TEST REPORT

Product Name:	WIFI MODULE
Trade Mark:	RGB
Model No.:	NTUD-U5
HVIN:	NTUD-U5
Report Number:	180627001RFC-4
Test Standards:	FCC 47 CFR Part 15 Subpart E RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	2ANM3NTUDU5
IC:	23165-NTUDU5
Test Result:	PASS
Date of Issue:	July 19, 2018

Prepared for:

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Date: July 19, 2018

UnionTrust Laboratories UnionTrust * Certified *

Version

Version No.	Date	Description
V1.0	July 19, 2018	Original

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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Shenzhen Chuangwei-RGB Electronics Co., Ltd.
Address of Applicant:	13F-16F, Unit A, Skyworth Building, Shennan Road, Nanshan District, Shenzhen, China
Manufacturer:	Shenzhen Chuangwei-RGB Electronics Co., Ltd. Shiyan Factory
Address of Manufacturer:	Skyworth Science and Industrial Park, Tangtou 1st Road, Shiyan Street, Bao'an District, Shenzhen, China

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	WIFI MODULE		
Model No.:	NTUD-U5		
HVIN:	NTUD-U5		
Add. Model No.:	N/A		
Trade Mark:	RGB		
DUT Stage:	Identical Prototype		
EUT Supports Function:	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
		Bluetooth 5.0	
	5 GHz U-NII Bands:	5150 MHz to 5250 MHz	IEEE 802.11a/n/ac
Sample Received Date:	June 28, 2018		
Sample Tested Date:	June 28, 2018 to July 10, 2018		

1.2.2 Description of Accessories

None.

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Band:	5150 MHz to 5250 MHz	
Frequency Range:	5180 MHZ to 5240 MHz	
Support Standards:	IEEE 802.11a/n/ac	
TPC Function:	Not Support	
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz	
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz	
	IEEE 802.11ac-VHT80/: 80 MHz	
Data Rate:	IEEE 802.11a: Up to 54 Mbps	
	IEEE 802.11n-HT20: Up to MCS15	
	IEEE 802.11n-HT40: Up to MCS15	
	IEEE 802.11ac-VHT20: Up to MCS8	
	IEEE 802.11ac-VHT40: Up to MCS9	
	IEEE 802.11ac-VHT80: Up to MCS9	
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80	
Antenna Type:	Chain 0	PIFA Antenna

	Chain 1	PIFA Antenna
Antenna Gain:	Chain 0	5150 MHz to 5250 MHz: 2.3 dBi
	Chain 1	5150 MHz to 5250 MHz: 2.3 dBi
Maximum conducted output power (dBm):	**SISO_Chain 0**	**U-NII-1**
	IEEE 802.11a:	16.49
	IEEE 802.11n-HT20:	15.01
	IEEE 802.11n-HT40:	9.41
	IEEE 802.11ac-VHT20:	15.32
	IEEE 802.11ac-VHT40:	9.93
	IEEE 802.11ac-VHT80:	7.03
	SISO_Chain 1	**U-NII-1**
	IEEE 802.11a:	14.75
	IEEE 802.11n-HT20:	12.89
	IEEE 802.11n-HT40:	6.04
	IEEE 802.11ac-VHT20:	12.73
	IEEE 802.11ac-VHT40:	6.05
	IEEE 802.11ac-VHT80:	3.64
	MIMO_Chain 0+1	**U-NII-1**
	IEEE 802.11n-HT20:	16.90
	IEEE 802.11n-HT40:	10.98
	IEEE 802.11ac-VHT20:	17.07
	IEEE 802.11ac-VHT40:	11.33
	IEEE 802.11ac-VHT80:	8.67
Maximum EIRP (dBm):	**SISO_Chain 0**	**U-NII-1**
	IEEE 802.11a:	18.79
	IEEE 802.11n-HT20:	17.62
	IEEE 802.11n-HT40:	12.23
	IEEE 802.11ac-VHT20:	17.31
	IEEE 802.11ac-VHT40:	11.71
	IEEE 802.11ac-VHT80:	9.33
	SISO_Chain 1	**U-NII-1**
	IEEE 802.11a:	17.05
	IEEE 802.11n-HT20:	15.03
	IEEE 802.11n-HT40:	8.35
	IEEE 802.11ac-VHT20:	15.19
	IEEE 802.11ac-VHT40:	8.34
	IEEE 802.11ac-VHT80:	5.94
	MIMO_Chain 0+1	**U-NII-1**
	IEEE 802.11n-HT20:	19.37
	IEEE 802.11n-HT40:	13.63
	IEEE 802.11ac-VHT20:	19.20
	IEEE 802.11ac-VHT40:	13.28
	IEEE 802.11ac-VHT80:	10.97
Normal Test Voltage:	5 Vdc	
Extreme Test Voltage:	4.5 to 5.5 Vdc	
Extreme Test Temperature:	0 °C to 60 °C	

1.4 OTHER INFORMATION

Operation Frequency Each of Channel	
	U-NII-1
IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11ac-VHT20	f = 5000 + 5k, k = 32 + 4n
	n = 1,…, 4
IEEE 802.11n-HT40, IEEE 802.11ac-VHT40	f = 5000 + 5k, k = 30 + 8n
	n = 1, 2
IEEE 802.11ac-VHT80	f = 5000 + 5k, k = 26 + 16n
	n = 1
Note: **f** is the operating frequency (MHz); **k** is the operating channel.	

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	Lenovo	E450	SL10G10780	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.30 Meter	UnionTrust

1.6 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

IC-Registration No.: 21600-1
The 3m Semi-anechoic chamber of Shenzhen UnionTrust Quality and Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 21600-1.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.8 dB
2	Conducted emission 150KHz-30MHz	±3.4 dB
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB

2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart E Test Cases			
Test Item	**Test Requirement**	**Test Method**	**Result**
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203 FCC 47 CFR Part 15 Subpart C Section 15.407(a)(1) (2)	ANSI C63.10-2013	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) RSS-247 Issue 2 Section 6.2.1.2	KDB 789033 D02 v02r01 Section C.1	PASS
Occupied Bandwidth	RSS-Gen section 6.7	KDB 789033 D02 v02r01 Section D	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section E.3.a(Method PM)	PASS
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
Frequency stability	FCC 47 CFR Part 15 Subpart E Section 15.407 (g) RSS-Gen Issue 5, Section 8.11	ANSI C63.10-2013	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205 RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013	PASS

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☑	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 20, 2015	Dec. 19, 2018
☑	Receiver	R&S	ESIB26	100114	Dec. 10, 2017	Dec. 10, 2018
☑	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec.10, 2017	Dec. 10, 2018
☑	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 22, 2017	Dec. 22, 2018
☑	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 17, 2017	Dec. 17, 2018
☑	Preamplifier	HP	8447F	2805A02960	Dec. 10, 2017	Dec. 10, 2018
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 22, 2018	May 22, 2019
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Dec. 17, 2017	Dec. 17, 2018
☑	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☑	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G1868	June 06, 2018	June 06, 2019
☑	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☑	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec.10, 2017	Dec. 10, 2018
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Dec. 10, 2017	Dec. 10, 2018
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Dec. 10, 2017	Dec. 10, 2018
☑	DC Source	KIKUSUI	PWR400L	LK003024	Sep. 14, 2017	Sep. 13, 2018
☑	Temp & Humidity chamber	Votisch	VT4002	58566133290 020	June 05, 2018	June 05, 2019

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☑	Receiver	R&S	ESR7	1316.3003K07 -101181-K3	Dec. 10, 2017	Dec. 10, 2018
☑	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Dec. 10, 2017	Dec. 10, 2018
☑	LISN	R&S	ESH2-Z5	860014/024	Dec. 10, 2017	Dec. 10, 2018
☑	Test Software	Audix	e3	Software Version: 9.160323		

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Test Environment	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
TN/VN	+15 to +35	5	20 to 75
TL/VL	0	4.5	20 to 75
TH/VL	60	4.5	20 to 75
TL/VH	0	5.5	20 to 75
TH/VH	60	5.5	20 to 75

Remark:
1) The EUT just work in such extreme temperature of 0 °C to 60 °C and the extreme voltage of 4.5 V to 5.5 V, so here the EUT is tested in the temperature of 0 °C to 60 °C and the voltage of 4.5 V to 5.5 V.
2) VN: Normal Voltage; TN: Normal Temperature;
TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11a IEEE 802.11n-HT20 IEEE 802.11ac-VHT20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
IEEE 802.11n-HT40 IEEE 802.11ac-VHT40	5150 MHz to 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
IEEE 802.11ac-VHT80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--

4.3 EUT TEST STATUS

Mode	Tx/Rx Function	Description
IEEE 802.11a/n/ac	1Tx/1Rx or 2Tx/2Rx	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Power Setting		
SISO(U-NII-1)		
	Chain 0	Chain 1
IEEE 802.11a	1F	1F
MIMO(U-NII-1)		
IEEE 802.11n-HT20	1D	
IEEE 802.11n-HT40	11	
IEEE 802.11ac-VHT20	1D	
IEEE 802.11ac-VHT40	11	
IEEE 802.11ac-VHT80	10	

Test Software
Test software name: QATool_Dbg;

4.4 PRE-SCAN

4.4.1 Pre-scan under all rates

Mode and Frequency	Maximum Conducted Average Power (dBm) for Data Rates (Mbps)							
IEEE 802.11a 5180 MHz	6	9	12	18	24	36	48	54
	16.38	16.29	16.26	16.21	16.07	15.37	14.59	13.15
IEEE 802.11n-HT20 5180 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	14.91	14.69	13.77	12.88	12.24	11.45	11.14	10.31
	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
	14.89	14.62	14.70	14.64	14.05	12.95	12.63	11.23
IEEE 802.11n-HT40 5190 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	8.74	6.94	6.10	5.47	4.69	4.36	4.17	3.26
	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
	9.16	8.81	7.98	7.02	6.05	5.52	5.55	4.28
IEEE 802.11ac-VHT20 5180 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	15.08	15.03	13.89	13.41	13.32	12.02	11.83	11.03
	MCS8							
	10.76							
IEEE 802.11ac-VHT40 5190 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	9.49	9.29	8.55	7.66	6.87	6.24	5.98	4.36
	MCS8	MCS9						
	4.33	4.26						
IEEE 802.11ac-VHT80 5210 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	6.27	4.90	4.22	3.97	3.52	3.54	3.28	2.41
	MCS8	MCS9						
	2.41	2.38						

4.4.2 Worst-case data rates

Mode	Worst-case data rates
IEEE 802.11a	6 Mbps
IEEE 802.11n-HT20	MCS8
IEEE 802.11n-HT40	MCS8
IEEE 802.11ac-VHT20	MCS0
IEEE 802.11ac-VHT40	MCS0
IEEE 802.11ac-VHT80	MCS0

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

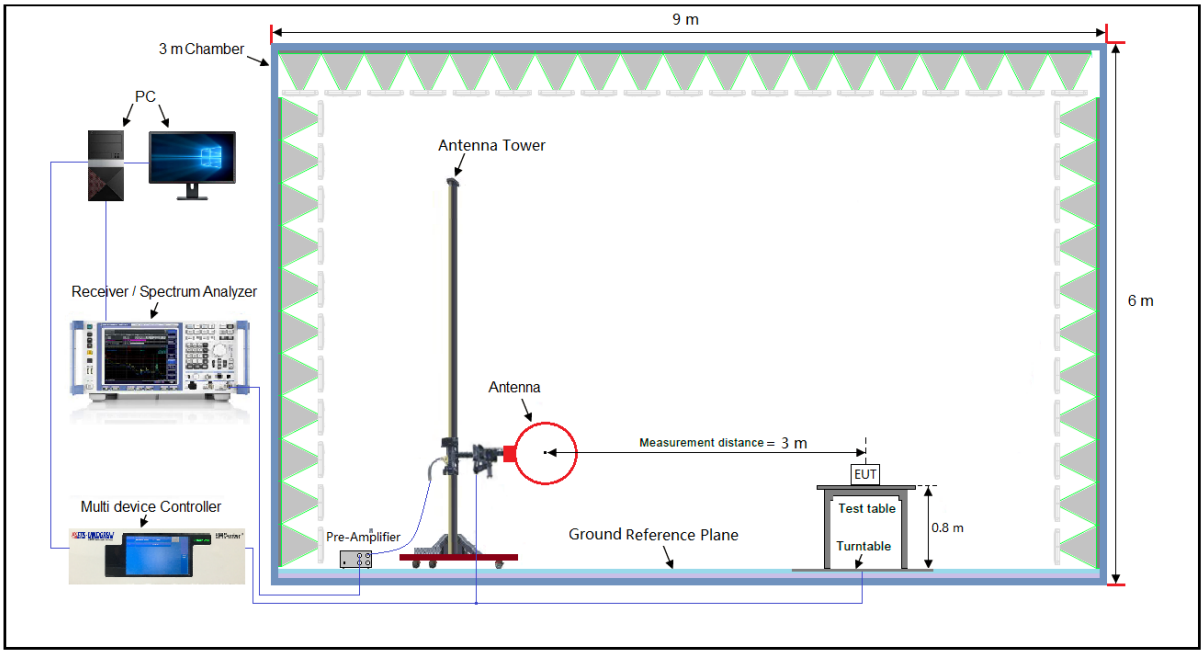


Figure 2. 30MHz to 1GHz

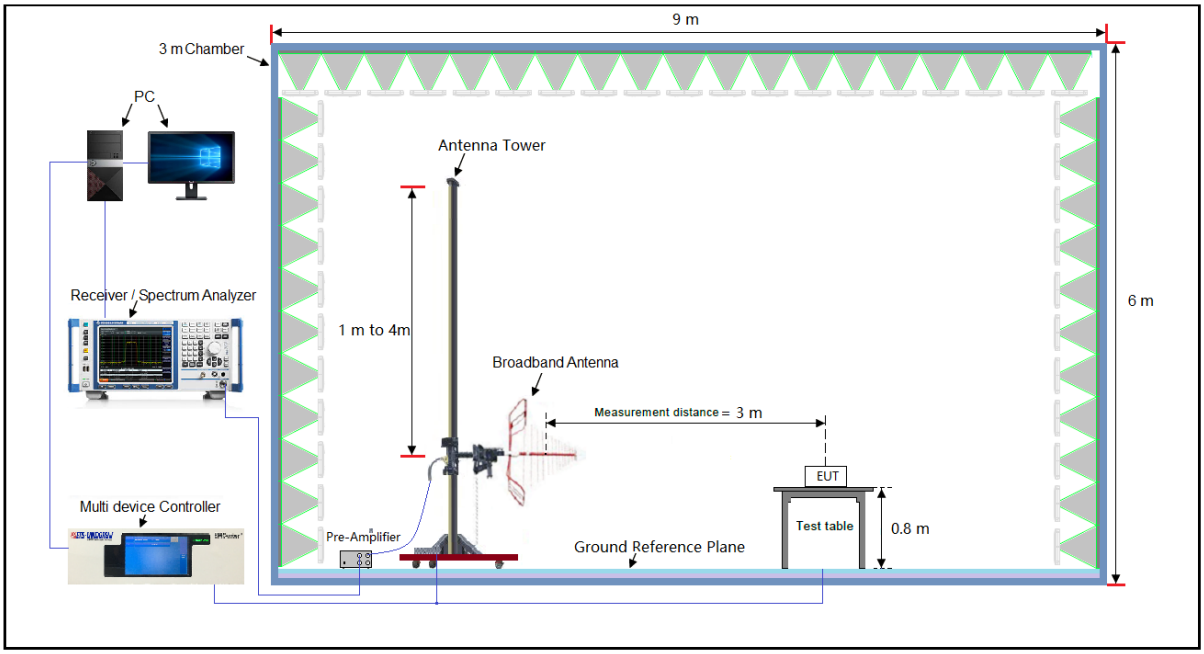
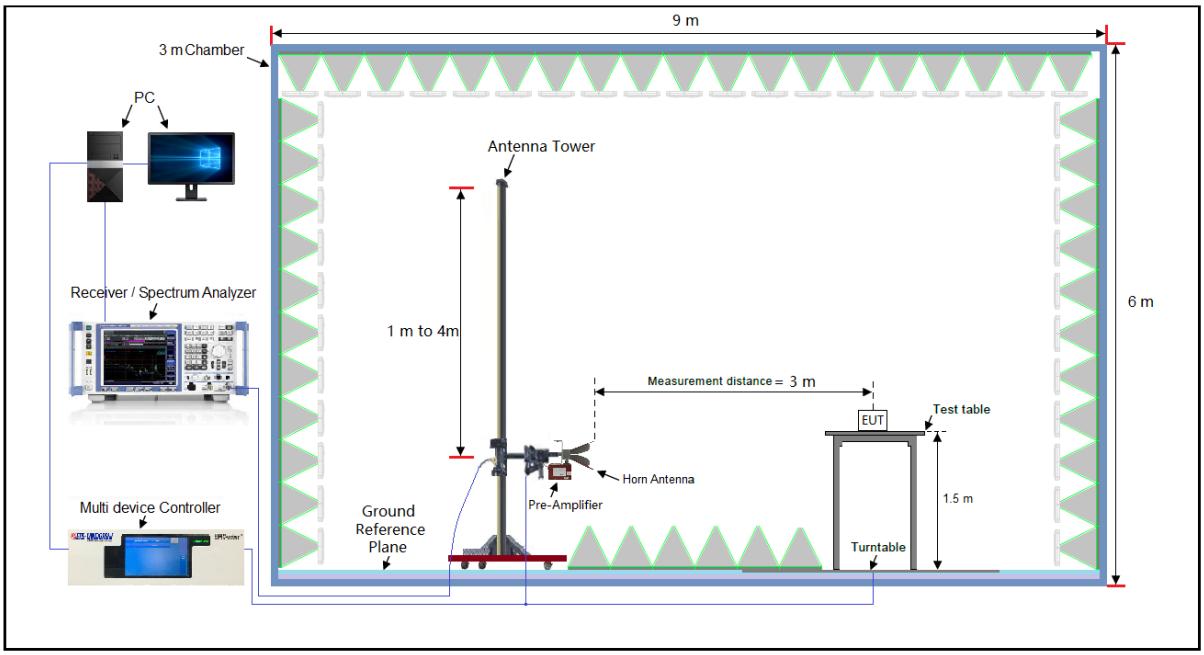
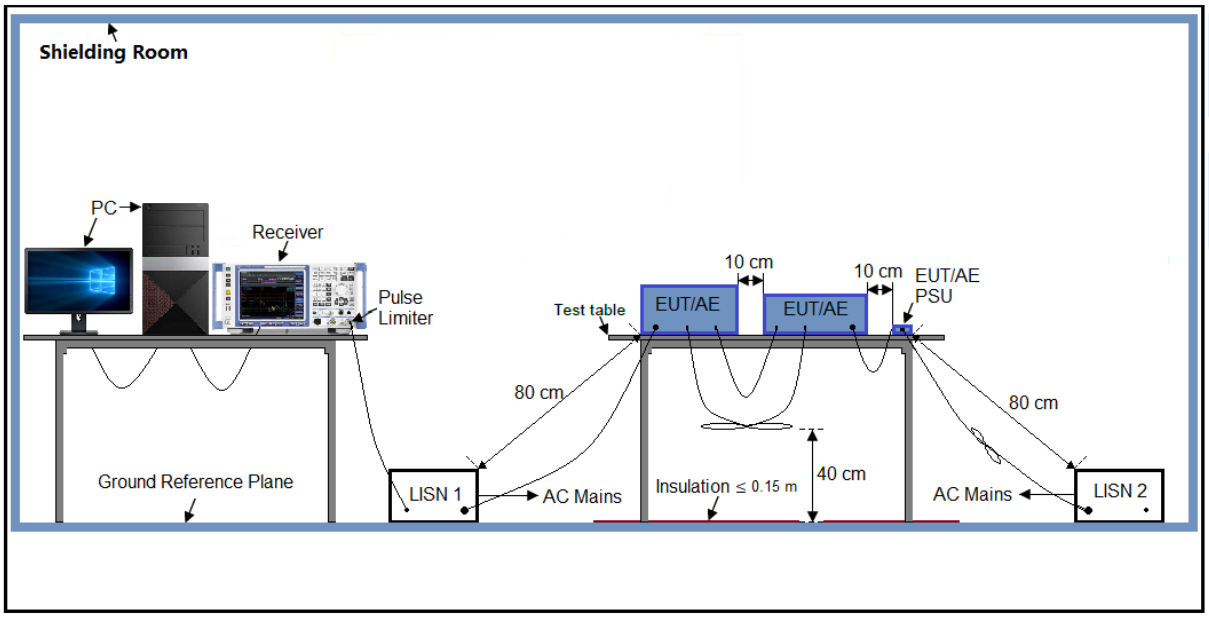


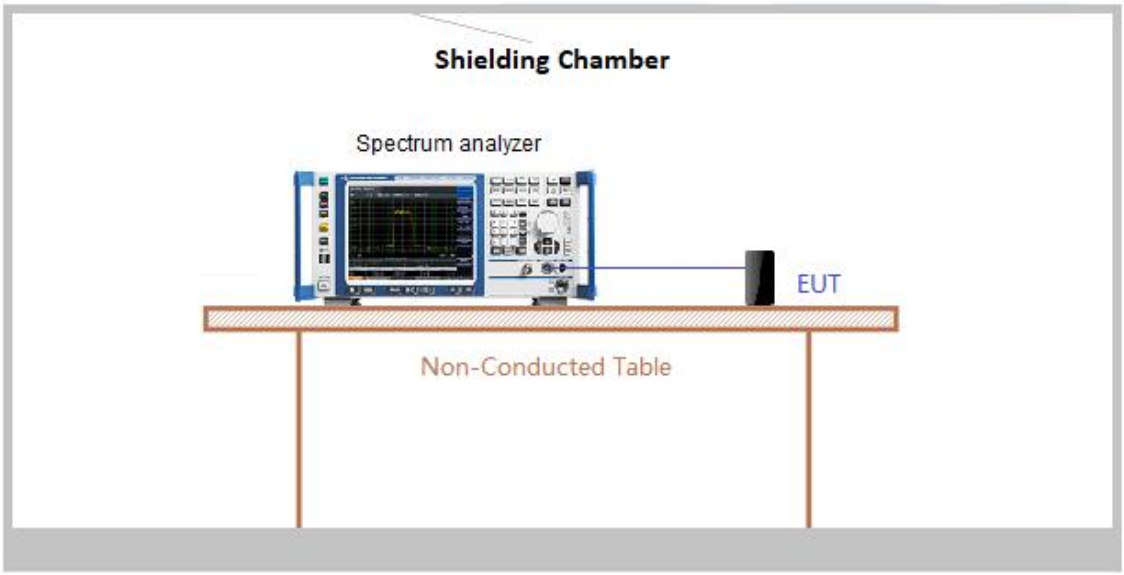
Figure 3. Above 1GHz



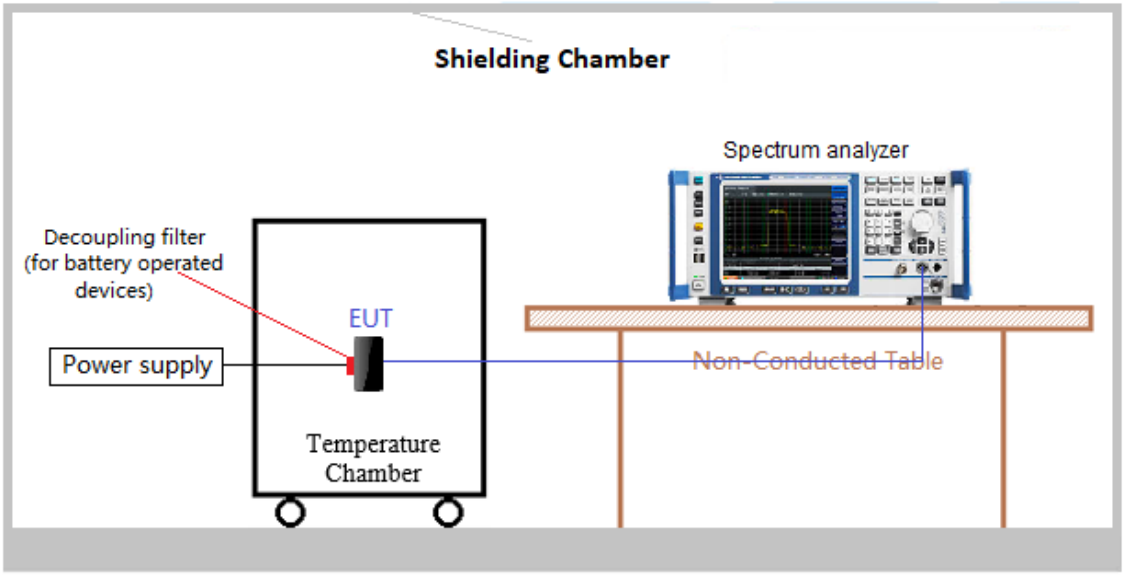
4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



Normal Environment



Extreme Environment

4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 5Vdc USB port. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Y axis
	1TX	Chain 1	Y axis
	2TX	Chain 0+1	Y axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

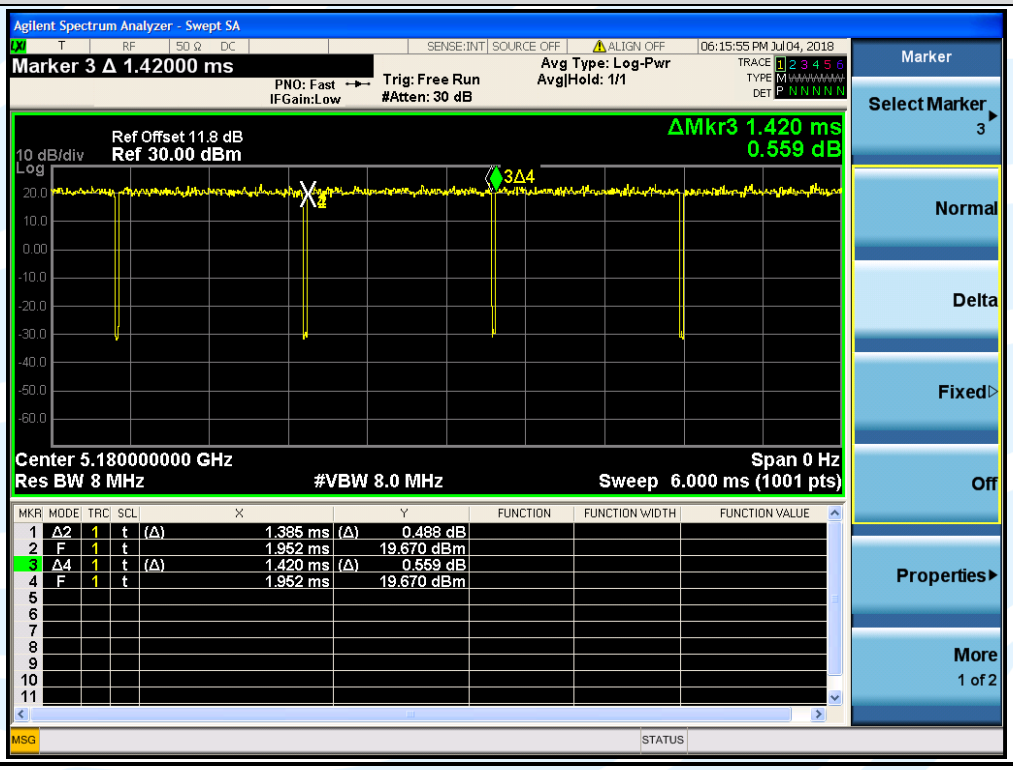
4.7 DUTY CYCLE

Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	6	1.39	1.42	0.98	97.54	0.11	0.72	-0.22
IEEE 802.11n-HT20	MCS0	1.30	1.33	0.97	97.37	0.12	0.77	-0.23
IEEE 802.11n-HT40	MCS0	0.65	0.69	0.94	94.31	0.25	1.55	-0.51
IEEE 802.11ac-VHT20	MCS0	0.68	0.72	0.95	94.55	0.24	1.48	-0.49
IEEE 802.11ac-VHT40	MCS0	0.35	0.39	0.90	90.39	0.44	2.87	-0.88
IEEE 802.11ac-VHT80	MCS0	0.19	0.22	0.84	83.93	0.76	5.32	-1.52

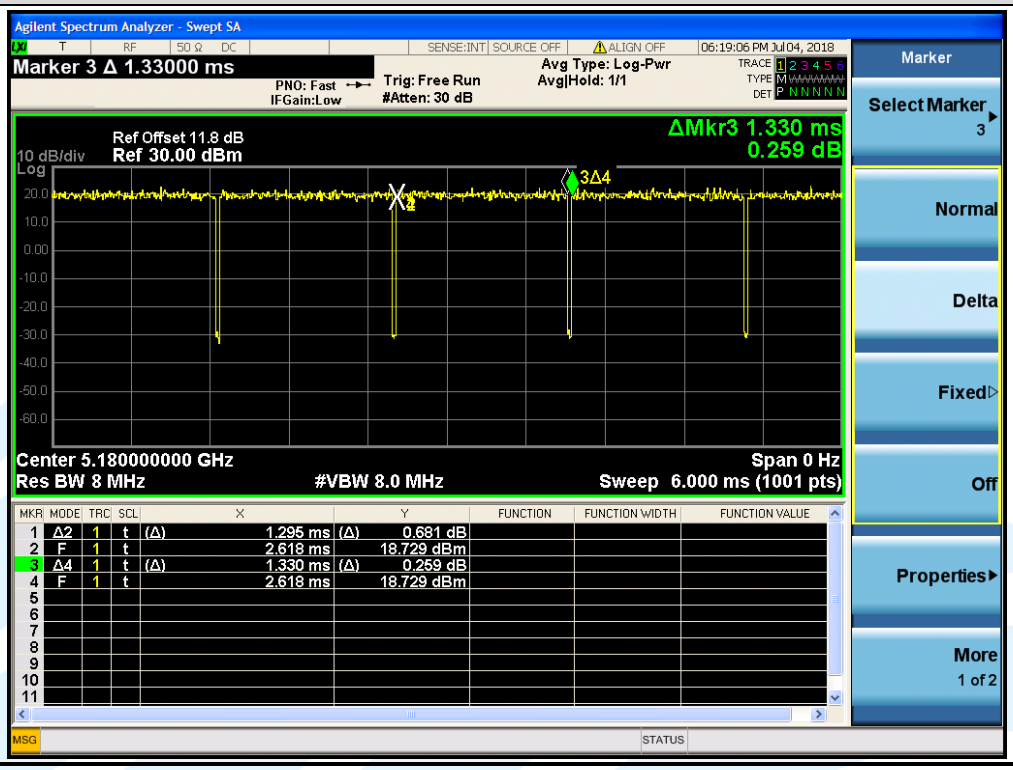
Remark:
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plot as follows

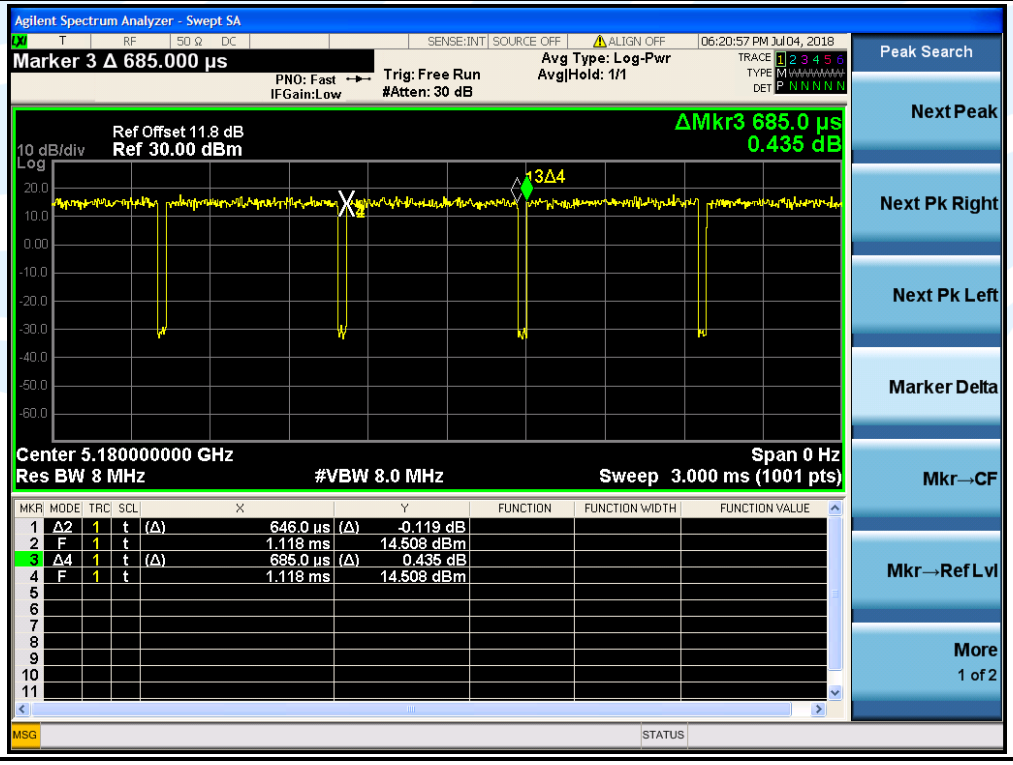
IEEE 802.11a



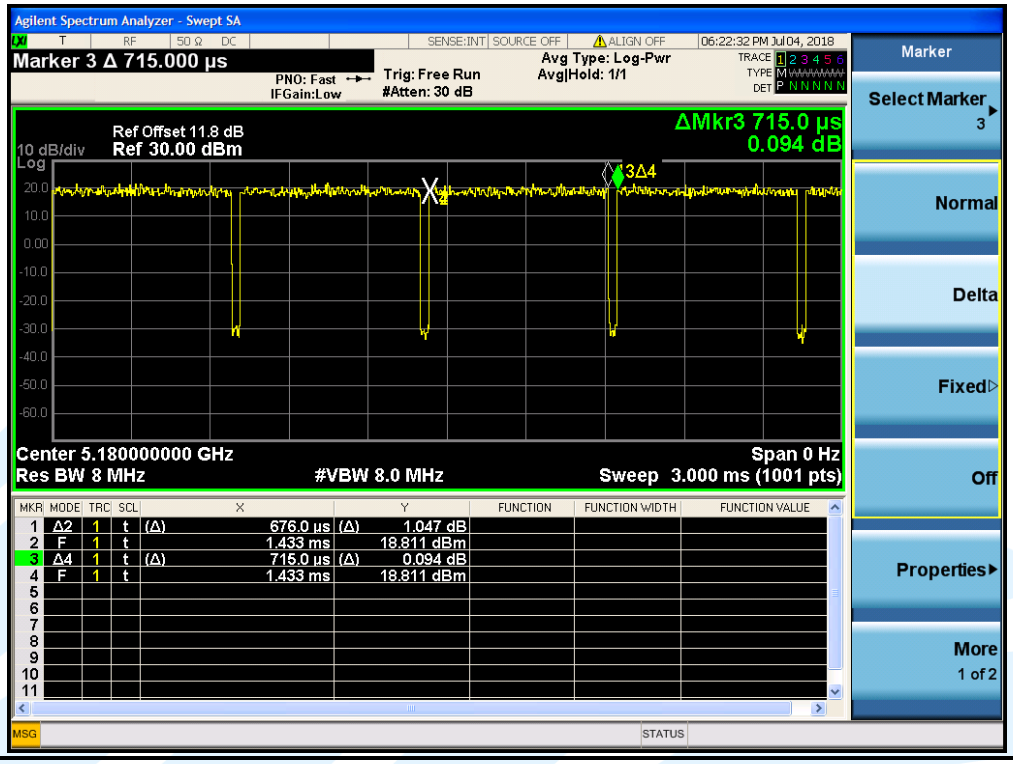
IEEE 802.11n-HT20



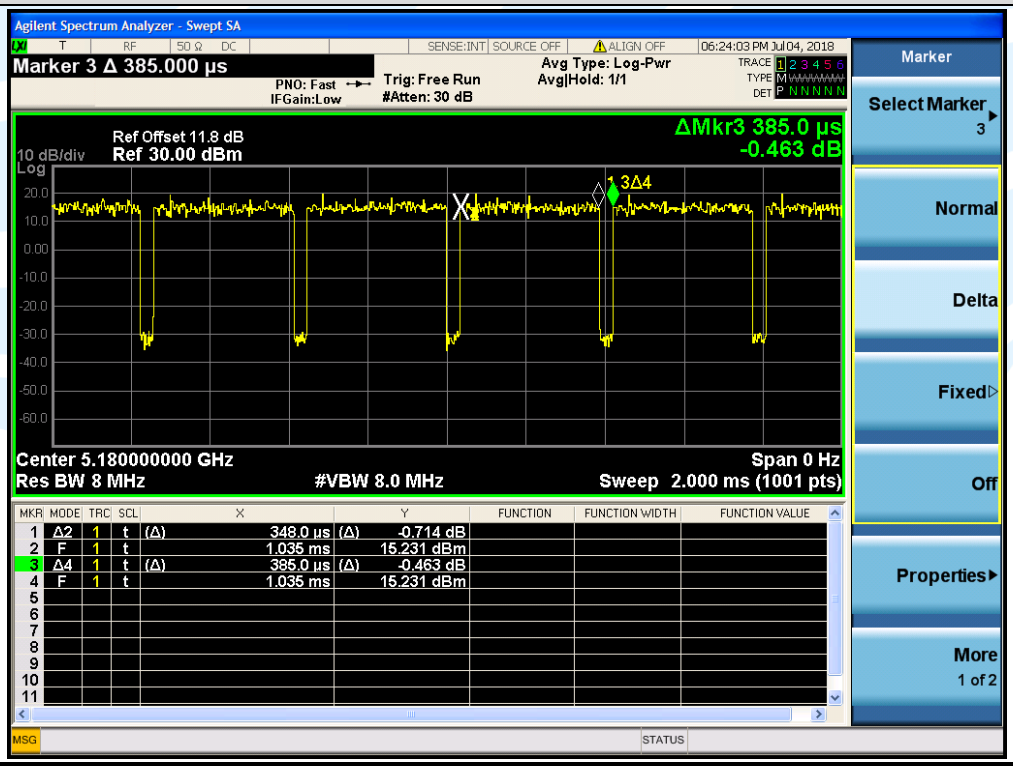
IEEE 802.11n-HT40



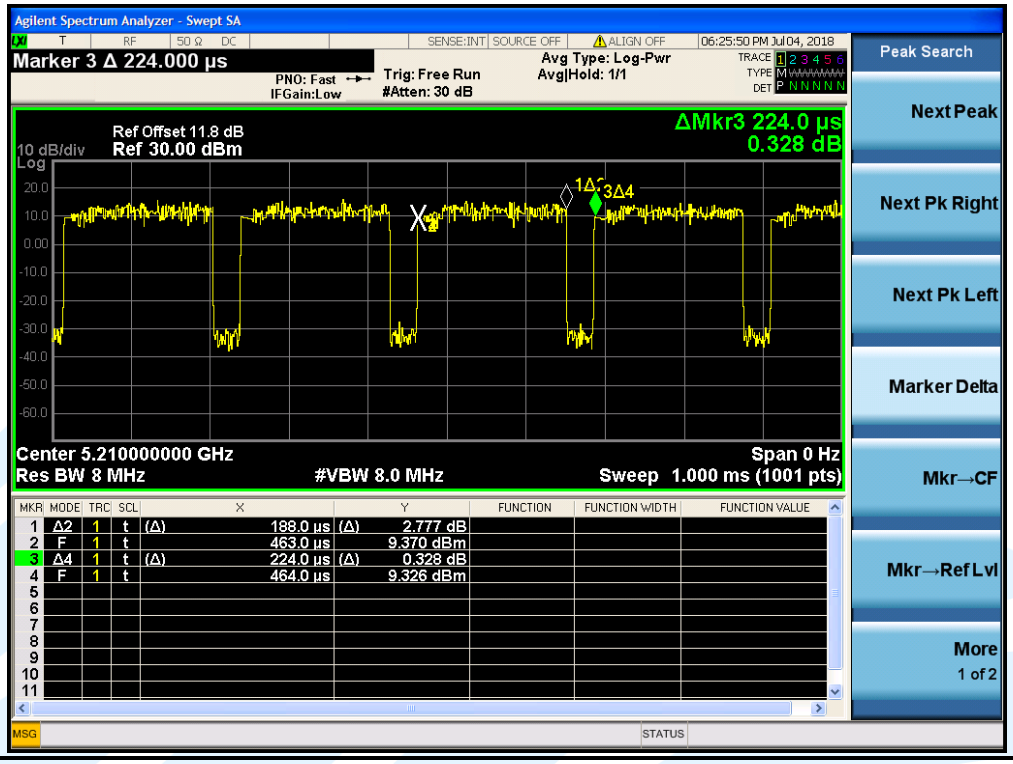
IEEE 802.11ac-VHT20



IEEE 802.11ac-VHT40



IEEE 802.11ac-VHT80



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
6	KDB 789033 D02 General UNII Test Procedures New Rules v02r01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15 subpart E
7	905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
8	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. **15.407(a)(1) (2) requirement:** The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
EUT Antenna:
Both antenna in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other and the antenna gain of both chains is completely consistent, the best case directional gain of the antenna is 5.31 dBi (See section 5.5).

5.3 26 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a) (2)(5)
RSS-247 Issue 2 Section 6.2.1.2

Test Method: KDB 789033 D02 v02r01Section C.1

Limit: None; for reporting purposes only.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.

Spectrum analyzer according to the following Settings:
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 %.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Mode	Channel	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
The worst case test data: Chain 0			
IEEE 802.11a	36 (5180)	25.51	16.902
	44 (5220)	28.82	16.978
	48 (5240)	26.54	17.030
IEEE 802.11n-HT20	36 (5180)	23.80	17.758
	44 (5220)	22.62	17.757
	48 (5240)	22.89	17.756
IEEE 802.11n-HT40	38 (5190)	49.43	36.368
	46 (5230)	53.53	36.360
IEEE 802.11ac-VHT20	36 (5180)	22.44	17.719
	44 (5220)	22.64	17.737
	48 (5240)	22.59	17.687
IEEE 802.11ac-VHT40	38 (5190)	46.88	36.282
	46 (5230)	47.05	36.344
IEEE 802.11ac-VHT80	42 (5210)	96.83	75.949

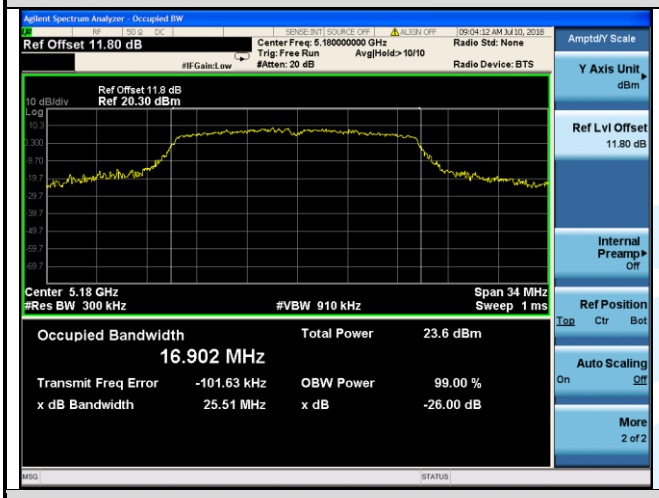
Remark:

For the case if a channel operating in U-NII 1 band has a 26-dB bandwidth that straddles into U-NII 2A band but its 99% occupied power bandwidth does not. For this rare case, DFS requirement does not apply.

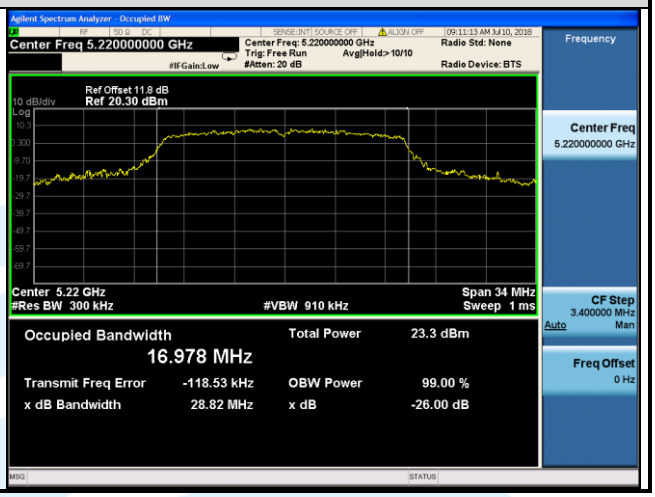
The test plot as follows:

IEEE 802.11a

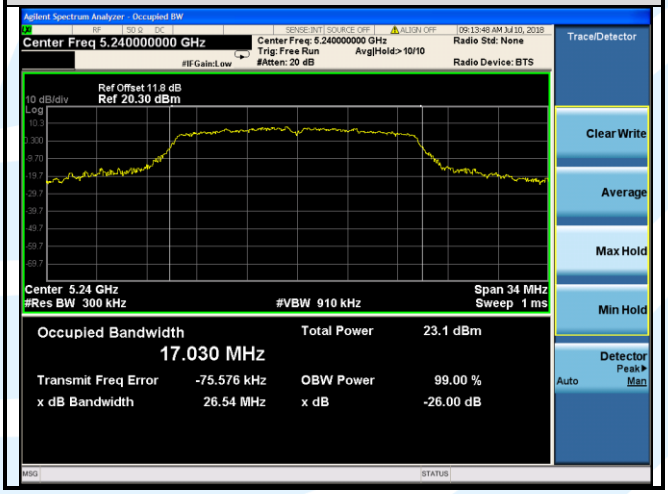
Channel 36



Channel 44

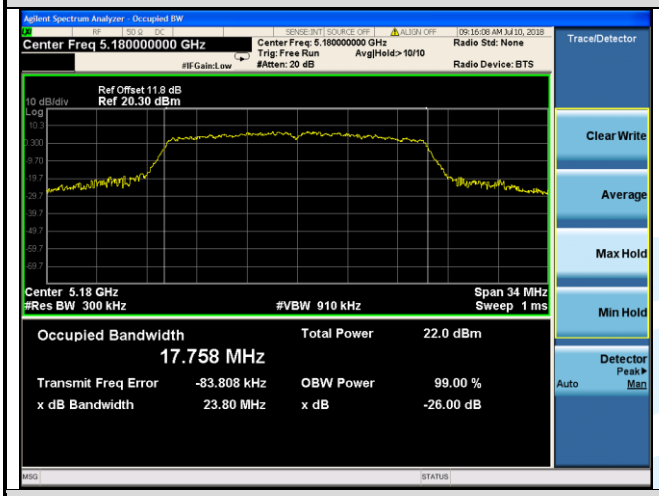


Channel 48

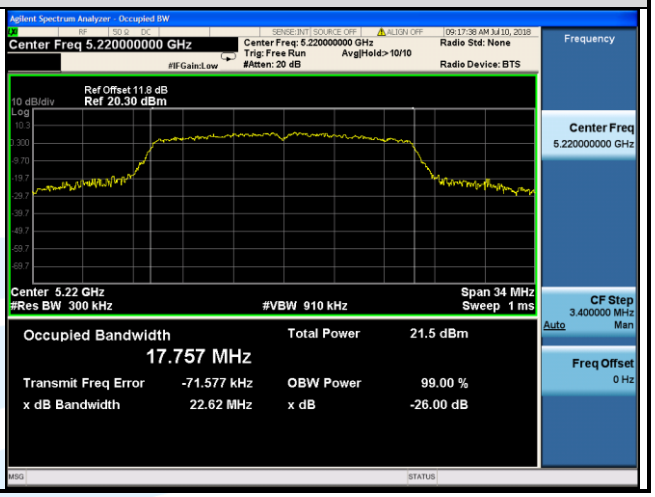


IEEE 802.11n-HT20

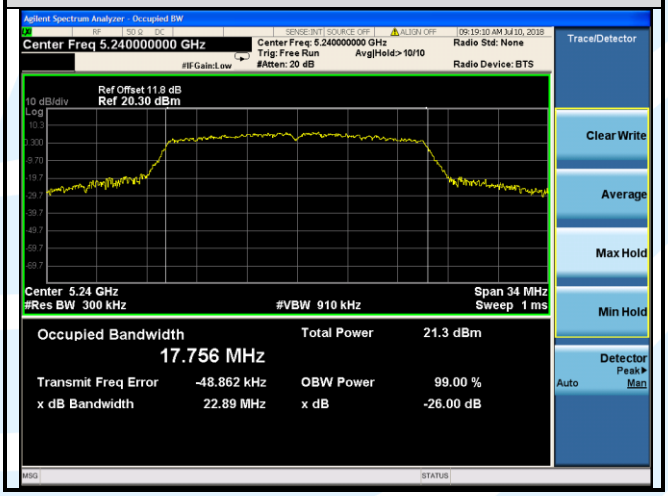
Channel 36



Channel 44

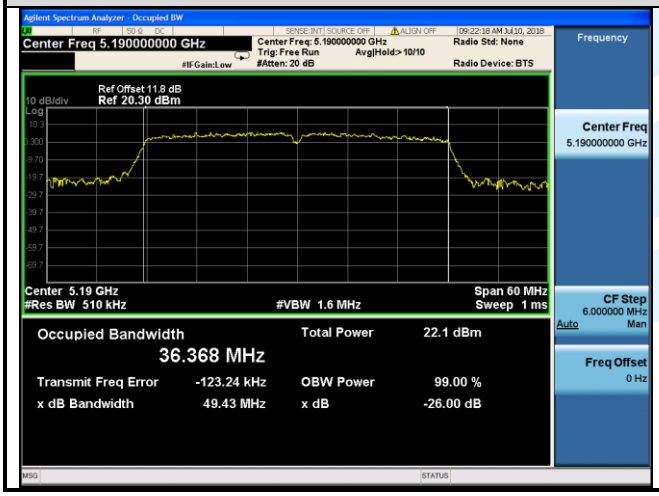


Channel 48

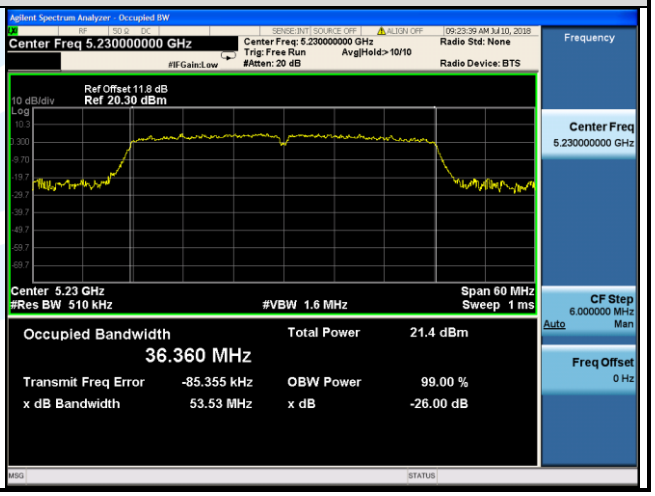


IEEE 802.11n-HT40

Channel 38

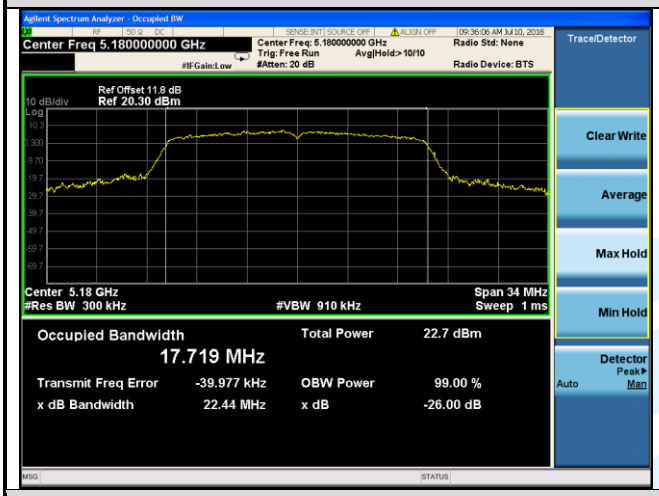


Channel 46

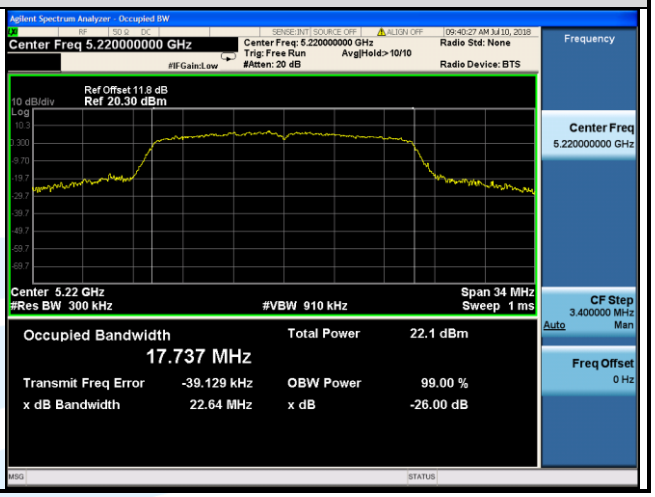


IEEE 802.11ac-VHT20

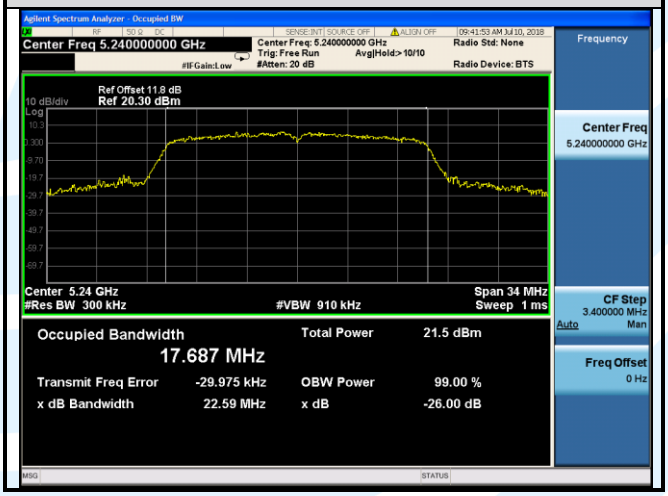
Channel 36



Channel 44

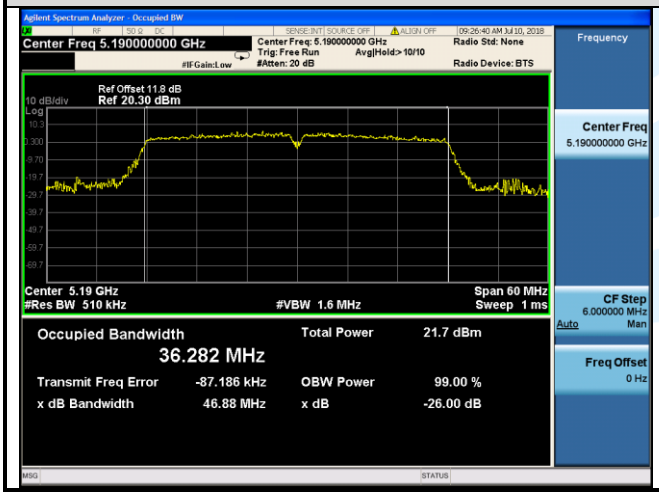


Channel 48

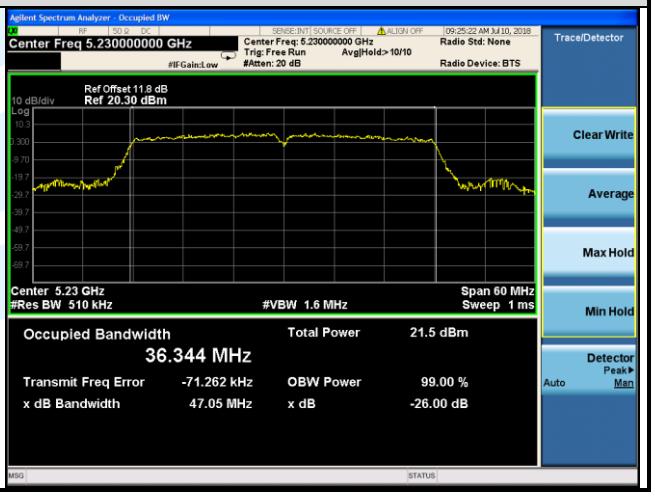


IEEE 802.11ac-VHT40

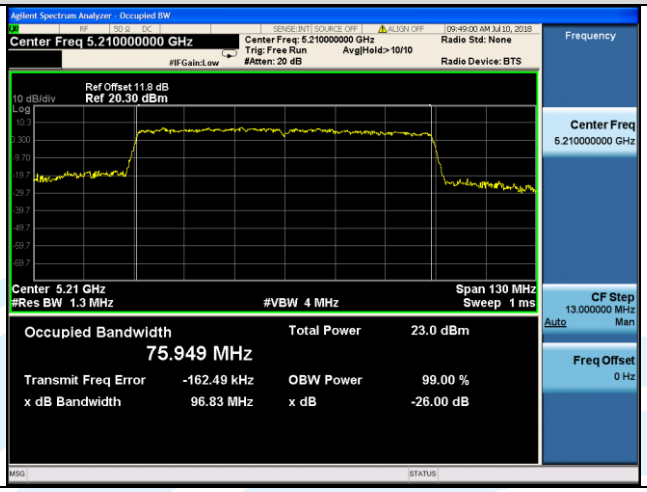
Channel 38



Channel 46



IEEE 802.11ac-VHT80
Channel 42



5.4 MAXIMUM CONDUCTED OUTPUT POWER OR E.I.R.P

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section E.3.a(Method PM)

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) 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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directiona

Limits: RSS-247 Issue 2

1. **Frequency band 5150-5250 MHz**
   For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

   For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 $\log_{10}$B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

Test Procedure:

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode
Test Results: Pass
Test Data:

Directional gain and the maximum output power limit.
RSS-247 Issue 2

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	2.30	2.30	5.31	23.00
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:				
If *any* transmit signals are *correlated* with each other,				
Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi				

FCC 47 CFR Part 15 Subpart E

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	2.30	2.30	5.31	23.00
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:				
If *any* transmit signals are *correlated* with each other,				
Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi				

Frequency band 5150-5250 MHz
RSS-247 Issue 2:
For IEEE 802.11 a/n-HT20, the minimum 99% emission bandwidth is 16.902 MHz
10 dBm + $10\log_{10}$ (16.902) = 22.28 dBm < 23 dBm (200mW)
So the 22.28 dB limit applicable

For IEEE 802.11 n-HT40/ac-VHT80, the minimum 99% emission bandwidth is 36.36 MHz
10 dBm + $10\log_{10}$ (36.36) = 25.61 dBm > 23 dBm (200mW)
So the 23 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum e.i.r.p (dBm) SISO		Total e.i.r.p MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	18.79	16.44	N/A	22.28	Pass
	44 (5220)	18.58	16.63	N/A	22.28	Pass
	48 (5240)	18.41	17.05	N/A	22.28	Pass
IEEE 802.11n-HT20	36 (5180)	17.62	14.59	19.37	22.28	Pass
	44 (5220)	17.33	14.76	19.24	22.28	Pass
	48 (5240)	17.25	15.03	19.29	22.28	Pass
IEEE 802.11n-HT40	38 (5190)	12.23	8.03	13.63	23	Pass
	46 (5230)	11.8	8.35	13.42	23	Pass
IEEE 802.11ac-VHT20	36 (5180)	17.31	14.67	19.20	23	Pass
	44 (5220)	16.94	14.80	19.01	23	Pass
	48 (5240)	16.81	15.19	19.09	23	Pass
IEEE 802.11ac-VHT40	38 (5190)	11.71	8.10	13.28	23	Pass
	46 (5230)	11.22	8.34	13.02	23	Pass
IEEE 802.11ac-VHT80	42 (5210)	9.33	5.94	10.97	23	Pass

Remark:
1. Maximum e.i.r.p = Maximum conducted output power + Antenna Gain
2. Total e.i.r.p (Chain 0+1) = $10*\log[(10^{Chain\ 0/10})+(10^{Chain\ 1/10})]$ + Directional gain

FCC 47 CFR Part 15 Subpart E:

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm) SISO		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	16.49	14.14	N/A	24	Pass
	44 (5220)	16.28	14.33	N/A	24	Pass
	48 (5240)	16.11	14.75	N/A	24	Pass
IEEE 802.11n-HT20	36 (5180)	15.01	12.37	16.90	24	Pass
	44 (5220)	14.64	12.50	16.71	24	Pass
	48 (5240)	14.51	12.89	16.79	24	Pass
IEEE 802.11n-HT40	38 (5190)	9.41	5.80	10.98	24	Pass
	46 (5230)	8.92	6.04	10.72	24	Pass
IEEE 802.11ac-VHT20	36 (5180)	15.32	12.29	17.07	24	Pass
	44 (5220)	15.03	12.46	16.94	24	Pass
	48 (5240)	14.95	12.73	16.99	24	Pass
IEEE 802.11ac-VHT40	38 (5190)	9.93	5.73	11.33	24	Pass
	46 (5230)	9.50	6.05	11.12	24	Pass
IEEE 802.11ac-VHT80	42 (5210)	7.03	3.64	8.67	24	Pass

Remark:

1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})]$

5.5 PEAK POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section F

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.

   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) 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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Limits: RSS-247 Issue 2

1. **Frequency band 5150-5250 MHz**

   For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

   For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 $\log_{10}$B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

1. For U-NII-1 band:

Using method SA-2

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 1 MHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Sweep time = auto, trigger set to “free run”.
d) Trace average at least 100 traces in power averaging mode.
e) Record the max value and add 10 log (1/duty cycle)

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.
Instruments Used: Refer to section 3 for details
Test Mode: Transmitter mode
Test Results: Pass
Test Data:

Directional gain and the maximum power spectral density limit.
RSS-247 Issue 2

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	2.30	2.30	5.31	10.00
Unequal antenna gains, with equal transmit powers. Directional gain is to be computed as follows:				
If transmit signals are correlated, then				
Directional gain = 10 log[(10^G1 /20 + 10^G2 /20 + … + 10^GN /20)^2 /NANT] dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]				

FCC 47 CFR Part 15 Subpart E

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	2.30	2.30	5.31	11.00
Unequal antenna gains, with equal transmit powers. Directional gain is to be computed as follows:				
If transmit signals are correlated, then				
Directional gain = 10 log[(10^G1 /20 + 10^G2 /20 + … + 10^GN /20)^2 /NANT] dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]				

Frequency band 5150-5250 MHz
RSS-247 Issue 2

Mode	Channel/ Frequency (MHz)	e.i.r.p. spectral density (dBm/MHz) SISO		Total e.i.r.p. spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	7.357	4.155	N/A	10	Pass
	44 (5220)	7.228	4.76	N/A	10	Pass
	48 (5240)	7.205	5.102	N/A	10	Pass
IEEE 802.11n-HT20	36 (5180)	6.719	2.422	8.09	10	Pass
	44 (5220)	6.115	2.61	7.72	10	Pass
	48 (5240)	6.033	3.046	7.80	10	Pass
IEEE 802.11n-HT40	38 (5190)	3.563	-5.732	4.05	10	Pass
	46 (5230)	3.152	-5.818	3.67	10	Pass
IEEE 802.11ac-VHT20	36 (5180)	6.67	-5.044	6.95	10	Pass
	44 (5220)	6.281	-3.476	6.72	10	Pass
	48 (5240)	6.359	-3.036	6.83	10	Pass
IEEE 802.11ac-VHT40	38 (5190)	-1.753	-5.152	-0.12	10	Pass
	46 (5230)	-3.226	-4.971	-1.00	10	Pass
IEEE 802.11ac-VHT80	42 (5210)	-7.718	-11.642	-6.24	10	Pass

Remark:

1. e.i.r.p. spectral density = Power spectral density + Duty Cycle Factor + Antenna Gain
2. Total e.i.r.p. spectral density (Chain 0+1) = $10*\log[(10^{Chain\ 0/10})+(10^{Chain\ 1/10})]$ + Directional gain

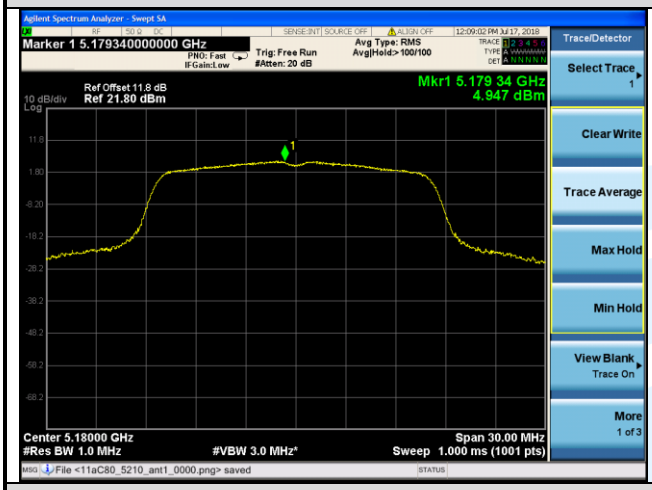
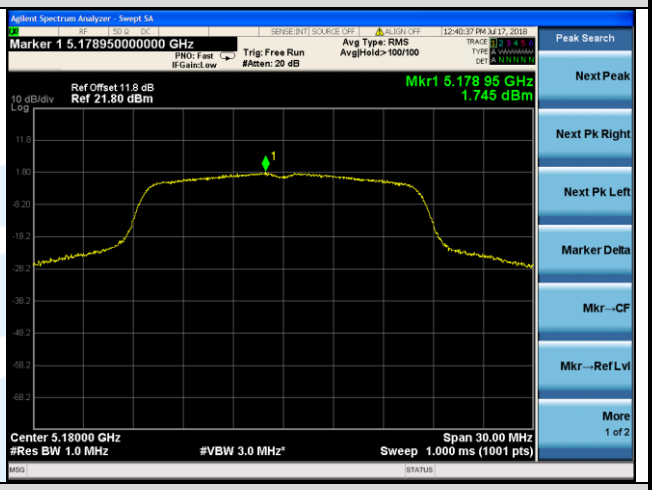
FCC 47 CFR Part 15 Subpart E

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz) SISO		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	5.057	1.855	N/A	11	Pass
	44 (5220)	4.928	2.46	N/A	11	Pass
	48 (5240)	4.905	2.802	N/A	11	Pass
IEEE 802.11n-HT20	36 (5180)	4.419	0.122	5.79	11	Pass
	44 (5220)	3.815	0.31	5.42	11	Pass
	48 (5240)	3.733	0.746	5.50	11	Pass
IEEE 802.11n-HT40	38 (5190)	1.263	-8.032	1.75	11	Pass
	46 (5230)	0.852	-8.118	1.37	11	Pass
IEEE 802.11ac-VHT20	36 (5180)	4.37	-7.344	4.65	11	Pass
	44 (5220)	3.981	-5.776	4.42	11	Pass
	48 (5240)	4.059	-5.336	4.53	11	Pass
IEEE 802.11ac-VHT40	38 (5190)	-4.053	-7.452	-2.42	11	Pass
	46 (5230)	-5.526	-7.271	-3.30	11	Pass
IEEE 802.11ac-VHT80	42 (5210)	-10.018	-13.942	-8.54	11	Pass

Remark:

1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{Chain\ 0/10})+(10^{Chain\ 1/10})]$

The test plot as follows:

IEEE 802.11a	
Chain 0	Chain 1
Channel 36	
	
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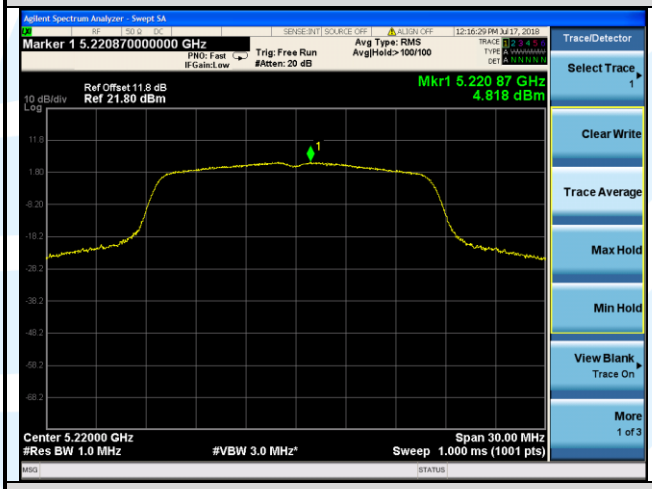	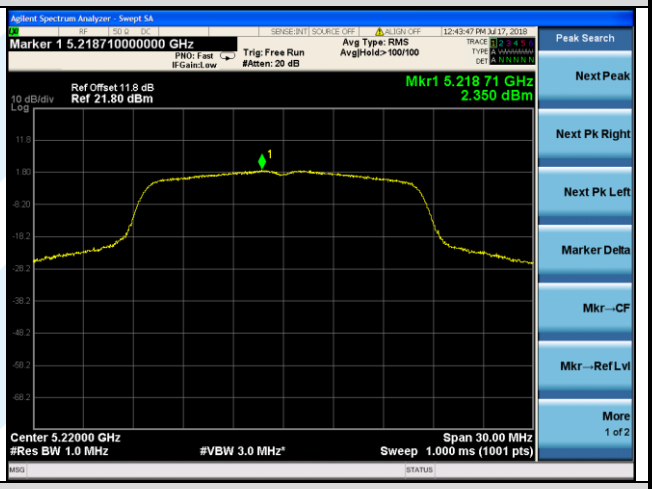
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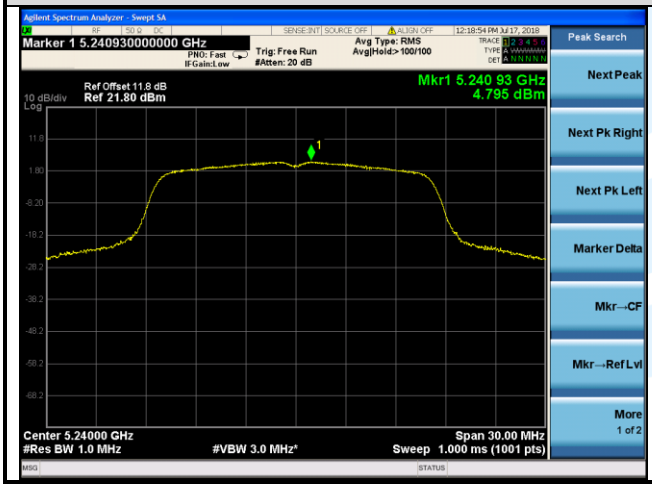	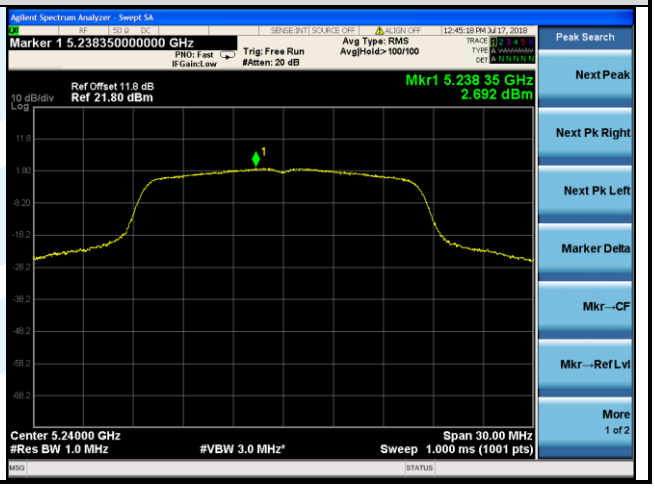

IEEE 802.11n-HT20	
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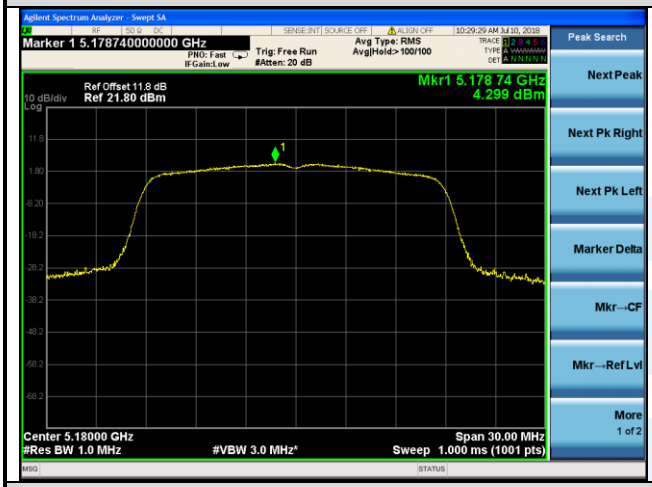
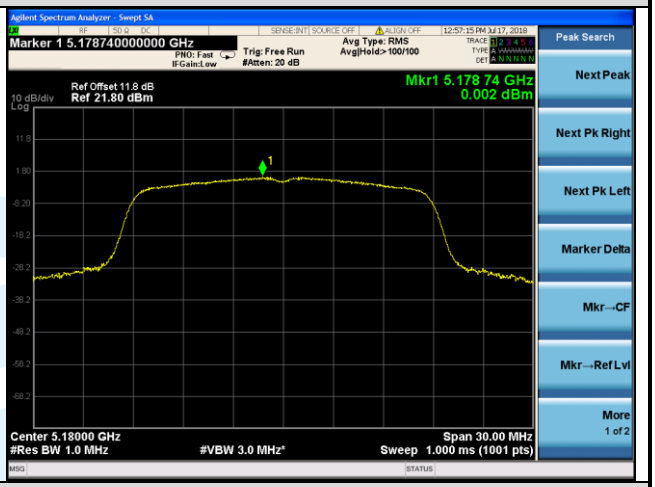
Channel 36	
	
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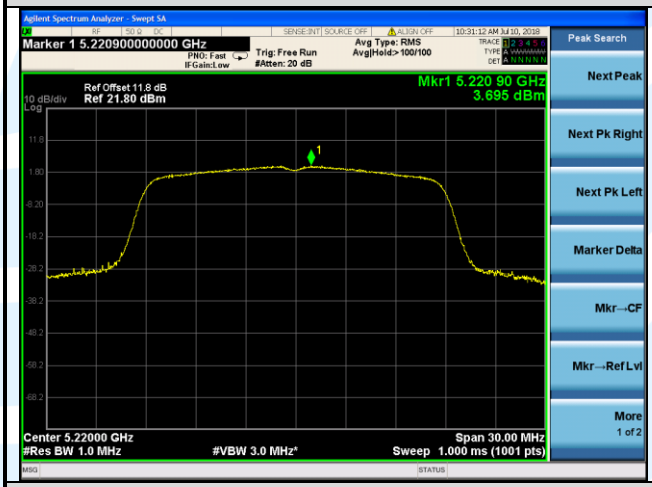	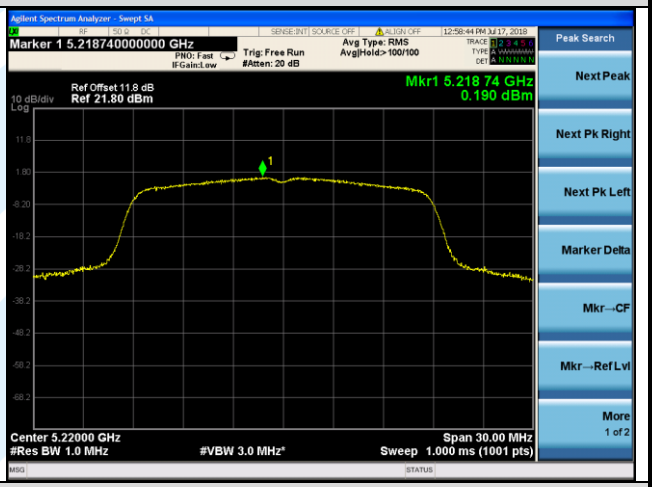
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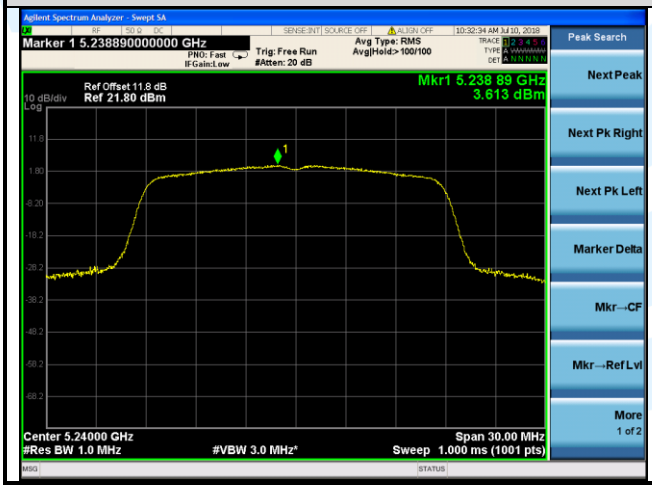	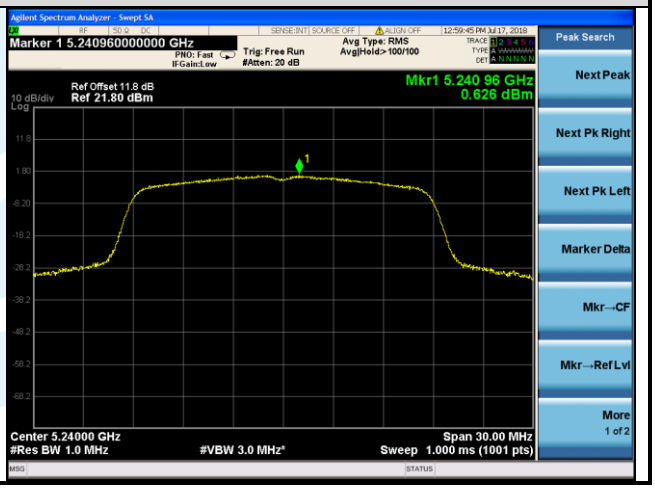

IEEE 802.11n-HT40	
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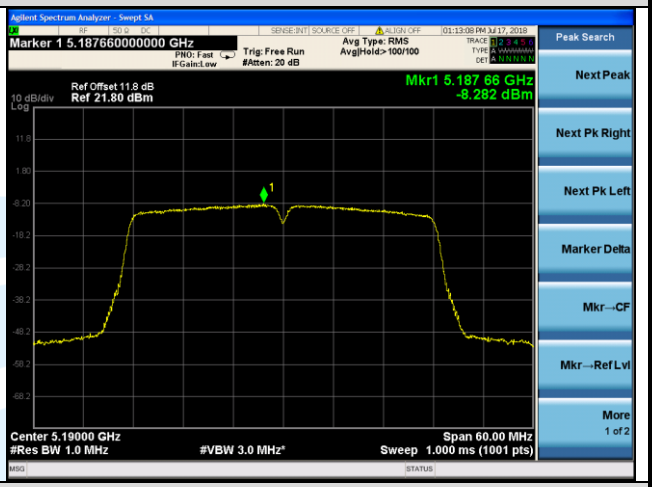
Channel 38	
	
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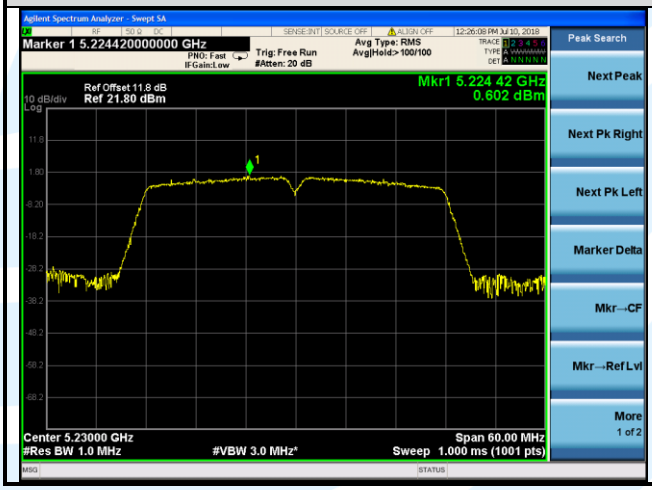	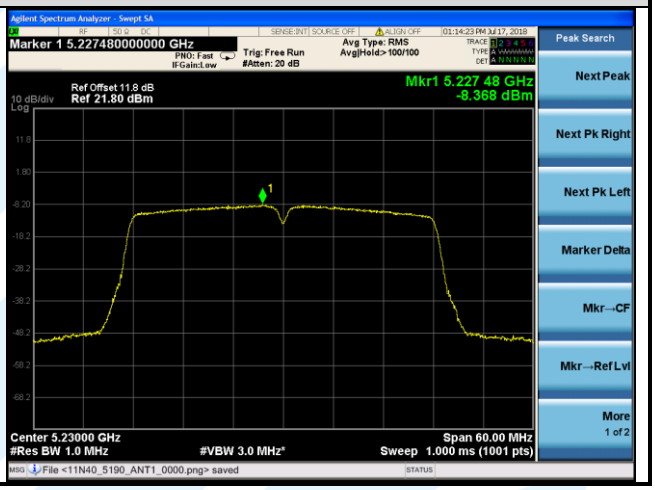

IEEE 802.11ac-VHT20	
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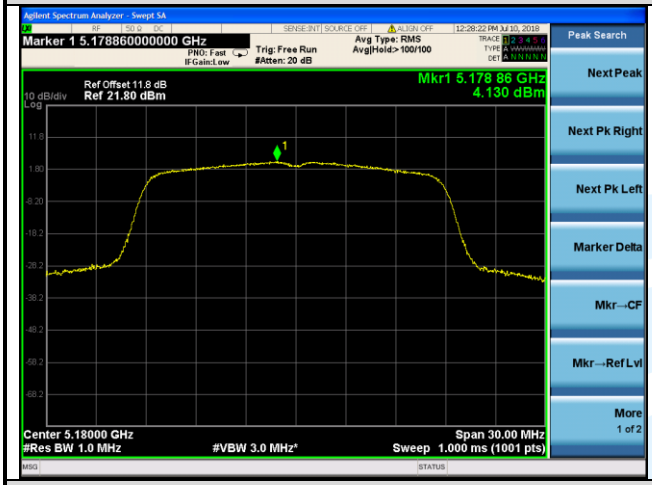	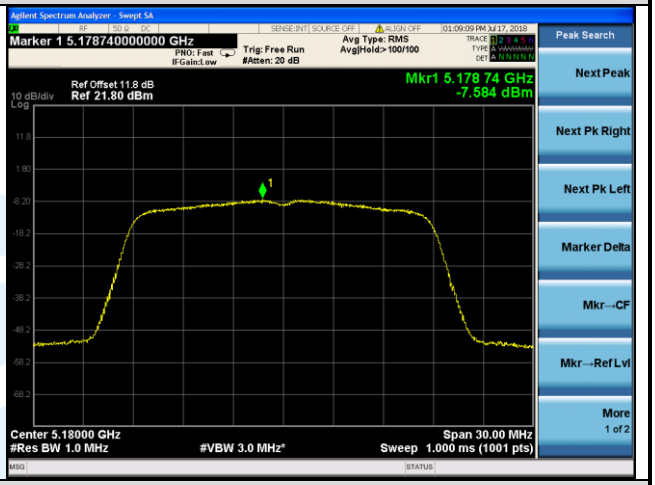
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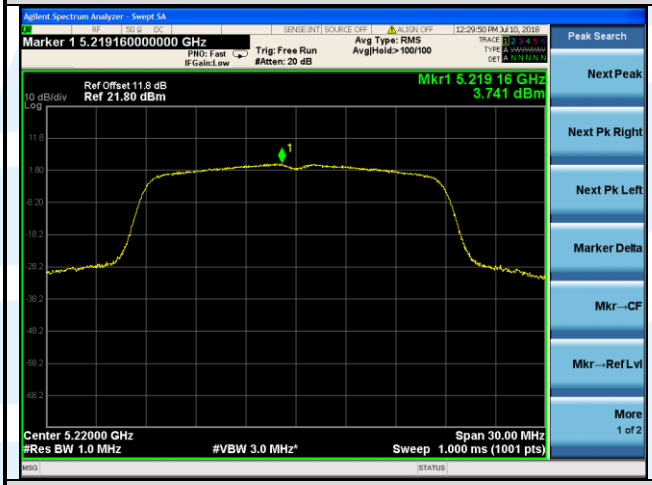	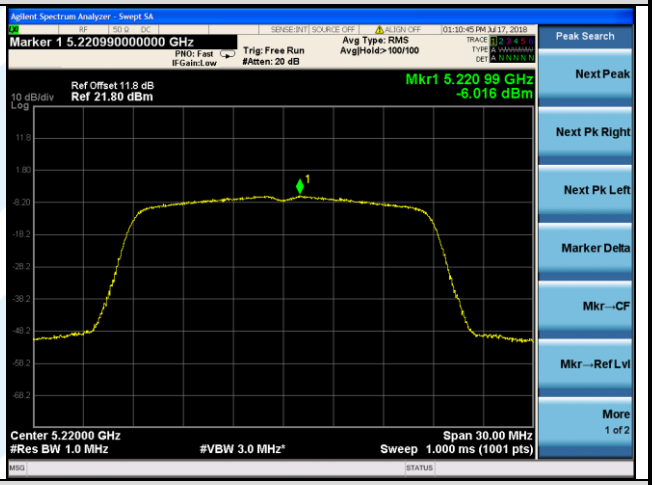
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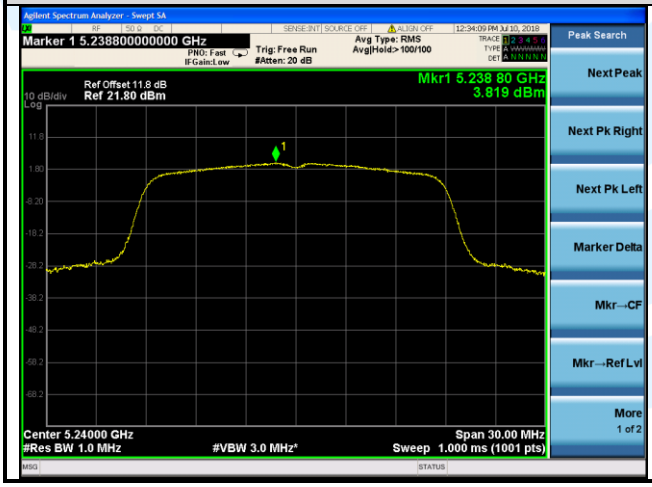	

IEEE 802.11ac-VHT40	
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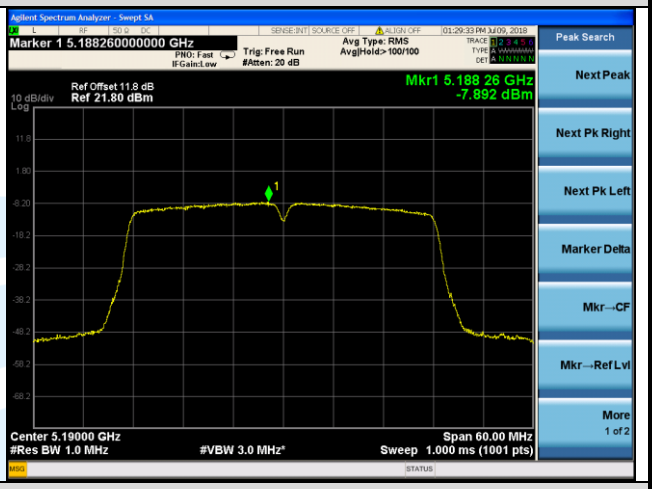
Channel 38	
	
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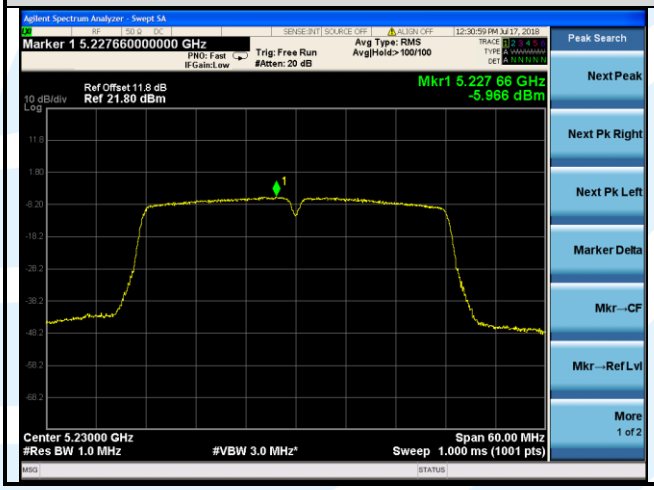
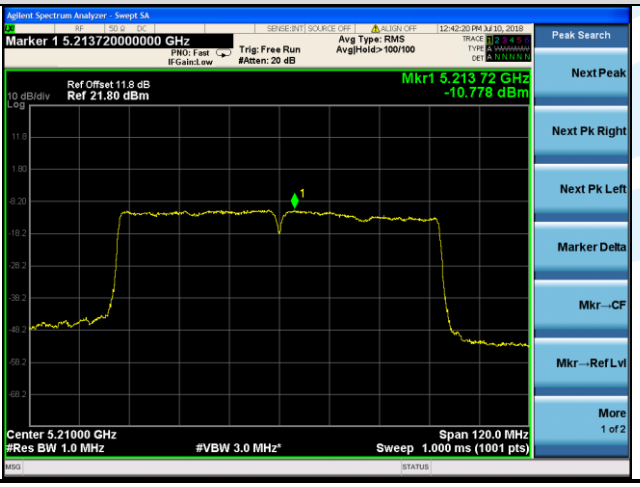
	

IEEE 802.11ac-VHT80	
Chain 0	Chain 1
Channel 42	
	

5.6 FREQUENCY STABILITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (g)
RSS-Gen Issue 5, Section 6.11

Test Method: ANSI C63.10-2013

Limit: The frequency of the carrier signal shall be maintained within band of operation.

Test Procedure:

a) To ensure emission at the band edge is maintained within the authorized band, those values shall be measured by radiation emissions at upper and lower frequency points, and finally compensated by frequency deviation as procedures below.
b) The EUT was operated at the maximum output power, and connected to the spectrum analyzer, which is set to maximum hold function and peak detector. The peak value of the power envelope was measured and noted. The upper and lower frequency points were respectively measured relatively 10 dB lower than the measured peak value.
c) The frequency deviation was calculated by adding the upper frequency point and the lower frequency point divided by two. Those detailed values of frequency deviation are provided in table below.

EUT Operation Condition:

☑ Keep the EUT transmit at un-modulation mode to frequency stability
☐ Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Frequency Stability Versus Temp.			
Operation Frequency: 5180 MHz			
Temp. (°C)	Voltage	Measured Frequency (MHz)	Frequency Drift (ppm)
0	VN	5180.017327	3.344981
10		5180.016545	3.194015
20		5180.015966	3.082239
30		5180.016343	3.155077
40		5180.016223	3.131911
50		5180.015150	2.924710
60		5180.014317	2.763822

Frequency Stability Versus Voltage			
Operation Frequency: 5180 MHz			
Temp.	Voltage	Measured Frequency (MHz)	Frequency Drift (ppm)
TN	VL	5180.015456	2.983784
	VN	5180.016335	3.153398
	VH	5180.018167	3.507143

The Maximum value is 3.507143 ppm.

It is proved that the frequency stability such that an emission is maintained within the band of operation under all condition.

5.7 RADIATED EMISSIONS AND BAND EDGE MEASUREMENT

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6)
FCC 47 CFR Part 15 Subpart C Section 15.209/205
RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2

Test Method: KDB 789033 D02 v01r04 Section G.3, G.4, G.5, and G.6

Receiver Setup:

Frequency	RBW
0.009 MHz-0.150 MHz	200/300 kHz
0.150 MHz -30 MHz	9/10 kHz
30 MHz-1 GHz	100/120 kHz
Above 1 GHz	1 MHz

Limits:

1. Limits of Radiated Emission and Band edge Measurement

Radiated emissions that fall in the restricted bands must comply with the general emissions limits in 15.209(a) as below table. Other emissions shall be at least 20 dB below the highest level of the desired power.

Frequency	Field strength (microvolt/meter)	Limit (dBμV/m)	Remark	Measurement distance (m)
0.009 MHz-0.490 MHz	2400/F(kHz)	--	--	300
0.490 MHz-1.705 MHz	24000/F(kHz)	--	--	30
1.705 MHz-30 MHz	30	--	--	30
30 MHz-88 MHz	100	40.0	Quasi-peak	3
88 MHz-216 MHz	150	43.5	Quasi-peak	3
216 MHz-960 MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1 GHz	500	54.0	Average	3

Remark:

a. The lower limit shall apply at the transition frequencies.
b. Emission level (dBuV/m) = 20 log Emission level (uV/m).
c. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

2. Limits of Unwanted Emission Out of the Restricted Bands

Applicable To	Limit	
789033 D02 General U-NII Test Procedures New Rules v02r01	Field Strength at 3 m	
	PK: 74 (dBμV/m)	AV: 54 (dBμV/m)
Applicable To	EIRP Limit	Equivalent Field Strength at 3 m
RSS-247 Issue 2 Section 6.2.1.2	PK: -27 (dBm/MHz)	PK: 74 (dBμV/m)
RSS-247 Issue 2 Section 6.2.2.2	PK: -27 (dBm/MHz)	PK: 74 (dBμV/m)
RSS-247 Issue 2 Section 6.2.3.2	PK: -27 (dBm/MHz)	PK: 68.2 (dBμV/m)
RSS-247 Issue 2 Section 6.2.4.2	27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;	PK: 68.2 (dBμV/m)
	15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;	
	10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27	

	dBm/MHz at 75 MHz above or below the band edges;	
	-27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.	

Test Setup: Refer to section 4.5.1 for details.

Test Procedures:

1. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
6. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Remark:

a) The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
b) The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
c) The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for RMS Average (Duty cycle < 98 %) for Average detection (AV) at frequency above 1 GHz, then the measurement results was added to a correction factor (10 log(1/duty cycle)).
d) The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) or ≥ 1/T(duty cycle is < 98%) for Average detection (AV) at frequency above 1 GHz.
e) All modes of operation were investigated and the worst-case emissions are reported.

Equipment Used: Refer to section 3 for details.

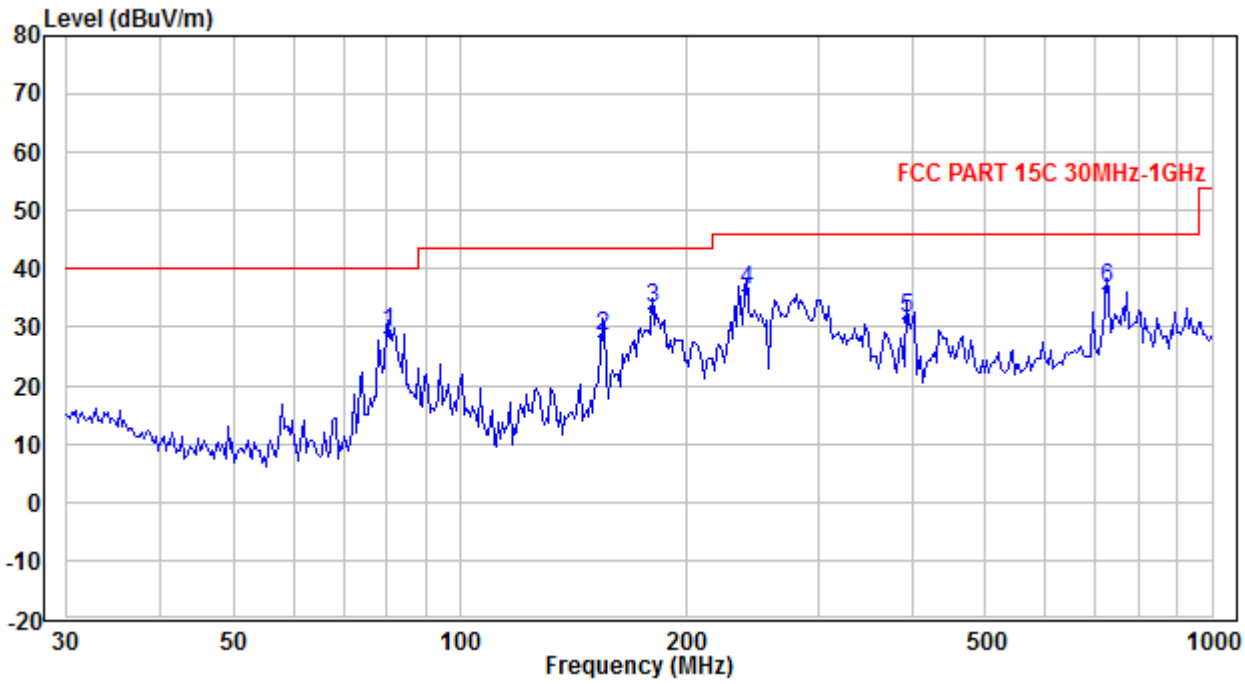
Test Result: Pass

The measurement data as follows:

Radiated Emission Test Data (9 KHz ~ 30 MHz):
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

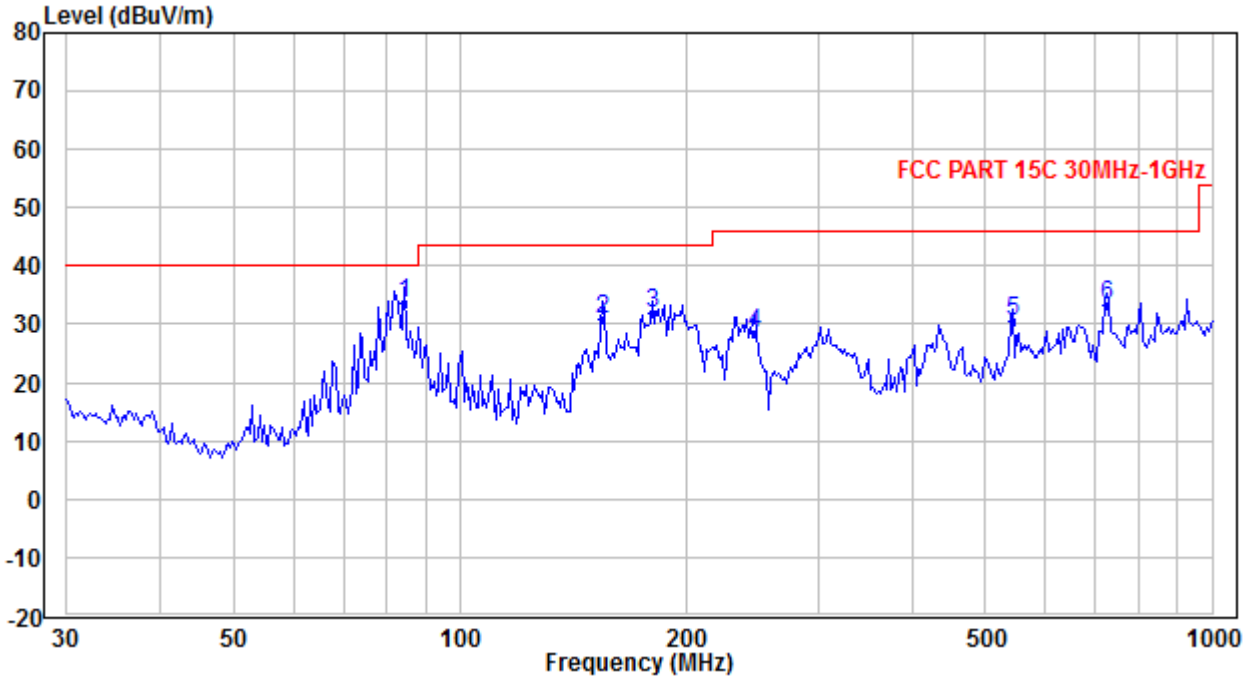
Radiated Emission Test Data (30 MHz ~ 1 GHz Worst Case):
Worst-Case Configuration

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	80.238	48.49	-19.22	29.27	40.00	-10.73	QP
2*	154.243	45.04	-16.48	28.56	43.50	-14.94	QP
3	180.030	48.54	-15.40	33.14	43.50	-10.36	QP
4	240.144	49.23	-12.92	36.31	46.00	-9.69	QP
5	392.738	39.69	-8.25	31.44	46.00	-14.56	QP
6	723.793	38.04	-1.45	36.59	46.00	-9.41	QP

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	84.284	52.38	-18.94	33.44	40.00	-6.56	QP
2	154.243	47.41	-16.48	30.93	43.50	-12.57	QP
3	180.030	47.41	-15.40	32.01	43.50	-11.49	QP
4*	246.990	41.02	-12.55	28.47	46.00	-17.53	QP
5	542.610	35.25	-4.63	30.62	46.00	-15.38	QP
6	723.793	34.63	-1.45	33.18	46.00	-12.82	QP

Radiated Emission Test Data (Above 1GHz):

SISO_ Chain 0_IEEE 802.11a_Channel 36

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10360.00	60.27	74.00	-13.73	Peak	Horizontal
2	10360.00	50.27	54.00	-3.73	Average	Horizontal
3	15540.00	49.78	74.00	-24.22	Peak	Horizontal
4	15540.00	39.78	54.00	-14.22	Average	Horizontal
5	10360.00	55.36	74.00	-18.64	Peak	Vertical
6	10360.00	45.04	54.00	-8.96	Average	Vertical
7	15540.00	49.33	74.00	-24.67	Peak	Vertical
8	15540.00	38.65	54.00	-15.35	Average	Vertical

SISO_ Chain 0_IEEE 802.11a_Channel 44

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10440.00	60.10	74.00	-13.90	Peak	Horizontal
2	10440.00	49.82	54.00	-4.18	Average	Horizontal
3	15660.00	49.09	74.00	-24.91	Peak	Horizontal
4	15660.00	38.12	54.00	-15.88	Average	Horizontal
5	10440.00	53.02	74.00	-20.98	Peak	Vertical
6	10440.00	42.82	54.00	-11.18	Average	Vertical
7	15660.00	49.43	74.00	-24.57	Peak	Vertical
8	15660.00	39.12	54.00	-14.88	Average	Vertical

SISO_ Chain 0_IEEE 802.11a_Channel 48

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10480.00	59.58	74.00	-14.42	Peak	Horizontal
2	10480.00	48.71	54.00	-5.29	Average	Horizontal
3	15720.00	49.91	74.00	-24.09	Peak	Horizontal
4	15720.00	39.32	54.00	-14.68	Average	Horizontal
5	10480.00	55.49	74.00	-18.51	Peak	Vertical
6	10480.00	44.71	54.00	-9.29	Average	Vertical
7	15720.00	49.17	74.00	-24.83	Peak	Vertical
8	15720.00	38.32	54.00	-15.68	Average	Vertical

SISO_ Chain 1_IEEE 802.11a_Channel 36

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10360.00	51.42	74.00	-22.58	Peak	Horizontal
2	10360.00	41.32	54.00	-12.68	Average	Horizontal
3	15540.00	48.04	74.00	-25.96	Peak	Horizontal
4	15540.00	38.14	54.00	-15.86	Average	Horizontal
5	10360.00	46.77	74.00	-27.23	Peak	Vertical
6	10360.00	36.79	54.00	-17.21	Average	Vertical
7	15540.00	49.15	74.00	-24.85	Peak	Vertical
8	15540.00	39.45	54.00	-14.55	Average	Vertical

SISO_ Chain 1_IEEE 802.11a_Channel 44

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10440.00	53.19	74.00	-20.81	Peak	Horizontal
2	10440.00	43.29	54.00	-10.71	Average	Horizontal
3	15660.00	49.08	74.00	-24.92	Peak	Horizontal
3	15660.00	39.28	54.00	-14.72	Average	Horizontal
5	10440.00	46.70	74.00	-27.30	Peak	Vertical
6	10440.00	36.32	54.00	-17.68	Average	Vertical
7	15660.00	48.98	74.00	-25.02	Peak	Vertical
8	15660.00	38.45	54.00	-15.55	Average	Vertical

SISO_ Chain 1_IEEE 802.11a_Channel 48

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10480.00	52.24	74.00	-21.76	Peak	Horizontal
2	10480.00	41.26	54.00	-12.74	Average	Horizontal
3	15720.00	49.59	74.00	-24.41	Peak	Horizontal
4	15720.00	39.79	54.00	-14.21	Average	Horizontal
5	10480.00	48.30	74.00	-25.70	Peak	Vertical
6	10480.00	38.32	54.00	-15.68	Average	Vertical
7	15720.00	48.68	74.00	-25.32	Peak	Vertical
8	15720.00	38.28	54.00	-15.72	Average	Vertical

IEEE 802.11n-HT20_Channel 36

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10360.00	60.59	74.00	-13.41	Peak	Horizontal
2	10360.00	50.04	54.00	-3.96	Average	Horizontal
3	15540.00	52.44	74.00	-21.56	Peak	Horizontal
4	15540.00	41.65	54.00	-12.35	Average	Horizontal
5	10360.00	56.19	74.00	-17.81	Peak	Vertical
6	10360.00	46.04	54.00	-7.96	Average	Vertical
7	15540.00	54.30	74.00	-19.70	Peak	Vertical
8	15540.00	43.65	54.00	-10.35	Average	Vertical

IEEE 802.11n-HT20_Channel 44

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10440.00	61.30	74.00	-12.70	Peak	Horizontal
2	10440.00	50.82	54.00	-3.18	Average	Horizontal
3	15660.00	52.11	74.00	-21.89	Peak	Horizontal
4	15660.00	41.12	54.00	-12.88	Average	Horizontal
5	10440.00	55.11	74.00	-18.89	Peak	Vertical
6	10440.00	44.82	54.00	-9.18	Average	Vertical
7	15660.00	51.64	74.00	-22.36	Peak	Vertical
8	15660.00	42.12	54.00	-11.88	Average	Vertical

IEEE 802.11n-HT20_Channel 48

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10480.00	61.69	74.00	-12.31	Peak	Horizontal
2	10480.00	48.17	54.00	-5.83	Average	Horizontal
3	15720.00	50.74	74.00	-23.26	Peak	Horizontal
4	15720.00	41.32	54.00	-12.68	Average	Horizontal
5	10480.00	55.61	74.00	-18.39	Peak	Vertical
6	10480.00	44.71	54.00	-9.29	Average	Vertical
7	15720.00	50.53	74.00	-23.47	Peak	Vertical
8	15720.00	41.32	54.00	-12.68	Average	Vertical

IEEE 802.11n-HT40_Channel 38

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10380.00	49.18	74.00	-24.82	Peak	Horizontal
2	10380.00	39.29	54.00	-14.71	Average	Horizontal
3	15570.00	47.81	74.00	-26.19	Peak	Horizontal
4	15570.00	37.71	54.00	-16.29	Average	Horizontal
5	10380.00	45.91	74.00	-28.09	Peak	Vertical
6	10380.00	35.99	54.00	-18.01	Average	Vertical
7	15570.00	47.77	74.00	-26.23	Peak	Vertical
8	15570.00	37.97	54.00	-16.03	Average	Vertical

IEEE 802.11n-HT40_Channel 46

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10460.00	48.96	74.00	-25.04	Peak	Horizontal
2	10460.00	38.95	54.00	-15.05	Average	Horizontal
3	15690.00	48.84	74.00	-25.16	Peak	Horizontal
4	15690.00	38.84	54.00	-15.16	Average	Horizontal
5	10460.00	48.75	74.00	-25.25	Peak	Vertical
6	10460.00	38.85	54.00	-15.15	Average	Vertical
7	15690.00	48.91	74.00	-25.09	Peak	Vertical
8	15690.00	39.97	54.00	-14.03	Average	Vertical

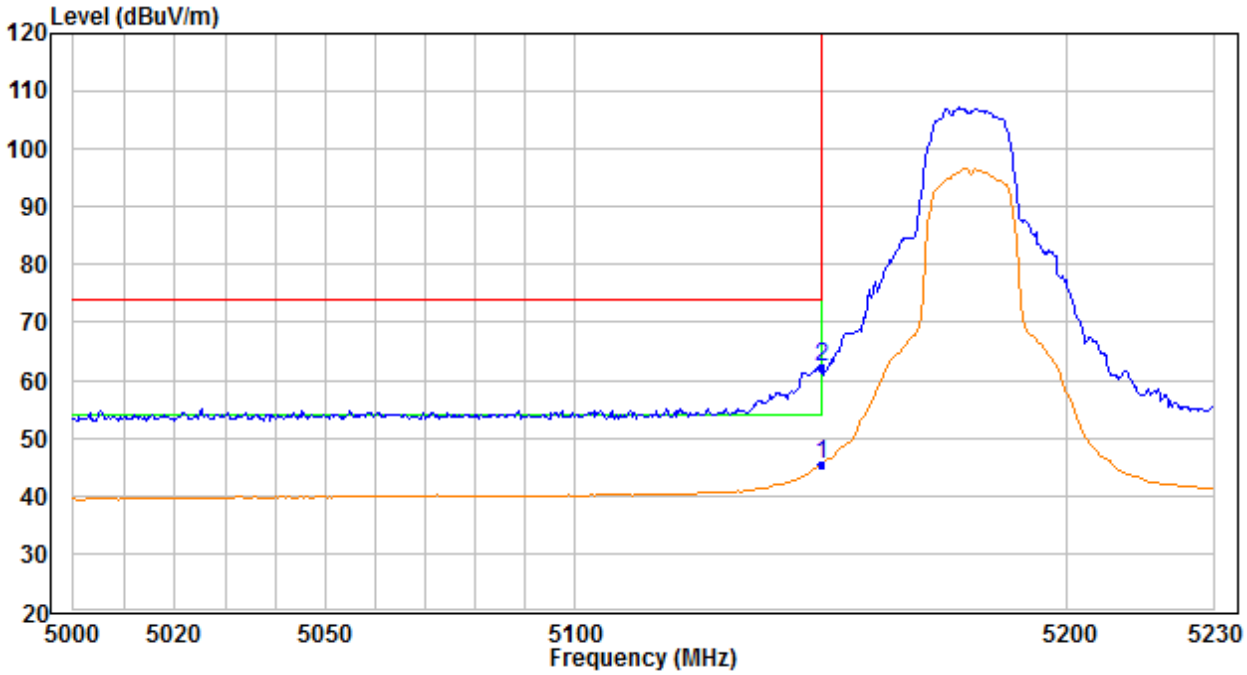
IEEE 802.11ac-VHT80_Channel 42

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	10420.00	46.86	74.00	-27.14	Peak	Horizontal
2	10420.00	39.82	54.00	-14.18	Average	Horizontal
3	15630.00	48.98	74.00	-25.02	Peak	Horizontal
4	15630.00	39.48	54.00	-14.52	Average	Horizontal
5	10420.00	46.09	74.00	-27.91	Peak	Vertical
6	10420.00	38.29	54.00	-15.71	Average	Vertical
7	15630.00	48.46	74.00	-25.54	Peak	Vertical
8	15630.00	39.49	54.00	-14.51	Average	Vertical

Band Edge Measurements (Radiated)

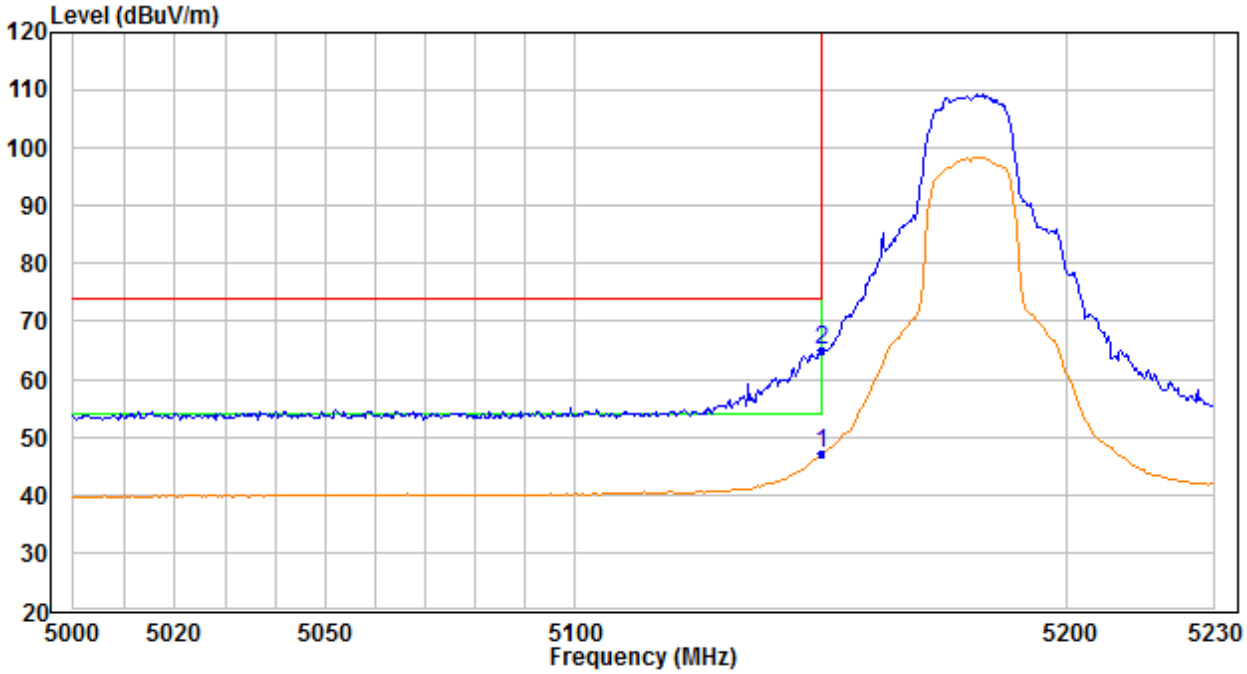
SISO_Chain 0_IEEE 802.11a

Test Channel:	Channel 36	Ant. Polar. :	Horizontal



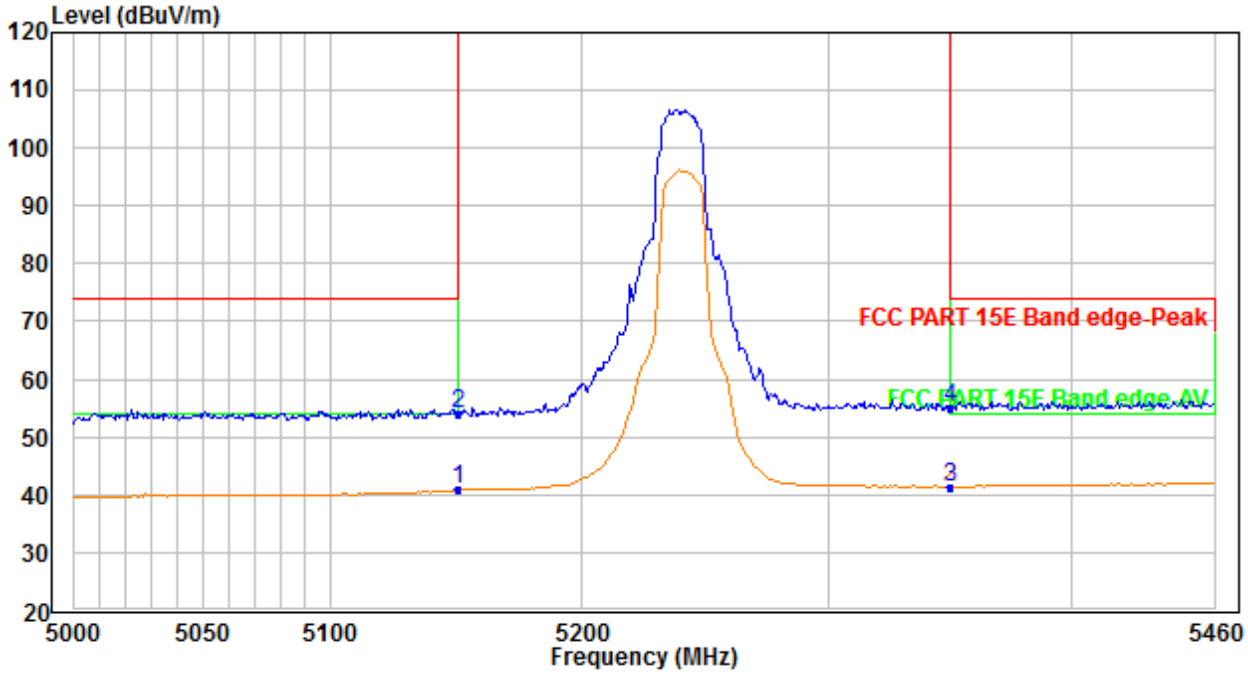
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	62.10	74.00	45.36	54.00	Pass

Test Channel:	Channel 36	Ant. Polar. :	Vertical



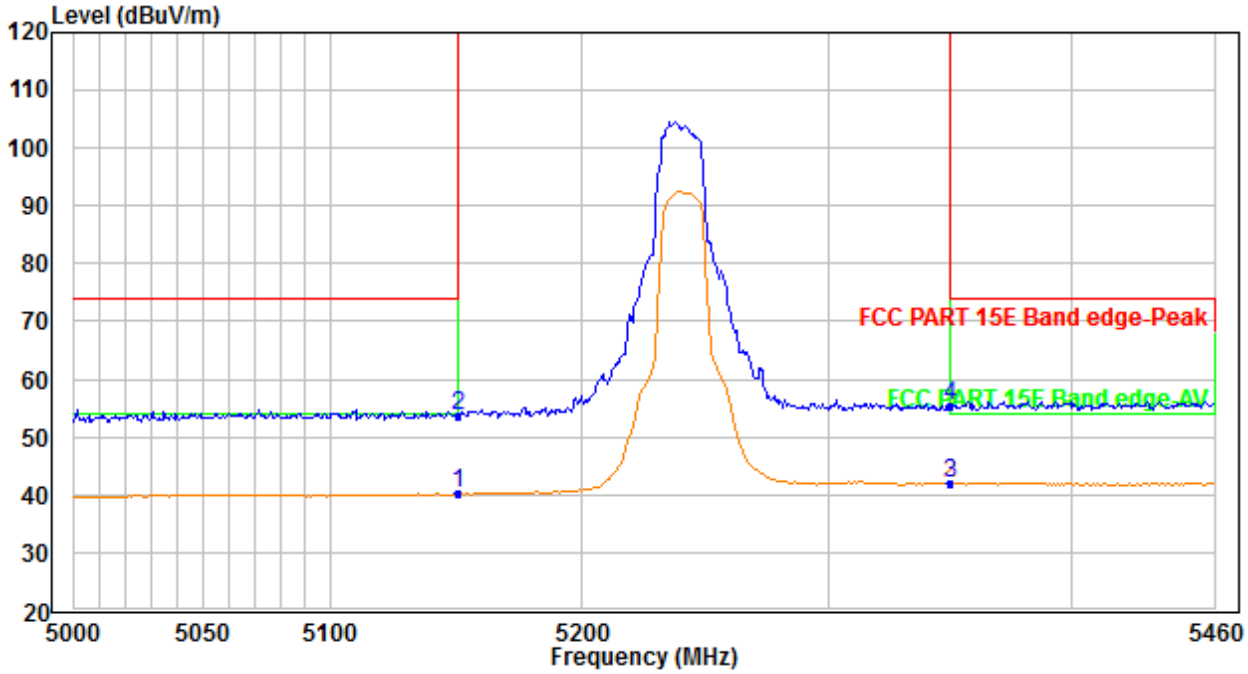
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	65.13	74.00	47.03	54.00	Pass

Test Channel:	Channel 48	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	54.18	74.00	40.81	54.00	Pass
5350.00	55.12	74.00	41.42	54.00	Pass

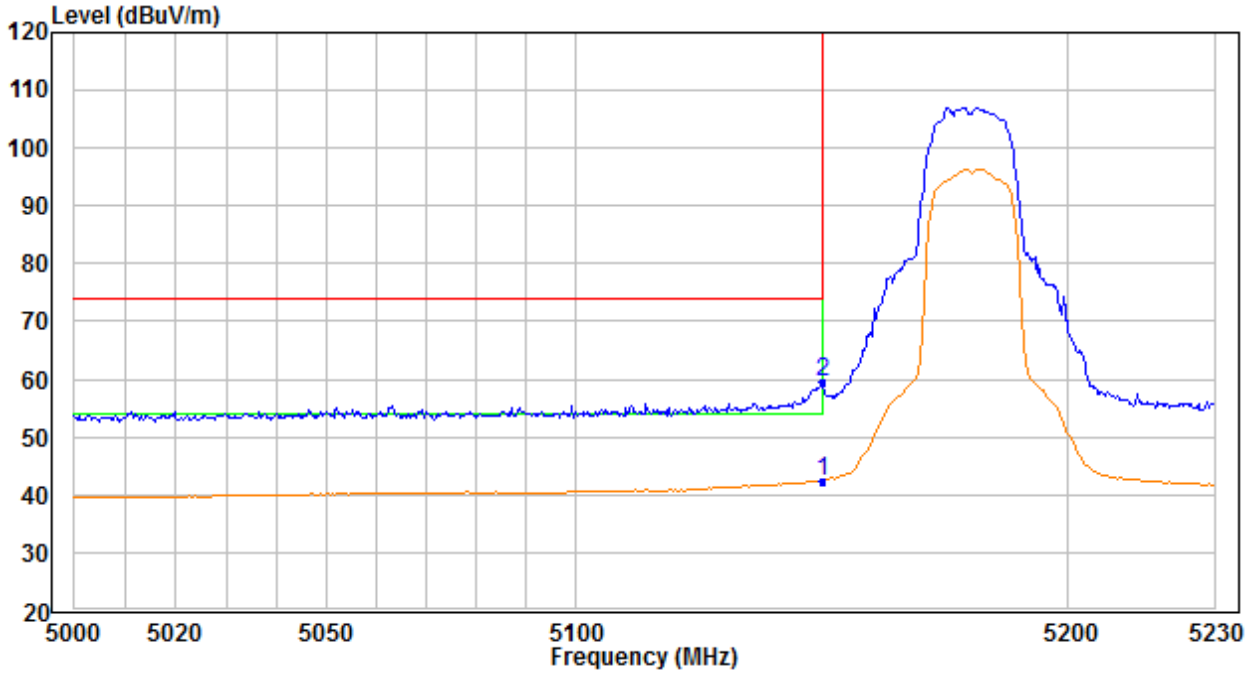
Test Channel:	Channel 48	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	53.59	74.00	40.13	54.00	Pass
5350.00	55.42	74.00	41.83	54.00	Pass

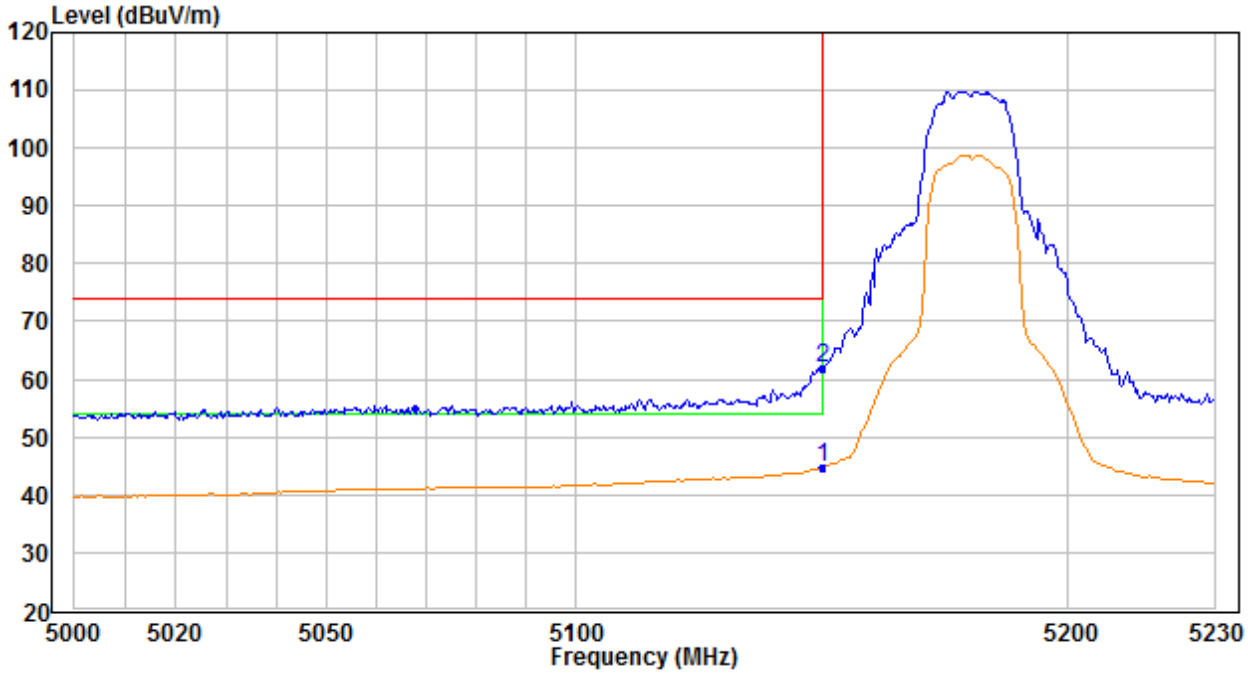
SISO_Chain 1_IEEE 802.11a

Test Channel:	Channel 36	Ant. Polar. :	Horizontal



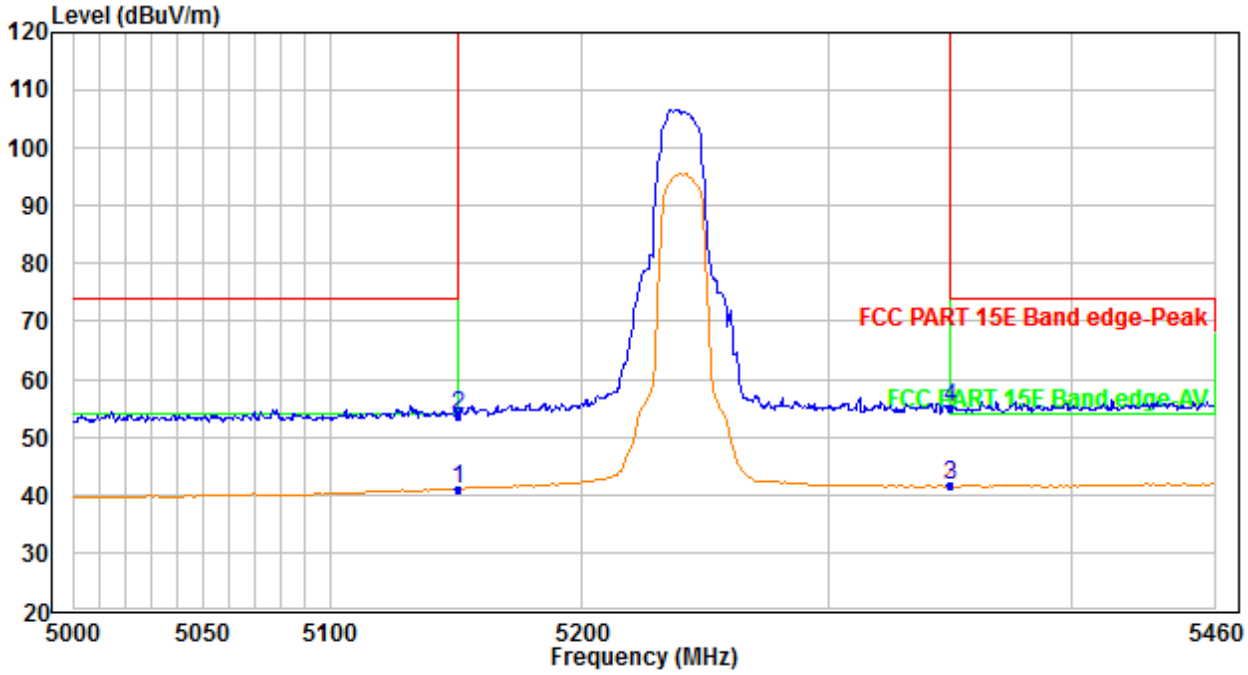
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	59.39	74.00	42.49	54.00	Pass

Test Channel:	Channel 36	Ant. Polar. :	Vertical



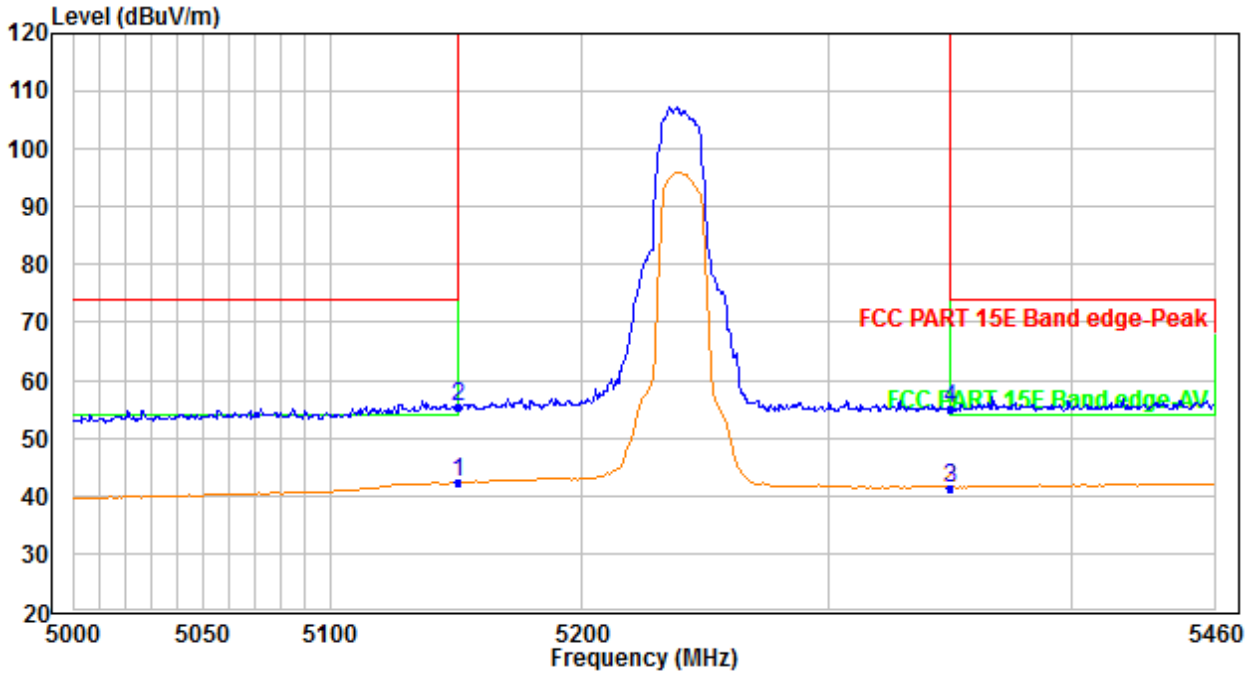
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	61.82	74.00	44.78	54.00	Pass

Test Channel:	Channel 48	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5350.00	55.17	74.00	41.54	54.00	Pass

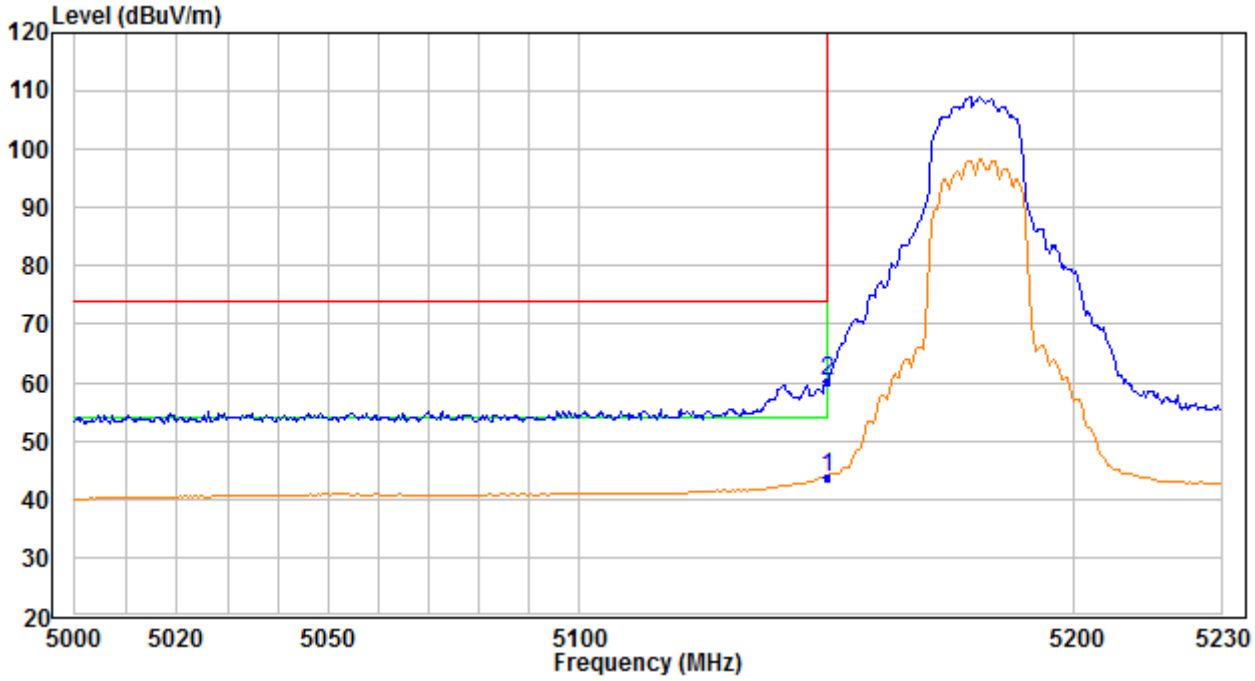
Test Channel:	Channel 48	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5350.00	55.03	74.00	41.47	54.00	Pass

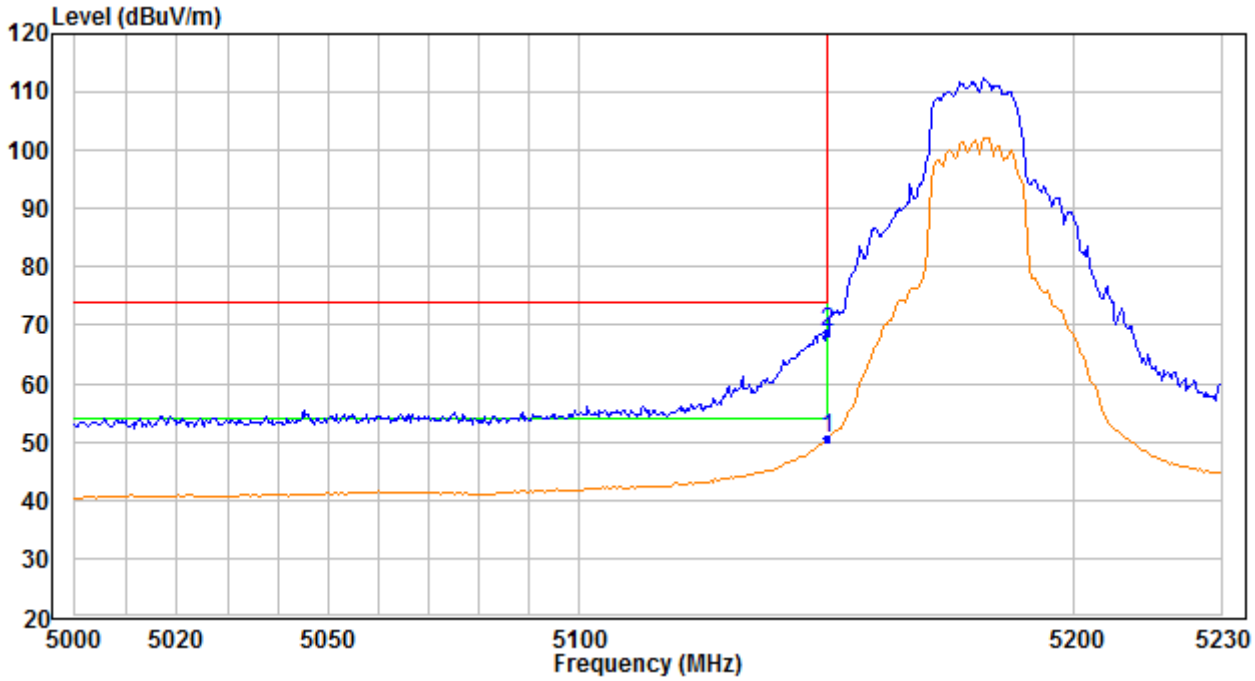
MIMO_Chain 0+1_IEEE 802.11n-HT20

Test Channel:	Channel 36	Ant. Polar. :	Horizontal



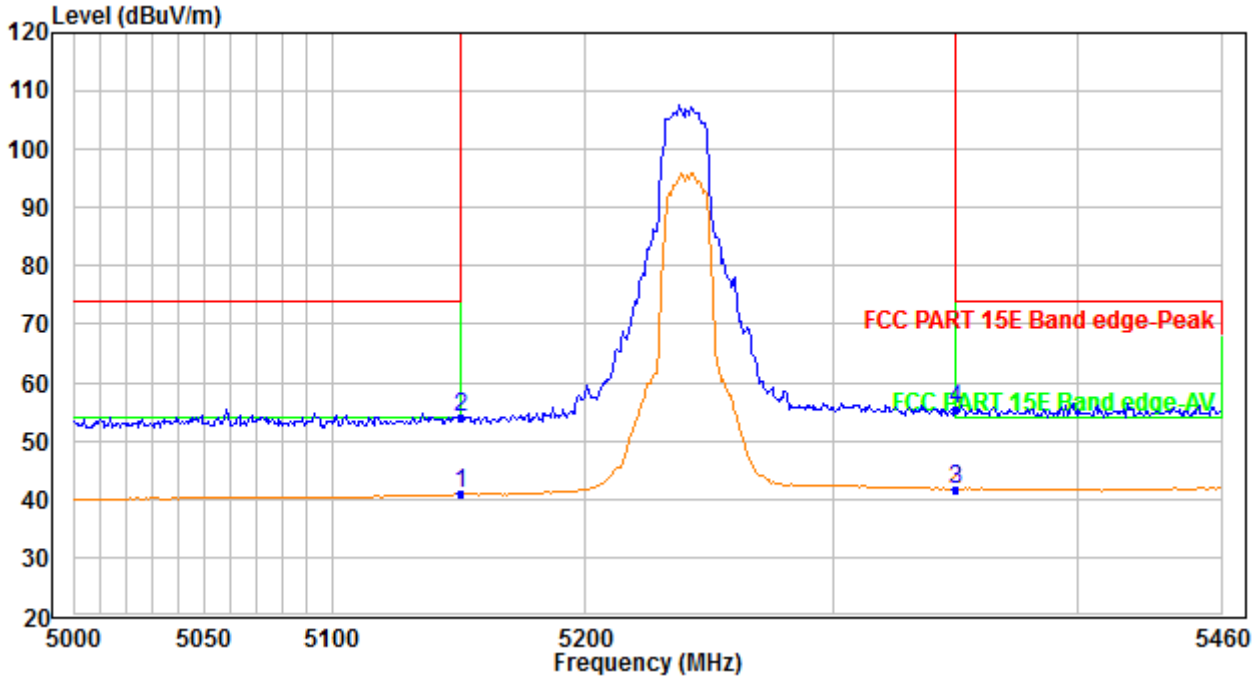
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150	60.17	74	43.59	54	Pass

Test Channel:	Channel 36	Ant. Polar. :	Vertical



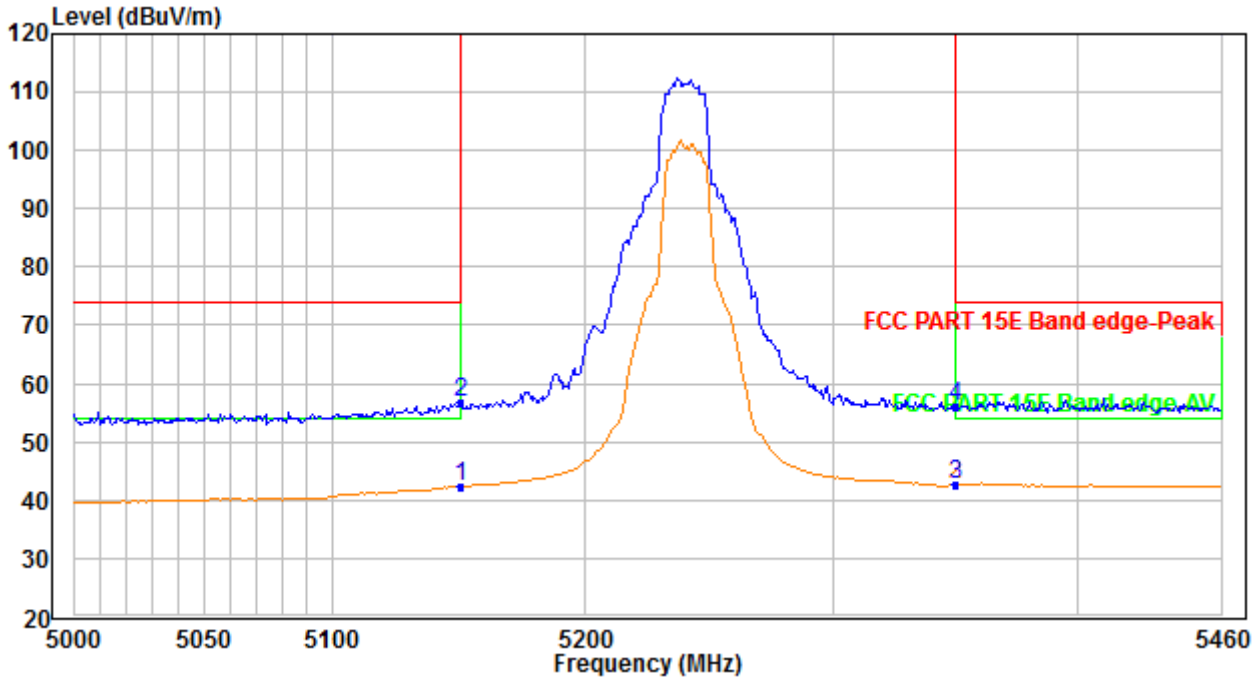
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150	68.70	74	50.49	54	Pass

Test Channel:	Channel 48	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5350	55.37	74	41.71	54	Pass

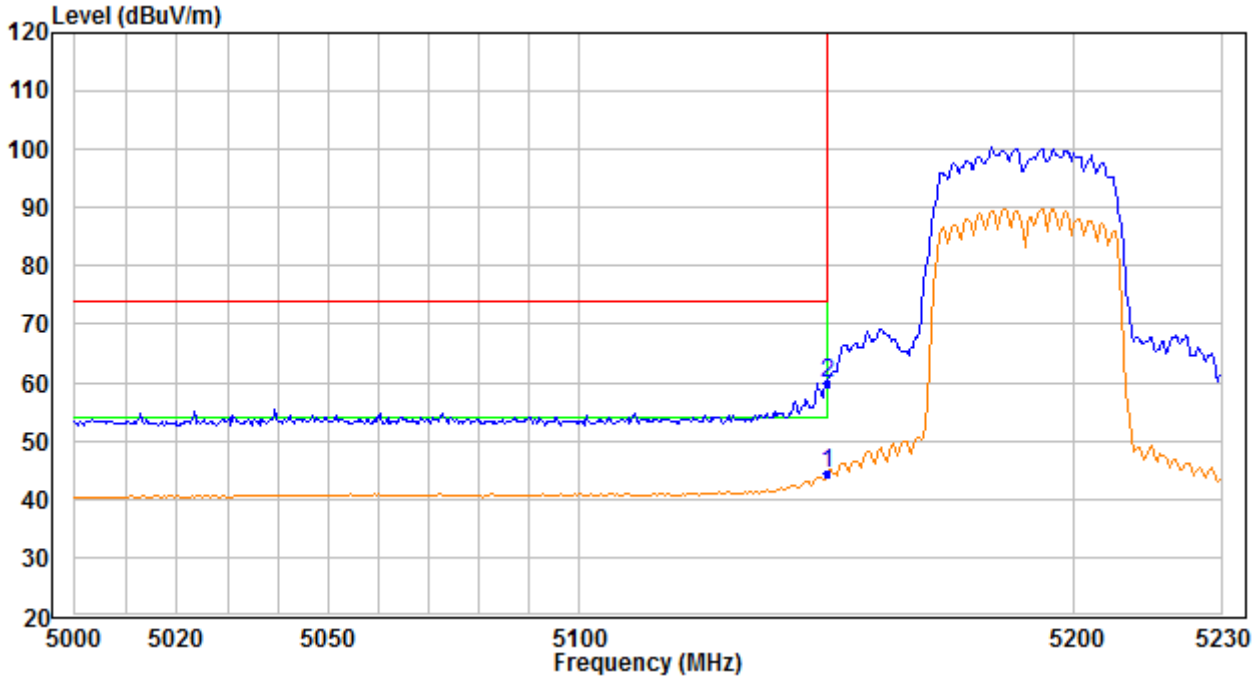
Test Channel:	Channel 48	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5350	56.21	74	42.52	54	Pass

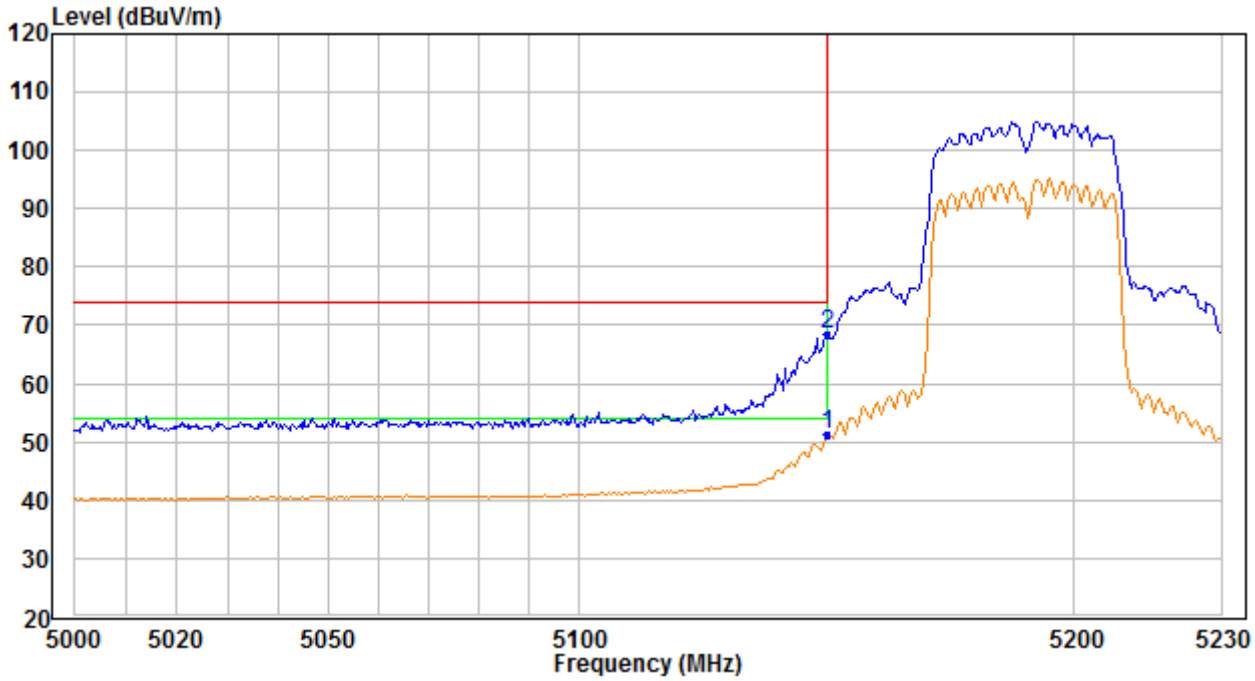
MIMO_Chain 0+1_IEEE 802.11n-HT40

Test Channel:	Channel 38	Ant. Polar. :	Horizontal



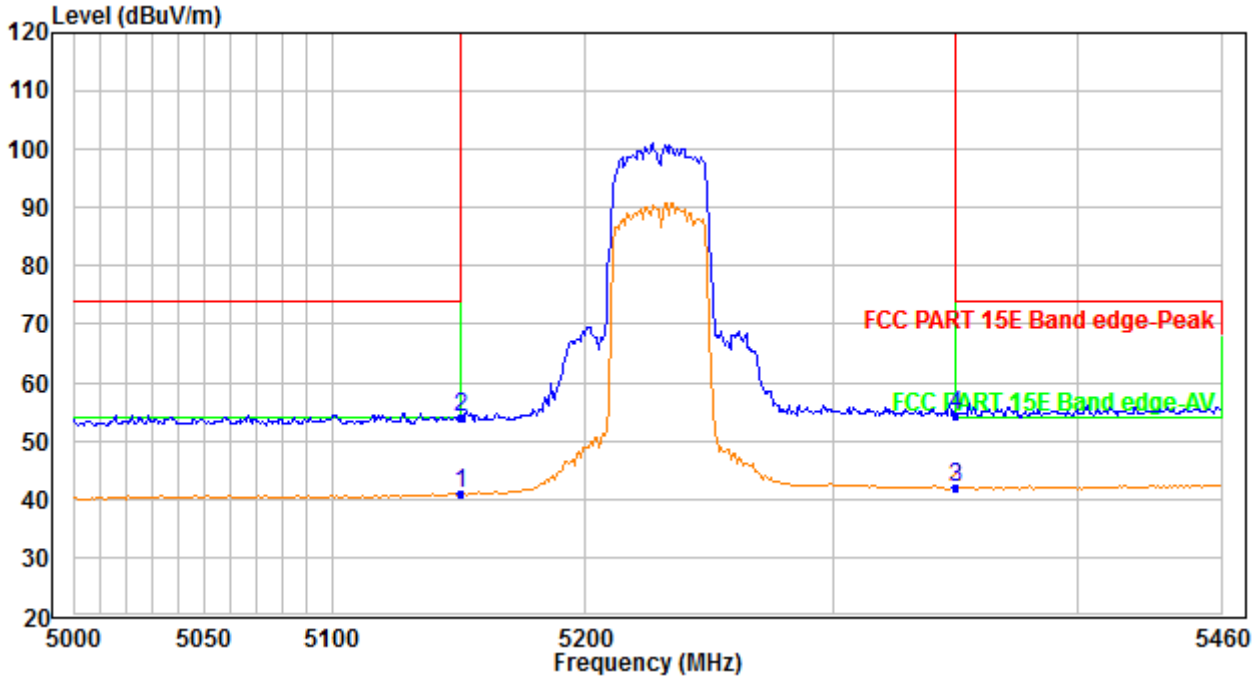
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150	59.81	74	44.47	54	Pass

Test Channel:	Channel 38	Ant. Polar. :	Vertical



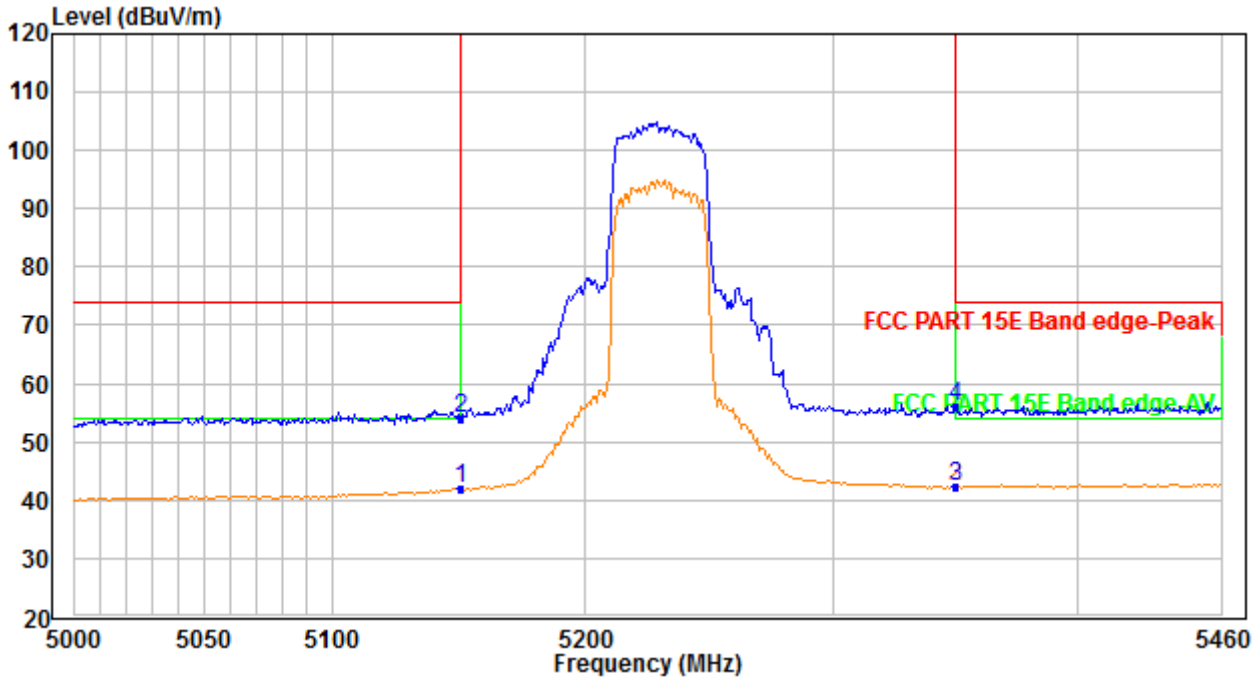
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150	53.44	68.61	51.34	54	Pass

Test Channel:	Channel 46	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5350	54.50	74	41.87	54	Pass

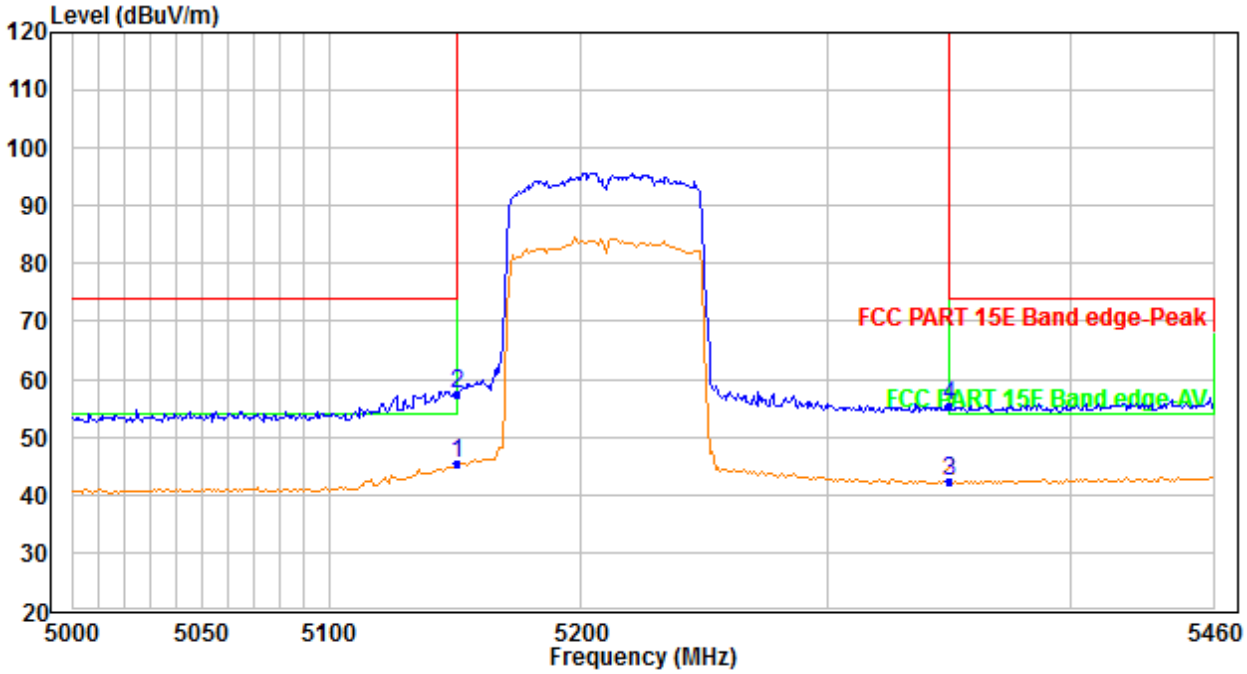
Test Channel:	Channel 46	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5350	55.94	74	42.27	54	Pass

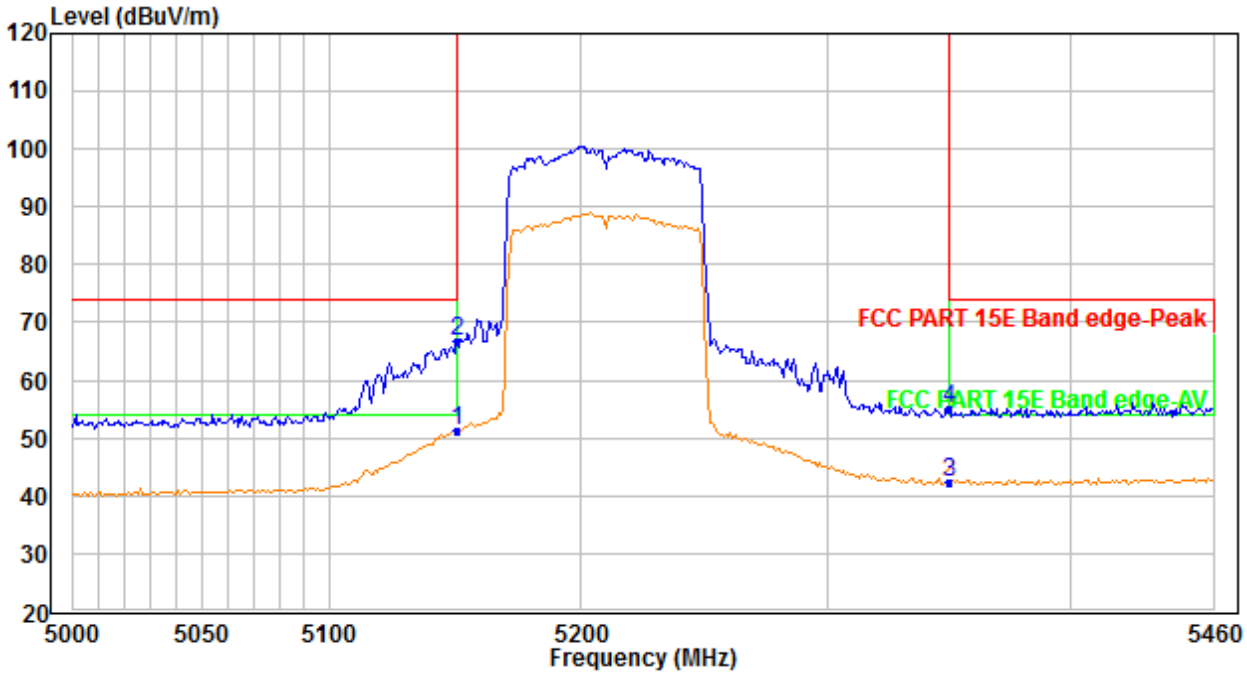
MIMO_Chain 0+1_IEEE 802.11ac-VHT80

Test Channel:	Channel 42	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	57.49	74.00	45.26	54.00	Pass
5350.00	55.31	74.00	42.17	54.00	Pass

Test Channel:	Channel 42	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
5150.00	66.84	74.00	51.17	54.00	Pass
5350.00	55.06	74.00	42.38	54.00	Pass

5.8 AC POWER LINE CONDUCTED EMISSION

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.207
RSS-Gen Issue 5, Section 8.8

Test Method: ANSI C63.10-2013 Section 6.2

Limits:

Frequency range (MHz)	Limits (dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

Remark:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

Test Setup: Refer to section 4.4.2 for details.

Test Procedures:

Test frequency range :150KHz-30MHz

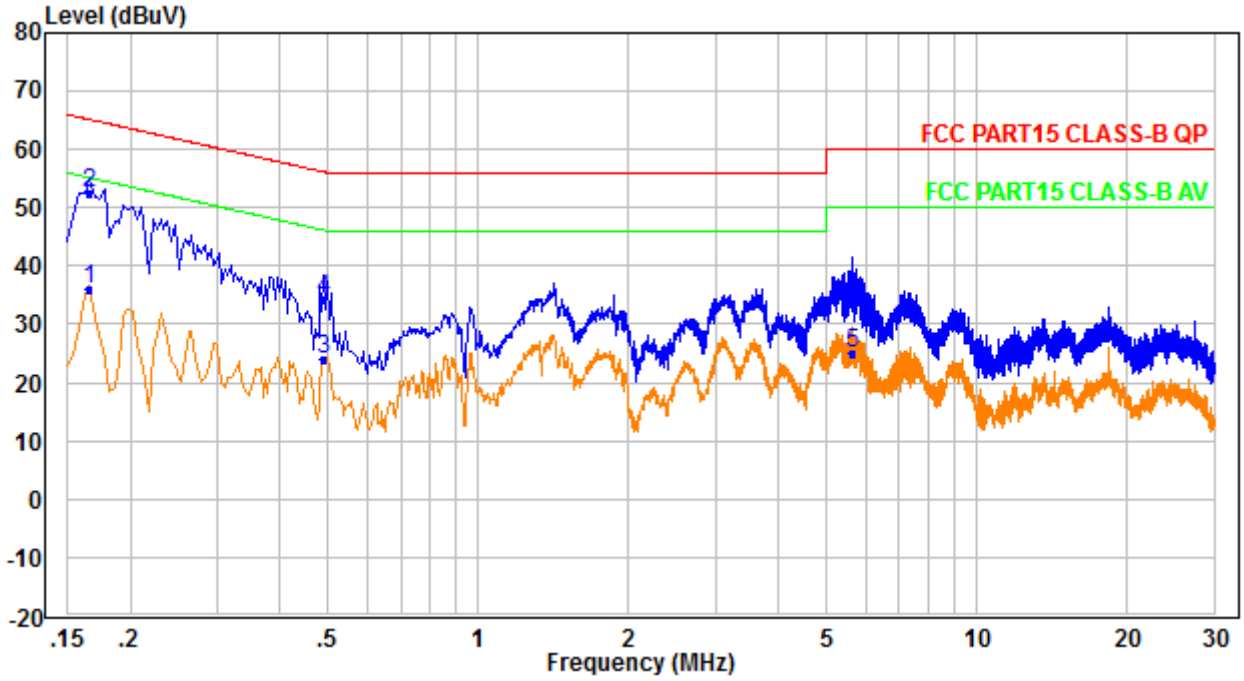
1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

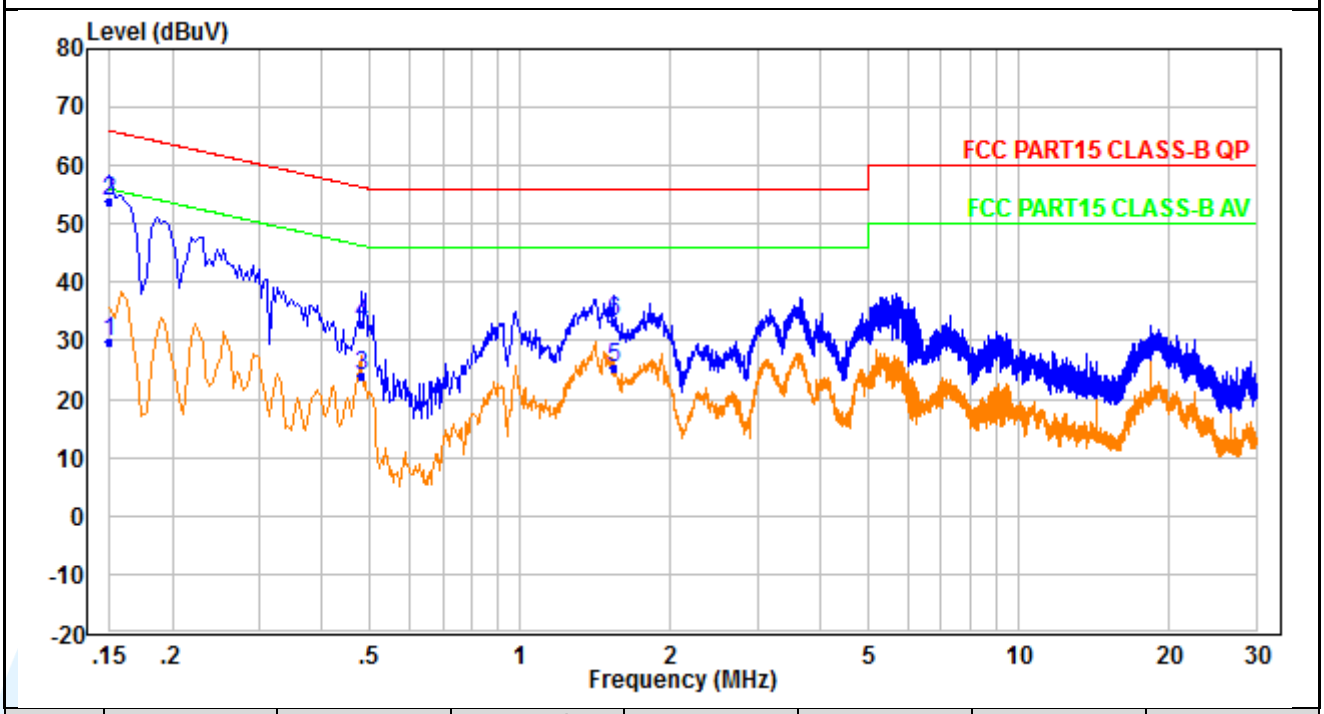
The measurement data as follows:
Quasi Peak and Average:
Mode: WIFI Link

Live Line



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.166	25.90	10.20	36.10	65.20	-29.10	Average
2	0.166	42.20	10.20	52.40	65.20	-12.80	QP
3	0.490	13.70	10.30	24.00	56.20	-32.20	Average
4	0.490	24.00	10.30	34.30	56.20	-21.90	QP
5*	5.626	14.60	10.50	25.10	60.00	-34.90	Average
6	5.626	23.10	10.50	33.60	60.00	-26.40	QP

Neutral Line



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1*	0.150	19.60	10.20	29.80	66.00	-36.20	Average
2	0.150	43.60	10.20	53.80	66.00	-12.20	QP
3	0.482	13.50	10.40	23.90	56.30	-32.40	Average
4	0.482	22.60	10.40	33.00	56.30	-23.30	QP
5	1.542	15.00	10.40	25.40	56.00	-30.60	Average
6	1.542	22.80	10.40	33.20	56.00	-22.80	QP

Remark:
1. An initial pre-scan was performed on the Phase and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

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