



ISO/IEC17025 Accredited Lab.

Report No.:

FCC 1409095

File reference No.:

2014-09-23

Applicant:

Product:

Shower Bluetooth Speaker

Model No.:

BTS-51

Trademark:

ILE

Test Standards:

FCC Part 15 Subpart C, Paragraph 15.247

Test result:

It is herewith confirmed and found to comply with the requirements set up by ANSI C63.4&FCC Part 15 Subpart C, Paragraph 15.247 regulations for the evaluation of electromagnetic compatibility

Approved By

*Jack Chung*

Jack Chung  
Manager

Dated:

Sep 23, 2014

**Results appearing herein relate only to the sample tested**

**The technical reports is issued errors and omissions exempt and is subject to withdrawal at**

**SHENZHEN TIMEWAY TECHNOLOGY CONSULTING CO LTD**

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### **Special Statement:**

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.

The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

Our test facility is recognized, certified, or accredited by the following organizations:

#### **CNAS-LAB Code: L2292**

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:1999 General Requirements) for the Competence of testing Laboratories.

#### **FCC-Registration No.: 899988**

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission. The acceptance letter from the FCC is maintained in our files. Registration No.:899988.

#### **IC- Registration No.: IC5205A-02**

The EMC Laboratory has been registered and fully described in a report filed with the (IC) Industry Canada. The acceptance letter from the IC is maintained in our files. Registration No.: IC 5205A-02.

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## 1.0 General Details

### 1.1 Test Lab Details

Name :

Address:

Telephone:

Fax:

Site on File with the Federal Communications Commission – United States

Registration Number: 899988

For 3m & 10 m OATS

Site Listed with Industry Canada of Ottawa, Canada

Registration Number: IC: 5205A-02

For 3m & 10 m OATS

### 1.2 Applicant Details

Applicant:

Address:

Telephone:

Fax:

### 1.3 Description of EUT

Product: Shower Bluetooth Speaker

Manufacturer:

Address:

|                     |   |
|---------------------|---|
| Type of Modulation  | GFSK, $\pi$ /4DQPSK, 8DPSK                  |
| Frequency range     | 2402-2480MHz                                |
| Number of Channel   | 79  |
| Frequency Selection | By software                                 |
| Antenna type        | PCB Antenna used, the antenna gain is 0 dBi |
| Bluetooth Version:  | 3.0   |

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1.4 Submitted Sample: 1 Sample

1.5 Test Duration:  
2014-09-11 to 2014-09-22

1.6 Test Uncertainty  
Conducted Emissions Uncertainty =3.6dB  
Radiated Emissions Uncertainty =4.7dB

1.7 Test Engineer

*Terry Tang*

The sample tested by \_\_\_\_\_

Print Name: Terry Tang

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| 2.0 Test Equipments    |              |            |                   |              |            |
|------------------------|--------------|------------|-------------------|--------------|------------|
| Instrument Type        | Manufacturer | Model      | Serial No.        | Date of Cal. | Due Date   |
| ESPI Test Receiver     | R&S          | ESPI 3     | 100379            | 2014-08-21   | 2015-08-20 |
| TWO<br>Line-V-NETW     | R&S          | EZH3-Z5    | 100294            | 2014-08-22   | 2015-08-21 |
| TWO<br>Line-V-NETW     | R&S          | EZH3-Z5    | 100253            | 2014-08-22   | 2015-08-21 |
| Ultra Broadband<br>ANT | R&S          | HL562      | 100157            | 2014-08-23   | 2015-08-22 |
| ESDV Test Receiver     | R&S          | ESDV       | 100008            | 2014-08-22   | 2015-08-21 |
| Impuls-Begrenzer       | R&S          | ESH3-Z2    | 100281            | 2014-08-21   | 2015-08-20 |
| System Controller      | CT           | SC100      | -                 | --           | --         |
| Printer                | EPSON        | PHOTO EX3  | CFNH234850        | --           | --         |
| Computer               | IBM          | 8434       | 1S8434KCE99BLXLO* | -            | -          |
| Loop Antenna           | EMCO         | 6502       | 00042960          | 2014-08-22   | 2015-08-21 |
| ESPI Test Receiver     | R&S          | ESI26      | 838786/013        | 2014-08-22   | 2015-08-21 |
| 3m OATS                | --           | --         | N/A               | 2014-08-21   | 2015-08-20 |
| Horn Antenna           | R&S          | BBHA 9170  | BBHA9170265       | 2014-08-23   | 2015-08-22 |
| Horn Antenna           | R&S          | BBHA 9120D | 9120D-631         | 2014-08-23   | 2015-08-22 |
| Power meter            | Anritsu      | ML2487A    | 6K00003613        | 2014-08-22   | 2015-08-21 |
| Power sensor           | Anritsu      | MA2491A    | 32263             | 2014-08-22   | 2015-08-21 |
| Bilog Antenna          | Schwarebeck  | VULB9163   | 9163/340          | 2014-08-23   | 2015-08-22 |
| LISN                   | AFJ          | LS16C      | 10010947251       | 2014-08-21   | 2015-08-20 |
| LISN (Three Phase)     | Schwarebeck  | NSLK 8126  | 8126453           | 2014-08-22   | 2015-08-21 |
| 9*6*6 Anechoic         | --           | --         | N/A               | 2014-08-21   | 2015-08-20 |
| EMI Test Receiver      | RS           | ESCS30     | 100139            | 2014-08-22   | 2015-08-21 |

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### 3.0 Technical Details

#### 3.1 Summary of test results

| The EUT has been tested according to the following specifications: |  |        |          |
|--|--|--------|----------|
| Requirement  | CFR 47 Section                         | Result | Notes    |
| Antenna Requirement  | 15.203, 15.247(b)(4)                   | PASS   | Complies |
| Maximum Peak Out Power   | 15.247 (b)(1), (4)                     | PASS   | Complies |
| Carrier Frequency Separation                                       | 15.247(a)(1)                           | PASS   | Complies |
| 20dB Channel Bandwidth   | 15.247 (a)(1)                          | PASS   | Complies |
| Number of Hopping Channels   | 15.247(a)(iii), 15.247(b)(1)           | PASS   | Complies |
| Time of Occupancy (Dwell Time)                                     | 15.247(a)(iii)                         | PASS   | Complies |
| Spurious Emission, Band Edge, and Restricted bands                 | 15.247(d),15.205(a), 15.209 (a),15.109 | PASS   | Complies |
| Conducted Emissions  | 15.207(a), 15.107                      | PASS   | Complies |
| RF Exposure  | 15.247(i), 1.1307(b)(1)                | PASS   | Complies |

**Note:** The data of GFSK Modulation and  $\pi/4$ DQPSK Modulation was recorded in the test report. They were the worse case.

#### 3.2 Test Standards

FCC Part 15 Subpart & Subpart C, Paragraph 15.247

#### 4.0 EUT Modification

No modification by Shenzhen Timeway Technology Consulting Co., Ltd

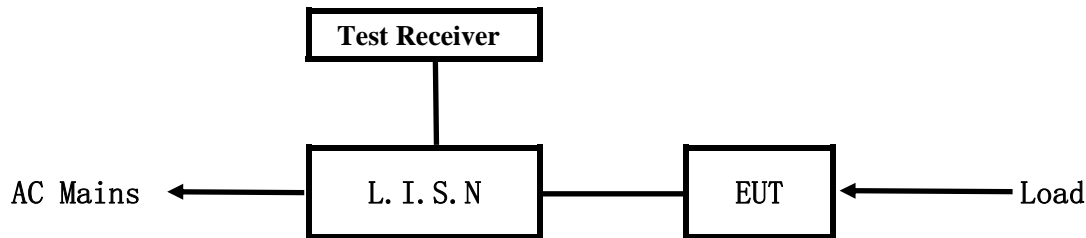
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## 5. Power Line Conducted Emission Test

### 5.1 Schematics of the test



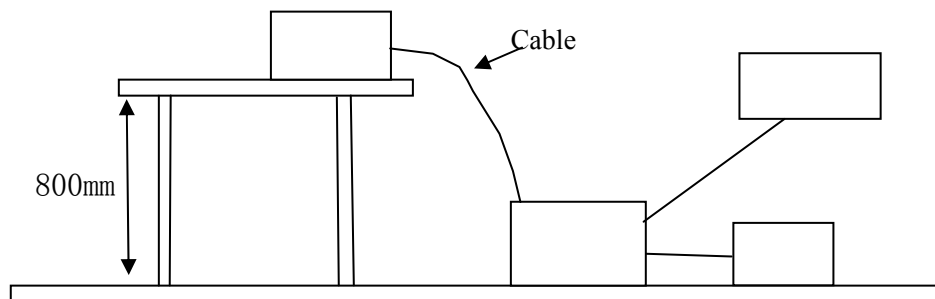
EUT: Equipment Under Test

### 5.2 Test Method and test Procedure

The EUT was tested according to ANSI C63.4-2003. The Frequency spectrum From 0.15MHz to 30MHz was investigated. The LISN used was 50ohm/50uH as specified by section 5.1 of ANSI C63.4 –2003.

Test Voltage: 120V~60Hz

Block diagram of Test setup



### 5.3 Configuration of The EUT

The EUT was configured according to ANSI C63.4-2003. All interface ports were connected to the Appropriate peripherals. All peripherals and cables are listed below.

79 channels are provided to the EUT

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A. EUT

| Device                   | Manufacturer                | Model  | FCC ID    |
|--------------------------|-----------------------------|--------|-----------|
| Shower Bluetooth Speaker | Richen Industrial Co., Ltd. | BTS-51 | RMZ-BTS51 |

B. Internal Device

| Device | Manufacturer | Model | FCC ID/DOC |
|--------|--------------|-------|------------|
| N/A    |              |       |            |

C. Peripherals

| Device       | Manufacturer | Model         | FCC ID/DOC | Cable |
|--------------|--------------|---------------|------------|-------|
| Power Supply | FJ           | FJ-SW0501500U | VOC        | --    |

5.4 EUT Operating Condition

Operating condition is according to ANSI C63.4 -2003.

A Setup the EUT and simulators as shown on follow

B Enable AF signal and confirm EUT active to normal condition

5.5 Power line conducted Emission Limit according to Paragraph 15.107 ,15.207

| Frequency<br>(MHz) | Class A Limits (dB $\mu$ V) |               | Class B Limits (dB $\mu$ V) |               |
|--------------------|-----------------------------|---------------|-----------------------------|---------------|
|                    | Quasi-peak Level            | Average Level | Quasi-peak Level            | Average Level |
| 0.15 ~ 0.50        | 79.0                        | 66.0          | 66.0~56.0*                  | 56.0~46.0*    |
| 0.50 ~ 5.00        | 73.0                        | 60.0          | 56.0                        | 46.0          |
| 5.00 ~ 30.00       | 73.0                        | 60.0          | 60.0                        | 50.0          |

- Notes:
- \*Decreasing linearly with logarithm of frequency.
  - The tighter limit shall apply at the transition frequencies

5.6 Test Results

The frequency spectrum from 0.15MHz to 30MHz was investigated. All reading are quasi-peak values with a resolution bandwidth of 9kHz.

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**A: Conducted Emission on Live Terminal (150kHz to 30MHz)**

**EUT Operating Environment**

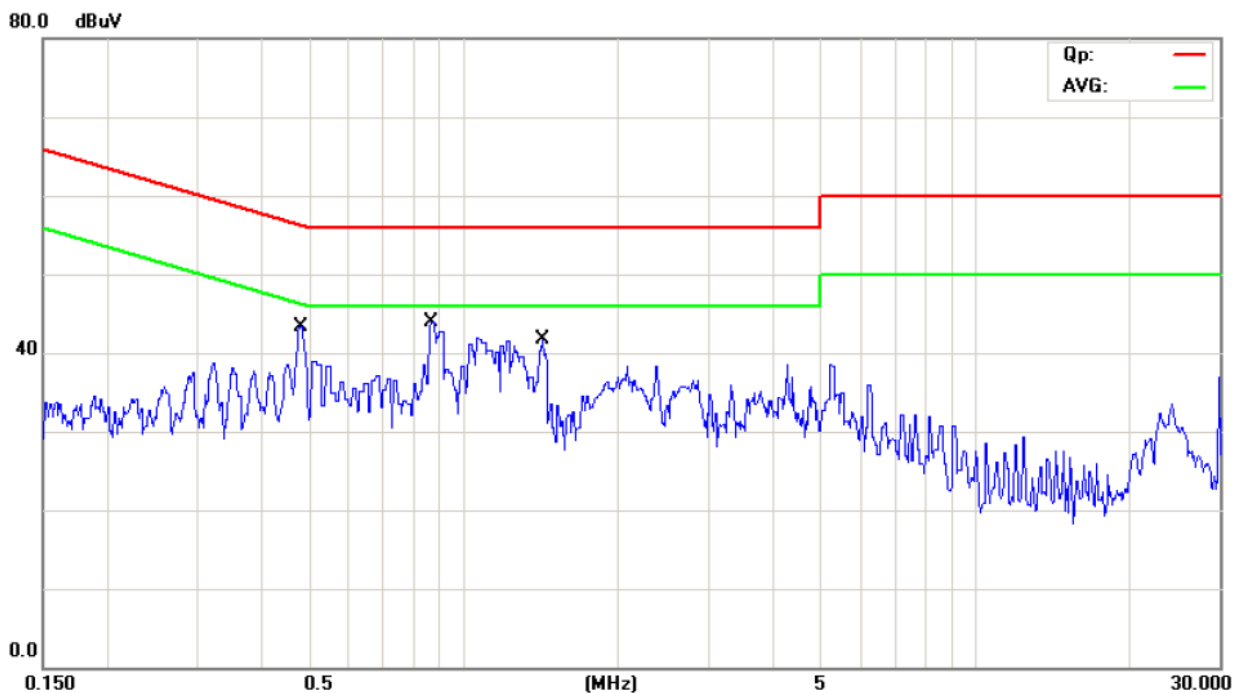
Temperature: 26°C Humidity: 65%RH Atmospheric Pressure: 101 KPa

**EUT set Condition: Charging and Keep Bluetooth Transmitting**

**Equipment Level: Class B**

**Results: PASS**

Please refer to following diagram for individual



| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit | Over   |          |         |
|-----|-----|--------|---------------|----------------|-------------|-------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV        | dBuV  | dB     | Detector | Comment |
| 1   |     | 0.4788 | 29.10         | 11.35          | 40.45       | 56.36 | -15.91 | QP       |         |
| 2   |     | 0.4788 | 22.90         | 11.35          | 34.25       | 46.36 | -12.11 | AVG      |         |
| 3   |     | 0.8675 | 31.40         | 11.76          | 43.16       | 56.00 | -12.84 | QP       |         |
| 4   | *   | 0.8675 | 24.40         | 11.76          | 36.16       | 46.00 | -9.84  | AVG      |         |
| 5   |     | 1.4127 | 21.90         | 12.07          | 33.97       | 56.00 | -22.03 | QP       |         |
| 6   |     | 1.4127 | 9.60          | 12.07          | 21.67       | 46.00 | -24.33 | AVG      |         |

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**B: Conducted Emission on Neutral Terminal (150kHz to 30MHz)**

**EUT Operating Environment**

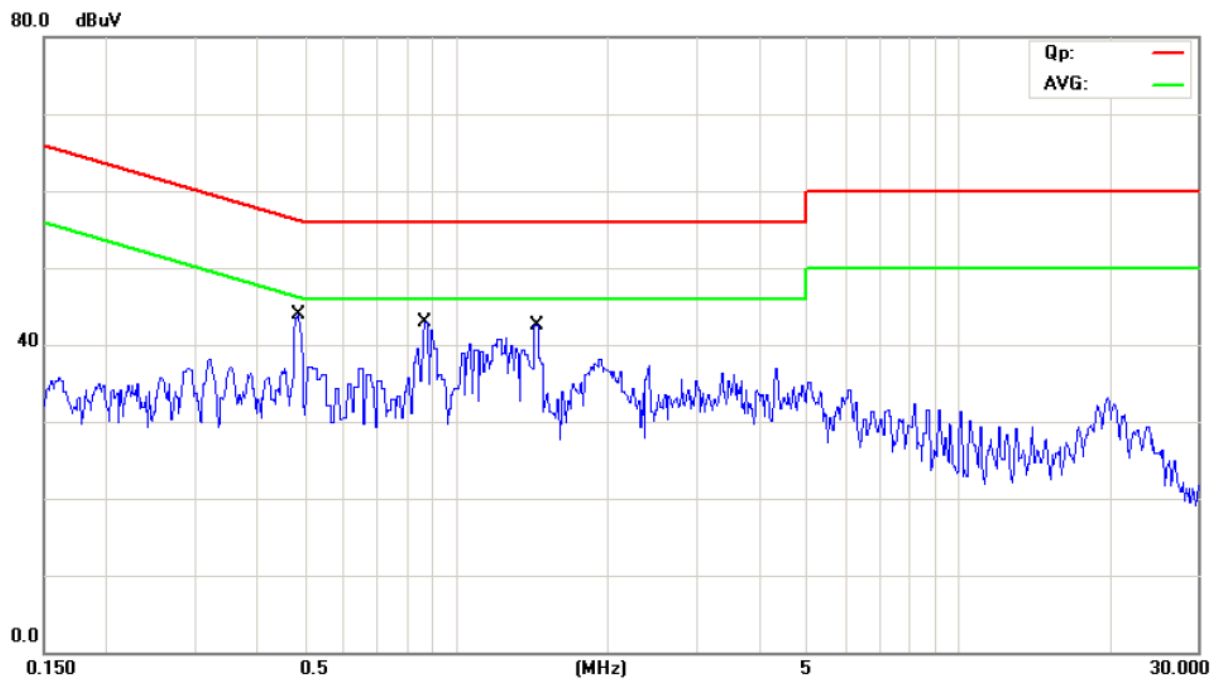
Temperature: 26°C Humidity: 65%RH Atmospheric Pressure: 101 KPa

**EUT set Condition: Charging and Keep Bluetooth Transmitting**

**Equipment Level: Class B**

**Results: Pass**

Please refer to following diagram for individual



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV | Limit<br>dBuV | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1   |     | 0.4795       | 30.00                    | 11.35                   | 41.35                    | 56.35         | -15.00     | QP       |         |
| 2   | *   | 0.4795       | 22.80                    | 11.35                   | 34.15                    | 46.35         | -12.20     | AVG      |         |
| 3   |     | 0.8673       | 29.90                    | 11.76                   | 41.66                    | 56.00         | -14.34     | QP       |         |
| 4   |     | 0.8673       | 19.90                    | 11.76                   | 31.66                    | 46.00         | -14.34     | AVG      |         |
| 5   |     | 1.4206       | 20.30                    | 12.07                   | 32.37                    | 56.00         | -23.63     | QP       |         |
| 6   |     | 1.4206       | 0.90                     | 12.07                   | 12.97                    | 46.00         | -33.03     | AVG      |         |

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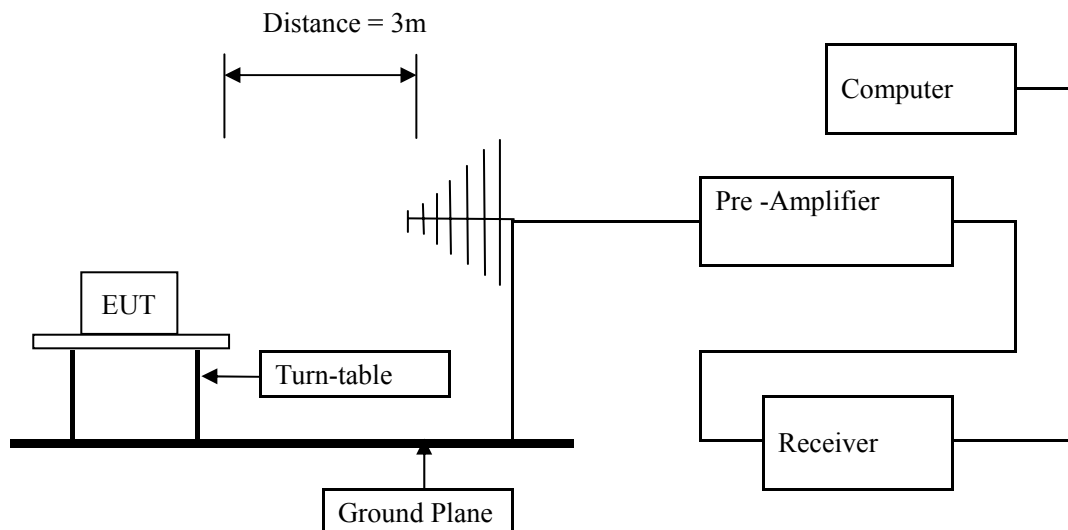
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## 6 Radiated Emission Test

### 6.1 Test Method and test Procedure:

- (1) The EUT was tested according to ANSI C63.4 –2003. The radiated test was performed at Timeway Laboratory. This site is on file with the FCC laboratory division, Registration No.899988
- (2) The EUT, peripherals were put on the turntable which table size is 1m x 1.5 m, table high 0.8 m. All set up is according to ANSI C63.4-2003.
- (3) The frequency spectrum from 30 MHz to 1 GHz was investigated. All readings from 30 MHz to 1 GHz are quasi-peak values with a resolution bandwidth of 120 kHz. For measurement above 1GHz, peak values with RBW=VBW=1MHz and PK detector. AV value with RBW=1MHz, VBW=10Hz and PK detector. Measurements were made at 3 meters.
- (4) The antenna high is varied from 1 m to 4 m high to find the maximum emission for each frequency.
- (5) Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dB of specification limit), and are distinguished with a "QP" in the data table.
- (6) The antenna polarization: Vertical polarization and Horizontal polarization.

### Block diagram of Test setup



- 6.2 Configuration of The EUT  
Same as section 5.3 of this report

- 6.3 EUT Operating Condition  
Same as section 5.4 of this report.

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#### 6.4 Radiated Emission Limit

All emission from a digital device, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strength specified below:

**Frequencies in restricted band are complied to limit on Paragraph 15.109. 15.209**

| Frequency Range (MHz) | Distance (m) | Field strength (dB $\mu$ V/m) |
|-----------------------|--------------|-------------------------------|
| 30-88                 | 3            | 40.0                          |
| 88-216                | 3            | 43.5                          |
| 216-960               | 3            | 46.0                          |
| Above 960             | 3            | 54.0                          |

- Note:
1. RF Voltage (dBuV) = 20 log RF Voltage ( $\mu$ V)
  2. In the Above Table, the higher limit applies at the band edges.
  3. Distance refers to the distance in meters between the measuring instrument antenna and the EUT
  4. This is a handheld device. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.
  5. After pre-scanning, **GFSK Mode** was the worse case. The test data of this mode was recorded.



**Test result**

**General Radiated Emission Data and Harmonics Radiated Emission Data**

**Radiated Emission In Horizontal/ In Vertical (30MHz----1000MHz)**

**EUT set Condition: Charging and Keep Bluetooth Transmitting**

**Results: Pass**

| Frequency (MHz) | Level@3m (dB $\mu$ V/m) | Antenna Polarity | Limit@3m (dB $\mu$ V/m) |
|-----------------|-------------------------|------------------|-------------------------|
| 435.720         | 35.61                   | H                | 46.00                   |
| 198.040         | 36.24                   | H                | 43.50                   |
| 356.920         | 39.83                   | H                | 46.00                   |
|                 |                         |                  |                         |
| 436.240         | 34.62                   | V                | 46.00                   |
| 198.360         | 33.18                   | V                | 43.50                   |
| 357.040         | 37.31                   | V                | 46.00                   |

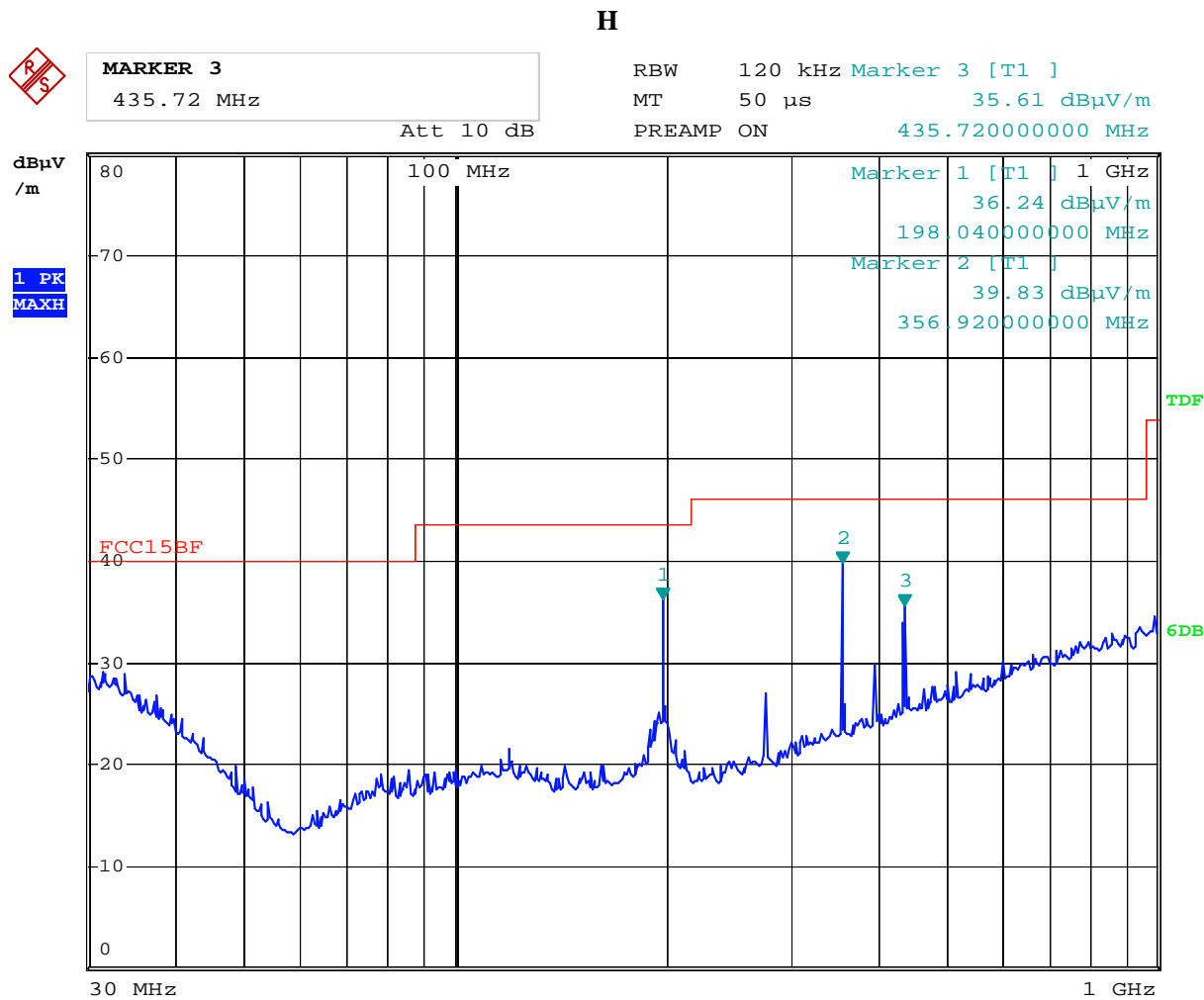
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Test Figure:

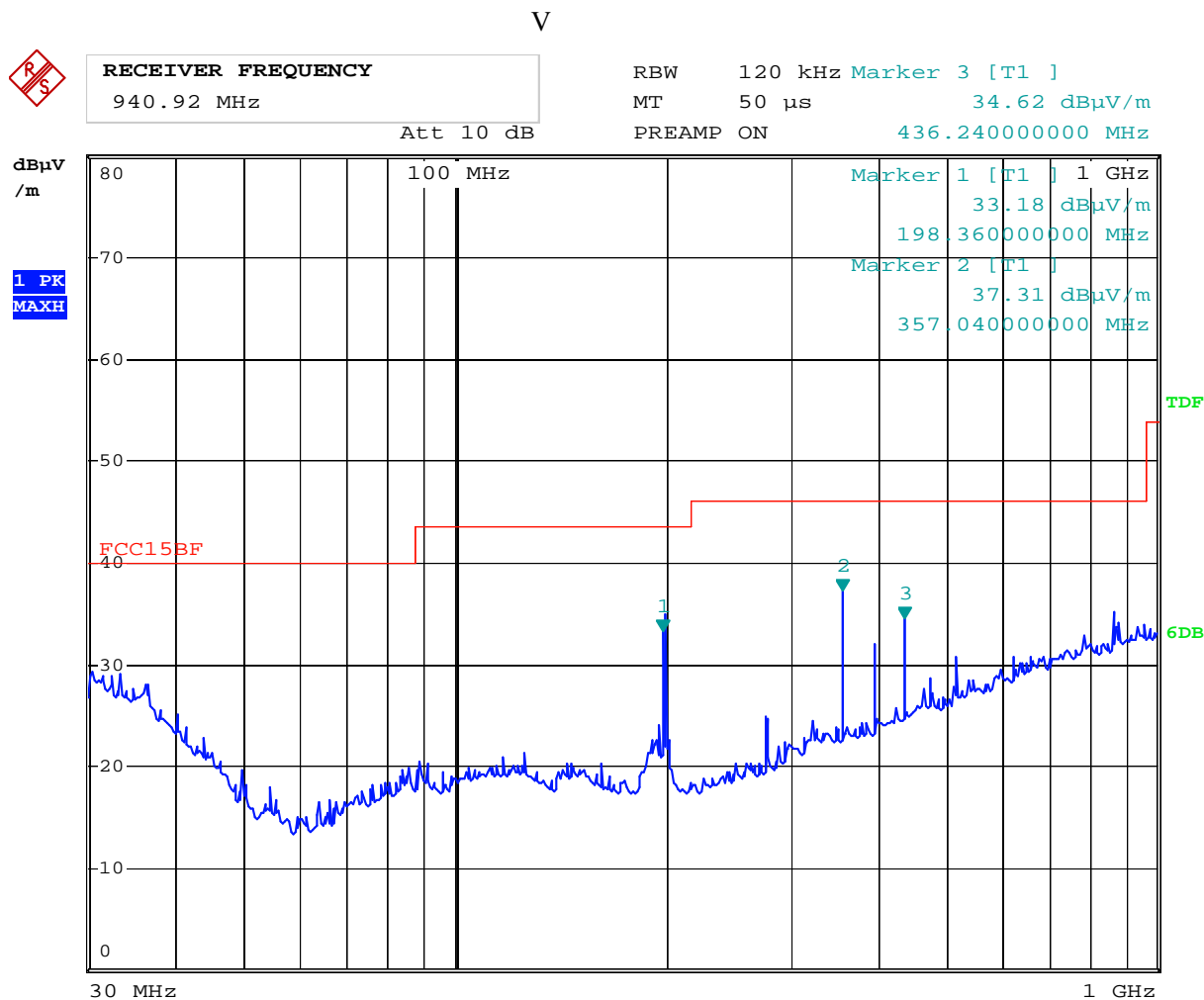


Date: 15.SEP.2014 10:58:39

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Test Figure:



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**Operation Mode: Transmitting under Low Channel (2402MHz)**

| Frequency (MHz) | Level@3m (dB $\mu$ V/m) | Antenna Polarity | Limit@3m (dB $\mu$ V/m) |
|-----------------|-------------------------|------------------|-------------------------|
| 4804            | --                      | H                | 74(Peak)/ 54(AV)        |
| 4804            | --                      | V                | 74(Peak)/ 54(AV)        |
| 7206            | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 9608            | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 12010           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 14412           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 16814           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 19216           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 21618           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 24020           | --                      | H/V              | 74(Peak)/ 54(AV)        |

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit  
2. Remark "---" means that the emissions level is too low to be measured

**Operation Mode: Transmitting g under Middle Channel (2441MHz)**

| Frequency (MHz) | Level@3m (dB $\mu$ V/m) | Antenna Polarity | Limit@3m (dB $\mu$ V/m) |
|-----------------|-------------------------|------------------|-------------------------|
| 4882            | --                      | H                | 74(Peak)/ 54(AV)        |
| 4882            | --                      | V                | 74(Peak)/ 54(AV)        |
| 7323            | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 9764            | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 12205           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 14646           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 17087           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 19528           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 21969           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 24410           | --                      | H/V              | 74(Peak)/ 54(AV)        |

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit  
2. Remark "---" means that the emissions level is too low to be measured

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**Operation Mode: Transmitting under High Channel (2480MHz)**

| Frequency (MHz) | Level@3m (dB $\mu$ V/m) | Antenna Polarity | Limit@3m (dB $\mu$ V/m) |
|-----------------|-------------------------|------------------|-------------------------|
| 4960            | --                      | H                | 74(Peak)/ 54(AV)        |
| 4960            | --                      | V                | 74(Peak)/ 54(AV)        |
| 7440            | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 9920            | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 12400           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 14880           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 17360           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 19840           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 22320           | --                      | H/V              | 74(Peak)/ 54(AV)        |
| 24800           | --                      | H/V              | 74(Peak)/ 54(AV)        |

- Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit  
2. Remark "---" means that the emissions level is too low to be measured

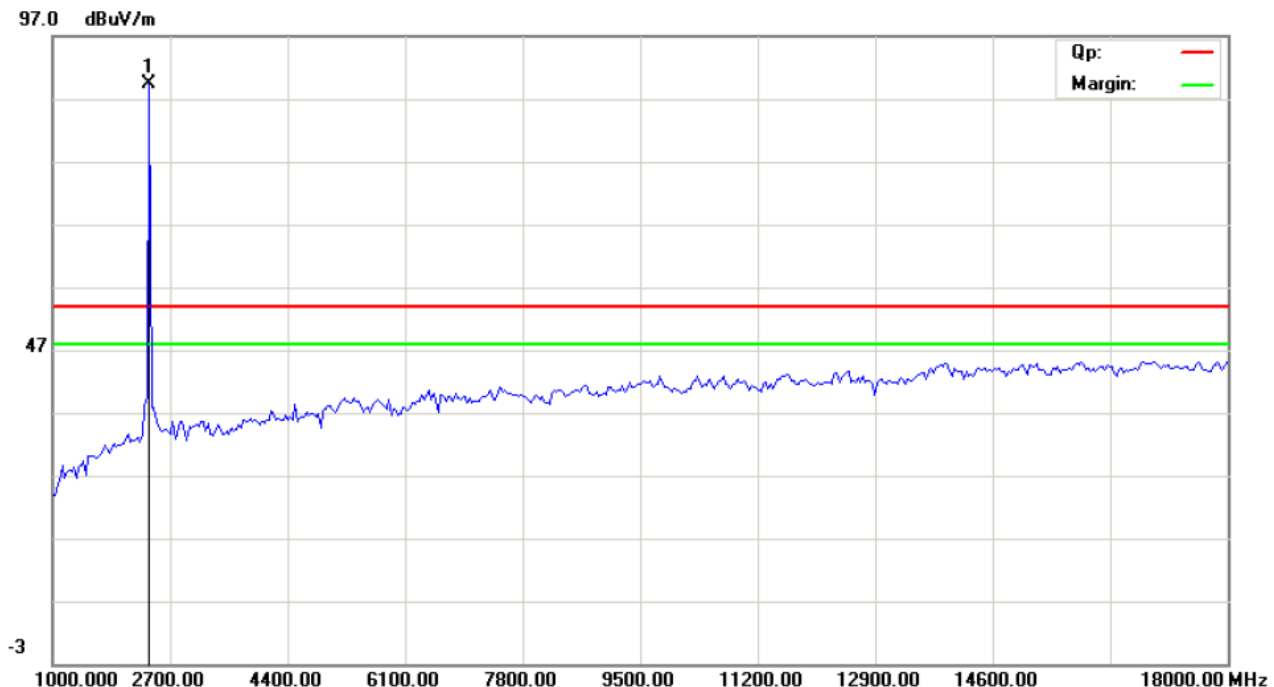
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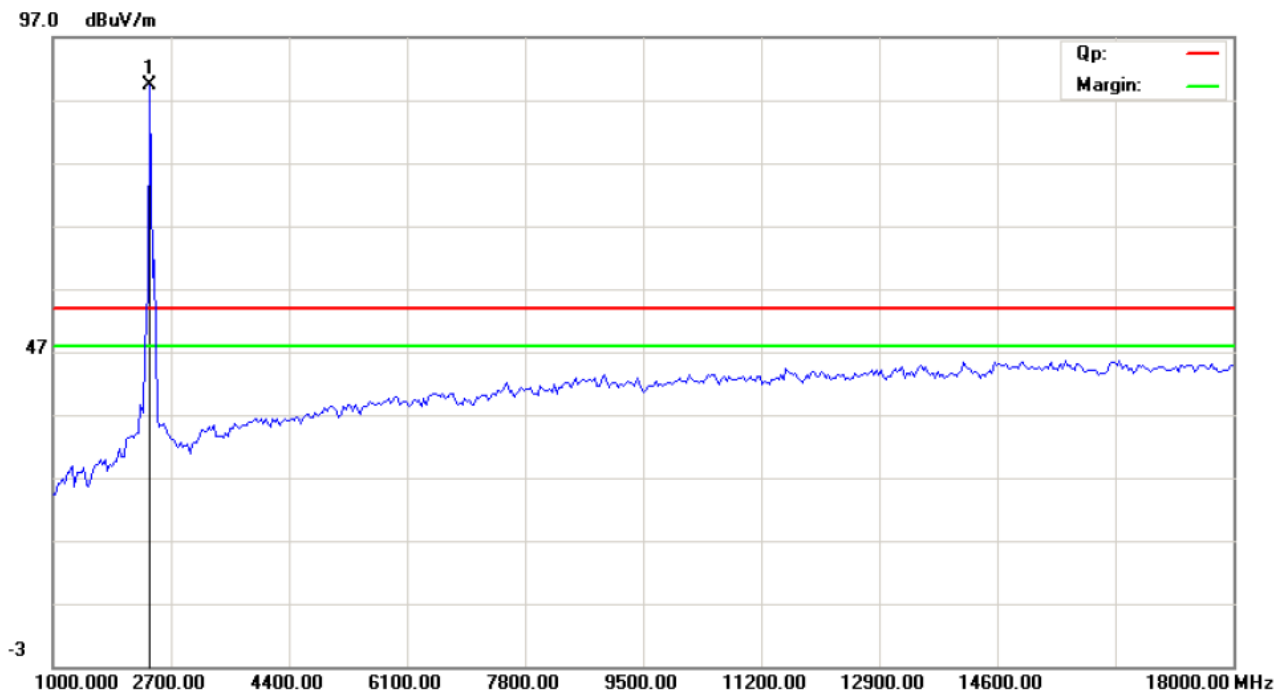
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Please refer to the following test plots for details:

### Low Channel: Horizontal



### Low Channel : Vertical

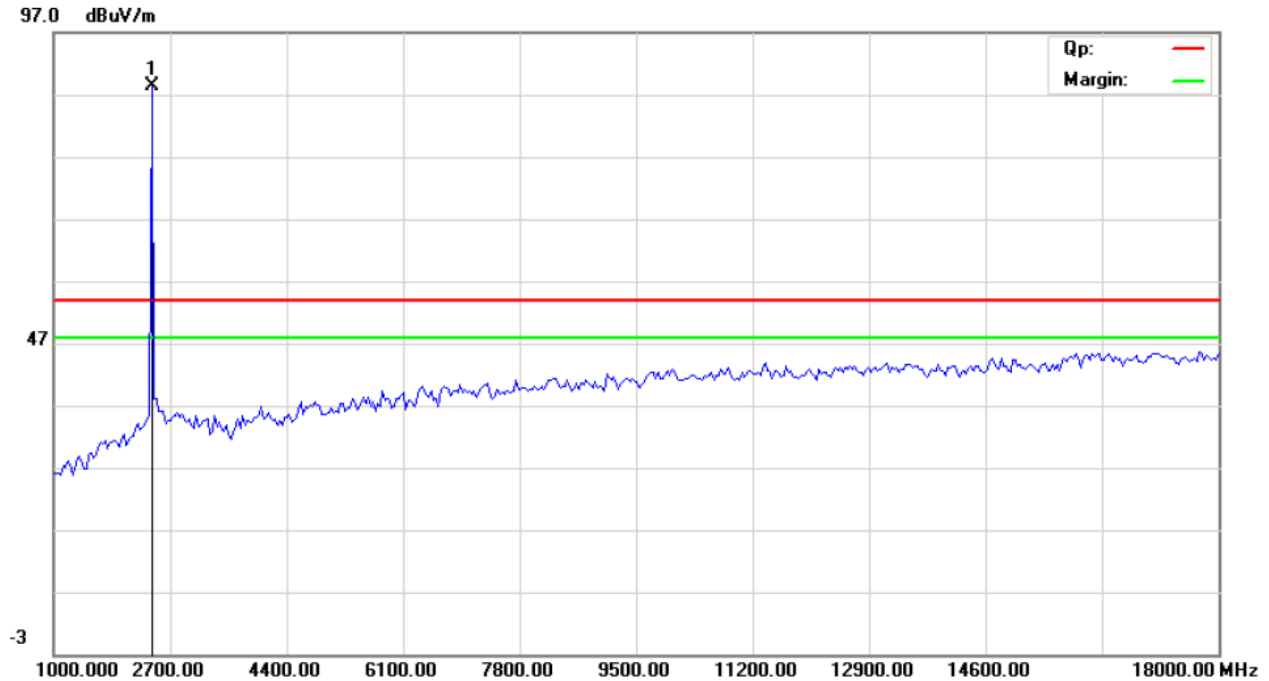


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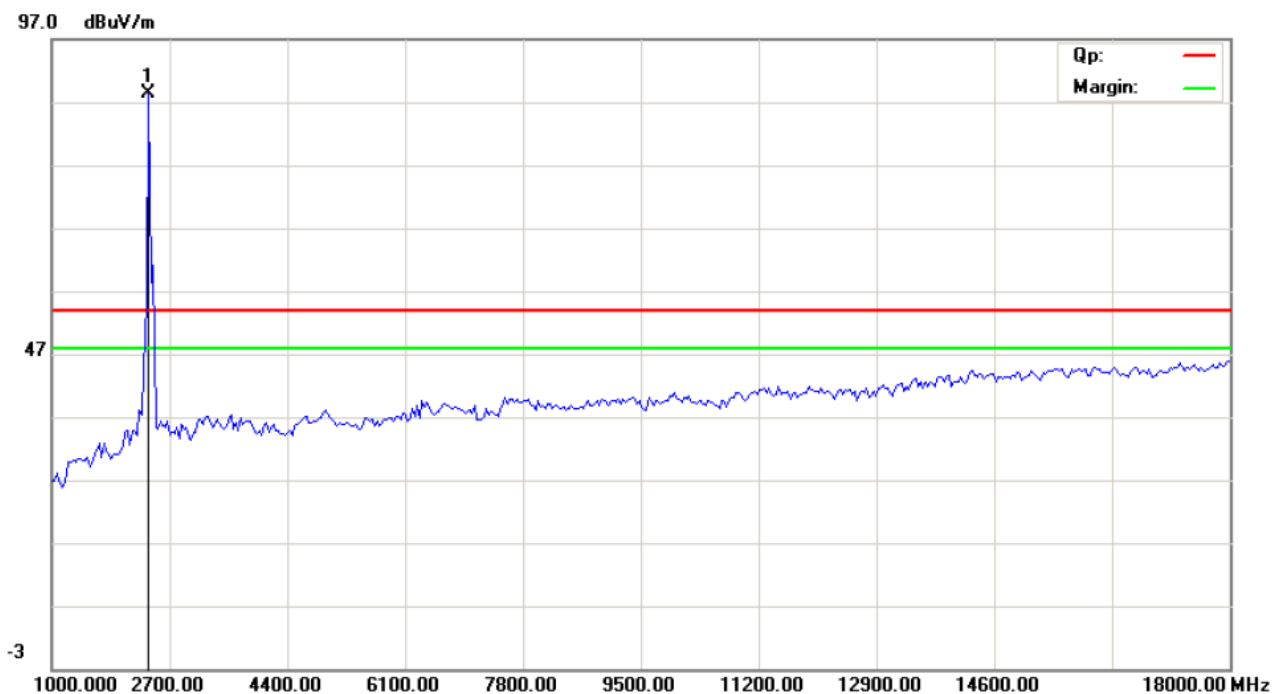
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### Middle Channel : Horizontal



### Middle Channel : Vertical



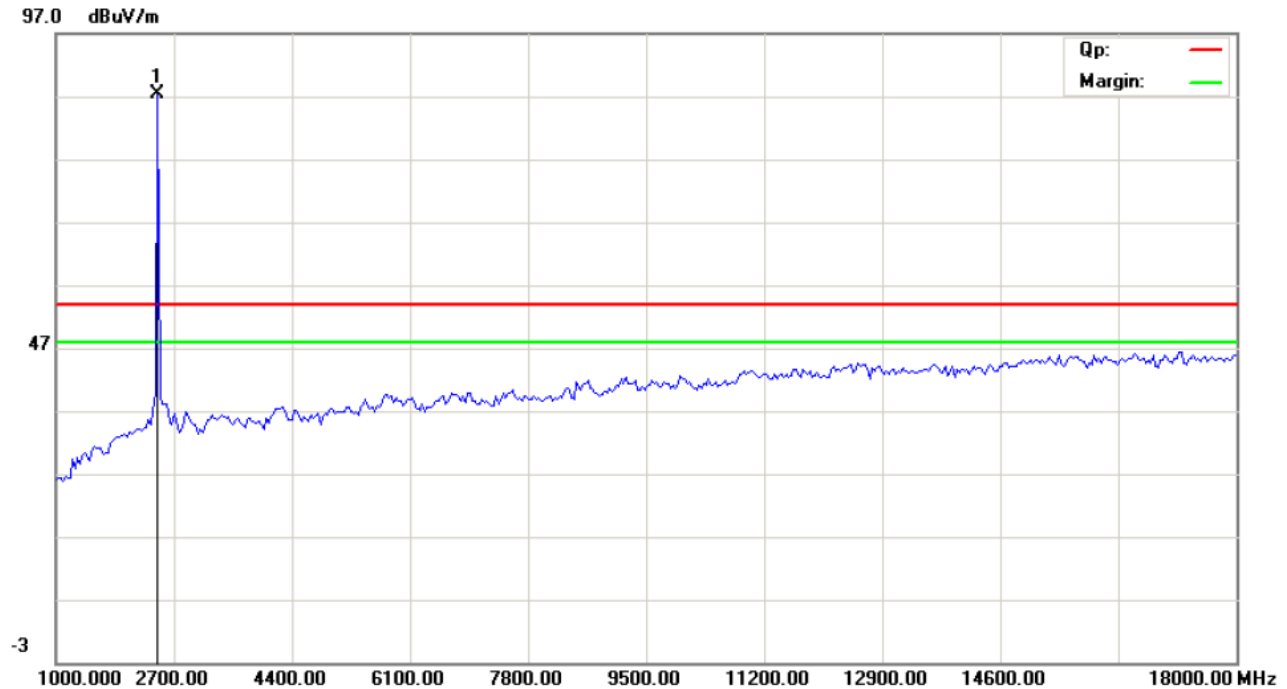
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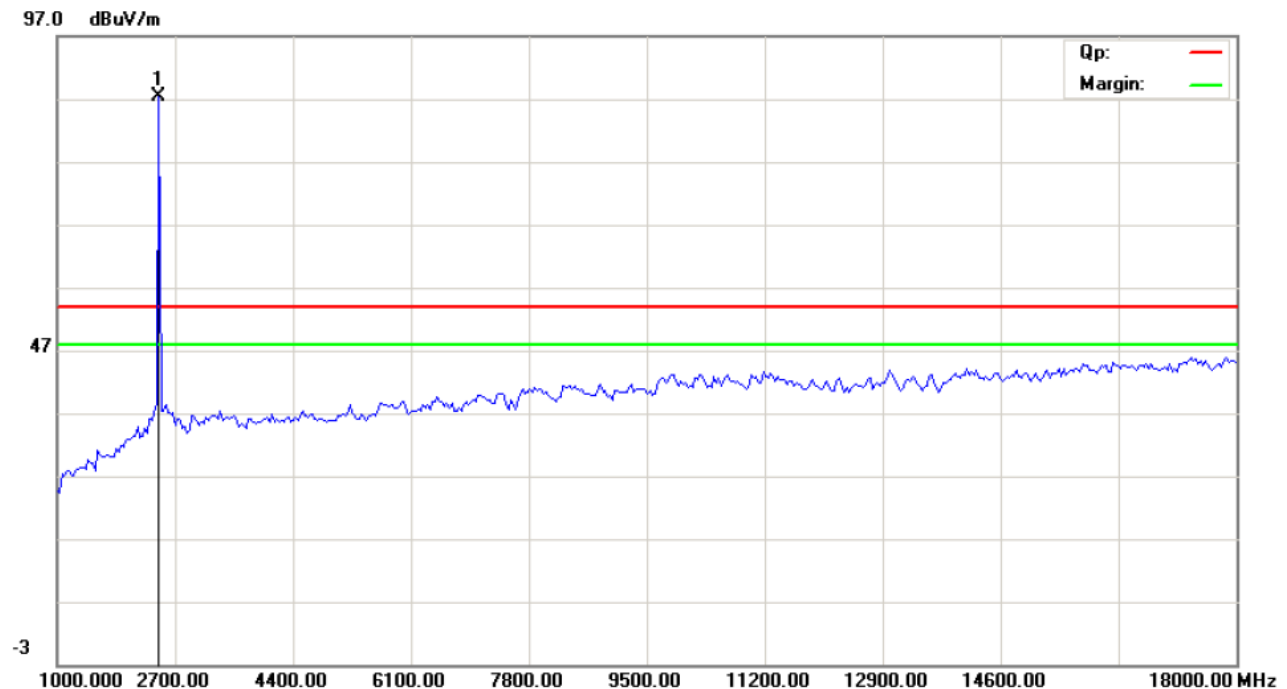
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### High Channel : Horizontal



### High Channel : Vertical



**Note: for the radiated emissions above 18G, it is the floor noise.**

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## 7.0 20dB Bandwidth Measurement

### 7.1 Regulation

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### 7.2 Limits of 20dB Bandwidth Measurement

N/A

### 7.3 Test Procedure.

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span =3MHz, VBW =30kHz, RBW=100kHz, Sweep = auto Detector function = peak ,Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results. 6. Repeat above procedures until all frequencies measured were complete.

### 7.4 Test Result

#### GFSK Mode

|             |                          |                       |                     |            |
|-------------|--------------------------|-----------------------|---------------------|------------|
| EUT         | Shower Bluetooth Speaker |                       | Model               | BTS-51     |
| Mode        | Keep Transmitting        |                       | Input Voltage       | DC3.7V     |
| Temperature | 24 deg. C,               |                       | Humidity            | 56% RH     |
| Channel     | Channel Frequency (MHz)  | 20 dB Bandwidth (kHz) | Maximum Limit (kHz) | Pass/ Fail |
| Low         | 2402                     | 990                   | --                  | Pass       |
| Middle      | 2441                     | 990                   | --                  | Pass       |
| High        | 2480                     | 996                   | --                  | Pass       |

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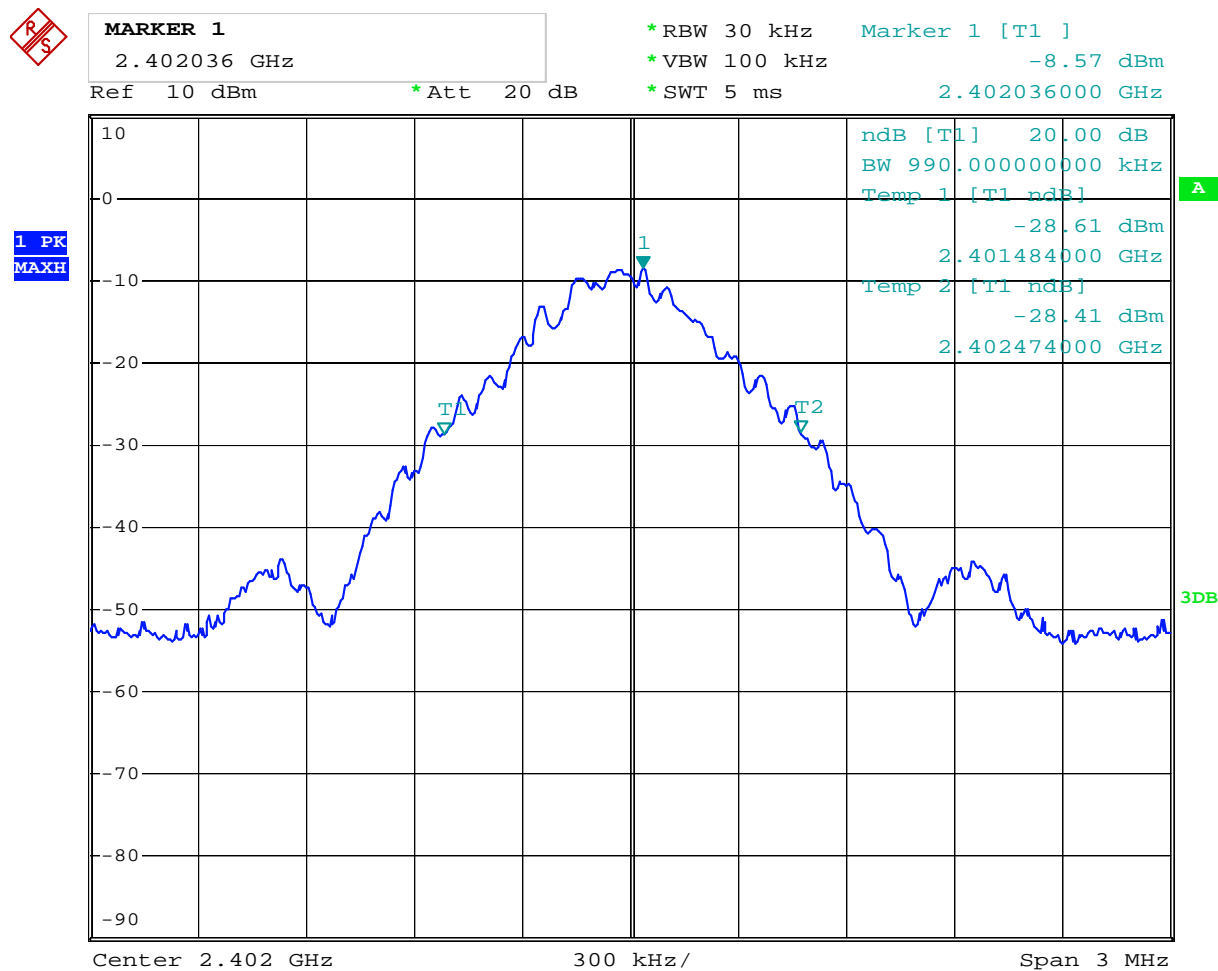
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Test Figure:

1. Condition: Low Channel

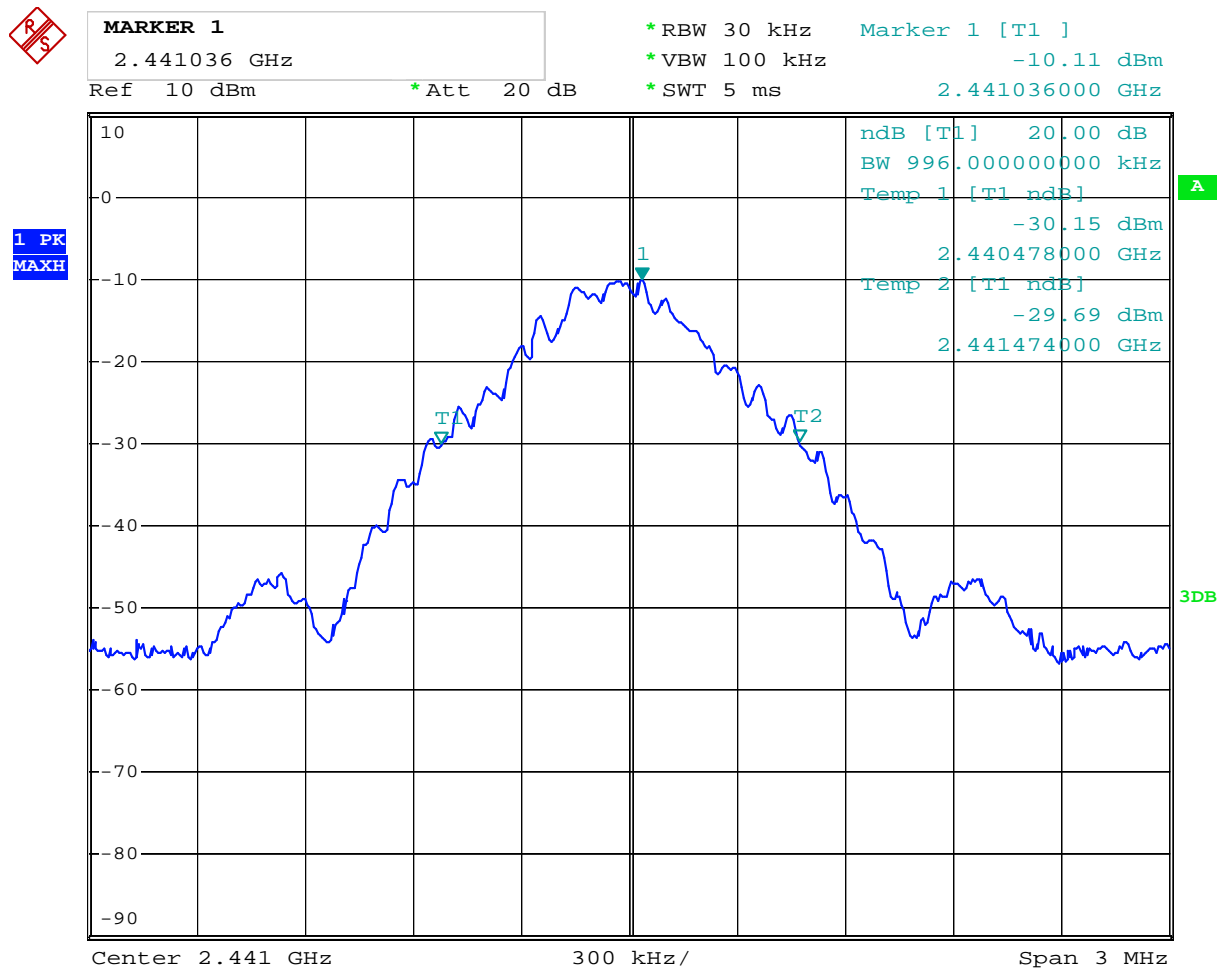


Date: 17.SEP.2014 11:27:59

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2. Condition: Middle Channel



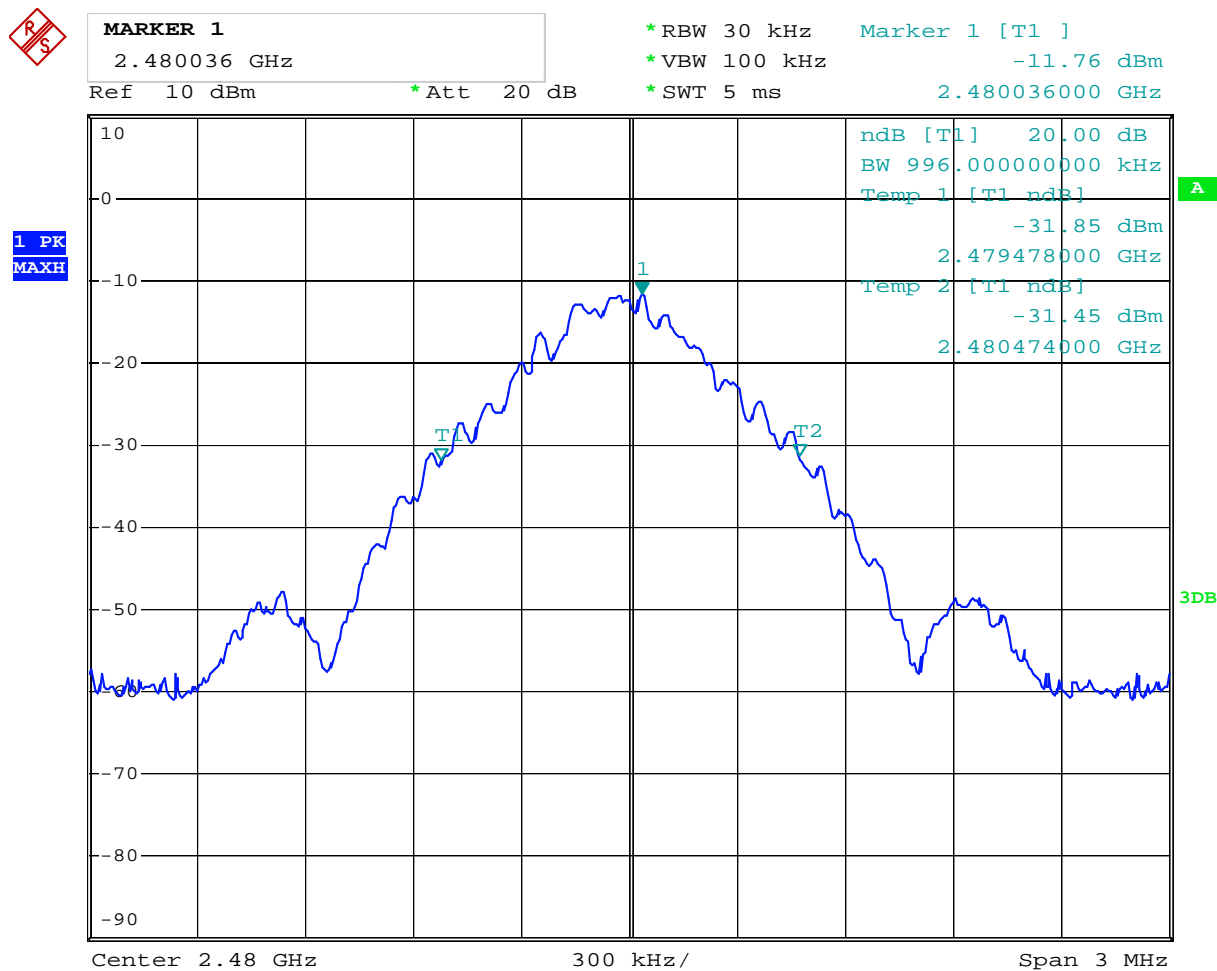
Date: 17.SEP.2014 12:25:03

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3. High Channel



Date: 17.SEP.2014 12:15:09

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## Test Result

### π/4DQPSK Mode

| EUT         | Shower Bluetooth Speaker   |                          | Model                  | BTS-51     |
|-------------|----------------------------|--------------------------|------------------------|------------|
| Mode        | Keep Transmitting          |                          | Input Voltage          | DC3.7V     |
| Temperature | 24 deg. C,                 |                          | Humidity               | 56% RH     |
| Channel     | Channel Frequency<br>(MHz) | 20 dB Bandwidth<br>(kHz) | Maximum Limit<br>(kHz) | Pass/ Fail |
| Low         | 2402                       | 1380                     | --                     | Pass       |
| Middle      | 2441                       | 1374                     | --                     | Pass       |
| High        | 2480                       | 1374                     | --                     | Pass       |

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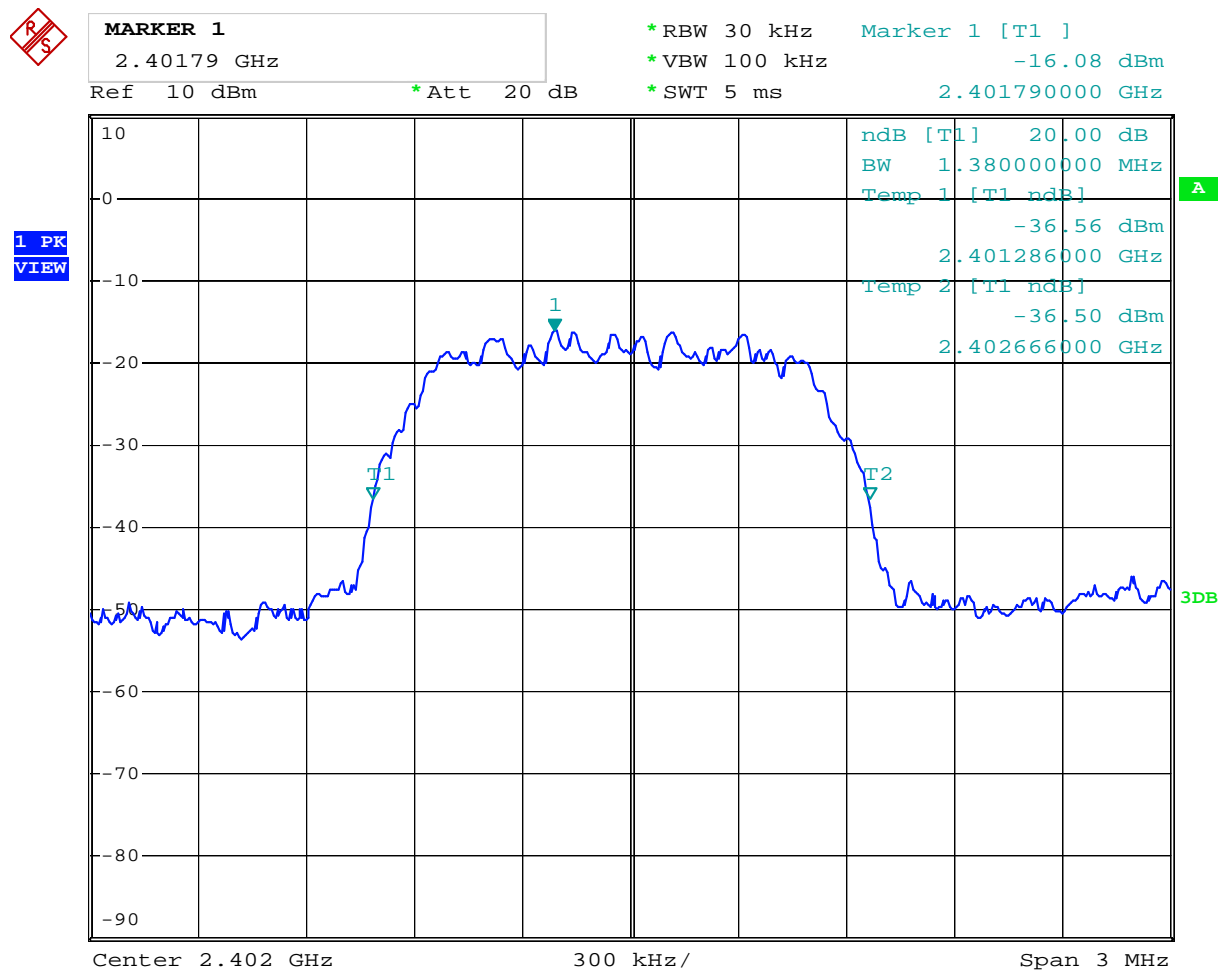
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Test Figure:

1. Condition: Low Channel

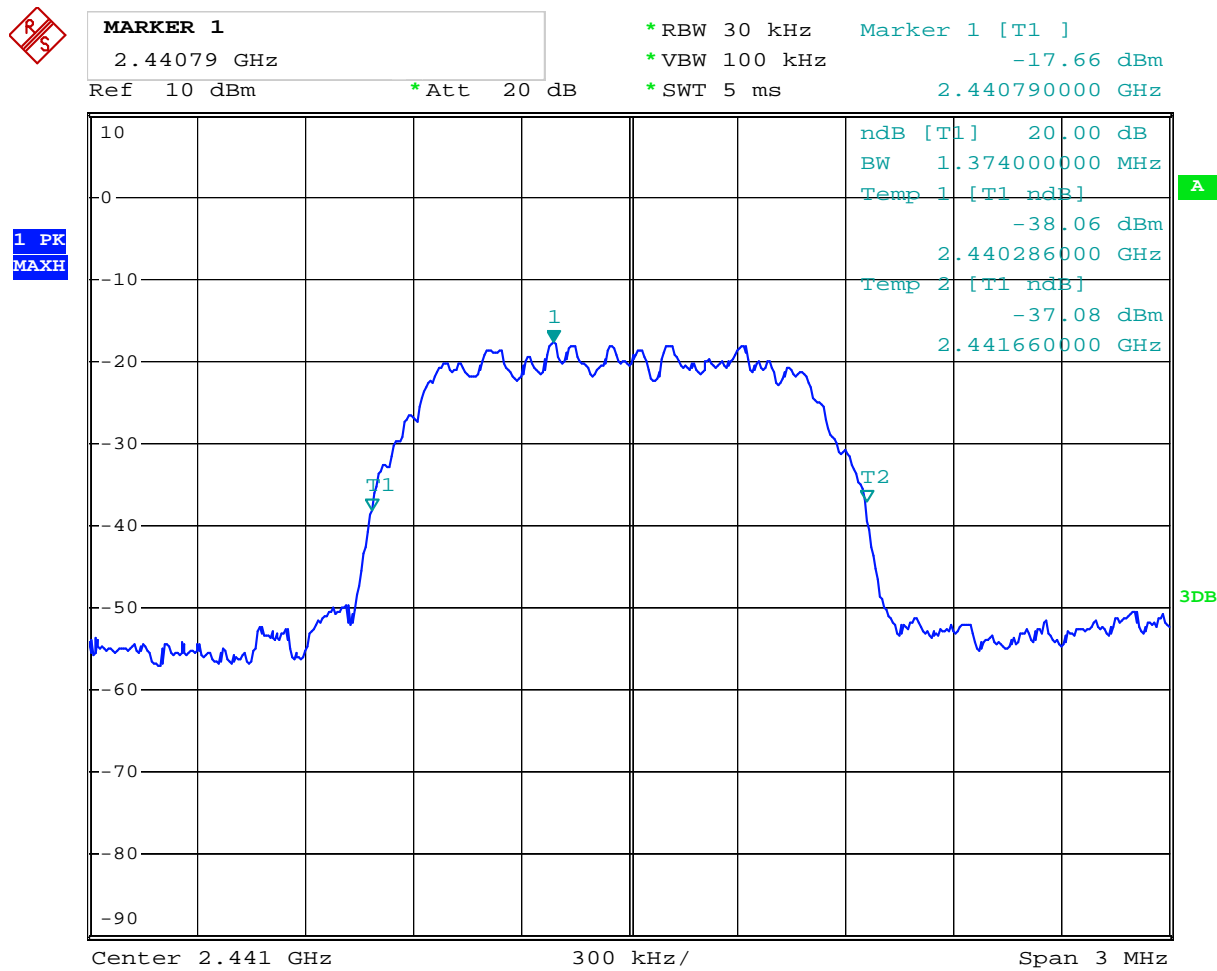


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2. Condition: Middle Channel

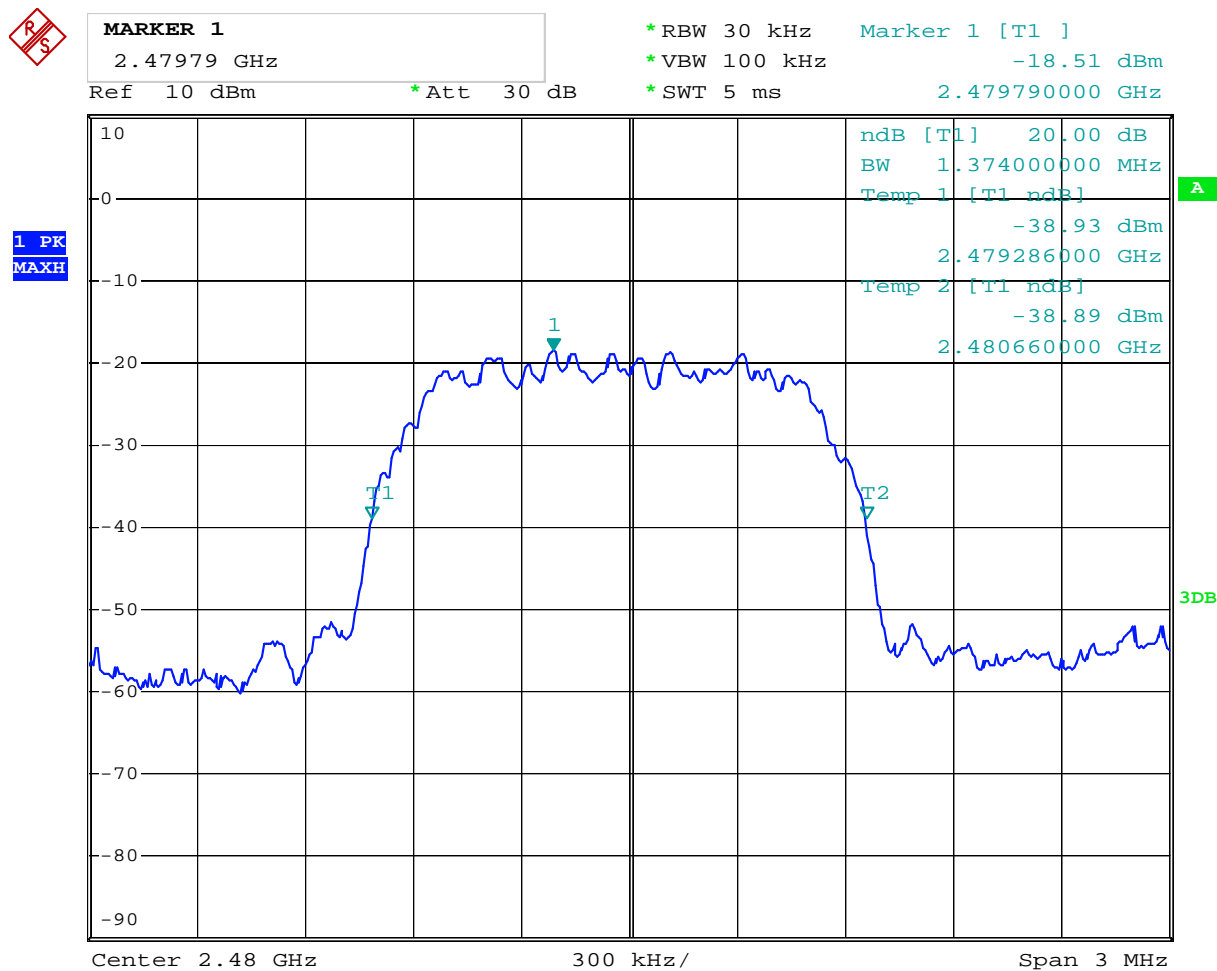


Date: 17.SEP.2014 12:24:05

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3. High Channel



Date: 19.SEP.2014 16:54:09

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## 8. Maximum Peak Output Power

### 8.1 Regulation

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5MHz band:0.125 watts. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 8.2 Limits of Maximum Peak Output Power

The Maximum Peak Output Power Measurement is 30dBm.

### 8.3 Test Procedure

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel; RBW > the 20 dB bandwidth of the emission being measured; VBW = RBW=3MHz; Sweep = auto; Detector function = peak; Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
4. Repeat above procedures until all frequencies measured were complete.

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## 8.4 Test Results

### GFSK Mode

| EUT         | Shower Bluetooth Speaker |                         | Model                  | BTS-51     |
|-------------|--------------------------|-------------------------|------------------------|------------|
| Mode        | Keep Transmitting        |                         | Input Voltage          | DC3.7V     |
| Temperature | 24 deg. C,               |                         | Humidity               | 56% RH     |
| Channel     | Channel Frequency (MHz)  | Peak Power Output (dBm) | Peak Power Limit (dBm) | Pass/ Fail |
| Low         | 2402                     | -5.44                   | 30                     | Pass       |
| Middle      | 2441                     | -7.03                   | 30                     | Pass       |
| High        | 2480                     | -8.80                   | 30                     | Pass       |

Note: 1. the result basic equation calculation as follow:

$$\text{Peak Power Output} = \text{Peak Power Reading} + \text{Cable loss} + \text{Attenuator}$$

2. Worse case was recorded

### π/4DQPSK Mode

| EUT         | Shower Bluetooth Speaker |                         | Model                  | BTS-51     |
|-------------|--------------------------|-------------------------|------------------------|------------|
| Mode        | Keep Transmitting        |                         | Input Voltage          | DC3.7V     |
| Temperature | 24 deg. C,               |                         | Humidity               | 56% RH     |
| Channel     | Channel Frequency (MHz)  | Peak Power Output (dBm) | Peak Power Limit (dBm) | Pass/ Fail |
| Low         | 2402                     | -7.15                   | 30                     | Pass       |
| Middle      | 2441                     | -8.68                   | 30                     | Pass       |
| High        | 2480                     | -10.60                  | 30                     | Pass       |

Note: 1. the result basic equation calculation as follow:

$$\text{Peak Power Output} = \text{Peak Power Reading} + \text{Cable loss} + \text{Attenuator}$$

2. Worse case was recorded

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## 9. Carrier Frequency Separation

### 9.1 Regulation

According to §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 9.2 Limits of Carrier Frequency Separation

The Maximum Power Spectral Density Measurement is 25kHz or two-thirds of the 20dB bandwidth of the hopping Channel which is great.

### 9.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = wide enough to capture the peaks of two adjacent channels: Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span; Video (or Average) Bandwidth (VBW)  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold
3. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.

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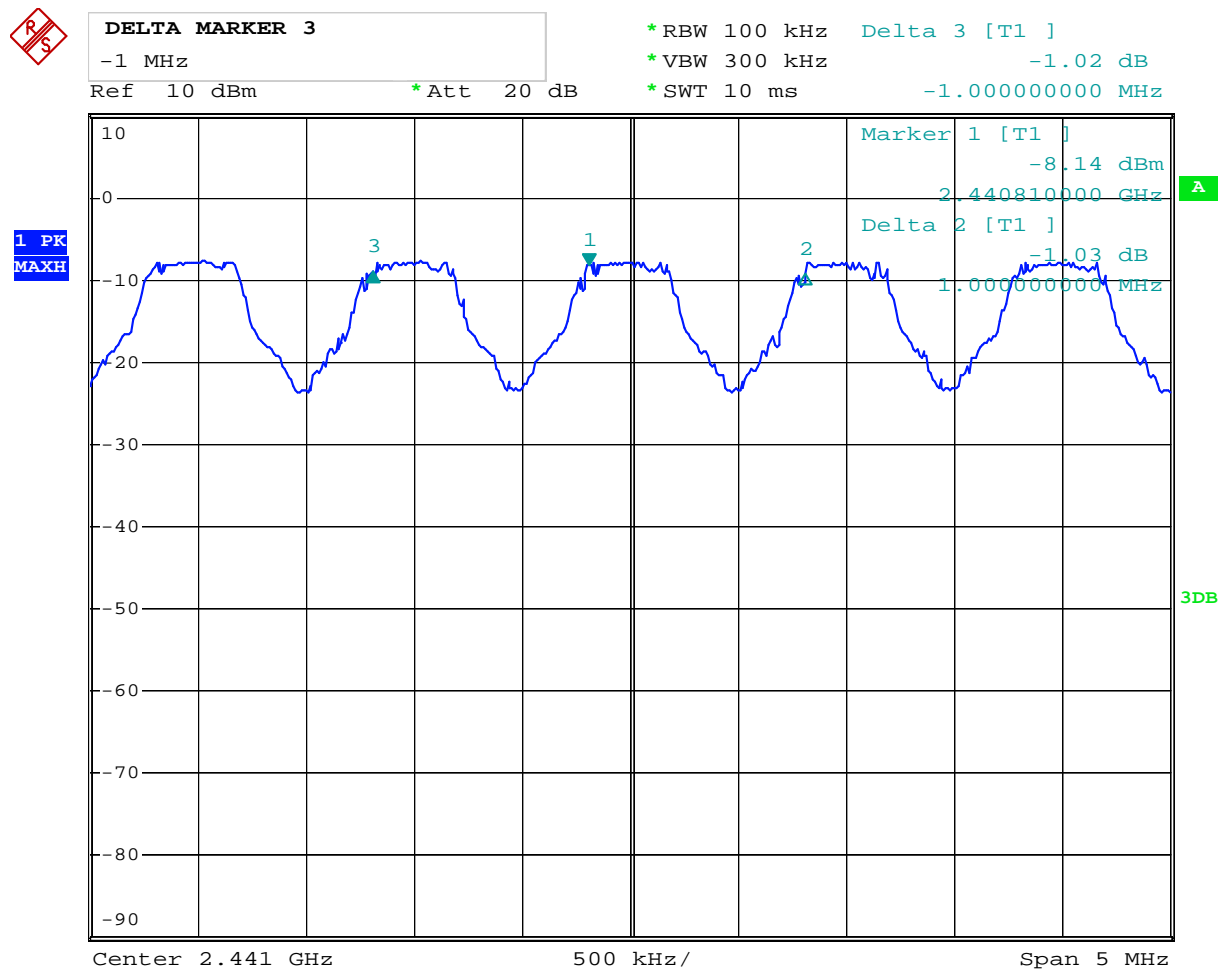




9.4Test Result  
GFSK Mode

|                              |                          |                                    |            |
|------------------------------|--------------------------|------------------------------------|------------|
| EUT                          | Shower Bluetooth Speaker | Model                              | BTS-51     |
| Mode                         | Hopping On               | Input Voltage                      | DC3.7V     |
| Temperature                  | 24 deg. C,               | Humidity                           | 56% RH     |
| Carrier Frequency Separation |                          | Limit                              | Pass/ Fail |
| 1000kHz                      |                          | ≥ 25 kHz or 2/3 of 20 dB bandwidth | Pass       |

Test Plots



Date: 18.SEP.2014 11:20:40

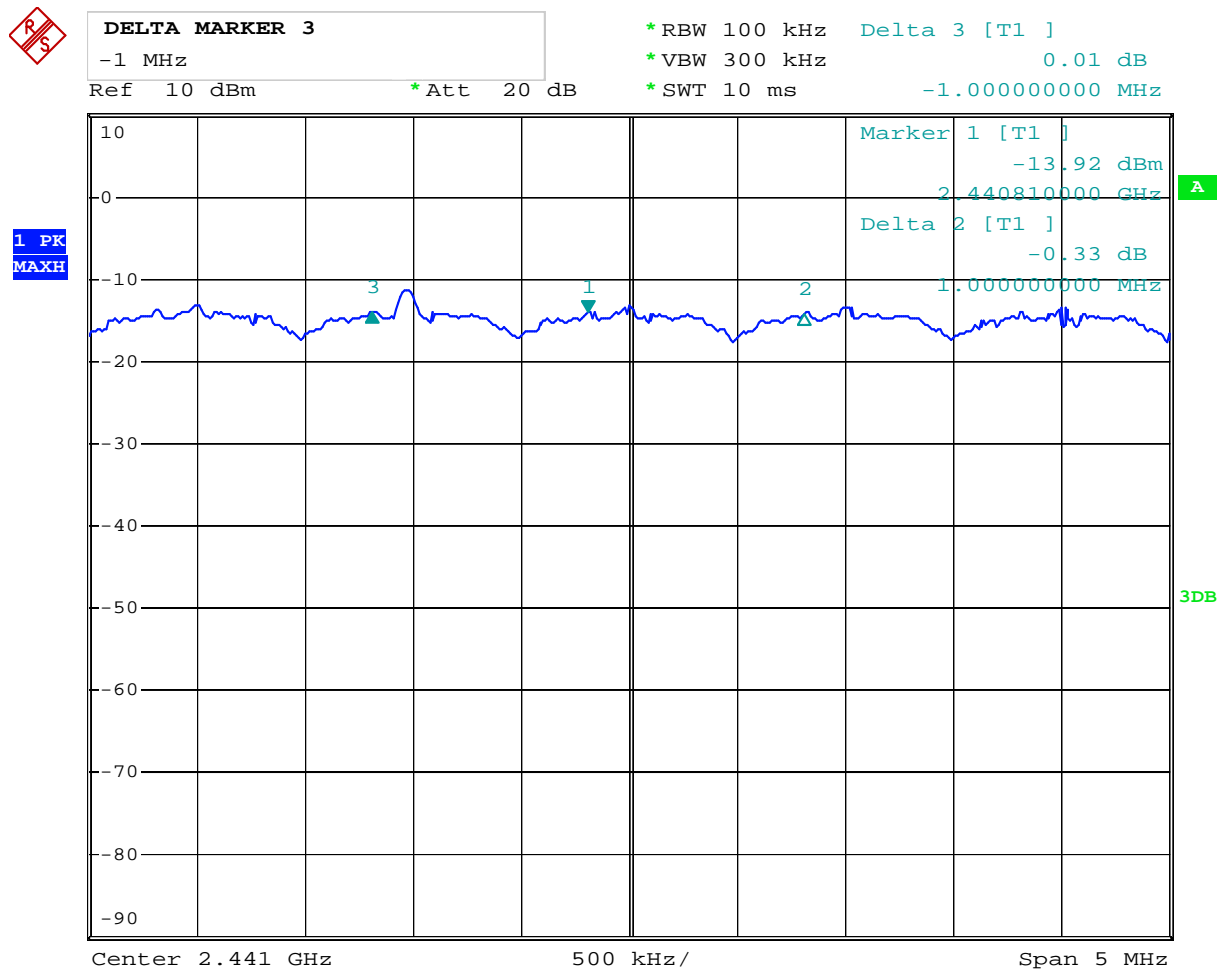
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π/4DQPSK Mode

|                              |                          |                                    |            |
|------------------------------|--------------------------|------------------------------------|------------|
| EUT                          | Shower Bluetooth Speaker | Model                              | BTS-51     |
| Mode                         | Hopping On               | Input Voltage                      | DC3.7V     |
| Temperature                  | 24 deg. C,               | Humidity                           | 56% RH     |
| Carrier Frequency Separation |                          | Limit                              | Pass/ Fail |
| 1000 kHz                     |                          | ≥ 25 kHz or 2/3 of 20 dB bandwidth | Pass       |

Test Plots



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## **10. Number of Hopping Channels**

### **10.1 Regulation**

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

### **10.2 Limits of Number of Hopping Channels**

The frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels.

### **10.3 Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = the frequency band of operation; RBW=100 kHz, VBW= 300 kHz;  
Sweep = auto; Detector function = peak; Trace = max hold
3. Record the number of hopping channels.

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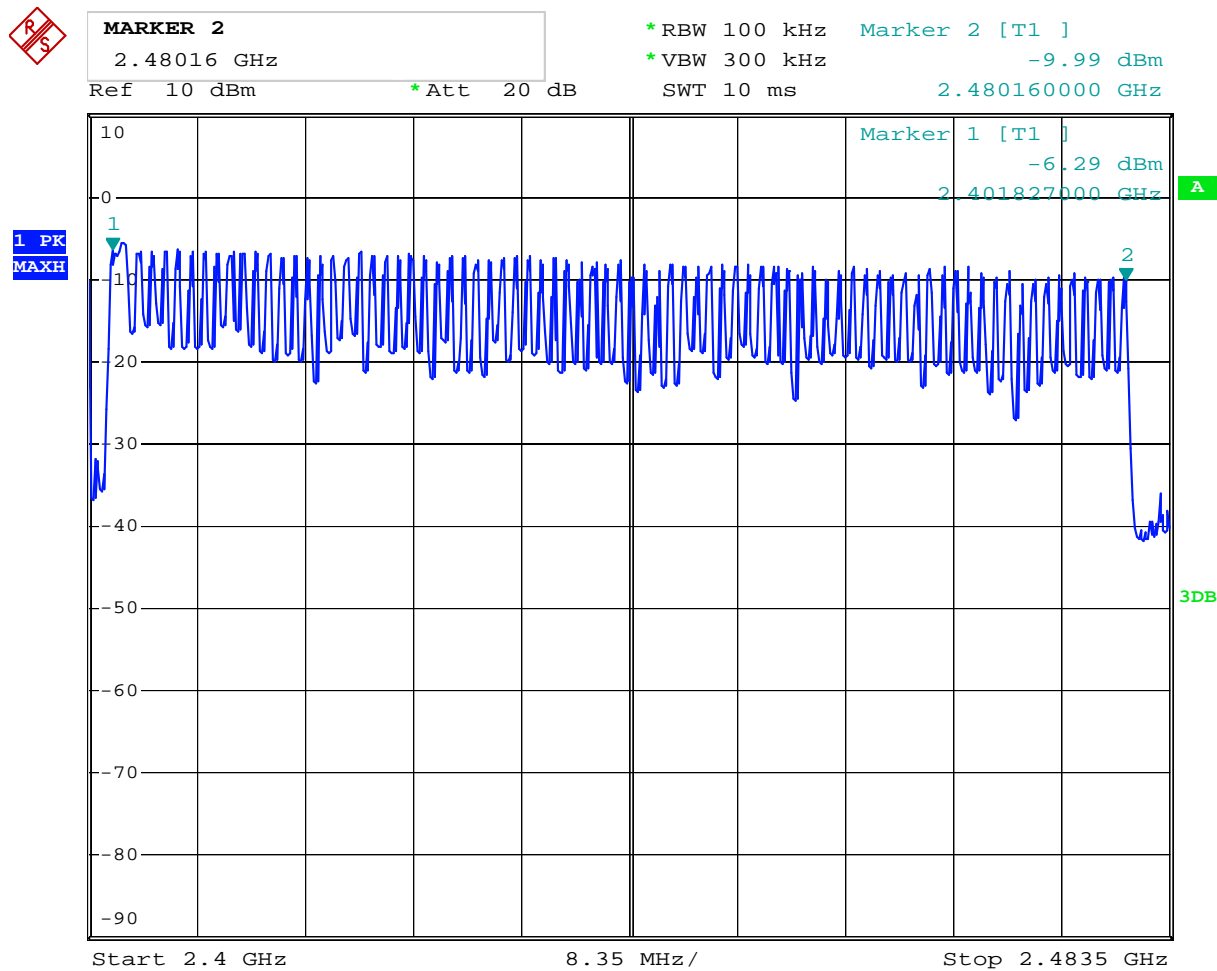
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10.4Test Result  
GFSK Mode

|                     |                            |               |            |
|---------------------|----------------------------|---------------|------------|
| EUT                 | Shower Bluetooth Speaker   | Model         | BTS-51     |
| Mode                | Hopping On                 | Input Voltage | DC3.7V     |
| Temperature         | 24 deg. C,                 | Humidity      | 56% RH     |
| Operating Frequency | Number of hopping channels | Limit         | Pass/ Fail |
| 2402-2480MHz        | 79                         | ≥ 15          | Pass       |

Test Plot



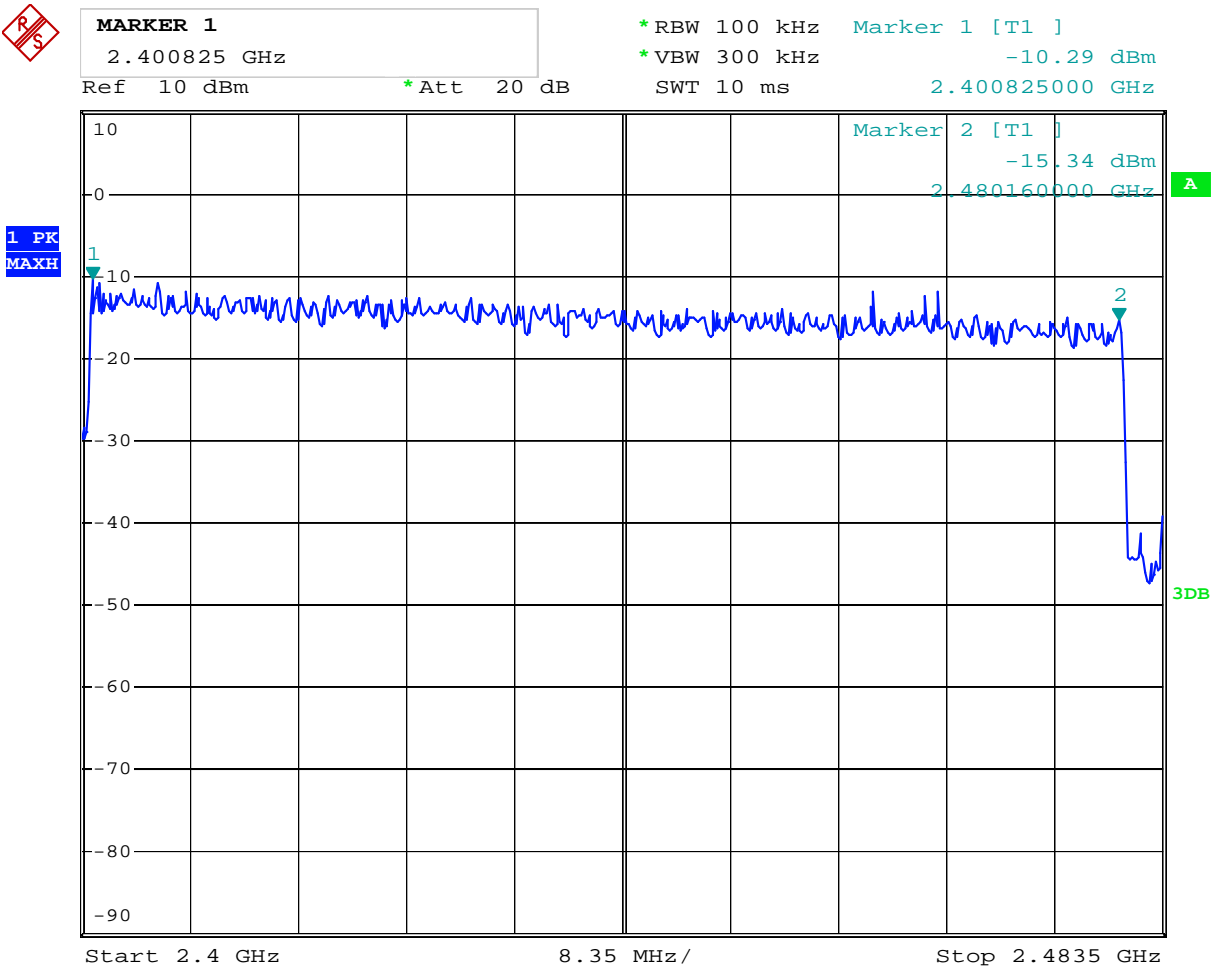
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π/4DQPSK Mode

|                     |                            |               |            |
|---------------------|----------------------------|---------------|------------|
| EUT                 | Shower Bluetooth Speaker   | Model         | BTS-51     |
| Mode                | Hopping On                 | Input Voltage | DC3.7V     |
| Temperature         | 24 deg. C,                 | Humidity      | 56% RH     |
| Operating Frequency | Number of hopping channels | Limit         | Pass/ Fail |
| 2402-2480MHz        | 79                         | ≥ 15          | Pass       |



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## **11. Time of Occupancy (Dwell Time)**

### **11.1 Regulation**

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### **11.2 Limits of Carrier Frequency Separation**

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed

### **11.3 Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW  $\geq$  RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold
3. Measure the dwell time using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.
5. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

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## 11.4 Test Result

### GFSK Mode

|             |                          |               |               |        |       |
|-------------|--------------------------|---------------|---------------|--------|-------|
| EUT         | Shower Bluetooth Speaker |               | Model         | BTS-51 |       |
| Mode        | Keep Transmitting        |               | Input Voltage | DC3.7V |       |
| Temperature | 24 deg. C,               |               | Humidity      | 56% RH |       |
| Channel     | Reading                  | Hopping Rate  |               | Actual | Limit |
| Low         | 2.96ms                   | 266.667 hop/s |               | 0.316s | 0.4s  |
| Middle      | 3.00ms                   | 266.667 hop/s |               | 0.320s | 0.4s  |
| High        | 2.96ms                   | 266.667 hop/s |               | 0.316s | 0.4s  |

Actual = Reading × (Hopping rate / Number of channels) × Test period, Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels. A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

**Note: DH5 was the worse case**

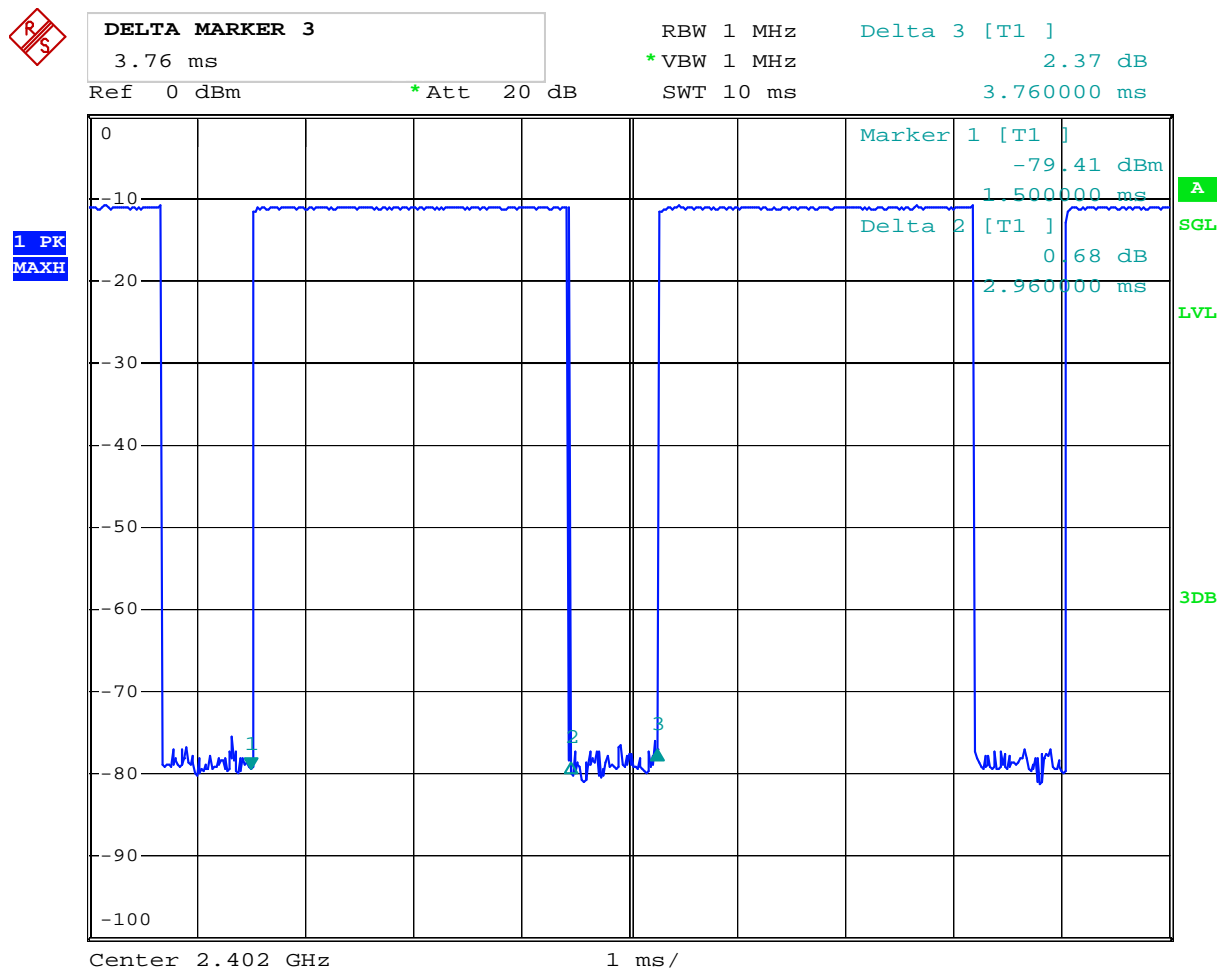
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Test Plots:  
Low Channel:



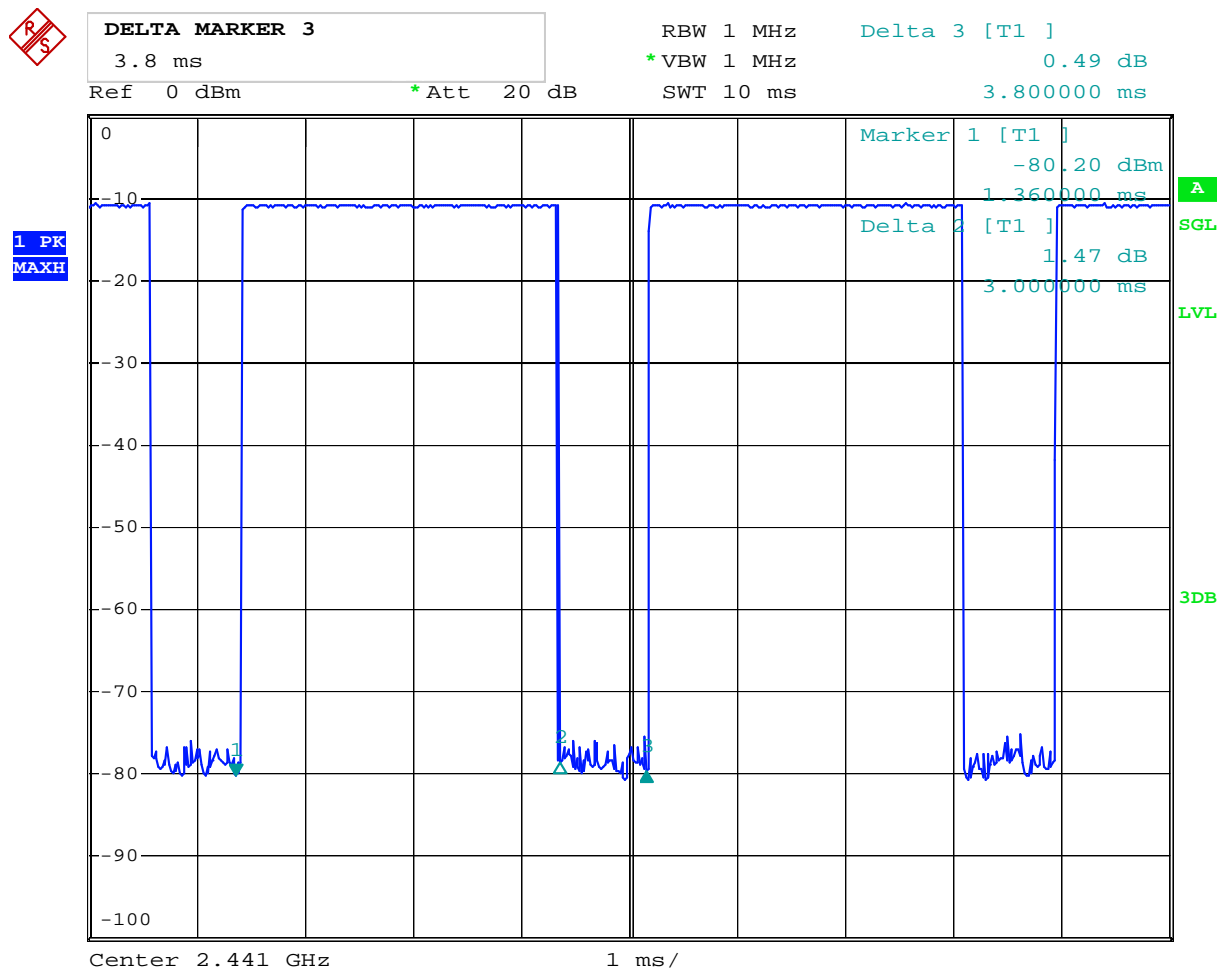
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Middle Channel:

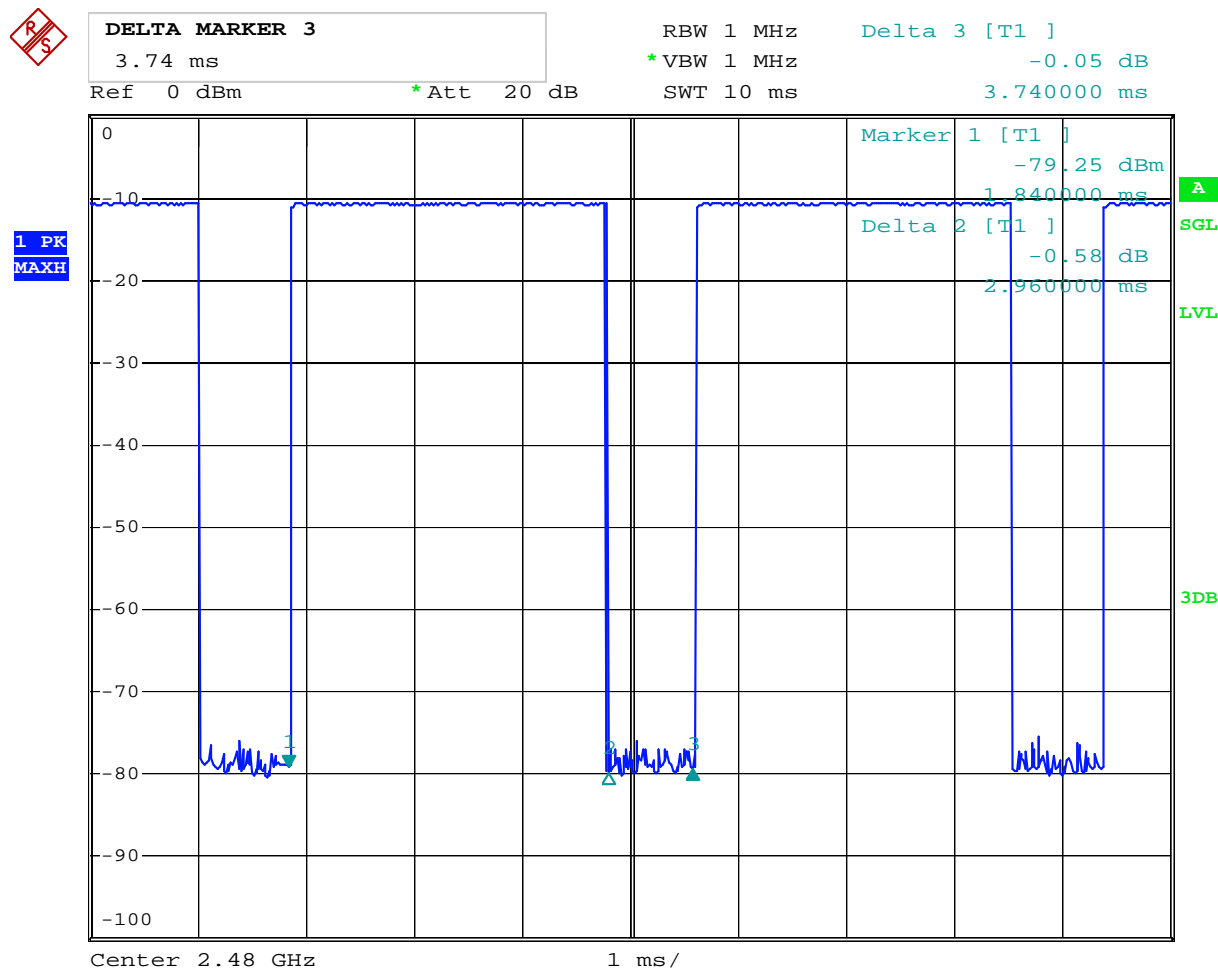


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High Channel



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## Test Result

### π/4DQPSK Mode

|             |                          |               |               |        |       |
|-------------|--------------------------|---------------|---------------|--------|-------|
| EUT         | Shower Bluetooth Speaker |               | Model         | BTS-51 |       |
| Mode        | Keep Transmitting        |               | Input Voltage | DC3.7V |       |
| Temperature | 24 deg. C,               |               | Humidity      | 56% RH |       |
| Channel     | Reading                  | Hopping Rate  |               | Actual | Limit |
| Low         | 3.00ms                   | 266.667 hop/s |               | 0.320s | 0.4s  |
| Middle      | 3.00ms                   | 266.667 hop/s |               | 0.320s | 0.4s  |
| High        | 2.96ms                   | 266.667 hop/s |               | 0.316s | 0.4s  |

Actual = Reading × (Hopping rate / Number of channels) × Test period ,Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels. A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

**Note: DH5 was the worse case**

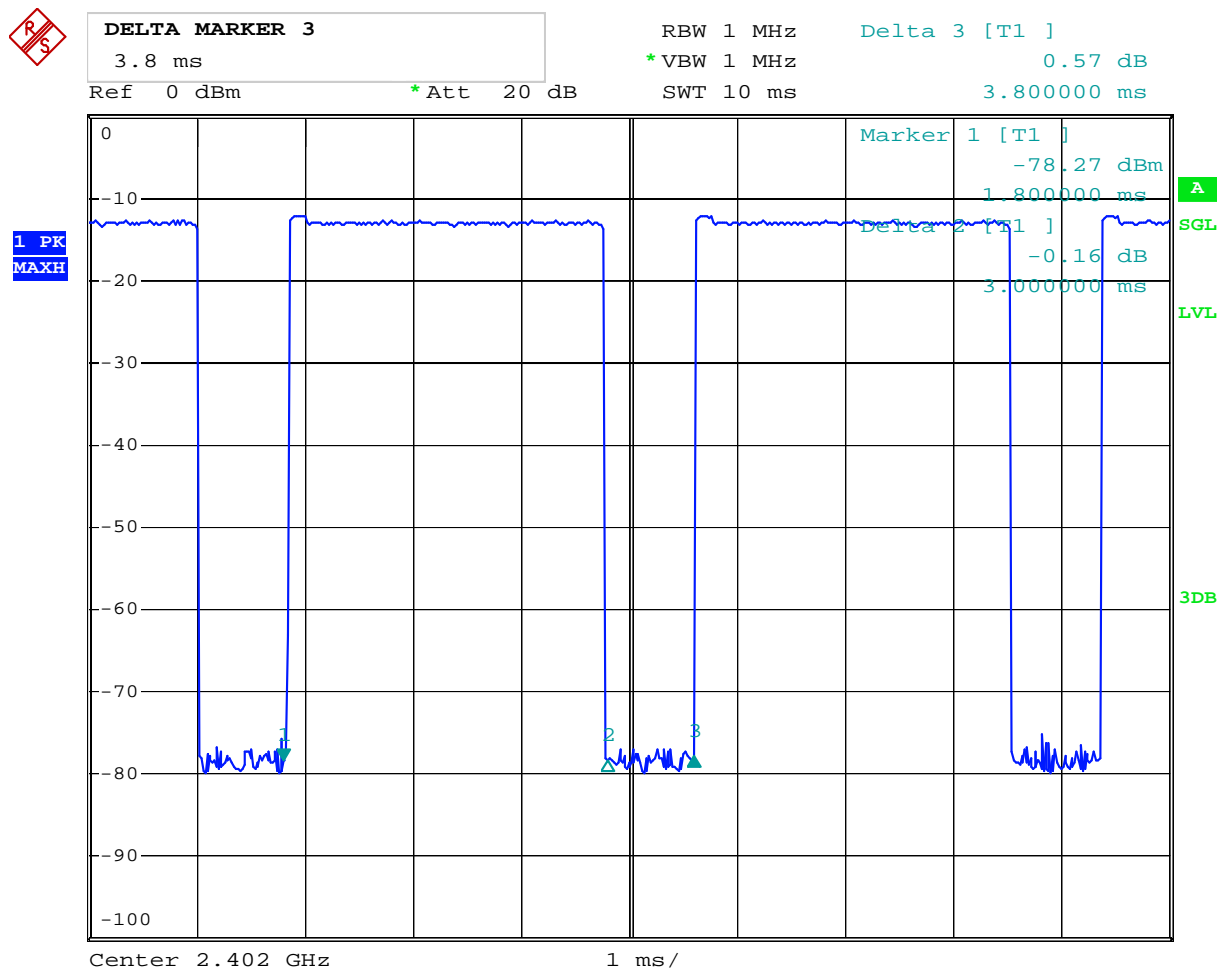
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Test Plots:  
Low Channel:

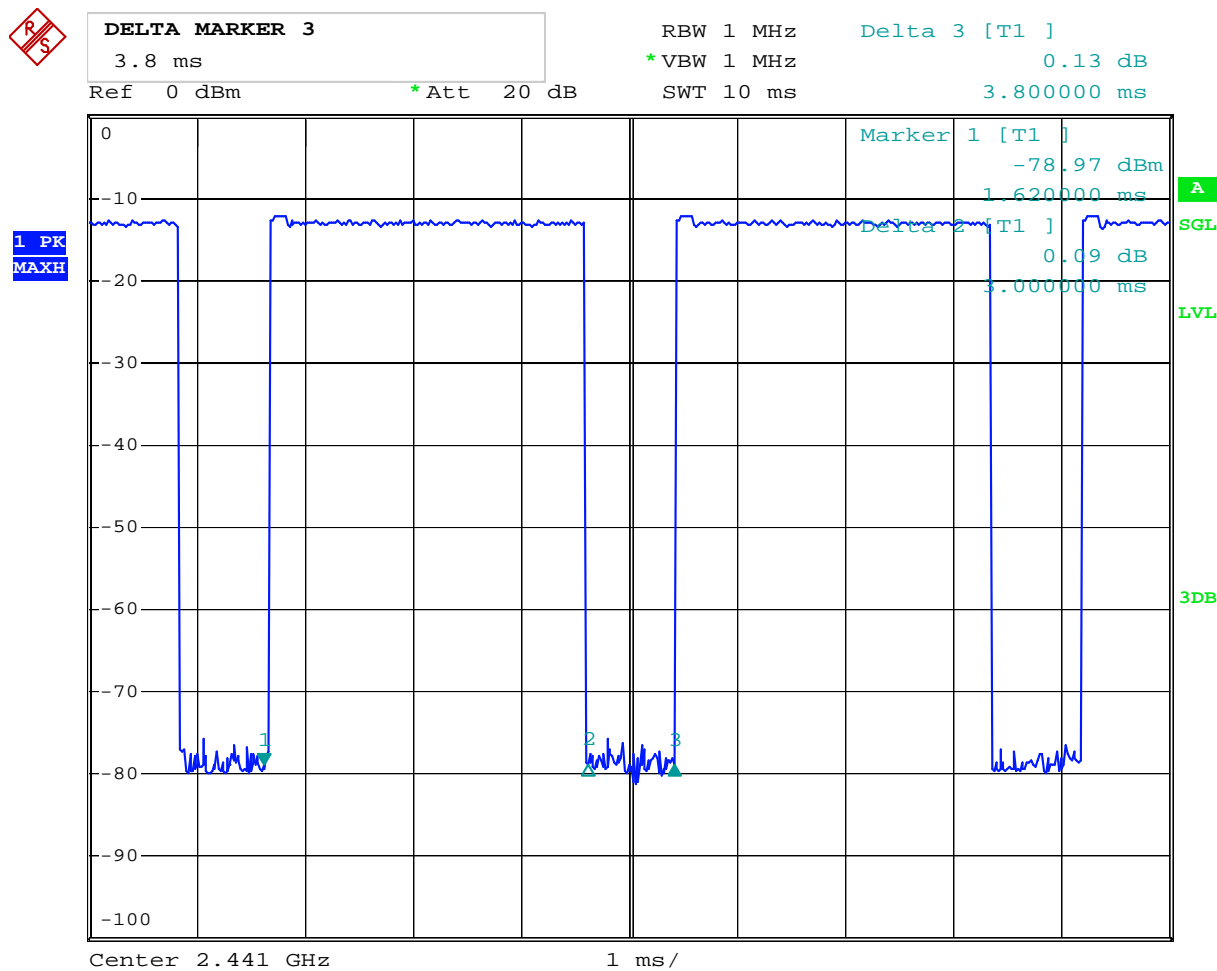


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Middle Channel:

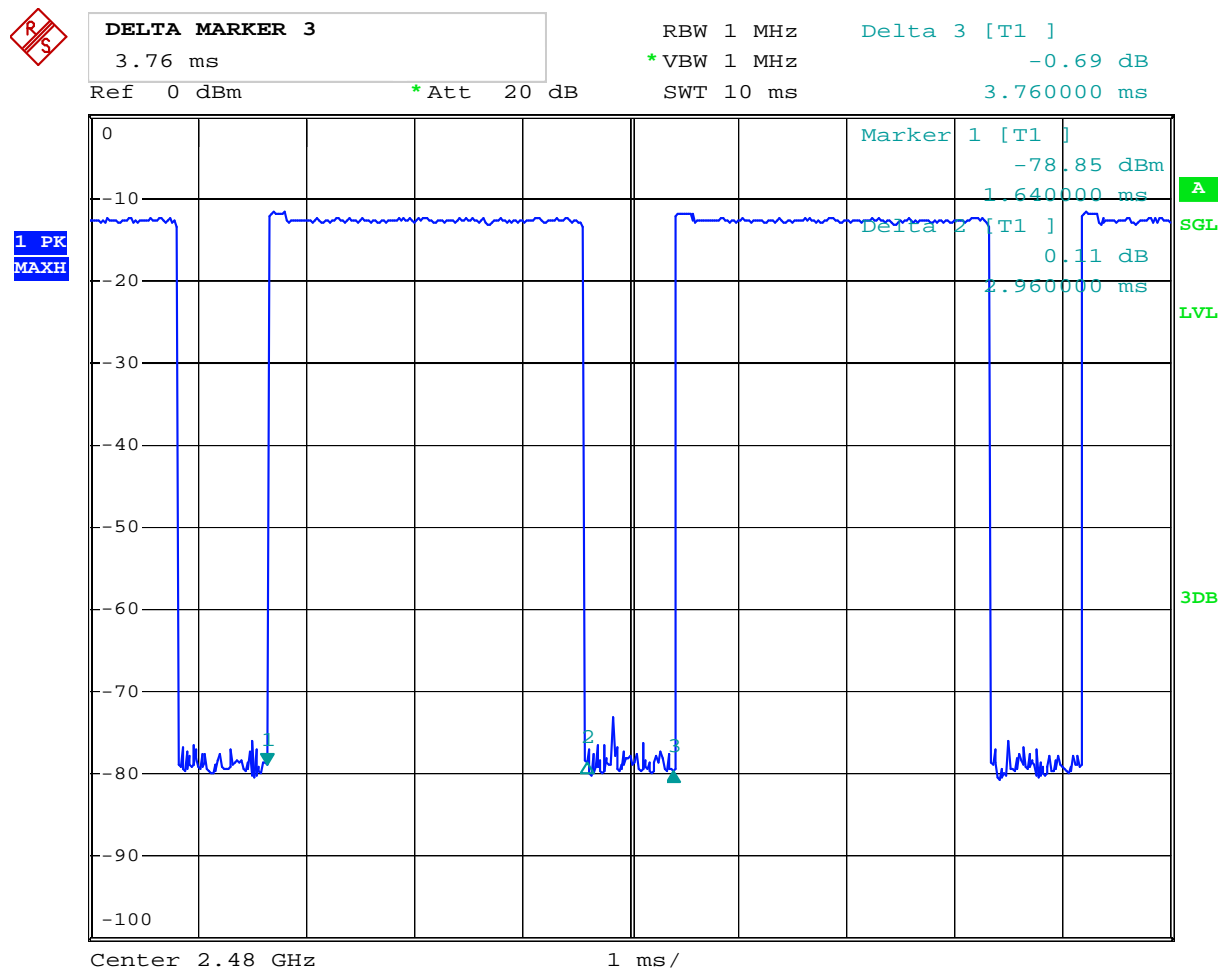


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High Channel

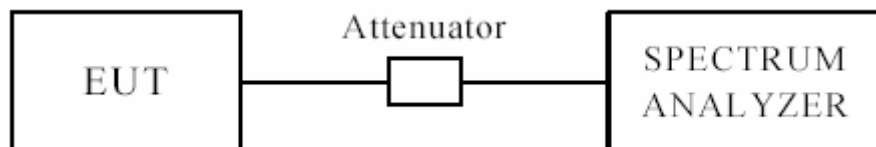


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## 12 Out of Band Measurement

### 12.1 Test Setup



The restricted band requirement based on radiated emission test; please see the clause 6 for the test setup

### 12.2 Limits of Out of Band Emissions Measurement

1. Below  $-20\text{dB}$  of the highest emission level of operating band (in 100kHz Resolution Bandwidth).
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

### 12.3 Test Procedure

For signals in the restricted bands above and below the 2.4-2.483GHz allocated band a measurement was made of Radiated emission test. Peak values with RBW=VBW=1MHz and PK detector.

For bandage test, the spectrum set as follows: RBW=VBW=100 kHz. A conducted measurement used

Note: 1. For band-edge measurement, the frequency from 30MHz-25GHz was tested. And It met the FCC rule.

2. This is a handheld device. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.

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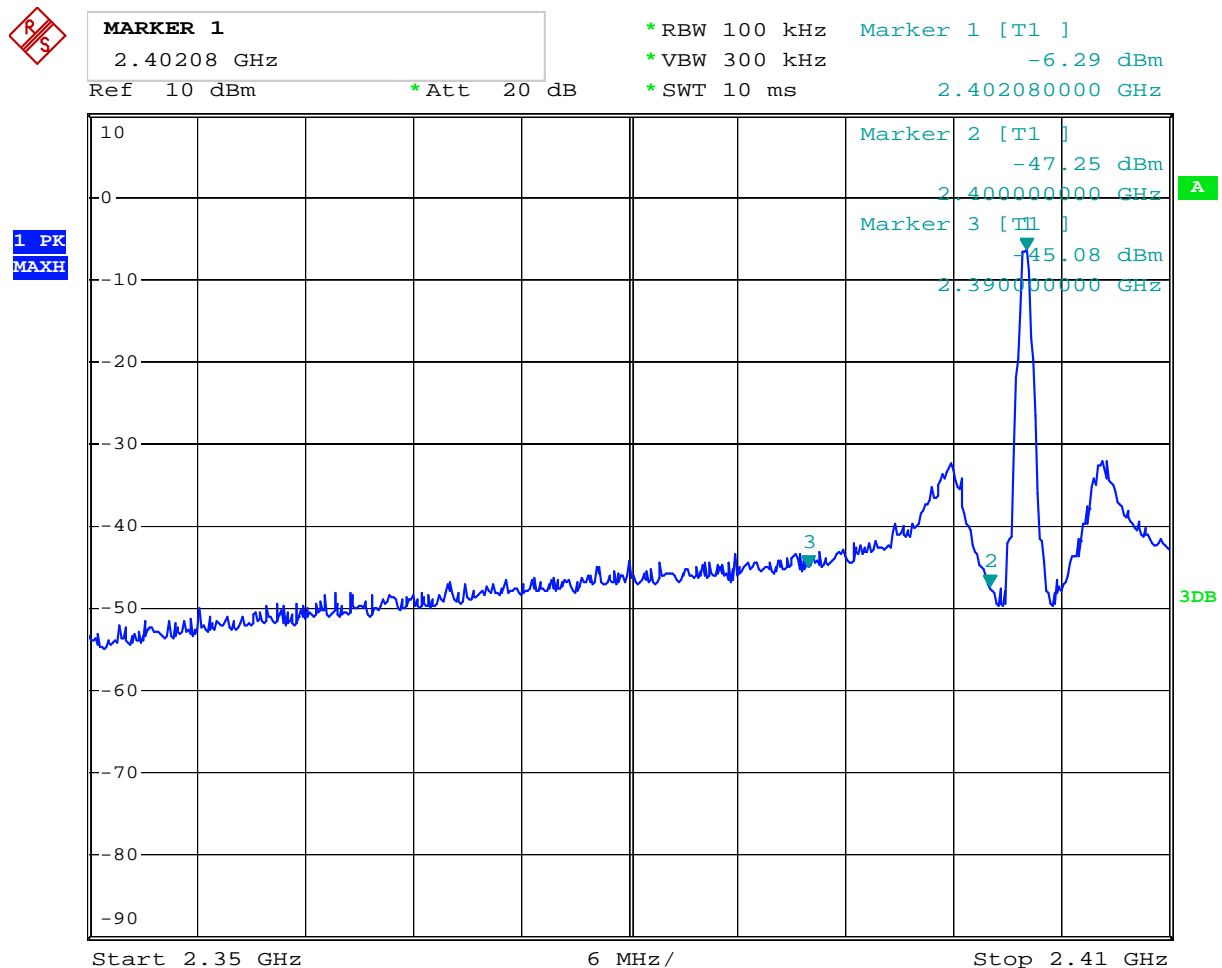


## GFSK Mode

### 12.4 Out of Band Test Result

|                                      |                          |      |               |             |
|--------------------------------------|--------------------------|------|---------------|-------------|
| Product:                             | Shower Bluetooth Speaker |      | Test Mode:    | Low Channel |
| Mode                                 | Keeping Transmitting     |      | Input Voltage | DC3.7V      |
| Temperature                          | 24 deg. C                |      | Humidity      | 56% RH      |
| Test Result:                         | Pass                     |      | Detector      | PK          |
| The Max. FS in Restrict Band 2390MHz | PK (dBμV/m)              | 48.2 | Limit         | 74(dBμV/m)  |
|                                      | AV(dBμV/m)               | --   |               | 54(dBμV/m)  |

#### Test Figure:



Date: 18.SEP.2014 11:43:30

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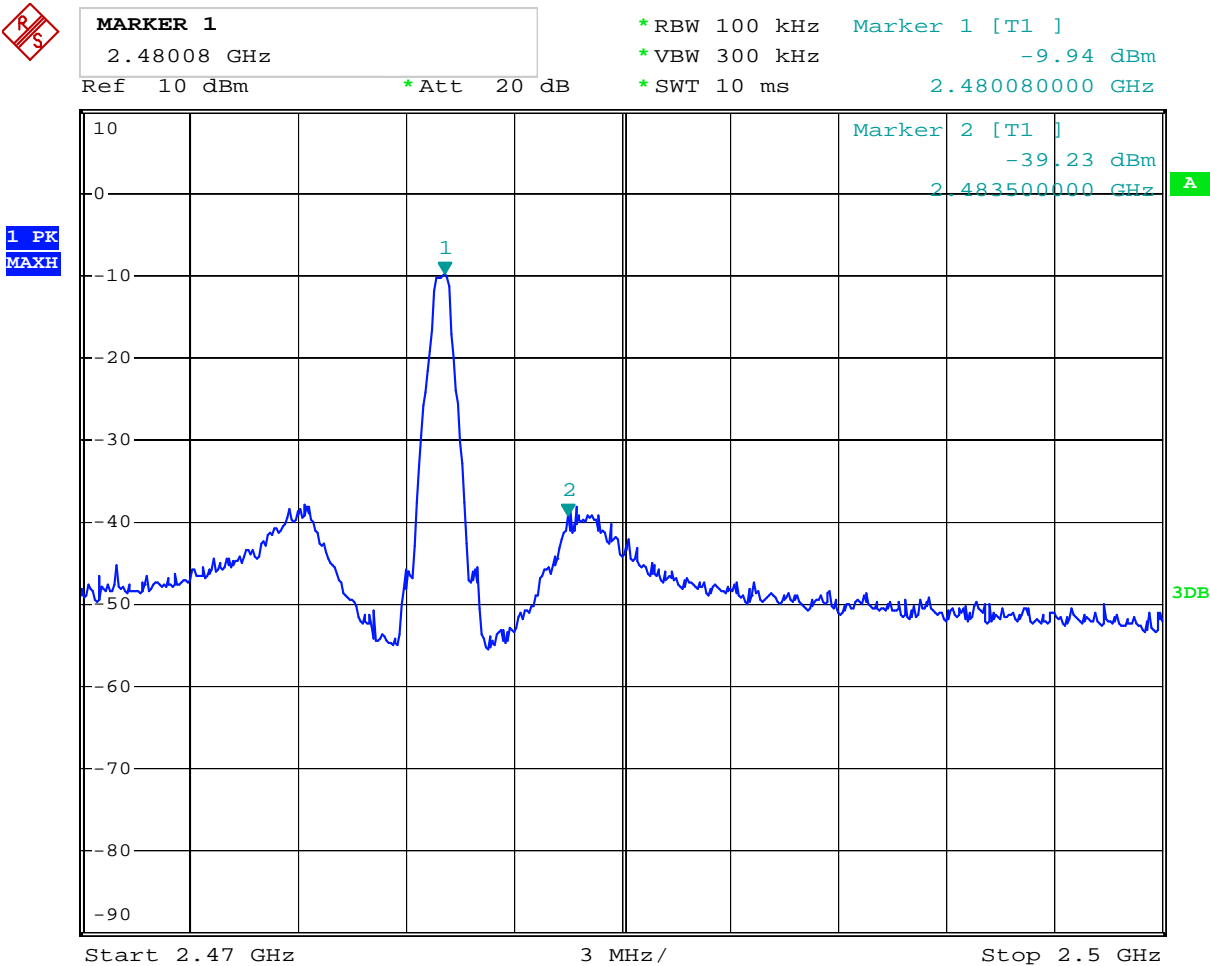


GFSK Mode

12.4 Out of Band Test Result

|  |                          |      |               |              |
|--|--------------------------|------|---------------|--------------|
| Product:                               | Shower Bluetooth Speaker |      | Test Mode:    | High Channel |
| Mode                                   | Keeping Transmitting     |      | Input Voltage | DC3.7V       |
| Temperature                            | 24 deg. C,               |      | Humidity      | 56% RH       |
| Test Result:                           | Pass                     |      | Detector      | PK           |
| The Max. FS in Restrict Band 2483.5MHz | PK (dBμV/m)              | 50.3 | Limit         | 74(dBμV/m)   |
|  | AV(dBμV/m)               | --   |               | 54(dBμV/m)   |

Test Figure:



Date: 18.SEP.2014 11:46:43

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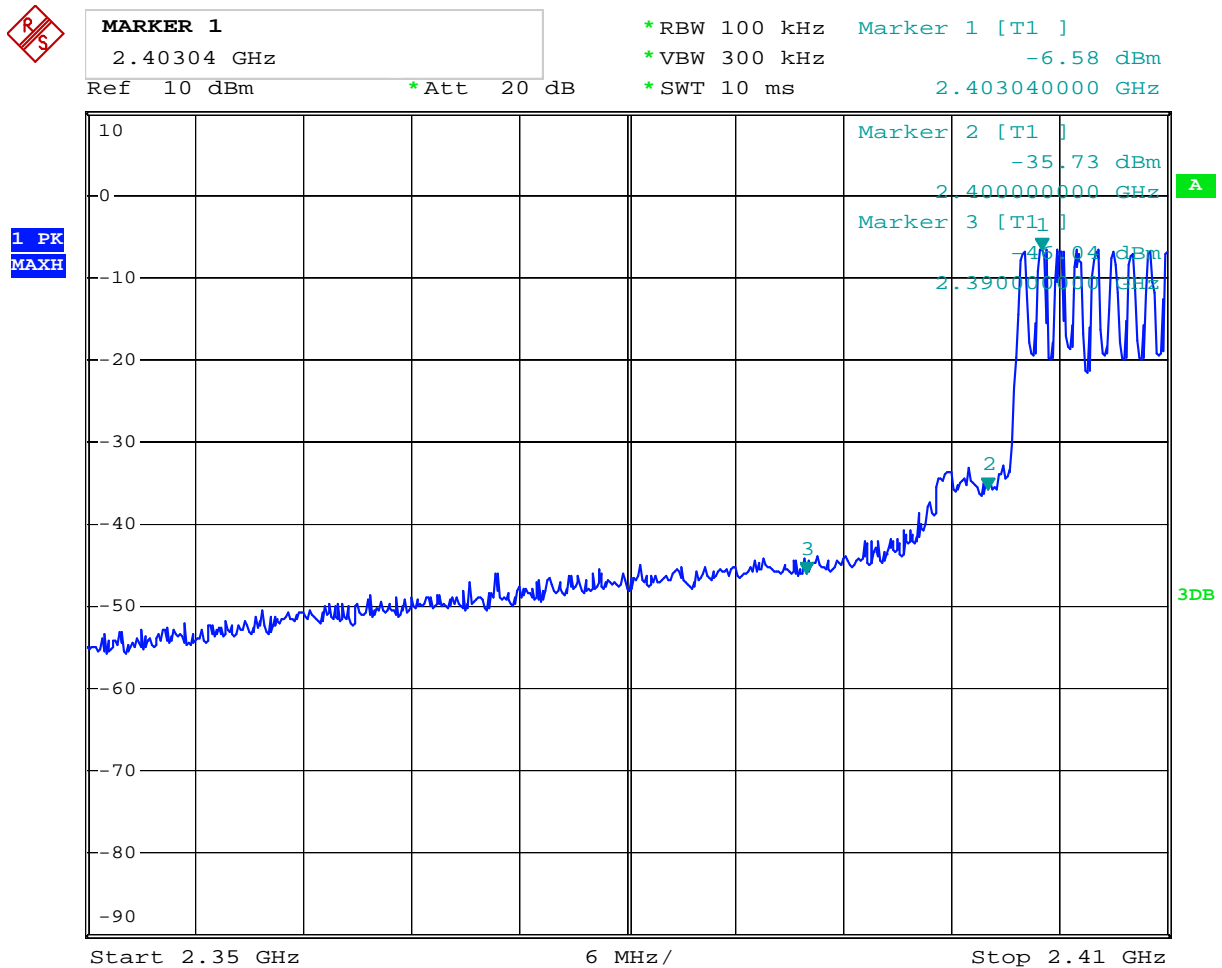


### GFSK Mode

#### 12.4 Out of Band Test Result

|                                      |                          |      |               |              |
|--------------------------------------|--------------------------|------|---------------|--------------|
| Product:                             | Shower Bluetooth Speaker |      | Test Mode:    | Hopping mode |
| Mode                                 | Hopping On               |      | Input Voltage | DC3.7V       |
| Temperature                          | 24 deg. C,               |      | Humidity      | 56% RH       |
| Test Result:                         | Pass                     |      | Detector      | PK           |
| The Max. FS in Restrict Band 2390MHz | PK (dBμV/m)              | 46.9 | Limit         | 74(dBμV/m)   |
|                                      | AV(dBμV/m)               | --   |               | 54(dBμV/m)   |

#### Test Figure:



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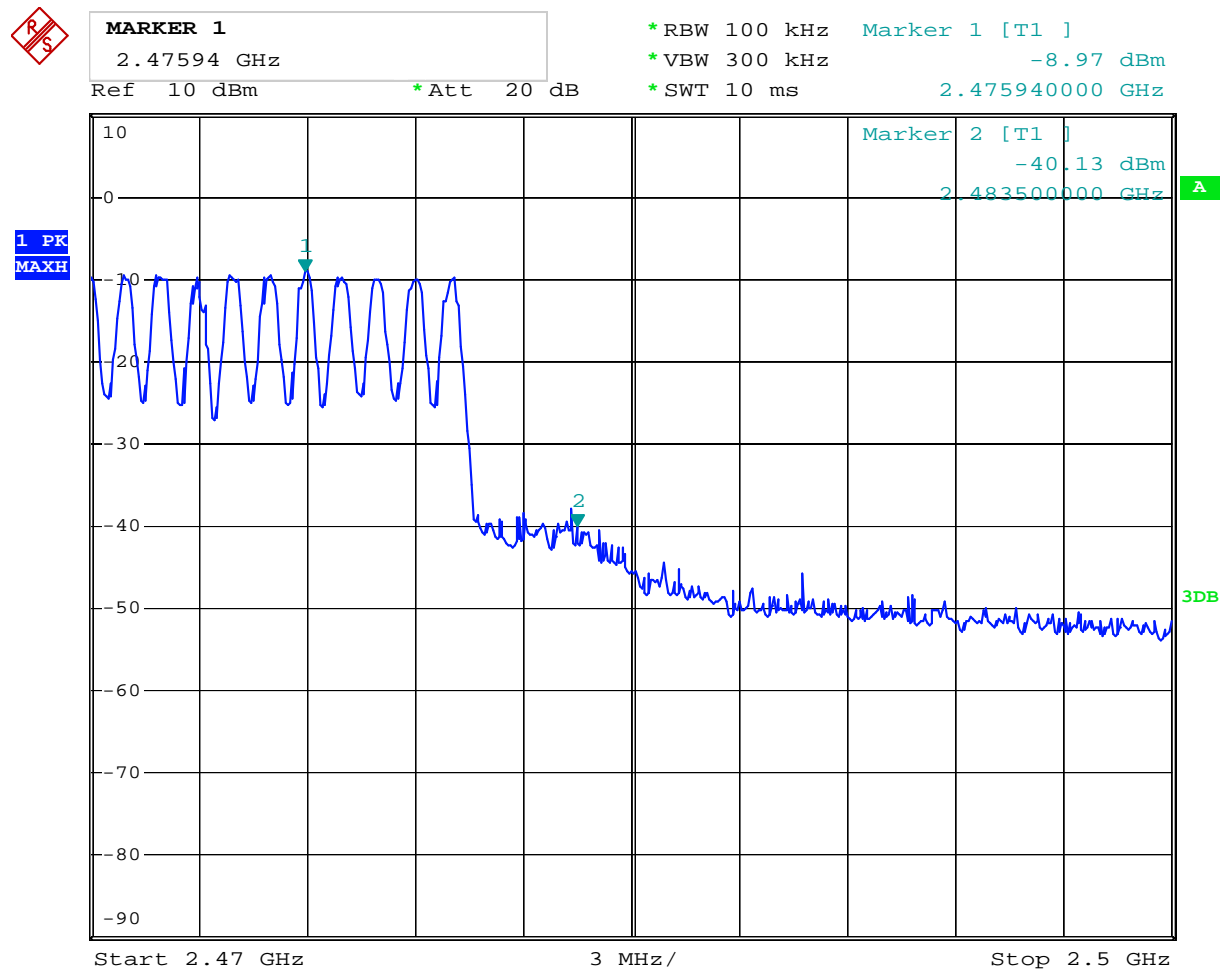


GFSK Mode

12.4 Out of Band Test Result

|  |                          |      |               |              |
|--|--------------------------|------|---------------|--------------|
| Product:                               | Shower Bluetooth Speaker |      | Test Mode:    | Hopping mode |
| Mode                                   | Hopping On               |      | Input Voltage | DC3.7V       |
| Temperature                            | 24 deg. C,               |      | Humidity      | 56% RH       |
| Test Result:                           | Pass                     |      | Detector      | PK           |
| The Max. FS in Restrict Band 2483.5MHz | PK (dBμV/m)              | 48.8 | Limit         | 74(dBμV/m)   |
|  | AV(dBμV/m)               | --   |               | 54(dBμV/m)   |

Test Figure:



Date: 18.SEP.2014 11:51:27

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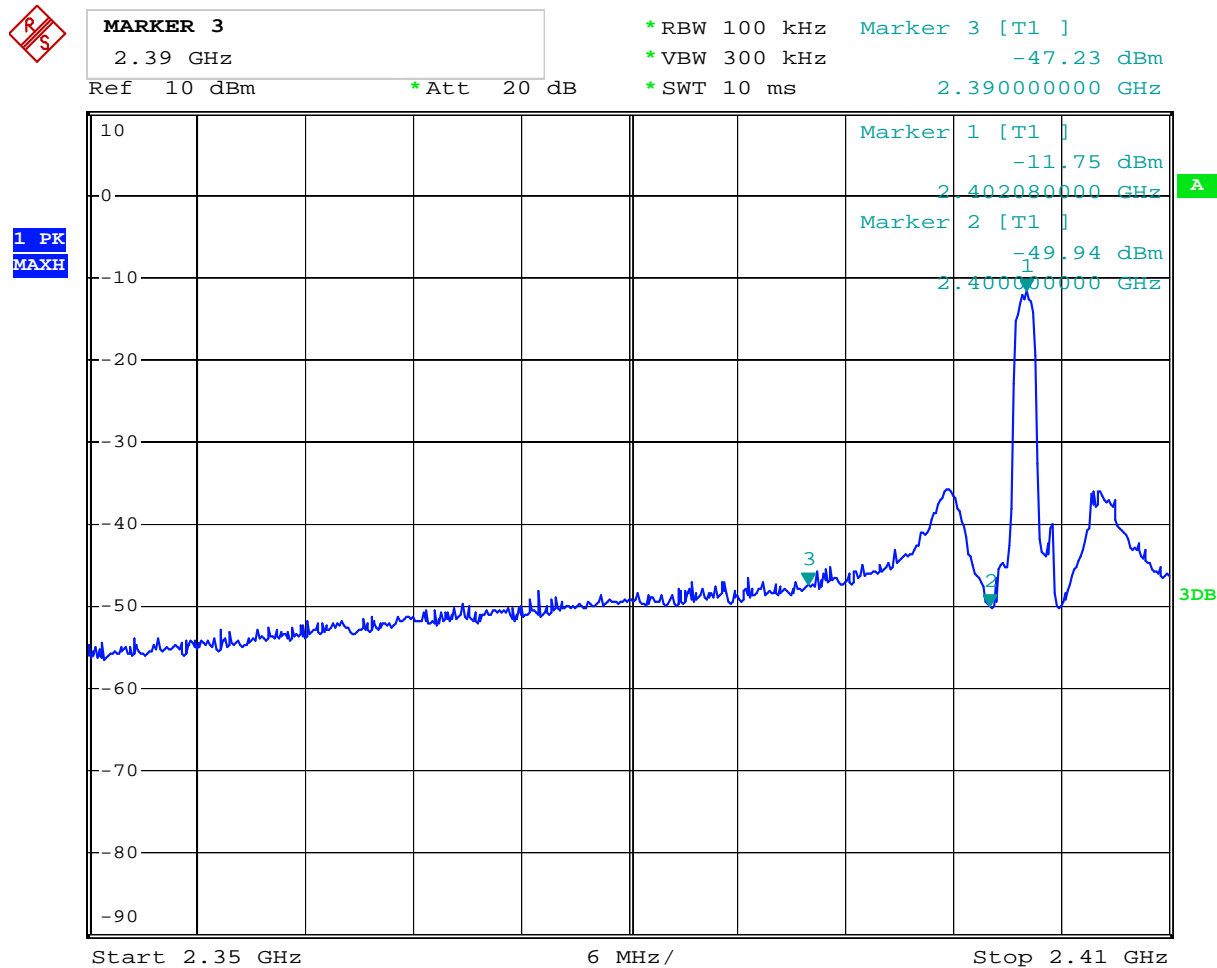


π/4DQPSK Mode

12.4 Out of Band Test Result

|                                      |                          |      |               |             |
|--------------------------------------|--------------------------|------|---------------|-------------|
| Product:                             | Shower Bluetooth Speaker |      | Test Mode:    | Low Channel |
| Mode                                 | Keeping Transmitting     |      | Input Voltage | DC3.7V      |
| Temperature                          | 24 deg. C                |      | Humidity      | 56% RH      |
| Test Result:                         | Pass                     |      | Detector      | PK          |
| The Max. FS in Restrict Band 2390MHz | PK (dBμV/m)              | 47.2 | Limit         | 74(dBμV/m)  |
|                                      | AV(dBμV/m)               | --   |               | 54(dBμV/m)  |

Test Figure:



Date: 18.SEP.2014 11:42:53

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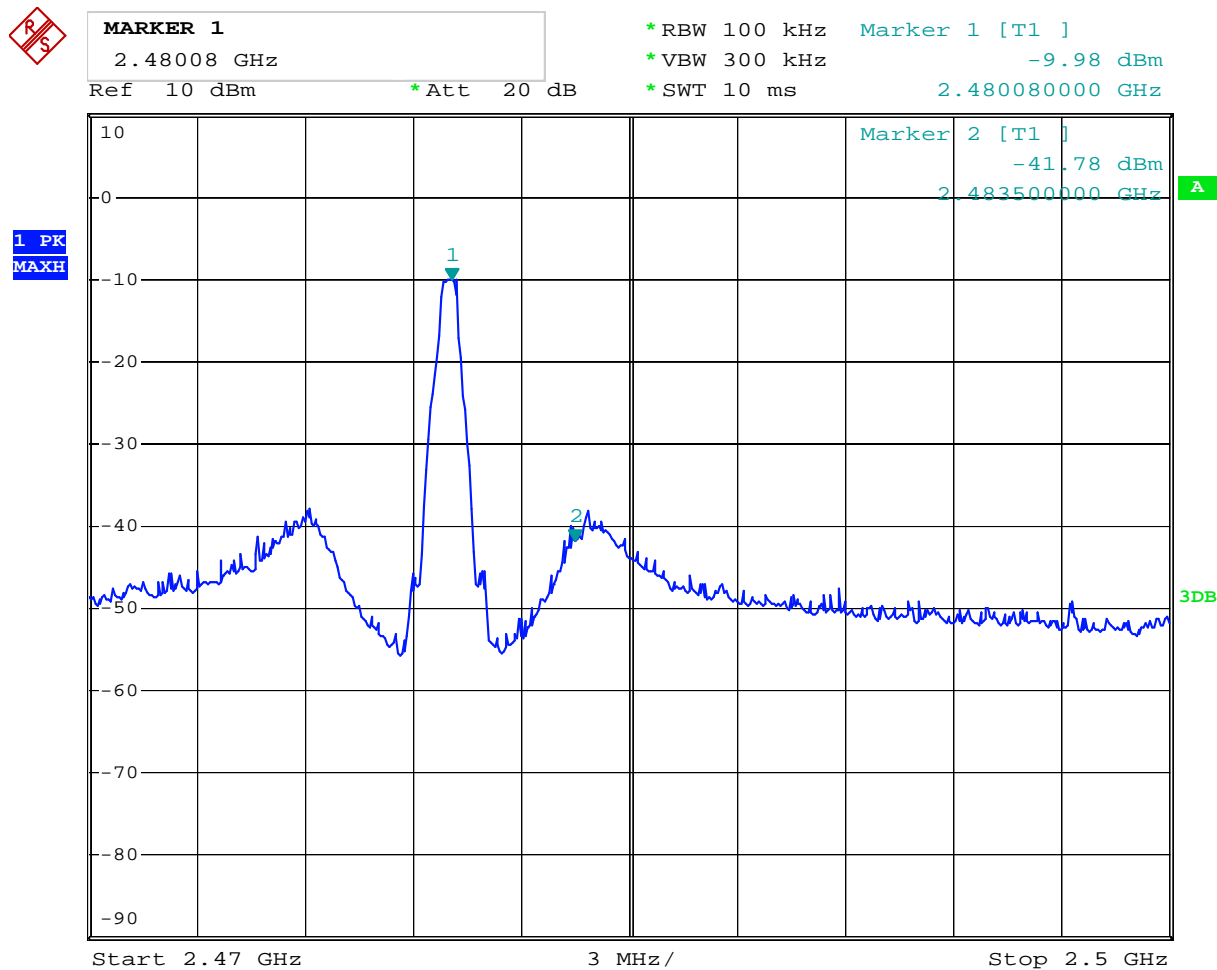


π/4DQPSK Mode

12.4 Out of Band Test Result

|  |                          |      |               |              |
|--|--------------------------|------|---------------|--------------|
| Product:                               | Shower Bluetooth Speaker |      | Test Mode:    | High Channel |
| Mode                                   | Keeping Transmitting     |      | Input Voltage | DC3.7V       |
| Temperature                            | 24 deg. C,               |      | Humidity      | 56% RH       |
| Test Result:                           | Pass                     |      | Detector      | PK           |
| The Max. FS in Restrict Band 2483.5MHz | PK (dBμV/m)              | 49.0 | Limit         | 74(dBμV/m)   |
|  | AV(dBμV/m)               | --   |               | 54(dBμV/m)   |

Test Figure:



Date: 18.SEP.2014 11:47:05

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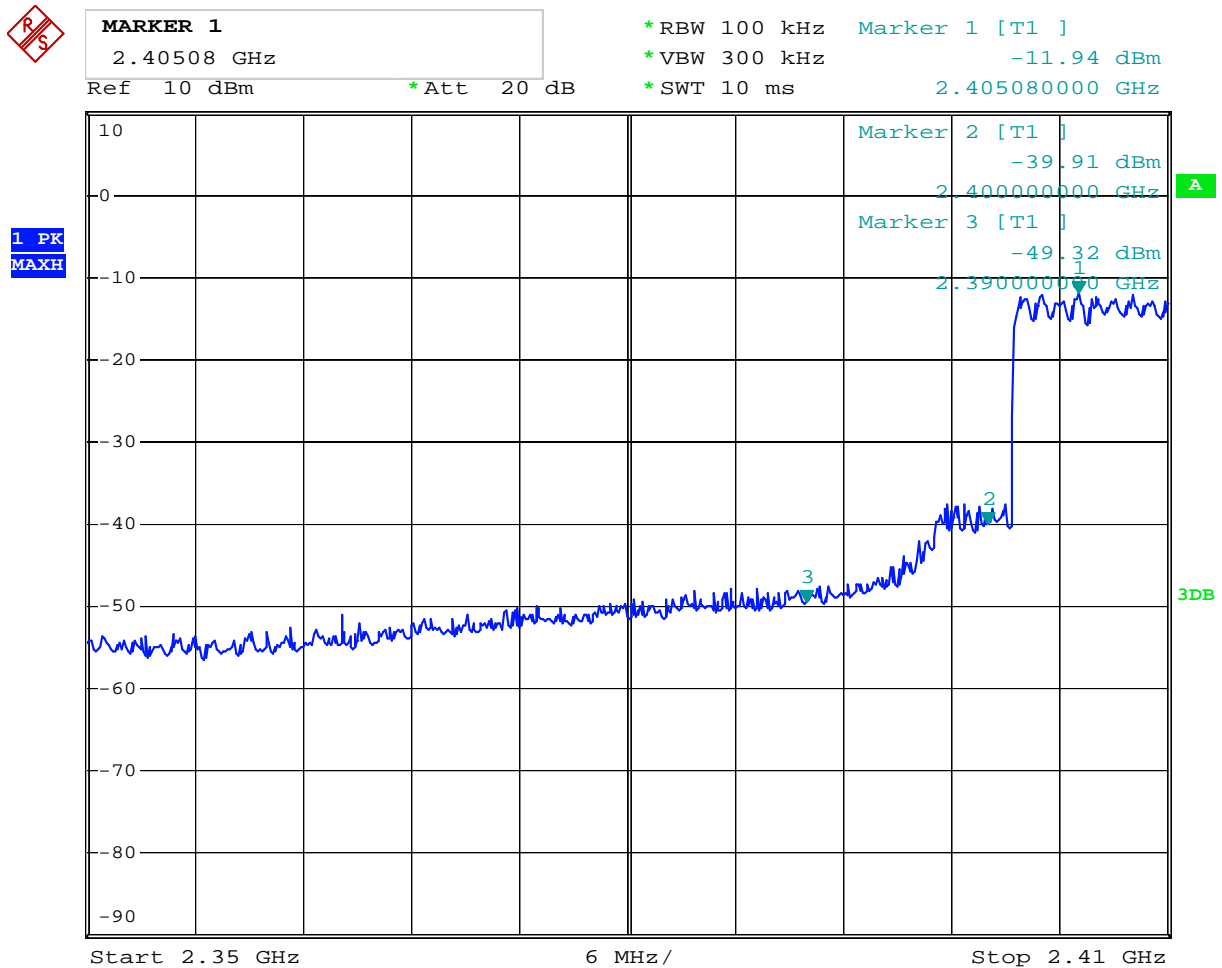


### π/4DQPSK Mode

#### 12.4 Out of Band Test Result

|                                      |                          |      |               |              |
|--------------------------------------|--------------------------|------|---------------|--------------|
| Product:                             | Shower Bluetooth Speaker |      | Test Mode:    | Hopping mode |
| Mode                                 | Hopping On               |      | Input Voltage | DC3.7V       |
| Temperature                          | 24 deg. C,               |      | Humidity      | 56% RH       |
| Test Result:                         | Pass                     |      | Detector      | PK           |
| The Max. FS in Restrict Band 2390MHz | PK (dBμV/m)              | 46.7 | Limit         | 74(dBμV/m)   |
|                                      | AV(dBμV/m)               | --   |               | 54(dBμV/m)   |

#### Test Figure:



Date: 18.SEP.2014 12:07:37

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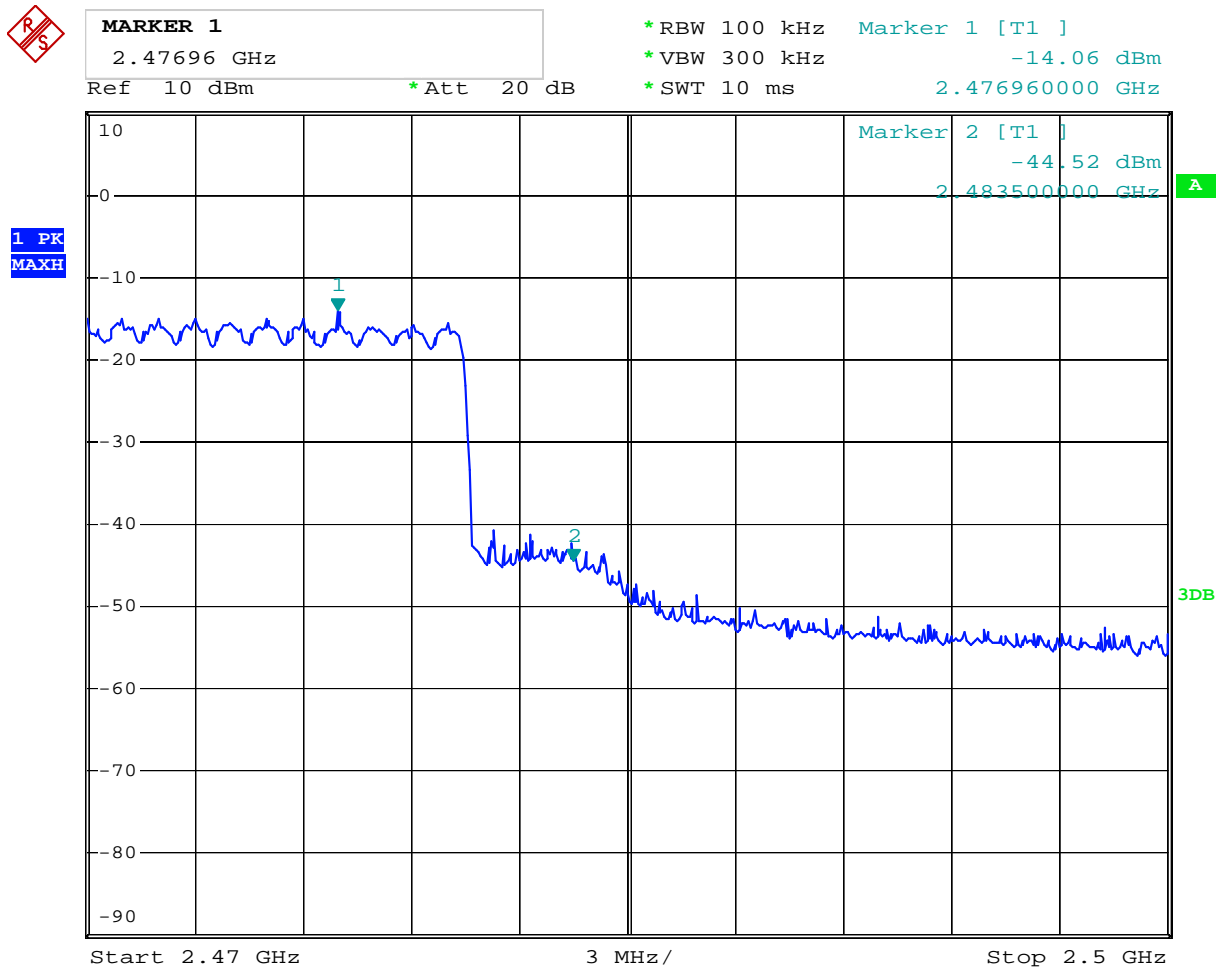


### π/4DQPSK Mode

#### 12.4 Out of Band Test Result

|  |                          |      |               |              |
|--|--------------------------|------|---------------|--------------|
| Product:                               | Shower Bluetooth Speaker |      | Test Mode:    | Hopping mode |
| Mode                                   | Hopping On               |      | Input Voltage | DC3.7V       |
| Temperature                            | 24 deg. C,               |      | Humidity      | 56% RH       |
| Test Result:                           | Pass                     |      | Detector      | PK           |
| The Max. FS in Restrict Band 2483.5MHz | PK (dBμV/m)              | 47.1 | Limit         | 74(dBμV/m)   |
|  | AV(dBμV/m)               | --   |               | 54(dBμV/m)   |

#### Test Figure:



Date: 18.SEP.2014 11:50:03

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## 13.0 Antenna Requirement

### 13.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

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

### 13.2 Antenna Connected constructions

PCB Antenna used. The maximum Gain of this antenna is 0 dBi

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#### 14.0 FCC ID Label

**FCC ID: RMZ-BTS51**

The label must not be a stick-on paper label. The label on these products must be permanently affixed to the product and readily visible at the time of purchase and must last the expected lifetime of the equipment not be readily detachable.

##### Mark Location:



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## 15.0 Photo of testing

Conducted Emission Test Setup:



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Radiated Emission Test Setup:



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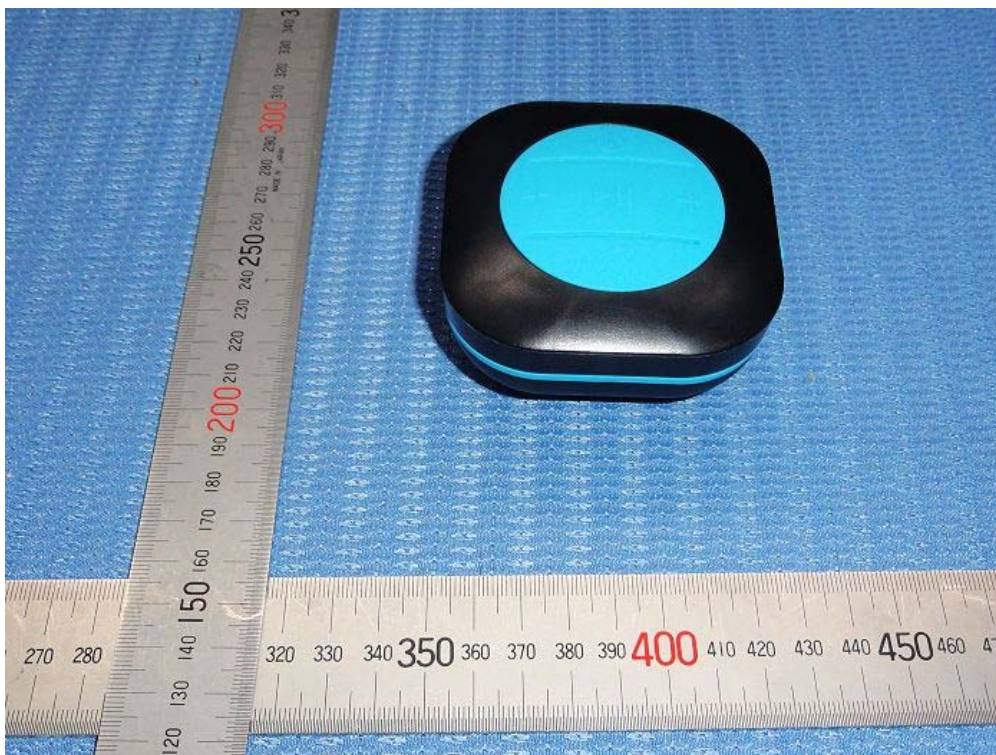
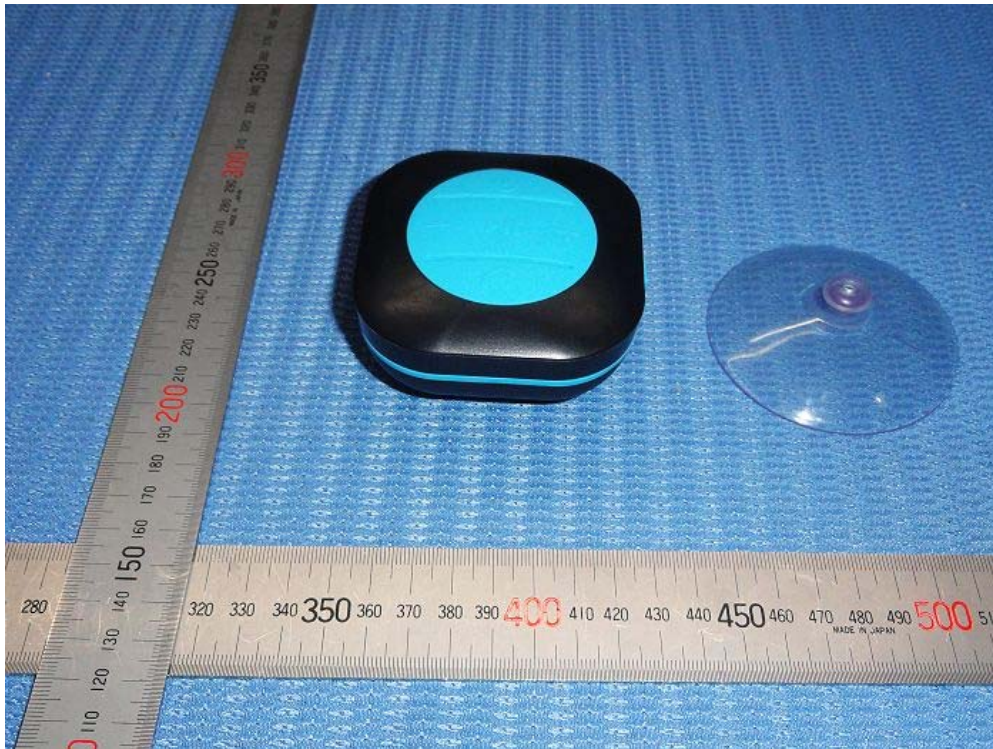
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## Photographs – EUT

Outside view



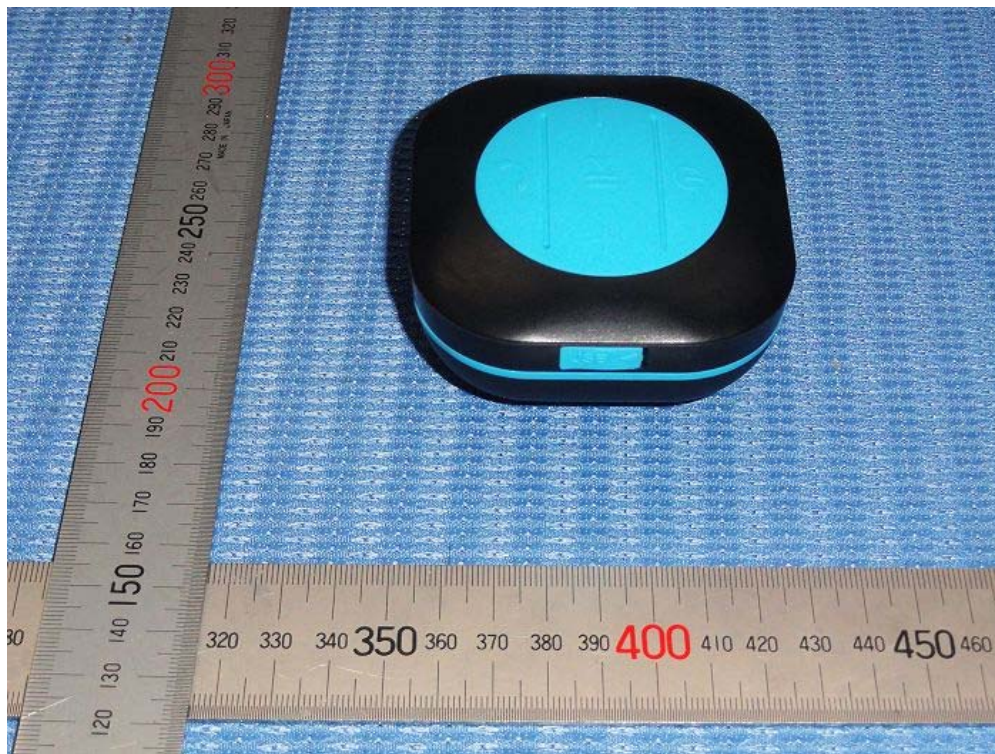
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Outside view



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Inside view



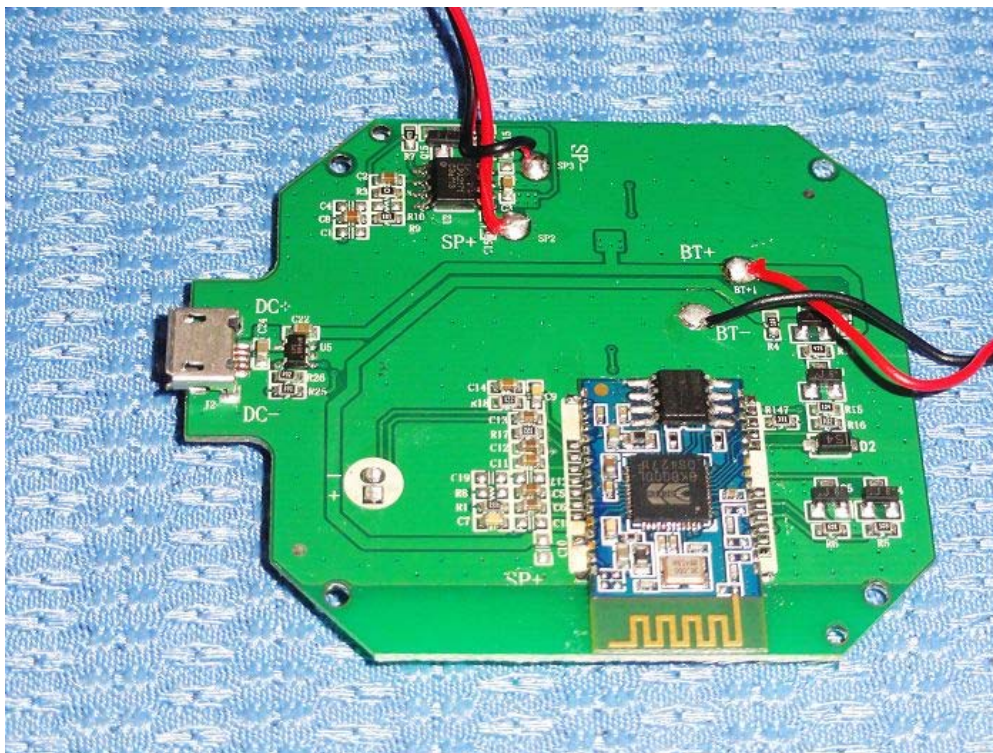
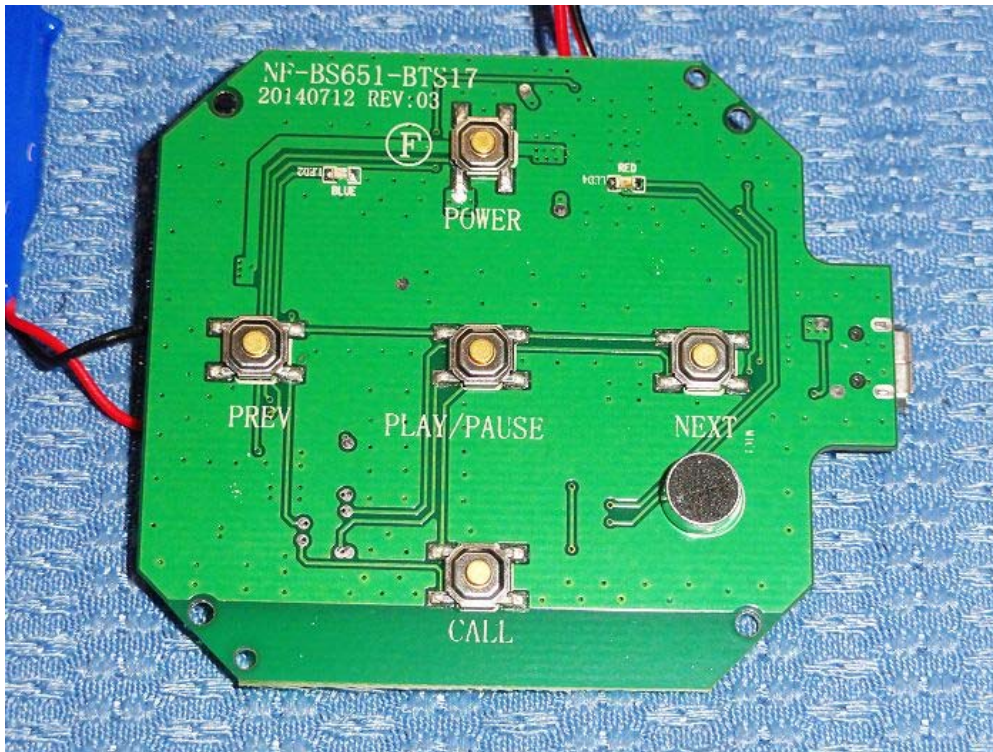
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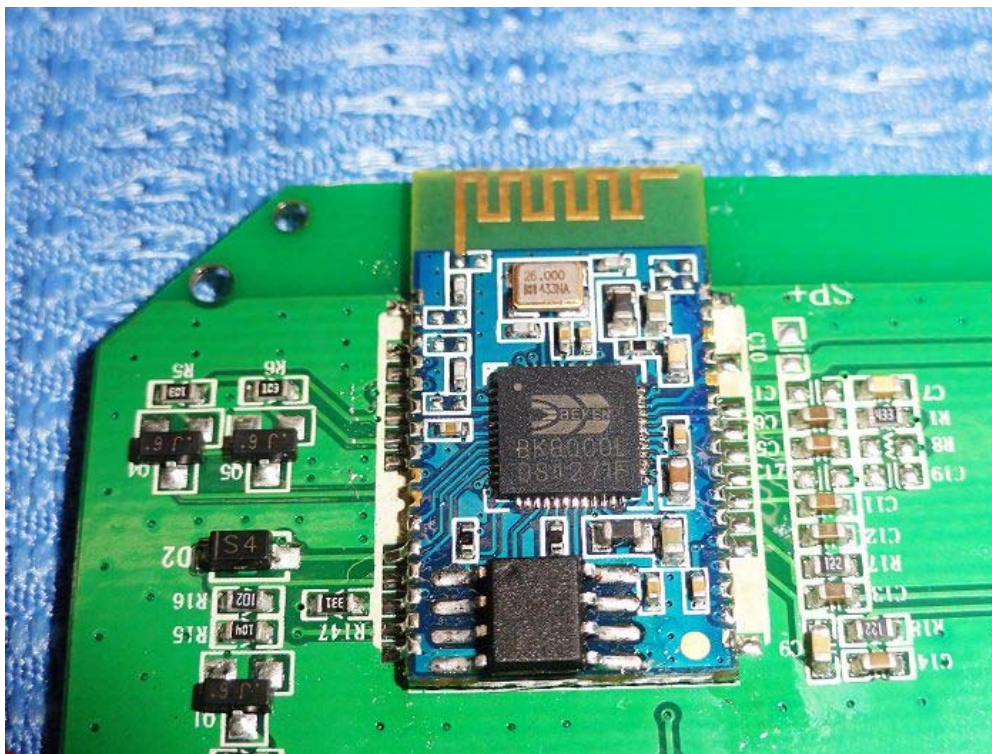
Inside view



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Inside view



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