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TEST REPORT

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Radio Spectrum
TEST REPORT

Applicant:	**DiCon Fiberoptics, Inc.** **1689 Regatta Blvd. Richmond, CA 94804**
Product:	**LED Aquarium Lighting**
Model No.:	**AP9X**
Brand Name:	**Kessil**
FCC ID:	**2ASL8-AP9X**
Test Method/ Standard:	**47 CFR FCC Part 15.407** **KDB 789033 D02 v02r01** **ANSI C63.10 2013** **KDB 662911 D01 v02r01**
Test By:	**Intertek Testing Services Taiwan Ltd.,** **Hsinchu Laboratory** **No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,** **Shiang-Shan District, Hsinchu City, Taiwan**

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Revision History

Report No.	Issue Date	Revision Summary
200300082TWN-001	Apr. 17, 2020	Original report

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Summary of Test Data

Test Requirement	Applicable Rule (Section 15.407)	Result
Maximum Conducted Output Power	15.407 (a)(1)/(2)/(3) KDB 789033 D02 v02r01	Pass
Power Spectrum Density	15.407 (a)(1)/(2)/(3) KDB 789033 D02 v02r01	Pass
Minimum Emission Bandwidth	15.407(a)(5), 15.407(e) KDB 789033 D02 v02r01	Pass
Emissions In Restricted Frequency Bands (Radiated emission measurements)	15.407(b), 15.209	Pass
Emission on The Band Edge	15.407(b), 15.209	Pass
AC Line Conducted Emission	15.407(b)(6) 15.207	Pass
Antenna requirement	15.203	Pass

Note: Please note that the test results with statement of conformity, the decision rules which are based on: Safety Testing: the specification, standard or IEC Guide 115.
Other Testing: the specification, standard and not taking into account the measurement uncertainty.

1. General Information

1.1 Identification of the EUT

Product:	LED Aquarium Lighting			
Model No.:	AP9X			
Operating Frequency Range & Number of Channels:	**Band**	**Mode**	**Frequency Range (MHz)**	**Number of Channels**
	UNII-I-1	IEEE 802.11a	5180 - 5240	4 Channels
		IEEE 802.11ac (VHT20)	5180 - 5240	4 Channels
		IEEE 802.11ac (VHT40)	5190 – 5230	2 Channels
		IEEE 802.11ac (VHT80)	5210	1 Channels
	UNII-I-3	IEEE 802.11a	5745 - 5825	5 Channels
		IEEE 802.11ac (VHT20)	5745 - 5825	5 Channels
		IEEE 802.11ac (VHT40)	5755 - 5795	2 Channels
		IEEE 802.11ac (VHT80)	5775	1 Channels
Access scheme:	OFDM			
Rated Power:	DC 48V from adapter			
Power Cord:	N/A			
Sample receiving date:	Mar. 05, 2020			
Sample condition:	Workable			
Test Date(s):	Mar. 10, 2020~ Apr. 7, 2020			

1.2 Antenna description

Antenna Gain : 2.66 dBi
Antenna Type : PCB antenna
Connector Type : I-Pex

1.3 Adapter information

The EUT will be supplied with a power supply from below list:

No.	Model no.	Specification
Adapter	HLG-185H-48	I/P: 100-240 Vac, 2.1 A, 50/60 Hz 277 Vac, 0.8 A, 50/60 Hz O/P: 48Vdc, 3.9 A, 187.2W

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Notebook PC	Dell	Latitude E5420	N/A	1. RJ-45 Cable 1 meter × 1 2. Non-shielded USB to Type-C cable 0.8 meter × 1

1.5 Operation mode

Test Voltage: 120 Vac, 60Hz
Connected to Notebook via USB Cable, executing "Tera Term"and setting COM port and Baud rate to enter test mode. selecting different frequency and modulation for the test.

With individual verifying, the maximum output power was found out 6 Mbps data rate for 802.11a mode, 6.5 Mbps data rate for 802.11ac(VHT20) mode, 13.5 Mbps data rate for 802.11ac(VHT40) mode, 29.3 Mbps data rate for 802.11ac(VHT80) mode the final tests were executed under these conditions recorded in this report individually.

Modulation mode	Transmit path
	Chain 0
802.11 a	V
802.11 ac (VHT20)	V
802.11 ac (VHT40)	V
802.11 ac (VHT80)	V

2. Maximum Conducted Output Power

2.1 Operating environment

Temperature:	21	℃
Relative Humidity:	53	%

2.2 Limit for maximum output power

Operating Frequency (MHz)	Conducted output power limit
5150~5725	< 0.25 W (24 dBm)
5725~5850	< 1 W (30 dBm)

Operating Frequency (MHz)	Maximum E.I.R.P. limit
5150~5725	< 1 W (30 dBm)
5725~5850	< 4 W (36 dBm)

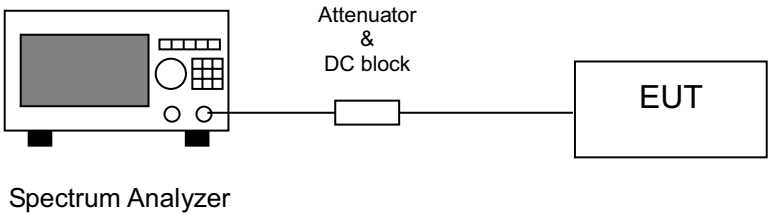
2.3 Measuring instrument setting

Spectrum Analyzer function	Setting
Detector	Average

2.4 Test procedure

Test procedures refer to clause E) 3) b) measurement using a gated RF average Spectrum analyzer of KDB 789033 D02 v01r02
Test procedures refer to clause E) 2) b) Method SA-1 of KDB 789033 D02 v01r02

2.5 Test diagram



2.6 Test results

Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Conducted Output Power (AV)		Duty Factor	Antenna Gain (dBi)	E.I.R.P. (dBm)	Limit of Conducted Power (dBm)	Margin (dB)	Limit of E.I.R.P. (dBm)	Margin (dB)
				dBm	mW							
802.11a	36	5180	6	15.08	32.23	0.91	2.66	18.65	24.00	-8.01	30.00	-11.35
	44	5220		15.81	38.08	0.91	2.66	19.38	24.00	-7.28	30.00	-10.62
	48	5240		15.92	39.12	0.91	2.66	19.49	24.00	-7.17	30.00	-10.51
	149	5745		12.96	19.76	0.91	2.66	16.53	30.00	-16.13	36.00	-19.47
	157	5785		13.77	23.81	0.91	2.66	17.34	30.00	-15.32	36.00	-18.66
	165	5825		14.26	26.64	0.91	2.66	17.83	30.00	-14.83	36.00	-18.17
802.11ac (VHT20)	36	5180	6.5	13.11	20.48	1.02	2.66	16.79	24.00	-9.87	30.00	-13.21
	44	5220		13.58	22.80	1.02	2.66	17.26	24.00	-9.40	30.00	-12.74
	48	5240		11.34	13.61	1.02	2.66	15.02	24.00	-11.64	30.00	-14.98
	149	5745		12.30	16.99	1.02	2.66	15.98	30.00	-16.68	36.00	-20.02
	157	5785		12.49	17.75	1.02	2.66	16.17	30.00	-16.49	36.00	-19.83
	165	5825		12.78	18.95	1.02	2.66	16.46	30.00	-16.20	36.00	-19.54
802.11ac (VHT40)	38	5190	13.5	11.87	15.40	1.77	2.66	16.31	24.00	-10.35	30.00	-13.69
	46	5230		14.06	25.48	1.77	2.66	18.49	24.00	-8.17	30.00	-11.51
	151	5755		10.45	11.10	1.77	2.66	14.88	30.00	-17.78	36.00	-21.12
	159	5795		11.35	13.65	1.77	2.66	15.78	30.00	-16.88	36.00	-20.22
802.11ac (VHT80)	42	5210	29.3	15.28	33.74	0.16	2.66	18.10	24.00	-8.56	30.00	-11.90
	155	5775		13.93	24.73	0.16	2.66	16.75	30.00	-15.91	36.00	-19.25

3. Power Spectrum Density

3.1 Operating environment

Temperature:	21	℃
Relative Humidity:	53	%

3.2 Limit for power spectrum density

Operating Frequency (MHz)	Power density limit
5150~5725	< 11 dBm/1MHz
5725~5850	< 30 dBm/500kHz

3.3 Measuring instrument setting

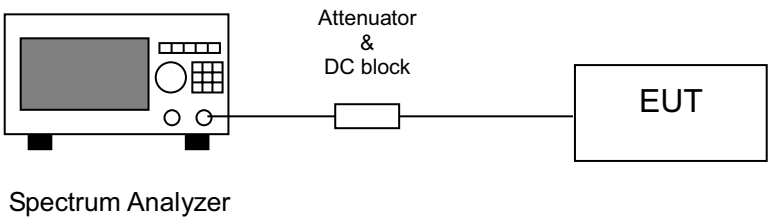
Spectrum analyzer settings (5150~5725MHz)	
Spectrum Analyzer function	**Setting**
Detector	RMS
RBW	=1MHz
VBW	≧3 MHz
Sweep	Auto couple
Trace	Average
Span	Encompass the 26 dB EBW
Attenuation	Auto
Sweep point	≥ 2 Span / RBW

Spectrum analyzer settings (5725~5850MHz)	
Spectrum Analyzer function	**Setting**
Detector	RMS
RBW	=100kHz
VBW	≧300 kHz
Sweep	Auto couple
Trace	Average
Span	Encompass the 6 dB EBW
Attenuation	Auto
Sweep point	≥ 2 Span / RBW

3.4 Test procedure

Set relevant parameter according to clause 4.3.
Trace average at least 100 traces in power averaging mode.
Compute power by integrating the spectrum across the 26 dB or 6dB EBW of the signal using the instrument's band power measurement function with band limits set equal to the EBW band edges.
If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement. The RBW is 100 kHz. So, we will add 6.989 to the results.

3.5 Test diagram



3.6 Test results

Mode	Channel	Frequency (MHz)	PSD		Result	Limit (dBm)	Margin (dB)
			(dBm)	(mW)			
802.11a	36	5180	5.38	3.45	5.38	11	-5.62
	44	5220	6.38	4.34	6.38	11	-4.63
	48	5240	6.55	4.52	6.55	11	-4.45

Mode	Channel	Frequency (MHz)	RBW factor	PSD in 100kHz	PSD in 500kHz		Result	Limit (dBm)	Margin (dB)
					(dBm)	(mW)			
802.11a	149	5745	-6.99	1.45	8.44	6.99	8.44	30	-21.56
	157	5785	-6.99	2.12	9.11	8.14	9.11	30	-20.89
	165	5825	-6.99	1.83	8.82	7.62	8.82	30	-21.18

Mode	Channel	Frequency (MHz)	PSD		Result	Limit (dBm)	Margin (dB)
			(dBm)	(mW)			
802.11ac (VHT20)	36	5180	3.70	2.34	3.70	11	-7.30
	44	5220	4.26	2.67	4.26	11	-6.74
	48	5240	1.52	1.42	1.52	11	-9.48

Mode	Channel	Frequency (MHz)	RBW factor	PSD in 100kHz	PSD in 500kHz		Result	Limit (dBm)	Margin (dB)
					(dBm)	(mW)			
802.11ac (VHT20)	149	5745	-6.99	1.35	8.34	6.83	8.34	30	-21.66
	157	5785	-6.99	0.94	7.93	6.21	7.93	30	-22.07
	165	5825	-6.99	1.24	8.23	6.65	8.23	30	-21.77

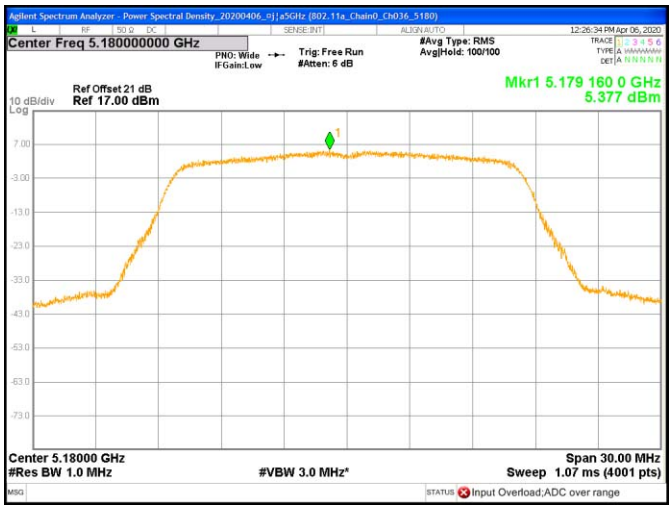
Mode	Channel	Frequency (MHz)	PSD		Result	Limit (dBm)	Margin (dB)
			(dBm)	(mW)			
802.11ac (VHT40)	38	5190	-0.82	0.83	-0.82	11	-11.82
	46	5230	1.20	1.32	1.20	11	-9.80

Mode	Channel	Frequency (MHz)	RBW factor	PSD in 100kHz	PSD in 500kHz		Result	Limit (dBm)	Margin (dB)
					(dBm)	(mW)			
802.11ac (VHT40)	151	5755	-6.99	-3.74	3.25	2.12	3.25	30	-26.75
	159	5795	-6.99	-2.61	4.38	2.74	4.38	30	-25.62

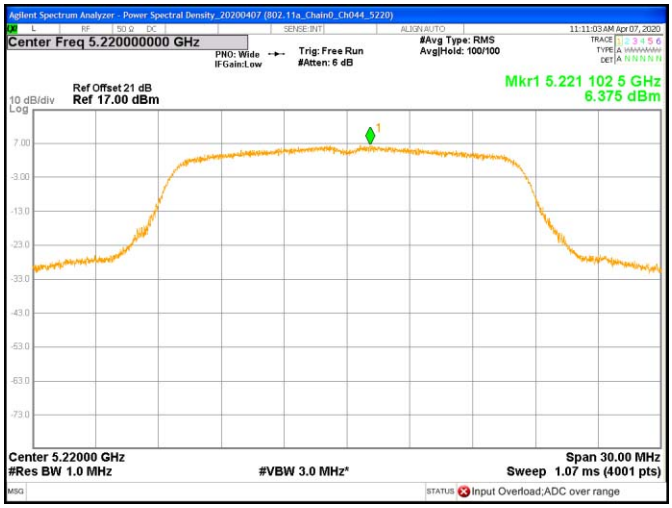
Mode	Channel	Frequency (MHz)	PSD		Result	Limit (dBm)	Margin (dB)
			(dBm)	(mW)			
802.11ac (VHT80)	42	5210	0.30	1.07	0.30	11	-10.71

Mode	Channel	Frequency (MHz)	RBW factor	PSD in 100kHz	PSD in 500kHz		Result	Limit (dBm)	Margin (dB)
					(dBm)	(mW)			
802.11ac (VHT80)	155	5775	-6.99	-3.66	3.33	2.15	3.33	30	-26.67

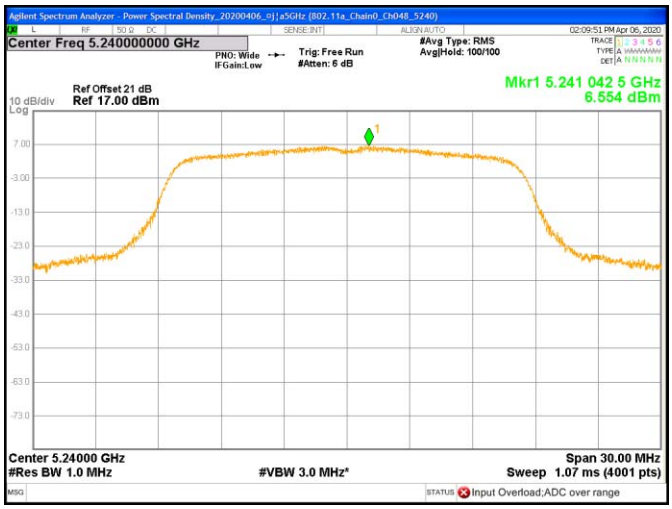
Chain0: Power Spectral Density @ 802.11a Mode Ch036



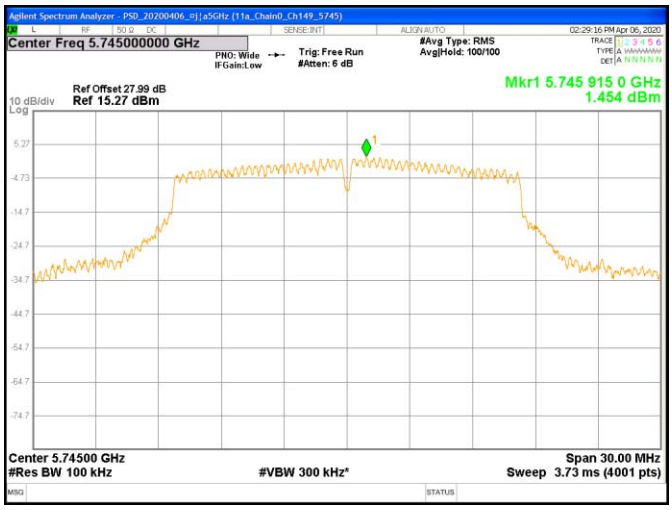
Chain0: Power Spectral Density @ 802.11a Mode Ch044



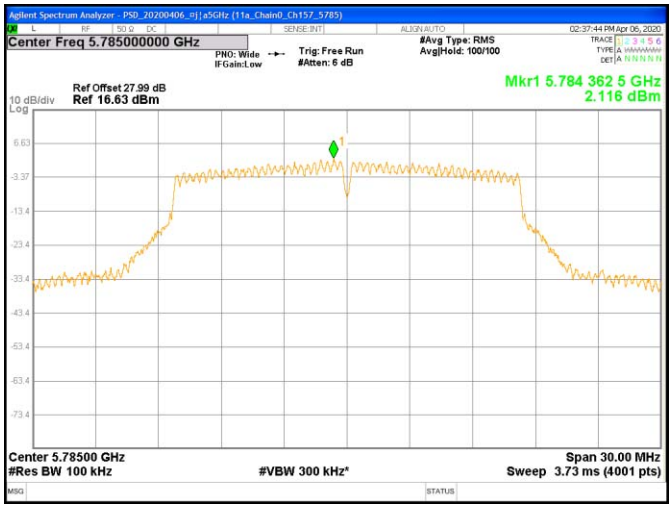
Chain0: Power Spectral Density @ 802.11a Mode Ch048



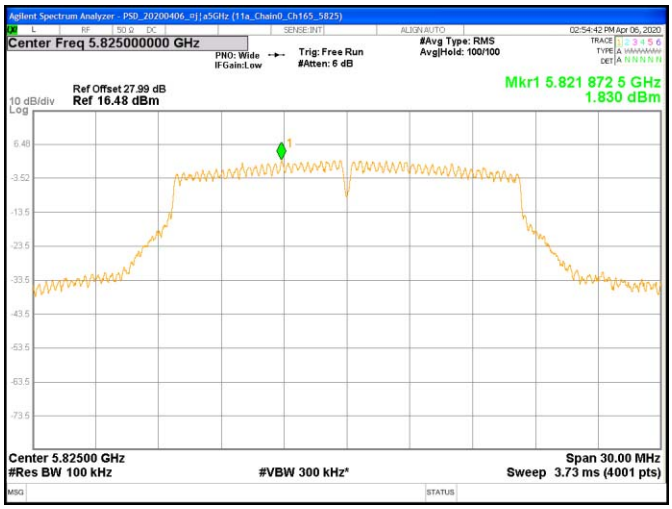
Chain0: Power Spectral Density @ 802.11a Mode Ch149



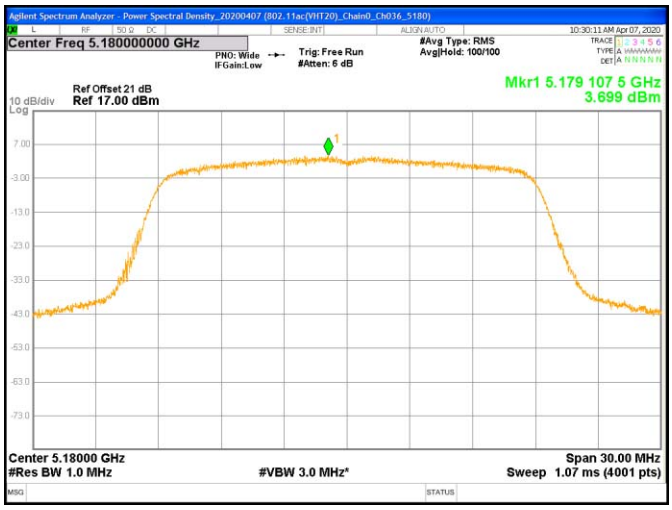
Chain0: Power Spectral Density @ 802.11a Mode Ch157



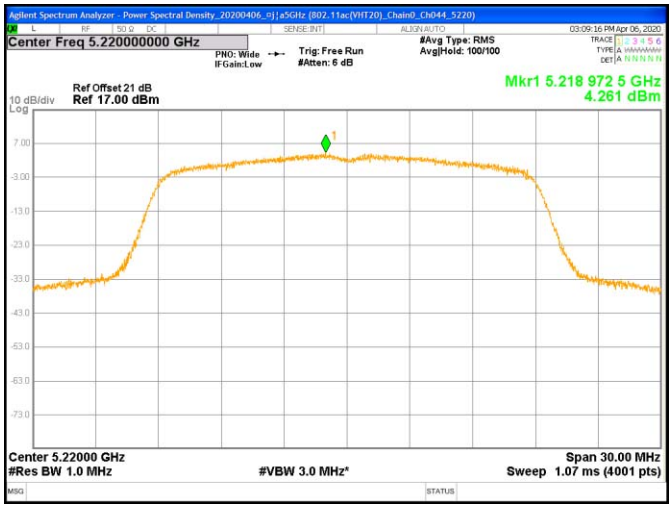
Chain0: Power Spectral Density @ 802.11a Mode Ch165



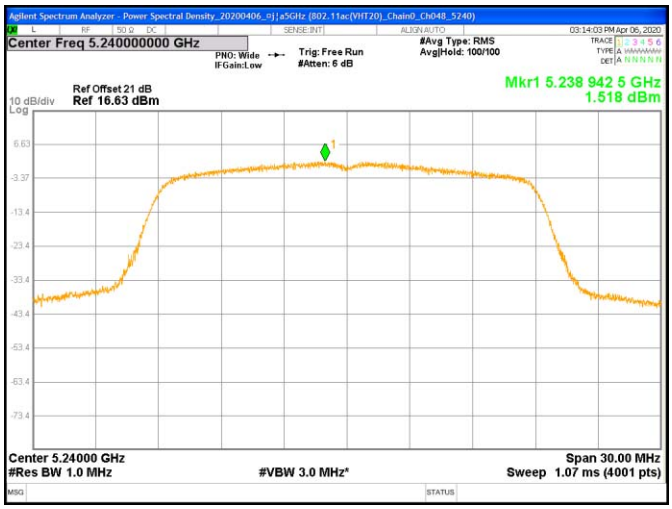
Chain0: Power Spectral Density @ 802.11ac(VHT20) Mode Ch036



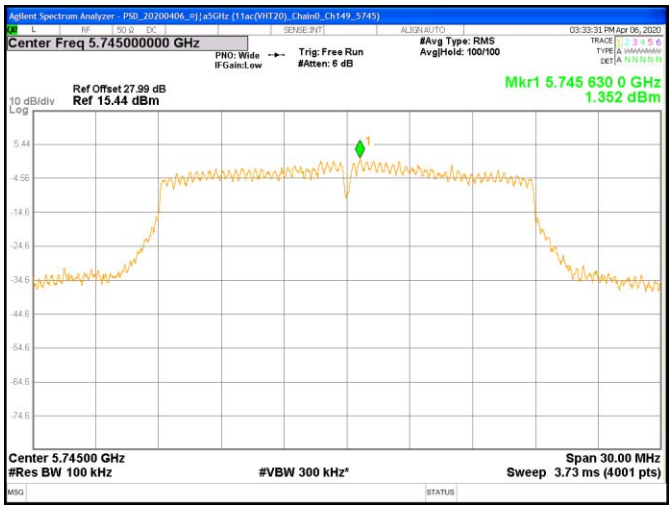
Chain0: Power Spectral Density @ 802.11ac(VHT20) Mode Ch044



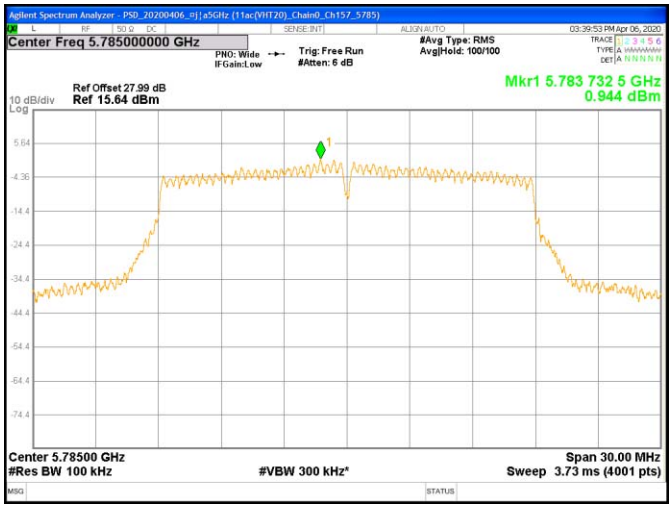
Chain0: Power Spectral Density @ 802.11ac(VHT20) Mode Ch048



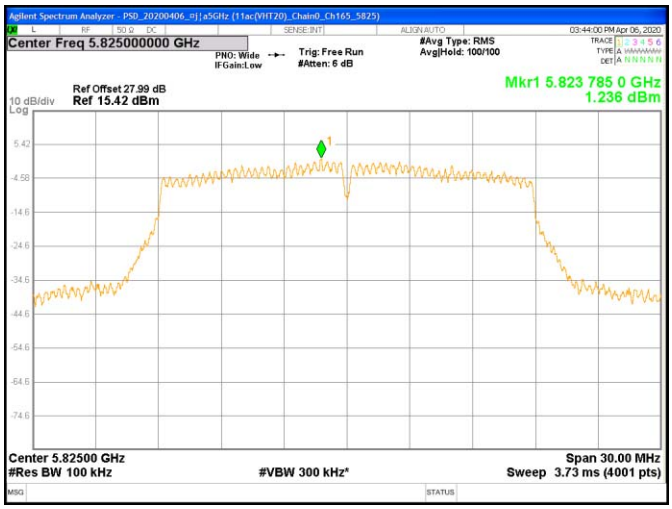
Chain0: Power Spectral Density @ 802.11ac(VHT20) Mode Ch149



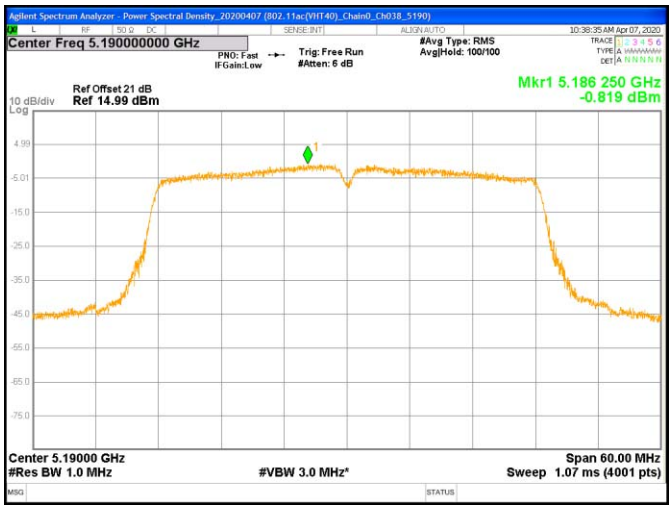
Chain0: Power Spectral Density @ 802.11ac(VHT20) Mode Ch157



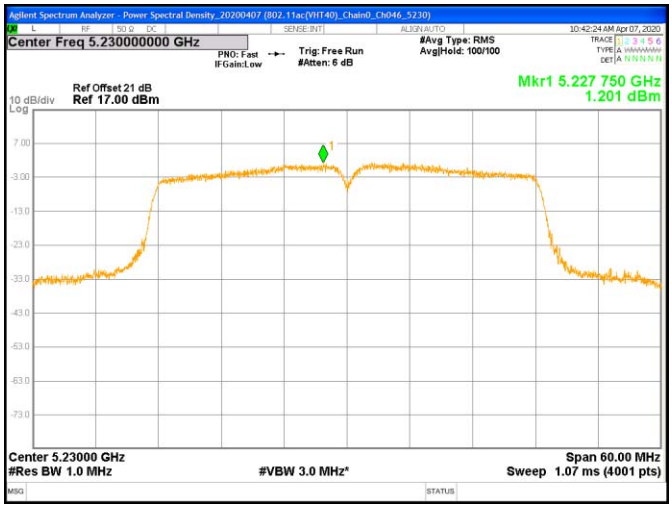
Chain0: Power Spectral Density @ 802.11ac(VHT20) Mode Ch165



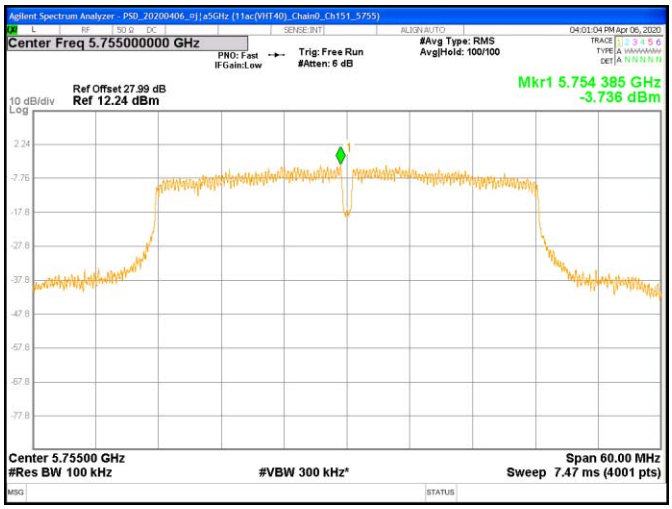
Chain0: Power Spectral Density @ 802.11ac(VHT40) Mode Ch038



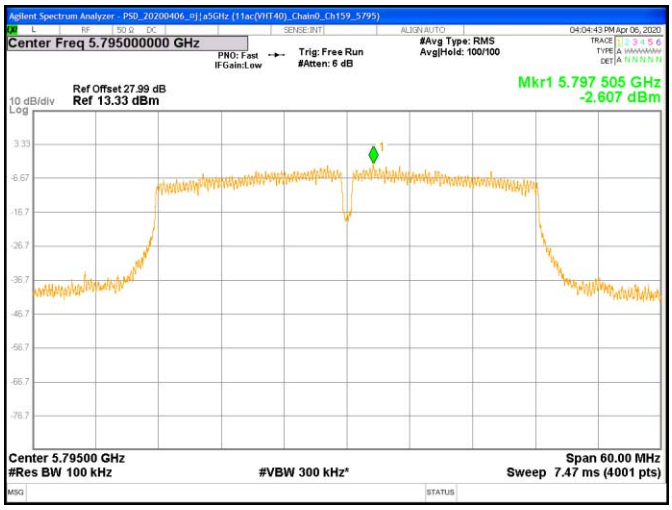
Chain0: Power Spectral Density @ 802.11ac(VHT40) Mode Ch046



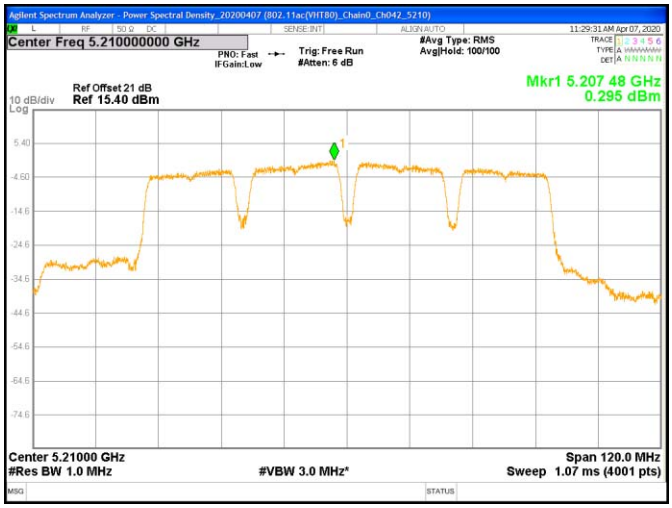
Chain0: Power Spectral Density @ 802.11ac(VHT40) Mode Ch151



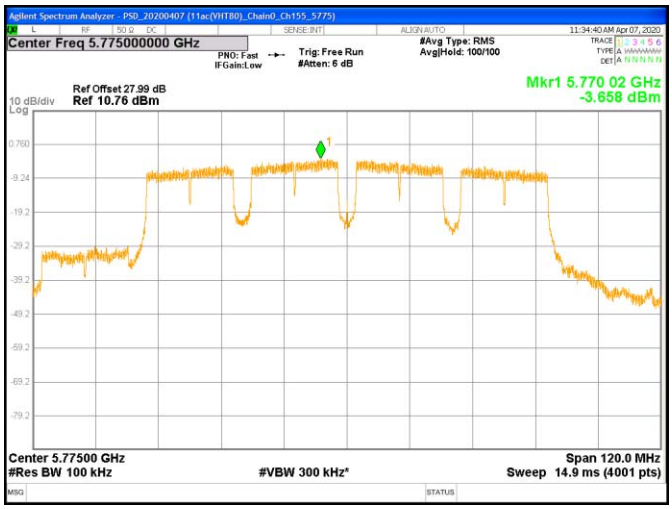
Chain0: Power Spectral Density @ 802.11ac(VHT40) Mode Ch159



Chain0: Power Spectral Density @ 802.11ac(VHT80) Mode Ch042



Chain0: Power Spectral Density @ 802.11ac(VHT80) Mode Ch155



4. Minimum Bandwidth

4.1 Operating environment

Temperature:	21	℃
Relative Humidity:	53	%
Requirement & Test method	15.407(a)(5) 15.407(e) KDB 789033 D02 v02r01	

4.2 Limit for minimum emission bandwidth.

Within the 5.15-5.725 GHz, the 26 dB bandwidth is for reporting purpose only.
Within the 5.725-5.85 GHz, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

4.3 Measuring instrument setting

For 5.15-5.25 GHz

Spectrum analyzer settings	
Spectrum Analyzer function	**Setting**
Detector	Peak
RBW	Approximately 1% of the EBW
VBW	> RBW
Trace mode	Max hold

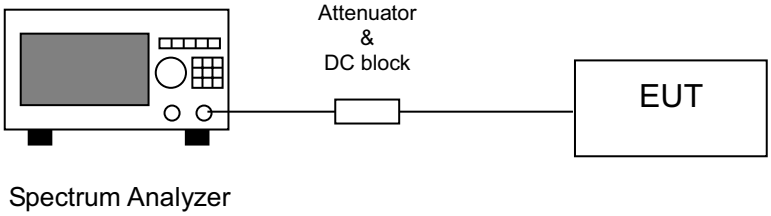
For 5.725-5.85 GHz

Spectrum analyzer settings	
Spectrum Analyzer function	**Setting**
Detector	Peak
RBW	100kHz
VBW	≧3 x RBW
Sweep	Auto couple
Trace mode	Max hold

4.4 Test procedure

1. The transmitter output was connected to the spectrum analyzer.
2. Test was performed in accordance with section C of KDB 789033 D02 v02r01.
3. For the 5.725-5.85 GHz, 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.
4. For the 5.15-5.25 GHz and 5.725-5.85 GHz, measure the maximum width of the emission that is 26 dB down from the maximum of the emission.

4.5 Test diagram



4.6 Test results

Mode	Channel	Frequency (MHz)	6dB Bandwidth (MHz)	26dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	36	5180		20.48	N/A	Pass
	44	5220		20.64		Pass
	48	5240		20.79		Pass
	149	5745	14.43		>0.5	Pass
	157	5785	14.65			Pass
	165	5825	16.30			Pass
802.11ac (VHT20)	36	5180		20.58	N/A	Pass
	44	5220		20.84		Pass
	48	5240		20.71		Pass
	149	5745	13.60		>0.5	Pass
	157	5785	15.13			Pass
	165	5825	15.11			Pass
802.11ac (VHT40)	38	5190		41.47	N/A	Pass
	46	5230		47.13		Pass
	151	5755	34.99		>0.5	Pass
	159	5795	35.04			Pass
802.11ac (VHT80)	42	5210		81.39	N/A	Pass
	155	5775	73.89		>0.5	Pass

Chain0: 6dB Bandwidth @ 802.11a Mode Ch149

Chain0: 6dB Bandwidth @ 802.11a Mode Ch157

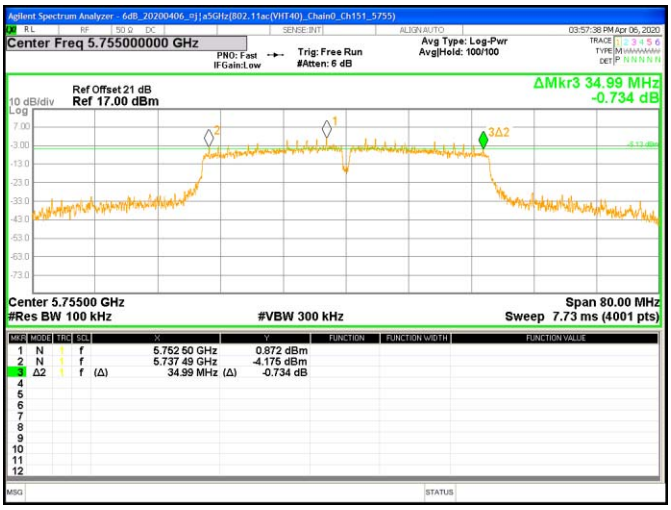
Chain0: 6dB Bandwidth @ 802.11a Mode Ch165

Chain0: 6dB Bandwidth @ 802.11ac(VHT20) Mode Ch149

Chain0: 6dB Bandwidth @ 802.11ac(VHT20) Mode Ch157

Chain0: 6dB Bandwidth @ 802.11ac(VHT20) Mode Ch165

Chain0: 6dB Bandwidth @ 802.11ac(VHT40) Mode Ch151



Chain0: 6dB Bandwidth @ 802.11ac(VHT40) Mode Ch159

Chain0: 6dB Bandwidth @ 802.11ac(VHT80) Mode Ch155

Chain0: Emission Bandwidth-26dB @ 802.11a Mode Ch36

Chain0: Emission Bandwidth-26dB @ 802.11a Mode Ch44

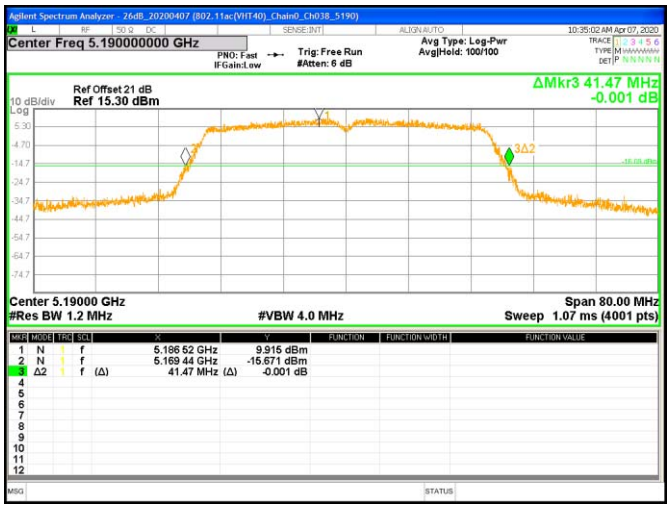
Chain0: Emission Bandwidth-26dB @ 802.11a Mode Ch48

Chain0: Emission Bandwidth-26dB @ 802.11ac(VHT20) Mode Ch36

Chain0: Emission Bandwidth-26dB @ 802.11ac(VHT20) Mode Ch44

Chain0: Emission Bandwidth-26dB @ 802.11ac(VHT20) Mode Ch48

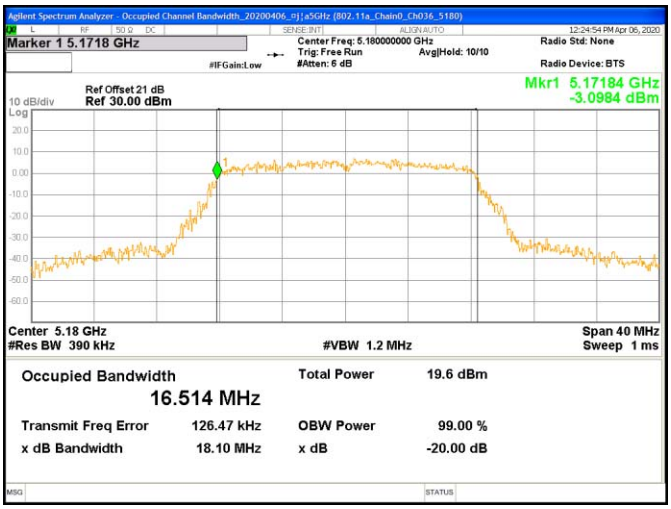
Chain0: Emission Bandwidth-26dB @ 802.11ac(VHT40) Mode Ch38



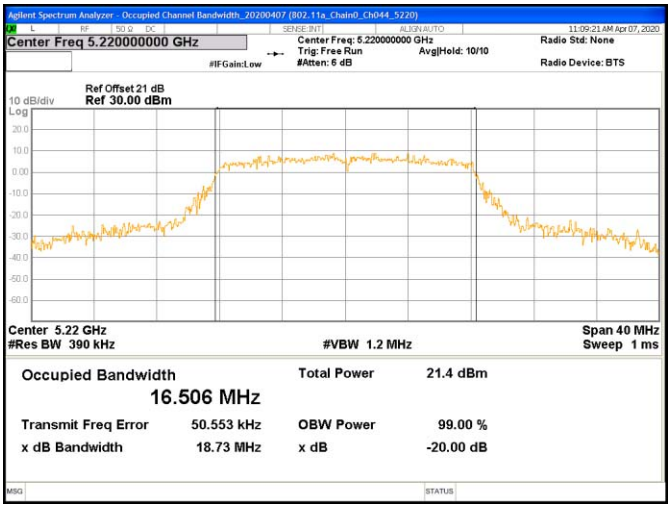
Chain0: Emission Bandwidth-26dB @ 802.11ac(VHT40) Mode Ch46

Chain0: Emission Bandwidth-26dB @ 802.11ac(VHT80) Mode Ch42

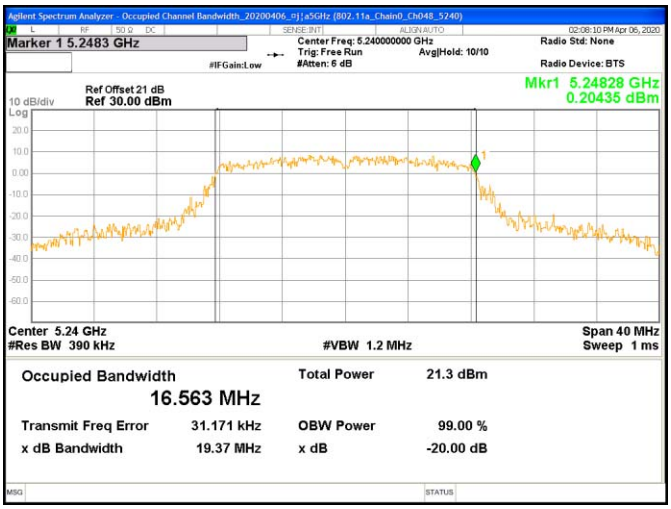
Chain0 : 99% OBW @ 802.11a Mode Ch036



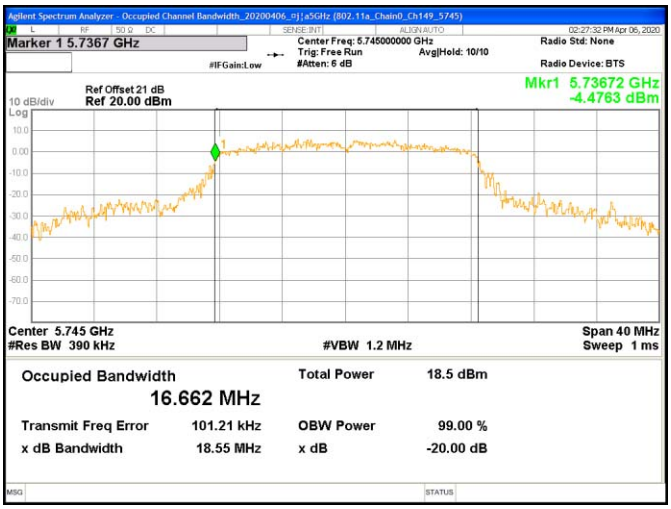
Chain0 : 99% OBW @ 802.11a Mode Ch044



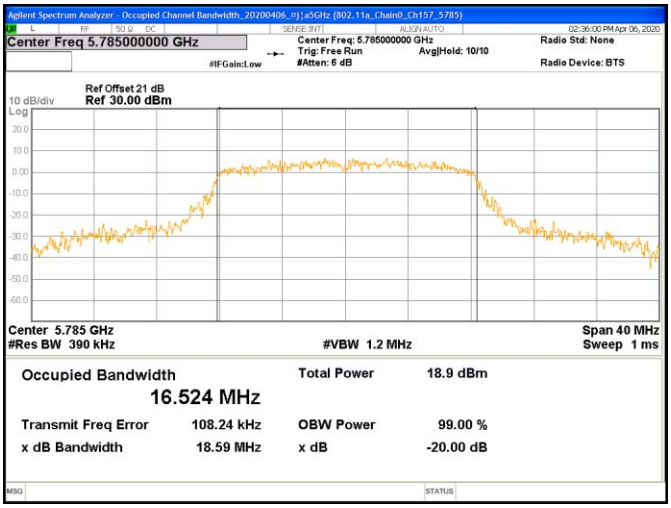
Chain0 : 99% OBW @ 802.11a Mode Ch048



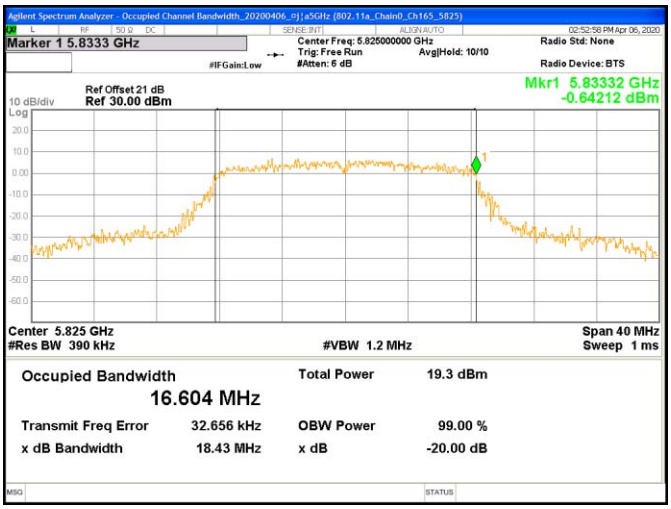
Chain0 : 99% OBW @ 802.11a Mode Ch149



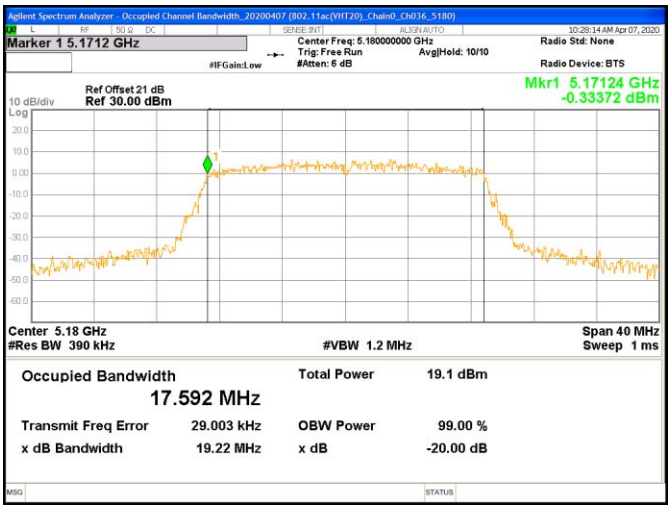
Chain0 : 99% OBW @ 802.11a Mode Ch157



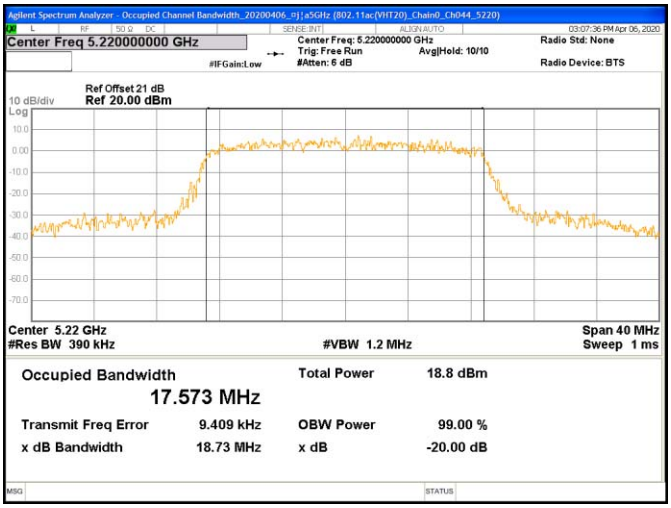
Chain0 : 99% OBW @ 802.11a Mode Ch165



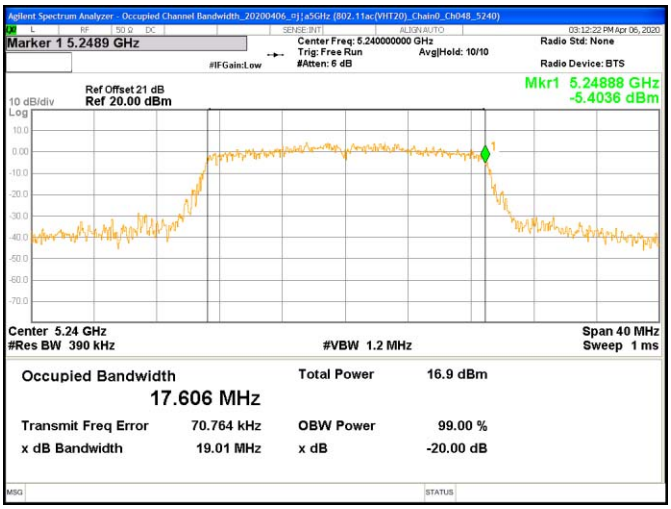
Chain0 : 99% OBW @ 802.11ac(VHT20) Mode Ch036



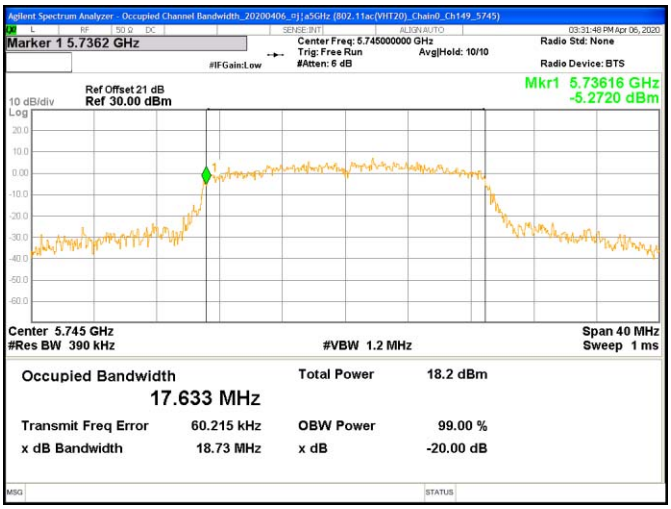
Chain0 : 99% OBW @ 802.11ac(VHT20) Mode Ch044



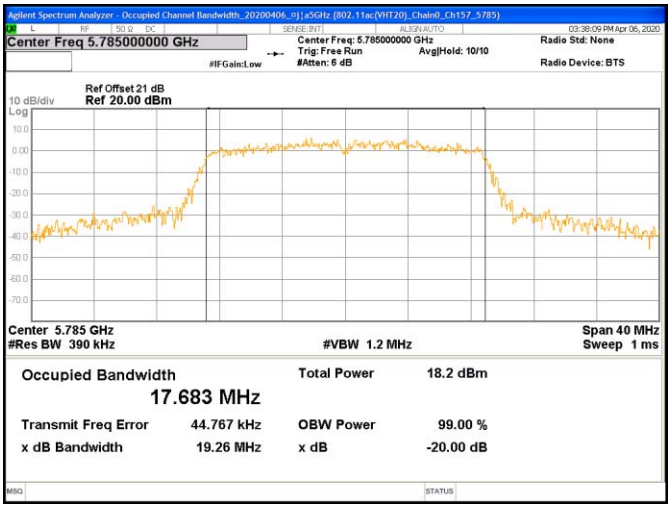
Chain0 : 99% OBW @ 802.11ac(VHT20) Mode Ch048



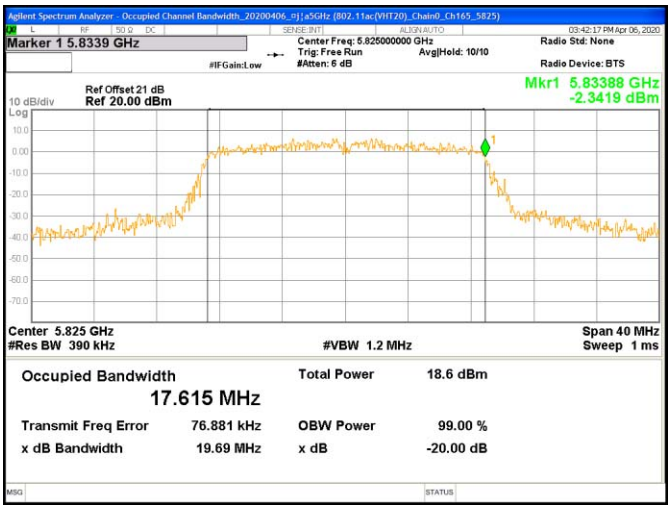
Chain0 : 99% OBW @ 802.11ac(VHT20) Mode Ch149



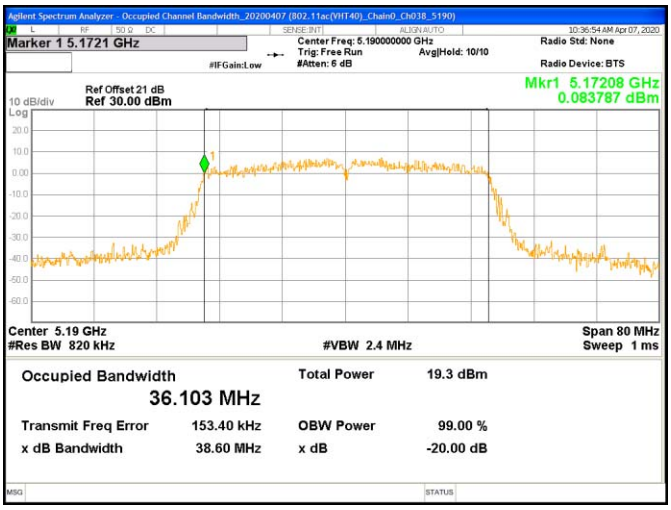
Chain0 : 99% OBW @ 802.11ac(VHT20) Mode Ch157



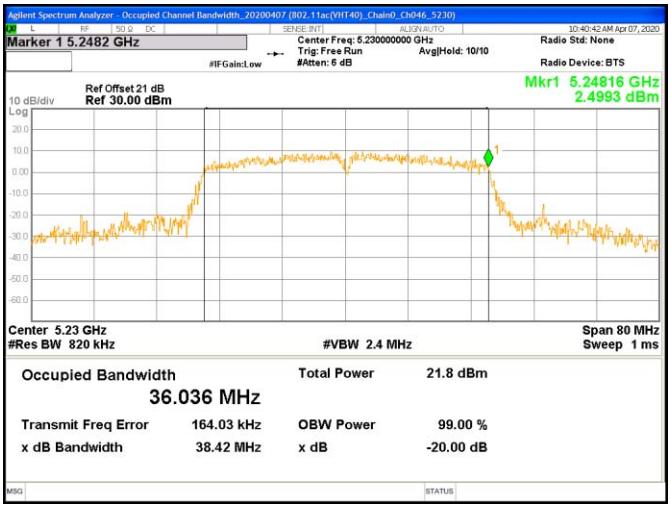
Chain0 : 99% OBW @ 802.11ac(VHT20) Mode Ch165



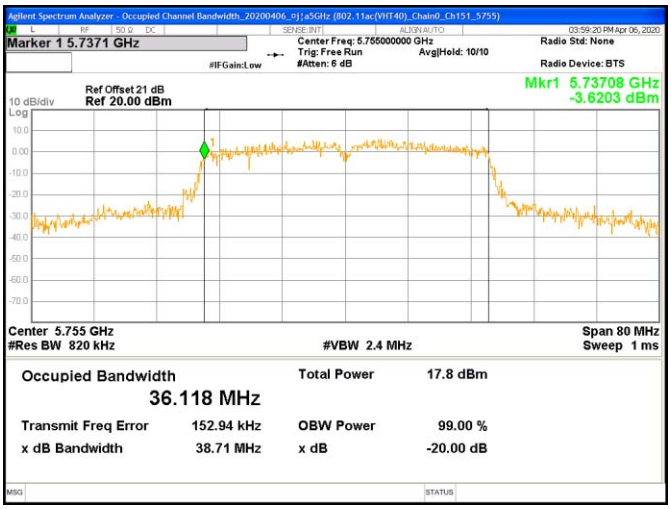
Chain0 : 99% OBW @ 802.11ac(VHT40) Mode Ch038



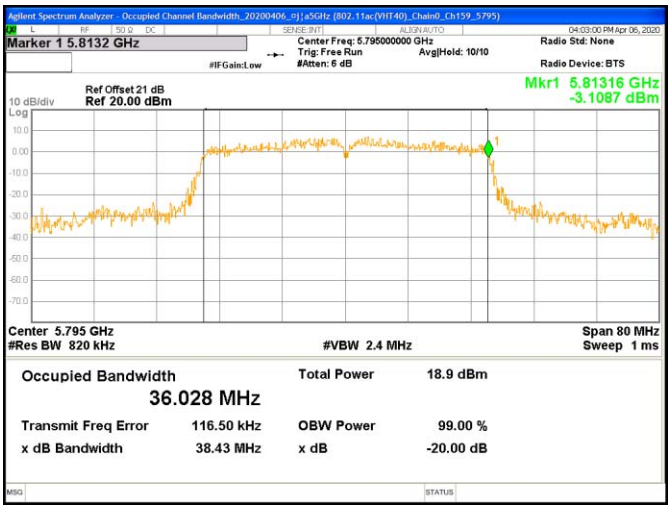
Chain0 : 99% OBW @ 802.11ac(VHT40) Mode Ch046



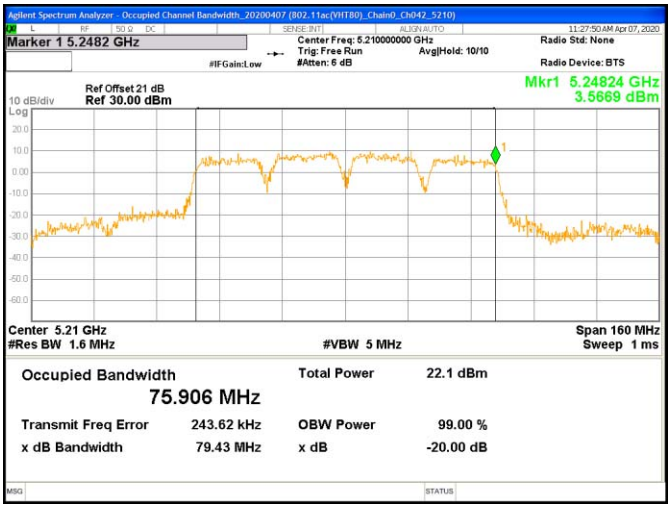
Chain0 : 99% OBW @ 802.11ac(VHT40) Mode Ch151



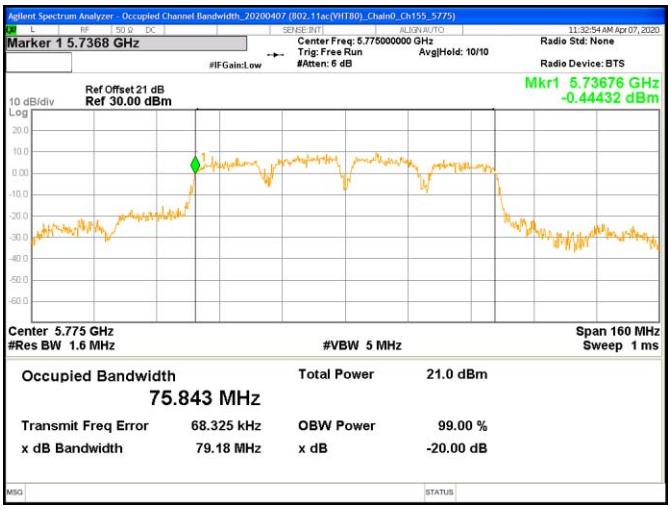
Chain0 : 99% OBW @ 802.11ac(VHT40) Mode Ch159



Chain0 : 99% OBW @ 802.11ac(VHT80) Mode Ch042



Chain0 : 99% OBW @ 802.11ac(VHT80) Mode Ch155



5. Emissions in Restricted Frequency Bands (Radiated emission measurements)

5.1 Operating environment

Temperature:	23	℃
Relative Humidity:	57	%

5.2 Limit for emission in restricted frequency bands (Radiated emission measurement)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	2400/F(kHz)	30
1.705~30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

As specified in 15.407(b), 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 e.i.r.p. of −27 dBm/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 e.i.r.p. of −27 dBm/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 e.i.r.p. of −27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:
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.

However, an out-of-band emission that complies with both the average and peak limits of 15.209 is not required to satisfy the -27 dBm/MHz or -17 dBm/MHz peak emission limit.

5.3 Measuring instrument setting

Below 1GHz measurement

Receiver settings	
Receiver function	**Setting**
Detector	QP
RBW	9-150 kHz ; 200-300 Hz 0.15-30 MHz; 9-10 kHz 30-1000 MHz; 100-120 kHz
VBW	≧3 x RBW
Sweep	Auto couple
Attenuation	Auto

Above 1GHz measurement

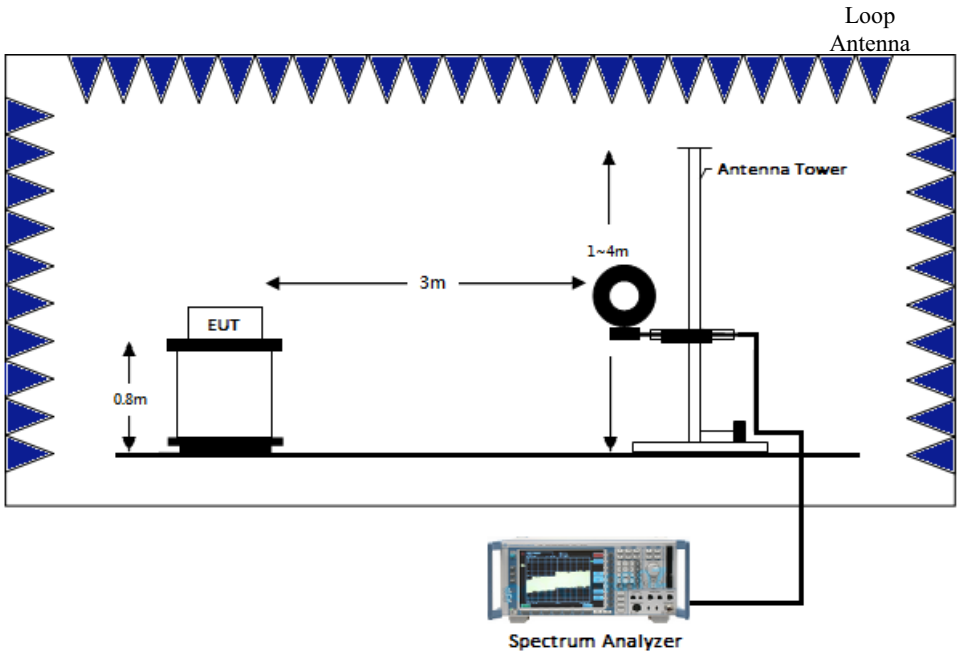
Spectrum analyzer settings	
Spectrum Analyzer function	**Setting**
Detector	Peak
RBW	1MHz
VBW	3MHz for Peak; 10Hz for Average
Sweep	Auto couple
Start Frequency	1GHz
Stop Frequency	Tenth harmonic
Attenuation	Auto

5.4 Test procedure

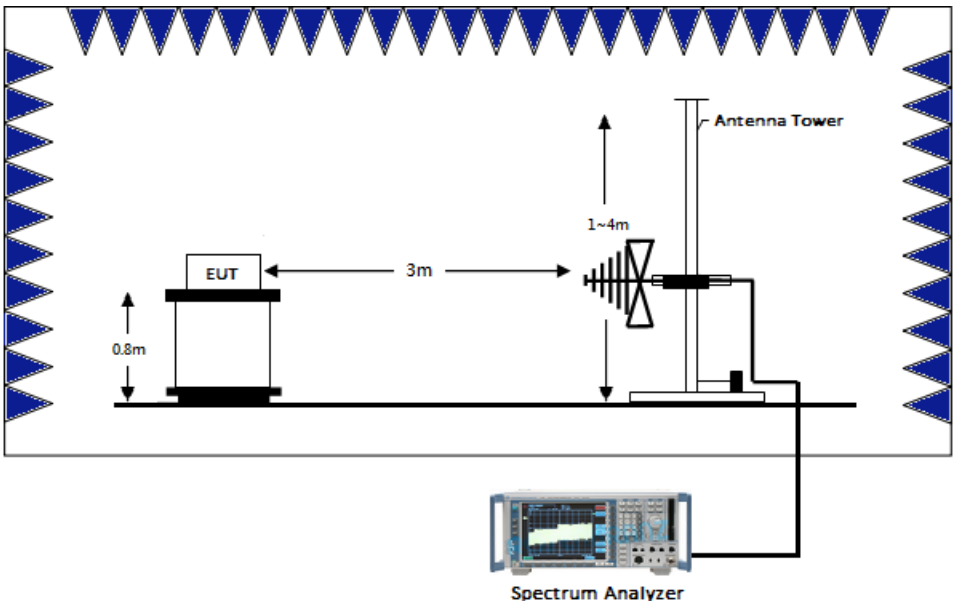
1. Configure the EUT according to ANSI C63.10: 2013 The EUT was placed on the top of the turntable 1.5 meter above ground for above 1GHz and placed on the top of the turntable 0.8 meter above ground for below 1GHz. The center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the companion devices. The turntable was rotated by 360 degree to find the position of the maximum emission level.
3. The height of the receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of the both horizontal and vertical polarization
4. If find the frequencies above the limit or below within 3dB, the antenna tower was scan (from 1m to 4m) and then the turntable was rotated to find the maximum reading.
5. Set the test-receiver system to peak or CISPR quasi-peak detector with specified bandwidth under maximum hold mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
   Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.
7. If the emissions level of the EUT in peak mode was 3dB lower than the average limit specified then testing will be stopped and peak values of the EUT will be reported. Otherwise, the emissions which do not have 3dB margin will be measured using the quasi-peak method for below 1GHz.
8. For testing above 1GHz, The emissions level of the EUT in peak mode was lower than average limit, then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported.
9. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be quasi-peak measured by receiver.

5.5 Test configuration

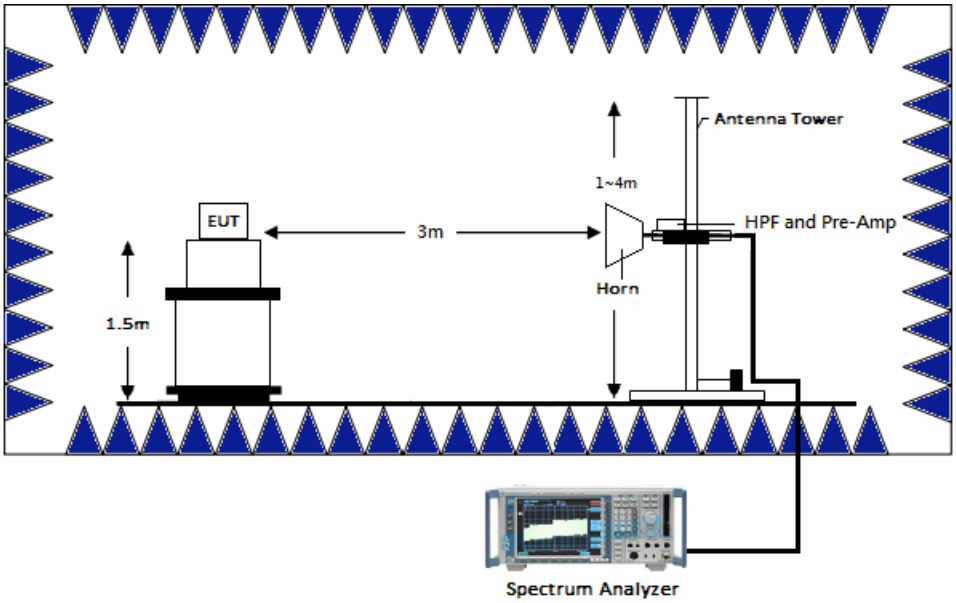
5.5.1 Radiated emission from 9 kHz to 30MHz using Loop Antenna



5.5.2 Radiated emission below 1GHz using Bilog Antenna



5.5.3 Radiated emission above 1GHz using Horn Antenna



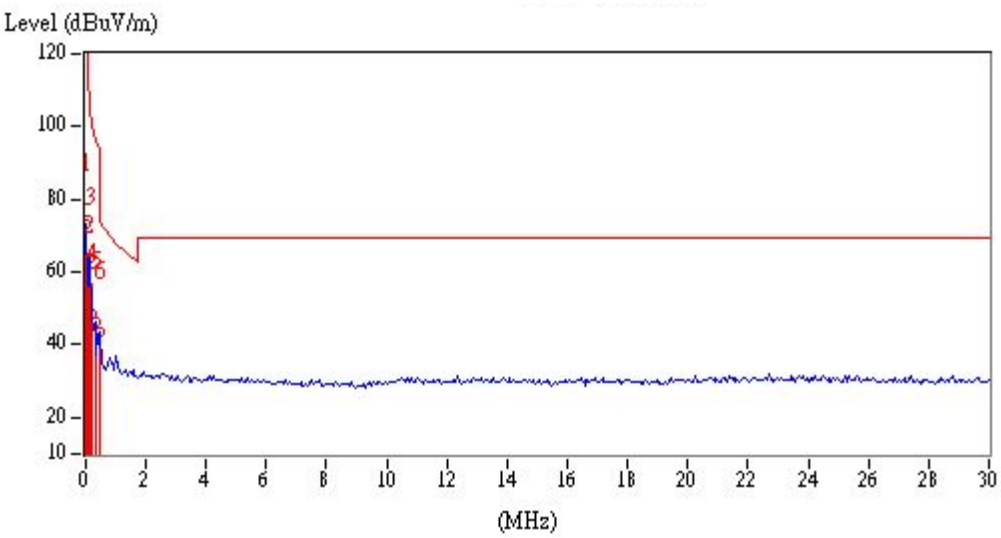
5.6 Test results

5.6.1 Measurement results: frequencies from 9 kHz to 30MHz

The test was performed on EUT under 802.11a/ac continuously transmitting mode. The worst case occurred at 802.11ac(VHT20) Channel 48.

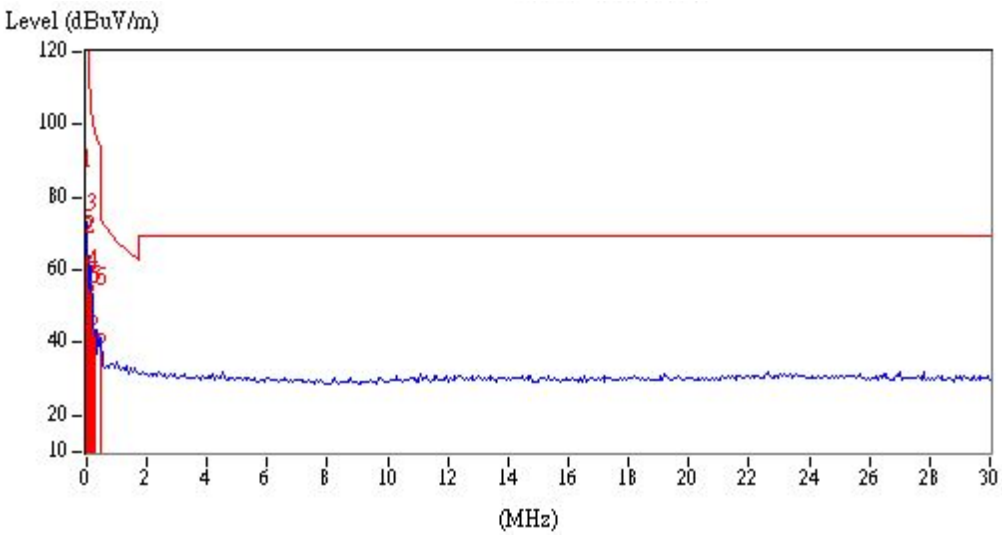
Ant Polarity	Frequency (MHz)	Detector	Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3m (dBμV/m)	Margin (dB)
Perpendicular	0.01	AV	18.38	54.65	73.03	127.60	-54.57
Perpendicular	0.07	AV	18.55	37.84	56.39	110.70	-54.31
Perpendicular	0.13	AV	18.33	45.75	64.08	105.33	-41.25
Perpendicular	0.19	AV	18.36	30.18	48.54	102.03	-53.49
Perpendicular	0.31	AV	18.43	27.68	46.11	97.78	-51.67
Perpendicular	0.49	AV	18.52	24.87	43.39	93.80	-50.41

Remark: Corr. Factor = Antenna Factor + Cable Loss



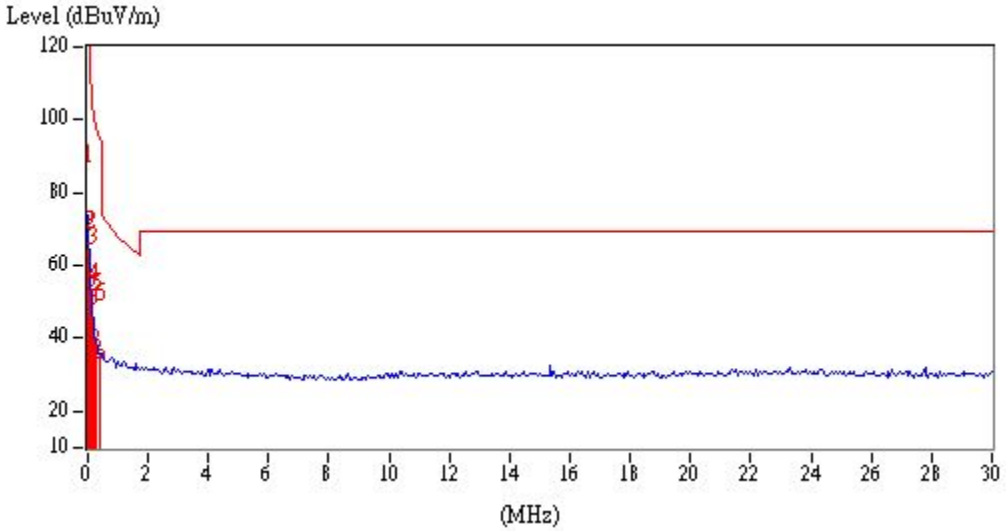
Ant Polarity	Frequency (MHz)	Detector	Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)
Parallel	0.01	AV	18.38	55.11	73.49	127.60	-54.11
Parallel	0.07	AV	18.55	36.81	55.36	110.70	-55.34
Parallel	0.13	AV	18.33	43.06	61.39	105.33	-43.94
Parallel	0.19	AV	18.36	28.02	46.38	102.03	-55.65
Parallel	0.25	AV	18.39	23.67	42.06	99.65	-57.59
Parallel	0.49	AV	18.52	22.70	41.22	93.80	-52.58

Remark: Corr. Factor = Antenna Factor + Cable Loss



Ant Polarity	Frequency (MHz)	Detector	Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)
Ground-parallel	0.04	AV	18.38	55.60	73.98	115.56	-41.58
Ground-parallel	0.07	AV	18.55	37.10	55.65	110.70	-55.05
Ground-parallel	0.31	AV	18.33	32.64	50.97	97.78	-46.81
Ground-parallel	0.19	AV	18.36	23.09	41.45	102.03	-60.58
Ground-parallel	0.25	AV	18.39	20.03	38.42	99.65	-61.23
Ground-parallel	0.43	AV	18.49	17.35	35.84	94.93	-59.09

Remark: Corr. Factor = Antenna Factor + Cable Loss



5.6.2 Measurement results: frequencies from 30 MHz to 1GHz

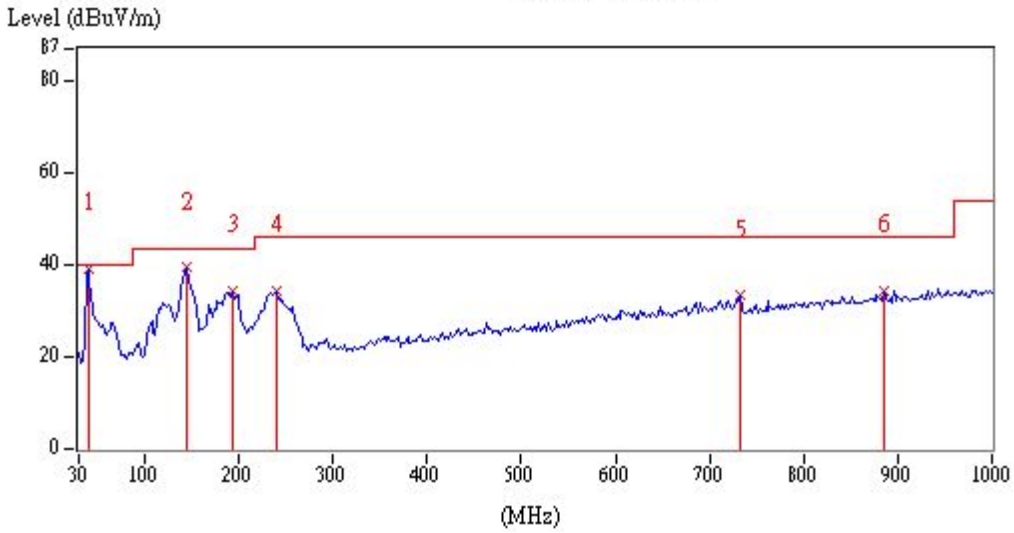
The test was performed on EUT under 802.11a/ac continuously transmitting mode. The worst case occurred at 802.11ac(VHT20) Channel 48.

Antenna Polariz. (V/H)	Freq. (MHz)	Receiver Detector	Corr. Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
Vertical	39.70	QP	19.78	19.47	39.25	40.00	-0.75
Vertical	144.46	QP	20.19	19.29	39.48	43.50	-4.02
Vertical	192.96	QP	18.05	16.46	34.51	43.50	-8.99
Vertical	239.52	QP	20.41	14.01	34.42	46.00	-11.58
Vertical	732.28	QP	30.51	2.87	33.38	46.00	-12.62
Vertical	885.54	QP	32.57	1.83	34.40	46.00	-11.60
Horizontal	70.74	QP	18.15	12.38	30.53	40.00	-9.47
Horizontal	119.24	QP	17.73	19.33	37.06	43.50	-6.44
Horizontal	196.84	QP	17.95	18.50	36.45	43.50	-7.05
Horizontal	245.34	QP	20.53	15.74	36.27	46.00	-9.73
Horizontal	291.90	QP	21.53	10.91	32.44	46.00	-13.56
Horizontal	344.28	QP	22.79	8.21	31.00	46.00	-15.00

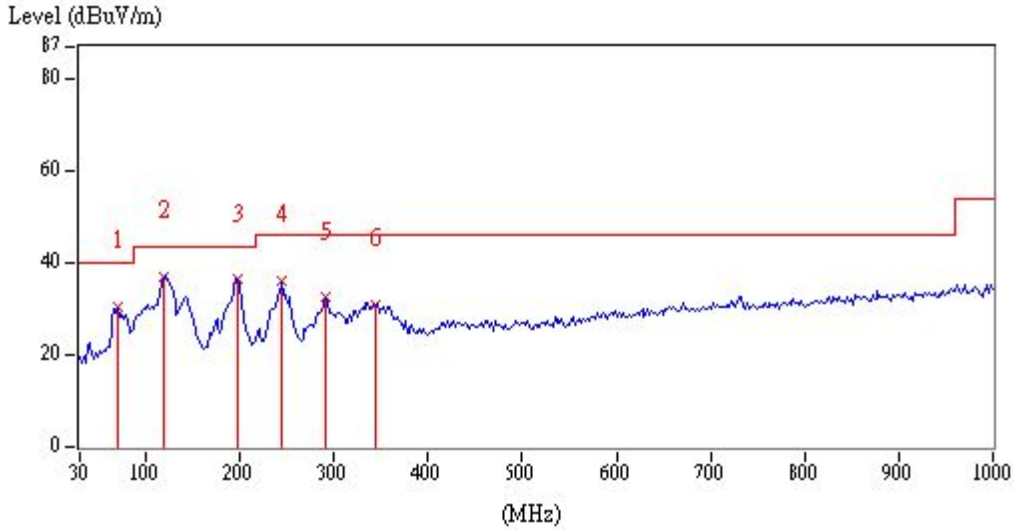
Remark:

1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor

Vertical



Horizontal



5.6.3 Measurement results: frequency above 1GHz to 40GHz

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)
802.11a_Ch36	10360	PK	V	21.33	39.37	60.70	74.00	-13.30
	10360	AV	V	21.33	27.35	48.68	54.00	-5.32
	10360	PK	H	21.33	33.81	55.14	74.00	-18.86
	10360	AV	H	21.33	23.29	44.62	54.00	-9.38
802.11a_Ch44	10440	PK	V	21.77	40.29	62.06	74.00	-11.94
	10440	AV	V	21.77	31.19	52.96	54.00	-1.04
	10440	PK	H	21.77	35.12	56.89	74.00	-17.11
	10440	AV	H	21.77	25.82	47.59	54.00	-6.41
802.11a_Ch48	10480	PK	V	21.98	42.21	64.19	74.00	-9.81
	10480	AV	V	21.98	31.10	53.08	54.00	-0.92
	10480	PK	H	21.98	30.43	52.41	74.00	-21.59
802.11a_Ch149	11490	PK	V	23.23	24.45	47.68	74.00	-26.32
	11490	PK	H	23.23	25.26	48.49	74.00	-25.51
802.11a_Ch157	11570	PK	V	22.96	27.79	50.75	74.00	-23.25
	11570	PK	H	22.96	26.00	48.96	74.00	-25.04
802.11a_Ch165	11650	PK	V	22.66	35.47	58.13	74.00	-15.87
	11650	AV	V	22.66	23.04	45.70	54.00	-8.30
	11650	PK	H	22.66	29.16	51.82	74.00	-22.18
802.11ac(VHT20) Ch36	10360	PK	V	21.33	38.92	60.25	74.00	-13.75
	10360	AV	V	21.33	29.28	50.61	54.00	-3.39
	10360	PK	H	21.33	35.04	56.37	74.00	-17.63
	10360	AV	H	21.33	24.54	45.87	54.00	-8.13
802.11ac(VHT20) Ch44	10440	PK	V	21.77	42.87	64.64	74.00	-9.36
	10440	AV	V	21.77	31.19	52.96	54.00	-1.04
	10440	PK	H	21.77	37.27	59.04	74.00	-14.96
	10440	AV	H	21.77	27.47	49.24	54.00	-4.76
802.11ac(VHT20) Ch48	10480	PK	V	21.98	38.59	60.57	74.00	-13.43
	10480	AV	V	21.98	27.73	49.71	54.00	-4.29
	10480	PK	H	21.98	34.77	56.75	74.00	-17.25
	10480	AV	H	21.98	22.97	44.95	54.00	-9.05
802.11ac(VHT20) Ch149	11490	PK	V	23.23	40.28	63.51	74.00	-10.49
	11490	AV	V	23.23	27.29	50.52	54.00	-3.48
	11490	PK	H	23.23	33.92	57.15	74.00	-16.85
	11490	AV	H	23.23	22.22	45.45	54.00	-8.55

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)
802.11ac(VHT20) Ch157	11570	PK	V	22.96	39.44	62.40	74.00	-11.60
	11570	AV	V	22.96	28.83	51.79	54.00	-2.21
	11570	PK	H	22.96	34.95	57.91	74.00	-16.09
	11570	AV	H	22.96	22.65	45.61	54.00	-8.39
802.11ac(VHT20) Ch165	11650	PK	V	22.66	38.94	61.60	74.00	-12.40
	11650	AV	V	22.66	29.10	51.76	54.00	-2.24
	11650	PK	H	22.66	34.60	57.26	74.00	-16.74
	11650	AV	H	22.66	23.91	46.57	54.00	-7.43
802.11ac(VHT40) Ch38	10380	PK	V	21.44	43.13	64.57	74.00	-9.43
	10380	AV	V	21.44	27.46	48.90	54.00	-5.10
	10380	PK	H	21.44	36.59	58.03	74.00	-15.97
	10380	AV	H	21.44	25.55	46.99	54.00	-7.01
802.11ac(VHT40) Ch46	10460	PK	V	21.87	44.19	66.06	74.00	-7.94
	10460	AV	V	21.87	31.02	52.89	54.00	-1.11
	10460	PK	H	21.87	39.33	61.20	74.00	-12.80
	10460	AV	H	21.87	27.28	49.15	54.00	-4.85
802.11ac(VHT40) Ch151	11510	PK	V	23.18	34.39	57.57	74.00	-16.43
	11510	AV	V	23.18	22.68	45.86	54.00	-8.14
	11510	PK	H	23.18	32.13	55.31	74.00	-18.69
	11510	AV	H	23.18	19.81	42.99	54.00	-11.01
802.11ac(VHT40) Ch159	11590	PK	V	22.88	37.03	59.91	74.00	-14.09
	11590	AV	V	22.88	25.71	48.59	54.00	-5.41
	11590	PK	H	22.88	31.38	54.26	74.00	-19.74
	11590	AV	H	22.88	20.76	43.64	54.00	-10.36
802.11ac(VHT80) Ch42	10420	PK	V	21.66	41.42	63.08	74.00	-10.92
	10420	AV	V	21.66	22.85	44.51	54.00	-9.49
	10420	PK	H	21.66	36.25	57.91	74.00	-16.09
	10420	AV	H	21.66	20.49	42.15	54.00	-11.85
802.11ac(VHT80) Ch155	11550	PK	V	23.03	34.68	57.71	74.00	-16.29
	11550	AV	V	23.03	20.40	43.43	54.00	-10.57
	11550	PK	H	23.03	30.14	53.17	74.00	-20.83
	11550	AV	H	23.03	16.44	39.47	54.00	-14.53

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

6. Emission on The Band Edge

6.1 Operating environment

Temperature:	21	℃
Relative Humidity:	56	%
Requirement	15.407(b), 15.205	

6.2 Measuring instrument setting

Spectrum analyzer settings	
Spectrum Analyzer function	**Setting**
Detector	Peak
RBW	1MHz
VBW	3MHz for Peak; 10Hz for Average
Sweep	Auto couple
Restrict bands	4500~5150MHz
	5350 ~5460MHz
Attenuation	Auto

Applicable to	Limit
	EIRP Limit (dBm)
5725-5850MHz	PK
	-27~27

6.3 Test procedure

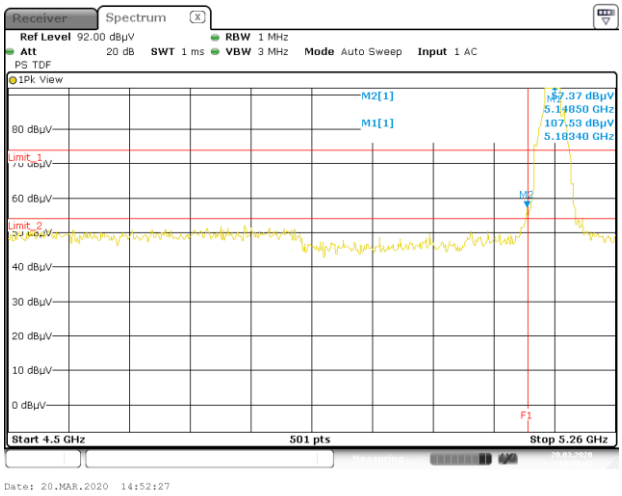
The test procedure is the same as clause 5.4

6.4 Test Result

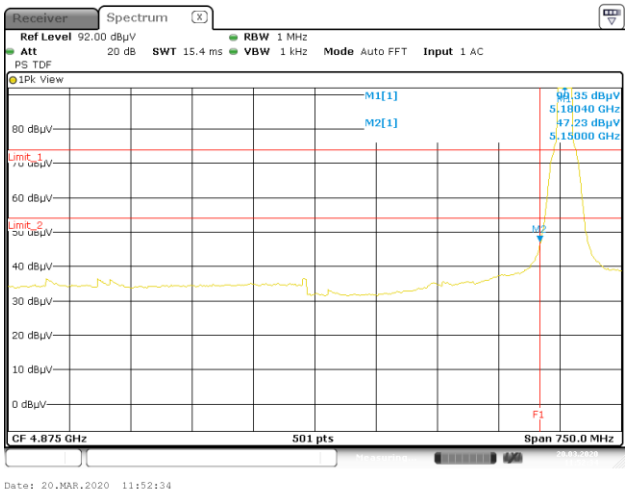
Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)	Restricted band (MHz)
802.11a	5148.50	PK	V	4.45	52.92	57.37	74	-16.63	4500~5150
	5150.00	AV	V	4.45	42.78	47.23	54	-6.77	
	5352.64	PK	V	4.46	42.03	46.49	74	-27.51	5350~5460
	5352.03	AV	V	4.46	31.73	36.19	54	-17.81	
802.11ac (VHT20)	5148.50	PK	V	4.45	55.56	60.01	74	-13.99	4500~5150
	5150.00	AV	V	4.45	40.82	45.27	54	-8.73	
	5399.67	PK	V	4.46	45.35	49.81	74	-24.19	5350~5460
	5351.41	AV	V	4.46	32.29	36.75	54	-17.25	
802.11ac (VHT40)	5150.00	PK	V	4.45	55.85	60.30	74	-13.70	4500~5150
	5150.00	AV	V	4.45	43.48	47.93	54	-6.07	
	5444.84	PK	V	4.46	41.96	46.42	74	-27.58	5350~5460
	5444.84	AV	V	4.46	30.64	35.10	54	-18.90	
802.11ac (VHT80)	5149.10	PK	V	4.45	64.67	69.12	74	-4.88	4500~5150
	5150.00	AV	V	4.45	48.99	53.44	54	-0.56	
	5452.88	PK	V	4.46	40.49	44.95	74	-29.05	5350~5460
	5446.08	AV	V	4.46	30.28	34.74	54	-19.26	

Remark: Correction Factor = Antenna Factor + Cable Loss – Pre Amplifier Gain

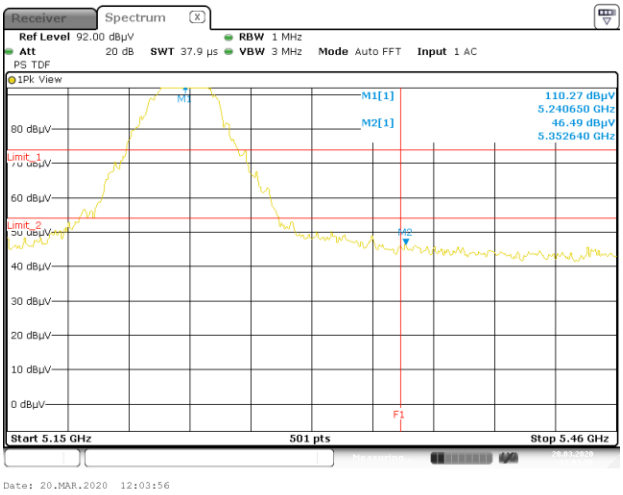
Restricted Band Bandedge @ 802.11a Mode Ch36 PK



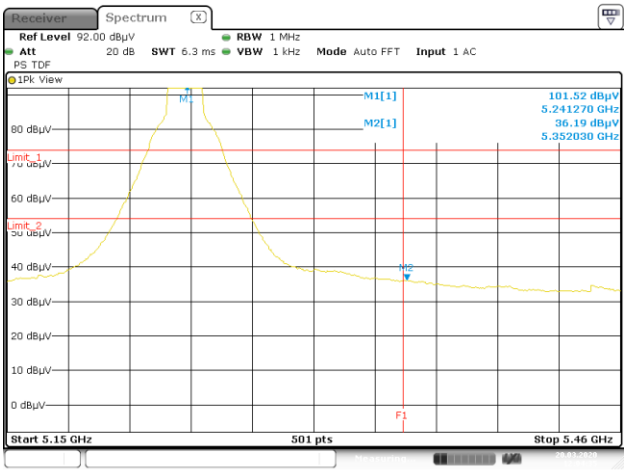
Restricted Band Bandedge @ 802.11a Mode Ch36 AV



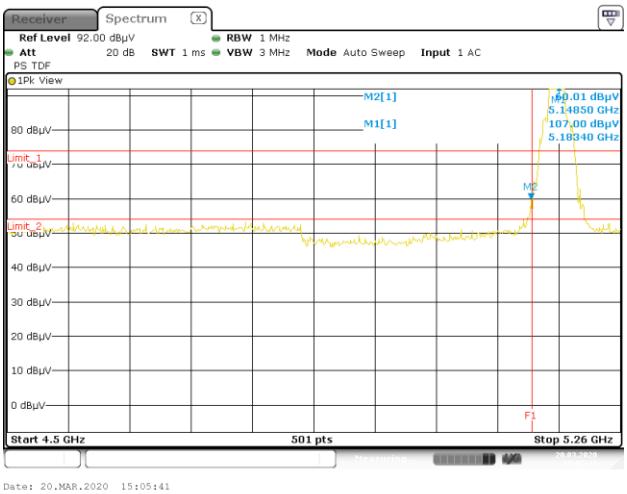
Restricted Band Bandedge @ 802.11a Mode Ch48 PK



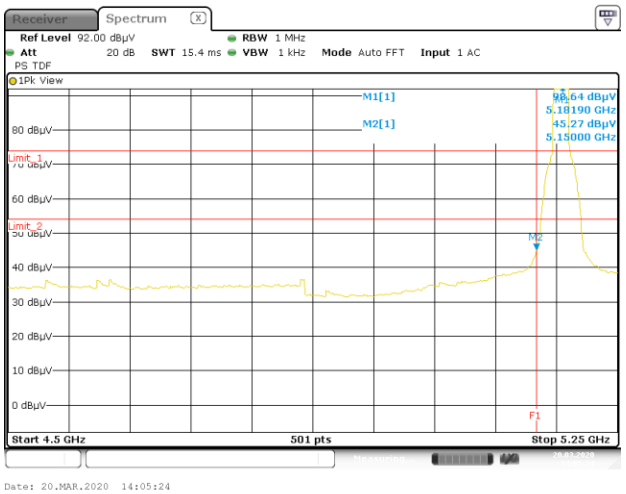
Restricted Band Bandedge @ 802.11a Mode Ch48 AV



Restricted Band Bandedge @ 802.11ac(VHT20) Mode Ch36 PK



Restricted Band Bandedge @ 802.11ac(VHT20) Mode Ch36 AV



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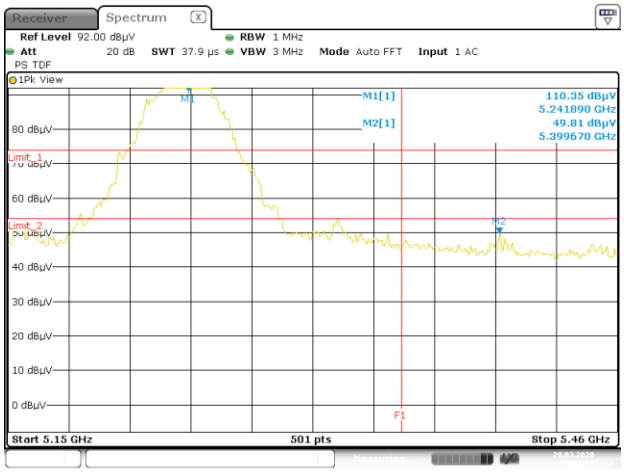
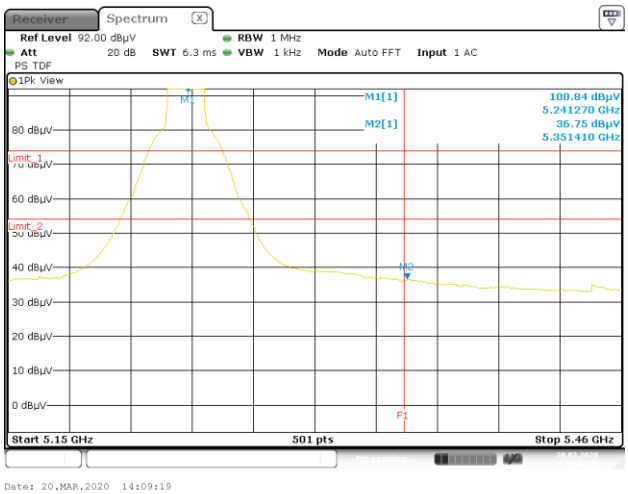
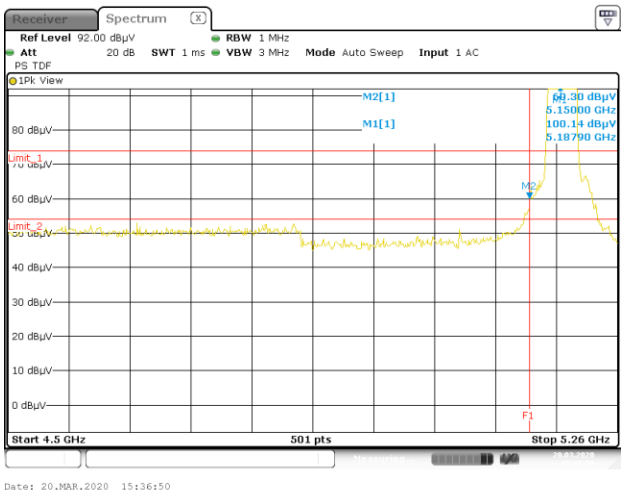


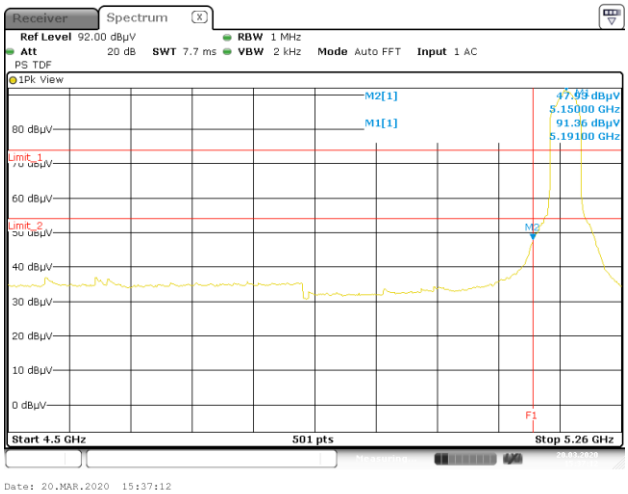
Restricted Band Bandedge @ 802.11ac(VHT20) Mode Ch48 AV



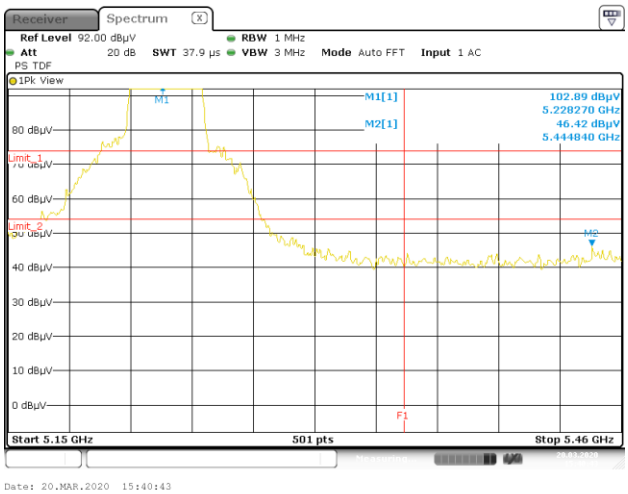
Restricted Band Bandedge @ 802.11ac(VHT40) Mode Ch38 PK



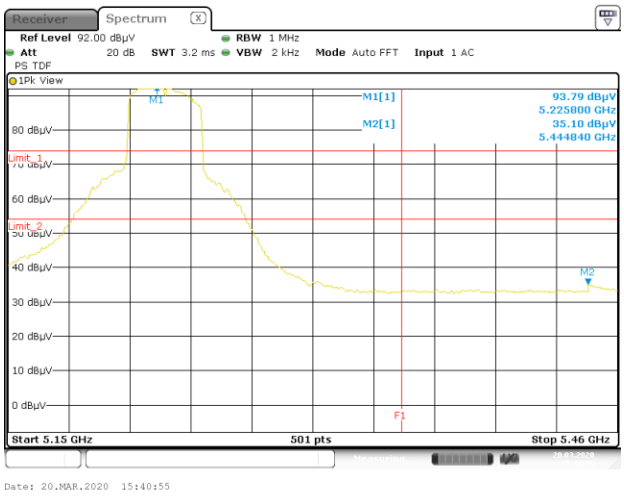
Restricted Band Bandedge @ 802.11ac(VHT40) Mode Ch38 AV



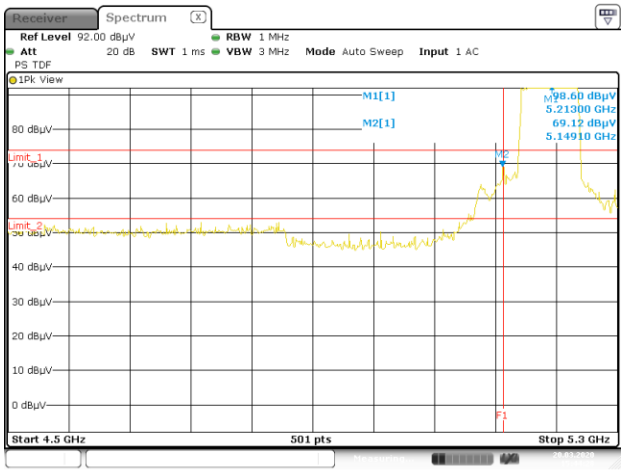
Restricted Band Bandedge @ 802.11ac(VHT40) Mode Ch46 PK



Restricted Band Bandedge @ 802.11ac(VHT40) Mode Ch46 AV

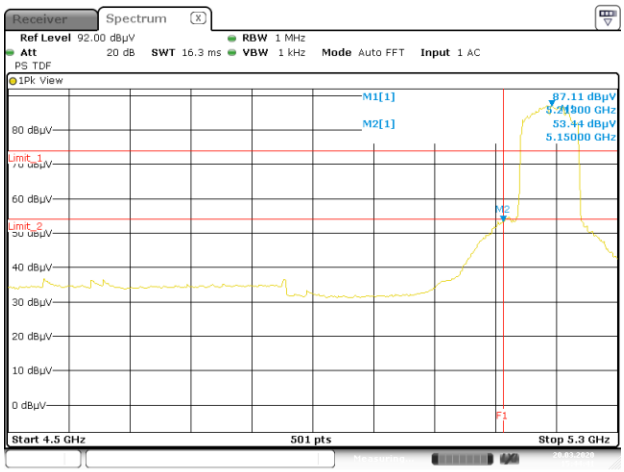


Restricted Band Bandedge @ 802.11ac(VHT80) Mode Ch42 PK



Date: 20.MAR.2020 15:44:29

Restricted Band Bandedge @ 802.11ac(VHT80) Mode Ch42 AV



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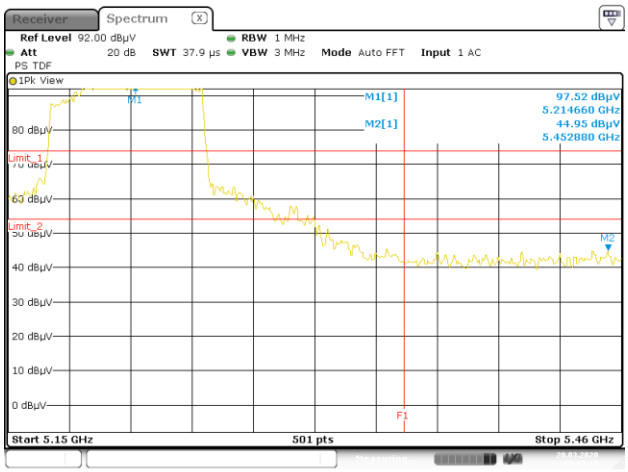

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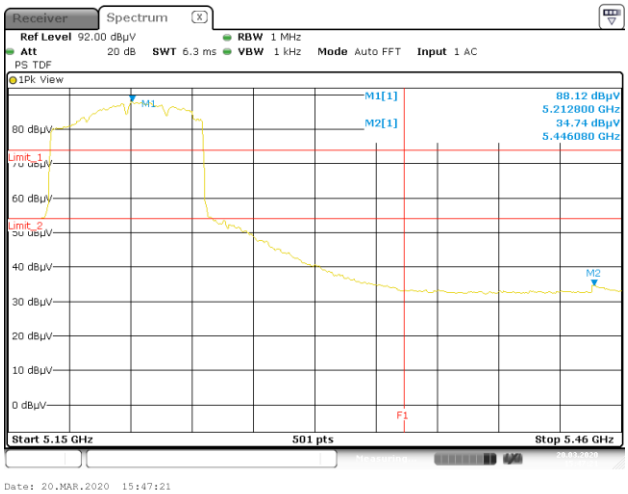
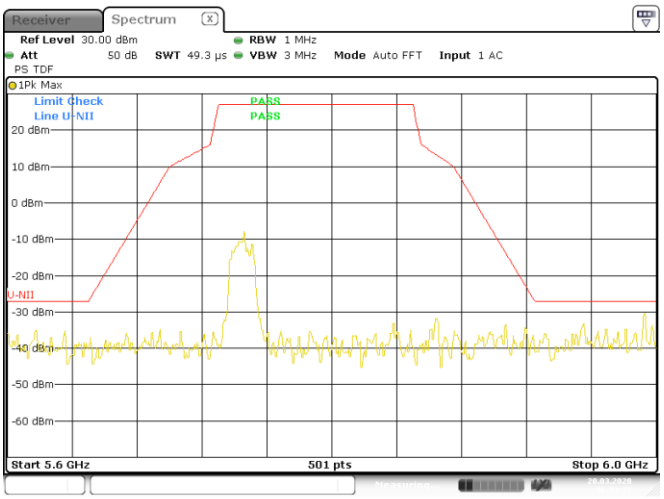
Restricted Band Bandedge @ 802.11ac(VHT80) Mode Ch42 AV

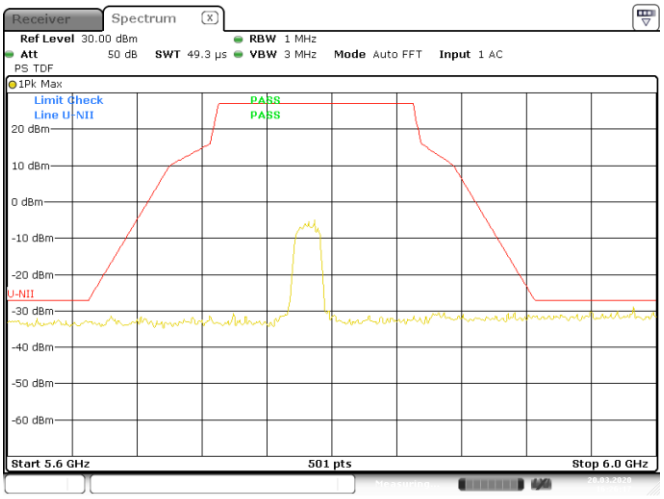


Out-of-band emission limits for U-NII-3 @ mode 802.11a Ch149



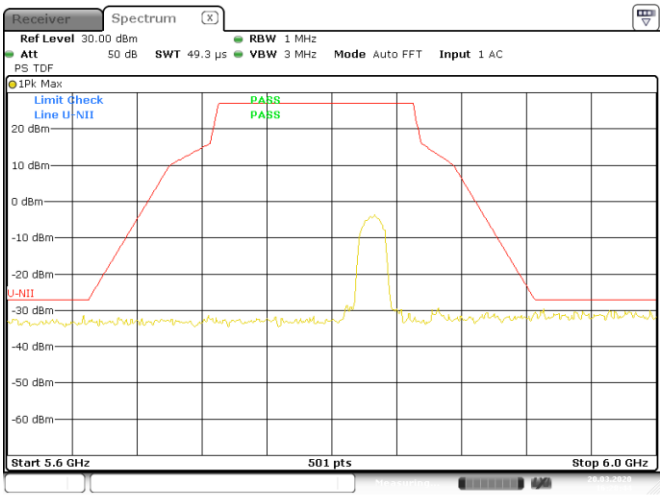
Date: 20.MAR.2020 16:23:25

Out-of-band emission limits for U-NII-3 @ mode 802.11a Ch157



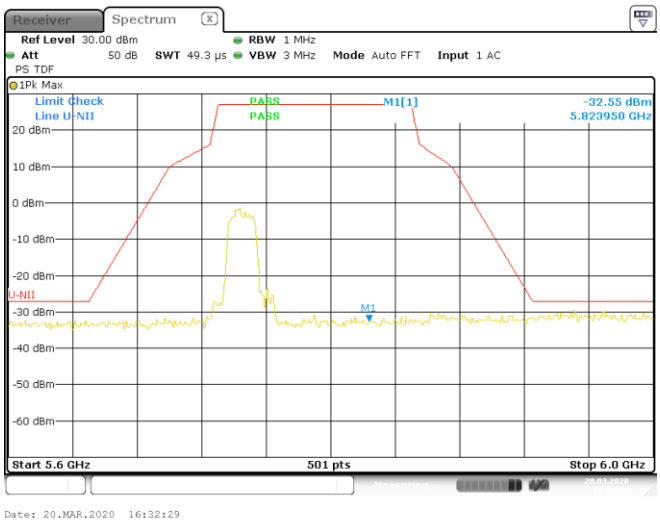
Date: 20.MAR.2020 16:26:17

Out-of-band emission limits for U-NII-3 @ mode 802.11a Ch165

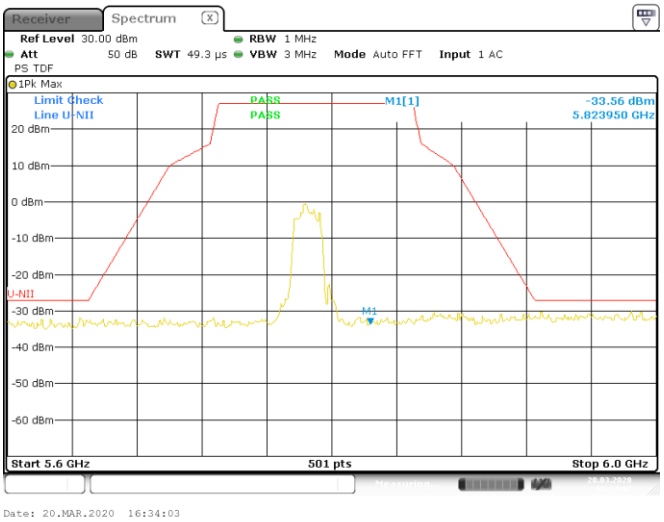


Date: 20.MAR.2020 16:28:44

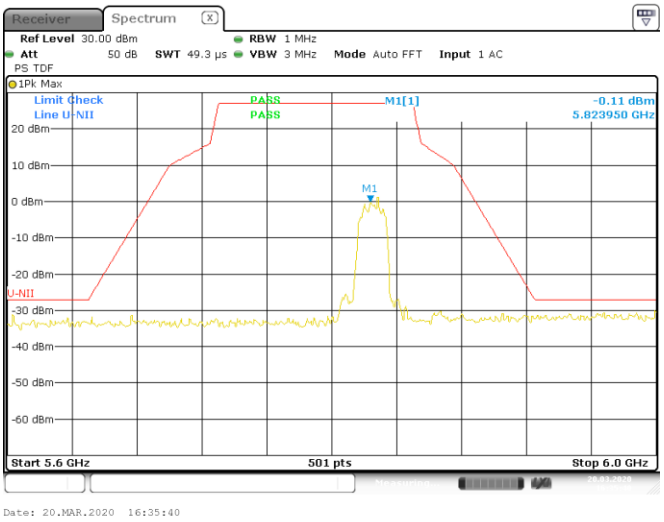
Out-of-band emission limits for U-NII-3 @ mode 802.11ac(VHT20) Ch149



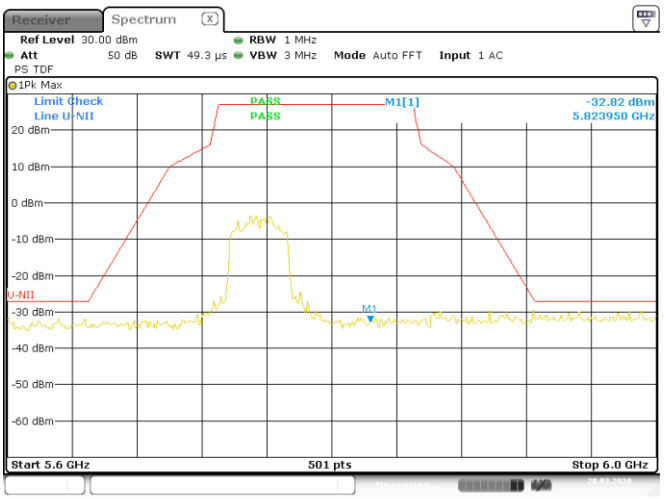
Out-of-band emission limits for U-NII-3 @ mode 802.11ac(VHT20) Ch157



Out-of-band emission limits for U-NII-3 @ mode 802.11ac(VHT20) Ch165

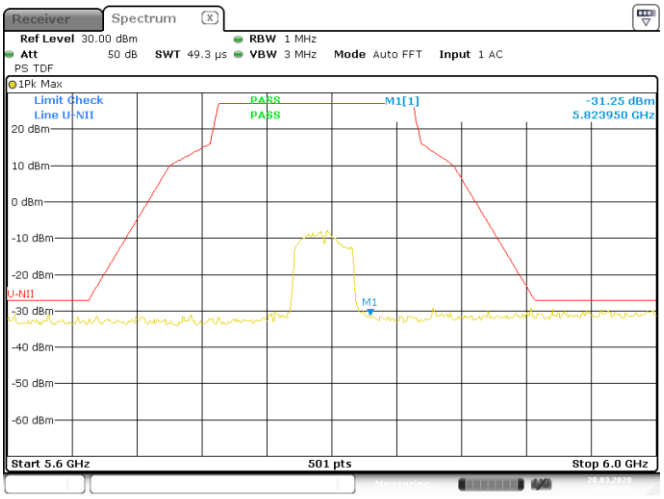


Out-of-band emission limits for U-NII-3 @ mode 802.11ac(VHT40) Ch151



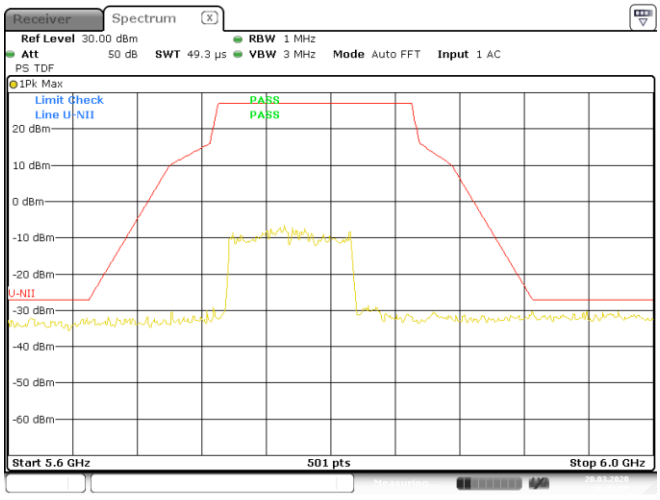
Date: 20.MAR.2020 16:37:41

Out-of-band emission limits for U-NII-3 @ mode 802.11ac(VHT40) Ch159



Date: 20.MAR.2020 16:41:46

Out-of-band emission limits for U-NII-3 @ mode 802.11ac(VHT80) Ch155



Date: 20.MAR.2020 16:47:10

7.AC Power Line Conducted Emission

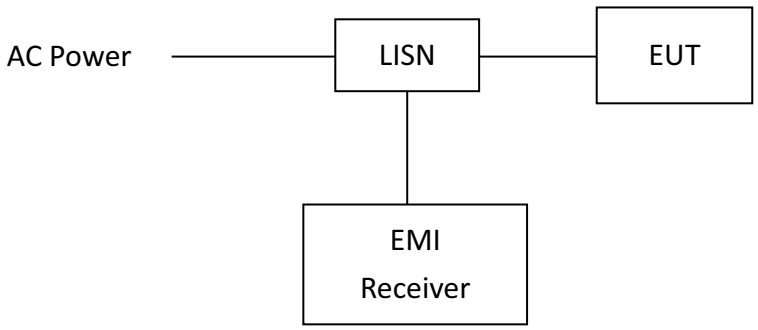
7.1 Measuring instrument setting

Receiver Function	Setting
Detector	QP
Start frequency	0.15MHz
Stop frequency	30MHz
IF bandwidth	9 kHz
Attenuation	10dB

7.2 Test Procedure

Step 1	Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
Step 2	Connect EUT or host of EUT to the power mains through a line impedance stabilization network.
Step 3	All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance.
Step 4	The frequency range from 150 kHz to 30MHz was searched.
Step 5	Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode.
Step 6	The measurement has to be done between each power line and ground at the power terminal.

7.3 Test Diagram



7.4 Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56	56 – 46
0.50~5.00	56	46
5.00~30.0	60	50

7.5 Operating Environment Condition

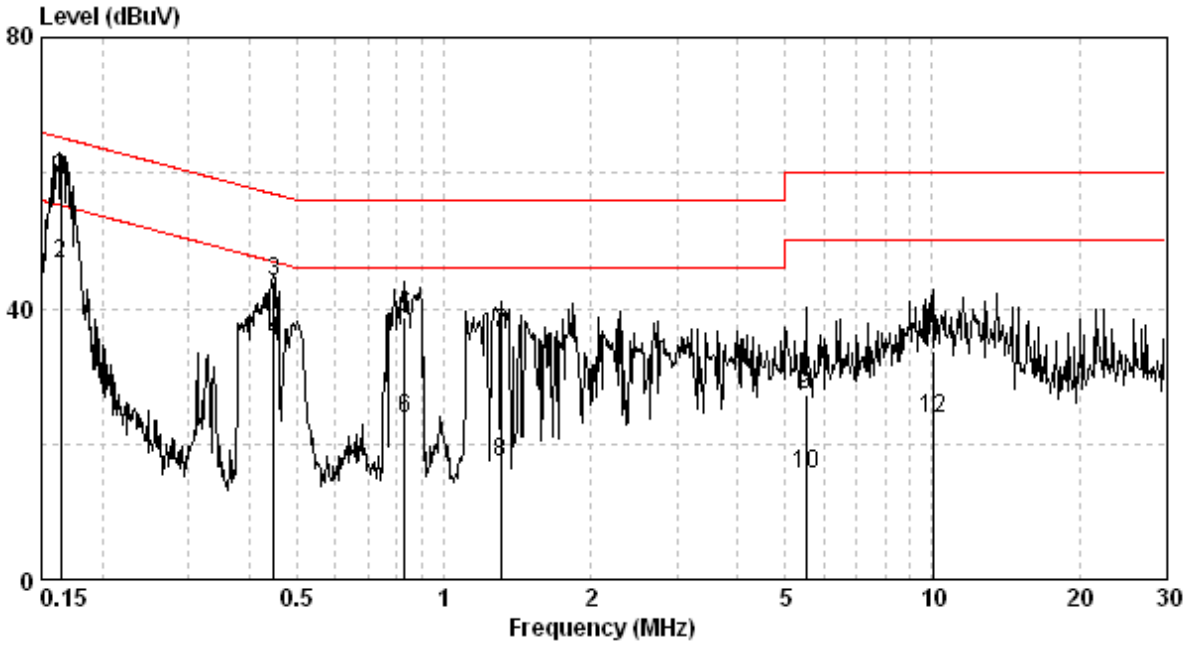
Temperature (℃) :	22
Relative Humidity (%) :	54
Atmospheric Pressure (hPa) :	1008

7.6 Test Results

Phase: Live Line
Model No.: AP9X
Test Condition: Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	Margin (dB) AV
0.164	9.70	49.74	59.44	65.25	36.94	46.64	55.25	-5.81	-8.61
0.449	9.70	34.28	43.98	56.89	25.59	35.29	46.89	-12.92	-11.60
0.830	9.72	28.94	38.66	56.00	14.08	23.80	46.00	-17.34	-22.20
1.310	9.74	26.47	36.21	56.00	7.66	17.40	46.00	-19.79	-28.60
5.505	9.81	17.44	27.25	60.00	5.78	15.59	50.00	-32.75	-34.41
10.072	9.82	23.78	33.60	60.00	13.84	23.66	50.00	-26.40	-26.34

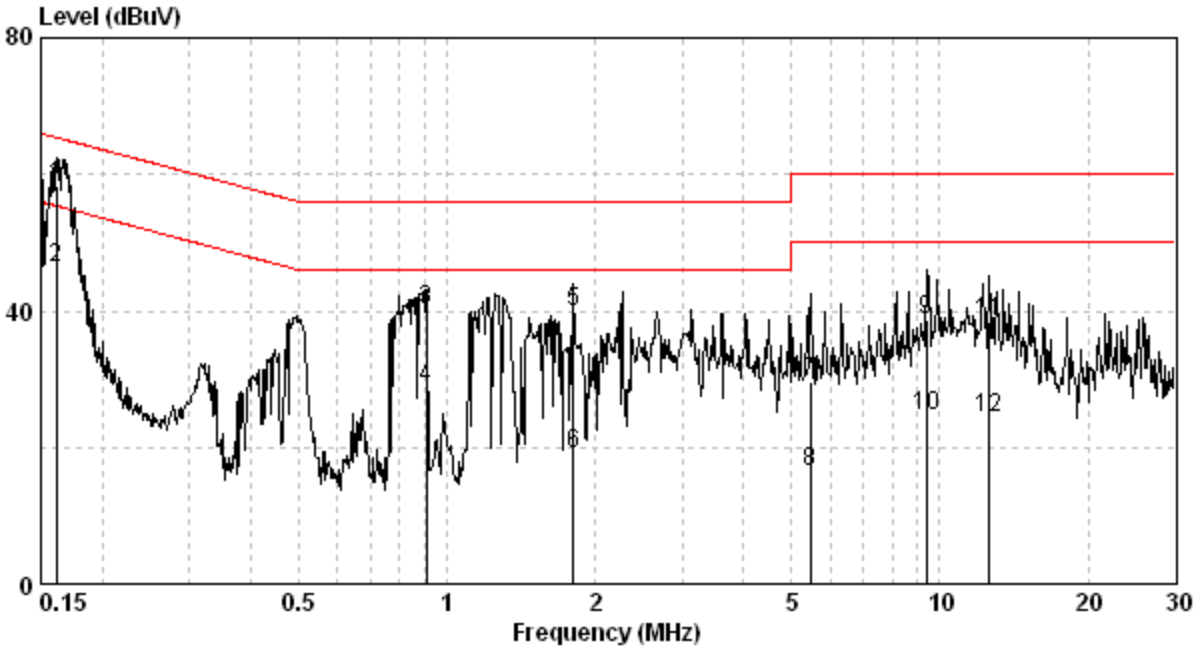
Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral Line
Model No.: AP9X
Test Condition: Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	Margin (dB) AV
0.162	9.71	48.63	58.34	65.38	36.67	46.38	55.38	-7.05	-9.00
0.909	9.74	30.28	40.02	56.00	19.02	28.75	46.00	-15.98	-17.25
1.810	9.77	30.18	39.95	56.00	9.37	19.14	46.00	-16.05	-26.86
5.476	9.83	19.82	29.65	60.00	6.47	16.29	50.00	-30.35	-33.71
9.401	9.86	28.77	38.63	60.00	14.67	24.53	50.00	-21.37	-25.47
12.582	9.88	28.52	38.40	60.00	14.47	24.35	50.00	-21.60	-25.65

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESR-7	101232	2020/01/18	2021/01/16
Horn Antenna	SHWARZBECK	BBHA 9120 D	9120D-456	2020/01/20	2021/01/18
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2019/06/05	2020/06/03
Pre-amplifier	SCHWARZBECK	BBV9718	9718-004	2019/10/16	2020/10/14
Power Meter	Anritsu	ML2495A	0844001	2019/10/23	2020/10/21
Power Sensor	Anritsu	MA2411B	0738452	2019/10/23	2020/10/21
Signal Analyzer	Agilent	N9030A	MY51380492	2019/08/21	2020/08/19
966-2(A) Cable	SUHNER	SMA / EX 100	N/A	2019/08/19	2020/08/17
966-2(B) Cable	SUHNER	SUCOFLEX 104P	CB0005	2019/08/19	2020/08/17
RF Cable	SUHNER	SUCOFLEX 102	CB0006	2019/05/02	2020/04/30
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2020/02/23	2021/02/22
Hight Pass Filter	Reactel	7HS-3G/18G-S11	N/A	2019/05/30	2020/05/28
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2019/04/19	2020/04/17

Note: No Calibration Required (NCR)

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI	100059	2019/11/05	2020/11/03
Two-Line V-Network	R&S	ENV216	101159	2019/06/12	2020/06/10
Two-Line -V-Network	R&S	ESH3-Z5	825562/003	2019/08/27	2020/08/25
CON-1 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-1 Cable	SUHNER	SUCOFLEX-104	26438414	2019/05/02	2020/04/30
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Appendix B: Measurement Uncertainty

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of *k*=2.

Item	Uncertainty
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	4.90 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	4.89 dB
Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Vertically polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Horizontally polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	3.32 dB
Emission on the Band Edge Test	4.29 dB
Minimum 6 dB Bandwidth	7.69 %
Maximum Peak Conducted Output Power	0.37 dB
Power Spectral Density	1.15 dB
Emissions In Non-Restricted Frequency Bands	1.15 dB
AC Power Line Conducted Emission	2.52 dB