



## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 1 of 73

**Applicant** : Huizhou Qingteng Electron Technology Co., Ltd  
Ho Pei Village, Pan Li, Li Lin Town, Hui Cheung District, Hui Zhou  
City, Guang Dong Province, China

**Supplier / Manufacturer** : Huizhou Qingteng Electron Technology Co., Ltd  
Ho Pei Village, Pan Li, Li Lin Town, Hui Cheung District, Hui Zhou  
City, Guang Dong Province, China

**Description of Sample(s)** : Submitted sample(s) said to be  
Product: Glow Tunes Speaker  
Brand Name: Sakar  
Model No.: SP2-14136A  
FCC ID: 2AAWNSP214136ABTS

**Date Samples Received** : 2019-12-23

**Date Tested** : 2019-12-24 to 2019-12-30

**Investigation Requested** : Perform Electro Magnetic Interference measurement in accordance  
with FCC 47CFR [Codes of Federal Regulations] Part 15 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)

  
  
CHEUNG Chi, Kenneth  
Authorized Signatory



## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 2 of 73

### CONTENT:

Cover	Page 1 of 73
Content	Page 2 of 73
<b><u>1.0 General Details</u></b>	
1.1 Test Laboratory	Page 3 of 73
1.2 Equipment Under Test [EUT] Description of EUT operation	Page 3 of 73
1.3 Date of Order	Page 3 of 73
1.4 Submitted Sample(s)	Page 3 of 73
1.5 Test Duration	Page 3 of 73
1.6 Country of Origin	Page 3 of 73
1.7 RF Module Details	Page 4 of 73
1.8 Antenna Details	Page 4 of 73
1.9 Channel List	Page 4 of 73
<b><u>2.0 Technical Details</u></b>	
2.1 Investigations Requested	Page 5-6 of 73
2.2 Test Standards and Results Summary	Page 7 of 73
2.3 Table for Test Modes	Page 8 of 73
<b><u>3.0 Test Results</u></b>	
3.1 Emission	Page 9-68 of 73
<b><u>Appendix A</u></b>	
List of Measurement Equipment	Page 69 of 73
<b><u>Appendix B</u></b>	
Photograph(s) of Product	Page 70-73 of 73

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 3 of 73

### **1.0 General Details**

#### **1.1 Test Laboratory**

The Hong Kong Standards and Testing Centre Ltd.  
EMC Laboratory  
10 Dai Wang Street, Taipo Industrial Estate, New Territories, Hong Kong  
Telephone: 852 2666 1888  
Fax: 852 2664 4353

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

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

Product:	Glow Tunes Speaker
Manufacturer:	Huizhou Qingteng Electron Technology Co., Ltd Ho Pei Village, Pan Li, Li Lin Town, Hui Cheung District, Hui Zhou City, Guang Dong Province, China
Brand Name:	Sakar
Model Number:	SP2-14136A
Rating:	5.0Vd.c. Powered by USB port/ 3.7 Vd.c. (1*3.7Vd.c. Rechargeable battery) lithium battery
RF Power:	0.5mW-3mW

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

The Equipment Under Test (EUT) is a Glow Tunes 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**

2019-12-23

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

1 Sample

#### **1.5 Test Duration**

2019-12-24 to 2019-12-30

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

China

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 4 of 73

### 1.7 RF Module Details

Module Model Number: IC: AC6925B  
Module FCC ID: N/A  
Module Transmission Type: Bluetooth V2.1 EDR  
Modulation: FHSS (GFSK /  $\pi/4$ -DQPSK)  
Data Rates: 1Mbps: GFSK  
2 Mbps:  $\pi/4$ -DQPSK  
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: -0.58dBi

### 1.9 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	42	2444
1	2403	43	2445
2	2404	44	2446
3	2405	45	2447
4	2406	46	2448
5	2407	47	2449
6	2408	48	2450
7	2409	...	...
8	2410	67	2469
9	2411	68	2470
...	...	69	2471
33	2435	70	2472
34	2436	71	2473
35	2437	72	2474
36	2438	73	2475
37	2439	74	2476
38	2440	75	2477
39	2441	76	2478
40	2442	77	2479
41	2443	78	2480

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 5 of 73

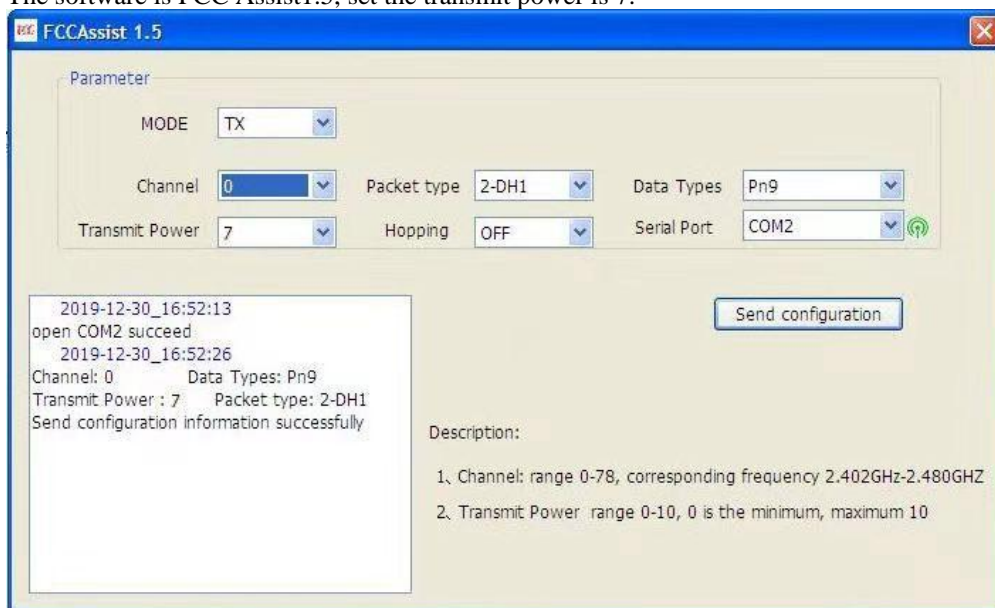
### 2.0 Technical Details

#### 2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 Regulations and ANSI C63.10:2013 for FCC Certification.  
According FCC KDB 558074 DSS Measurement Guidance, Duty cycle  $\geq 98\%$ .  
The test mode sample is provided by manufacturer.

##### 2.1.0 Operating conditions for the EUT

The sample went into test mode using the software.  
The software is FCC Assist1.5, set the transmit power is 7.



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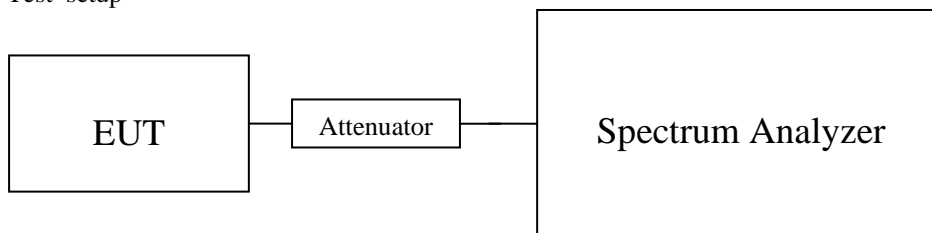
Page 6 of 73

### 2.1.1 EUT Duty cycle

The EUT shall be configured or modified to transmit continuously. The intent is to test at 100% duty cycle; however, a small reduction in duty cycle (to no lower than 98%) is permitted if required by the EUT for amplitude control purposes.

The test mode sample is provided by manufacturer.

Test setup



Results

Mode	On Time (msec)	Period (msec)	Duty Cycle X (Linear)	Duty Cycle (%)*
GFSK	1	1	1	100
$\pi/4$ -DQPSK	1	1	1	100

-\*: If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

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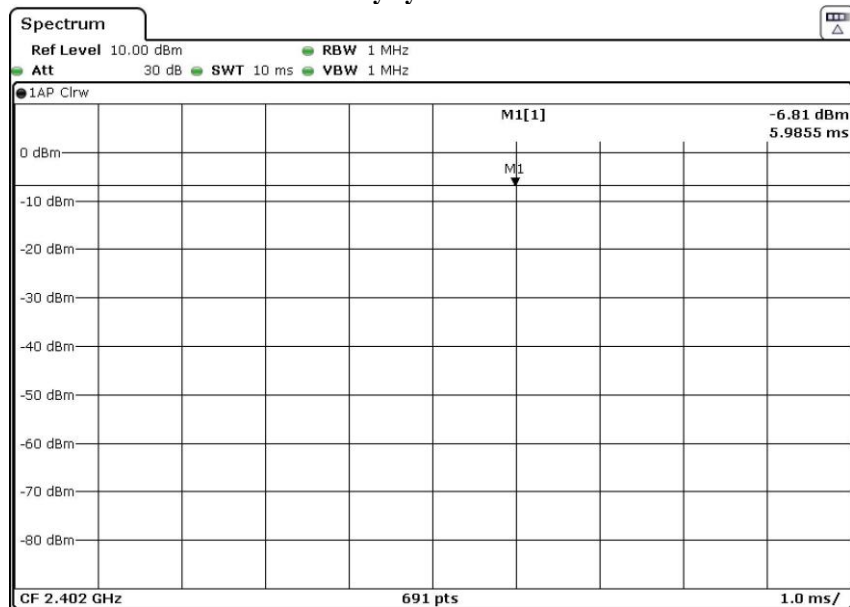


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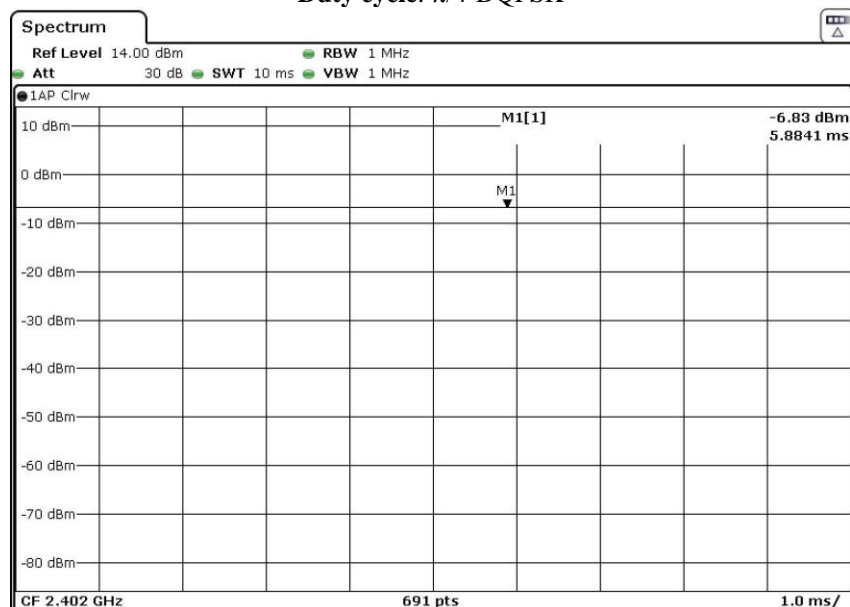
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No. : HMD19120015

Page 7 of 73

Duty cycle: GFSK



Duty cycle:  $\pi/4$ -DQPSK



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Date : 2019-12-30  
No. : HMD19120015

Page 8 of 73

### 2.2 Test Standards and Results Summary Tables

EMISSION Results Summary						
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"/>

Note: N/A - Not Applicable

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 9 of 73

### 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	1MBps / 2MBps
Hopping Channel Separation	GFSK / $\pi/4$ -DQPSK	1MBps / 2MBps
Number of Hopping Frequency	GFSK / $\pi/4$ -DQPSK	1MBps / 2MBp
Time of Occupancy(Dwell Time)	$\pi/4$ -DQPSK (2DH1 / 2DH3 / 2DH5)	2MBps
Radiated Spurious Emissions	GFSK / $\pi/4$ -DQPSK	1MBps / 2MBps
Band-edge compliance of Conducted Emission	GFSK / $\pi/4$ -DQPSK	1MBps / 2MBps

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 10 of 73

### **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:	2019-12-25
Mode of Operation:	Bluetooth Tx mode

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

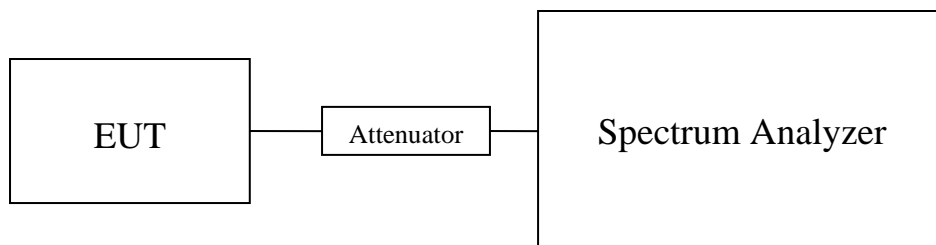
#### **Test Method:**

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.



## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 11 of 73

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

The maximum peak output power shall not exceeded the following limits:  
For frequency hopping systems employing at least 75 hopping channels: 1 Watt  
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts  
For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt

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

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000387

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000335

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000268

Results of Bluetooth Communication mode ( $\pi/4$ -DQPSK) (Fundamental Power): Pass

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2402	0.000476

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2441	0.000415

Transmitter Frequency (MHz)	Maximum conducted output power (Watt)
2480	0.000318

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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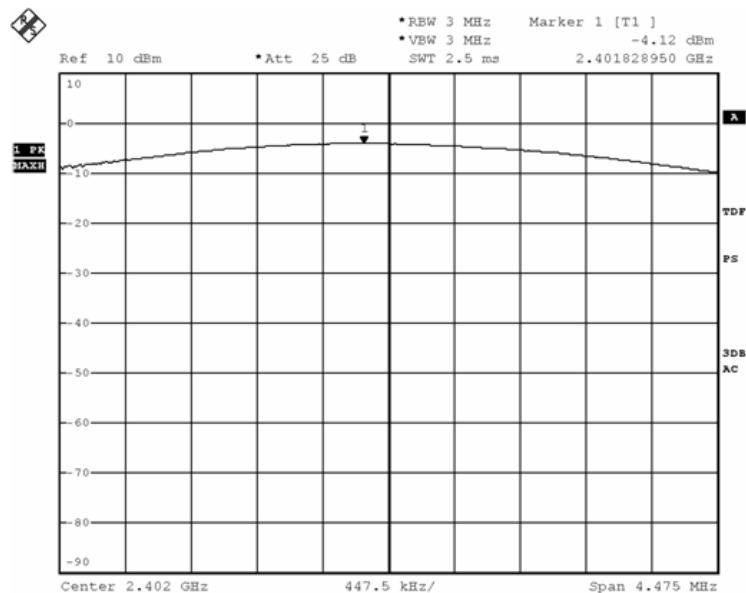
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No. : HMD19120015

Page 12 of 73

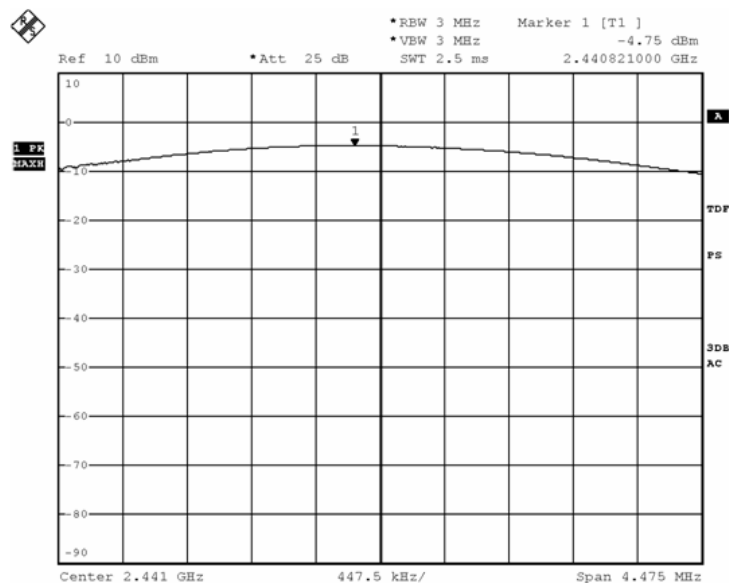
Test plot of Maximum Peak Conducted Output Power :

The following plots include cable losses and attenuator: 3.4dB (The attenuator is 3dB).

Bluetooth Communication mode (GFSK, 2402MHz)



Bluetooth Communication mode (GFSK, 2441MHz)



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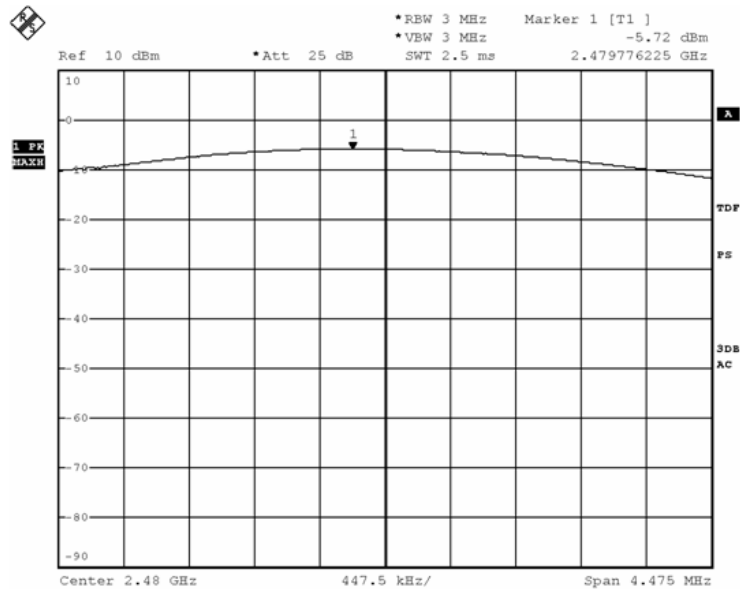
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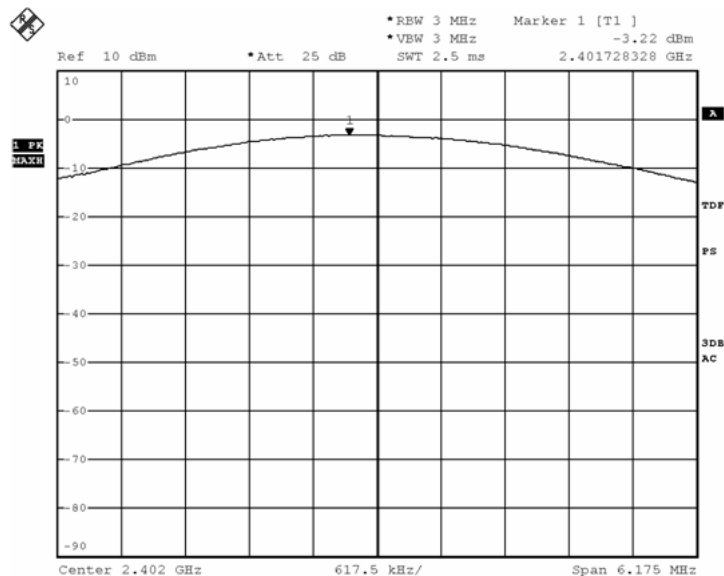
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No. : HMD19120015

Page 13 of 73

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



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



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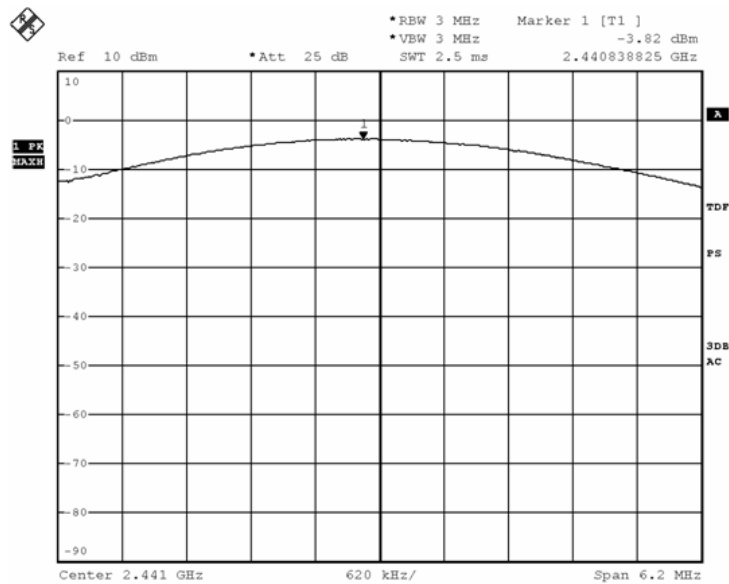


## Test Report

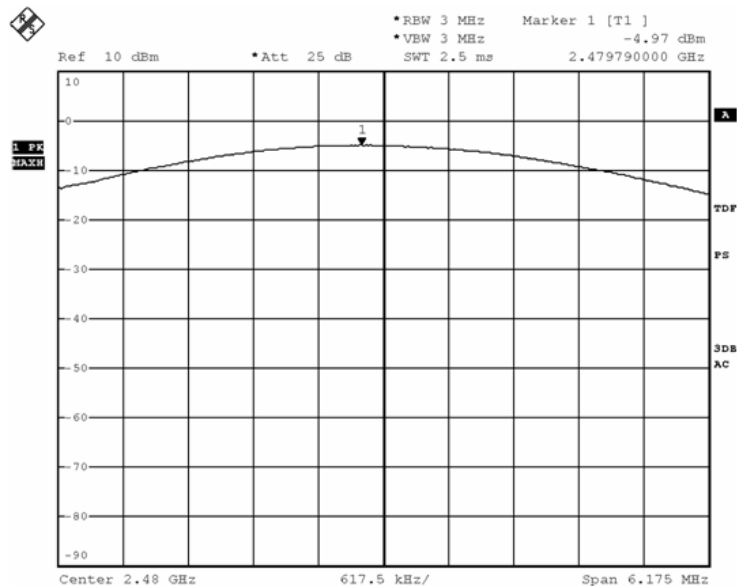
Date : 2019-12-30  
No. : HMD19120015

Page 14 of 73

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



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



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## Test Report

**Date : 2019-12-30**  
**No. : HMD19120015**

**Page 15 of 73**

### **3.1.2 Radiated Spurious Emissions**

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2019-12-24 to 2019-12-25
Mode of Operation:	Bluetooth Tx mode

Ambient Temperature: 23.5°C      Relative Humidity: 58.0%      Atmospheric Pressure: 101.0 kPa

#### **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 G/F of The Hong Kong Standards and Testing Centre Ltd. with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 16 of 73

### **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)

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

Above 1GHz (Av)

RBW: 1MHz  
VBW: 10Hz  
Sweep: Auto  
Span: Fully capture the emissions being measured  
Trace: Max. hold

### **Test Setup:**

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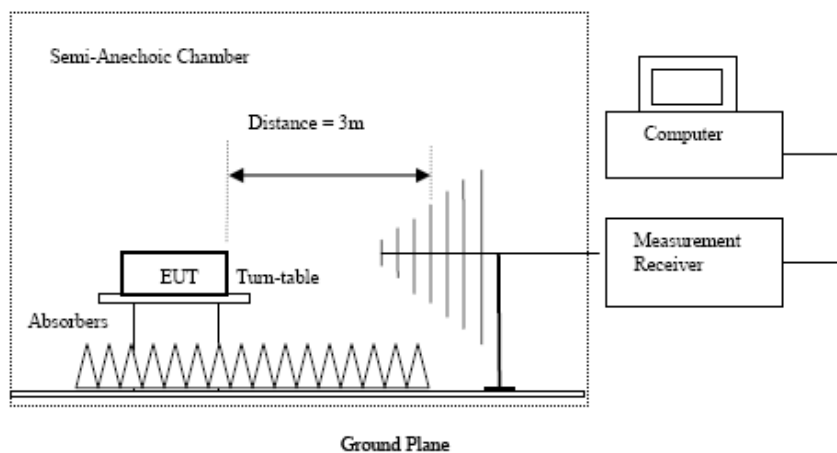
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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 17 of 73



- 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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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 18 of 73

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

Frequency Range	Quasi-Peak Limits
[MHz]	[μV/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						
Peak Value						
Frequency	Measured Level	Correction Factor	Field Strength	Field Strength	Limit	E-Field Polarity
MHz	dBμV	dB/m	dBμV/m	μV/m	μV/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						
Peak Value						
Frequency	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBμV	dB/m	dBμV/m	dBμV/m	dB	
4804.0	16.3	41.5	57.8	74.0	16.2	Vertical
4804.0	14.4	42.4	56.8	74.0	17.2	Horizontal
7206.0	13.0	45.1	58.1	74.0	15.9	Vertical
7206.0	11.7	46.2	57.9	74.0	16.1	Horizontal
9608.0	7.5	48.0	55.5	74.0	18.5	Vertical
9608.0	6.0	48.8	54.8	74.0	19.2	Horizontal
12010.0	4.5	51.8	56.3	74.0	17.7	Vertical
12010.0	3.5	52.4	55.9	74.0	18.1	Horizontal

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## Test Report

Date : 2019-12-30

Page 19 of 73

No. : HMD19120015

Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dB	E-Field Polarity
4804.0	1.1	41.5	42.6	54.0	11.4	Vertical
4804.0	0.0	42.4	42.4	54.0	11.6	Horizontal
7206.0	-2.2	45.1	42.9	54.0	11.1	Vertical
7206.0	-3.6	46.2	42.6	54.0	11.4	Horizontal
9608.0	-7.6	48.0	40.4	54.0	13.6	Vertical
9608.0	-8.4	48.8	40.4	54.0	13.6	Horizontal
12010.0	-6.2	51.8	45.6	54.0	8.4	Vertical
12010.0	-9.0	52.4	43.4	54.0	10.6	Horizontal

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

Field Strength of Spurious Emissions						
Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
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 MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4882.0	16.0	41.6	57.6	74.0	16.4	Vertical
4882.0	14.4	42.5	56.9	74.0	17.1	Horizontal
7323.0	5.5	53.2	58.7	74.0	15.3	Vertical
7323.0	10.8	46.3	57.1	74.0	16.9	Horizontal
9764.0	7.8	48.1	55.9	74.0	18.1	Vertical
9764.0	5.6	48.9	54.5	74.0	19.5	Horizontal
12205.0	3.9	51.6	55.5	74.0	18.5	Vertical
12205.0	3.8	52.5	56.3	74.0	17.7	Horizontal

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## Test Report

Date : 2019-12-30

Page 20 of 73

No. : HMD19120015

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dB	E-Field Polarity
4882.0	1.1	41.6	42.7	54.0	11.3	Vertical
4882.0	-0.6	42.5	41.9	54.0	12.1	Horizontal
7323.0	-1.6	45.2	43.6	54.0	10.4	Vertical
7323.0	-3.4	46.3	42.9	54.0	11.1	Horizontal
9764.0	-7.4	48.1	40.7	54.0	13.3	Vertical
9764.0	-8.0	48.9	40.9	54.0	13.1	Horizontal
12205.0	-11.5	51.6	40.1	54.0	13.9	Vertical
12205.0	-10.1	52.5	42.4	54.0	11.6	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field 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 Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4960.0	15.6	41.4	57.0	74.0	17.0	Vertical
4960.0	13.9	42.7	56.6	74.0	17.4	Horizontal
7440.0	13.3	45.6	58.9	74.0	15.1	Vertical
7440.0	11.5	46.5	58.0	74.0	16.0	Horizontal
9920.0	6.7	48.6	55.3	74.0	18.7	Vertical
9920.0	4.8	49.7	54.5	74.0	19.5	Horizontal
12400.0	4.4	51.7	56.1	74.0	17.9	Vertical
12400.0	3.2	52.7	55.9	74.0	18.1	Horizontal

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 21 of 73

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4960.0	1.4	41.4	42.8	54.0	11.2	Vertical
4960.0	-0.7	42.7	42.0	54.0	12.0	Horizontal
7440.0	0.1	45.6	45.7	54.0	8.3	Vertical
7440.0	-1.4	46.5	45.1	54.0	8.9	Horizontal
9920.0	-8.1	48.6	40.5	54.0	13.5	Vertical
9920.0	-8.8	49.7	40.9	54.0	13.1	Horizontal
12400.0	-9.2	51.7	42.5	54.0	11.5	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 Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field 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 Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4804.0	15.9	41.5	57.4	74.0	16.6	Vertical
4804.0	14.4	42.4	56.8	74.0	17.2	Horizontal
7206.0	13.5	45.1	58.6	74.0	15.4	Vertical
7206.0	11.7	46.2	57.9	74.0	16.1	Horizontal
9608.0	8.9	48.0	56.9	74.0	17.1	Vertical
9608.0	7.0	48.8	55.8	74.0	18.2	Horizontal
12010.0	4.5	51.5	56.0	74.0	18.0	Vertical
12010.0	4.1	52.4	56.5	74.0	17.5	Horizontal

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 22 of 73

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4804.0	3.3	41.5	44.8	54.0	9.2	Vertical
4804.0	0.7	42.4	43.1	54.0	10.9	Horizontal
7206.0	0.1	45.1	45.2	54.0	8.8	Vertical
7206.0	-3.4	46.2	42.8	54.0	11.2	Horizontal
9608.0	-7.4	48.0	40.6	54.0	13.4	Vertical
9608.0	-7.4	48.8	41.4	54.0	12.6	Horizontal
12010.0	-9.9	51.5	41.6	54.0	12.4	Vertical
12010.0	-10.3	52.4	42.1	54.0	11.9	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field 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 Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4882.0	15.4	41.6	57.0	74.0	17.0	Vertical
4882.0	13.2	42.5	55.7	74.0	18.3	Horizontal
7323.0	4.1	53.2	57.3	74.0	16.7	Vertical
7323.0	11.7	46.3	58.0	74.0	16.0	Horizontal
9764.0	7.5	48.1	55.6	74.0	18.4	Vertical
9764.0	6.4	48.9	55.3	74.0	18.7	Horizontal
12205.0	5.9	51.6	57.5	74.0	16.5	Vertical
12205.0	3.8	52.5	56.3	74.0	17.7	Horizontal

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 23 of 73

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dB	E-Field Polarity
4882.0	1.2	41.6	42.8	54.0	11.2	Vertical
4882.0	-0.2	42.5	42.3	54.0	11.7	Horizontal
7323.0	-2.6	45.2	42.6	54.0	11.4	Vertical
7323.0	-2.2	46.3	44.1	54.0	9.9	Horizontal
9764.0	-8.1	48.1	40.0	54.0	14.0	Vertical
9764.0	-7.2	48.9	41.7	54.0	12.3	Horizontal
12205.0	-9.5	51.6	42.1	54.0	11.9	Vertical
12205.0	-10.3	52.5	42.2	54.0	11.8	Horizontal

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

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field 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 Peak Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4960.0	15.3	41.4	56.7	74.0	17.3	Vertical
4960.0	13.7	42.7	56.4	74.0	17.6	Horizontal
7440.0	12.4	45.6	58.0	74.0	16.0	Vertical
7440.0	11.2	46.5	57.7	74.0	16.3	Horizontal
9920.0	7.0	48.6	55.6	74.0	18.4	Vertical
9920.0	6.3	49.7	56.0	74.0	18.0	Horizontal
12400.0	4.7	51.7	56.4	74.0	17.6	Vertical
12400.0	2.2	52.7	54.9	74.0	19.1	Horizontal

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 24 of 73

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4960.0	2.0	41.4	43.4	54.0	10.6	Vertical
4960.0	0.4	42.7	43.1	54.0	10.9	Horizontal
7440.0	-1.5	45.6	44.1	54.0	9.9	Vertical
7440.0	-2.6	46.5	43.9	54.0	10.1	Horizontal
9920.0	-6.8	48.6	41.8	54.0	12.2	Vertical
9920.0	-7.2	49.7	42.5	54.0	11.5	Horizontal
12400.0	-8.9	51.7	42.8	54.0	11.2	Vertical
12400.0	-10.8	52.7	41.9	54.0	12.1	Horizontal

**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 (9kHz-30MHz): 2.0dB  
uncertainty (30MHz -1GHz): 4.9dB  
(1GHz -6GHz): 4.02dB  
(6GHz -26.5GHz): 4.03dB

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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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 25 of 73

### 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						
Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2390.0	13.2	36.8	50.0	74.0	24.0	Vertical
2390.0	7.0	36.4	43.4	74.0	30.6	Horizontal
Field Strength of Band-edge Compliance						
Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2390.0	1.6	36.8	38.4	54.0	15.6	Vertical
2390.0	0.8	36.4	37.2	54.0	16.8	Horizontal

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

Field Strength of Band-edge Compliance						
Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2483.5	15.3	36.8	52.1	74.0	21.9	Vertical
2483.5	14.4	36.4	50.8	74.0	23.2	Horizontal
Field Strength of Band-edge Compliance						
Average Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2483.5	2.4	36.8	39.2	54.0	14.8	Vertical
2483.5	2.1	36.4	38.5	54.0	15.5	Horizontal

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Tel: +852 2666 1888 Fax: +852 2664 4353 Email: hkstc@stc.group Website: www.stc.group

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 26 of 73

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

Field Strength of Band-edge Compliance						
Peak Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
2390.0	13.3	36.8	50.1	74.0	23.9	Vertical
2390.0	12.6	36.4	49.0	74.0	25.0	Horizontal

Field Strength of Band-edge Compliance						
Average Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
2390.0	1.4	36.8	38.2	54.0	15.8	Vertical
2390.0	1.1	36.4	37.5	54.0	16.5	Horizontal

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

Field Strength of Band-edge Compliance						
Peak Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
2483.5	14.6	36.8	51.4	74.0	22.6	Vertical
2483.5	13.7	36.4	50.1	74.0	23.9	Horizontal

Field Strength of Band-edge Compliance						
Average Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
2483.5	2.0	36.8	38.8	54.0	15.2	Vertical
2483.5	1.4	36.4	37.8	54.0	16.2	Horizontal

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 27 of 73

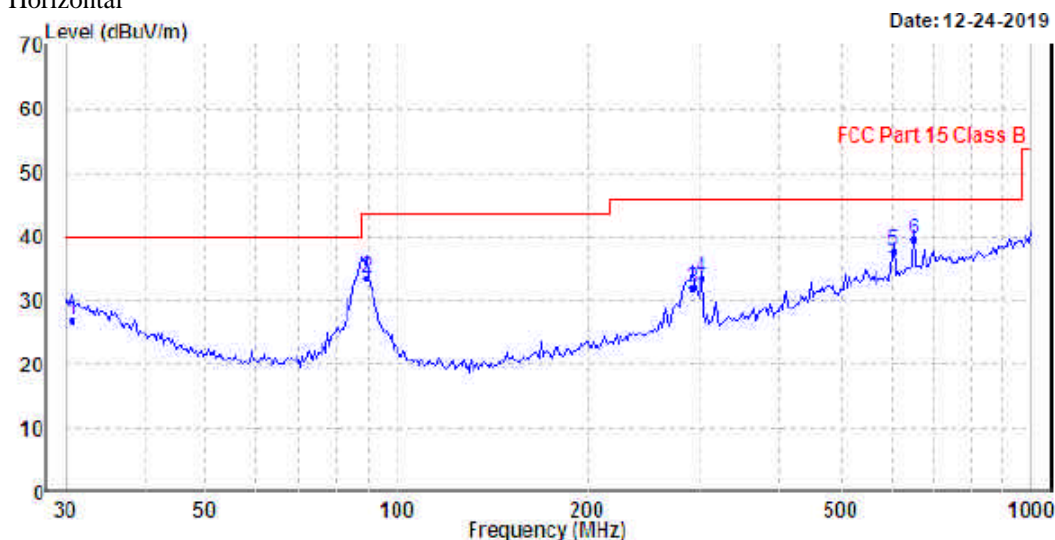
### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B:

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 Tx mode (30MHz – 1GHz): Pass

Horizontal



Ambient Temperature: 25C

Relative Humidity : 50%

	Freq	Level	Limit	Over	Remark	Pol/Phase
	MHz	dBuV/m	Line	Limit		
1	30.853	26.96	40.00	-13.04	QP	Horizontal
2	89.590	33.55	43.50	-9.95	QP	Horizontal
3	291.036	31.87	46.00	-14.13	QP	Horizontal
4	301.422	33.46	46.00	-12.54	QP	Horizontal
5	603.539	37.69	46.00	-8.31	QP	Horizontal
6	651.942	39.74	46.00	-6.26	QP	Horizontal

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 28 of 73

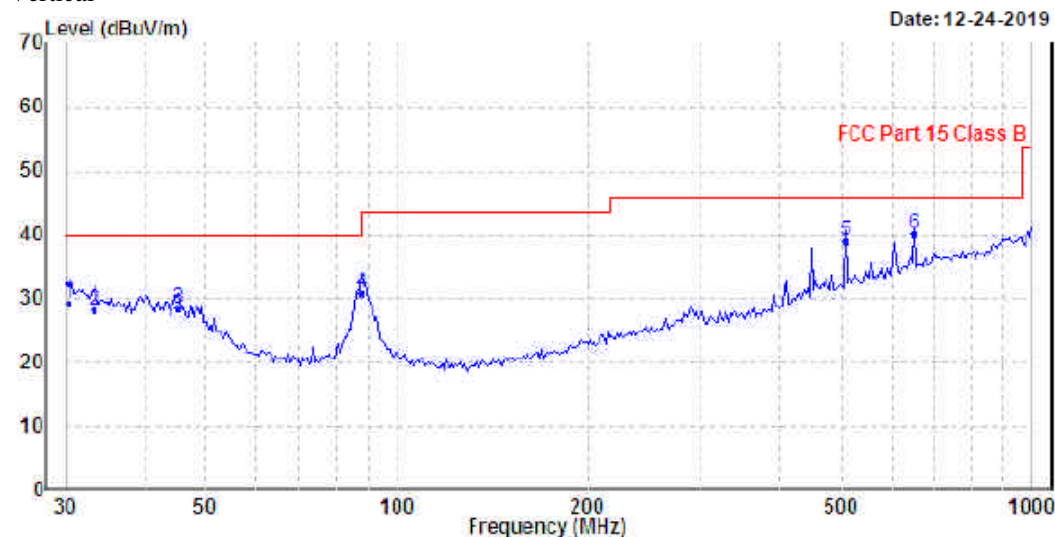
### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B):

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 Tx mode (30MHz – 1GHz): Pass

Vertical



Ambient Temperature: 25C  
Relative Humidity : 50%

	Freq	Level	Limit	Over	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	30.424	29.20	40.00	-10.80	QP	Vertical
2	33.328	28.28	40.00	-11.72	QP	Vertical
3	45.375	28.52	40.00	-11.48	QP	Vertical
4	87.725	30.99	40.00	-9.01	QP	Vertical
5	506.479	39.06	46.00	-6.94	QP	Vertical
6	651.942	40.24	46.00	-5.76	QP	Vertical

Remarks: Calculated measurement uncertainty (30MHz – 1GHz): 4.9dB

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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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 29 of 73

### 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:	2019-12-24
Mode of Operation:	Bluetooth Tx mode
Test Voltage:	120V a.c. 60Hz

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

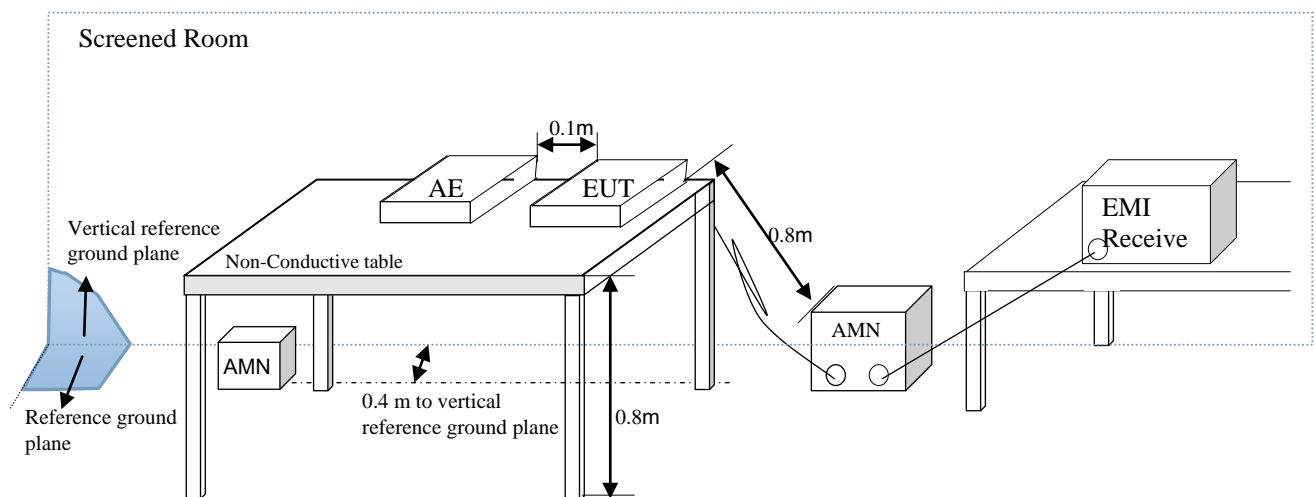
#### Test Method:

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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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 30 of 73

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

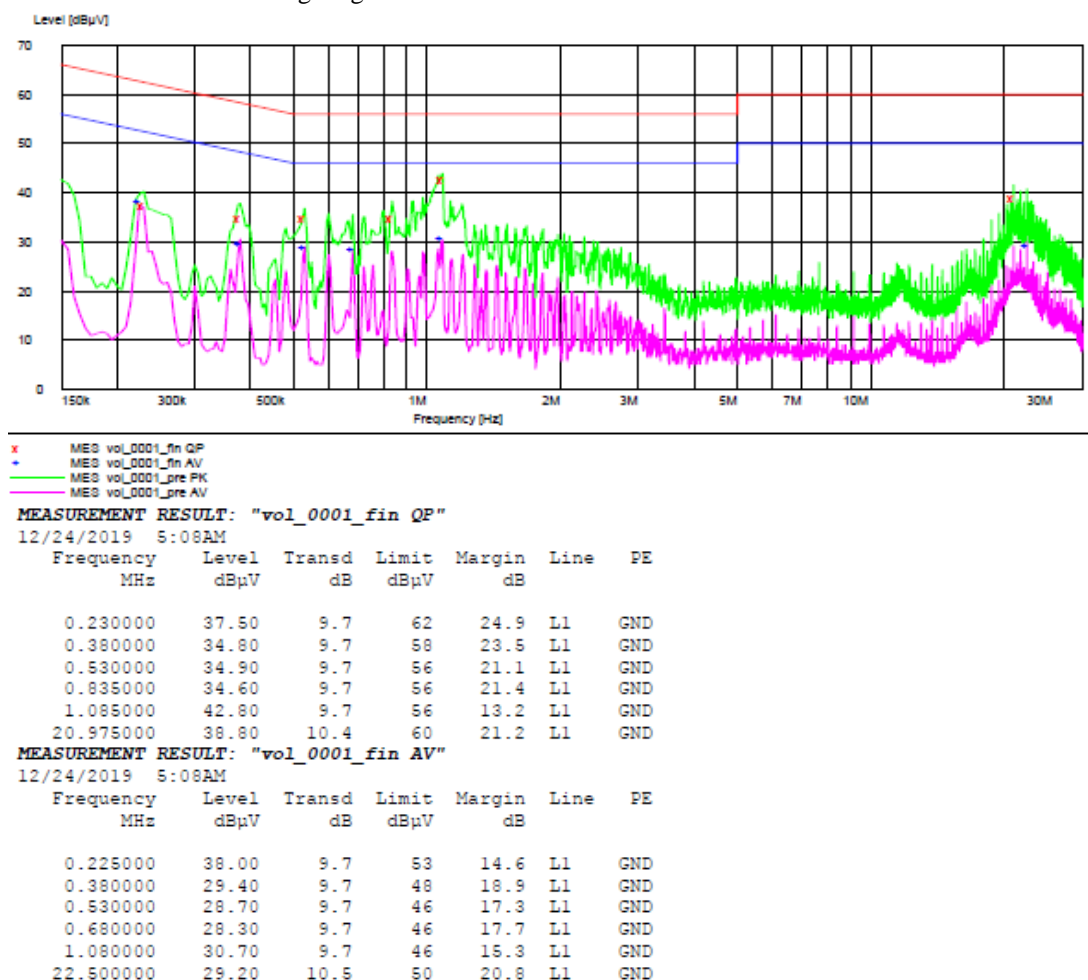
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

\* 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 Tx mode (L): PASS

Please refer to the following diagram for individual results.



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 31 of 73

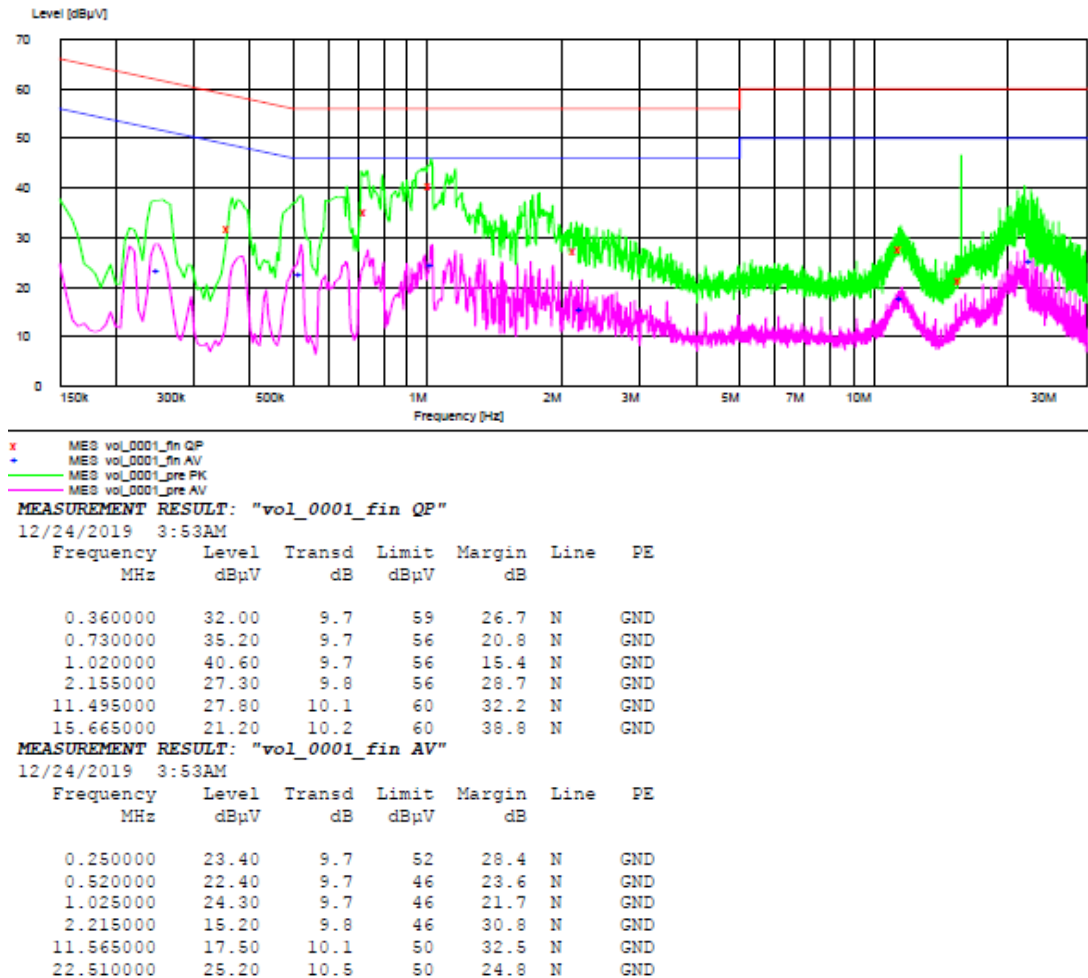
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

\* 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 Tx mode (N): PASS

Please refer to the following diagram for individual results.



### Remarks:

Calculated measurement uncertainty (0.15MHz – 30MHz): 3.25dB

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## Test Report

**Date : 2019-12-30**

**No. : HMD19120015**

**Page 32 of 73**

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

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 33 of 73

### 3.1.4 Number of Hopping Frequency

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

### 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:

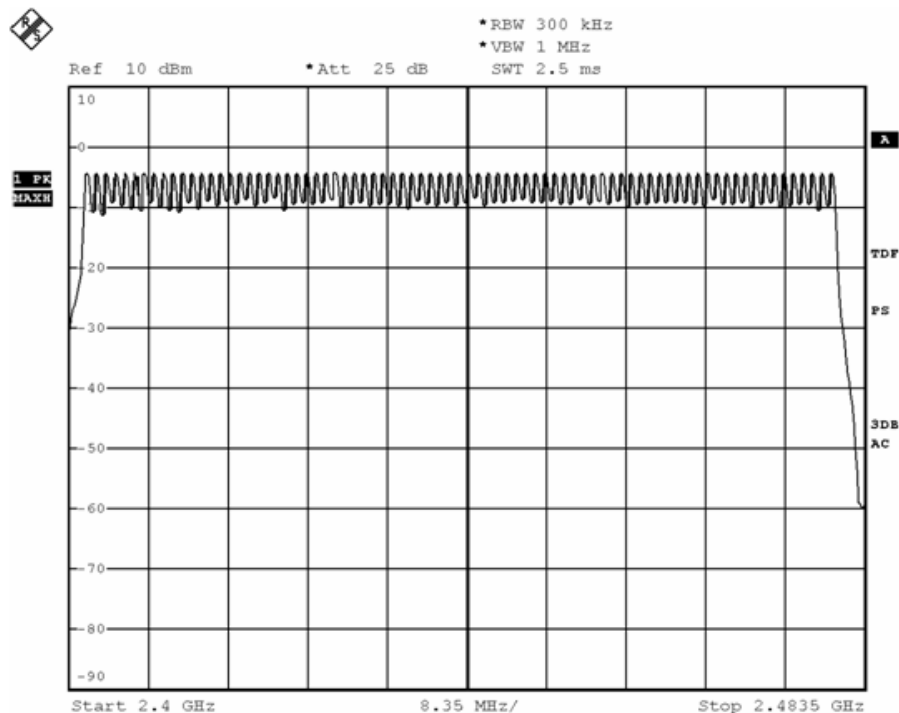
RBW = 300kHz, VBW  $\geq$  RBW, Sweep = Auto, Span = the frequency band of operation  
Detector = Peak, Trace = Max. hold

### 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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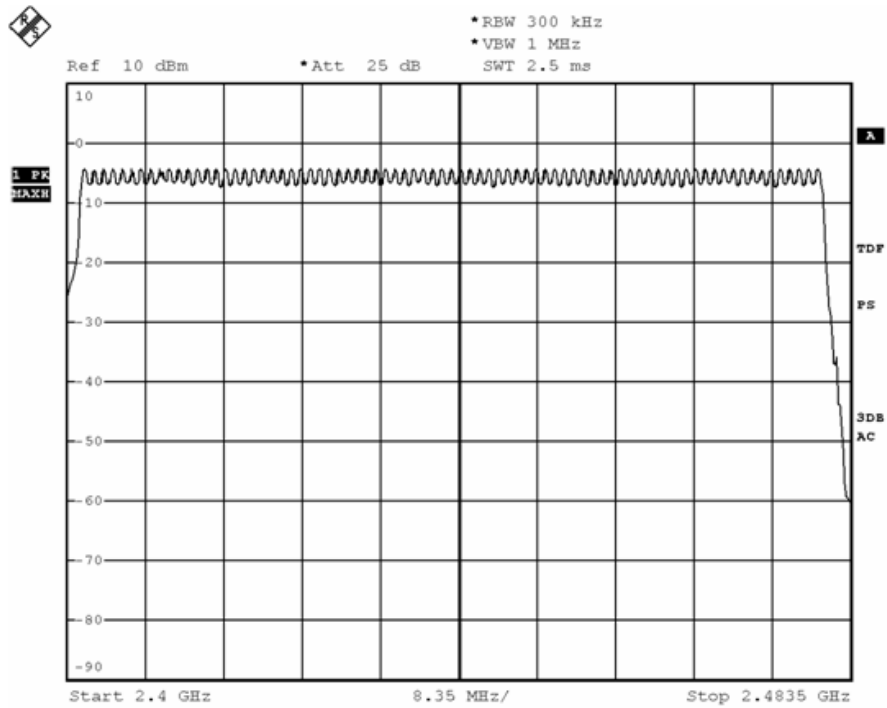


## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 34 of 73

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



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 35 of 73

### 3.1.5 20dB Bandwidth

Test Requirement: FCC 47CFR 15.247(a)(1)  
Test Method: ANSI C63.10:2013  
Test Date: 2019-12-27  
Mode of Operation: Bluetooth Tx mode

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### **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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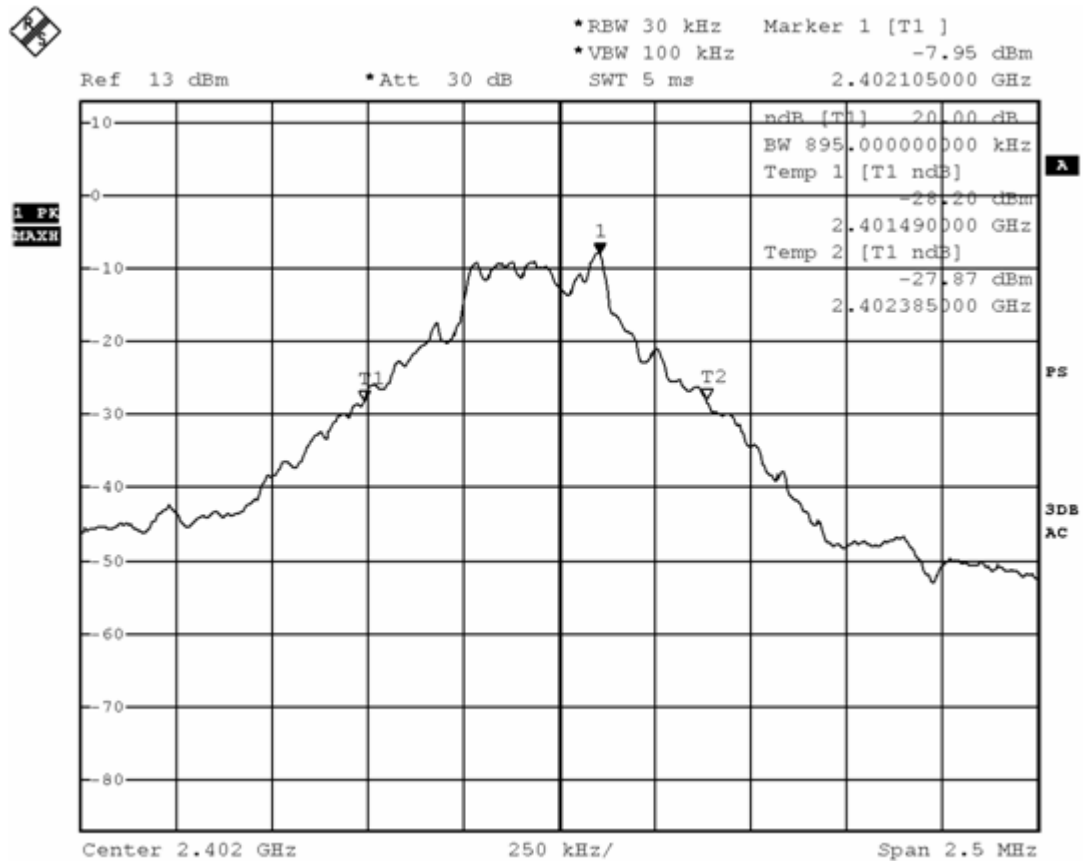
## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 36 of 73

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2402	895.0	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)



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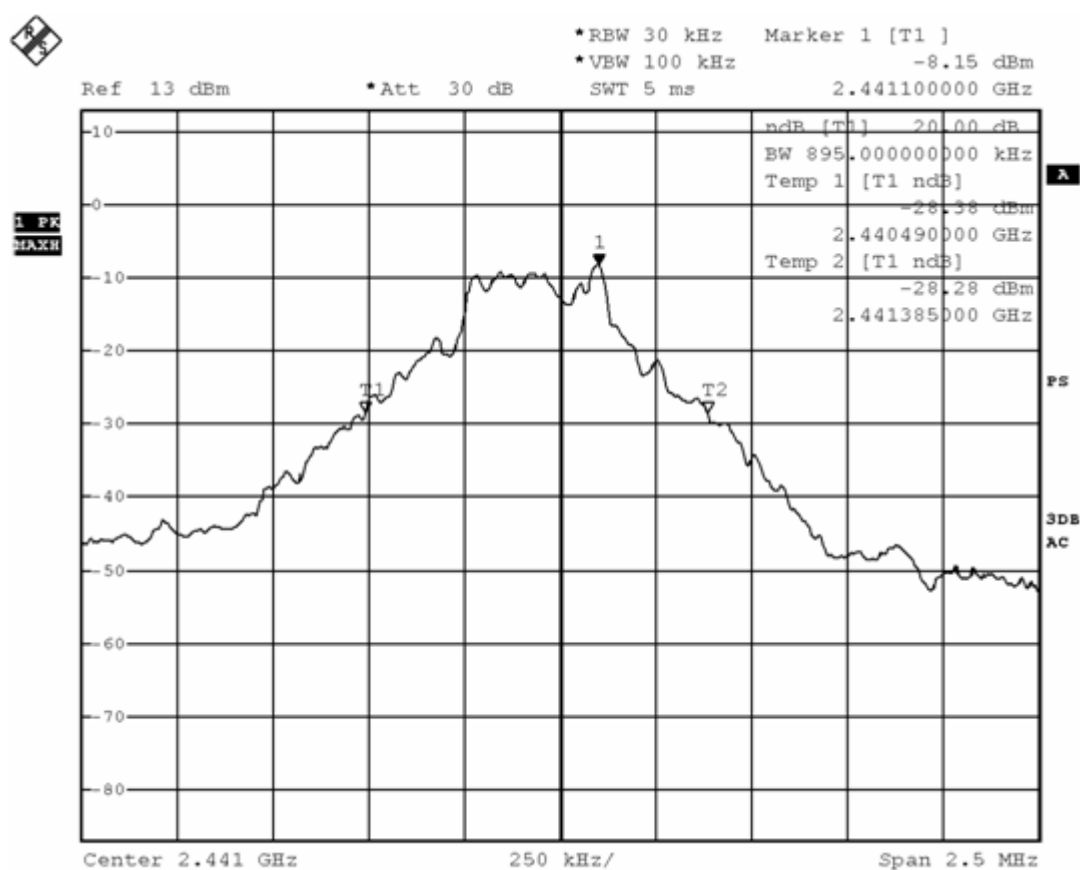
## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 37 of 73

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2441	895.0	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



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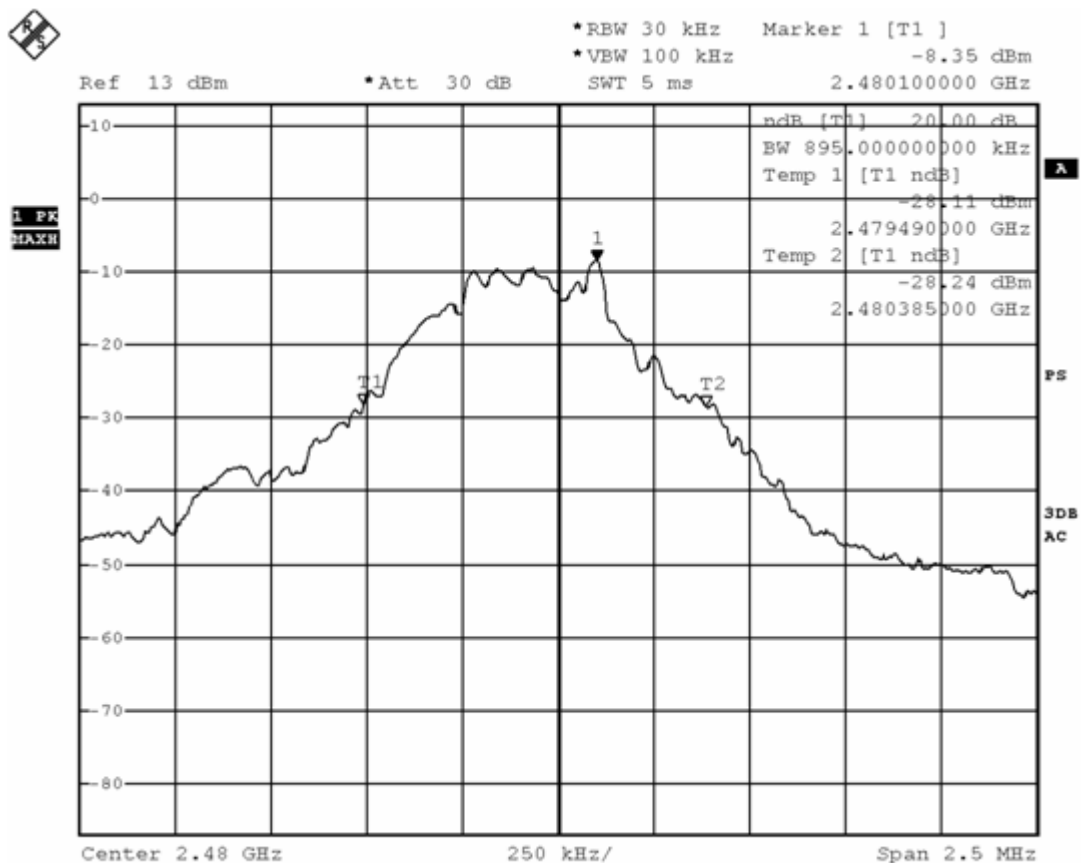
## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 38 of 73

Fundamental Frequency [MHz]	20dB Bandwidth [kHz]	FCC Limits [MHz]
2480	895.0	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)



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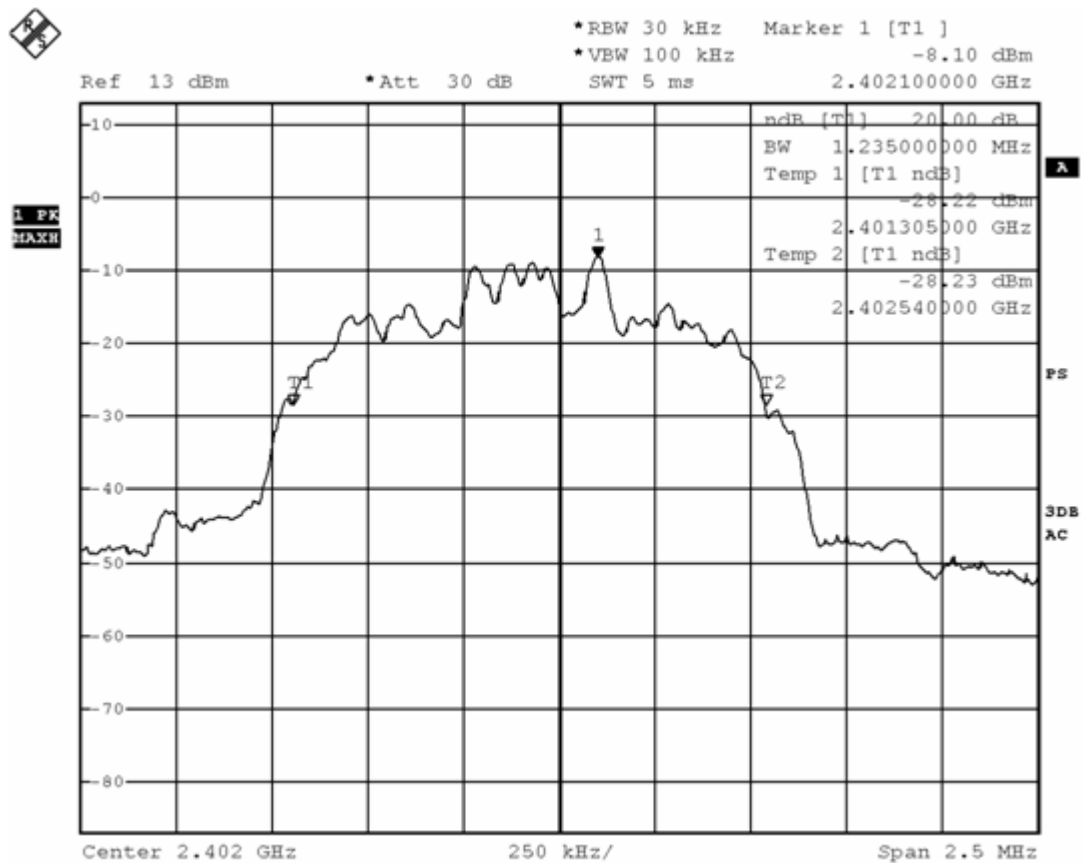
## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 39 of 73

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2402	1.235	Within 2400-2483.5

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



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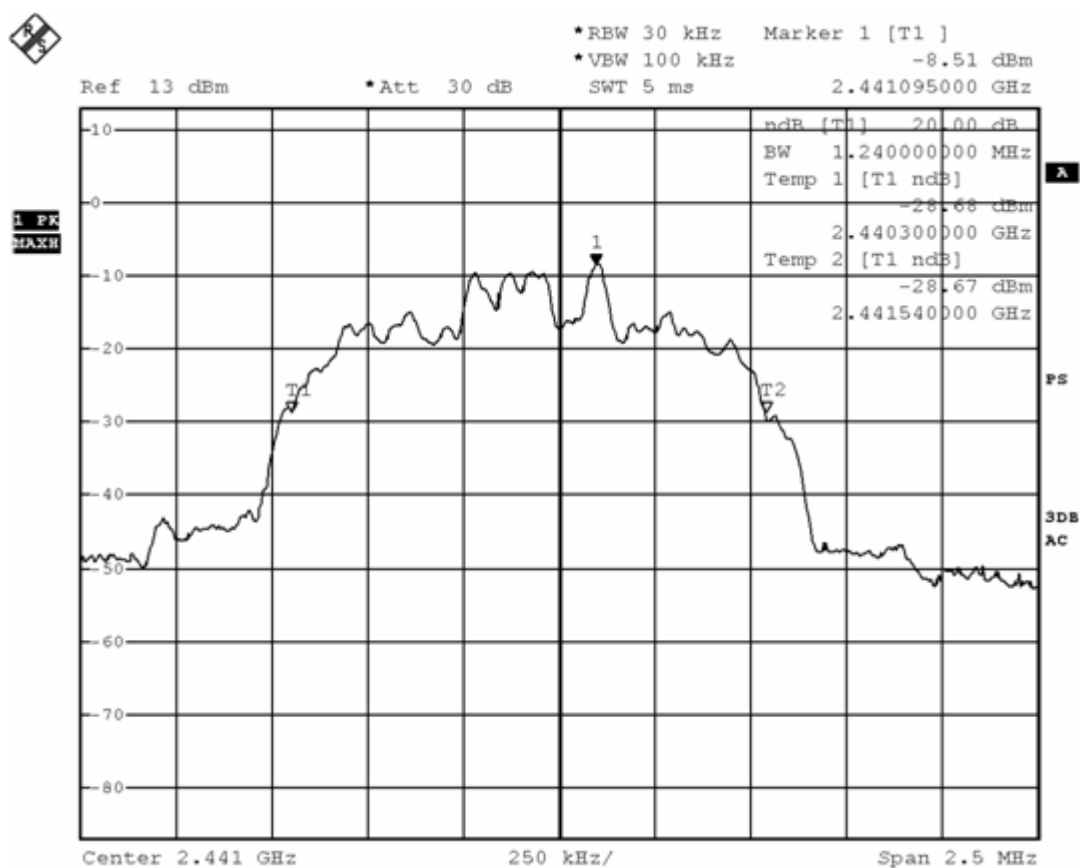
## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 40 of 73

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2441	1.240	Within 2400-2483.5

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



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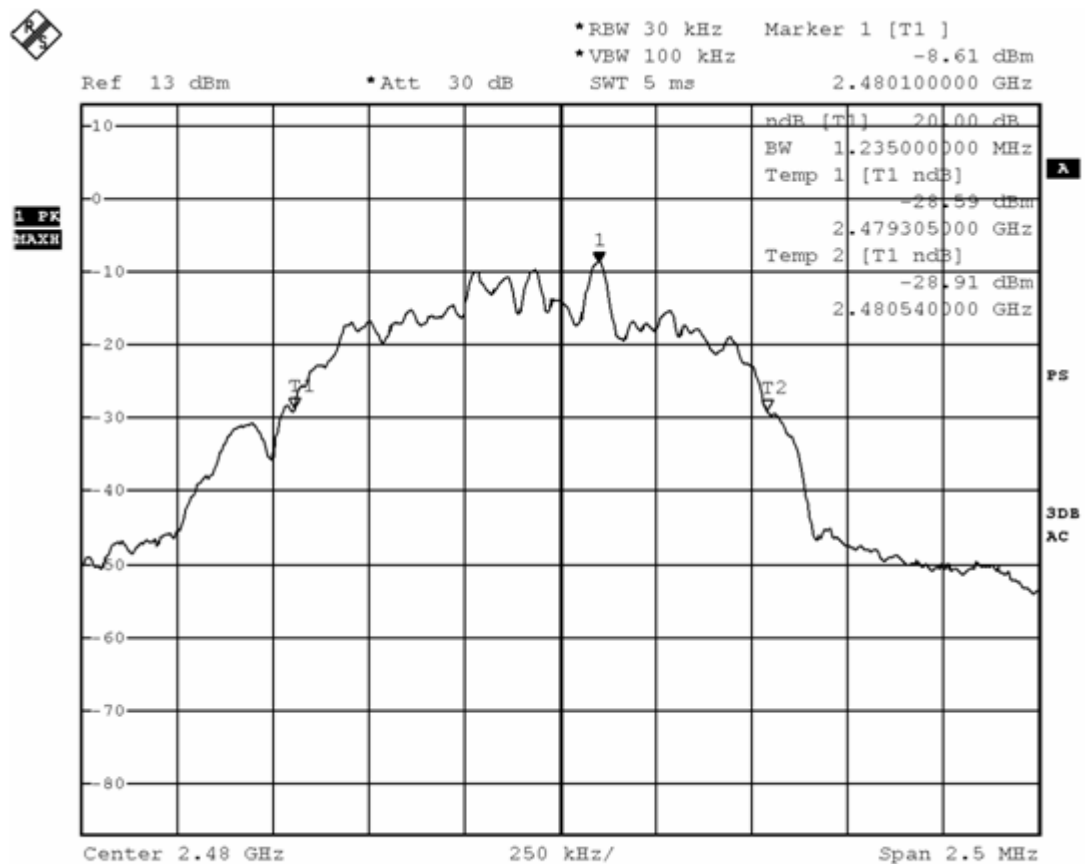
## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 41 of 73

Fundamental Frequency [MHz]	20dB Bandwidth [MHz]	FCC Limits [MHz]
2480	1.235	Within 2400-2483.5

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



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 42 of 73

### 3.1.6 Hopping Channel Separation

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

#### 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 = 1.24MHz ( $\pi/4$  DQPSK)

The measured maximum bandwidth  $\times 2/3 = 1.24\text{MHz} \times 2/3 = 826.7\text{kHz}(\pi/4 \text{ DQPSK})$

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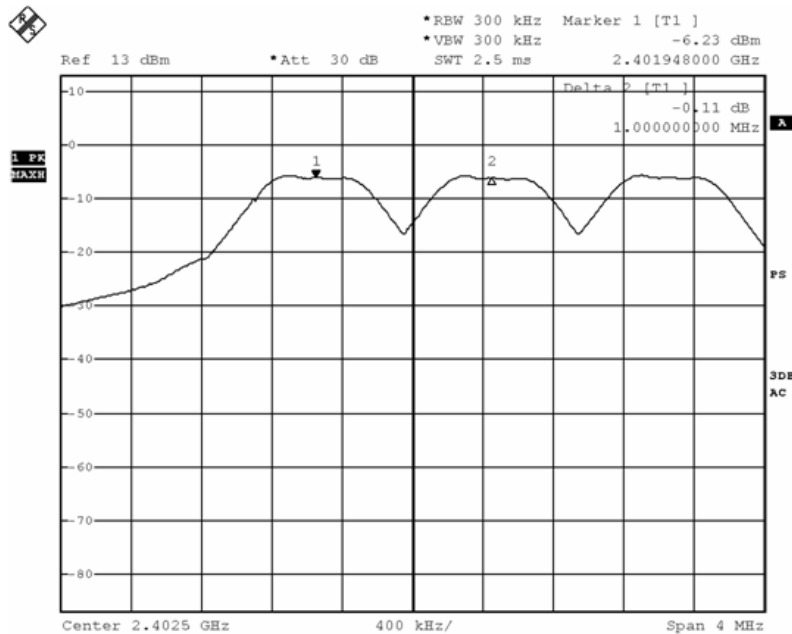


## Test Report

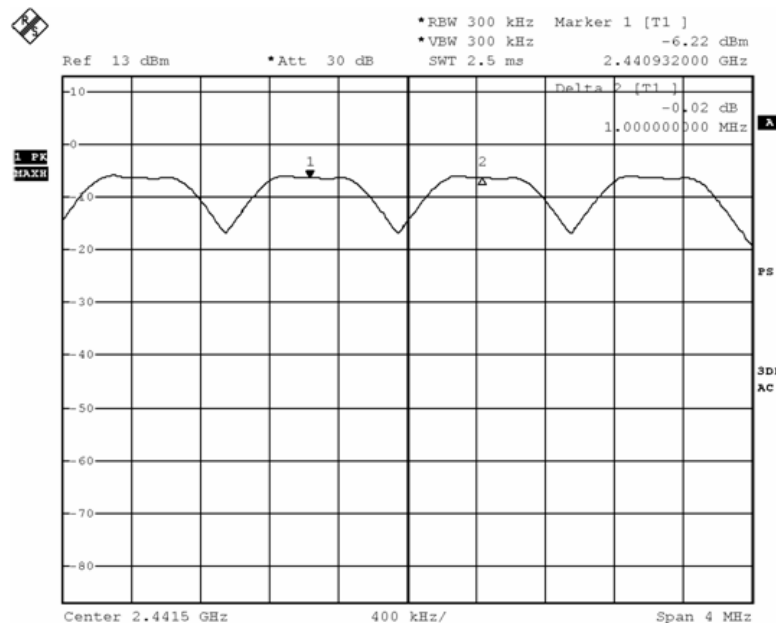
Date : 2019-12-30  
No. : HMD19120015

Page 43 of 73

Channel separation = 1MHz (>826.7kHz) (Lowest) (GFSK)



Channel separation = 1MHz (>826.7kHz) (Mid) (GFSK)



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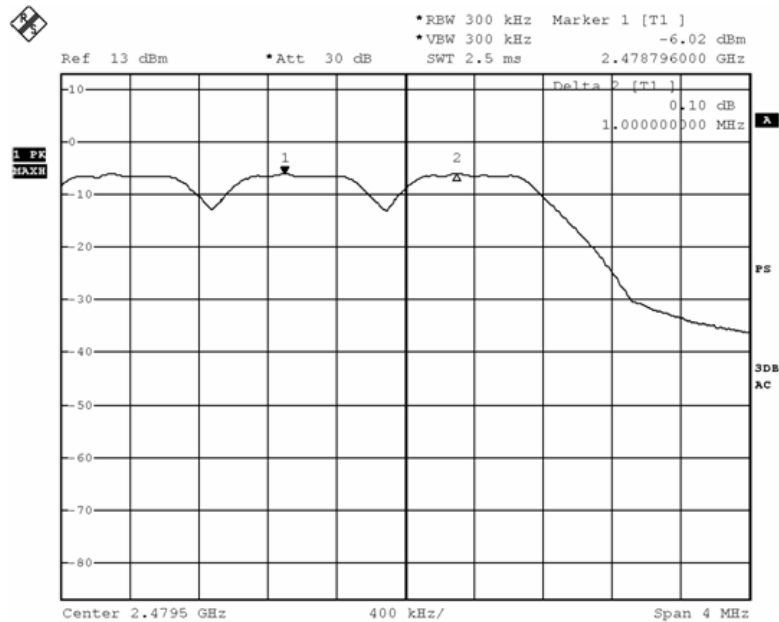


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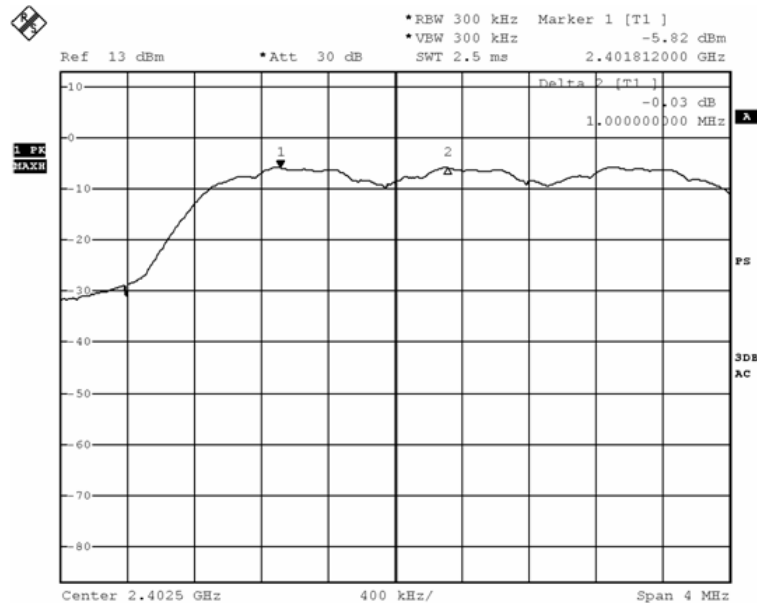
Date : 2019-12-30  
No. : HMD19120015

Page 44 of 73

Channel separation = 1MHz (>826.7kHz) (Highest) (GFSK)



Channel separation = 1MHz (>826.7kHz) (Lowest) ( $\pi/4$  DQPSK)



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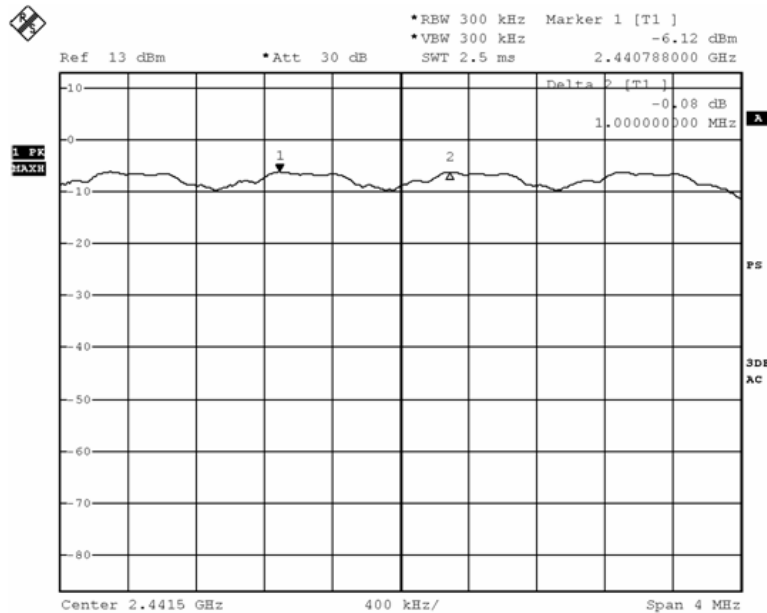


## Test Report

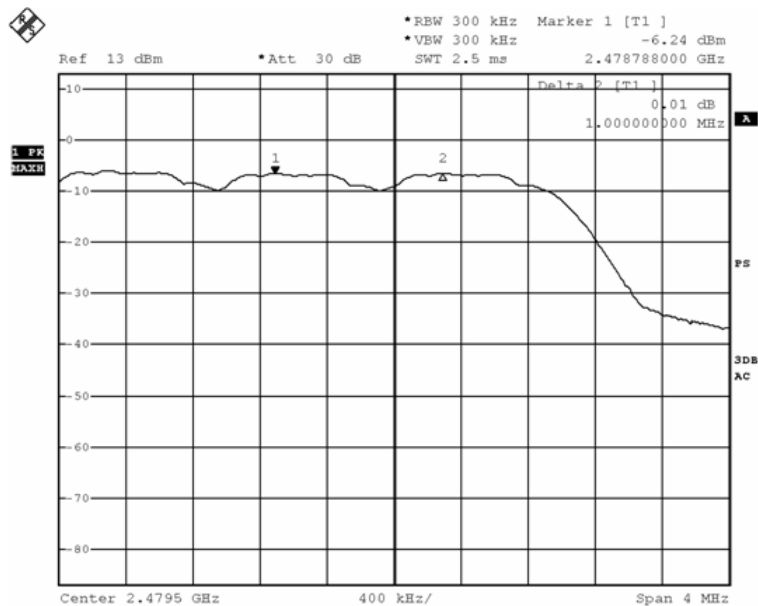
Date : 2019-12-30  
No. : HMD19120015

Page 45 of 73

Channel separation = 1MHz (>826.7kHz) (Mid) ( $\pi/4$  DQPSK)



Channel separation = 1MHz (>826.7kHz) (Highest) ( $\pi/4$  DQPSK)



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 46 of 73

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

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### **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.

The following plots include cable losses and attenuator: 3.4dB (The attenuator is 3dB).

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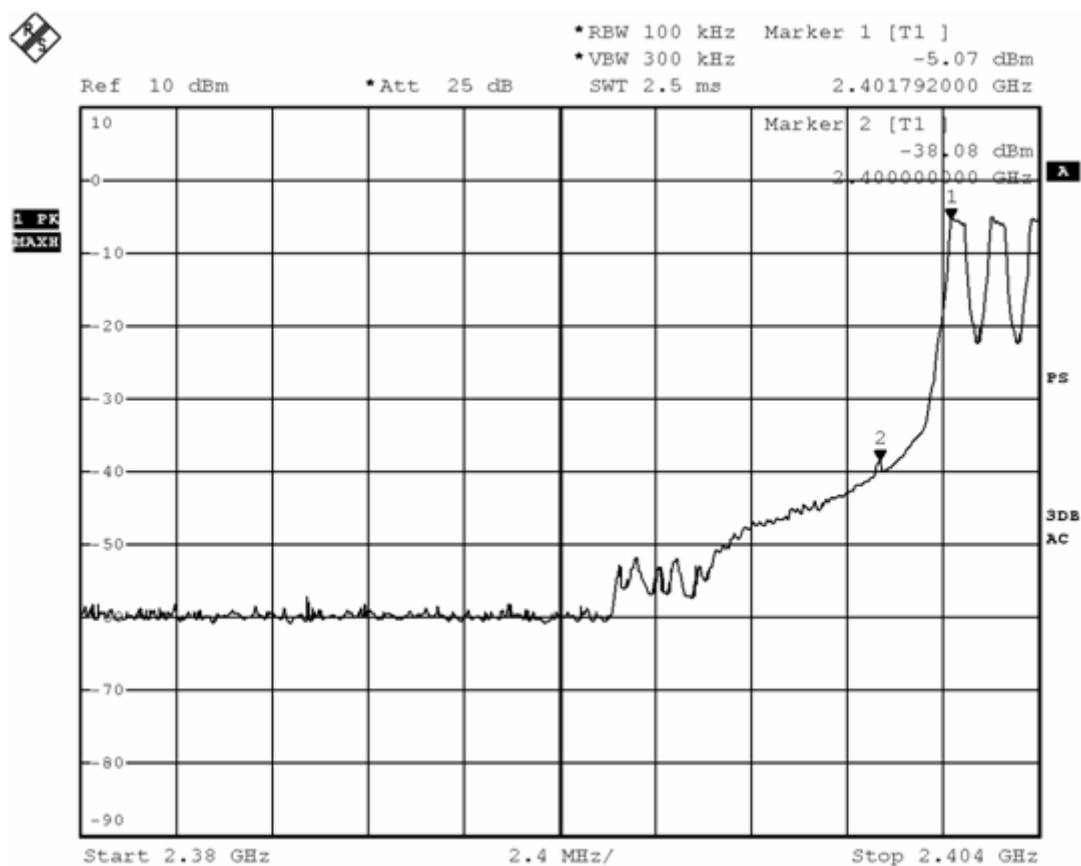
Date : 2019-12-30  
No. : HMD19120015

Page 47 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2400 – Lowest Fundamental (2402)	-5.07	-25.07	-38.08	Pass

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



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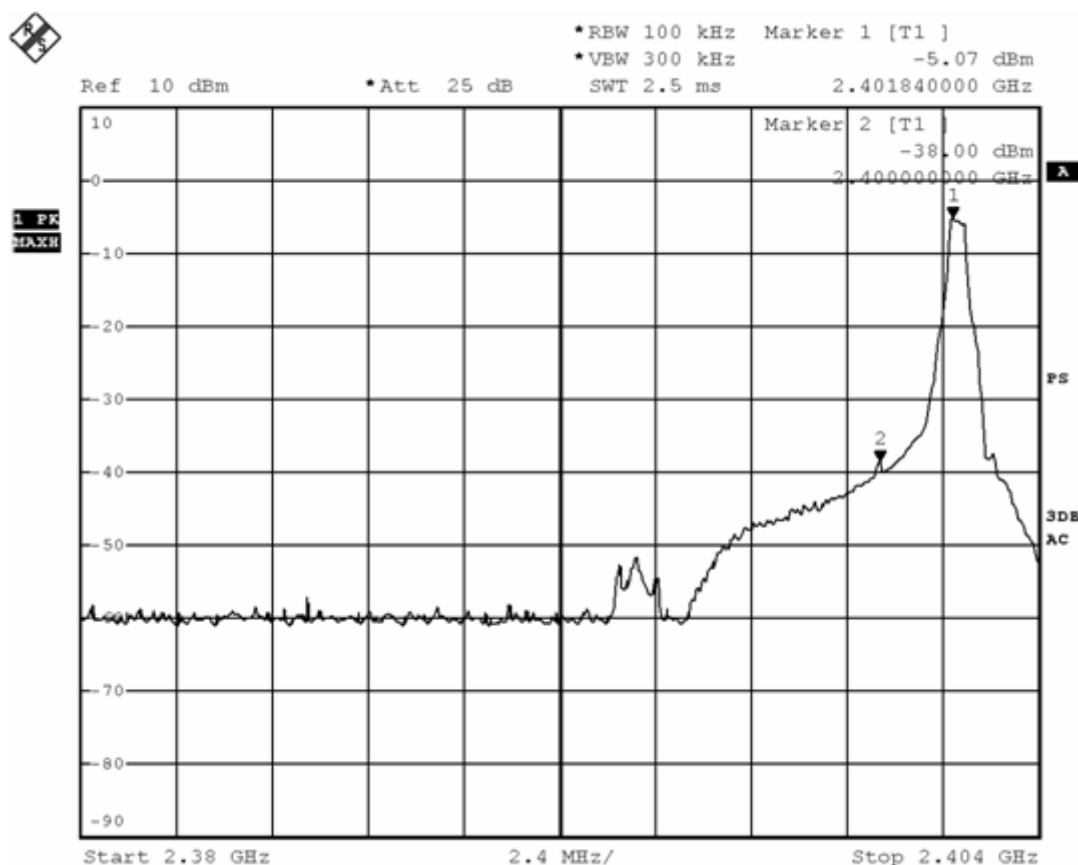
Date : 2019-12-30  
No. : HMD19120015

Page 48 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2400 – Lowest Fundamental (2402)	-5.07	-25.07	-38.00	Pass

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



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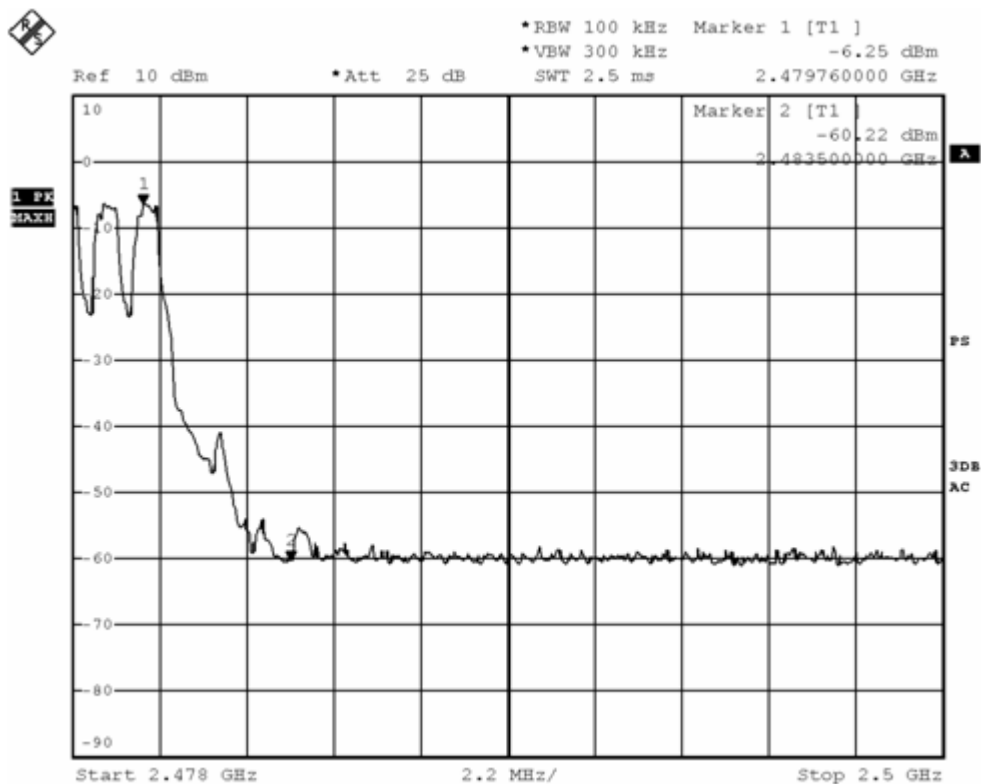
Date : 2019-12-30  
No. : HMD19120015

Page 49 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2483.5 - Highest Fundamental (2480)	-6.25	-26.25	-60.22	Pass

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



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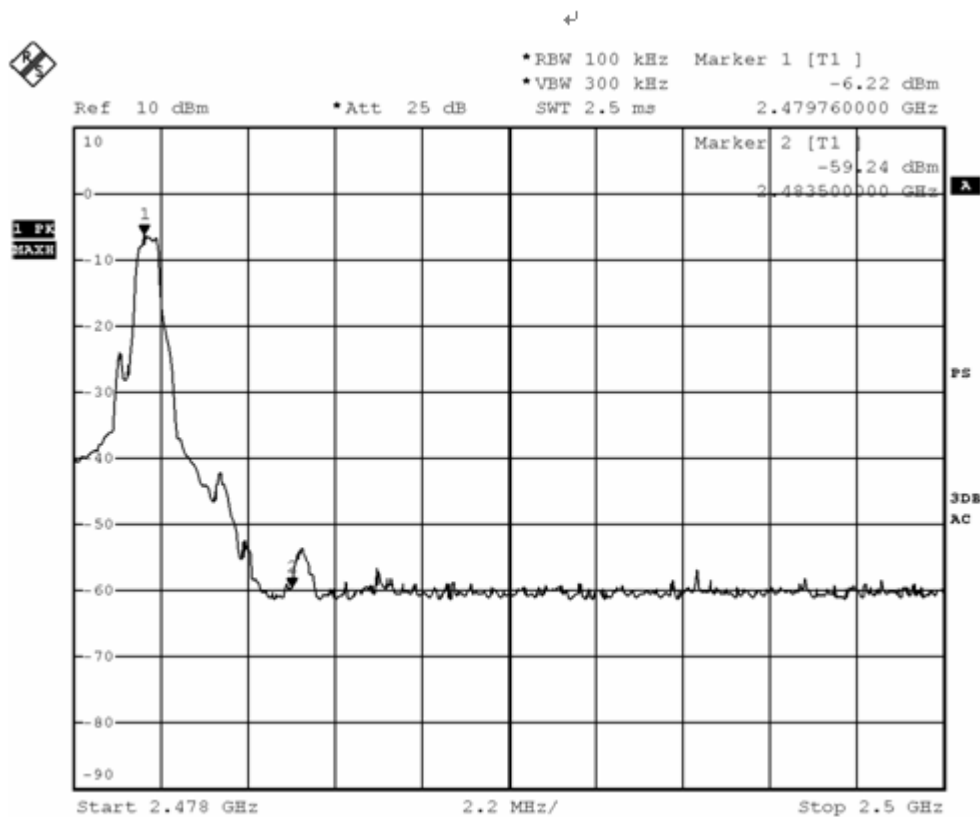
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No. : HMD19120015

Page 50 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2483.5 - Highest Fundamental (2480)	-6.22	-26.22	-59.24	Pass

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



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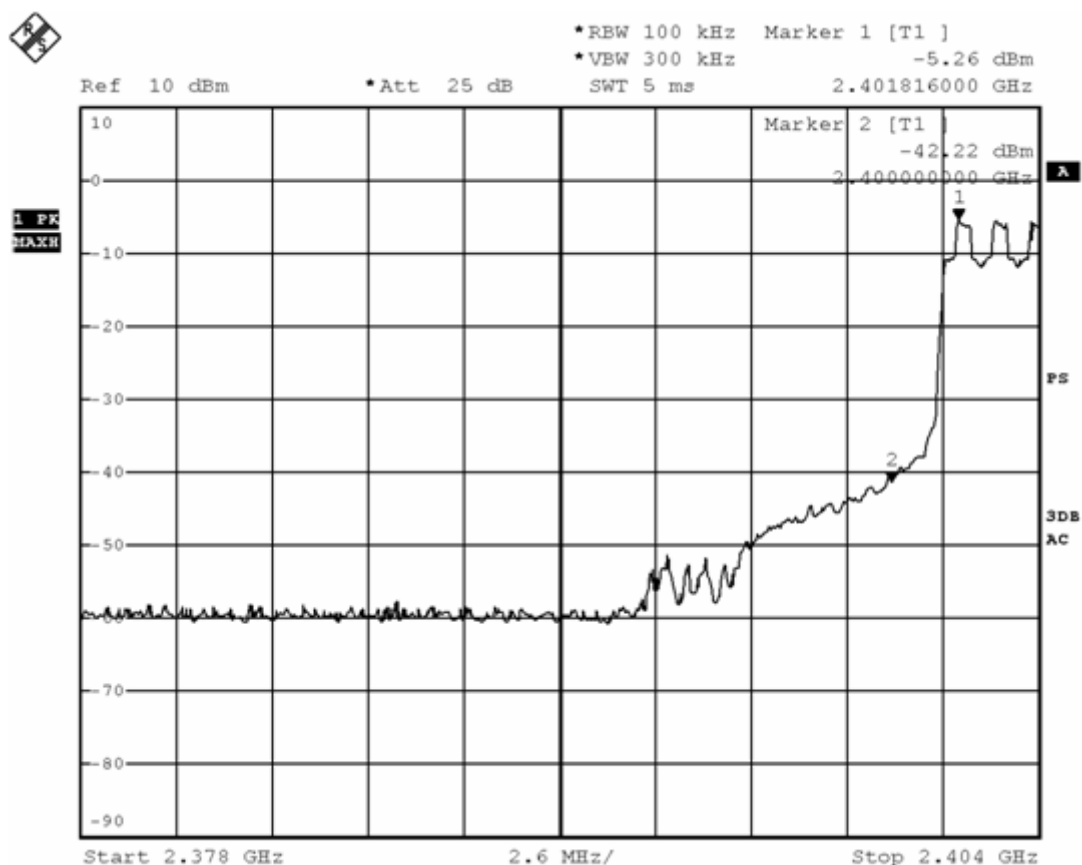
Date : 2019-12-30  
No. : HMD19120015

Page 51 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2400 – Lowest Fundamental (2402)	-5.26	-25.26	-42.22	Pass

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



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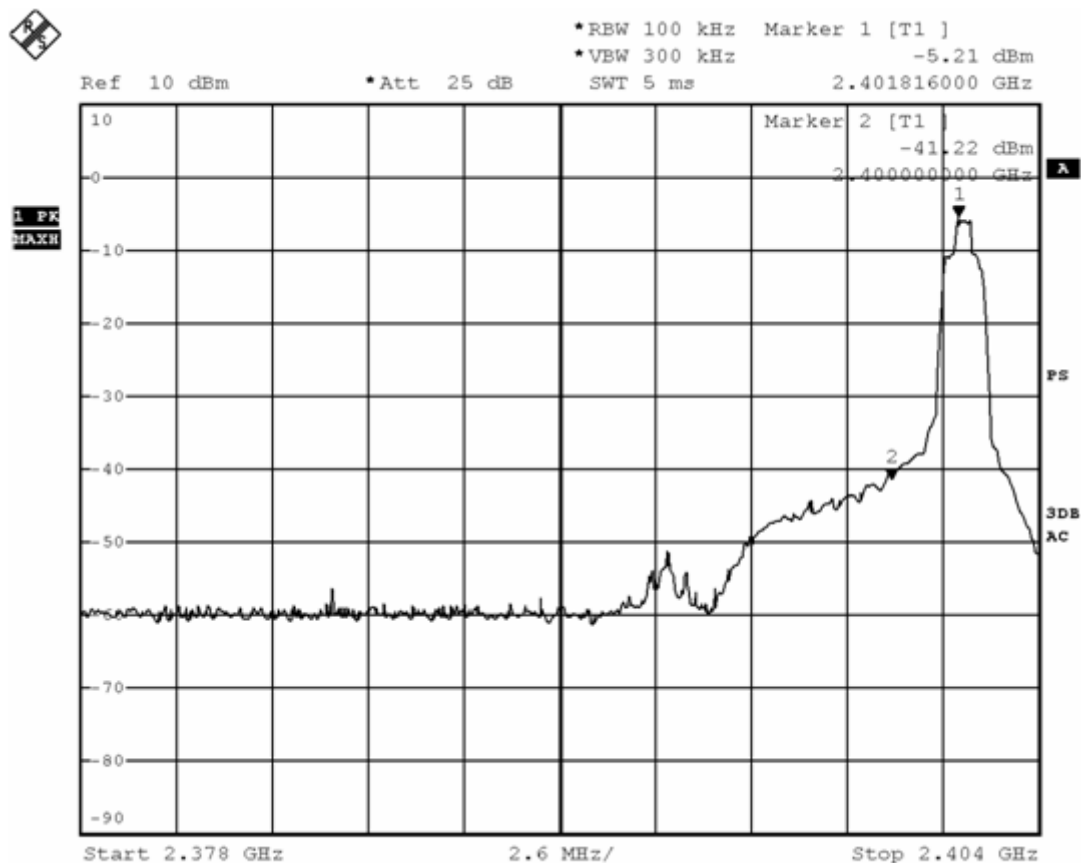
Date : 2019-12-30  
No. : HMD19120015

Page 52 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2400 – Lowest Fundamental (2402)	-5.21	-25.21	-41.22	Pass

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



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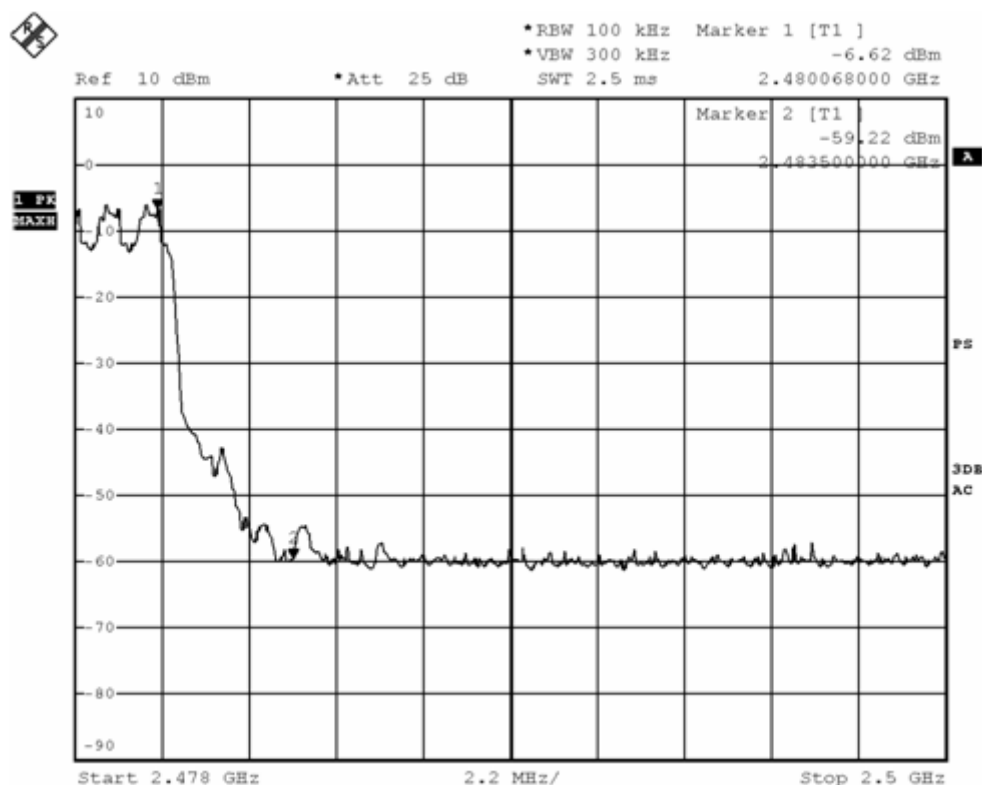
Date : 2019-12-30  
No. : HMD19120015

Page 53 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2483.5 - Highest Fundamental (2480)	-6.62	-26.62	-59.22	Pass

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



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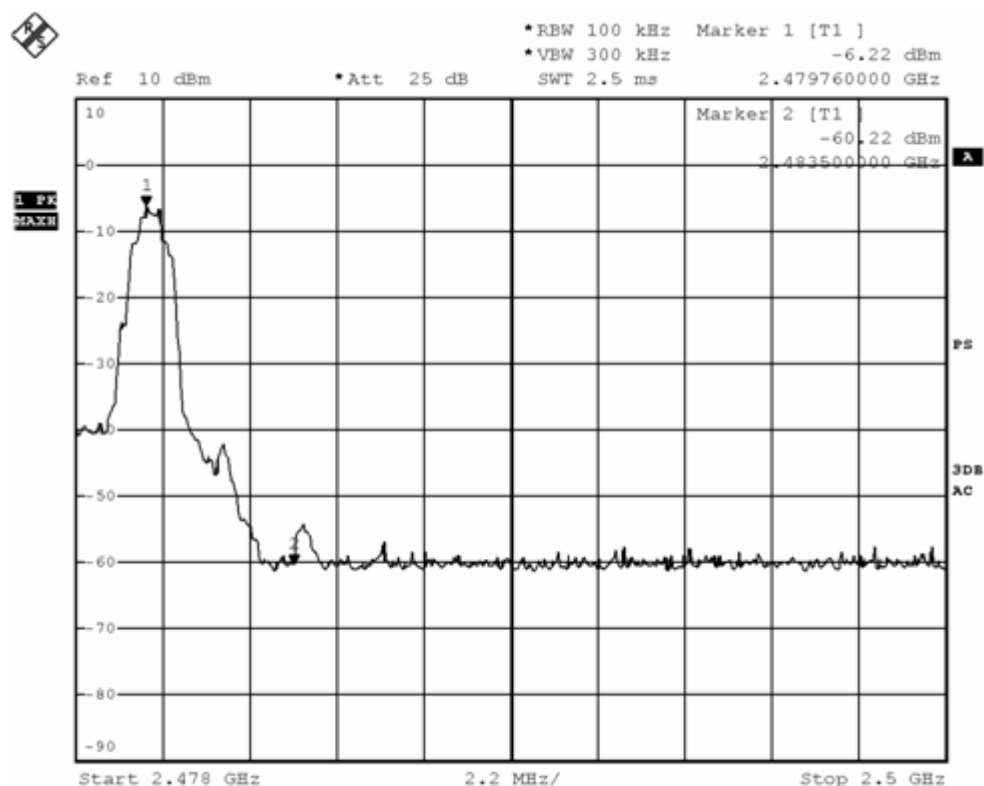
Date : 2019-12-30  
No. : HMD19120015

Page 54 of 73

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

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
2483.5 - Highest Fundamental (2480)	-6.22	-26.22	-60.22	Pass

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



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 55 of 73

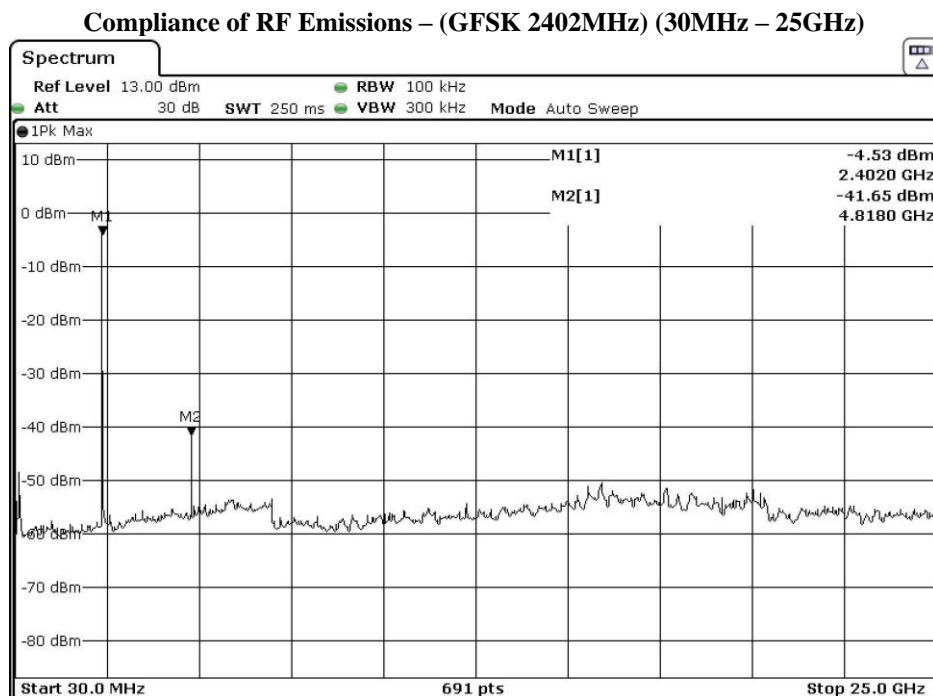
### Compliance of RF Conducted Emissions Measurement:

#### 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.

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

The following plots include cable losses and attenuator: 3.4dB (The attenuator is 3dB).



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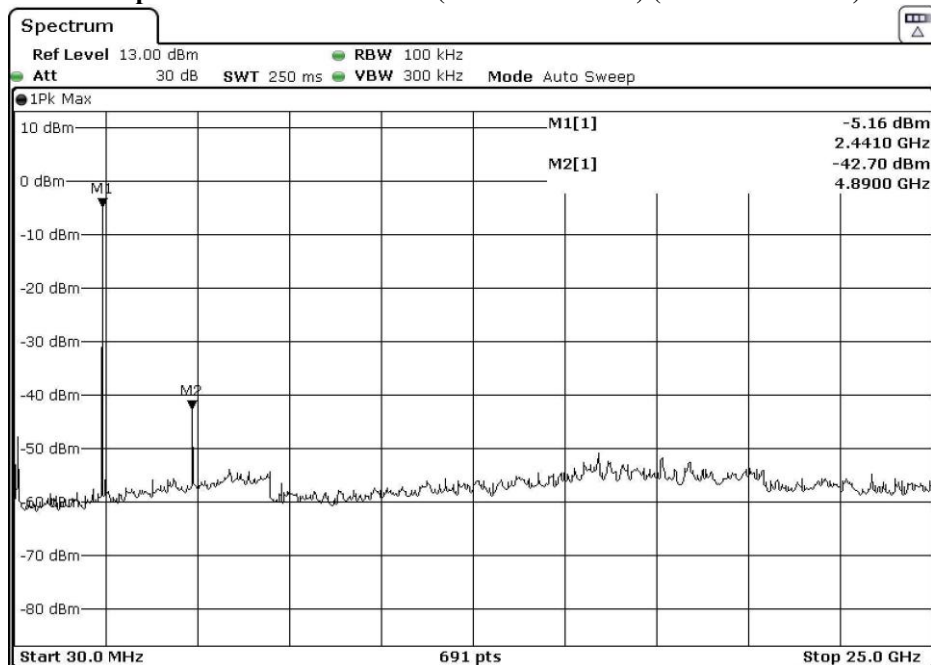


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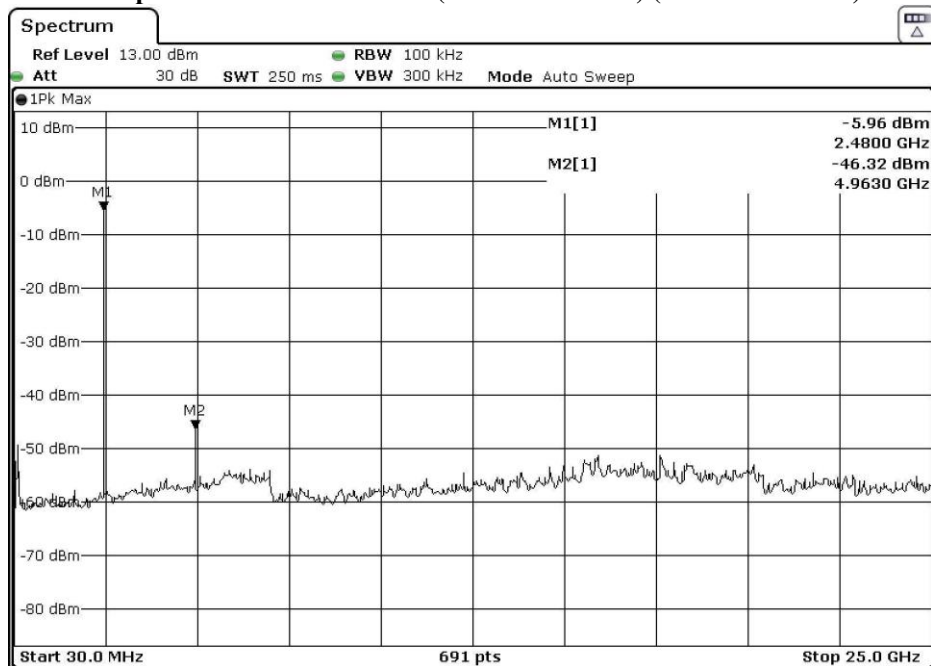
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No. : HMD19120015

Page 56 of 73

### Compliance of RF Emissions – (GFSK 2441MHz) (30MHz – 25GHz)



### Compliance of RF Emissions – (GFSK 2480MHz) (30MHz – 25GHz)



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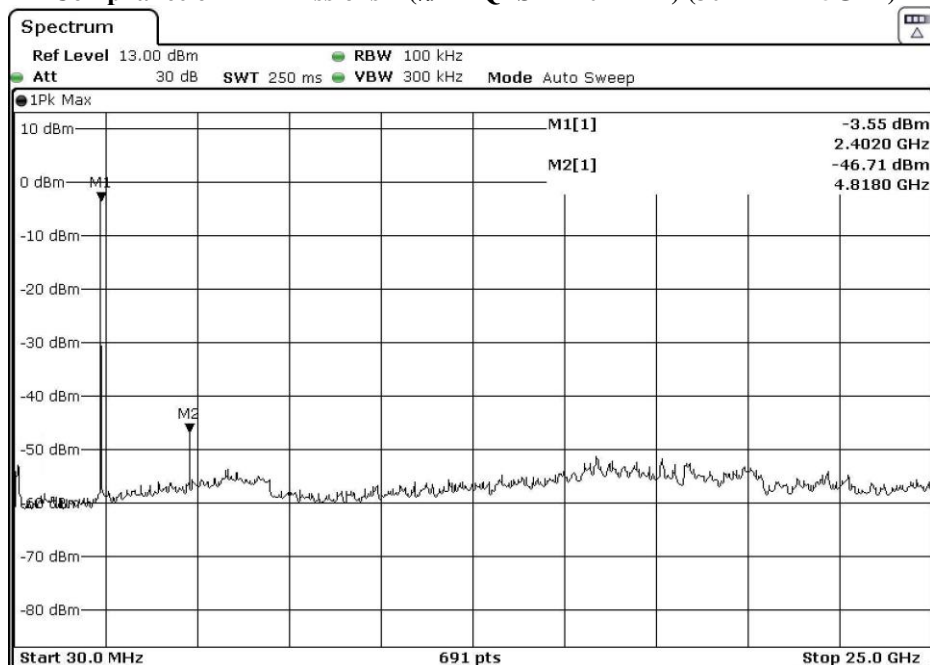


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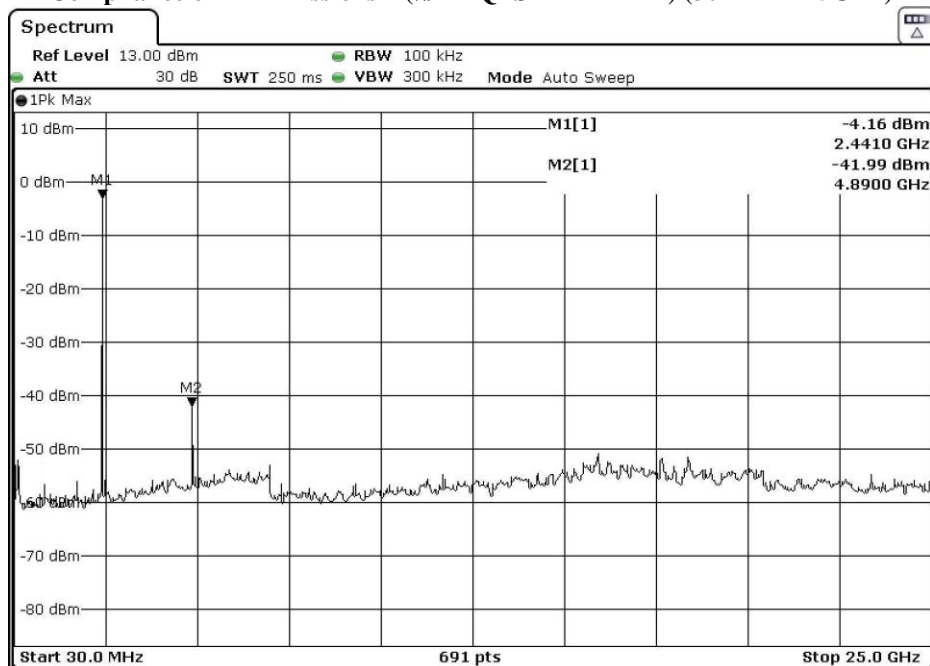
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No. : HMD19120015

Page 57 of 73

### Compliance of RF Emissions – ( $\pi/4$ -DQPSK 2402MHz) (30MHz – 25GHz)



### Compliance of RF Emissions – ( $\pi/4$ -DQPSK 2441MHz) (30MHz – 25GHz)



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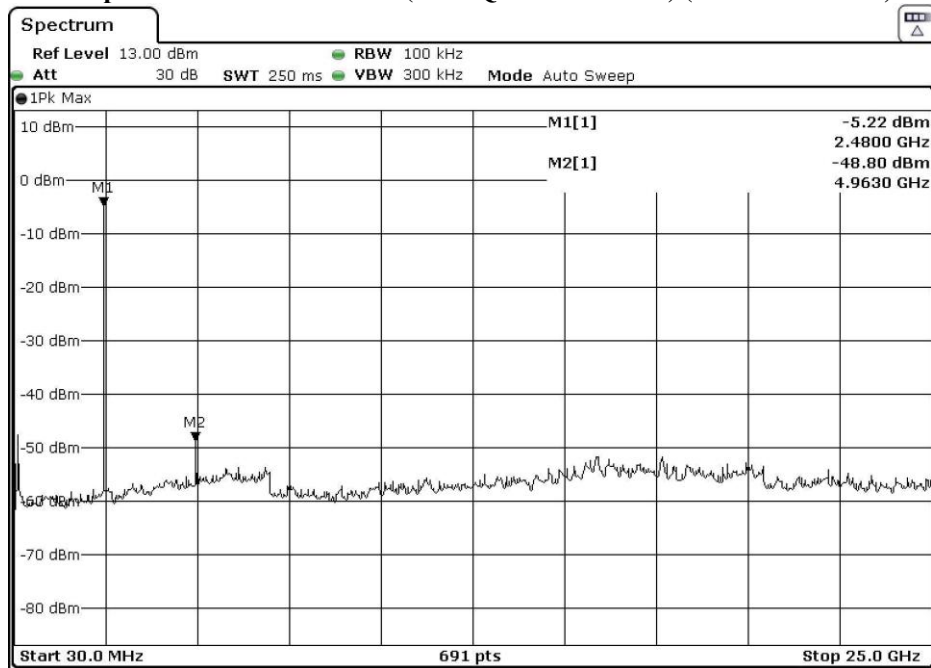


## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 58 of 73

### Compliance of RF Emissions – ( $\pi/4$ -DQPSK 2480MHz) (30MHz – 25GHz)



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 59 of 73

### 3.1.8 Time of Occupancy (Dwell Time)

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

#### 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 ≥ RBW,

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

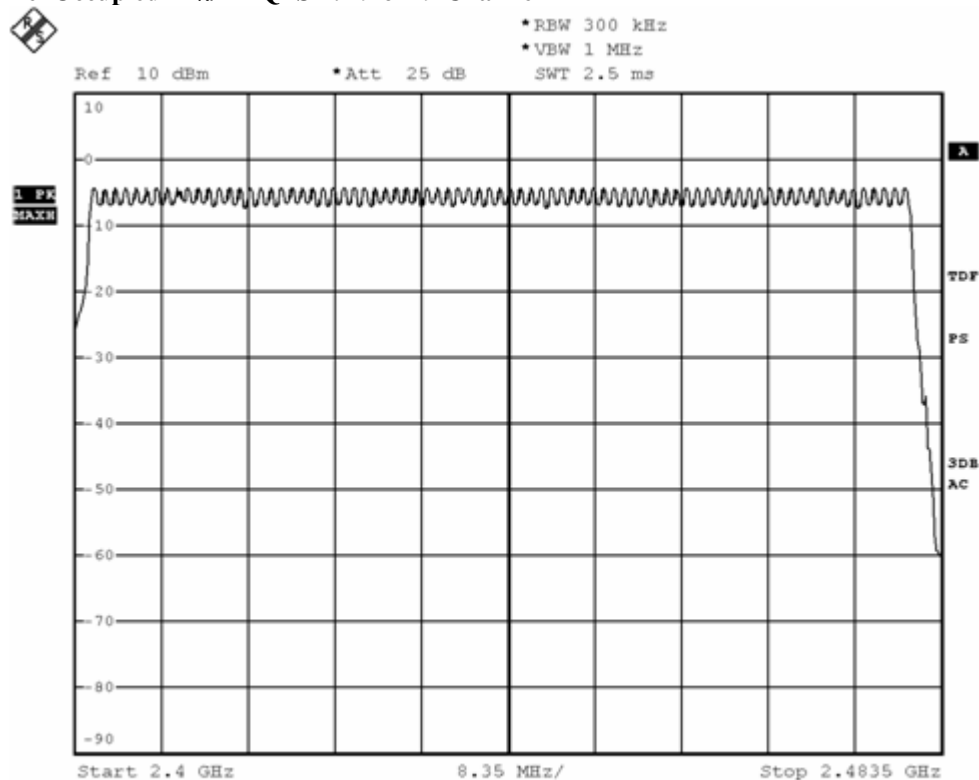
Span = Zero, Detector = Peak, Trace = Max. hold

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

Observed duration: 0.4s x 79 = 31.6s

#### Measurement Data:

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



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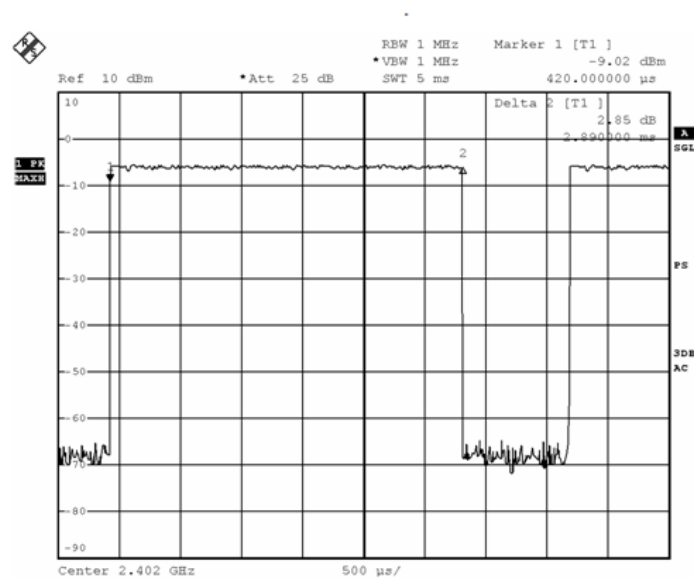
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No. : HMD19120015

Page 60 of 73

### 2DH5 Packet:

2DH5 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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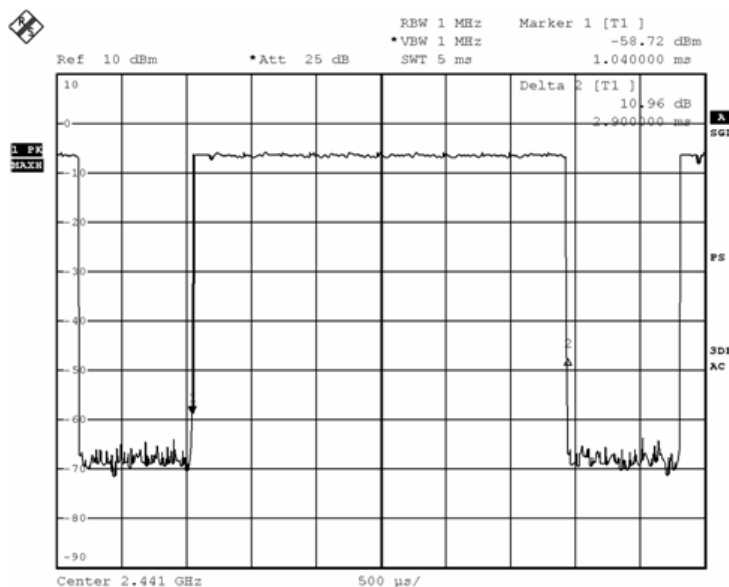
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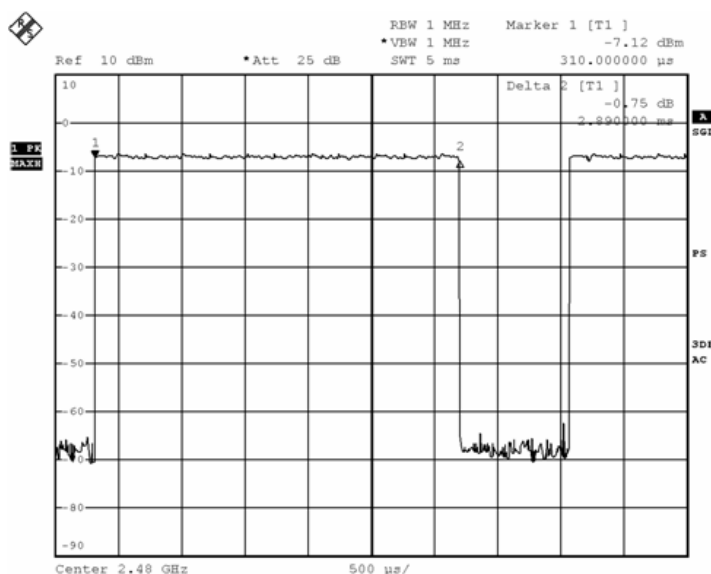
Date : 2019-12-30  
No. : HMD19120015

Page 61 of 73

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



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



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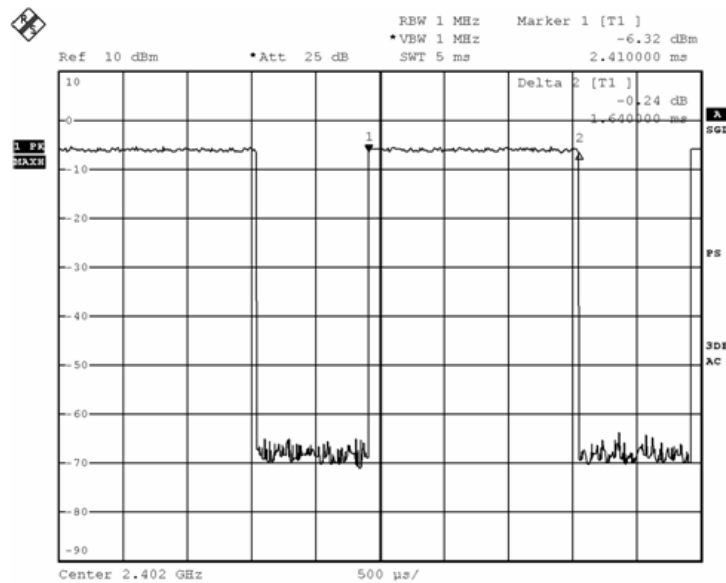
Date : 2019-12-30  
No. : HMD19120015

Page 62 of 73

### 2DH3 Packet:

2DH3 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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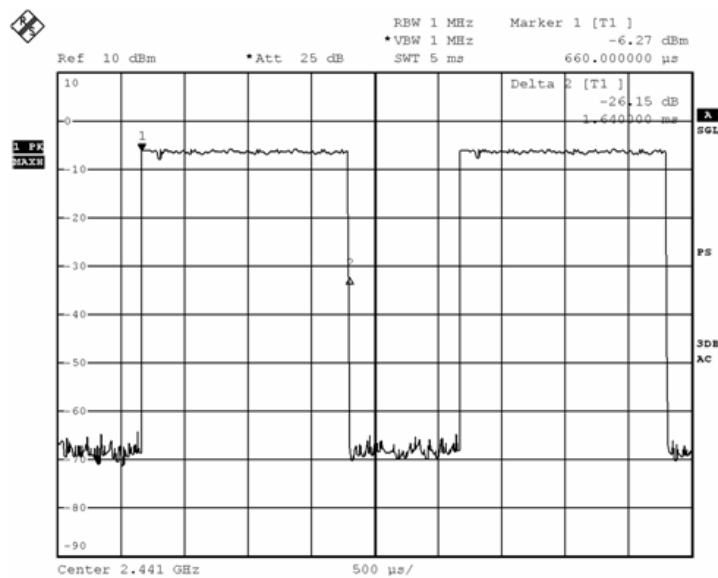
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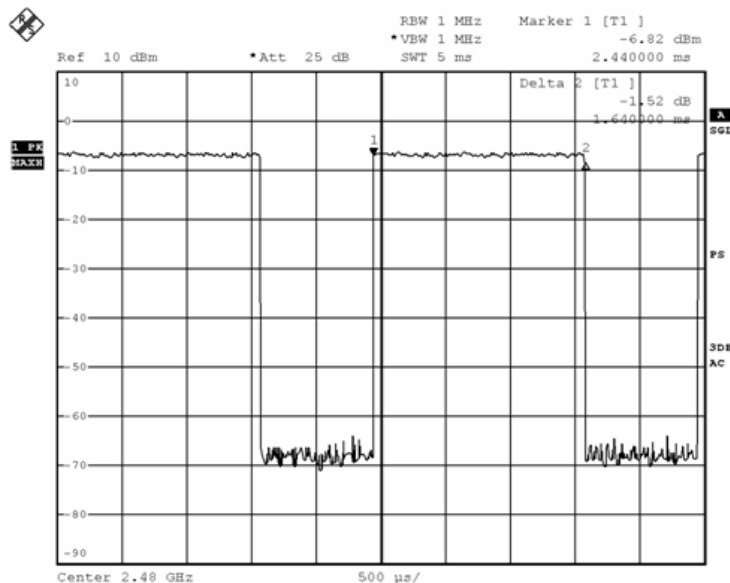
Date : 2019-12-30  
No. : HMD19120015

Page 63 of 73

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



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



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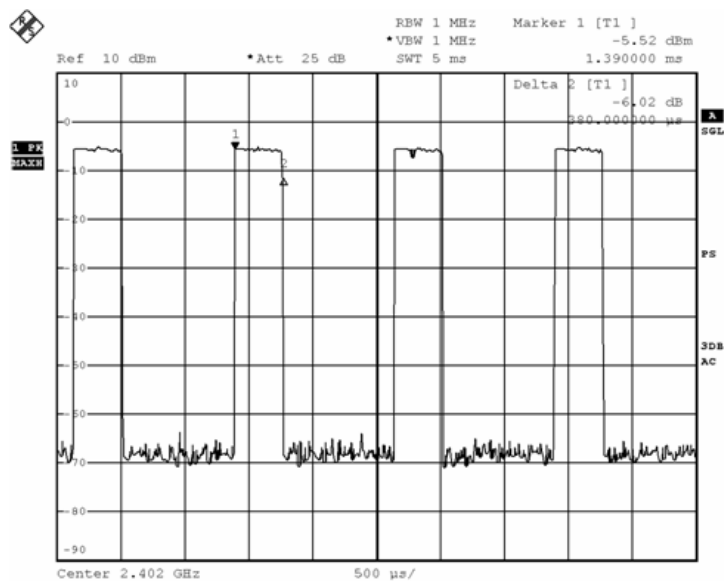
Date : 2019-12-30  
No. : HMD19120015

Page 64 of 73

### 2DH1 Packet:

2DH1 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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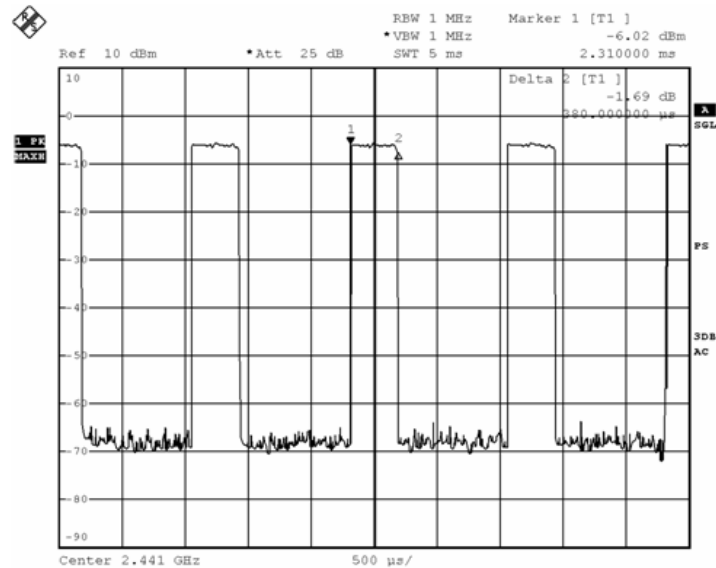


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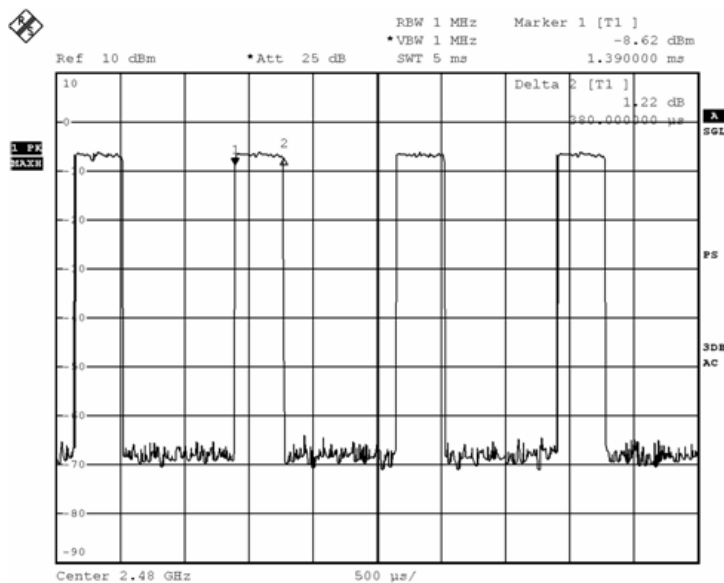
Date : 2019-12-30  
No. : HMD19120015

Page 65 of 73

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



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



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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 66 of 73

### Time of occupancy (Dwell Time):

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Results
2DH5	2402	2.890	0.308	0.400	Complies
2DH5	2441	2.900	0.309	0.400	Complies
2DH5	2480	2.890	0.308	0.400	Complies
2DH3	2402	1.640	0.262	0.400	Complies
2DH3	2441	1.640	0.262	0.400	Complies
2DH3	2480	1.640	0.262	0.400	Complies
2DH1	2402	0.380	0.122	0.400	Complies
2DH1	2441	0.380	0.122	0.400	Complies
2DH1	2480	0.380	0.122	0.400	Complies

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 67 of 73

### 3.1.9 Channel Centre Frequency

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

#### **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 = 0,...,78 (Channel separation = 1MHz)

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## Test Report

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No. : HMD19120015

Page 68 of 73

### 3.1.10 Pseudorandom Hopping Algorithm

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

#### **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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## **Test Report**

**Date : 2019-12-30**  
**No. : HMD19120015**

**Page 69 of 73**

### **3.1.11 Antenna Requirement**

Ambient Temperature: 25°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

**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 is -0.58dBi.  
User is unable to remove or changed the Antenna.

The Hong Kong Standards and Testing Centre Limited

Head Office: 10 Dai Wang Street, Taipo Industrial Estate, Tai Po, N.T., Hong Kong

Unit B, 10/F, Block 1, Tai Ping Industrial Centre, No. 57 Ting Kok Road, Tai Po, N.T., Hong Kong

Tel: +852 2666 1888 Fax: +852 2664 4353 Email: hkstc@stc.group Website: www.stc.group

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 70 of 73

### Appendix A

#### List of Measurement Equipment

##### Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2018/04/20	2020/04/20
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM354	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00142073	2018/03/29	2020/03/29
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2018/06/01	2020/06/01
EM276	BROADBAND HORN ANTENNA	A-INFOMW	JXTXLB- 10180-SF	J203109090300 7	2018/04/27	2020/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2018/05/13	2020/05/13
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2018/05/13	2020/05/13
EM302	PRECISION OMNIDIRECTIONAL DIPOLE (1 – 6GHZ)	SEIBERSDORF LABORATORIES	POD 16	161806/L	2018/05/11	2020/05/11
EM303	PRECISION OMNIDIRECTIONAL DIPOLE (6 – 18GHZ)	SEIBERSDORF LABORATORIES	POD 618	6181908/L	2018/05/11	2020/05/11
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2018/04/16	2020/04/16
EM045	POWER METER	ROHDE & SCHWARZ	NRVD	843246/028	2018/06/01	2020/06/01

##### Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2018/11/09	2020/11/09
EM145	EMI TEST RECEIVER	R & S	ESCS 30	830245/021	2018/06/01	2020/06/01
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2019/01/11	2020/01/11
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057- 99A	2017/02/02	2022/02/02
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	BSIB-K1	V1.20	N/A	N/A

Remarks:-

CM Corrective Maintenance  
N/A Not Applicable  
TBD To Be Determined

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## Test Report

Date : 2019-12-30  
No. : HMD19120015

Page 71 of 73

### Appendix B

#### Photographs of EUT

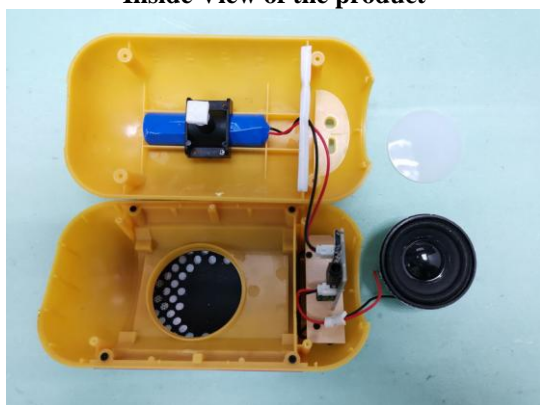
View of the product



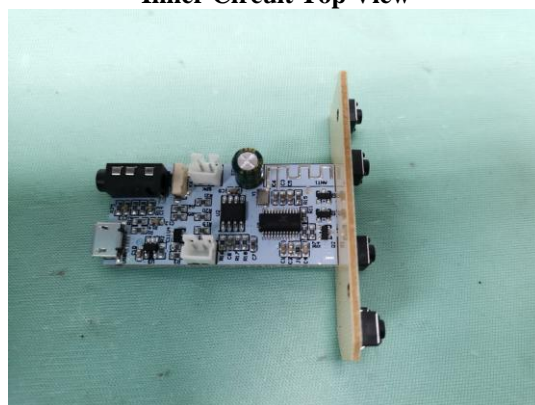
View of the product



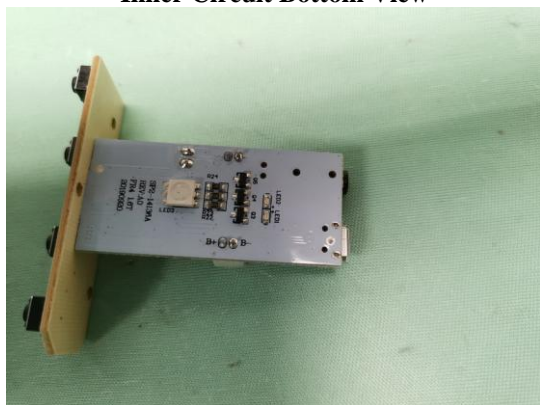
Inside View of the product



Inner Circuit Top View



Inner Circuit Bottom View



Inner Circuit Top View



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Tel: +852 2666 1888 Fax: +852 2664 4353 Email: hkstc@stc.group Website: www.stc.group

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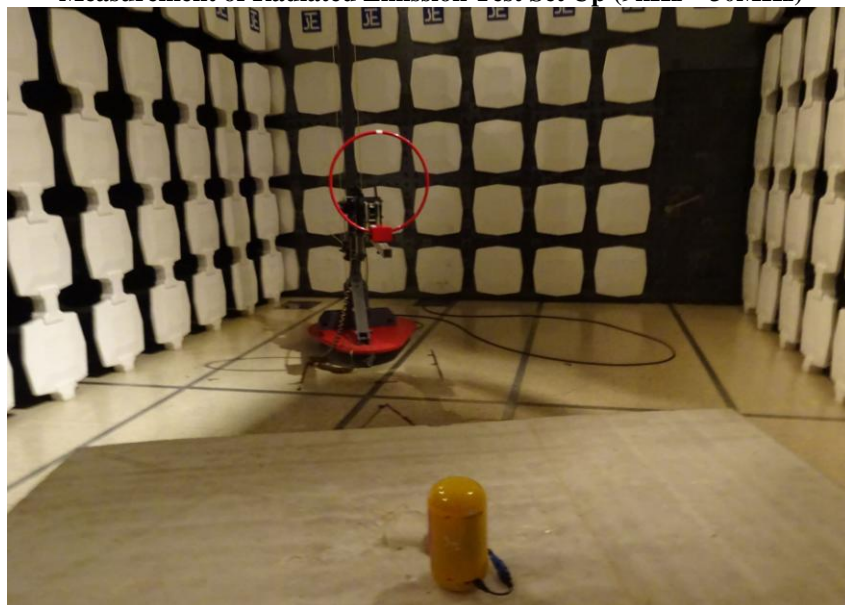
## Test Report

Date : 2019-12-30  
No. : HMD19120015

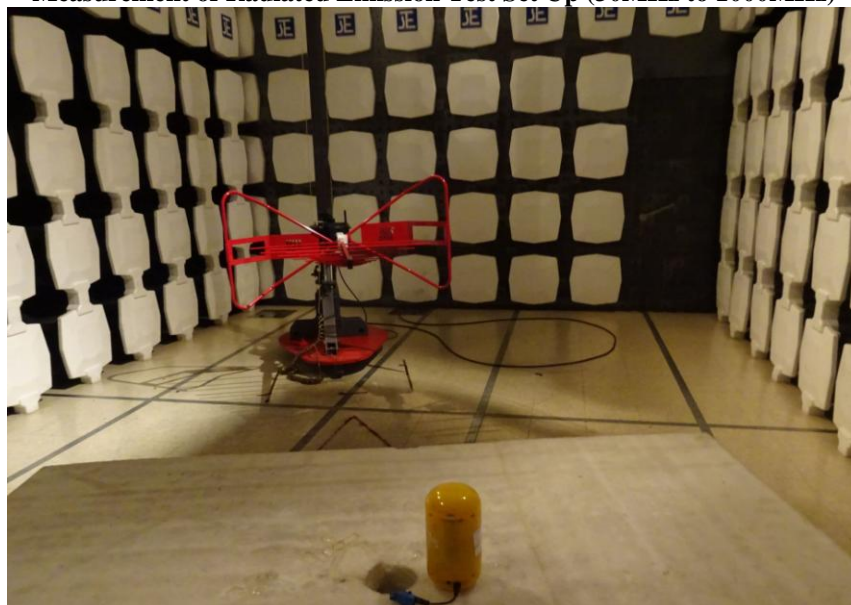
Page 72 of 73

### Photographs of EUT

**Measurement of Radiated Emission Test Set Up (9kHz – 30MHz)**



**Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)**



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Head Office: 10 Dai Wang Street, Taipo Industrial Estate, Tai Po, N.T., Hong Kong

Unit B, 10/F, Block 1, Tai Ping Industrial Centre, No. 57 Ting Kok Road, Tai Po, N.T., Hong Kong

Tel: +852 2666 1888 Fax: +852 2664 4353 Email: [hkstc@stc.group](mailto:hkstc@stc.group) Website: [www.stc.group](http://www.stc.group)

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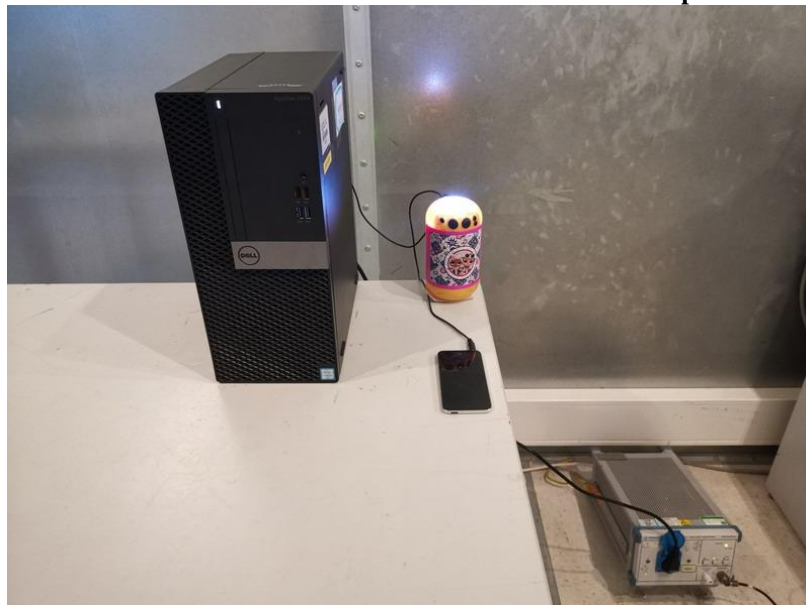
Page 73 of 73

### Photographs of EUT

Measurement of Radiated Emission Test Set Up (Above 1000MHz)



Measurement of Conducted Emission Test Set Up



\*\*\*\*\* End of Test Report \*\*\*\*\*

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12. Issuance records of the Report are available on the internet at [www.stc.group](http://www.stc.group). Further enquiry of validity or verification of the Reports should be addressed to the Company.