



TEST REPORT

Date: 2015-05-15

Report No.: 60.870.15.006.02F

Applicant:

Acoustic Arc International Ltd.

Unit 110-112, 1/F., Philips Electronics Bldg., No.5 Science
Park East Avenue, Hong Kong Science Park, Shatin, New
Territories, Hong Kong

Description of Samples:

Model name: 4.0 Bluetooth Wireless Headphone

Model no.: CL7400BT

FCCID: VHC-AAI-BH1250-00

Date Samples Received:

2015-04-27

Date Tested:

2015-04-28 to 2015-05-14

Investigation Requested:

FCC Part 15 Subpart C, Section 15.247

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:

Checked by:

Approved by:-

Ray Cheung
Project Engineer
Wireless & Telecom Department

John Zhi
Project Manager
Wireless & Telecom Department

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Photos of Test Setup

Appendix B

External EUT Photos

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Internal EUT Photos



1.0 **General Details**

1.1 **Test Laboratory**

TUV SUD Certification and Testing (China) Co., Ltd
Building 12&13, Zhiheng Wisdomland Business Park,
Nantou Checkpoint Road 2, Shenzhen, 518052
Registration Number: 502708

Tested by:

A handwritten signature in blue ink, appearing to read 'Ray', written over a horizontal line.

Ray Cheung

1.2 **Applicant Details**

Applicant

Acoustic Arc International Ltd.

Unit 110-112, 1/F., Philips Electronics Bldg., No.5
Science Park East Avenue, Hong Kong Science Park,
Shatin, New Territories, Hong Kong

Manufacturer

Acoustic Arc International Ltd.

Unit 110-112, 1/F., Philips Electronics Bldg., No.5
Science Park East Avenue, Hong Kong Science Park,
Shatin, New Territories, Hong Kong



1.3 Equipment Under Test [EUT]

Description of EUT

Product Description:	4.0 Bluetooth Wireless Headphone
Model No.:	CL7400BT
Brand Name:	
FCCID:	VHC-AAI-BH1250-00
Rating:	3.7VDC, 1000mAh
Operated Frequency:	2402 - 2480 MHz
No. of Operated Channel:	79
Modulation:	GFSK, 8DPSK, $\pi/4$ -DQPSK
Accessories and Auxiliary Equipments:	- Mobile Phone
Antenna Type:	Integral
Manufacture of Antenna:	Acoustic Arc International Ltd.
Antenna Gain:	0 dBi
Antenna Model:	N/A

General Operation of EUT

The Equipment Under Test (EUT) is a Wireless Headphone with Bluetooth function.

FHSS Operation Principle:

This module is controlled by Bluetooth microchip to generate Pseudorandom Frequency Hopping Sequence, this module support 79 hopping channels. Refer to section 4.5 of this report to have more detail of Pseudorandom Hopping Algorithm.

1.4 Related Submittal(s) Grants

This is a signal application subjected to Certificate Authorization.

2.0 Technical Details

2.1 Investigations Requested

Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 and ANSI C63.4: 2009

2.2 Test Standards and Results Summary Tables

Test Condition	Test Requirement	Test Result	
		Pass	N/A
Number of Frequency Hopping	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
20dB Bandwidth Measurement	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Hopping Channel Carrier Frequency Separation	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Average Time of Occupancy	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Pseudorandom Hopping Algorithm	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Band Edge Measurement	Section 15.247	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Maximum Output Power	Section 15.247 (b1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Out of Band Emission	Section 15.247 (d)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Radiated Emission in Restricted Band	Section 15.247 (d)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Conducted Emission on AC Mains	Section 15.207	<input type="checkbox"/>	<input checked="" type="checkbox"/>
RF Exposure	Section 15.247 (i)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Antenna Requirement	Section 15.203	<input checked="" type="checkbox"/> See note 1	<input type="checkbox"/>

Note 1 : The EUT uses a permanently attached antenna, which in accordance to Section 15.203, is considered sufficient to comply with the provisions of this section.

Remark: N/A - Not Applicable



3.0 Test Methodology

3.1 Radiated Emission

The sample was placed 0.8m above the ground plane on a standard emission test site *. 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.

3.2 Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

$$\begin{aligned} FS &= R + \text{System Factor} \\ \text{System Factor} &= AF + CF + FA - PA \end{aligned}$$

Where FS = Net Field Strength in dBuV/m at 3 meters.

R = Reading of Spectrum Analyzer / Test Receiver in dBuV.

AF = Antenna Factor in dB.

CF = Cable Attenuation Factor in dB.

FA = Filter Attenuation Factor in dB.

PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

3.3 Conducted Emissions

The test was performed in accordance with ANSI C63.4: 2009, with the following: initial measurements were performed in peak and average detection modes on the live line of personal computer, any emissions recorded within 30dB of the relevant limit lines 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.

4.0 Test Results

4.1 Number of Hopping Frequency

Test Requirement:	FCC part 15 section 15.247 (a1)(iii)
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode.
Detector Function:	Max Hold

Result: PASS

Measured Result :

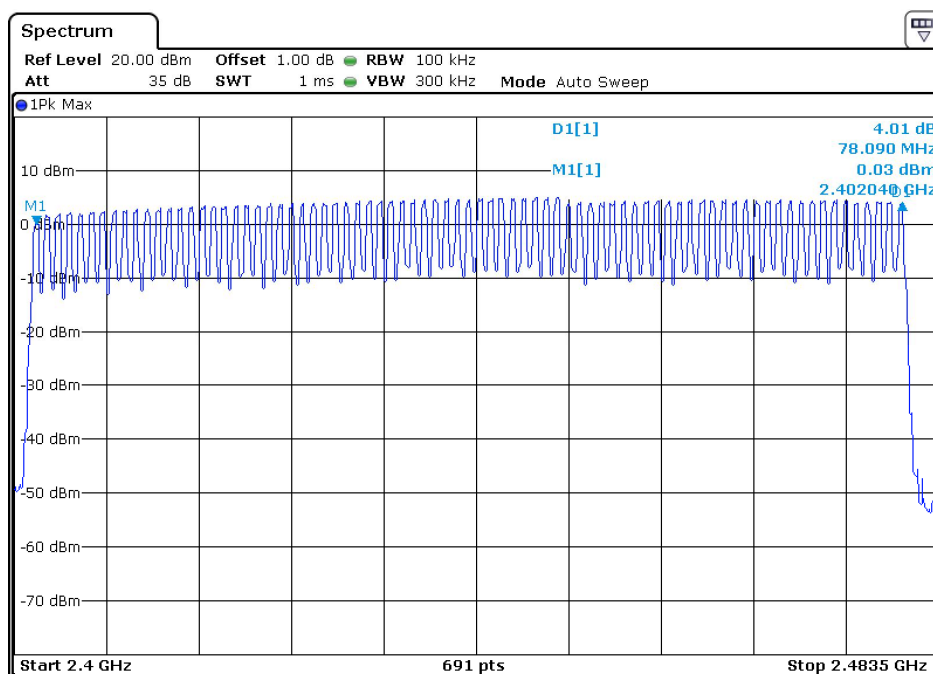
Operating Channel Frequency in sequence:

2402 ; 2403 ; 2404 ; 2405 ; 2406 ; 2407 ; 2408 ; 2409 ; 2410 ; 2411 ; 2412 ; 2413 ; 2414 ; 2415 ;
 2416 ; 2417 ; 2418 ; 2419 ; 2420 ; 2421 ; 2422 ; 2423 ; 2424 ; 2425 ; 2426 ; 2427 ; 2428 ; 2429 ;
 2430 ; 2431 ; 2432 ; 2433 ; 2434 ; 2435 ; 2436 ; 2437 ; 2438 ; 2439 ; 2440 ; 2441 ; 2442 ; 2443 ;
 2444 ; 2445 ; 2446 ; 2447 ; 2448 ; 2449 ; 2450 ; 2451 ; 2452 ; 2453 ; 2454 ; 2455 ; 2456 ; 2457 ;
 2458 ; 2459 ; 2460 ; 2461 ; 2462 ; 2463 ; 2464 ; 2465 ; 2466 ; 2467 ; 2468 ; 2469 ; 2470 ; 2471 ;
 2472 ; 2473 ; 2474 ; 2475 ; 2476 ; 2477 ; 2478 ; 2479 ; 2480

Limit for Number of Hopping Channel [Section 15.247 (a1)(iii)]

At least 79 non-overlapping channels for 2400-2483.5MHz.

Result data graph shows the number of operation channels:



4.2 20dB Bandwidth Measurement

Test Requirement:	FCC part 15 section 15.247 (a1)
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode.
Detector Function:	Max Hold

Test Setup:

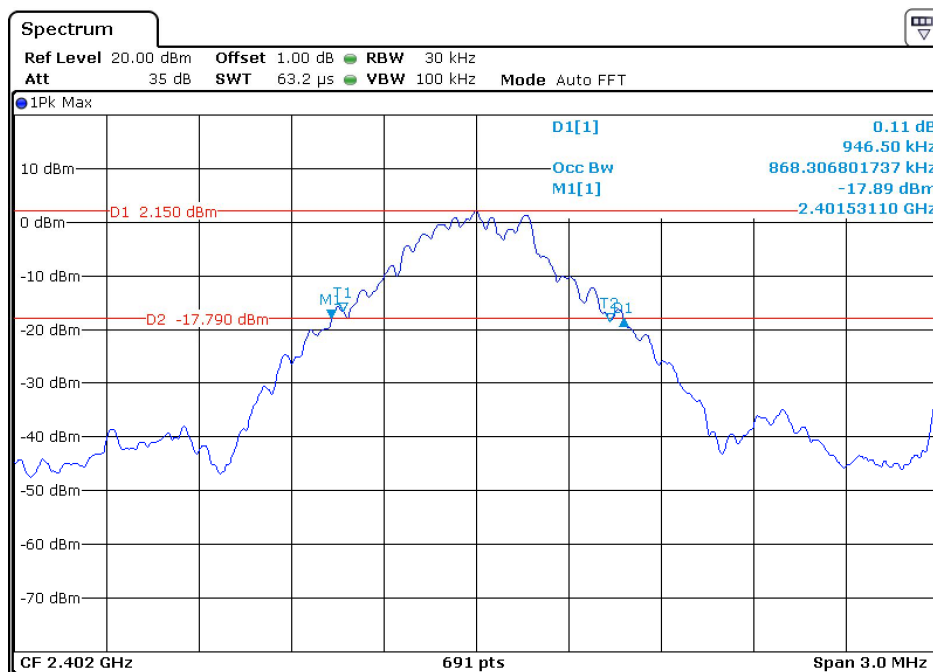
The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with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

GFSK

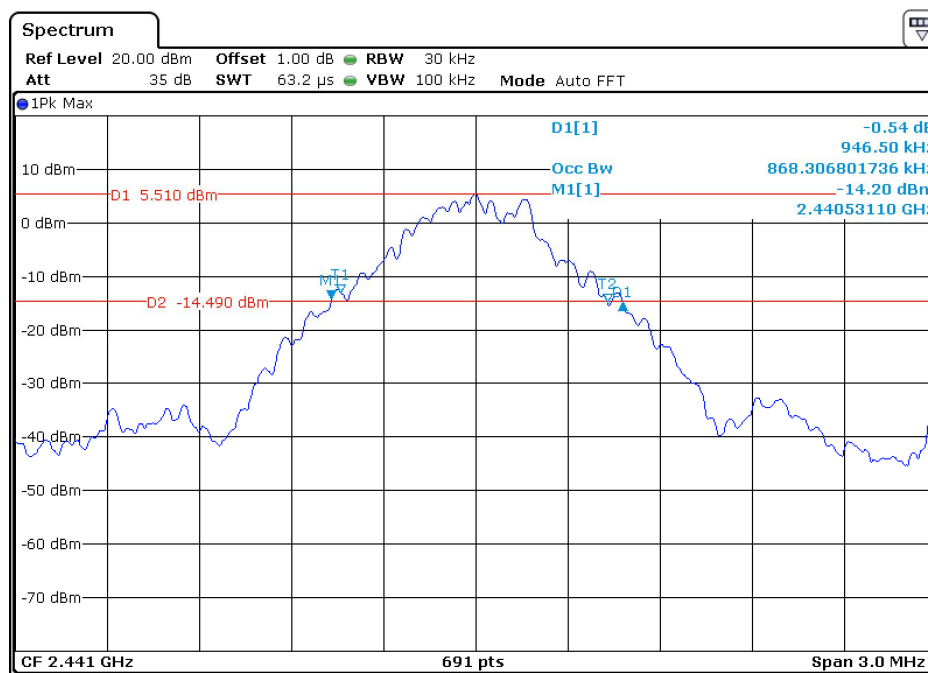
Channel	Measured frequency (MHz)	20dB Bandwidth (MHz)
Lowest	2.402	0.868
Middle	2.441	0.868
Highest	2.480	0.860

This result is used for checking the hopping channel carrier frequencies separation.

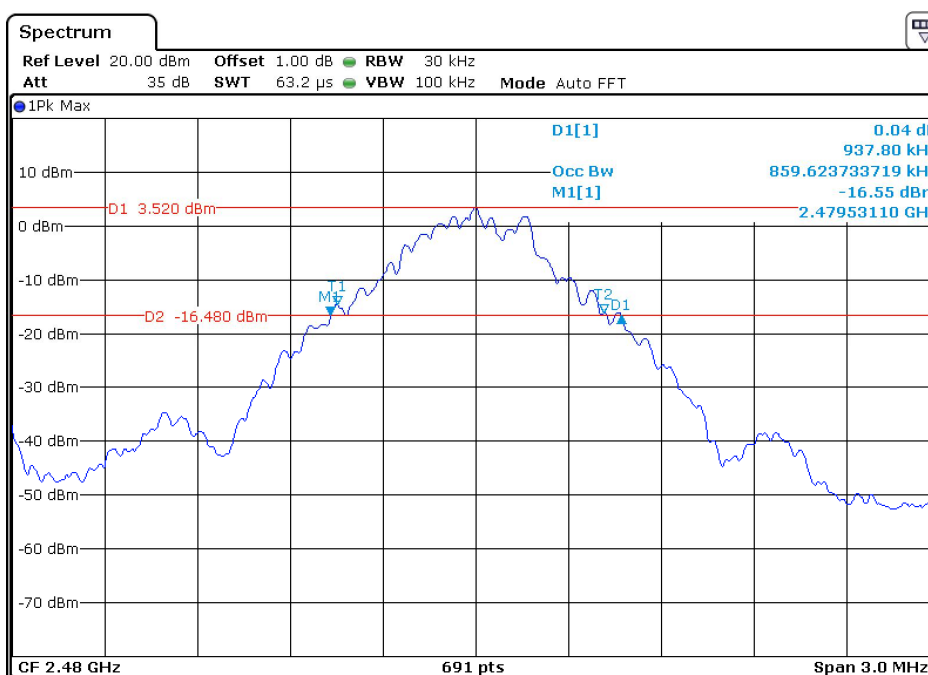
Result data graph shows 20 dB bandwidth, CF = 2.402GHz, BW = 0.868MHz



Result data graph shows 20 dB bandwidth, CF = 2.441GHz, BW = 0.868MHz



Result data graph shows 20 dB bandwidth, CF = 2.480GHz, BW = 0.860MHz

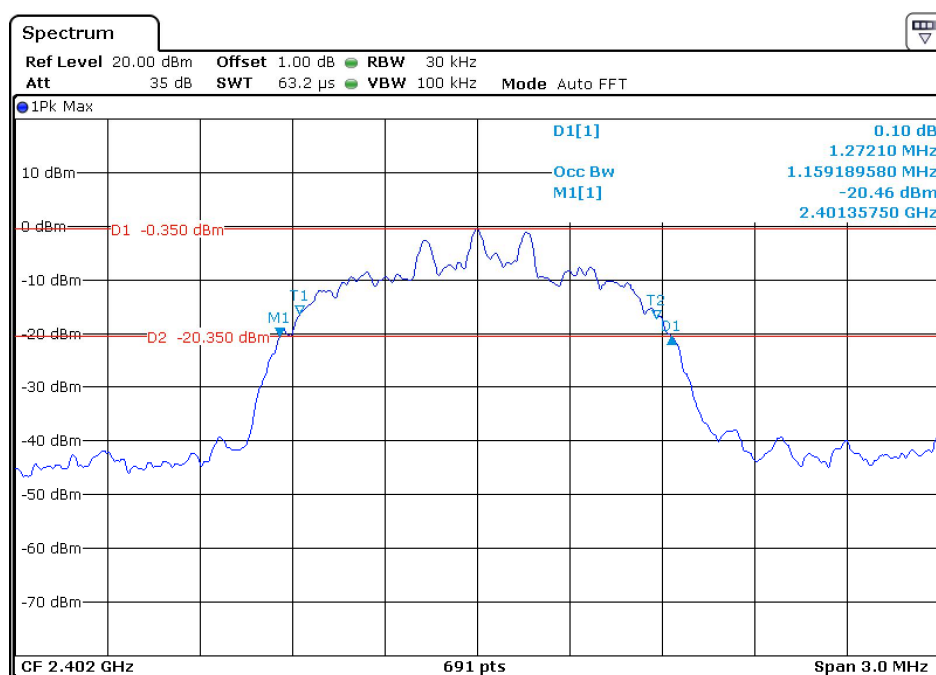


8DPSK

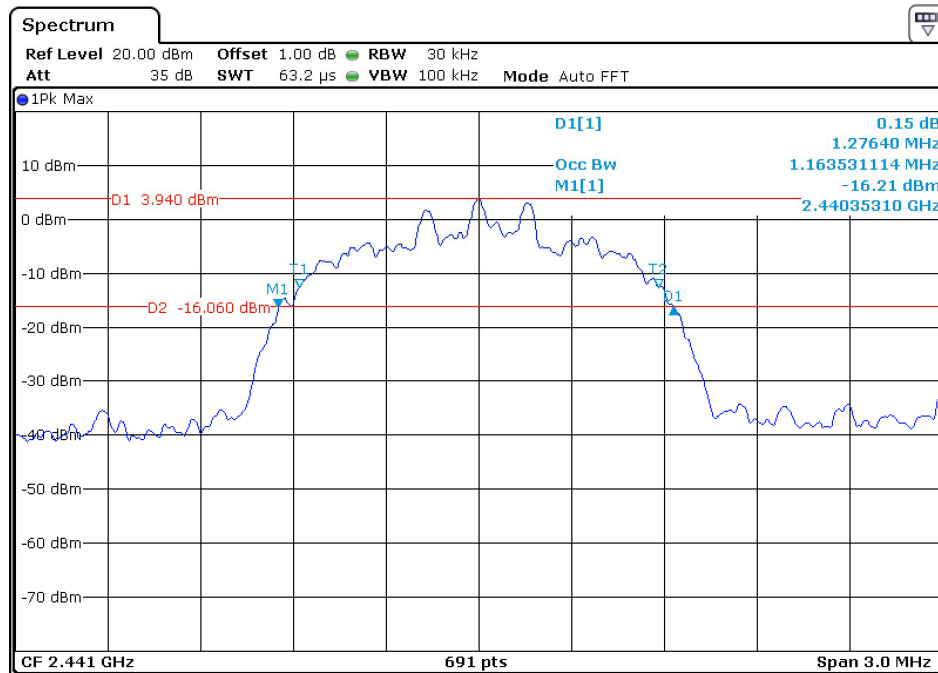
Channel	Measured frequency (MHz)	20dB Bandwidth (MHz)
Lowest	2.402	1.159
Middle	2.441	1.164
Highest	2.480	1.159

This result is used for checking the hopping channel carrier frequencies separation.

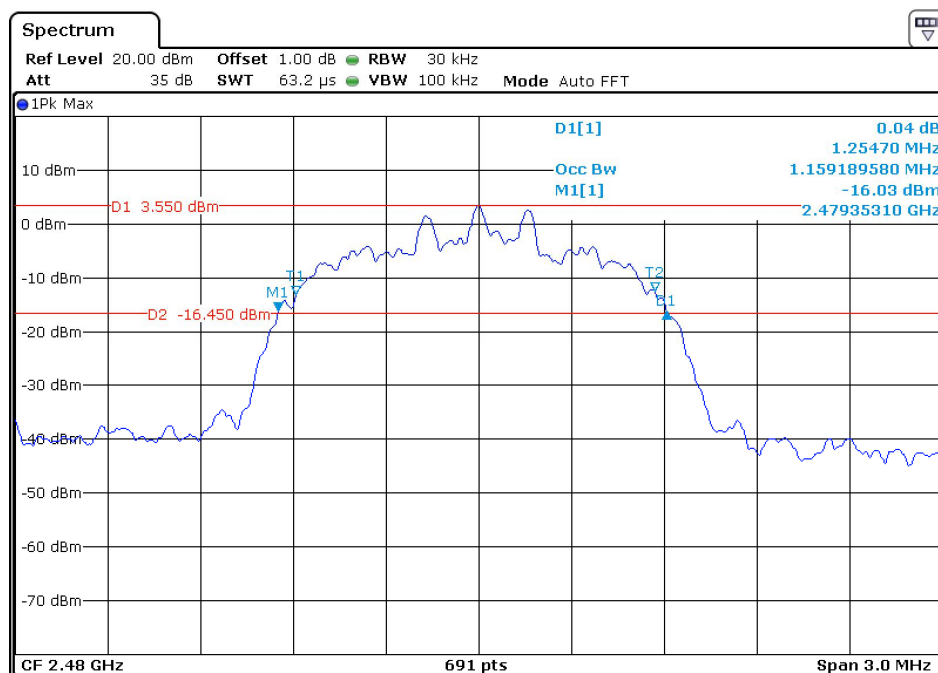
Result data graph shows 20 dB bandwidth, CF = 2.402GHz, BW = 1.159MHz



Result data graph shows 20 dB bandwidth, CF = 2.441GHz, BW = 1.164MHz



Result data graph shows 20 dB bandwidth, CF = 2.480GHz, BW = 1.159MHz



4.3 Hopping Channel Carrier Frequency Separation

Test Requirement:	FCC part 15 section 15.247 (a1)
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode.
Detector Function:	Max Hold

Result: PASS

Measured Result :

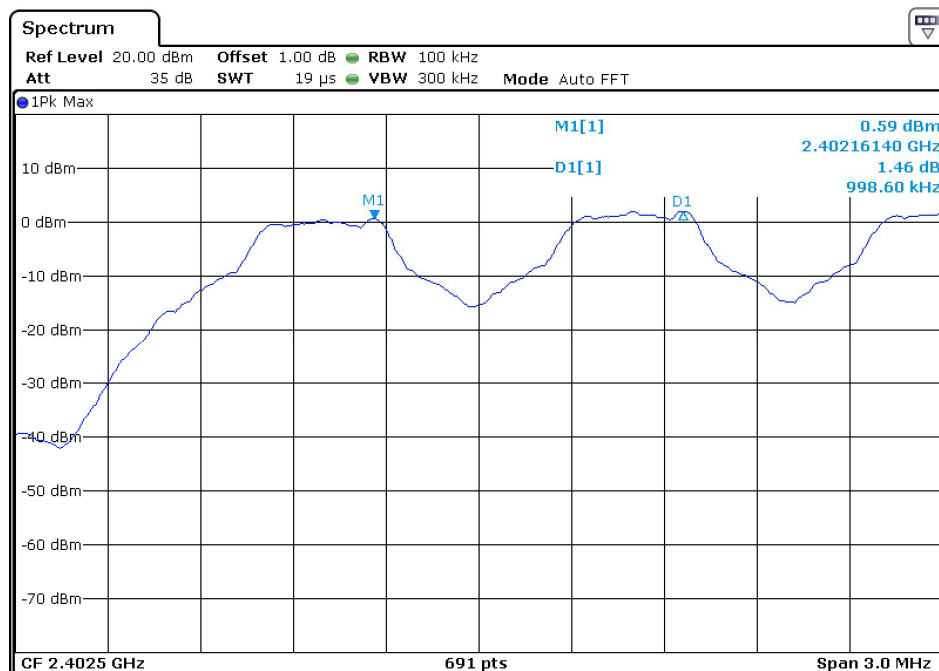
Refer to the delta marker, the frequency separation between two adjacent channels is 1 MHz, therefore, the requirement of channel separated by a two-thirds of the 20dB bandwidth of the hopping channel is applied.

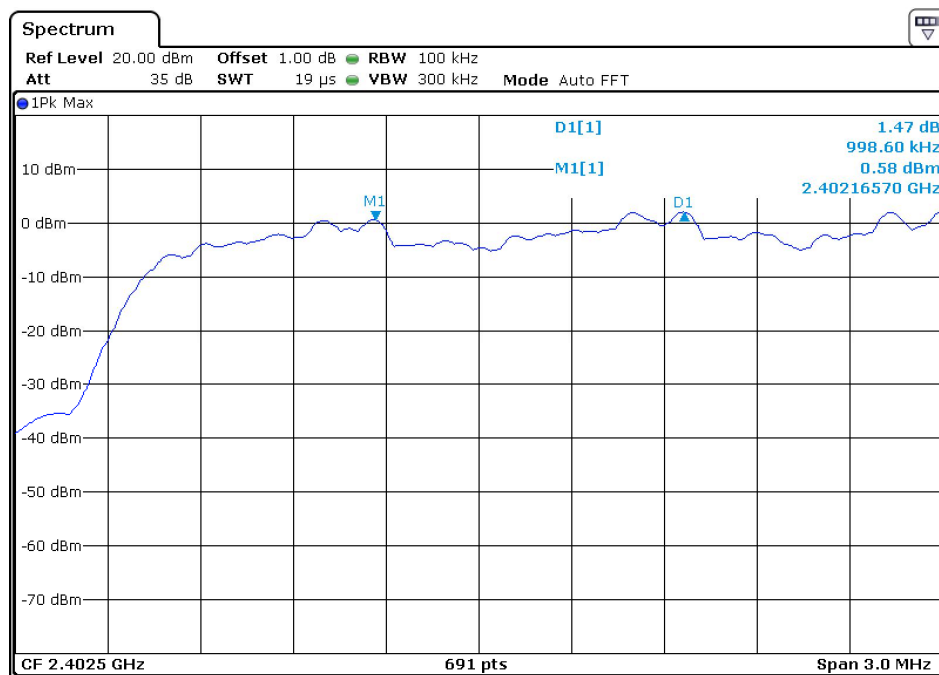
Limits for Hopping Channel Separation [Section 15.247 (a1)]:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

Result data graph shows the channel separation

GPSK



8DPSK:

4.4 Average Time of Channel Occupancy

Test Requirement:	FCC part 15 section 15.247 (a1)(iii)
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode.
Detector Function:	Zero span

Result : PASS

Measured Result :

DH5 Packet permit maximum:

= 1600 /79/6

= 3.37 hop/s in each channel (5 time slots Rx, 1 times slot Tx)

Transmission Times within observing period

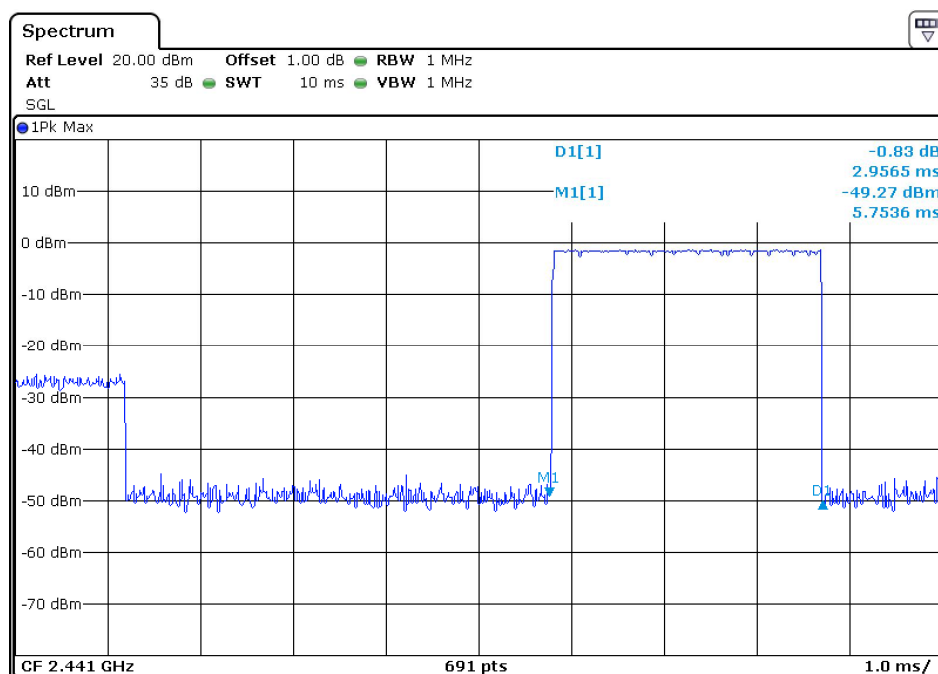
= 3.37 x 31.6

= 106.6

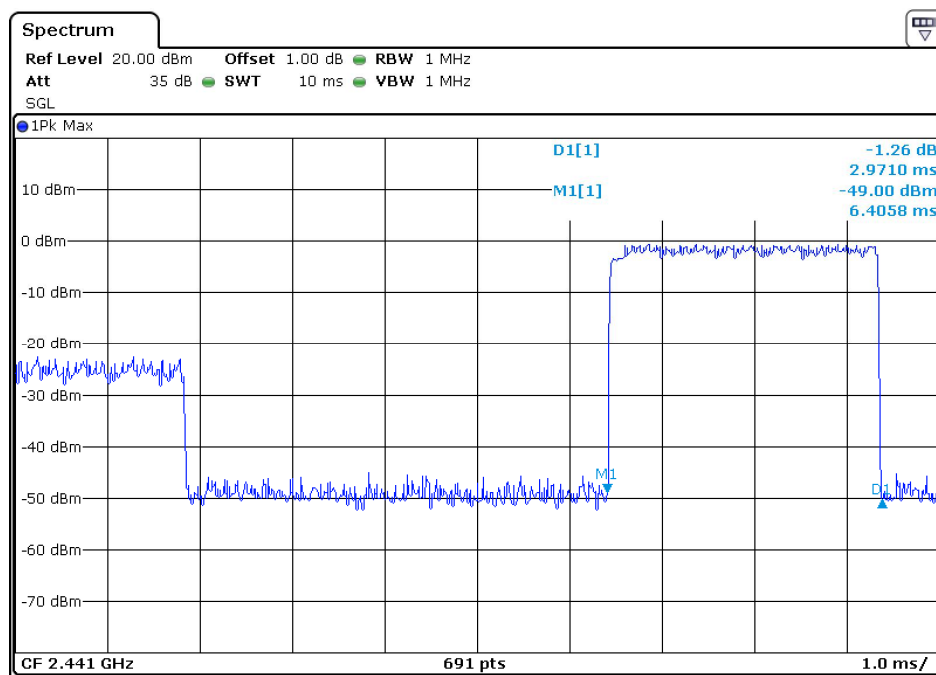
Limits for Average Time of Occupancy [Section 15.247 (a1)(iii)]:

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

Result data graph shows the DH5 Package at 1MHz



Result data graph shows the DH5 Package at 3MHz



The table shown the result of DH5

Frequency (MHz)	Pulse Duration (ms)	Dwell time (ms)	Limit (ms)
2441	2.96	315.5	400
2441	2.97	316.6	400

4.5 Band Edge Measurement

Test Requirement:	FCC part 15 section 15.247
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode.
Detector Function:	Max Hold

Result: PASS

Measured Result :

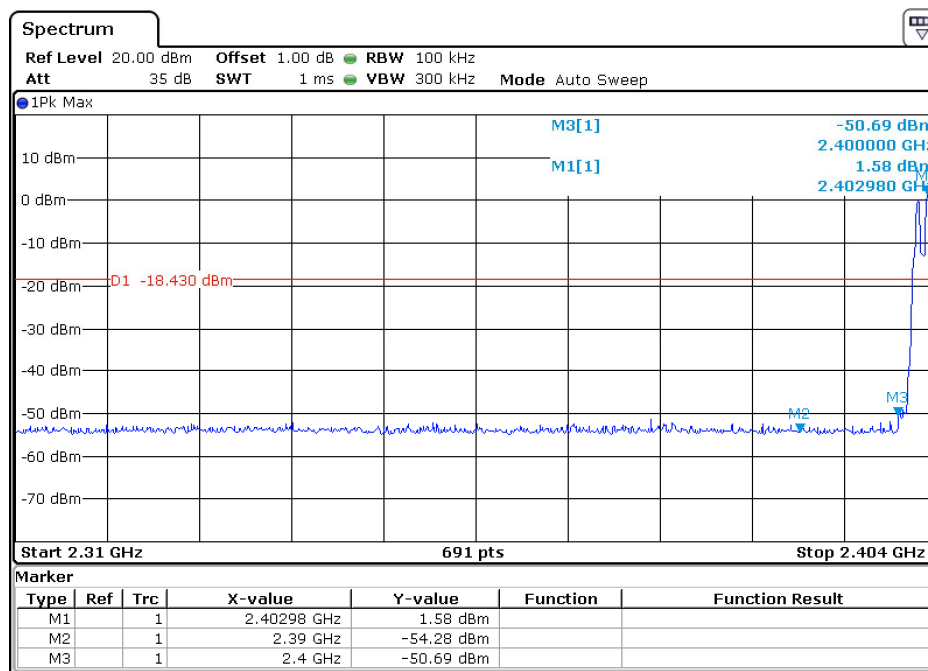
Refer to the table and data graph, it shows the frequency of lower band edge and upper band edge separately.

Limits of Band Edge for Carrier Frequencies Operated within the Bands [Section 15.247]:

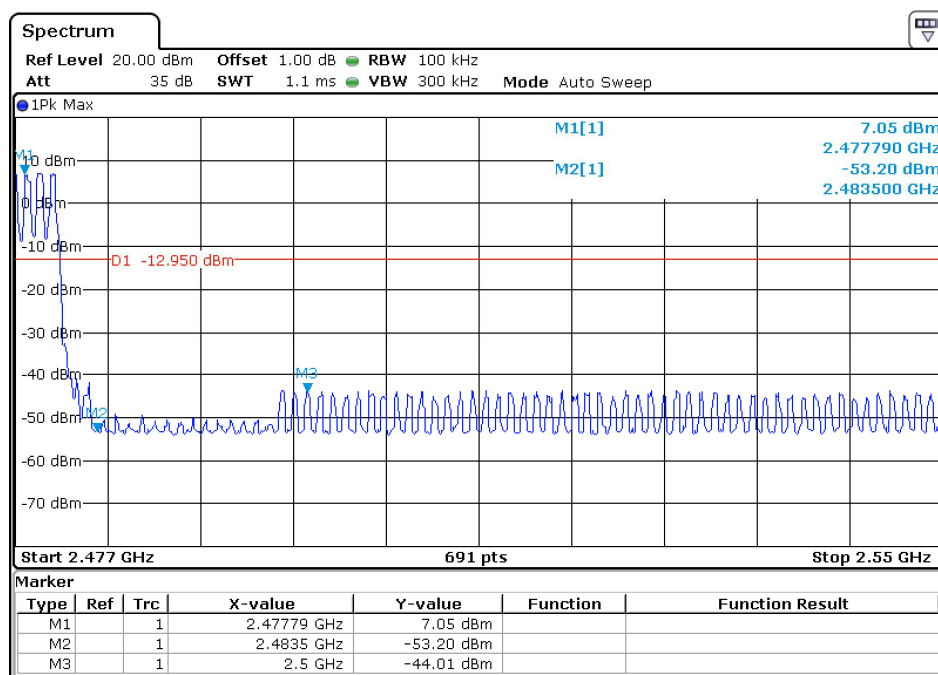
The carrier frequencies should operate within 2400-2483.5MHz.

GPSK:

Result table and data graph shows the frequency of lower channel.

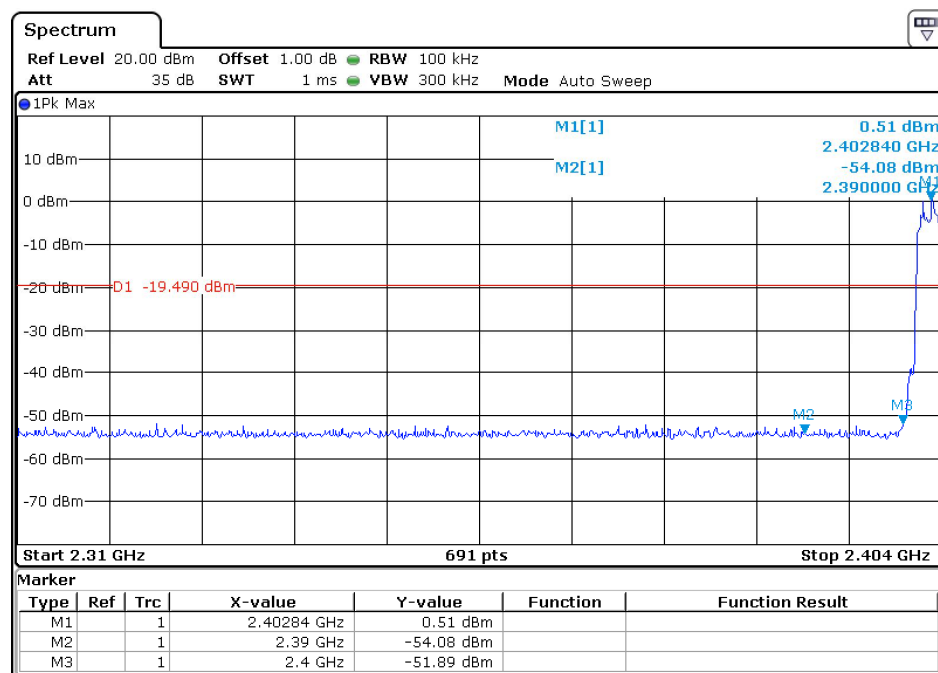


Result table and data graph shows the frequency of upper channel.



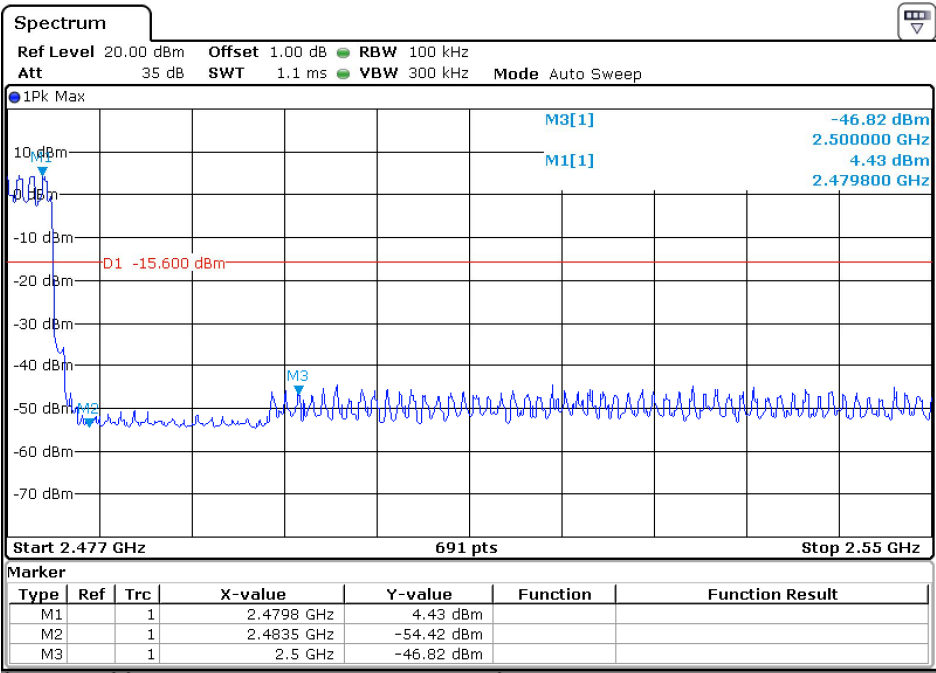
8DPSK:

Result table and data graph shows the frequency of lower channel.





Result table and data graph shows the frequency of upper channel.



4.6 Maximum Output Power

Test Requirement:	FCC part 15 section 15.247 (a1)
Test Method:	ANSI C63.4:2009
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode.
Detector Function:	Peak
Measurement BW:	RBW 1MHz ; VBW 3MHz

Test Setup:



Result : PASS

GPSK:

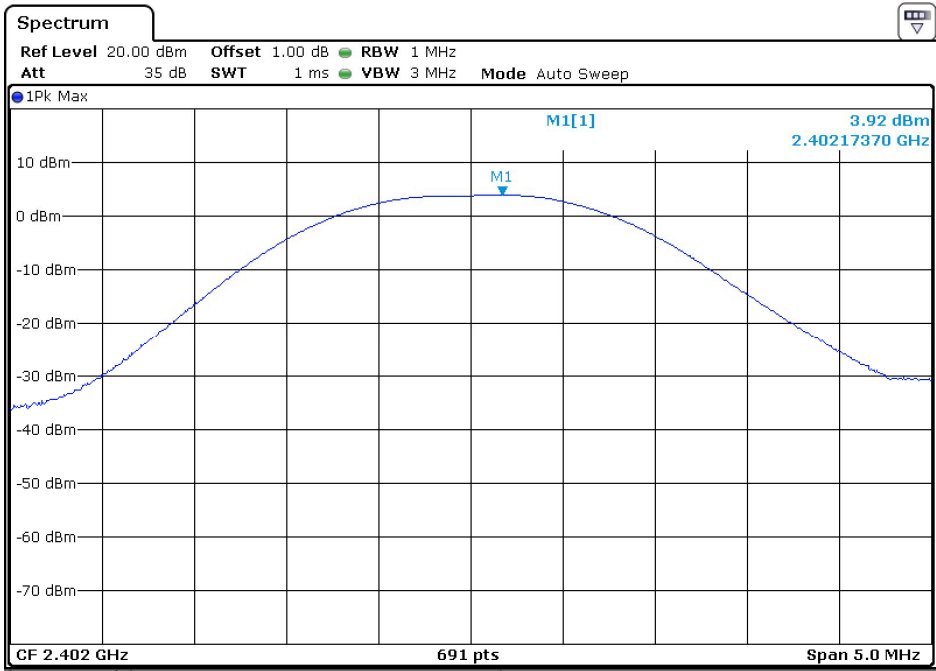
Frequency (MHz)	Peak Output Power		Limit	
	(dBm)	(W)	(dBm)	(W)
Lowest Channel : 2402	3.92	0.0025	21	0.125
Middle Channel : 2441	6.98	0.0050	21	0.125
Highest Channel : 2480	7.23	0.0053	21	0.125

Limits for Maximum Output Power [Section 15.247 (a1)(iii)]:

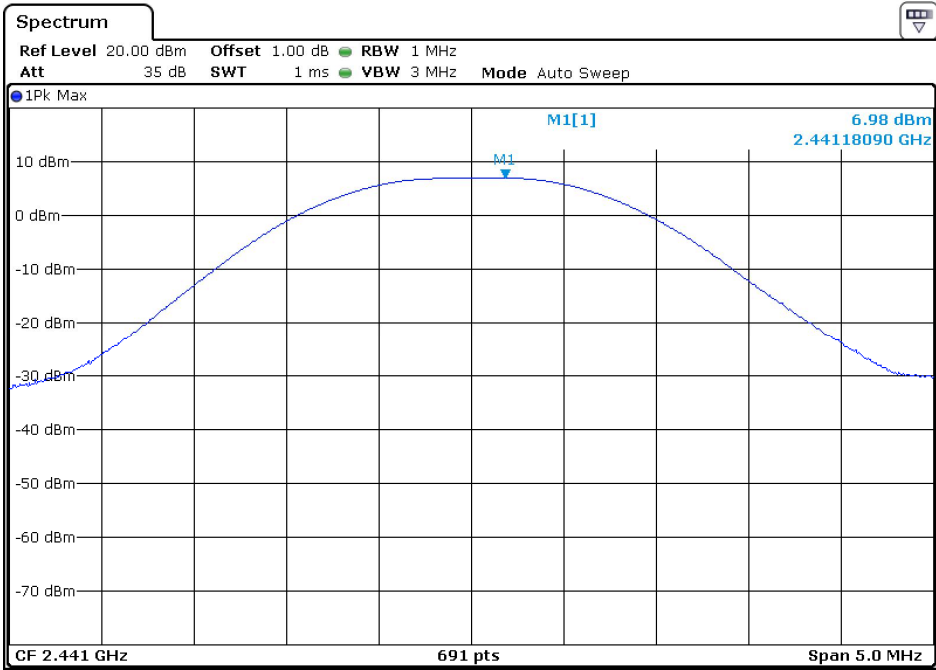
For frequency hopping systems employing at least 75 hopping channels: 1 Watt
 For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts



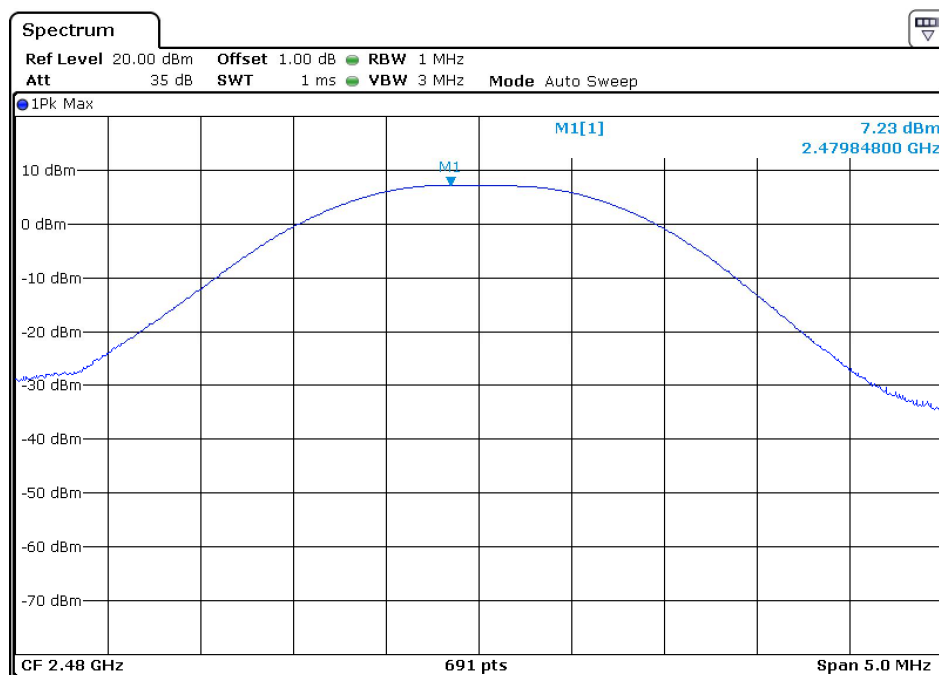
Result data graph shows the frequency of lowest channel.



Result data graph shows the frequency of middle channel.



Result data graph shows the frequency of highest channel.



8DPSK:

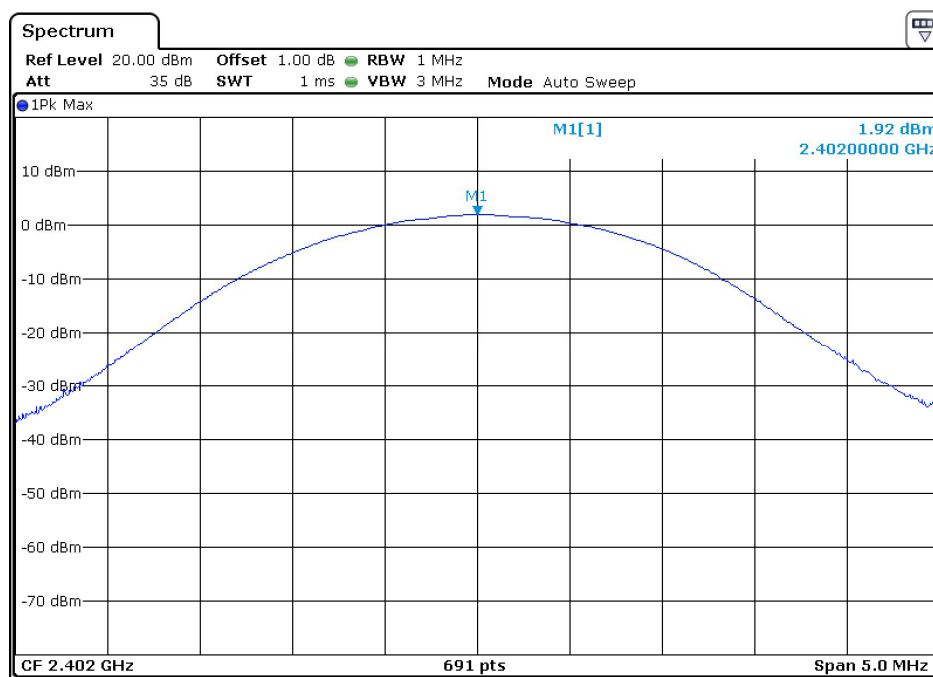
Frequency (MHz)	Peak Output Power		Limit	
	(dBm)	(W)	(dBm)	(W)
Lowest Channel : 2402	1.92	0.0016	21	0.125
Middle Channel : 2441	5.80	0.0038	21	0.125
Highest Channel : 2480	5.62	0.0036	21	0.125

Limits for Maximum Output Power [Section 15.247 (a1)(iii)]:

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

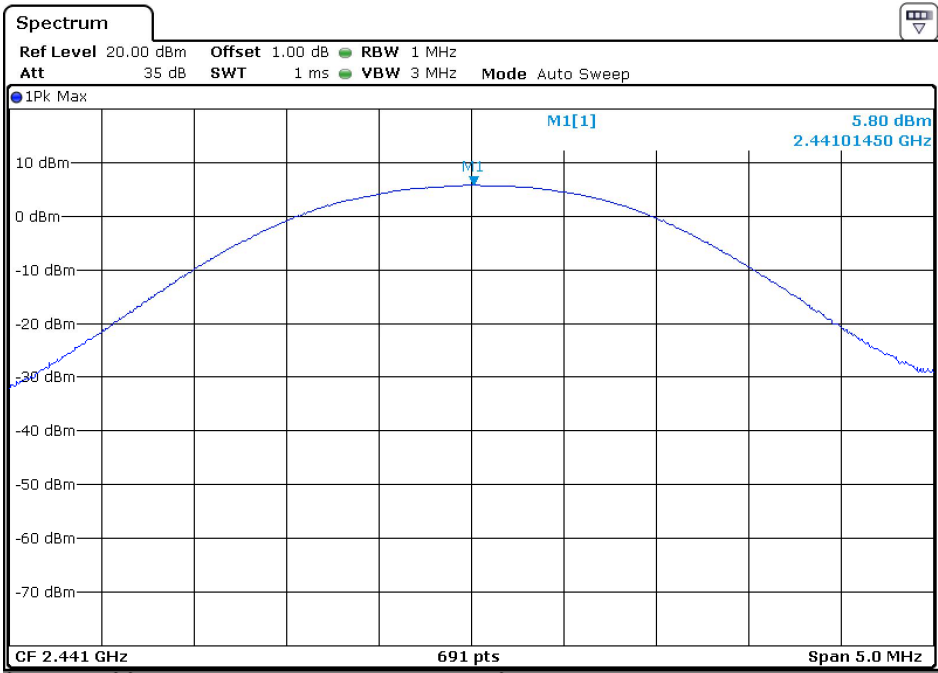
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts

Result data graph shows the frequency of lowest channel.

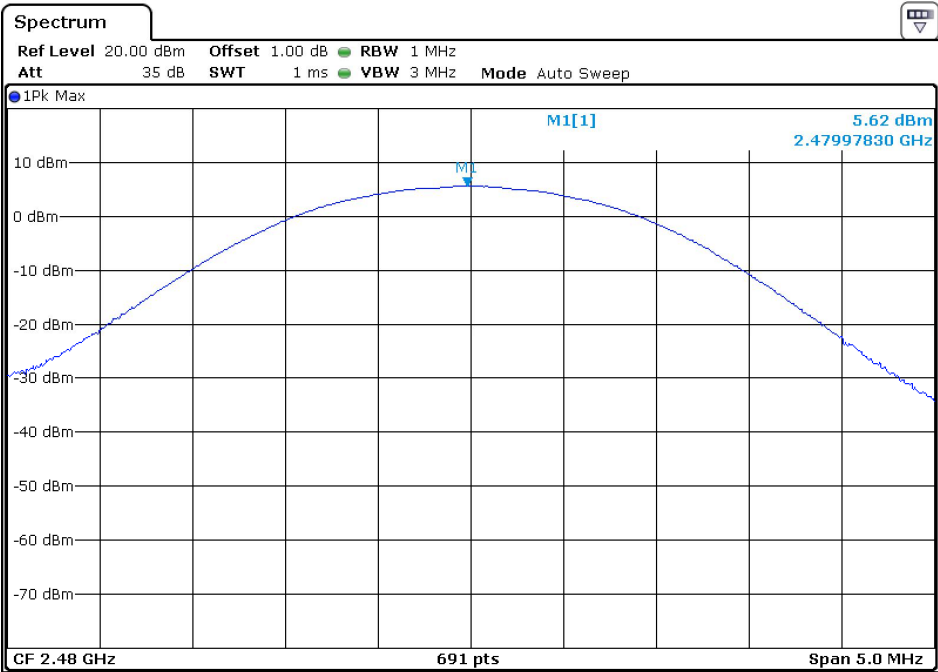




Result data graph shows the frequency of middle channel.



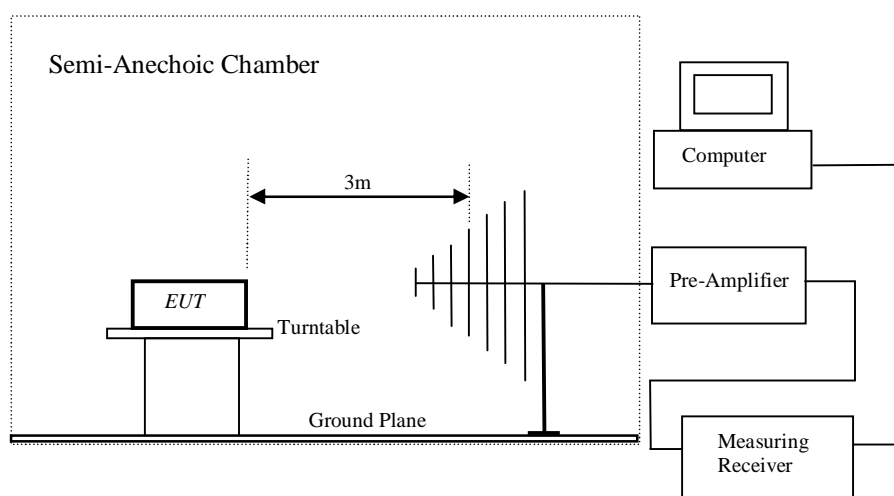
Result data graph shows the frequency of highest channel.



4.7 Out of Band Emissions and Emissions in Restricted Bands

Test Requirement:	FCC part 15 section 15.247 (d)
Test Method:	ANSI C63.4:2003
Test Date:	2015-05-12
Mode of Operation:	Transmitting mode, connected with iPod
Detector Function:	Peak
Measurement BW:	RBW 100KHz ; VBW 300KHz

Test Setup:



Result : PASS

Out of Frequency Band Emissions:

For out of band emissions that are close to or exceed 20dB attenuation requirement, and emission falls into restricted band, radiated emission was performed in order to show compliance with the general radiated emission requirement.

Result Summary:

Refer to the data graph for the emission data graph, result shows that the significant emissions detected are with more than 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

Limits for Out of Frequency Band Emission [Section 15.247 (d)]:

In any 100kHz 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 100kHz bandwidth within the band that contains the highest level of the desired power. Attenuation below the general limits specified in Section 15.209(a) is not required.

Limit for Radiated Emission Falling in Restricted Bands [Section 15.209]:

Frequency (MHz)	Field Strength [$\mu\text{V/m}$]	Field Strength [dB $\mu\text{V/m}$]
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

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.

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 : PASS

All Emission and Emissions Fall into Restricted Band were recorded as below:

Radiated Emissions							
	Emissions Frequency	E-Field Polarity	Reading	System Factor	Field strength at 3m	Limit	Delta to Limit
	MHz		dBuV/m	dB	dBuV/m	dBuV/m	dBuV/m
Lowest Channel							
PK	4804.38	V	71.90	-4.64	67.26	74.00	-6.74
AV		V	42.84	-4.64	38.20	54.00	-15.80
Middle Channel							
PK	4881.10	H	60.53	-4.58	55.95	74.00	-18.05
AV		H	41.87	-4.58	37.29	74.00	-36.71
Highest Channel							
PK	4954.42	H	51.81	-4.51	47.30	74.00	-26.70
AV		H	39.94	-4.51	35.43	74.00	-38.57
Spurious Emissions							
QP	160.04	V	29.69	10.40	27.37	43.50	-16.13
QP	411.76	V	31.04	18.20	26.83	46.00	-19.17
QP	58.74	H	31.93	14.10	19.05	40.00	-20.95
QP	68.32	H	31.67	11.90	14.98	40.00	-25.02

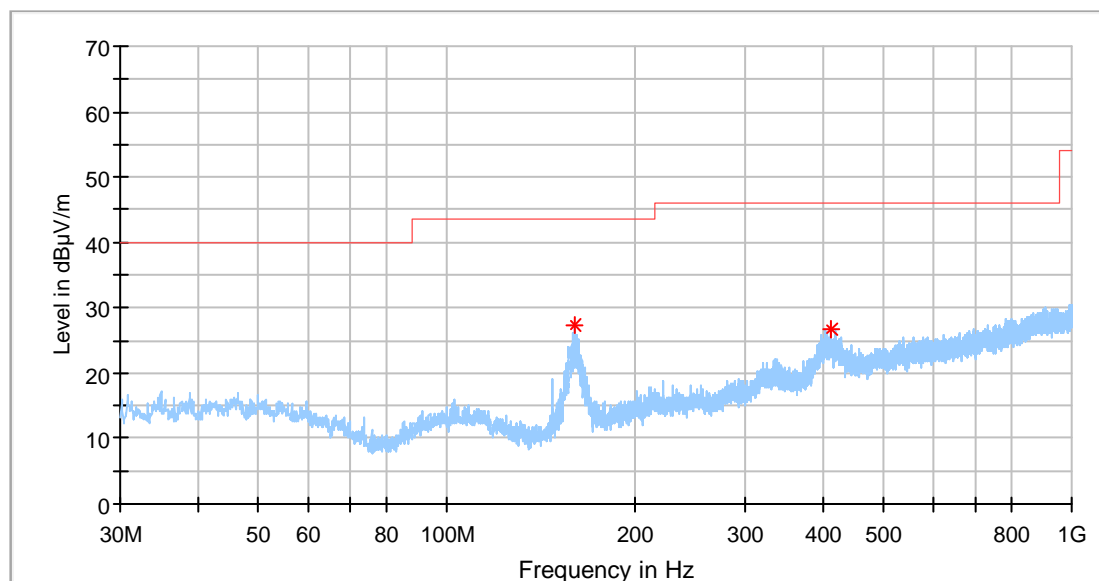
- Refer to the data graph shows the worst case channel's emission data graph from 30MHz-1GHz.
- Only background noise was measured from 1GHz-26GHz except related to the operation frequency.

Result Summary:

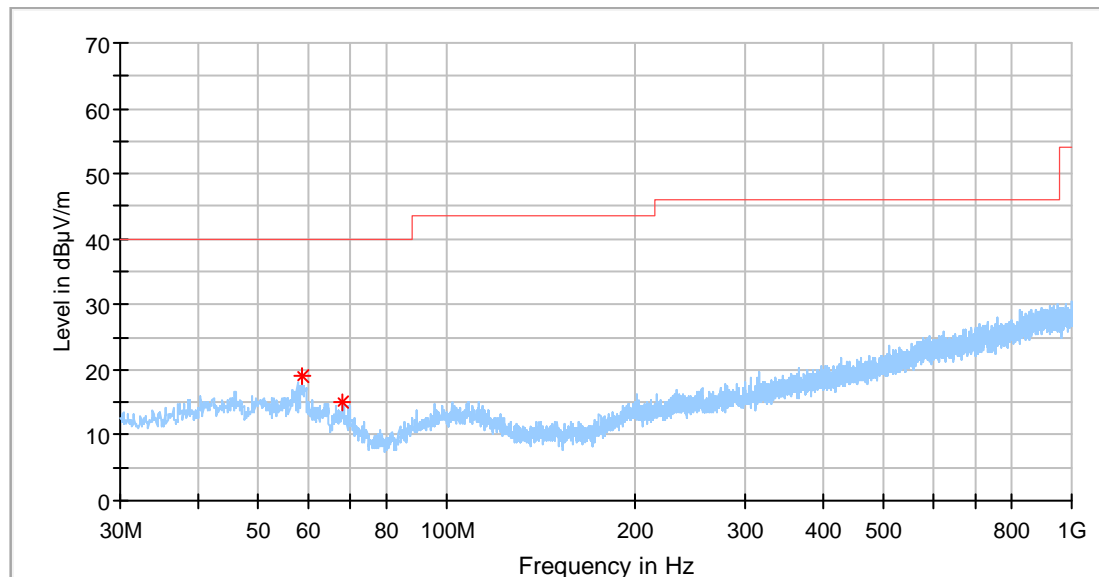
- 1) Communication mode: All other emissions are more than 20dB below limit which will not record.
- 2) No further spurious emissions found between 30 MHz and lowest internal used/generated frequency and from 30MHz to 1GHz.

Remarks:

1. " * " Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).
2. Emission level with more than 20dB below the FCC required limit is not mentioned in table.
3. Delta to Limit = Field strength (dBuV/m) – Limit (dBuV/m).
4. Calculated measurement uncertainty: 9kHz -30MHz: 3.88dB.
30MHz -1GHz: 4.91dB.
1GHz -18GHz: 4.89dB.

Radiated emission data graph (Vertical polarization, 30MHz-1GHz), Transmitting Mode

Remark: Only background noise was measured from 1GHz-26GHz excluding the operation frequency relational.

Radiated emission data graph (Vertical polarization, 1GHz-26GHz), Transmitting Mode

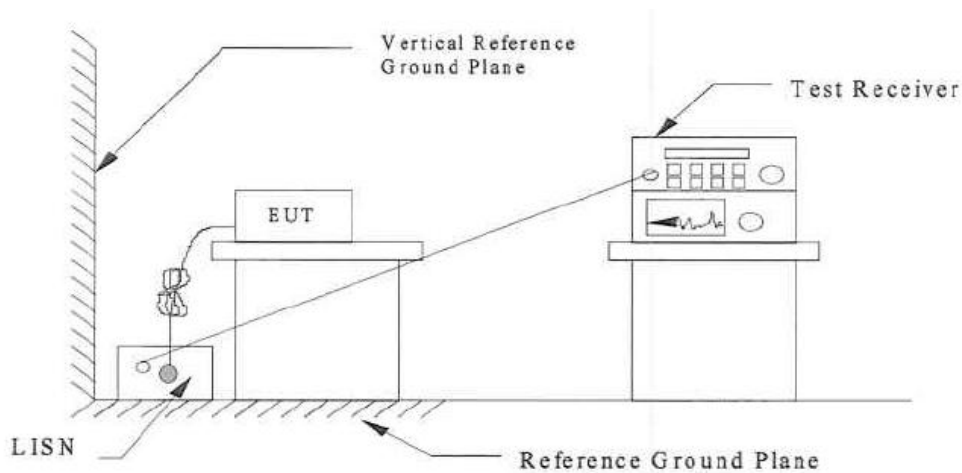
Remark: Only background noise was measured from 1GHz-26GHz excluding the operation frequency relational.

4.8 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement: FCC part 15 Section 15.207 Class B
 Test Method: ANSI C63.4:2009
 Test Date: ---
 Mode of Operation: ---
 Detector Function: CISPR Quasi Peak
 Measurement BW: ---
 Worst Case Channel: ---

Results : N/A

Test Setup:



Limits for Conducted Emission [Section 15.207]:

Frequency Range [MHz]	Quasi-Peak Limit [dB μ V]	Average Limit [dB μ 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.

Remarks:

Calculated measurement uncertainty: ± 2.8 dB

The result shown the worst case of the connection.

5.0 List of Measurement Equipment**Radiated Emission**

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2015-8-17
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2017-8-17
Horn Antenna	Rohde & Schwarz	HF907	102294	2017-8-17
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2015-8-17
Spectrum Analyzer	Agilent	E7405A	MY45111421	2015-8-19
Spectrum Analyzer	R&S	FSV40	101031	2015-8-17
3m Semi-anechoic chamber	TDK	9X6X6	----	2019-5-29

N/A Not Applicable or Not Available