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# TEST REPORT

## FCC PART 15 SUBPART E 15.407

Report Reference No. ....: CTL1903152011-WF02

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Product Name.....: wireless module

Model/Type reference .....: AR1021X-NV5

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

Trade Mark.....: N/A

FCC ID .....: ZLJ-AR1021X-NV5

Applicant's name .....: **TOPLINKST TECHNOLOGY COMPANY LIMITED**

Address of applicant .....: UNIT 04, 7F, BRIGHT WAY TOWER, NO.33 MONG KOK ROAD,  
KOWLOON, Hong Kong

Test Firm .....: **Shenzhen CTL Testing Technology Co., Ltd.**

Address of Test Firm .....: Floor 1-A, Baisha Technology Park, No.3011, Shaheji 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.....: Mar. 15, 2019

Date of sampling.....: Mar. 15, 2019

Date of Test Date.....: Mar. 15, 2019–Apr.15, 2019

Data of Issue.....: Apr.15, 2019

Result.....: **Pass**

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# TEST REPORT

<b>Test Report No. :</b> CTL1903152011-WF02	Apr.15, 2019 Date of issue
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Equipment under Test : wireless module

Model /Type : AR1021X-NV5

Listed Models : N/A

**Applicant** : **TOPLINKST TECHNOLOGY COMPANY LIMITED**

Address : UNIT 04, 7F, BRIGHT WAY TOWER, NO,33 MONG  
KOK ROAD, KOWLOON, Hong Kong

**Manufacturer** : **TOPLINKST TECHNOLOGY COMPANY LIMITED**

Address : UNIT 04, 7F, BRIGHT WAY TOWER, NO,33 MONG  
KOK ROAD, KOWLOON, Hong Kong

<b>Test result</b>	<b>Pass *</b>
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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.

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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 <sub>Note1</sub>
FCC Part 15.407(e)	Minimum Emission Bandwidth(6dBm Bandwidth)	PASS <sub>Note2</sub>
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 <sub>Note 3</sub>
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:

##### **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 Huatongwei International Inspection 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	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±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:	wireless module	
Model:	AR1021X-NV5	
Power supply:	DC 3.3V	
WIFI		
Supported type:	20MHz system	40MHz system
	802.11a 802.11n	802.11n
Operation frequency:	5180-5240MHz 5745-5825MHz	5190-5230MHz 5755MHz-5795MHz
Modulation:	OFDM	OFDM
Channel number:	9	4
Channel separation:	20MHz	40MHz
Antenna type/gain:	Integral Antenna : 2*TX 2*RX: 3dBi on 5GHz	

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	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
U-NII 1 (5150MHz-5250MHz)	36	5180	38	5190
	40	5200		
	44	5220	46	5230
	48	5240		
U-NII 3 (5725MHz-5850MHz)	149	5745	151	5755
	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		
Emission Bandwidth(26dBm Bandwidth)	11n(20MHz)/OFDM	7.2 Mbps
Minimum Emission Bandwidth(6dBm Bandwidth)		
Undesirable emission	11n(40MHz) /OFDM	15.0Mbps
Frequency Stability		

## 2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.1 2	2018/05/25	2019/05/24
LISN	R&S	ESH2-Z5	860014/010	2018/05/25	2019/05/24
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2018/05/25	2019/05/24
EMI Test Receiver	R&S	ESCI	1166.5950.03	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
Power Sensor	Agilent	U2021XA	MY55130004	2018/05/25	2019/05/24
Power Meter	Agilent	U2021XA	MY55130006	2018/05/25	2019/05/24
Controller	EM Electronics	EM 1000	060859	2018/05/21	2019/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2018/05/25	2019/05/24
Active Loop Antenna	Da Ze	ZN30900A	/	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	2018/05/17	2019/05/16
High-Pass Filter	micro-tranics	HPM50108	G174	2018/05/17	2019/05/16
High-Pass Filter	micro-tranics	HPM50111	G142	2018/05/17	2019/05/16
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2018/05/17	2019/05/16
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2018/05/17	2019/05/16
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2018/05/17	2019/05/16
RF Cable	Megalon	RF-A303	N/A	2018/05/17	2019/05/16

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

## 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

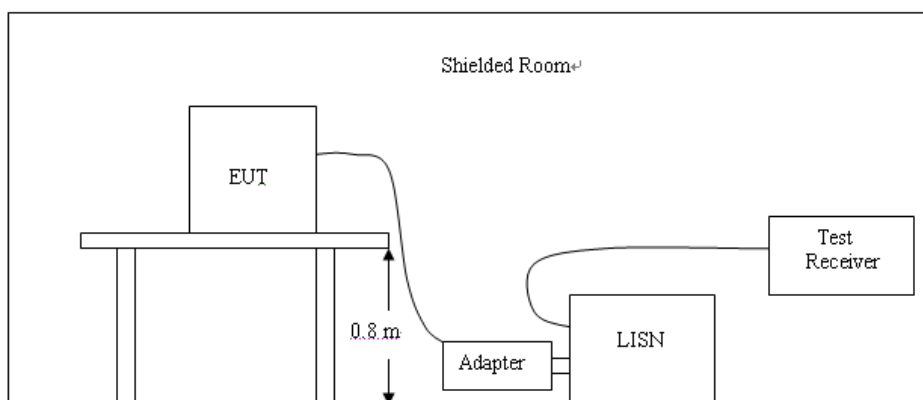
##### LIMIT

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



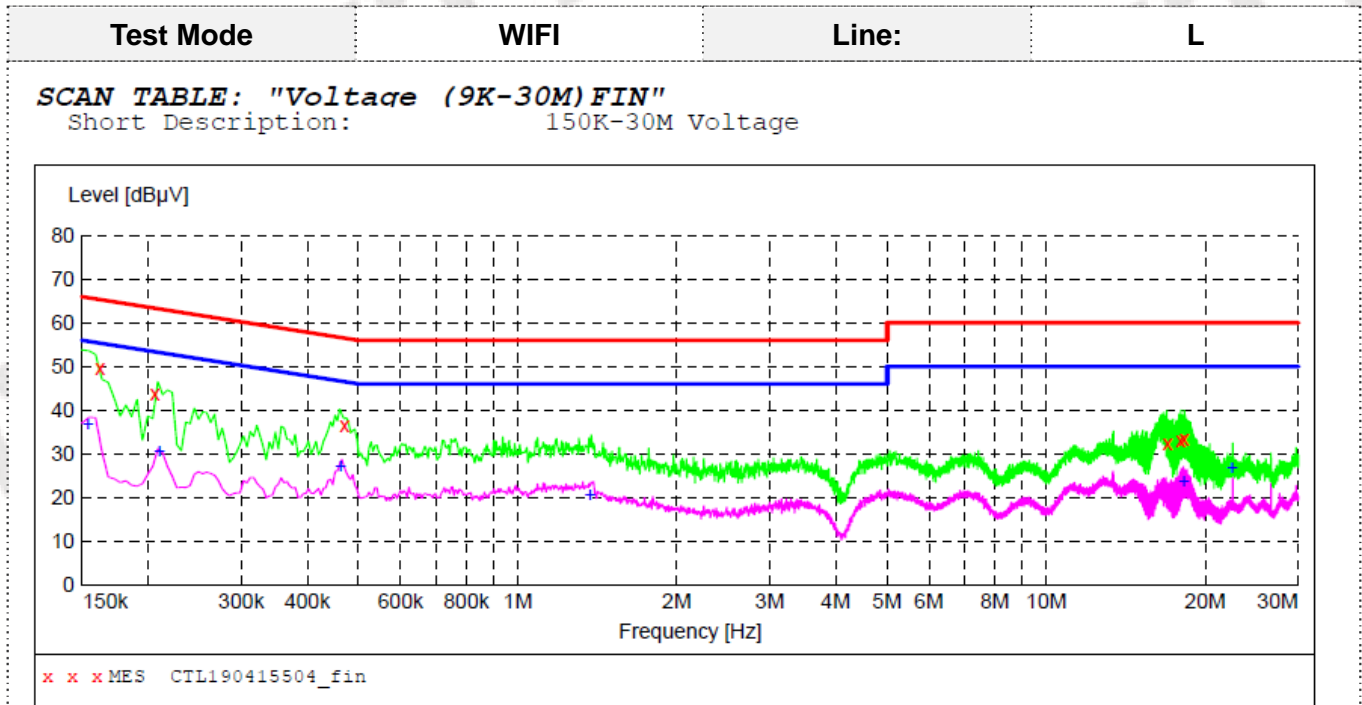
##### TEST PROCEDURE

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/n were tested at Low, Middle, and High channel; only the worst result of 802.11a 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:
3. Pre-test AC conducted emission at power from AC mains mode and at charge from PC mode, recorded worst case.

**MEASUREMENT RESULT: "CTL190415504\_fin"**

2019-4-15 05:37??

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.162000	49.60	11.2	65	15.8	QP	L1	GND
0.206000	43.80	11.2	63	19.6	QP	L1	GND
0.470000	36.40	11.2	57	20.1	QP	L1	GND
16.958000	32.30	11.3	60	27.7	QP	L1	GND
17.948000	33.10	11.3	60	26.9	QP	L1	GND
18.224000	33.30	11.4	60	26.7	QP	L1	GND

**MEASUREMENT RESULT: "CTL190415504\_fin2"**

2019-4-15 05:37??

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.154000	37.00	11.2	56	18.8	AV	L1	GND
0.210000	30.80	11.2	53	22.4	AV	L1	GND
0.462000	27.30	11.2	47	19.4	AV	L1	GND
1.370000	20.80	11.3	46	25.2	AV	L1	GND
18.182000	23.70	11.4	50	26.3	AV	L1	GND
22.526000	26.70	11.5	50	23.3	AV	L1	GND

Test Mode

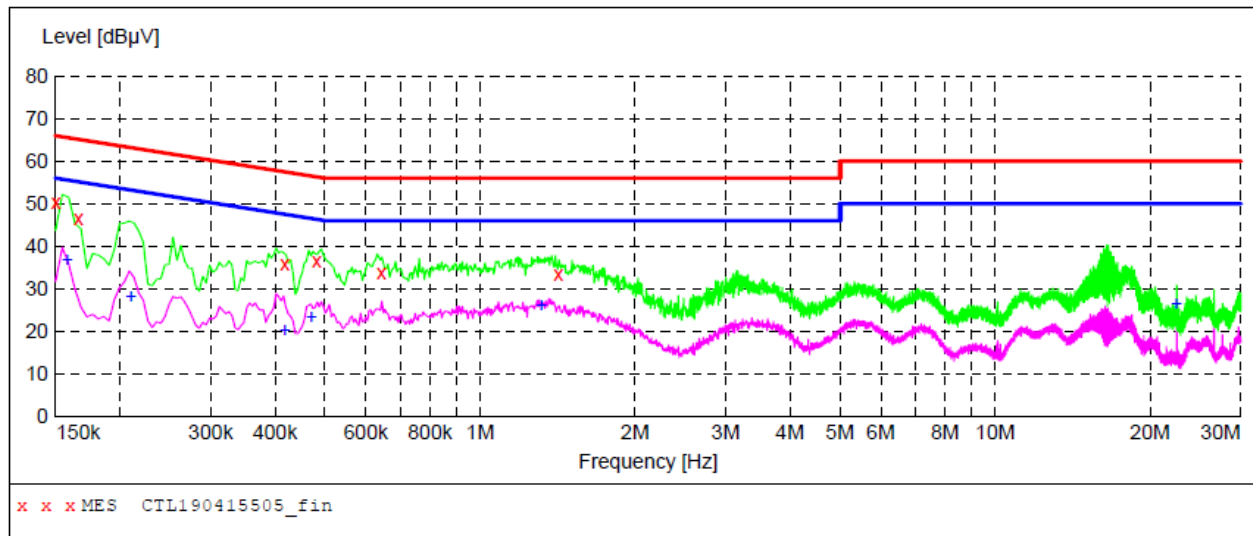
WIFI

Line:

N

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

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL190415505\_fin"**

2019-4-15 05:40??

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150000	50.50	11.2	66	15.5	QP	N	GND
0.166000	46.60	11.2	65	18.6	QP	N	GND
0.418000	35.90	11.2	58	21.6	QP	N	GND
0.482000	36.40	11.2	56	19.9	QP	N	GND
0.644000	33.80	11.2	56	22.2	QP	N	GND
1.418000	33.50	11.3	56	22.5	QP	N	GND

**MEASUREMENT RESULT: "CTL190415505\_fin2"**

2019-4-15 05:40??

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.158000	36.90	11.2	56	18.7	AV	N	GND
0.210000	28.20	11.2	53	25.0	AV	N	GND
0.418000	20.40	11.2	48	27.1	AV	N	GND
0.470000	23.40	11.2	47	23.1	AV	N	GND
1.316000	26.20	11.3	46	19.8	AV	N	GND
22.526000	26.60	11.5	50	23.4	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) <sup>Note1</sup>
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)		

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

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

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

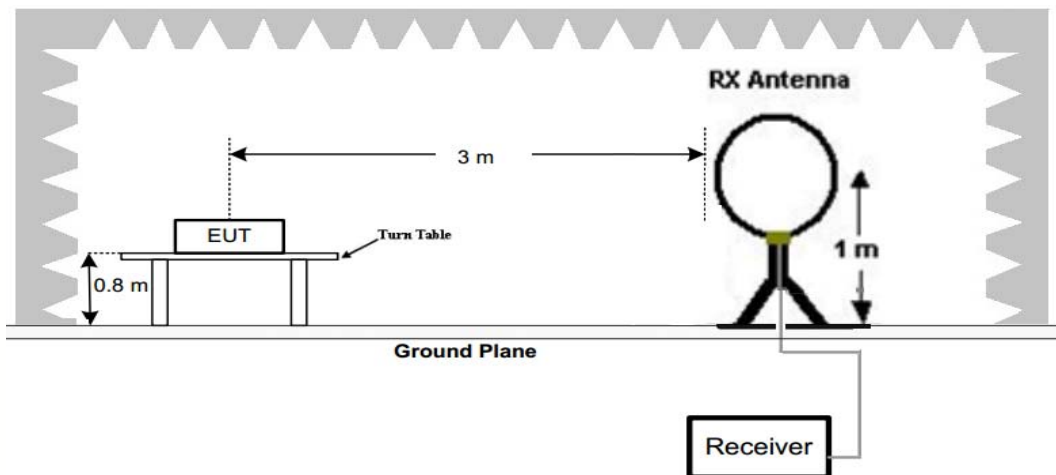
(6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

#### **Radiated emission limits**

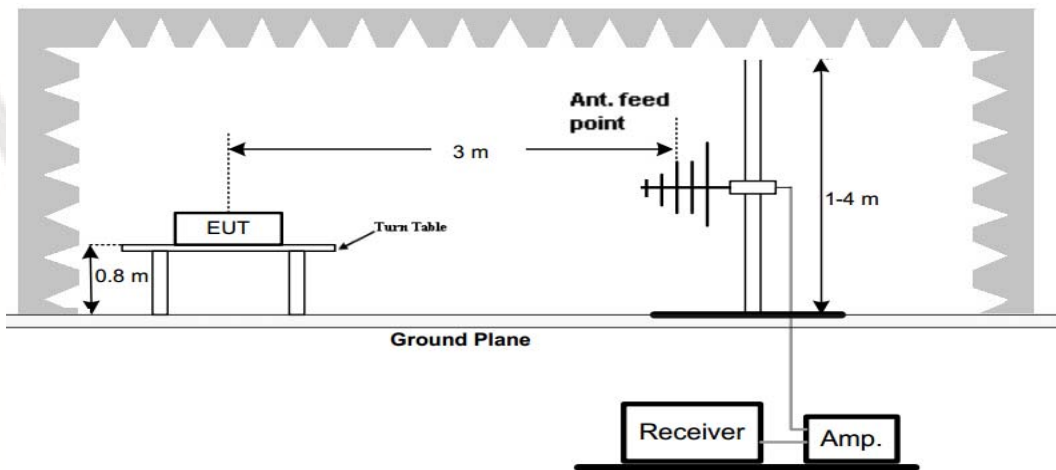
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960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

**TEST CONFIGURATION**

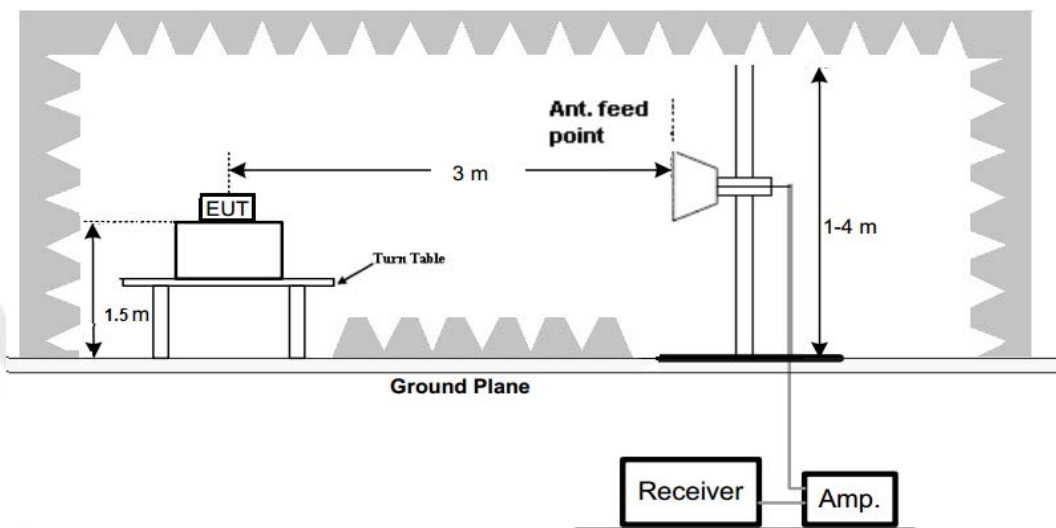
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



### **Test Procedure**

- 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.
- 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
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until all frequency measurements have been completed.
- Radiated emission test frequency band from 9KHz to 40GHz.
- 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 Antennna	1

- 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, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

### **TEST RESULTS**

Remark:

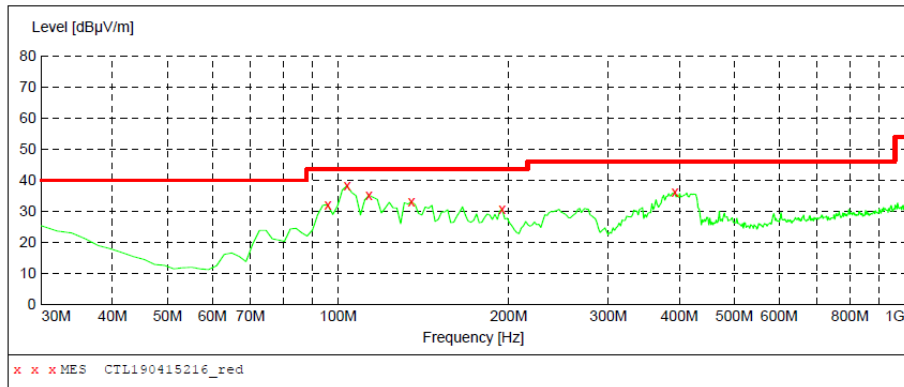
- This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
- All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for below 1GHz test, only the worst case 802.11n (HT20) low channel of U-NII 1 band was recorded.
- All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11n (HT20) was recorded.
- 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 100 kHz JB1

**MEASUREMENT RESULT: "CTL190415216\_red"**

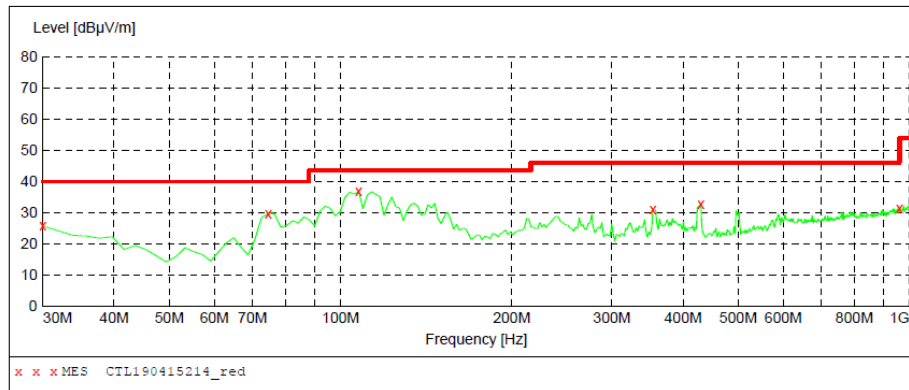
15/04/2019 13:34

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
95.960000	32.00	10.3	43.5	11.5	---	0.0	0.00	HORIZONTAL
103.720000	38.20	12.1	43.5	5.3	---	0.0	0.00	HORIZONTAL
113.420000	35.10	14.0	43.5	8.4	---	0.0	0.00	HORIZONTAL
134.760000	33.00	15.1	43.5	10.5	---	0.0	0.00	HORIZONTAL
194.900000	30.50	14.6	43.5	13.0	---	0.0	0.00	HORIZONTAL
392.780000	36.20	18.1	46.0	9.8	---	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 100 kHz JB1

**MEASUREMENT RESULT: "CTL190415214\_red"**

15/04/2019 13:31

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	25.70	22.1	40.0	14.3	---	0.0	0.00	VERTICAL
74.620000	29.70	9.0	40.0	10.3	---	0.0	0.00	VERTICAL
107.600000	36.80	12.9	43.5	6.7	---	0.0	0.00	VERTICAL
353.980000	31.00	17.3	46.0	15.0	---	0.0	0.00	VERTICAL
429.640000	32.70	19.0	46.0	13.3	---	0.0	0.00	VERTICAL
959.260000	31.30	27.5	46.0	14.7	---	0.0	0.00	VERTICAL

Note: All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11n (HT20) 2T\*2R was recorded.

[illegible][illegible][illegible][illegible]

## 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.
6. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40.

### 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.

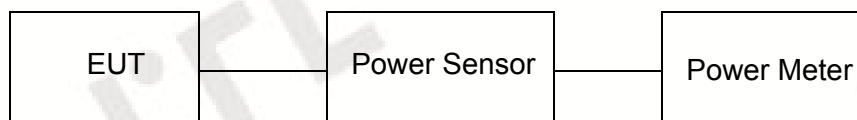
**For the 5.25-5.35 GHz and 5.47-5.725 GHz bands**, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz.

**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	18.33	18.30	N/A	23.98	Pass
	40	18.53	18.15	N/A		
	48	18.97	18.44	N/A		
802.11n(HT20)	36	18.15	18.53	21.35	23.98	Pass
	40	18.30	17.80	21.07		
	48	18.73	17.35	21.10		
802.11n(HT40)	38	17.80	17.32	20.58	23.98	Pass
	46	18.57	17.37	21.02		

**U-NII 3**

Type	Channel	Output power Average(dBm)		Total (dBm)	Limit (dBm)	Result
		Ant.1	Ant.2			
802.11a	149	17.35	17.14	N/A	30.00	Pass
	157	17.11	17.05	N/A		
	165	17.03	16.63	N/A		
802.11n(HT20)	149	17.43	17.59	20.52	30.00	Pass
	157	17.20	17.25	20.24		
	165	17.26	17.46	20.37		
802.11n(HT40)	151	17.80	17.66	20.74	30.00	Pass
	159	18.57	16.69	20.74		

*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.

### 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.<sup>note1</sup>
- (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.<sup>note1</sup>
- (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.<sup>note1</sup>

##### **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**

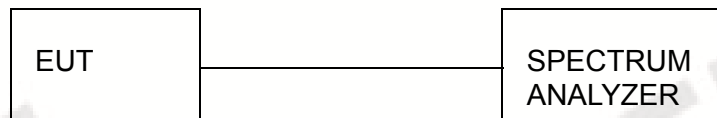
The maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.<sup>note1, note2</sup>

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	5.050	6.245	N/A	11	Pass
	40	5.140	5.990	N/A		
	48	4.459	6.818	N/A		
802.11n(HT20)	36	3.860	5.239	7.61		Pass
	40	4.608	5.768	8.24		
	48	4.498	5.855	8.24		
802.11n(HT40)	38	0.455	1.351	3.94		Pass
	46	0.318	1.325	3.86		

**U-NII 3**

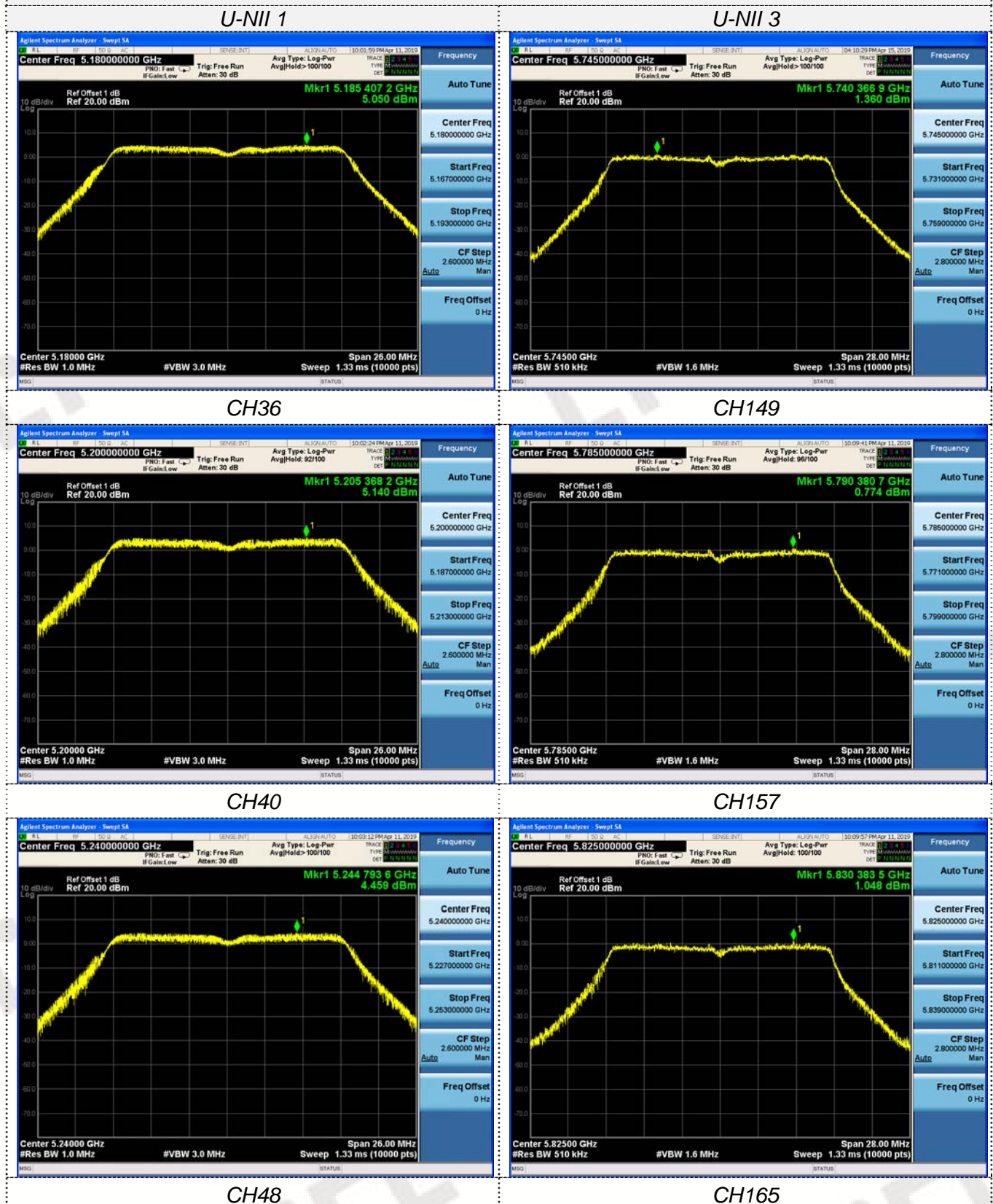
Type	Channel	Power Spectral Density (dBm/500KHz)		Total (dBm//500KHz)	Limit (dBm/500KHz)	Result
		Ant. 1	Ant.2			
802.11a	149	1.360	0.562	N/A	30	Pass
	157	0.774	0.601	N/A		
	165	1.048	-0.940	N/A		
802.11n(HT20)	149	-1.936	0.046	2.18		
	157	-1.666	-1.119	1.63		
	165	-1.415	-0.287	2.20		
802.11n(HT40)	151	-2.820	-4.527	-0.58		
	159	-2.472	-4.430	-0.33		

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.
4. Please refer to following test plots;

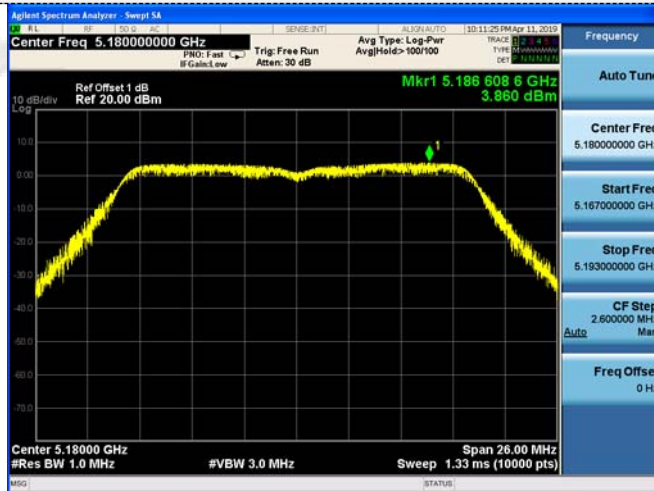
### Ant.1

#### 802.11a



802.11n20

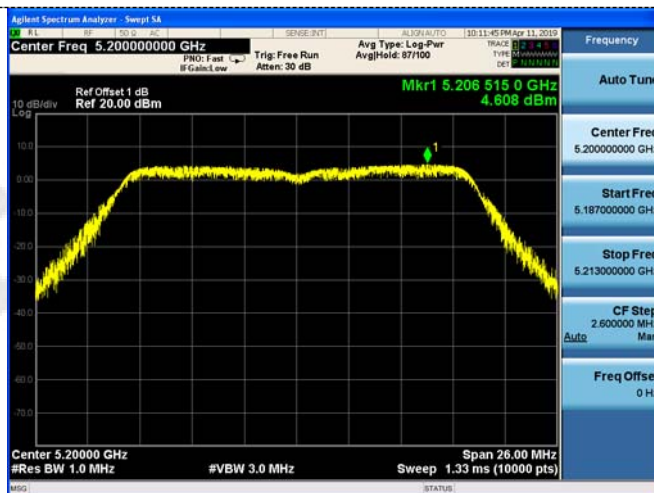
U-NII 1



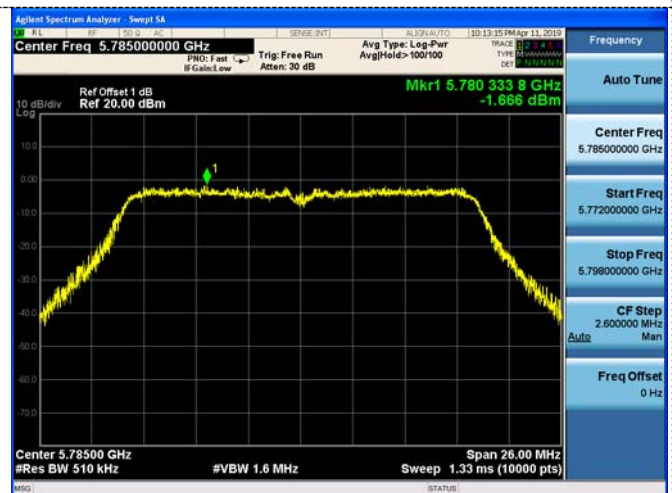
U-NII 3



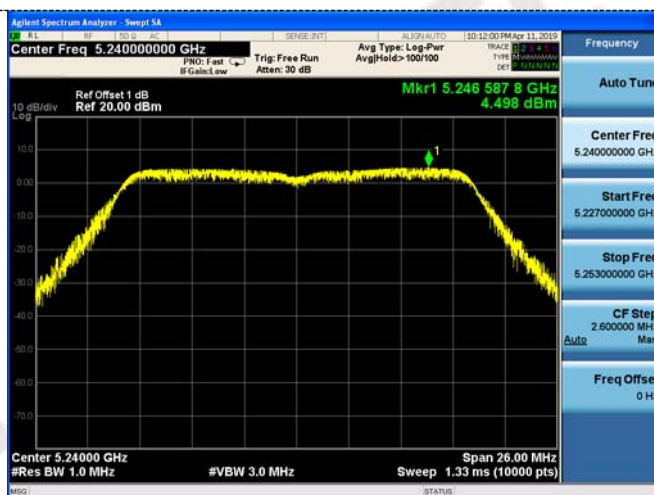
CH36



CH149



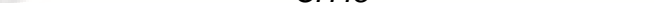
CH40



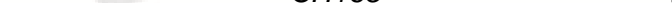
CH157



CH48

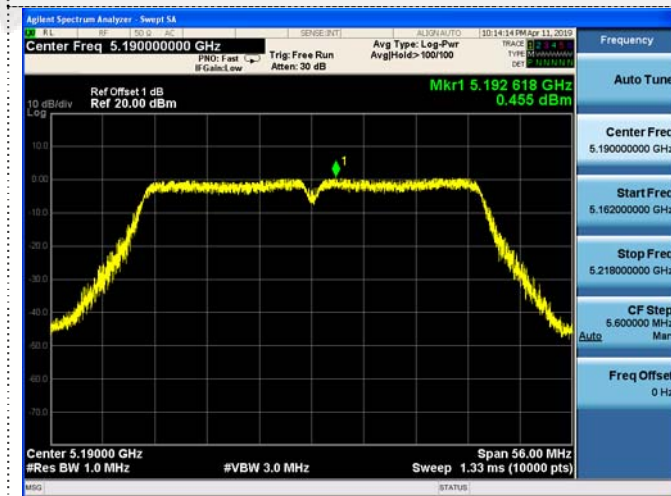


CH165

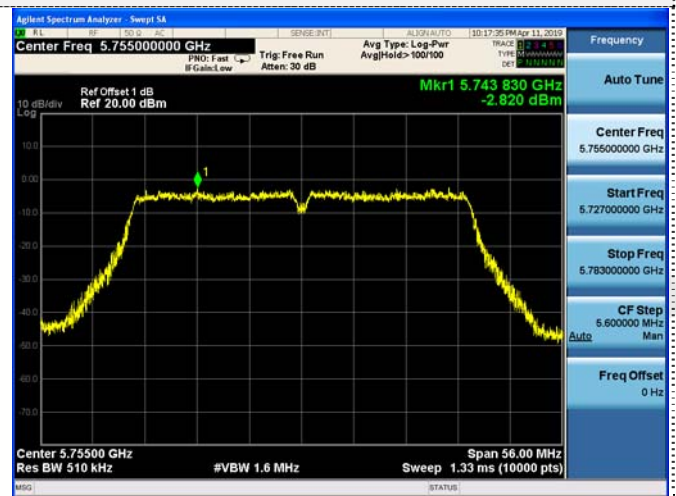


## 802.11n(HT40)

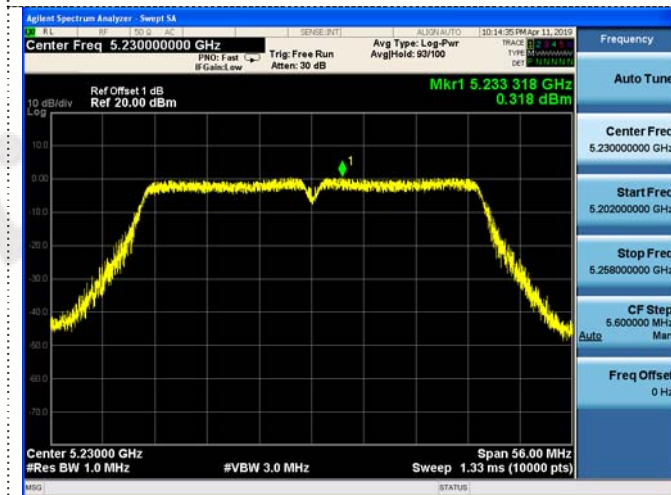
## U-NII 1



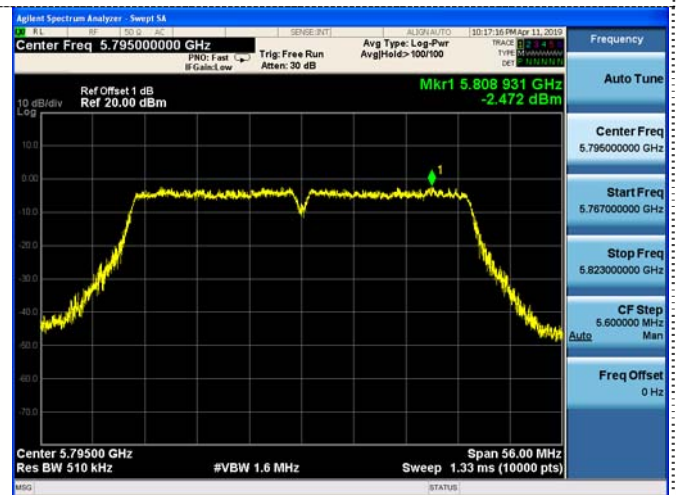
## U-NII 3



## CH38



## CH151

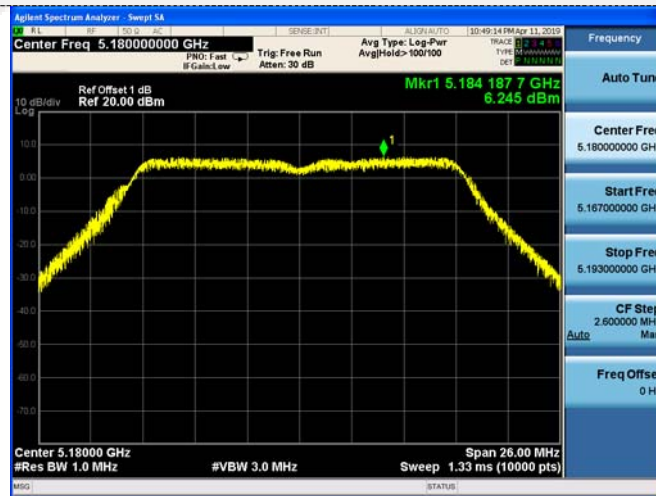
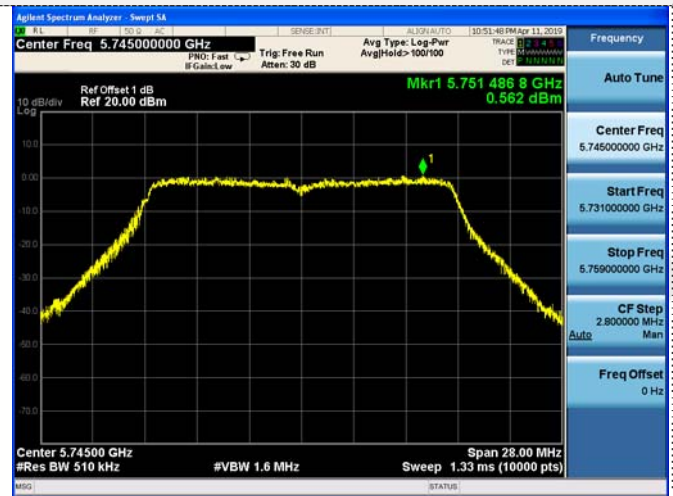
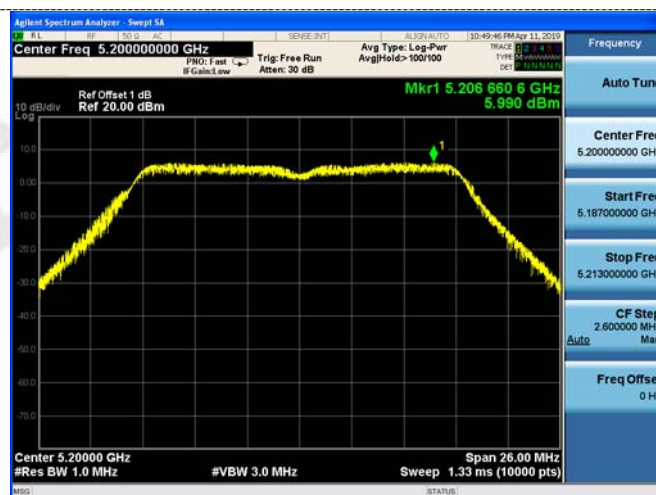
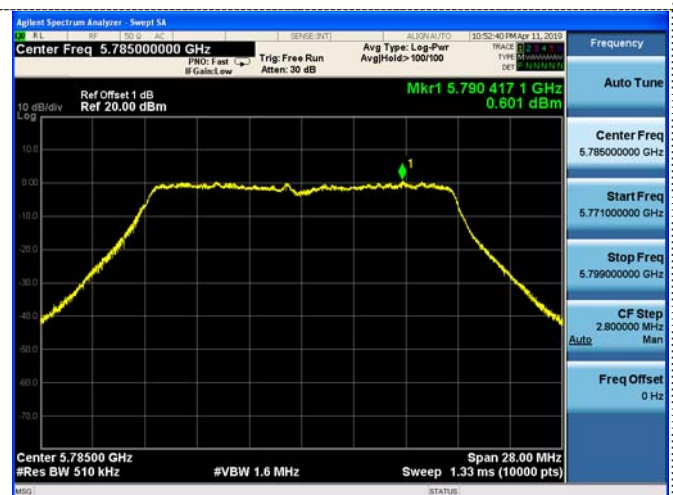
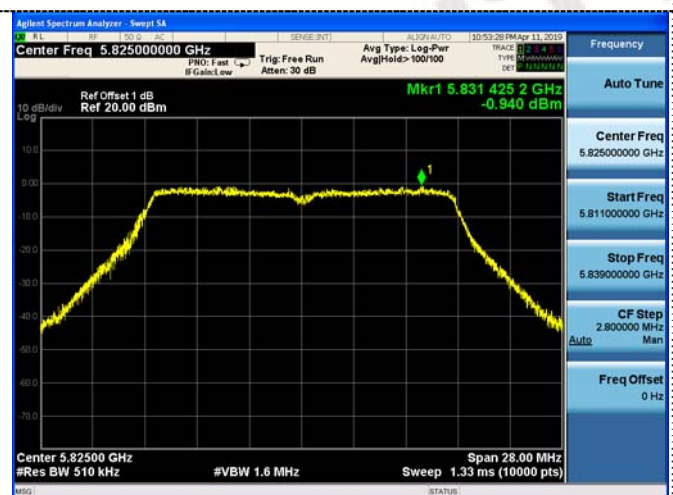


## CH46



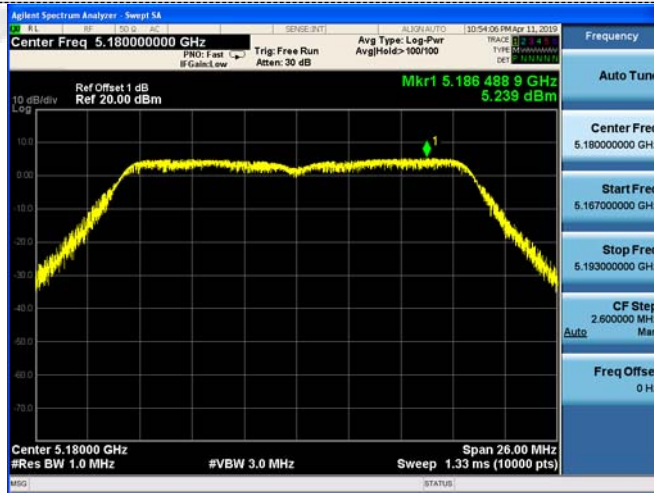
## CH159



**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

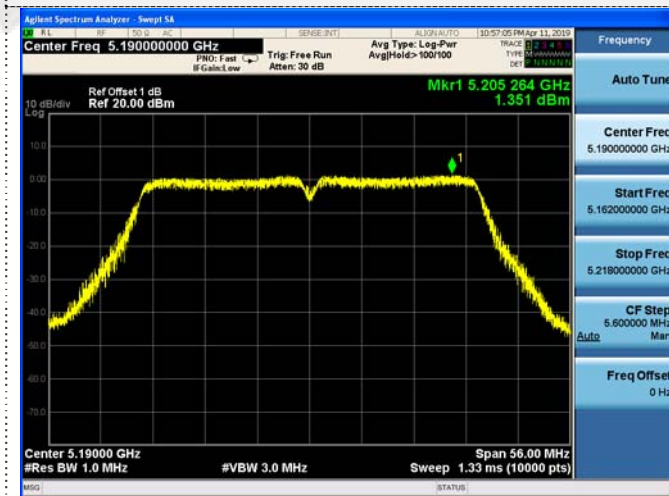


CH165

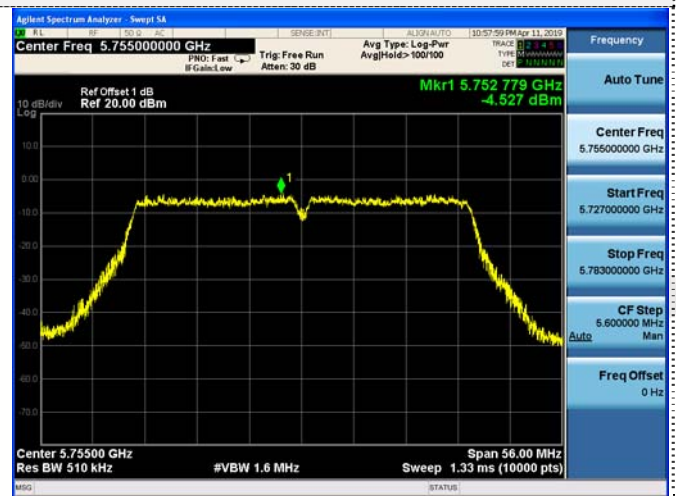


## 802.11n(HT40)

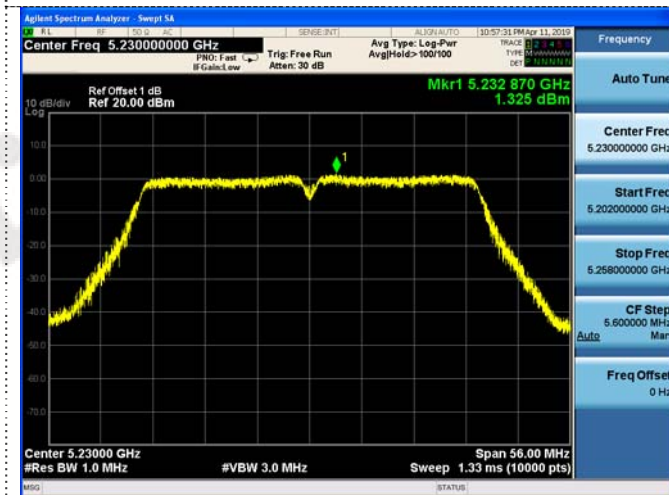
## U-NII 1



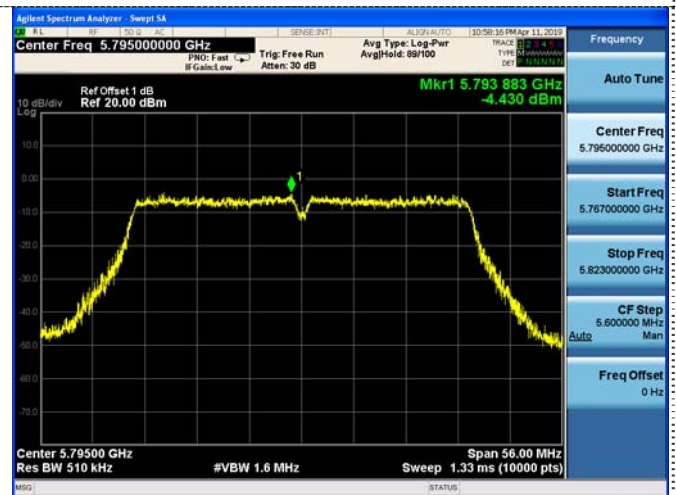
## U-NII 3



## CH38



## CH151



## CH46



## CH159



### 3.5. Emission Bandwidth (26dBm Bandwidth)

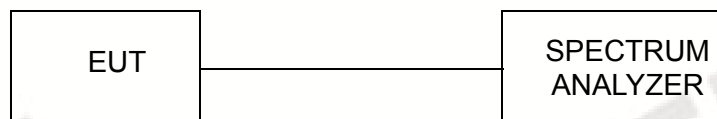
#### Limit

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



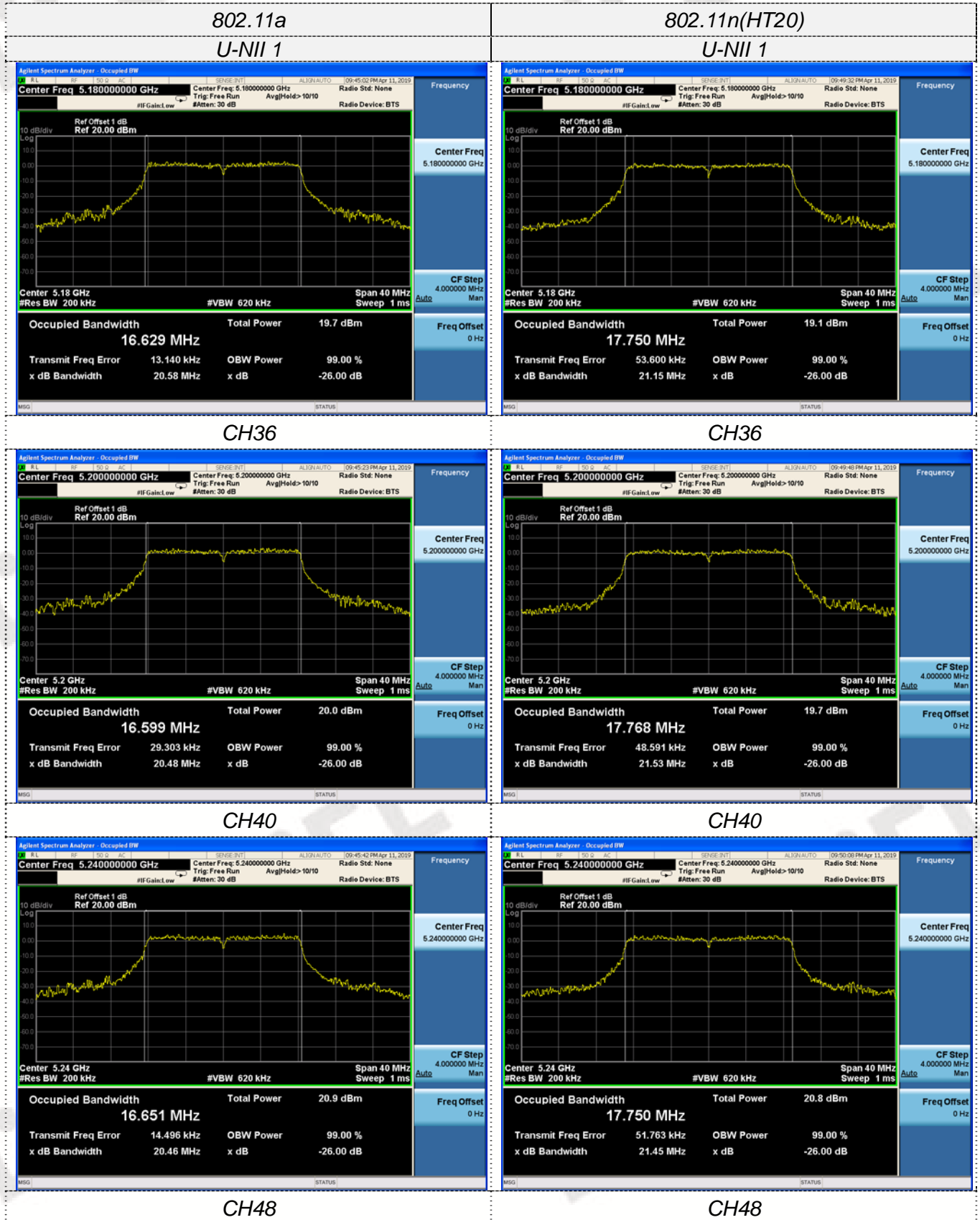
#### Test Results

Type	Bands	Channel	26dB Bandwidth (MHz)		Limit (MHz)	Result
			Ant.1	Ant.2		
802.11a	U-NII 1	36	20.58	20.88	N/A	Pass
		40	20.48	20.52		
		48	20.46	20.40		
802.11n(HT20)	U-NII 1	36	21.15	21.42		
		40	21.53	21.21		
		48	21.45	21.28		
802.11n(HT40)	U-NII 1	38	41.41	41.48		
		46	41.14	41.43		

*Note:*

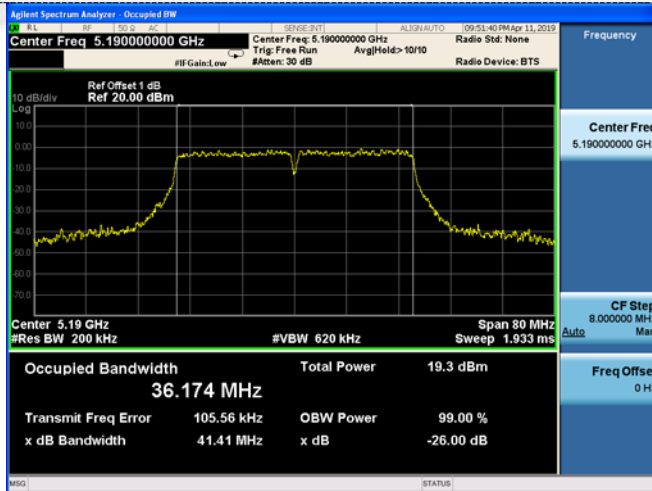
1. Measured 26dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40,
4. Please refer to following test plots;

## Ant.1

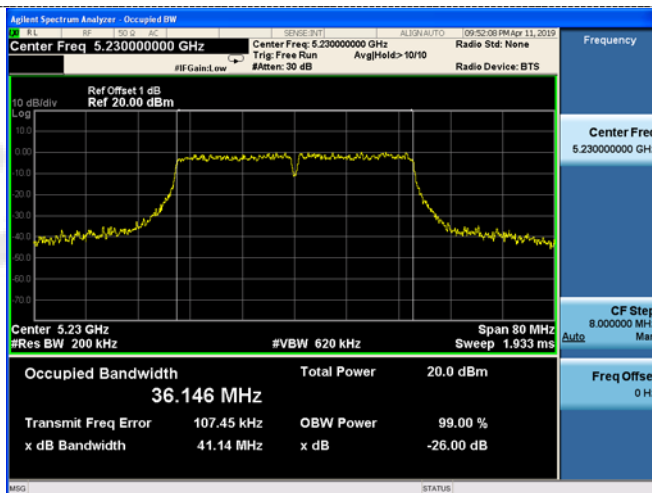


802.11n(HT40)

U-NII 1

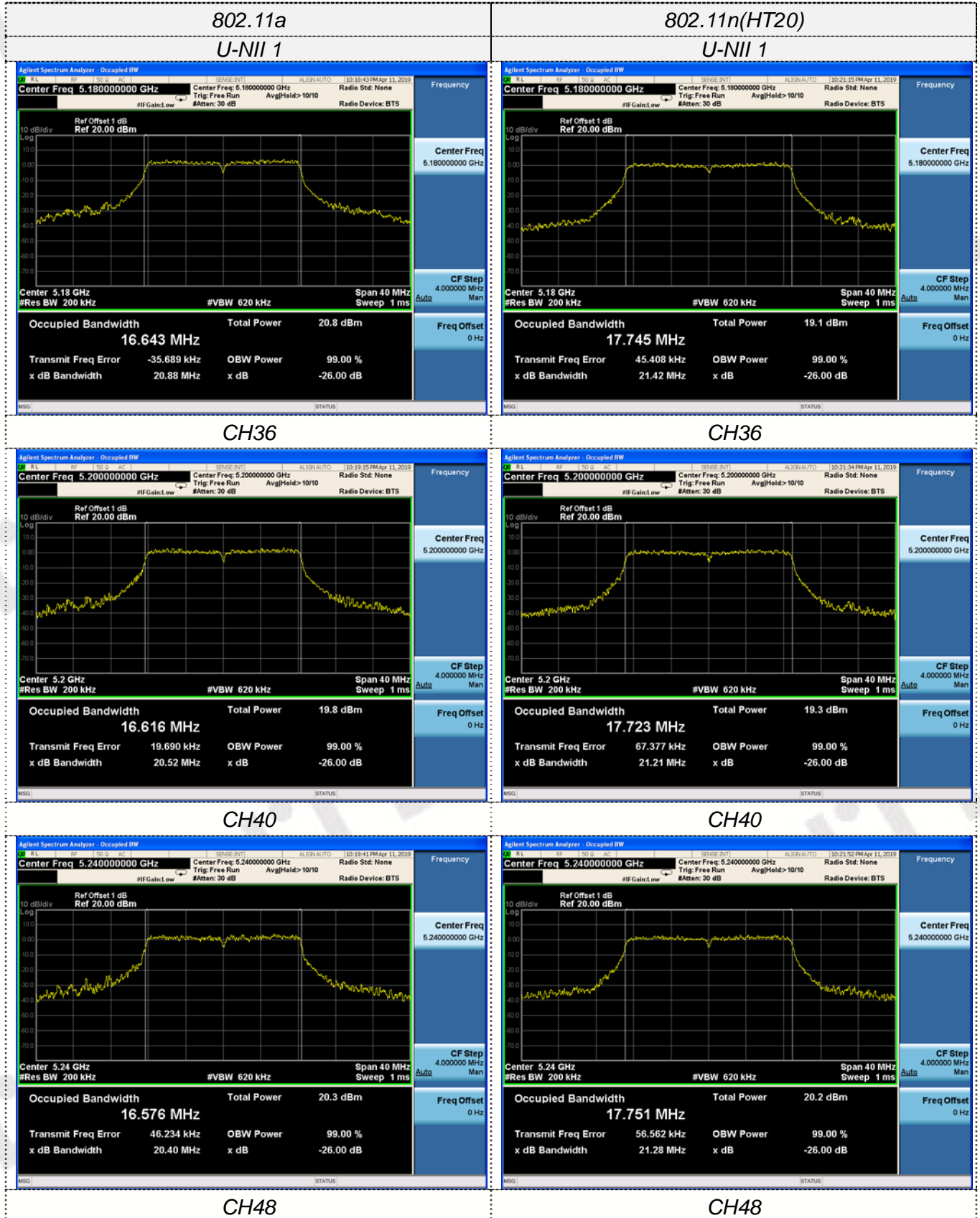


CH38



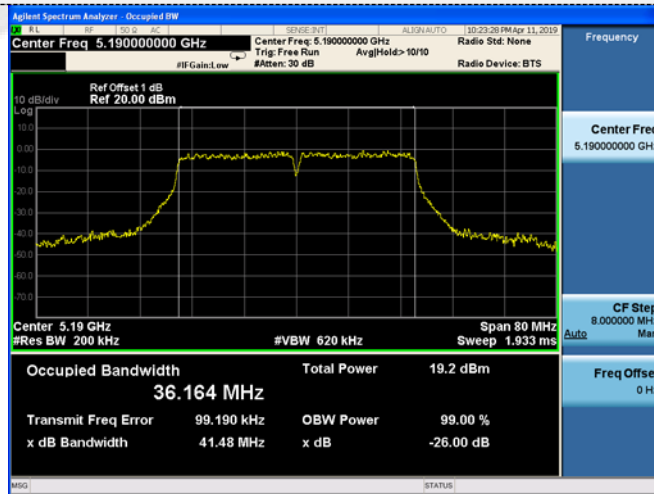
CH46

## Ant.2

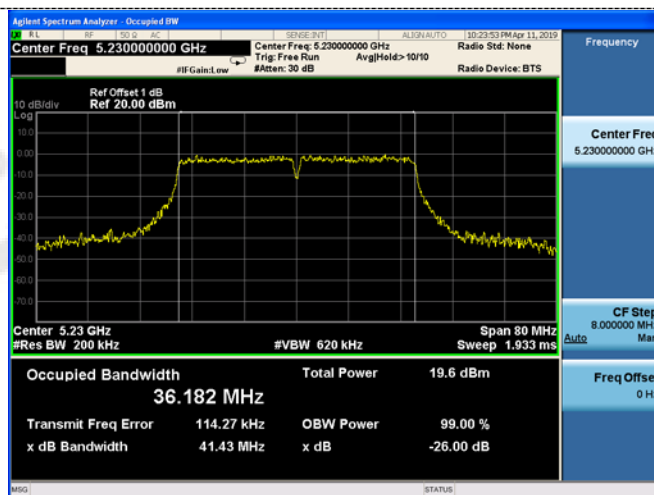


802.11n(HT40)

U-NII 1



CH38



CH46

### 3.6. Minimum Emission Bandwidth (6dBm Bandwidth)

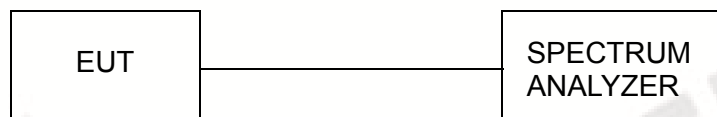
#### Limit

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

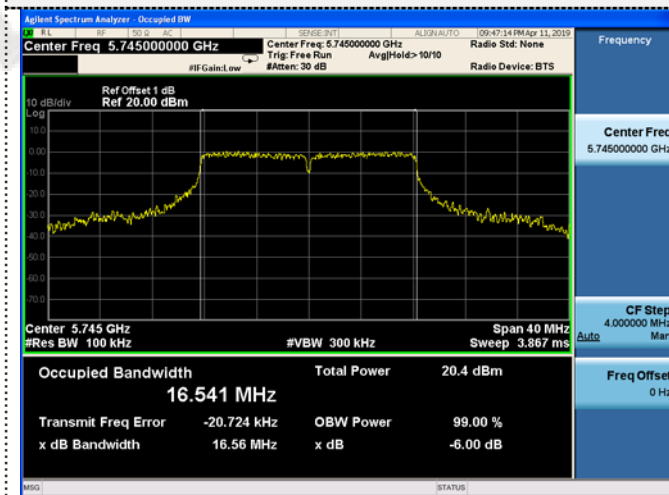
Type	Bands	Channel	6dB Bandwidth (MHz)		Limit (KHz)	Result
			Ant.1	Ant.2		
802.11a	U-NII 3	149	16.56	16.58	≥500KHz	Pass
		157	16.54	16.57		
		165	16.56	16.57		
802.11n(HT20)	U-NII 3	149	17.80	17.78		
		157	17.77	17.73		
		165	17.77	17.71		
802.11n(HT40)	U-NII 3	151	36.53	36.53		
		159	36.57	36.52		

Note:

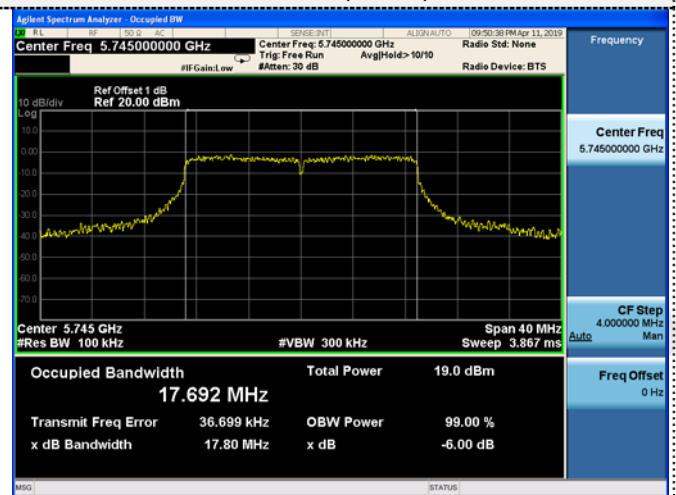
1. Measured 6dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40,
4. Please refer to following test plots;

## Ant.1

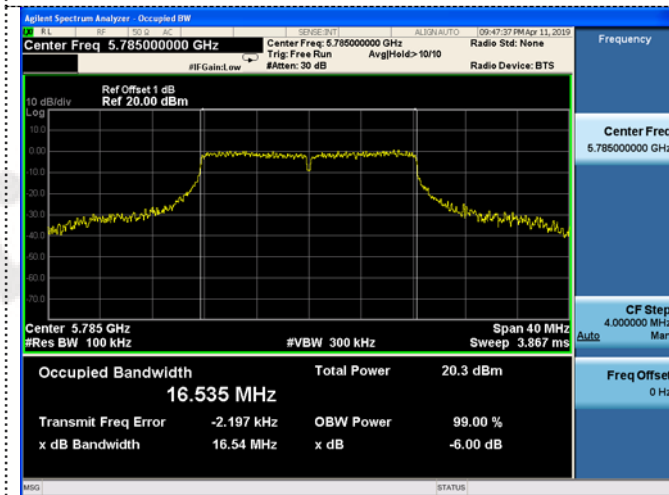
## 802.11a



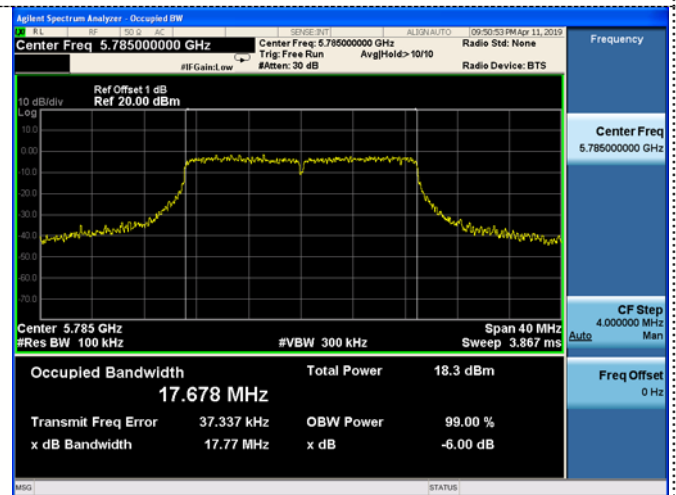
## 802.11n(HT20)



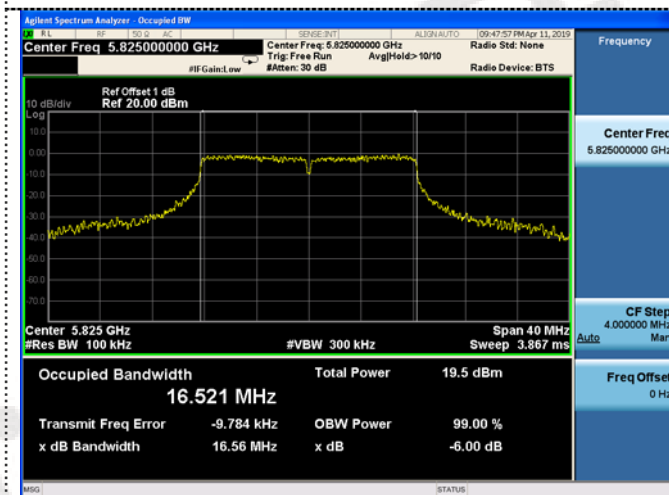
## CH149



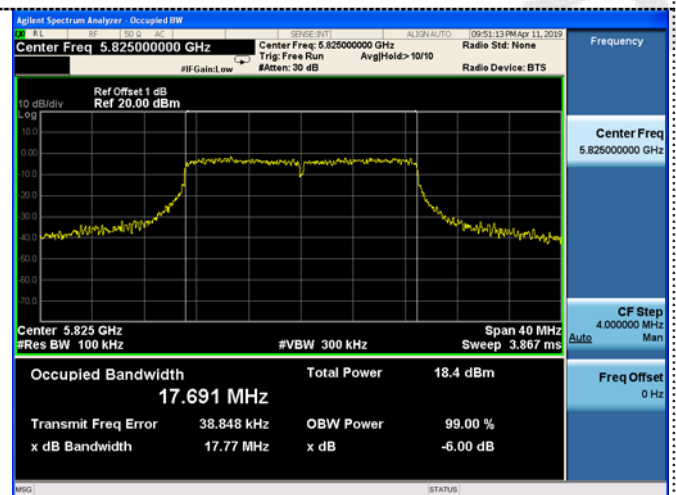
## CH149



## CH157



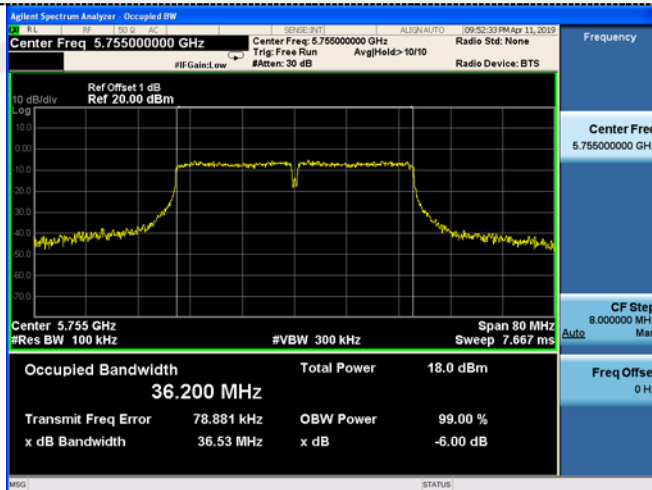
## CH157



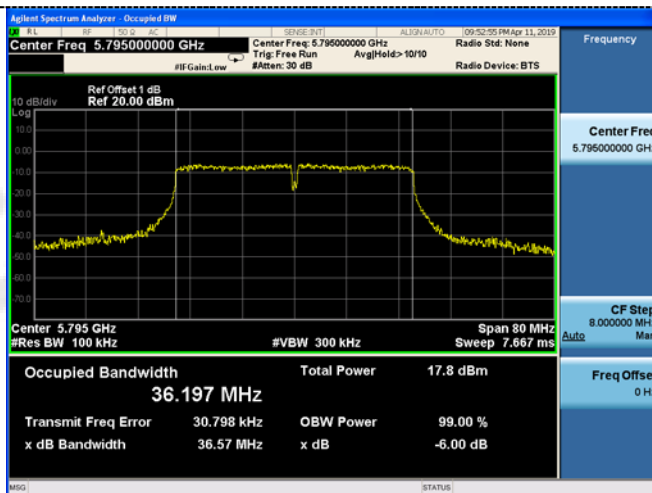
## CH165

## CH165

## 802.11n(HT40)



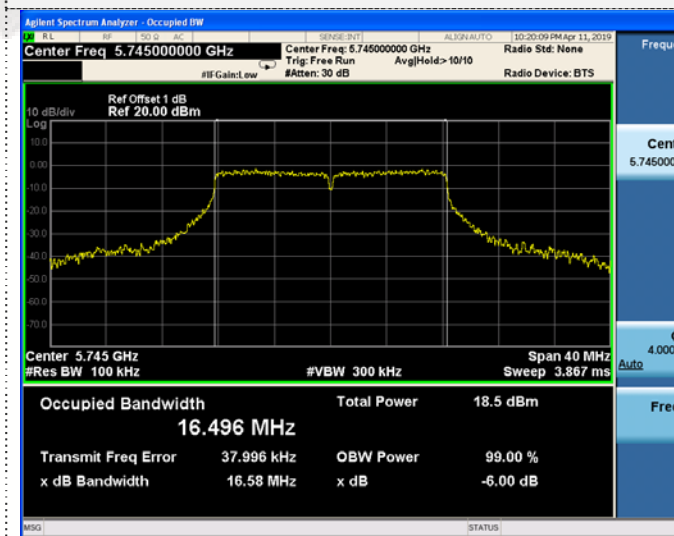
## CH151



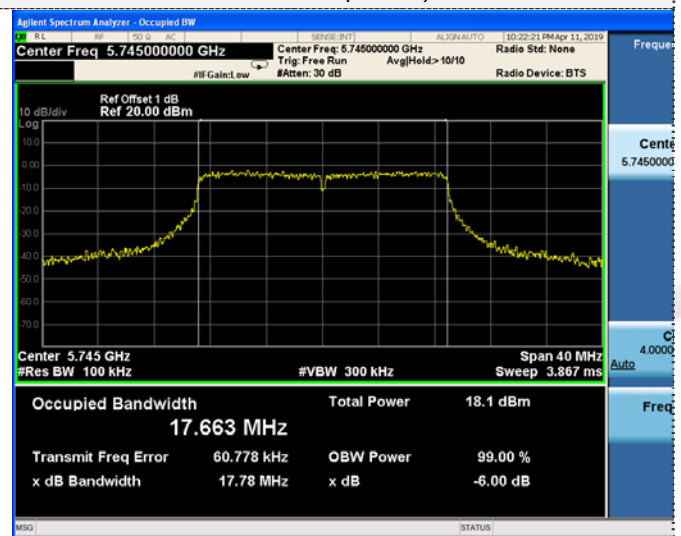
## CH159

## Ant.2

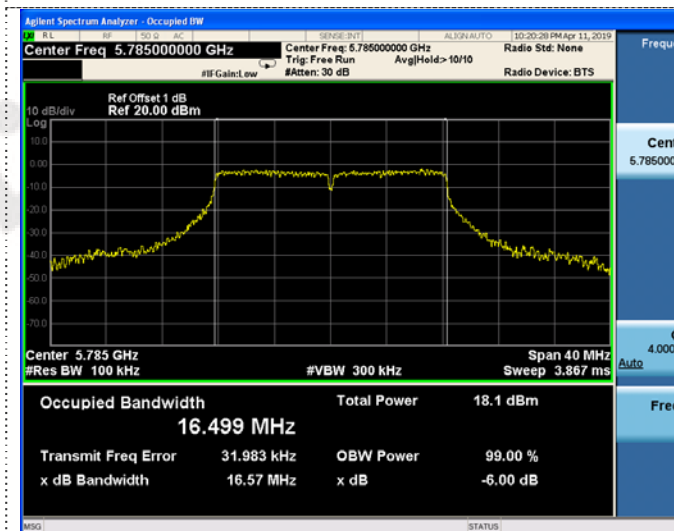
802.11a



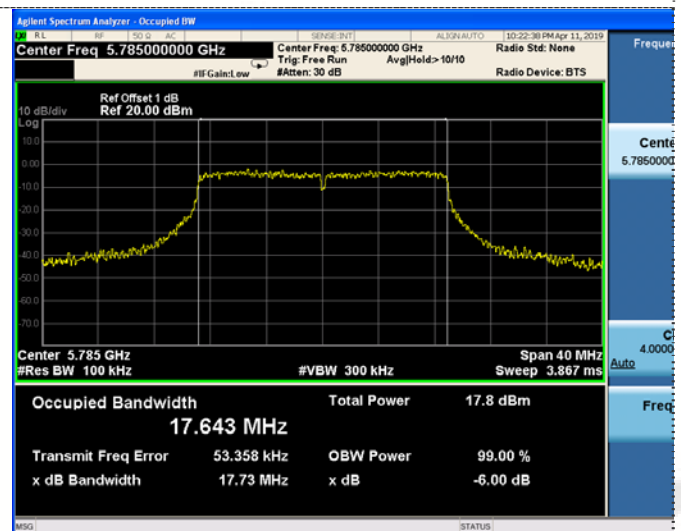
802.11n(HT20)



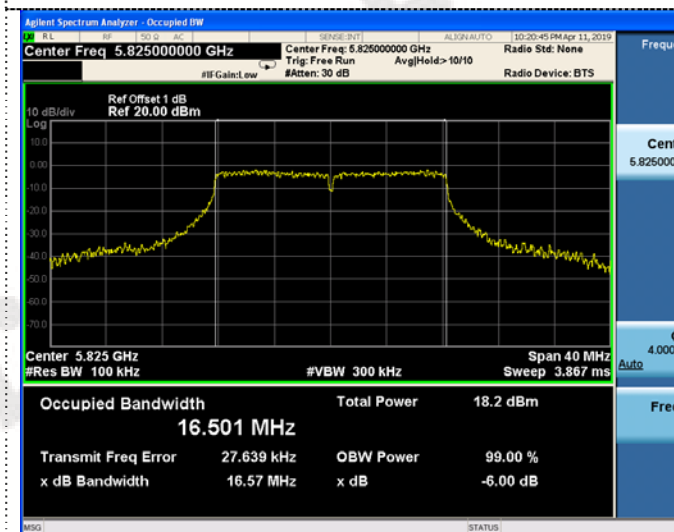
CH149



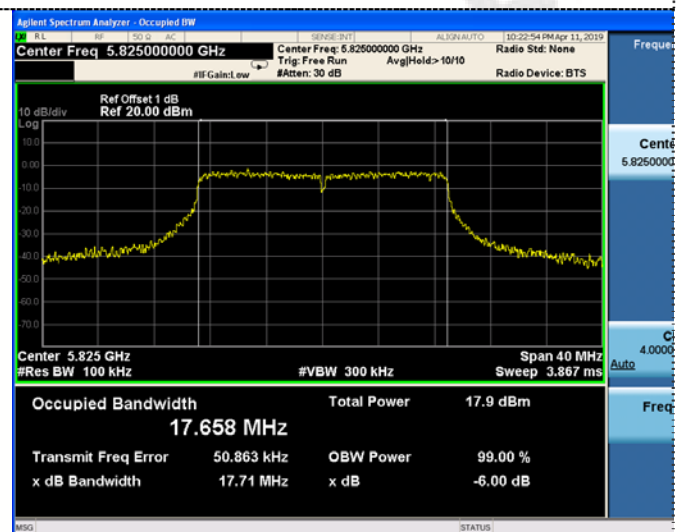
CH149



CH157



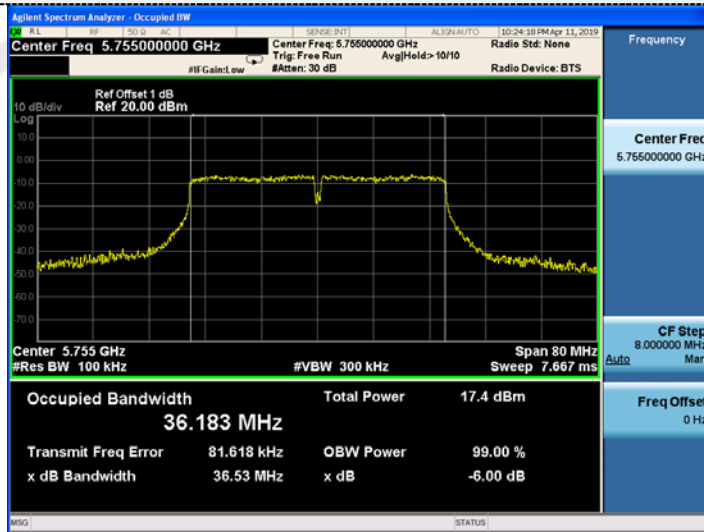
CH157



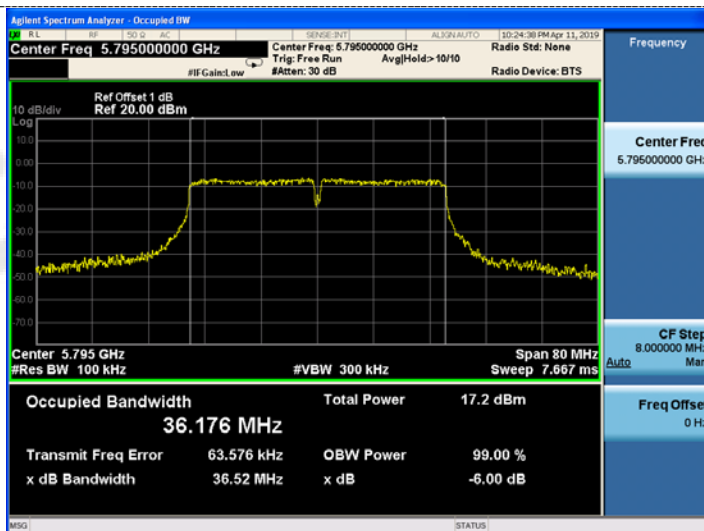
CH165

CH165

## 802.11n(HT40)



## CH151



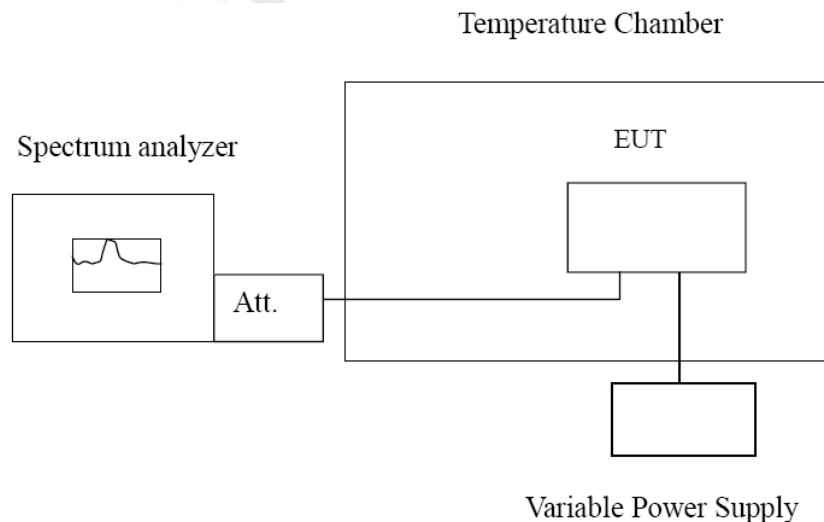
## CH159

### 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 (802.11a ant.1) as below:

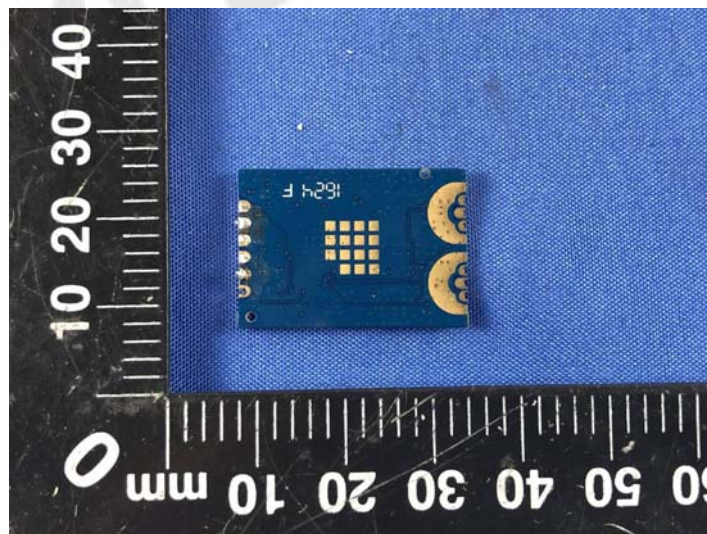
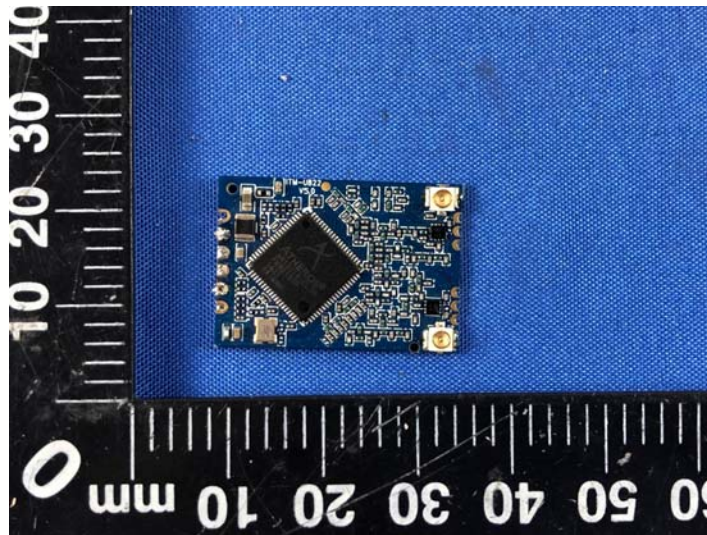
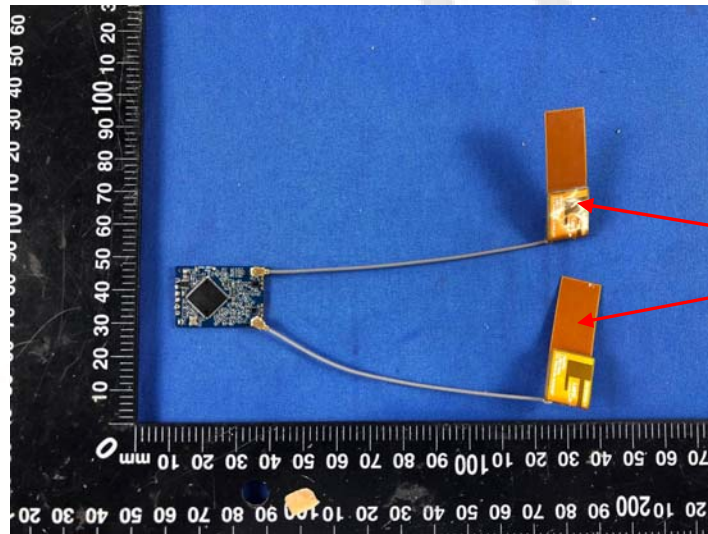
Reference Frequency: 802.11a channel=36 frequency=5180MHz					
Voltage ( V )	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
3.3	-30	715	0.138	Within the band of operation	Pass
	-20	681	0.131		
	-10	511	0.099		
	0	438	0.085		
	10	225	0.043		
	20	139	0.027		
	30	294	0.057		
	40	547	0.106		
	50	670	0.129		
3.6	25	418	0.081	Within the band of operation	Pass
3.0	25	371	0.072		

Reference Frequency: 802.11a channel=149 frequency=5745MHz					
Voltage ( V )	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
3.3	-30	702	0.122	Within the band of operation	Pass
	-20	617	0.107		
	-10	549	0.096		
	0	496	0.086		
	10	307	0.053		
	20	211	0.037		
	30	380	0.066		
	40	536	0.093		
	50	629	0.109		
3.6	25	394	0.069	Within the band of operation	Pass
3.0	25	408	0.071		

#### 4. Test Setup Photos of the EUT



## 5. Photos of the EUT



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