



## Test Report

Date : 2017-04-06

No. : DM126878

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**Applicant** : KORG Inc.  
4015-2, Yanokuchi, Inagi-City, Tokyo, 206-0812, Japan

**Supplier / Manufacturer** : KORG Inc.  
4015-2, Yanokuchi, Inagi-City, Tokyo, 206-0812, Japan

**Description of Sample(s)** : Submitted sample(s) said to be  
Product: Bluetooth Speaker  
Brand Name: KORG  
Model No.: KONNECT  
FCC ID: KIJ-KONNECT

**Date Samples Received** : 2017-03-14

**Date Tested** : 2017-03-21 to 2017-04-02

**Investigation Requested** : Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2015 and ANSI C63.10:2013 for FCC Certification.

**Conclusions** : The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

**Remarks** : Bluetooth FHSS (GFSK/  $\pi/4$ -DQPSK/ 8DPSK)

  
LONG Yun Jian/Along  
Authorized Signatory  
ElectroMagnetic Compatibility Department  
For and on behalf of  
STC (Dongguan) Company Limited

### STC (Dongguan) Company Limited

68 Fumin Nan Road, Dalang, Dongguan, Guangdong, China. Zip Code: 523770

Tel : (86 769) 81119888 Fax : (86 769) 81116222 Email : dgstc@dgstc.org Website : www.dgstc.org

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### **1.0 General Details**

#### **1.1 Test Laboratory**

STC (Dongguan) Company Limited  
EMC Laboratory  
68 Fumin Nan Road, Dalang, Dongguan, Guangdong, China  
Telephone: (86 769) 81119888  
Fax: (86 769) 81116222

#### **1.2 Equipment Under Test [EUT]**

##### **Description of Sample(s)**

Product: Bluetooth Speaker  
Manufacturer: KORG Inc.  
4015-2, Yanokuchi, Inagi-City, Tokyo, 206-0812, Japan  
Brand Name: KORG  
Model Number: KONNECT  
Rating: Input: 100-240V a.c. 50/60Hz 1.5A;  
Output: 20.0V d.c. 3.25A.

The AC/DC adaptor was provided by the applicant with following details:

Brand name: DYS; Model no.: DYS602-200325W

#### **1.2.1 Description of EUT Operation**

The Equipment Under Test (EUT) is a Bluetooth Speaker. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC; the type of modulation used was frequency hopping spread spectrum Modulation.

#### **1.3 Date of Order**

2017-03-14

#### **1.4 Submitted Sample(s):**

1 Sample

#### **1.5 Test Duration**

2017-03-21 to 2017-04-02

#### **1.6 Country of Origin**

Japan

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### 1.7 RF Module Details

Module Model Number: N/A  
Module FCC ID: N/A  
Module Transmission Type: Bluetooth V4.0  
Modulation: FHSS (GFSK /  $\pi/4$ -DQPSK / 8DPSK)  
Data Rates:  
1Mbps: GFSK  
2 Mbps:  $\pi/4$ -DQPSK  
3 Mbps: 8DPSK  
Frequency Range: 2400-2483.5MHz  
Carrier Frequencies: 2402MHz – 2480MHz

Module Specification (specification provided by manufacturer)

### 1.8 Antenna Details

Antenna Type: PCB antenna  
Antenna Gain: -0.66dBi

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### 2.0 Technical Details

#### **2.1 Investigations Requested**

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2015 Regulations and ANSI C63.10:2013 for FCC Certification.

According FCC KDB 558074 DTS Measurement Guidance, Duty cycle  $\geq 98\%$ .

The device was realized by test software.

#### **2.2 Test Standards and Results Summary Tables**

| <b>EMISSION<br/>Results Summary</b> |                             |                   |                  |                                     |                          |                          |
|-------------------------------------|-----------------------------|-------------------|------------------|-------------------------------------|--------------------------|--------------------------|
| Test Condition                      | Test Requirement            | Test Method       | Class / Severity | Test Result                         |                          |                          |
|                                     |                             |                   |                  | Pass                                | Failed                   | N/A                      |
| Maximum Peak Conducted Output Power | FCC 47CFR 15.247(b)(1)      | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Radiated Spurious Emissions         | FCC 47CFR 15.209            | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| AC Mains Conducted Emissions        | FCC 47CFR 15.207            | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Number of Hopping Frequency         | FCC 47CFR 15.247 (b)(1)     | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20dB Bandwidth                      | FCC 47CFR 15.247(a)(2)      | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Hopping Channel Separation          | FCC 47CFR 15.247(a)(1)      | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Band-edge measurement (Radiated)    | FCC 47CFR 15.247(d)         | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Pseudorandom Hopping Algorithm      | FCC 47CFR 15.247(a)(1)      | N/A               | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Time of Occupancy (Dwell Time)      | FCC 47CFR 15.247(a)(1)(iii) | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Antenna requirement                 | FCC 47CFR 15.203            | N/A               | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RF Exposure                         | FCC 47CFR 15.247(i)         | N/A               | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Note: N/A - Not Applicable

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### 2.3 Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate in the table below is the worst case rate with respect to the specific test item.

Investigation has been done on all the possible configurations for searching the worst cases.

The device was realized by test software.

The following table is a list of the test modes shown in this test report.

| Test Items                                 | Mode                          | Data Rate             |
|--------------------------------------------|-------------------------------|-----------------------|
| Maximum Peak Conducted Output Power        | GFSK / $\pi/4$ -DQPSK/ 8DPSK  | 1MBps / 2MBps/ 3MBps  |
| Hopping Channel Separation                 | GFSK / $\pi/4$ -DQPSK/ 8DPSK  | 1MBps / 2MBps / 3MBps |
| Number of Hopping Frequency                | GFSK / $\pi/4$ -DQPSK/ 8DPSK  | 1MBps / 2MBps/ 3MBps  |
| Time of Occupancy(Dwell Time)              | 8DPSK (DH1 / DH3 / DH5)       | 3MBps                 |
| Radiated Spurious Emissions                | GFSK / $\pi/4$ -DQPSK/ 8DPSK  | 1MBps / 2MBps /3MBps  |
| Band-edge compliance of Conducted Emission | GFSK / $\pi/4$ -DQPSK / 8DPSK | 1MBps / 2MBps /3MBps  |

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### 3.0 Test Results

#### **3.1 Emission**

##### **3.1.1 Maximum Peak Conducted Output Power**

|                    |                         |
|--------------------|-------------------------|
| Test Requirement:  | FCC 47CFR 15.247(b) (1) |
| Test Method:       | ANSI C63.10: 2013       |
| Test Date:         | 2017-03-23              |
| Mode of Operation: | Tx mode                 |

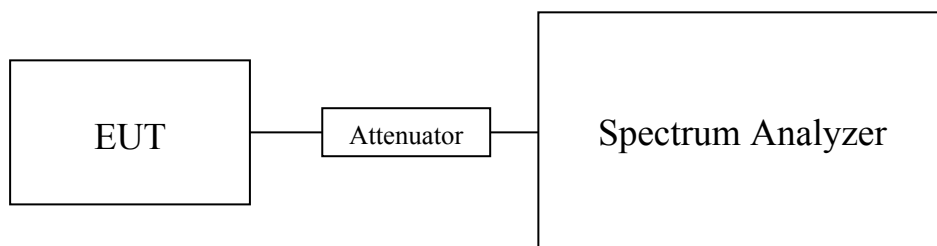
#### **Test Method:**

A temporary antenna connector was soldered to the RF output. The RF output of the EUT was connected to the spectrum analyzer. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

#### **Spectrum Analyzer Setting:**

RBW = 3 MHz, VBW = 3MHz, Sweep = Auto, Span: Approximately five times the 20 dB bandwidth  
Detector = Peak, Trace = Max. hold

#### **Test Setup:**



Note: a temporary antenna connector was soldered to the RF output.

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### Limits for Maximum Peak Conducted Output Power [FCC 47CFR 15.247]:

The maximum peak output power shall not exceeded the following limits:  
For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt  
Results of Bluetooth Communication mode (GFSK) (Fundamental Power): Pass

Results of Bluetooth Communication mode (GFSK) (Fundamental Power): Pass

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2402                        | 0.000891                              |

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2441                        | 0.001358                              |

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2480                        | 0.001910                              |

The maximum peak output power shall not exceeded the following limits:  
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts  
Results of Bluetooth Communication mode ( $\pi/4$ -DQPSK) (Fundamental Power): Pass

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2402                        | 0.000822                              |

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2441                        | 0.001086                              |

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2480                        | 0.001581                              |

Results of Bluetooth Communication mode (8DPSK) (Fundamental Power): Pass

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2402                        | 0.000828                              |

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2441                        | 0.001096                              |

| Transmitter Frequency (MHz) | Maximum conducted output power (Watt) |
|-----------------------------|---------------------------------------|
| 2480                        | 0.001510                              |

Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB  
1GHz to 18GHz 1.7dB

Remark:

1. All test data for each data rate were verified, but only the worst case was reported.
2. The EUT is programmed to transmit signals continuously for all testing.

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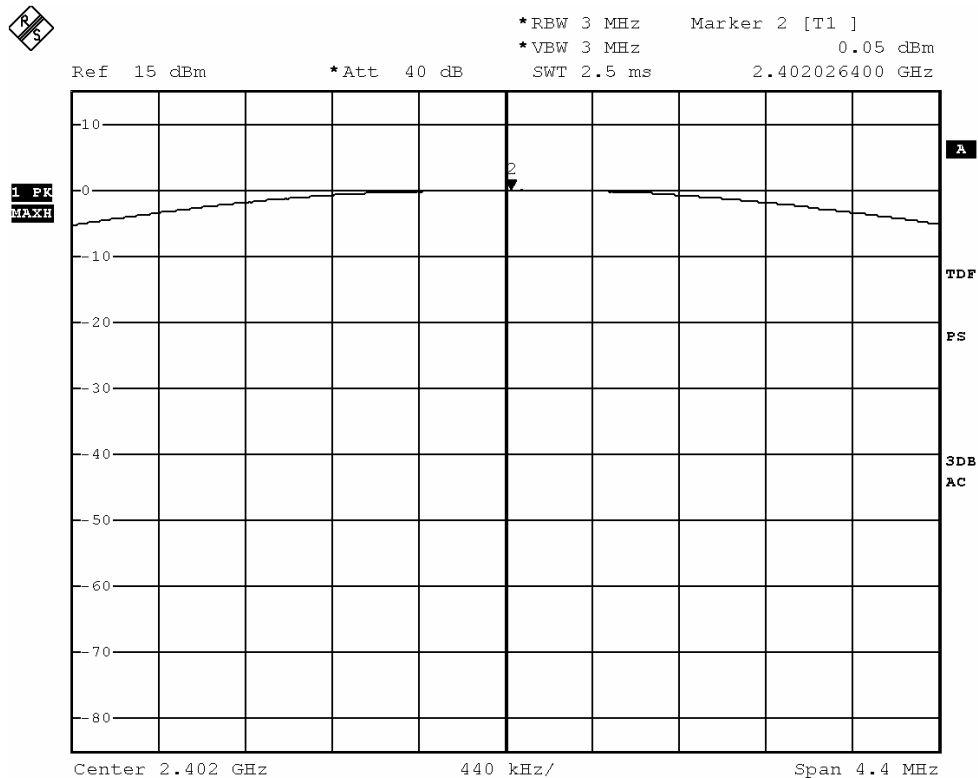
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Test plot of Maximum Peak Conducted Output Power :

Bluetooth Communication mode (GFSK, 2402MHz)



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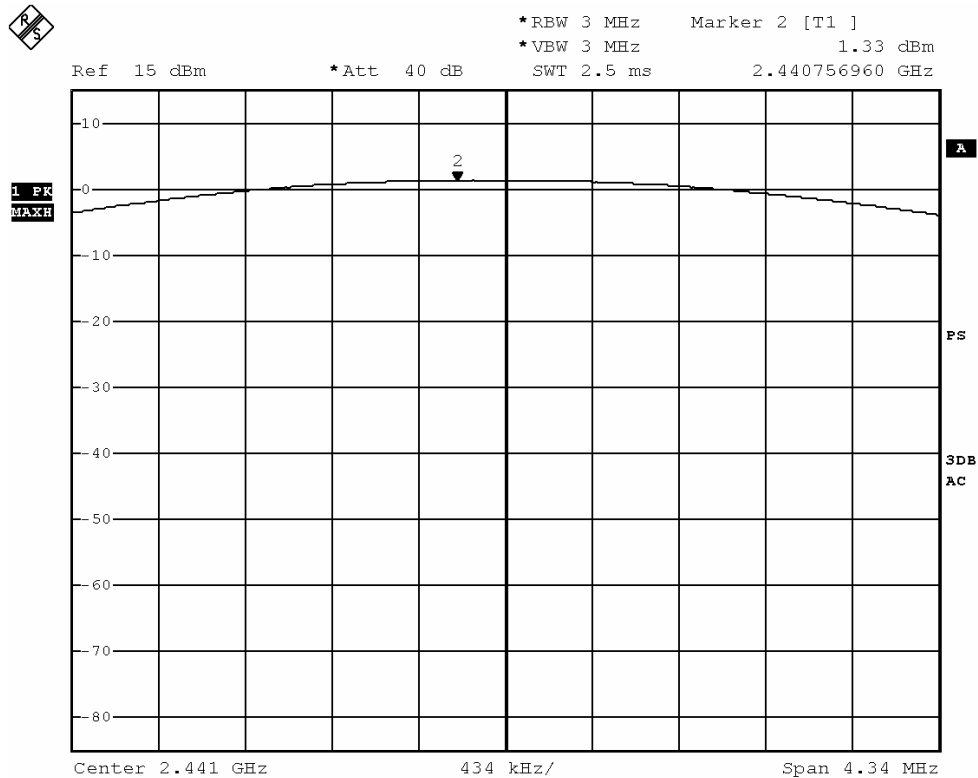
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### Bluetooth Communication mode (GFSK, 2441MHz)



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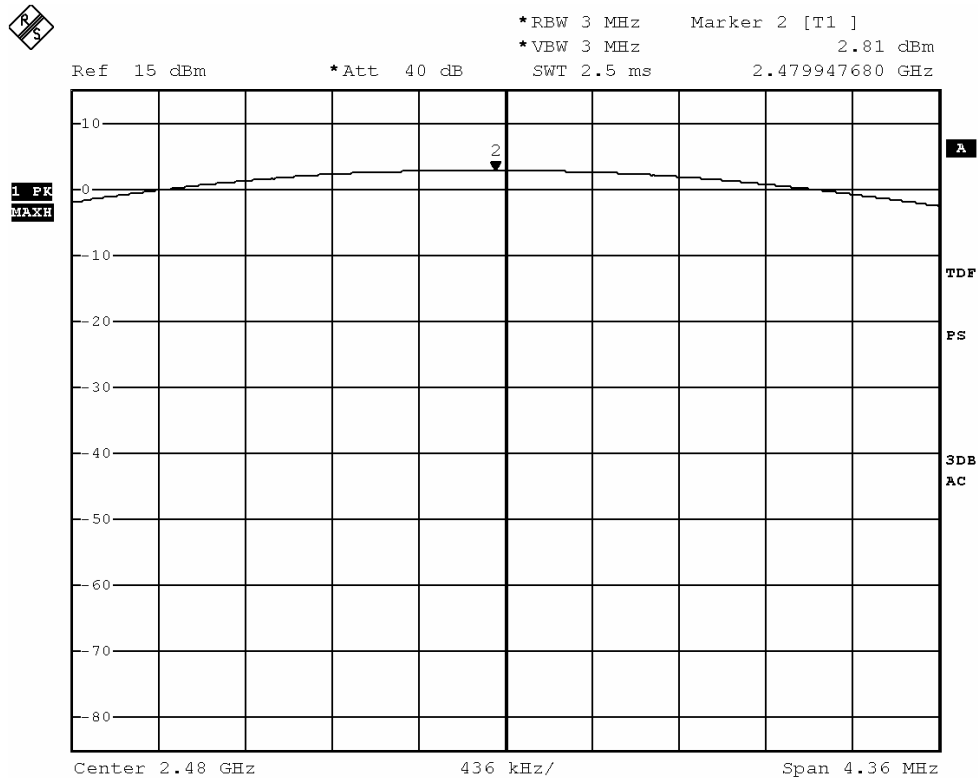
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### Bluetooth Communication mode (GFSK, 2480MHz)



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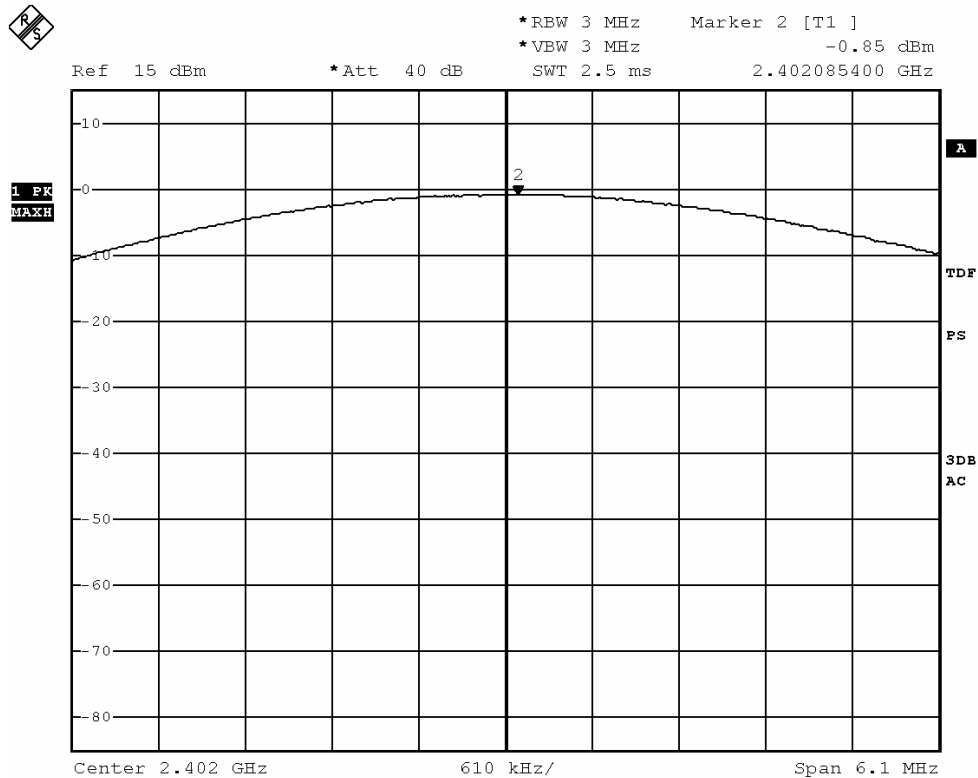
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Bluetooth Communication mode ( $\pi/4$  DQPSK, 2402MHz)



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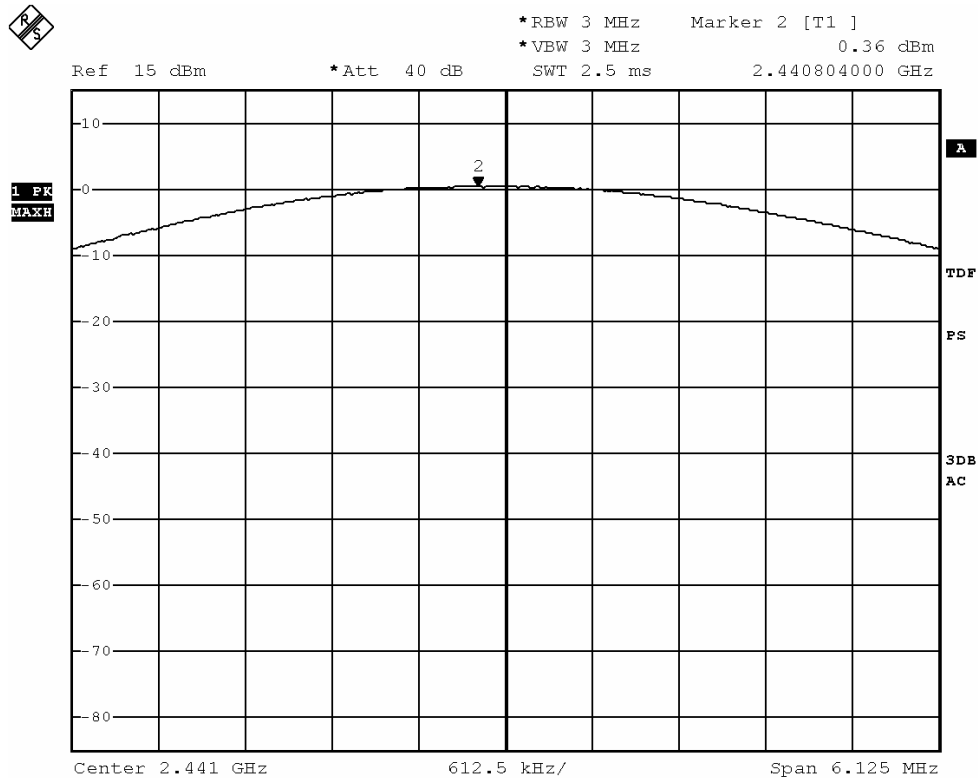
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### Bluetooth Communication mode ( $\pi/4$ DQPSK, 2441MHz)



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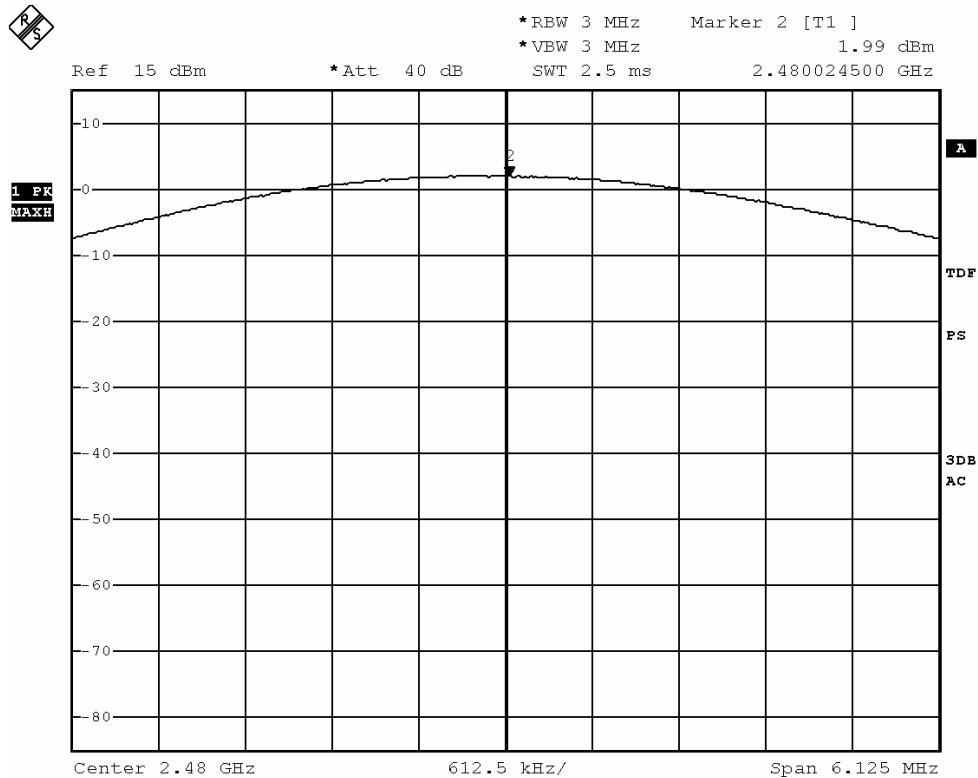
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### Bluetooth Communication mode ( $\pi/4$ DQPSK, 2480MHz)



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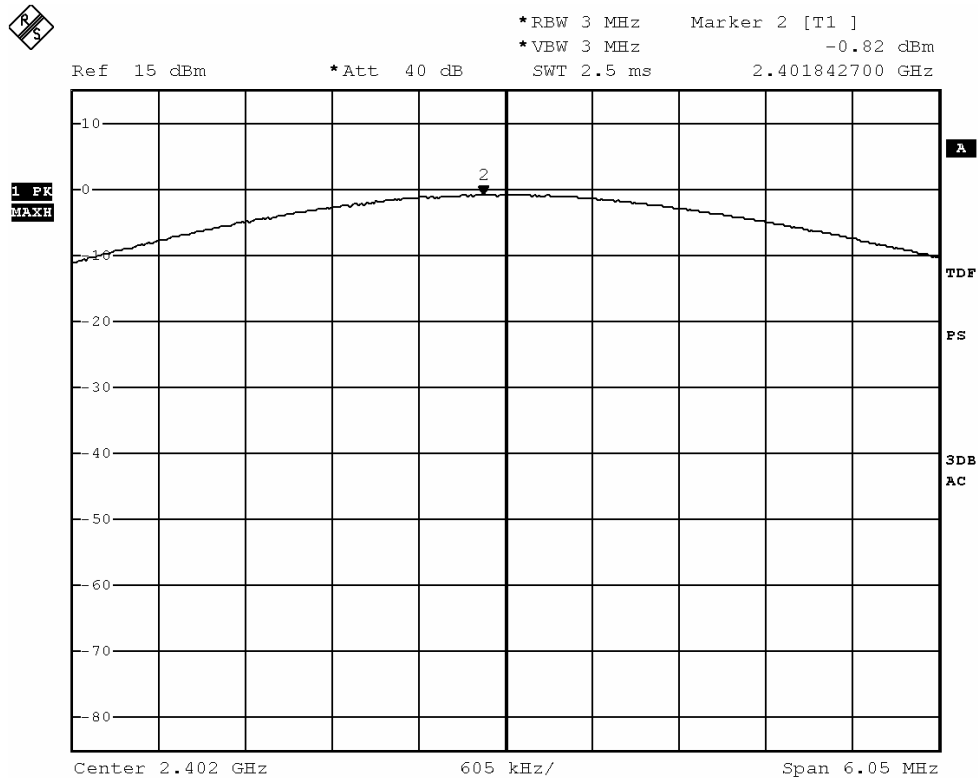
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### Bluetooth Communication mode (8DPSK, 2402MHz)



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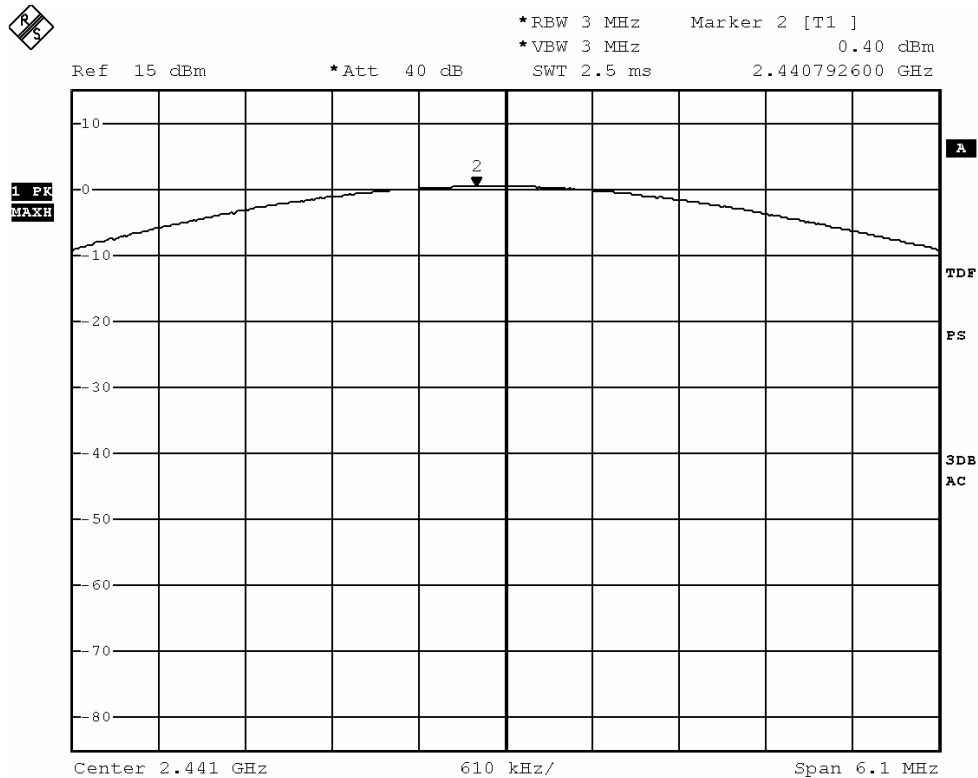
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### Bluetooth Communication mode (8DPSK, 2441MHz)



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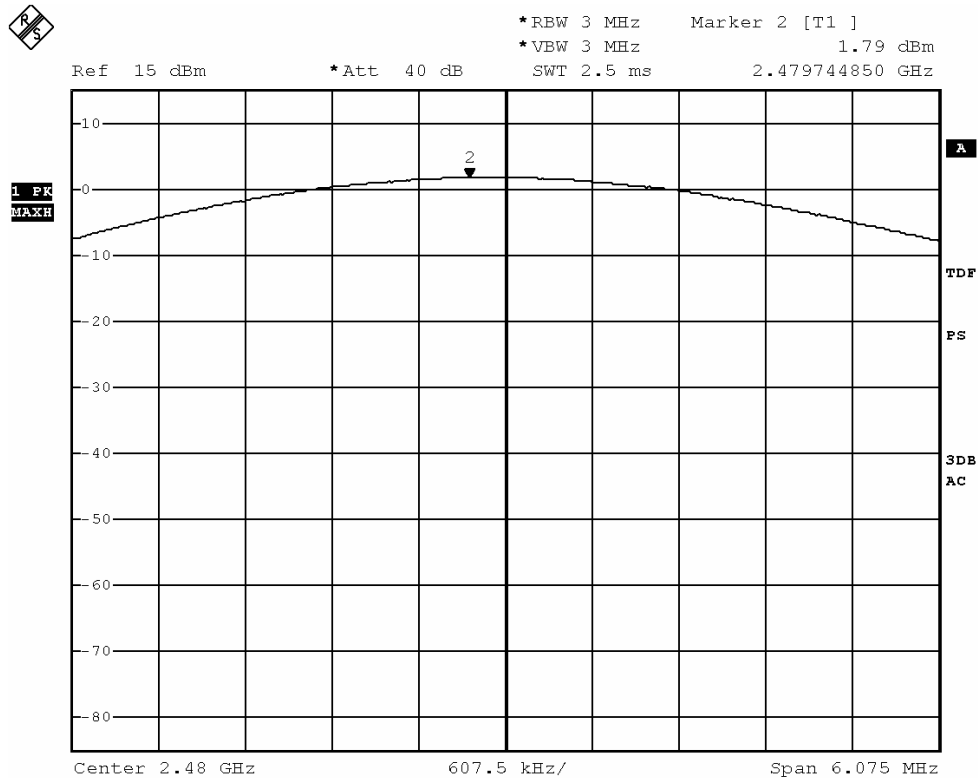
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### Bluetooth Communication mode (8DPSK, 2480MHz)



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### 3.1.2 Radiated Spurious Emissions

|                    |                                               |
|--------------------|-----------------------------------------------|
| Test Requirement:  | FCC 47CFR 15.209                              |
| Test Method:       | ANSI C63.10:2013                              |
| Test Date:         | 2017-04-02                                    |
| Mode of Operation: | Tx mode / Bluetooth Communication mode (GFSK) |

#### Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber\*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber\*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

- \* Semi-anechoic chamber located on the STC (Dongguan) Company Ltd. 68 Fumin Nan Road, Dalang, Dongguan, Guangdong, PRC with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 629686.

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### Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)

RBW: 10kHz  
VBW: 30kHz  
Sweep: Auto  
Span: Fully capture the emissions being measured  
Trace: Max. hold

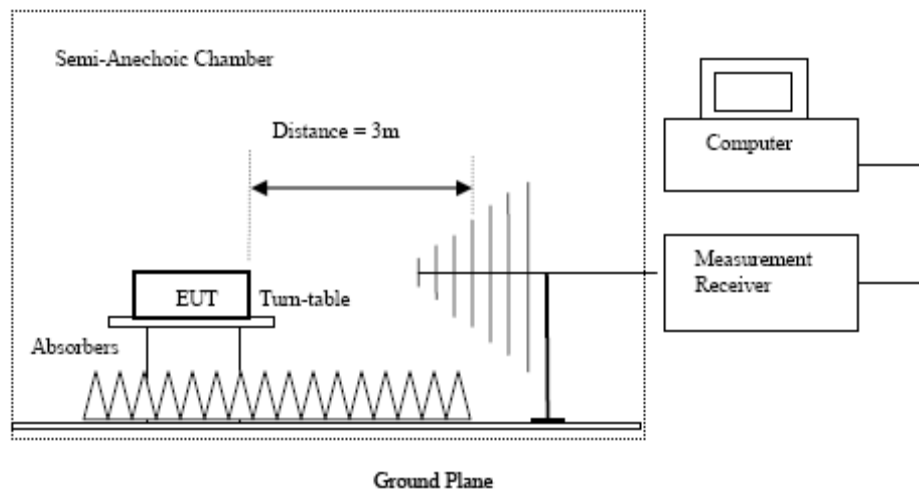
30MHz – 1GHz (QP)

RBW: 120kHz  
VBW: 120kHz  
Sweep: Auto  
Span: Fully capture the emissions being measured  
Trace: Max. hold

Above 1GHz (Pk & Av)

RBW: 1MHz  
VBW: 1MHz  
Sweep: Auto  
Span: Fully capture the emissions being measured  
Trace: Max. hold

### Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.

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### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B1:

| Frequency Range | Quasi-Peak Limits |
|-----------------|-------------------|
| [MHz]           | [ $\mu$ V/m]      |
| 0.009-0.490     | 2400/F (kHz)      |
| 0.490-1.705     | 24000/F (kHz)     |
| 1.705-30        | 30                |
| 30-88           | 100               |
| 88-216          | 150               |
| 216-960         | 200               |
| Above 960       | 500               |

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Result of Tx mode (2402.0 MHz) (GFSK) (9kHz – 30MHz): Pass

| Field Strength of Spurious Emissions<br>Peak Value          |                |                   |                |                |           |                  |
|-------------------------------------------------------------|----------------|-------------------|----------------|----------------|-----------|------------------|
| Frequency                                                   | Measured Level | Correction Factor | Field Strength | Field Strength | Limit     | E-Field Polarity |
| MHz                                                         | dB $\mu$ V     | dB/m              | dB $\mu$ V/m   | $\mu$ V/m      | $\mu$ V/m |                  |
| Emissions detected are more than 20 dB below the FCC Limits |                |                   |                |                |           |                  |

### Result of Tx mode (2402.0 MHz) (GFSK) (Above 1GHz): Pass

| Field Strength of Spurious Emissions<br>Peak Value |                    |                   |                |              |              |                  |
|----------------------------------------------------|--------------------|-------------------|----------------|--------------|--------------|------------------|
| Frequency                                          | Measured Level @3m | Correction Factor | Field Strength | Limit @3m    | Margin       | E-Field Polarity |
| MHz                                                | dB $\mu$ V         | dB/m              | dB $\mu$ V/m   | dB $\mu$ V/m | dB $\mu$ V/m |                  |
| 4804.0                                             | 14.6               | 41.5              | 56.1           | 74.0         | 17.9         | Vertical         |
| 4804.0                                             | 13.4               | 42.4              | 55.8           | 74.0         | 18.2         | Horizontal       |
| 7206.0                                             | 10.2               | 45.1              | 55.3           | 74.0         | 18.7         | Vertical         |
| 7206.0                                             | 9.4                | 46.2              | 55.6           | 74.0         | 18.4         | Horizontal       |
| 9608.0                                             | 7.7                | 48.0              | 55.7           | 74.0         | 18.3         | Vertical         |
| 9608.0                                             | 6.6                | 48.8              | 55.4           | 74.0         | 18.6         | Horizontal       |
| 12010.0                                            | 4.1                | 51.5              | 55.6           | 74.0         | 18.4         | Vertical         |
| 12010.0                                            | 3.6                | 52.4              | 56.0           | 74.0         | 18.0         | Horizontal       |

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| Field Strength of Spurious Emissions |           |            |          |        |        |            |
|--------------------------------------|-----------|------------|----------|--------|--------|------------|
| Average Value                        |           |            |          |        |        |            |
| Frequency                            | Measured  | Correction | Field    | Limit  | Margin | E-Field    |
|                                      | Level @3m | Factor     | Strength | @3m    |        | Polarity   |
| MHz                                  | dBuV      | dB/m       | dBuV/m   | dBuV/m | dBuV/m |            |
| 4804.0                               | 0.2       | 41.5       | 41.7     | 54.0   | 12.3   | Vertical   |
| 4804.0                               | -1.7      | 42.4       | 40.7     | 54.0   | 13.3   | Horizontal |
| 7206.0                               | -4.6      | 45.1       | 40.5     | 54.0   | 13.5   | Vertical   |
| 7206.0                               | -5.9      | 46.2       | 40.3     | 54.0   | 13.7   | Horizontal |
| 9608.0                               | -7.6      | 48.0       | 40.4     | 54.0   | 13.6   | Vertical   |
| 9608.0                               | -7.5      | 48.8       | 41.3     | 54.0   | 12.7   | Horizontal |
| 12010.0                              | -11.3     | 51.5       | 40.2     | 54.0   | 13.8   | Vertical   |
| 12010.0                              | -10.1     | 52.4       | 42.3     | 54.0   | 11.7   | Horizontal |

**Result of Tx mode (2441.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions                        |          |            |          |          |       |          |
|-------------------------------------------------------------|----------|------------|----------|----------|-------|----------|
| Peak Value                                                  |          |            |          |          |       |          |
| Frequency                                                   | Measured | Correction | Field    | Field    | Limit | E-Field  |
| MHz                                                         | Level    | Factor     | Strength | Strength |       | Polarity |
|                                                             | dBuV     | dB/m       | dBuV/m   | uV/m     | uV/m  |          |
| Emissions detected are more than 20 dB below the FCC Limits |          |            |          |          |       |          |

**Result of Tx mode (2441.0 MHz) (GFSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions |           |            |          |        |        |            |
|--------------------------------------|-----------|------------|----------|--------|--------|------------|
| Peak Value                           |           |            |          |        |        |            |
| Frequency                            | Measured  | Correction | Field    | Limit  | Margin | E-Field    |
| MHz                                  | Level @3m | Factor     | Strength | @3m    |        | Polarity   |
|                                      | dBuV      | dB/m       | dBuV/m   | dBuV/m | dBuV/m |            |
| 4882.0                               | 14.3      | 41.6       | 55.9     | 74.0   | 18.1   | Vertical   |
| 4882.0                               | 13.9      | 42.5       | 56.4     | 74.0   | 17.6   | Horizontal |
| 7323.0                               | 10.1      | 45.2       | 55.3     | 74.0   | 18.7   | Vertical   |
| 7323.0                               | 9.2       | 46.3       | 55.5     | 74.0   | 18.5   | Horizontal |
| 9764.0                               | 7.5       | 48.1       | 55.6     | 74.0   | 18.4   | Vertical   |
| 9764.0                               | 5.5       | 48.9       | 54.4     | 74.0   | 19.6   | Horizontal |
| 12205.0                              | 4.7       | 51.6       | 56.3     | 74.0   | 17.7   | Vertical   |
| 12205.0                              | 3.4       | 52.5       | 55.9     | 74.0   | 18.1   | Horizontal |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4882.0                                                | -0.3                          | 41.6                         | 41.3                        | 54.0                   | 12.7             | Vertical            |
| 4882.0                                                | -0.8                          | 42.5                         | 41.7                        | 54.0                   | 12.3             | Horizontal          |
| 7323.0                                                | -4.7                          | 45.2                         | 40.5                        | 54.0                   | 13.5             | Vertical            |
| 7323.0                                                | -6.0                          | 46.3                         | 40.3                        | 54.0                   | 13.7             | Horizontal          |
| 9764.0                                                | -7.8                          | 48.1                         | 40.3                        | 54.0                   | 13.7             | Vertical            |
| 9764.0                                                | -8.1                          | 48.9                         | 40.8                        | 54.0                   | 13.2             | Horizontal          |
| 12205.0                                               | -9.8                          | 51.6                         | 41.8                        | 54.0                   | 12.2             | Vertical            |
| 12205.0                                               | -10.6                         | 52.5                         | 41.9                        | 54.0                   | 12.1             | Horizontal          |

**Result of Tx mode (2480.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2480.0 MHz) (GFSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |                  |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4960.0                                             | 15.3                          | 41.4                         | 56.7                        | 74.0                   | 17.3             | Vertical            |
| 4960.0                                             | 13.1                          | 42.7                         | 55.8                        | 74.0                   | 18.2             | Horizontal          |
| 7440.0                                             | 10.1                          | 45.6                         | 55.7                        | 74.0                   | 18.3             | Vertical            |
| 7440.0                                             | 8.8                           | 46.5                         | 55.3                        | 74.0                   | 18.7             | Horizontal          |
| 9920.0                                             | 6.8                           | 48.6                         | 55.4                        | 74.0                   | 18.6             | Vertical            |
| 9920.0                                             | 5.6                           | 49.7                         | 55.3                        | 74.0                   | 18.7             | Horizontal          |
| 12400.0                                            | 4.4                           | 51.7                         | 56.1                        | 74.0                   | 17.9             | Vertical            |
| 12400.0                                            | 3                             | 52.7                         | 55.7                        | 74.0                   | 18.3             | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4960.0                                                | 0.5                           | 41.4                         | 41.9                        | 54.0                   | 12.1             | Vertical            |
| 4960.0                                                | -1.5                          | 42.7                         | 41.2                        | 54.0                   | 12.8             | Horizontal          |
| 7440.0                                                | -5.0                          | 45.6                         | 40.6                        | 54.0                   | 13.4             | Vertical            |
| 7440.0                                                | -5.3                          | 46.5                         | 41.2                        | 54.0                   | 12.8             | Horizontal          |
| 9920.0                                                | -9.1                          | 48.6                         | 39.5                        | 54.0                   | 14.5             | Vertical            |
| 9920.0                                                | -8.9                          | 49.7                         | 40.8                        | 54.0                   | 13.2             | Horizontal          |
| 12400.0                                               | -10.2                         | 51.7                         | 41.5                        | 54.0                   | 12.5             | Vertical            |
| 12400.0                                               | -11.6                         | 52.7                         | 41.1                        | 54.0                   | 12.9             | Horizontal          |

**Result of Tx mode (2402.0 MHz) ( $\pi/4$ -DQPSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2402.0 MHz) ( $\pi/4$ -DQPSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                                     |                              |                                   |                              |                        |                     |
|----------------------------------------------------|-------------------------------------|------------------------------|-----------------------------------|------------------------------|------------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dB $\mu$ V | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB $\mu$ V/m | E-Field<br>Polarity |
| 4804.0                                             | 14.8                                | 41.5                         | 56.3                              | 74.0                         | 17.7                   | Vertical            |
| 4804.0                                             | 13.5                                | 42.4                         | 55.9                              | 74.0                         | 18.1                   | Horizontal          |
| 7206.0                                             | 9.7                                 | 45.1                         | 54.8                              | 74.0                         | 19.2                   | Vertical            |
| 7206.0                                             | 8.5                                 | 46.2                         | 54.7                              | 74.0                         | 19.3                   | Horizontal          |
| 9608.0                                             | 7.6                                 | 48.0                         | 55.6                              | 74.0                         | 18.4                   | Vertical            |
| 9608.0                                             | 5.8                                 | 48.8                         | 54.6                              | 74.0                         | 19.4                   | Horizontal          |
| 12010.0                                            | 4.2                                 | 51.5                         | 55.7                              | 74.0                         | 18.3                   | Vertical            |
| 12010.0                                            | 3.5                                 | 52.4                         | 55.9                              | 74.0                         | 18.1                   | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4804.0                                                | -0.3                          | 41.5                         | 41.2                        | 54.0                   | 12.8             | Vertical            |
| 4804.0                                                | -1.8                          | 42.4                         | 40.6                        | 54.0                   | 13.4             | Horizontal          |
| 7206.0                                                | -4.8                          | 45.1                         | 40.3                        | 54.0                   | 13.7             | Vertical            |
| 7206.0                                                | -5.3                          | 46.2                         | 40.9                        | 54.0                   | 13.1             | Horizontal          |
| 9608.0                                                | -7.5                          | 48.0                         | 40.5                        | 54.0                   | 13.5             | Vertical            |
| 9608.0                                                | -7.5                          | 48.8                         | 41.3                        | 54.0                   | 12.7             | Horizontal          |
| 12010.0                                               | -10.1                         | 51.5                         | 41.4                        | 54.0                   | 12.6             | Vertical            |
| 12010.0                                               | -10.8                         | 52.4                         | 41.6                        | 54.0                   | 12.4             | Horizontal          |

**Result of Tx mode (2441.0 MHz) ( $\pi/4$ -DQPSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2441.0 MHz) ( $\pi/4$ -DQPSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |                  |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4882.0                                             | 14.2                          | 41.6                         | 55.8                        | 74.0                   | 18.2             | Vertical            |
| 4882.0                                             | 13.8                          | 42.5                         | 56.3                        | 74.0                   | 17.7             | Horizontal          |
| 7323.0                                             | 10.6                          | 45.2                         | 55.8                        | 74.0                   | 18.2             | Vertical            |
| 7323.0                                             | 8.3                           | 46.3                         | 54.6                        | 74.0                   | 19.4             | Horizontal          |
| 9764.0                                             | 6.6                           | 48.1                         | 54.7                        | 74.0                   | 19.3             | Vertical            |
| 9764.0                                             | 6.3                           | 48.9                         | 55.2                        | 74.0                   | 18.8             | Horizontal          |
| 12205.0                                            | 4.7                           | 51.6                         | 56.3                        | 74.0                   | 17.7             | Vertical            |
| 12205.0                                            | 3.2                           | 52.5                         | 55.7                        | 74.0                   | 18.3             | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4882.0                                                | -0.1                          | 41.6                         | 41.5                        | 54.0                   | 12.5             | Vertical            |
| 4882.0                                                | -1.6                          | 42.5                         | 40.9                        | 54.0                   | 13.1             | Horizontal          |
| 7323.0                                                | -4.8                          | 45.2                         | 40.4                        | 54.0                   | 13.6             | Vertical            |
| 7323.0                                                | -5.5                          | 46.3                         | 40.8                        | 54.0                   | 13.2             | Horizontal          |
| 9764.0                                                | -6.6                          | 48.1                         | 41.5                        | 54.0                   | 12.5             | Vertical            |
| 9764.0                                                | -8.9                          | 48.9                         | 40.0                        | 54.0                   | 14.0             | Horizontal          |
| 12205.0                                               | -9.8                          | 51.6                         | 41.8                        | 54.0                   | 12.2             | Vertical            |
| 12205.0                                               | -11.2                         | 52.5                         | 41.3                        | 54.0                   | 12.7             | Horizontal          |

**Result of Tx mode (2480.0 MHz) ( $\pi/4$ -DQPSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2480.0 MHz) ( $\pi/4$ -DQPSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |                  |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4960.0                                             | 14.8                          | 41.4                         | 56.2                        | 74.0                   | 17.8             | Vertical            |
| 4960.0                                             | 14.0                          | 42.7                         | 56.7                        | 74.0                   | 17.3             | Horizontal          |
| 7440.0                                             | 8.9                           | 45.6                         | 54.5                        | 74.0                   | 19.5             | Vertical            |
| 7440.0                                             | 9.2                           | 46.5                         | 55.7                        | 74.0                   | 18.3             | Horizontal          |
| 9920.0                                             | 6.8                           | 48.6                         | 55.4                        | 74.0                   | 18.6             | Vertical            |
| 9920.0                                             | 5.6                           | 49.7                         | 55.3                        | 74.0                   | 18.7             | Horizontal          |
| 12400.0                                            | 4.8                           | 51.7                         | 56.5                        | 74.0                   | 17.5             | Vertical            |
| 12400.0                                            | 3.3                           | 52.7                         | 56.0                        | 74.0                   | 18.0             | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4960.0                                                | 0.4                           | 41.4                         | 41.8                        | 54.0                   | 12.2             | Vertical            |
| 4960.0                                                | -1.2                          | 42.7                         | 41.5                        | 54.0                   | 12.5             | Horizontal          |
| 7440.0                                                | -4.0                          | 45.6                         | 41.6                        | 54.0                   | 12.4             | Vertical            |
| 7440.0                                                | -6                            | 46.5                         | 40.5                        | 54.0                   | 13.5             | Horizontal          |
| 9920.0                                                | -6.9                          | 48.6                         | 41.7                        | 54.0                   | 12.3             | Vertical            |
| 9920.0                                                | -8.7                          | 49.7                         | 41.0                        | 54.0                   | 13.0             | Horizontal          |
| 12400.0                                               | -10.2                         | 51.7                         | 41.5                        | 54.0                   | 12.5             | Vertical            |
| 12400.0                                               | -10.6                         | 52.7                         | 42.1                        | 54.0                   | 11.9             | Horizontal          |

**Result of Tx mode (2402.0 MHz) (8DPSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2402.0 MHz) (8DPSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |                  |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4804.0                                             | 14.2                          | 41.5                         | 55.7                        | 74.0                   | 18.3             | Vertical            |
| 4804.0                                             | 14.0                          | 42.4                         | 56.4                        | 74.0                   | 17.6             | Horizontal          |
| 7206.0                                             | 9.0                           | 45.1                         | 54.1                        | 74.0                   | 19.9             | Vertical            |
| 7206.0                                             | 9.5                           | 46.2                         | 55.7                        | 74.0                   | 18.3             | Horizontal          |
| 9608.0                                             | 7.3                           | 48.0                         | 55.3                        | 74.0                   | 18.7             | Vertical            |
| 9608.0                                             | 6.2                           | 48.8                         | 55.0                        | 74.0                   | 19.0             | Horizontal          |
| 12010.0                                            | 4.3                           | 51.8                         | 56.1                        | 74.0                   | 17.9             | Vertical            |
| 12010.0                                            | 3.3                           | 52.4                         | 55.7                        | 74.0                   | 18.3             | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4804.0                                                | -0.1                          | 41.5                         | 41.4                        | 54.0                   | 12.6             | Vertical            |
| 4804.0                                                | -0.8                          | 42.4                         | 41.6                        | 54.0                   | 12.4             | Horizontal          |
| 7206.0                                                | -5.8                          | 45.1                         | 39.3                        | 54.0                   | 14.7             | Vertical            |
| 7206.0                                                | -5.6                          | 46.2                         | 40.6                        | 54.0                   | 13.4             | Horizontal          |
| 9608.0                                                | -7.4                          | 48.0                         | 40.6                        | 54.0                   | 13.4             | Vertical            |
| 9608.0                                                | -8.3                          | 48.8                         | 40.5                        | 54.0                   | 13.5             | Horizontal          |
| 12010.0                                               | -9.9                          | 51.8                         | 41.9                        | 54.0                   | 12.1             | Vertical            |
| 12010.0                                               | -11.0                         | 52.4                         | 41.4                        | 54.0                   | 12.6             | Horizontal          |

**Result of Tx mode (2441.0 MHz) (8DPSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2441.0 MHz) (8DPSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |                  |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4882.0                                             | 14.8                          | 41.6                         | 56.4                        | 74.0                   | 17.6             | Vertical            |
| 4882.0                                             | 13.2                          | 42.5                         | 55.7                        | 74.0                   | 18.3             | Horizontal          |
| 7323.0                                             | 10.3                          | 45.2                         | 55.5                        | 74.0                   | 18.5             | Vertical            |
| 7323.0                                             | 7.9                           | 46.3                         | 54.2                        | 74.0                   | 19.8             | Horizontal          |
| 9764.0                                             | 6.5                           | 48.1                         | 54.6                        | 74.0                   | 19.4             | Vertical            |
| 9764.0                                             | 5.1                           | 48.9                         | 54.0                        | 74.0                   | 20.0             | Horizontal          |
| 12205.0                                            | 4.2                           | 51.5                         | 55.7                        | 74.0                   | 18.3             | Vertical            |
| 12205.0                                            | 3.6                           | 52.5                         | 56.1                        | 74.0                   | 17.9             | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4882.0                                                | 0.4                           | 41.6                         | 42.0                        | 54.0                   | 12.0             | Vertical            |
| 4882.0                                                | -1.7                          | 42.5                         | 40.8                        | 54.0                   | 13.2             | Horizontal          |
| 7323.0                                                | -5.1                          | 45.2                         | 40.1                        | 54.0                   | 13.9             | Vertical            |
| 7323.0                                                | -5.9                          | 46.3                         | 40.4                        | 54.0                   | 13.6             | Horizontal          |
| 9764.0                                                | -8.5                          | 48.1                         | 39.6                        | 54.0                   | 14.4             | Vertical            |
| 9764.0                                                | -8.5                          | 48.9                         | 40.4                        | 54.0                   | 13.6             | Horizontal          |
| 12205.0                                               | -10.4                         | 51.6                         | 41.2                        | 54.0                   | 12.8             | Vertical            |
| 12205.0                                               | -10.4                         | 52.5                         | 42.1                        | 54.0                   | 11.9             | Horizontal          |

**Result of Tx mode (2480.0 MHz) (8DPSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value          |                           |                              |                             |                           |               |                     |
|-------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                            | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| Emissions detected are more than 20 dB below the FCC Limits |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2480.0 MHz) (8DPSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |                  |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4960.0                                             | 14.7                          | 41.4                         | 56.1                        | 74.0                   | 17.9             | Vertical            |
| 4960.0                                             | 13.7                          | 42.7                         | 56.4                        | 74.0                   | 17.6             | Horizontal          |
| 7440.0                                             | 9.0                           | 45.6                         | 54.6                        | 74.0                   | 19.4             | Vertical            |
| 7440.0                                             | 8.4                           | 46.5                         | 54.9                        | 74.0                   | 19.1             | Horizontal          |
| 9920.0                                             | 6.3                           | 48.6                         | 54.9                        | 74.0                   | 19.1             | Vertical            |
| 9920.0                                             | 5.0                           | 49.7                         | 54.7                        | 74.0                   | 19.3             | Horizontal          |
| 12400.0                                            | 4.8                           | 51.7                         | 56.5                        | 74.0                   | 17.5             | Vertical            |
| 12400.0                                            | 3.5                           | 52.7                         | 56.2                        | 74.0                   | 17.8             | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |                  |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dBuV/m | E-Field<br>Polarity |
| 4960.0                                                | -0.2                          | 41.4                         | 41.2                        | 54.0                   | 12.8             | Vertical            |
| 4960.0                                                | -0.9                          | 42.7                         | 41.8                        | 54.0                   | 12.2             | Horizontal          |
| 7440.0                                                | -4.2                          | 45.6                         | 41.4                        | 54.0                   | 12.6             | Vertical            |
| 7440.0                                                | -7.3                          | 46.5                         | 39.2                        | 54.0                   | 14.8             | Horizontal          |
| 9920.0                                                | -7.5                          | 48.6                         | 41.1                        | 54.0                   | 12.9             | Vertical            |
| 9920.0                                                | -9.4                          | 49.7                         | 40.3                        | 54.0                   | 13.7             | Horizontal          |
| 12400.0                                               | -9.4                          | 51.7                         | 42.3                        | 54.0                   | 11.7             | Vertical            |
| 12400.0                                               | -11.3                         | 52.7                         | 41.4                        | 54.0                   | 12.6             | Horizontal          |

Note: Above 13GHz Emissions detected are more than 20 dB below the FCC Limits .

Remarks:

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

\* Denotes restricted band of operation.

Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty : 9kHz-30MHz 3.3dB  
30MHz -1GHz 4.6dB  
1GHz -26GHz 4.4dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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### **Radiated Emissions Measurement:**

#### **Limit :**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

#### **Result: RF Radiated Emissions (Lowest)-GFSK**

| Field Strength of Band-edge Compliance<br>Peak Value |                               |                              |                             |                        |                  |                     |
|------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2390.0                                               | 18.1                          | 36.8                         | 54.9                        | 74.0                   | 19.1             | Vertical            |

| Field Strength of Band-edge Compliance<br>Average Value |                               |                              |                             |                        |                  |                     |
|---------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2390.0                                                  | 3.3                           | 36.8                         | 40.1                        | 54.0                   | 13.9             | Vertical            |

#### **Result: RF Radiated Emissions (Highest) -GFSK**

| Field Strength of Band-edge Compliance<br>Peak Value |                               |                              |                             |                        |                  |                     |
|------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2483.5                                               | 23.8                          | 36.4                         | 60.2                        | 74.0                   | 13.8             | Horizontal          |

| Field Strength of Band-edge Compliance<br>Average Value |                               |                              |                             |                        |                  |                     |
|---------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2483.5                                                  | 6.2                           | 36.4                         | 42.6                        | 54.0                   | 11.4             | Horizontal          |

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### Radiated Emissions Measurement:

#### Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

#### Result: RF Radiated Emissions (Lowest)- $\pi/4$ -DQPSK

| Field Strength of Band-edge Compliance<br>Peak Value |                                     |                              |                                   |                              |                        |                     |
|------------------------------------------------------|-------------------------------------|------------------------------|-----------------------------------|------------------------------|------------------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dB $\mu$ V | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB $\mu$ V/m | E-Field<br>Polarity |
| 2390.0                                               | 17.4                                | 36.8                         | 54.2                              | 74.0                         | 19.8                   | Vertical            |

| Field Strength of Band-edge Compliance<br>Average Value |                                     |                              |                                   |                              |                        |                     |
|---------------------------------------------------------|-------------------------------------|------------------------------|-----------------------------------|------------------------------|------------------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dB $\mu$ V | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB $\mu$ V/m | E-Field<br>Polarity |
| 2390.0                                                  | 3.2                                 | 36.8                         | 40.0                              | 54.0                         | 14.0                   | Vertical            |

#### Result: RF Radiated Emissions (Highest) - $\pi/4$ -DQPSK

| Field Strength of Band-edge Compliance<br>Peak Value |                                     |                              |                                   |                              |                        |                     |
|------------------------------------------------------|-------------------------------------|------------------------------|-----------------------------------|------------------------------|------------------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dB $\mu$ V | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB $\mu$ V/m | E-Field<br>Polarity |
| 2483.5                                               | 24.6                                | 36.4                         | 61.0                              | 74.0                         | 13.0                   | Horizontal          |

| Field Strength of Band-edge Compliance<br>Average Value |                                     |                              |                                   |                              |                        |                     |
|---------------------------------------------------------|-------------------------------------|------------------------------|-----------------------------------|------------------------------|------------------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dB $\mu$ V | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB $\mu$ V/m | E-Field<br>Polarity |
| 2483.5                                                  | 6.1                                 | 36.4                         | 42.5                              | 54.0                         | 11.5                   | Horizontal          |

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### Radiated Emissions Measurement:

#### Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

#### Result: RF Radiated Emissions (Lowest)- 8DPSK

| Field Strength of Band-edge Compliance<br>Peak Value |                               |                              |                             |                        |                  |                     |
|------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2390.0                                               | 18.1                          | 36.8                         | 54.9                        | 74.0                   | 19.1             | Vertical            |

| Field Strength of Band-edge Compliance<br>Average Value |                               |                              |                             |                        |                  |                     |
|---------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2390.0                                                  | 3.5                           | 36.8                         | 40.3                        | 54.0                   | 13.7             | Vertical            |

#### Result: RF Radiated Emissions (Highest) -8DPSK

| Field Strength of Band-edge Compliance<br>Peak Value |                               |                              |                             |                        |                  |                     |
|------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2483.5                                               | 25.8                          | 36.4                         | 62.2                        | 74.0                   | 11.8             | Horizontal          |

| Field Strength of Band-edge Compliance<br>Average Value |                               |                              |                             |                        |                  |                     |
|---------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|------------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dBμV/m | E-Field<br>Polarity |
| 2483.5                                                  | 6.4                           | 36.4                         | 42.8                        | 54.0                   | 11.2             | Horizontal          |

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### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B1:

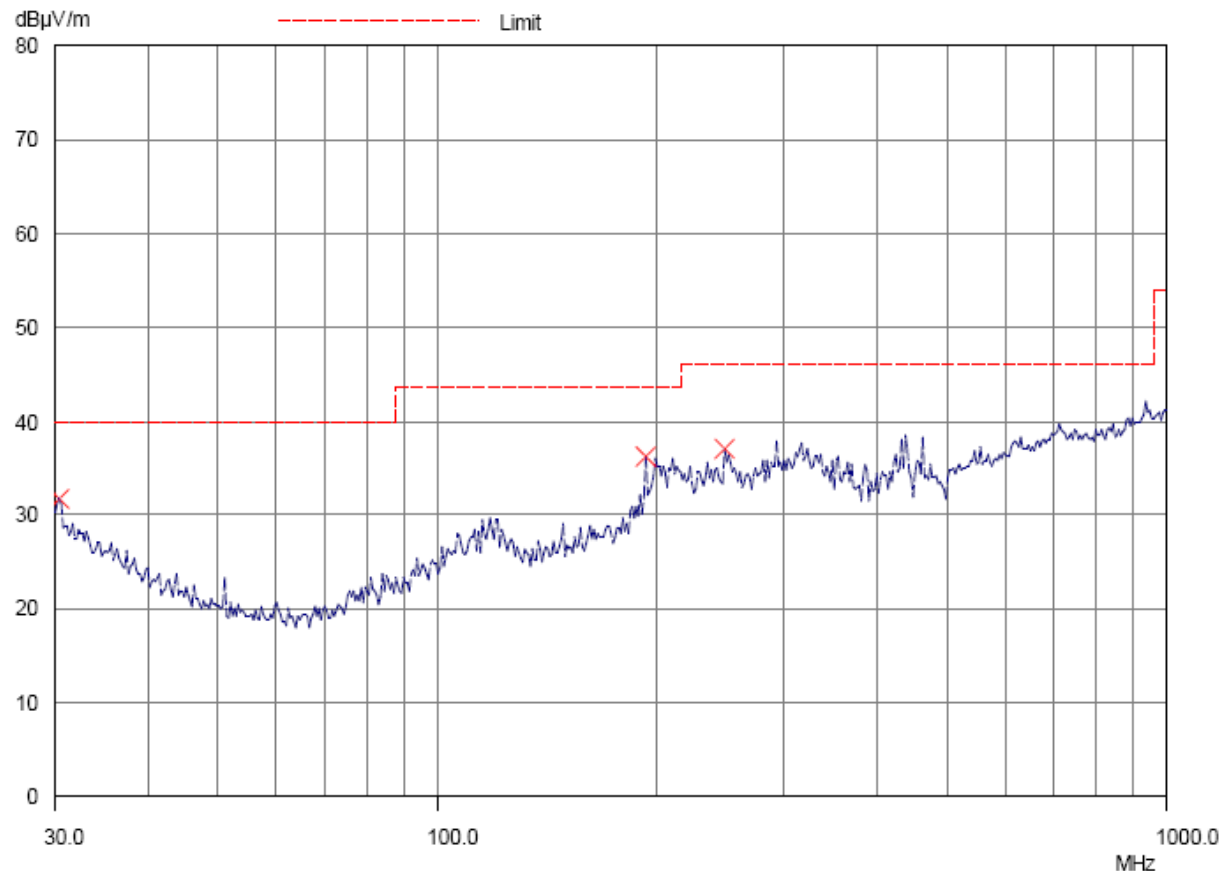
| Frequency Range | Quasi-Peak Limits |
|-----------------|-------------------|
| [MHz]           | [ $\mu$ V/m]      |
| 0.009-0.490     | 2400/F (kHz)      |
| 0.490-1.705     | 24000/F (kHz)     |
| 1.705-30        | 30                |
| 30-88           | 100               |
| 88-216          | 150               |
| 216-960         | 200               |
| Above960        | 500               |

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Results of Bluetooth Communication mode (GFSK 2402.0 MHz) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Horizontal



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**Result of Bluetooth Communication mode (GFSK 2402.0 MHz) (30MHz – 1GHz): Pass**

| <b>Radiated Emissions<br/>Quasi-Peak</b> |                     |                              |                              |                           |                           |
|------------------------------------------|---------------------|------------------------------|------------------------------|---------------------------|---------------------------|
| Emission<br>Frequency<br>MHz             | E-Field<br>Polarity | Level<br>@3m<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Level<br>@3m<br>$\mu$ V/m | Limit<br>@3m<br>$\mu$ V/m |
| 30.2                                     | Horizontal          | 30.3                         | 40.0                         | 32.7                      | 100                       |
| 192.1                                    | Horizontal          | 34.1                         | 43.5                         | 50.7                      | 150                       |
| 246.6                                    | Horizontal          | 35.8                         | 46.0                         | 61.7                      | 200                       |

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### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B1:

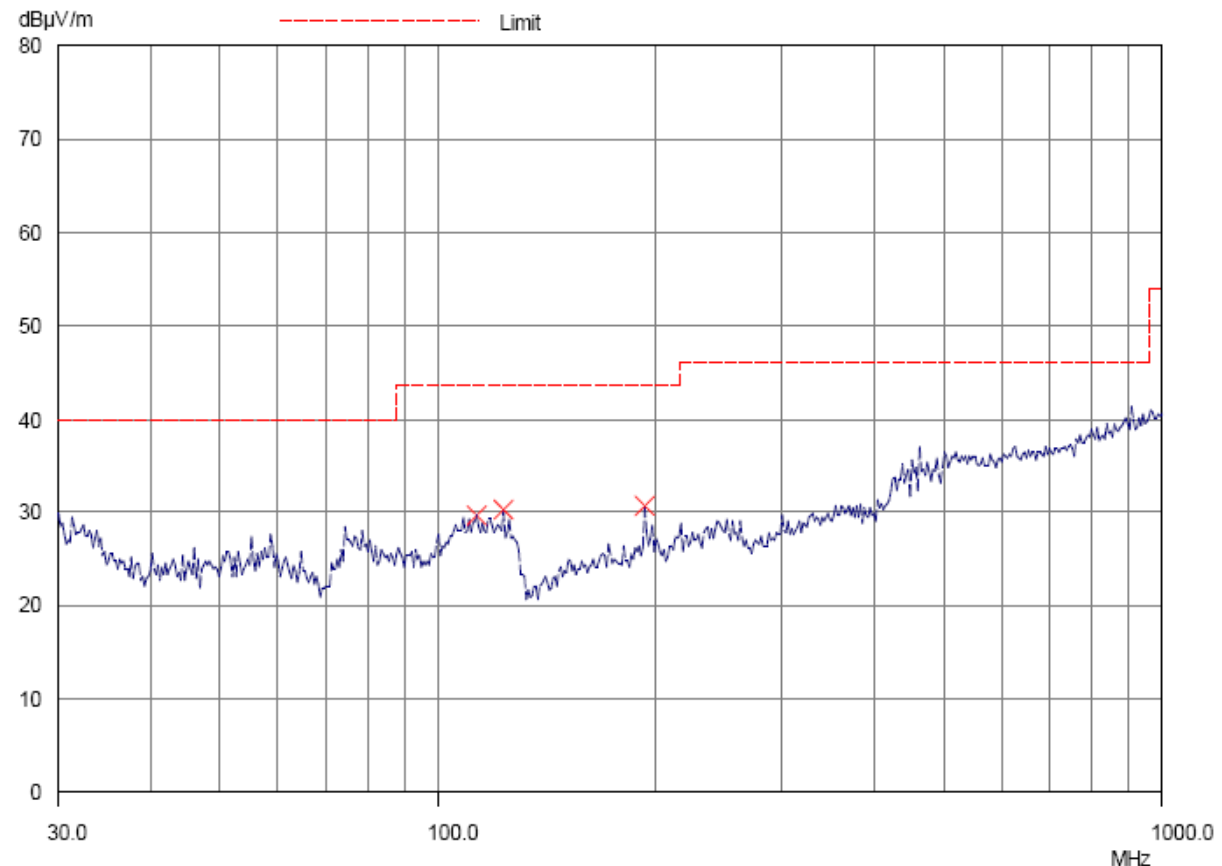
| Frequency Range | Quasi-Peak Limits   |
|-----------------|---------------------|
| [MHz]           | [ $\mu\text{V/m}$ ] |
| 0.009-0.490     | 2400/F (kHz)        |
| 0.490-1.705     | 24000/F (kHz)       |
| 1.705-30        | 30                  |
| 30-88           | 100                 |
| 88-216          | 150                 |
| 216-960         | 200                 |
| Above 960       | 500                 |

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Results of Bluetooth Communication mode (GFSK 2402.0 MHz) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Vertical



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### **Result of Bluetooth Communication mode (GFSK 2402.0 MHz) (30MHz – 1GHz): Pass**

| <b>Radiated Emissions<br/>Quasi-Peak</b> |                     |                              |                              |                           |                           |
|------------------------------------------|---------------------|------------------------------|------------------------------|---------------------------|---------------------------|
| Emission<br>Frequency<br>MHz             | E-Field<br>Polarity | Level<br>@3m<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Level<br>@3m<br>$\mu$ V/m | Limit<br>@3m<br>$\mu$ V/m |
| 113.1                                    | Vertical            | 27.2                         | 43.5                         | 22.9                      | 150                       |
| 123.6                                    | Vertical            | 28.1                         | 43.5                         | 25.4                      | 150                       |
| 192.0                                    | Vertical            | 30.5                         | 43.5                         | 33.5                      | 150                       |

Remarks:

Calculated measurement uncertainty (30MHz – 1GHz): 4.6dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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### 3.1.3 AC Mains Conducted Emissions (0.15MHz to 30MHz)

|                    |                              |
|--------------------|------------------------------|
| Test Requirement:  | FCC 47CFR 15.207             |
| Test Method:       | ANSI C63.10:2013             |
| Test Date:         | 2017-03-20                   |
| Mode of Operation: | Bluetooth Communication mode |
| Test Voltage:      | 120V a.c. 60Hz               |

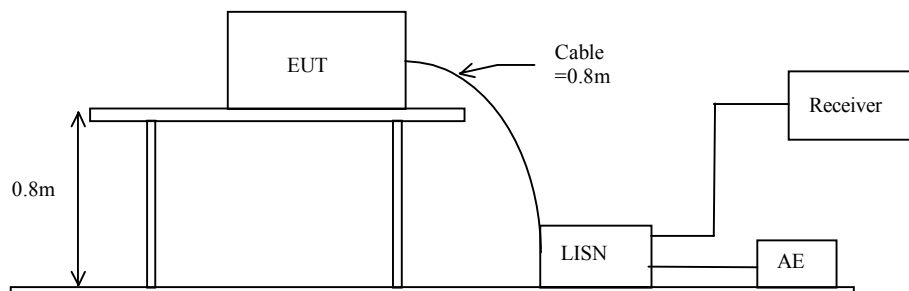
#### Test Method:

The test was performed in accordance with ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

#### Receiver Setting:

Bandw. = 9 kHz, Meas. Time = 10.0 ms, Step Width = 5.0kHz  
Detector = MaxPeak and CISPR AV

#### Test Setup:



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### Limits for Conducted Emissions (FCC 47 CFR 15.207):

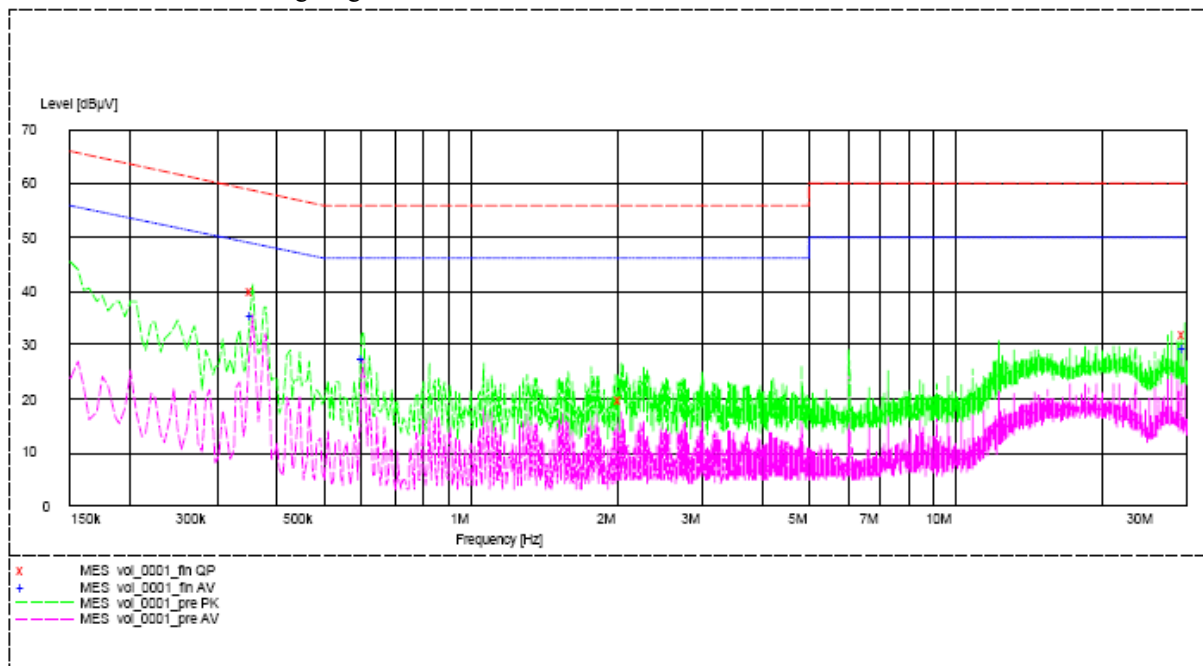
| Frequency Range<br>[MHz] | Quasi-Peak Limits<br>[dBμV] | Average<br>[dBμV] |
|--------------------------|-----------------------------|-------------------|
| 0.15-0.5                 | 66 to 56*                   | 56 to 46*         |
| 0.5-5.0                  | 56                          | 46                |
| 5.0-30.0                 | 60                          | 50                |

\* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

### Results of Bluetooth Communication mode (L): PASS

Please refer to the following diagram for individual results.



| Conductor<br>Live or Neutral | Frequency<br>MHz | Quasi-peak    |               | Average       |               |
|------------------------------|------------------|---------------|---------------|---------------|---------------|
|                              |                  | Level<br>dBμV | Limit<br>dBμV | Level<br>dBμV | Limit<br>dBμV |
| Live                         | 0.355            | 40.2          | 59.0          | -*-           | -*-           |
| Live                         | 2.045            | 19.9          | 56.0          | -*-           | -*-           |
| Live                         | 29.750           | 32.3          | 60.0          | -*-           | -*-           |
| Live                         | 0.355            | -*-           | -*-           | 35.5          | 49.0          |
| Live                         | 0.605            | -*-           | -*-           | 27.4          | 46.0          |
| Live                         | 29.750           | -*-           | -*-           | 29.4          | 50.0          |

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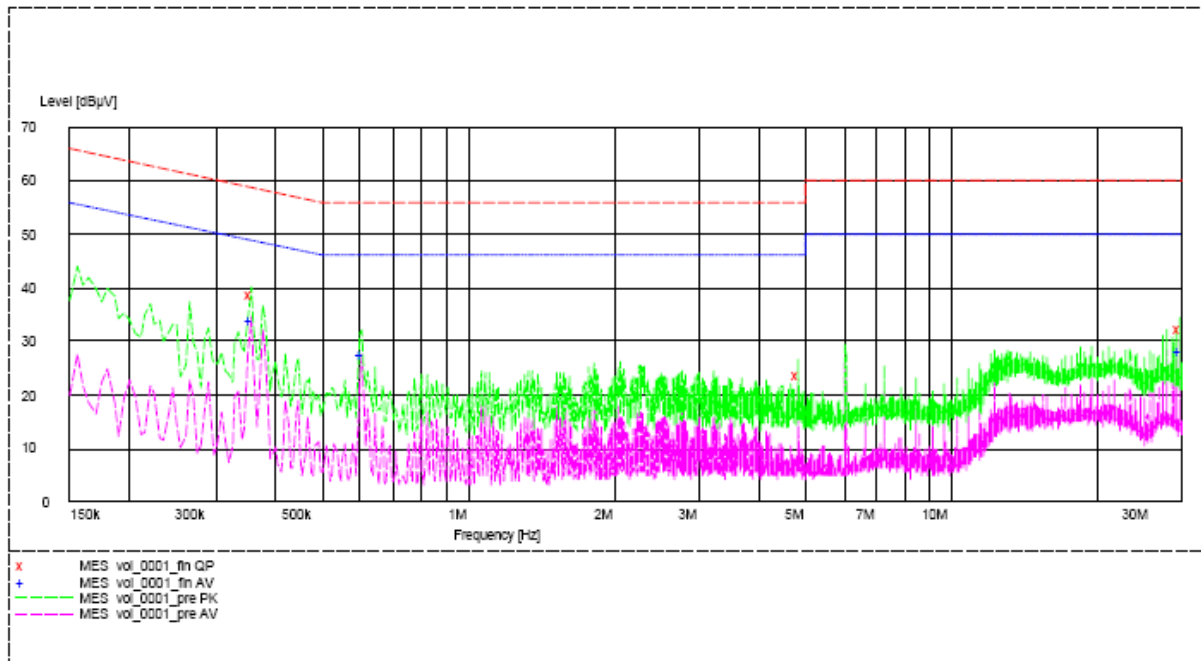
| Frequency Range<br>[MHz] | Quasi-Peak Limits<br>[dB $\mu$ V] | Average<br>[dB $\mu$ V] |
|--------------------------|-----------------------------------|-------------------------|
| 0.15-0.5                 | 66 to 56*                         | 56 to 46*               |
| 0.5-5.0                  | 56                                | 46                      |
| 5.0-30.0                 | 60                                | 50                      |

\* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

### Results of Bluetooth Communication mode (N): PASS

Please refer to the following diagram for individual results.



| Conductor<br>Live or Neutral | Frequency<br>MHz | Quasi-peak          |                     | Average             |                     |
|------------------------------|------------------|---------------------|---------------------|---------------------|---------------------|
|                              |                  | Level<br>dB $\mu$ V | Limit<br>dB $\mu$ V | Level<br>dB $\mu$ V | Limit<br>dB $\mu$ V |
| Neutral                      | 0.355            | 38.9                | 59.0                | -*-                 | -*-                 |
| Neutral                      | 4.835            | 23.9                | 56.0                | -*-                 | -*-                 |
| Neutral                      | 29.740           | 32.6                | 60.0                | -*-                 | -*-                 |
| Neutral                      | 0.355            | -*-                 | -*-                 | 33.8                | 49.0                |
| Neutral                      | 0.605            | -*-                 | -*-                 | 27.4                | 46.0                |
| Neutral                      | 29.740           | -*-                 | -*-                 | 28.3                | 50.0                |

Remarks:

Calculated measurement uncertainty (0.15MHz – 30MHz): 3.2dB

-\*- Emission(s) that is far below the corresponding limit line.

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### 3.1.4 Number of Hopping Frequency

#### Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels

#### Test Method:

The RF output of the EUT was connected to the spectrum analyzer by a low loss cable.

#### Spectrum Analyzer Setting:

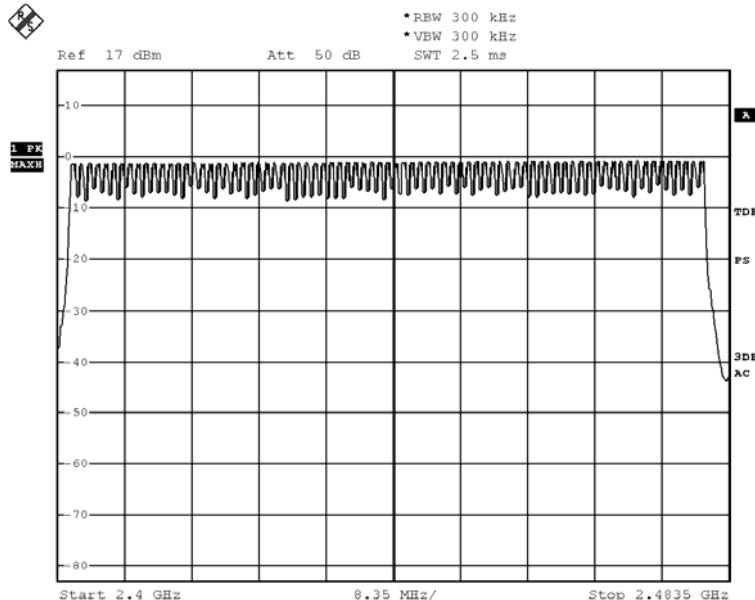
RBW = 300kHz, VBW  $\geq$  RBW, Sweep = Auto, Span = the frequency band of operation  
Detector = Peak, Trace = Max. hold

#### Test Setup:

As Test Setup of clause 3.1.1 in this test report.

#### Measurement Data:

##### GFSK: 79 of 79 Channel



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$\pi/4$ -DQPSK: 79 of 79 Channel



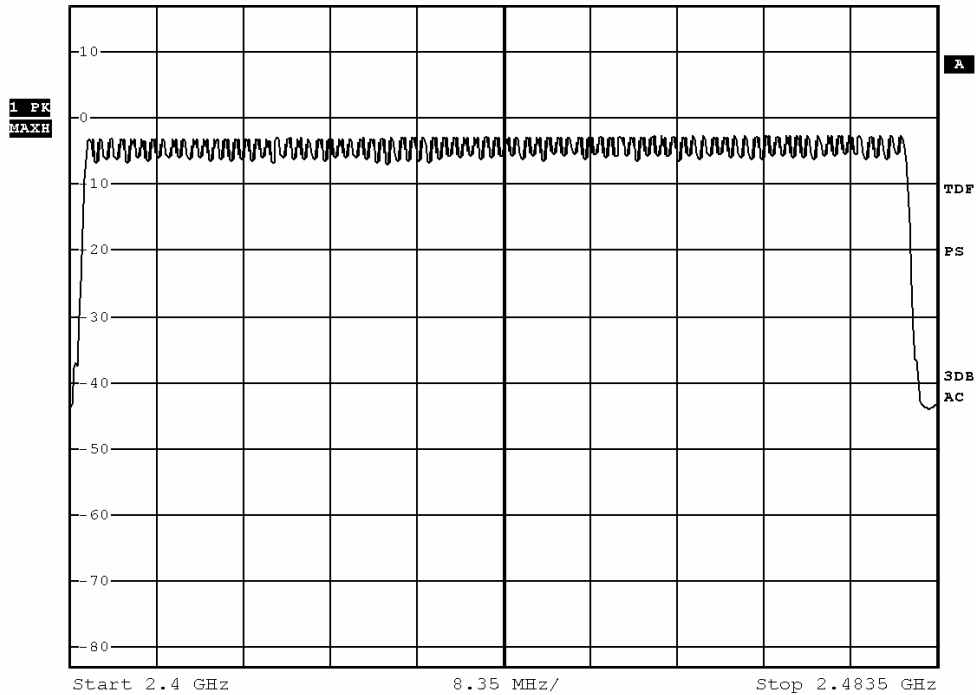
\*RBW 300 kHz

\*VBW 300 kHz

SWT 2.5 ms

Ref 17 dBm

Att 50 dB



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### 8DPSK: 79 of 79 Channel



\*RBW 300 kHz

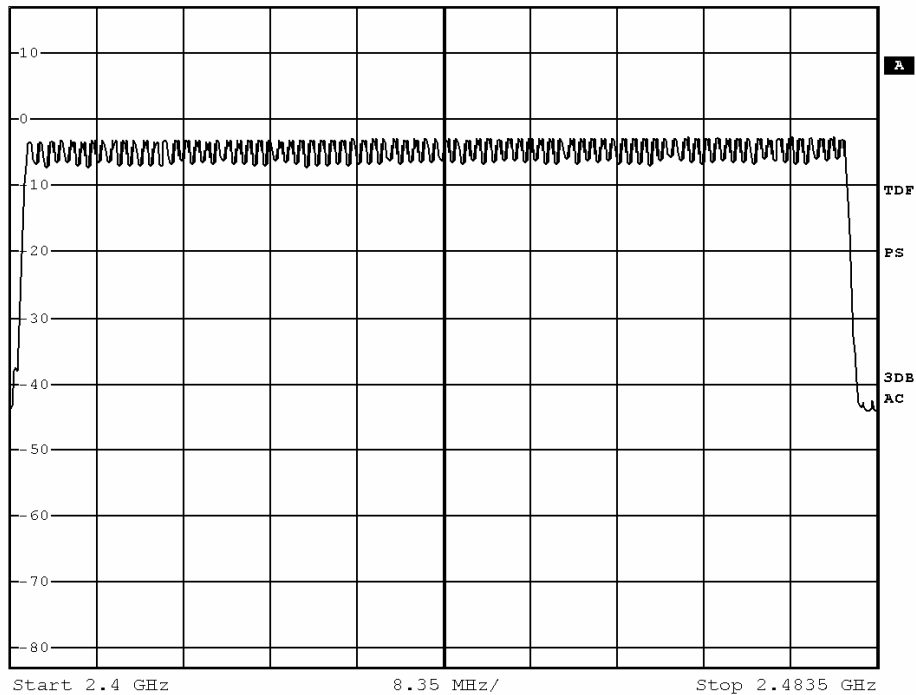
\*VBW 300 kHz

SWT 2.5 ms

Ref 17 dBm

Att 50 dB

1 PK  
MAXH



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### **3.1.5 20dB Bandwidth**

|                    |                        |
|--------------------|------------------------|
| Test Requirement:  | FCC 47CFR 15.247(a)(1) |
| Test Method:       | ANSI C63.10:2013       |
| Test Date:         | 2017-03-21             |
| Mode of Operation: | Tx mode                |

#### **Remark:**

The result has been done on all the possible configurations for searching the worst cases.

#### **Test Method:**

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

#### **Spectrum Analyzer Setting:**

RBW = 30kHz, VBW  $\geq$  RBW, Sweep = Auto, Span = two times and five times the OBW  
Detector = Peak, Trace = Max. hold

#### **Test Setup:**

As Test Setup of clause 3.1.1 in this test report.

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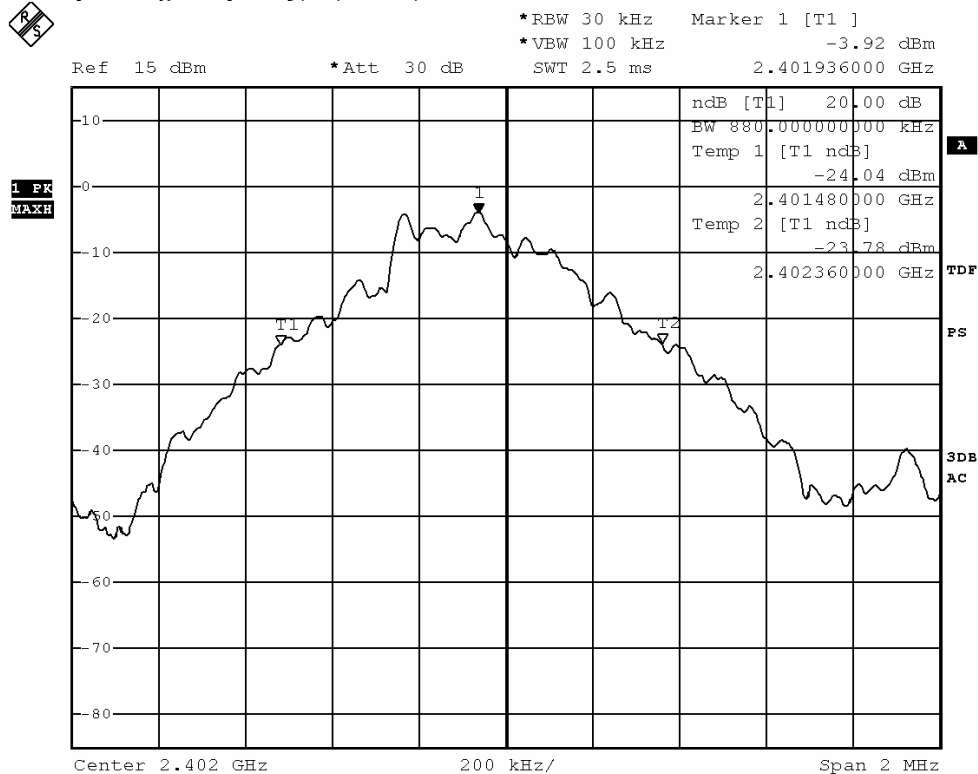
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[KHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2402                           | 880.0                   | Within 2400-2483.5  |

### (Lowest Operating Frequency) - (GFSK)



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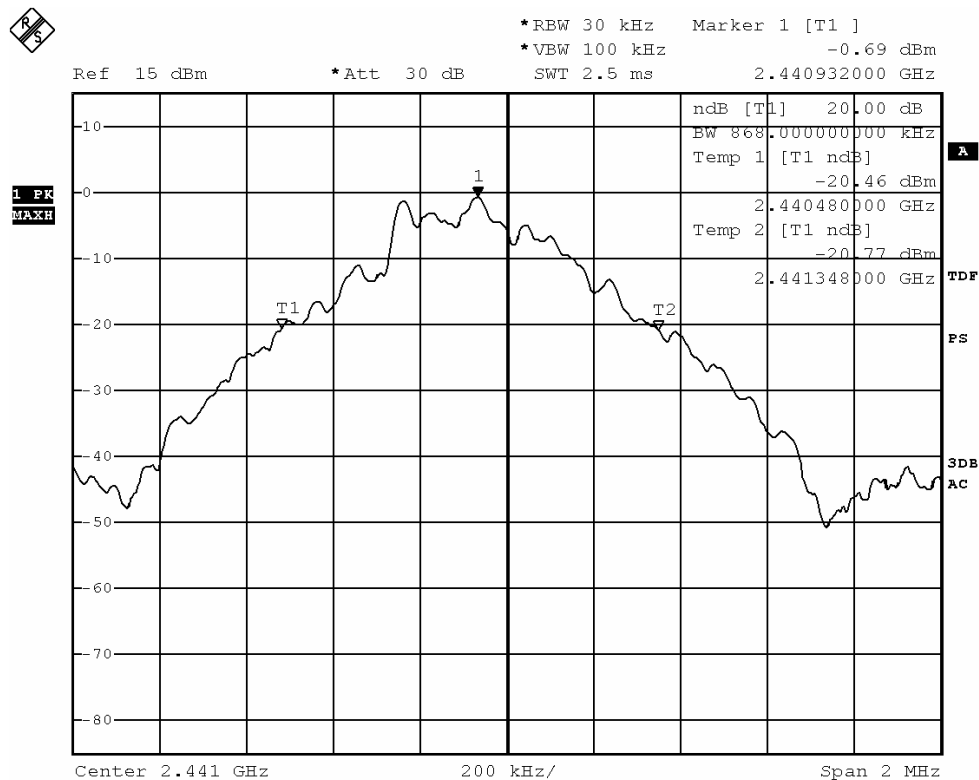
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[KHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2441                           | 868.0                   | Within 2400-2483.5  |

(Middle Operating Frequency) - (GFSK)



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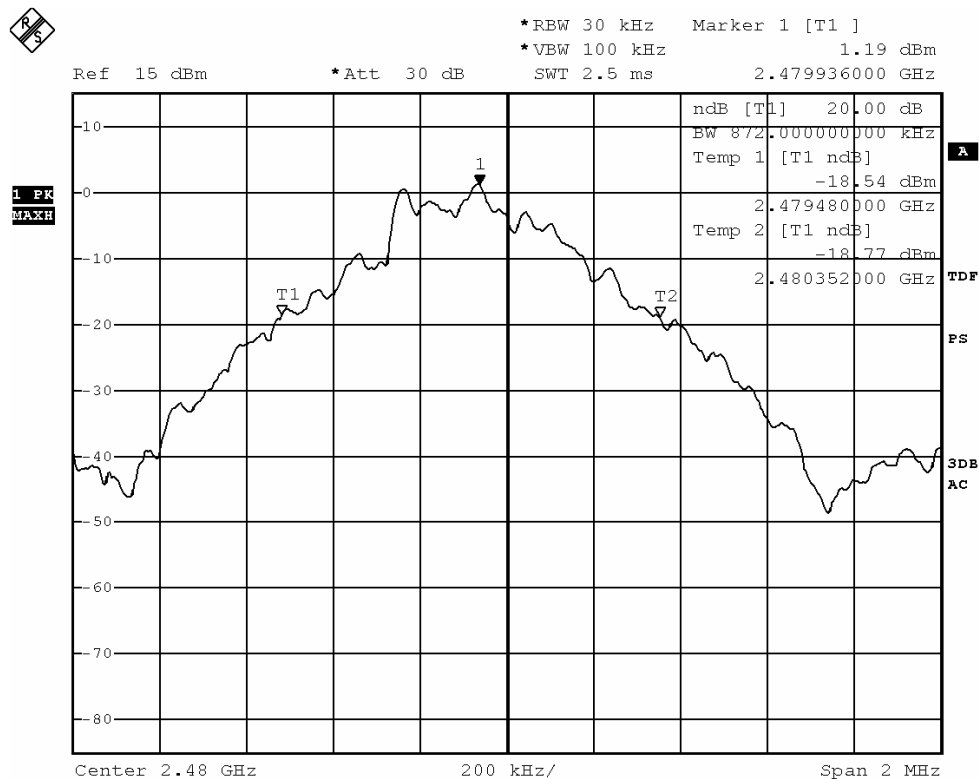
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[KHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2480                           | 872.0                   | Within 2400-2483.5  |

### (Highest Operating Frequency) - (GFSK)



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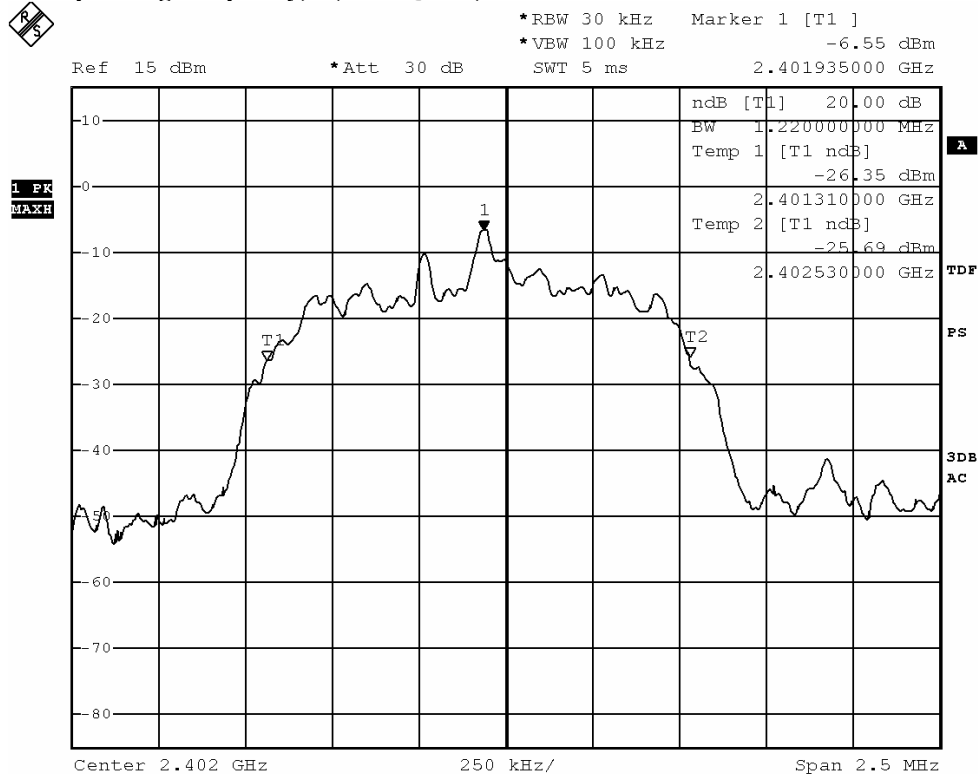
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[MHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2402                           | 1.220                   | Within 2400-2483.5  |

(Lowest Operating Frequency) - ( $\pi/4$  DQPSK)



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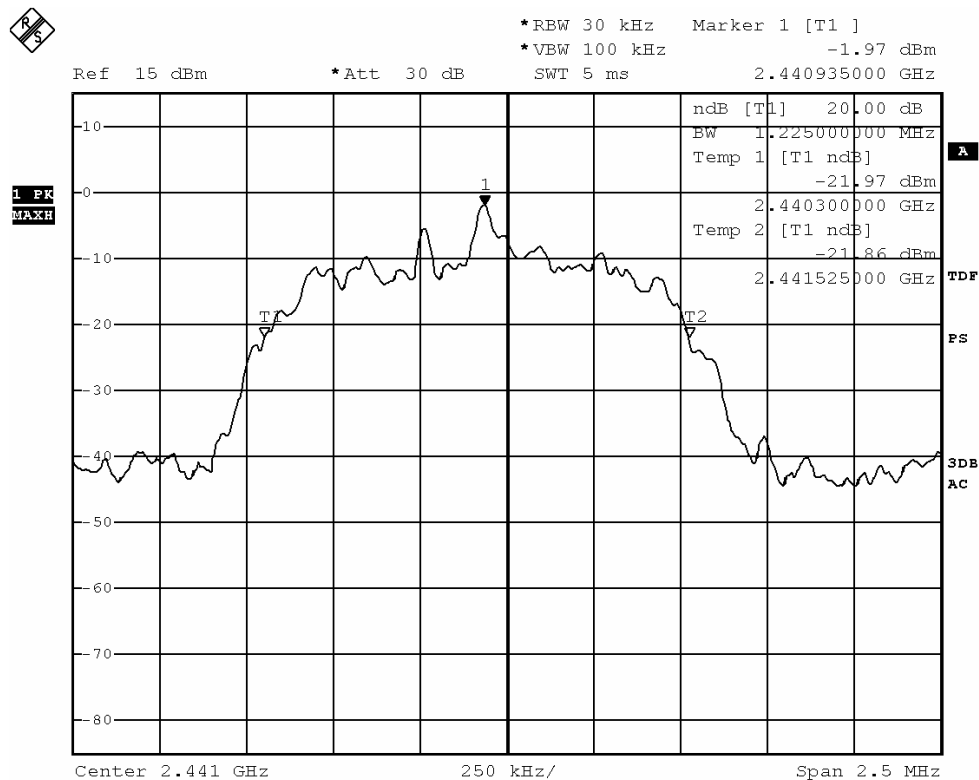
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[MHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2441                           | 1.225                   | Within 2400-2483.5  |

(Middle Operating Frequency) - ( $\pi/4$  DQPSK)



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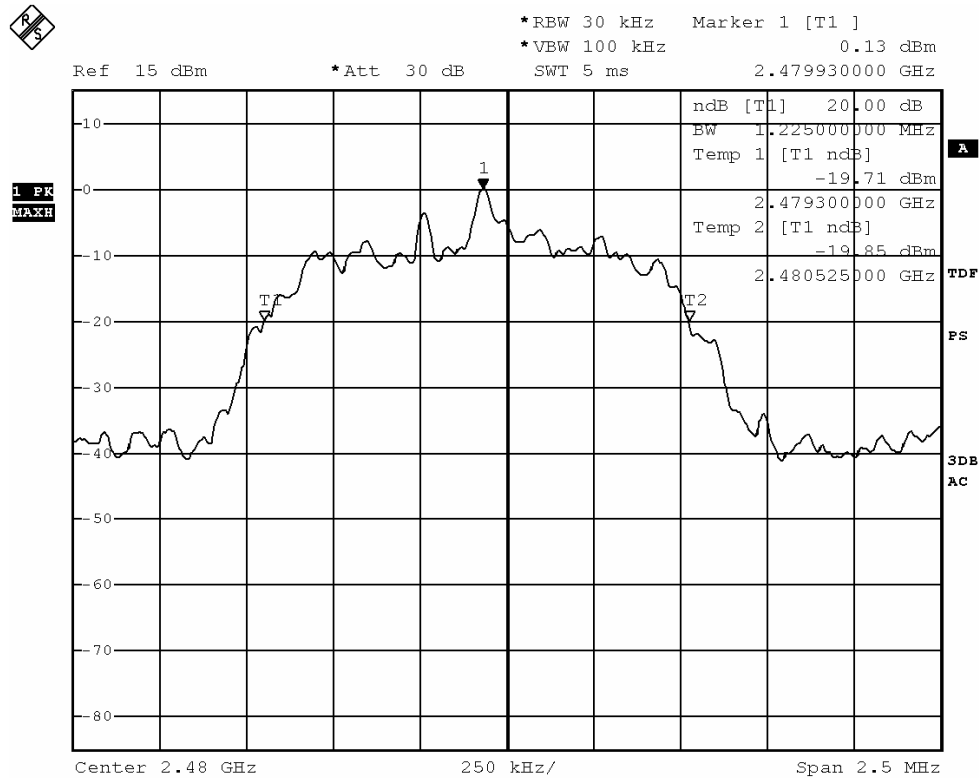
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[MHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2480                           | 1.225                   | Within 2400-2483.5  |

### (Highest Operating Frequency) - ( $\pi/4$ DQPSK)



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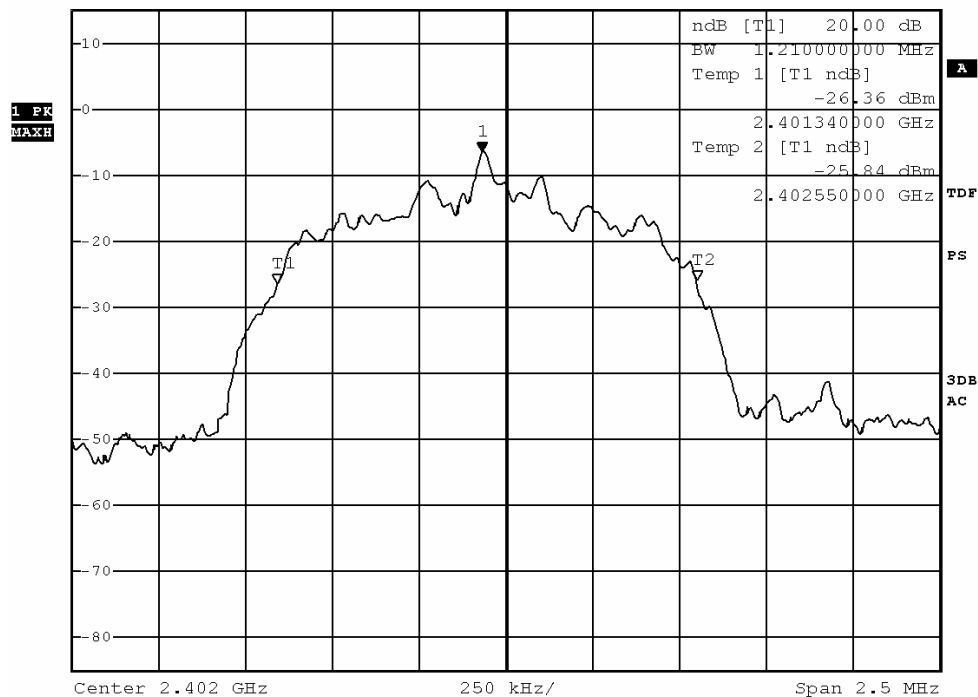
No. : DM126878

| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[MHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2402                           | 1.210                   | Within 2400-2483.5  |

### (Lowest Operating Frequency) - (8DPSK)



\*RBW 30 kHz Marker 1 [T1 ]  
\*VBW 100 kHz -6.45 dBm  
Ref 15 dBm \*Att 30 dB SWT 5 ms 2.401930000 GHz



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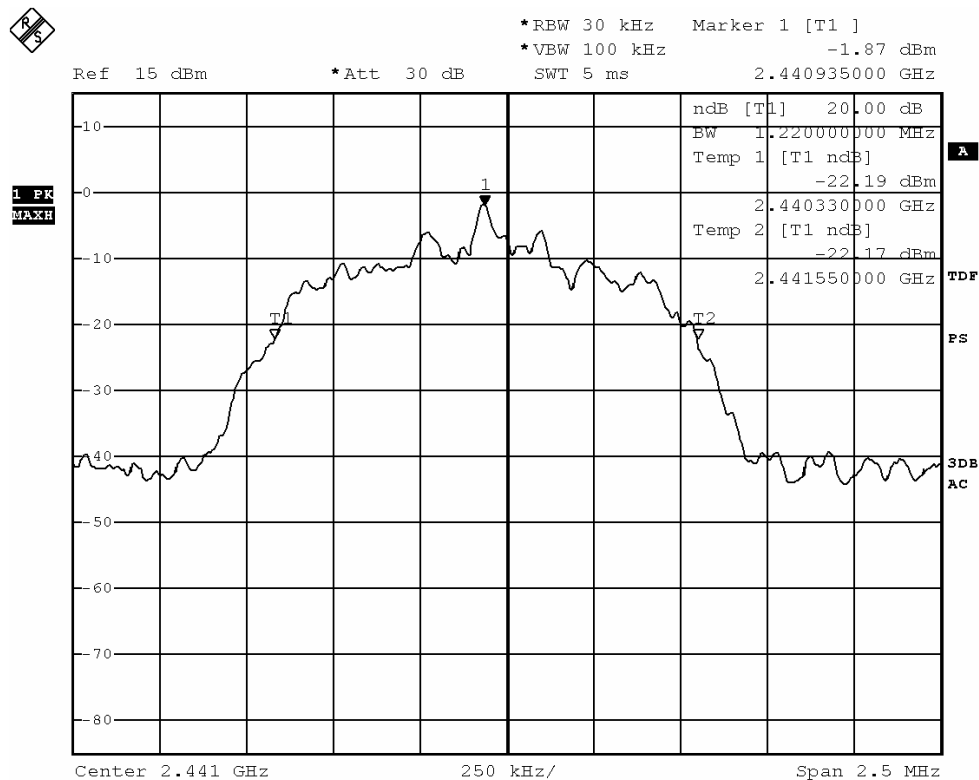
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[MHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2441                           | 1.220                   | Within 2400-2483.5  |

(Middle Operating Frequency) - (8DPSK)



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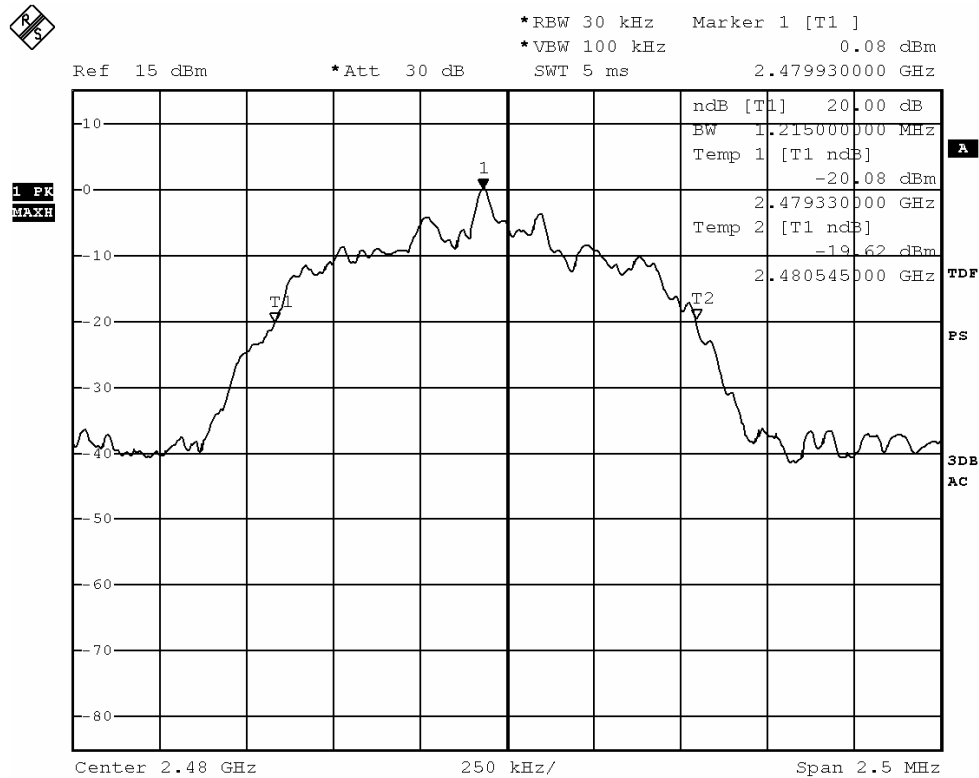
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| Fundamental Frequency<br>[MHz] | 20dB Bandwidth<br>[MHz] | FCC Limits<br>[MHz] |
|--------------------------------|-------------------------|---------------------|
| 2480                           | 1.215                   | Within 2400-2483.5  |

### (Highest Operating Frequency) - (8DPSK)



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### 3.1.6 Hopping Channel Separation

#### Requirements:

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.

#### Spectrum Analyzer Setting:

RBW = 300kHz, VBW  $\geq$  RBW, Sweep = Auto,  
Span = Wide enough to capture the peaks of two adjacent channels  
Detector = Peak, Trace = Max. hold

#### Limit:

The measured maximum bandwidth \*  $2/3$  = 880kHz (GFSK)

The measured maximum bandwidth \*  $2/3$  = 1.225MHz \*  $2/3$  = 816.7kHz ( $\pi/4$  DQPSK, 8DPSK)

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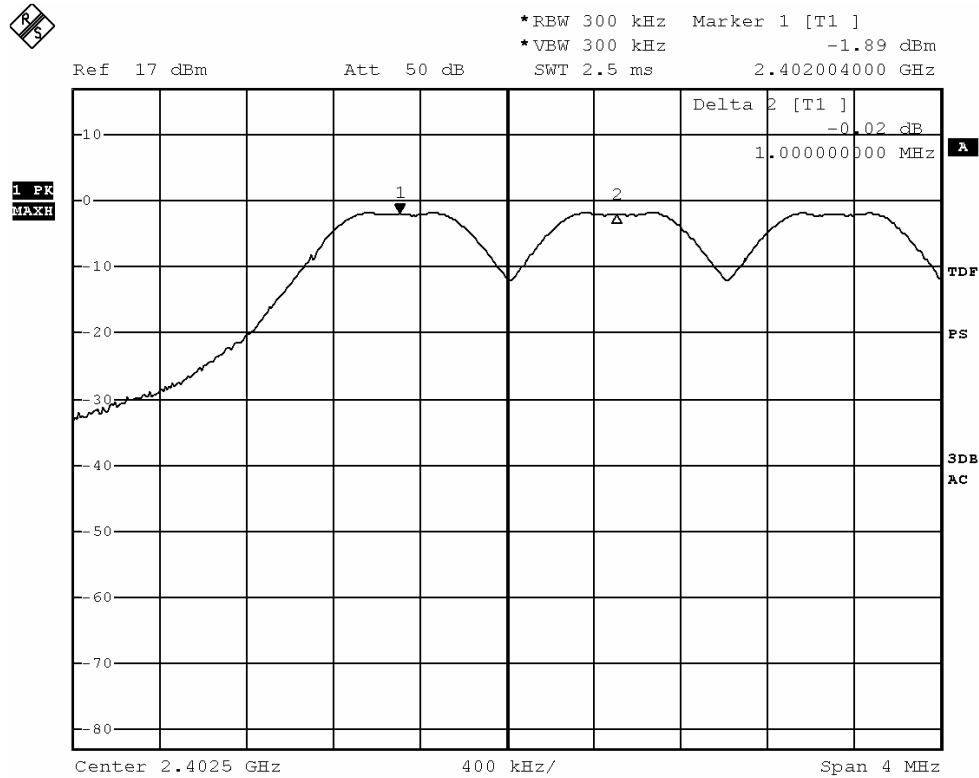
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Channel separation = 1MHz (>880kHz) (Lowest) (GFSK)



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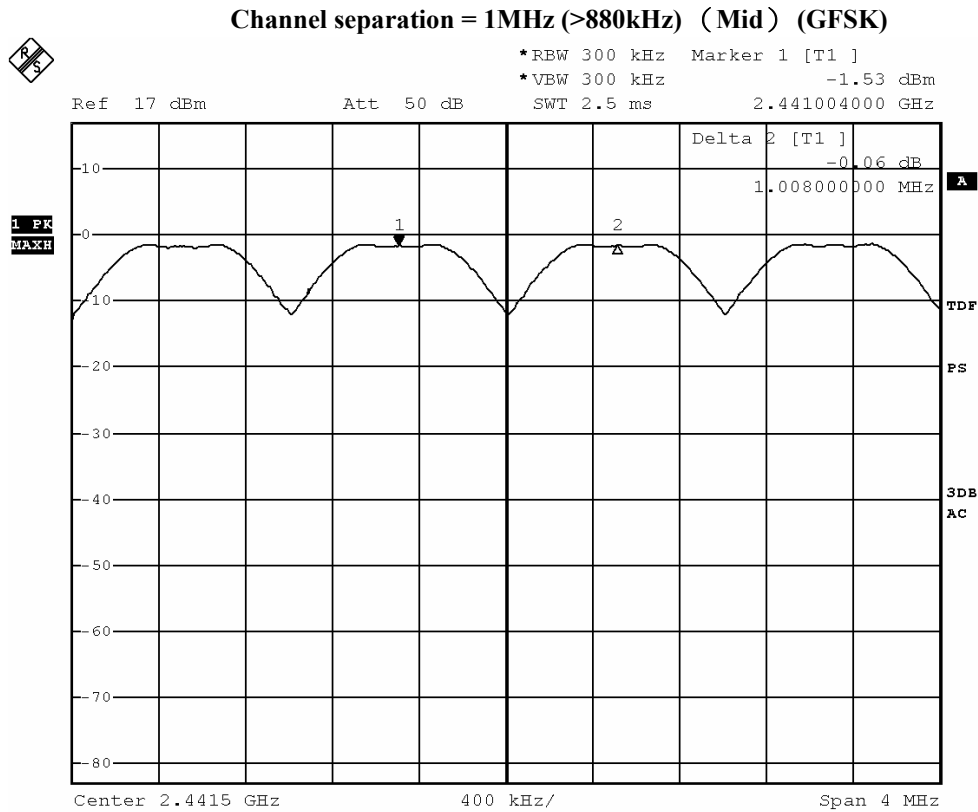


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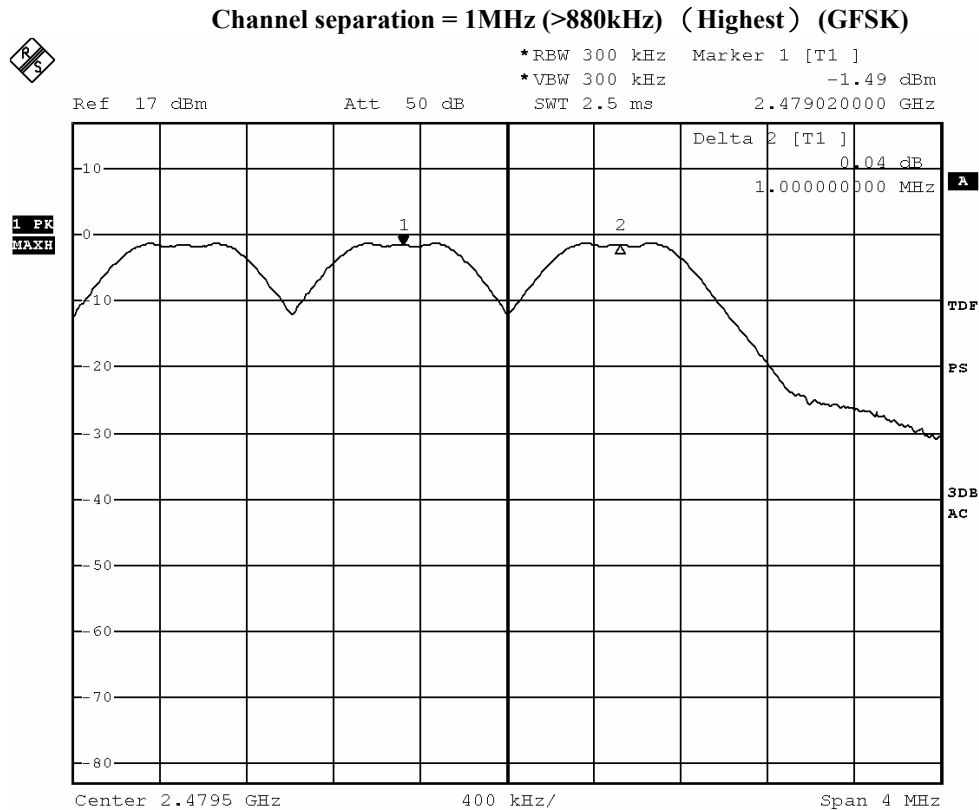


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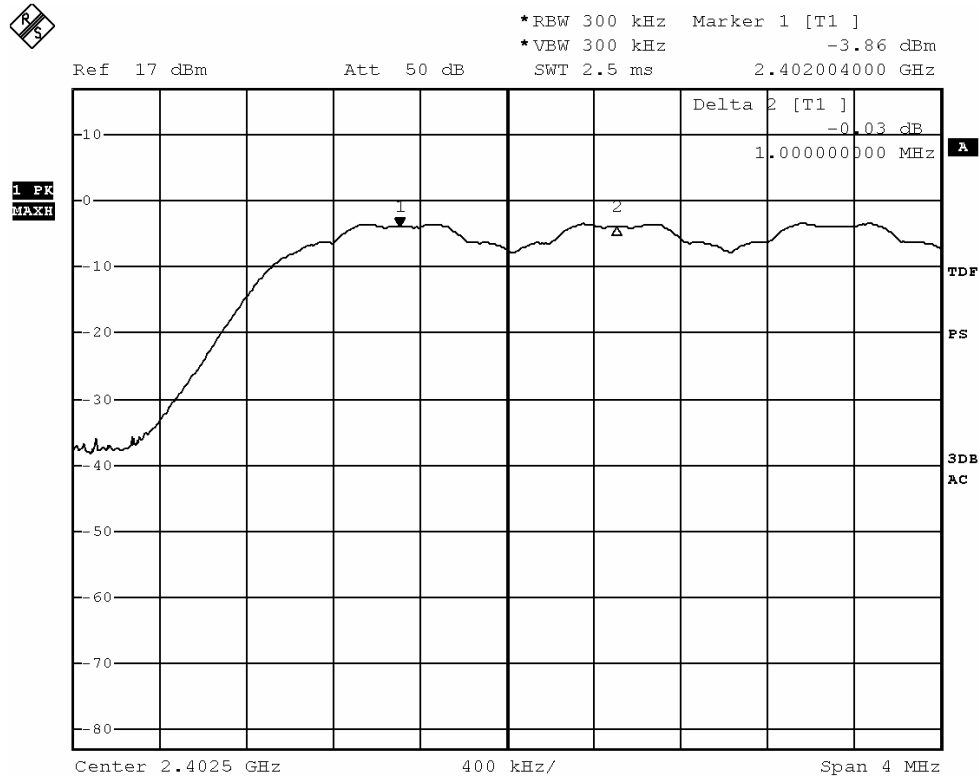
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Channel separation = 1MHz (>816.7kHz) (Lowest) ( $\pi/4$  DQPSK)



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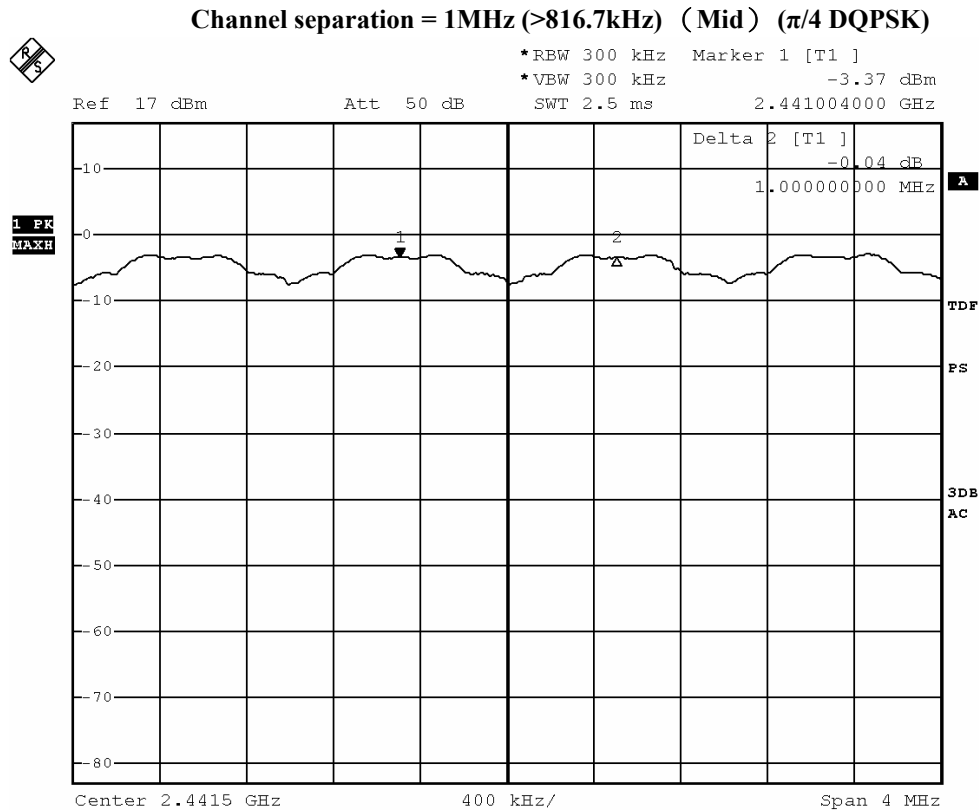


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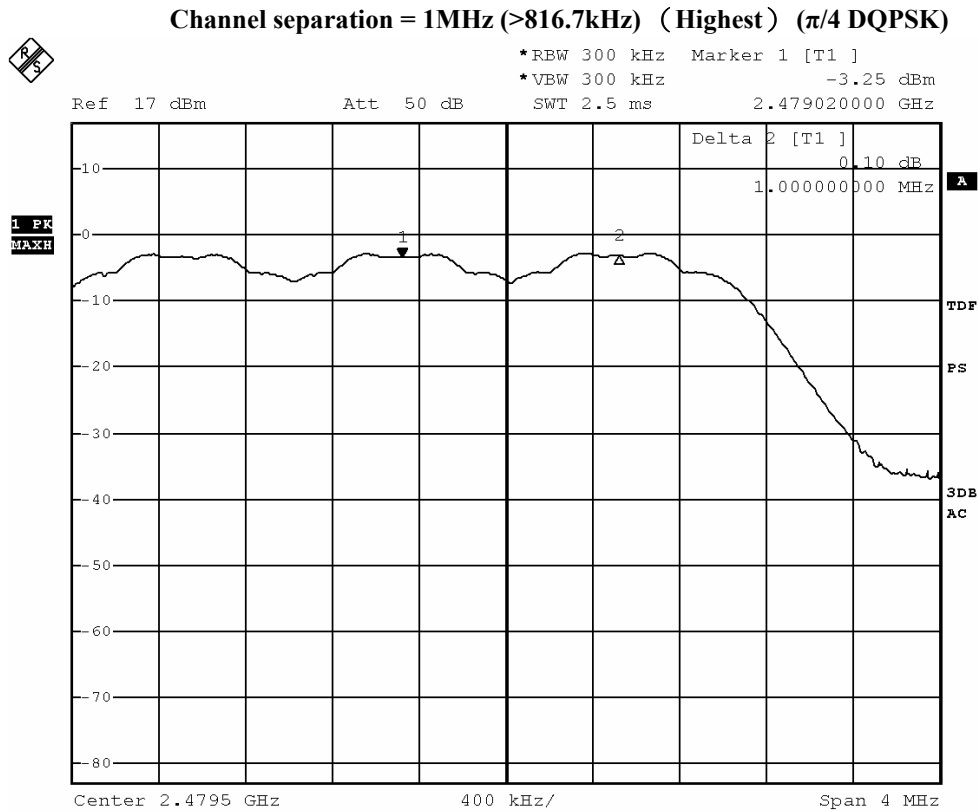


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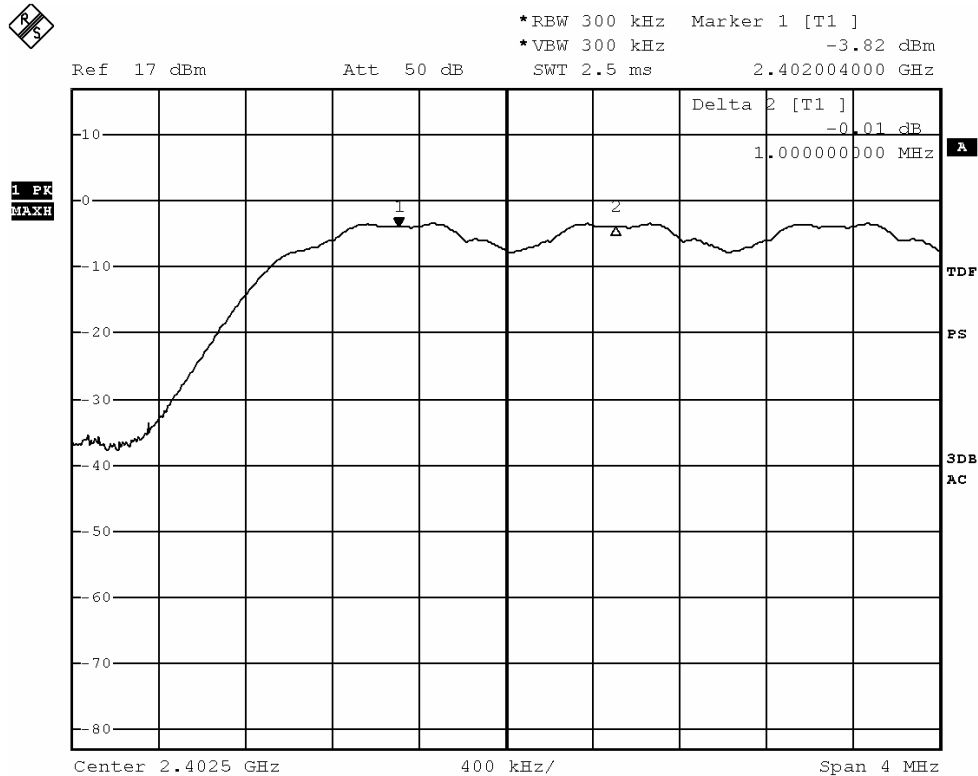
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Channel separation = 1MHz (>816.7kHz) (Lowest) (8DPSK)



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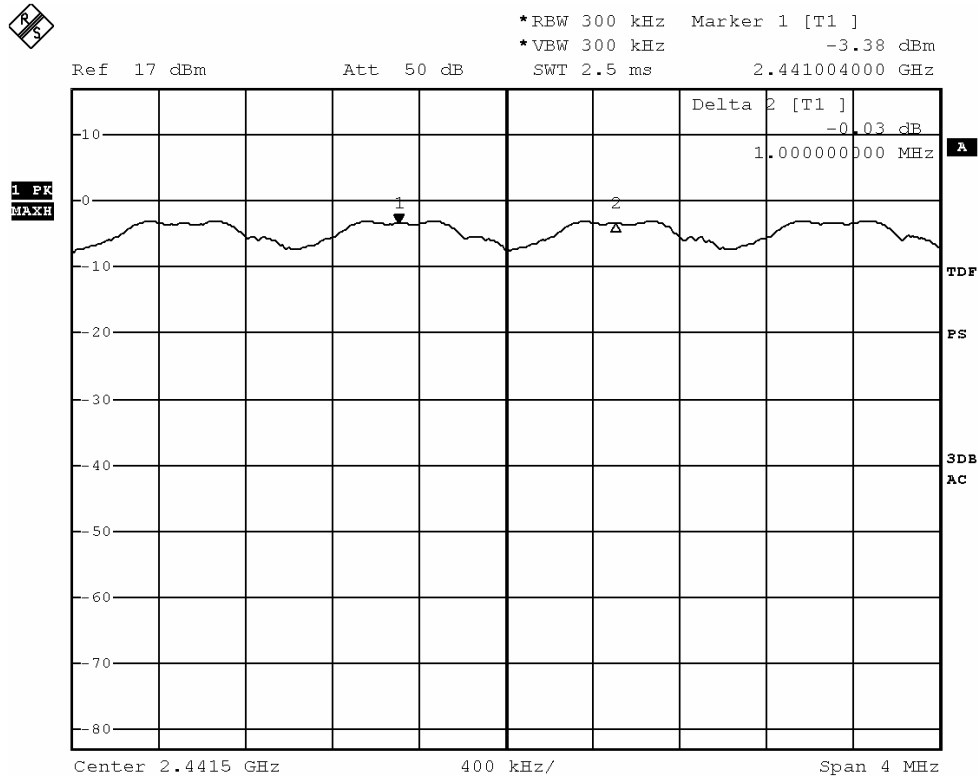
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Channel separation = 1MHz (>816.7kHz) (Mid) (8DPSK)



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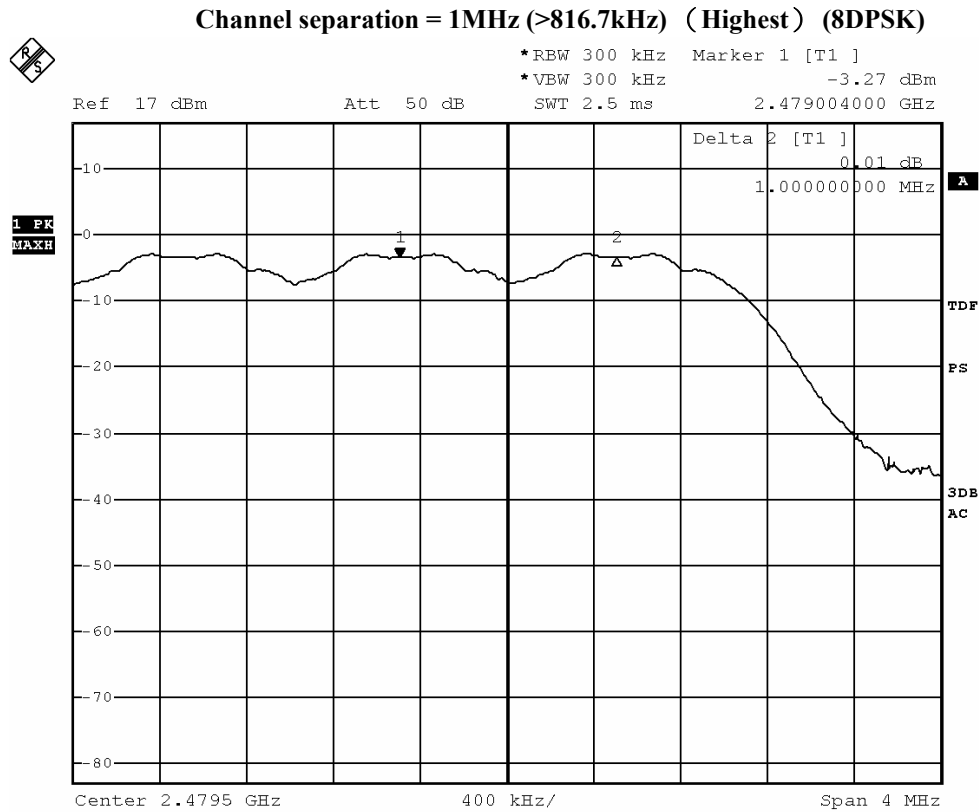


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### **3.1.7 Band-edge Compliance of RF Conducted Emissions Measurement:**

#### **Limit :**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

According to the test method DA 00-705.

#### **Spectrum Analyzer Setting:**

RBW = 100kHz, VBW= 300kHz, Sweep = Coupled,

Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

Detector = Peak, Trace = Max. hold

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

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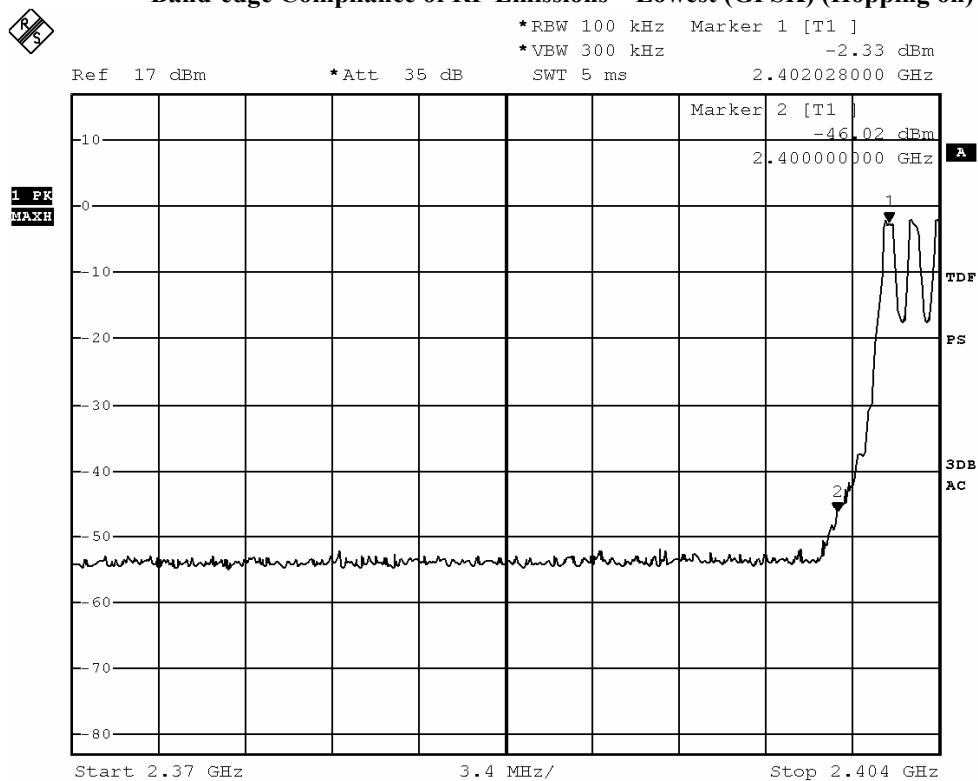
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 43.69                                                      |

### Band-edge Compliance of RF Emissions – Lowest (GFSK) (Hopping on)



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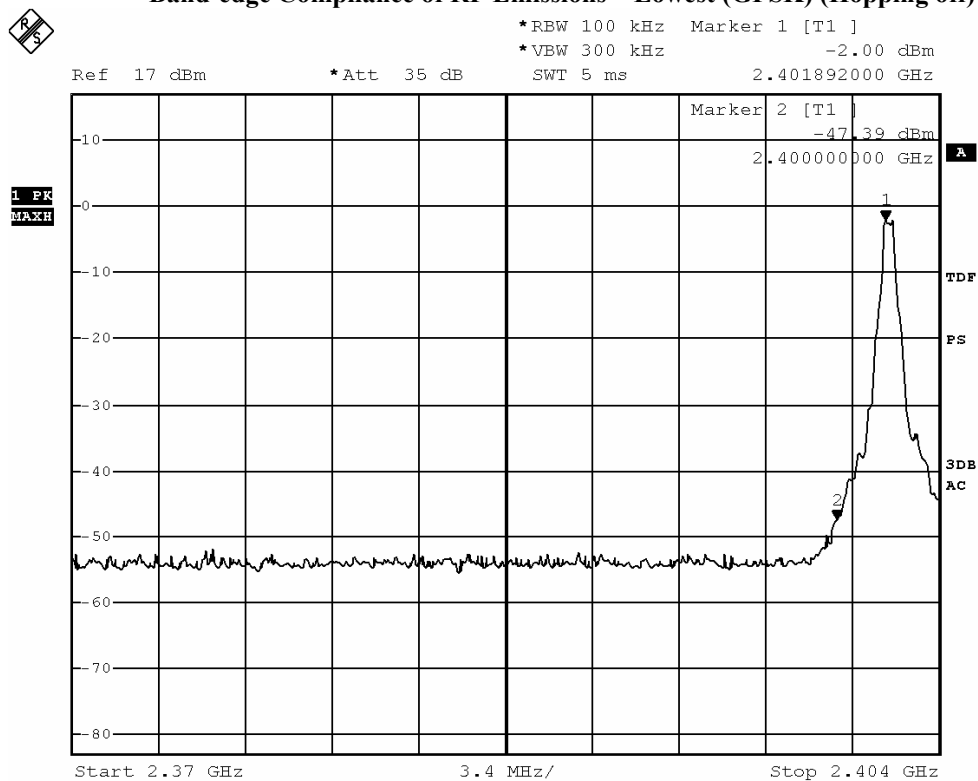
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 45.39                                                      |

### Band-edge Compliance of RF Emissions – Lowest (GFSK) (Hopping off)



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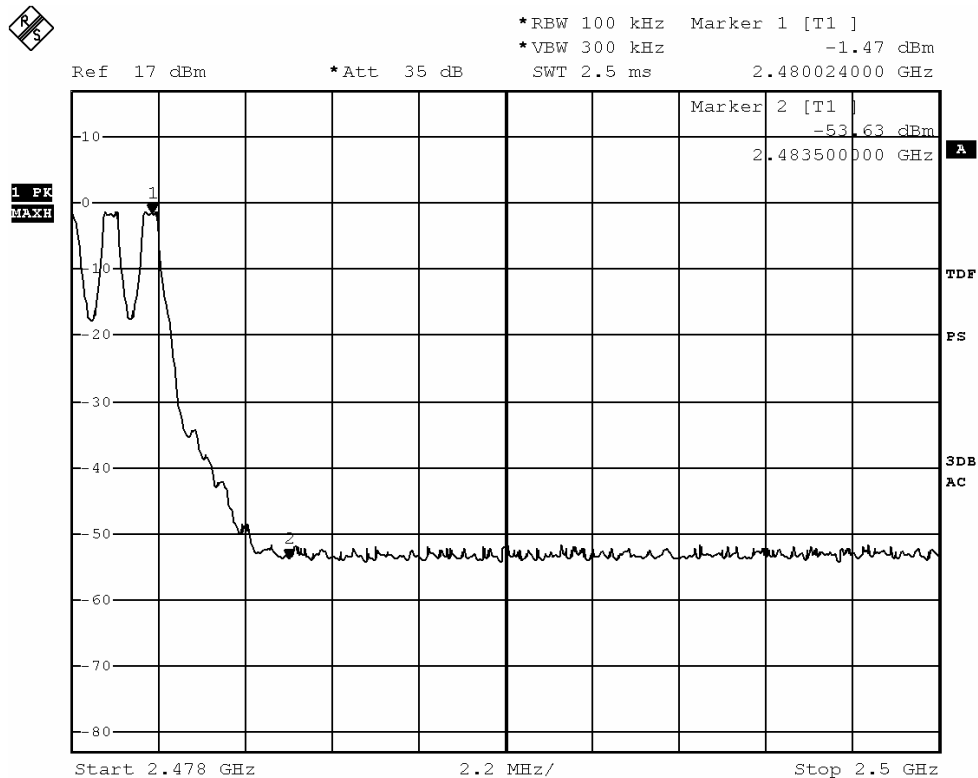
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 52.16                                                      |

### Band-edge Compliance of RF Emissions – Highest (GFSK) (Hopping on)



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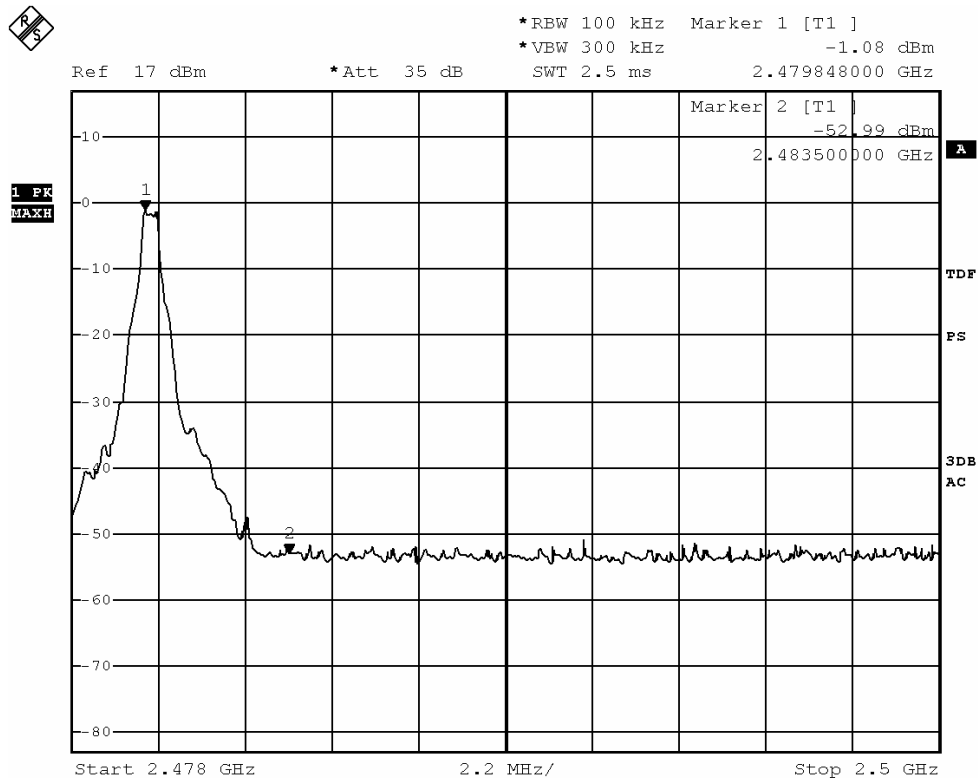
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 51.91                                                      |

### Band-edge Compliance of RF Emissions – Highest (GFSK) (Hopping off)



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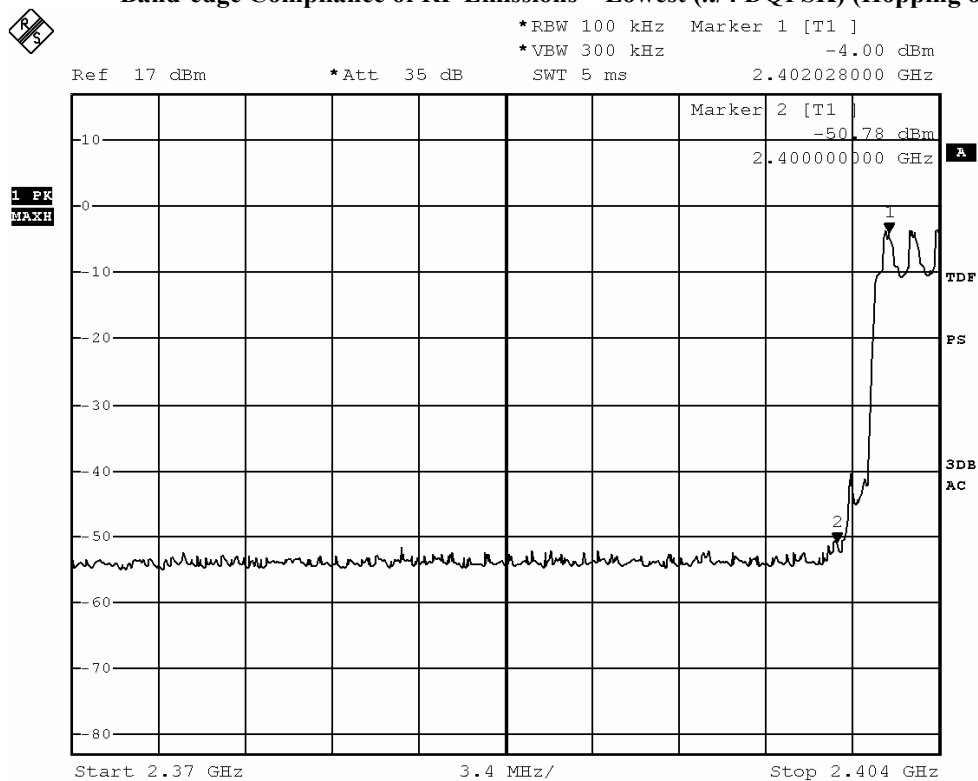
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 46.78                                                      |

### Band-edge Compliance of RF Emissions – Lowest ( $\pi/4$ DQPSK) (Hopping on)



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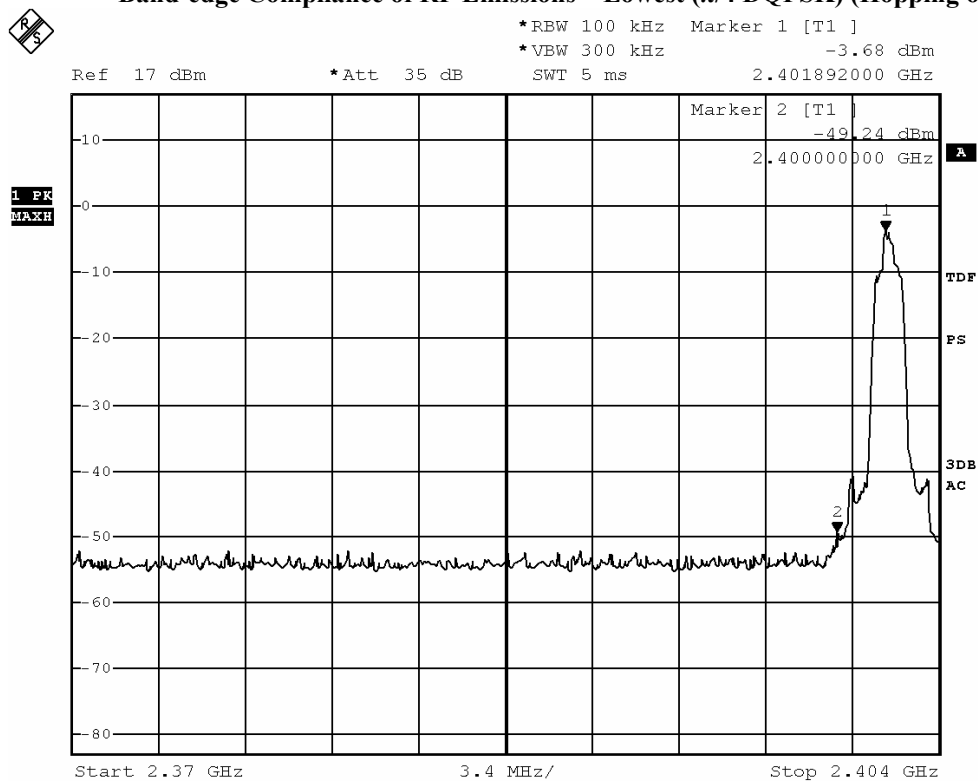
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 45.56                                                      |

### Band-edge Compliance of RF Emissions – Lowest ( $\pi/4$ DQPSK) (Hopping off)



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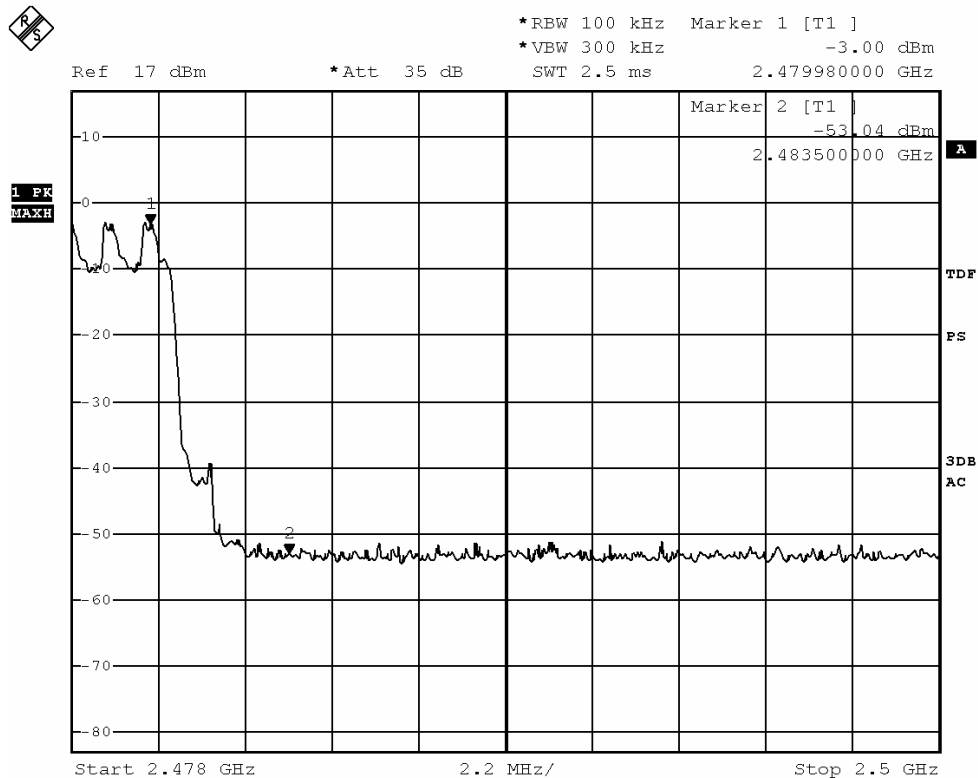
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 50.04                                                      |

### Band-edge Compliance of RF Emissions – Highest ( $\pi/4$ DQPSK) (Hopping on)



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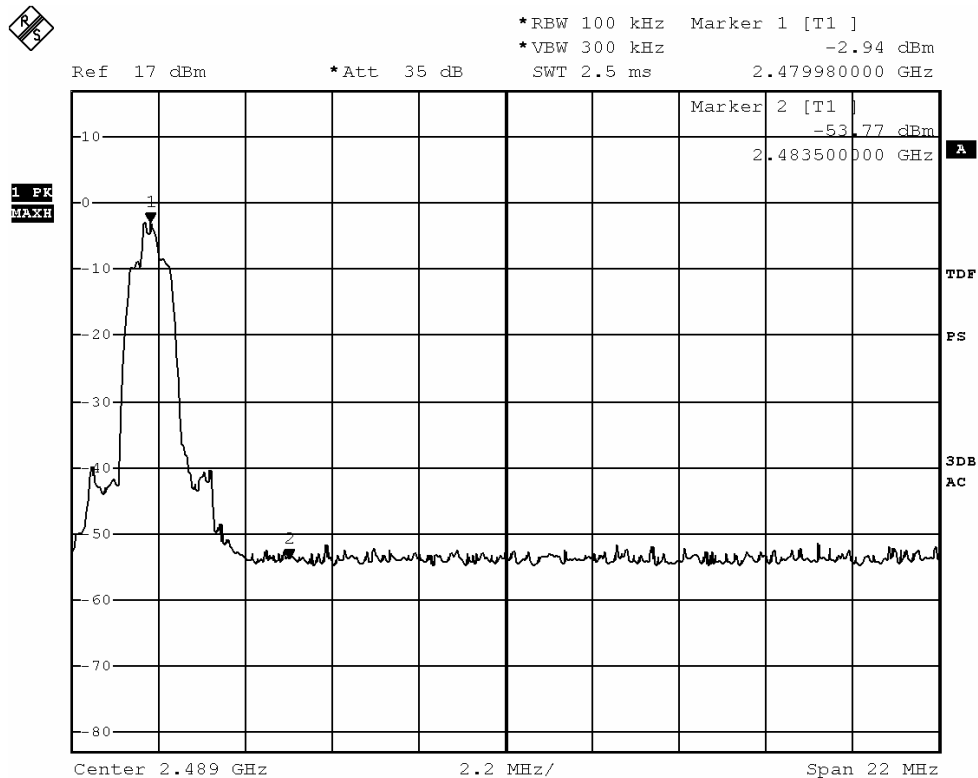
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 50.83                                                      |

### Band-edge Compliance of RF Emissions – Highest ( $\pi/4$ DQPSK) (Hopping off)



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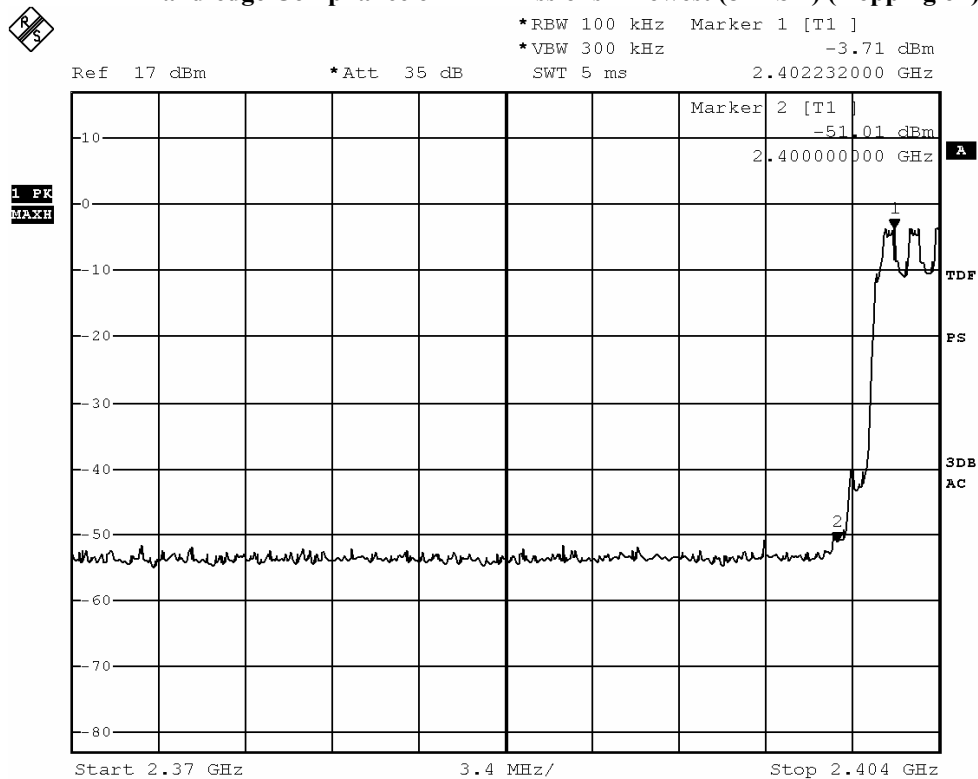
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 47.30                                                      |

### Band-edge Compliance of RF Emissions – Lowest (8DPSK) (Hopping on)



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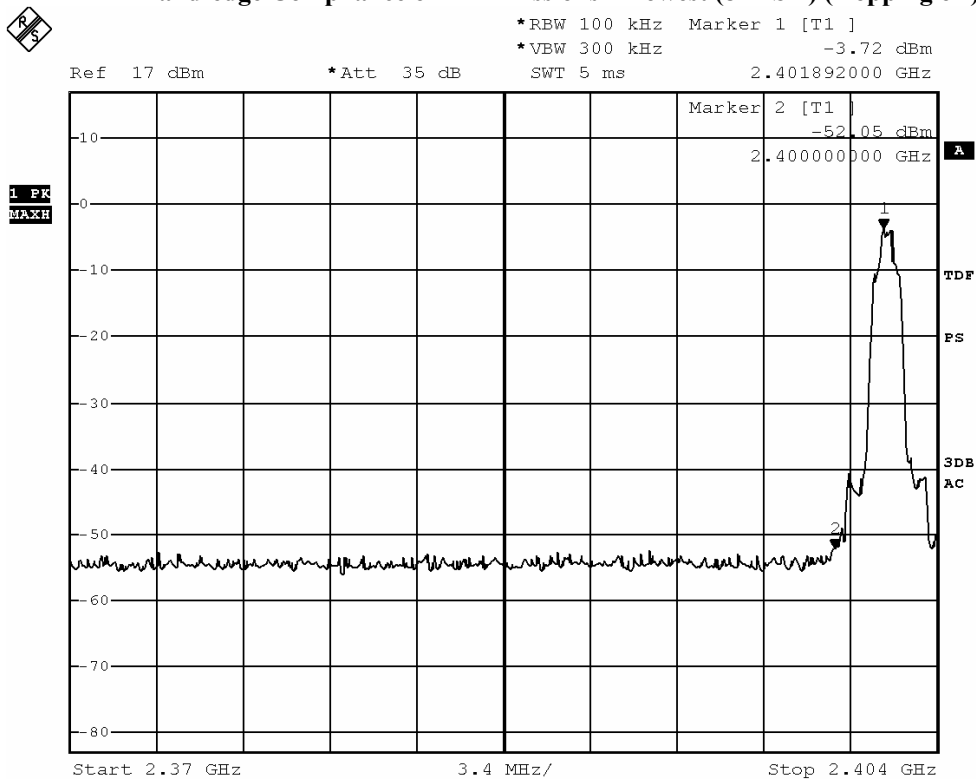
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 48.33                                                      |

### Band-edge Compliance of RF Emissions – Lowest (8DPSK) (Hopping off)



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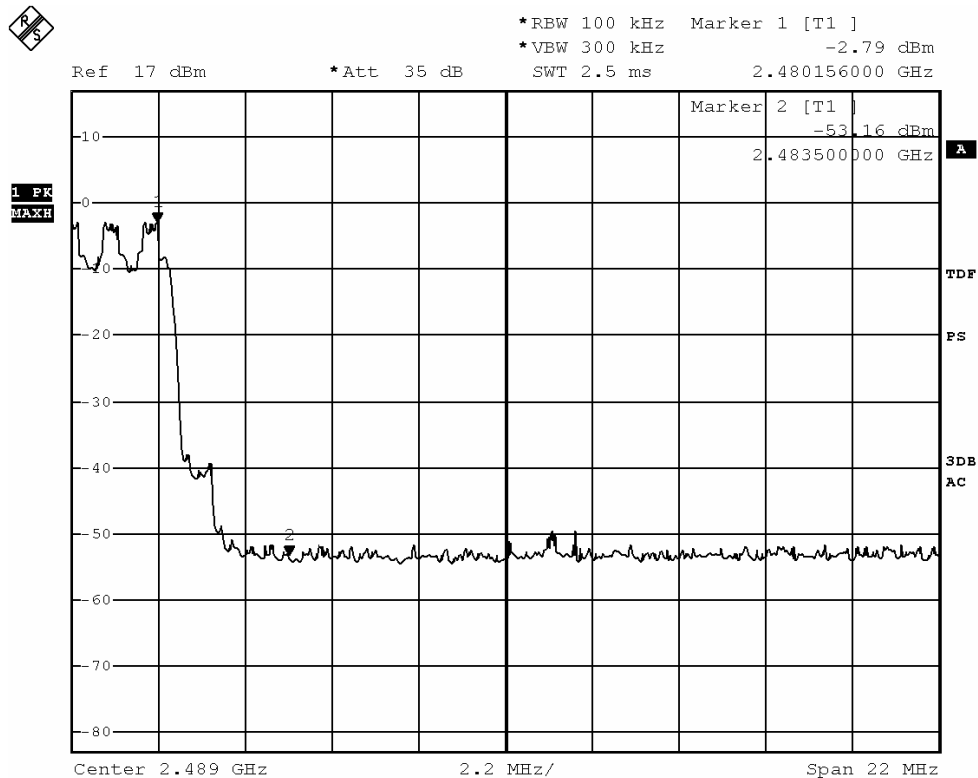
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 50.37                                                      |

### Band-edge Compliance of RF Emissions – Highest (8DPSK) (Hopping on)



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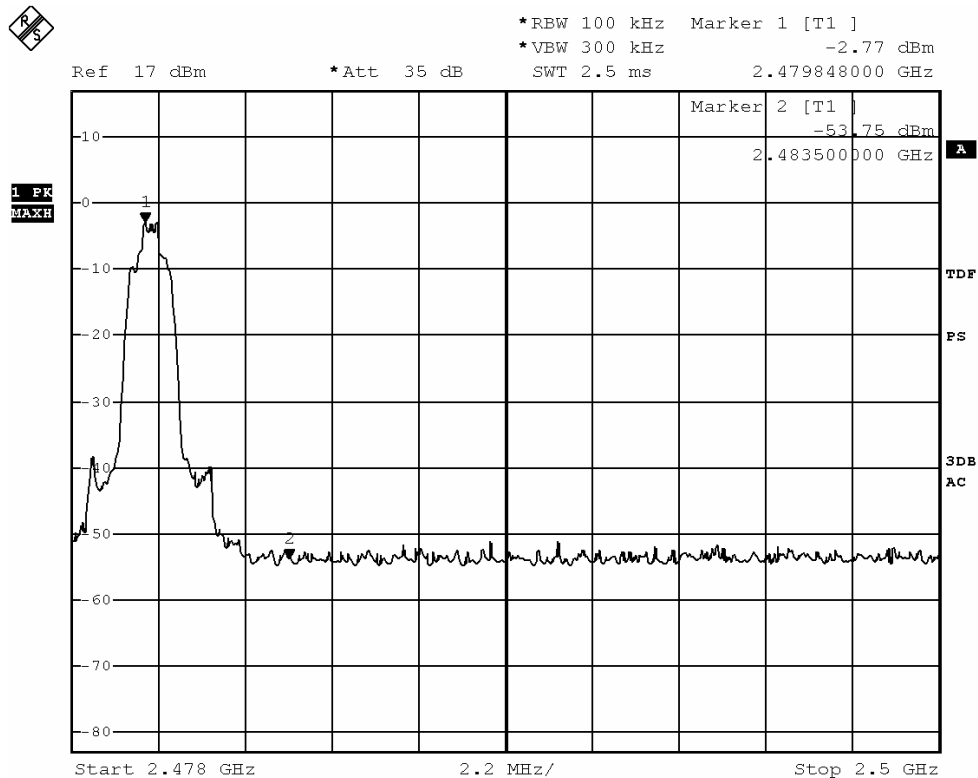
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 50.98                                                      |

### Band-edge Compliance of RF Emissions – Highest (8DPSK) (Hopping off)



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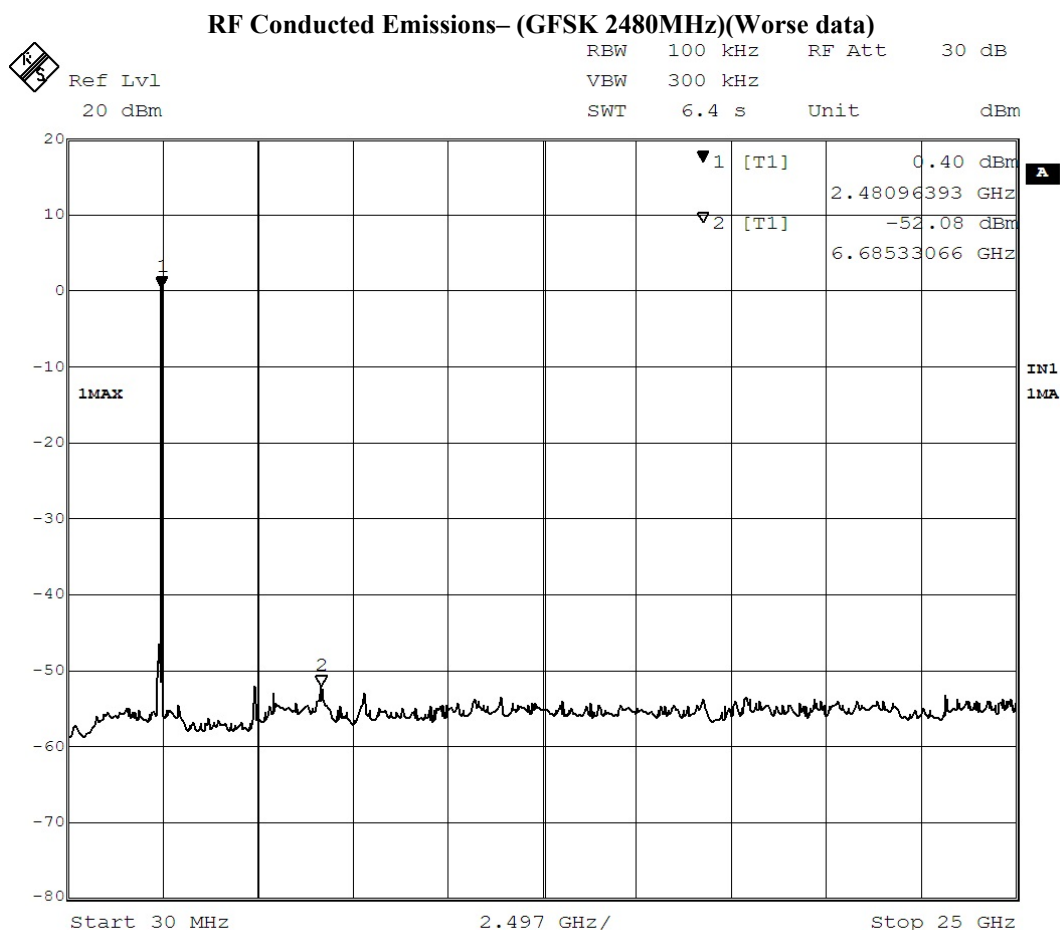
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### RF Conducted Emissions Measurement:

#### Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report



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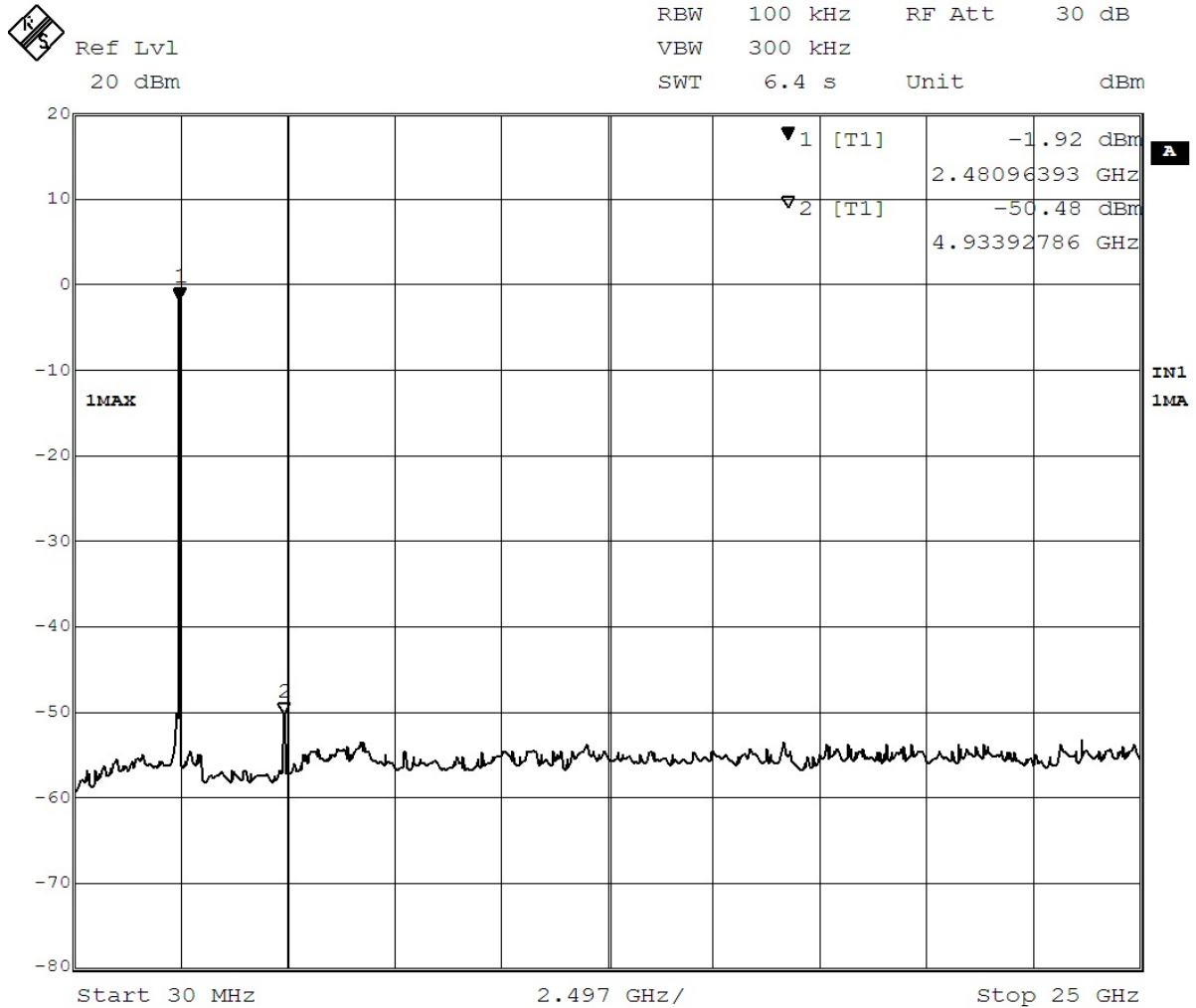
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### RF Conducted Emissions – ( $\pi/4$ -DQPSK 2480MHz) (Worse data)



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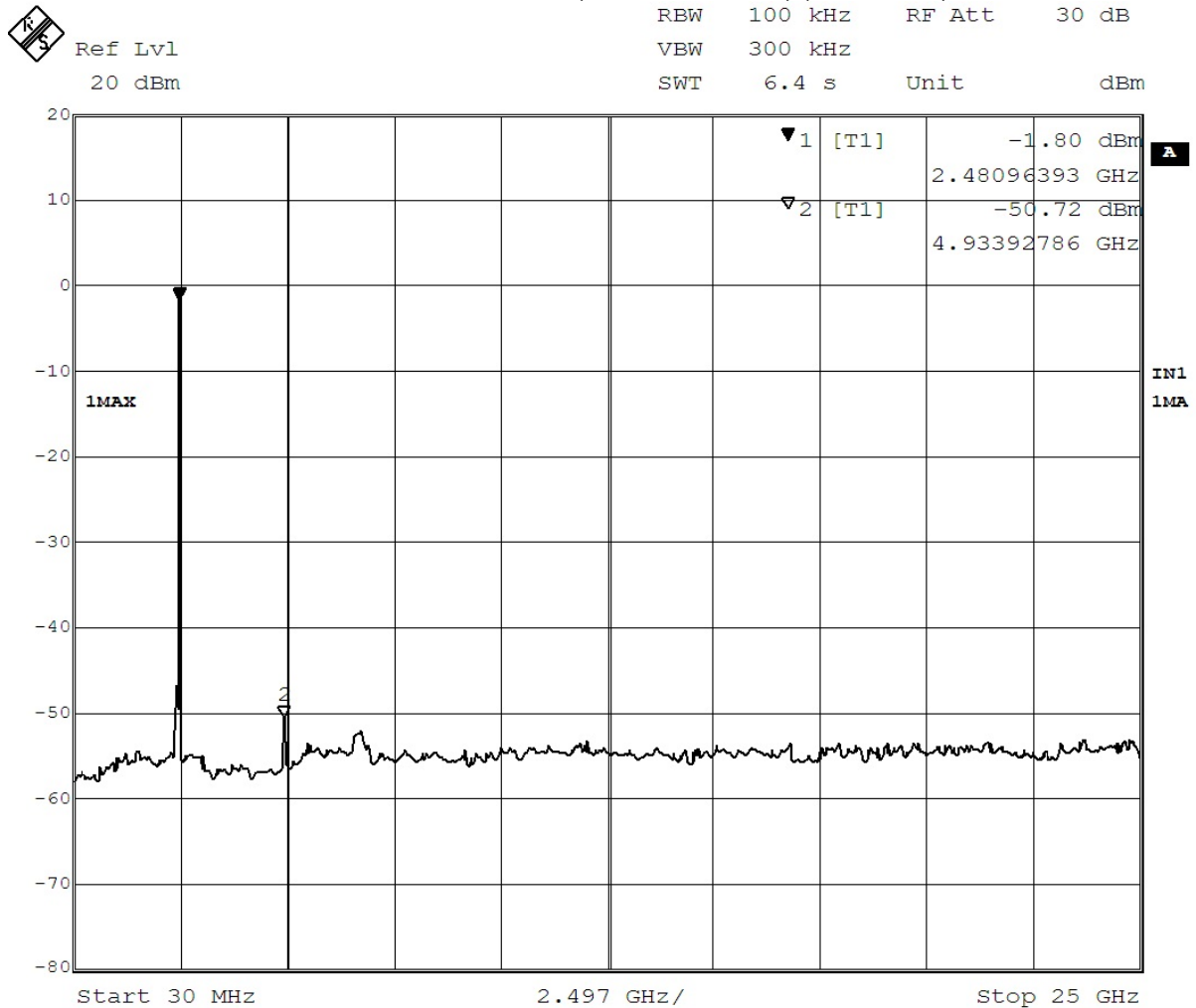


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### RF Conducted Emissions – (8DPSK 2480MHz) (Worse data)



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### 3.1.8 Time of Occupancy (Dwell Time)

#### Requirements:

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 channel employed.

No requirements for Digital Transmission System.

#### Spectrum Analyzer Setting:

RBW = 300kHz, VBW  $\geq$  RBW,

Sweep = A longer sweep time to show two successive hops on a channel,

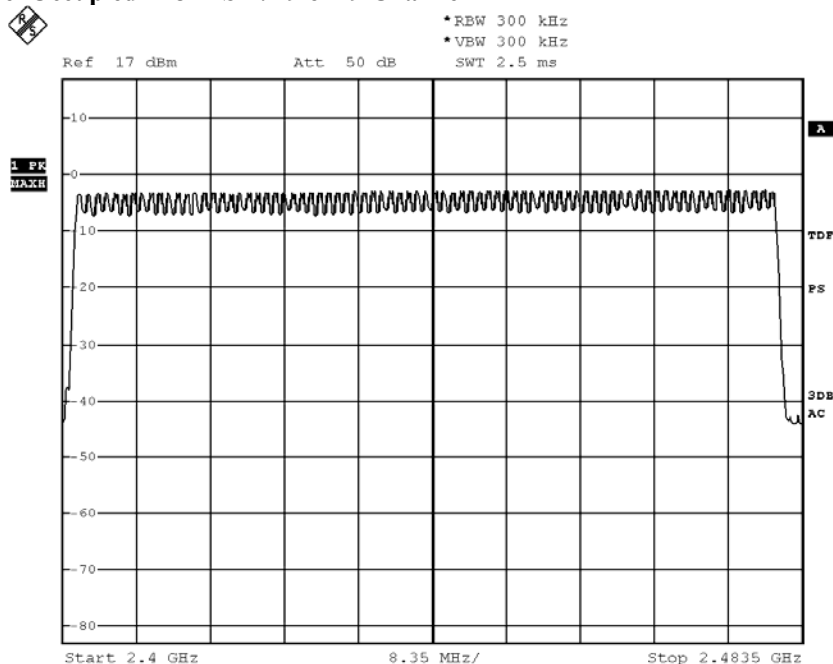
Span = Zero, Detector = Peak, Trace = Max. hold

Dwell Time = Pulse Duration \* hop rate / number of channel \* observation duration

Observed duration: 0.4s x 79 = 31.6s

#### Measurement Data:

##### Channel Occupied in 8DPSK: 79 of 79 Channel



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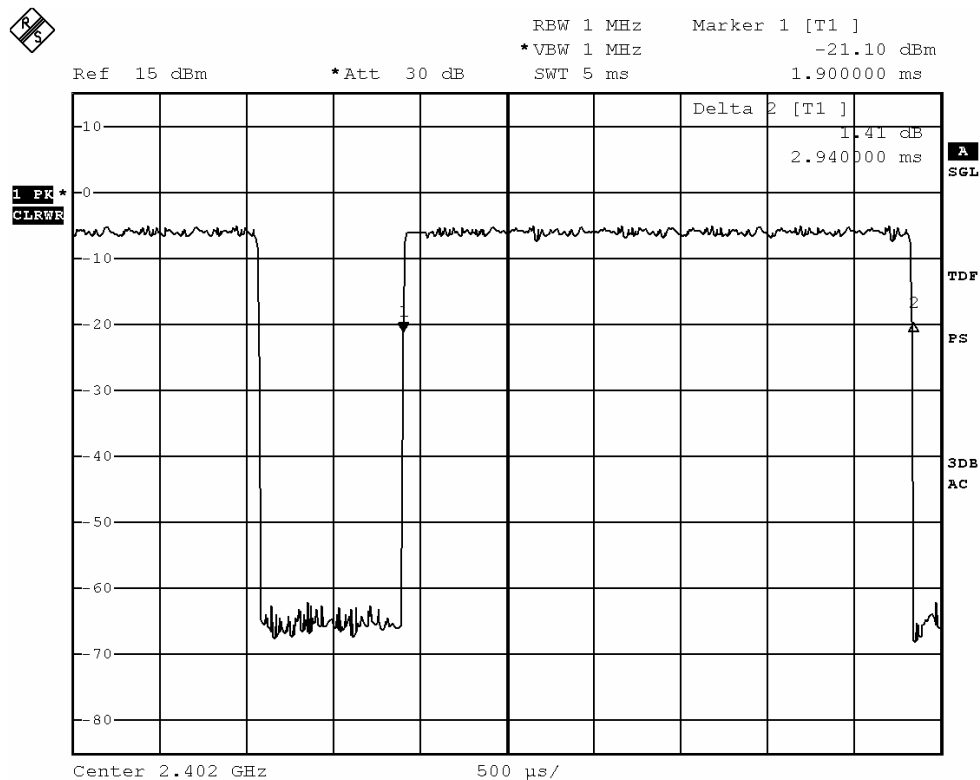
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### DH5 Packet:

DH5 Packet permit maximum  $1600/79/6 = 3.37$  hops per second in each channel (5 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times  $3.37 \times 31.6 = 106.6$  within 31.6 seconds

**Fig. A**  
**[Pulse duration of Lowest Channel]**



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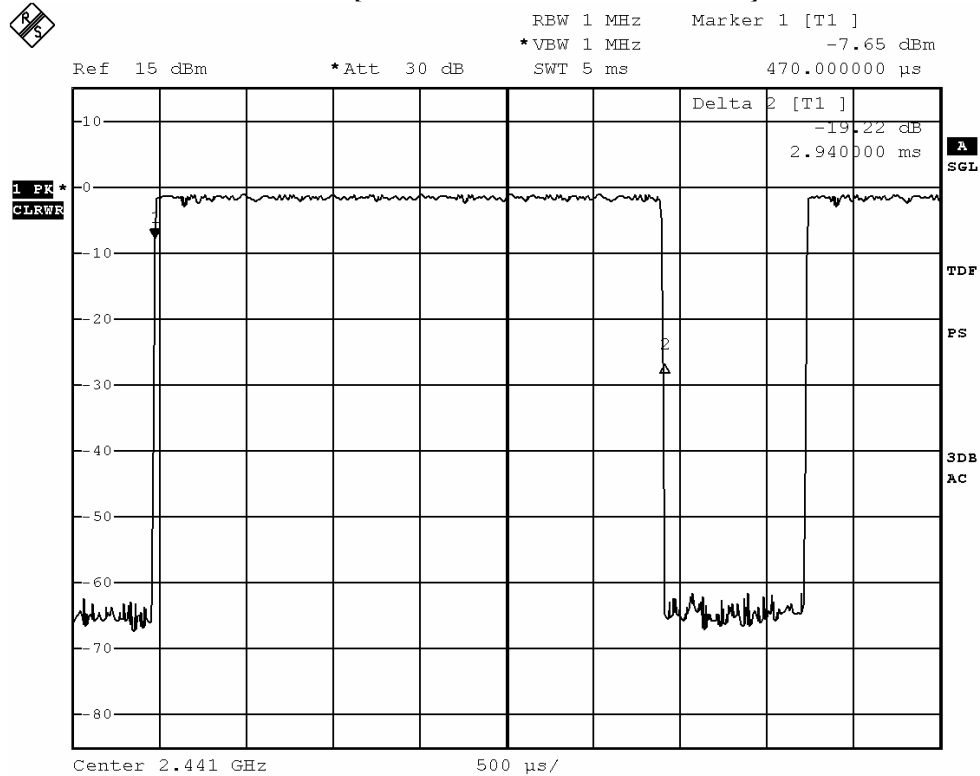
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**Fig. B**  
**[Pulse duration of Middle Channel]**



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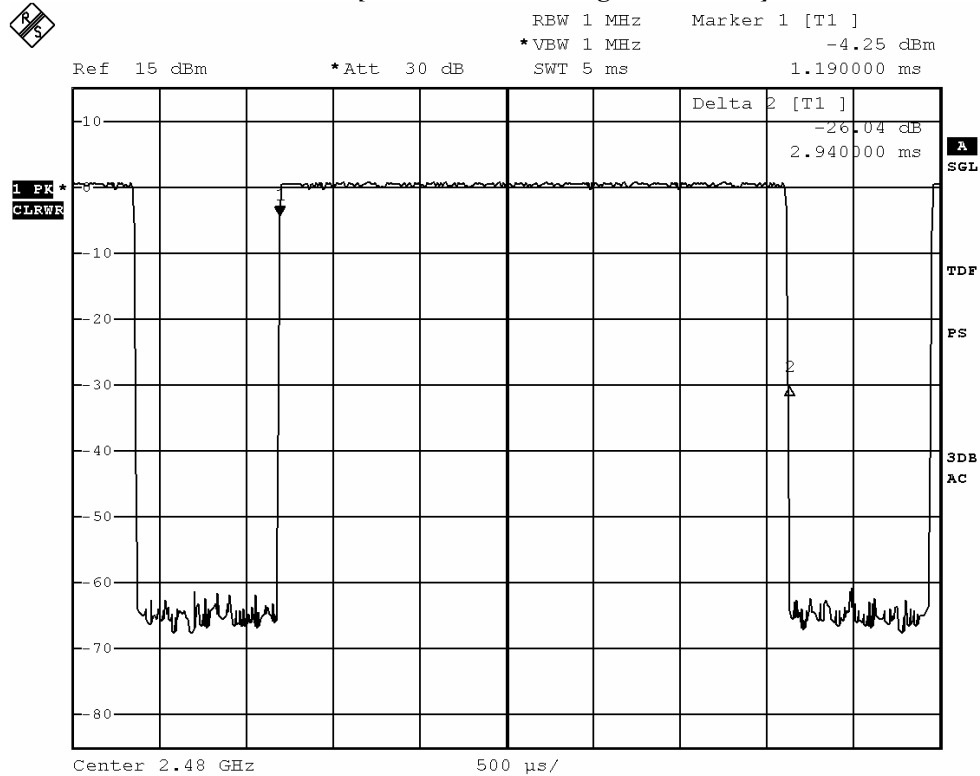
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**Fig. C**  
**[Pulse duration of Highest Channel]**



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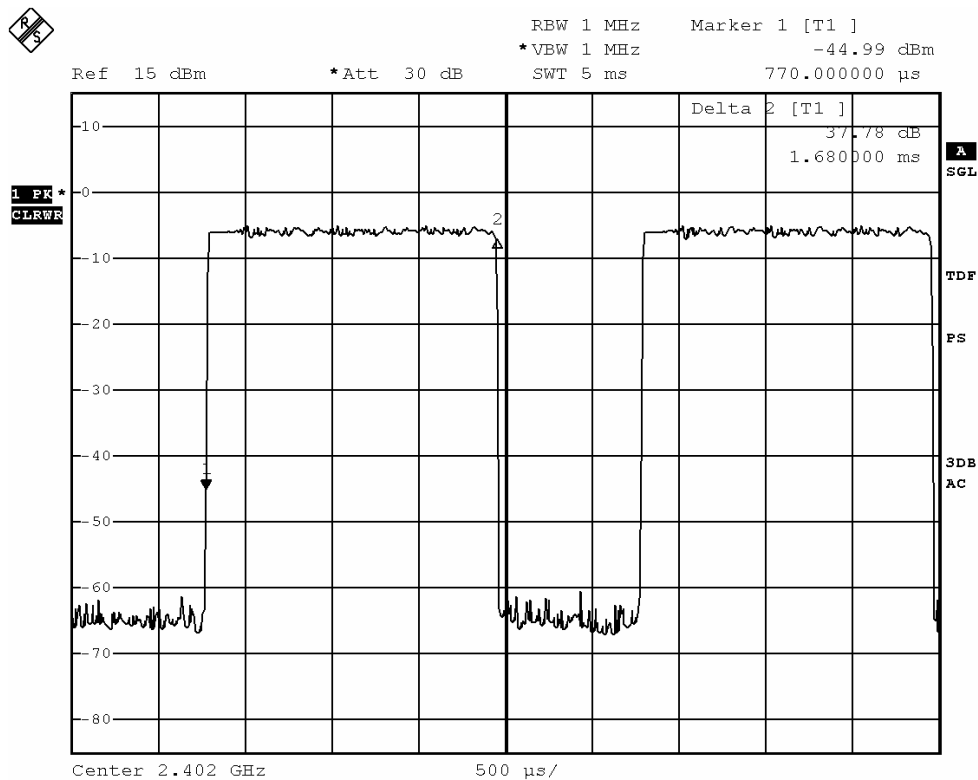
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### DH3 Packet:

DH3 Packet permit maximum  $1600/79/4 = 5.06$  hops per second in each channel (3 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times  $5.06 \times 31.6 = 160$  within 31.6 seconds

**Fig. D**  
**[Pulse duration of Lowest Channel]**



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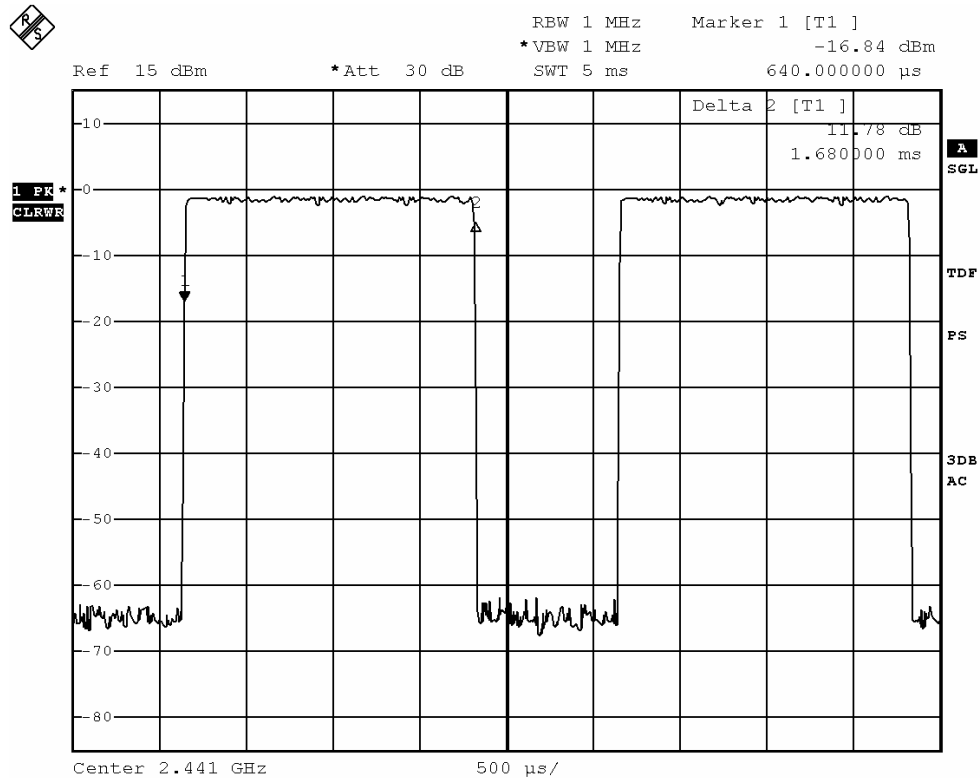
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**Fig. E**  
**[Pulse duration of Middle Channel]**



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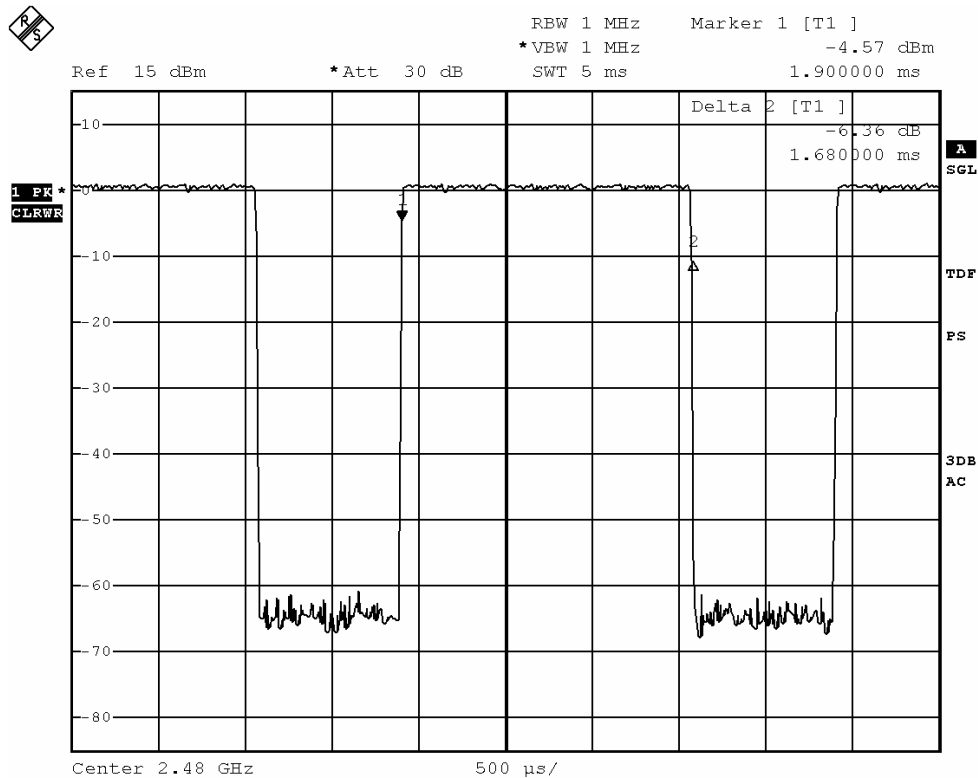
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**Fig. F**  
**[Pulse duration of Highest Channel]**



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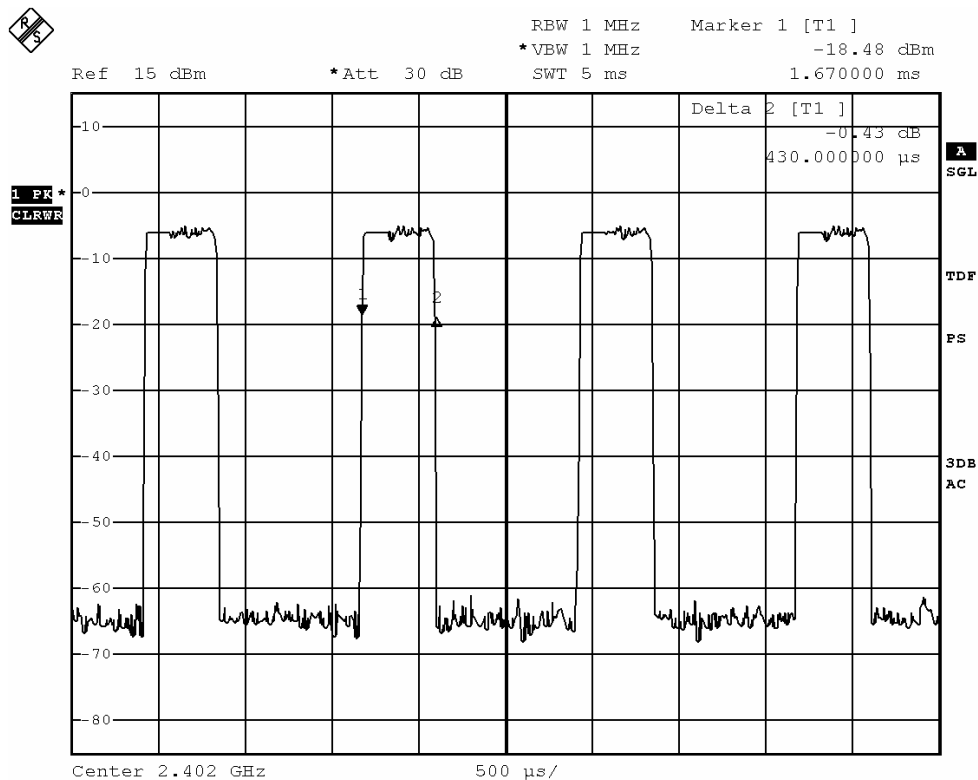
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### DH1 Packet:

DH1 Packet permit maximum  $1600/79/2 = 10.12$  hops per second in each channel (3 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times  $10.12 \times 31.6 = 320$  within 31.6 seconds

**Fig. G**  
**[Pulse duration of Lowest Channel]**



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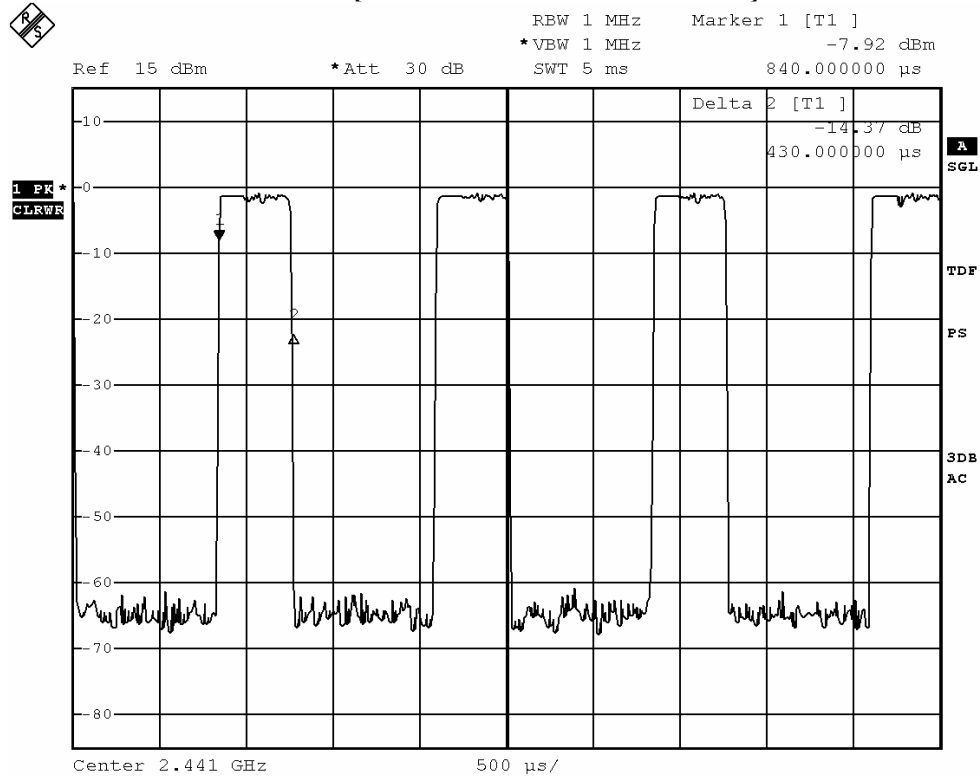
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**Fig. H**  
**[Pulse duration of Middle Channel]**



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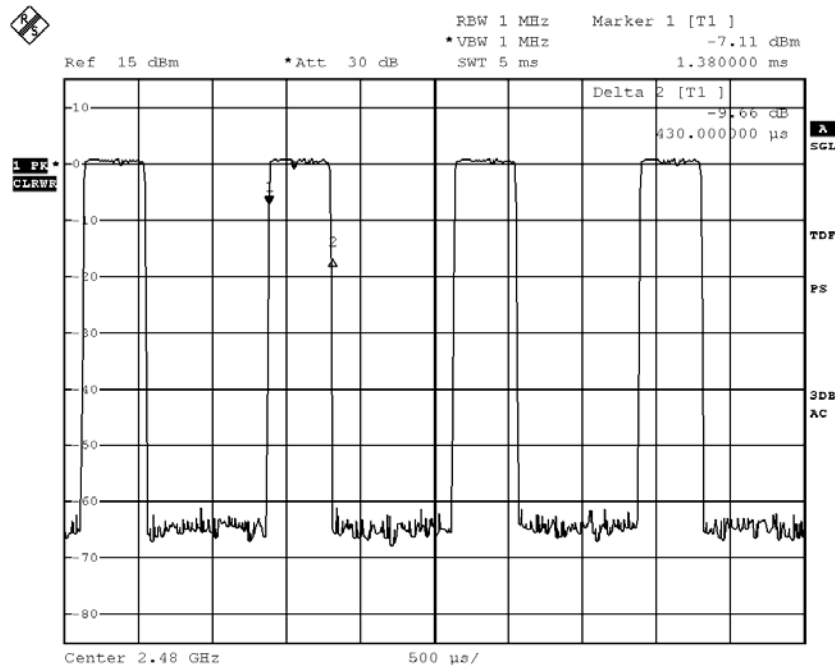
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**Fig. I**  
**[Pulse duration of Highest Channel]**



Time of occupancy (Dwell Time):

| Data Packet | Frequency (MHz) | Pulse Duration (ms) | Dwell Time (s) | Limits (s) | Test Results |
|-------------|-----------------|---------------------|----------------|------------|--------------|
| DH5         | 2402            | 2.940               | 0.313          | 0.400      | Complies     |
| DH5         | 2441            | 2.940               | 0.313          | 0.400      | Complies     |
| DH5         | 2480            | 2.940               | 0.313          | 0.400      | Complies     |
| DH3         | 2402            | 1.680               | 0.268          | 0.400      | Complies     |
| DH3         | 2441            | 1.680               | 0.268          | 0.400      | Complies     |
| DH3         | 2480            | 1.680               | 0.268          | 0.400      | Complies     |
| DH1         | 2402            | 0.430               | 0.137          | 0.400      | Complies     |
| DH1         | 2441            | 0.430               | 0.137          | 0.400      | Complies     |
| DH1         | 2480            | 0.430               | 0.137          | 0.400      | Complies     |

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### 3.1.9 Channel Centre Frequency

#### **Requirements:**

Frequency hopping system in the 2400-2483.5MHz band shall use at least 79 (Channel 1 to 79) non-overlapping channels.

The EUT operates in according with the Bluetooth system specification within the 2400 - 2483.5 MHz frequency band.

RF channels for Bluetooth systems are spaced 1 MHz and are ordered in channel number k. In order to comply with out-of-band regulations, a lower frequency guard band of 2.0 MHz and a higher frequency guard band of 3.5MHz is used.

The operating frequencies of each channel are as follows:

First RF channel start from 2400MHz + 2MHz guard band = 2402MHz

Frequency of RF Channel = 2402+k MHz, k = 1,...,79 (Channel separation = 1MHz)

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### **3.1.10 Pseudorandom Hopping Algorithm**

#### **Requirements:**

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

#### **EUT Pseudorandom Hopping Algorithm**

The EUT is a Bluetooth device, the Pseudo-random hopping pattern; hopping characteristics and algorithm are based on the Bluetooth specification.

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### **3.1.11 Antenna Requirement**

**Test Requirements: § 15.203**

#### **Test Specification:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

#### **Test Results:**

This is PCB antenna. There is no external antenna, the antenna gain = -0.66dBi. User is unable to remove or changed the Antenna.

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### 3.1.12 RF Exposure

Test Requirement: FCC 47CFR 15.247(i)  
Test Date: 2017-03-24  
Mode of Operation: Tx mode

#### Test Method:

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

#### Test Results:

The EUT complied with the requirement(s) of this section.  
EUT meets the requirements of these sections as proven through MPE calculation  
The MPE calculation for EUT @ 20cm  
Based on the highest P = 1.91 mW

$$\begin{aligned} P_d &= PG / 4\pi R^2 = (1.91 \times 0.86) / 12.566 \times (20)^2 \\ &= (1.641) / 12.566 \times 400 = 1.641 / 5026.4 \\ &= 0.000326 \text{ mW/cm}^2 \end{aligned}$$

where:

- \*  $P_d$  = power density in mW/cm<sup>2</sup>
- \* G = Antenna numeric gain (0.86);  $\text{Log } G = g/10$  (  $g = -0.66\text{dBi}$  ).
- \* P = Conducted RF power to antenna (1.91 mW).
- \* R = Minimum allowable distance.(20 cm)

- \*The power density  $P_d = 0.000326 \text{ mW/cm}^2$  is less than 1 mW/cm<sup>2</sup> (listed MPE limit)
- \*The SAR evaluation is not needed ( this is a desk top device,  $R > 20 \text{ cm}$  )
- \* The EUT( antenna ) must be 0.2 meters away from the General Population.

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### Appendix A

#### List of Measurement Equipment

| EQP NO. | DESCRIPTION                                  | MANUFACTURER              | MODEL NO.         | SERIAL NO.     | LAST CAL   | DUE CAL    |
|---------|----------------------------------------------|---------------------------|-------------------|----------------|------------|------------|
| EMD004  | LISN                                         | ROHDE & SCHWARZ           | ESH3-Z5           | 100102         | 2016.3.29  | 2017.3.29  |
| EMD022  | EMI Test Receiver                            | ROHDE & SCHWARZ           | ESCS30            | 100314         | 2016.3.29  | 2017.3.29  |
| EMD035  | EMI Test Receiver                            | ROHDE & SCHWARZ           | ESCI              | 100441         | 2016.3.29  | 2017.3.29  |
| EMD036  | EMI Test Receiver                            | ROHDE & SCHWARZ           | ESIB 26           | 100388         | 2016.3.29  | 2017.3.29  |
| EMD041  | TWO-LINE V-NETWORK                           | ROHDE & SCHWARZ           | ENV216            | 100261         | 2016.3.29  | 2017.3.29  |
| EMD061  | Biconilog Antenna                            | ETS.LINDGREN              | 3142C             | 00060439       | 2016.12.30 | 2018.12.30 |
| EMD062  | Double-Ridged Waveguide (1GHz – 18GHz)       | ETS.LINDGREN              | 3117              | 00075933       | 2014.11.15 | 2017.11.15 |
| EMD084  | MULTI-DVICE CONTROLLER                       | ETS.LINDGREN              | 2090              | 00060107       | N/A        | N/A        |
| EMD088  | Video Contol Unit                            | ETS.LINDGREN              | Y21953A           | 2601073        | N/A        | N/A        |
| EMD093  | Monitor                                      | ViewSonic                 | VA9036            | Q8X064201876   | N/A        | N/A        |
| EMD102  | Intelligent Frequency                        | Ainuo Instrument Co., Ltd | AN97005SS         | 79707454       | N/A        | N/A        |
| EMD103  | Intelligent Frequency                        | Ainuo Instrument Co., Ltd | AN97005SS         | 79707455       | N/A        | N/A        |
| EMD105  | FACT-3 EMC Chamber                           | ETS.LINDGREN              | FACT-3            | 3803           | N/A        | N/A        |
| EMD106  | Shielding Room #1                            | ETS.LINDGREN              | RFD-100           | 3802           | N/A        | N/A        |
| EMD111  | Power meter                                  | ROHDE & SCHWARZ           | NRVD              | 102051         | 2016.3.29  | 2017.3.29  |
|         | 100V Insertion Unit                          | ROHDE & SCHWARZ           | URV5-Z4           | 100464         | 2016.3.29  | 2017.3.29  |
| EMD113  | Pre-Amplifier                                | ROHDE & SCHWARZ           | N/A               | 1129588        | 2016.3.29  | 2017.3.29  |
| EMD124  | Loop Antenna                                 | ETS-Lindgren              | 6502              | 00104905       | 2016.05.23 | 2017.05.23 |
| EMD131  | Standard Gain Horn Antenna (18GHz – 26.5GHz) | Chengdu AINFO Inc.        | JXTXLB-42-15-C-KF | J2021100721001 | 2015.04.09 | 2017.04.09 |
| RE01    | RF cable                                     | N/A                       | N/A               | N/A            | 2016-9-28  | 2018-9-27  |
| RE02    | RF cable                                     | N/A                       | N/A               | N/A            | 2016-9-28  | 2018-9-27  |

Remarks:-

N/A Not Applicable or Not Available

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