UNII-1 (5150-5250 MHz) Wi-Fi Radio Test Report

For

SPK-SHARE

supports

2.4 GHz/5.0 GHz Wi-Fi Radio 802.11a/ac/b/g/n+ Bluetooth v2.1+EDR, BTLE v4.0

FCC ID: LDKSPKSH1576

ISED ID: 2461L-SPKSH1576

Against the following Specifications:

47 CFR 15.407

47 CFR 15.209

47 CFR 15.205

RSS-Gen issue 4

RSS-247 Issue 2

ACCREDITED

Cisco Systems
170 West Tasman Drive
San Jose, CA 95134

Author: Danh Le **Tested By:** Danh Le, Zain Ali	**Approved By:** Diana Canafoglia **Title:** Compliance Manager **Revision:** See EDCS

This report replaces any previously entered test report under EDCS –. This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 1526148 and EDCS# 1527727.

Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Specifications
47 CFR Part 15.407 47 CFR Part 15.209 47 CFR Part 15.205
RSS-Gen Issue 4 RSS-247 Issue 2

Measurements were made in accordance with

- ANSI C63.10:2013 Procedure for Compliance Testing of Unlicensed Wireless Devices
- KDB Publication No. 789033 - D02 General UNII Test Procedures New Rules v1r4
- KDB 644545 D03 Guidance for IEEE 802.11ac v1
- KDB 662911 D01 MIMO v02

Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Radio Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc.

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)

2.2 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss.

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m

Measurement Uncertainty Values

voltage and power measurements	± 2 dB
conducted emissions measurements	± 1.4 dB
radiated emissions measurements	± 3.2 dB
frequency measurements	± 2.4 10-7
temperature measurements	± 0.54º.
humidity measurements	± 2.3%
DC and low frequency measurements	± 2.5%.

Where relevant measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Radiated emissions (expanded uncertainty, confidence interval 95%)

30 MHz - 300 MHz	+/- 3.8 dB
300 MHz - 1000 MHz	+/- 4.3 dB
1 GHz - 10 GHz	+/- 4.0 dB
10 GHz - 18GHz	+/- 8.2 dB
18GHz - 26.5GHz	+/- 4.1 dB
26.5GHz - 40GHz	+/- 3.9 dB

Conducted emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 40GHz	+/- 0.38 dB

A product is considered to comply with a requirement if the nominal measured value is below the limit line. The product is considered to not be in compliance in case the nominal measured value is above the limit line.

2.3 Date of testing

29 Sep, 2017 to 02 Dec, 2017

2.4 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.5 Testing facilities

This assessment was performed by:

Testing Laboratories
Cisco Systems, Inc.
125 West Tasman Drive (Building P)
San Jose, CA 95134
USA

Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134
USA

Registration Numbers for Industry Canada

Cisco System Site	Address	Site Identifier
Building P, 10m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-2
Building P, 5m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-1
Building I, 5m Chamber	285 W. Tasman Drive San Jose, California 95134	Company #: 2461M-1
Building 7, 5m Chamber	425 E. Tasman Drive San Jose, California 95134 United States	Company #: 2461N-3

Test Engineer(s)
Danh Le
Zain Ali

2.6 Equipment Assessed (EUT)

SPK_SHARE Dongle

2.7 EUT Description

Cisco SPK-SHARE dongle is the next generation cloud collaboration platform that unifies messaging, meeting and calling and content-sharing. Cisco SPK-Share provides HDMI support for connection to a display and USB Type-C interface to receive 5V power. Cisco SPK-Share offers both wired and wireless solution with Ethernet via USB 2.0 external adapter and 802.11a/b/g/n/ac, Bluetooth classic and Bluetooth LE radios.

Below are brief summary of the SPK-SHARE hardware specifications:

Wired Protocol support

- USB C main interface (Power, Ethernet via USB2)
- External POE Ethernet adapter (Ethernet Injector accessory connected via USB type C)
  - Ethernet: 10/100/1000BASE-T Ethernet network (IEEE 802.3i/802.3u/802.3ab/802.3az)
- External18W power supply (Direct connected via USB)

Wireless Protocols support

- Wi-Fi: IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac
- Bluetooth: IEEE 802.15 Basic Rate v2.1+ EDR, Low Energy v4.0

2.4GHz FHSS Radio Supported Modes:

- 802.15 BlueTooth ver 2.1+EDR (1Mbps – 3Mbps, Single stream)

2.4GHz BTLE Radio Supported Modes:

- 802.15 BlueTooth ver 4.0 (1Mbps, Single stream)

2.4GHz WLAN Radio Supported Modes:

- 802.11b (1Mbps – 11Mbps)
- 802.11g (6Mbps - 54Mbps)
- 802.11n (HT20, M0 – M15)
- 802.11n (HT40, M0 – M15)

5GHz WLAN Radio Supported Modes:

- 802.11a (6Mbps – 54Mbps,)
- 802.11n (HT20, M0 – M15)
- 802.11n (HT40, M0 – M15)
- 802.11ac (VHT20, M0 – M8)
- 802.11ac (VHT40, M0 – M9)
- 802.11ac (VHT80, M0 – M9)

Model Differences

SPK-SHARE
SPK-SHARE-K9

Both have identical components, PCB layout, electronics circuitries and enclosure. The only difference is the encryption software being offered for SPK_SHARE-K9

Section 3: Result Summary

3.1 Results Summary Table

RF Conducted Emissions		
Basic Standard	**Technical Requirements / Details**	**Result**
FCC 15.407/ RSS-247	**99% & 26 dB Bandwidth**: **FCC/RSS**: The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. There is no limit for 99% OBW. The 26 dB emission is the 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 26 dB relative to the maximum level measured in the fundamental emission.	**Pass**
FCC 15.407 (a)(1)(iv) **RSS-247 6.2.1.1**	**Maximum Conducted Output Power**: **FCC:** For mobile and portable 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **RSS:** For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz.	**Pass**
FCC 15.407 (a)(1)(iv) **RSS-247 6.2.1.1**	**Power Spectral Density** **FCC:** 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 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **RSS:** For other devices, the e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.	**Pass**
FCC 15.407 (g)/ RSS-Gen 6.11	**Frequency Stability** **FCC/RSS**: 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 user manual.	**Pass**

RF Conducted Emissions (Continue)		
Basic Standard	**Technical Requirements / Details**	**Result**
	Band Edge into Restricted Bands and Out-Of-Band Emissions:	
FCC15.407(b)(1)	**FCC:** 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 EIRP of -27dBm/MHz.	
FCC15.407(b)(7)	**FCC:** The provisions of §15.205 apply to intentional radiators operating under this section.	
FCC 15.205	**FCC:** (b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209.	**Pass**
RSS-247 6.2.1.2	**RSS**: All emissions outside the band 5150-5250 MHz shall not exceed -27 dBm/MHz e.i.r.p.	
RSS-Gen 8.10	**RSS:** Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits of Table 4 specified in RSS-Gen 8.9.	

Radiated Emissions & AC Conducted Emissions		
	TX Spurious Emissions:	
FCC15.407(b)(6)	**FCC:** Unwanted emissions below 1GHz must comply with general field strength limits set forth in §15.209. Further any U-NII devices using an AC power line are required to comply also with conducted emissions limits set forth in §15.207. Refer to limit section for detailed limits	**Pass**
FCC15.407(b)(1)	**FCC:** 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.	
RSS-247 6.2.1.2	**RSS:** Emissions outside the band 5.150-5.350 GHz shall have e.i.r.p -27dBm/MHz e.i.r.p.	
	AC Conducted Emissions	
FCC15.207	**FCC:** (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).	**Pass**
RSS-Gen 8.8	**RSS:** A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 0.15 MHz to 30 MHz shall not exceed the limits in Table 3 shown in this section.	

Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

4.1 Sample Details

Sample Number	Equipment Description	Manufacturer / Model#	Hardware Rev.	Firmware Rev.	Serial Number
S01	Wireless dongle (radiated sample)	Cisco / SPK-SHARE	P3	novum1.1.0 PreAlpha1 2017-10-03	FCH2138EAMB
S02	Wireless dongle (conducted sample)	Cisco / SPK-SHARE	P3	novum1.1.0 PreAlpha1 2017-10-03	FCH2135DG58
S03	Switching Power Supply	Cisco / AQ18A-59CFA	Production	----------	PH1212400BC

4.2 System Details

System #	Description	Samples
1	Radiated Radio Test Sample and Power Supply	S01 & S03
2	RF Conducted Radio Test Sample and Power Supply	S02 & S03

4.3 Mode of Operation Details

Mode#	Description	Comments
1, 2, 3, 4, 5, 6	802.11a,n20,n40,ac20,ac40,ac80 Test Mode	The radio shall be set in a continuous Transmitter Mode at various data rate and channel combinations per all Transmitter Test Requirements. If 99% duty cycle or more cannot be achieved, measurements of duty cycle, x, are required for each tested mode of operation.

4.4 Test Mode, Modulation and Data Rate Description

Setting#	Wi-Fi Mode	Modulation	Data Rate
1*	802.11a	BPSK	6 Mbps
2	802.11n (HT20)	BPSK	6.5 Mbps (MCS0)
	802.11n (HT40)		13.5 Mbps (MCS0)
3	802.11ac (VHT20)	BPSK	6.5 Mbps (MCS0)
	802.11ac (VHT40)		13.5 Mbps (MCS0)
	802.11ac (VHT80)		29.3 Mbps (MCS0)
Note1: Table above represents the worst case scenarios in all modulation and data rate combination for each mode. ***: Setting**#1 was determined to be the worst case emissions of all modes and selected for RSE testing.			

4.5 Software Used for Testing

Tool#	Description	Comments
1	EMIsoft Vasona, version 6.0	Vasona is Windows based automated software PC controlled tool kit designed to run radiated emissions.
2	QRCT Radio Control Software version 3.0.242.0	QRCT is the Windows based software tool kit designed to control radio setting for RF conducted

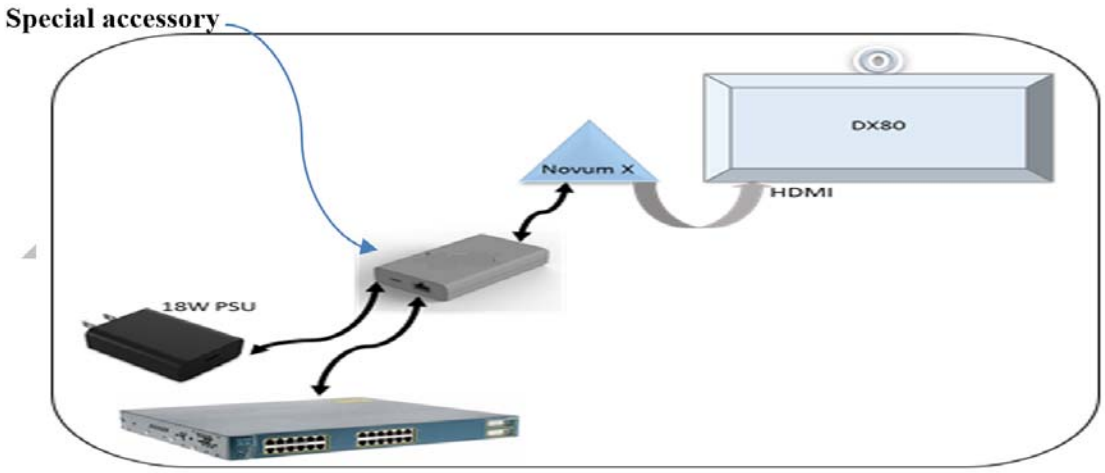
4.6 Antenna Information

The following antennas are supported by this product series.
The data included in this report represent the worst case data for all antennas.

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain Peak (dBi)
2400 – 2500	CI8847-11-000-R-FA	PIFA	1.24
5150 – 5250	CI8847-11-000-R-FA	PIFA	4.26
5250 – 5350	CI8847-11-000-R-FA	PIFA	4.26
5470 – 5725	CI8847-11-000-R-FA	PIFA	3.77
5725 – 5850	CI8847-11-000-R-FA	PIFA	2.85

4.7 Special Accessories included in the test setup

Due to hardware design limitation, an **external Ethernet adapter** was used as a special accessory to access into the EUT in order to execute all required radio test command scripts.



Appendix A: Conducted Test Results

Target Maximum Channel Power
The following table details the maximum supported Total Channel Power for all operating modes.

Operating Mode	Maximum Channel Power (dBm)		
	Frequency (MHz)		
	5180	5220	5240
802.11a	----	16.5	----

Operating Mode	Maximum Channel Power (dBm)	
	Frequency (MHz)	
	5190	5230
802.11n HT40	----	15

Operating Mode	Maximum Channel Power (dBm)
	Frequency (MHz)
	5210
802.11ac VHT80	13

A.1 Duty Cycle

Duty Cycle Test Requirement
From KDB 789033 D02 General UNII Test Procedures New Rules v01
B. Duty Cycle (x), Transmission Duration (T), and Maximum Power Control Level

1. All measurements are to be performed with the EUT transmitting at 100 percent duty cycle at its maximum power control level; however, if 100 percent duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, *T*, are required for each tested mode of operation.

Duty Cycle Test Method
From KDB 789033 D02 General UNII Test Procedures New Rules v01:
B. Duty Cycle (x), Transmission Duration (T), and Maximum Power Control Level
The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T, where T is defined in section II.B.1.a), and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

Duty Cycle Correction Factor and Duty Cycle Percentage can be derived by using the following formulas:

DCCF = 10 log **(**1/ (TXon / TXon + TXoff)**)**

DC % = (TXon / TXon + TXoff) * 100

Tested By: Danh Le	**Date of testing:** 22-Nov-2017
Test Result : For References Only	

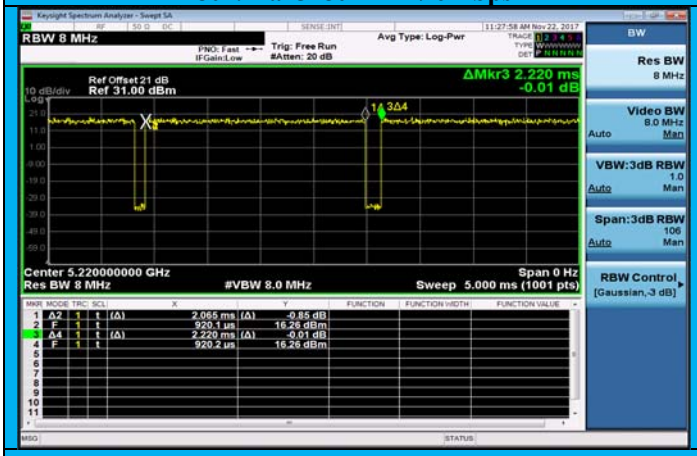
A.1.2 Duty Cycle Data Table

Mode	Data Rate (Mbps)	On-time (ms)	Total on+off Time (ms)	Duty Cycle (%)	Correction Factor (dB)
802.11a	6	2.065	2.220	93.0	0.3
802.11n20	MCS0	1.725	1.850	93.2	0.3
802.11n40	MCS0	0.950	1.065	88.3	0.5
802.11ac40	MCS0	0.955	1.075	88.8	0.5
802.11ac20	MCS0	1.925	2.080	92.5	0.3
802.11ac80	MCS0	0.462	0.580	79.6	1.0

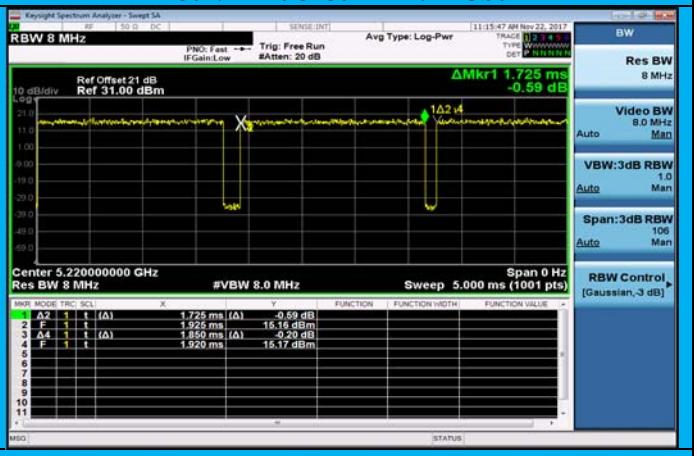
A.1.3 Duty Cycle Graphical Test results

Duty Cycle

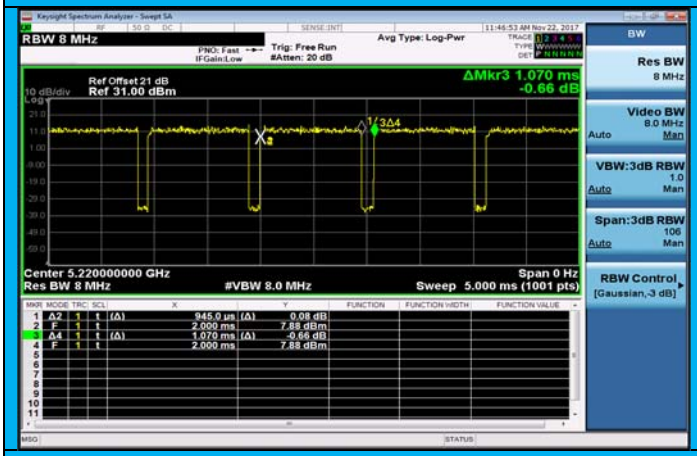
802.11a 5180 MHz / 6Mbps



802.11n20 5180 MHz / MCS0

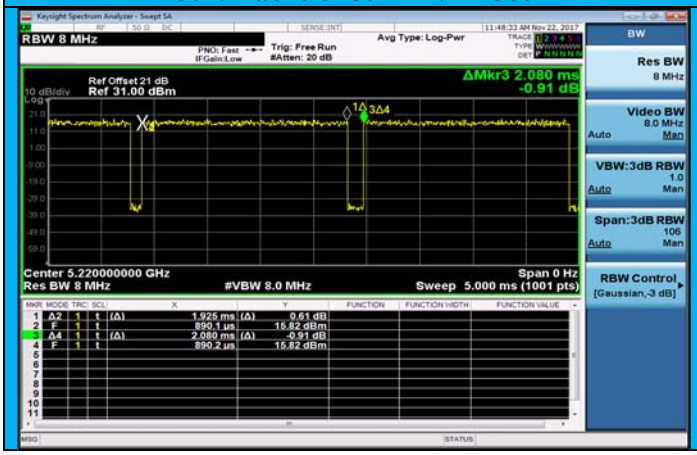


802.11n40 5190 MHz / MCS0

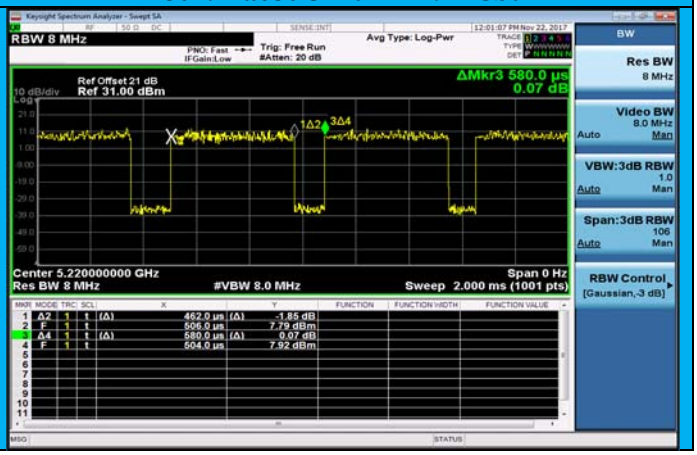


802.11ac40 5190 MHz/ MCS0

802.11ac20 5180 MHz/ MCS0



802.11ac80 5210 MHz / MCS0



A.2 Frequency Stability

A.2.1 Limits.

FCC 15.407(g) / RSS-Gen 6.11

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 user's manual.

A.2.2 Test Procedure

ANSI C63.10-2013 section 6.8.2

Test Procedure
Unless otherwise specified, these tests shall be made at ambient room temperature An antenna shall be connected to the antenna output terminals of the EUT if possible. If the EUT is equipped with or uses an adjustable-length antenna, then it shall be fully extended. i) Supply the EUT with nominal voltage or install a new or fully charged battery in the EUT. Turn ON the EUT and couple its output to a frequency counter or other frequency-measuring instrument. ii) Tune the EUT to one of the number of frequencies required in 5.6. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). iii) Measure the frequency at each of the Centre frequencies at normal temperature. iv) Vary the temperature in the range from high to low or vice versa according to the specified product category. v) Measure the frequency at each of the Centre frequencies in extreme temperature range. vi) Repeat the above procedure at 85% and 115% of the nominal supply voltage as descried in 5.13

Tested By: Danh Le	**Date of testing:** 29-Nov-2017 – 02-Dec-2017
Test Result : PASS	

A.2.3 Frequency Stability Test Data

Temperature (°C)	Voltage Level	Declared Frequency (MHz)	Measured Frequency Ant. Port 0 (MHz)	Deviation Ant. Port 0 (ppm)	Limit (ppm)	Results
Mode: 802.11a						
0	**Low**	**5180**	5179.9840	-3.088803	Note1	**Pass**
	High		5179.9890	-2.123552		
Normal Temperature	**Nominal**	**5180**	5180.23000	44.40154		
50	**Low**	**5180**	5180.2200	42.47104		
	High		5180.2650	51.15830		
Mode: 802.11a						
0	**Low**	**5220**	5219.9840	-3.065134	Note1	**Pass**
	High		5219.9890	-2.107280		
Normal Temperature	**Nominal**	**5220**	5220.21000	40.22988		
50	**Low**	**5220**	5220.2010	38.50575		
	High		5220.2620	50.19157		
Mode: 802.11a						
0 degree	**Low**	**5240**	5239.9840	-3.053435	Note1	**Pass**
	High		5239.9870	-2.480916		
Normal Temperature	**Nominal**	**5240**	5240.2160	41.22137		
50 degree	**Low**	**5240**	5240.2090	39.88545		
	High		5240.2600	49.61832		

Note1: 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 user manual.

Frequency Stability Test Data (continue)

Temperature (°C)	Voltage Level	Declared Frequency (MHz)	Measured Frequency Ant. Port 0 (MHz)	Deviation Ant. Port 0 (ppm)	Limit (ppm)	Results
Mode: 802.11n40						
0	**Low**	**5190**	5179.9840	-3.088803	Note1	**Pass**
	High		5190.9850	-2.890173		
Normal Temperature	**Nominal**	**5190**	5189.9850	-2.890173		
50	**Low**	**5190**	5190.2250	43.352601		
	High		5190.2410	46.435453		
Mode: 802.11n40						
0	**Low**	**5230**	5229.9840	-3.059273	Note1	**Pass**
	High		5229.9870	-2.485660		
Normal Temperature	**Nominal**	**5230**	5230.1930	36.902485		
50	**Low**	**5230**	5230.2180	41.682600		
	High		5230.2610	49.904398		
Mode: 802.11ac80						
0 degree	**Low**	**5210**	5209.9820	-3.454894	Note1	**Pass**
	High		5210.0140	2.687140		
Normal Temperature	**Nominal**	**5210**	5210.2250	43.186180		
50 degree	**Low**	**5210**	5210.2576	49.44338		
	High		5210.2700	51.82341		

Note1: 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 user manual.

A.3 99% and 26dB Bandwidth

The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. There is no limit for 99% OBW.

The 26 dB emission is the 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 26 dB relative to the maximum level measured in the fundamental emission.

A.3.1 Limits.

There is no requirement for the value of bandwidth. Power measurements are made using the 99% Bandwidth as the integration bandwidth.

A.3.2 Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section C (1) & D

99% BW and EBW (-26dB) Test Procedure
1. Set the radio in the continuous transmitting mode. 2. Allow the trace to stabilize. 3. Select the automatic OBW measurement function of an instrument to perform bandwidth measurement. 4. Setting the x-dB bandwidth mode to -26B and OBW power function to 99% within the measurement set up function. 5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. 6. Capture graphs and record pertinent measurement data.

99% BW and EBW (-26dB) Test parameters
Span = 1.5 x to 5.0 times OBW RBW = approx. 1% to 5% of the OBW VBW ≥ 3 x RBW Detector = Peak or where practical sample shall be used Trace = Max. Hold

Ref. KDB 789033 Section D. 99 Percent Occupied Bandwidth

99% BW Test Parameters
1. Set center frequency to the nominal EUT channel center frequency. 2. Set span = 1.5 times to 5.0 times the OBW. 3. Set RBW = 1 % to 5 % of the OBW 4. Set VBW ≥ 3 · RBW 5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. 6. Use the 99 % power bandwidth function of the instrument (if available).

Ref KDB 789033 in Section C. Measurement Bandwidth, Section 1

26 BW Test parameters
X dB BW = -26dB (using the OBW function of the spectrum analyzer) Emission Bandwidth (EBW) a) Set RBW = approximately 1% of the emission bandwidth. b) Set the VBW > RBW. c) Detector = Peak. d) Trace mode = max hold. e) Measure the maximum width of the emission that is 26 dB down from the maximum 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%.

Tested By: Danh Le	**Date of testing:** 16-Nov-2017 – 20-Nov-2017
Test Result : PASS	

A.3.3 99% and 26dB Bandwidth Data Table

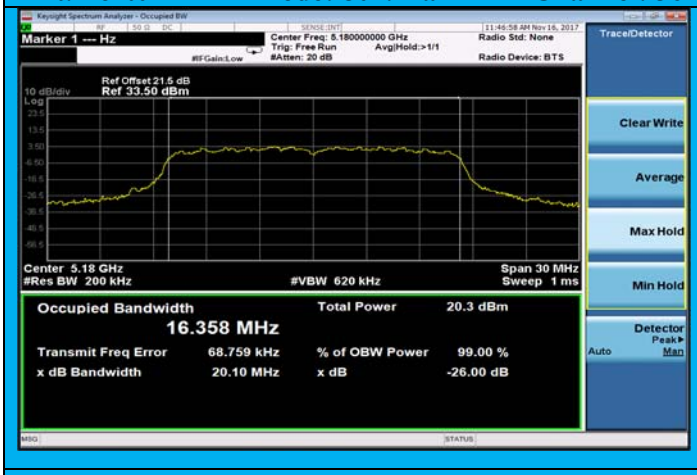
Channel No.	Frequency (MHz)	Mode	Data Rate (Mbps)	99% BW (MHz) Ant. Port0	26dB BW (MHz) Ant. Port0	99% BW (MHz) Ant. Port1	26dB BW (MHz) Ant. Port1
Radio Mode: 802.11a							
36	5180	802.11a	6	16.36	20.10	16.26	19.15
44	5220	802.11a	6	16.27	20.97	16.26	19.17
48	5240	802.11a	6	16.23	19.49	16.28	20.14
Radio Mode: 802.11n40							
38	5190	802.11n40	MCS0	35.88	45.84	35.75	42.44
46	5230	802.11n40	MCS0	35.71	39.67	35.87	46.48
Radio Mode: 802.11ac40							
42	5210	802.11ac80	MCS0	74.77	82.18	74.63	81.33

Tested By: Danh Le	**Date of testing:** 16-Nov-2017 – 20-Nov-2017
Test Result : PASS	

A.3.4 99% Occupied & 26dB Bandwidth Graphical Test Results

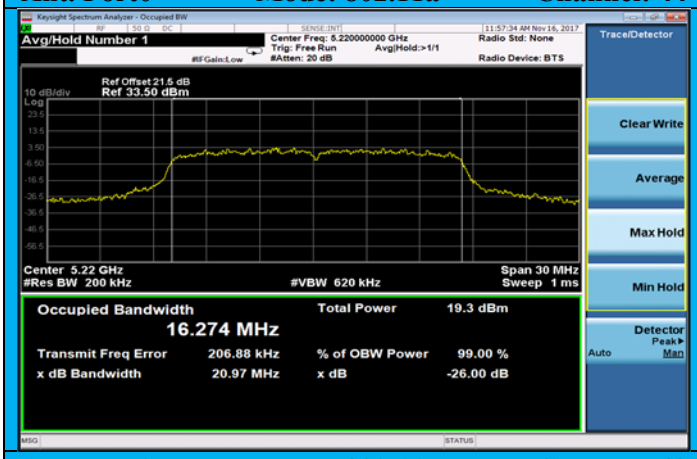
99% Occupied Bandwidth & 26 dB Bandwidth

Ant. Port0 Mode: 802.11a Channel: 36

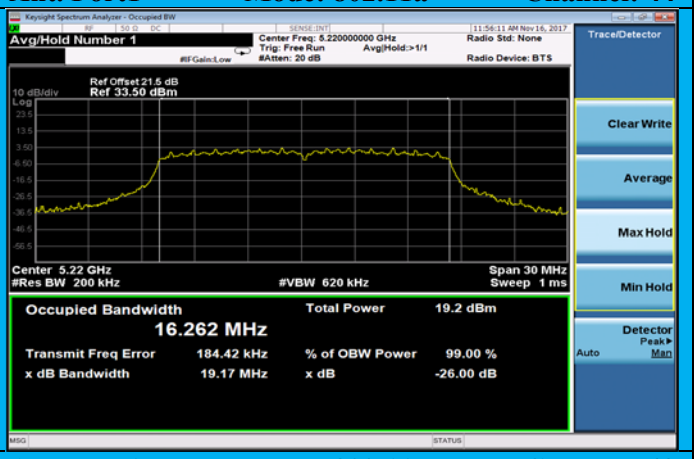


Ant. Port1 Mode: 802.11a Channel: 36

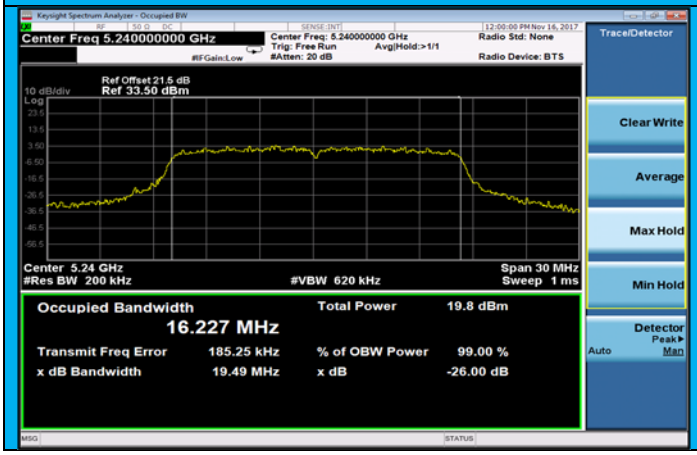
Ant. Port0 Mode: 802.11a Channel: 44



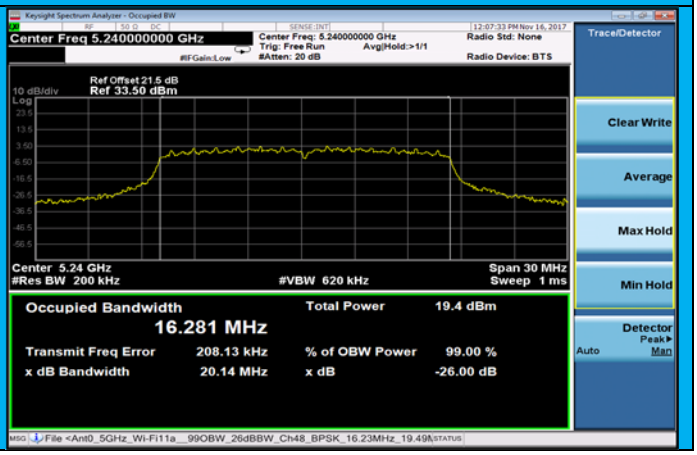
Ant. Port1 Mode: 802.11a Channel: 44

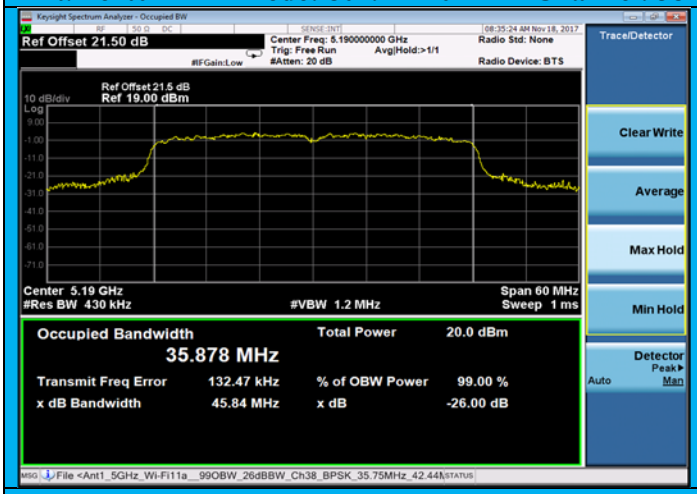
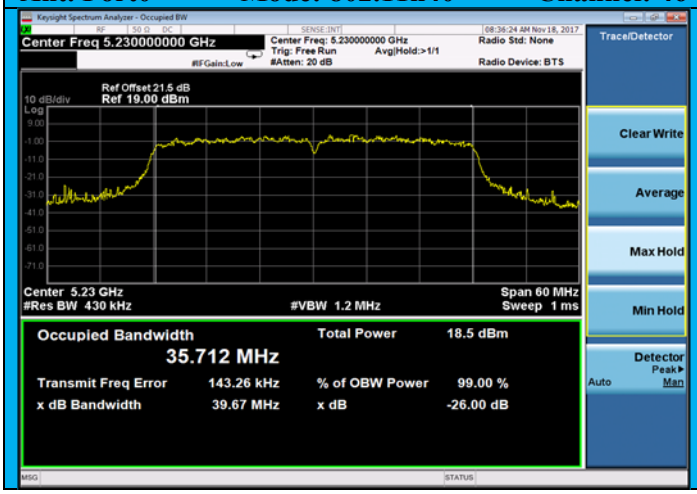


Ant. Port0 Mode: 802.11a Channel: 48

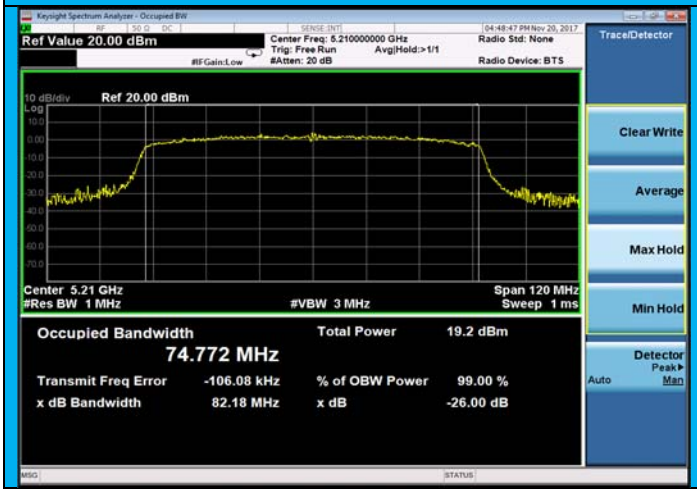


Ant. Port1 Mode: 802.11a Channel: 48



99% Occupied Bandwidth & 26 dB Bandwidth			
Ant. Port0	**Mode: 802.11n40**	**Channel: 38**	
			
Ant. Port1	**Mode: 802.11n40**	**Channel: 38**	
			
Ant. Port0	**Mode: 802.11n40**	**Channel: 46**	
			
Ant. Port1	**Mode: 802.11n40**	**Channel: 46**	
			

99% Occupied Bandwidth & 26 dB Bandwidth					
Ant. Port0	**Mode: 802.11ac80**	**Channel: 42**	**Ant. Port1**	**Mode: 802.11ac80**	**Channel: 42**



A.4 Maximum Conducted Output Power and e.i.r.p

Maximum Conducted Output Power is defined as the total transmit power delivered to all antenna when the transmitter is operating at its maximum control level.

A.4.1 Limits.

FCC 15.407(a) (1) (iv)
For mobile and portable 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 (~ 24 dBm) provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 6.2.1.1
For other devices, the maximum e.i.r.p. shall not exceed 200 mW (~23 dBm) or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz.

Limits Calculation

RSS Limits				
99% OBW (MHz)	**10*log10B (dB)**	**10+10*log10B (dBm)**	***250mW converted to (dBm)**	**Conducted Power Limits (dBm)**
802.11a				
16.36	12.14	**22.14**	23.14	23
802.11n40				
35.87	15.54	25.54	23.98	**23**
802.11ac80				
74.68	18.73	28.73	23.98	**23**

Note:** Unit limit conversion: **200mW ~ 23.0dBm.

A.4.2 Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section E

Test Procedure
1. Set the radio in the transmitting mode 2. Compute power by integrating the spectrum across the EBW (or alternatively entire 99% OBW) of the signal using the instrument's band power measurement function. The integration shall be performed using the spectrum analyzer band-power measurement function with band limits set equal to the EBW or the OBW band edges. 3. Make the following adjustments to the peak value of the spectrum, by adding duty cycle correction factor to the measured value. 4. Capture graphs and record pertinent measurement data.

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section E.2 (d), **Method SA-2**

Test parameters
(i) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal. (ii) Set RBW = 1 MHz (iii) Set VBW ≥ 3 MHz (iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.) (v) Sweep time = auto. (vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode. (vii) Do not use sweep triggering. Allow the sweep to "free run". (viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.

Tested By: Danh Le	**Date of testing:** 20-Nov-2017
Test Result : PASS	

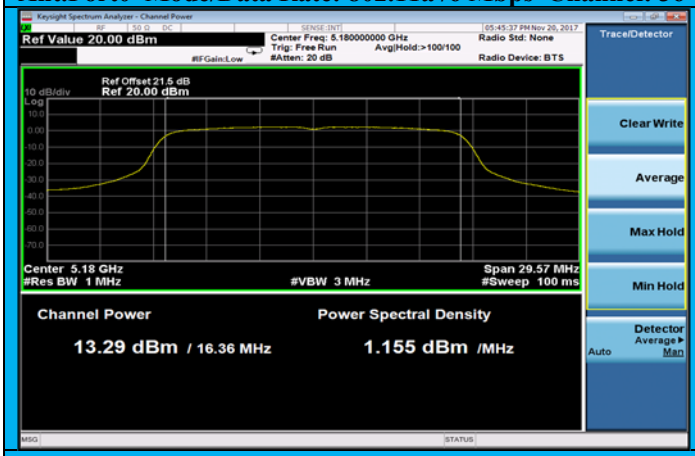
A.4.3 Maximum Conducted Output Power Data Table

Maximum Conducted Output Power & EIRP								
Antenna Gain = 4.26 dBi								
Channel/ Frequency (MHz)	Data Rate (Mbp)	Ant. Port0 Output Power (dBm)	Ant. Port1 Output Power (dBm)	Total Output Power Ant.P0+Ant.P1 (mW) / (dBm)		Duty Cycle Correction Factor (dB)	Corrected Total Output Power (add DCCF) (dBm)	Total e.i.r.p (dBm)
Mode : 802.11a								
FCC Limits: 24 dBm (conducted) / 30 dBm (e.i.r.p) / ISED Limit: 22.14 dBm (e.i.r.p)								
36 / 5180	6	13.29	12.42	38.79	15.89	0.3	16.19	20.45
44 / 5220	6	13.64	12.40	40.50	16.07	0.3	16.37	20.63
48 / 5240	6	13.63	12.12	39.36	15.95	0.3	16.25	20.51
Result: Pass								
Mode : 802.11n40								
FCC Limits: 24 dBm (conducted) / 30 dBm (e.i.r.p) / ISED Limit: 23 dBm (e.i.r.p)								
38 / 5190	MCS0	11.65	10.49	25.82	14.12	0.5	14.62	18.88
46 / 5230	MCS0	11.61	11.01	27.11	14.33	0.5	14.83	19.09
Result: Pass								
Mode : 802.11ac80								
FCC Limits: 24 dBm (conducted) / 30 dBm (e.i.r.p) / ISED Limit: 23 dBm (e.i.r.p)								
42 / 5210	MCS0	9.73	8.35	16.24	12.10	1.0	13.10	17.36
Result: Pass								

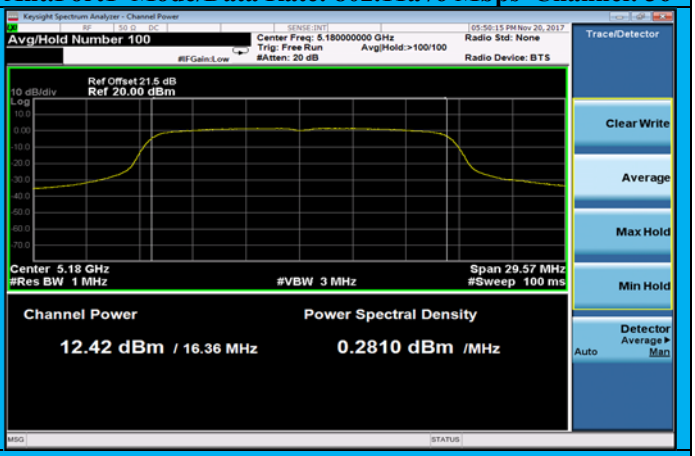
A.4.4 Maximum Conducted Output Power Graphical Test Results

Maximum Conducted Output Power

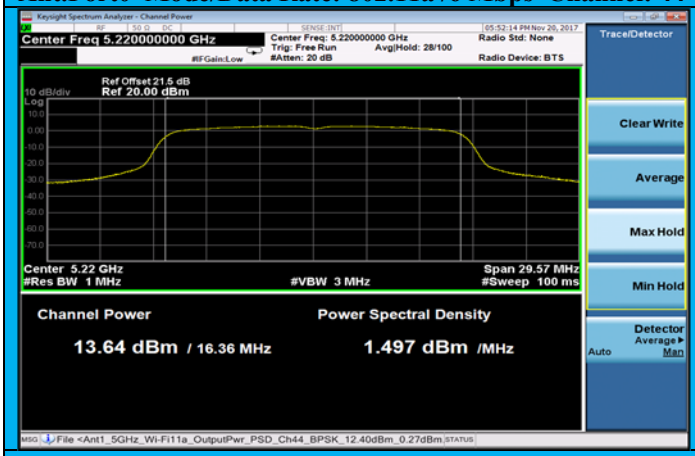
Ant.Port0 Mode/Data Rate: 802.11a /6 Mbps Channel: 36



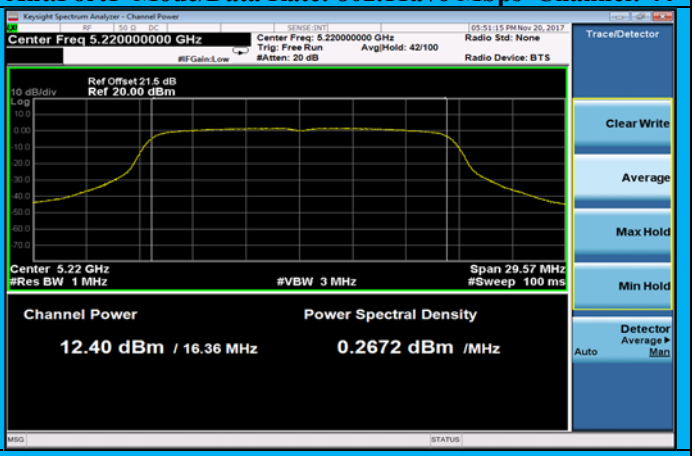
Ant.Port1 Mode/Data Rate: 802.11a /6 Mbps Channel: 36



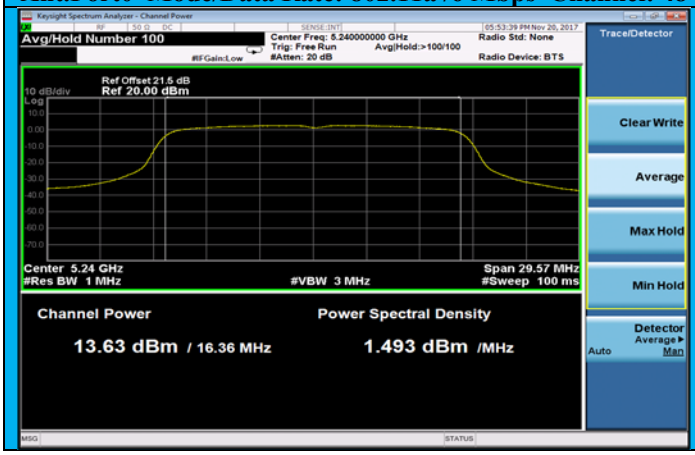
Ant.Port0 Mode/Data Rate: 802.11a /6 Mbps Channel: 44



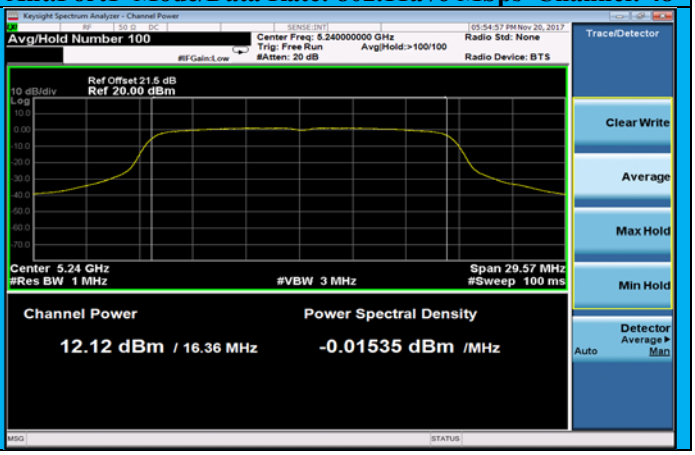
Ant.Port1 Mode/Data Rate: 802.11a /6 Mbps Channel: 44



Ant.Port0 Mode/Data Rate: 802.11a /6 Mbps Channel: 48

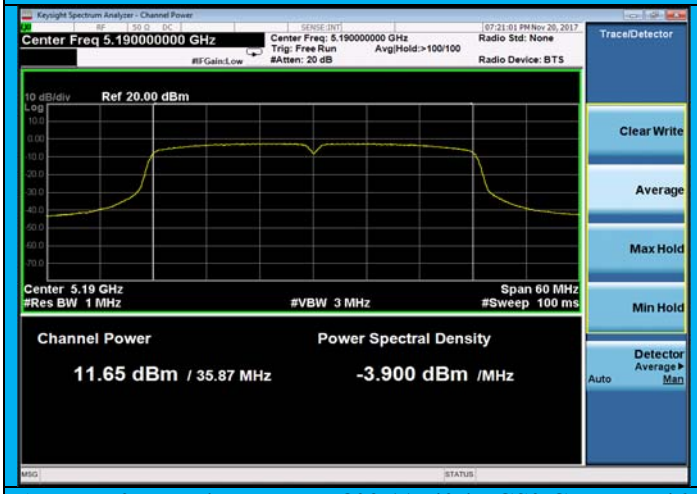


Ant.Port1 Mode/Data Rate: 802.11a /6 Mbps Channel: 48

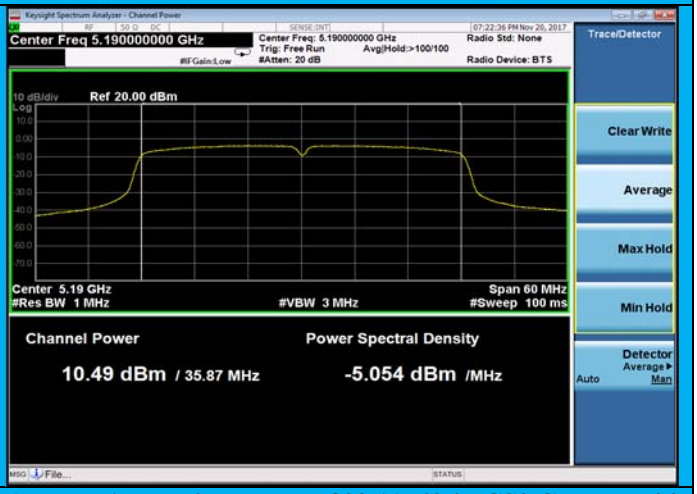


Maximum Conducted Output Power

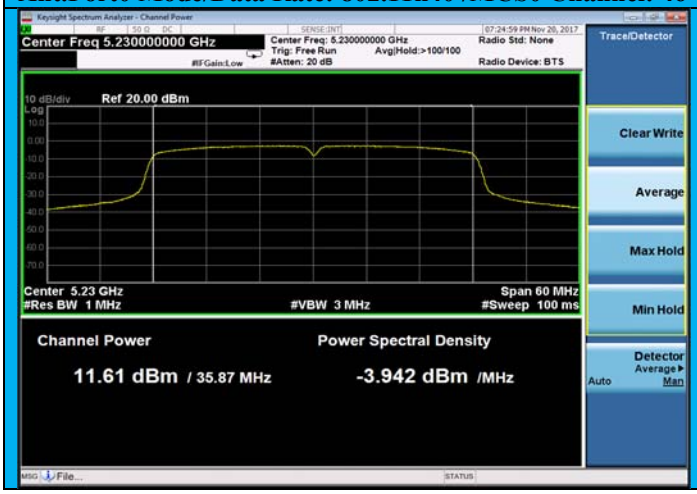
Ant.Port0 Mode/Data Rate: 802.11n40 /MCS0 Channel: 38



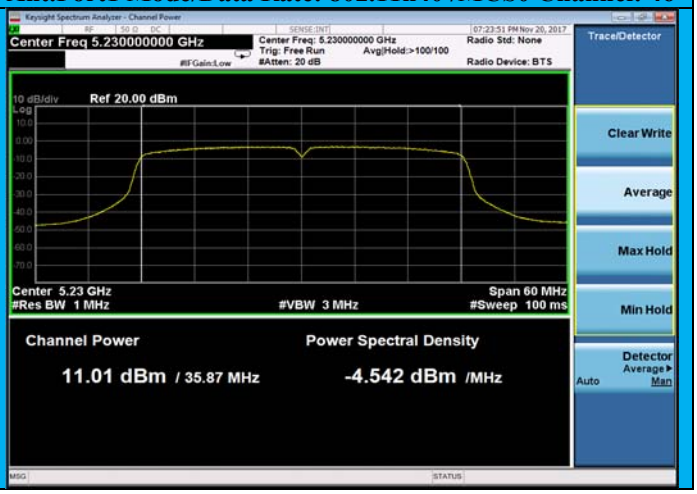
Ant.Port1 Mode/Data Rate: 802.11n40 /MCS0 Channel: 38

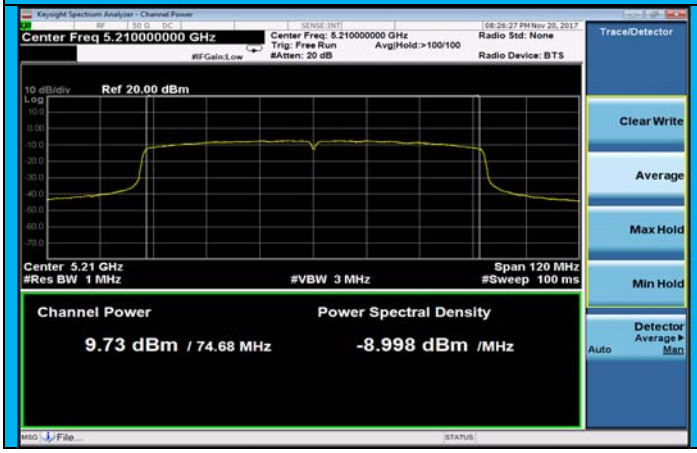
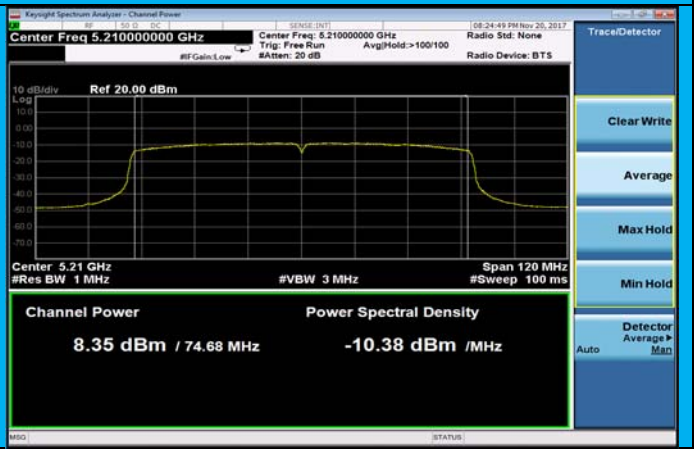


Ant.Port0 Mode/Data Rate: 802.11n40 /MCS0 Channel: 46



Ant.Port1 Mode/Data Rate: 802.11n40 /MCS0 Channel: 46



Conducted Output Power	
Ant.Port0 Mode/Data Rate: 802.11n80 /MCS0 Channel: 42	**Ant.Port1 Mode/Data Rate: 802.11n80 /MCS0 Channel: 42**
	

A.5 Power Spectral Density

The Power Spectral Density is the total energy output per unit bandwidth from a pulse or sequence of pulses for which the transmit power is at its maximum level, divided by the total duration of the pulses, This total time does not include the time between pulses during which the transmit power is off or below its maximum level.

A.5.1 Limits.

FCC 15.407(a) (1) (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 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 6.2.1.1
For other devices, the e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

A.5.2 Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4, section E & F.

Test Procedure
1. Set the radio in the transmitting mode
2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
3. Make the following adjustments to the peak value of the spectrum, by adding duty cycle correction factor to the measured value.
4. Capture graphs and record pertinent measurement data.
5. The result is the Maximum PSD over 1 MHz reference bandwidth.

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section E.2 (d) & F,
Method SA-2 & F

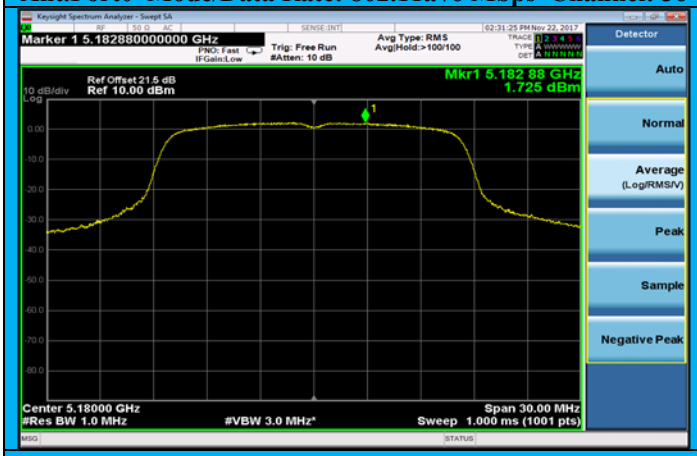
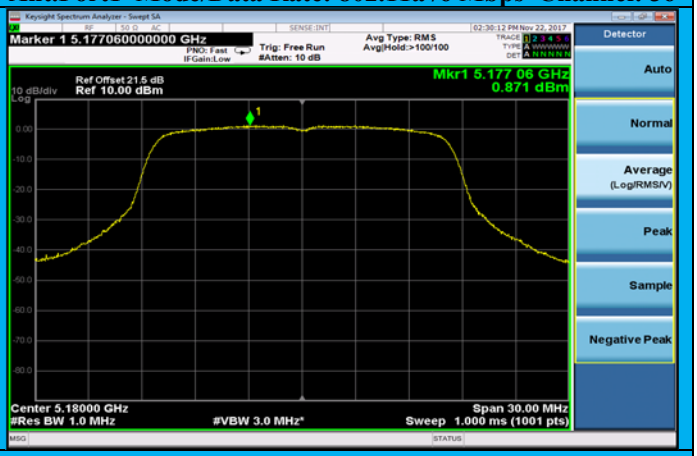
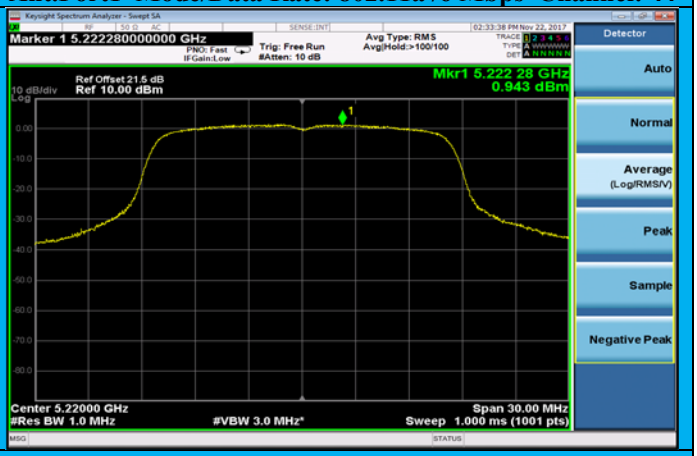
Test parameters
(i) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal. (ii) Set RBW = 1 MHz (iii) Set VBW ≥ 3 MHz (iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.) (v) Sweep time = auto. (vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode. (vii) Do not use sweep triggering. Allow the sweep to "free run". (viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.

Tested By: Danh Le	**Date of testing:** 22-Nov-2017
Test Result : PASS	

A.5.3 Power Spectral Density Data Table

Power Spectral Density								
Antenna Gain = 4.26 dBi								
FCC Limit: 11 dBm (conducted) / ISEDC Limit: 10 dBm (e.i.r.p)								
Channel/ Frequency (MHz)	Data Rate (Mbp)	Ant. Port0 Power Spectral Density (dBm)	Ant. Port1 Power Spectral Density (dBm)	Total PSD Ant.P0+Ant.P1 (mW) / (dBm)		Duty Cycle Correction Factor (dB)	Corrected Total PSD (+ DCCF) (dBm)	Total e.i.r.p Spectral Density (dBm)
Mode : 802.11a								
36 / 5180	MCS0	1.725	0.871	2.710	4.329	0.3	4.629	8.889
44 / 5220	MCS0	2.163	0.943	2.888	4.606	0.3	4.906	9.166
48 / 5240	MCS0	1.788	1.473	2.913	4.644	0.3	4.944	9.204
Result: Pass								

A.5.4 Power Spectral Density Graphical Test Results

Power Spectral Density	
Ant.Port0 Mode/Data Rate: 802.11a /6 Mbps Channel: 36	**Ant.Port1 Mode/Data Rate: 802.11a /6 Mbps Channel: 36**
	
Ant.Port0 Mode/Data Rate: 802.11a /6 Mbps Channel: 44	**Ant.Port1 Mode/Data Rate: 802.11a /6 Mbps Channel: 44**
	
Ant.Port0 Mode/Data Rate: 802.11a /6 Mbps Channel: 48	**Ant.Port1 Mode/Data Rate: 802.11a /6 Mbps Channel: 48**
	

A.6 Conducted Band Edge into Restricted Band

A.6.1 Limits

FCC 15.407 (b) (1)
For transmitters operating in the 5.150-5.250 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.

RSS-247 6.2.1.2
All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p.

FCC 15.407 (b) (7)
The provisions of §15.205 apply to intentional radiators operating under this section.

FCC 15.205 / FCC 15.209
(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209.

Restricted Bands			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz

Limit Conversion (field strength to power)

When the DUT power is measured using conducted test method, the field strength limit in dBµV can be converted to power (logarithmic) by using the field strength (linear) approach formula as follows:

eirp = pt x gt = $(E \times d)^2 / 30$

where: **pt** = transmitter output power in watts,
gt = numeric gain of the transmitting antenna (unit less),
E = electric field strength in V/m,
d = measurement distance in meters (m).

From the equation above, unit conversion from log => linear with a known field strength limit of 74 dBµV @ 3 meters distance.

(1) Conversion from dBµV to V

E (v/m) = 10 exp $^{(74 -120) / 20}$
E (V/m) = **0.0051187**

(2) Power in watts can be derived by using the equation above with known field strength in V/m with using antenna numeric gain of 1.

pt x gt = $(E \times d)^2 / 30$
pt (W) x gt = $(0.0051187)^2 \times (3)^2 / 30$
pt (W) x 1 = $(0.0000251188 \times 9) / 30$
pt (W) = $2.261 \times 10^{-4} / 30$ **= 7.535566 x10 $^{-6}$**
pt (mW) = 0.007535566

(3) Convert from linear power to log, using the using the following formula:

dBm = 10 log (mW)
= 10 log (0.007535566)
= -21.23

A.6.2 Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section II G.1 (c)/ section II G.5 & G.6

Restricted Bands **Test Procedure**
1. The radio is configured in the continuous transmitting mode. 2. Set test parameters for peak measurement. 3. Set start frequency at the beginning of the restricted band and stop frequency at the end of the restricted band of interest. 3. Allow trace to fully stabilize. 4. Use marker peak search function to determine the maximum emissions amplitude within the restricted band. 5. Capture the transmitter waveforms on the spectrum analyzer, and record pertinent measurement data. 6. Set test parameter for average measurement. 7. Repeat step 3 – 5.

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section II G.5

Restricted Bands Peak Measurement **Test parameters**
Span = Enough to capture the full restricted band of interest RBW= 1 MHz VBW ≥ 3 x RBW Detector= Peak Trace Mode= Max. Hold Sweep time= Auto

Ref. KDB 789033 D02 General UNII Test Procedure New Rules v01r4 section II G.6

Restricted Bands Average Measurement Test parameters
Span = Enough to capture the full restricted band of interest RBW = 1 MHz VBW ≥ 3 x RBW Detector = RMS Averaging Type = Power average (RMS) Trace Average ≥ 100 Sweep time = Auto

Tested By: Danh Le	**Date of testing:** 27-Sep-2017 – 28-Sep-2017
Test Result : PASS	

A.6.3 Restricted Bands Recorded Test Data

Band Edge into Lower Restricted Band (4500 MHz – 5150 MHz)									
FCC Limit: -21.2 dBm (Peak) / ISED Limit: -41.2 dBm (Average)									
Operating Channel/ Frequency (MHz)	**Data Rate (Mbps)**	**Ant. Port0 Output Power (dBm)**	**Ant. Port1 Output Power (dBm)**	**Total Output Power Ant.P0+Ant.P1 (mW)/(dBm)**		**Duty Cycle Factor (dB)**	**Corrected Total Output Power (add DCCF) (dBm)**	**A.G (dBi)**	**Total e.i.r.p (dBm)**
Mode : 802.11a									
36 / 5180	6	-29.50 Pk	-29.41 Pk	0.0023	-26.44	N/A	-26.44	4.1	-22.34
36 / 5180	6	-53.87 Av	-54.803Av	0.0000	-50.94	0.3	-50.64	4.1	-46.54
Result: Pass									
Mode : 802.11n HT40									
38 / 5190	MCS0	-28.18	-31.90	0.002	-26.64	N/A	-26.64	4.1	-22.54
38 / 5190	MCS0	-53.33	-56.11	0.000	-51.49	0.54	-50.95	4.1	-46.85
Result: Pass									
Mode : 802.11ac VHT80									
42 / 5210	MCS0	-29.84 Pk	-29.63 Pk	0.002	-26.72	N/A	-26.72	4.1	-22.62
42 / 5210	MCS0	-53.37 Av	-53.83 Av	0.000	-50.58	1.0	-49.58	4.1	-45.48
Result: Pass									

Note1: *Correction factors (ext. attenuation + cable loss) are compensated in the offset function of the measuring instrument.*

Note2*: KDB 789033 D02, section G3 footnote[3]. An out-of-band emission that complies with both peak and average limits of section 15.209 is not required to satisfy the -27dBm/MHz peak emission limit.*

A.6.4 Restricted Bands Graphical Test Results

Lower Restricted Band (4500 MHz – 5150 MHz)	
Operating Channel (Frequency): 36 (5180 MHz)	
Ant.Port0 Mode/Data Rate: 802.11a/ 6Mbps Pk	**Ant.Port1 Mode/Data Rate: 802.11a/ 6Mbps Pk**
	
Ant.Port0 Mode/Data Rate: 802.11a/ 6Mbps Av	**Ant.Port1 Mode/Data Rate: 802.11a/ 6Mbps Av**
	

Lower Restricted Band (4500 MHz – 5150 MHz)			
Operating Channel (Frequency): 38 (5190 MHz)			
Ant.Port0	**Mode/Data Rate: 802.11n40/ MCS0**	**Pk**	
			
Ant.Port1	**Mode/Data Rate: 802.11n40/ MCS0**	**Pk**	
			
Ant.Port0	**Mode/Data Rate: 802.11n40/ MCS0**	**Av**	
			
Ant.Port1	**Mode/Data Rate: 802.11n40/ MCS0**	**Av**	
			

Lower Restricted Band (4500 MHz – 5150 MHz)	
Operating Channel (Frequency): 42 (5210 MHz)	
Ant.Port0 Mode/Data Rate: 802.11ac80/ MCS0 Pk	**Ant.Port1 Mode/Data Rate: 802.11ac80/ MCS0 Pk**
	
Ant.Port0 Mode/Data Rate: 802.11ac80/ MCS0 Av	**Ant.Port1 Mode/Data Rate: 802.11ac80/ MCS0 Av**
	

Appendix B: Radiated Test Results

B1. Radiated Spurious Emissions & Restricted Bands

Emissions on frequency or frequencies which are outside the necessary bandwidth and level of which may be reduced without effecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

B.1.1 Limits

Unwanted Emissions Outside of the Restricted Bands
Frequency range: Below 1GHz
FCC 15.407 (b) (6)
Unwanted emissions below 1GHz must comply with general field strength limits set forth in §15.209. Further any U-NII devices using an AC power line are required to comply also with conducted emissions limits set forth in §15.207. Refer to limit section for detailed limits

RSS-Gen 8.9: Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 3 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Frequency range: Above 1GHz
FCC 15.407 (b) (1) / RSS-247 6.2.1.2
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.

Restricted Bands

FCC 15.407 (b) (7)
The provision of §15.205 apply to intentional radiators operating under FCC 15.407(b).

FCC 15.205 / FCC 15.209
(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. Refer to limit section for detailed limits.

Restricted Bands for FCC			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz

RSS-Gen 8.10
(**b**) Unwanted emissions that fall into restricted bands of the table below or restricted bands of Table 6 in the RSS-Gen standard, shall comply with the limits specified in RSS-Gen; and

(**c**) Unwanted emissions that do not fall within the restricted frequency bands in the table below shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6

Restricted Bands for ISEDC			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	12.51975-12.52025	608-614	7.25-7.75
2.1735-2.1905	12.57675-12.57725	960-1240	8.025-8.5
3.020-30.26	13.36-13.41	1435-1626.5	9.0-9.2
[1]0.495-0.505	16.42-16.423	1645.5-1646.5	9.3-9.5
4.125-4.128	16.69475-16.69525	1660-1710	10.6-12.7
4.17725-4.17775	16.80425-16.80475	1718.8-1722.2	13.25-13.4
4.20725-4.20775	25.5-25.67	2200-2300	14.47-14.5
5.677-5.683	37.5-38.25	2310-2390	15.35-16.2
6.215-6.218	73-74.6	2690-2900	17.7-21.4
6.26775-6.26825	74.8-75.2	3260-3267	22.01-23.12
6.31175-6.31225	108-121.94	3332-3339	23.6-24.0
8.291-8.294	156.52475-156.525	3345.8-3358	31.2-31.8
8.362-8.366	156.7-156.9	3500-4400	36.43-36.5
8.37625-8.38675	240-285	4500-5150	Above 38.6
8.41425-8.41475	322-335.4	5350-5460	
12.29-12.293	399.9-410	7250-7750	

Restricted Band and General Field Strength Limits

FCC 15.209
The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the table specified in the table in FCC§15.209(a).

FCC15.407 (b) (6)
Unwanted emissions below 1GHz must comply with general field strength limits set forth in §15.209.

RSS-Gen 8.9
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits Table			
Frequency (MHz)	**Field strength (uV/meter)**	**Field strength (dBuV/meter)**	**Measurement distance (meters)**
30-88	100**	40 Qp	3
88-216	150**	43.5 Qp	3
216-960	200**	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

Limit Conversion

When the DUT power is measured using a radiated test configuration, the EIRP can be directly determined using the field strength (linear) approach as follows:

eirp = pt x gt = (E x d)2/30

where: **pt** = transmitter output power in watts,
gt = numeric gain of the transmitting antenna (unit less),
E = electric field strength in V/m,
d = measurement distance in meters (m).

Based on the equation above, unit conversion from log => linear with a known limit of – 27 dBm

(1) Conversion from dBm to Watt

W = 10 EXP (-27dBm – 30 /10)
W = 10 EXP (-5.7) = 2 E-6

(2) E Field Strength can be derived by inverse calculation.

E = 9 (**pt** x **gt** x **30) / d**
E = SQRT (2E-6 x 1.0 x 30) / 3 = 0.0026 V/m

(3) Conversion from Linear to Log, using the following formula

Volts to dBuV = 20 log (*Volts)* + 120
E (in dBuV)**/m @3 meter** = 20 Log (0.0026) + 120 = **68.23**

B.1.2 Test Procedure

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater than the applicable CISPR quasi-peak bandwidth or 1 MHz bandwidth, respectively.

Ref. ANSI C63.10-2013 section 6.5 & 6.6

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Place the radio in continuous transmit mode. Maximize Turntable (find worst case table angle) and maximize Antenna (find worst case height). 3. Use the peak marker function to determine the maximum amplitude level. 4. Center marker frequency and perform final measurement in Quasi-peak (≤ 1Ghz) and Average (above 1 GHz) 5. Record at least 6 highest readings for the worst case operating mode.

ANSI C63.10: 2013 section 4.1.4 / section 12.7.5 (Quasi-Peak), section 12.7.6 (peak), section 12.7.7.3 (average)

Test parameters
(i) Span = Entire frequency range or segment if necessary. (ii) Reference Level = 80 dBuV (iii) RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz) (iv) VBW ≥ 3 x RBW (v) Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Change VBW to 10 Hz for average measurement (vi) Sweep Time = Couple

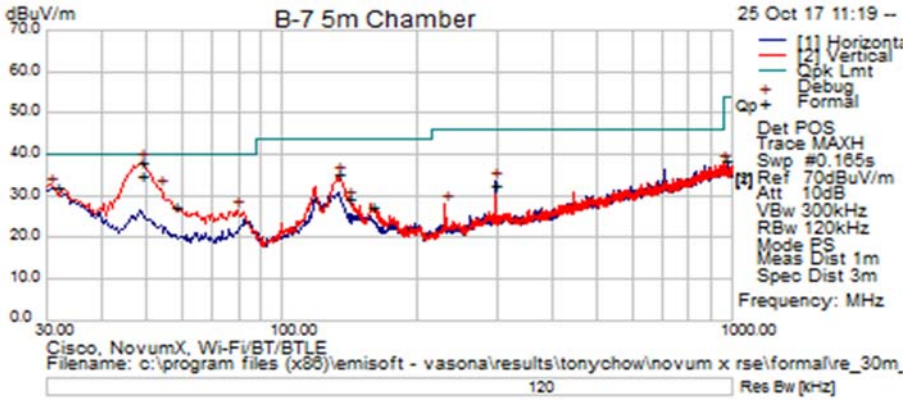
. The system was evaluated up to 40 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

Note1: A Notch Filter was used during formal testing from 1 – 18GHz to help prevent the front end of the analyzer from over loading. The Notch filters used are designed to suppress TX fundamental frequency but do not effect harmonics of the fundamental frequency from being measured

Note2: The data displayed on the plots detailed in the graphical test results section were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements.

B.1.3 Transmitter Radiated Spurious Emissions Graphical Data Results

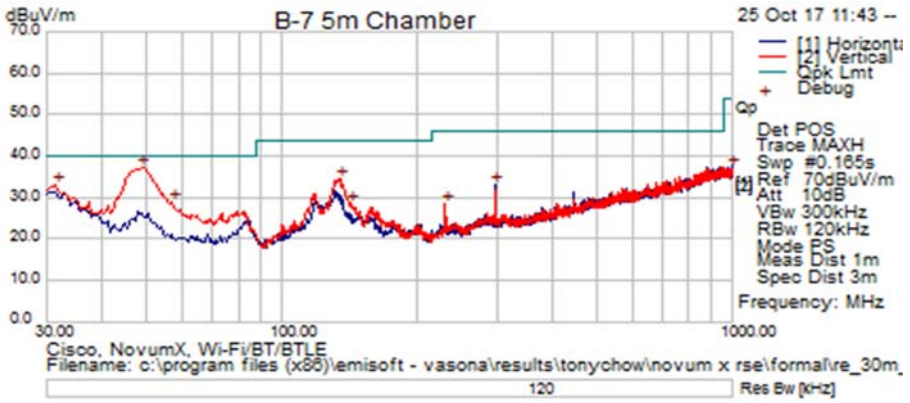
Subtest Date:	25-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	802.11a, Tx Channel 36 (5180 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch36 (5180 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
48.915	38.58	0.77	-1.21	38.14	Peak	V	100	0	40	-1.86	Pass	Tx/Ch36
48.829	35.5	0.8	-1.2	35.1	Quasi-Pk	V	119	319	40	-4.9	Pass	Tx/Ch36
30.485	20.29	0.61	11.62	32.51	Peak	V	100	260	40	-7.49	Pass	Tx/Ch36
53.765	33.42	0.84	-2.32	31.93	Peak	V	100	38	40	-8.07	Pass	Tx/Ch36
957.805	20.58	3.53	13.56	37.68	Peak	V	200	266	46	-8.32	Pass	Tx/Ch36
132.82	29.53	1.29	4.26	35.08	Peak	V	100	149	43.5	-8.42	Pass	Tx/Ch36
296.75	27.94	1.94	3.76	33.64	Peak	H	100	83	46	-12.36	Pass	Tx/Ch36
79.47	27.41	1.01	-1.79	26.63	Peak	V	100	80	40	-13.37	Pass	Tx/Ch36
141.065	24.4	1.32	3.45	29.18	Peak	V	100	158	43.5	-14.32	Pass	Tx/Ch36
230.79	24.87	1.7	1.64	28.21	Peak	V	200	190	46	-17.79	Pass	Tx/Ch36

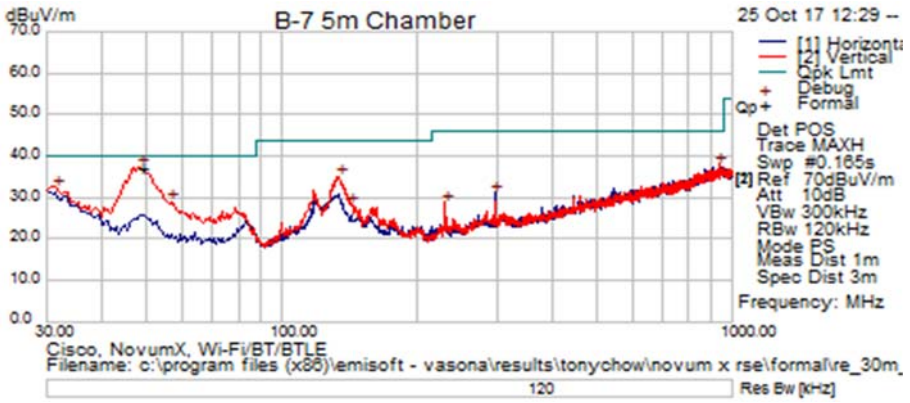
Subtest Date:	25-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	802.11a, Tx Channel 44 (5220 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch44 (5220 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
31.455	21.79	0.62	10.89	33.3	Peak	V	100	293	40	-6.7	Pass	Tx/Ch44
48.915	37.78	0.77	-1.21	37.35	Peak	V	100	332	40	-2.65	Pass	Tx/Ch44
48.425	34.6	0.77	-1.21	34.16	Quasi-Pk	V	136	0	40	-5.7	Pass	Tx/Ch44
57.16	30.55	0.86	-2.33	29.09	Peak	V	100	3	40	-10.91	Pass	Tx/Ch44
135.245	29.29	1.3	4.03	34.62	Peak	V	100	349	43.5	-8.88	Pass	Tx/Ch44
142.035	23.84	1.33	3.36	28.53	Peak	V	100	302	43.5	-14.97	Pass	Tx/Ch44
230.79	25.19	1.7	1.64	28.53	Peak	V	200	224	46	-17.47	Pass	Tx/Ch44
296.75	27.46	1.94	3.76	33.16	Peak	H	100	83	46	-12.84	Pass	Tx/Ch44
997.09	20.38	3.61	13.56	37.55	Peak	H	100	364	54	-16.45	Pass	Tx/Ch44

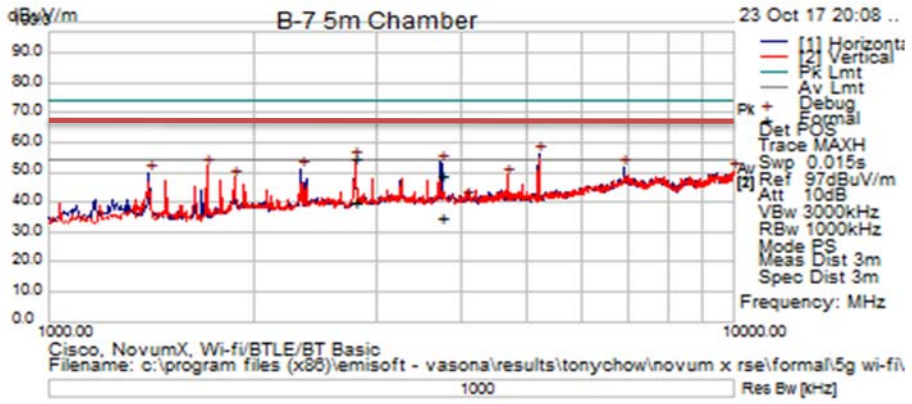
Subtest Date:	25-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	802.11a, Tx Channel 48 (5240 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch48 (5240 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
31.455	21.06	0.62	10.89	32.57	Peak	V	300	60	40	-7.43	Pass	Tx/Ch48
48.43	37.58	0.77	-1.02	37.34	Peak	V	140	332	40	-2.66	Pass	Tx/Ch48
48.44225	34.73	0.77	-1.02	34.47	Quasi-Pk	V	140	332	40	-5.53	Pass	Tx/Ch48
56.675	30.43	0.86	-2.34	28.94	Peak	V	100	37	40	-11.06	Pass	Tx/Ch48
134.275	29.61	1.3	4.13	35.03	Peak	V	100	140	43.5	-8.47	Pass	Tx/Ch48
142.52	23.65	1.33	3.36	28.34	Peak	V	100	0	43.5	-15.16	Pass	Tx/Ch48
230.79	25.46	1.7	1.64	28.8	Peak	V	200	224	46	-17.2	Pass	Tx/Ch48
296.75	25.45	1.94	3.76	31.15	Peak	H	100	104	46	-14.85	Pass	Tx/Ch48
936.95	21.23	3.5	13.25	37.98	Peak	V	200	258	46	-8.02	Pass	Tx/Ch48

Subtest Date:	23-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	802.11a,Tx Channel 36 (5180 MHz)



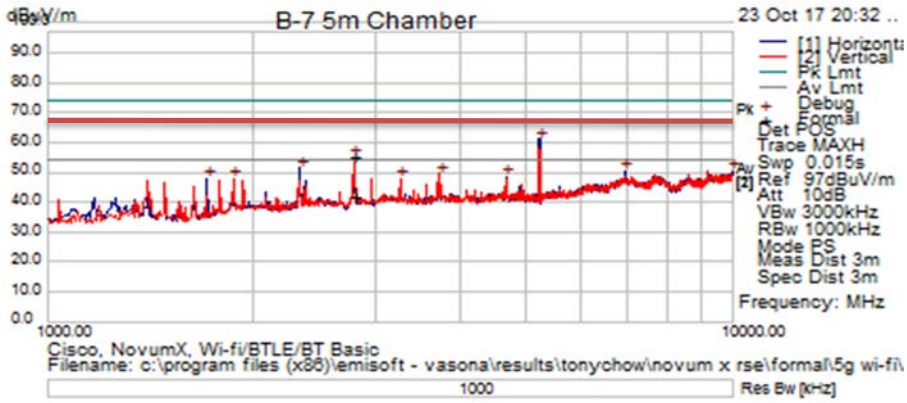
Title: **TX Spurious Emissions from 1-10GHz – Ch36 (5180 MHz) – Peak Trace**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average); —— 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5185	55.38	9.34	-8.4	56.32	Peak	H	200	196	N/A	N/A	Ignored	Fundamental
2797.295	58.03	6.65	-9.83	54.84	Peak	V	242	209	74	-19.16	Pass	Tx/Ch36
2797.295	43.4	6.65	-9.83	40.21	Average	H	243	115	54	-13.79	Pass	Tx/Ch36
3736.27	50.01	7.8	-8.49	49.32	Peak	H	125	137	74	-24.68	Pass	Tx/Ch36
3736.27	35.93	7.8	-8.49	35.24	Average	H	125	137	54	-18.76	Pass	Tx/Ch36
1703.125	60.93	5.06	-13.81	52.18	Peak	V	150	80	74	-21.82	Pass	Tx/Ch36
6917.5	46.53	10.9	-5.66	51.77	Peak	H	200	194	74	-22.23	Pass	Tx/Ch36
2333.125	55.34	5.99	-10.39	50.94	Peak	H	150	223	74	-23.06	Pass	Tx/Ch36
9977.5	40.47	13.71	-3.69	50.5	Peak	V	350	228	74	-23.5	Pass	Tx/Ch36
1399.375	58.14	4.54	-12.8	49.89	Peak	H	150	167	74	-24.11	Pass	Tx/Ch36
4667.5	48.65	8.82	-8.68	48.79	Peak	V	300	134	74	-25.21	Pass	Tx/Ch36
1866.25	54.06	5.32	-11.17	48.21	Peak	V	200	189	74	-25.79	Pass	Tx/Ch36
4087.898	40.86	8.18	-8.2	40.83	Peak	H	99	361	74	-33.17	Pass	Tx/Ch36

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

Subtest Date:	23-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	802.11a,Tx Channel 44 (5220 MHz)



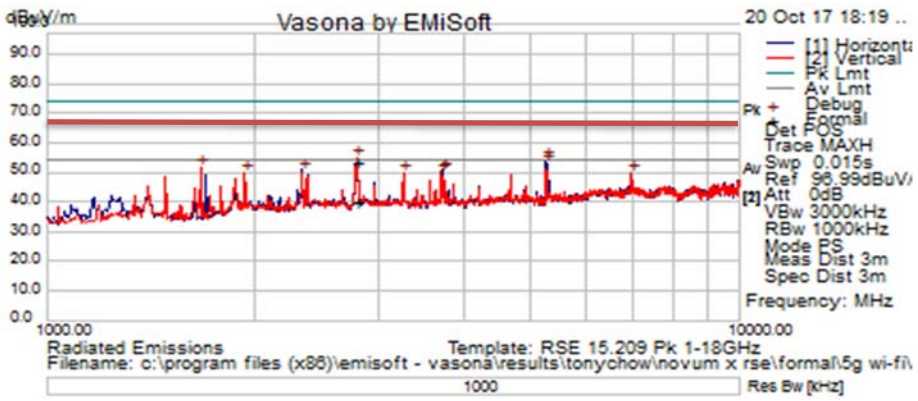
Title: **TX Spurious Emissions from 1-10GHz – Ch44 (5220 MHz) – Peak Trace**

Legend: 74dBµV/m (Peak); 54 dBµV/m (Average); 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5224.375	60.09	9.4	-8.56	60.93	Peak	H	150	204	N/A	N/A	Ignored	Fundamental
2799.838	58.73	6.65	-9.83	55.55	Peak	V	265	175	74	-18.45	Pass	Tx/Ch44
2799.838	45.16	6.65	-9.83	41.98	Average	V	265	175	54	-12.02	Pass	Tx/Ch44
2333.125	55.7	5.99	-10.39	51.3	Peak	H	300	151	74	-22.7	Pass	Tx/Ch44
9994.375	40.46	13.74	-3.64	50.56	Peak	H	400	17	74	-23.44	Pass	Tx/Ch44
6962.5	45.28	10.9	-5.68	50.5	Peak	H	200	196	74	-23.5	Pass	Tx/Ch44
3733.75	50.23	7.79	-8.49	49.53	Peak	V	200	120	74	-24.47	Pass	Tx/Ch44
4667.5	48.49	8.82	-8.68	48.62	Peak	H	150	144	74	-25.38	Pass	Tx/Ch44
3266.875	49.3	7.23	-8.46	48.07	Peak	V	150	192	74	-25.93	Pass	Tx/Ch44
1708.75	56.64	5.07	-13.76	47.95	Peak	H	200	185	74	-26.05	Pass	Tx/Ch44
1866.25	53.73	5.32	-11.17	47.87	Peak	V	300	219	74	-26.13	Pass	Tx/Ch44

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement

Subtest Date:	20-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	802.11a,Tx Channel 48 (5240 MHz)



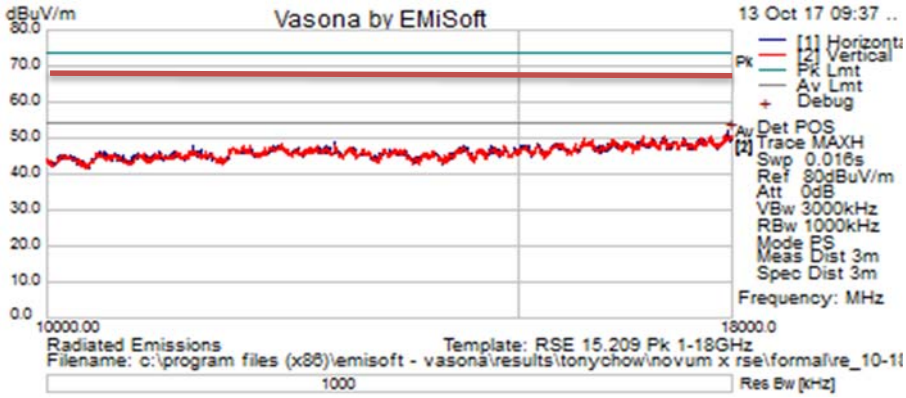
Title: **TX Spurious Emissions from 1-10GHz – Ch48 (5240 MHz) – Peak Trace**

Legend: 74dBµV/m (Peak); 54 dBµV/m (Average); 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5246.875	53.62	9.42	-8.6	54.44	Peak	H	125	189	N/A	N/A	Ignored	Fundamental
2798.6	56.89	6.65	-9.83	53.7	Peak Max	V	290	172	74	-20.3	Pass	Tx/Ch48
2798.6	43.4	6.65	-9.83	40.22	Average	H	215	103	54	-13.78	Pass	Tx/Ch48
5275	52.05	9.44	-8.47	53.02	Peak	H	225	166	74	-20.98	Pass	Tx/Ch48
1669.375	61.02	5.02	-14.15	51.89	Peak	V	225	72	74	-22.11	Pass	Tx/Ch48
2333.125	55.27	5.99	-10.39	50.87	Peak	H	250	172	74	-23.13	Pass	Tx/Ch48
3733.75	51.45	7.79	-8.49	50.75	Peak	H	300	191	74	-23.25	Pass	Tx/Ch48
3711.25	51.02	7.77	-8.61	50.18	Peak	V	300	142	74	-23.82	Pass	Tx/Ch48
6985	44.7	10.93	-5.7	49.93	Peak	V	125	200	74	-24.07	Pass	Tx/Ch48
3266.875	51.1	7.23	-8.46	49.86	Peak	V	150	189	74	-24.14	Pass	Tx/Ch48
1928.125	55.29	5.42	-10.96	49.75	Peak	V	175	176	74	-24.25	Pass	Tx/Ch48

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement

Subtest Date:	13-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	802.11a,Tx Channel 36 (5180 MHz)



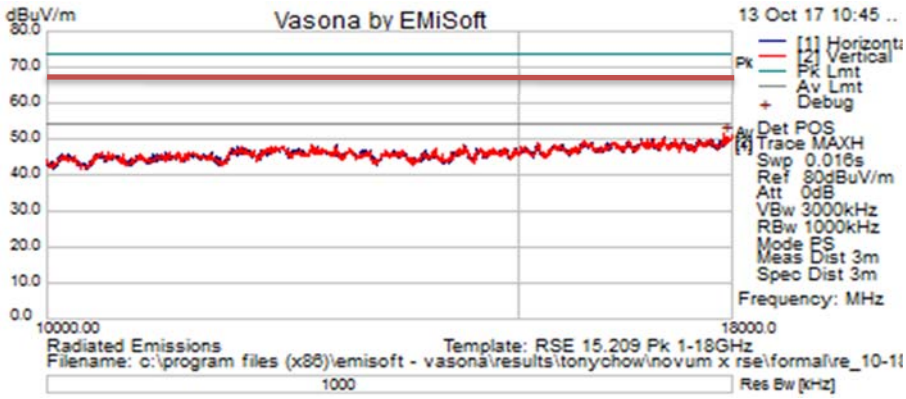
Title: **TX Spurious Emissions from 10-18GHz – Ch36 (5180 MHz) – Peak Trace**

Legend: 74dBµV/m (Peak); 54 dBµV/m (Average); 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17940	45.64	19.06	-12.82	51.89	Peak	H	400	308	54	-2.11	Pass	Tx/Ch36

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement

Subtest Date:	13-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	802.11a,Tx Channel 44 (5220 MHz)



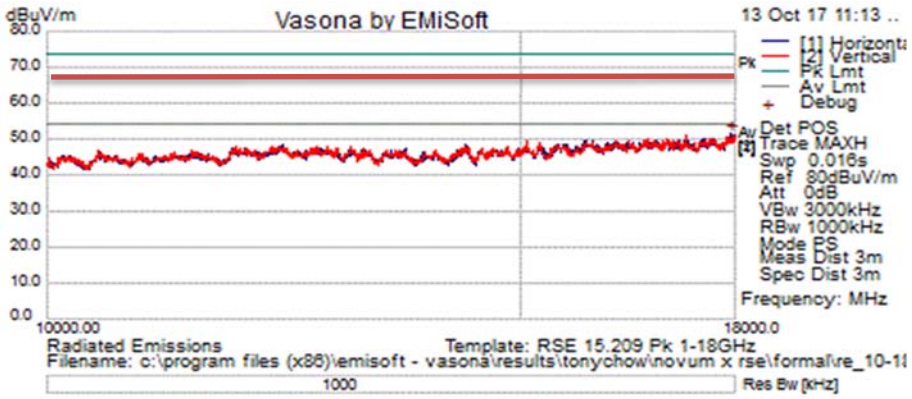
Title: **TX Spurious Emissions from 10-18GHz – Ch44 (5220 MHz) – Peak Trace**

Legend: 74dBµV/m (Peak); 54 dBµV/m (Average); 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
9915.625	39.29	14	-2.76	51.02	Peak [Scan]	H	100	61	54	-2.98	Pass	Tx/Ch44
5213.125	48.61	10	-8.54	50.03	Peak [Scan]	V	225	100	54	-3.97	Pass	Tx/Ch44

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement

Subtest Date:	22-Oct-2015
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	802.11a,Tx Channel 48(5240 MHz)



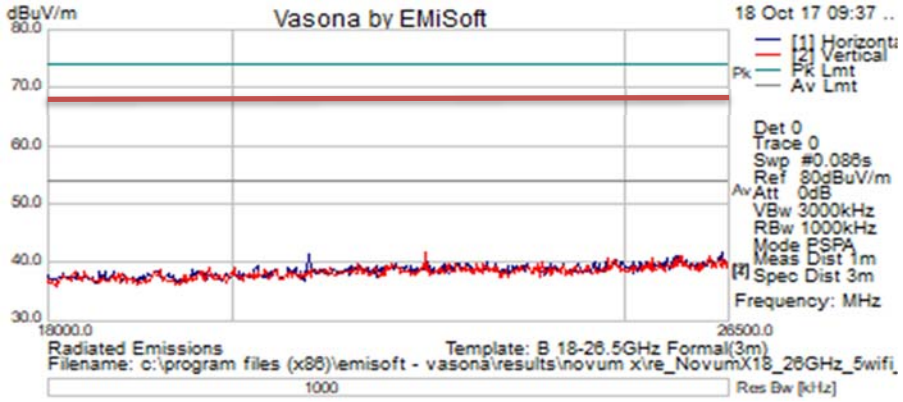
Title: **TX Spurious Emissions from 10-18GHz – Ch48 (5240 MHz) – Peak Trace**

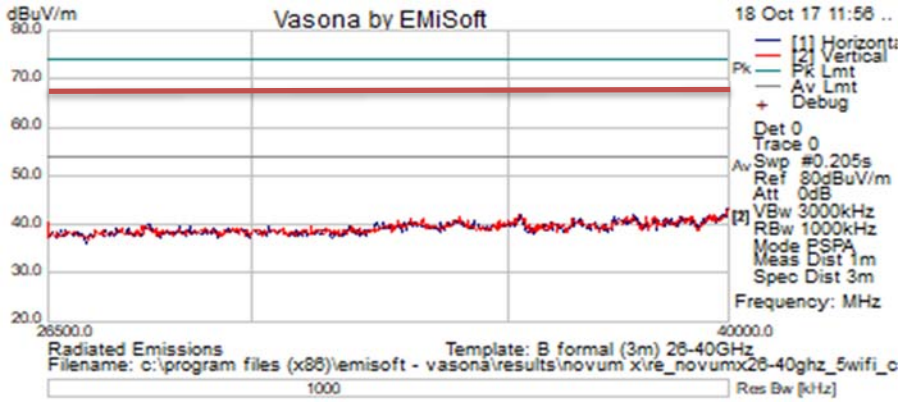
Legend: 74dBµV/m (Peak); 54 dBµV/m (Average); 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17930	45.6	19	-12.8	51.8	Peak [Scan]	H	300	75	54	-2.2	Pass	Tx/Ch48

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement

Subtest Date:	18-Oct-2015
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	18-40GHz
Comments on the above Test Results	802.11a,Tx Channel 44 (5220 MHz)





Title: **TX Spurious Emissions from 18-40GHz – Ch44 (5220 MHz) – Peak Trace**

Legend: 74dBµV/m (Peak); 54 dBµV/m (Average); 68dBµV/m (Peak) ~ -27dbm

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
26397.8	32.99	0	8.86	41.85	Peak	H	170	0	54	-12.15	Pass	Tx/Ch44
40000	50.95	0	-7.21	43.74	Peak	H	170	0	54	-10.26	Pass	Tx/Ch44

Note: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement

B.2 AC Conducted Emissions

B.2.1 Limits.

FCC 15.207 / RSS-Gen 8.8 issue4

FCC 15.207
(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

RSS-Gen 8.8
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 0.15 MHz to 30 MHz shall not exceed the limits in Table 3 shown in this section.

	Conducted Limits	
Frequency of Emission (MHz)	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

B.2.2 Test Procedure

Measurement requirements
Ref: C63.10:2013, section 6.2.2

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument, or where permitted or required, the emission currents on the power line sensed by a current probe. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer, and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements, using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having a 50 Ω input impedance. All other ports are terminated in 50 Ω loads. Figure 5, Figure 6, and Figure 7 show typical test setups for ac power-line conducted emissions testing (see 6.13). For information about the use of a RF-shielded (screen) room, vertical conducting plane and voltage probe, see ANSI C63.4.

Tabletop devices shall be placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above thereference ground plane. The vertical conducting plane or wall of an RF-shielded (screen) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

Final ac power-line conducted emission measurements
Ref: C63.10:2013, section 6.2.5

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each
current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

Ref. C63.10:2013, section 6.2

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Set the radio in continuous transmit mode. 3. Connect cable end to LISN Hot port and other cable end to the spectrum Analyzer/EMC receiver RF input port. Terminate the LISN neutral port with a 50 Ω impedance terminator. 4. Sweep the frequency range from 150 kHz to 30 MHz (segment if necessary) 5. Use the peak marker function to determine the maximum amplitude level. 6. Center marker frequency and perform final measurement using applicable detector (Quasi-Pk/Average). 7. Record at least 6 highest reading for the worst case operating modes in Quasi-peak/Average. 8. Repeat the test on Neutral lead. 9. Repeat step 3 – 7 with the radio sets in the Receiver mode. 10. Record at least 6 highest reading in Quasi-peak/Average

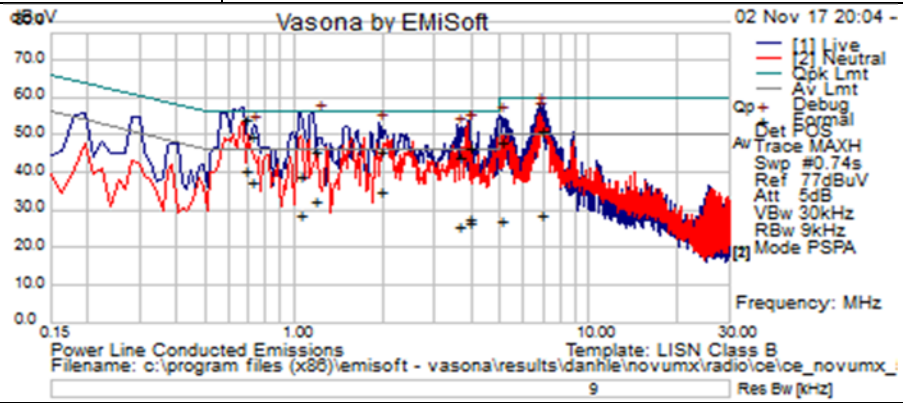
Ref. C63.10:2013, section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 70 dBuV RBW = 9 kHz VBW ≥ 3 x RBW Sweep Time = Couple Detector = Quasi-Peak & Average

B.2.3 Recorded Test Data and Graphical Test results

AC Conducted Emissions Test Result Tables for 802.11a / Mid Channel

Subtest Date:	02-Nov-2017
Engineer	Danh Le
Lab Information	Building 7, formal immunity room
Subtest Title	Conducted Emissions
Frequency Range	150 kHz - 30 MHz
Comments on the above Test Results	TX Ch44 (5220 MHz) with BPSK modulation – 6 Mbps



AC Conducted Emissions Test Result Tables for 802.11a / TX Ch44 (Peak Trace)

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	Factors (dB)	Level (dBuV)	Detector	Lines (Live/Neutral)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
0.641644	32.4	20	0.06	52.45	Quasi Peak	Live	56	-3.55	Pass	Tx/Ch44
3.876066	26.05	20.05	0.1	46.2	Quasi Peak	Live	56	-9.8	Pass	Tx/Ch44
6.892774	30.62	20.12	0.11	50.85	Quasi Peak	Live	60	-9.15	Pass	Tx/Ch44
0.891264	30.51	19.98	0.05	50.54	Quasi Peak	Live	56	-5.46	Pass	Tx/Ch44
4.990905	27.39	20.08	0.08	47.54	Quasi Peak	Live	56	-8.46	Pass	Tx/Ch44
1.18233	26.62	19.98	0.05	46.65	Quasi Peak	Live	56	-9.35	Pass	Tx/Ch44
3.49644	21.85	20.04	0.08	41.97	Quasi Peak	Live	56	-14.03	Pass	Tx/Ch44
5.274081	26.5	20.08	0.08	46.66	Quasi Peak	Live	60	-13.34	Pass	Tx/Ch44
0.543594	29.85	20	0.06	49.91	Quasi Peak	Live	56	-6.09	Pass	Tx/Ch44
7.285374	27.18	20.12	0.11	47.41	Quasi Peak	Live	60	-12.59	Pass	Tx/Ch44
0.641644	20.69	20	0.06	40.74	Average	Live	46	-5.26	Pass	Tx/Ch44
3.876066	7.11	20.05	0.1	27.26	Average	Live	46	-18.74	Pass	Tx/Ch44
6.892774	8.47	20.12	0.11	28.7	Average	Live	50	-21.3	Pass	Tx/Ch44
0.891264	15.57	19.98	0.05	35.61	Average	Live	46	-10.39	Pass	Tx/Ch44
4.990905	7.45	20.08	0.08	27.6	Average	Live	46	-18.4	Pass	Tx/Ch44
1.18233	12.47	19.98	0.05	32.51	Average	Live	46	-13.49	Pass	Tx/Ch44
3.49644	7.87	20.04	0.08	27.99	Average	Live	46	-18.01	Pass	Tx/Ch44
5.274081	6.96	20.08	0.08	27.12	Average	Live	50	-22.88	Pass	Tx/Ch44
0.543594	19.75	20	0.06	39.81	Average	Live	46	-6.19	Pass	Tx/Ch44
7.285374	6.84	20.12	0.11	27.07	Average	Live	50	-22.93	Pass	Tx/Ch44

Appendix C: List of Test Equipment Used to perform the test

Equip#	Manufacturer/ Model	Description	Last Cal	Next Due	Test Item
Radiated Emissions					
CIS008113	Cisco/NSA 5m Chamber	NSA 5m Chamber	06-Sep-17	06-Sep-18	B1
CIS034741	ETS Lindgren / 3117	Double Ridged Guide Horn Antenna	09-Aug-17	09-Aug-18	B1
CIS045723	Cisco / TH0118	Mast Mount Preamplifier Array, 1-18GHz	27-Feb-17	27-Feb-17	B1
CIS033670	Sunol Sciences / JB1	Combination Bi-Log Antenna, 30MHz-2GHz	09-Mar-17	09-Mar-18	B1
CIS036710	Cisco/1840	18-40GHz EMI Test Head/Verification Fixture	14-Dec-17	14-Dec-18	BI
CIS018231	Rohde & Schwarz /ESI 40(ESIB 40)	EMI RECEIVER TEST 20Hz-40GHz	03-Feb-17	03-Feb-18	BI
CIS041955	Rohde & Schwarz / ESCI	EMI Test Receiver	07-Mar-17	07-Mar-18	B1
CIS040604	Agilent / E4440A	Precision Spectrum Analyzer	20-Oct-17	20-Oct-18	B1
CIS055178	Huber+Suhner /Sucoflex 106PA	RF Coaxial Cable, to 18GHz, 8.5 m	30-Nov-17	30-Nov-18	B1
CIS025660	Huber+Suhner /Sucoflex 106PA	RF Coaxial Cable, to 18GHz, 8.5 m	30-Nov-17	30-Nov-18	B1
CIS025640	Micro-Coax / UFB311A-0-2720-520520	Coaxial Cable, 272.0 in. to 18GHz	30-Nov-17	30-Nov-18	B1
CIS56056	Wainwright Instruments/ WRCJV 8-5100-5150-5250-5300-4+	SMA Band Reject Filter. 5.100GHz to 5.300GHz	30-Mar-17	30-Mar-18	B1
AC Conducted Emissions					
CIS42014	Rohde & Schwarz / ESCI	EMI Test Receiver	21-Apr-17	21-Apr-18	B2
CIS019210	TTE / H785-150K-50-21378	High Pass Filter 150KHz	28-Feb-17	28-Feb-18	B2
CIS05039	Fisher Custom Com / 50/250-50-2-02	LISN (9kHz-30MHz)	21-Feb-17	21-Feb-18	B2
CIS034158	Fisher Custom Com / 50-2-RA-NEMA-5-20R	LISN Receptacle Adaptor	21-Feb-17	21-Feb-18	B2
CIS040532	Huber + Suhner / RG-223	25 ft RG-223 Cable	04-Dec-16	04-Dec-17	B2
Frequency Stability					
CIS006697	Lufft / 5063-33W	Temperature/Humidity Gauge	09-Mar-17	09-Mar-18	A2
CIS035619	TestEquity/ HalfCube105A	Temperature Chamber	27-Mar-17	27-Mar-18	A2
CIS054393	Huber + Suhner/ Sucoflex 106PA	Sucoflex N Type Blue 3ft cable	27-APR-17	27-APR-18	A2
CIS54415	Huber + Suhner/ Sucoflex 106PA	Sucoflex N Type Blue 3ft cable	27-APR-17	27-APR-18	A2
CIS55980	Agilent/ MXA N9020A	Signal Analyzer 10Hz - 8.4GHz	12-OCT-17	12-OCT-18	A2

RF Conducted Emissions					
Equip#	**Manufacturer/ Model**	**Description**	**Last Cal**	**Next Due**	**Test Item**
CIS042660	Gore/ EJR01R01036.0	SMA RF Cable 26.5GHz	18-Oct-2017	18-Oct-18	A1, A2, A3, A4, A5, A6
CIS056098	Keysight (Agilent/HP) / N9020A-526	MXA Spectrum Analyzer, 10Hz-26.5GHz	20-Sep-2017	20-Sep-18	A1, A2, A3, A4, A5, A6
CIS55609	Mini-Circuits/BW-S20W2	20dB Attenuator	31-Aug-17	31-Aug-18	A1, A2, A3, A4, A5

Appendix D: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

Abbreviation	Description	Abbreviation	Description
EMC	Electro Magnetic Compatibility	°F	Degrees Fahrenheit
EMI	Electro Magnetic Interference	°C	Degrees Celsius
EUT	Equipment Under Test	Temp	Temperature
ITE	Information Technology Equipment	S/N	Serial Number
TAP	Test Assessment Schedule	Qty	Quantity
ESD	Electro Static Discharge	Emf	Electromotive force
EFT	Electric Fast Transient	RMS	Root mean square
EDCS	Engineering Document Control System	Qp	Quasi Peak
Config	Configuration	Av	Average
CIS#	Cisco Number (unique identification number for Cisco test equipment)	Pk	Peak
Cal	Calibration	kHz	Kilohertz ($1x10^3$)
EN	European Norm	MHz	MegaHertz ($1x10^6$)
IEC	International Electro technical Commission	GHz	Gigahertz ($1x10^9$)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt ($1x10^3$)
L1	Line 1	µV	Microvolt ($1x10^{-6}$)
L2	Line2	A	Amp
L3	Line 3	µA	Micro Amp ($1x10^{-6}$)
DC	Direct Current	mS	Milli Second ($1x10^{-3}$)
RAW	Uncorrected measurement value, as indicated by the measuring device	µS	Micro Second ($1x10^{-6}$)
RF	Radio Frequency	µS	Micro Second ($1x10^{-6}$)
SLCE	Signal Line Conducted Emissions	M	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

Appendix E: Software Used to Perform Testing

EMIsoft Vasona, version 6.024

QRCT Radio Control Software version 3.0.242.0

Appendix F: Test Procedures

Measurements were made in accordance with

- ANSI C63.10:2013, Procedure for Compliance Testing of Unlicensed Wireless Devices
- KDB 789033 D02 General UNII Test Procedures New Rules v01
- KDB 644545 D03 Guidance for IEEE 802.11ac v01
- KDB 662911 D01 MIMO v02

Appendix G: Scope of Accreditation (A2LA certificate number 1178-01)

The scope of accreditation of Cisco Systems, Inc. can be found on the A2LA web page at:

http://www.a2la.org/scopepdf/1178-01.pdf

Note: FCC 15.205, FCC 15.207 and FCC 15.209 are additional requirement not covered under the scope of accreditation

Appendix H: Test Assessment Plan

Compliance Test Plan (Excel) EDCS- 11790857
Target Power Tables EDCS-12164400

Appendix I: Worst Case Justification

Worst case modes were selected by ANSI C63.10 2013 Section **5.6.2.2**

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

a) Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).

b) Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).

c) In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.