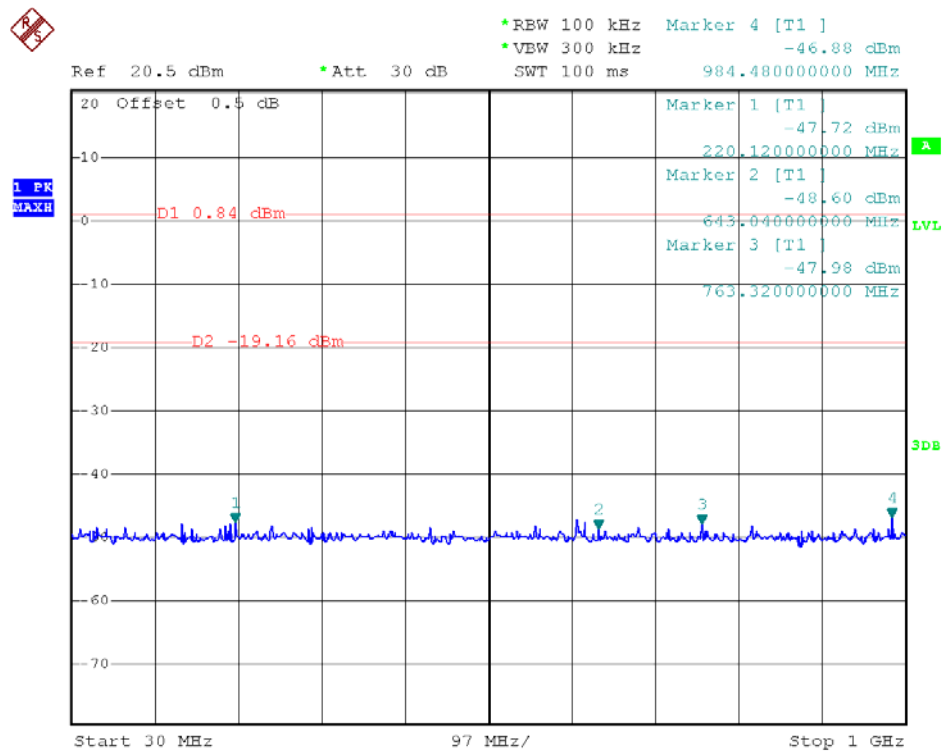
### 2.7.3. Test Setup



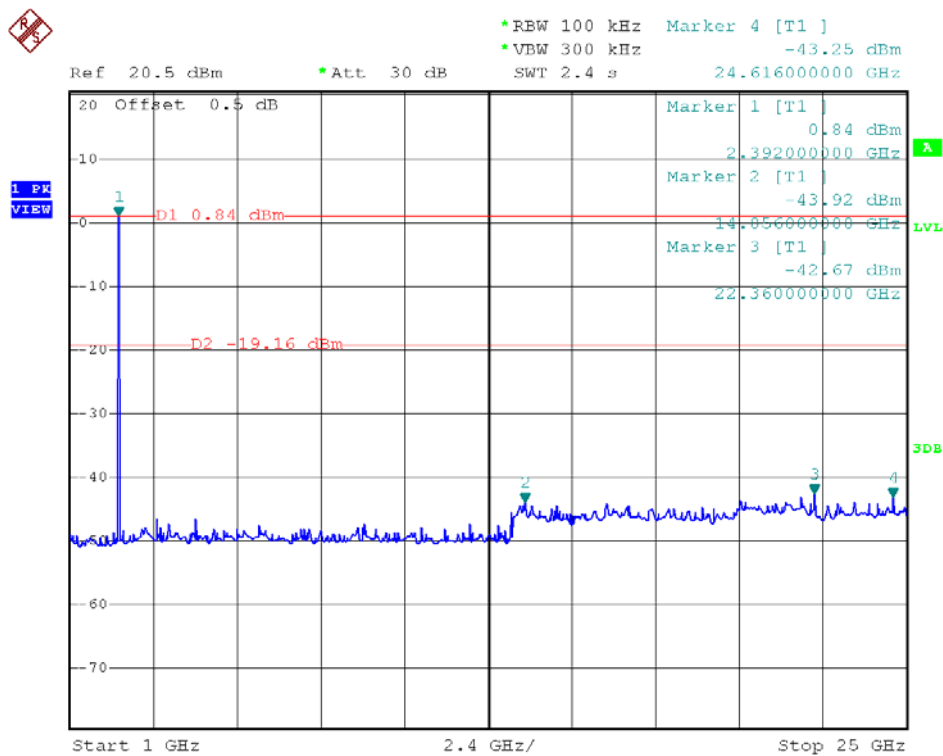
### 2.7.4. Test Procedure

1. The testing follows the guidelines in Spurious RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

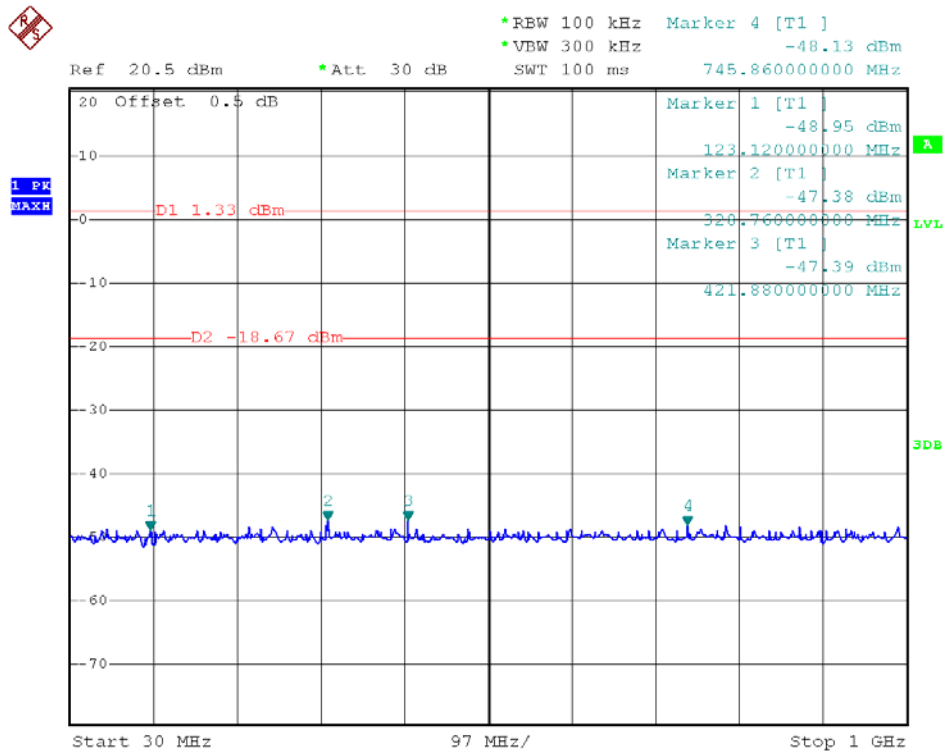
## 2.7.5. Test Results of Conducted Spurious Emissions



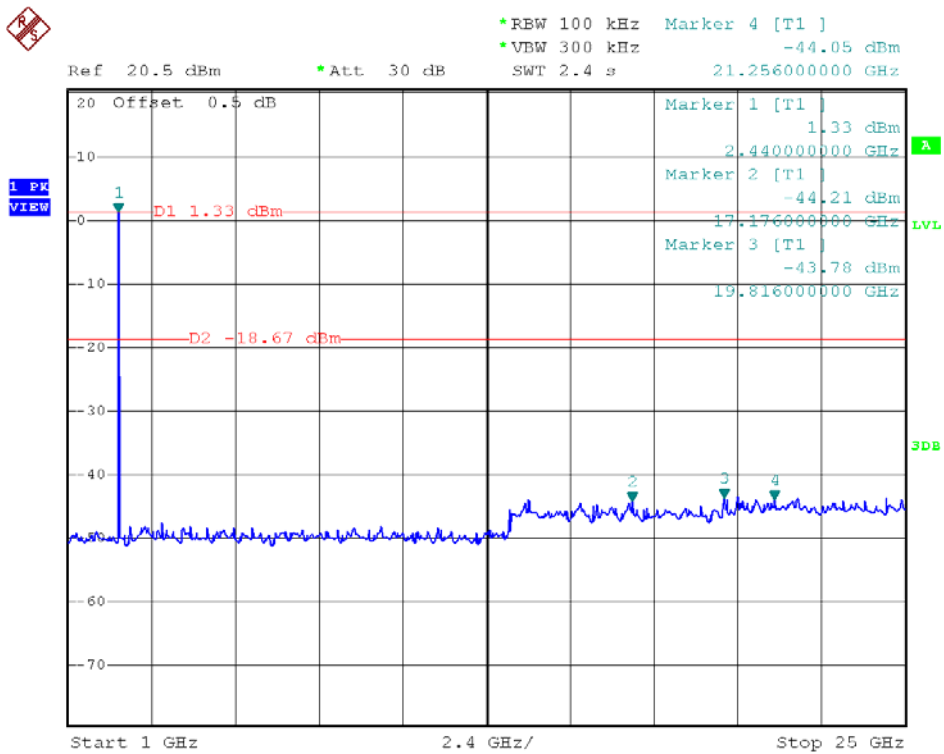
Low Channel 30MHz to 1GHz @ GFSK Mode



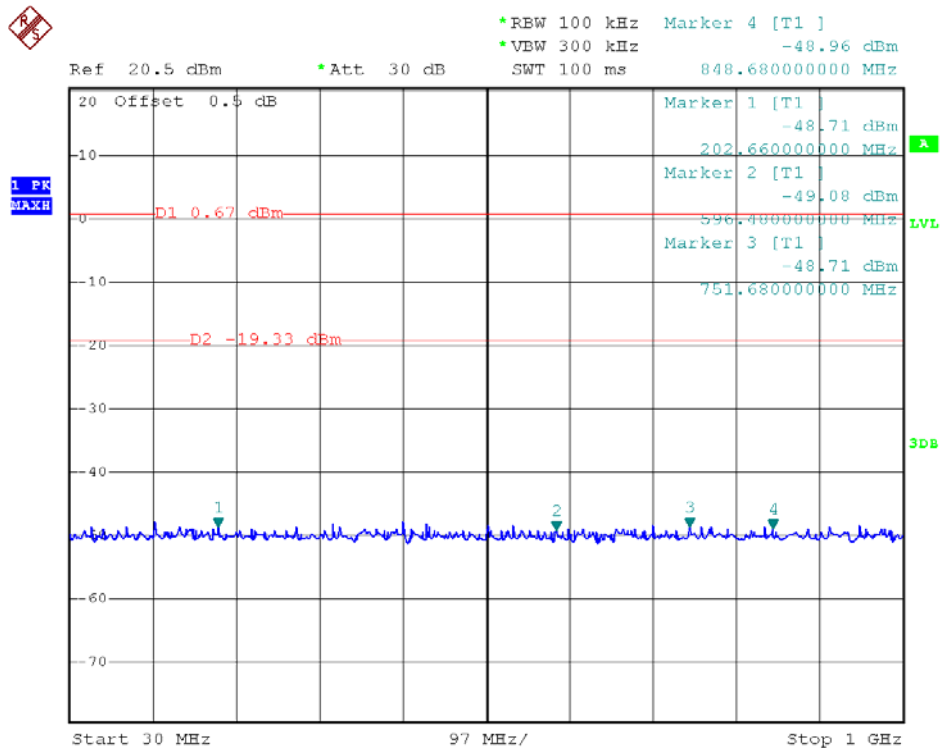
Low Channel 1GHz to 25GHz @ GFSK Mode



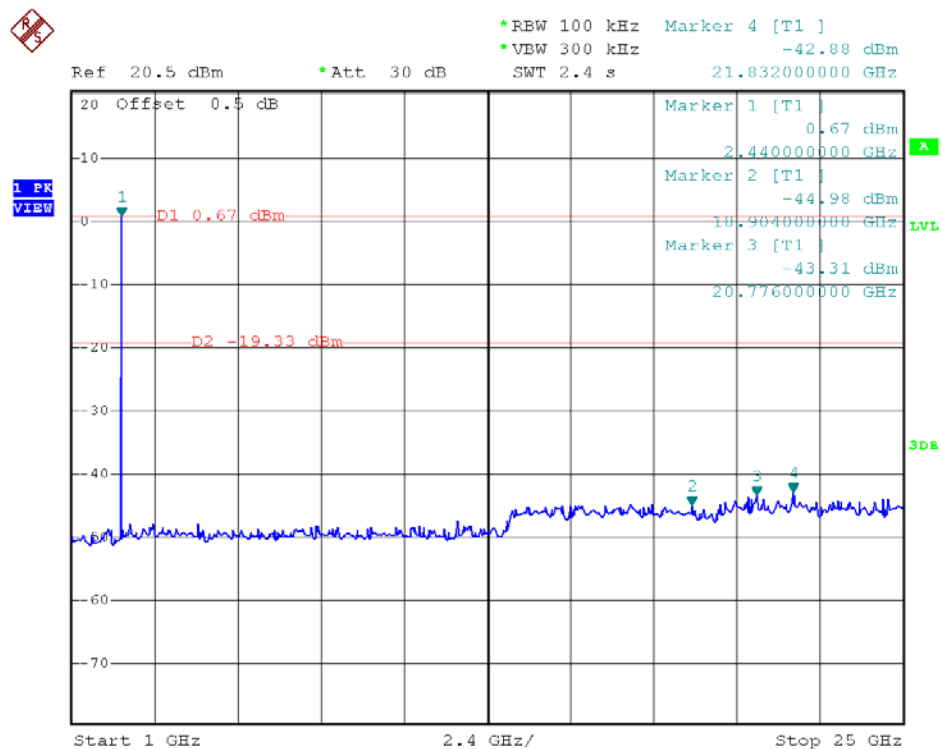
Mid Channel 30MHz to 1GHz @ GFSK Mode



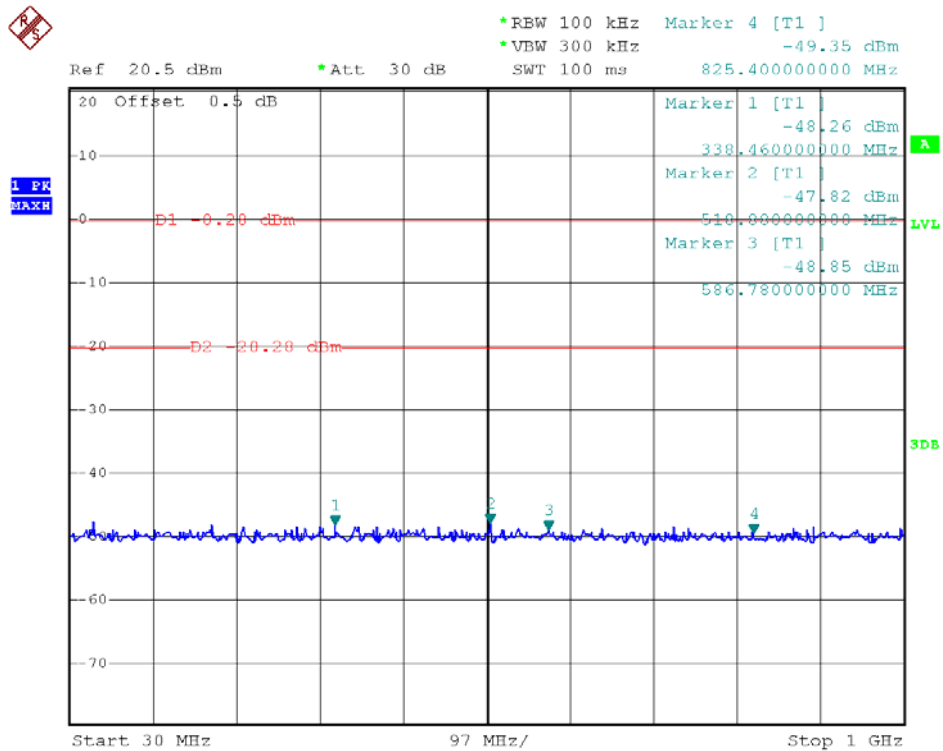
Mid Channel 1GHz to 25GHz @ GFSK Mode



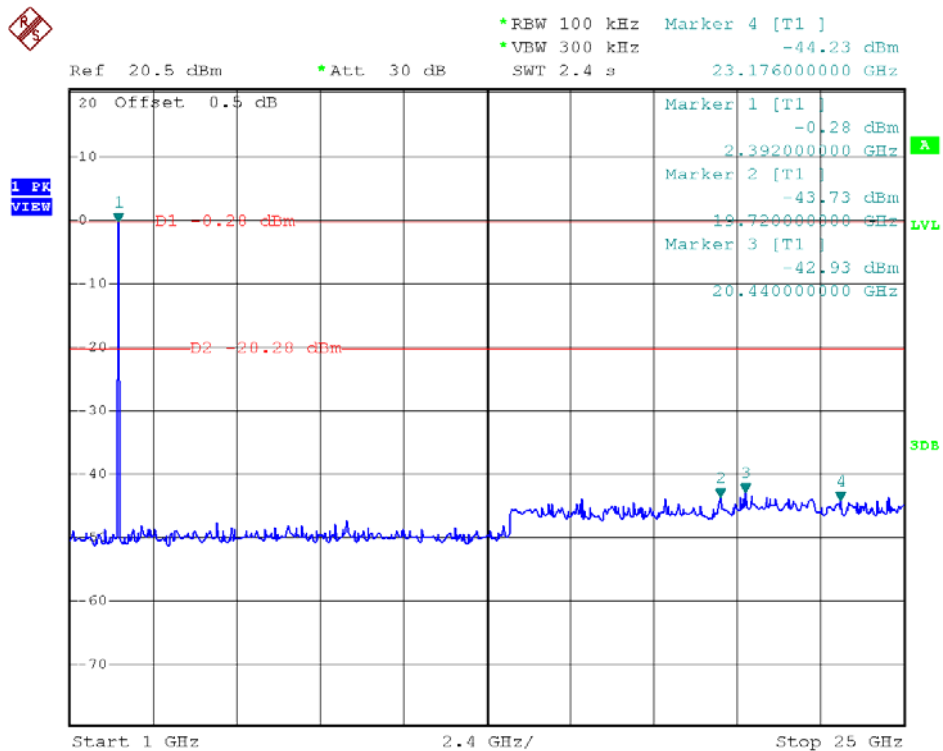
High Channel 30MHz to 1GHz @ GFSK Mode



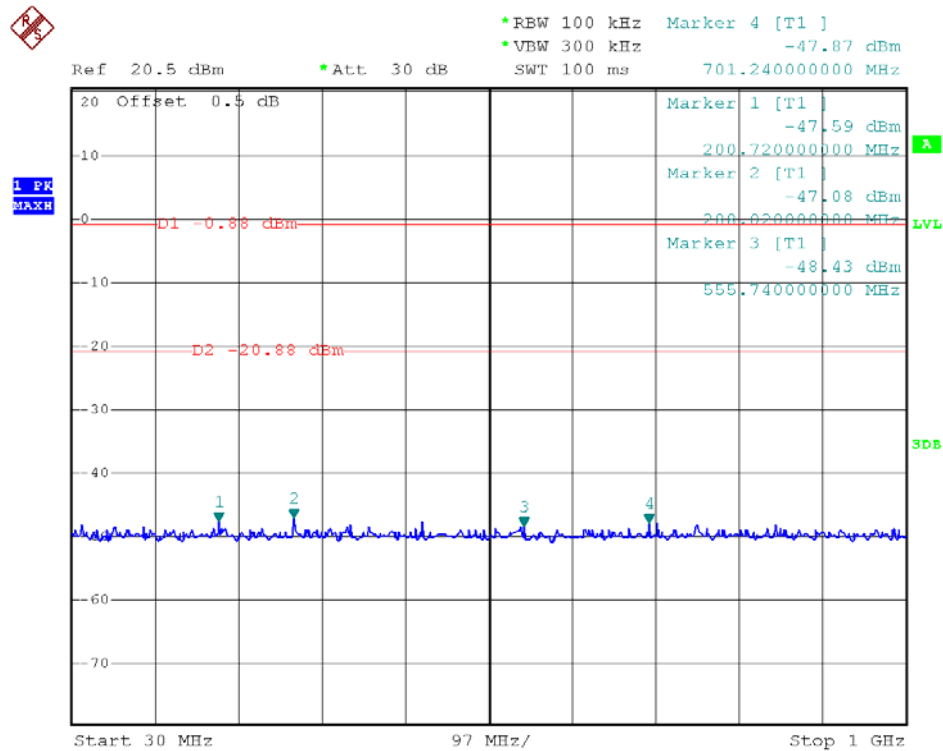
High Channel 1GHz to 25GHz @ GFSK Mode



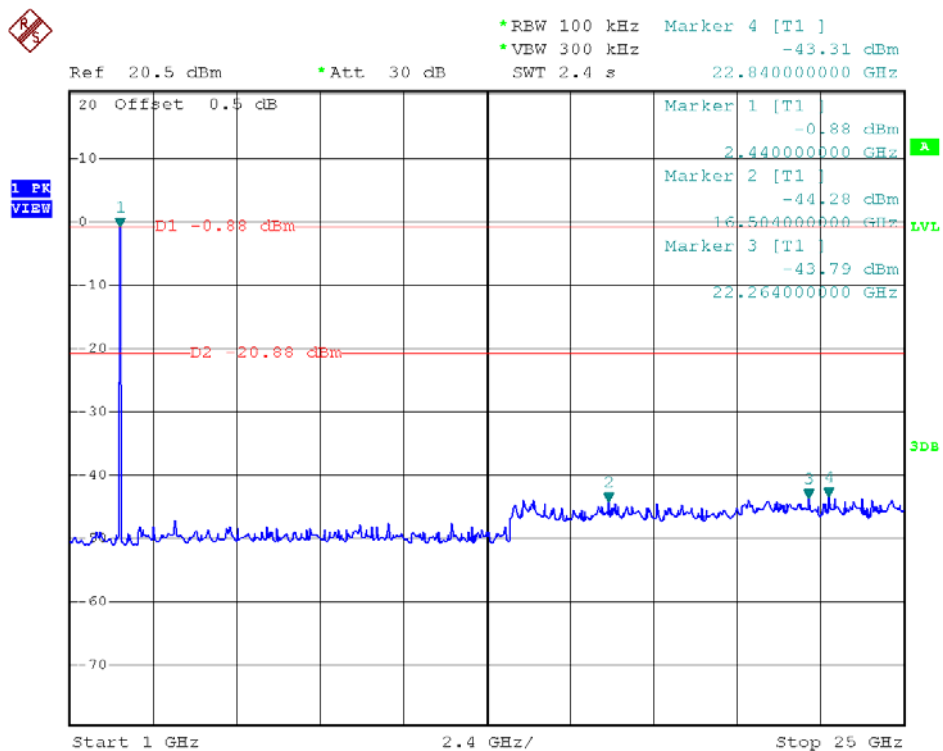
Low Channel 30MHz to 1GHz @ $\pi/4$ -DQPSK



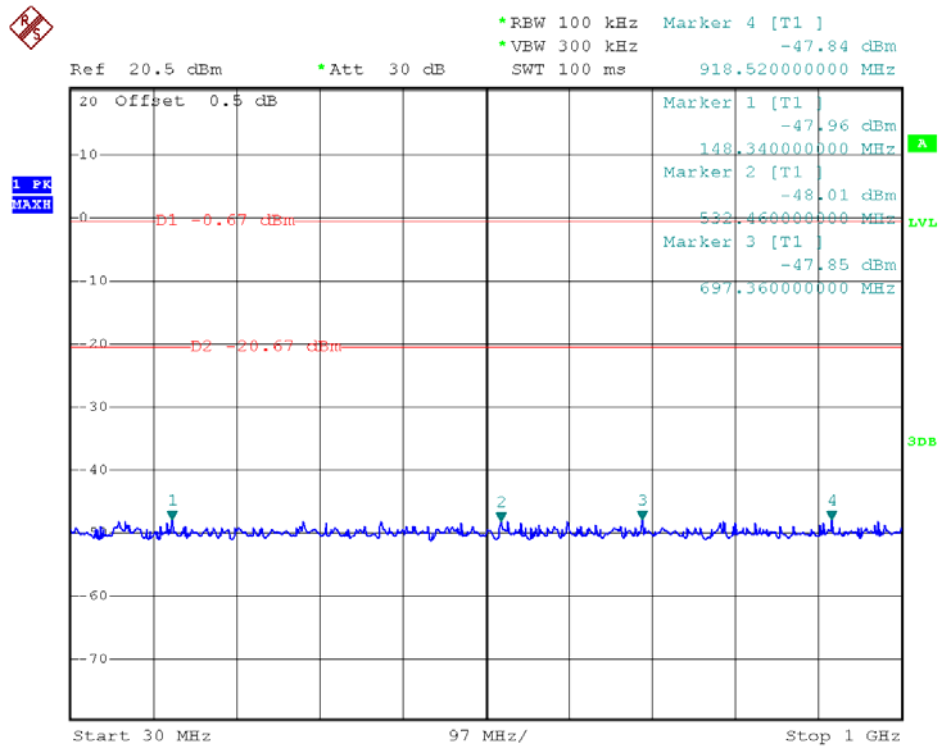
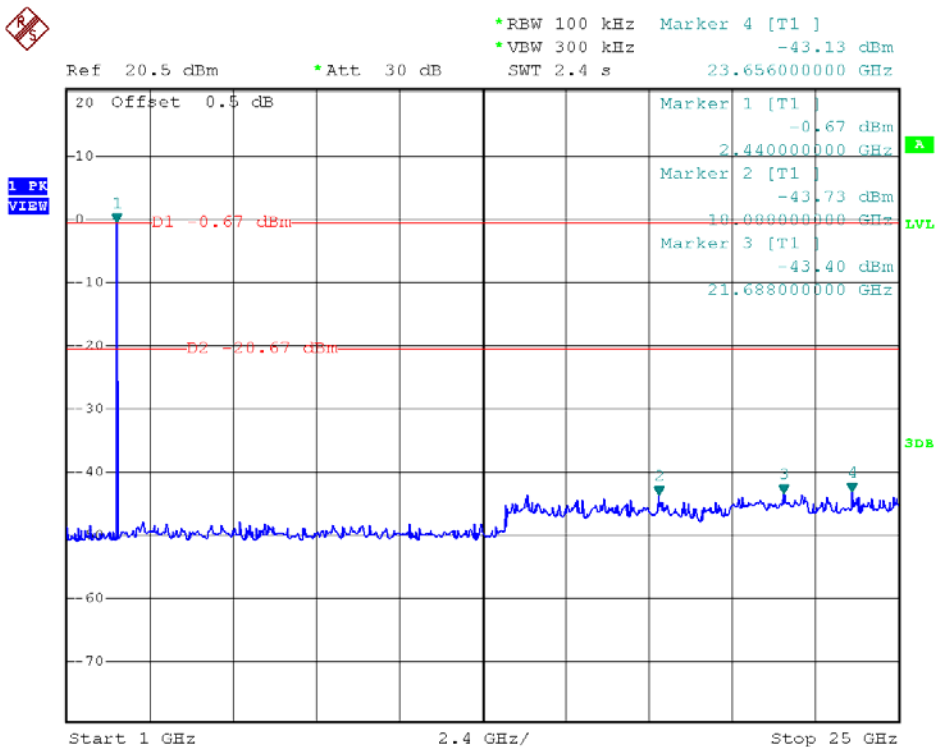
Low Channel 1GHz to 25GHz @ $\pi/4$ -DQPSK

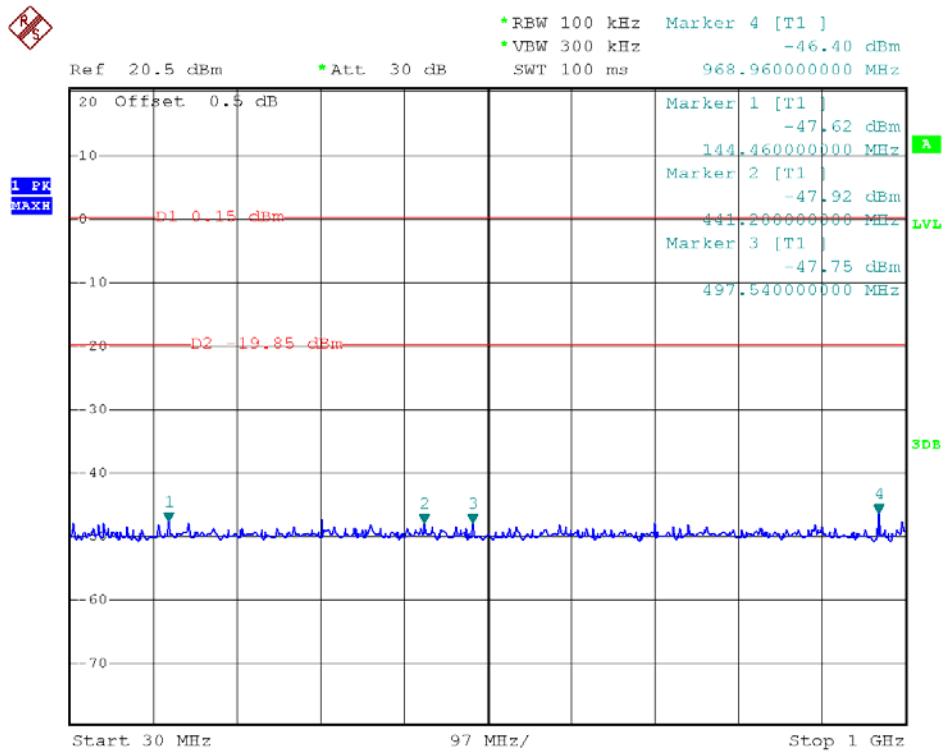


Mid Channel 30MHz to 1GHz @ $\pi/4$ -DQPSK

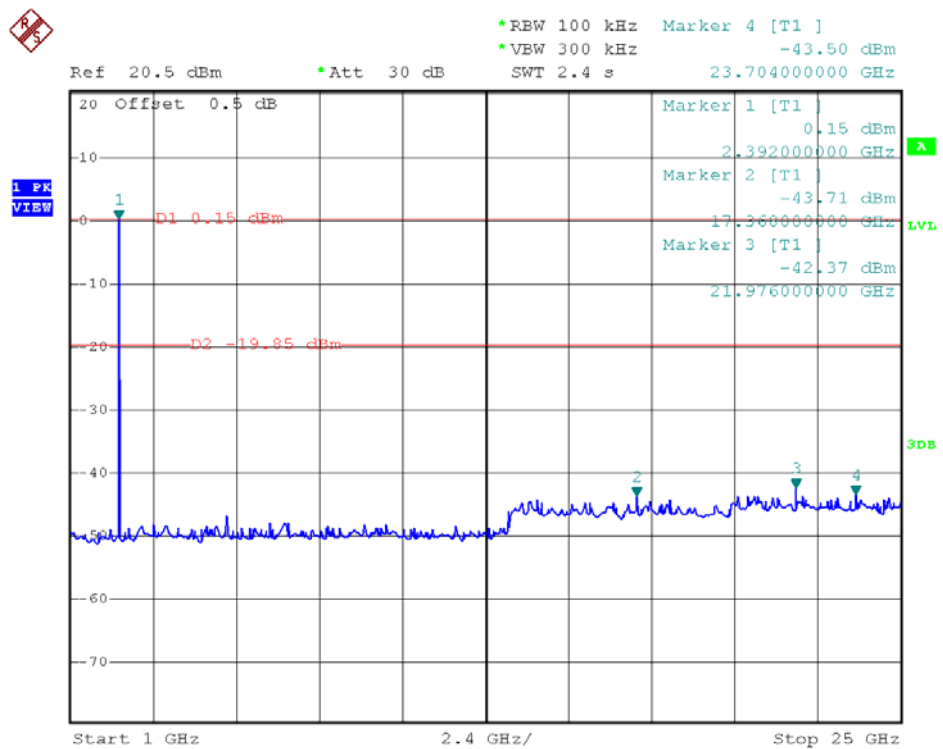


Mid Channel 1GHz to 25GHz @ $\pi/4$ -DQPSK

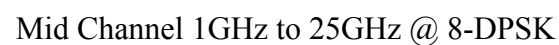
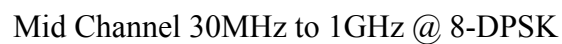
High Channel 30MHz to 1GHz @ $\pi/4$ -DQPSKHigh Channel 1GHz to 25GHz @ $\pi/4$ -DQPSK

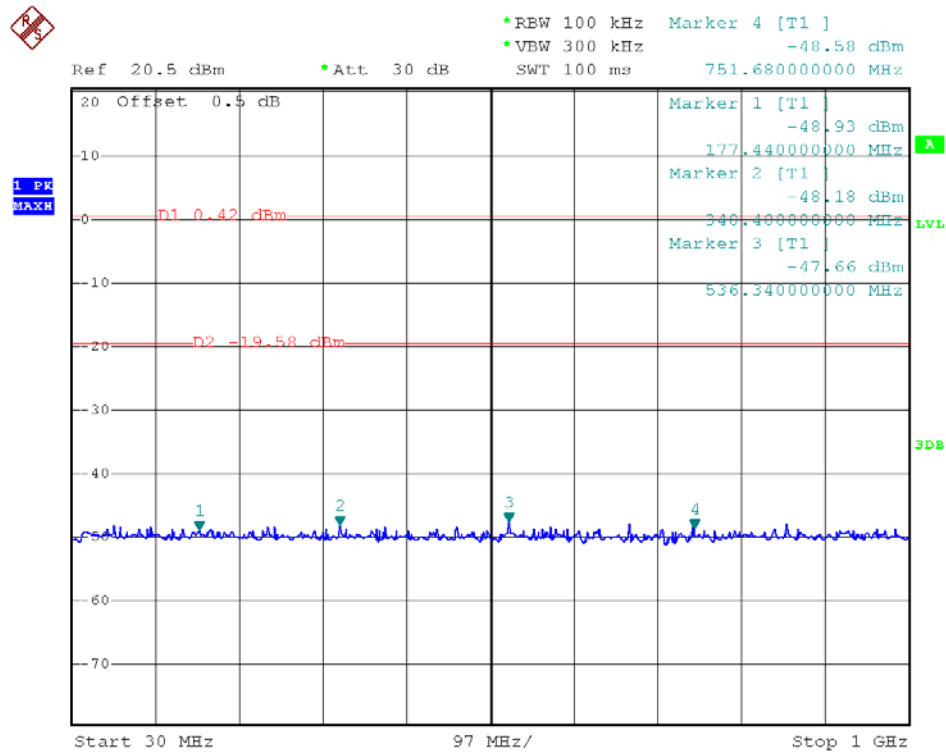


Low Channel 30MHz to 1GHz @ 8-DPSK

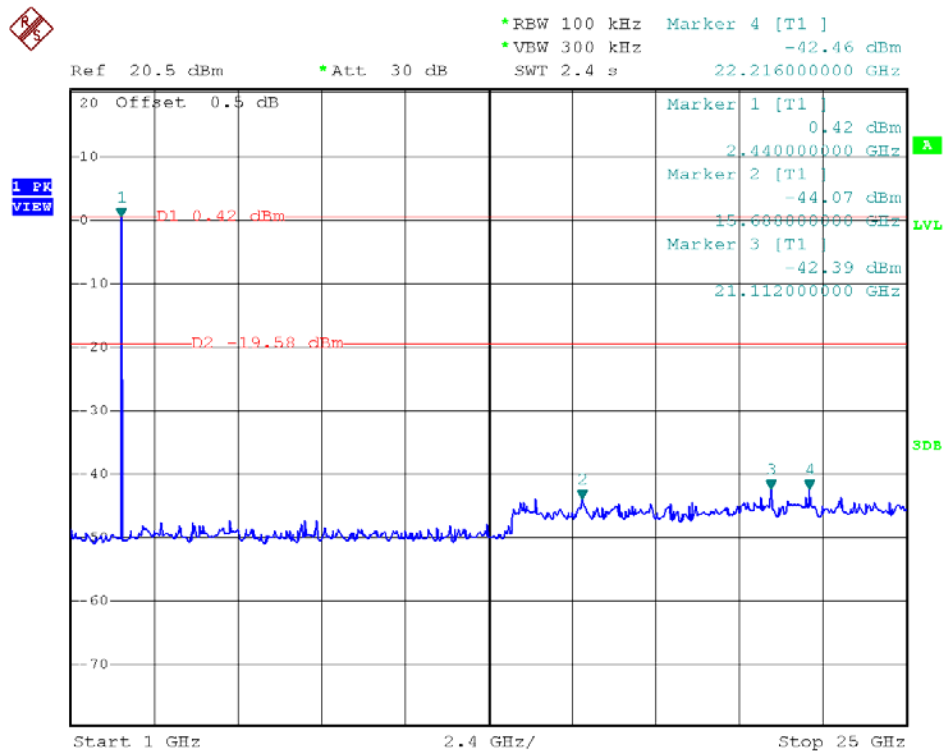


Low Channel 1GHz to 25GHz @ 8-DPSK





High Channel 30MHz to 1GHz @ 8-DPSK



High Channel 1GHz to 25GHz @ 8-DPSK

## 2.8. Conducted Band Edge

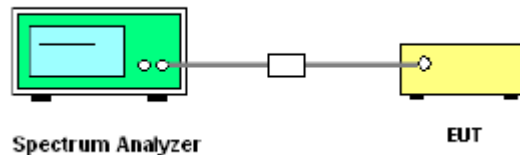
### 2.8.1. Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

### 2.8.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.8.3. Test Setup

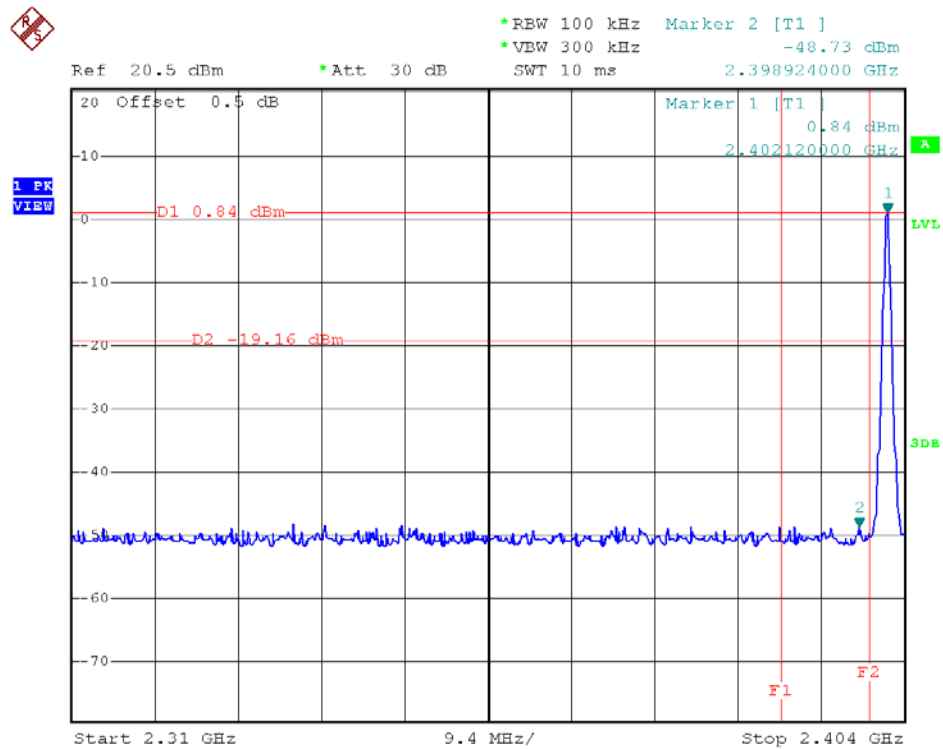


### 2.8.1. Test Procedure

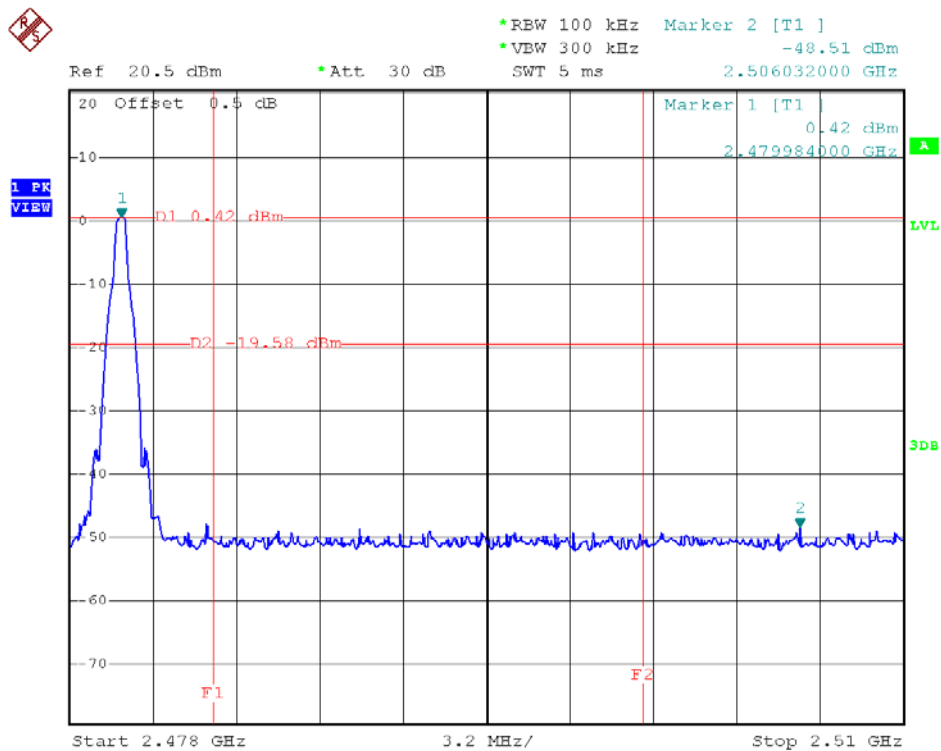
1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set  $RBW = 100\text{kHz}$  ( $\geq 1\%$  span=10MHz ),  $VBW = 300\text{kHz}$  ( $\geq RBW$ ). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

## 2.8.2. Test Results of Conducted Band Edge

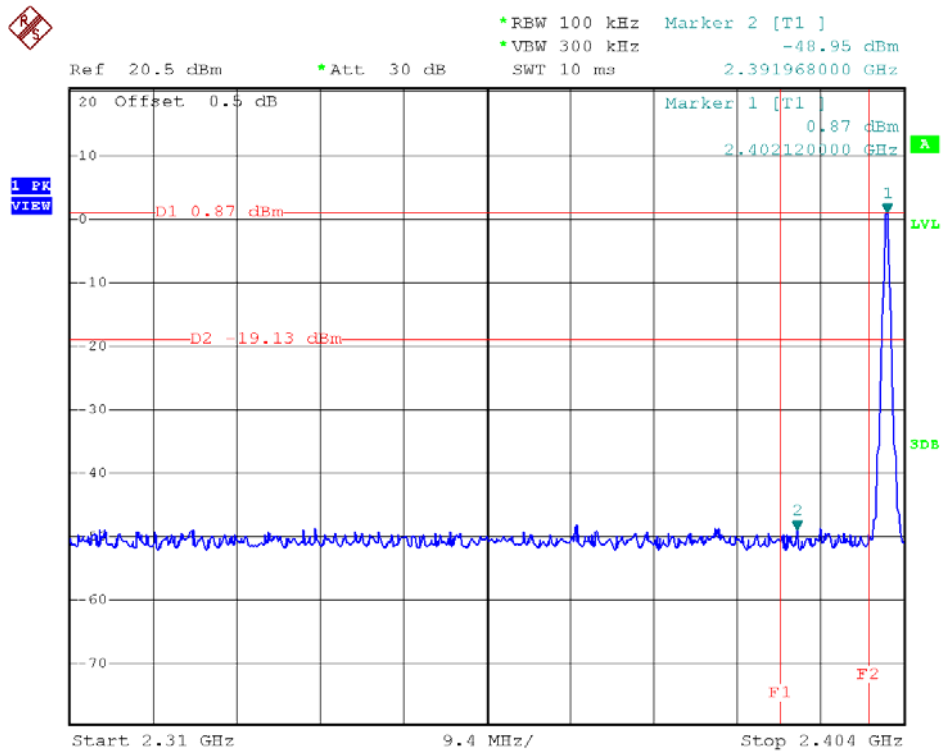
Band edge – Conducted (Un-hopping)



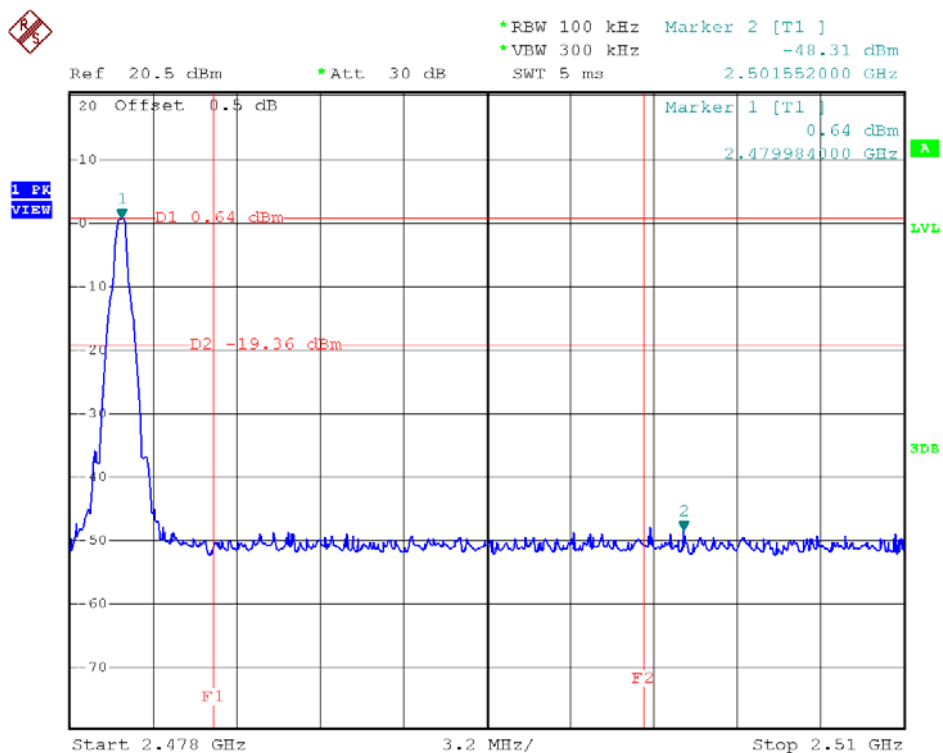
Low Band Edge Plot on channel 0 @ GFSK



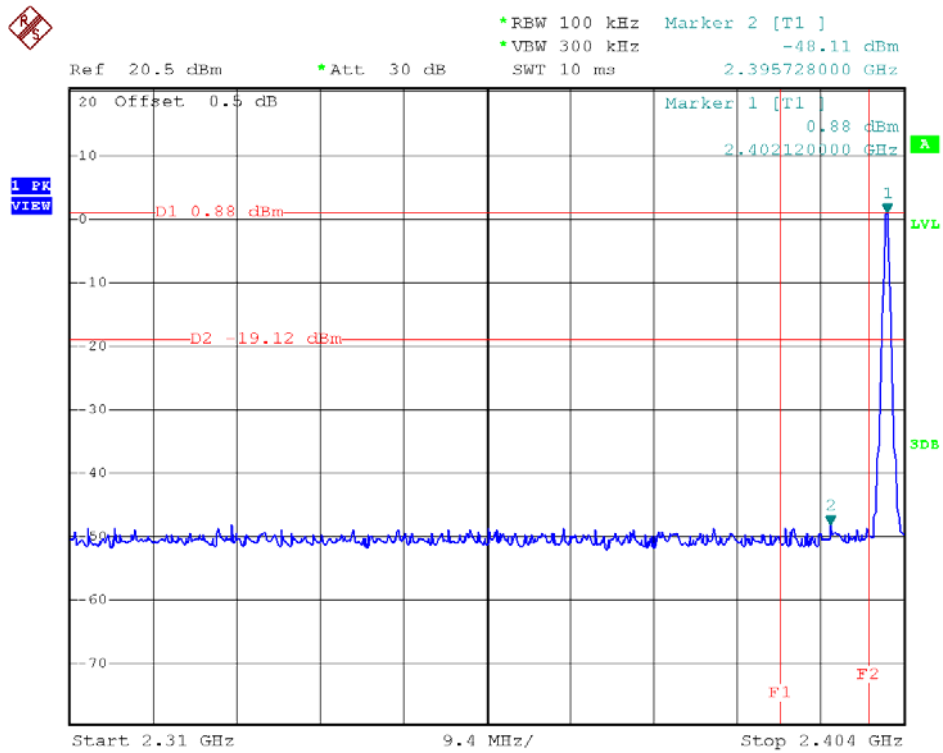
High Band Edge Plot on channel 78 @ GFSK



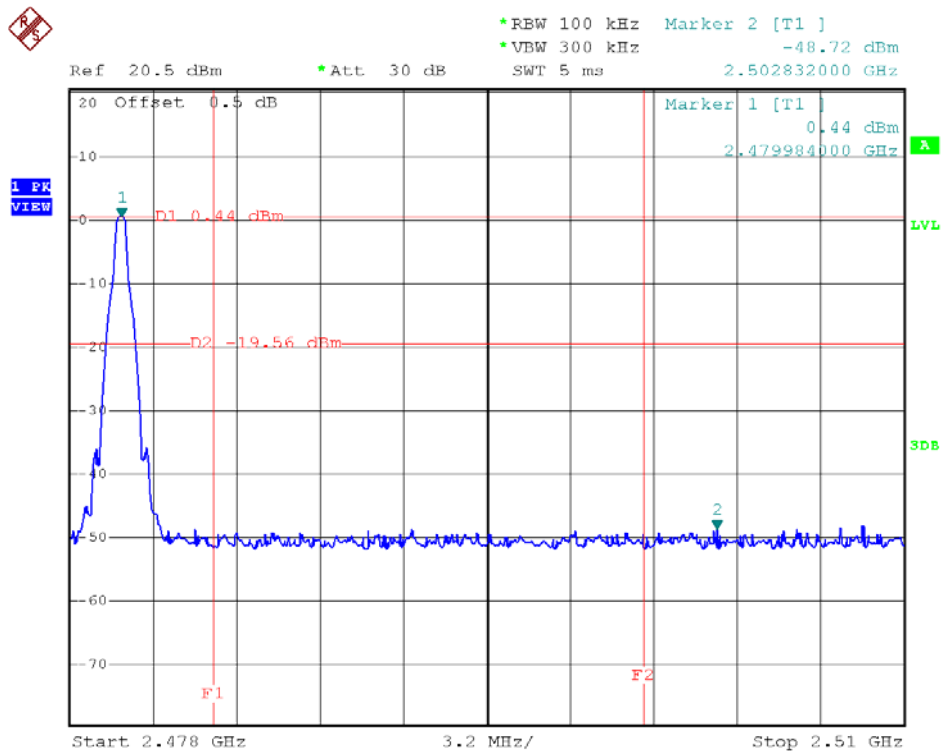
Low Band Edge Plot on channel 0 @ $\pi/4$ -DQPSK



High Band Edge Plot on channel 78 @ $\pi/4$ -DQPSK

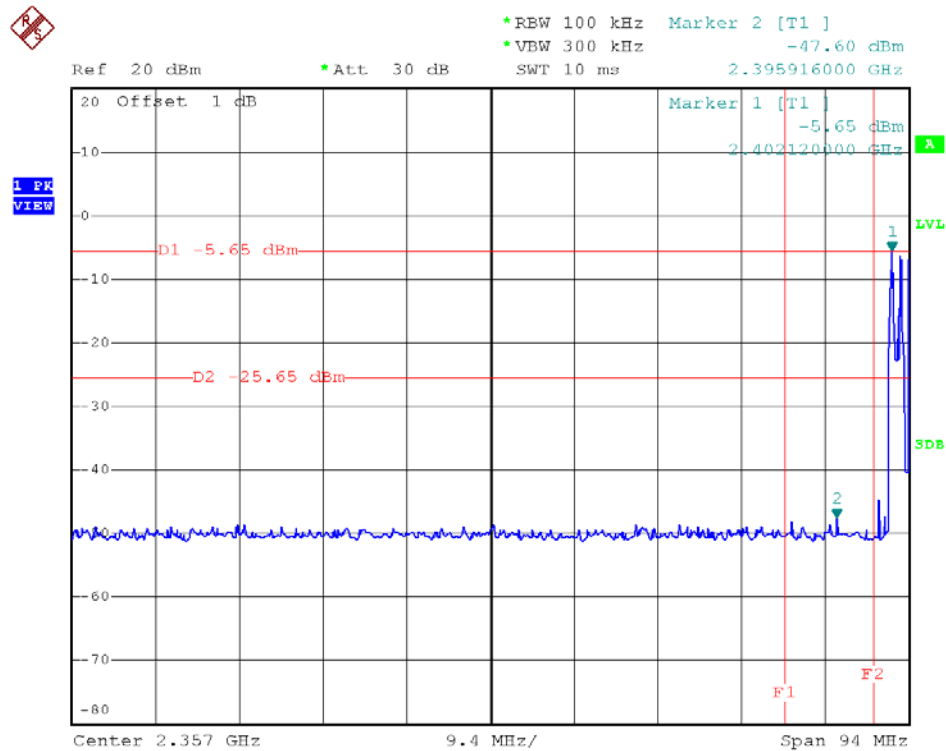


Low Band Edge Plot on channel 0 @8-DPSK

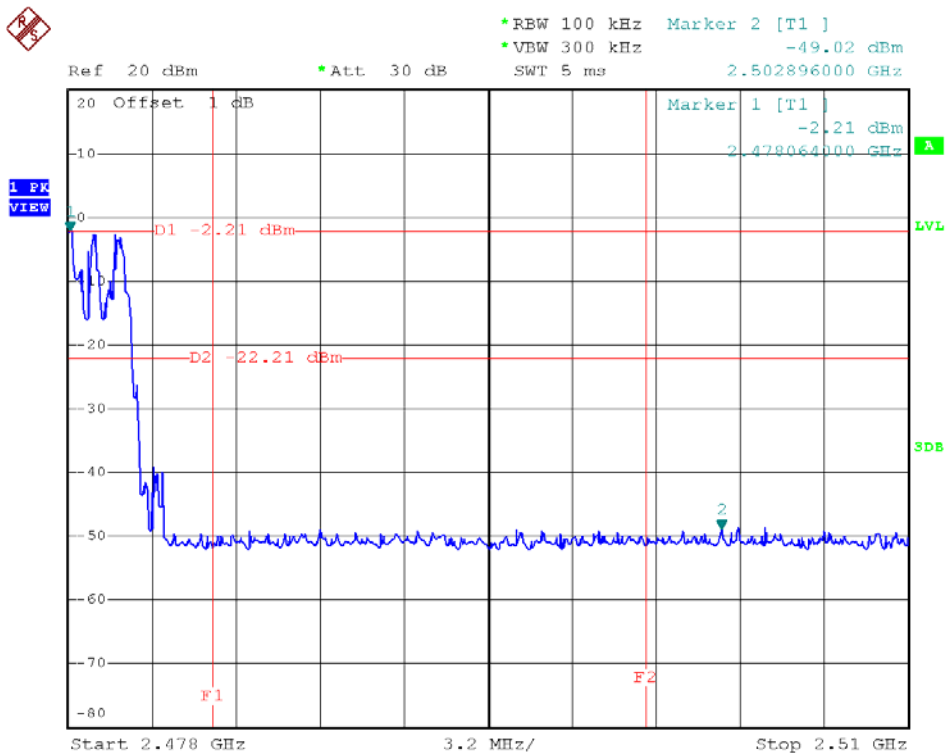


High Band Edge Plot on channel 78 @8-DPSK

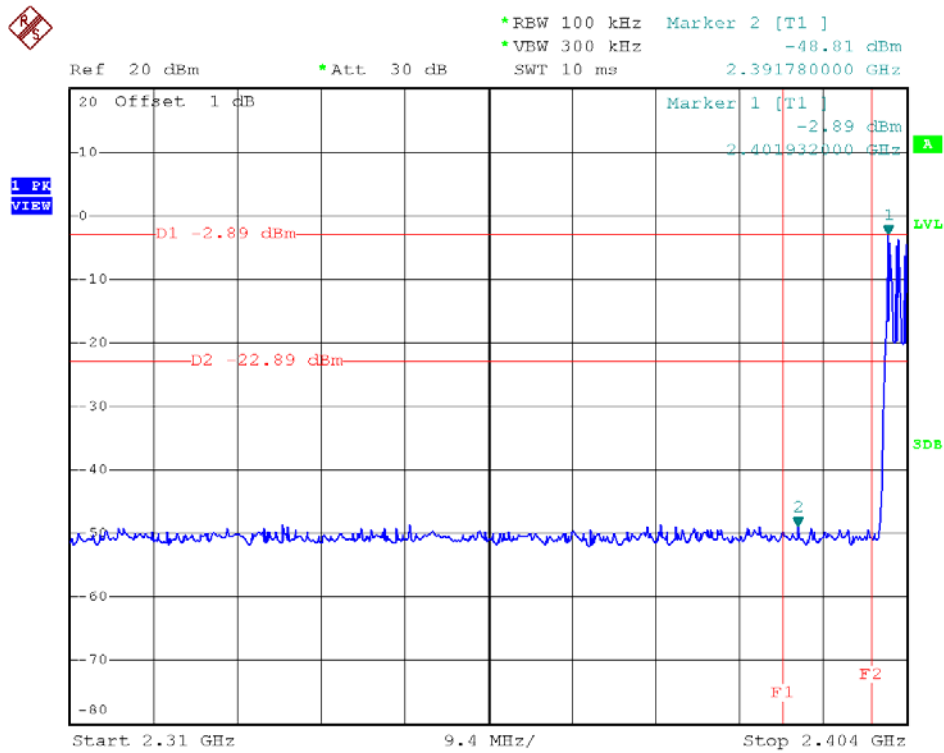
# Band edge - Conducted (hopping)



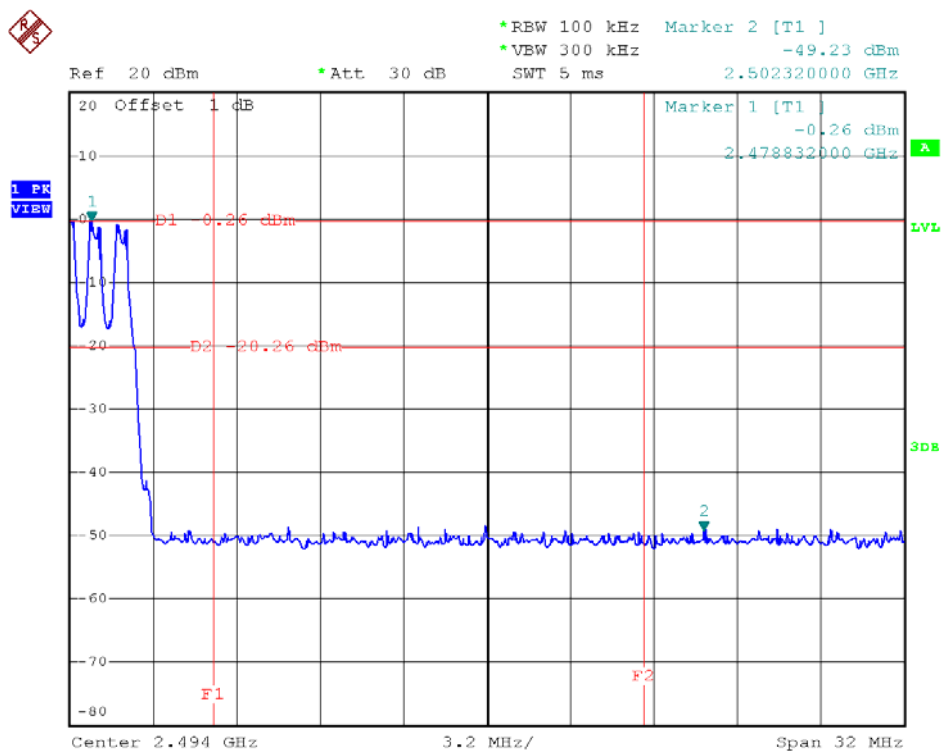
## Low Band Edge Plot on channel 0 @ GFSK



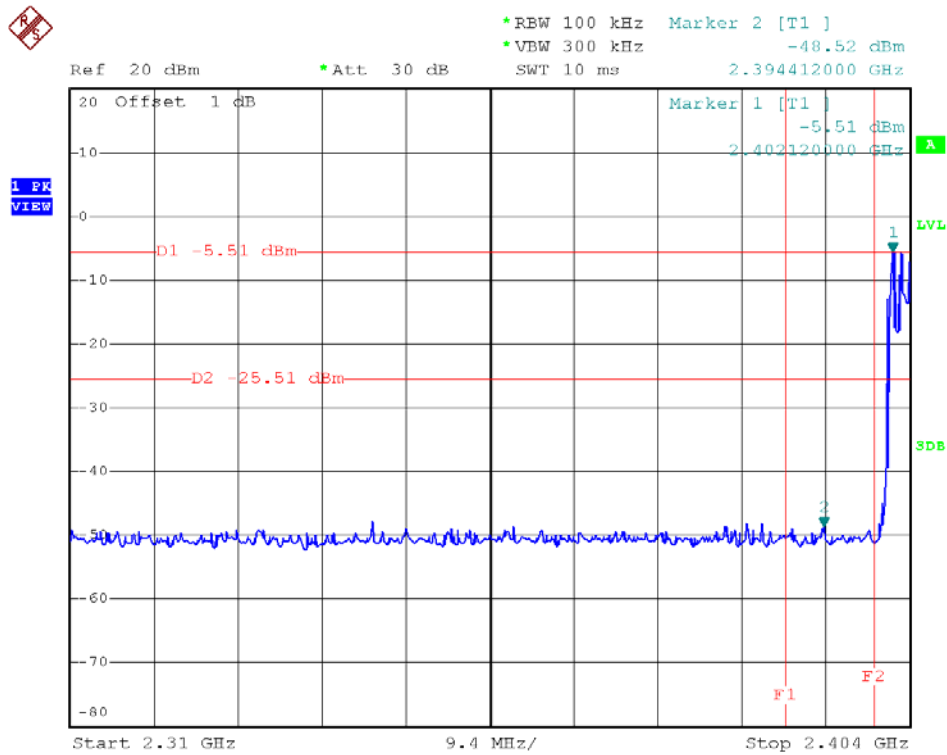
## High Band Edge Plot on channel 78 @ GFSK



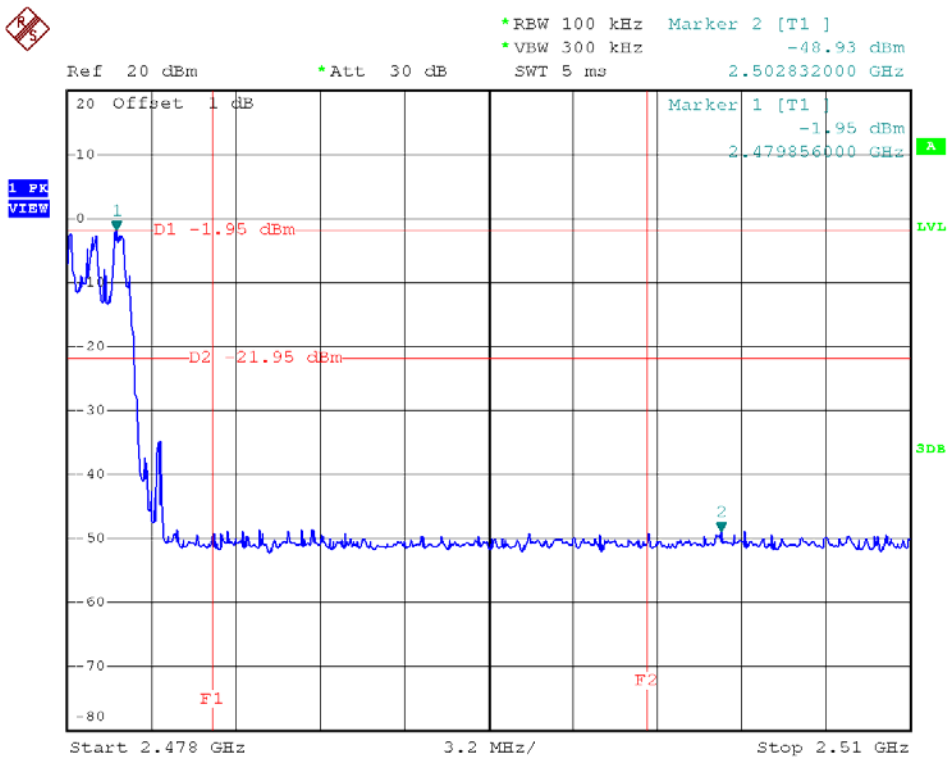
Low Band Edge Plot on channel 0 @ $\pi/4$ -DQPSK



High Band Edge Plot on channel 0 @ $\pi/4$ -DQPSK



Low Band Edge Plot on channel 0 @8-DPSK



High Band Edge Plot on channel 0 @8-DPSK

## 2.9. Conducted Emission

### 2.9.1. Limit of Conducted Emission

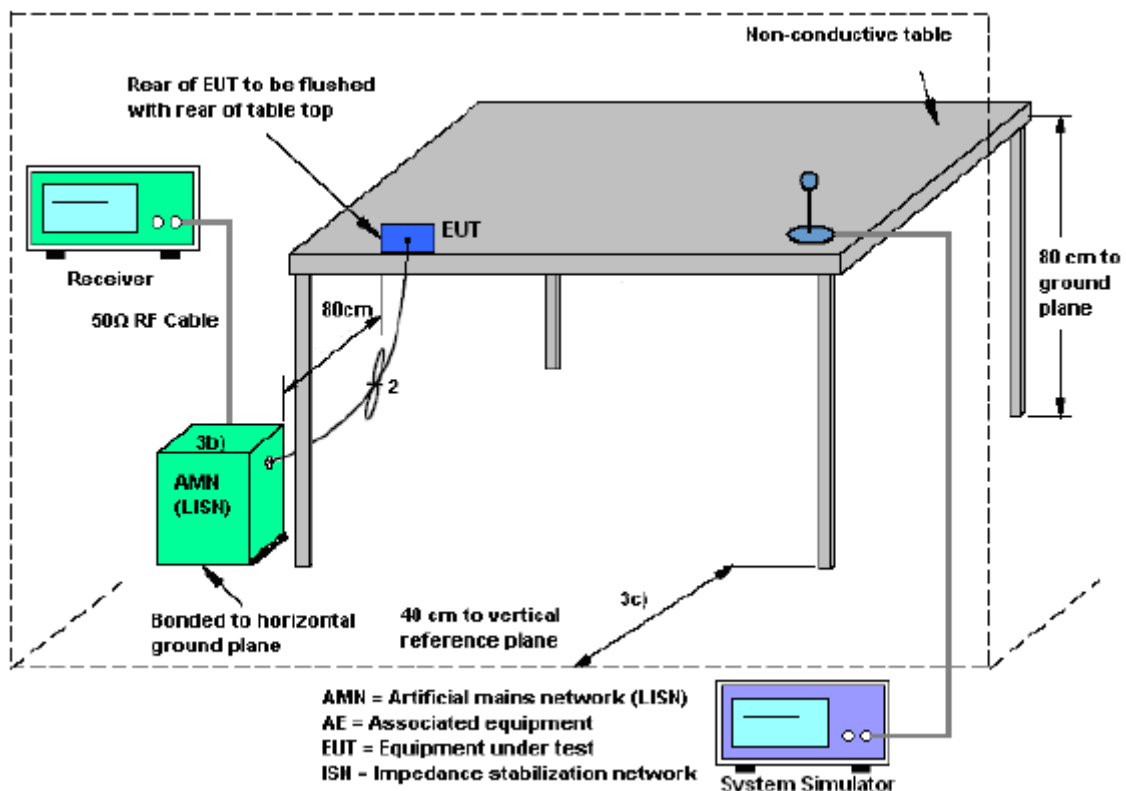
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency range (MHz) | Conducted Limit (dB $\mu$ V) |          |
|-----------------------|------------------------------|----------|
|                       | Quai-peak                    | Average  |
| 0.15 - 0.50           | 66 to 56                     | 56 to 46 |
| 0.50 - 5              | 56                           | 46       |
| 0.50 - 30             | 60                           | 50       |

### 2.9.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.9.3. Test Setup

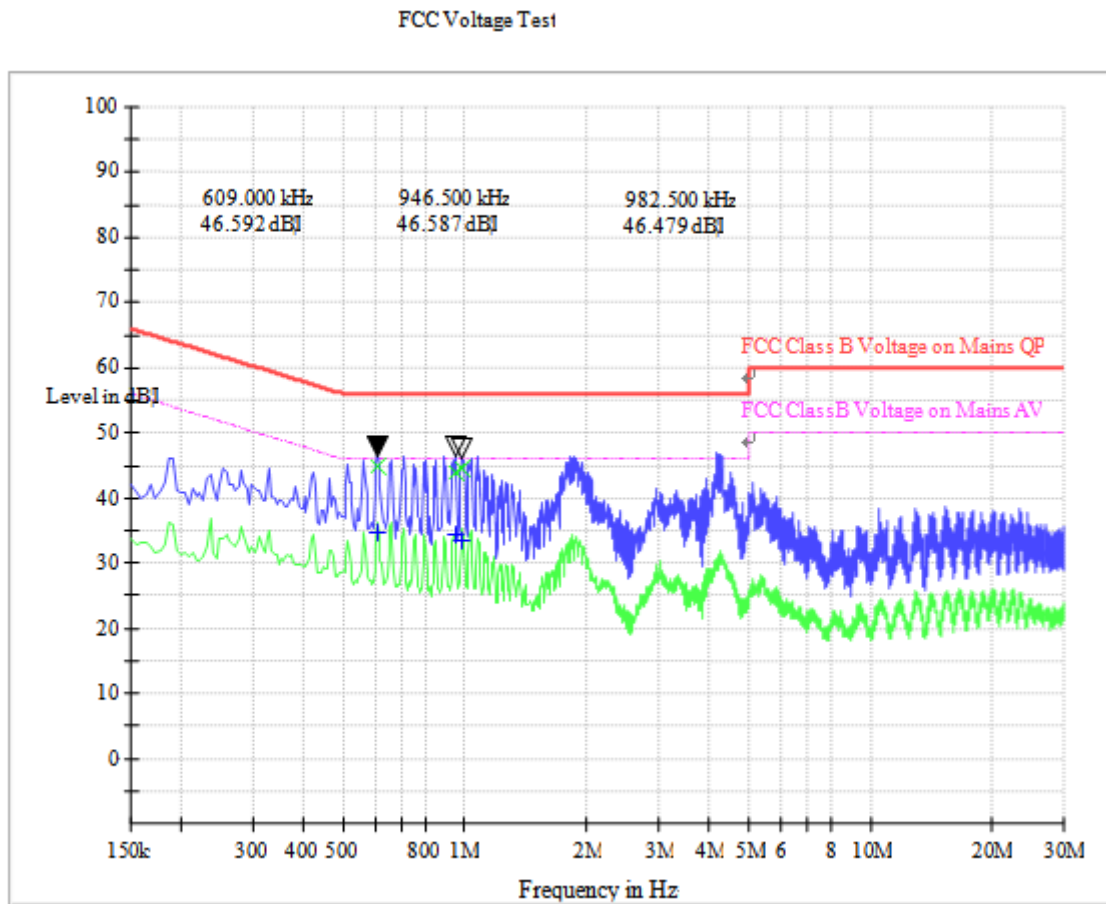


#### **2.9.4. Test Procedures**

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

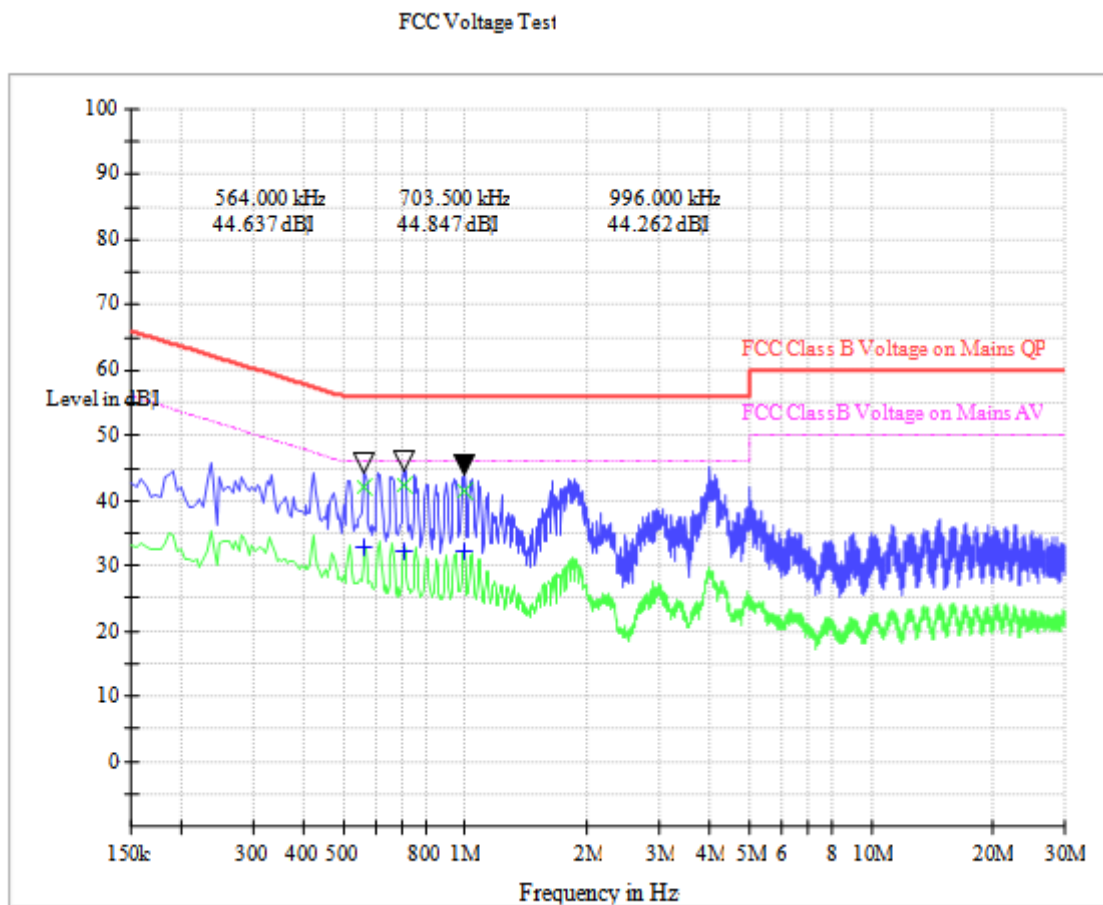
#### **2.9.3. Test Results of Conducted Emission**

The EUT configuration of the emission tests is Bluetooth Link + USB Cable (Charging from Adapter).



(Plot A: L Phase)

| Conducted Disturbance at Mains Terminals |               |                          |                 |               |                          |
|------------------------------------------|---------------|--------------------------|-----------------|---------------|--------------------------|
| L Test Data                              |               |                          |                 |               |                          |
| QP                                       |               |                          | AV              |               |                          |
| Frequency (MHz)                          | Limits (dBμV) | Measurement Value (dBμV) | Frequency (MHz) | Limits (dBμV) | Measurement Value (dBμV) |
| 0.609000                                 | 56.0          | 46.59                    | 0.609000        | 46.0          | 35.65                    |
| 0.946500                                 | 56.0          | 46.59                    | 0.946500        | 46.0          | 34.59                    |
| 0.982500                                 | 56.0          | 46.48                    | 0.982500        | 46.0          | 33.46                    |



(Plot B: N Phase)

| Conducted Disturbance at Mains Terminals |               |                          |                 |               |                          |
|------------------------------------------|---------------|--------------------------|-----------------|---------------|--------------------------|
| N Test Data                              |               |                          |                 |               |                          |
| QP                                       |               |                          | AV              |               |                          |
| Frequency (MHz)                          | Limits (dBμV) | Measurement Value (dBμV) | Frequency (MHz) | Limits (dBμV) | Measurement Value (dBμV) |
| 0.564000                                 | 56.0          | 44.64                    | 0.564000        | 46.0          | 33.70                    |
| 0.703500                                 | 56.0          | 44.85                    | 0.703500        | 46.0          | 33.30                    |
| 0.996000                                 | 56.0          | 44.26                    | 0.996000        | 46.0          | 33.35                    |

**Test Result: PASS**

## 2.10. Radiated Band Edges and Spurious Emission

### 2.10.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

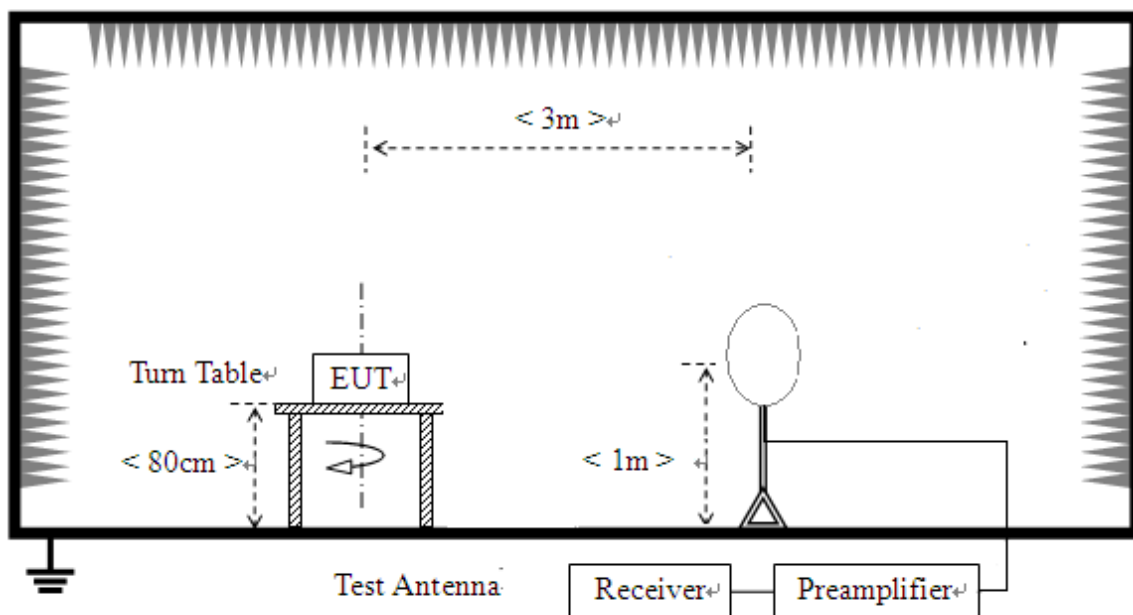
| Frequency (MHz) | Field Strength ( $\mu\text{V/m}$ ) | Measurement Distance (m) |
|-----------------|------------------------------------|--------------------------|
| 0.009 - 0.490   | $2400/F(\text{kHz})$               | 300                      |
| 0.490 - 1.705   | $24000/F(\text{kHz})$              | 30                       |
| 1.705 - 30.0    | 30                                 | 30                       |
| 30 - 88         | 100                                | 3                        |
| 88 - 216        | 150                                | 3                        |
| 216 - 960       | 200                                | 3                        |
| Above 960       | 500                                | 3                        |

### 2.10.2. Measuring Instruments

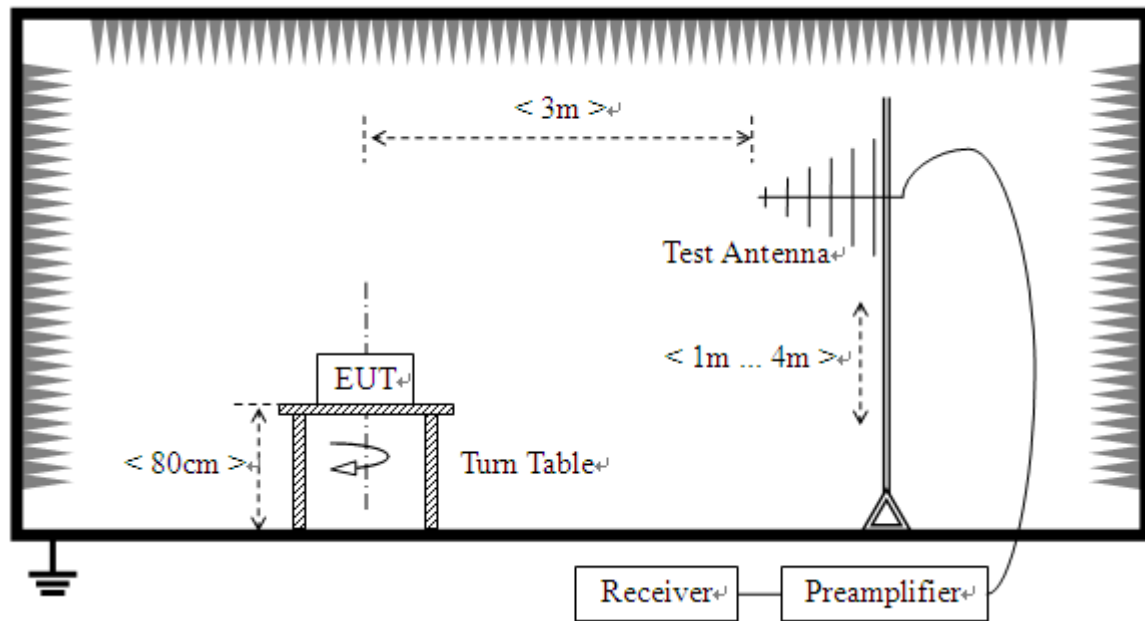
The measuring equipment is listed in the section 3 of this test report.

### 2.10.3. Test Setup

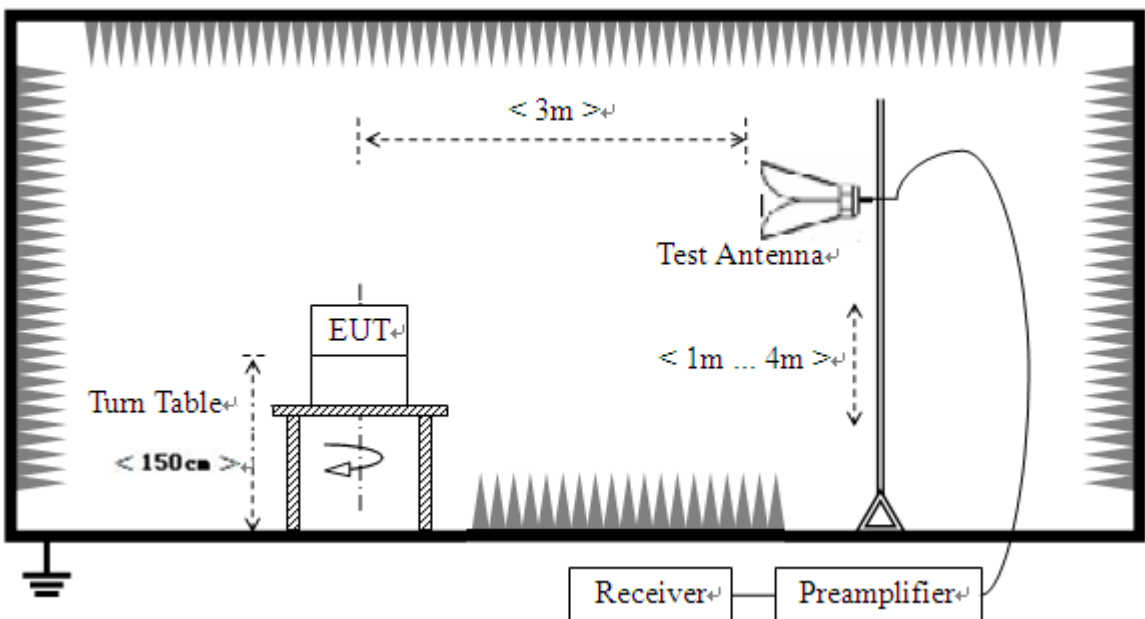
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



- 3) For radiated emissions above 1GHz



#### 2.10.4. Test Procedure

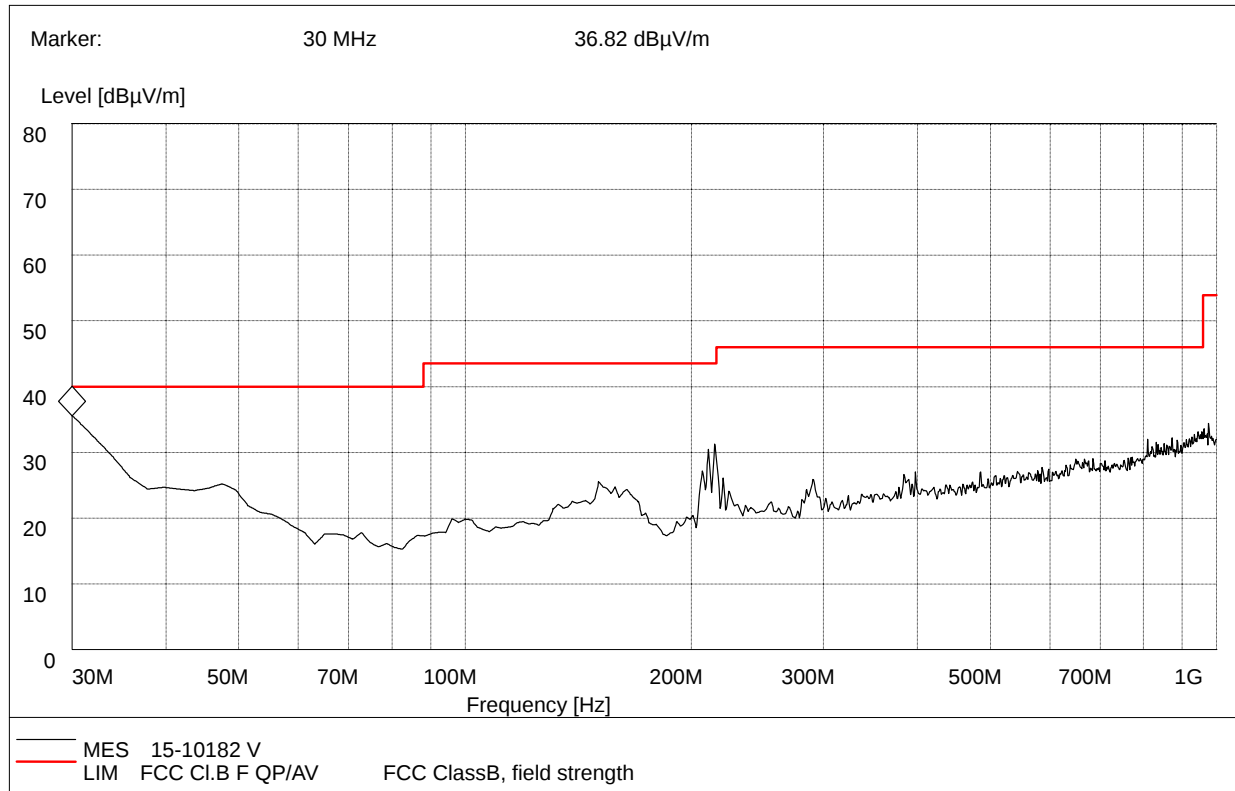
1. The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. The EUT was placed on a turntable with 0.8 meter above ground for below 1GHz, 1.5meter for above 1GHz
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1 \text{ GHz}$ , RBW=1MHz for  $f > 1\text{GHz}$  ; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c).  
Duty cycle = On time/100 milliseconds  
On time =  $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{N_{n-1}} + N_n * L_n$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level + 20\*log (Duty cycle)
7. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
8. All modes (three orthogonal orientations) of operation were investigated and the worst-case emissions are reported.

## 2.10.5. Test Results of Radiated Band Edge and Spurious Emission

### For 9KHz to 30MHz

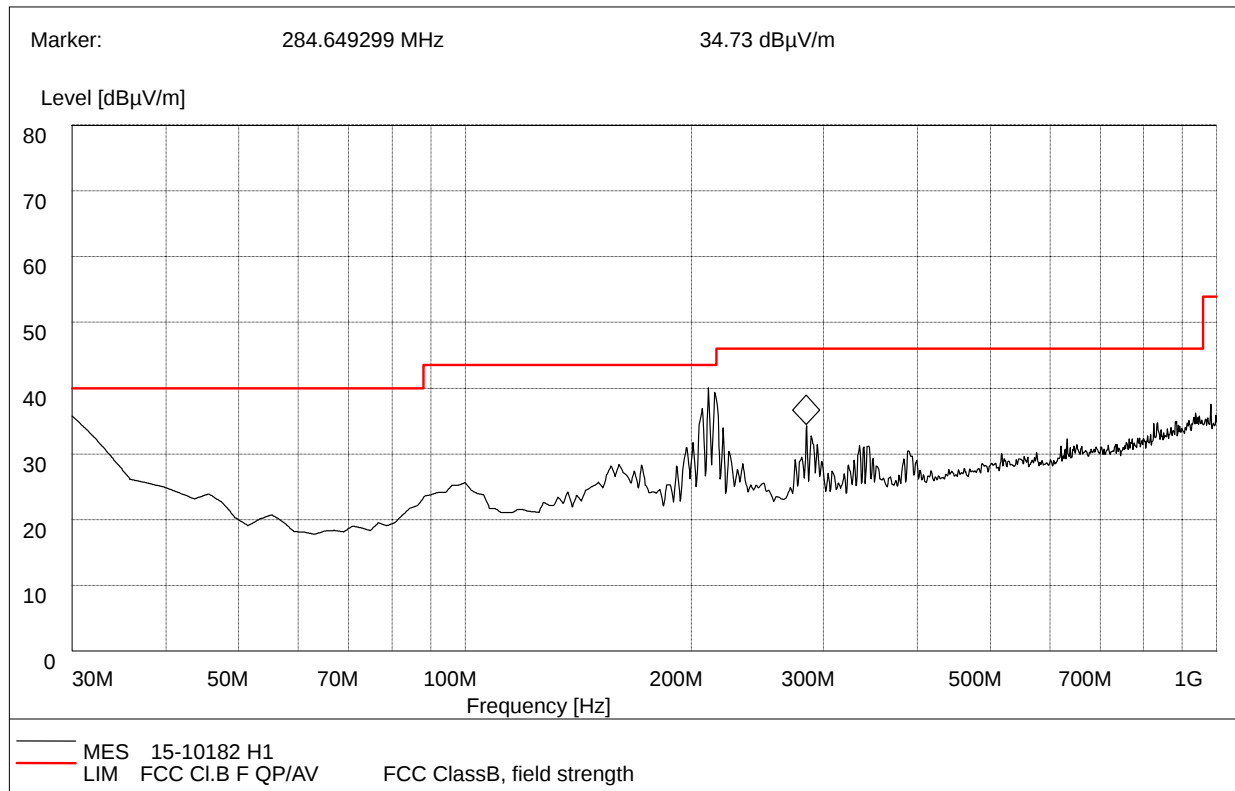
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

### For 30MHz to 1000MHz



| Frequency (MHz) | QuasiPeak (dB $\mu$ V/m) | Bandwidth (kHz) | Antenna height (cm) | Limit (dB $\mu$ V/m) | Antenna  | Verdict |
|-----------------|--------------------------|-----------------|---------------------|----------------------|----------|---------|
| 30.000          | 36.82                    | 120.000         | 100.0               | 40.00                | Vertical | Pass    |
| 214.360         | 31.41                    | 120.000         | 100.0               | 43.50                | Vertical | Pass    |

(Plot A: 30MHz to 1GHz, Antenna Vertical)



| Frequency (MHz) | QuasiPeak (dB $\mu$ V/m) | Bandwidth (kHz) | Antenna height (cm) | Limit (dB $\mu$ V/m) | Antenna    | Verdict |
|-----------------|--------------------------|-----------------|---------------------|----------------------|------------|---------|
| 211.000         | 40.24                    | 120.000         | 100.0               | 43.5                 | Horizontal | Pass    |
| 214.360         | 39.15                    | 120.000         | 100.0               | 43.5                 | Horizontal | Pass    |
| 284.649         | 34.73                    | 120.000         | 100.0               | 46.0                 | Horizontal | Pass    |

(Plot B: 30MHz to 1GHz, Antenna Horizontal)

**For 1GHz to 25GHz**
**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (GFSK-2402MHz)**

| No. | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | 2390.00         | 56.70                   | PK | 74.0           | -17.30      | 1.01 H             | 228                  | 24.50              | 32.20                    |
| 2   | 2390.00         | 43.50                   | AV | 54.0           | -10.50      | 1.01 H             | 228                  | 11.30              | 32.20                    |
| 3   | *2402.00        | 106.60                  | PK | /              | /           | 1.03 H             | 112                  | 74.40              | 32.20                    |
| 4   | *2402.00        | 105.80                  | AV | /              | /           | 1.03 H             | 112                  | 73.60              | 32.20                    |
| 5   | 4804.00         | 50.50                   | PK | 74.00          | -23.50      | 1.00 H             | 254                  | 45.20              | 5.30                     |
| 6   | 4804.00         | 42.80                   | AV | 54.00          | -11.20      | 1.00 H             | 254                  | 37.50              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (GFSK-2402MHz)**

| No. | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | 2390.00         | 56.90                   | PK | 74.0           | -17.10      | 1.11 V             | 228                  | 24.70              | 32.20                    |
| 2   | 2390.00         | 44.30                   | AV | 54.0           | -9.70       | 1.11 V             | 228                  | 12.10              | 32.20                    |
| 3   | *2402.00        | 107.10                  | PK | /              | /           | 1.09 V             | 112                  | 74.90              | 32.20                    |
| 4   | *2402.00        | 107.60                  | AV | /              | /           | 1.03 V             | 112                  | 75.40              | 32.20                    |
| 5   | 4804.00         | 51.40                   | PK | 74.00          | -22.60      | 1.21 V             | 254                  | 46.10              | 5.30                     |
| 6   | 4804.00         | 43.70                   | AV | 54.00          | -10.30      | 1.21 V             | 254                  | 38.40              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (GFSK\_2441MHz)**

| No. | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2441.00        | 107.80                  | PK | /              | /           | 1.01 H             | 210                  | 75.60              | 32.20                    |
| 2   | *2441.00        | 106.70                  | AV | /              | /           | 1.01 H             | 210                  | 74.50              | 32.20                    |
| 3   | 4882.00         | 54.50                   | PK | 74.00          | -19.50      | 1.03 H             | 272                  | 49.20              | 5.30                     |
| 4   | 4882.00         | 43.6                    | AV | 54.00          | -10.40      | 1.03 H             | 272                  | 38.30              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (GFSK\_2441MHz)**

| No. | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2441.00        | 108.40                  | PK | /              | /           | 1.09 V             | 112                  | 76.20              | 32.20                    |
| 2   | *2441.00        | 106.10                  | AV | /              | /           | 1.09 V             | 112                  | 73.90              | 32.20                    |
| 3   | 4884.00         | 55.50                   | PK | 74.00          | -18.50      | 1.21 V             | 254                  | 50.20              | 5.30                     |
| 4   | 4884.00         | 42.80                   | AV | 54.00          | -11.20      | 1.21 V             | 254                  | 37.50              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (GFSK\_2480MHz)**

| No. | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2480.00        | 108.00                  | PK | /              | /           | 1.05 H             | 215                  | 75.70              | 32.30                    |
| 2   | *2480.00        | 106.50                  | AV | /              | /           | 1.05 H             | 215                  | 74.20              | 32.30                    |
| 3   | 2483.50         | 56.80                   | PK | 74.0           | -17.20      | 1.05 H             | 211                  | 24.40              | 32.40                    |
| 4   | 2483.50         | 45.20                   | AV | 54.0           | -8.80       | 1.05 H             | 211                  | 12.80              | 32.40                    |
| 5   | 4960.00         | 52.20                   | PK | 74.0           | -21.80      | 1.45 H             | 320                  | 46.70              | 5.50                     |
| 6   | 4960.00         | 45.10                   | AV | 54.0           | -8.90       | 1.45 H             | 320                  | 39.60              | 5.50                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (GFSK\_2480MHz)**

| No. | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2480.00        | 109.10                  | PK | /              | /           | 1.05 V             | 174                  | 76.80              | 32.30                    |
| 2   | *2480.00        | 107.80                  | AV | /              | /           | 1.05 V             | 174                  | 75.50              | 32.30                    |
| 3   | 2483.50         | 56.30                   | PK | 74.0           | -17.70      | 1.05 V             | 177                  | 23.90              | 32.40                    |
| 4   | 2483.50         | 45.90                   | AV | 54.0           | -8.10       | 1.05 V             | 177                  | 13.50              | 32.40                    |
| 5   | 4960.00         | 53.70                   | PK | 74.0           | -20.30      | 1.45 V             | 201                  | 48.20              | 5.50                     |
| 6   | 4960.00         | 42.60                   | AV | 54.0           | -11.40      | 1.45 V             | 201                  | 37.10              | 5.50                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M ( $\pi/4$ -DQPSK -2402MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | 2390.00         | 57.30                  | PK | 74.0           | -16.70      | 1.01 H             | 228                  | 25.10              | 32.20                    |
| 2   | 2390.00         | 43.70                  | AV | 54.0           | -10.30      | 1.01 H             | 228                  | 11.40              | 32.20                    |
| 3   | *2402.00        | 107.70                 | PK | /              | /           | 1.03 H             | 112                  | 75.50              | 32.20                    |
| 4   | *2402.00        | 106.50                 | AV | /              | /           | 1.03 H             | 112                  | 74.30              | 32.20                    |
| 5   | 4804.00         | 52.80                  | PK | 74.00          | -21.2       | 1.00 H             | 254                  | 47.50              | 5.30                     |
| 6   | 4804.00         | 44.30                  | AV | 54.00          | -9.70       | 1.00 H             | 254                  | 39.00              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M ( $\pi/4$ -DQPSK -2402MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | 2390.00         | 56.70                  | PK | 74.0           | -17.30      | 1.11 V             | 228                  | 24.50              | 32.20                    |
| 2   | 2390.00         | 43.30                  | AV | 54.0           | -10.70      | 1.11 V             | 228                  | 12.10              | 32.20                    |
| 3   | *2402.00        | 108.4                  | PK | /              | /           | 1.09 V             | 112                  | 76.20              | 32.20                    |
| 4   | *2402.00        | 107.3                  | AV | /              | /           | 1.03 V             | 112                  | 75.10              | 32.20                    |
| 5   | 4804.00         | 54.10                  | PK | 74.00          | -19.90      | 1.21 V             | 254                  | 48.80              | 5.30                     |
| 6   | 4804.00         | 43.40                  | AV | 54.00          | -10.60      | 1.21 V             | 254                  | 38.10              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M ( $\pi/4$ -DQPSK \_2441MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2441.00        | 108.60                 | PK | /              | /           | 1.01 H             | 210                  | 76.40              | 32.20                    |
| 2   | *2441.00        | 107.90                 | AV | /              | /           | 1.01 H             | 210                  | 75.70              | 32.20                    |
| 3   | 4882.00         | 53.20                  | PK | 74.00          | -19.80      | 1.03 H             | 272                  | 47.90              | 5.30                     |
| 4   | 4882.00         | 40.80                  | AV | 54.00          | -13.20      | 1.03 H             | 272                  | 35.50              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M ( $\pi/4$ -DQPSK \_2441MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2441.00        | 109.40                 | PK | /              | /           | 1.09 V             | 112                  | 77.20              | 32.20                    |
| 2   | *2441.00        | 107.30                 | AV | /              | /           | 1.09 V             | 112                  | 75.10              | 32.20                    |
| 3   | 4884.00         | 53.60                  | PK | 74.00          | -20.40      | 1.21 V             | 254                  | 48.30              | 5.30                     |
| 4   | 4884.00         | 41.80                  | AV | 54.00          | -12.20      | 1.21 V             | 254                  | 36.50              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M ( $\pi/4$ -DQPSK \_2480MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2480.00        | 108.40                 | PK | /              | /           | 1.05 H             | 215                  | 76.10              | 32.30                    |
| 2   | *2480.00        | 107.60                 | AV | /              | /           | 1.05 H             | 215                  | 75.30              | 32.30                    |
| 3   | 2483.50         | 57.10                  | PK | 74.0           | -16.90      | 1.05 H             | 211                  | 24.70              | 32.40                    |
| 4   | 2483.50         | 43.20                  | AV | 54.0           | -10.80      | 1.05 H             | 211                  | 10.80              | 32.40                    |
| 5   | 4960.00         | 52.00                  | PK | 74.0           | -22.00      | 1.45 H             | 320                  | 46.50              | 5.50                     |
| 6   | 4960.00         | 44.30                  | AV | 54.0           | -9.70       | 1.45 H             | 320                  | 38.80              | 5.50                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M ( $\pi/4$ -DQPSK \_2480MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2480.00        | 109.80                 | PK | /              | /           | 1.05 V             | 174                  | 77.50              | 32.30                    |
| 2   | *2480.00        | 106.40                 | AV | /              | /           | 1.05 V             | 174                  | 74.10              | 32.30                    |
| 3   | 2483.50         | 55.80                  | PK | 74.0           | -18.20      | 1.05 V             | 177                  | 23.40              | 32.40                    |
| 4   | 2483.50         | 43.90                  | AV | 54.0           | -10.10      | 1.05 V             | 177                  | 11.50              | 32.40                    |
| 5   | 4960.00         | 53.80                  | PK | 74.0           | -20.20      | 1.45 V             | 201                  | 48.30              | 5.50                     |
| 6   | 4960.00         | 44.60                  | AV | 54.0           | -9.40       | 1.45 V             | 201                  | 39.10              | 5.50                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (8-DPSK -2402MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1   | 2390.00         | 55.30                  | PK | 74.0           | -18.70      | 1.01 H             | 228                  | 23.10            | 32.20                    |
| 2   | 2390.00         | 44.60                  | AV | 54.0           | -9.40       | 1.01 H             | 228                  | 12.40            | 32.20                    |
| 3   | *2402.00        | 109.70                 | PK | /              | /           | 1.03 H             | 112                  | 77.50            | 32.20                    |
| 4   | *2402.00        | 108.30                 | AV | /              | /           | 1.03 H             | 112                  | 76.10            | 32.20                    |
| 5   | 4804.00         | 52.50                  | PK | 74.00          | -21.50      | 1.00 H             | 254                  | 47.20            | 5.30                     |
| 6   | 4804.00         | 45.40                  | AV | 54.00          | -8.60       | 1.00 H             | 254                  | 40.10            | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (8-DPSK -2402MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | 2390.00         | 56.40                  | PK | 74.0           | -17.60      | 1.11 V             | 228                  | 24.20              | 32.20                    |
| 2   | 2390.00         | 44.00                  | AV | 54.0           | -10.00      | 1.11 V             | 228                  | 11.80              | 32.20                    |
| 3   | *2402.00        | 109.10                 | PK | /              | /           | 1.09 V             | 112                  | 76.90              | 32.20                    |
| 4   | *2402.00        | 109.60                 | AV | /              | /           | 1.03 V             | 112                  | 77.40              | 32.20                    |
| 5   | 4804.00         | 53.40                  | PK | 74.00          | -20.60      | 1.21 V             | 254                  | 48.10              | 5.30                     |
| 6   | 4804.00         | 44.70                  | AV | 54.00          | -9.30       | 1.21 V             | 254                  | 39.40              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (8-DPSK\_2441MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2441.00        | 107.60                 | PK | /              | /           | 1.01 H             | 210                  | 75.40              | 32.20                    |
| 2   | *2441.00        | 106.70                 | AV | /              | /           | 1.01 H             | 210                  | 74.50              | 32.20                    |
| 3   | 4882.00         | 53.40                  | PK | 74.00          | -20.60      | 1.03 H             | 272                  | 48.10              | 5.30                     |
| 4   | 4882.00         | 45.10                  | AV | 54.00          | -8.90       | 1.03 H             | 272                  | 39.80              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (8-DQPSK\_2441MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2441.00        | 108.30                 | PK | /              | /           | 1.09 V             | 112                  | 76.10              | 32.20                    |
| 2   | *2441.00        | 106.10                 | AV | /              | /           | 1.09 V             | 112                  | 73.90              | 32.20                    |
| 3   | 4884.00         | 54.80                  | PK | 74.00          | -17.2       | 1.21 V             | 254                  | 49.50              | 5.30                     |
| 4   | 4884.00         | 43.90                  | AV | 54.00          | -10.5       | 1.21 V             | 254                  | 38.60              | 5.30                     |

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (8-DPSK \_2480MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2480.00        | 110.20                 | PK | /              | /           | 1.05 H             | 215                  | 77.90              | 32.30                    |
| 2   | *2480.00        | 107.80                 | AV | /              | /           | 1.05 H             | 215                  | 75.50              | 32.30                    |
| 3   | 2483.50         | 57.60                  | PK | 74.0           | -16.40      | 1.05 H             | 211                  | 25.20              | 32.40                    |
| 4   | 2483.50         | 44.70                  | AV | 54.0           | -9.30       | 1.05 H             | 211                  | 12.30              | 32.40                    |
| 5   | 4960.00         | 54.60                  | PK | 74.0           | -19.40      | 1.45 H             | 320                  | 49.10              | 5.50                     |
| 6   | 4960.00         | 41.70                  | AV | 54.0           | -12.30      | 1.45 H             | 320                  | 36.20              | 5.50                     |

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (8-DPSK \_2480MHz)**

| No. | Frequency (MHz) | Emssion Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) |
|-----|-----------------|------------------------|----|----------------|-------------|--------------------|----------------------|--------------------|--------------------------|
| 1   | *2480.00        | 109.10                 | PK | /              | /           | 1.05 V             | 174                  | 76.80              | 32.30                    |
| 2   | *2480.00        | 109.70                 | AV | /              | /           | 1.05 V             | 174                  | 77.40              | 32.30                    |
| 3   | 2483.50         | 57.20                  | PK | 74.0           | -16.80      | 1.05 V             | 177                  | 24.80              | 32.40                    |
| 4   | 2483.50         | 43.90                  | AV | 54.0           | -10.10      | 1.05 V             | 177                  | 11.50              | 32.40                    |
| 5   | 4960.00         | 54.90                  | PK | 74.0           | -19.10      | 1.45 V             | 201                  | 49.40              | 5.50                     |
| 6   | 4960.00         | 42.80                  | AV | 54.0           | -11.20      | 1.45 V             | 201                  | 37.30              | 5.50                     |

**REMARKS:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)  
- Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level - Limit value
5. " \* ": Fundamental frequency.

### 3. List of measuring equipment

| Description                    | Manufacturer  | Model                | Serial No.    | Test Date  | Due Date   | Remark    |
|--------------------------------|---------------|----------------------|---------------|------------|------------|-----------|
| EMI Test Receiver              | R&S           | ESIB26               | A0304218      | 2015.06.02 | 2016.06.02 | Radiation |
| Full-Anechoic Chamber          | Albatross     | 12.8m*6.8m*6.4m      | A0412372      | 2015.01.05 | 2016.01.04 | Radiation |
| Loop Antenna                   | Schwarz beck  | HFH2-Z2              | 100047        | 2015.06.02 | 2016.06.02 | Radiation |
| Bilog Antenna                  | Schwarzbeck   | VULB 9163            | 9163-274      | 2015.06.02 | 2016.06.02 | Radiation |
| Double ridge horn antenna      | R&S           | HF960                | 100150        | 2015.06.02 | 2016.06.02 | Radiation |
| Ultra-wideband antenna         | R&S           | HL562                | 100089        | 2015.06.02 | 2016.06.02 | Radiation |
| Test Antenna – Horn (18-25GHz) | ETS           | UG-596A/U            | A0902607      | 2015.06.02 | 2016.06.02 | Radiation |
| Amplifier 20M~3GHz             | R&S           | PAP-0203H            | 22018         | 2015.06.02 | 2016.06.02 | Radiation |
| Amplifier 1G~18GHz             | R&S           | MITEQ AFS42-00101800 | 25-S-42       | 2015.06.02 | 2016.06.02 | Radiation |
| Amplifier 18G~40GHz            | R&S           | JS42-18002600-28-5A  | 12111.0980.00 | 2015.06.02 | 2016.06.02 | Radiation |
| Spectrum Analyzer              | R&S           | FSP40                | 1164.4391.40  | 2015.07.07 | 2016.07.06 | Conducted |
| Power Meter                    | R&S           | NRVS                 | 1020.1809.02  | 2015.06.02 | 2016.06.02 | Conducted |
| Power Sensor                   | R&S           | NRV-Z4               | 823.3618.03   | 2015.06.02 | 2016.06.02 | Conducted |
| LISN                           | ROHDE&SCHWARZ | ESH2-Z5              | A0304221      | 2015.06.02 | 2016.06.02 | Conducted |
| Test Receiver                  | R&S           | ESCS30               | A0304260      | 2015.06.02 | 2016.06.02 | Conducted |
| Cable                          | SUNHNER       | SUCOFLEX 100         | /             | 2015.06.02 | 2016.06.02 | Radiation |
| Cable                          | SUNHNER       | SUCOFLEX 104         | /             | 2015.06.02 | 2016.06.02 | Radiation |

\*\* END OF REPORT \*\*