



Report No.: SET2013-02640

RF TEST REPORT

Report No.: SET2013-02640

Product Name: 3D Bluetooth Glasses

FCC ID: A4GESG806

Model No. : ESG806, GX21AB

Brand Name: N.A

Applicant: ESTAR DISPLAY TECHCO.,LTD

Address: 16F Hall A, GDC Building, 9 Gaoxin Central Avenue 3rd,
Nanshan District, Shenzhen, China

Issued by: CCIC-SET

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

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Test Report

Product Name : 3D Bluetooth Glasses

Model No. : ESG806, GX21AB

Trade Name : N.A

Brand Name..... : N.A

Applicant : ESTAR DISPLAY TECHCO., LTD

Applicant Address : 16F Hall A, GDC Building, 9 Gaoxin Central Avenue 3rd,
Nanshan District, Shenzhen, China

Manufacturer : ESTAR DISPLAY TECHCO., LTD

Manufacturer Address : 16F Hall A, GDC Building, 9 Gaoxin Central Avenue 3rd,
Nanshan District, Shenzhen, 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 :
Mo Huina July 05, 2013
Mo Huina, Test Engineer

Reviewed by :
Shuangwen Zhang July 5, 2013
Shuangwen Zhang, Senior Engineer

Approved by :
Wu Li'an July 5, 2013
Wu Li'an, Manager

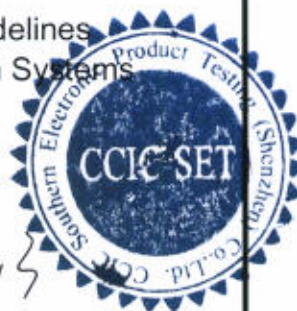


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Change History		
Issue	Date	Reason for change
1.0	July 5, 2013	First edition

1. General Information

1.1. EUT Description

EUT Type: 3D Bluetooth Glasses
Serial No.....: (n.a, marked #1 by test site)
Hardware Version: N.A
Software Version: N.A
Applicant: ESTAR DISPLAY TECH CO., LTD
16F Hall A, GDC Building, 9 Gaoxin Central Avenue 3rd, Nanshan District, Shenzhen, China
Manufacturer: ESTAR DISPLAY TECH CO., LTD
16F Hall A, GDC Building, 9 Gaoxin Central Avenue 3rd, Nanshan District, Shenzhen, China
Frequency Range.....: The frequency range used is 2402MHz - 2480MHz (79 channels, at intervals of 1MHz);
The frequency block is 2400MHz to 2483.5MHz.
Modulation Type: Bluetooth: FHSS (GFSK)
Antenna Type.....: PCB Antenna
Antenna Gain.....: 1.87dBi

Note 1: The EUT is a 3D Bluetooth Glasses, 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 a Connection command from the other BT devices.

b. When receiving the signal from the other BT devices, The EUT transmit a response signal.

c. The other devices receive the response signal and recognize it, then send a connection 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 a same pseudo randomly ordered list of hopping frequencies, the hopping rate is 1600 times per second. This device conforms to the criteria in FCC Public Notice DA 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, DH5 package is largest, we are testing DH5 in the document.

Note 5: The antenna of EUT is designed with permanent attachment and no consideration of replacement, it is printed on the circuit board with a maximum gain of 1.87dBi, and it is used to radiate the RF emissions

1.2. 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

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 C63.4 2009.

1.3. Facilities and Accreditations

1.3.1. 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.

1.3.2. 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.

2.1.2. Result: Compliant

The antennas used for this product is PCB Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1.87dBi.

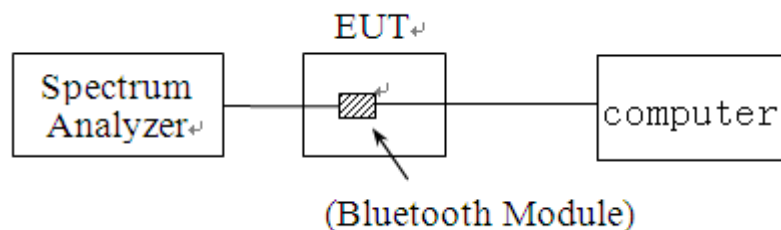
2.2. Number of Hopping Frequency

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. Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2013.06.10

The Cal. Interval was one year.

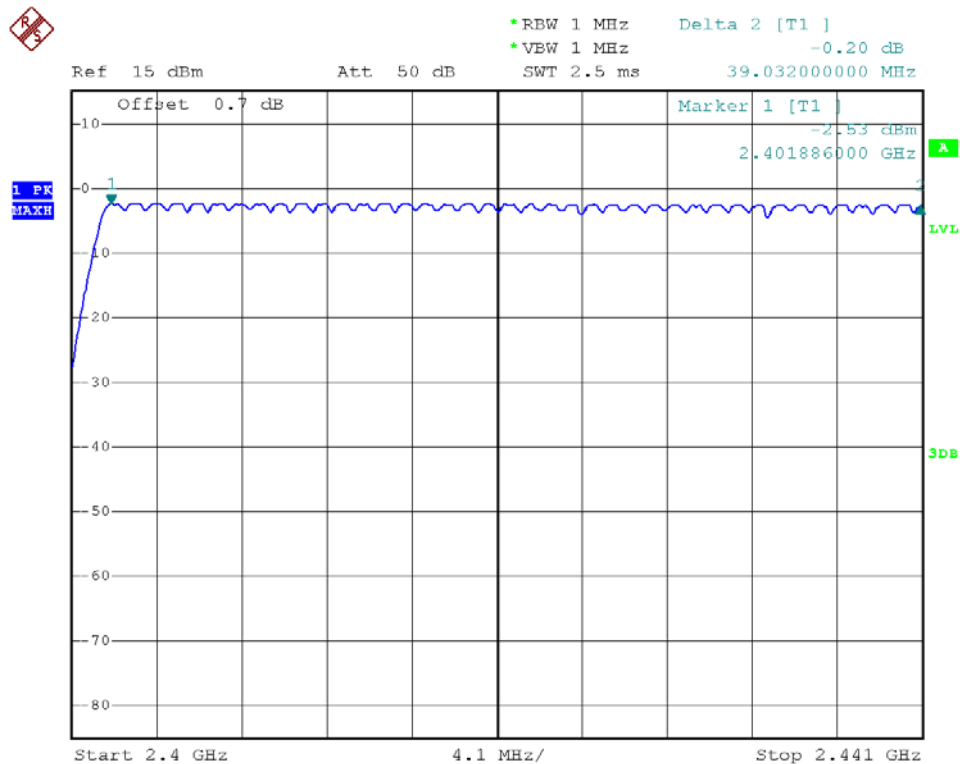
2.2.3. Test Result

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.

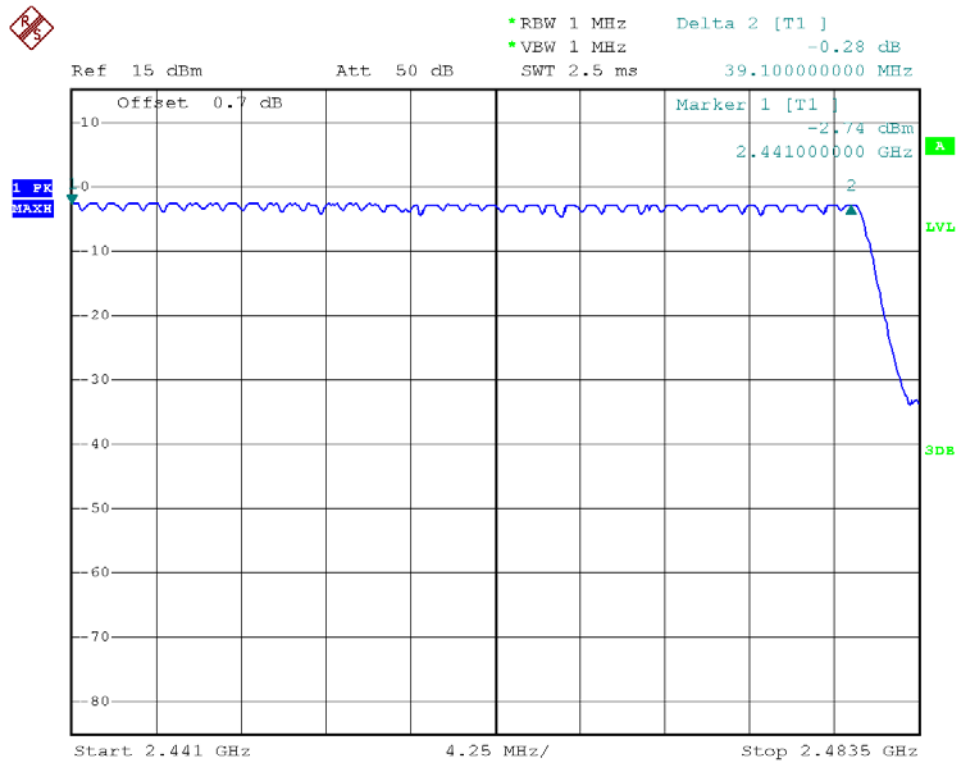
A. Test Verdict:

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Refer to Plot	Verdict
GFSK	2400 - 2483.5	79	15	Plot A/ PlotB	PASS

B. Test Plots:



(Plot A)



(Plot B)

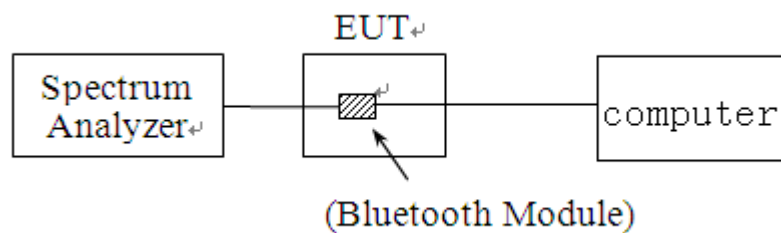
2.3. Peak Output Power

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. Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2013.06.10

The Cal. Interval was one year.

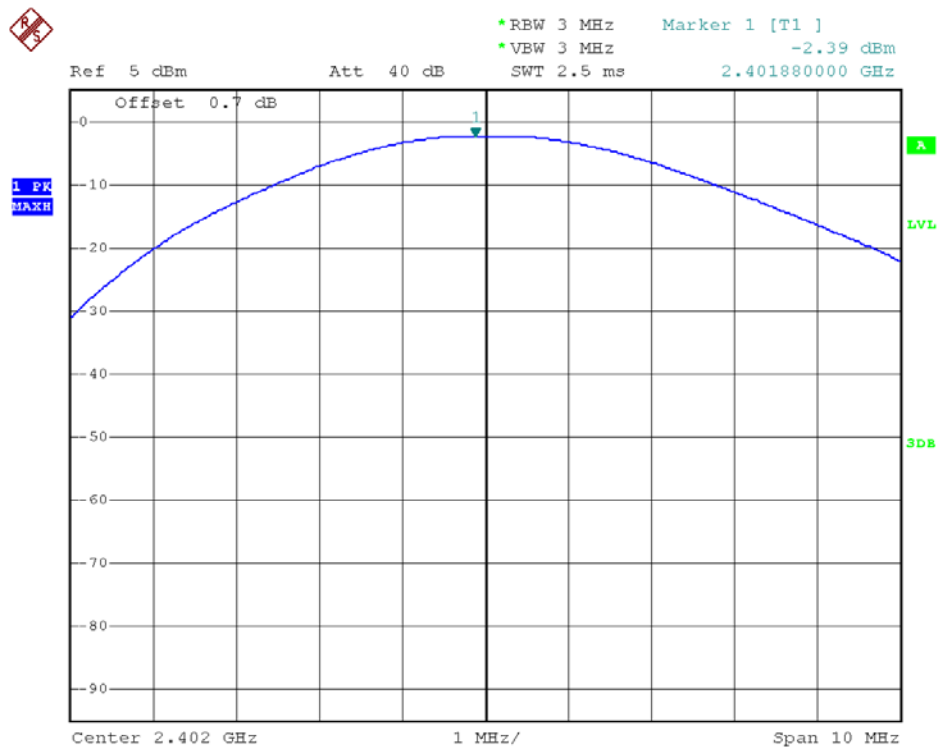
2.3.3. Test Result

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.

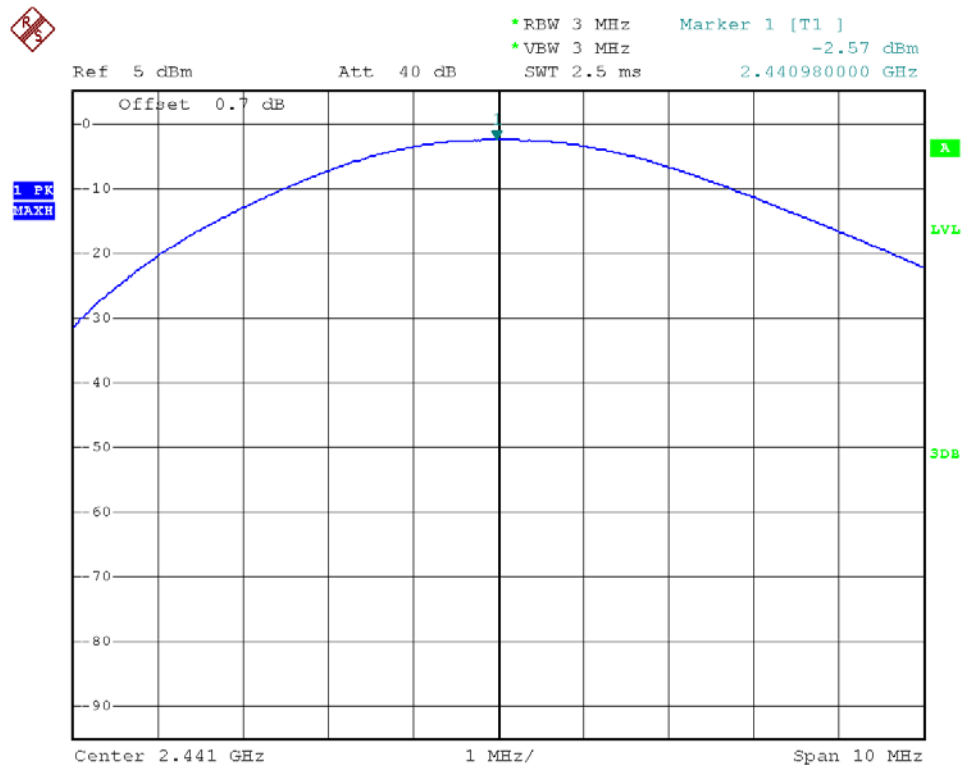
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict	Refer to Plot
		dBm	W	dBm	W		
0	2402	-2.39	0.000577	30	1	PASS	Plot A
39	2441	-2.57	0.000553			PASS	Plot B
78	2480	-2.81	0.000524			PASS	Plot C

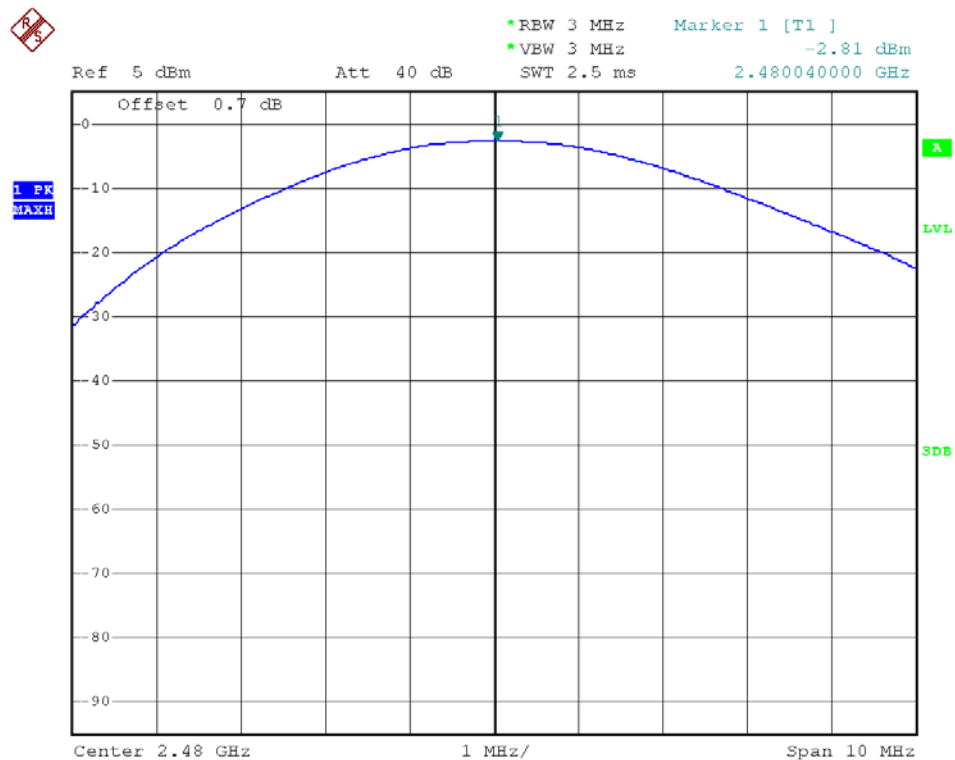
B. Test Plots::



(Plot A)



(Plot B)



(Plot C)

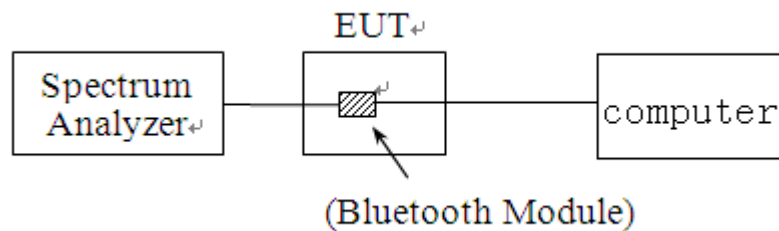
2.4. 20dB Bandwidth

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. Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2013.06.10

The Cal. Interval was one year.

2.4.1. 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

2.4.2. Test Result

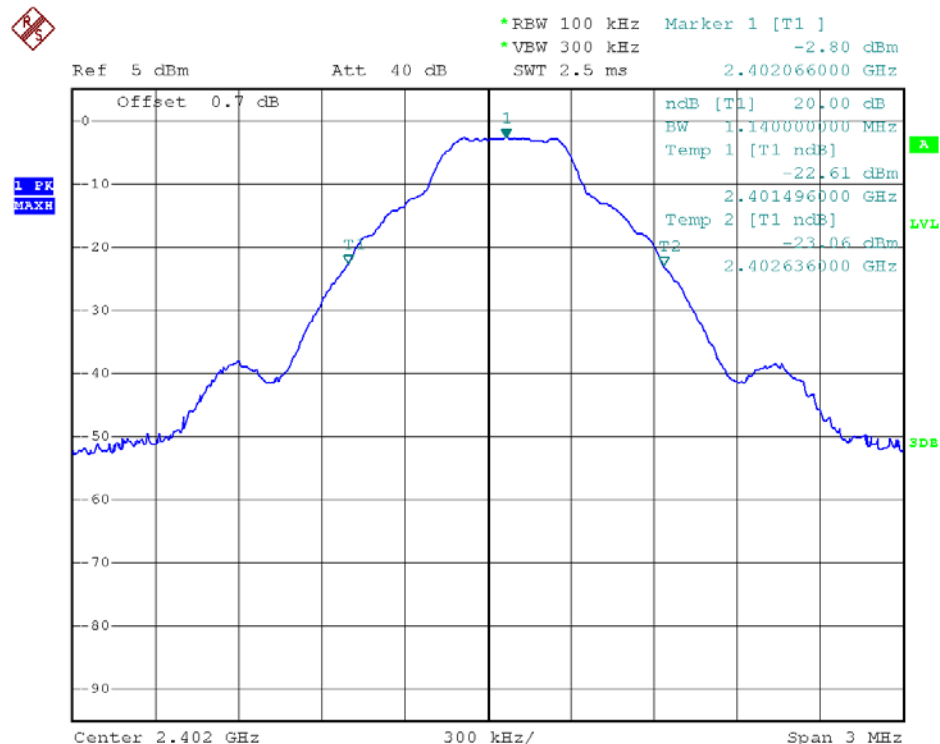
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

A. Test Verdict:

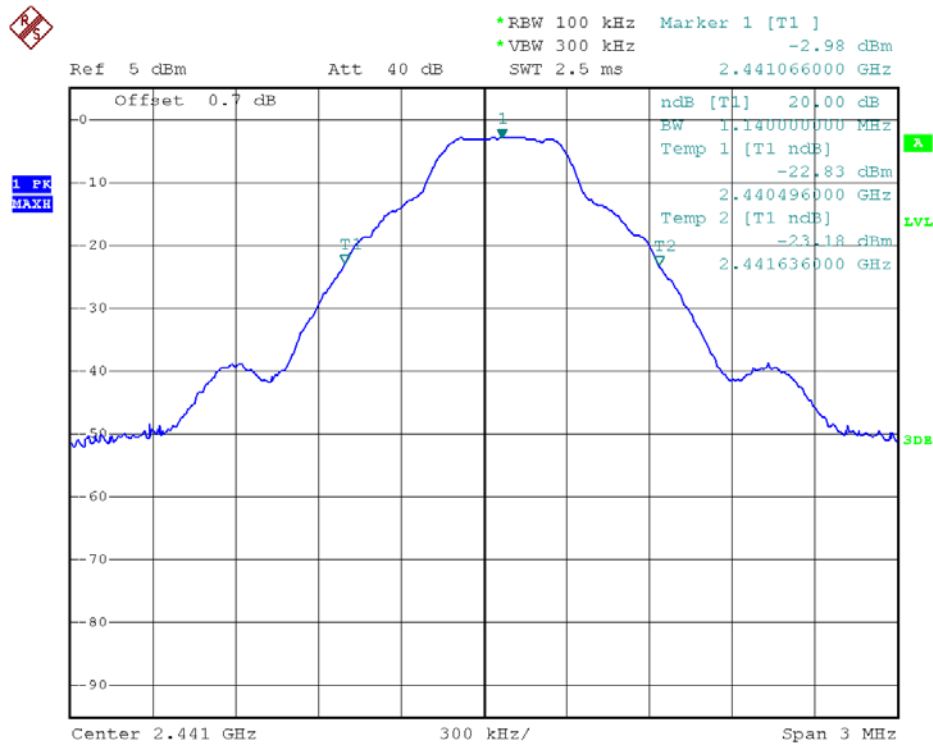
The maximum 20dB bandwidth measured is 1.14MHz according to the table below.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot
0	2402	1.14	Plot A
39	2441	1.14	Plot B
78	2480	1.14	Plot C

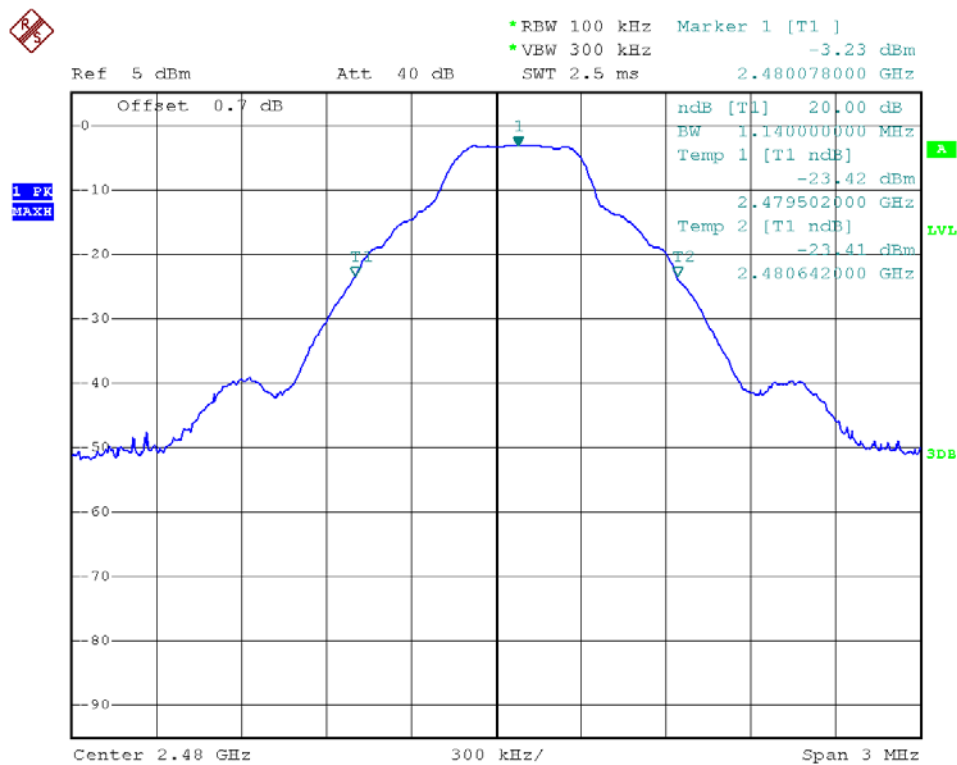
B. Test Plots:



(Plot A: Channel = 2402)



(Plot B: Channel = 2441)



(Plot C: Channel = 2480)

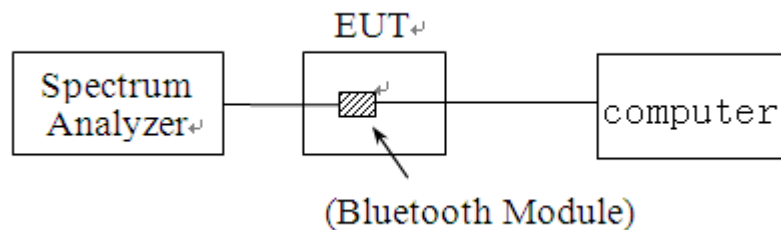
2.5. Carried Frequency Separation

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. Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2013.06.10

The Cal. Interval was one year.

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

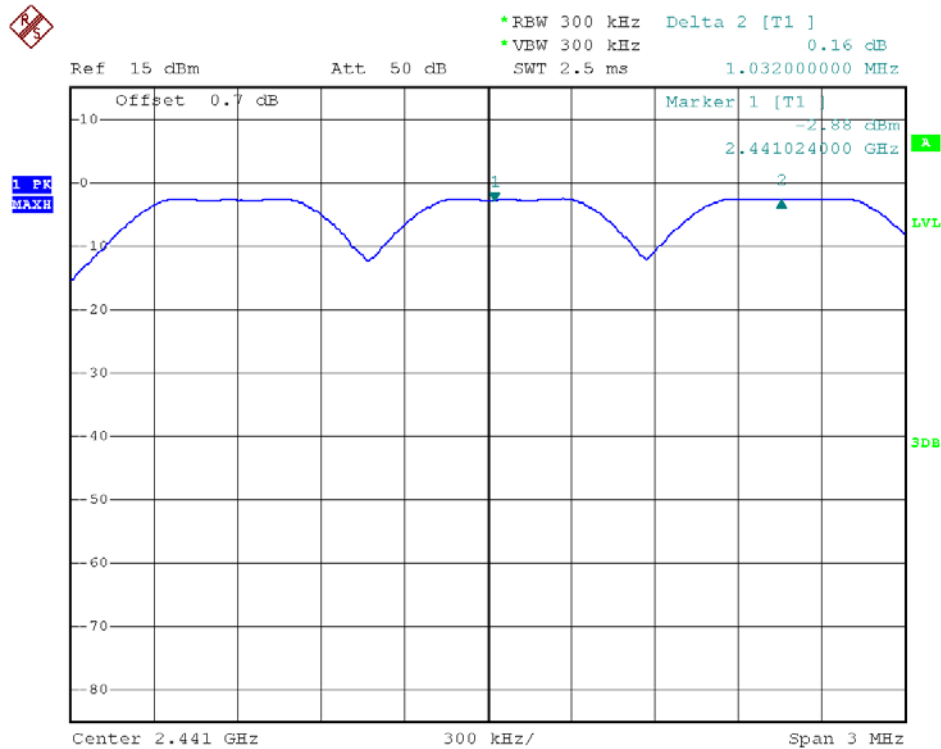
Trace = max hold

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 (1.14MHz for GFSK mode, refer to section 2.4.1), whichever is greater. So, the verdict is PASSING



(Plot A)

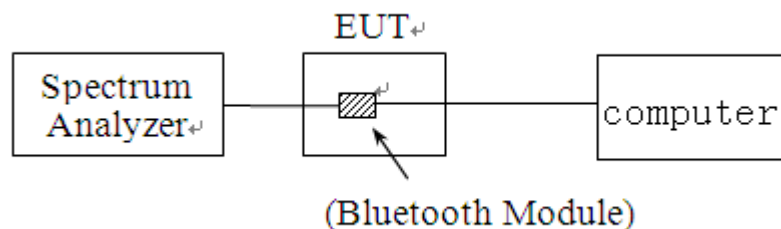
2.6. Time of Occupancy (Dwell time)

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 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.

2.6.3. 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):

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

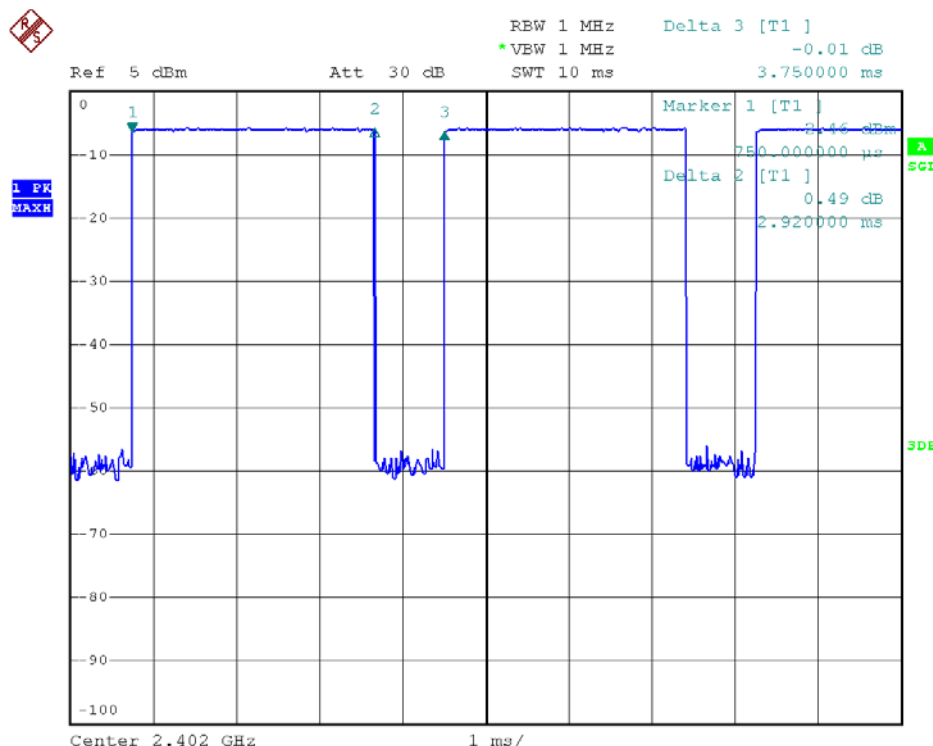
The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

A. Test Verdict:

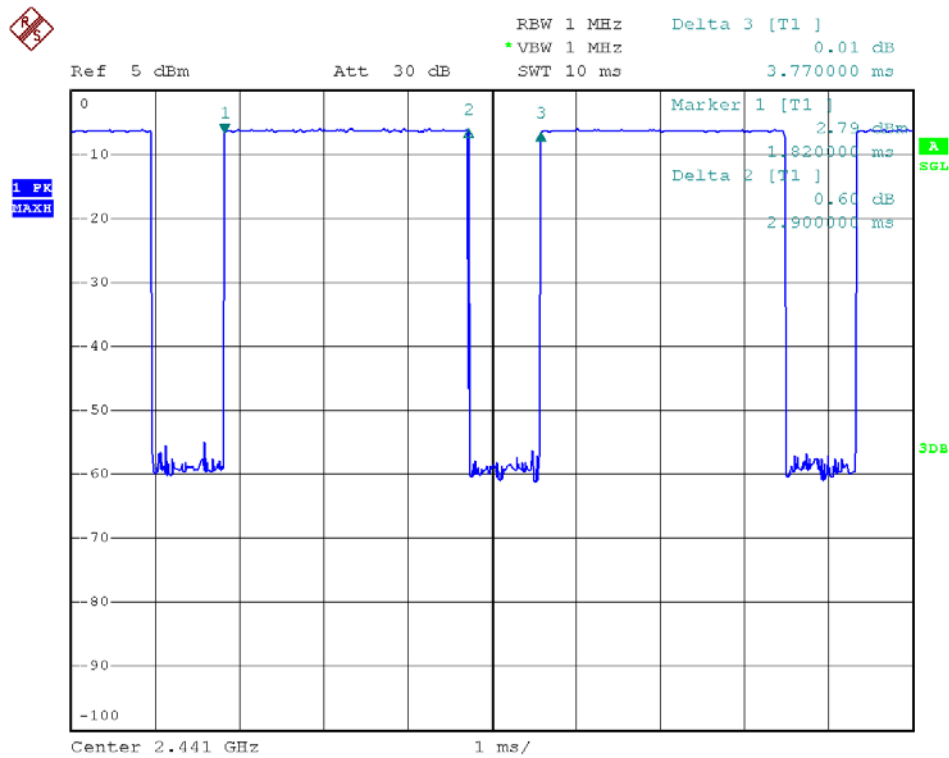
Channel	Frequency (MHz)	Pulse Time		Total of Dwell (ms)	Limit (ms)	Verdict
		ms	Refer to Plot			
0	2402	2.920	Plot A	309.334	400	PASS
39	2441	2.920	Plot B	311.468		PASS
78	2480	2.900	Plot C	309.334		PASS

Test Plots:

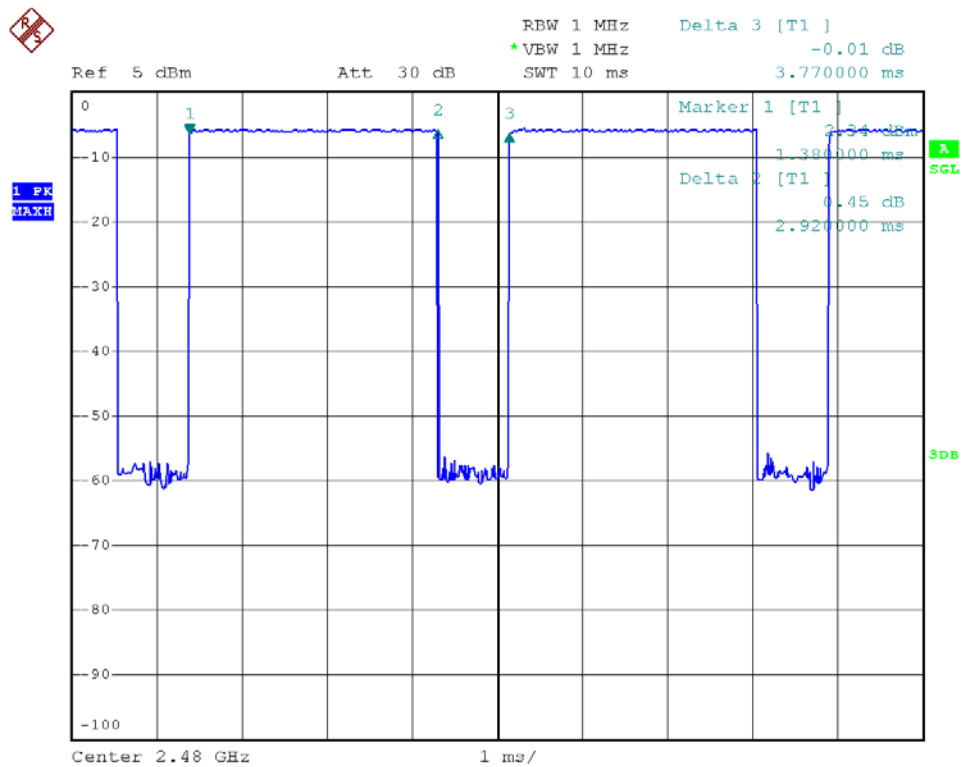
Note: the following plots record the Pulse Time of the Module carrier.



(Plot A: Channel = 2402)



(Plot B: Channel = 2441)



(Plot C: Channel = 2480)

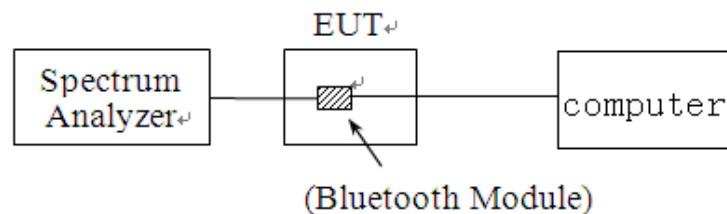
2.7. Conducted Spurious Emissions

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

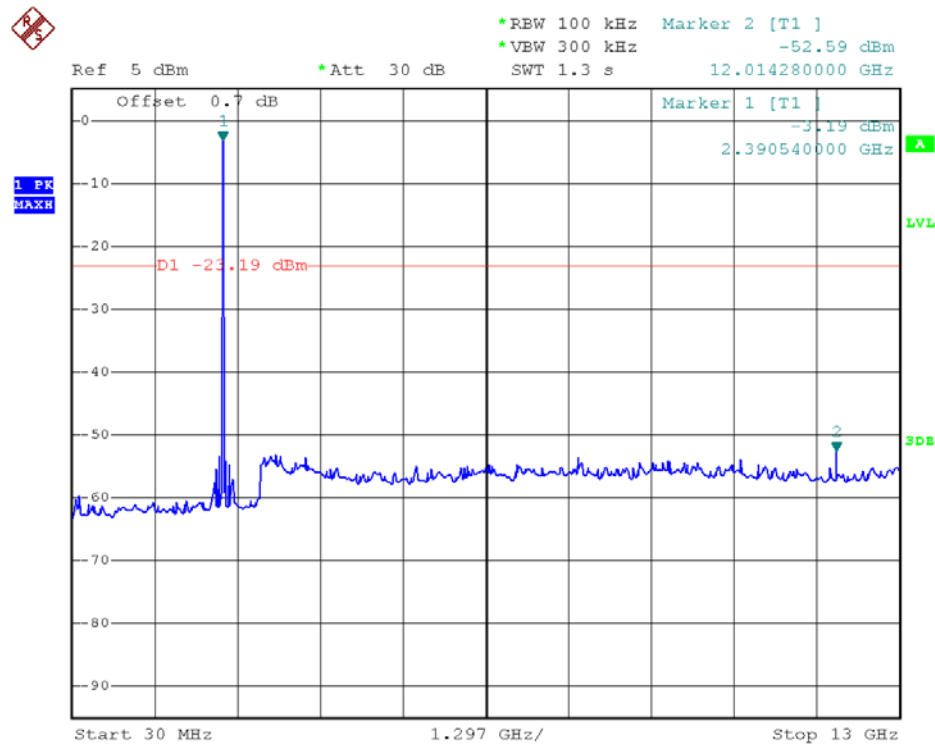
The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

A. Test Verdict:

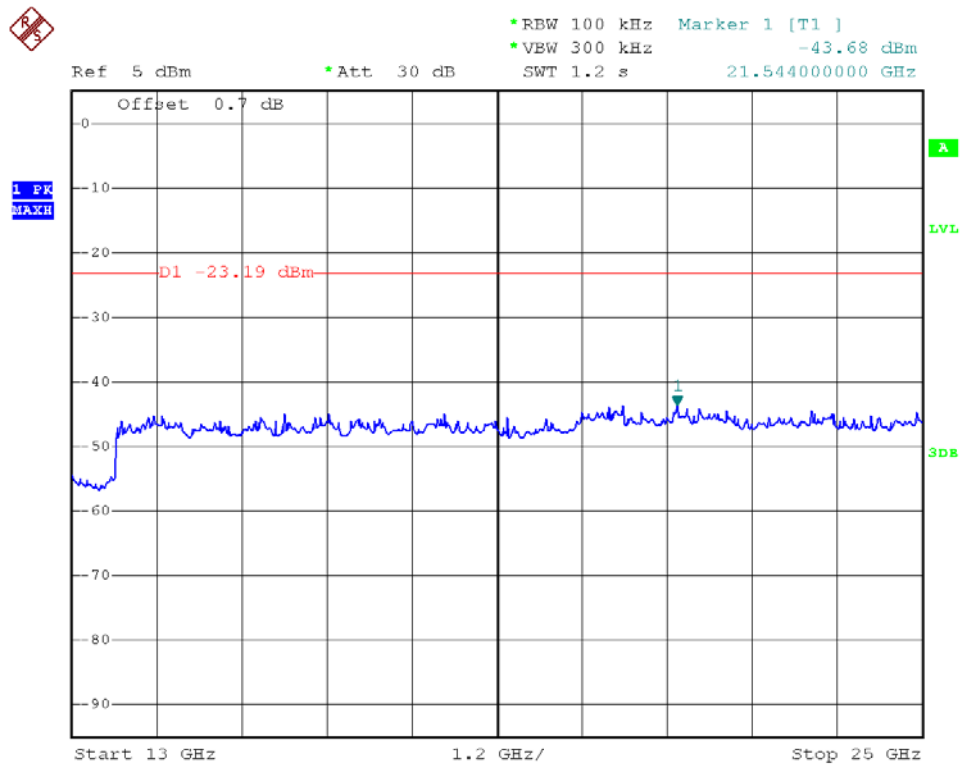
Channel	Frequency (MHz)	Measured Max. Out of Band EmissiondBm)	Refer to Plot	Limit (dBm)		Verdict
				Carrier Level	Calculated -20dBc Limit	
0	2402	-43.68	Plot A.2	-3.19	-23.19	PASS
39	2441	-44.30	Plot B.2	-3.21	-23.21	PASS
78	2480	-43.63	Plot C.2	-3.17	-23.17	PASS

B. Test Plots:

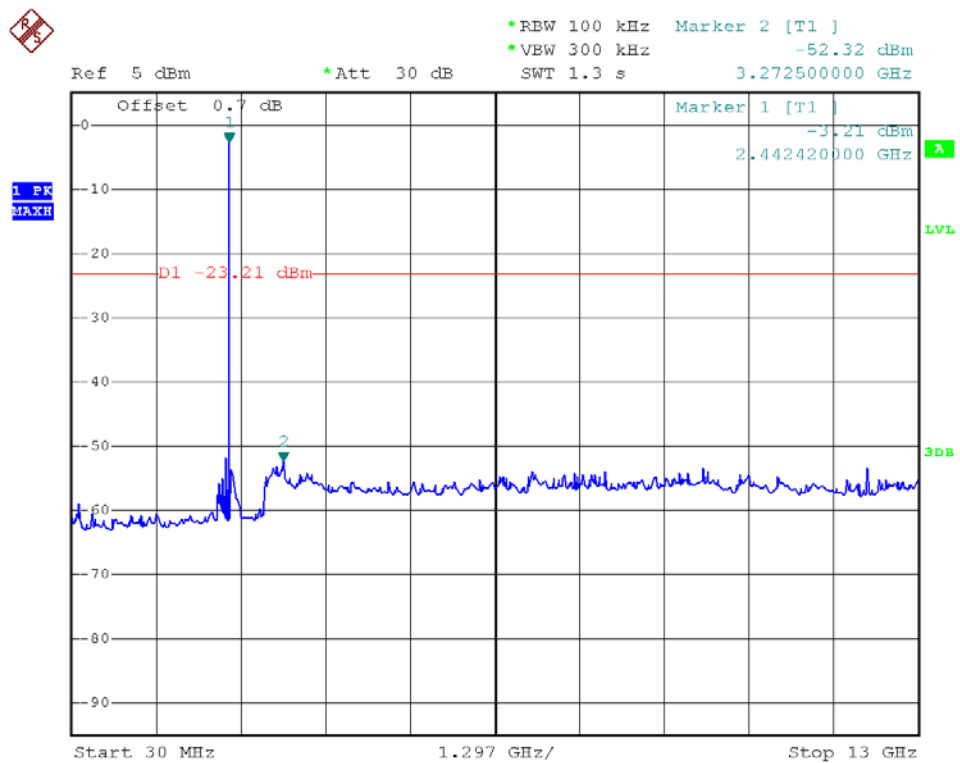
Note: the power of the Module transmitting frequency should be ignored.



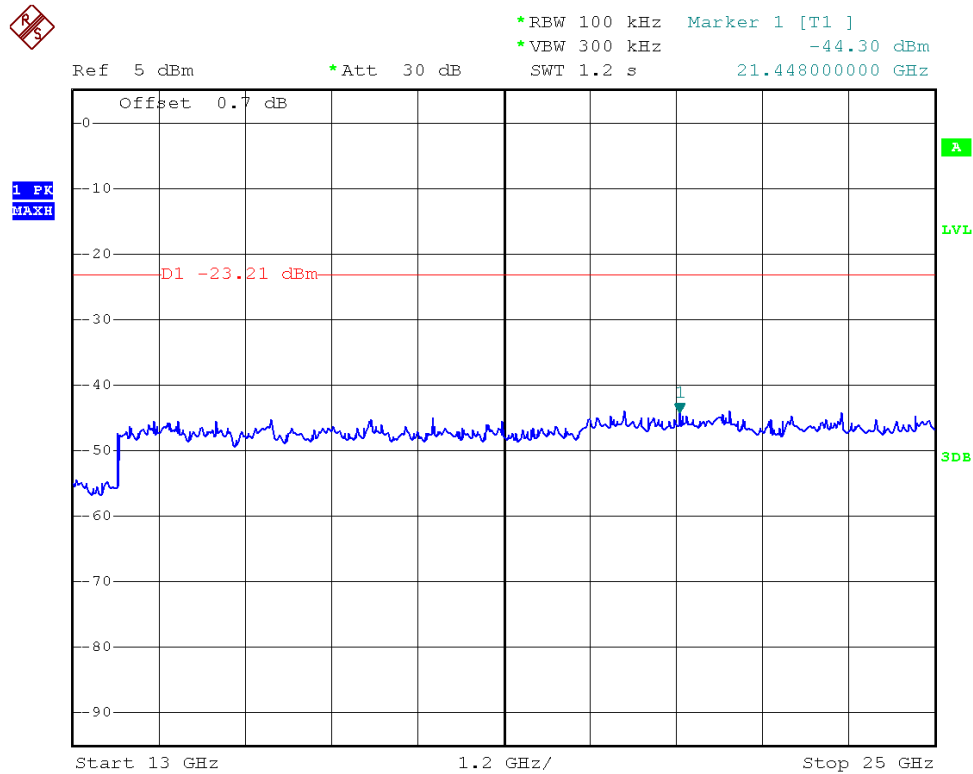
(Plot A.1: Channel = 0, 30MHz to 13GHz)



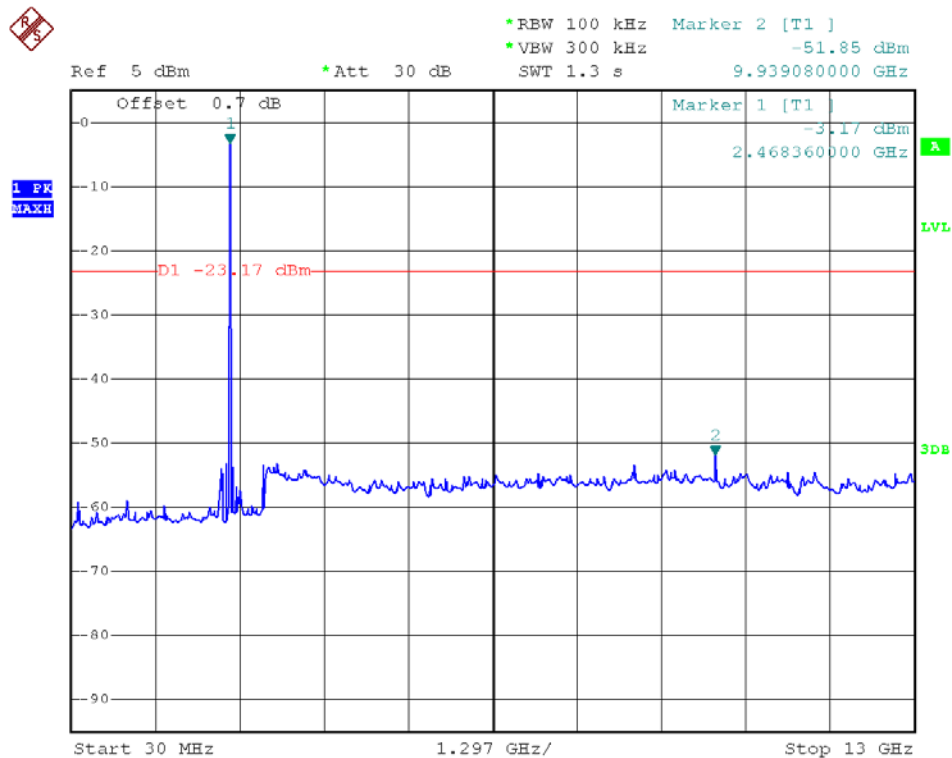
(Plot A.2: Channel = 0, 13GHz to 25GHz)



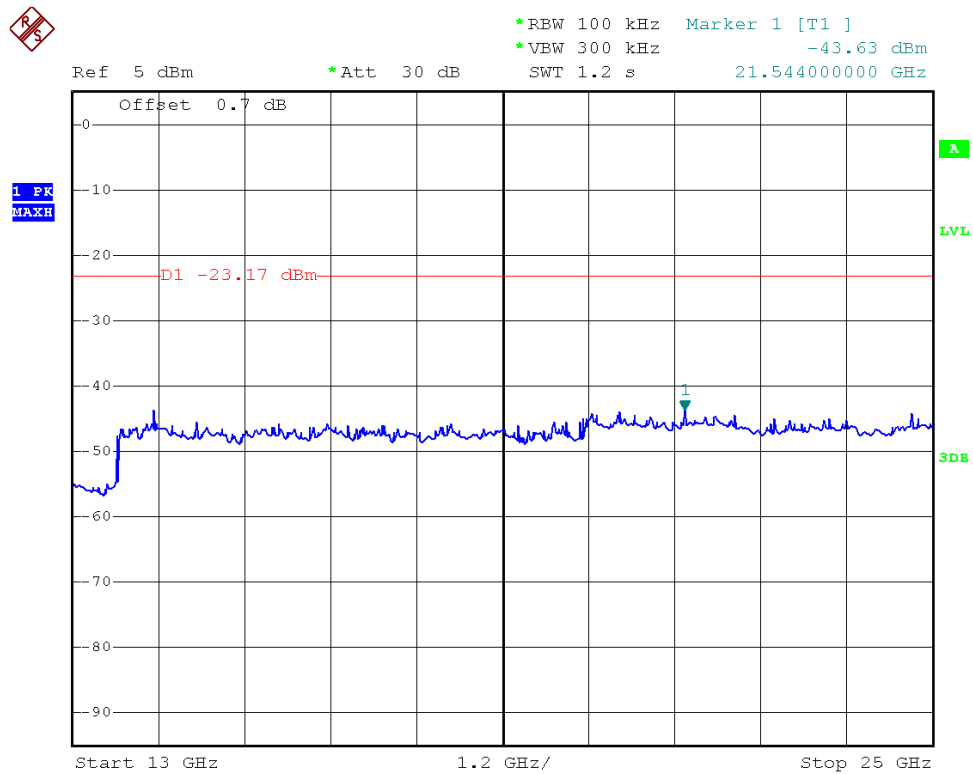
(Plot B.1: Channel = 39, 30MHz to 13GHz)



(Plot B.2: Channel = 39, 13GHz to 25GHz)



(Plot C.1: Channel = 78, 30MHz to 13GHz)



(Plot C.2: Channel = 78, 13GHz to 25GHz)

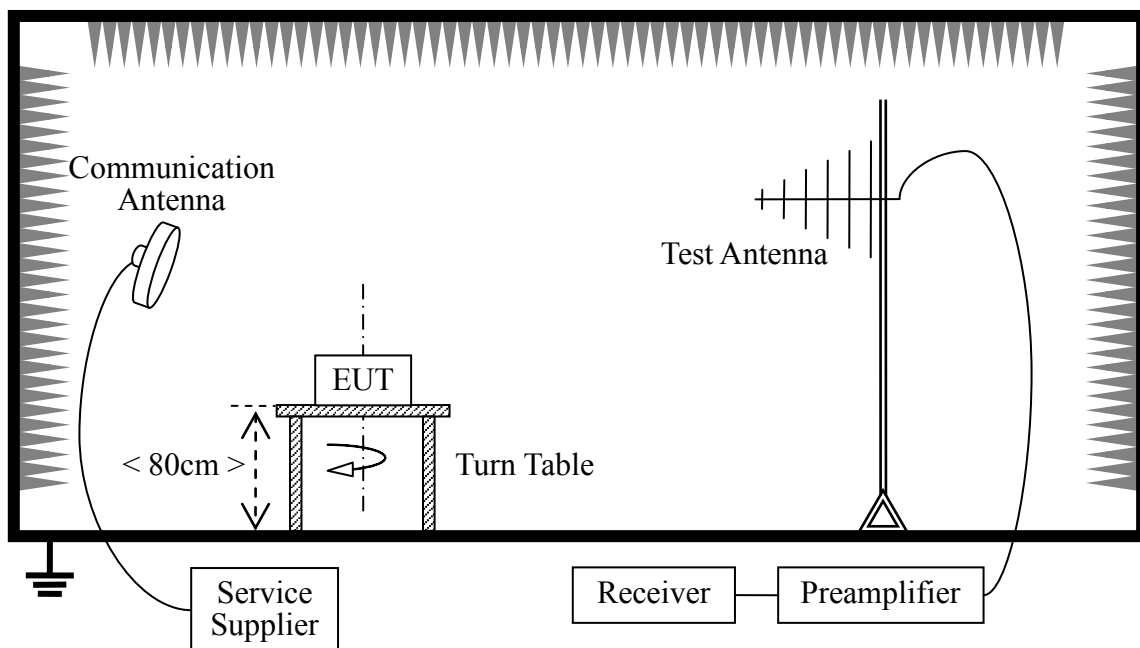
2.8. Band Edge

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. Date
Receiver	R&S	FSP40	1164.4391.40	2013.06.10
Full-Anechoic Chamber	Albatross	12.8m*6.8m*6.4m	A0412372	2013.06.10
Double ridge horn antenna	R&S	HF906	100150	2013.06.10

Description	Manufacturer	Model	Serial No.	Cal. Date
Ultra-wideband antenna	R&S	HL562	A0304224	2013.06.10
Ampilier 1G~18GHz	R&S	MITEQ AFS42-00101800	25-S-42	2013.06.10

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

RBW \geq 1% of the span

VBW \geq RBW

Sweep = auto

Detector function = peak /AV

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

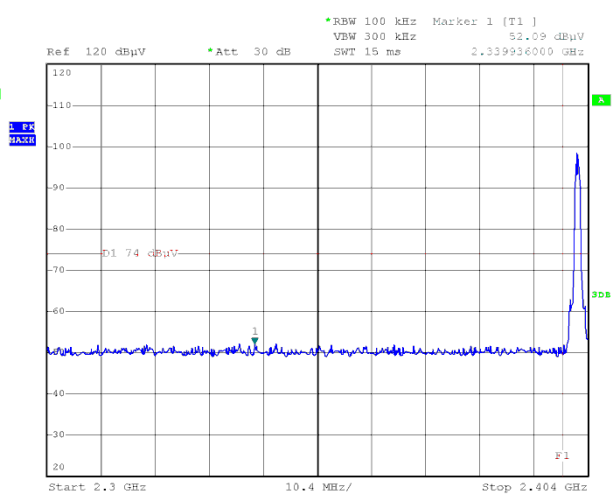
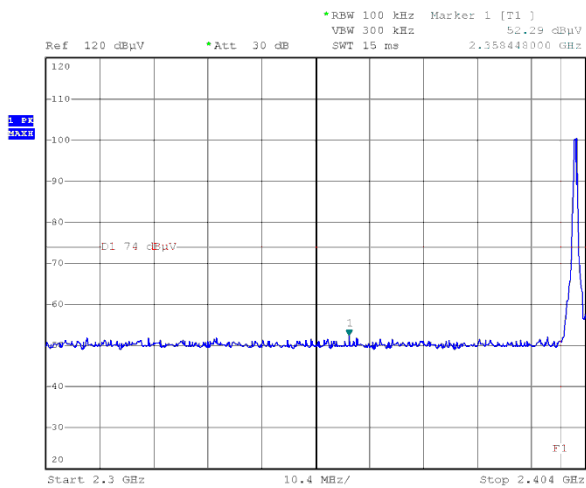
Note: The red vertical lines “F1” in the following charts is to indicate the frequencies 2400MHz and 2483.5MHz respectively

A. Test Verdict:

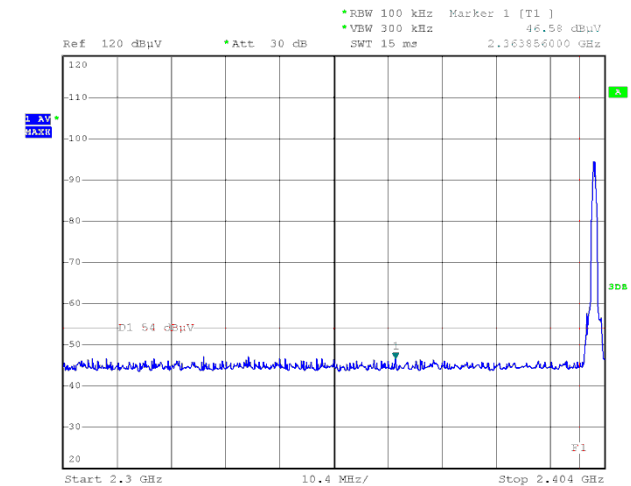
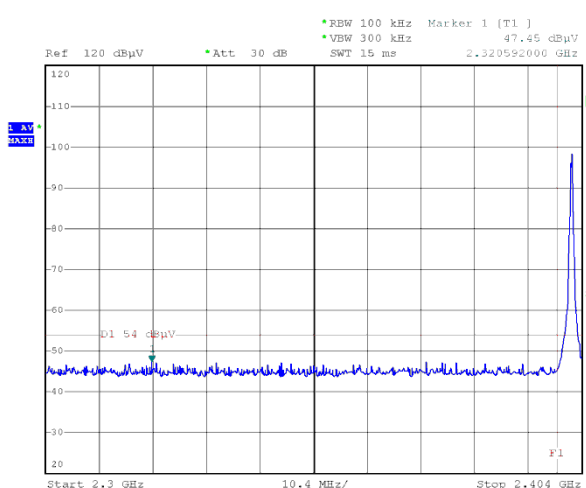
(Un-hopping)

CH	Frequency (MHz)	Detector	ANT polarity	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV							
0	2358.448	PK	Horizontal	52.29	-31.70	28.3	48.89	74	Pass
	2339.936		Vertical	52.09	-31.70	28.5	48.89		Pass
0	2320.592	AV	Horizontal	47.45	-31.72	28.3	44.03	54	Pass
	2363.856		Vertical	46.58	-31.70	28.4	43.28		Pass
78	2491.332	PK	Horizontal	52.21	-29.24	29.2	52.17	74	Pass
	2489.792		Vertical	53.40	-29.24	29.3	53.46		Pass
78	2495.952	AV	Horizontal	42.26	-29.25	29.2	42.21	54	Pass
	2496.084		Vertical	42.31	-29.25	29.3	42.36		Pass

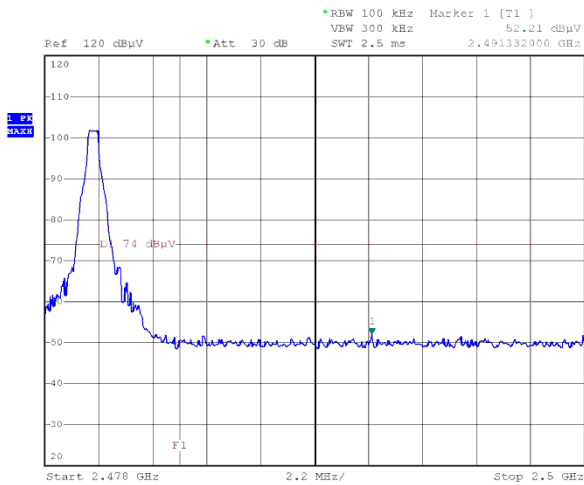
B. Test Plots:



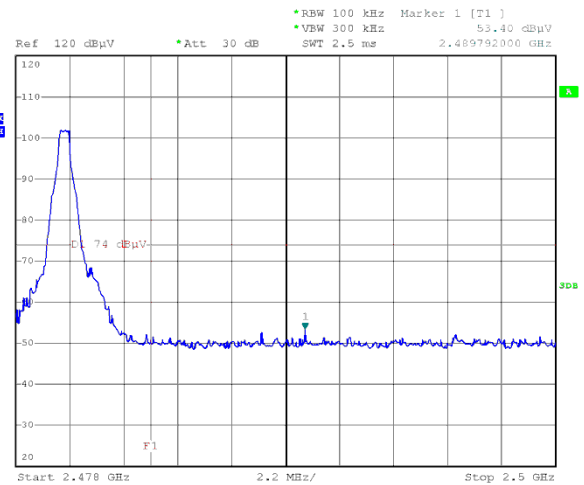
(Plot A1: Channel = 0 PEAK@ Horizontal) (Plot A2: Channel = 0 PEAK@ Vertical)



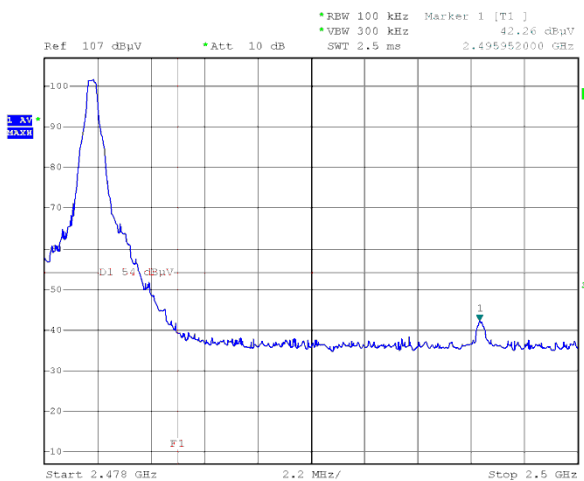
(Plot B1: Channel = 0 AVG@ Horizontal) (Plot B2: Channel = 0 AVG@ Vertical)



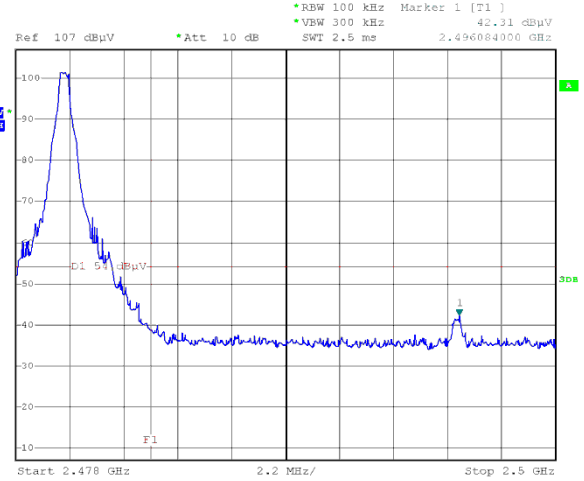
(Plot C1: Channel = 78 PEAK@ Horizontal)



(Plot C2: Channel = 78 PEAK@ Vertical)



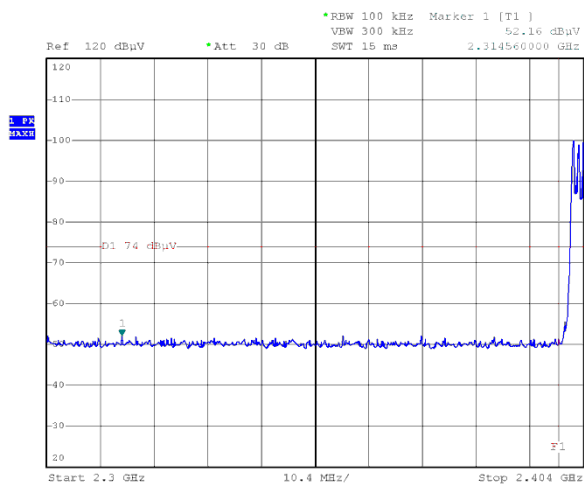
(Plot D1: Channel = 78 AVG@ Horizontal)



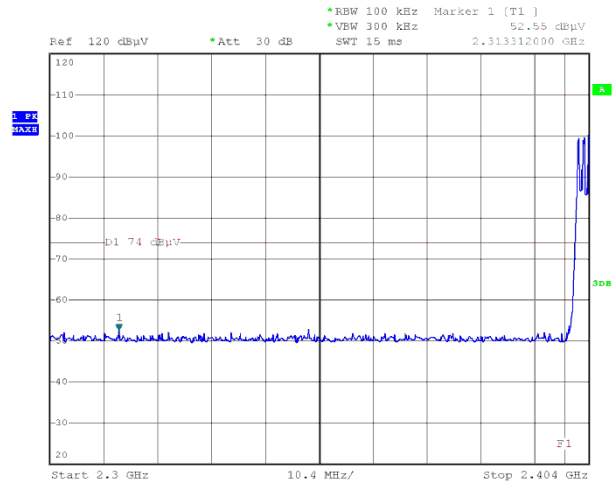
(Plot D2: Channel = 78 AVG@ Vertical)

(hopping)

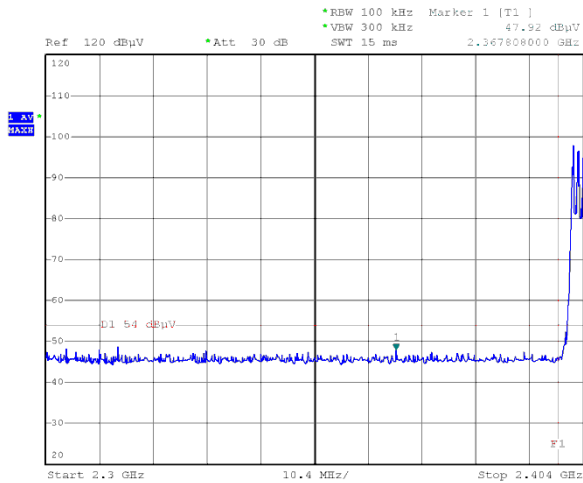
CH	Frequency (MHz)	Detector	ANT polarity	Receiver Reading UR (dBuV)	AT (dB)	AFactor (dB@3m)	Max. Emission E (dBuV/m)	Limit (dBuV/m)	Verdict
		PK/ AV							
0	2314.560	PK	Horizontal	52.16	-31.78	28.2	48.58	74	Pass
	2313.312		Vertical	52.55	-31.78	28.2	48.97		Pass
0	2367.808	AV	Horizontal	47.92	-31.73	28.3	44.49	54	Pass
	2343.056		Vertical	47.64	-31.75	28.2	44.09		Pass
78	2491.728	PK	Horizontal	51.48	-29.24	29.3	51.54	74	Pass
	2493.268		Vertical	52.02	-29.24	29.3	52.08		Pass
78	2496.040	AV	Horizontal	43.01	-29.24	29.3	43.07	54	Pass
	2494.016		Vertical	42.55	-29.24	29.3	42.61		Pass



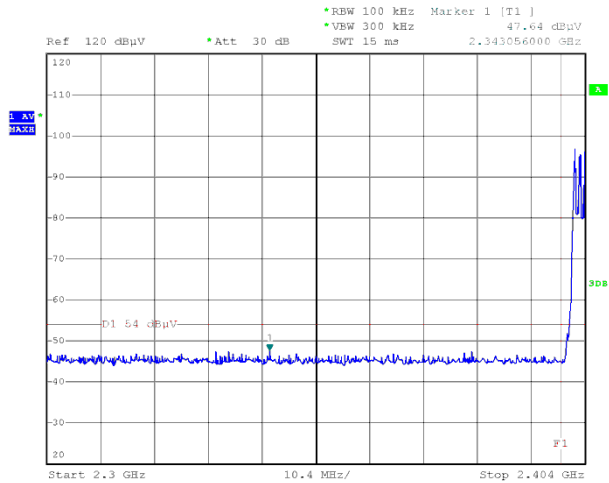
(Plot E1: Channel = 0 PEAK@ Horizontal)



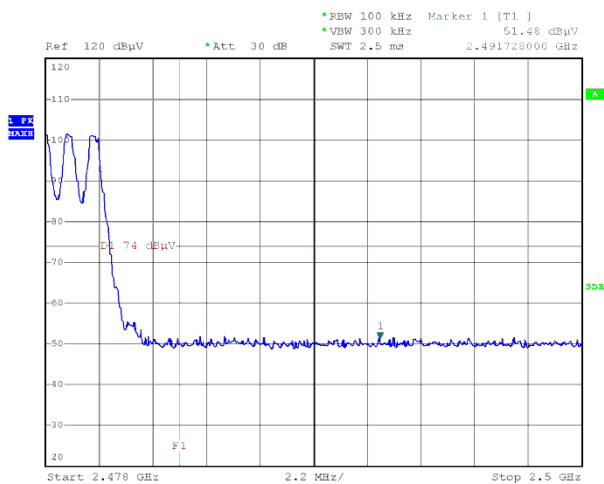
(Plot E2: Channel = 0 PEAK @ Vertical)



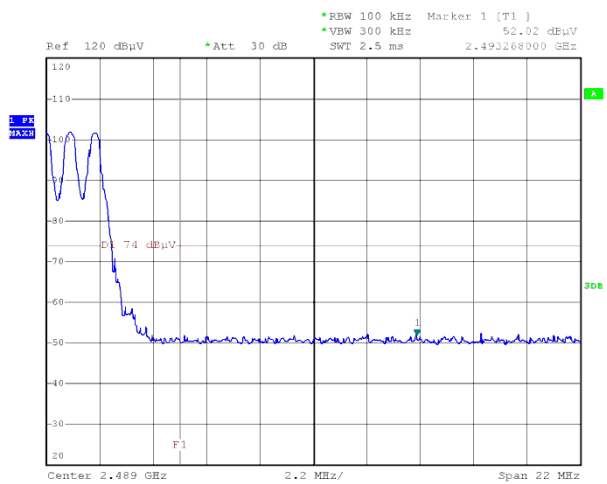
(Plot F1: Channel = 0 AVG@ Horizontal)



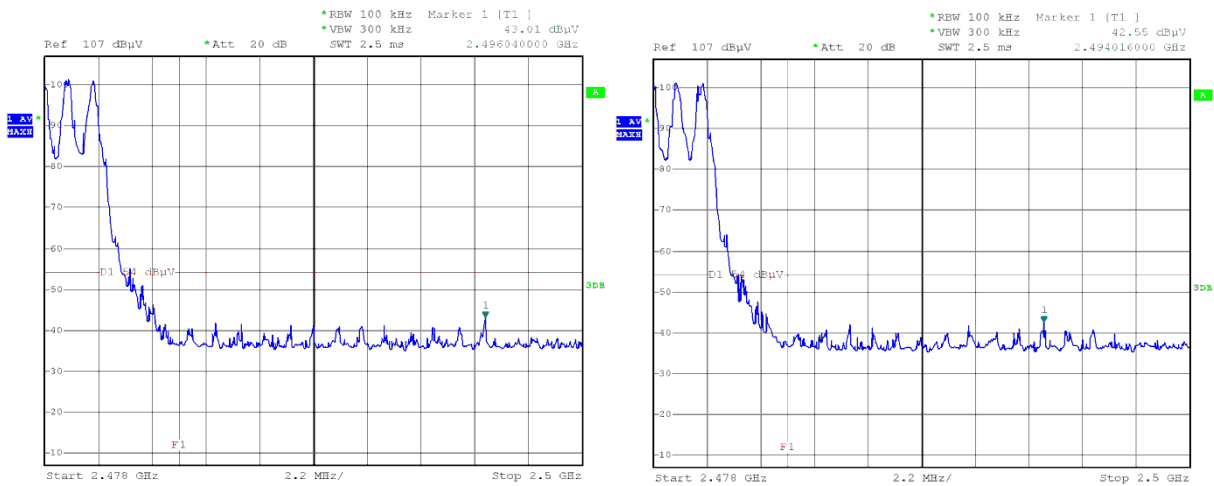
(Plot F2: Channel = 0 AVG@ Vertical)



(Plot G1: Channel = 78 PEAK@ Horizontal)



(Plot G2: Channel = 78 PEAK@ Vertical)



(PlotH1: Channel = 78 AVG@ Horizontal) (PlotH2: Channel = 78 AVG@ Vertical)

2.9. Conducted Emission

The product without the adapter, only powered by the battery, with no provisions for connection to the public utility ac power lines to operate the EUT and does not apply to Conducted Emission test.

2.10. Radiated Emission

2.10.1. Requirement

According to FCC section 15.247(c) and RSS-A8.5, 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:

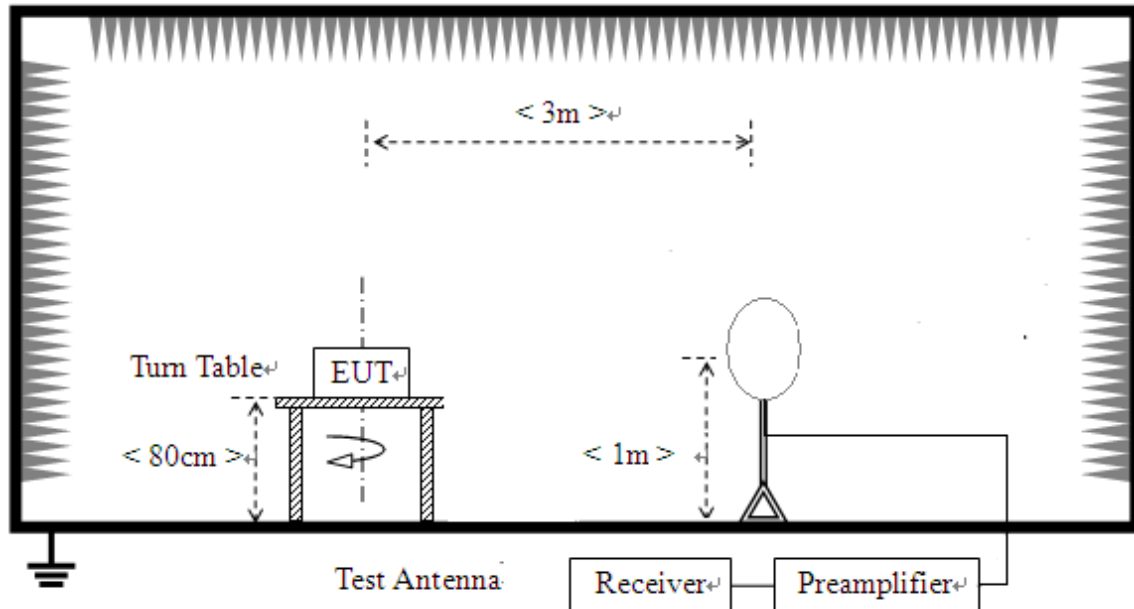
1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
2. For above 1000MHz, limit field strength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

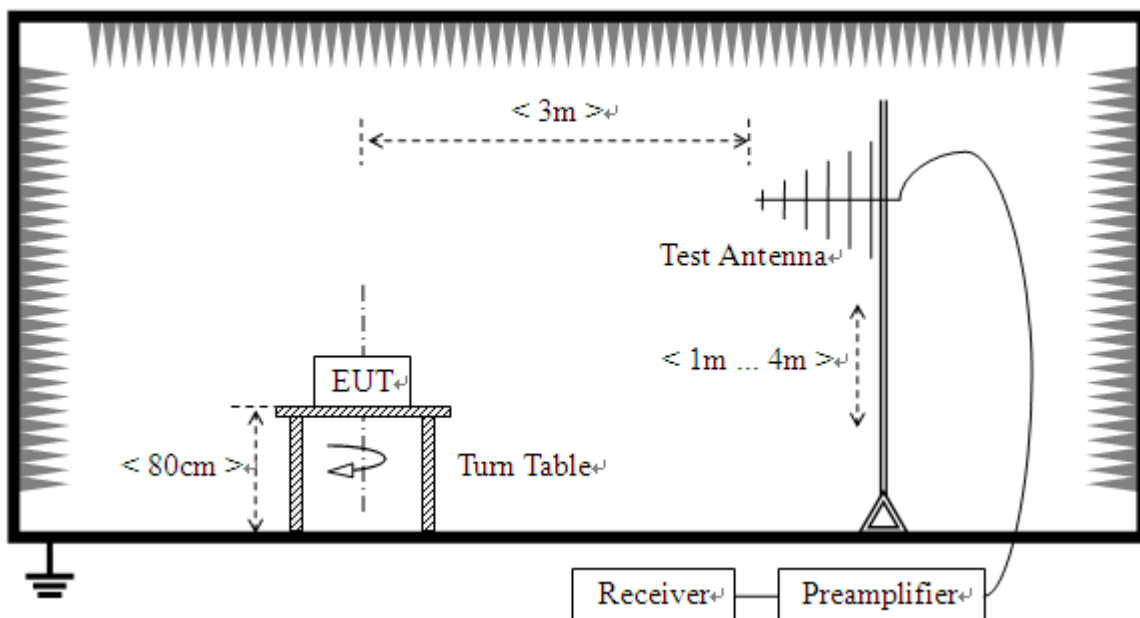
2.10.2. Test Description

A. Test Setup:

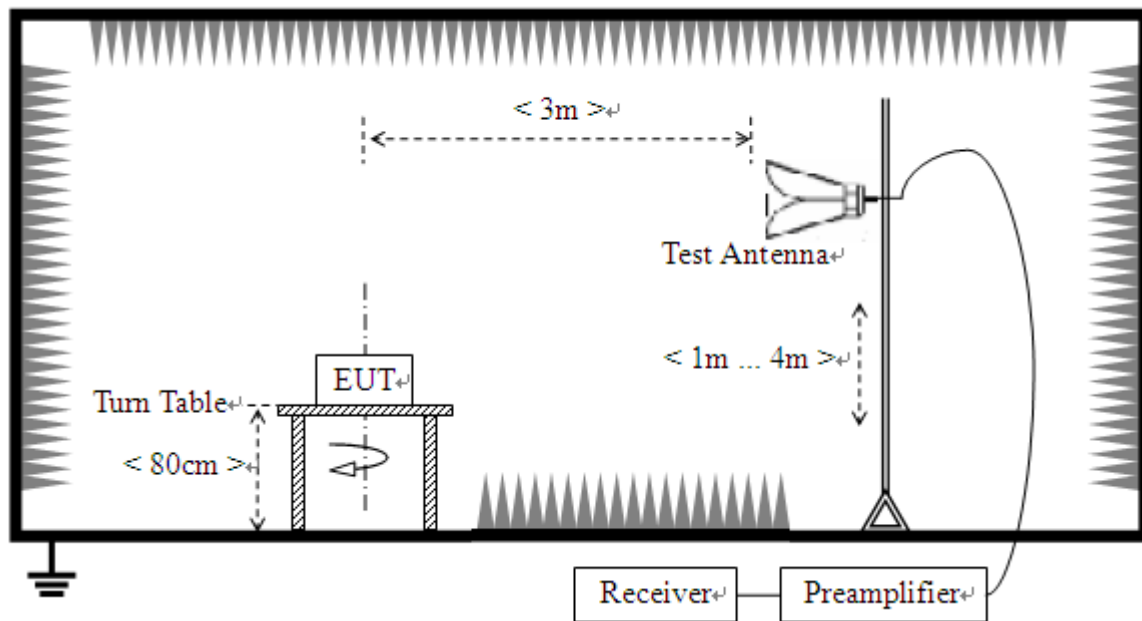
- 1) For radiated emissions from 9kHz to 30MHz



- 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 (2009). 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 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:

- 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. Date
System Simulator	R&S	CMU200	100448	2013.06.10
Receiver	R&S	ESIB26	A0304218	2013.06.10
Full-Anechoic Chamber	Albatross	12.8m*6.8m*6.4m	A0412372	2013.06.10
Test Antenna - Bi-Log	Schwarzbeck	VULB 9163	9163-274	2013.06.10
Test Antenna - Horn	Schwarzbeck	BBHA 9120D	9120C-963	2013.06.10

Description	Manufacturer	Model	Serial No.	Cal. Date
Test Antenna - Horn	R&S	HL050S7	71688	2013.06.10
Test Antenna -Loop	Schwarzbeck	HFH2-Z2	100047	2013.06.10
Ampilier 1G~18GHz	R&S	MITEQ AFS42-00101800	25-S-42	2013.06.10
amplifier 20M~3GHz	R&S	PAP-0203H	22018	2013.06.10

Note: The Cal. Interval was one year.

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

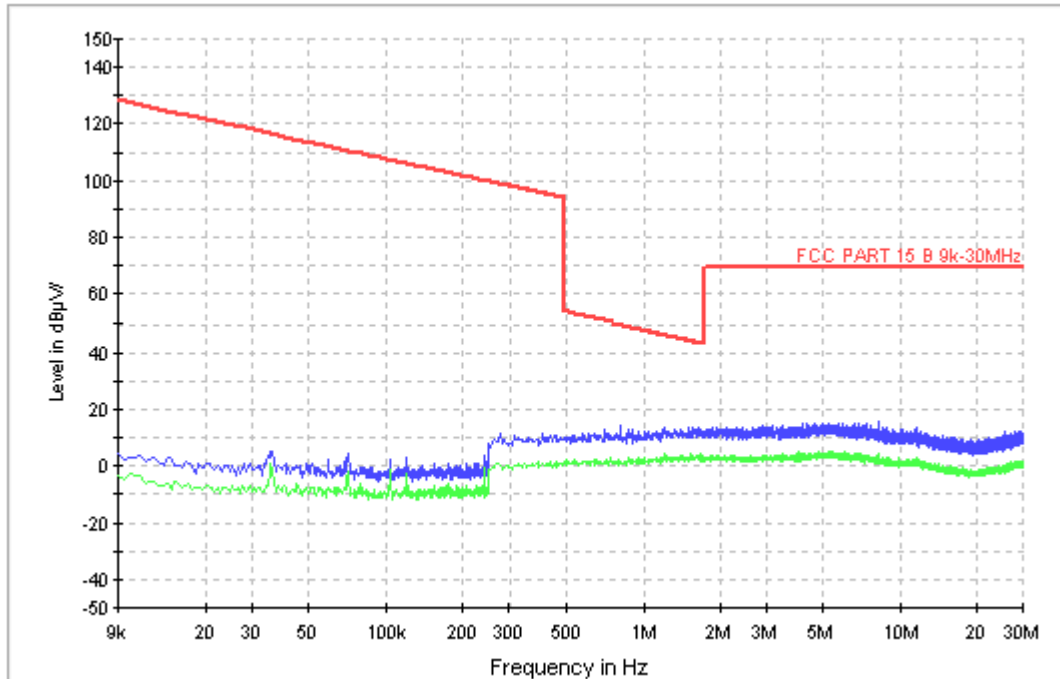
G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

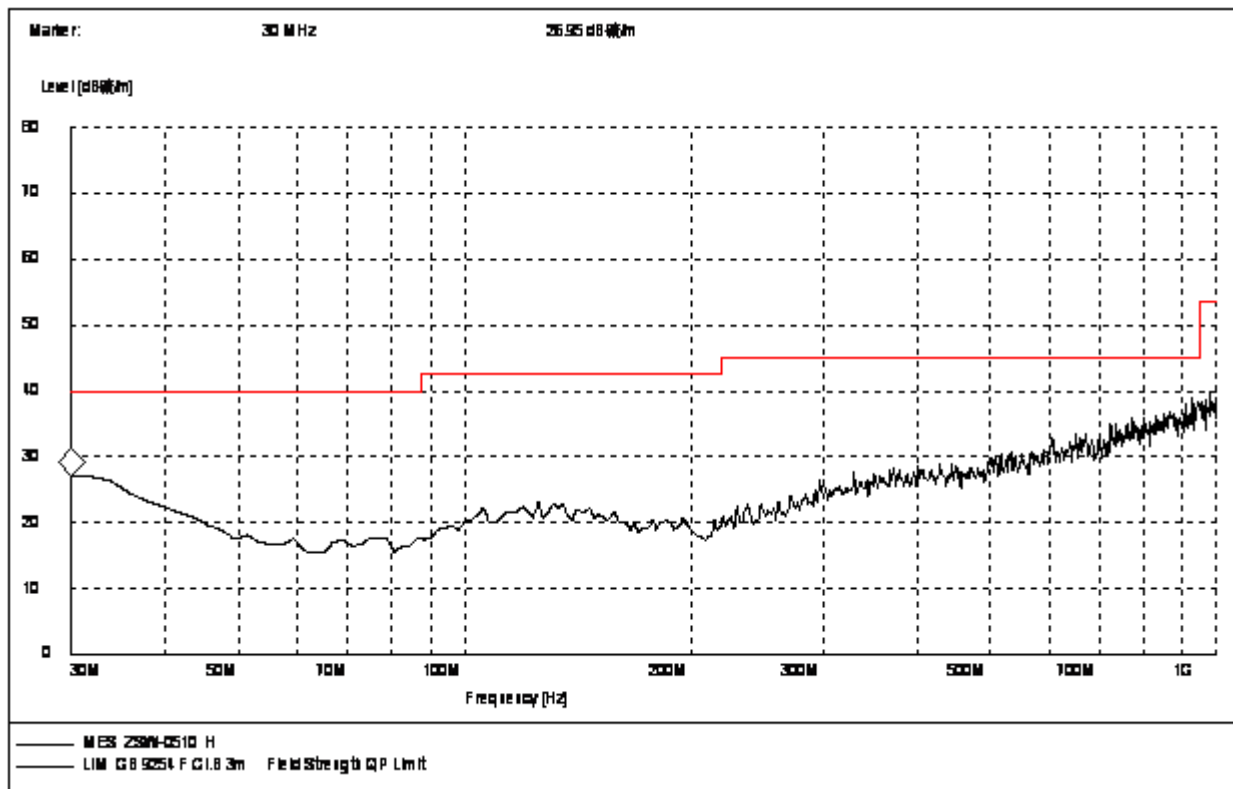
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

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

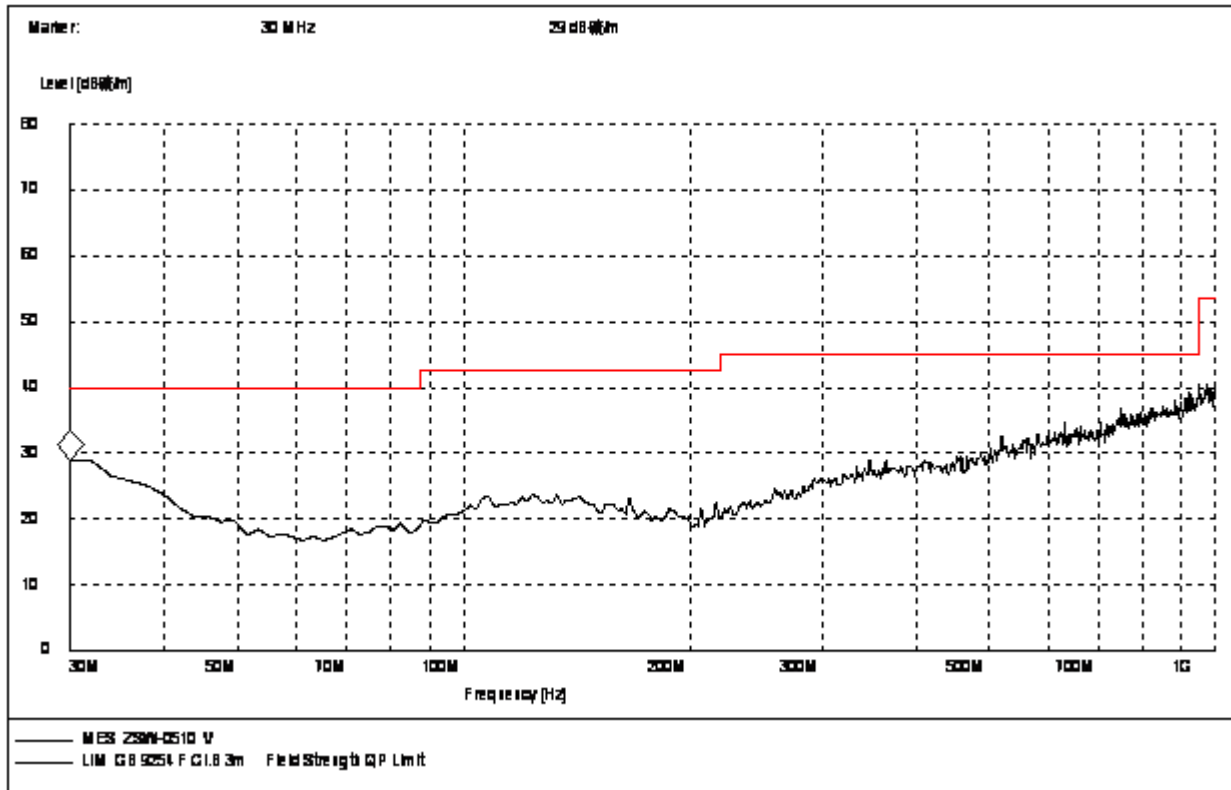


For 30MHz to 1000 MHz



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Degree	Antenna	Verdict
30	26.95	N.A	N.A	N.A	40.0	N.A	54	Horizontal	PASS

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



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Degree	Antenna	Verdict
30	29.00	N.A	N.A	N.A	40.0	N.A	112	Vertical	PASS

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

For 1GHz to 25GHz

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	93.55 PK	/	/	1.00 H	27	96.85	28.3	4.90	-36.6
1	*2402.00	91.47 AV	/	/	1.00 H	27	94.77	28.3	4.90	-36.6
2	4804.00	46.32 PK	74.00	27.68	1.00 H	136	42.52	32.7	7.00	-36.5
2	4804.00	44.12 AV	54.00	9.88	1.00 H	136	40.32	32.7	7.00	-36.5
3	7206.00	49.94 PK	74.00	24.06	1.00 H	219	40.54	35.8	8.90	-35.3
3	7206.00	47.08 AV	54.00	6.92	1.00 H	219	37.68	35.8	8.90	-35.3
4	9608.00	62.33 PK	74.00	11.67	1.00 H	89	49.73	37.2	10.20	-34.8
4	9608.00	47.42 AV	54.00	6.58	1.00 H	89	34.82	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	97.35 PK	/	/	1.00 V	90	100.65	28.3	4.90	-36.6
1	*2402.00	94.08 AV	/	/	1.00 V	90	97.38	28.3	4.90	-36.6
2	4804.00	48.33 PK	74.00	25.67	1.00 V	225	44.53	32.7	7.00	-36.5
2	4804.00	47.25 AV	54.00	6.75	1.00 V	225	43.45	32.7	7.00	-36.5
3	7206.00	51.06 PK	74.00	22.94	1.00 V	16	41.66	35.8	8.90	-35.3
3	7206.00	44.03 AV	54.00	9.97	1.00 V	16	34.63	35.8	8.90	-35.3
4	9608.00	52.54 PK	74.00	21.46	1.00 V	75	39.94	37.2	10.20	-34.8
4	9608.00	46.57 AV	54.00	7.43	1.00 V	75	33.97	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	96.99 PK	/	/	1.00 H	21	100.29	28.3	5.10	-36.6
1	*2441.00	95.37 AV	/	/	1.00 H	21	98.67	28.3	5.10	-36.6
2	4882.00	46.33 PK	74.00	27.67	1.00 H	18	42.53	32.3	7.60	-36.5
2	4882.00	40.03 AV	54.00	13.97	1.00 H	18	36.23	32.3	7.60	-36.5
3	7323.00	51.04 PK	74.00	22.96	1.00 H	215	41.64	36.1	8.60	-35.3
3	7323.00	48.32 AV	54.00	5.68	1.00 H	215	38.92	36.1	8.60	-35.3
4	9764.00	51.09 PK	74.00	22.91	1.00 H	45	38.49	37.2	10.20	-34.8
4	9764.00	44.72 AV	54.00	9.28	1.00 H	45	32.12	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	96.89 PK	/	/	1.00 V	122	100.19	28.3	5.10	-36.6
1	*2441.00	92.05 AV	/	/	1.00 V	122	95.35	28.3	5.10	-36.6
2	4882.00	46.98 PK	74.00	27.02	1.00 V	105	43.18	32.3	7.60	-36.5
2	4882.00	38.25 AV	54.00	15.75	1.00 V	105	34.45	32.3	7.60	-36.5
3	7323.00	57.11 PK	74.00	16.89	1.00 V	99	47.71	36.1	8.60	-35.3
3	7323.00	45.32 AV	54.00	8.68	1.00 V	99	35.92	36.1	8.60	-35.3
4	9764.00	52.36 PK	74.00	21.64	1.00 V	30	39.76	37.2	10.20	-34.8
4	9764.00	40.17 AV	54.00	13.83	1.00 V	30	27.57	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	98.31 PK	/	/	1.00 H	32	101.61	28.6	4.70	-36.6
1	*2480.00	92.03 AV	/	/	1.00 H	32	95.33	28.6	4.70	-36.6
2	4960.00	51.11 PK	74.00	22.89	1.00 H	305	47.31	33.0	7.00	-36.2
2	4960.00	37.46 AV	54.00	16.54	1.00 H	305	33.66	33.0	7.00	-36.2
3	7440.00	51.62 PK	74.00	22.38	1.00 H	347	42.22	36.2	8.50	-35.3
3	7440.00	43.23 AV	54.00	10.77	1.00 H	347	33.83	36.2	8.50	-35.3
4	9920.00	50.99 PK	74.00	23.01	1.00 H	11	38.39	37.2	10.20	-34.8
4	9920.00	44.01 AV	54.00	9.99	1.00 H	11	31.41	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	95.84	PK	/	/	1.00 V	105	99.14	28.6	4.70	-36.6
1	*2480.00	89.05	AV	/	/	1.00 V	105	92.35	28.6	4.70	-36.6
2	4960.00	50.66	PK	74.00	23.34	1.00 V	3	46.86	33.0	7.00	-36.2
2	4960.00	47.03	AV	54.00	6.97	1.00 V	3	43.23	33.0	7.00	-36.2
3	7440.00	54.38	PK	74.00	19.62	1.00 V	19	44.98	36.2	8.50	-35.3
3	7440.00	44.00	AV	54.00	10	1.00 V	19	34.6	36.2	8.50	-35.3
4	9920.00	52.17	PK	74.00	21.83	1.00 V	97	39.57	37.2	10.20	-34.8
4	9920.00	42.99	AV	54.00	11.01	1.00 V	97	30.39	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. Margin value = Limit value- Emission level.
 4. The limit value is defined as per 15.247
 5. “* “: Fundamental frequency

2.11. RF exposure evaluation

According to § 1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of Commission's guideline.

According to 447498 D01 General RF Exposure Guidance v05, exclusion threshold values at selected frequencies and distances table as following.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	
MHz	30	35	40	45	50	mm
150	232	271	310	349	387	SAR Test Exclusion Threshold (mW)
300	164	192	219	246	274	
450	134	157	179	201	224	
835	98	115	131	148	164	
900	95	111	126	142	158	
1500	73	86	98	110	122	
1900	65	76	87	98	109	
2450	57	67	77	86	96	
3600	47	55	63	71	79	
5200	39	46	53	59	66	
5400	39	45	52	58	65	
5800	37	44	50	56	62	

Routine SAR evaluation refers to the specifically required by § 2.1093, using measurements or computer simulation. When routine SAR evolution is not required, the portable transmitters with output power greater than the applicable low threshold SAR evolution to qualify for TCB approval.

Result:

This is portable device and the Max conducted peak output power is -2.39dBm, the maximum gain of antenna is 1.87dBi, the maximum output power is -2.39dBm (0.577mW), which is lower than the exclusion threshold 10mW, at frequency 2450MHz, and distance is 5mm.

The SAR measurement is not required.

**** END OF REPORT ****