REPORT No.: SZ15120107W02

FCC RF TEST REPORT

APPLICANT	:	TechMille Ltd.
PRODUCT NAME	:	Vibration Mote
MODEL NAME	:	Model 1,Model 2
TRADE NAME	:	Petasense
BRAND NAME	:	Petasense
FCC ID	:	2AHKW-00061
STANDARD(S)	:	47 CFR Part 15 Subpart C
ISSUE DATE	:	2016-07-08

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.

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DIRECTORY

Change History		
Issue	Date	Reason for change
1.0	2016-07-08	First edition

TEST REPORT DECLARATION

Applicant	TechMille Ltd.
Applicant Address	B609 Botai Int'l Plaza, No. 122 Guangshun North Street, Chaoyang District, Beijing
Manufacturer Address	HONG KONG ZONGWELL INDUSTRIAL CO., LTD.
Manufacturer	UNIT 04, 7/F, BRIGHT WAY TOWER, NO. 33 MONG KOK ROAD, KOWLOON, HK
Product Name	Vibration Mote
Model Name	Model 1,Model 2
Brand Name	Petasense
HW Version	C18
SW Version	V2.0.0
Test Standards	47 CFR Part 15 Subpart C
Test Date	2016-06-14 to 2016-06-22
Test Result	PASS

Tested by : Zou Jian

Reviewed by : Qiu Xiaojun

Approved by : Peng Huarui

1. TECHNICAL INFORMATION

Note: Provide by applicant.

1.1 Applicant Information

Company:	TechMille Ltd.
Address	B609 Botai Int'l Plaza, No. 122 Guangshun North Street, Chaoyang District, Beijing

1.2 Equipment under Test (EUT) Description

Brand Name:	Petasense
Trade Name:	Petasense
Model Name:	Model 1,Model 2
Frequency Range:	802.11b/g/n-20MHz: 2.412GHz - 2.462GHz 802.11n-40MHz: 2.422GHz - 2.452GHz
Channel Number:	802.11b/g/n-20MHz: 11
Modulation Type:	DSSS, OFDM
Antenna Type:	PCB Antenna
Antenna Gain:	2 dBi

NOTE:

1. The EUT is a Vibration Mote, it contains WIFI Module operating at 2.4GHz ISM; it supports 802.11b, 802.11g, 802.11n and they are all tested in this report.

For 802.11b/g/n-20MHz (2.4GHz band), the frequencies allocated is F (MHz) =2412+5*(n-1) (1<=n<=11). The lowest, middle, highest channel numbers of the EUT used and tested in this report are separately 1 (2412MHz), 6 (2437MHz) and 11 (2462MHz).

2. The EUT powered by battery. During the test, the EUT powered by a new battery.
3. The EUT connected to the serial port of the computer with a serial communication cable, and then use the dedicated software to control the EUT into the test mode.
4. For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.
5. The antenna connector of EUT is designed with permanent attachment and no consideration of replacement.

1.2.1 Identification of all used EUTs

The EUT identity consists of numerical and letter characters, the letter character indicates the test sample, and the following two numerical characters indicate the software version of the test sample.

EUT Identity	Hardware Version	Software Version
A01	C18	V2.0.0

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 (10-1-15 Edition)	Radio Frequency Devices

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

No.	Section	Description	Test Date	Result
1	15.203	Antenna Requirement	N.A	**PASS**
2	15.247(b)	Peak Output Power	Jun 14, 2016	**PASS**
3	15.247(a)	Bandwidth	Jun 14, 2016	**PASS**
4	15.247(d)	Conducted Spurious Emission and Band Edge	Jun 14, 2016	**PASS**
5	15.247(d)	Restricted Frequency Bands	Jun 22, 2016	**PASS**
6	15.207	Conducted Emission	N.A	**N.A**
7	15.209 ,15.247(d)	Radiated Emission	Jun 22, 2016	**PASS**
8	15.247(e)	Power spectral density (PSD)	Jun 14, 2016	**PASS**
Note: Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.				

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

1.3.1 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):	86-106

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 EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2 Peak Output Power

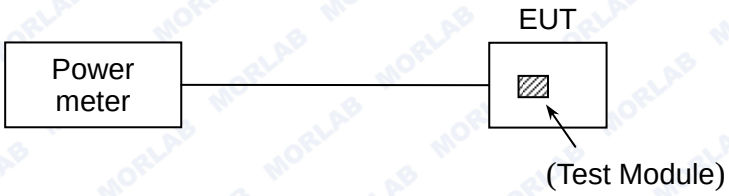
2.2.1 Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed1 Watt.

2.2.2 Test Description

The measured output power was calculated by the reading of the Power Meter and calibration.

A. Test Setup:



The EUT (Equipment under the test) which is coupled to the Power Meter; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in power meter.

B. Equipments List:

Please reference ANNEX A(1.5).

2.2.3 Test Result

The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

2.2.3.1 802.11b Test Mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	13.97	0.0249	30	1	PASS
6	2437	13.73	0.0236			PASS
11	2462	13.94	0.0248			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	9.77	0.0095	30	1	PASS
6	2437	9.58	0.0091			PASS
11	2462	9.74	0.0094			PASS

2.2.3.2 802.11g Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	16.99	0.0500	30	1	PASS
6	2437	17.19	0.0524			PASS
11	2462	17.15	0.0519			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	7.66	0.0058	30	1	PASS
6	2437	7.55	0.0057			PASS
11	2462	7.55	0.0057			PASS

2.2.3.3 802.11n-20MHz Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	16.43	0.0440	30	1	PASS
6	2437	16.58	0.0455			PASS
11	2462	16.4	0.0437			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	4.92	0.0031	30	1	PASS
6	2437	4.72	0.0030			PASS
11	2462	4.86	0.0031			PASS

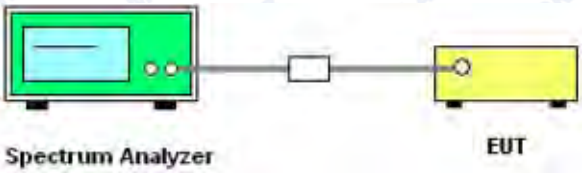
2.3 Bandwidth

2.3.1 Requirement

According to FCC section 15.247(a) (2), Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.3.2 Test Description

A. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

KDB 558074 Section 8.1 Option 1 was used in order to prove compliance.

B. Equipments List:

Please reference ANNEX A(1.5).

2.3.3 Test Result

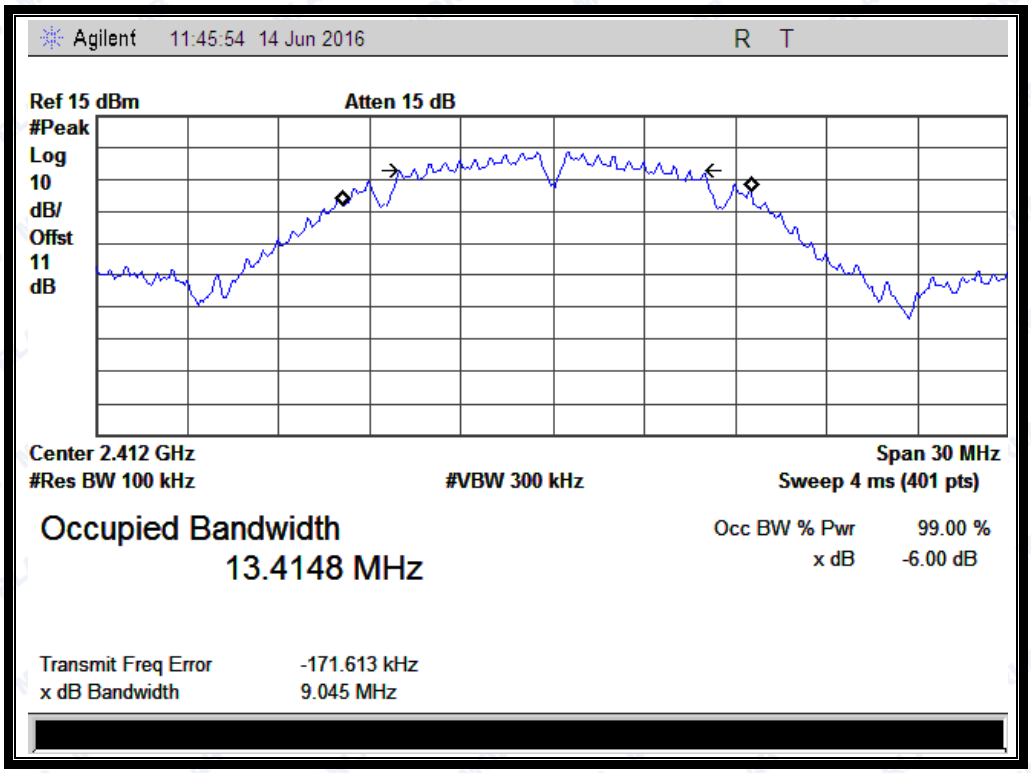
The lowest, middle and highest channels are selected to perform testing to record the 6 dB bandwidth of the Module.

2.3.3.1 802.11b Test mode

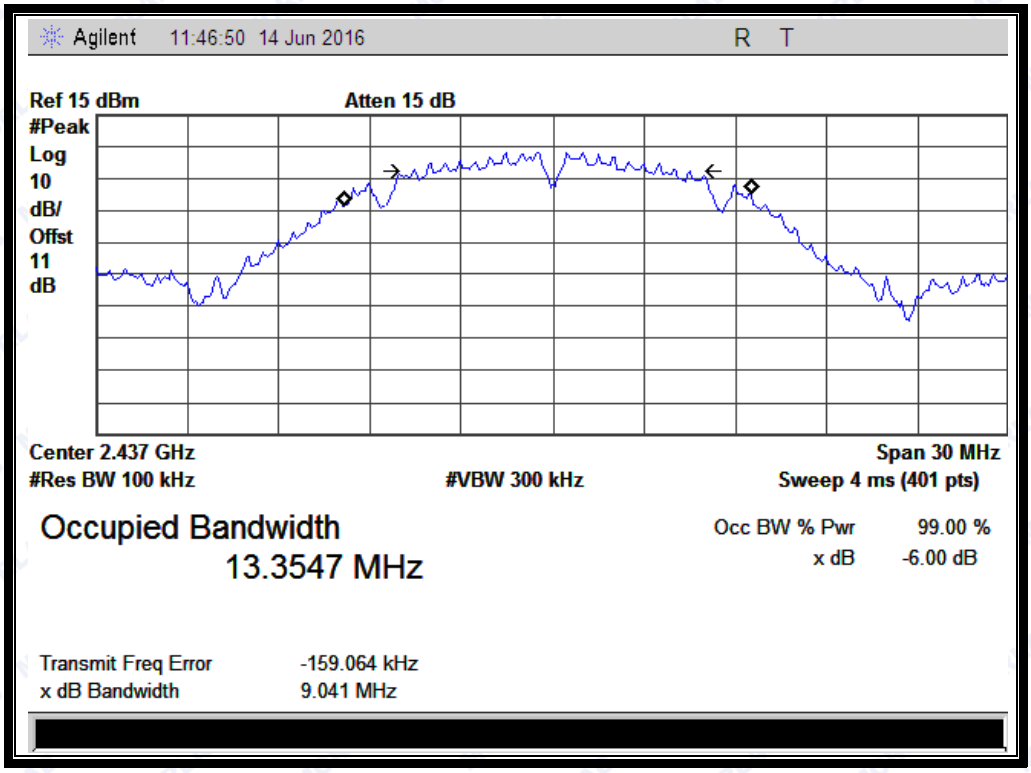
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	9.045	≥500	PASS
6	2437	9.041	≥500	PASS
11	2462	8.616	≥500	PASS

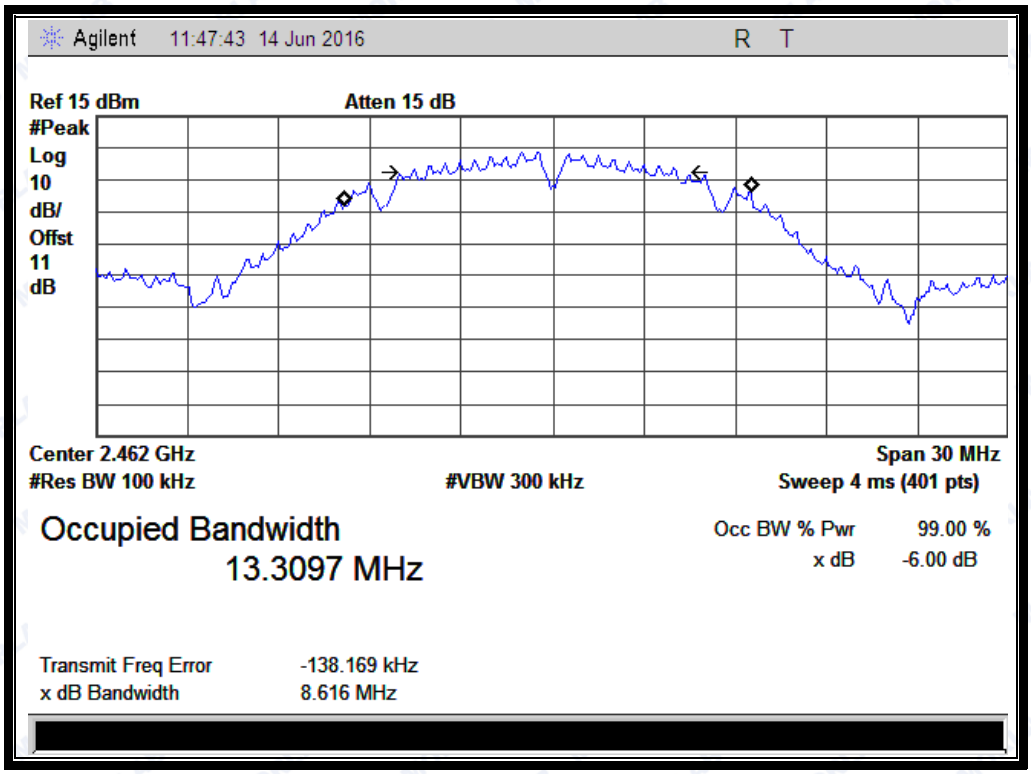
B. Test Plots



(Channel 1: 2412MHz @ 802.11b)



(Channel 6: 2437 MHz @ 802.11b)



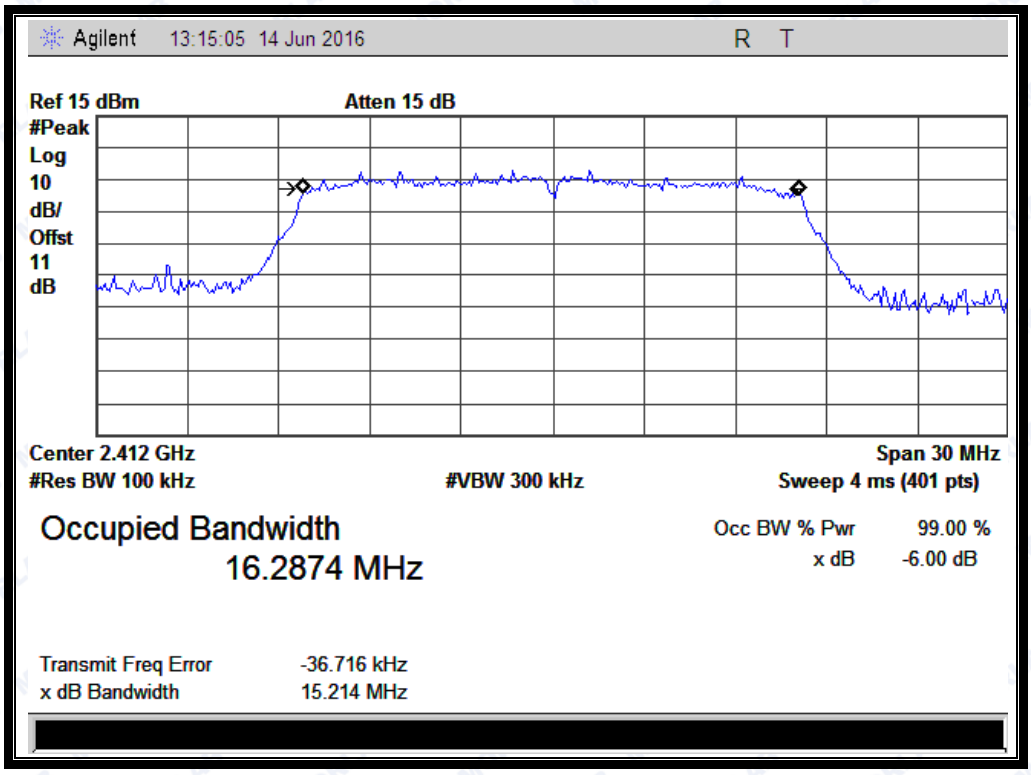
(Channel 11: 2462MHz @ 802.11b)

2.3.3.2 802.11g Test mode

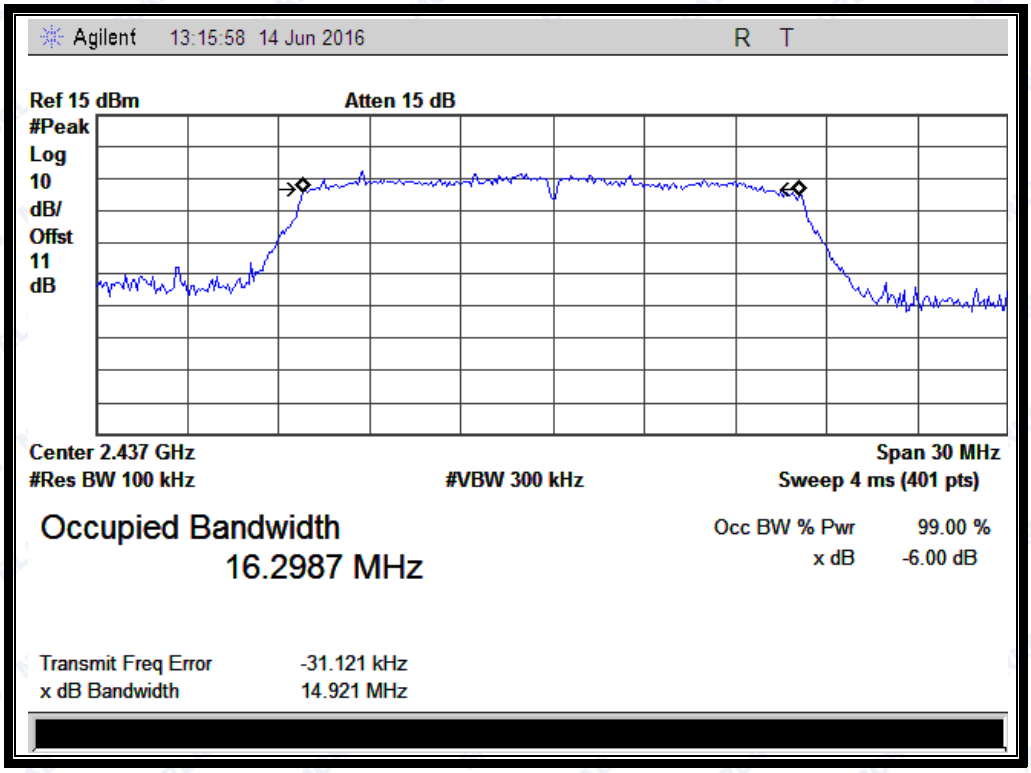
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	15.214	≥500	PASS
6	2437	14.921	≥500	PASS
11	2462	14.653	≥500	PASS

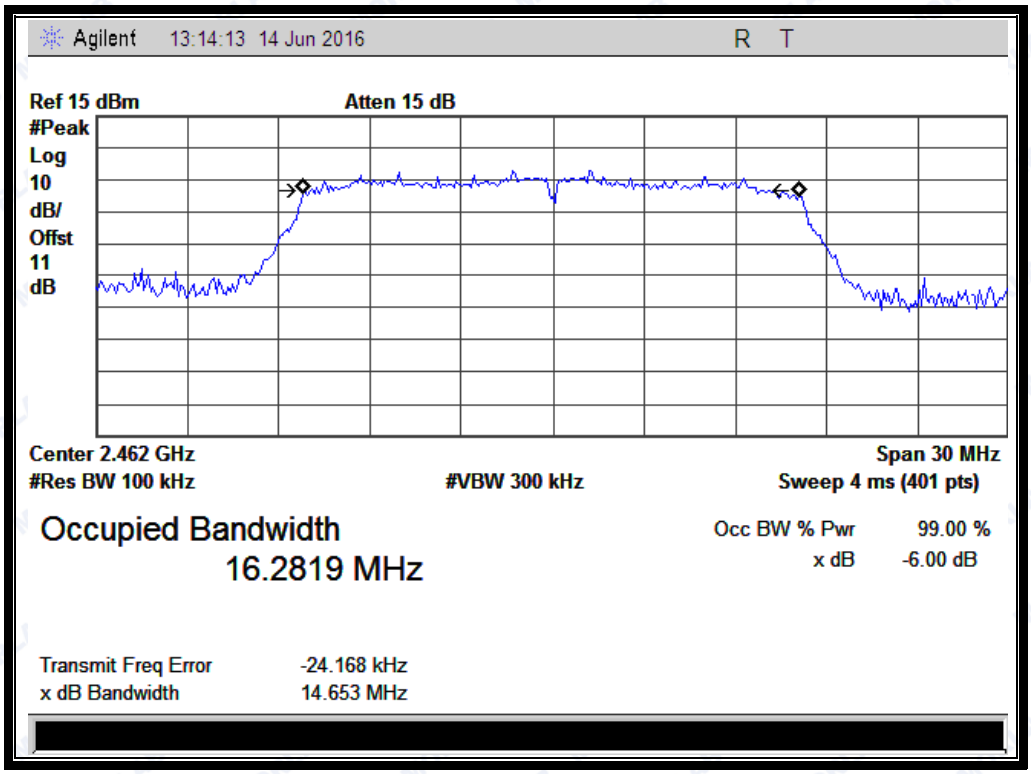
B. Test Plots:



(Channel 1: 2412MHz @ 802.11g)



(Channel 6: 2437MHz @ 802.11g)



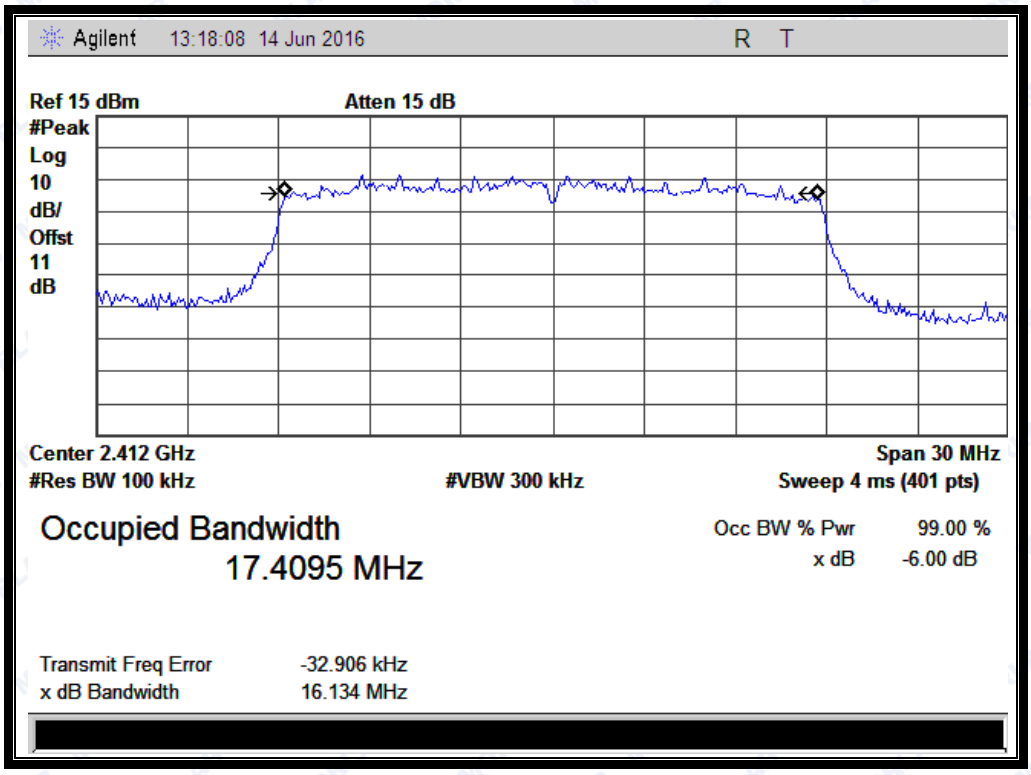
(Channel 11: 2462MHz @ 802.11g)

2.3.3.3 802.11n-20 Test mode

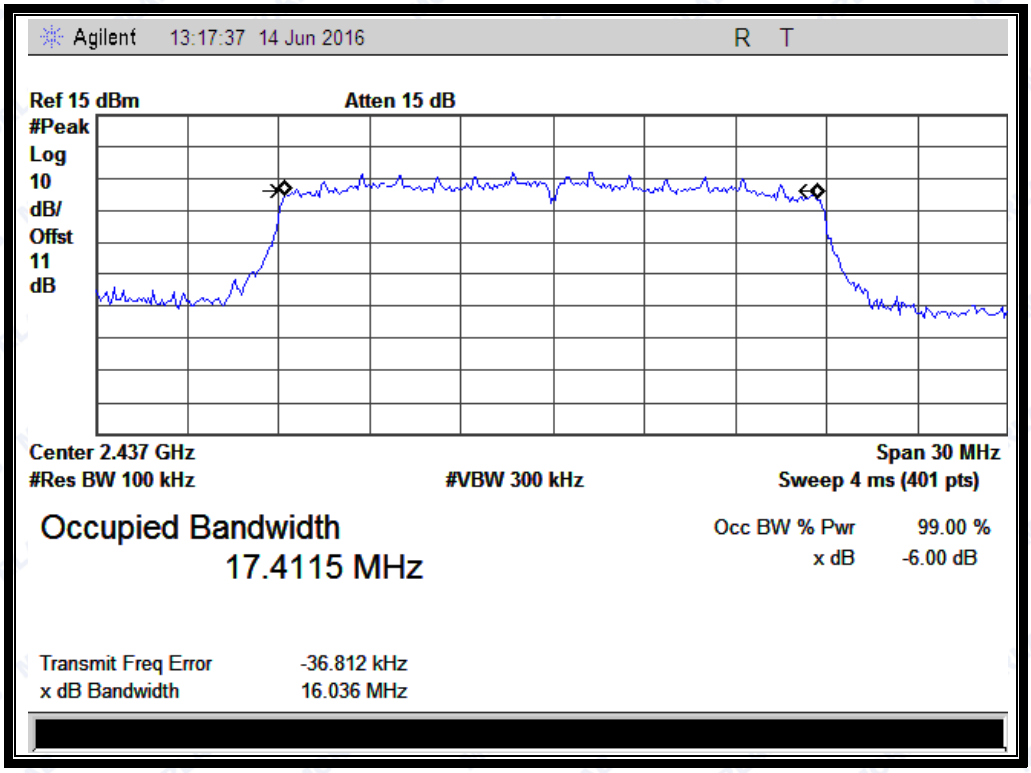
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	16.134	≥500	PASS
6	2437	16.036	≥500	PASS
11	2462	16.122	≥500	PASS

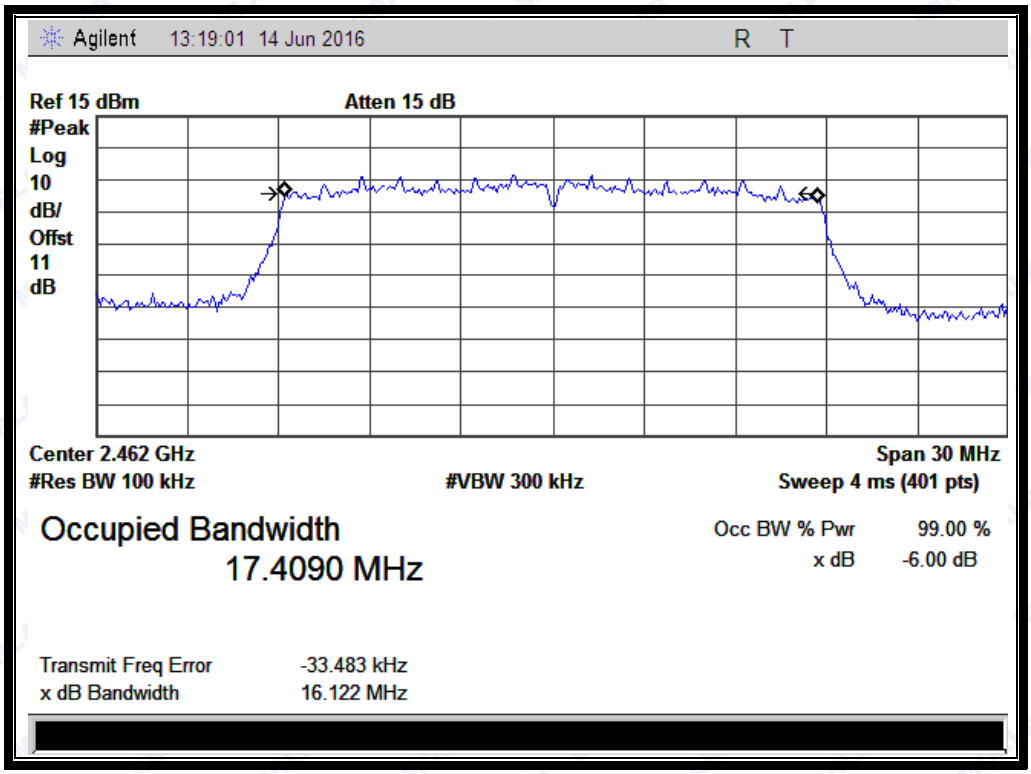
B. Test Plots:



(Channel 1: 2412MHz @ 802.11n-20)



(Channel 6: 2437MHz @ 802.11n-20)



(Channel 11: 2462MHz @ 802.11n-20)

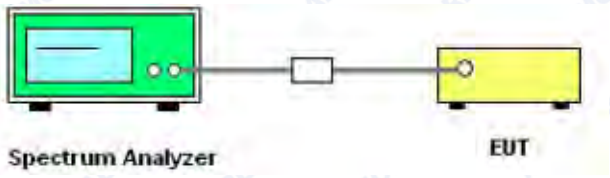
2.4 Conducted Spurious Emissions and Band Edge

2.4.1 Requirement

According to FCC section 15.247(c), 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.

2.4.2 Test Description

A. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

KDB 558074 Section 11.0 was used in order to prove compliance.

B. Equipments List:

Please reference ANNEX A(1.5).

2.4.3 Test Result

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.

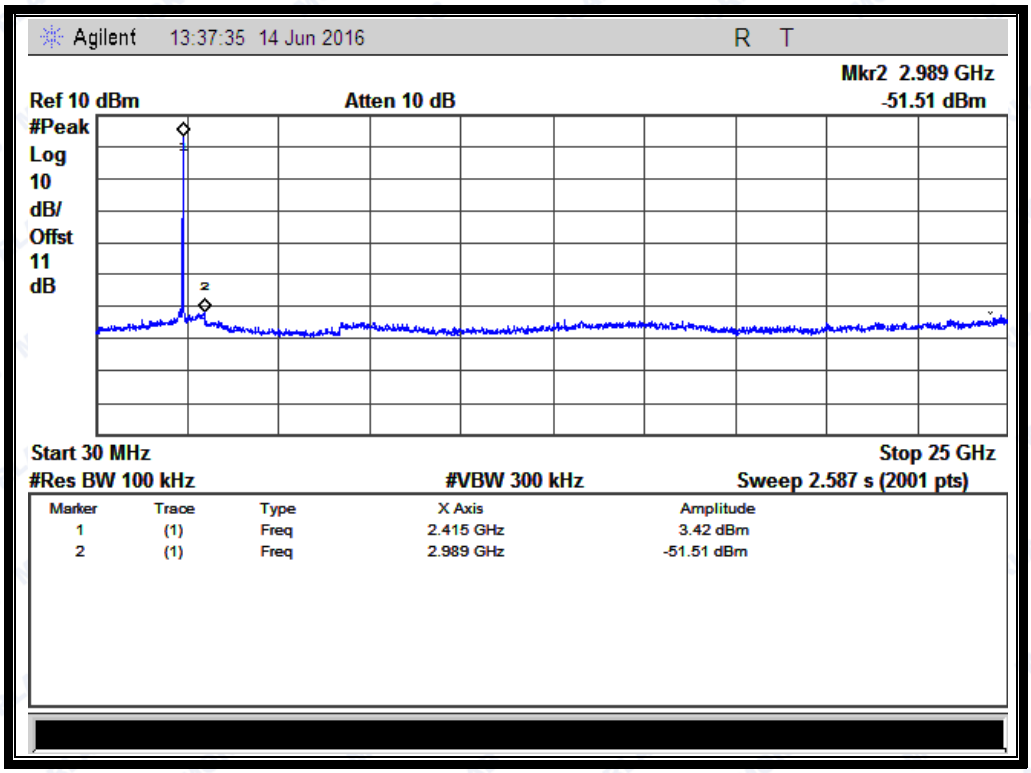
2.4.3.1 802.11b Test mode

A. Test Verdict:

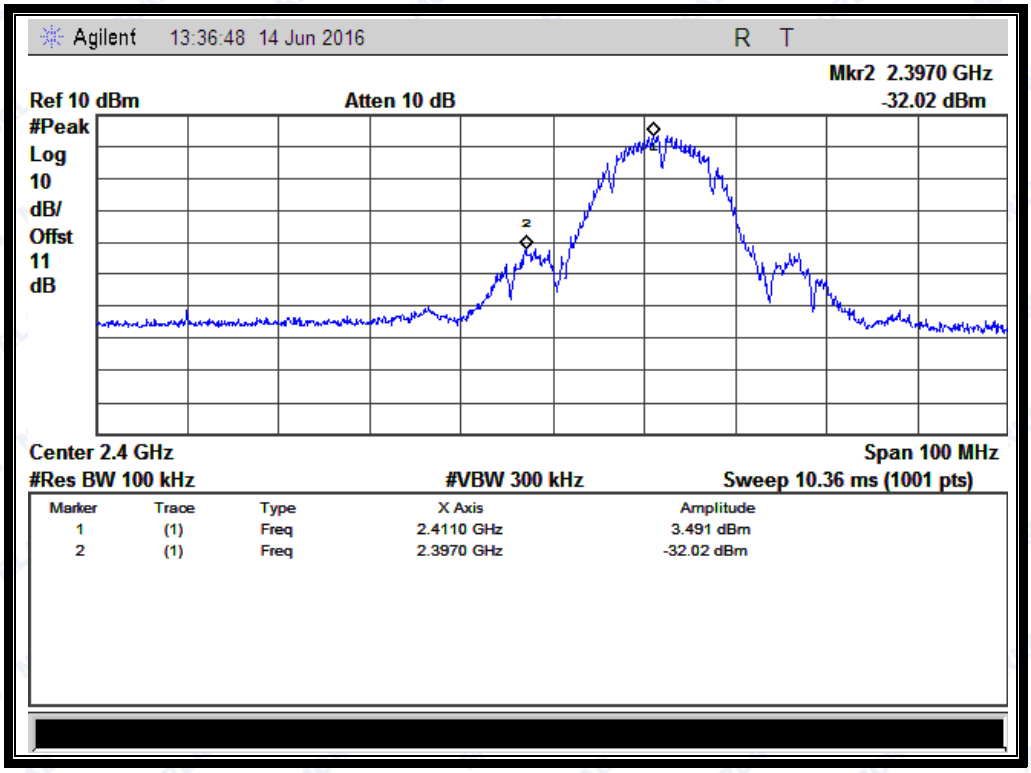
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-51.51	3.42	-16.58	PASS
6	2437	-52.11	2.84	-17.16	PASS
11	2462	-52.00	1.26	-18.74	PASS

B. Test Plots:

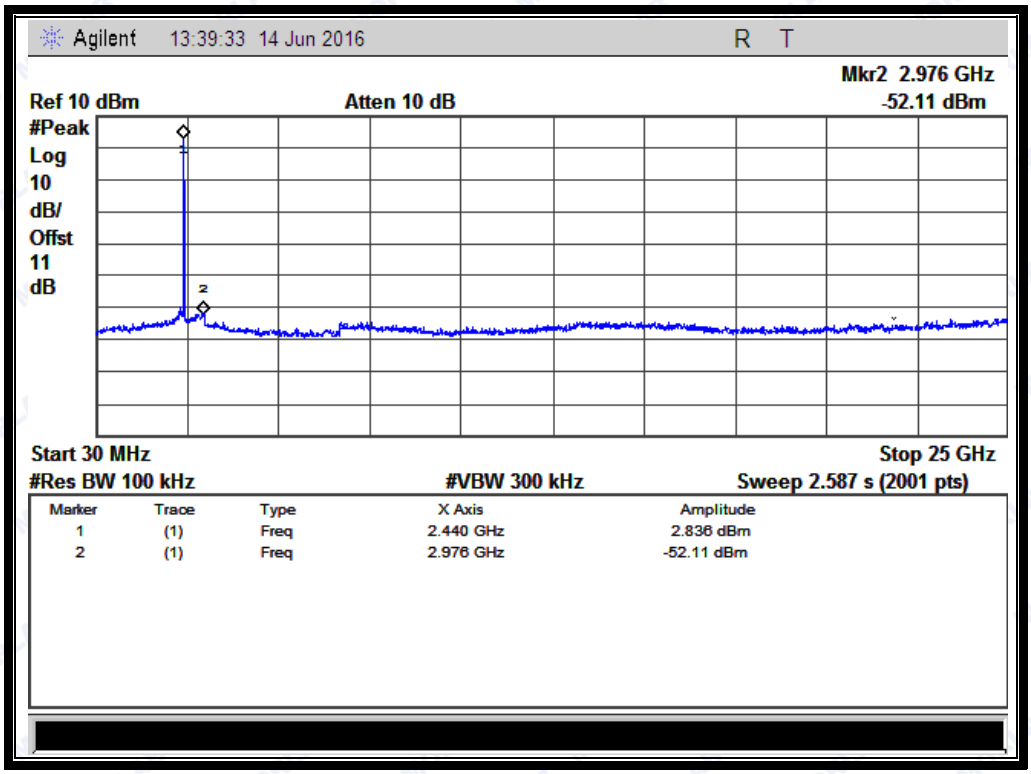
Note: the power of the Module transmitting frequency should be ignored.



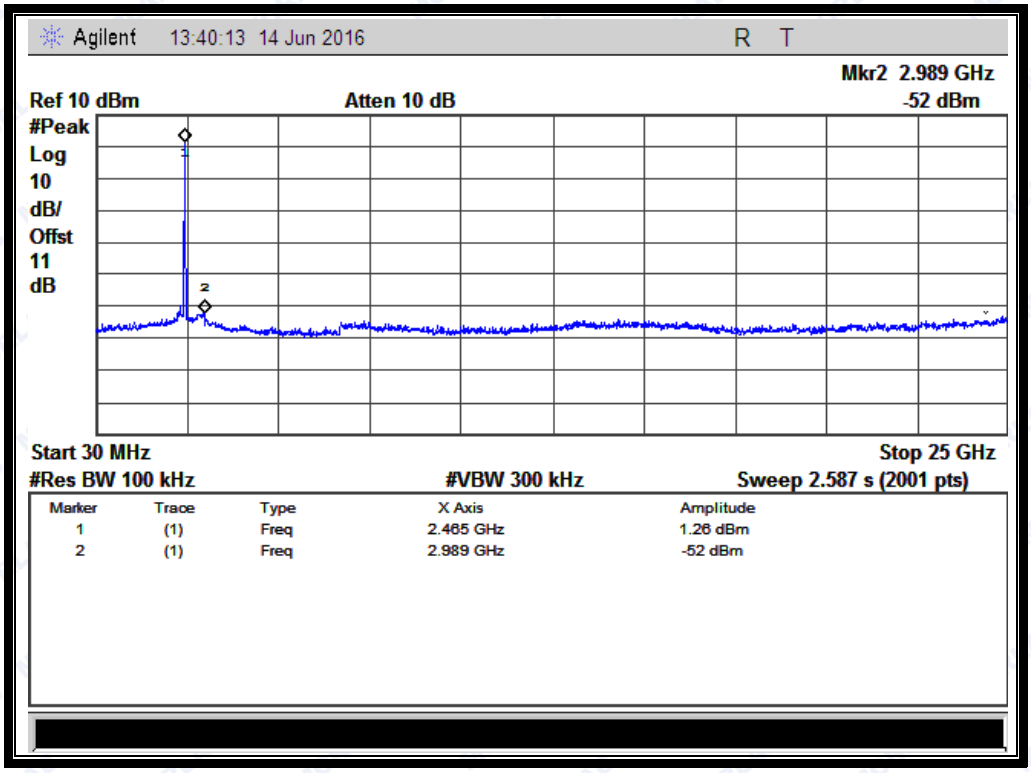
(Channel = 1, 30MHz to 25GHz)



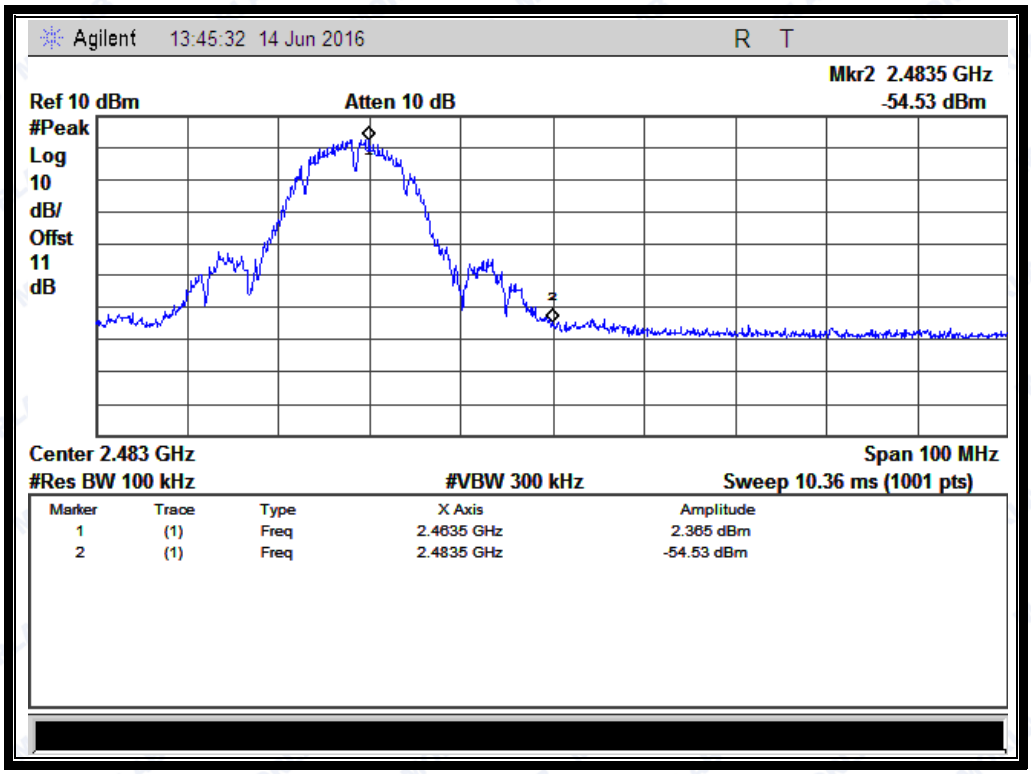
(Band Edge @ Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge @ Channel = 11)

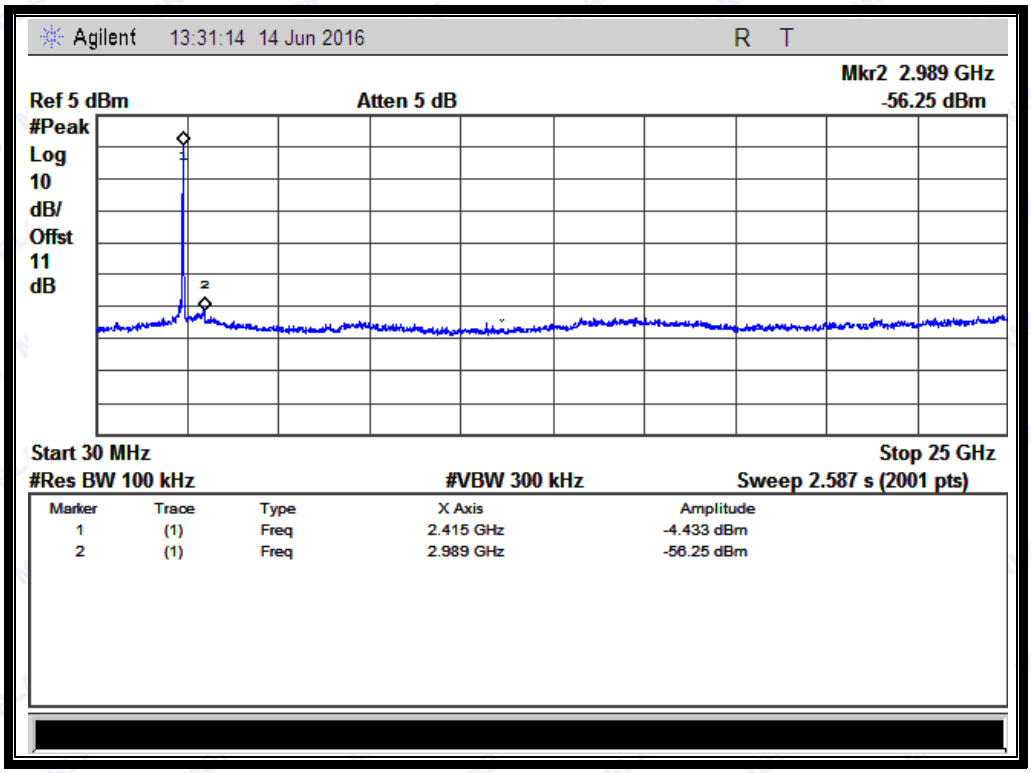
2.4.3.2 802.11g Test mode

A. Test Verdict:

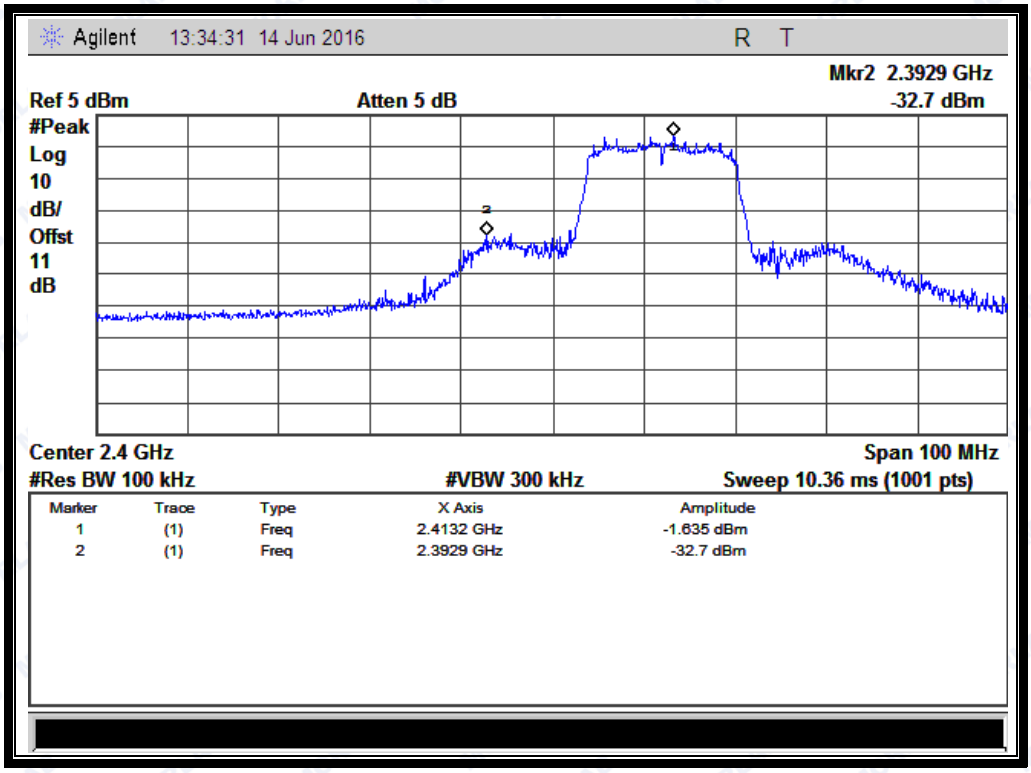
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-56.25	-4.43	-24.43	PASS
6	2437	-56.47	-3.54	-23.54	PASS
11	2462	-55.87	-5.22	-25.22	PASS

B. Test Plots:

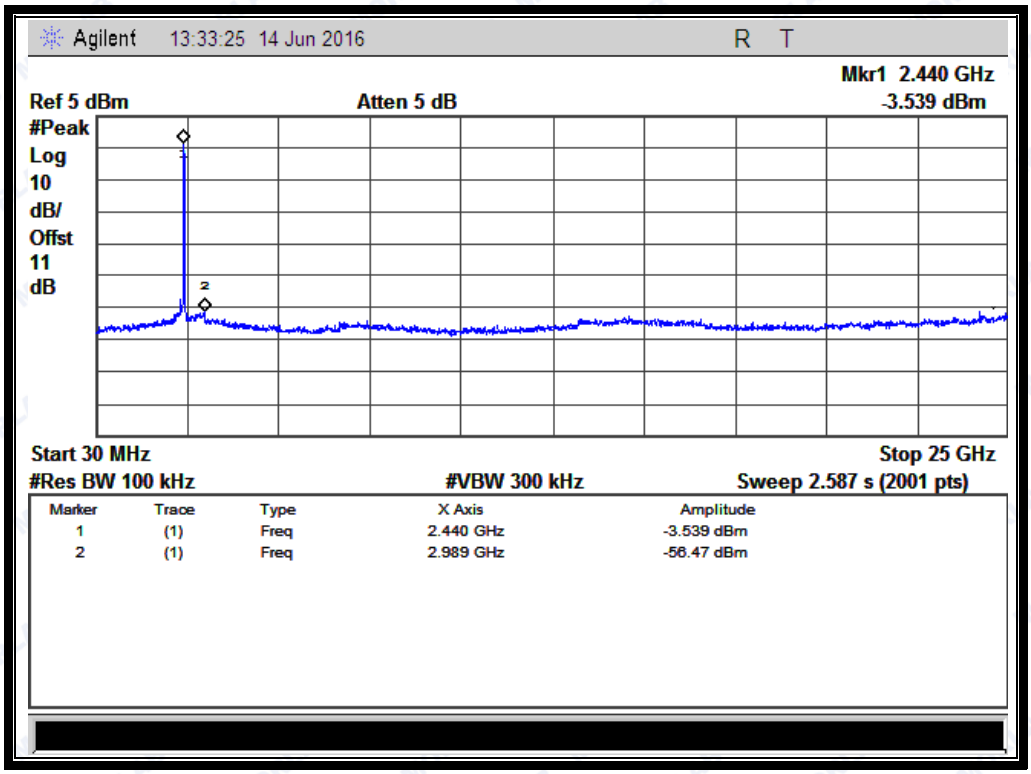
Note: the power of the Module transmitting frequency should be ignored.



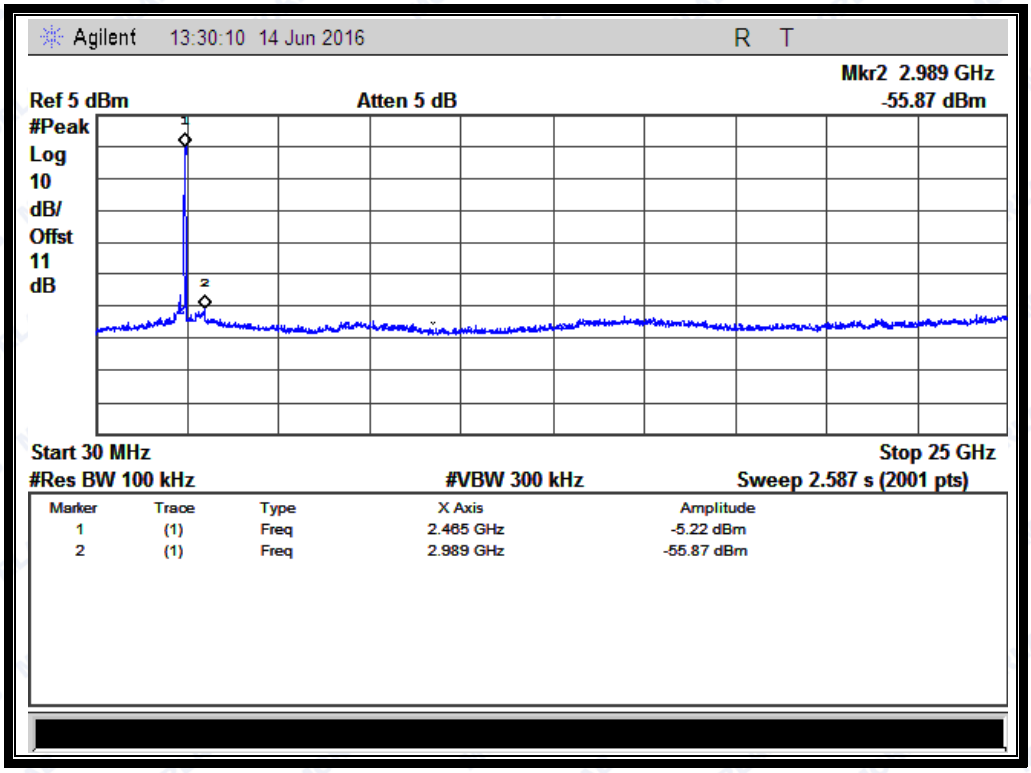
(Channel = 1, 30MHz to 25GHz)



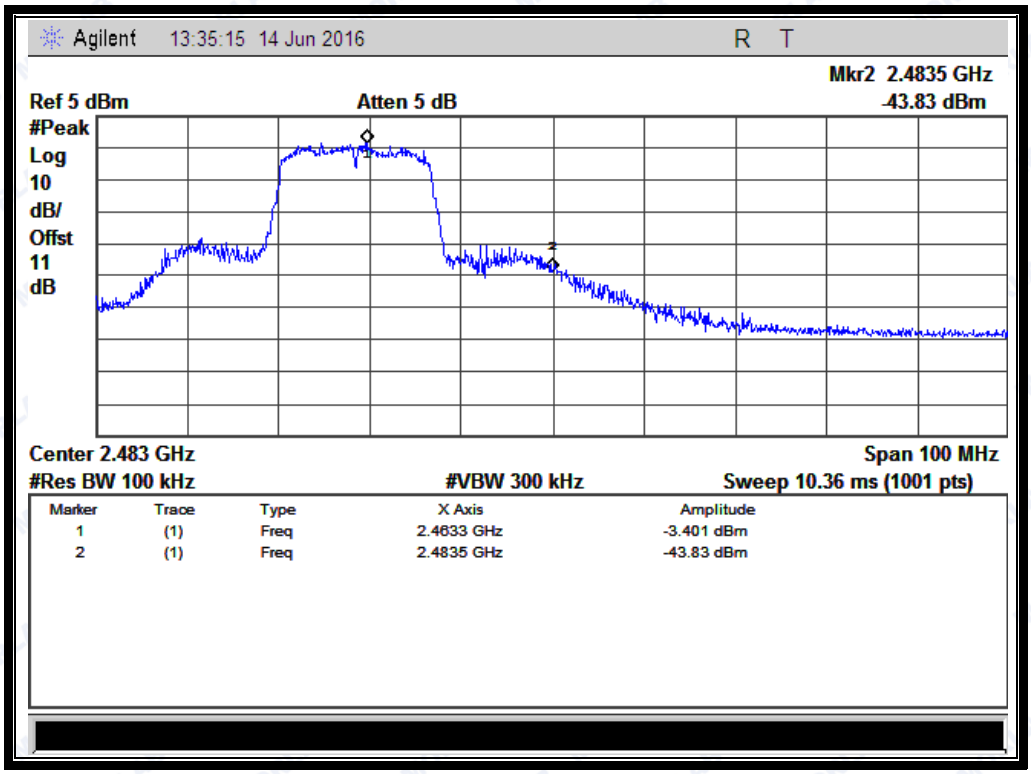
(Band Edge @ Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge @ Channel = 11)

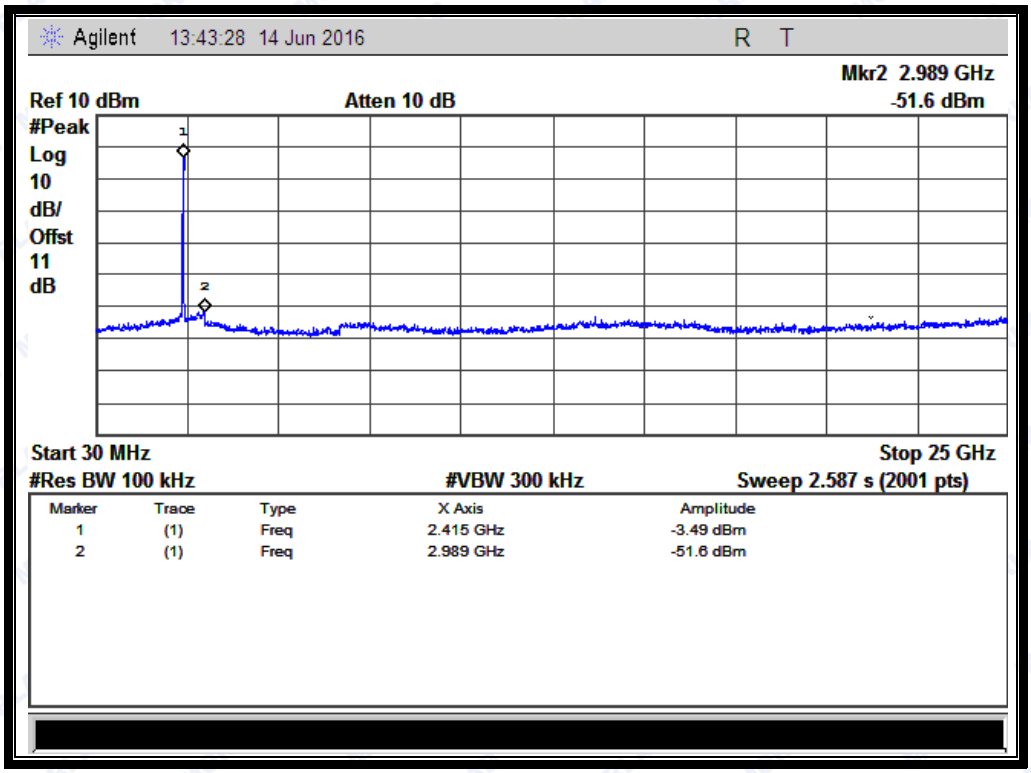
2.4.3.3 802.11n -20MHz Test mode

A. Test Verdict:

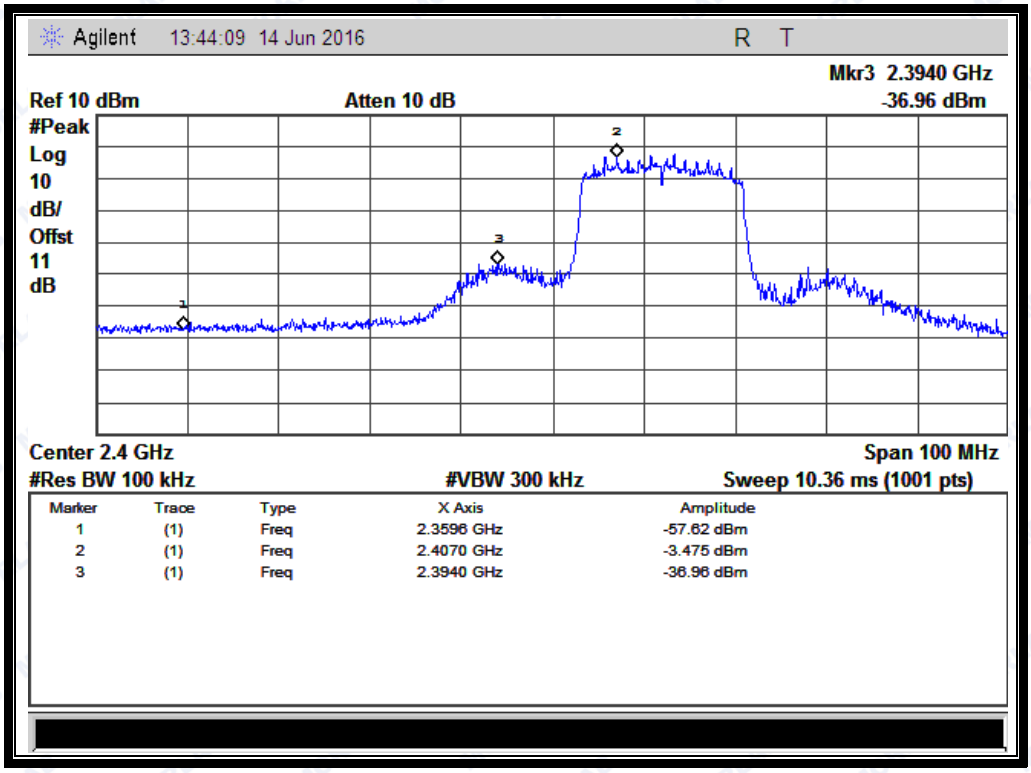
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-51.60	-3.49	-23.49	PASS
6	2437	-50.76	-4.41	-24.41	PASS
11	2462	-50.56	-4.03	-24.03	PASS

B. Test Plots:

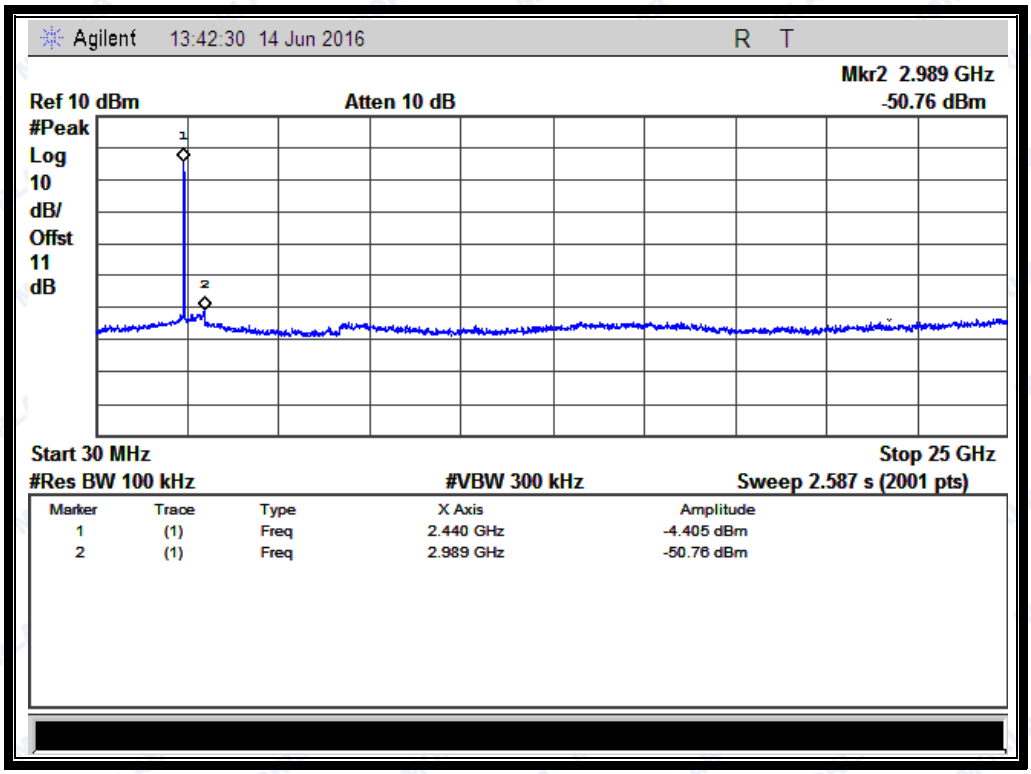
Note: the power of the Module transmitting frequency should be ignored.



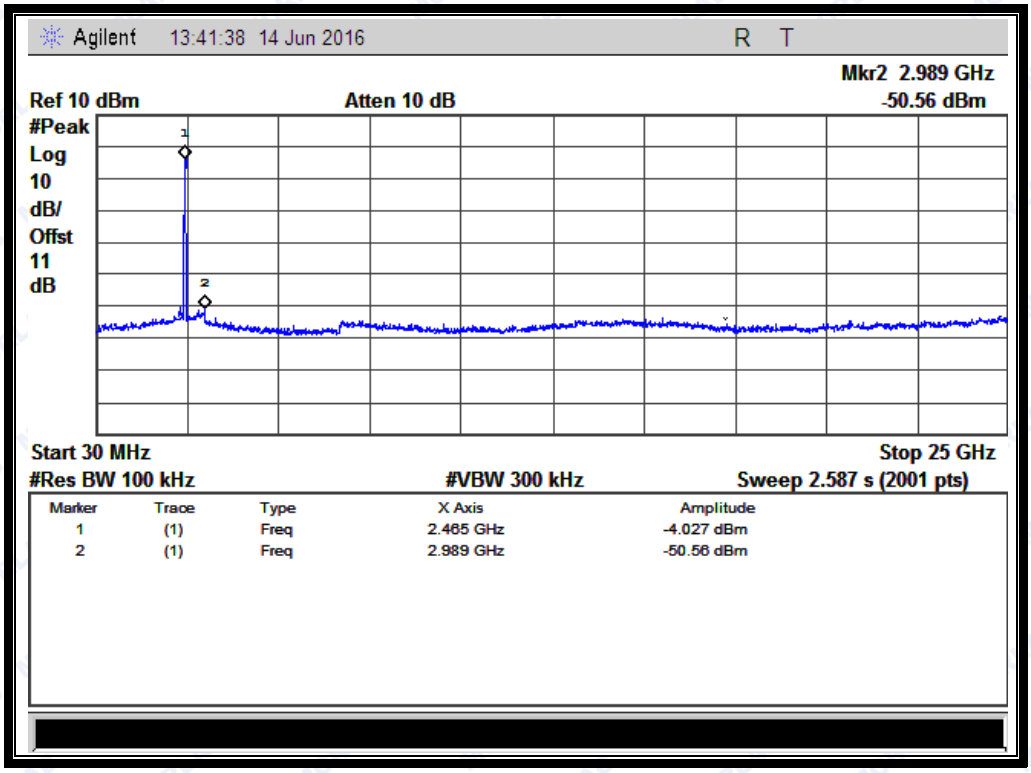
(Channel = 1, 30MHz to 25GHz)



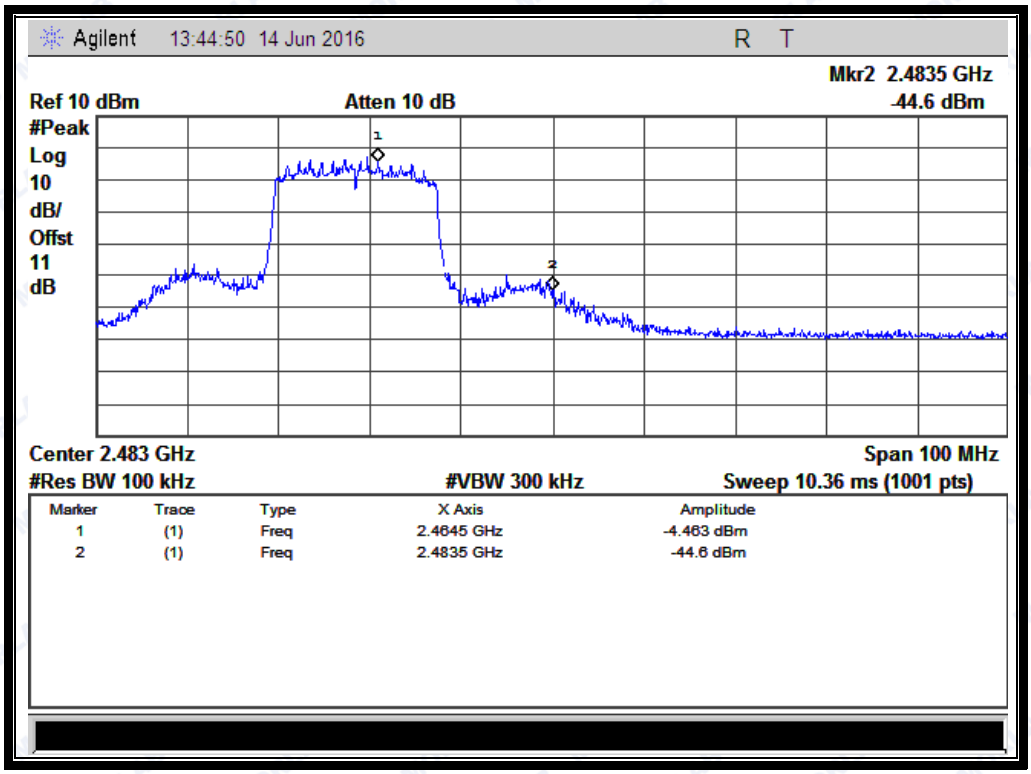
(Band Edge @ Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge @ Channel = 11)

2.5 Power spectral density (PSD)

2.5.1 Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

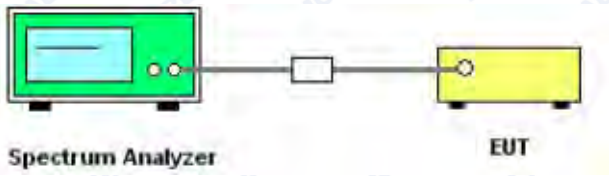
2.5.2 Test Description

A. Test procedure

The measured power spectral density was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for PSD test:

a) Set analyzer center frequency to channel center frequency.
b) Set the span to 30MHz
c) Set the RBW to 3 kHz
d) Set the VBW to 10KHz
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.

B. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

KDB 558074 Section 10.2 was used in order to prove compliance.

C. Equipments List:

Please reference ANNEX A(1.5).

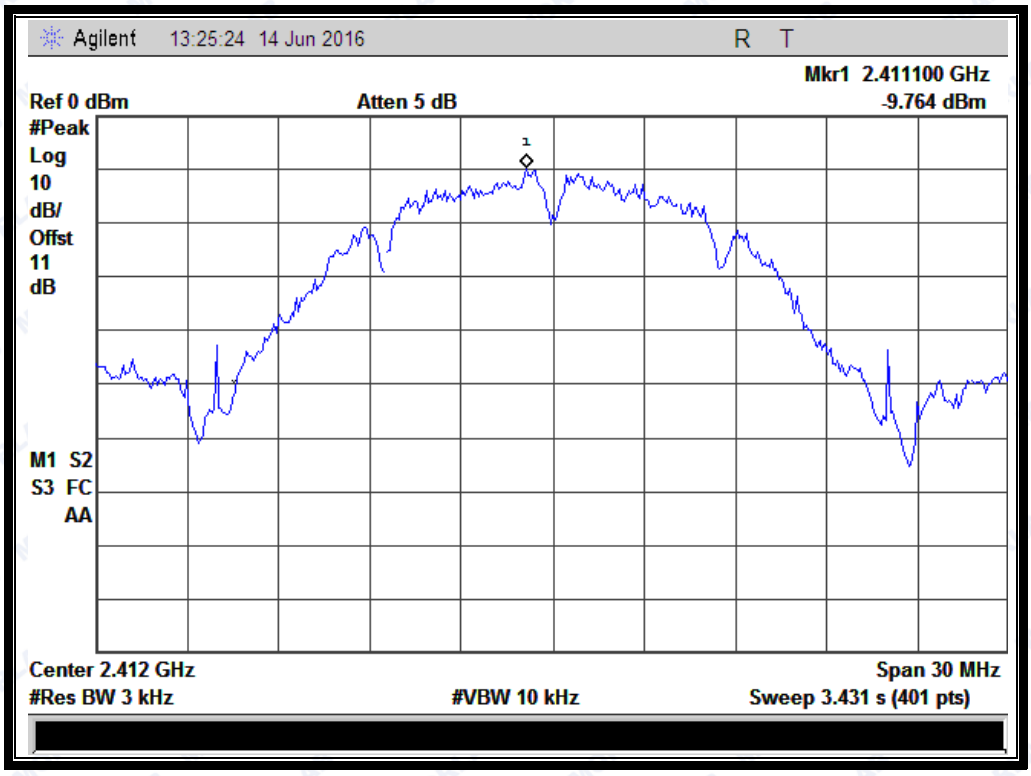
2.5.3 Test Result

2.5.3.1 802.11b Test mode

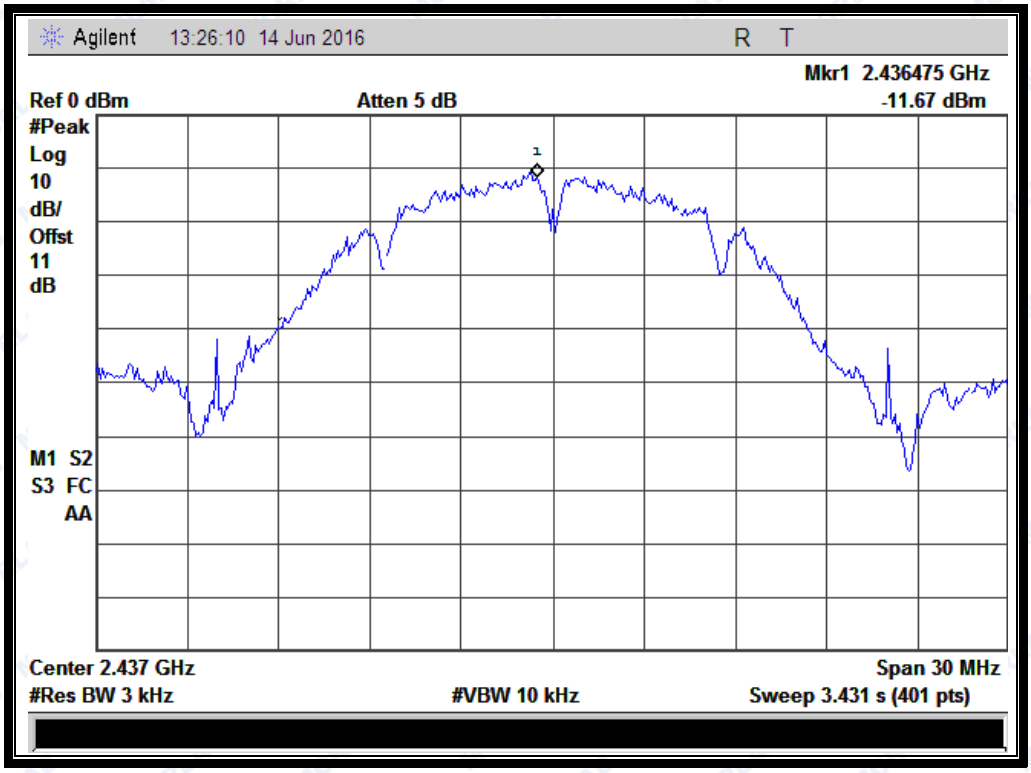
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-9.76	8	PASS
6	2437	-11.67	8	PASS
11	2462	-10.43	8	PASS
Measurement uncertainty: ±1.3dB				

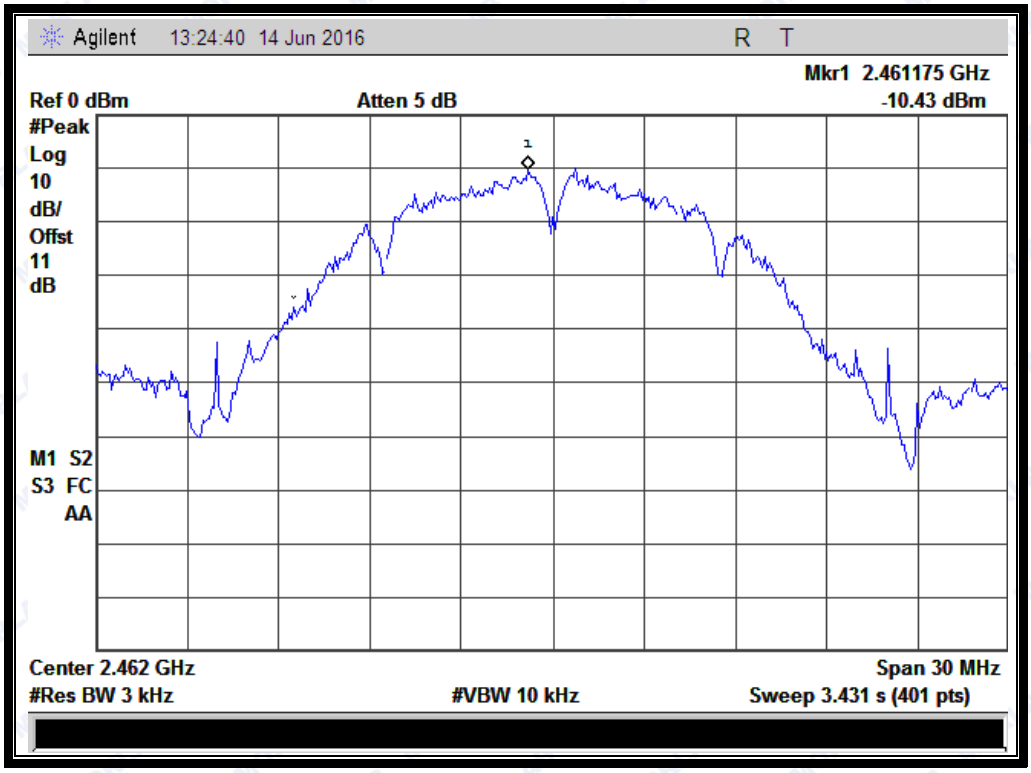
B. Test Plots:



(Channel = 1 @ 802.11b)



(Channel = 6 @ 802.11b)



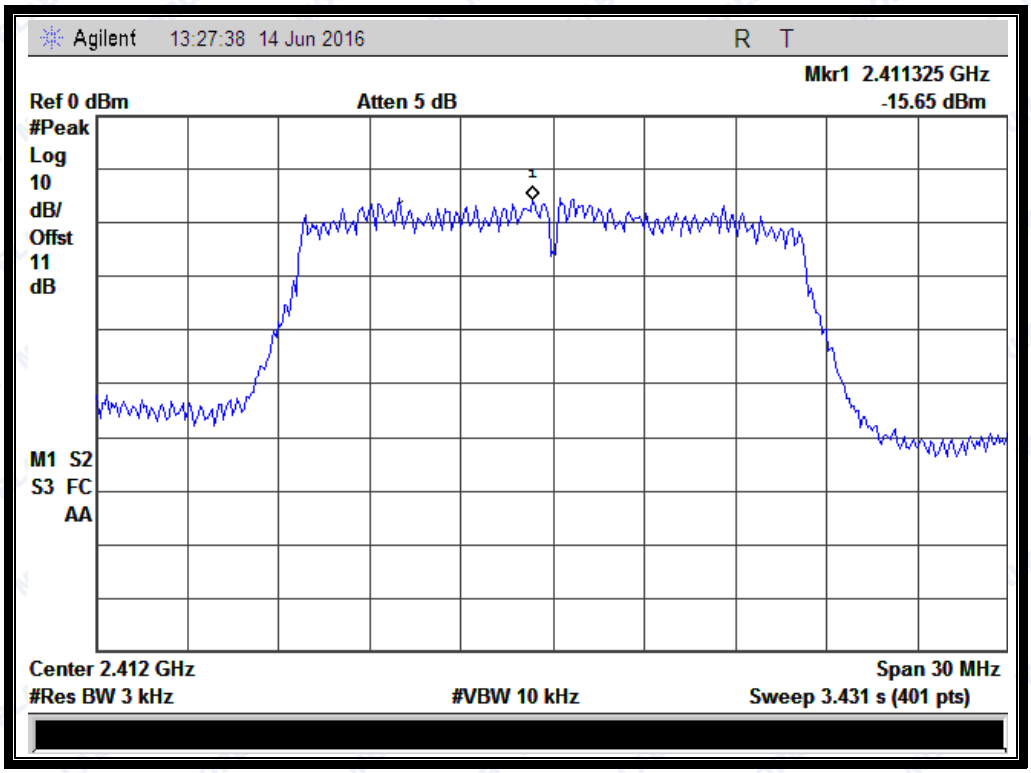
(Channel = 11 @ 802.11b)

2.5.3.2 802.11g Test mode

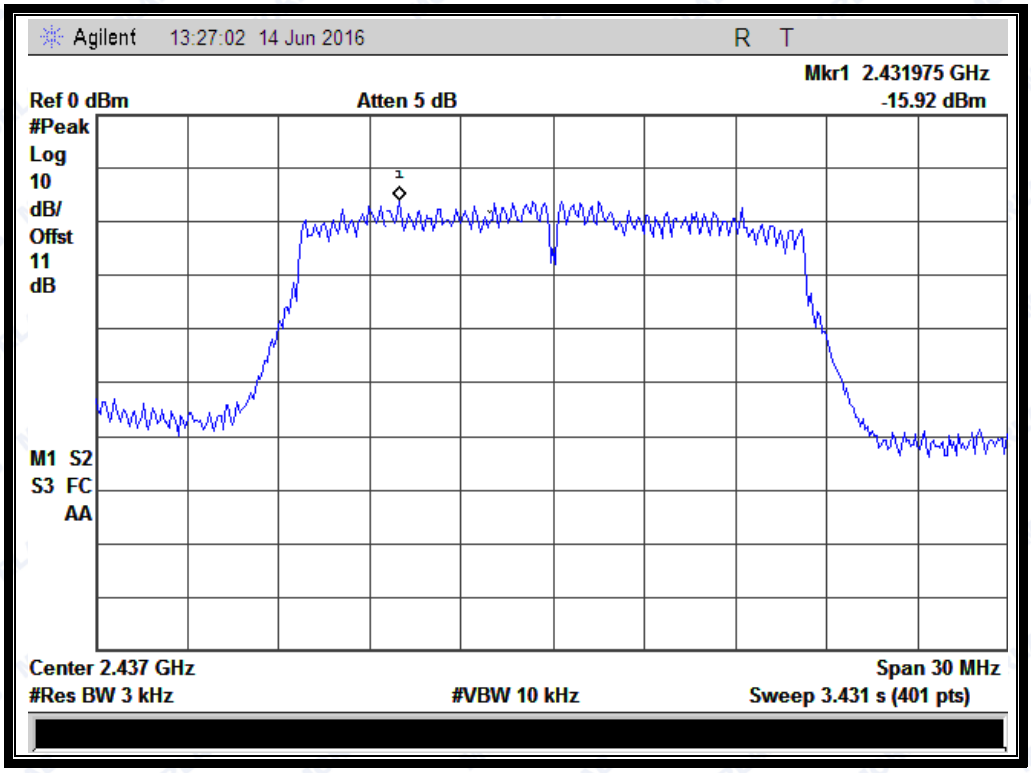
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-15.65	8	PASS
6	2437	-15.92	8	PASS
11	2462	-15.89	8	PASS
Measurement uncertainty: ±1.3dB				

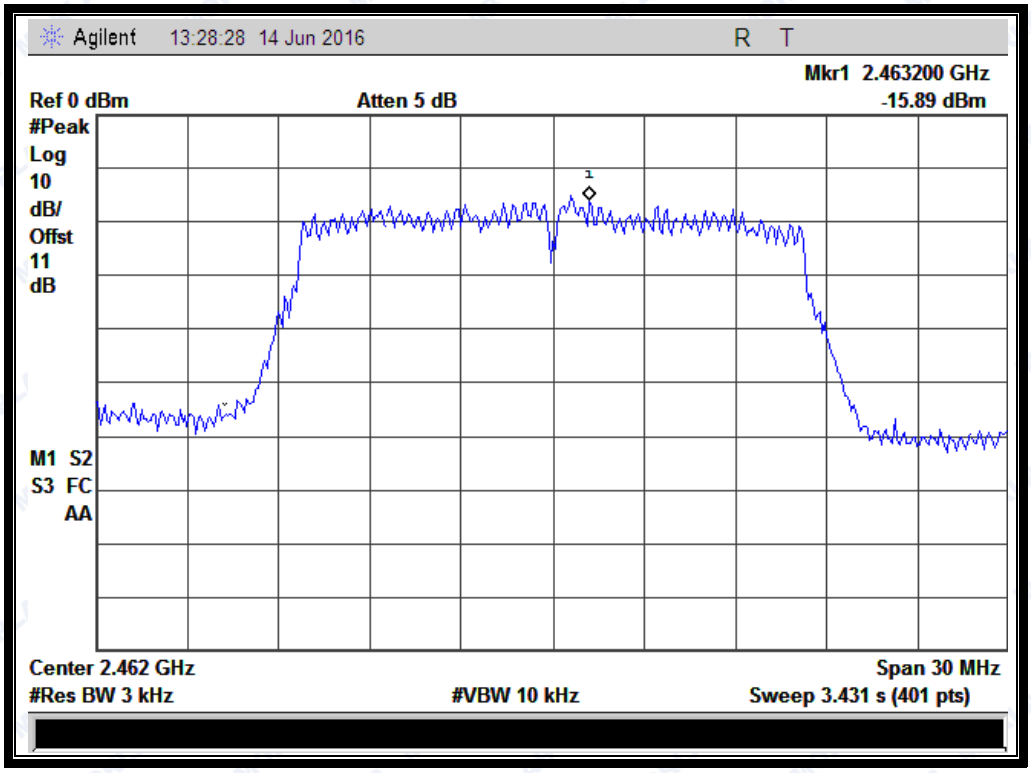
B. Test Plots:



(Channel = 1 @ 802.11g)



(Channel = 6 @ 802.11g)



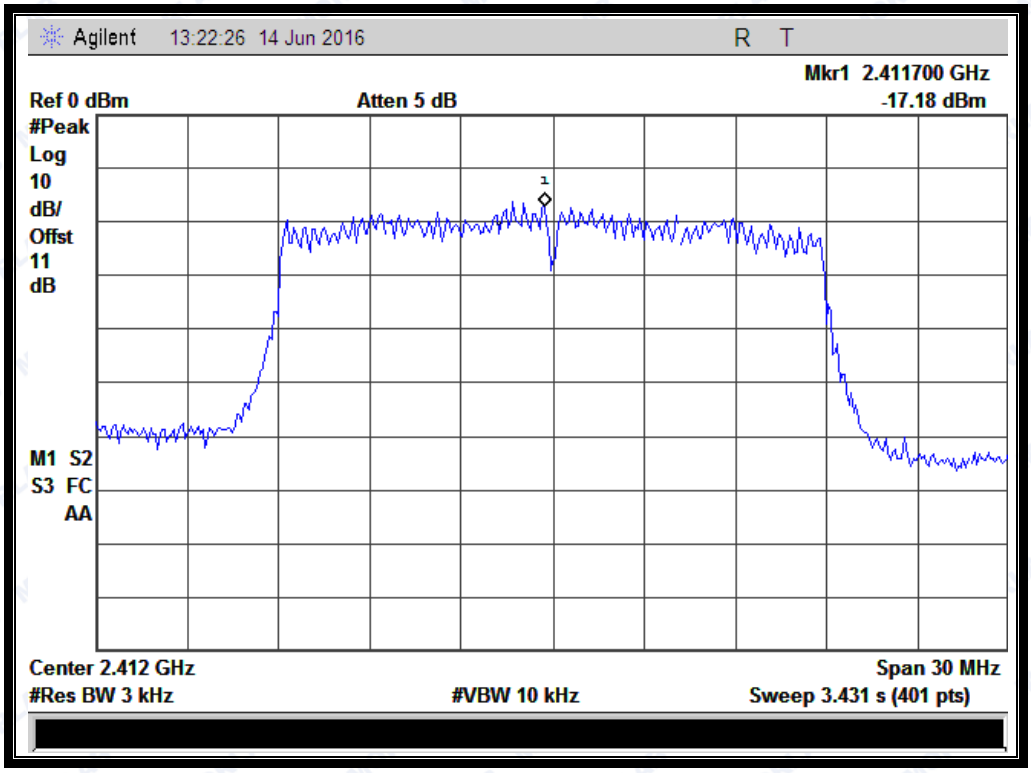
(Channel = 11 @ 802.11g)

2.5.3.3 802.11n-20MHz Test mode

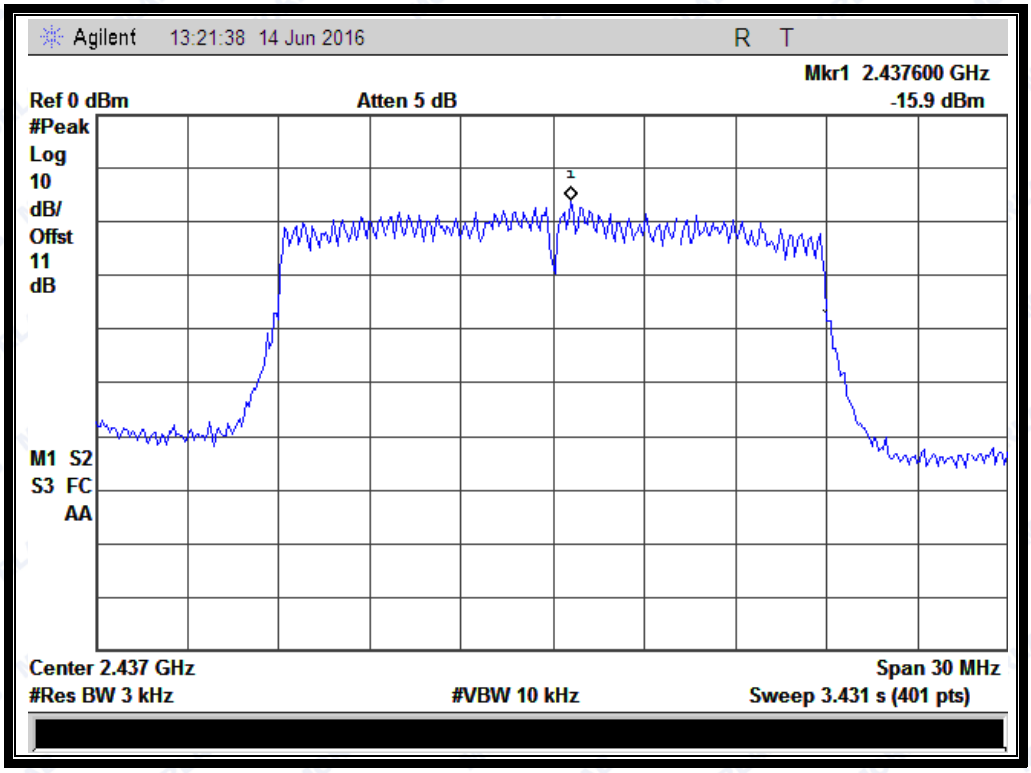
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-17.18	8	PASS
6	2437	-15.90	8	PASS
11	2462	-17.17	8	PASS
Measurement uncertainty: ±1.3dB				

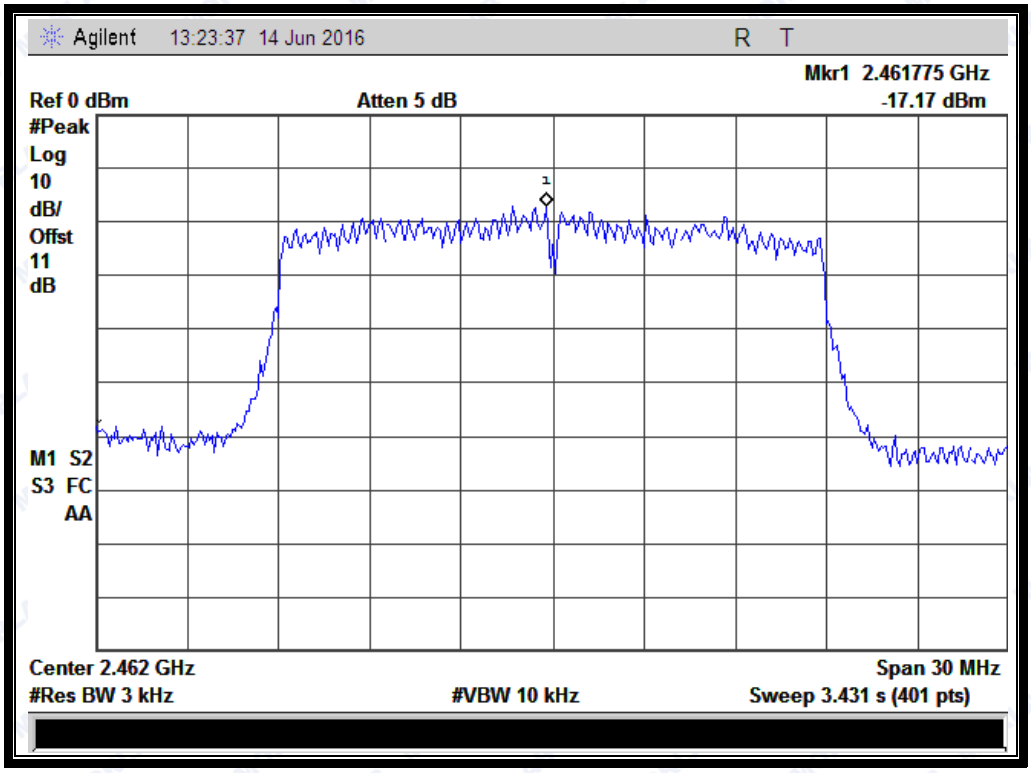
B. Test Plots:



(Channel = 1 @ 802.11n-20MHz)



(Channel = 6 @ 802.11n-20MHz)



(Channel = 11 @ 802.11n-20MHz)

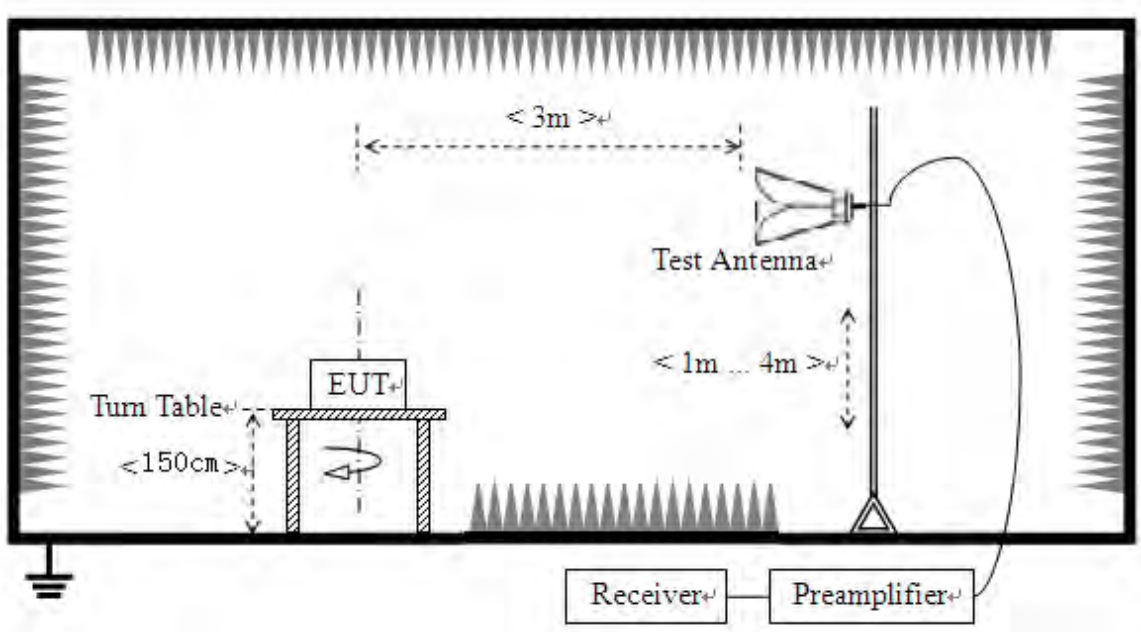
2.6 Restricted Frequency Bands

2.6.1 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, In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

2.6.2 Test Description

A. Test Setup



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.

For the Test Antenna:

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.

KDB 558074 Section 12.1 was used in order to prove compliance.

B. Equipments List:

Please reference ANNEX A(1.5).

2.6.3 Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:
$E\ [dB\mu V/m] = U_R + A_T + A_{Factor}\ [dB]$; $A_T = L_{Cable\ loss}\ [dB] - G_{preamp}\ [dB]$
A_T: Total correction Factor except Antenna
U_R: Receiver Reading
G_{preamp}: Preamplifier Gain
A_{Factor}: Antenna Factor at 3m

Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

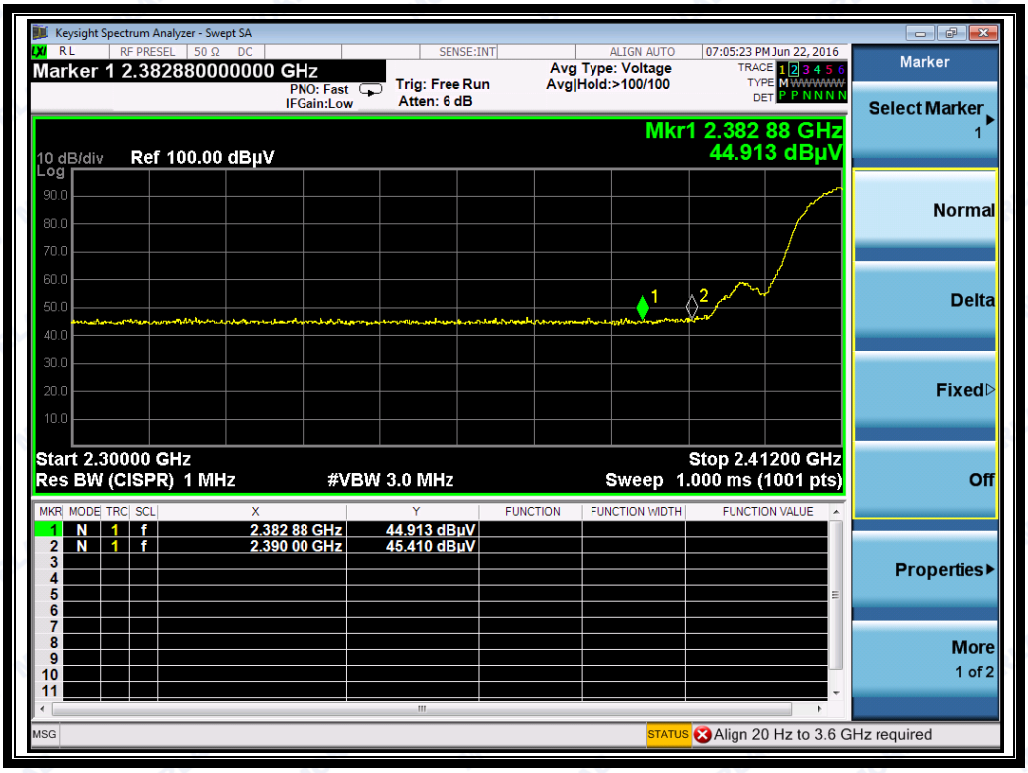
2.6.3.1 802.11b Test mode

The lowest and highest channels are tested to verify the band edge emissions.

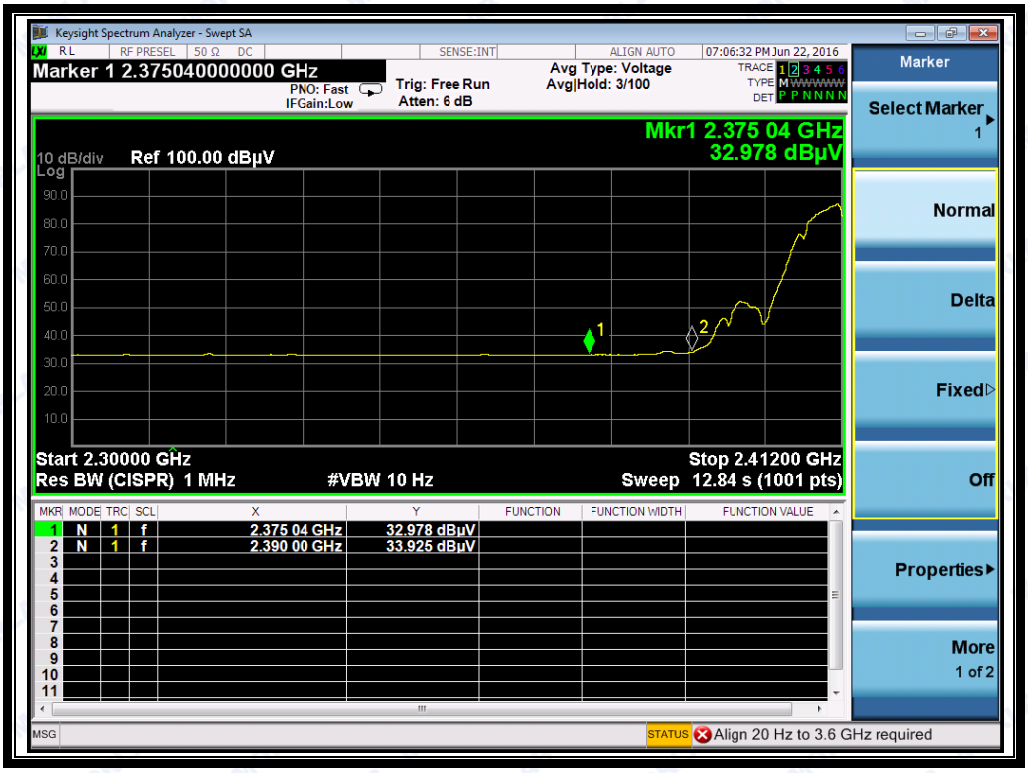
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
1	2382.88	PK	44.91	-33.63	32.56	43.84	74	Pass
1	2375.04	AV	32.98	-33.63	32.56	31.91	54	Pass
11	2484.47	PK	56.69	-33.18	32.5	56.01	74	Pass
11	2484.78	AV	48.14	-33.18	32.5	47.46	54	Pass

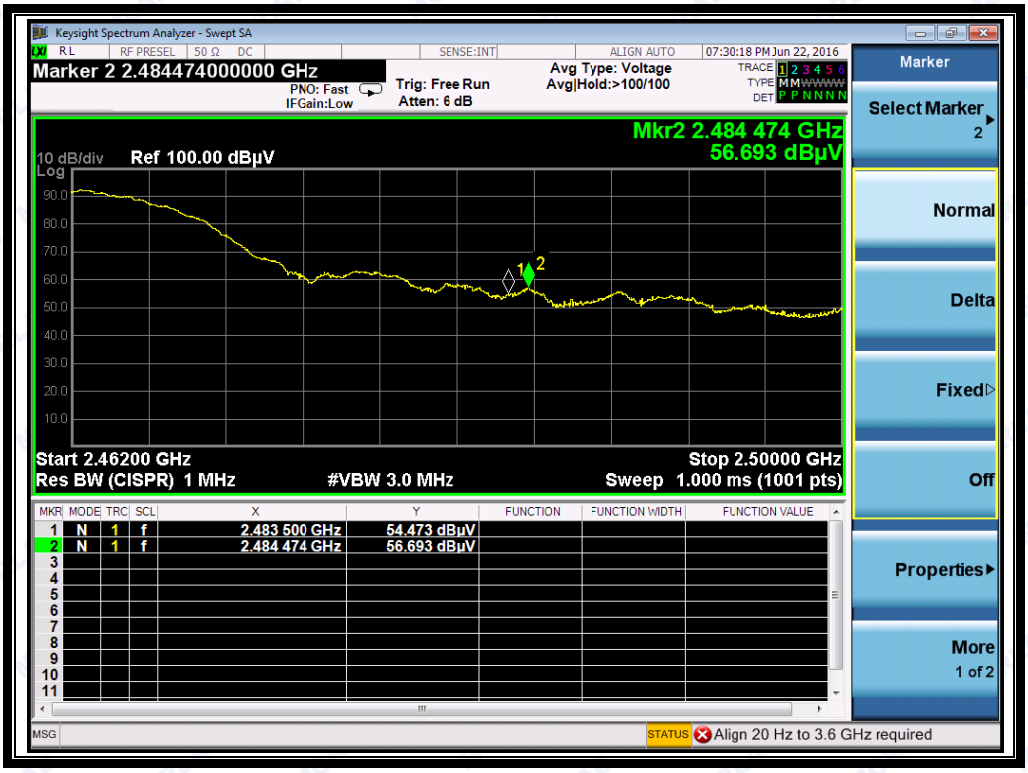
B. Test Plots:



(Plot A1: Channel = 1 PEAK @ 802.11b)



(Plot A2: Channel = 1 AVG @ 802.11b)



(Plot B1: Channel = 11 PEAK @ 802.11b)

(Plot B2: Channel = 11 AVG @ 802.11b)

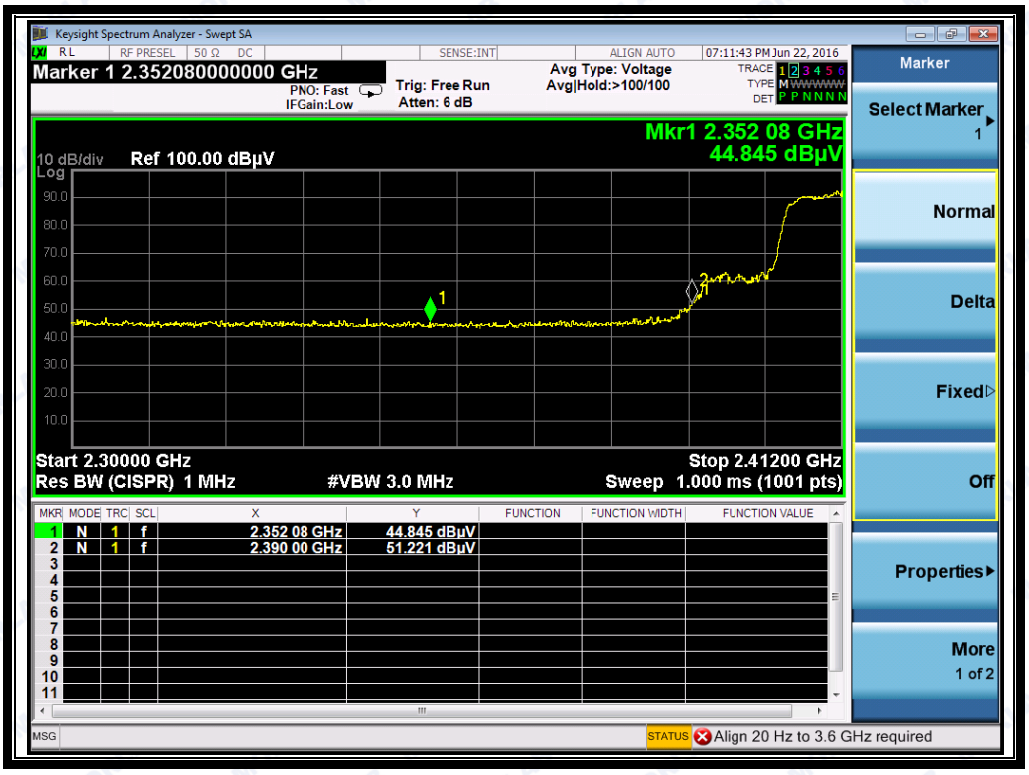
2.6.3.2 802.11g Test mode

The lowest and highest channels are tested to verify the band edge emissions.

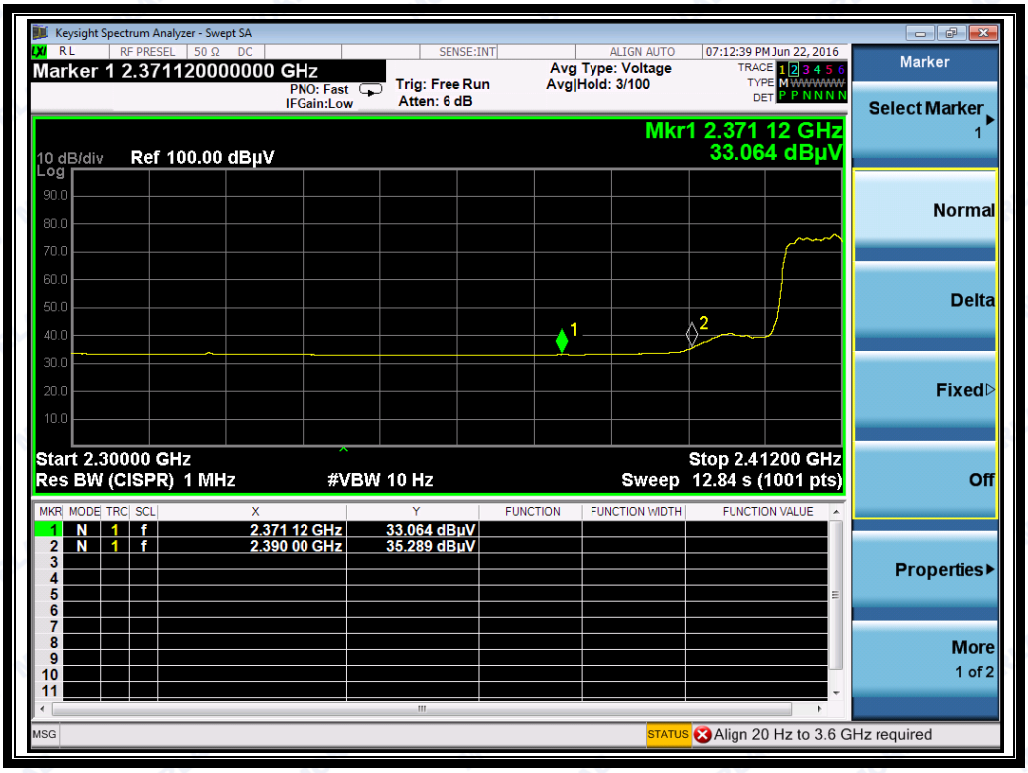
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBµV/m)	Limit (dBµV/m)	Verdict
		PK/ AV						
1	2352.08	PK	44.85	-33.63	32.56	43.78	74	Pass
1	2371.12	AV	33.06	-33.63	32.56	31.99	54	Pass
11	2484.44	PK	50.23	-33.18	32.5	49.55	74	Pass
11	2485.58	AV	33.51	-33.18	32.5	32.83	54	Pass

B. Test Plots:



(Plot C1: Channel = 1 PEAK @ 802.11g)



(Plot C2: Channel = 1 AVG @ 802.11g)

(Plot D1: Channel = 11 PEAK @ 802.11g)

(Plot D2: Channel = 11 AVG @ 802.11g)

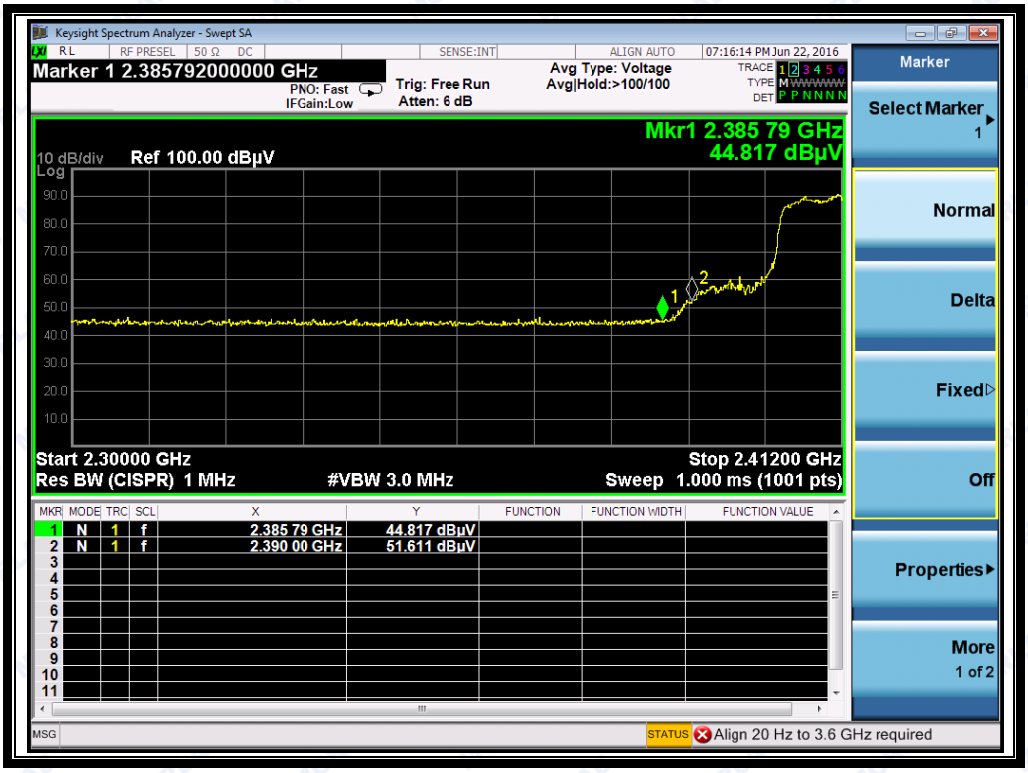
2.6.3.3 802.11n-20MHz Test mode

The lowest and highest channels are tested to verify the band edge emissions.

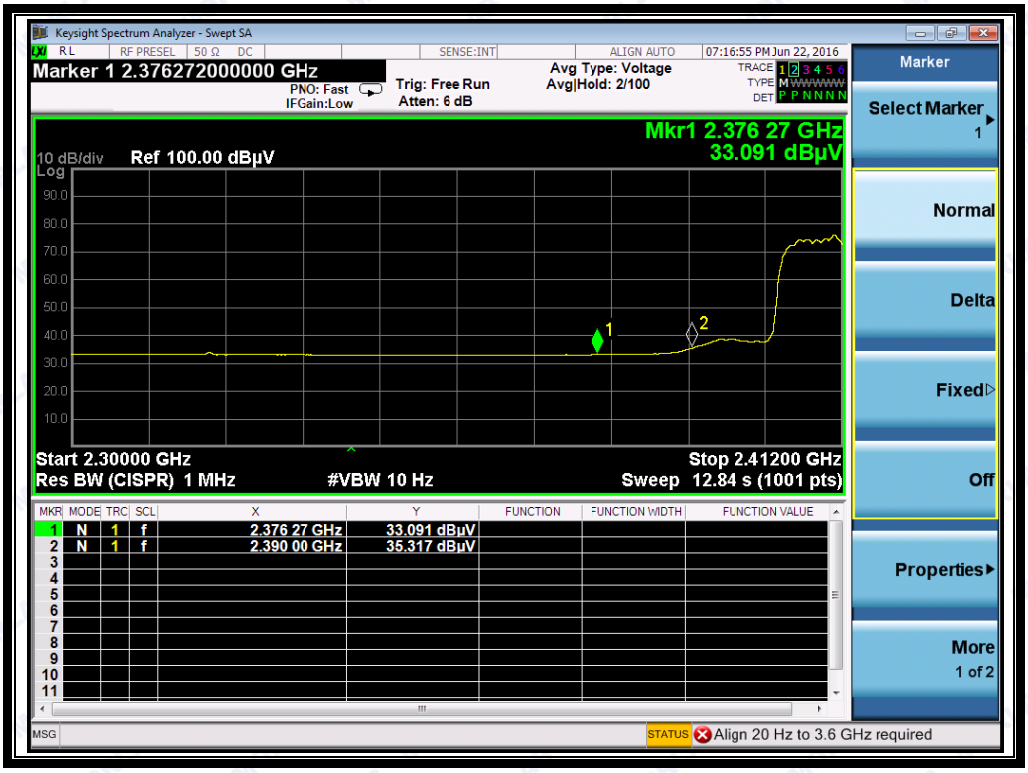
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBµV/m)	Limit (dBµV/m)	Verdict
		PK/ AV						
1	2385.79	PK	44.82	-33.63	32.56	43.75	74	Pass
1	2376.27	AV	33.09	-33.63	32.56	32.02	54	Pass
11	2484.89	PK	48.96	-33.18	32.5	48.28	74	Pass
11	2484.44	AV	33.86	-33.18	32.5	33.18	54	Pass

B. Test Plots:

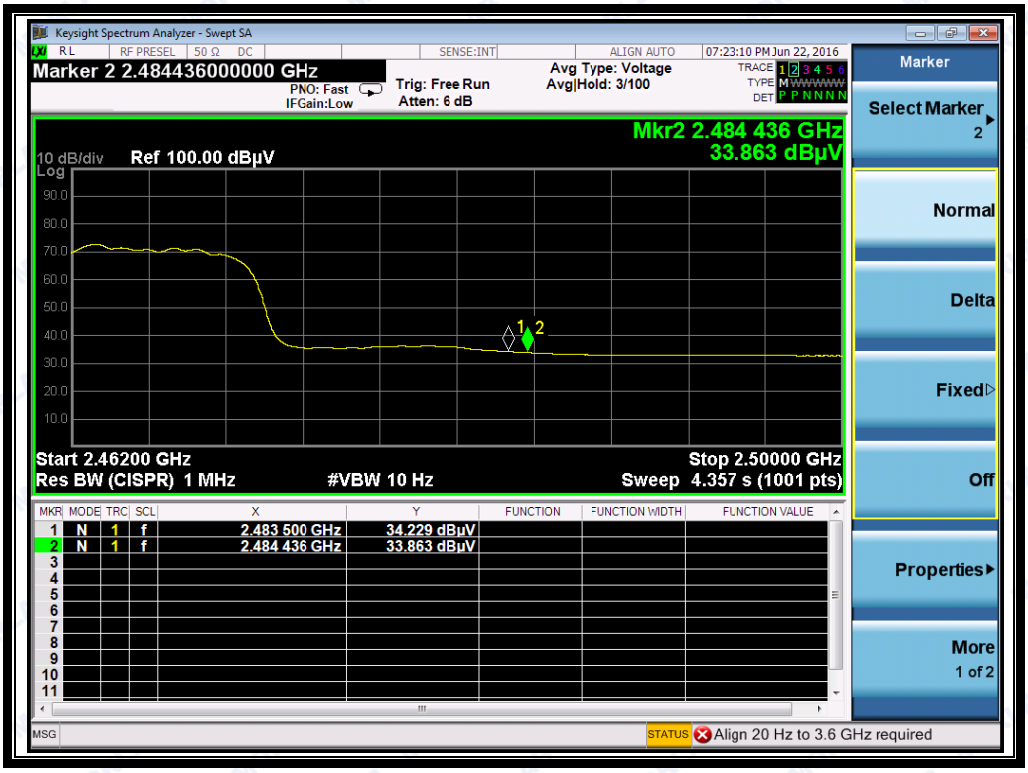


(Plot E1: Channel = 1 PEAK @ 802.11n-20)



(Plot E2: Channel = 1 AVG @ 802.11n-20)

(Plot F1: Channel = 11 PEAK @ 802.11n-20)



(Plot F2: Channel = 11 AVG @ 802.11n-20)

2.7 Conducted Emission

2.7.1 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 50μH/50Ω line impedance stabilization network (LISN).

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

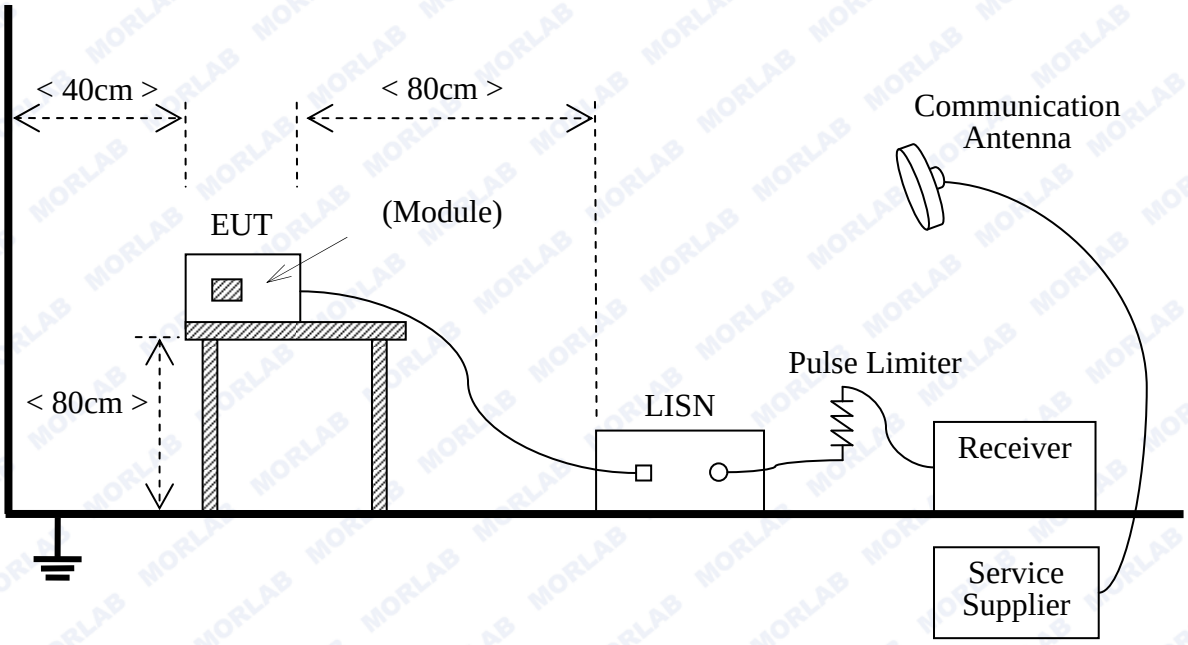
NOTE:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.7.2 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 C63.10 2013.

B. Equipments List:

Please reference ANNEX A(1.5).

2.7.3 Test Result

Note: Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

A. Test setup:

N.A

B. Test Plots:

N.A

2.8 Radiated Emission

2.8.1 Requirement

According to FCC section 15.247(d), 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 (μV/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.

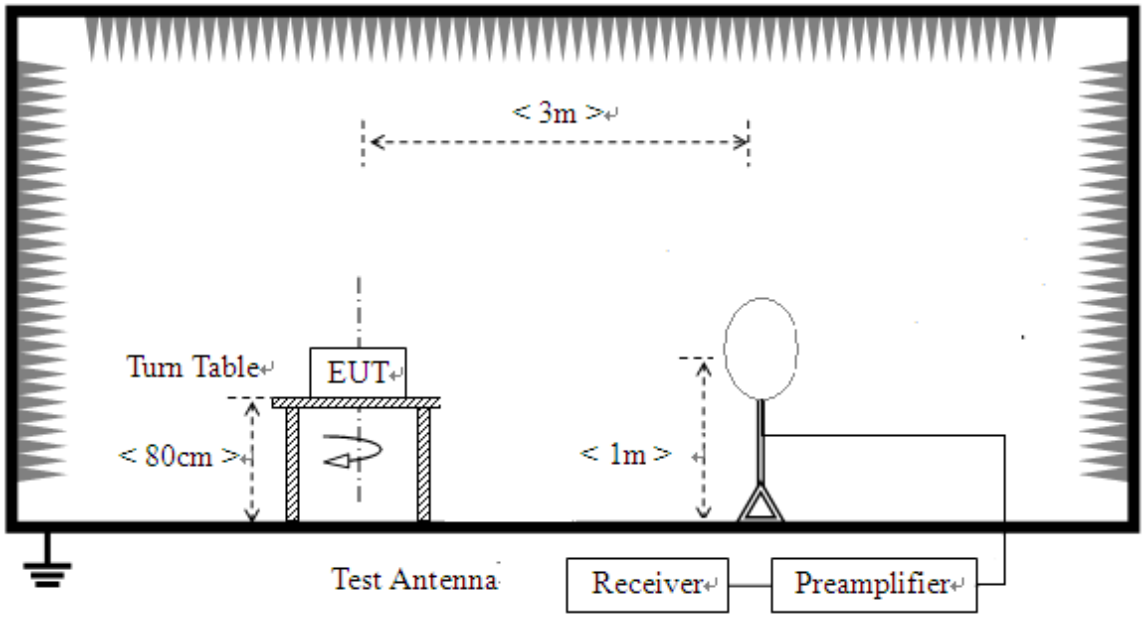
For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

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)

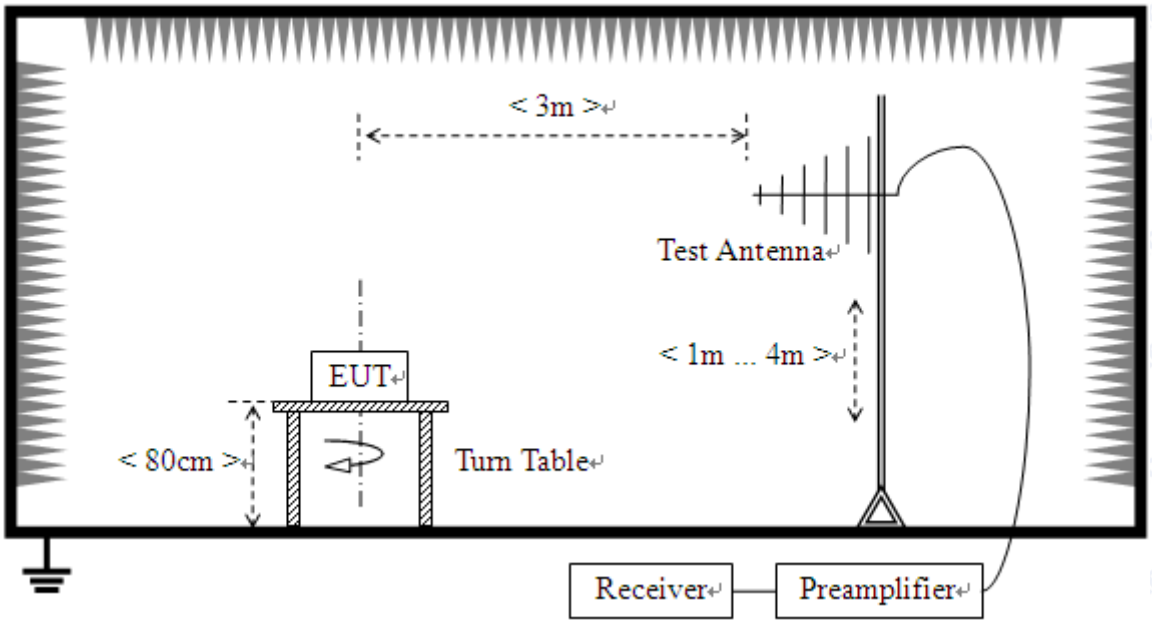
2.8.2 Test Description

A. Test Setup:

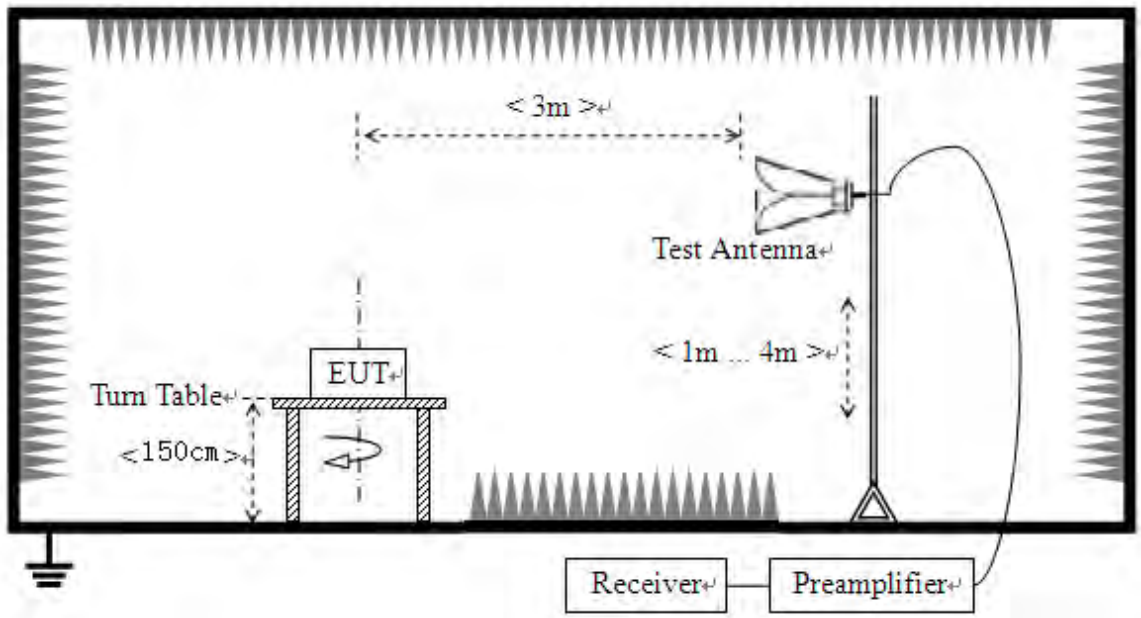
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



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 C63.10 (2013). For radiated emissions below or equal to 1GHz,The EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10

For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

The EUT 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

For the Test Antenna:

(a) 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.

(b) 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:

Please reference ANNEX A(1.5).

2.8.3 Test Result

According to ANSI C63.10, 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:

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

A_T: Total correction Factor except Antenna

U_R: Receiver Reading

G_{preamp}: Preamplifier Gain

A_{Factor}: Antenna Factor at 3m

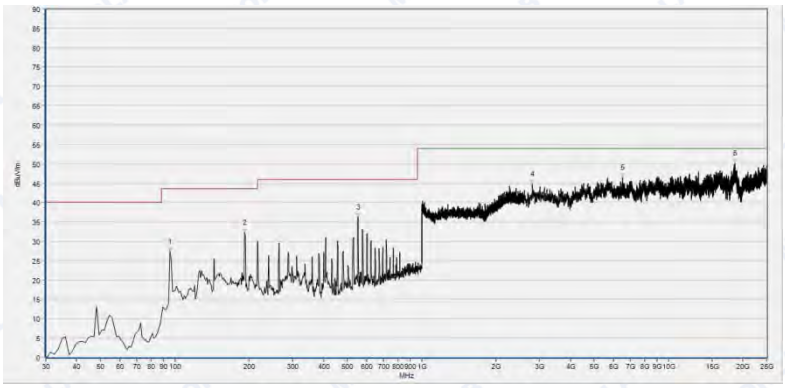
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

2.8.3.1 802.11b Test mode

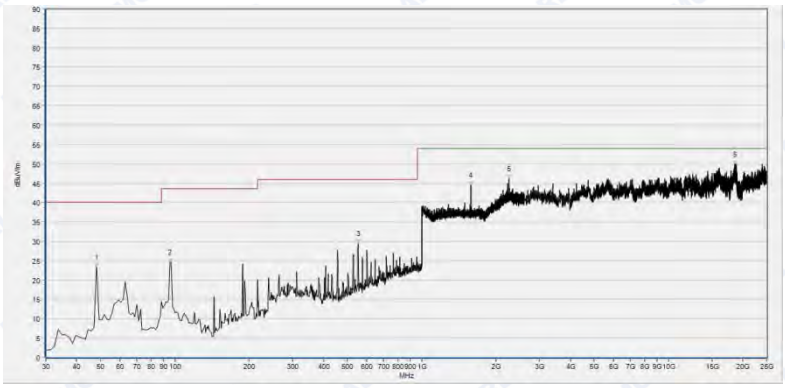
A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 1



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
95.557	27.34	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
191.464	32.19	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
552.028	36.15	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2811.820	44.70	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
6510.529	46.35	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
18539.480	50.09	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

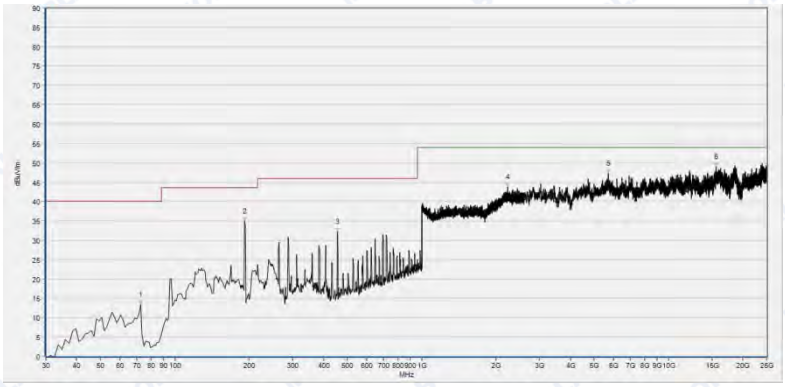
(Antenna Horizontal, 30MHz to 25GHz)



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	23.22	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	24.49	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
553.242	29.32	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
1581.993	44.48	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
2256.823	46.16	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
18567.994	49.72	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

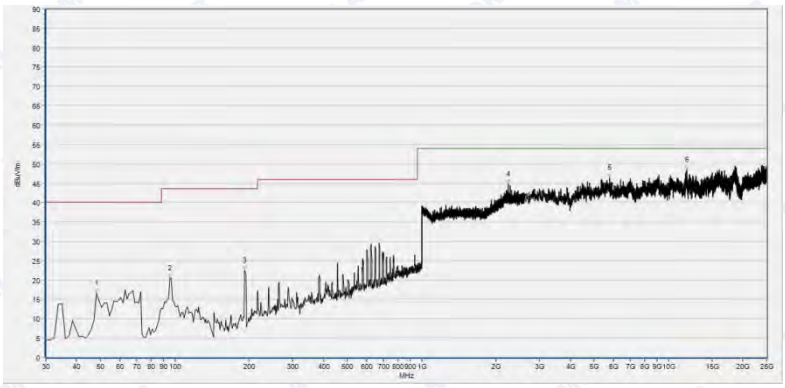
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
72.491	13.38	N.A	N.A	N.A	40.00	N.A	Horizontal	PASS
191.464	34.87	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
456.120	32.10	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2231.853	43.80	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
5708.056	47.25	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
15610.656	49.02	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

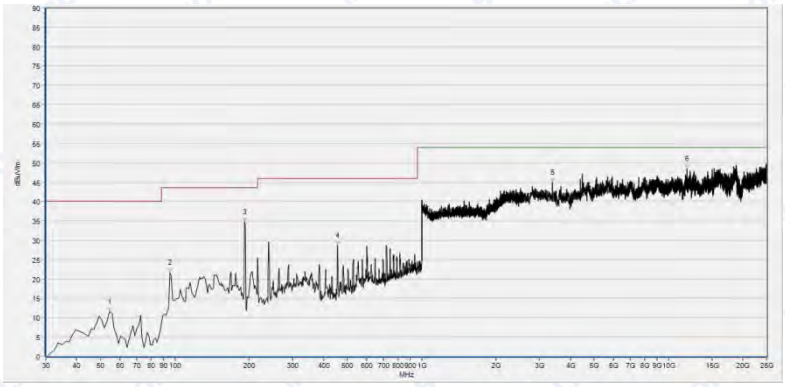
(Antenna Horizontal, 30MHz to 25GHz)



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	16.60	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	20.48	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
191.464	22.43	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
2239.536	44.68	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
5773.231	46.36	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
11891.580	48.51	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

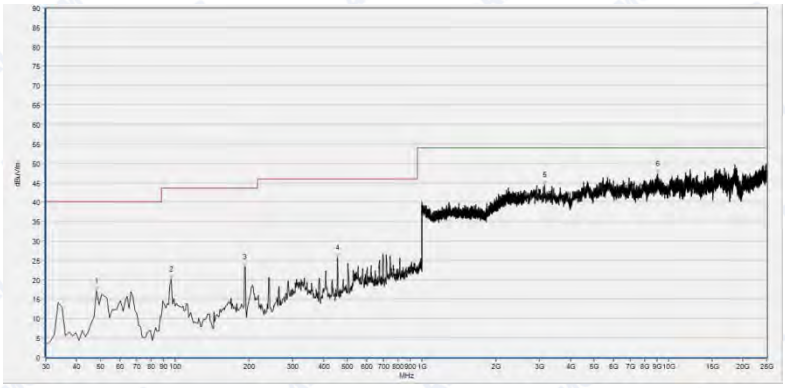
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 11



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
54.280	11.59	N.A	N.A	N.A	40.00	N.A	Horizontal	PASS
95.557	21.55	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
191.464	34.77	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
456.120	28.64	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
3386.179	44.84	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
11899.727	48.47	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



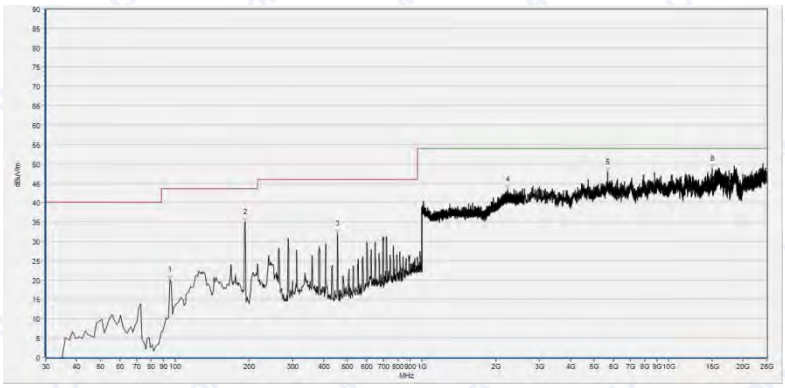
Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	17.08	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
96.771	20.15	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
191.464	23.38	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
456.120	25.59	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
3153.992	44.48	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
9048.300	47.28	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

2.8.3.2 802.11g Test mode

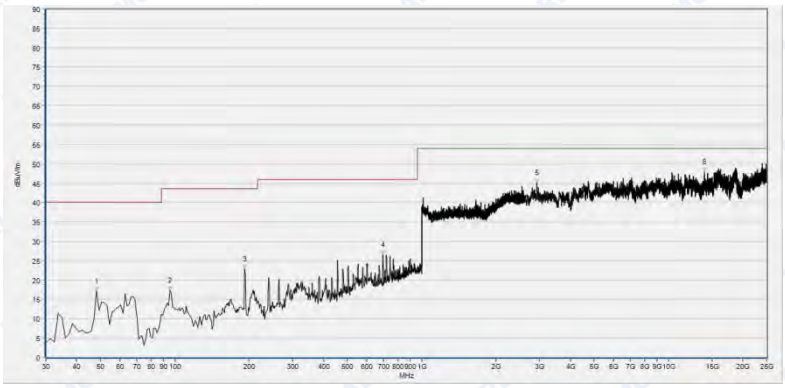
A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 1



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
95.557	20.18	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
192.678	35.03	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
456.120	32.03	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2232.493	43.41	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
5675.468	47.85	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
15020.004	48.72	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

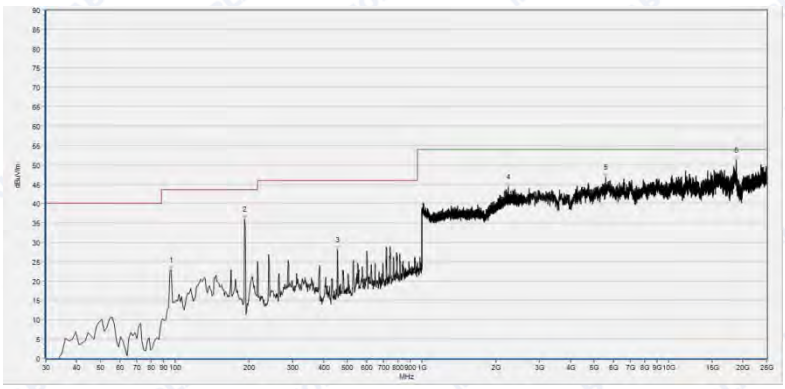
(Antenna Horizontal, 30MHz to 25GHz)



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	17.10	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	17.20	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
191.464	22.75	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
696.496	26.42	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
2929.951	45.11	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
14001.637	47.92	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

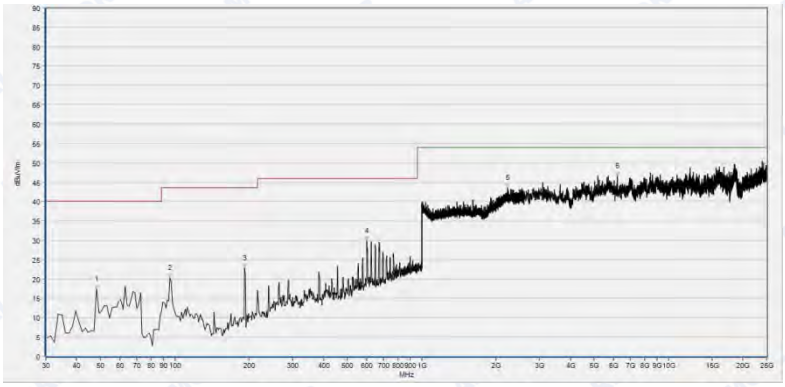
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
96.771	22.73	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
191.464	35.93	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
456.120	28.02	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2247.859	44.30	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
5577.705	46.75	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
18853.137	51.15	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

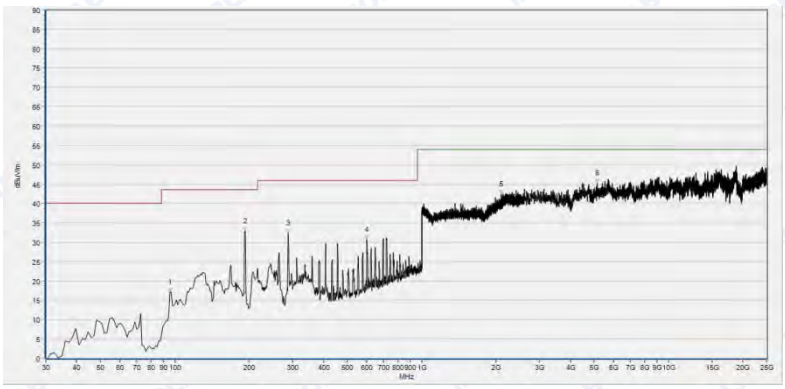
(Antenna Horizontal, 30MHz to 25GHz)



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	17.43	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	20.34	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
191.464	22.85	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
599.374	29.89	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
2224.170	43.62	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
6205.019	46.53	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

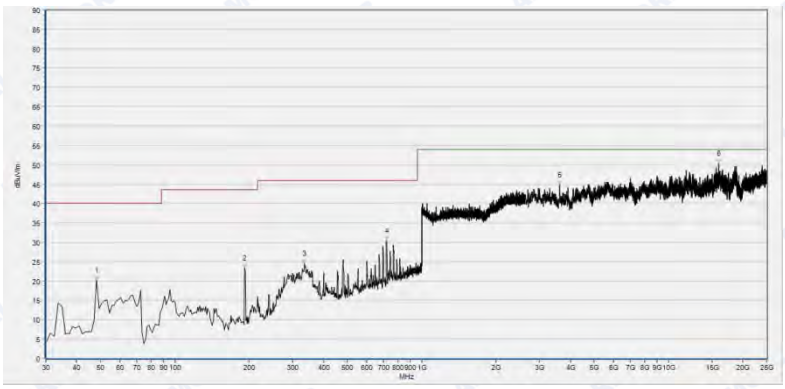
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 11



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
95.557	17.15	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
192.678	32.92	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
287.372	32.31	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
599.374	30.73	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2092.917	42.47	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
5145.917	45.30	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



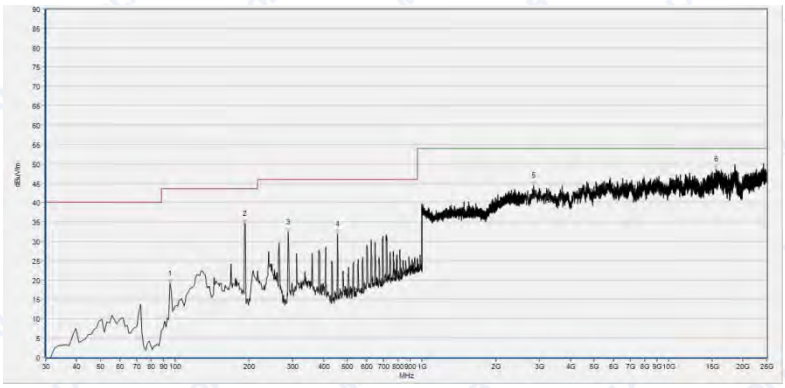
Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	20.17	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
191.464	23.37	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
334.718	24.55	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
720.776	30.38	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
3626.514	44.68	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
16009.856	50.26	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

2.8.3.3 802.11n-20MHz Test mode

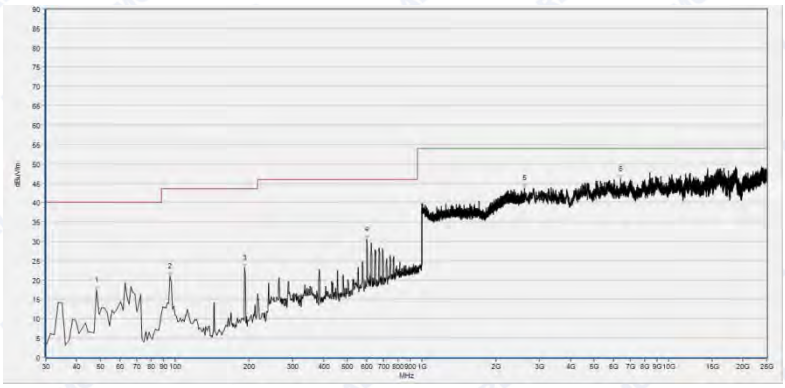
A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 1



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
95.557	19.17	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
191.464	34.60	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
287.372	32.28	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
456.120	31.79	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2836.261	44.36	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
15626.950	48.55	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

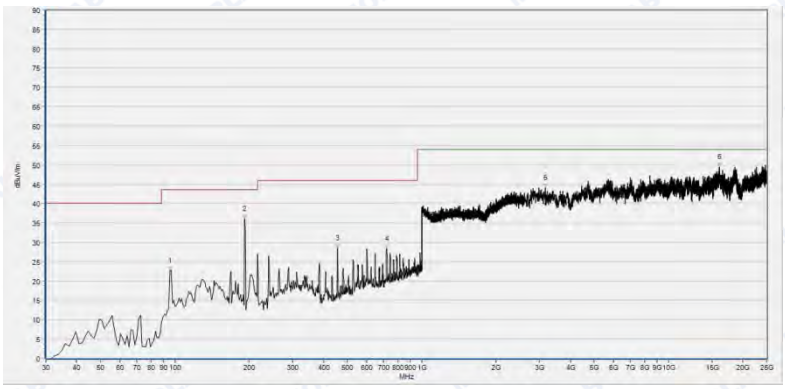
(Antenna Horizontal, 30MHz to 25GHz)



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	17.47	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	20.95	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
191.464	23.14	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
599.374	30.49	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
2608.147	43.73	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
6404.619	46.06	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

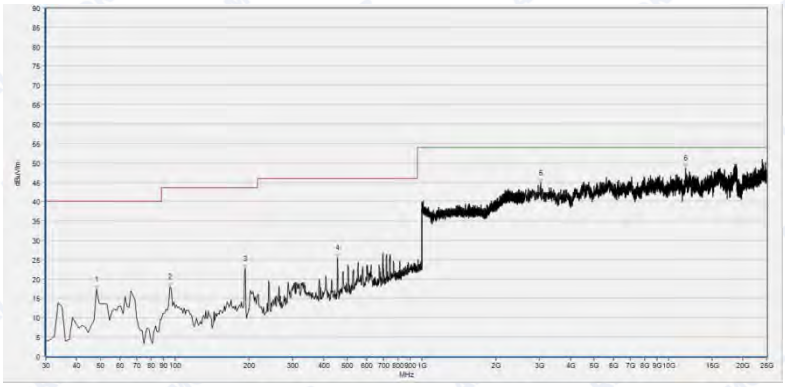
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
95.557	22.60	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
191.464	36.07	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
456.120	28.53	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
721.990	28.29	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
3162.139	44.13	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
16038.371	49.39	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

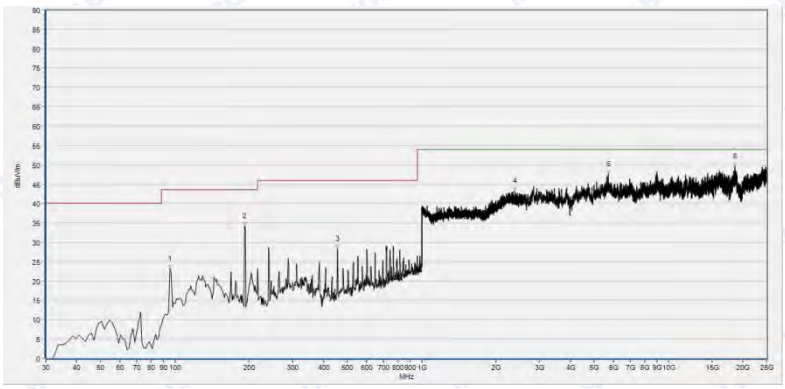
(Antenna Horizontal, 30MHz to 25GHz)



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	17.29	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	17.85	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
192.678	22.58	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
456.120	25.54	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
3035.861	44.80	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
11749.009	48.61	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

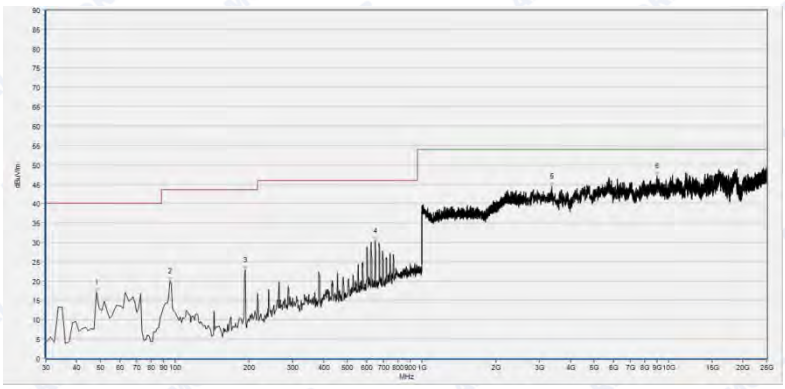
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 11



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
95.557	23.15	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
191.464	34.20	N.A	N.A	N.A	43.50	N.A	Horizontal	PASS
456.120	28.32	N.A	N.A	N.A	46.00	N.A	Horizontal	PASS
2377.191	43.23	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
5691.762	47.52	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
18588.362	49.68	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



Fre.(MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
48.210	17.06	N.A	N.A	N.A	40.00	N.A	Vertical	PASS
95.557	19.91	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
192.678	22.80	N.A	N.A	N.A	43.50	N.A	Vertical	PASS
647.935	30.29	N.A	N.A	N.A	46.00	N.A	Vertical	PASS
3361.738	44.46	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
8962.757	47.09	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

ANNEX A GENERAL INFORMATION

1.1 Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

1.2 Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

1.3 Facilities and Accreditations

Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L3572.

All measurement facilities used to collect the measurement data are located at FL.1, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10 2013, ANSI C63.4 2014 and CISPR Publication 22; the FCC registration number is 695796.

1.4 Maximum measurement uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Measurements	**Frequency**	**Uncertainty**
Conducted emissions	9KHz~30MHz	2.44dB
Radiated emissions	30MHz~200MHz	2.93
	200MHz~1000MHz	2.95
	1GHz~18GHz	2.26
	18GHz~40GHz	1.94

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2

1.5 Test Equipments Utilized

1.5.1 Conducted Test Equipments

Conducted Test Equipment						
No.	**Equipment Name**	**Serial No.**	**Type**	**Manufacturer**	**Cal. Date**	**Cal. Due**
1	Spectrum Analyzer	MY45101810	E4407B	Agilent	2016.03.02	2017.03.01
2	USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2016.03.02	2017.03.01
3	EXA Signal Analzyer	MY53470838	N9010A	Agilent	2015.08.26	2016.08.25
4	RF cable	CB01	RF01	Morlab	N/A	N/A
5	Attenuator	(n.a.)	10dB	Resnet	N/A	N/A
6	SMA connector Note	CN01	RF03	HUBER-SUHNER	N/A	N/A
Note: The SMA antenna connector is soldered on the PCB board in order to perform conducted tests and this SMA antenna connector is listed in the equipment list.						

1.5.2 Radiated Test Equipments

Radiated Test Equipments						
No.	**Equipment Name**	**Serial No.**	**Type**	**Manufacturer**	**Cal. Date**	**Cal.Due Date**
1	System Simulator	GB45360846	8960-E5515C	Agilent	2016.03.02	2017.03.01
2	Receiver	MY54130016	N9038A	Agilent	2016.03.02	2017.03.01
3	Test Antenna - Bi-Log	N/A	VULB9163	Schwarzbeck	2016.03.02	2017.03.01
4	Test Antenna - Horn	9170C-531	BBHA9170	Schwarzbeck	2016.03.02	2017.03.01
5	Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2016.03.02	2017.03.01
6	Test Antenna - Horn	71688	BBHA 9120D	Schwarzbeck	2016.03.02	2017.03.01
7	Coaxial cable(N male)	CB02	EMC02	Morlab	N/A	N/A
8	Coaxial cable(N male)	CB03	EMC03	Morlab	N/A	N/A
9	1-18GHz pre-Amplifier	MA02	TS-PR18	Rohde&Schwarz	2016.03.02	2017.03.01
10	18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde&Schwarz	2016.03.02	2017.03.01

1.5.3 Climate Chamber

Climate Chamber						
No.	**Equipment Name**	**Serial No.**	**Type**	**Manufacturer**	**Cal.Date**	**Cal.Due Date**
1	Climate Chamber	2004012	HL4003T	Yinhe	2016.03.02	2017.03.01

1.5.4 Vibration Table

Vibration Table						
No.	**Equipment Name**	**Serial No.**	**Type**	**Manufacturer**	**Cal.Date**	**Cal.Due Date**
1	Vibration Table	N/A	ACT2000-S015L	CMI-COM	2016.03.02	2017.03.01

1.5.5 Anechoic Chamber

Anechoic Chamber						
No.	**Equipment Name**	**Serial No.**	**Type**	**Manufacturer**	**Cal.Date**	**Cal.Due Date**
1	Anechoic Chamber	N/A	9m*6m*6m	Changning	2016.03.02	2017.03.01

1.5.6 Auxiliary Test Equipment

Auxiliary Test Equipment						
No.	**Equipment Name**	**Serial No.**	**Type**	**Manufacturer**	**Cal.Date**	**Cal.Due Date**
1	Computer	N.A	PU500C	Asus	N.A	N.A

***** END OF REPORT *****