



Shenzhen CTL Testing Technology Co., Ltd.
Tel: +86-755-89486194 E-mail: ctl@ctl-lab.com

TEST REPORT

FCC PART 15 SUBPART E 15.407

Report Reference No: **CTL1808037031-WF02**

Compiled by: (position+printed name+signature)	Happy Guo (File administrators)	
Tested by: (position+printed name+signature)	Nice Nong (Test Engineer)	
Approved by: (position+printed name+signature)	Ivan Xie (Manager)	

Product Name	VoIP Wireless Router
Model/Type reference	FWR9601
List Model(s)	FWR9600
Trade Mark	Flyingvoice
FCC ID	2AL9D-FWR9601
Applicant's name	Flyingvoice Network Technology Co., Ltd
Address of applicant	Rm 207-209, Unit B52, Zhong Chuang Industrial Park, Nanshan District, Shenzhen, China
Test Firm	Shenzhen CTL Testing Technology Co., Ltd.
Address of Test Firm	Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055
Test specification	
Standard	47 CFR FCC Part 15 Subpart E 15.407
TRF Originator	Shenzhen CTL Testing Technology Co., Ltd.
Master TRF	Dated 2011-01
Date of Receipt	Aug. 19, 2018
Date of Test Date	Aug. 19, 2018–Dec.18, 2018
Data of Issue	Dec.18, 2018
Result	Pass

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TEST REPORT

Test Report No. :	CTL1808037031-WF02	Dec.18, 2018 Date of issue
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Equipment under Test : VoIP Wireless Router

Model /Type : FWR9601

Listed Models : FWR9600

Applicant : Flyingvoice Network Technology Co., Ltd

Address : Rm 207-209, Unt B52, Zhong Chuang Industrial Park, Nanshan District, Shenzhen, China

Manufacturer : Flyingvoice Network Technology Co., Ltd

Address : Rm 207-209, Unt B52, Zhong Chuang Industrial Park, Nanshan District, Shenzhen, China

Test result	Pass *
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* In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

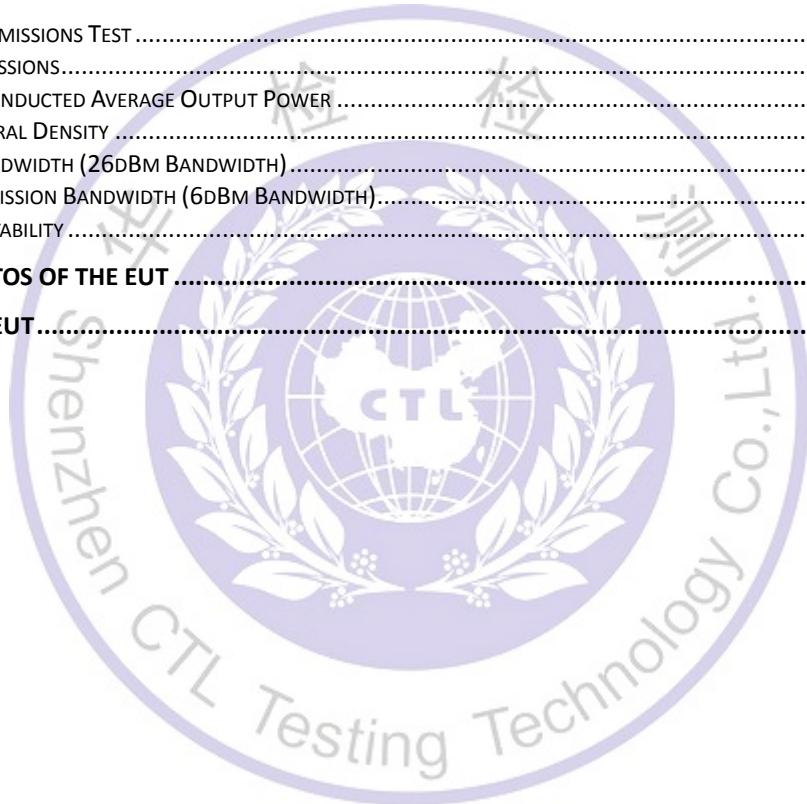
**** Modified History ****

Revisions	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2018-12-19	CTL1808037031-WF02	Tracy Qi



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1. SUMMARY

1.1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15 Subpart E—Unlicensed National Information Infrastructure Devices

ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

KDB789033 D02: General UNII Test Procedures New Rules v02r01

1.2. Test Description

FCC Requirement		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.407(a)	Emission Bandwidth(26dBm Bandwidth)	PASS _{Note1}
FCC Part 15.407(e)	Minimum Emission Bandwidth(6dBm Bandwidth)	PASS _{Note2}
FCC Part 15.407(a)	Maximum Conducted Output Power	PASS
FCC Part 15.407(a)	Peak Power Spectral Density	PASS
FCC Part 15.407(g)	Frequency Stability	PASS
FCC Part 15.407(b)	Undesirable emission	PASS
FCC Part 15.407(b)/15.205/15.209	Radiated Emissions	PASS
FCC Part 15.407(h)	Dynamic Frequency Selection	N/A _{Note 3}
FCC Part 15.203/15.247(b)	Antenna Requirement	PASS

Note 1: Apply to U-NII 1, U-NII 2A, and U-NII 2C band.

Note 2: Apply to U-NII 3 band only.

Note 3: This device not work in DFS band.

1.3. Test Facility

1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.

Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.3.2 Laboratory accreditation

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

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

FCC-Registration No.: 399832

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 399832, December 08, 2017.

1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance 0.15~30MHz	±3.20dB	(1)

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

2. GENERAL INFORMATION

2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2. General Description of EUT

Product Name:	VoIP Wireless Router			
Model:	FWR9601			
Power supply:	DC 12V from AC adapter			
WIFI				
	20MHz system	40MHz system	80MHz system	160MHz system
Supported type:	802.11a 802.11n 802.11ac	802.11n 802.11ac	802.11ac	N/A
Operation frequency:	5180-5240MHz 5745-5825MHz	5190-5230MHz 5755MHz-5795MHz	5210MHz; 5775MHz	N/A
Modulation:	OFDM	OFDM	OFDM	N/A
Channel number:	9	4	2	N/A
Channel separation:	20MHz	40MHz	80MHz	N/A
Antenna type/gain:	Integral Antenna : 2*TX 2*RX: 2.5dBi on 5GHz			

NOTE:802.11a is only SISO mode ;

802.11n(HT20), 802.11n(HT40),802.11ac(VHT20), 802.11ac(VHT40) and 802.11ac(VHT80) are MIMO mode only.

Directional gain= $2.5+10\log_2=5.51\text{dBi}$

2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

All test performed at the low, middle and high of operational frequency range of each mode.

Operation Frequency List WIFI on 5G Band:

Operating band	20MHz		40MHz		80MHz			
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)		
U-NII 1 (5150MHz-5250MHz)	36	5180	38	5190	42	5210		
	40	5200						
	44	5220	46	5230				
	48	5240						
U-NII 3 (5725MHz-5850MHz)	149	5745	151	5755	155	5775		
	153	5765						
	157	5785	159	5795				
	161	5805						
	165	5825						

Note: The line display in grey is those Channels/Frequencies select to test in this report for each operation mode.

Data Rate Used:

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate
Maximum Conducted Output Power	11a/OFDM	6 Mbps
Power Spectral Density	11n(20MHz),11ac(20MHz)/OFDM	7.2 Mbps
Emission Bandwidth(26dBm Bandwidth)		
Minimum Emission Bandwidth(6dBm Bandwidth)	11n(40MHz),11ac(40MHz)/OFDM	15.0Mbps
Undesirable emission		
Frequency Stability	11ac(80MHz)/OFDM	65.0Mbps

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date recent	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2018/05/20	2019/05/19
LISN	R&S	ESH2-Z5	860014/010	2018/05/20	2019/05/19
Power Meter	Agilent	U2531A	TW53323507	2018/05/20	2019/05/19
Power Sensor	Agilent	U2021XA	MY5365004	2018/05/20	2019/05/19
EMI Test Receiver	R&S	ESCI	103710	2018/05/20	2019/05/19
Spectrum Analyzer	Agilent	E4407B	MY41440676	2018/05/20	2019/05/19
Spectrum Analyzer	Agilent	N9020	US46220290	2018/05/20	2019/05/19
Controller	EM Electronics	Controller EM 1000	N/A	2018/05/20	2019/05/19
Active Loop Antenna	Daze	ZN30900A	N/A	2018/05/20	2019/05/19
Bilog Antenna	Schwarzbeck	VULB 9168	00824	2018/05/20	2019/05/19
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2018/05/20	2019/05/19
Horn Antenna	SCHWARZBACK	BBHA 9170	BBHA9170184	2018/05/20	2019/05/19
Amplifier	Agilent	8349B	3008A02306	2018/05/20	2019/05/19
Amplifier	Agilent	8447D	2944A10176	2018/05/20	2019/05/19
Temperature/Humidity Meter	Gangxing	CTH-608	02	2018/05/20	2019/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2018/05/20	2019/05/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2018/05/20	2019/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2018/05/20	2019/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLE 104PEA-3M	3m	2018/05/20	2019/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLE 104PEA-3M	3m	2018/05/20	2019/05/19
RF Cable	Megalon	RF-A303	N/A	2018/05/20	2019/05/19
EMI Test Software	R&S	ES-K1	V1.7.1	2018/05/20	2019/05/19
EMI Test Software	AUDIX	E3	V6.0	2018/05/20	2019/05/19

The calibration interval was one year

2.5. Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
ASUS	Notebook PC	FL5900U	9014	FCC ID:PPD-QCNFA335
Delta	AC Adapter	S12B22-120A100-C4	00A99	SDOC

2.6. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.

2.7. Modifications

No modifications were implemented to meet testing criteria.

3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emissions Test

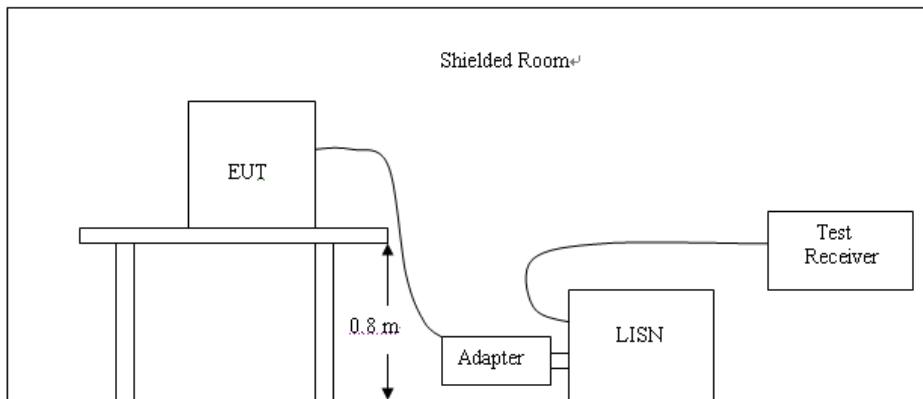
LIMIT

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST CONFIGURATION



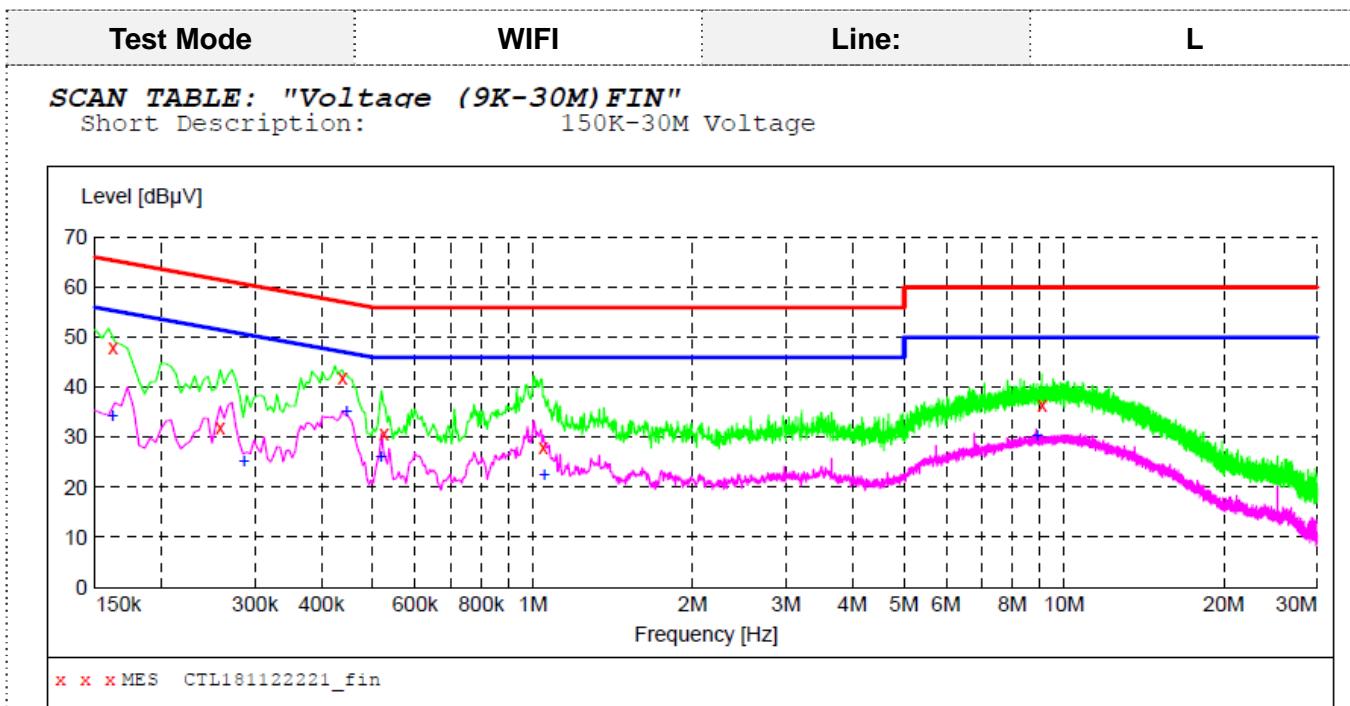
TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

Remark:

1. All modes of 802.11a SISO ANT1 ANT2 mode ,802.11nH20/ac(VHT20), 802.11nH40/ac(VHT40) and 802.11ac(VHT80) MIMO mode were tested at Low, Middle, and High channel; only the worst result of 802.11a SISO mode ANT 1 CH36 was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:



MEASUREMENT RESULT: "CTL181122221_fin"

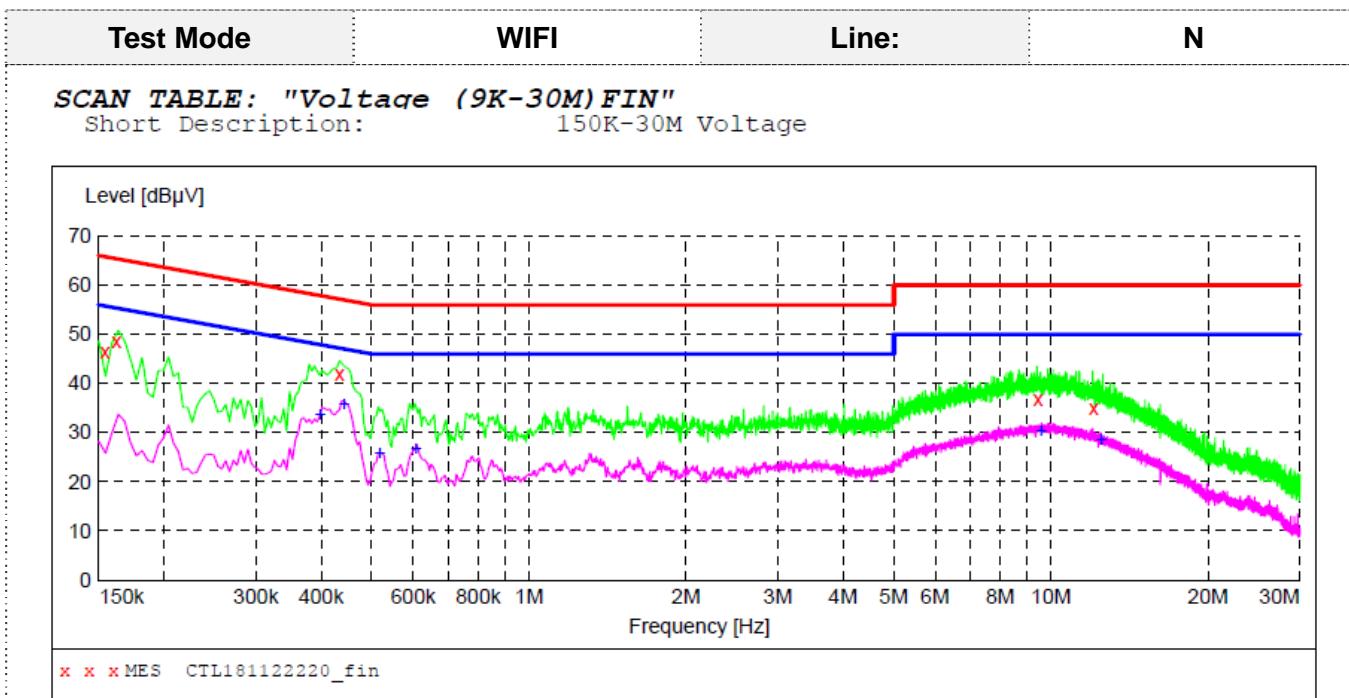
2018-11-23 02:21??

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.162000	48.00	10.2	65	17.4	QP	L1	GND
0.258000	32.00	10.2	62	29.5	QP	L1	GND
0.438000	41.90	10.2	57	15.2	QP	L1	GND
0.524000	30.90	10.2	56	25.1	QP	L1	GND
1.046000	28.10	10.3	56	27.9	QP	L1	GND
9.104000	36.60	10.6	60	23.4	QP	L1	GND

MEASUREMENT RESULT: "CTL181122221_fin2"

2018-11-23 02:21??

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.162000	34.50	10.2	55	20.9	AV	L1	GND
0.286000	25.30	10.2	51	25.3	AV	L1	GND
0.446000	35.20	10.2	47	11.7	AV	L1	GND
0.518000	26.10	10.2	46	19.9	AV	L1	GND
1.052000	22.60	10.3	46	23.4	AV	L1	GND
8.912000	30.30	10.6	50	19.7	AV	L1	GND

**MEASUREMENT RESULT: "CTL181122220_fin"**

2018-11-23 02:18??

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line	PE
0.154000	46.30	10.2	66	19.5	QP	N	GND
0.162000	48.60	10.2	65	16.8	QP	N	GND
0.434000	41.80	10.2	57	15.4	QP	N	GND
9.440000	36.70	10.6	60	23.3	QP	N	GND
12.062000	35.00	10.6	60	25.0	QP	N	GND

MEASUREMENT RESULT: "CTL181122220_fin2"

2018-11-23 02:18??

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line	PE
0.398000	33.70	10.2	48	14.2	AV	N	GND
0.442000	35.80	10.2	47	11.2	AV	N	GND
0.518000	26.00	10.2	46	20.0	AV	N	GND
0.608000	26.80	10.2	46	19.2	AV	N	GND
9.578000	30.60	10.6	50	19.4	AV	N	GND
12.494000	28.50	10.6	50	21.5	AV	N	GND

3.2. Radiated Emissions

Limit

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

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an 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.

Undesirable emission limits

Requirement	Limit(EIRP)	Limit (Field strength at 3m) _{Note1}
15.407(b)(1)	PK:-27(dBm/MHz)	PK:68.2(dB μ V/m)
15.407(b)(2)		
15.407(b)(3)		
15.407(b)(4)		

Note1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3} \mu\text{V}/\text{m}, \text{ where } P \text{ is the eirp (Watts)}$$

(5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209

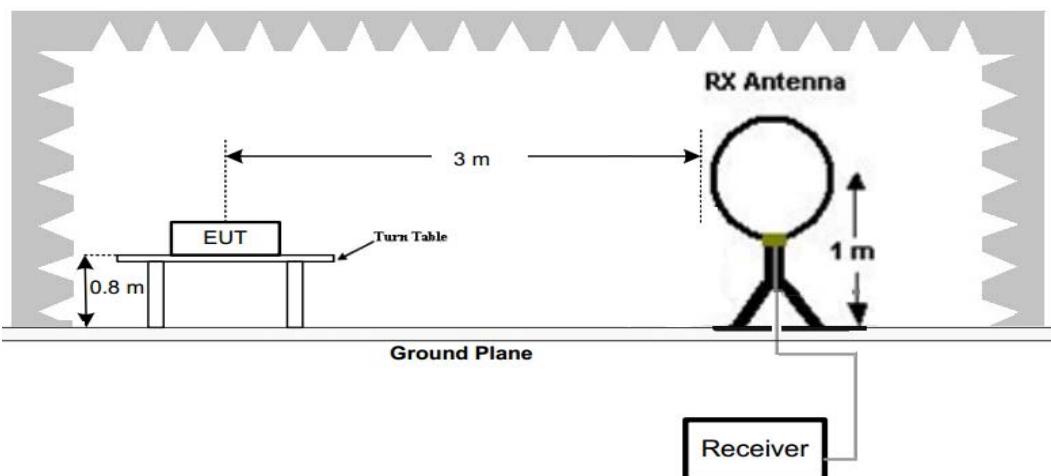
(6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

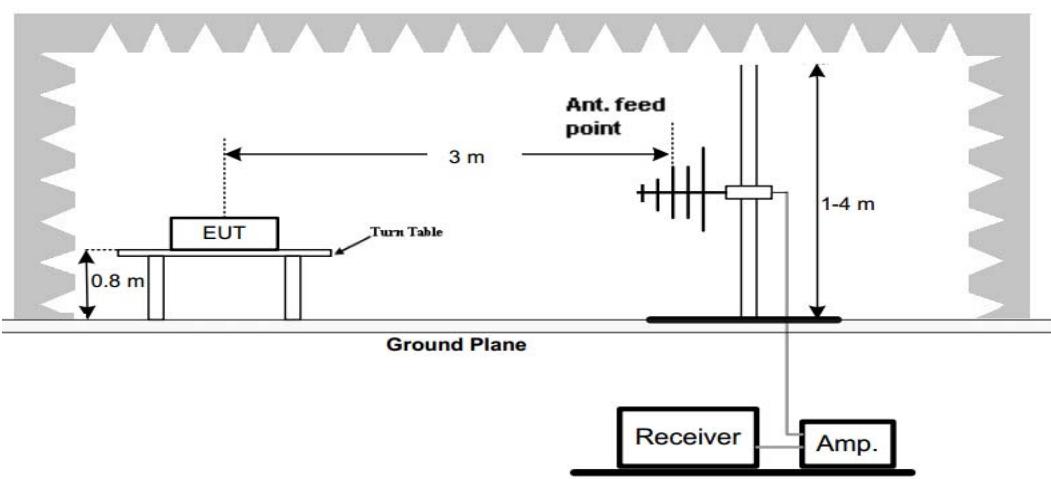
Frequency (MHz)	Distance (Meters)	Radiated (dB μ V/m)	Radiated (μ V/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST CONFIGURATION

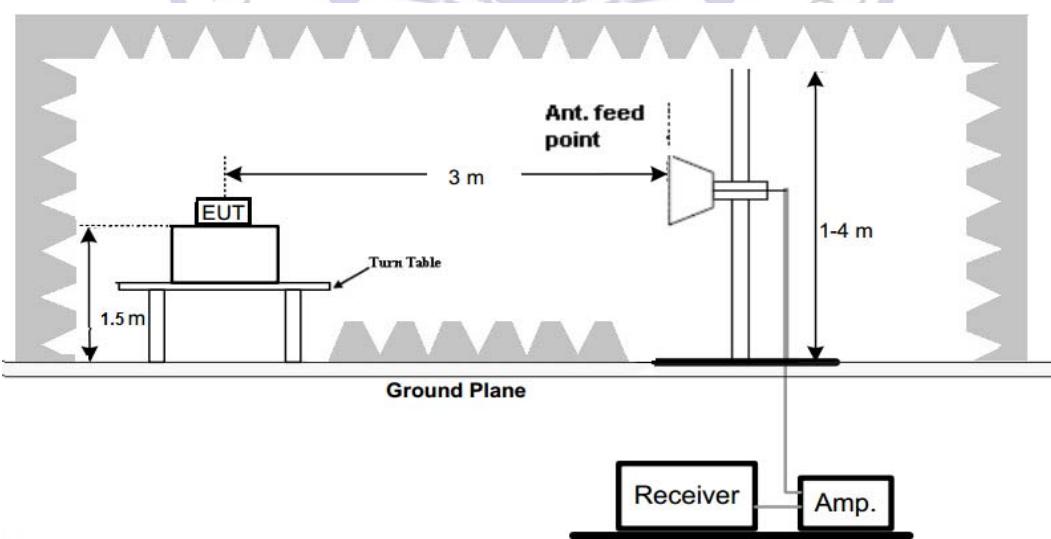
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



Test Procedure

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 40GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Average Value: RBW=1MHz VBW=3MHz, RMS detector	Peak/ RMS

TEST RESULTS

Remark:

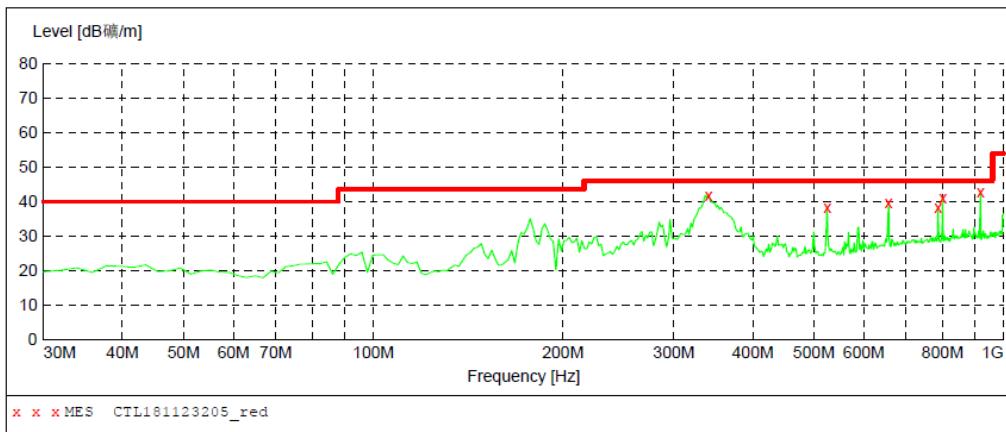
1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. All modes of 802.11a SISO ANT1 ANT2 mode ,802.11nH20/ac(VHT20), 802.11nH40/ac(VHT40) and 802.11ac(VHT80) MIMO mode were tested at Low, Middle, and High channel have been tested for below 1GHz test, only the worst case 802.11ac (VHT20) MIMO mode low channel of U-NII 1 band was recorded.
3. All modes of 802.11a SISO ANT1 ANT2 mode ,802.11nH20/ac(VHT20), 802.11nH40/ac(VHT40) and 802.11ac(VHT80) MIMO mode were tested at Low, Middle, and High channel have been tested for above 1GHz test, only the worst case 802.11ac (VHT20) MIMO mode was recorded.
4. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal

SWEEP TABLE: "test (30M-1G)"

Short Description: Field Strength
 Start Stop Detector Meas. IF Transducer
 Frequency Frequency Time Bandw.
 30.0 MHz 1.0 GHz MaxPeak 200.0 ms 120 kHz VULB 9168

**MEASUREMENT RESULT: "CTL181123205_red"**

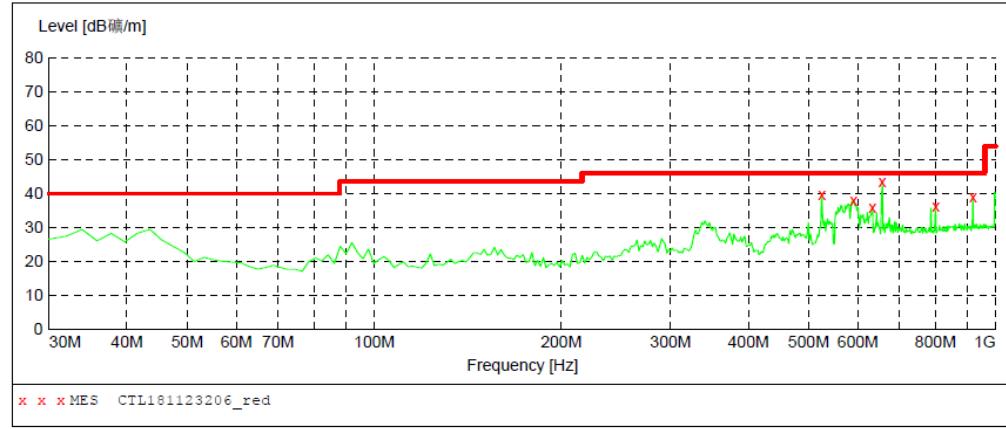
2018-11-23 9:08

Frequency MHz	Level dB/m	Transd dB	Limit dB/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
340.400000	41.90	15.1	46.0	4.1	---	0.0	0.00	HORIZONTAL
524.700000	38.40	18.6	46.0	7.6	---	0.0	0.00	HORIZONTAL
656.620000	39.50	21.0	46.0	6.5	---	0.0	0.00	HORIZONTAL
786.600000	38.20	22.6	46.0	7.8	---	0.0	0.00	HORIZONTAL
800.180000	40.90	22.7	46.0	5.1	---	0.0	0.00	HORIZONTAL
918.520000	42.60	24.0	46.0	3.4	---	0.0	0.00	HORIZONTAL

Vertical

SWEEP TABLE: "test (30M-1G)"

Short Description: Field Strength
 Start Stop Detector Meas. IF Transducer
 Frequency Frequency Time Bandw.
 30.0 MHz 1.0 GHz MaxPeak 200.0 ms 120 kHz VULB 9168

**MEASUREMENT RESULT: "CTL181123206_red"**

2018-11-23 9:10

Frequency MHz	Level dB/m	Transd dB	Limit dB/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
524.700000	39.80	18.6	46.0	6.2	---	0.0	0.00	VERTICAL
590.660000	38.00	19.9	46.0	8.0	---	0.0	0.00	VERTICAL
633.340000	36.00	20.7	46.0	10.0	---	0.0	0.00	VERTICAL
656.620000	43.60	21.0	46.0	2.4	---	0.0	0.00	VERTICAL
800.180000	36.20	22.7	46.0	9.8	---	0.0	0.00	VERTICAL
918.520000	38.90	24.0	46.0	7.1	---	0.0	0.00	VERTICAL

For 1GHz to 25GHz

Note: All modes of 802.11a SISO ANT1 ANT2 mode ,802.11nH20/ac(VHT20), 802.11nH40/ac(VHT40) and 802.11ac(VHT80) MIMO mode have been tested for above 1GHz test, only the worst case 802.11ac (VHT20) was recorded.

U-NII 1 & 802.11ac (HT20) Mode (above 1GHz)

U-NII 3 & 802.11ac (HT20) Mode (above 1GHz)

REMARKS:

1. Emission level (dB_{UV}/m) = Raw Value (dB_{UV}) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier Factor
3. Margin value = Limit value - Emission level.
4. -- Mean the other emission levels were very low against the limit.
5. RBW 1MHz VBW 3MHz Peak detector is for PK value; RMS detector is for AV value.
6. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20 ,IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;



3.3. Maximum Conducted Average Output Power

Limit

FCC requirement:

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.

(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.

(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.

(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.

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

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

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results

U-NII 1

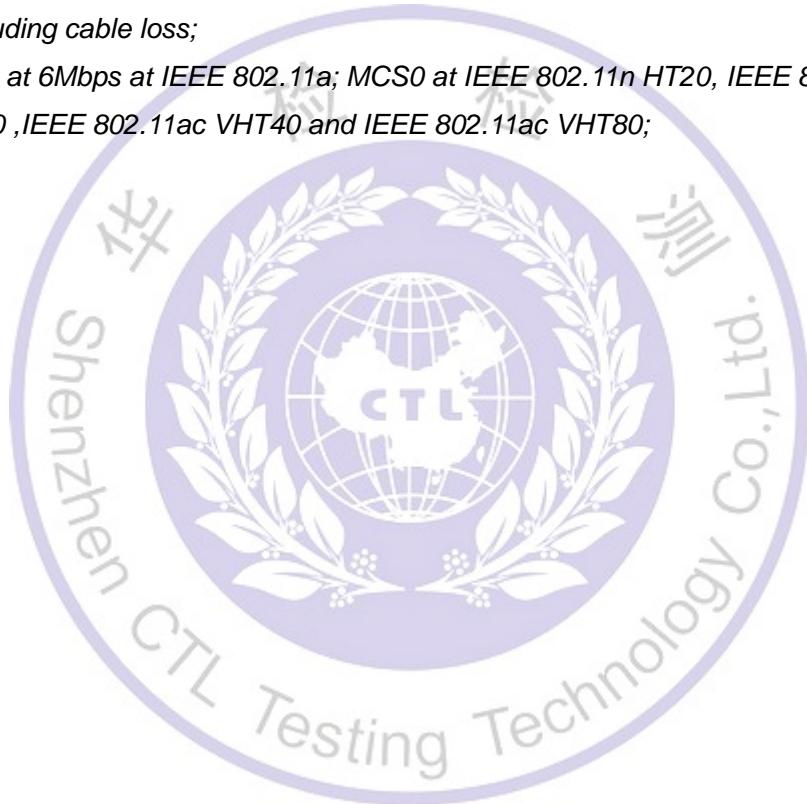
Type	Channel	Output power Average(dBm)		Total (dBm)	Limit (dBm)	Result
		Ant.1	Ant.2			
802.11a	36	15.14	14.95	N/A	23.98	Pass
	40	15.08	14.95	N/A		
	48	15.75	15.62	N/A		
802.11n(HT20)	36	14.69	14.58	17.65	23.98	Pass
	40	15.06	14.87	17.98		
	48	15.64	15.20	18.44		
802.11n(HT40)	38	14.75	14.55	17.66	23.98	Pass
	46	15.12	15.16	18.15		
802.11ac(HT20)	36	14.69	14.63	17.67	23.98	Pass
	40	15.06	14.92	18.00		
	48	15.43	15.82	18.64		
802.11ac(HT40)	38	14.63	14.58	17.62	23.98	Pass
	46	15.44	14.91	18.19		
802.11ac(HT80)	42	14.72	13.30	17.08	23.98	Pass

U-NII 3

Type	Channel	Output power Average(dBm)		Total (dBm)	Limit (dBm)	Result
		Ant.1	Ant.2			
802.11a	149	15.46	15.42	N/A	30.00	Pass
	157	14.18	13.29	N/A		
	165	13.15	12.40	N/A		
802.11n(HT20)	149	15.66	15.05	18.38	30.00	Pass
	157	13.81	13.37	16.61		
	165	13.08	12.33	15.73		
802.11n(HT40)	151	14.84	14.69	17.78	30.00	Pass
	159	13.12	13.02	16.08		
802.11ac(HT20)	149	15.10	15.11	18.12	30.00	Pass
	157	13.30	13.40	16.36		
	165	13.02	12.52	15.79		
802.11ac(HT40)	151	14.79	14.76	17.79	30.00	Pass
	159	13.14	12.71	15.94		
802.11ac(HT80)	155	13.70	13.04	16.39	30.00	Pass

Note:

1. Measured output power at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20 ,IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;



3.4. Power Spectral Density

Limit

FCC requirement:

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 power spectral density shall not exceed 17 dBm in any 1 MHz band.^{note1}
- (ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.^{note1}
- (iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.
- (iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band. ^{note1}

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands

The maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

IC requirement:

For the band 5.15-5.25 GHz.

The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

Frequency band 5250-5350 MHz

The power spectral density shall not exceed 11 dBm in any 1.0 MHz band

Frequency bands 5470-5600 MHz and 5650-5725 MHz

The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

For the band 5.725 - 5.85 GHz

The maximum power spectral density shall not exceed 30 dBm in any 500 kHz band. ^{note1, note2}

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 1MHz for U-NII 1, U-NII 2A, U-NII C band and 510KHz for U-NII 3 band.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to encompass the entire EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.

Test Configuration



Test Results

U-NII 1

Type	Channel	P.S.D(dBm/MHz)		Total (dBm/MHz)	Limit (dBm/ MHz)	Result
		Ant.1	Ant.2			
802.11a	36	7.368	5.394	N/A		Pass
	40	7.741	5.334	N/A		
	48	8.271	5.925	N/A		
802.11n(HT20)	36	7.360	4.850	9.29		Pass
	40	7.622	5.280	9.62		
	48	8.419	5.923	10.36		
802.11n(HT40)	38	4.307	2.286	6.42		Pass
	46	4.850	2.474	6.83		
802.11ac(HT20)	36	6.723	5.274	9.07		Pass
	40	7.748	5.123	9.64		
	48	8.511	5.442	10.25		
802.11ac(HT40)	38	3.848	1.799	5.95		Pass
	46	4.568	2.794	6.78		
802.11ac(HT80)	42	2.181	-0.647	4.00		Pass

U-NII 3

Type	Channel	Power Spectral Density (dBm//500KHz)		Total (dBm//500KHz)	Limit (dBm//500KHz)	Result
		Ant.1	Ant.2			
802.11a	149	5.032	3.261	N/A		Pass
	157	2.866	1.525	N/A		
	165	1.601	0.464	N/A		
802.11n(HT20)	149	5.069	4.723	7.91		Pass
	157	4.401	2.342	6.50		
	165	2.294	1.189	4.79		
802.11n(HT40)	151	1.581	1.325	4.47		Pass
	159	0.032	-0.794	2.65		
802.11ac(HT20)	149	5.388	4.224	7.86		Pass
	157	3.875	1.723	5.94		
	165	2.016	1.130	4.61		
802.11ac(HT40)	151	2.359	-0.026	4.34		Pass
	159	0.927	-1.821	2.78		
802.11ac(HT80)	155	-2.294	-3.545	0.14		

11

30

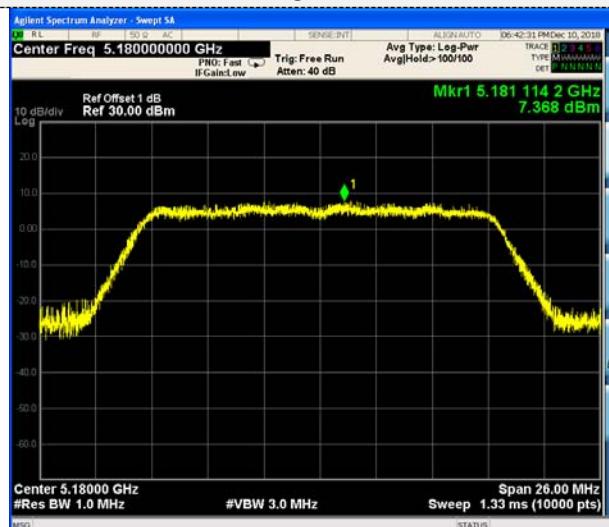
Note:

1. Measured output power at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20 ,IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;
4. Please refer to following test plots;

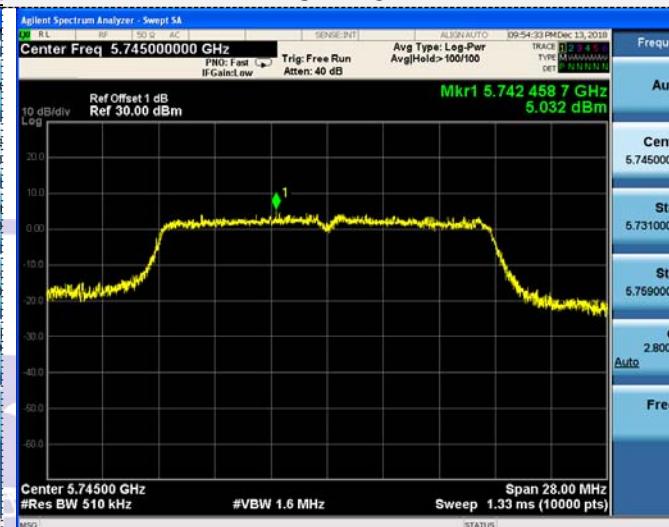
Ant.1

802.11a

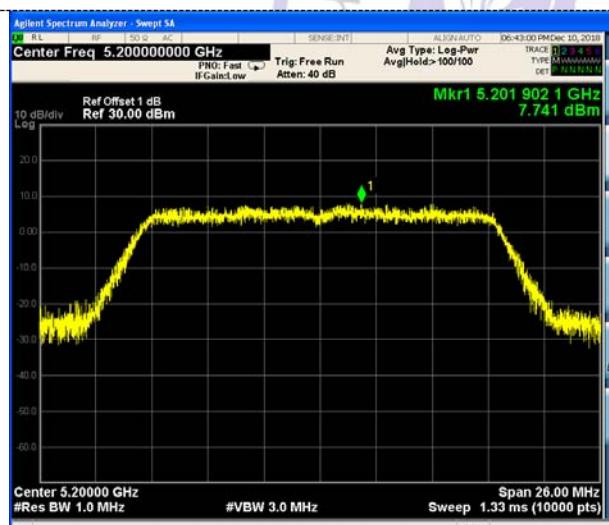
U-NII 1



U-NII 3



CH36



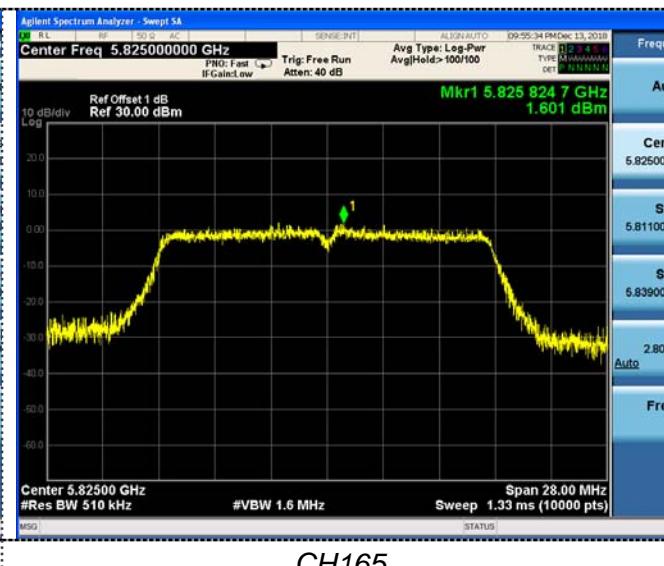
CH149



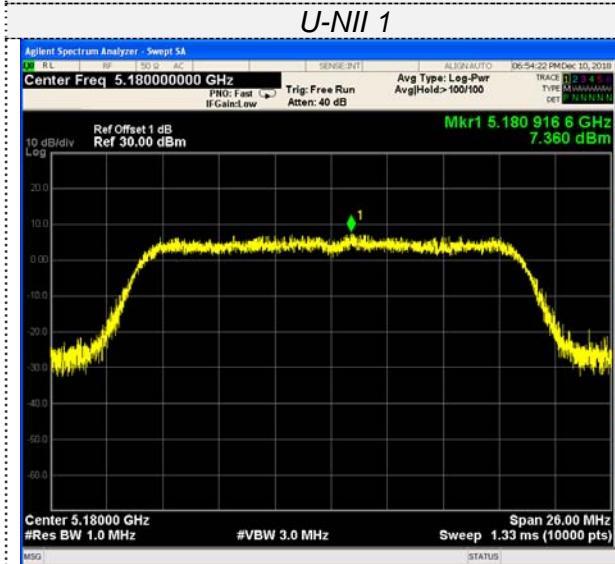
CH40

MSG STATUS

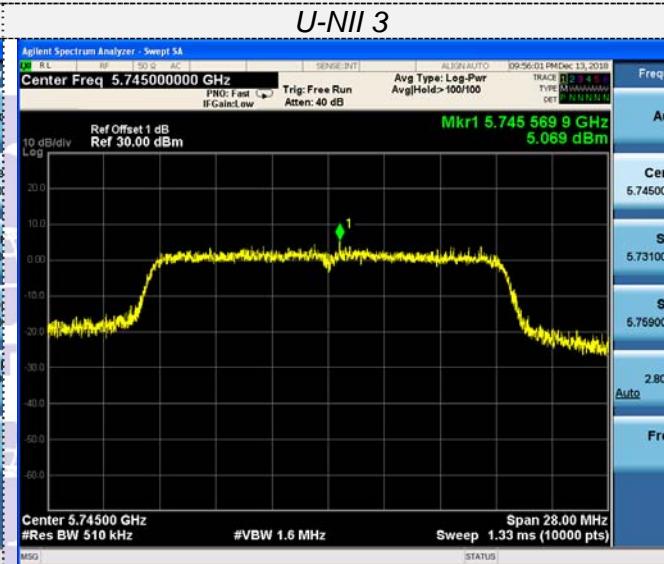
CH157



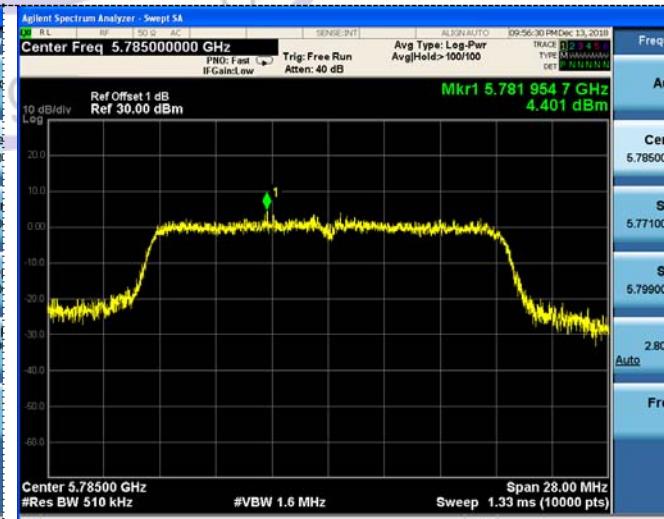
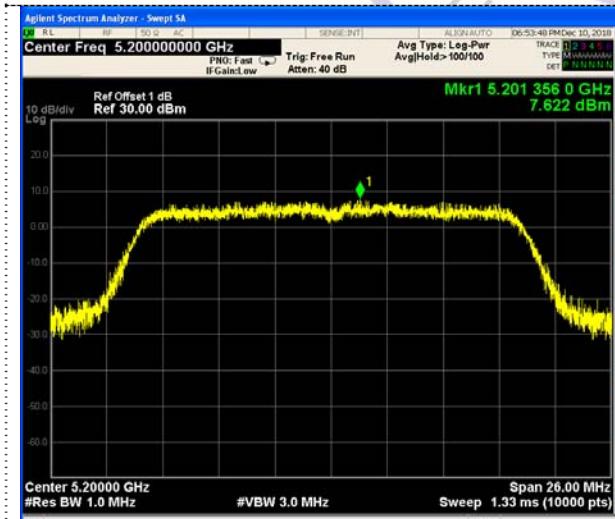
U-NII 1



U-NII 3



CH40

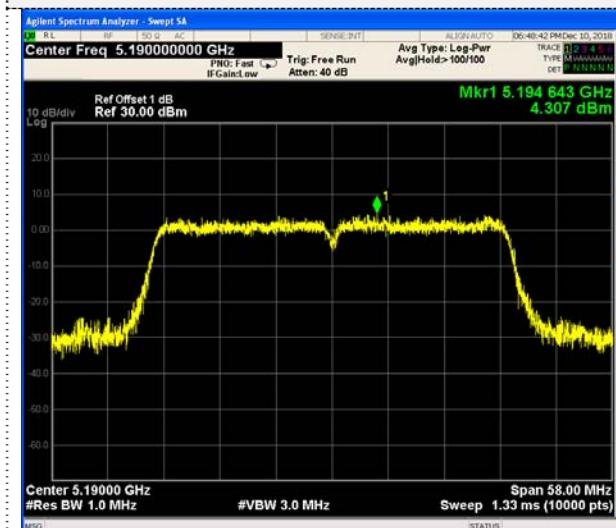




CH48



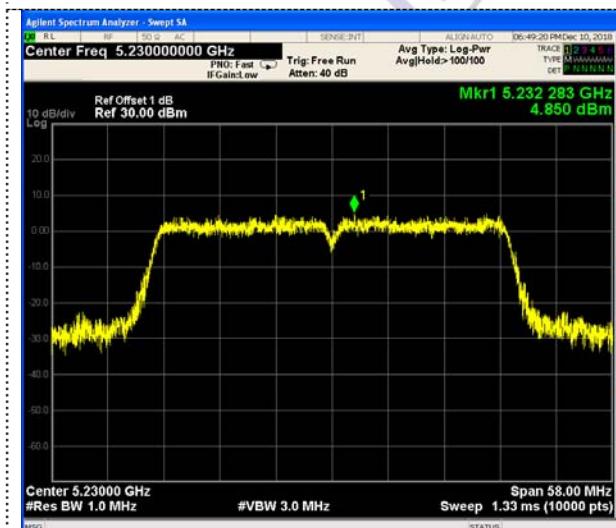
CH165

802.11n(HT40)**U-NII 1**

CH38

U-NII 3

CH151



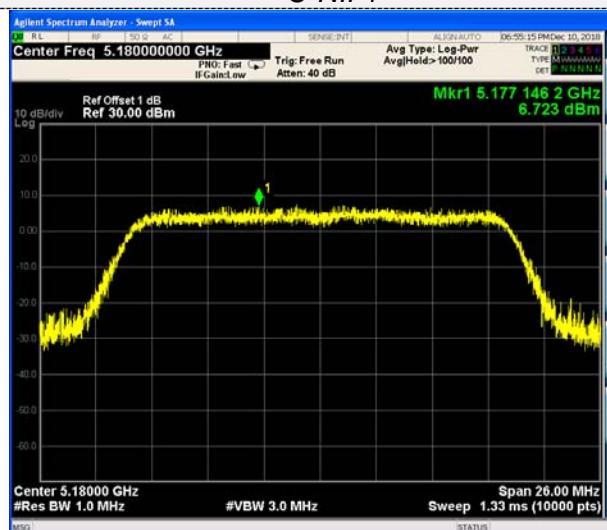
CH46



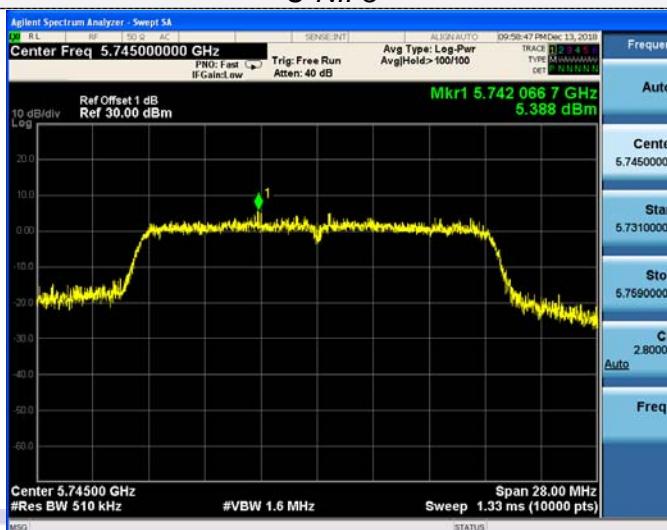
CH159

802.11ac(HT20)

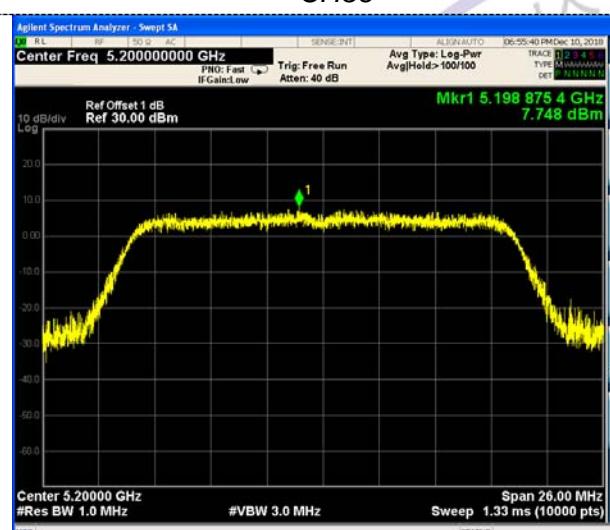
U-NII 1



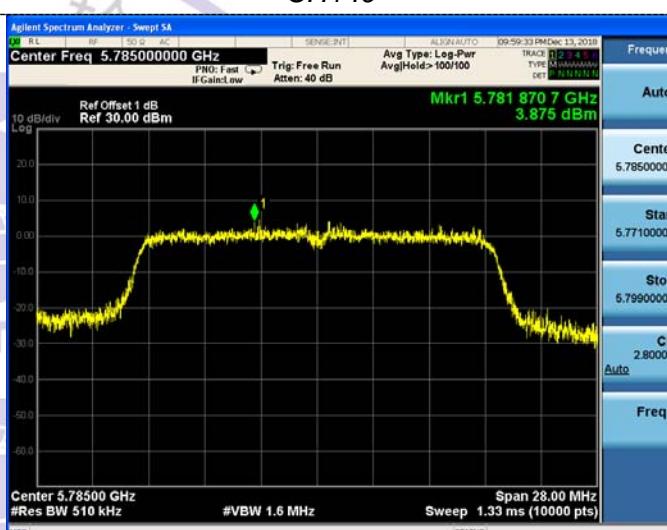
U-NII 3



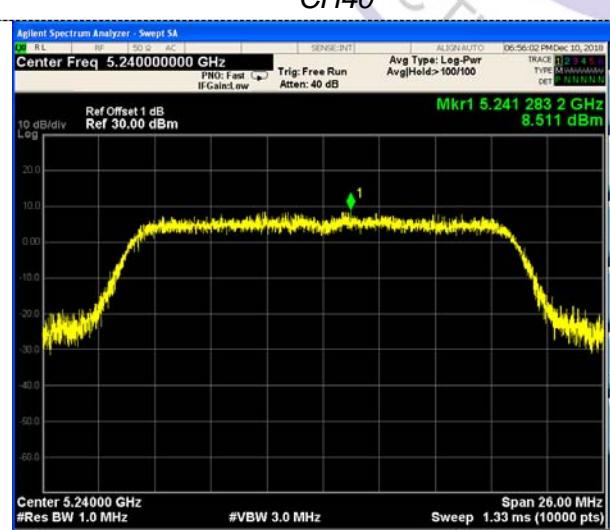
CH36



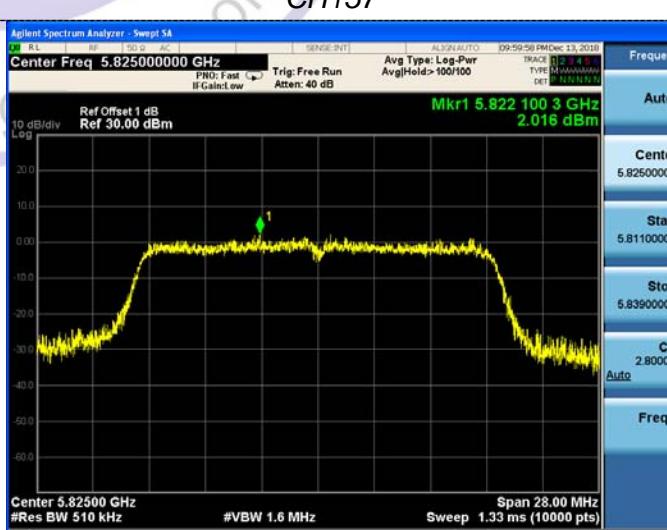
CH149



CH40



CH157

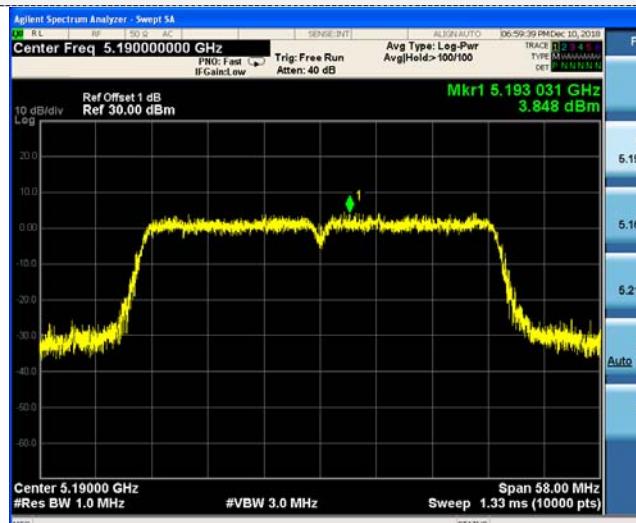


CH48

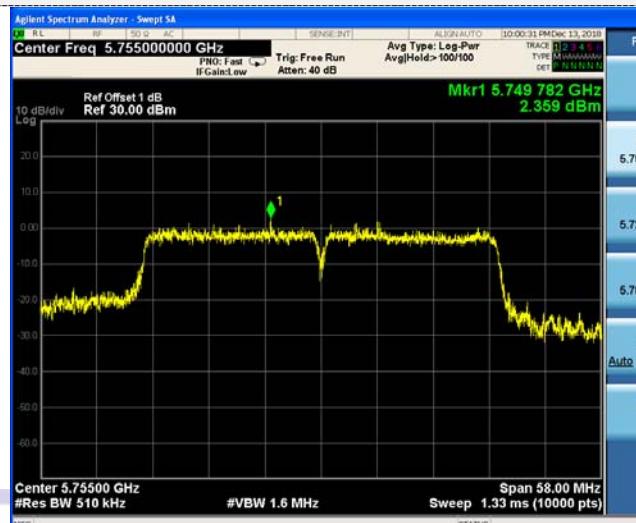
CH165

802.11ac(HT40)

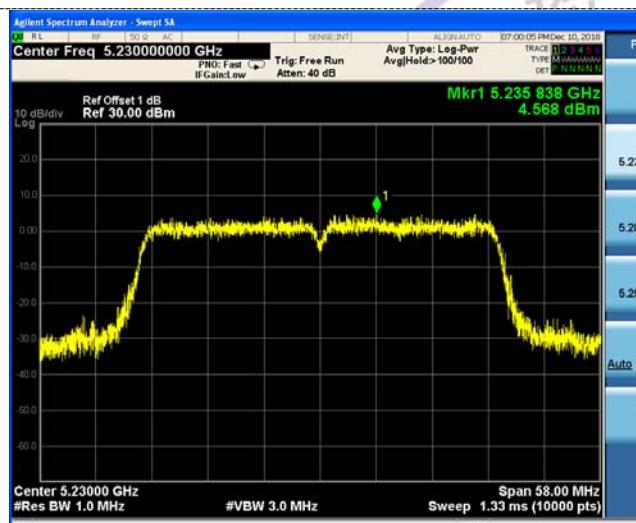
U-NII 1



U-NII 3



CH38



CH151



CH46



CH159

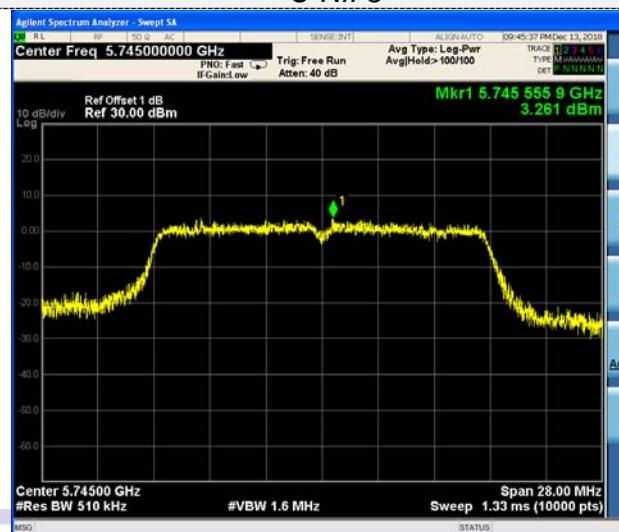
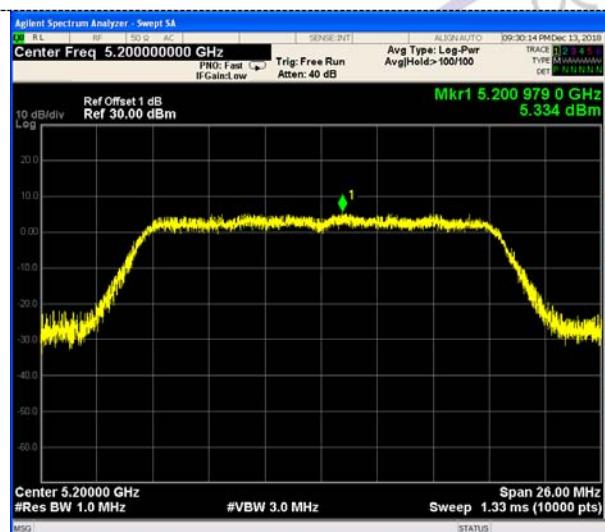
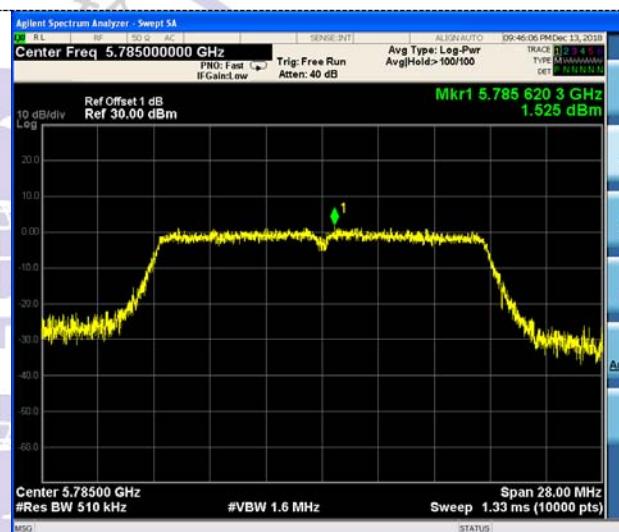
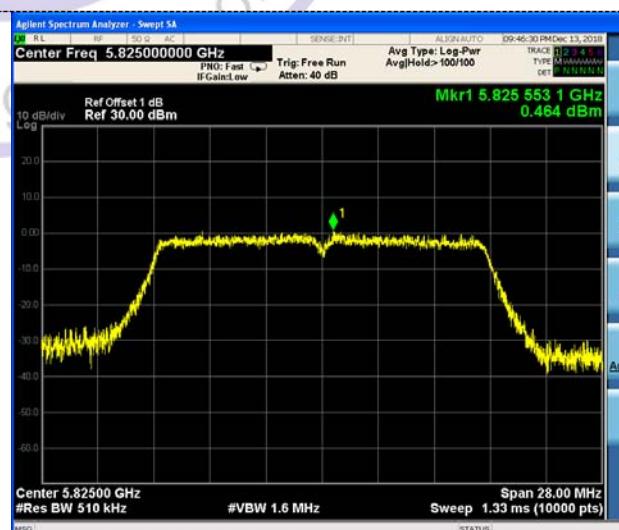


CH42

CH155

Ant.2

802.11a

U-NII 1**U-NII 3****CH36****CH149****CH40****CH157****CH48****CH165**

802.11n20

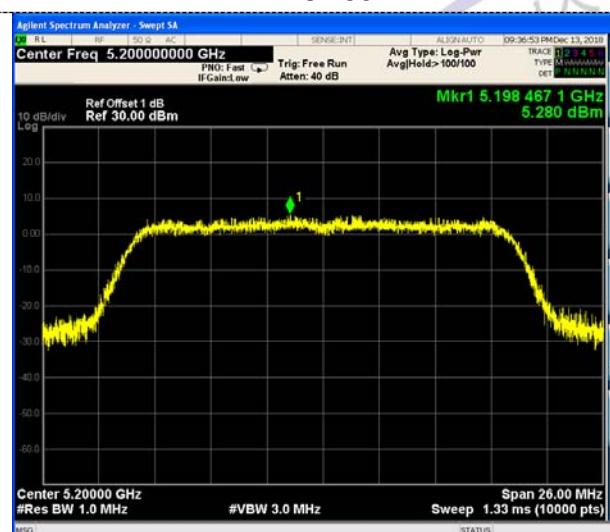
U-NII 1



U-NII 3



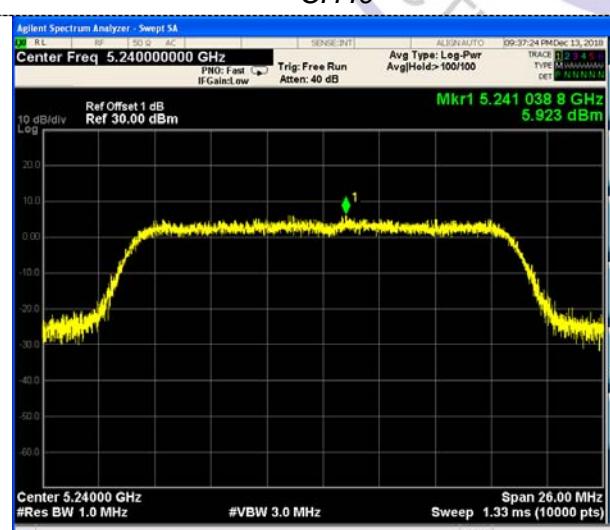
CH36



CH149



CH40



CH157

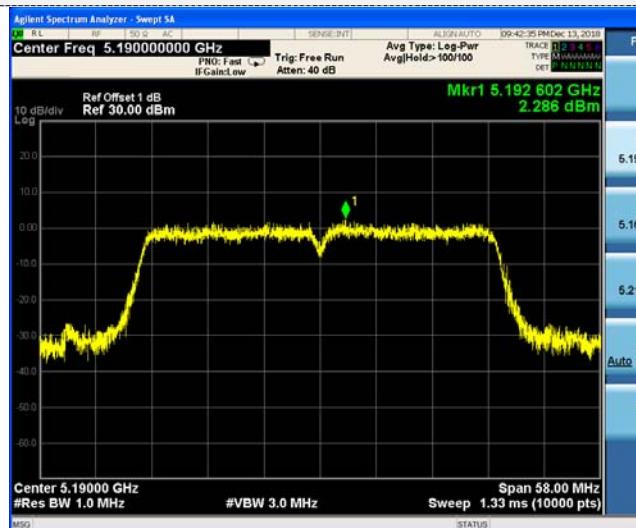


CH48

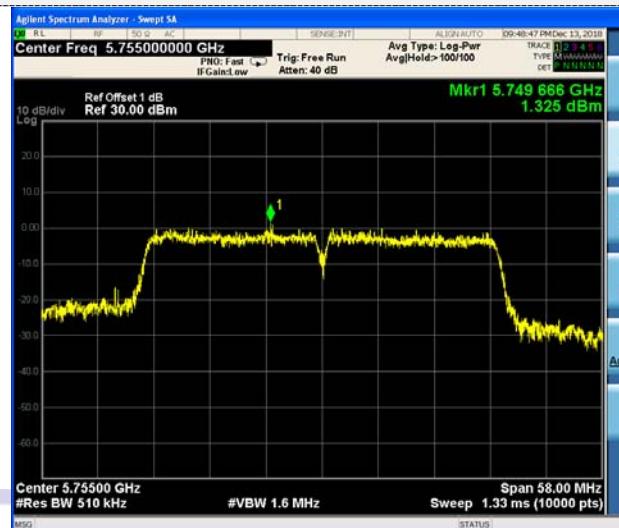
CH165

802.11n(HT40)

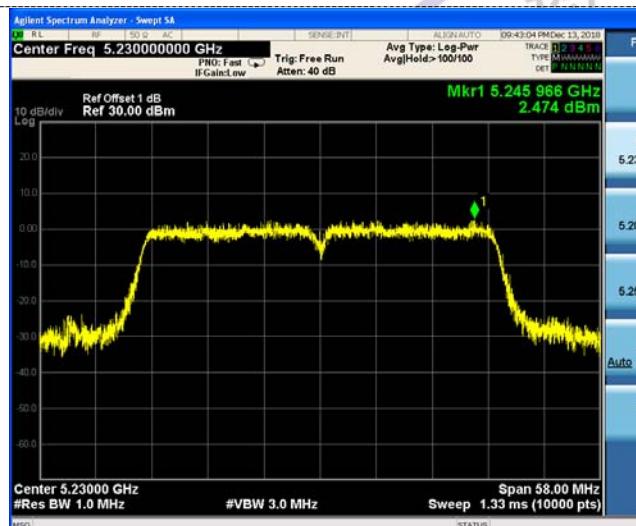
U-NII 1



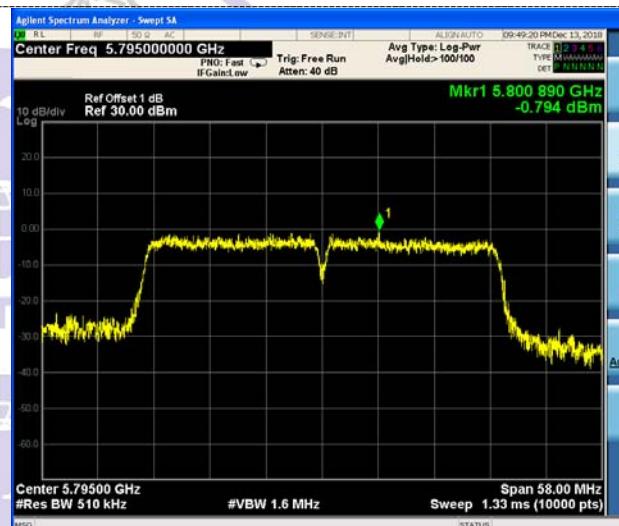
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CH38



CH151

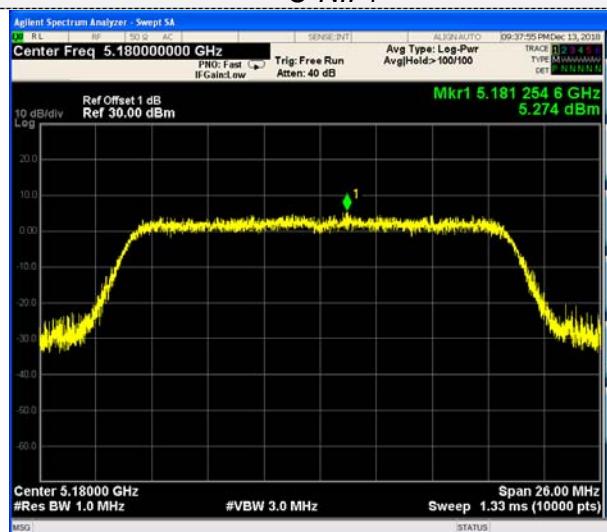


CH46

CH159

802.11ac(HT20)

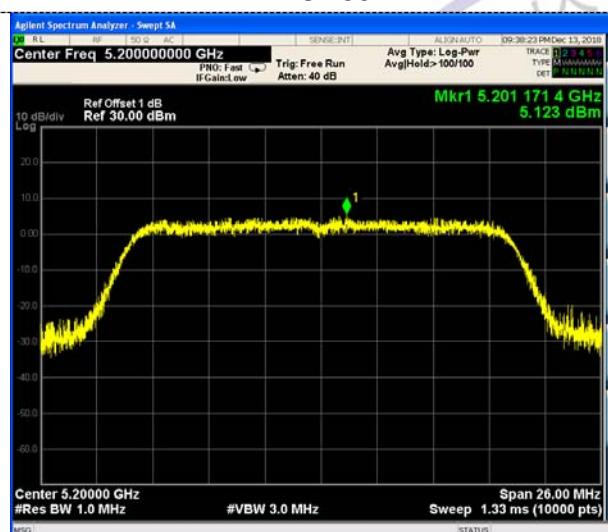
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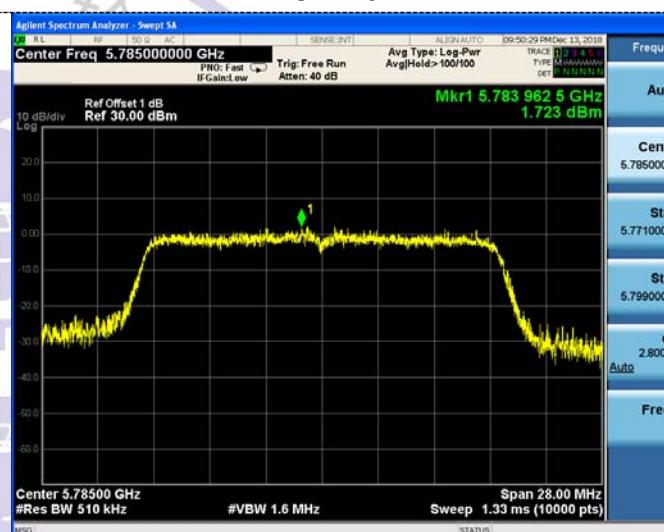
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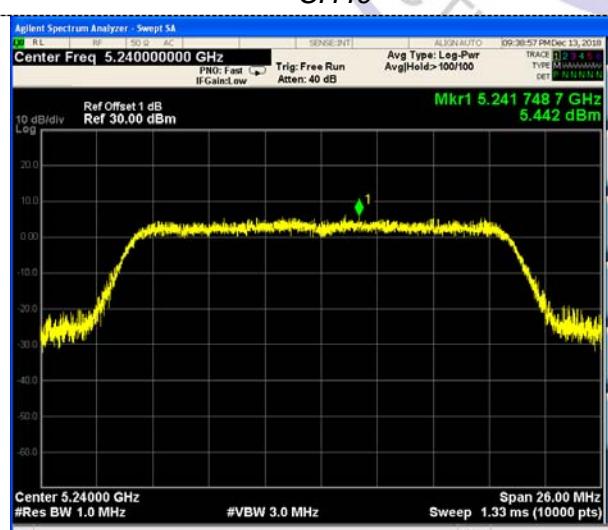
CH36



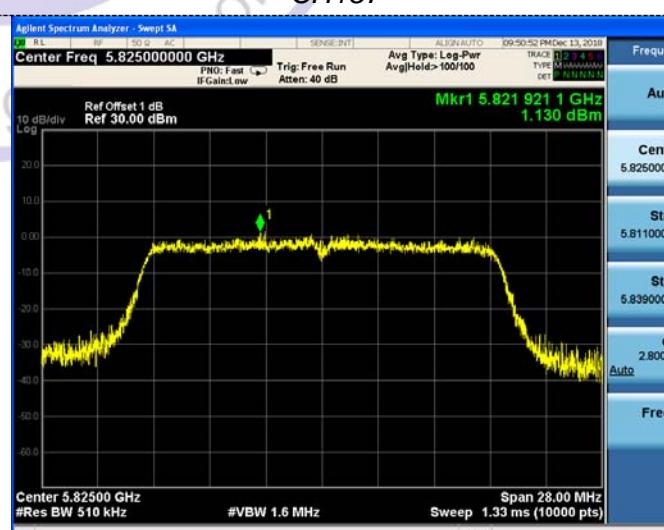
CH149



CH40



CH157

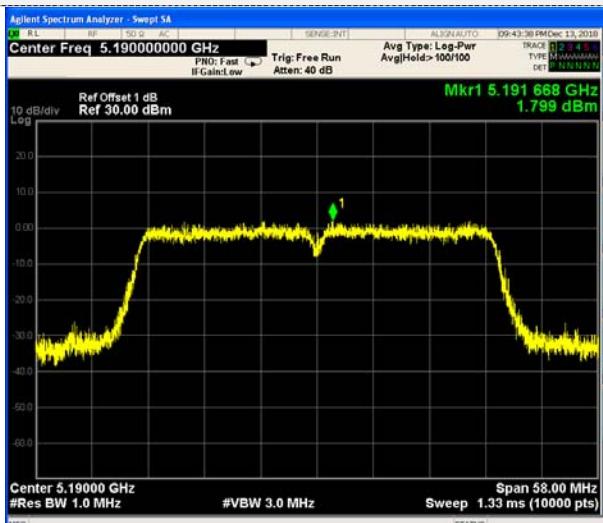


CH48

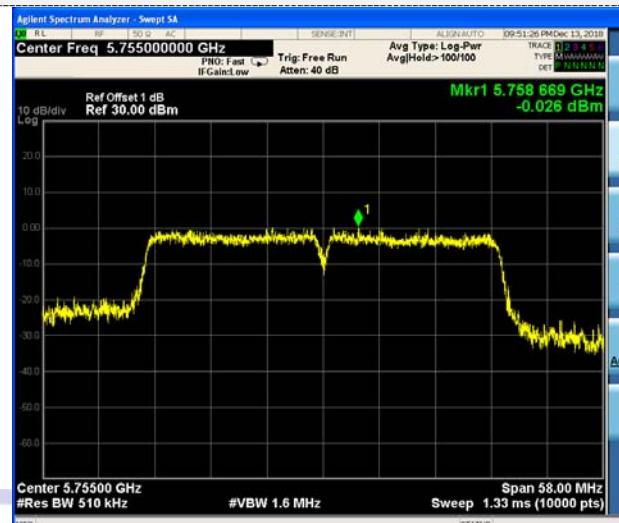
CH165

802.11ac(HT40)

U-NII 1



U-NII 3



CH38



CH151



CH46

CH159

802.11ac(HT80)

U-NII 1



U-NII 3



CH42

CH155

3.5. Emission Bandwidth (26dBm Bandwidth)

Limit

N/A

Test Procedure

1. Set resolution bandwidth (RBW) = approximately 1 % of the EBW.
2. Set the video bandwidth (VBW) > RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. 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 %.

Test Configuration



Test Results

Type	Bands	Channel	26dB Bandwidth (MHz)		Limit (MHz)	Result
			Ant.1	Ant.2		
802.11a	U-NII 1	36	19.21	19.10	N/A	Pass
		40	19.17	19.11		
		48	19.26	19.25		
802.11n(HT20)	U-NII 1	36	19.66	19.31	N/A	Pass
		40	19.30	19.53		
		48	19.72	19.47		
802.11n(HT40)	U-NII 1	38	39.92	40.12	N/A	Pass
		46	39.50	39.46		
802.11ac(HT20)	U-NII 1	36	19.84	19.55	N/A	Pass
		40	19.68	19.35		
		48	19.37	19.59		
802.11ac(HT40)	U-NII 1	38	39.52	39.64	N/A	Pass
		46	39.84	39.26		
802.11ac(HT80)	U-NII 1	42	92.44	92.44		

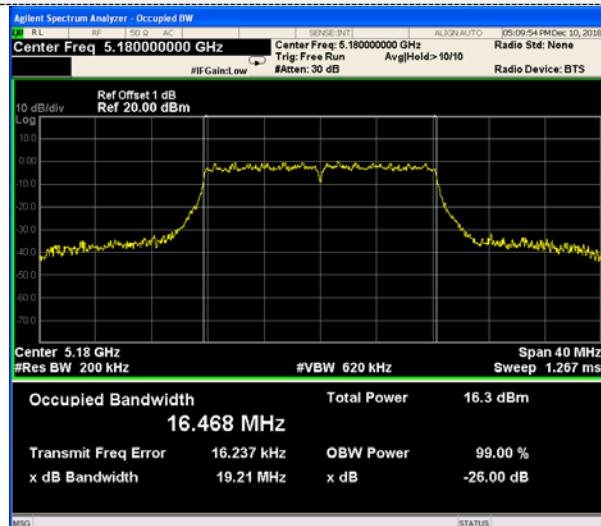
Note:

1. Measured 26dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20 ,IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;
4. Please refer to following test plots;

Ant.1

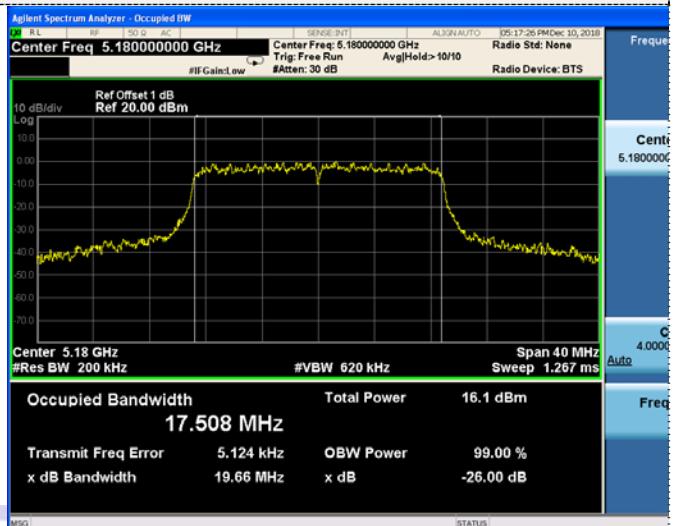
802.11a

U-NII 1

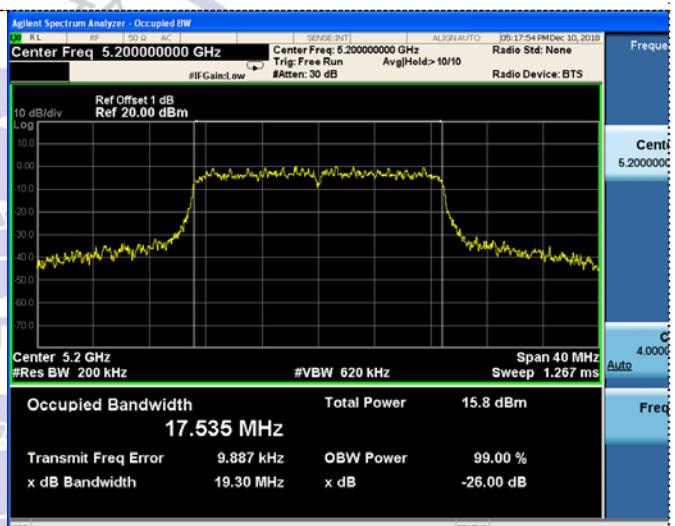
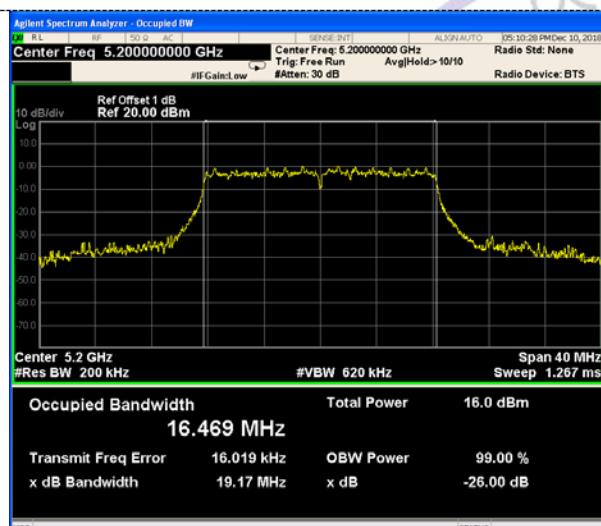


802.11n(HT20)

U-NII 1



CH36



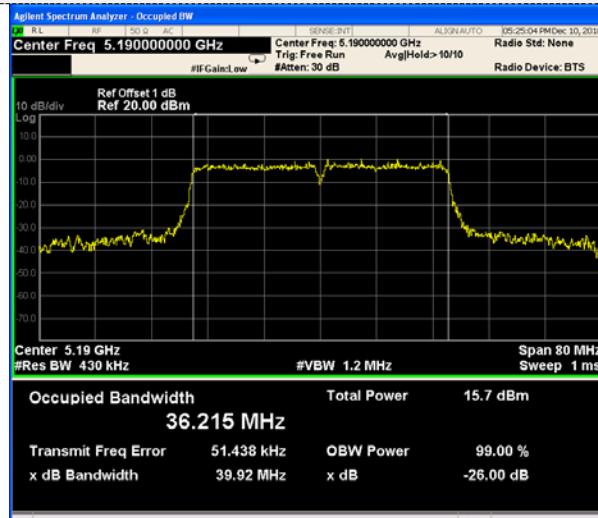
CH40



CH48

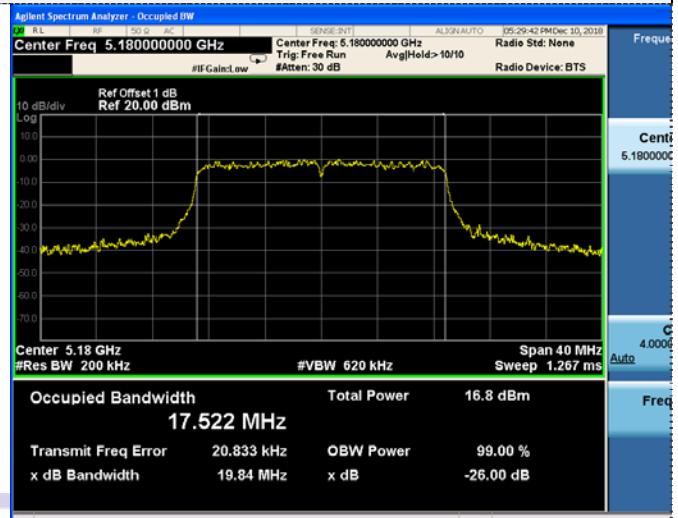
802.11n(HT40)

U-NII 1

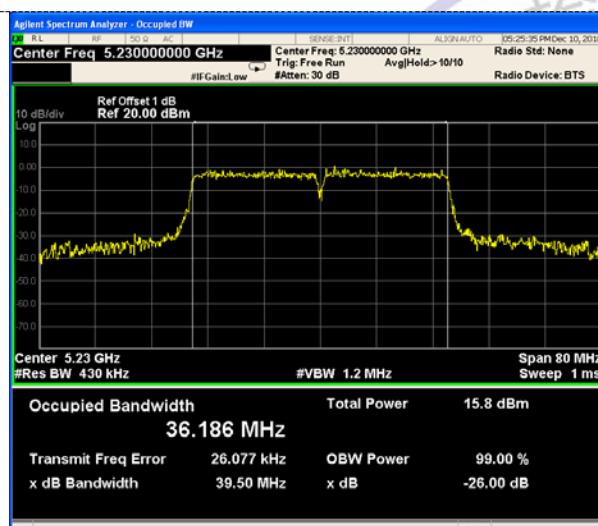


802.11ac(HT20)

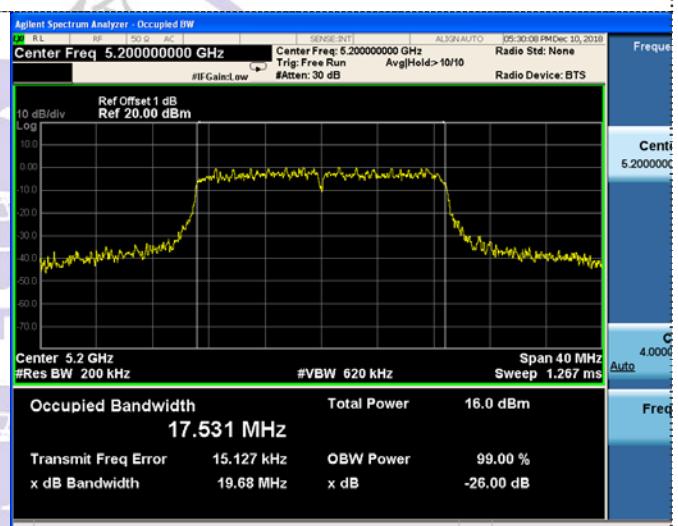
U-NII 1



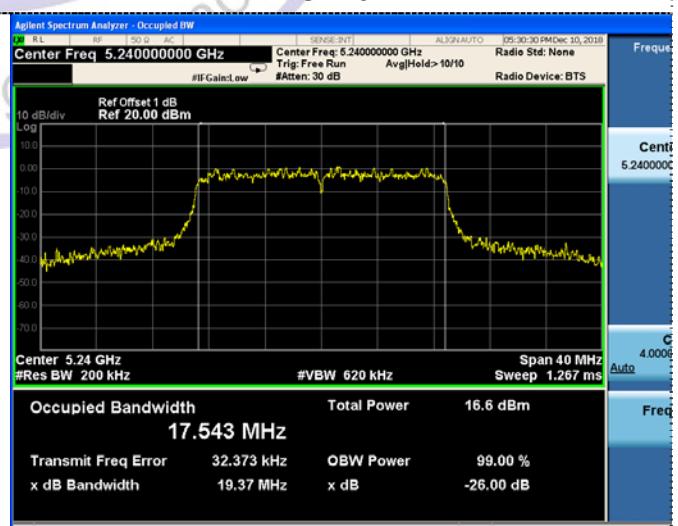
CH38



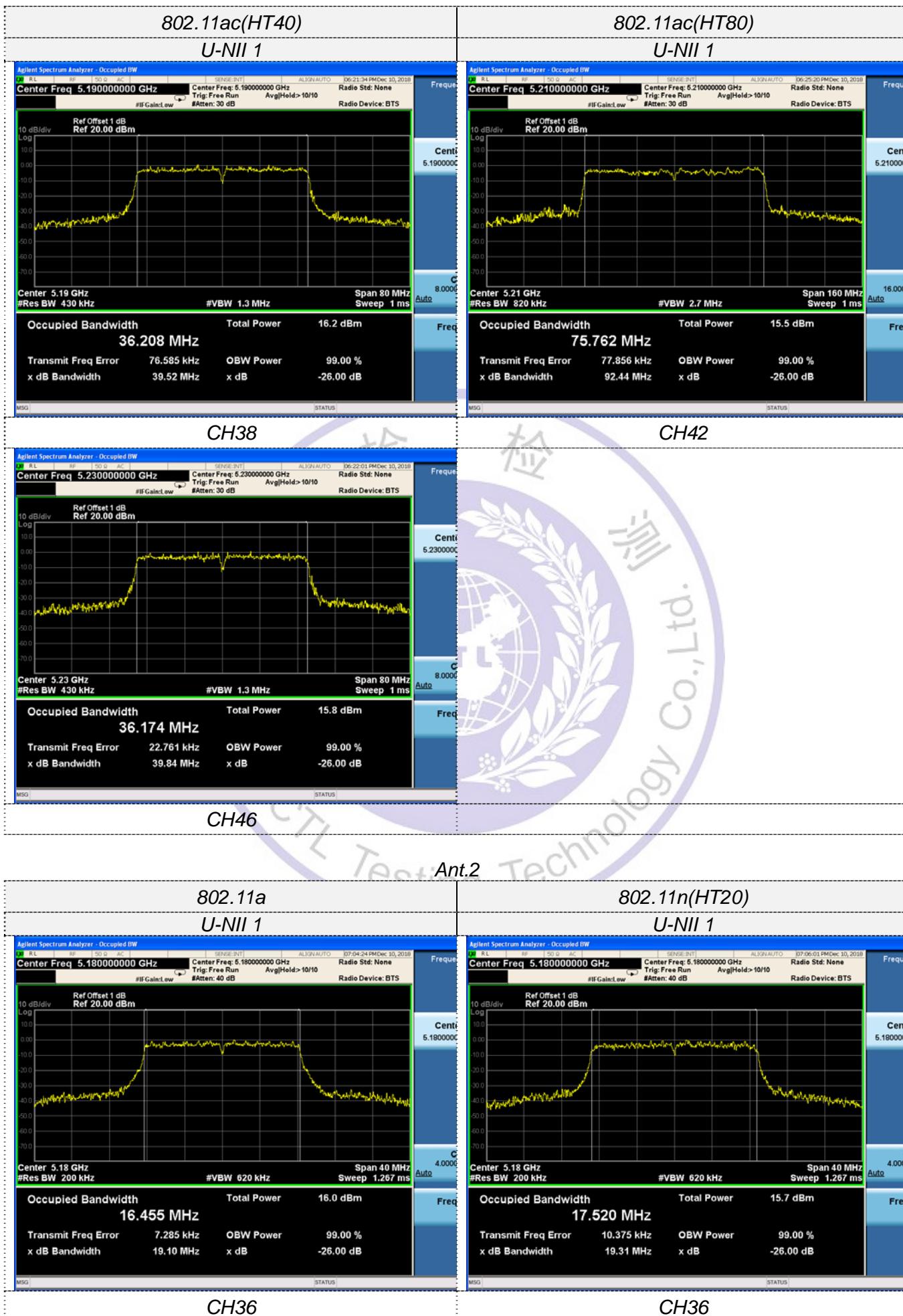
CH36

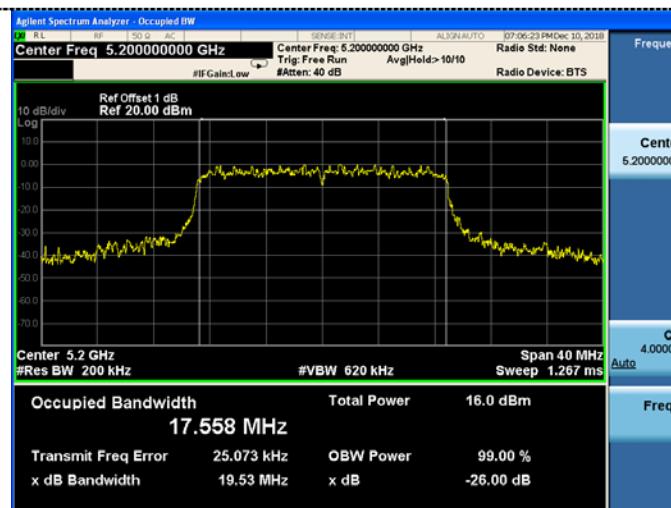
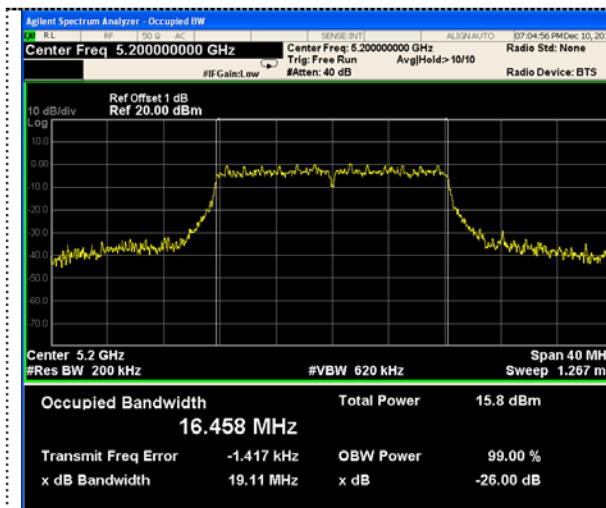


CH46

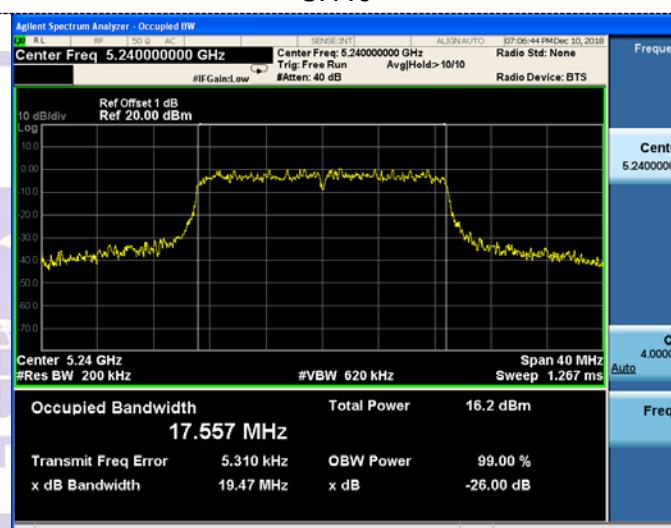
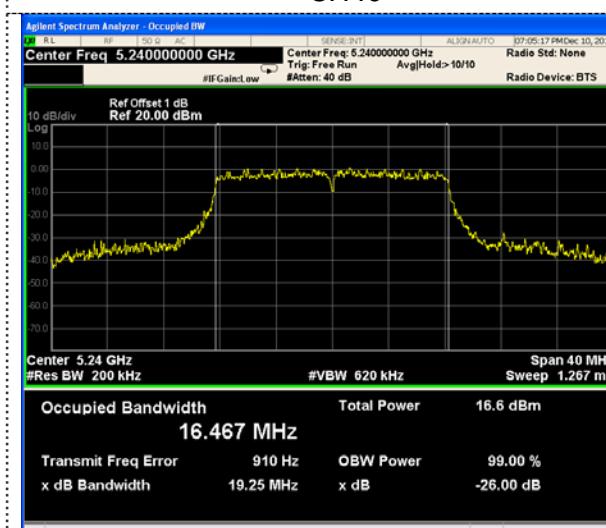


CH48





CH40

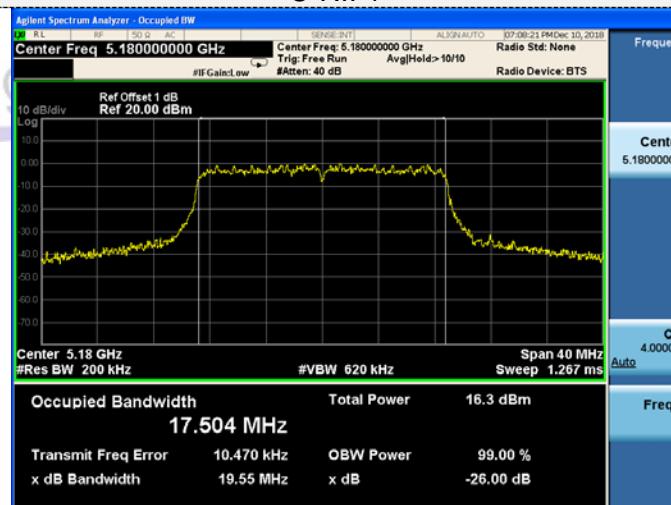
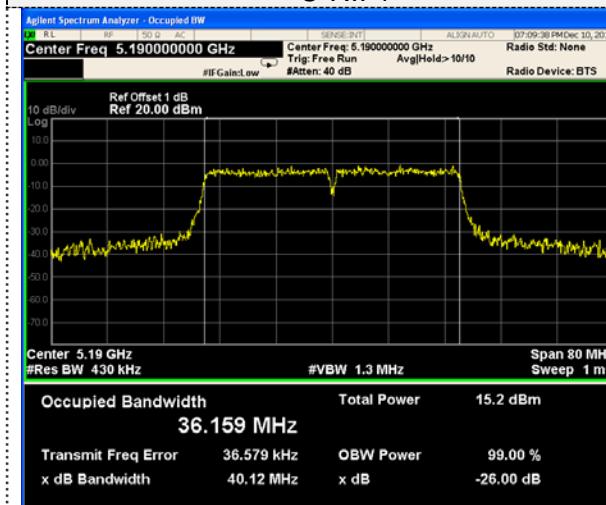


CH48

CH48

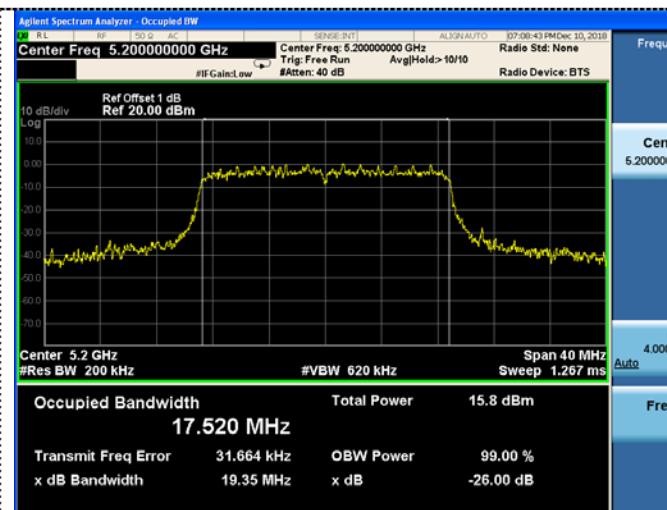
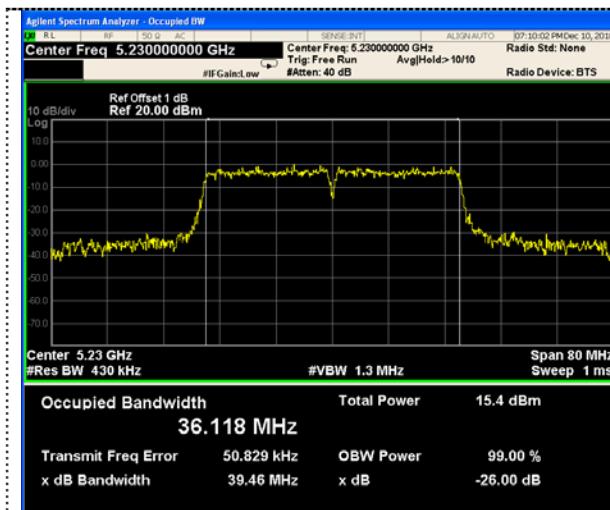
802.11n(HT40)

U-NII 1



CH38

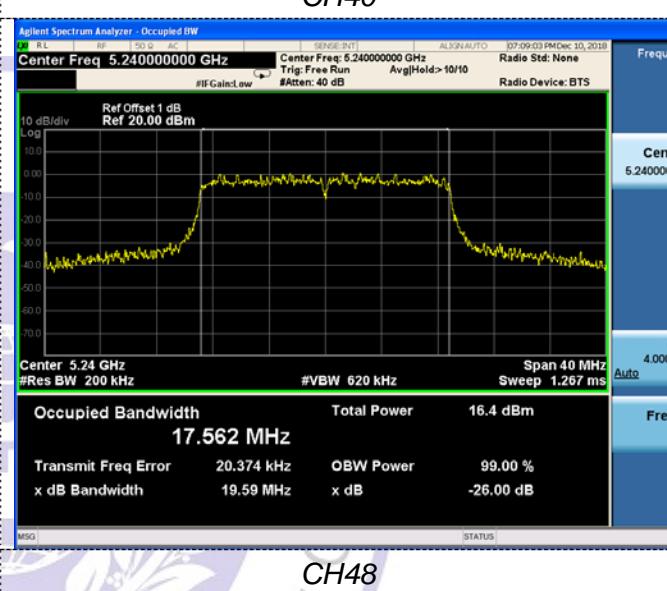
CH36



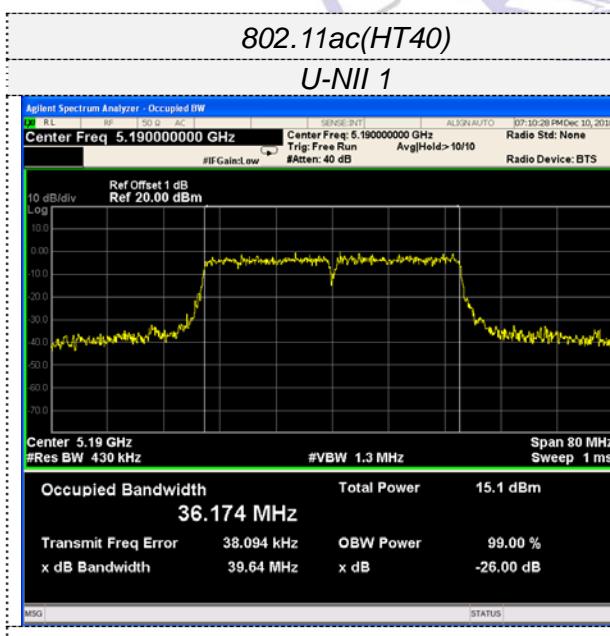
CH46



CH40

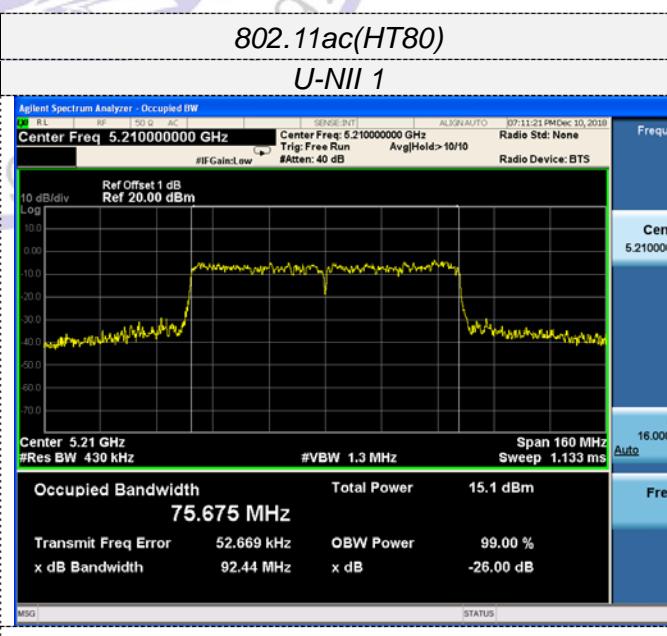


CH48



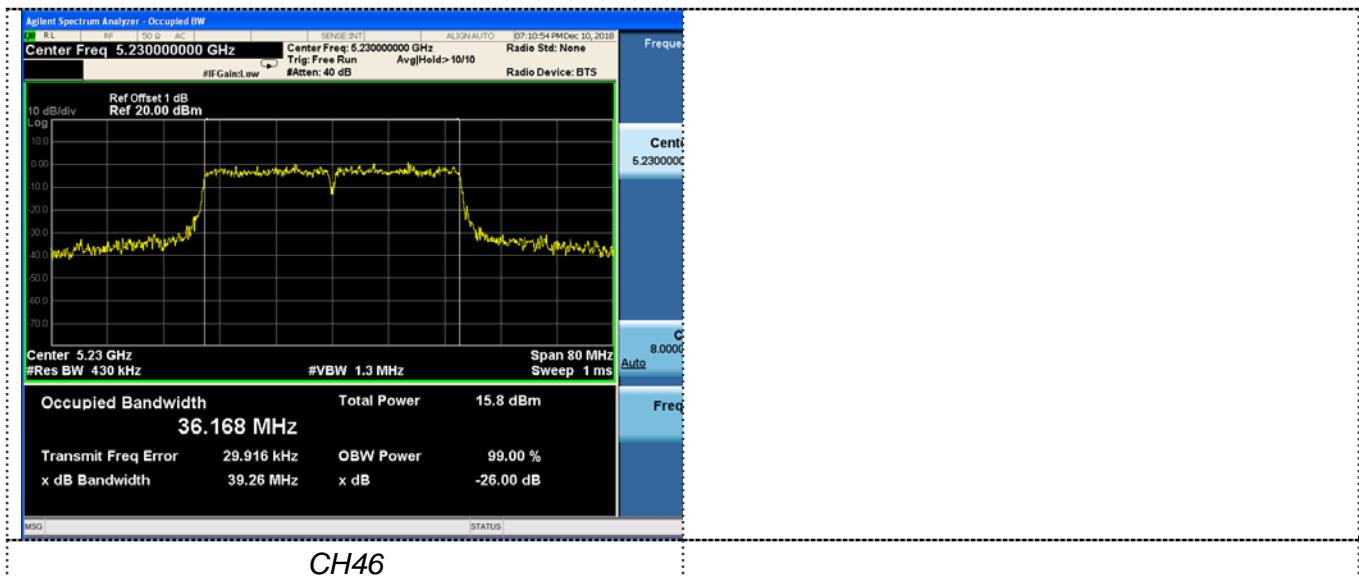
802.11ac(HT40)

U-NII 1



CH38

CH42



3.6. Minimum Emission Bandwidth (6dBm Bandwidth)

Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Procedure

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. 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.

Test Configuration



Test Results

Type	Bands	Channel	6dB Bandwidth (MHz)		Limit (KHz)	Result
			Ant.1	Ant.2		
802.11a	U-NII 3	149	16.41	16.41	≥500KHz	Pass
		157	16.42	16.44		
		165	16.44	16.44		
802.11n(HT20)	U-NII 3	149	17.20	16.72	≥500KHz	Pass
		157	17.54	17.24		
		165	17.27	17.80		
802.11n(HT40)	U-NII 3	151	36.01	35.49	≥500KHz	Pass
		159	35.63	35.66		
802.11ac(HT20)	U-NII 3	149	17.46	17.25	≥500KHz	Pass
		157	17.19	17.30		
		165	17.20	17.53		
802.11ac(HT40)	U-NII 3	151	36.02	35.73	≥500KHz	Pass
		159	35.52	36.00		
802.11ac(HT80)	U-NII 3	155	75.70	75.70		

Note:

1. Measured 6dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20 ,IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;
4. Please refer to following test plots;