TEST REPORT

APPLICANT	:	Golden Mark (HK) Limited
PRODUCT NAME	:	Smart Hub
MODEL NAME	:	ZL-100
BRAND NAME	:	N/A
FCC ID	:	2AMY9ZL100
STANDARD(S)	:	47 CFR Part 15 Subpart C
TEST DATE	:	2018-01-22 to 2018-02-07
ISSUE DATE	:	2018-03-19

Tested by: Tu Ya'nan

Tu Ya'nan (Test Engineer)

Approved by: Andy Yeh

Andy Yeh (Technical Director)

NOTE: This document is issued by MORLAB, the test report shall not be reproduced except in full without prior written permission of the company. The test results apply only to the particular sample(s) tested and to the specific tests carried out which is available on request for validation and information confirmed at our website.

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China

Tel: 86-755-36698555 Fax: 86-755-36698525

Http://www.morlab.cn E-mail: service@morlab.cn

DIRECTORY

1. Technical Information 4
1.1. Applicant and Manufacturer Information 4
1.2. Equipment Under Test (EUT) Description 4
1.3. Test Standards and Results 5
1.4. Environmental Conditions 5
2. 47 CFR Part 15C Requirements 6
2.1. Antenna requirement 6
2.2. Peak Output Power 6
2.3. Bandwidth 9
2.4. Conducted Spurious Emissions and Band Edge 16
2.5. Power spectral density (PSD) 26
2.6. Restricted Frequency Bands 33
2.7. Conducted Emission 42
2.8. Radiated Emission 45
Annex A Test Uncertainty 58
Annex B Testing Laboratory Information 59

Change History		
Issue	**Date**	**Reason for change**
1.0	2018-03-19	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Golden Mark (HK) Limited
Applicant Address:	6/F., Kimberley Plaza, 45-47 Kimberley Road, Tsim Sha Tsui, Kowloon, Hong Kong,China
Manufacturer:	Golden Mark (HK) Limited
Manufacturer Address:	6/F., Kimberley Plaza, 45-47 Kimberley Road, Tsim Sha Tsui, Kowloon, Hong Kong,China

1.2. Equipment Under Test (EUT) Description

Product Name:	Smart Hub
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	N/A
Software Version:	N/A
Modulation Type:	DSSS, OFDM
Operating Frequency Range:	802.11b/g/n-20MHz: 2.412GHz - 2.462GHz
Channel Number:	802.11b/g/n-20MHz: 11
Antenna Type:	PCB Antenna
Antenna Gain:	2 dBi

Note 1: The EUT is 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).

Note 2: The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT continuous transmission.

Note 3: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C 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	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	PASS
2	15.247(b)	Peak Output Power	Feb 08, 2018	Tu Ya'nan	PASS
3	15.247(a)	Bandwidth	Jan 22, 2018	Tu Ya'nan	PASS
4	15.247(d)	Conducted Spurious Emission and Band Edge	Jan 22, 2018	Tu Ya'nan	PASS
5	15.247(d)	Restricted Frequency Bands	Feb 06, 2018	Wu Junke	PASS
6	15.207	Conducted Emission	Jan 24, 2018	Wu Junke	PASS
7	15.209, 15.247(d)	Radiated Emission	Feb 07, 2018	Wu Junke	PASS
8	15.247(e)	Power spectral density (PSD)	Jan 22, 2018	Tu Ya'nan	PASS
Note1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013 and KDB558074 D01 v04 (04/05/2017).					

1.4. Environmental 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

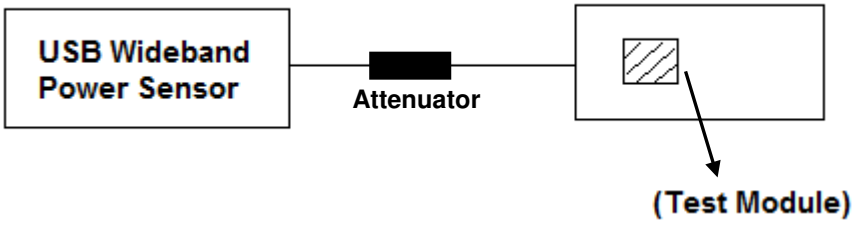
2.2.1. Requirement

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 USB Wideband Power Sensor and calibration.

A. Test Setup:



The EUT (Equipment under the test) which is coupled to the USB Wideband Power Sensor; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

B. Equipments List:

Please refer ANNEX A(1.5).

2.2.3. Test Result

2.2.3.1 802.11b Test Mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	9.98	0.00995	30	1	PASS
6	2437	11.33	0.01358			PASS
11	2462	12.38	0.01730			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	6.33	0.00430	30	1	PASS
6	2437	7.57	0.00571			PASS
11	2462	8.64	0.00731			PASS

2.2.3.2 802.11g Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	12.86	0.01932	30	1	PASS
6	2437	12.83	0.01919			PASS
11	2462	13.98	0.02500			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	4.95	0.00313	30	1	PASS
6	2437	4.94	0.00312			PASS
11	2462	7.33	0.00541			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	12.93	0.01963	30	1	PASS
6	2437	13.28	0.02128			PASS
11	2462	14.01	0.02518			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	5.22	0.00333	30	1	PASS
6	2437	5.50	0.00355			PASS
11	2462	7.44	0.00555			PASS

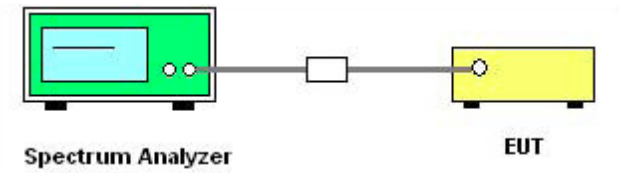
2.3. Bandwidth

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 refer ANNEX A(1.5).

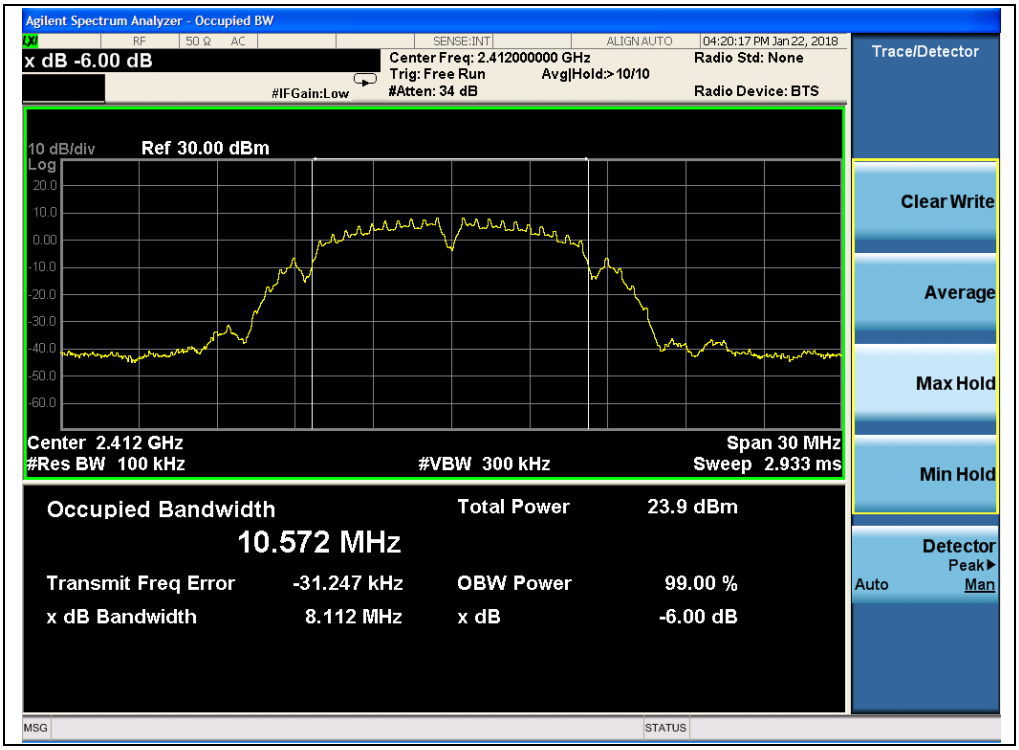
2.3.3. Test Result

2.3.3.1 802.11b Test mode

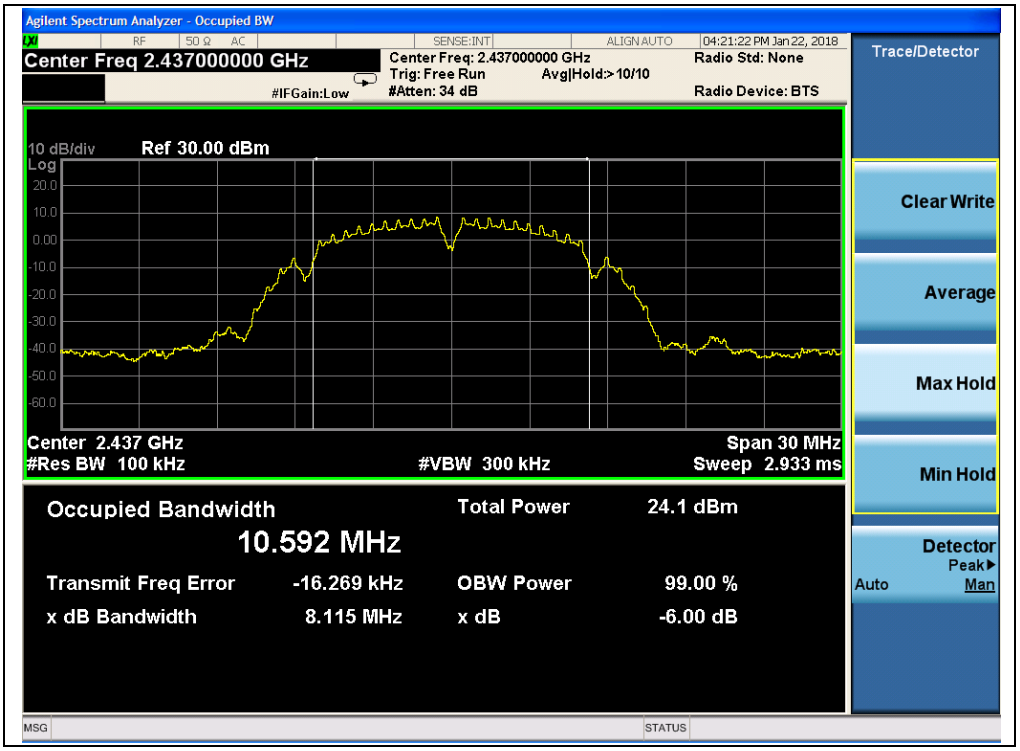
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	8.112	≥500	PASS
6	2437	8.115	≥500	PASS
11	2462	8.107	≥500	PASS

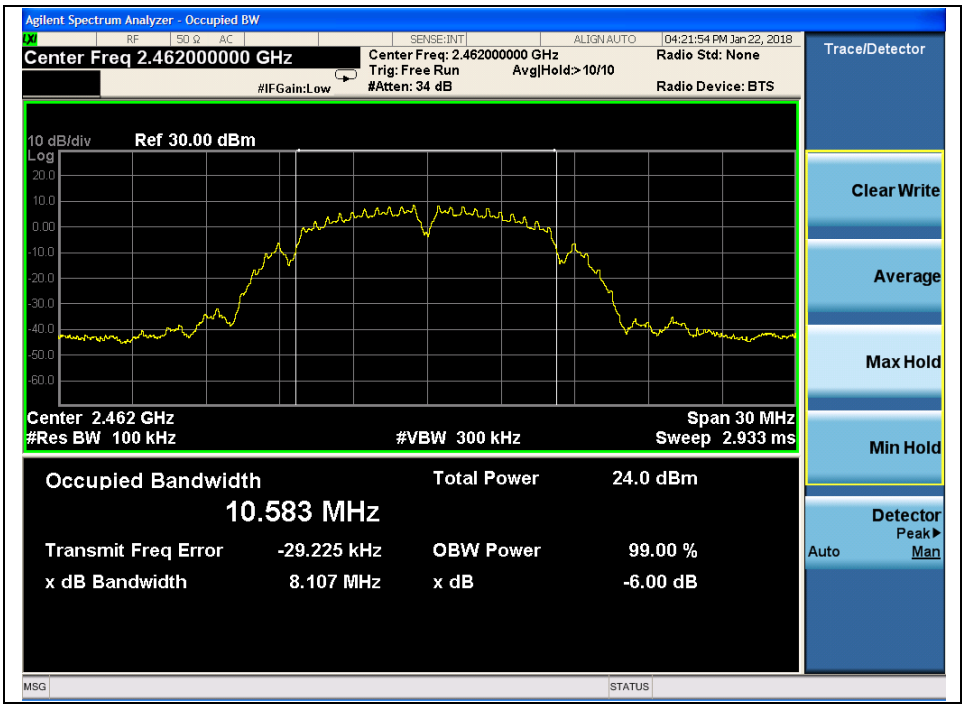
B. Test Plots



(Channel 1, 2412MHz, 802.11b)



(Channel 6, 2437 MHz, 802.11b)



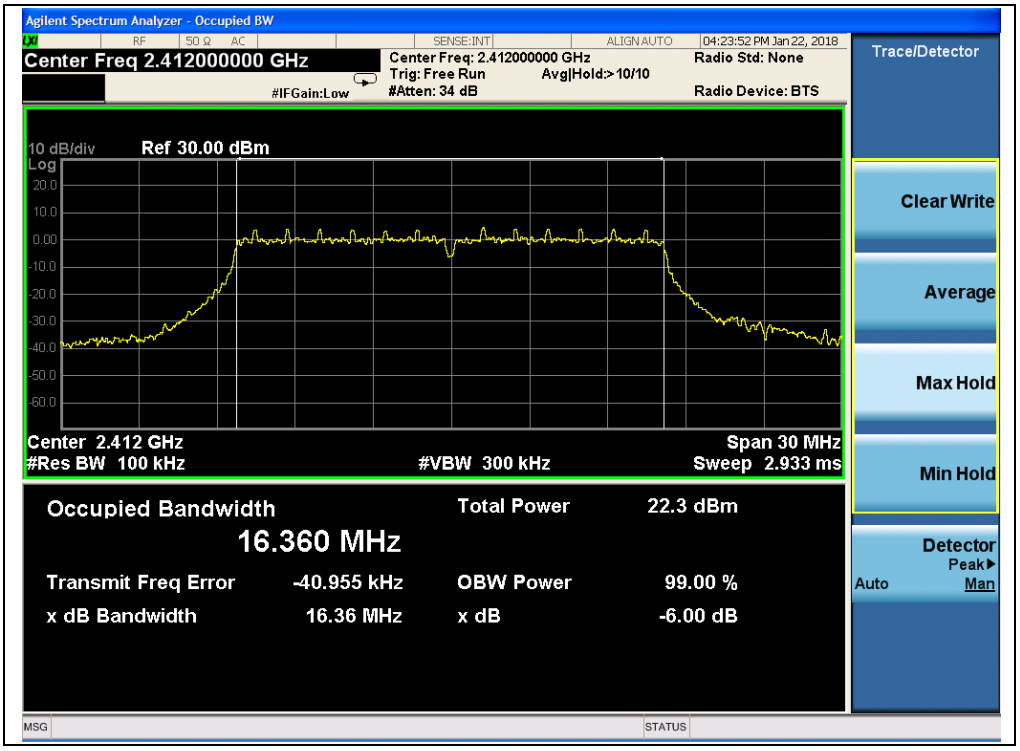
(Channel 11, 2462MHz, 802.11b)

2.3.3.2 802.11g Test mode

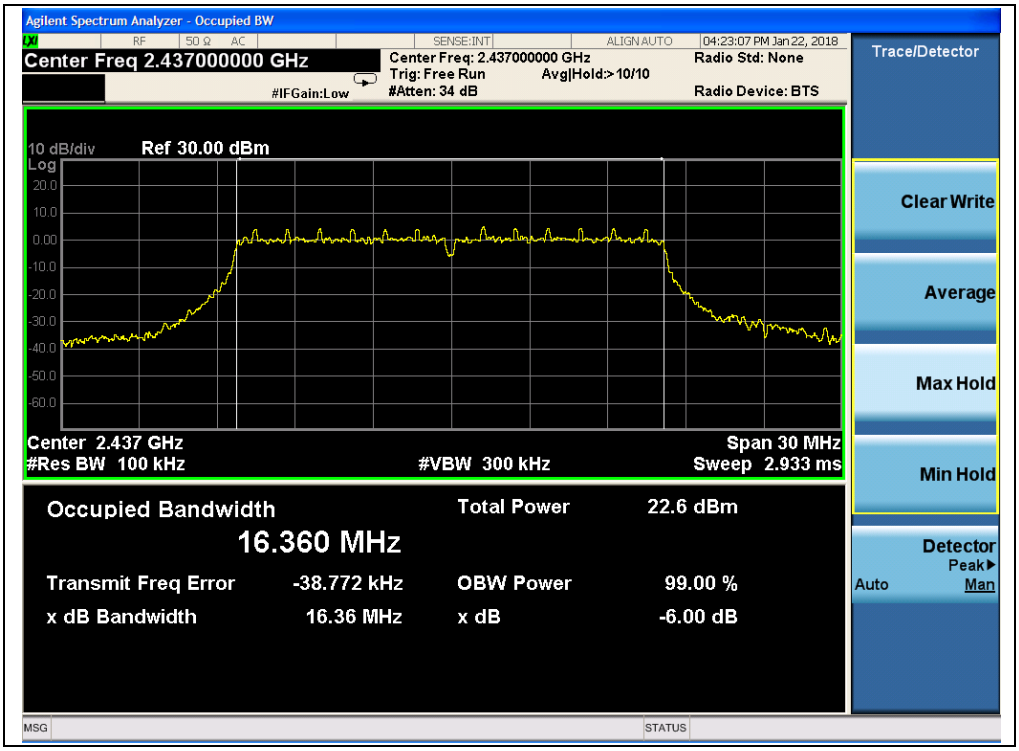
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	16.36	≥500	PASS
6	2437	16.36	≥500	PASS
11	2462	16.36	≥500	PASS

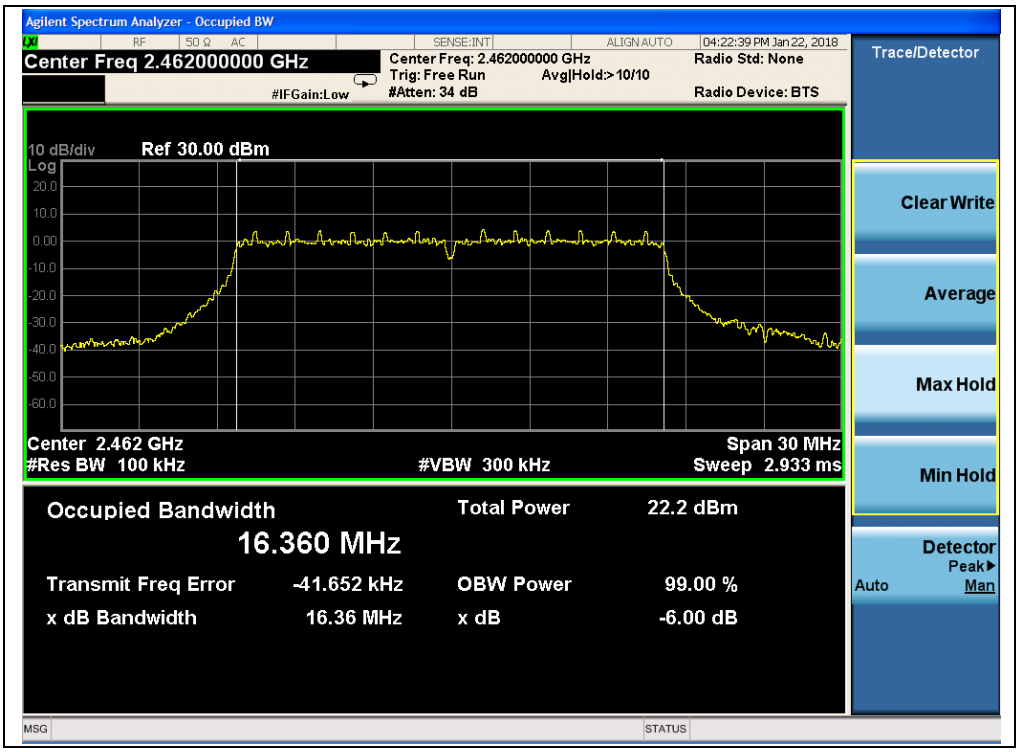
B. Test Plots:



(Channel 1, 2412MHz, 802.11g)



(Channel 6, 2437MHz, 802.11g)



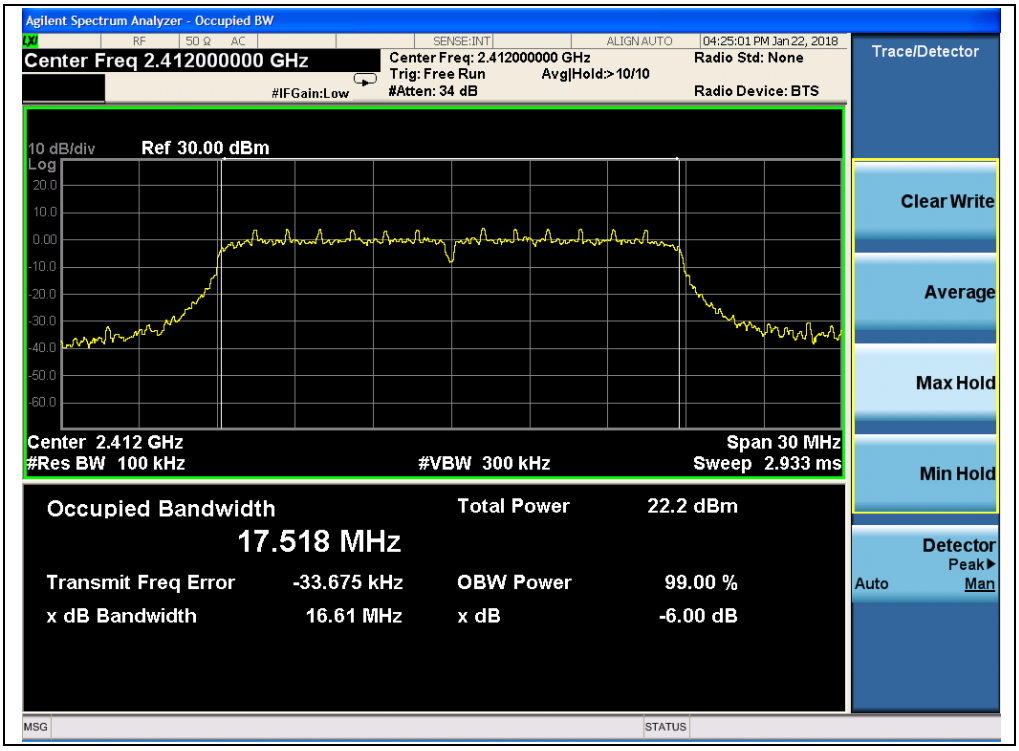
(Channel 11, 2462MHz, 802.11g)

2.3.3.3 802.11n-20 Test mode

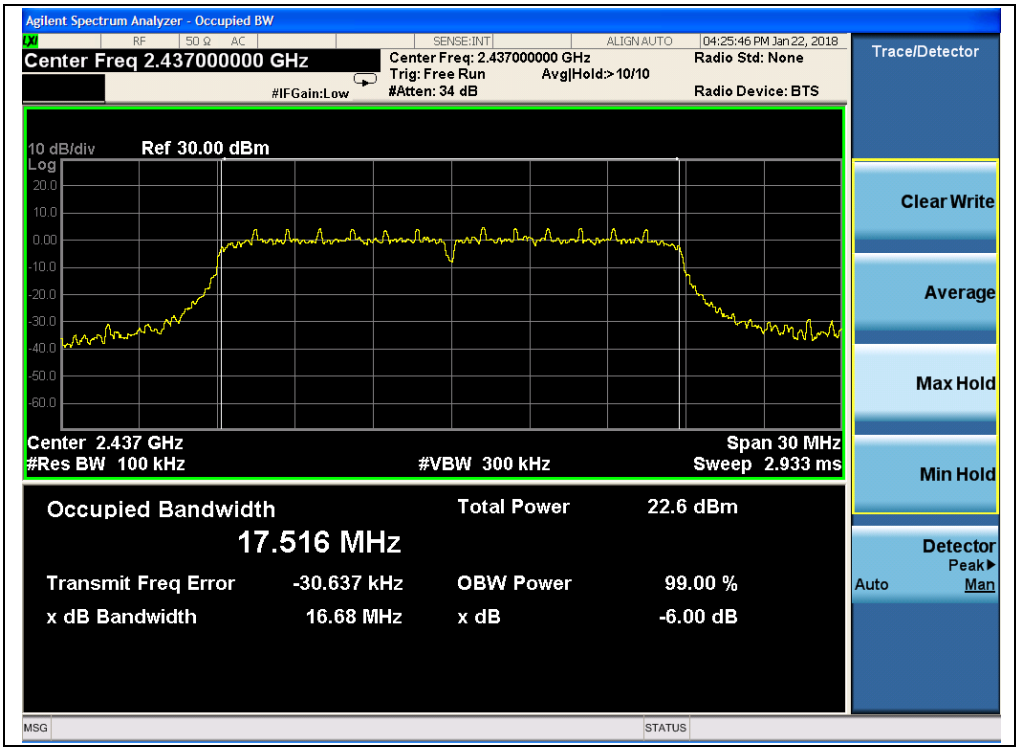
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	16.61	≥500	PASS
6	2437	16.68	≥500	PASS
11	2462	16.61	≥500	PASS

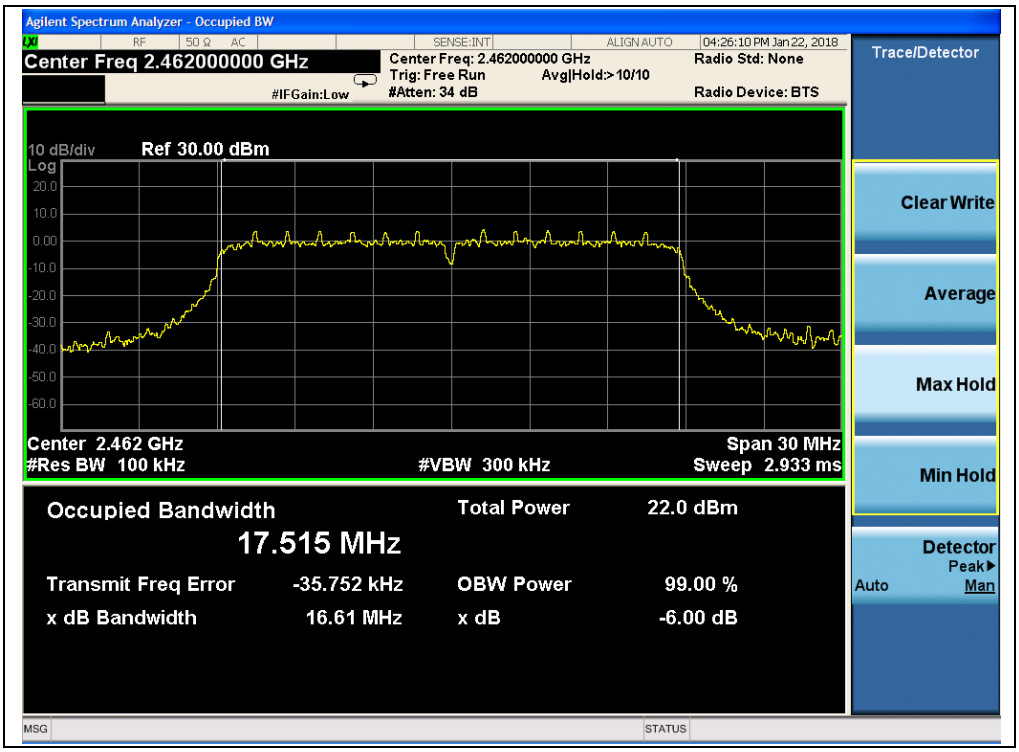
B. Test Plots:



(Channel 1, 2412MHz, 802.11n-20)



(Channel 6, 2437MHz, 802.11n-20)



(Channel 11, 2462MHz, 802.11n-20)

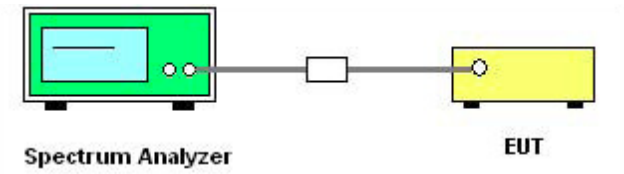
2.4. Conducted Spurious Emissions and Band Edge

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 refer ANNEX A(1.5).

2.4.3. Test Result

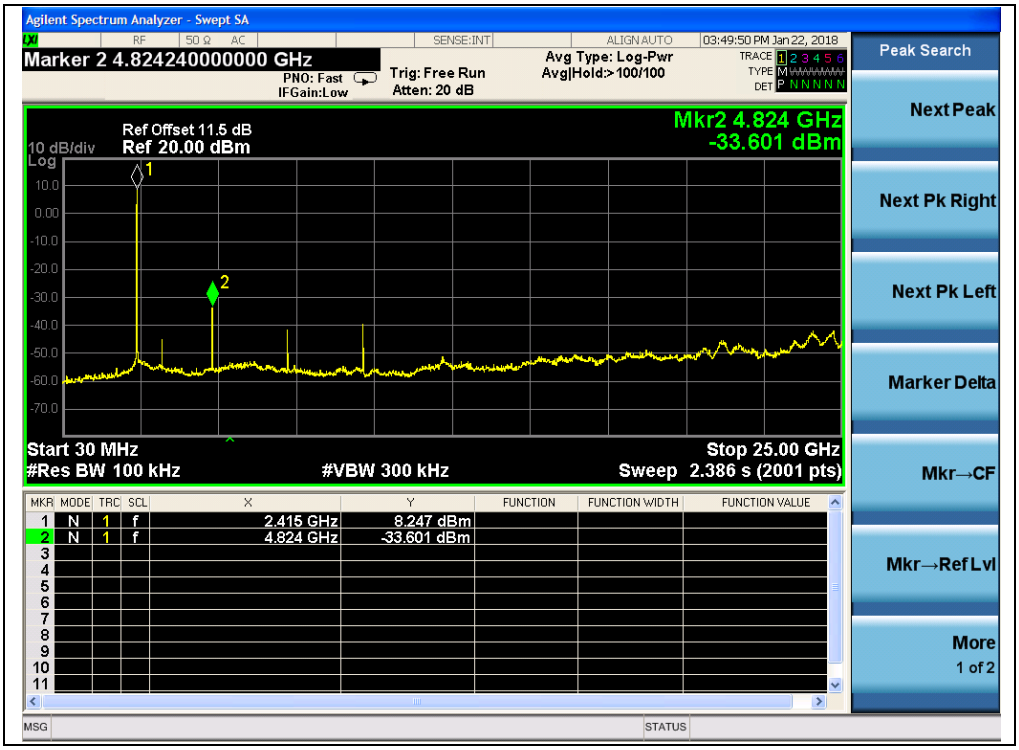
2.4.3.1 802.11b Test mode

A. Test Verdict:

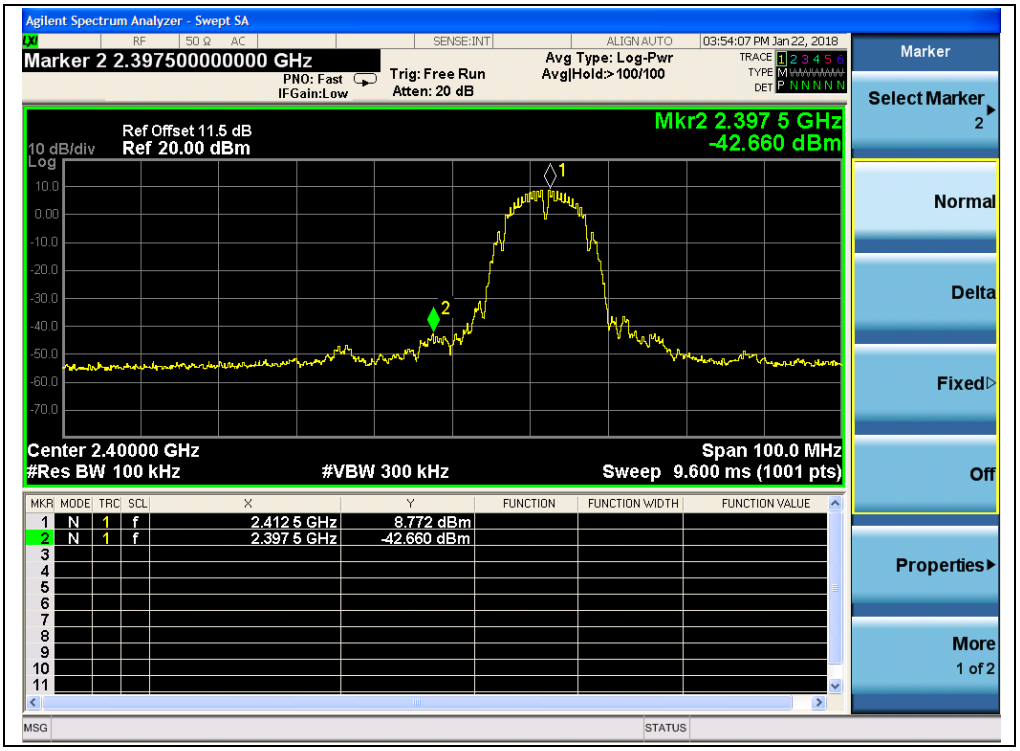
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-33.60	8.25	-11.75	PASS
6	2437	-39.96	7.56	-12.44	PASS
11	2462	-39.86	9.12	-10.88	PASS

B. Test Plots:

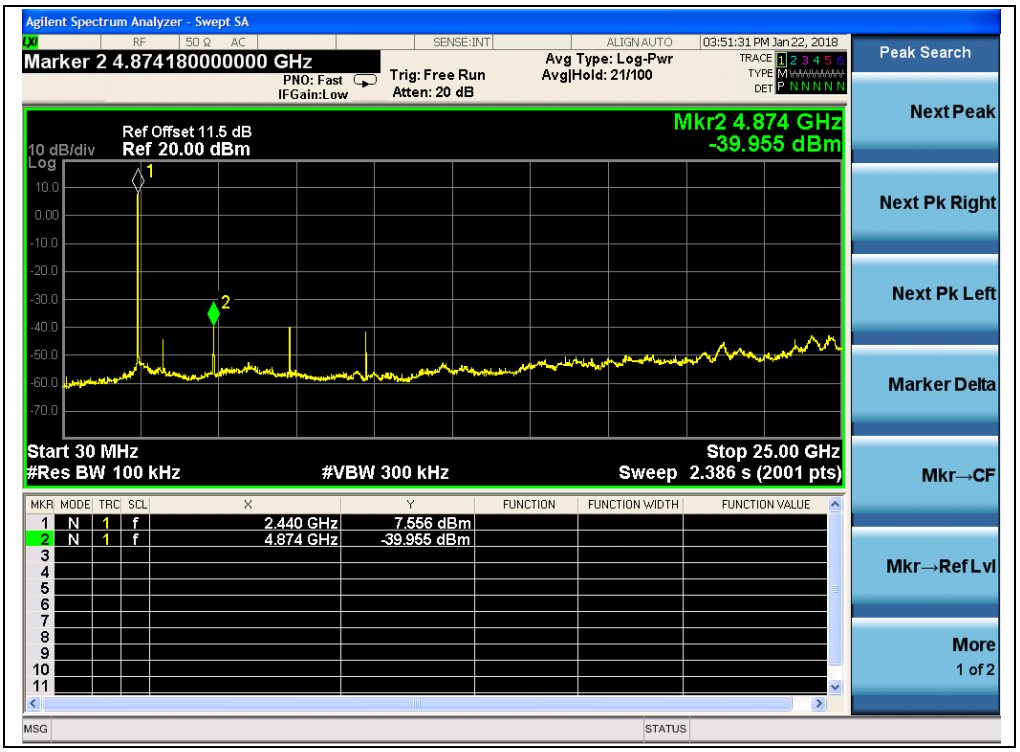
Note: The power of the Module transmitting frequency should be ignored.



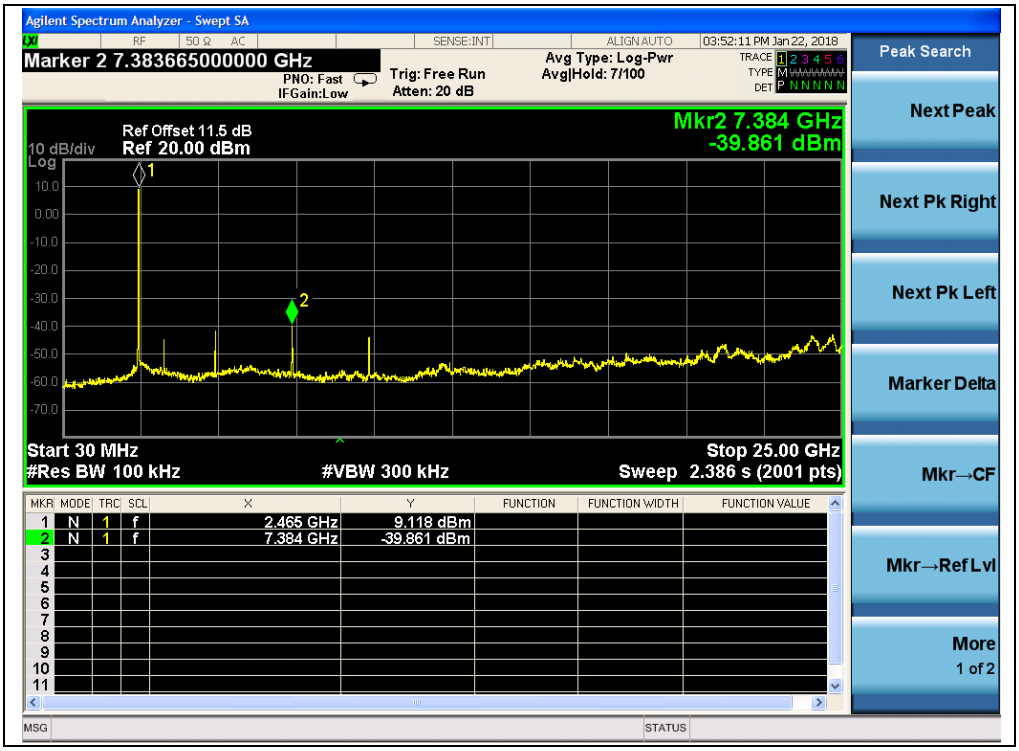
(Channel = 1, 30MHz to 25GHz)



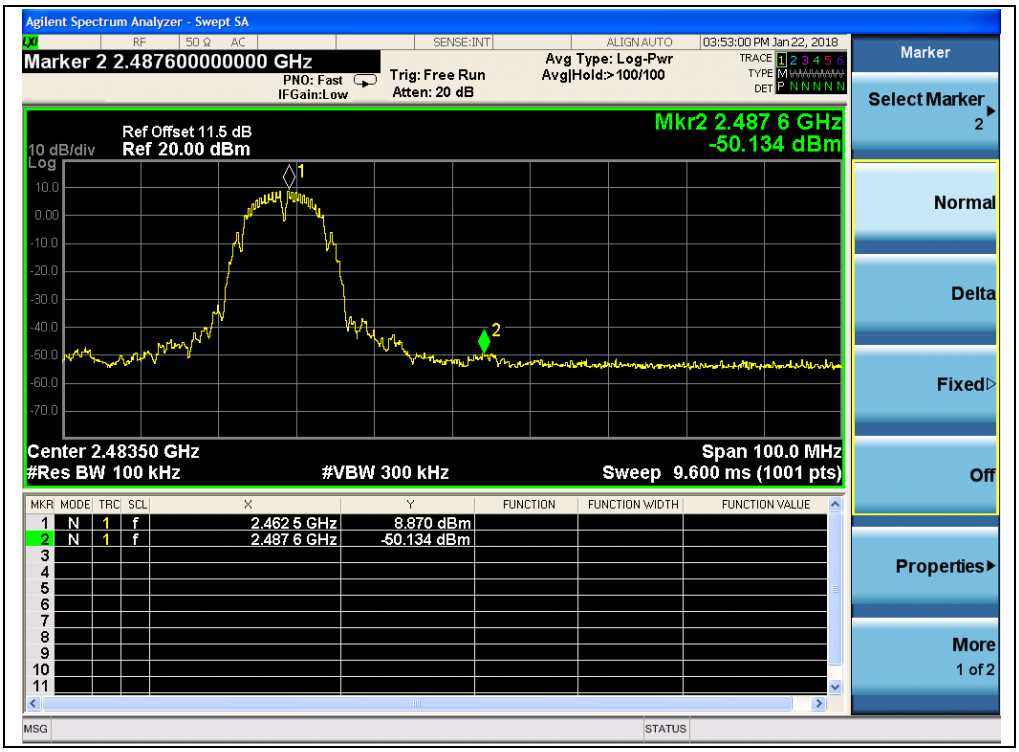
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

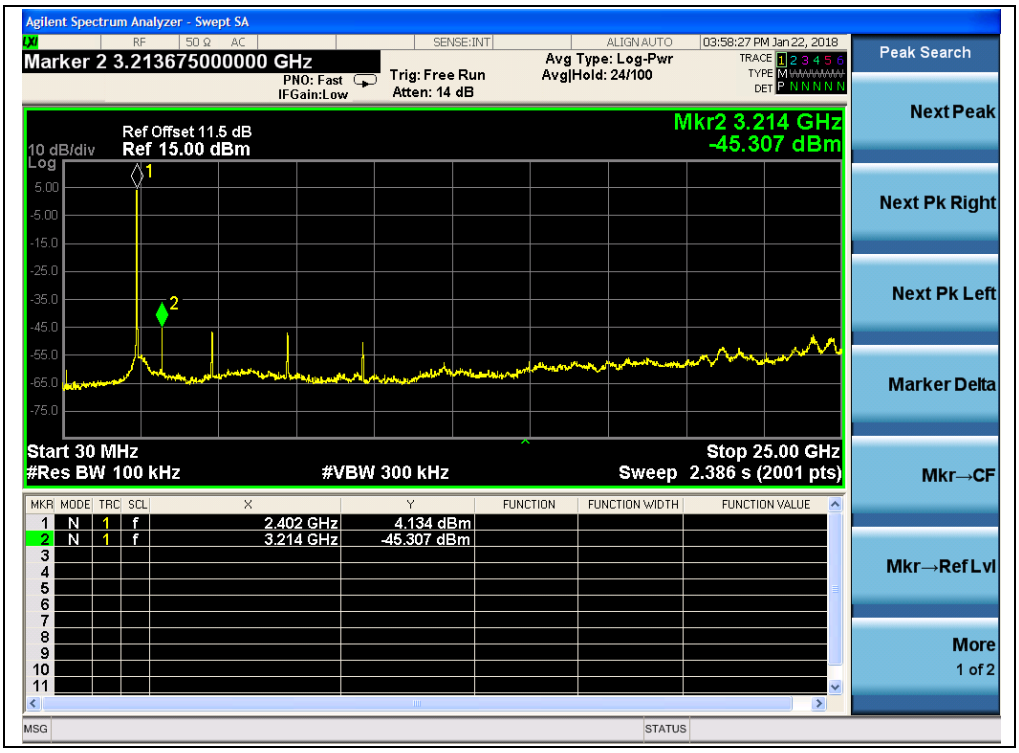
2.4.3.2 802.11g Test mode

A. Test Verdict:

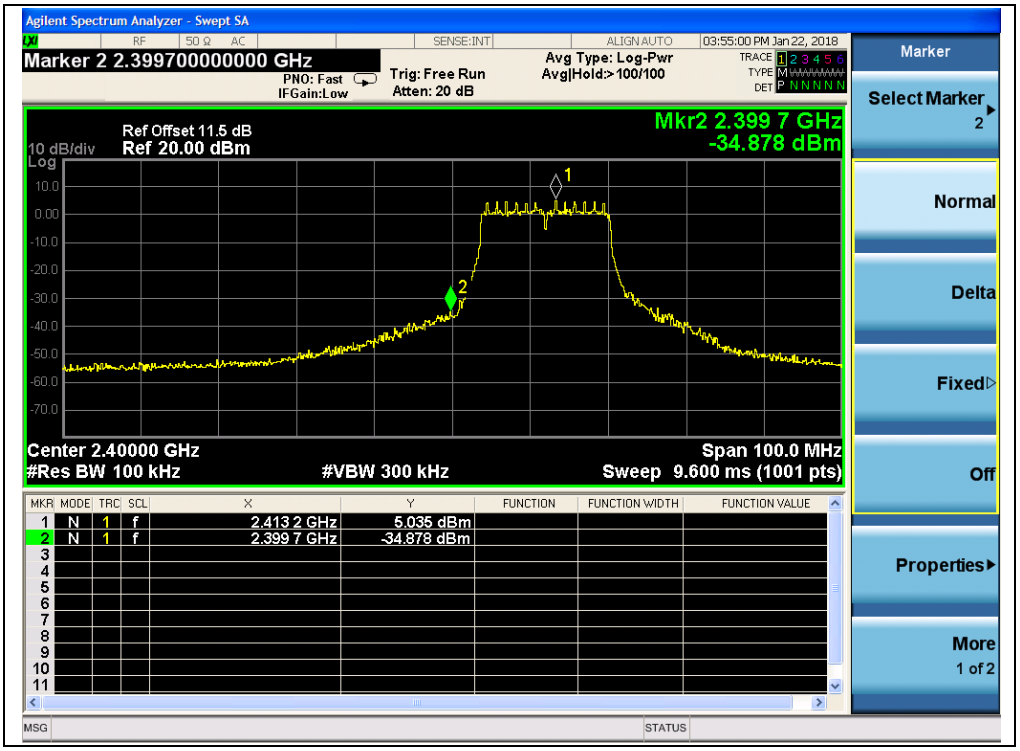
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-45.31	4.13	-15.87	PASS
6	2437	-42.92	3.60	-16.40	PASS
11	2462	-43.88	2.73	-17.27	PASS

B. Test Plots:

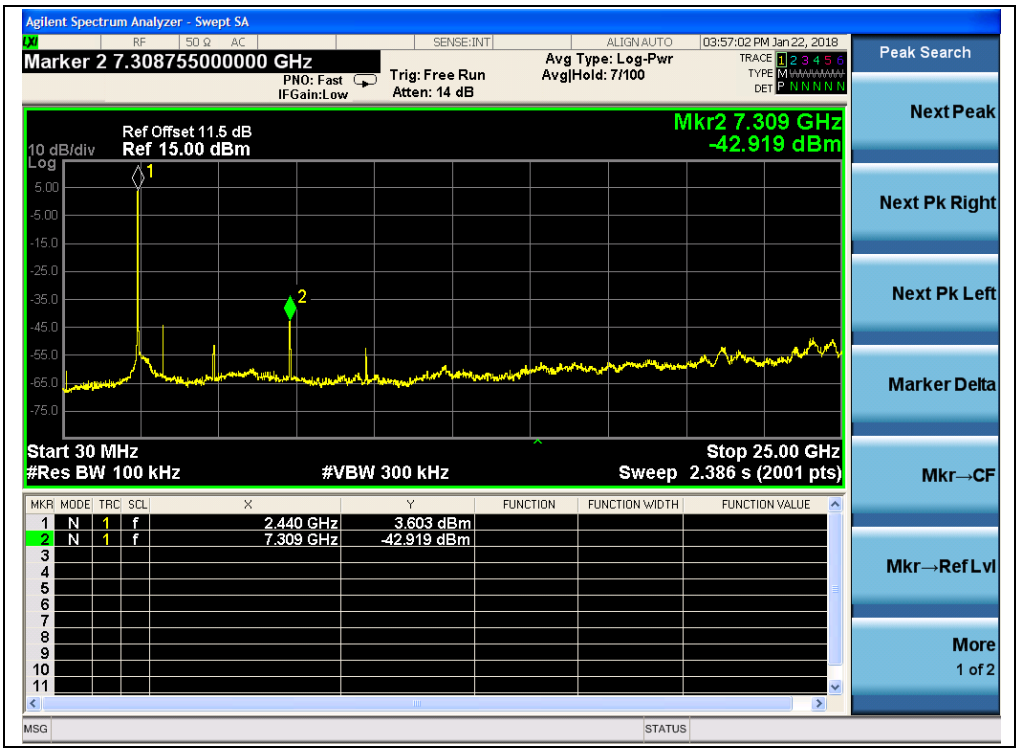
Note: The power of the Module transmitting frequency should be ignored.



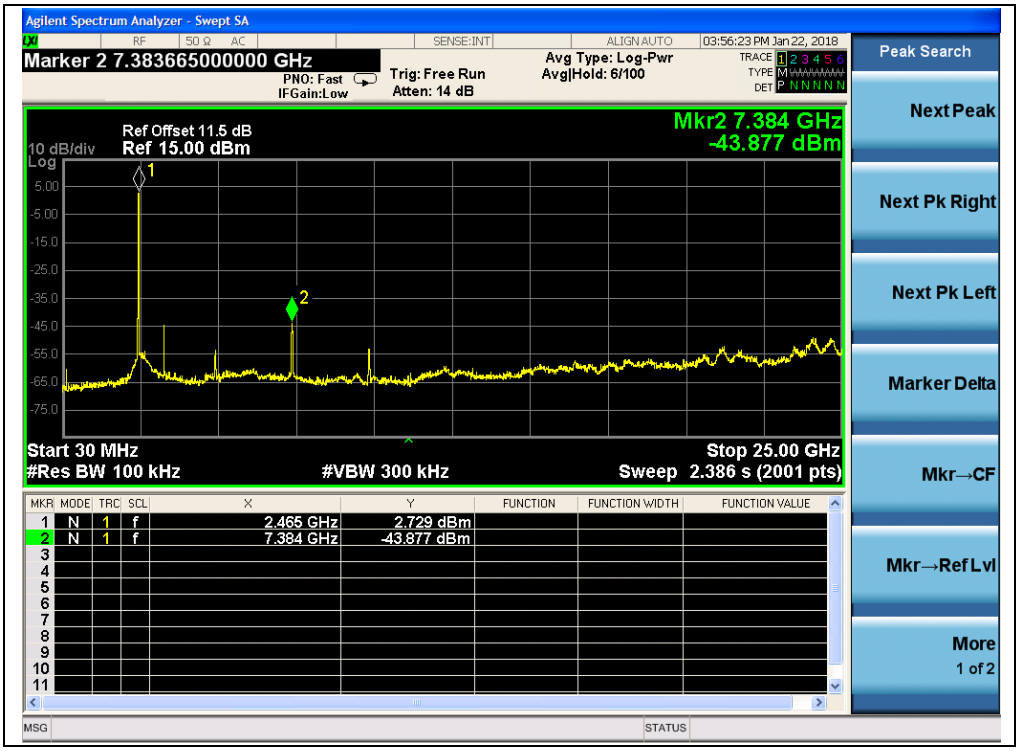
(Channel = 1, 30MHz to 25GHz)



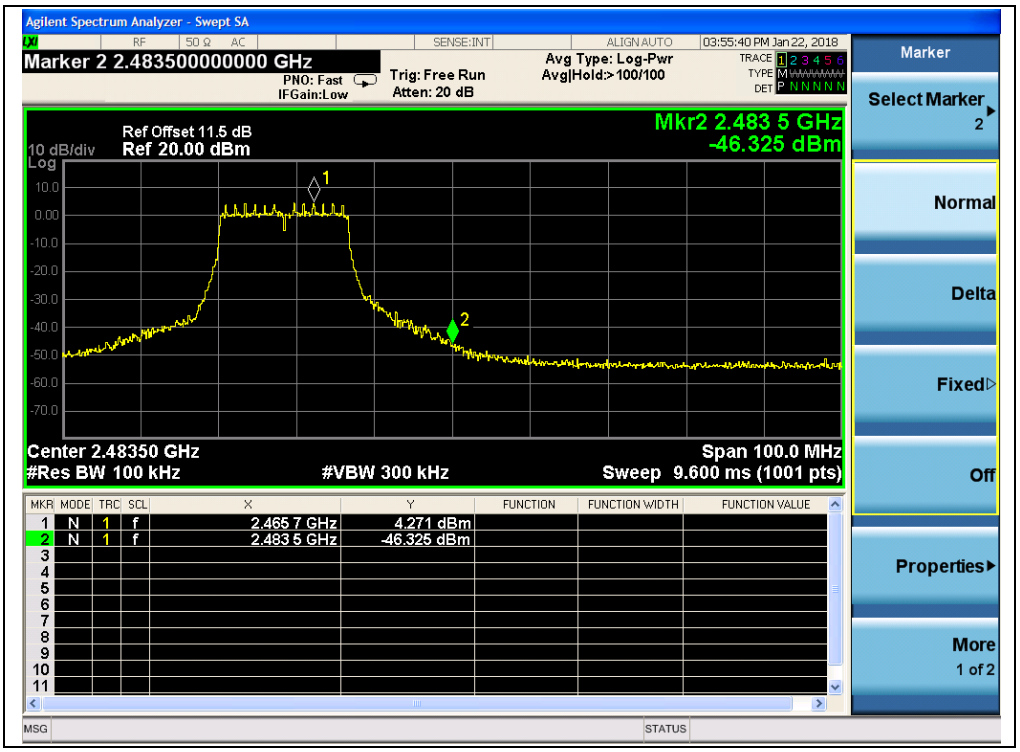
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

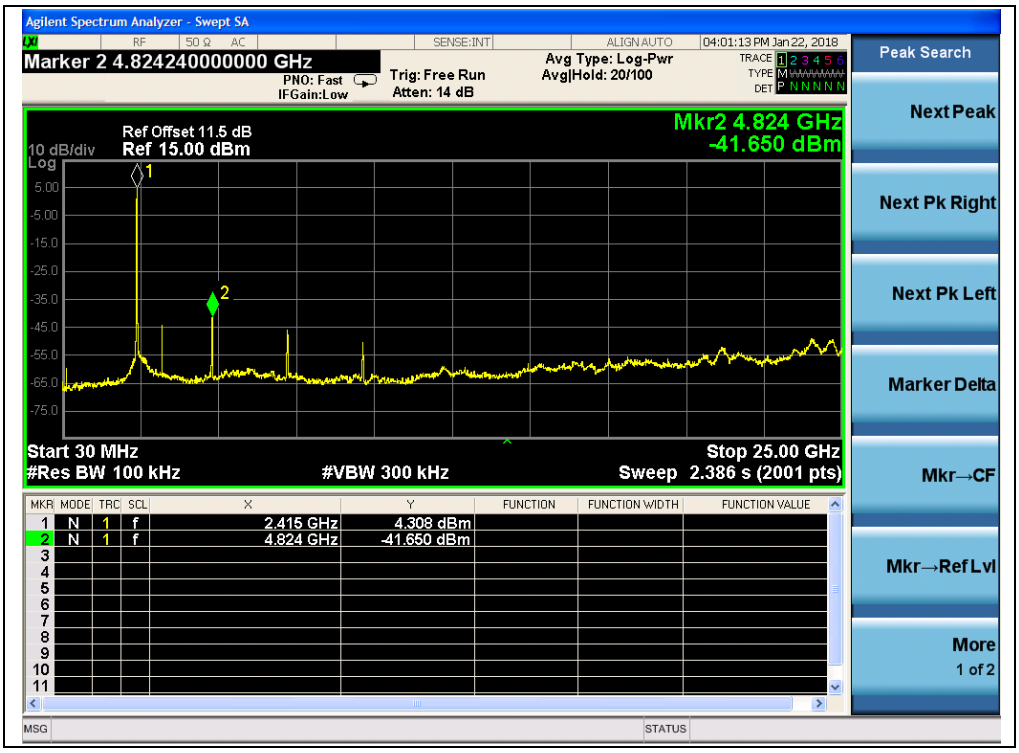
2.4.3.3 802.11n -20MHz Test mode

A. Test Verdict:

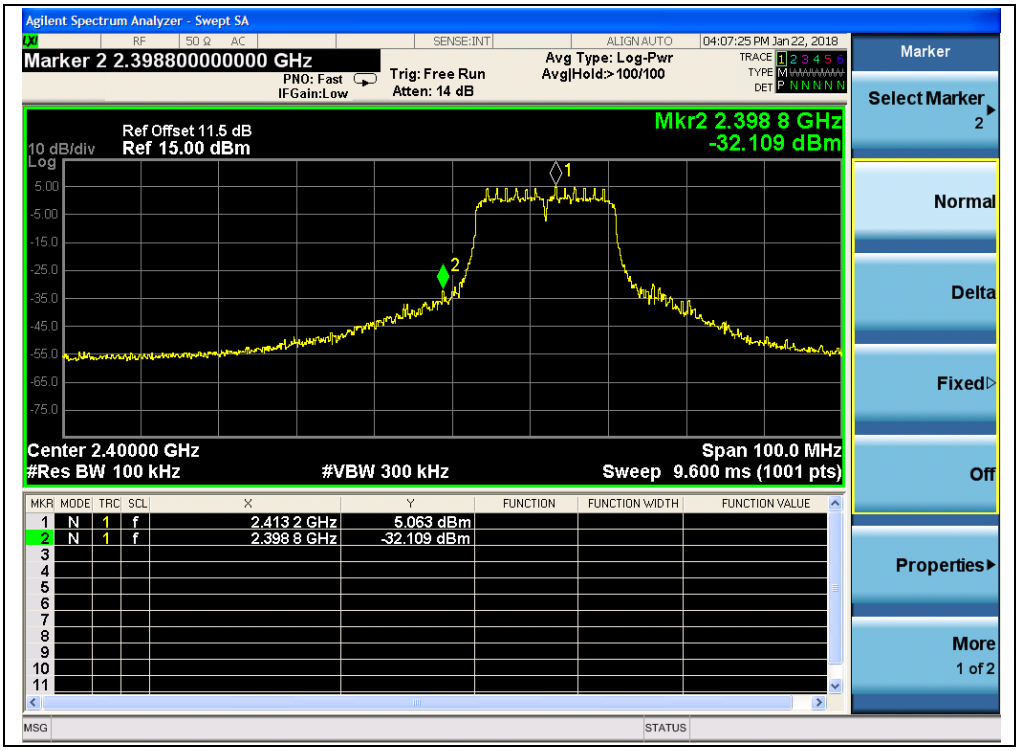
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-41.65	4.31	-15.69	PASS
6	2437	-43.50	4.88	-15.12	PASS
11	2462	-43.71	3.68	-16.32	PASS

B. Test Plots:

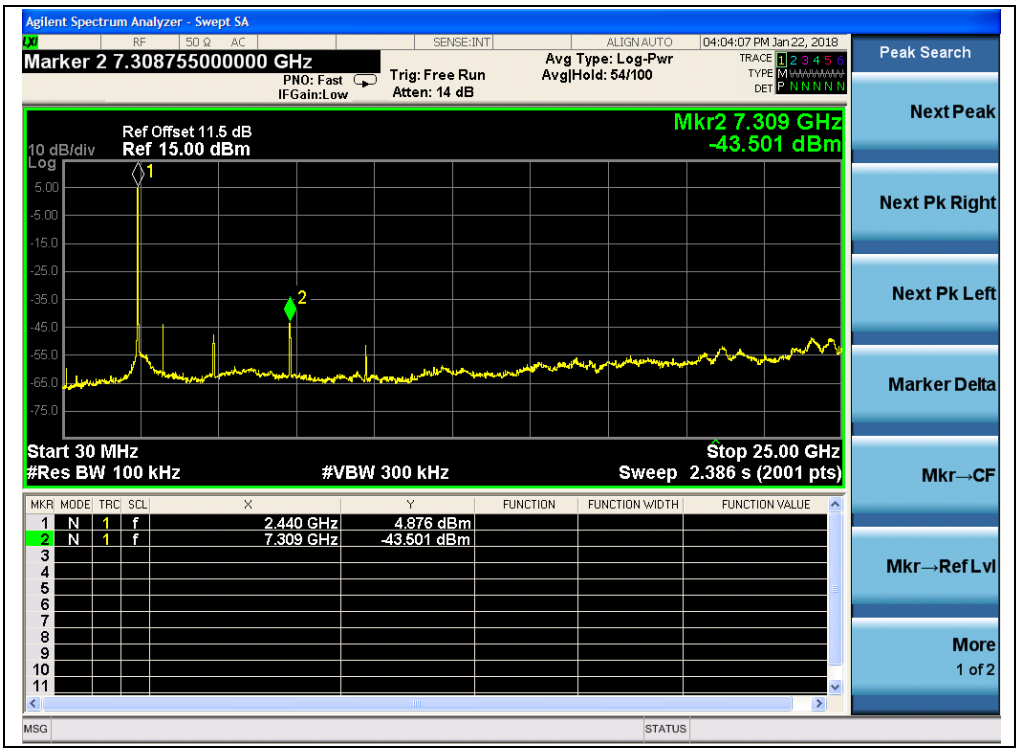
Note: The power of the Module transmitting frequency should be ignored.



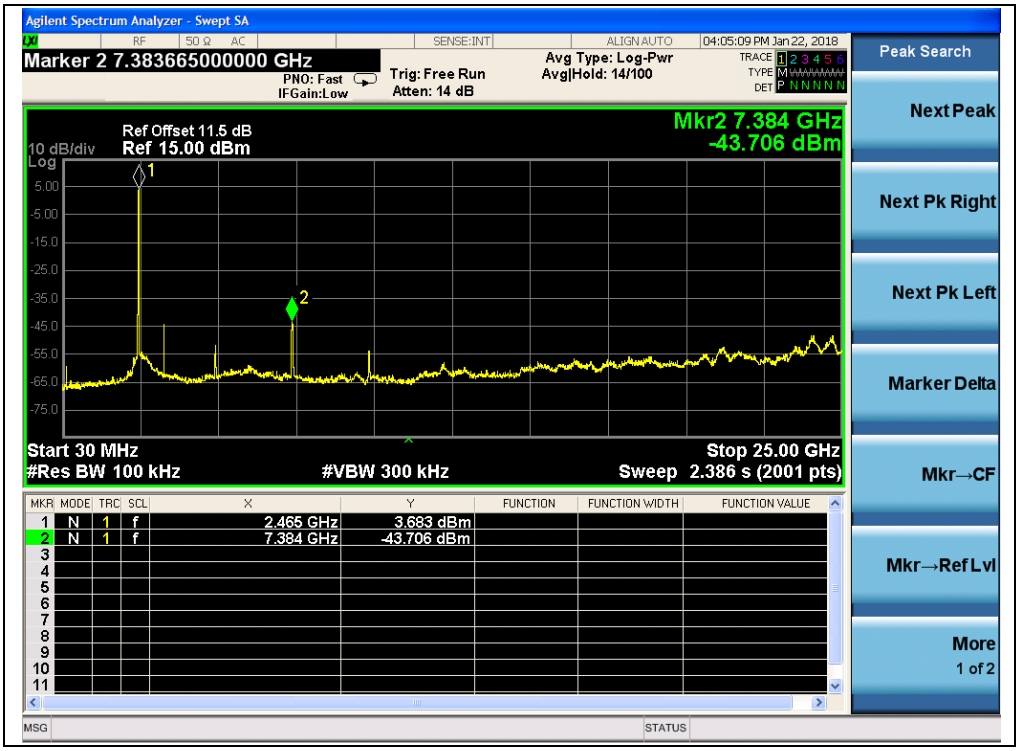
(Channel = 1, 30MHz to 25GHz)



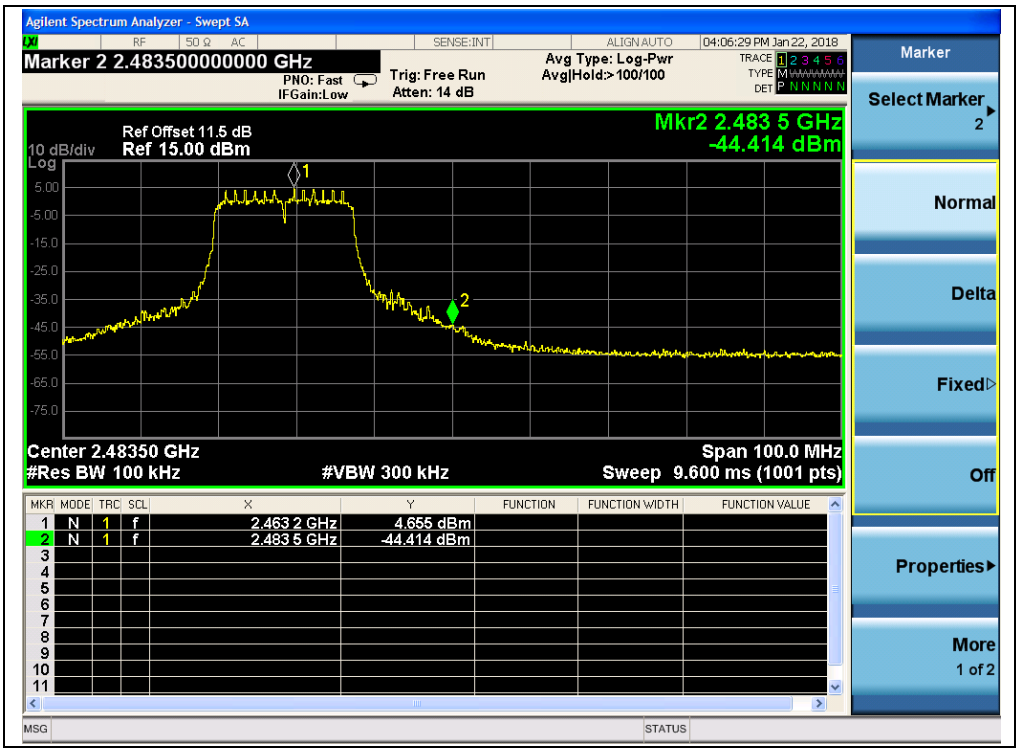
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

2.5. Power spectral density (PSD)

2.5.1. Requirement

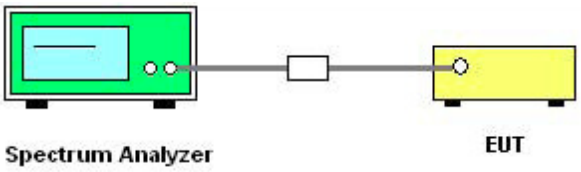
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of 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 1.5 times DTS
c) Set the RBW to 3 kHz
d) Set the VBW to 10 kHz
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 refer 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	-6.16	8	PASS
6	2437	-6.22	8	PASS
11	2462	-6.27	8	PASS
Measurement uncertainty: ±1.3dB				

B. Test Plots:

(Channel = 1, 802.11b)

(Channel = 6, 802.11b)

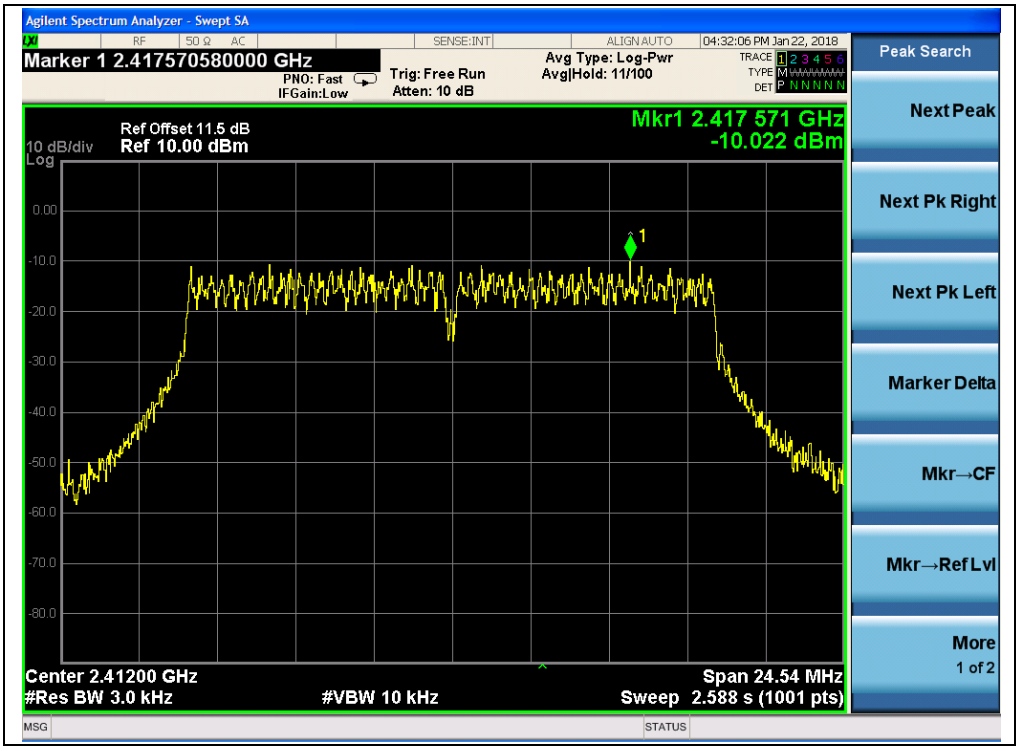
(Channel = 11, 802.11b)

2.5.3.2 802.11g Test mode

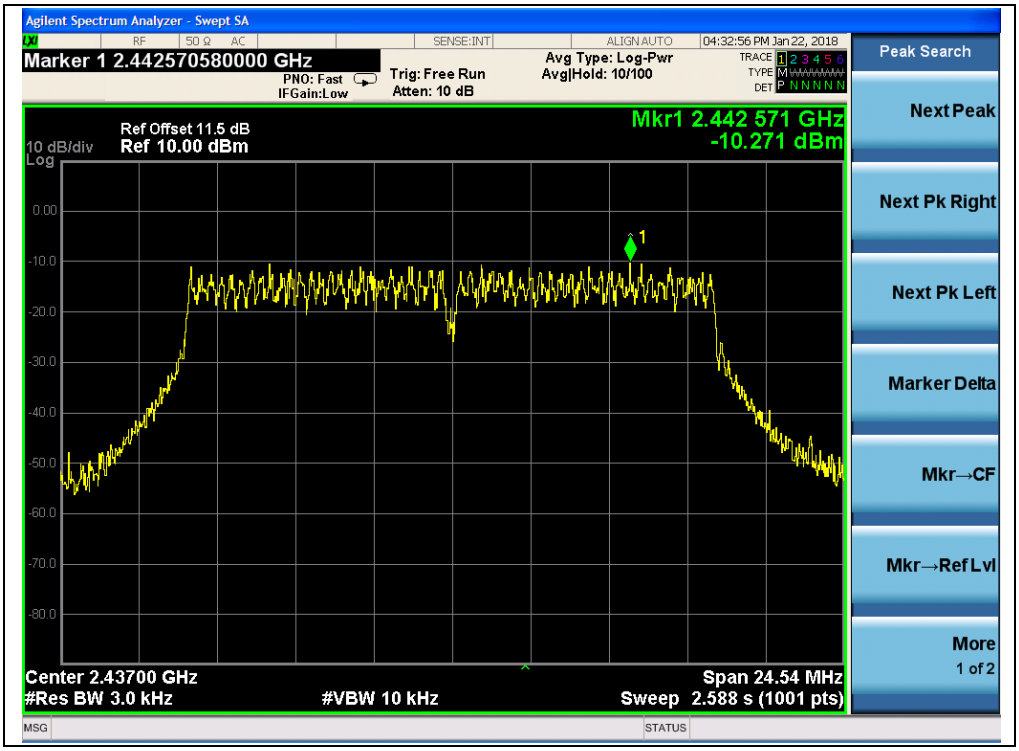
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-10.02	8	PASS
6	2437	-10.27	8	PASS
11	2462	-10.49	8	PASS
Measurement uncertainty: ±1.3dB				

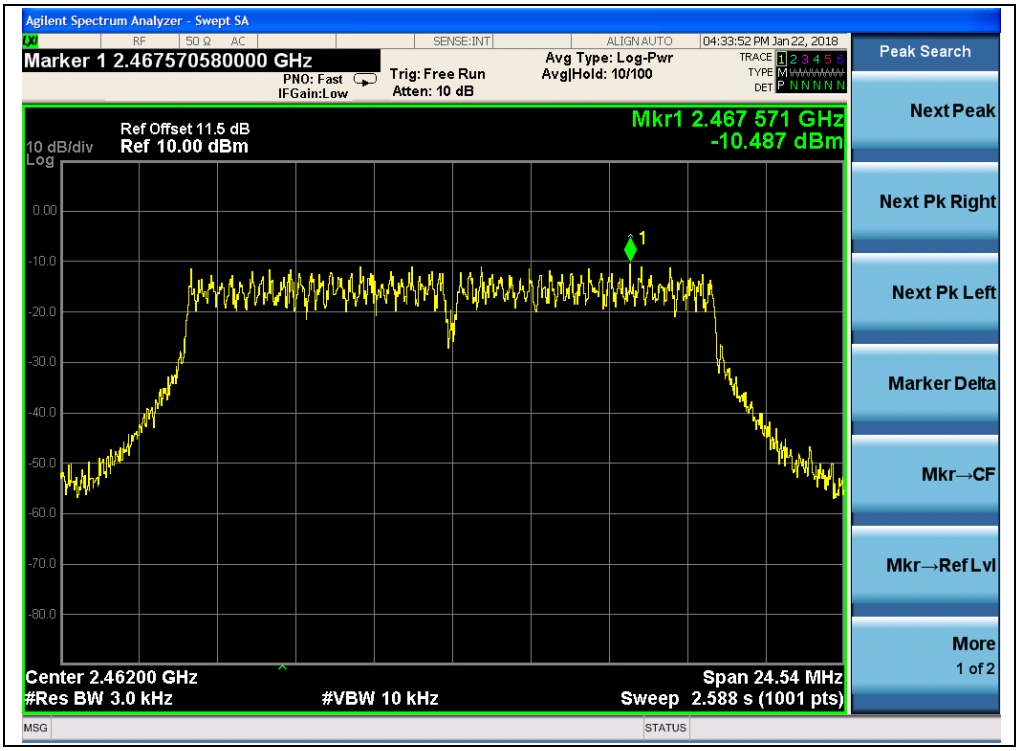
B. Test Plots:



(Channel = 1, 802.11g)



(Channel = 6, 802.11g)



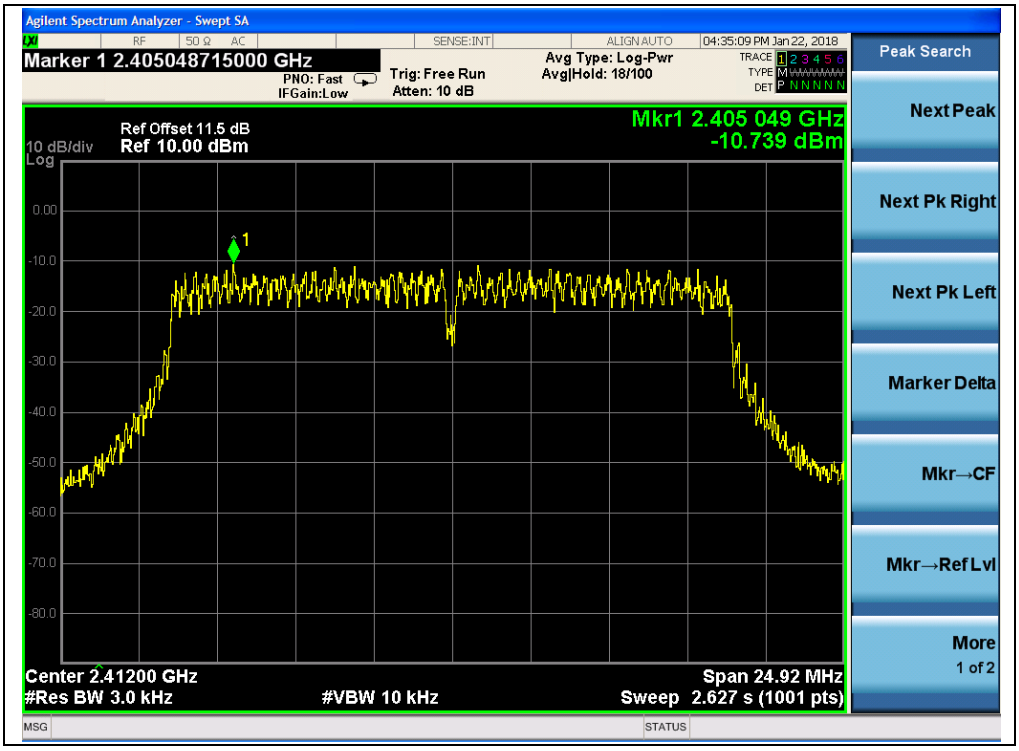
(Channel = 11, 802.11g)

2.5.3.3 802.11n-20MHz Test mode

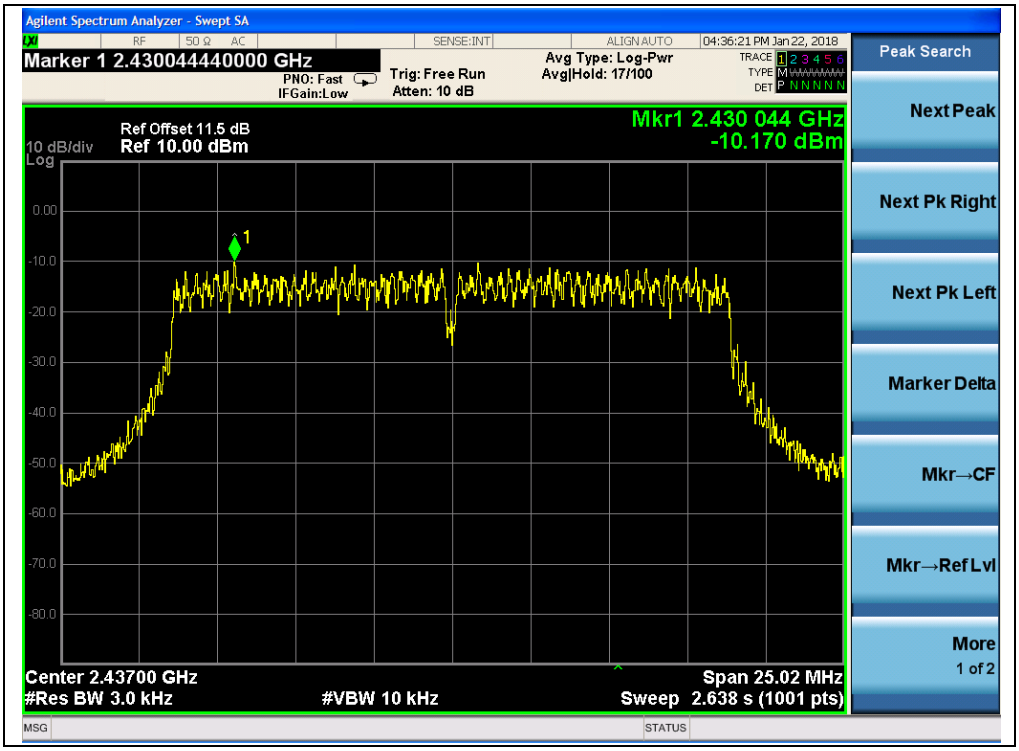
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-10.74	8	PASS
6	2437	-10.17	8	PASS
11	2462	-10.67	8	PASS
Measurement uncertainty: ±1.3dB				

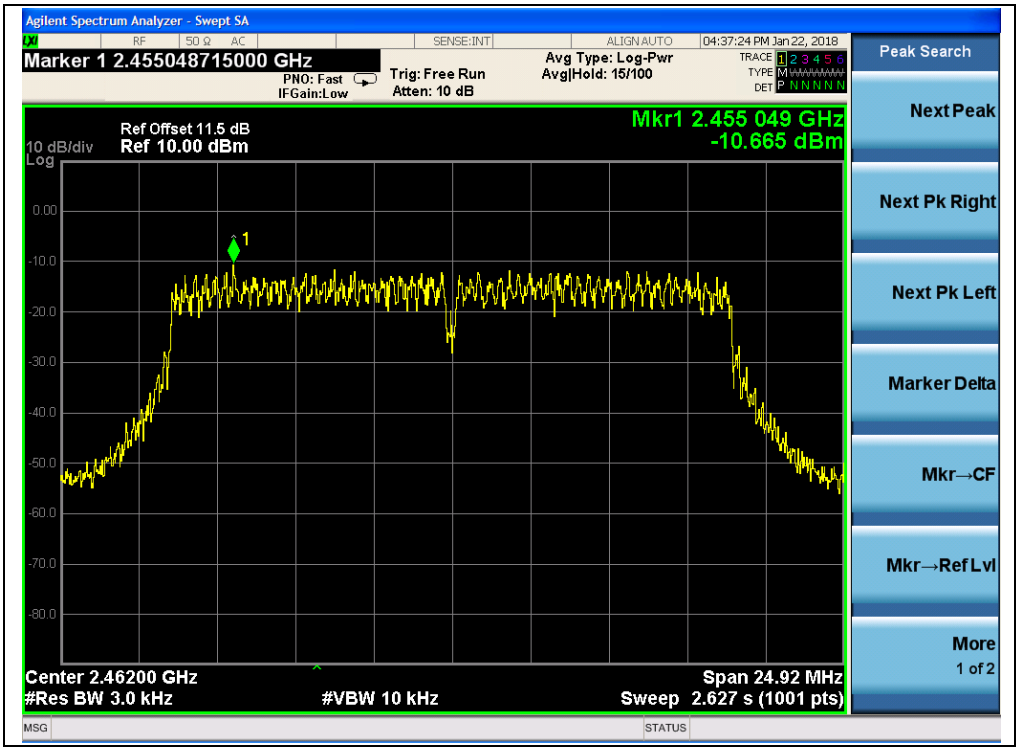
B. Test Plots:



(Channel = 1, 802.11n-20MHz)



(Channel = 6, 802.11n-20MHz)



(Channel = 11, 802.11n-20MHz)

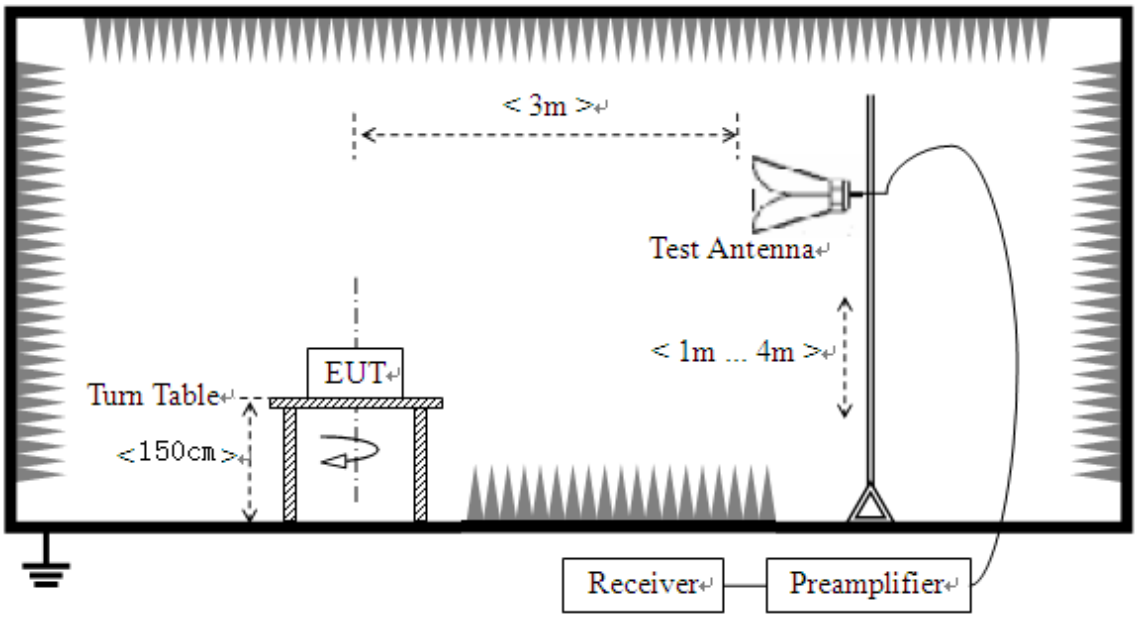
2.6. Restricted Frequency Bands

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 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:

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 refer 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 [dBμV/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

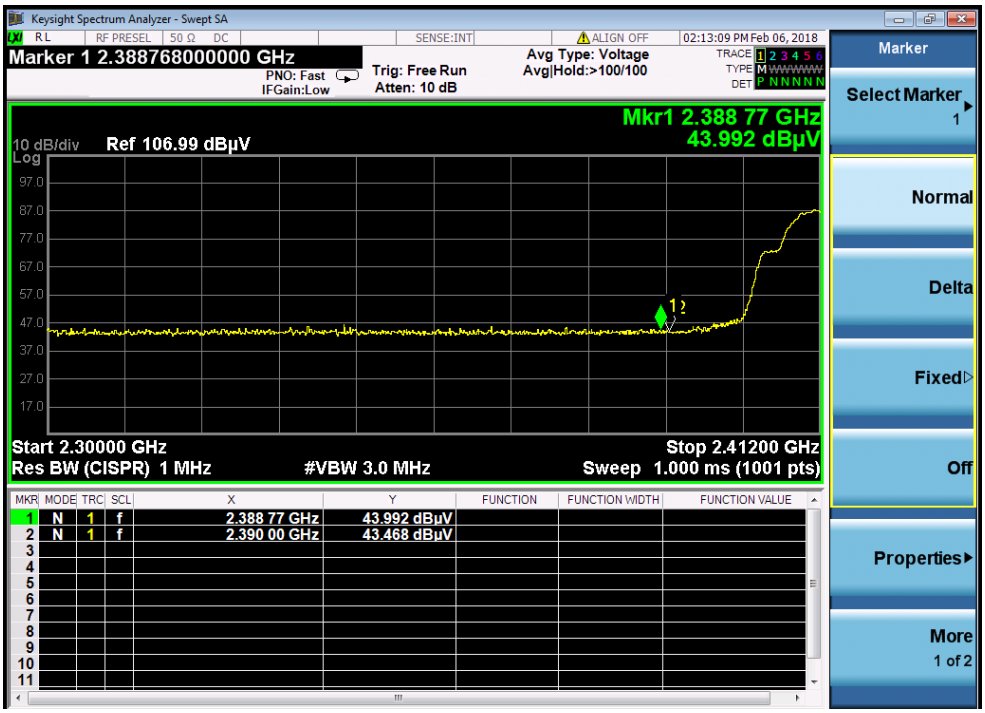
Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

2.6.3.1 802.11b Test mode

A. Test Verdict:

Channel	Frequency (MHz)	Detector PK/ AV	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
1	2388.77	PK	43.99	-33.63	32.56	42.92	74	Pass
1	2388.77	AV	37.43	-33.63	32.56	36.36	54	Pass
11	2485.61	PK	48.95	-33.18	32.50	48.27	74	Pass
11	2485.72	AV	40.64	-33.18	32.50	39.96	54	Pass

B. Test Plots:



(Channel = 1 PEAK, 802.11b)

(Channel = 1 AVG, 802.11b)

(Channel = 11 PEAK, 802.11b)

(Channel = 11 AVG, 802.11b)

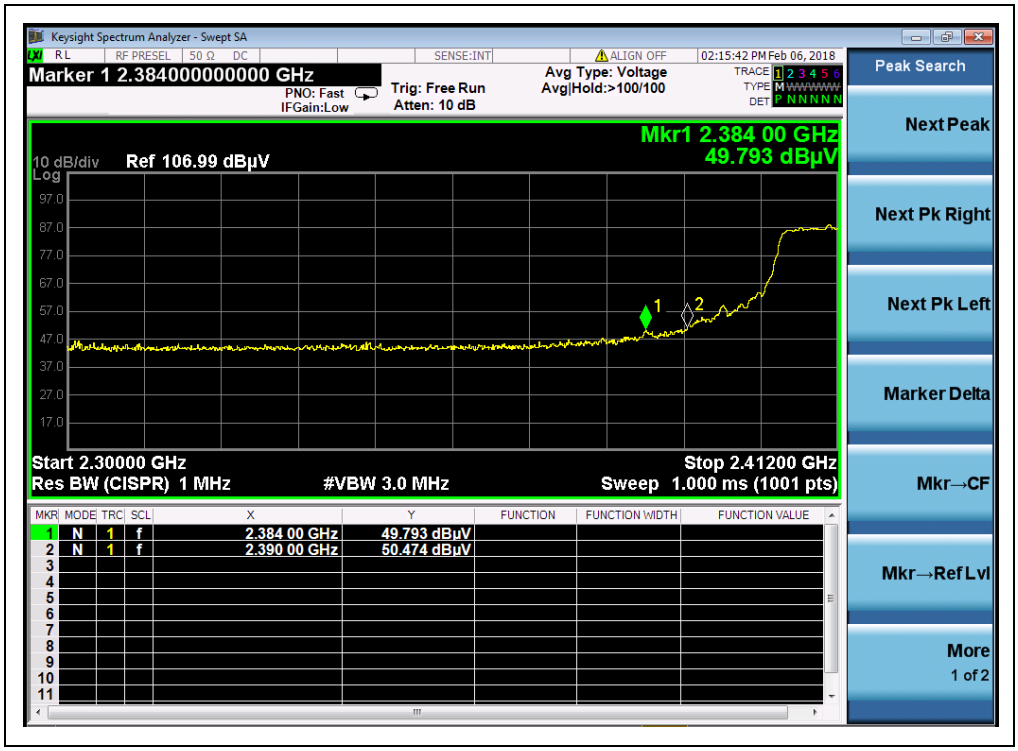
2.6.3.2 802.11g Test mode

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

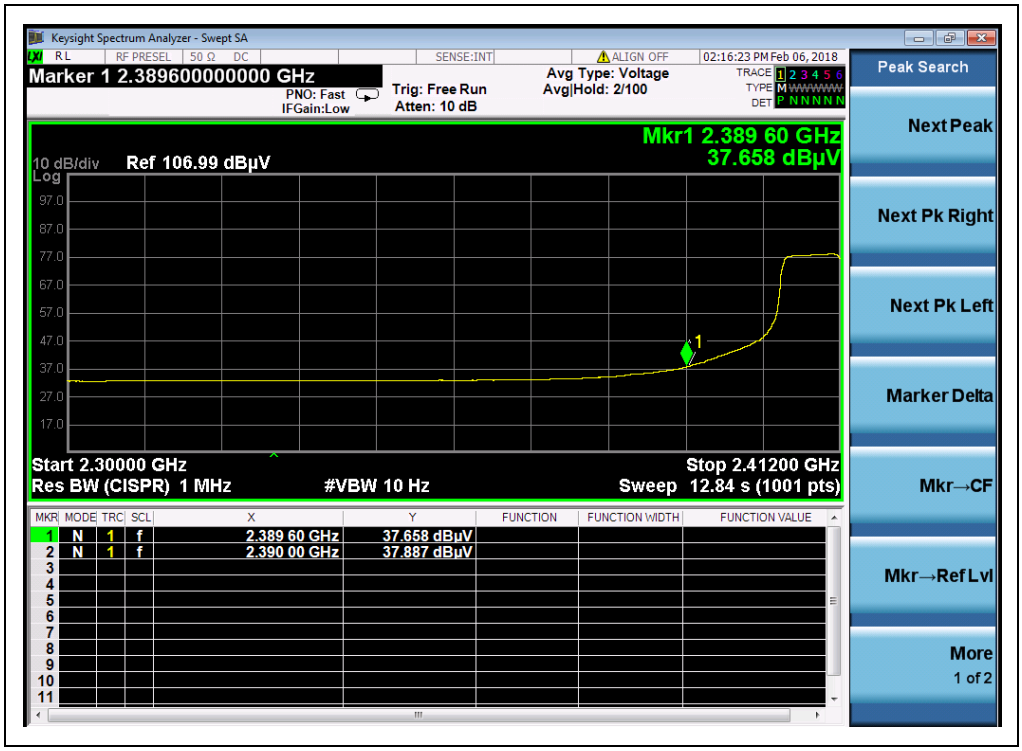
A. Test Verdict:

Channel	Frequency (MHz)	Detector PK/ AV	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
1	2384.00	PK	49.79	-33.63	32.56	48.72	74	Pass
1	2389.60	AV	37.66	-33.63	32.56	36.59	54	Pass
11	2483.61	PK	54.28	-33.18	32.50	53.6	74	Pass
11	2483.65	AV	39.82	-33.18	32.50	39.14	54	Pass

B. Test Plots:

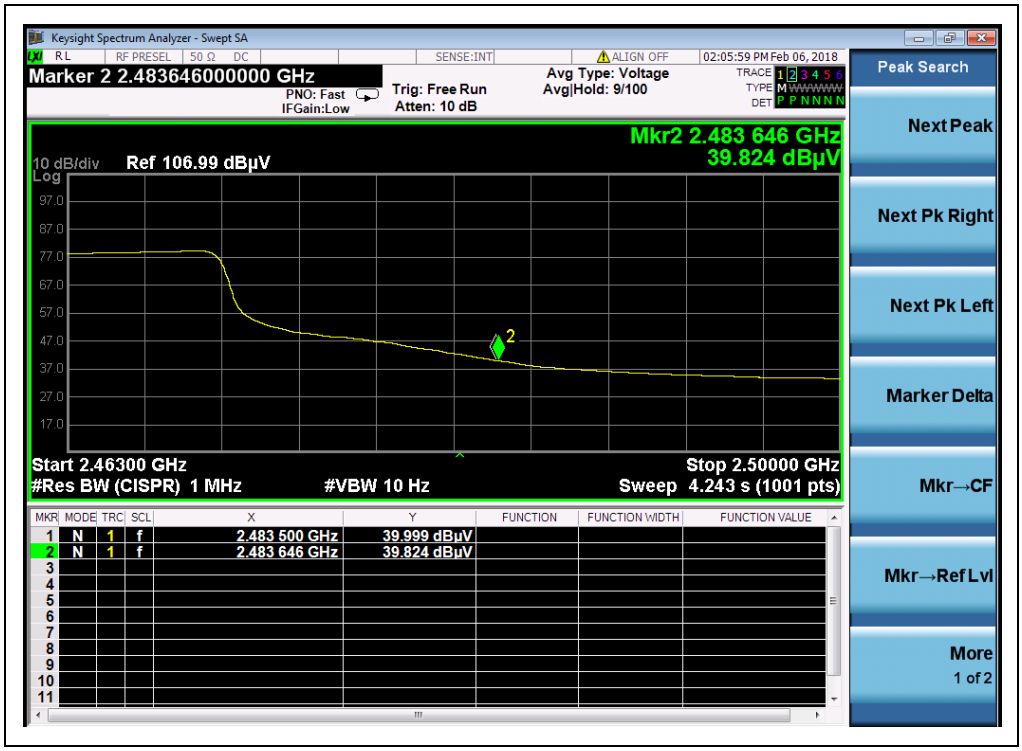


(Channel = 1 PEAK, 802.11g)



(Channel = 1 AVG, 802.11g)

(Channel = 11 PEAK, 802.11g)



(Channel = 11 AVG, 802.11g)

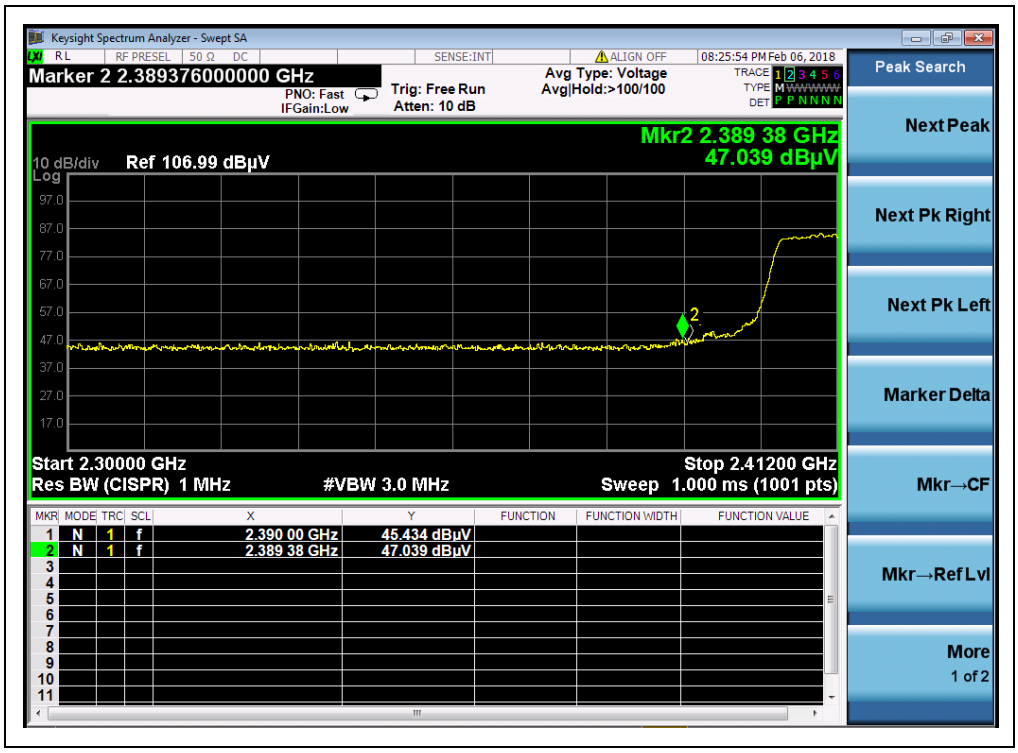
2.6.3.3 802.11n-20MHz Test mode

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

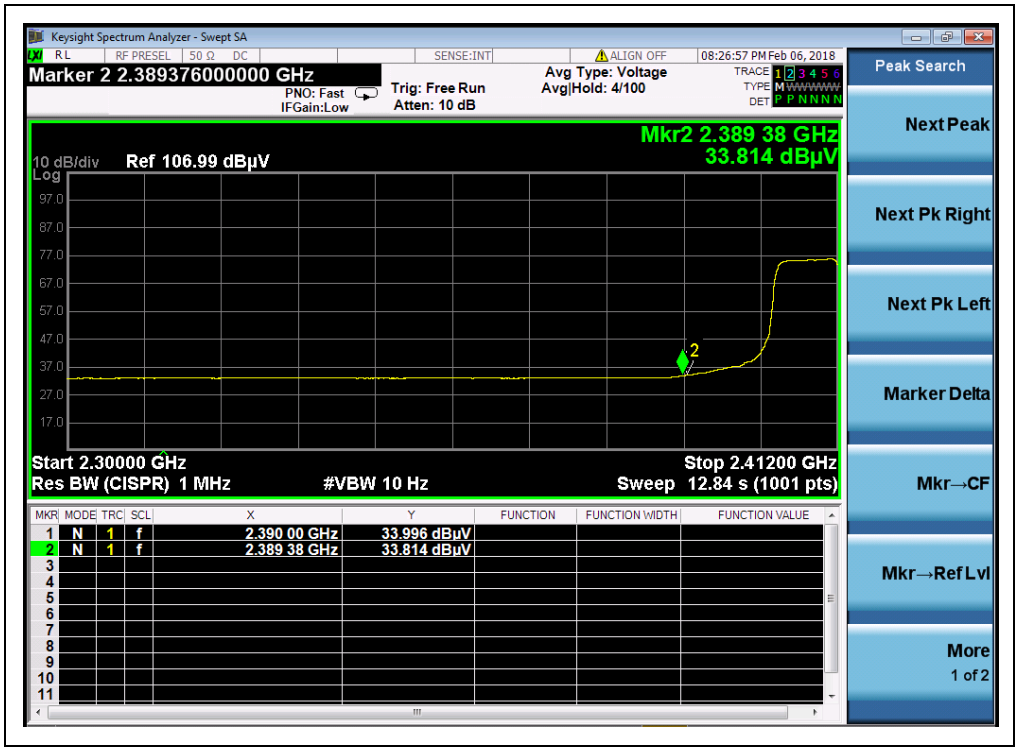
A. Test Verdict:

Channel	Frequency (MHz)	Detector PK/ AV	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBµV/m)	Limit (dBµV/m)	Verdict
1	2389.38	PK	47.04	-33.63	32.56	45.97	74	Pass
1	2389.38	AV	33.81	-33.63	32.56	32.74	54	Pass
11	2483.87	PK	54.00	-33.18	32.50	53.32	74	Pass
11	2483.57	AV	39.41	-33.18	32.50	38.73	54	Pass

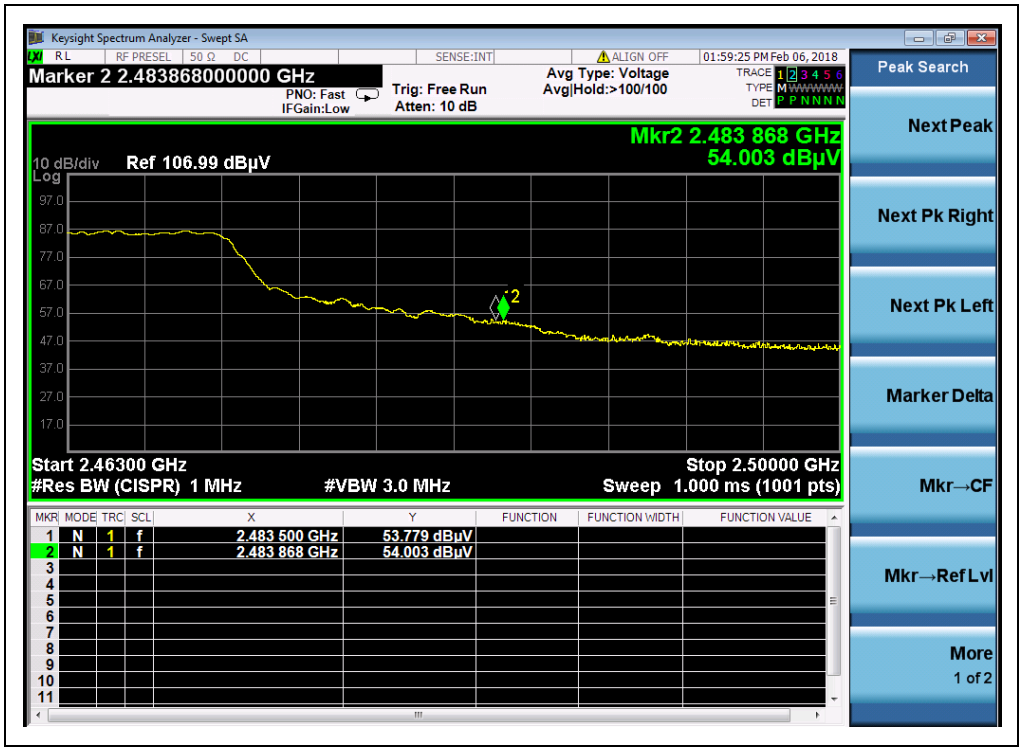
B. Test Plots:



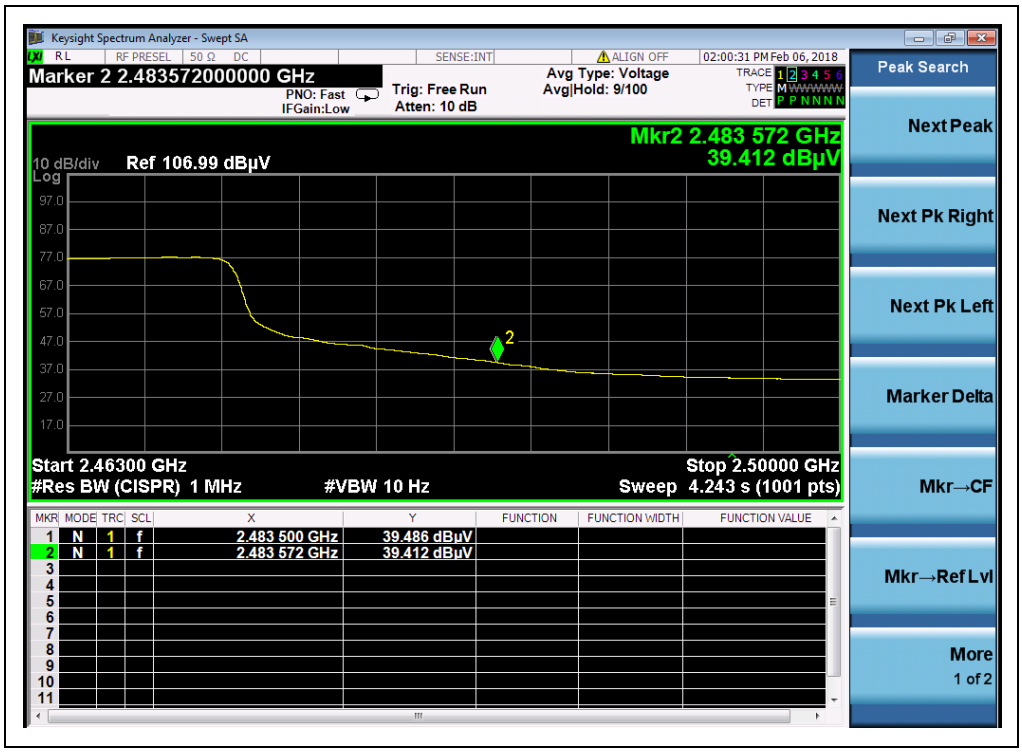
(Channel = 1 PEAK, 802.11n-20)



(Channel = 1 AVG, 802.11n-20)



(Channel = 11 PEAK, 802.11n-20)



(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

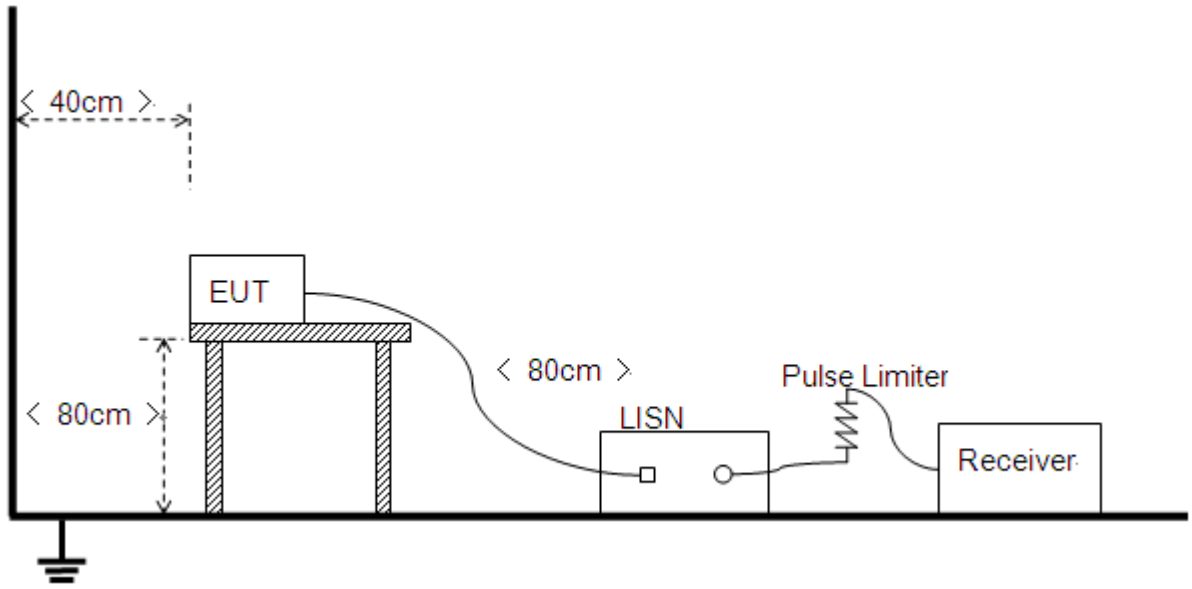
NOTE:

(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 refer ANNEX A(1.5).

2.7.3. Test Result

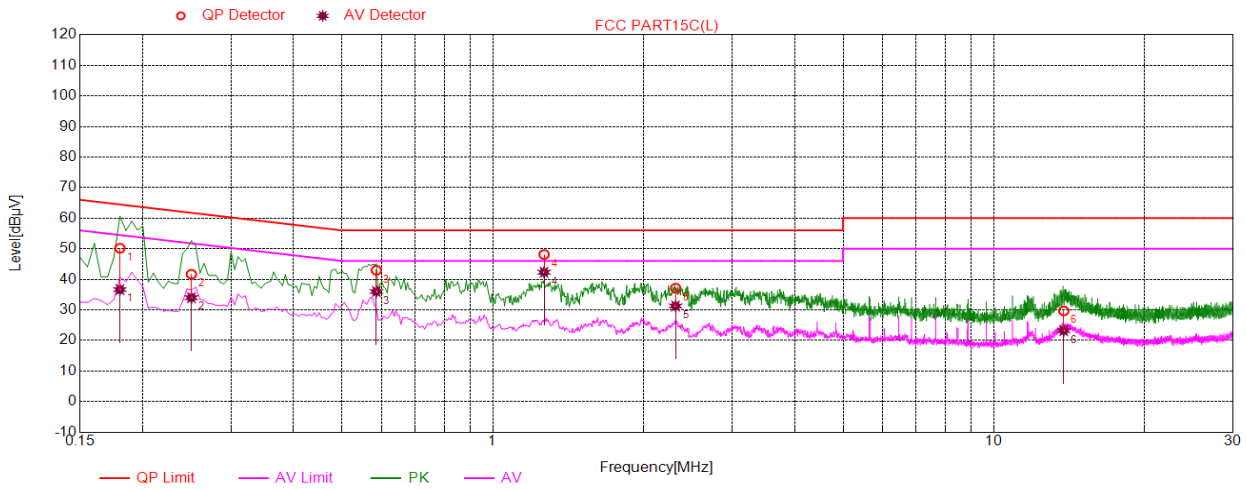
The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT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

A. Test setup:

The EUT configuration of the emission tests is EUT + Link.

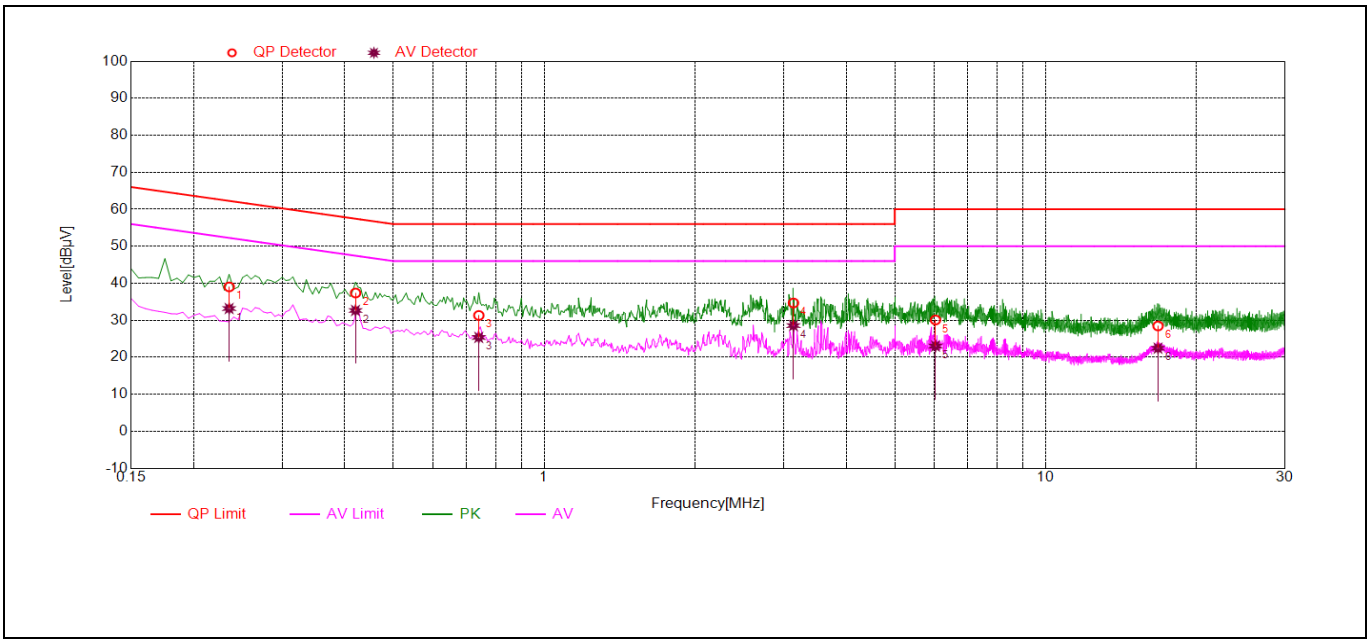
Note: The test voltage is AC 120V/60Hz.

B. Test Plots:



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.18	50.17	36.64	64.49	54.49	Line	PASS
2	0.25	41.66	33.99	61.76	51.76		PASS
3	0.59	42.96	36.00	56.00	46.00		PASS
4	1.27	48.13	42.32	56.00	46.00		PASS
5	2.31	37.11	31.28	56.00	46.00		PASS
6	13.79	29.66	23.21	60.00	50.00		PASS



(N Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.24	39.02	33.18	62.27	52.27	Neutral	PASS
2	0.42	37.38	32.65	57.45	47.45		PASS
3	0.74	31.32	25.38	56.00	46.00		PASS
4	3.14	34.68	28.56	56.00	46.00		PASS
5	6.03	30.09	23.03	60.00	50.00		PASS
6	16.76	28.47	22.45	60.00	50.00		PASS

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.

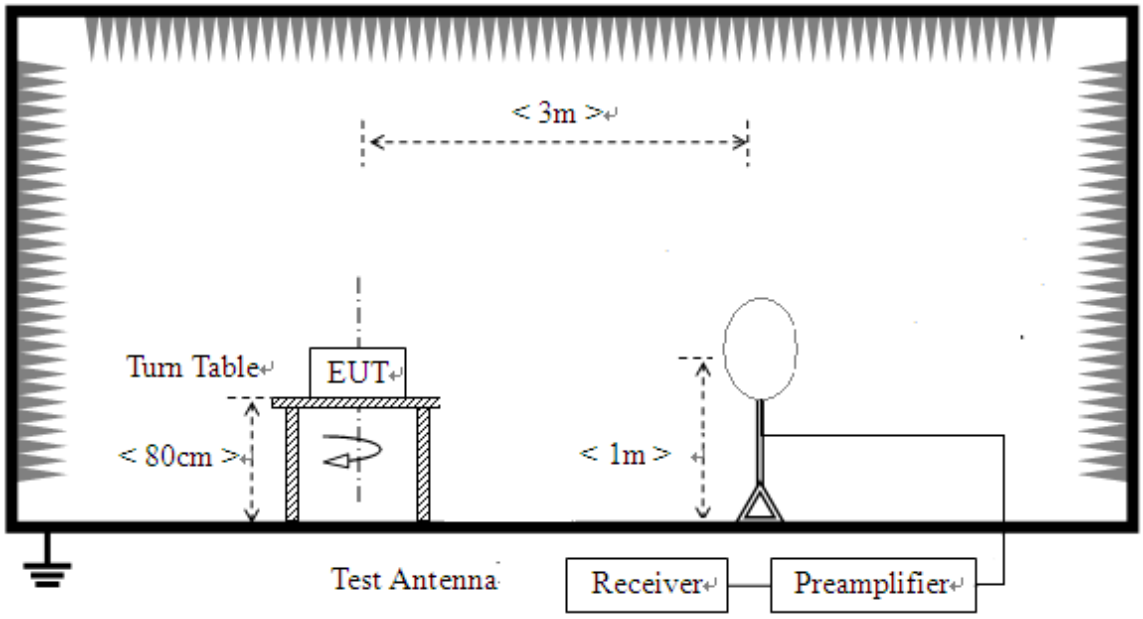
For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

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)

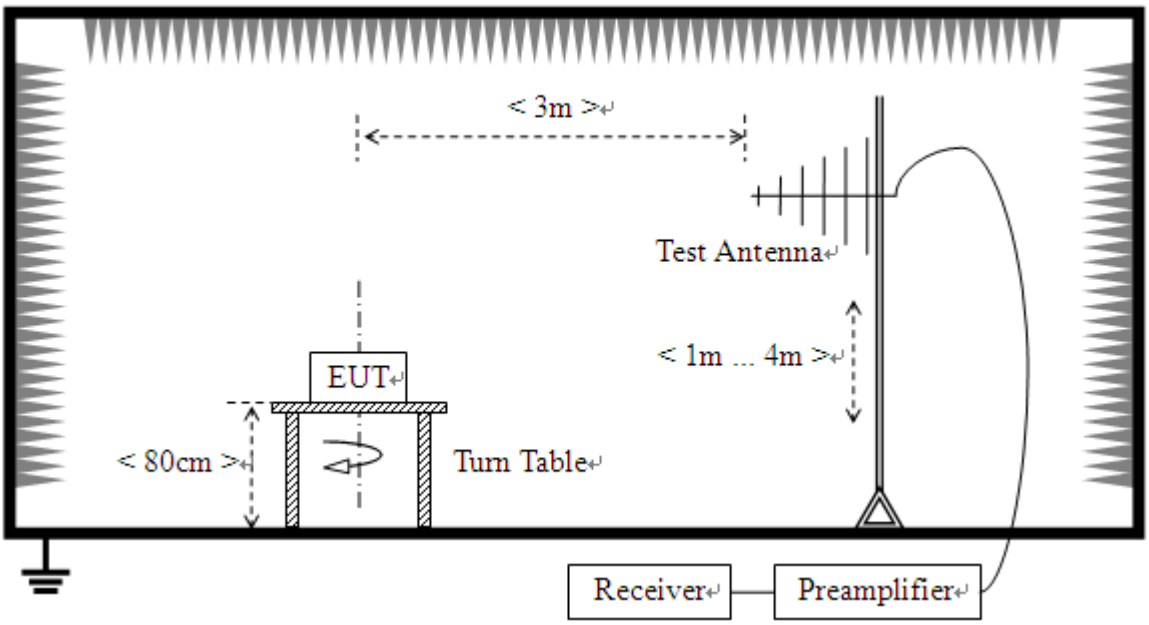
2.8.2. Test Description

A. Test Setup:

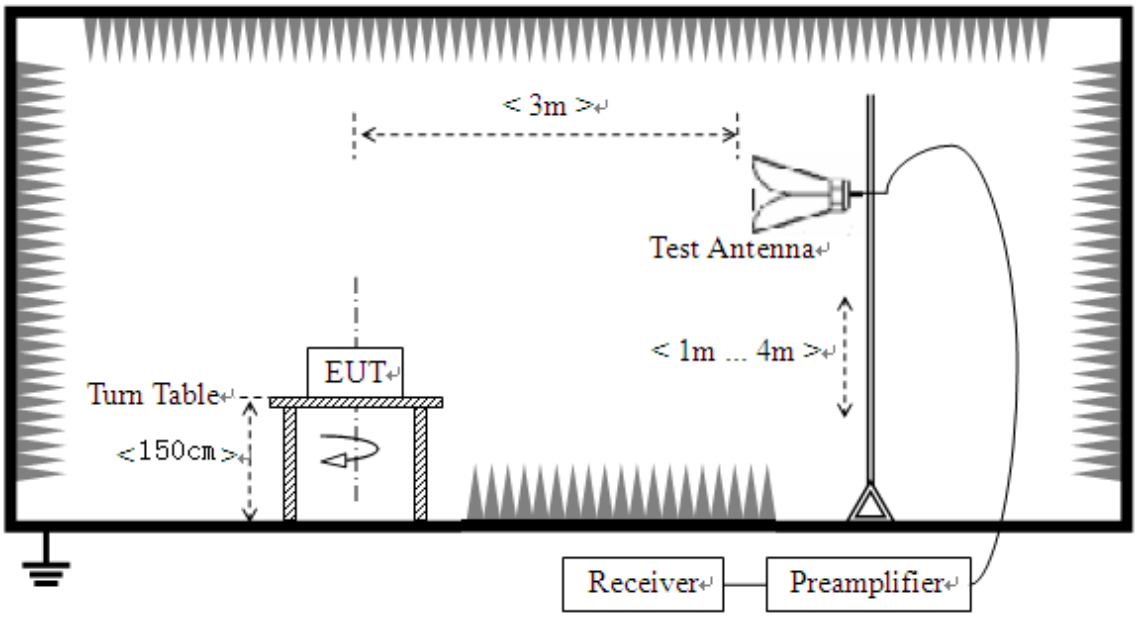
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz. Test site have a minimum area of the ground plane covered with RF absorbing material as specified in Figure 6 of ANSI C63.4: 2014.

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. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test 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 test antenna elevation shall be that which maximizes the emissions. The test 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 emission levels at both horizontal and vertical polarizations should be tested.

A. Equipments List:

Please refer 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 [dBμV/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

Plots for Channel = 1

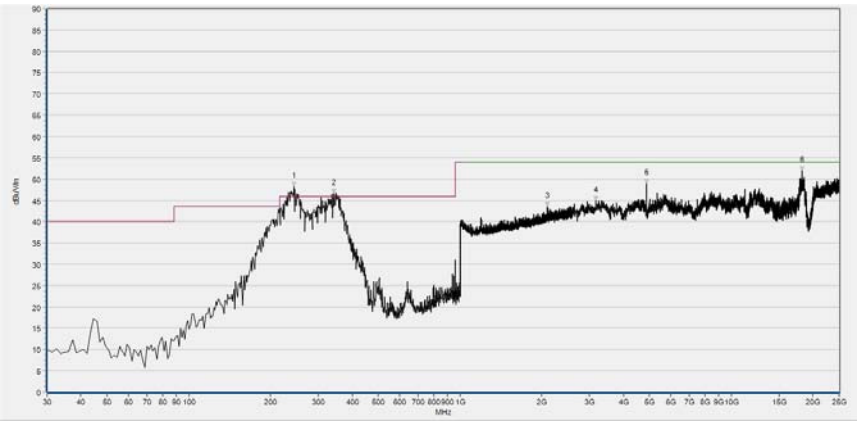
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
244.881	48.04	42.59	N/A	N/A	46.00	N/A	Horizontal	PASS
342.003	46.99	42.18	N/A	N/A	46.00	N/A	Horizontal	PASS
2199.840	46.37	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
3227.314	45.73	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4824.000	54.24	N/A	47.44	74.0	N/A	54.0	Horizontal	PASS
18176.941	51.45	N/A	41.58	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
243.667	37.53	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
326.220	37.84	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1195.278	49.77	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2332.373	48.09	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4824.000	55.32	N/A	51.49	74.0	N/A	54.0	Vertical	PASS
18172.868	51.64	N/A	46.59	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6



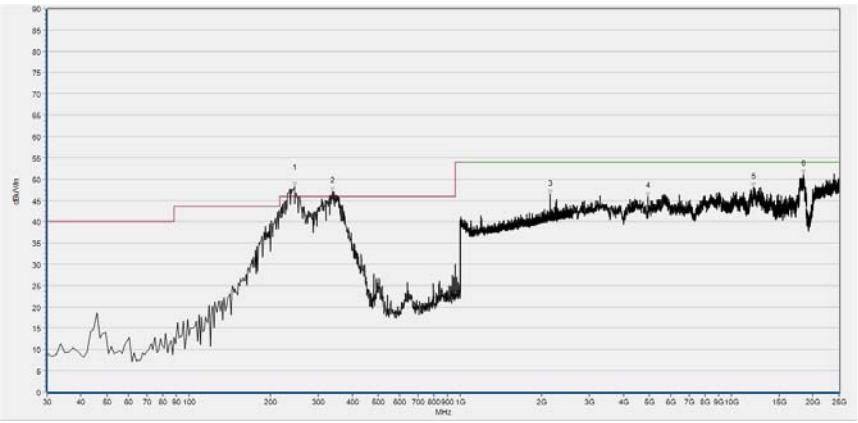
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
243.667	48.28	42.30	N/A	N/A	46.00	N/A	Horizontal	PASS
343.217	46.55	40.89	N/A	N/A	46.00	N/A	Horizontal	PASS
2096.759	43.66	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
3162.139	44.87	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4873.900	49.35	N/A	46.76	74.0	N/A	54.0	Horizontal	PASS
18221.749	51.88	N/A	47.68	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
243.667	38.08	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
327.434	39.54	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1197.839	49.46	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2072.429	47.21	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4873.900	55.28	N/A	51.50	74.0	N/A	54.0	Vertical	PASS
18168.794	50.51	N/A	N/A	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 11



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
244.881	48.34	42.99	N/A	N/A	46.00	N/A	Horizontal	PASS
338.360	47.03	41.85	N/A	N/A	46.00	N/A	Horizontal	PASS
2152.461	46.36	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4921.877	45.93	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
12070.813	48.06	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
18458.011	51.18	N/A	47.98	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
242.453	37.98	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
323.792	38.47	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1196.559	49.61	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2233.774	46.87	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4923.900	52.10	N/A	47.65	74.0	N/A	54.0	Vertical	PASS
18005.856	51.56	N/A	49.63	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

2.8.3.2 802.11g Test mode

Plots for Channel = 1

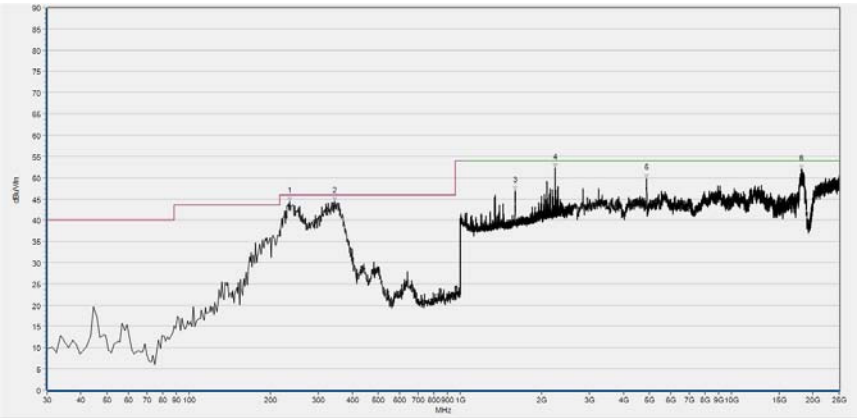
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
240.025	45.51	42.15	N/A	N/A	46.00	N/A	Horizontal	PASS
345.645	41.77	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1597.359	43.79	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4824.113	47.70	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
9064.594	47.80	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
18181.015	51.84	N/A	48.99	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
244.881	35.66	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
328.648	42.37	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1595.438	43.09	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
3239.534	45.97	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4815.967	48.26	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
18254.337	52.13	N/A	49.22	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
235.169	44.40	39.59	N/A	N/A	46.00	N/A	Horizontal	PASS
345.645	44.39	38.69	N/A	N/A	46.00	N/A	Horizontal	PASS
1595.438	46.95	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
2248.600	53.26	N/A	44.02	74.0	N/A	54.0	Horizontal	PASS
4864.848	49.83	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
18181.015	52.02	N/A	48.96	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
246.095	36.16	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
337.146	43.36	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1595.438	47.23	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2192.797	48.76	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4878.400	54.36	N/A	39.34	74.0	N/A	54.0	Vertical	PASS
18474.304	51.54	N/A	47.25	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 11

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
235.169	45.72	41.59	N/A	N/A	46.00	N/A	Horizontal	PASS
343.217	41.88	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1596.719	49.05	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
2290.116	50.26	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
3284.343	47.90	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
17932.533	50.90	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
248.523	36.05	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
335.932	43.31	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1599.920	47.29	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2298.439	50.25	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
12233.752	48.76	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
18213.602	51.64	N/A	49.25	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

2.8.3.3 802.11n-20MHz Test mode

Plots for Channel = 1

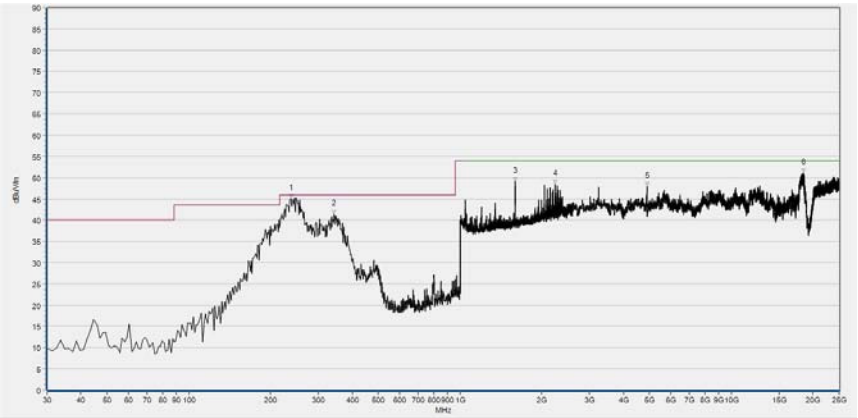
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
241.239	46.01	41.58	N/A	N/A	46.00	N/A	Horizontal	PASS
337.146	41.27	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1597.359	50.36	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
2142.857	48.82	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4832.260	49.84	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
18189.162	51.28	N/A	49.35	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
246.095	36.36	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
340.788	42.99	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1595.438	47.62	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2299.720	50.48	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4825.600	55.28	N/A	41.39	74.0	N/A	54.0	Vertical	PASS
18356.174	51.82	N/A	48.26	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6



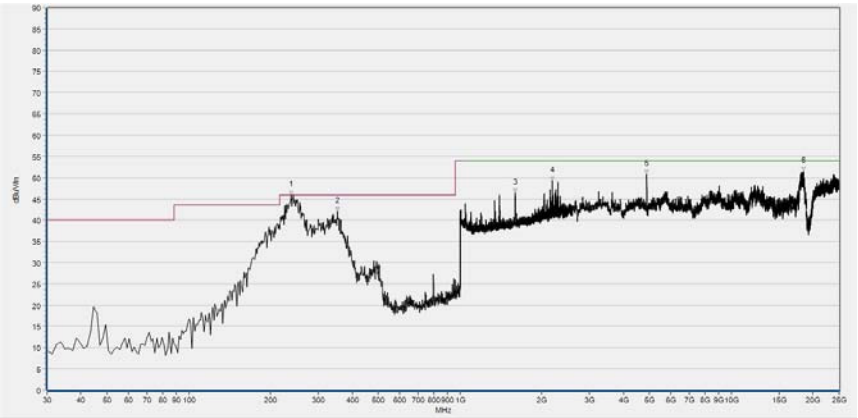
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
237.597	45.06	41.27	N/A	N/A	46.00	N/A	Horizontal	PASS
343.217	41.42	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1597.999	49.03	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
2242.737	48.52	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4885.215	47.88	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
18453.937	51.11	N/A	47.21	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
246.095	35.64	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
338.360	42.18	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1597.359	49.37	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2292.037	49.99	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4875.800	53.65	N/A	39.81	74.0	N/A	54.0	Vertical	PASS
18201.382	51.62	N/A	48.24	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 11



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
238.811	45.96	40.26	N/A	N/A	46.00	N/A	Horizontal	PASS
352.929	42.02	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1597.999	46.43	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
2192.157	49.19	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
4923.580	50.86	N/A	N/A	74.0	N/A	54.0	Horizontal	PASS
18453.937	51.49	N/A	48.69	74.0	N/A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
244.881	35.35	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
335.932	42.67	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1594.798	46.52	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
2295.238	49.41	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
4924.365	51.98	N/A	38.59	74.0	N/A	54.0	Vertical	PASS
18229.896	51.07	N/A	47.85	74.0	N/A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Annex A Test Uncertainty

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

Test items	Uncertainty
Peak Output Power	±2.22dB
Power spectral density (PSD)	±2.22dB
Bandwidth	±5%
Conducted Spurious Emission	±2.77 dB
Restricted Frequency Bands	±5%
Radiated Emission	±2.95dB
Conducted Emission	±2.44dB

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

Annex B Testing Laboratory Information

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

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

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, 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 and CISPR Publication 22; the FCC designation number is CN1192.

4. Test Equipments Utilized

4.1 Conducted Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Power Splitter	NW521	1506A	Weinschel	2017.05.24	2018.05.23
Attenuator 1	(N/A.)	10dB	Resnet	2017.05.24	2018.05.23
Attenuator 2	(N/A.)	3dB	Resnet	2017.05.24	2018.05.23
EXA Signal Analzyer	MY53470836	N9010A	Agilent	2017.12.03	2018.12.02
USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2017.05.24	2018.05.23
RF cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial cable	CB02	RF02	Morlab	N/A	N/A
SMA connector	CN01	RF03	HUBER-SUHNER	N/A	N/A

4.2 Conducted Emission Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Receiver	MY56400093	N9038A	KEYSIGHT	2017.07.13	2018.07.12
LISN	812744	NSLK 8127	Schwarzbeck	2017.05.17	2018.05.16
Pulse Limiter (20dB)	9391	VTSD 9561-D	Schwarzbeck	2017.05.17	2018.05.16
Coaxial cable(BNC) (30MHz-26GHz)	CB01	EMC01	Morlab	N/A	N/A

4.3Auxiliary Test Equipment

Equipment Name	Model No.	Brand Name	Manufacturer	Cal.Date	Cal.Due Date
Computer	T430i	Think Pad	Lenovo	N/A	N/A

4.4 Radiated Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal.Due Date
Receiver	MY54130016	N9038A	Agilent	2017.05.17	2018.05.16
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2017.05.14	2018.05.13
Test Antenna - Horn	9170C-531	BBHA9170	Schwarzbeck	2017.09.13	2018.09.12
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2017.03.07	2018.03.06
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2017.09.13	2018.09.12
Coaxial cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
Coaxial cable(N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
1-18GHz pre-Amplifier	MA02	TS-PR18	Rohde& Schwarz	2017.05.17	2018.05.16
18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde& Schwarz	2017.05.17	2018.05.16
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

END OF REPORT