

RF TEST REPORT

Report No.: SET2014-04032

Product Name: Bluetooth stereo headphones

FCC ID: SHKASCEHB2

Model No. : AS500, AS500G

Applicant: AfterShokz, LLC

Address: 6311 Fly Road, Suite 106, East Syracuse, NY13057, United States

Issued by: CCIC-SET

Lab Location: Electronic Testing Building, Shahe Road, Xili, Nanshan District, Shenzhen, 518055, P. R. China

Tel: 86 755 26627338 **Fax:** 86 755 26627238

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Test Report

Product Name: Bluetooth stereo headphones

Brand Name: AfterShokz

Trade Name: AfterShokz

Applicant: AfterShokz, LLC

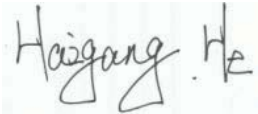
Applicant Address: 6311 Fly Road, Suite 106, East Syracuse, NY13057,
United States


Manufacturer: Shenzhen Voxtech Co., Ltd.


Manufacturer Address: 4th floor, Building 1, Baodazhou, Shancheng Industrial
Park, Shiyan, Bao'an, Shenzhen, PR China.

Test Standards: 47 CFR Part 15 Subpart C: Radio Frequency Devices
ANSI C63.10:2009 : American National Standard for
Testing Unlicensed Wireless Devices
DA 00-705: Filing and Measurement Guidelines
for Frequency Hopping Spread Spectrum Systems

Test Result: PASS

Tested by: 
2014.05.08
Haigang He, Test Engineer

Reviewed by: 
2014.05.08
Lu Lei, Senior EGINEER

Approved by: 
2014.05.08
Wu Li'an, Manager

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Change History		
Issue	Date	Reason for change
1.0	May 08, 2014	First edition

1. General Information

1.1. EUT Description

EUT Type: Bluetooth stereo headphones
Serial No.....: (n.a, marked #1 by test site)
Hardware Version: 1.6
Software Version: 8.6
Applicant: AfterShokz, LLC
6311 Fly Road, Suite 106, East Syracuse, NY13057, United States
Manufacturer: Shenzhen Voxtech Co., Ltd.
4th floor, Building 1, Baodazhou, Shancheng Industrial Park,
Shiyan, Bao'an, Shenzhen, PR China.
Frequency Range.....: The frequency range used is 2402MHz - 2480MHz (79 channels, at
intervals of 1MHz).
Modulation Type: Bluetooth: GFSK (1Mbps), $\pi/4$ -DQPSK(2Mbps),
8-DPSK(3Mbps)
Antenna Type.....: monopole Antenna
AntennaGain.....: 0.5dBi

- Note 1: The EUT is a Bluetooth stereo headphones, it contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is $F(\text{MHz})=2402+1*n$ ($0 \leq n \leq 78$). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).
- Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.
- Note 3: a. When power on, the EUT will scan the whole frequency until aConnection command from the other BT devices.
b. When receiving the signal from the other BT devices, The EUT transmit aresponse signal.
c. The other devices receive the response signal and recognize it, then send aconnection command to establish the connection.
d. After the connection establish successfully, the data transmission is beginning.At the same time, the both devices will shift frequencies in synchronization per asame pseudo randomly ordered list of hopping frequencies, the hopping rate is1600 times per second. This device conforms to the criteria in FCC Public NoticeDA 00-705.
e. The bandwidth of the receiver, which is set to a fixed width by the software.
- Note 4: Bluetooth signal has 9 packages DH1, DH3, DH5, 3DH1, 3DH3, 3DH5, 5DH1, 5DH3, 5DH5, DH5 package is largest, we are testing DH5 in the document.

1.2. Support Equipment

No.	Equipment	Brand Name	Model Name	Manufacturer	Serial No.	Note
1	Notebook	DELL	PP11L	DELL	H5914A03	FCC DOC

1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C 2012	Radio Frequency Devices
2	ANSIC63.4-2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz
3	ANSIC63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section in CFR 47	Description	Result
1	15.203	Antenna Requirement	PASS
2	15.247(a)	Number of Hopping Frequency	PASS
3	15.247(b)	Peak Output Power	PASS
4	15.247(a)	20dB Bandwidth	PASS
5	15.247(a)	Carrier Frequency Separation	PASS
6	15.247(a)	Time of Occupancy (Dwell time)	PASS
7	15.247(d)	Conducted Spurious Emission	PASS
8	15.247(d)	Band Edge	PASS
9	15.207	Conducted Emission	PASS
10	15.209 15.247(c)	Radiated Emission	PASS

Note 1: The tests were performed according to the method of measurements prescribed in DA-00-705.

Note 2: The test of Radiated Emission and Conducted Spurious Emission were performed according to the method of measurements prescribed in ANSI C63.10 2009.

1.4. Facilities and Accreditations

1.4.1. Facilities

CNAS-Lab Code: L1659

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. CCIC is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659. A 12.8*6.8*6.4 (m) fully anechoic chamber was used for the radiated spurious emissions test.

FCC-Registration No.: 406086

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 406086, Renewal date Nov. 19, 2011, valid time is until Nov. 18, 2014.

1.4.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86KPa-106KPa

2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

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

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

2.1.2. Antenna Information

Antenna Category: Externalantenna

An Externalantenna was soldered to EUT via an adaptor cable, can't be removed away.

Antenna General Information:

No.	EUT Model	Ant. Type	Ant. Model	Manufacturer	Gain(dBi)
1	Bluetooth stereo headphones	monopole	N/A	Shenzhen Voxtech Co., Ltd.	0.5

2.1.3. Result: comply

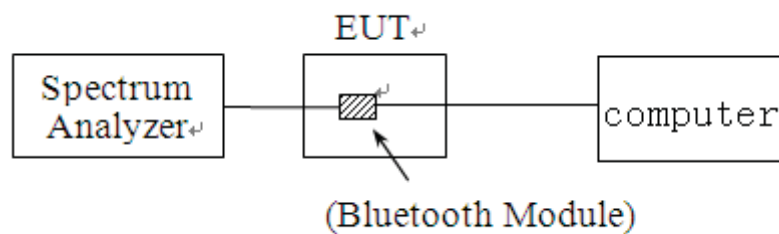
2.2. Number of Hopping Frequency

2.2.1. Requirement

According to FCC §15.247(a)(1)(iii), frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

2.2.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is connected to the Spectrum Analyzer (SA), the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the PC, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Due Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2014.06.10

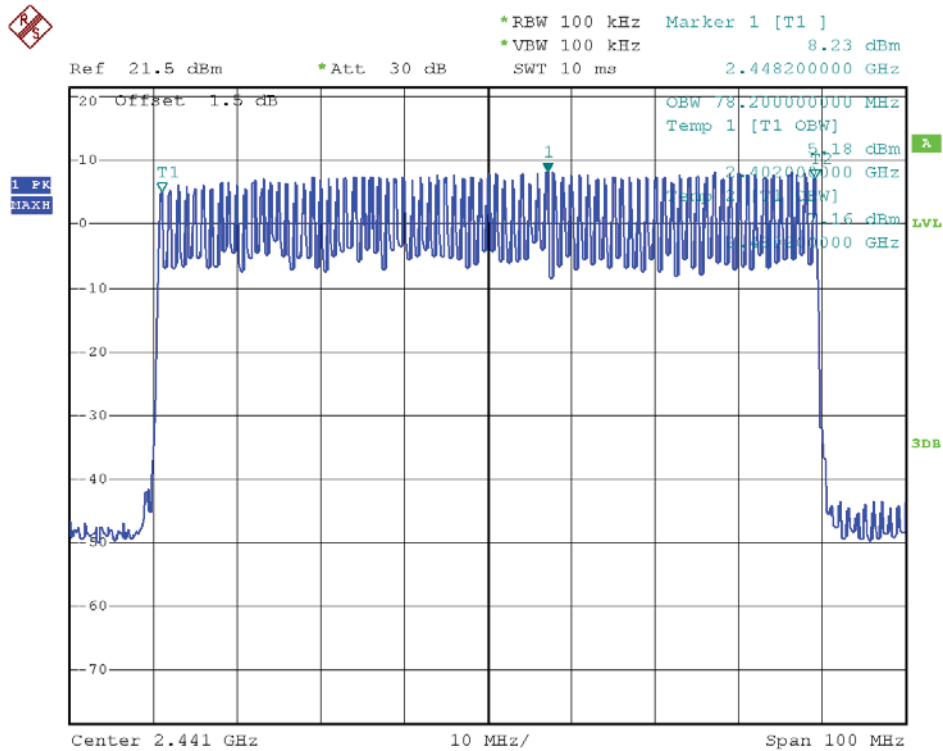
2.2.3. Test Result

The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

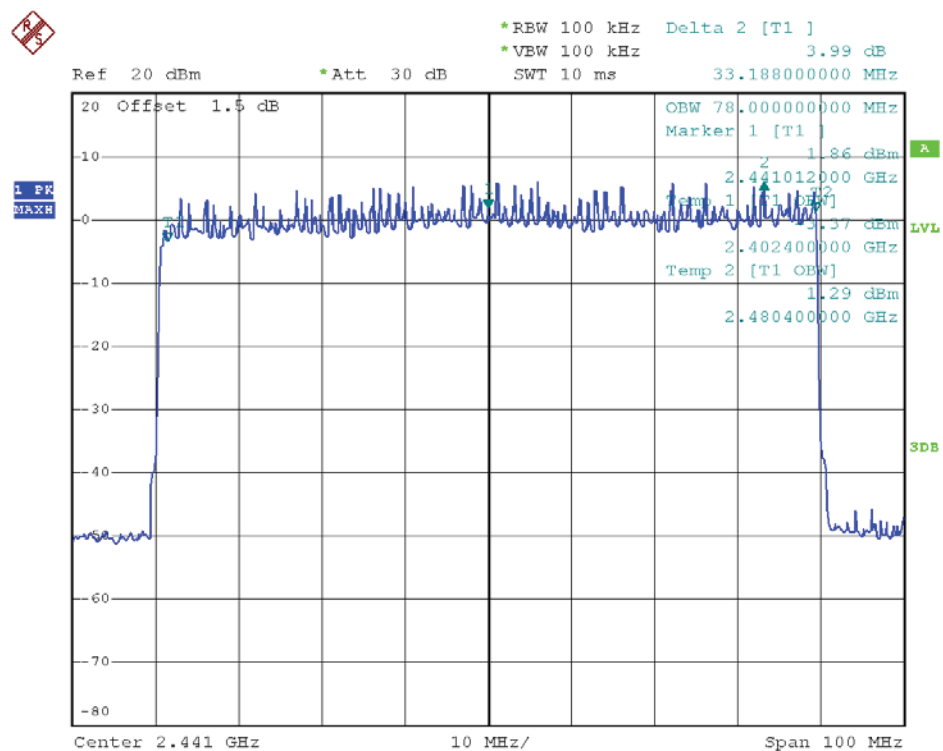
A. Test Verdict:

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Refer to Plot	Verdict
GFSK	2400 - 2483.5	79	15	Plot A	PASS
$\pi/4$ -DQPSK	2400 - 2483.5	79	15	Plot B	PASS
8-DPSK	2400 - 2483.5	79	15	Plot C	PASS

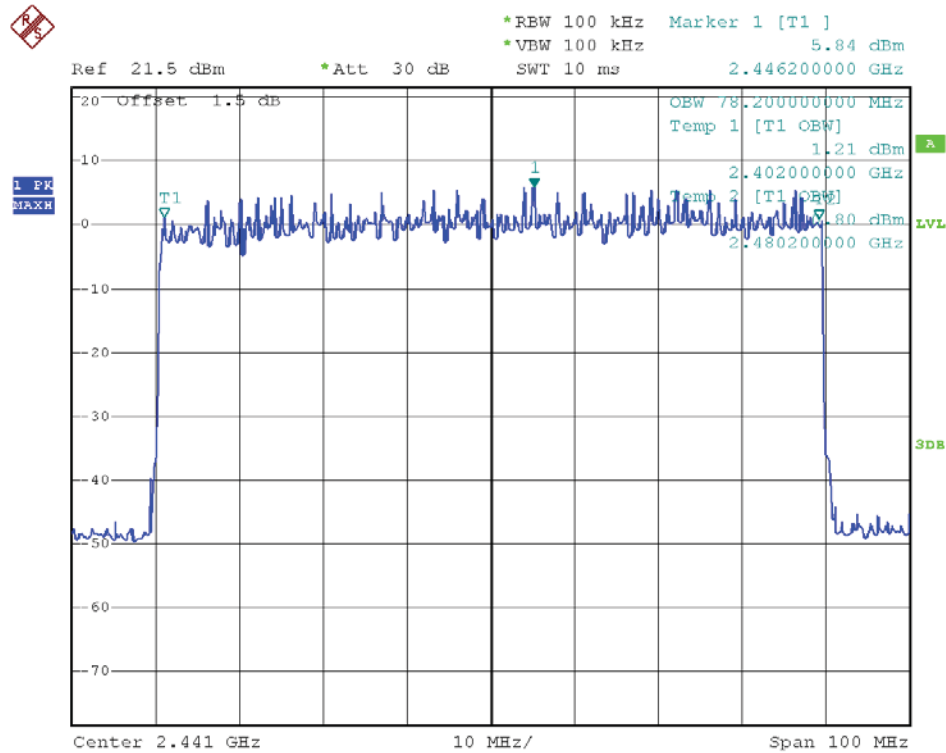
B. Test Plots:



(Plot A:GFSK)



(Plot B:π/4-DQPSK)



(Plot C:8- DPSK)

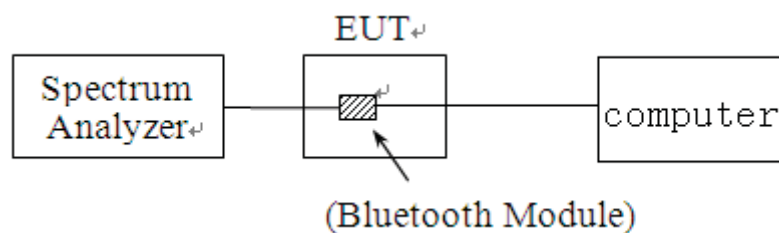
2.3. Peak Output Power

2.3.1. Requirement

According to FCC §15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

2.3.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is connected to the Spectrum Analyzer (SA), the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the PC, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Due Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2014.06.10

2.3.3. Test Result

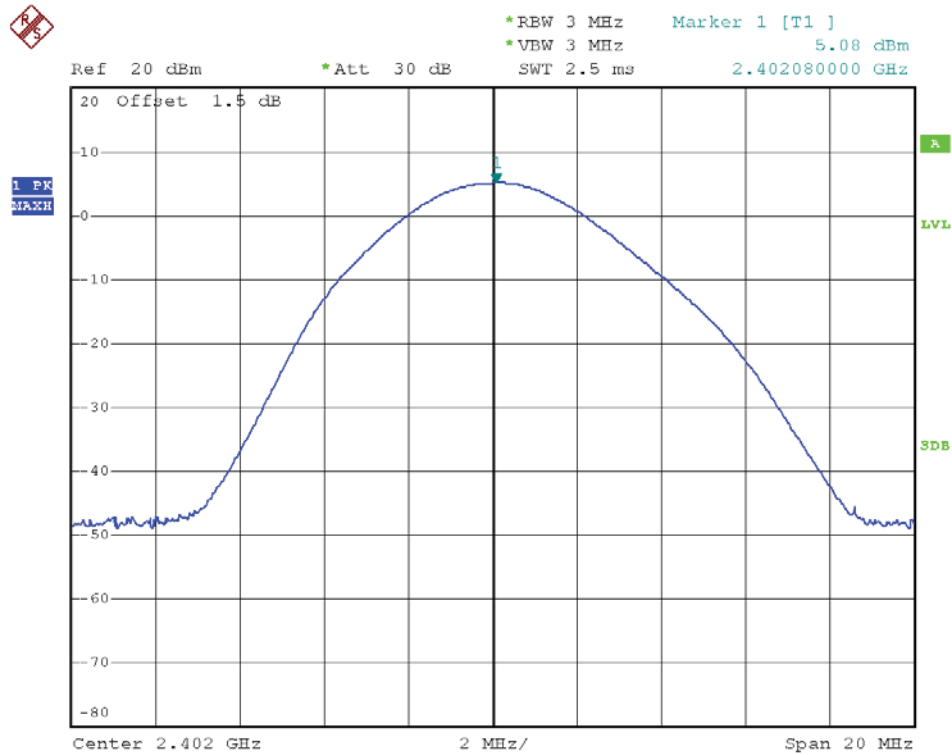
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module. The lowest, middle and highest channel were tested by Power meter.

2.3.3.1. GFSK Mode

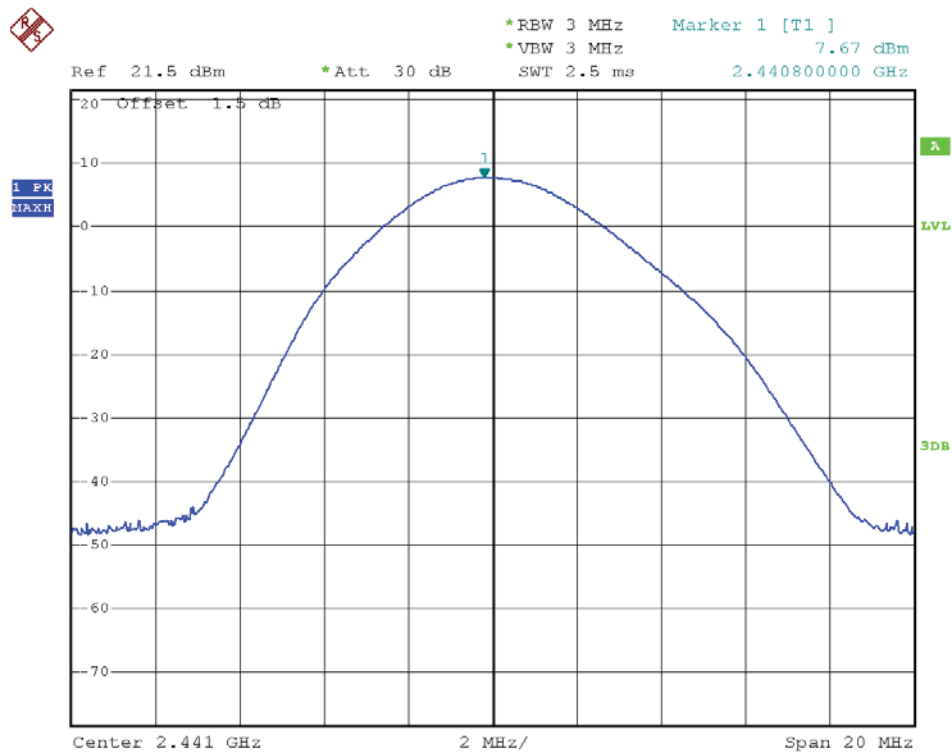
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limit (dBm)	Verdict	Refer to Plot
0	2402	5.08	30	PASS	Plot A
39	2441	7.67		PASS	Plot B
78	2480	7.90		PASS	Plot C

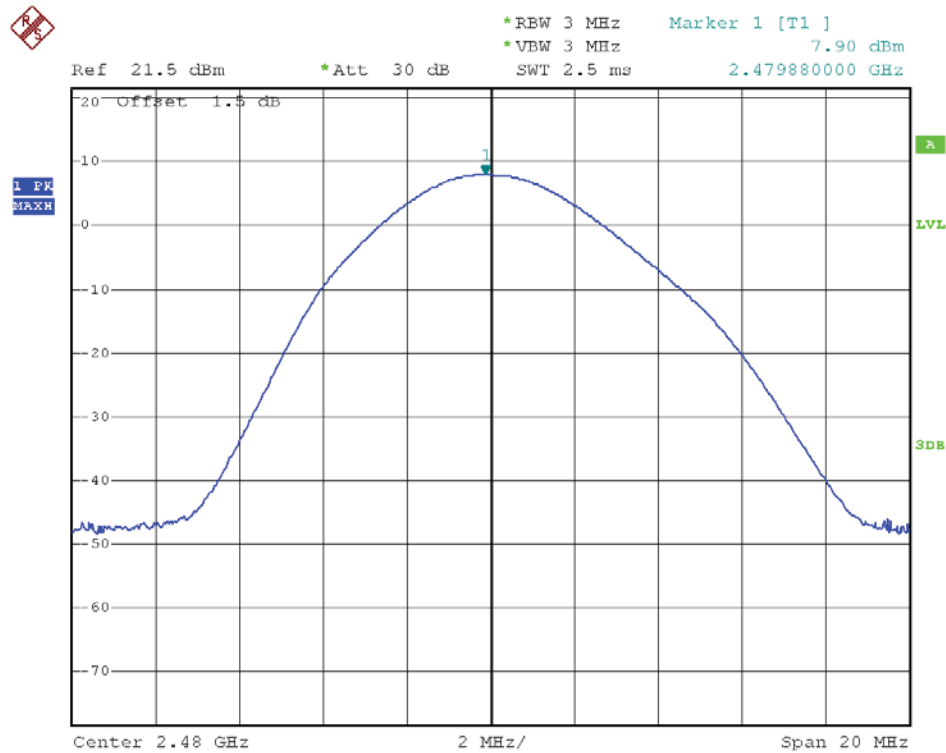
B. Test Plots:



(Plot A: Channel = 2402 @ GFSK)



(Plot B: Channel = 2441 @ GFSK)



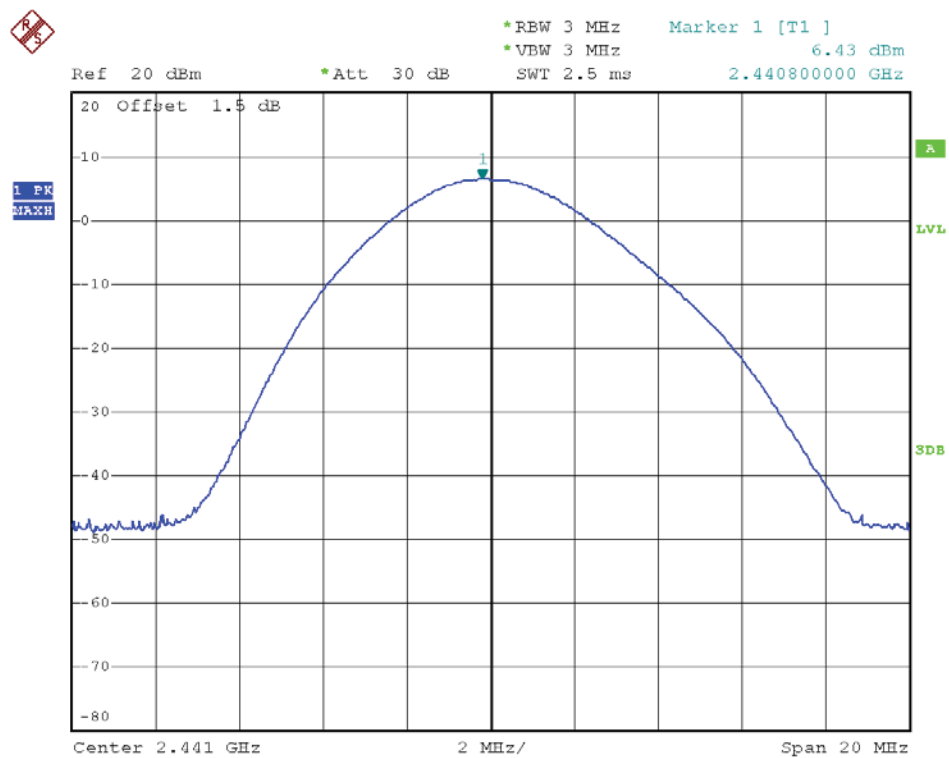
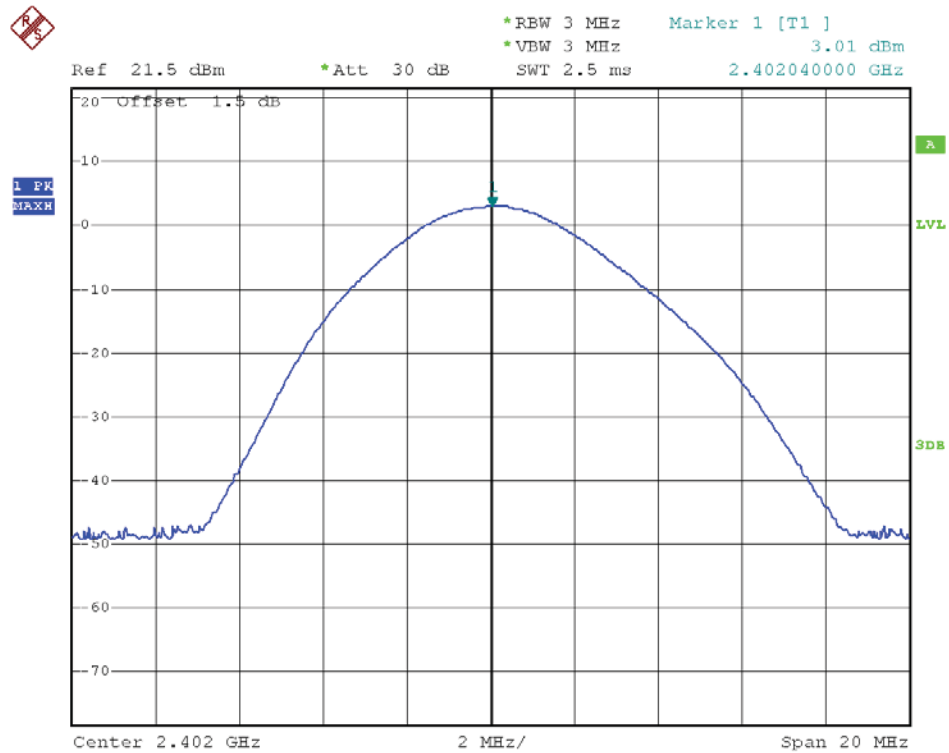
(Plot C: Channel = 2480 @ GFSK)

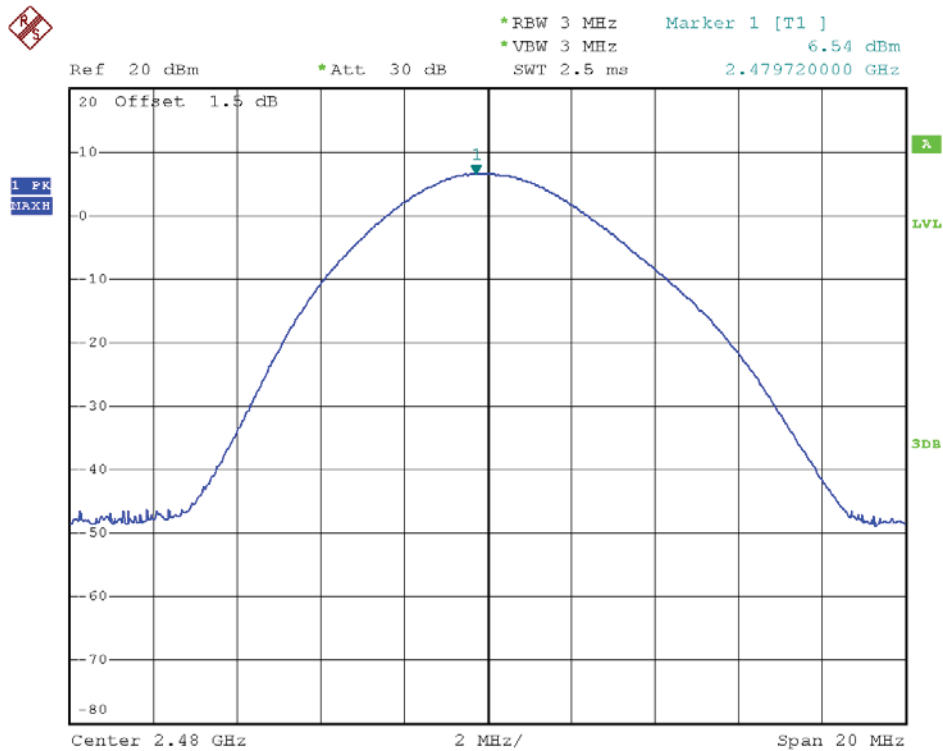
2.3.3.2. $\pi/4$ -DQPSK Mode

A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limit (dBm)	Verdict	Refer to Plot
0	2402	3.01	30	PASS	Plot A
39	2441	6.43		PASS	Plot B
78	2480	6.54		PASS	Plot C

B. Test Plots:





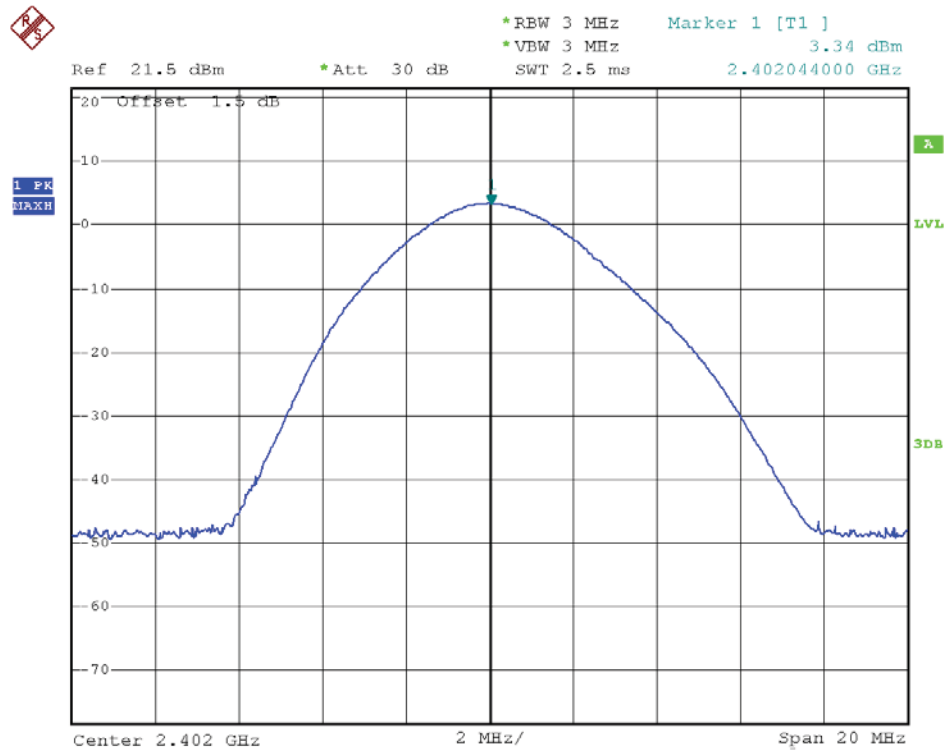
(Plot C: Channel = 2480 @ $\pi/4$ -DQPSK)

2.3.3.3. 8-DPSK Mode

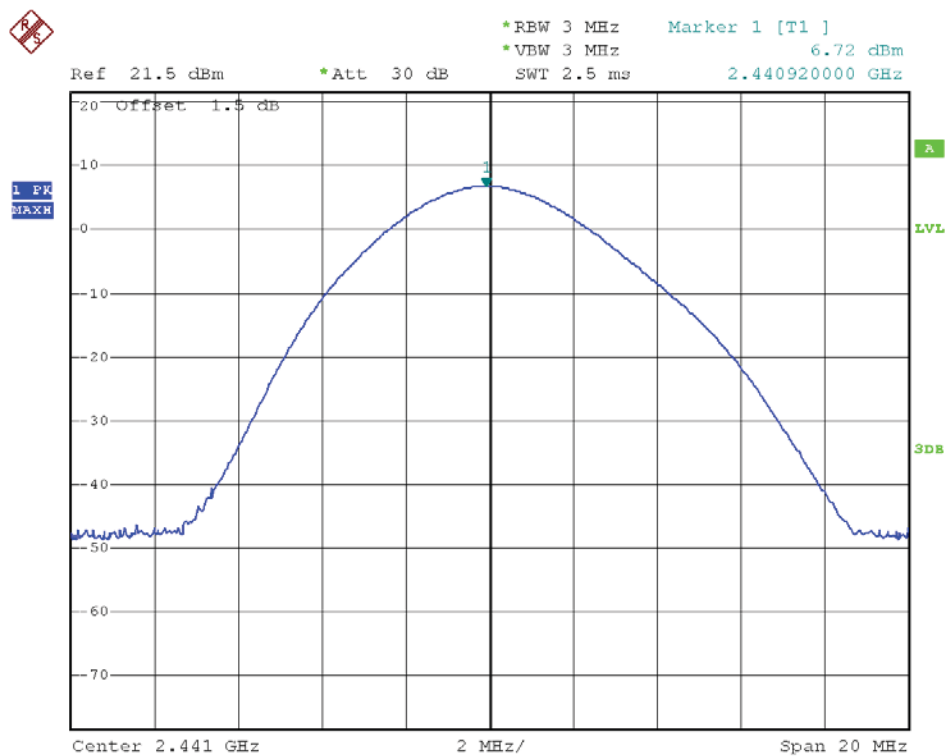
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limit (dBm)	Verdict	Refer to Plot
0	2402	3.34	30	PASS	Plot A
39	2441	6.72		PASS	Plot B
78	2480	6.82		PASS	Plot C

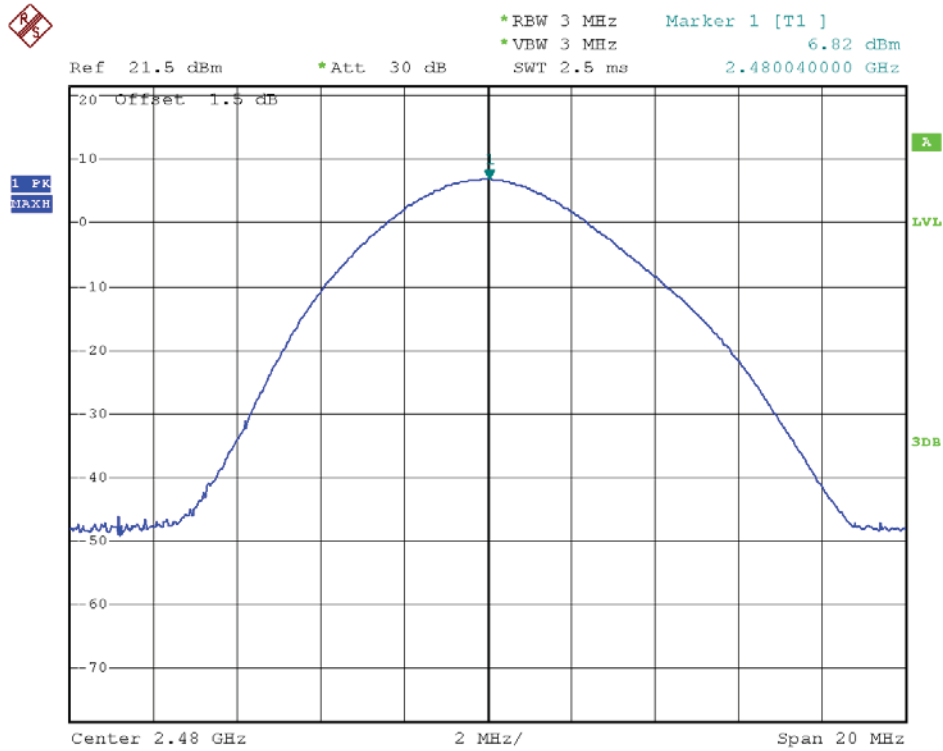
B. Test Plots:



(Plot A: Channel = 2402 @8-DPSK)



(Plot B: Channel = 2441 @ 8-DPSK)



(Plot C: Channel = 2480 @ 8-DPSK)

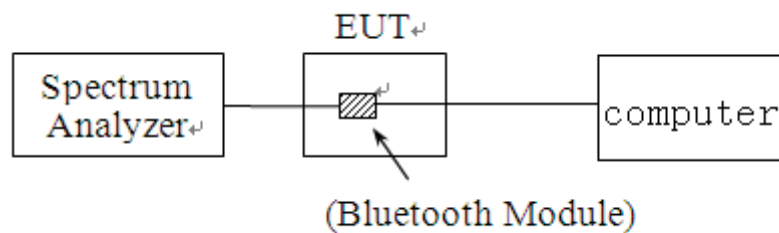
2.4. 20dB Bandwidth

2.4.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth ($10 \cdot \log 1\% = 20\text{dB}$) taking the total RF output power.

2.4.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is connected to the Spectrum Analyzer (SA), the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the PC, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal.Due Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2014.06.10

2.4.3. Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW \geq 1% of the 20 dB bandwidth

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

2.4.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels

are selected to perform testing to record the 20dB bandwidth of the Module.

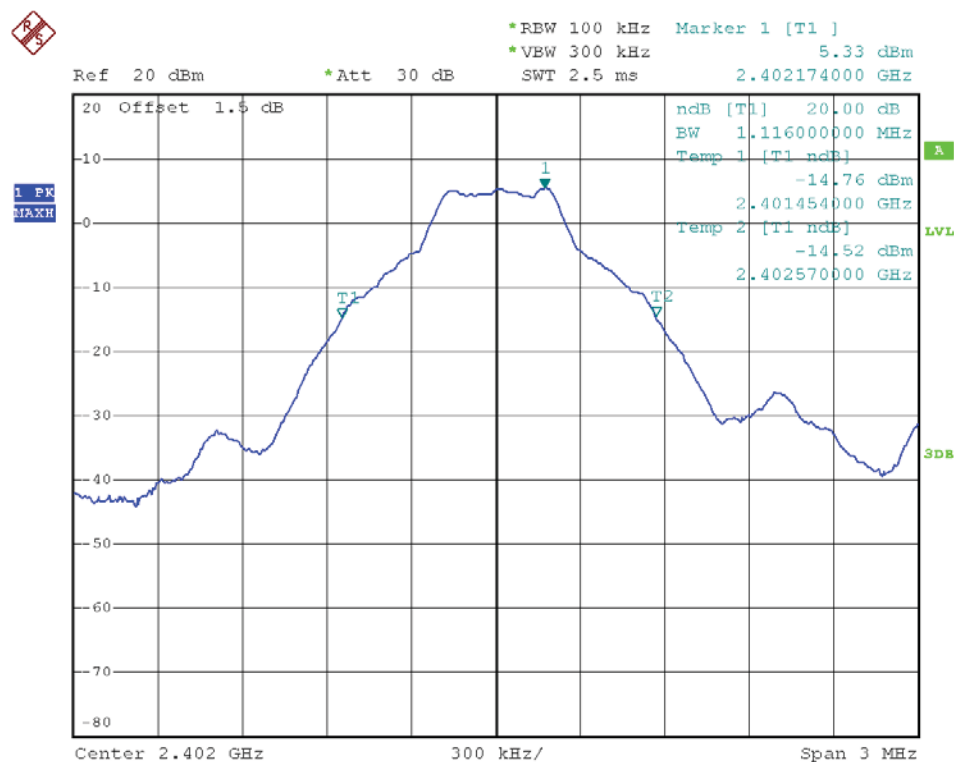
2.4.4.1. GFSK Mode

A. Test Verdict:

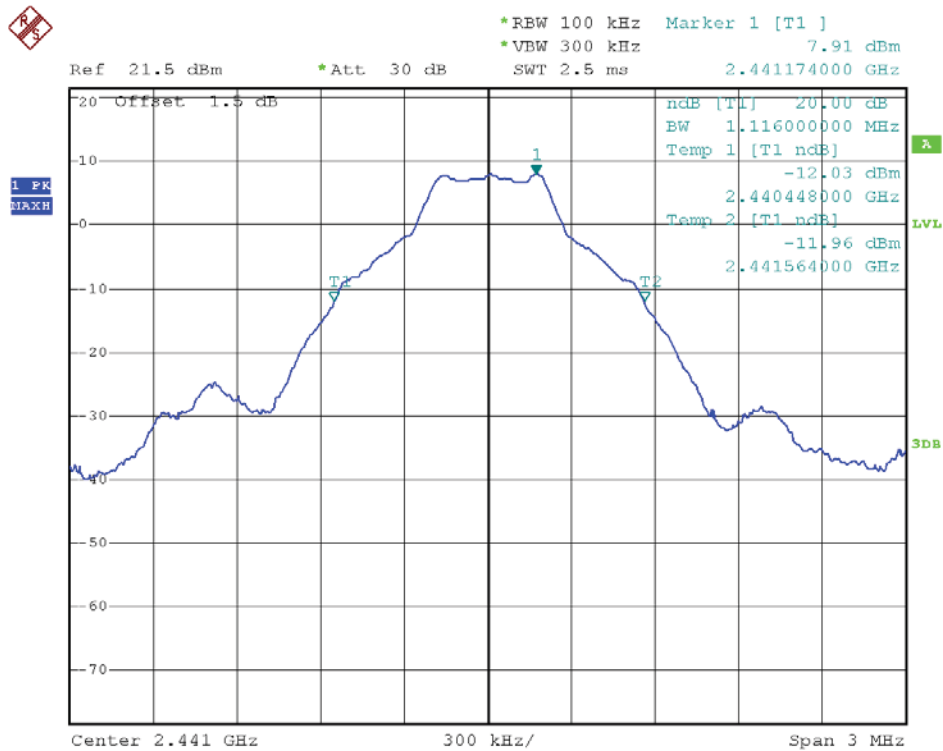
The maximum 20dB bandwidth measured is 1.116MHz according to the table below.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot
0	2402	1.116	Plot A
39	2441	1.116	Plot B
78	2480	1.116	Plot C

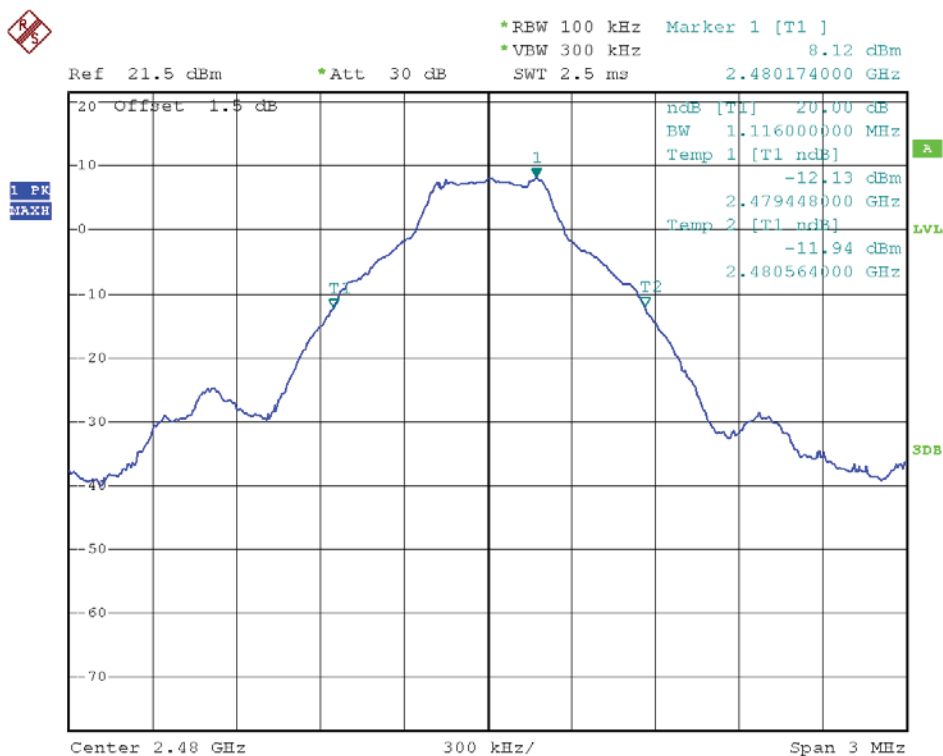
C. Test Plots:



(Plot A: Channel = 2402 @ GFSK)



(Plot B: Channel = 2441 @ GFSK)



(Plot C: Channel = 2480 @ GFSK)

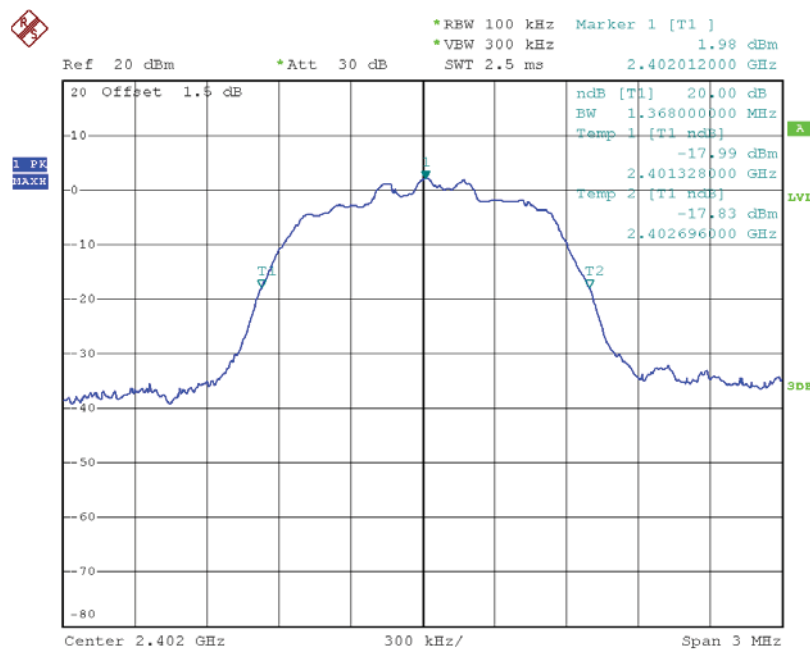
2.4.4.2. $\pi/4$ -DQPSK Mode

A. Test Verdict:

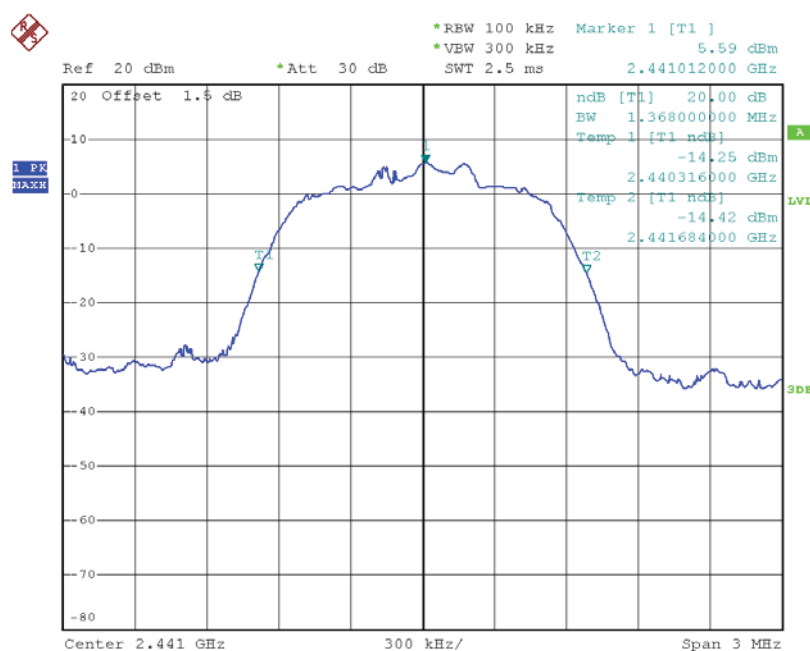
The maximum 20dB bandwidth measured is 1.368MHz according to the table below.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot
0	2402	1.368	Plot A
39	2441	1.368	Plot B
78	2480	1.368	Plot C

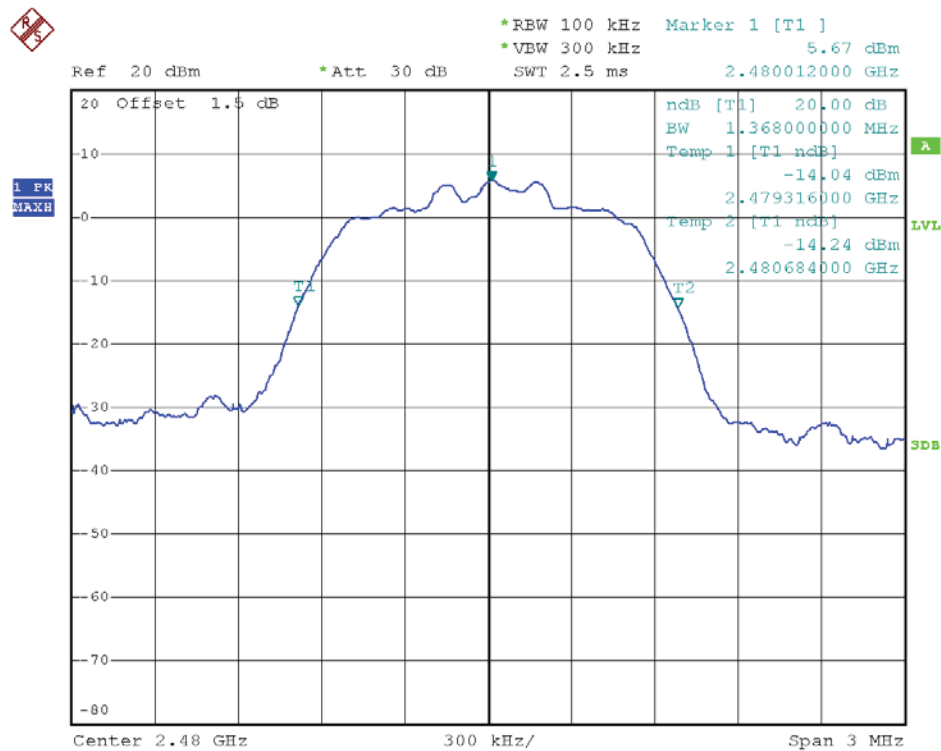
Test Plots:



(Plot A: Channel = 2402 @ $\pi/4$ -DQPSK)



(Plot B: Channel = 2441 @ $\pi/4$ -DQPSK)



(Plot C: Channel = 2480 @ $\pi/4$ -DQPSK)

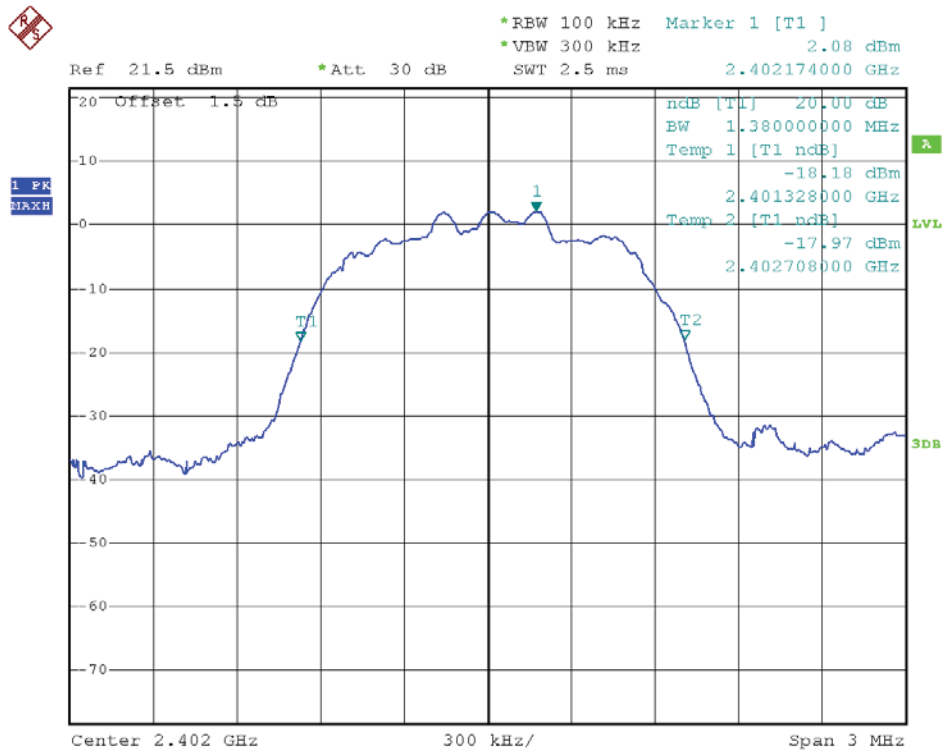
2.4.4.3. 8-DPSK Mode

A. Test Verdict:

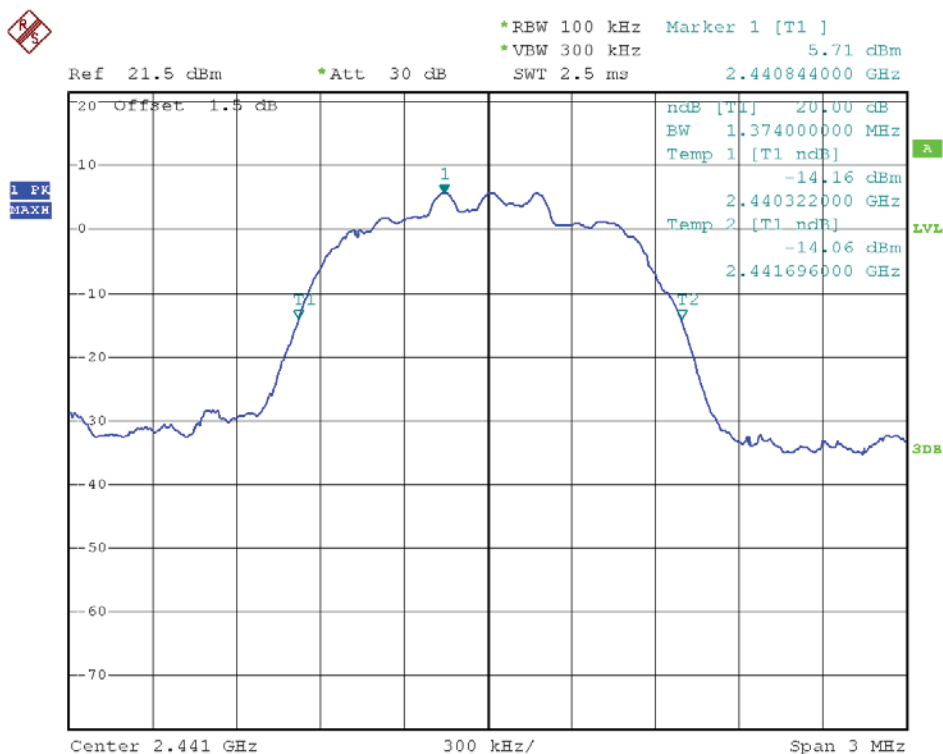
The maximum 20dB bandwidth measured is 1.380MHz according to the table below.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot
0	2402	1.380	Plot A
39	2441	1.374	Plot B
78	2480	1.350	Plot C

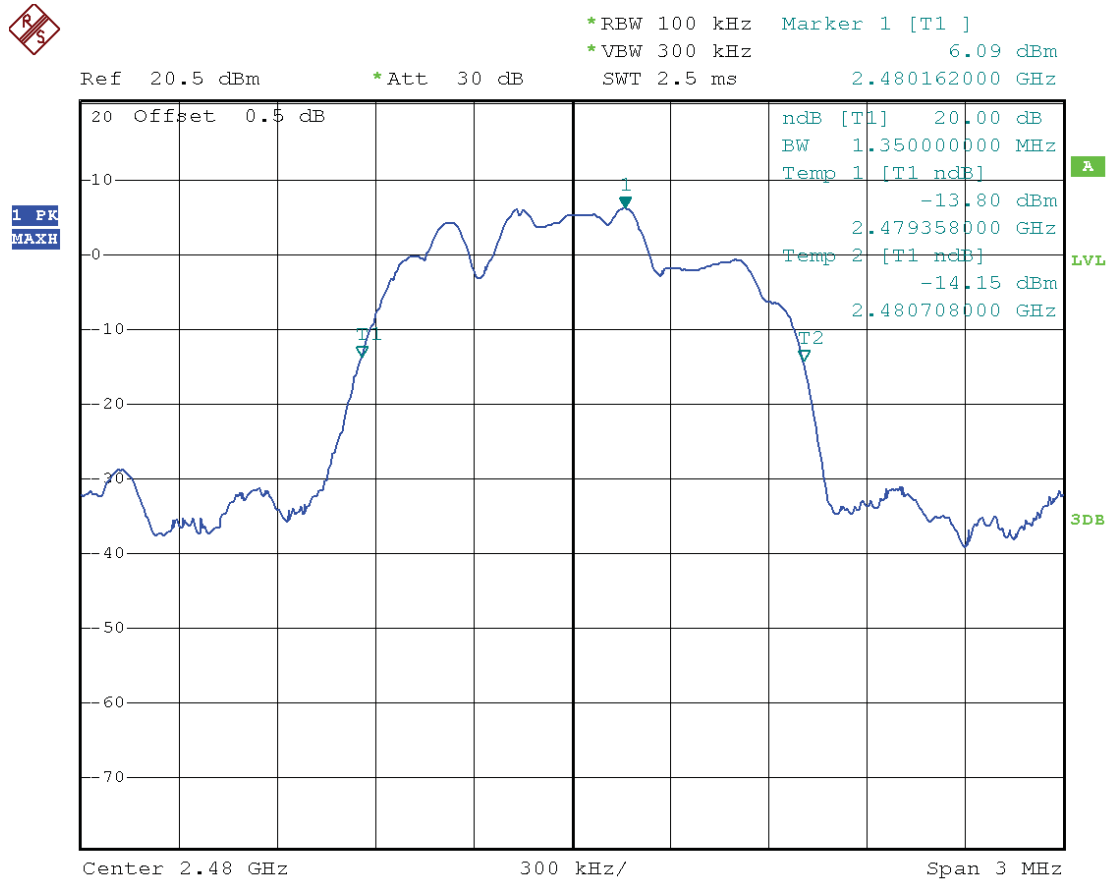
B. Test Plots:



(Plot A: Channel = 2402 @ 8-DPSK)



(Plot B: Channel = 2441 @ 8-DPSK)



(Plot C: Channel = 2480 @ 8-DPSK)

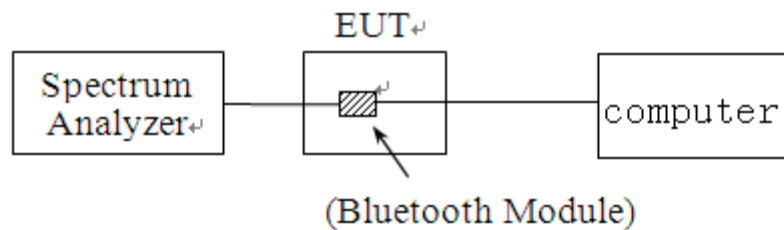
2.5. Carried Frequency Separation

2.5.1. Definition

According to FCC §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

2.5.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is connected to the Spectrum Analyzer (SA), the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the PC, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Due Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2014.06.10

2.5.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) \geq 1% of the span

Video (or Average) Bandwidth (VBW) \geq RBW

Sweep = auto

Detector function = peak

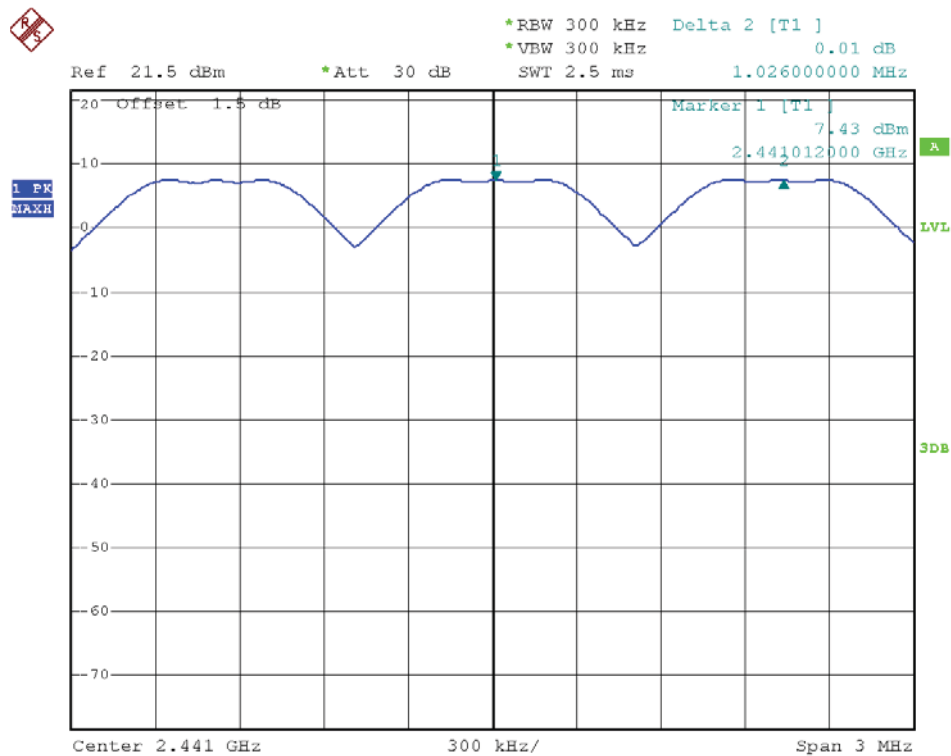
Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

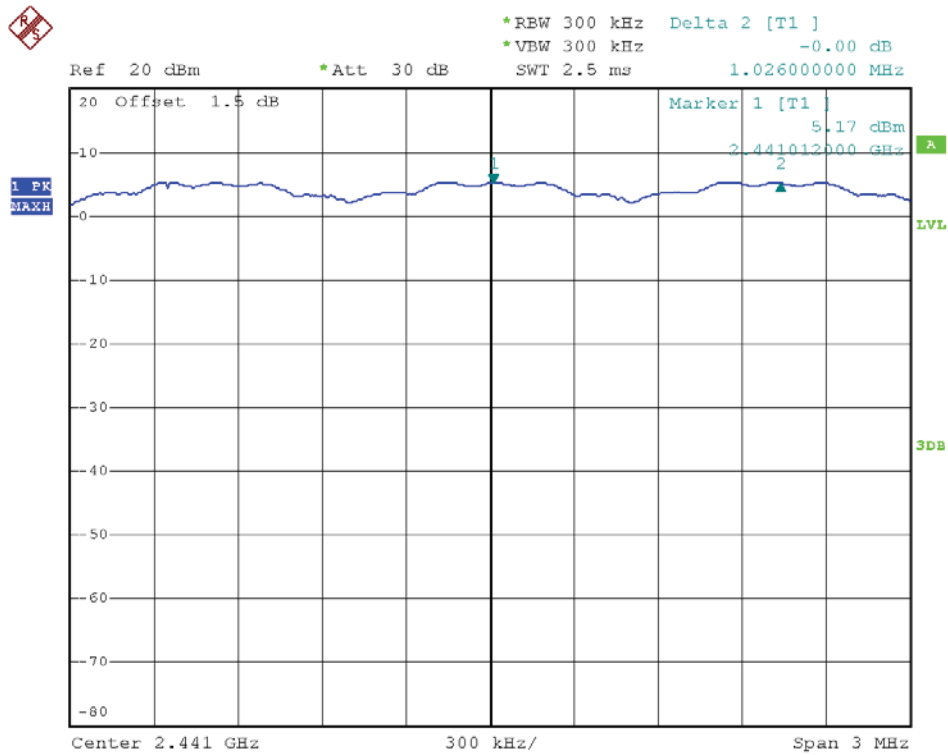
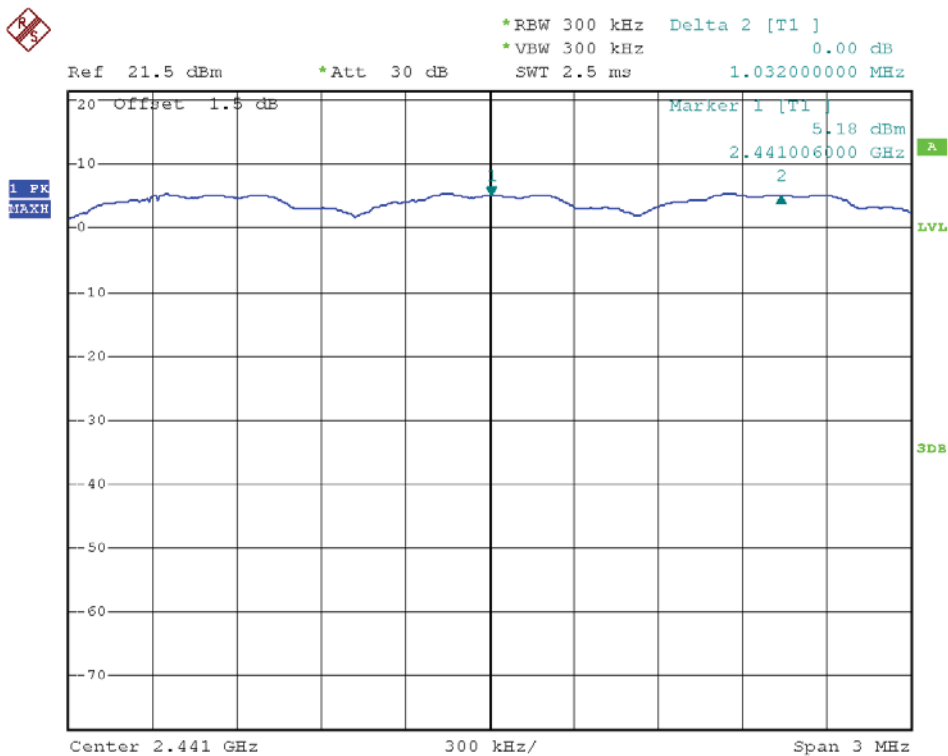
2.5.4. Test Result

The Bluetooth Module operates at hopping-on test mode.

For any adjacent channels (e.g. the channel 39 and 40 as showed in the Plot A), the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (1.116MHz for GFSK mode, 1.368MHz for $\pi/4$ -DQPSK mode and 1.380MHz for 8-DPSK mode, refer to section 2.4.1), whichever is greater. So, the verdict is PASSING



(Plot A: GFSK)


(Plot B: $\pi/4$ -DQPSK)


(Plot C: 8-DPSK)

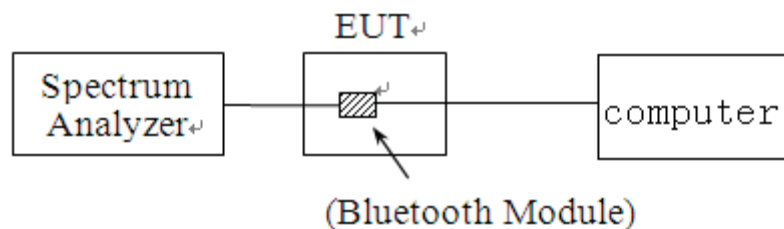
2.6. Time of Occupancy (Dwell time)

2.6.1. Requirement

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

2.6.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the PC is connected to the Spectrum Analyzer (SA), the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the PC, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Due Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2014.06.10

2.6.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW \geq RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

2.6.4. Test Result

The average time of occupancy on any channel within the Period can be calculated with formulas (for DH5 package type):

$$\begin{aligned} \{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (1600 / 6) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4s * \{\text{Number of Hopping Frequency}\} \end{aligned}$$

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

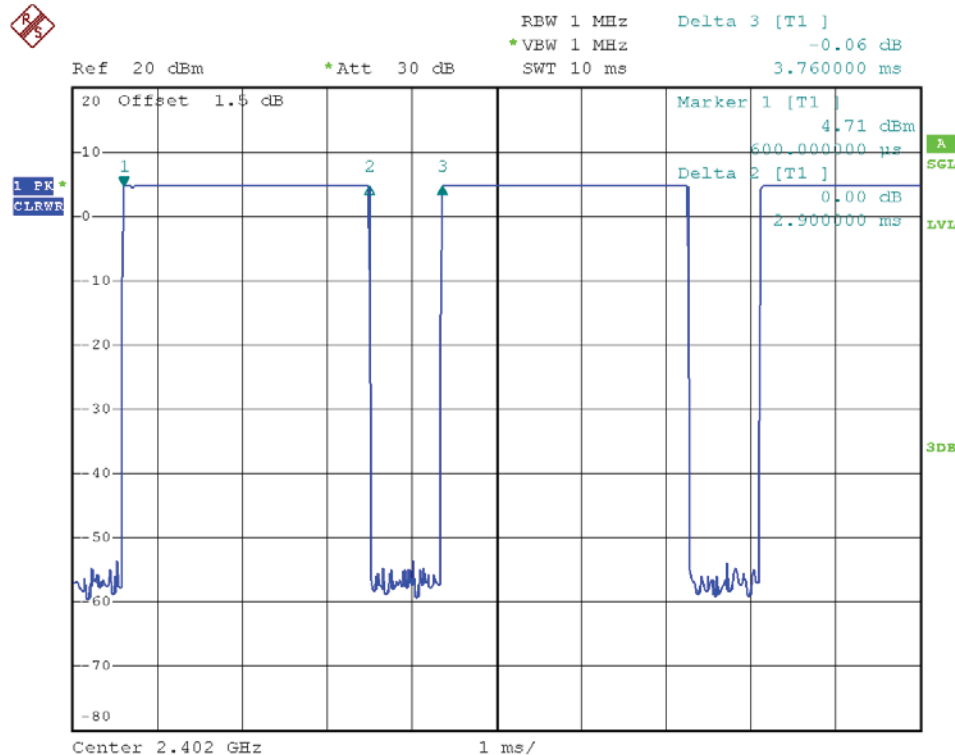
2.6.4.1. GFSK Mode

A. Test Verdict:

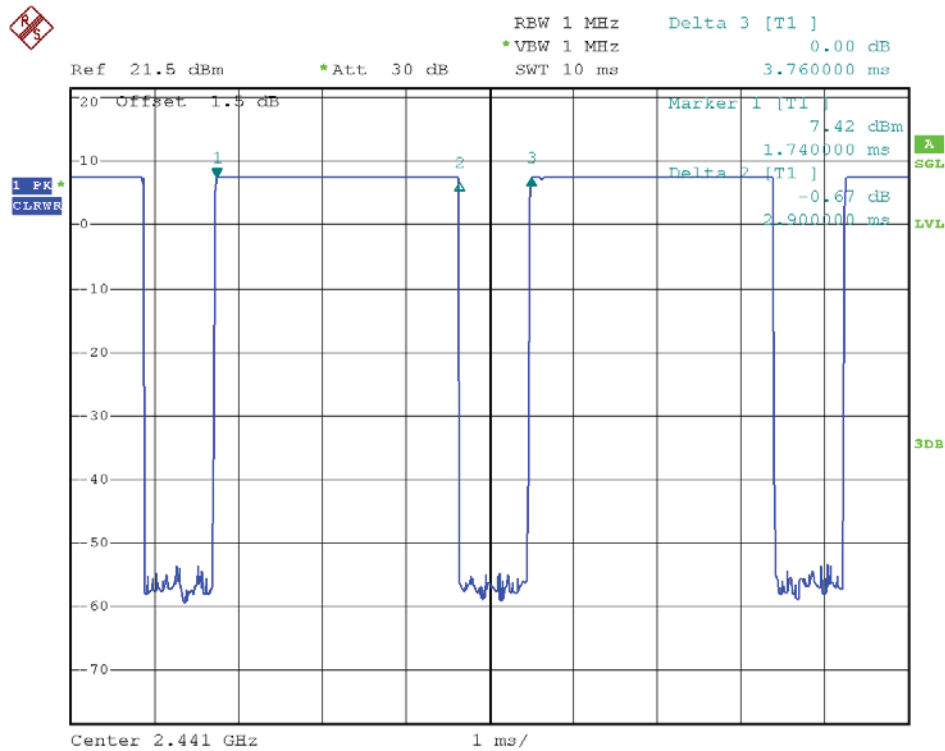
Channel	Frequency (MHz)	Pulse Time		Total of Dwell (ms)	Limit (ms)	Verdict
		ms	Refer to Plot			
0	2402	2.90	Plot A	309.333	400	PASS
39	2441	2.90	Plot B	309.333		PASS
78	2480	2.90	Plot C	309.333		PASS

B. Test Plots:

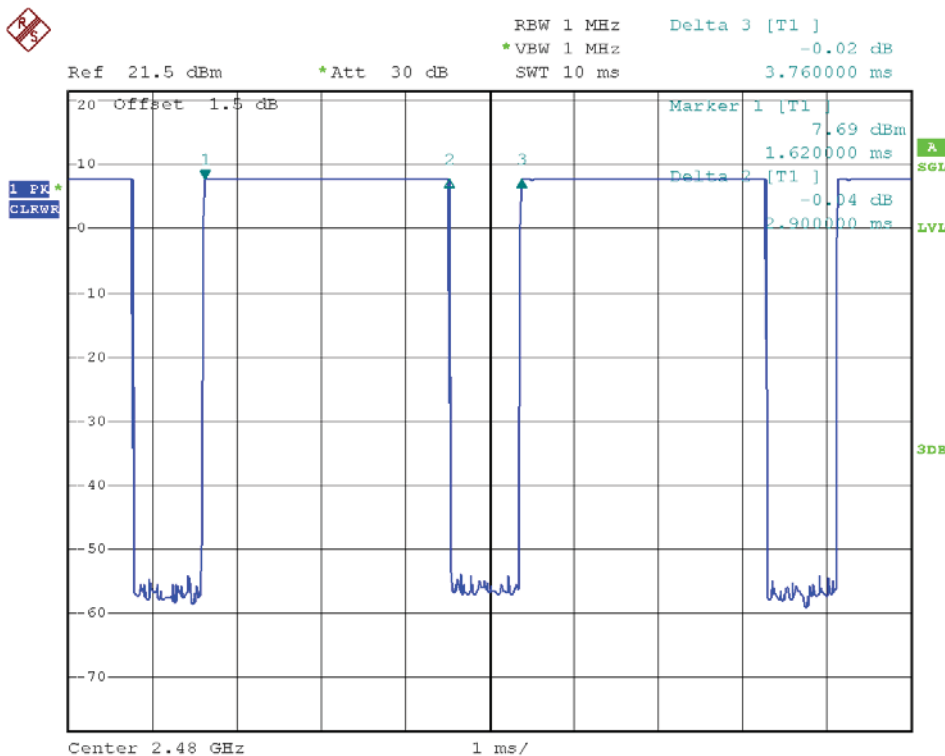
Note: the following plots record the Pulse Time of the Module carrier.



(Plot A: Channel = 2402 @ GFSK)



(Plot B: Channel = 2441 @ GFSK)



(Plot C: Channel = 2480 @ GFSK)

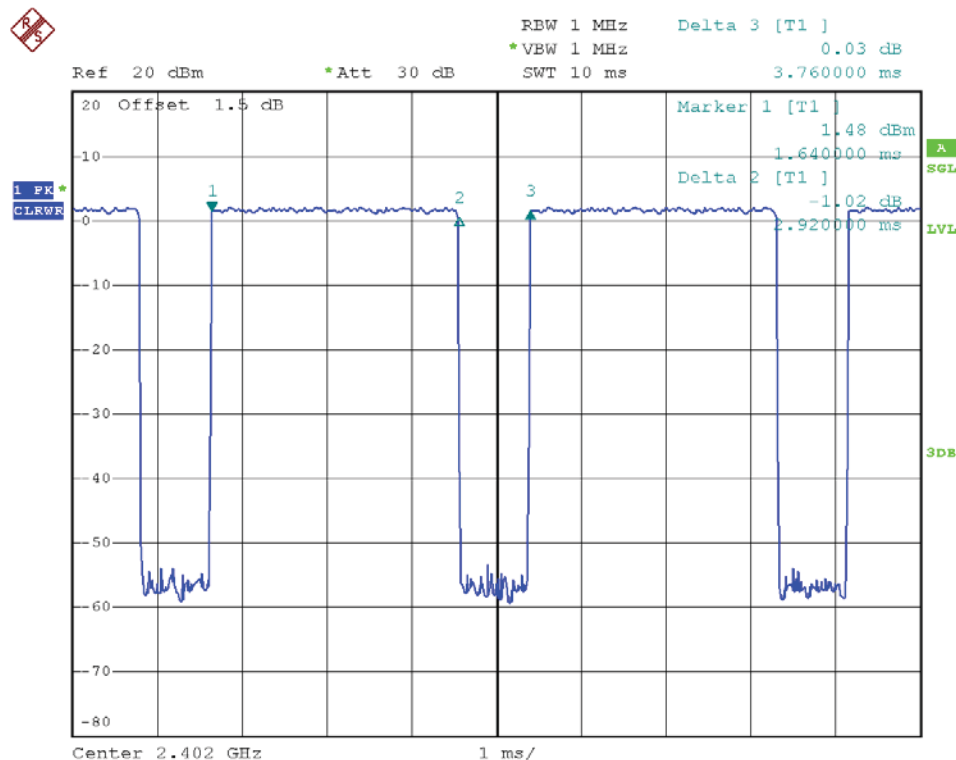
2.6.4.2. $\pi/4$ -DQPSK Mode

A. Test Verdict:

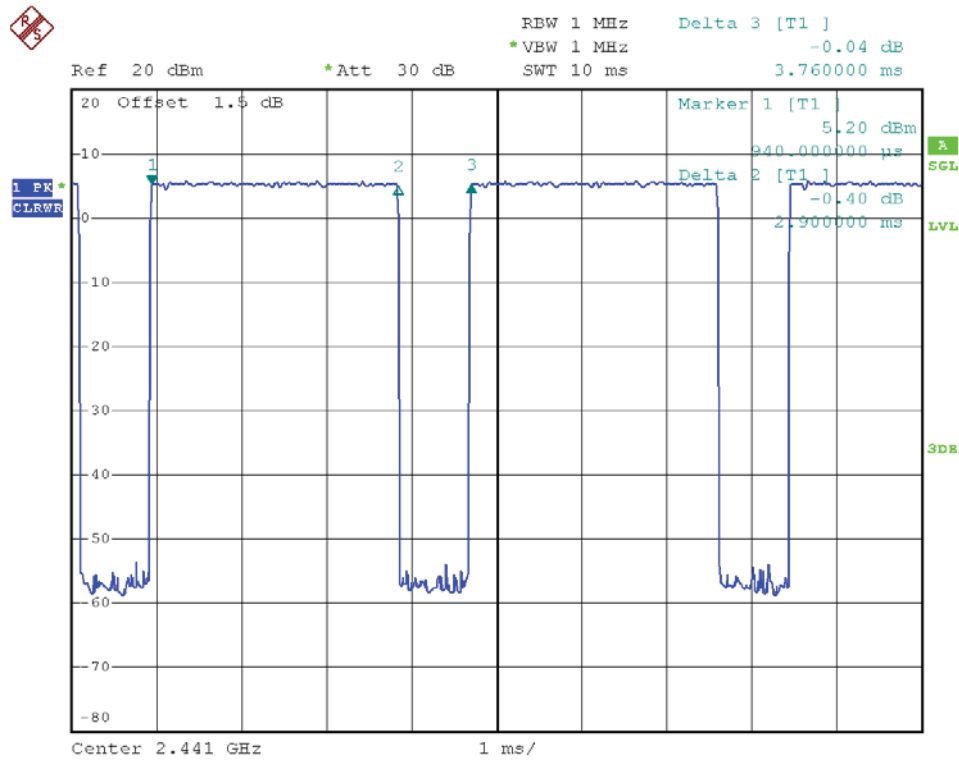
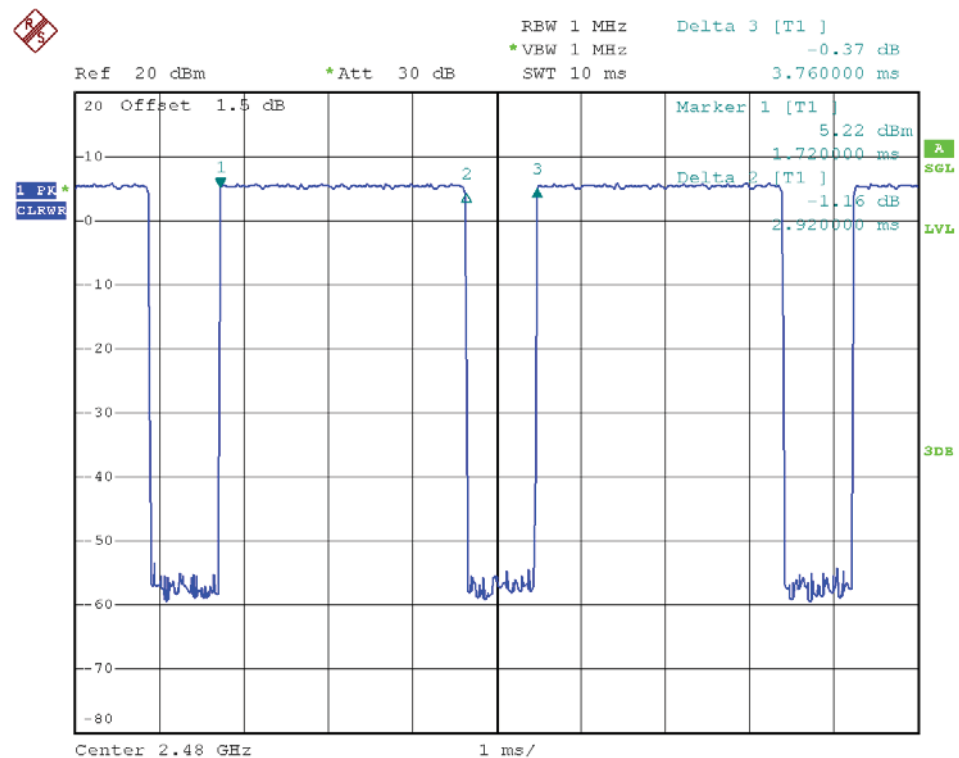
Channel	Frequency (MHz)	Pulse Time		Total of Dwell (ms)	Limit (ms)	Verdict
		ms	Refer to Plot			
0	2402	2.92	Plot A	311.467	400	PASS
39	2441	2.90	Plot B	309.333		PASS
78	2480	2.92	Plot C	311.467		PASS

B. Test Plots:

Note: the following plots record the Pulse Time of the Module carrier.



(Plot A: Channel = 2402 @ $\pi/4$ -DQPSK)


(Plot B: Channel = 2441 @ $\pi/4$ -DQPSK)

(Plot C: Channel = 2480 @ $\pi/4$ -DQPSK)

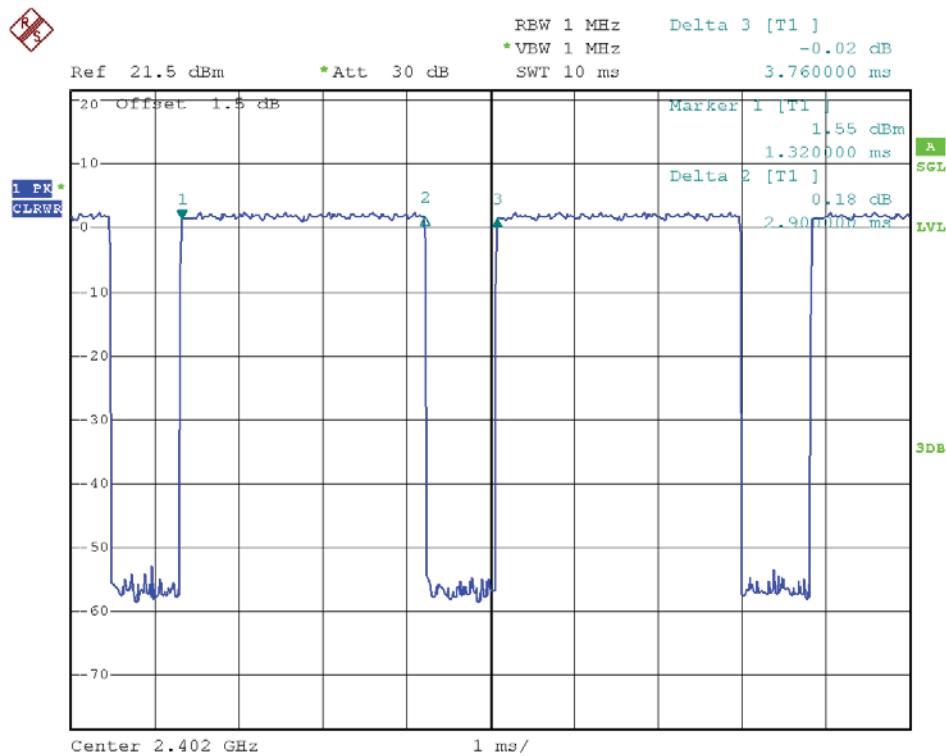
2.6.4.3. 8-DPSK mode

A. Test Verdict:

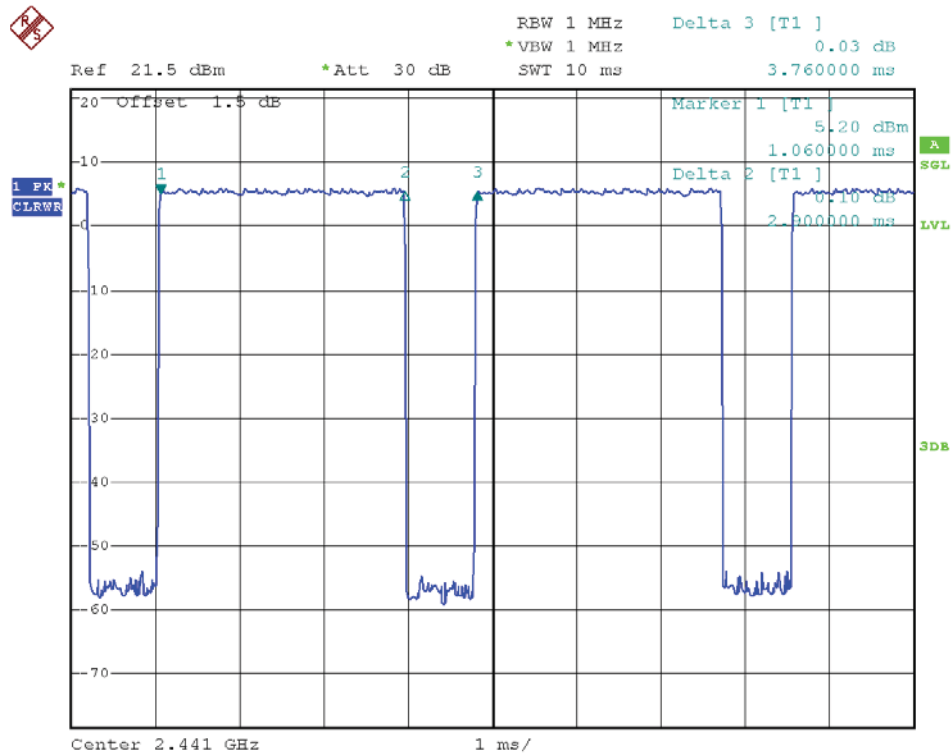
Channel	Frequency (MHz)	Pulse Time		Total of Dwell (ms)	Limit (ms)	Verdict
		ms	Refer to Plot			
0	2402	2.90	Plot A	309.333	400	PASS
39	2441	2.90	Plot B	309.333		PASS
78	2480	2.92	Plot C	311.467		PASS

B. Test Plots:

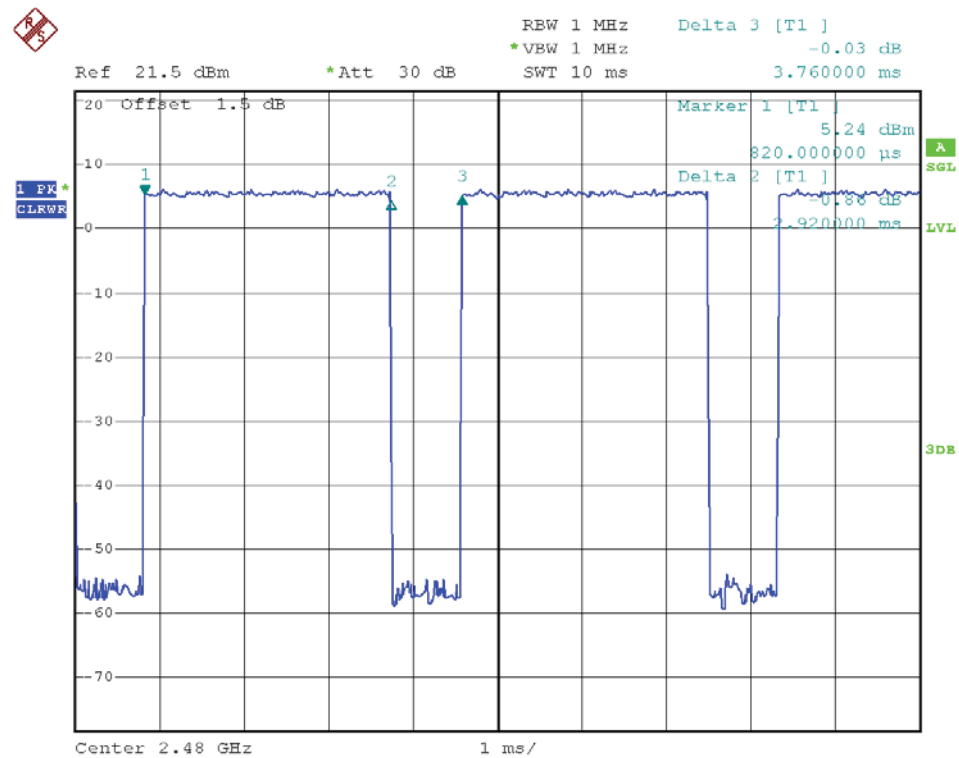
Note: the following plots record the Pulse Time of the Module carrier.



(Plot A: Channel = 2402 @ 8-DPSK)



(Plot B: Channel = 2441 @ 8-DPSK)



(Plot C: Channel = 2480 @ 8-DPSK)

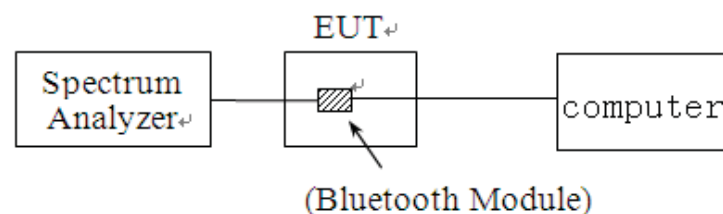
2.7. Conducted Spurious Emissions

2.7.1. Requirement

According to FCC §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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

2.7.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is connected to the Spectrum Analyzer (SA), the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the PC, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2013.06.10

The Cal. Interval was one year.

2.7.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

2.7.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

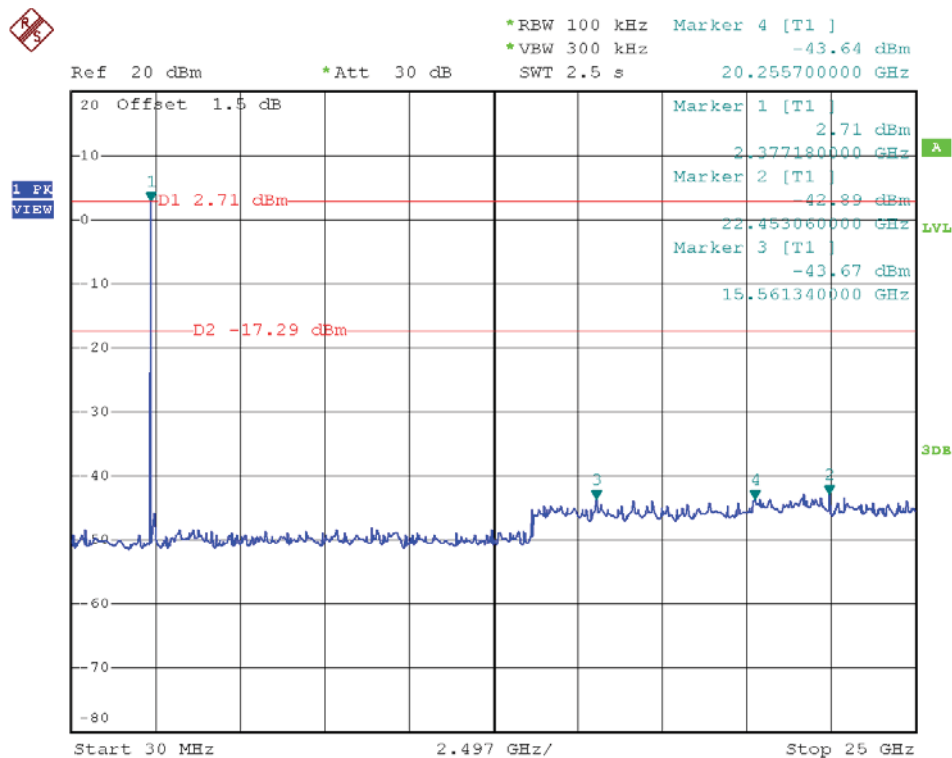
2.7.4.1. GFSK Mode

A. Test Verdict:

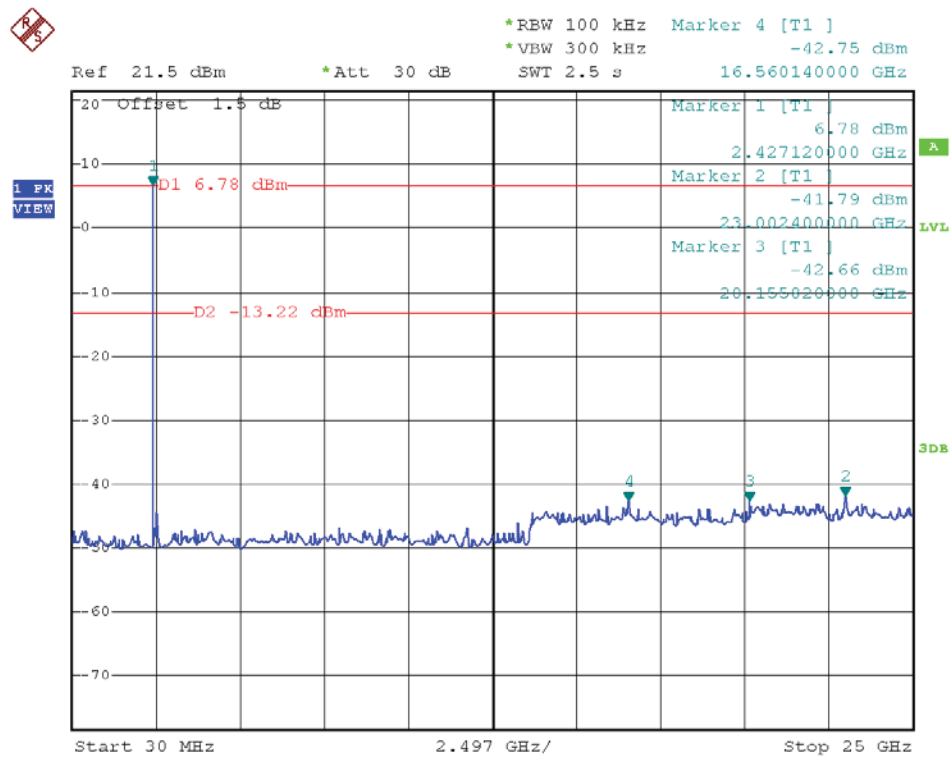
Channel	Frequency (MHz)	Refer to Plot	Limit (dBc)	Verdict
0	2402	Plot A	-20	PASS
39	2441	Plot B	-20	PASS
78	2480	Plot C	-20	PASS

B. Test Plots:

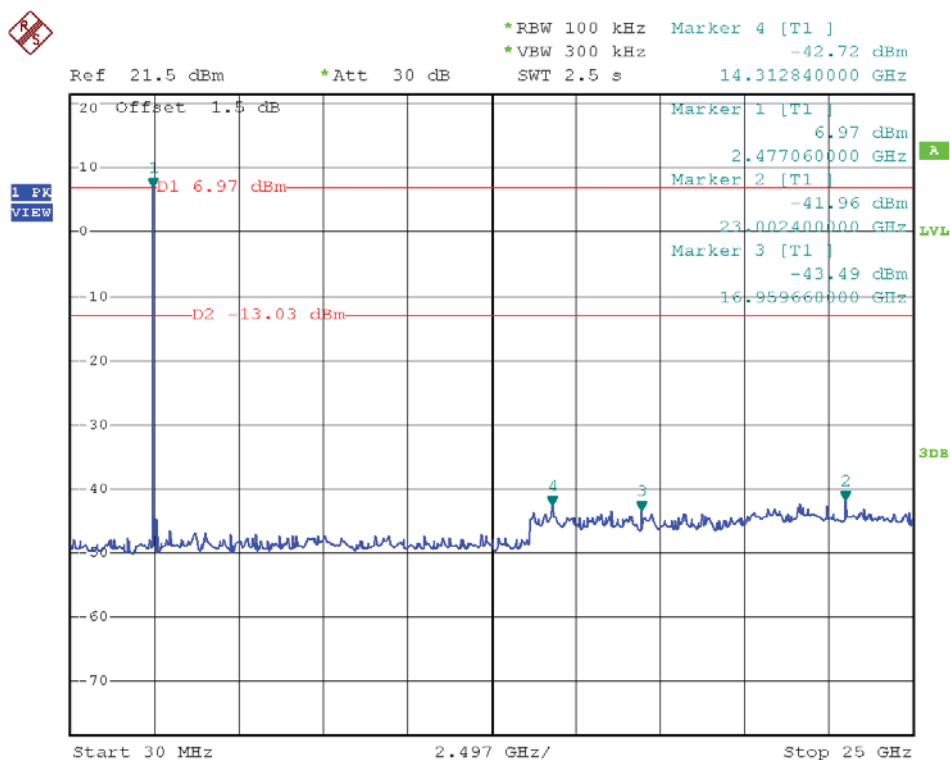
Note: the power of the Module transmitting frequency should be ignored.



(Plot A: Channel = 0, 30MHz to 25GHz @ GFSK Mode)



(Plot B: Channel = 39, 30MHz to 25GHz @ GFSK Mode)



(Plot C: Channel = 78, 30MHz to 25GHz @ GFSK Mode)

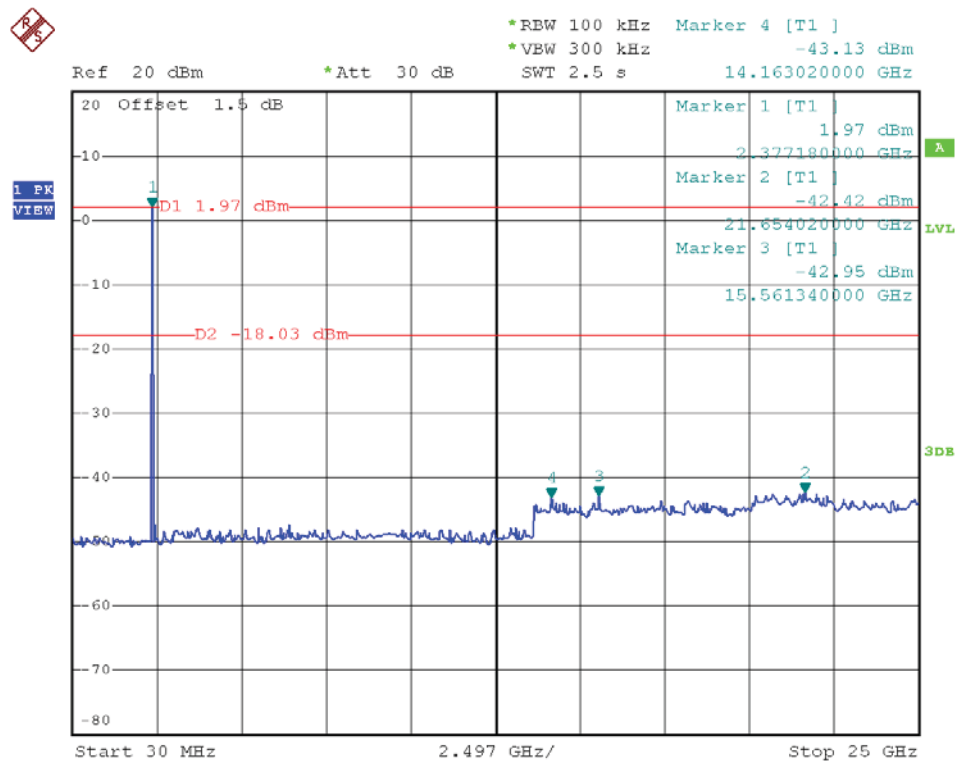
2.7.4.2. $\pi/4$ -DQPSK Mode

A. Test Verdict:

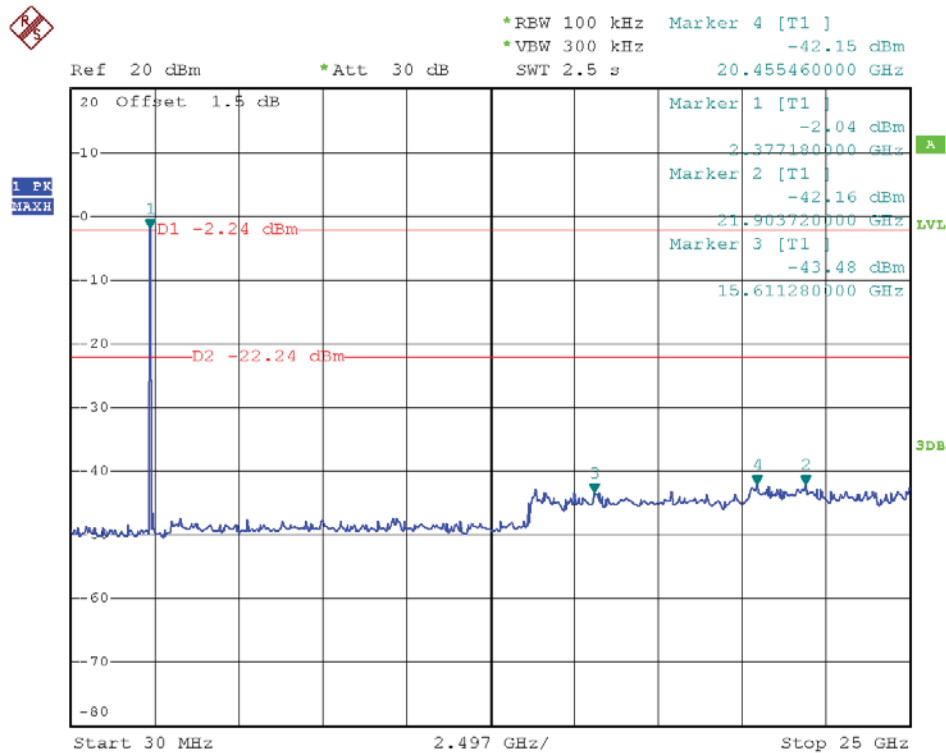
Channel	Frequency (MHz)	Refer to Plot	Limit (dBc)	Verdict
0	2402	Plot A	-20	PASS
39	2441	Plot B	-20	PASS
78	2480	Plot C	-20	PASS

B. Test Plots:

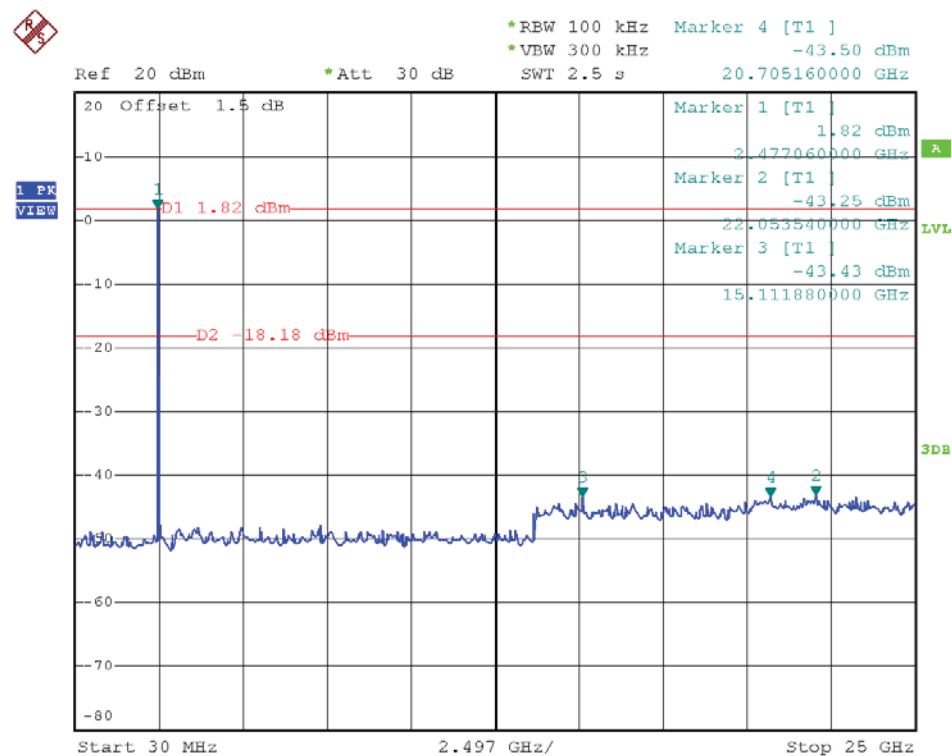
Note: the power of the Module transmitting frequency should be ignored.



(Plot A: Channel = 0, 30MHz to 25GHz @ $\pi/4$ -DQPSK)



(Plot B: Channel = 39, 30MHz to 25GHz @ $\pi/4$ -DQPSK)



(PlotC: Channel = 78, 30MHz to 25GHz @ $\pi/4$ -DQPSK)

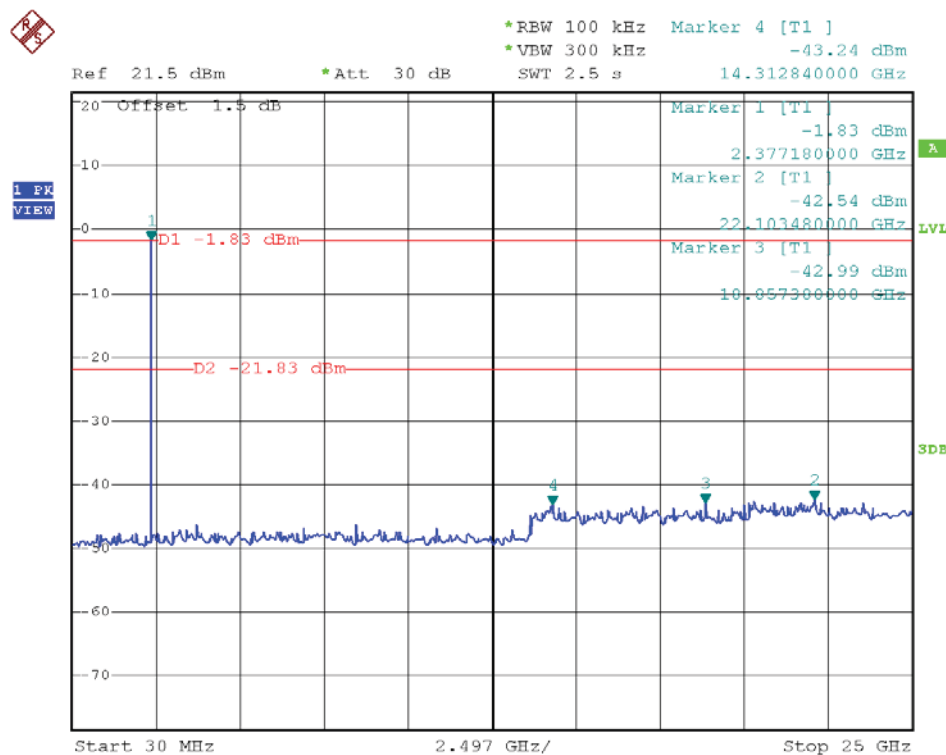
2.7.4.3. 8-DPSK Mode

A. Test Verdict:

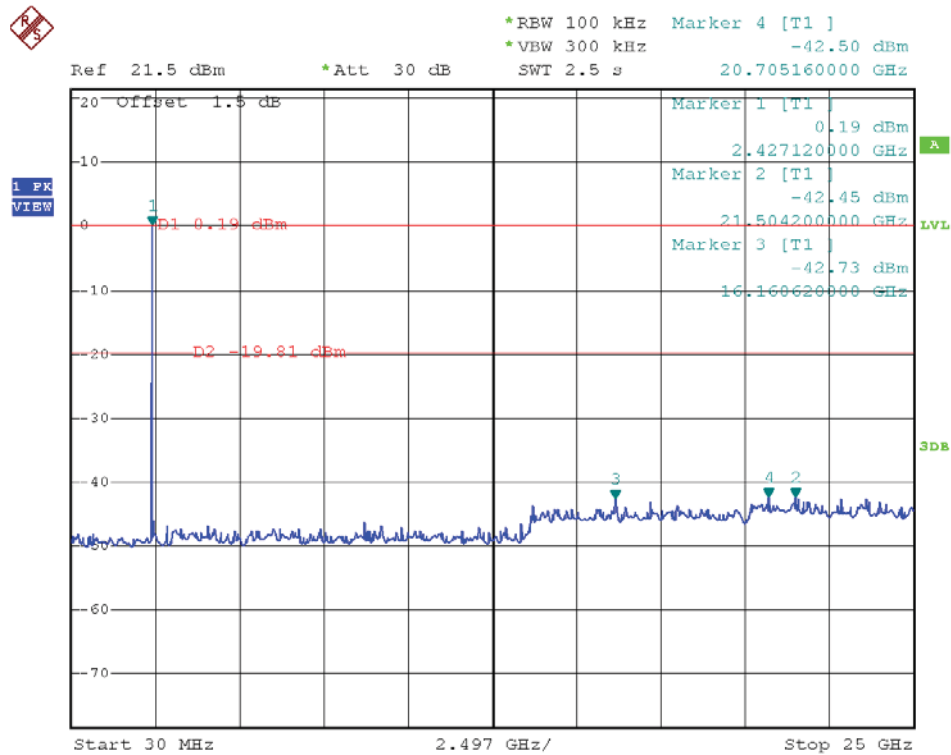
Channel	Frequency (MHz)	Refer to Plot	Limit (dBc)	Verdict
0	2402	Plot A	-20	PASS
39	2441	Plot B	-20	PASS
78	2480	Plot C	-20	PASS

B. Test Plots:

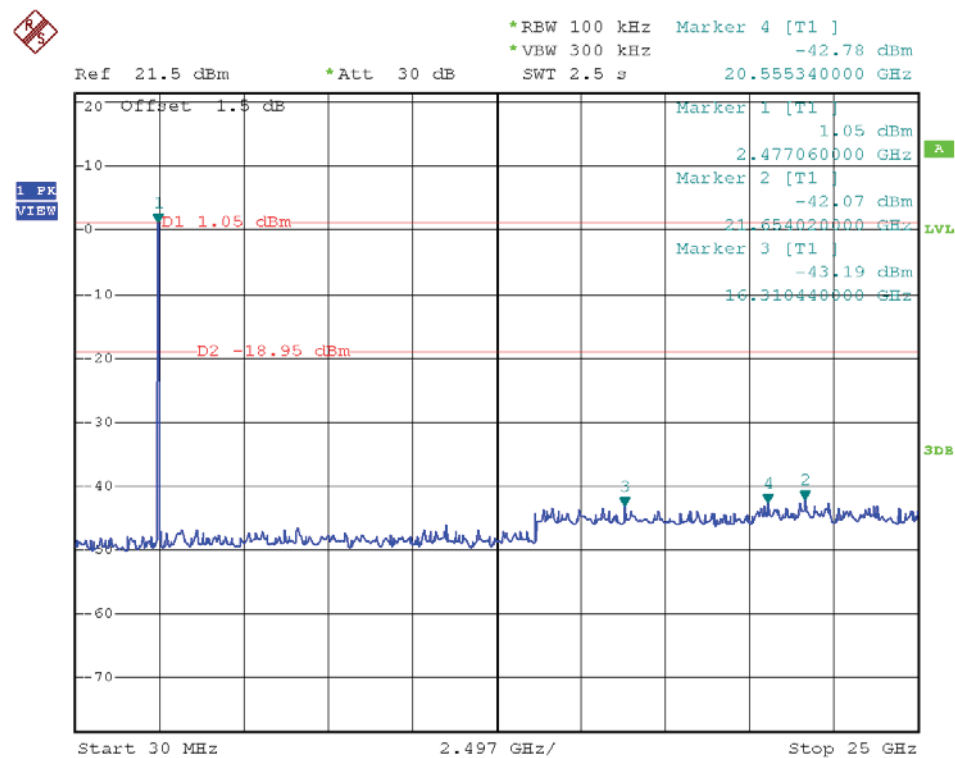
Note: the power of the Module transmitting frequency should be ignored.



(Plot A: Channel = 0, 30MHz to 25GHz @ 8-DPSK)



(Plot B: Channel = 0, 30MHz to 25GHz @ 8-DPSK)



(Plot C: Channel = 78, 30MHz to 25GHz @ 8-DPSK)

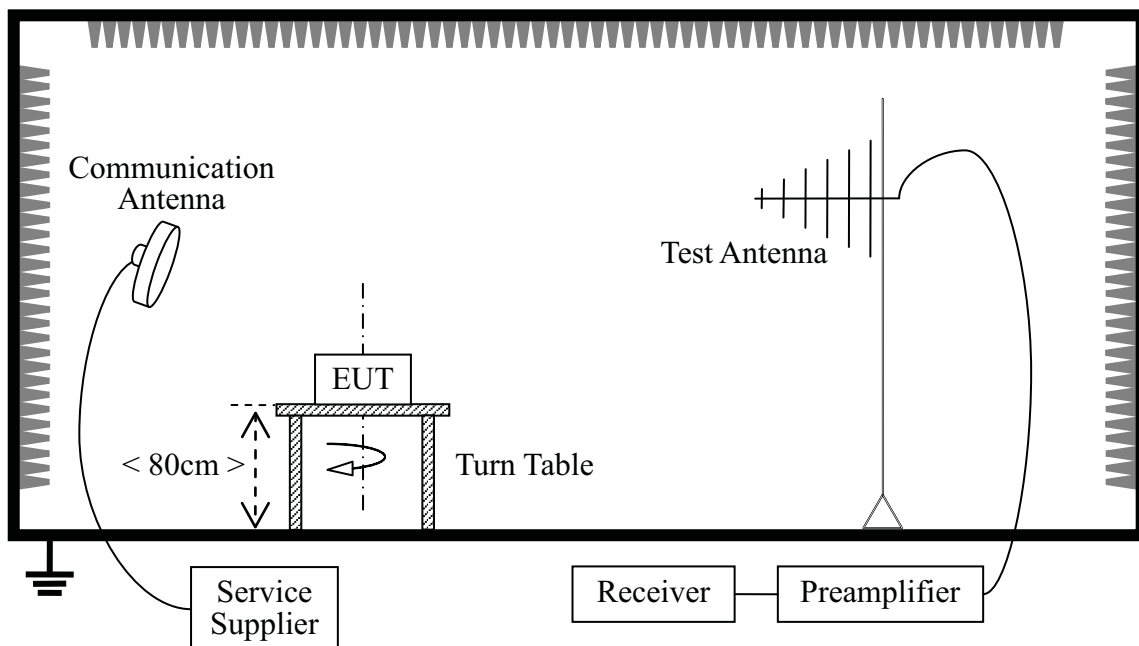
2.8. Band Edge

2.8.1. Requirement

According to FCC 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

2.8.2. Test Description

A. Test Setup:



The Bluetooth Module of the EUT is powered by the Battery. The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading. During the measurement, the Bluetooth Module is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

For the Test Antenna:

Horn Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal.Due Date
Receiver	R&S	ESIB26	A0304218	2014.06.07
Full-Anechoic Chamber	Albatross	12.8m*6.8m*6.4m	A0412372	2014.06.07
Double ridge horn antenna	R&S	HF906	A0304225	2014.06.10
Ultra-wideband antenna	R&S	HL562	A0304224	2014.06.10
Ampilier1G~18GHz	R&S	MITEQ AFS42-00101800	25-S-42	2014.06.05

2.8.3. Test Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

For radiated test

RBW =1MHz ,VBW=3MHz PK detector for PK value ,

RBW=1MHz VBW=10Hz , PK detector for AV value

Trace = max hold

Allow the trace to stabilize.

2.8.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest and highest channels are tested to verify the band edge emissions.

The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V/m]} = U_R + A_T + A_{\text{Factor}} \text{ [dB]}; A_T = L_{\text{Cable loss}} \text{ [dB]} - G_{\text{preamp}} \text{ [dB]}$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

Note1: The red vertical lines “F1” in the following charts is to indicate the frequencies 2400MHz and 2483.5MHz respectively.

Note2: Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.

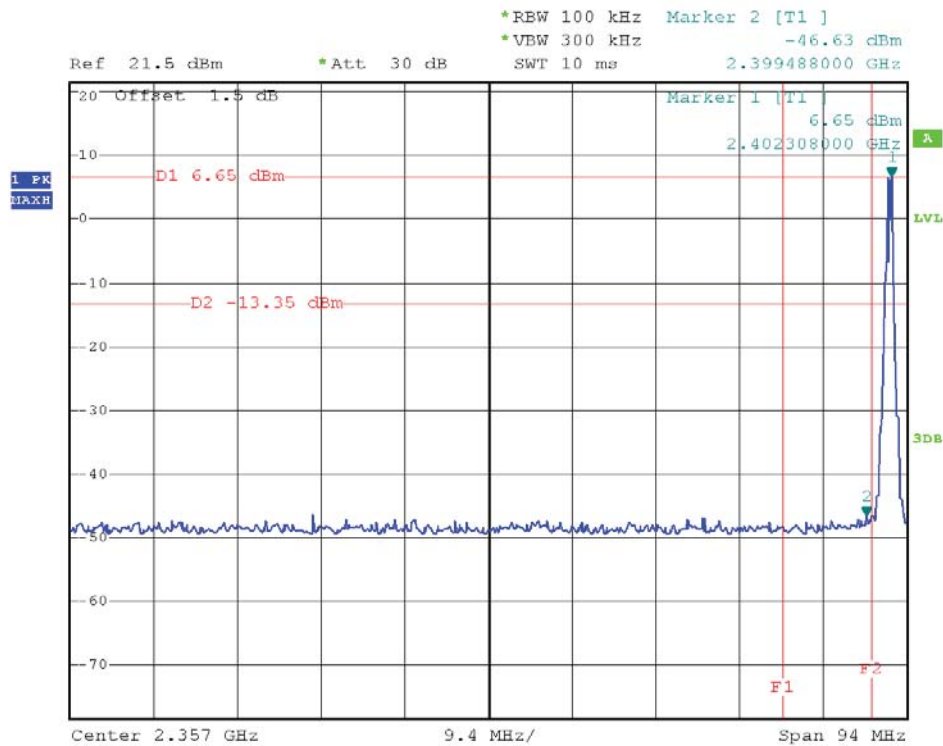
2.8.4.1. GFSK Mode

A. Test Verdict: All restriction band all have been tested include 2310 to 2390MHz , 2483.5 to 2500MHz ,Only the worse case is reported. Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.

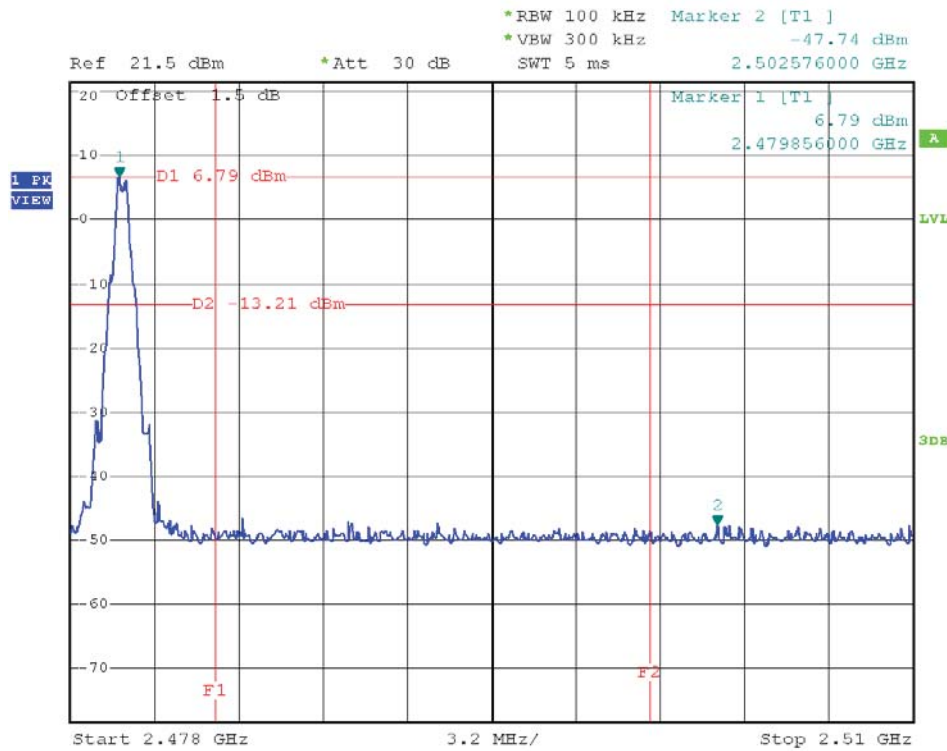
(Un-hopping)

Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2317.424	PK	59.46	-31.7	28.3	56.06	74	Pass
0	2317.128	AV	45.32	-31.7	28.3	41.92	54	Pass
78	2485.964	PK	57.33	-29.45	29.2	57.08	74	Pass
78	2483.940	AV	42.65	-29.45	29.2	42.40	54	Pass

B. Test Plots:



(Plot A1: Channel = 0 PEAK @ GFSK)

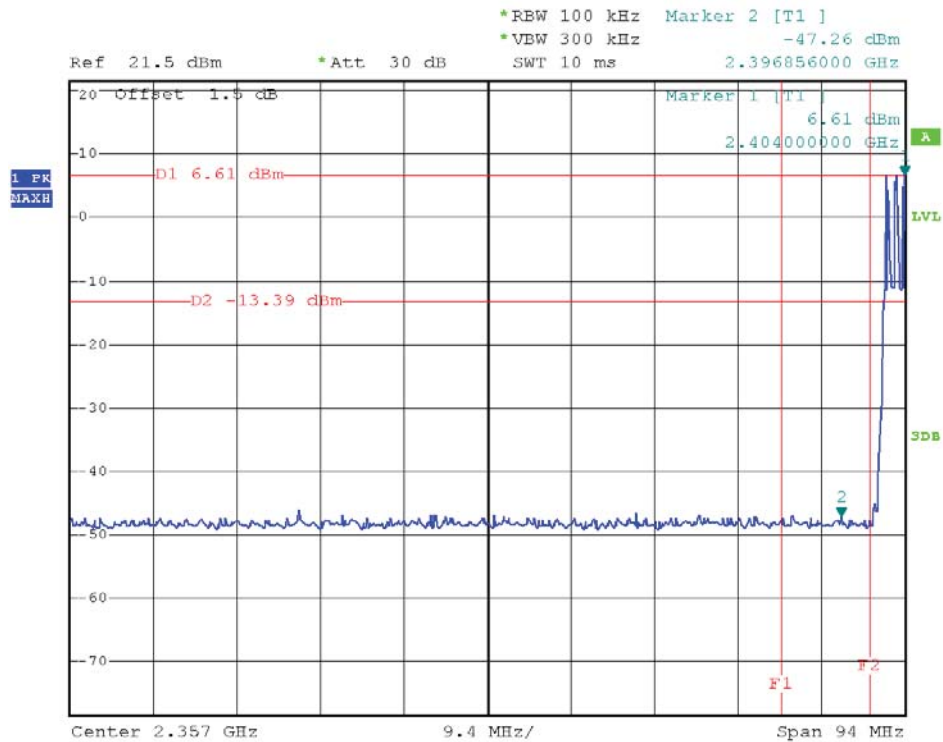


(Plot B1: Channel = 78 PEAK @ GFSK)

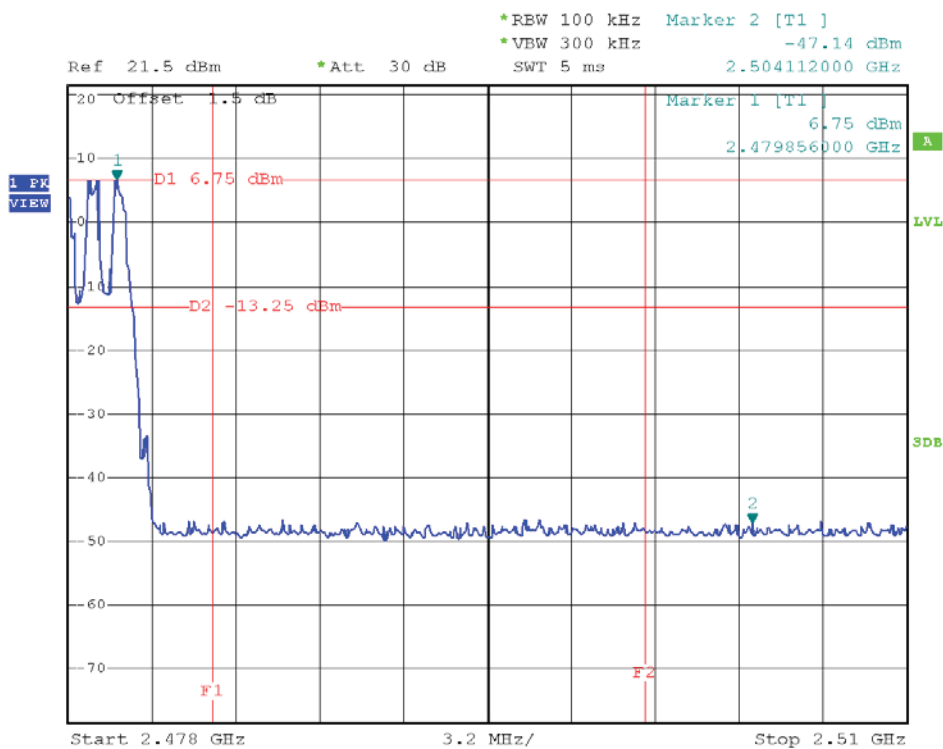
(hopping)

Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2365.569	PK	60.03	-31.78	28.2	56.45	74	Pass
0	2365.569	AV	49.12	-31.78	28.2	45.54	54	Pass
78	2484.028	PK	58.82	-29.24	29.3	58.88	74	Pass
78	2484.512	AV	48.34	-29.45	29.2	48.09	54	Pass

All restriction band all have been tested include 2310 to 2390MHz , 2483.5 to 2500MHz ,Only the worse case is reported. Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.



(Plot A1-1: Channel = 0 PEAK)



(Plot B1-1: Channel = 78 PEAK)

2.8.4.2. $\pi/4$ -DQPSK Mode

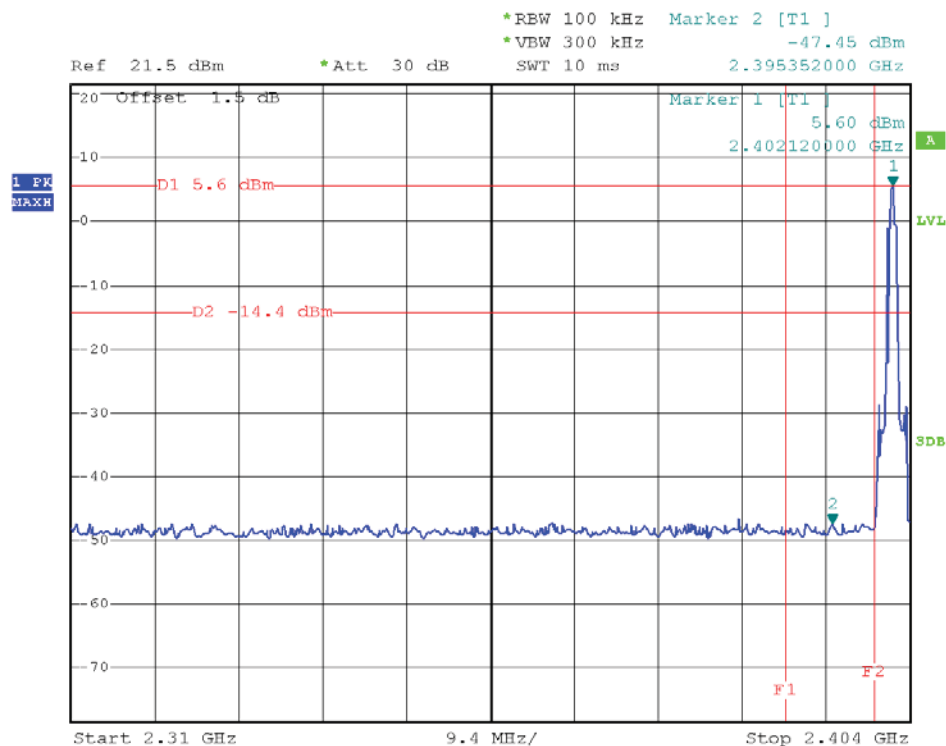
A. Test Verdict:

(Un-hopping)

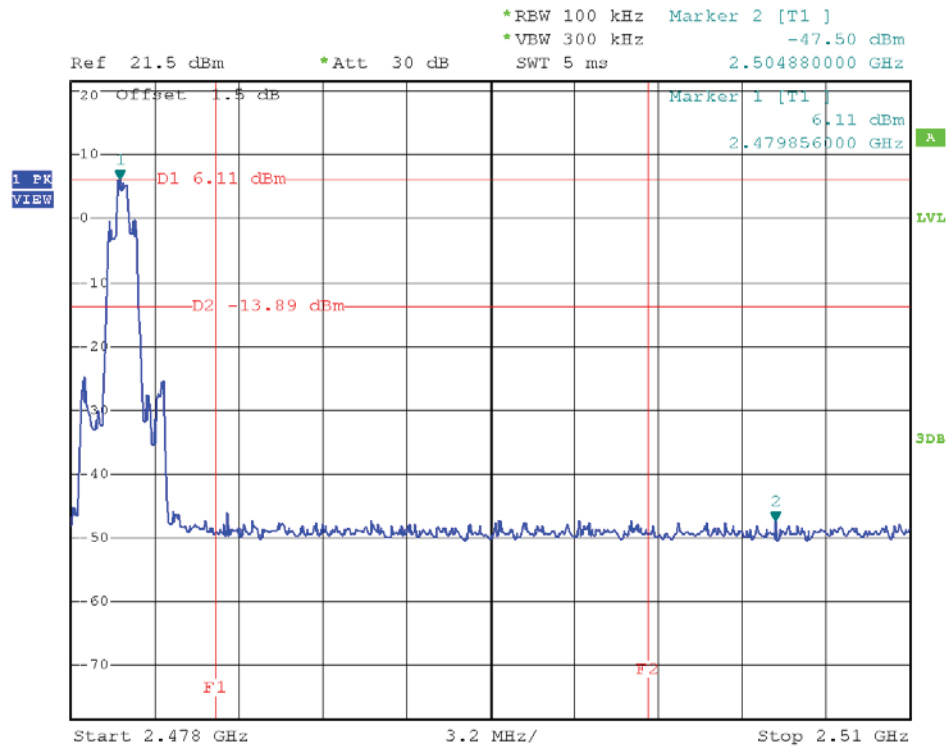
Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dB μ V/m)	Limit (dB μ V/m)	Verdict
		PK/ AV						
0	2352.468	PK	60.54	-31.75	28.2	56.99	74	Pass
0	2352.468	AV	46.77	-31.74	28.2	43.23	54	Pass
78	2489.792	PK	58.40	-29.45	29.2	58.15	74	Pass
78	2489.792	AV	48.62	-29.45	29.2	48.37	54	Pass

All restriction band all have been tested include 2310 to 2390MHz , 2483.5 to 2500MHz ,Only the worse case is reported. Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.

B. Test Plots:



(Plot C1: Channel = 0 PEAK @ $\pi/4$ -DQPSK)

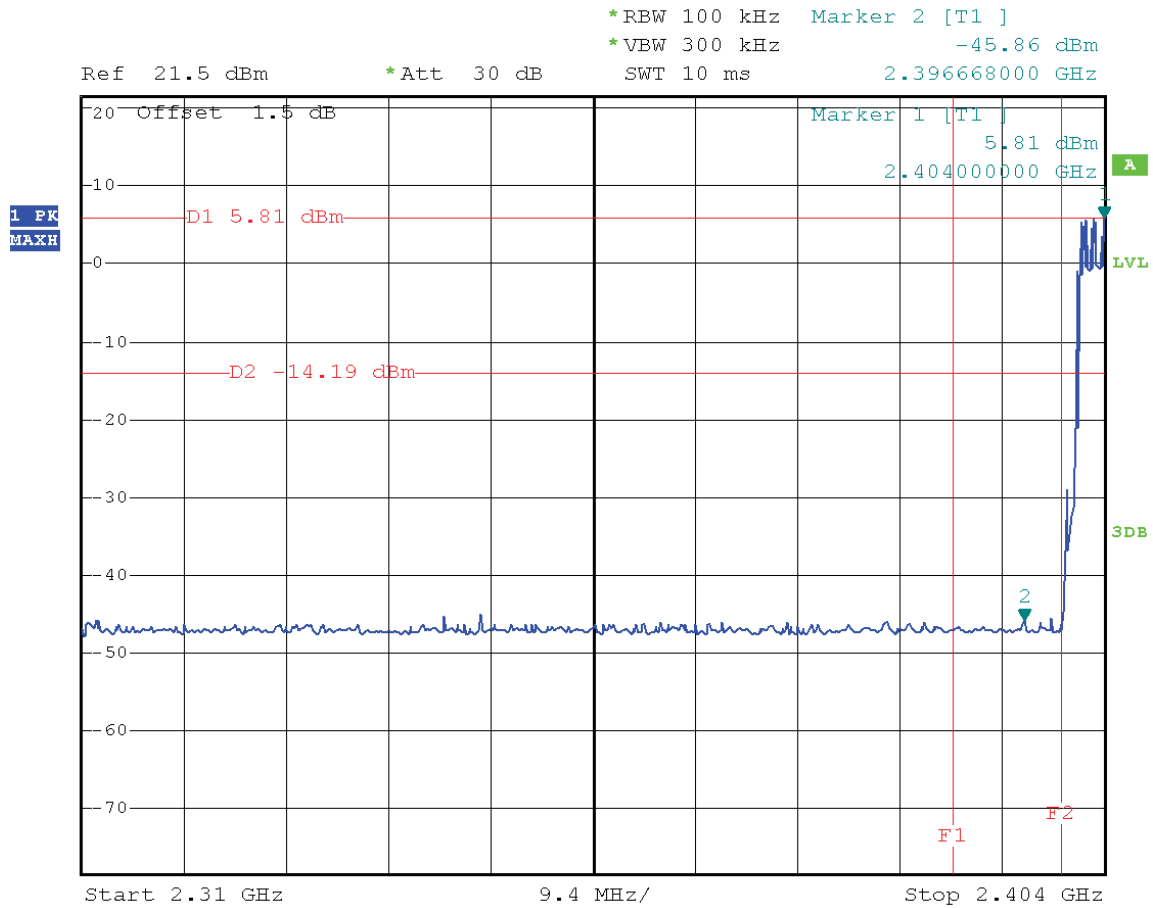


(Plot D1: Channel = 78 PEAK @ $\pi/4$ -DQPSK)

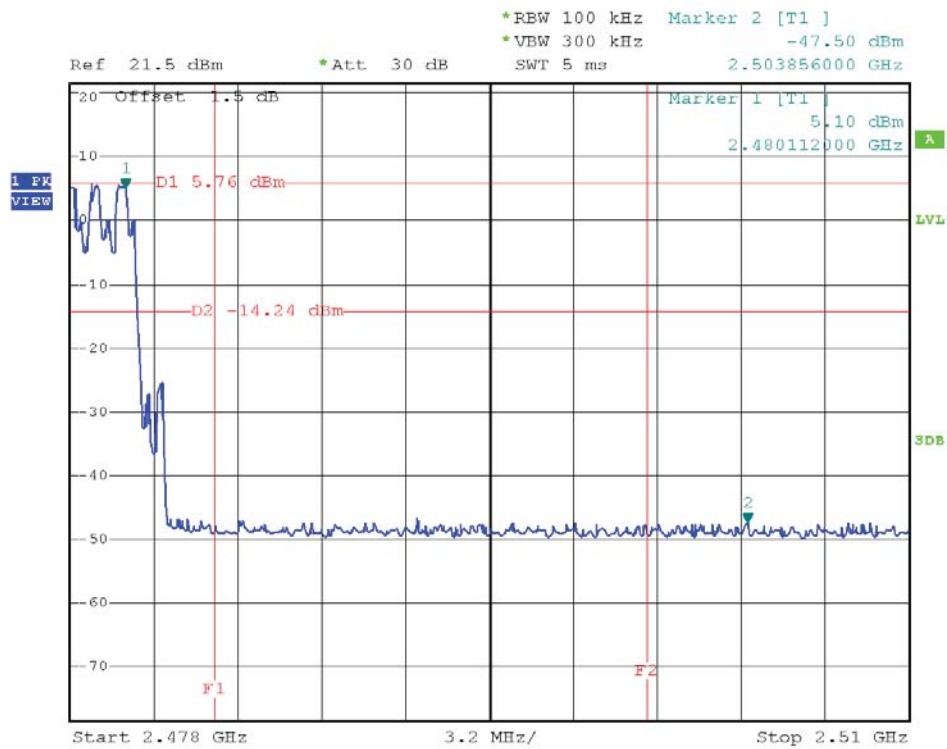
(hopping)

Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2365.376	PK	58.82	-31.65	28.5	55.67	74	Pass
0	2365.376	AV	47.96	-31.82	28.1	44.24	54	Pass
78	2490.320	PK	60.35	-29.45	29.2	60.10	74	Pass
78	2490.320	AV	49.97	-29.45	29.2	49.72	54	Pass

All restriction band all have been tested include 2310 to 2390MHz , 2483.5 to 2500MHz ,Only the worse case is reported. Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.



(Plot C1-1: Channel = 0 PEAK)



(Plot D1-1: Channel = 78 PEAK)

2.8.4.3. 8-DPSK Mode

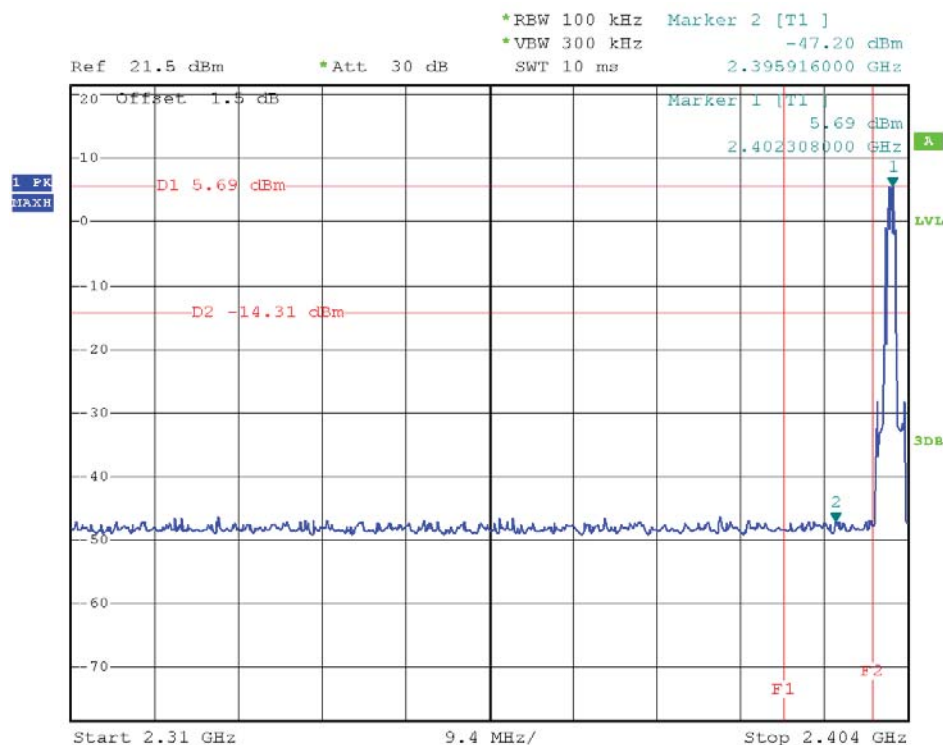
A. Test Verdict:

(Un-hopping)

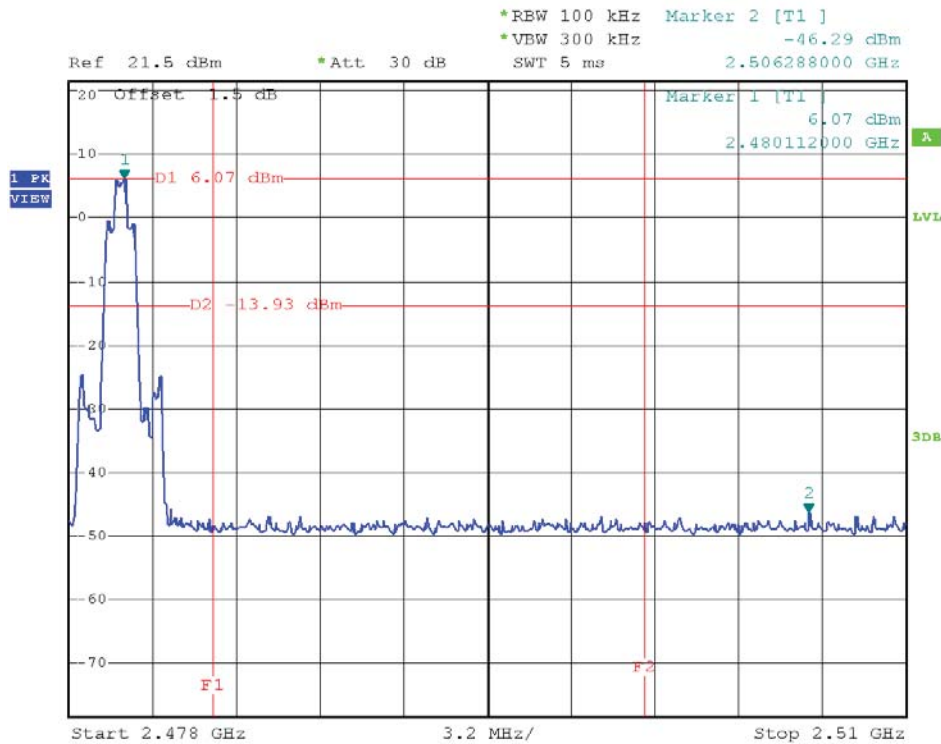
Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2345.238	PK	60.54	-31.81	28.1	56.83	74	Pass
0	2345.238	AV	49.67	-31.7	28.3	46.27	54	Pass
78	2492.212	PK	59.36	-29.45	29.2	59.11	74	Pass
78	2492.212	AV	47.32	-29.45	29.2	47.07	54	Pass

All restriction band all have been tested include 2310 to 2390MHz , 2483.5 to 2500MHz ,Only the worse case is reported. Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.

B. Test Plots:



(Plot E1: Channel = 0 PEAK @ 8-DPSK Mode)

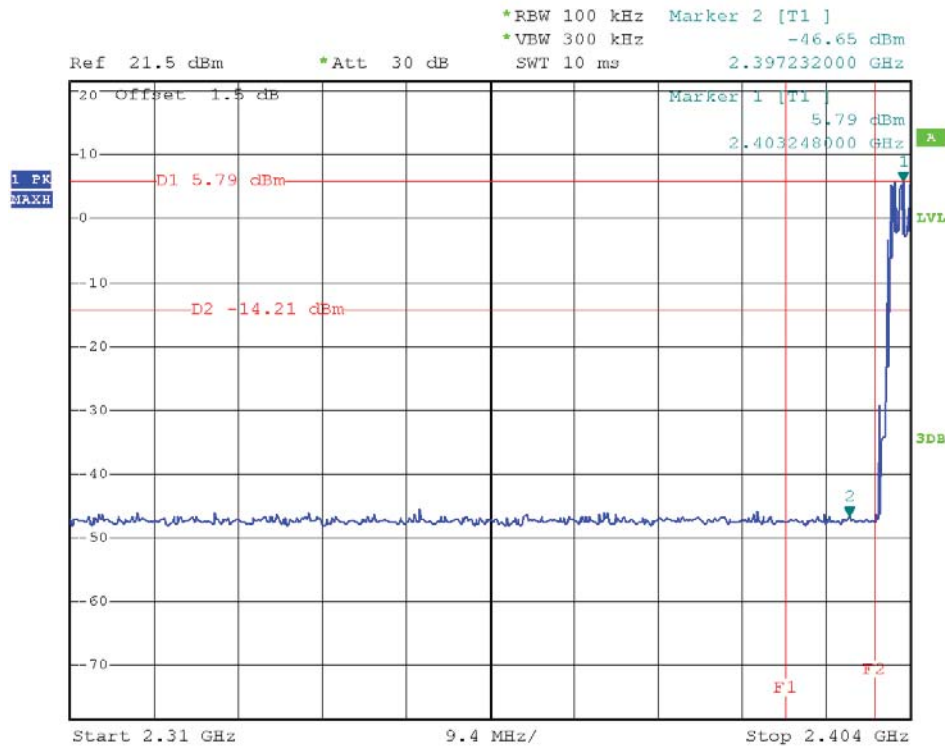


(Plot F1: Channel = 78 PEAK @ 8-DPSK Mode)

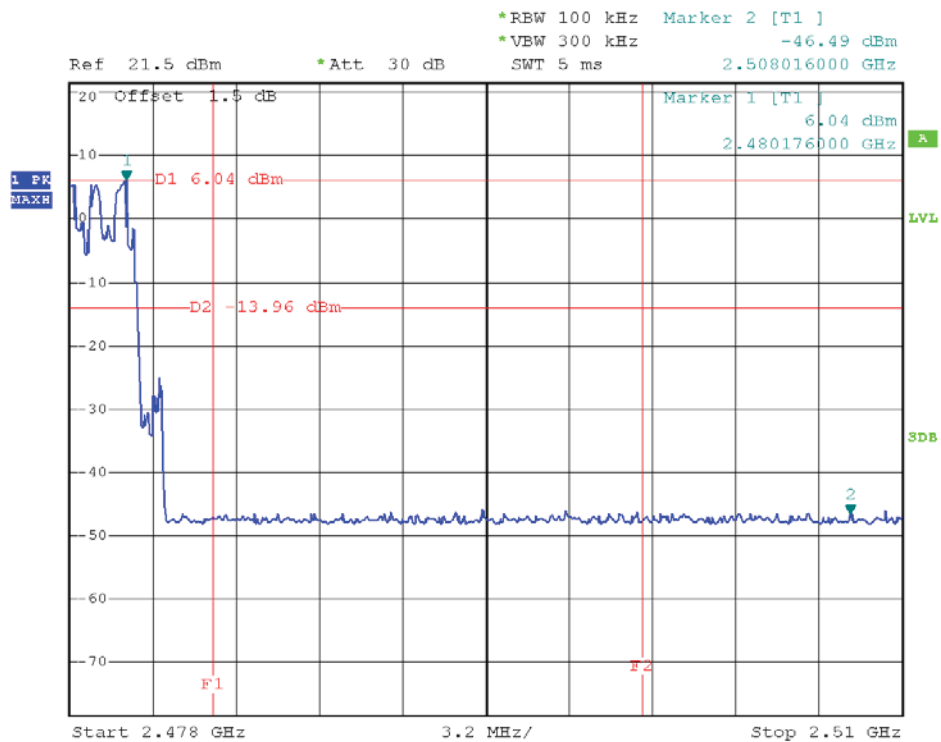
(hopping)

Channel	Frequency (MHz)	Detector	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2313.576	PK	61.43	-31.7	28.3	58.03	74	Pass
0	2313.576	AV	51.36	-31.7	28.3	47.96	54	Pass
78	2485.304	PK	59.81	-29.45	29.2	59.56	74	Pass
78	2485.304	AV	50.23	-29.25	29.3	50.28	54	Pass

All restriction band all have been tested include 2310 to 2390MHz , 2483.5 to 2500MHz ,Only the worse case is reported. Both horizontal and vertical polarization direction of the antenna has been performed, only the worst case recorded in this report.



(Plot E1-1: Channel = 0 PEAK)



(Plot F1-1: Channel = 78 PEAK)

2.9. Conducted Emission

2.9.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

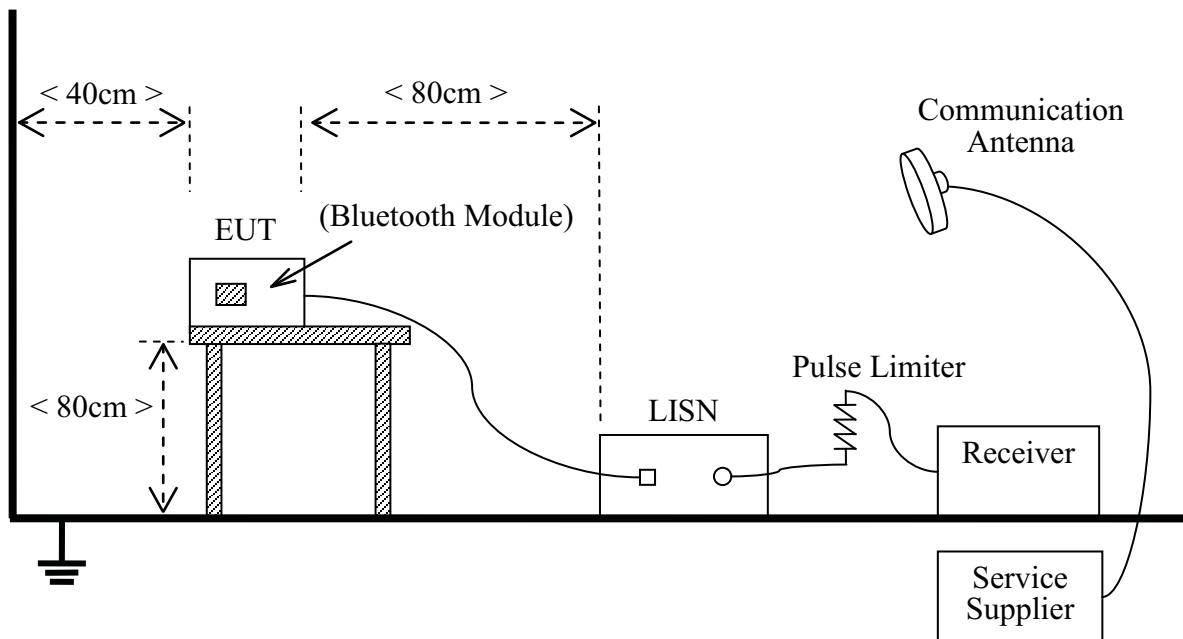
Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

NOTE:

- The lower limit shall apply at the band edges.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.9.2. Test Description

A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.4:2003

The Bluetooth Module of the EUT is powered by the PC. The factors of the site are calibrated to correct the reading. During the measurement, the Bluetooth Module is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Due Date
Test Receiver	ROHDE&SCHWARZ	ESCS30	A0304260	2014.06.10
LISN	ROHDE&SCHWARZ	ESH2-Z5	A0304221	2014.06.10

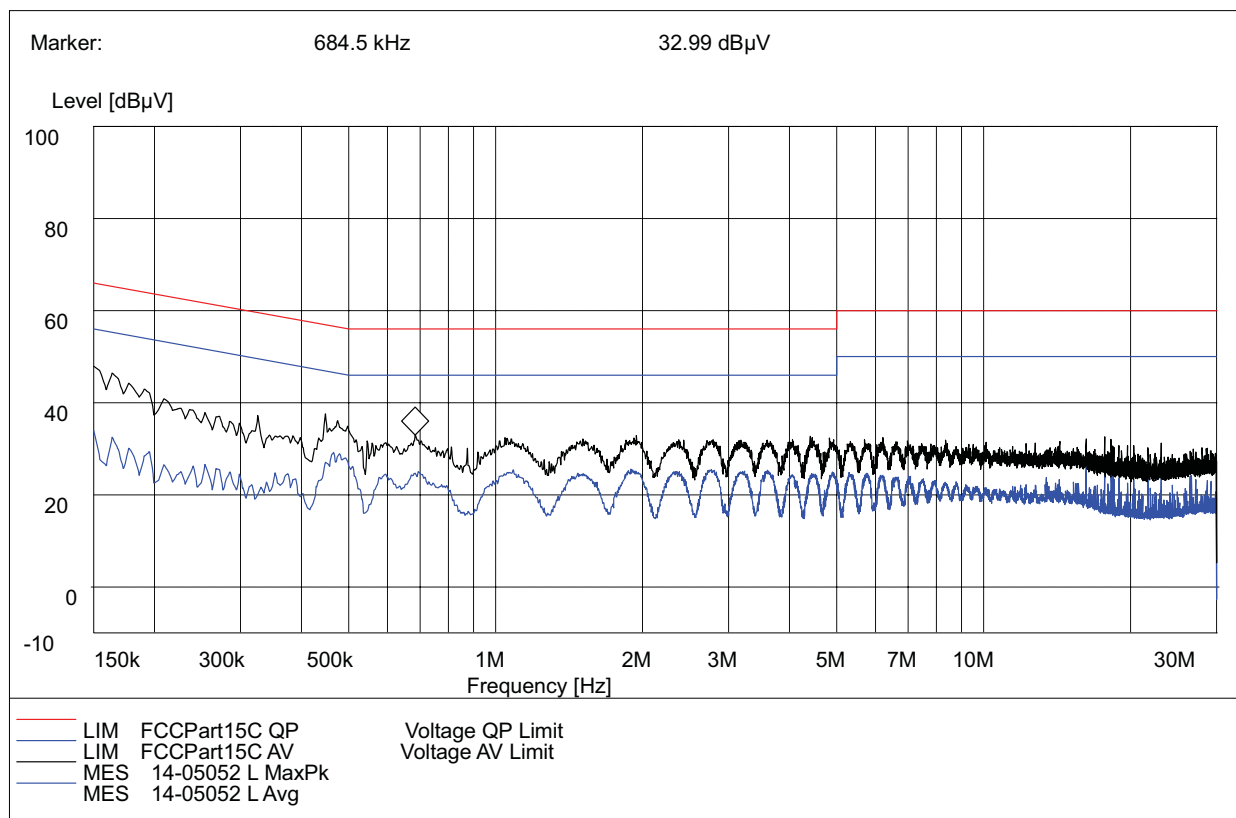
2.9.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

A. Test setup:

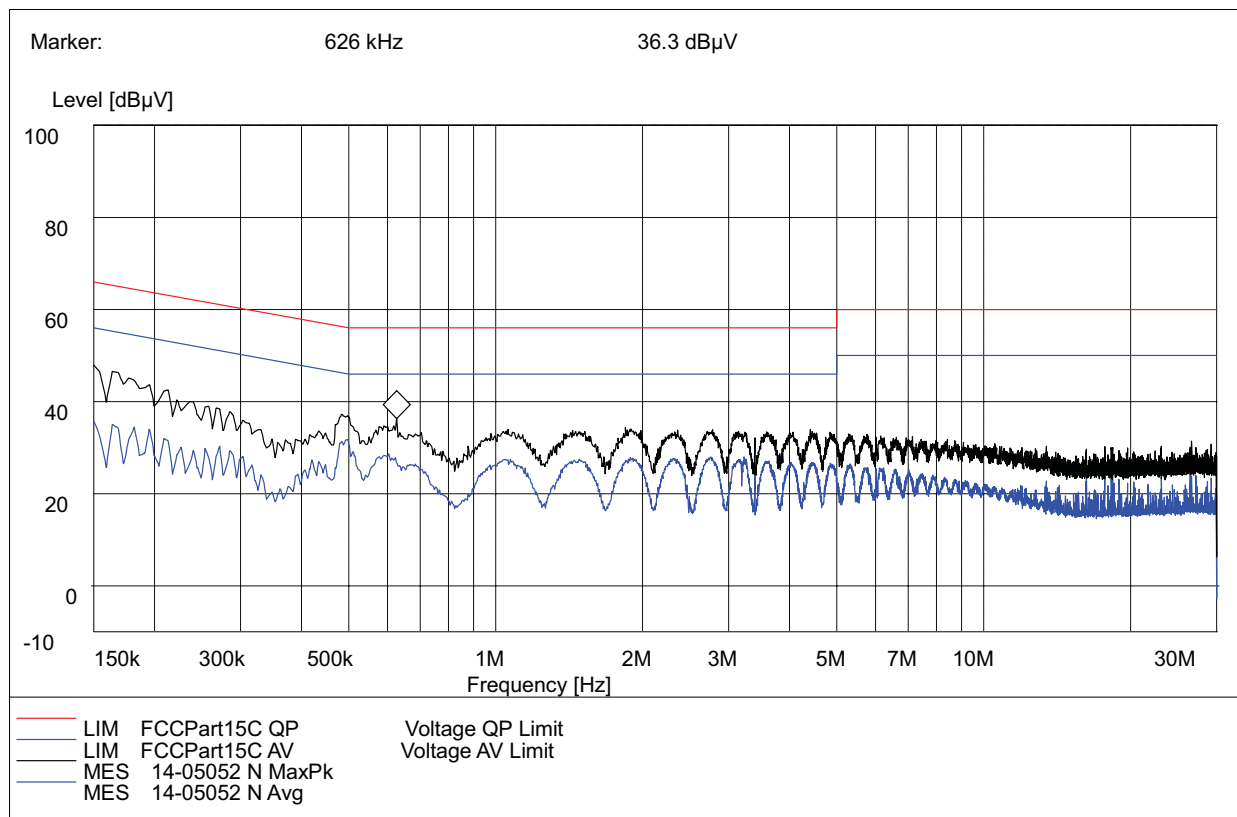
The EUT configuration of the emission tests is KEEPING TX.

B. Test Plots:



(Plot A: L Phase)

Conducted Disturbance at Mains Terminals					
L Test Data					
QP			AV		
Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)	Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)
0.1500	66.00	45.64	0.1500	56.00	30.44
0.5203	56.90	37.60	0.5203	46.90	28.55
4.6067	56.00	32.76	4.6067	46.00	21.36
L Test Curve					



(Plot B: N Phase)



Conducted Disturbance at Mains Terminals					
N Test Data					
QP			AV		
Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)	Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)
0.1500	66.00	45.88	0.1500	56.00	31.92
0.4830	56.30	36.95	0.4830	46.30	28.54
0.6260	56.00	36.11	0.6260	46.00	28.53
NTest Curve					

(Plot B: N Phase)

Test Result: PASS

2.10. Radiated Emission

2.10.1. Requirement

According to FCC section 15.247(c), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

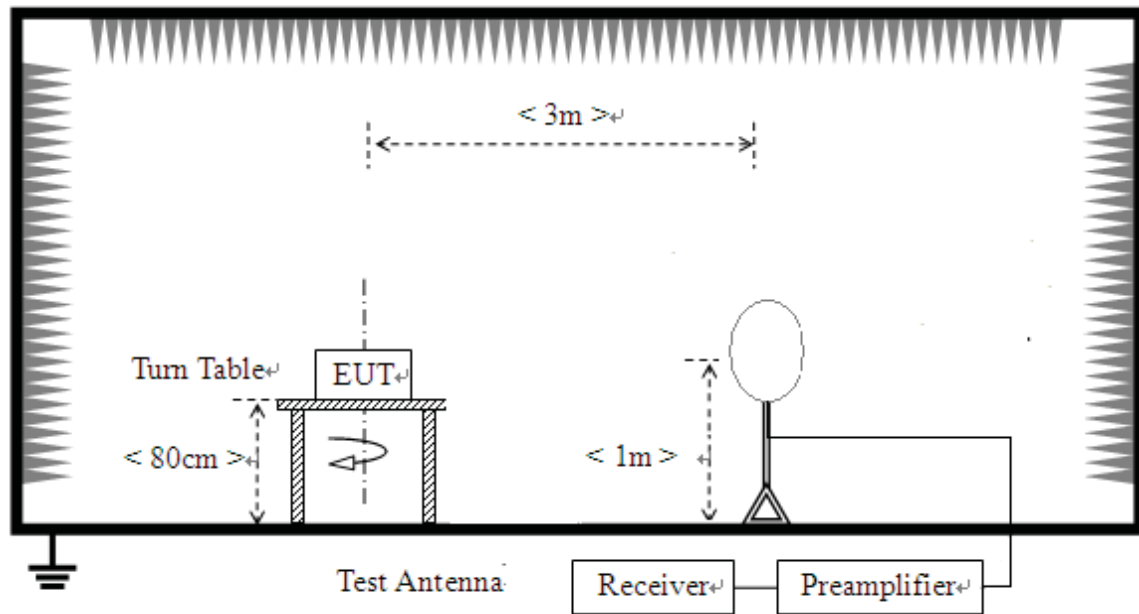
For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

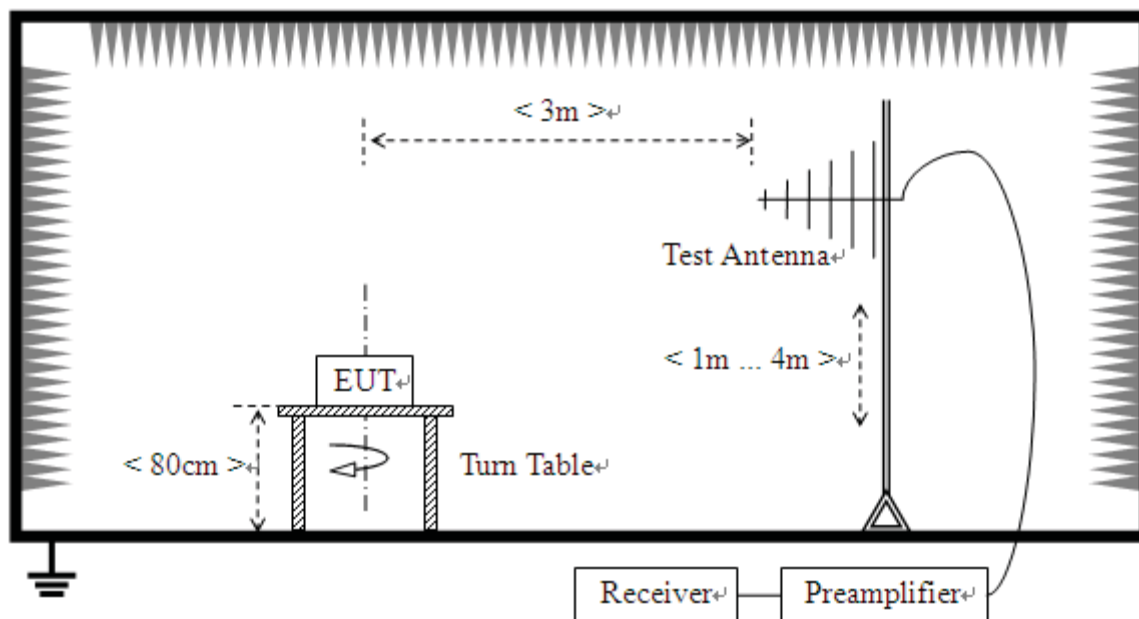
2.10.2. Test Description

A. Test Setup: KEEPING TX mode

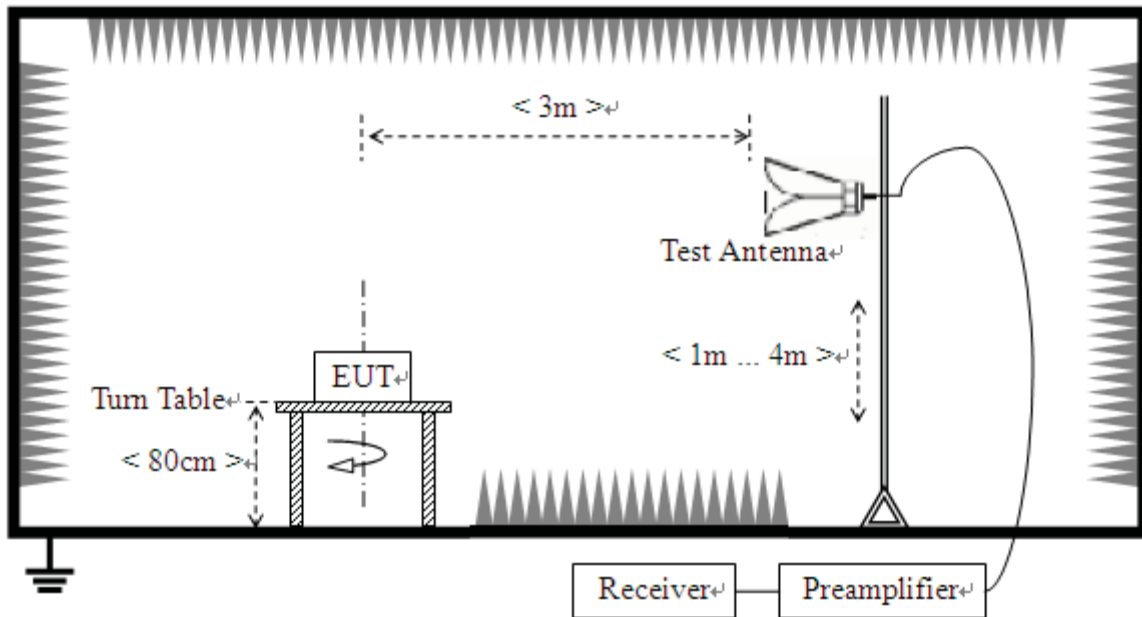
- 1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.4 (2003). The EUT was set-up on insulator 80cm above the Ground Plane. The set-up and test methods were according to ANSI C63.4.

The EUT is powered by the PC. The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading. During the measurement, the frequency hopping operation of the hybrid system, with the direct sequence operation turned off, the Module is activated and controlled by the PC, set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

For the Test Antenna:

- In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal.Due Date
Receiver	R&S	ESIB26	A0304218	2014.06.07
Full-Anechoic Chamber	Albatross	12.8m*6.8m*6.4m	A0412372	2014.06.07
Test Antenna - Bi-Log	Schwarzbeck	VULB 9163	9163-274	2014.06.09
Test Antenna - Horn	R&S	BBHA 9120D	9120C-963	2014.06.09
Test Antenna - Horn	R&S	HF960	100150	2014.06.10
Test Antenna – Horn (18-25GHz)	ETS	UG-596A/U	A0902607	2014.06.05
Test Antenna -Loop	Schwarzbeck	HFH2-Z2	100047	2014.06.02
Ampilier1G~18GHz	R&S	MITEQ AFS42-00101800	25-S-42	2014.06.05
Ampilier18G~40GHz	R&S	JS42-18002600-28 -5A	12111.0980.0 0	2014.06.05
amplifier 20M~3GHz	R&S	PAP-0203H	22018	2014.06.10

2.10.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

2.10.4. Test Result

According to ANSI C63.4 selection 4.2.2, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

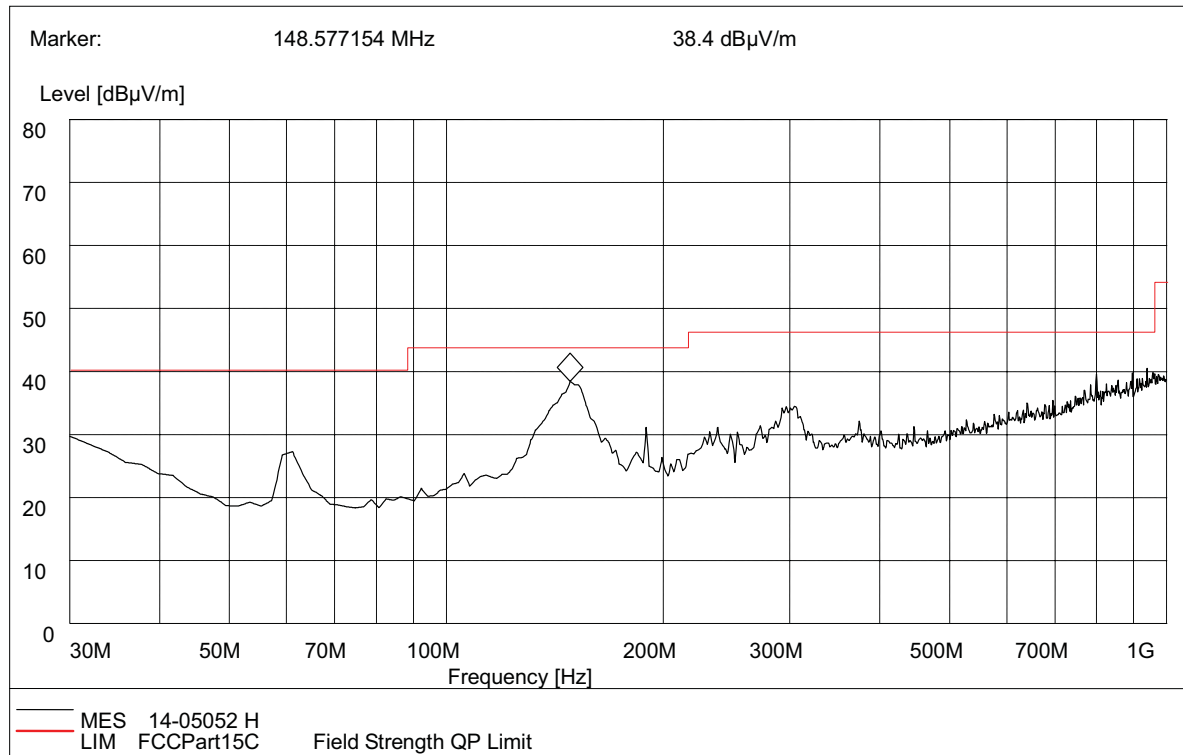
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

Note: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

For 9KHz to 30MHz

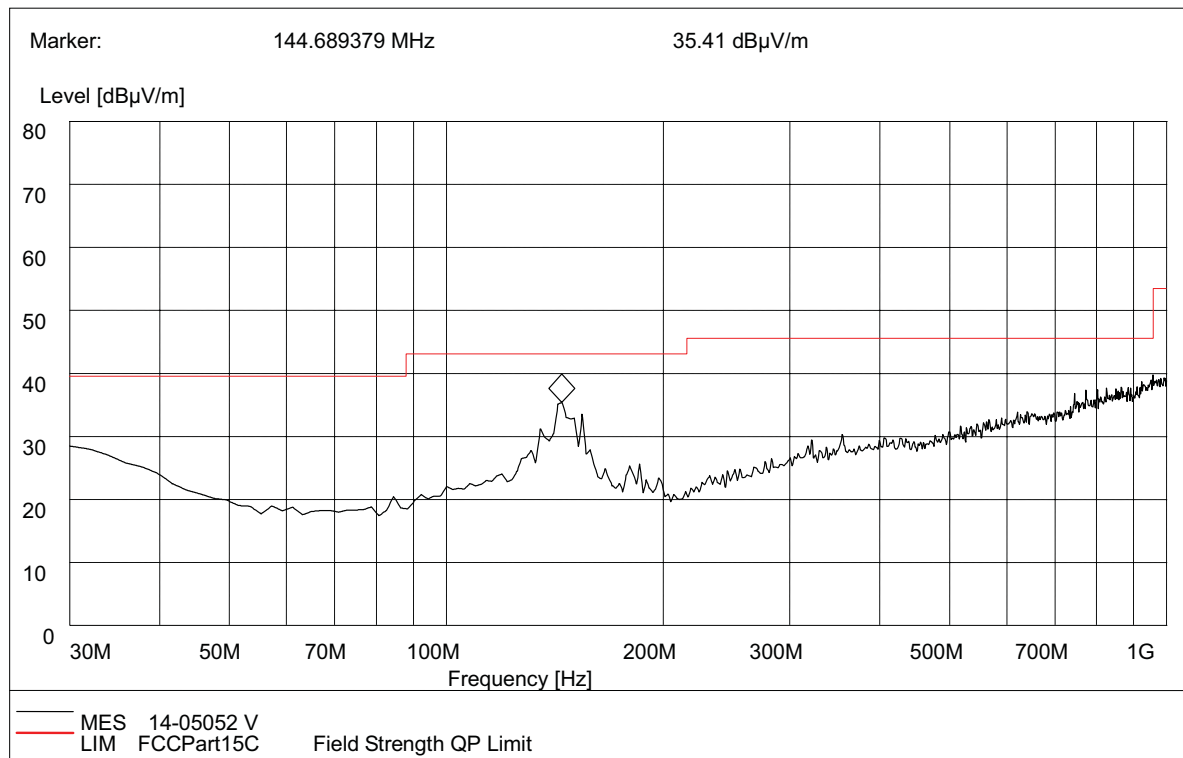
The test has been performed, and the Radiated Emission level is too low to the limit.

For 30MHz to 1000 MHz



(Plot A: 30MHz to 1GHz, Antenna Horizontal)

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB μ V/m)	Antenna	Verdict
149.54	34.51	120.000	100.0	43.50	Horizontal	Pass



(Plot B: 30MHz to 1GHz, Antenna Vertical)

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB μ V/m)	Antenna	Verdict
143.55	32.51	120.000	100.0	43.50	Vertical	Pass

For 1GHz to 25GHz

GFSK Mode:

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (0CH_2402MHz)											
No.	Frequency (MHz)	Emssion Level		Limit (dBUV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	104.49	PK	/	/	1.00 H	112	107.89	28.3	4.90	-36.6
1	*2402.00	97.72	AV	/	/	1.00 H	112	101.12	28.3	4.90	-36.6
2	4804.00	48.31	PK	74.00	25.69	1.00 H	254	45.11	32.7	7.00	-36.5
2	4804.00	41.84	AV	54.00	12.16	1.00 H	254	38.64	32.7	7.00	-36.5
3	7206.00	49.79	PK	74.00	24.21	1.00 H	104	40.39	35.8	8.90	-35.3
3	7206.00	44.39	AV	54.00	9.61	1.00 H	104	34.99	35.8	8.90	-35.3
4	9608.00	48.80	PK	74.00	25.20	1.00 H	10	36.20	37.2	10.20	-34.8
4	9608.00	45.18	AV	54.00	8.82	1.00 H	10	32.58	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (0CH_2402MHz)

No.	Frequency (MHz)	Emssion Level	Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	103.53 PK	/	/	1.00 V	84	106.93	28.3	4.90	-36.6
1	*2402.00	95.43 AV	/	/	1.00 V	84	98.83	28.3	4.90	-36.6
2	4804.00	48.45 PK	74.00	25.55	1.00 V	109	45.25	32.7	7.00	-36.5
2	4804.00	45.00 AV	54.00	9.00	1.00 V	109	41.80	32.7	7.00	-36.5
3	7206.00	49.44 PK	74.00	24.56	1.00 V	22	40.04	35.8	8.90	-35.3
3	7206.00	42.75 AV	54.00	11.25	1.00 V	22	33.35	35.8	8.90	-35.3
4	9608.00	50.84 PK	74.00	23.16	1.00 V	323	38.24	37.2	10.20	-34.8
4	9608.00	44.66 AV	54.00	9.34	1.00 V	323	32.06	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (39CH_2441MHz)

No.	Frequency (MHz)	Emssion Level	Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2441.00	104.73 PK	/	/	1.00 H	15	107.93	28.3	5.10	-36.6
1	*2441.00	98.41 AV	/	/	1.00 H	15	101.61	28.3	5.10	-36.6
2	4882.00	46.71 PK	74.00	27.29	1.00 H	28	43.31	32.3	7.60	-36.5
2	4882.00	42.55 AV	54.00	11.45	1.00 H	28	39.15	32.3	7.60	-36.5
3	7323.00	51.66 PK	74.00	22.34	1.00 H	39	42.26	36.1	8.60	-35.3
3	7323.00	45.92 AV	54.00	8.08	1.00 H	39	36.52	36.1	8.60	-35.3
4	9764.00	50.18 PK	74.00	23.82	1.00 H	205	37.58	37.2	10.20	-34.8
4	9764.00	44.98 AV	54.00	9.02	1.00 H	205	32.38	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (39CH_2441MHz)

No.	Frequency (MHz)	Emssion Level	Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2441.00	104.64 PK	/	/	1.00 V	87	107.84	28.3	5.10	-36.6
1	*2441.00	96.75 AV	/	/	1.00 V	87	99.95	28.3	5.10	-36.6
2	4882.00	47.81 PK	74.00	26.19	1.00 V	112	44.41	32.3	7.60	-36.5
2	4882.00	41.70 AV	54.00	12.30	1.00 V	112	38.30	32.3	7.60	-36.5
3	7323.00	54.23 PK	74.00	19.77	1.00 V	91	44.83	36.1	8.60	-35.3
3	7323.00	46.74 AV	54.00	7.26	1.00 V	91	37.34	36.1	8.60	-35.3
4	9764.00	49.41 PK	74.00	24.59	1.00 V	336	36.81	37.2	10.20	-34.8
4	9764.00	44.54 AV	54.00	9.46	1.00 V	336	31.94	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (78CH_2480MHz)

No.	Frequency (MHz)	Emission Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	105.43	PK	/	/	1.00 H	15	108.73	28.6	4.70	-36.6
1	*2480.00	98.08	AV	/	/	1.00 H	15	101.38	28.6	4.70	-36.6
2	4960.00	50.86	PK	74.00	23.14	1.00 H	99	47.06	33	7.00	-36.2
2	4960.00	43.67	AV	54.00	10.33	1.00 H	99	39.87	33	7.00	-36.2
3	7440.00	49.80	PK	74.00	24.20	1.00 H	215	40.40	36.2	8.50	-35.3
3	7440.00	43.35	AV	54.00	10.65	1.00 H	215	33.95	36.2	8.50	-35.3
4	9920.00	50.66	PK	74.00	23.34	1.00 H	9	38.06	37.2	10.20	-34.8
4	9920.00	41.52	AV	54.00	12.48	1.00 H	9	28.92	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (78CH_2480MHz)

No.	Frequency (MHz)	Emission Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	104.99	PK	/	/	1.00 V	29	108.29	28.6	4.70	-36.6
1	*2480.00	97.77	AV	/	/	1.00 V	29	101.07	28.6	4.70	-36.6
2	4960.00	50.11	PK	74.00	23.89	1.00 V	114	46.31	33	7.00	-36.2
2	4960.00	48.26	AV	54.00	5.74	1.00 V	114	44.46	33	7.00	-36.2
3	7440.00	50.01	PK	74.00	23.99	1.00 V	87	40.61	36.2	8.50	-35.3
3	7440.00	44.47	AV	54.00	9.53	1.00 V	87	35.07	36.2	8.50	-35.3
4	9920.00	49.91	PK	74.00	24.09	1.00 V	168	37.31	37.2	10.20	-34.8
4	9920.00	45.09	AV	54.00	8.91	1.00 V	168	32.49	37.2	10.20	-34.8

$\pi/4$ -DQPSK Mode:

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (0CH_2402MHz)

No.	Frequency (MHz)	Emission Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	104.35	PK	/	/	1.00 H	106	107.75	28.3	4.90	-36.6
1	*2402.00	96.53	AV	/	/	1.00 H	106	99.93	28.3	4.90	-36.6
2	4804.00	50.47	PK	74.00	23.53	1.00 H	88	47.27	32.7	7.00	-36.5
2	4804.00	43.09	AV	54.00	10.91	1.00 H	88	39.89	32.7	7.00	-36.5
3	7206.00	51.54	PK	74.00	22.46	1.00 H	305	42.14	35.8	8.90	-35.3
3	7206.00	44.13	AV	54.00	9.87	1.00 H	305	34.73	35.8	8.90	-35.3
4	9608.00	50.22	PK	74.00	23.78	1.00 H	1	37.62	37.2	10.20	-34.8
4	9608.00	46.31	AV	54.00	7.69	1.00 H	1	33.71	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (0CH_2402MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	104.56	PK	/	/	1.00 V	7	107.96	28.3	4.90	-36.6
1	*2402.00	96.08	AV	/	/	1.00 V	7	99.48	28.3	4.90	-36.6
2	4804.00	50.77	PK	74.00	23.23	1.00 V	118	47.57	32.7	7.00	-36.5
2	4804.00	44.41	AV	54.00	9.59	1.00 V	118	41.21	32.7	7.00	-36.5
3	7206.00	50.57	PK	74.00	23.43	1.00 V	215	41.17	35.8	8.90	-35.3
3	7206.00	45.38	AV	54.00	8.62	1.00 V	215	35.98	35.8	8.90	-35.3
4	9608.00	49.34	PK	74.00	24.66	1.00 V	43	36.74	37.2	10.20	-34.8
4	9608.00	45.92	AV	54.00	8.08	1.00 V	43	33.32	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (39CH_2441MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2441.00	104.82	PK	/	/	1.00 H	196	108.02	28.3	5.10	-36.6
1	*2441.00	98.86	AV	/	/	1.00 H	196	102.06	28.3	5.10	-36.6
2	4882.00	52.56	PK	74.00	21.44	1.00 H	75	49.16	32.3	7.60	-36.5
2	4882.00	46.34	AV	54.00	7.66	1.00 H	75	42.94	32.3	7.60	-36.5
3	7323.00	50.65	PK	74.00	23.35	1.00 H	178	41.25	36.1	8.60	-35.3
3	7323.00	45.12	AV	54.00	8.88	1.00 H	178	35.72	36.1	8.60	-35.3
4	9764.00	52.39	PK	74.00	21.61	1.00 H	150	39.79	37.2	10.20	-34.8
4	9764.00	45.64	AV	54.00	8.36	1.00 H	150	33.04	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (39CH_2441MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2441.00	104.85	PK	/	/	1.00 V	357	108.05	28.3	5.10	-36.6
1	*2441.00	95.19	AV	/	/	1.00 V	357	98.39	28.3	5.10	-36.6
2	4882.00	51.59	PK	74.00	22.41	1.00 V	21	48.19	32.3	7.60	-36.5
2	4882.00	47.15	AV	54.00	6.85	1.00 V	21	43.75	32.3	7.60	-36.5
3	7323.00	53.69	PK	74.00	20.31	1.00 V	95	44.29	36.1	8.60	-35.3
3	7323.00	46.84	AV	54.00	7.16	1.00 V	95	37.44	36.1	8.60	-35.3
4	9764.00	54.98	PK	74.00	19.02	1.00 V	327	42.38	37.2	10.20	-34.8
4	9764.00	48.48	AV	54.00	5.52	1.00 V	327	35.88	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (78CH_2480MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	105.83	PK	/	/	1.00 H	17	109.13	28.6	4.70	-36.6
1	*2480.00	95.89	AV	/	/	1.00 H	17	99.19	28.6	4.70	-36.6
2	4960.00	51.40	PK	74.00	22.60	1.00 H	209	47.60	33	7.00	-36.2
2	4960.00	44.28	AV	54.00	9.72	1.00 H	209	40.48	33	7.00	-36.2
3	7440.00	53.41	PK	74.00	20.59	1.00 H	188	44.01	36.2	8.50	-35.3
3	7440.00	44.74	AV	54.00	9.26	1.00 H	188	35.34	36.2	8.50	-35.3
4	9920.00	51.86	PK	74.00	22.14	1.00 H	34	39.26	37.2	10.20	-34.8
4	9920.00	43.72	AV	54.00	10.28	1.00 H	34	31.12	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (78CH_2480MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	105.52	PK	/	/	1.00 V	59	108.82	28.6	4.70	-36.6
1	*2480.00	93.71	AV	/	/	1.00 V	59	97.01	28.6	4.70	-36.6
2	4960.00	50.95	PK	74.00	23.05	1.00 V	102	47.15	33	7.00	-36.2
2	4960.00	43.86	AV	54.00	10.14	1.00 V	102	40.06	33	7.00	-36.2
3	7440.00	55.09	PK	74.00	18.91	1.00 V	134	45.69	36.2	8.50	-35.3
3	7440.00	43.79	AV	54.00	10.21	1.00 V	134	34.39	36.2	8.50	-35.3
4	9920.00	50.07	PK	74.00	23.93	1.00 V	304	37.47	37.2	10.20	-34.8
4	9920.00	43.91	AV	54.00	10.09	1.00 V	304	31.31	37.2	10.20	-34.8

8-DPSK Mode:

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (0CH_2402MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2402.00	105.53	PK	/	/	1.00 H	20	108.93	28.3	4.90	-36.6
1	*2402.00	93.78	AV	/	/	1.00 H	20	97.18	28.3	4.90	-36.6
2	4804.00	51.90	PK	74.00	22.10	1.00 H	309	48.70	32.7	7.00	-36.5
2	4804.00	43.56	AV	54.00	10.44	1.00 H	309	40.36	32.7	7.00	-36.5
3	7206.00	51.00	PK	74.00	23.00	1.00 H	164	41.60	35.8	8.90	-35.3
3	7206.00	44.86	AV	54.00	9.14	1.00 H	164	35.46	35.8	8.90	-35.3

4	9608.00	50.10	PK	74.00	23.90	1.00 H	199	37.50	37.2	10.20	-34.8
4	9608.00	43.70	AV	54.00	10.30	1.00 H	199	31.10	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (0CH_2402MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre- amplifier
1	*2402.00	104.85	PK	/	/	1.00 V	51	108.25	28.3	4.90	-36.6
1	*2402.00	92.75	AV	/	/	1.00 V	51	96.15	28.3	4.90	-36.6
2	4804.00	50.45	PK	74.00	23.55	1.00 V	176	47.25	32.7	7.00	-36.5
2	4804.00	43.69	AV	54.00	10.31	1.00 V	176	40.49	32.7	7.00	-36.5
3	7206.00	51.82	PK	74.00	22.18	1.00 V	85	42.42	35.8	8.90	-35.3
3	7206.00	43.60	AV	54.00	10.40	1.00 V	85	34.20	35.8	8.90	-35.3
4	9608.00	50.63	PK	74.00	23.37	1.00 V	332	38.03	37.2	10.20	-34.8
4	9608.00	44.83	AV	54.00	9.17	1.00 V	332	32.23	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (39CH_2441MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre- amplifier
1	*2441.00	105.74	PK	/	/	1.00 H	57	108.94	28.3	5.10	-36.6
1	*2441.00	97.80	AV	/	/	1.00 H	57	101.00	28.3	5.10	-36.6
2	4882.00	49.77	PK	74.00	24.23	1.00 H	169	46.37	32.3	7.60	-36.5
2	4882.00	42.82	AV	54.00	11.18	1.00 H	169	39.42	32.3	7.60	-36.5
3	7323.00	51.17	PK	74.00	22.83	1.00 H	76	41.77	36.1	8.60	-35.3
3	7323.00	44.83	AV	54.00	9.17	1.00 H	76	35.43	36.1	8.60	-35.3
4	9764.00	51.84	PK	74.00	22.16	1.00 H	111	39.24	37.2	10.20	-34.8
4	9764.00	44.78	AV	54.00	9.22	1.00 H	111	32.18	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (39CH_2441MHz)

No.	Frequency (MHz)	Emssion Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre- amplifier
1	*2441.00	105.09	PK	/	/	1.00 V	61	108.29	28.3	5.10	-36.6
1	*2441.00	93.59	AV	/	/	1.00 V	61	96.79	28.3	5.10	-36.6
2	4882.00	50.55	PK	74.00	23.45	1.00 V	175	47.15	32.3	7.60	-36.5
2	4882.00	44.83	AV	54.00	9.17	1.00 V	175	41.43	32.3	7.60	-36.5
3	7323.00	51.45	PK	74.00	22.55	1.00 V	34	42.05	36.1	8.60	-35.3

3	7323.00	43.51	AV	54.00	10.49	1.00 V	34	34.11	36.1	8.60	-35.3
4	9764.00	51.64	PK	74.00	22.36	1.00 V	309	39.04	37.2	10.20	-34.8
4	9764.00	45.77	AV	54.00	8.23	1.00 V	309	33.17	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (78CH_2480MHz)

No.	Frequency (MHz)	Emission Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	105.54	PK	/	/	1.00 H	83	108.84	28.6	4.70	-36.6
1	*2480.00	97.63	AV	/	/	1.00 H	83	100.93	28.6	4.70	-36.6
2	4960.00	51.94	PK	74.00	22.06	1.00 H	174	48.14	33	7.00	-36.2
2	4960.00	45.65	AV	54.00	8.35	1.00 H	174	41.85	33	7.00	-36.2
3	7440.00	52.95	PK	74.00	21.05	1.00 H	152	43.55	36.2	8.50	-35.3
3	7440.00	47.63	AV	54.00	6.37	1.00 H	152	38.23	36.2	8.50	-35.3
4	9920.00	51.28	PK	74.00	22.72	1.00 H	337	38.68	37.2	10.20	-34.8
4	9920.00	45.64	AV	54.00	8.36	1.00 H	337	33.04	37.2	10.20	-34.8

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (78CH_2480MHz)

No.	Frequency (MHz)	Emission Level		Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Antenna Factor	Cable Factor	Pre-amplifier
1	*2480.00	104.44	PK	/	/	1.00 V	118	107.74	28.6	4.70	-36.6
1	*2480.00	95.68	AV	/	/	1.00 V	118	98.98	28.6	4.70	-36.6
2	4960.00	50.02	PK	74.00	23.98	1.00 V	92	46.22	33	7.00	-36.2
2	4960.00	42.46	AV	54.00	11.54	1.00 V	92	38.66	33	7.00	-36.2
3	7440.00	51.02	PK	74.00	22.98	1.00 V	13	41.62	36.2	8.50	-35.3
3	7440.00	43.64	AV	54.00	10.36	1.00 V	13	34.24	36.2	8.50	-35.3
4	9920.00	52.62	PK	74.00	21.38	1.00 V	67	40.02	37.2	10.20	-34.8
4	9920.00	43.21	AV	54.00	10.79	1.00 V	67	30.61	37.2	10.20	-34.8

- REMARKS:**
1. Emission level (dBuV/m) = Raw Value (dBuV) + Antenna Factor (dB/m) + Cable Factor (dB) + Pre-amplifier Factor
 2. The other emission levels were very low against the limit.
 3. The other emission levels were very low against the limit.
 4. Margin value = Limit value - Emission level.
 5. The limit value is defined as per 15.247
 6. “ * “ : Fundamental frequency

**** END OF REPORT ****