TEST REPORT

APPLICANT	:	Nortek Security & Control LLC
PRODUCT NAME	:	Edge Panel
MODEL NAME	:	2GIG-EDG-NA-A
BRAND NAME	:	2GIG
FCC ID	:	EF400216
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2020-12-24
TEST DATE	:	2021-01-11 to 2021-01-17
ISSUE DATE	:	2021-02-04

Edited by: Peng Mi (Rapporteur)

Approved by: Peng Huarui (Supervisor)

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Change History		
Version	Date	Reason for change
1.0	2021-02-04	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Nortek Security & Control LLC
Applicant Address:	5919 Sea Otter Place, Carlsbad, CA 92010, United States
Manufacturer:	Flextronics Electronics Technology (Shenzhen) Co., Ltd
Manufacturer Address:	89 Yong Fu Road, Tong Fu Yu Industrial Park, Fu Yong Town, Bao An District, Shenzhen, Guangdong, 518103, China

1.2. Equipment Under Test (EUT) Description

Product Name:	Edge Panel	
Serial No.:	(N/A, marked #1 by test site)	
Hardware Version:	A	
Software Version:	0	
Equipment Type:	WLAN2.4G	
Modulation Type:	DSSS, OFDM	
Operating Frequency Range:	802.11b/g/ n(HT20): 2.412GHz - 2.462GHz	
Antenna Type:	FPC Antenna	
Antenna Gain:	3.13dBi	
Accessory Information:	Battery	
	Brand Name:	Highpower
	Model No.:	115150
	Serial No.:	(N/A, marked #1 by test site)
	Capacity:	4020mAh
	Rated Voltage:	3.8V
	Charge Limit:	4.4V
	Manufacturer:	Huizhou Highpower Technology Co.,LTD.

Accessory Information:	Adaptor	
	Brand Name:	ZBPOWER
	Model No.:	ZB-H140017
	Serial No.:	(N/A, marked #1 by test site)
	Rated Output:	14.00V⎓1.70A
	Rated Input:	100-240V～50/60Hz, Max 0.6A
	Manufacturer:	Huizhou Zhong bang electronics co., ltd.

Note1: We use the dedicated software to control the EUT continuous transmission.

Note2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. Modulation Type and Data Rate of EUT

Modulation technology	Modulation Type	Data Rate (Mbps)Note1
DSSS (802.11b)	DBPSK	**1**
	DQPSK	2
	CCK	5.5/ 11
OFDM (802.11g)	BPSK	**6** / 9
	QPSK	12 / 18
	16QAM	24 / 36
	64QAM	48 / 54
OFDM (802.11n-20MHz)	BPSK	**6.5**
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65

Note1: The worst-case mode(bold face) in all data rates has been determined during the pre-scan, only the test data of the worst-case were recorded in this report.

1.4. 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.

1.5. 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	Method determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	N/A	Duty Cycle of Test Signal	Jan 12, 2021	Liu Bo	PASS	No deviation
3	15.247(b)	Maximum Peak and Average Conducted Output Power	Jan 12, 2021	Liu Bo	PASS	No deviation
4	15.247(a)	Bandwidth	Jan 12, 2021	Liu Bo	PASS	No deviation
5	15.247(d)	Conducted Spurious Emission and Band Edge	Jan 12, 2021	Liu Bo	PASS	No deviation
6	15.247(e)	Power spectral density (PSD)	Jan 12, 2021	Liu Bo	PASS	No deviation
7	15.207	Conducted Emission	Jan 17, 2021	Huang Zhiye	PASS	No deviation
8	15.247(d)	Restricted Frequency Bands	Jan 16, 2021	Peng Xuewei	PASS	No deviation
9	15.209, 15.247(d)	Radiated Emission	Jan 11, 2021	Peng Xuewei	PASS	No deviation

Note 1: The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013, KDB558074 D01 v05r02.

Note 2: 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.

Note 3: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.
Note 4: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% risk level.

1.6. 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.

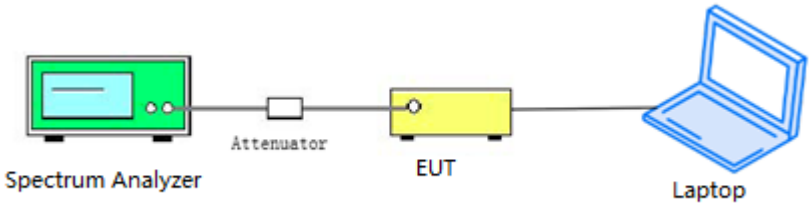
2.2. Duty Cycle of Test Signal

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 ±2%; otherwise, the duty cycle is considered to be nonconstant.

2.2.2. Test Description

Test Setup:



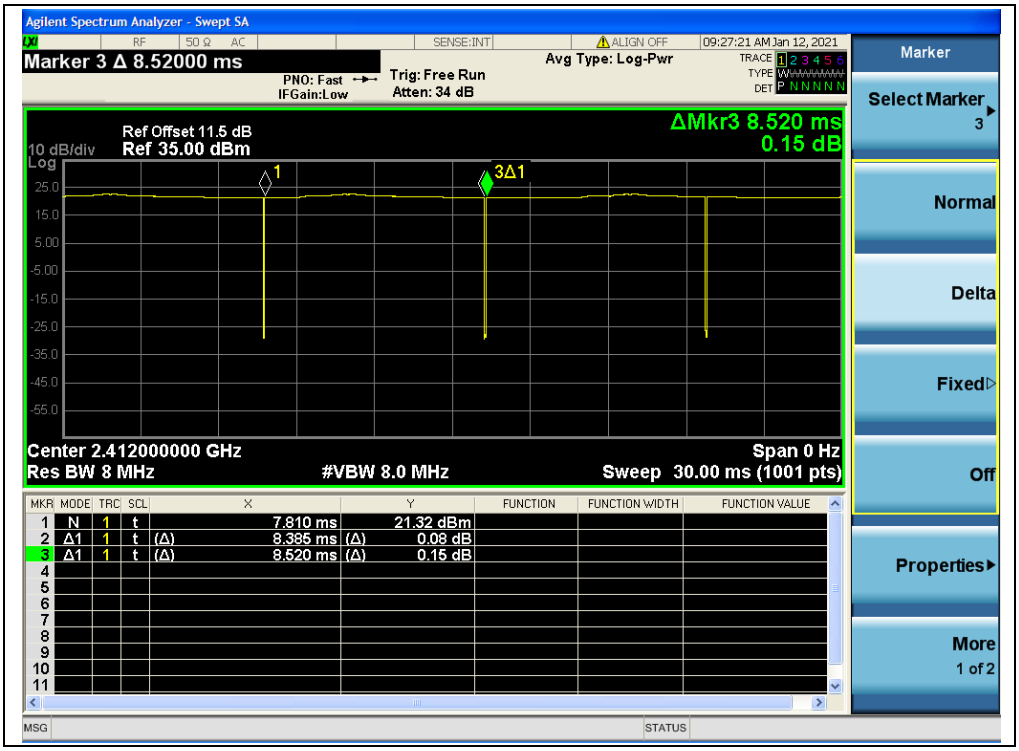
ANSI C63.10 2013 Clause 11.6 was used in order to prove compliance.

2.2.3. Test Result

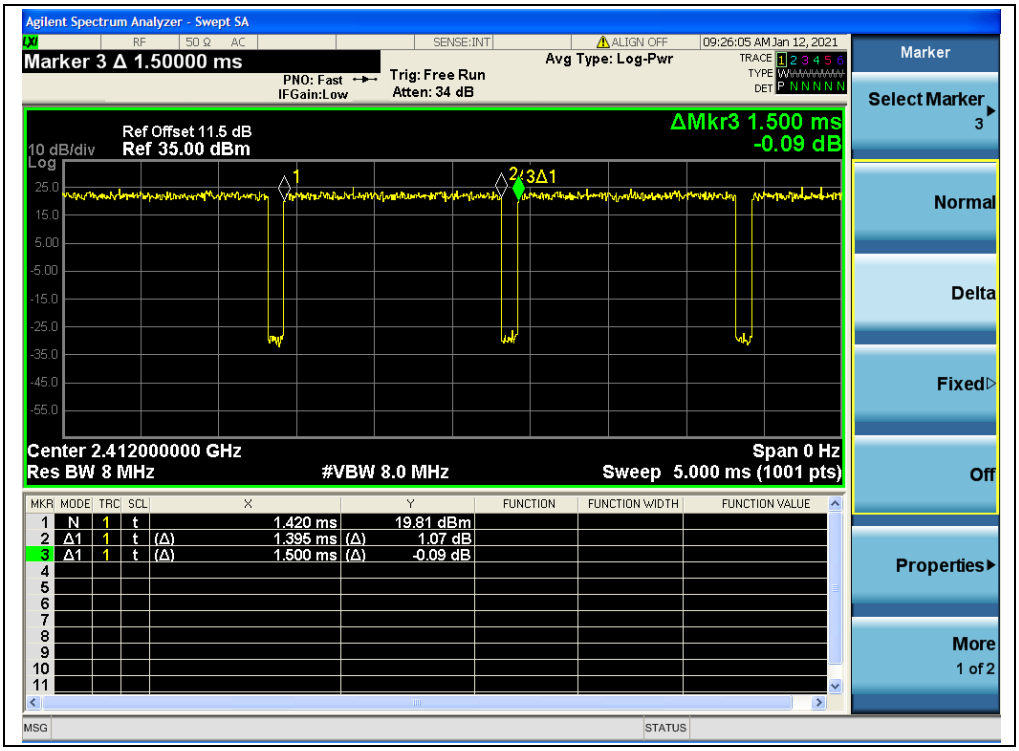
A. Test Verdict:

Test Mode	Duty Cycle(%) (D)	Duty Factor (10*lg[1/D])
802.11b	98.42	0.07
802.11g	93.00	0.32
802.11n(HT20)	92.55	0.34

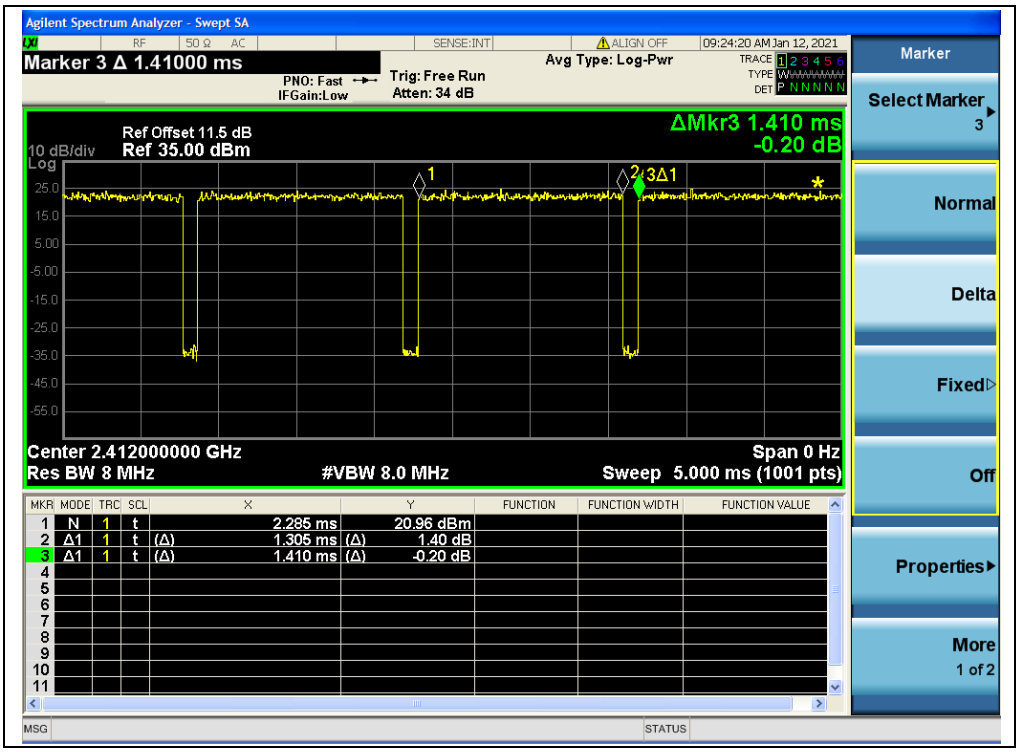
B. Test Plot:



(Channel 1, 2412MHz, 802.11b)



(Channel 1, 2412MHz,802.11g)



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

2.3. Maximum Peak and Average Conducted Output Power

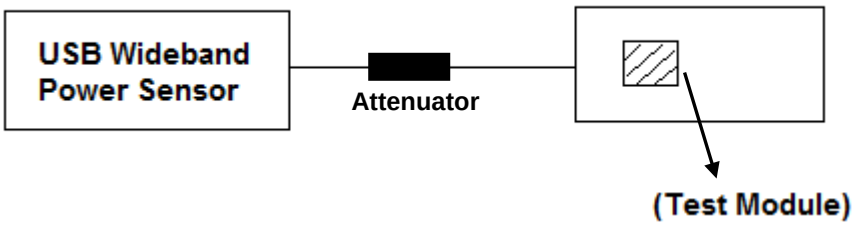
2.3.1. Requirement

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 exceed1 Watt.

2.3.2. Test Description

The measured output power was calculated by the reading of the USB Wideband Power Sensor and calibration.

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	21.26	0.134	30	1	PASS
6	2437	21.32	0.136			PASS
11	2462	21.56	0.143			PASS

802.11g Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	23.71	0.235	30	1	PASS
6	2437	23.87	0.244			PASS
11	2462	23.89	0.245			PASS

802.11n(HT20) Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	23.76	0.238	30	1	PASS
6	2437	23.88	0.244			PASS
11	2462	**24.03**	**0.253**			PASS

Maximum Average Conducted Output Power

802.11b Test Mode

Channel	Frequency (MHz)	Average Power				Limit		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
1	2412	18.20	0.07	18.27	0.067	30	1	PASS
6	2437	18.32		18.39	0.069			PASS
11	2462	18.37		18.44	0.070			PASS

802.11g Test mode

Channel	Frequency (MHz)	Average Power				Limit		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
1	2412	17.95	0.32	18.27	0.067	30	1	PASS
6	2437	18.19		18.51	0.071			PASS
11	2462	18.23		18.55	0.072			PASS

802.11n(HT20) Test mode

Channel	Frequency (MHz)	Average Power				Limit		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
1	2412	18.45	0.34	18.79	0.076	30	1	PASS
6	2437	18.60		18.94	0.078			PASS
11	2462	18.77		**19.11**	**0.081**			PASS

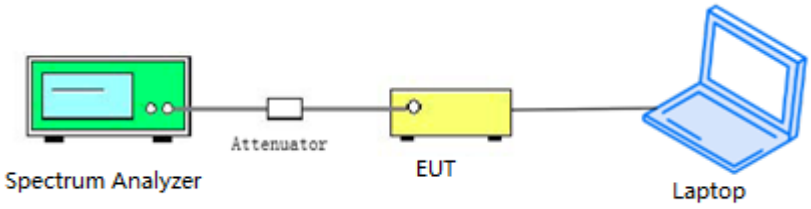
2.4. Bandwidth

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

Test Setup:



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.

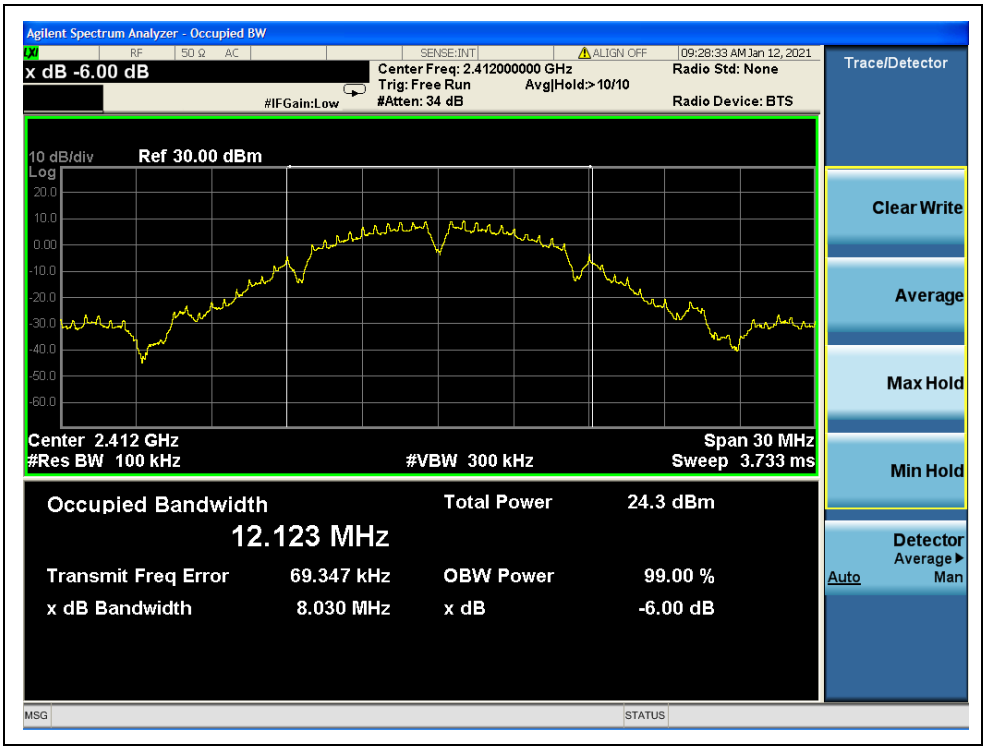
2.4.4. Test Result

802.11b Test mode

A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	8.03	≥500	PASS
6	2437	8.04	≥500	PASS
11	2462	8.02	≥500	PASS

B. Test Plot:



(Channel 1, 802.11b)

(Channel 6, 802.11b)

(Channel 11, 802.11b)

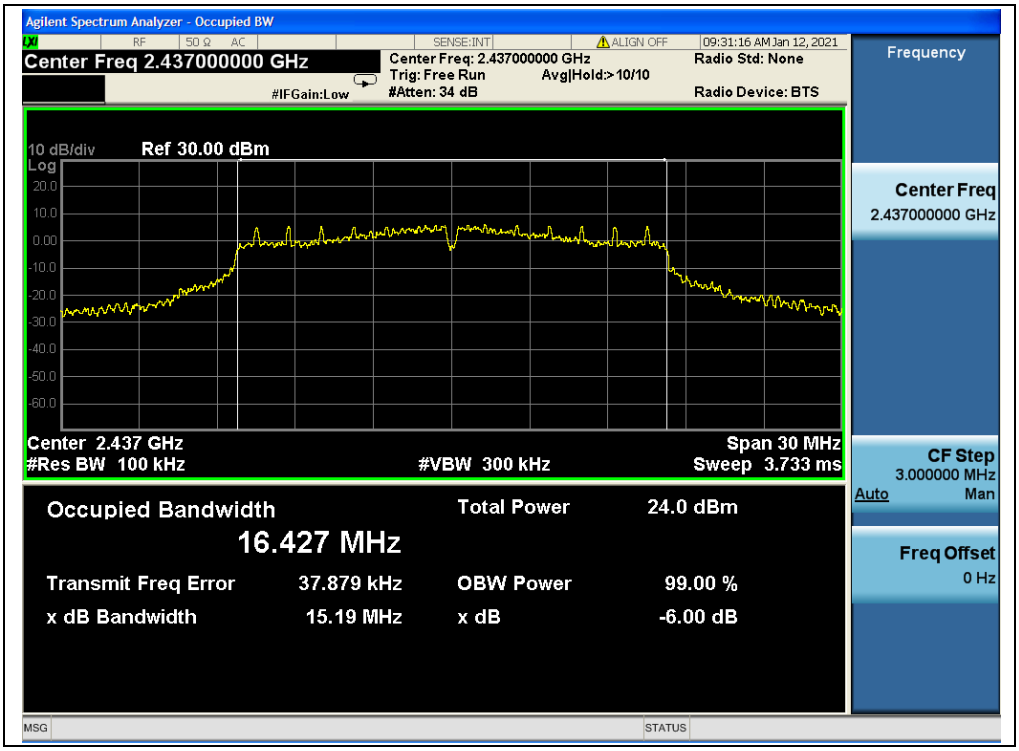
802.11g Test mode

A. Test Verdict:

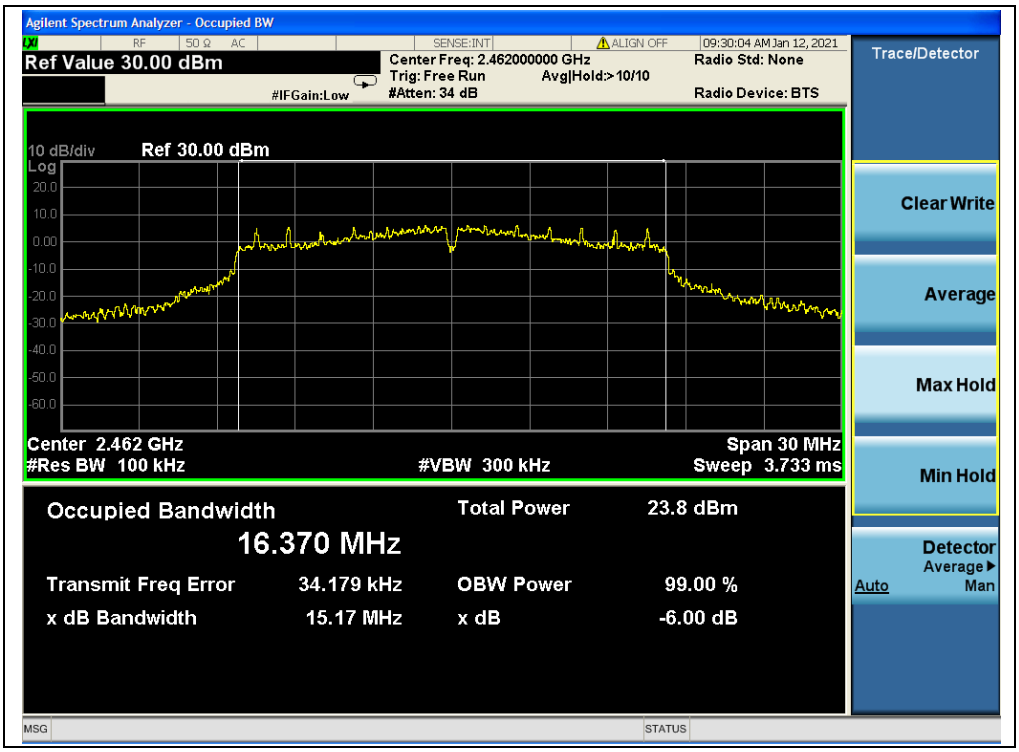
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	14.13	≥500	PASS
6	2437	15.19	≥500	PASS
11	2462	15.17	≥500	PASS

B. Test Plot:

(Channel 1, 802.11g)



(Channel 6, 802.11g)



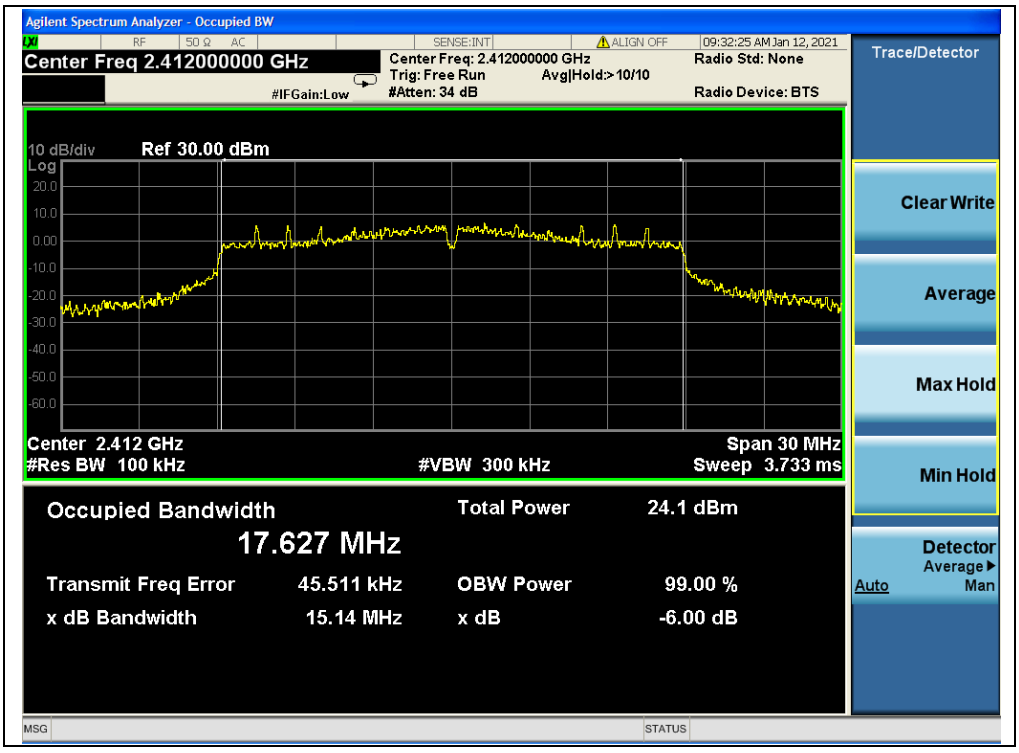
(Channel 11, 802.11g)

802.11n(HT20) Test mode

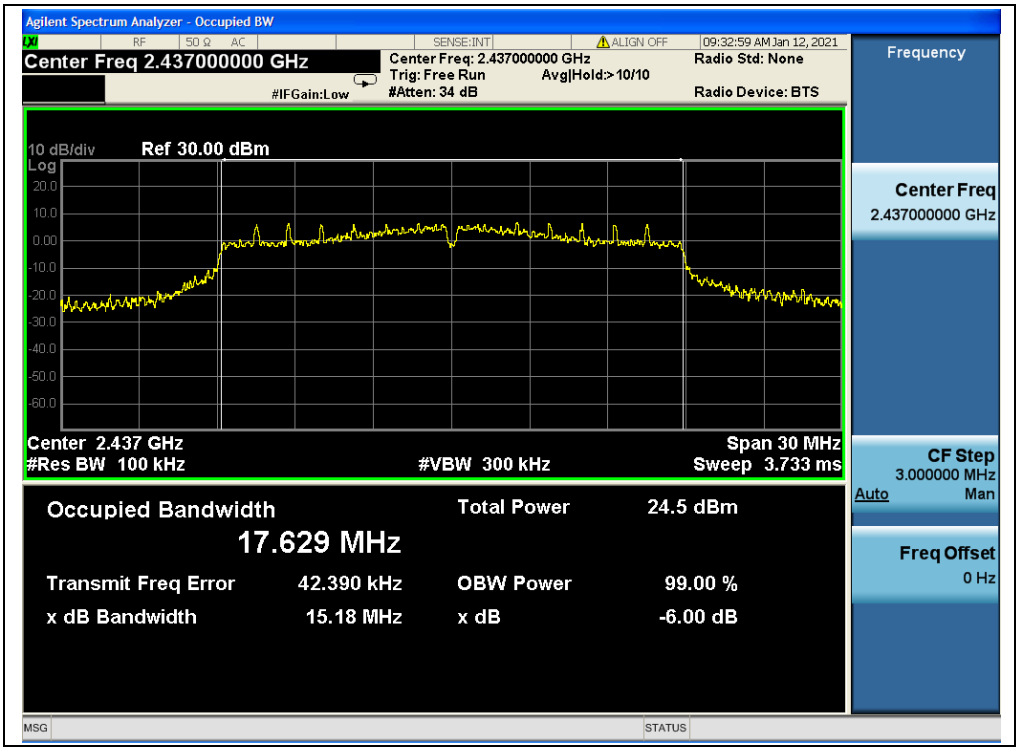
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	15.14	≥500	PASS
6	2437	15.18	≥500	PASS
11	2462	15.15	≥500	PASS

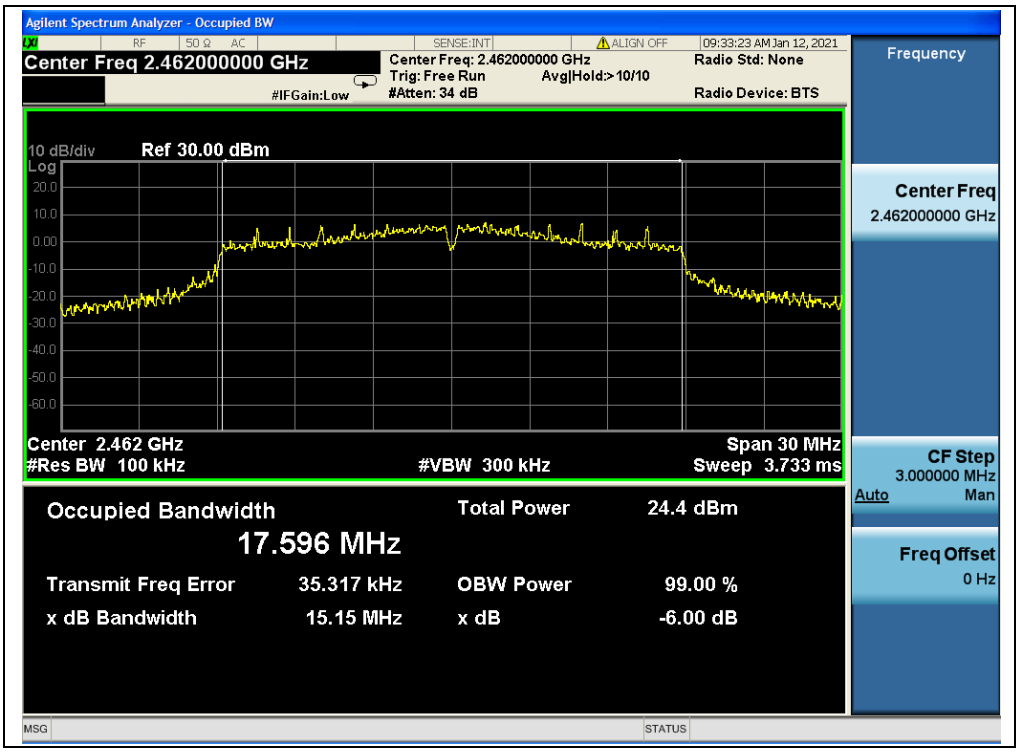
B. Test Plot:



(Channel 1, 802.11n(HT20))



(Channel 6, 802.11n(HT20))



(Channel 11, 802.11n(HT20))

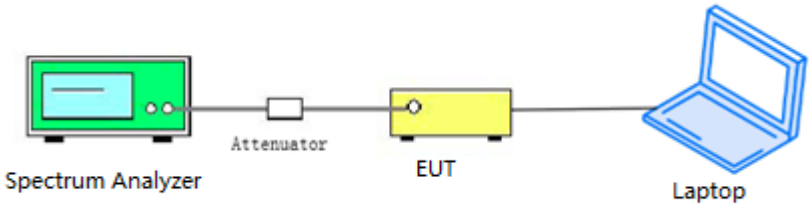
2.5. Conducted Spurious Emissions and Band Edge

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

Test Setup:



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.

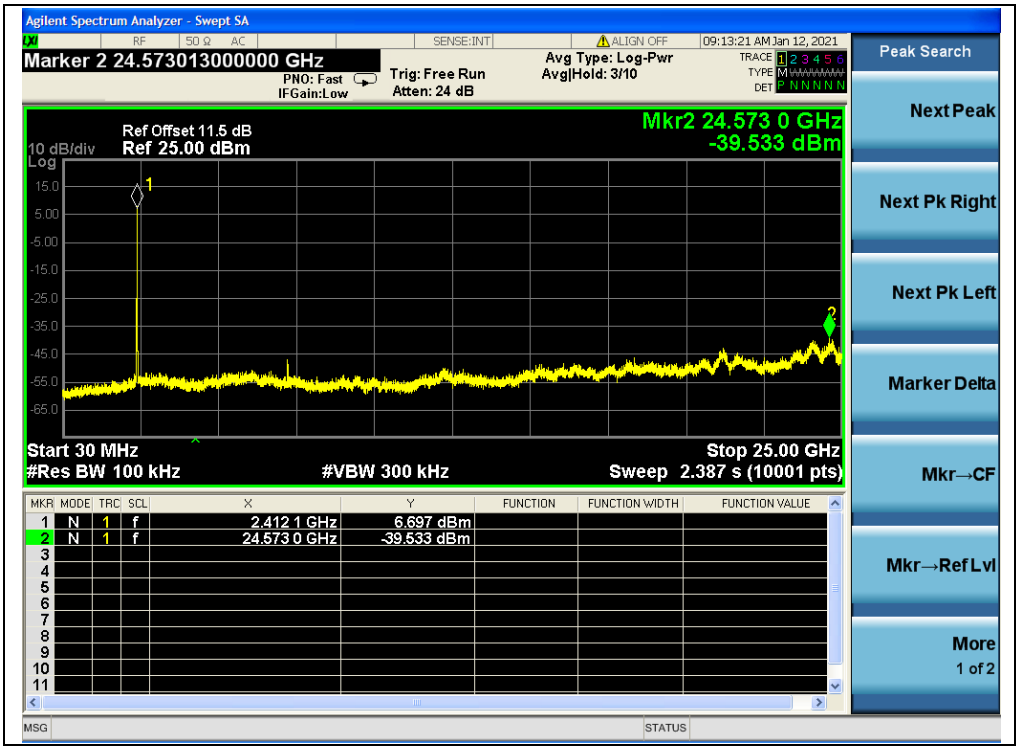
2.5.4. Test Result

802.11b Test mode

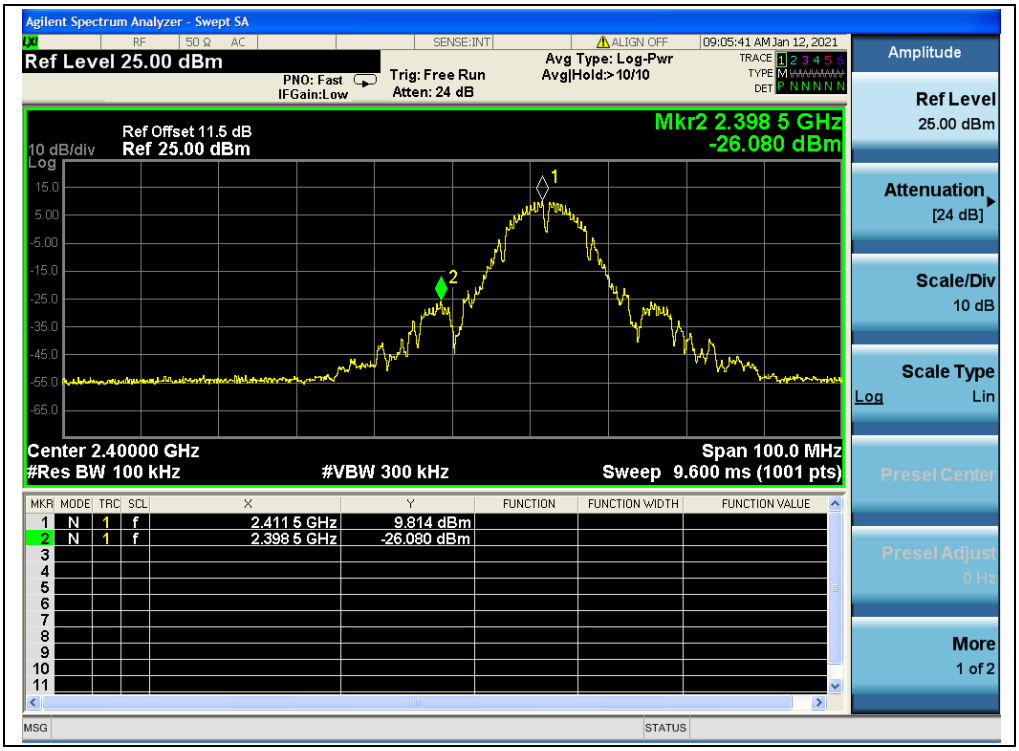
A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-39.53	6.70	-13.30	PASS
6	2437	-39.21	9.23	-10.77	PASS
11	2462	39.76	8.44	-11.56	PASS

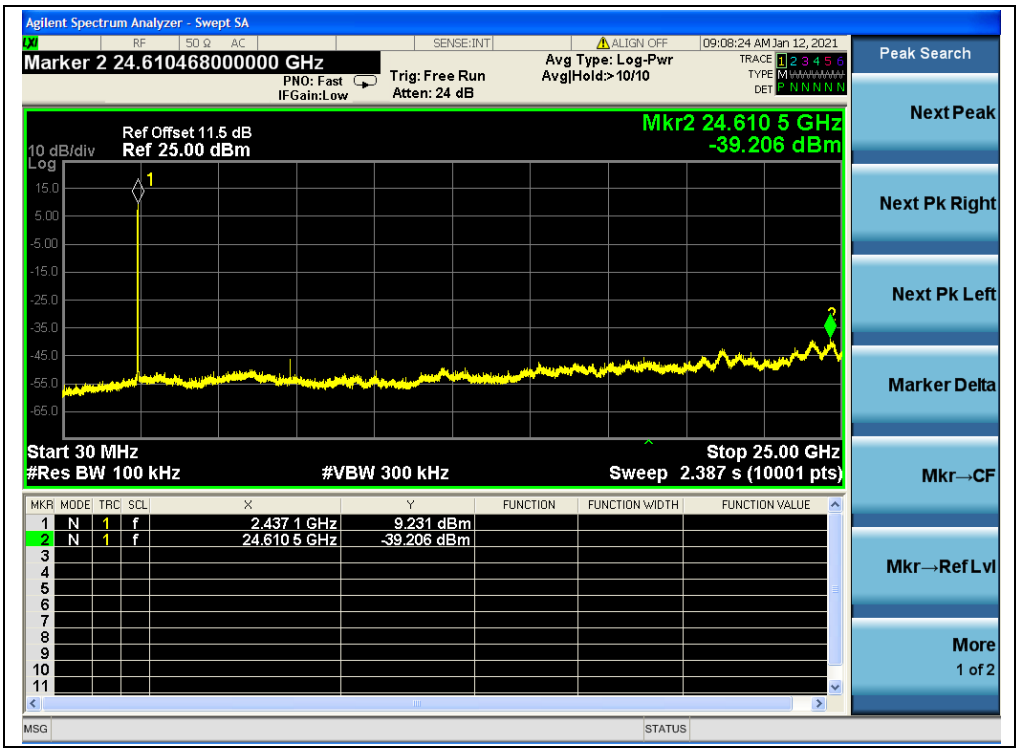
B. Test Plot:



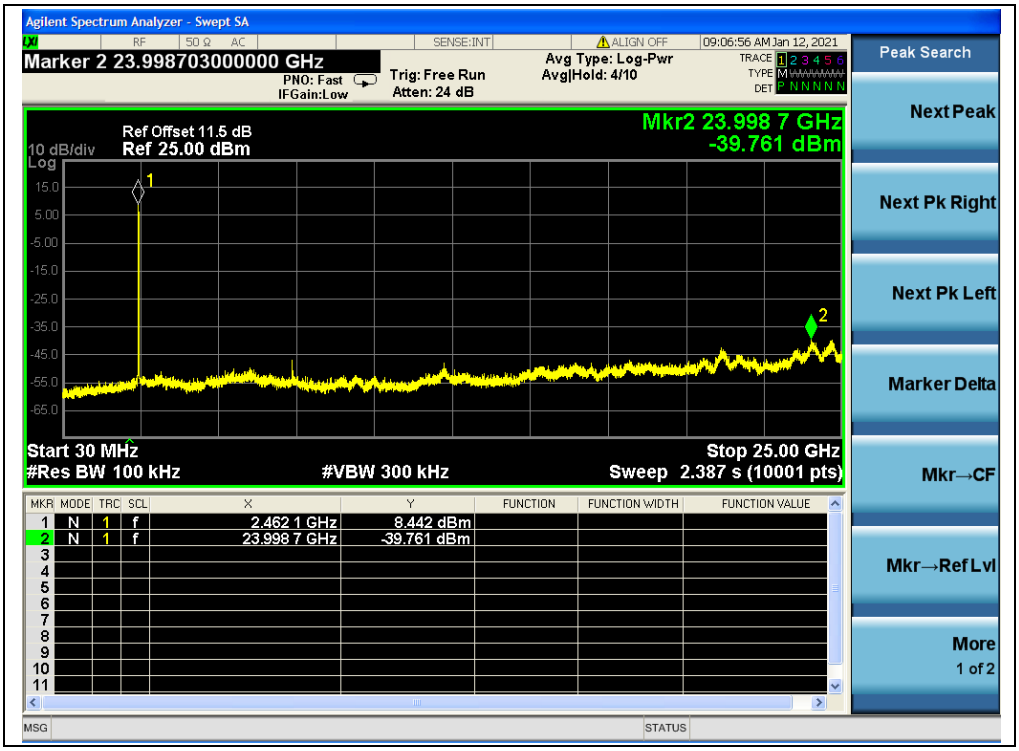
(Channel = 1, 30MHz to 25GHz)



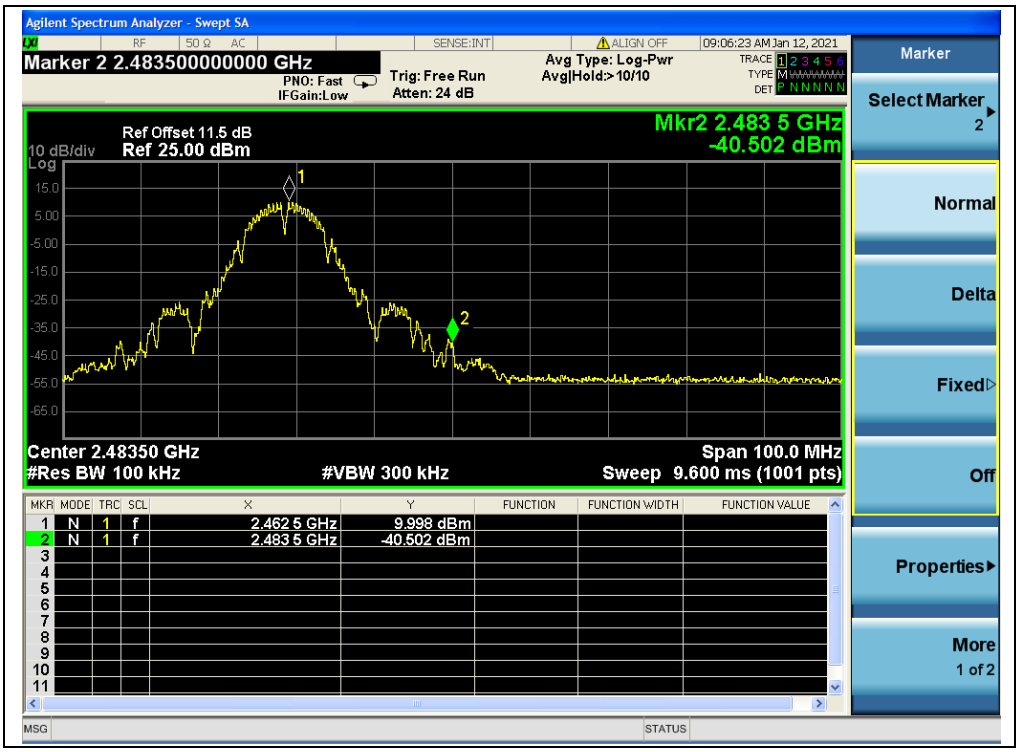
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



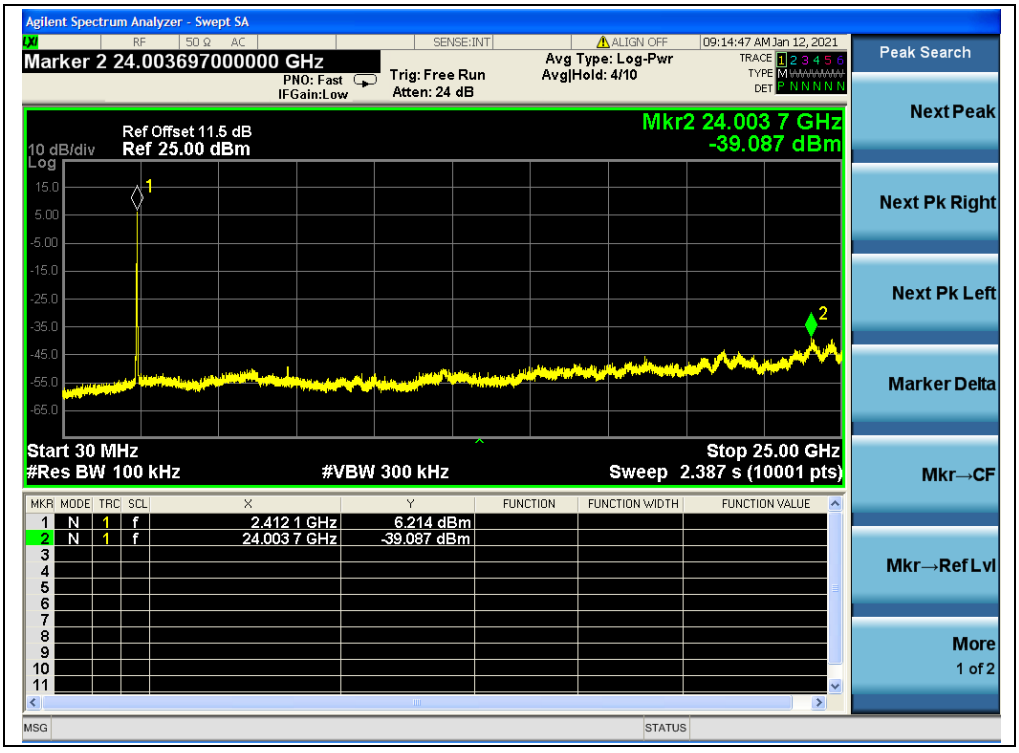
(Band Edge, Channel = 11)

802.11g Test mode

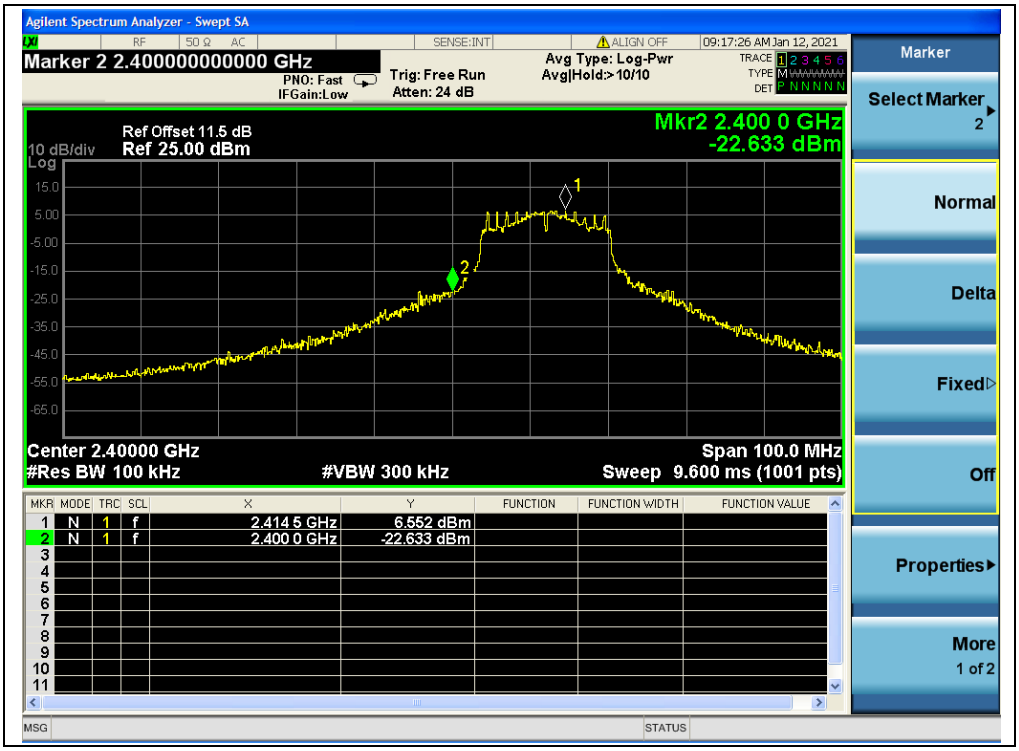
A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-39.09	6.21	-13.79	PASS
6	2437	-38.83	5.06	-14.94	PASS
11	2462	-39.69	6.95	-13.05	PASS

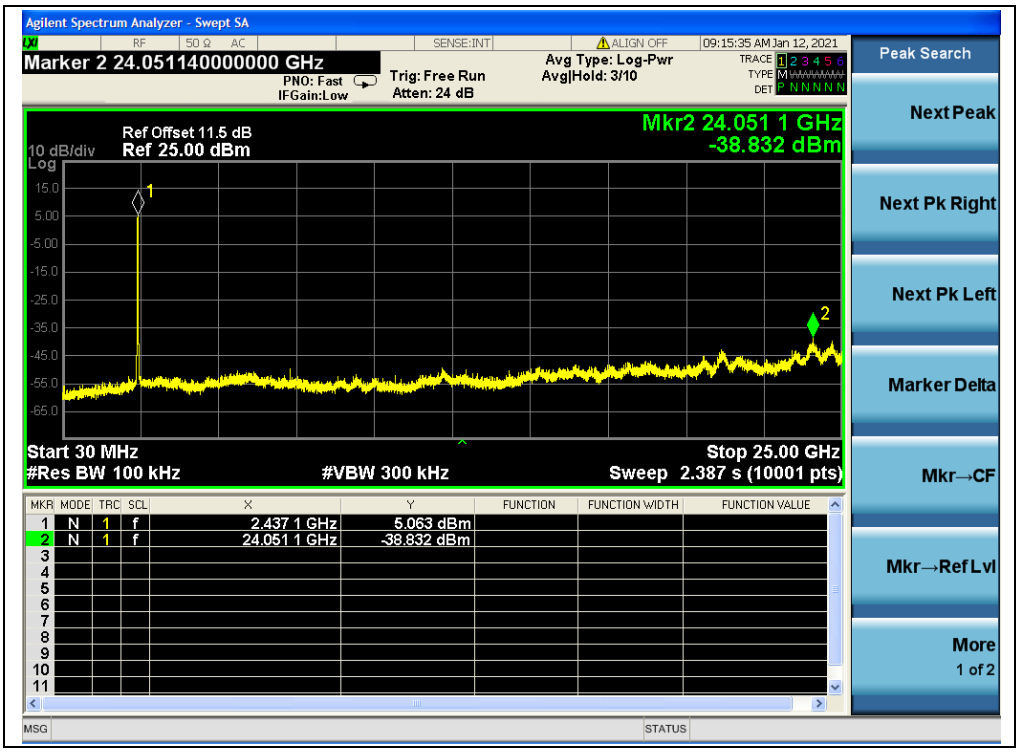
B. Test Plot:



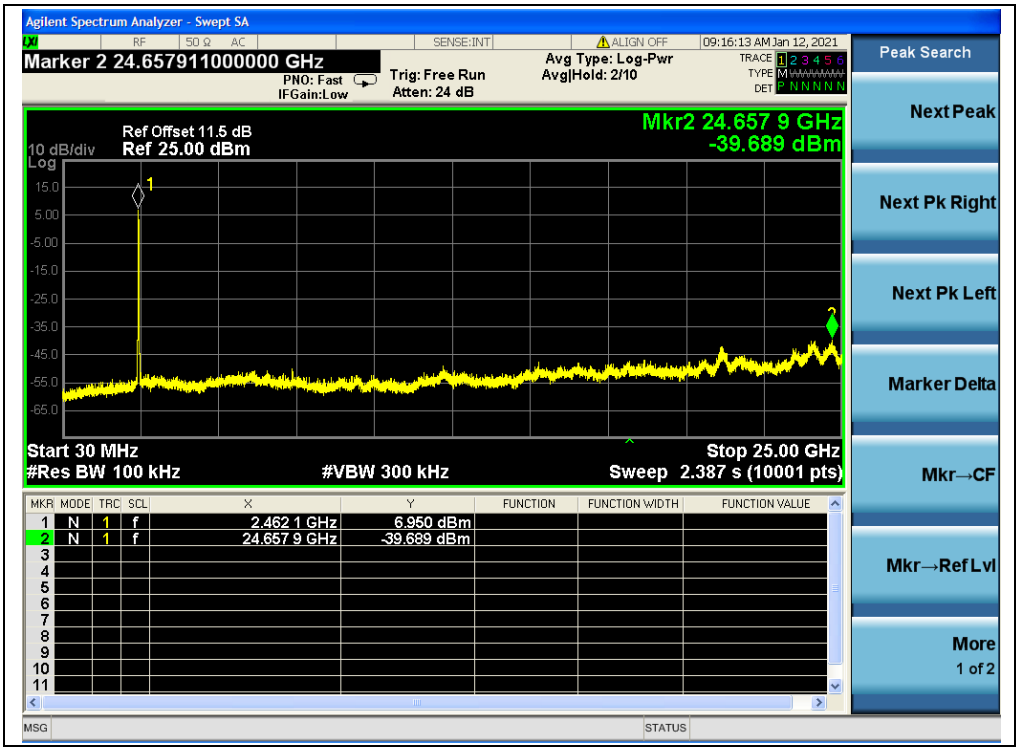
(Channel = 1, 30MHz to 25GHz)



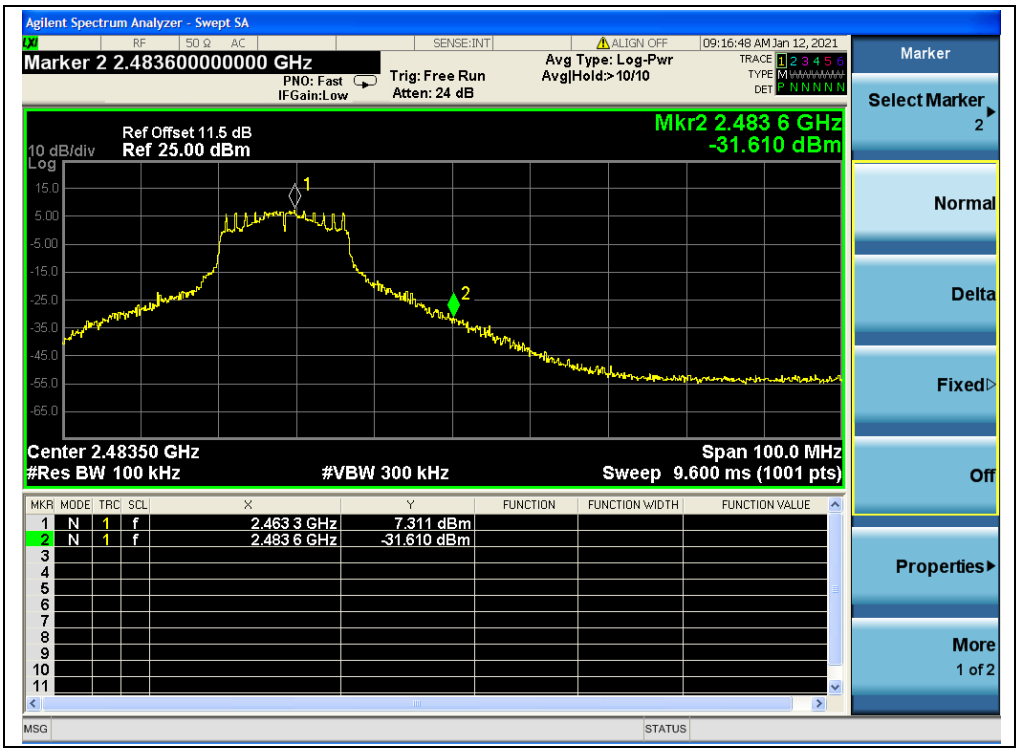
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



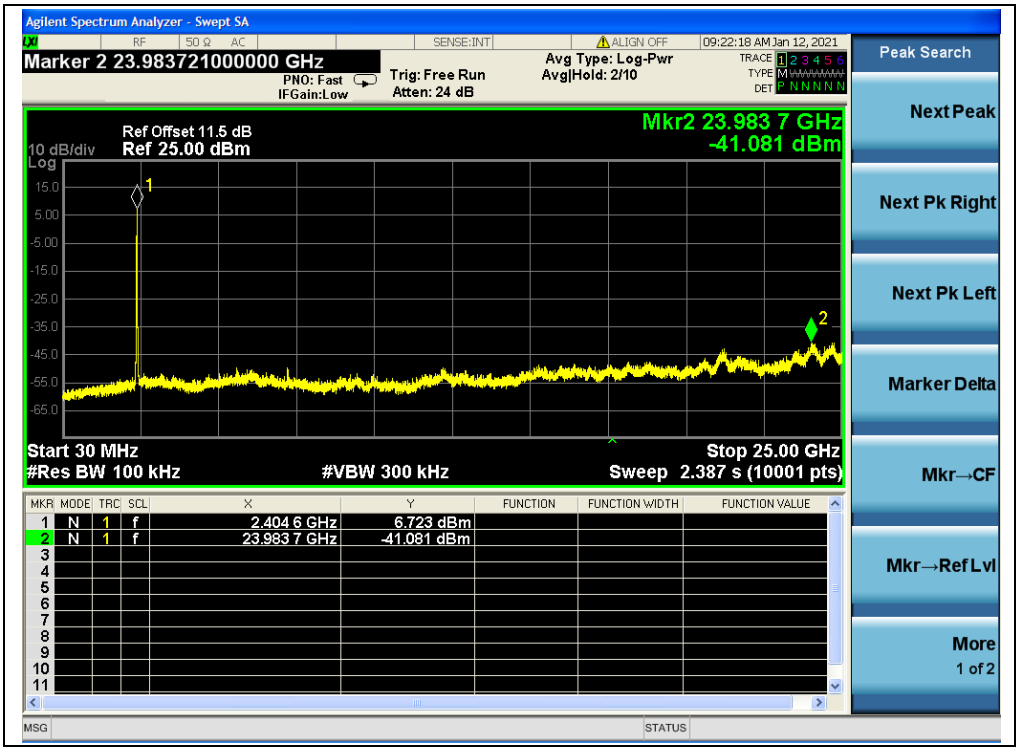
(Band Edge, Channel = 11)

802.11n(HT20) Test mode

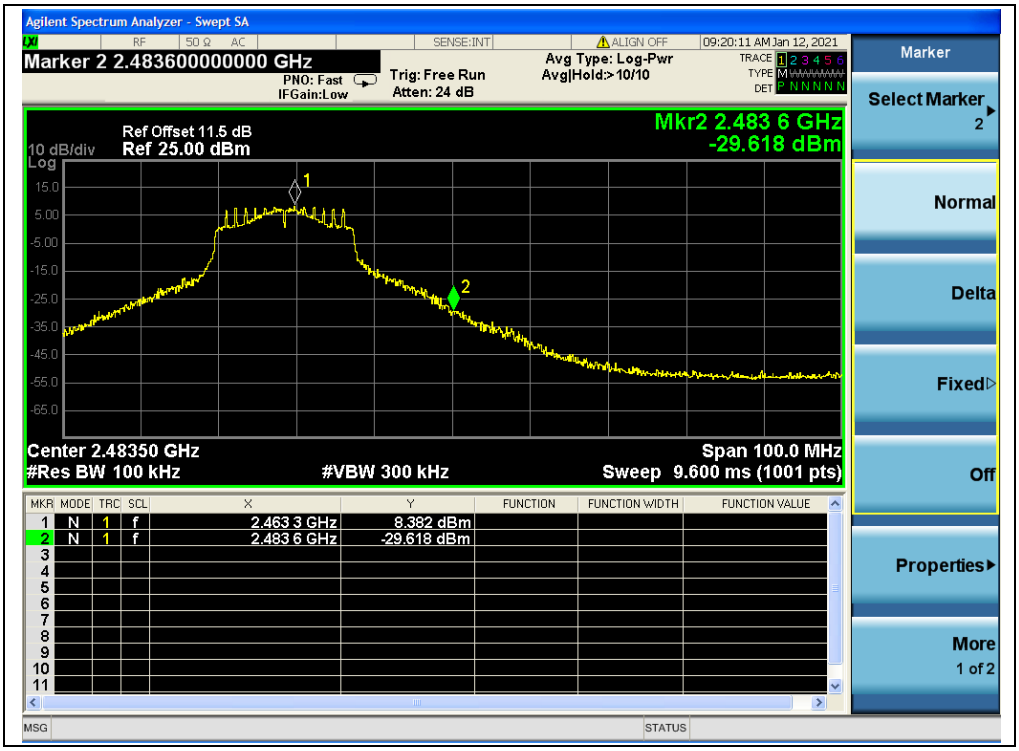
A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-41.08	6.72	-13.28	PASS
6	2437	-40.23	7.09	-12.91	PASS
11	2462	-40.33	6.49	-13.51	PASS

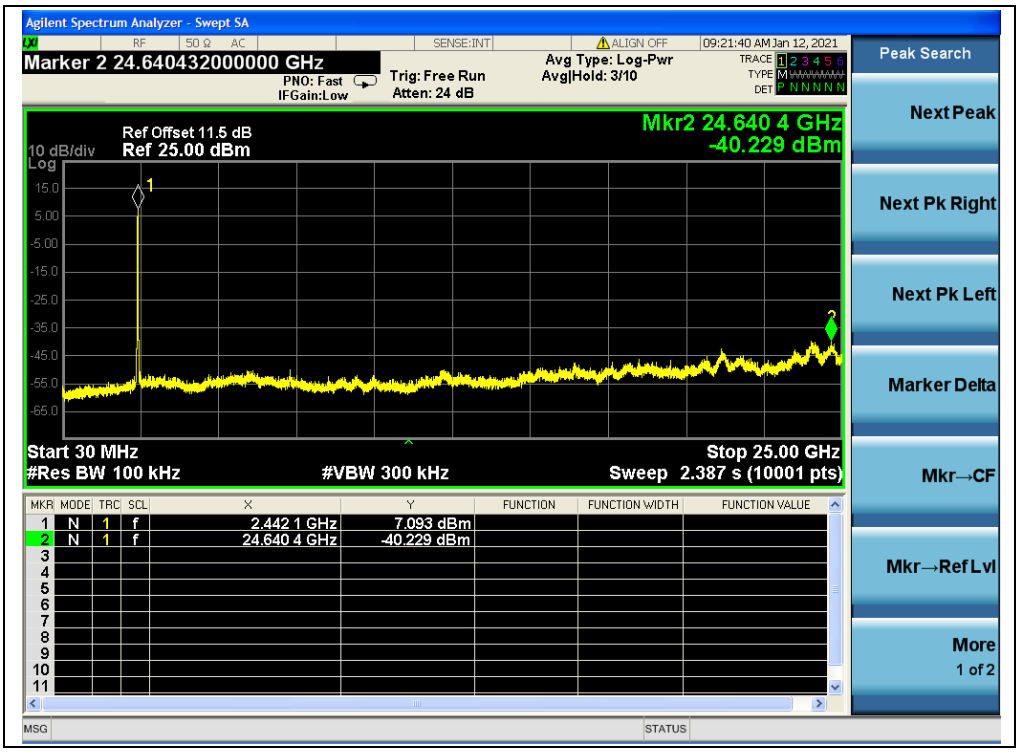
B. Test Plot:



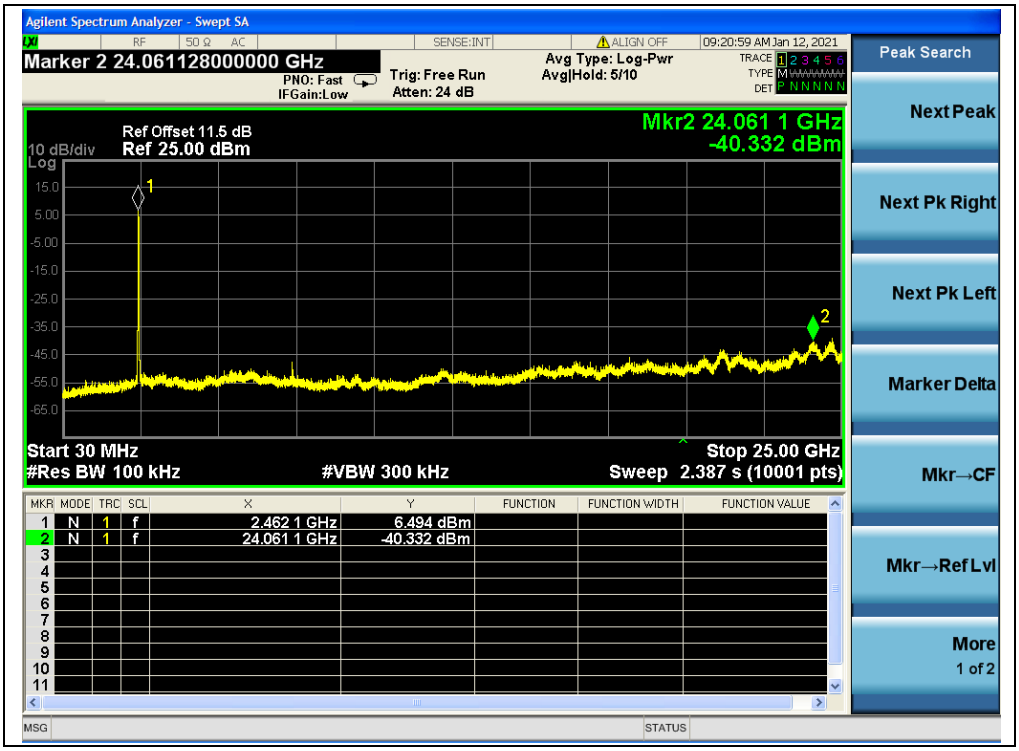
(Channel = 1, 30MHz to 25GHz)



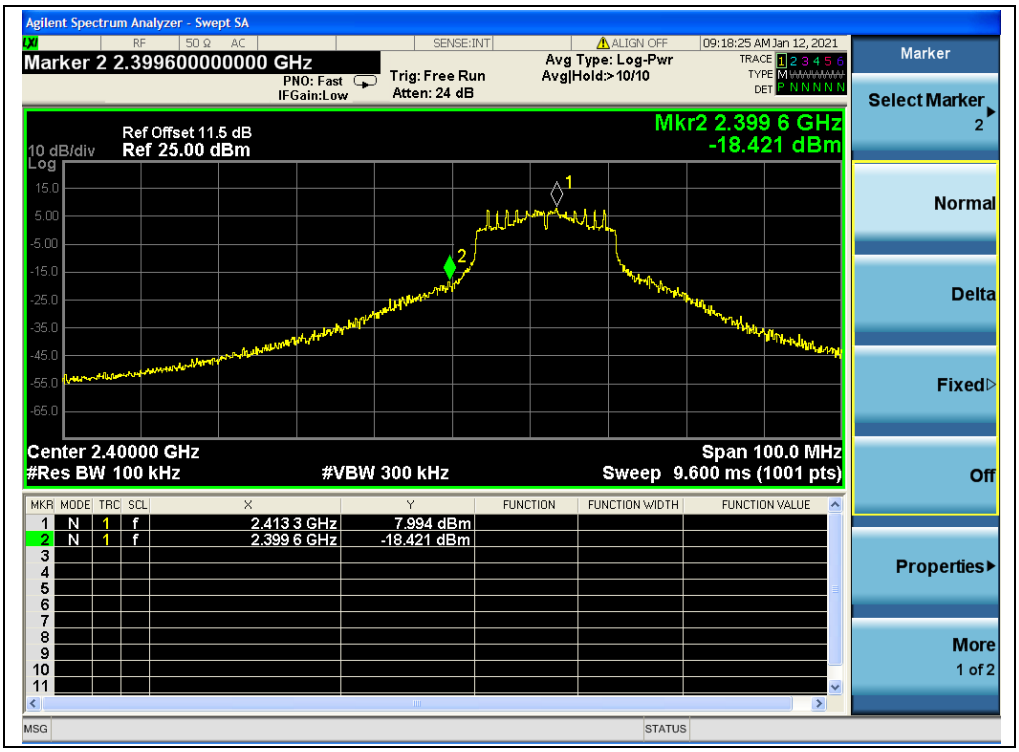
(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



(Channel = 11, 30MHz to 25GHz)



(Band Edge, Channel = 11)

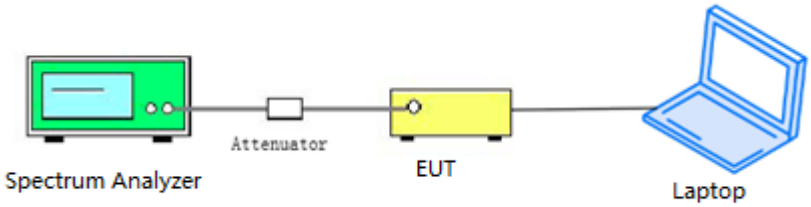
2.6. Power Spectral Density (PSD)

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

Test Setup:



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	-4.81	8	PASS
6	2437	-5.02	8	PASS
11	2462	-3.80	8	PASS

B. Test Plot:

(Channel = 1, 802.11b)

(Channel = 6, 802.11b)

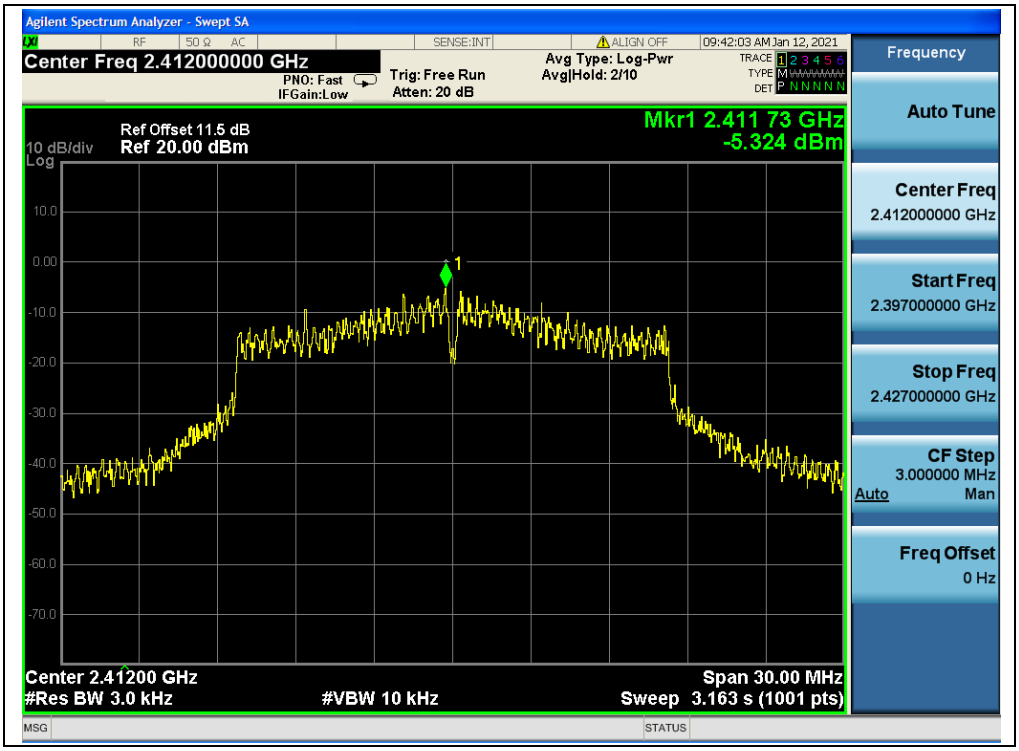
(Channel = 11, 802.11b)

802.11g Test mode

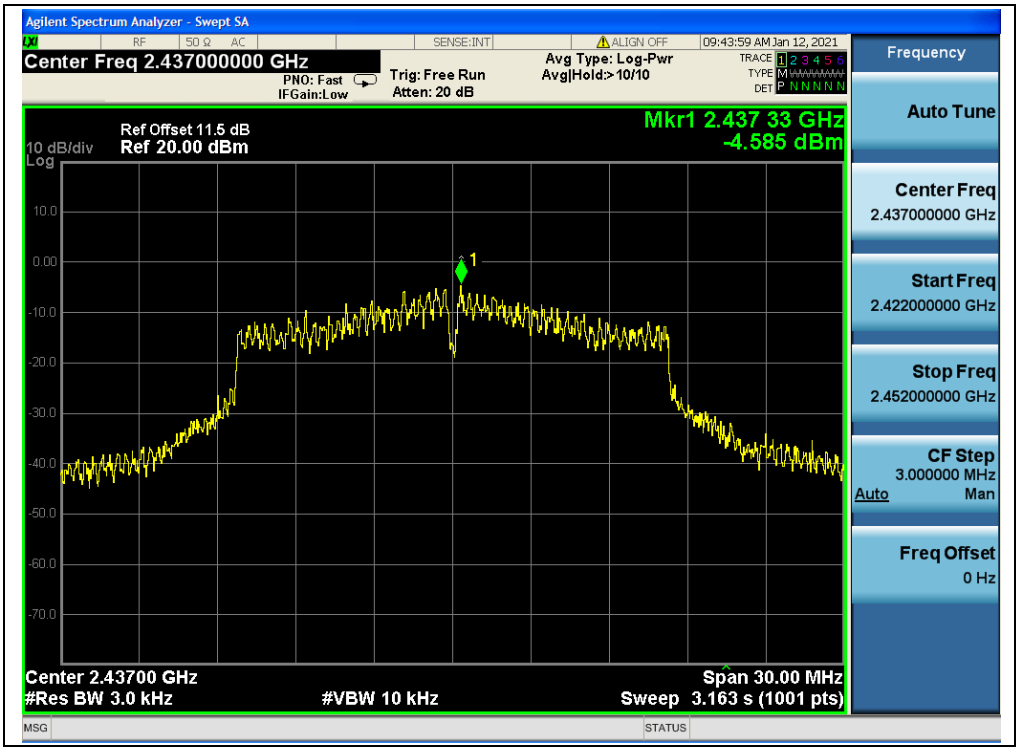
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-5.32	8	PASS
6	2437	-4.59	8	PASS
11	2462	-4.38	8	PASS

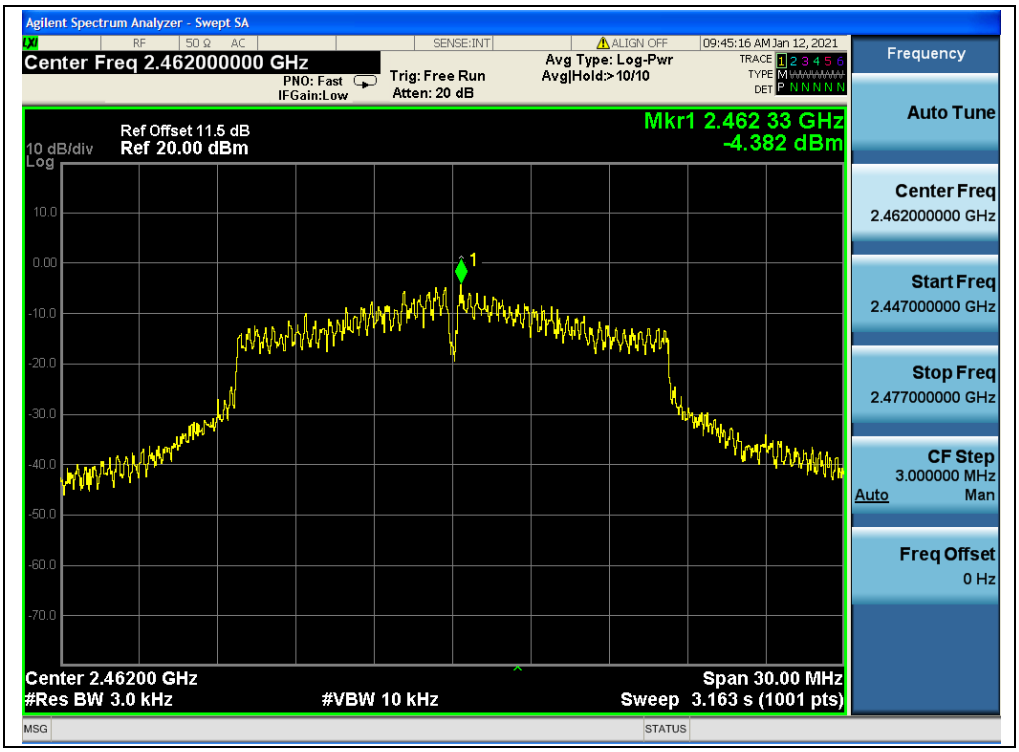
B. Test Plot:



(Channel = 1, 802.11g)



(Channel = 6, 802.11g)



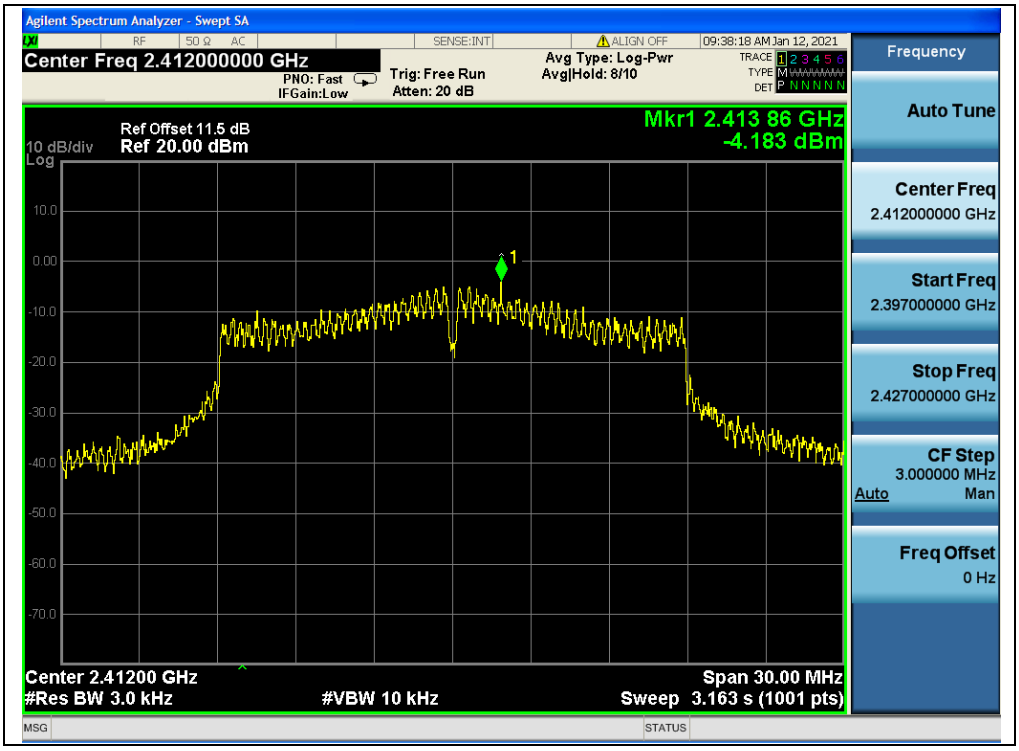
(Channel = 11, 802.11g)

802.11n(HT20) Test mode

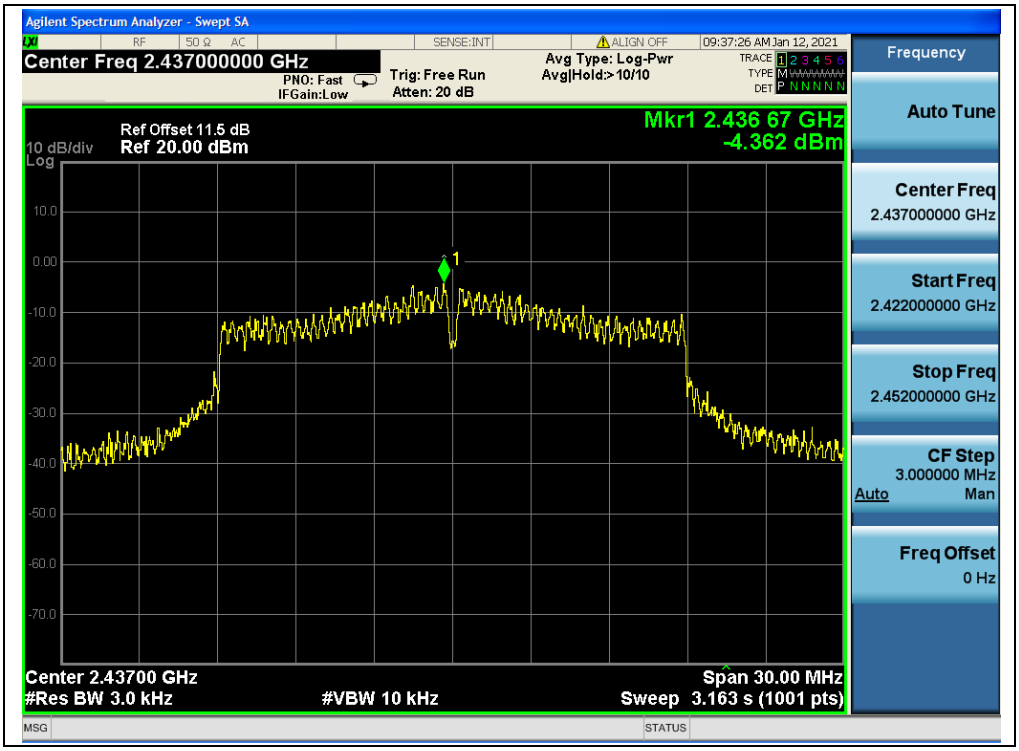
A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-4.18	8	PASS
6	2437	-4.36	8	PASS
11	2462	-3.91	8	PASS

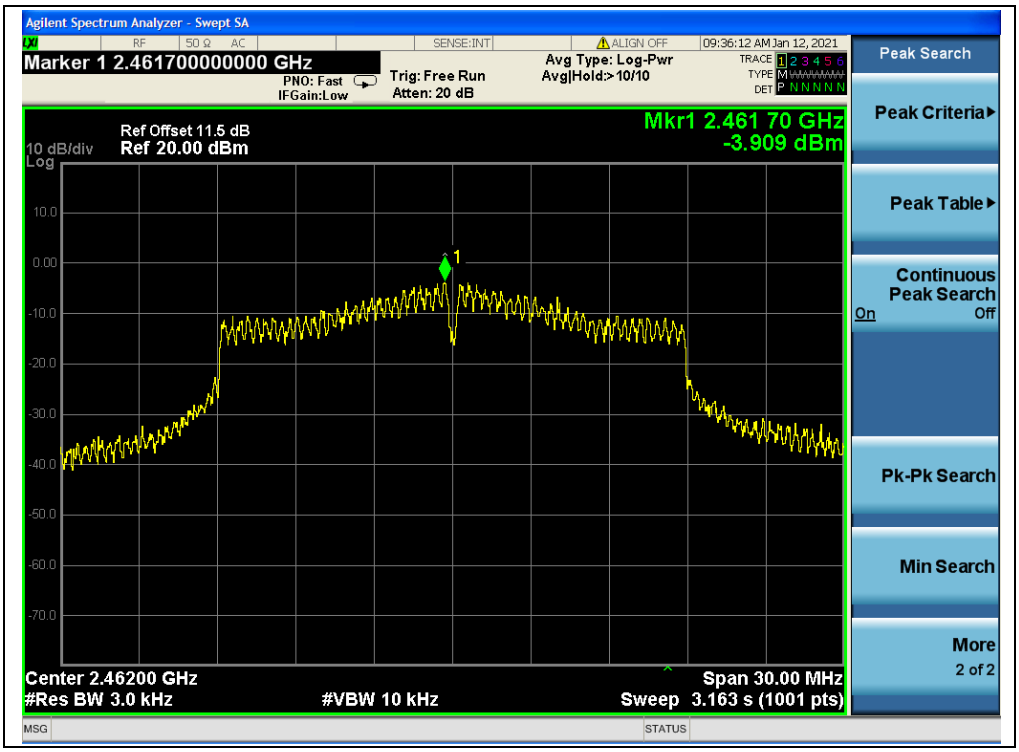
B. Test Plot:



(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

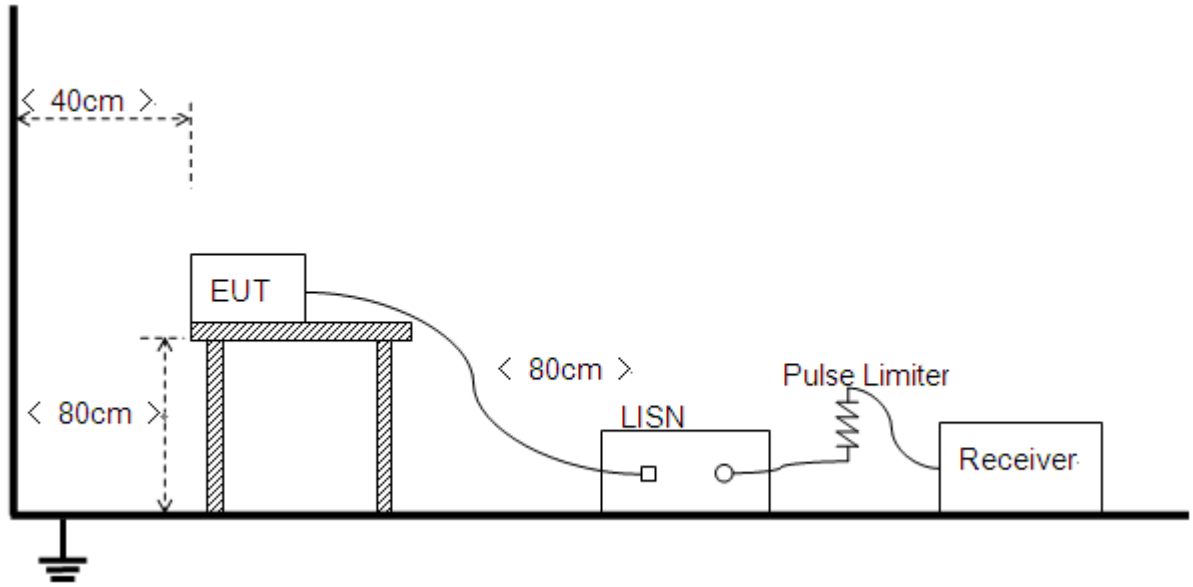
NOTE:

(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

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/50Hzwere considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test Setup:

Test Mode1:EUT+ADAPTER+ WIFI TX

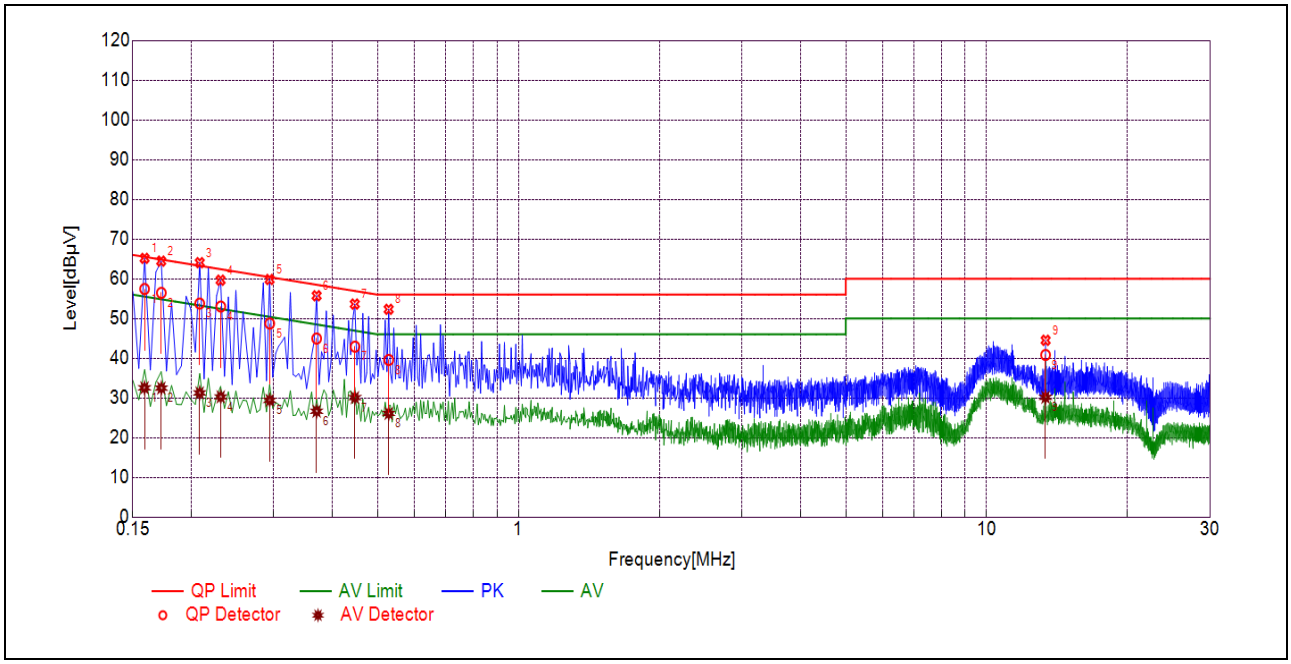
Test Voltage:AC 120V/60Hz

The measurement results are obtained as below:

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

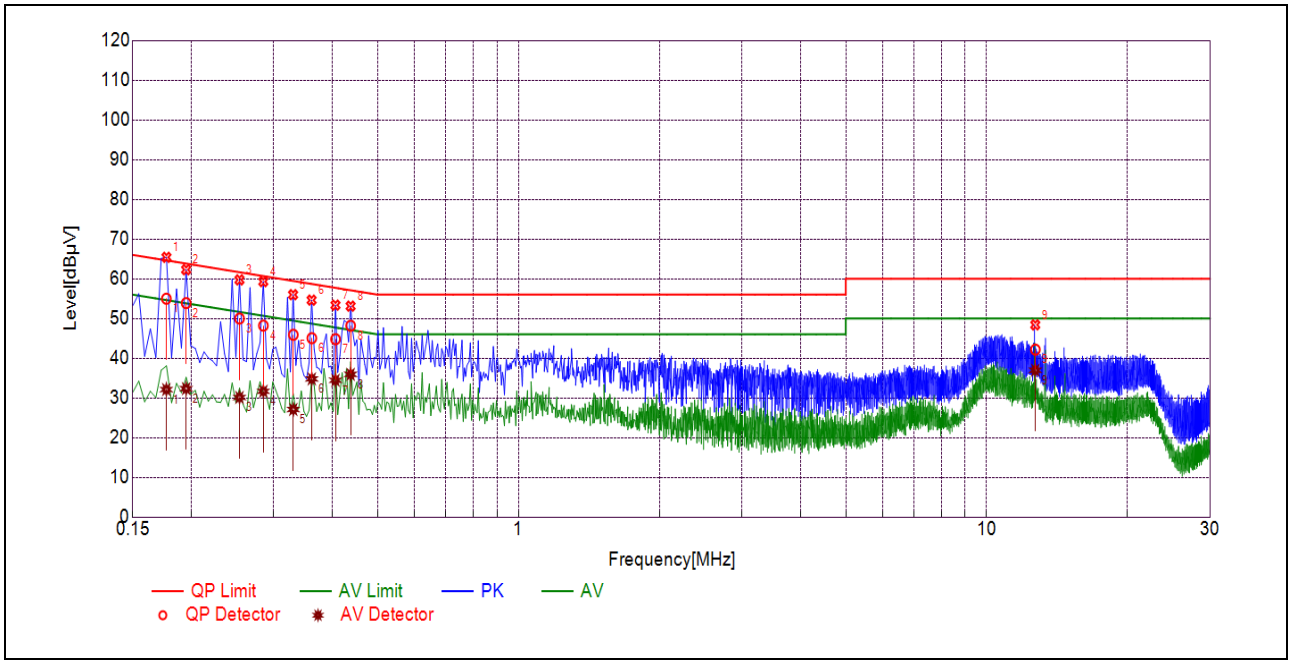
U_R: Receiver Reading

A_{Factor}: Voltage division factor of LISN



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1589	57.43	32.53	65.52	55.52	Line	PASS
2	0.1726	56.46	32.48	64.83	54.83		PASS
3	0.2084	53.76	31.26	63.27	53.27		PASS
4	0.2312	53.01	30.26	62.41	52.41		PASS
5	0.2941	48.74	29.39	60.41	50.41		PASS
6	0.3704	44.96	26.65	58.49	48.49		PASS
7	0.4473	42.92	30.07	56.92	46.92		PASS
8	0.5282	39.56	26.09	56.00	46.00		PASS
9	13.3567	40.82	30.15	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	0.1769	54.99	32.11	64.63	54.63	Neutral	PASS
2	0.1950	53.87	32.33	63.82	53.82		PASS
3	0.2535	49.99	30.12	61.64	51.64		PASS
4	0.2851	48.20	31.67	60.67	50.67		PASS
5	0.3303	45.90	27.10	59.44	49.44		PASS
6	0.3618	45.05	34.79	58.69	48.69		PASS
7	0.4065	44.80	34.44	57.72	47.72		PASS
8	0.4379	48.18	35.93	57.10	47.10		PASS
9	12.7050	42.16	36.96	60.00	50.00		PASS

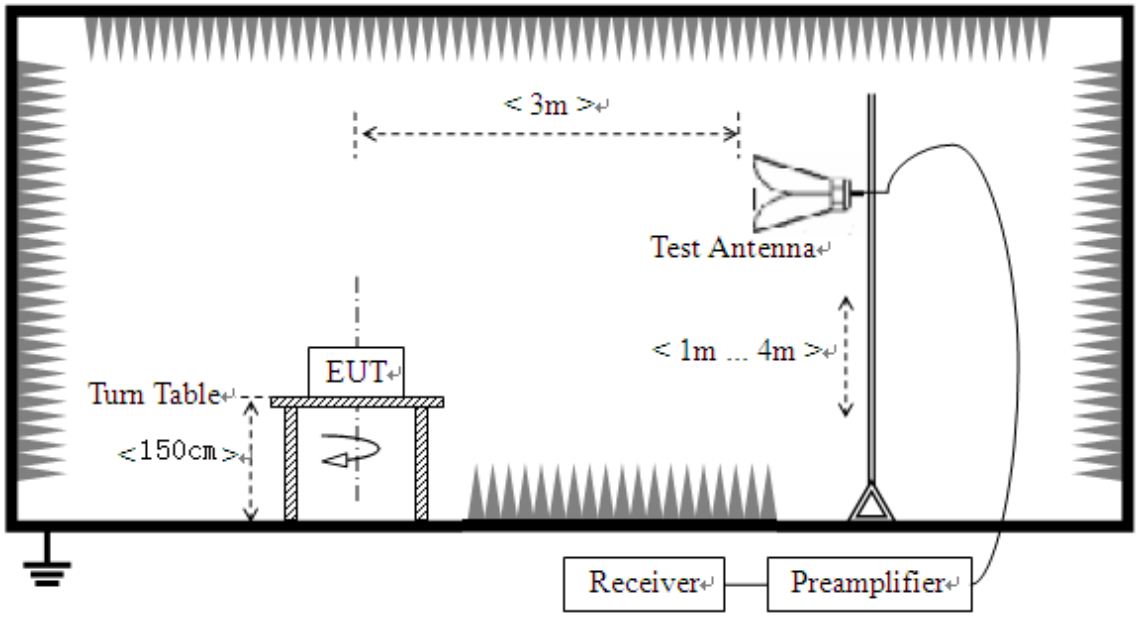
2.8. Restricted Frequency Bands

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

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 [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

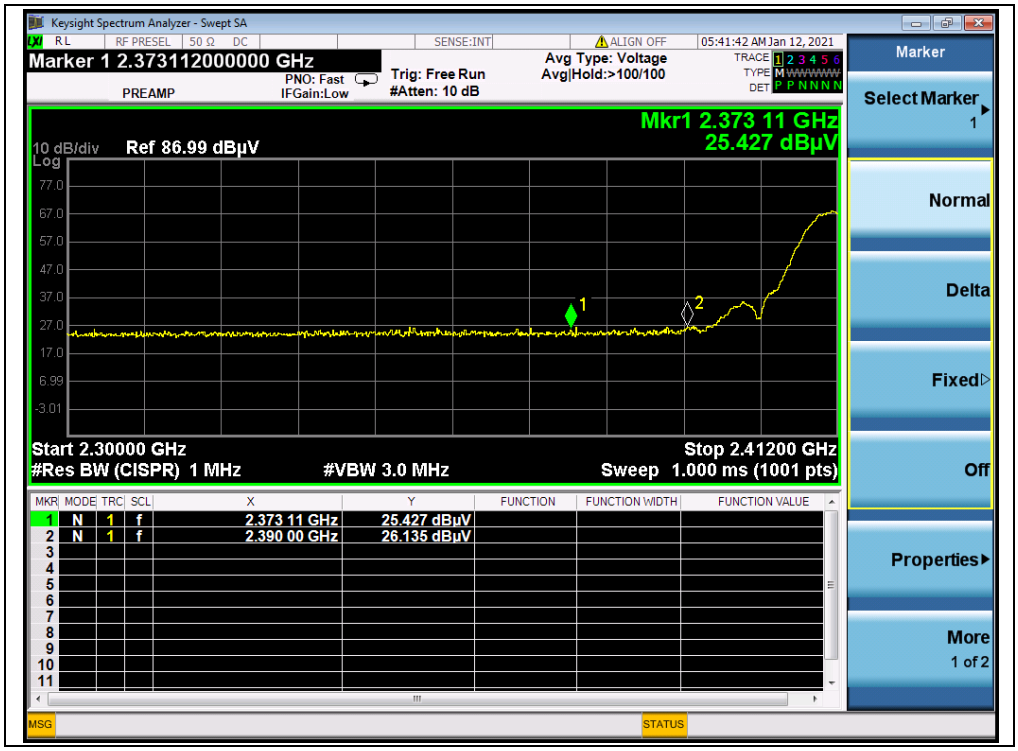
Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

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	2390.00	PK	26.14	6.74	27.20	60.08	74	PASS
1	2390.00	AV	13.87	6.74	27.20	47.81	54	PASS
11	2486.05	PK	25.28	6.74	27.20	59.22	74	PASS
11	2483.74	AV	15.18	6.74	27.20	49.12	54	PASS

B. Test Plot:



(PEAK,Channel = 1, 802.11b)

(AVG,Channel = 1, 802.11b)

(PEAK,Channel = 11, 802.11b)

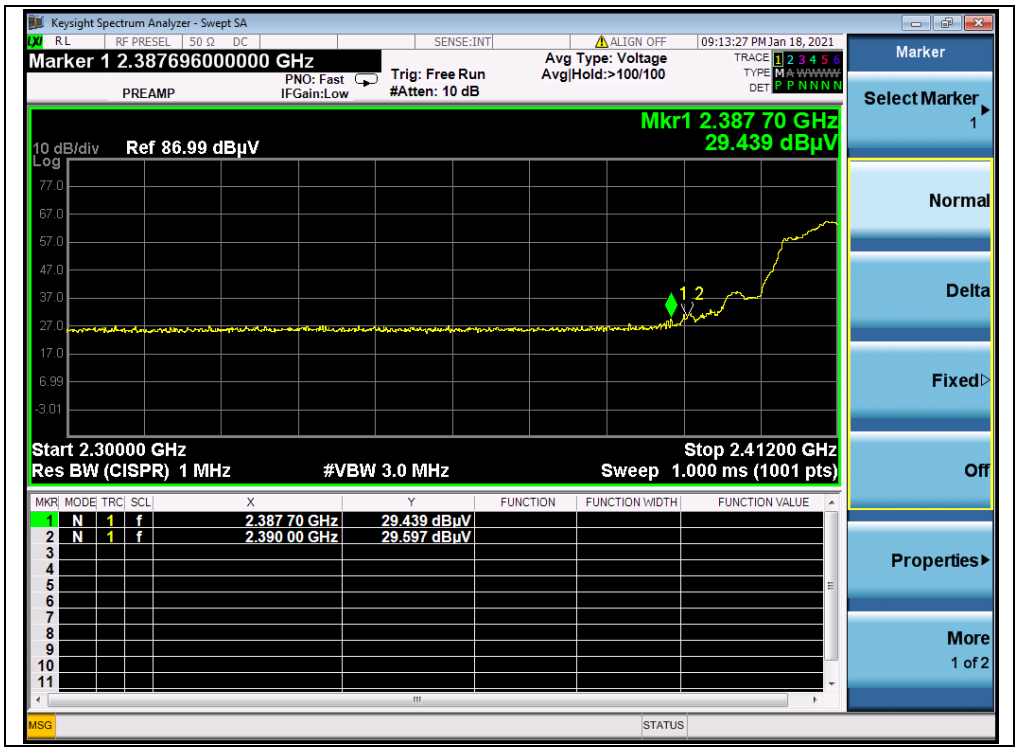
(AVG,Channel = 11, 802.11b)

802.11g Test mode

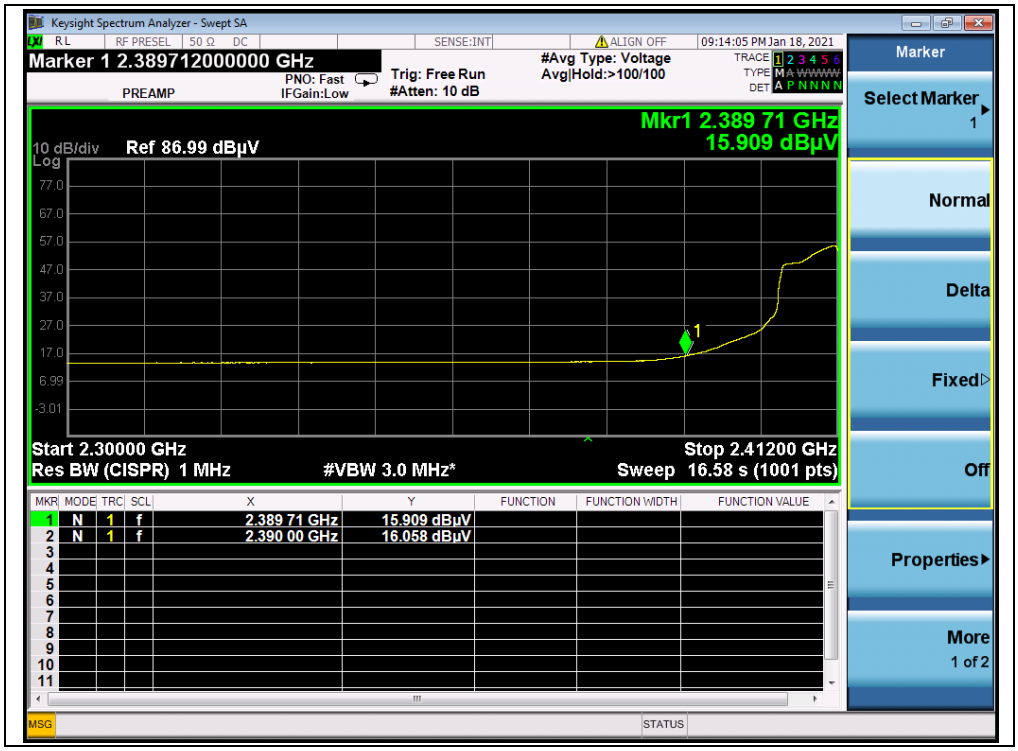
A. Test Verdict:

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	2390.00	PK	29.60	6.74	27.20	63.54	74	PASS
1	2390.00	AV	16.06	6.74	27.20	50.00	54	PASS
11	2484.57	PK	29.71	6.74	27.20	63.65	74	PASS
11	2483.66	AV	15.23	6.74	27.20	49.17	54	PASS

B. Test Plot:

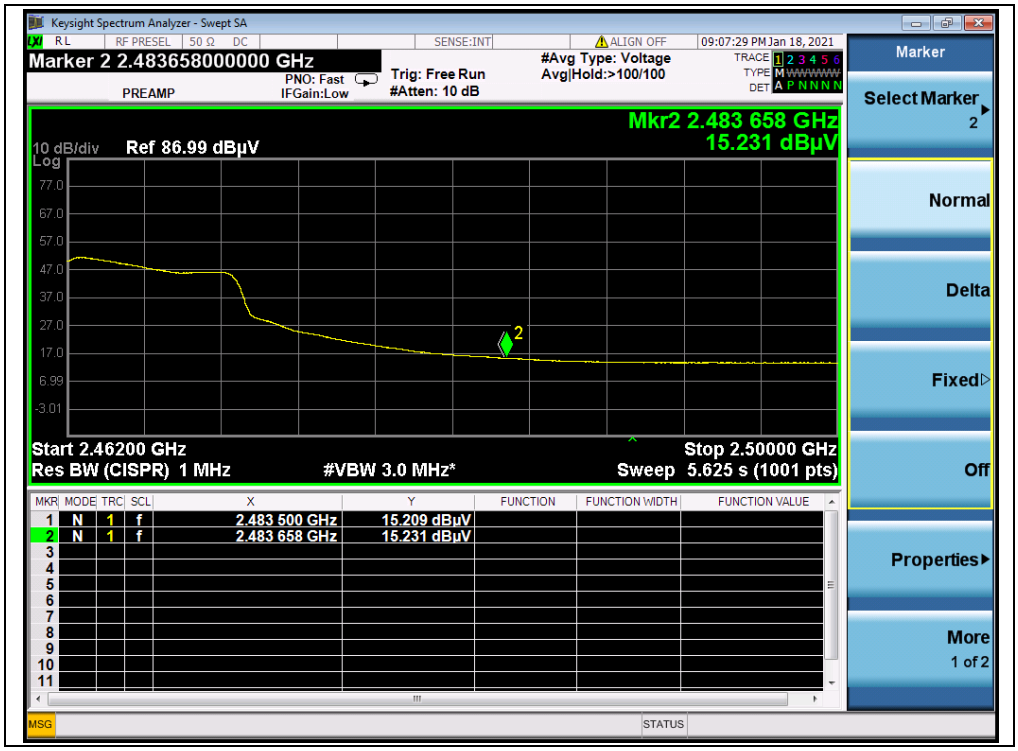


(PEAK,Channel = 1, 802.11g)



(AVG,Channel = 1, 802.11g)

(PEAK,Channel = 11, 802.11g)



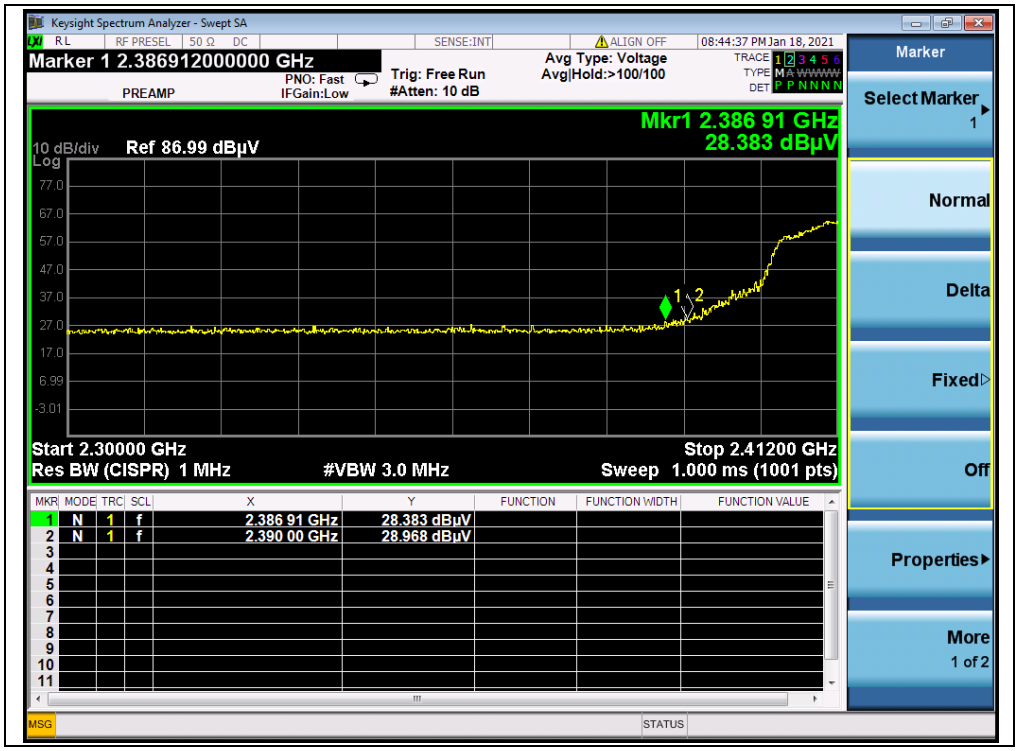
(AVG,Channel = 11,802.11g)

802.11n(HT20) Test mode

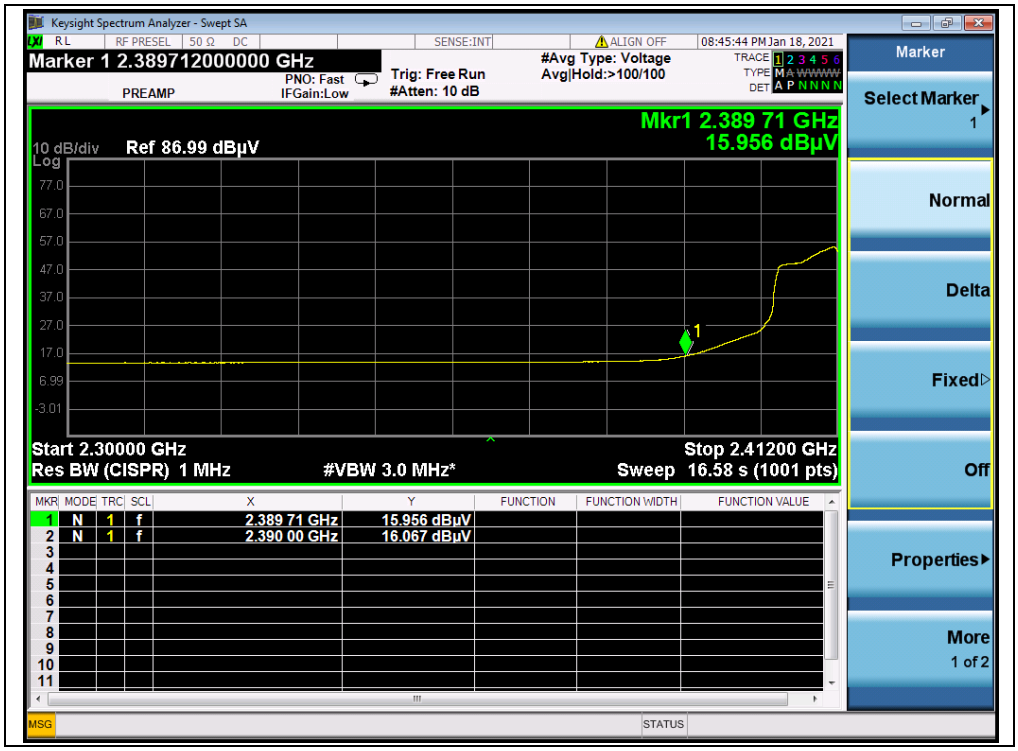
A. Test Verdict:

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	2390.00	PK	28.97	6.74	27.20	62.91	74	PASS
1	2390.00	AV	16.07	6.74	27.20	50.01	54	PASS
11	2484.76	PK	32.98	6.74	27.20	66.92	74	PASS
11	2483.50	AV	17.04	6.74	27.20	50.98	54	PASS

B. Test Plot:

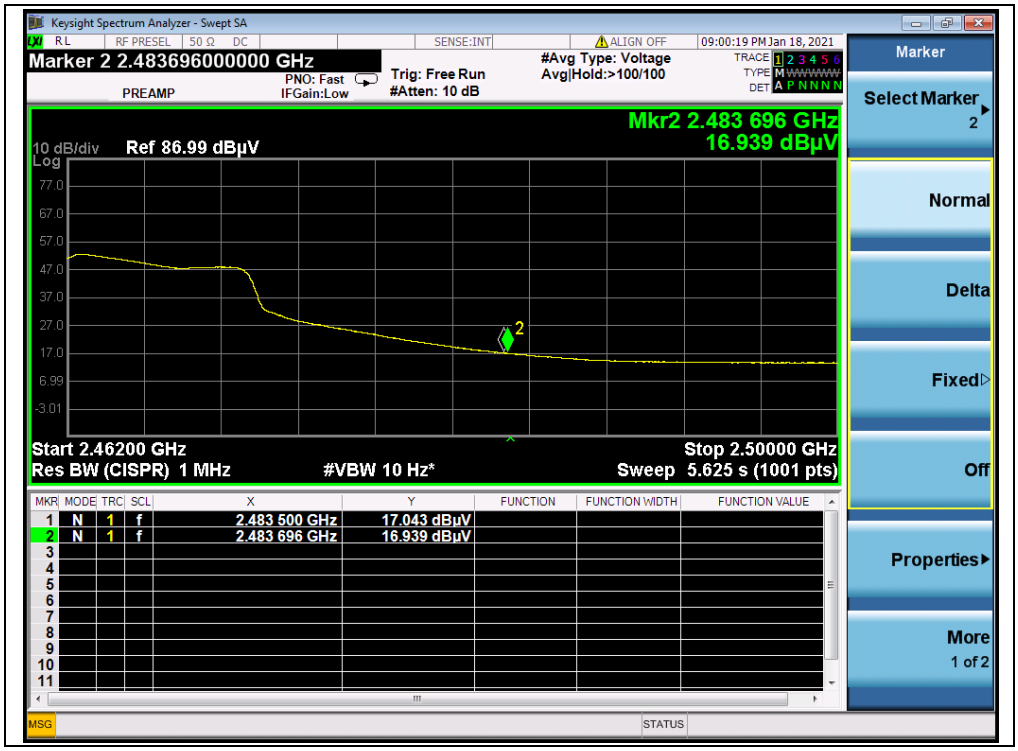


(PEAK,Channel = 1, 802.11n(HT20))



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

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



(AVG,Channel = 11, 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 (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

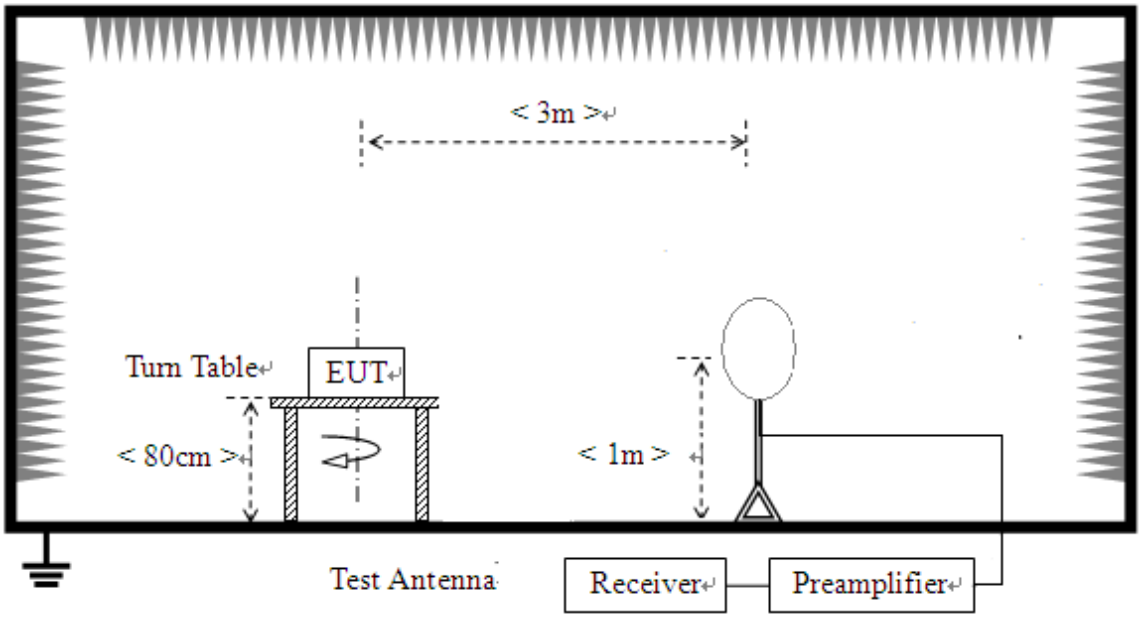
Note1: For above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

Note2: 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).

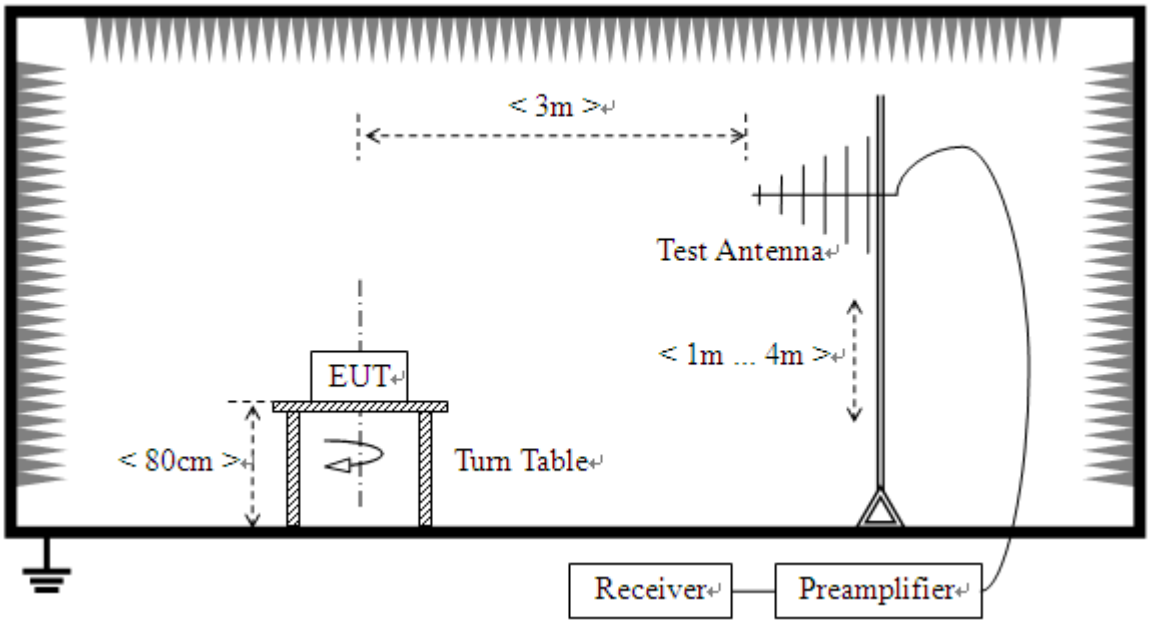
2.9.2. Test Description

Test Setup:

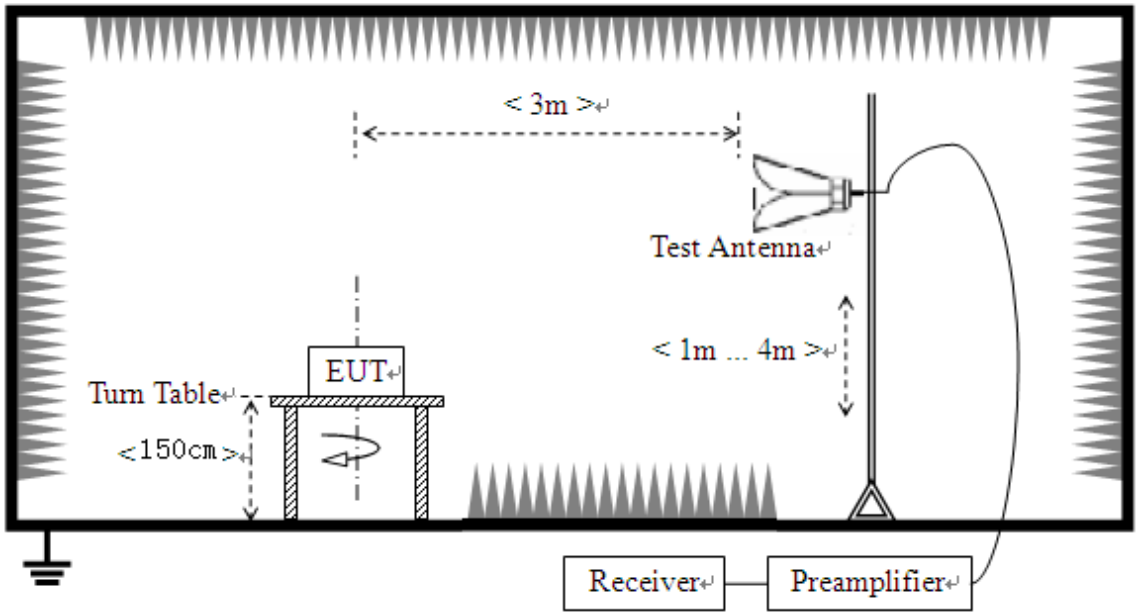
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz.The antenna to EUT distance is 3meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 30MHz, the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9kHz-90 kHz, 110kHz-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

For measurements below 1GHz the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video band width is set to 3MHz for peak measurements and as applicable for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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 (or average) limit, it is unnecessary to perform an quasi-peak measurement (or average).

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.

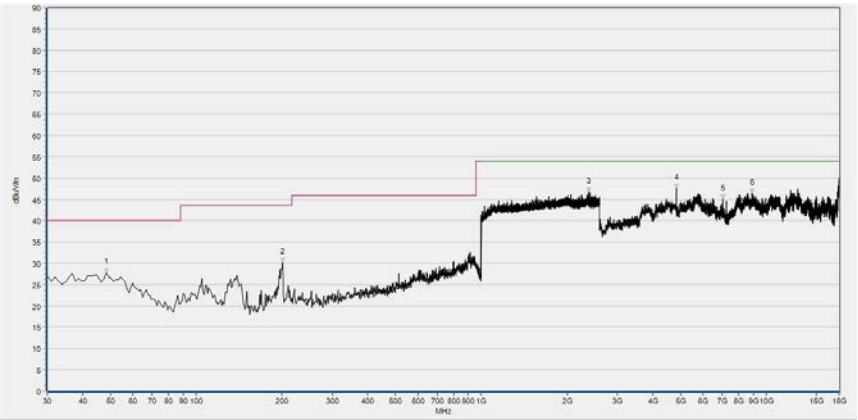
Note1: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Note2: For the frequency, which started from 9kHz 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 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

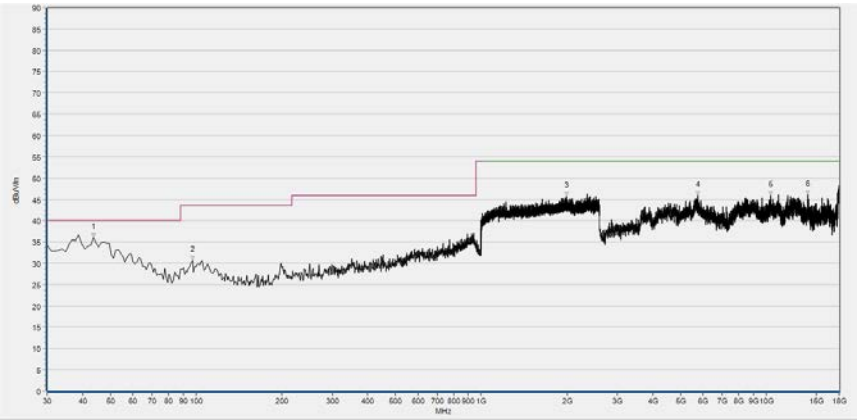
802.11b Test mode

Plot 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
48.430	27.78	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
200.720	30.11	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2385.600	46.79	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4823.760	47.54	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7047.520	45.09	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8895.520	46.37	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

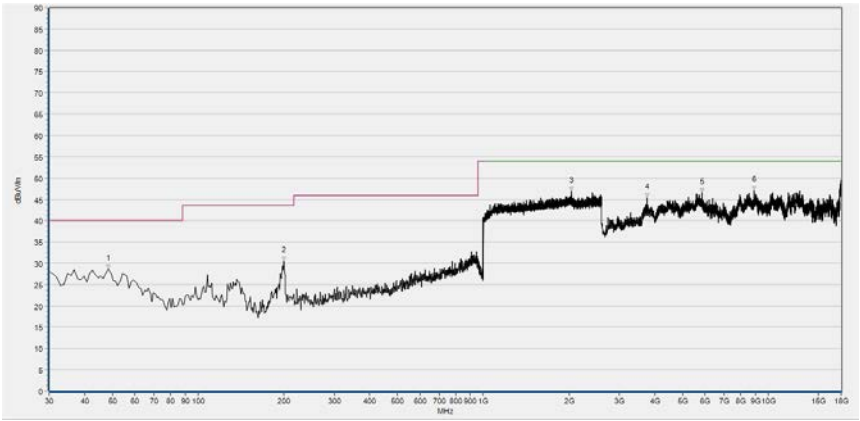
(Antenna Horizontal, 30MHz to 18GHz)



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
43.580	35.99	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
96.930	30.73	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1986.667	45.69	N/A	N/A	74.00	N/A	54.00	Vertical	PA□S
5750.840	45.99	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10377.000	45.95	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
14008.320	46.04	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

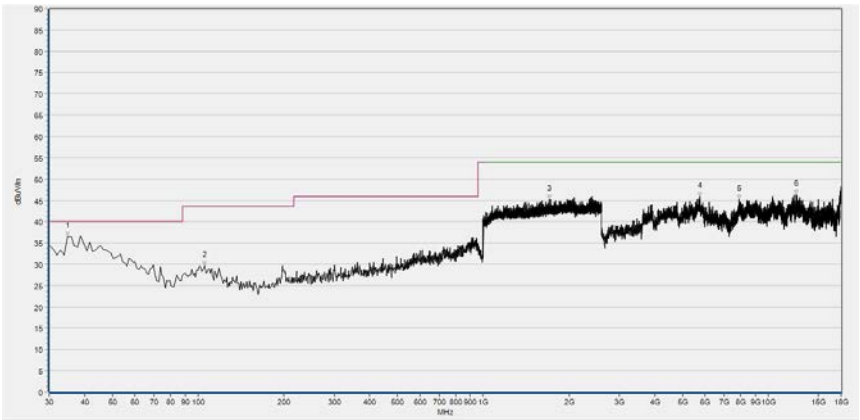
(Antenna Vertical, 30MHz to 18GHz)

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
48.430	28.72	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
199.750	30.50	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2035.733	46.99	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
3758.080	45.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5846.320	46.58	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8923.240	47.14	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

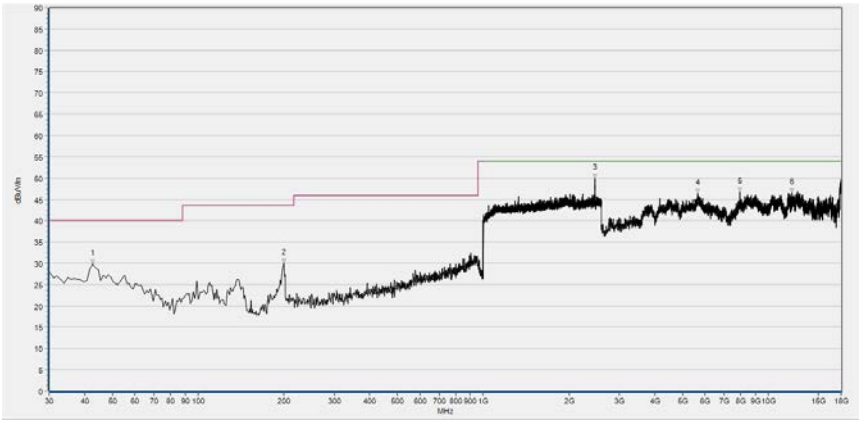
(Antenna Horizontal, 30MHz to18GHz)



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
34.850	36.47	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
105.660	29.62	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1704.533	45.21	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5741.600	45.93	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
7897.600	45.17	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12489.880	46.45	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

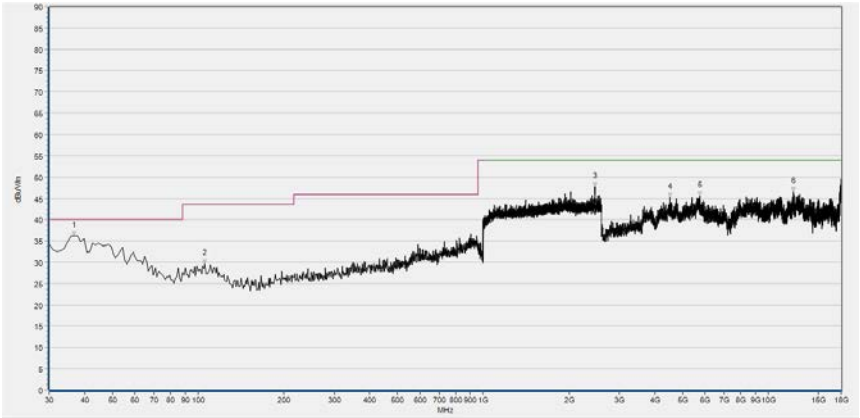
(Antenna Vertical, 30MHz to 18GHz)

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
42.610	29.88	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
199.750	29.97	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2464.000	49.93	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5664.600	46.39	N/A	N/A	74.00	N/A	54.00	Ho□izontal	PASS
7959.200	46.68	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12074.080	46.64	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)

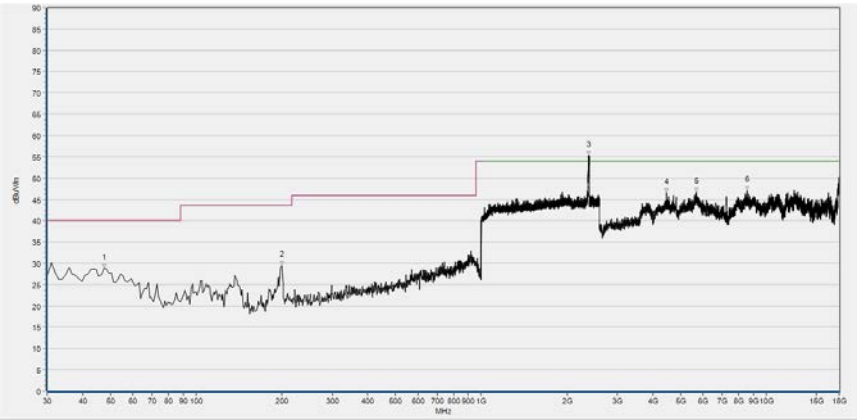


Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
36.790	36.13	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
105.660	29.60	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2464.533	47.68	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4521.920	45.21	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5735.440	45.58	□/A	N/A	74.00	N/A	54.00	Vertical	PASS
12203.440	46.61	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)

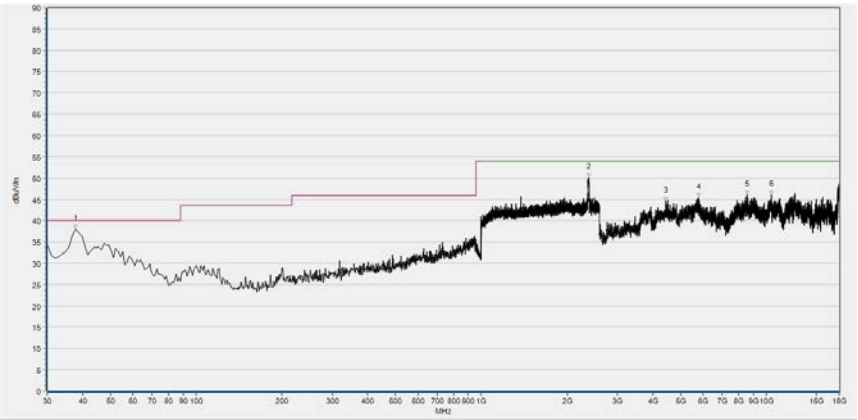
802.11g Test mode

Plot 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
47.460	28.83	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
199.750	29.49	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2384.300	56.43	N/A	42.30	74.00	N/A	54.00	Horizontal	PASS
4463.400	46.61	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5683.080	46.68	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8578.280	47.08	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

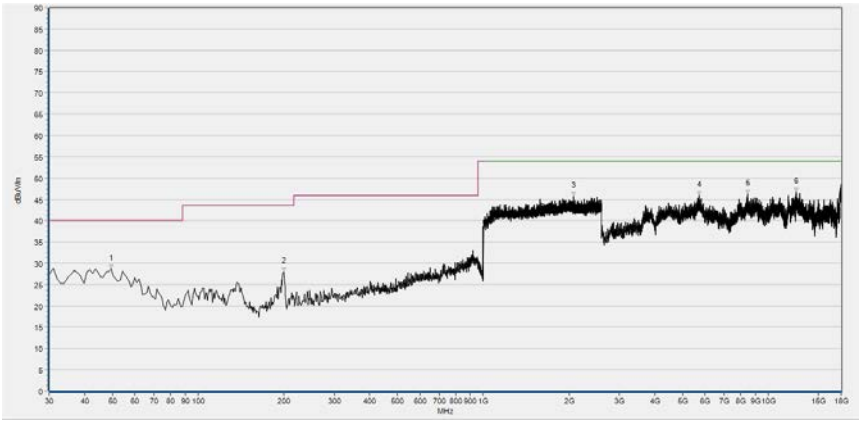
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	A□tenna	Verdict
37.760	37.09	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
2375.467	50.15	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4435.680	44.65	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5775.480	45.38	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8581.360	46.01	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10401.640	46.10	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

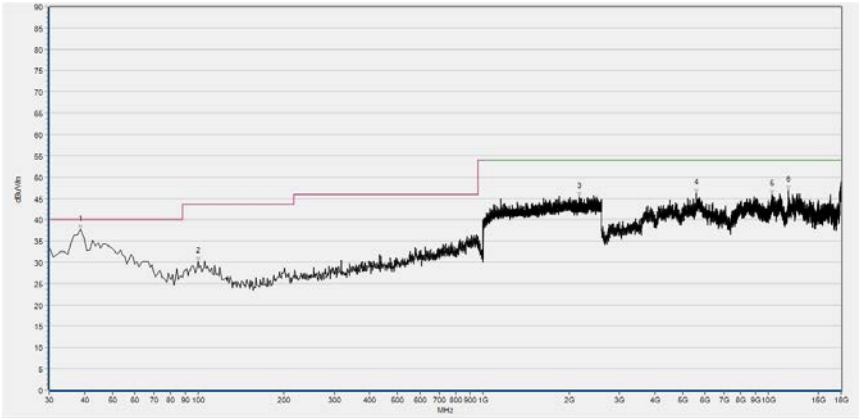
(Antenna Vertical, 30MHz to 18GHz)

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
49.400	28.61	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
199.750	28.01	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2073.067	45.77	N/A	N/A	74.00	N/A	54.00	Horizon□al	PASS
5723.120	45.88	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8448.920	46.18	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12520.680	46.84	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

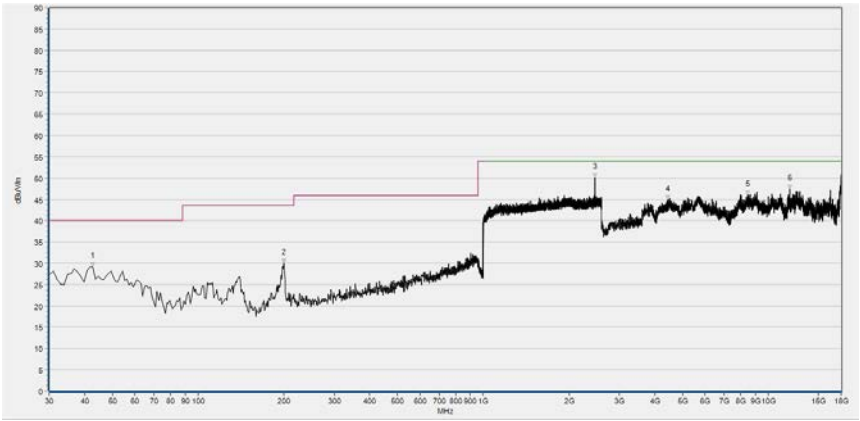
(Antenna Horizontal, 30MHz to 18GHz)



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
38.730	36.97	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
99.840	30.18	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2173.333	45.48	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5590.680	46.19	N/	N/A	74.00	N/A	54.00	Vertical	PASS
10318.480	45.99	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
11735.280	46.90	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

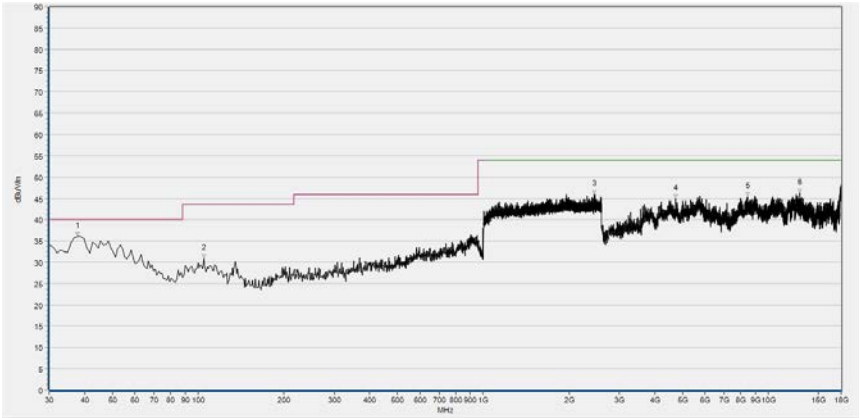
(Antenna Vertical, 30MHz to 18GHz)

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
42.610	29.14	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
199.750	30.06	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2464.533	50.17	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4432.600	44.87	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8470.480	46.12	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
11870.800	47.42	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)

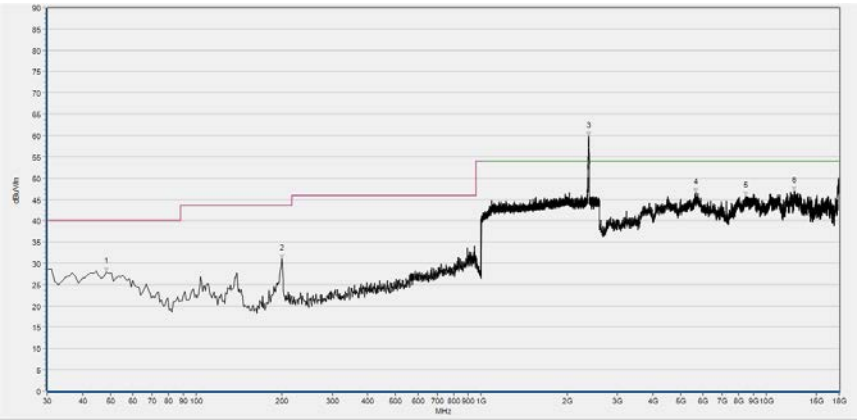


Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
37.760	36.04	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
104.690	30.85	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2452.800	45.95	N/A	N/A	74.00	N/A	54.00	Vertica	PASS
4728.280	44.84	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8476.640	45.44	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12890.280	46.20	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)

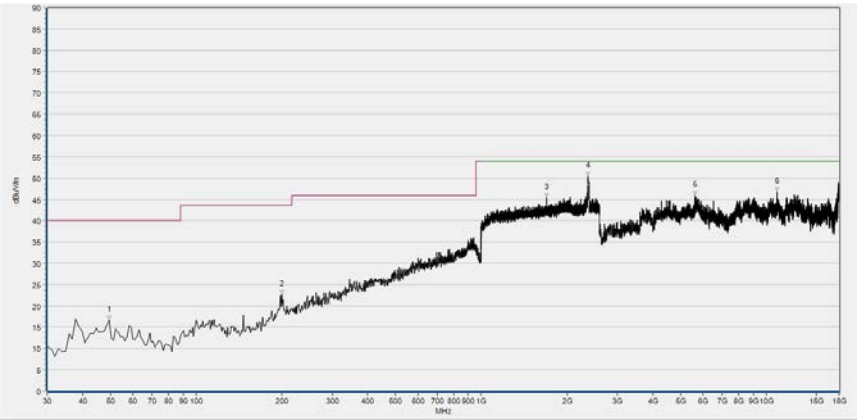
802.11n(HT20) Test mode

Plot 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
48.430	28.05	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
199.750	31.04	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2384.500	61.61	N/A	43.84	74.00	N/A	54.00	Horizontal	PASS
5639.960	46.55	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8470.480	45.81	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12499.120	46.98	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

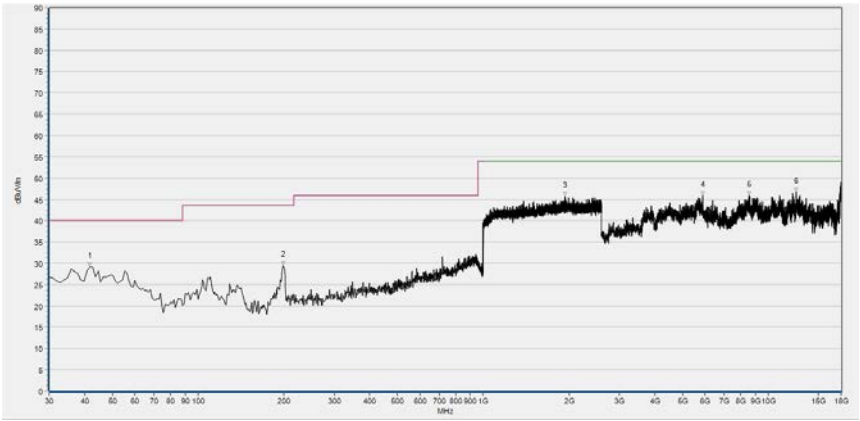
(Antenna Horizontal, 30MHz to 18GHz)



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
49.400	16.55	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
199.750	22.70	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1691.733	45.49	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2370.133	50.49	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5633.800	45.89	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10912.920	46.68	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

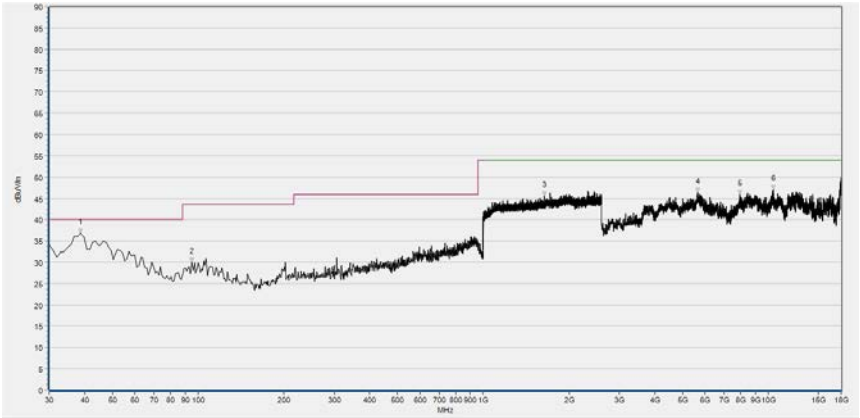
(Antenna Vertical, 30MHz to 18GHz)

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
41.640	29.19	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
198.780	29.44	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1940.267	45.72	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5886.360	45.97	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8562.880	45.99	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12496.040	46.75	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

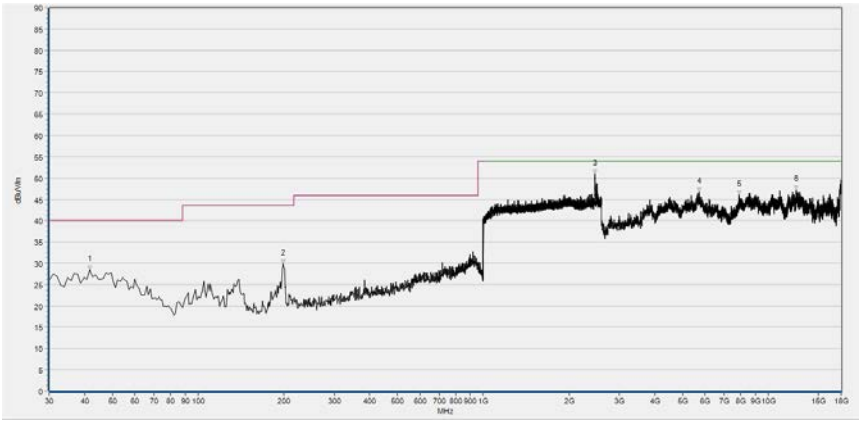
(Antenna Horizontal, 30MHz to 18GHz)



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
38.730	36.91	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
94.990	30.02	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1641.600	45.65	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5649.200	46.41	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
7934.560	45.84	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
10435.520	47.10	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

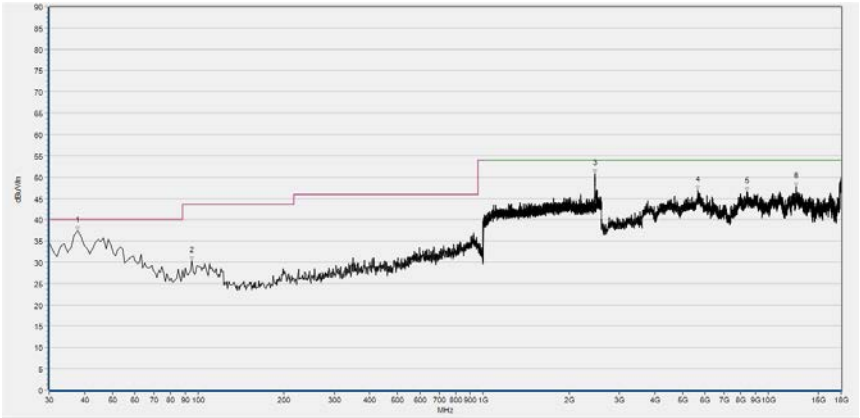
(Antenna Vertical, 30MHz to 18GHz)

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
41.640	28.44	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
198.780	29.83	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2464.000	50.32	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5704.640	46.68	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7894.520	46.13	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
12483.720	47.21	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)



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
37.760	36.42	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
94.990	30.32	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2464.000	50.75	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5667.680	46.89	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8421.200	46.52	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12545.320	47.79	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)

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	±2.77dB
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

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 C63.10-2013and 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	Due Date
Attenuator 1	(N/A.)	10dB	Resent	N/A	N/A
EXA Signal Analyzer	MY53470836	N9010A	Agilent	2020.04.01	2021.03.31
USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2020.04.01	2021.03.31
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	Due Date
Receiver	MY56400093	N9038A	KEYSIGHT	2020.03.26	2021.03.25
LISN	8127449	NSLK 8127	Schwarzbeck	2020.03.26	2021.03.25
Pulse Limiter (10dB)	VTSD 9561 F-B #206	VTSD 9561-F	Schwarzbeck	2020.07.24	2021.07.23
Coaxial cable(BNC) (30MHz-26GHz)	CB01	EMC01	Morlab	N/A	N/A
Adapter	NA	HA-190501 00UU	HONGGUAN GDE	N/A	N/A

4.3 List of Software Used

Description	Manufacturer	Software Version
Test system	Townsend	V2.6
Power Panel	Agilent	V3.8
MORLAB EMCR V1.2	MORLAB	V1.0

4.4Radiated Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY54130016	N9038A	Agilent	2020.07.21	2021.07.20
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2019.05.24	2022.05.23
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2019.02.14	2022.02.13
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2019.05.24	2022.05.23
Test Antenna – Horn	BBHA9170 #774	BBHA9170	Schwarzbeck	2019.05.24	2022.05.23
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	61171/61172	S020180L3203	Tonscend	2020.07.21	2021.07.20
18-26.5GHz pre-Amplifier	46732	S10M100L3802	Tonscend	2020.07.21	2021.07.20
26-40GHz pre-Amplifier	56774	S40M400L4002	Tonscend	2020.07.21	2021.07.20
Notch Filter	N/A	WRCG-2400-2483.5-60SS	Wainwright	2020.07.21	2021.07.20
Anechoic Chamber	N/A	9m*6m*6m	CRT	2020.01.06	2023.01.05

END OF REPORT