
FCC PART 15 SUBPART C MEASUREMENT AND TEST REPORT

For

Shenzhen Fenda Technology Co., Ltd.

**Fenda Hi-Tech Park, Zhoushi Road, Shiyan Town, Baoan District, Shenzhen
City, Guangdong, China**

E.U.T.: Universal Bluetooth Speaker

Model Name: W15BT, QAA14AV002, QAA14AV004

Brand Name: N/A

FCC ID: HBOW15BT

Report Number: NTC1401067F

Test Date(s): January 09, 2014 to January 16, 2014

Report Date(s): January 16, 2014

Prepared by

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Approved & Authorized Signer



Chris Pan / 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 NTC 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 is a Bluetooth speaker with BT and AUX IN functions. It's powered by DC 3.7V internal Li-ion Battery or DC 5V powered by USB Port. For more details features, please refer to User's Manual.

| | |
|---------------------|--|
| Manufacturer | : Shenzhen Fenda Technology Co., Ltd |
| Address | : Fenda Hi-Tech Park, Zhoushi Road, Shiyan Town, Baoan District, Shenzhen City, Guangdong, China |
| Frequency: | : 2402-2480MHz |
| Modulation | : GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Number of Channel | : 79 |
| Channel space | : 1MHz |
| Max RF Output Power | : -1.82dBm (0.66mW) |
| Antenna Type | : PCB |
| Antenna Gain | : 2dBi |
| Power Supply | : DC 3.7V internal Battery, AC 120V 60Hz(PC input) |
| Model name | : W15BT, QAA14AV002, QAA14AV004 |
| Note: | : All of them have the same circuit schematic, construction and critical components. Their difference in model name is only for trading purpose. |

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: HBOW15BT filing to comply with Section 15.247 of the FCC Part 15 (2012), 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

| | |
|-------------|--|
| Notebook PC | : Manufacturer: IBM Corporation M/N: R50e S/N: L3-HZNGO P/N: 1834KDC |
| Adapter | : Manufacturer: IBM Corporation M/N: 08K8210 Input: AC100-240V 50/60Hz 0.5-1.0A Output: DC 16V 4.5A |

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 NTC Co., Ltd.

Building D, Gaosheng Science and Technology Park,
Hongtu Road, Nancheng District, Dongguan City,
Guangdong Province, 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 (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, §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

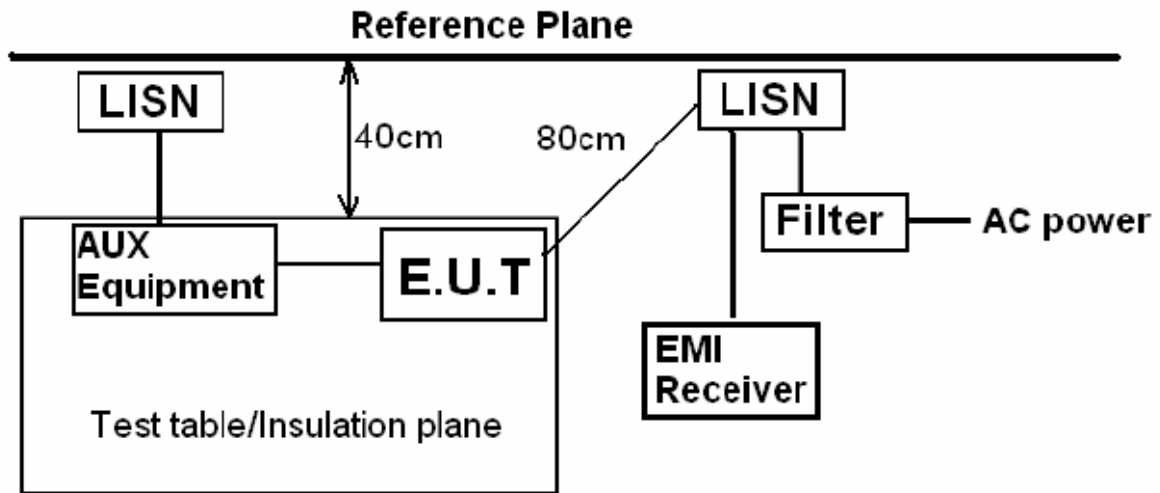
The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and normal mode is programmed. The Lowest, middle and highest channel were chosen for testing, and all packets DH1, DH3 and DH5 mode in all modulation type GFSK, $\pi/4$ -DQPSK,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

3.3 Measurement Results

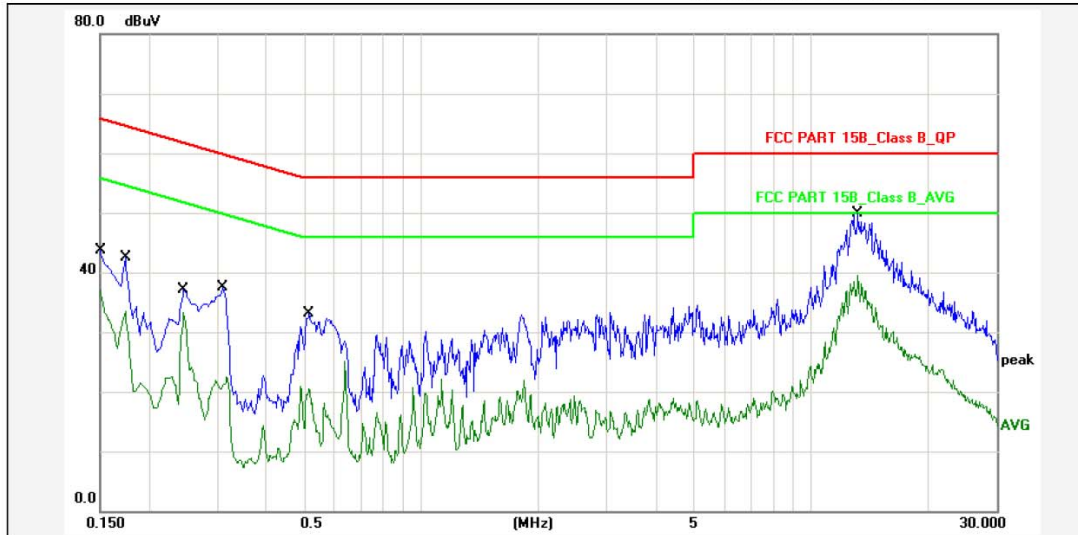
Please refer to following plots.



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Site: Conduction

Test Time: 2014-1-13 14:57:13



Report No.: W15BT
 Test Standard: FCC PART 15B_Class B_QP
 Test item: Conducted Emission
 Applicant: FENDA
 Product: Universal Bluetooth Speaker
 Model No.: W15BT
 Phase: N
 Temp.()/Hum.(%): 22(C) / 47 %
 Power Rating: AC 120V/60Hz
 Test Engineer: Sance
 Test Mode: Charging + BT Mode
 Remark:

| No. | Frequency (MHz) | Factor (dBuV) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|-----|-----------------|---------------|----------------|--------------|--------------|-------------|----------|-----|--------|
| 1 | 0.1500 | 10.80 | 30.80 | 41.60 | 65.99 | -24.39 | QP | P | |
| 2 | 0.1500 | 10.80 | 24.40 | 35.20 | 55.99 | -20.79 | AVG | P | |
| 3 | 0.1740 | 10.80 | 29.70 | 40.50 | 64.76 | -24.26 | QP | P | |
| 4 | 0.1740 | 10.80 | 20.80 | 31.60 | 54.76 | -23.16 | AVG | P | |
| 5 | 0.2460 | 10.80 | 24.40 | 35.20 | 61.89 | -26.69 | QP | P | |
| 6 | 0.2460 | 10.80 | 20.50 | 31.30 | 51.89 | -20.59 | AVG | P | |
| 7 | 0.3099 | 10.80 | 24.50 | 35.30 | 59.97 | -24.67 | QP | P | |
| 8 | 0.3099 | 10.80 | 9.70 | 20.50 | 49.97 | -29.47 | AVG | P | |
| 9 | 0.5180 | 10.80 | 20.40 | 31.20 | 56.00 | -24.80 | QP | P | |
| 10 | 0.5180 | 10.80 | 8.10 | 18.90 | 46.00 | -27.10 | AVG | P | |
| 11 | 13.2140 | 10.80 | 37.10 | 47.90 | 60.00 | -12.10 | QP | P | |
| 12 | 13.2140 | 10.80 | 26.70 | 37.50 | 50.00 | -12.50 | AVG | P | |

Note: Level=Reading+Factor.
 Margin=Limit-Level.

File:W15BT\#3

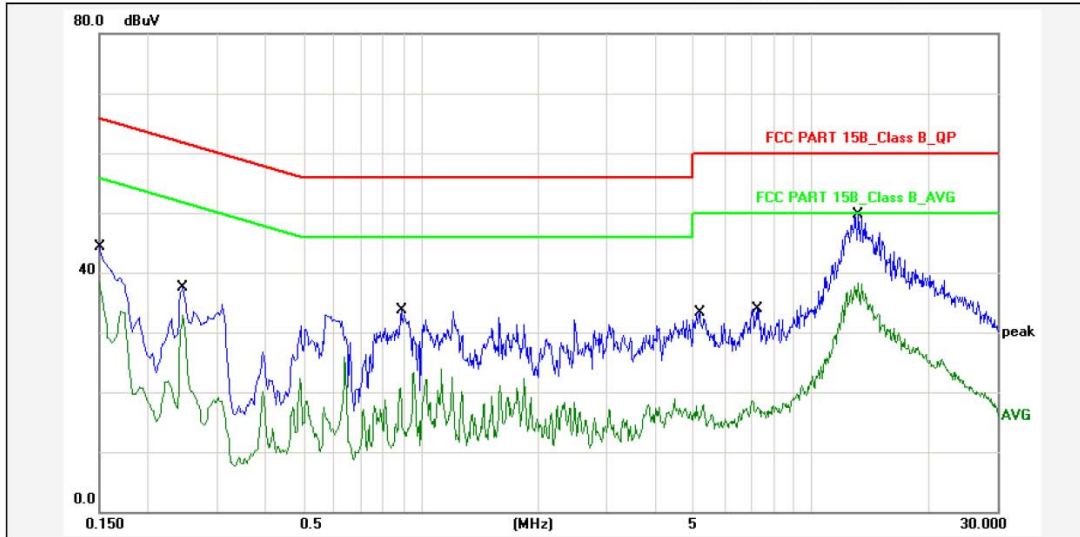
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Site: Conduction

Test Time: 2014-1-13 14:59:34



Report No.: W15BT
 Test Standard: FCC PART 15B_Class B_QP
 Test item: Conducted Emission
 Applicant: FENDA
 Product: Universal Bluetooth Speaker
 Model No.: W15BT
 Phase: L1
 Temp.()/Hum.(%): 22(C) / 47 %
 Power Rating: AC 120V/60Hz
 Test Engineer: Sance
 Test Mode: Charging + BT Mode
 Remark:

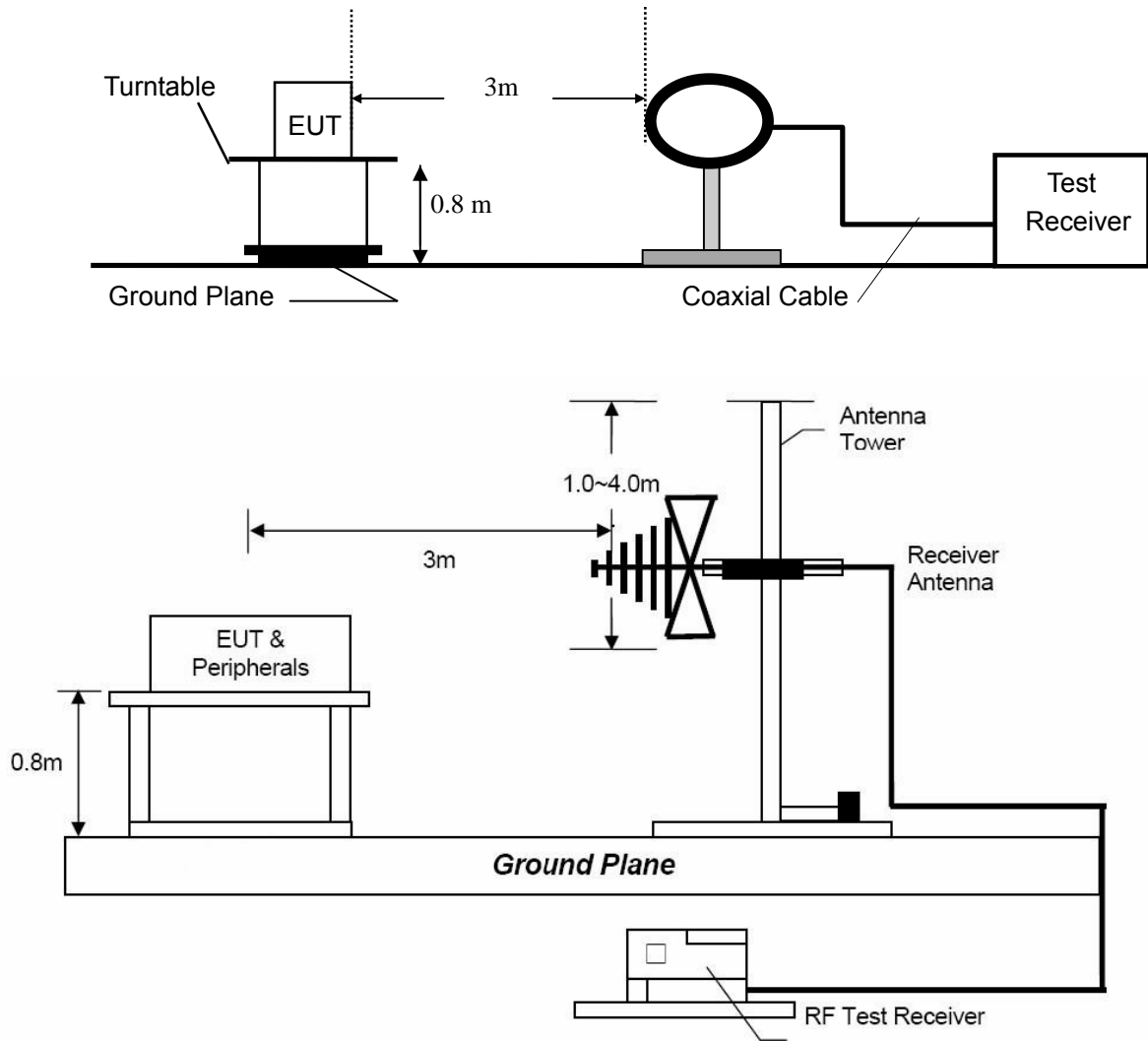
| No. | Frequency (MHz) | Factor (dBuV) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|-----|-----------------|---------------|----------------|--------------|--------------|-------------|----------|-----|--------|
| 1 | 0.1500 | 10.80 | 31.40 | 42.20 | 65.99 | -23.79 | QP | P | |
| 2 | 0.1500 | 10.80 | 25.60 | 36.40 | 55.99 | -19.59 | AVG | P | |
| 3 | 0.2460 | 10.80 | 24.60 | 35.40 | 61.89 | -26.49 | QP | P | |
| 4 | 0.2460 | 10.80 | 20.10 | 30.90 | 51.89 | -20.99 | AVG | P | |
| 5 | 0.8900 | 10.80 | 20.80 | 31.60 | 56.00 | -24.40 | QP | P | |
| 6 | 0.8900 | 10.80 | 7.80 | 18.60 | 46.00 | -27.40 | AVG | P | |
| 7 | 5.1779 | 10.80 | 20.50 | 31.30 | 60.00 | -28.70 | QP | P | |
| 8 | 5.1779 | 10.80 | 6.00 | 16.80 | 50.00 | -33.20 | AVG | P | |
| 9 | 7.2579 | 10.80 | 21.10 | 31.90 | 60.00 | -28.10 | QP | P | |
| 10 | 7.2579 | 10.80 | 5.60 | 16.40 | 50.00 | -33.60 | AVG | P | |
| 11 | 13.2060 | 10.80 | 36.80 | 47.60 | 60.00 | -12.40 | QP | P | |
| 12 | 13.2060 | 10.80 | 25.60 | 36.40 | 50.00 | -13.60 | AVG | P | |

Note: Level=Reading+Factor.
 Margin=Limit-Level.

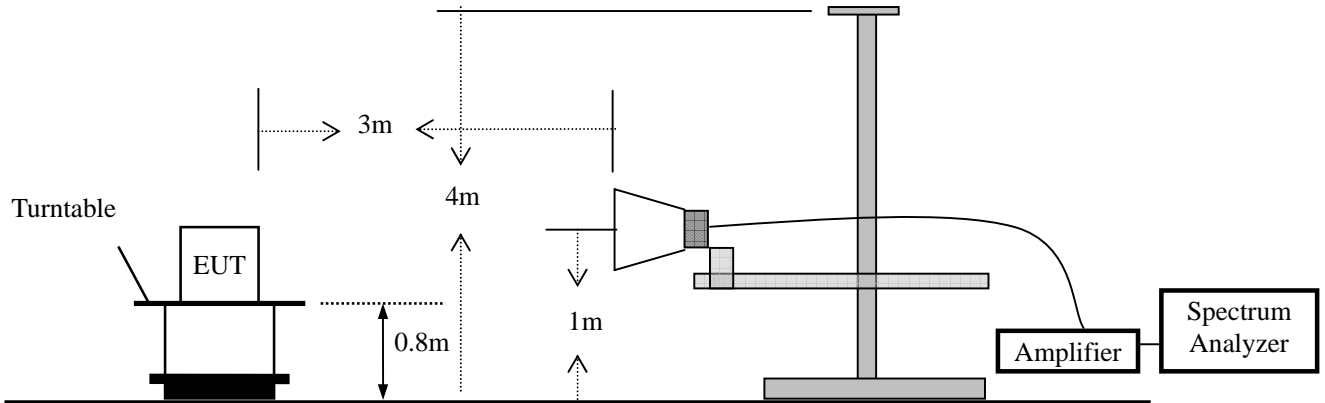
4. Radiated Emission Test

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

- a. 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.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. 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.
- d. 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.

4.3 Limit

| Frequency range MHz | Distance Meters | Field Strengths Limit (15.209) |
|------------------------|-----------------|--------------------------------|
| | | $\mu\text{V/m}$ |
| 0.009 ~ 0.490 | 300 | 2400/F(kHz) |
| 0.490 ~ 1.705 | 30 | 24000/F(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) μV = 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 Temperature : 22°C
 Test Result: PASS Humidity : 42%
 Measured Distance: 3m Test By: Sance
 Test Date : January 15, 2014

| Freq. (MHz) | Ant.Pol. H/V | Reading Level (dBuV) | Factor (dB/m) | Emission Level (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) | Note |
|----------------|-----------------|----------------------------|------------------|-------------------------------|-------------------------|----------------|------|
| 57.1599 | V | 33.80 | -16.20 | 17.60 | 40.00 | -22.40 | QP |
| 121.1800 | V | 46.95 | -15.45 | 31.50 | 43.50 | -12.00 | QP |
| 159.0099 | V | 34.92 | -15.22 | 19.70 | 43.50 | -23.80 | QP |
| 191.9900 | V | 33.58 | -14.98 | 18.60 | 43.50 | -24.90 | QP |
| 205.5699 | V | 34.72 | -14.92 | 19.80 | 43.50 | -23.70 | QP |
| 256.0100 | V | 41.46 | -13.16 | 28.30 | 46.00 | -17.70 | QP |
| | | | | | | | |
| 121.1800 | H | 51.15 | -15.45 | 37.50 | 43.50 | -6.00 | QP |
| 168.7100 | H | 40.62 | -15.12 | 25.50 | 43.50 | -18.00 | QP |
| 202.6599 | H | 40.24 | -14.94 | 25.30 | 43.00 | -18.20 | QP |
| 214.3000 | H | 40.03 | -14.83 | 25.20 | 43.00 | -18.30 | QP |
| 255.0400 | H | 43.96 | -13.16 | 30.80 | 46.00 | -15.20 | QP |
| 288.0199 | H | 41.43 | -12.93 | 28.50 | 46.00 | -17.50 | 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 : ±3.4dB
 - (4) Loop antenna used for the emission below 30MHz.

Modulation: GFSK (the worst case)
 (Mid Frequency: 2402MHz)
 Operation Mode: TX Mode (Low) Test Date : January 15, 2014
 Frequency Range: 1-25GHz Temperature : 22 °C
 Test Result: PASS Humidity : 42 %
 Measured Distance: 3m Test By: Sance

| Freq. (MHz) | Ant. Pol. | Reading Level (dBuV) | | Factor (dB/m) | Emission Level (dBuV) | | Limit 3m (dBuV/m) | | Margin (dB) | |
|-------------|-----------|----------------------|-------|---------------|-----------------------|-------|-------------------|-------|-------------|-------|
| | | Peak | AV | | Peak | AV | Peak | AV | Peak | AV |
| 4804 | V | 43.64 | 14.63 | 14.63 | 58.27 | 48.90 | 74.00 | 54.00 | -15.73 | -5.10 |
| 7206 | V | 44.56 | 15.30 | 15.30 | 59.86 | 46.61 | 74.00 | 54.00 | -14.14 | -7.39 |
| --- | | | | | | | | | | |
| --- | | | | | | | | | | |
| 4804 | H | 41.43 | 14.63 | 14.63 | 56.06 | 47.17 | 74.00 | 54.00 | -17.94 | -6.83 |
| 7206 | H | 44.71 | 15.30 | 15.30 | 60.01 | 46.94 | 74.00 | 54.00 | -13.99 | -7.06 |
| --- | | | | | | | | | | |
| --- | | | | | | | | | | |

- 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 : ±3.7dB.
 - (6) Horn antenna used for the emission over 1000MHz.



Modulation: GFSK (the worst case)
 (Mid Frequency: 2441MHz)
 Operation Mode: TX Mode (Mid) Test Date : January 15, 2014
 Frequency Range: 1-25GHz Temperature : 22 °C
 Test Result: PASS Humidity : 42 %
 Measured Distance: 3m Test By: Sance

| Freq. (MHz) | Ant. Pol. | Reading Level (dBuV) | | Factor (dB/m) | Emission Level (dBuV) | | Limit 3m (dBuV/m) | | Margin (dB) | |
|-------------|-----------|----------------------|-------|---------------|-----------------------|-------|-------------------|-------|-------------|-------|
| | | Peak | AV | | Peak | AV | Peak | AV | Peak | AV |
| 4882 | V | 43.87 | 34.09 | 14.97 | 58.84 | 49.06 | 74.00 | 54.00 | -15.16 | -4.94 |
| 7323 | V | 38.16 | 25.21 | 20.91 | 59.07 | 46.12 | 74.00 | 54.00 | -14.93 | -7.88 |
| --- | | | | | | | | | | |
| --- | | | | | | | | | | |
| 4882 | H | 42.26 | 31.98 | 14.97 | 57.23 | 46.95 | 74.00 | 54.00 | -16.77 | -7.05 |
| 7323 | H | 38.93 | 25.49 | 20.91 | 59.84 | 46.40 | 74.00 | 54.00 | -14.16 | -7.60 |
| --- | | | | | | | | | | |
| --- | | | | | | | | | | |

- 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 : ±3.7dB.
 - (6) Horn antenna used for the emission over 1000MHz.



Modulation: GFSK (the worst case)
 (High Frequency: 2480MHz)
 Operation Mode: TX Mode (High) Test Date : January 15, 2014
 Frequency Range: 1-25GHz Temperature : 22 °C
 Test Result: PASS Humidity : 42 %
 Measured Distance: 3m Test By: Sance

| Freq. (MHz) | Ant. Pol. | Reading Level (dBuV) | | Factor (dB/m) | Emission Level (dBuV) | | Limit 3m (dBuV/m) | | Margin (dB) | |
|-------------|-----------|----------------------|-------|---------------|-----------------------|-------|-------------------|-------|-------------|-------|
| | | Peak | AV | | Peak | AV | Peak | AV | Peak | AV |
| 4960 | V | 45.21 | 35.71 | 15.30 | 60.51 | 51.01 | 74.00 | 54.00 | -13.49 | -2.99 |
| 7440 | V | 37.86 | 25.06 | 21.16 | 59.02 | 46.22 | 74.00 | 54.00 | -14.98 | -7.78 |
| --- | | | | | | | | | | |
| --- | | | | | | | | | | |
| 4960 | H | 42.93 | 32.55 | 15.30 | 58.23 | 47.85 | 74.00 | 54.00 | -15.77 | -6.15 |
| 7440 | H | 38.65 | 25.90 | 21.16 | 59.81 | 47.06 | 74.00 | 54.00 | -14.19 | -6.94 |
| --- | | | | | | | | | | |
| --- | | | | | | | | | | |

- 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 : ±3.7dB.
 - (6) Horn antenna used for the emission over 1000MHz.

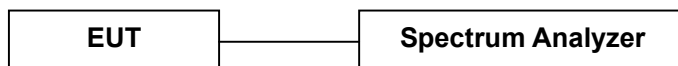
5. Channel Separation test

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)

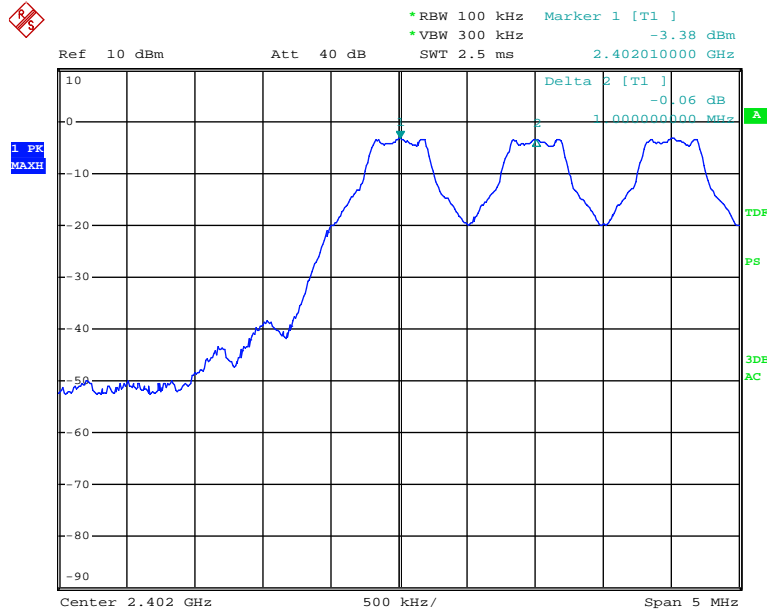


5.3 Measurement Results

| | | | |
|---------------|-----------------------------|--------------------|------------------|
| Modulation: | GFSK, $\pi/4$ -DQPSK, 8DPSK | | |
| RBW: | 100KHz | VBW: | 300KHz |
| Packet: | DH5 | Spectrum Detector: | PK |
| Test By: | Sance | Test Date : | January 15, 2014 |
| Temperature : | 22 °C | Humidity : | 42 % |
| Test Result: | PASS | | |

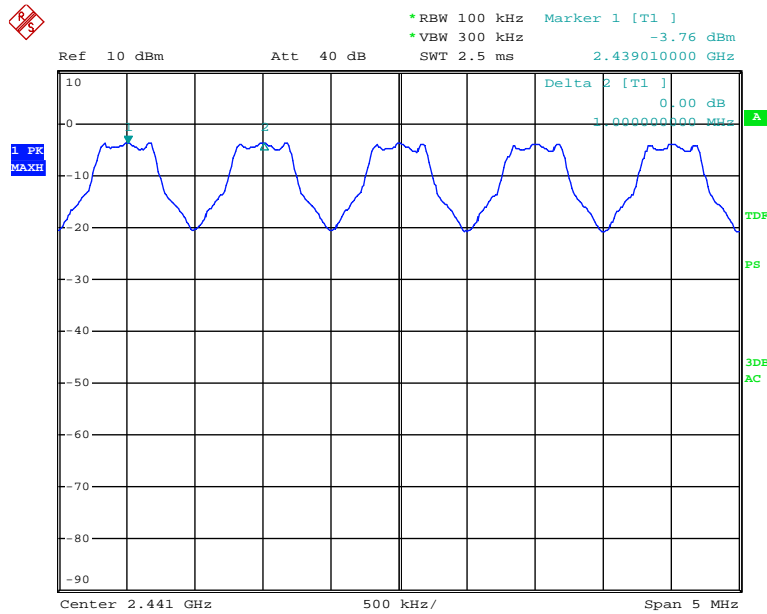
| Channel number | Channel frequency (MHz) | Separation Read Value (KHz) | Separation Limit (KHz) |
|----------------|-------------------------|-----------------------------|------------------------|
| GFSK | | | |
| Lowest | 2402 | 1000 | >548 |
| Middle | 2441 | 1000 | >584 |
| Highest | 2480 | 1000 | >584 |
| $\pi/4$ -DQPSK | | | |
| Lowest | 2402 | 1000 | >816 |
| Middle | 2441 | 1000 | >820 |
| Highest | 2480 | 1000 | >824 |
| 8DPSK | | | |
| Lowest | 2402 | 1000 | >816 |
| Middle | 2441 | 1000 | >844 |
| Highest | 2480 | 1000 | >844 |

GFSK Lowest Channel



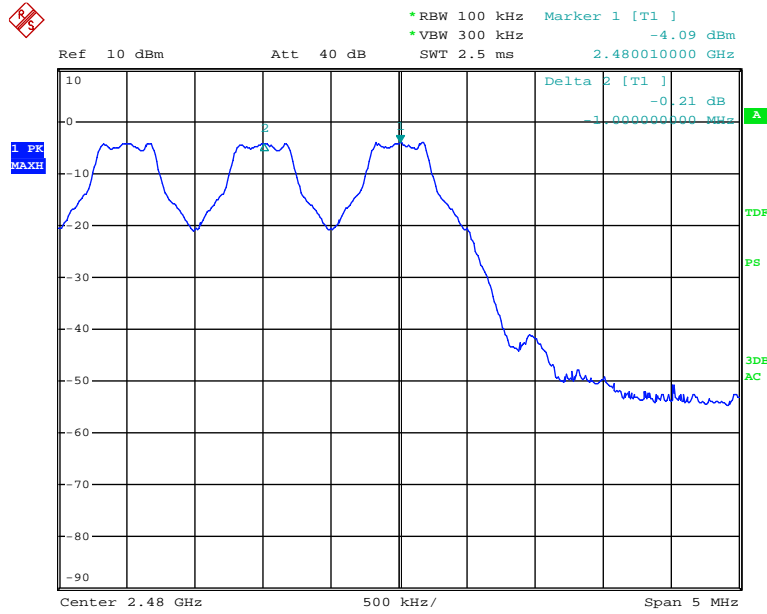
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GFSK Middle Channel



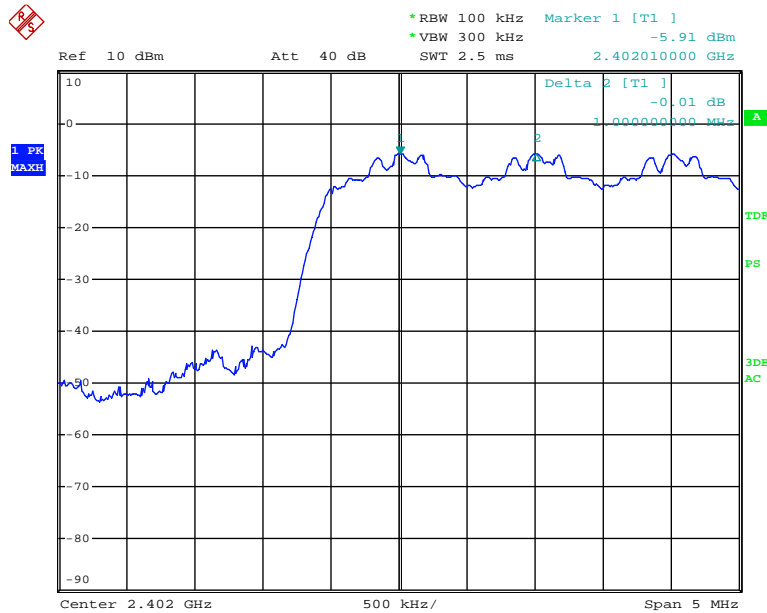
Date: 15.JAN.2014 13:41:56

GFSK Highest Channel



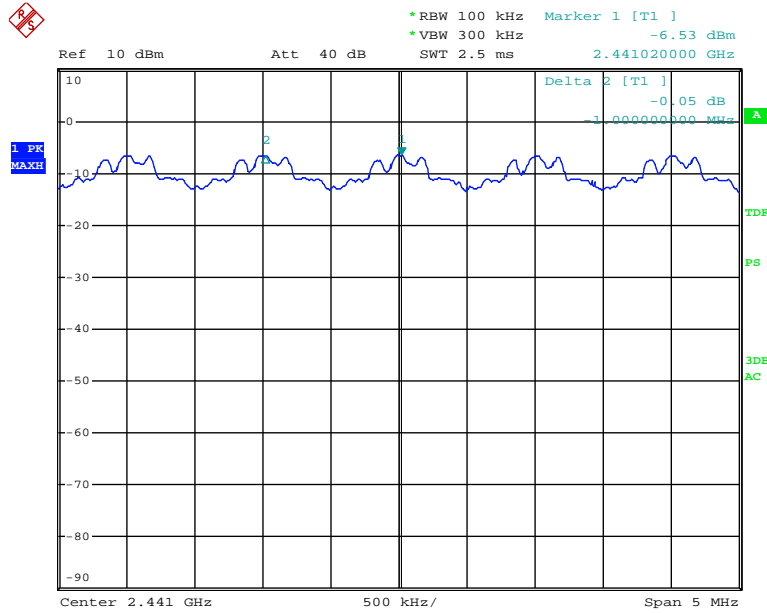
Date: 15.JAN.2014 13:59:03

$\pi/4$ -DQPSK Lowest Channel



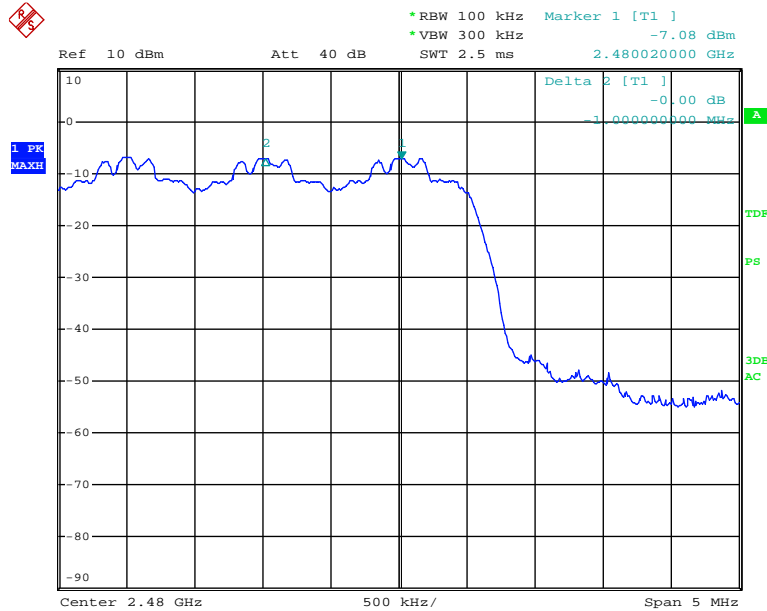
Date: 15.JAN.2014 14:02:36

$\pi/4$ -DQPSK Middle Channel



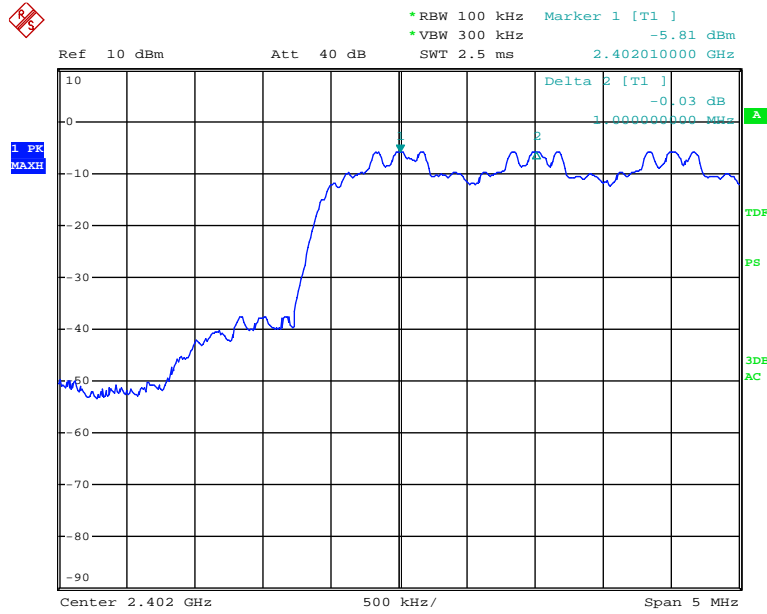
Date: 15.JAN.2014 14:04:58

$\pi/4$ -DQPSK Highest Channel



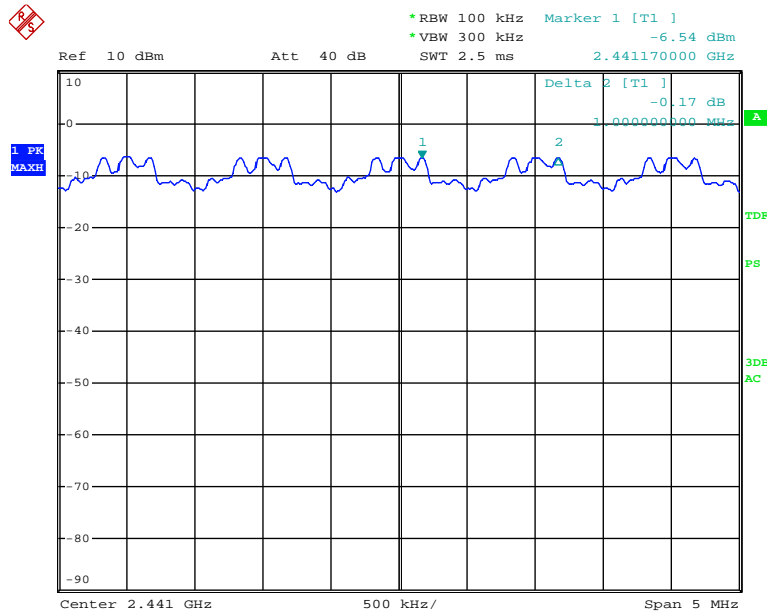
Date: 15.JAN.2014 14:07:07

8DPSK Lowest Channel



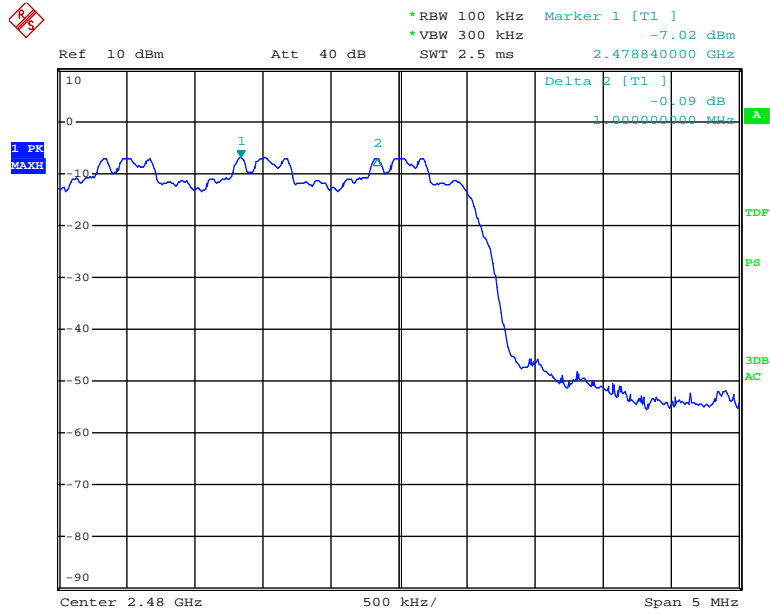
Date: 15.JAN.2014 14:09:11

8DPSK Middle Channel



Date: 15.JAN.2014 14:11:41

8DPSK Highest Channel



Date: 15.JAN.2014 14:13:10

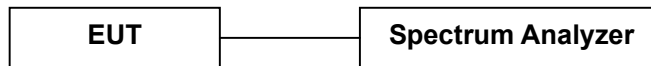
6. 20dB Bandwidth

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)



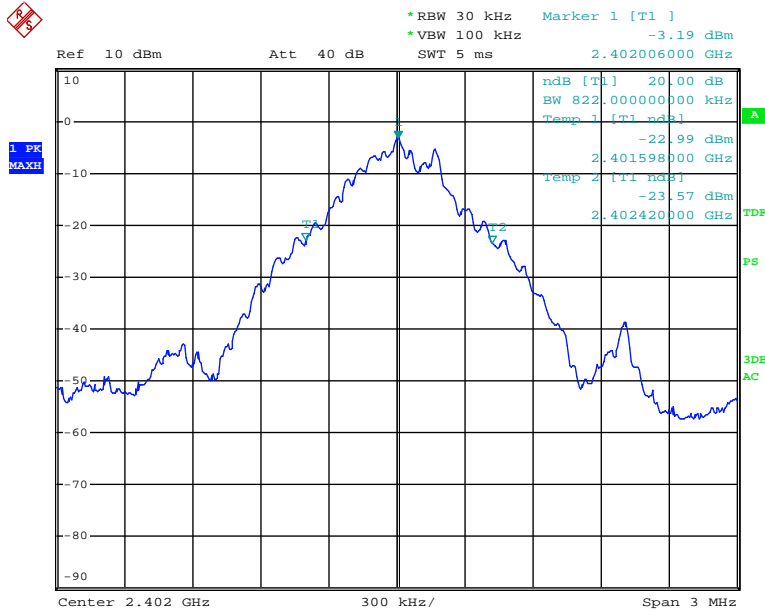
6.3 Measurement Results

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 : | January 15, 2014 |
| Temperature : | 22 °C | Humidity : | 42 % |
| Test Result: | PASS | | |

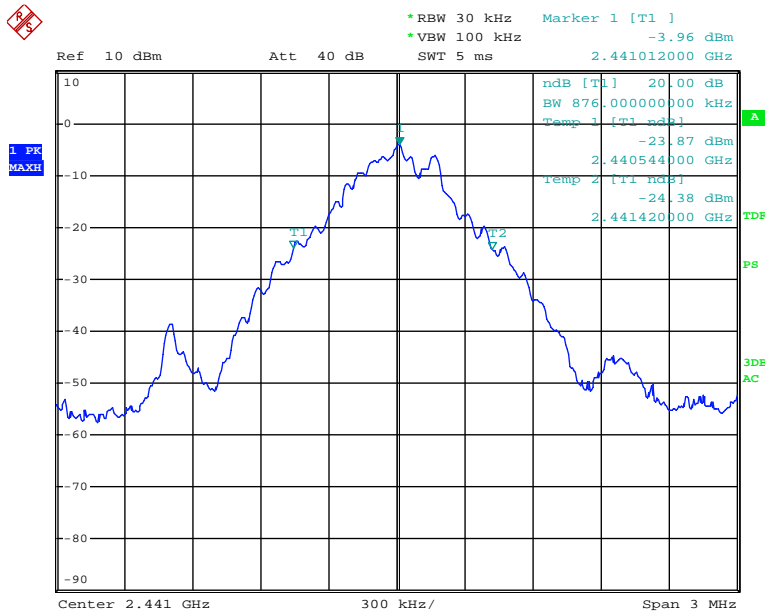
| Channel frequency (MHz) | 20dB Down BW(kHz) |
|---------------------------------|-------------------|
| GFSK | |
| 2402 | 822 |
| 2441 | 876 |
| 2480 | 876 |
| $\pi/4$-DQPSK | |
| 2402 | 1224 |
| 2441 | 1230 |
| 2480 | 1236 |
| 8DPSK | |
| 2402 | 1224 |
| 2441 | 1266 |
| 2480 | 1266 |

GFSK Lowest Channel



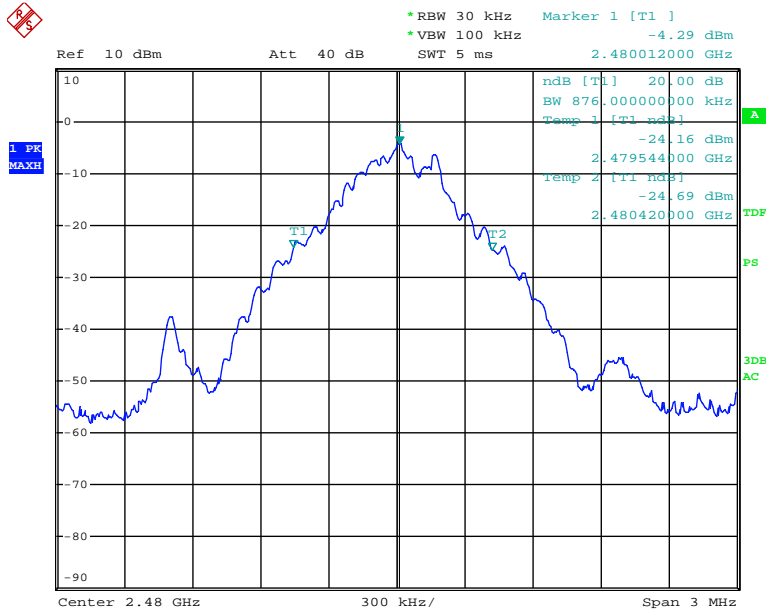
Date: 15.JAN.2014 14:14:19

GFSK Middle Channel



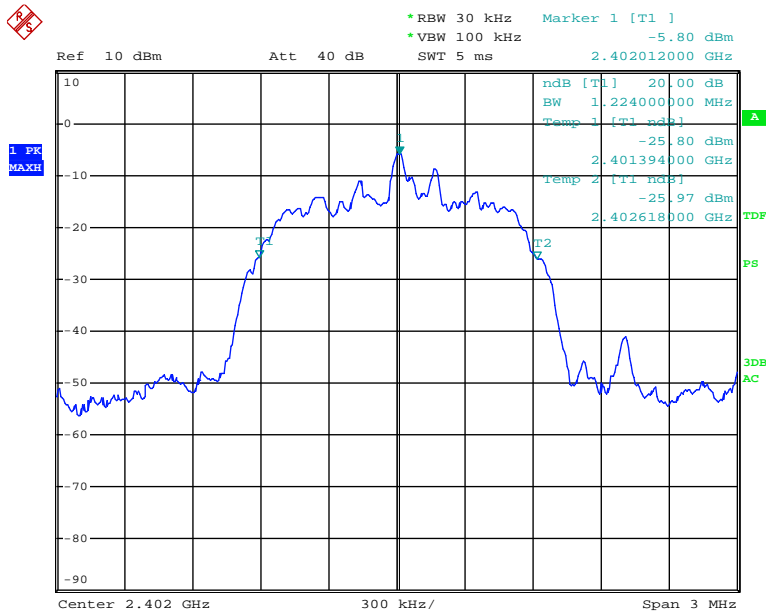
Date: 15.JAN.2014 14:15:33

GFSK Highest Channel



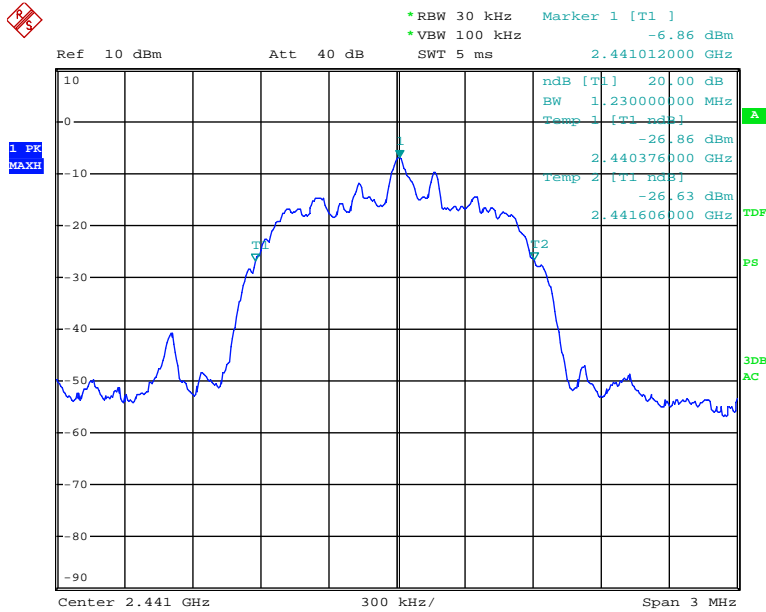
Date: 15.JAN.2014 14:16:10

$\pi/4$ -DQPSK Lowest Channel



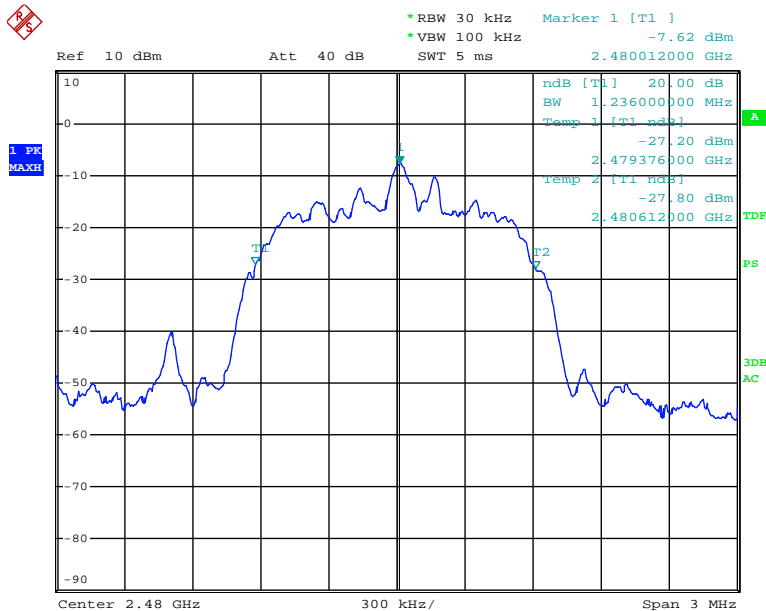
Date: 15.JAN.2014 14:17:43

$\pi/4$ -DQPSK Middle Channel



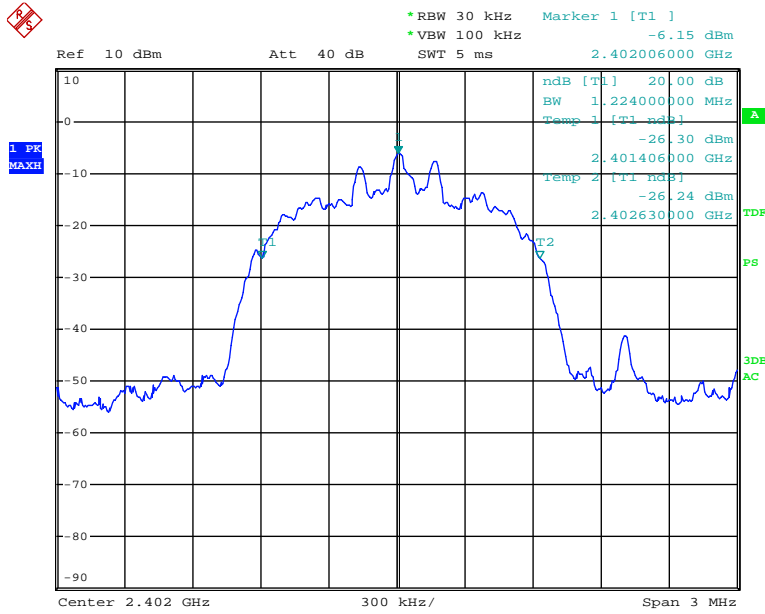
Date: 15.JAN.2014 14:18:47

$\pi/4$ -DQPSK Highest Channel



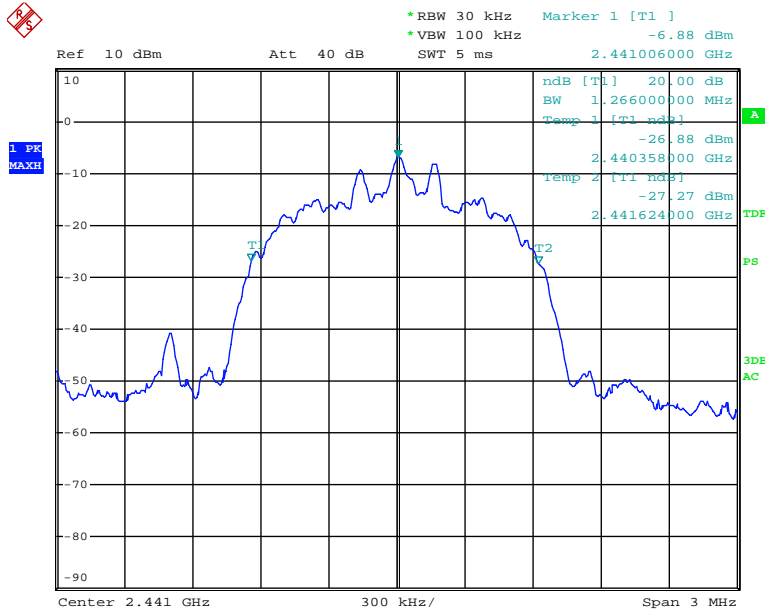
Date: 15.JAN.2014 14:19:43

8DPSK Lowest Channel



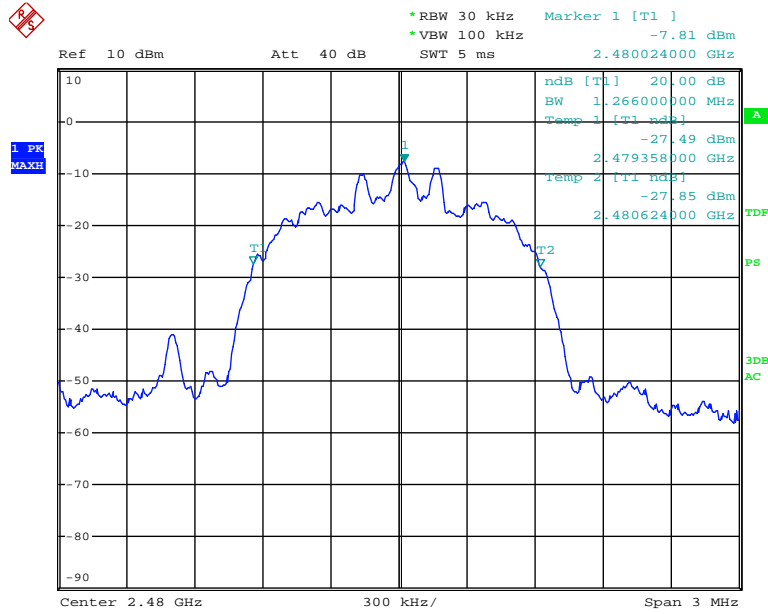
Date: 15.JAN.2014 14:20:39

8DPSK Middle Channel



Date: 15.JAN.2014 14:21:45

8DPSK Highest Channel



Date: 15.JAN.2014 14:22:37

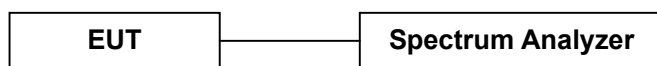
7. Hopping Channel Number

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)



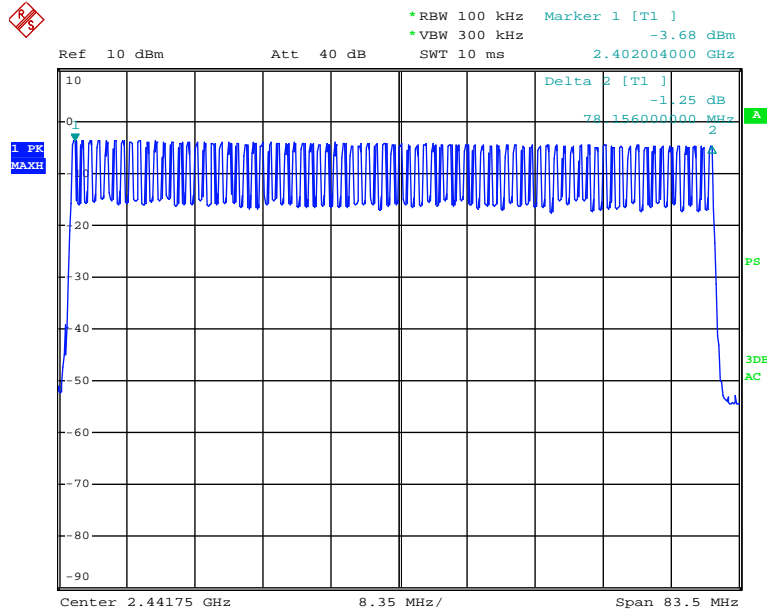
7.3 Measurement Results

| | | | |
|---------------|-----------------------------|--------------------|------------------|
| Modulation | GFSK, $\pi/4$ -DQPSK, 8DPSK | | |
| RBW: | 100KHz | VBW: | 300KHz |
| Packet: | DH5 | Spectrum Detector: | PK |
| Test By: | Sance | Test Date : | January 15, 2014 |
| Temperature : | 22 °C | Humidity : | 42 % |
| Test Result: | PASS | | |

| Hopping Channel Frequency Range | Number of Hopping Channels | Limit |
|---------------------------------|----------------------------|-----------|
| 2402-2480 | 79 | ≥ 15 |

The worst case: GFSK

GFSK



Date: 15.JAN.2014 15:19:37

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

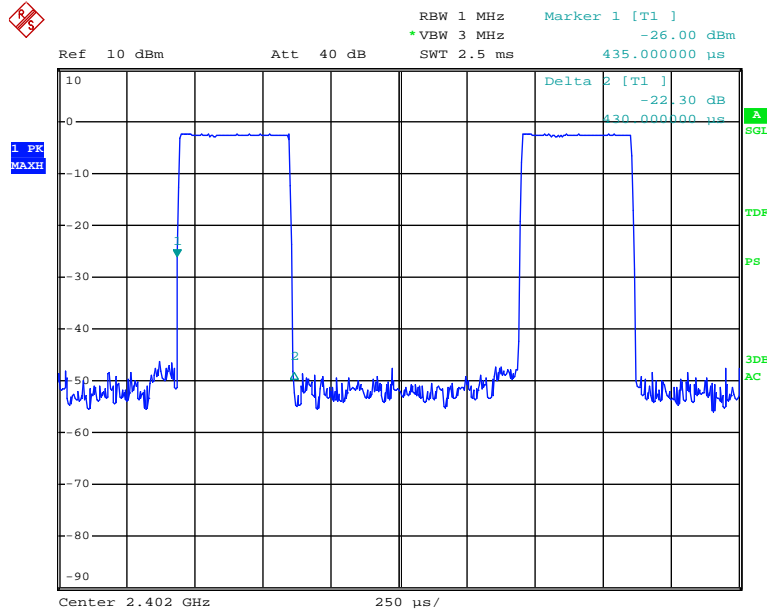
The maximum number of hopping channels in 31.6s (0.4s/Channel x 79 Channel)

Refer to attached data chart.

| | | | |
|--------------------|-----------------------------|---------------|-------|
| Modulation : | GFSK, $\pi/4$ -DQPSK, 8DPSK | | |
| RBW : | 1MHz | VBW : | 3MHz |
| Spectrum Detector: | PK | Test By: | Sance |
| Test Date : | January 15, 2014 | Temperature : | 22 °C |
| Test Result: | PASS | Humidity : | 42 % |

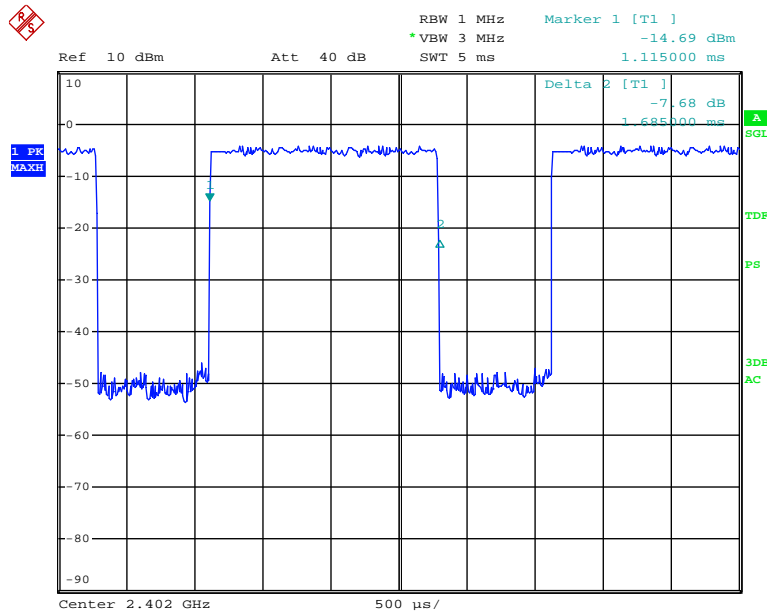
| Packet | Frequency (MHz) | Result (msec) | Limit (msec) |
|----------------|-----------------|--|--------------|
| GFSK | | | |
| DH1 | 2402 | $0.435(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 139.2$ | 400 |
| DH3 | 2402 | $1.685(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 269.6$ | 400 |
| DH5 | 2402 | $2.925(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 312.0$ | 400 |
| $\pi/4$ -DQPSK | | | |
| 2-DH1 | 2402 | $0.425(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 137.6$ | 400 |
| 2-DH3 | 2402 | $1.705(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 272.8$ | 400 |
| 2-DH5 | 2402 | $2.935(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 313.1$ | 400 |
| 8DPSK | | | |
| 3-DH1 | 2402 | $0.435(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 139.2$ | 400 |
| 3-DH3 | 2402 | $1.685(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 269.6$ | 400 |
| 3-DH5 | 2402 | $2.930(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 312.5$ | 400 |

GFSK DH1



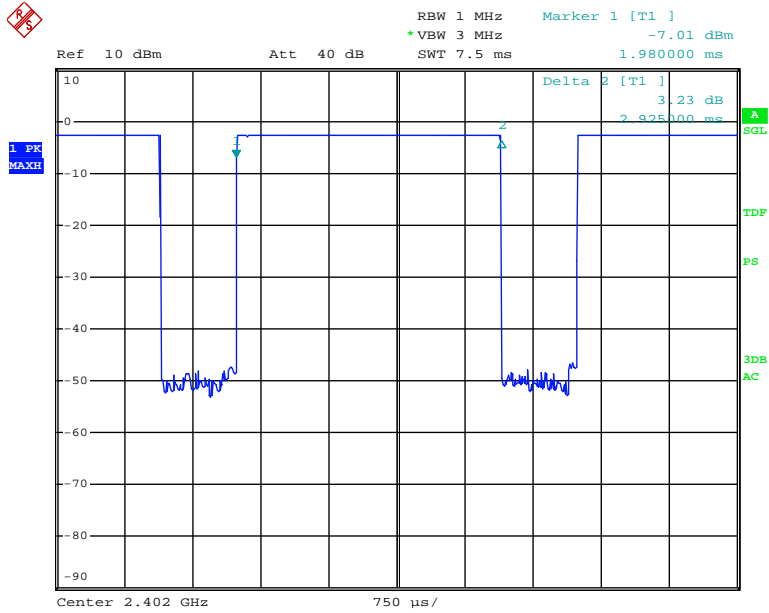
Date: 15.JAN.2014 14:29:11

GFSK DH3



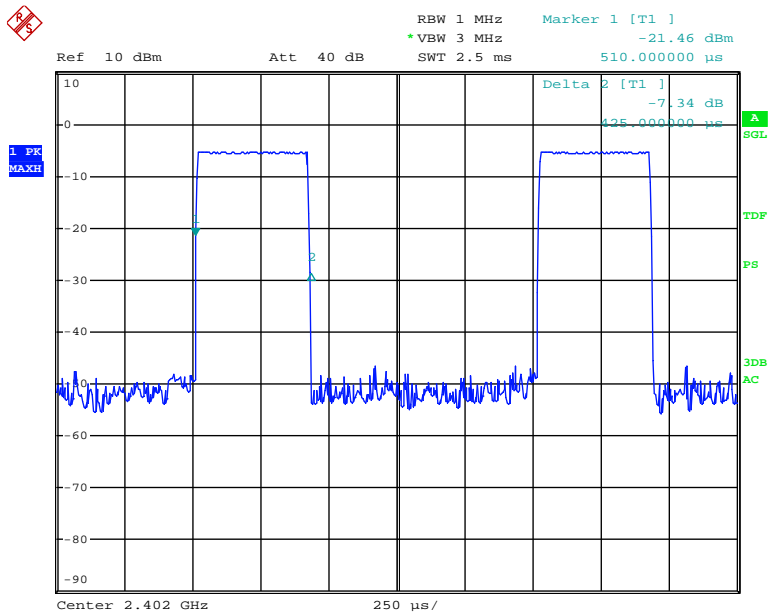
Date: 15.JAN.2014 14:33:18

GFSK DH5



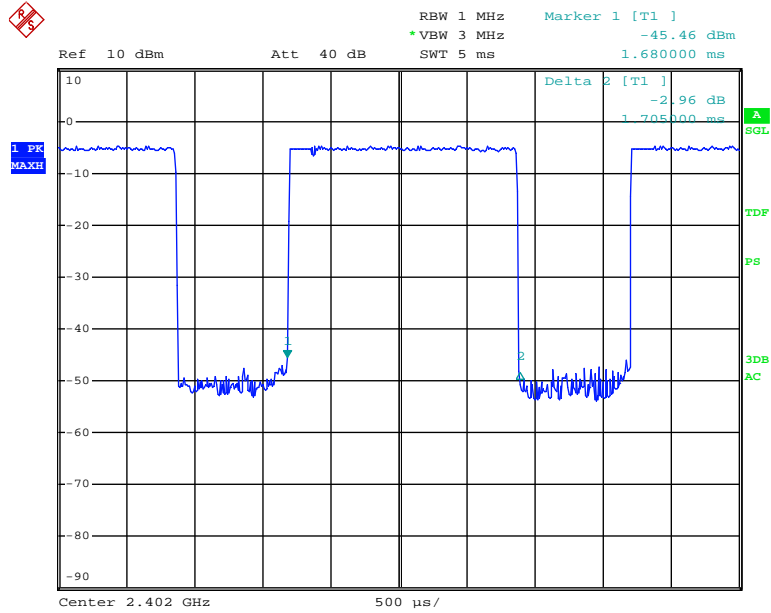
Date: 15.JAN.2014 14:29:58

$\pi/4$ -DQPSK 2-DH1



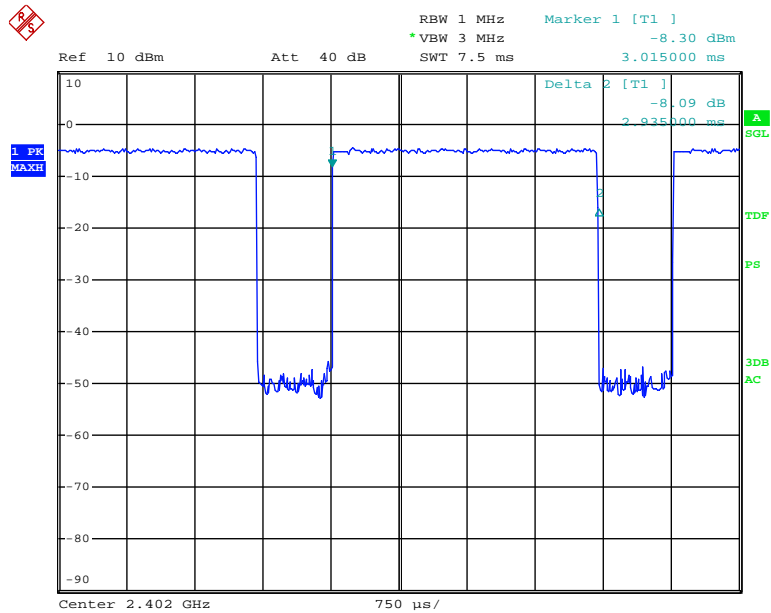
Date: 15.JAN.2014 14:31:21

$\pi/4$ -DQPSK 2-DH3



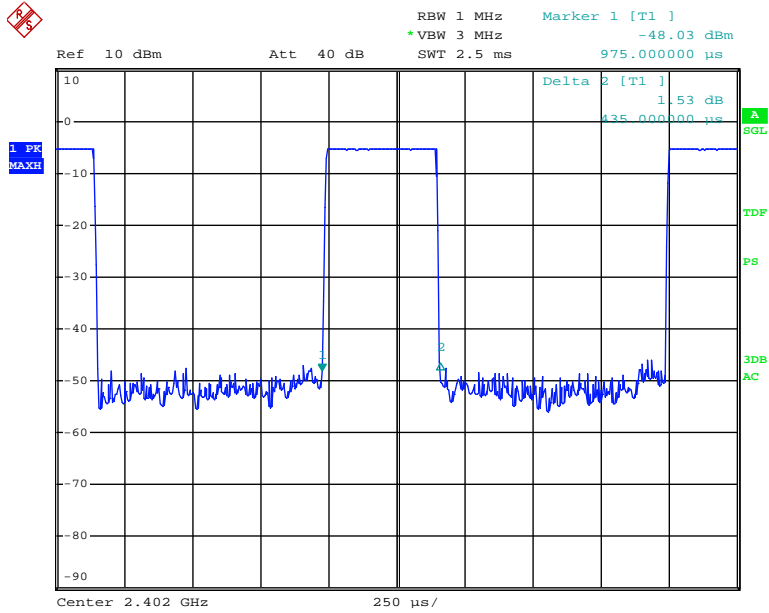
Date: 15.JAN.2014 14:31:58

$\pi/4$ -DQPSK 2-DH5



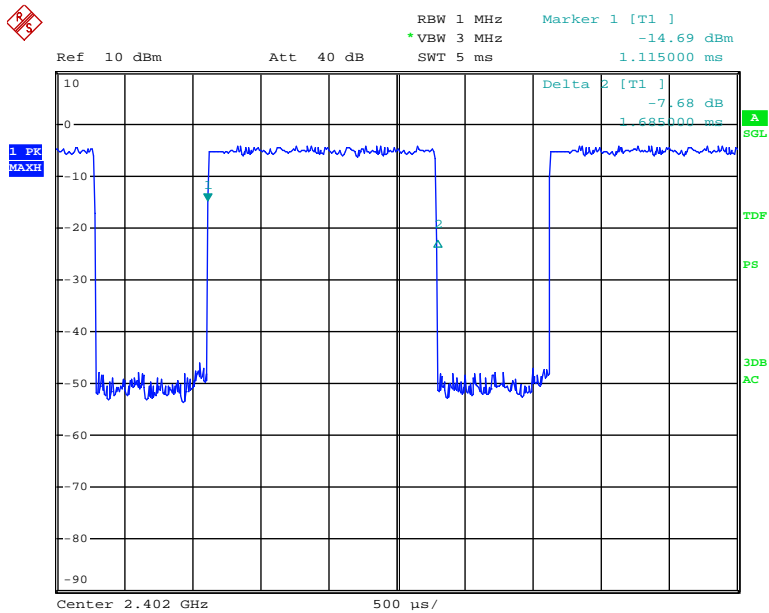
Date: 15.JAN.2014 14:32:21

8DPSK 3-DH1



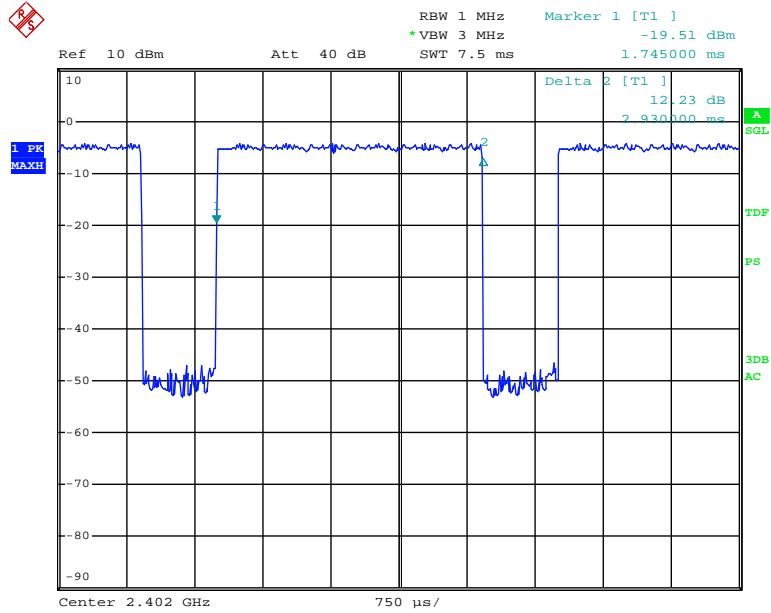
Date: 15.JAN.2014 14:32:50

8DPSK 3-DH3



Date: 15.JAN.2014 14:33:18

8DPSK 3-DH5



Date: 15.JAN.2014 14:33:45

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.

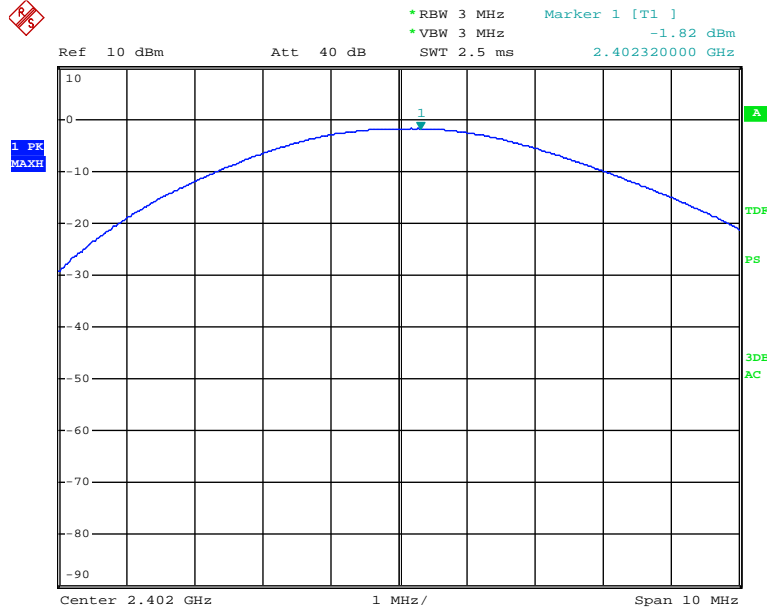
9.2 Measurement Results

Refer to attached data chart.

| | | | |
|--------------------|-----------------------------|---------------|------------------|
| Modulation : | GFSK, $\pi/4$ -DQPSK, 8DPSK | | |
| RBW : | 3MHz | VBW : | 3MHz |
| Spectrum Detector: | PK | Test Date : | January 15, 2014 |
| Test By: | Sance | Temperature : | 22 °C |
| Test Result: | PASS | Humidity : | 42 % |

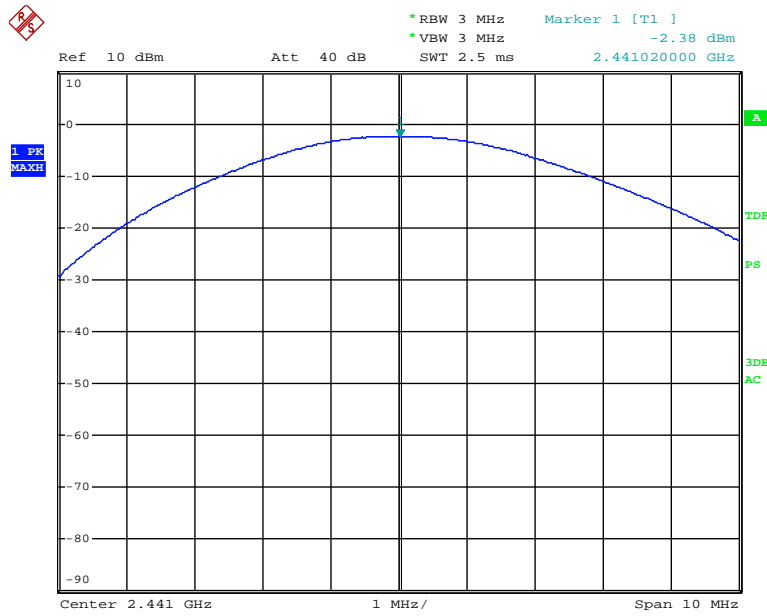
| Channel Frequency (MHz) | Cable Loss dB | Peak Power output(mW) | Peak Power output(dBm) | Peak Power Limit(dBm) | Pass/Fail |
|---------------------------------|---------------|-----------------------|------------------------|-----------------------|-----------|
| GFSK | | | | | |
| 2402.00 | 1.5 | 0.66 | -1.82 | 21 | PASS |
| 2441.00 | 1.5 | 0.58 | -2.38 | 21 | PASS |
| 2480.00 | 1.5 | 0.54 | -2.71 | 21 | PASS |
| $\pi/4$-DQPSK | | | | | |
| 2402.00 | 1.5 | 0.45 | -3.51 | 21 | PASS |
| 2441.00 | 1.5 | 0.37 | -4.37 | 21 | PASS |
| 2480.00 | 1.5 | 0.33 | -4.82 | 21 | PASS |
| 8DPSK | | | | | |
| 2402.00 | 1.5 | 0.50 | -3.03 | 21 | PASS |
| 2441.00 | 1.5 | 0.42 | -3.75 | 21 | PASS |
| 2480.00 | 1.5 | 0.38 | -4.20 | 21 | PASS |

GFSK Lowest Channel



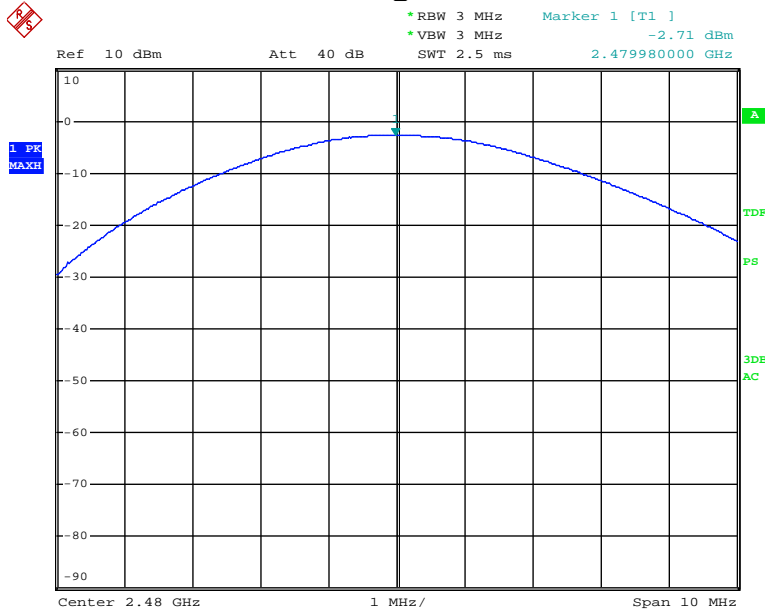
Date: 15.JAN.2014 14:35:00

GFSK Middle Channel



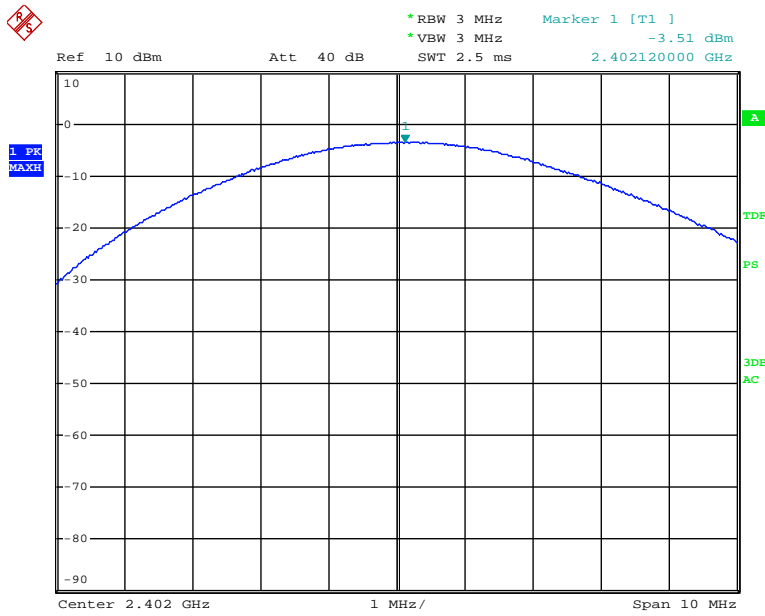
Date: 15.JAN.2014 14:35:12

GFSK Highest Channel



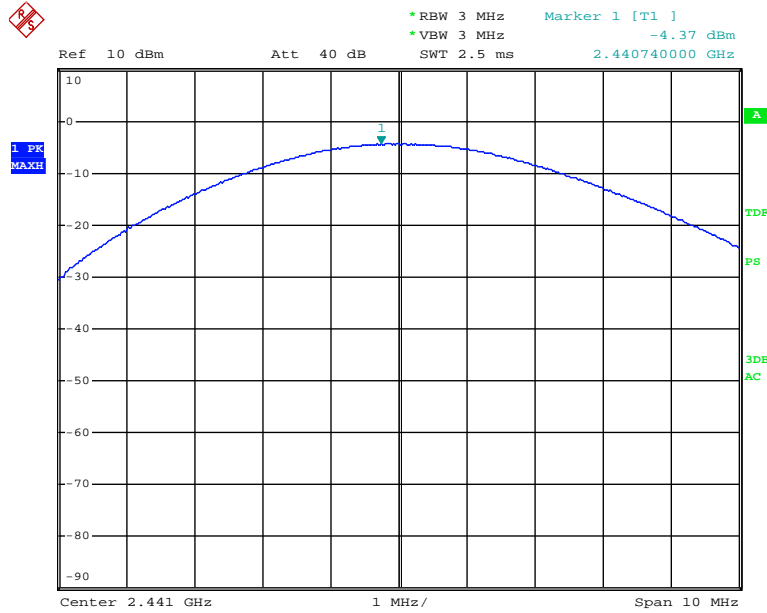
Date: 15.JAN.2014 14:35:26

$\pi/4$ -DQPSK Lowest Channel



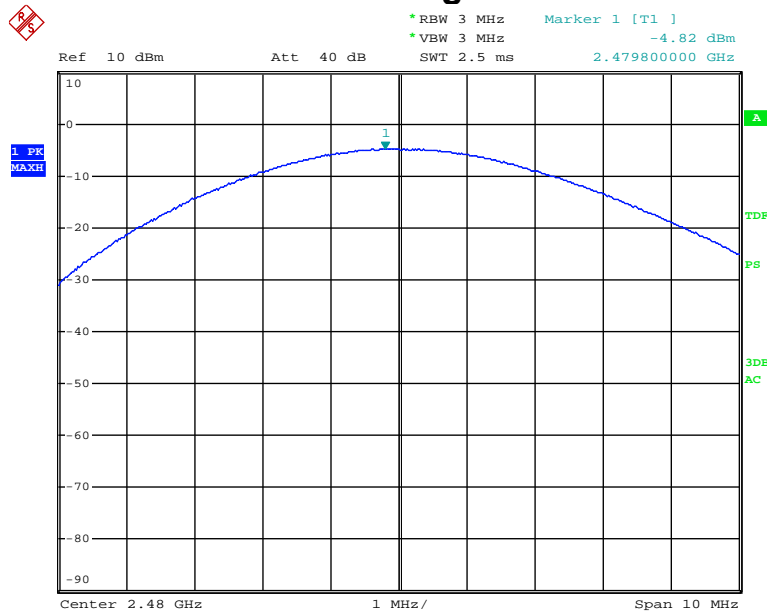
Date: 15.JAN.2014 14:35:54

$\pi/4$ -DQPSK Middle Channel



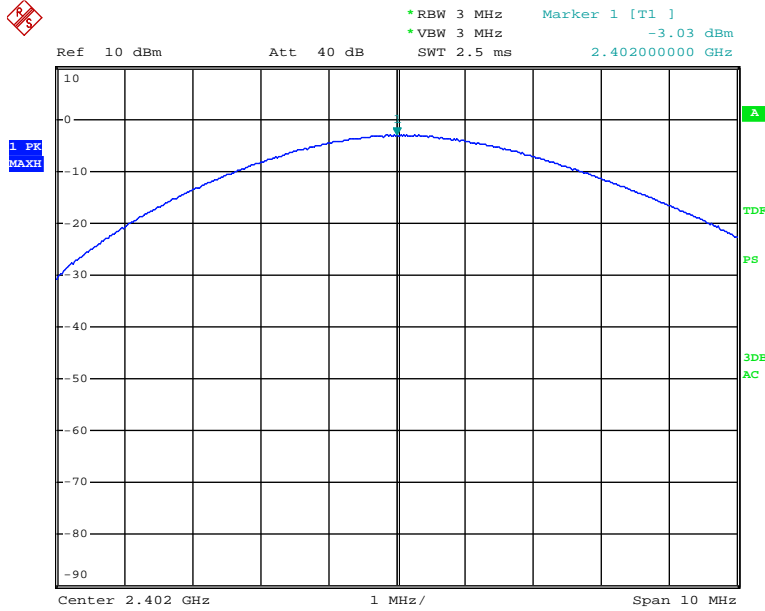
Date: 15.JAN.2014 14:36:09

$\pi/4$ -DQPSK Highest Channel



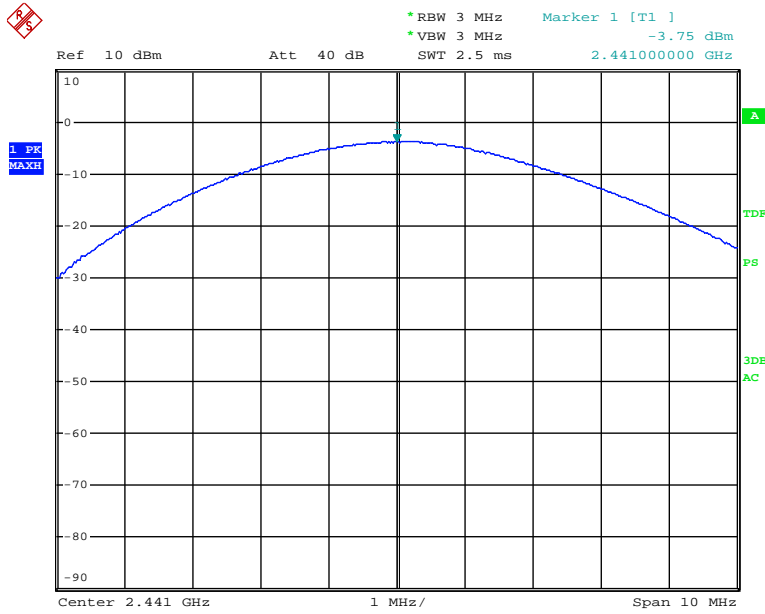
Date: 15.JAN.2014 14:36:22

8DPSK Lowest Channel



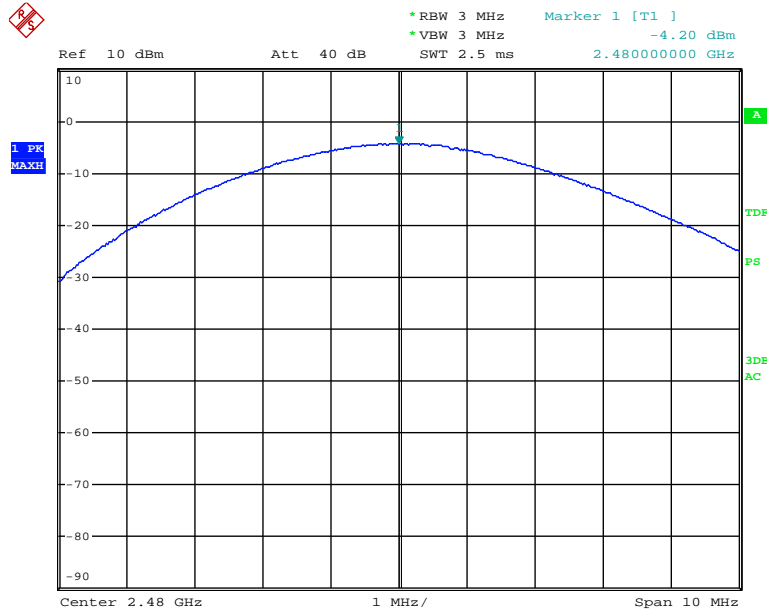
Date: 15.JAN.2014 14:36:52

8DPSK Middle Channel



Date: 15.JAN.2014 14:37:09

8DPSK Highest Channel



Date: 15.JAN.2014 14:37:23

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.

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

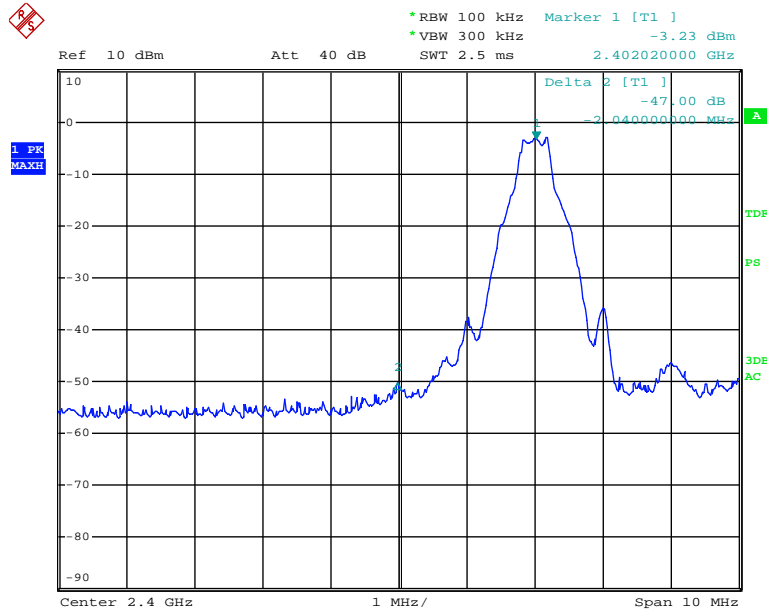
Please see below test table and plots.
 For Radiated Emission
 The worst case: GFSK

| Freq. (MHz) | Ant. Pol. | Reading Level (dBUV) | | Factor (dB/m) | Emission Level (dBUV) | | Limit 3m (dBUV/m) | | Margin (dB) | |
|-------------|-----------|----------------------|-------|---------------|-----------------------|-------|-------------------|-------|-------------|--------|
| | | Peak | AV | | Peak | AV | Peak | AV | Peak | AV |
| GFSK | | | | | | | | | | |
| 2399.820 | H | 40.26 | 23.47 | 8.09 | 48.35 | 31.56 | 74.00 | 54.00 | -25.65 | -22.44 |
| 2399.900 | V | 39.15 | 22.89 | 8.09 | 47.24 | 30.98 | 74.00 | 54.00 | -26.76 | -23.02 |
| 2483.620 | H | 32.32 | 21.47 | 8.36 | 40.68 | 29.83 | 74.00 | 54.00 | -30.32 | -24.17 |
| 2483.650 | V | 32.73 | 22.08 | 8.36 | 41.09 | 30.44 | 74.00 | 54.00 | -32.91 | -23.56 |

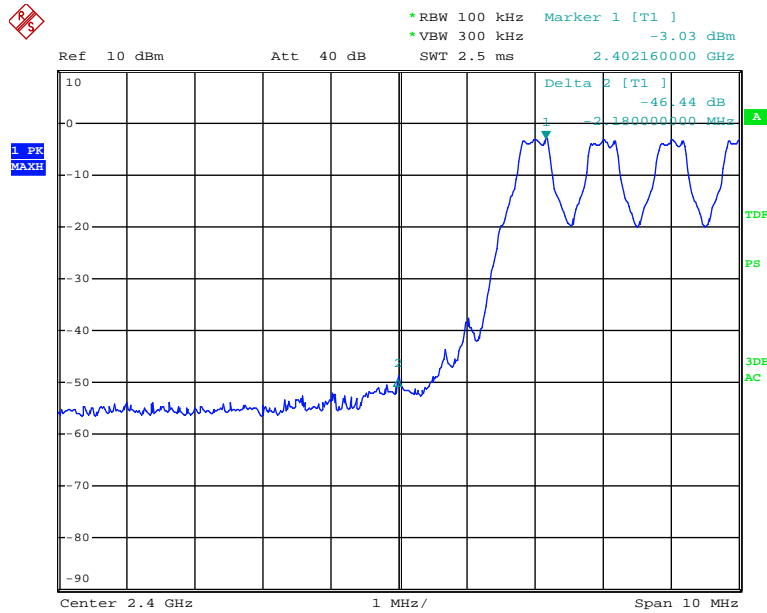
- Note:**
- (1) Emission Level= Reading Level + Factor
 - (2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
 - (3) Horn antenna used for the emission over 1000MHz.

For RF Conducted

GFSK Lowest Channel

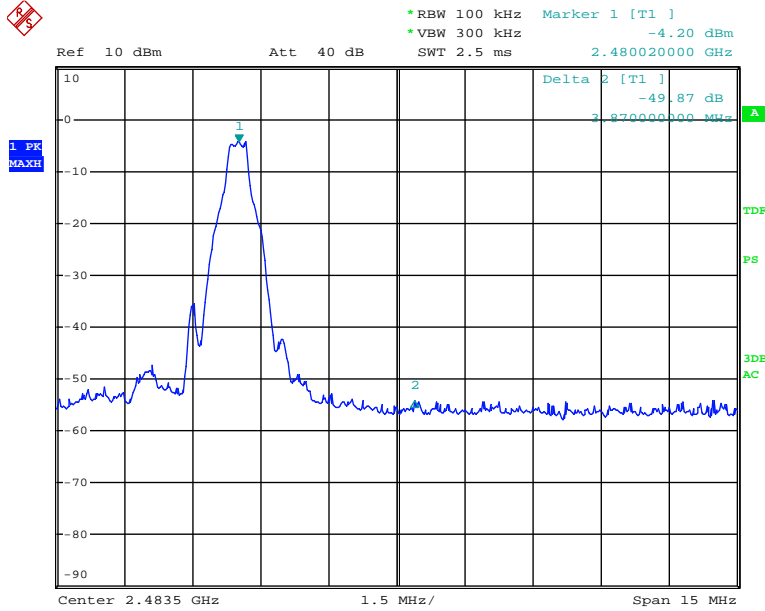


Date: 15.JAN.2014 14:46:50

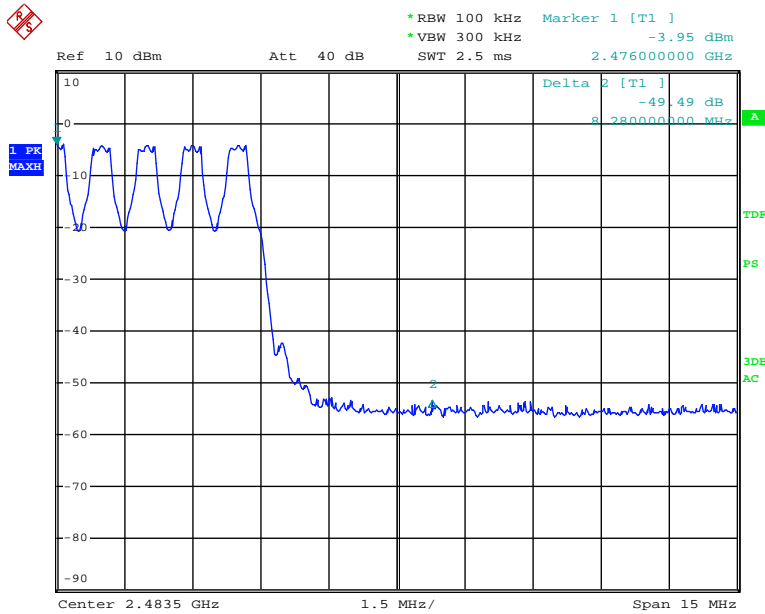


Date: 15.JAN.2014 14:47:56

GFSK Highest Channel

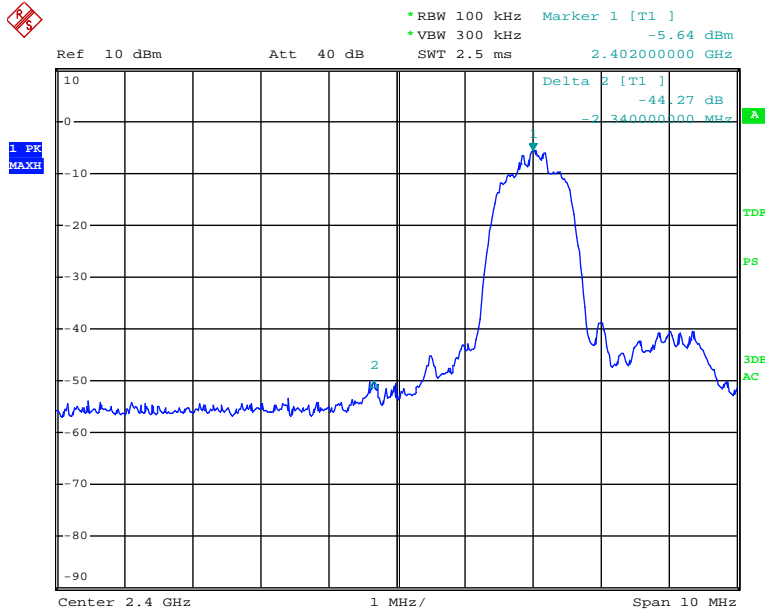


Date: 15.JAN.2014 15:04:51

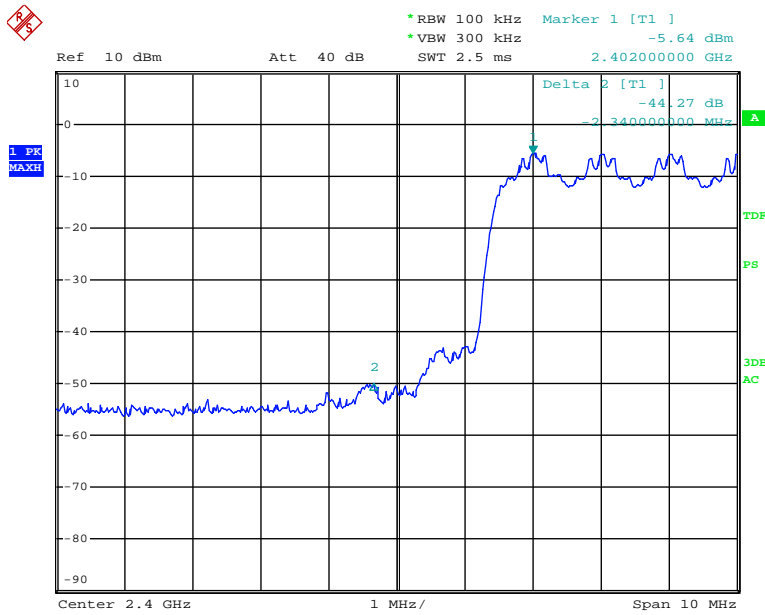


Date: 15.JAN.2014 15:05:46

$\pi/4$ -DQPSK Lowest Channel

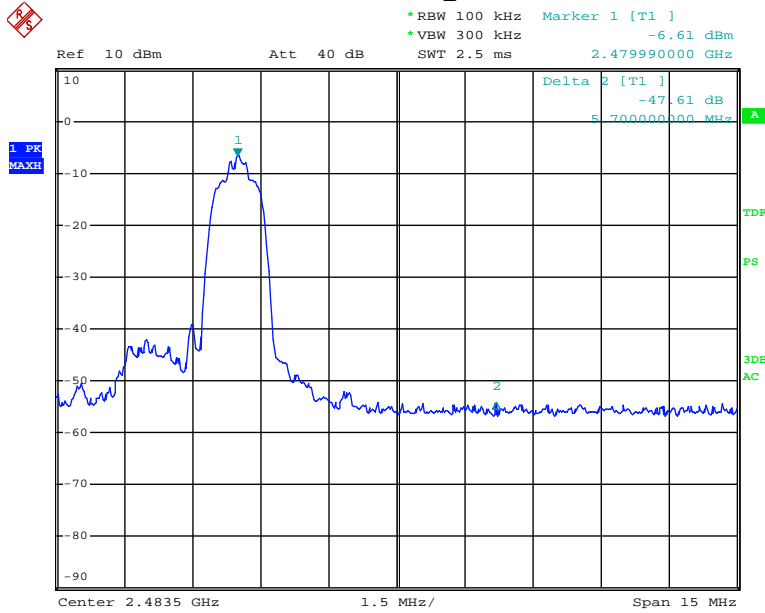


Date: 15.JAN.2014 14:49:16

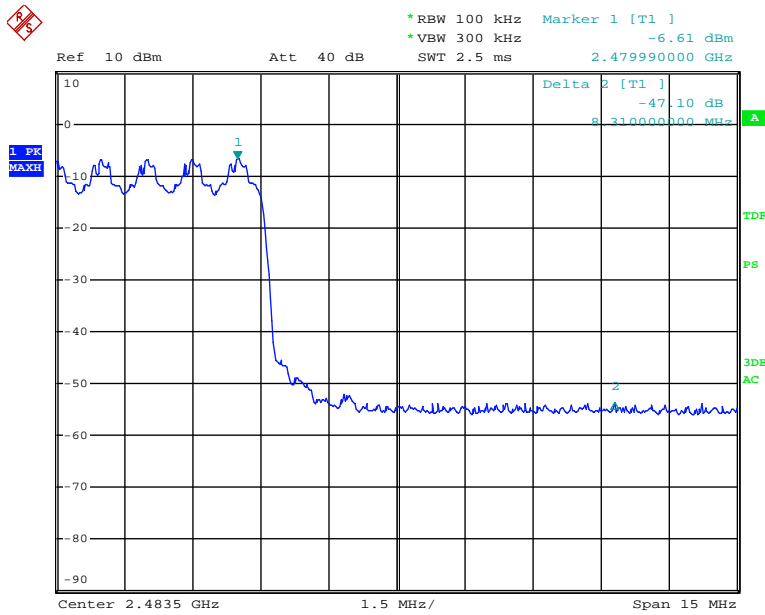


Date: 15.JAN.2014 14:50:58

$\pi/4$ -DQPSK Highest Channel

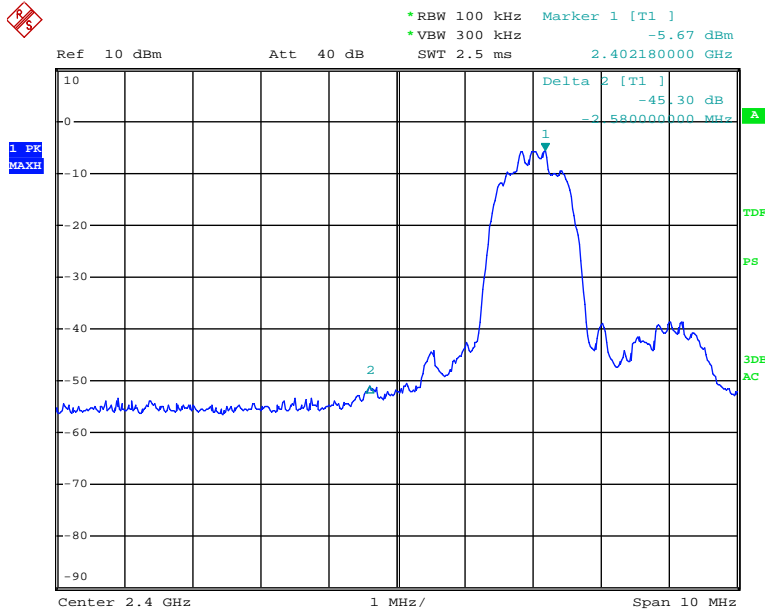


Date: 15.JAN.2014 15:00:40

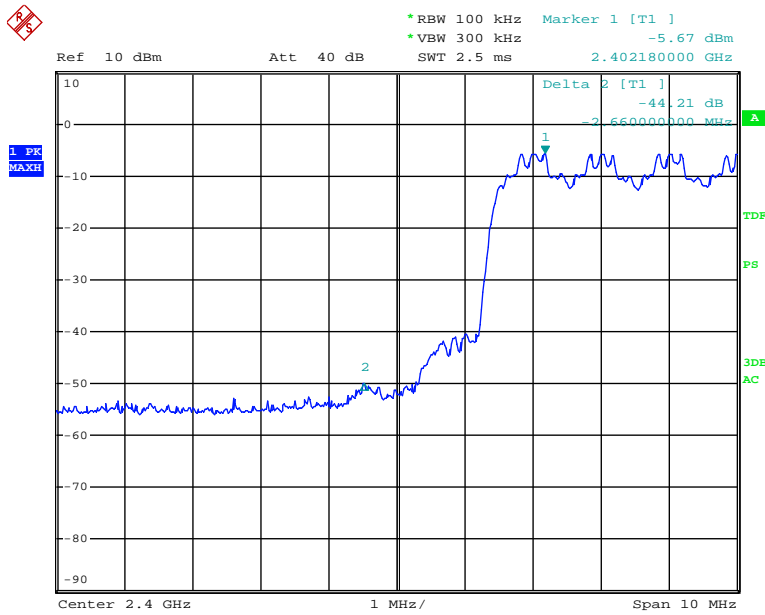


Date: 15.JAN.2014 15:02:34

8DPSK Lowest Channel

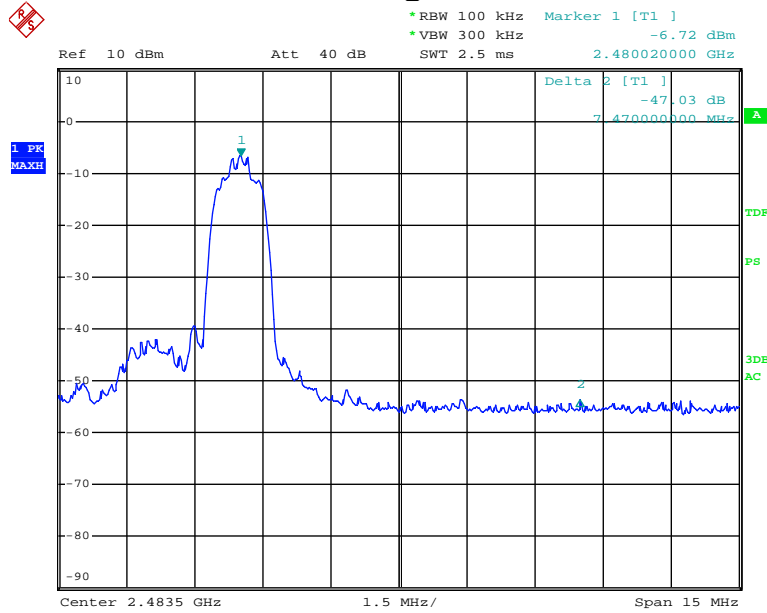


Date: 15.JAN.2014 14:53:05

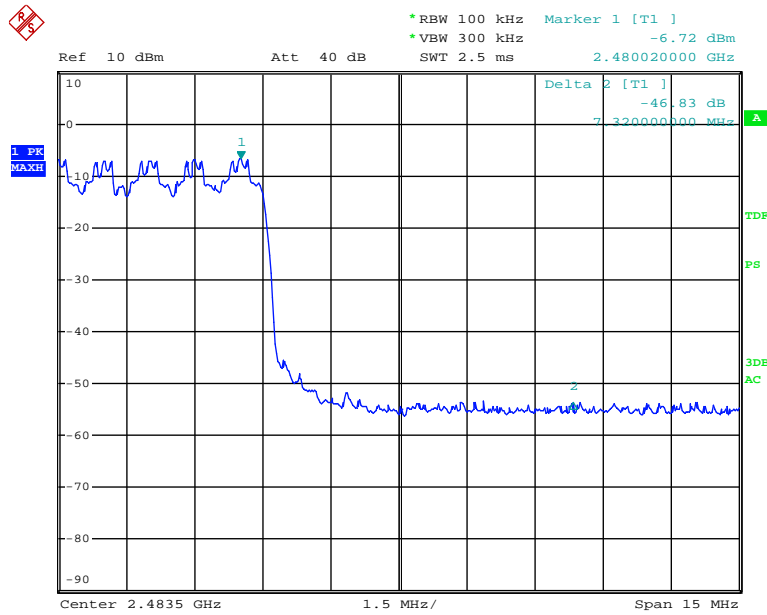


Date: 15.JAN.2014 14:54:19

8DPSK Highest Channel



Date: 15.JAN.2014 14:58:09



Date: 15.JAN.2014 14:59:31

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 2dBi. So, the antenna is consider meet the requirement.

12. Conducted Spurious Emissions

12.1 Measurement Procedure

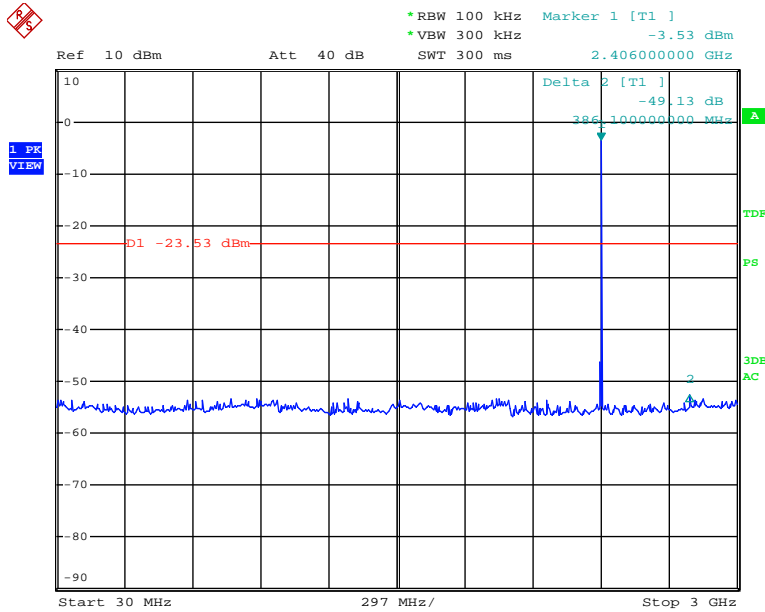
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

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: 15.JAN.2014 14:25:26

Agilent 15:55:33 Jan 15, 2014 R T

Ref 16.5 dBm Atten 25 dB Mkr1 16.53 GHz
 -23.5 dBm -46.97 dBm

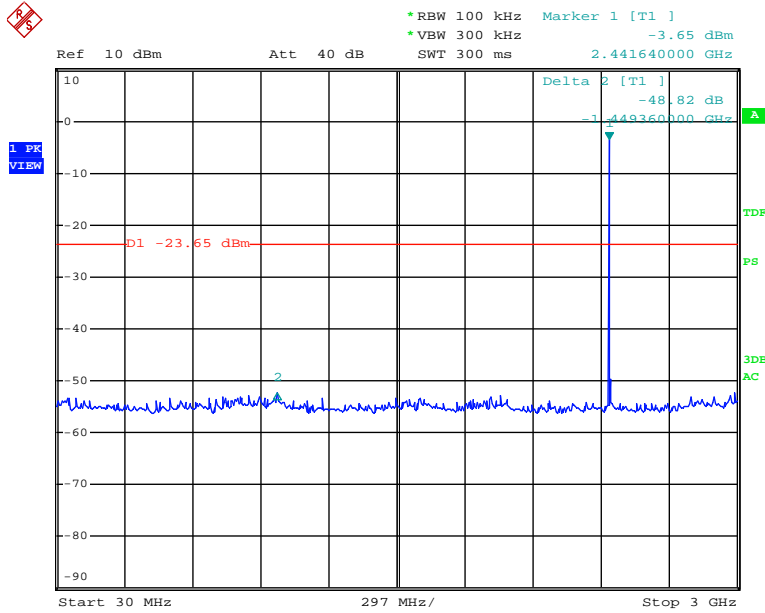
Peak Search
 Meas Tools ▾
 Next Peak
 Next Pk Right
 Next Pk Left
 Min Search
 Pk-Pk Search
 More 1 of 2

Log 10 dB/Offst 1.5 dB
 DI -23.5 dBm
 Marker
 16.530000000 GHz
 -46.97 dBm

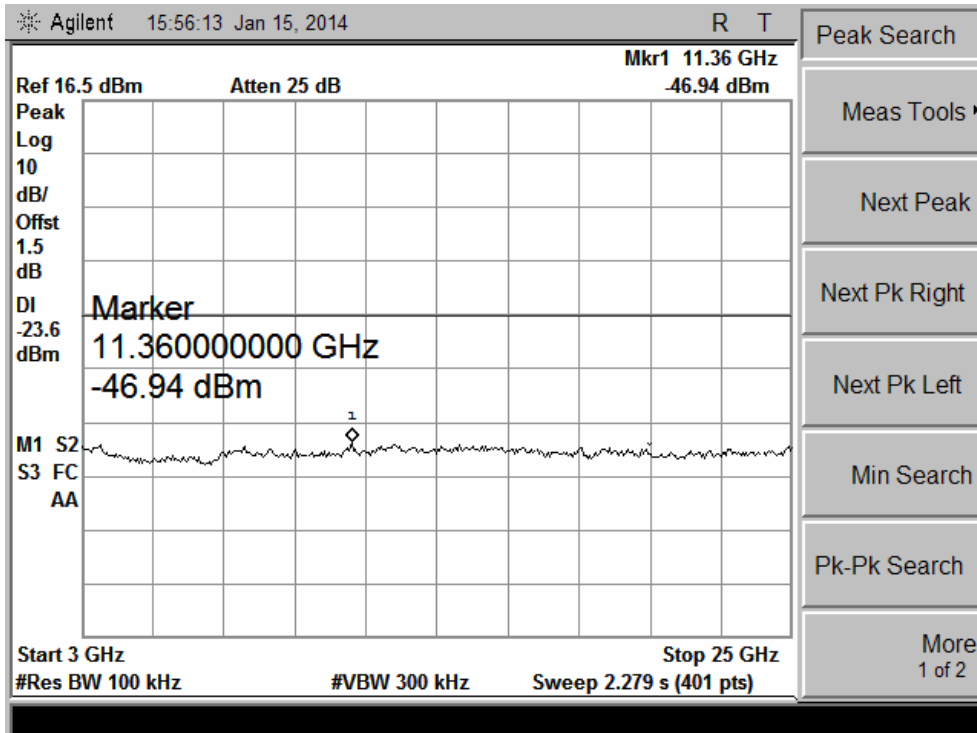
M1 S2
 S3 FC
 AA

Start 3 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 2.279 s (401 pts) Stop 25 GHz

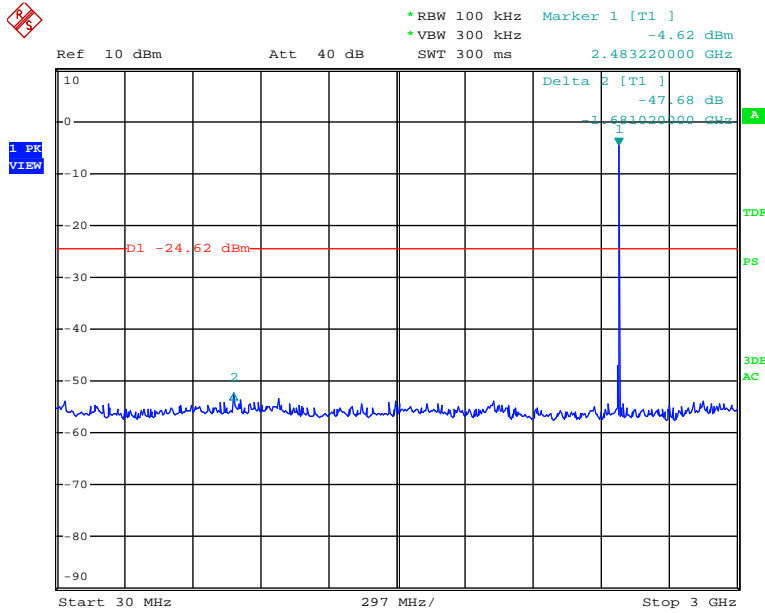
GFSK Middle Channel



Date: 15.JAN.2014 15:20:58



GFSK Highest Channel



Date: 15.JAN.2014 14:26:49

Agilent 15:56:46 Jan 15, 2014 R T

Ref 16.5 dBm Atten 25 dB Mkr1 13.12 GHz -47.6 dBm

Peak Log 10 dB/Offst 1.5 dB

DI -24.6 dBm

Marker
 13.120000000 GHz
 -47.6 dBm

M1 S2
 S3 FC
 AA

Start 3 GHz Stop 25 GHz
 #Res BW 100 kHz #VBW 300 kHz Sweep 2.279 s (401 pts)

Peak Search
 Meas Tools
 Next Peak
 Next Pk Right
 Next Pk Left
 Min Search
 Pk-Pk Search
 More 1 of 2

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 | SUNSP0 | 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---