



# TEST REPORT

**APPLICANT** : Anker Innovations Limited

**PRODUCT NAME** : Nebula Mars II Pro

**MODEL NAME** : D2323

**BRAND NAME** : Nebula

**FCC ID** : 2AOKB-D2323

**STANDARD(S)** : 47 CFR Part 15 Subpart E

**RECEIPT DATE** : 2019-05-27

**TEST DATE** : 2019-05-29 to 2019-06-17

**ISSUE DATE** : 2019-06-18

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<b>Change History</b>		
<b>Version</b>	<b>Date</b>	<b>Reason for change</b>
1.0	2019-06-18	First edition



# 1. Technical Information

**Note:** Provide by applicant.

## 1.1. Applicant and Manufacturer Information

<b>Applicant:</b>	Anker Innovations Limited
<b>Applicant Address:</b>	Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong
<b>Manufacturer:</b>	Anker Innovations Limited
<b>Manufacturer Address:</b>	Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong

## 1.2. Equipment Under Test (EUT) Description

<b>Product Name:</b>	Nebula Mars II Pro	
<b>Serial No:</b>	(N/A, marked #1 by test site)	
<b>Hardware Version:</b>	P2_PRO-Main_V0.2	
<b>Software Version:</b>	NBUI_P2_V3.0.3	
<b>Modulation Type:</b>	OFDM	
<b>Modulation Mode:</b>	802.11a, 802.11n(HT20), 802.11n(HT40)	
<b>Operating Frequency Range:</b>	5.180 GHz- 5.240 GHz; 5.745GHz- 5.825GHz	
<b>Channel Number:</b>	Refer to 1.3	
<b>Antenna Type:</b>	Monopole Antenna	
<b>Antenna Gain:</b>	0 dBi	
<b>Accessory Information:</b>	Battery	
	<b>Brand Name:</b>	N/A
	<b>Model No.:</b>	BT-H003
	<b>Serial No.:</b>	(N/A, marked #1 by test site)
	<b>Capacity:</b>	3350mAh
	<b>Rated Voltage:</b>	14.52V
	<b>Charge Limit:</b>	16.80 V



<b>Accessory Information:</b>	AC Adapter	
	Brand Name:	N/A
	Model No.:	NSA60ED-190300
	Serial No.:	(N/A, marked #1 by test site)
	Rated Output:	19V=3A
	Rated Input:	100-240V ~ 50/60Hz 1.5A

**Note 1:** WIFI hotspot does not support U-NII band.

**Note 2:** During test, the duty cycle of the EUT was setting to 100%.

**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 of EUT

<b>Frequency Range: 5180MHz-5240MHz</b>				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	<b>36</b>	<b>5180</b>	40	5200
	<b>44</b>	<b>5220</b>	<b>48</b>	<b>5240</b>
40MHz	<b>38</b>	<b>5190</b>	<b>46</b>	<b>5230</b>
<b>Frequency Range: 5745-5825MHz</b>				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	<b>149</b>	<b>5745</b>	153	5765
	<b>157</b>	<b>5785</b>	161	5805
	<b>165</b>	<b>5825</b>		
40MHz	<b>151</b>	<b>5775</b>	<b>159</b>	<b>5795</b>

**Note 1:** The black bold channels were selected for test.



## 1.4. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart E (U-NII band) for the EUT FCC ID Certification:

No	Identity	Document Title
1	47 CFR Part 15 (5-1-14 Edition)	Radio Frequency Devices

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

No.	Section	Description	Test Date	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	PASS
2	ANSI C63.10	Duty Cycle of the test signal	May 29, 2019	Wang Meng	PASS
3	15.407(a)	Maximum conducted output Power	May 29, 2019	Wang Meng	PASS
4	15.407(a) (e)	Emission Bandwidth	May 29, 2019	Wang Meng	PASS
5	15.407(a)	Peak Power spectral density	May 29, 2019	Wang Meng	PASS
6	15.407(g)	Frequency Stability	May 29, 2019	Wang Meng	PASS
7	15.207	Conducted Emission	May 31, 2019	Wu Zhongwen	PASS
8	15.407(b)	Restricted Frequency Bands	Jun 15, 2019	Wu Zhongwen	PASS
9	15.407(b)	Radiated Emission	Jun 17, 2019	Wu Zhongwen	PASS

**Note1:** The DFS test report was documented in a separate report (Report No.: SZ19050237W05).

**Note2:** The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

**Note3:** These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 General UNII Test Procedures New Rules v01r03.

**Note4:** The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The ref offset 12dB contains two parts that cable loss 2.0dB 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 15E 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. 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 the test signal

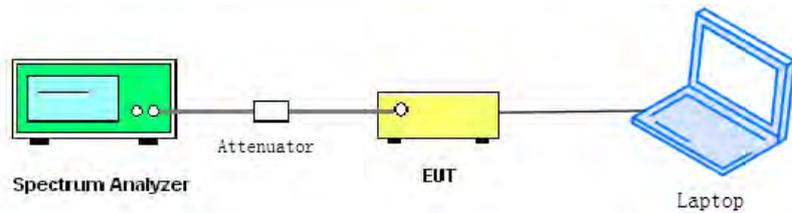
#### 2.2.1. Requirement

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:



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.

### B. Test Procedure

KDB 789033 Section B was used in order to prove compliance.

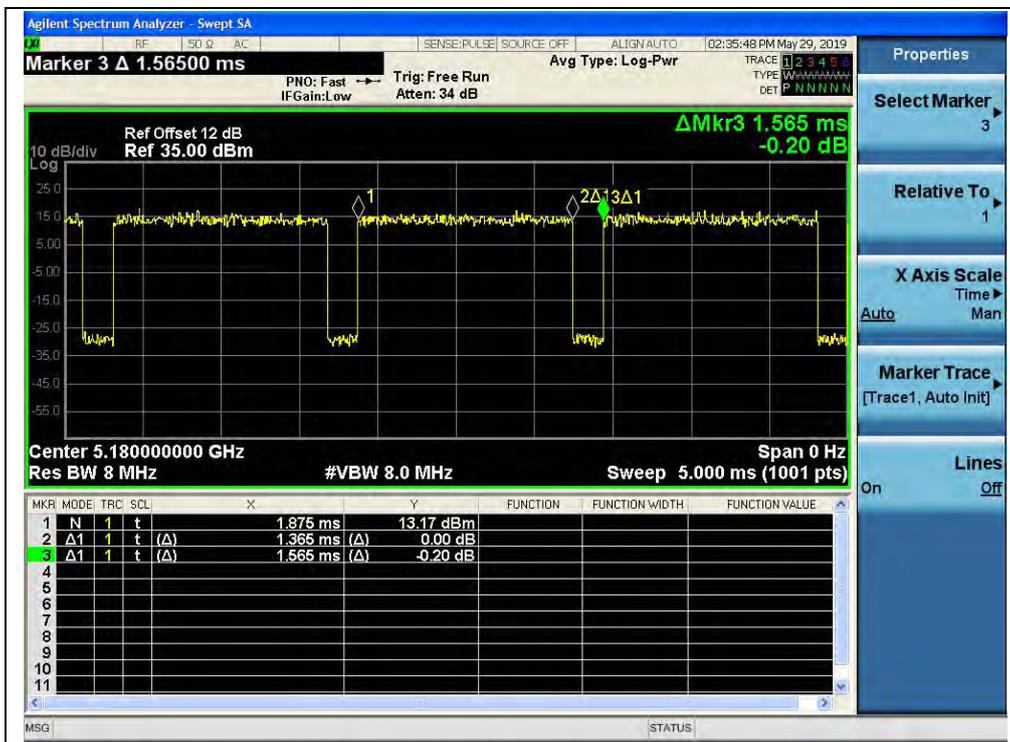


2.2.3. Test Result

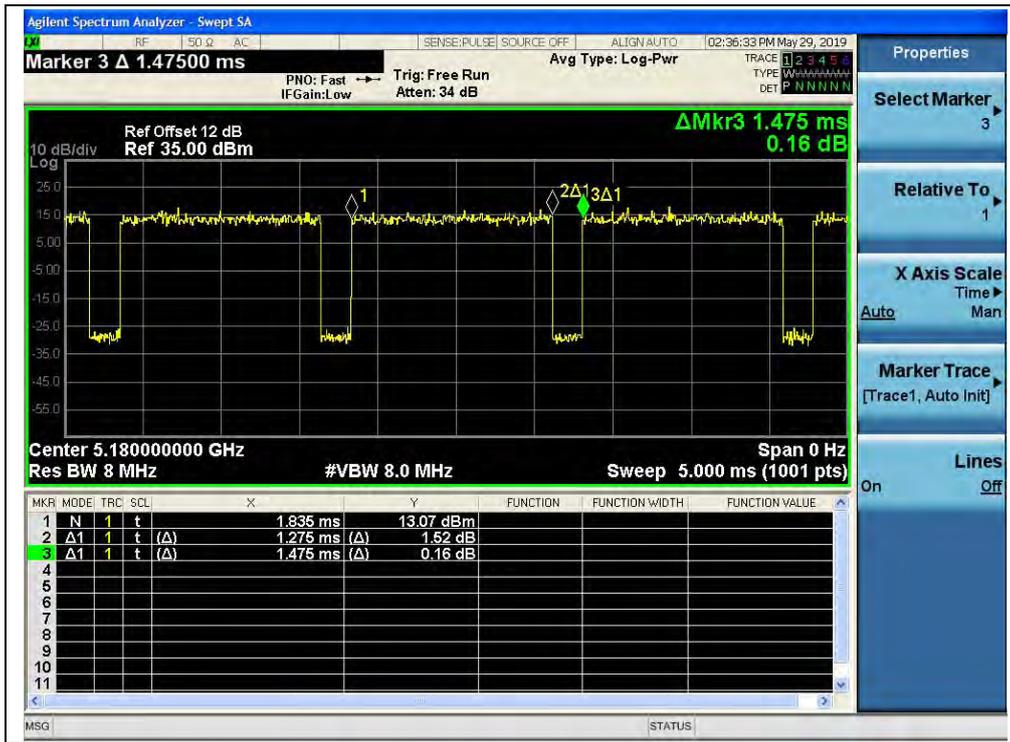
A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor (10*log[1/D])
802.11a	87.22	0.59
802.11n(HT20)	86.44	0.63
802.11n(HT40)	76.26	1.18

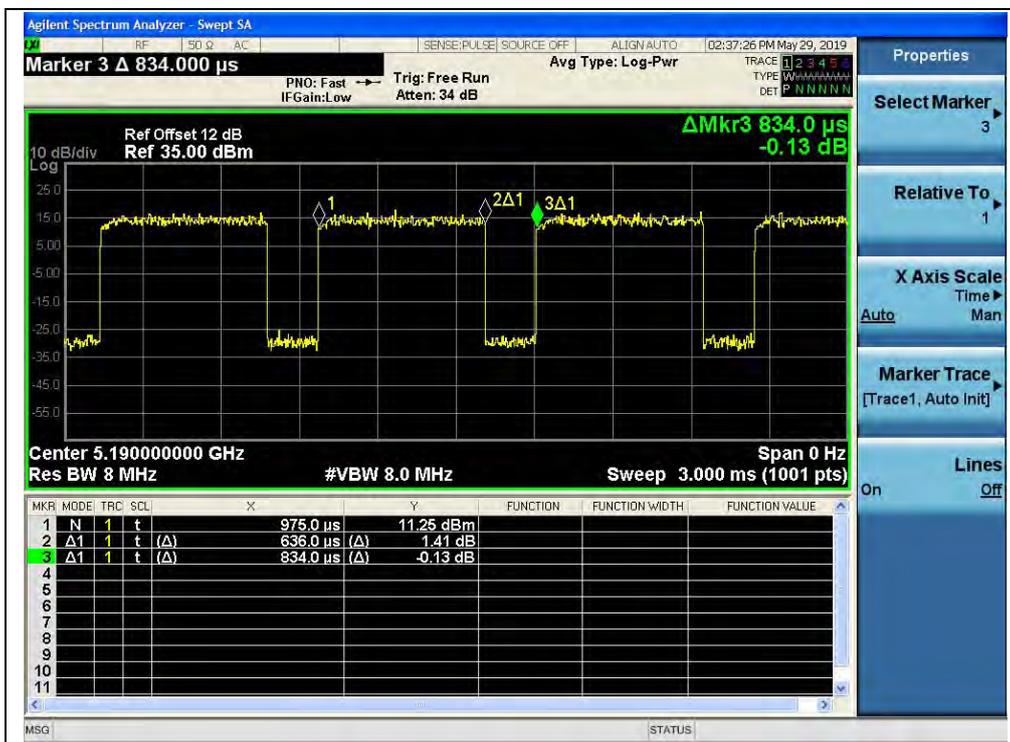
B. Test Plots



(CH36\_5180MHz\_802.11a)



(CH36\_5180MHz\_802.11n(HT20))



(CH38\_5190MHz\_802.11n(HT40))

## 2.3. Maximum conducted output power

### 2.3.1. Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

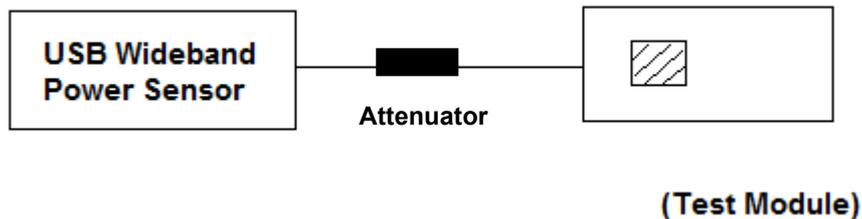
(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.

(5) According to KDB 662911 D01, the directional gain =  $G_{\text{ANT}} + 10 \log(N_{\text{ANT}})$  dBi, where  $G_{\text{ANT}}$  is the antenna gain in dBi,  $N_{\text{ANT}}$  is the number of outputs.

### 2.3.2. Test Description

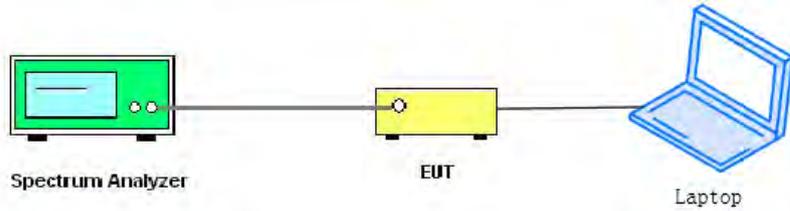
Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor.

#### 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, all test result in USB Wideband Power Sensor.

**For ac (VHT80) mode power**



The EUT (Equipment under the test) 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, all test result in Spectrum analyzer.

**2.3.3. Test Result**

**802.11a Test mode**

Channel	Frequency (MHz)	Measured Peak Power		Limit (dBm)		Verdict	
		dBm	W	dBm	W		
36	5180	20.92	0.124	24	0.25	PASS	
44	5220	21.08	0.128				
48	5240	21.29	0.135				
149	5745	22.60	0.182	30	1		
157	5785	22.50	0.178				
165	5825	22.09	0.162				
Channel	Frequency (MHz)	Average Power (dBm)			Limit (dBm)		Verdict
		Measured	Duty factor Calculated		dBm	W	
		dBm	dBm	W			
36	5180	10.62	11.21	0.013	24	0.25	PASS
44	5220	11.44	12.03	0.016			
48	5240	12.26	12.85	0.019			
149	5745	16.25	16.84	0.048	30	1	
157	5785	16.01	16.60	0.046			
165	5825	15.14	15.73	0.037			



**802.11n (HT20) Test mode**

Channel	Frequency (MHz)	Measured Peak Power		Limit (dBm)		Verdict	
		dBm	W	dBm	W		
36	5180	20.78	0.120	24	0.25	PASS	
44	5220	21.25	0.133				
48	5240	21.50	0.141				
149	5745	22.73	0.187	30	1		
157	5785	22.66	0.185				
165	5825	22.14	0.164				
Channel	Frequency (MHz)	Average Power (dBm)			Limit (dBm)		Verdict
		Measured	Duty factor Calculated		dBm	W	
		dBm	dBm	W			
36	5180	11.03	11.66	0.015	24	0.25	PASS
44	5220	11.82	12.45	0.018			
48	5240	12.79	13.42	0.022			
149	5745	16.78	17.41	0.055	30	1	
157	5785	16.46	17.09	0.051			
165	5825	15.41	16.04	0.040			

**802.11n (HT40) Test mode**

Channel	Frequency (MHz)	Measured Peak Power		Limit (dBm)		Verdict	
		dBm	W	dBm	W		
38	5190	21.74	0.149	24	0.25	PASS	
46	5230	22.04	0.160				
151	5755	22.93	0.196	30	1		
159	5795	22.67	0.185				
Channel	Frequency (MHz)	Average Power			Limit (dBm)		Verdict
		Measured	Duty factor Calculated		dBm	W	
		dBm	dBm	W			
38	5190	14.31	15.49	0.035	24	0.25	PASS
46	5230	15.43	16.61	0.046			
151	5755	16.38	17.56	0.057	30	1	
159	5795	16.01	17.19	0.052			

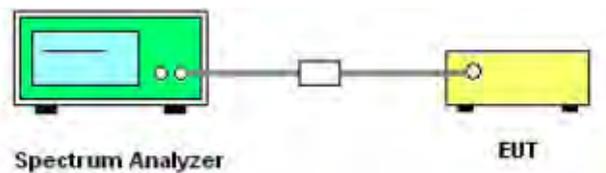
## 2.4. Emission Bandwidth

### 2.4.1. Requirement

For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement. Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

### 2.4.2. Test Description

#### A. Test Set:



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

#### B. Test Procedure

1. KDB 789033 Section C) 1) Emission Bandwidth was used in order to prove compliance

- a) Set RBW = approximately 1% of the emission bandwidth.
- b) Set the VBW > RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. KDB 789033 Section C) 2) minimum emission bandwidth for the band 5.725-5.85GHz was used in order to prove compliance.

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.



- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

**2.4.3. Test Result**

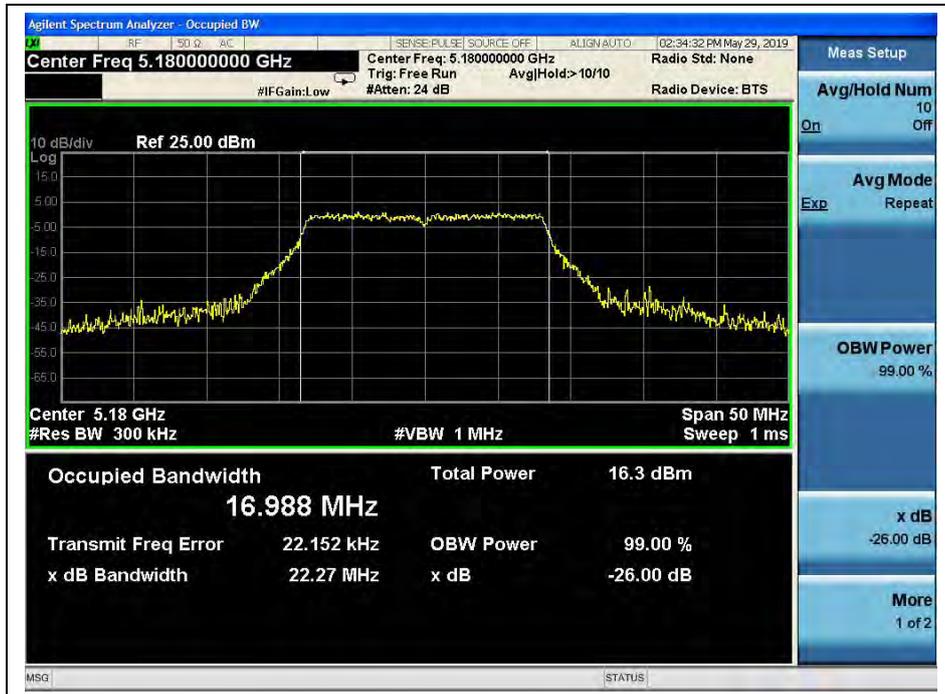
**802.11a Test mode**

**A. Test Verdict:**

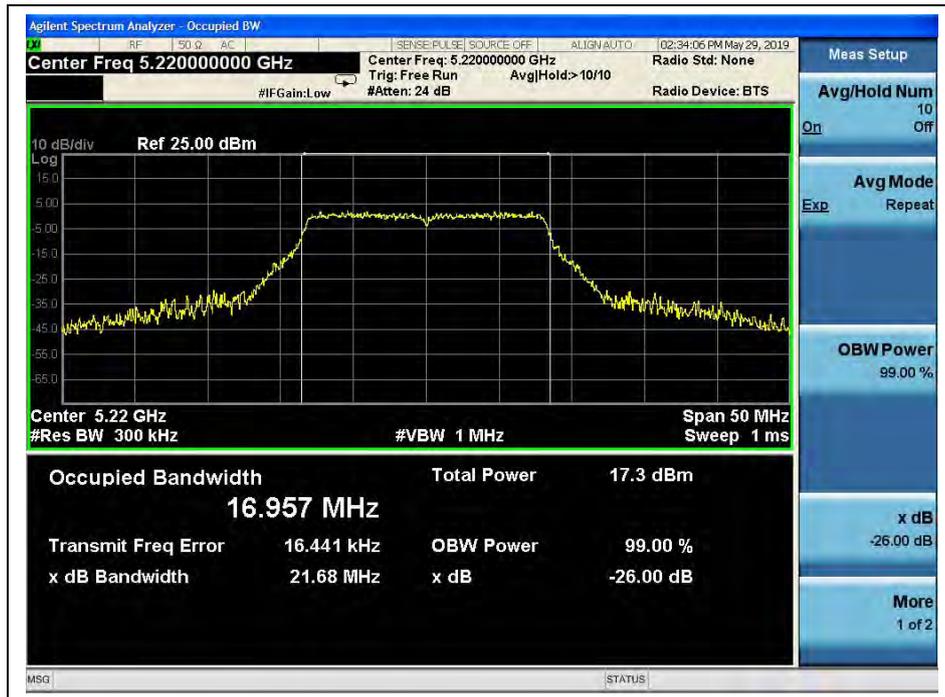
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	22.27
44	5220	21.68
48	5240	21.59 <sub>Note</sub>
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
149	5745	25.07
157	5785	21.36
165	5825	21.84

**Note:** The high frequency of the -26dB is 5251.36MHz which is in the DFS frequency range, so DFS testing is required. Please refer to DFS report (Report No.: SZ19050237W05).

**B. Test Plots**



(Channel 36, 5180MHz, 802.11a,)



(Channel 44, 5220 MHz, 802.11a,)



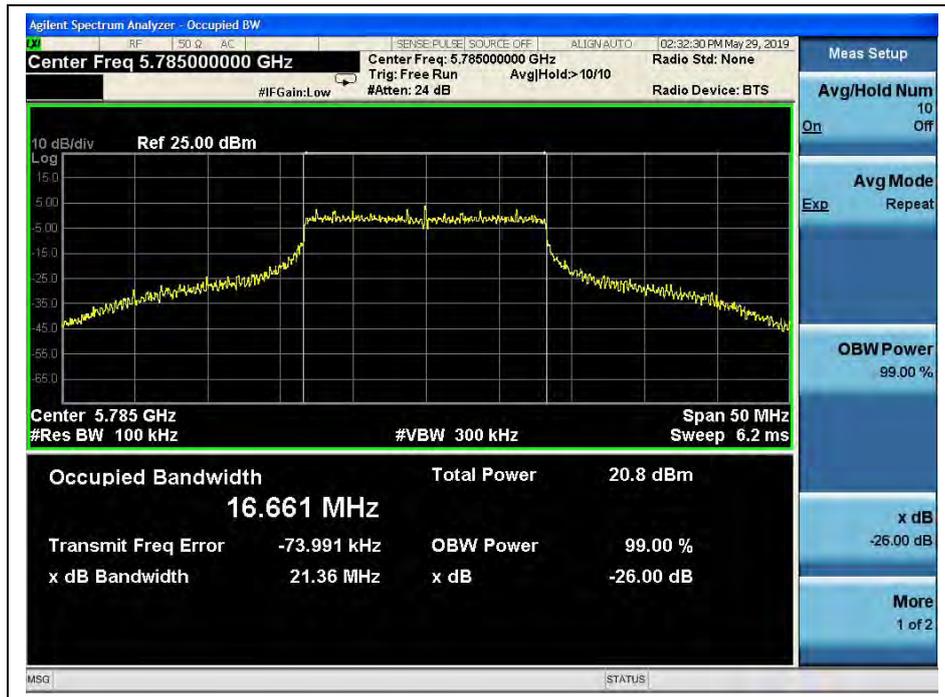
(Channel 48, 5240MHz, 802.11a,)



(Channel 48, 5240MHz, fh of -26dB, 802.11a,)



(Channel 149, 5745MHz, 802.11a)



(Channel 157, 5785MHz, 802.11a)



(Channel 165, 5825MHz, 802.11a)



802.11n (HT20) Test mode

A. Test Verdict:

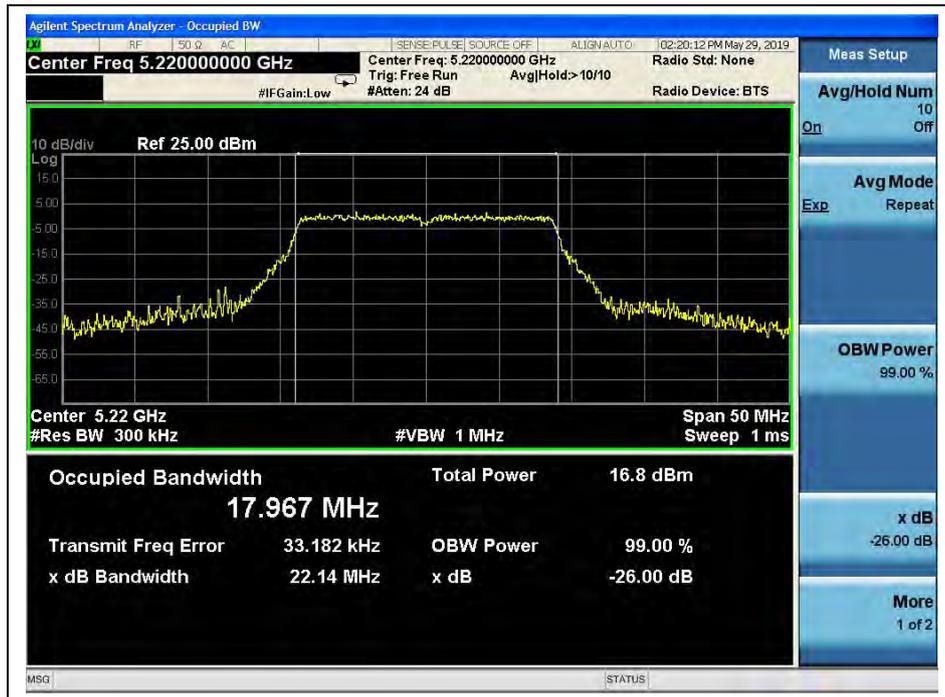
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	22.46
44	5220	22.14
48	5240	22.24 <sub>Note</sub>
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
149	5745	22.79
157	5785	21.74
165	5825	20.79

**Note:** The high frequency of the -26dB is 5251.52MHz which is in the DFS frequency range, so DFS testing is required. Please refer to DFS report (Report No.: SZ19050237W05).

B. Test Plots



(Channel 36, 5180MHz, 802.11 n (HT20))



(Channel 44, 5220 MHz, 802.11 n (HT20))



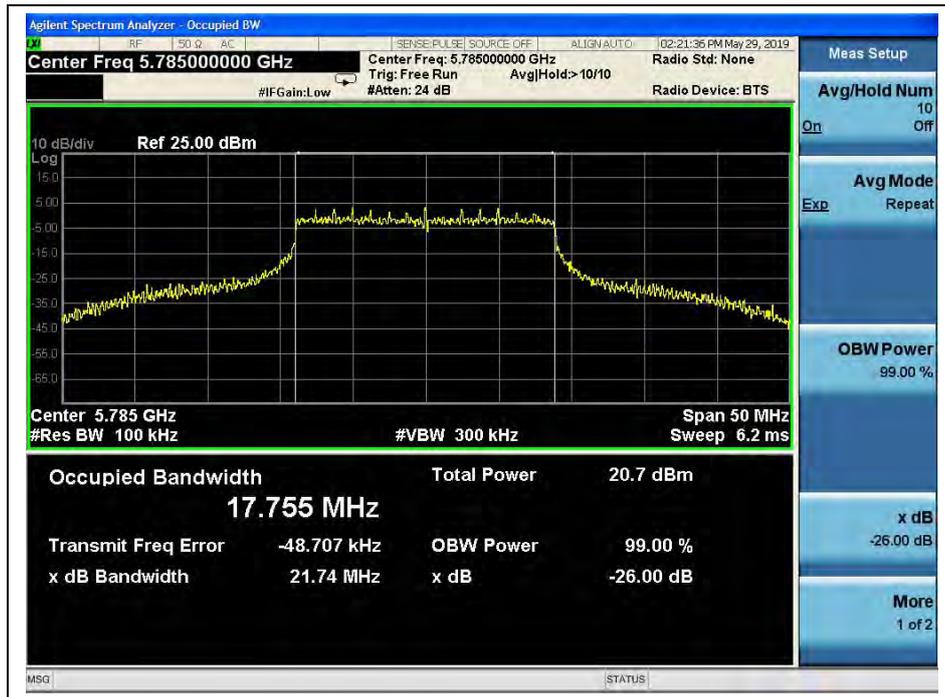
(Channel 48, 5240MHz, 802.11 n (HT20))



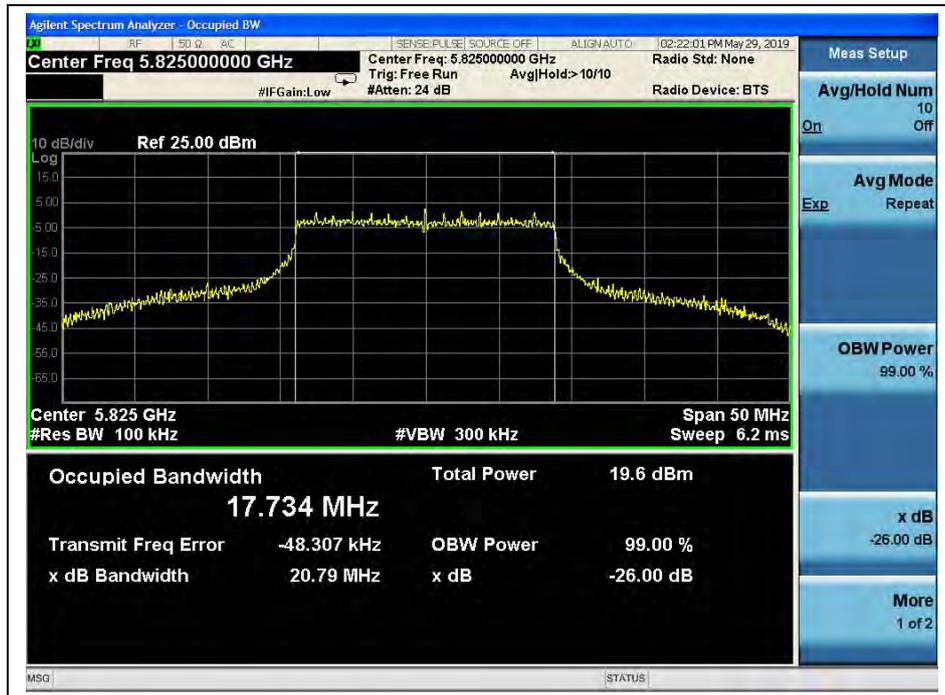
(Channel 48, 5240MHz, fh of -26dB, 802.11 n (HT20))



(Channel 149, 5745MHz, 802.11 n (HT20))



(Channel 157, 5785MHz, 802.11 n (HT20))



(Channel 165, 5825MHz, 802.11 n (HT20))



802.11n (HT40) Test mode

A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	60.11
46	5230	58.18 <small>Note</small>
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
151	5755	38.26
159	5795	38.31

**Note:** The high frequency of the -26dB is 5264.00MHz which is in the DFS frequency range, so DFS testing is required. Please refer to DFS report (Report No.: SZ19050237W05).

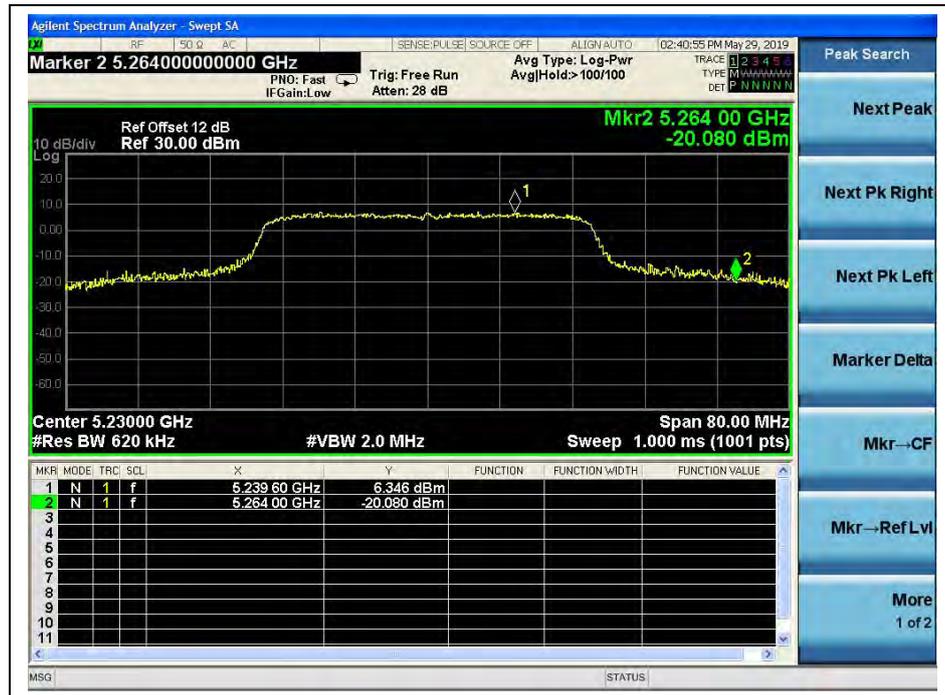
B. Test Plots



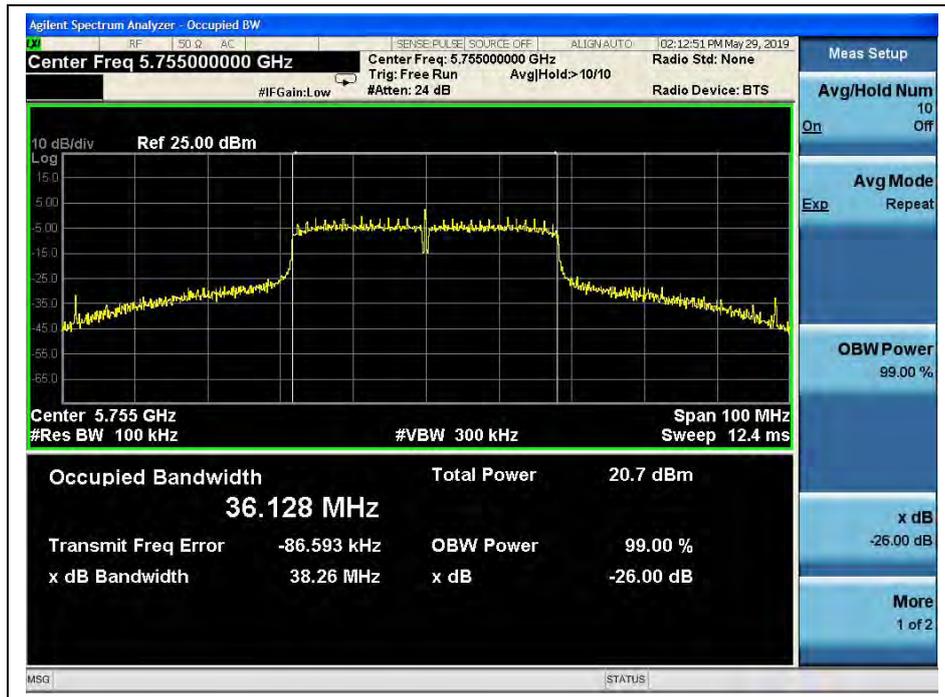
(Channel 38, 5190MHz, 802.11n (HT40))



(Channel 46, 5230 MHz, 802.11n (HT40))



(Channel 46, 5230 MHz, fh of -26dB, 802.11n (HT40))



(Channel 151, 5755 MHz, 802.11n (HT40))



(Channel 159, 5795MHz, 802.11n (HT40))

## 2.5. Peak Power spectral density

### 2.5.1. Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

(3) For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500KHz band.

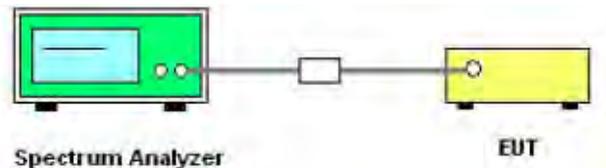
If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.

(5) According to KDB 662911 D01, the directional gain =  $G_{ANT} + 10\log(N_{ANT})$  dBi, where  $G_{ANT}$  is the antenna gain in dBi,  $N_{ANT}$  is the number of outputs.

### 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.

#### B. Test Procedure

KDB 789033 Section F) Maximum Power Spectral Density (PSD) Method SA-1 was used in order to prove compliance

- 1) Set span to encompass the entire 26-dB emission bandwidth
- 2) Set RBW = 1 MHz. Set VBW  $\geq$  3 MHz.
- 3) Number of points in sweep  $\geq$  2 Span / RBW. Sweep time = auto.
- 4) Detector = Peak
- 5) Trace mode=Max hold
- 6) Record the max value



2.5.3. Test Result

802.11a Test mode

A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
36	5180	9.58	11	PASS
44	5220	9.35		
48	5240	10.03		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
149	5745	11.64	30	PASS
157	5785	11.19		
165	5825	9.31		

B. Test Plots



(Channel 36, 5180MHz, 802.11a,)





(Channel 149, 5745MHz, 802.11a)



(Channel 157, 5785MHz, 802.11a)





**802.11n (HT20) Test mode**

**A. Test Verdict:**

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
36	5180	8.09	11	PASS
44	5220	9.72		
48	5240	10.04		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
149	5745	11.30	30	PASS
157	5785	10.14		
165	5825	9.80		

**B. Test Plots**



(Channel 36, 5180MHz, 802.11 n (HT20))



(Channel 44, 5220 MHz, 802.11 n (HT20))



(Channel 48, 5240MHz, 802.11 n (HT20))



(Channel 149, 5745MHz, 802.11 n (HT20))



(Channel 157, 5785MHz, 802.11 n (HT20))



(Channel 165, 5825MHz, 802.11 n (HT20))



**802.11n (HT40) Test mode**

**A. Test Verdict:**

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
38	5190	8.32	11	PASS
46	5230	9.61		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
151	5755	6.86	30	PASS
159	5795	6.80		

**B. Test Plots**



(Channel 38, 5190MHz, 802.11n (HT40))



(Channel 46, 5230 MHz, 802.11n (HT40))



(Channel 151, 5755 MHz, 802.11n (HT40))





## 2.6. Frequency Stability

### 2.6.1. Requirement

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

### 2.6.2. Test Procedure

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between 5°C to 40°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

### 2.6.3. Test Result

U-NII-1 (Ch. 36) 5180MHz				
VOLTAGE (%)	POWER (VDC)	TEMP (°C)	Freq Dev. (Hz)	Deviation (ppm)
100%	14.52	+20(Ref)	19	0.004
100%		-30	50	0.010
100%		-20	42	0.008
100%		-10	34	0.007
100%		0	27	0.005
100%		+10	25	0.005
100%		+20	24	0.005
100%		+30	33	0.006
100%		+40	44	0.008
100%		+50	48	0.009
85%		12.34	+20	51
115%	16.70	+20	40	0.008



<b>U-NII-3 (Ch. 149)</b>				
<b>5745MHz</b>				
<b>VOLTAGE (%)</b>	<b>POWER (VDC)</b>	<b>TEMP (°C)</b>	<b>Freq Dev. (Hz)</b>	<b>Deviation (ppm)</b>
100%	14.52	+20(Ref)	24	0.004
100%		-30	51	0.009
100%		-20	45	0.008
100%		-10	39	0.007
100%		0	30	0.005
100%		+10	25	0.004
100%		+20	31	0.005
100%		+30	26	0.005
100%		+40	38	0.007
100%		+50	43	0.007
85%	12.34	+20	50	0.009
115%	16.70	+20	39	0.007

## 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).

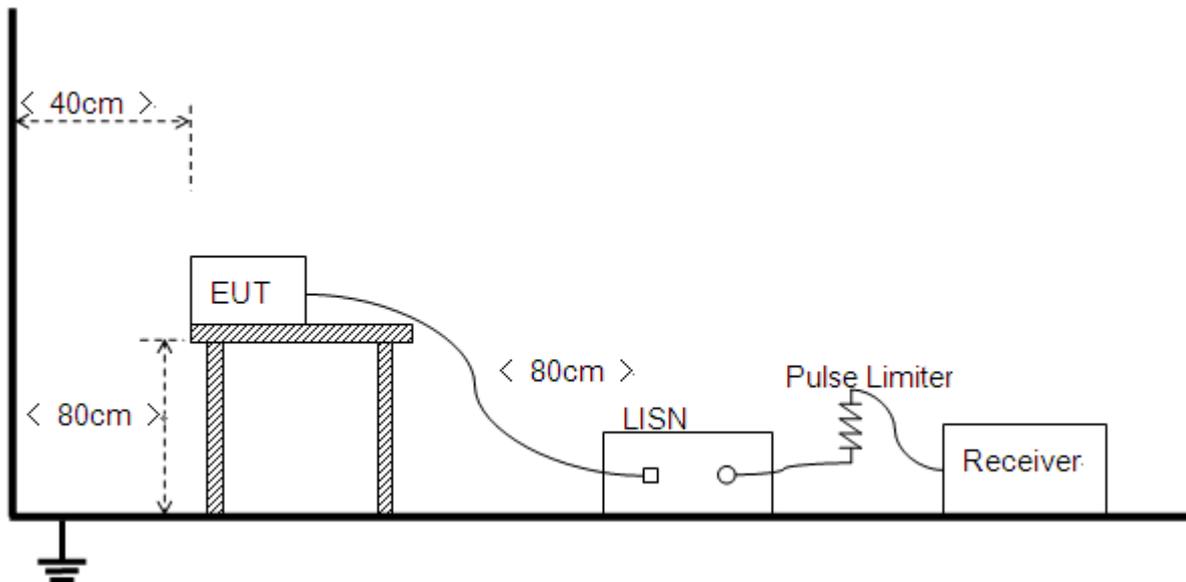
Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

**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+ ADAPTOR + WIFI TX

Test Voltage: AC 120V/60Hz

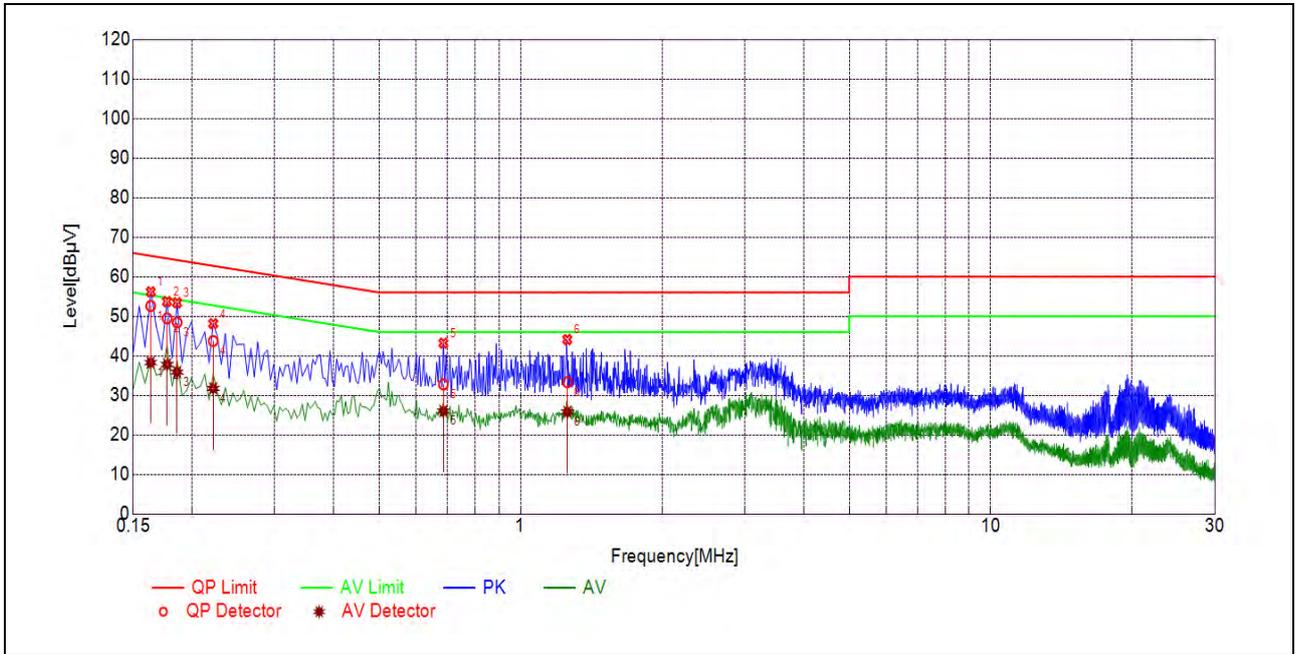
The measurement results are obtained as below:

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

$U_R$ : Receiver Reading

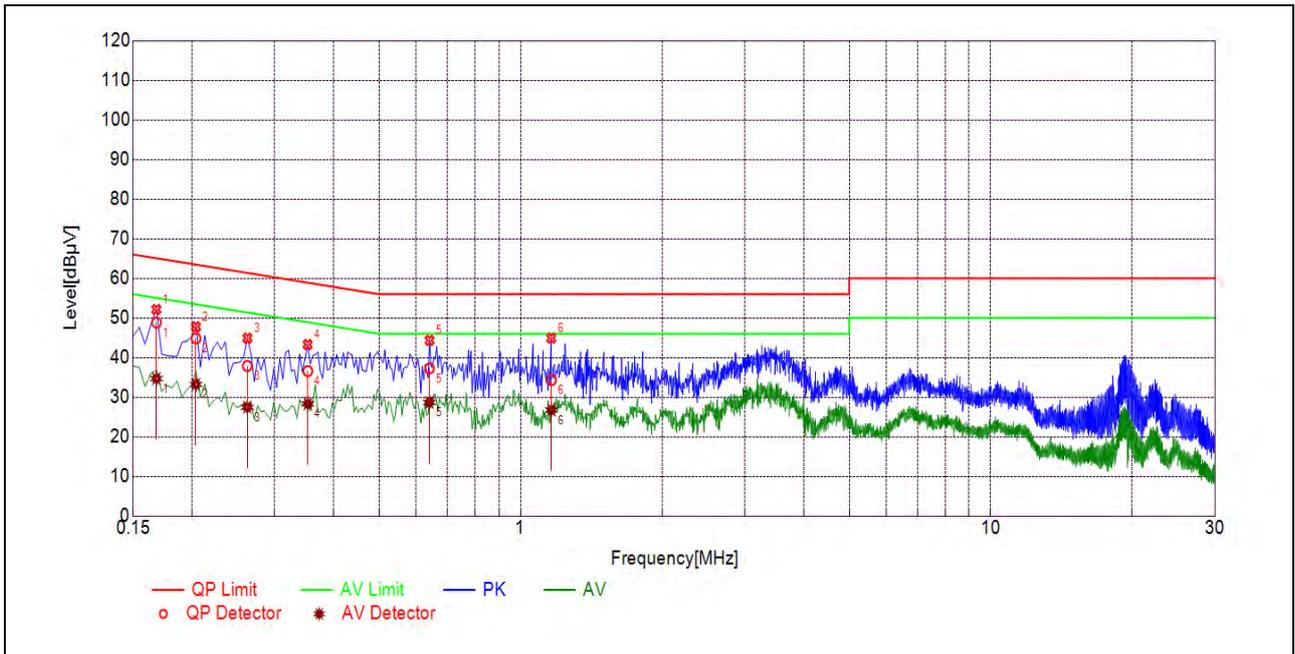
$A_{\text{Factor}}$ : Voltage division factor of LISN

**B. Test Plots:**



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1634	52.60	65.29	38.27	55.29	Line	PASS
2	0.1771	49.47	64.62	37.78	54.62		PASS
3	0.1860	48.43	64.21	35.89	54.21		PASS
4	0.2219	43.74	62.75	31.75	52.75		PASS
5	0.6853	32.75	56.00	26.03	46.00		PASS
6	1.2581	33.32	56.00	25.81	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	48.81	34.69	65.05	55.05	Neutral	PASS
2	0.2040	44.82	33.21	63.45	53.45		PASS
3	0.2623	37.88	27.48	61.36	51.36		PASS
4	0.3528	36.57	28.33	58.90	48.90		PASS
5	0.6401	37.25	28.68	56.00	46.00		PASS
6	1.1635	34.31	26.75	56.00	46.00		PASS

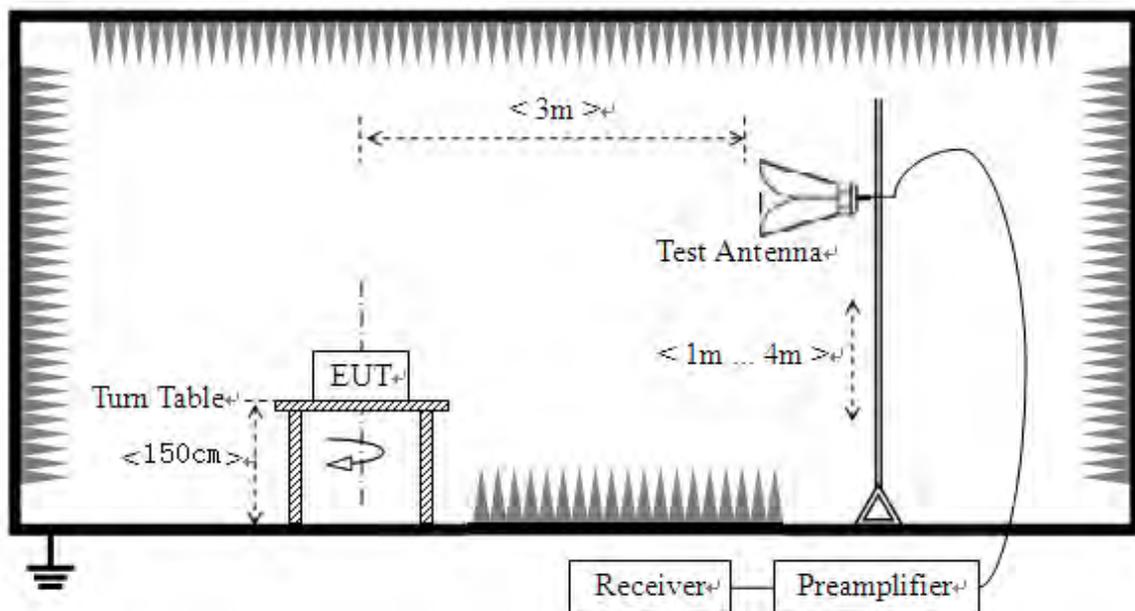
## 2.8. Restricted Frequency Bands

### 2.8.1. Requirement

According to FCC section 15.407(b)(7), 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 Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

KDB 789033 Section H) 3)5)6(d)) was used in order to prove compliance

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 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

$G_{\text{preamp}}$ : Preamplifier Gain;  $A_{\text{Factor}}$ : 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.

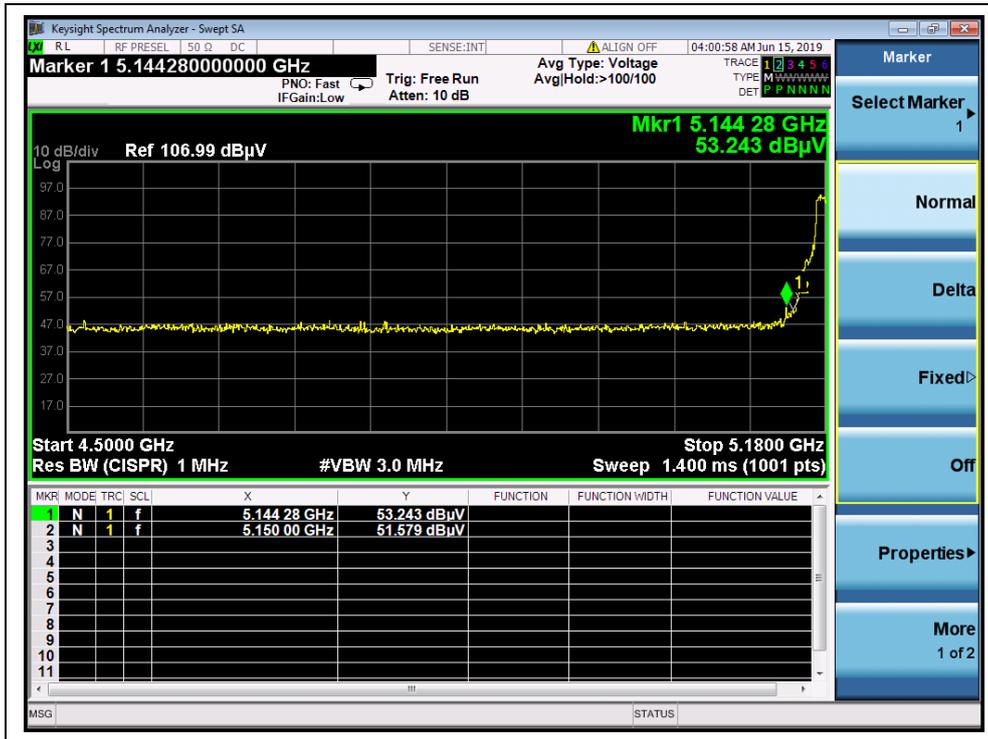
### 802.11a Test mode

#### A. Test Verdict:

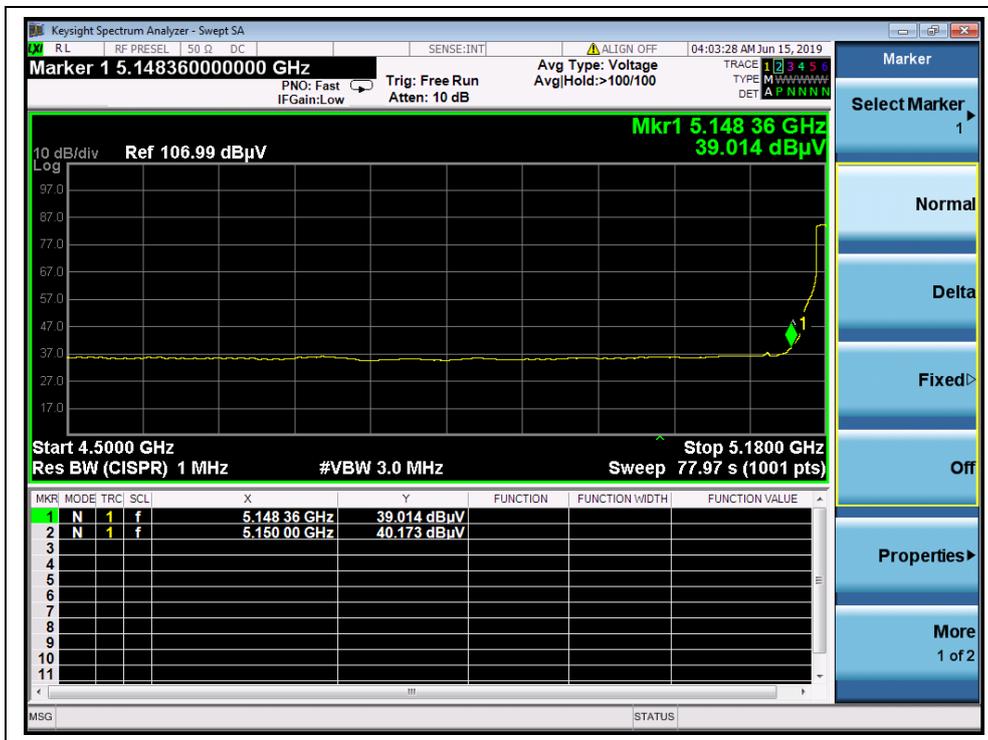
Channel	Frequency (MHz)	Detector	Receiver Reading	$A_T$ (dB)	$A_{\text{Factor}}$ (dB@3m)	Max. Emission E (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Verdict
		PK/ AV	$U_R$ (dB $\mu$ V)					
36	5144.28	PK	53.24	-26.92	32.20	58.52	74	PASS
36	5150.00	AV	40.17	-26.92	32.20	45.45	54	PASS
48	5422.92	PK	44.59	-26.92	32.20	49.87	74	PASS
48	5351.64	AV	33.94	-26.92	32.20	39.22	54	PASS
149	5723.06	PK	62.97	-26.23	32.20	68.94	117.81	PASS
149	5725.00	AV	49.57	-26.23	32.20	55.54	54	PASS
165	5852.58	PK	46.24	-26.23	32.20	52.21	116.35	PASS
165	5850.00	AV	38.42	-26.23	32.20	44.39	54	PASS



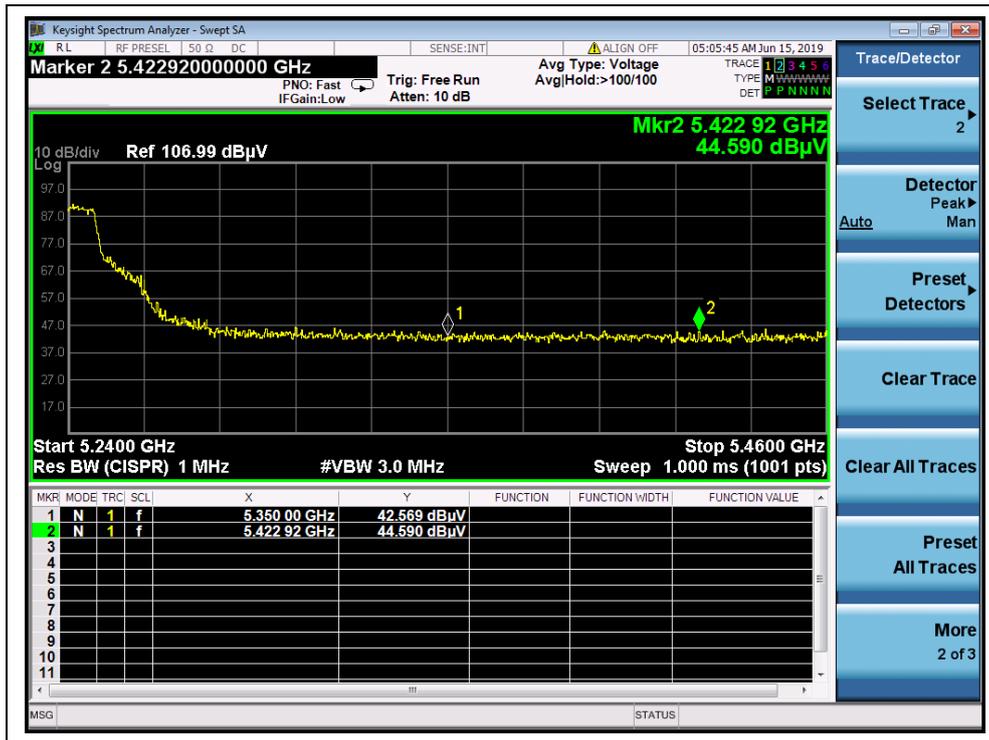
B. Test Plots:



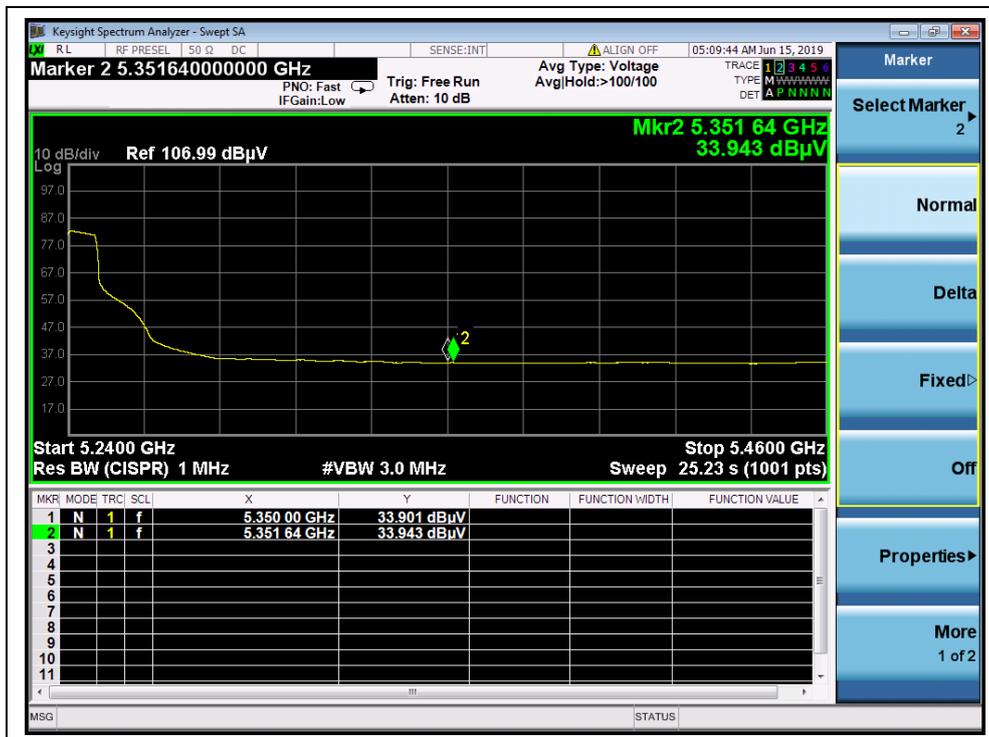
(Channel 36, PEAK, 802.11a)



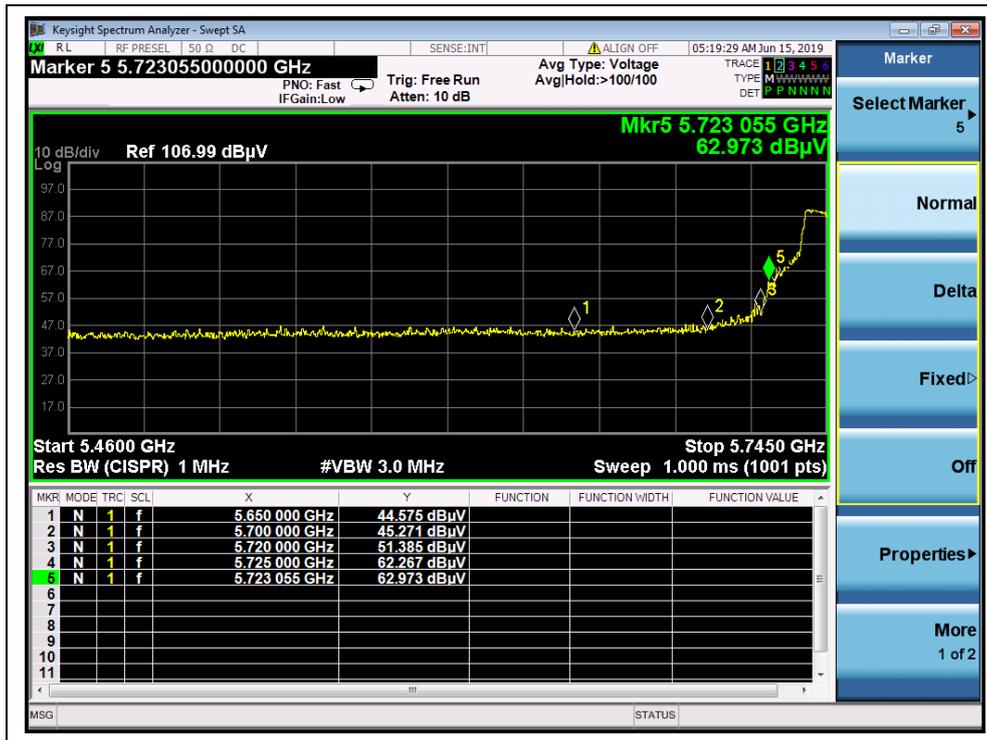
(Channel 36, AVG, 802.11a)



(Channel 48, PEAK, 802.11a)



(Channel 48, AVG, 802.11a)



(Channel 149, PEAK, 802.11a)



(Channel 149, AVG, 802.11a)



(Channel 165, PEAK, 802.11a)



(Channel 165, AVG, 802.11a)

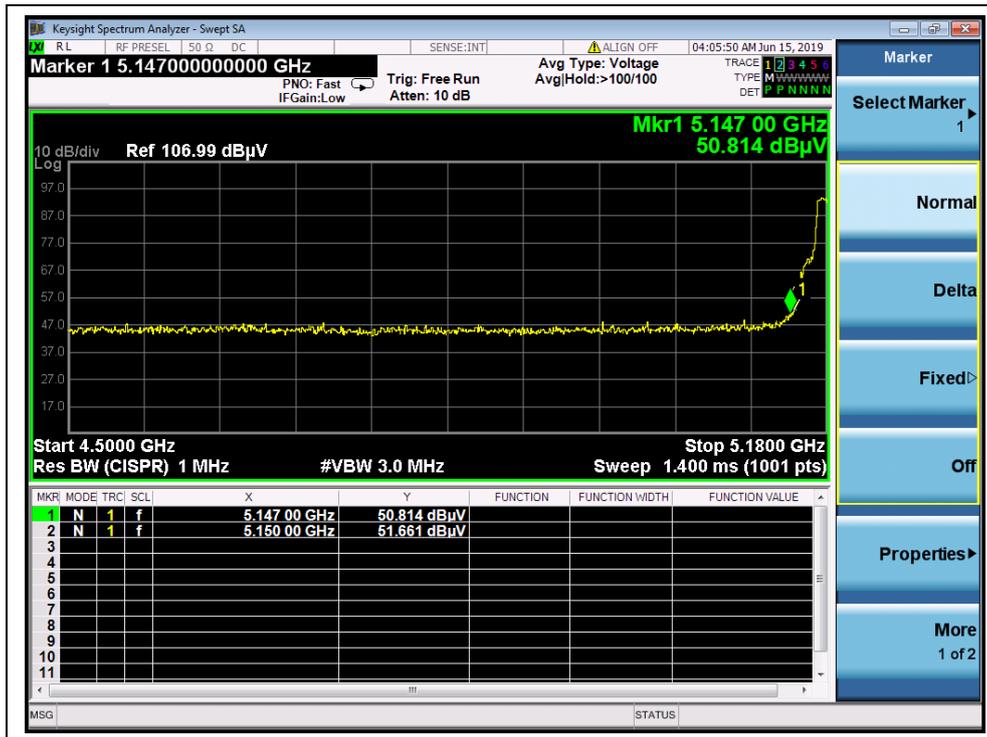


802.11n (HT20) Test mode

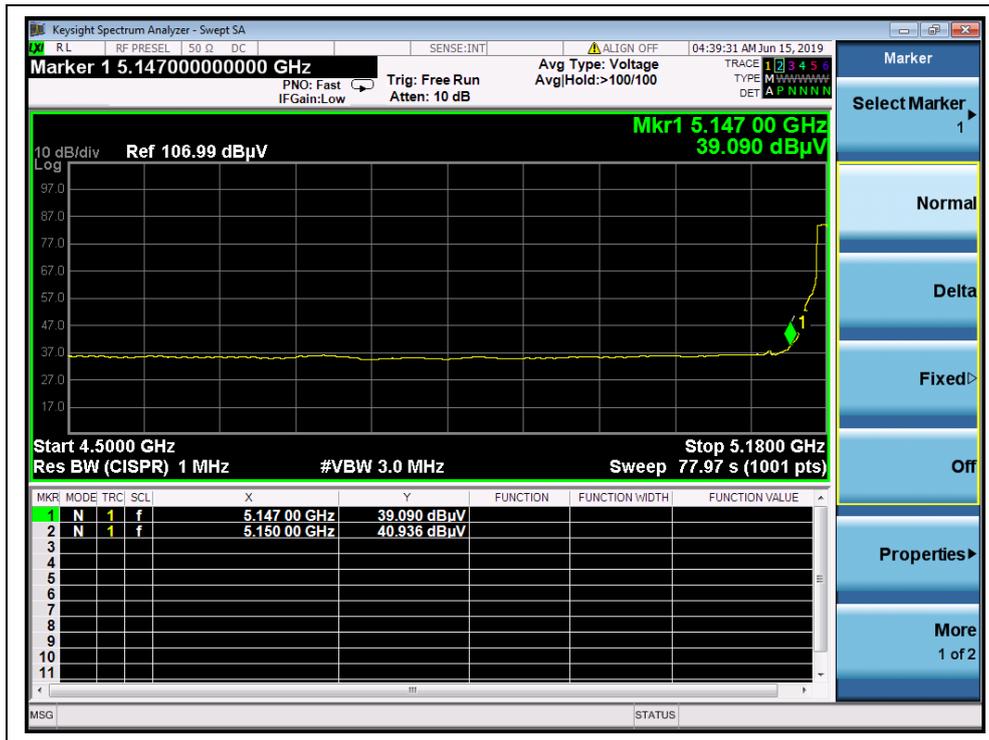
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading	$A_T$	$A_{Factor}$	Max. Emission	Limit	Verdict
		PK/ AV	$U_R$ (dBuV)	(dB)	(dB@3m)	E (dBμV/m)	(dBμV/m)	
36	5150.00	PK	51.66	-26.92	32.20	56.94	74	PASS
36	5150.00	AV	40.94	-26.92	32.20	46.22	54	PASS
48	5367.26	PK	44.80	-26.92	32.20	50.08	74	PASS
48	5350.00	AV	33.89	-26.92	32.20	39.17	54	PASS
149	5725.00	PK	62.77	-26.23	32.20	68.74	122.23	PASS
149	5725.00	AV	49.81	-26.23	32.20	55.78	54	PASS
165	5850.00	PK	47.57	-26.23	32.20	53.54	122.23	PASS
165	5850.00	AV	38.43	-26.23	32.20	44.40	54	PASS

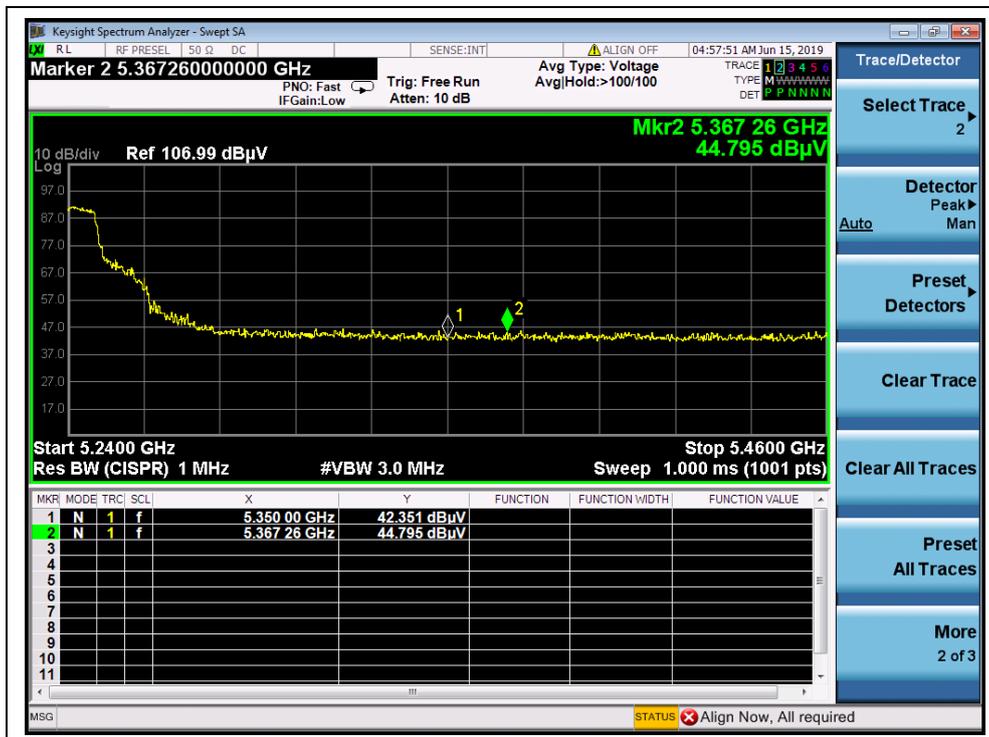
B. Test Plots:



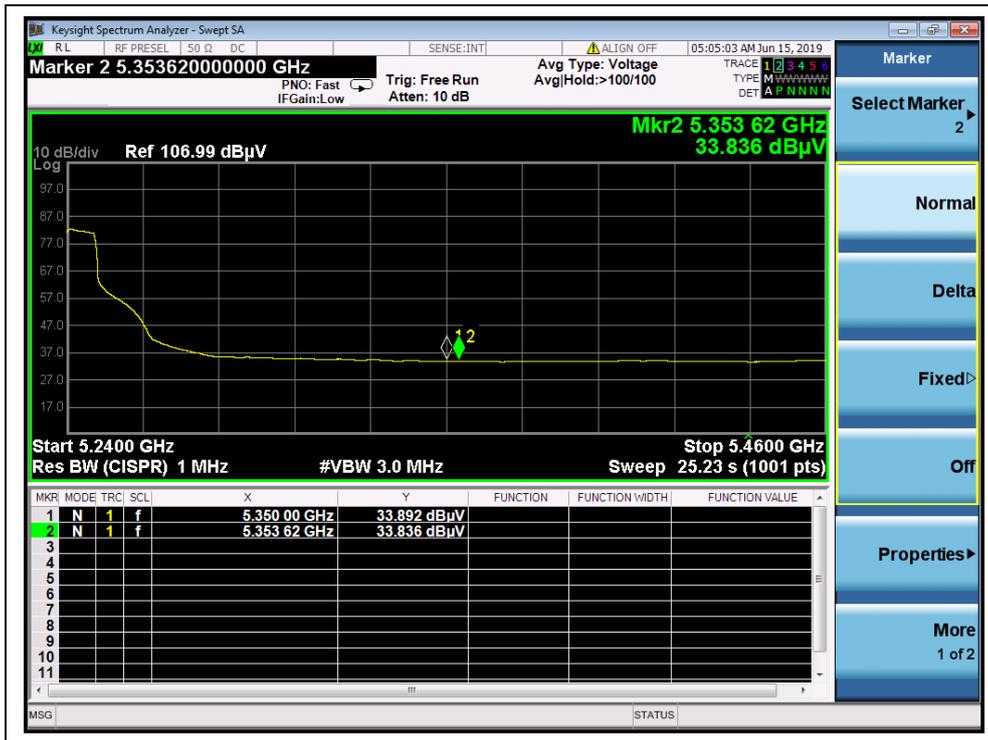
(Channel 36, PEAK, 802.11n (HT20))



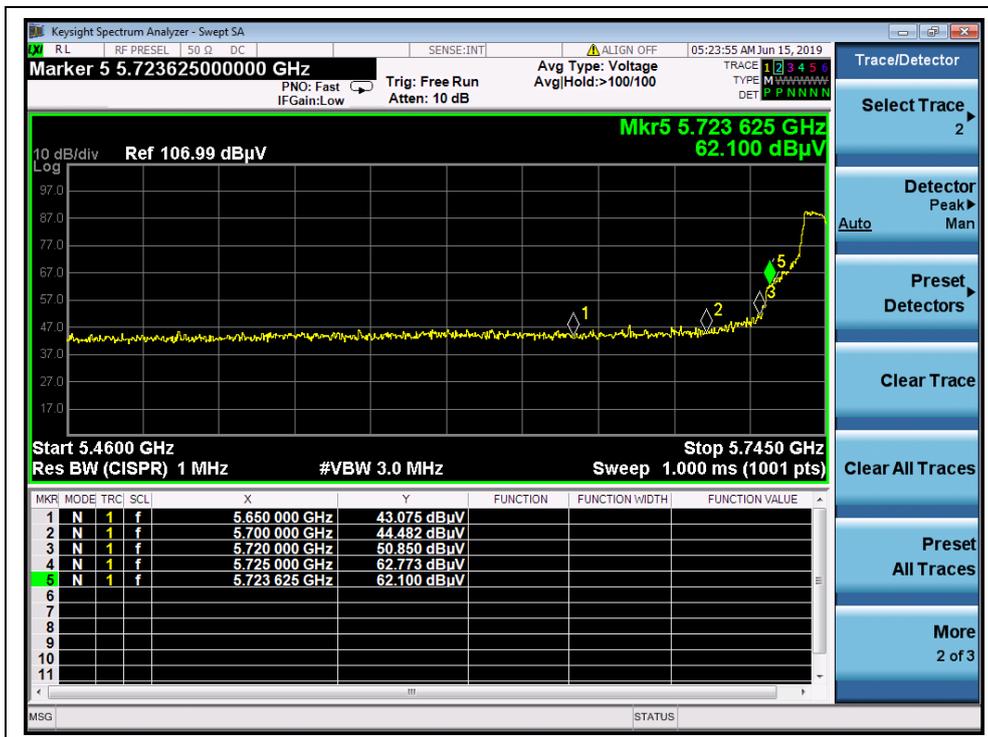
(Channel 36, AVG, 802.11 n (HT20))



(Channel 48, PEAK, 802.11 n (HT20))



(Channel 48, AVG, 802.11n (HT20))



(Channel 149, PEAK, 802.11 n (HT20))



(Channel 149, AVG, 802.11n (HT20))



(Channel 165, PEAK, 802.11 n (HT20))



(Channel 165, AVG, 802.11n (HT20))

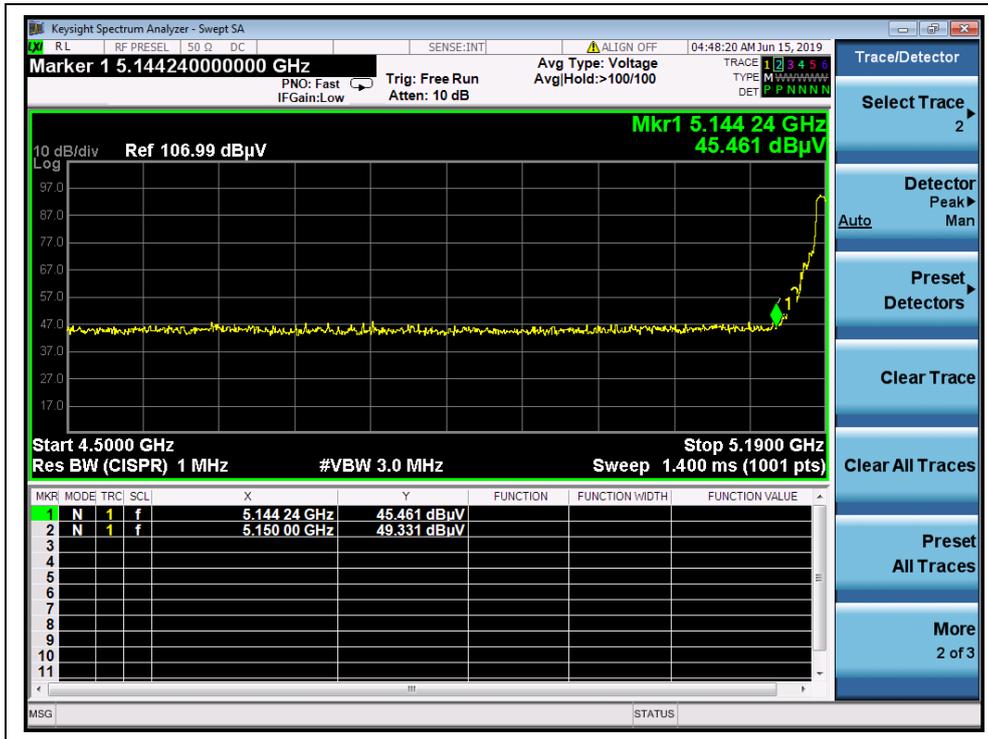
**802.11n (HT40) Test mode**

**A. Test Verdict:**

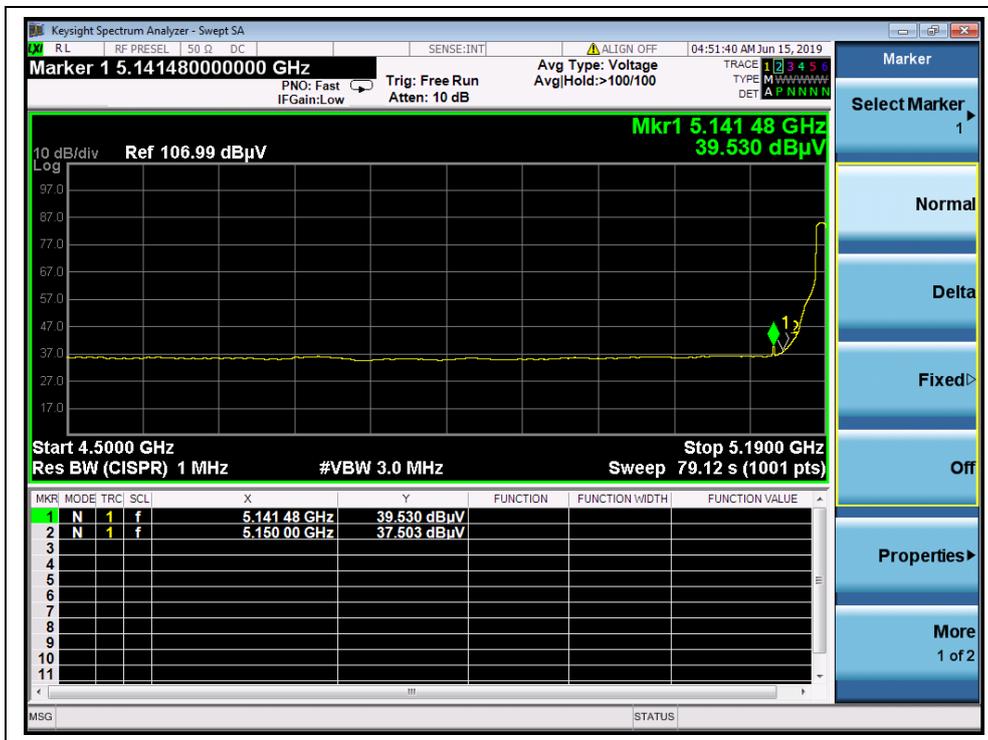
Channel	Frequency (MHz)	Detector	Receiver Reading $U_R$ (dBuV)	$A_T$ (dB)	$A_{Factor}$ (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
38	5150.00	PK	49.33	-26.92	32.20	54.61	74	PASS
38	5141.48	AV	39.53	-26.92	32.20	44.81	54	PASS
46	5360.22	PK	44.37	-26.92	32.20	49.65	74	PASS
46	5350.00	AV	33.90	-26.92	32.20	39.18	54	PASS
151	5722.71	PK	53.39	-26.23	32.20	59.36	117.01	PASS
151	5707.07	AV	39.19	-26.23	32.20	45.16	54	PASS
159	5852.40	PK	46.44	-26.23	32.20	52.41	116.76	PASS
159	5852.20	AV	35.24	-26.23	32.20	41.21	54	PASS



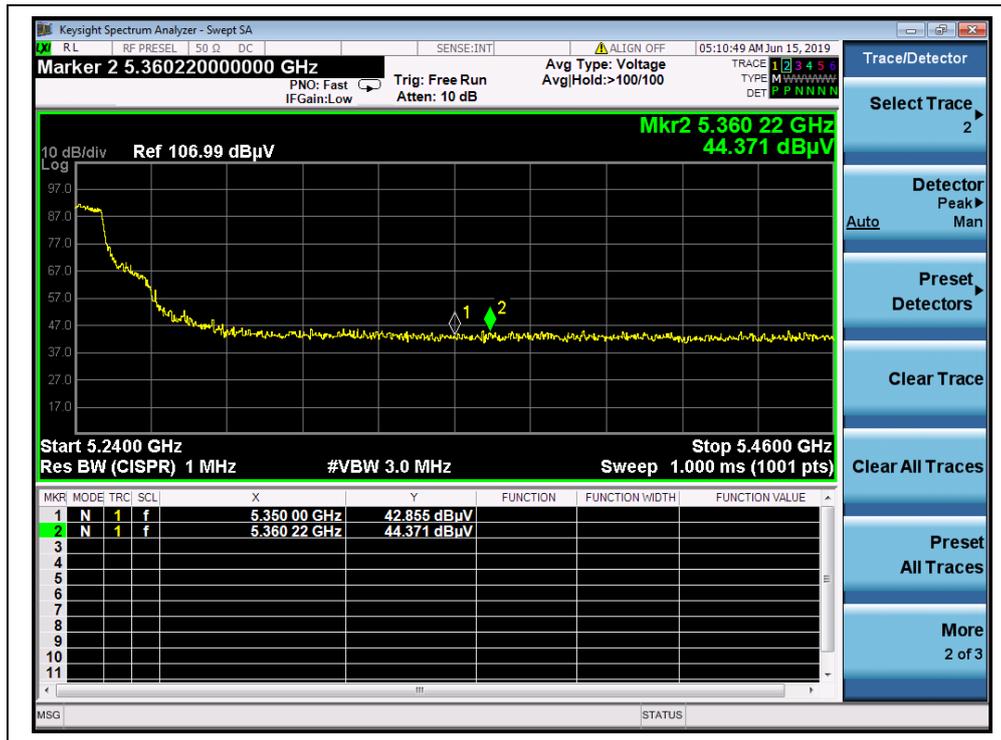
B. Test Plots:



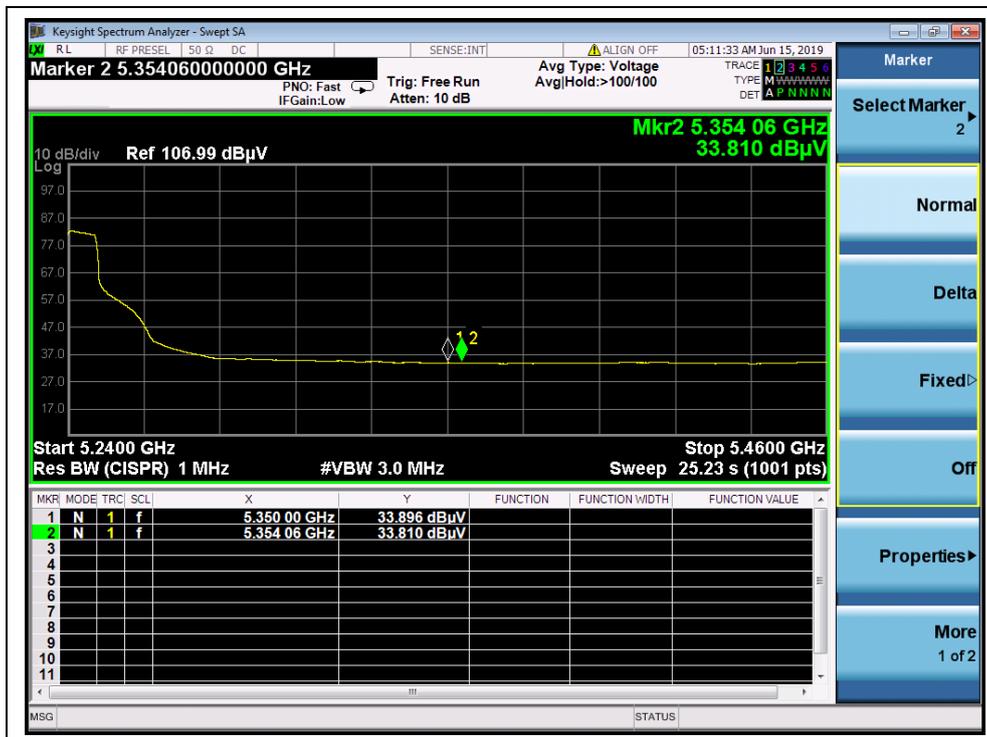
(Channel 38, PEAK, 802.11n (HT40))



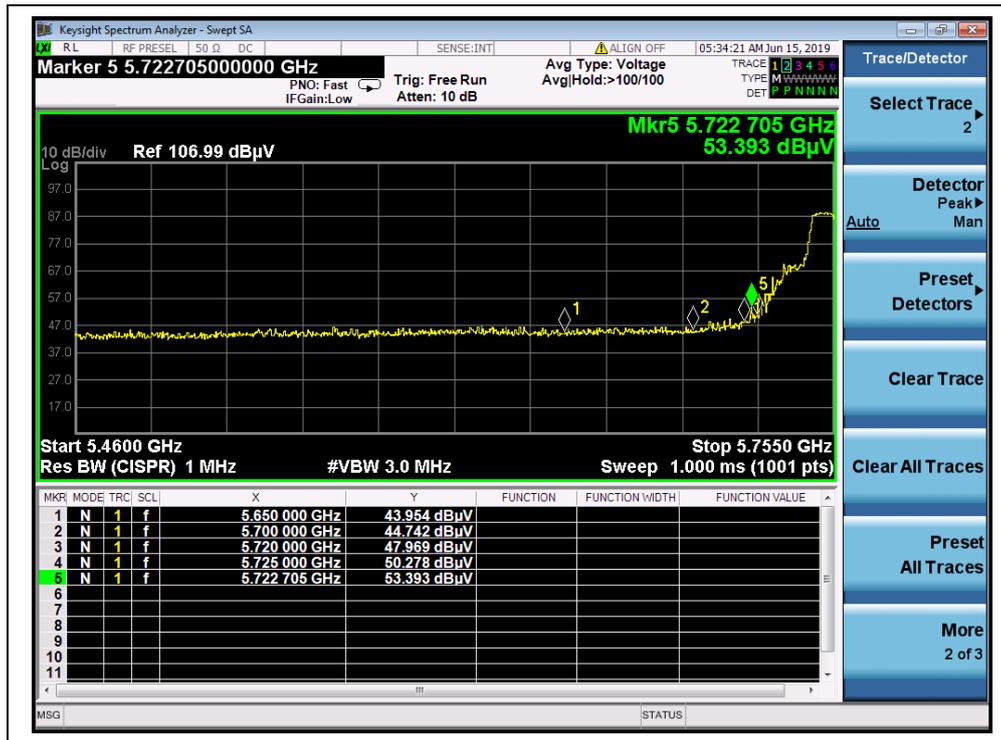
(Channel 38, AVG, 802.11n (HT40))



(Channel 46, PEAK, 802.11n (HT40))



(Channel 46, AVG, 802.11n (HT40))



(Channel 151, PEAK, 802.11n (HT40))



(Channel 151, AVG, 802.11n (HT40))



(Channel 159, PEAK, 802.11n (HT40))



(Channel 159, AVG, 802.11n (HT40))



## 2.9. Radiated Emission

### 2.9.1. Requirement

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.
- (2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.
- (3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of -27dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

The following formula is used to convert the equipment isotropic radiated power(eirp) to field strength (dBμV/m);

$$E = 1000000 \times \sqrt{30P} / 3 \mu\text{V/m}$$

where P is the EIRP in Watts

Therefore: -27 dBm/MHz = 68.23 dBuV/m

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

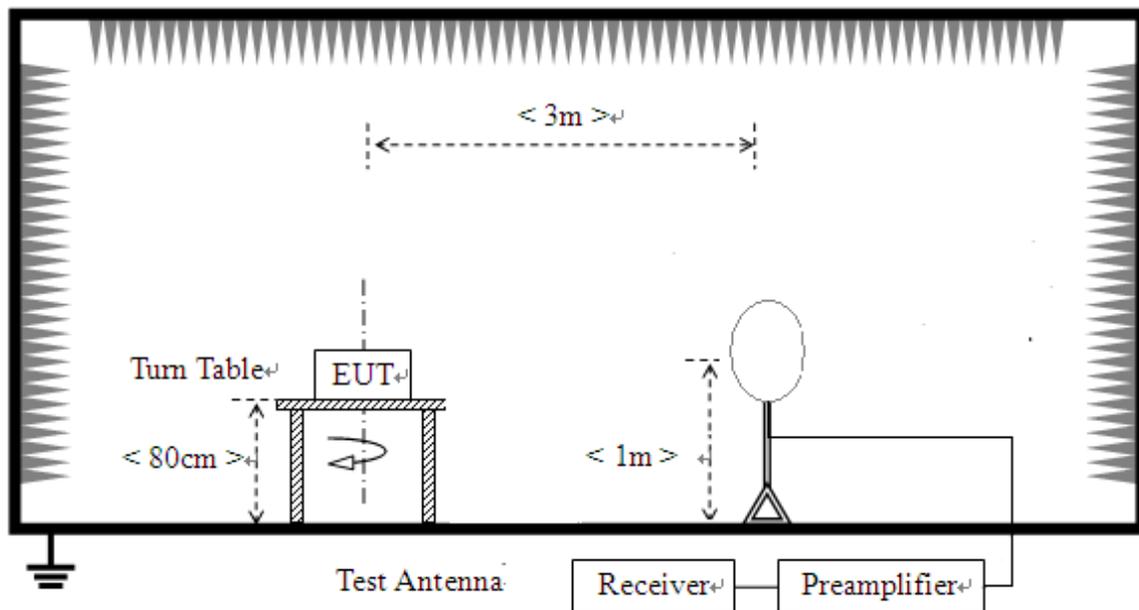
**Note:**

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

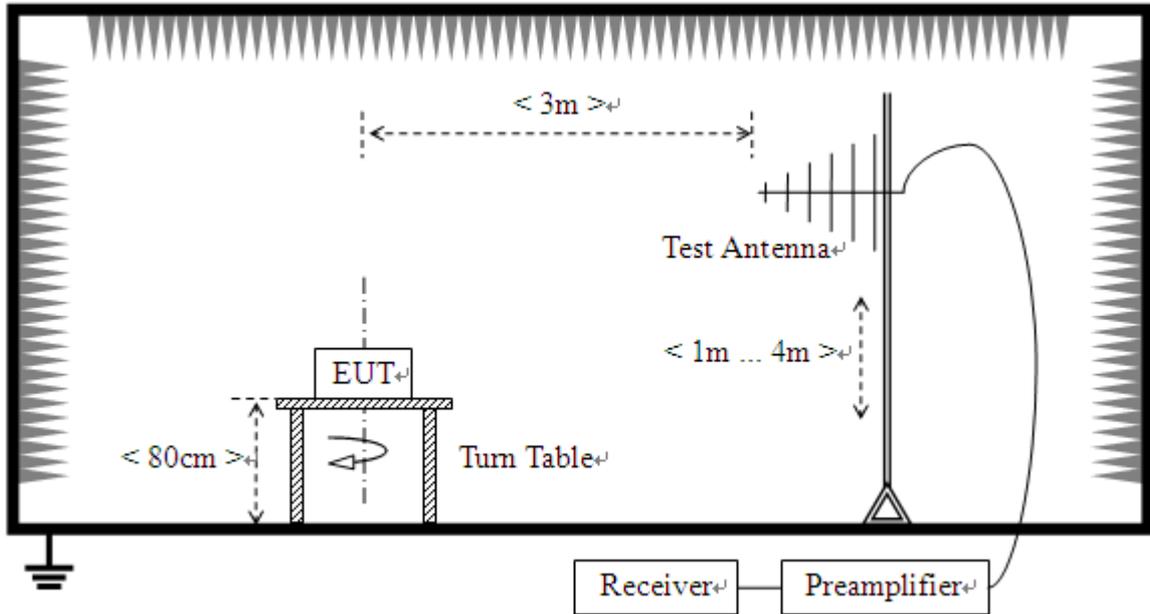
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

**2.9.2. Test Description****A. Test Setup:**

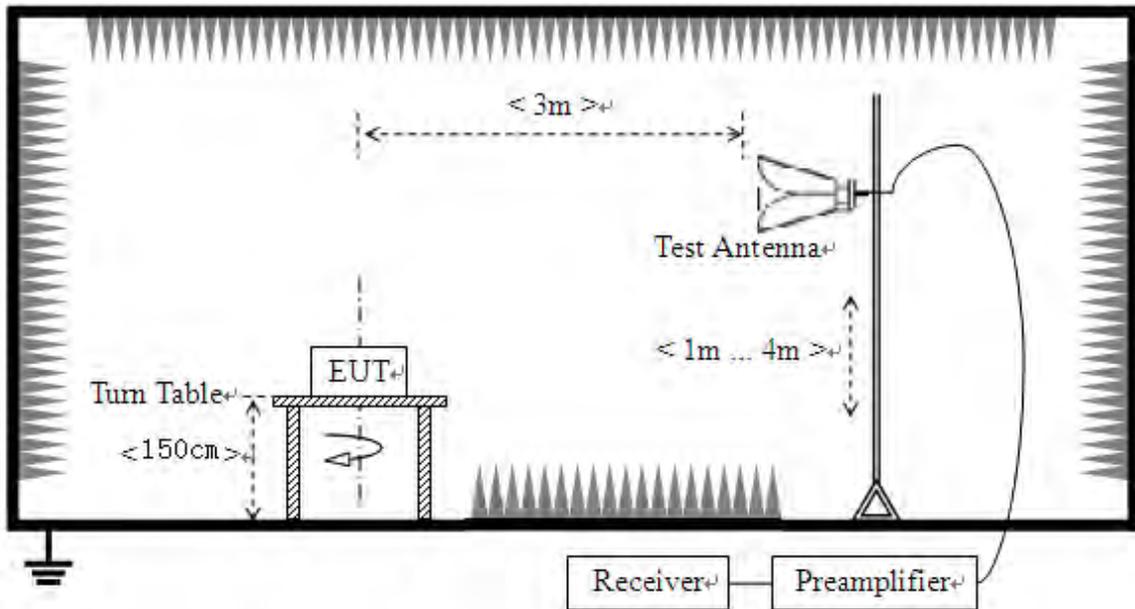
- 1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz.

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 C63.4 selection 4.2.2, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

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

$A_T$ : Total correction Factor except Antenna

$U_R$ : Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

During the test, the total correction Factor  $A_T$  and  $A_{\text{Factor}}$  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.

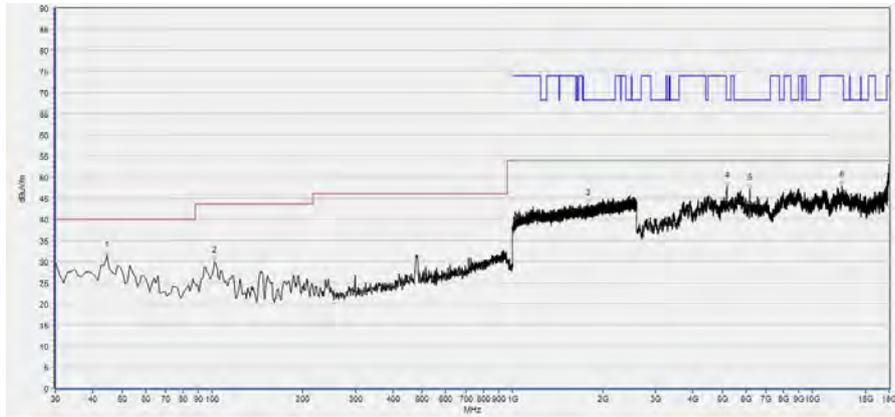
**Note2:** For the frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**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.



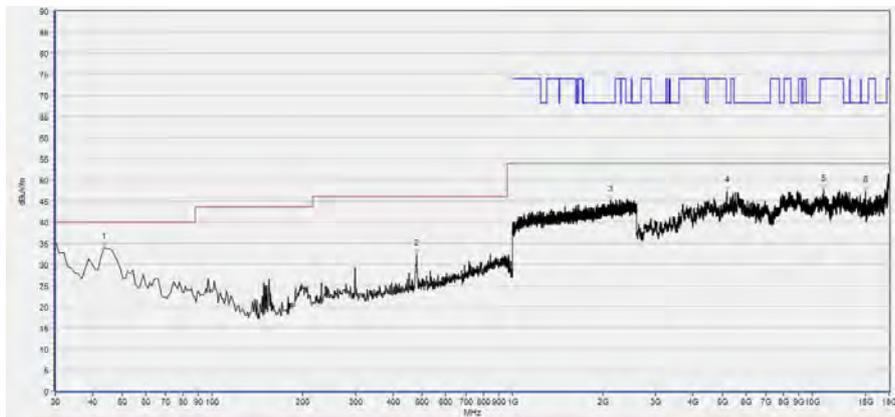
**802.11a Test mode**

Plots for Channel = 36



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
44.565	31.33	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
101.852	29.94	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1785.328	43.59	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5184.637	47.68	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
6195.079	47.10	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
12525.745	47.79	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

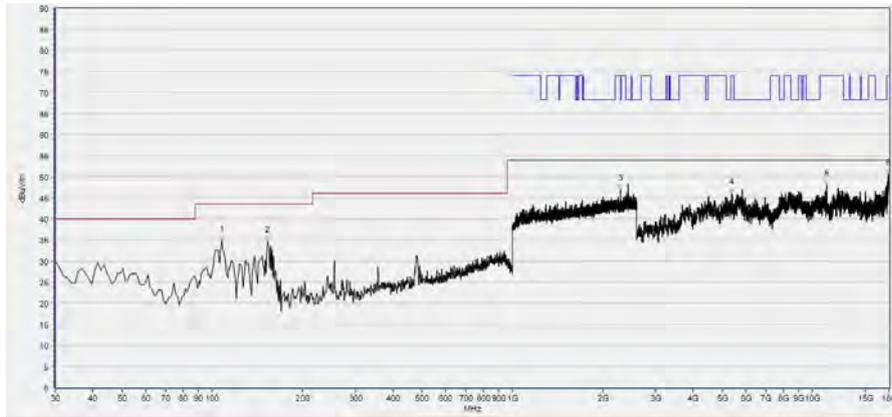
(Antenna Horizontal, 30MHz to 25GHz)



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
43.594	33.87	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
479.560	32.40	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2127.309	45.12	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
5184.637	47.40	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
10920.744	47.64	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
15005.641	47.24	N/A	N/A	68.32	N/A	54.00	Vertical	PASS

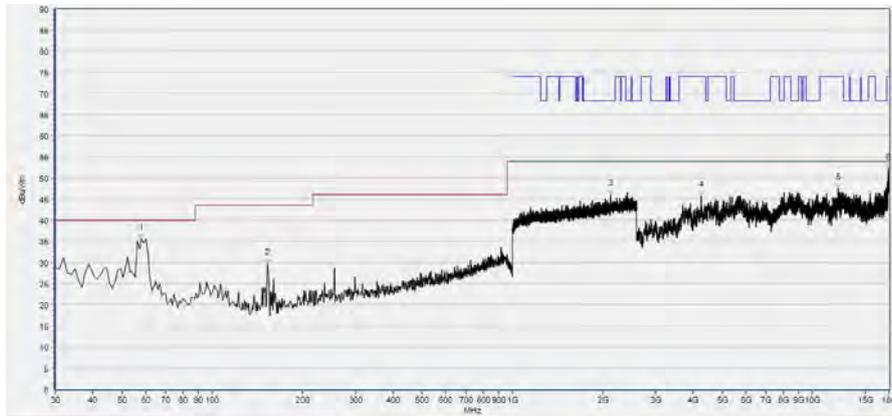
(Antenna Vertical, 30MHz to 25GHz)

Plots for Channel = 44



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
107.678	34.91	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
153.313	34.68	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2292.698	46.90	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5391.038	46.06	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
11136.387	47.98	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17864.453	50.56	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

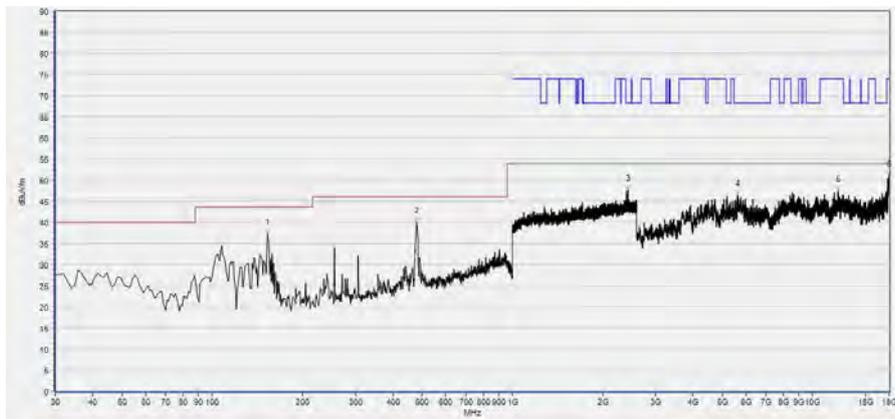
(Antenna Horizontal, 30MHz to 25GHz)



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
58.158	35.56	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
153.313	29.71	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2131.044	46.15	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
4251.210	45.67	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12149.910	47.45	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17919.904	52.14	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

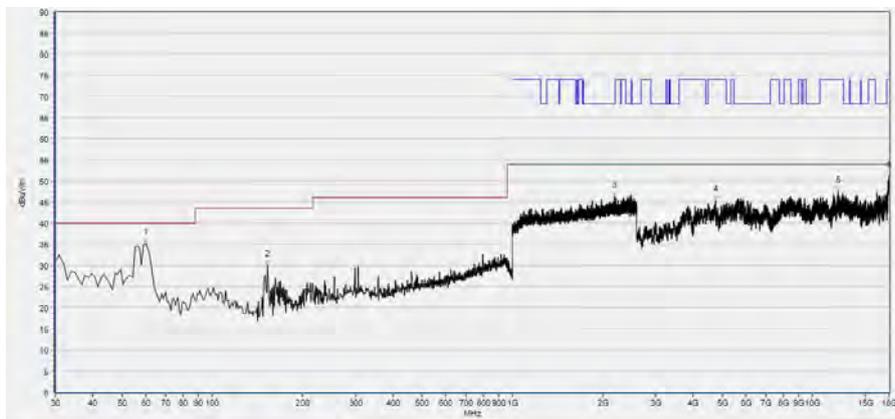
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 48



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
153.313	37.33	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
479.560	39.96	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2427.676	47.64	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5646.729	46.44	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
12149.910	47.42	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17950.710	51.13	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

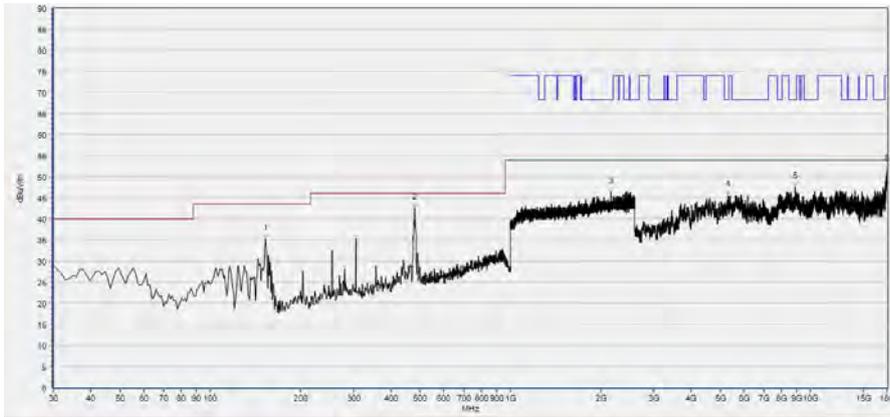
(Antenna Horizontal, 30MHz to 25GHz)



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
60.100	35.12	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
153.313	29.94	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2193.998	46.19	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
4747.189	45.41	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12152.991	47.53	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17959.952	51.11	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

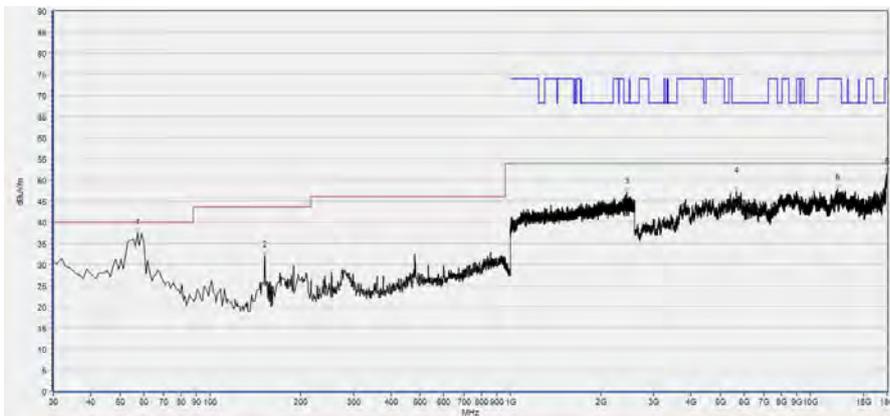
(Antenna Vertical, 30MHz to 25GHz)

Plots for Channel = 149



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
153.313	35.17	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
479.560	42.54	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2166.789	46.16	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5323.265	45.54	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
8906.021	47.42	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
17972.274	51.58	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

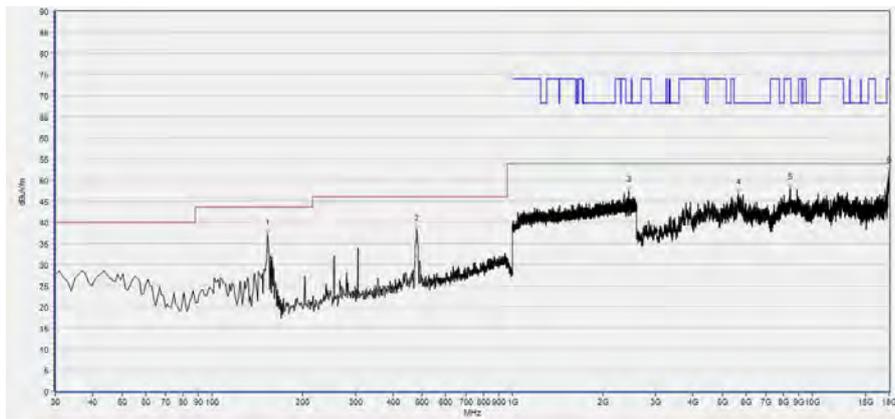
(Antenna Horizontal, 30MHz to 25GHz)



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
57.187	37.24	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
152.342	31.99	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2450.617	46.98	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
5659.052	47.30	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
12307.021	47.81	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17953.791	51.59	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

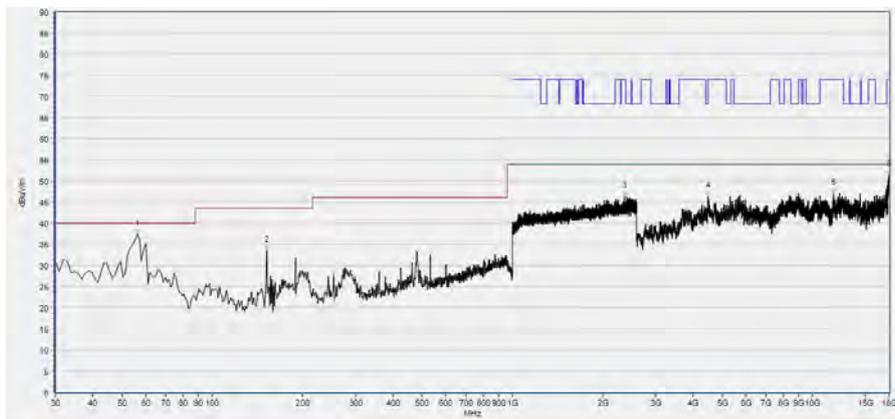
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 157



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
153.313	37.19	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
479.560	38.21	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2447.416	47.47	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5652.891	46.77	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
8425.445	47.95	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17981.516	52.01	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

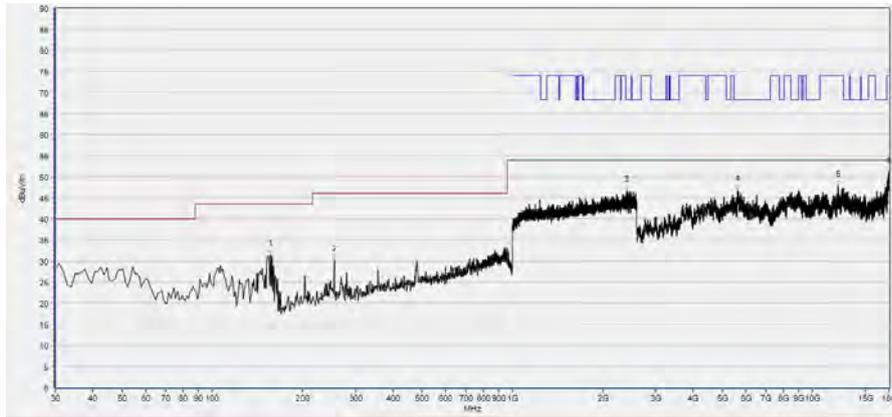
(Antenna Horizontal, 30MHz to 25GHz)



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
56.216	37.39	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
152.342	33.32	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2361.521	46.31	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
4488.418	46.27	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
11743.269	46.94	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17978.436	51.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

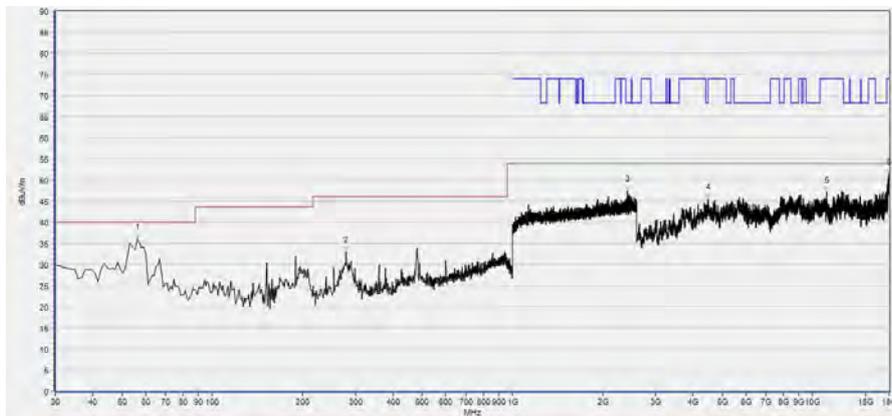
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 165



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
156.226	31.50	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
255.265	30.11	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2410.070	46.58	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5634.407	46.70	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
12196.119	47.89	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17950.710	50.99	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



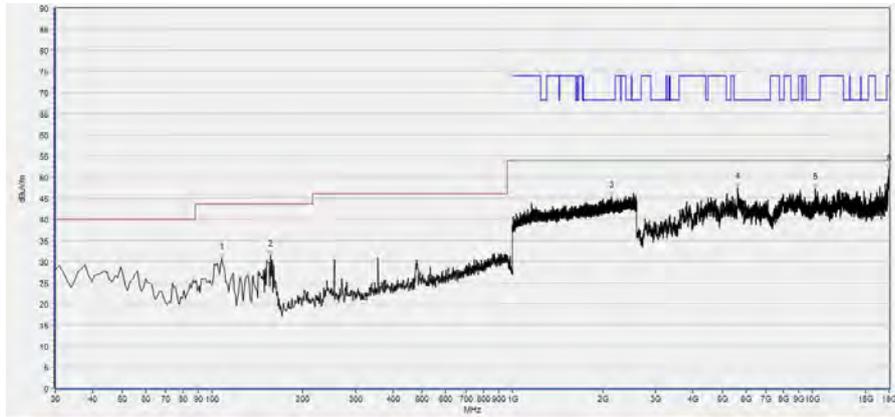
Fre. (MHz)	Pk (dBµV/m)	QP (dBµV/m)	AV (dBµV/m)	Limit-PK (dBµV/m)	Limit-QP (dBµV/m)	Limit-AV (dBµV/m)	Antenna	Verdict
56.216	36.04	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
279.540	33.05	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2417.006	47.51	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
4485.337	45.49	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
11142.549	47.07	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17984.597	51.39	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)



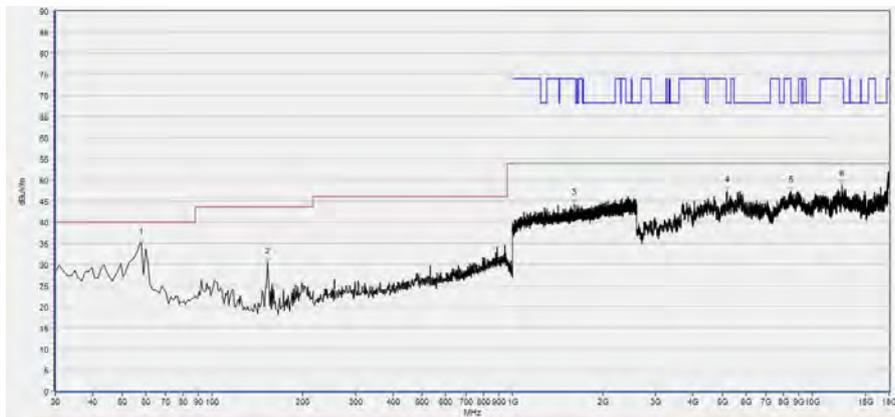
**802.11n (HT20) Test mode**

Plots for Channel = 36



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
107.678	30.71	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
156.226	31.40	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2141.714	45.37	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5646.729	47.57	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
10230.686	47.27	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
17950.710	51.74	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

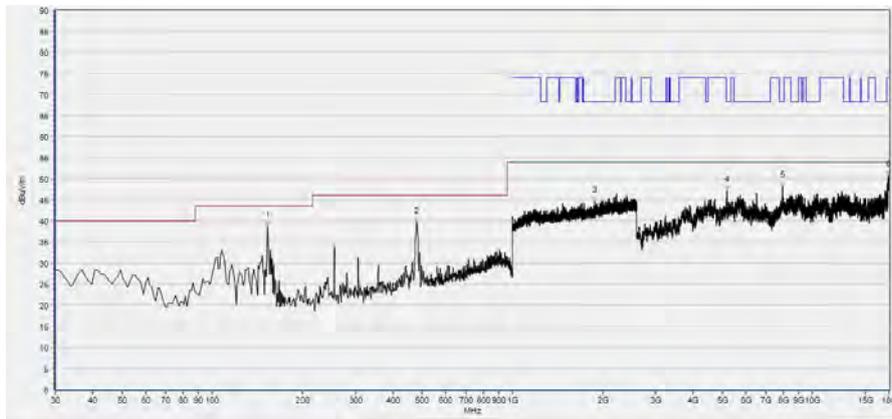
(Antenna Horizontal, 30MHz to 25GHz)



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
58.158	35.03	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
153.313	30.36	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1608.203	44.32	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5187.718	47.25	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
8465.493	47.25	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
12525.745	48.78	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

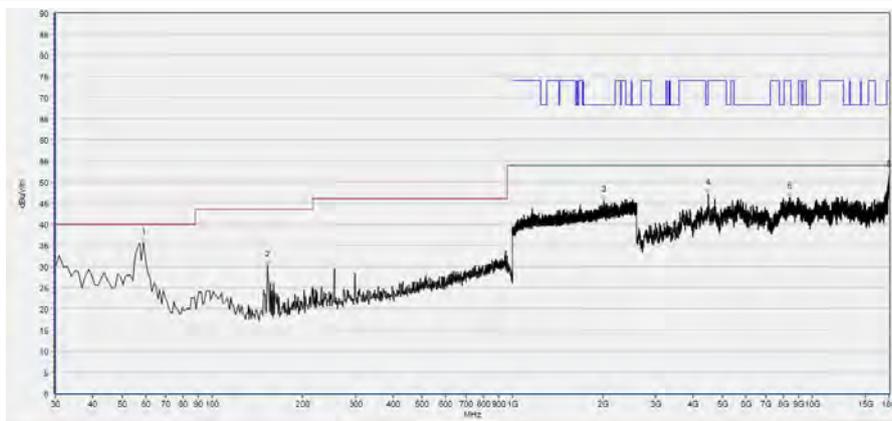
(Antenna Vertical, 30MHz to 25GHz)

Plots for Channel = 44



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
153.313	38.80	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
479.560	39.70	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1884.028	44.66	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5224.637	47.21	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
7966.433	48.19	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
17929.146	50.71	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

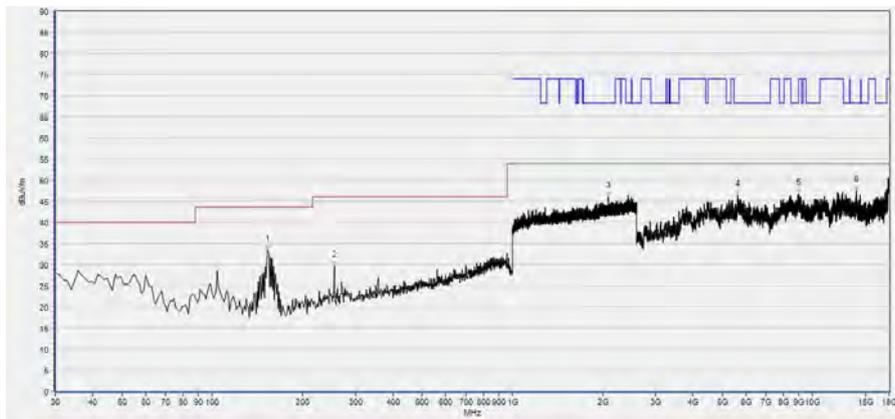
(Antenna Horizontal, 30MHz to 25GHz)



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
59.129	35.56	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
153.313	30.19	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2022.741	45.62	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
4497.660	47.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8382.316	46.23	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17990.758	51.37	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

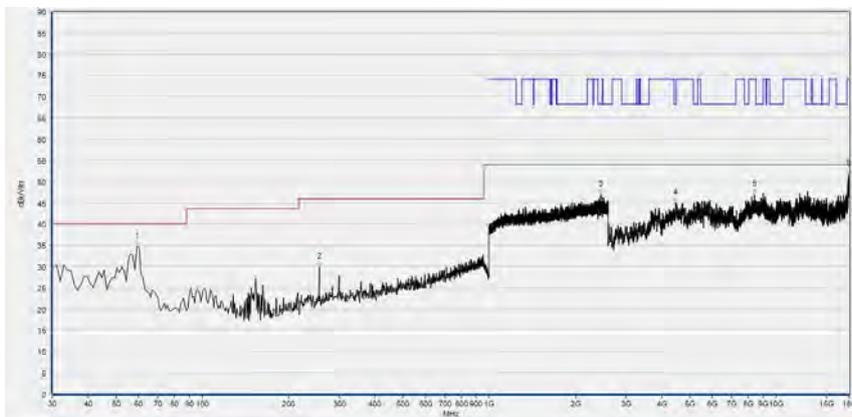
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 48



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
153.313	33.44	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
255.265	29.65	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2085.695	46.07	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5649.810	46.47	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
8992.278	46.71	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
13985.957	47.55	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS

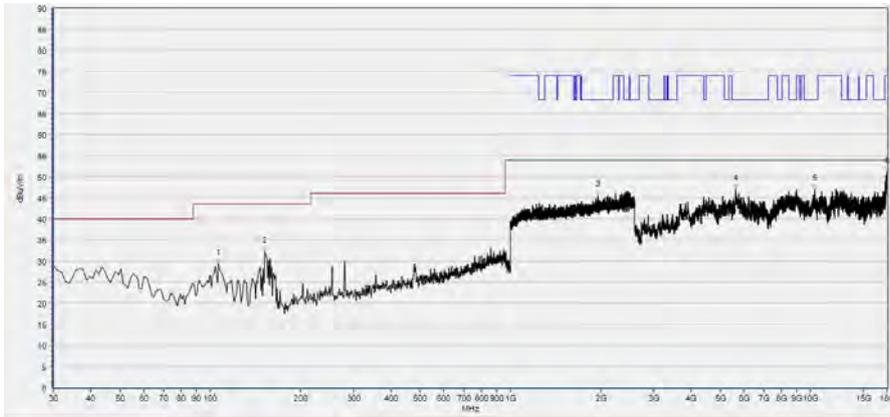
(Antenna Horizontal, 30MHz to 25GHz)



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
59.129	34.71	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
255.265	29.75	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2454.351	46.95	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
4469.934	44.84	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8428.526	47.00	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17941.468	51.59	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

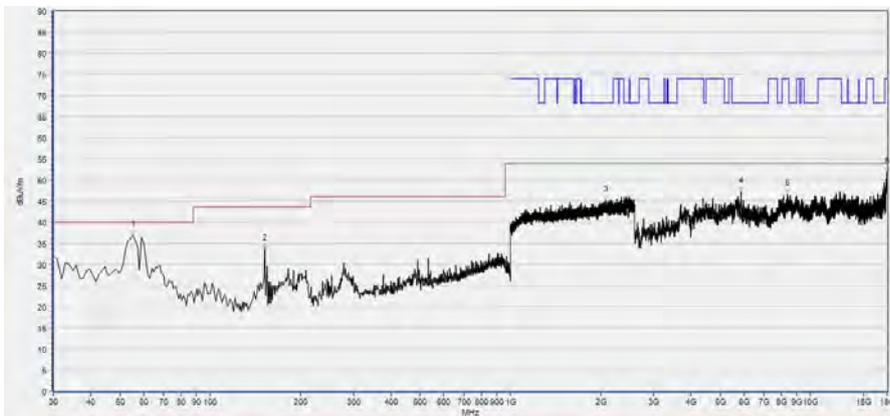
(Antenna Vertical, 30MHz to 25GHz)

Plots for Channel = 149



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
106.707	29.29	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
152.342	32.17	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1957.653	45.54	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5646.729	46.97	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
10326.185	47.03	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
17953.791	51.11	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

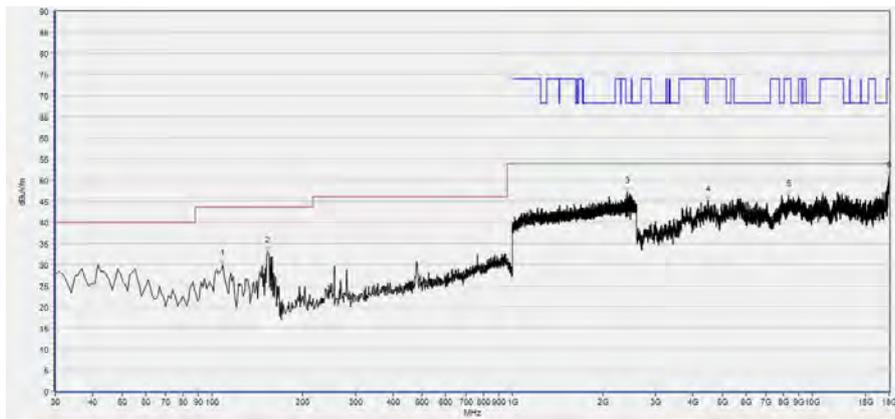
(Antenna Horizontal, 30MHz to 25GHz)



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
55.245	36.73	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
152.342	33.49	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2073.958	45.15	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
5874.695	47.22	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
8400.800	46.60	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17953.791	51.70	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

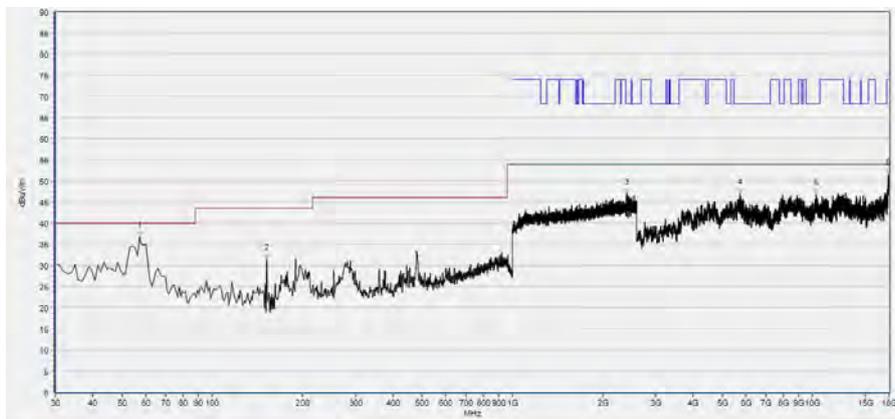
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 157



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
108.649	29.93	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
153.313	32.98	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2410.604	47.11	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
4494.579	45.23	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
8308.382	46.41	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17975.355	50.86	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

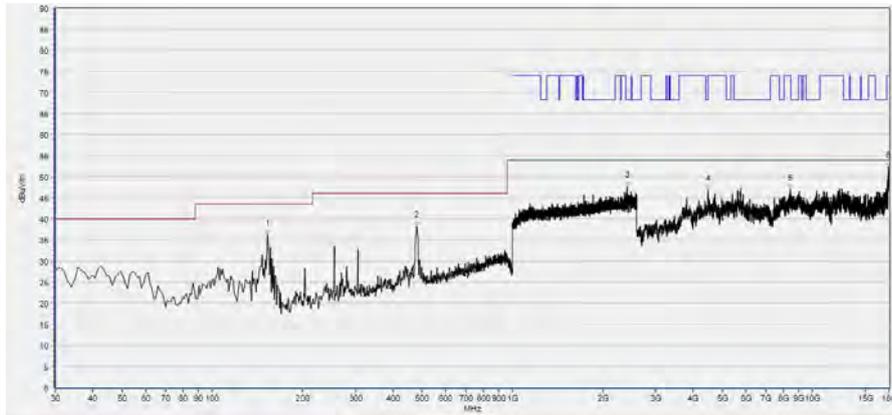
(Antenna Horizontal, 30MHz to 25GHz)



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
57.187	36.78	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
152.342	31.36	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2409.003	46.90	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
5729.906	46.91	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
10307.702	46.75	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
17941.468	51.68	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

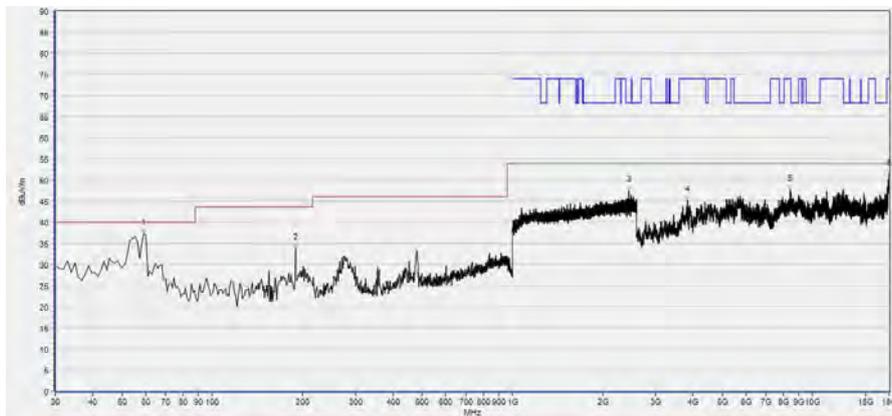
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 165



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
153.313	36.31	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
479.560	38.20	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2410.604	47.70	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
4482.256	46.85	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
8422.364	46.94	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17944.549	52.29	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



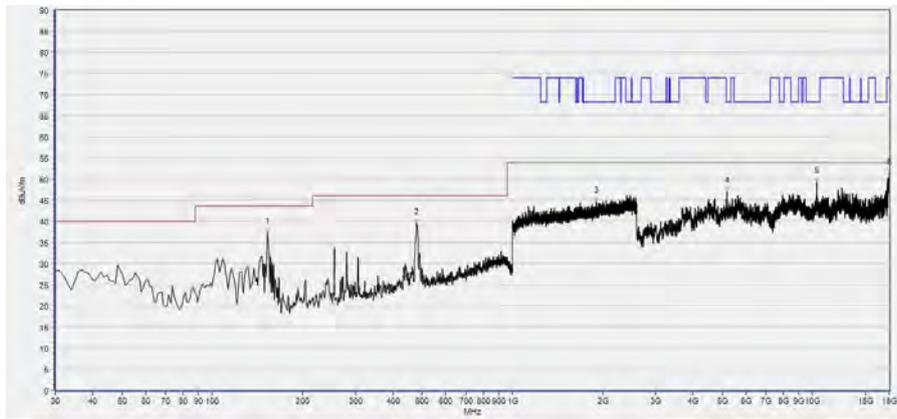
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
59.129	36.95	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
189.239	33.76	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2446.882	47.53	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
3823.005	45.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8443.929	47.70	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17993.839	51.31	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)



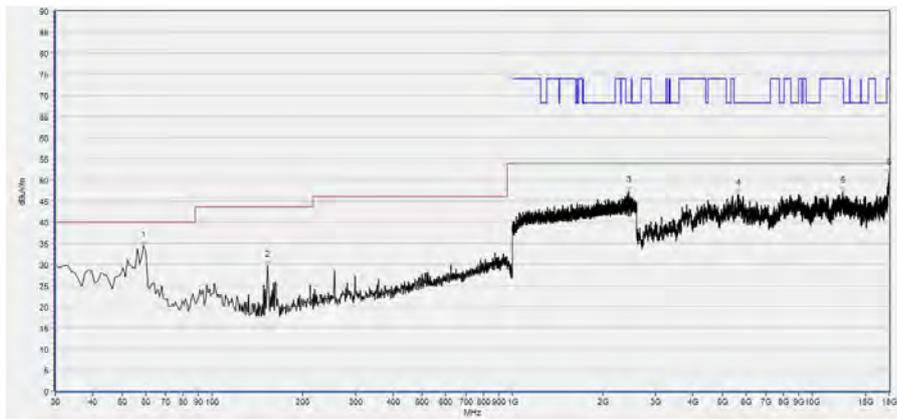
**802.11n (HT40) Test mode**

Plots for Channel = 38



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
153.313	37.26	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
479.560	39.39	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1905.368	44.66	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5191.556	47.01	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
10338.508	49.29	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
18000.000	51.26	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

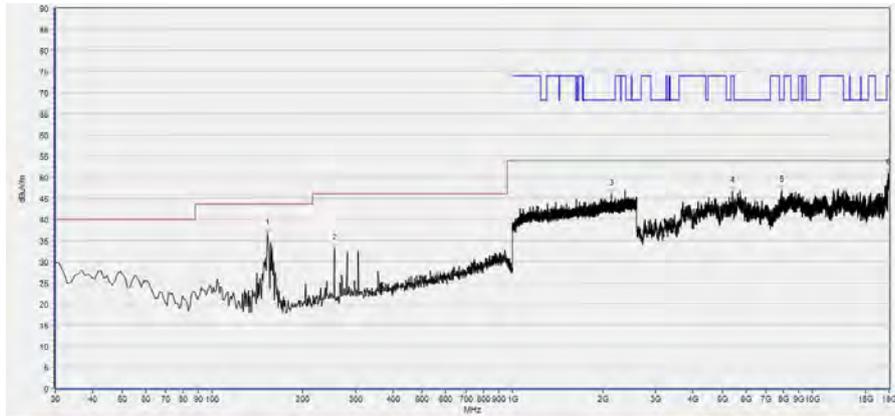
(Antenna Horizontal, 30MHz to 25GHz)



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
59.129	34.32	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
153.313	29.58	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2451.684	47.29	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
5668.294	46.52	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
12615.083	47.22	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17993.839	51.42	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

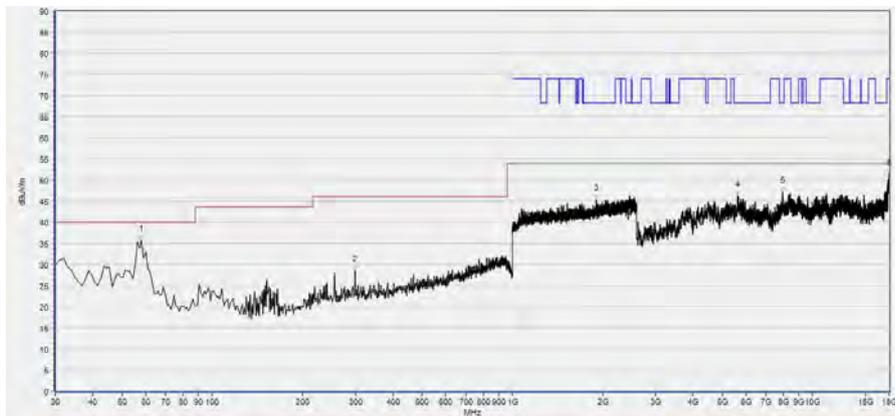
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 46



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
153.313	36.65	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
255.265	33.03	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2141.714	45.94	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5412.603	46.62	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7895.579	46.82	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
17867.534	50.85	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

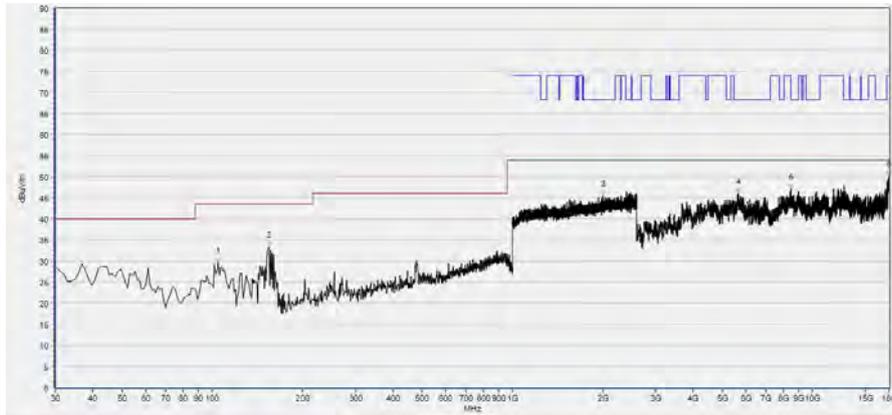
(Antenna Horizontal, 30MHz to 25GHz)



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
58.158	35.66	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
299.930	28.51	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1904.835	45.27	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
5622.084	46.24	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
7966.433	47.12	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
17956.871	51.34	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

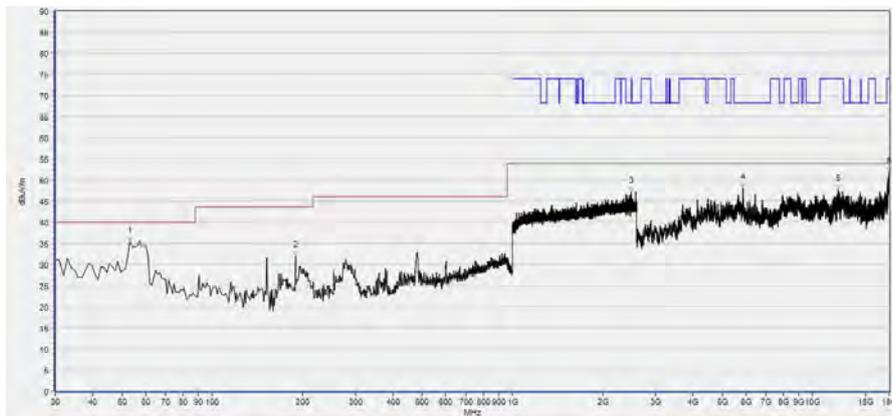
(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 151



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
104.765	29.63	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
154.284	33.34	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
2008.336	45.52	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5655.971	45.99	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
8465.493	47.07	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17947.630	50.25	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

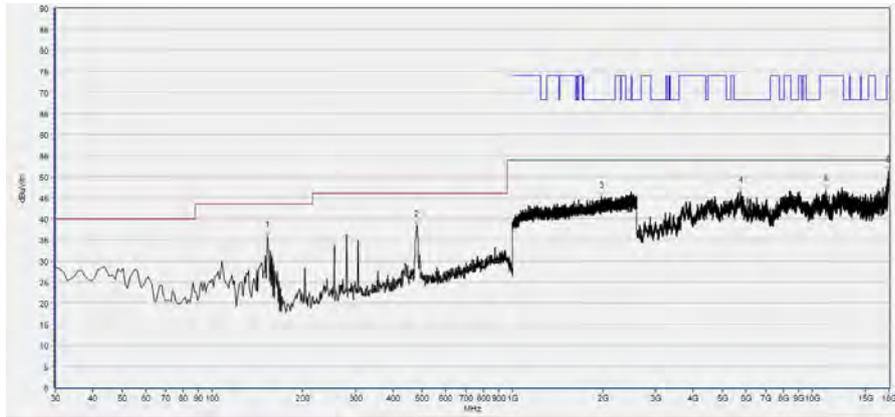
(Antenna Horizontal, 30MHz to 25GHz)



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
53.303	35.37	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
189.239	31.96	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
2492.764	47.13	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5862.372	47.98	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
12149.910	47.73	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17984.597	51.73	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

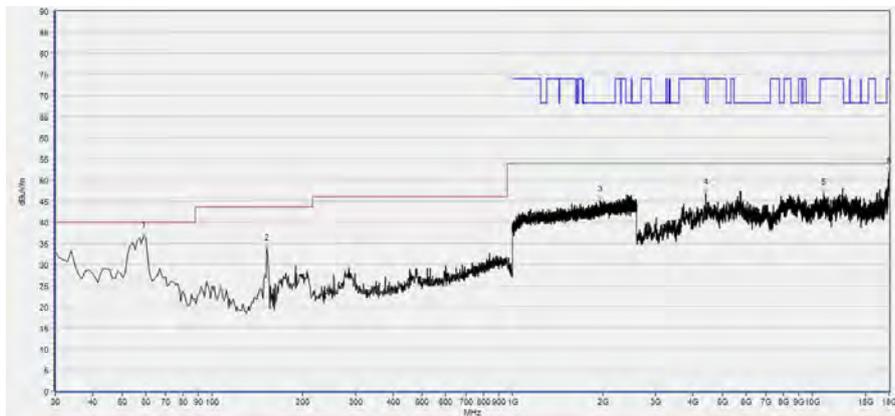
(Antenna Vertical, 30MHz to 25GHz)

Plots for Channel = 159



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
153.313	35.86	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
480.531	38.39	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1980.060	45.15	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
5757.632	46.52	N/A	N/A	68.32	N/A	54.00	Horizontal	PASS
11065.533	46.87	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
17944.549	51.20	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
59.129	36.60	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
152.342	33.50	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1955.519	45.26	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
4417.564	46.70	N/A	N/A	68.32	N/A	54.00	Vertical	PASS
10877.616	46.78	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
17969.194	51.87	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	$\pm 5\%$
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

<b>Laboratory Name:</b>	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
<b>Laboratory Address:</b>	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
<b>Telephone:</b>	+86 755 36698555
<b>Facsimile:</b>	+86 755 36698525

### 2. Identification of the Responsible Testing Location

<b>Name:</b>	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
<b>Address:</b>	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	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
Temperature Chamber	YOMA	(N/A)	(N/A)	2019.01.22	2020.01.21
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)	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 - Horn	9170C-531	BBHA9170	Schwarzbeck	2019.02.15	2020.02.14
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2018.08.06	2019.08.05
Test Antenna - Horn	01774	BBHA 9120D	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
Coaxial cable (N male) (30MHz-40GHz)	CB05	EMC05	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
26GHz -40GHz pre-Amplifier	MA05	BBV9721	Rohde& Schwarz	2019.05.08	2020.05.09
Notch Filter	N/A	WRCG-5150-5350	Wainwright	2018.12.01	2019.11.30
Notch Filter	N/A	WRCG-5470-5725	Wainwright	2018.12.01	2019.11.30
Notch Filter	N/A	WRCG-5725-5850	Wainwright	2018.12.01	2019.11.30



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<b>Equipment Name</b>	<b>Serial No.</b>	<b>Type</b>	<b>Manufacturer</b>	<b>Cal. Date</b>	<b>Cal. Due</b>
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

————— END OF REPORT —————