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TEST REPORT

FCC PART 15.407

Report Reference No.: CTL1905077021-WF04

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Product Name.....: Notebook

Model/Type reference: HNB-IA26XX

List Model(s).....: N/A

Trade Mark.....: Haitech

FCC ID.....: 2ATES-HNB-IA26XX

Applicant's name: China Hainergy New Energy Co., Ltd.

Address of applicant: Unit 1908, 19/F, Harbour Centre, 25 Harbour Road, Wan Chai, Hong Kong

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.....: FCC Part 15 Subpart E—Unlicensed National Information Infrastructure Devices

TRF Originator.....: Shenzhen CTL Testing Technology Co., Ltd.

Master TRF.....: Dated 2011-01

Date of receipt of test item.....: May 08, 2019

Date of sampling.....: May 08, 2019

Date of Test Date.....: May 08, 2019–May 23, 2019

Data of Issue.....: May 23, 2019

Result.....: Pass

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TEST REPORT

Test Report No. : CTL1905077021-WF04	May 23, 2019 Date of issue
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Equipment under Test : Notebook

Model /Type : HNB-IA26XX

Listed Models : N/A

Applicant : China Hainergy New Energy Co., Ltd.

Address : Unit 1908, 19/F, Harbour Centre, 25 Harbour Road,
Wan Chai, Hong Kong

Manufacturer : China Hainergy New Energy Co., Ltd.

Address : Unit 1908, 19/F, Harbour Centre, 25 Harbour Road,
Wan Chai, Hong Kong

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

The test results presented in this report relate only to the object tested.

This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.

** Modified History **

[illegible]

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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

[ANSI C63.4: 2014](#): American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40GHz

Range of 9 kHz to 40GHz

[KDB789033 D02](#): General UNII Test Procedures New Rules v01r02

[KDB 662911](#): D01Emissions Testing of Transmitters with Multiple Outputs in the Same Band

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
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.

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

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

1.3.2 Laboratory accreditation

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

CNAS-Lab Code: L7497

Shenzhen CTL Testing Technology Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No. 4343.01

Shenzhen CTL Testing Technology Co., Ltd, EMC Laboratory 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.

IC Registration No.: 9518B

CAB identifier: CN0041

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 9518B on Jan. 22, 2019.

FCC-Registration No.: 399832

Designation No.: CN1216

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	± 0.01 ppm	(1)
Radiated Emission 30~1000MHz	± 4.10 dB	(1)
Radiated Emission Above 1GHz	± 4.32 dB	(1)
Conducted Disturbance 0.15~30MHz	± 3.20 dB	(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:	Notebook			
Model:	HNB-IA26XX			
Power supply:	DC 7.4V from battery			
Adapter information:	Model: SOY-1200250US Input: 100-240V~, 50/60Hz, 1.0A Output: 12V---2.5A			
WIFI				
Supported type:	20MHz system	40MHz system	80MHz system	160MHz system
	802.11a 802.11n 802.11ac	802.11n 802.11ac	802.11ac	N/A
Operation frequency:	5180MHz-5240MHz 5745MHz-5825MHz	5190MHz-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:	FPC Antenna : 2*TX 2*RX			
Antenna gain:	2.0dBi			

Note: For more details, please refer to the user's manual of the EUT.

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:

1. "--"Means no channel(s) available any more.
2. The line display in grey is those Channels/Frequencies select to test is 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 Power Spectral Density Emission Bandwidth(26dBm Bandwidth) Minimum Emission Bandwidth(6dBm Bandwidth) Undesirable emission Frequency Stability	11a/OFDM	6 Mbps
	11n(20MHz),11ac(20MHz)/OFDM	7.2 Mbps
	11n(40MHz),11ac(40MHz)/OFDM	15.0Mbps
	11ac(80MHz)/OFDM	65.0Mbps

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2018/05/25	2019/05/24
LISN	R&S	ESH2-Z5	860014/010	2018/05/25	2019/05/24
Power Meter	Agilent	U2531A	TW53323507	2018/05/25	2019/05/24
Power Sensor	Agilent	U2021XA	MY5365004	2018/05/25	2019/05/24
EMI Test Receiver	R&S	ESCI	103710	2018/05/25	2019/05/24
Spectrum Analyzer	Agilent	E4407B	MY41440676	2018/05/25	2019/05/24
Spectrum Analyzer	Agilent	N9020	US46220290	2018/05/25	2019/05/24
Controller	EM Electronics	Controller EM 1000	N/A	2018/05/25	2019/05/24
Active Loop Antenna	Daze	ZN30900A	N/A	2018/05/25	2019/05/24
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2018/05/25	2019/05/24
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2018/05/25	2019/05/24
Horn Antenna	SCHWARZBACK	BBHA 9170	BBHA9170184	2018/05/25	2019/05/24
Amplifier	Agilent	8449B	3008A02306	2018/05/25	2019/05/24
Amplifier	Agilent	8447D	2944A10176	2018/05/25	2019/05/24
Temperature/Humidity Meter	Gangxing	CTH-608	02	2018/05/25	2019/05/24
High-Pass Filter	K&L	9SH10-2700/ X12750-O/O	N/A	2018/05/25	2019/05/24
High-Pass Filter	K&L	41H10-1375/ U12750-O/O	N/A	2018/05/25	2019/05/24
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2018/05/25	2019/05/24
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2018/05/25	2019/05/24
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2018/05/25	2019/05/24
RF Cable	Megalon	RF-A303	N/A	2018/05/25	2019/05/24

The calibration interval was one year

2.5. 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.

2.6. Modifications

No modifications were implemented to meet testing criteria.

3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emissions Test

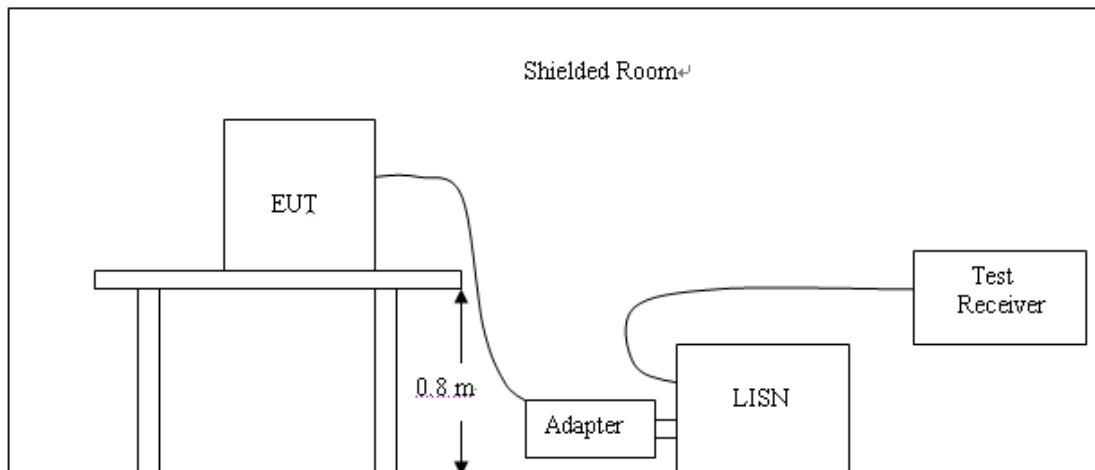
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

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

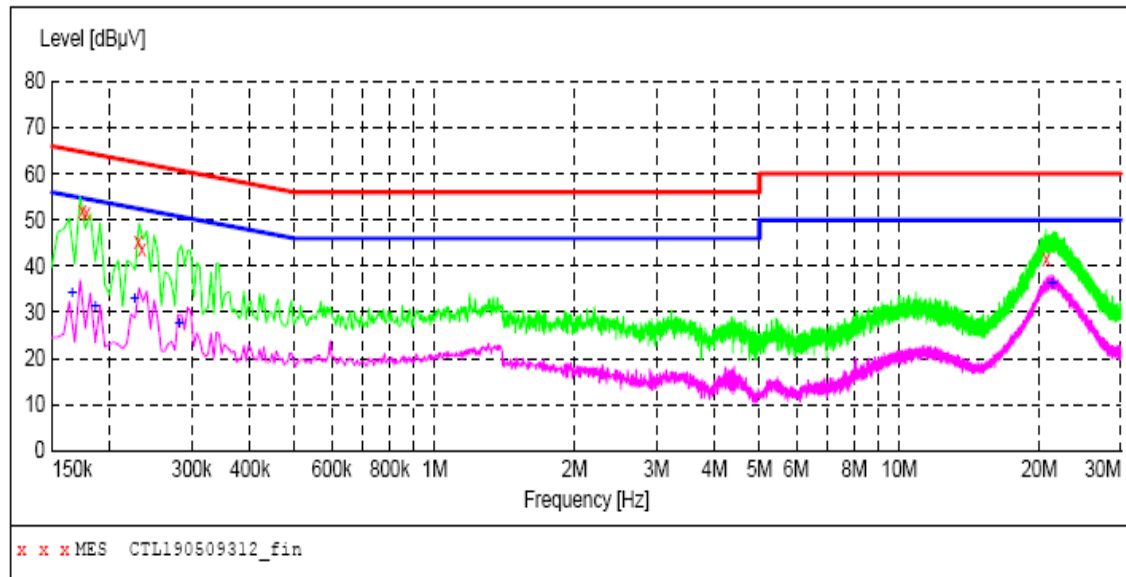
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as 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 EUT 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: 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) / 802.11ac (HT80) mode all have been tested, only worse case is reported

SCAN TABLE: "Voltage (9K-30M) FIN"

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL190509312_fin"**

2019-5-9 12:15??

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.174000	52.00	11.2	65	12.8	QP	L1	GND
0.178000	51.50	11.2	65	13.1	QP	L1	GND
0.230000	45.10	11.2	62	17.3	QP	L1	GND
0.234000	43.60	11.2	62	18.7	QP	L1	GND
20.732000	41.60	11.5	60	18.4	QP	L1	GND

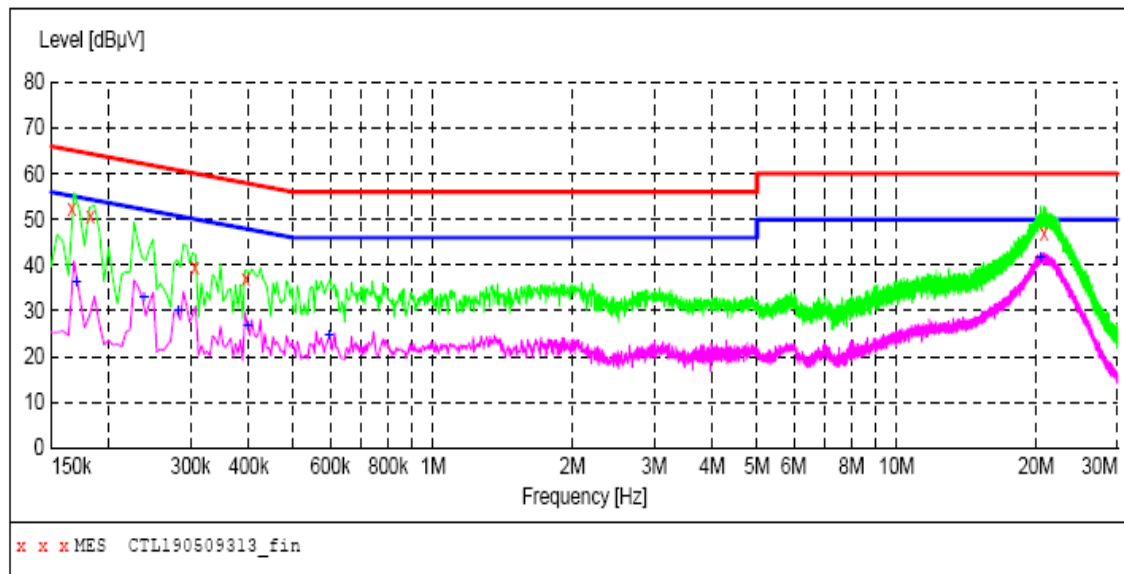
MEASUREMENT RESULT: "CTL190509312_fin2"

2019-5-9 12:15??

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.166000	34.00	11.2	55	21.2	AV	L1	GND
0.186000	31.40	11.2	54	22.8	AV	L1	GND
0.226000	32.90	11.2	53	19.7	AV	L1	GND
0.282000	27.60	11.2	51	23.2	AV	L1	GND
21.380000	36.20	11.5	50	13.8	AV	L1	GND

SCAN TABLE: "Voltage (9K-30M) FIN"

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL190509313_fin"**

2019-5-9 12:18??

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.166000	52.50	11.2	65	12.7	QP	N	GND
0.182000	50.70	11.2	64	13.7	QP	N	GND
0.306000	39.40	11.2	60	20.7	QP	N	GND
0.394000	36.90	11.2	58	21.1	QP	N	GND
20.798000	47.00	11.5	60	13.0	QP	N	GND

MEASUREMENT RESULT: "CTL190509313_fin2"

2019-5-9 12:18??

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.170000	36.10	11.2	55	18.9	AV	N	GND
0.238000	32.90	11.2	52	19.3	AV	N	GND
0.282000	30.10	11.2	51	20.7	AV	N	GND
0.398000	26.50	11.2	48	21.4	AV	N	GND
0.596000	24.70	11.2	46	21.3	AV	N	GND
20.516000	41.40	11.5	50	8.6	AV	N	GND

3.2. Undesirable 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 within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

Undesirable emission limits

Requirement	Limit(EIRP)	Limit (Field strength at 3m) ^{Note3}
15.407(b)(1)	PK:-27(dBm/MHz)	PK:68.2(dBμV/m)
15.407(b)(2)		
15.407(b)(3)		
15.407(b)(4)	PK:-27(dBm/MHz) ^{Note1} PK:-17(dBm/MHz) ^{Note2}	PK:68.2(dBμV/m) ^{Note1} PK:78.2(dBμV/m) ^{Note2}

Note1: For frequencies beyond 10MHz of band edge.

Note2: For frequencies within 10MHz of band edge.

Note3: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

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

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

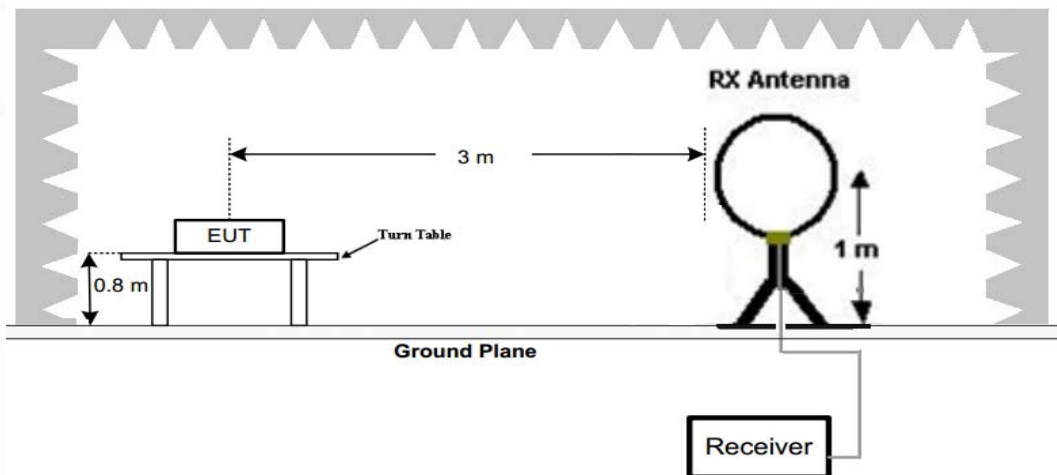
(6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

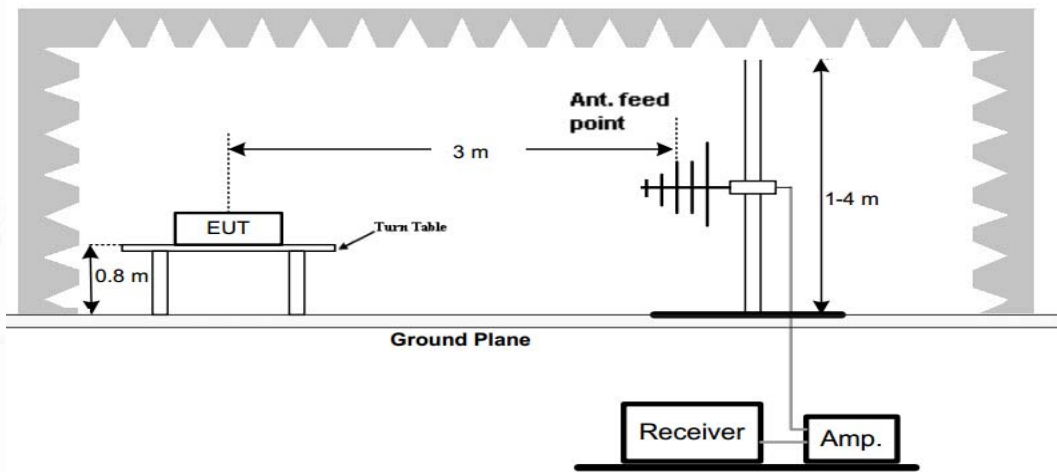
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST CONFIGURATION

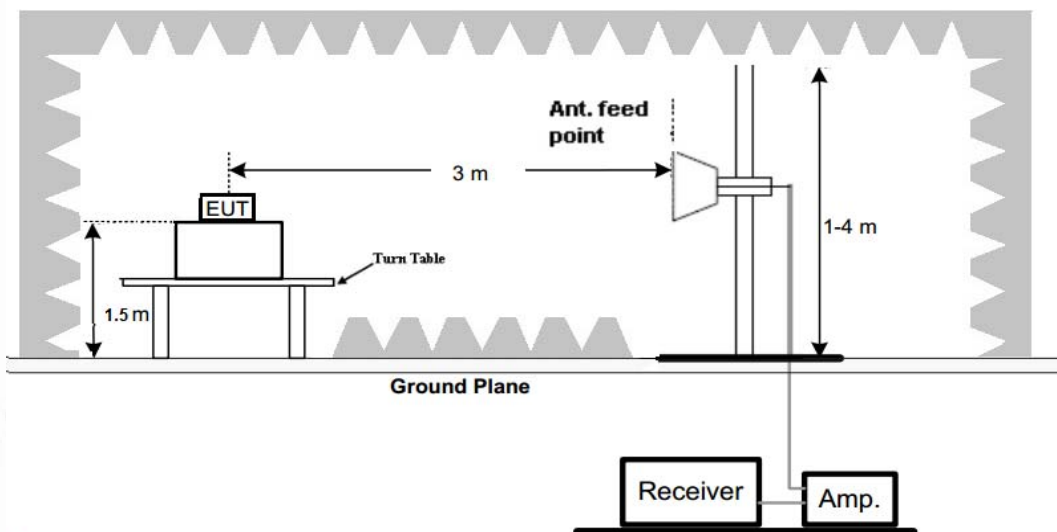
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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. 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 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.
4. The test-receiver system was set to peak and average detects 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.
5. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency measurements have been completed.

TEST RESULTS

Remark:

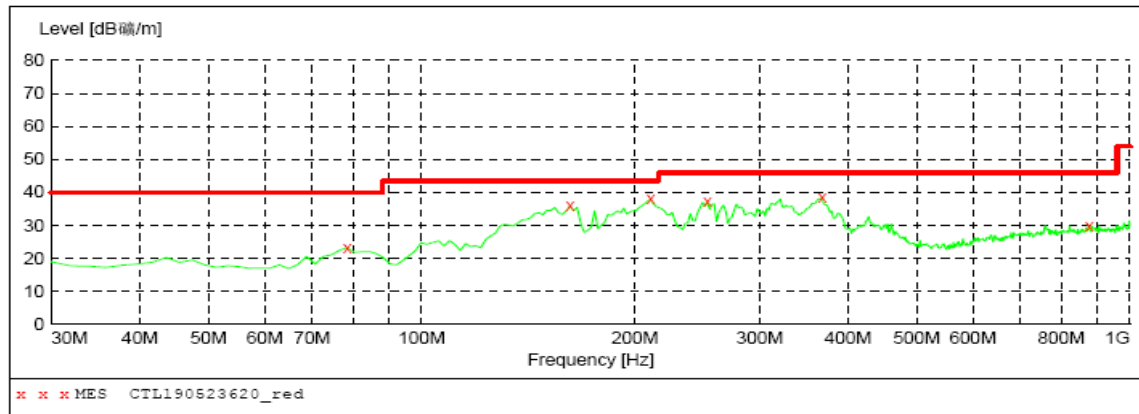
1. All 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) / 802.11ac (HT80) modes have been tested for below 1GHz test, only the worst case 802.11ac (HT20) low channel of U-NII 1 band was recorded.
2. All 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) / 802.11ac (HT80) modes have been tested for above 1GHz test, only the worst case 802.11ac (HT20) was recorded.
3. 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	300.0 ms	120 kHz	VULB9168

***MEASUREMENT RESULT: "CTL190523620_red"***

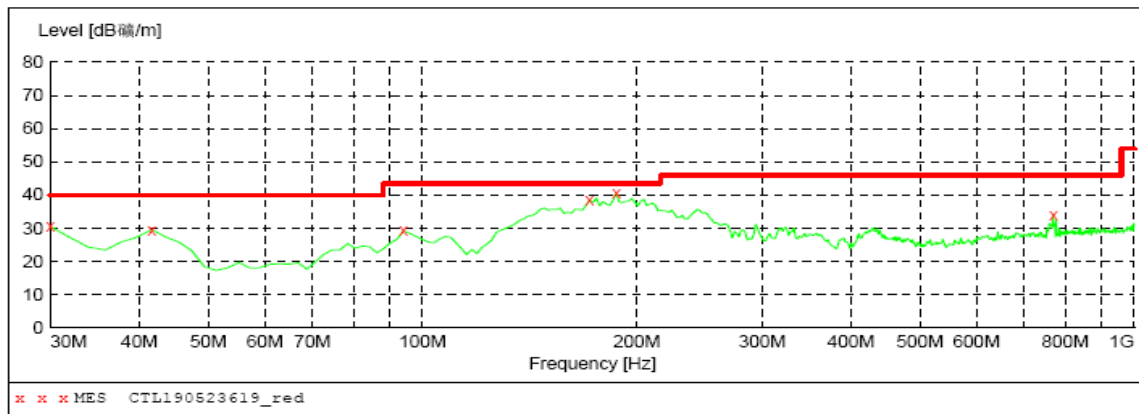
2019-5-23 16:47

Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
78.500000	23.30	10.3	40.0	16.7	---	0.0	0.00	HORIZONTAL
161.920000	35.90	15.0	43.5	7.6	---	0.0	0.00	HORIZONTAL
210.420000	38.00	11.3	43.5	5.5	---	0.0	0.00	HORIZONTAL
253.100000	37.20	12.9	46.0	8.8	---	0.0	0.00	HORIZONTAL
367.560000	38.60	15.6	46.0	7.4	---	0.0	0.00	HORIZONTAL
875.840000	30.00	23.4	46.0	16.0	---	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	300.0 ms	120 kHz	VULB9168

***MEASUREMENT RESULT: "CTL190523619_red"***

2019-5-23 16:45

Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	30.50	13.9	40.0	9.5	---	0.0	0.00	VERTICAL
41.640000	29.60	14.7	40.0	10.4	---	0.0	0.00	VERTICAL
94.020000	29.30	10.7	43.5	14.2	---	0.0	0.00	VERTICAL
171.620000	38.50	14.0	43.5	5.0	---	0.0	0.00	VERTICAL
187.140000	40.60	11.9	43.5	2.9	---	0.0	0.00	VERTICAL
769.140000	34.00	22.4	46.0	12.0	---	0.0	0.00	VERTICAL

For 1GHz to 25GHz

Note: All 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) / 802.11ac (HT80) modes have been tested for above 1GHz test, only the worst case 802.11ac (HT20) was recorded.

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

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36 (5180MHz)	5150.00	53.59	PK	H	68.20	14.61	46.32	34.44	7.12	34.28	7.27
	5150.00	46.30	AV	H	54.00	7.70	39.03	34.44	7.12	34.28	7.27
	10360.00	47.88	PK	H	68.20	20.32	32.15	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	48.09	PK	H	68.20	20.11	32.27	39.22	11.48	34.89	15.82
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	51.71	PK	H	68.20	16.49	44.15	34.69	7.23	34.36	7.56
	10480.00	48.93	PK	H	68.20	19.27	32.94	39.27	11.55	34.83	15.99
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36 (5180MHz)	5150.00	54.33	PK	V	68.20	13.87	47.06	34.44	7.12	34.28	7.27
	5150.00	47.46	AV	V	54.00	6.54	40.19	34.44	7.12	34.28	7.27
	10360.00	49.72	PK	V	68.20	18.48	33.99	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	50.63	PK	V	68.20	17.57	34.81	39.22	11.48	34.89	15.82
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	52.03	PK	V	68.20	16.17	44.47	34.69	7.23	34.36	7.56
	10480.00	47.10	PK	V	68.20	21.10	31.11	39.27	11.55	34.83	15.99
	--	--	--	--	--	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + 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. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

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

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
149 (5745MHz)	5720.00	51.21	PK	H	68.20	16.99	43.48	34.79	7.43	34.49	7.73
	11490.00	50.83	PK	H	68.20	17.37	45.17	34.79	7.43	36.57	5.66
	--	--	--	--	--	--	--	--	--	--	--
157 (5785MHz)	11570.00	51.77	PK	H	68.20	16.43	33.33	39.71	13.05	34.31	18.44
	--	--	--	--	--	--	--	--	--	--	--
165 (5825MHz)	5855.00	50.19	PK	H	68.20	18.01	42.41	34.81	7.51	34.54	7.78
	11650.00	49.08	PK	H	68.20	19.12	43.39	34.81	7.51	36.62	5.69
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
149 (5745MHz)	5720.00	51.23	PK	V	68.20	16.97	43.50	34.79	7.43	34.49	7.73
	11490.00	47.20	PK	V	68.20	21.00	41.54	34.79	7.43	36.57	5.66
	--	--	--	--	--	--	--	--	--	--	--
157 (5785MHz)	11570.00	50.83	PK	V	68.20	17.37	32.39	39.71	13.05	34.31	18.44
	--	--	--	--	--	--	--	--	--	--	--
165 (5825MHz)	5855.00	50.66	PK	V	68.20	17.54	42.88	34.81	7.51	34.54	7.78
	11650.00	47.24	PK	V	68.20	20.96	41.55	34.81	7.51	36.62	5.69
	--	--	--	--	--	--	--	--	--	--	--

REMARKS:

6. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
7. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
8. Margin value = Limit value- Emission level.
9. -- Mean the other emission levels were very low against the limit.
10. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

3.3. Maximum Conducted Output Power

Limit

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

Type	Bands	Channel	Output power Ant1 (dBm)	Output power Ant2 (dBm)	Output power Total (dBm)	Limit (dBm)	Result
802.11a	U-NII 1	36	6.47	6.35	/	23.98	Pass
		40	6.25	6.14	/		
		48	6.02	6.45	/		
	U-NII 3	149	6.20	6.28	/	30.00	
		157	6.35	6.33	/		
		165	6.09	6.00	/		
802.11n(HT20) MIMO	U-NII 1	36	3.39	3.26	6.34	23.98	Pass
		40	3.24	3.14	6.20		
		48	3.01	3.39	6.21		
	U-NII 3	149	3.13	3.02	6.09	30.00	
		157	3.19	3.44	6.33		
		165	3.33	3.23	6.29		
802.11n(HT40) MIMO	U-NII 1	38	3.05	3.27	6.17	23.98	Pass
		46	3.37	3.46	6.43		
	U-NII 3	151	3.06	3.28	6.18	30.00	
		159	3.30	3.28	6.30		
802.11ac(HT20) MIMO	U-NII 1	36	3.05	3.06	6.07	23.98	Pass
		40	3.29	3.23	6.27		
		48	3.33	3.23	6.29		
	U-NII 3	149	3.25	3.12	6.20	30.00	
		157	3.12	3.02	6.08		
		165	3.35	3.33	6.35		
802.11ac(HT40) MIMO	U-NII 1	38	3.35	3.27	6.32	23.98	Pass
		46	3.41	3.35	6.39		
	U-NII 3	151	3.28	3.24	6.27	30.00	
		159	3.34	3.09	6.23		
802.11ac(HT80) MIMO	U-NII 1	42	3.13	3.24	6.20	23.98	Pass
	U-NII 3	155	3.47	3.19	6.34	30.00	

3.4. Power Spectral Density

Limit

(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 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}

(2) For the 5.25 - 5.35 GHz and 5.47 - 5.725 GHz bands, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band.^{note1}

(3) 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

Type	Bands	Channel	Power Spectral Density Ant1 (dBm/MHz)	Power Spectral Density Ant2 (dBm/MHz)	Power Spectral Density Total (dBm/ MHz)	Limit (dBm/MHz)	Result
802.11a SISO	U-NII 1	36	1.806	1.926	/	11	Pass
		40	1.133	0.879	/		
		48	0.985	1.087	/		
802.11n (HT20) MIMO	U-NII 1	36	0.772	1.648	4.24		
		40	1.039	0.455	3.77		
		48	0.810	0.394	3.62		
802.11n (HT40) MIMO	U-NII 1	38	-2.080	-2.613	0.67		
		46	-1.776	-2.428	0.92		
802.11ac (HT20) MIMO	U-NII 1	36	1.751	0.597	4.22		
		40	1.065	0.354	3.73		
		48	1.241	0.939	4.10		
802.11ac (HT40) MIMO	U-NII 1	38	-2.088	-2.681	0.64		
		46	-2.656	-2.517	0.42		
802.11ac (HT80) MIMO	U-NII 1	42	-4.680	-5.678	-2.14		

Type	Bands	Channel	Power Spectral Density Ant1 (dBm/500KHz)	Power Spectral Density Ant2 (dBm/500KHz)	Power Spectral Density Total (dBm/ 500KHz)	Limit (dBm/500KHz)	Result
802.11a SISO	U-NII 3	149	-1.787	-2.020	/	30	Pass
		157	-0.761	-1.459	/		
		165	-0.820	-2.231	/		
802.11n (HT20) MIMO	U-NII 3	149	-1.365	-1.800	1.43		
		157	-1.067	-2.376	1.34		
		165	-1.618	-1.884	1.26		
802.11n (HT40) MIMO	U-NII 3	151	2.095	-4.783	2.91		
		159	2.459	-6.319	3.00		
802.11ac (HT20) MIMO	U-NII 3	149	-1.337	-1.696	1.50		
		157	-0.866	-1.227	1.97		
		165	-0.625	-2.129	1.70		
802.11ac (HT40) MIMO	U-NII 3	151	2.909	-4.356	3.66		
		159	2.876	-5.087	3.52		
802.11ac (HT80) MIMO	U-NII 3	155	-7.453	-7.048	-4.24		

Test plot as follows:

ANT1
802.11a

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48

CH165

802.11n(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48

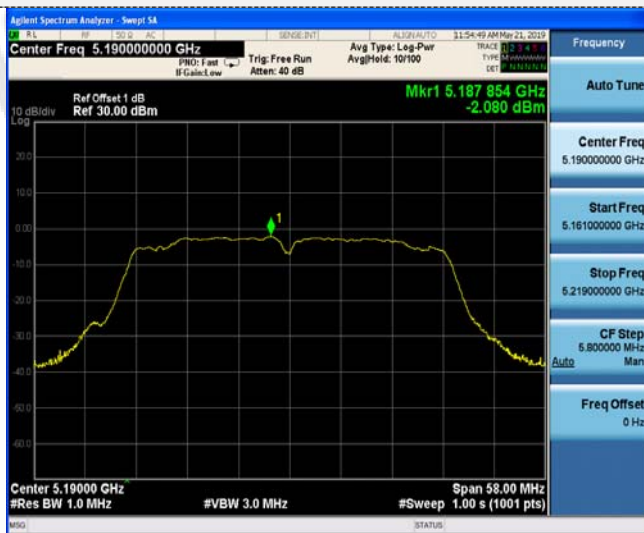


CH165



802.11n(HT40)

U-NII 1



U-NII 3



CH38



CH151



CH46

CH159

802.11ac(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157

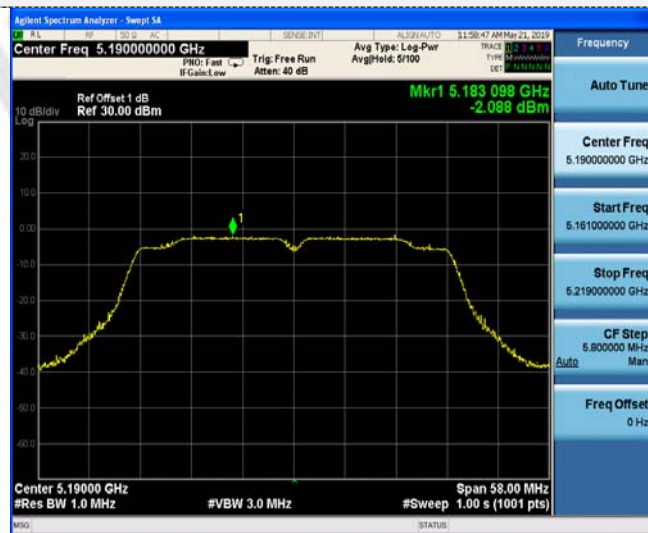


CH48

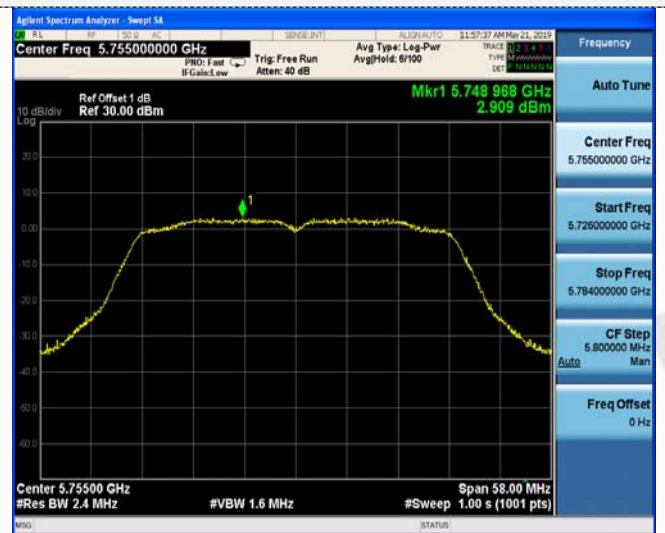
CH165

802.11ac(HT40)

U-NII 1



U-NII 3



CH38



CH151



CH46

CH159

802.11ac(HT80)

U-NII 1



U-NII 3



CH42

CH155

ANT2
802.11a

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48

CH165

802.11n(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48



CH165

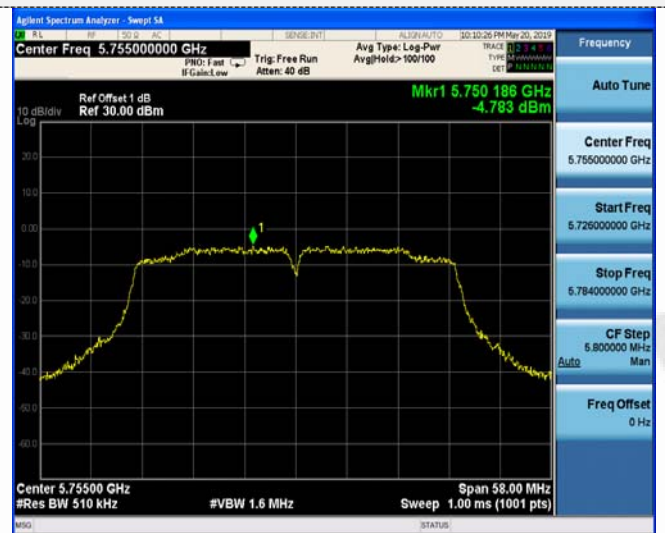


802.11n(HT40)

U-NII 1



U-NII 3



CH38



CH151



CH46

CH159

802.11ac(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157

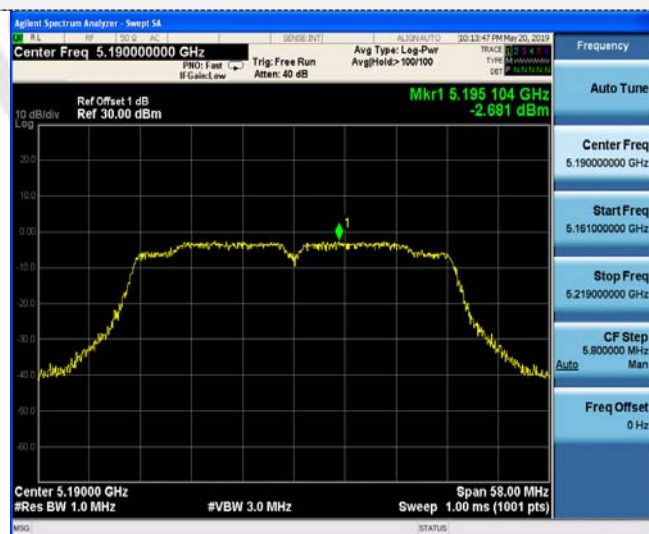


CH48

CH165

802.11ac(HT40)

U-NII 1



U-NII 3



CH38



CH151



CH46

CH159

802.11ac(HT80)

U-NII 1



U-NII 3



CH42

CH155

3.5. Emission Bandwidth (26dBm Bandwidth)

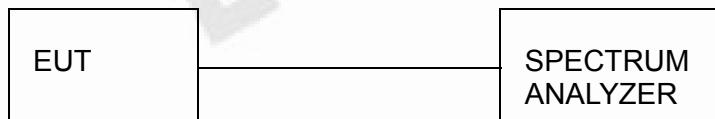
Limit

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

ANT1

Type	Bands	Channel	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	22.60	16.470	N/A	Pass
		40	21.90	16.451		
		48	21.60	16.454		
802.11n(HT20)	U-NII 1	36	22.32	17.632		
		40	22.15	17.622		
		48	22.55	17.618		
802.11n(HT40)	U-NII 1	38	42.25	36.088		
		46	41.72	35.994		
802.11ac(HT20)	U-NII 1	36	22.24	17.638		
		40	21.97	17.602		
		48	21.94	17.640		
802.11ac(HT40)	U-NII 1	38	42.17	36.041		
		46	41.74	36.062		
802.11ac(HT80)	U-NII 1	42	80.59	75.328		

ANT2

Type	Bands	Channel	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	22.98	16.443	N/A	Pass
		40	22.14	16.475		
		48	21.63	16.450		
802.11n(HT20)	U-NII 1	36	21.32	17.640		
		40	22.33	17.610		
		48	22.03	17.632		
802.11n(HT40)	U-NII 1	38	42.53	36.081		
		46	41.39	36.101		
802.11ac(HT20)	U-NII 1	36	22.02	17.621		
		40	21.70	17.622		
		48	22.52	17.609		
802.11ac(HT40)	U-NII 1	38	41.63	36.061		
		46	41.92	36.092		
802.11ac(HT80)	U-NII 1	42	80.42	75.393		

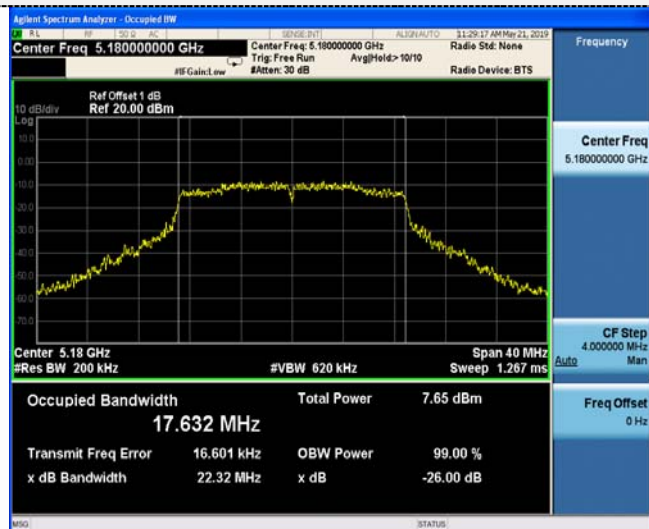
Test plot as follows:

ANT1

802.11a



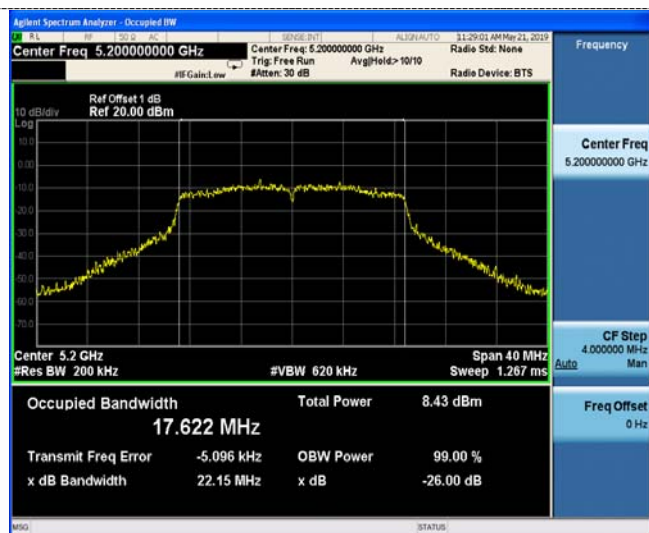
802.11n(HT20)



CH36



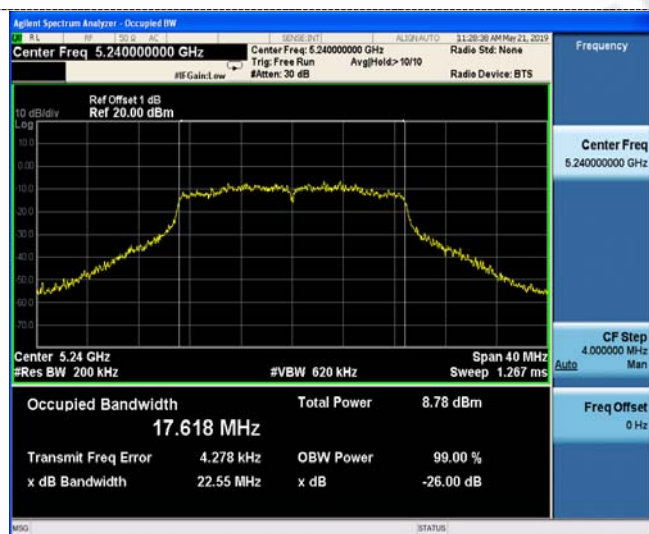
CH36



CH40



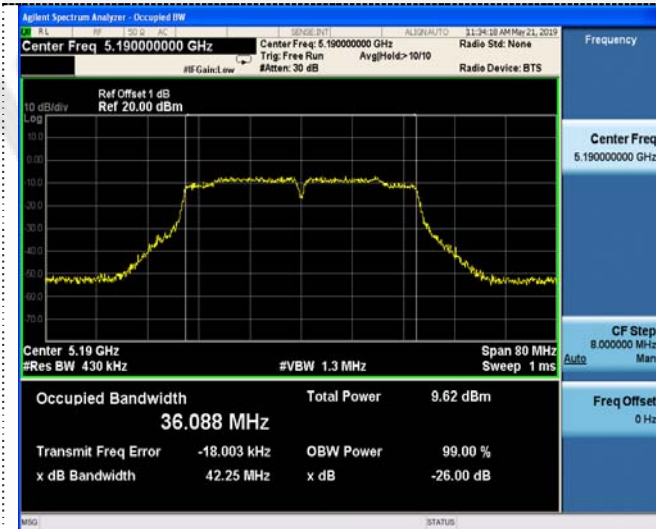
CH40



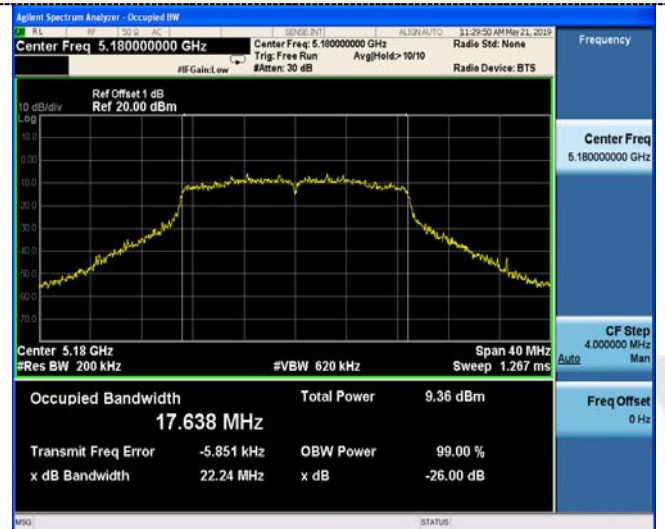
CH48

CH48

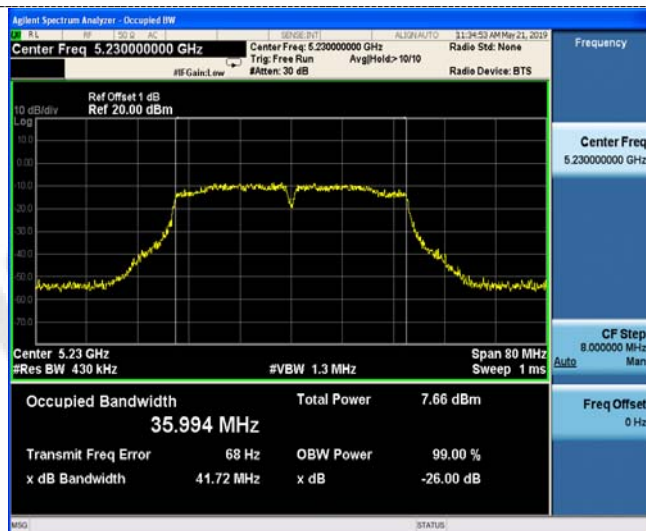
802.11n(HT40)



802.11ac(HT20)



CH38



CH36



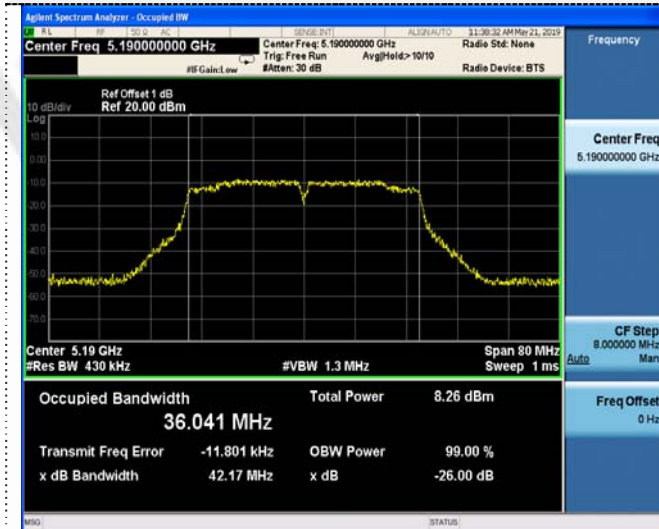
CH46

CH40

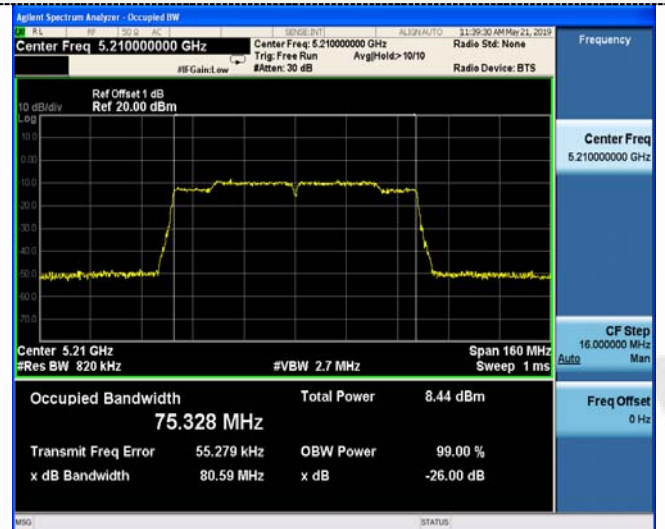


CH48

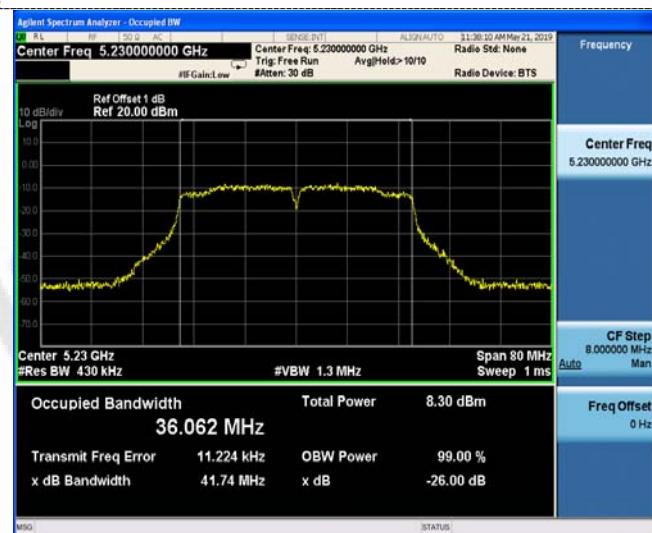
802.11ac(HT40)



802.11ac(HT80)



CH38

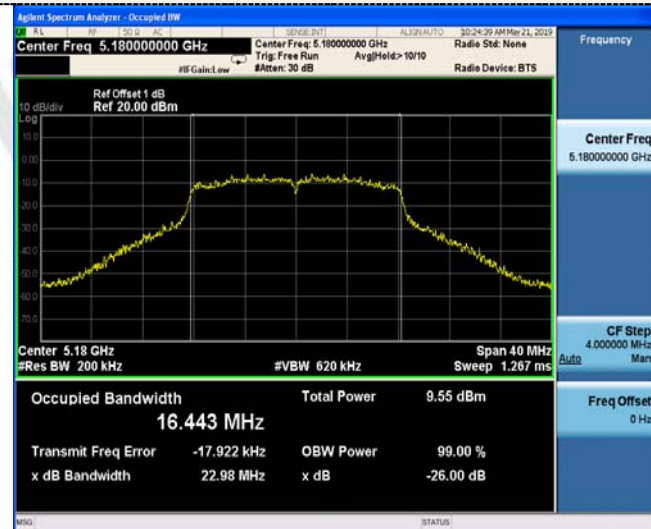


CH46

CH42

ANT2

802.11a



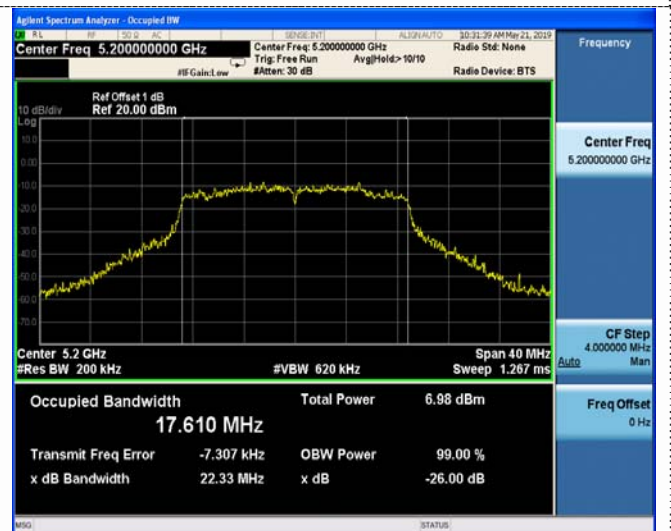
802.11n(HT20)



CH36



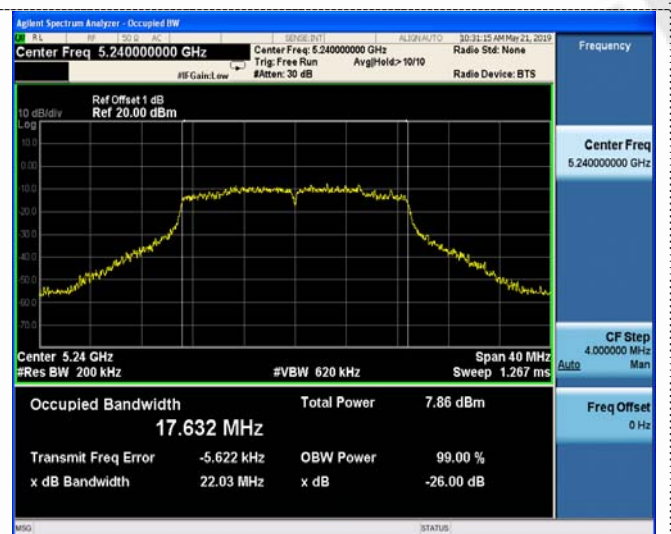
CH36



CH40



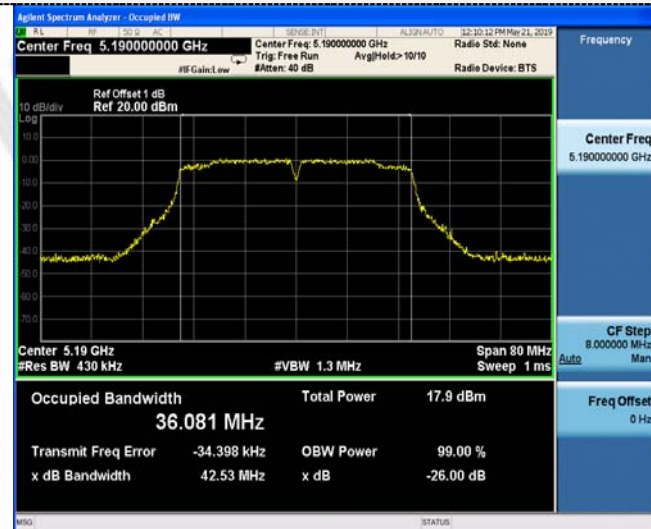
CH40



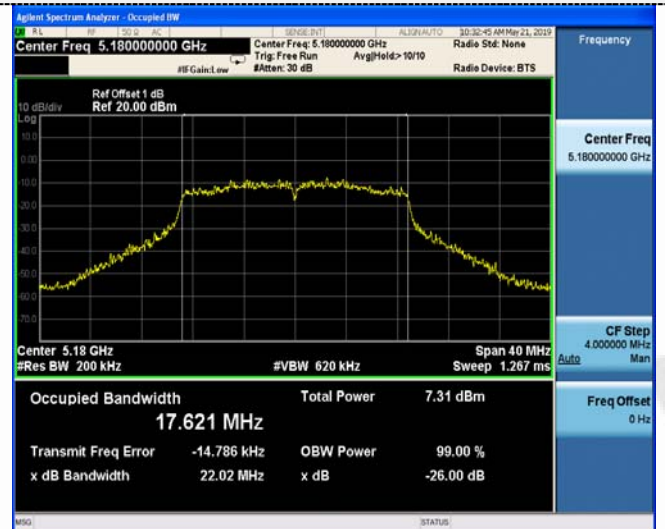
CH48

CH48

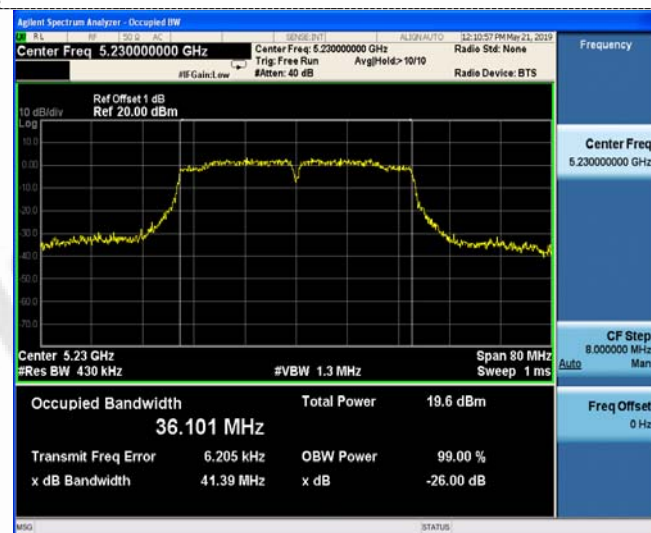
802.11n(HT40)



802.11ac(HT20)



CH38



CH36



CH46



CH40

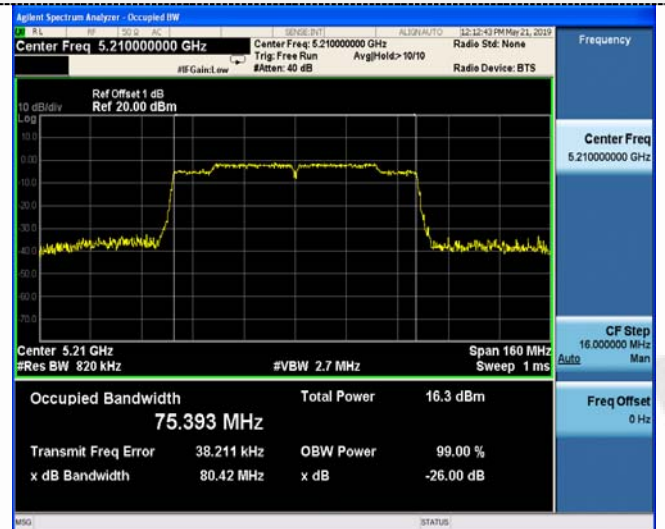


CH48

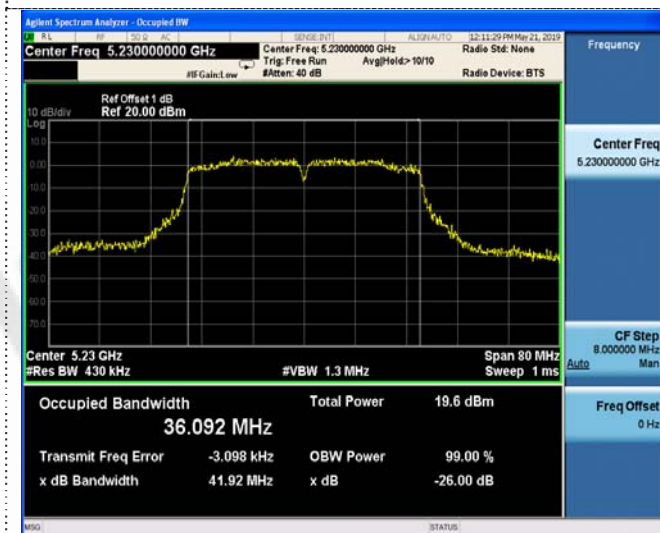
802.11ac(HT40)



802.11ac(HT80)



CH38



CH42

CH46

3.6. Minimum Emission Bandwidth (6dBm Bandwidth)

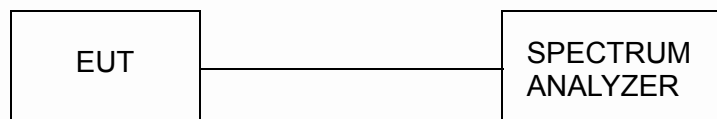
Limit

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

ANT1

Type	Bands	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	U-NII 3	149	15.52	≥500KHz	Pass
		157	15.70		
		165	15.55		
802.11n(HT20)	U-NII 3	149	15.06		
		157	16.25		
		165	15.91		
802.11n(HT40)	U-NII 3	151	35.11		
		159	35.12		
802.11ac(HT20)	U-NII 3	149	15.11		
		157	15.68		
		165	14.99		
802.11ac(HT40)	U-NII 3	151	35.08		
		159	35.10		
802.11ac(HT80)	U-NII 3	155	75.27		

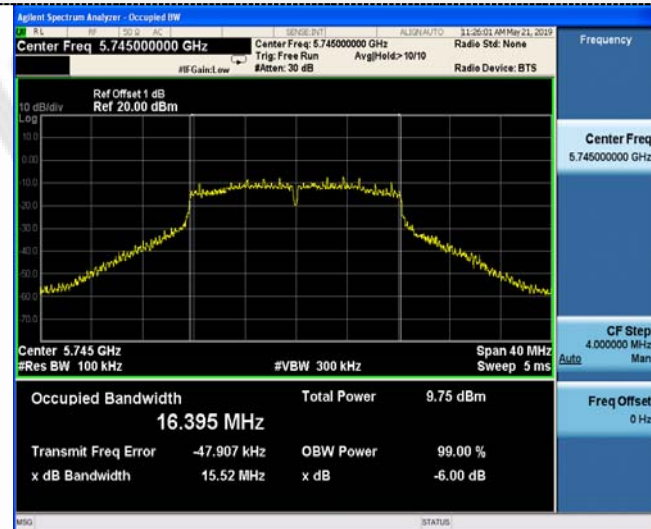
ANT2

Type	Bands	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	U-NII 3	149	15.65	≥500KHz	Pass
		157	15.28		
		165	15.63		
802.11n(HT20)	U-NII 3	149	21.32		
		157	22.33		
		165	22.03		
802.11n(HT40)	U-NII 3	151	35.11		
		159	35.13		
802.11ac(HT20)	U-NII 3	149	15.80		
		157	14.18		
		165	15.66		
802.11ac(HT40)	U-NII 3	151	35.11		
		159	35.10		
802.11ac(HT80)	U-NII 3	155	75.27		

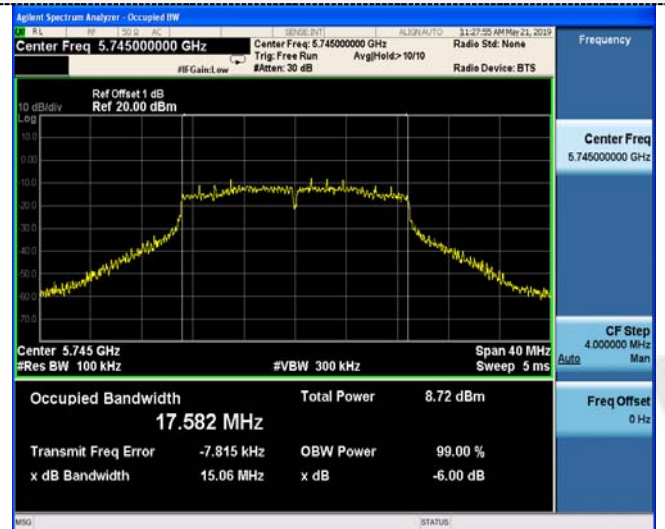
Test plot as follows:

ANT1

802.11a



802.11n(HT20)



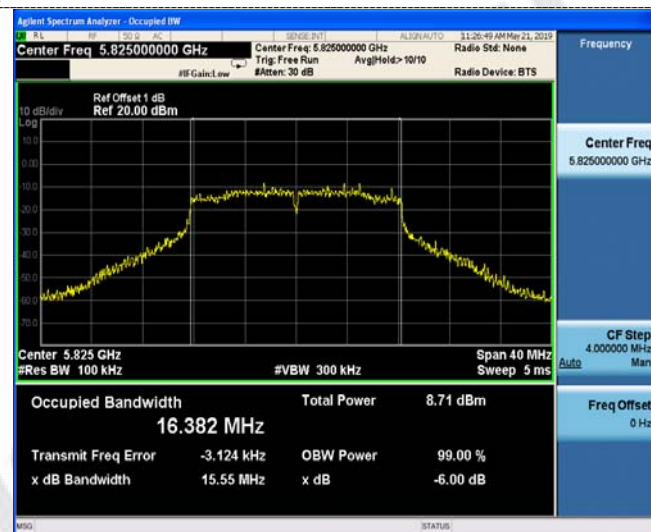
CH149



CH149



CH157



CH157



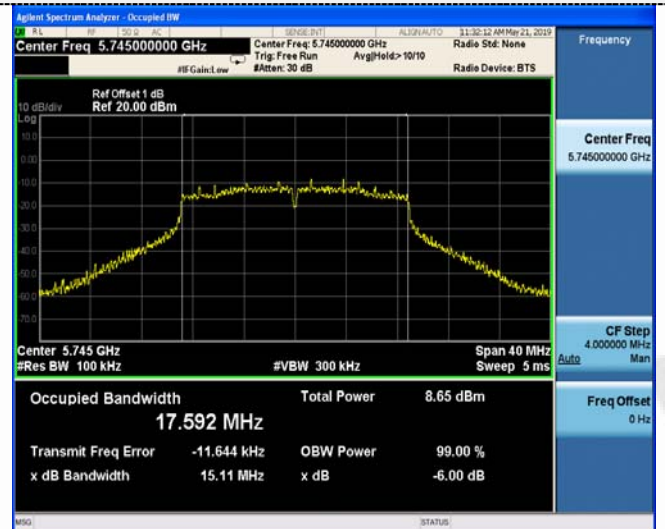
CH165

CH165

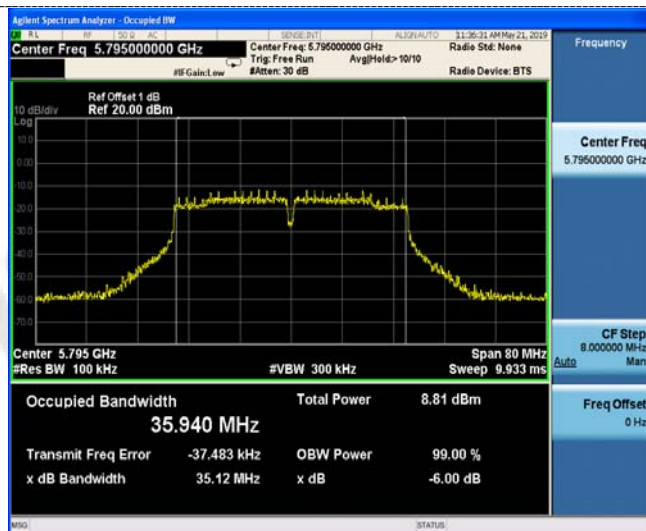
802.11n(HT40)



802.11ac(HT20)



CH151



CH149



CH159

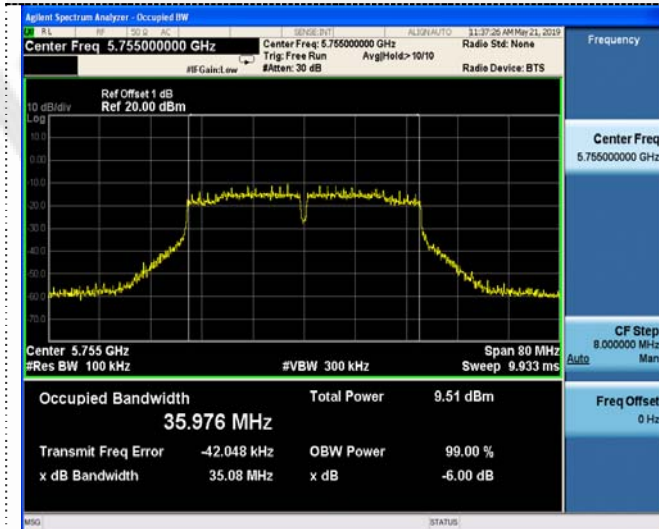


CH157



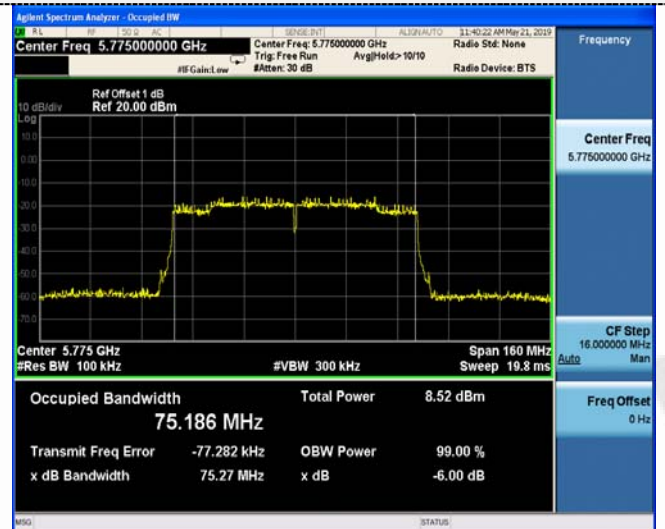
CH165

802.11ac(HT40)

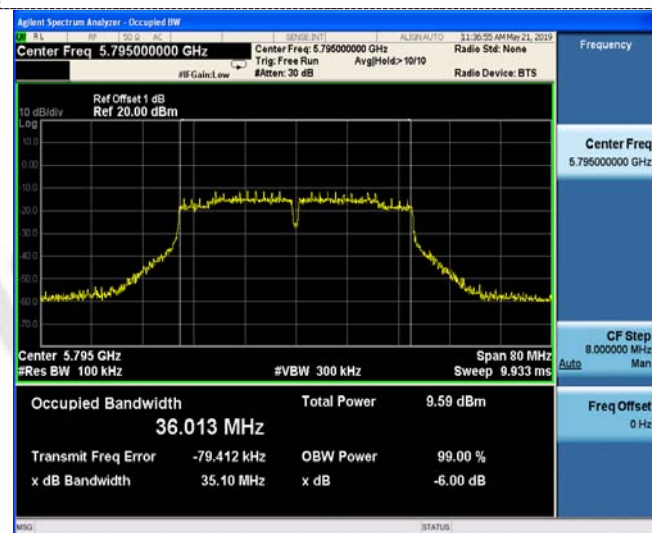


CH151

802.11ac(HT80)



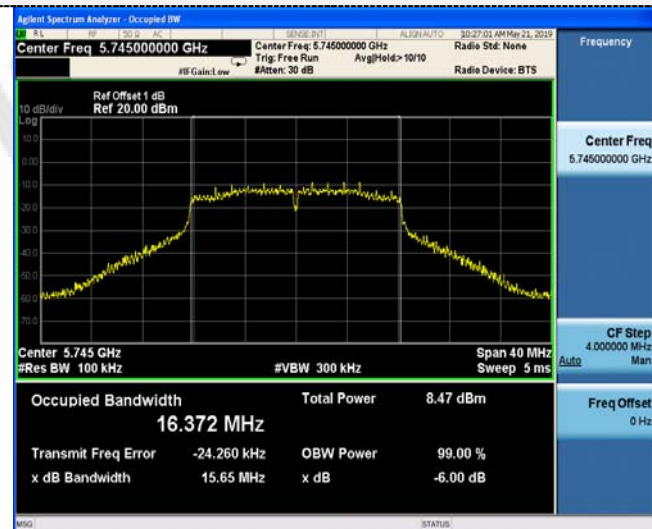
CH155



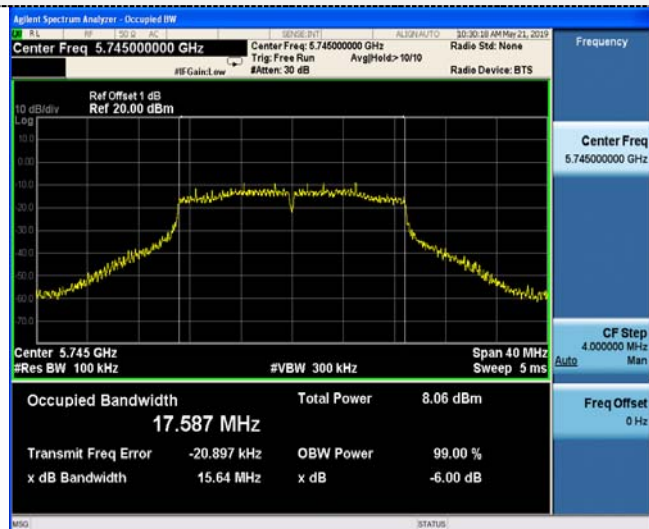
CH159

ANT2

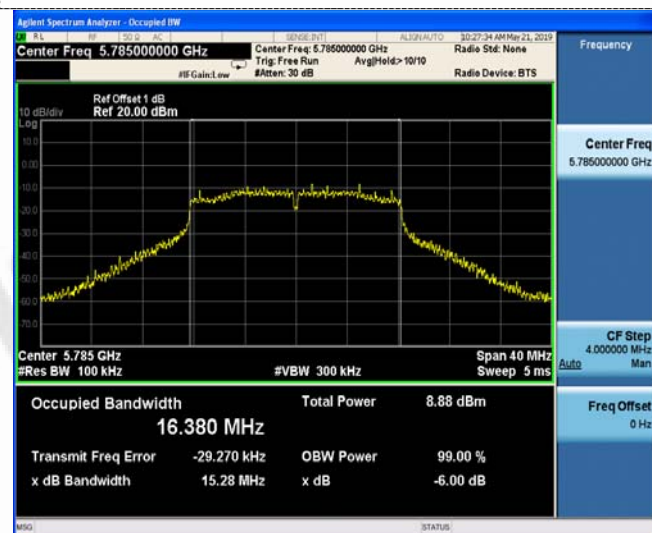
802.11a



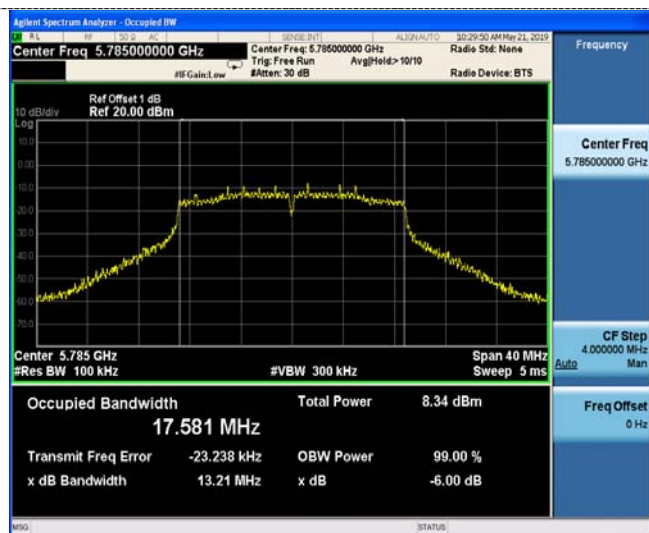
802.11n(HT20)



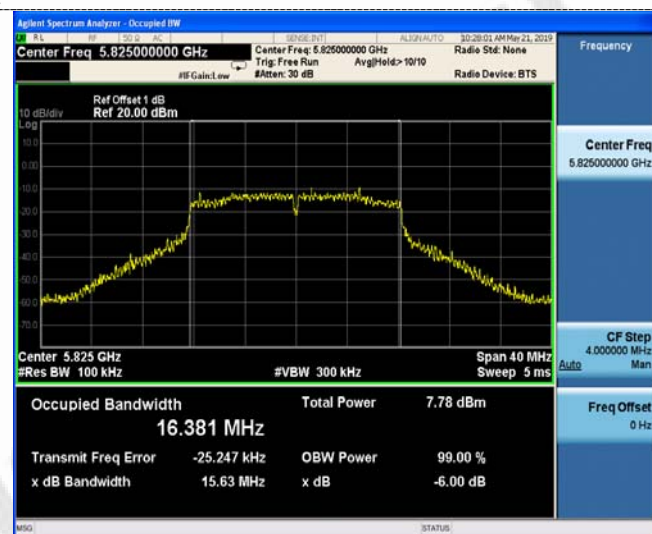
CH149



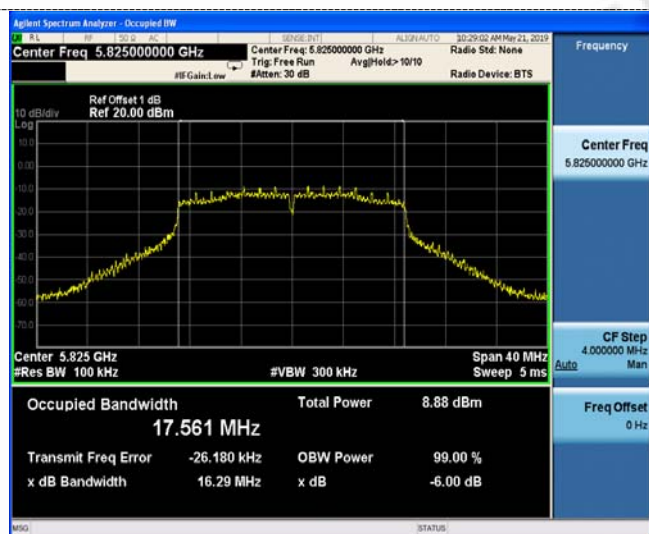
CH149



CH157



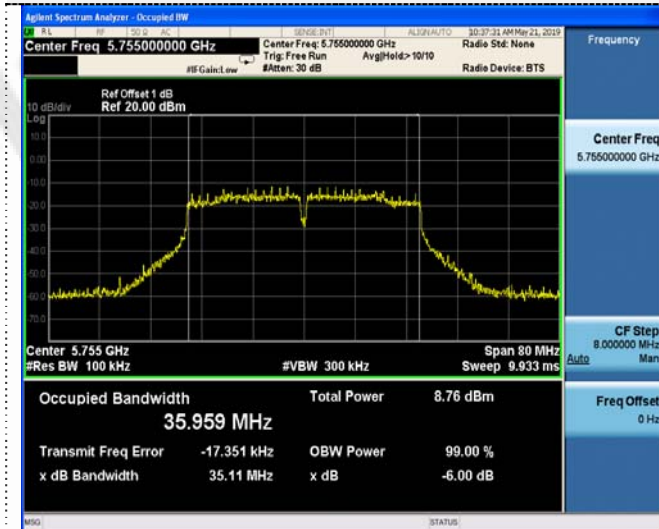
CH157



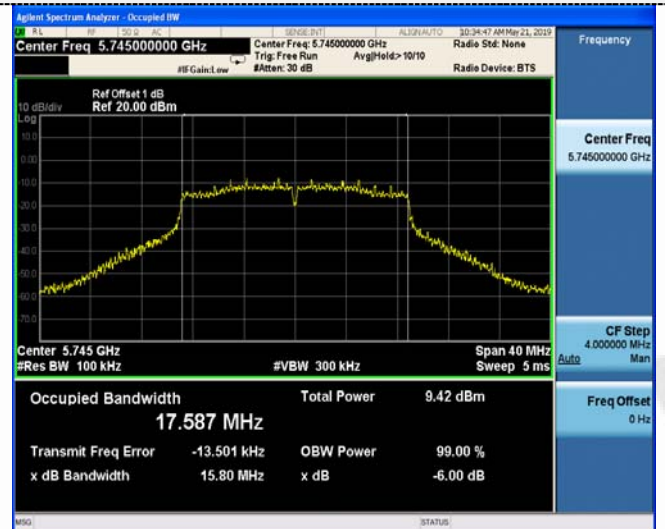
CH165

CH165

802.11n(HT40)



802.11ac(HT20)



CH151



CH149



CH159

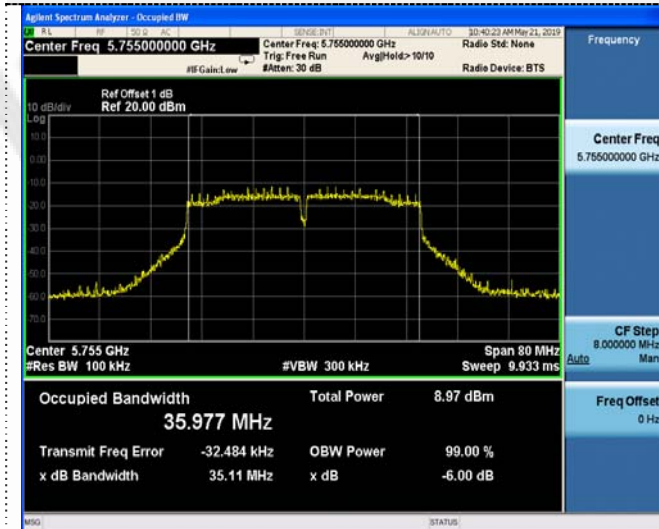


CH157



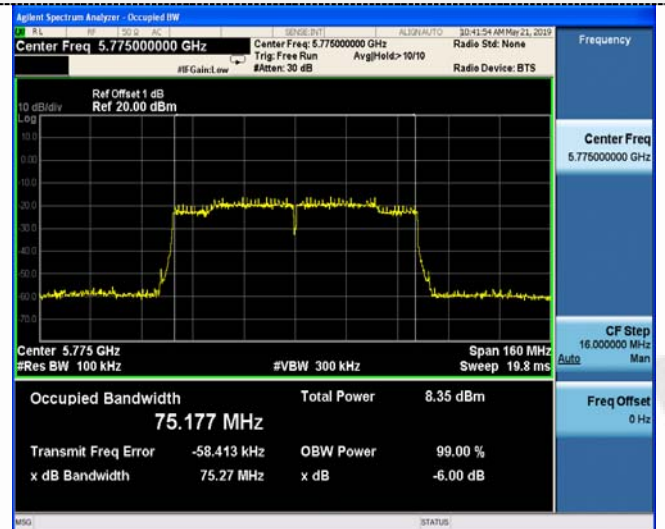
CH165

802.11ac(HT40)

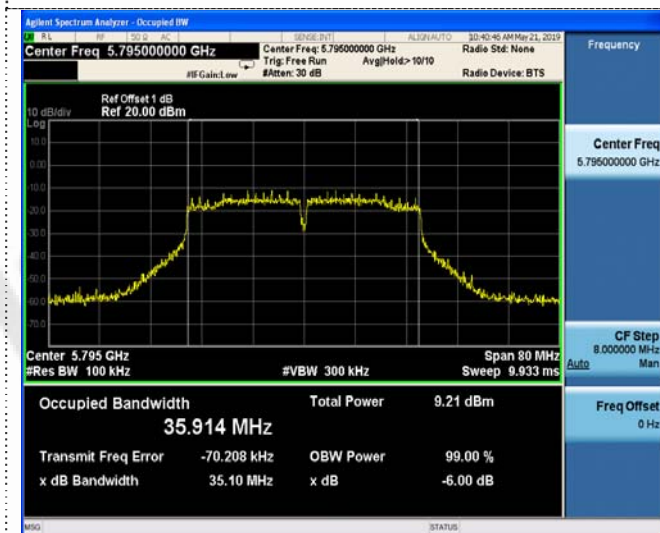


CH151

802.11ac(HT80)



CH155



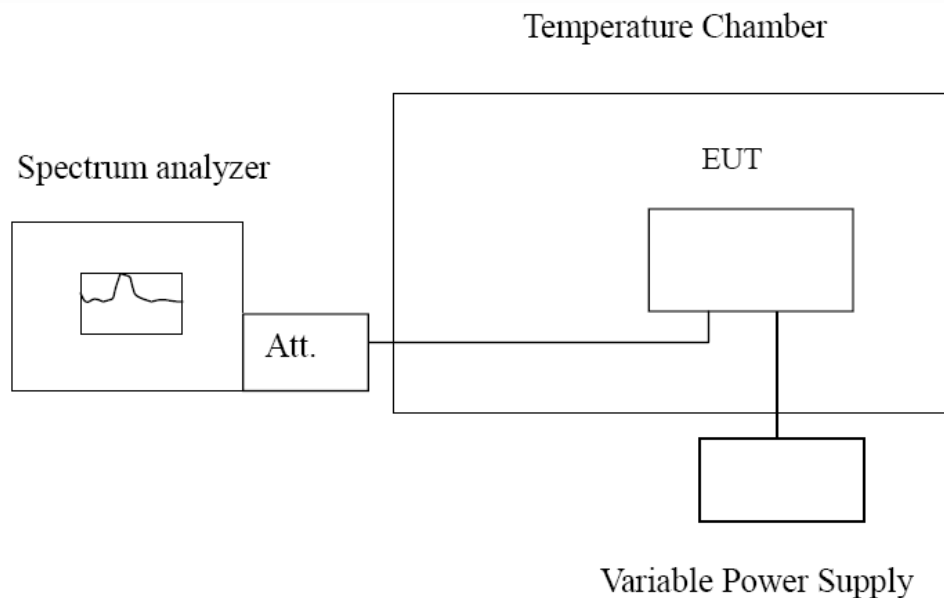
CH159

3.7. Frequency Stability

LIMIT

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

TEST CONFIGURATION



TEST PROCEDURE

Frequency Stability under Temperature Variations:

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

Frequency Stability under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint, record the maximum frequency change.

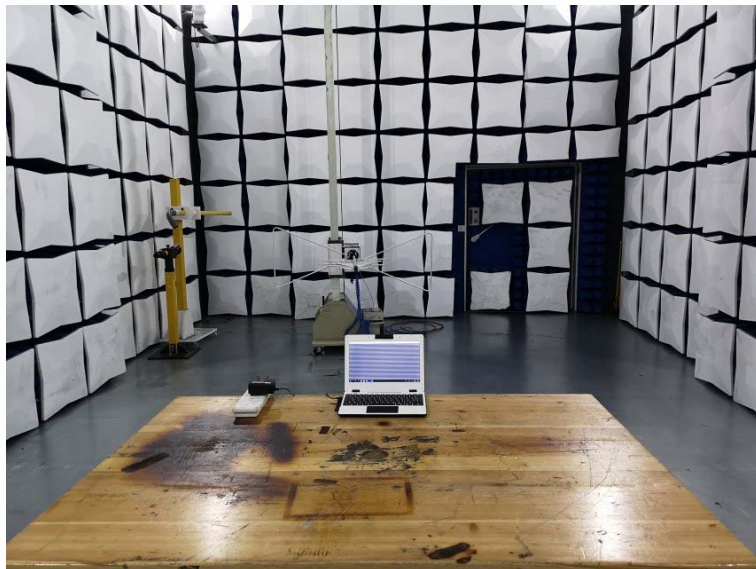
TEST RESULTS

Record worst case as below:

Reference Frequency: 802.11ac channel=36 frequency=5180MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
7.40	-30	1130	0.2181	Within the band of operation	Pass
	-20	1107	0.2137		
	-10	1017	0.1963		
	0	1050	0.2027		
	10	1062	0.2050		
	20	998	0.1927		
	30	1035	0.1998		
	40	1092	0.2108		
	50	1141	0.2203		
8.51	25	1037	0.2002	Within the band of operation	Pass
6.29	25	1135	0.2191		

Reference Frequency: 802.11ac channel=149 frequency=5745MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
7.40	-30	1215	0.2115	Within the band of operation	Pass
	-20	1185	0.2063		
	-10	1106	0.1925		
	0	1083	0.1885		
	10	1135	0.1976		
	20	1058	0.1842		
	30	1069	0.1861		
	40	1120	0.1950		
	50	1195	0.2080		
8.51	25	1032	0.1796	Within the band of operation	Pass
6.29	25	1057	0.1840		

4. Test Setup Photos of the EUT



5. Photos of the EUT

Reference to the test report No. CTL1905077021-WF02

***** End of Report *****