REPORT No.: SZ19080383W01

TEST REPORT

APPLICANT	:	Shenzhen ImagineVision Technology Limited
PRODUCT NAME	:	Z CAM E2 Series Camera
MODEL NAME	:	E1701, E1901, E1902, E1511
BRAND NAME	:	Z CAM
FCC ID	:	2AENNE2F
STANDARD(S)	:	47 CFR Part 15 Subpart E
RECEIPT DATE	:	2019-09-12
TEST DATE	:	2019-09-30 to 2019-10-15
ISSUE DATE	:	2020-01-08

Edited by: Peng Mi (Rapporteur)

Approved by: Peng Huarui (Supervisor)

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MORLAB

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DIRECTORY

Change History		
Version	**Date**	**Reason for change**
1.0	2020-01-08	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Shenzhen ImagineVision Technology Limited
Applicant Address:	1A, Block F5, TCL International E City, 1001 Zhong Shan Park Road, Nan Shan, Shenzhen, China
Manufacturer:	Shenzhen ImagineVision Technology Limited
Manufacturer Address:	1A, Block F5, TCL International E City, 1001 Zhong Shan Park Road, Nan Shan, Shenzhen, China

1.2. Equipment Under Test (EUT) Description

Product Name:	Z CAM E2 Series Camera
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	ver1
Software Version:	2019086_0.88
Modulation Technology:	OFDM
Modulation Mode:	802.11a, 802.11n(HT20), 802.11n(HT40) 802.11ac(VHT20), 802.11ac(VHT40), 802.11ac(VHT80),
Operating Frequency Range:	5.180 GHz- 5.240 GHz; 5.745GHz- 5.825GHz
Channel Number:	Refer to 1.4
Antenna Type:	Monopole Antenna
Antenna Gain:	2.0dBi

Note 1: According to the certificate holder, they declared that the models: E1701, E1901, E1902, E1511, only different in lens mount of the appearance structure, correspond sensor & sensor's PCBA and the model name, everything else is the same. The main measuring model is E1701, only the results for E1701 were recorded in this report.

Note 2: WIFI hotspot does not support U-NII band.

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

1.3. Modulation Type and Data Rate of EUT

Modulation Technology	Modulation Type	Data Rate (Mbps) Note1
OFDM (802.11a)	BPSK	**6**/9
	QPSK	12/18
	16QAM	24/36
	64QAM	48/54
OFDM (802.11n)	BPSK	**6.5**
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65
OFDM (802.11ac)	BPSK	**6.5**
	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: 5180MHz-5240MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	**36**	**5180**	40	5200
	44	**5220**	**48**	**5240**
40MHz	**38**	**5190**	**46**	**5230**
80MHz	**42**	**5210**		
Frequency Range: 5745-5825MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	**149**	**5745**	153	5765
	157	**5785**	161	5805
	165	**5825**		
40MHz	**151**	**5775**	**159**	**5795**
80MHz	**155**	**5775**		

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	Oct 14, 2019	Zhou Chuang	PASS	No deviation
3	15.407(a)	Maximum conducted output Power	Oct 14, 2019	Zhou Chuang	PASS	No deviation
4	15.407(a)(e)	Emission Bandwidth	Oct 14, 2019	Zhou Chuang	PASS	No deviation
5	15.407(a)	Maximum Power spectral density	Oct 14, 2019	Zhou Chuang	PASS	No deviation
6	15.407(g)	Frequency Stability	Oct 14, 2019	Zhou Chuang	PASS	No deviation
7	15.207	Conducted Emission	Oct 13, 2019	Lin Jiayong	PASS	No deviation
8	15.407(b)	Restricted Frequency Bands	Oct 15, 2019	Peng Xuewei	PASS	No deviation
9	15.407(b)	Radiated Emission	Sep 30, 2019	Peng Xuewei	PASS	No deviation

Note1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

Note2: These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 v02r01.

Note3: 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.

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. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna with the RP-SMA Jack. Please refer to the EUT external and internal photos.

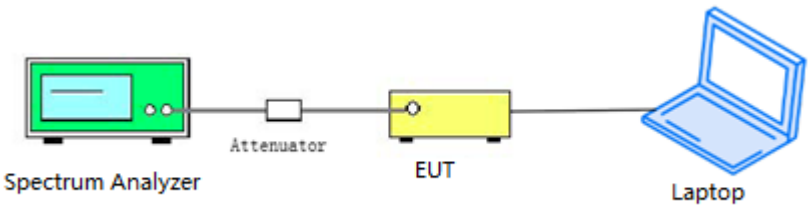
2.2. Duty Cycle of the Test Signal

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 ±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

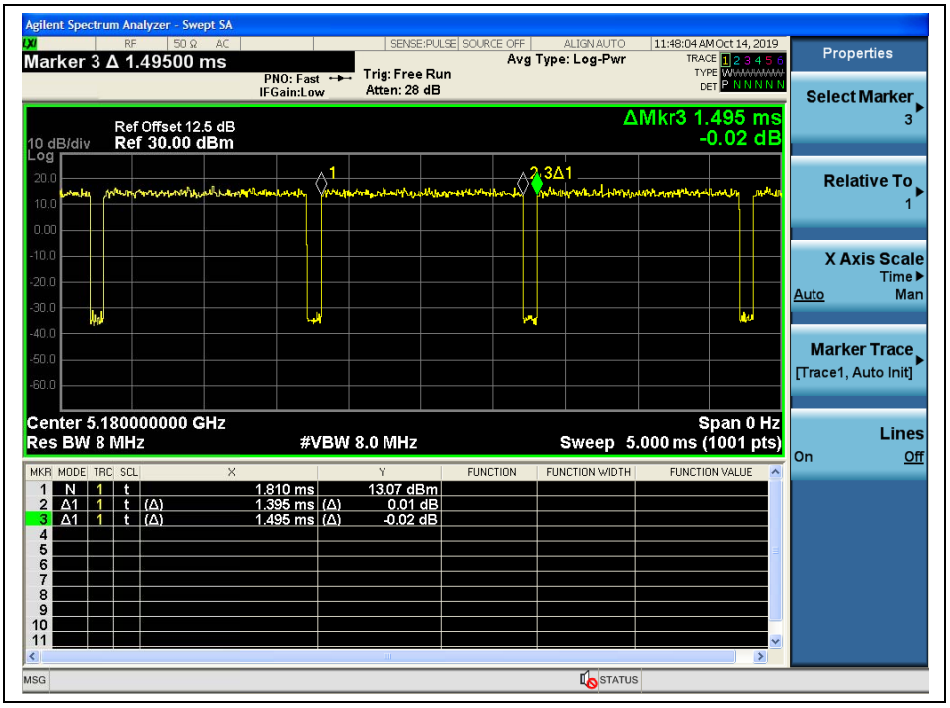
KDB 789033 Section B was used in order to prove compliance.

2.2.4. Test Result

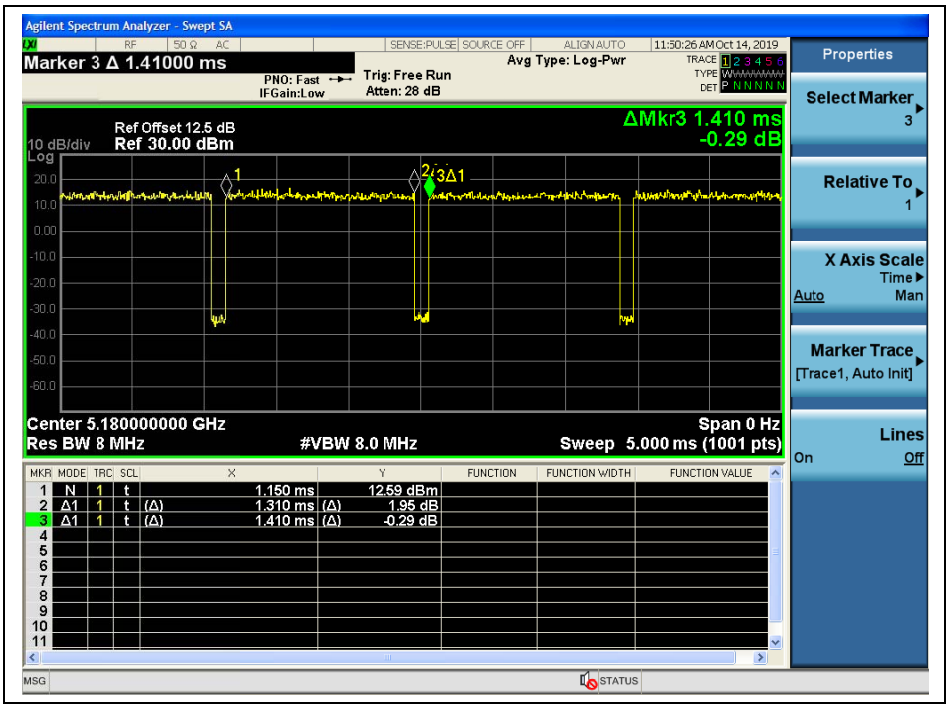
A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor (10*log[1/D])
802.11a	93.31	0.30
802.11n(HT20)	92.91	0.32
802.11n(HT40)	92.96	0.32
802.11ac(VHT20)	92.93	0.32
802.11ac(VHT40)	86.84	0.61
802.11ac(VHT80)	76.06	1.19

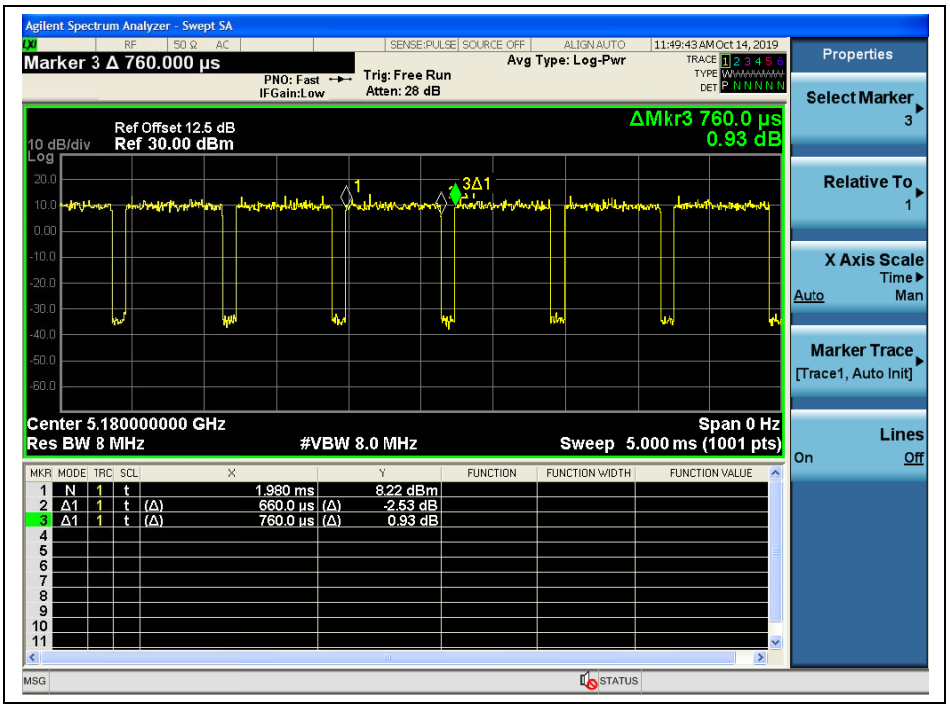
B. Test Plots



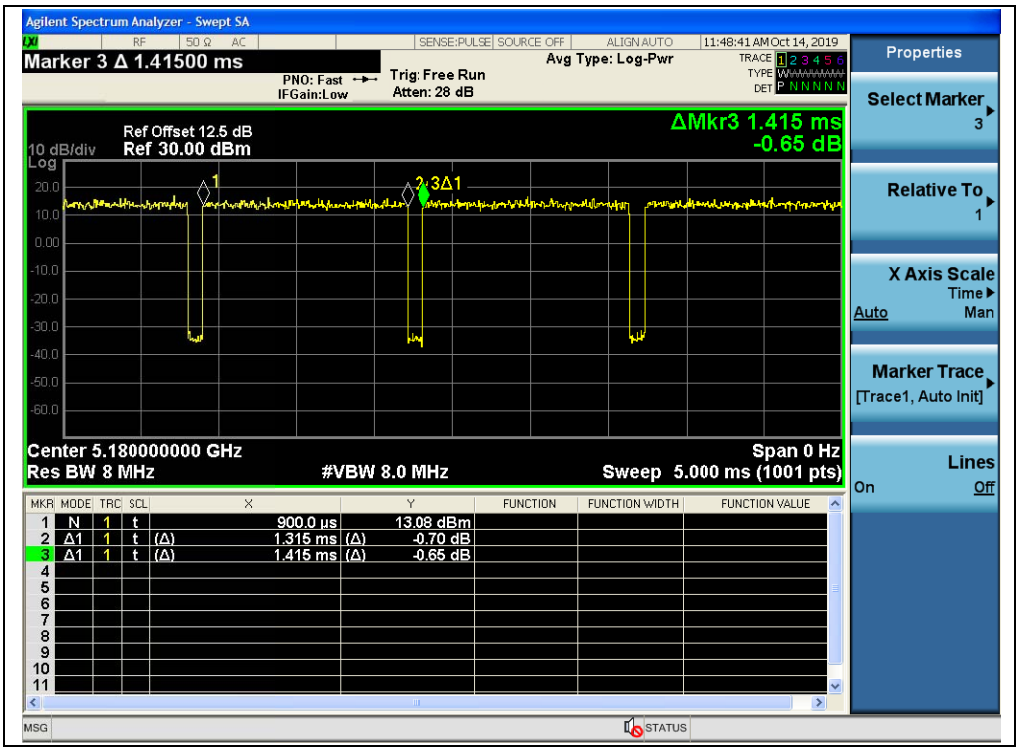
(CH36_5180MHz_802.11a)



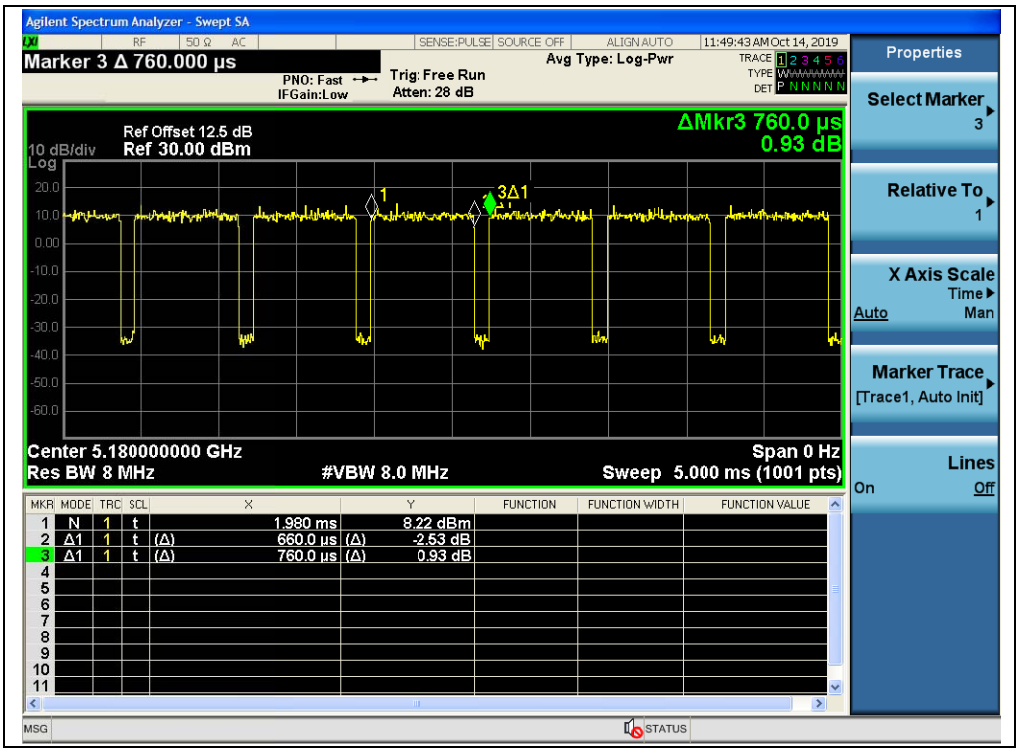
(CH36_5180MHz _802.11n(HT20))



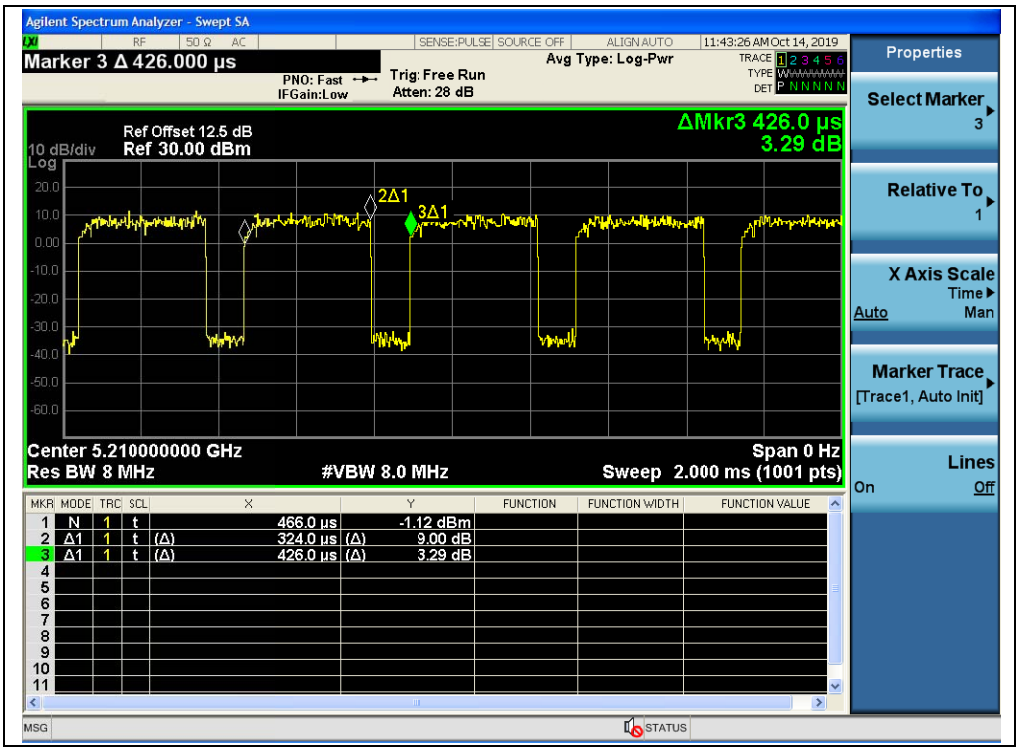
(CH38_5190MHz _802.11n(HT40))



(CH36_5180MHz _802.11ac(VHT20))



(CH38_5190MHz _802.11 ac(VHT40))



(CH42_5210MHz _802.11 ac(VHT80))

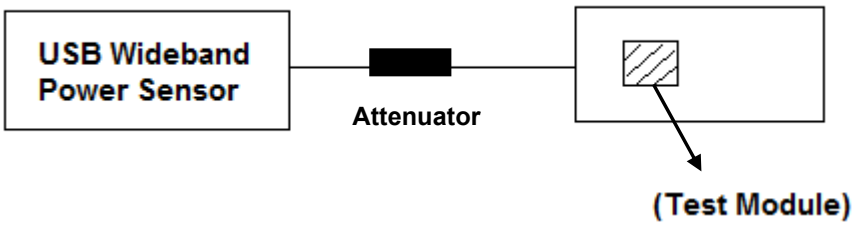
2.3. Maximum Conducted Output Power

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 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 KDB662911D01Measure-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} +10log(N_{ANT}) dBi, where G_{ANT} is the antenna gain in dBi, N_{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.

2.3.3. Test Result

Maximum Average Conducted Output Power

802.11a Test mode

Channel	Frequency (MHz)	Average Power (dBm)				Limit (dBm)		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
36	5180	10.46	0.30	10.76	0.0119	24	0.25	PASS
44	5220	10.51		10.81	0.0121			
48	5240	10.61		10.91	0.0123			
149	5745	-4.98		-4.68	0.0003	30	1	
157	5785	-5.14		-4.84	0.0003			
165	5825	-5.40		-5.10	0.0003			

802.11 n (HT20) Test mode

Channel	Frequency (MHz)	Average Power (dBm)				Limit (dBm)		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
36	5180	9.12	0.32	9.44	0.0088	24	0.25	PASS
44	5220	8.98		9.30	0.0085			
48	5240	9.41		9.73	0.0094			
149	5745	-4.93		-4.61	0.0003	30	1	
157	5785	-5.21		-4.89	0.0003			
165	5825	-5.38		-5.06	0.0003			

802.11 n (HT40) Test mode

Channel	Frequency (MHz)	Average Power				Limit (dBm)		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
38	5190	11.47	0.61	12.08	0.0161	24	0.25	PASS
46	5230	11.15		11.76	0.0150			
151	5755	-5.62		-5.01	0.0003	30	1	
159	5795	-6.01		-5.40	0.0003			

802.11 ac (VHT20) Test mode

Channel	Frequency (MHz)	Average Power (dBm)				Limit (dBm)		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
36	5180	11.54	0.32	11.86	0.0153	24	0.25	PASS
44	5220	11.12		11.44	0.0139			
48	5240	11.41		11.73	0.0149			
149	5745	-5.10		-4.78	0.0003	30	1	
157	5785	-5.27		-4.95	0.0003			
165	5825	-5.41		-5.09	0.0003			

802.11 ac (VHT40) Test mode

Channel	Frequency (MHz)	Average Power				Limit (dBm)		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
38	5190	11.65	0.61	12.26	0.0168	24	0.25	PASS
46	5230	11.54		12.15	0.0164			
151	5755	-5.59		-4.98	0.0003	30	1	
159	5795	-5.95		-5.34	0.0003			

802.11ac (VHT80) Test mode

Channel	Frequency (MHz)	Average Power				Limit (dBm)		Verdict
		Measured	Duty Factor	Duty factor Calculated				
		dBm		dBm	W	dBm	W	
42	5210	2.74	1.19	3.93	0.0025	24	0.25	PASS
155	5775	-7.01		-5.82	0.0003	30	1	

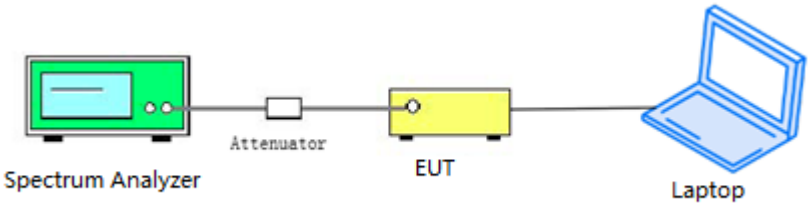
2.4. Emission Bandwidth

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 50Ohm; 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 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) ≥ 3 × 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

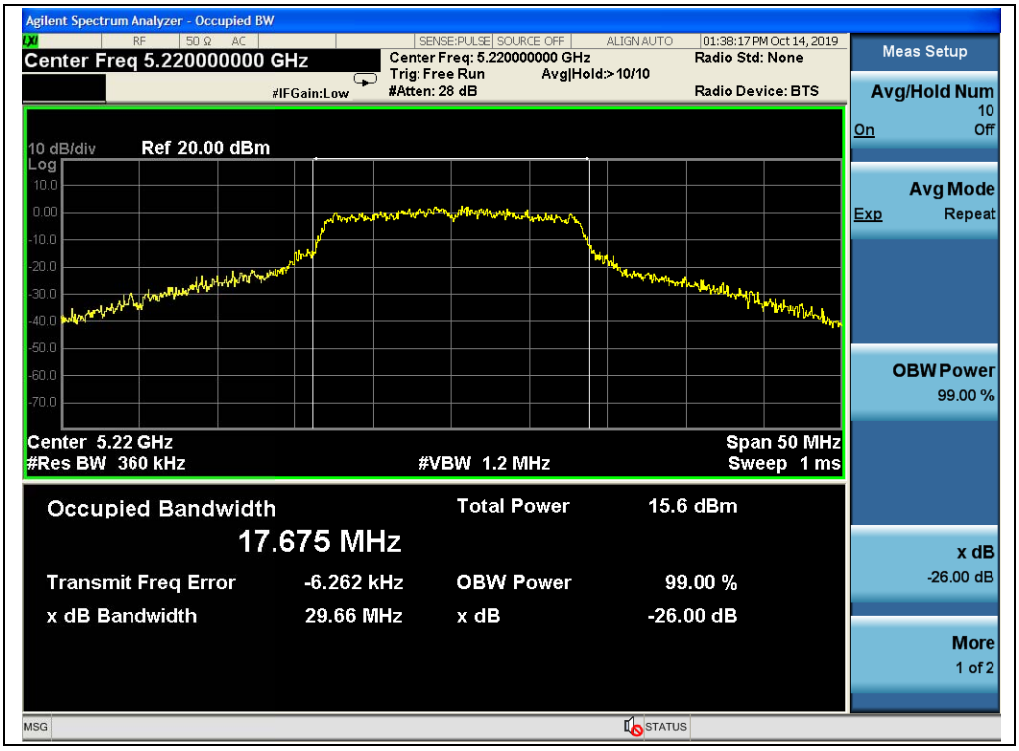
802.11a Test mode

A. Test Verdict:

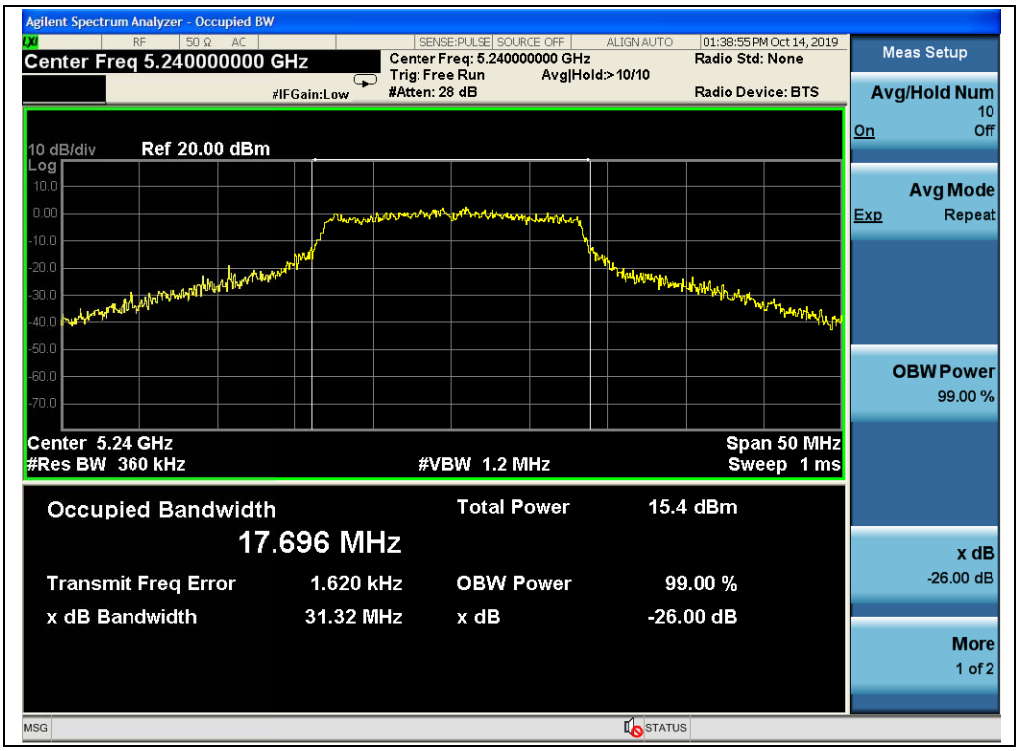
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	31.81
44	5220	29.66
48	5240	31.32
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
149	5745	16.32
157	5785	16.30
165	5825	16.31

B. Test Plots

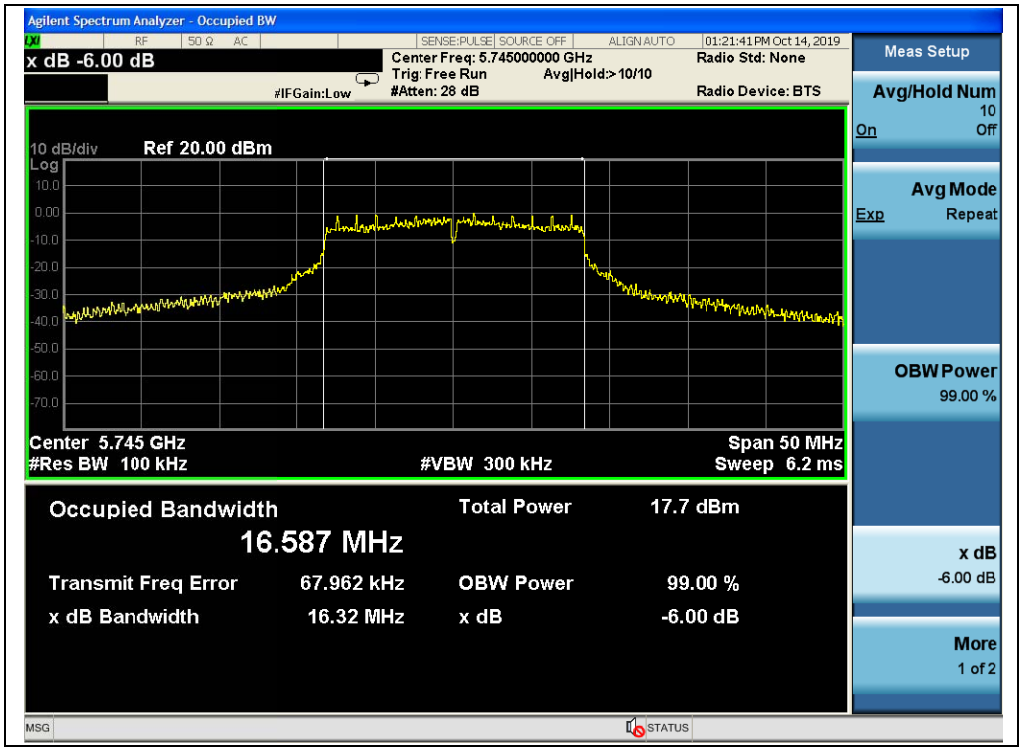
(Channel 36, 5180MHz, 802.11a,)



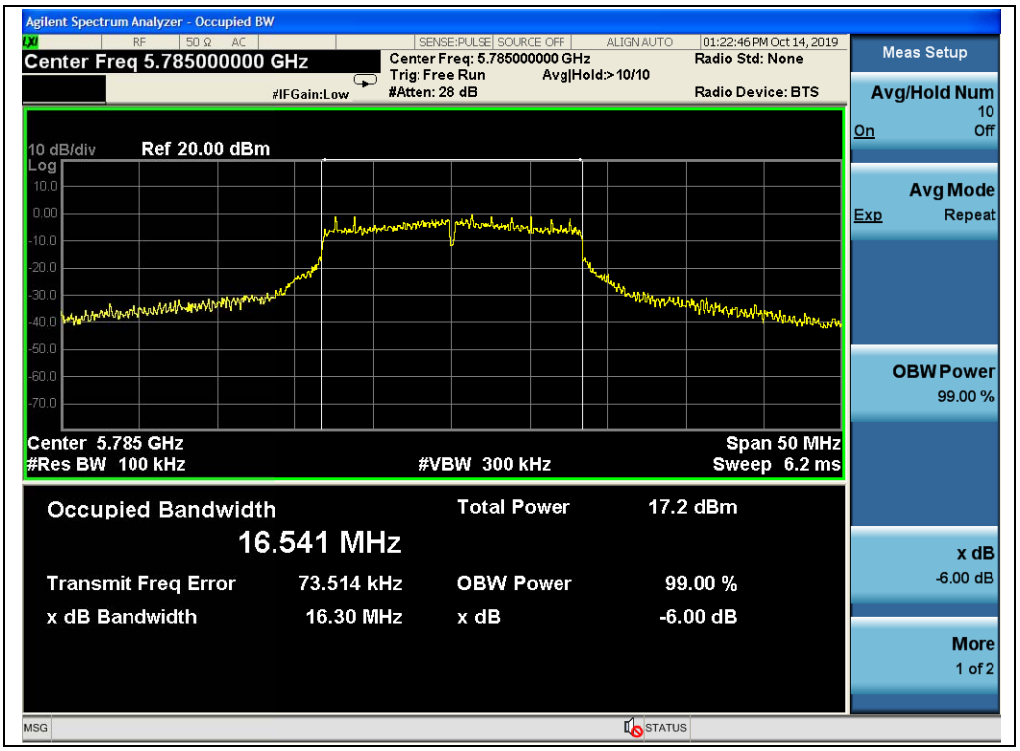
(Channel 44, 5220 MHz, 802.11a,)



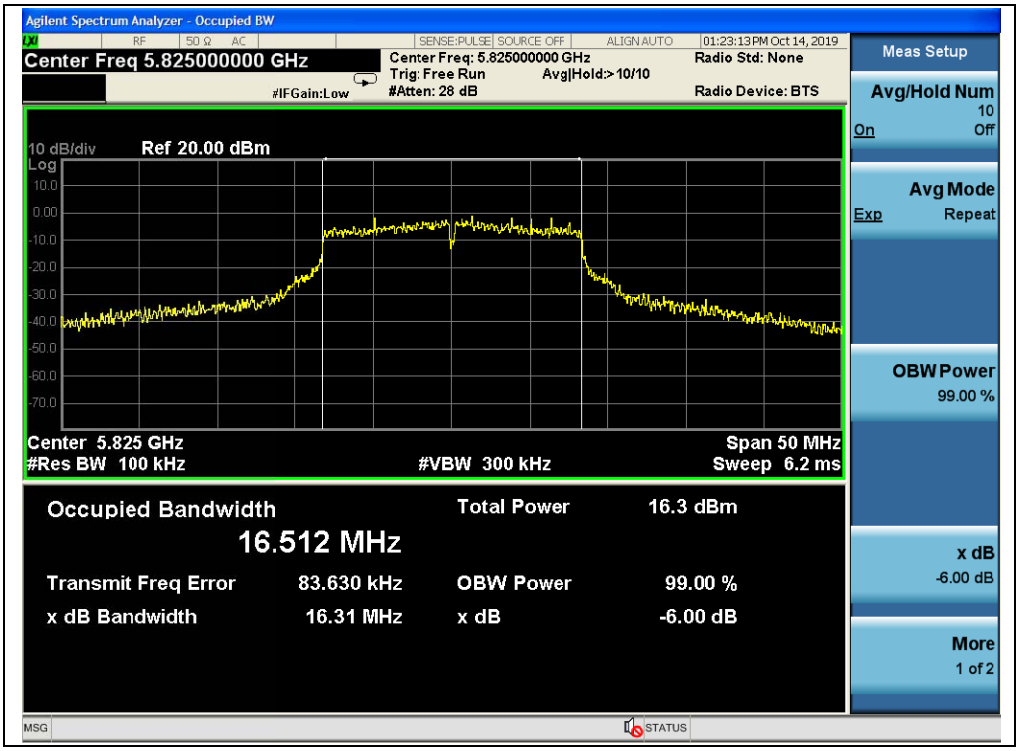
(Channel 48, 5240MHz, 802.11a,)



(Channel 149, 5745MHz, 802.11a)



(Channel 157, 5785MHz, 802.11a)



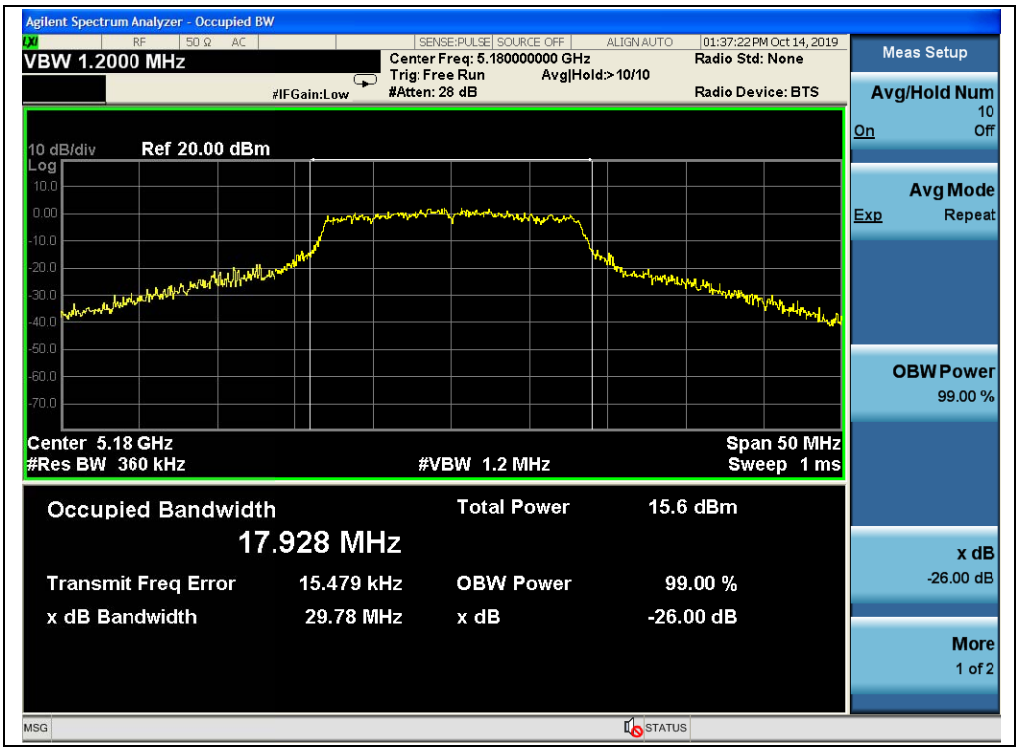
(Channel 165, 5825MHz, 802.11a)

802.11n (HT20) Test mode

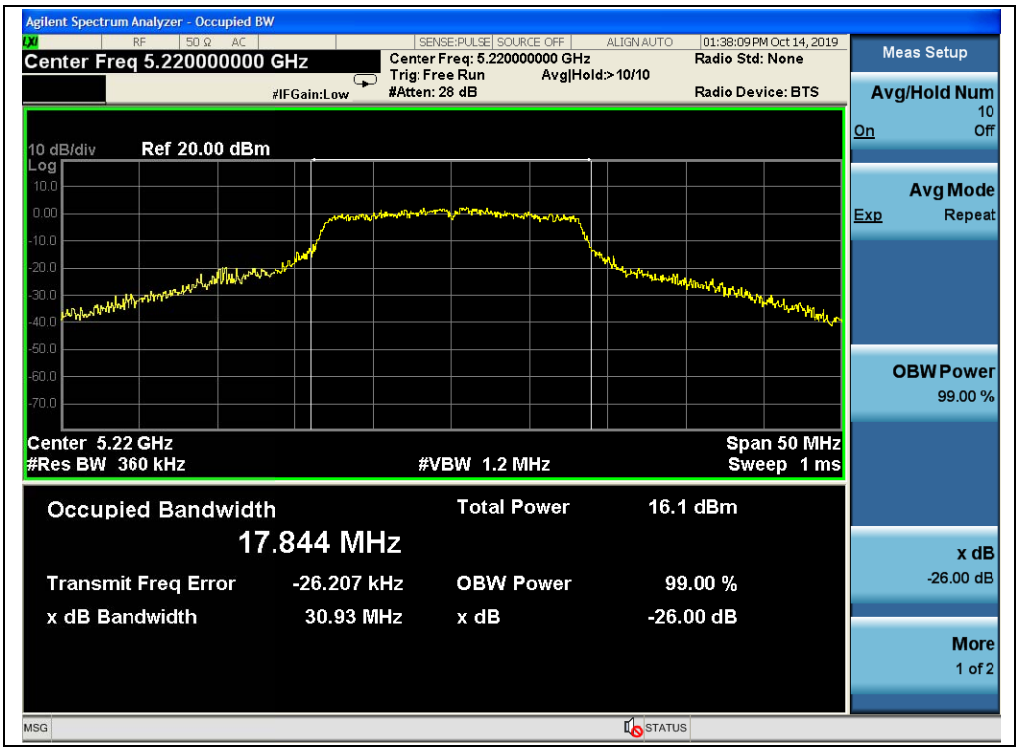
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	29.78
44	5220	30.93
48	5240	31.71
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
149	5745	16.93
157	5785	17.52
165	5825	17.52

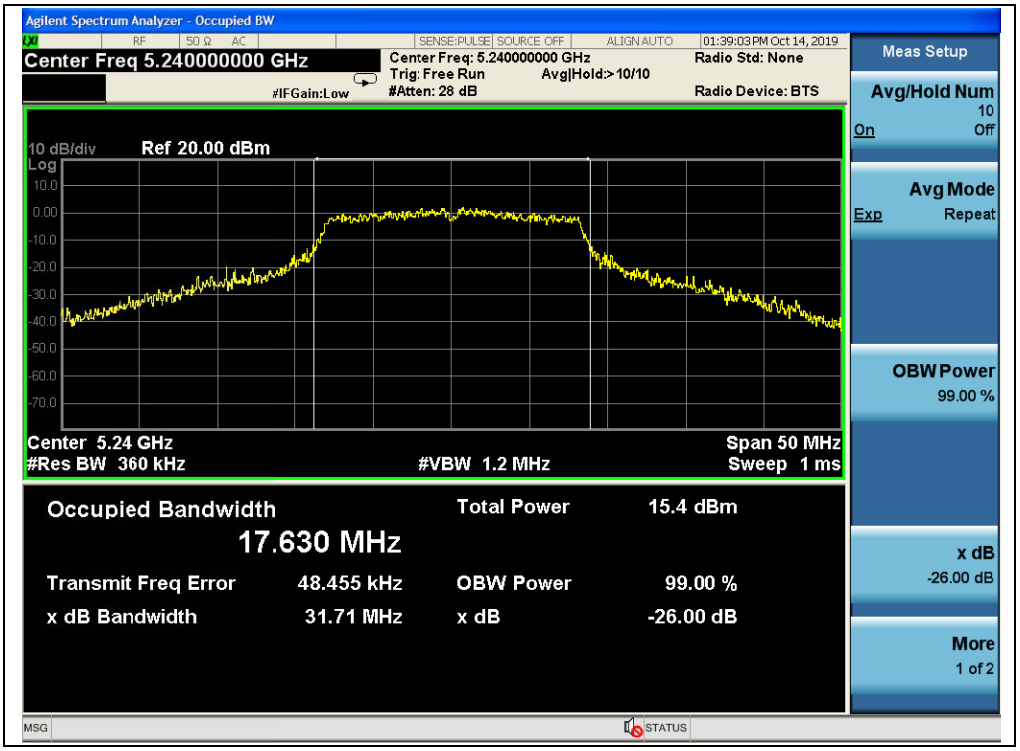
B. Test Plots



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

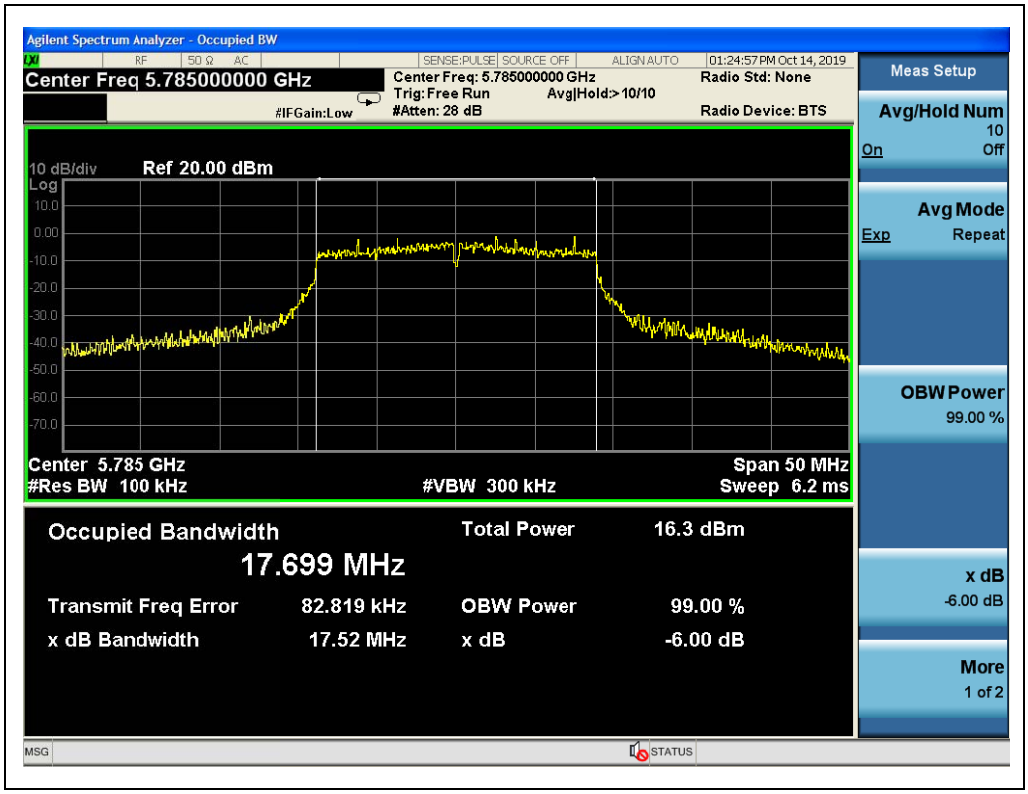


(Channel 44, 5220 MHz, 802.11 n (HT20))

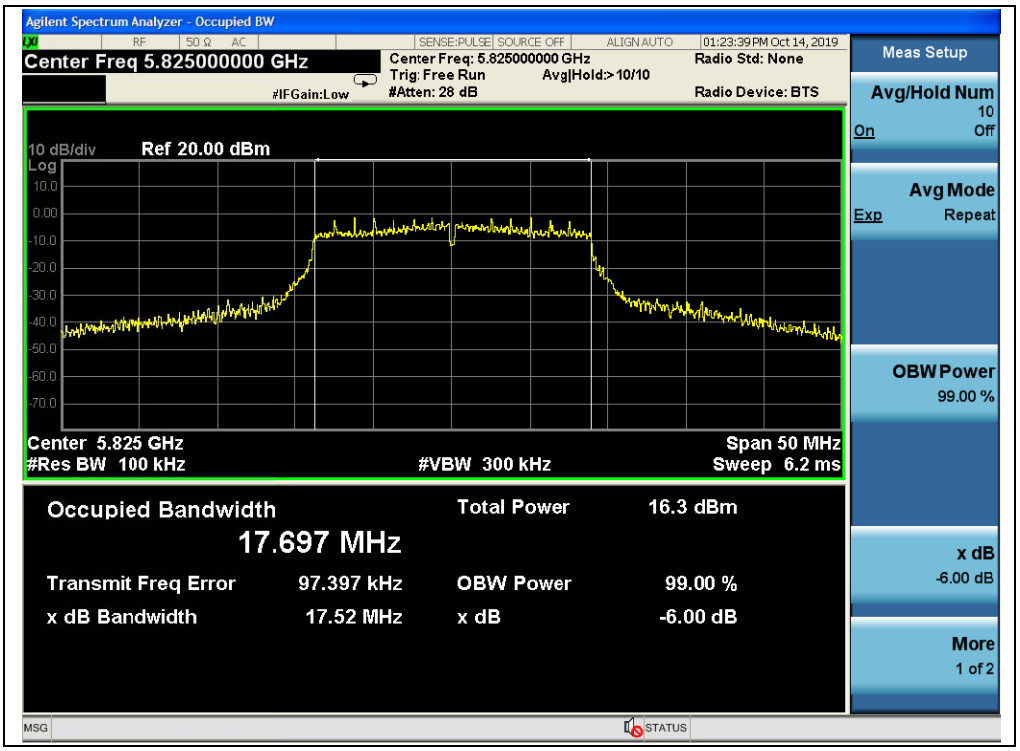


(Channel 48, 5240MHz, 802.11 n (HT20))

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



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



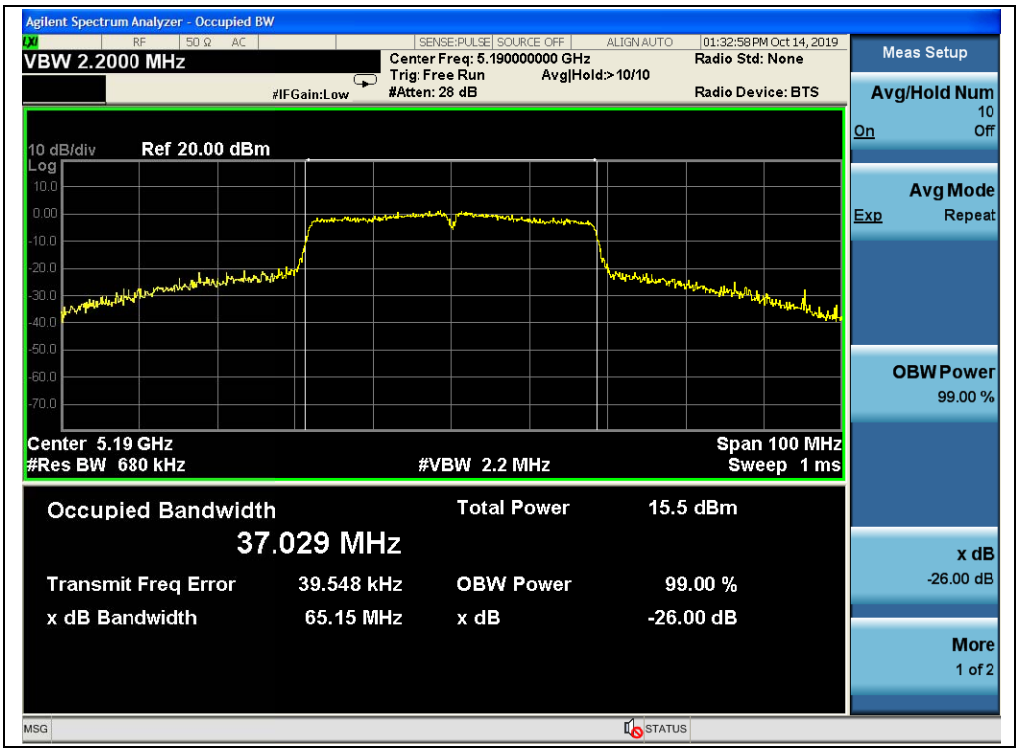
(Channel 165, 5825MHz, 802.11 n (HT20))

802.11n (HT40) Test mode

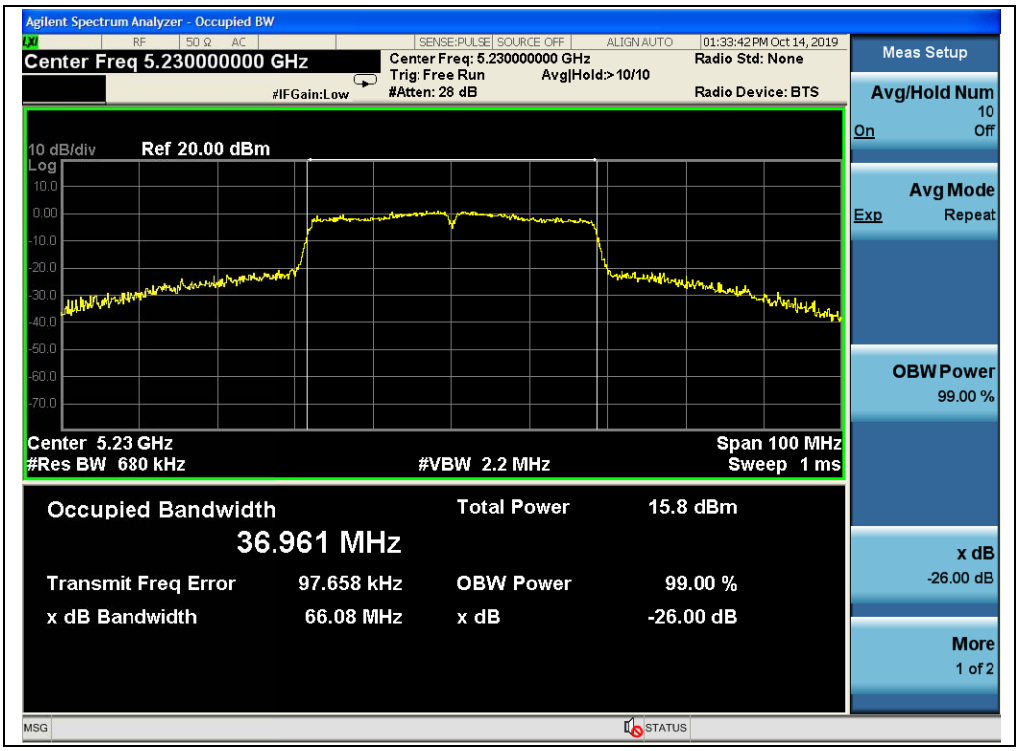
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	65.15
46	5230	66.08
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
151	5755	36.06
159	5795	36.32

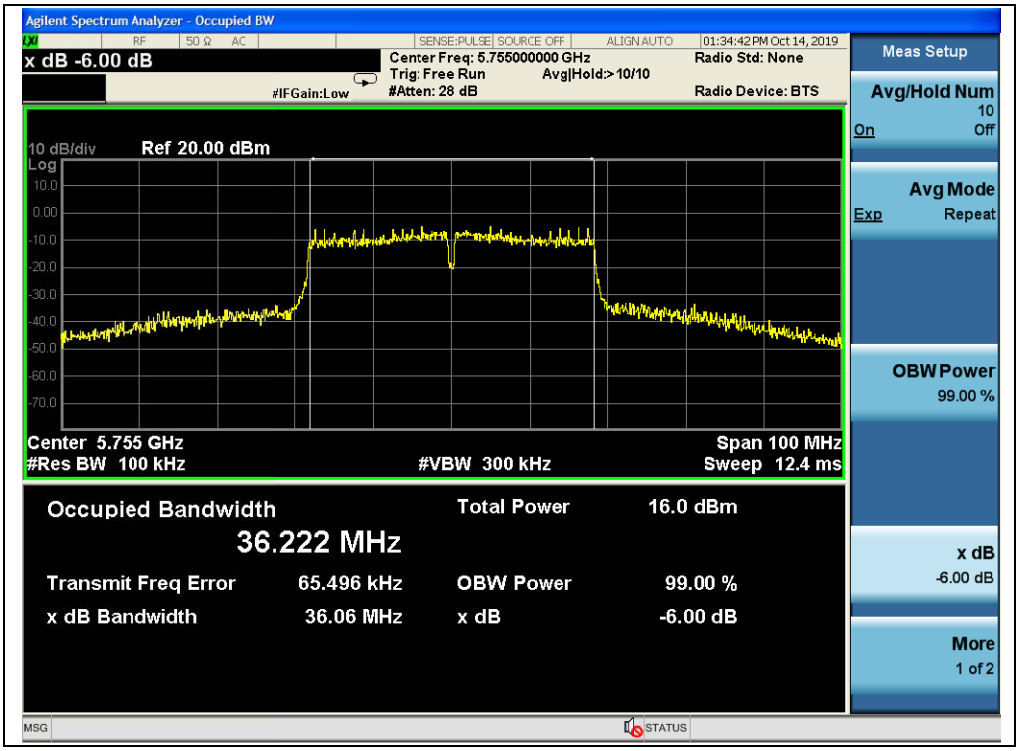
B. Test Plots



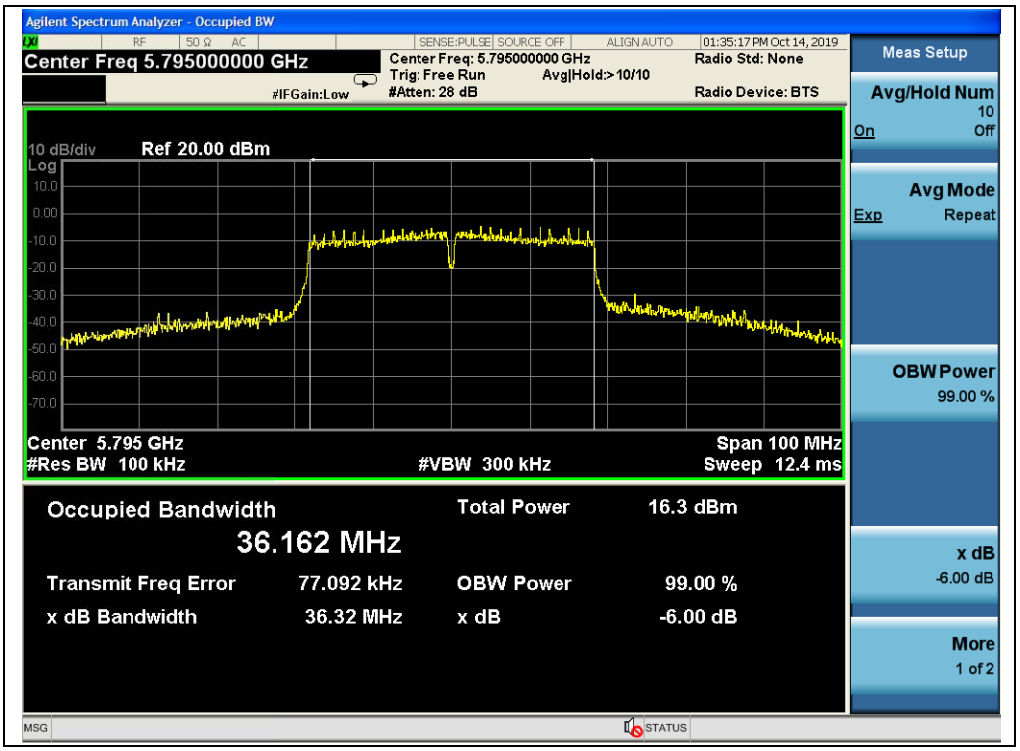
(Channel 38, 5190MHz, 802.11n (HT40))



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



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



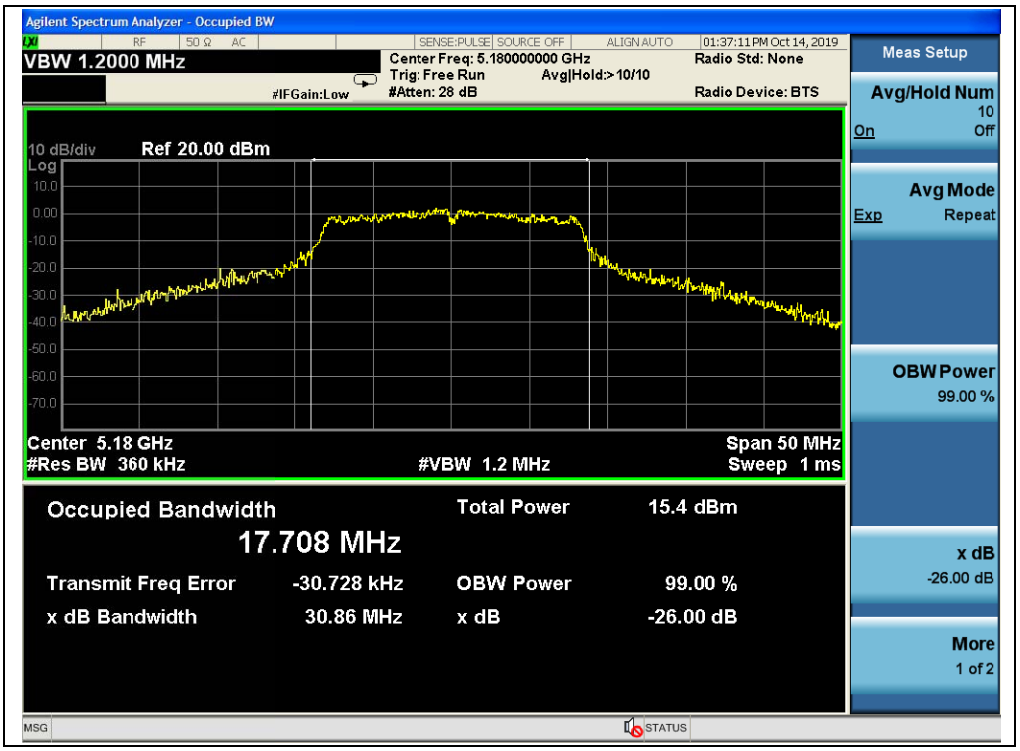
(Channel 159, 5795MHz, 802.11n (HT40))

802.11ac (VHT20) Test mode

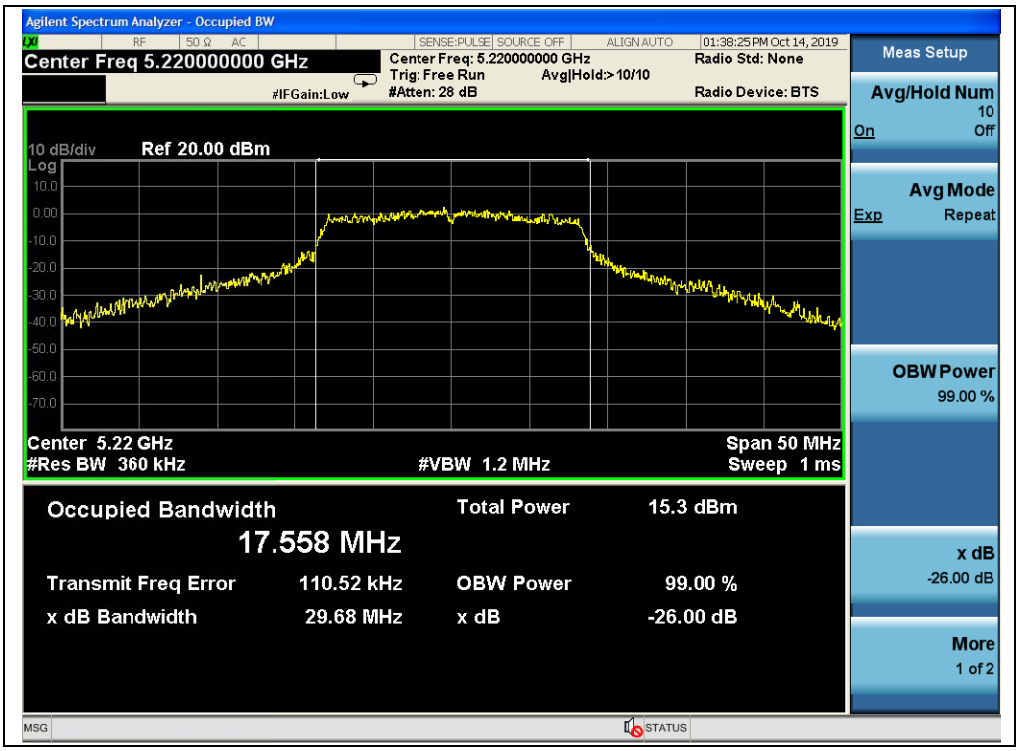
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	30.86
44	5220	29.68
48	5240	30.91
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
149	5745	17.34
157	5785	17.59
165	5825	17.29

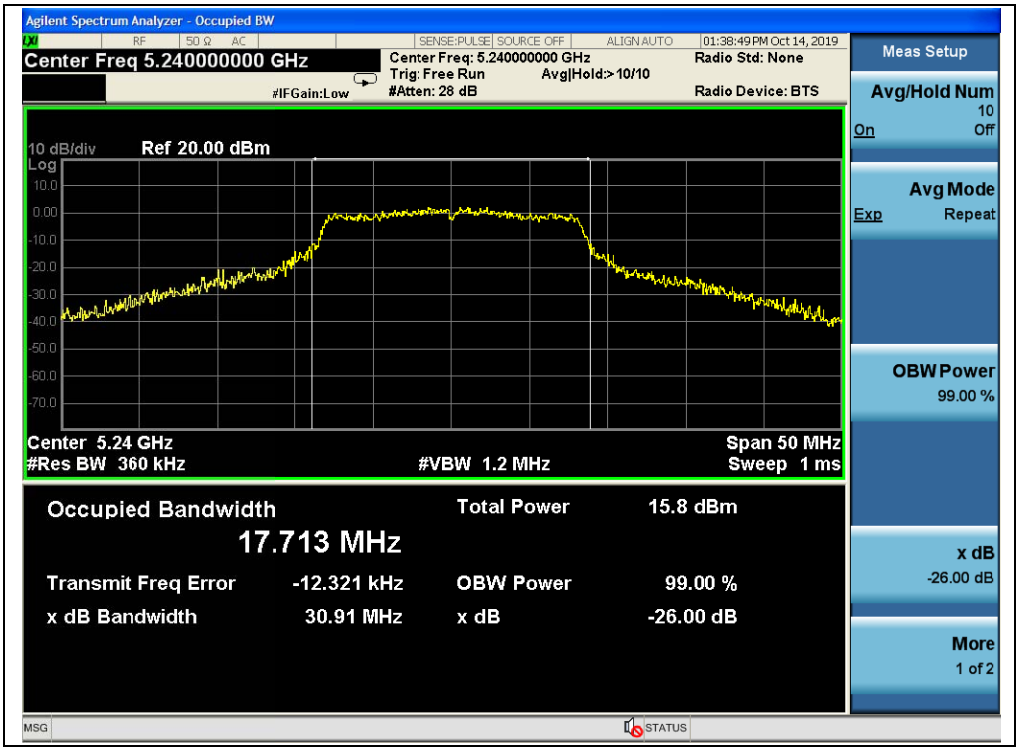
B. Test Plots



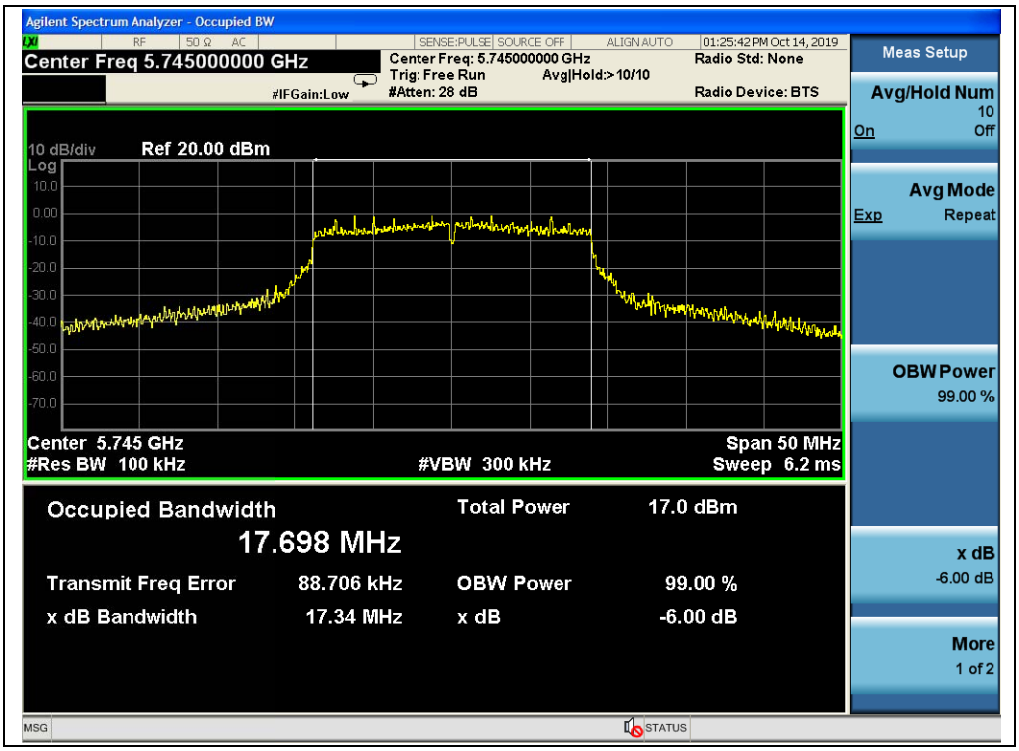
(Channel 36, 5180MHz, 802.11 ac (VHT20))



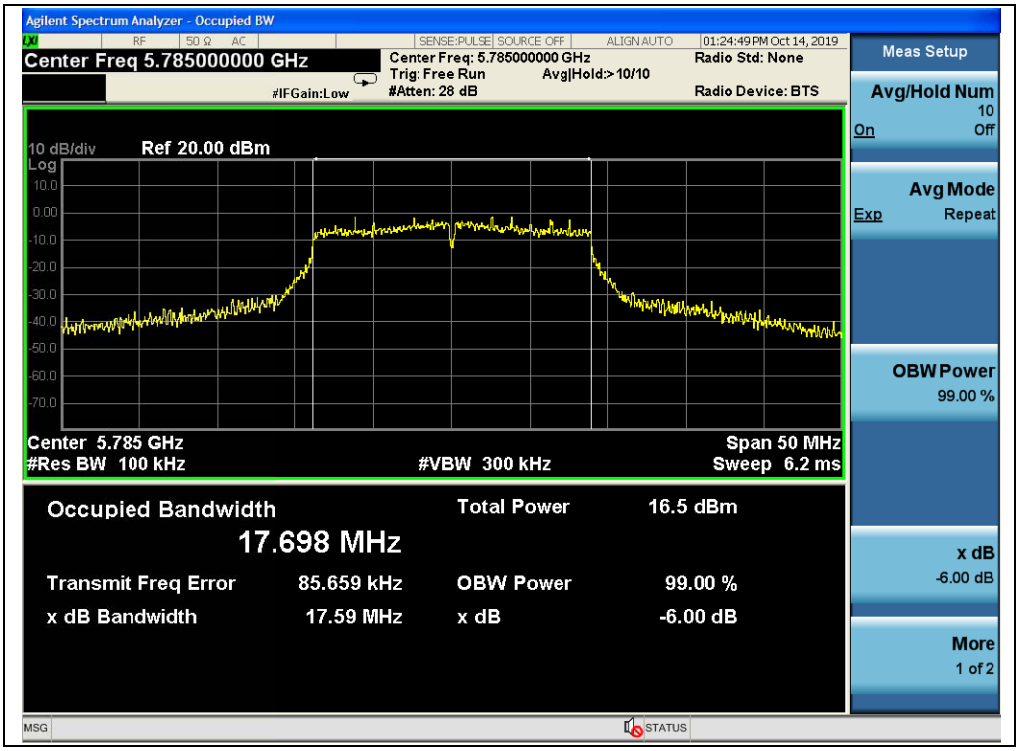
(Channel 44, 5220 MHz, 802.11 ac (VHT20))



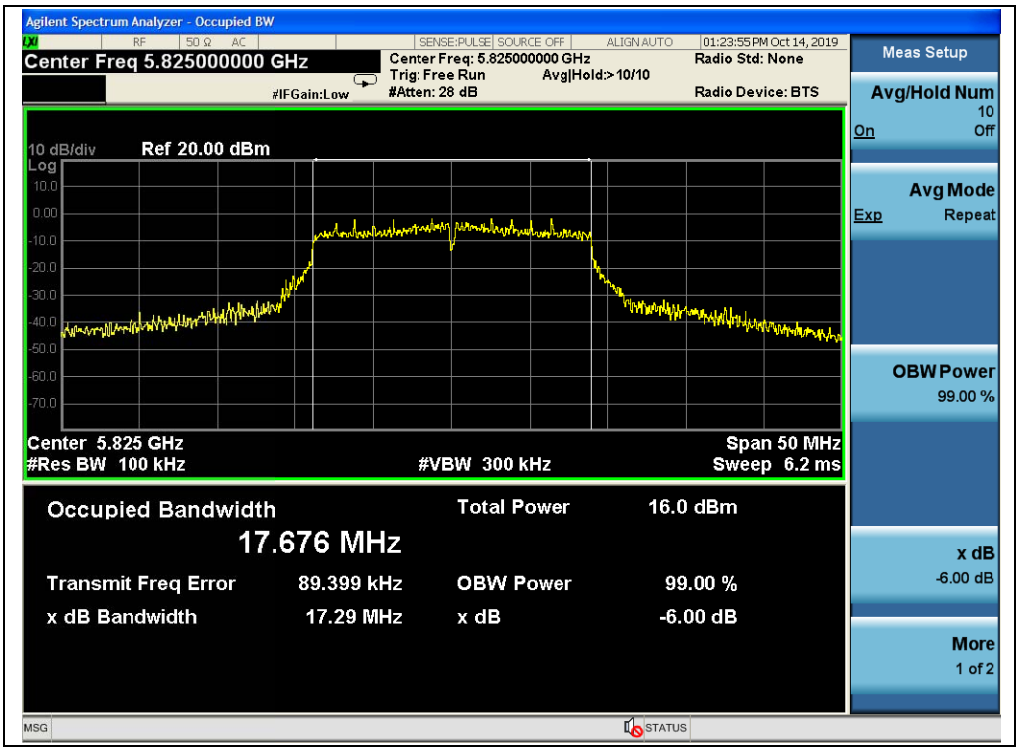
(Channel 48, 5240MHz, 802.11 ac (VHT20))



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



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



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

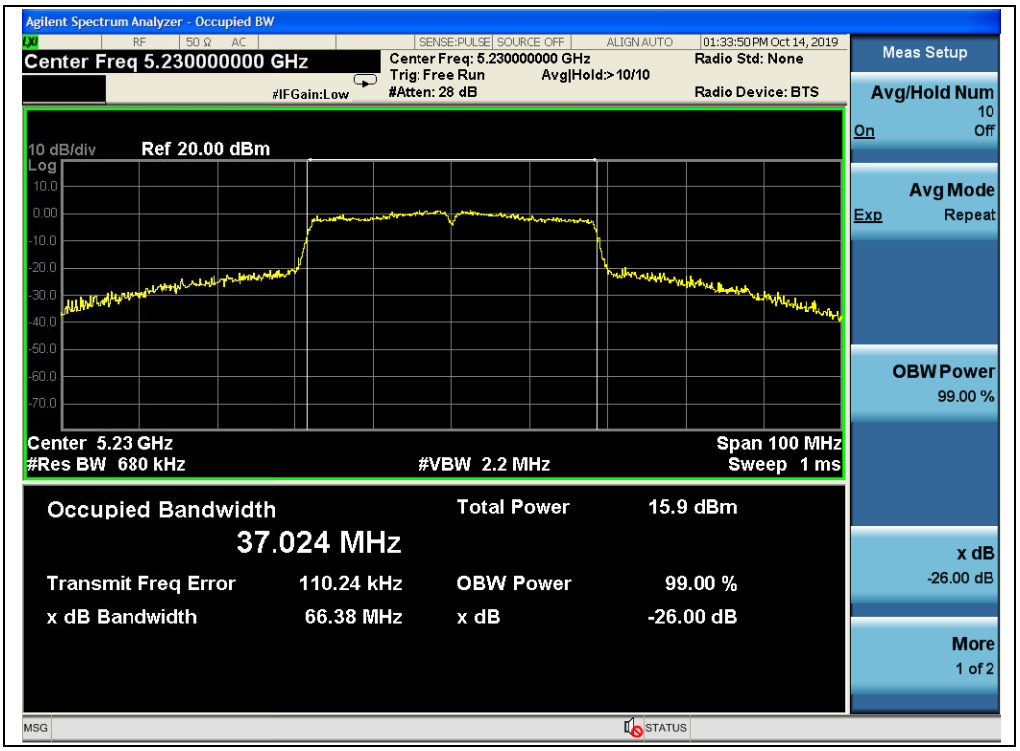
802.11 ac (VHT40) Test mode

A. Test Verdict:

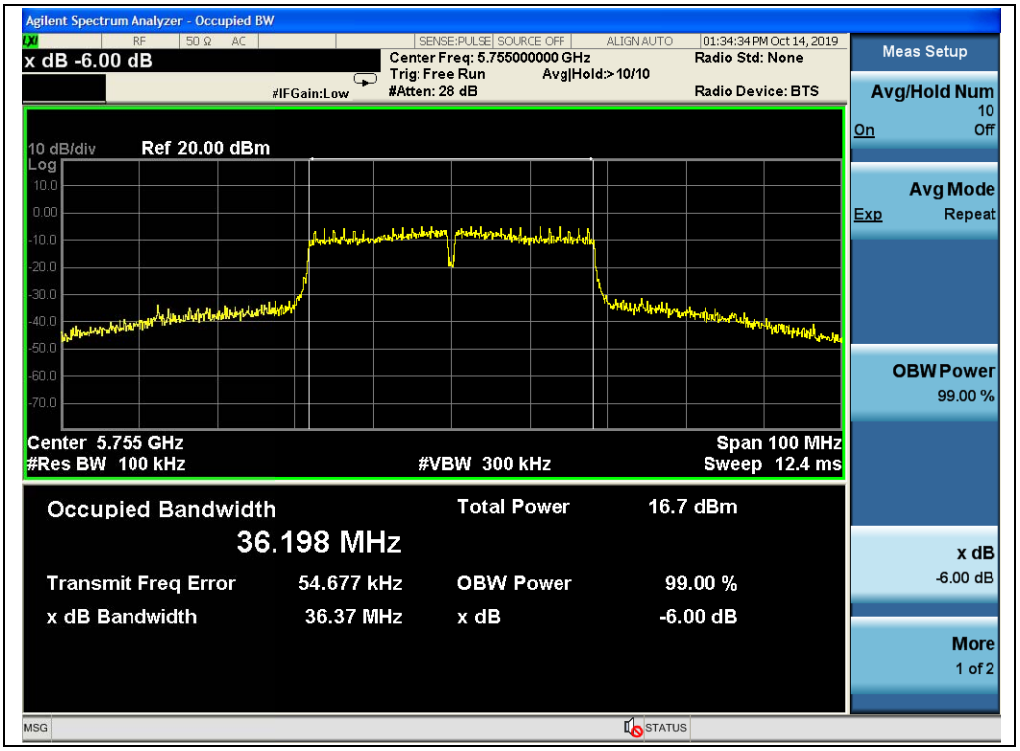
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	67.48
46	5230	66.38
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
151	5755	36.37
159	5795	36.35

B. Test Plots

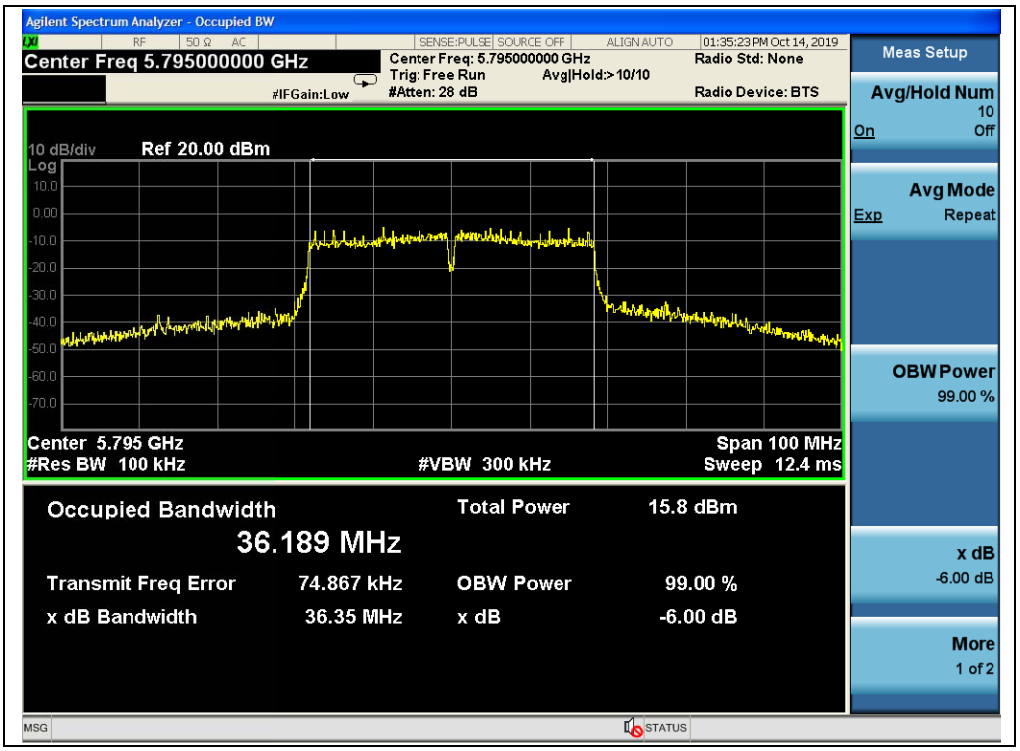
(Channel 38, 5190MHz, 802.11 ac (VHT40))



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



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



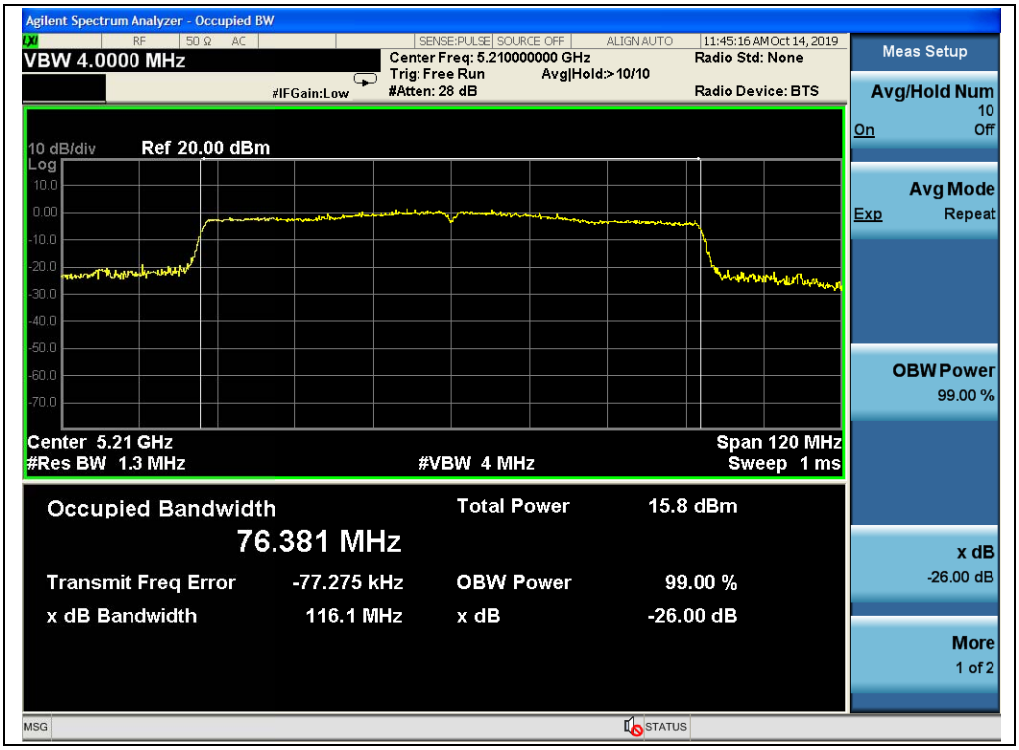
(Channel 159, 5795MHz, 802.11 ac (VHT40))

802.11 ac (VHT80) Test mode

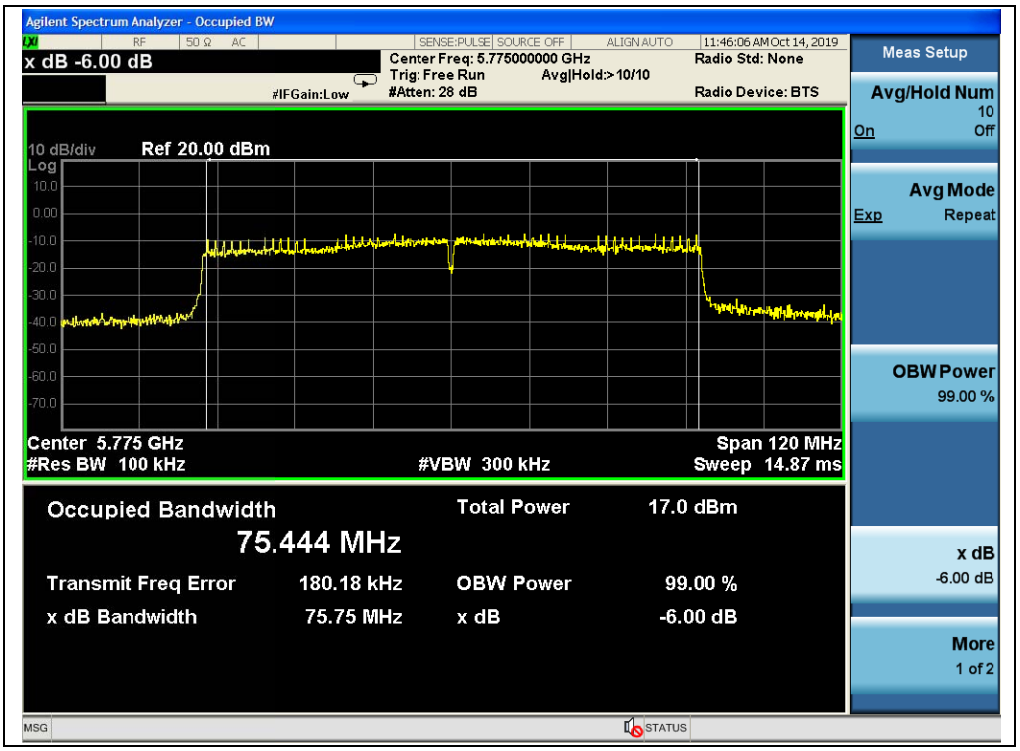
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
42	5210	116.1
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**
155	5775	75.75

B. Test Plots



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



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

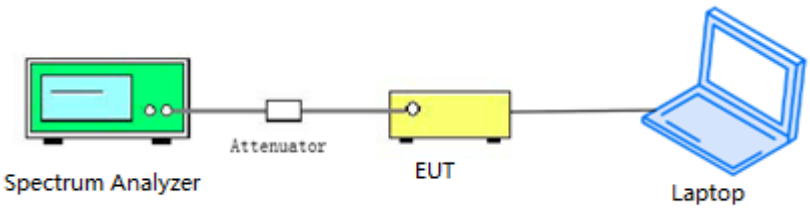
2.5. Peak Power spectral density

2.5.1. Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 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 KDB662911D01Measure-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} +10log(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-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 ≥ 3 MHz.
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

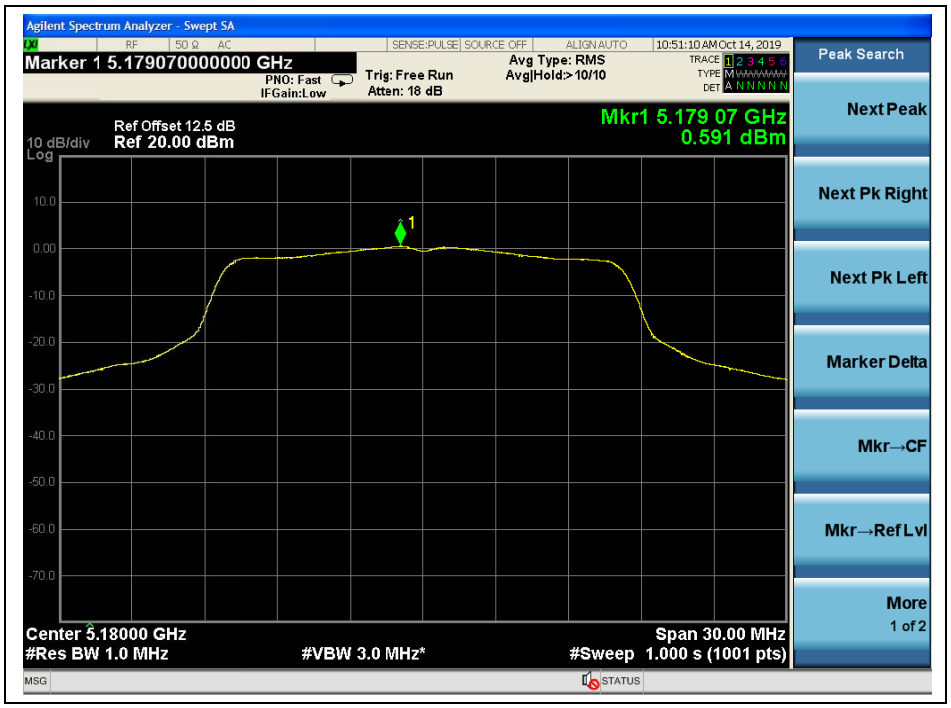
2.5.4. Test Result

802.11a Test mode

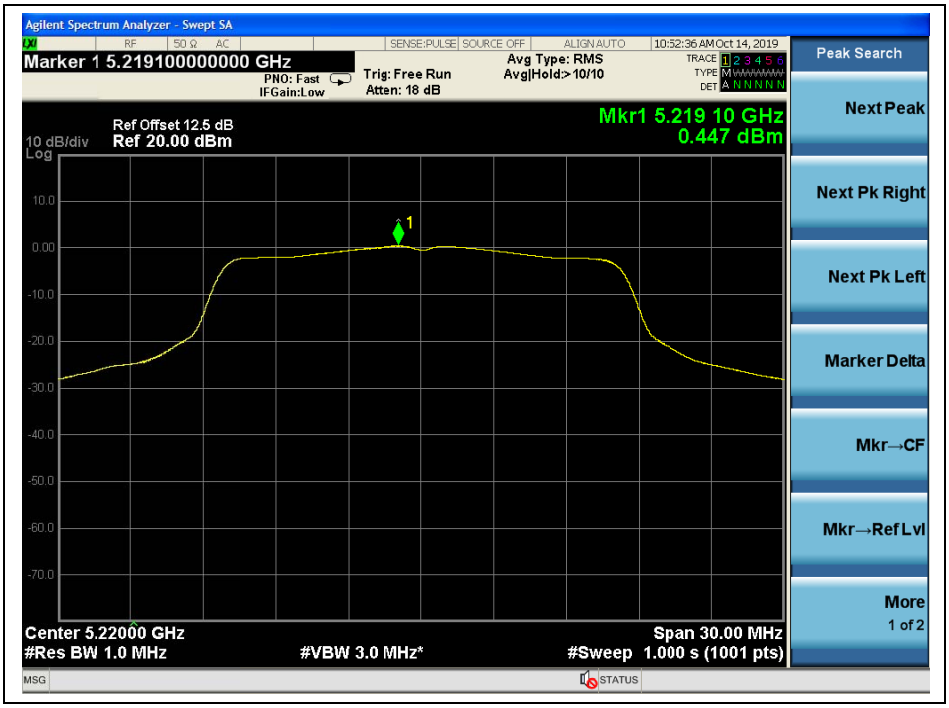
A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
36	5180	0.591	11	PASS
44	5220	0.447		
48	5240	0.609		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
149	5745	-0.339	30	PASS
157	5785	-0.923		
165	5825	-1.315		

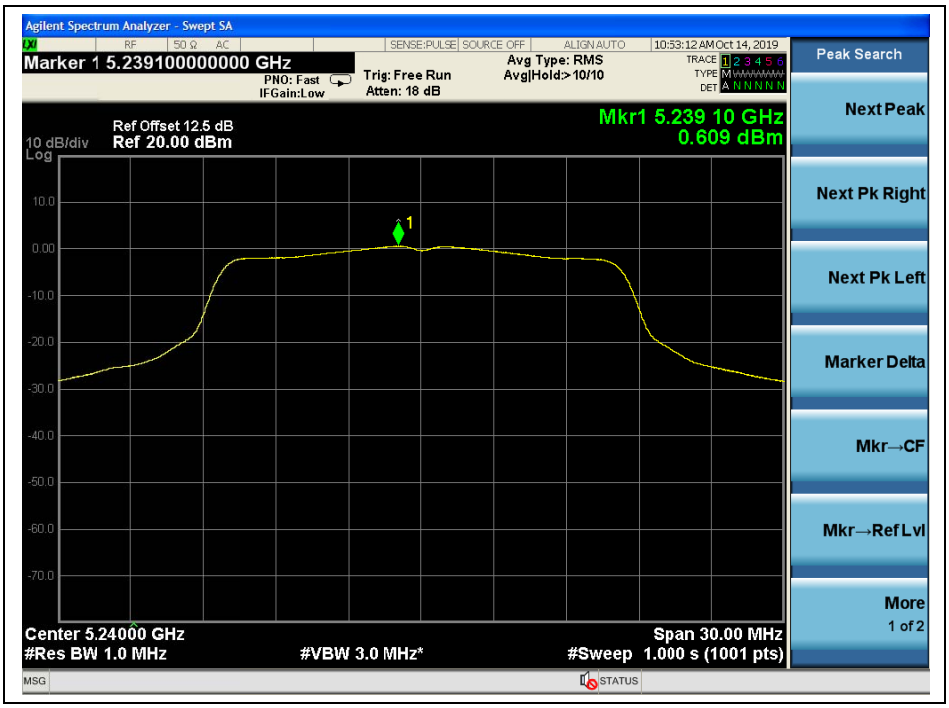
B. Test Plots



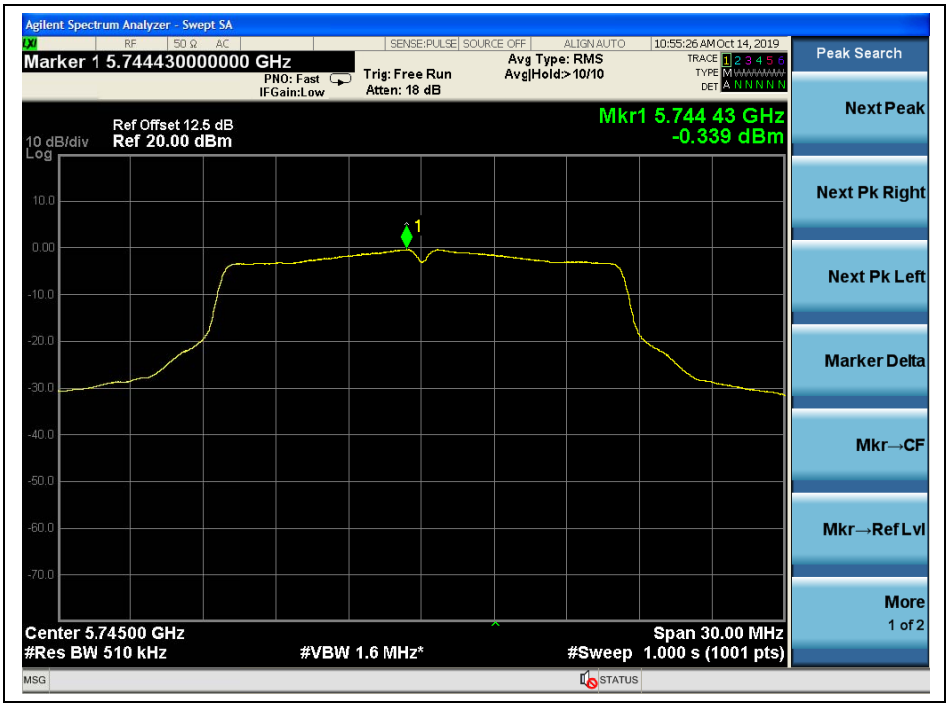
(Channel 36, 5180MHz, 802.11a,)



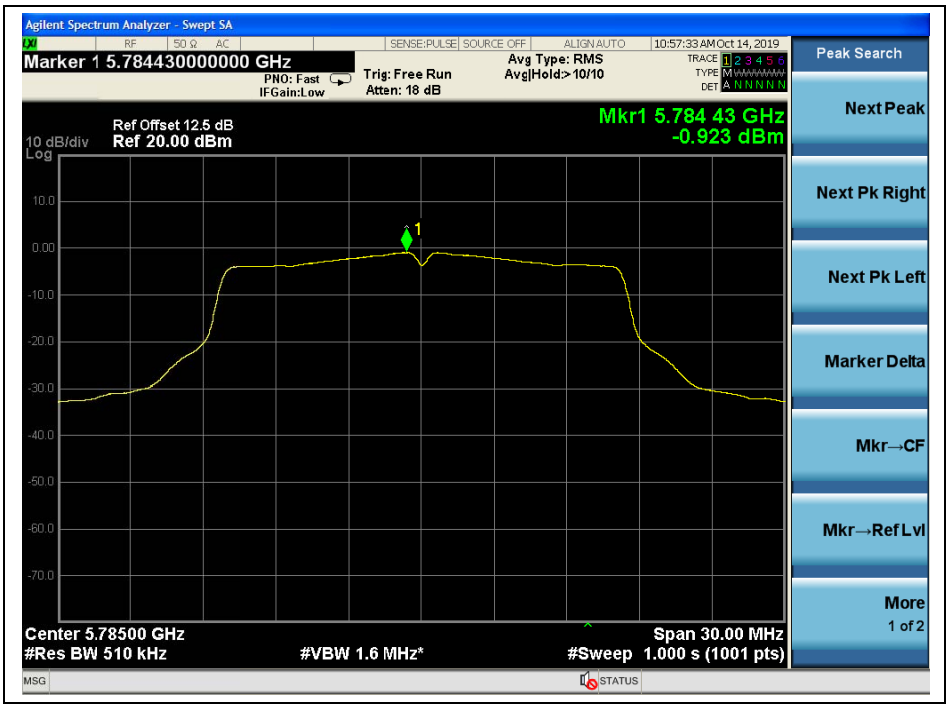
(Channel 44, 5220 MHz, 802.11a,)



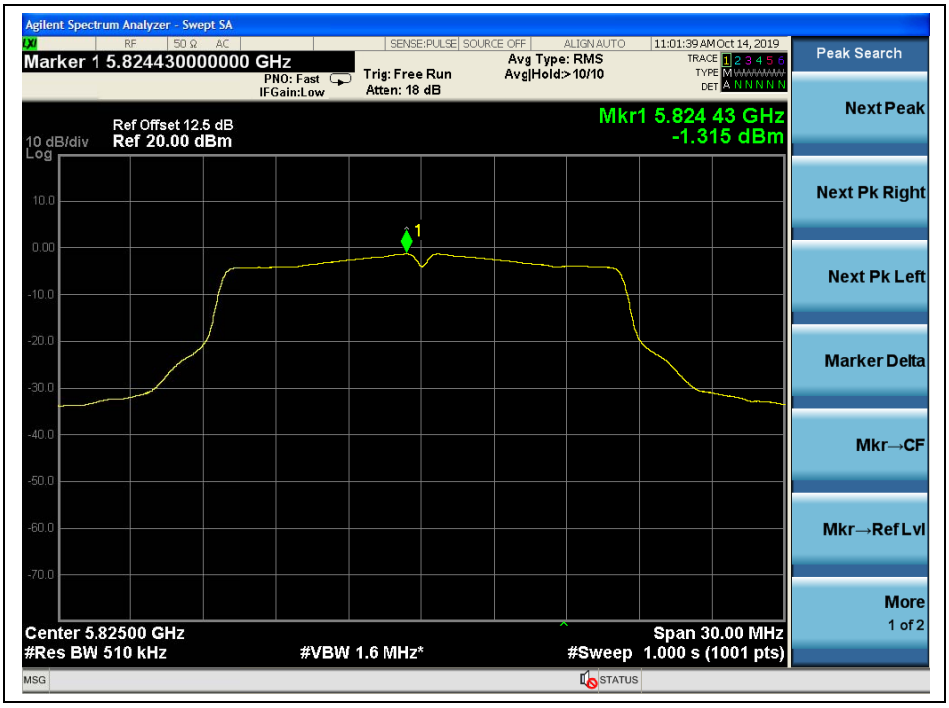
(Channel 48, 5240MHz, 802.11a,)



(Channel 149, 5745MHz, 802.11a)



(Channel 157, 5785MHz, 802.11a)



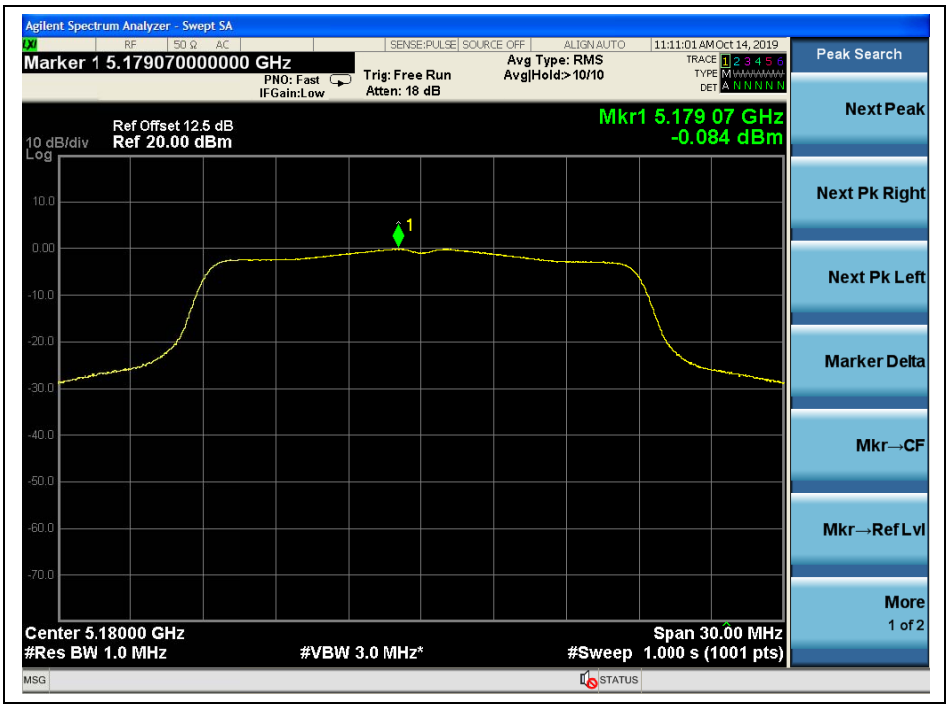
(Channel 165, 5825MHz, 802.11a)

802.11n (HT20) Test mode

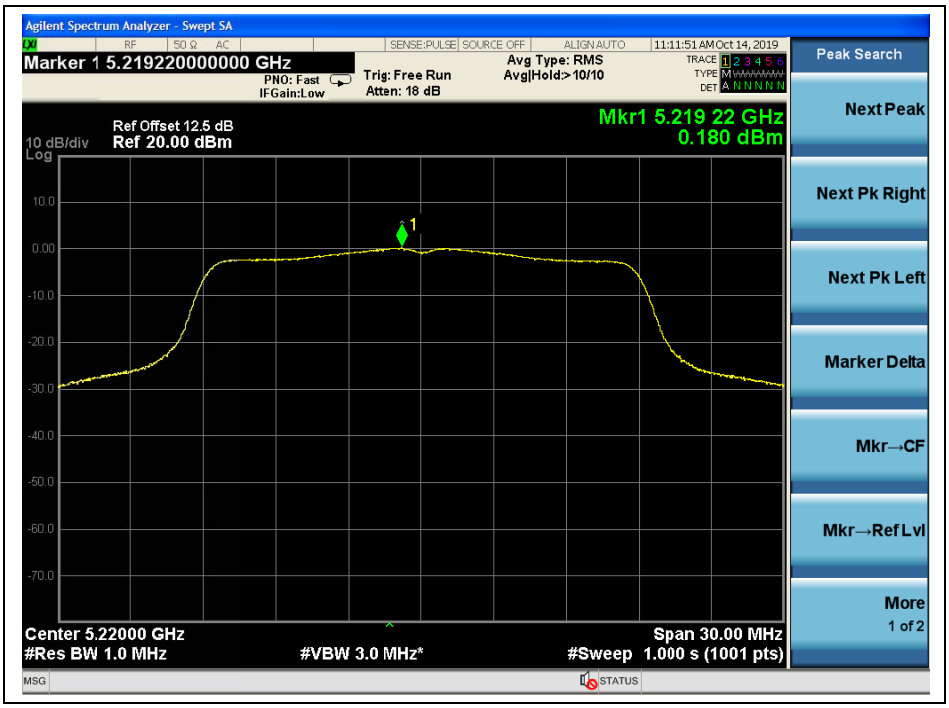
A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
36	5180	-0.084	11	PASS
44	5220	0.180		
48	5240	0.255		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
149	5745	-0.637	30	PASS
157	5785	-1.082		
165	5825	-1.749		

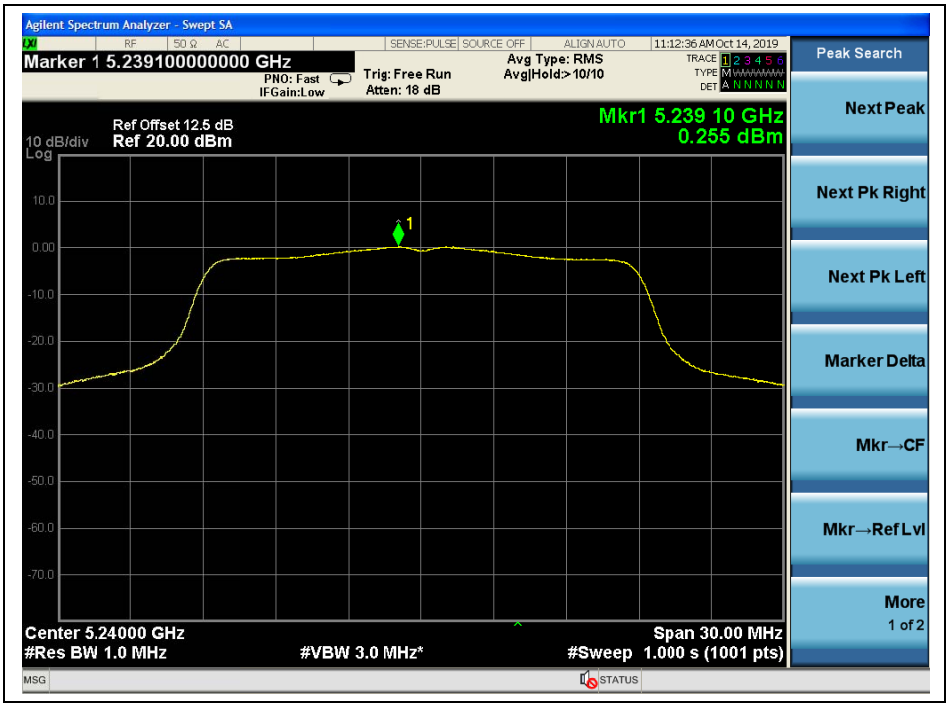
B. Test Plots



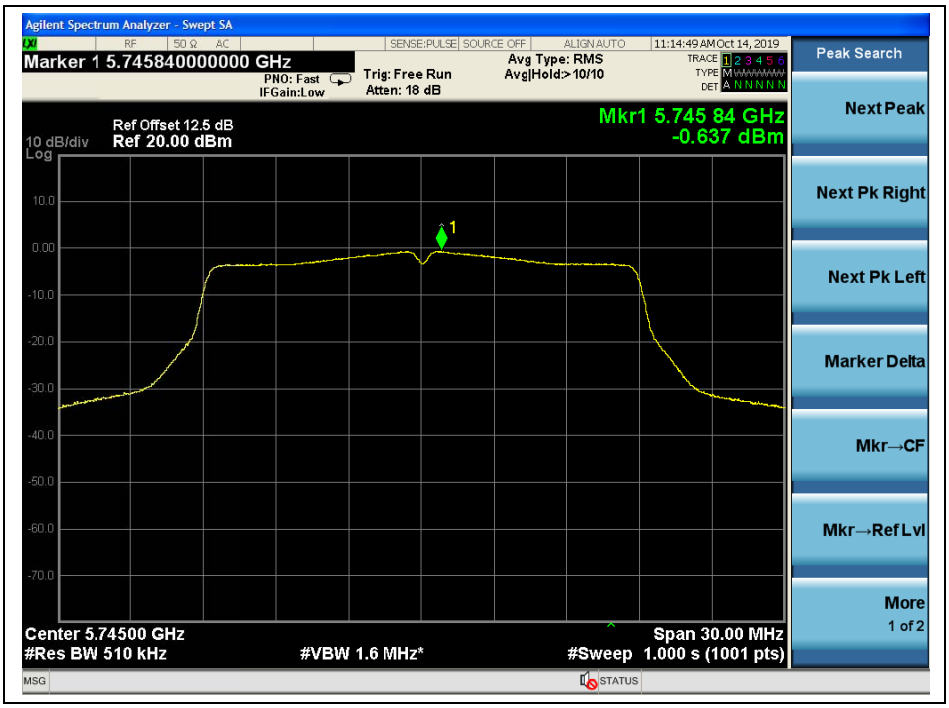
(Channel 36, 5180MHz, 802.11 n (HT20))



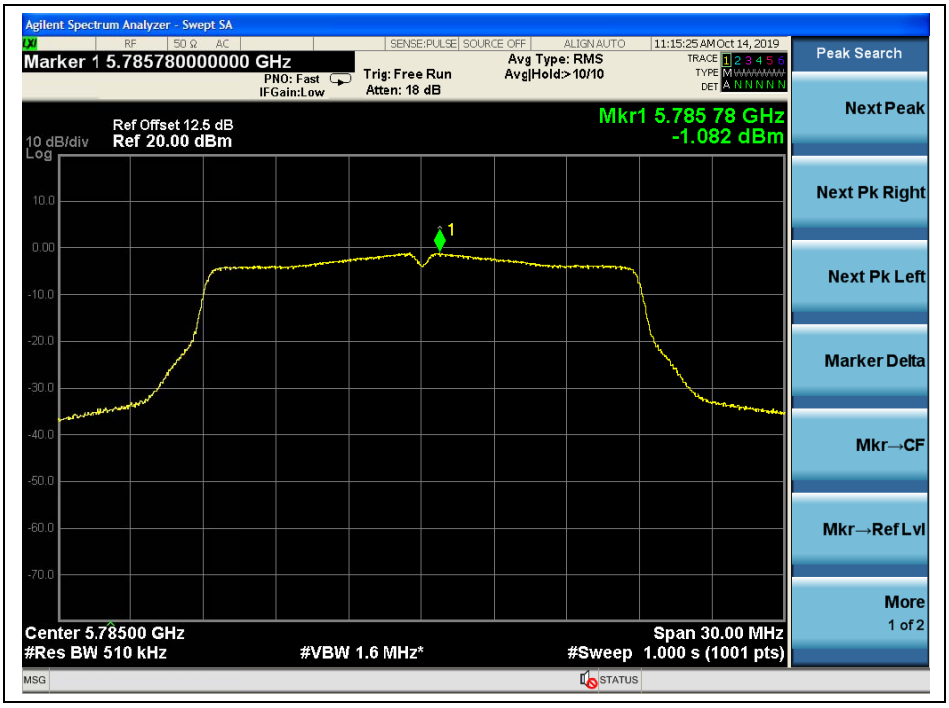
(Channel 44, 5220 MHz, 802.11 n (HT20))



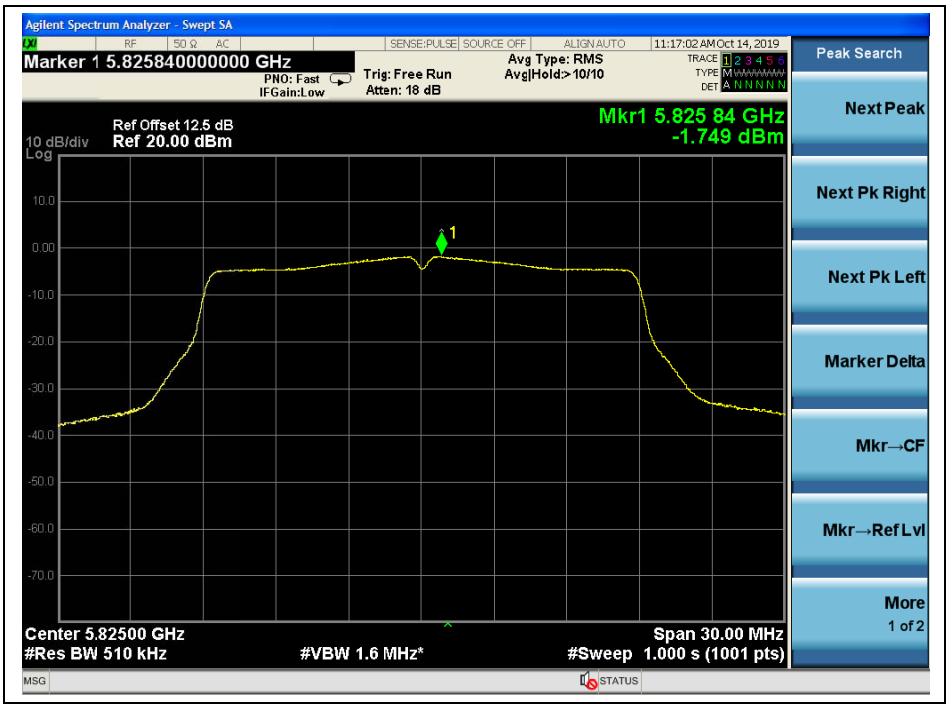
(Channel 48, 5240MHz, 802.11 n (HT20))



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



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



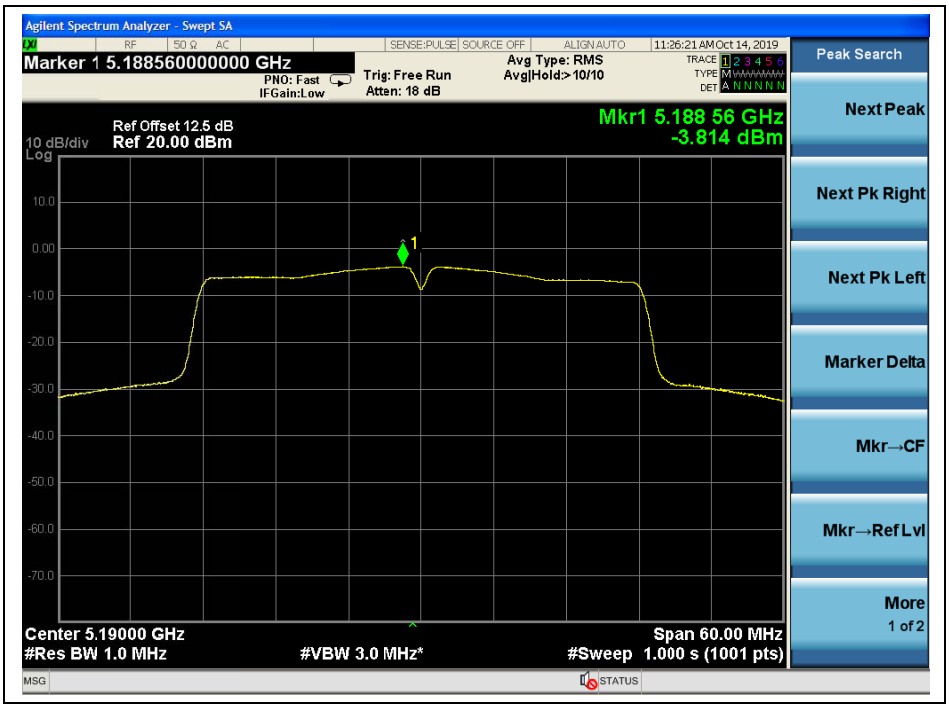
(Channel 165, 5825MHz, 802.11 n (HT20))

802.11n (HT40) Test mode

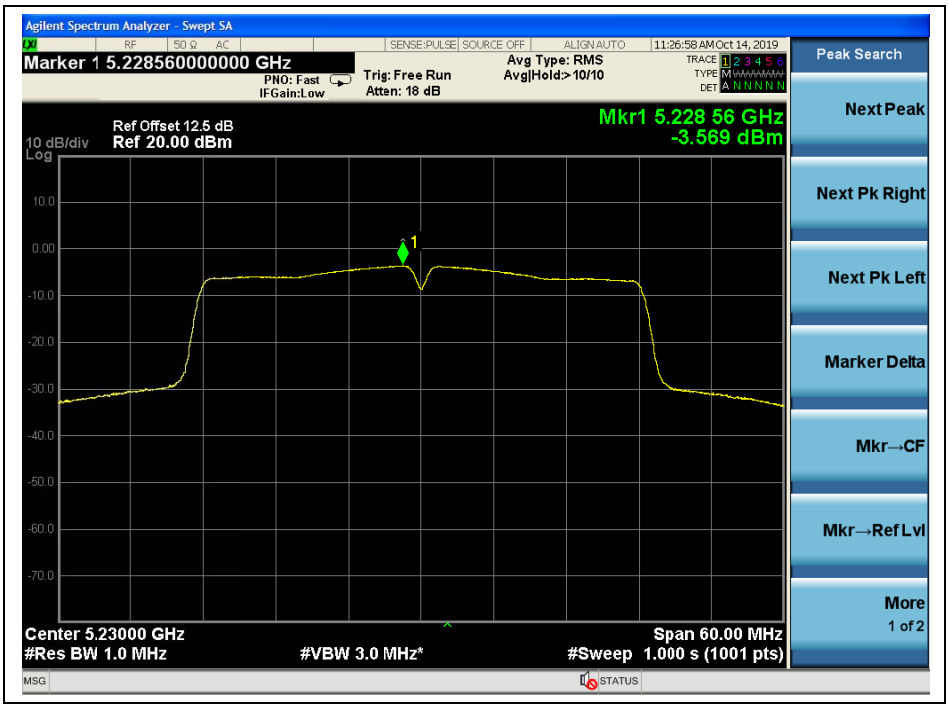
A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
38	5190	-3.814	11	PASS
46	5230	-3.569		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
151	5755	-4.812	30	PASS
159	5795	-5.210		

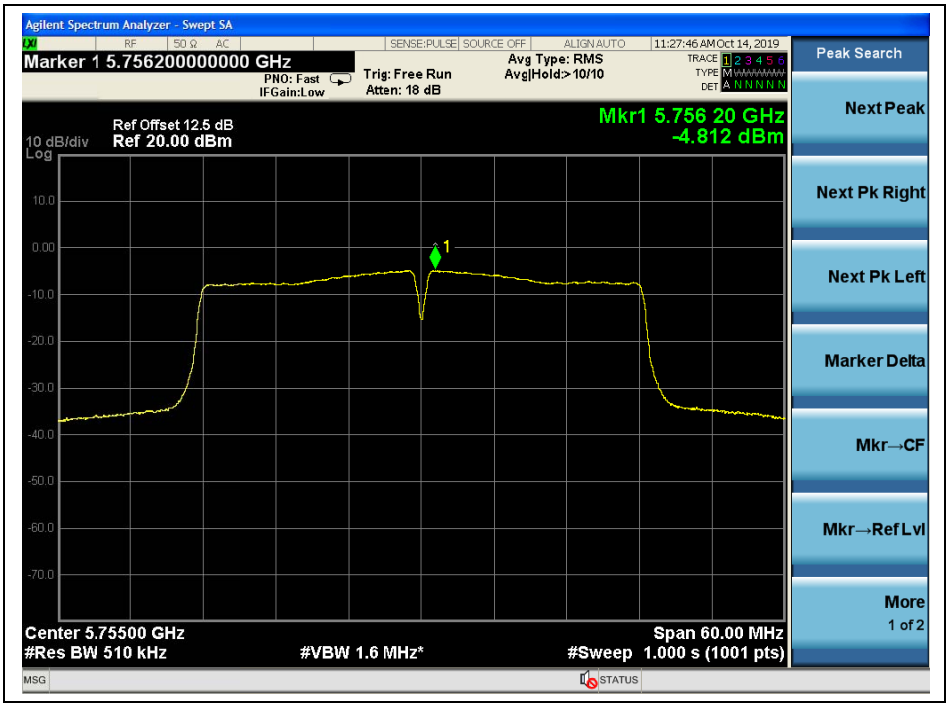
B. Test Plots



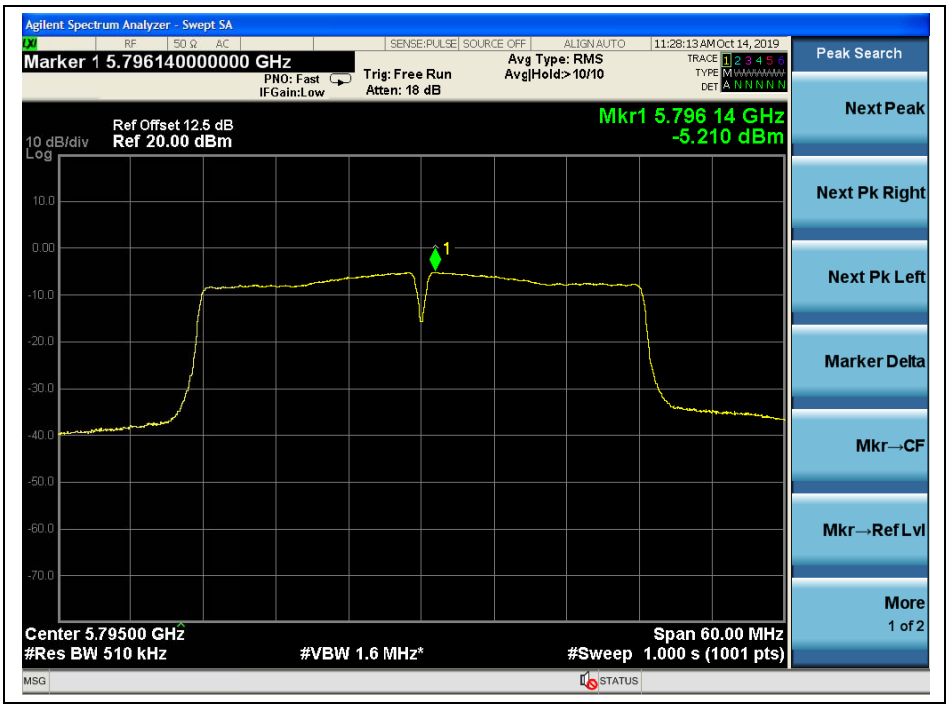
(Channel 38, 5190MHz, 802.11n (HT40))



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



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



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

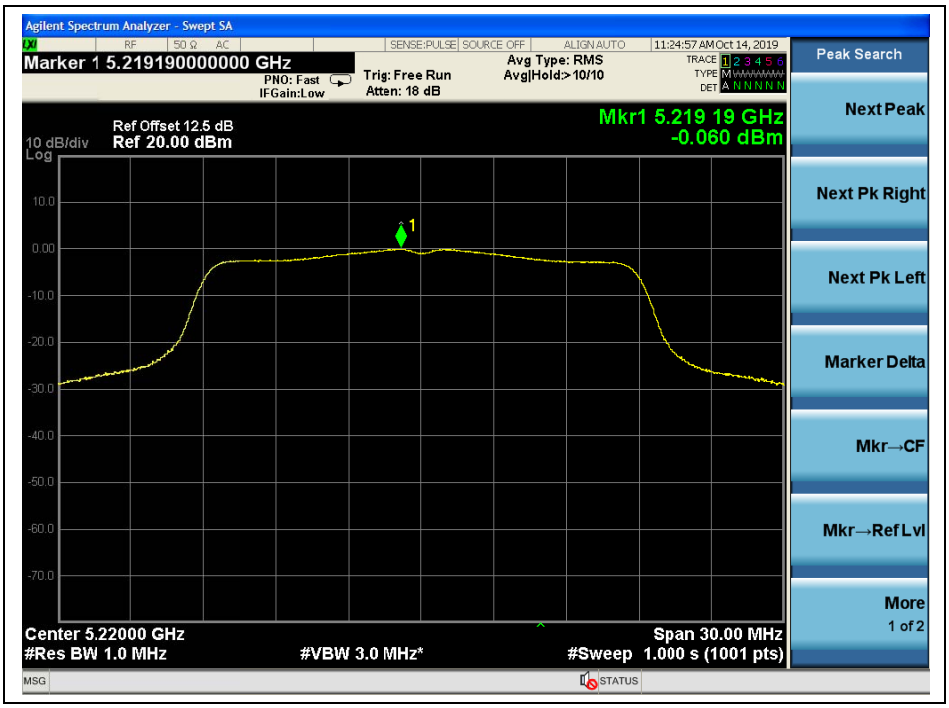
802.11ac (VHT20) Test mode

A. Test Verdict:

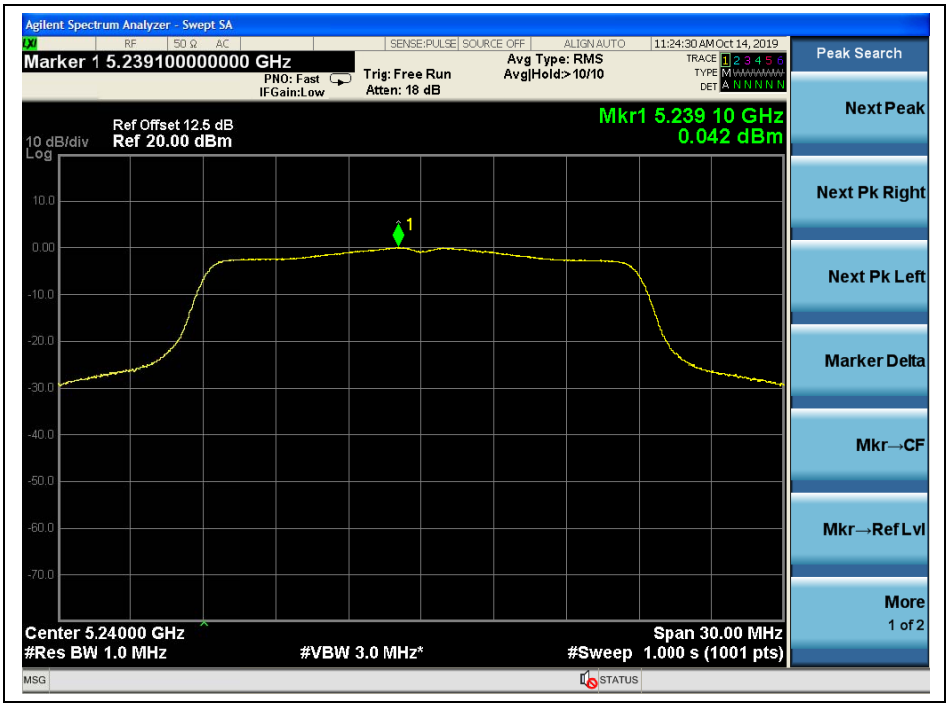
Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
36	5180	-0.255	11	PASS
44	5220	-0.060		
48	5240	0.042		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
149	5745	-0.935	30	PASS
157	5785	-1.348		
165	5825	-1.748		

B. Test Plots

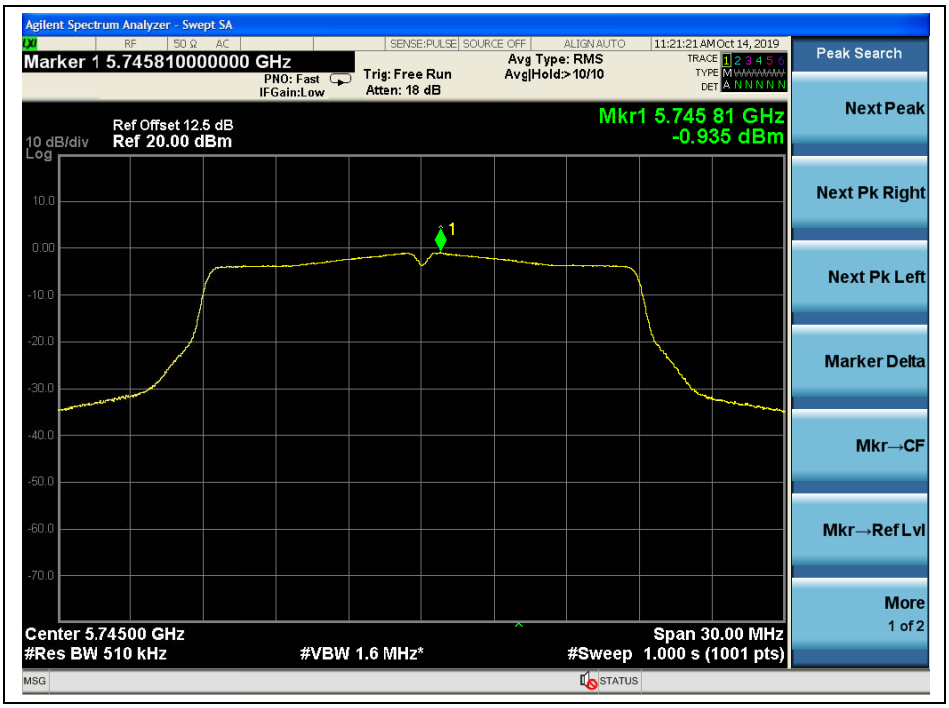
(Channel 36, 5180MHz, 802.11ac (VHT20))



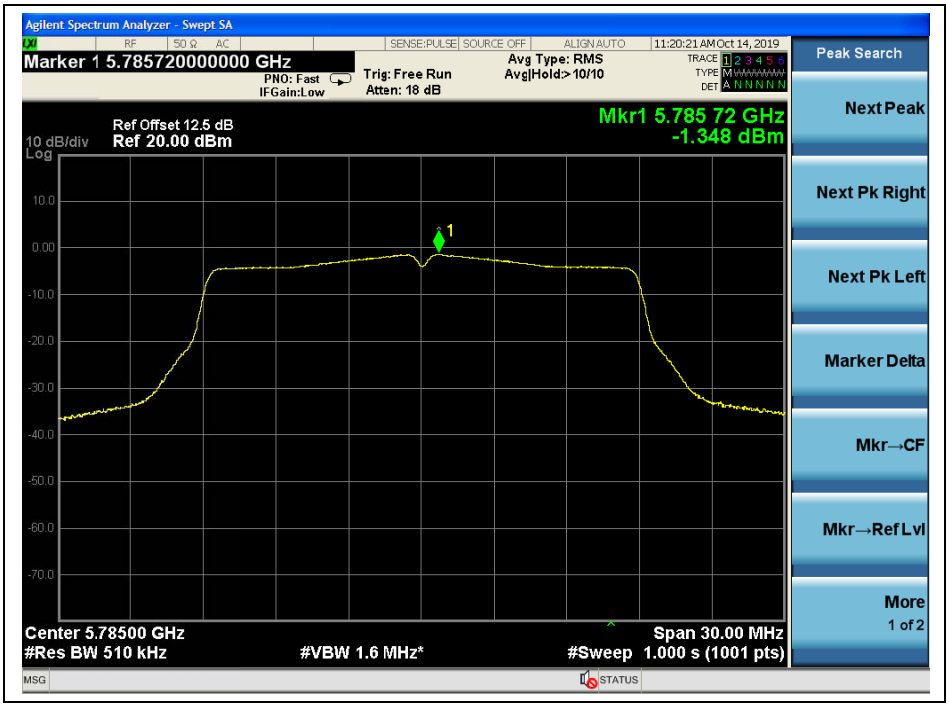
(Channel 44, 5220 MHz, 802.11 ac (VHT20))



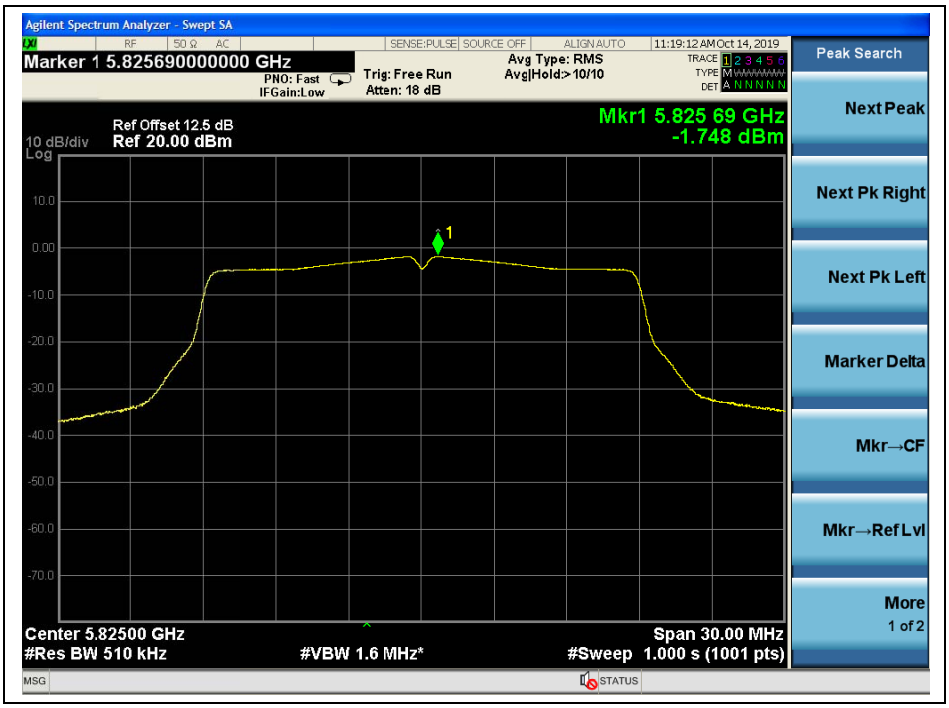
(Channel 48, 5240MHz, 802.11 ac (VHT20))



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



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



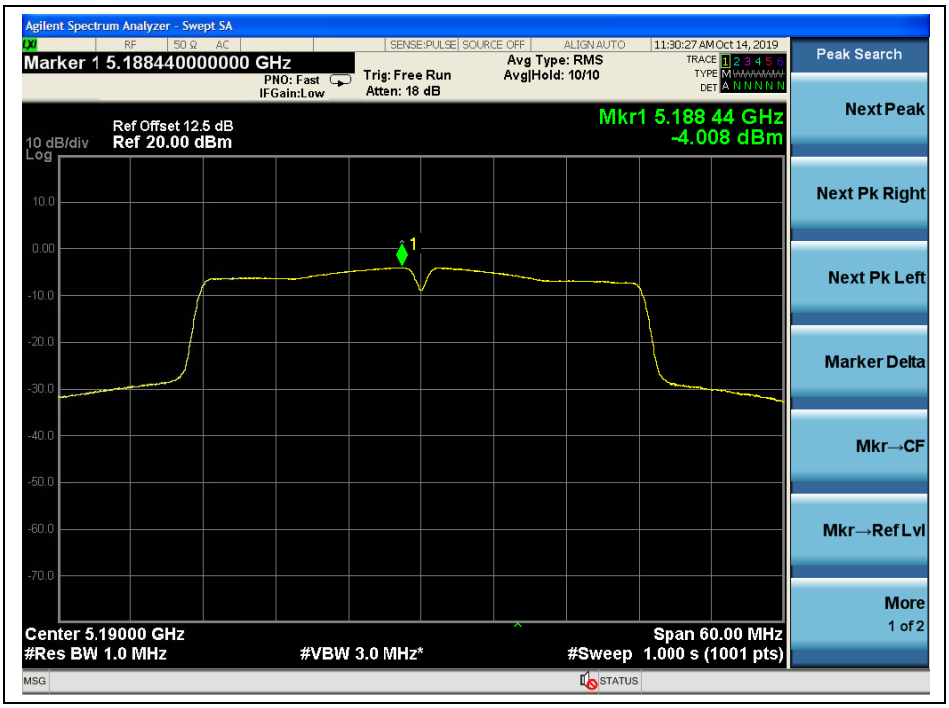
(Channel 165, 5825MHz, 802.11 ac (VHT20))

802.11ac (VHT40) Test mode

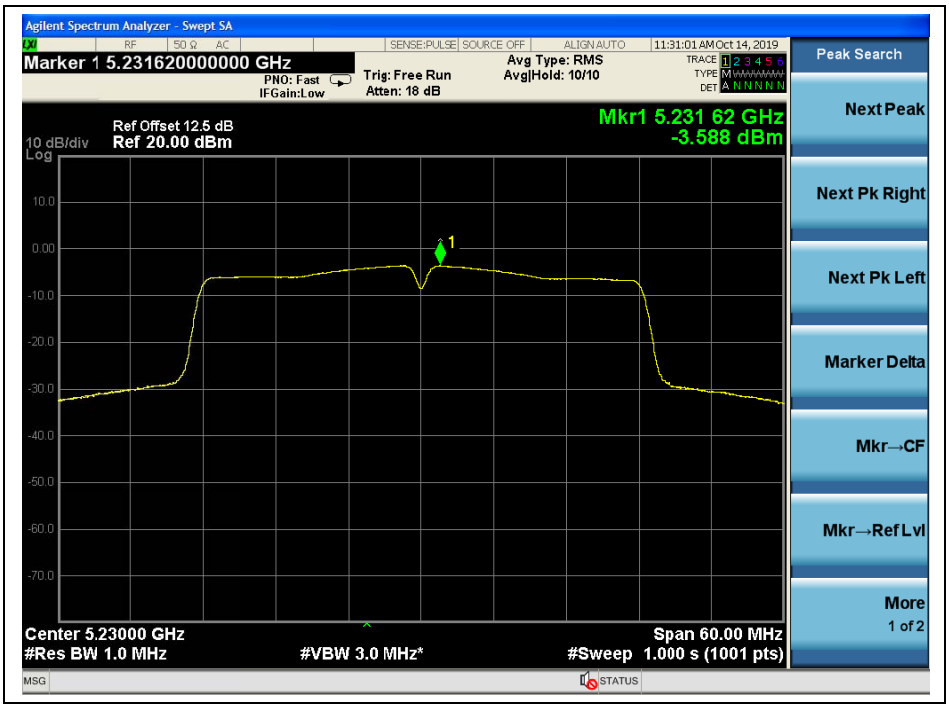
A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
38	5190	-4.008	11	PASS
46	5230	-3.588		
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
151	5755	-4.864	30	PASS
155	5795	-5.075		

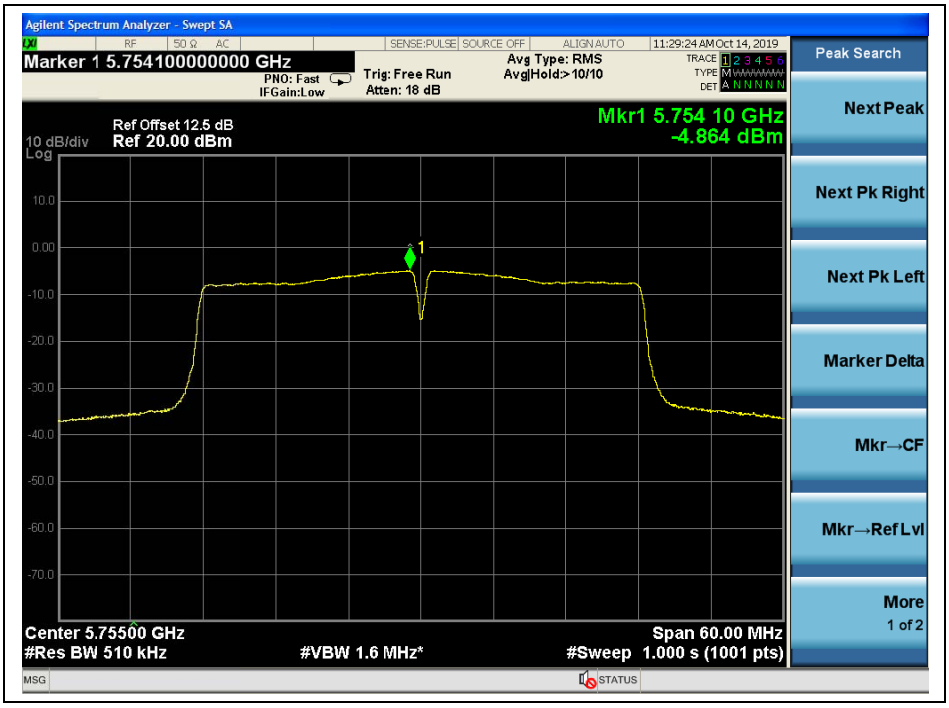
B. Test Plots



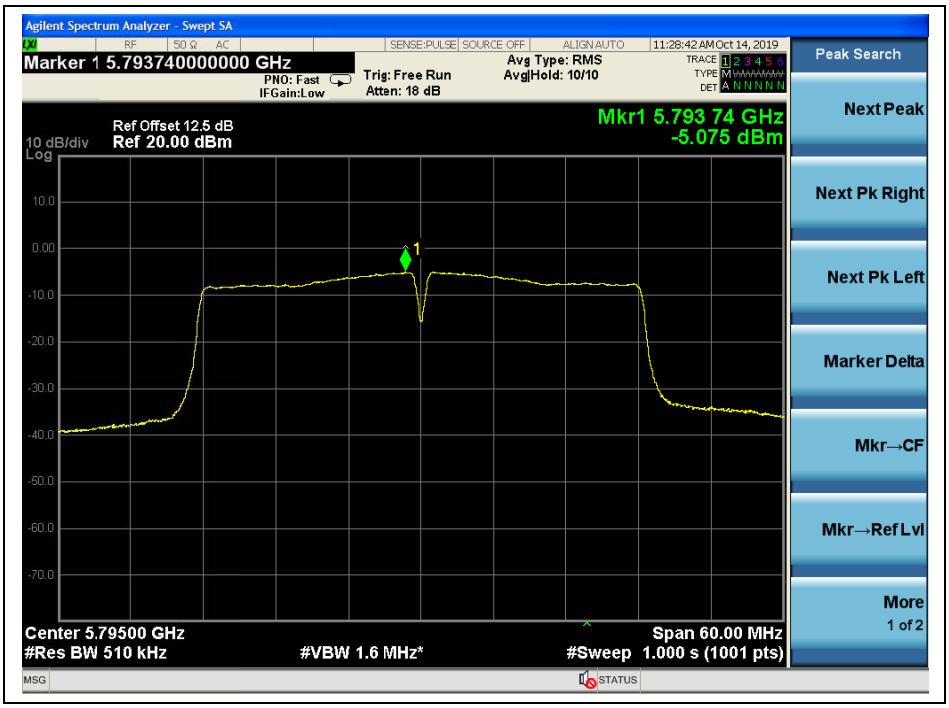
(Channel 38, 5190MHz, 802.11 ac (VHT40))



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



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



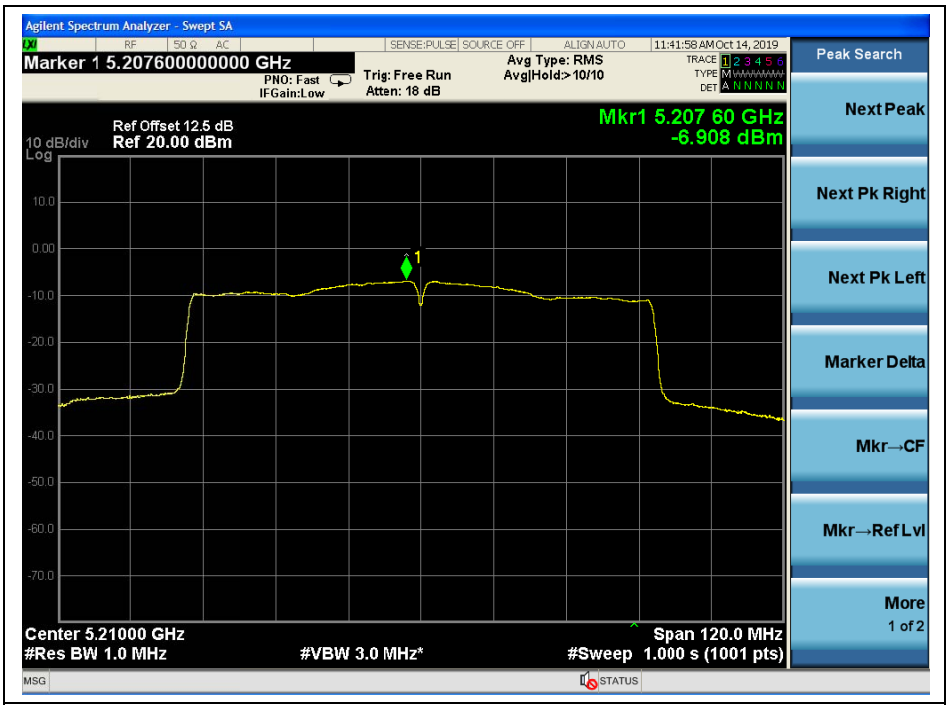
(Channel 159, 5795MHz, 802.11 ac (VHT40))

802.11ac (VHT80) Test mode

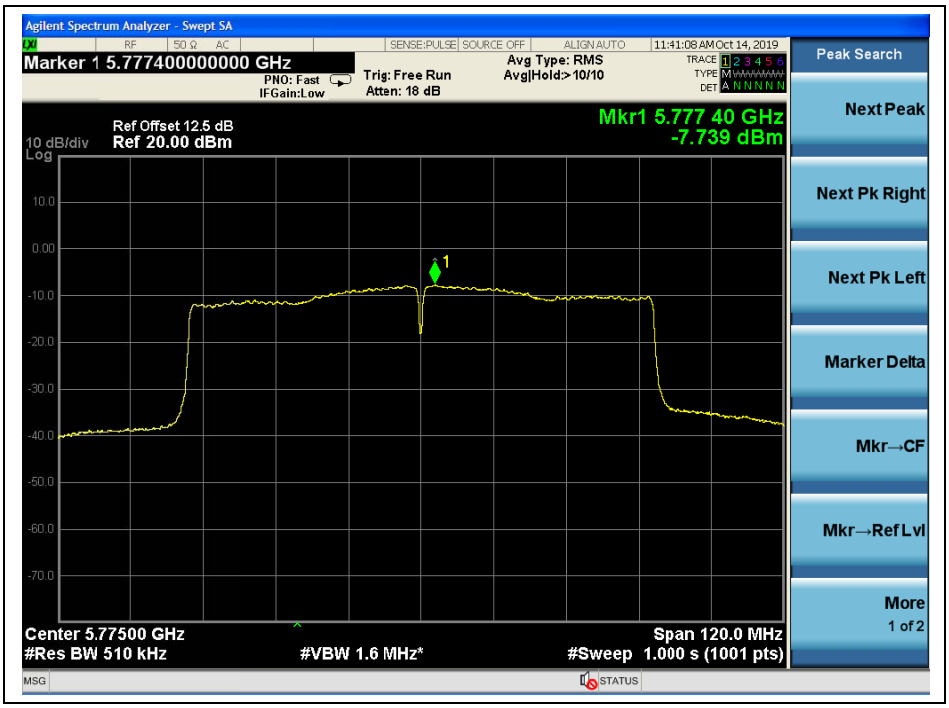
A. Test Verdict:

Channel	Frequency (MHz)	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
42	5210	-6.908	11	PASS
Channel	Frequency (MHz)	Measured PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
155	5775	-7.739	30	PASS

B. Test Plots



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



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

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 Description

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%	12.00	+20(Ref)	22	0.004
100%		-30	50	0.010
100%		-20	42	0.008
100%		-10	35	0.007
100%		0	30	0.006
100%		+10	21	0.004
100%		+20	25	0.005
100%		+30	33	0.006
100%		+40	41	0.008
100%		+50	43	0.008
85%	10.20	+20	54	0.010
115%	13.80	+20	43	0.008

U-NII-3 (Ch. 149) 5745MHz				
VOLTAGE (%)	POWER (VDC)	TEMP (°C)	Freq Dev. (Hz)	Deviation (ppm)
100%	12.00	+20(Ref)	26	0.005
100%		-30	47	0.008
100%		-20	42	0.007
100%		-10	34	0.006
100%		0	31	0.005
100%		+10	22	0.004
100%		+20	28	0.005
100%		+30	26	0.005
100%		+40	40	0.007
100%		+50	46	0.008
85%	10.20	+20	45	0.008
115%	13.80	+20	31	0.005

2.7. Conducted Emission

2.7.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

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

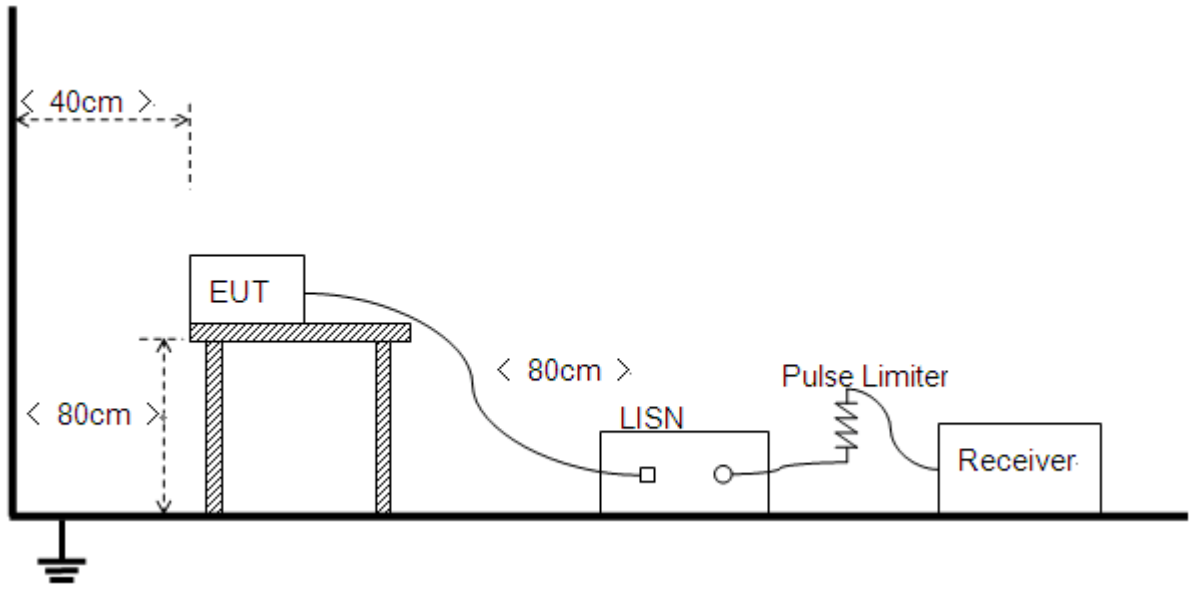
NOTE:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.7.2. Test Description

Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.

2.7.3. Test Result

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

Note: Both of the test voltage AC 120V/60Hz and AC 230V/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

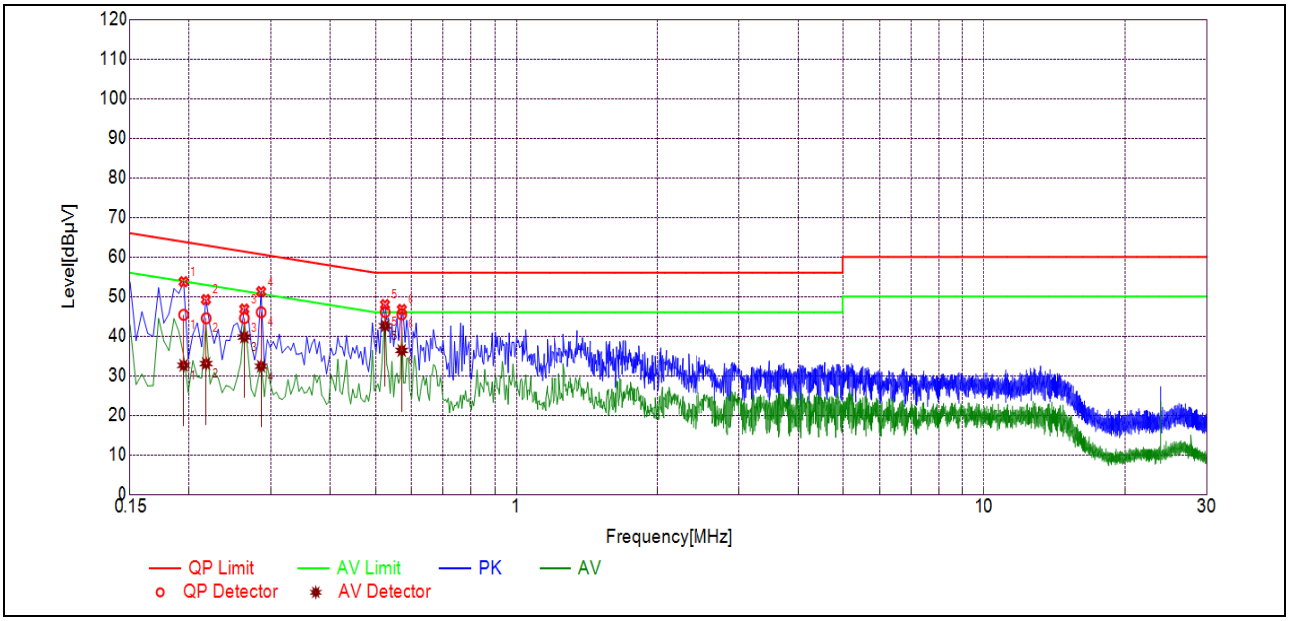
The measurement results are obtained as below:

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

U_R: Receiver Reading

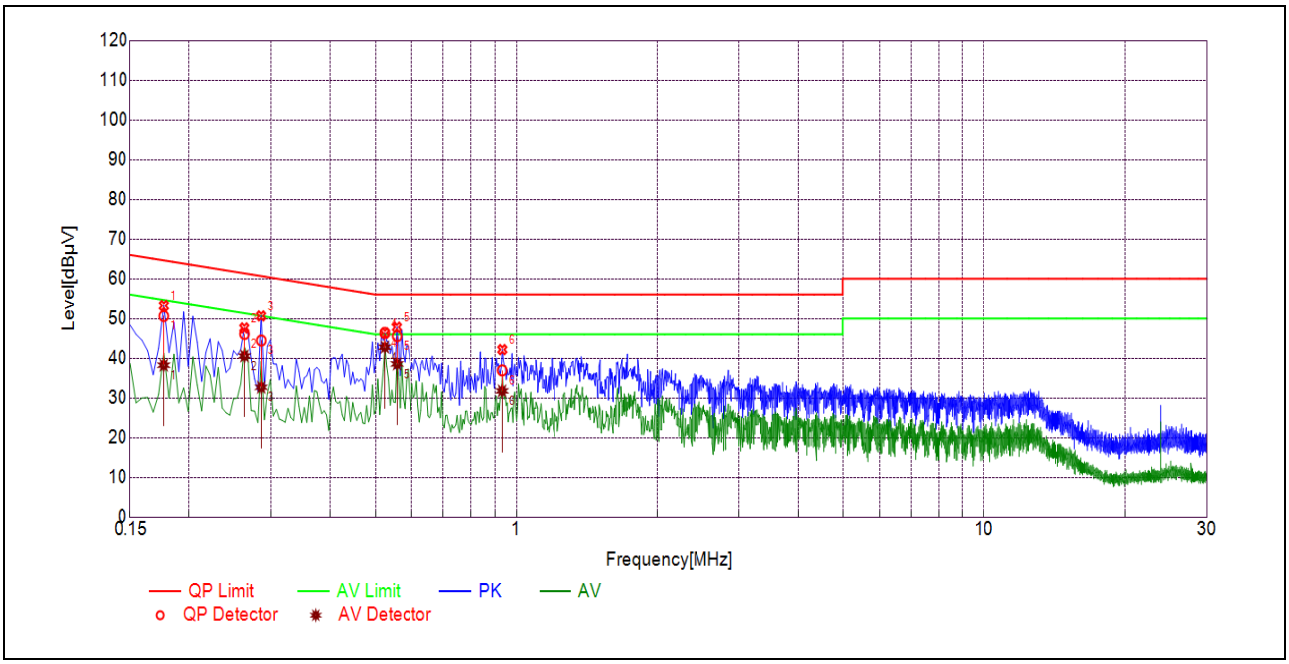
A_{Factor}: Voltage division factor of LISN

B. Test Plots:



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1950	45.38	32.61	63.82	53.82	Line	PASS
2	0.2177	44.51	33.06	62.91	52.91		PASS
3	0.2625	44.55	39.78	61.35	51.35		PASS
4	0.2850	46.02	32.38	60.67	50.67		PASS
5	0.5238	46.07	42.59	56.00	46.00		PASS
6	0.5680	45.50	36.37	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	0.1769	50.63	38.24	64.63	54.63	Neutral	PASS
2	0.2627	46.10	40.57	61.35	51.35		PASS
3	0.2852	44.46	32.68	60.66	50.66		PASS
4	0.5231	46.38	42.78	56.00	46.00		PASS
5	0.5555	45.56	38.55	56.00	46.00		PASS
6	0.9321	36.93	31.77	56.00	46.00		PASS

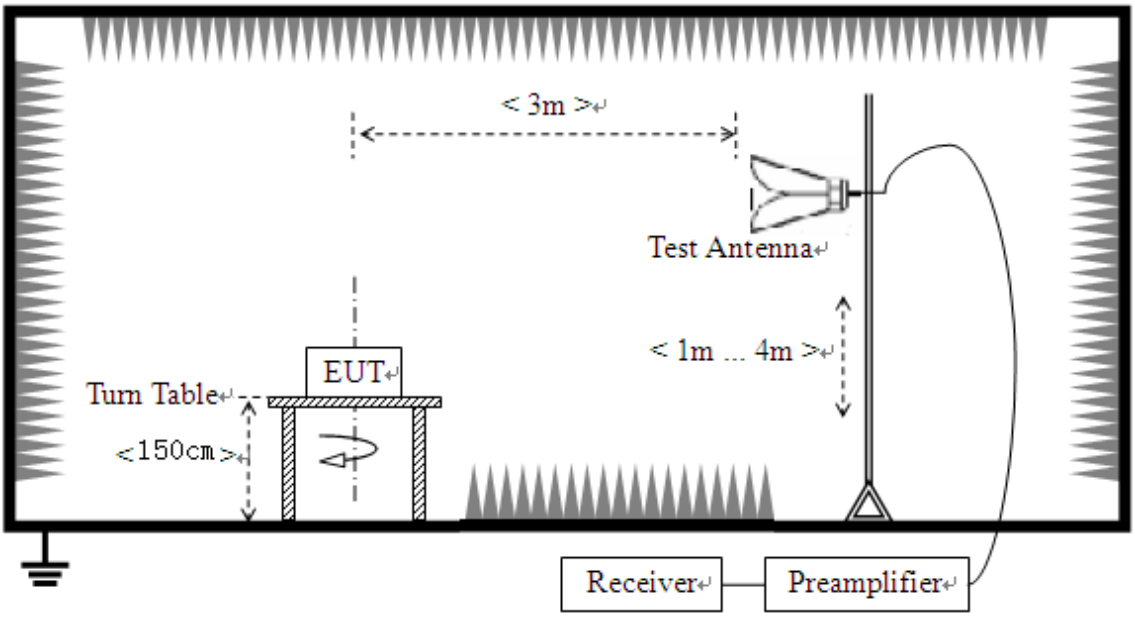
2.8. Restricted Frequency Bands

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

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

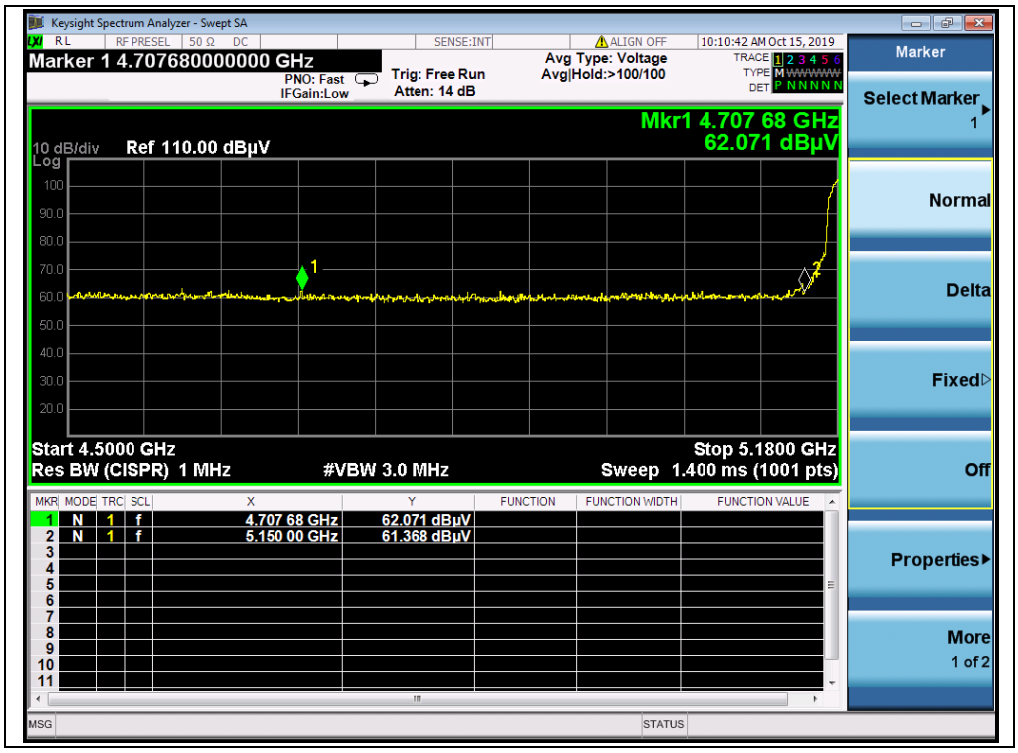
The lowest and highest channels are tested to verify Restricted Frequency Bands.
The measurement results are obtained as below:
E [dBμV/m] =U_R + A_T + A_{Factor} [dB]; A_T =$L_{Cable\ loss}$ [dB]-G_{preamp} [dB]
A_T: Total correction Factor except Antenna; U_R: Receiver Reading
G_{preamp}: Preamplifier Gain; A_{Factor}: Antenna Factor at 3m
Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

802.11a Test mode

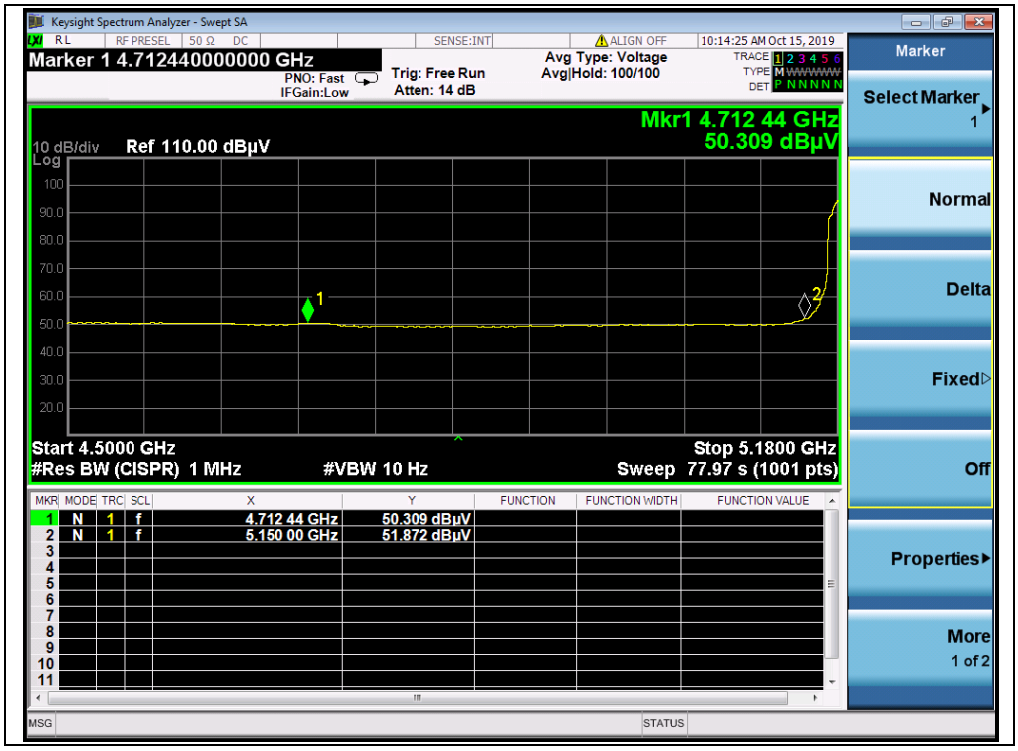
A. Test Verdict:

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						
36	4707.68	PK	62.07	-41.55	31.70	52.22	74	PASS
36	5150.00	AV	51.87	-41.55	31.70	42.02	54	PASS
48	5362.32	PK	59.12	-41.55	31.70	49.27	74	PASS
48	5362.32	AV	48.71	-41.55	31.70	38.86	54	PASS
149	5725.00	PK	71.69	-42.15	32.50	62.04	122.23	PASS
149	5725.00	AV	58.00	-42.15	32.50	48.35	54	PASS
165	5850.00	PK	63.07	-42.15	32.50	53.42	122.23	PASS
165	5850.00	AV	52.35	-42.15	32.50	42.7	54	PASS

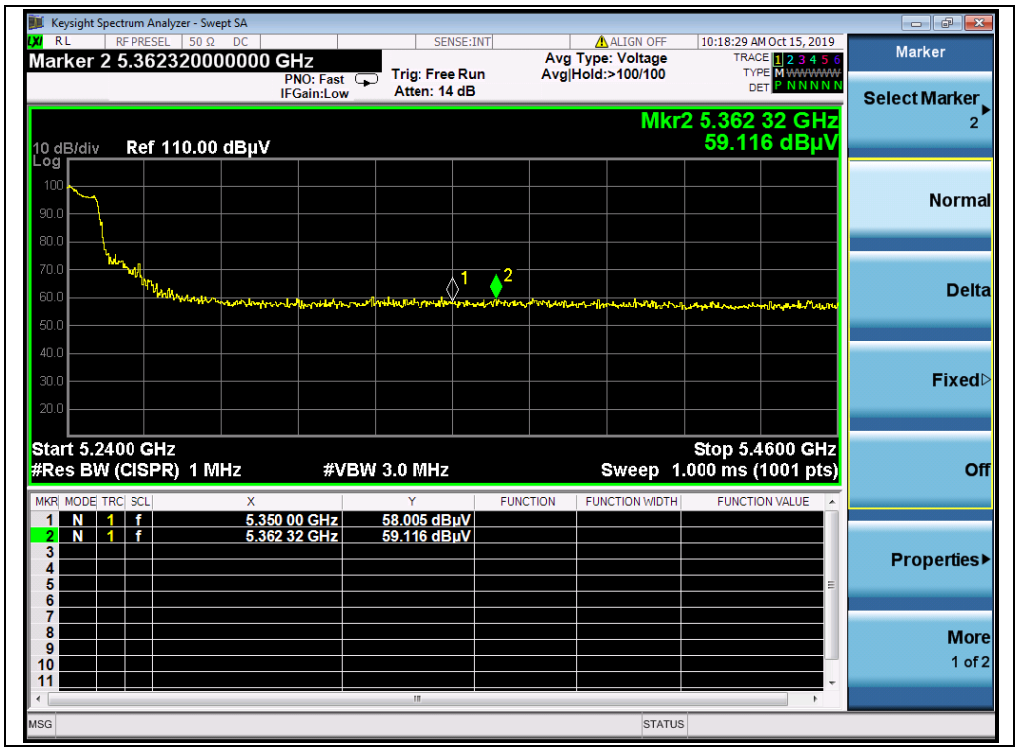
B. Test Plots:



(Channel 36, PEAK, 802.11a)

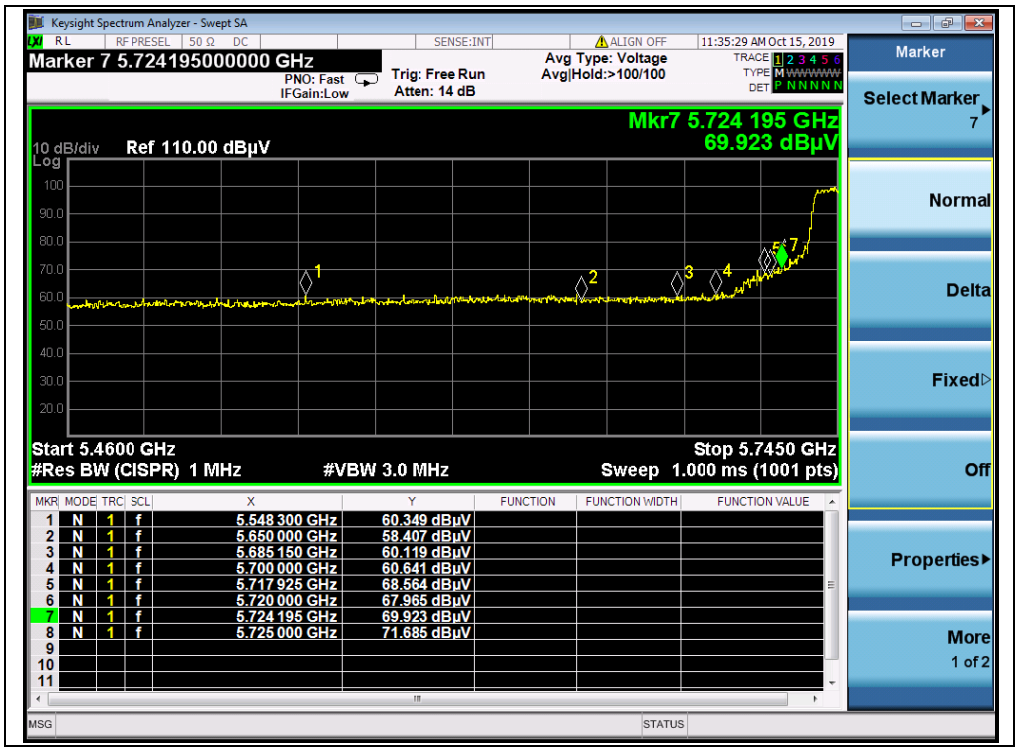


(Channel 36, AVG, 802.11a)



(Channel 48, PEAK, 802.11a)

(Channel 48, AVG, 802.11a)



(Channel 149, PEAK, 802.11a)

(Channel 149, AVG, 802.11a)