



TEST REPORT

APPLICANT : Grandstream Networks, Inc.
PRODUCT NAME : IP Multimedia Phone
MODEL NAME : GXV3380
BRAND NAME : GRANDSTREAM
FCC ID : YZZGXV3380
STANDARD(S) : 47 CFR Part 15 Subpart C
RECEIPT DATE : 2019-04-12
TEST DATE : 2019-05-10 to 2019-06-06
ISSUE DATE : 2019-06-10

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Change History		
Version	Date	Reason for change
1.0	2019-06-10	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Grandstream Networks, Inc.
Applicant Address:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA
Manufacturer:	Grandstream Networks, Inc.
Manufacturer Address:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

1.2. Equipment Under Test (EUT) Description

Product Name:	IP Multimedia Phone	
Serial No:	(N/A, marked #1 by test site)	
Hardware Version:	V1.6	
Software Version:	1.0.0.10	
Equipment type:	WLAN2.4G	
Modulation Type:	DSSS, OFDM	
Operating Frequency Range:	802.11b/g/ n(HT20): 2.412GHz - 2.462GHz	
Antenna Type:	PCB Antenna	
Antenna Gain:	4.0 dBi	
Accessory Information:	AC Adapter1	
	Brand Name:	FRECOM
	Model No.:	F18W8-120150SPAUY
	Serial No.:	(N/A, marked #1 by test site)
	Rated Output:	12V=1.5A
	Rated Input:	100-240V ~ 50/60Hz 0.6A
	AC Adapter2	
	Brand Name:	SUNLIGHT
	Model No.:	H18US1200150A
	Serial No.:	(N/A, marked #1 by test site)
	Rated Output:	12V=1.5A
	Rated Input:	100-240V ~ 50/60Hz 0.8A



Note 1: The product provides two adapters, which are shipped randomly. Both of the two adapters were tested, only the worst test result(Adapter2) were recorded in the test report.

Note 2: 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. The channel number and frequency

Test Mode	Channel	Frequency (MHz)	Channel	Frequency (MHz)
802.11b/g/n(HT20)	1	2412	8	2447
	2	2417	9	2452
	3	2422	10	2457
	4	2427	11	2462
	5	2432		
	6	2437		
	7	2442		

Note1: The Lowest Channel (1), Middle Channel (6) and Highest Channel (11) was selected test for 802.11b/g/n(HT20) mode;



1.4. 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	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	N/A	Duty Cycle Of Test Signal	May 10, 2019	Wang Meng	PASS
3	15.247(b)	Maximum Peak and Average Conducted Output Power	Jun 02, 2019	Wang Meng	PASS
4	15.247(a)	Bandwidth	May 10, 2019	Wang Meng	PASS
5	15.247(d)	Conducted Spurious Emission and Band Edge	May 10, 2019	Wang Meng	PASS
6	15.247(e)	Power spectral density (PSD)	May 10, 2019	Wang Meng	PASS
7	15.207	Conducted Emission	Jun 06, 2019	Li Zihao	PASS
8	15.247(d)	Restricted Frequency Bands	May 12, 2019	Li Zihao	PASS
9	15.209, 15.247(d)	Radiated Emission	Jun 06, 2019	Li Zihao	PASS

Note1: The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013, KDB558074 D01 v05r02 and KDB594280 D01 v02r01.

Note2: The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The ref offset 11.5dB contains two parts that cable loss 1.5dB and Attenuator 10dB.

1.5. 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. Duty Cycle Of Test Signal

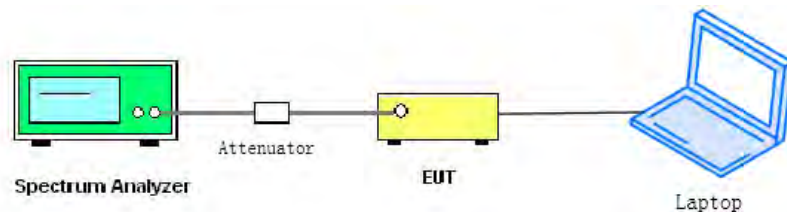
2.2.1. Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this subclause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than $\pm 2\%$; otherwise, the duty cycle is considered to be nonconstant.

2.2.2. Test Description

A. Test Set:



ANSI C63.10 2013 Clause 11.6 was used in order to prove compliance.



2.2.3. Test Result

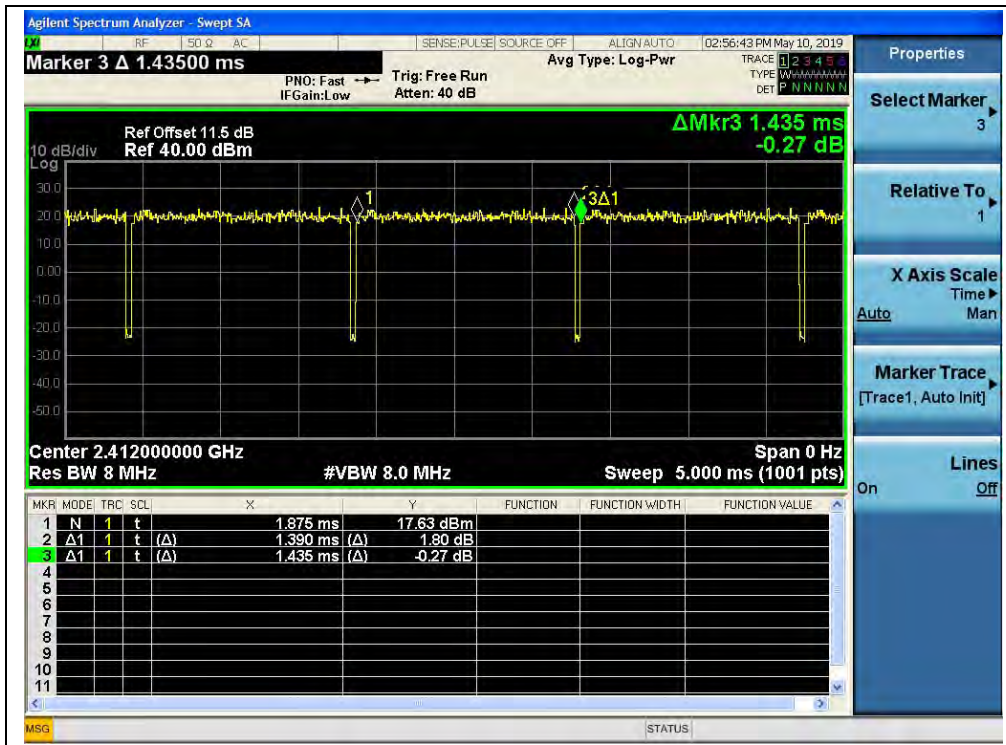
A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor ($10 \cdot \lg[1/D]$)
802.11b	100.00	0.00
802.11g	96.86	0.14
802.11n(HT20)	96.67	0.15

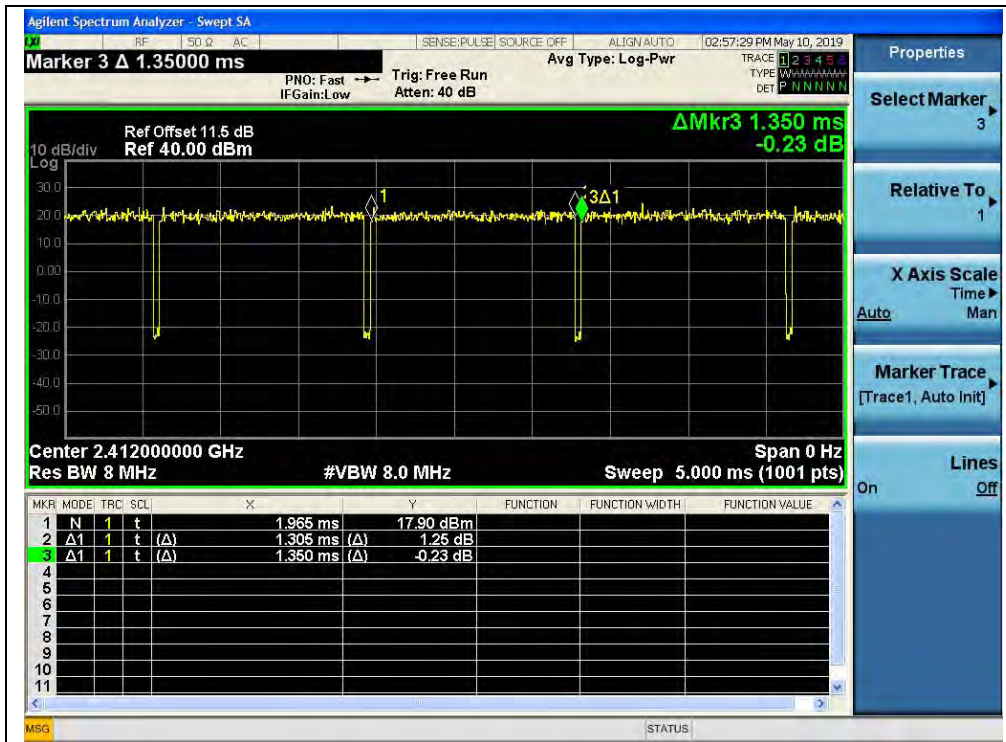
B. Test Plots



(Channel 1, 2412MHz, 802.11b)



(Channel 1, 2412MHz, 802.11g)



(Channel 1, 2412MHz, 802.11 n(HT20))

2.3. Maximum Peak and Average Conducted Output Power

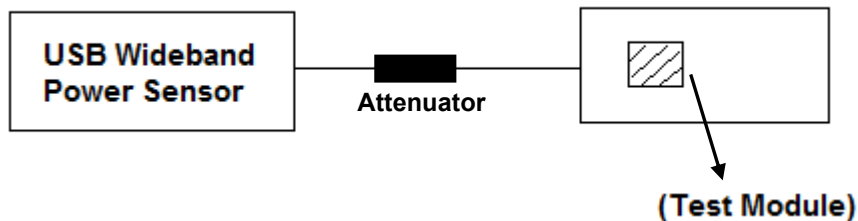
2.3.1. Requirement

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 exceed 1 Watt.

2.3.2. 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.



2.3.3. Test Result

Maximum Peak Conducted Output Power

802.11b Test Mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	17.35	0.054	30	1	PASS
6	2437	17.40	0.055			PASS
11	2462	16.92	0.049			PASS

802.11g Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	23.16	0.207	30	1	PASS
6	2437	23.21	0.209			PASS
11	2462	22.97	0.198			PASS

802.11n(HT20) Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	23.51	0.224	30	1	PASS
6	2437	23.37	0.217			PASS
11	2462	23.23	0.210			PASS

**Maximum Average Conducted Output Power****802.11b Test Mode**

Channel	Frequency (MHz)	Average Power			Limit		Verdict
		Measured	Duty factor Calculated		dBm	W	
		dBm	dBm	W			
1	2412	14.21	14.21	0.026	30	1	PASS
6	2437	14.24	14.24	0.027			PASS
11	2462	13.85	13.85	0.024			PASS

802.11g Test mode

Channel	Frequency (MHz)	Average Power			Limit		Verdict
		Measured	Duty factor Calculated		dBm	W	
		dBm	dBm	W			
1	2412	13.29	13.43	0.022	30	1	PASS
6	2437	13.39	13.53	0.023			PASS
11	2462	13.24	13.38	0.022			PASS

802.11n(HT20) Test mode

Channel	Frequency (MHz)	Average Power			Limit		Verdict
		Measured	Duty factor Calculated		dBm	W	
		dBm	dBm	W			
1	2412	13.51	13.66	0.023	30	1	PASS
6	2437	13.46	13.61	0.023			PASS
11	2462	13.37	13.52	0.022			PASS

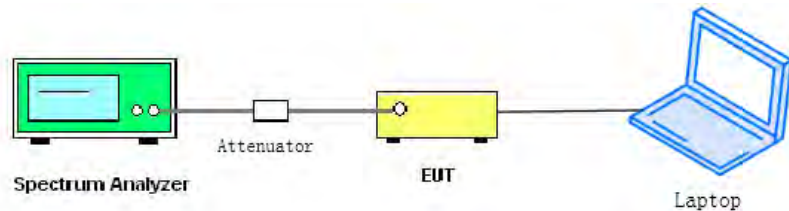
2.4. Bandwidth

2.4.1. 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.

2.4.2. Test Description

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.

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.

2.4.3. Test procedure

KDB 558074 Section 8.2 was used in order to prove compliance.



2.4.4. Test Result

802.11b Test mode

A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	7.551	≥500	PASS
6	2437	7.563	≥500	PASS
11	2462	8.038	≥500	PASS

B. Test Plots



(Channel 1, 2412MHz, 802.11b)



(Channel 6, 2437 MHz, 802.11b)



(Channel 11, 2462MHz, 802.11b)

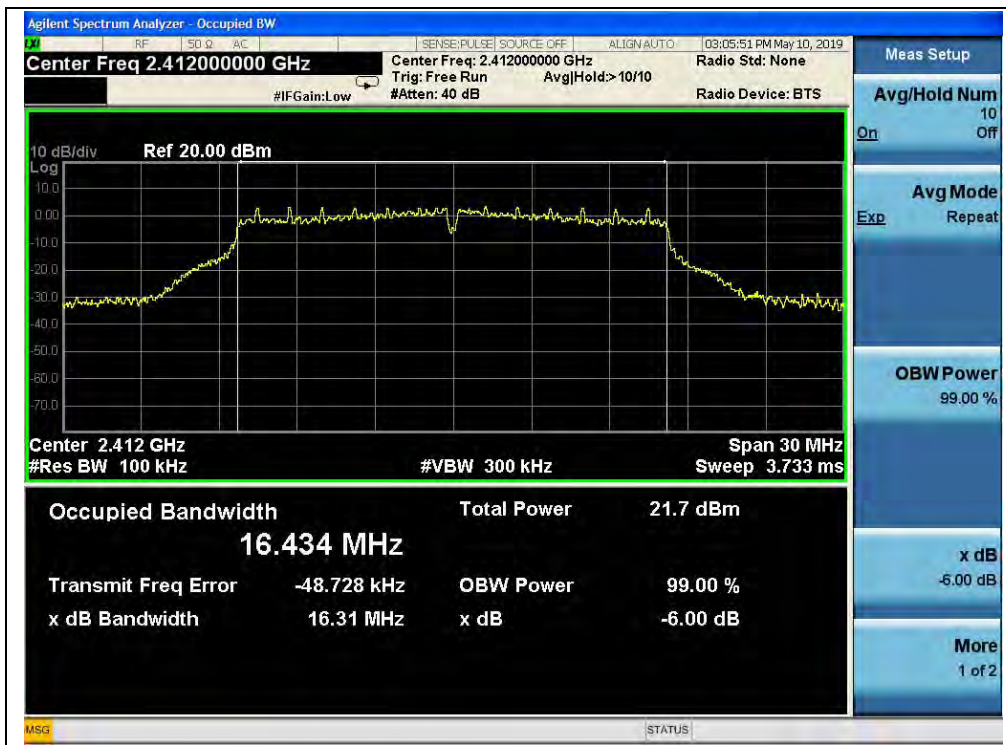


802.11g Test mode

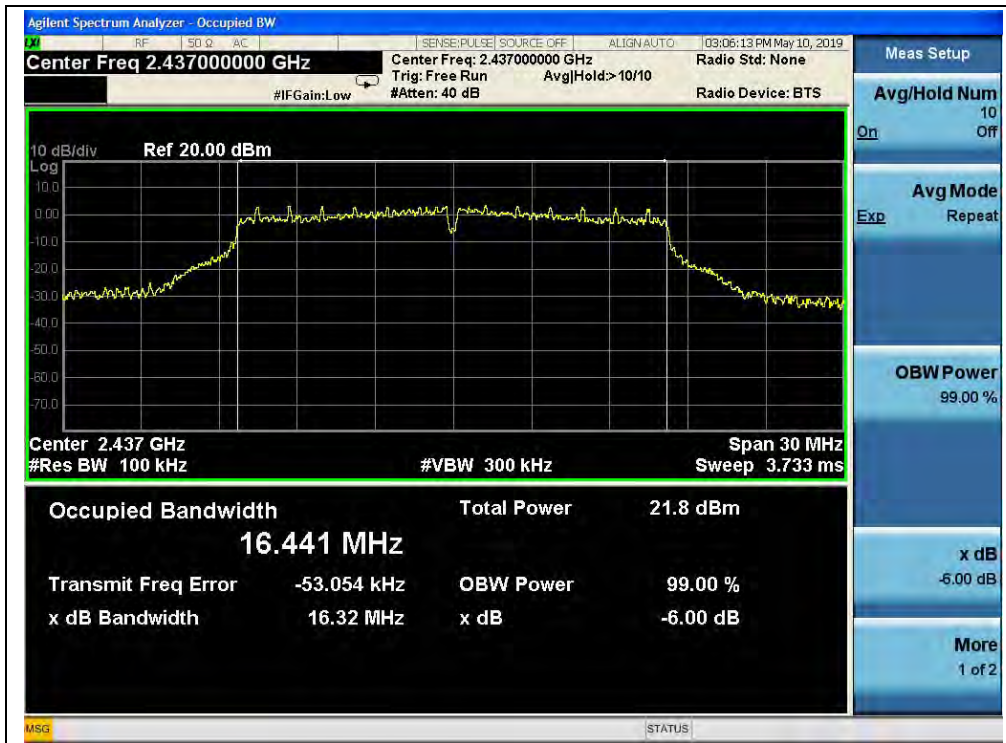
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	16.31	≥500	PASS
6	2437	16.32	≥500	PASS
11	2462	16.27	≥500	PASS

B. Test Plots:



(Channel 1, 2412MHz, 802.11g)



(Channel 6, 2437MHz, 802.11g)



(Channel 11, 2462MHz, 802.11g)

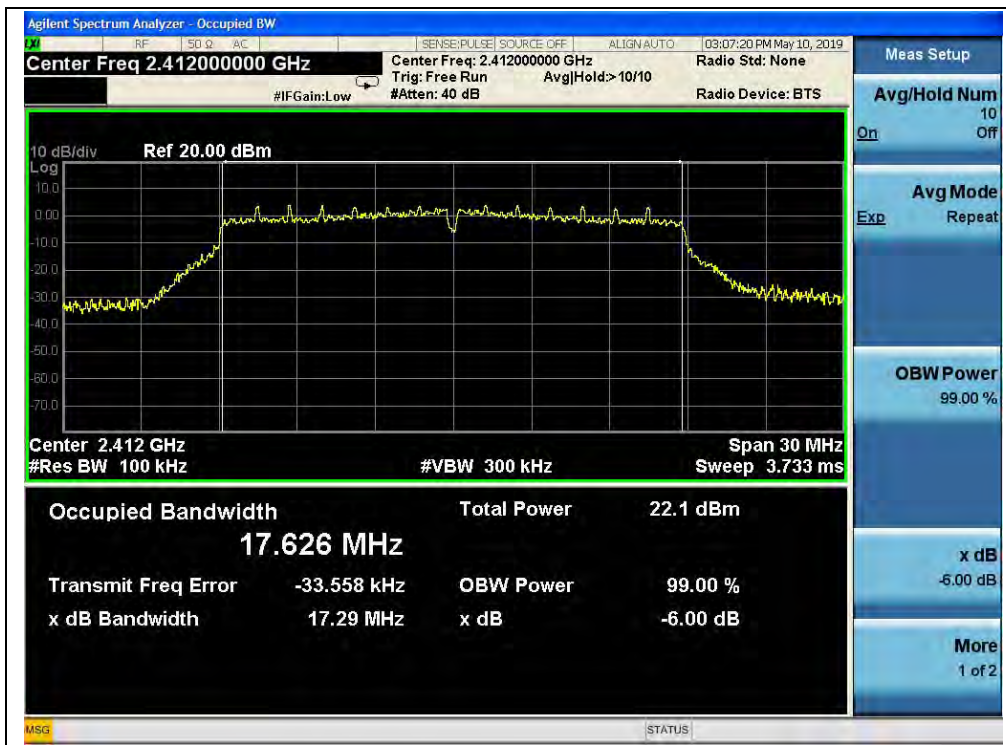


802.11n(HT20) Test mode

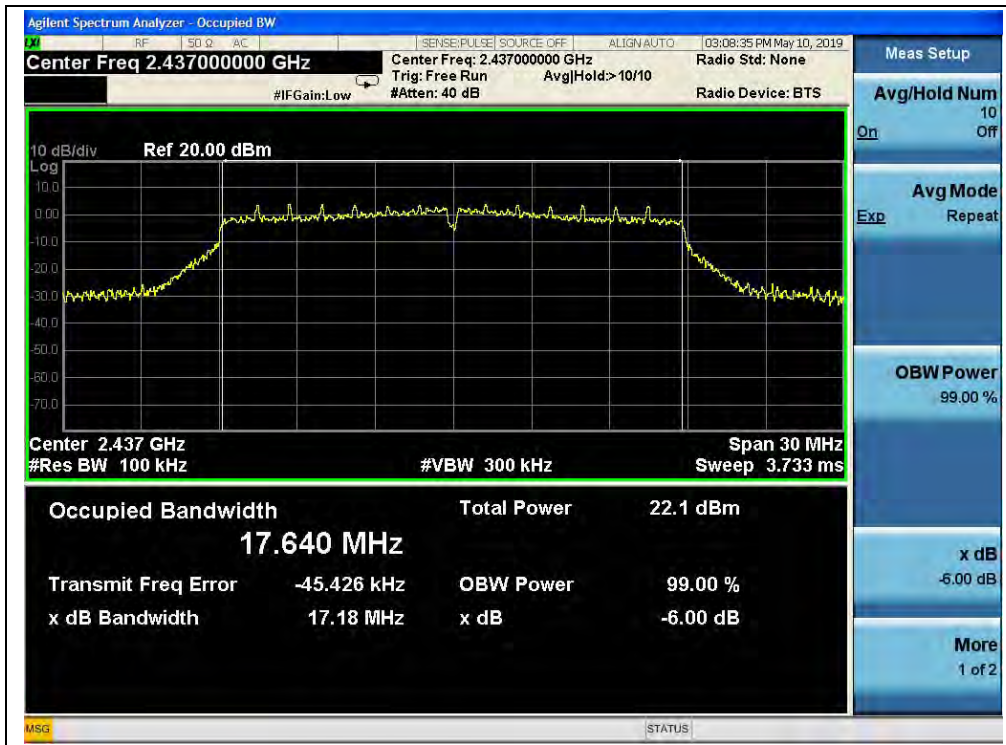
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	17.29	≥500	PASS
6	2437	17.18	≥500	PASS
11	2462	17.15	≥500	PASS

B. Test Plots:



(Channel 1, 2412MHz, 802.11n(HT20))



(Channel 6, 2437MHz, 802.11n(HT20))



(Channel 11, 2462MHz, 802.11n(HT20))

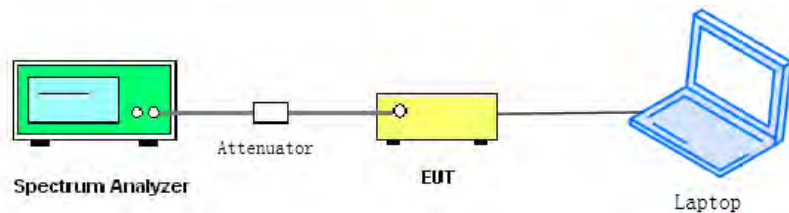
2.5. Conducted Spurious Emissions and Band Edge

2.5.1. 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.

2.5.2. 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.

2.5.3. Test procedure

KDB 558074 Section 8.5 and 8.7 was used in order to prove compliance.



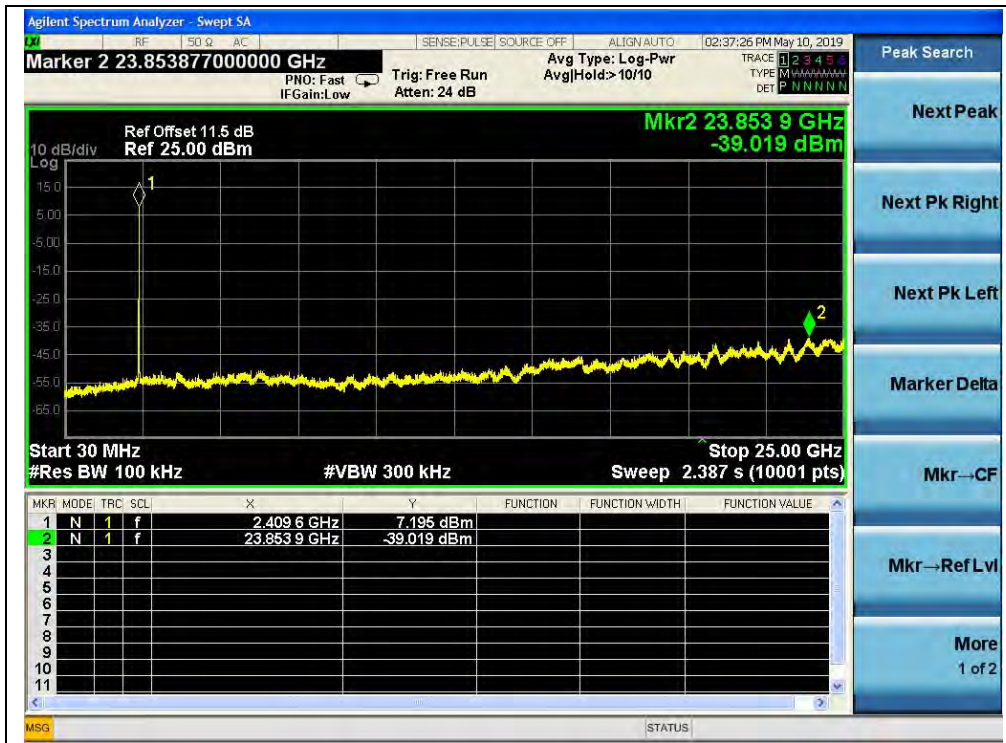
2.5.4. Test Result

802.11b Test mode

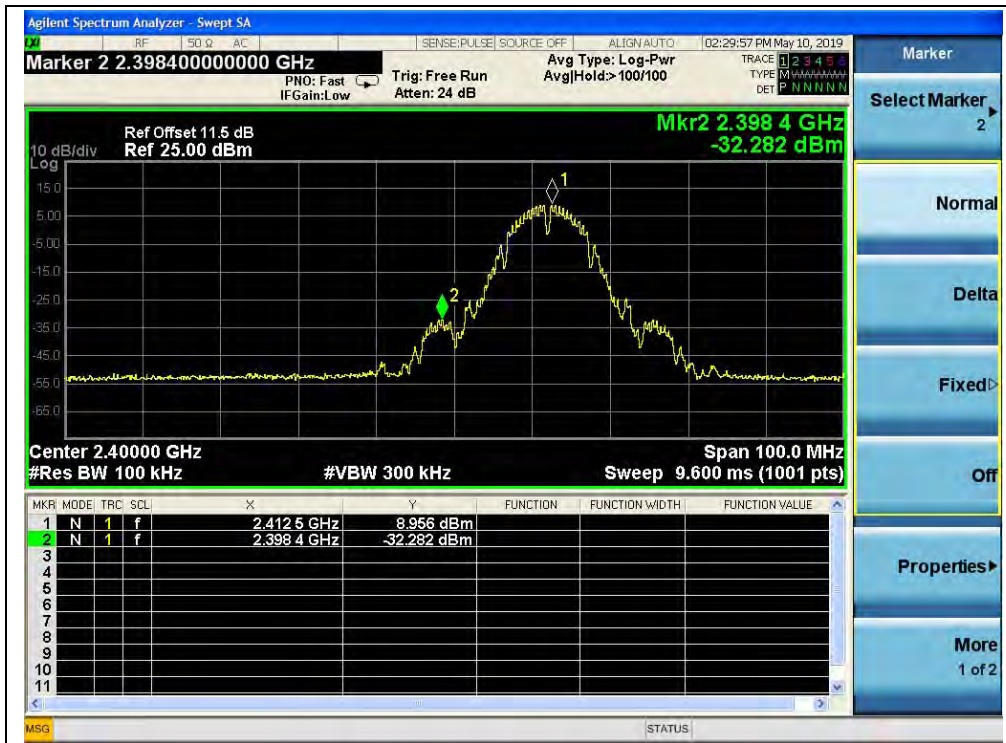
A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-39.02	7.20	-12.80	PASS
6	2437	-38.03	7.21	-12.79	PASS
11	2462	-38.76	7.54	-12.46	PASS

B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



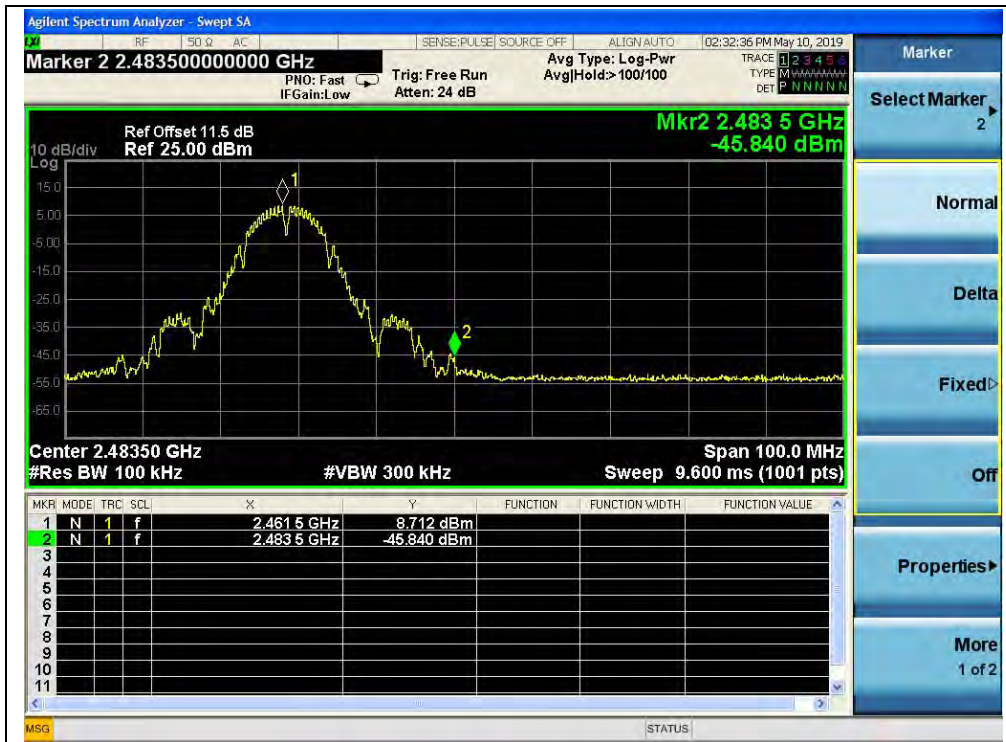
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

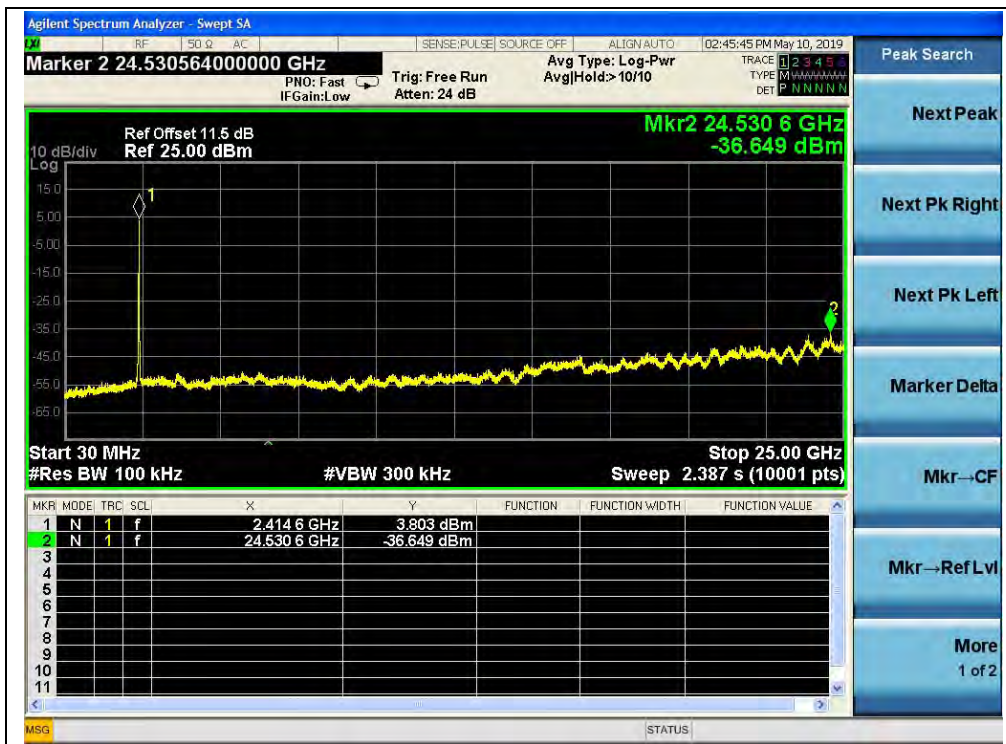


802.11g Test mode

A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-36.65	3.80	-16.20	PASS
6	2437	-39.21	3.68	-16.32	PASS
11	2462	-37.60	4.26	-15.74	PASS

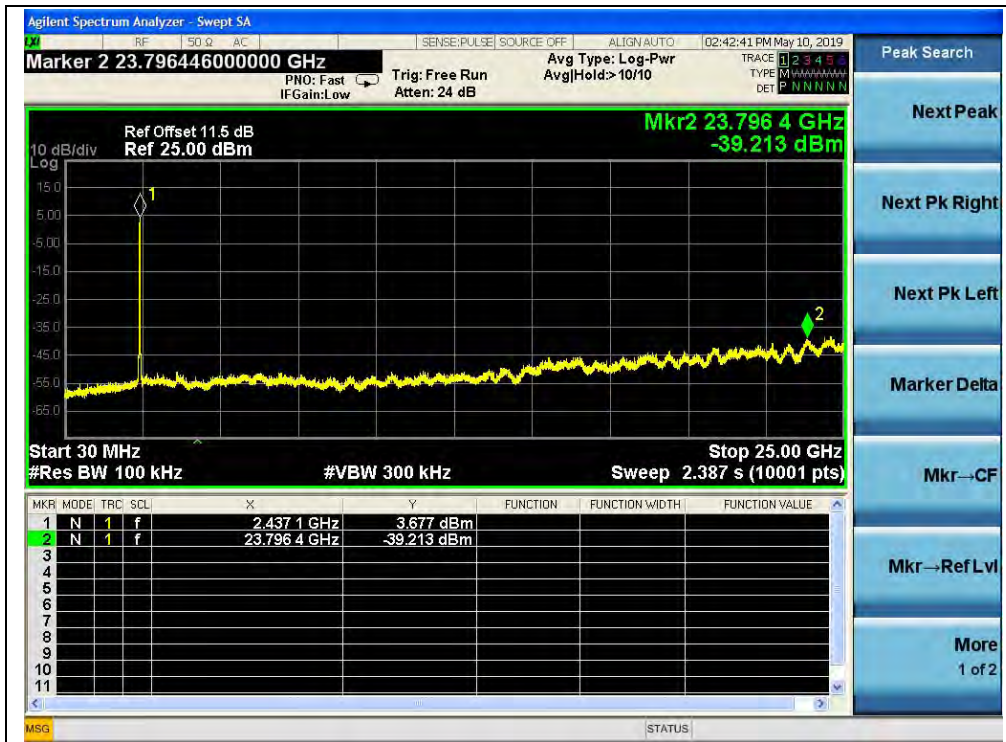
B. Test Plots:



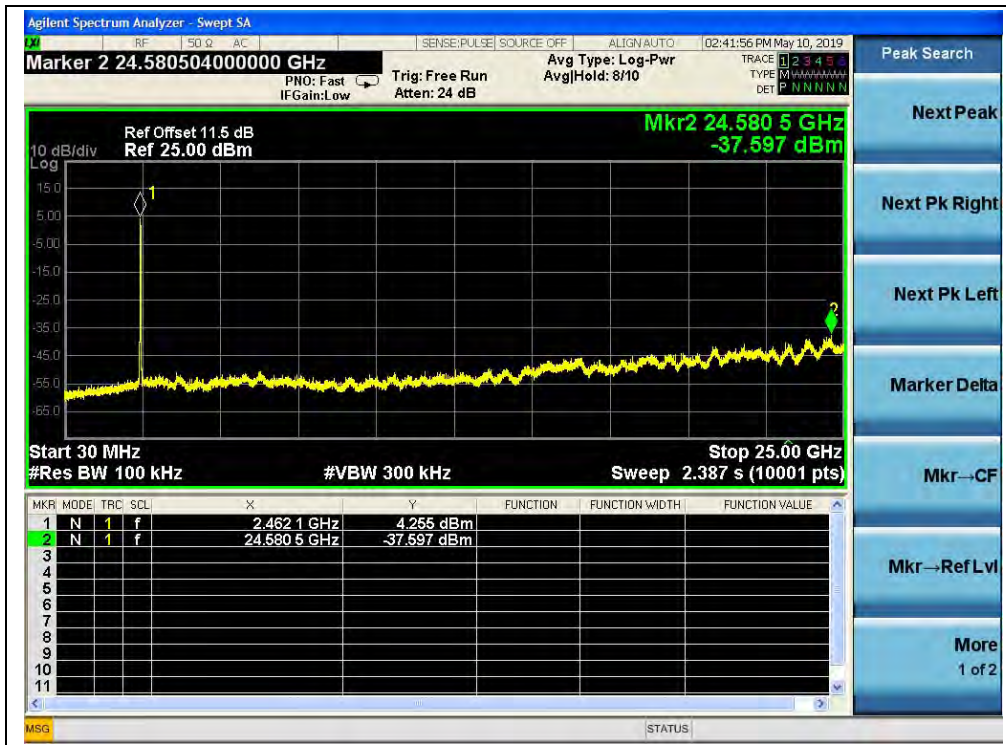
(Channel = 1, 30MHz to 25GHz)



(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

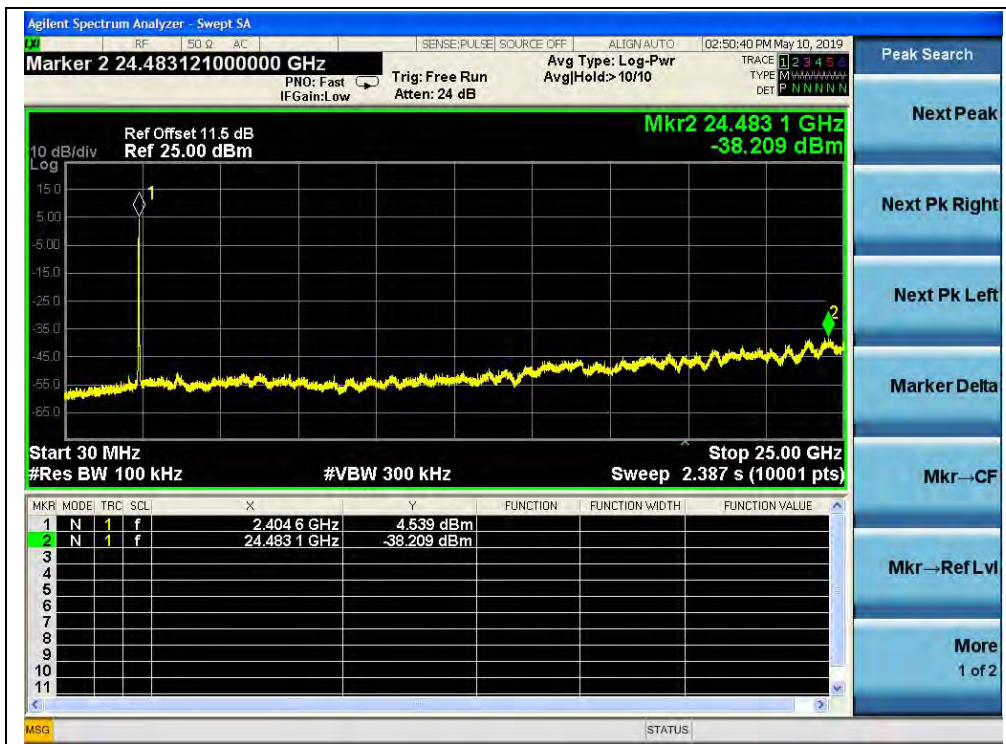


802.11n(HT20) Test mode

A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-38.21	4.54	-15.46	PASS
6	2437	-37.92	4.58	-15.42	PASS
11	2462	-38.73	4.15	-15.85	PASS

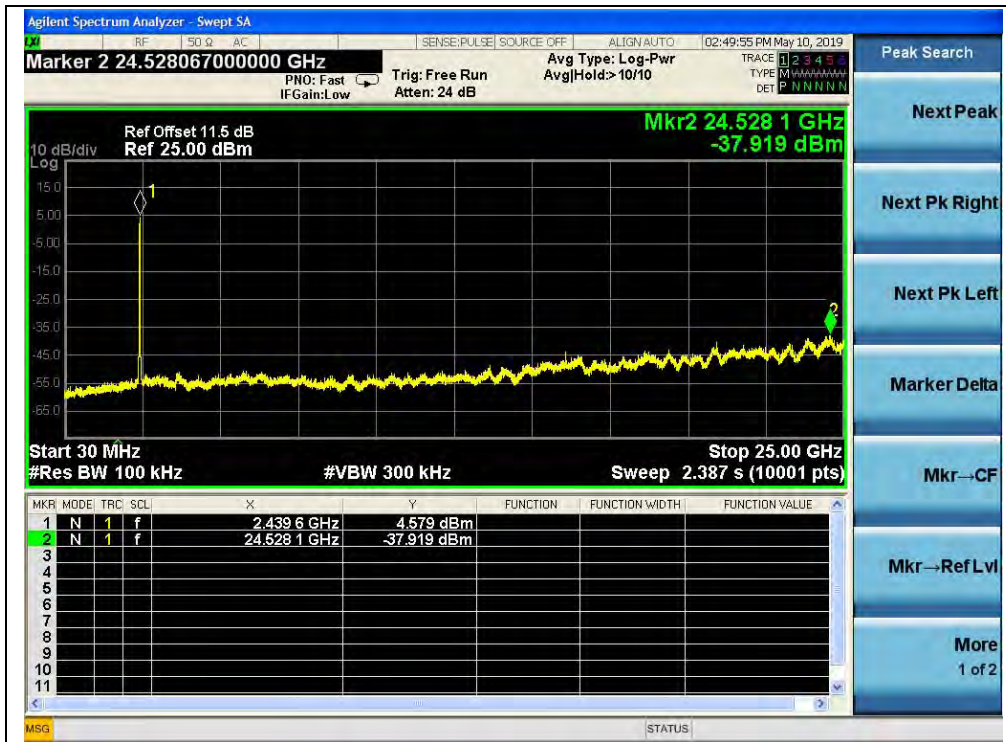
B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

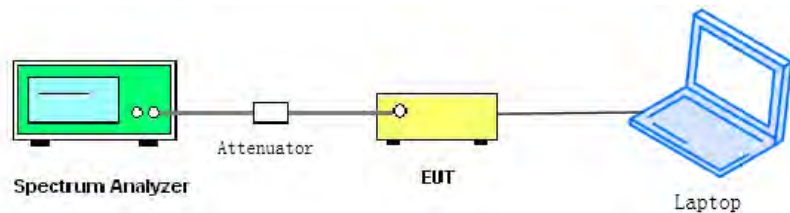
2.6. Power spectral density (PSD)

2.6.1. 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.

2.6.2. 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.

2.6.3. Test procedure

KDB 558074 Section 8.4 was used in order to prove compliance.



2.6.4. Test Result

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	-5.23	8	PASS
6	2437	-4.84	8	PASS
11	2462	-5.21	8	PASS

B. Test Plots:



(Channel = 1, 802.11b)



(Channel = 6, 802.11b)



(Channel = 11, 802.11b)

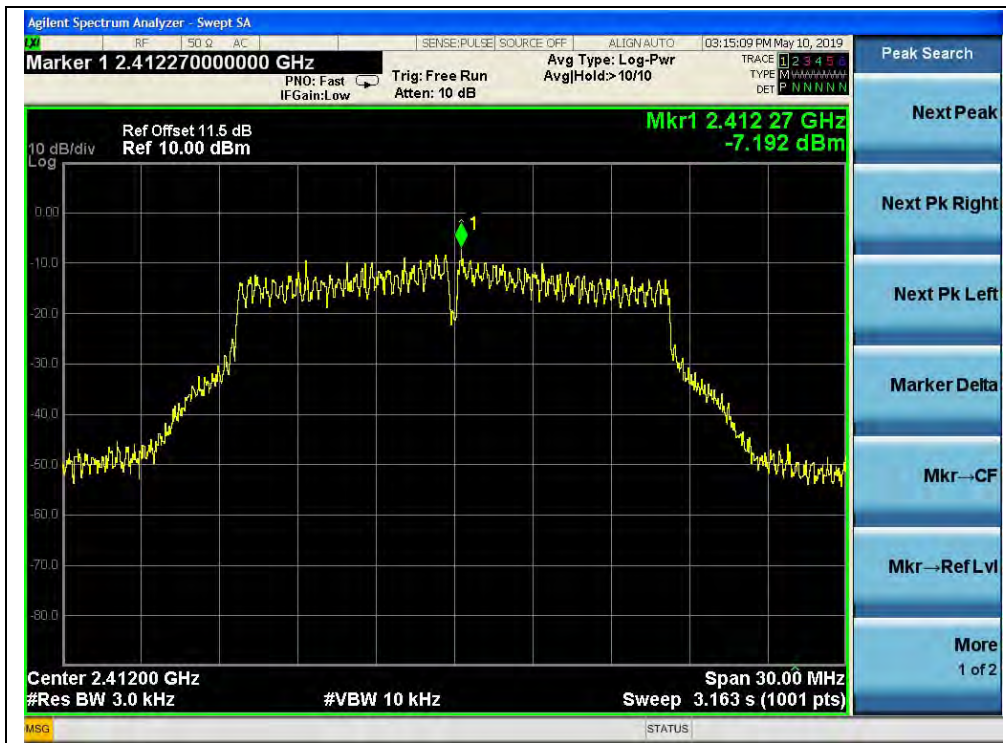


802.11g Test mode

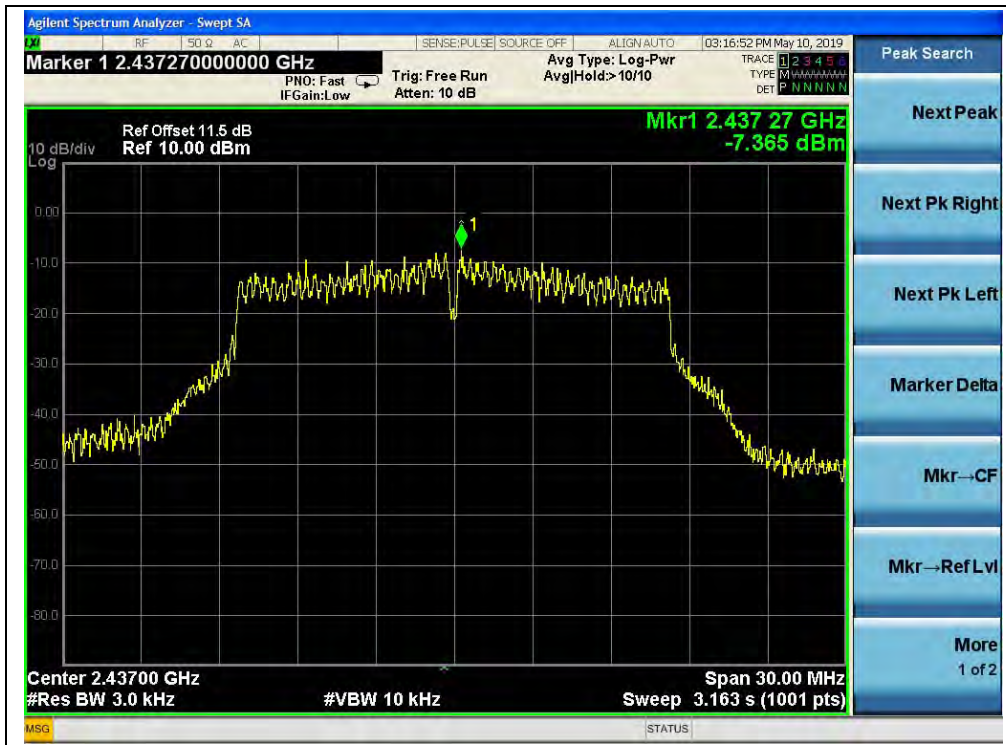
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-7.19	8	PASS
6	2437	-7.37	8	PASS
11	2462	-7.36	8	PASS

B. Test Plots:



(Channel = 1, 802.11g)



(Channel = 6, 802.11g)



(Channel = 11, 802.11g)



802.11n(HT20) Test mode

A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-6.42	8	PASS
6	2437	-6.89	8	PASS
11	2462	-6.31	8	PASS

B. Test Plots:



(Channel = 1, 802.11n(HT20))



(Channel = 6, 802.11n(HT20))



(Channel = 11, 802.11n(HT20))

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).

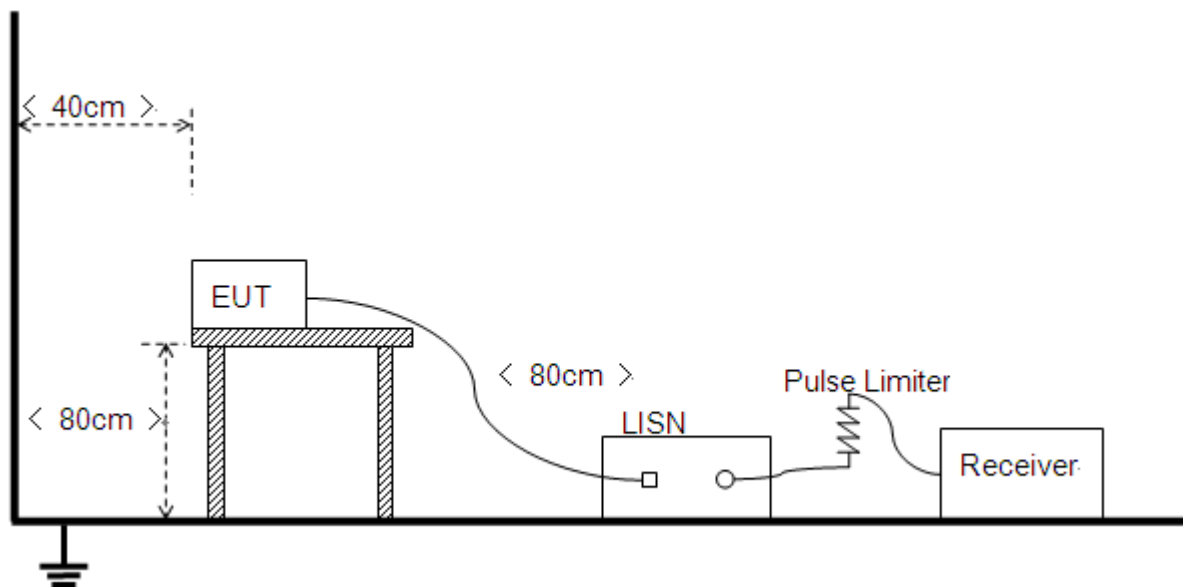
Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

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.



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.

Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test setup:

Test Mode: EUT+ADAPTER + WIFI TX

Test Voltage: AC 120V/60Hz

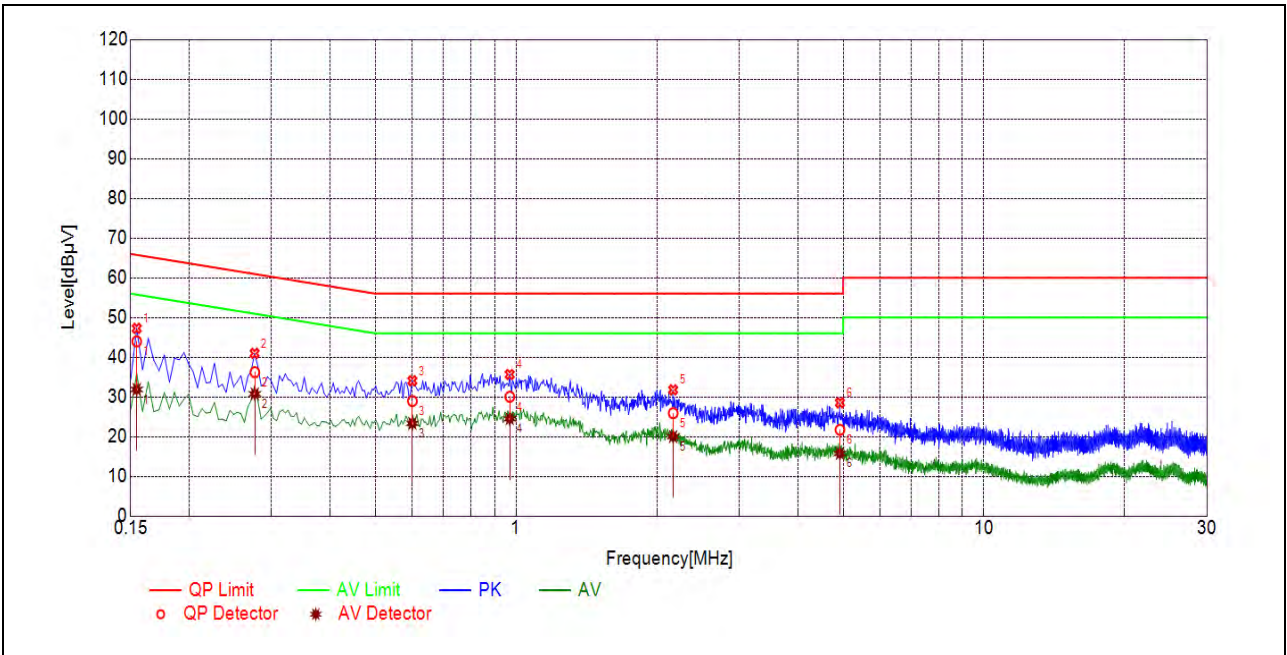
The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V]} = U_R + L_{\text{Cable loss}} \text{ [dB]} + A_{\text{Factor}}$$

U_R : Receiver Reading

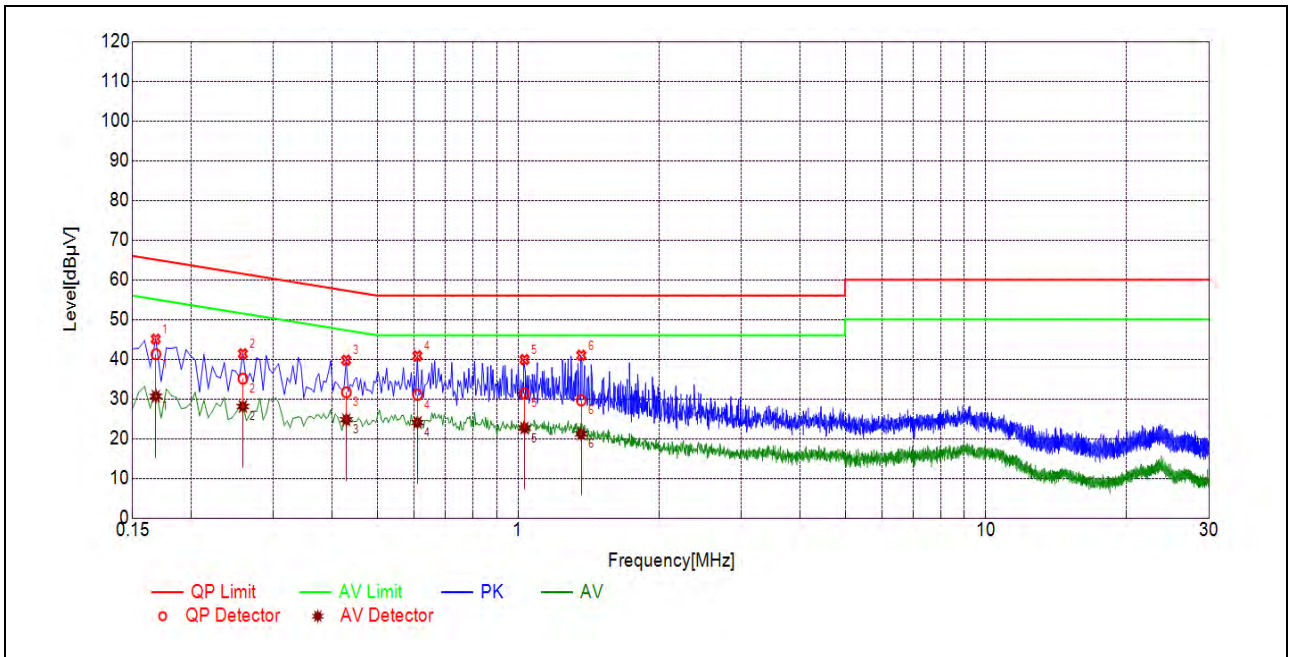
A_{Factor} : Voltage division factor of LISN

B. Test Plots:



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1545	43.99	31.88	65.76	55.76	Line	PASS
2	0.2763	36.22	30.78	60.93	50.93		PASS
3	0.6001	28.96	23.34	56.00	46.00		PASS
4	0.9692	30.05	24.48	56.00	46.00		PASS
5	2.1661	25.92	20.01	56.00	46.00		PASS
6	4.9225	21.71	15.76	56.00	46.00		PASS



(N Phase)

NO.	Fre. (MHz)	Emission Level (dBμV)		Limit (dBμV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1681	41.27	30.69	65.06	55.06	Neutral	PASS
2	0.2580	35.10	28.10	61.50	51.50		PASS
3	0.4293	31.64	24.75	57.27	47.27		PASS
4	0.6096	31.02	24.04	56.00	46.00		PASS
5	1.0319	31.41	22.66	56.00	46.00		PASS
6	1.3642	29.64	21.19	56.00	46.00		PASS

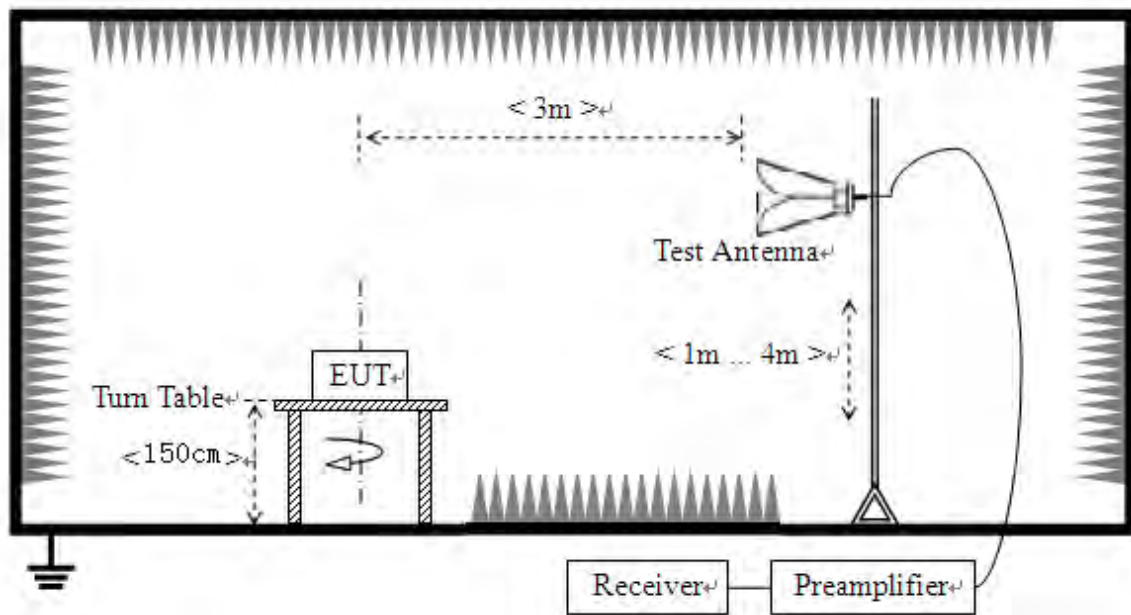
2.8. Restricted Frequency Bands

2.8.1. Requirement

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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).

2.8.2. 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.

**2.8.3. Test procedure**

KDB 558074 Section 8.6 and 8.7 was used in order to prove compliance.

2.8.4. Test Result

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

The measurement results are obtained as below:

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

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

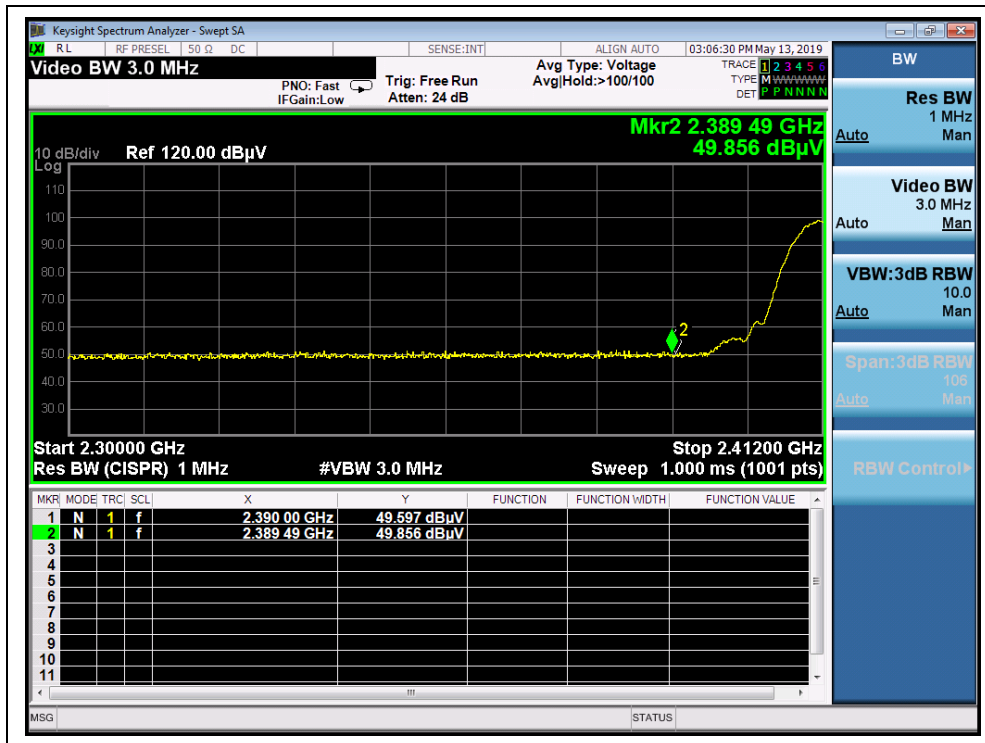
Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

802.11b Test mode**A. Test Verdict:**

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dB μ V/m)	Limit (dB μ V/m)	Verdict
		PK/ AV						
1	2389.49	PK	49.86	-29.67	32.56	52.75	74	PASS
1	2390.00	AV	39.16	-29.67	32.56	42.05	54	PASS
11	2484.46	PK	50.11	-29.67	32.56	53.00	74	PASS
11	2483.50	AV	39.34	-29.67	32.56	42.23	54	PASS



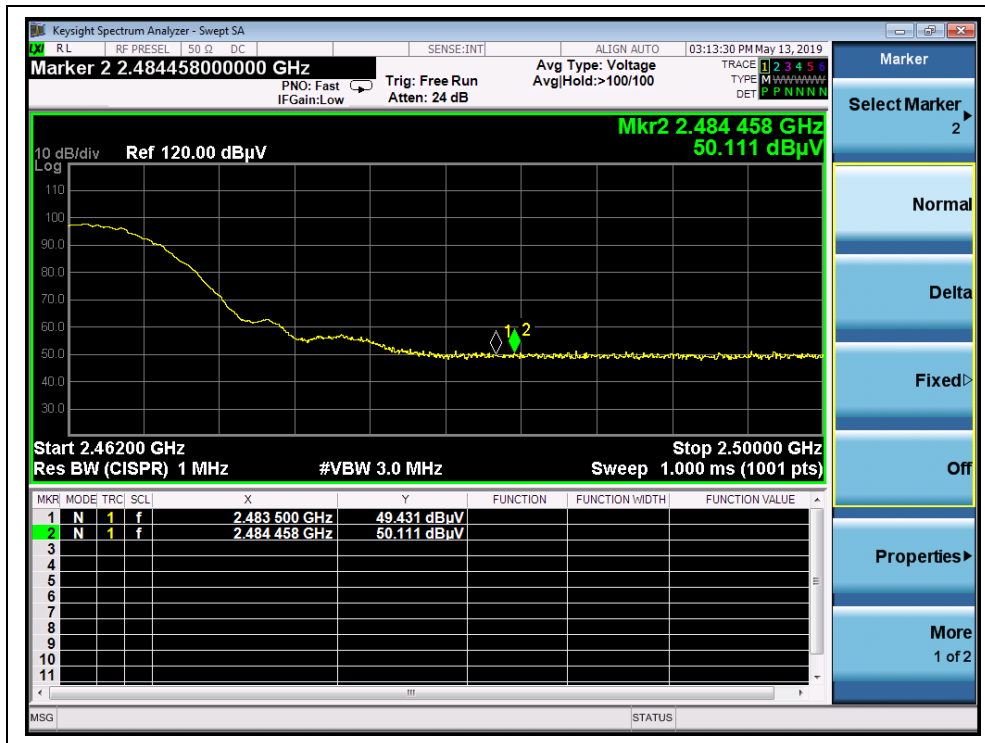
B. Test Plots:



(Channel = 1 PEAK, 802.11b)



(Channel = 1 AVG, 802.11b)



(Channel = 11 PEAK, 802.11b)



(Channel = 11 AVG, 802.11b)

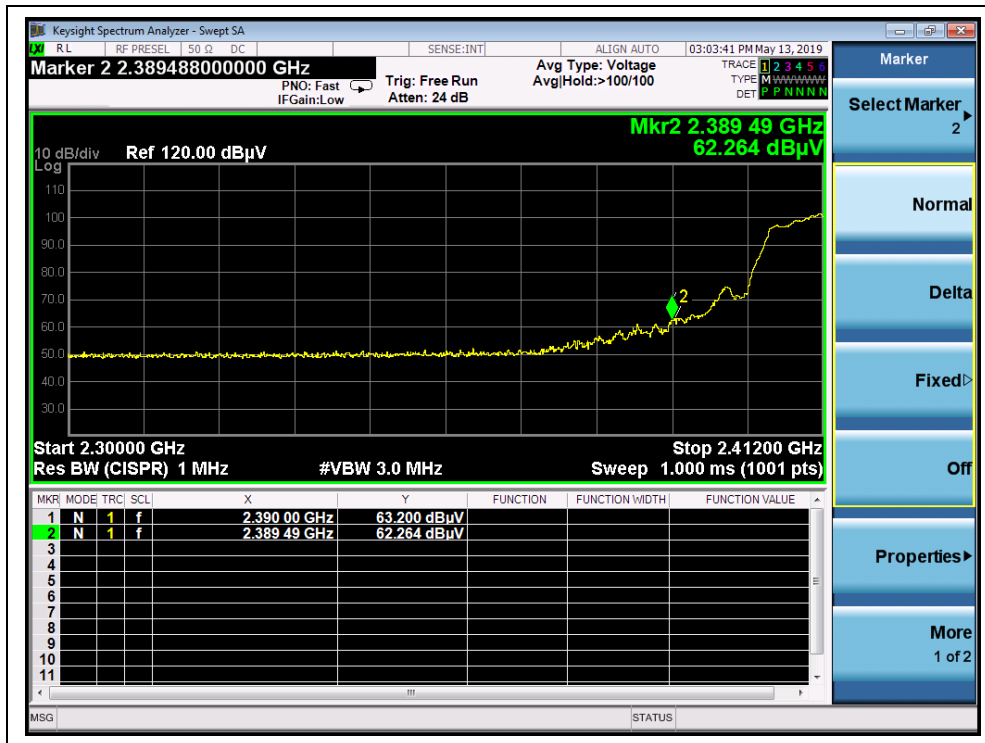


802.11g Test mode

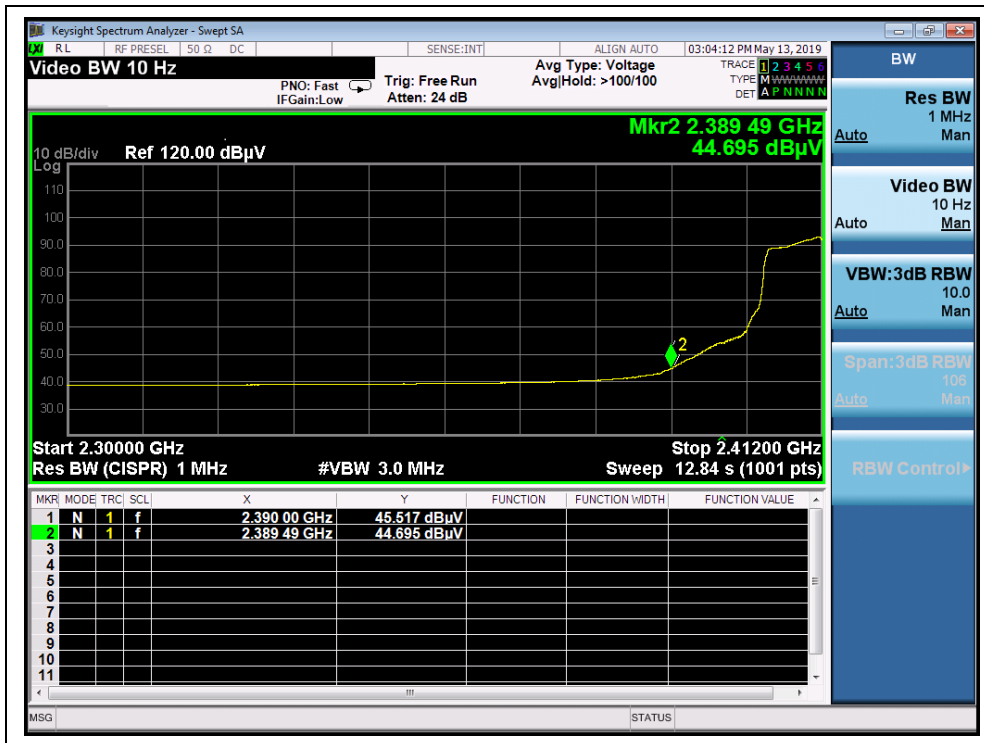
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBuV/m)	Limit (dBuV/m)	Verdict
		PK/ AV						
1	2390.00	PK	63.20	-29.67	32.56	66.09	74	PASS
1	2389.49	AV	44.70	-29.67	32.56	47.59	54	PASS
11	2485.48	PK	58.75	-29.67	32.56	61.64	74	PASS
11	2483.50	AV	44.06	-29.67	32.56	46.95	54	PASS

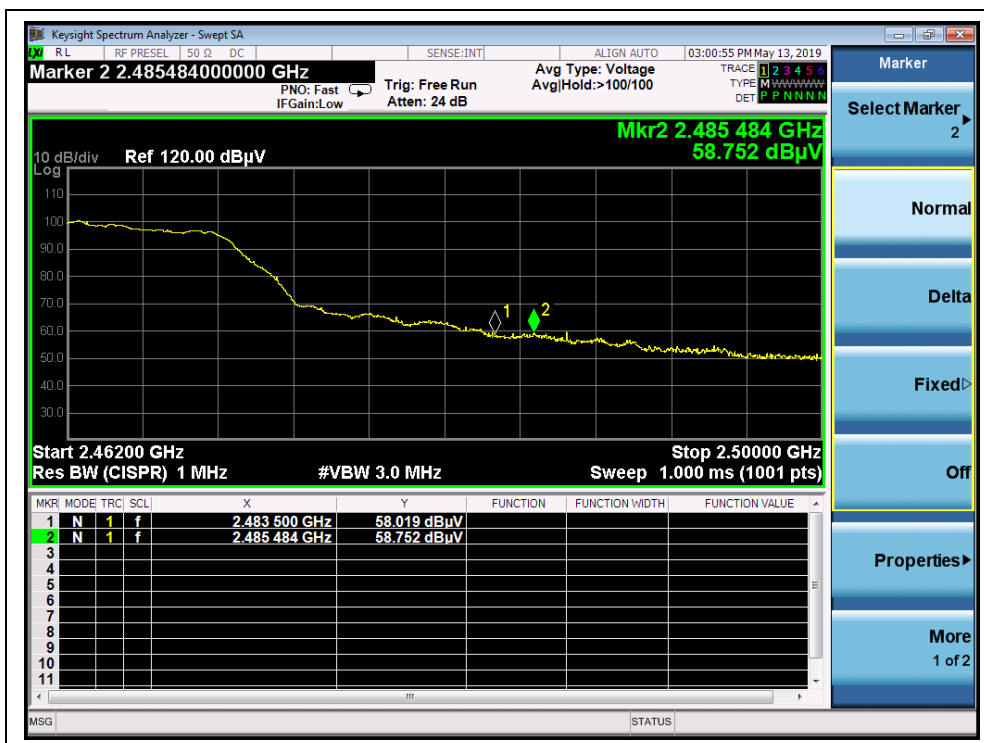
B. Test Plots:



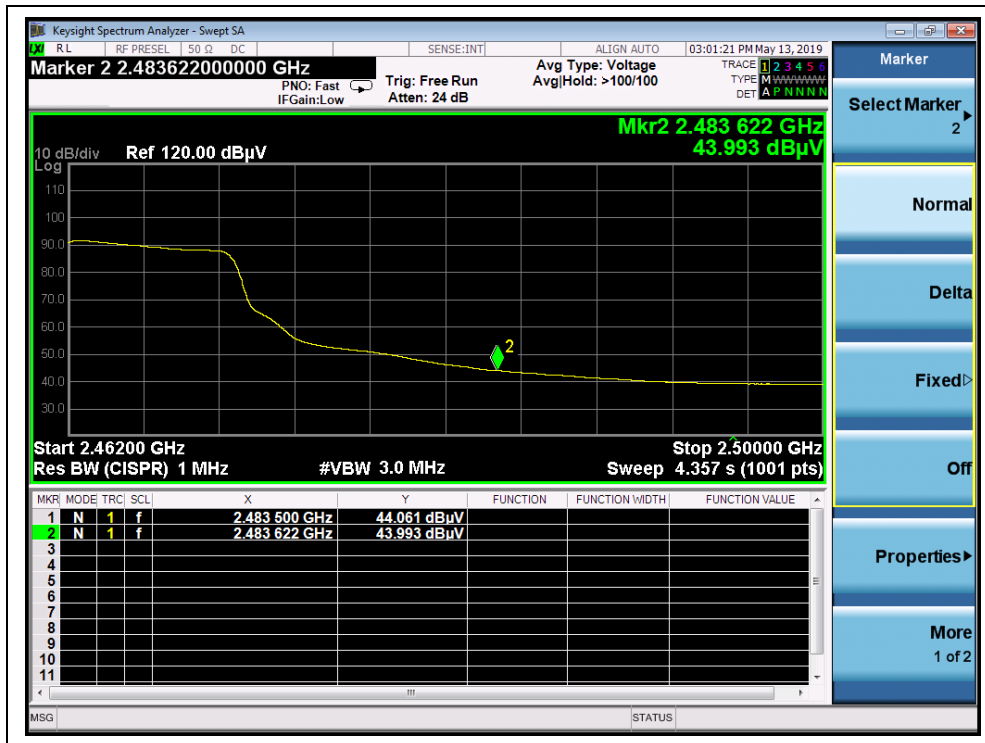
(Channel = 1 PEAK, 802.11g)



(Channel = 1 AVG, 802.11g)



(Channel = 11 PEAK, 802.11g)



(Channel = 11 AVG, 802.11g)

802.11 n(HT20) Test mode

A. Test Verdict:

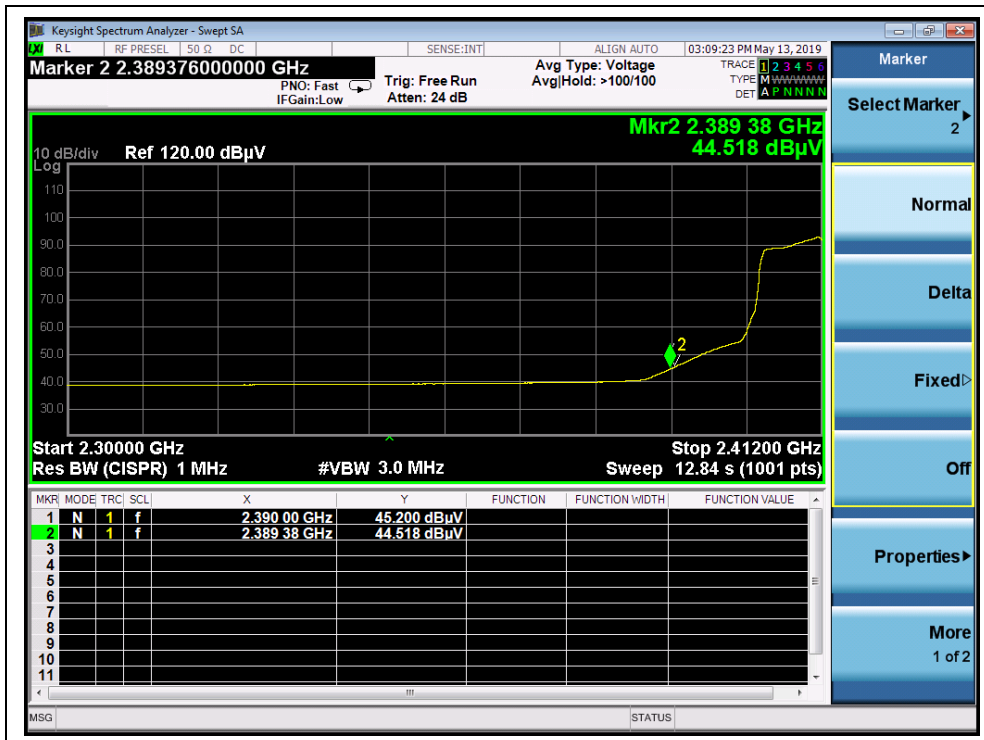
Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBμV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
1	2388.93	PK	62.13	-29.67	32.56	65.02	74	PASS
1	2390.00	AV	45.20	-29.67	32.56	48.09	54	PASS
11	2483.81	PK	65.82	-29.67	32.56	68.71	74	PASS
11	2483.50	AV	43.51	-29.67	32.56	46.40	54	PASS



B. Test Plots:



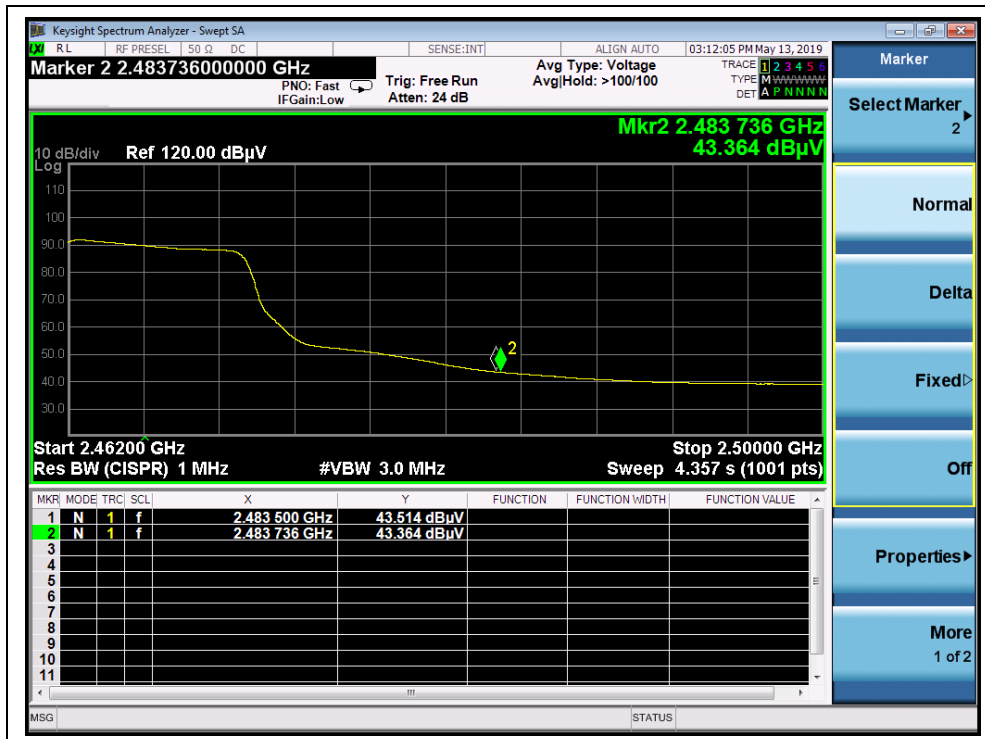
(Channel = 1 PEAK, 802.11n(HT20))



(Channel = 1 AVG, 802.11n(HT20))



(Channel = 11 PEAK, 802.11n(HT20))



(Channel = 11 AVG, 802.11n(HT20))



2.9. Radiated Emission

2.9.1. 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 ($\mu\text{V}/\text{m}$)	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.

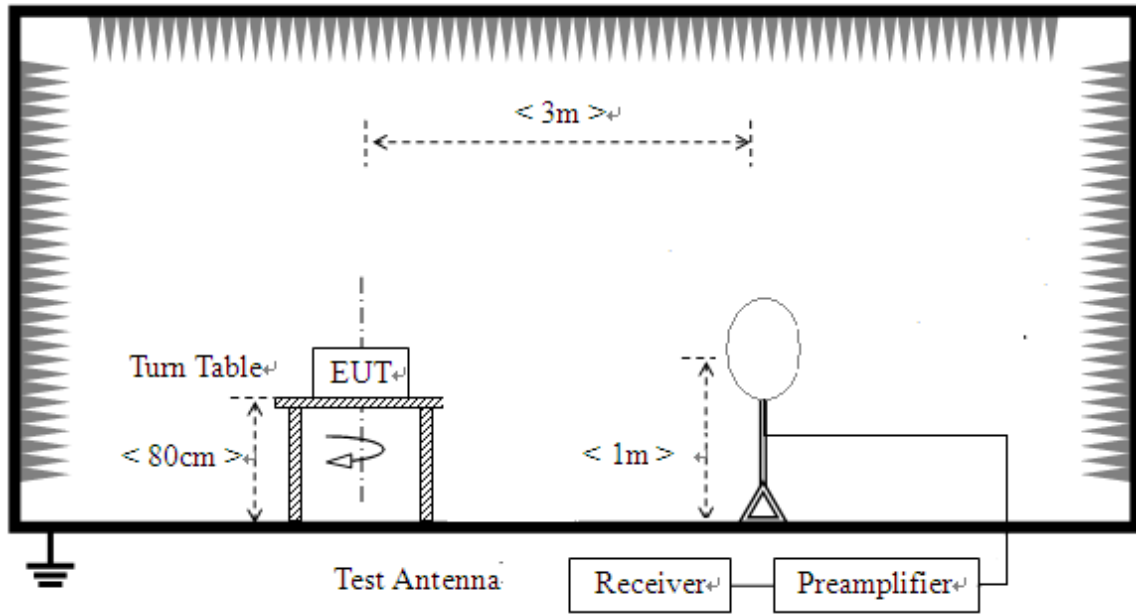
For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

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)

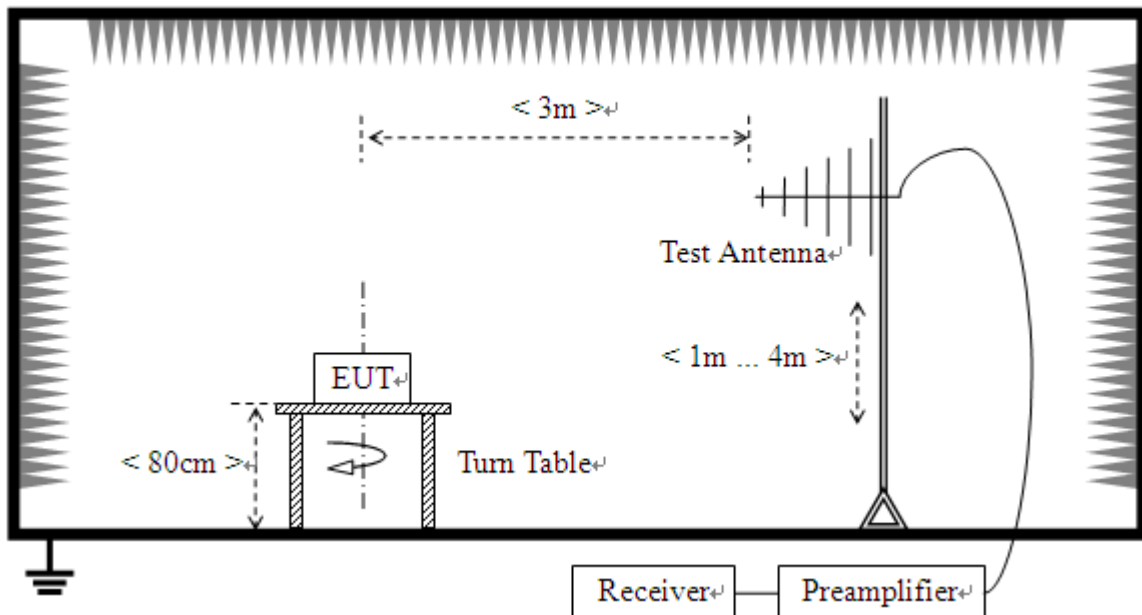
2.9.2. Test Description

A. Test Setup:

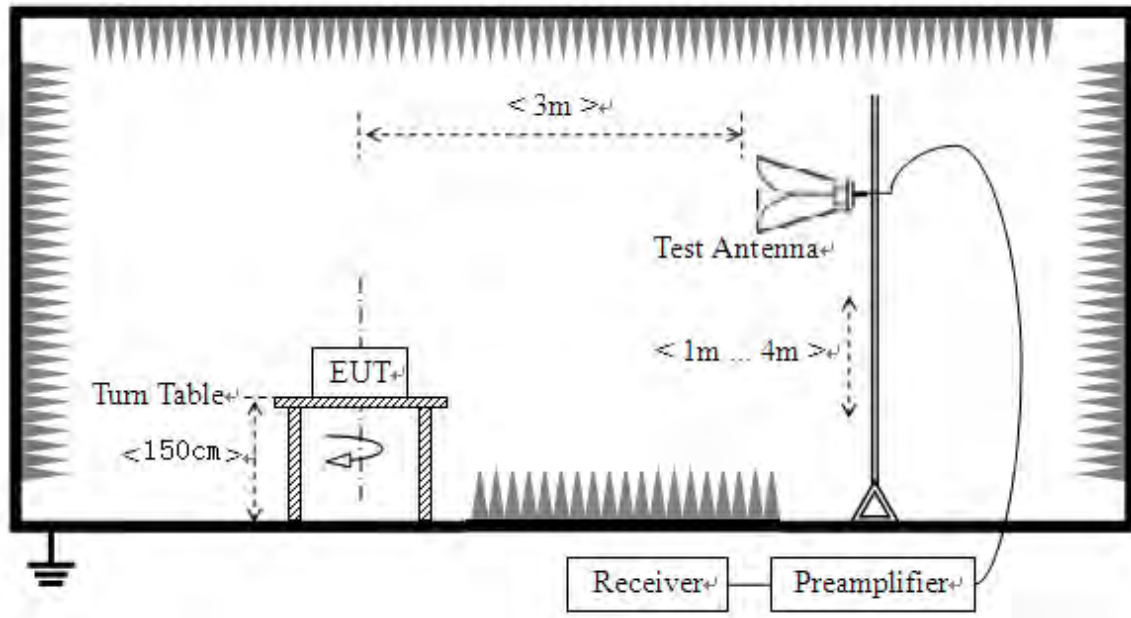
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



The 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.

2.9.3. 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:

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

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

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

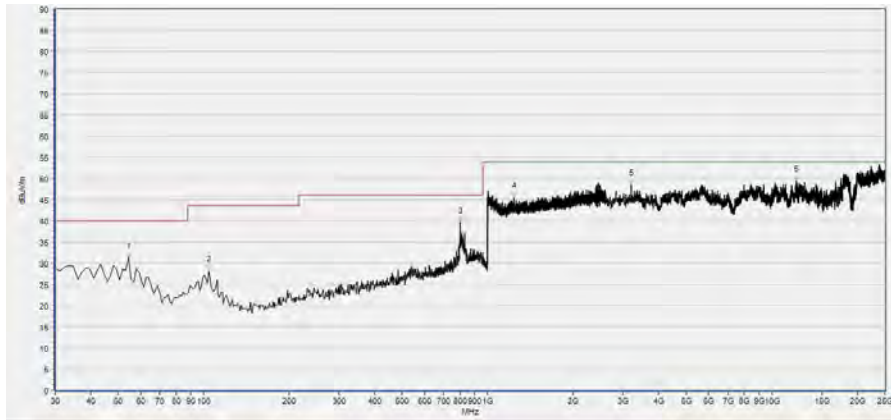
Note1: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Note2: For the frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Note3: For the frequency, which started from 25GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

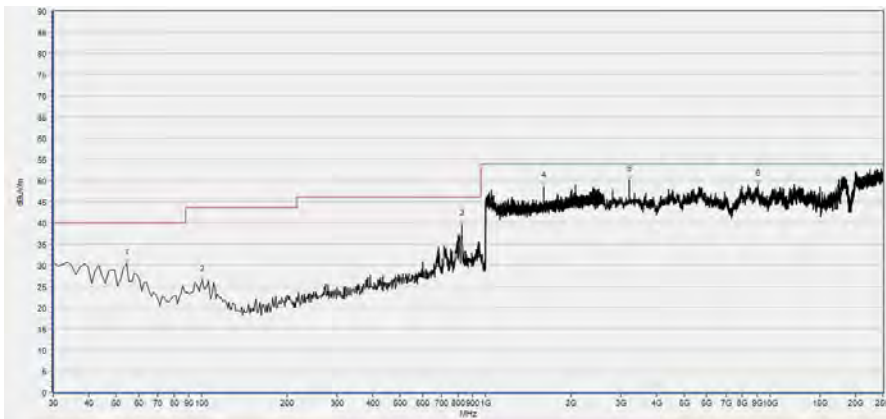
802.11b Test mode

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
54.280	31.25	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	28.27	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
799.687	39.63	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1237.535	45.46	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
3202.873	48.53	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12197.090	49.53	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

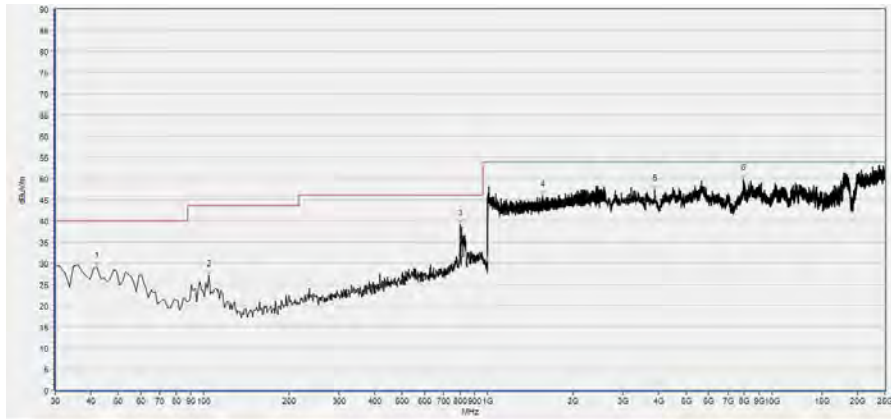
(Antenna Horizontal, 30MHz to 25GHz)



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
54.280	30.30	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
100.413	26.38	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
822.753	39.69	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1600.560	48.62	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3198.800	49.94	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9109.402	48.96	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

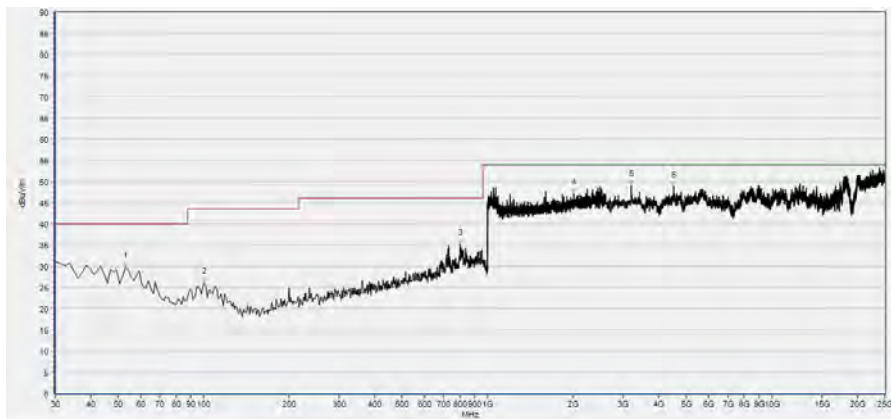
(Antenna Vertical, 30MHz to 25GHz)

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
42.140	29.10	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	27.23	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
799.687	39.17	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1556.383	45.81	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
3874.995	47.41	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7924.023	49.84	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)

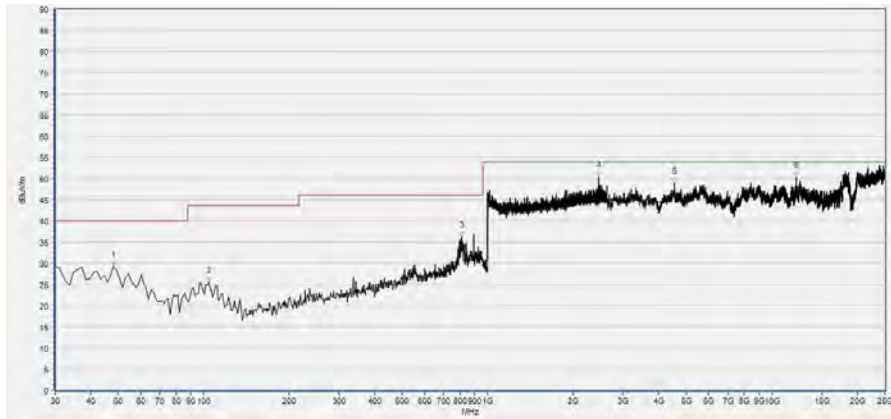


Fre. (MHz)	Pk (dBµV/m)	QP (dBµV/m)	AV (dBµV/m)	Limit-PK (dBµV/m)	Limit-QP (dBµV/m)	Limit-AV (dBµV/m)	Antenna	Verdict
53.066	29.85	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
100.413	25.99	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
799.687	35.20	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2008.403	47.08	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3198.800	49.13	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4506.383	48.74	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

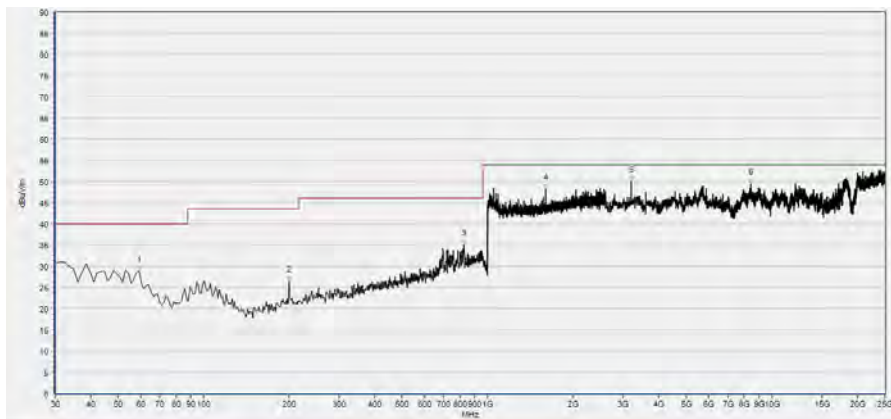


Plot for Channel = 11



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
48.210	29.26	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	25.48	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
809.399	36.29	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2463.625	50.35	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4551.191	48.86	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12184.870	50.30	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



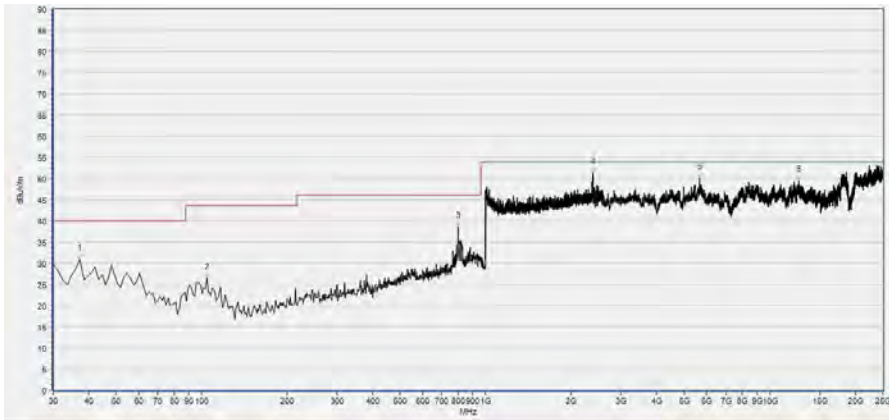
Fre. (MHz)	Pk (dBµV/m)	QP (dBµV/m)	AV (dBµV/m)	Limit-PK (dBµV/m)	Limit-QP (dBµV/m)	Limit-AV (dBµV/m)	Antenna	Verdict
59.136	28.78	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
199.962	26.41	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
823.967	35.01	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1600.560	48.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3198.800	50.00	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8420.986	49.50	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)



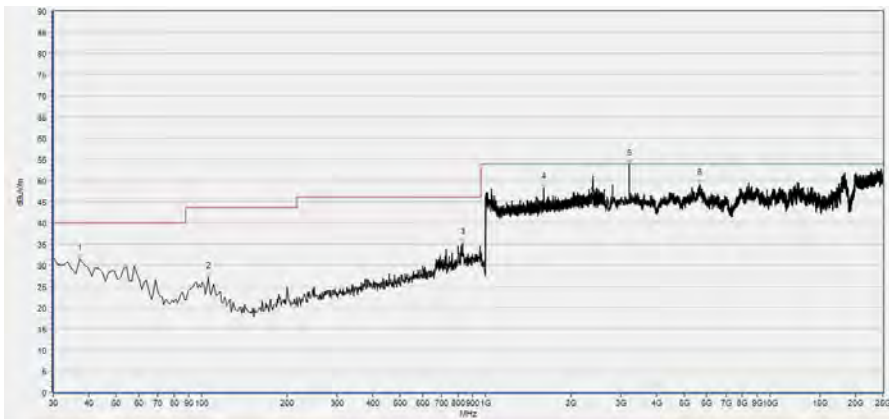
802.11g Test mode

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
37.284	30.82	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	26.50	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
799.687	38.62	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2380.392	51.29	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5667.321	49.94	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12669.613	49.39	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

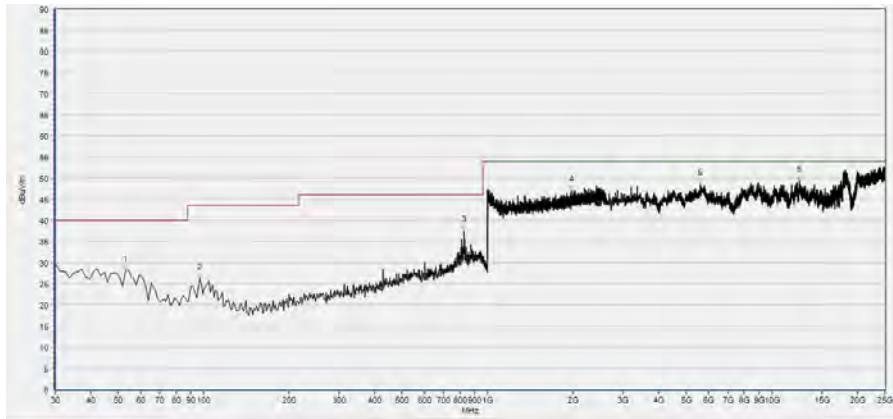
(Antenna Horizontal, 30MHz to 25GHz)



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
37.284	31.37	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
105.269	27.14	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
830.038	35.25	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1599.920	48.20	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3199.800	53.67	N/A	36.15	74.00	N/A	54.00	Vertical	PASS
5663.248	49.03	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

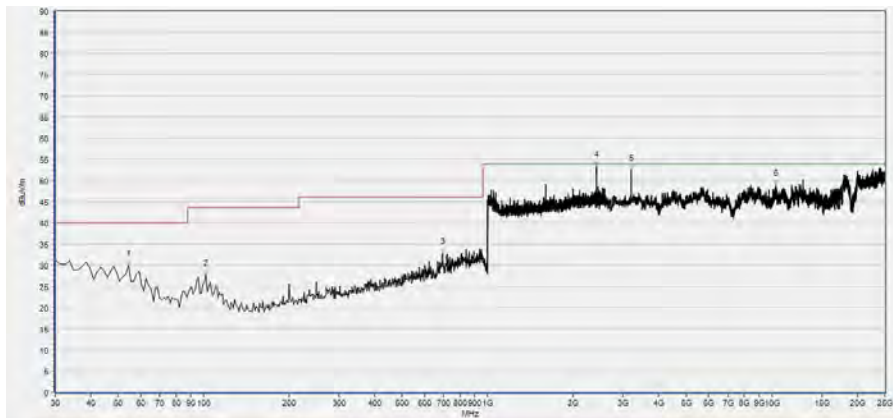
(Antenna Vertical, 30MHz to 25GHz)

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
53.066	27.98	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
96.771	26.31	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
826.395	37.42	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1971.269	46.91	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5610.293	48.64	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12527.041	49.26	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

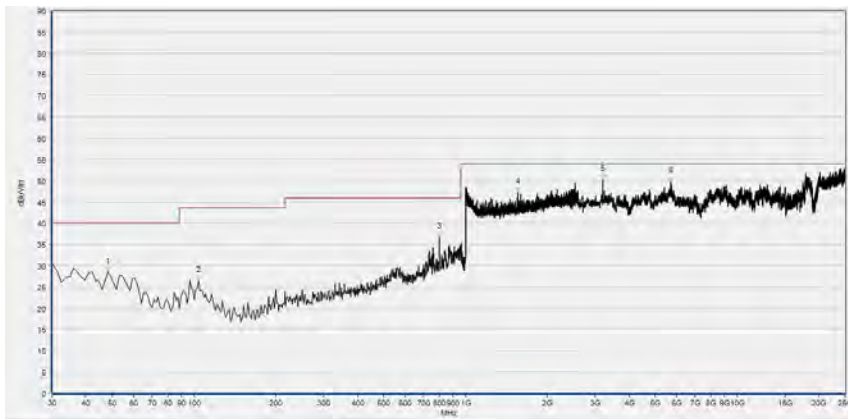
(Antenna Horizontal, 30MHz to 25GHz)



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
54.280	30.08	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
101.627	27.66	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
692.854	32.85	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2411.124	53.34	N/A	51.11	74.00	N/A	54.00	Vertical	PASS
3198.800	52.49	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10343.662	48.95	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

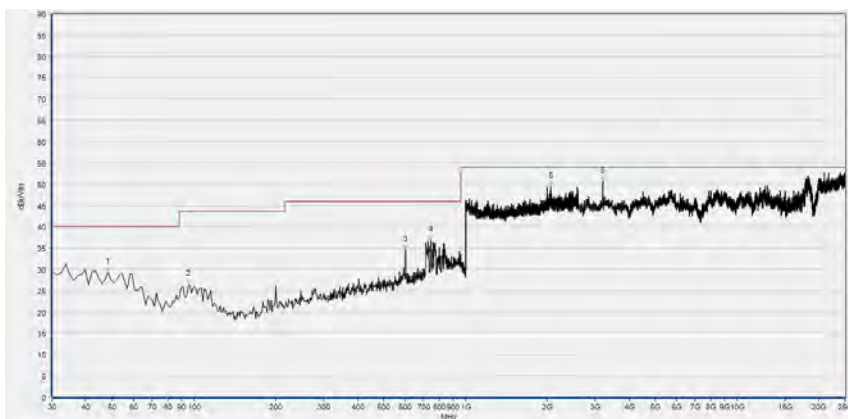
(Antenna Vertical, 30MHz to 25GHz)

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
48.210	28.46	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	26.52	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
799.687	36.62	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1559.584	47.20	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
3198.800	50.32	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5683.615	49.81	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



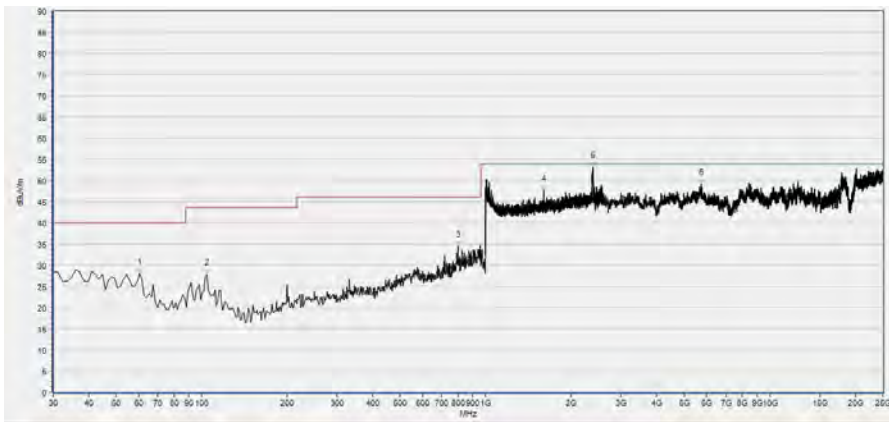
Fre. (MHz)	Pk (dBµV/m)	QP (dBµV/m)	AV (dBµV/m)	Limit-PK (dBµV/m)	Limit-QP (dBµV/m)	Limit-AV (dBµV/m)	Antenna	Verdict
48.210	29.26	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
95.557	26.53	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
599.374	34.48	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
743.842	36.80	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2060.904	49.44	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3198.800	50.64	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)



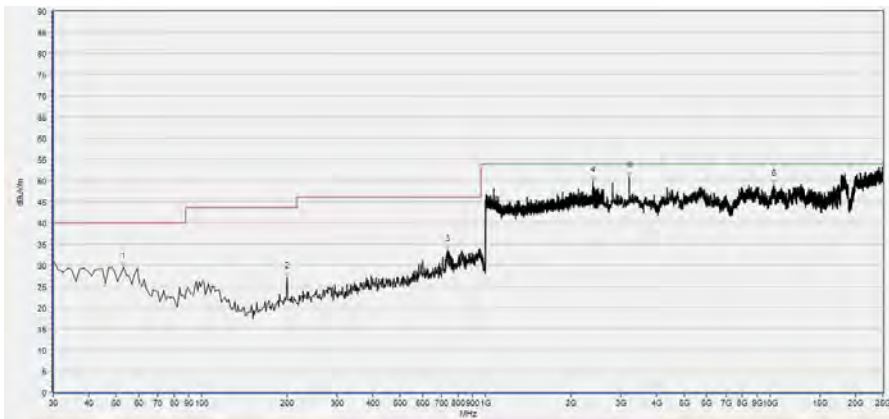
802.11n(HT20) Test mode

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
60.350	28.12	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	27.86	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
799.687	34.46	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1600.560	47.62	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2384.874	53.22	N/A	50.31	74.00	N/A	54.00	Horizontal	PASS
5728.423	49.04	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

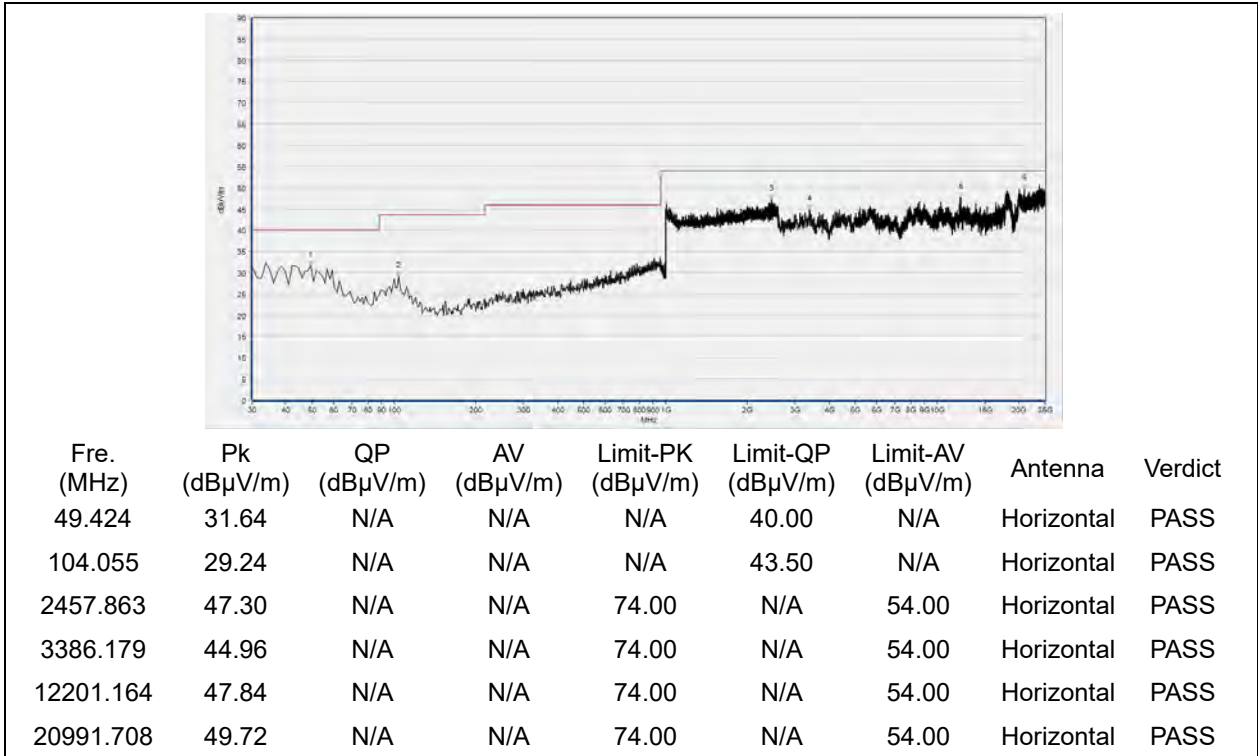
(Antenna Horizontal, 30MHz to 25GHz)



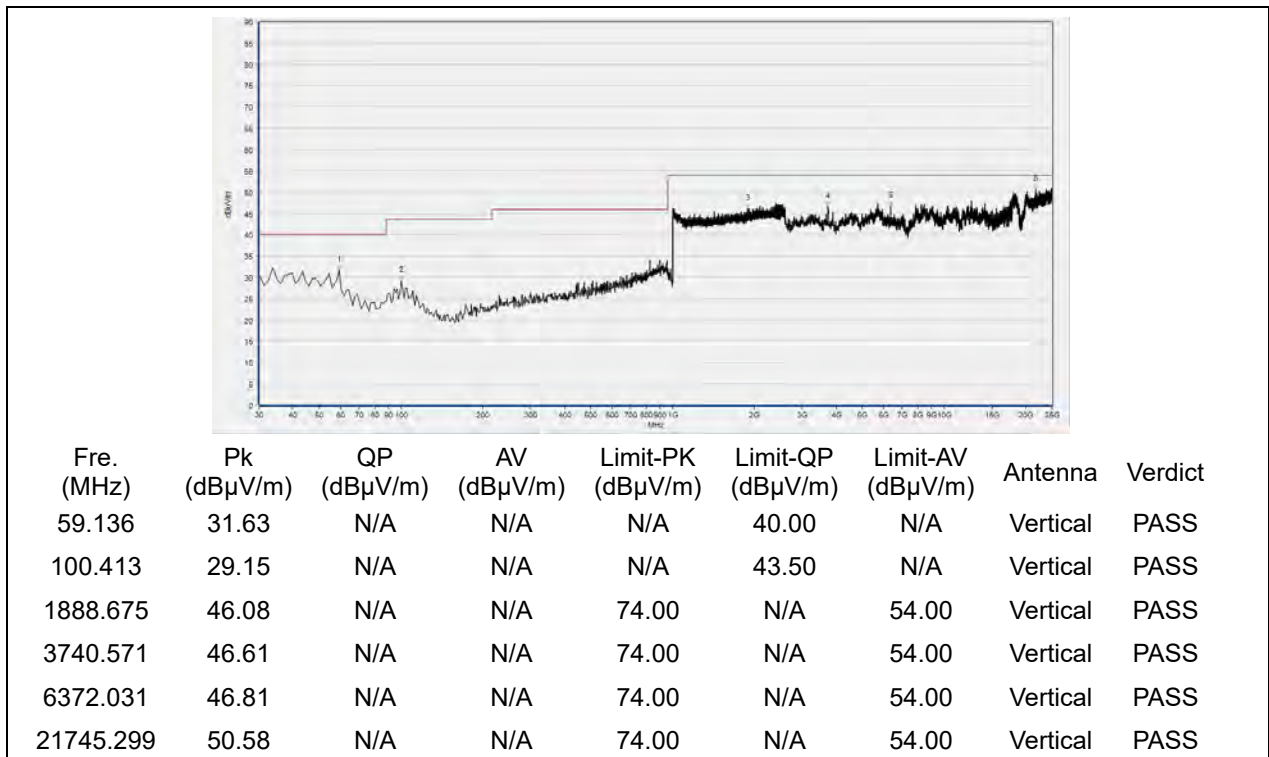
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
53.066	29.42	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
199.962	27.20	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
732.916	33.65	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2387.435	49.74	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
3198.800	50.94	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10359.956	48.95	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 6

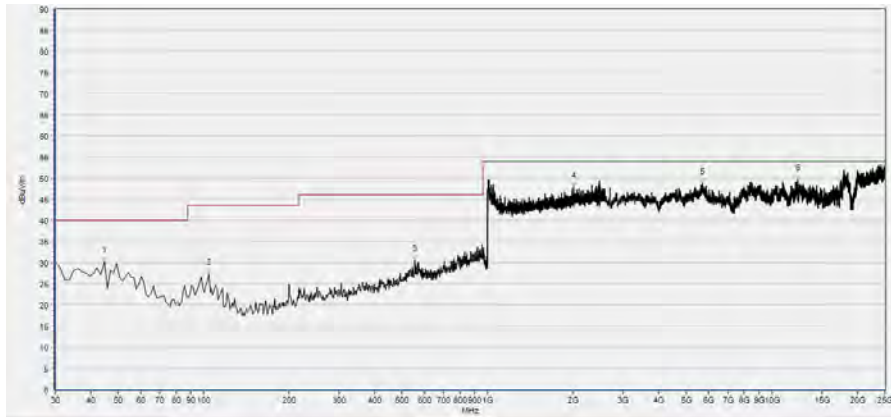


(Antenna Horizontal, 30MHz to 25GHz)



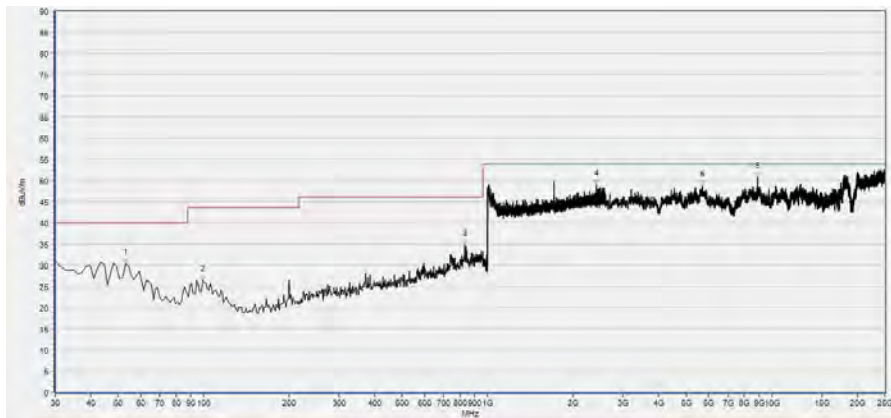
(Antenna Vertical, 30MHz to 25GHz)

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
44.568	30.26	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
104.055	27.25	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
553.242	30.57	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2009.044	47.77	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5695.836	48.73	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12319.294	49.67	N/A	N/A	74.00	N/A	54.00	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
53.066	30.40	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
99.199	26.50	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
830.038	34.89	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2412.405	48.88	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5691.762	48.74	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8926.096	50.67	N/A	N/A	74.00	N/A	54.00	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	$\pm 2.22\text{dB}$
Power spectral density (PSD)	$\pm 2.22\text{dB}$
Bandwidth	$\pm 5\%$
Conducted Spurious Emission	$\pm 2.77\text{ dB}$
Restricted Frequency Bands	$\pm 5\%$
Radiated Emission	$\pm 2.95\text{dB}$
Conducted Emission	$\pm 2.44\text{dB}$

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

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
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, the test firm registration number is 226174.



4. Test Equipments Utilized

4.1 Conducted Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Attenuator 1	(N/A.)	10dB	Resnet	N/A	N/A
EXA Signal Analyzer	MY53470836	N9010A	Agilent	2019.04.09	2020.04.08
USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2019.04.16	2020.04.15
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
Computer	T430i	Think Pad	Lenovo	N/A	N/A

4.2 Conducted Emission Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Receiver	MY56400093	N9038A	KEYSIGHT	2019.05.08	2020.05.09
LISN	812744	NSLK 8127	Schwarzbeck	2019.05.08	2020.05.09
Pulse Limiter (20dB)	9391	VTSD 9561-D	Schwarzbeck	2019.05.08	2020.05.09
Coaxial cable(BNC) (30MHz-26GHz)	CB01	EMC01	Morlab	N/A	N/A

4.3 List of Software Used

Description	Manufacturer	Software Version
Test system	Tonscend	V2.6
Power Panel	Agilent	V3.8
MORLAB EMCR V1.2	MORLAB	V 1.0

**4.4 Radiated Test Equipments**

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Receiver	MY54130016	N9038A	Agilent	2018.08.04	2019.08.03
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2019.05.08	2020.05.09
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2019.02.15	2020.02.14
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2018.08.06	2019.08.05
Test Antenna – Horn	BBHA9170 #774	BBHA9170	Schwarzbeck	2018.08.02	2019.08.01
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	2019.05.08	2020.05.09
18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde& Schwarz	2019.05.08	2020.05.09
Notch Filter	N/A	WRCG-2400-2483.5-60SS	Wainwright	2018.12.01	2019.11.30
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

————— END OF REPORT —————