

# FCC REPORT

## (Bluetooth)

**Applicant:** Grand Electronics, INC

**Address of Applicant:** 11650 Brentcross Dr Tomball, TX 77377, United States

**Equipment Under Test (EUT)**

Product Name: Bluetooth Earphone

Model No.: HPB4HE

Trade mark: tec.art, tecart

**FCC ID:** 2AGNK-HPB4HE

**Applicable standards:** FCC CFR Title 47 Part 15 Subpart C Section 15.247

**Date of sample receipt:** 26 Sep., 2016

**Date of Test:** 26 Sep., to 09 Oct., 2016

**Date of report issued:** 09 Oct., 2016

**Test Result:** PASS \*

\* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Bruce Zhang  
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the CCIS product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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## 2 Version

| Version No. | Date          | Description |
|-------------|---------------|-------------|
| 00          | 09 Oct., 2016 | Original    |
|             |               |             |
|             |               |             |
|             |               |             |
|             |               |             |

Tested by:

*Zora Lee*

Date:

09 Oct., 2016

Test Engineer

Reviewed by:

*M. Liang*

Date:

09 Oct., 2016

Project Engineer

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## 4 Test Summary

| Test Item                        | Section in CFR 47 | Result |
|----------------------------------|-------------------|--------|
| Antenna Requirement              | 15.203/15.247 (c) | Pass   |
| AC Power Line Conducted Emission | 15.207            | Pass   |
| Conducted Peak Output Power      | 15.247 (b)(1)     | Pass   |
| 20dB Occupied Bandwidth          | 15.247 (a)(1)     | Pass   |
| Carrier Frequencies Separation   | 15.247 (a)(1)     | Pass   |
| Hopping Channel Number           | 15.247 (a)(1)     | Pass   |
| Dwell Time                       | 15.247 (a)(1)     | Pass   |
| Radiated Emission                | 15.205/15.209     | Pass   |
| Band Edge                        | 15.247(d)         | Pass   |

*Pass: The EUT complies with the essential requirements in the standard.*

## 5 General Information

### 5.1 Client Information

|                          |  |
|--------------------------|--|
| Applicant:               | Grand Electronics, INC   |
| Address of Applicant:    | 11650 Brentcross Dr Tomball, TX 77377, United States   |
| Manufacturer:            | GRAND ELECTRI-TECH GLOBAL TRADING LIMITED  |
| Address of Manufacturer: | UNIT 04, 7/F, BRIGHT WAY TOWER, NO. 33 MONG KOK ROAD, KOWLOON, HK.                                   |
| Factory:                 | SHENZHEN KAINUOMING TECHNOLOGYCO., LTD   |
| Address of Factory:      | 6A6, Xingsheng Creative Park, Wushaxing Second Road No. 18, Changan Town, Dongguan, Guangdong, China |

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

|                        |  |
|------------------------|--|
| Product Name:          | Bluetooth Earphone                           |
| Model No.:             | HPB4HE                                       |
| Operation Frequency:   | 2402MHz~2480MHz                              |
| Transfer rate:         | 1/2/3 Mbits/s                                |
| Number of channel:     | 79   |
| Modulation type:       | GFSK, $\pi/4$ -DQPSK, 8DPSK                  |
| Modulation technology: | FHSS   |
| Antenna Type:          | Internal Antenna                             |
| Antenna gain:          | 2.0 dBi                                      |
| Power supply:          | DC 3.7V supplied by the rechargeable battery |

| Operation Frequency each of channel for GFSK, $\pi/4$ -DQPSK, 8DPSK     |           |         |           |         |           |         |           |
|---|-----------|---------|-----------|---------|-----------|---------|-----------|
| Channel   | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 0   | 2402MHz   | 20      | 2422MHz   | 40      | 2442MHz   | 60      | 2462MHz   |
| 1   | 2403MHz   | 21      | 2423MHz   | 41      | 2443MHz   | 61      | 2463MHz   |
| 2   | 2404MHz   | 22      | 2424MHz   | 42      | 2444MHz   | 62      | 2464MHz   |
| 3   | 2405MHz   | 23      | 2425MHz   | 43      | 2445MHz   | 63      | 2465MHz   |
| 4   | 2406MHz   | 24      | 2426MHz   | 44      | 2446MHz   | 64      | 2466MHz   |
| 5   | 2407MHz   | 25      | 2427MHz   | 45      | 2447MHz   | 65      | 2467MHz   |
| 6   | 2408MHz   | 26      | 2428MHz   | 46      | 2448MHz   | 66      | 2468MHz   |
| 7   | 2409MHz   | 27      | 2429MHz   | 47      | 2449MHz   | 67      | 2469MHz   |
| 8   | 2410MHz   | 28      | 2430MHz   | 48      | 2450MHz   | 68      | 2470MHz   |
| 9   | 2411MHz   | 29      | 2431MHz   | 49      | 2451MHz   | 69      | 2471MHz   |
| 10  | 2412MHz   | 30      | 2432MHz   | 50      | 2452MHz   | 70      | 2472MHz   |
| 11  | 2413MHz   | 31      | 2433MHz   | 51      | 2453MHz   | 71      | 2473MHz   |
| 12  | 2414MHz   | 32      | 2434MHz   | 52      | 2454MHz   | 72      | 2474MHz   |
| 13  | 2415MHz   | 33      | 2435MHz   | 53      | 2455MHz   | 73      | 2475MHz   |
| 14  | 2416MHz   | 34      | 2436MHz   | 54      | 2456MHz   | 74      | 2476MHz   |
| 15  | 2417MHz   | 35      | 2437MHz   | 55      | 2457MHz   | 75      | 2477MHz   |
| 16  | 2418MHz   | 36      | 2438MHz   | 56      | 2458MHz   | 76      | 2478MHz   |
| 17  | 2419MHz   | 37      | 2439MHz   | 57      | 2459MHz   | 77      | 2479MHz   |
| 18  | 2420MHz   | 38      | 2440MHz   | 58      | 2460MHz   | 78      | 2480MHz   |
| 19  | 2421MHz   | 39      | 2441MHz   | 59      | 2461MHz   |         |           |
| Remark: Channel 0, 39 & 78 selected for GFSK, $\pi/4$ -DQPSK and 8DPSK. |           |         |           |         |           |         |           |

### 5.3 Test mode

|   |  |
|---|--|
| Transmitting mode:  | Keep the EUT in transmitting mode with worst case data rate. |
| Remark  | GFSK (1 Mbps) is the worst case mode.                        |
| <p>The sample was placed 0.8m(below 1GHz)/1.5m(above 1GHz) above the ground plane of 3m chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working with a fresh battery, investigated all operating modes, rotated about all 3 axis (X, Y &amp; Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.</p> |  |

### 5.4 Measurement Uncertainty

| Items                               | Expanded Uncertainty (Confidence of 95%) |
|-------------------------------------|--|
| Conducted Emission (9kHz ~ 30MHz)   | 2.14 dB (k=2)                            |
| Radiated Emission (9kHz ~ 30MHz)    | 4.24 dB (k=2)                            |
| Radiated Emission (30MHz ~ 1000MHz) | 4.35 dB (k=2)                            |
| Radiated Emission (1GHz ~ 18GHz)    | 4.44 dB (k=2)                            |
| Radiated Emission (18GHz ~ 26.5GHz) | 4.56 dB (k=2)                            |

### 5.5 Laboratory Facility

|  |
|--|
| <p>The test facility is recognized, certified, or accredited by the following organizations:</p> <ul style="list-style-type: none"> <li>● <b>FCC - Registration No.: 817957</b><br/>Shenzhen Zhongjian Nanfang Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in out files. Registration 817957, February 27, 2012.</li> <li>● <b>IC - Registration No.: 10106A-1</b><br/>The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.</li> <li>● <b>CNAS - Registration No.: CNAS L6048</b><br/>Shenzhen Zhongjian Nanfang Testing Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6048.</li> </ul> |
|--|

### 5.6 Laboratory Location

|   |
|---|
| <p>Shenzhen Zhongjian Nanfang Testing Co., Ltd.<br/>Address: No. B-C, 1/F., Building 2, Laodong No.2 Industrial Park, Xixiang Road, Bao'an District, Shenzhen, Guangdong, China<br/>Tel: +86-755-23118282<br/>Fax: +86-755-23116366</p> |
|---|

## 5.7 Test Instruments list


| Radiated Emission: |                              |                                   |                             |               |                      |                          |
|--------------------|------------------------------|-----------------------------------|-----------------------------|---------------|----------------------|--------------------------|
| Item               | Test Equipment               | Manufacturer                      | Model No.                   | Inventory No. | Cal. Date (mm-dd-yy) | Cal. Due date (mm-dd-yy) |
| 1                  | 3m SAC                       | SAEMC                             | 9(L)*6(W)* 6(H)             | CCIS0001      | 08-23-2014           | 08-22-2017               |
| 2                  | BiConiLog Antenna            | SCHWARZBECK                       | VULB9163                    | CCIS0005      | 03-25-2016           | 03-25-2017               |
| 3                  | Horn Antenna                 | SCHWARZBECK                       | BBHA9120D                   | CCIS0006      | 03-25-2016           | 03-25-2017               |
| 4                  | Pre-amplifier (10kHz-1.3GHz) | HP                                | 8447D                       | CCIS0003      | 04-01-2016           | 03-31-2017               |
| 5                  | Pre-amplifier (1GHz-18GHz)   | Compliance Direction Systems Inc. | PAP-1G18                    | CCIS0011      | 04-01-2016           | 03-31-2017               |
| 6                  | Pre-amplifier (18-26GHz)     | Rohde & Schwarz                   | AFS33-18002<br>650-30-8P-44 | GTS218        | 04-01-2016           | 03-31-2017               |
| 7                  | Horn Antenna                 | ETS-LINDGREN                      | 3160                        | GTS217        | 04-01-2016           | 03-31-2017               |
| 8                  | Spectrum analyzer 9k-30GHz   | Rohde & Schwarz                   | FSP30                       | CCIS0023      | 03-28-2016           | 03-28-2017               |
| 9                  | EMI Test Receiver            | Rohde & Schwarz                   | ESRP7                       | CCIS0167      | 03-28-2016           | 03-28-2017               |
| 10                 | Loop antenna                 | Laplace instrument                | RF300                       | EMC0701       | 04-01-2016           | 03-31-2017               |
| 11                 | EMI Test Software            | AUDIX                             | E3                          | N/A           | N/A                  | N/A                      |

| Conducted Emission: |                   |                    |                       |               |                      |                          |
|---------------------|-------------------|--------------------|-----------------------|---------------|----------------------|--------------------------|
| Item                | Test Equipment    | Manufacturer       | Model No.             | Inventory No. | Cal. Date (mm-dd-yy) | Cal. Due date (mm-dd-yy) |
| 1                   | Shielding Room    | ZhongShuo Electron | 11.0(L)x4.0(W)x3.0(H) | CCIS0061      | 08-23-2014           | 08-22-2017               |
| 2                   | EMI Test Receiver | Rohde & Schwarz    | ESCI                  | CCIS0002      | 03-24-2016           | 03-24-2017               |
| 3                   | LISN              | CHASE              | MN2050D               | CCIS0074      | 03-26-2016           | 03-26-2017               |
| 4                   | Coaxial Cable     | CCIS               | N/A                   | CCIS0086      | 04-01-2016           | 03-31-2017               |
| 5                   | EMI Test Software | AUDIX              | E3                    | N/A           | N/A                  | N/A                      |



## 6 Test results and Measurement Data

### 6.1 Antenna requirement

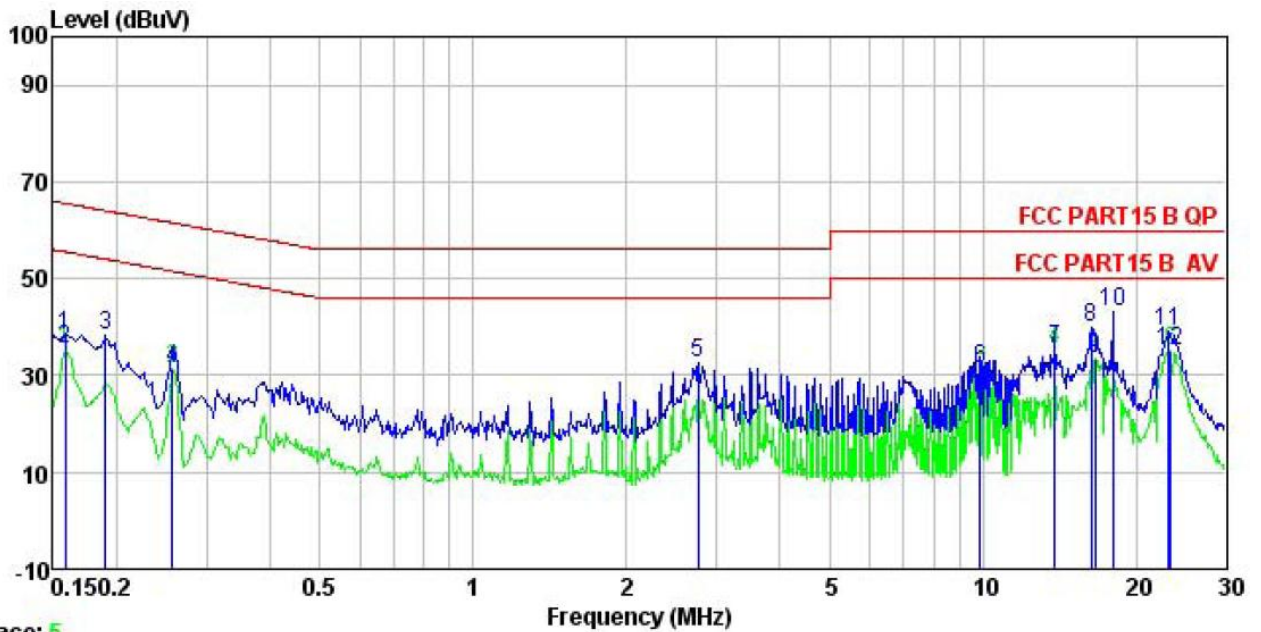
|  |                                      |
|--|--------------------------------------|
| <b>Standard requirement:</b>   | FCC Part 15 C Section 15.203 /247(c) |
| <p><i>15.203 requirement:</i><br/> <i>An intentional radiator shall be designed to ensure that no antenna other than that furnished by the 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.</i></p> <p><i>15.247(c) (1)(i) requirement:</i><br/> <i>(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.</i></p> |                                      |
| <b>E.U.T Antenna:</b>  |                                      |
| <p><i>The Bluetooth antenna is an integral antenna which permanently attached, and the best case gain of the antenna is 2.0 dBi.</i></p>   |                                      |
|   |                                      |

## 6.2 Conducted Emissions

|  |  |              |           |
|--|--|--------------|-----------|
| Test Requirement:                                | FCC Part 15 C Section 15.207   |              |           |
| Test Method:                                     | ANSI C63.4:2014  |              |           |
| Test Frequency Range:                            | 150 kHz to 30 MHz  |              |           |
| Class / Severity:                                | Class B  |              |           |
| Receiver setup:                                  | RBW=9 kHz, VBW=30 kHz, Sweep time=auto   |              |           |
| Limit:   | Frequency range (MHz)  | Limit (dBuV) |           |
|  |  | Quasi-peak   | Average   |
|  | 0.15-0.5   | 66 to 56*    | 56 to 46* |
|  | 0.5-5  | 56           | 46        |
|  | 5-30   | 60           | 50        |
| * Decreases with the logarithm of the frequency. |  |              |           |
| Test setup:                                      | <p><i>Remark</i><br/> E.U.T: Equipment Under Test<br/> LISN: Line Impedance Stabilization Network<br/> Test table height=0.8m</p>  |              |           |
| Test procedure:                                  | <ol style="list-style-type: none"> <li>1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.</li> <li>2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).</li> <li>3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.</li> </ol> |              |           |
| Test Instruments:                                | Refer to section 5.7 for details   |              |           |
| Test mode:                                       | Bluetooth (Continuous transmitting) mode   |              |           |
| Test results:                                    | Pass   |              |           |

**Measurement Data:**

Line:



Trace: 5

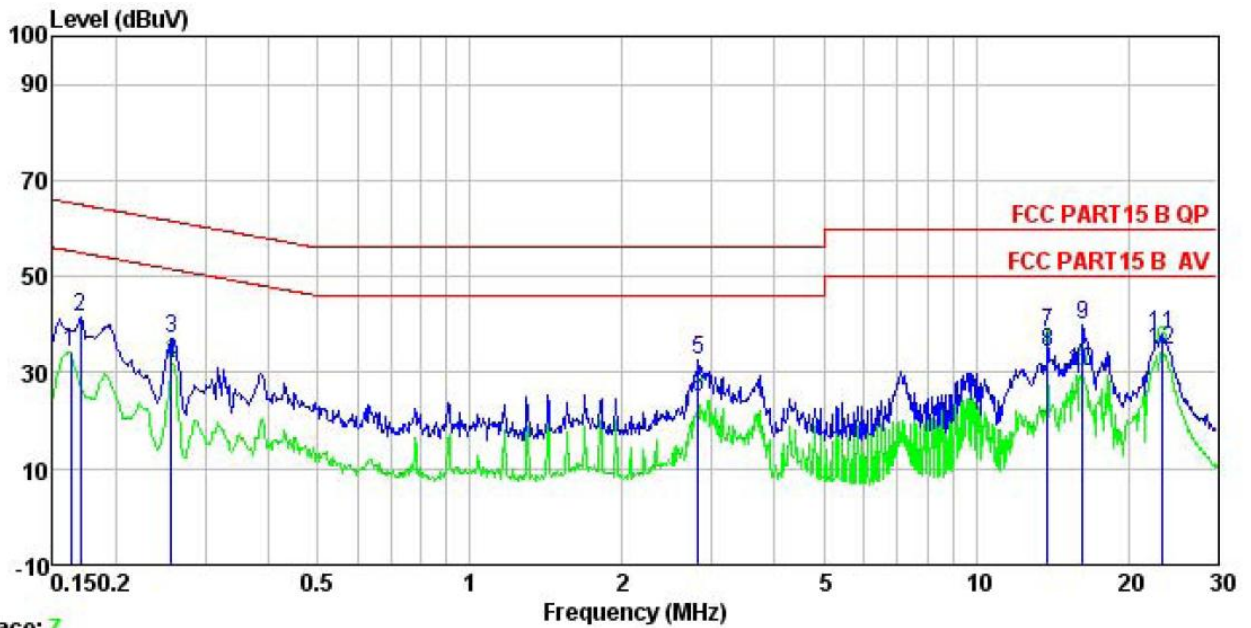
Site : CCIS Shielding Room  
 Condition : FCC PART15 B QP LISN LINE  
 EUT : Bluetooth Earphone  
 Model : HPB4HE  
 Test Mode : BT mode  
 Power Rating : AC120/60Hz  
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa  
 Test Engineer: Zora  
 Remark :

|    | Read Freq | Level | LISN Factor | Cable Loss | Level | Limit | Over   | Remark  |
|----|-----------|-------|-------------|------------|-------|-------|--------|---------|
|    | MHz       | dBuV  | dB          | dB         | dBuV  | dBuV  | dB     |         |
| 1  | 0.158     | 27.53 | 0.14        | 10.78      | 38.45 | 65.56 | -27.11 | QP      |
| 2  | 0.158     | 24.51 | 0.14        | 10.78      | 35.43 | 55.56 | -20.13 | Average |
| 3  | 0.190     | 27.32 | 0.15        | 10.76      | 38.23 | 64.02 | -25.79 | QP      |
| 4  | 0.258     | 20.55 | 0.16        | 10.75      | 31.46 | 51.51 | -20.05 | Average |
| 5  | 2.765     | 21.33 | 0.33        | 10.93      | 32.59 | 56.00 | -23.41 | QP      |
| 6  | 9.861     | 20.00 | 0.30        | 10.93      | 31.23 | 50.00 | -18.77 | Average |
| 7  | 13.841    | 24.17 | 0.26        | 10.91      | 35.34 | 50.00 | -14.66 | Average |
| 8  | 16.312    | 28.78 | 0.28        | 10.91      | 39.97 | 60.00 | -20.03 | QP      |
| 9  | 16.573    | 22.12 | 0.28        | 10.91      | 33.31 | 50.00 | -16.69 | Average |
| 10 | 17.944    | 31.86 | 0.31        | 10.90      | 43.07 | 60.00 | -16.93 | QP      |
| 11 | 23.140    | 27.86 | 0.35        | 10.89      | 39.10 | 60.00 | -20.90 | QP      |
| 12 | 23.387    | 23.99 | 0.35        | 10.89      | 35.23 | 50.00 | -14.77 | Average |

**Notes:**

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss.

Neutral:



Trace: 7

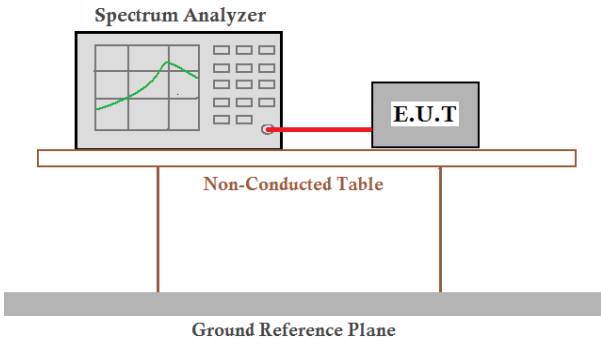
Site : CCIS Shielding Room  
 Condition : FCC PART15 B QP LISN NEUTRAL  
 EUT : Bluetooth Earphone  
 Model : HPB4HE  
 Test Mode : BT mode  
 Power Rating : AC120/60Hz  
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa  
 Test Engineer: Zora  
 Remark :

|    | Read Freq | Read Level | LISN Factor | Cable Loss | Level | Limit Line | Over Limit | Remark  |
|----|-----------|------------|-------------|------------|-------|------------|------------|---------|
|    | MHz       | dBuV       | dB          | dB         | dBuV  | dBuV       | dB         |         |
| 1  | 0.162     | 23.30      | 0.13        | 10.77      | 34.20 | 55.34      | -21.14     | Average |
| 2  | 0.170     | 30.53      | 0.13        | 10.77      | 41.43 | 64.94      | -23.51     | QP      |
| 3  | 0.258     | 26.10      | 0.17        | 10.75      | 37.02 | 61.51      | -24.49     | QP      |
| 4  | 0.258     | 20.71      | 0.17        | 10.75      | 31.63 | 51.51      | -19.88     | Average |
| 5  | 2.824     | 21.41      | 0.30        | 10.93      | 32.64 | 56.00      | -23.36     | QP      |
| 6  | 2.824     | 13.75      | 0.30        | 10.93      | 24.98 | 46.00      | -21.02     | Average |
| 7  | 13.841    | 27.23      | 0.26        | 10.91      | 38.40 | 60.00      | -21.60     | QP      |
| 8  | 13.841    | 23.04      | 0.26        | 10.91      | 34.21 | 50.00      | -15.79     | Average |
| 9  | 16.226    | 28.56      | 0.27        | 10.91      | 39.74 | 60.00      | -20.26     | QP      |
| 10 | 16.226    | 19.10      | 0.27        | 10.91      | 30.28 | 50.00      | -19.72     | Average |
| 11 | 23.387    | 26.60      | 0.25        | 10.89      | 37.74 | 60.00      | -22.26     | QP      |
| 12 | 23.387    | 23.48      | 0.25        | 10.89      | 34.62 | 50.00      | -15.38     | Average |

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss.

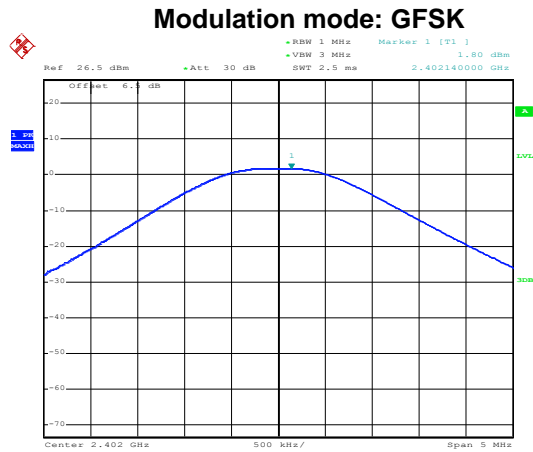
## 6.3 Conducted Output Power

|                   |  |
|-------------------|--|
| Test Requirement: | FCC Part 15 C Section 15.247 (b)(1)  |
| Test Method:      | ANSI C63.10:2013 and DA00-705  |
| Receiver setup:   | RBW=1MHz, VBW=3MHz, Detector=Peak (If 20dB BW ≤1 MHz)<br>RBW=3MHz, VBW=10MHz, Detector=Peak (If 20dB BW > 1 MHz and < 3MHz)  |
| Limit:            | 125 mW(21 dBm)   |
| Test setup:       |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p> |
| Test Instruments: | Refer to section 5.7 for details   |
| Test mode:        | Non-hopping mode   |
| Test results:     | Pass   |

### Measurement Data:

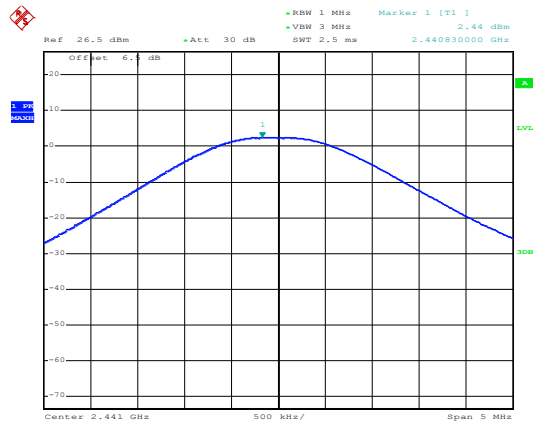
| GFSK mode      |                         |             |        |
|----------------|-------------------------|-------------|--------|
| Test channel   | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest         | 1.80                    | 21.00       | Pass   |
| Middle         | 2.44                    | 21.00       | Pass   |
| Highest        | 1.74                    | 21.00       | Pass   |
| π/4-DQPSK mode |                         |             |        |
| Test channel   | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest         | 0.47                    | 21.00       | Pass   |
| Middle         | 0.28                    | 21.00       | Pass   |
| Highest        | -0.11                   | 21.00       | Pass   |
| 8DPSK mode     |                         |             |        |
| Test channel   | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest         | -0.27                   | 21.00       | Pass   |
| Middle         | 0.50                    | 21.00       | Pass   |
| Highest        | -0.08                   | 21.00       | Pass   |

Test plot as follows:



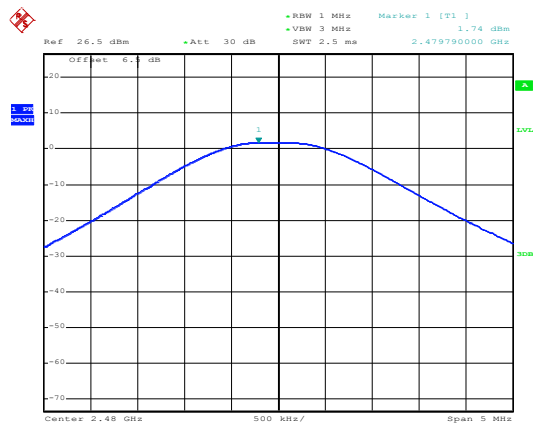
Date: 27.SEP.2016 10:00:53

### Lowest channel



Date: 27.SEP.2016 10:02:01

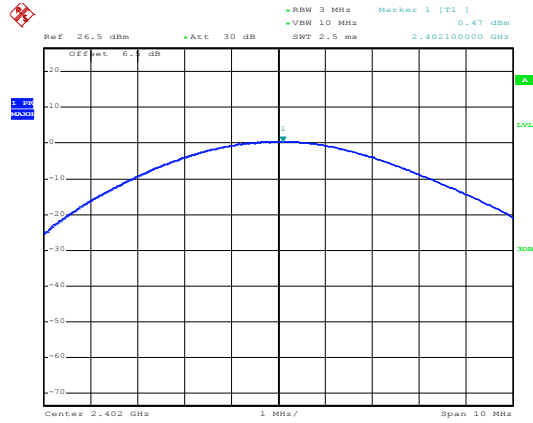
### Middle channel



Date: 27.SEP.2016 10:02:27

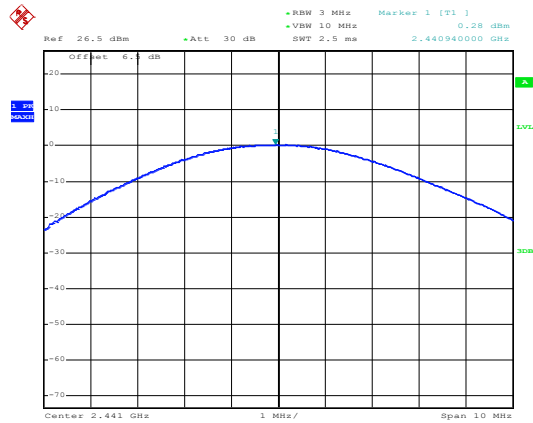
### Highest channel

### Modulation mode: $\pi/4$ -DQPSK



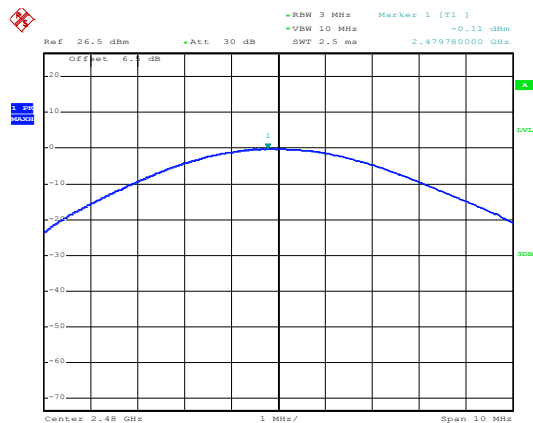
Date: 27.SEP.2016 10:06:01

### Lowest channel



Date: 27.SEP.2016 11:50:29

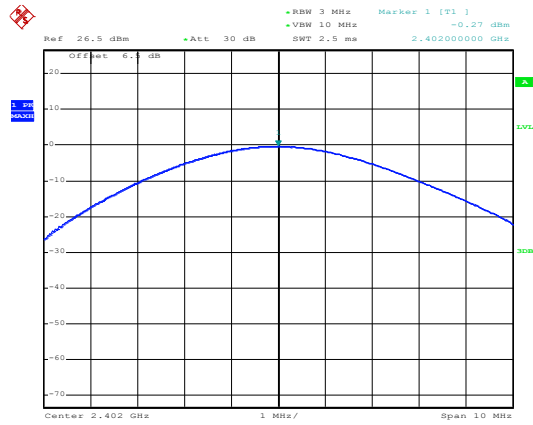
### Middle channel



Date: 27.SEP.2016 11:49:38

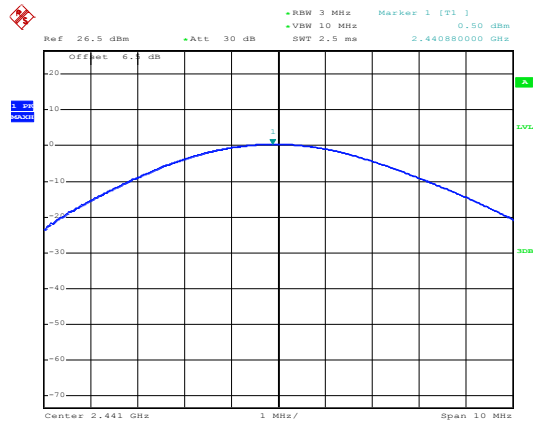
### Highest channel

### Modulation mode: 8DPSK



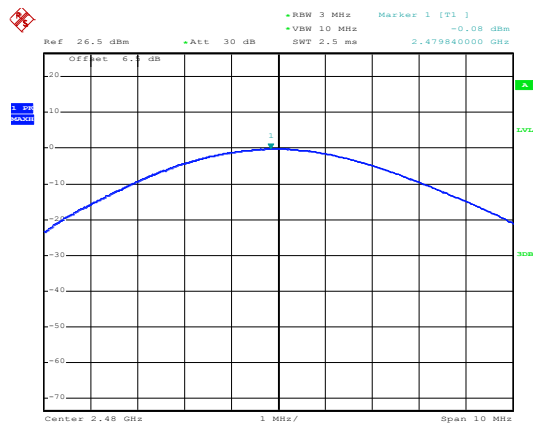
Date: 27.SEP.2016 11:46:07

### Lowest channel



Date: 27.SEP.2016 11:47:02

### Middle channel

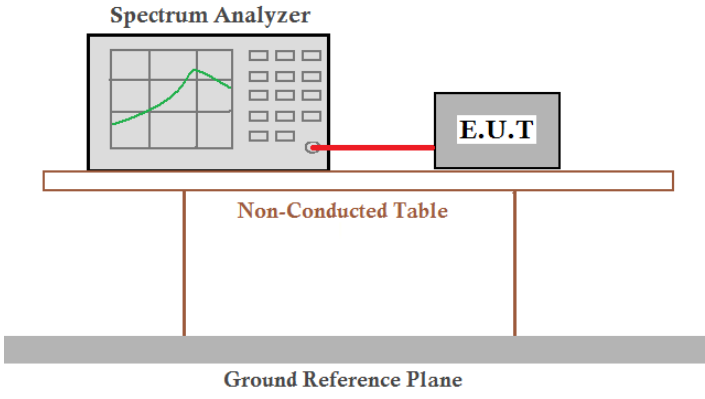


Date: 27.SEP.2016 11:48:06

### Highest channel



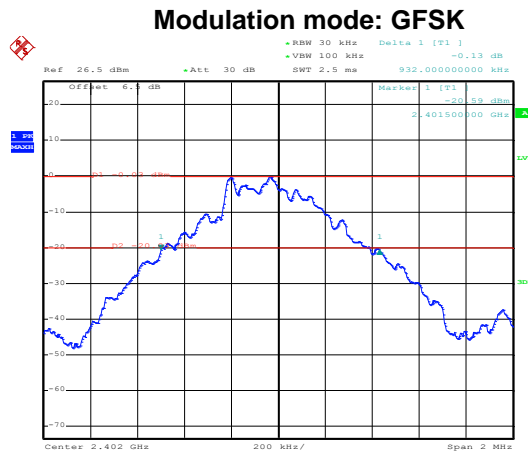
## 6.4 20dB Occupy Bandwidth

|                   |  |
|-------------------|--|
| Test Requirement: | FCC Part 15 C Section 15.247 (a)(1)  |
| Test Method:      | ANSI C63.10:2013 and DA00-705  |
| Receiver setup:   | RBW=30 kHz, VBW=100 kHz, detector=Peak   |
| Limit:            | NA   |
| Test setup:       |  <p>The diagram shows a Spectrum Analyzer on the left and an E.U.T. on the right, connected by a red cable. They are both on a table labeled 'Non-Conducted Table'. Below the table is a 'Ground Reference Plane'.</p> |
| Test Instruments: | Refer to section 5.7 for details   |
| Test mode:        | Non-hopping mode   |
| Test results:     | Pass   |

### Measurement Data:

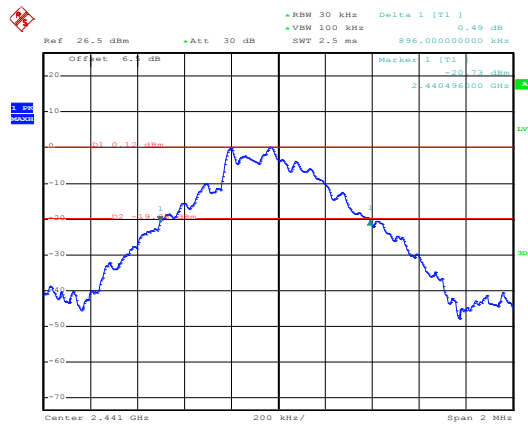
| Test channel | 20dB Occupy Bandwidth (kHz) |                |       |
|--------------|-----------------------------|----------------|-------|
|              | GFSK                        | $\pi/4$ -DQPSK | 8DPSK |
| Lowest       | 932                         | 1224           | 1216  |
| Middle       | 896                         | 1232           | 1220  |
| Highest      | 872                         | 1232           | 1224  |

Test plot as follows:



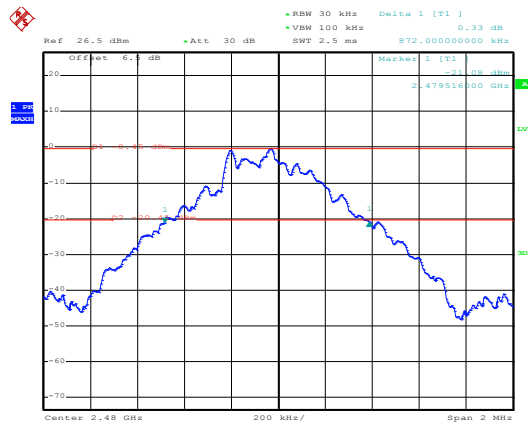
Date: 27.SEP.2016 11:29:05

### Lowest channel



Date: 27.SEP.2016 11:30:33

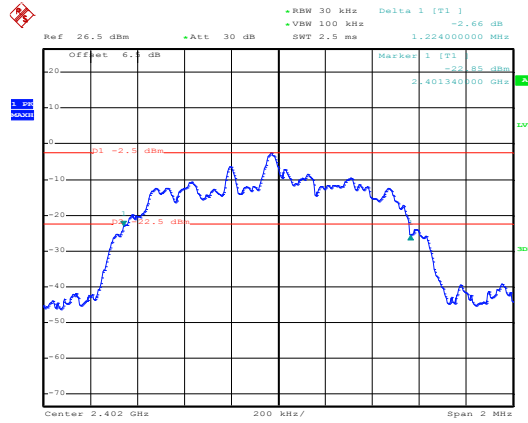
### Middle channel



Date: 27.SEP.2016 11:31:52

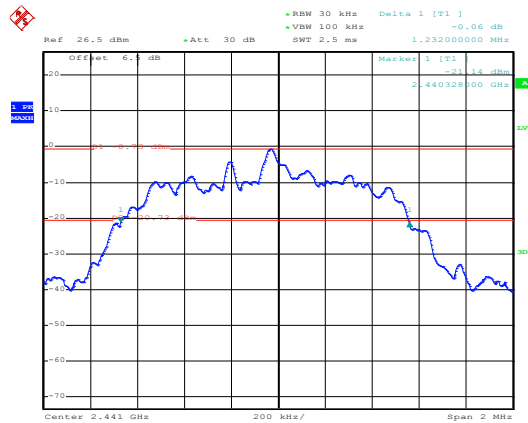
### Highest channel

### Modulation mode: $\pi/4$ -DQPSK



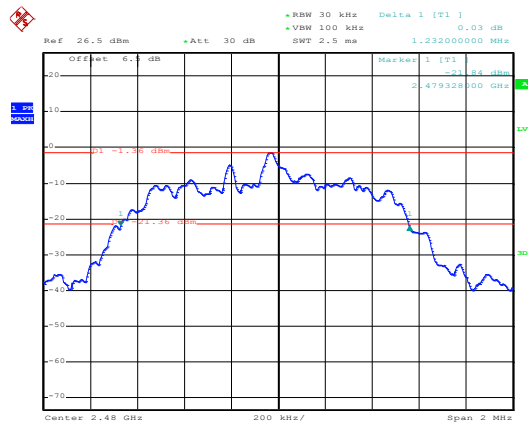
Date: 27.SEP.2016 11:33:31

### Lowest channel



Date: 27.SEP.2016 11:38:02

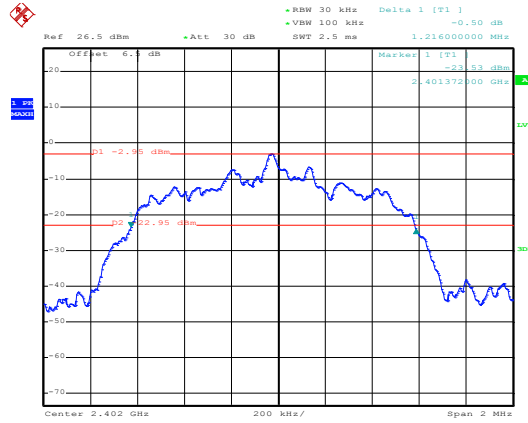
### Middle channel



Date: 27.SEP.2016 11:40:06

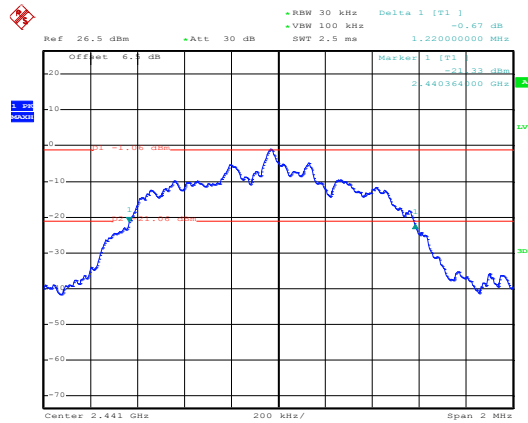
### Highest channel

### Modulation mode: 8DPSK



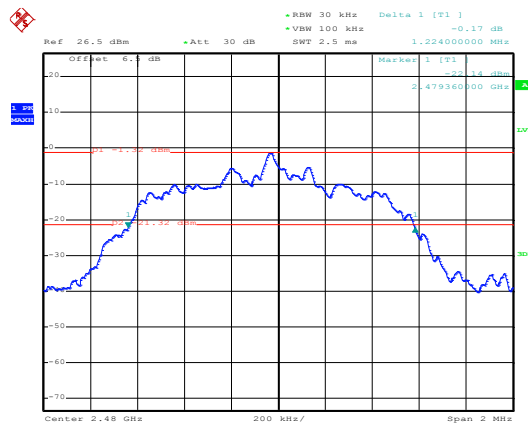
Date: 27.SEP.2016 11:44:14

### Lowest channel



Date: 27.SEP.2016 11:43:11

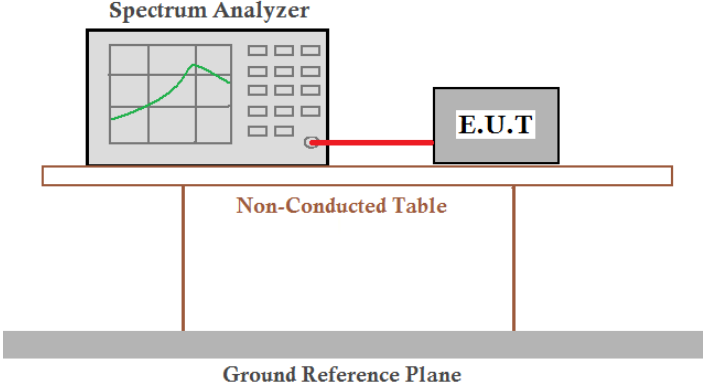
### Middle channel



Date: 27.SEP.2016 11:41:48

### Highest channel

## 6.5 Carrier Frequencies Separation

|                   |  |
|-------------------|--|
| Test Requirement: | FCC Part 15 C Section 15.247 (a)(1)  |
| Test Method:      | ANSI C63.10:2013 and DA00-705  |
| Receiver setup:   | RBW=100 kHz, VBW=300 kHz, detector=Peak  |
| Limit:            | 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)   |
| Test setup:       |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both are placed on a Non-Conducted Table, which is supported by two vertical legs. Below the table is a Ground Reference Plane, represented by a thick grey bar.</p> |
| Test Instruments: | Refer to section 5.7 for details   |
| Test mode:        | Hopping mode   |
| Test results:     | Pass   |

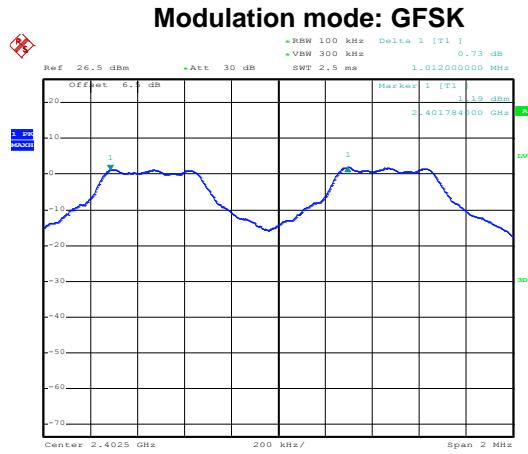
**Measurement Data:**

| GFSK mode           |                                      |             |        |
|---------------------|--------------------------------------|-------------|--------|
| Test channel        | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest              | 1012                                 | 621.33      | Pass   |
| Middle              | 1004                                 | 621.33      | Pass   |
| Highest             | 1004                                 | 621.33      | Pass   |
| $\pi/4$ -DQPSK mode |                                      |             |        |
| Test channel        | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest              | 1004                                 | 821.33      | Pass   |
| Middle              | 1004                                 | 821.33      | Pass   |
| Highest             | 1004                                 | 821.33      | Pass   |
| 8DPSK mode          |                                      |             |        |
| Test channel        | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest              | 1012                                 | 816.00      | Pass   |
| Middle              | 1004                                 | 816.00      | Pass   |
| Highest             | 1004                                 | 816.00      | Pass   |

Note: According to section 6.4

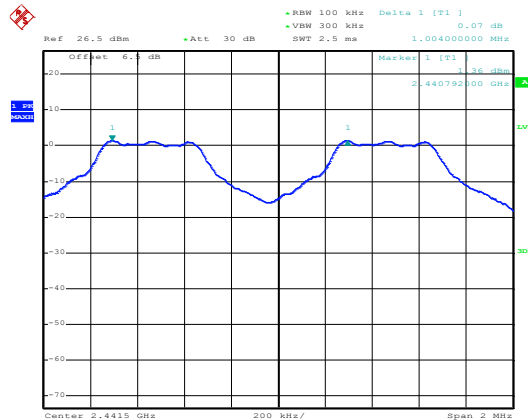
| Mode           | 20dB bandwidth (kHz)<br>(worse case) | Limit (kHz)<br>(Carrier Frequencies Separation) |
|----------------|--------------------------------------|---|
| GFSK           | 932                                  | 621.33  |
| $\pi/4$ -DQPSK | 1232                                 | 821.33  |
| 8DPSK          | 1224                                 | 816.00  |

Test plot as follows:



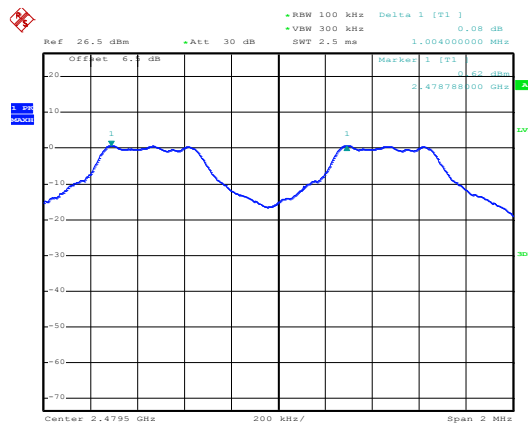
Date: 27.SEP.2016 13:46:10

### Lowest channel



Date: 27.SEP.2016 13:47:13

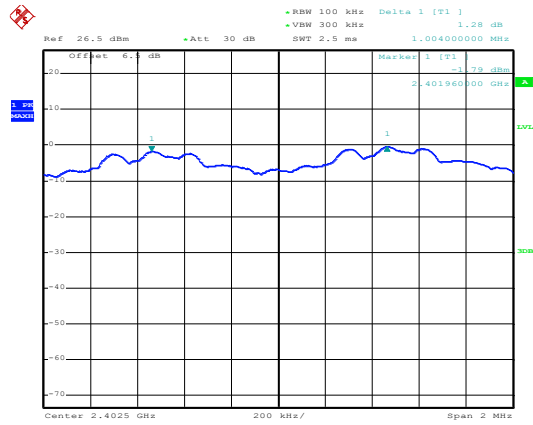
### Middle channel



Date: 27.SEP.2016 13:48:20

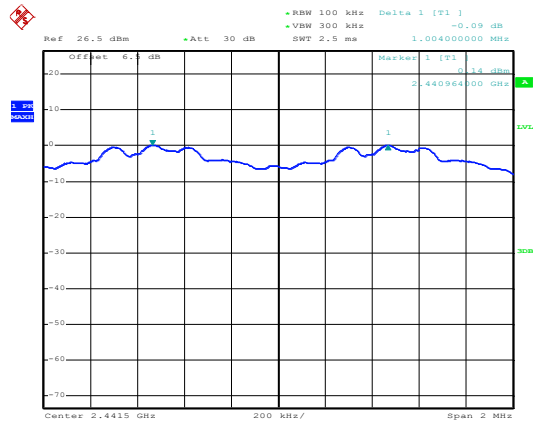
### Highest channel

### Modulation mode: $\pi/4$ -DQPSK



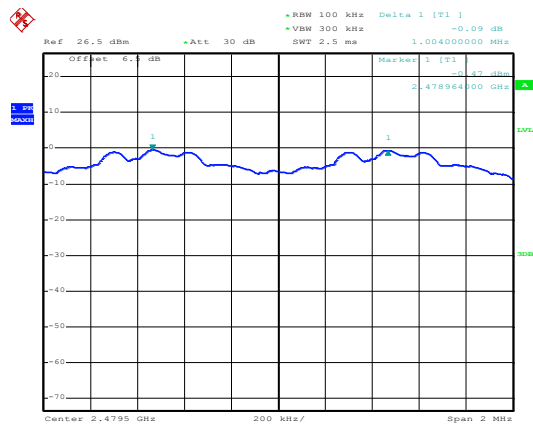
Date: 27.SEP.2016 13:49:51

### Lowest channel



Date: 27.SEP.2016 13:51:03

### Middle channel

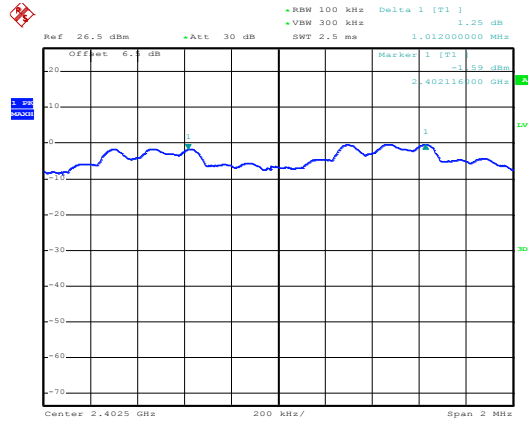


Date: 27.SEP.2016 13:52:18

### Highest channel

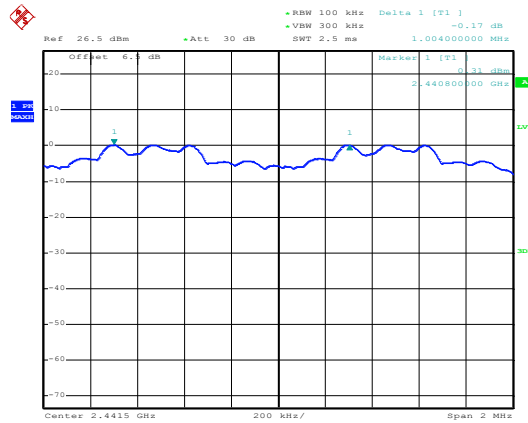


### Modulation mode: 8DPSK



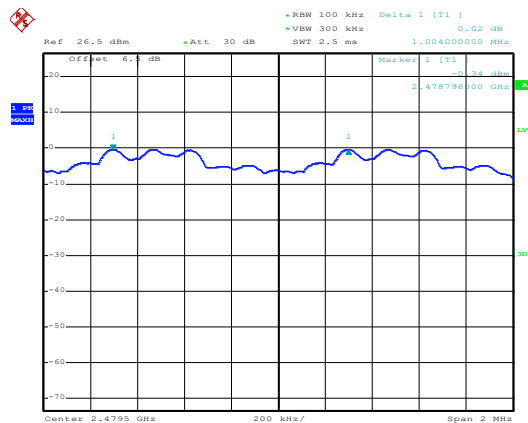
Date: 27.SEP.2016 13:53:45

### Lowest channel



Date: 27.SEP.2016 13:55:08

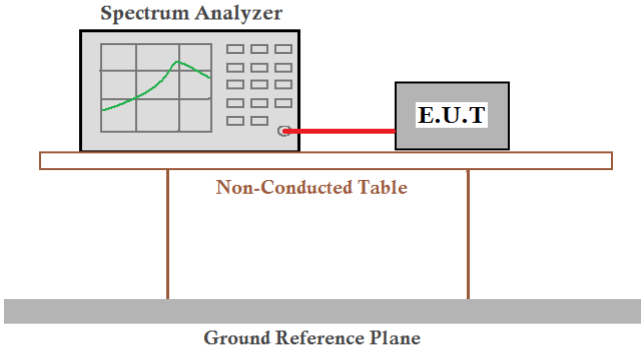
### Middle channel



Date: 27.SEP.2016 13:56:22

### Highest channel

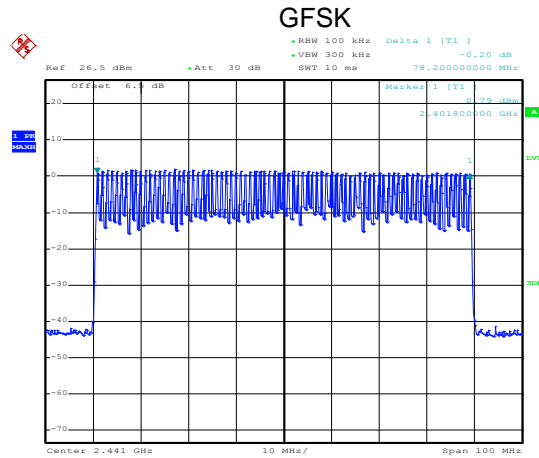
## 6.6 Hopping Channel Number

|                   |   |
|-------------------|---|
| Test Requirement: | FCC Part 15 C Section 15.247 (a)(1)   |
| Test Method:      | ANSI C63.10:2013 and DA00-705   |
| Receiver setup:   | RBW=100 kHz, VBW=300 kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak  |
| Limit:            | 15 channels   |
| Test setup:       |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. This table is supported by two vertical legs and sits on a Ground Reference Plane, which is represented by a thick grey bar at the bottom of the diagram.</p> |
| Test Instruments: | Refer to section 5.7 for details  |
| Test mode:        | Hopping mode  |
| Test results:     | Pass  |

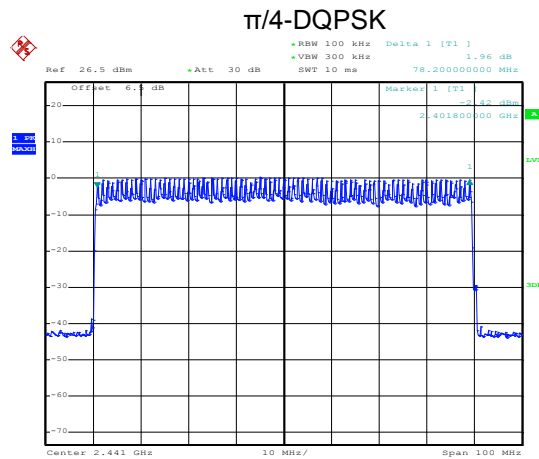
### Measurement Data:

| Mode                        | Hopping channel numbers | Limit | Result |
|-----------------------------|-------------------------|-------|--------|
| GFSK, $\pi/4$ -DQPSK, 8DPSK | 79                      | 15    | Pass   |

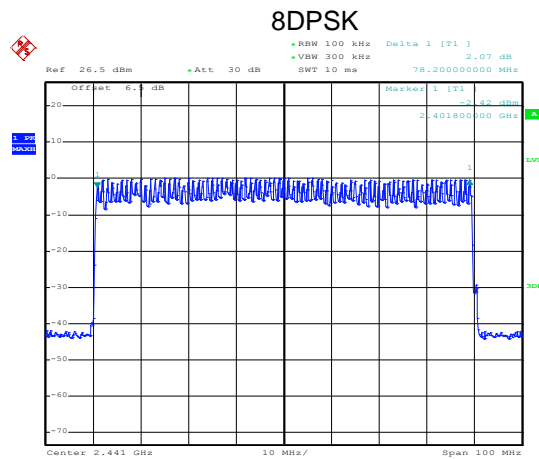
Test plot as follows:



Date: 27.SEP.2016 13:59:39

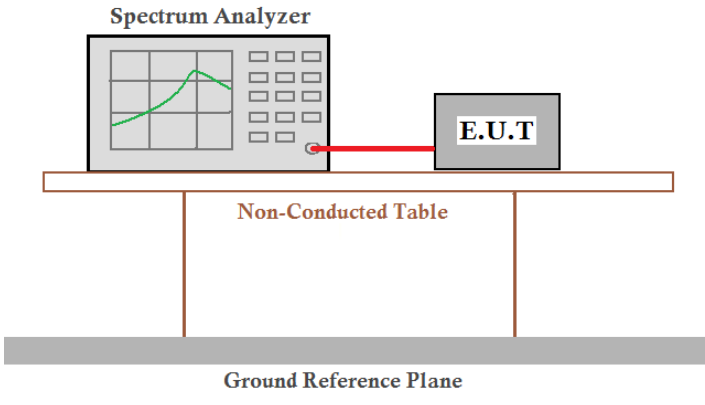


Date: 27.SEP.2016 14:03:11



Date: 27.SEP.2016 14:06:04

## 6.7 Dwell Time

|                   |  |
|-------------------|--|
| Test Requirement: | FCC Part 15 C Section 15.247 (a)(1)  |
| Test Method:      | ANSI C63.10:2013 and KDB DA00-705  |
| Receiver setup:   | RBW=1 MHz, VBW=1 MHz, Span=0 Hz, Detector=Peak   |
| Limit:            | 0.4 Second   |
| Test setup:       |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p> |
| Test Instruments: | Refer to section 5.7 for details   |
| Test mode:        | Hopping mode   |
| Test results:     | Pass   |

### Measurement Data (Worse case):

| Mode      | Packet | Dwell time (second) | Limit (second) | Result |
|-----------|--------|---------------------|----------------|--------|
| GFSK      | DH1    | 0.13952             | 0.4            | Pass   |
|           | DH3    | 0.27328             |                |        |
|           | DH5    | 0.31680             |                |        |
| π/4-DQPSK | 2-DH1  | 0.14400             | 0.4            | Pass   |
|           | 2-DH3  | 0.27616             |                |        |
|           | 2-DH5  | 0.31680             |                |        |
| 8DPSK     | 3-DH1  | 0.14336             | 0.4            | Pass   |
|           | 3-DH3  | 0.27424             |                |        |
|           | 3-DH5  | 0.31765             |                |        |

For GFSK, π/4-DQPSK and 8DPSK:

The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

DH1 time slot =  $0.436 \times (1600 / (2 \times 79)) \times 31.6 = 139.52 \text{ ms}$

DH3 time slot =  $1.708 \times (1600 / (4 \times 79)) \times 31.6 = 273.28 \text{ ms}$

DH5 time slot =  $2.970 \times (1600 / (6 \times 79)) \times 31.6 = 316.80 \text{ ms}$

2-DH1 time slot =  $0.450 \times (1600 / (2 \times 79)) \times 31.6 = 144.00 \text{ ms}$

2-DH3 time slot =  $1.726 \times (1600 / (4 \times 79)) \times 31.6 = 276.16 \text{ ms}$

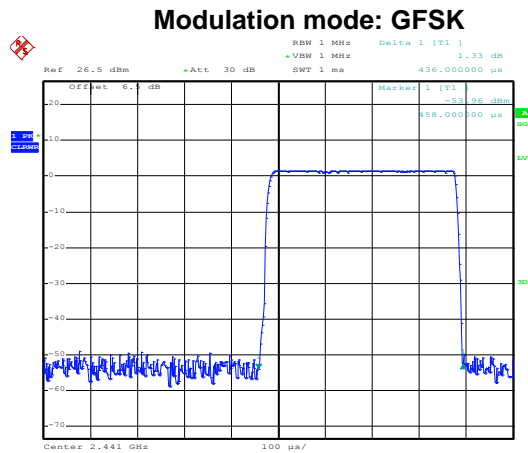
2-DH5 time slot =  $2.970 \times (1600 / (6 \times 79)) \times 31.6 = 316.80 \text{ ms}$

3-DH1 time slot =  $0.448 \times (1600 / (2 \times 79)) \times 31.6 = 143.36 \text{ ms}$

3-DH3 time slot =  $1.714 \times (1600 / (4 \times 79)) \times 31.6 = 274.24 \text{ ms}$

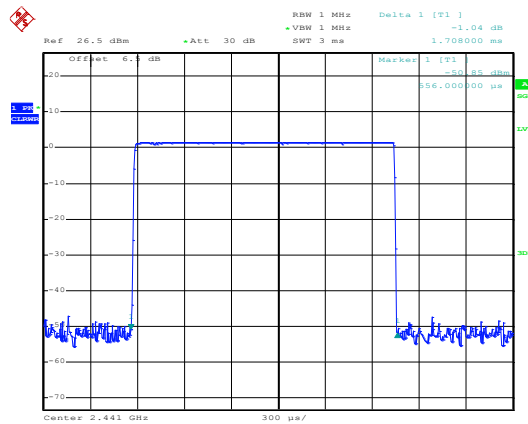
3-DH5 time slot =  $2.978 \times (1600 / (6 \times 79)) \times 31.6 = 317.65 \text{ ms}$

Test plot as follows:



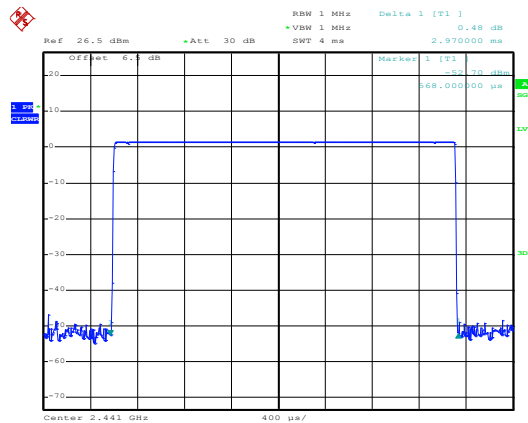
Date: 27.SEP.2016 10:55:54

DH1



Date: 27.SEP.2016 10:59:39

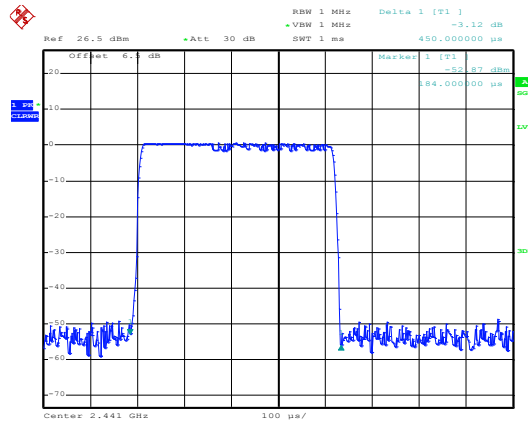
DH3



Date: 27.SEP.2016 11:03:03

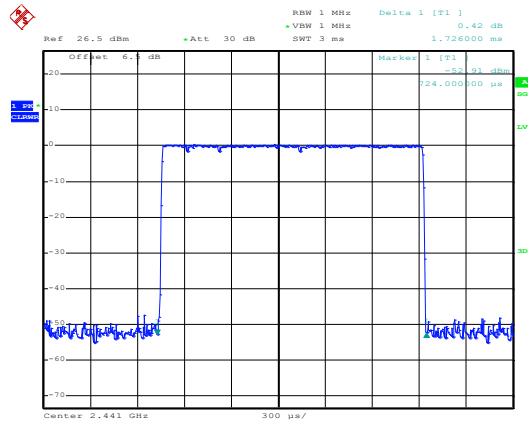
DH5

### Modulation mode: $\pi/4$ -DQPSK



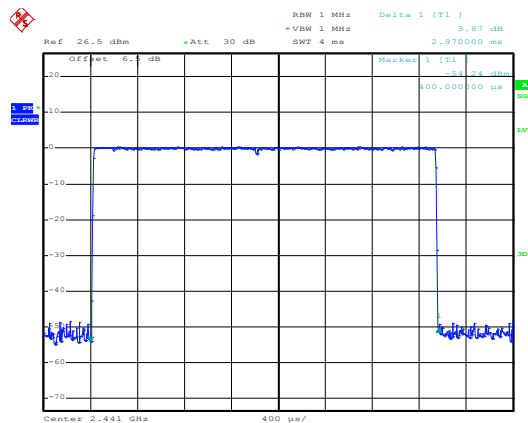
Date: 27.SEP.2016 10:57:19

### 2-DH1



Date: 27.SEP.2016 11:00:41

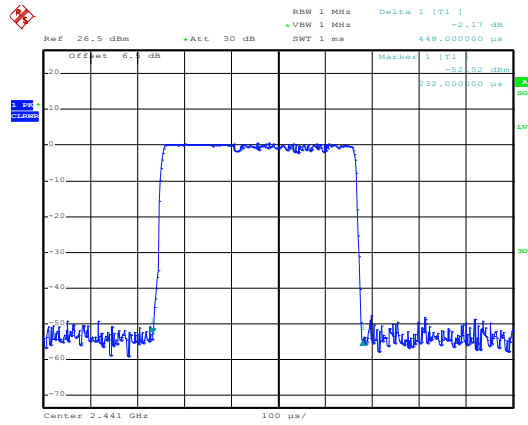
### 2-DH3



Date: 27.SEP.2016 11:04:49

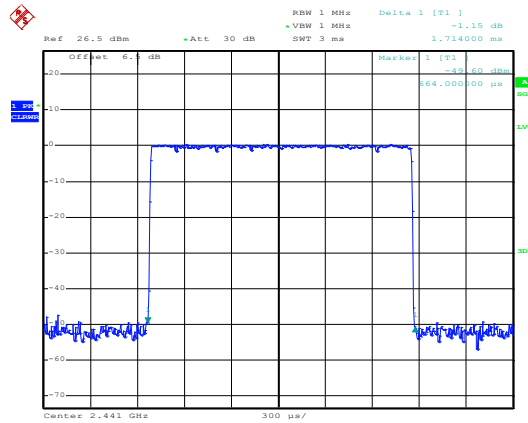
### 2-DH5

### Modulation mode: 8DPSK



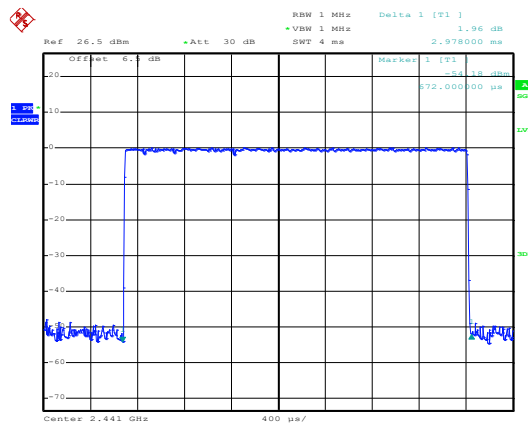
Date: 27.SEP.2016 10:58:15

### 3-DH1



Date: 27.SEP.2016 11:01:38

### 3-DH3



Date: 27.SEP.2016 11:05:44

### 3-DH5