

**FCC PART 15 SUBPART C MEASUREMENT AND TEST REPORT**

**For**

**ECORE TECHNOLOGY COMPANY LIMITED**

**North of Bingang East Road, Huahu Development Zone, Ezhou City, Hubei  
Province, China**

**E.U.T.: Academia**

**Model Name: HL2505**

**Brand Name:** 

**FCC ID: PXX-HL2505**

**Report Number: NTC1405551F**

**Test Date(s): May 19, 2014 to June 26, 2014**

**Report Date(s): June 26, 2014**

**Prepared by**

**Dongguan Nore Testing Center Co., Ltd.**

**Building D, Gaosheng Science & Technology Park, Zhouxi Longxi Road,  
Nancheng District, Dongguan, Guangdong, China.**

**Tel: +86-769-22022444**

**Fax: +86-769-22022799**

**Prepared By**

**Approved & Authorized Signer**

  
**Rose Hu / Engineer**

  
**Sunm Lv / Q.A. Director**

**Note: This test report is for the customer shown above and their specific product only. It may not be duplicated or used in part without prior written consent from Dongguan Nore Testing Center Co., Ltd. The test results referenced from this report are relevant only to the sample tested.**

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## 1. GENERAL INFORMATION

### 1.1 Product Description for Equipment under Test

This device is a BT speaker with Charging, AUX IN, Lamp and BT functions. It's powered by DC 12V come from external adapter. For more details features, please refer to User's Manual.

|                     |                                                                                                                       |
|---------------------|-----------------------------------------------------------------------------------------------------------------------|
| Manufacturer        | : ECORE TECHNOLOGY COMPANY LIMITED                                                                                    |
| Address             | : North of Bingang East Road, Huahu Development Zone, Ezhou City, Hubei Province, China                               |
| Frequency:          | : 2402-2480MHz                                                                                                        |
| Modulation          | : For V2.1+EDR: GFSK, $\pi/4$ -DQPSK, 8DPSK<br>For V4.0: GFSK                                                         |
| Number of Channel   | : For V2.1+EDR: 79; For V4.0: 40                                                                                      |
| Channel space       | : For V2.1+EDR: 1MHz; For V4.0: 2MHz                                                                                  |
| Bluetooth Version   | : 2.1+EDR                                                                                                             |
| Max RF Output Power | : -2.37dBm (0.58mW)                                                                                                   |
| Antenna Type        | : PCB                                                                                                                 |
| Antenna Gain        | : -0.61dBi (declaration by manufacturer)                                                                              |
| Power Supply        | : DC 12V Come from Adapter<br>Adapter M/N: JX-B1203000-B<br>Input: AC 90-240V 50-60Hz 1.2A Max<br>Output: DC 12V 3.0A |
| Model name          | : HL2505                                                                                                              |
| <b>Note:</b>        | : N/A                                                                                                                 |

## **1.2 Related Submittal(s) / Grant (s)**

This submittal(s) (test report) is intended for FCC ID: PXX-HL2505 filing to comply with Section 15.247 of the FCC Part 15 (2013), Subpart C Rule.

## **1.3 Test Methodology**

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2009) and DA 00-705. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters.

## **1.4 Equipment Modifications**

Not available for this EUT intended for grant.

## **1.5 Support Device**

None

## **1.6 Test Facility and Location**

Listed by FCC, August 02, 2011  
The Certificate Registration Number is 665078.

Listed by Industry Canada, July 01, 2011  
The Certificate Registration Number is 46405-9743.

Dongguan Nore Testing Center Co., Ltd.  
Building D, Gaosheng Science & Technology Park,  
Zhouxi Longxi Road, Nancheng District, Dongguan,  
Guangdong, China.

## 1.7 Summary of Test Results

| FCC Rules                       | Description Of Test               | Result    |
|---------------------------------|-----------------------------------|-----------|
| §15.247(a)(1)                   | Channel Separation test           | Compliant |
| §15.247(a)(1)                   | 20dB Bandwidth                    | Compliant |
| §15.247(a)(1)(iii)              | Hopping Channel Number            | Compliant |
| §15.247(a)(1)(iii)              | Time of Occupancy<br>(Dwell Time) | Compliant |
| §15.247(b)                      | Max Peak output Power test        | Compliant |
| §15.247(d)                      | Band edge test                    | Compliant |
| §15.207 (a)                     | AC Power Conducted Emission       | Compliant |
| §15.247(d), §15.209,<br>§15.205 | Radiated Emission                 | Compliant |
| §15.203                         | Antenna Requirement               | Compliant |
| §15.247(d)                      | Conducted Spurious Emission       | Compliant |

## **2. System Test Configuration**

### **2.1 EUT Configuration**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### **2.2 Special Accessories**

Not available for this EUT intended for grant.

### **2.3 Description of test modes**

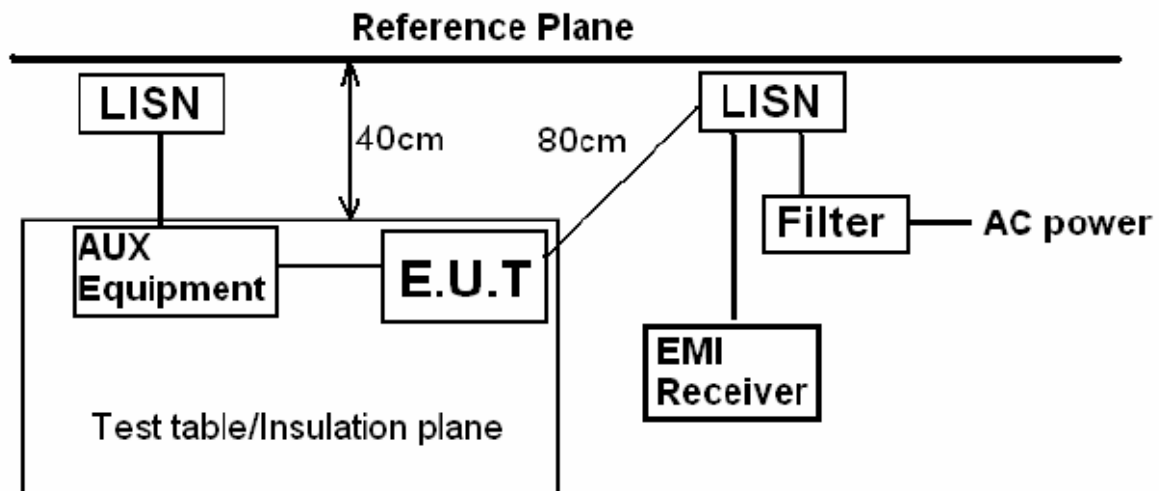
The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and normal mode is programmed. The Lowest, middle and highest channel were chosen for testing, and all packets DH1, DH3 and DH5 mode in all modulation type GFSK,  $\pi/4$ -DQPSK, 8DPSK were tested.

### **2.4 EUT Exercise**

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

### 3. Conducted Emissions Test

#### 3.1 Test SET-UP (Block Diagram of Configuration)



#### 3.2 Test Condition

Test Requirement: FCC Part 15.207

Frequency Range: 150KHz ~ 30MHz

Detector: RBW 9KHz, VBW 30KHz

Operation Mode: BT Mode

#### 3.3 Measurement Results

Please refer to following plots.

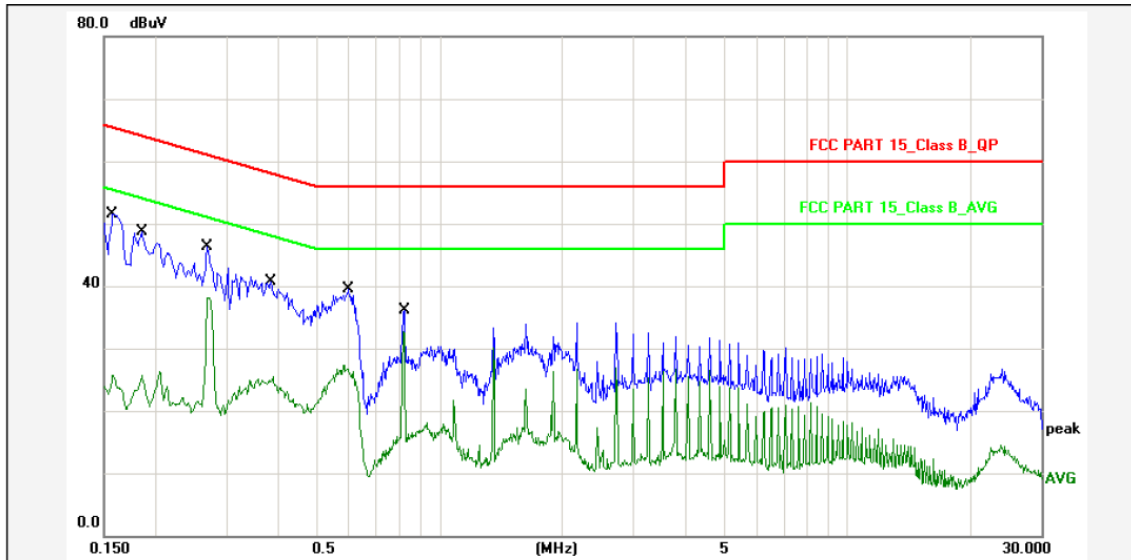




**Dongguan NTC Co., Ltd.**  
Tel: +86-769-22022444 Fax: +86-769-22022799  
Web: [Http://www.ntc-c.com](http://www.ntc-c.com)

Site: Conduction

Test Time: 2014-5-29 10:28:51



Report No.: HL2505

Test Standard: FCC PART 15\_Class B\_QP

Test item: Conducted Emission

Phase: L1

Applicant: ECORE

Temp.( )/Hum.(%): 24(C) / 53 %

Product: Academia

Power Rating: AC 120V/60Hz

Model No.: HL2505

Test Engineer: Alex

Test Mode: BT Mode

Remark:

| No. | Frequency (MHz) | Factor (dBuV) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|-----|-----------------|---------------|----------------|--------------|--------------|-------------|----------|-----|--------|
| 1   | 0.1580          | 10.80         | 38.70          | 49.50        | 65.56        | -16.06      | QP       | P   |        |
| 2   | 0.1580          | 10.80         | 13.00          | 23.80        | 55.56        | -31.76      | AVG      | P   |        |
| 3   | 0.1859          | 10.80         | 35.90          | 46.70        | 64.21        | -17.51      | QP       | P   |        |
| 4   | 0.1859          | 10.80         | 12.80          | 23.60        | 54.21        | -30.61      | AVG      | P   |        |
| 5   | 0.2700          | 10.80         | 33.40          | 44.20        | 61.12        | -16.92      | QP       | P   |        |
| 6   | 0.2700          | 10.80         | 25.40          | 36.20        | 51.12        | -14.92      | AVG      | P   |        |
| 7   | 0.3860          | 10.80         | 27.80          | 38.60        | 58.15        | -19.55      | QP       | P   |        |
| 8   | 0.3860          | 10.80         | 12.60          | 23.40        | 48.15        | -24.75      | AVG      | P   |        |
| 9   | 0.5979          | 10.80         | 26.70          | 37.50        | 56.00        | -18.50      | QP       | P   |        |
| 10  | 0.5979          | 10.80         | 14.50          | 25.30        | 46.00        | -20.70      | AVG      | P   |        |
| 11  | 0.8180          | 10.80         | 23.20          | 34.00        | 56.00        | -22.00      | QP       | P   |        |
| 12  | 0.8180          | 10.80         | 19.80          | 30.60        | 46.00        | -15.40      | AVG      | P   |        |

Note: Level=Reading+Factor.

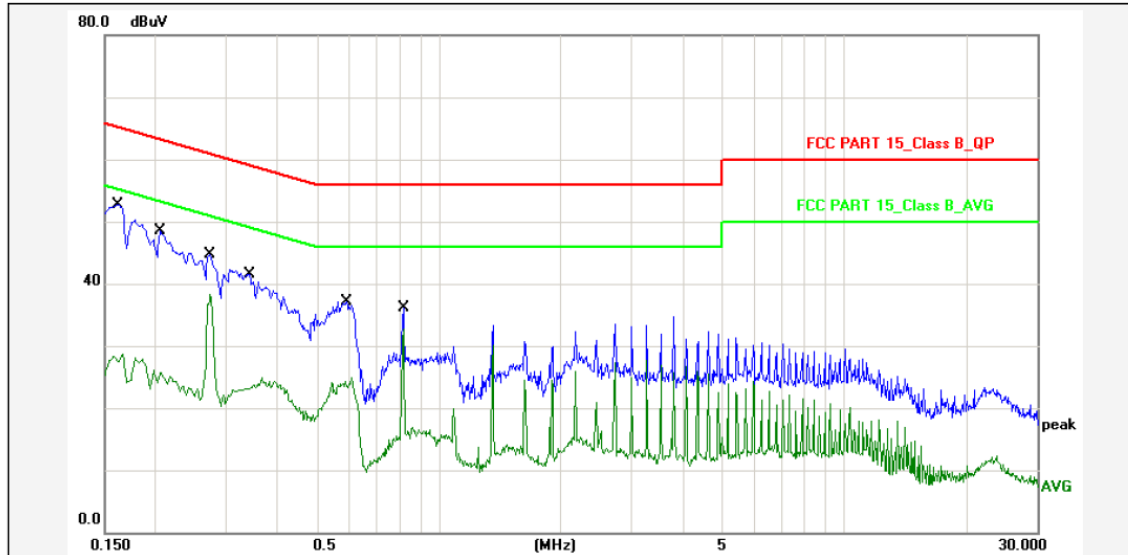
Margin=Limit-Level.



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Web: [Http://www.ntc-c.com](http://www.ntc-c.com)

Site: Conduction

Test Time: 2014-5-29 10:31:50



Report No.: HL2505

Test Standard: FCC PART 15\_Class B\_QP

Test item: Conducted Emission

Phase: N

Applicant: ECOPE

Temp.( )/Hum.(%): 24(C) / 53 %

Product: Academia

Power Rating: AC 120V/60Hz

Model No.: HL2505

Test Engineer: Alex

Test Mode: BT Mode

Remark:

| No. | Frequency (MHz) | Factor (dBuV) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|-----|-----------------|---------------|----------------|--------------|--------------|-------------|----------|-----|--------|
| 1   | 0.1620          | 10.80         | 39.90          | 50.70        | 65.36        | -14.66      | QP       | P   |        |
| 2   | 0.1620          | 10.80         | 16.00          | 26.80        | 55.36        | -28.56      | AVG      | P   |        |
| 3   | 0.2060          | 10.80         | 36.00          | 46.80        | 63.36        | -16.56      | QP       | P   |        |
| 4   | 0.2060          | 10.80         | 13.20          | 24.00        | 53.36        | -29.36      | AVG      | P   |        |
| 5   | 0.2740          | 10.80         | 32.00          | 42.80        | 60.99        | -18.19      | QP       | P   |        |
| 6   | 0.2740          | 10.80         | 25.60          | 36.40        | 50.99        | -14.59      | AVG      | P   |        |
| 7   | 0.3420          | 10.80         | 28.70          | 39.50        | 59.15        | -19.65      | QP       | P   |        |
| 8   | 0.3420          | 10.80         | 11.00          | 21.80        | 49.15        | -27.35      | AVG      | P   |        |
| 9   | 0.5940          | 10.80         | 24.40          | 35.20        | 56.00        | -20.80      | QP       | P   |        |
| 10  | 0.5940          | 10.80         | 12.10          | 22.90        | 46.00        | -23.10      | AVG      | P   |        |
| 11  | 0.8180          | 10.80         | 23.20          | 34.00        | 56.00        | -22.00      | QP       | P   |        |
| 12  | 0.8180          | 10.80         | 20.00          | 30.80        | 46.00        | -15.20      | AVG      | P   |        |

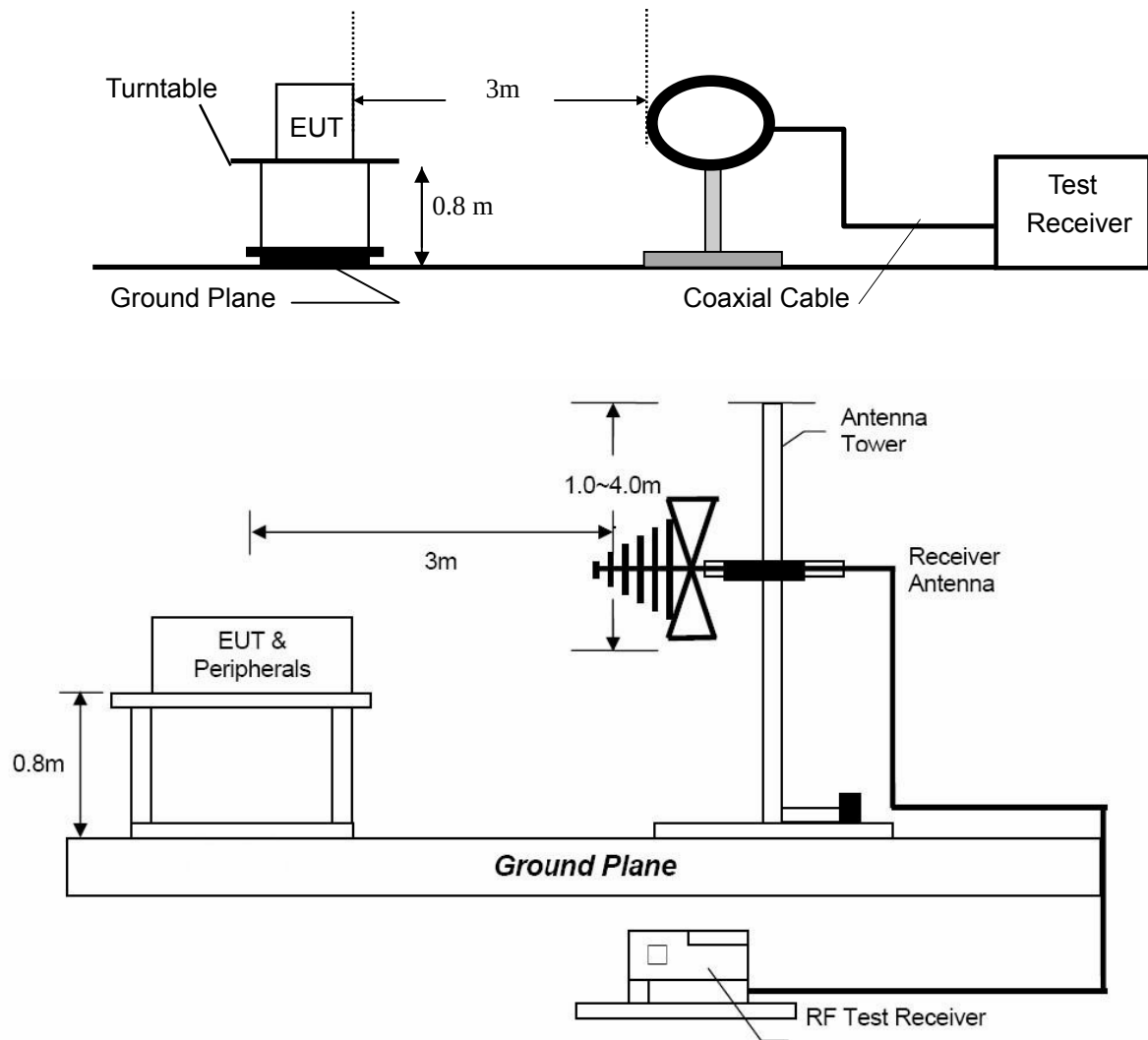
Note: Level=Reading+Factor.

Margin=Limit-Level.

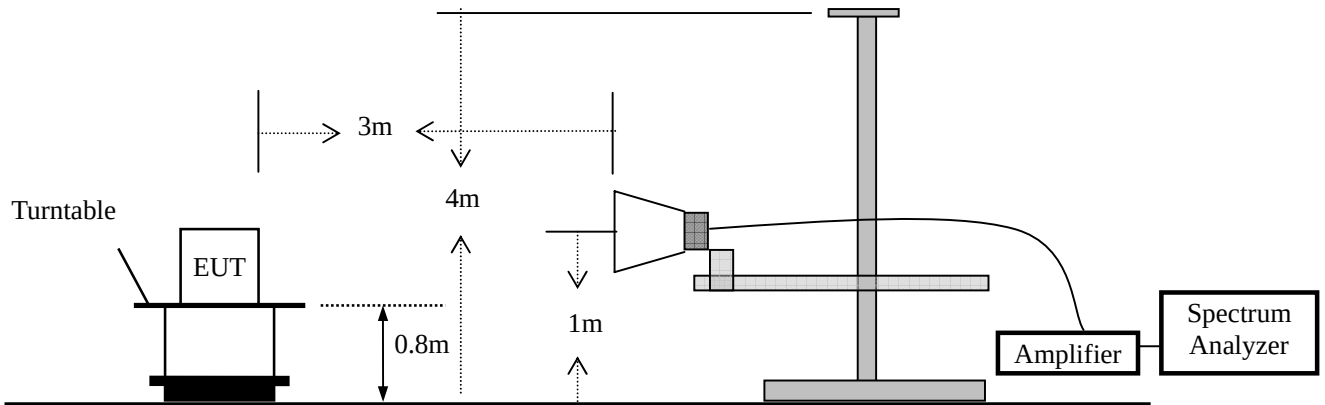
## 4. Radiated Emission Test

### 4.1 Test SET-UP (Block Diagram of Configuration)

#### 4.1.1 Radiated Emission Test Set-Up, Frequency Below 30MHz



#### 4.1.2 Radiated Emission Test Set-Up, Frequency above 1GHz



#### 4.2 Measurement Procedure

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
- A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.
  - The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
  - The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
  - The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth for average detection(AV) at below at frequency above 1GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

| Frequency Band (MHz) | Function | Resolution Bandwidth | Video Bandwidth |
|----------------------|----------|----------------------|-----------------|
| 30 to 1000           | Peak     | 100 kHz              | 100 kHz         |
| Above 1000           | Peak     | 1 MHz                | 1 MHz           |
|                      | Average  | 1 MHz                | 10 Hz           |

### 4.3 Limit

| Frequency range MHz | Distance Meters | Field Strengths Limit (15.209) |
|---------------------|-----------------|--------------------------------|
|                     |                 | $\mu\text{V/m}$                |
| 0.009 ~ 0.490       | 300             | $2400/F(\text{kHz})$           |
| 0.490 ~ 1.705       | 30              | $24000/F(\text{kHz})$          |
| 1.705 ~ 30          | 30              | 30                             |
| 30 ~ 88             | 3               | 100                            |
| 88 ~ 216            | 3               | 150                            |
| 216 ~ 960           | 3               | 200                            |
| Above 960           | 3               | 500                            |

- Remark : (1) Emission level (dB) $\mu\text{V}$  = 20 log Emission level  $\mu\text{V/m}$   
 (2) The smaller limit shall apply at the cross point between two frequency bands.  
 (3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.  
 (4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

#### 4.4 Measurement Results

Operation Mode: TX  
Frequency Range: 9KHz~1GHz  
Test Result: PASS  
Measured Distance: 3m  
Test Date : May 29, 2014

Temperature : 21 °C  
Humidity : 55 %  
Test By: Sance

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission<br>Level<br>(dBuV/m) | Limit<br>3m<br>(dBuV/m) | Margin<br>(dB) | Note |
|----------------|-----------------|-------------------------------|-------------------------|----------------|------|
| 58.1300        | V               | 24.10                         | 40.00                   | -15.90         | QP   |
| 71.7099        | V               | 26.10                         | 40.00                   | -13.90         | QP   |
| 95.9599        | V               | 25.70                         | 43.50                   | -17.80         | QP   |
| ---            |                 |                               |                         |                |      |
| ---            |                 |                               |                         |                |      |
| ---            |                 |                               |                         |                |      |
| 95.9599        | H               | 30.20                         | 43.50                   | -13.30         | QP   |
| 113.4200       | H               | 31.20                         | 43.50                   | -12.30         | QP   |
| 119.2400       | H               | 31.50                         | 43.50                   | -12.00         | QP   |
| ---            |                 |                               |                         |                |      |
| ---            |                 |                               |                         |                |      |
| ---            |                 |                               |                         |                |      |

Other emissions are lower than 10dB below the allowable limit.

**Note:**

- (1) Emission Level= Reading Level + Factor
- (2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
- (3) Measurement uncertainty :  $\pm 3.4$ dB
- (4) Loop antenna used for the emission below 30MHz.
- (5) Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.

Modulation: GFSK (the worst case)  
 (Low Frequency: 2402MHz)  
 Operation Mode: TX Mode (Low) Test Date : June 07, 2014  
 Frequency Range: 1-25GHz Temperature : 21 °C  
 Test Result: PASS Humidity : 55 %  
 Measured Distance: 3m Test By: Sance

| Freq.<br>(MHz) | Ant.<br>Pol. | Emission Level<br>(dBuV) |       | Limit<br>3m<br>(dBuV/m) |       | Margin<br>(dB) |        |
|----------------|--------------|--------------------------|-------|-------------------------|-------|----------------|--------|
|                |              | Peak                     | AV    | Peak                    | AV    | Peak           | AV     |
| 4804           | V            | 51.22                    | 37.96 | 74.00                   | 54.00 | -22.78         | -16.04 |
| 7206           | V            | 58.37                    | 45.29 | 74.00                   | 54.00 | -15.63         | -8.71  |
| ---            |              |                          |       |                         |       |                |        |
| ---            |              |                          |       |                         |       |                |        |
| 4804           | H            | 51.23                    | 38.77 | 74.00                   | 54.00 | -22.77         | -15.23 |
| 7206           | H            | 58.12                    | 45.22 | 74.00                   | 54.00 | -15.88         | -8.78  |
| ---            |              |                          |       |                         |       |                |        |
| ---            |              |                          |       |                         |       |                |        |

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level + Factor
  - (3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
  - (4) Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
  - (5) Measurement uncertainty :  $\pm 3.7$ dB.
  - (6) Horn antenna used for the emission over 1000MHz.

Modulation: GFSK (the worst case)  
(Mid Frequency: 2441MHz)  
Operation Mode: TX Mode (Mid) Test Date : June 07, 2014  
Frequency Range: 1-25GHz Temperature : 21 °C  
Test Result: PASS Humidity : 55 %  
Measured Distance: 3m Test By: Sance

| Freq.<br>(MHz) | Ant.<br>Pol. | Emission Level<br>(dBUV) |       | Limit<br>3m<br>(dBUV/m) |       | Margin<br>(dB) |        |
|----------------|--------------|--------------------------|-------|-------------------------|-------|----------------|--------|
|                |              | Peak                     | AV    | Peak                    | AV    | Peak           | AV     |
| 4882           | V            | 51.33                    | 38.46 | 74.00                   | 54.00 | -22.67         | -15.54 |
| 7323           | V            | 58.34                    | 45.33 | 74.00                   | 54.00 | -15.66         | -8.67  |
| ---            |              |                          |       |                         |       |                |        |
| ---            |              |                          |       |                         |       |                |        |
| 4882           | H            | 49.86                    | 38.54 | 74.00                   | 54.00 | -24.14         | -15.46 |
| 7323           | H            | 58.66                    | 45.97 | 74.00                   | 54.00 | -15.34         | -8.03  |
| ---            |              |                          |       |                         |       |                |        |
| ---            |              |                          |       |                         |       |                |        |

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level + Factor
  - (3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
  - (4) Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
  - (5) Measurement uncertainty :  $\pm 3.7$ dB.
  - (6) Horn antenna used for the emission over 1000MHz.



|                    |                                                    |               |               |
|--------------------|----------------------------------------------------|---------------|---------------|
| Modulation:        | GFSK (the worst case)<br>(High Frequency: 2480MHz) |               |               |
| Operation Mode:    | TX Mode (High)                                     | Test Date :   | June 07, 2014 |
| Frequency Range:   | 1-25GHz                                            | Temperature : | 21 °C         |
| Test Result:       | PASS                                               | Humidity :    | 55 %          |
| Measured Distance: | 3m                                                 | Test By:      | Sance         |

| Freq.<br>(MHz) | Ant.<br>Pol. | Emission Level<br>(dBuV) |       | Limit<br>3m<br>(dBuV/m) |       | Margin<br>(dB) |        |
|----------------|--------------|--------------------------|-------|-------------------------|-------|----------------|--------|
|                |              | Peak                     | AV    | Peak                    | AV    | Peak           | AV     |
| 4960           | V            | 49.68                    | 39.27 | 74.00                   | 54.00 | -24.32         | -14.73 |
| 7440           | V            | 58.37                    | 46.52 | 74.00                   | 54.00 | -15.63         | -7.48  |
| ---            |              |                          |       |                         |       |                |        |
| ---            |              |                          |       |                         |       |                |        |
| 4960           | H            | 48.66                    | 38.37 | 74.00                   | 54.00 | -25.34         | -15.63 |
| 7440           | H            | 58.76                    | 46.55 | 74.00                   | 54.00 | -15.24         | -7.45  |
| ---            |              |                          |       |                         |       |                |        |
| ---            |              |                          |       |                         |       |                |        |

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level + Factor
  - (3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
  - (4) Data of measurement within this frequency range shown “ ---” in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
  - (5) Measurement uncertainty :  $\pm 3.7$ dB.
  - (6) Horn antenna used for the emission over 1000MHz.

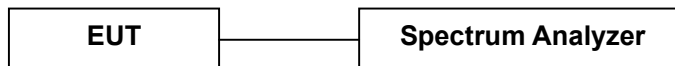
## 5. Channel Separation test

### 5.1 Measurement Procedure

Minimum Hopping Channel Carrier Frequency Separation, FCC Rule 15.247(a)(1):

Connect EUT antenna terminal to the spectrum analyzer with a low loss cable, and using the MARKER and Max-Hold function to record the separation of two adjacent channels.

### 5.2 Test SET-UP (Block Diagram of Configuration)

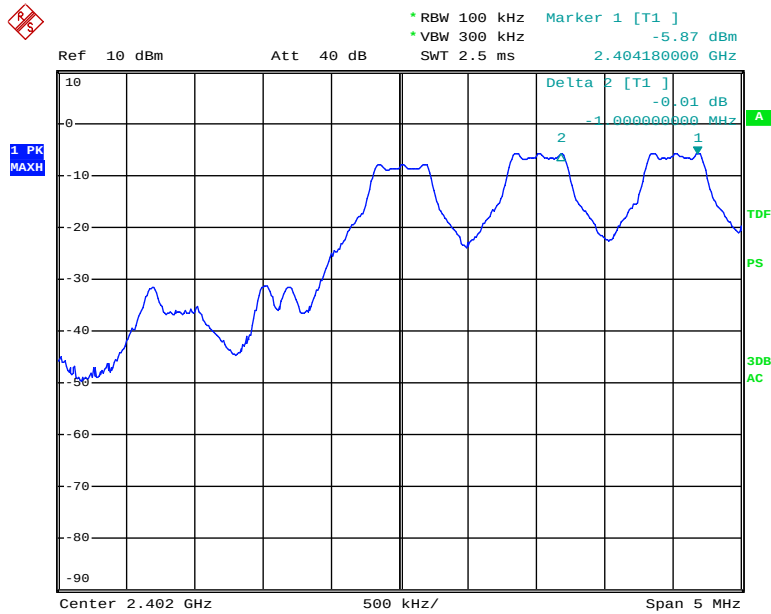


### 5.3 Measurement Results

|               |                             |                    |               |
|---------------|-----------------------------|--------------------|---------------|
| Modulation:   | GFSK, $\pi/4$ -DQPSK, 8DPSK |                    |               |
| RBW:          | 100KHz                      | VBW:               | 300KHz        |
| Packet:       | DH5                         | Spectrum Detector: | PK            |
| Test By:      | Sance                       | Test Date :        | Jun. 03, 2014 |
| Temperature : | 24 °C                       | Humidity :         | 52 %          |
| Test Result:  | PASS                        |                    |               |

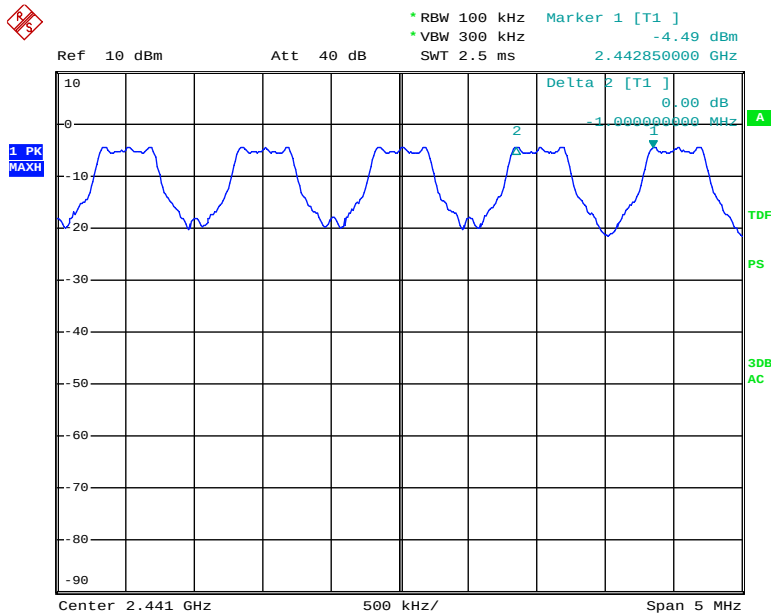
| Channel number | Channel frequency (MHz) | Separation Read Value (KHz) | Separation Limit (KHz) |
|----------------|-------------------------|-----------------------------|------------------------|
| GFSK           |                         |                             |                        |
| Lowest         | 2402                    | 1000                        | >852                   |
| Middle         | 2441                    | 1000                        | >804                   |
| Highest        | 2480                    | 1010                        | >804                   |
| $\pi/4$ -DQPSK |                         |                             |                        |
| Lowest         | 2402                    | 1000                        | >852                   |
| Middle         | 2441                    | 1010                        | >852                   |
| Highest        | 2480                    | 1000                        | >852                   |
| 8DPSK          |                         |                             |                        |
| Lowest         | 2402                    | 1010                        | >856                   |
| Middle         | 2441                    | 1180                        | >848                   |
| Highest        | 2480                    | 1000                        | >852                   |

### GFSK Lowest Channel



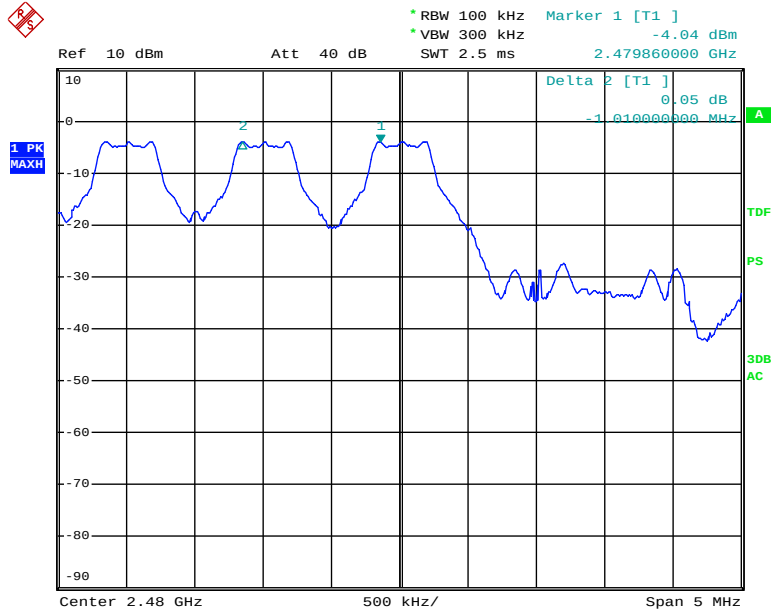
Date: 3.JUN.2014 20:06:05

### GFSK Middle Channel



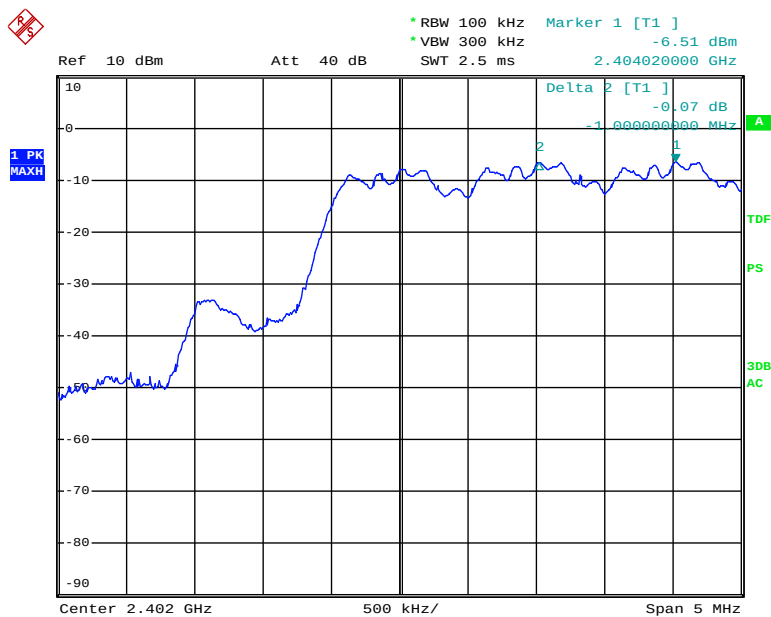
Date: 3.JUN.2014 20:07:13

## GFSK Highest Channel



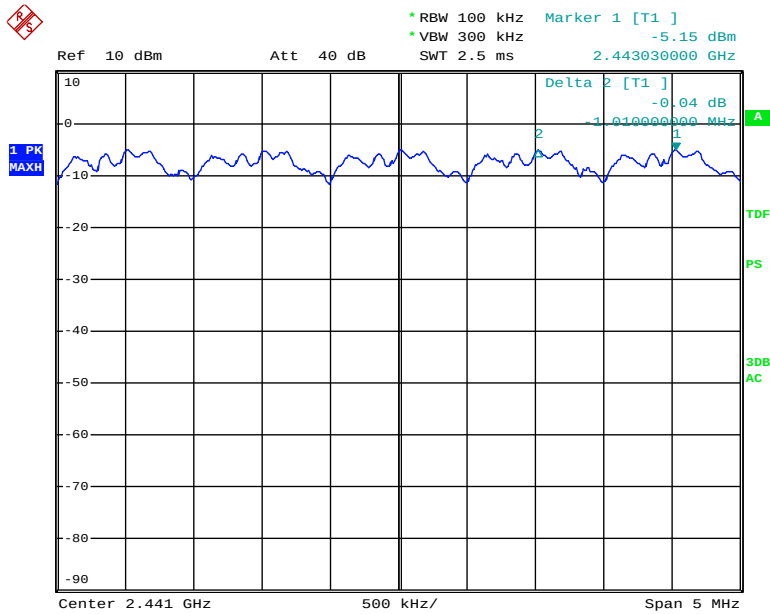
Date: 3.JUN.2014 20:08:18

## $\pi/4$ -DQPSK Lowest Channel



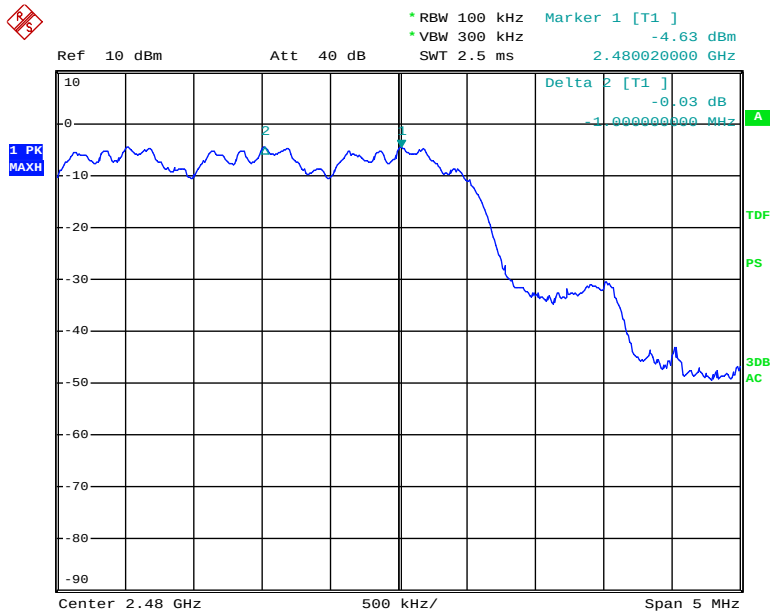
Date: 3.JUN.2014 20:11:10

$\pi/4$ -DQPSK Middle Channel



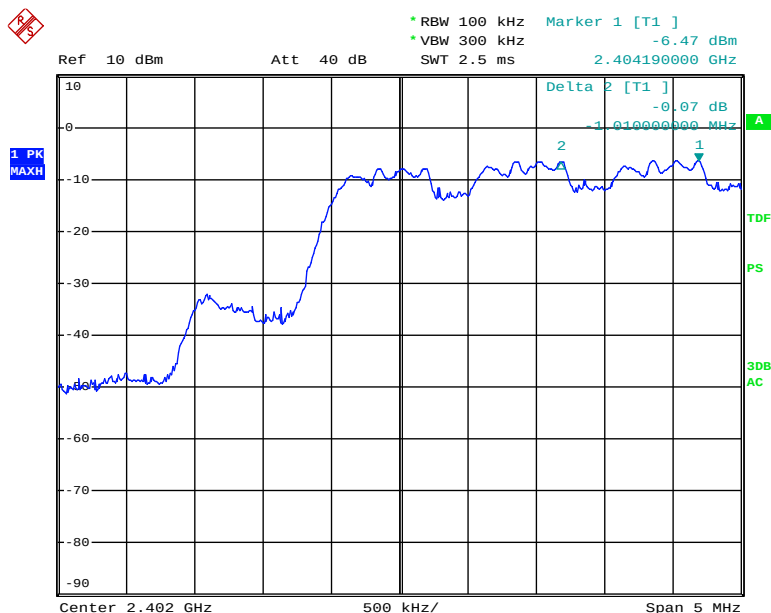
Date: 3.JUN.2014 20:14:43

$\pi/4$ -DQPSK Highest Channel



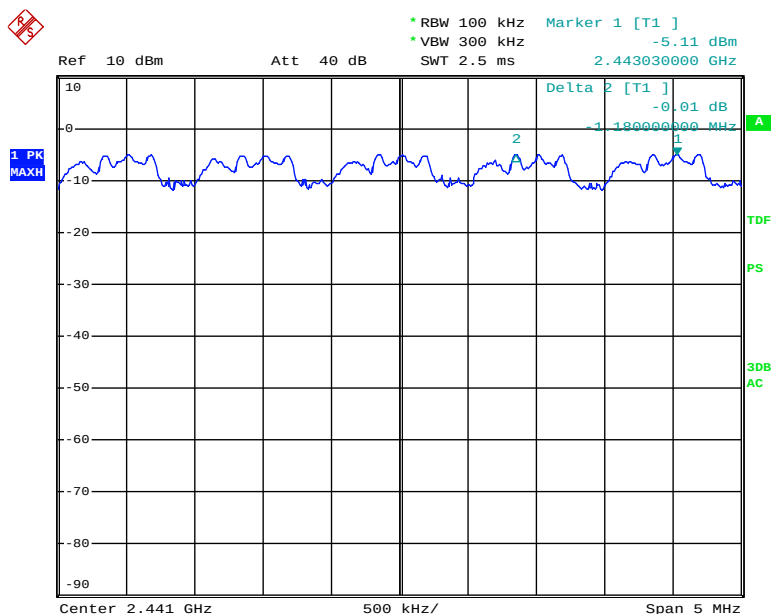
Date: 3.JUN.2014 20:16:57

## 8DPSK Lowest Channel



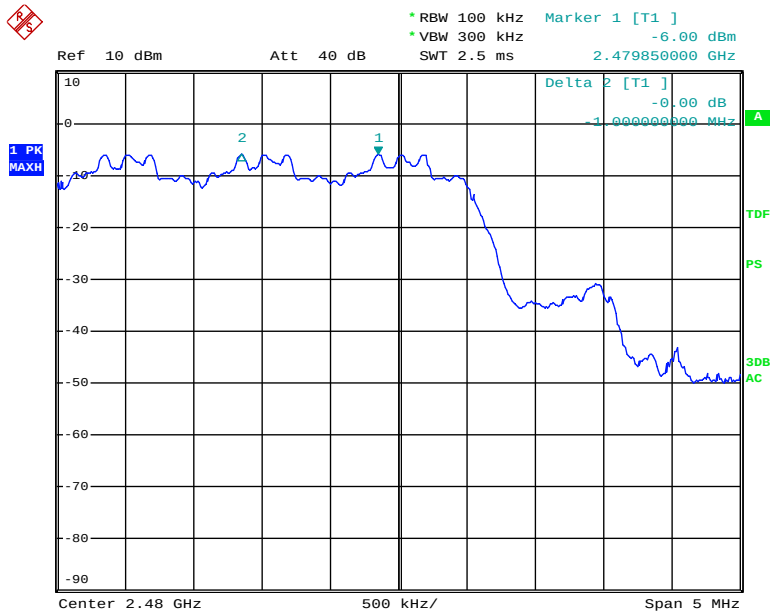
Date: 3.JUN.2014 20:20:26

## 8DPSK Middle Channel



Date: 3.JUN.2014 20:23:15

8DPSK Highest Channel



Date: 3.JUN.2014 22:30:47

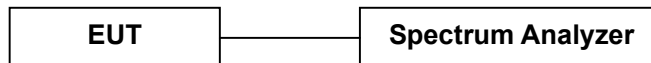
## 6. 20dB Bandwidth

### 6.1 Measurement Procedure

Maximum 20dB RF Bandwidth, FCC Rule 15.247(a)(1):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

### 6.2 Test SET-UP (Block Diagram of Configuration)



### 6.3 Measurement Results

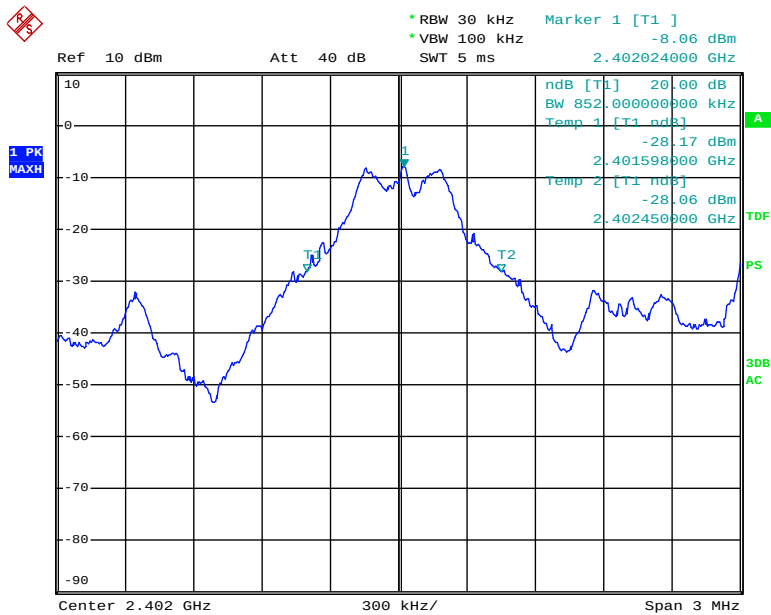
Refer to attached data chart.

|               |                             |                    |               |
|---------------|-----------------------------|--------------------|---------------|
| Modulation:   | GFSK, $\pi/4$ -DQPSK, 8DPSK |                    |               |
| RBW:          | 30KHz                       | VBW:               | 100KHz        |
| Packet:       | DH5                         | Spectrum Detector: | PK            |
| Test By:      | Sance                       | Test Date :        | Jun. 03, 2014 |
| Temperature : | 24 °C                       | Humidity :         | 52 %          |
| Test Result:  | PASS                        |                    |               |

| Channel frequency (MHz) | 20dB Down BW(kHz) |
|-------------------------|-------------------|
| GFSK                    |                   |
| 2402                    | 852               |
| 2441                    | 804               |
| 2480                    | 804               |
| $\pi/4$ -DQPSK          |                   |
| 2402                    | 1278              |
| 2441                    | 1278              |
| 2480                    | 1278              |
| 8DPSK                   |                   |
| 2402                    | 1284              |
| 2441                    | 1272              |
| 2480                    | 1278              |

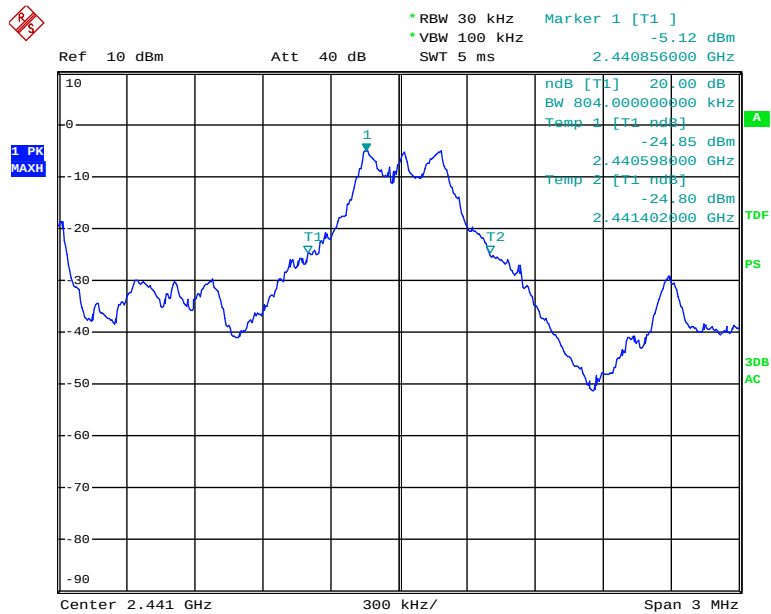


GFSK Lowest Channel



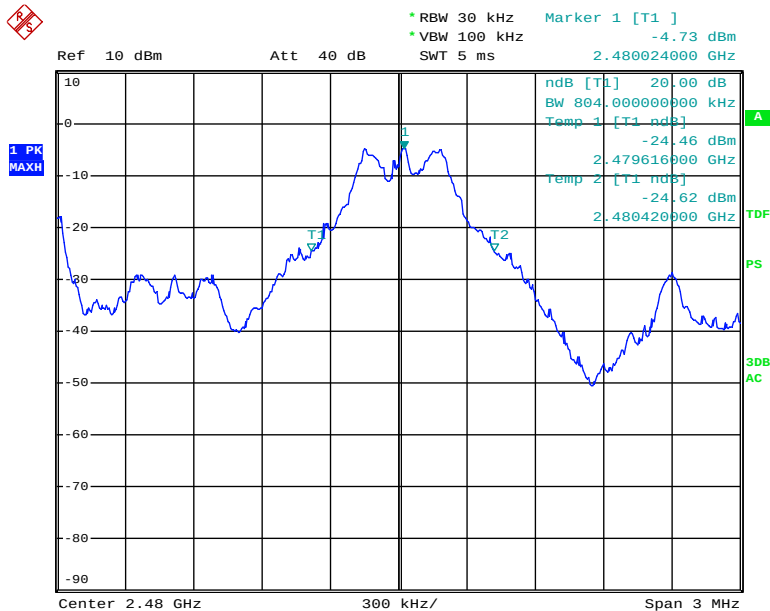
Date: 3.JUN.2014 19:47:26

GFSK Middle Channel



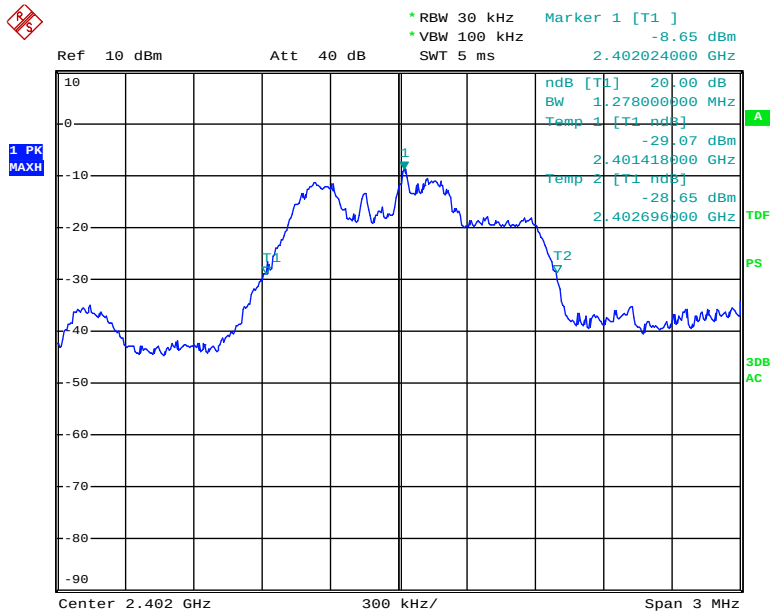
Date: 3.JUN.2014 19:48:04

GFSK Highest Channel



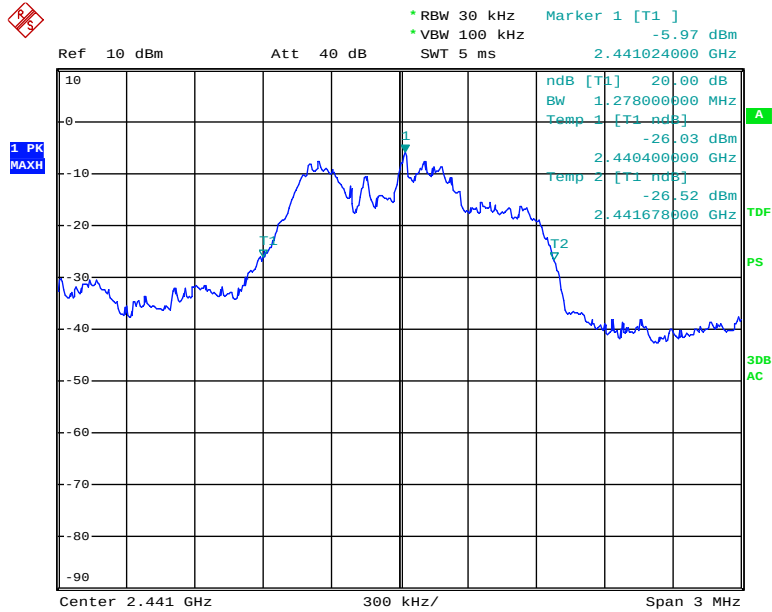
Date: 3.JUN.2014 19:48:31

$\pi/4$ -DQPSK Lowest Channel



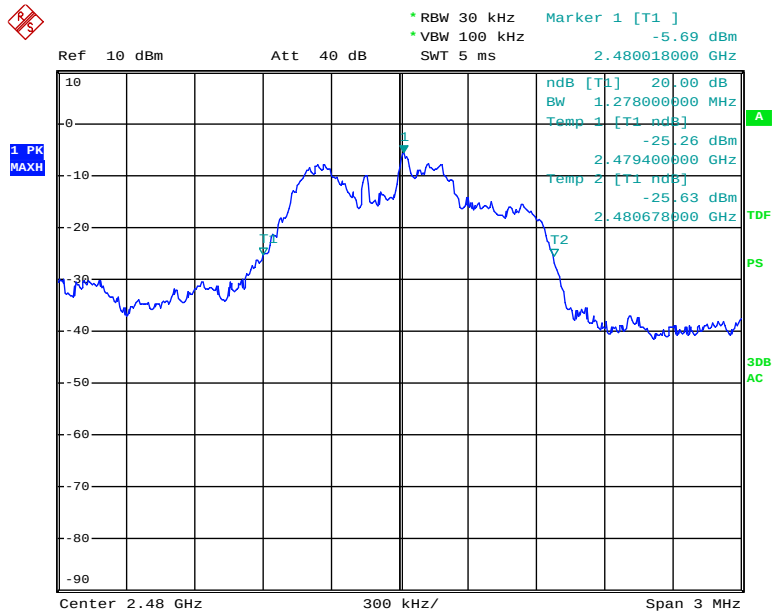
Date: 3.JUN.2014 19:49:18

## $\pi/4$ -DQPSK Middle Channel



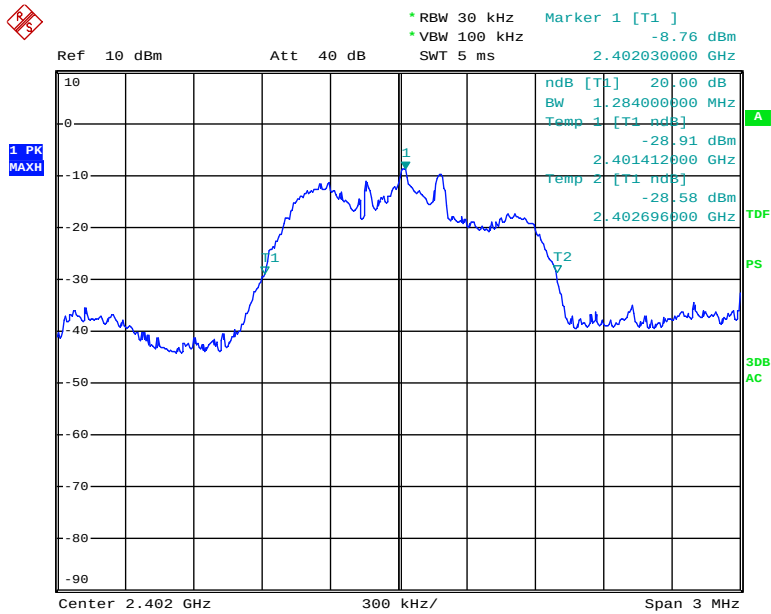
Date: 3.JUN.2014 19:49:41

## $\pi/4$ -DQPSK Highest Channel



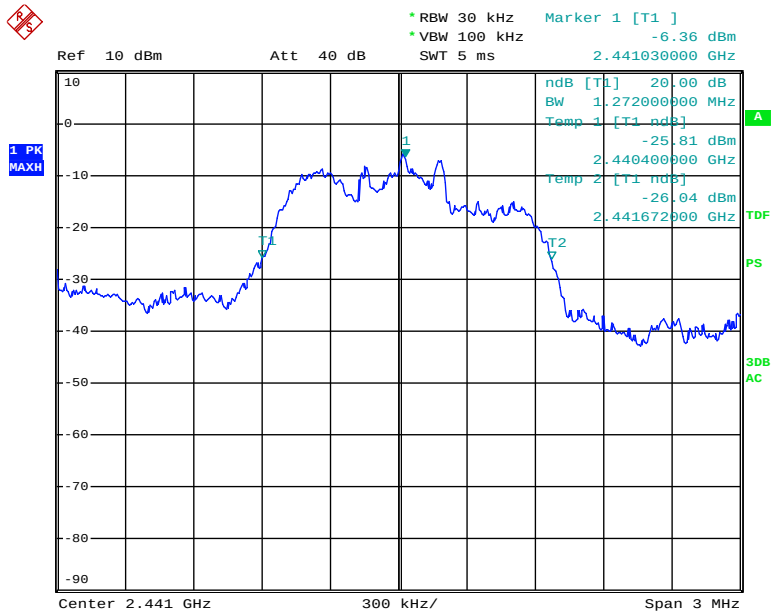
Date: 3.JUN.2014 19:50:01

8DPSK Lowest Channel



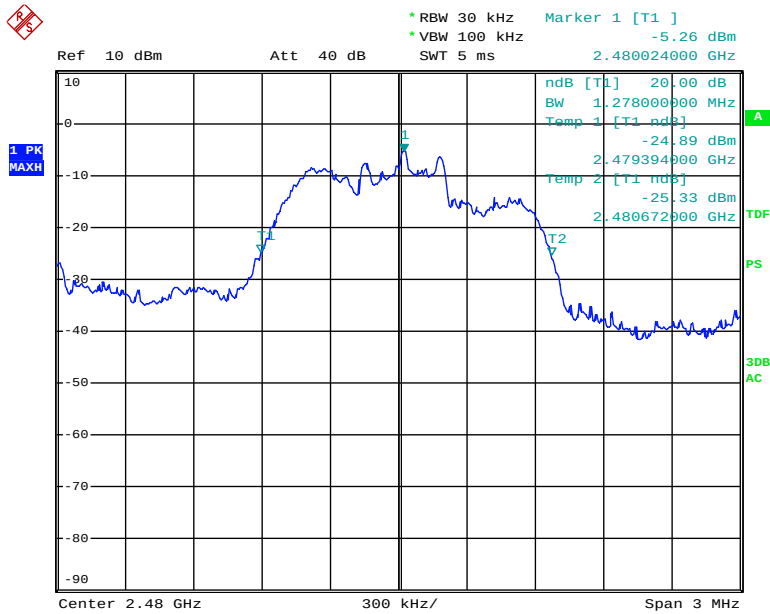
Date: 3.JUN.2014 19:50:42

8DPSK Middle Channel



Date: 3.JUN.2014 19:51:04

8DPSK Highest Channel



Date: 3.JUN.2014 19:51:32

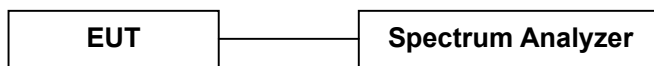
## 7. Hopping Channel Number

### 7.1 Measurement Procedure

Minimum Number of Hopping Frequencies, FCC Rule 15.247(a)(1)(iii):

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, and the spectrum analyzer set to MAX HOLD readings were taken for 3-5 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

### 7.2 Test SET-UP (Block Diagram of Configuration)

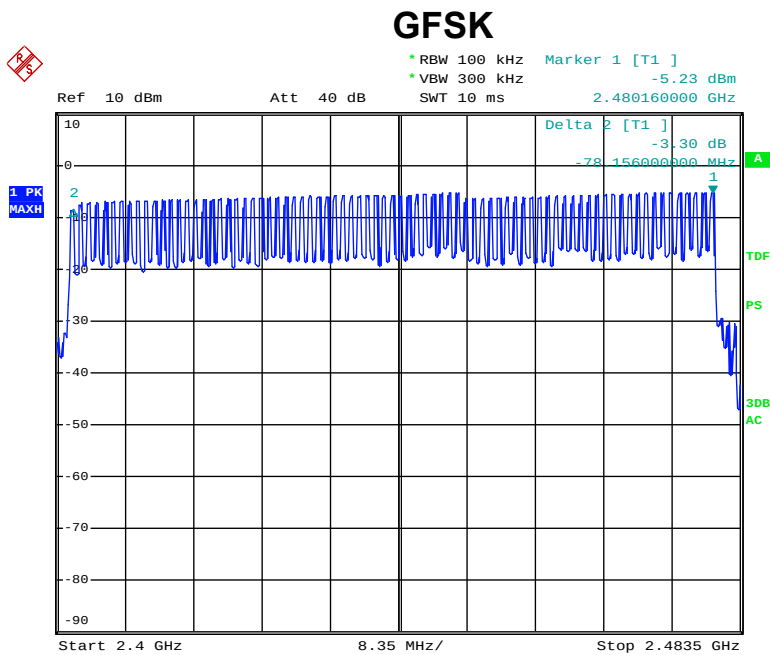


### 7.3 Measurement Results

|               |                             |                    |               |
|---------------|-----------------------------|--------------------|---------------|
| Modulation    | GFSK, $\pi/4$ -DQPSK, 8DPSK |                    |               |
| RBW:          | 100KHz                      | VBW:               | 300KHz        |
| Packet:       | DH5                         | Spectrum Detector: | PK            |
| Test By:      | Sance                       | Test Date :        | Jun. 03, 2014 |
| Temperature : | 24 °C                       | Humidity :         | 52 %          |
| Test Result:  | PASS                        |                    |               |

| Hopping Channel Frequency Range | Number of Hopping Channels | Limit     |
|---------------------------------|----------------------------|-----------|
| 2402-2480                       | 79                         | $\geq 15$ |

The worst case: GFSK



Date: 3.JUN.2014    22:09:54

## 8. Time of Occupancy (Dwell Time)

### 8.1 Measurement Procedure

Average Channel Occupancy Time, FCC Ref:15.247(a)(1)(iii):

Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.

The spectrum analyzer center frequency was set to one of the known hopping channels. The Sweep was set to 10 ms, the SPAN was set to Zero SPAN. The time duration of the transmissions so captured was measured with the Marker Delta function

### 8.2 Measurement Results

The maximum number of hopping channels in 31.6s (0.4s/Channel x 79 Channel)

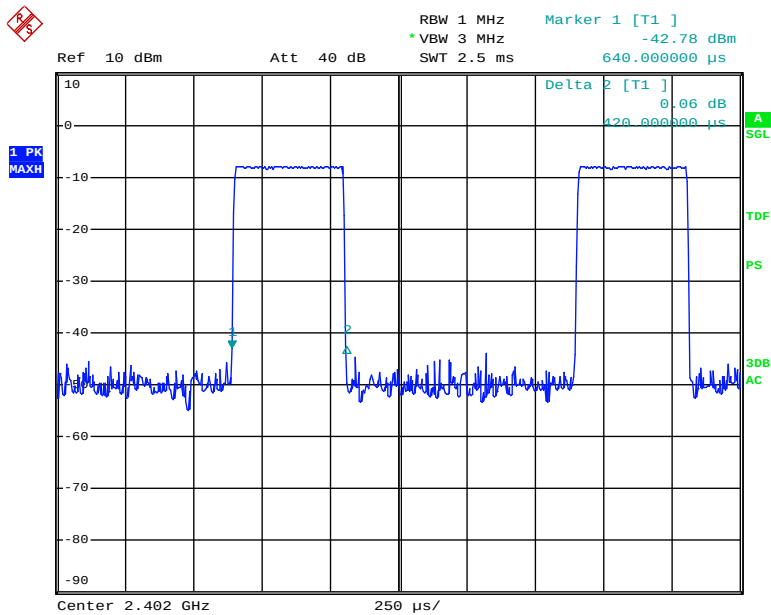
Refer to attached data chart.

|                    |                             |               |       |
|--------------------|-----------------------------|---------------|-------|
| Modulation :       | GFSK, $\pi/4$ -DQPSK, 8DPSK |               |       |
| RBW :              | 1MHz                        | VBW :         | 3MHz  |
| Spectrum Detector: | PK                          | Test By:      | Sance |
| Test Date :        | Jun. 03, 2014               | Temperature : | 24 °C |
| Test Result:       | PASS                        | Humidity :    | 52 %  |

| Packet         | Frequency (MHz) | Result (msec)                                                        | Limit (msec) |
|----------------|-----------------|----------------------------------------------------------------------|--------------|
| GFSK           |                 |                                                                      |              |
| DH1            | 2402            | $0.420(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 134.4$ | 400          |
| DH3            | 2402            | $1.690(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 270.4$ | 400          |
| DH5            | 2402            | $2.950(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 314.7$ | 400          |
| $\pi/4$ -DQPSK |                 |                                                                      |              |
| 2-DH1          | 2402            | $0.430(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 137.6$ | 400          |
| 2-DH3          | 2402            | $1.700(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 272.0$ | 400          |
| 2-DH5          | 2402            | $2.930(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 312.5$ | 400          |
| 8DPSK          |                 |                                                                      |              |
| 3-DH1          | 2402            | $0.425(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 136.0$ | 400          |
| 3-DH3          | 2402            | $1.685(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 269.6$ | 400          |
| 3-DH5          | 2402            | $2.940(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 313.6$ | 400          |

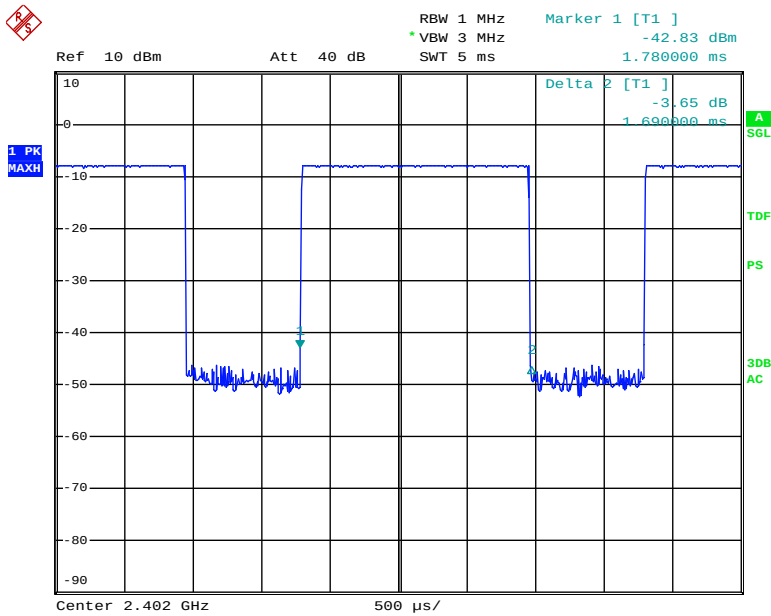


GFSK DH1



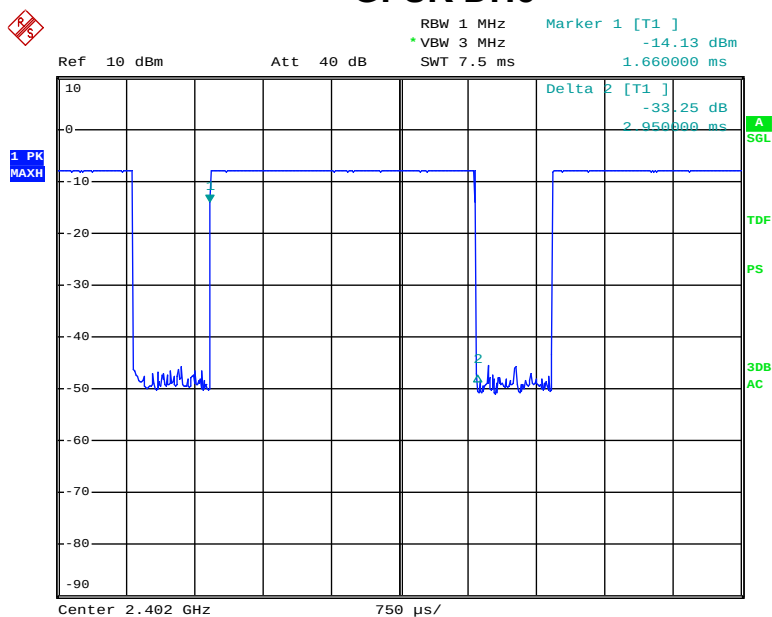
Date: 3.JUN.2014 20:29:26

GFSK DH3



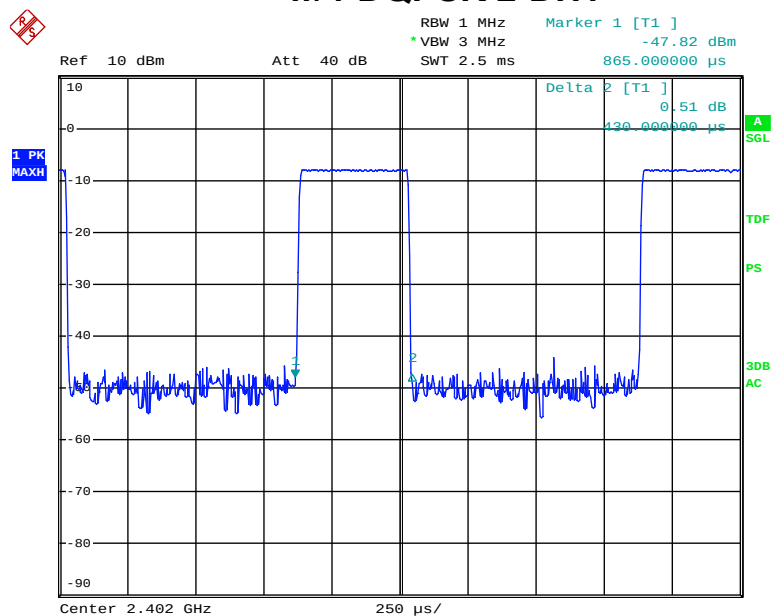
Date: 3.JUN.2014 20:29:56

## GFSK DH5



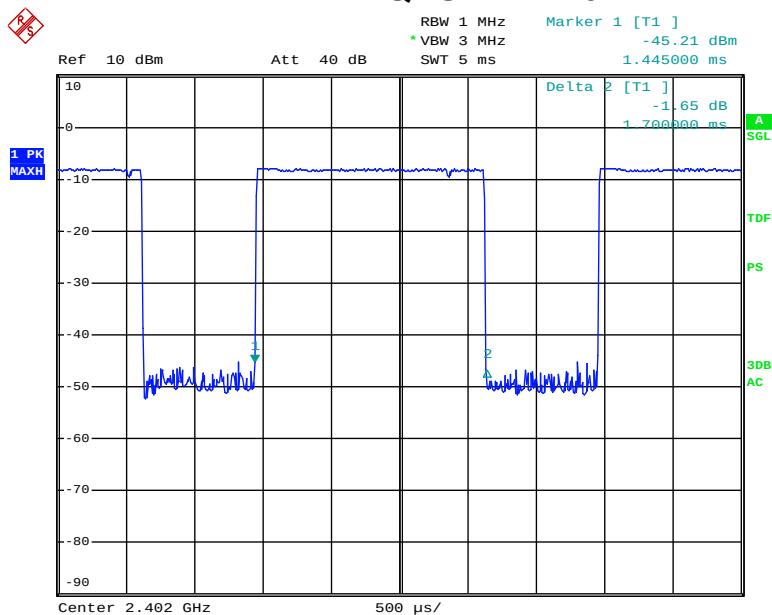
Date: 3.JUN.2014 20:30:22

## $\pi/4$ -DQPSK 2-DH1



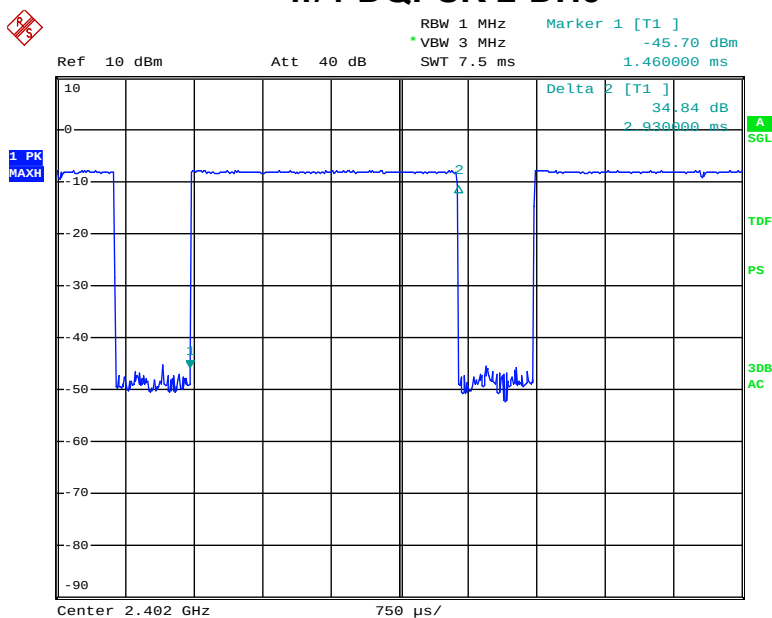
Date: 3.JUN.2014 20:31:16

### $\pi/4$ -DQPSK 2-DH3



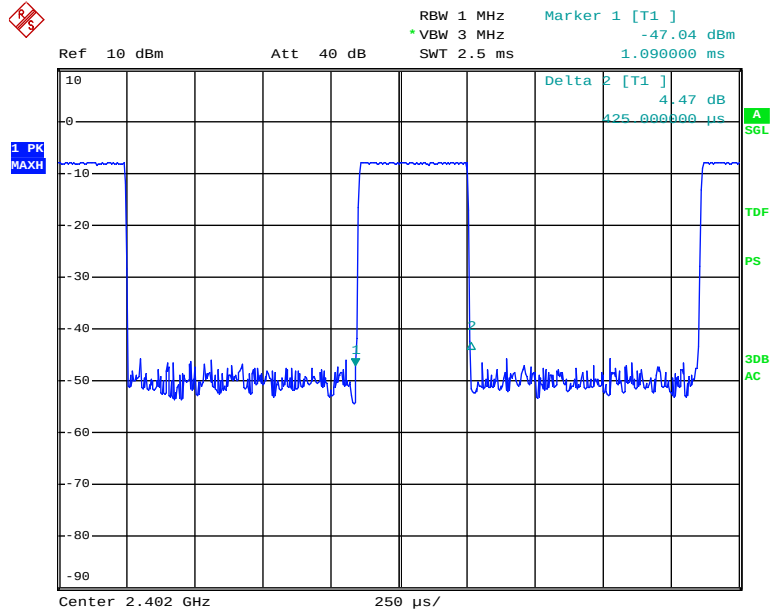
Date: 3.JUN.2014 20:31:44

### $\pi/4$ -DQPSK 2-DH5



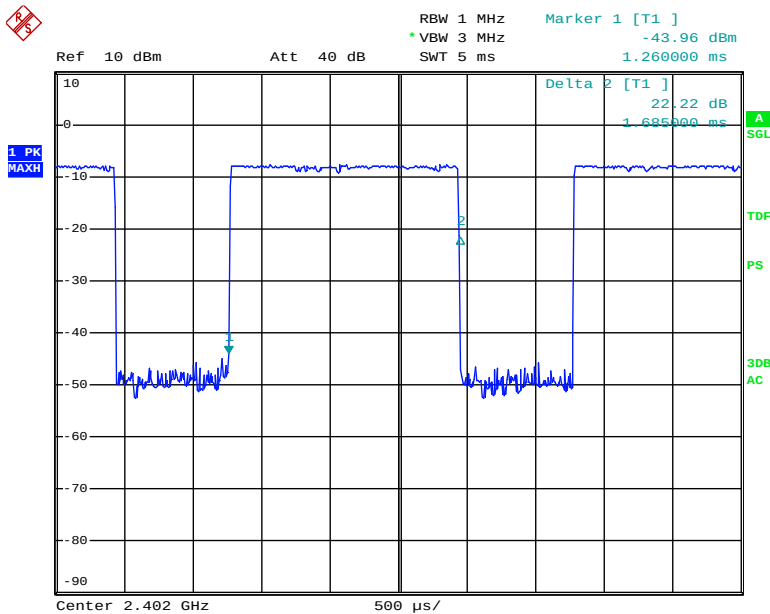
Date: 3.JUN.2014 20:32:10

### 8DPSK 3-DH1



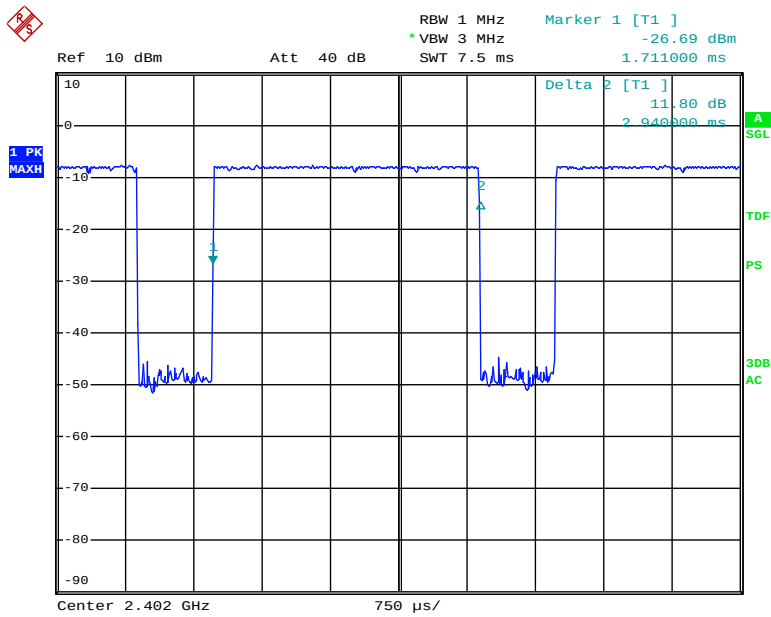
Date: 3.JUN.2014 20:32:37

### 8DPSK 3-DH3



Date: 3.JUN.2014 20:33:00

8DPSK 3-DH5



Date: 3.JUN.2014 20:33:38

## 9. MAXIMUM PEAK OUTPUT POWER

### 9.1 Measurement Procedure

Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(1):

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum. The analyzer was set for RBW > 20dB bandwidth and power was read directly in dBm. Cable loss was considered during this measurement.

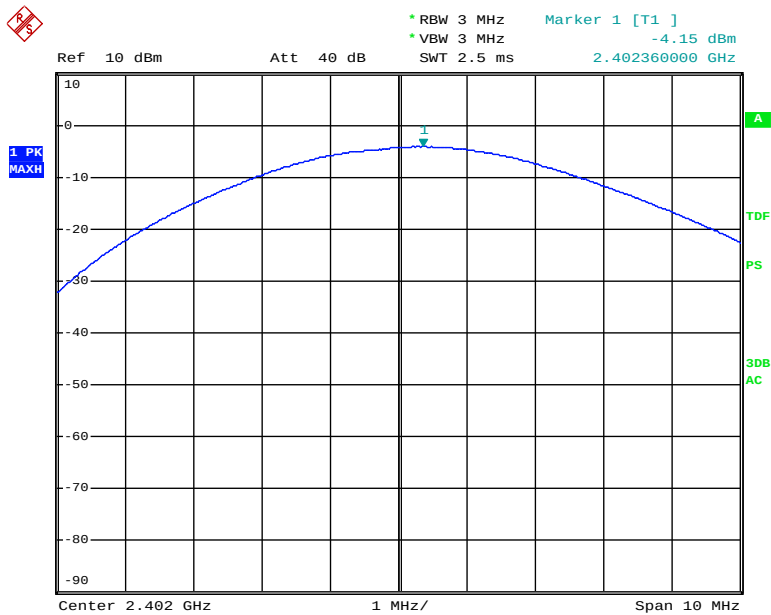
### 9.2 Measurement Results

Refer to attached data chart.

|                    |                             |               |               |
|--------------------|-----------------------------|---------------|---------------|
| Modulation :       | GFSK, $\pi/4$ -DQPSK, 8DPSK |               |               |
| RBW :              | 3MHz                        | VBW :         | 3MHz          |
| Spectrum Detector: | PK                          | Test Date :   | Jun. 03, 2014 |
| Test By:           | Sance                       | Temperature : | 24 °C         |
| Test Result:       | PASS                        | Humidity :    | 52 %          |

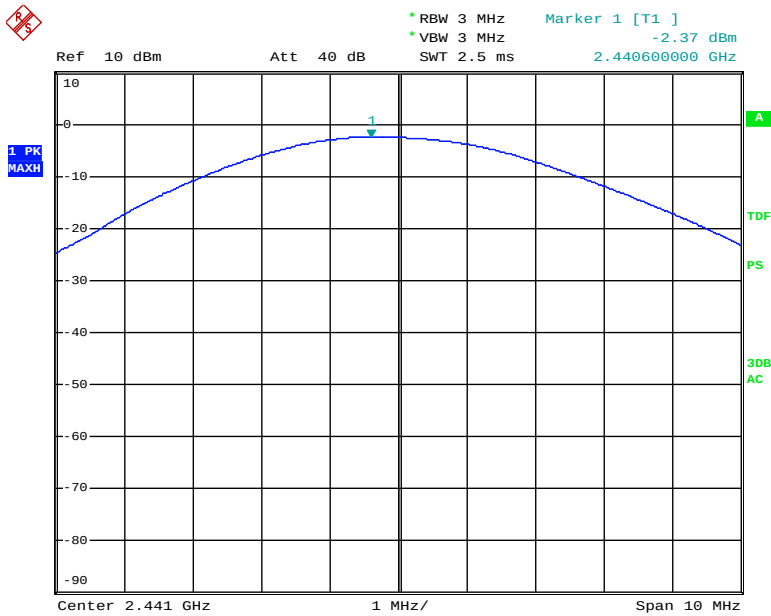
| Channel Frequency (MHz) | Cable Loss dB | Peak Power output(mW) | Peak Power output(dBm) | Peak Power Limit(dBm) | Pass/Fail |
|-------------------------|---------------|-----------------------|------------------------|-----------------------|-----------|
| GFSK                    |               |                       |                        |                       |           |
| 2402.00                 | 1.5           | 0.38                  | -4.15                  | 30                    | PASS      |
| 2441.00                 | 1.5           | 0.58                  | -2.37                  | 30                    | PASS      |
| 2480.00                 | 1.5           | 0.54                  | -2.70                  | 30                    | PASS      |
| $\pi/4$ -DQPSK          |               |                       |                        |                       |           |
| 2402.00                 | 1.5           | 0.32                  | -5.01                  | 21                    | PASS      |
| 2441.00                 | 1.5           | 0.48                  | -3.17                  | 21                    | PASS      |
| 2480.00                 | 1.5           | 0.45                  | -3.50                  | 21                    | PASS      |
| 8DPSK                   |               |                       |                        |                       |           |
| 2402.00                 | 1.5           | 0.32                  | -4.94                  | 21                    | PASS      |
| 2441.00                 | 1.5           | 0.49                  | -3.09                  | 21                    | PASS      |
| 2480.00                 | 1.5           | 0.45                  | -3.44                  | 21                    | PASS      |

GFSK Lowest Channel



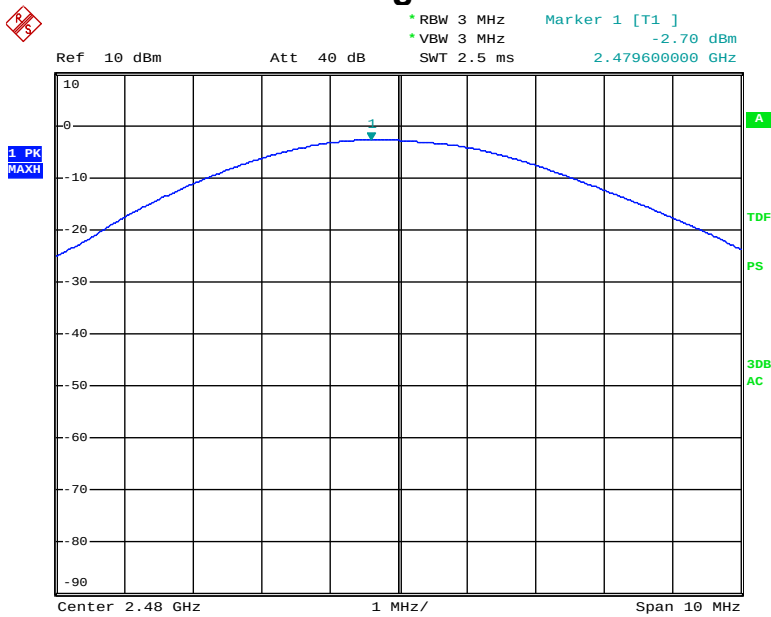
Date: 3.JUN.2014 21:06:22

GFSK Middle Channel



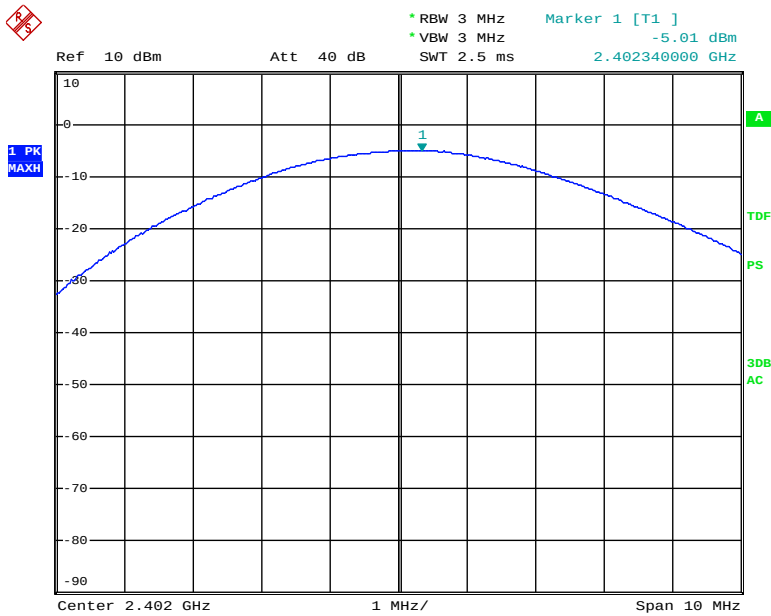
Date: 3.JUN.2014 21:06:33

GFSK Highest Channel



Date: 3.JUN.2014 21:06:43

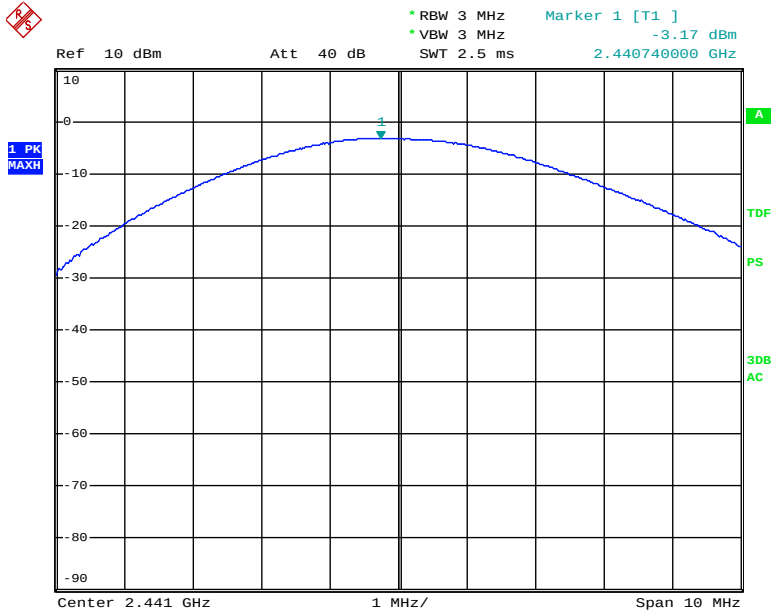
$\pi/4$ -DQPSK Lowest Channel



Date: 3.JUN.2014 21:07:08

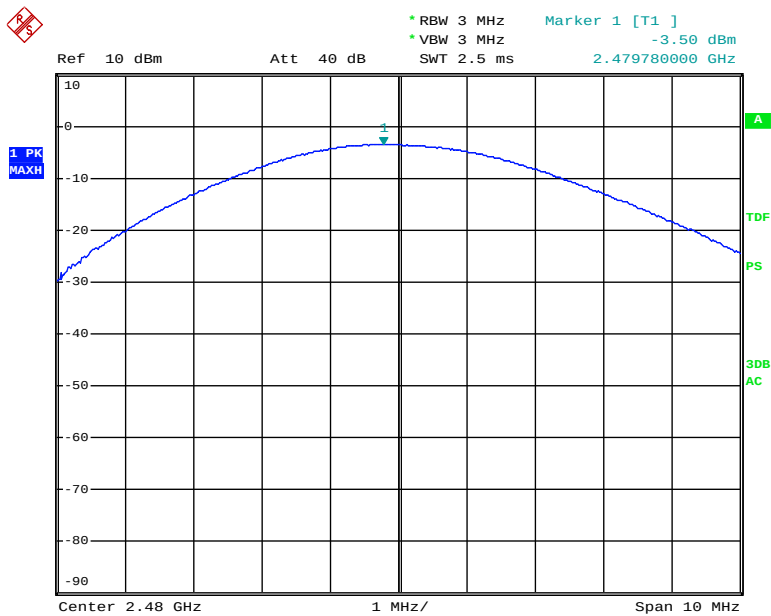


$\pi/4$ -DQPSK Middle Channel



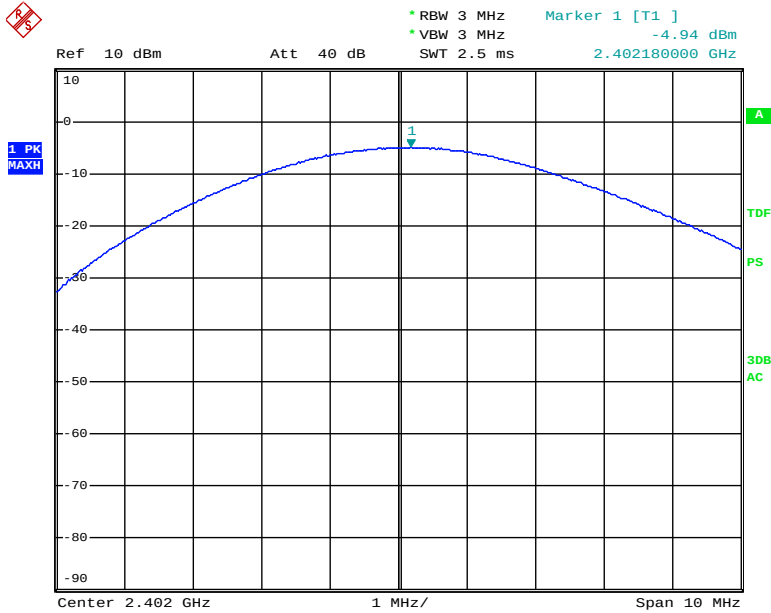
Date: 3.JUN.2014 21:07:19

$\pi/4$ -DQPSK Highest Channel



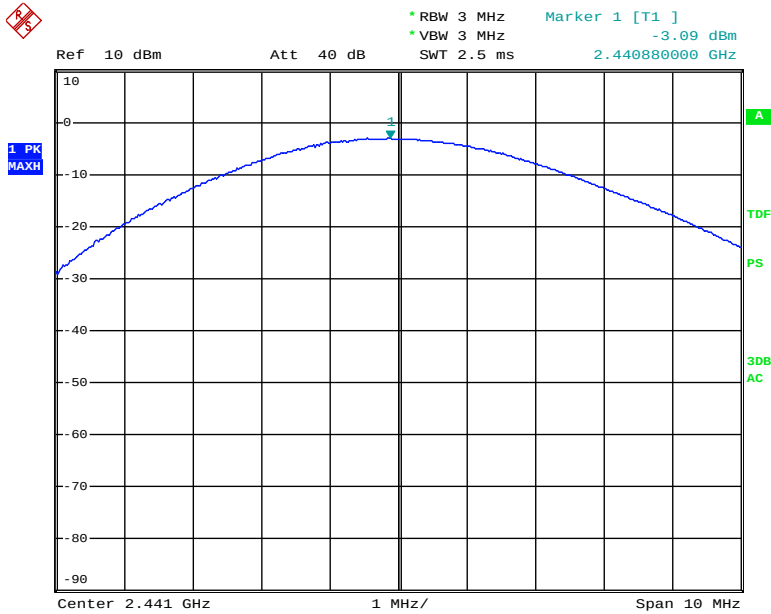
Date: 3.JUN.2014 21:07:30

8DPSK Lowest Channel



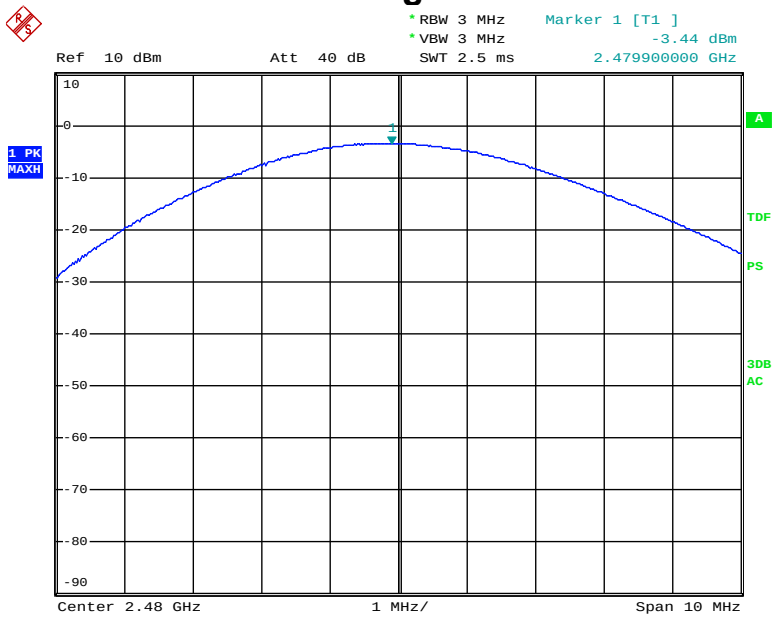
Date: 3.JUN.2014 21:07:57

8DPSK Middle Channel



Date: 3.JUN.2014 21:08:14

8DPSK Highest Channel



Date: 3.JUN.2014 21:08:27

## 10. Band Edge

### 10.1 Measurement Procedure

Out of Band Conducted Emissions, FCC Rule 15.247(d):

The transmitter output is connected to spectrum analyzer. The resolution bandwidth is set to 100KHz, and the video bandwidth set to 300KHz.

A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth for average detection(AV) at below at frequency above 1GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

| Frequency Band (MHz) | Function | Resolution Bandwidth | Video Bandwidth |
|----------------------|----------|----------------------|-----------------|
| 30 to 1000           | Peak     | 100 kHz              | 100 kHz         |
| Above 1000           | Peak     | 1 MHz                | 1 MHz           |
|                      | Average  | 1 MHz                | 10 Hz           |

### 10.2 Limit

15.247(d) In any 100KHz 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 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### 10.3 Measurement Results

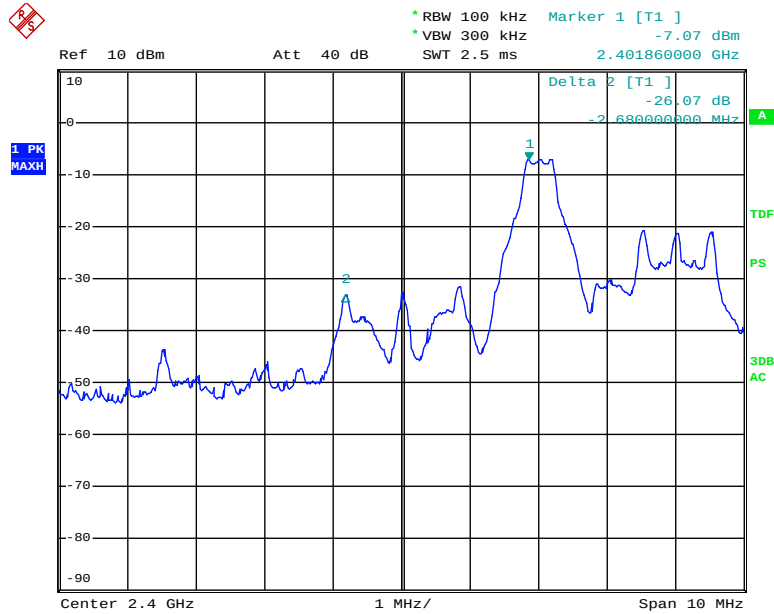
Please see below test table and plots.  
 For Radiated Emission  
 The worst case: GFSK

| Freq.<br>(MHz) | Ant.<br>Pol. | Emission Level<br>(dBuV) |       | Limit<br>3m<br>(dBuV/m) |       | Margin<br>(dB) |       |
|----------------|--------------|--------------------------|-------|-------------------------|-------|----------------|-------|
|                |              | Peak                     | AV    | Peak                    | AV    | Peak           | AV    |
| 2398.870       | H            | 65.12                    | 49.88 | 74.00                   | 54.00 | -8.88          | -4.12 |
| 2398.760       | V            | 62.13                    | 47.38 | 74.00                   | 54.00 | -11.87         | -6.62 |
| 2487.500       | H            | 65.43                    | 51.32 | 74.00                   | 54.00 | -8.57          | -2.68 |
| 2484.930       | V            | 58.32                    | 46.72 | 74.00                   | 54.00 | -15.68         | -7.28 |

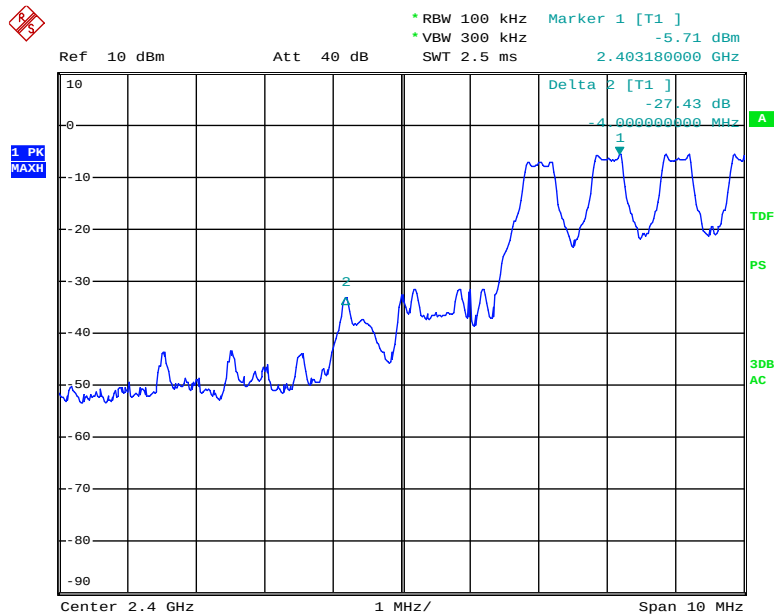
**Note:** (1) Emission Level= Reading Level + Factor  
 (2) Factor= Antenna Gain + Cable Loss – Amplifier Gain  
 (3) Horn antenna used for the emission over 1000MHz.

For RF Conducted

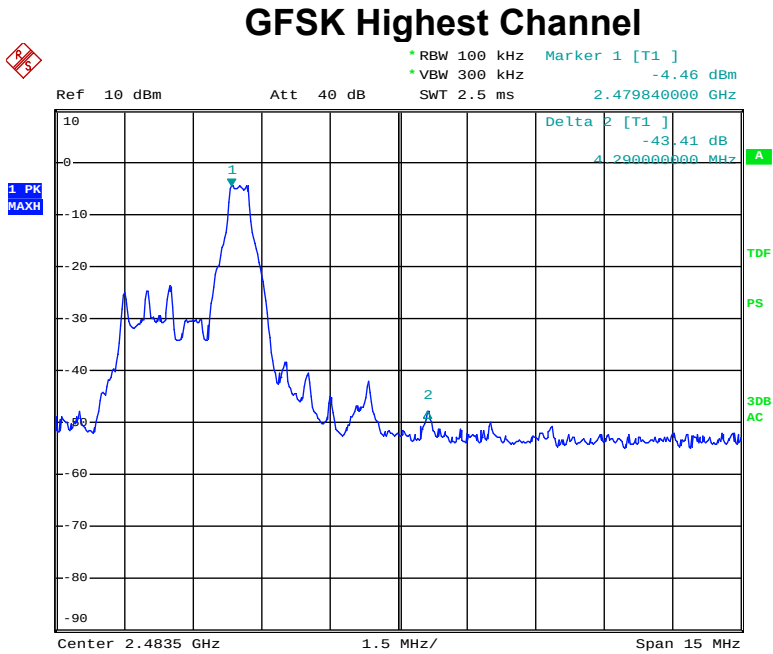
### GFSK Lowest Channel



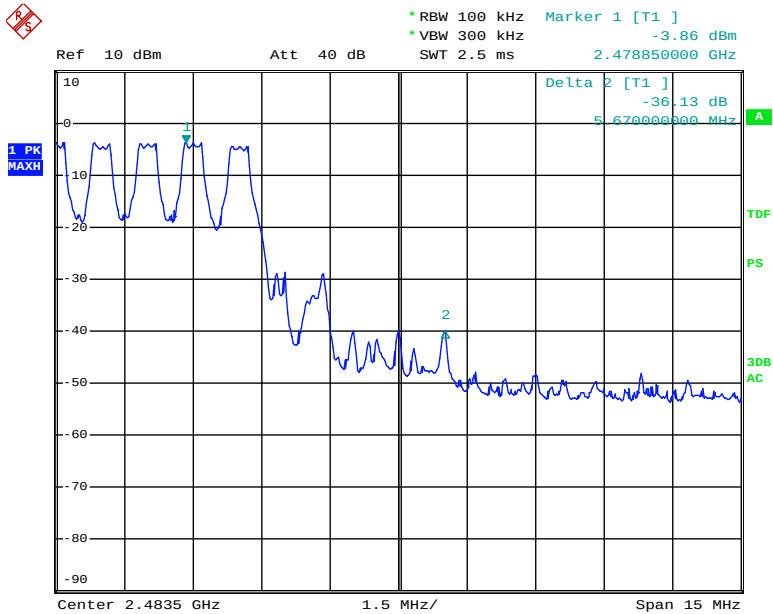
Date: 3.JUN.2014 20:39:02



Date: 3.JUN.2014 20:39:39

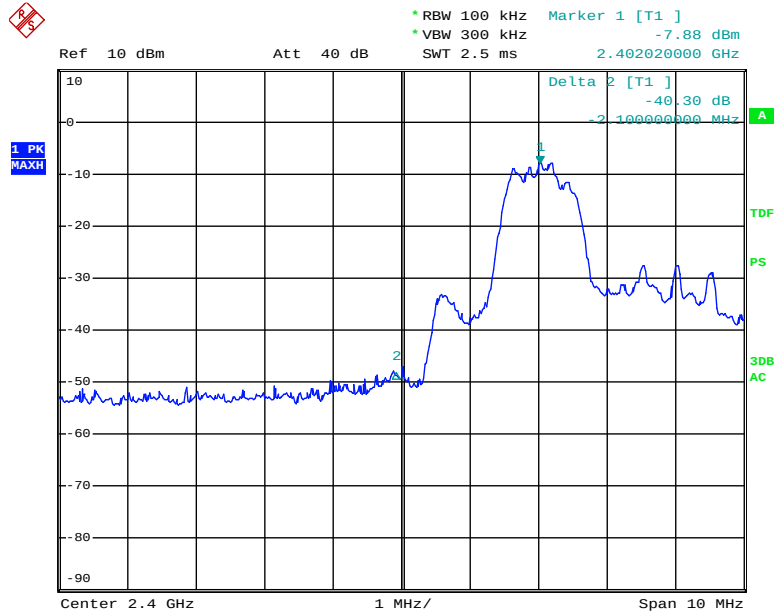


Date: 3.JUN.2014 20:46:04

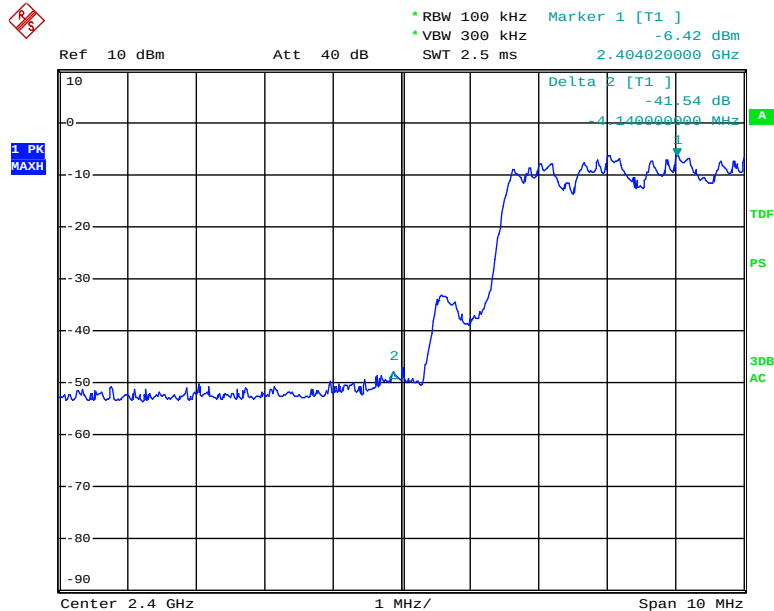


Date: 3.JUN.2014 20:46:45

## $\pi/4$ -DQPSK Lowest Channel



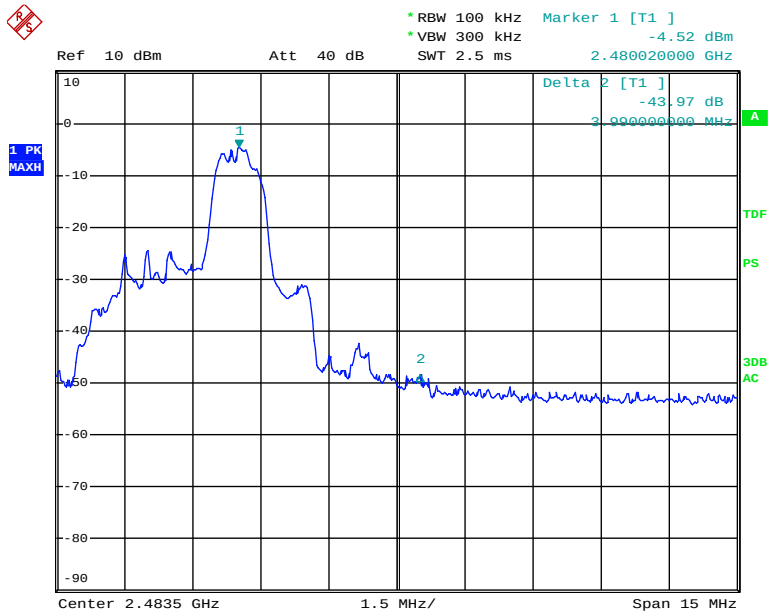
Date: 3.JUN.2014 20:40:34



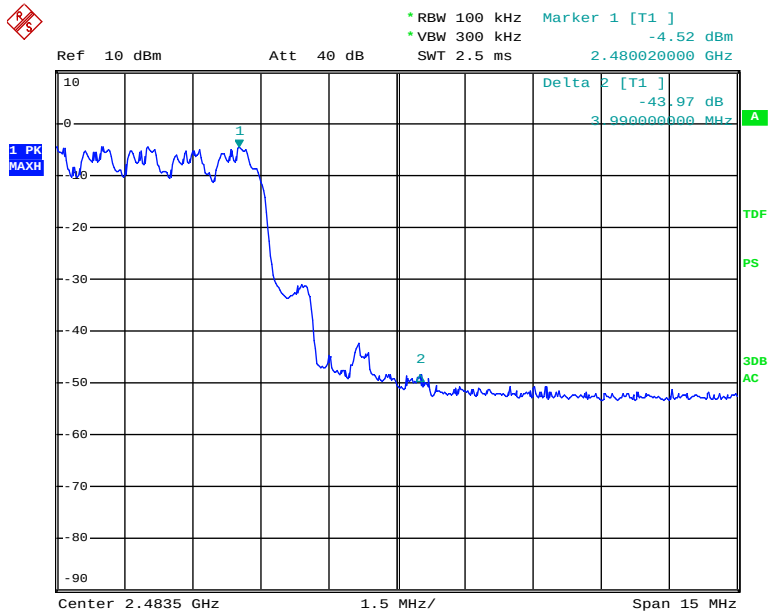
Date: 3.JUN.2014 20:42:04



$\pi/4$ -DQPSK Highest Channel



Date: 3.JUN.2014 20:47:54

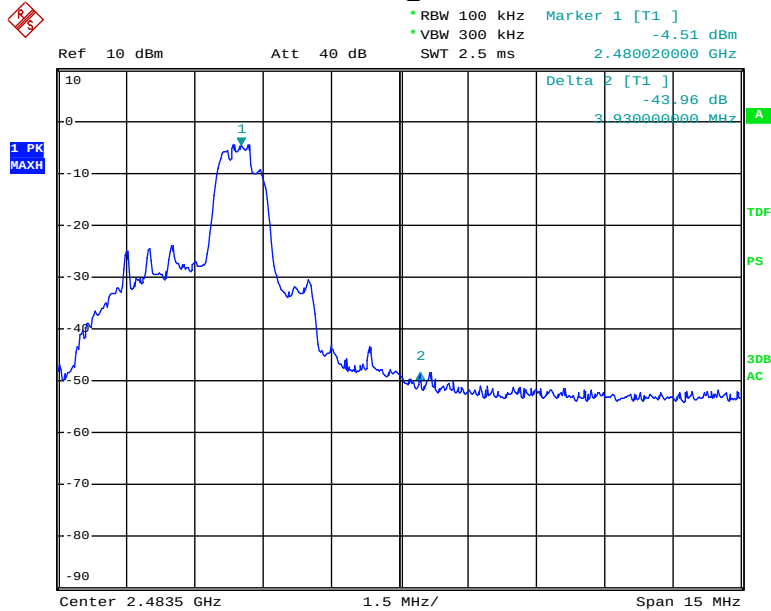


Date: 3.JUN.2014 20:49:36

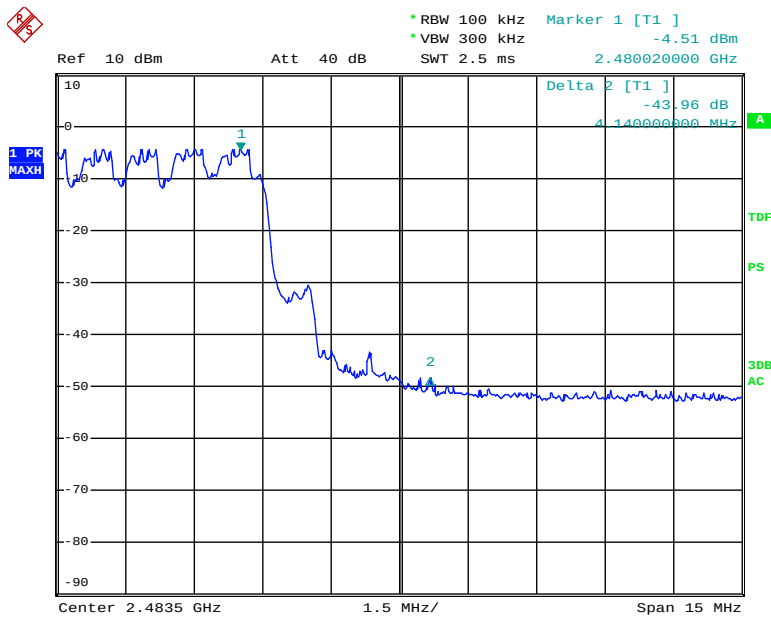


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## 8DPSK Highest Channel



Date: 3.JUN.2014 20:50:46



Date: 3.JUN.2014 20:56:57

## **11. Antenna Application**

### **11.1 Antenna requirement**

According to of FCC part 15C section 15.203 and 15.240:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Systems operating in the 2400-2483.5MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### **11.2 Measurement Results**

The antenna is integrated on the main PCB and no consideration of replacement, and the best case gain of the antenna is -0.61dBi. So, the antenna is consider meet the requirement.

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## 12. Conducted Spurious Emissions

### 12.1 Measurement Procedure

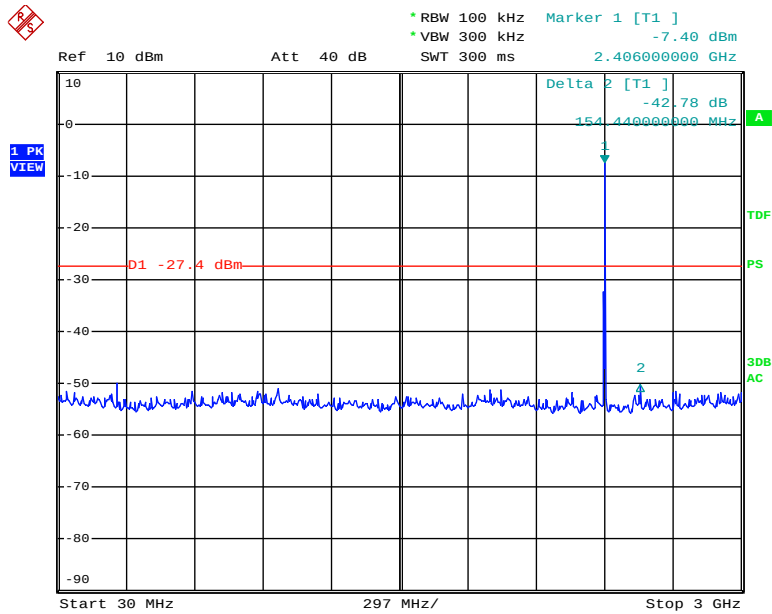
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

The transmitter output is connected to spectrum analyzer. All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20dB below the highest level of the desired power in the passband.

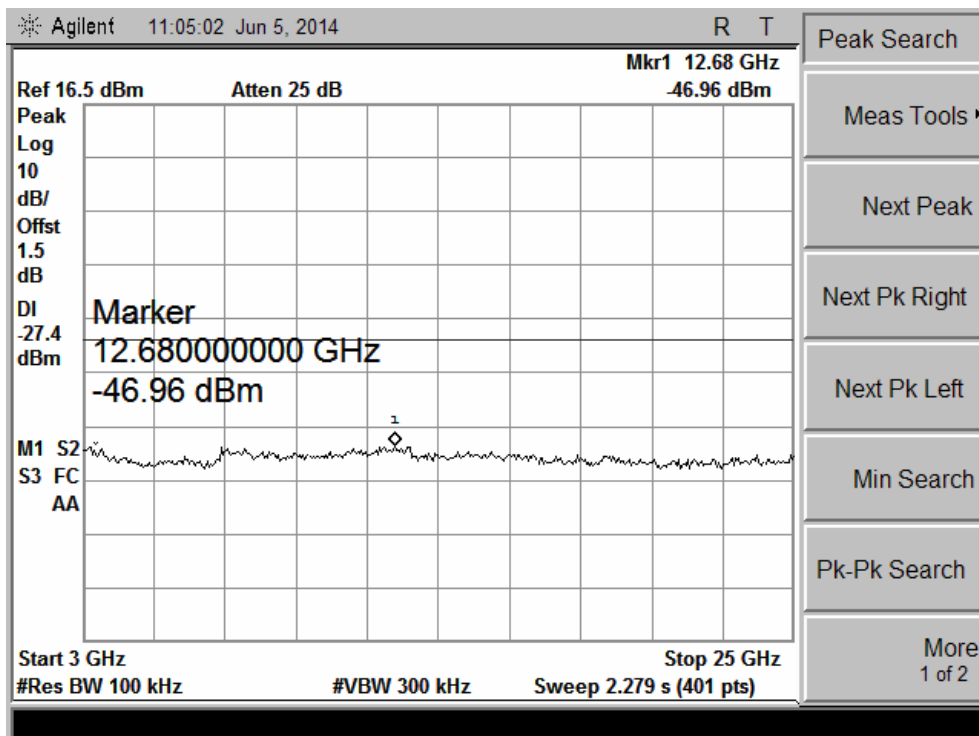
### 12.2. Measurement Results

Please refer to following plots, the worst case (GFSK) was shown.

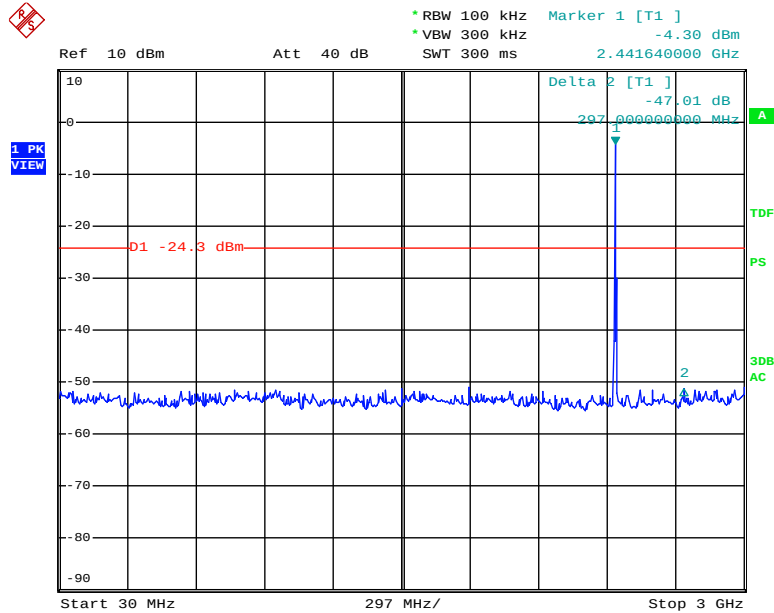
## GFSK Lowest Channel



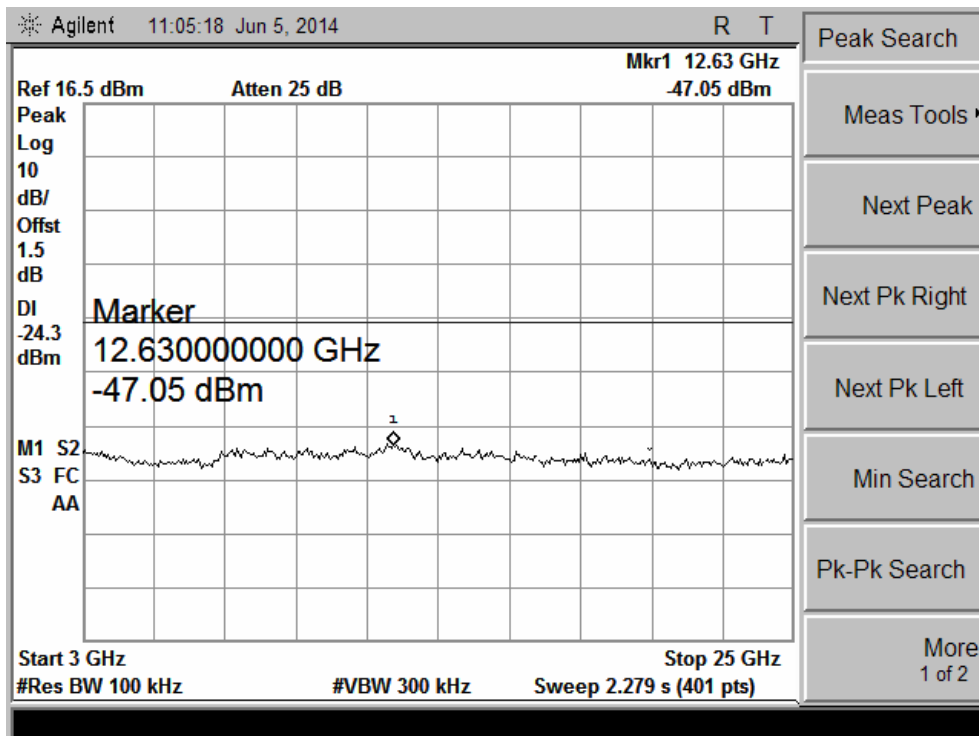
Date: 3.JUN.2014 20:36:27



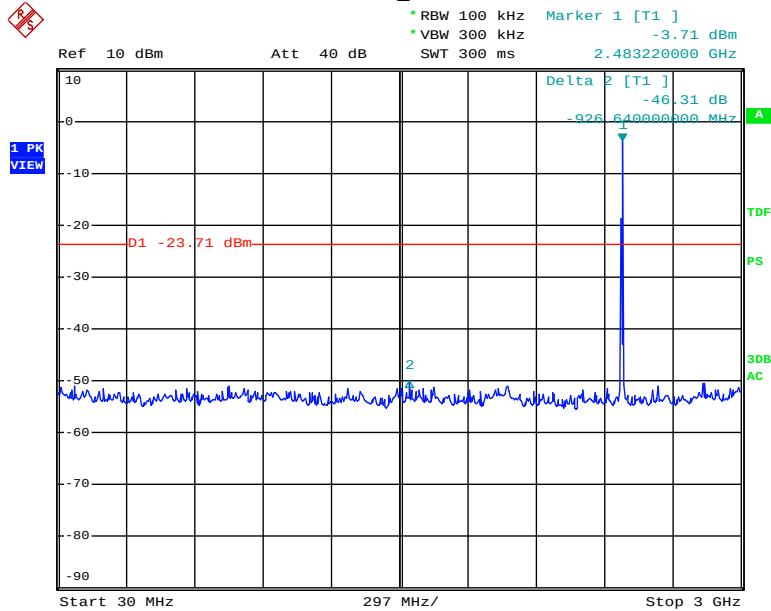
## GFSK Middle Channel



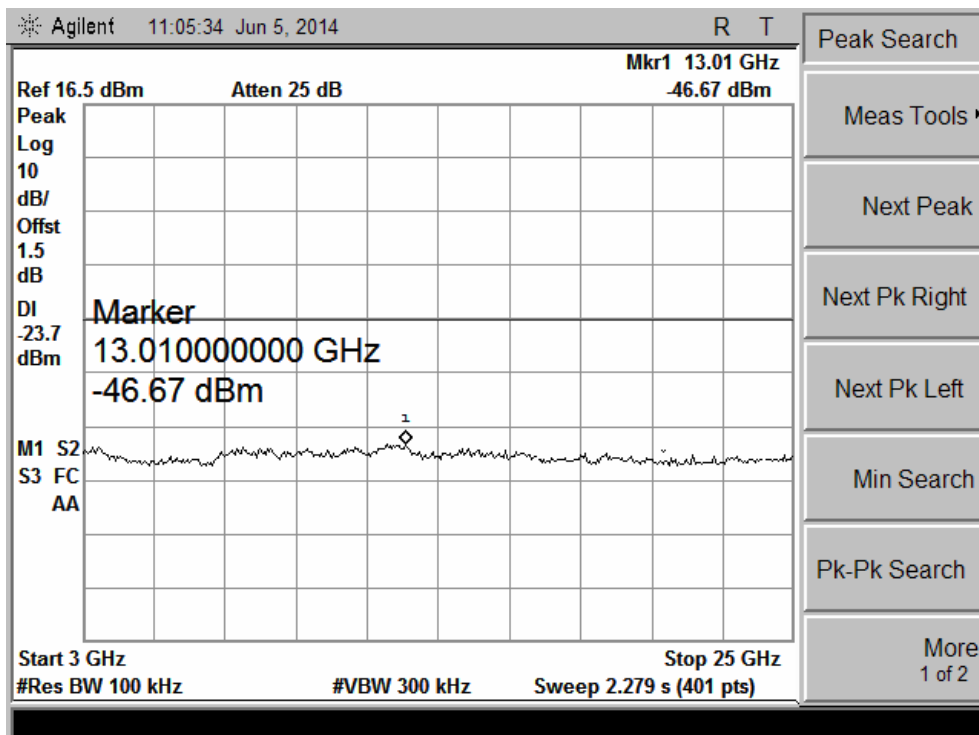
Date: 3.JUN.2014 20:37:15



## GFSK Highest Channel



Date: 3.JUN.2014 20:37:55





### 13. Test Equipment List

| Description                    | Manufacturer    | Model Number | Serial Number | Characteristics | Calibration Date | Calibration Due Date |
|--------------------------------|-----------------|--------------|---------------|-----------------|------------------|----------------------|
| Test Receiver                  | Rohde & Schwarz | ESCI7        | 100837        | 9KHz~7GHz       | Nov. 25, 2013    | Nov. 24, 2014        |
| Antenna                        | Schwarzbeck     | VULB9162     | 9162-010      | 30MHz~7GHz      | Nov. 28, 2013    | Nov. 27, 2014        |
| Positioning Controller         | UC              | UC 3000      | N/A           | 0~360° , 1-4m   | N/A              | N/A                  |
| Color Monitor                  | SUNSPO          | SP-140A      | N/A           | N/A             | N/A              | N/A                  |
| Single Phase Power Line Filter | SAEMC           | PF201A-32    | 110210        | 32A             | N/A              | N/A                  |
| 3 Phase Power Line Filter      | SAEMC           | PF401A-200   | 110318        | 200A            | N/A              | N/A                  |
| DC Power Filter                | SAEMC           | PF301A-200   | 110245        | 200A            | N/A              | N/A                  |
| Cable                          | Huber+Suhner    | CBL2-NN-1M   | 22390001      | 9KHz~7GHz       | Nov. 09, 2013    | Nov. 08, 2014        |
| Cable                          | Huber+Suhner    | CIL02        | N/A           | 9KHz~7GHz       | Nov. 09, 2013    | Nov. 08, 2014        |
| Power Amplifier                | HP              | HP 8447D     | 1145A00203    | 100KHz~1.3GHz   | Nov. 09, 2013    | Nov. 08, 2014        |
| Horn Antenna                   | Schwarzbeck     | BBHA9170     | 9170-372      | 15GHz~26.5GHz   | Oct.24, 2013     | Oct.23, 2014         |
| Horn Antenna                   | Com-Power       | AH-118       | 071078        | 1GHz~18GHz      | Nov. 07, 2013    | Nov. 06, 2014        |
| Loop antenna                   | Daze            | ZA30900A     | 0708          | 9KHz~30MHz      | Oct.11, 2013     | Oct.10, 2014         |
| Spectrum Analyzer              | Agilent         | E4408B       | MY414407D     | 9KHz~26.5GHz    | Nov. 05, 2013    | Nov. 04, 2014        |
| Pre-Amplifier                  | Agilent         | 8449B        | 3008A02964    | 1GHz~26.5GHz    | Nov. 05, 2013    | Nov. 04, 2014        |
| L.I.S.N.                       | Rohde & Schwarz | ENV 216      | 101317        | 9KHz~30MHz      | Nov. 09, 2013    | Nov. 08, 2014        |

---End of report---