



# TEST REPORT

**APPLICANT** : Unimax Communications  
**PRODUCT NAME** : G1401  
**MODEL NAME** : G1401  
**BRAND NAME** : UNI America  
**FCC ID** : P46-G1401  
**STANDARD(S)** : 47 CFR Part 15 Subpart E  
**RECEIPT DATE** : 2020-08-17  
**TEST DATE** : 2020-09-01 to 2020-12-11  
**ISSUE DATE** : 2020-12-22

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Change History		
Version	Date	Reason for change
1.0	2020-12-22	First edition



# 1. Technical Information

Note: Provide by applicant.

## 1.1. Applicant and Manufacturer Information

<b>Applicant:</b>	Unimax Communications
<b>Applicant Address:</b>	18201 McDermott St. West Suite E, Irvine, CA 92614, United States
<b>Manufacturer:</b>	Unimaxcomm
<b>Manufacturer Address:</b>	35th Floor, Office Building, HBC Huilong Center, Minzhi Street, Longhua District, Shenzhen, Guangdong, China

## 1.2. Equipment Under Test (EUT) Description

<b>Product Name:</b>	G1401	
<b>Serial No.:</b>	(N/A, marked #1 by test site)	
<b>Hardware Version:</b>	V1.0	
<b>Software Version:</b>	G1401_V1.0.0	
<b>Modulation Type:</b>	OFDM	
<b>Modulation Mode:</b>	802.11a, 802.11n (HT20), 802.11n (HT40) 802.11ac (VHT20), 802.11ac (VHT40), 802.11ac (VHT80),	
<b>Operating Frequency Range:</b>	5180MHz-5240MHz; 5745MHz-5825MHz	
<b>Channel Number:</b>	Refer to 1.3	
<b>Antenna Type:</b>	PIFA Antenna	
<b>Antenna Gain:</b>	ANT0: 1.20dBi; ANT1: 1.81dBi	
<b>Directional Gain:</b>	4.82dBi <sub>Note 3</sub>	
<b>Accessory Information:</b>	Battery	
	<b>Brand Name:</b>	Phenix New Energy
	<b>Model No.:</b>	BTE-4001
	<b>Serial No.:</b>	(N/A, marked #1 by test site)
	<b>Capacity:</b>	4000mAh
	<b>Rated Voltage:</b>	3.80V
	<b>Charge Limit:</b>	4.35V
	<b>Manufacturer:</b>	Phenix New Energy



<b>Accessory Information:</b>	AC Adapter	
	Brand Name:	N/A
	Model No.:	TPA-5950100UU
	Serial No.:	(N/A, marked #1 by test site)
	Rated Output:	5V=1A
	Rated Input:	100-240V~50/60Hz, 0.2A
	Manufacturer:	ShenZhen Kingfulin Technology Co., Ltd

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

**Note 2:** The EUT has two antennas and supports a MIMO function. Physically, the EUT provides two completed transmitters and two receivers for 802.11n modulation mode.

<b>Modulation Mode:</b>	<b>TX Function</b>
802.11n	2TX
802.11ac	2TX

**Note 3:** According to KDB 662911 D01, the directional gain =  $G_{ANT} + 10\log(N_{ANT})$  dBi, where  $G_{ANT}$  is the maximum antenna gain in dBi,  $N_{ANT}$  is the number of outputs.

**Note 4:** For conducted test item Maximum conducted output power and Peak Power spectral density of each modulation mode, we recorded the test result of two antennas separately, for other conducted test items both of the two antennas were tested separately, we only recorded the worst test result(ANT1) in this report.

**Note 5:** Radiation test items for all modulation operate at 2Tx mode during the test, only the worst test result(ANT1) was recorded in this report.

**Note 6:** 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) <sup>Note1</sup>
OFDM (802.11a)	BPSK	<b>6/9</b>
	QPSK	12/18
	16QAM	24/36
	64QAM	48/54
OFDM (802.11n)	BPSK	<b>6.5</b>
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65
OFDM (802.11ac)	BPSK	<b>6.5</b>
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65
	256QAM	78

**Note1:** The worst-case mode (black bold) 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

Frequency Range: 5150MHz-5250MHz				
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>
80MHz	<b>42</b>	<b>5210</b>		
Frequency Range: 5725MHz-5825MHz				
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>
80MHz	<b>155</b>	<b>5775</b>		

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



## 1.5. 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	Method determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	ANSI C63.10	Duty Cycle of the Test Signal	Sep 19, 2020	Ouyang Feng	PASS	No deviation
3	15.407(a)	Maximum Conducted Output Power	Dec 10, 2020	Ouyang Feng	PASS	No deviation
4	15.407(a)(e)	Emission Bandwidth	Sep 19, 2020 Dec 11, 2020	Ouyang Feng	PASS	No deviation
5	15.407(a)	Peak Power Spectral Density	Sep 19, 2020 Dec 10, 2020	Ouyang Feng	PASS	No deviation
6	15.407(g)	Frequency Stability	Dec 11, 2020	Ouyang Feng	PASS	No deviation
7	15.207	Conducted Emission	Sep 01, 2020	Wu Runfeng	PASS	No deviation
8	15.407(b)	Restricted Frequency Bands	Sep 15, 2020	Peng Xuewei	PASS	No deviation
9	15.407(b)	Radiated Emission	Sep 15, 2020	Peng Xuewei	PASS	No deviation

**Note 1:** The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.102013.

**Note 2:** These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 v01r03.

**Note 3:** The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The ref offset 12.5dB contains two parts that cable loss 2.5dB and



Attenuator 10dB.

**Note 4:** 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 5:** 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 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. Test Result: Compliant

Inside of the EUT has a PIFA antenna coupled with the metal shrapnel. 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 sub clause, 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

#### Test Setup:

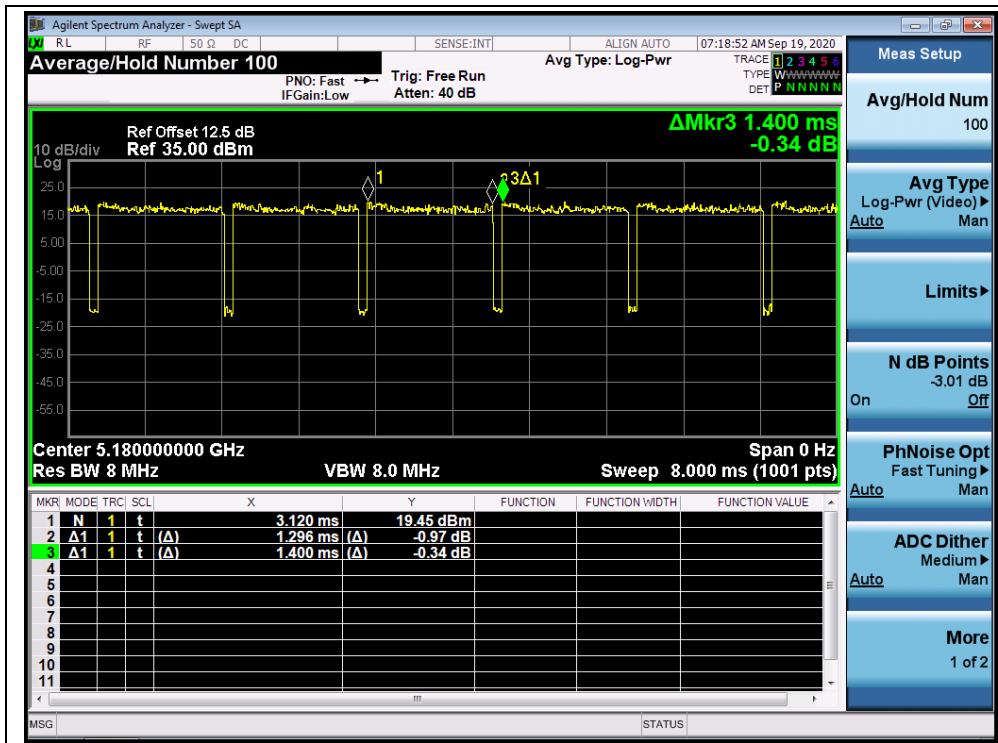


The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

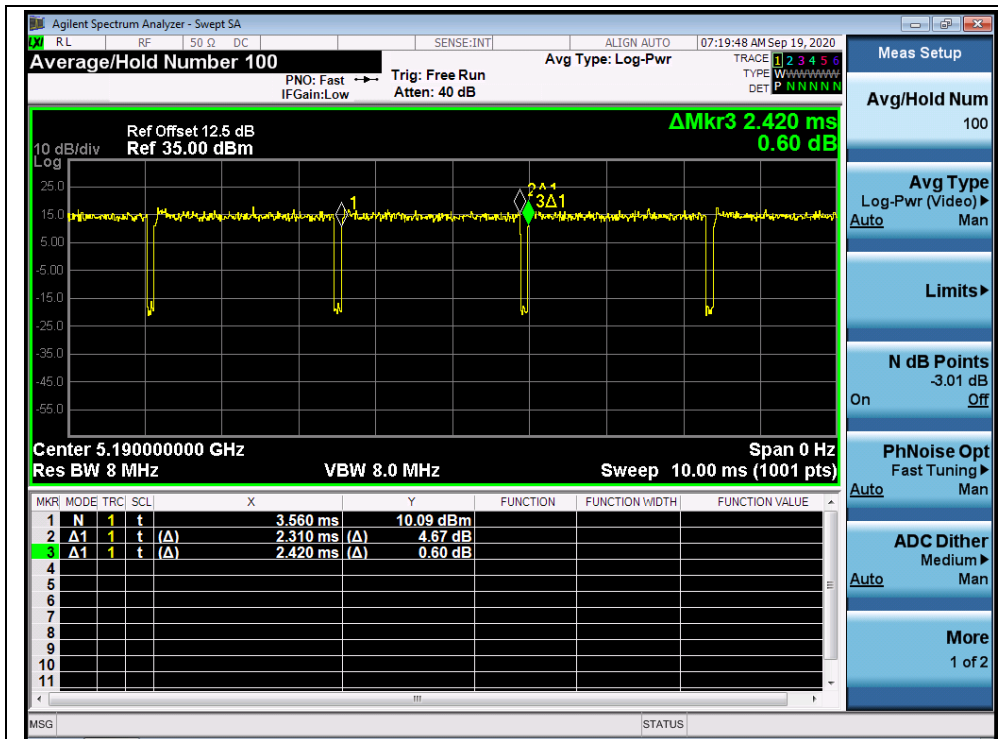
### 2.2.3. Test Procedure

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

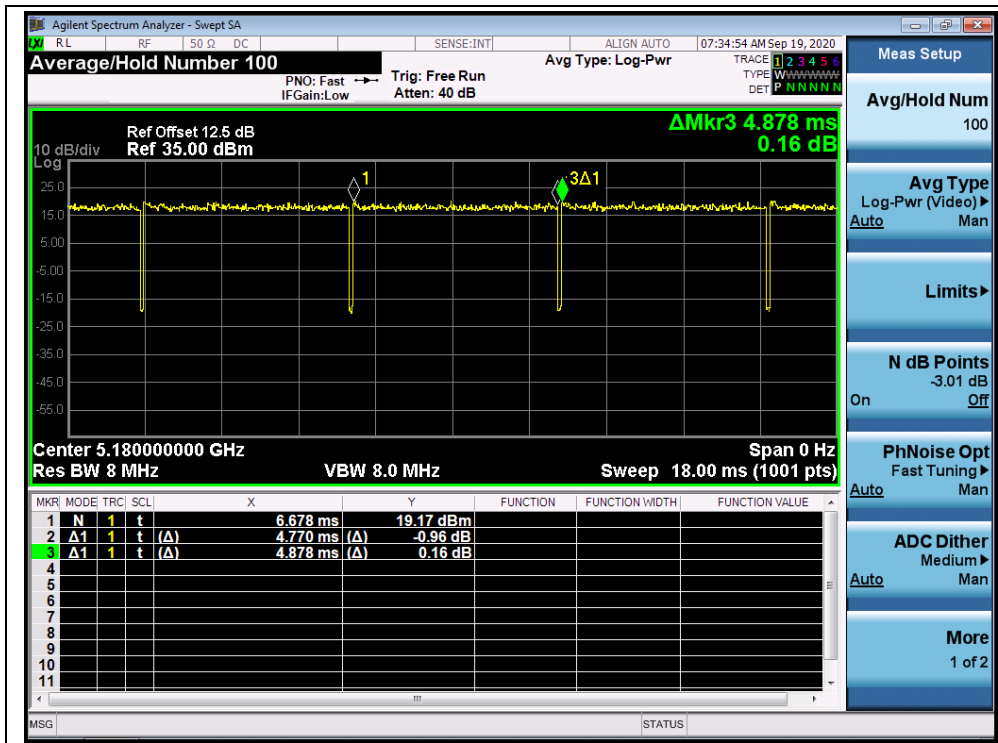




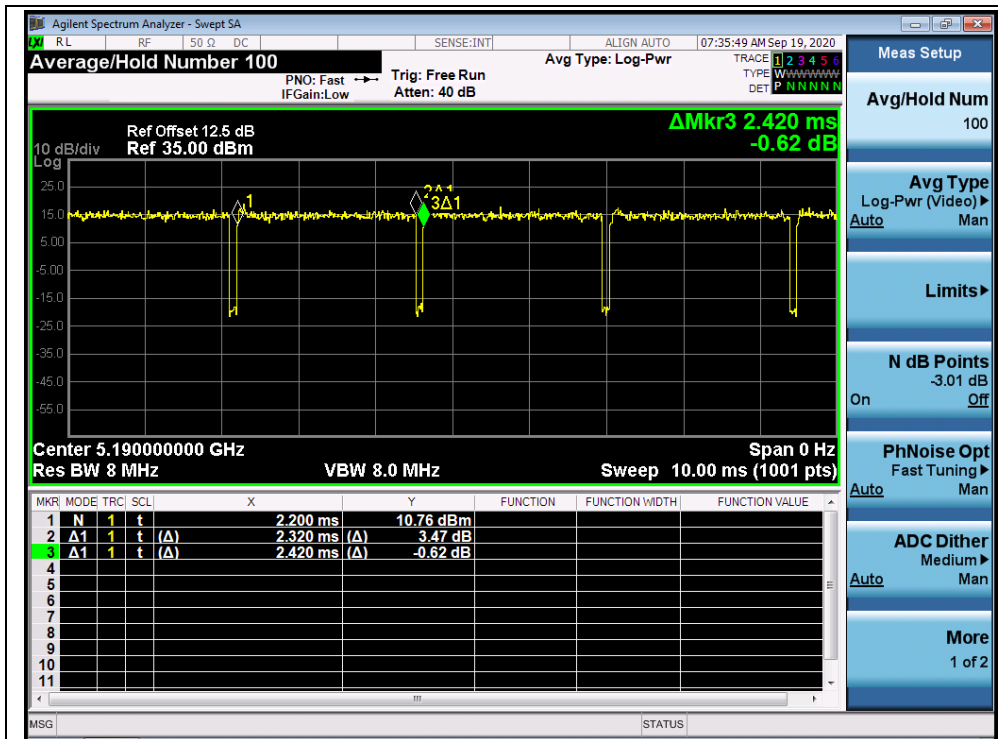
(Channel 36, 5180MHz, 802.11n (HT20))



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



(Channel 36, 5180MHz, 802.11ac (VHT20))



(Channel 38, 5190MHz, 802.11ac (VHT40))



## 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 250mW provided the maximum antenna gain does not exceed 6dBi.

(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 250mW 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 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

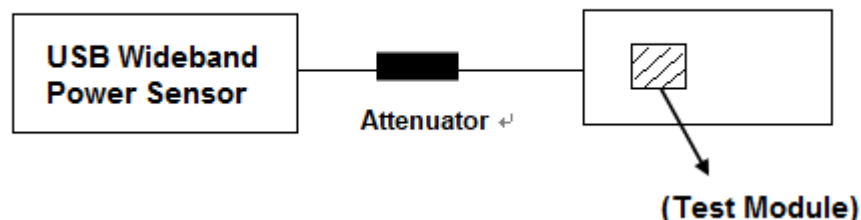
(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the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

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

### 2.3.2. Test Description

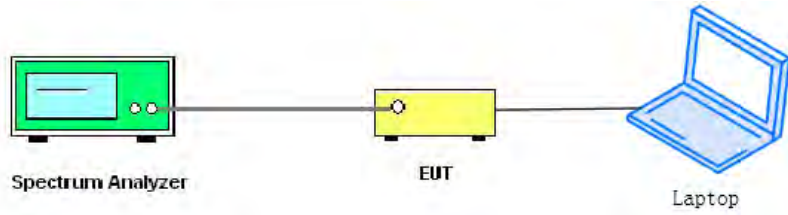
Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor.

#### 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**

**Maximum Average Conducted Output Power**

**802.11a Mode**

Frequency (MHz)	Average Power							Limit		Verdict
	Measured		Duty Factor	Duty factor Calculated						
	ANT0	ANT1		ANT0		ANT1				
	dBm	dBm		dBm	W	dBm	W			
5180	10.29	12.12	1.11	11.40	0.014	13.23	0.021	24	0.25	PASS
5220	11.09	12.43		12.20	0.017	13.54	0.023			
5240	11.08	12.53		12.19	0.017	13.64	0.023			
5745	10.59	12.65		11.70	0.015	<b>13.76</b>	<b>0.024</b>	30	1	PASS
5785	11.41	12.45		12.52	0.018	13.56	0.023			
5825	12.25	12.64		13.36	0.022	13.75	0.024			





**802.11n (HT20) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		W	dBm	dBm		W
5180	13.12	11.96	0.34	15.91	0.039	24	0.25	PASS
5220	13.20	11.98		16.02	0.040			
5240	13.17	12.04		16.02	0.040			
5745	13.48	12.64		16.43	0.044	30	1	PASS
5785	14.32	12.84		16.99	0.050			
5825	14.50	12.59		<b>16.99</b>	<b>0.050</b>			

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the power limit shall be 24dBm for 5.18-5.24 GHz band and 30dBm for 5.745-5.825 GHz band.

**802.11n (HT40) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		W	dBm	dBm		W
5190	12.32	12.58	0.15	15.68	0.037	24	0.25	PASS
5230	12.75	12.76		15.91	0.039			
5755	13.42	13.53		16.72	0.047	30	1	
5795	13.31	13.57		16.63	0.046			

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the power limit shall be 24dBm for 5.18-5.24 GHz band and 30dBm for 5.745-5.825 GHz band.



**802.11ac (VHT20) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		W	dBm	dBm		W
5180	7.71	11.24	0.34	13.01	0.020	24	0.25	PASS
5220	8.64	11.29		13.22	0.021			
5240	9.09	11.32		13.42	0.022			
5745	10.02	13.70		15.31	0.034	30	1	PASS
5785	10.92	13.84		15.68	0.037			
5825	11.77	13.68		<b>15.91</b>	<b>0.039</b>			

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the power limit shall be 24dBm for 5.18-5.24 GHz band and 30dBm for 5.745-5.825 GHz band.

**802.11ac (VHT40) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		W	dBm	dBm		W
5190	9.64	11.41	0.15	13.80	0.024	24	0.25	PASS
5230	10.35	11.32		13.98	0.025			
5755	11.21	13.36		15.56	0.036	30	1	
5795	11.83	13.25		<b>15.80</b>	<b>0.038</b>			

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the power limit shall be 24dBm for 5.18-5.24 GHz band and 30dBm for 5.745-5.825 GHz band.

**802.11ac (VHT80) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		W	dBm	dBm		W
5210	8.70	10.13	0.15	12.79	0.019	24	0.25	PASS
5775	9.59	10.32		<b>13.42</b>	<b>0.022</b>	30	1	

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the power limit shall be 24dBm for 5.18-5.24 GHz band and 30dBm for 5.745-5.825 GHz band.

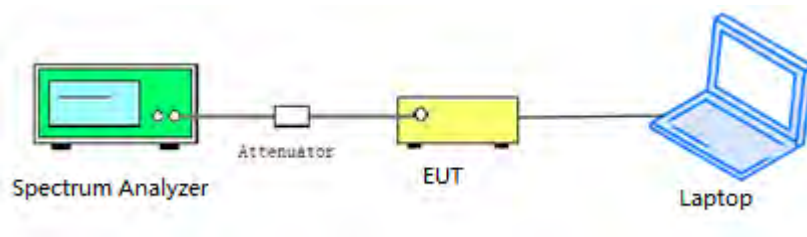
## 2.4. Emission Bandwidth

### 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

#### Test Setup:



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.

### 2.4.3. 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 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 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.

**2.4.4. Test Result**

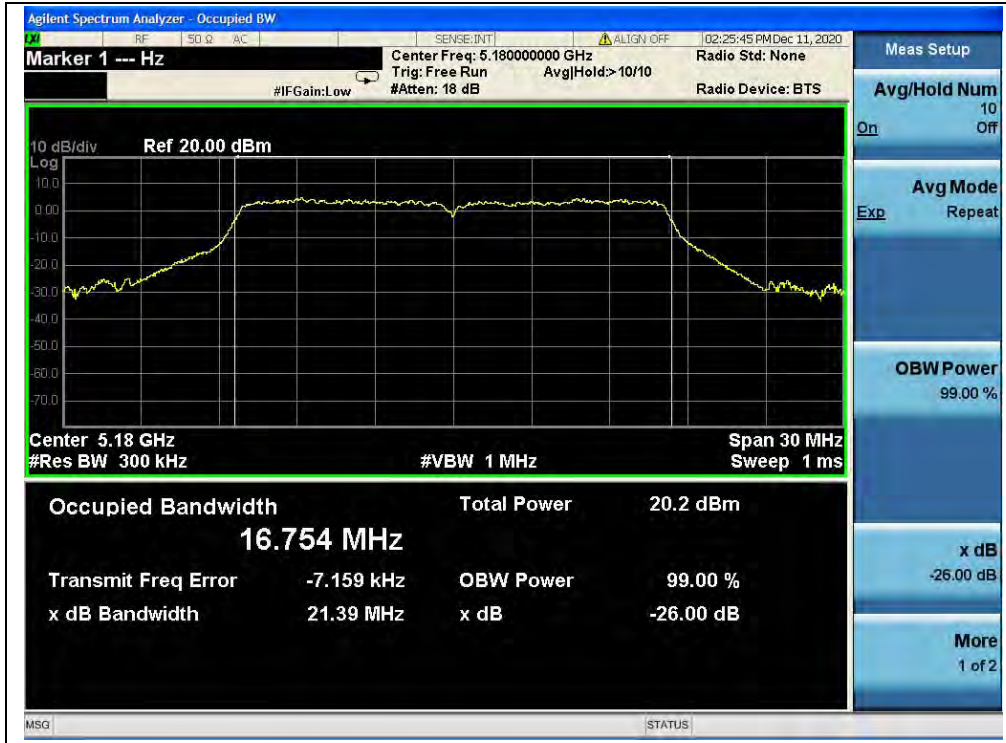
**802.11a Mode**

**A. Test Verdict:**

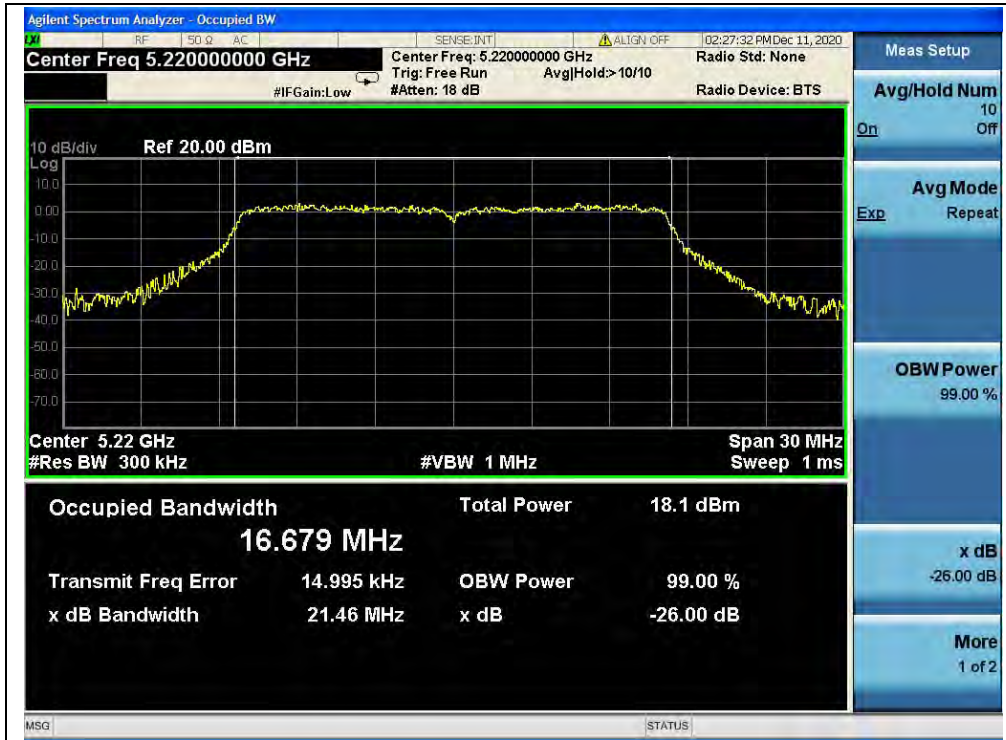
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	21.39
44	5220	21.46
48	5240	21.29
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
149	5745	16.48
157	5785	16.40
165	5825	16.36



B.Test Plot:



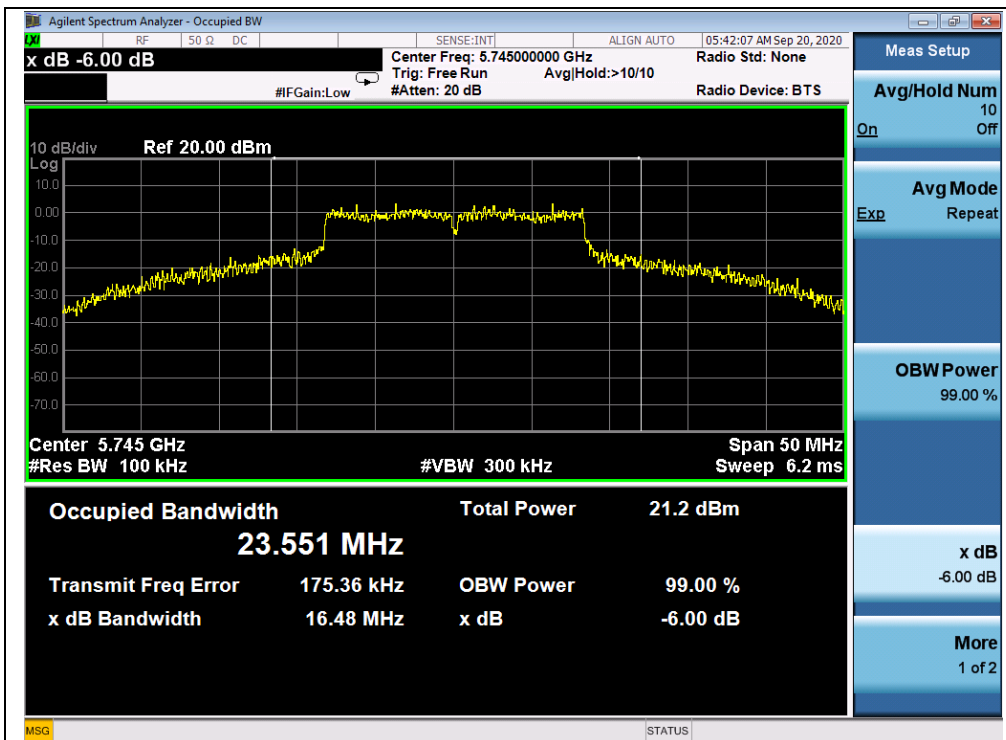
(Channel 36, 5180MHz, 802.11a)



(Channel 44, 5220 MHz, 802.11a)

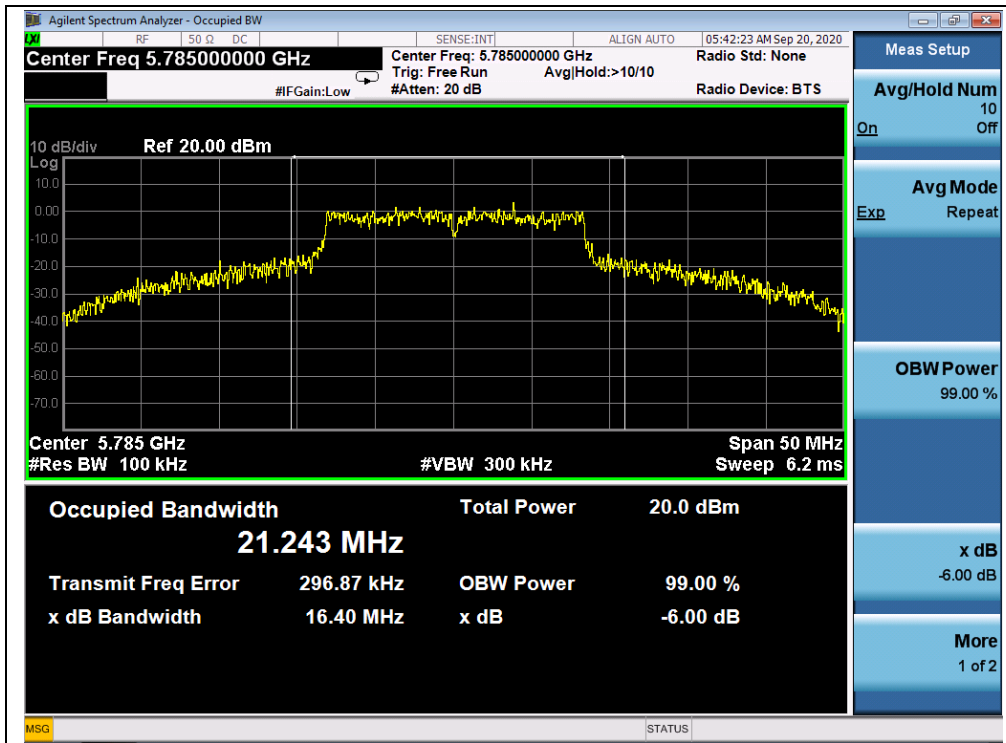


(Channel 48, 5240MHz, 802.11a)

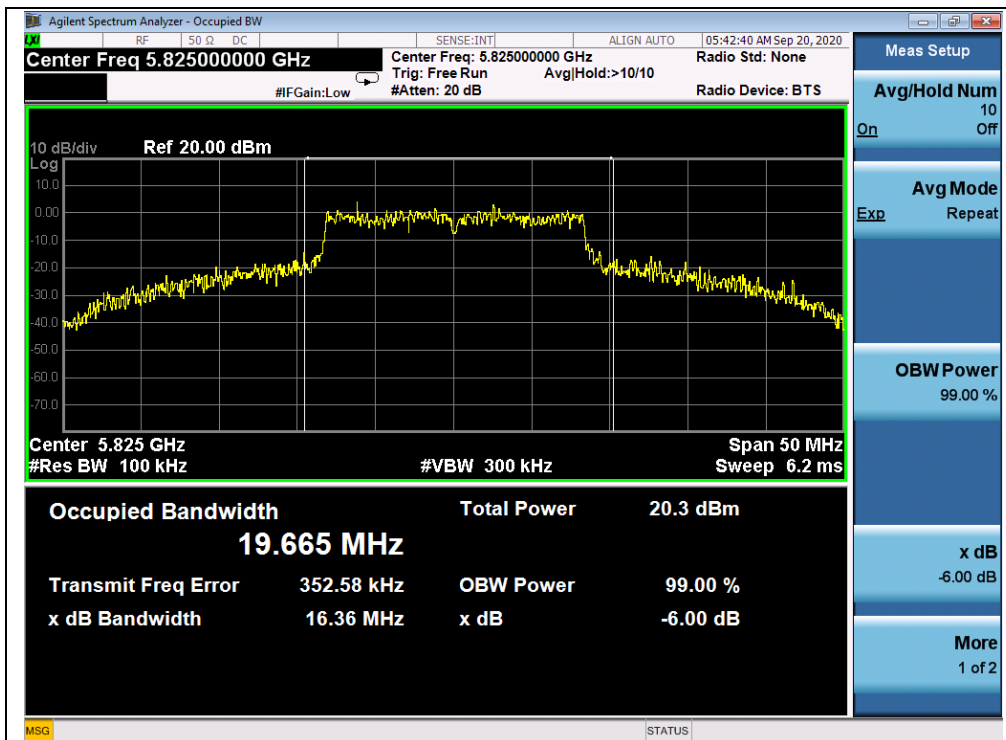


(Channel 149, 5745MHz, 802.11a)





(Channel 157,5785MHz, 802.11a)



(Channel 165, 5825MHz, 802.11a)



802.11n (HT20) Mode

A. Test Verdict:

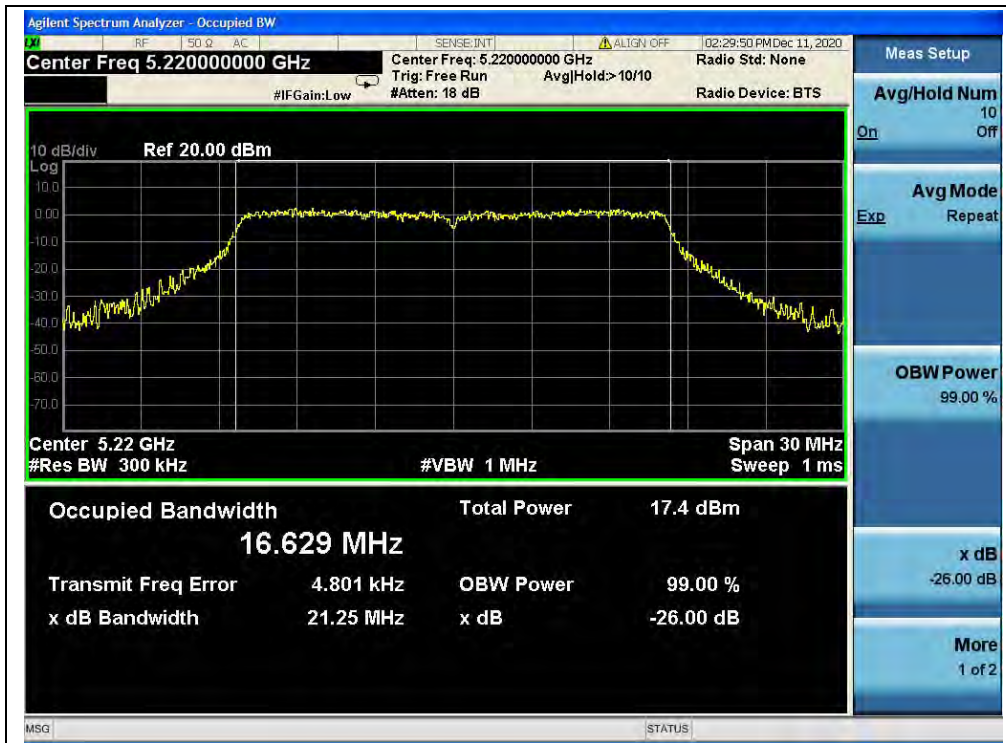
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	21.11
44	5220	21.25
48	5240	21.24
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
149	5745	16.46
157	5785	16.55
165	5825	16.09

B. Test Plot:



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

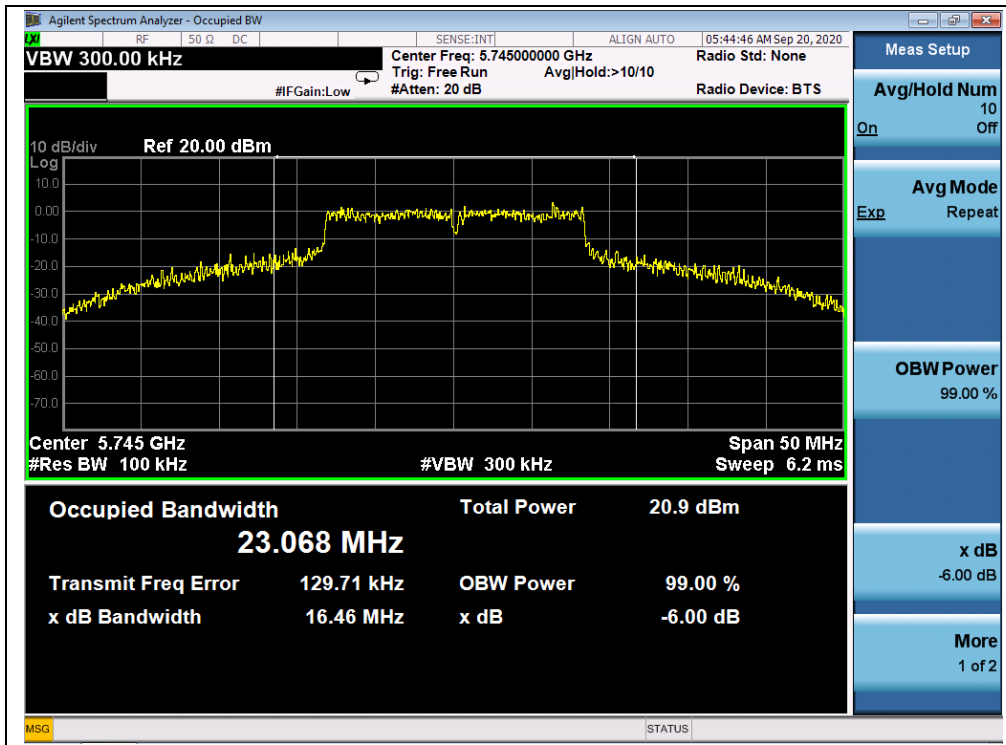




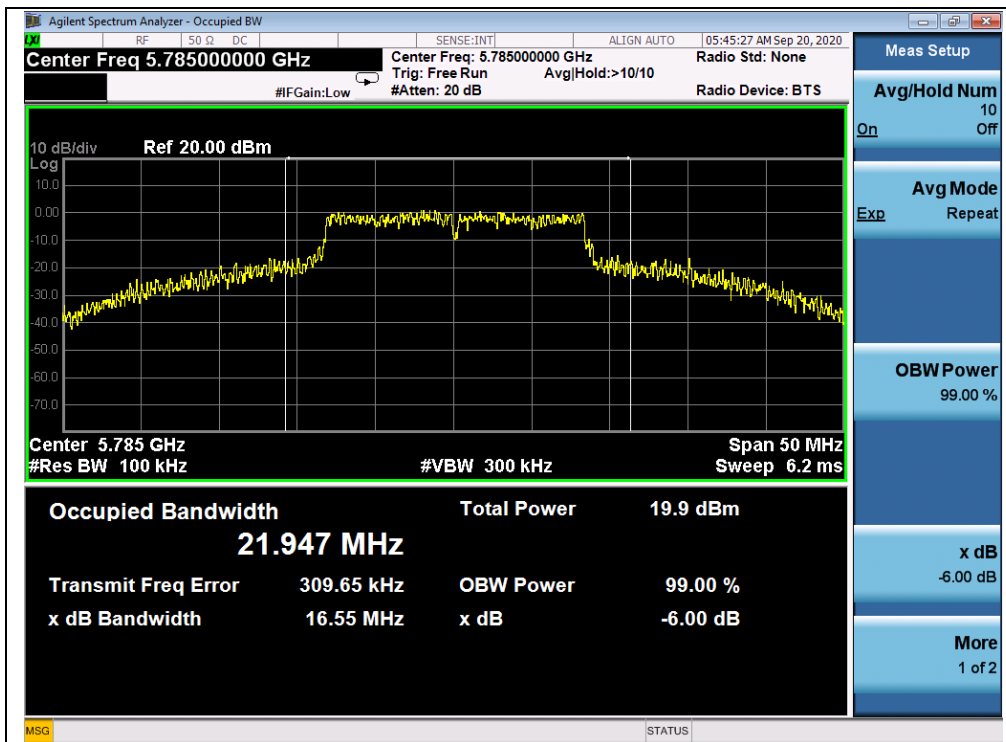
(Channel 44, 5220MHz, 802.11n (HT20))



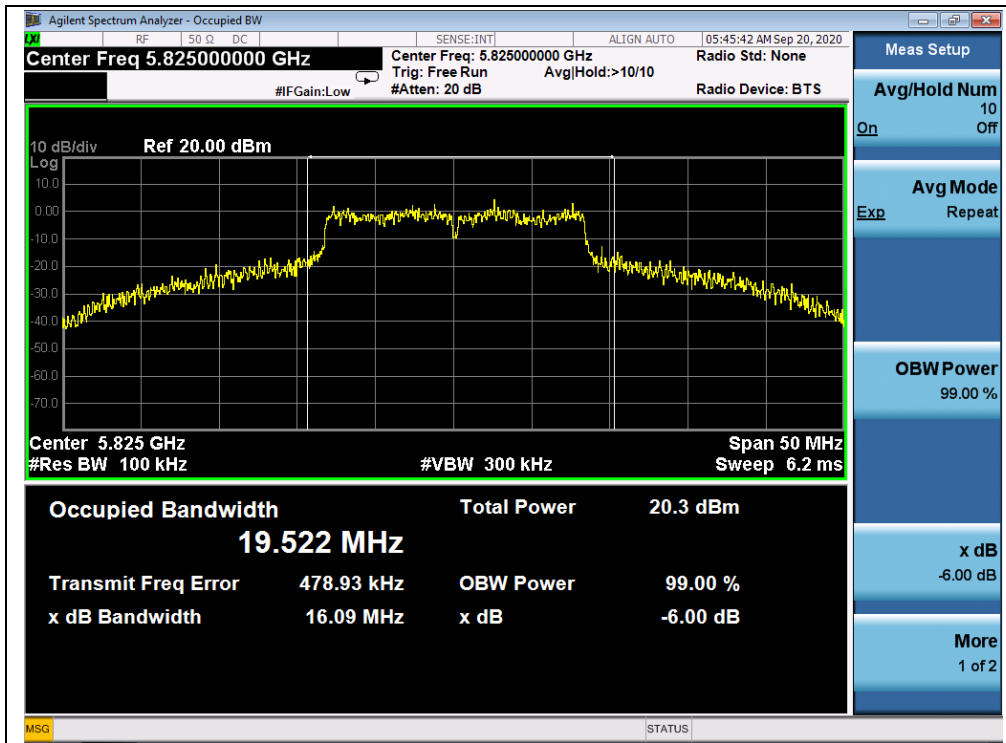
(Channel 48, 5240MHz, 802.11n (HT20))



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



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



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

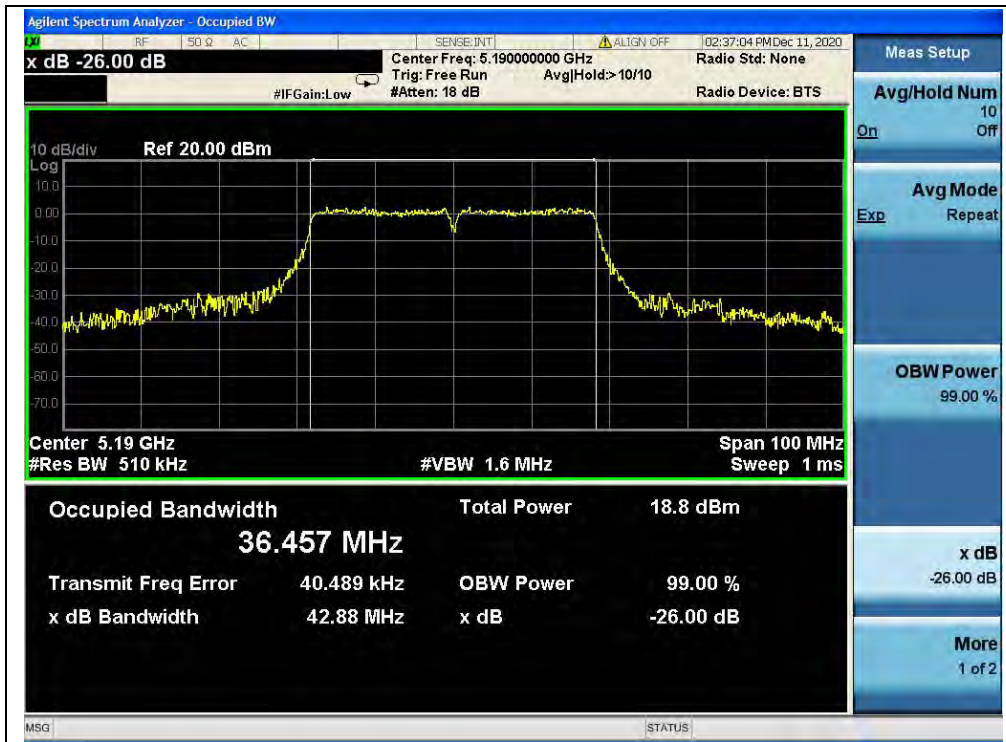


802.11n (HT40) Test mode

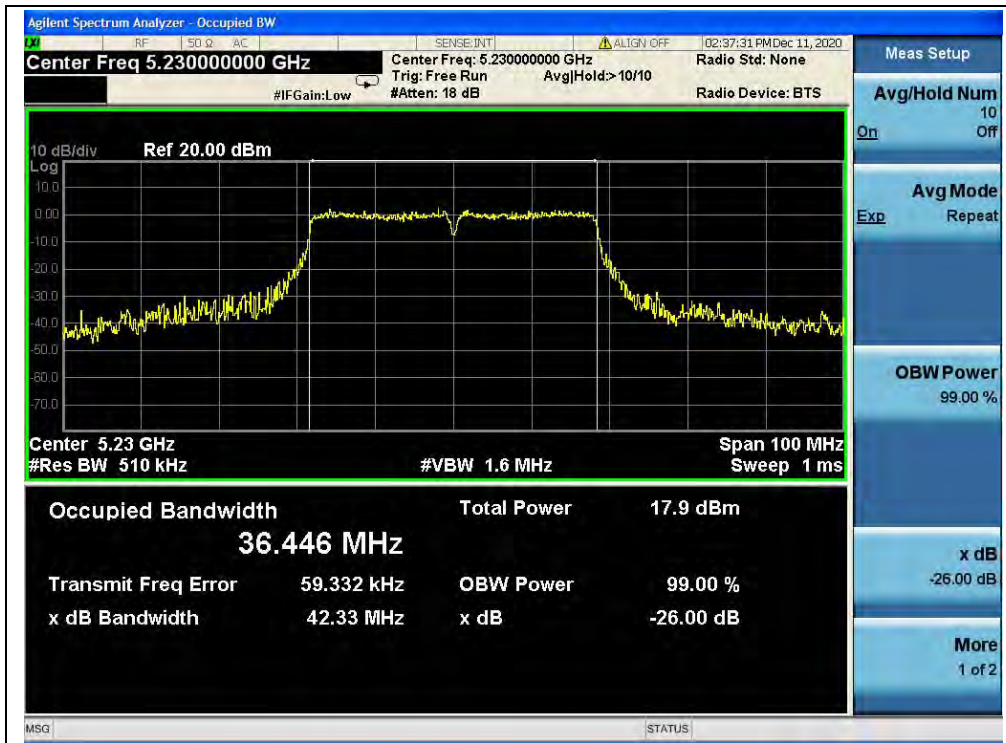
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	42.88
46	5230	42.33
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
151	5755	36.37
159	5795	36.26

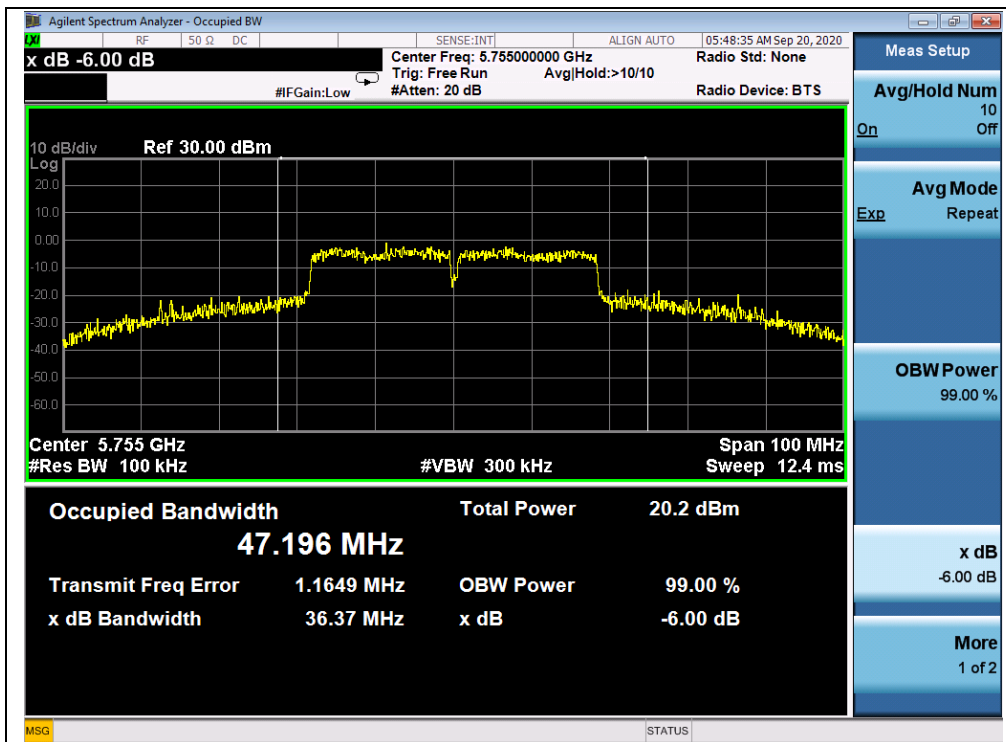
B. Test Plot:



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

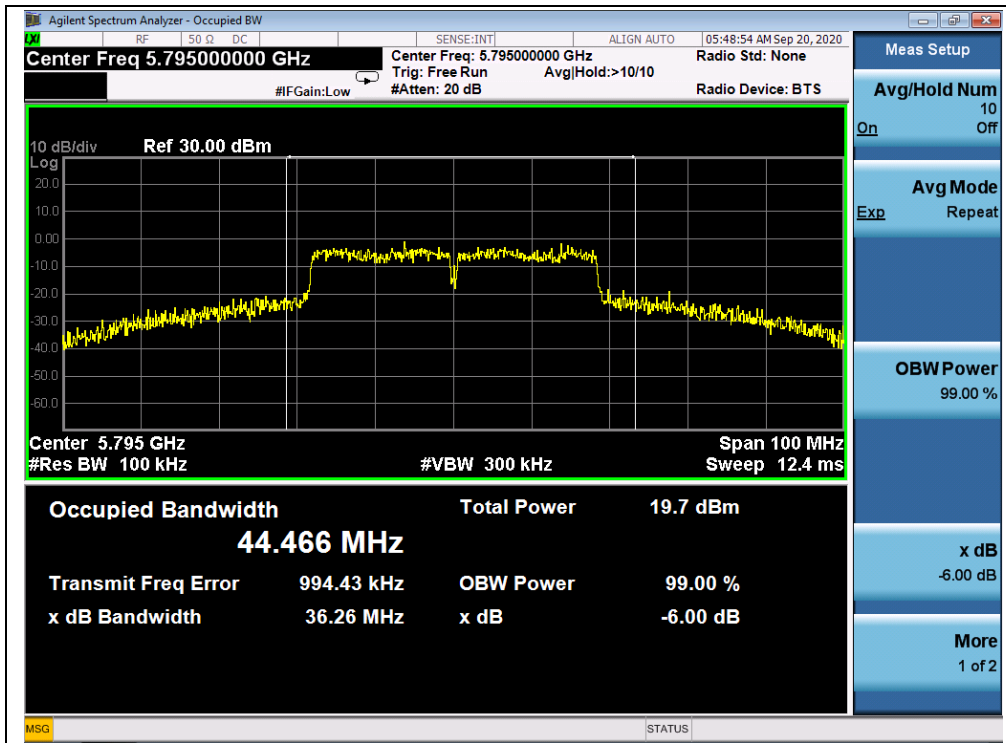


(Channel 46, 5230MHz, 802.11n (HT40))



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





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

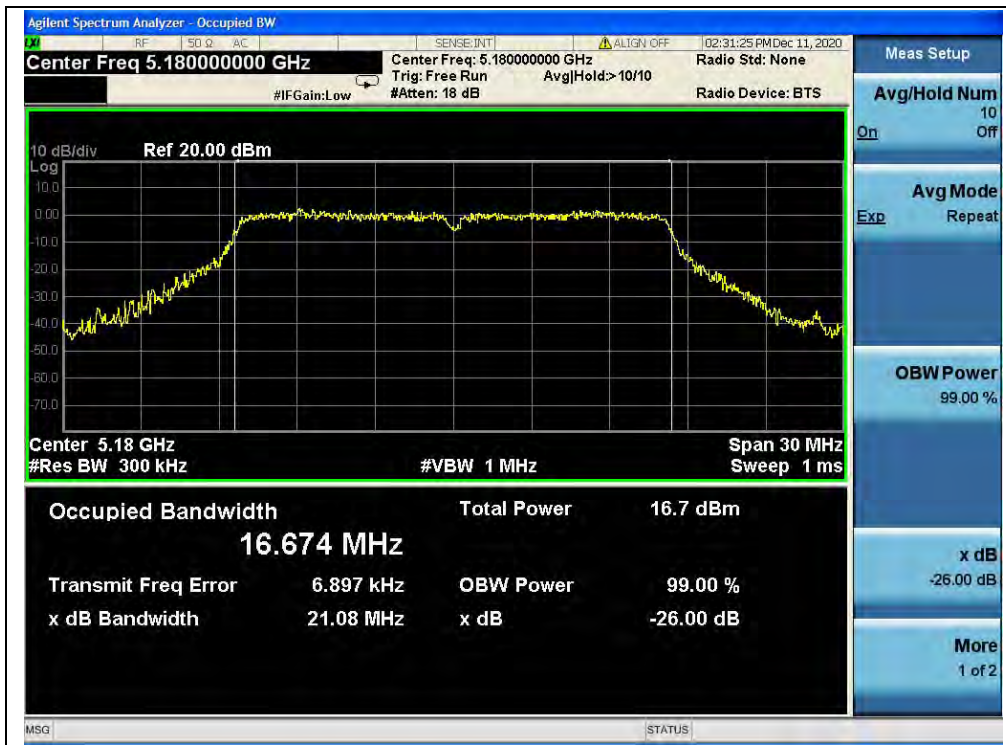


802.11ac (VHT20) Test mode

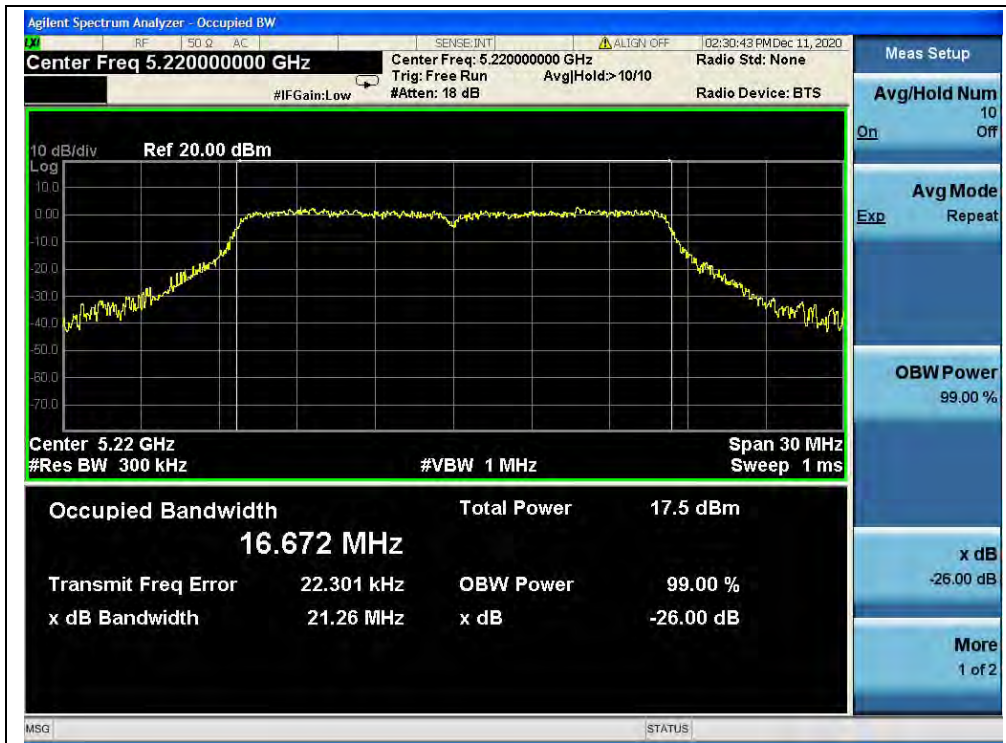
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	21.08
44	5220	21.26
48	5240	21.38
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
149	5745	17.60
157	5785	17.67
165	5825	17.68

B. Test Plot:



(Channel 36, 5180MHz, 802.11ac (VHT20))

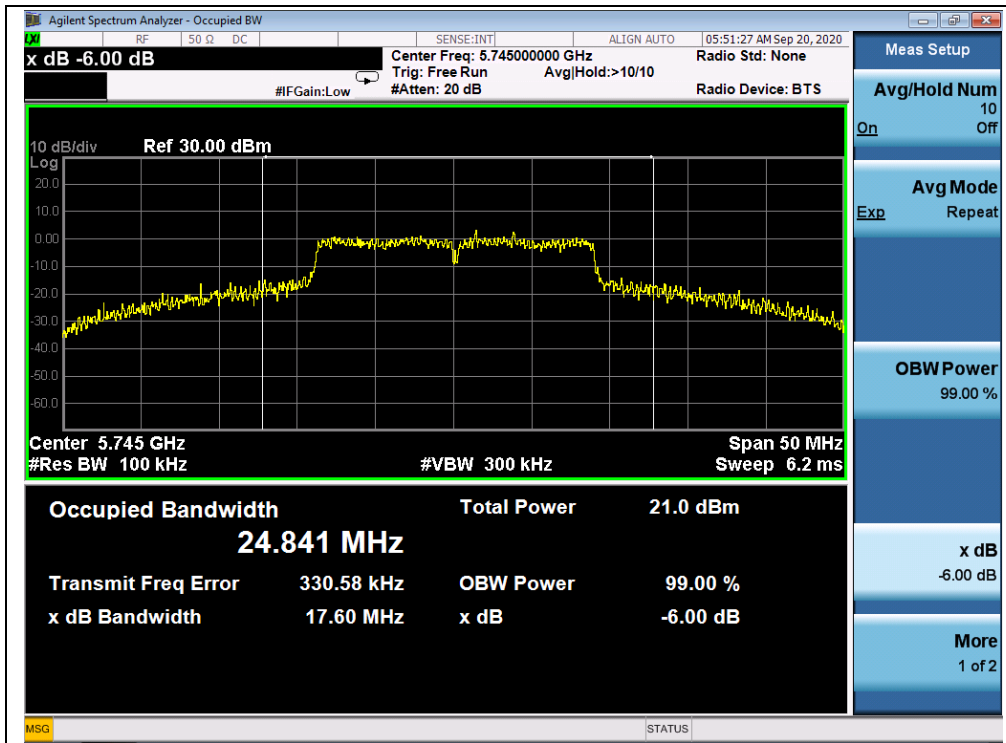


(Channel 44, 5220 MHz, 802.11ac (VHT20))

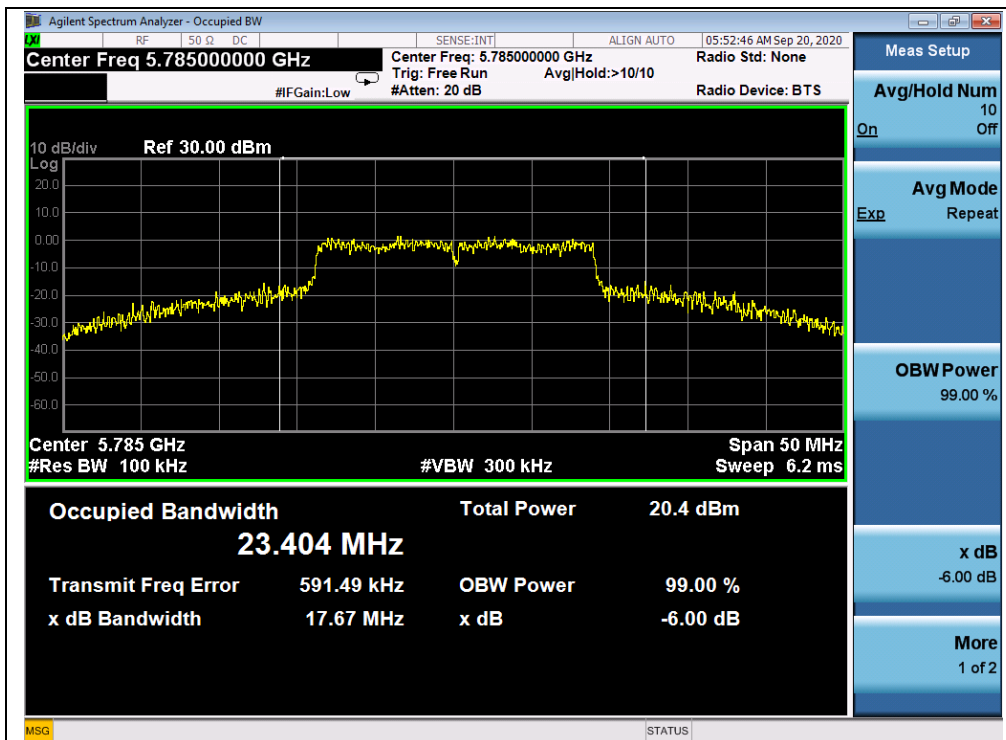


(Channel 48, 5240MHz, 802.11ac (VHT20))

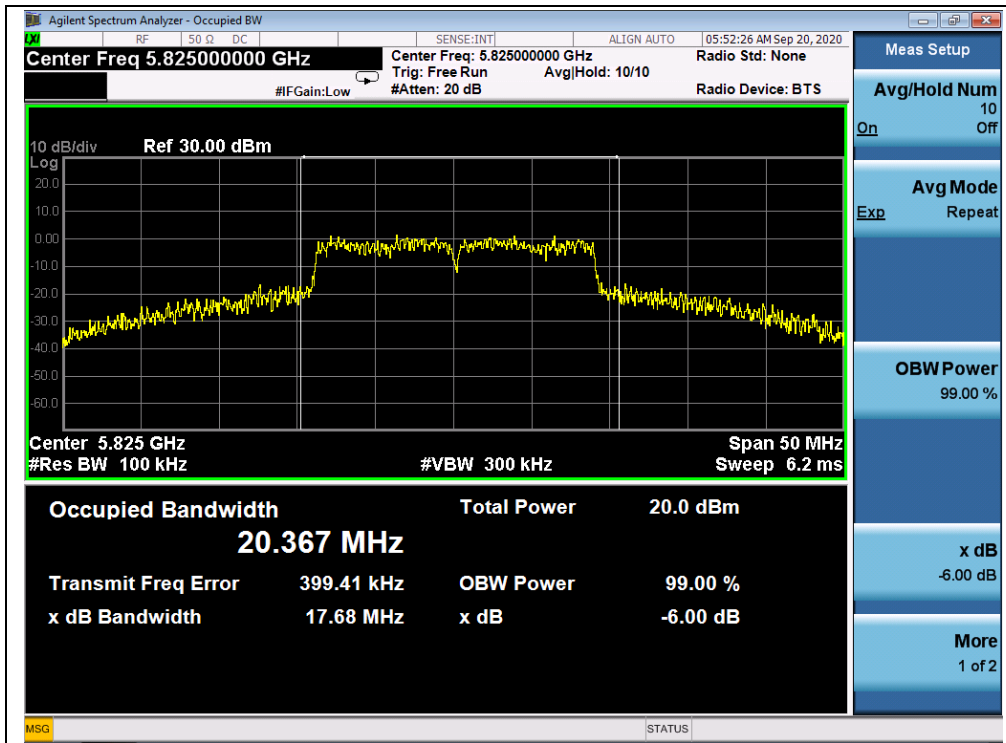




(Channel 149, 5745MHz, 802.11ac (VHT20))



(Channel 157, 5785MHz, 802.11ac (VHT20))



(Channel 165, 5825MHz, 802.11ac (VHT20))



**802.11ac (VHT40) Test mode**

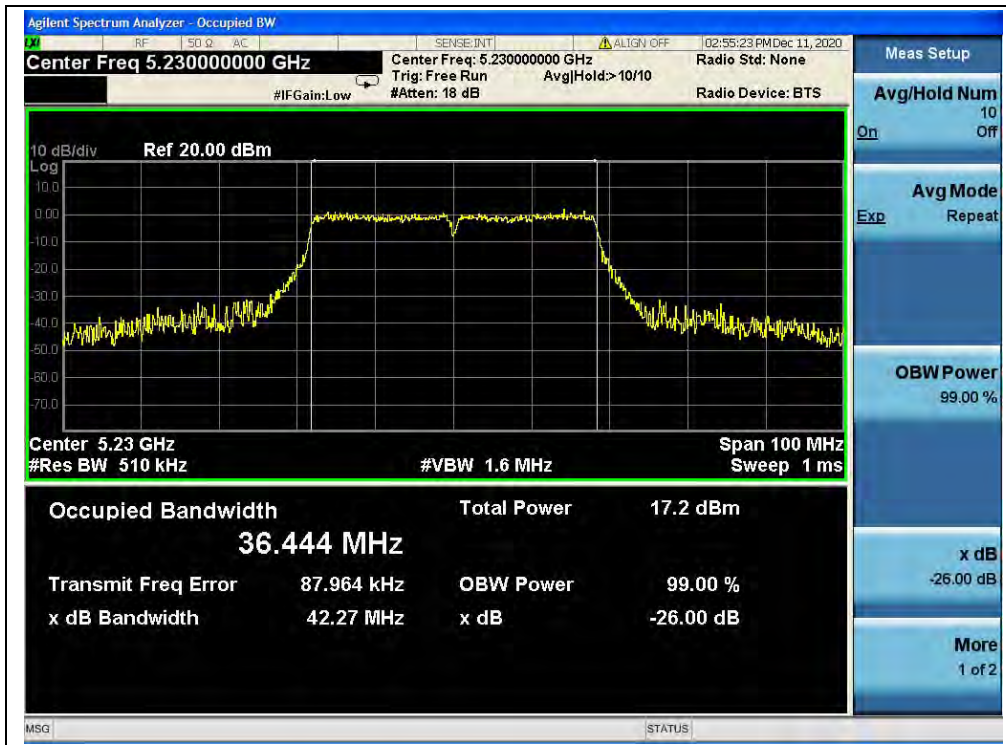
**A. Test Verdict:**

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	43.21
46	5230	42.27
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
151	5755	36.39
159	5795	36.06

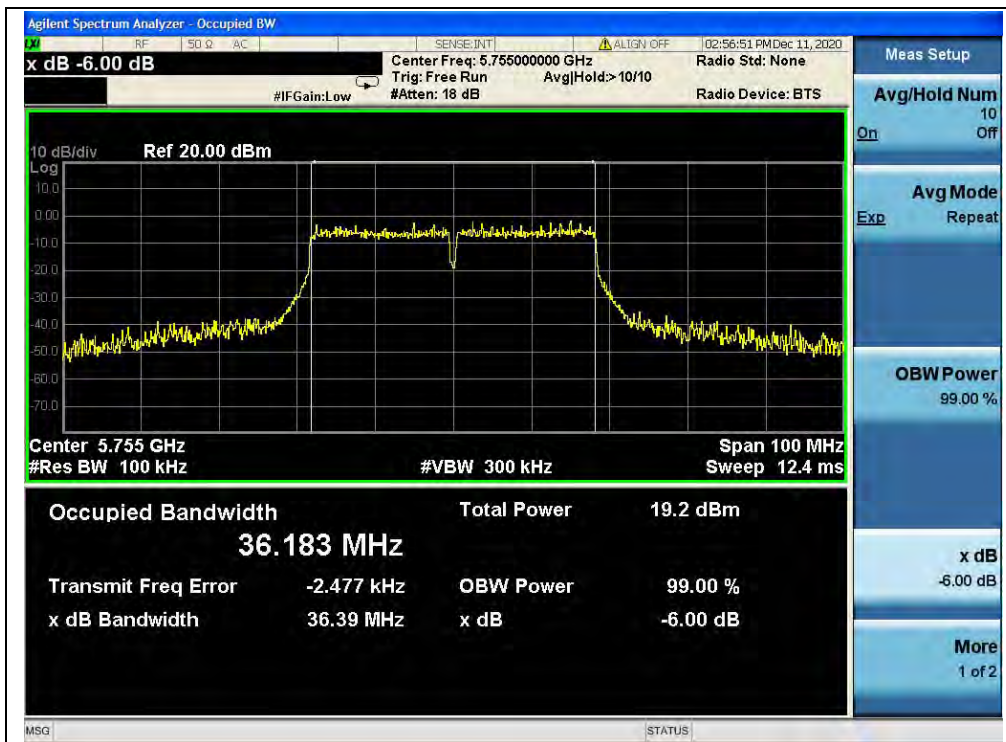
**B. Test Plot:**



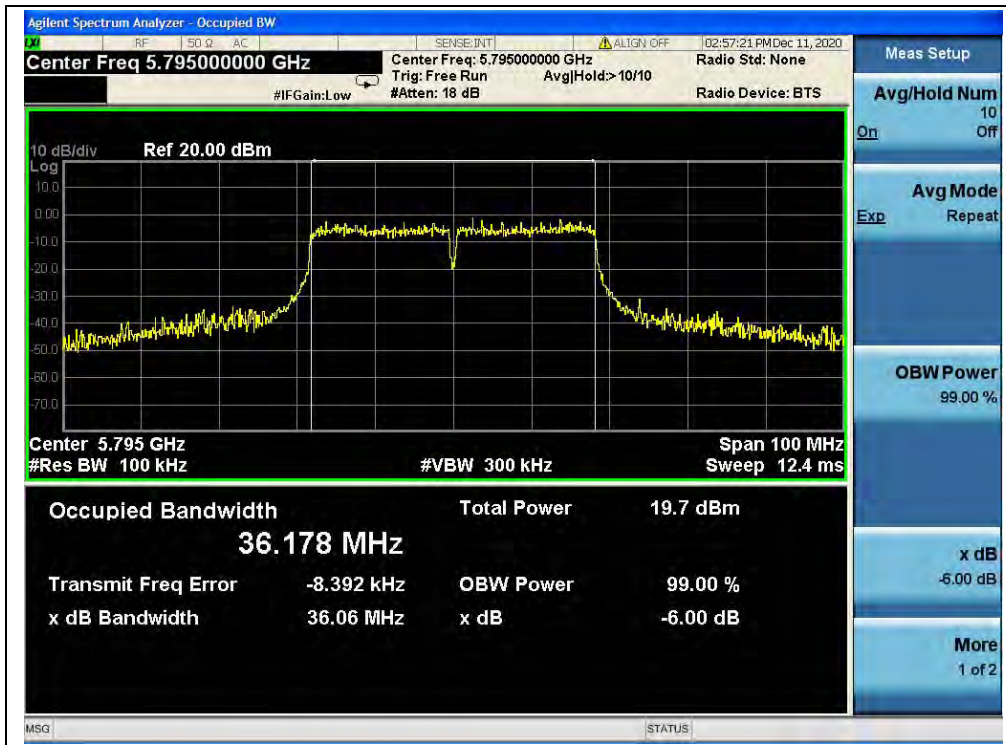
(Channel 38, 5190MHz, 802.11ac (VHT40))



(Channel 46, 5230 MHz, 802.11ac (VHT40))



(Channel 151, 5755 MHz, 802.11ac (VHT40))



(Channel 159, 5795MHz, 802.11ac (VHT40))



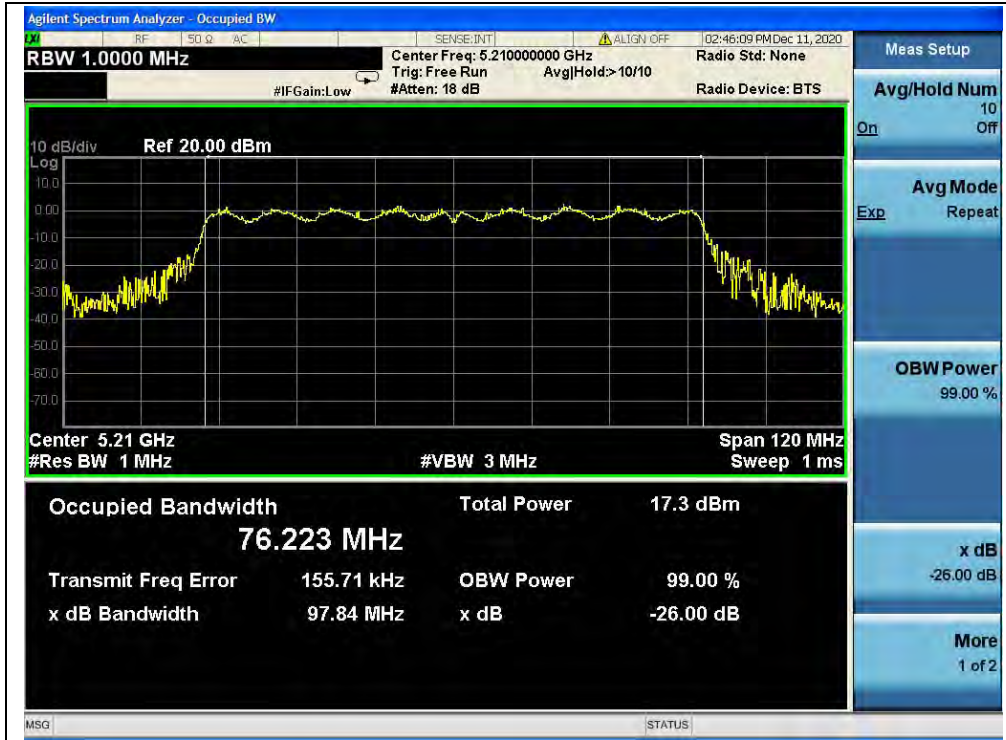


802.11 ac (VHT80) Test mode

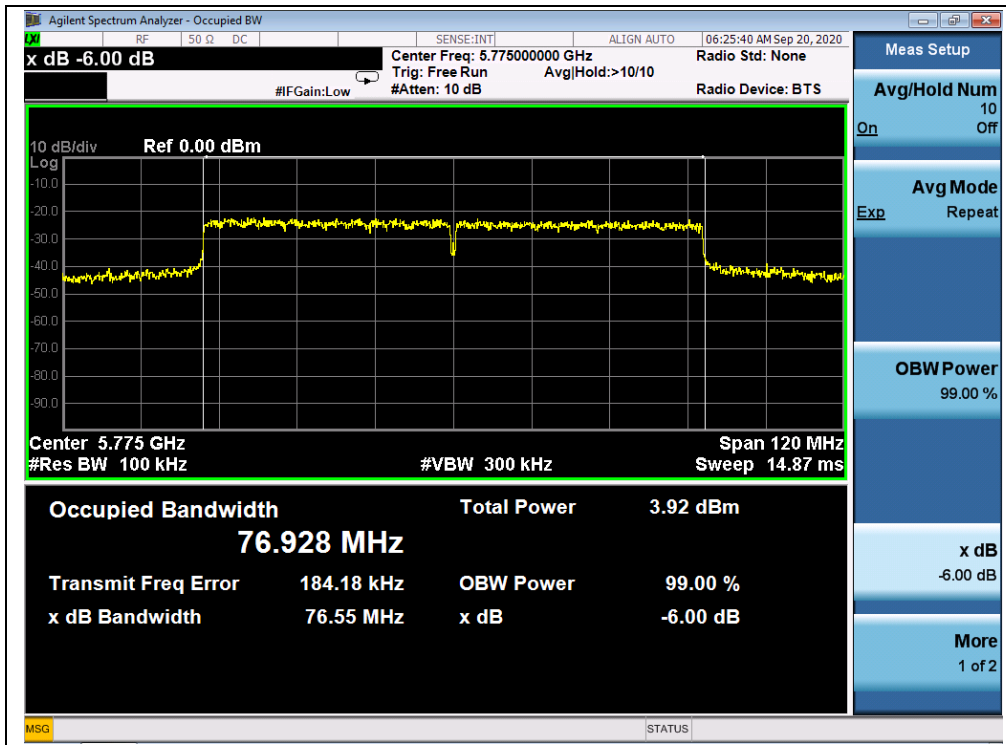
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
42	5210	97.84
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
155	5775	76.55

B. Test Plot:



(Channel 42, 5210MHz, 802.11ac (VHT80))



(Channel 155, 5775 MHz, 802.11ac (VHT80))

## 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 11dBm 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 11dBm in any 1 megahertz band.

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

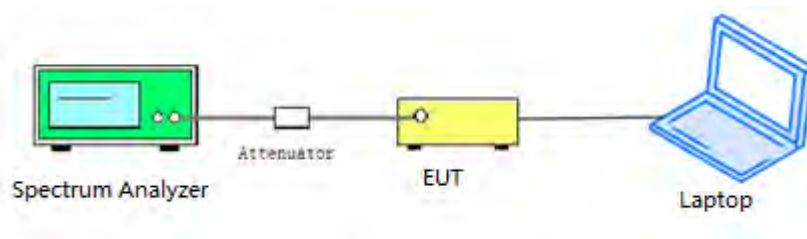
If transmitting antennas of directional gain greater than 6dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

(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

#### 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.





**2.5.3. Test Procedure**

KDB 789033 Section F) Maximum Power Spectral Density (PSD) Method SA-3 was used in order to prove compliance

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

**2.5.4. Test Result**

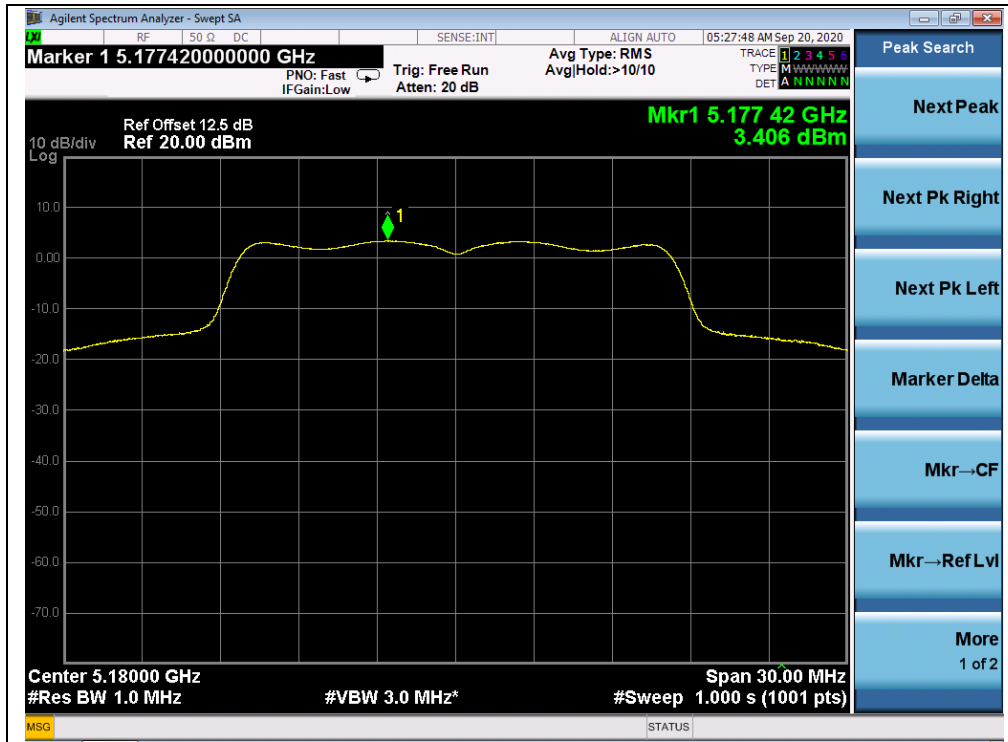
**802.11a Mode**

**A. Test Verdict:**

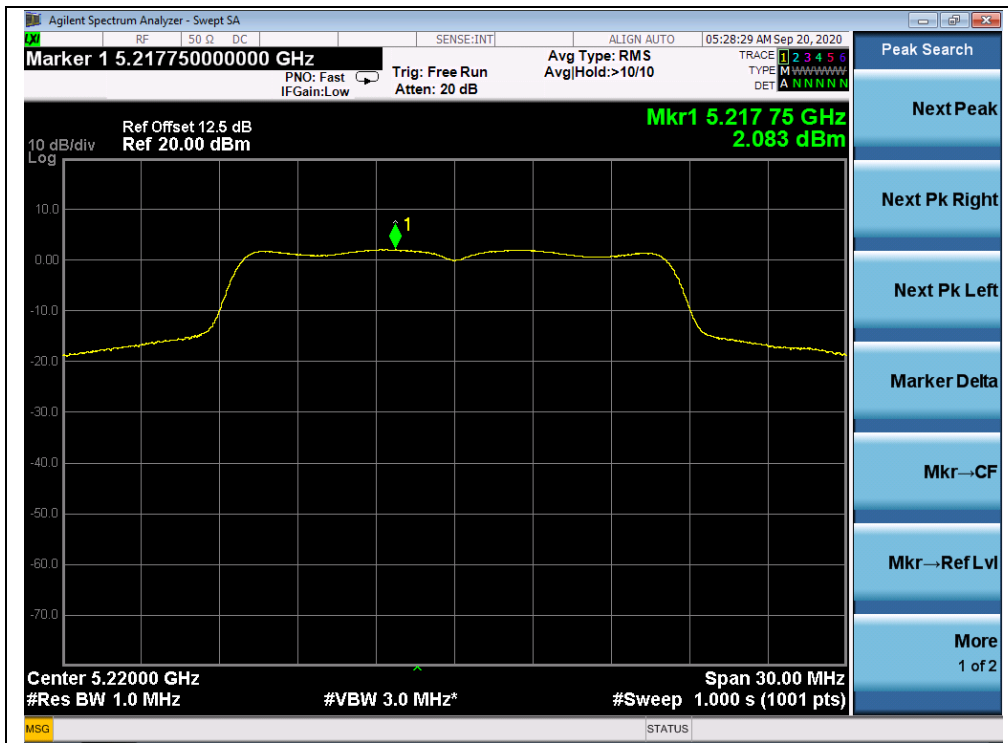
Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Corrected PPSD (dBm/MHz)		Limit (dBm/MHz)	Verdict
		ANT0	ANT1		ANT0	ANT1		
36	5180	3.41	3.92	1.11	4.52	5.03	11	PASS
44	5220	2.08	4.04		3.19	5.15		
48	5240	4.01	4.01		5.12	5.12		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)		Limit (dBm/500KHz)	Verdict
		ANT0	ANT1		ANT0	ANT1		
149	5745	1.77	2.18	1.11	2.88	3.29	30	PASS
157	5785	3.04	1.96		4.15	3.07		
165	5825	2.67	1.82		3.78	2.93		



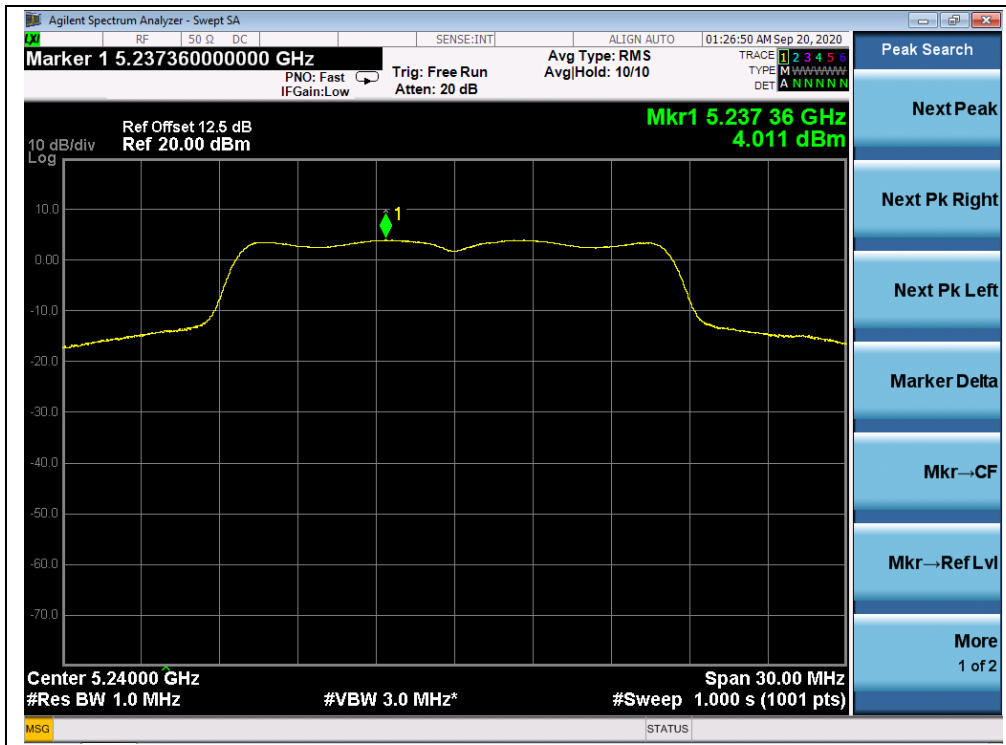
B.Test Plot:



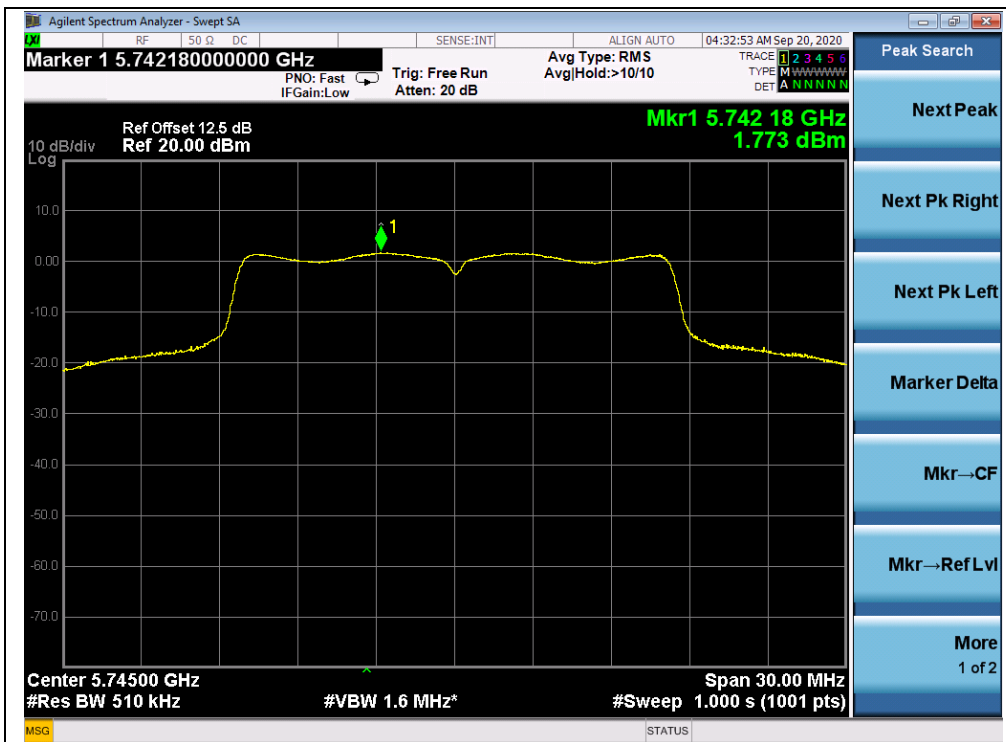
(Channel 36, 5180MHz, 802.11a, ANT0)



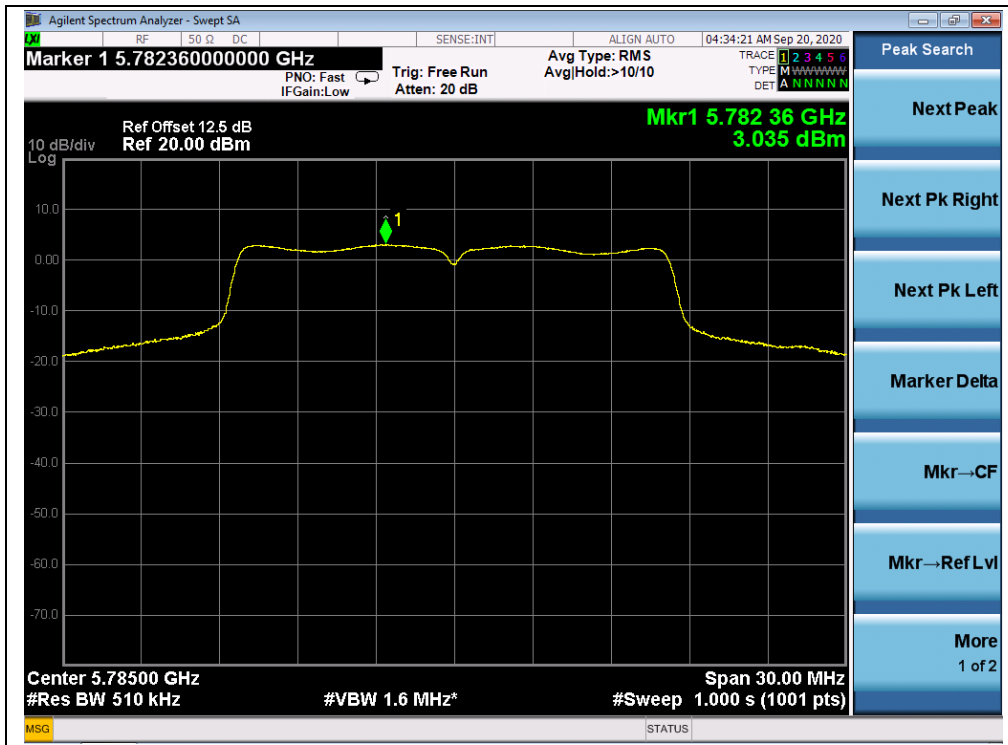
(Channel 44, 5220MHz, 802.11a, ANT0)



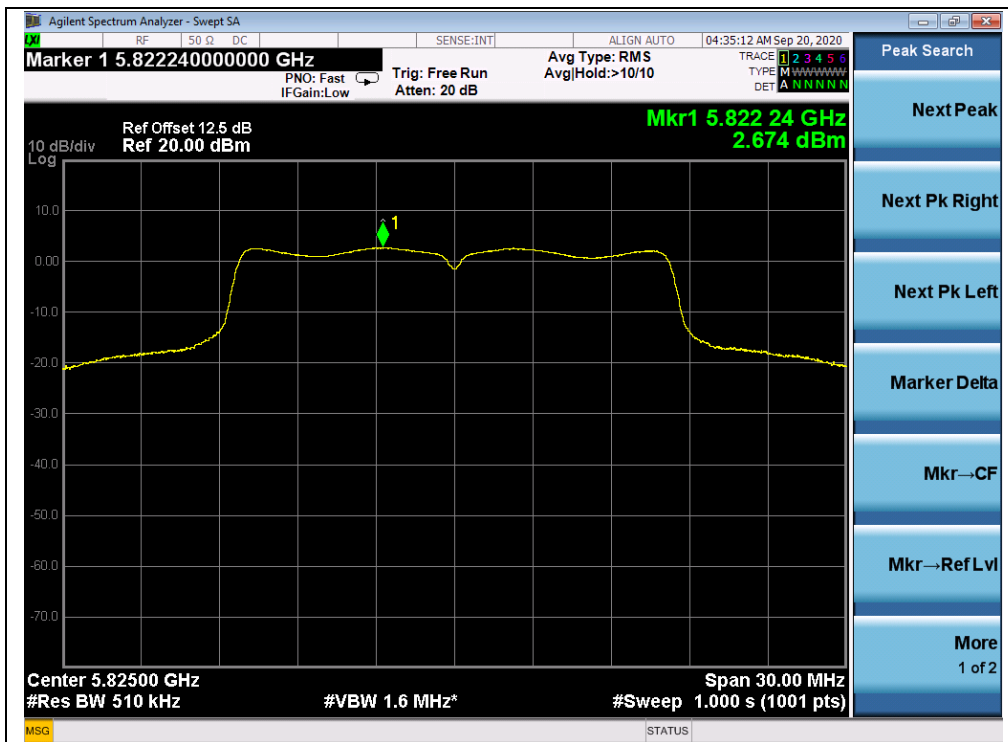
(Channel 48, 5240MHz, 802.11a, ANT0)



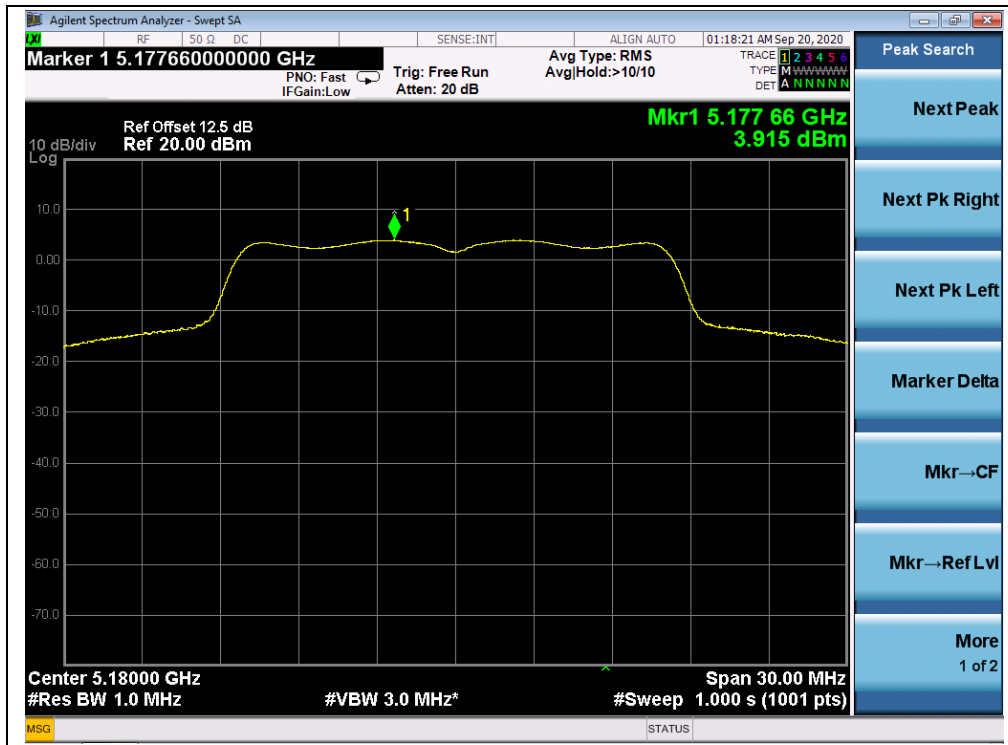
(Channel 149, 5745MHz, 802.11a, ANT0)



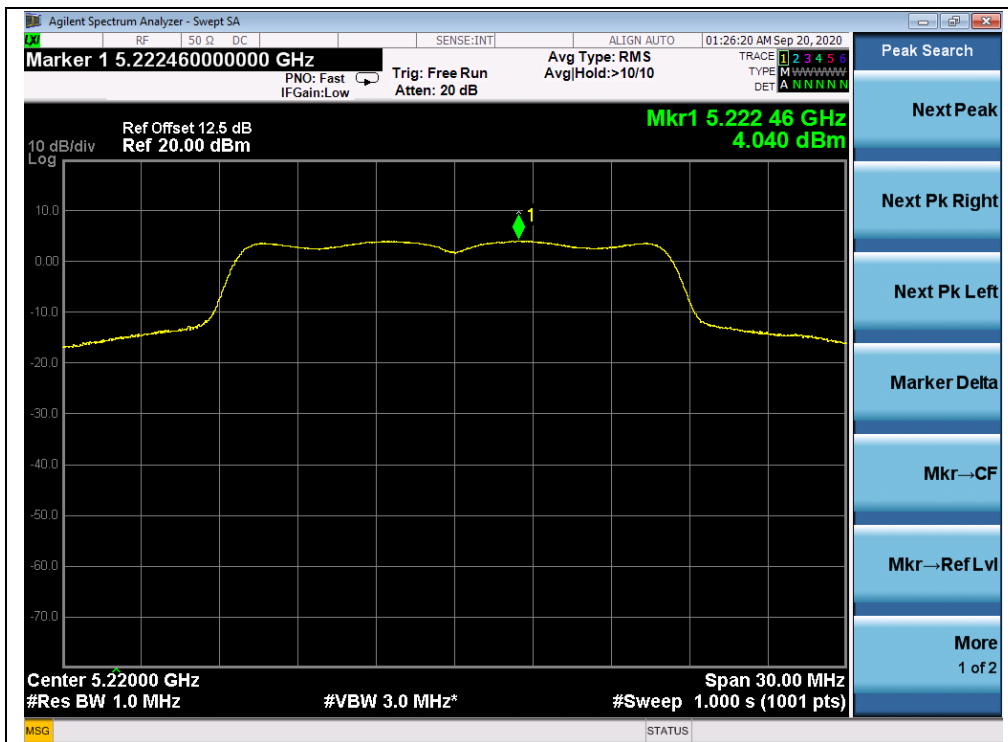
(Channel 157, 5785MHz, 802.11a, ANT0)



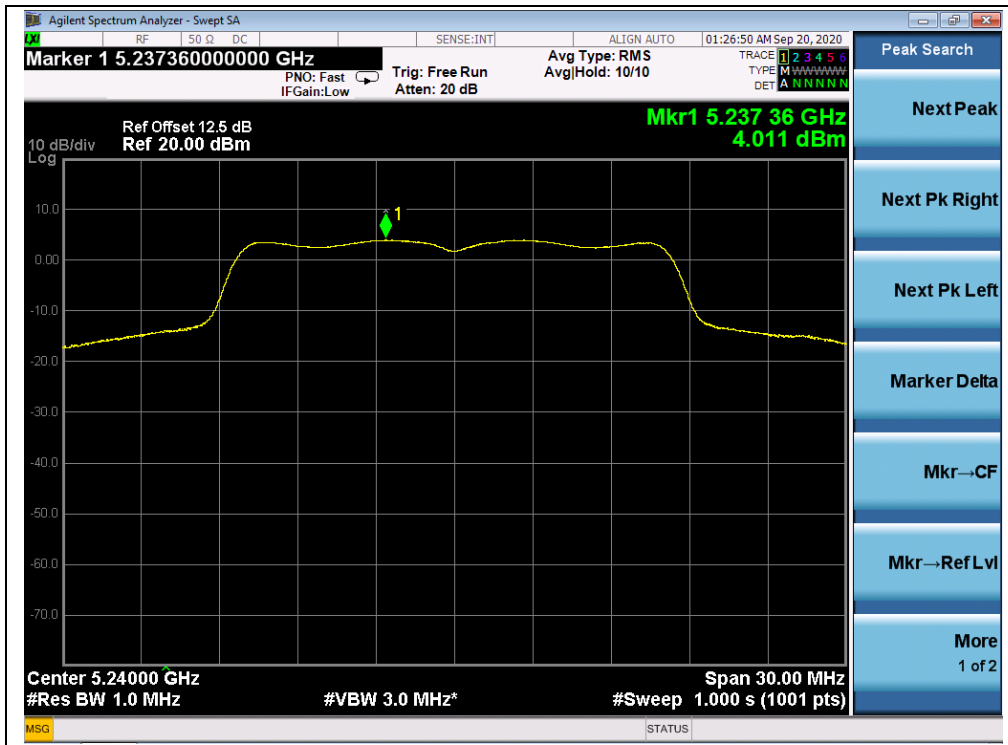
(Channel 165, 5825MHz, 802.11a, ANT0)



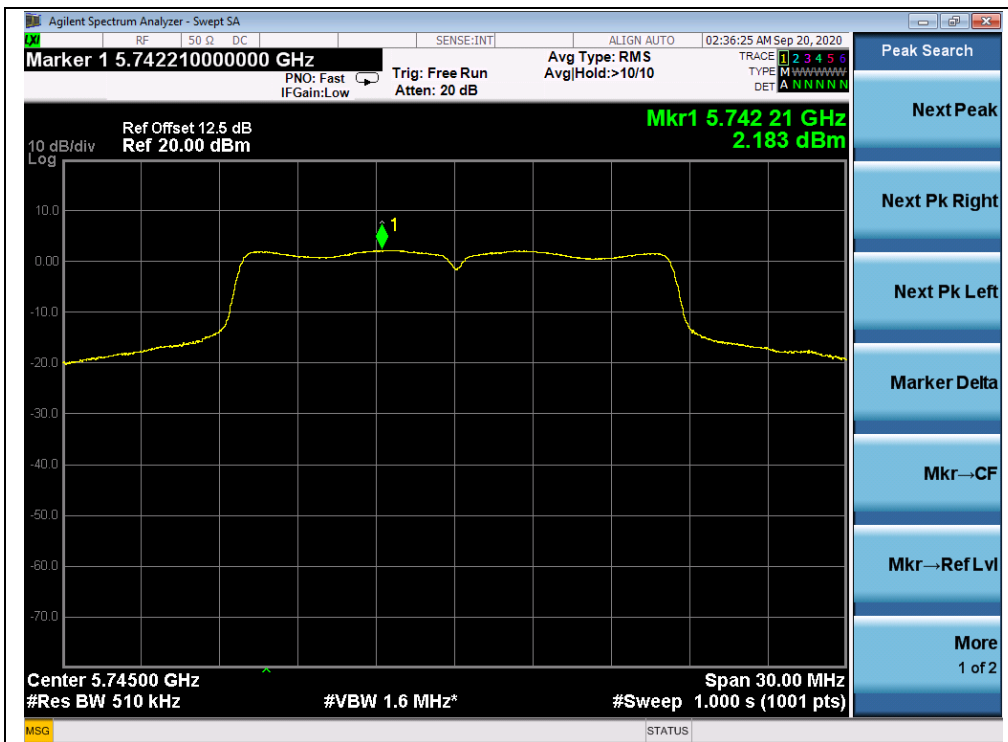
(Channel 36, 5180MHz, 802.11a, ANT1)



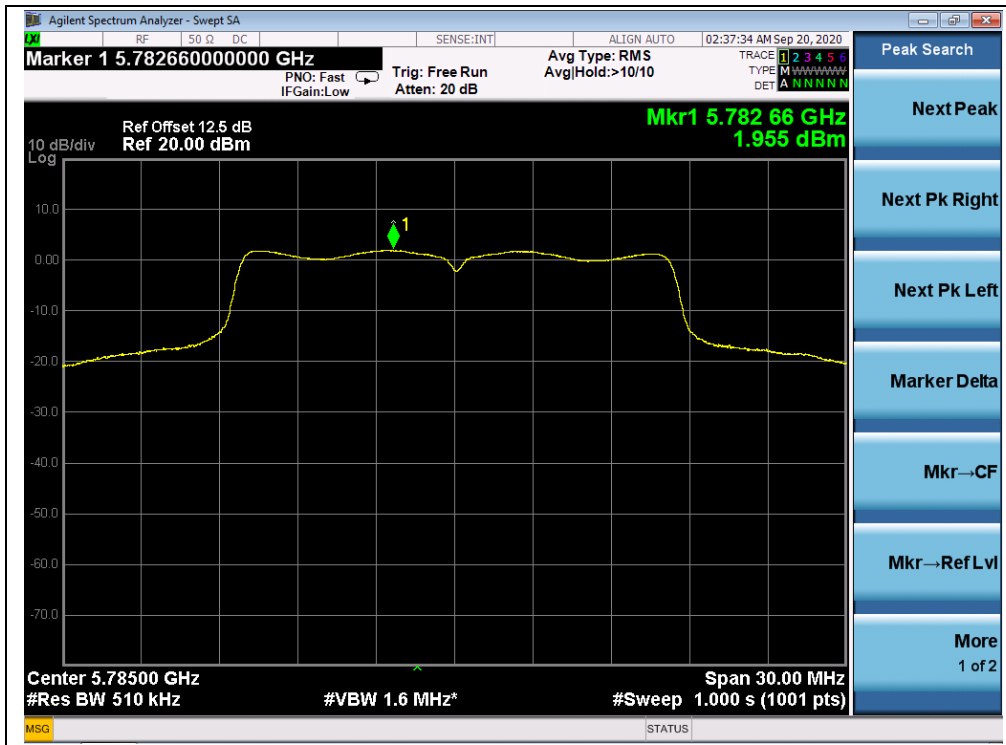
(Channel 44, 5220MHz, 802.11a, ANT1)



(Channel 48, 5240MHz, 802.11a, ANT1)



(Channel 149, 5745MHz, 802.11a, ANT1)



(Channel 157, 5785MHz, 802.11a, ANT1)



(Channel 165, 5825MHz, 802.11a, ANT1)





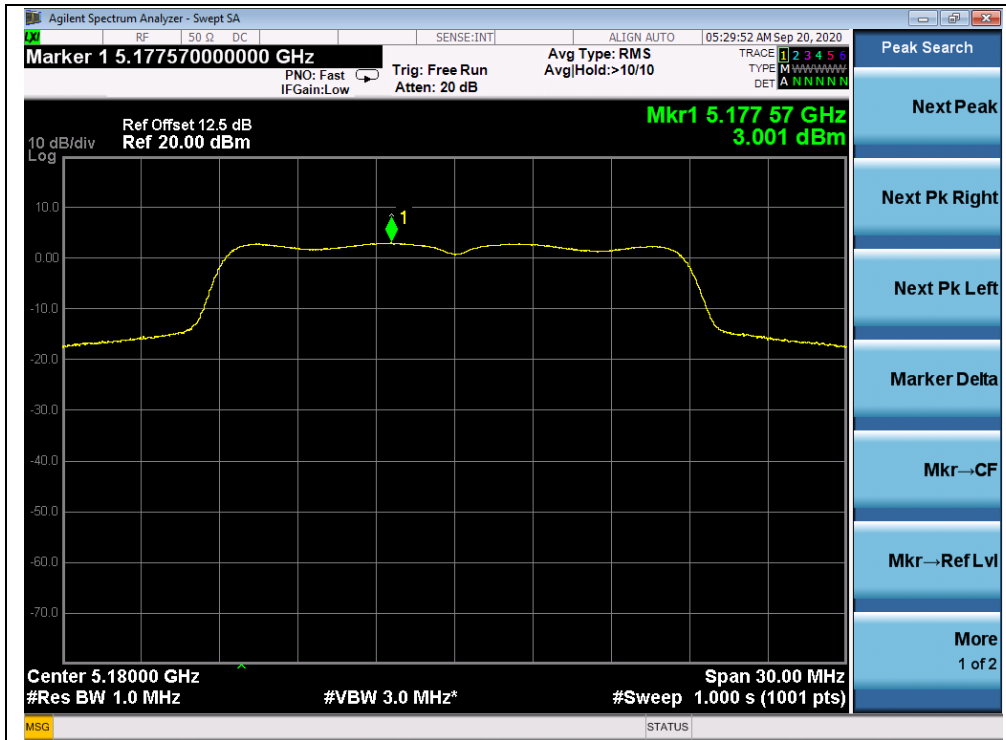
**802.11n (HT20) Mode**

**A.Test Verdict:**

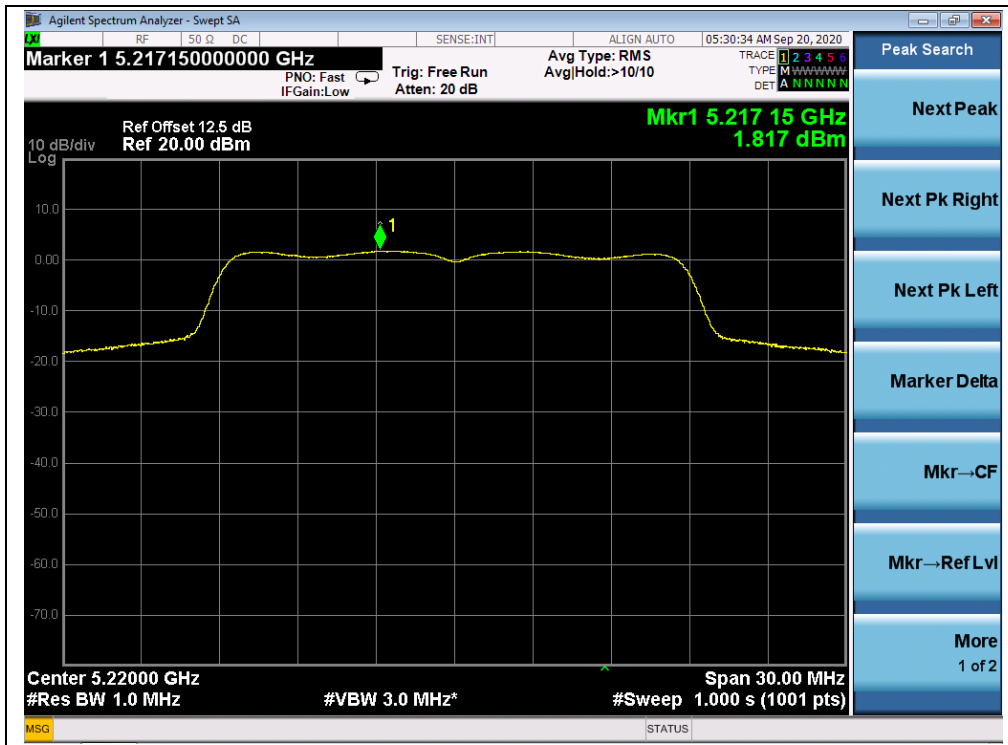
Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
		ANT0	ANT1				
36	5180	3.00	3.13	0.34	6.42	11	PASS
44	5220	1.82	3.20				
48	5240	1.63	3.37				
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
		ANT0	ANT1				
149	5745	2.49	2.14	0.34	5.67	30	PASS
157	5785	2.23	1.75				
165	5825	2.32	1.90				

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the limit shall be 11 dBm/MHz for 5.18-5.24 GHz band and 30 dBm/500KHz for 5.745-5.825 GHz band.

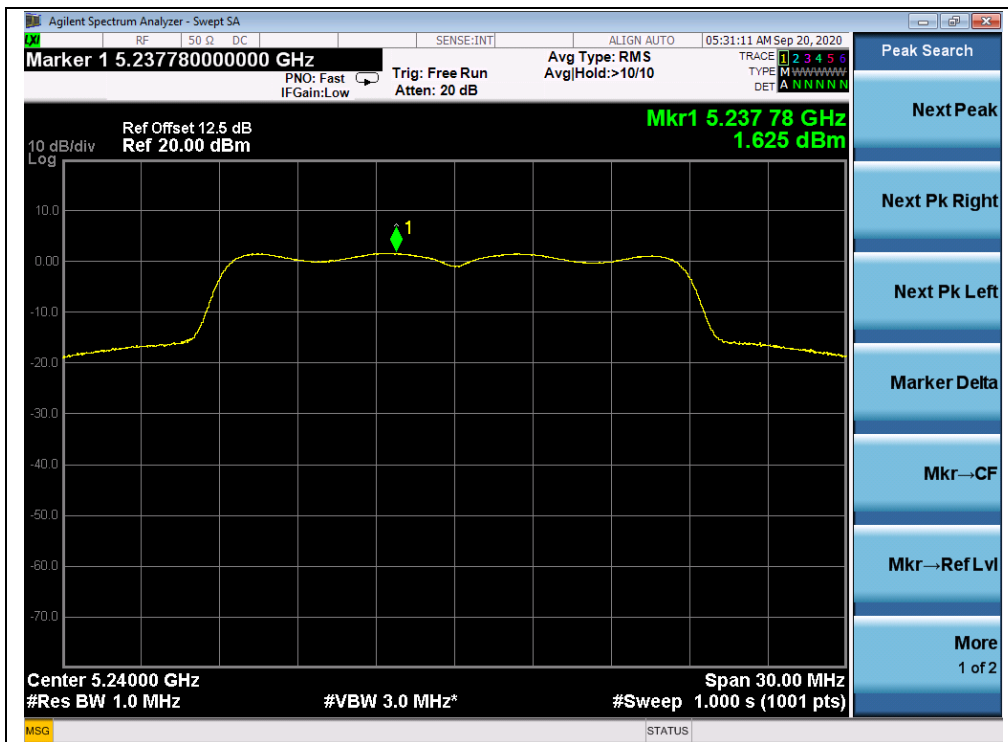
**B.Test Plot:**



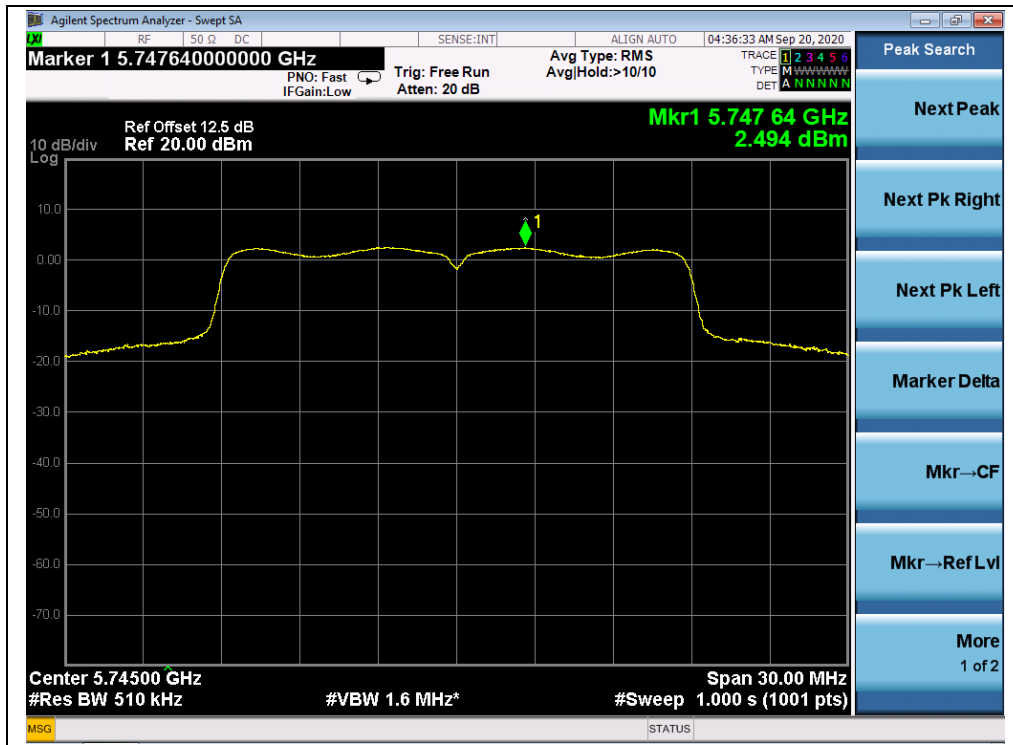
(Channel 36, 5180MHz, 802.11n (HT20), ANT0)



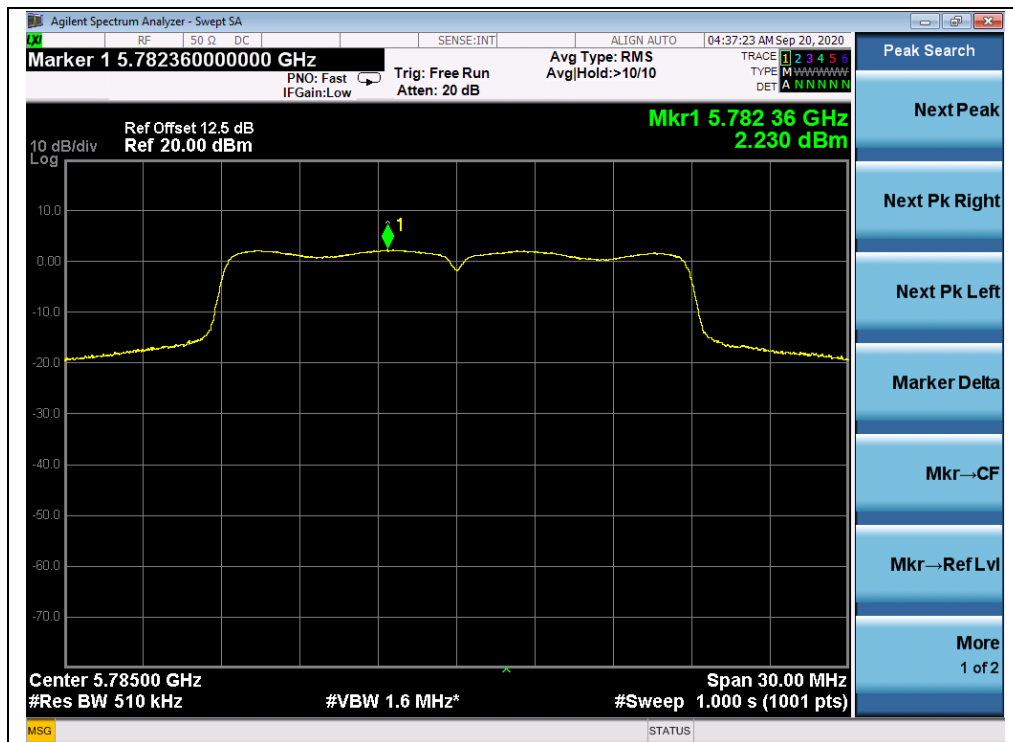
(Channel 44, 5220MHz, 802.11n (HT20), ANT0)



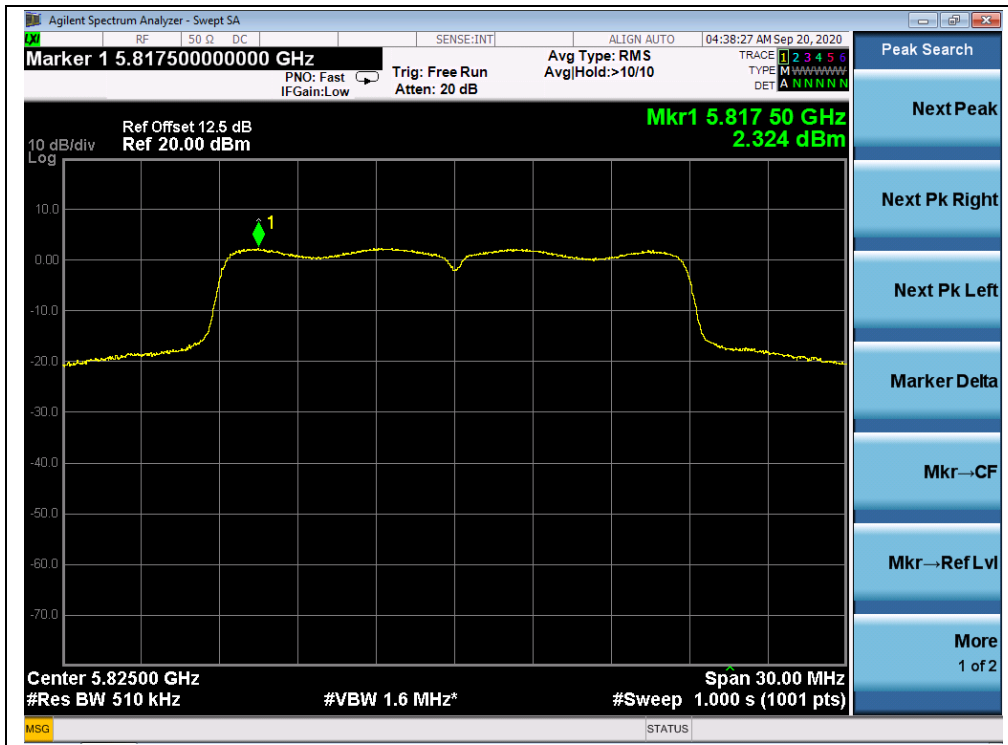
(Channel 48, 5240MHz, 802.11n (HT20), ANT0)



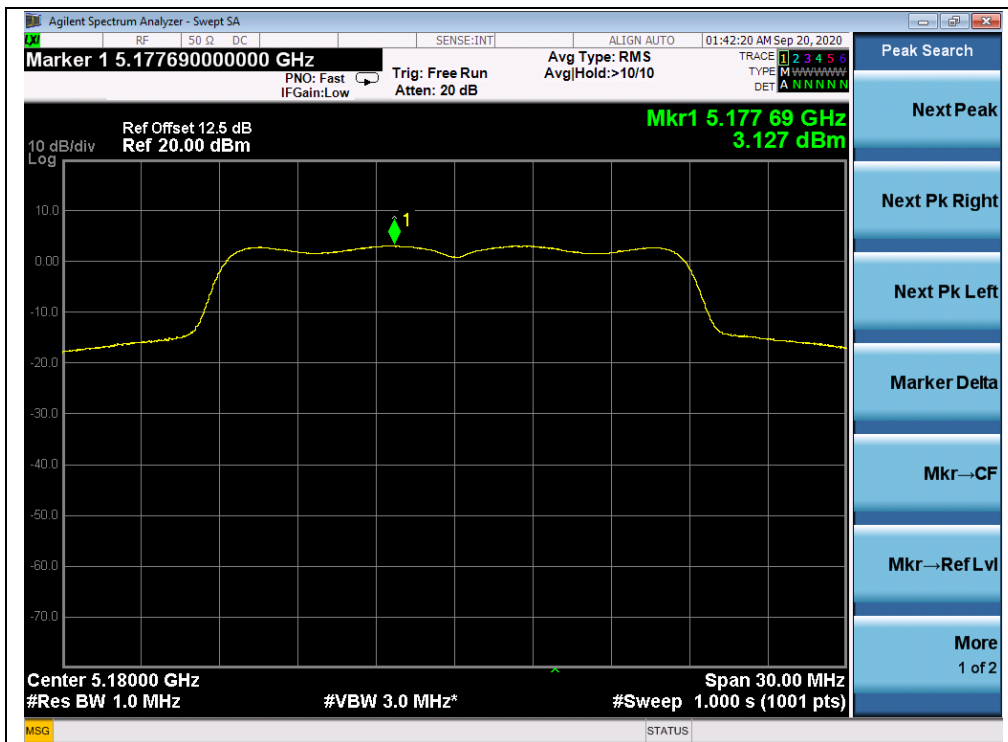
(Channel 149, 5745MHz, 802.11n (HT20), ANT0)



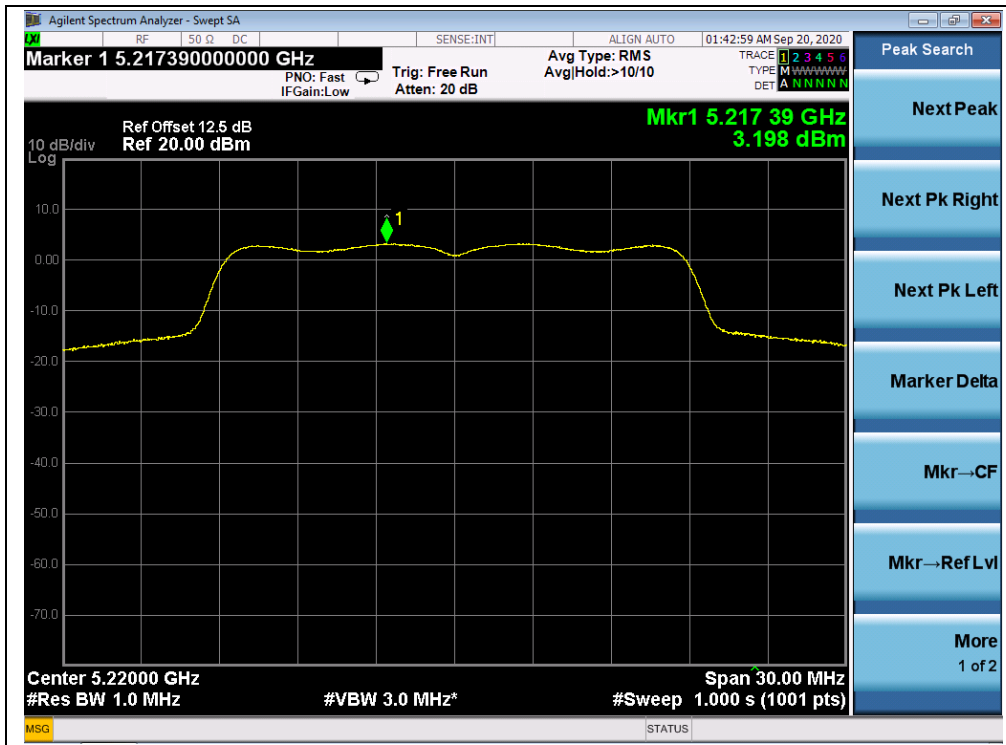
(Channel 157, 5785MHz, 802.11n (HT20), ANT0)



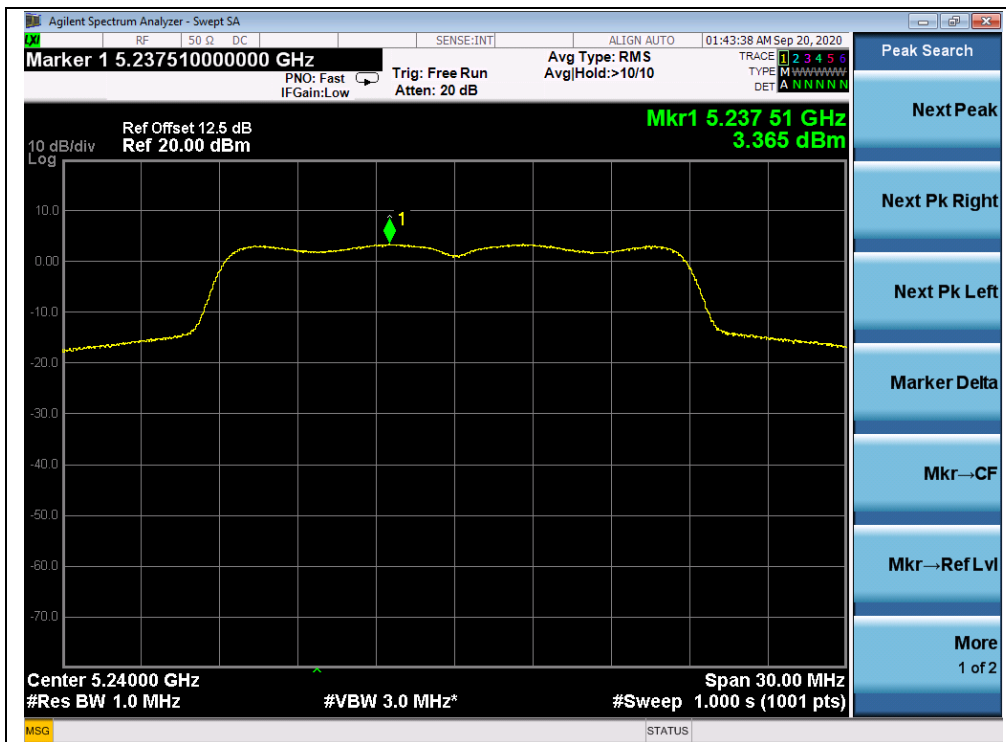
(Channel 165, 5825MHz, 802.11n (HT20), ANT0)



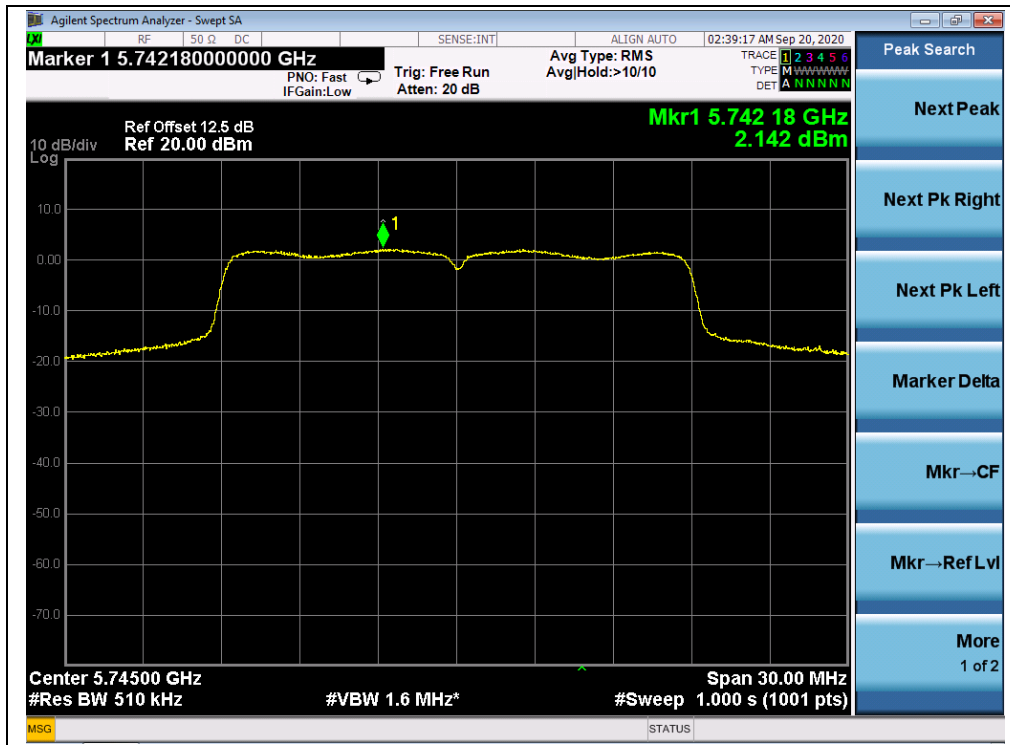
(Channel 36, 5180MHz, 802.11n (HT20), ANT1)



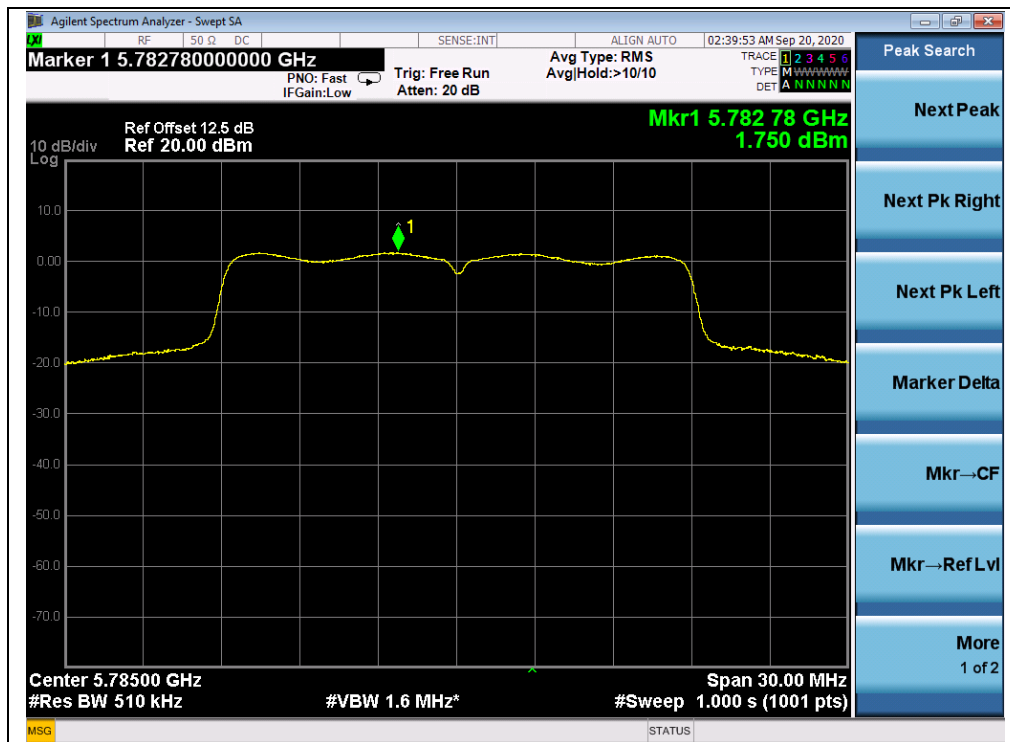
(Channel 44, 5220MHz, 802.11n (HT20), ANT1)



(Channel 48, 5240MHz, 802.11n (HT20), ANT1)

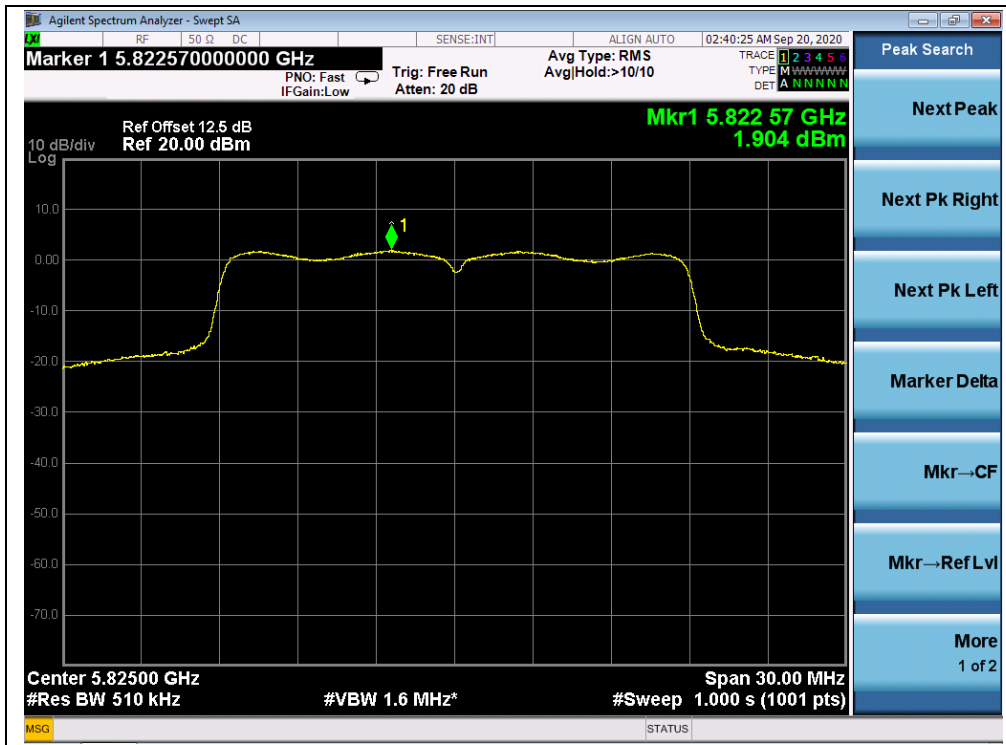


(Channel 149, 5745MHz, 802.11n (HT20), ANT1)



(Channel 157, 5785MHz, 802.11n (HT20), ANT1)





(Channel 165, 5825MHz, 802.11n (HT20), ANT1)



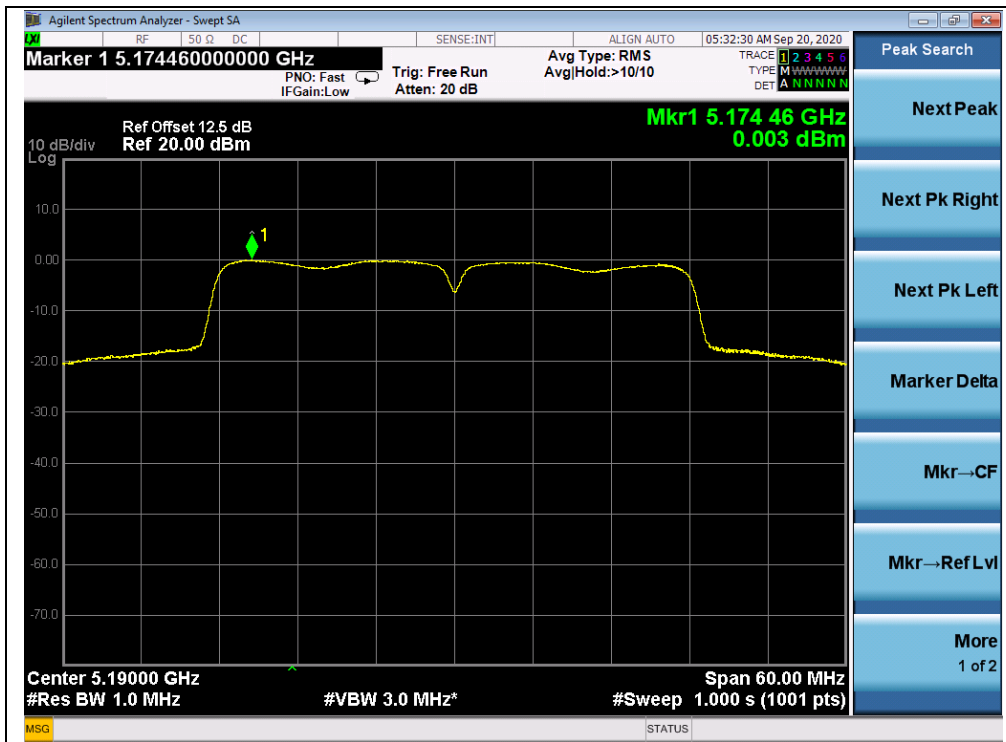
802.11n (HT40) Mode

A. Test Verdict:

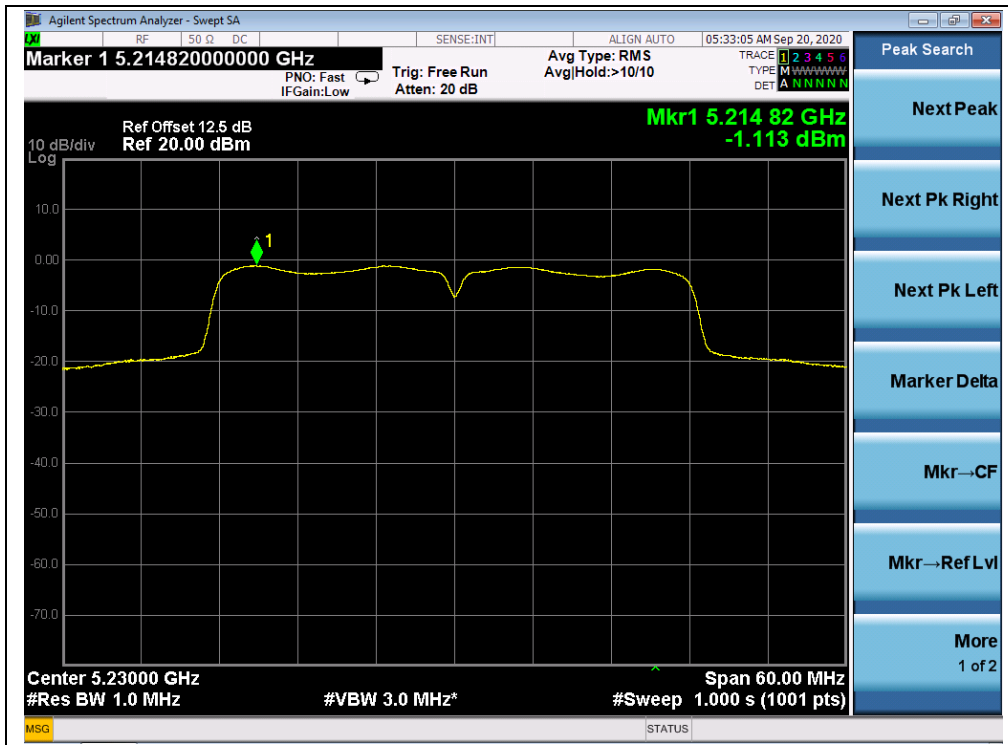
Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
		ANT0	ANT1				
38	5190	0.003	-0.84	0.20	2.81	11	PASS
46	5230	-1.11	0.07		2.73		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
		ANT0	ANT1				
151	5755	-0.65	-1.08	0.20	2.35	30	PASS
159	5795	-0.98	-0.82		2.31		

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the limit shall be 11 dBm/MHz for 5.18-5.24 GHz band and 30 dBm/500KHz for 5.745-5.825 GHz band.

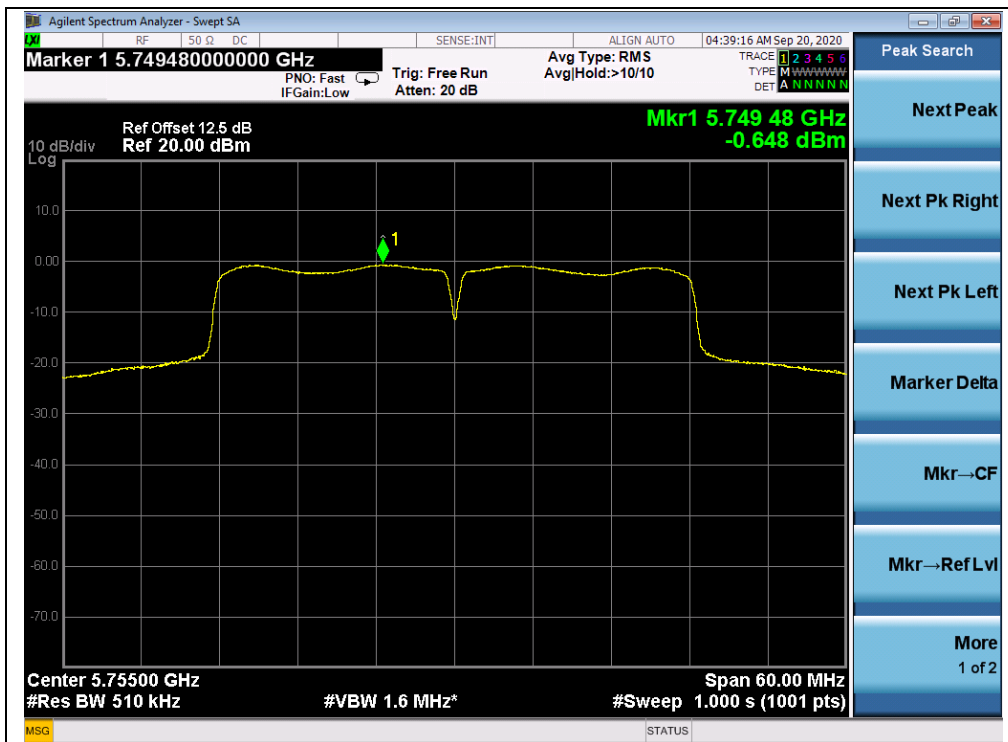
B. Test Plot:



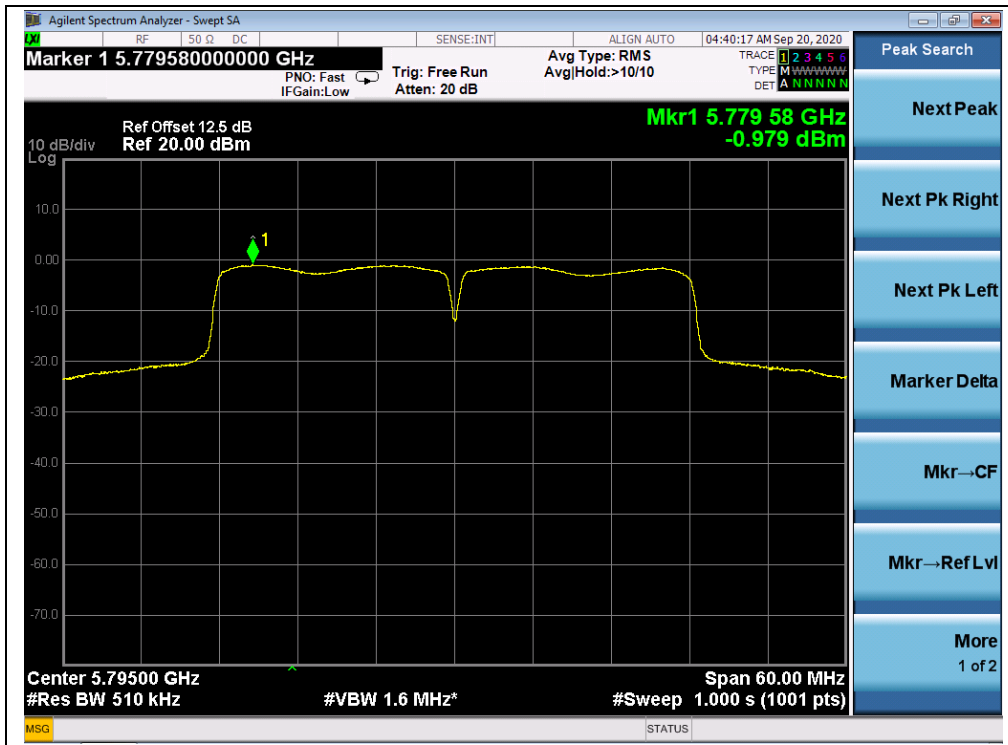
(Channel 38, 5190MHz, 802.11n (HT40), ANT0)



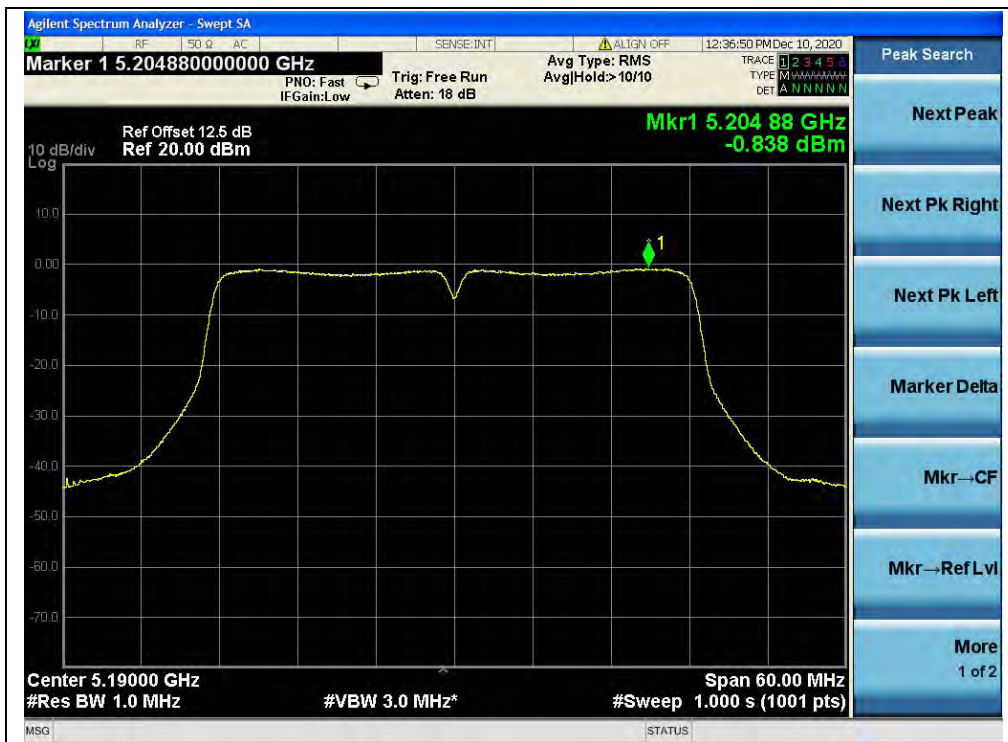
(Channel 46, 5230MHz, 802.11n (HT40), ANT0)



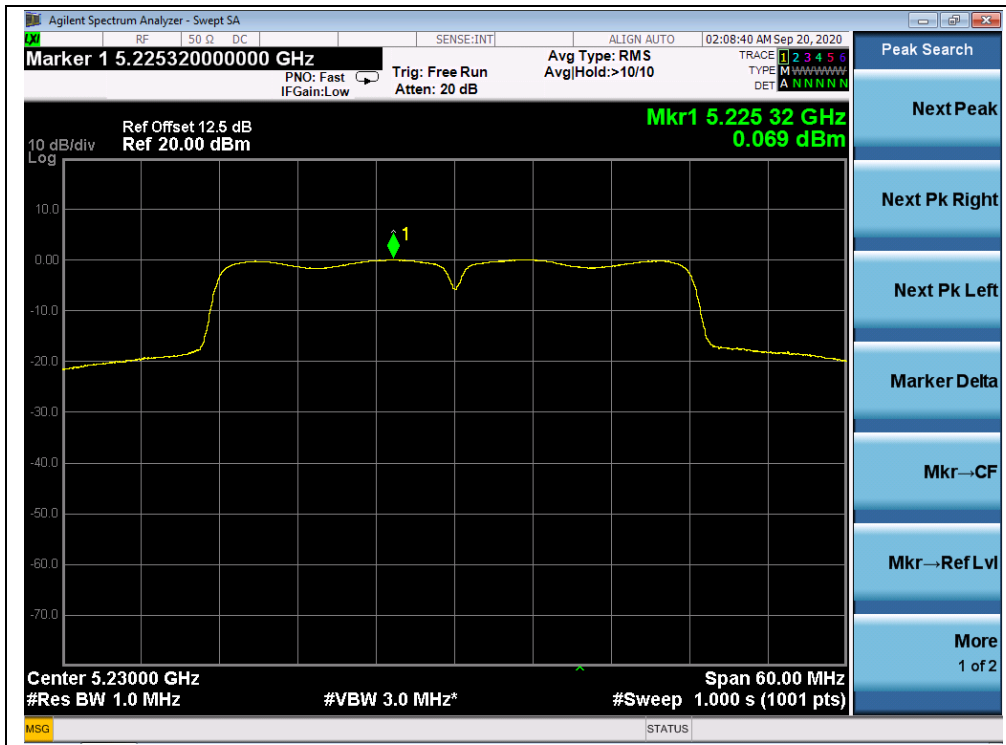
(Channel 151, 5755MHz, 802.11n (HT40), ANT0)



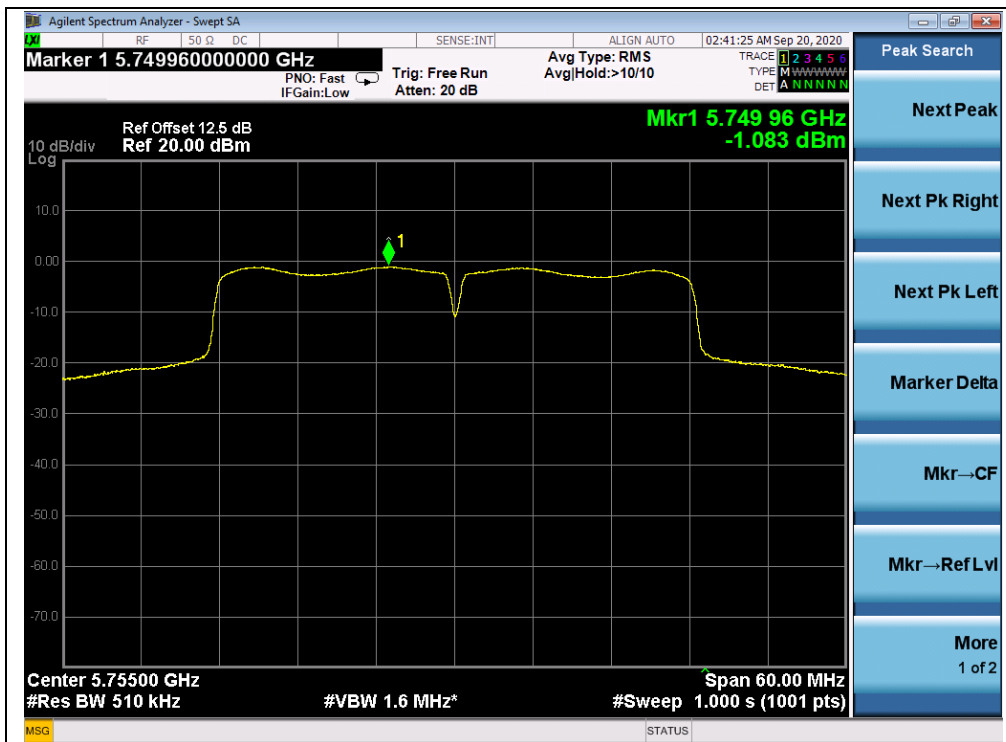
(Channel 159, 5795MHz, 802.11n (HT40), ANT0)



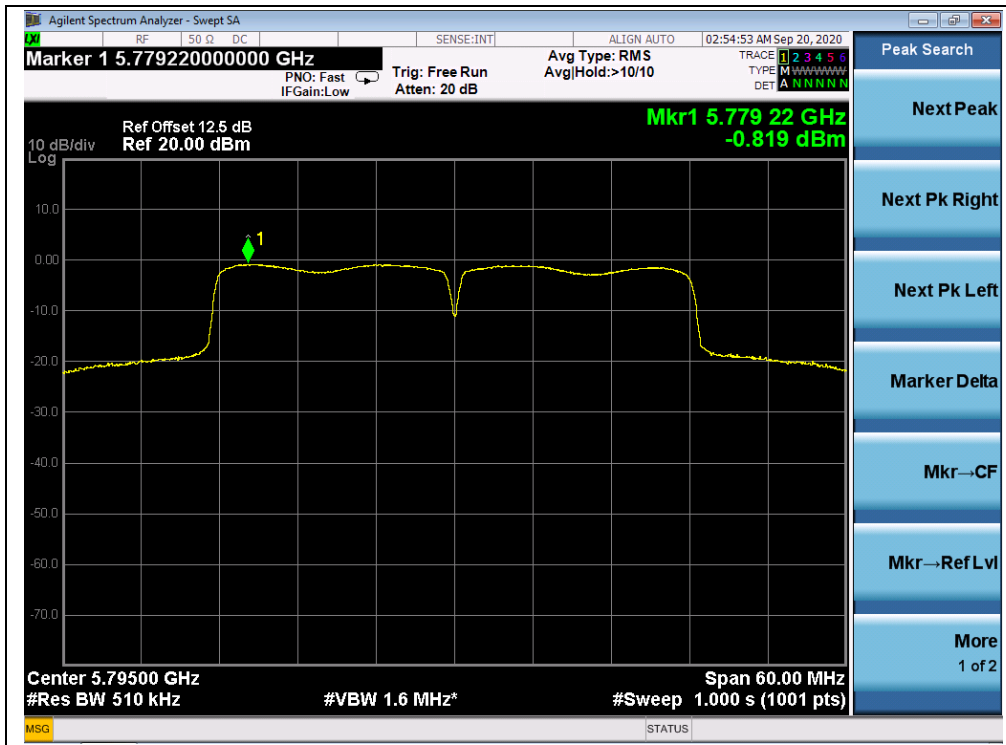
(Channel 38, 5190MHz, 802.11n (HT40), ANT1)



(Channel 46, 5230MHz, 802.11n (HT40), ANT1)



(Channel 151, 5755MHz, 802.11n (HT40), ANT1)



(Channel 159, 5795MHz, 802.11n (HT40), ANT1)





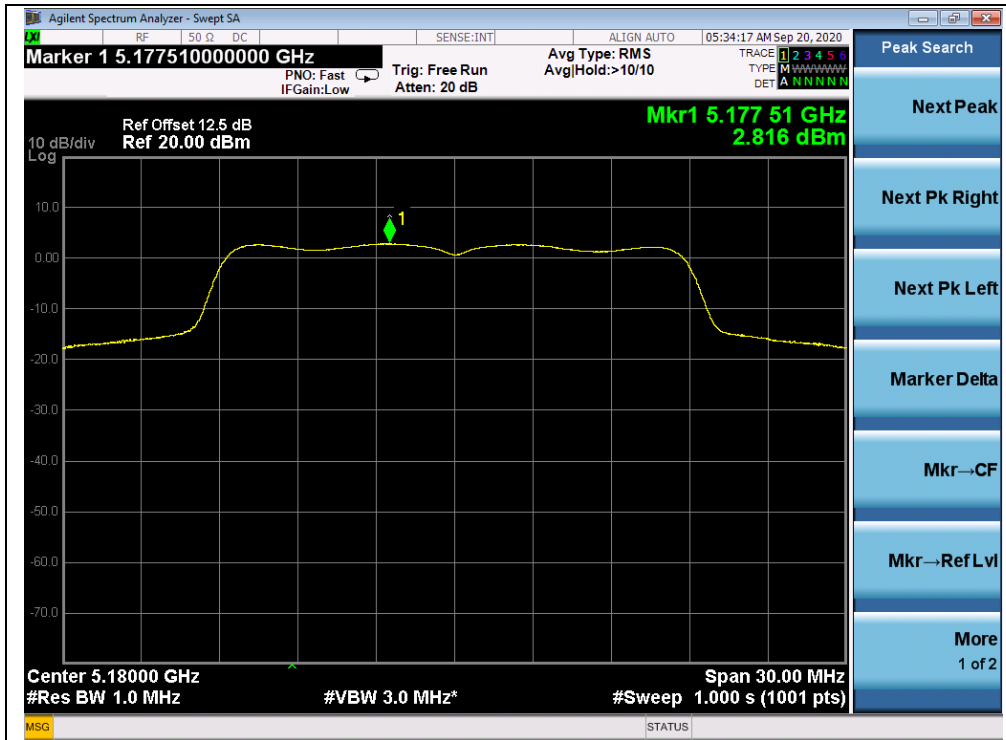
**802.11ac (VHT20) Mode**

**A.Test Verdict:**

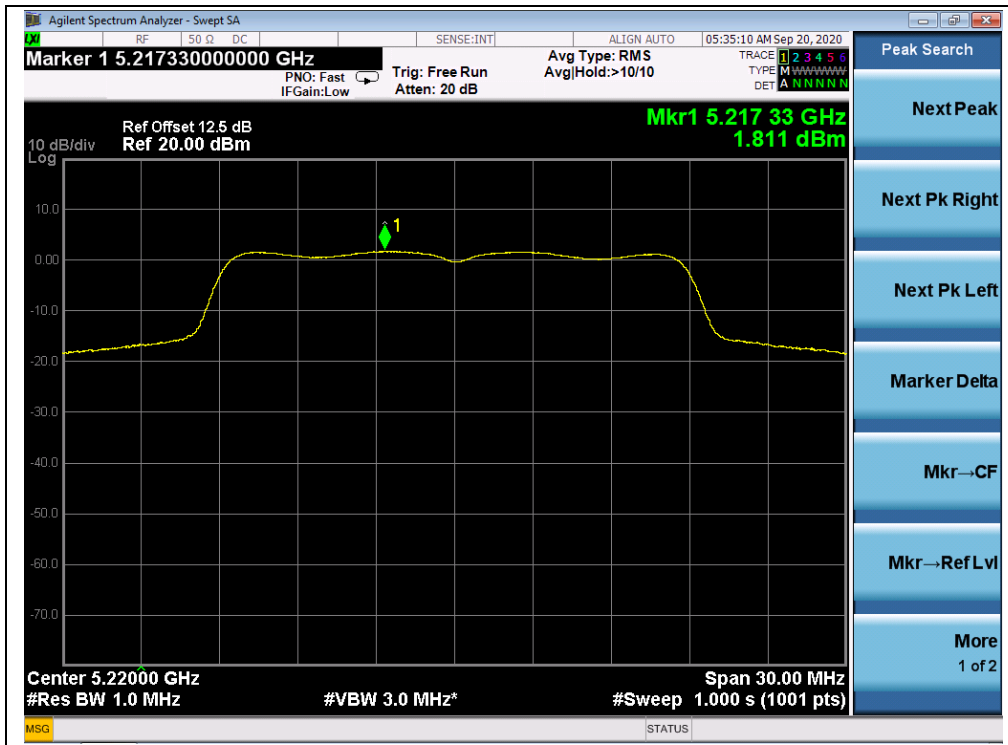
Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
		ANT0	ANT1				
36	5180	2.82	2.92	0.10	5.98	11	PASS
44	5220	1.81	3.11				
48	5240	1.24	3.20				
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
		ANT0	ANT1				
149	5745	2.43	1.90	0.10	5.28	30	PASS
157	5785	2.38	1.53				
165	5825	2.22	1.78				

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the limit shall be 11 dBm/MHz for 5.18-5.24 GHz band and 30 dBm/500KHz for 5.745-5.825 GHz band.

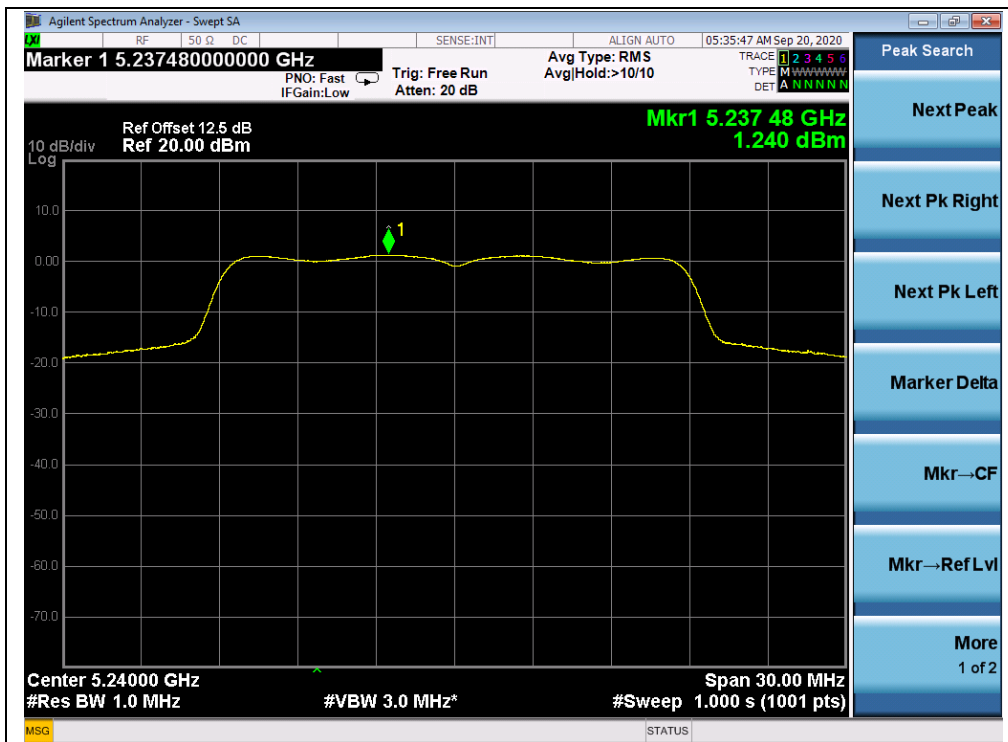
**B.Test Plot:**



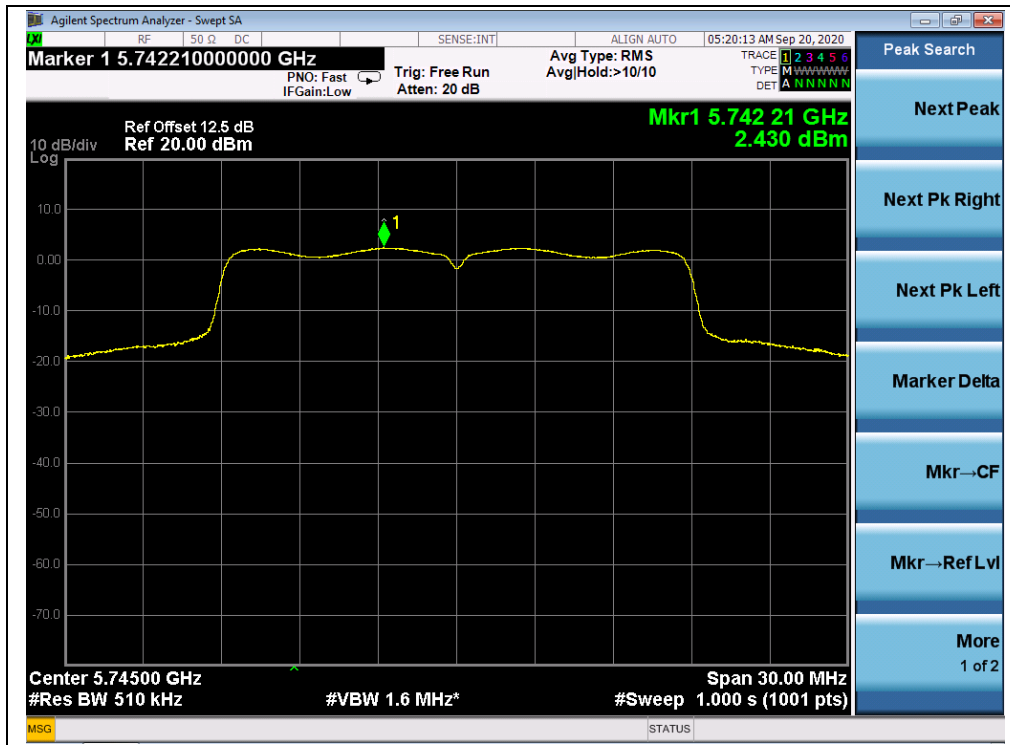
(Channel 36, 5180MHz, 802.11ac (VHT20), ANT0)



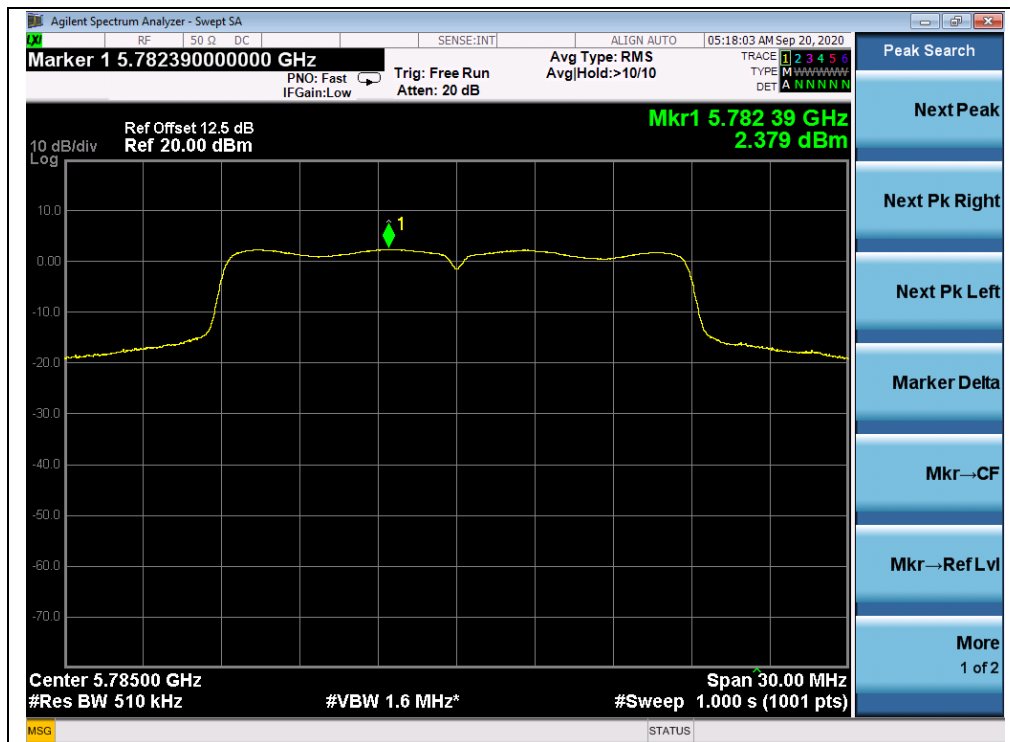
(Channel 44, 5220MHz, 802.11ac (VHT20), ANT0)



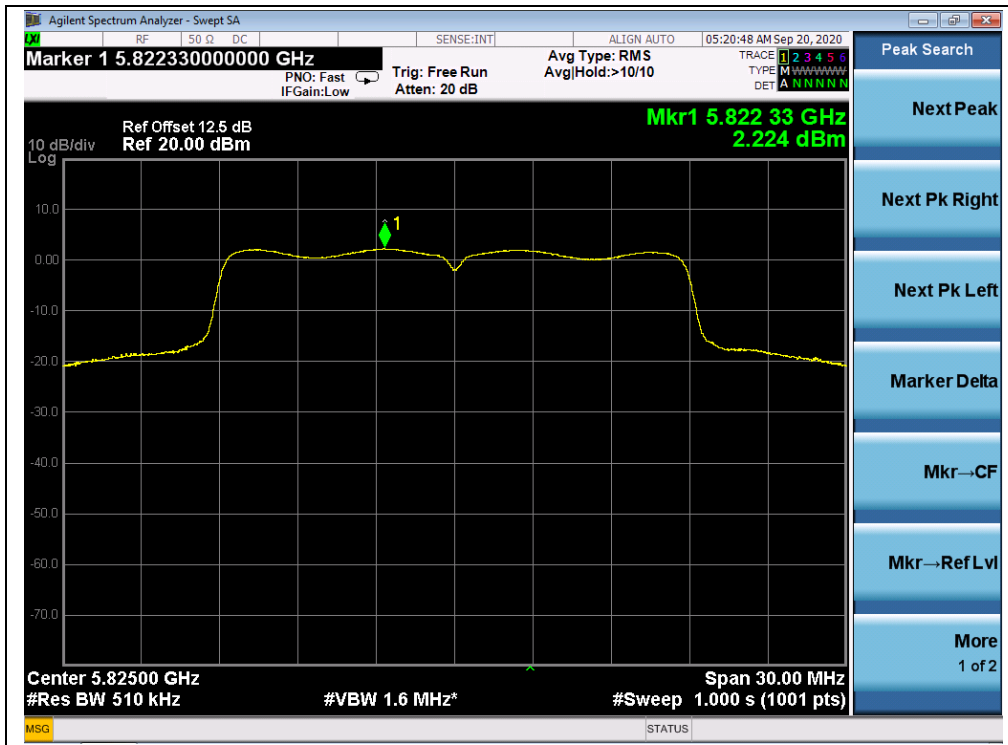
(Channel 48, 5240MHz, 802.11ac (VHT20), ANT0)



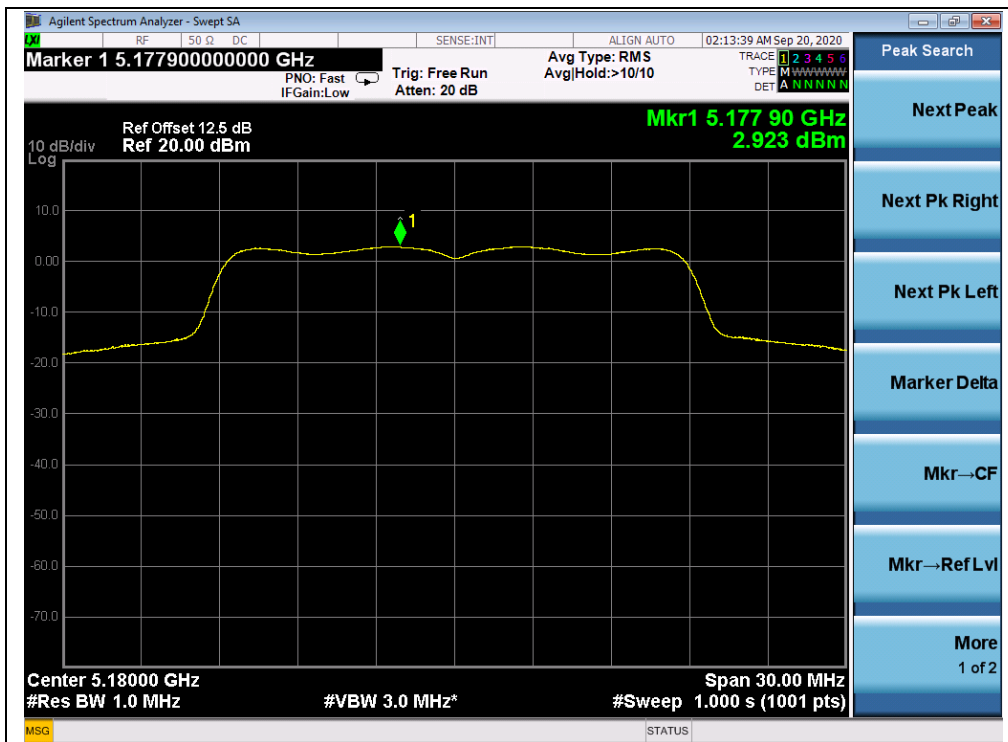
(Channel 149, 5745MHz, 802.11ac (VHT20), ANT0)



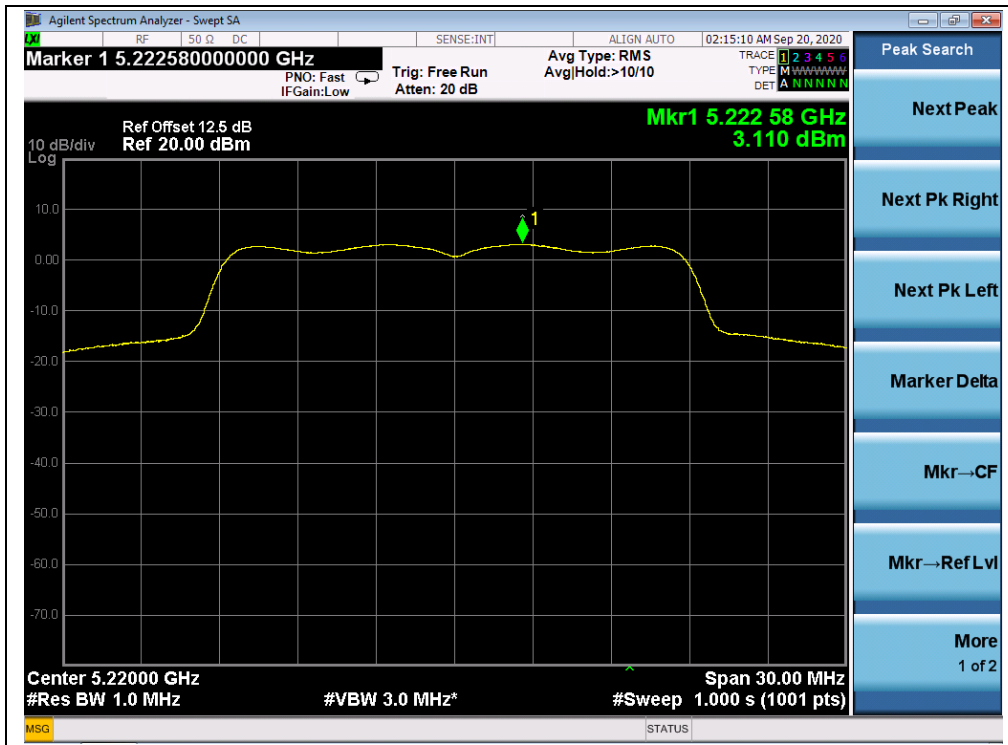
(Channel 157, 5785MHz, 802.11ac (VHT20), ANT0)



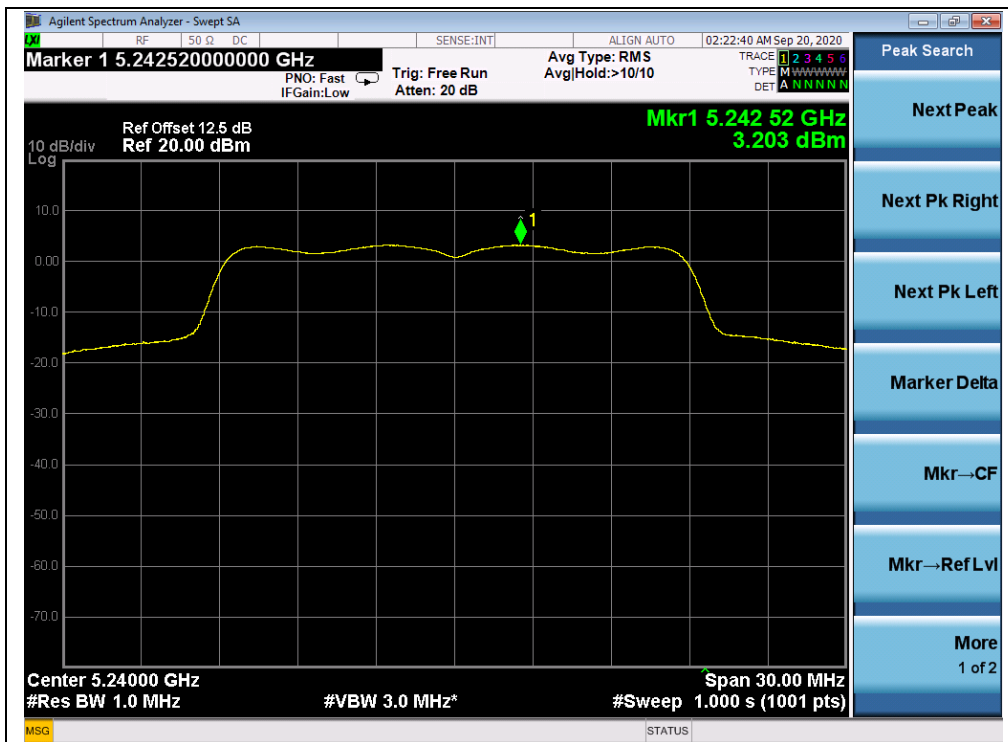
(Channel 165, 5825MHz, 802.11ac (VHT20), ANT0)



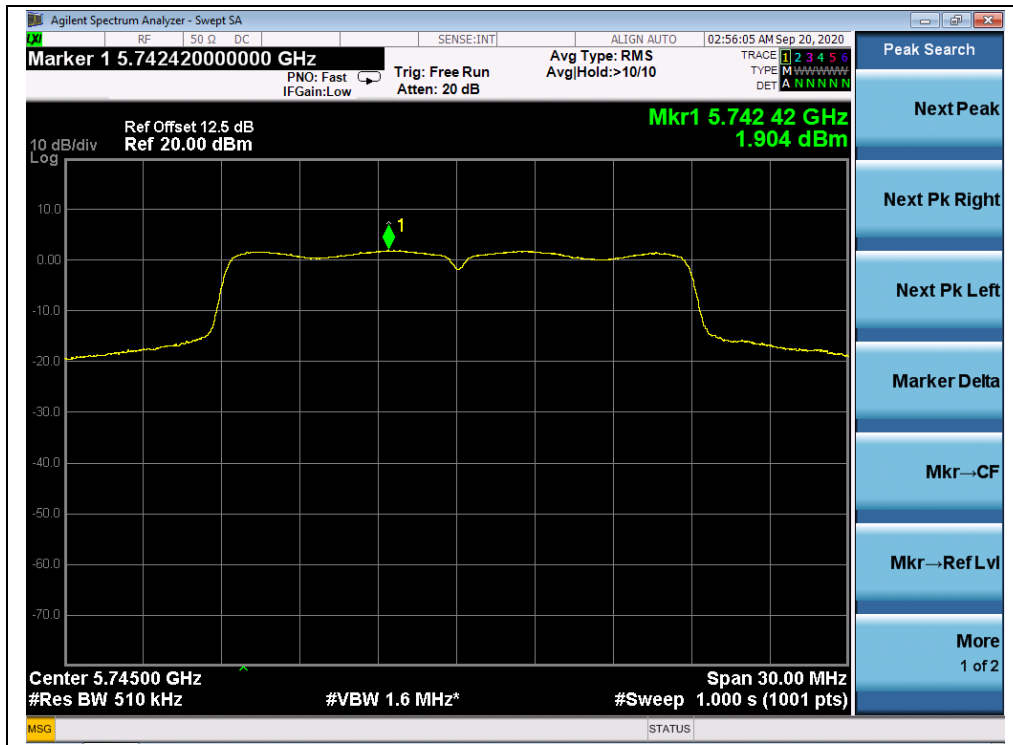
(Channel 36, 5180MHz, 802.11ac (VHT20), ANT1)



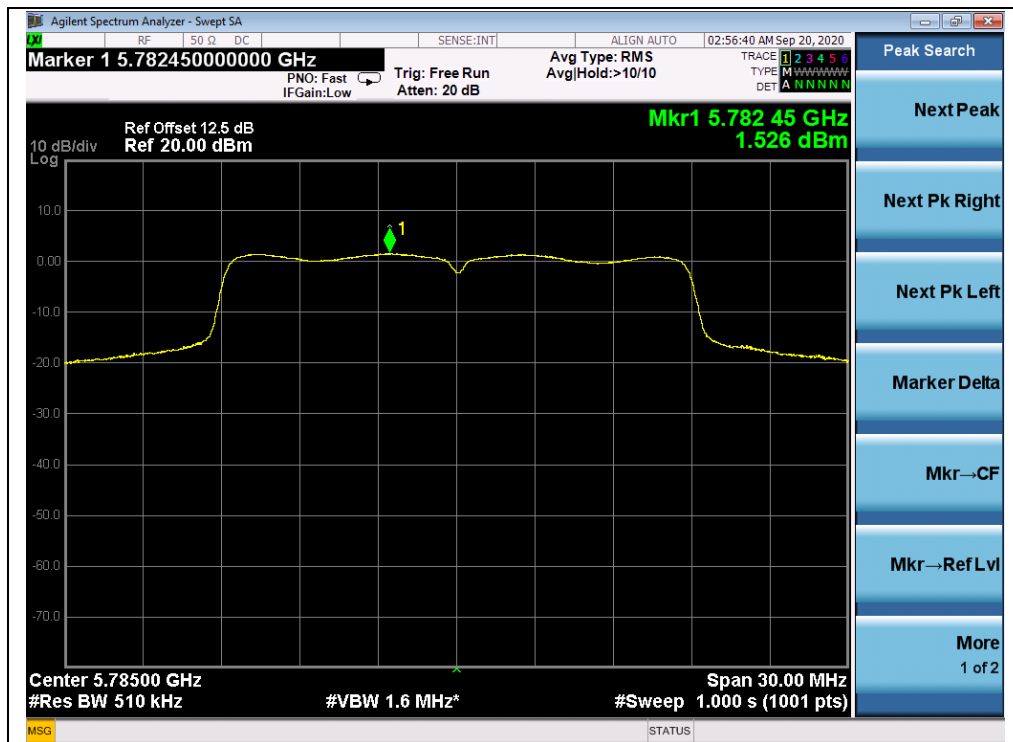
(Channel 44, 5220MHz, 802.11ac (VHT20), ANT1)



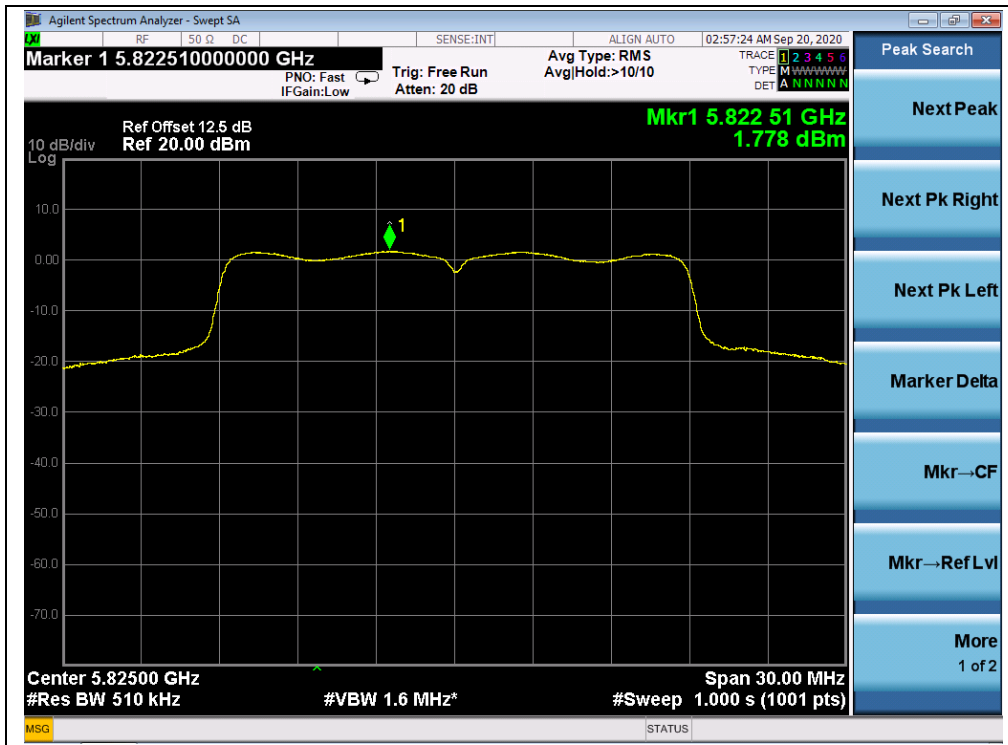
(Channel 48, 5240MHz, 802.11ac (VHT20), ANT1)



(Channel 149, 5745MHz, 802.11ac (VHT20), ANT1)



(Channel 157, 5785MHz, 802.11ac (VHT20), ANT1)



(Channel 165, 5825MHz, 802.11ac (VHT20), ANT1)





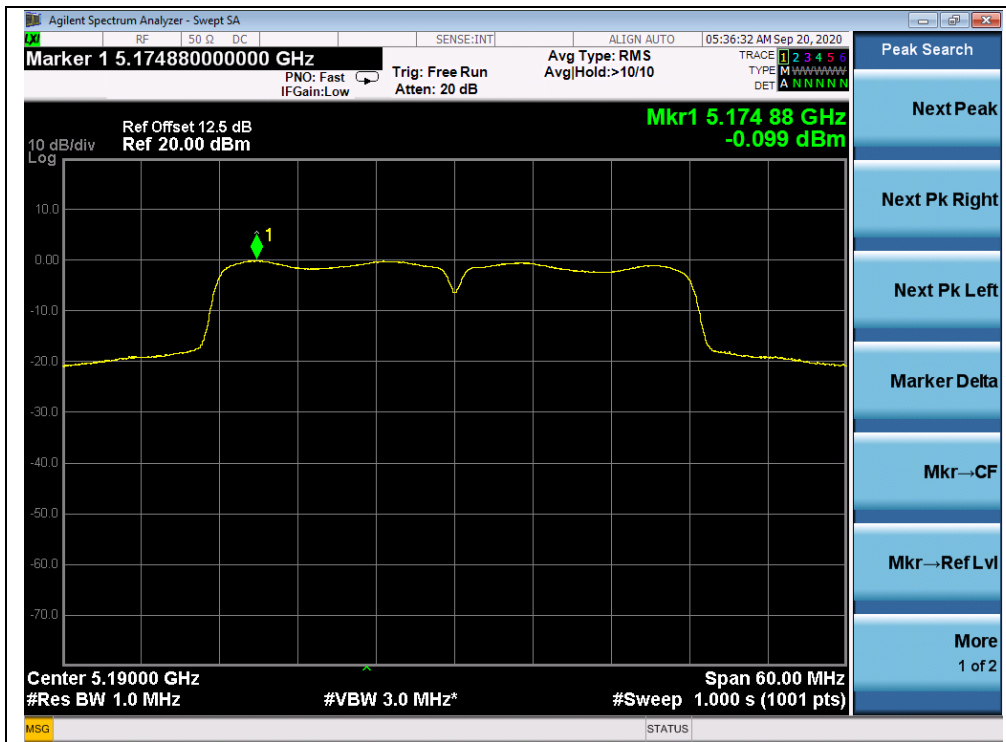
802.11ac (VHT40) Mode

A. Test Verdict:

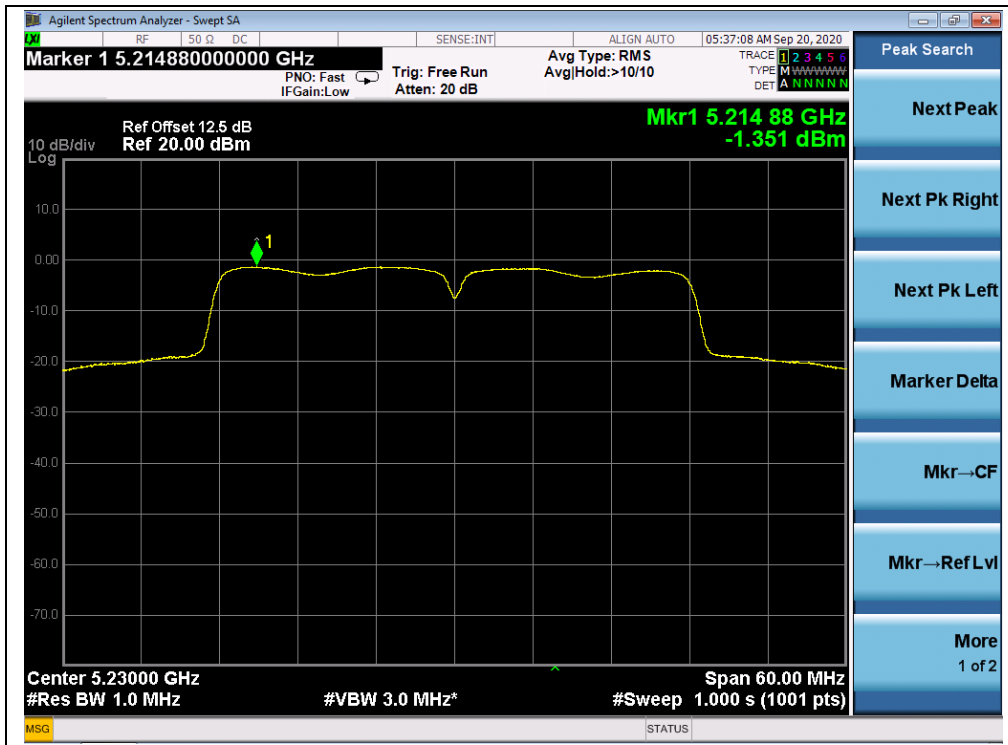
Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
		ANT0	ANT1				
38	5190	-0.10	-0.08	0.18	3.10	11	PASS
46	5230	-1.35	0.08		2.61		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
		ANT0	ANT1				
151	5755	-0.58	-1.17	0.18	2.33	30	PASS
159	5795	-0.81	-1.46		2.07		

**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the limit shall be 11 dBm/MHz for 5.18-5.24 GHz band and 30 dBm/500KHz for 5.745-5.825 GHz band.

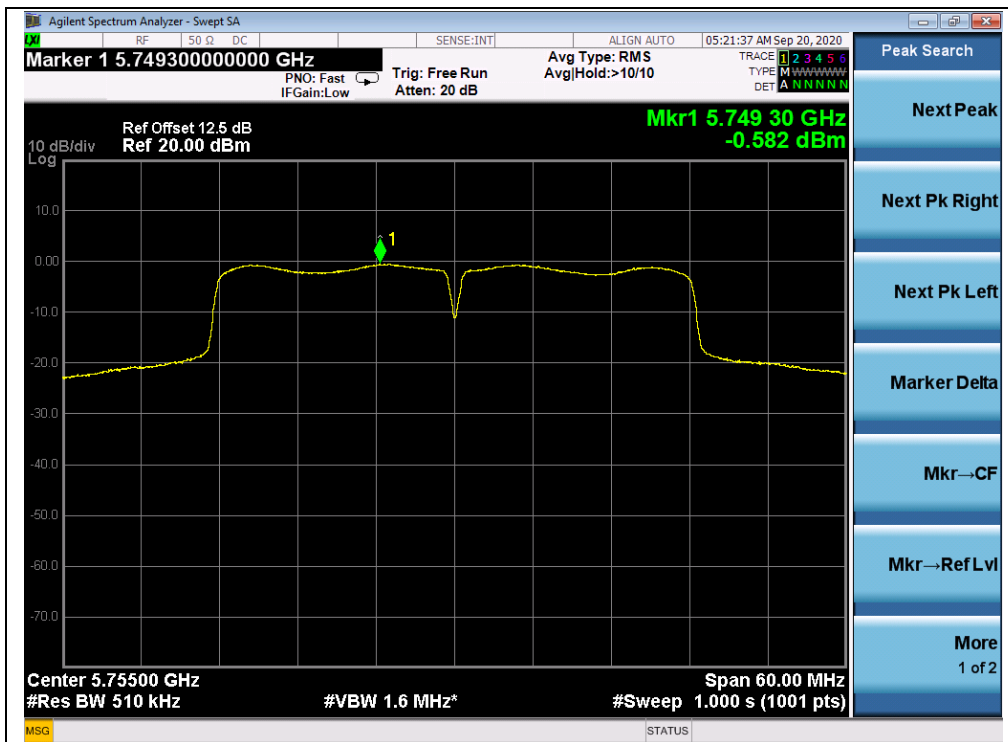
B. Test Plot:



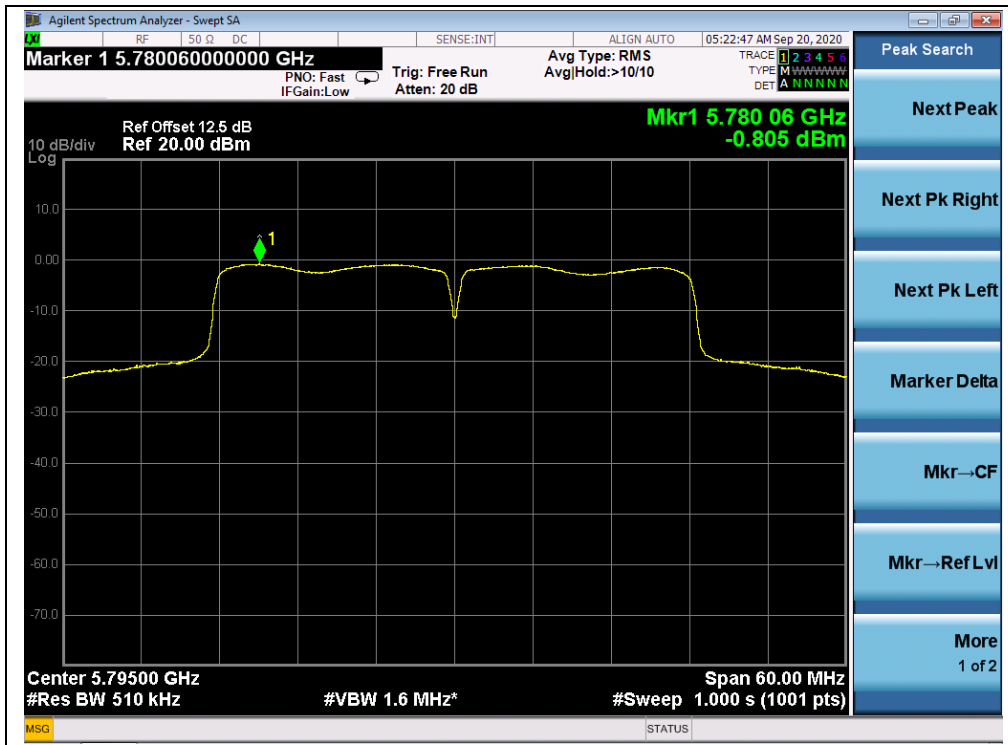
(Channel 38, 5190MHz, 802.11ac (VHT40), ANT0)



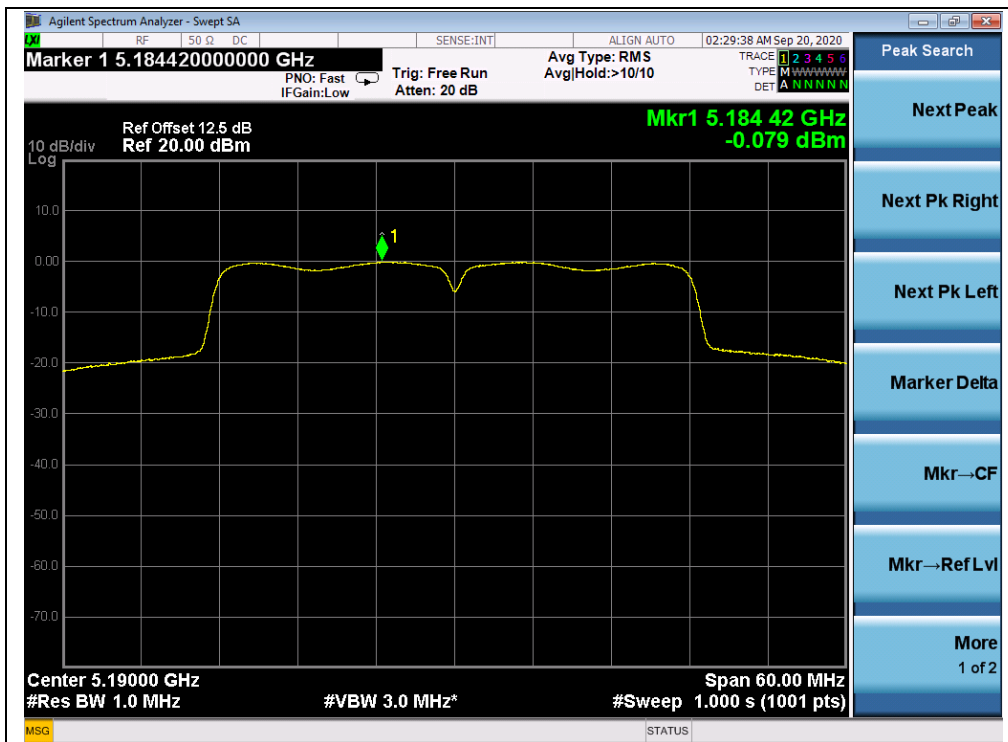
(Channel 46, 5230MHz, 802.11ac (VHT40), ANT0)



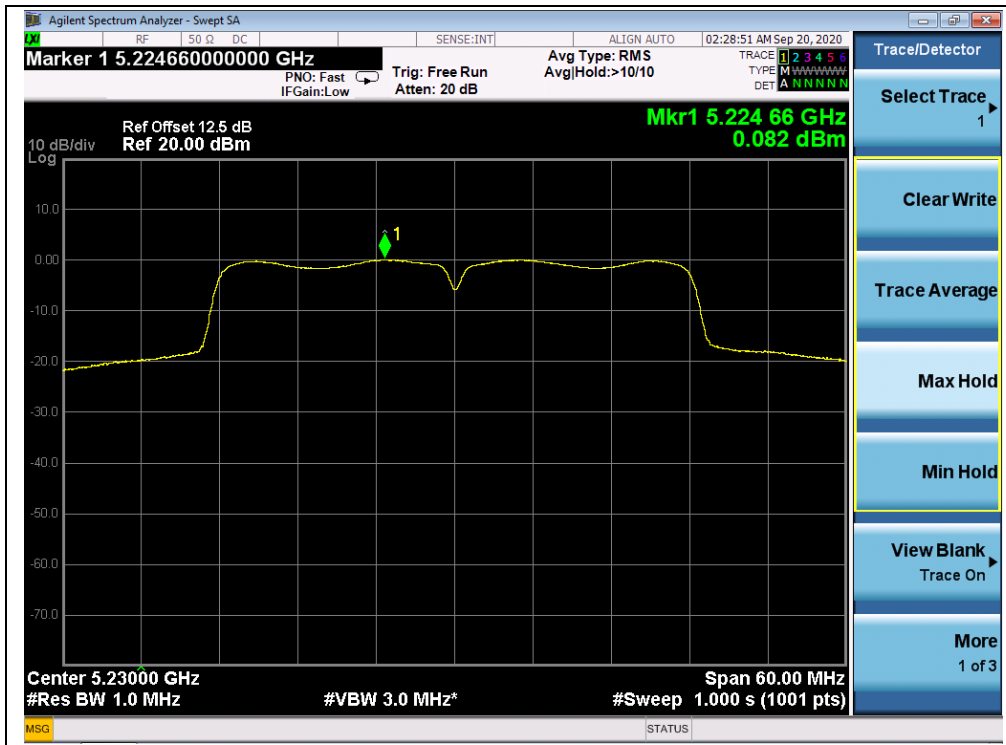
(Channel 151, 5755MHz, 802.11ac (VHT40), ANT0)



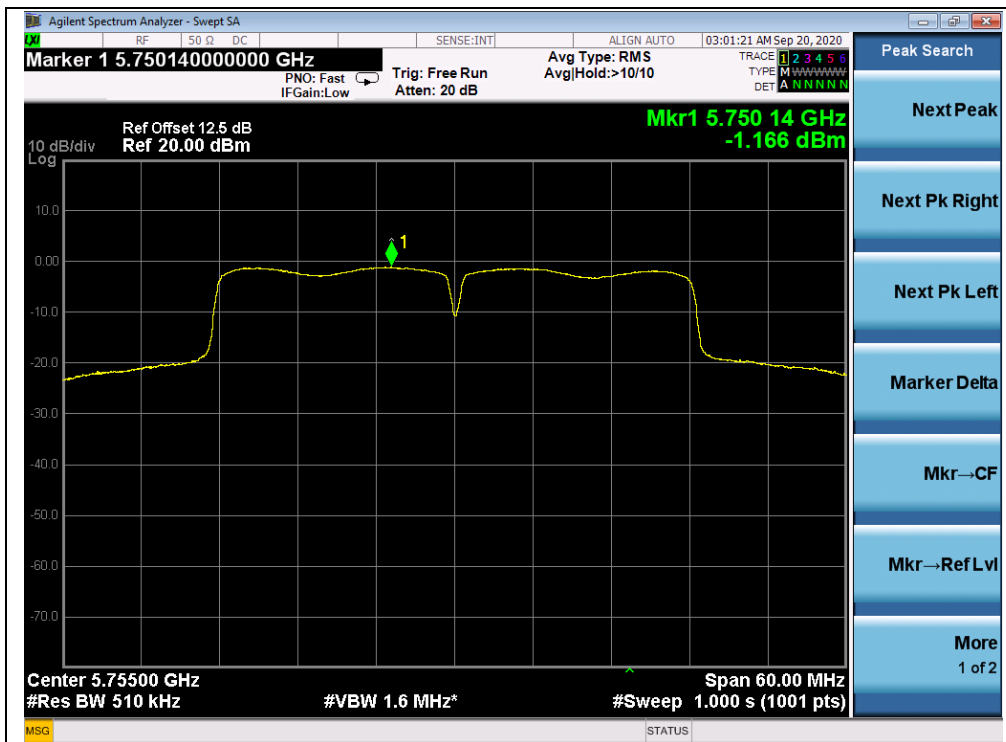
(Channel 159, 5795MHz, 802.11ac (VHT40), ANT0)



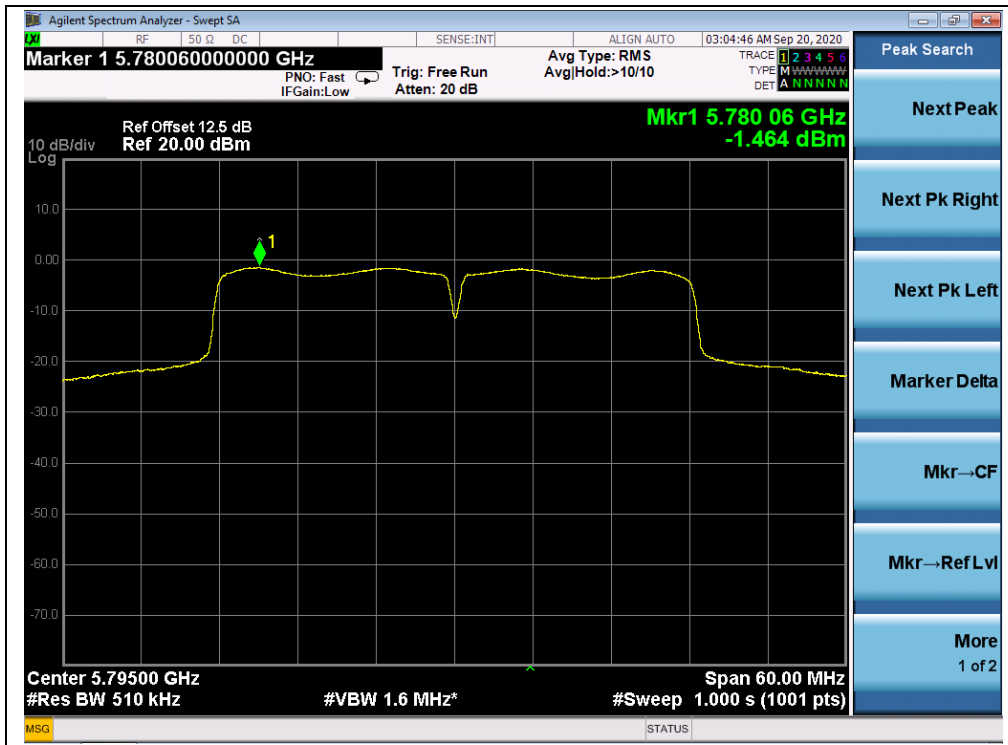
(Channel 38, 5190MHz, 802.11ac (VHT40), ANT1)



(Channel 46, 5230MHz, 802.11ac (VHT40), ANT1)



(Channel 151, 5755MHz, 802.11ac (VHT40), ANT1)



(Channel 159, 5795MHz, 802.11ac (VHT40), ANT1)



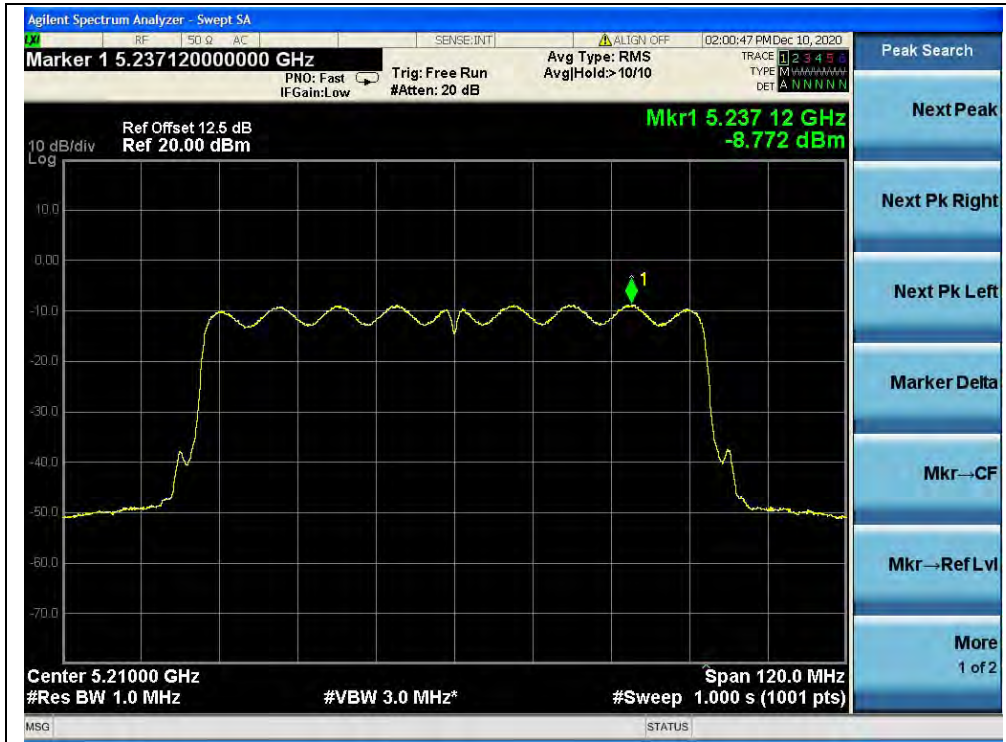
**802.11ac (VHT80) Mode**

**A. Test Verdict:**

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
		ANT0	ANT1				
42	5210	-8.77	-5.11	0.39	-3.17	11	PASS
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
		ANT0	ANT1				
155	5775	-4.37	-8.98	0.39	-2.69	30	PASS

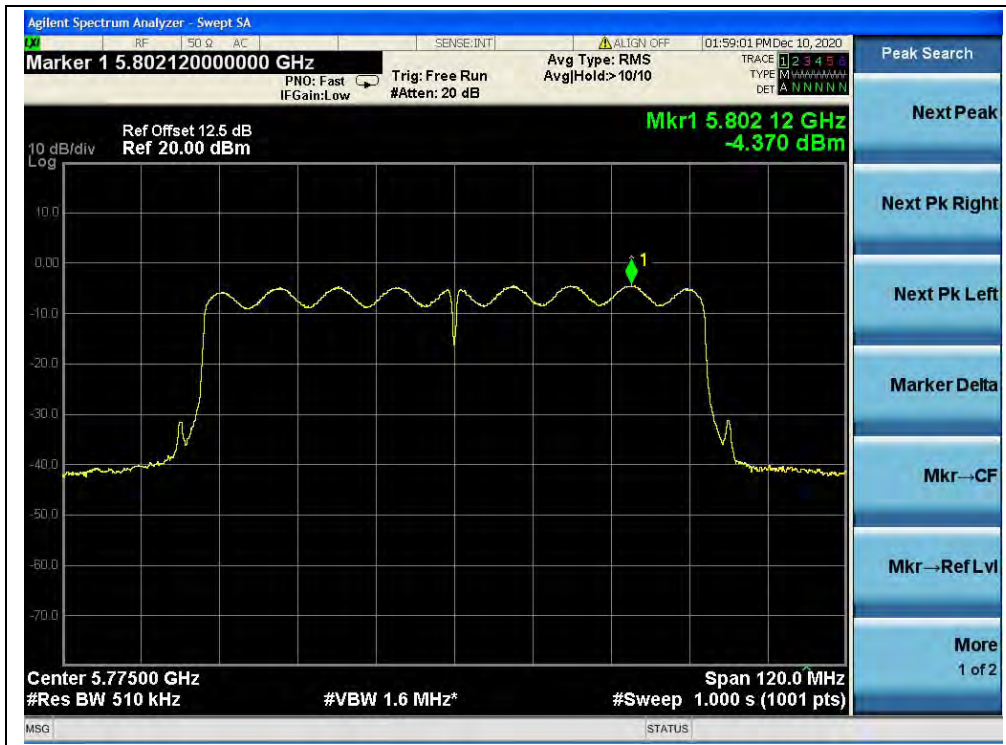
**Note:** Directional gain = 1.81dBi + 10log(2) = 4.82dBi < 6dBi, so the limit shall be 11 dBm/MHz for 5.18-5.24 GHz band and 30 dBm/500KHz for 5.745-5.825 GHz band.

**B. Test Plot:**

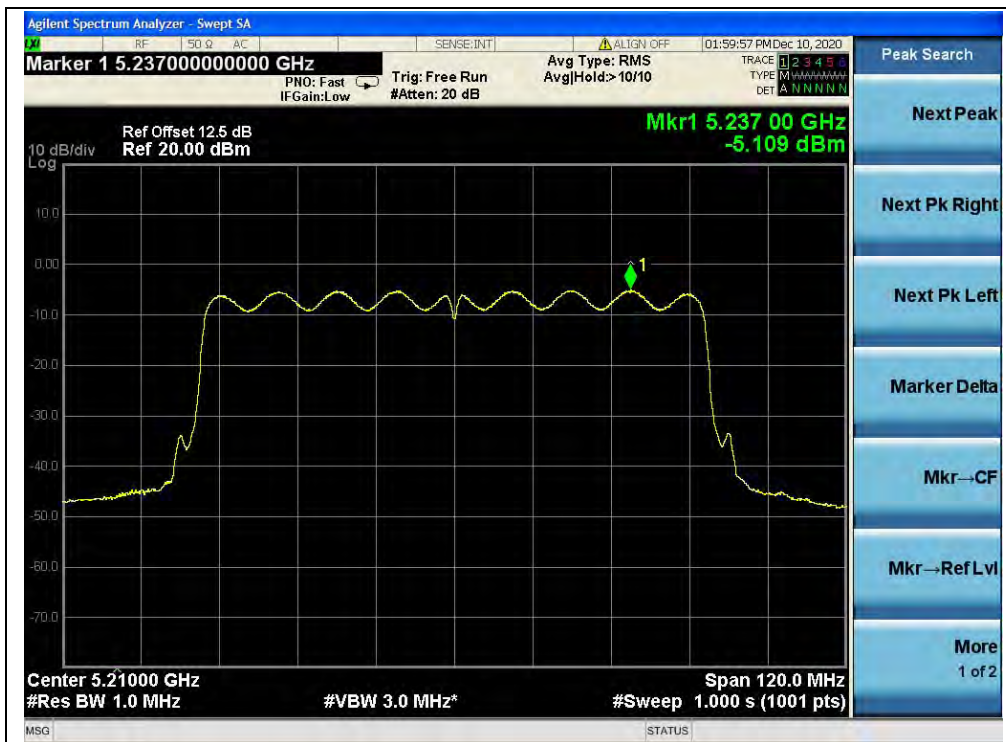


(Channel 42, 5210MHz, 802.11ac (VHT80), ANT0)



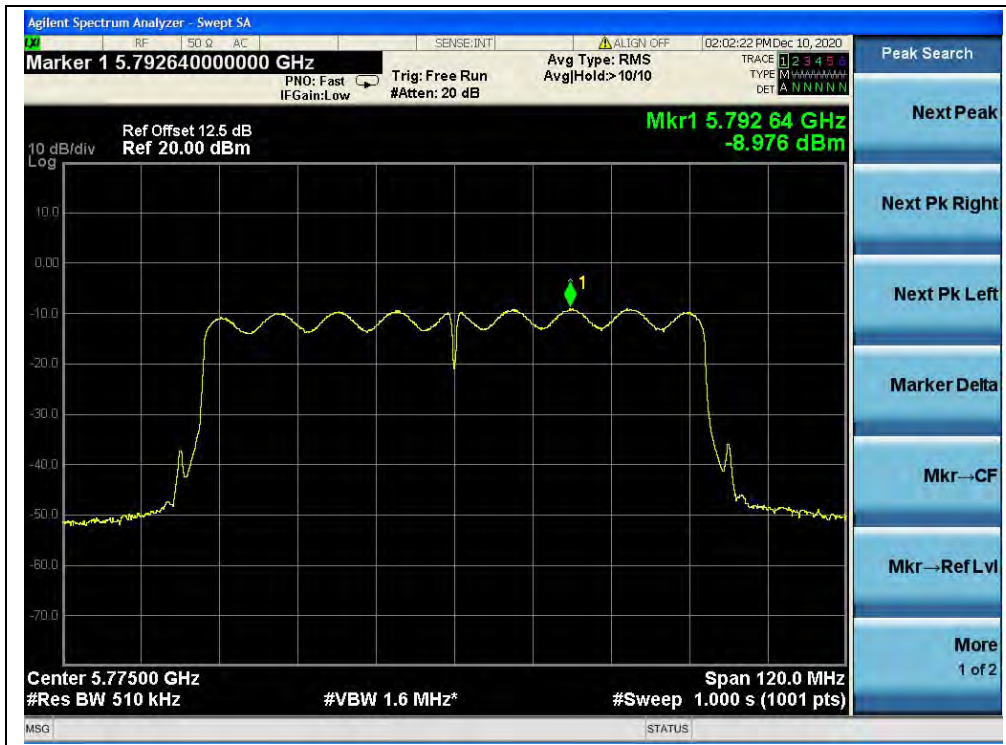


(Channel 155, 5775MHz, 802.11ac (VHT80), ANT0)



(Channel 42, 5210MHz, 802.11ac (VHT80), ANT1)





(Channel 155, 5775MHz, 802.11ac (VHT80), ANT1)



## 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)	Fre. Dev. (kHz)	Deviation (ppm)
100%	3.80	+20(Ref)	21	4.054
100%		-30	25	4.826
100%		-20	30	5.792
100%		-10	29	5.598
100%		0	22	4.247
100%		+10	19	3.668
100%		+20	23	4.440
100%		+30	32	6.178
100%		+40	35	6.757
100%		+50	25	4.826
85%		3.60	+20	30
115%	4.35	+20	27	5.212



<b>U-NII-3 (Ch. 149)</b>				
<b>5745MHz</b>				
VOLTAGE (%)	POWER (VDC)	TEMP (°C)	Fre. Dev. (kHz)	Deviation (ppm)
100%	3.80	+20(Ref)	18	3.133
100%		-30	22	3.829
100%		-20	25	4.352
100%		-10	27	4.700
100%		0	19	3.307
100%		+10	17	2.959
100%		+20	21	3.655
100%		+30	26	4.526
100%		+40	30	5.222
100%		+50	25	4.352
85%		3.23	+20	21
115%	4.37	+20	19	3.307

## 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).

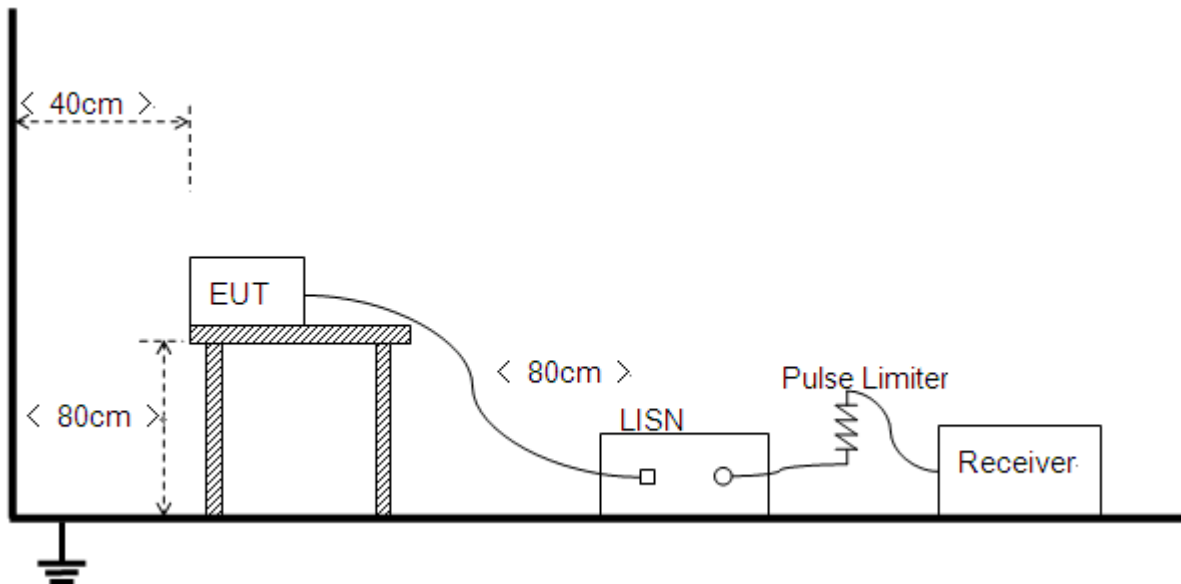
Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

**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. Set RBW=9kHz, VBW=30kHz. Refer to recorded points and plots below.

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

#### A. Test Setup:

Test Mode: EUT+ADAPTER+ WIFI TX

Test Voltage: AC 120V/60Hz

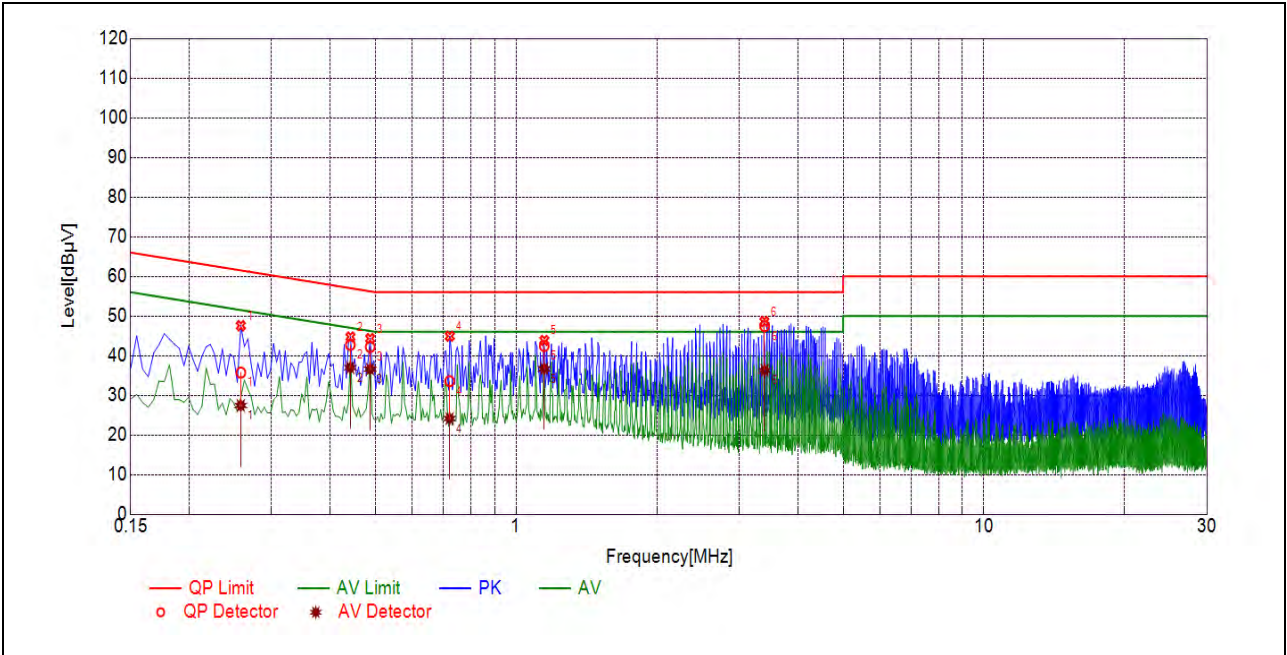
The measurement results are obtained as below:

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

$U_R$ : Receiver Reading

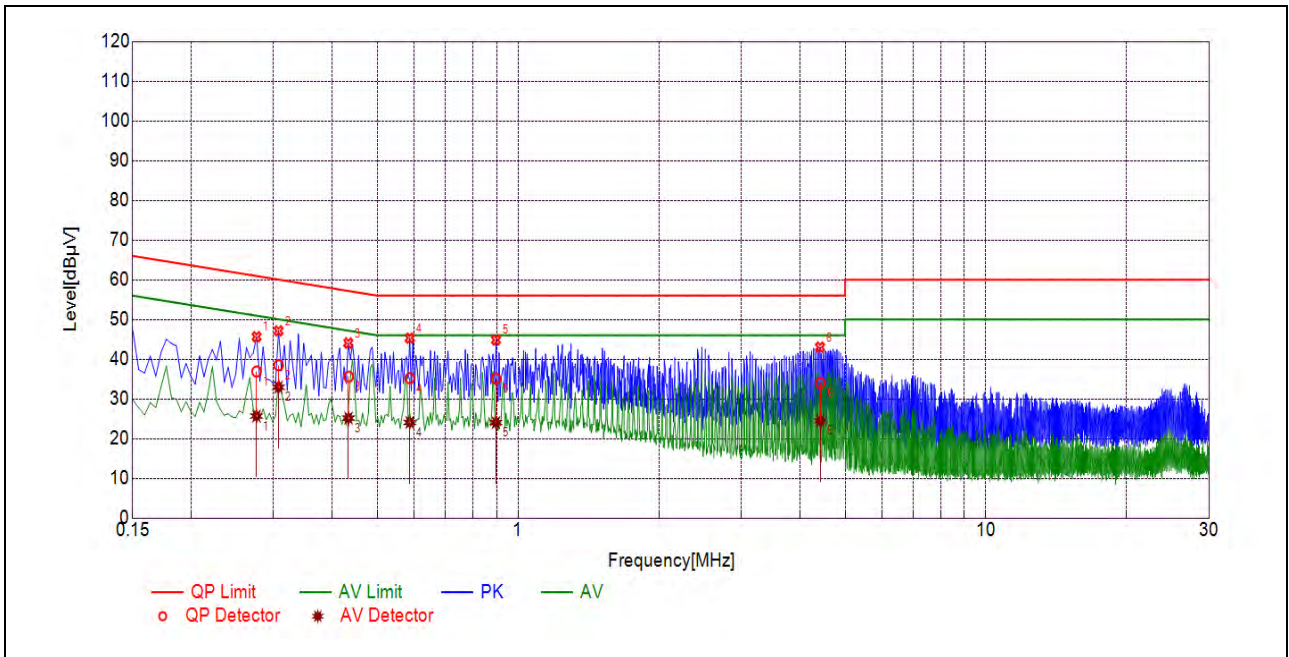
$A_{\text{Factor}}$ : Voltage division factor of LISN

**B.Test Plot:**



(L Phase)

No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.2579	35.74	27.43	61.50	51.50	Line	PASS
2	0.4421	42.73	36.98	57.02	47.02		PASS
3	0.4874	42.20	36.60	56.21	46.21		PASS
4	0.7208	33.57	24.15	56.00	46.00		PASS
5	1.1482	42.43	36.69	56.00	46.00		PASS
6	3.3979	47.46	36.27	56.00	46.00		PASS



(N Phase)

No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.2759	36.89	25.69	60.94	50.94	Neutral	PASS
2	0.3075	38.48	32.94	60.04	50.04		PASS
3	0.4339	35.59	25.17	57.18	47.18		PASS
4	0.5865	35.21	24.06	56.00	46.00		PASS
5	0.8965	35.12	24.03	56.00	46.00		PASS
6	4.4249	33.99	24.46	56.00	46.00		PASS



## 2.8. Restricted Frequency Bands

### 2.8.1. 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:
  - (i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

The following formula is used to convert the equipment isotropic radiated power(e.i.r.p.) 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

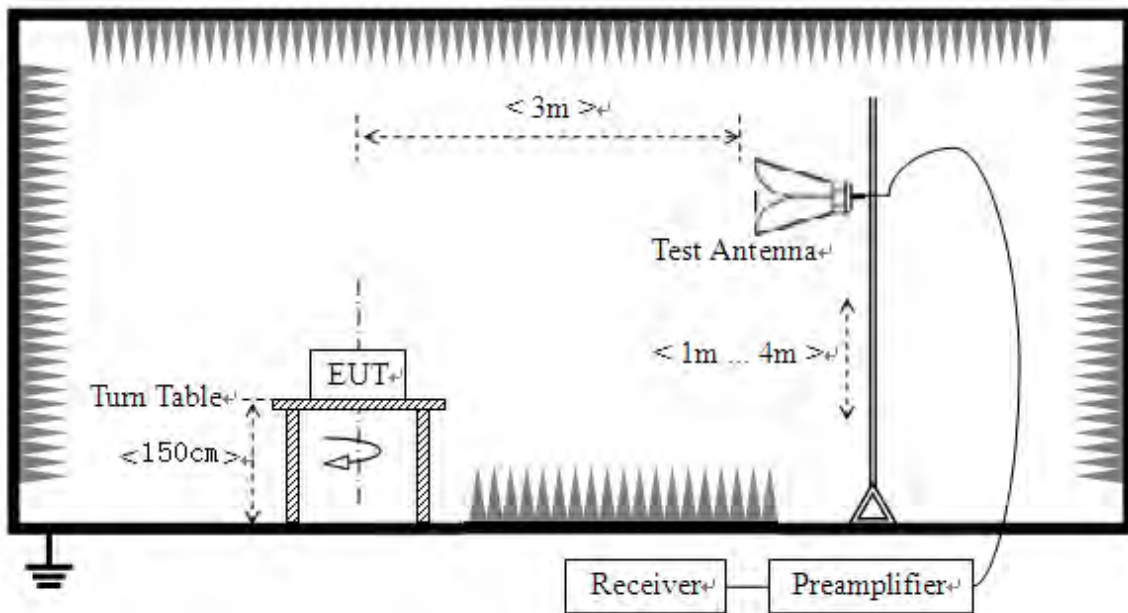
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following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

Frequency (MHz)	Field Strength ( $\mu\text{V}/\text{m}$ )	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

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).

### 2.8.2. 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.

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 1:** 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.

**Note 2** All test modes and bandwidth were considered and evaluated respectively by performing full test, only the worst data were recorded for each bandwidth.

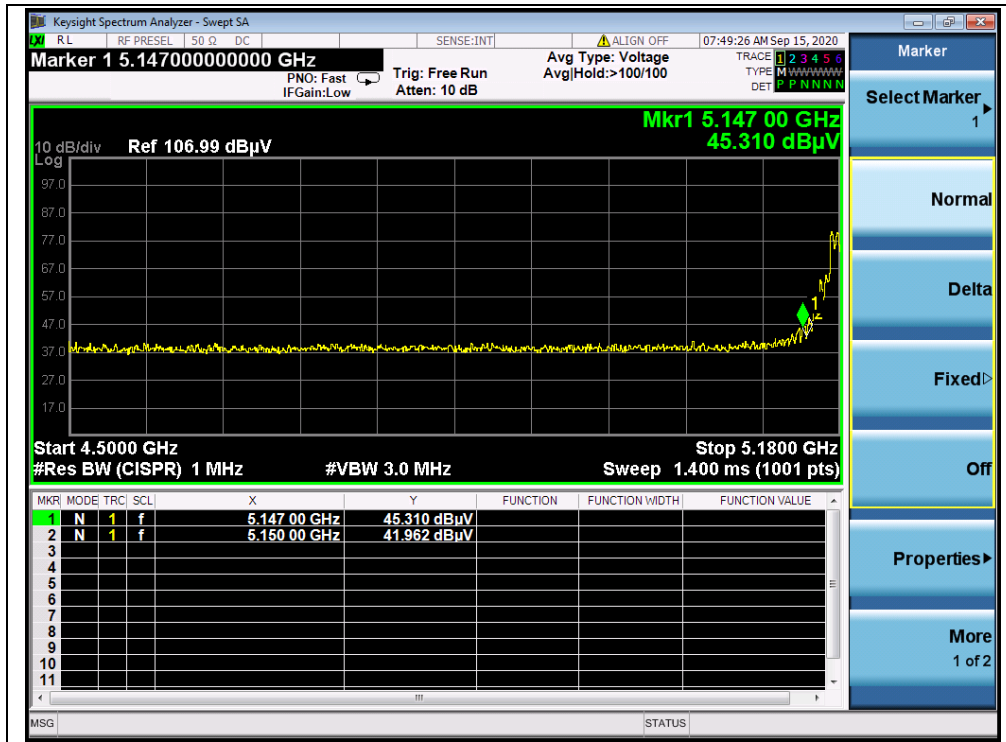
**802.11a Mode**

**A.Test Verdict:**

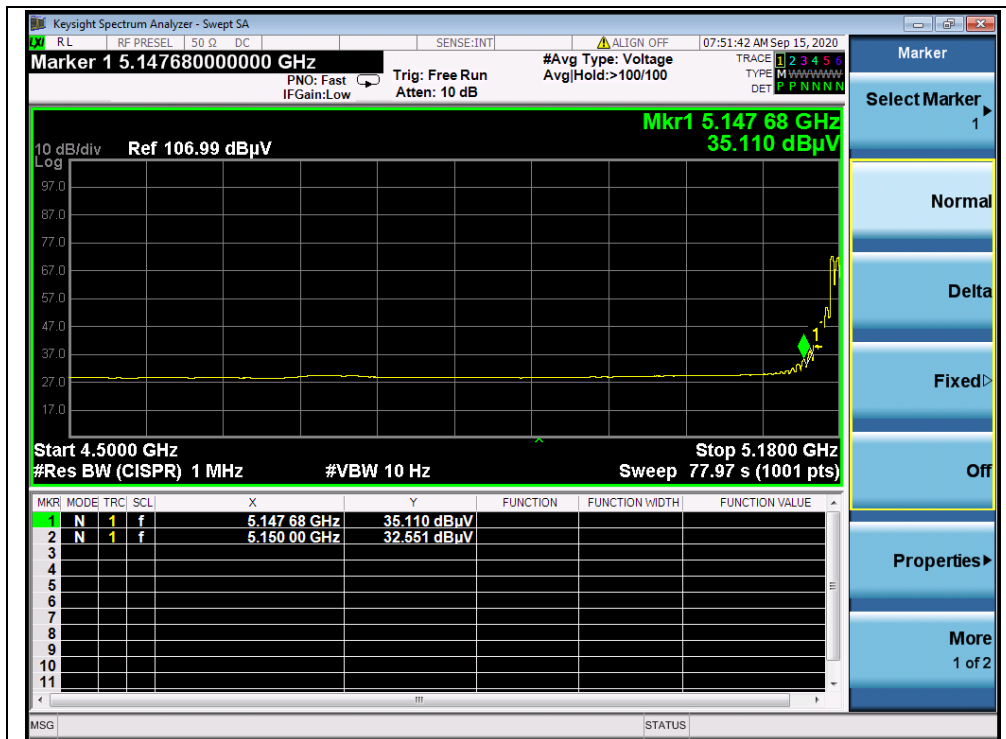
Channel	Frequency (MHz)	Detector	Receiver Reading	$A_T$ (dB)	$A_{\text{Factor}}$ (dB@3m)	Max. Emission E (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Verdict
		PK/ AV	$U_R$ (dB $\mu$ V)					
36	5147.00	PK	45.31	-26.92	32.20	50.59	74	PASS
36	5147.68	AV	35.11	-26.92	32.20	40.39	54	PASS
48	5454.06	PK	37.72	-26.92	32.20	43.00	74	PASS
48	5353.18	AV	27.54	-26.92	32.20	32.82	54	PASS
149	5725.00	PK	45.12	-26.23	32.20	51.09	122.23	PASS
165	5850.00	PK	42.49	-26.23	32.20	48.46	122.23	PASS



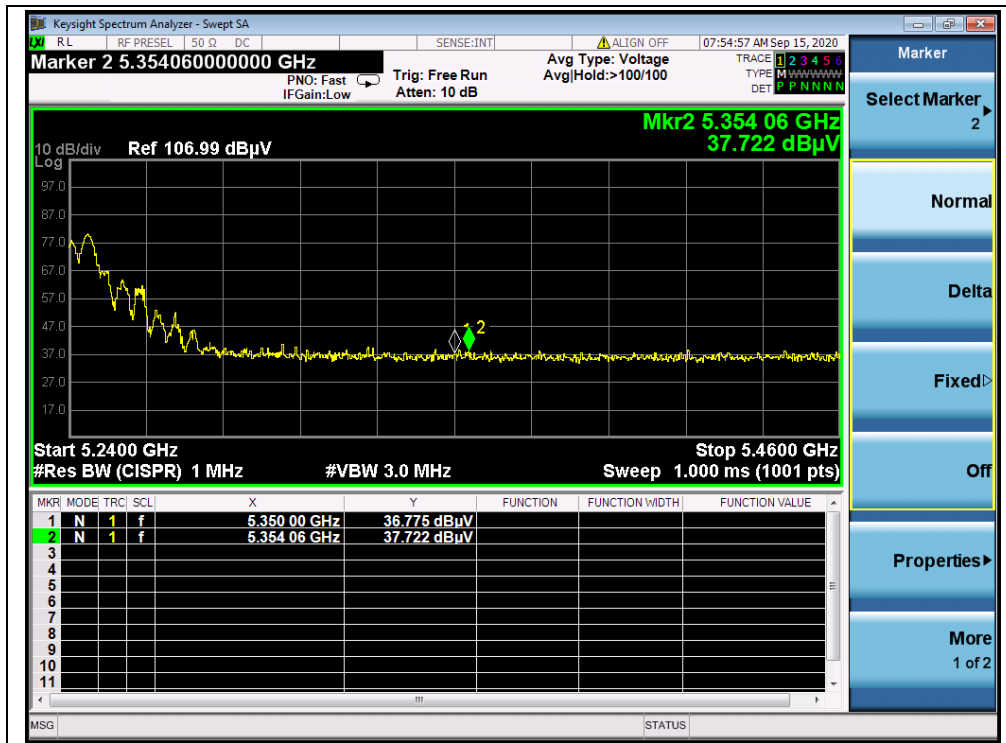
B.Test Plot:



(PEAK, Channel 36, 802.11a)



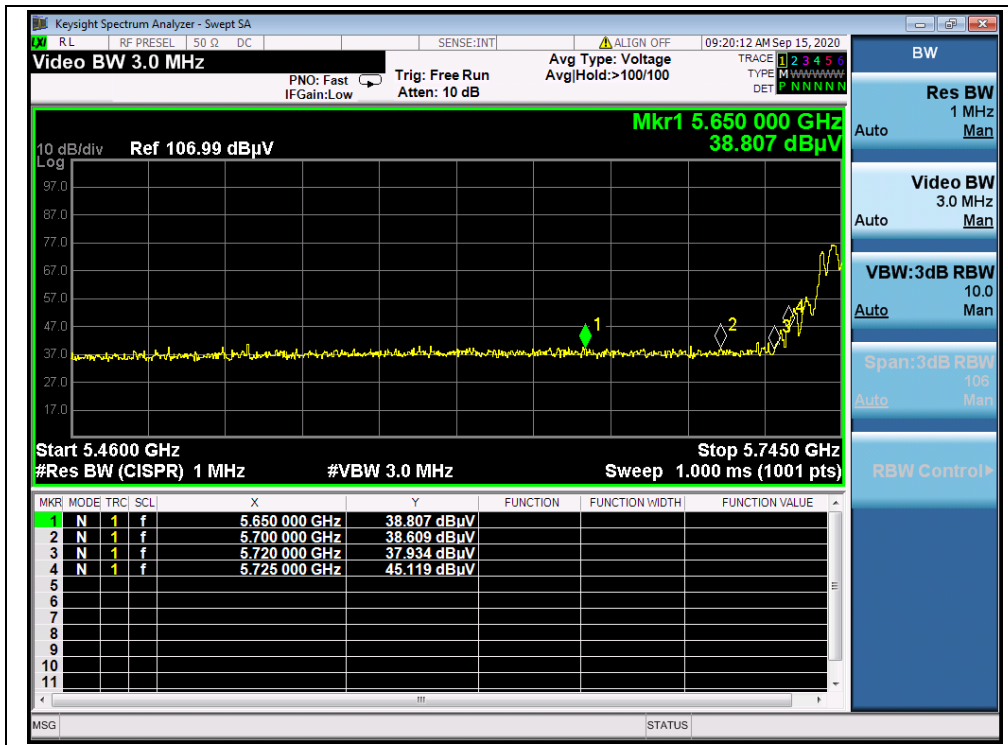
(AVERAGE, Channel 36, 802.11a)



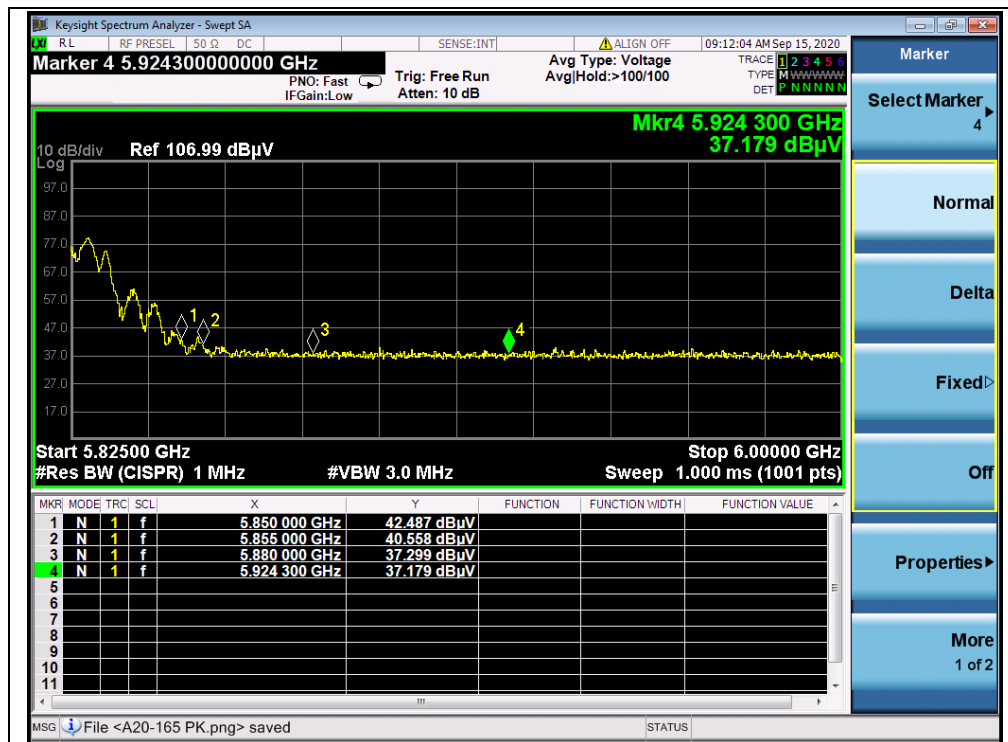
(PEAK, Channel 48, 802.11a)



(AVERAGE, Channel 48, 802.11a)



(PEAK, Channel 149, 802.11a)



(PEAK, Channel 165, 802.11a)

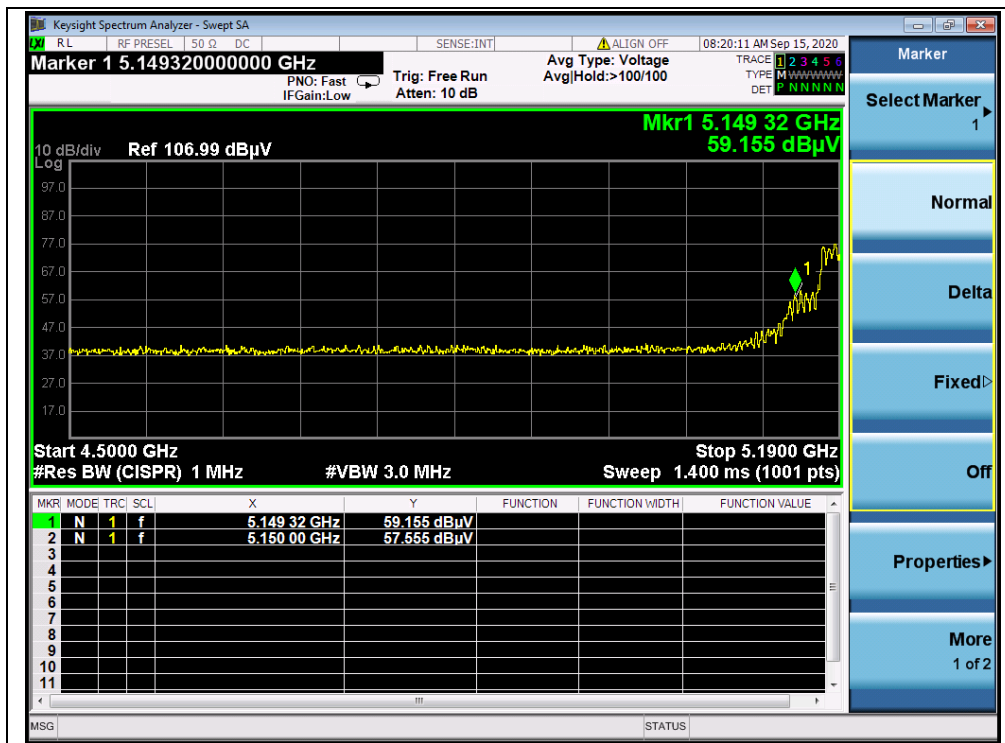


802.11n (HT40) Mode

A. Test Verdict:

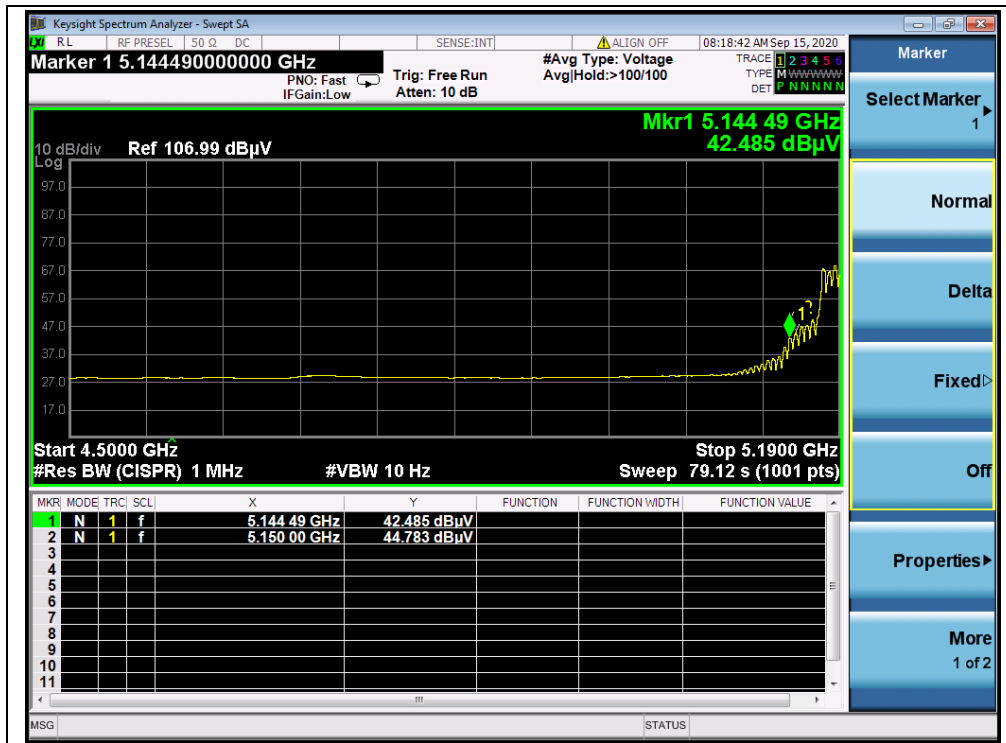
Channel	Frequency (MHz)	Detector	Receiver Reading	$A_T$	$A_{Factor}$	Max. Emission	Limit (dB $\mu$ V/m)	Verdict
		PK/ AV	$U_R$ (dB $\mu$ V)	(dB)	(dB@3m)	E (dB $\mu$ V/m)		
38	5149.32	PK	59.16	-26.92	32.20	64.44	74	PASS
38	5150.00	AV	44.78	-26.92	32.20	50.06	54	PASS
46	5361.10	PK	38.51	-26.92	32.20	43.79	74	PASS
46	5353.84	AV	27.31	-26.92	32.20	32.59	54	PASS
151	5725.00	PK	49.94	-26.23	32.20	55.91	122.23	PASS
159	5854.80	PK	40.73	-26.23	32.20	46.70	122.23	PASS

B. Test Plot:

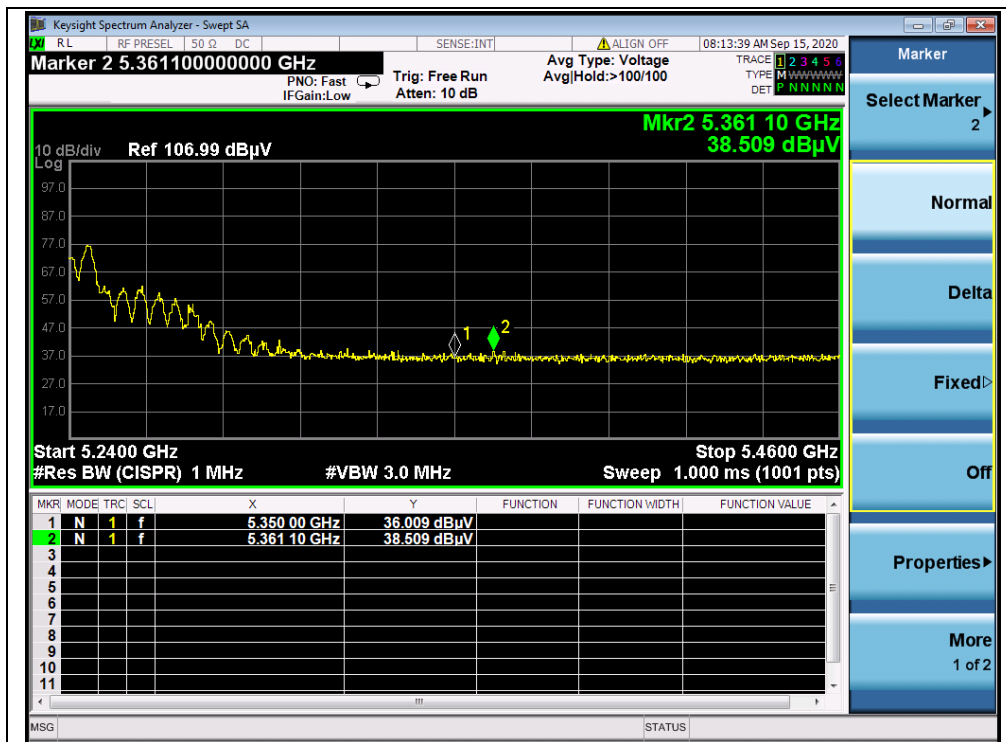


(PEAK, Channel 38, 802.11n (HT40))





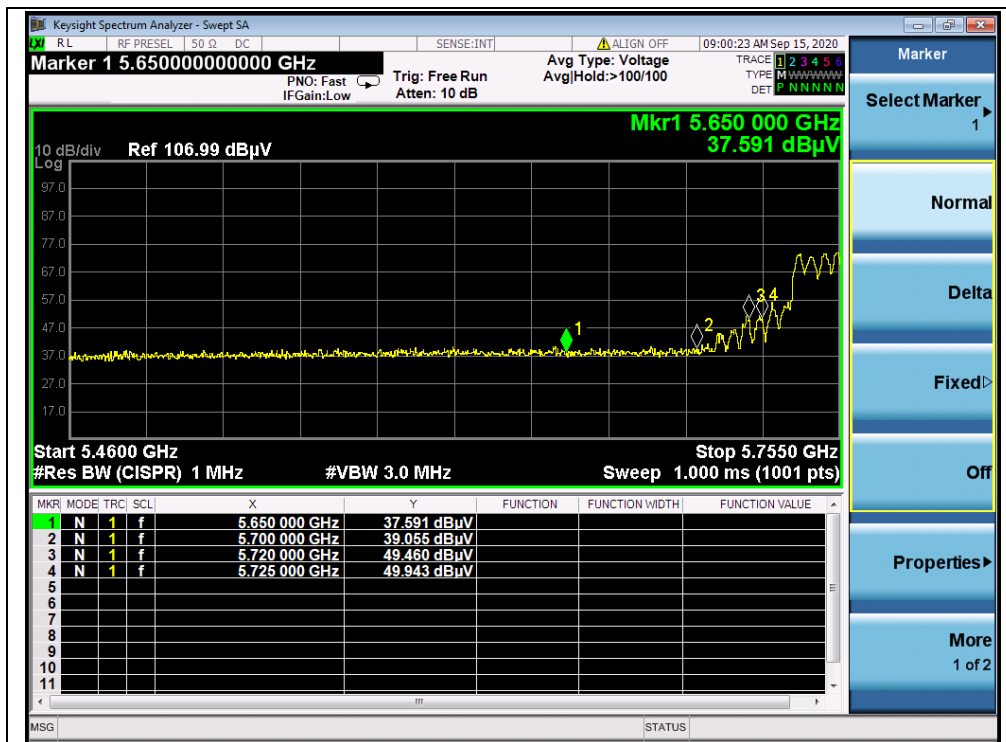
(AVERAGE, Channel 38, 802.11n (HT40))



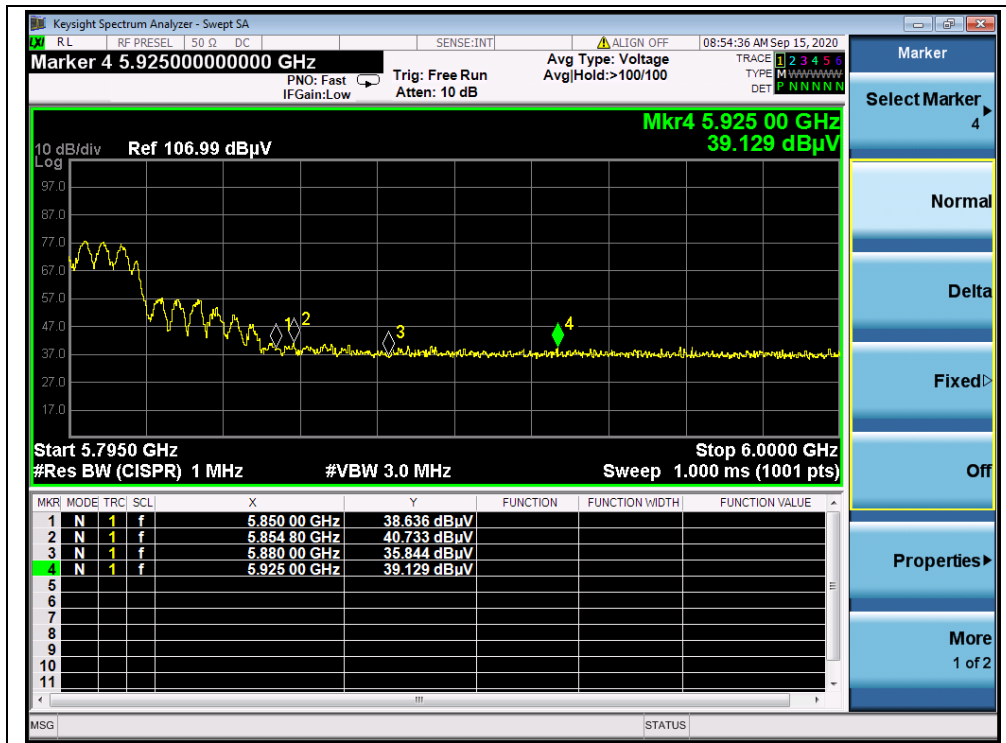
(PEAK, Channel 48, 802.11n (HT40))



(AVERAGE, Channel 48, 802.11n (HT40))



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



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

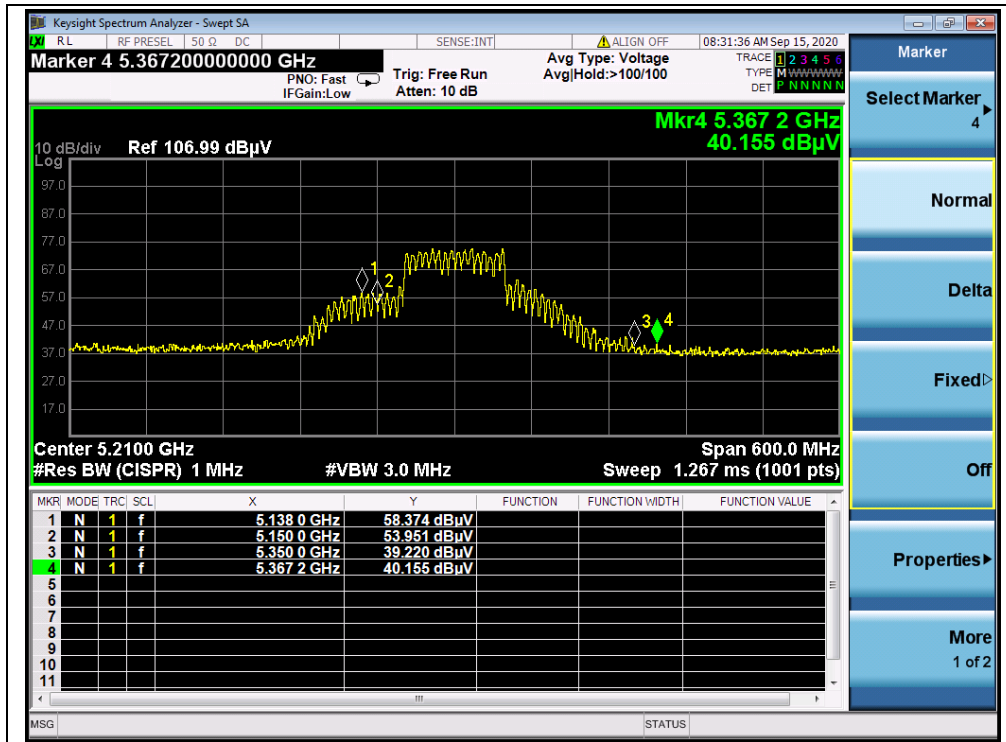


**802.11 ac (VHT80) Mode**

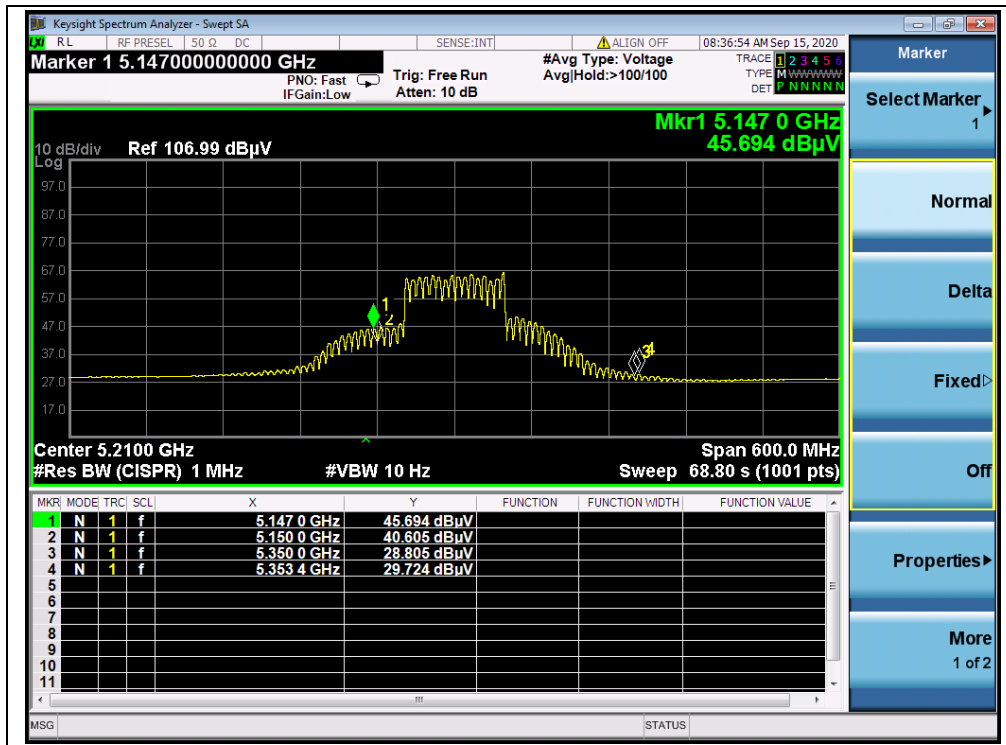
**A. Test Verdict:**

Channel	Frequency (MHz)	Detector	Receiver Reading	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV	U <sub>R</sub> (dBuV)					
42	5138.00	PK	58.37	-26.92	32.20	63.65	74	PASS
42	5147.00	AV	45.69	-26.92	32.20	50.97	54	PASS
42	5367.20	PK	40.16	-26.92	32.20	45.44	74	PASS
42	5353.40	AV	29.72	-26.92	32.20	35.00	54	PASS
155	5721.60	PK	55.55	-26.23	32.20	61.52	114.48	PASS
155	5851.20	PK	49.37	-26.92	32.20	55.34	119.49	PASS

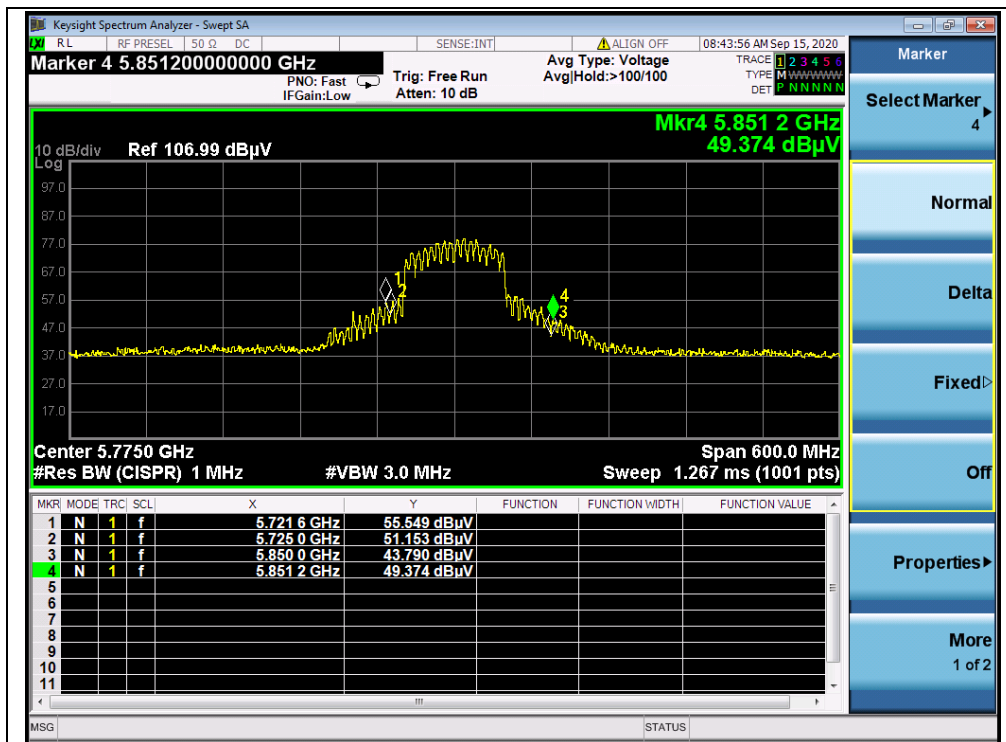
**B. Test Plot:**



(Channel 42, PEAK, 802.11ac (VHT80))



(Channel 42, AVG, 802.11ac (VHT80))



(Channel 155, PEAK, 802.11ac (VHT80))



## 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(e.i.r.p.) 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:

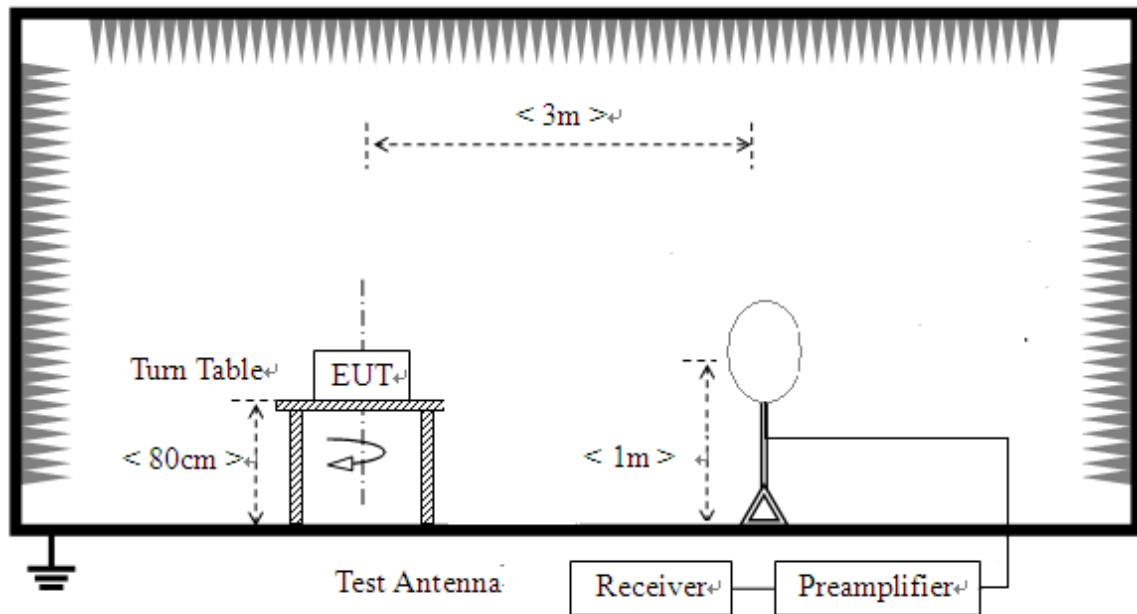
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

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

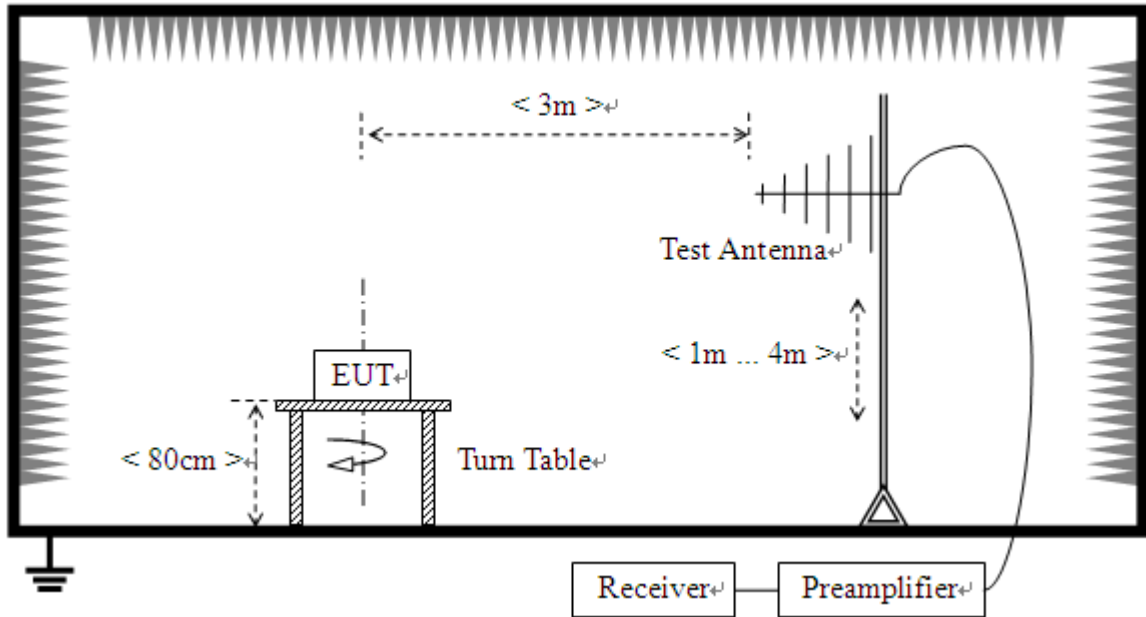
#### Test Setup:

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

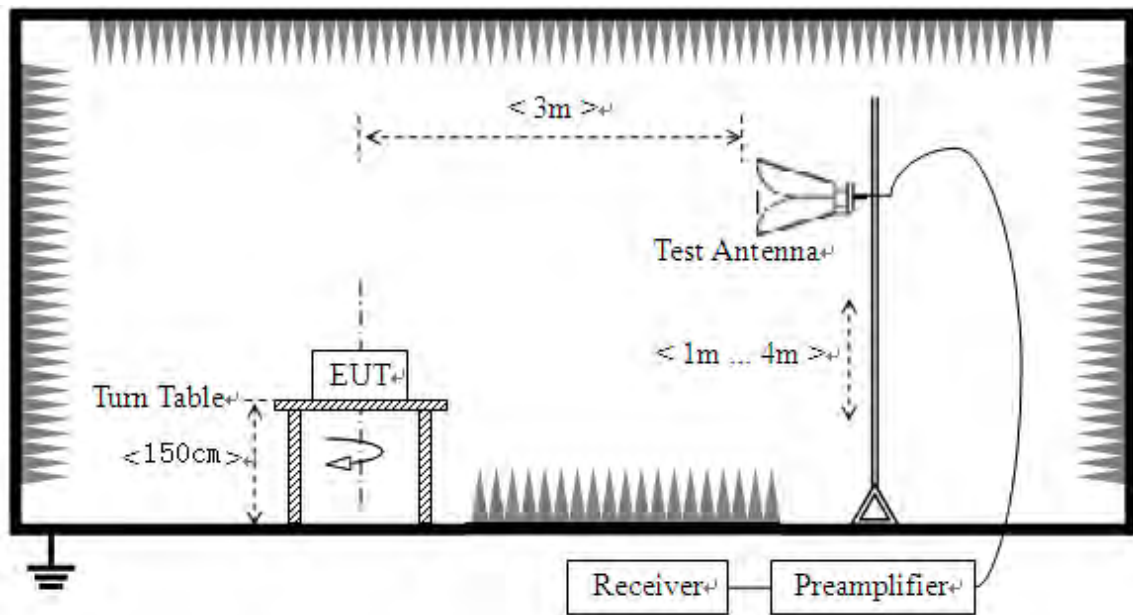




2) For radiated emissions from 30MHz to1GHz



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 a quasi-peak measurement (or average).

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.

**Note 1:** 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.

**Note 2:** 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.

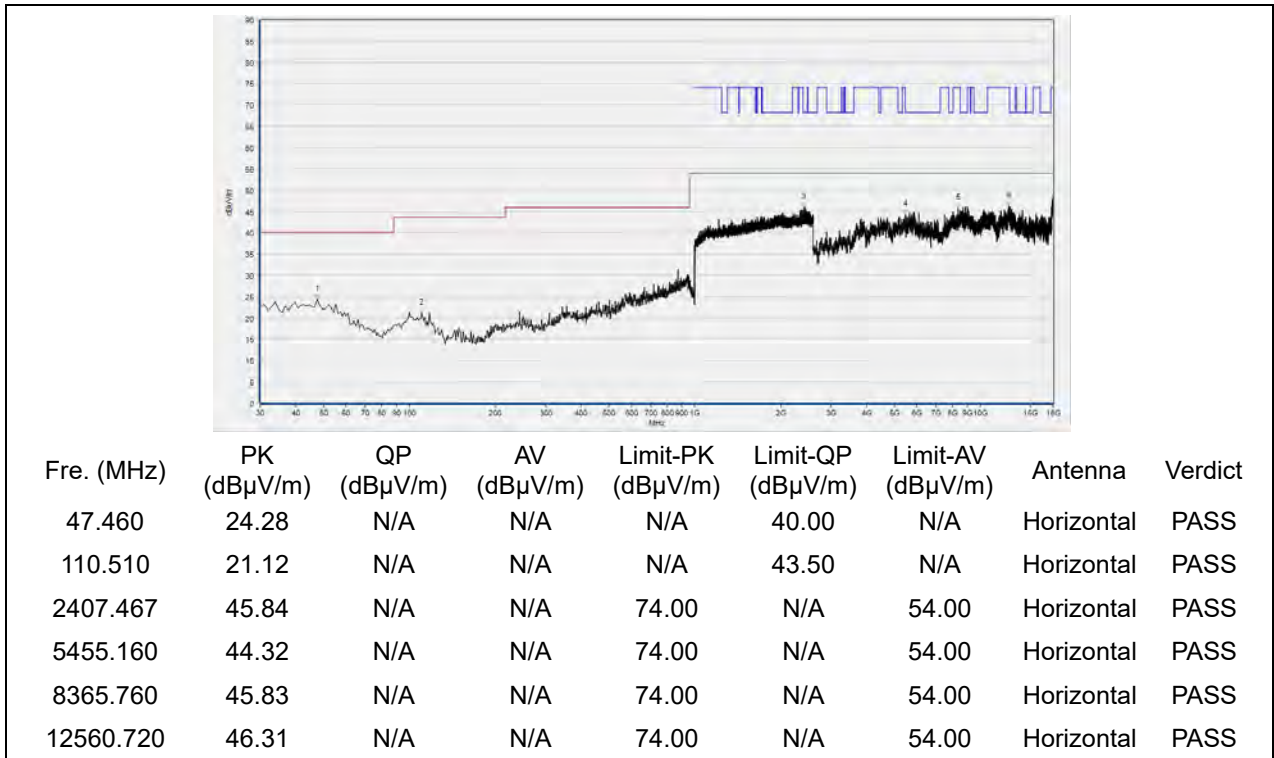
**Note 3:** For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**Note 4:** All test modes and bandwidth were considered and evaluated respectively by performing full test, only the worst data were recorded for each bandwidth.

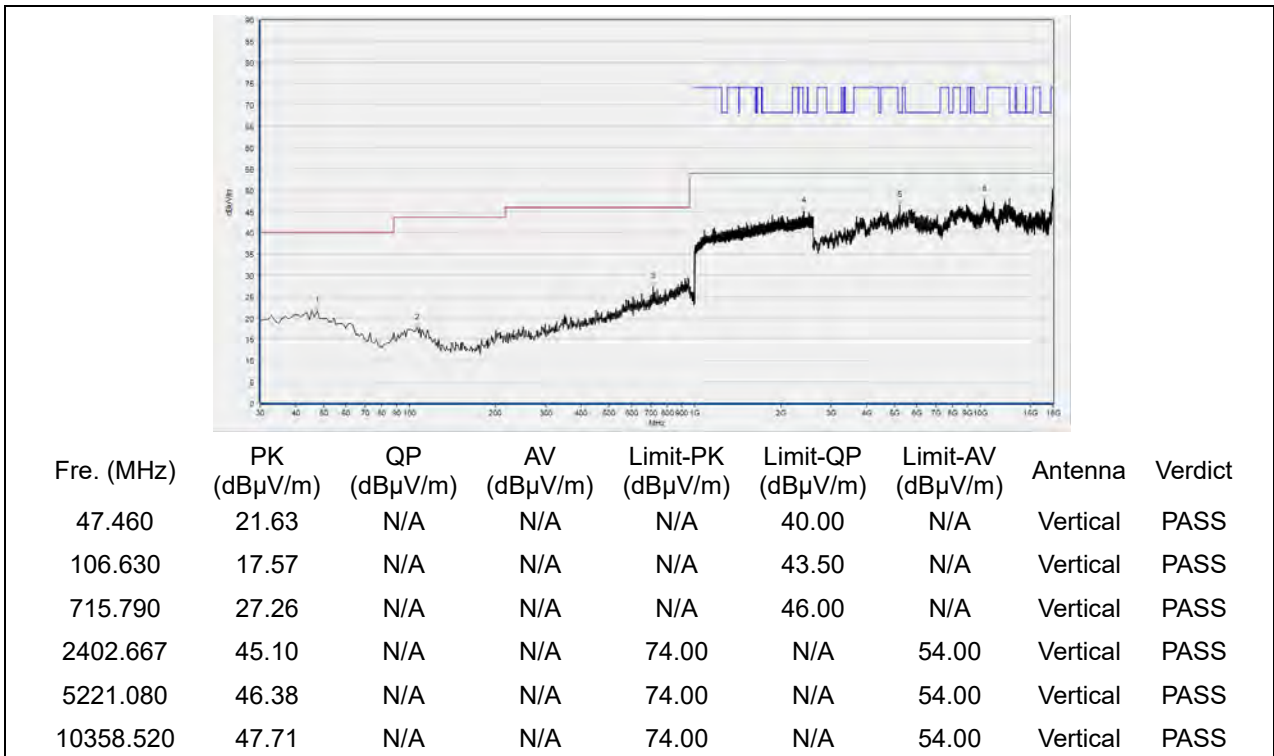


**802.11a Mode**

**Plot for Channel 36**

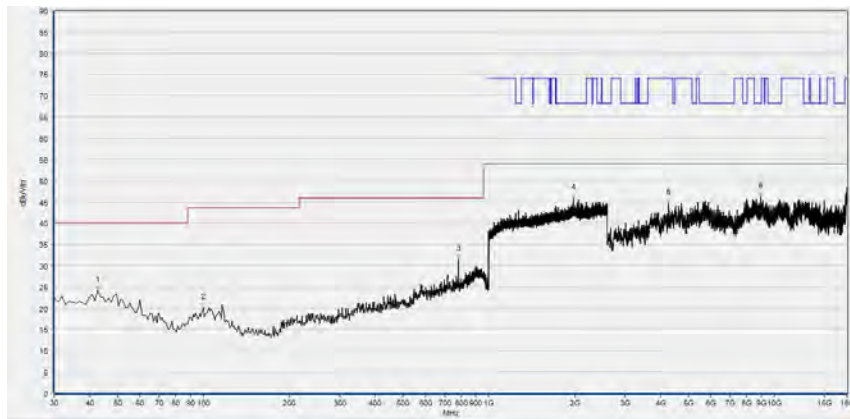


(Antenna Horizontal, 30MHz to 18GHz)



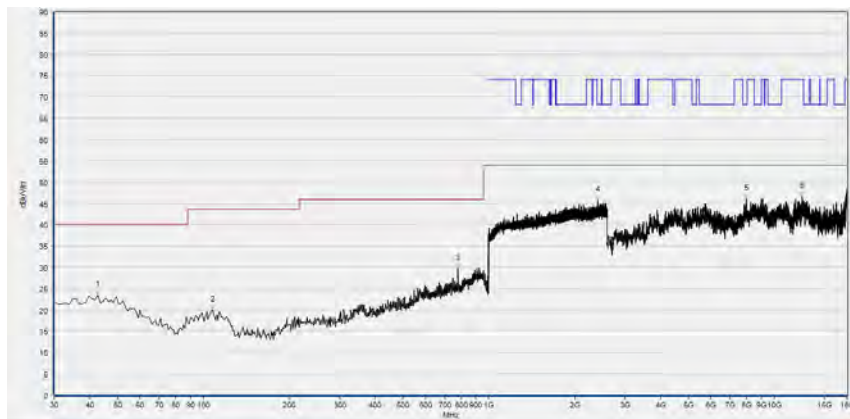
(Antenna Vertical, 30MHz to 18GHz)

Plot 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
42.610	24.09	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
99.840	20.07	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
782.720	31.57	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1981.867	45.96	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS
4263.200	44.70	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8981.760	46.18	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS

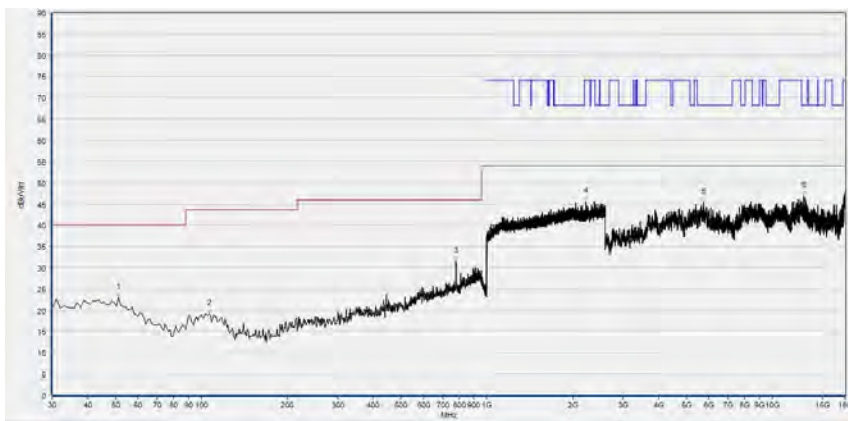
(Antenna Horizontal, 30MHz to 18GHz)



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
42.610	23.38	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
107.600	19.90	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
779.810	29.65	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2413.333	45.76	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
7965.360	46.11	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
12514.520	46.65	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

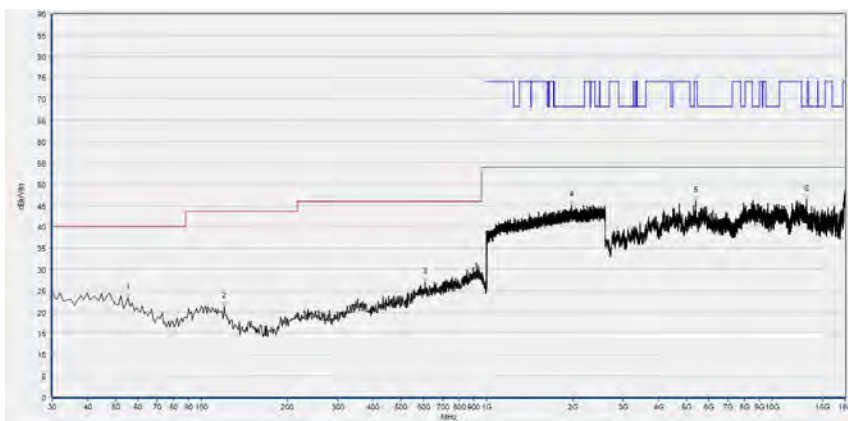
(Antenna Vertical, 30MHz to 18GHz)

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
51.340	23.00	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
106.630	19.16	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
777.870	31.45	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2218.667	45.55	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5741.600	45.44	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS
12877.960	46.91	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)

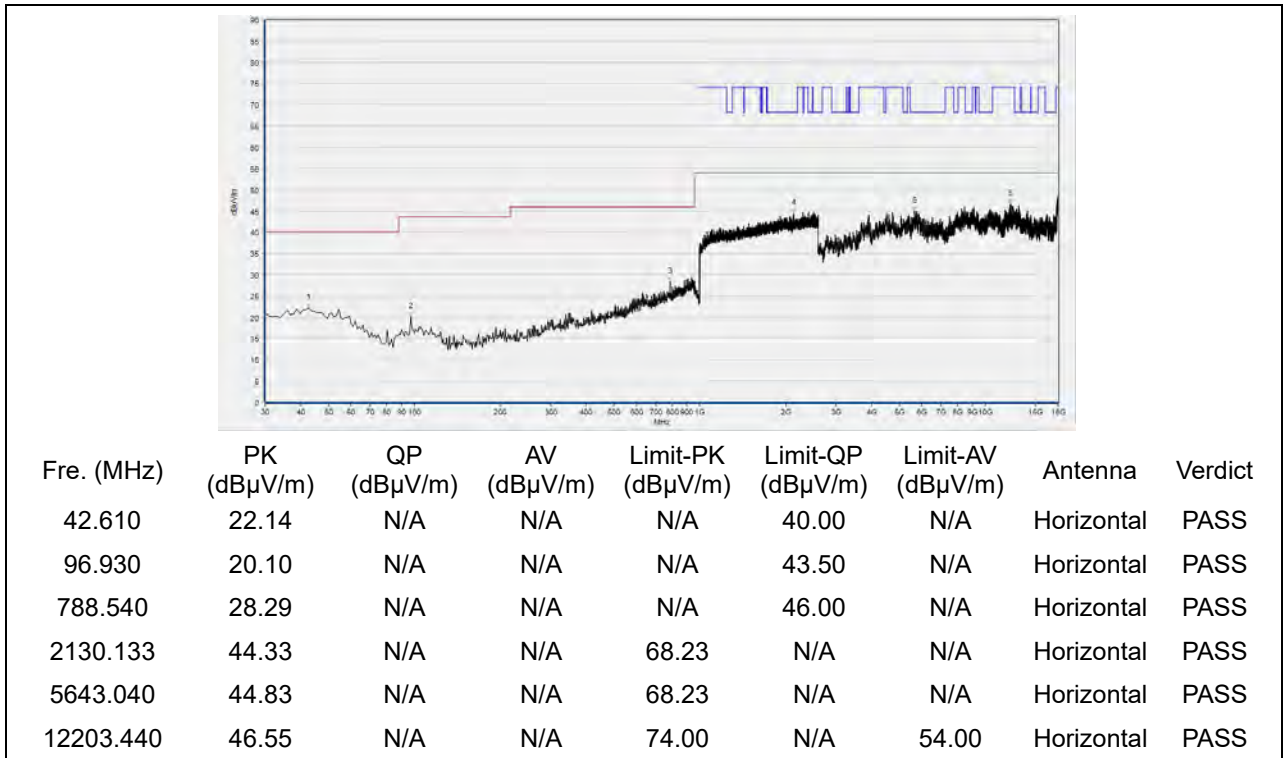


Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
55.220	23.31	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
120.210	21.27	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
608.120	27.00	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1981.333	45.00	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
5399.720	46.04	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
13152.080	46.38	N/A	N/A	68.23	N/A	N/A	Vertical	PASS

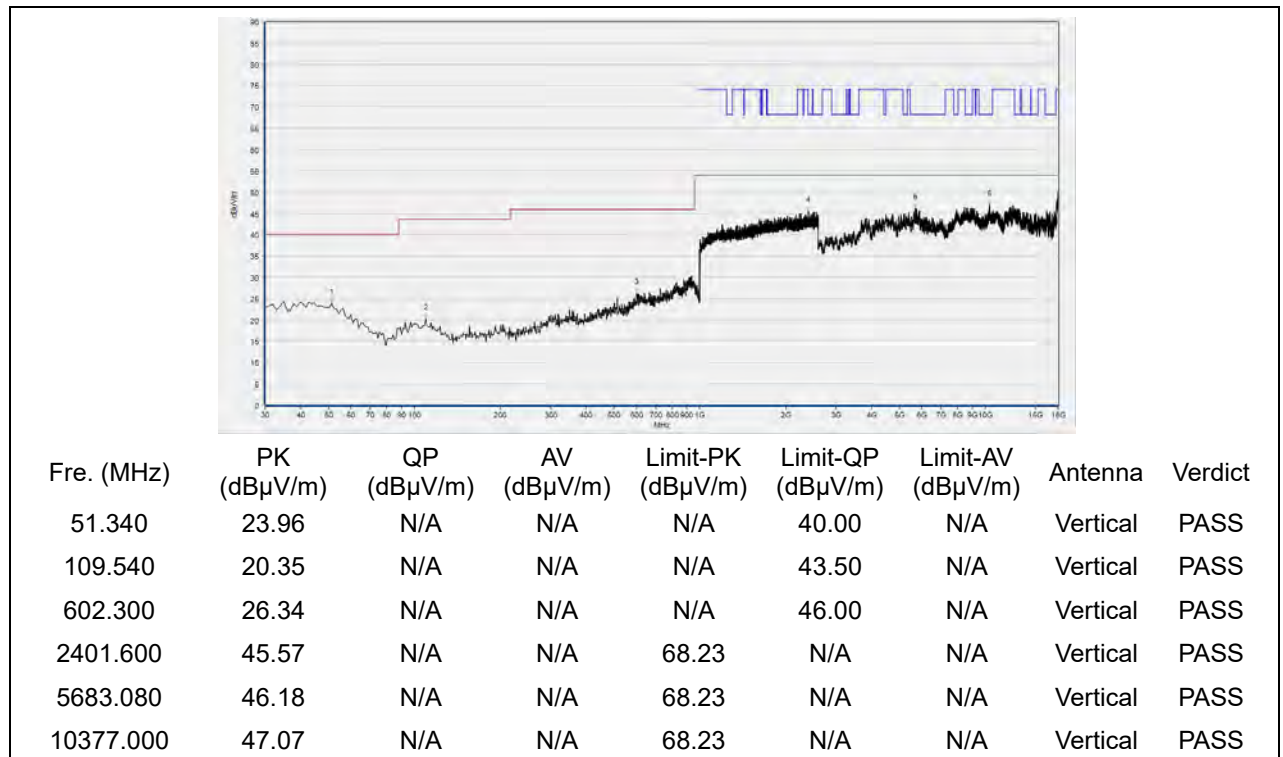
(Antenna Vertical, 30MHz to 18GHz)



Plot for Channel 149

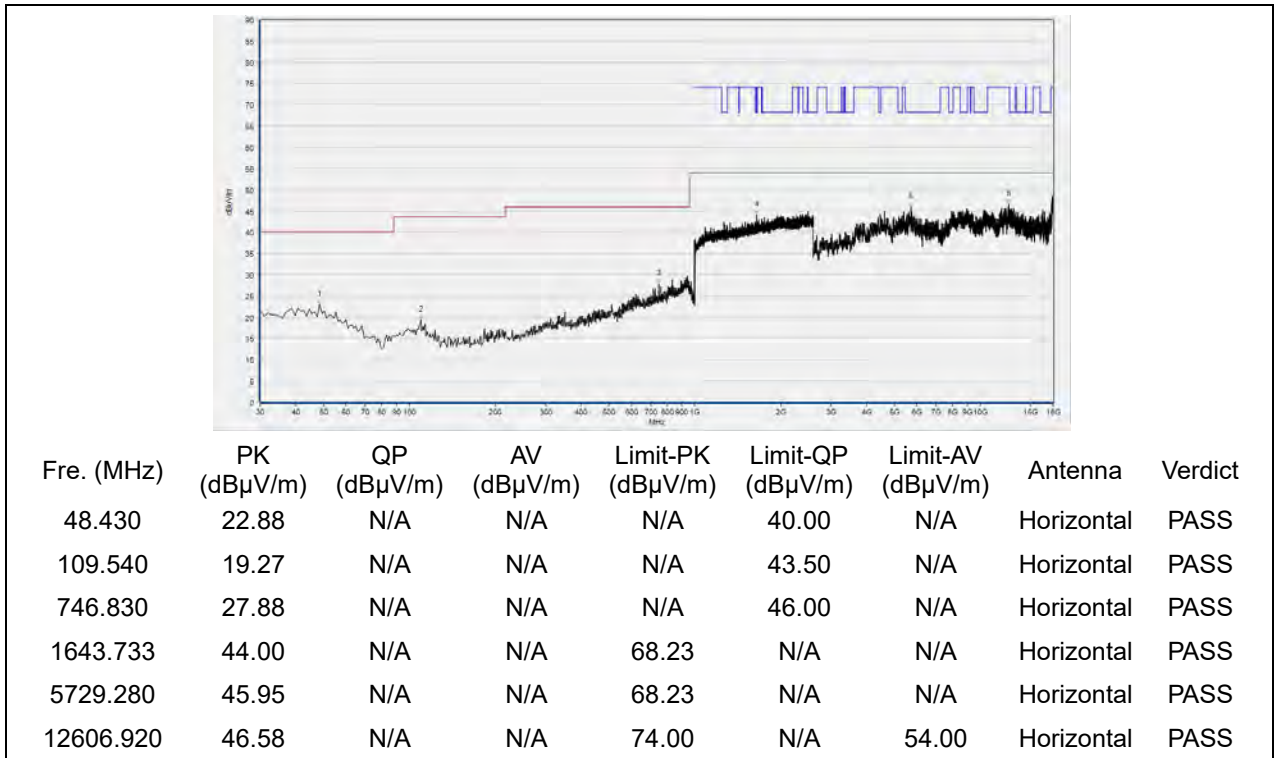


(Antenna Horizontal, 30MHz to 18GHz)

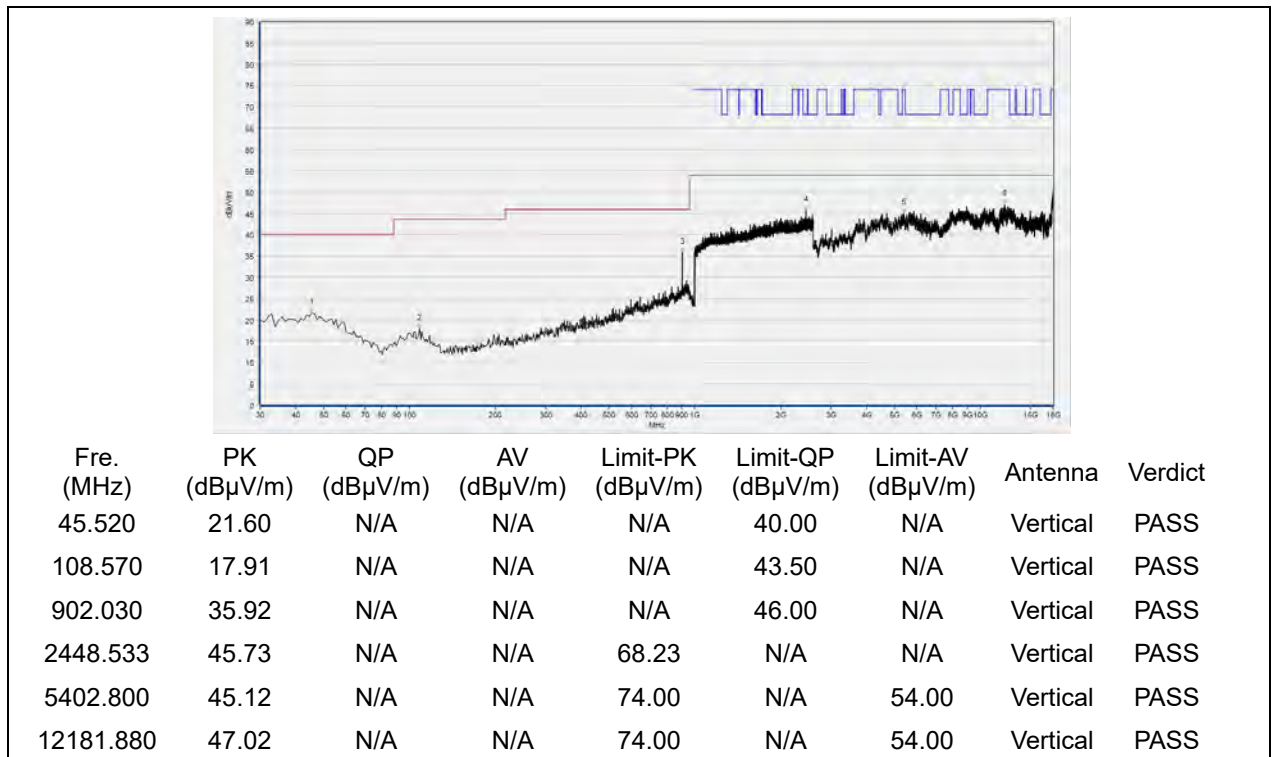


(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 157



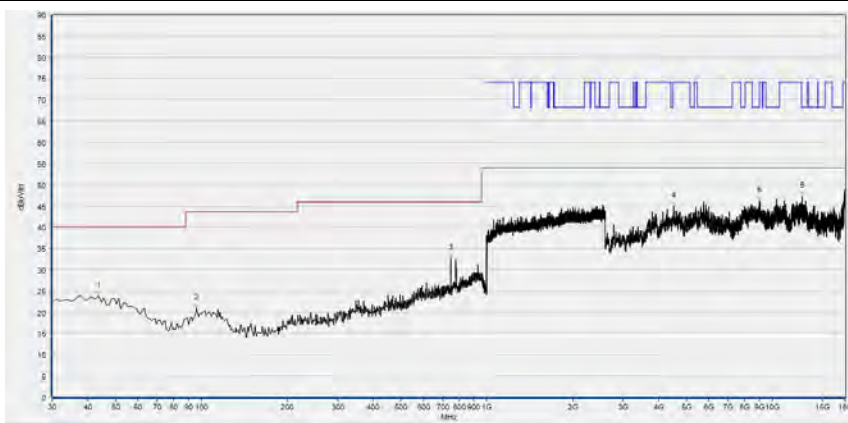
(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)

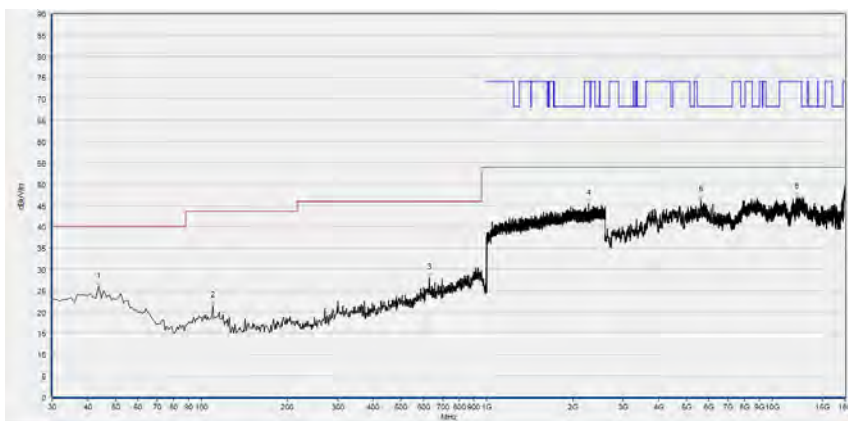


Plot for Channel 165



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
43.580	23.73	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
95.960	20.97	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
746.830	32.64	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
4506.520	44.93	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8994.080	46.19	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS
12730.120	47.34	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)



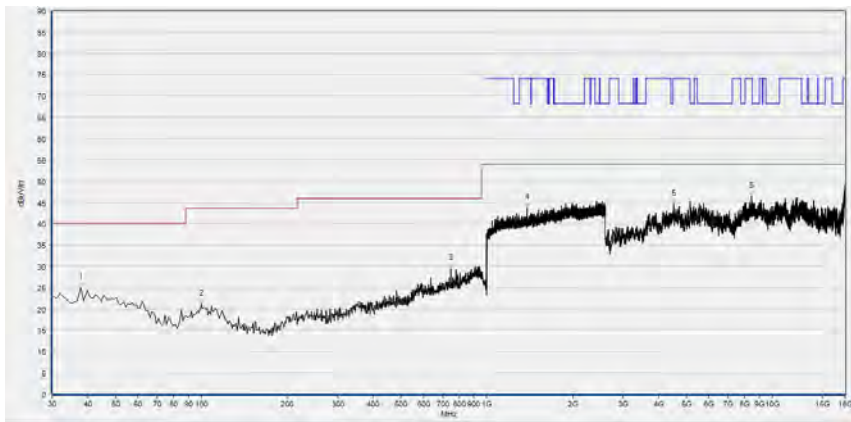
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
43.580	25.91	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
109.540	21.42	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
627.520	28.06	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2274.133	45.36	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5624.560	46.32	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
12144.920	46.93	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)



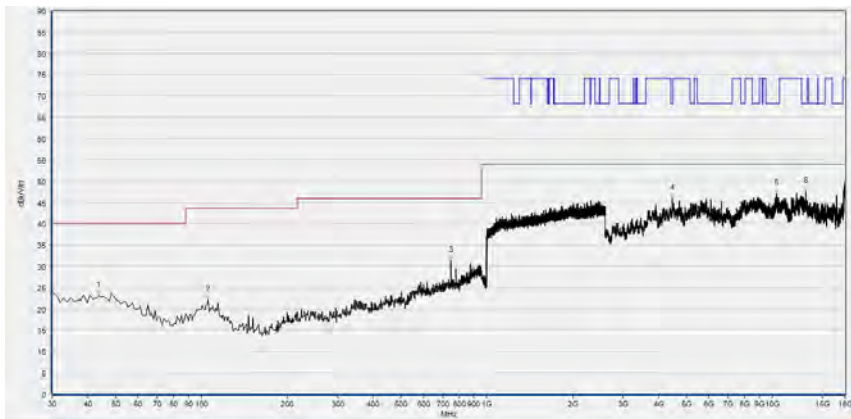
**802.11n (HT40) mode**

**Plot 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
37.760	24.97	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
99.840	21.19	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
748.770	29.47	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1381.867	43.79	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4506.520	44.57	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8464.320	46.50	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

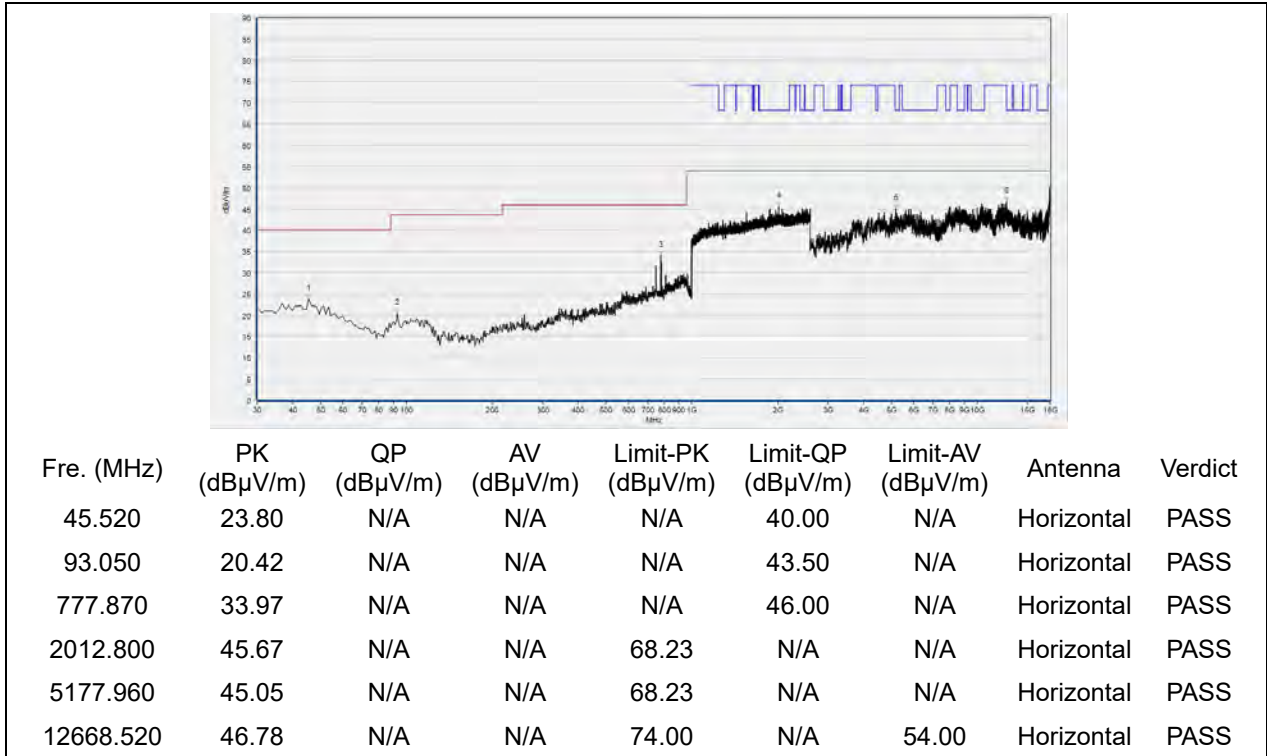
(Antenna Horizontal, 30MHz to 18GHz)



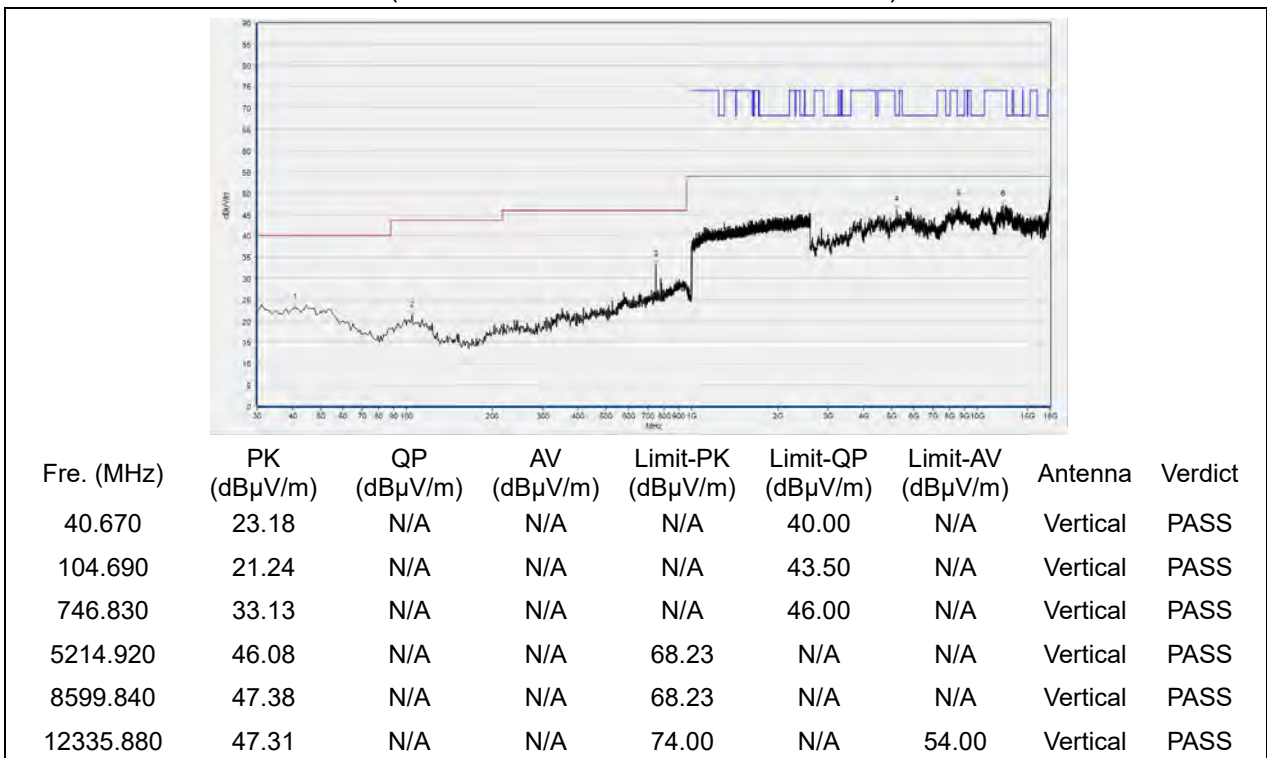
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
43.580	23.16	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
105.660	22.14	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
749.740	31.27	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
4463.400	45.87	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
10370.840	47.07	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
13093.560	47.63	N/A	N/A	68.23	N/A	N/A	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 46

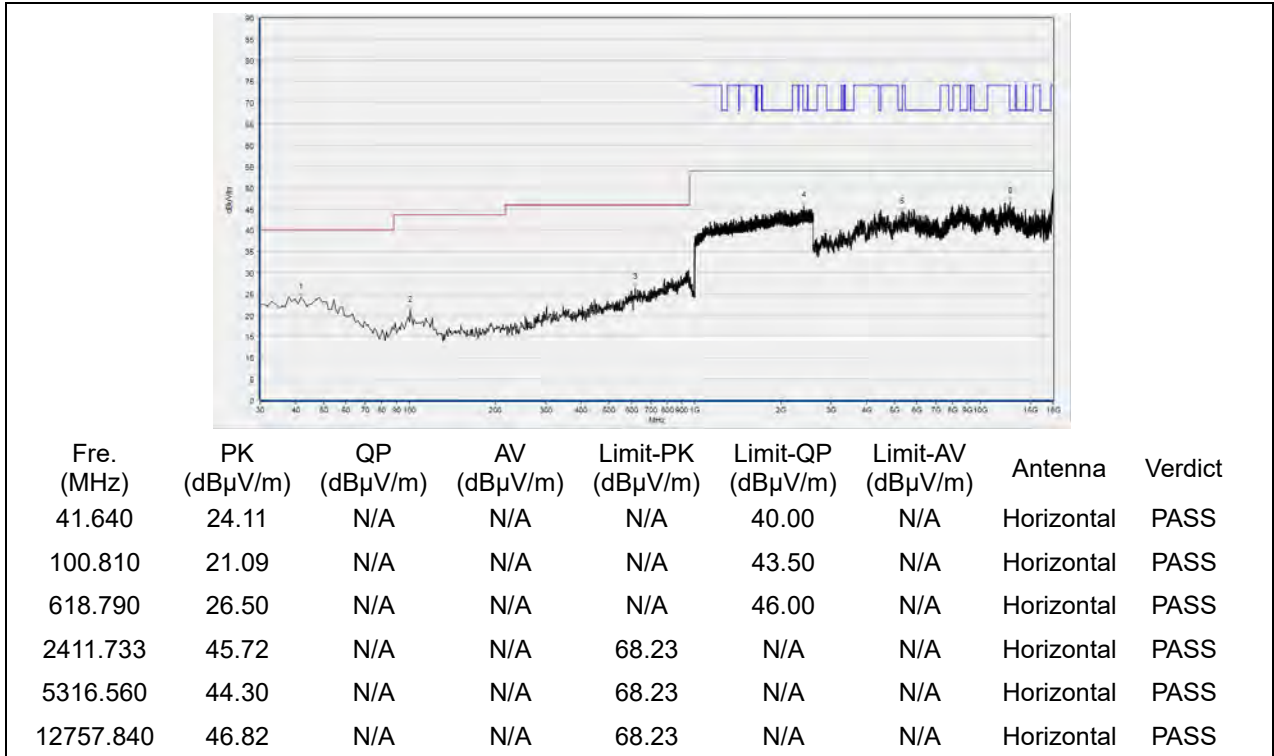


(Antenna Horizontal, 30MHz to 18GHz)

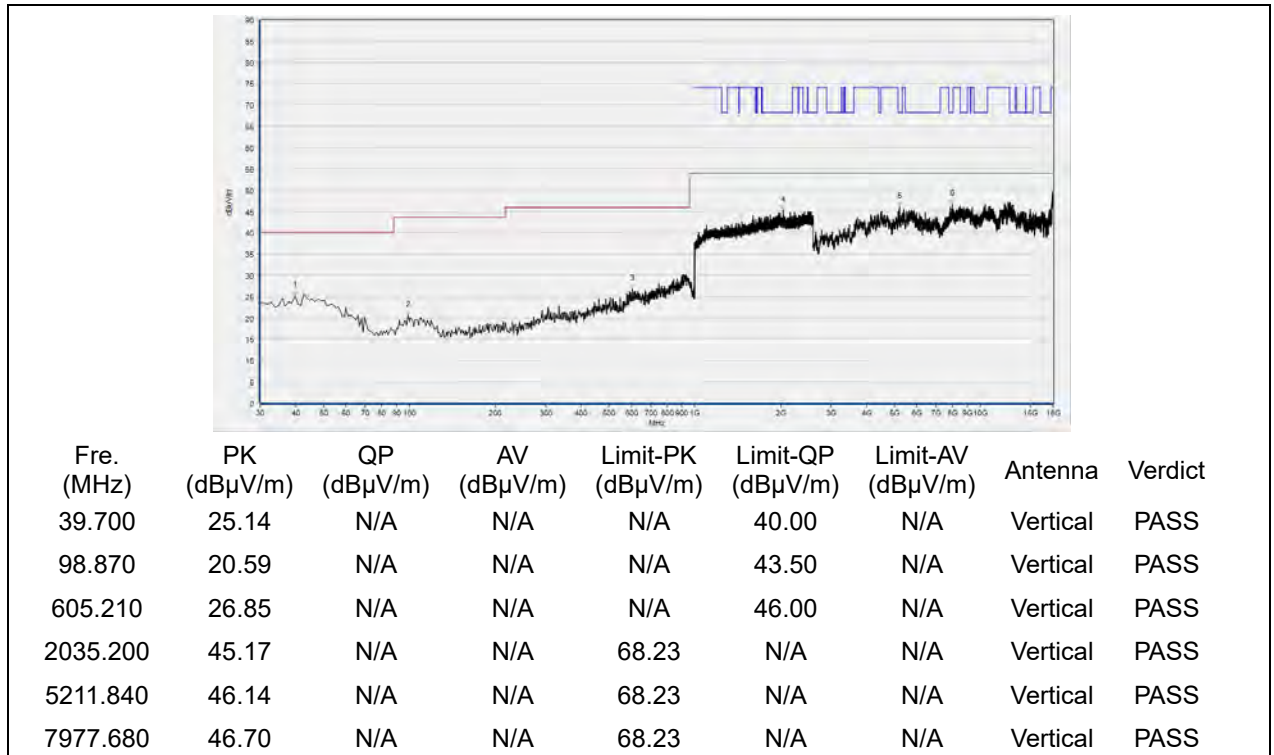


(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 151

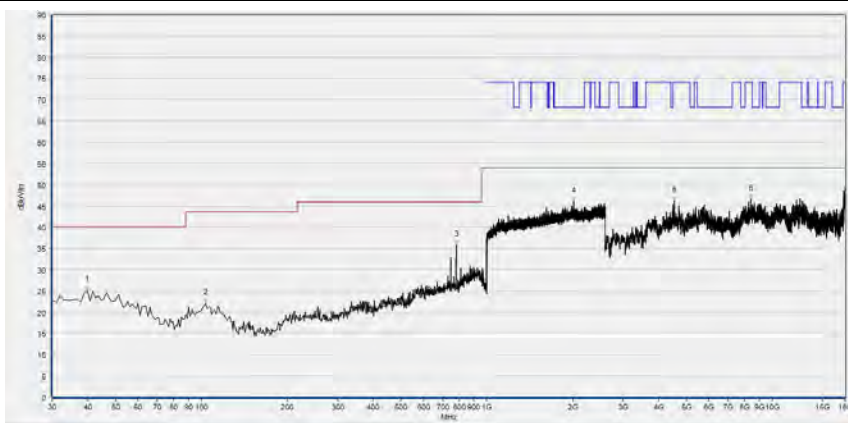


(Antenna Horizontal, 30MHz to 18GHz)



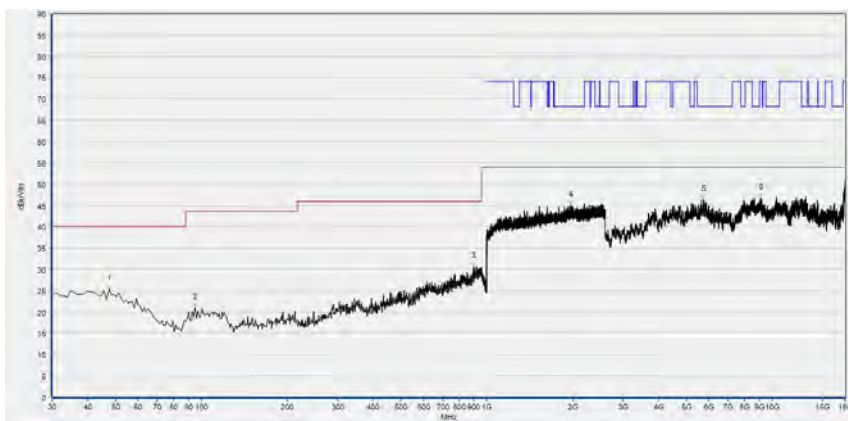
(Antenna Vertical, 30MHz to 18GHz)

Plot 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
39.700	25.08	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
103.720	22.16	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
780.780	35.81	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2017.600	46.07	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS
4534.240	46.33	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8418.120	46.61	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)



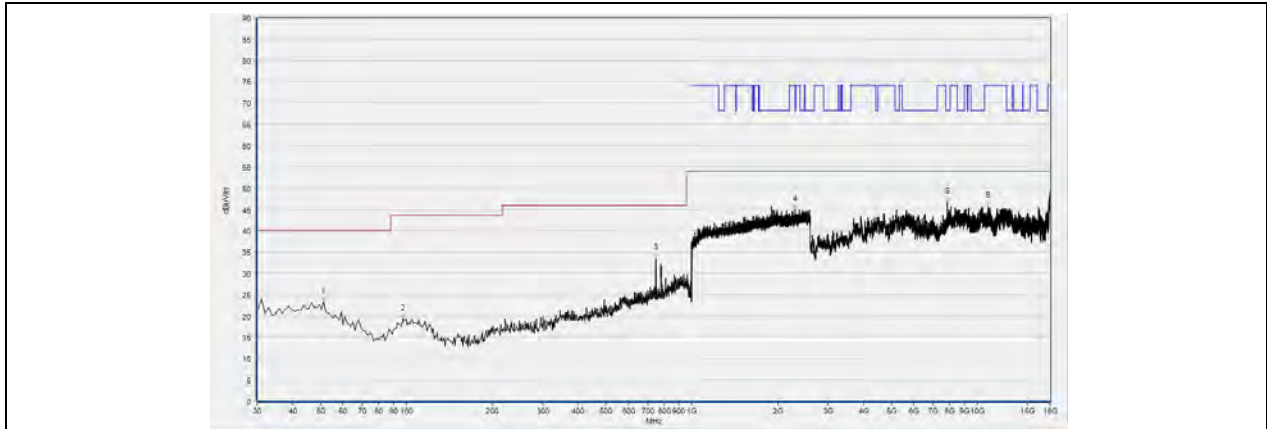
Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
47.460	25.38	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
94.990	20.93	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
897.180	30.75	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1972.800	45.16	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
5738.520	46.46	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
9120.360	46.79	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)



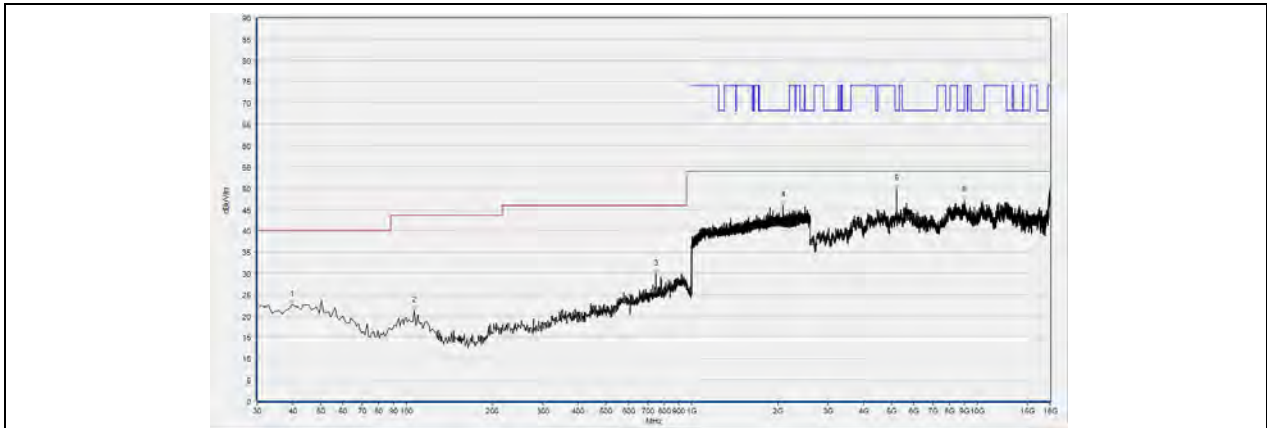
**802.11ac (VHT80) Mode**

Plot for Channel 42



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
51.340	23.31	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
96.930	19.28	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
749.740	33.56	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
2296.533	44.86	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
7869.880	46.84	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS
10925.240	45.76	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

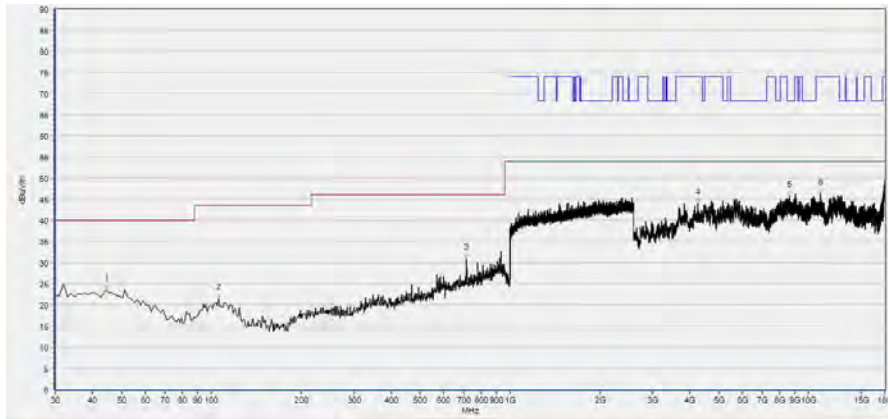
(Antenna Horizontal, 30MHz to 18GHz)



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
39.700	22.71	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
106.630	21.27	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
749.740	29.83	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
2084.800	45.88	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
5211.840	49.73	N/A	N/A	68.23	N/A	N/A	Vertical	PASS
9018.720	47.16	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

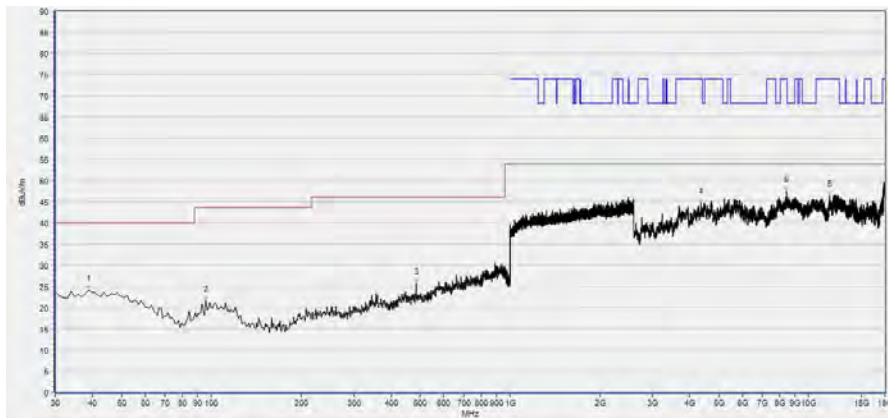
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 155



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
44.550	23.46	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
105.660	21.47	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
715.790	30.96	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
4260.120	43.96	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
8639.880	45.77	N/A	N/A	68.23	N/A	N/A	Horizontal	PASS
10931.400	46.18	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	24.03	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
95.960	21.63	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
485.900	25.72	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
4371.000	44.57	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
8452.000	47.58	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
11732.200	46.50	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	$\pm 2.22\text{dB}$
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	Due Date
Attenuator 1	N/A	10dB	Resnet	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
Temperature Chamber	12108015	DTL-003S101	YOMA	2020.01.08	2021.01.07

##### 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	812744	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

##### 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	V1.0
TS+ -[JS32-CE]	Tonscend	V2.5.0.0

**4.4 Radiated 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 - Horn	BBHA9170 #774	BBHA 9170	Schwarzbeck	2019.07.26	2022.07.25
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2019.02.14	2022.02.13
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2019.07.26	2022.07.25
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	61171/61172	S020180L32 03	Tonscend	2020.07.21	2021.07.20
26-40GHz pre-Amplifier	56774	S40M400L4 002	Tonscend	2020.07.21	2021.07.20
18-26.5GHz pre-Amplifier	46732	S10M100L38 02	Tonscend	2020.07.21	2021.07.20
Notch Filter	N/A	WRCG-5150-5350	Wainwright	2020.07.21	2021.07.20
Notch Filter	N/A	WRCG-5470-5725	Wainwright	2020.07.21	2021.07.20
Notch Filter	N/A	WRCG-5725-5850	Wainwright	2020.07.21	2021.07.20



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Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Anechoic Chamber	N/A	9m*6m*6m	CRT	2020.01.06	2023.01.05

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