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# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
# INTENTIONAL RADIATOR CERTIFICATION TO
# FCC PART 15 SUBPART C REQUIREMENT

*OF*

## Speaker Mojo II

## Model No.: HL2750

**Trademark:** bēm WIRELESS

## FCC ID: PXK-HL2750

## Report No.: KAD150731172E

## Issue Date: October 27, 2015

*Prepared for*

## ECORE TECHNOLOGY COMPANY LIMITED
## North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China

*Prepared by*


## DONGGUAN EMTEK CO., LTD.

## No.281, Guantai Road, Nancheng District,
## Dongguan, Guangdong, China
## TEL: 86-769-22807078
## FAX: 86-769-22807079

## VERIFICATION OF COMPLIANCE

| | |
|---|---|
| Applicant: | ECORE TECHNOLOGY COMPANY LIMITED<br>North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China |
| Manufacturer: | ECORE TECHNOLOGY COMPANY LIMITED<br>North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China |
| Product Description: | Speaker Mojo II |
| Trade Mark: | bēm WIRELESS |
| Model Number: | HL2750 |

**We hereby certify that:**

The above equipment was tested by DONGGUAN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10-2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2015).

Date of Test : July 31, 2015 to September 08, 2015

Prepared by : Ivy Huang/Editor

Reviewer : Alan He/Supervisor

Approved & Authorized Signer : Sam Lv/Manager

# Modified Information

| Version | Summary | Revision Date | Report No. |
|---|---|---|---|
| Ver.1.0 | Original Report | / | KAD150731172E |
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# Table of Contents

# 1. GENERAL INFORMATION

## 1.1 Product Description

| | |
|---|---|
| Product Name | Speaker Mojo II |
| Model number | HL2750 |
| Power Supply | USB 5V |
| Product Software Version | Rev0 |
| Product Hardware version | Rev0 |
| Radio Software Version | Rev1.0 |
| Radio Hardware version | Rev1.0 |
| Test Software Version | Rev0 |
| RF power setting in Test Software | 0dBi |
| Technical Description | |
| | Bluetooth 2.1+EDR |
| Operation Frequency | 2402-2480MHz |
| Modulation | GFSK, π/4-DQPSK, 8DPSK |
| Number of Channel | 79 |
| Channel space | 1MHz |
| Max RF Output Power | -0.74dBm(0.000843W) |
| Antenna Type | Internal PCB antenna |
| Antenna Gain | 0 dBi |

## 1.2 Test Facility

Site Description

EMC Lab. : Registered on FCC, June 18, 2014
The Certificate Number is 247565.

Registered on Industry Canada, February 19, 2014
The Certificate Number is 9444A

Name of Firm : DONGGUAN EMTEK CO., LTD.

Site Location : No.281, Guantai Road, Nancheng District,
Dongguan, Guangdong, China

# 2. System Test Configuration

## 2.1 EUT Configuration

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

## 2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

## 2.3 Test Procedure

### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

### 2.3.2 Radiated Emissions

Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of EUT was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

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## 2.4 Configuration of Tested System

### Fig. 2-1 Configuration of Tested System

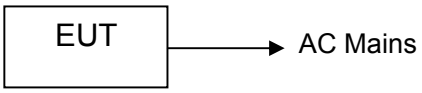



Table 2-1 Equipment Used in Tested System

| Item | Equipment | Trade Mark | Model No. | FCC ID | Note |
|---|---|---|---|---|---|
| 1. | Speaker Mojo II | bem WIRELESS | HL2750 | PXK-HL2750 | ***EUT*** |

**Note:**

**(1)** Unless otherwise denoted as EUT in『Remark』column , device(s) used in tested system is a support equipment.

## 3. Summary of Test Results

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

## 4. Description of test modes

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

For Radiated: The EUT's antenna was pre-tested under the following modes:

| Test Mode | Description |
|---|---|
| **Mode A** | **X-Y axis** |
| Mode B | Y-Z axis |
| Mode C | X-Z axis |

From the above modes, the worst case was found in Mode A. Therefore only the test data of the mode was recorded in this report.

The 3 channels of lower, medium and higher were chosen for test.

| Channel | Frequency(MHz) |
|---|---|
| 1 | 2402 |
| 40 | 2441 |
| 79 | 2480 |

# 5. TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| Parameter | Uncertainty |
|---|---|
| Radio Frequency | ±1x10^-5 |
| Maximum Peak Output Power Test | ±1.0dB |
| Conducted Emissions Test | ±2.0dB |
| Radiated Emission Test | ±2.0dB |
| Power Density | ±2.0dB |
| Occupied Bandwidth Test | ±1.0dB |
| Band Edge Test | ±3dB |
| All emission, radiated | ±3dB |
| Antenna Port Emission | ±3dB |
| Temperature | ±0.5℃ |
| Humidity | ±3% |

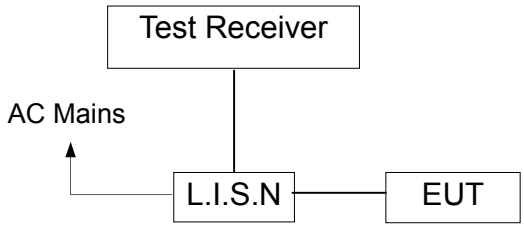
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%

# 6. Conducted Emissions Test

## 6.1 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

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




## 6.3 Measurement Equipment Used:

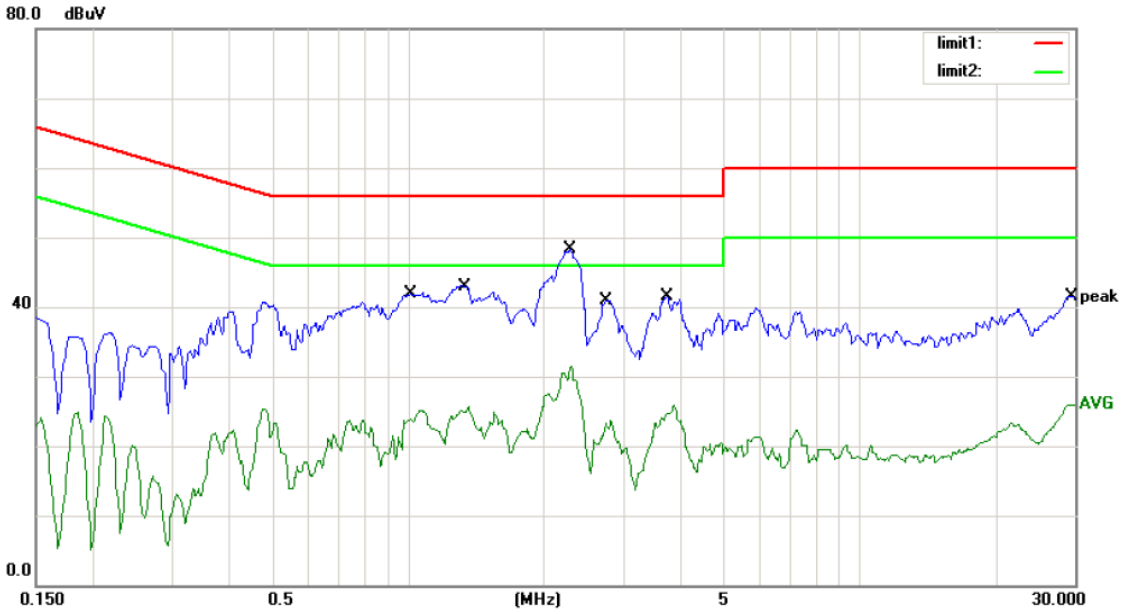
| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **Last Cal.** | **Due date** |
| Test Receiver | Rohde & Schwarz | ESCS30 | 100018 | 03/16/2015 | 03/15/2016 |
| L.I.S.N | Rohde & Schwarz | ENV216 | 100017 | 03/16/2015 | 03/15/2016 |
| RF Switching Unit | CDS | RSU-M2 | 38401 | 03/16/2015 | 03/15/2016 |
| Coaxial Cable | CDS | 79254 | 46107086 | 03/16/2015 | 03/15/2016 |

## 6.4 Measurement Result:

Pass.

All the modulation modes were tested the data are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.




Site site #1 Phase: *L1* Temperature: 24

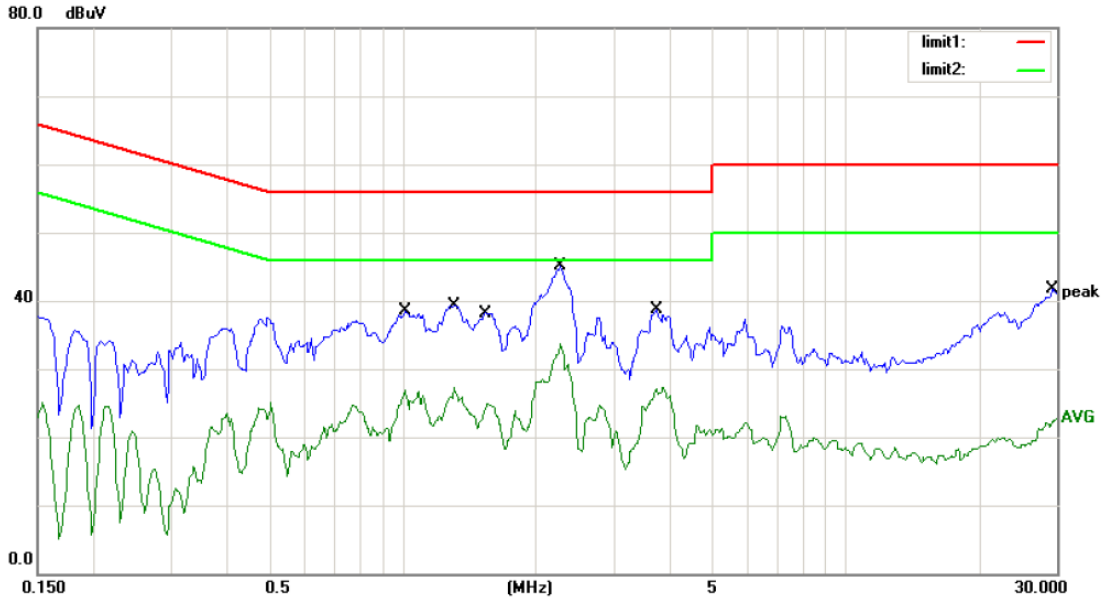
Limit: (CE)FCC PART 15 class B_QP Power: AC 120V/60Hz Humidity: 55 %

Mode: TX2402

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 1.0140 | 33.23 | 0.00 | 33.23 | 56.00 | -22.77 | QP | |
| 2 | | 1.0140 | 24.71 | 0.00 | 24.71 | 46.00 | -21.29 | AVG | |
| 3 | | 1.3380 | 35.40 | 0.00 | 35.40 | 56.00 | -20.60 | QP | |
| 4 | | 1.3380 | 25.21 | 0.00 | 25.21 | 46.00 | -20.79 | AVG | |
| 5 | | 2.2900 | 37.40 | 0.00 | 37.40 | 56.00 | -18.60 | QP | |
| 6 | * | 2.2900 | 31.52 | 0.00 | 31.52 | 46.00 | -14.48 | AVG | |
| 7 | | 2.7648 | 38.26 | 0.00 | 38.26 | 56.00 | -17.74 | QP | |
| 8 | | 2.7648 | 23.66 | 0.00 | 23.66 | 46.00 | -22.34 | AVG | |
| 9 | | 3.7500 | 36.25 | 0.00 | 36.25 | 56.00 | -19.75 | QP | |
| 10 | | 3.7500 | 25.42 | 0.00 | 25.42 | 46.00 | -20.58 | AVG | |
| 11 | | 29.4500 | 35.12 | 0.00 | 35.12 | 60.00 | -24.88 | QP | |
| 12 | | 29.4500 | 25.90 | 0.00 | 25.90 | 50.00 | -24.10 | AVG | |

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.




Site site #1 Phase: N Temperature: 24

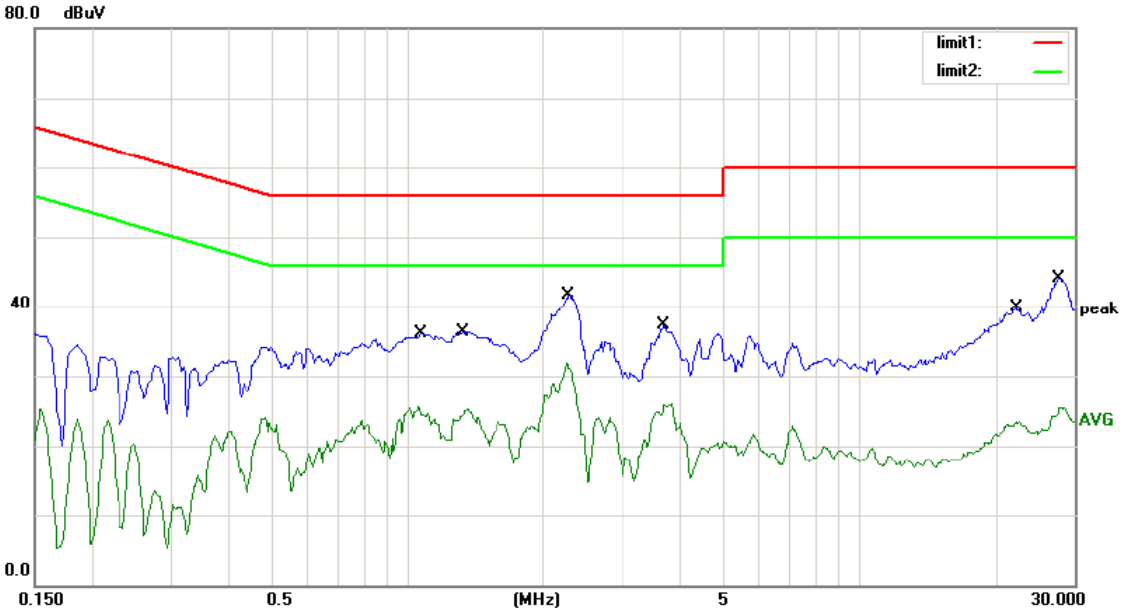
Limit: (CE)FCC PART 15 class B_QP Power: AC 120V/60Hz Humidity: 55 %

Mode: TX2402

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 1.0140 | 36.23 | 0.00 | 36.23 | 56.00 | -19.77 | QP | |
| 2 | | 1.0140 | 26.82 | 0.00 | 26.82 | 46.00 | -19.18 | AVG | |
| 3 | | 1.3064 | 37.12 | 0.00 | 37.12 | 56.00 | -18.88 | QP | |
| 4 | | 1.3064 | 27.08 | 0.00 | 27.08 | 46.00 | -18.92 | AVG | |
| 5 | | 1.5360 | 36.25 | 0.00 | 36.25 | 56.00 | -19.75 | QP | |
| 6 | | 1.5360 | 24.93 | 0.00 | 24.93 | 46.00 | -21.07 | AVG | |
| 7 | | 2.2700 | 43.14 | 0.00 | 43.14 | 56.00 | -12.86 | QP | |
| 8 | * | 2.2700 | 33.77 | 0.00 | 33.77 | 46.00 | -12.23 | AVG | |
| 9 | | 3.7400 | 36.25 | 0.00 | 36.25 | 56.00 | -19.75 | QP | |
| 10 | | 3.7400 | 27.40 | 0.00 | 27.40 | 46.00 | -18.60 | AVG | |
| 11 | | 29.3250 | 39.23 | 0.00 | 39.23 | 60.00 | -20.77 | QP | |
| 12 | | 29.3250 | 22.62 | 0.00 | 22.62 | 50.00 | -27.38 | AVG | |

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.




Site site #1 Phase: *L1* Temperature: 24

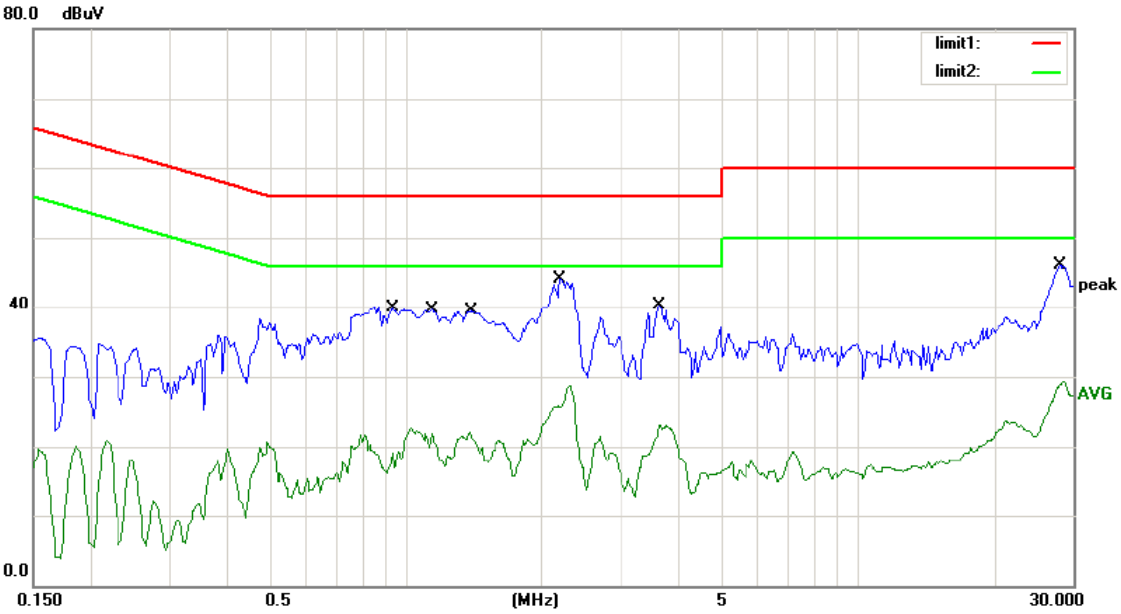
Limit: (CE)FCC PART 15 class B_QP Power: AC 240V/50Hz Humidity: 55 %

Mode: TX2402

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 1.0725 | 32.15 | 0.00 | 32.15 | 56.00 | -23.85 | QP | |
| 2 | | 1.0725 | 25.46 | 0.00 | 25.46 | 46.00 | -20.54 | AVG | |
| 3 | | 1.3290 | 32.56 | 0.00 | 32.56 | 56.00 | -23.44 | QP | |
| 4 | | 1.3290 | 25.31 | 0.00 | 25.31 | 46.00 | -20.69 | AVG | |
| 5 | | 2.2800 | 37.58 | 0.00 | 37.58 | 56.00 | -18.42 | QP | |
| 6 | * | 2.2800 | 31.80 | 0.00 | 31.80 | 46.00 | -14.20 | AVG | |
| 7 | | 3.7100 | 32.96 | 0.00 | 32.96 | 56.00 | -23.04 | QP | |
| 8 | | 3.7100 | 26.12 | 0.00 | 26.12 | 46.00 | -19.88 | AVG | |
| 9 | | 22.3250 | 34.56 | 0.00 | 34.56 | 60.00 | -25.44 | QP | |
| 10 | | 22.3250 | 23.52 | 0.00 | 23.52 | 50.00 | -26.48 | AVG | |
| 11 | | 27.8250 | 39.26 | 0.00 | 39.26 | 60.00 | -20.74 | QP | |
| 12 | | 27.8250 | 25.51 | 0.00 | 25.51 | 50.00 | -24.49 | AVG | |

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.




Site site #1 Phase: N Temperature: 24

Limit: (CE)FCC PART 15 class B_QP Power: AC 240V/50Hz Humidity: 55 %

Mode: TX2402

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.9420 | 35.12 | 0.00 | 35.12 | 56.00 | -20.88 | QP | |
| 2 | | 0.9420 | 21.37 | 0.00 | 21.37 | 46.00 | -24.63 | AVG | |
| 3 | | 1.1445 | 35.17 | 0.00 | 35.17 | 56.00 | -20.83 | QP | |
| 4 | | 1.1445 | 21.81 | 0.00 | 21.81 | 46.00 | -24.19 | AVG | |
| 5 | | 1.4032 | 35.36 | 0.00 | 35.36 | 56.00 | -20.64 | QP | |
| 6 | | 1.4032 | 22.10 | 0.00 | 22.10 | 46.00 | -23.90 | AVG | |
| 7 | * | 2.1900 | 39.28 | 0.00 | 39.28 | 56.00 | -16.72 | QP | |
| 8 | | 2.1900 | 28.78 | 0.00 | 28.78 | 46.00 | -17.22 | AVG | |
| 9 | | 3.6500 | 36.12 | 0.00 | 36.12 | 56.00 | -19.88 | QP | |
| 10 | | 3.6500 | 23.16 | 0.00 | 23.16 | 46.00 | -22.84 | AVG | |
| 11 | | 28.0750 | 41.59 | 0.00 | 41.59 | 60.00 | -18.41 | QP | |
| 12 | | 28.0750 | 29.27 | 0.00 | 29.27 | 50.00 | -20.73 | AVG | |

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.

## 6.5 Conducted Measurement Photos:

# 7. Radiated Emission Test

## 7.1 Measurement Procedure

1. 1. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.
5. The following table is the setting of spectrum analyzer:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

| EMI Test Receiver | Setting |
|---|---|
| Attenuation | Auto |
| RB | 120KHz |
| VB | 300KHz |
| Detector | QP |
| Trace | Max hold |

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

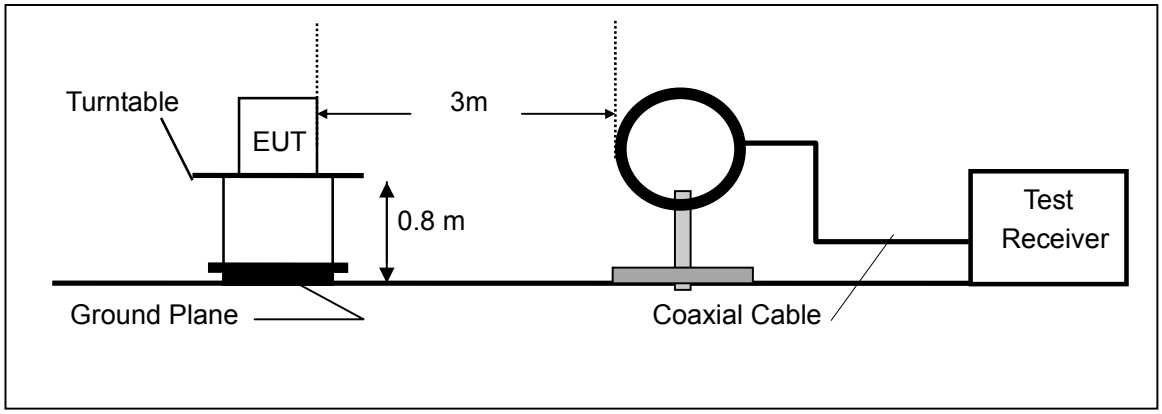
| EMI Test Receiver | Setting |
|---|---|
| Attenuation | Auto |
| RB | 1MHz |
| VB | 3MHz |
| Detector | Peak |
| Trace | Max hold |

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

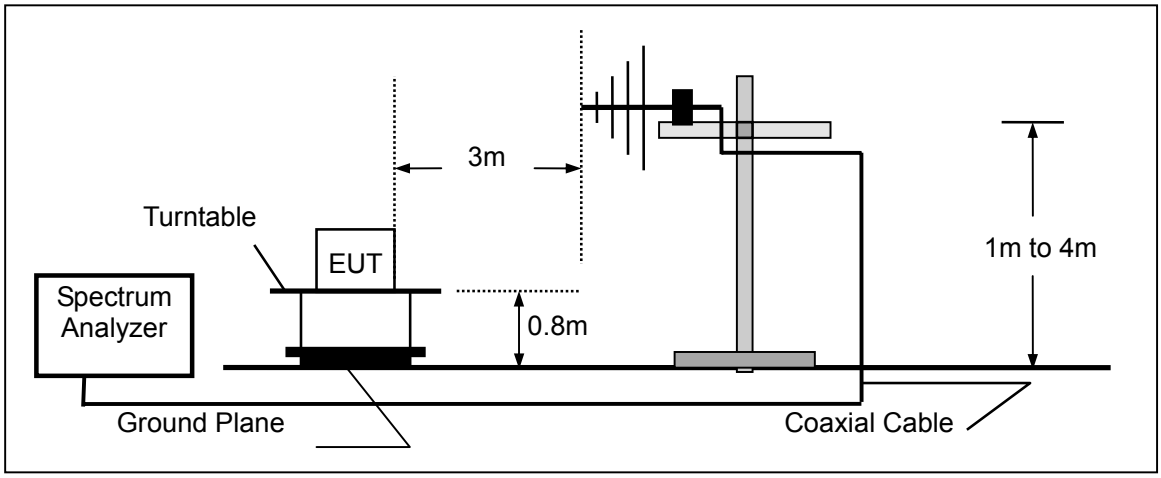
| EMI Test Receiver | Setting |
|---|---|
| Attenuation | Auto |
| RB | 1MHz |
| VB | 10Hz |
| Detector | Peak |
| Trace | Max hold |

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

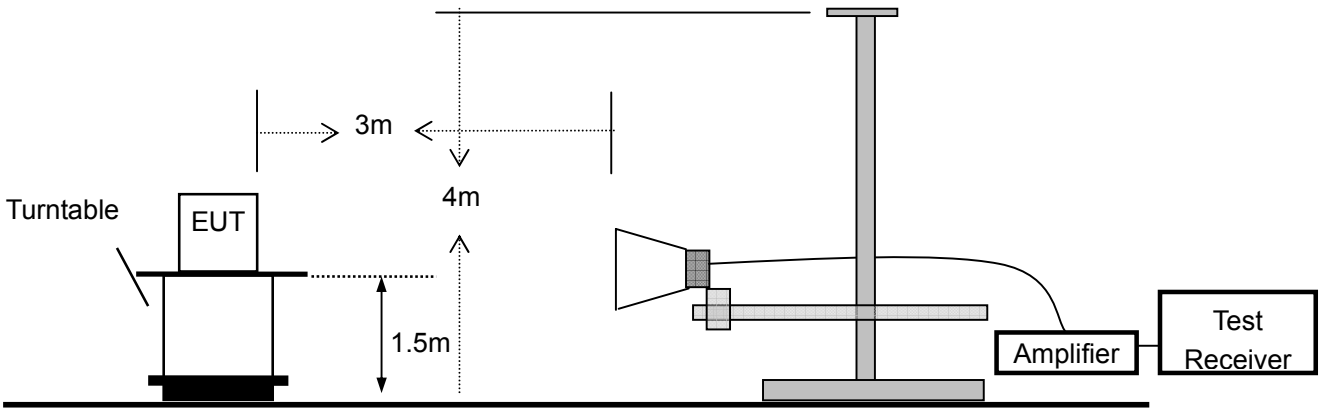
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz




(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz




(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



## 7.3 Measurement Equipment Used:

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Test Receiver | Rohde & Schwarz | ESCI | 1166.5950.03 | 03/16/2015 | 1 Year |
| 2. | Bilog Antenna | Schwarzbeck | VULB9163 | 000141 | 03/16/2015 | 1 Year |
| 3. | Power Amplifier | CDS | RSU-M352 | 818 | 03/16/2015 | 1 Year |
| 4. | Power Amplifier | HP | 8447F | OPT H64 | 03/16/2015 | 1 Year |
| 5. | Color Monitor | SUNSPO | SP-140A | N/A | 03/16/2015 | 1 Year |
| 6. | Single Line Filter | JIANLI | XL-3 | N/A | 03/16/2015 | 1 Year |
| 7. | Single Phase Power Line Filter | JIANLI | DL-2X100B | N/A | 03/16/2015 | 1 Year |
| 8. | 3 Phase Power Line Filter | JIANLI | DL-4X100B | N/A | 03/16/2015 | 1 Year |
| 9. | DC Power Filter | JIANLI | DL-2X50B | N/A | 03/16/2015 | 1 Year |
| 10. | Cable | Schwarzbeck | PLF-100 | 549489 | 03/16/2015 | 1 Year |
| 11. | Cable | Rosenberger | CIL02 | A0783566 | 03/16/2015 | 1 Year |
| 12. | Cable | Rosenberger | RG 233/U | 525178 | 03/16/2015 | 1 Year |
| 13. | Signal Analyzer | Rohde & Schwarz | FSV30 | 103040 | 12/29/2014 | 1 Year |
| 14. | Horn Antenna | Schwarzbeck | BBHA9120D | 9120D-1272 | 12/29/2014 | 1 Year |
| 15. | Power Amplifier | LUNAR EM | LNA1G18-40 | J10100000081 | 12/29/2014 | 1 Year |
| 16. | Cable | H+S | CBL-26 | N/A | 12/29/2014 | 1 Year |
| 17. | Cable | H+S | CBL-26 | N/A | 12/29/2014 | 1 Year |
| 18. | Cable | H+S | CBL-26 | N/A | 12/29/2014 | 1 Year |

### 7.4 Radiated Emission Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table 15.209(a):

| Frequencies (MHz) | Field Strength (micorvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

15.205 Restricted bands of operation

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| [1]0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2690 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | ([2]) |

Remark : 1. Emission level in dBuV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of ξ 15.205, and the emissions located in restricted bands also comply with 15.209 limit.

### 7.5 Measurement Result

**Below 30MHz:**

| | | | |
|---|---|---|---|
| Operation Mode: | TX | Test Date : | August 03, 2015 |
| Frequency Range: | 9KHz~30MHz | Temperature : | 28℃ |
| Test Result: | PASS | Humidity : | 65 % |
| Measured Distance: | 3m | Test By: | Andy |

| Freq. (MHz) | Ant.Pol. H/V | Emission Level (dBuV/m) | Limit 3m (dBuV/m) | Over (dB) |
|---|---|---|---|---|
| -- | -- | -- | -- | -- |

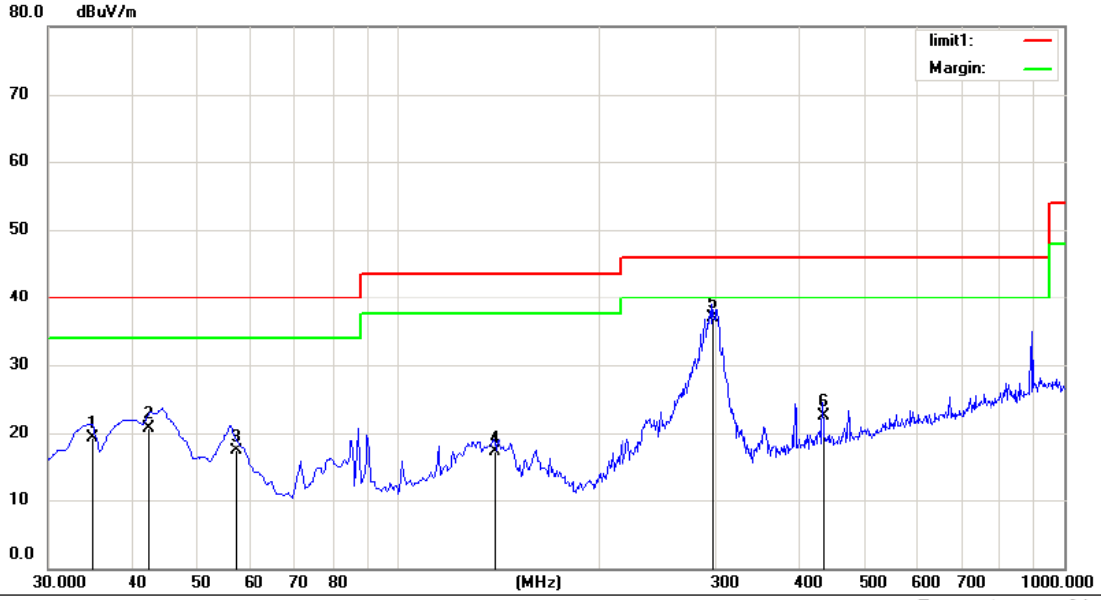
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

## Below 1000MHz:

Pass.

All the modulation modes were tested the data of the worst mode (GFSK) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.




Site Chamber #1 Polarization: **Horizontal** Temperature: 24

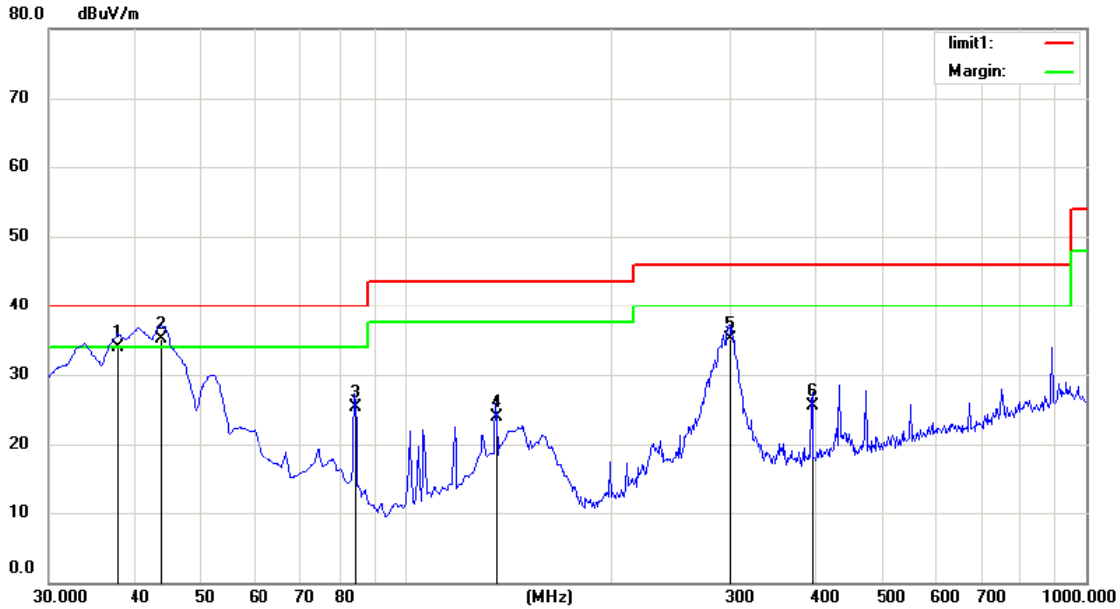
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX2402

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 34.8500 | 33.55 | -14.19 | 19.36 | 40.00 | -20.64 | QP | | | |
| 2 | | 42.4508 | 34.29 | -13.50 | 20.79 | 40.00 | -19.21 | QP | | | |
| 3 | | 57.1600 | 35.57 | -18.26 | 17.31 | 40.00 | -22.69 | QP | | | |
| 4 | | 139.6100 | 34.15 | -17.00 | 17.15 | 43.50 | -26.35 | QP | | | |
| 5 | * | 296.7500 | 51.54 | -14.54 | 37.00 | 46.00 | -9.00 | QP | | | |
| 6 | | 435.4600 | 33.82 | -11.30 | 22.52 | 46.00 | -23.48 | QP | | | |

*:Maximum data x:Over limit !:over margin Operator: John




Site Chamber #1 Polarization: **Vertical** Temperature: 24

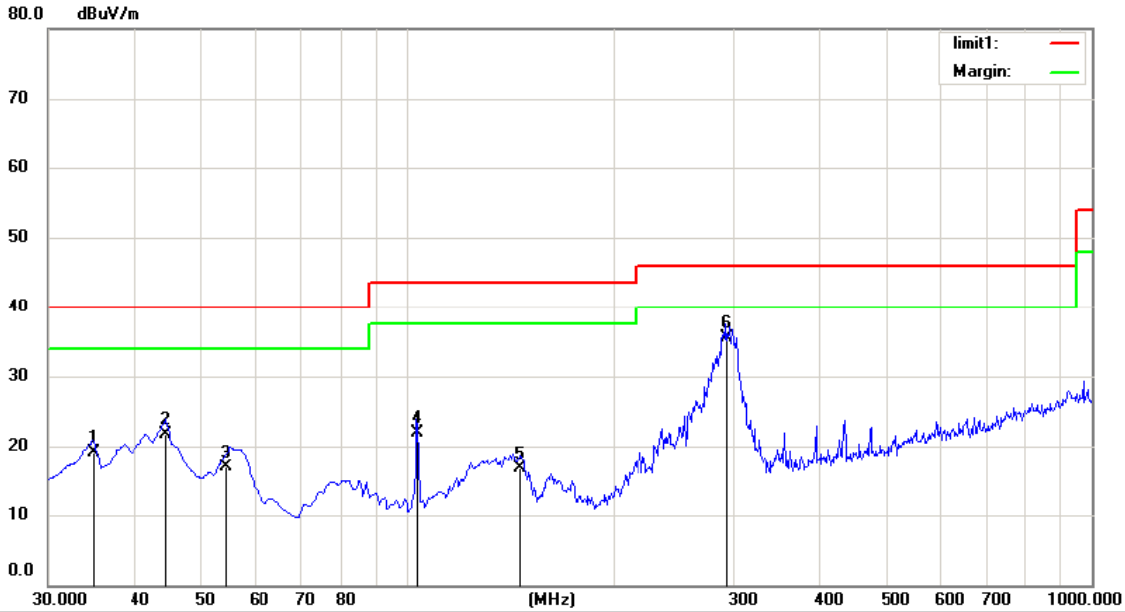
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX2402

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 37.7600 | 47.75 | -13.84 | 33.91 | 40.00 | -6.09 | QP | | | |
| 2 | * | 43.9658 | 48.35 | -13.33 | 35.02 | 40.00 | -4.98 | QP | | | |
| 3 | | 84.3200 | 47.12 | -21.91 | 25.21 | 40.00 | -14.79 | QP | | | |
| 4 | | 135.7300 | 40.43 | -16.58 | 23.85 | 43.50 | -19.65 | QP | | | |
| 5 | | 298.6900 | 49.58 | -14.42 | 35.16 | 46.00 | -10.84 | QP | | | |
| 6 | | 396.6600 | 36.85 | -11.42 | 25.43 | 46.00 | -20.57 | QP | | | |

*:Maximum data x:Over limit !:over margin Operator: John




Site Chamber #1 Polarization: **Horizontal** Temperature: 24

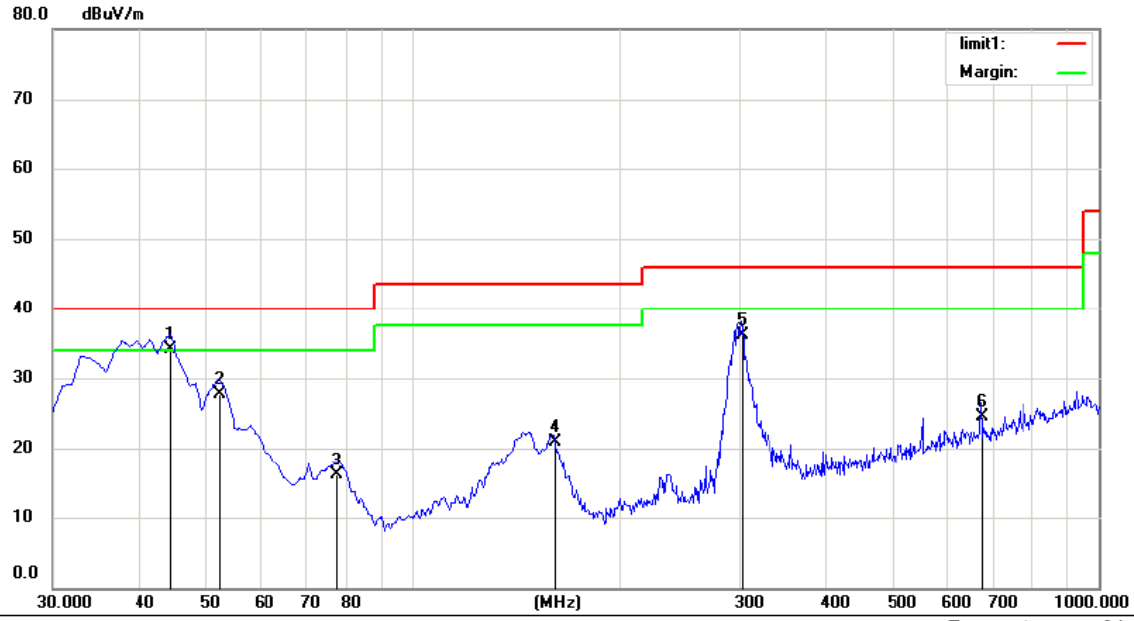
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX2441

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 34.8500 | 33.20 | -14.19 | 19.01 | 40.00 | -20.99 | QP | | | |
| 2 | | 44.5500 | 35.27 | -13.47 | 21.80 | 40.00 | -18.20 | QP | | | |
| 3 | | 54.4515 | 34.06 | -17.16 | 16.90 | 40.00 | -23.10 | QP | | | |
| 4 | | 103.7200 | 40.32 | -18.43 | 21.89 | 43.50 | -21.61 | QP | | | |
| 5 | | 146.4000 | 34.15 | -17.48 | 16.67 | 43.50 | -26.83 | QP | | | |
| 6 | * | 292.8700 | 50.20 | -14.69 | 35.51 | 46.00 | -10.49 | QP | | | |

*:Maximum data x:Over limit !:over margin Operator: John




Site Chamber #1 Polarization: **Vertical** Temperature: 24

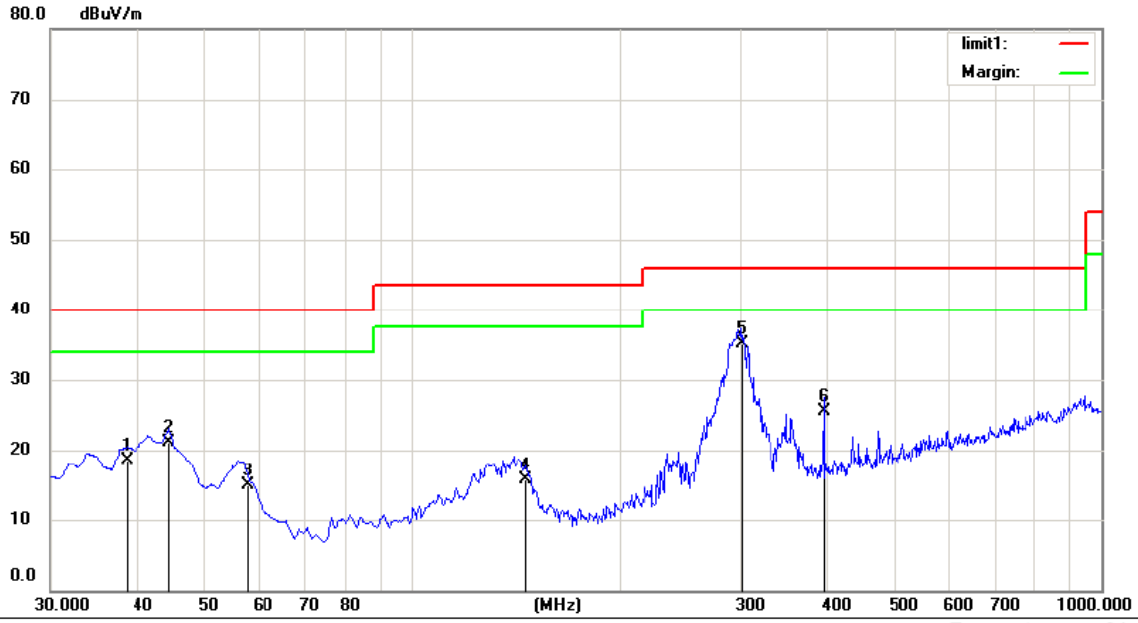
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX2441

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | * | 44.5500 | 47.58 | -13.47 | 34.11 | 40.00 | -5.89 | QP | | | |
| 2 | | 52.3100 | 44.12 | -16.32 | 27.80 | 40.00 | -12.20 | QP | | | |
| 3 | | 77.5927 | 38.74 | -22.60 | 16.14 | 40.00 | -23.86 | QP | | | |
| 4 | | 160.9500 | 39.32 | -18.43 | 20.89 | 43.50 | -22.61 | QP | | | |
| 5 | | 301.6000 | 50.41 | -14.23 | 36.18 | 46.00 | -9.82 | QP | | | |
| 6 | | 674.0800 | 32.20 | -7.66 | 24.54 | 46.00 | -21.46 | QP | | | |

*:Maximum data x:Over limit !:over margin Operator: John




Site Chamber #1 Polarization: **Horizontal** Temperature: 24

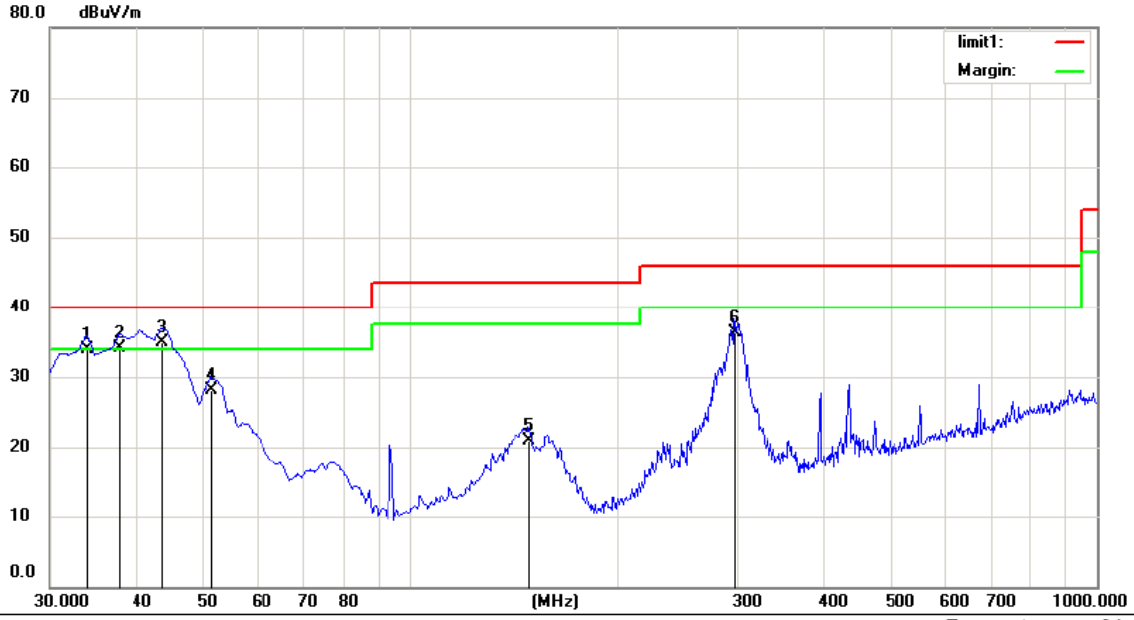
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX2480

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 38.7300 | 32.20 | -13.77 | 18.43 | 40.00 | -21.57 | QP | | | |
| 2 | | 44.5500 | 34.51 | -13.47 | 21.04 | 40.00 | -18.96 | QP | | | |
| 3 | | 57.5940 | 33.41 | -18.45 | 14.96 | 40.00 | -25.04 | QP | | | |
| 4 | | 146.4000 | 33.27 | -17.48 | 15.79 | 43.50 | -27.71 | QP | | | |
| 5 | * | 300.6300 | 49.35 | -14.28 | 35.07 | 46.00 | -10.93 | QP | | | |
| 6 | | 396.6600 | 36.84 | -11.42 | 25.42 | 46.00 | -20.58 | QP | | | |

*:Maximum data x:Over limit !:over margin Operator: John




Site Chamber #1 Polarization: **Vertical** Temperature: 24

Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX2480

Note:

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 33.8800 | 48.24 | -14.31 | 33.93 | 40.00 | -6.07 | QP | | | |
| 2 | ! | 37.7600 | 47.96 | -13.84 | 34.12 | 40.00 | -5.88 | QP | | | |
| 3 | * | 43.5800 | 48.31 | -13.37 | 34.94 | 40.00 | -5.06 | QP | | | |
| 4 | | 51.3400 | 44.04 | -15.96 | 28.08 | 40.00 | -11.92 | QP | | | |
| 5 | | 149.3100 | 38.52 | -17.68 | 20.84 | 43.50 | -22.66 | QP | | | |
| 6 | | 296.7500 | 50.84 | -14.54 | 36.30 | 46.00 | -9.70 | QP | | | |

*:Maximum data x:Over limit !:over margin Operator: John

## Above 1000MHz

| | | | |
|---|---|---|---|
| Worst Operation Mode: | GFSK (CH1: 2402MHz) | Test Date : | August 03, 2015 |
| Frequency Range: | 1-25GHz | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Measured Distance: | 3m | Test By: | Andy |

| Freq. | Ant. Pol. | Emission Level(dBuV/m) | | Limit 3m(dBuV/m) | | Margin(dB) | |
|---|---|---|---|---|---|---|---|
| (MHz) | H/V | PK | AV | PK | AV | PK | AV |
| 4804 | V | 68.05 | 46.13 | 74 | 54 | -5.95 | -7.87 |
| 7206 | V | 66.25 | 44.82 | 74 | 54 | -7.75 | -9.18 |
| 9608 | V | 64.82 | 43.61 | 74 | 54 | -9.18 | -10.39 |
| 12010 | V | 65.36 | 42.72 | 74 | 54 | -8.64 | -11.28 |
| 14412 | V | 60.82 | 41.15 | 74 | 54 | -13.18 | -12.85 |
| 16814 | V | 59.34 | 40.39 | 74 | 54 | -14.66 | -13.61 |
| 4804 | H | 65.34 | 46.82 | 74 | 54 | -8.66 | -7.18 |
| 7206 | H | 63.26 | 45.72 | 74 | 54 | -10.74 | -8.28 |
| 9608 | H | 63.19 | 44.33 | 74 | 54 | -10.81 | -9.67 |
| 12010 | H | 62.96 | 43.92 | 74 | 54 | -11.04 | -10.08 |
| 14412 | H | 60.15 | 42.85 | 74 | 54 | -13.85 | -11.15 |
| 16814 | H | 57.48 | 41.03 | 74 | 54 | -16.52 | -12.97 |

**Other harmonics emissions are lower than 20dB below the allowable limit.**

**Note:** (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.
(4) The results of worst cased (GFSK) was recorded.

| | | | |
|---|---|---|---|
| Worst Operation Mode: | GFSK (CH40: 2441MHz) | Test Date : | August 03, 2015 |
| Frequency Range: | 1-25GHz | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Measured Distance: | 3m | Test By: | Andy |

| Freq. | Ant. Pol. | Emission Level(dBuV/m) | | Limit 3m(dBuV/m) | | Margin(dB) | |
|---|---|---|---|---|---|---|---|
| (MHz) | H/V | PK | AV | PK | AV | PK | AV |
| 4882 | V | 66.33 | 44.11 | 74 | 54 | -7.67 | -9.89 |
| 7323 | V | 65.72 | 43.38 | 74 | 54 | -8.28 | -10.62 |
| 9764 | V | 64.82 | 42.19 | 74 | 54 | -9.18 | -11.81 |
| 12205 | V | 63.95 | 41.23 | 74 | 54 | -10.05 | -12.77 |
| 14646 | V | 62.82 | 40.82 | 74 | 54 | -11.18 | -13.18 |
| 17087 | V | 60.72 | 39.82 | 74 | 54 | -13.28 | -14.18 |
| 4882 | H | 65.92 | 45.92 | 74 | 54 | -8.08 | -8.08 |
| 7323 | H | 64.37 | 44.15 | 74 | 54 | -9.63 | -9.85 |
| 9764 | H | 63.82 | 43.69 | 74 | 54 | -10.18 | -10.31 |
| 12205 | H | 62.16 | 42.82 | 74 | 54 | -11.84 | -11.18 |
| 14646 | H | 60.95 | 41.72 | 74 | 54 | -13.05 | -12.28 |
| 17087 | H | 58.95 | 40.38 | 74 | 54 | -15.05 | -13.62 |

**Other harmonics emissions are lower than 20dB below the allowable limit.**

**Note:** (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.
(4) The results of worst cased (GFSK) was recorded.

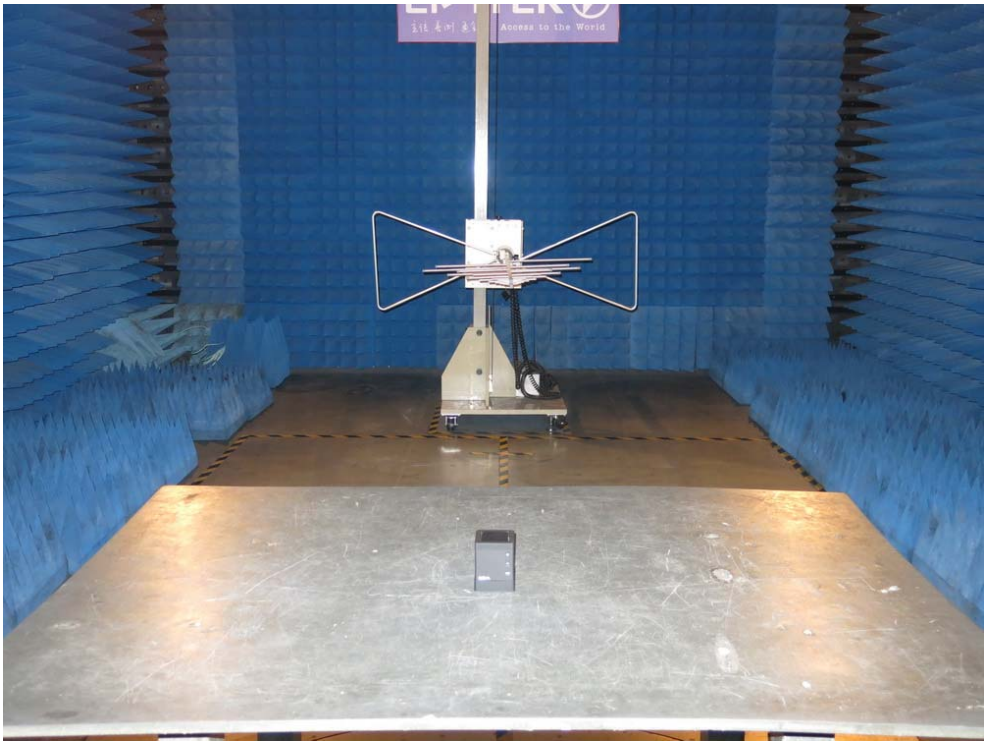
| | | | |
|---|---|---|---|
| Worst Operation Mode: | GFSK (CH79: 2480MHz) | Test Date : | August 03, 2015 |
| Frequency Range: | 1-25GHz | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Measured Distance: | 3m | Test By: | Andy |

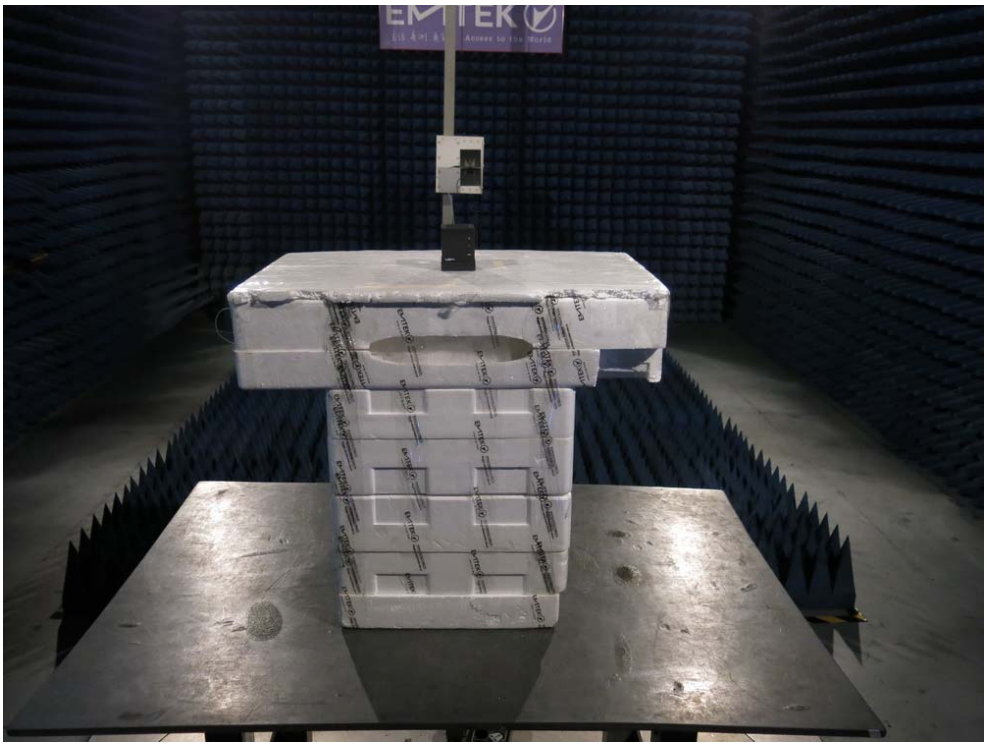
| Freq. | Ant. Pol. | Emission Level(dBuV/m) | | Limit 3m(dBuV/m) | | Margin(dB) | |
|---|---|---|---|---|---|---|---|
| (MHz) | H/V | PK | AV | PK | AV | PK | AV |
| 4960 | V | 65.33 | 44.18 | 74 | 54 | -8.67 | -9.82 |
| 7440 | V | 64.72 | 43.38 | 74 | 54 | -9.28 | -10.62 |
| 9920 | V | 63.59 | 42.82 | 74 | 54 | -10.41 | -11.18 |
| 12400 | V | 62.15 | 41.13 | 74 | 54 | -11.85 | -12.87 |
| 14880 | V | 61.02 | 40.59 | 74 | 54 | -12.98 | -13.41 |
| 17360 | V | 60.38 | 38.95 | 74 | 54 | -13.62 | -15.05 |
| 4960 | H | 66.33 | 45.72 | 74 | 54 | -7.67 | -8.28 |
| 7440 | H | 65.82 | 44.66 | 74 | 54 | -8.18 | -9.34 |
| 9920 | H | 64.72 | 43.69 | 74 | 54 | -9.28 | -10.31 |
| 12400 | H | 63.81 | 42.17 | 74 | 54 | -10.19 | -11.83 |
| 14880 | H | 62.33 | 41.35 | 74 | 54 | -11.67 | -12.65 |
| 17360 | H | 60.82 | 40.07 | 74 | 54 | -13.18 | -13.93 |

**Other harmonics emissions are lower than 20dB below the allowable limit.**

**Note:** (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.
(4) The results of worst cased (GFSK) was recorded.

## 7.5 Radiated Measurement Photos:



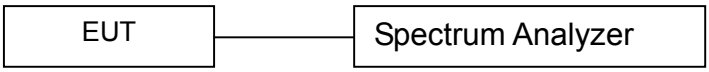


# 8. Channel Separation test

## 8.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

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




## 8.3 Measurement Equipment Used:

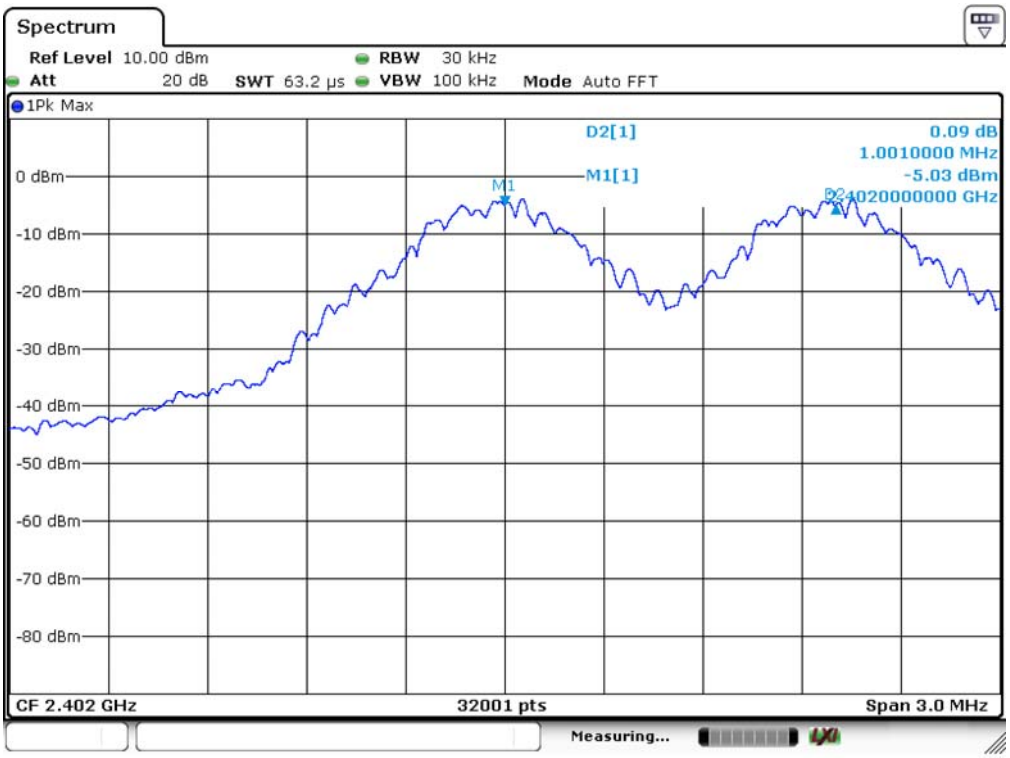
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSV30 | 1321.3008K | 03/16/2015 | 03/15/2016 |
| Coaxial Cable | CDS | 79254 | 46107086 | 03/16/2015 | 03/15/2016 |

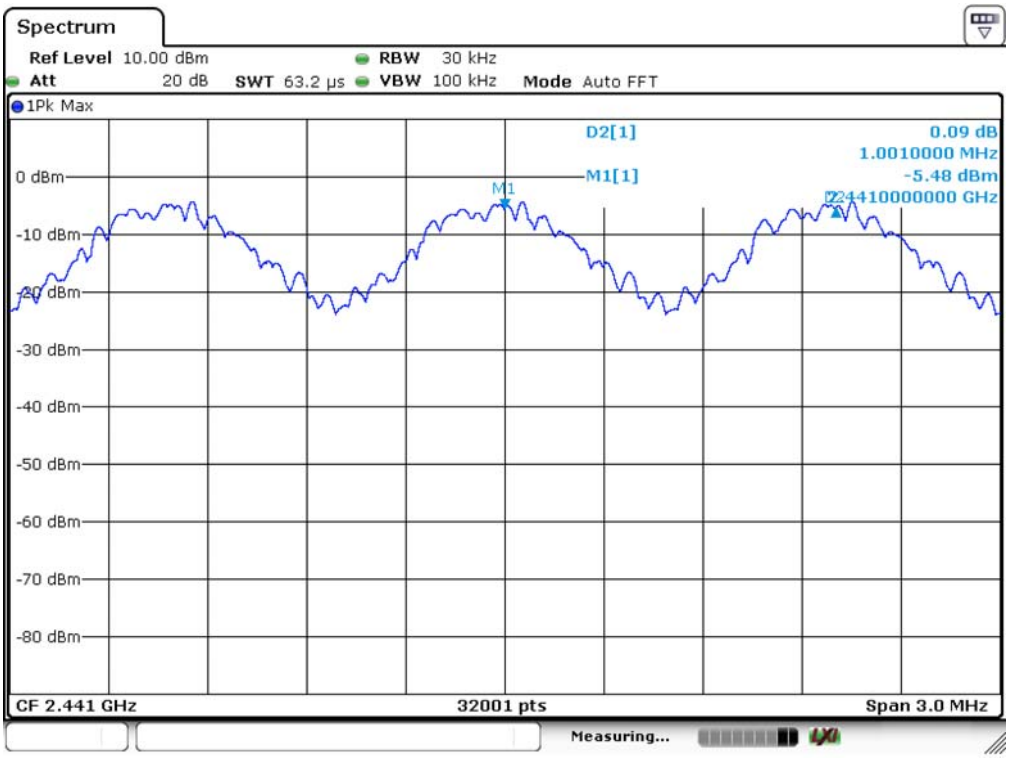
## 8.4 Measurement Results:

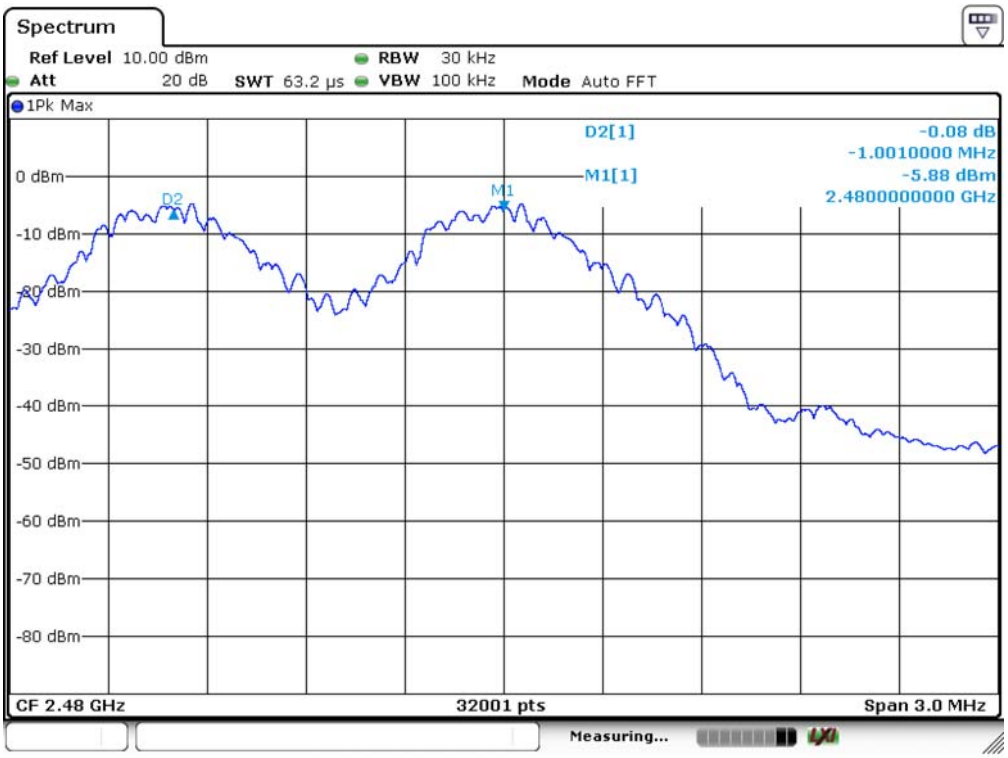
Refer to attached data chart.

| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Modulation: | GFSK | | |

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit (kHz) |
|---|---|---|---|
| 1 | 2402 | 1001 | >818 |
| 40 | 2441 | 1001 | >818 |
| 79 | 2480 | 1001 | >818 |

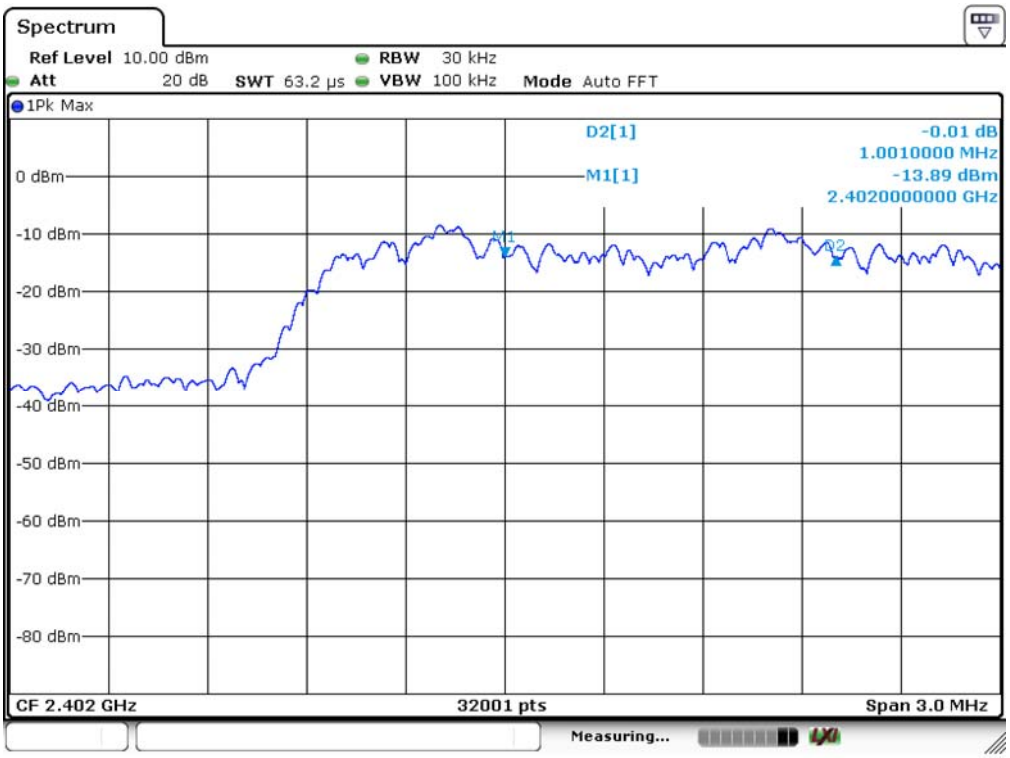

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.09 dB
1.0010000 MHz
M1[1]
-5.03 dBm
2.4020000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Measuring...

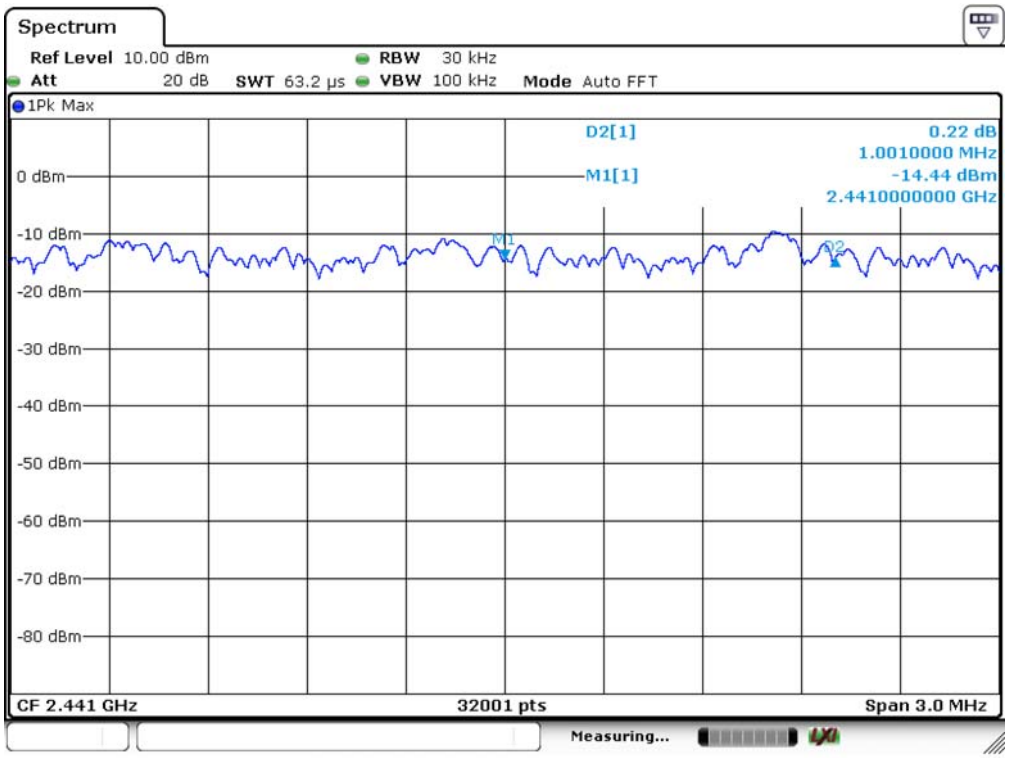

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.09 dB
1.0010000 MHz
M1[1]
-5.48 dBm
2.4410000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Measuring...

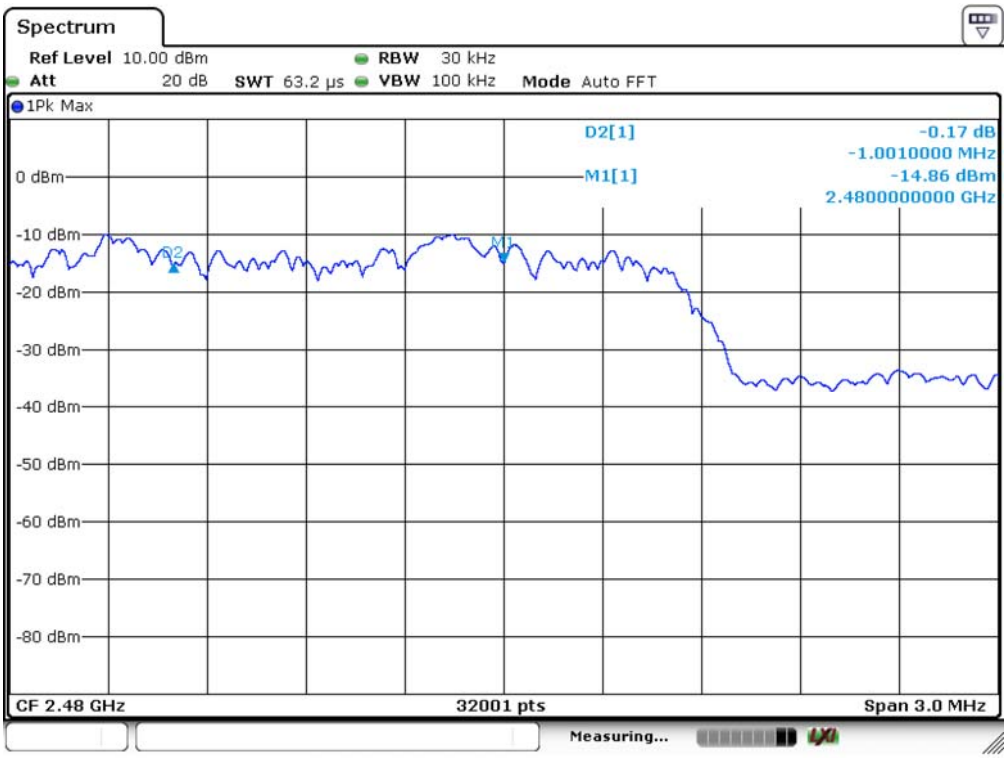



| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 24℃ |
| Test Result: | PASS | Humidity : | 53 % |
| Modulation: | Π/4-DQPSK | | |

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit 2/3 20dB Down BW(kHz) |
|---|---|---|---|
| 1 | 2402 | 1001 | >897 |
| 40 | 2441 | 1001 | >908 |
| 79 | 2480 | 1001 | >833 |

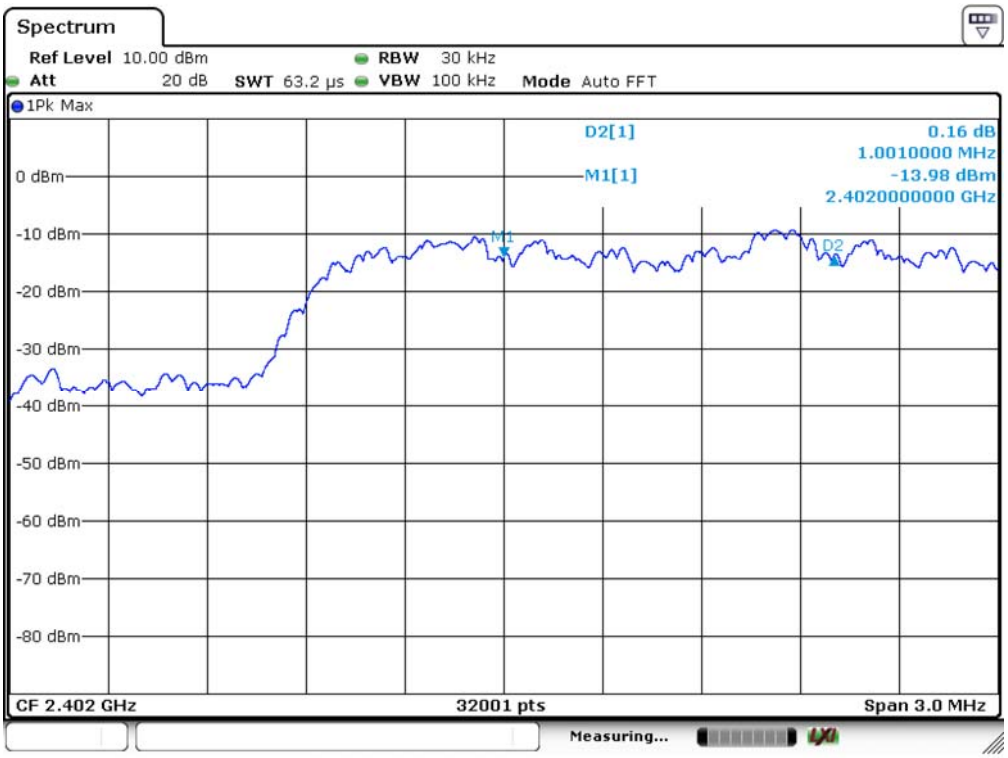

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
-0.01 dB
1.0010000 MHz
M1[1]
-13.89 dBm
2.4020000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Measuring...

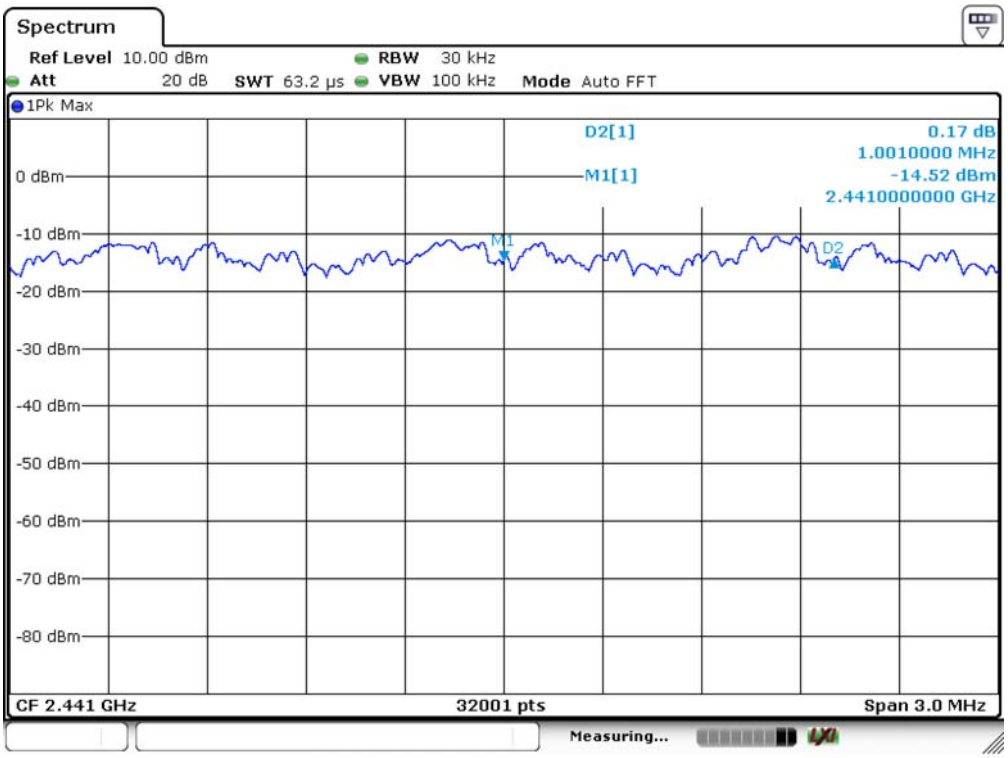

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.22 dB
1.0010000 MHz
M1[1]
-14.44 dBm
2.4410000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Measuring...

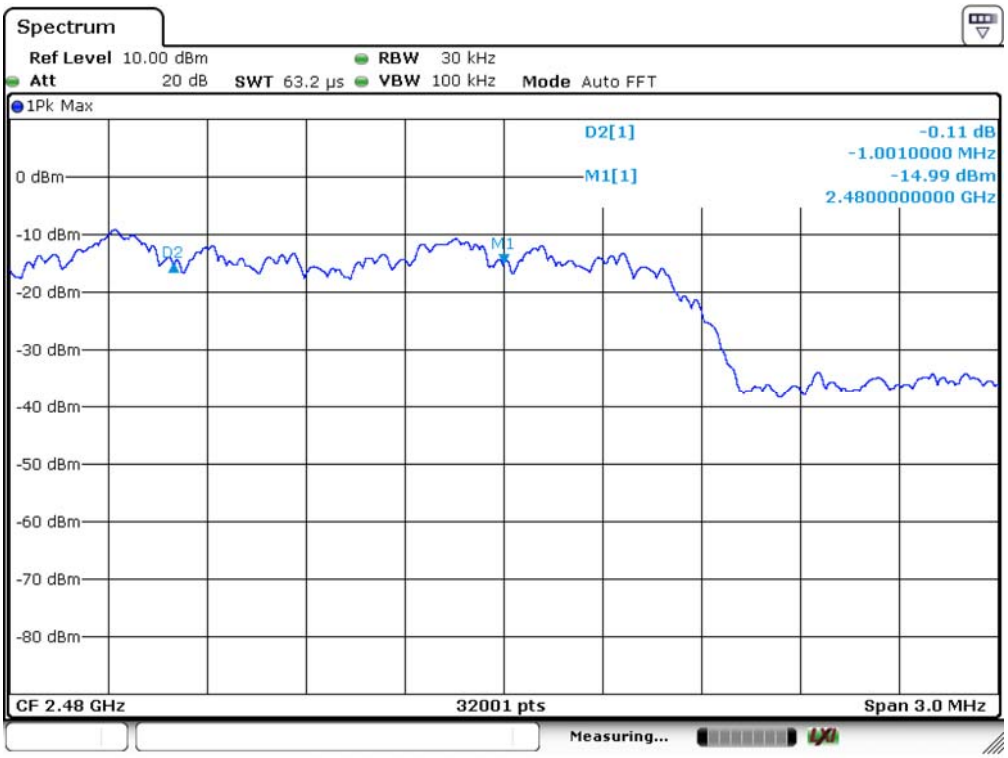



| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 24℃ |
| Test Result: | PASS | Humidity : | 53 % |
| Modulation: | 8DPSK | | |

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit 2/3 20dB Down BW(kHz) |
|---|---|---|---|
| 1 | 2402 | 1001 | >812 |
| 40 | 2441 | 1001 | >809 |
| 79 | 2480 | 1001 | >897 |


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.16 dB
1.0010000 MHz
M1[1]
-13.98 dBm
2.4020000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D2
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.17 dB
1.0010000 MHz
M1[1]
-14.52 dBm
2.4410000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D2
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Measuring...

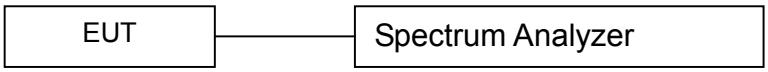

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
D2[1]
-0.11 dB
-1.0010000 MHz
M1[1]
-14.99 dBm
2.4800000000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
D2
M1
CF 2.48 GHz
32001 pts
Span 3.0 MHz
Measuring...

# 9. 20dB Bandwidth test

## 9.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

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




## 9.3 Measurement Equipment Used:

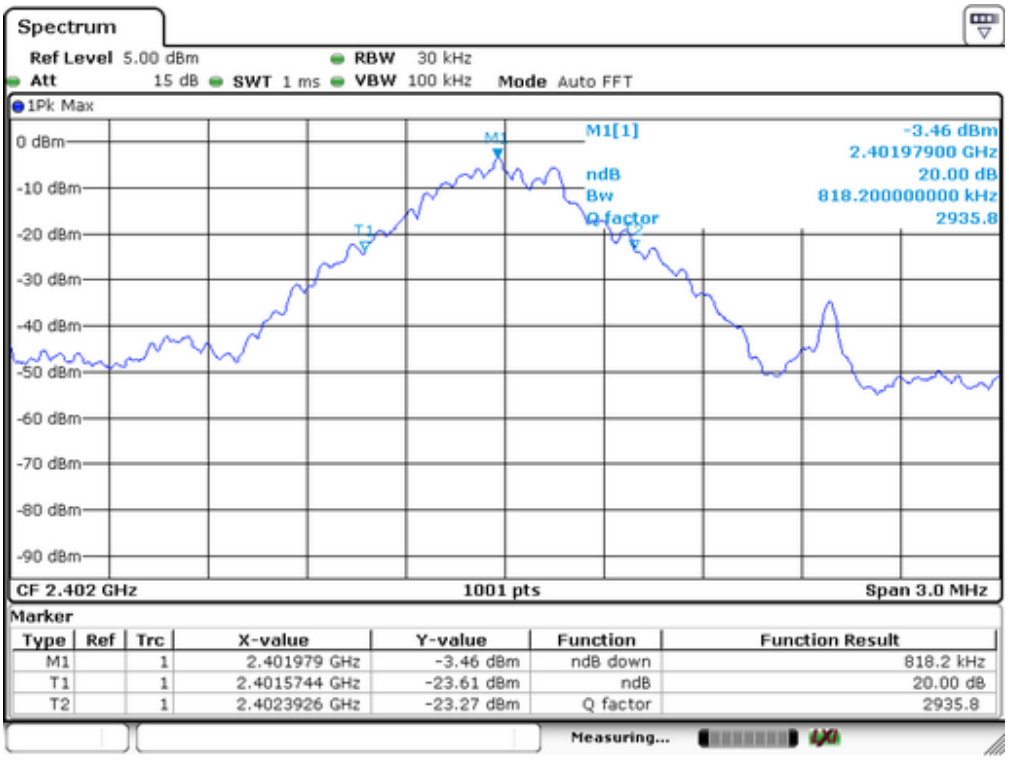
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSV30 | 1321.3008K | 03/16/2015 | 03/15/2016 |
| Coaxial Cable | CDS | 79254 | 46107086 | 03/16/2015 | 03/15/2016 |

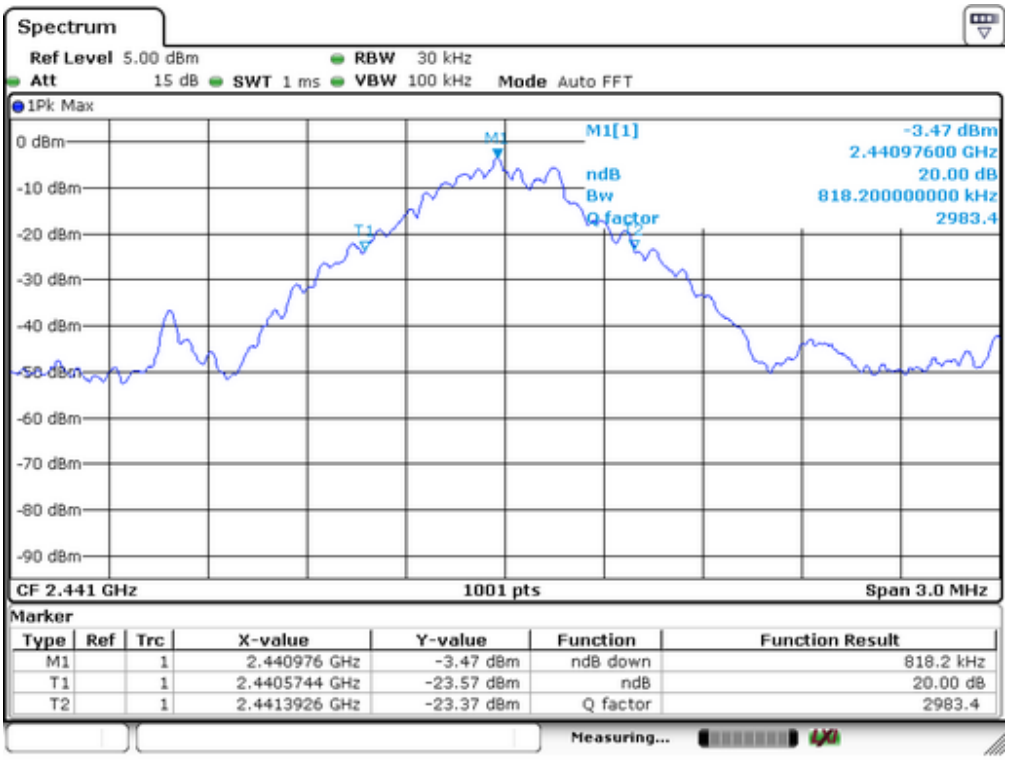
## 9.4 Measurement Results:

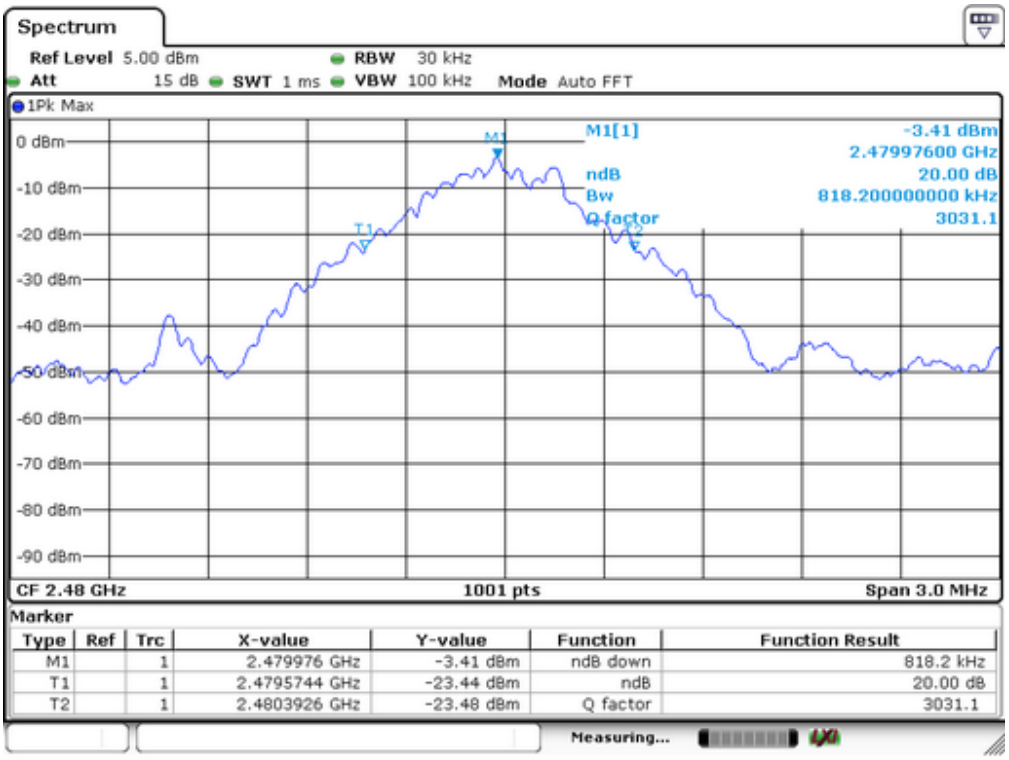
Refer to attached data chart.

| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 24℃ |
| Test Result: | PASS | Humidity : | 53 % |
| Modulation: | GFSK | | |

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|---|---|---|
| 1 | 2402 | 818 |
| 40 | 2441 | 818 |
| 79 | 2480 | 818 |

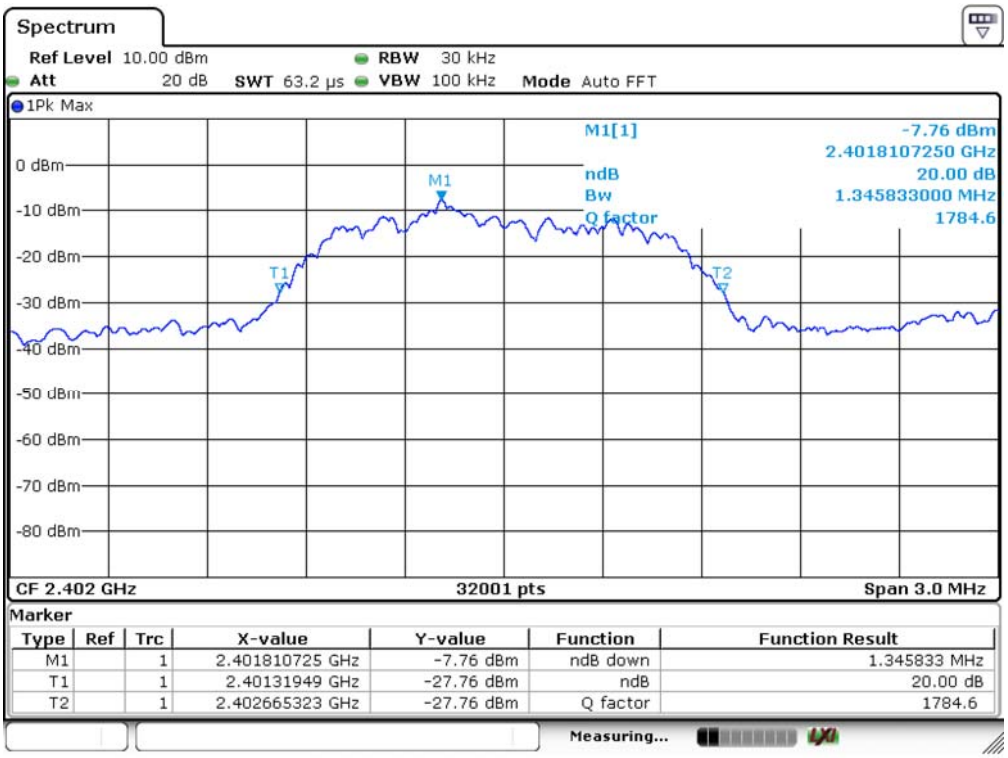

Spectrum
Ref Level 5.00 dBm
RBW 30 kHz
Att 15 dB SWT 1 ms VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1]
-3.46 dBm
2.40197900 GHz
ndB 20.00 dB
Bw 818.200000000 kHz
Q factor 2935.8
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.401979 GHz -3.46 dBm ndB down 818.2 kHz
T1 1 2.4015744 GHz -23.61 dBm ndB 20.00 dB
T2 1 2.4023926 GHz -23.27 dBm Q factor 2935.8
Measuring...

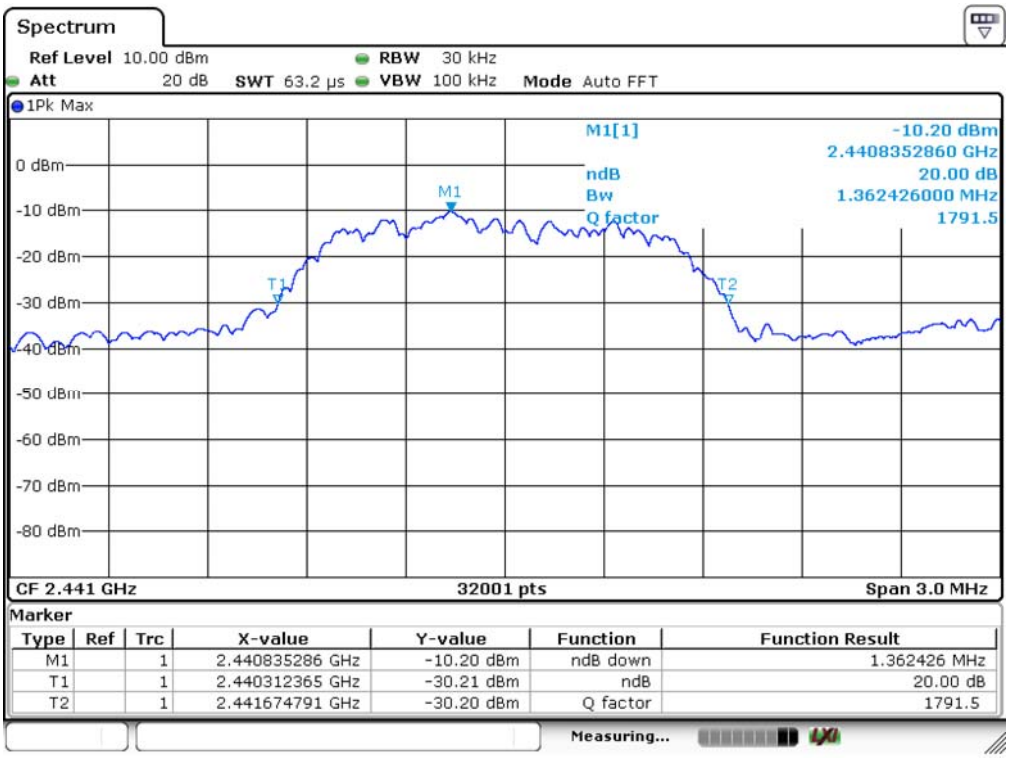

Spectrum
Ref Level 5.00 dBm
RBW 30 kHz
Att 15 dB SWT 1 ms VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1]
-3.47 dBm
2.44097600 GHz
ndB 20.00 dB
Bw 818.200000000 kHz
Q factor 2983.4
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440976 GHz -3.47 dBm ndB down 818.2 kHz
T1 1 2.4405744 GHz -23.57 dBm ndB 20.00 dB
T2 1 2.4413926 GHz -23.37 dBm Q factor 2983.4
Measuring...

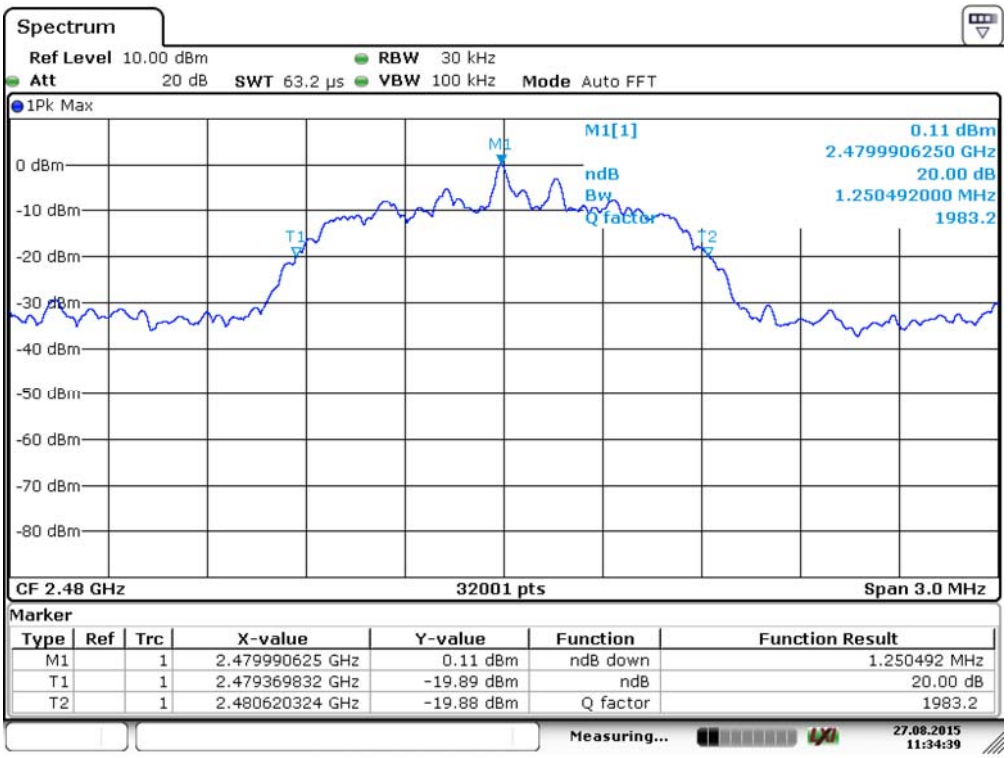



| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 24℃ |
| Test Result: | PASS | Humidity : | 53 % |
| Modulation: | Π/4-DQPSK | | |

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|---|---|---|
| 1 | 2402 | 1346 |
| 40 | 2441 | 1362 |
| 79 | 2480 | 1250 |

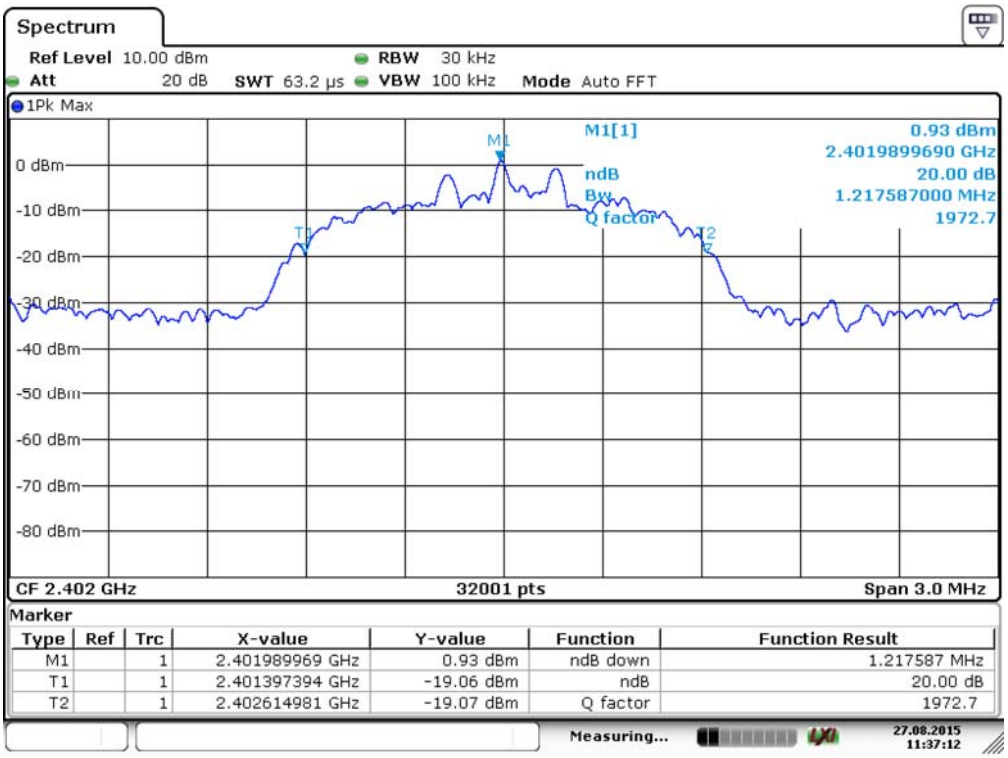

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
M1[1]
-7.76 dBm
2.4018107250 GHz
ndB 20.00 dB
Bw 1.345833000 MHz
Q factor 1784.6
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
T1
T2
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.401810725 GHz -7.76 dBm ndB down 1.345833 MHz
T1 1 2.40131949 GHz -27.76 dBm ndB 20.00 dB
T2 1 2.402665323 GHz -27.76 dBm Q factor 1784.6
Measuring...

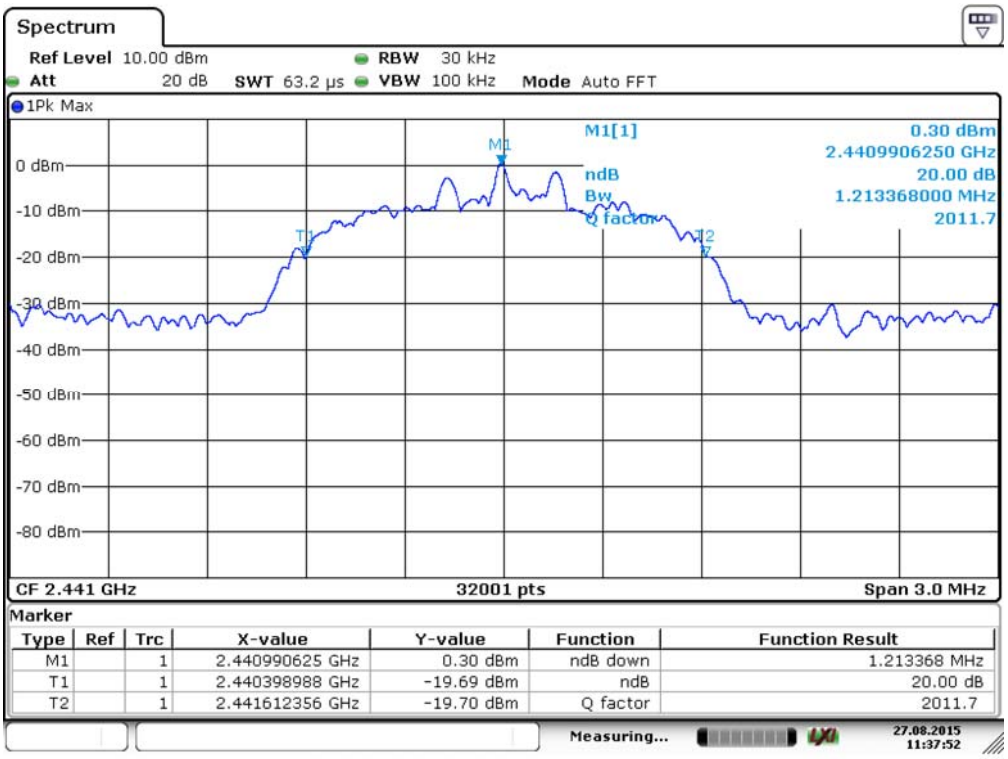

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
M1[1]
-10.20 dBm
2.4408352860 GHz
ndB 20.00 dB
Bw 1.362426000 MHz
Q factor 1791.5
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
T1
T2
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440835286 GHz -10.20 dBm ndB down 1.362426 MHz
T1 1 2.440312365 GHz -30.21 dBm ndB 20.00 dB
T2 1 2.441674791 GHz -30.20 dBm Q factor 1791.5
Measuring...

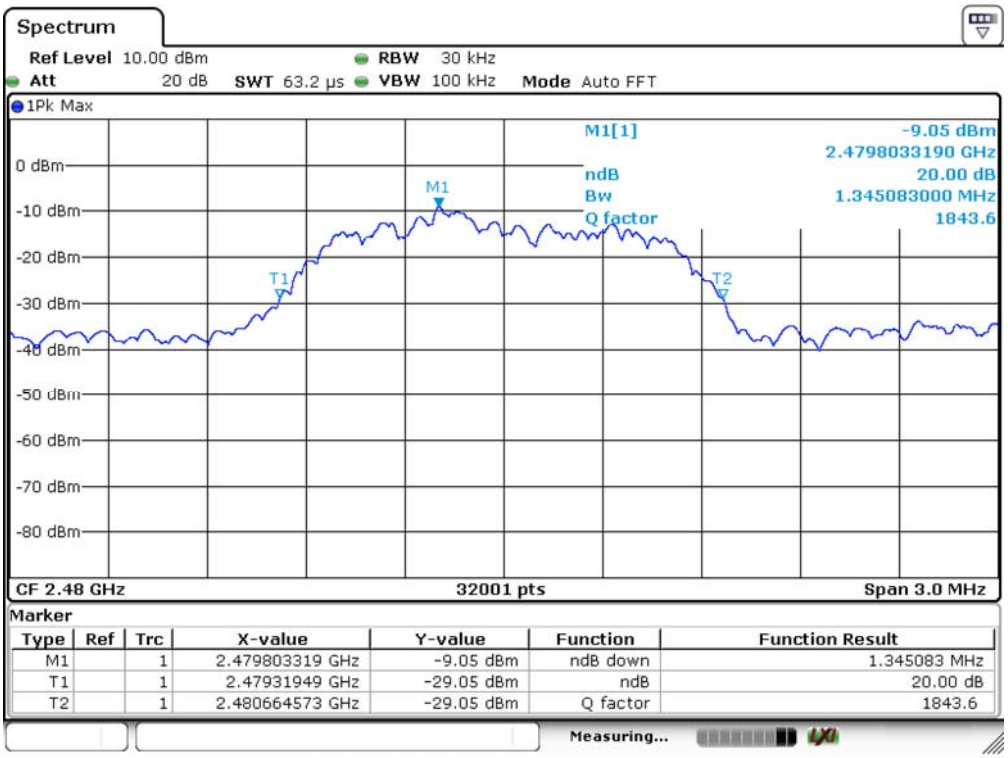



| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 24℃ |
| Test Result: | PASS | Humidity : | 53 % |
| Modulation: | 8DPSK | | |

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|---|---|---|
| 1 | 2402 | 1218 |
| 40 | 2441 | 1213 |
| 79 | 2480 | 1345 |


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
M1[1]
0.93 dBm
2.4019899690 GHz
ndB 20.00 dB
Bw 1.217587000 MHz
Q factor 1972.7
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.401989969 GHz 0.93 dBm ndB down 1.217587 MHz
T1 1 2.401397394 GHz -19.06 dBm ndB 20.00 dB
T2 1 2.402614981 GHz -19.07 dBm Q factor 1972.7
Measuring...
27.08.2015
11:37:12


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
M1[1]
0.30 dBm
2.4409906250 GHz
ndB 20.00 dB
Bw 1.213368000 MHz
Q factor 2011.7
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440990625 GHz 0.30 dBm ndB down 1.213368 MHz
T1 1 2.440398988 GHz -19.69 dBm ndB 20.00 dB
T2 1 2.441612356 GHz -19.70 dBm Q factor 2011.7
Measuring...
27.08.2015
11:37:52

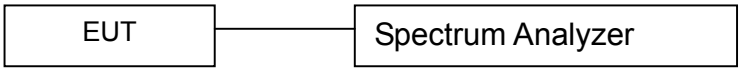

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Pk Max
M1[1]
-9.05 dBm
2.4798033190 GHz
ndB
20.00 dB
Bw
1.345083000 MHz
Q factor
1843.6
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
T1
T2
CF 2.48 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.479803319 GHz -9.05 dBm ndB down 1.345083 MHz
T1 1 2.47931949 GHz -29.05 dBm ndB 20.00 dB
T2 1 2.480664573 GHz -29.05 dBm Q factor 1843.6
Measuring...

# 10. Quantity of Hopping Channel Test

## 10.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

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




## 10.3 Measurement Equipment Used:

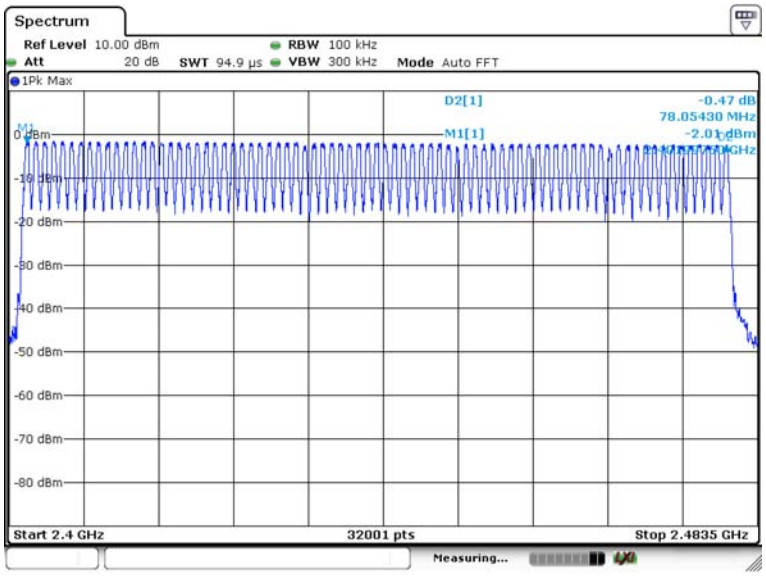
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSV30 | 1321.3008K | 03/16/2015 | 03/15/2016 |
| Coaxial Cable | CDS | 79254 | 46107086 | 03/16/2015 | 03/15/2016 |

## 10.4 Measurement Results:

Refer to attached data chart.

| | | | |
|---|---|---|---|
| Worst Test Mode | GFSK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |

| Hopping Channel Frequency Range | Quantity of Hopping Channel | Quantity of Hopping Channel |
|---|---|---|
| 2402-2480 | 79 | ＞15 |



# 11. Time of Occupancy (Dwell Time) test

## 11.1 Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6s

with:
- hop rate = 1600 * 1/s for DH1 packets = 1600 $s^{-1}$
- hop rate = 1600/3 * 1/s for DH3 packets = 533.33 $s^{-1}$
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

## 11.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

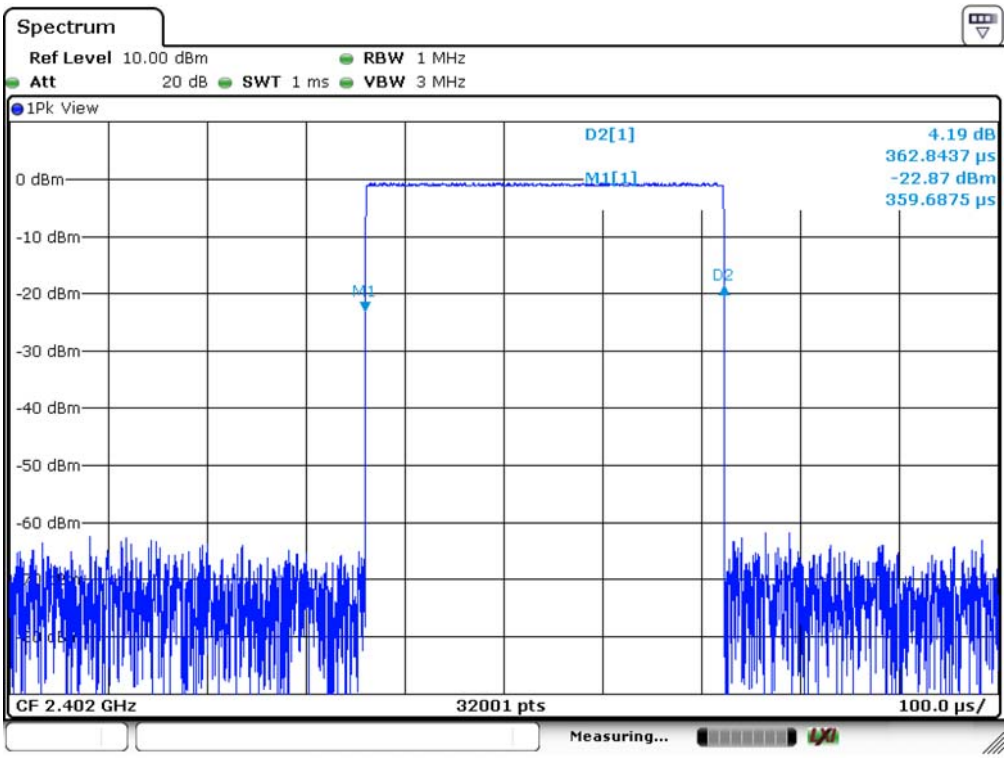
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6seconds. Refer to attached data chart.

## 11.3 Test result

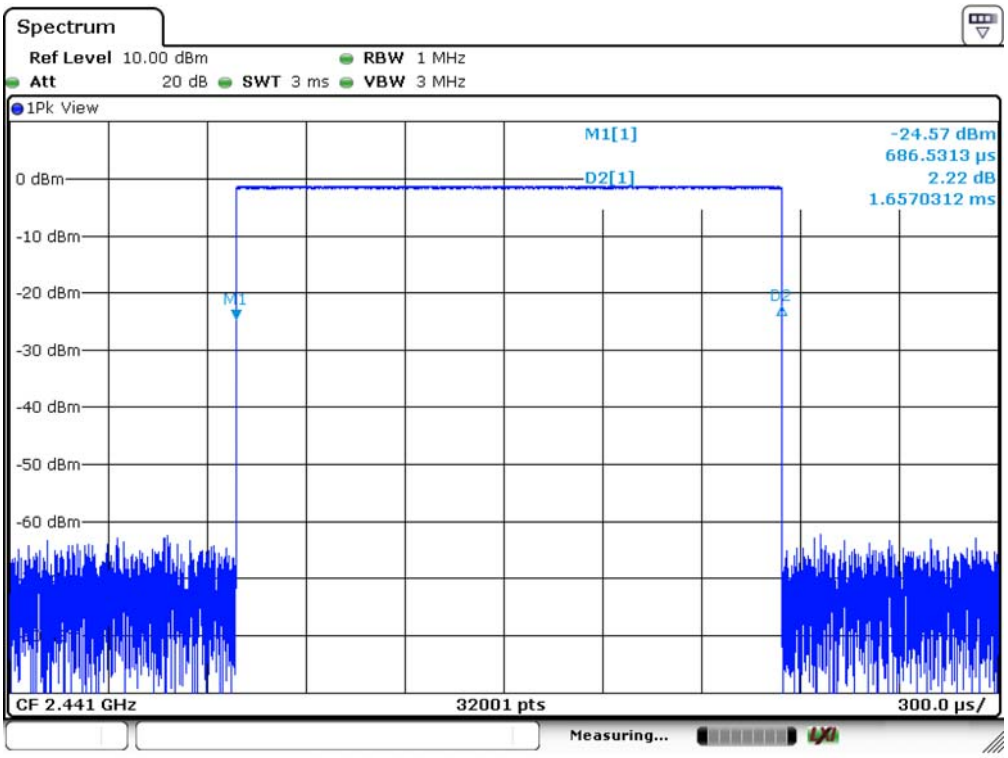
| Mode | Number of transmission in a 31.6( 79 Hopping*0.4) | Length of transmissions time(msec) | Result (msec) | Limit (msec) |
|---|---|---|---|---|
| DH1 | 1600/(2*79) x 31.6 = 320 | 0.359 | 114.88 | 400 |
| DH3 | 1600/(4*79) x 31.6 =160 | 1.657 | 265.12 | 400 |
| DH5 | 1600/(6*79) x 31.6 =106.67 | 2.778 | 296.32 | 400 |

Remark: The results of worst cased was recorded.
.

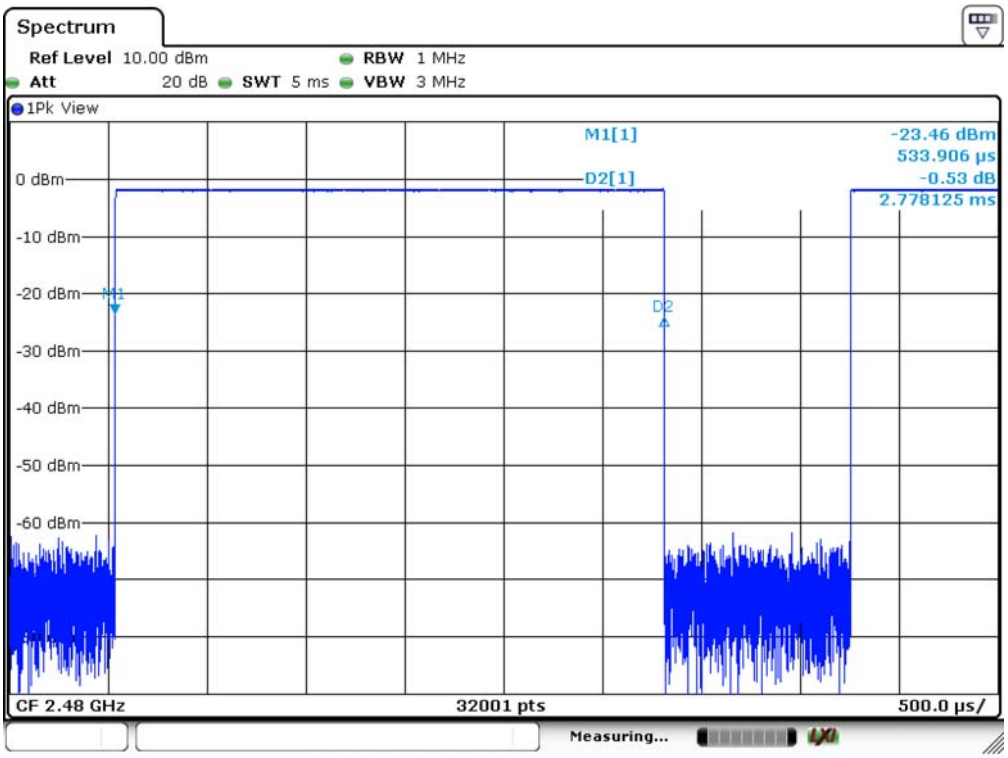
DH1:


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB SWT 1 ms VBW 3 MHz
1Pk View
D2[1] 4.19 dB
362.8437 µs
M1[1] -22.87 dBm
359.6875 µs
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
D2
CF 2.402 GHz
32001 pts
100.0 µs/
Measuring...

DH3:


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB SWT 3 ms VBW 3 MHz
1Pk View
M1[1] -24.57 dBm
686.5313 µs
D2[1] 2.22 dB
1.6570312 ms
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
D2
CF 2.441 GHz
32001 pts
300.0 µs/
Measuring...

DH5:


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB SWT 5 ms VBW 3 MHz
1Pk View
M1[1]
-23.46 dBm
533.906 µs
D2[1]
-0.53 dB
2.778125 ms
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
D2
CF 2.48 GHz
32001 pts
500.0 µs/
Measuring...

# 12. MAXIMUM PEAK OUTPUT POWER TEST

## 12.1 Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.

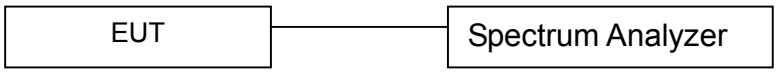
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.

d. Measure the captured power within the band and recording the plot.

e. Repeat above procedures until all frequencies required were complete.

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




## 12.3 Measurement Equipment Used:

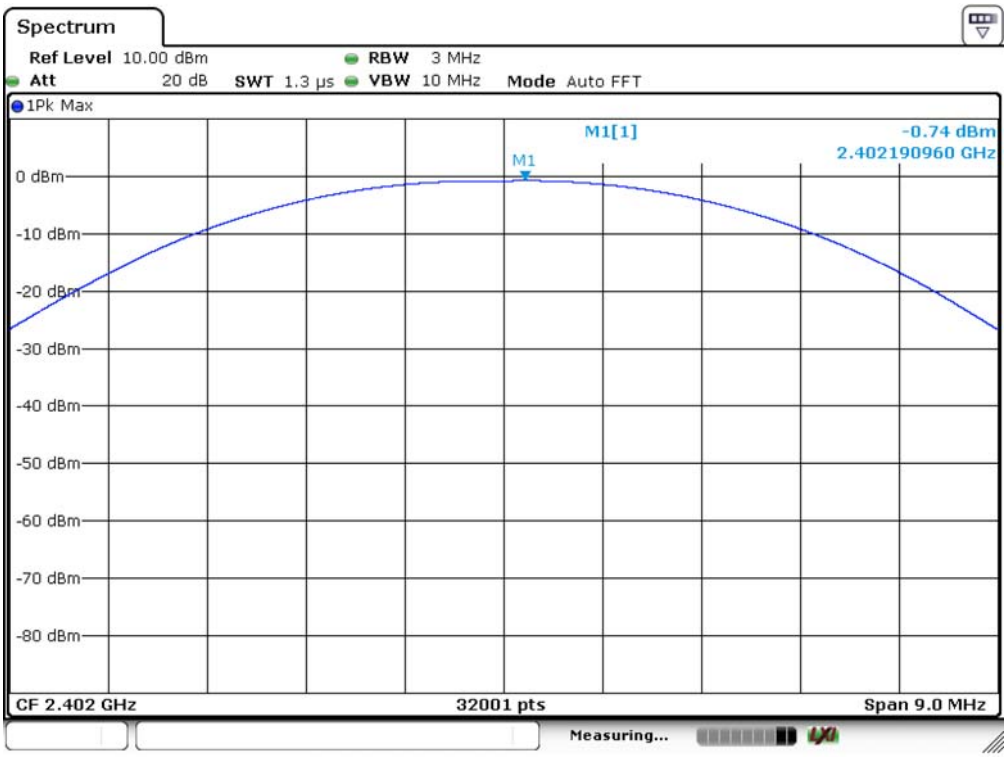
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSV30 | 1321.3008K | 03/16/2015 | 03/15/2016 |
| Coaxial Cable | CDS | 79254 | 46107086 | 03/16/2015 | 03/15/2016 |

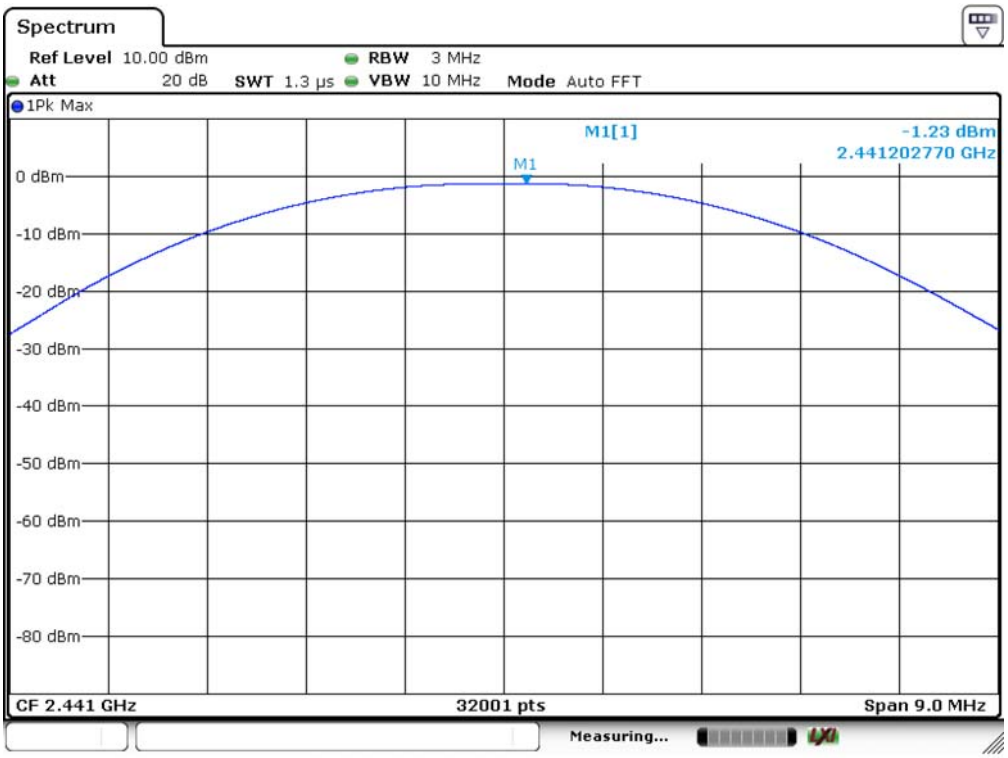
## 12.4Measurement Results:

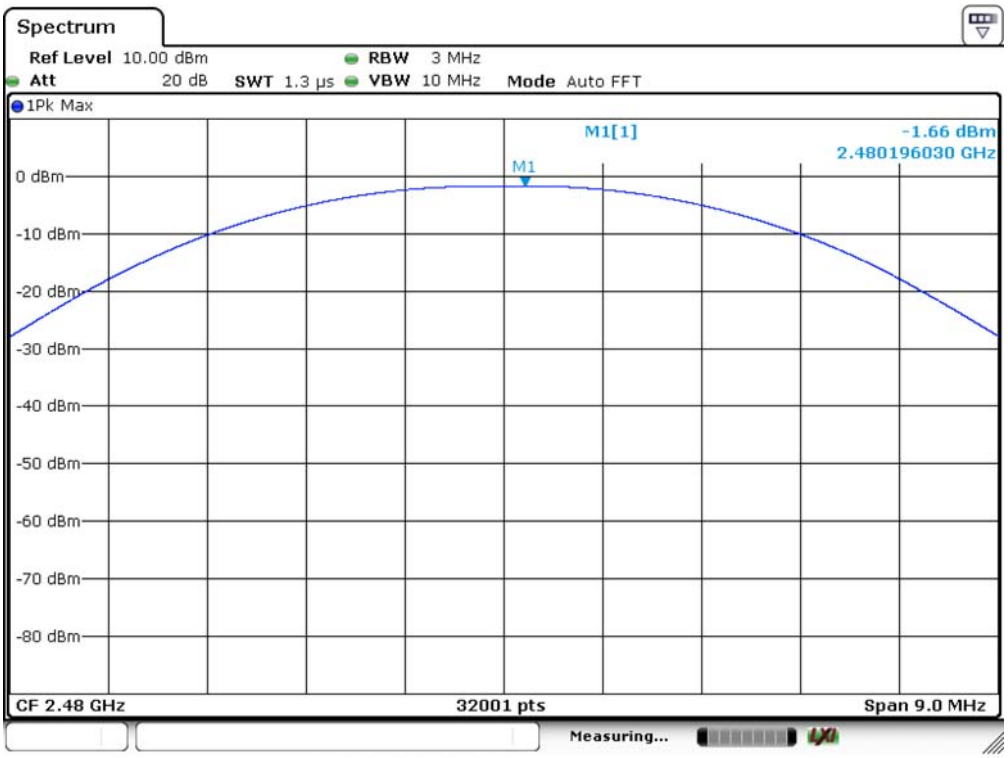
Refer to attached data chart.

| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Modulation: | GFSK | | |

| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(mW) | Pass/Fail |
|---|---|---|---|---|---|
| 01 | 2402 | **-0.74** | **0.843** | 1000 | PASS |
| 40 | 2441 | -1.23 | 0.753 | 1000 | PASS |
| 79 | 2480 | -1.66 | 0.682 | 1000 | PASS |

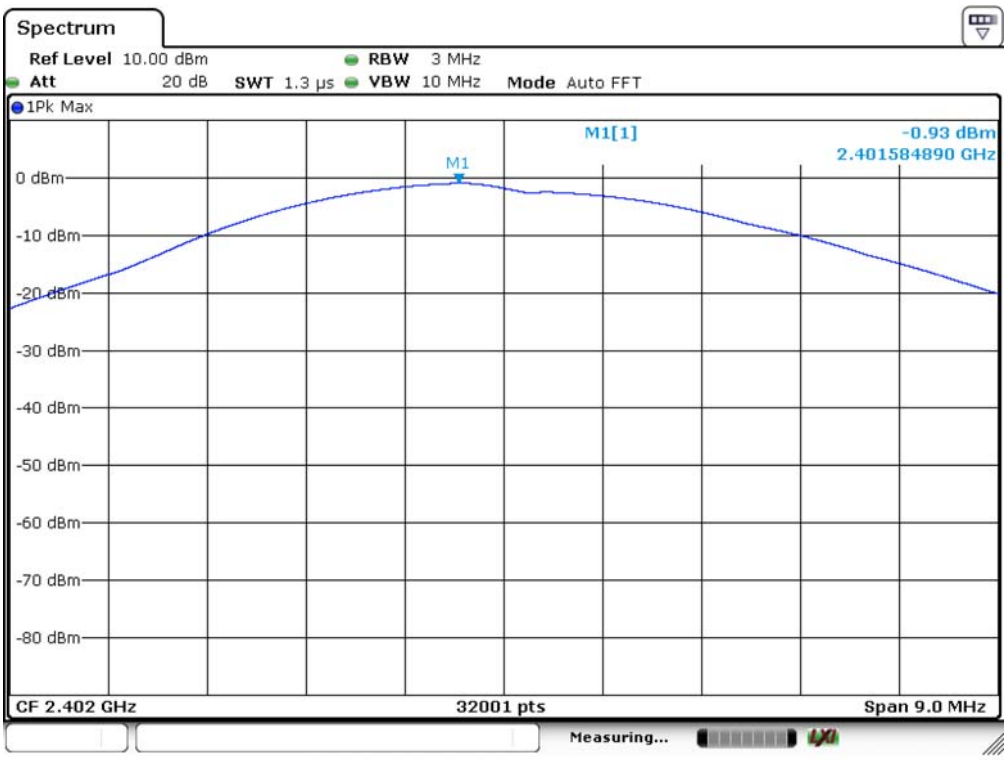


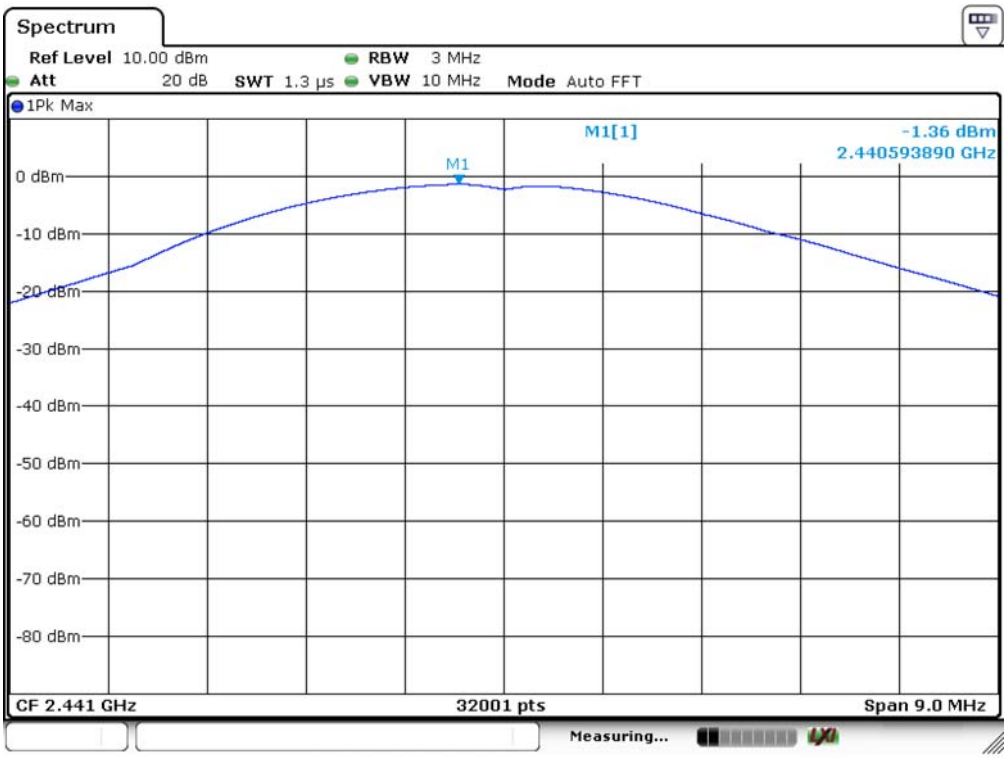

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 10 MHz
Mode Auto FFT
1Pk Max
M1[1]
-1.23 dBm
2.441202770 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 9.0 MHz
Measuring...

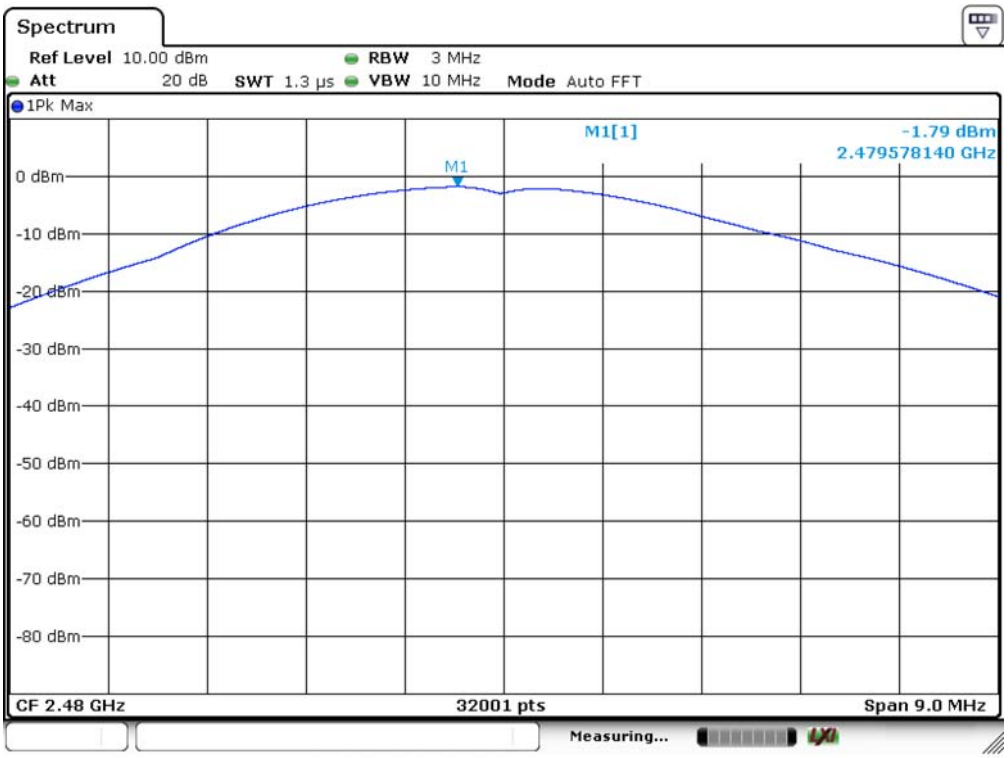

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 10 MHz
Mode Auto FFT
1Pk Max
M1[1]
-1.66 dBm
2.480196030 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
32001 pts
Span 9.0 MHz
Measuring...

| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Modulation: | Π/4-DQPSK | | |

| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(mW) | Pass/Fail |
|---|---|---|---|---|---|
| 01 | 2402 | -0.93 | 0.807 | 125 | PASS |
| 40 | 2441 | -1.36 | 0.731 | 125 | PASS |
| 79 | 2480 | -1.79 | 0.662 | 125 | PASS |

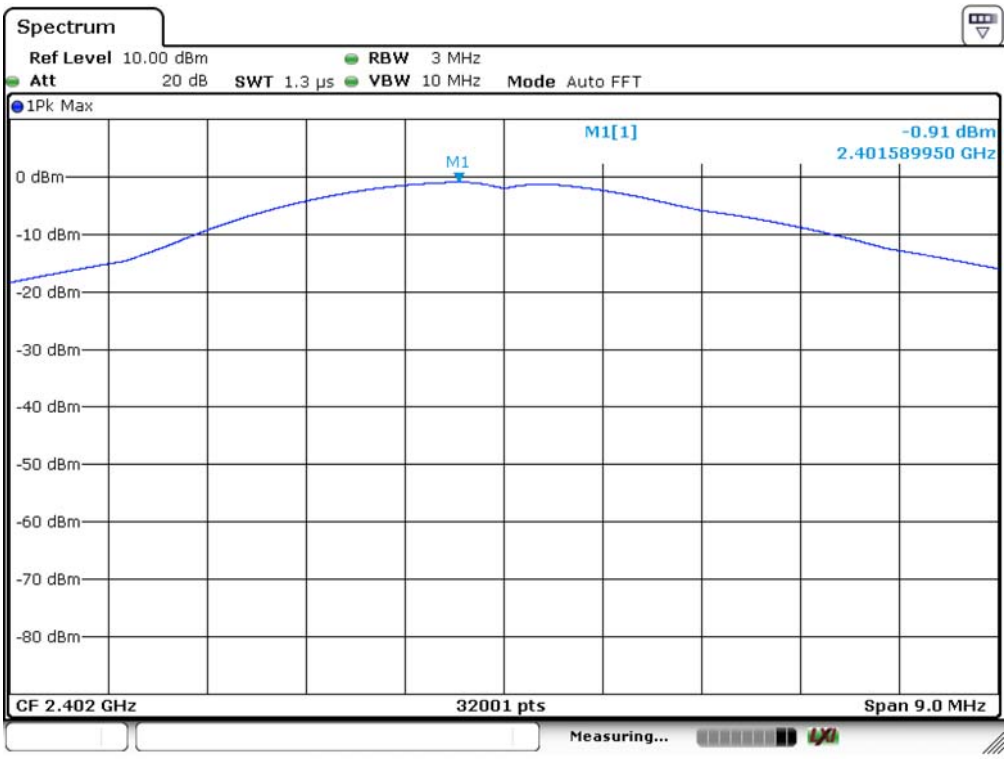


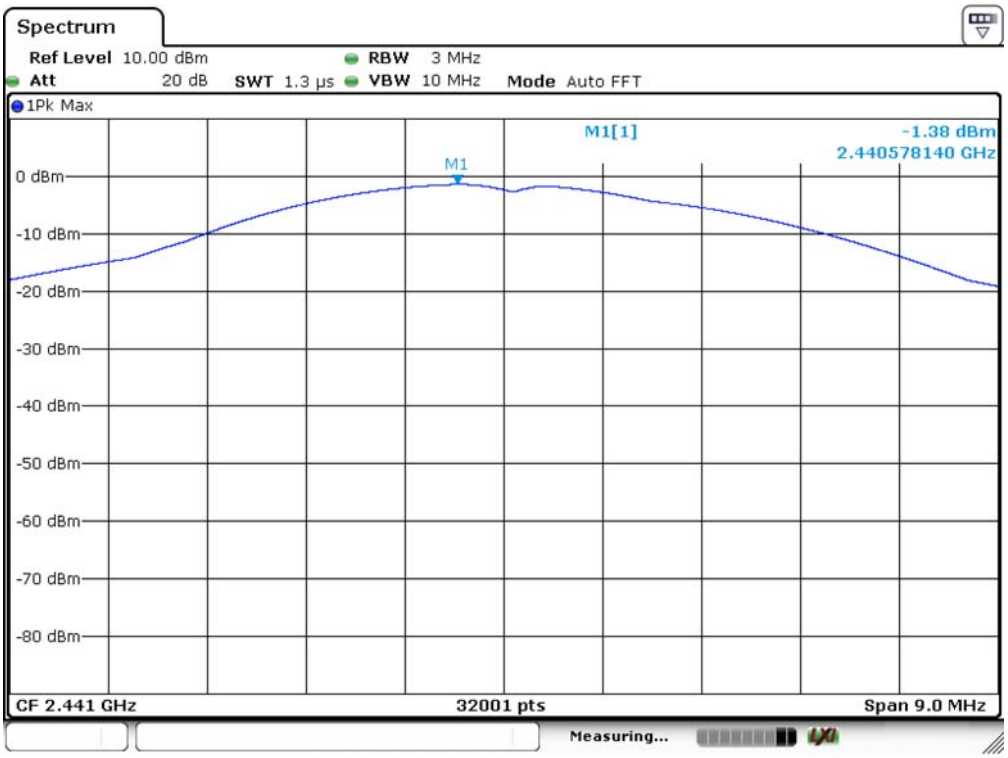

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 10 MHz
Mode Auto FFT
1Pk Max
M1[1]
-1.36 dBm
2.440593890 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 9.0 MHz
Measuring...

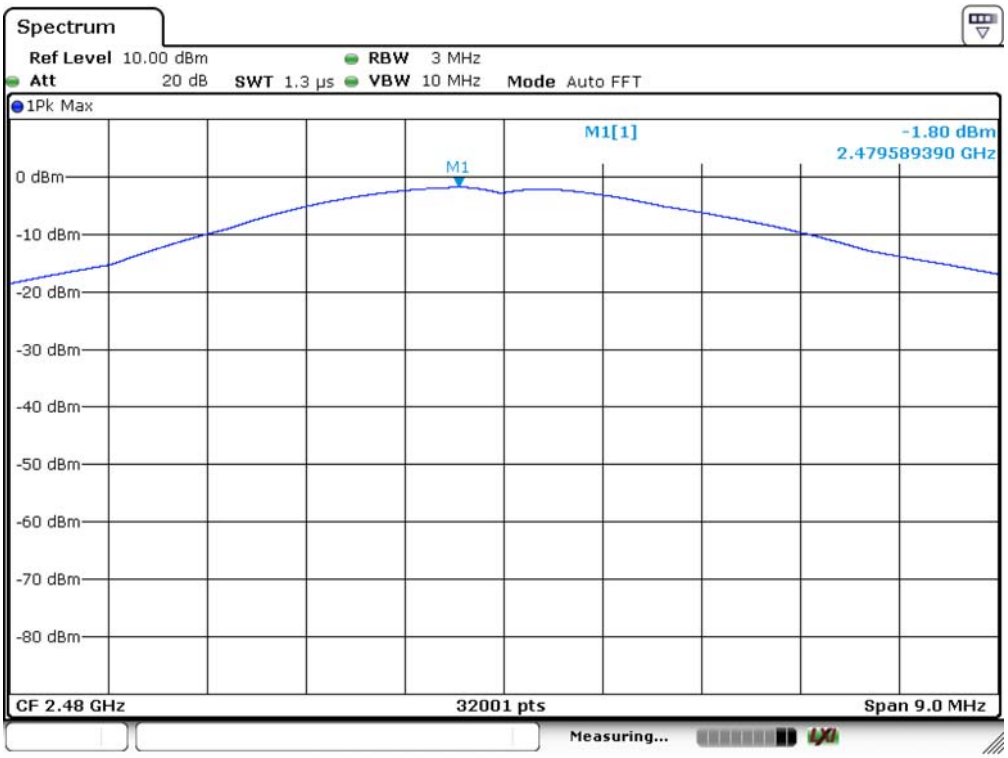

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 10 MHz
Mode Auto FFT
1Pk Max
M1[1]
-1.79 dBm
2.479578140 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
32001 pts
Span 9.0 MHz
Measuring...

| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Modulation: | 8DPSK | | |

| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(mW) | Pass/Fail |
|---|---|---|---|---|---|
| 01 | 2402 | -0.91 | 0.811 | 125 | PASS |
| 40 | 2441 | -1.38 | 0.728 | 125 | PASS |
| 79 | 2480 | -1.80 | 0.661 | 125 | PASS |




Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 10 MHz
Mode Auto FFT
1Pk Max
M1[1]
-1.38 dBm
2.440578140 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 9.0 MHz
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 10 MHz
Mode Auto FFT
1Pk Max
M1[1]
-1.80 dBm
2.479589390 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
32001 pts
Span 9.0 MHz
Measuring...

# 13. Band EDGE test

## 13.1 Measurement Procedure

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a styrofoam table which is 1.5m above ground plane
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.
6. Use the following spectrum analyzer settings:

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

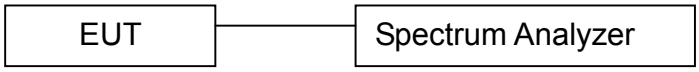
| EMI Test Receiver | Setting |
|---|---|
| Attenuation | Auto |
| RB | 1MHz |
| VB | 3MHz |
| Detector | Peak |
| Trace | Max hold |

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

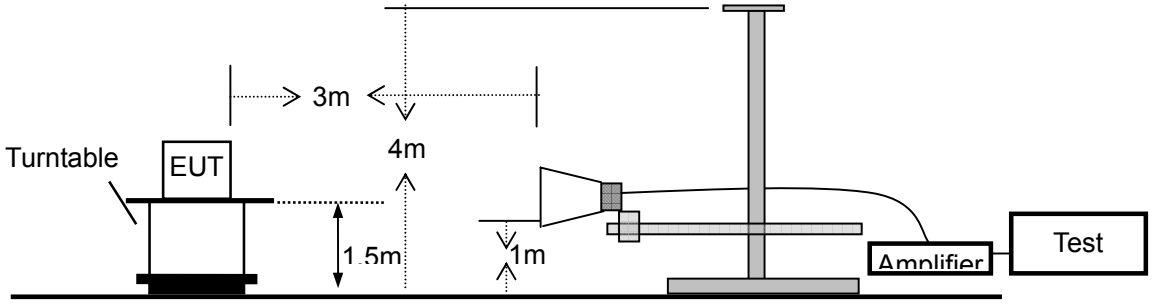
| EMI Test Receiver | Setting |
|---|---|
| Attenuation | Auto |
| RB | 1MHz |
| VB | 10Hz |
| Detector | Peak |
| Trace | Max hold |

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

For Conducted Test



For Radiated emission Test




**13.3 Measurement Equipment Used:**

For Conducted Test

| | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| Spectrum Analyzer | Rohde & Schwarz | FSV30 | 1321.3008K | 03/16/2015 | 03/15/2016 |
| Coaxial Cable | CDS | 79254 | 46107086 | 03/16/2015 | 03/15/2016 |

For Radiated emission Test

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Signal Analyzer | Rohde & Schwarz | FSV30 | 103040 | 12/29/2014 | 1 Year |
| 2 | Horn Antenna | Schwarzbeck | BBHA9120D | 9120D-1272 | 12/29/2014 | 1 Year |
| 3 | Power Amplifier | LUNAR EM | LNA1G18-40 | J1010000008 1 | 12/29/2014 | 1 Year |
| 4 | Cable | H+S | CBL-26 | N/A | 12/29/2014 | 1 Year |
| 5 | Cable | H+S | CBL-26 | N/A | 12/29/2014 | 1 Year |
| 6 | Cable | H+S | CBL-26 | N/A | 12/29/2014 | 1 Year |

### 13.4 Measurement Results:

Refer to attached data chart.

| | | | |
|---|---|---|---|
| Spectrum Detector: | PK | Test Date : | August 03, 2015 |
| Test By: | Andy | Temperature : | 25 ℃ |
| Test Result: | PASS | Humidity : | 50 % |

1. Conducted Test

For Non-Hopping Mode:

| Frequency (MHz) | Modulation | Peak Power Output(dBm) | Emission read Value(dBm) | Result of Band edge(dBc) | Band edge Limit(dBc) |
|---|---|---|---|---|---|
| 2399.29 | GFSK | -1.31 | -36.48 | 35.17 | >20dBc |
| 2399.75 | pi/4-DQPSK | -2.97 | -25.66 | 22.69 | >20dBc |
| 2399.75 | 8DPSK | -1.89 | -26.27 | 24.38 | >20dBc |
| 2484.45 | GFSK | -2.31 | -42.83 | 40.52 | >20dBc |
| 2493.93 | pi/4-DQPSK | -3.51 | -33.64 | 30.13 | >20dBc |
| 2483.77 | 8DPSK | -2.85 | -32.76 | 29.91 | >20dBc |

For Hopping Mode:

| Frequency (MHz) | Modulation | Peak Power Output(dBm) | Emission read Value(dBm) | Result of Band edge(dBc) | Band edge Limit(dBc) |
|---|---|---|---|---|---|
| 2399.79 | GFSK | -1.54 | -38.37 | 36.83 | >20dBc |
| 2399.76 | pi/4-DQPSK | -2.76 | -27.74 | 24.98 | >20dBc |
| 2399.59 | 8DPSK | -2.7 | -26.24 | 23.54 | >20dBc |
| 2484.23 | GFSK | -2.47 | -43.51 | 41.04 | >20dBc |
| 2483.74 | pi/4-DQPSK | -4.08 | -40.93 | 36.85 | >20dBc |
| 2484.32 | 8DPSK | -7.7 | -33.74 | 26.04 | >20dBc |

2. Radiated emission Test

**Worst test modulation GFSK**

For Non-Hopping Mode:

| Frequency (MHz) | Antenna polarization (H/V) | Emission (dBuV/m) | | Band edge Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|
| | | PK | AV | PK | AV | PK | AV |
| 2398.459 | H | 66.34 | 44.38 | 74 | 54 | -7.66 | -9.62 |
| 2399.059 | V | 61.52 | 41.92 | 74 | 54 | -12.48 | -12.08 |
| 2483.956 | H | 66.03 | 45.13 | 74 | 54 | -7.97 | -8.87 |
| 2484.029 | V | 55.86 | 38.95 | 74 | 54 | -18.14 | -15.05 |

For Hopping Mode:

| Frequency (MHz) | Antenna polarization (H/V) | Emission (dBuV/m) | | Band edge Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|
| | | PK | AV | PK | AV | PK | AV |
| 2399.489 | H | 65.72 | 46.38 | 74 | 54 | -8.28 | -7.62 |
| 2398.014 | V | 61.33 | 41.23 | 74 | 54 | -12.67 | -12.77 |
| 2483.896 | H | 67.92 | 44.19 | 74 | 54 | -6.08 | -9.81 |
| 2484.169 | V | 59.15 | 40.52 | 74 | 54 | -14.85 | -13.48 |

# 14. Antenna Application

## 14.1 Antenna requirement

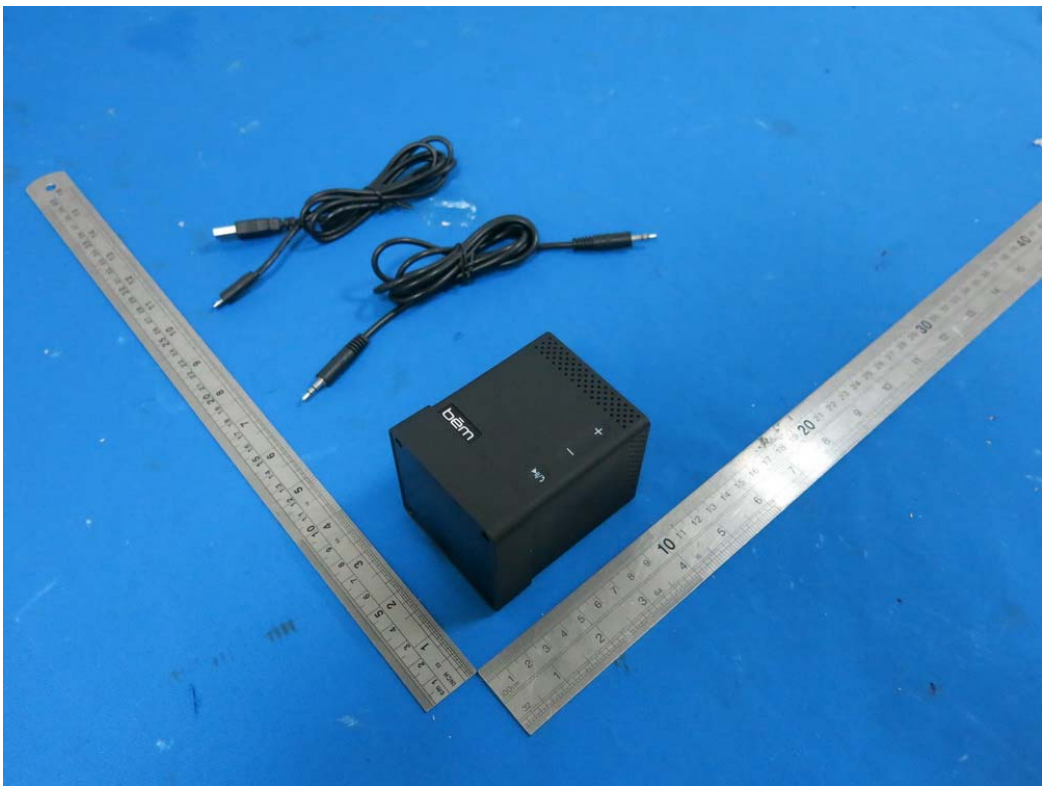
The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

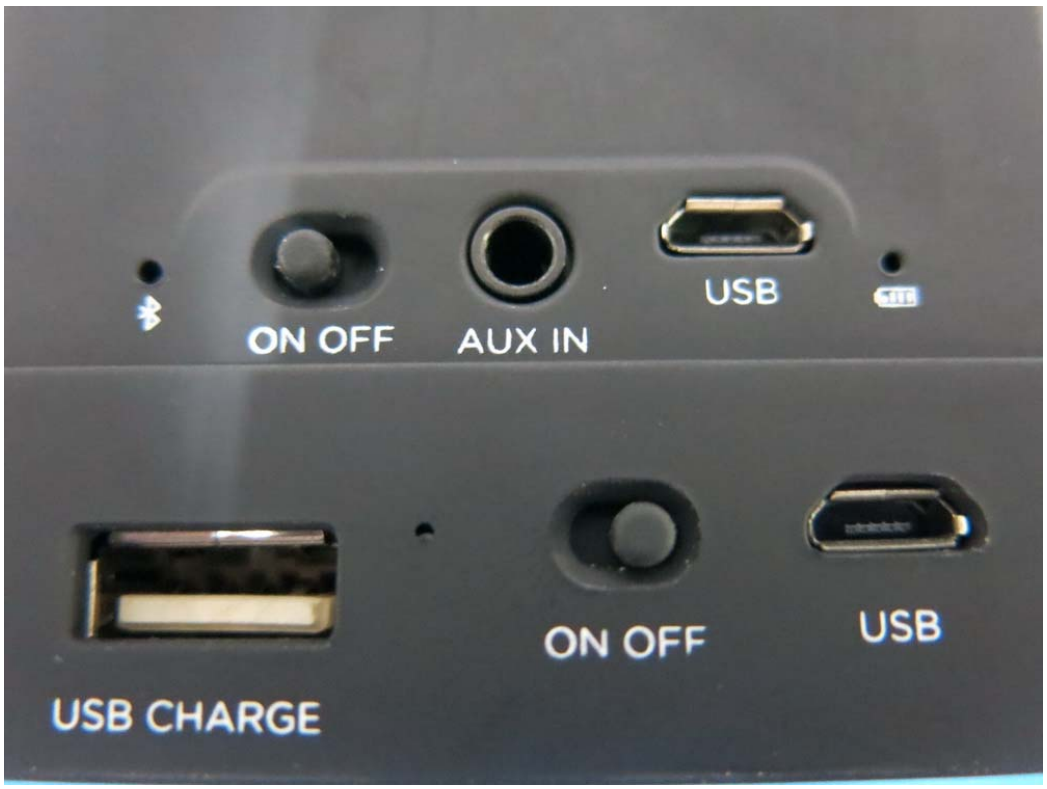
FCC part 15C section 15.247 requirements:
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

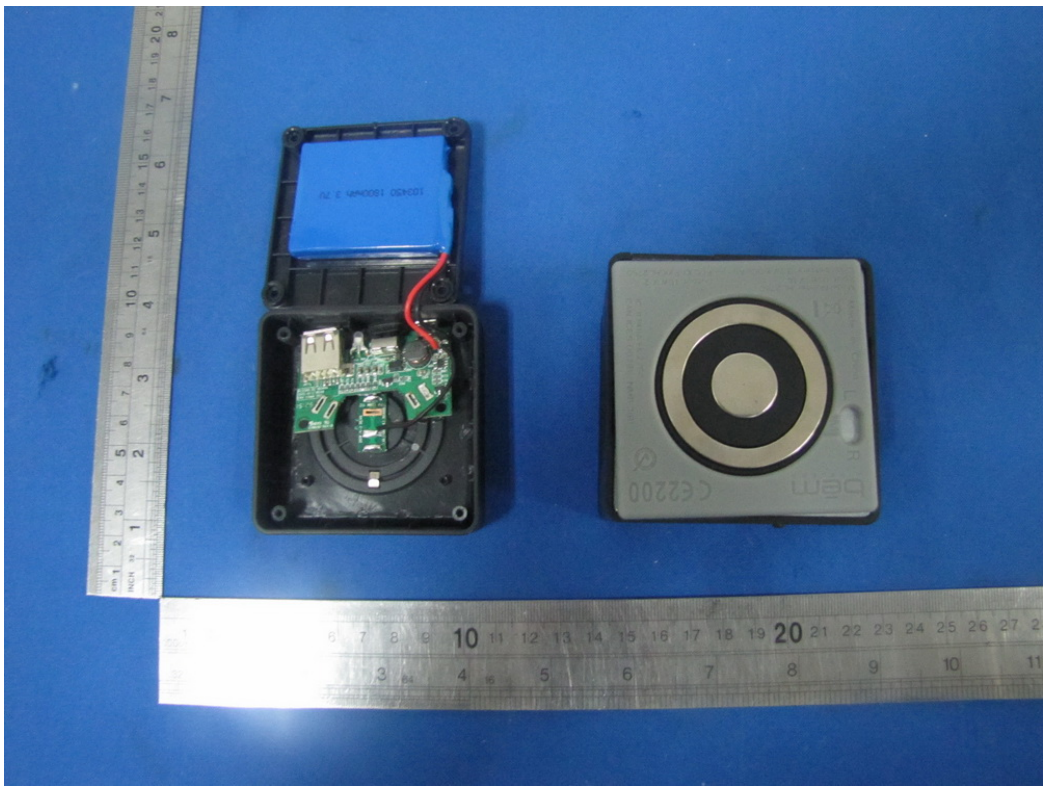
## 14.2 Result

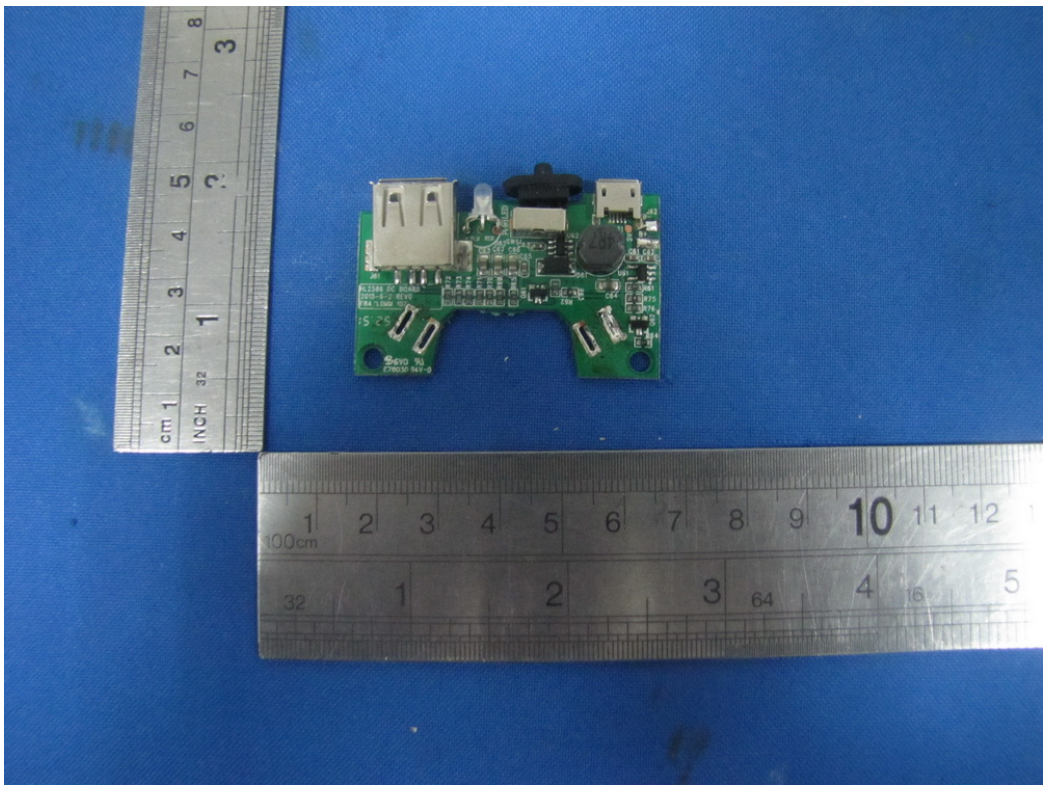
The EUT's antenna, permanent attached antenna, used a PCB antenna and integrated on PCB, The antenna's gain is 0 dBi and meets the requirement.

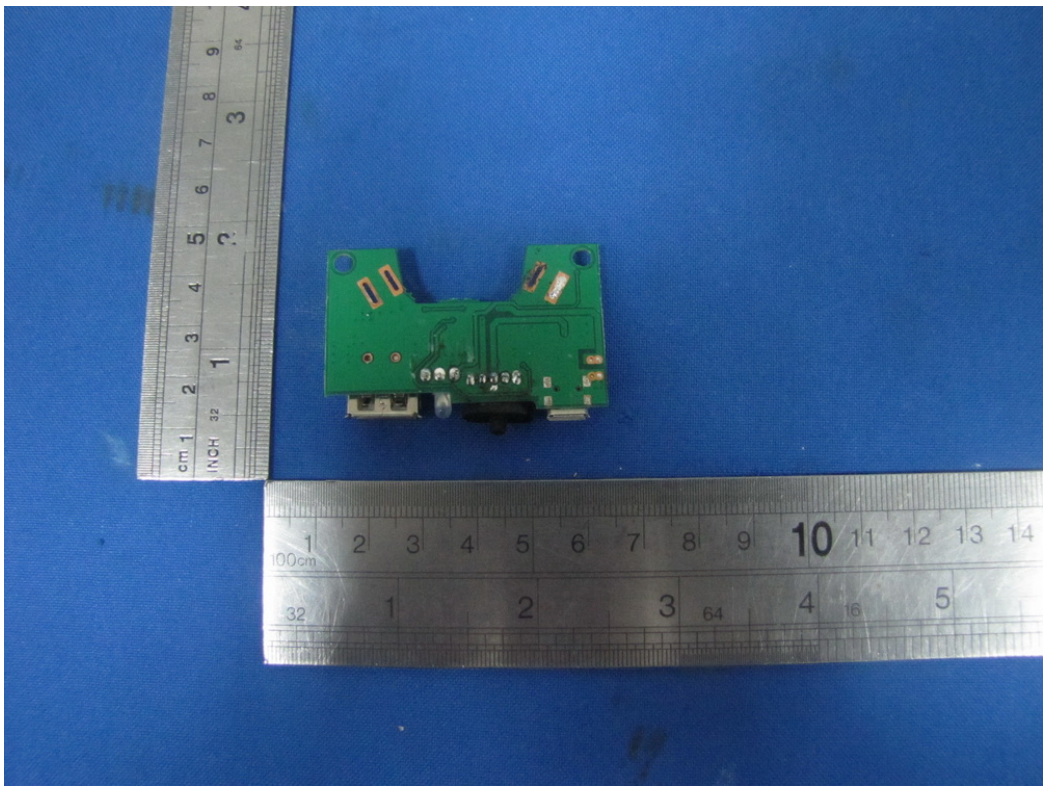
# APPENDIX I
# (Photos of EUT)

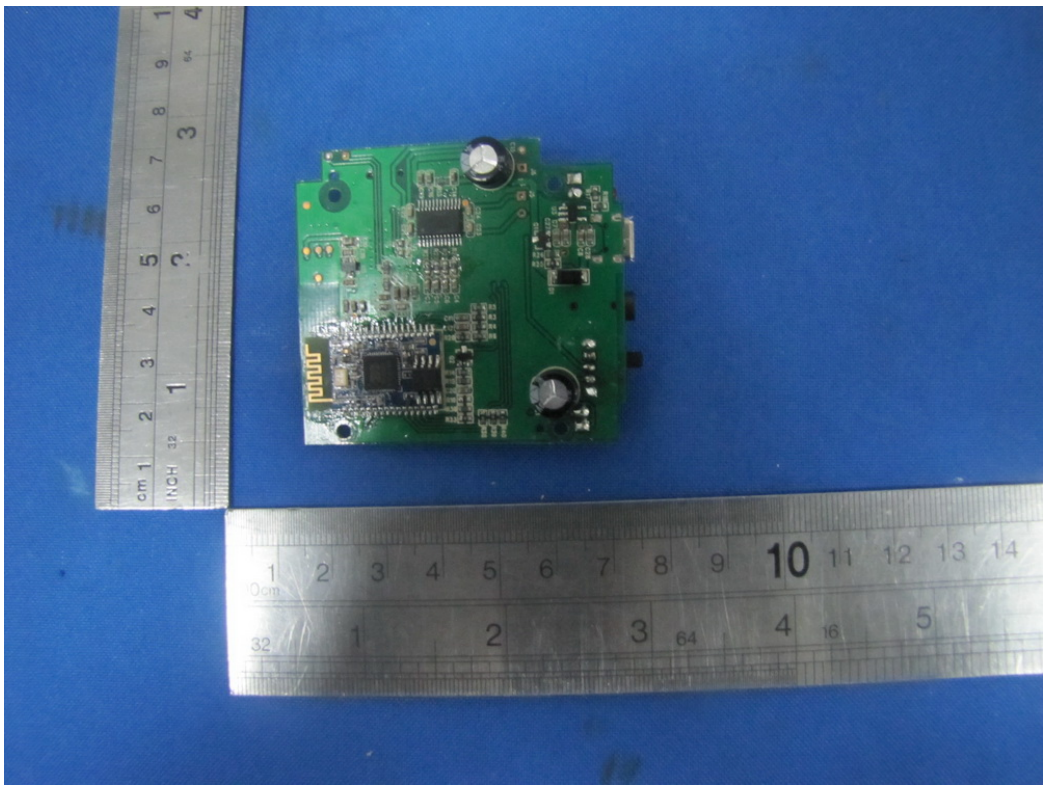


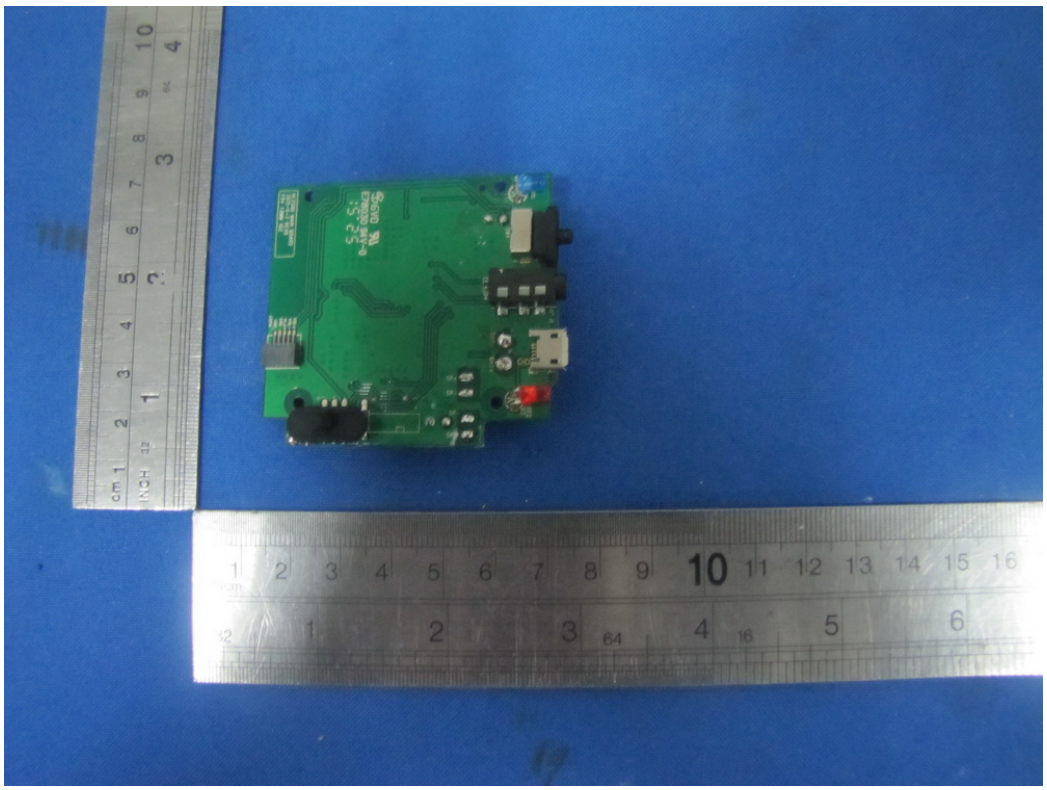

ON OFF
AUX IN
USB
ON OFF
USB
USB CHARGE

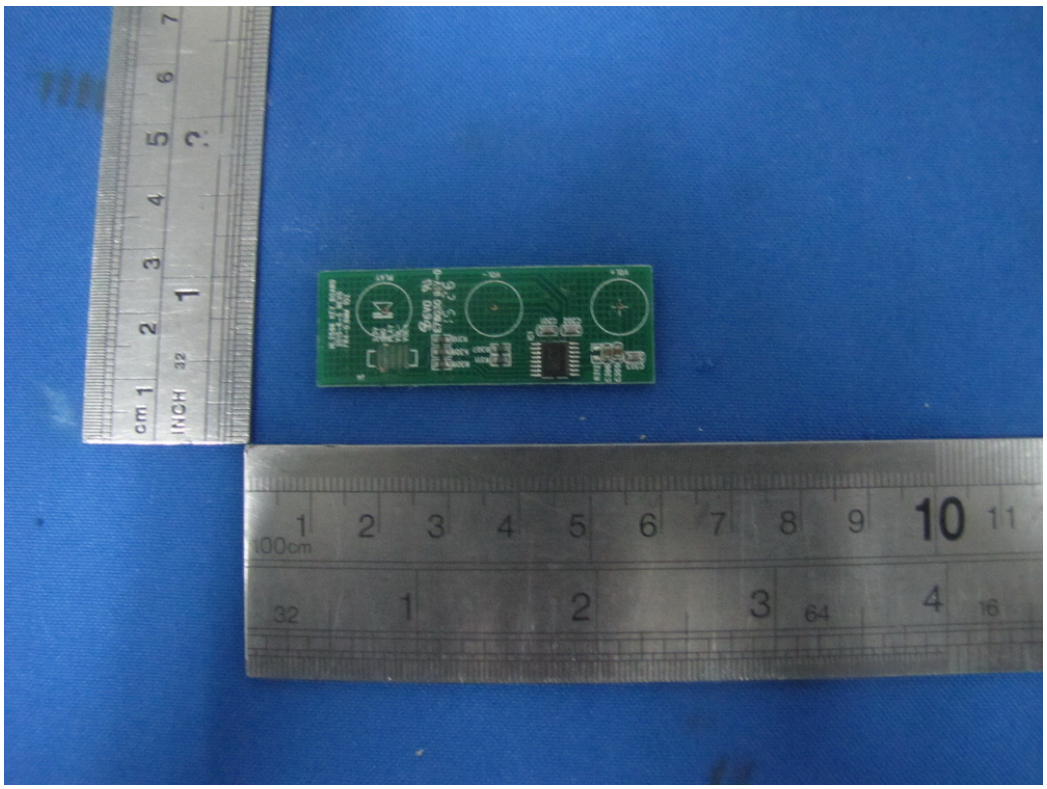


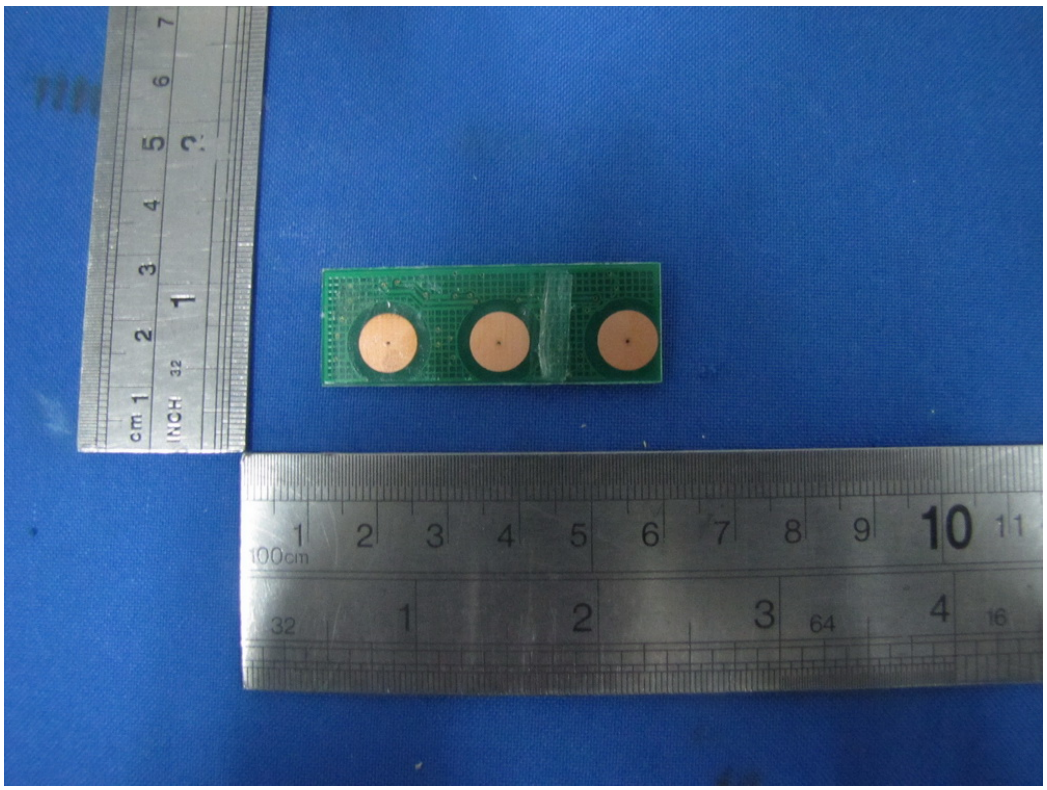


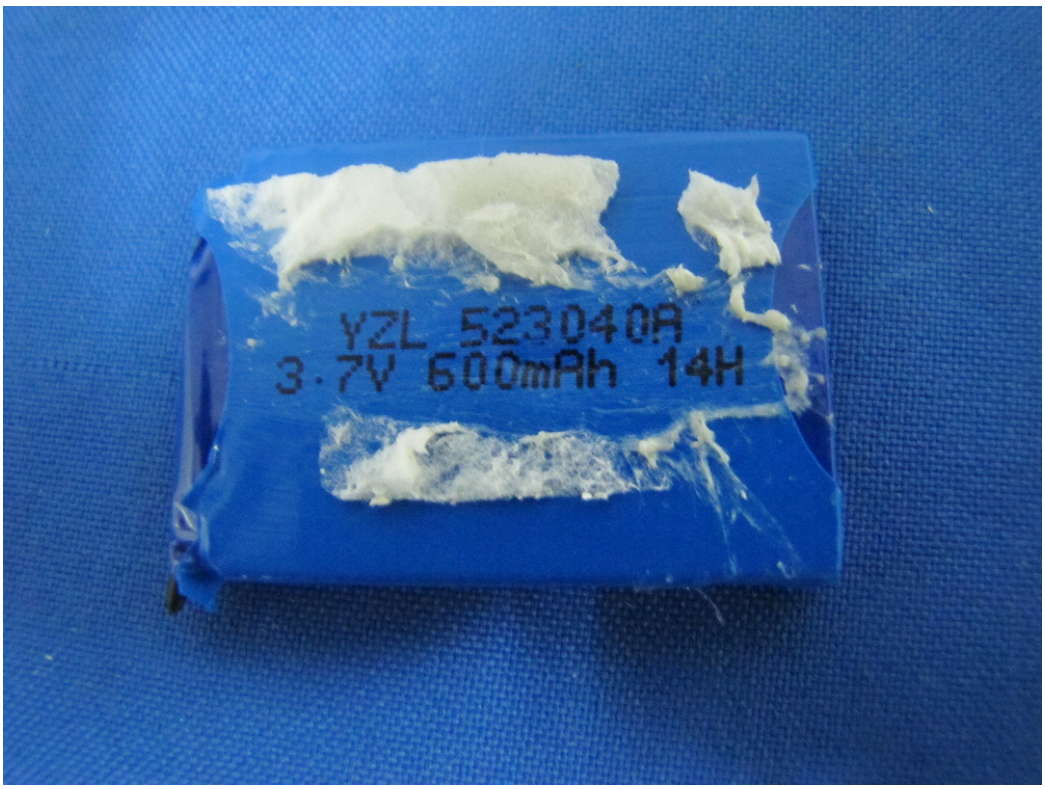











YZL 523040A
3.7V 600mAh 14H