Radio Test Report

For

CP-8861

2.4 GHz/5.0 GHz Wi-Fi Radio 802.11a/ac/b/g/n + Bluetooth v2.0

FCC ID: LDK88611057

UNII-3 (5725-5850 MHz)

Against the following Specifications:

CFR47 Part 15.407

ACCREDITED

Cisco Systems
170 West Tasman Drive
San Jose, CA 95134

Author: Danh Le
Approved By:
Title: See EDCS
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# 1526149.

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
CFR47 15.407

Measurements were made in accordance with

- ANSI C63.10:2013,
- KDB 789033 D02 General UNII Test Procedures New Rules v01

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 EIRP measurements	± 1.4 dB
radiated 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 Dates of testing

March 21st - Apr 7th, 2016

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 Laboratory
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

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 N, 5m Chamber	125 Rio Robles, San Jose, California 95134	Company #: 6111A

Test Engineers
Ronak Patel and Danh Le

2.6 Purpose of Assessment

The purpose of the assessment is to show proof that the UNII-3 radio device specified in section 2.7, has been tested and determined in compliance with FCC part15.407 (new rules) which was previously tested under FCC part 15.247 rules.

2.7 Equipment Assessed (EUT)

CP-8861

2.8 EUT Description

The CP-8861 802.11AC IP Phone supports the following modes of operation. The modes are further defined in the radio Theory of Operation. The modes included in this report represent the worst case data for all modes.

This specification is applied to the IEEE802.11a/b/g/n/ac W-LAN + Bluetooth 3.0/HS.

- Broadcom BCM4339 inside
- Compliant with IEEE802.11a/b/g/n/ac
- Compliant with Bluetooth specification v3.0+HS
- Supports standard SDIO v3.0 host interface
- Interface support for Bluetooth is Host Controller Interface (HCI)
- RoHS compliant

Section 3: Result Summary

3.1 Results Summary Table

Basic Standard	Technical Requirements / Details	Result
15.407(e)	**6 dB Bandwidth**: Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.	Pass
15.407(a)(3)	**Output Power**: For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. If the transmitting antennas of directional gain greater than 6dBi are used, The maximum conducted output power shall be reduced by amount in dB that the directional gain of the antenna exceeds 6 dBi. However, 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.	Pass
15.407(a)(3)	**Power Spectral Density** The maximum power spectral density shall not exceed 30 dBm in any 500-kHz 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.	Pass
15.407(b)(4)(i)	**Band-Edge and Out-of-Band**: 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.	Pass
15.407(b)(4)&(6) 15.209(a)	**Unwanted / Spurious Emissions** 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. Unwanted emissions below 1 GHz, must comply with the general field strength limits set forth in §15.209.	Pass

Section 4: Sample Details

Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. 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 No.	Equipment Details	Part Number	Manufacturer	Hardware Rev.	Serial Number
S01	CP-8861	68-5283-01	Cisco Systems	P2	FCH18018UG2
S02	Power Supply	BT-AG4404GE	Bestec	NA	12E000156

4.2 Antenna Information

The following antenna is supported by this product series

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain (dBi)
5725-5850	Internal	Onmi-Directional	3.79

4.3 System Details

System #	Description	Samples
1	5GHz WLAN radio	S01, S02

4.4 Mode of Operation Details

Mode#	Description	Comments
1	802.11a	System is placed in a continuous transmit mode at various channels per test requirements. Worse Case Data Rate 802.11a / 6 Mbps is used for all testing.
2	802.11n20	System is placed in a continuous transmit mode at various channels per test requirements. Worse Case Data Rate 802.11n HT20 / MCS0 is used for all testing.
3	802.11n40	System is placed in a continuous transmit mode at various channels per test requirements. Worse Case Data Rate 802.11n HT40 / MCS0 is used for all testing.
4	802.11ac80	System is placed in a continuous transmit mode at various channels per test requirements. Worse Case Data Rate 802.11n VHT80 / MCS0 is used for all testing.

Measurements were made in accordance with

- ANSI C63.10:2013,
- KDB 789033 D02 General UNII Test Procedures New Rules v01

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)		
	5745	5785	5825
802.11a	18	18	18
802.11n HT20	15	15	15

Operating Mode	Maximum Channel Power (dBm)	
	Frequency (MHz)	
	5755	5795
802.11n HT40	15	15

Operating Mode	Maximum Channel Power (dBm)
	Frequency (MHz)
	5775
802.11ac VHT80	15

A.1 Duty Cycle, transmission duration

Ref. KDB 789033 D02 General U-NII Test Procedure New Rules v01r02, section B.1

A.1.1 Duty Cycle Test Requirement

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.

A.1.2 Duty Cycle Test Method

Ref. KDB 789033 D02 General U-NII Test Procedure New Rules v01r02, section B.2 (b)

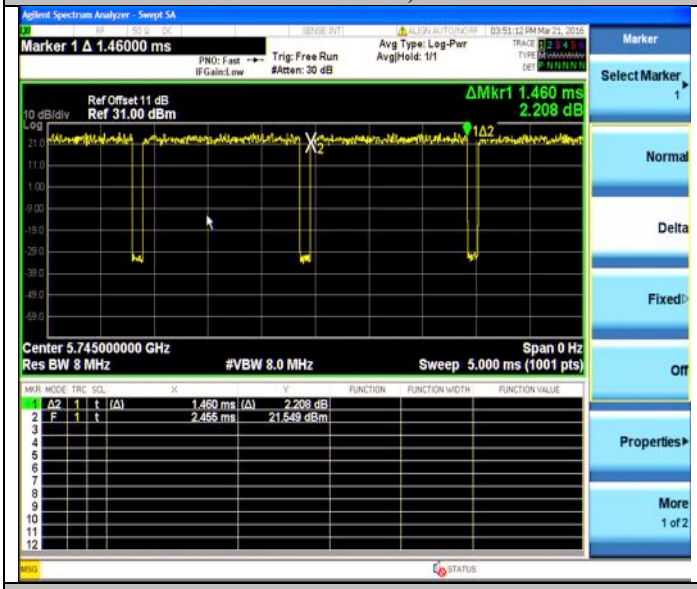
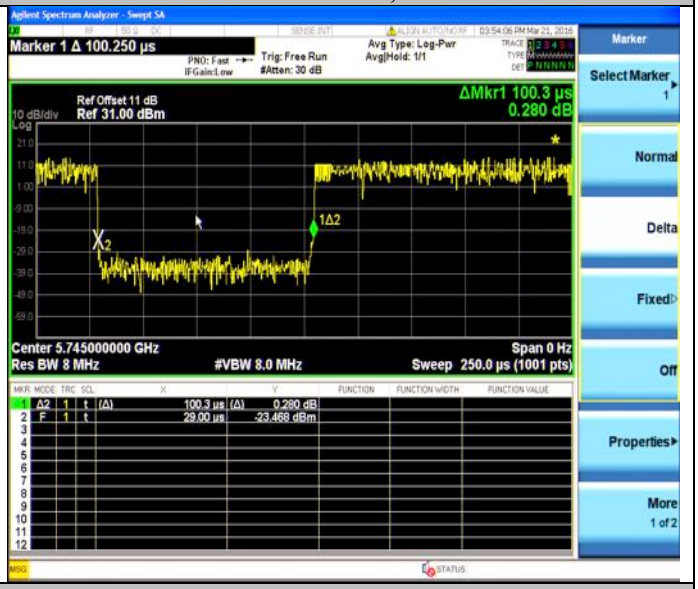
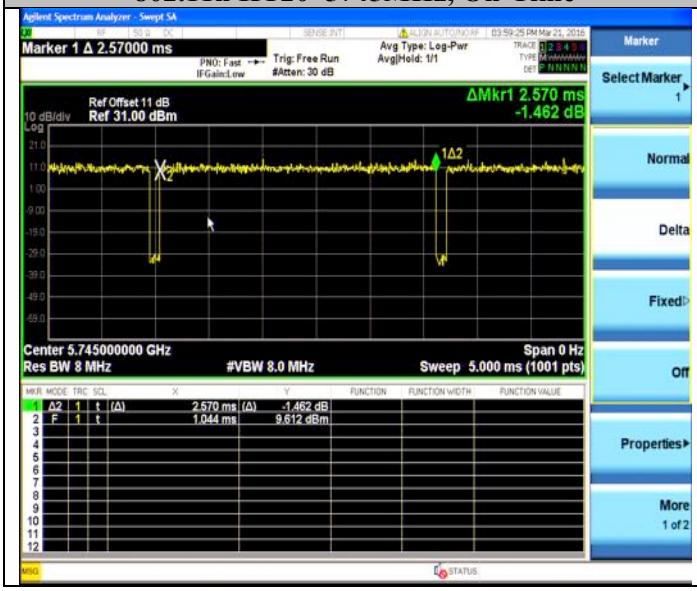
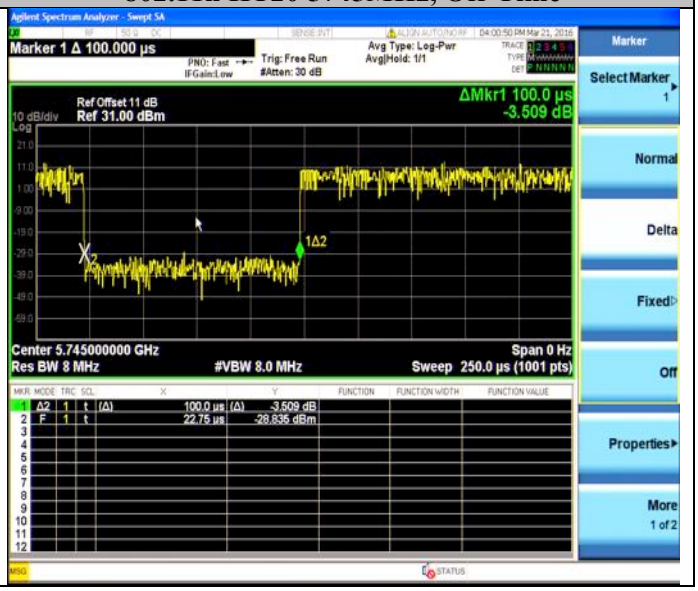
B. Measurements of duty cycle and transmission duration shall be performed using the following technique:

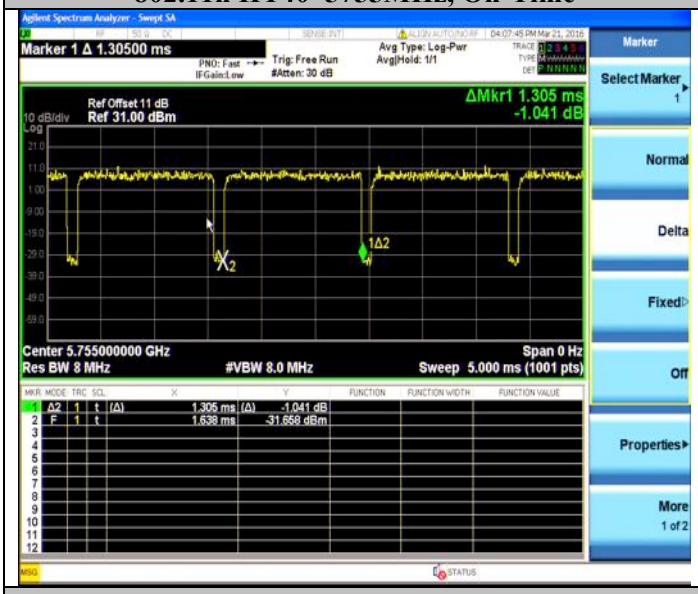
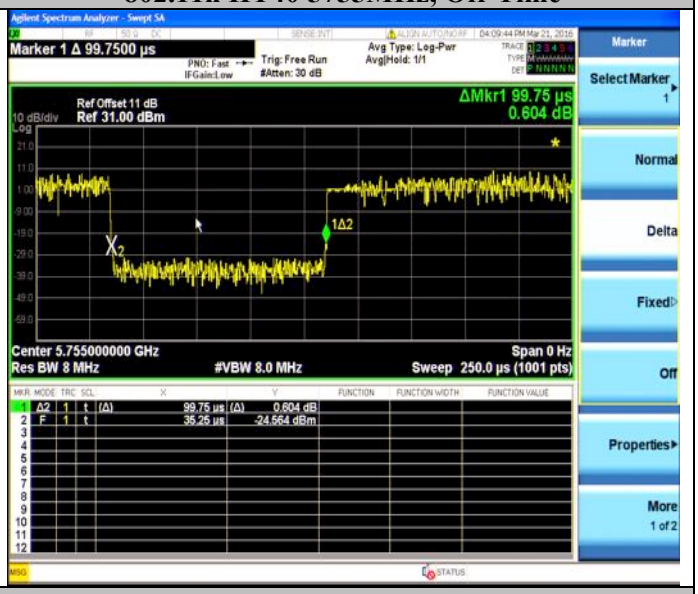
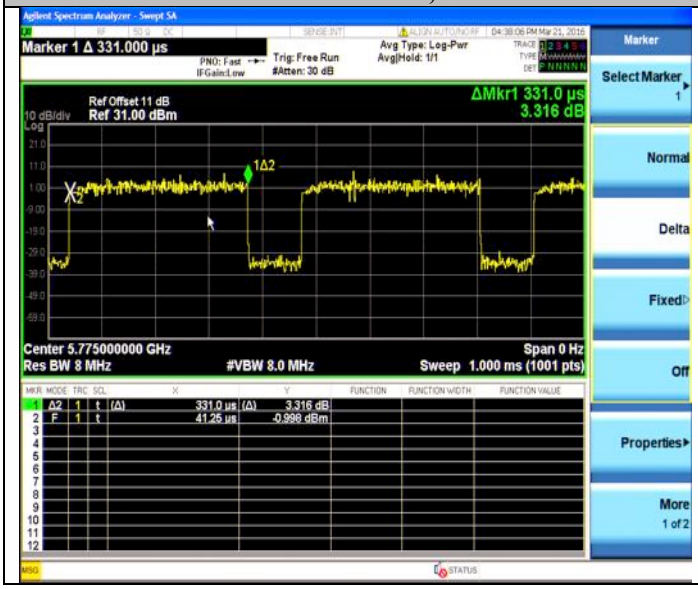
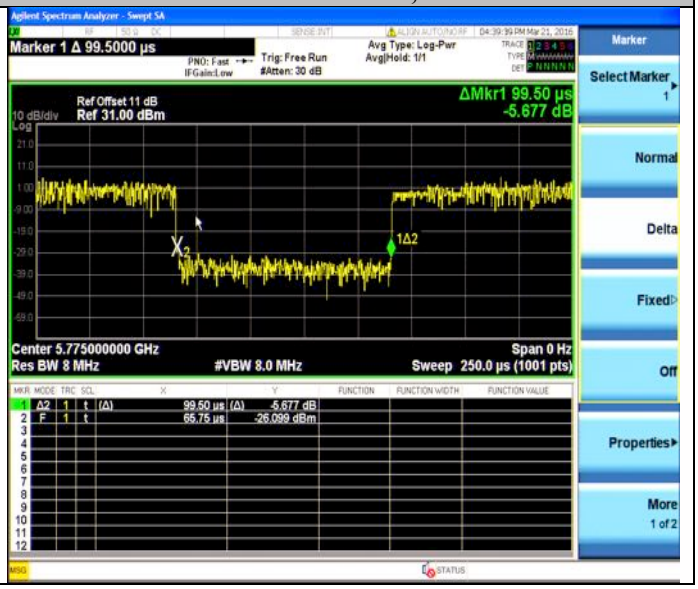
2 (b) The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. 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.)

A.1.3 Duty Cycle Data Table

Mode	Data Rate (Mbps)	On-time (ms)	Off-Time (ms)	Total Time (ms)	Duty Cycle (%)	Correction Factor (dB)
802.11a	6	1.460	0.1003	1.5603	93.57%	0.29
802.11n20	MCS0	2.570	0.1000	2.670	96.25%	0.17
802.11n40	MCS0	1.305	0.09975	1.40475	92.90%	0.32
802.11ac80	MCS0	0.331	0.09950	0.4305	76.89%	1.15

A.1.4 Duty Cycle Graphical Test results

Duty Cycle	
802.11a 5745MHz, On-Time	**802.11a 5745MHz, Off-Time**
	
802.11n HT20 5745MHz, On-Time	**802.11n HT20 5745MHz, Off-Time**
	

Duty Cycle	
802.11n HT40 5755MHz, On-Time	**802.11n HT40 5755MHz, Off-Time**
	
802.11ac80 5775MHz, On-Time	**802.11ac80 5775MHz, Off-Time**
	

A.2 99% Occupied Bandwidth and 6dB Emission 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 6 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 6 dB relative to the maximum level measured in the fundamental emission.

A.2.1 Limits.

Ref. FCC 15.407 (e)

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

A.2.2 99% OBW and 6dB Bandwidth Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedures New Rules v01, section C (2) & E

99% OBW and 6dB EBW Test Procedure
1. Set the radio in the continuous transmitting mode. 2. Allow the trace to stabilize. 3. Setting the x-dB bandwidth mode to -6dB within the measurement set up function. 4. Select the automatic OBW measurement function of an instrument to perform bandwidth measurement. 5. Capture graphs and record pertinent measurement data.

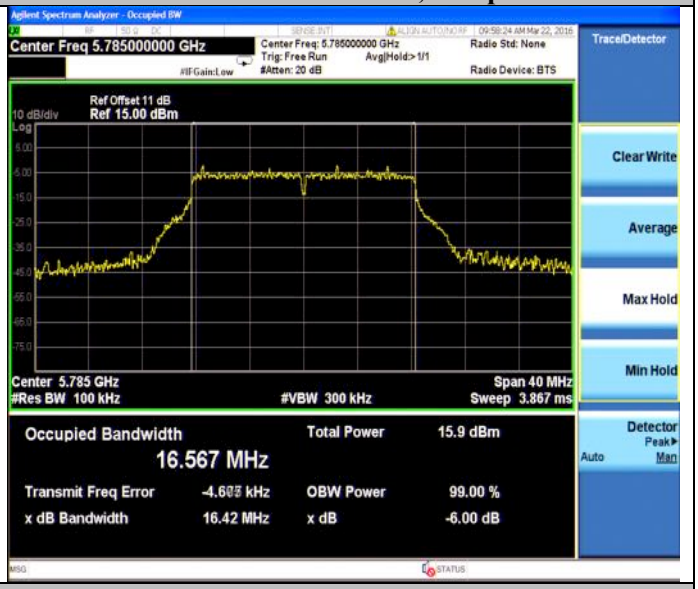
Ref. KDB 789033 D02 General UNII Test Procedures New Rules v01, section C (2) & E

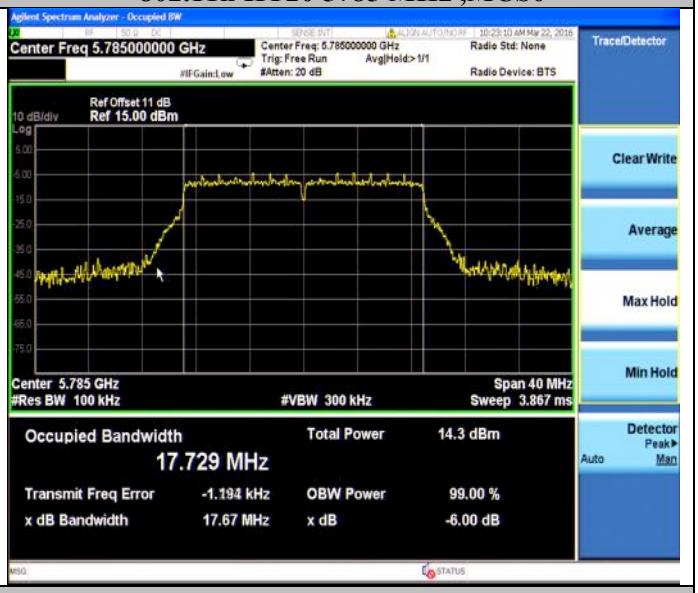
99% OBW and 6dB EBW Test parameters
a) Span = Large enough to capture the entire EBW b) Set RBW = 100 kHz. c) Set the video bandwidth (VBW) ≥ 3 × RBW. d) Detector = Peak. e) Trace mode = max hold. f) Sweep = auto couple. g) Allow the trace to stabilize. h) For 6 dB BW, measure the maximum width of the 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. i) For 99% BW, the recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as lower frequency. The process is repeated until the 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies. **Note**: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

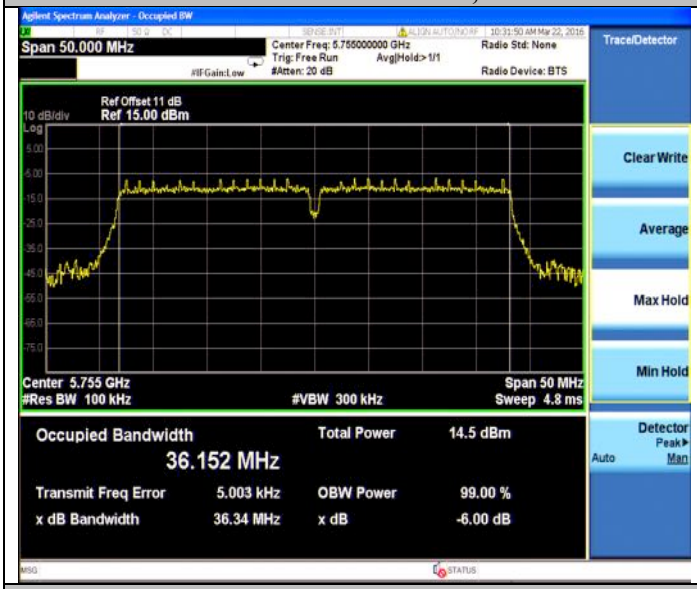
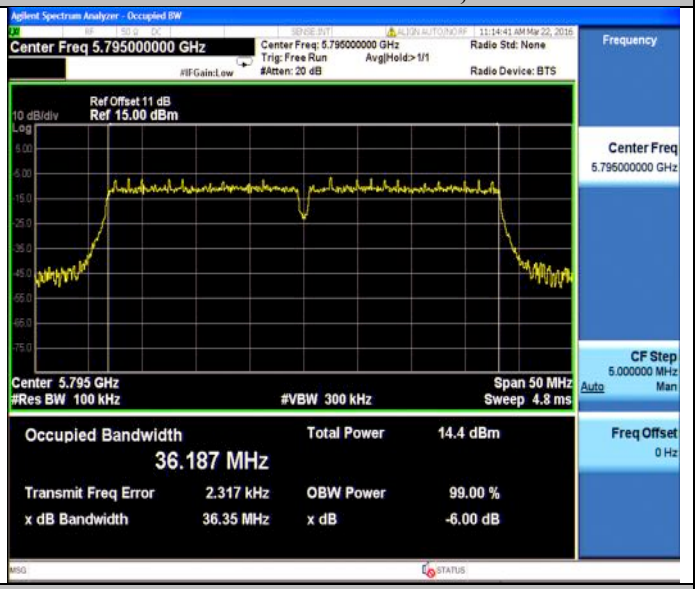
A.2.3 99% Occupied Bandwidth & 6 dB Emission Bandwidth Data Table

Frequency (MHz)	Mode	Data Rate (Mbps)	99% BW (MHz)	6dB BW (MHz)	Limits (KHz)	Results
5745	802.11a	6	16.566	16.390	≥500	Pass
5785	802.11a	6	16.567	16.420	≥500	Pass
5825	802.11a	6	16.551	16.400	≥500	Pass
5745	802.11n20	MCS0	17.742	17.620	≥500	Pass
5785	802.11n20	MCS0	17.729	17.67	≥500	Pass
5825	802.11n20	MCS0	17.729	17.64	≥500	Pass
5755	802.11n40	MCS0	36.152	36.340	≥500	Pass
5795	802.11n40	MCS0	36.187	36.350	≥500	Pass
5775	802.11ac80	MCS0	75.483	75.720	≥500	Pass

A.2.4 99% Occupied Bandwidth & 6dB Emission Bandwidth Graphical Test Results

99%&6dB Occupied Bandwidth	
802.11a 5745 MHz ,6MBps	802.11 a 5785 MHz ,6MBps
	
802.11a 5825 MHz ,6MBps	
	

99%&6dB Occupied Bandwidth	
802.11n HT20 5745 MHz ,MCS0	802.11n HT20 5785 MHz ,MCS0
	
802.11n HT20 5825 MHz ,MCS0	
	

99%&6dB Occupied Bandwidth	
802.11n HT40 5755 MHz , MCS0	**802.11n HT40 5795 MHz ,MCS0**
	
802.11ac80 5775 MHz , MCS0	
	

A.3 Maximum Conducted Output Power

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.3.1 Limits.

FCC 15.407(a) (3)

30dBm

A.3.2 Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedures New Rules v01, section II 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. Capture graphs and record pertinent measurement data. 4. Make the following adjustments to the peak value of the spectrum, by adding duty cycle correction factor to the measured value

Ref. KDB 789033 D02 General UNII Test Procedures New Rules v01, section II E (2) (d) SA-2

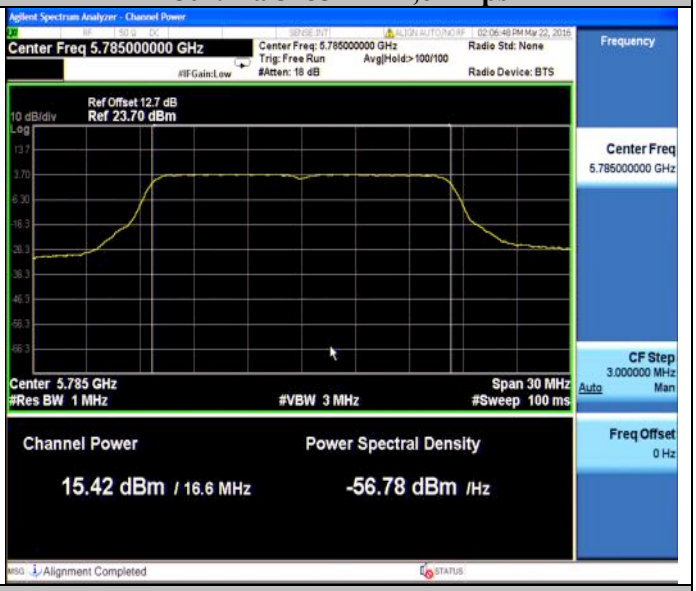
Test parameters
(i) Measure the duty cycle, x, of the transmitter output signal (ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal. (iii) Set RBW = 1 MHz (iv) Set VBW ≥ 3 MHz (v) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.) (vi) Sweep time = auto. (vii) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode (viii) Do not use sweep triggering. Allow the sweep to "Free run". (ix) 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. (x) Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is 25 percent.

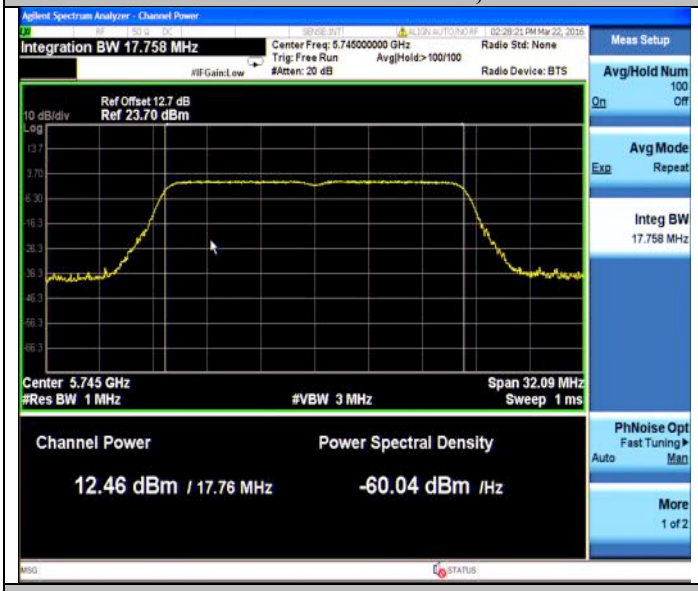
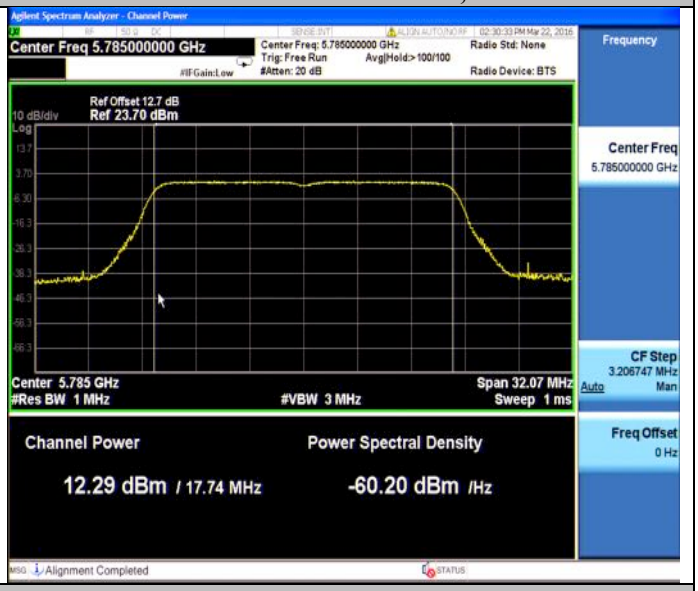
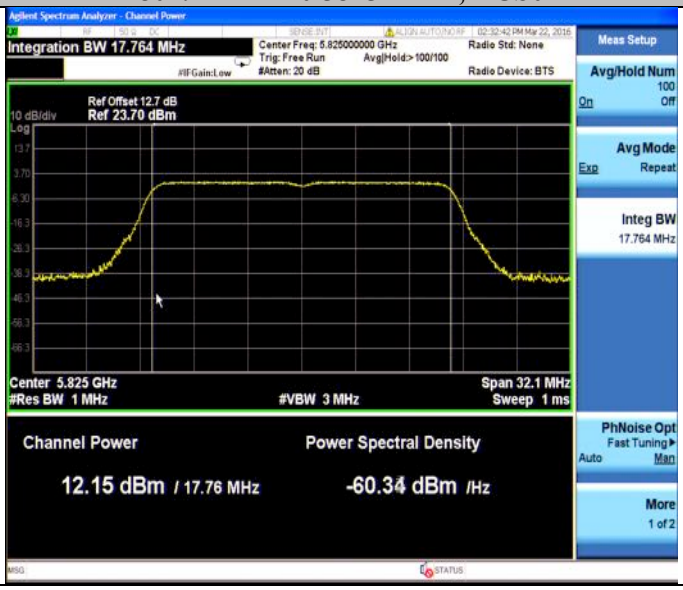
A.3.3 Maximum Conducted Output Power Data Table

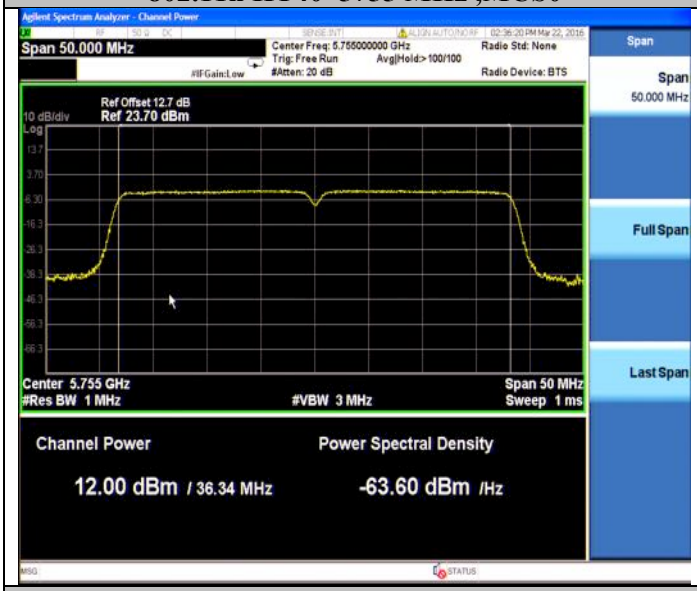
Maximum Conducted Output Power							
Channel No	**Frequency (MHz)**	**Correction Factors (dB)**	**Duty Cycle Cor.Factors (dB)**	**Maximum Output Power (dBm)**	**Corrected Max.Output Power (dBm)**	**Limits (dBm)**	**Results**
Mode#1: 802.11a / 6 Mbps							
149	5745	compensated	0.29	15.40	15.69	30	**Pass**
157	5785	compensated	0.29	15.42	15.71	30	**Pass**
161	5805	compensated	0.29	15.41	15.70	30	**Pass**
Mode#2: 802.11n20 / MCS0							
149	5745	compensated	0.17	12.46	12.63	30	**Pass**
157	5785	compensated	0.17	12.29	12.46	30	**Pass**
161	5805	compensated	0.17	12.15	12.32	30	**Pass**
Mode#3: 802.11n40 / MCS0							
151	5755	compensated	0.32	12.00	12.32	30	**Pass**
159	5795	compensated	0.32	12.00	12.32	30	**Pass**
Mode#4: 802.11ac80 / MCS0							
155	5775	compensated	1.15	11.63	12.78	30	**Pass**

Note: Correction factors of cable losses and ext. attenuator were compensated in the offset function.

A.3.4 Maximum Conducted Output Power Graphical Test Results

Maximum Conducted Output Power	
802.11a 5745 MHz ,6MBps	**802.11a 5785 MHz ,6MBps**
	
802.11a 5825 MHz ,6MBps	
	

Maximum Conducted Output Power	
802.11n HT20 5745 MHz ,MCS0	**802.11n HT20 5785 MHz ,MCS0**
	
802.11n HT20 5825 MHz ,MCS0	
	

Maximum Conducted Output Power	
802.11n HT40 5755 MHz ,MCS0	**802.11n HT40 5795 MHz ,MCS0**
	
802.11ac80 5775 MHz ,MCS0	
	

A.4 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.4.1 Limits.

FCC 15.407(3)
30dBm/500 KHz

A.4.2 Test Procedure

Ref. KDB 789033 D02 General UNII Test Procedures New Rules v01, section II 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. Capture graphs and record pertinent measurement data.
4. The result is the Maximum PSD over 500 KHz reference bandwidth.

Ref. KDB 789033 D02 General UNII Test Procedures New Rules v01, section II E (2) (d) SA-2

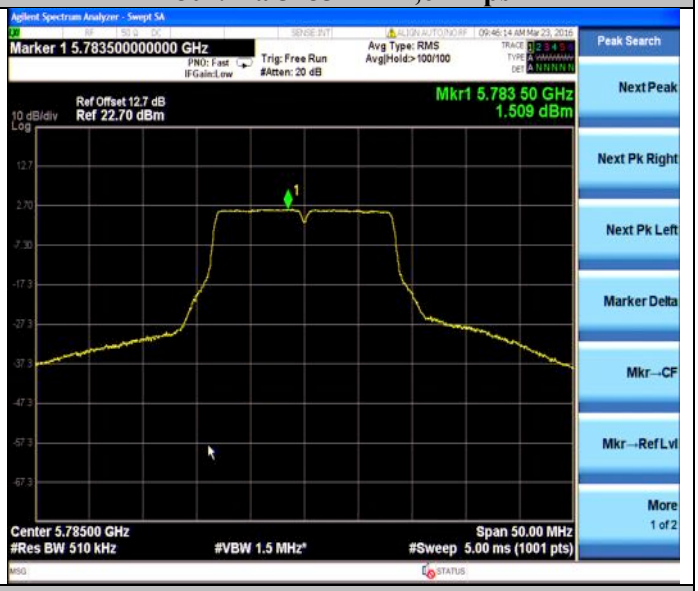
Test parameters
(i) Measure the duty cycle, x, of the transmitter output signal (ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal. (iii) Set RBW = 1 MHz (iv) Set VBW ≥ 3 MHz (v) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so That narrowband signals are not lost between frequency bins.) (vi) Sweep time = auto. (vii) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode (viii) Do not use sweep triggering. Allow the sweep to "Free run". (ix) 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. (x) Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is 25 percent.

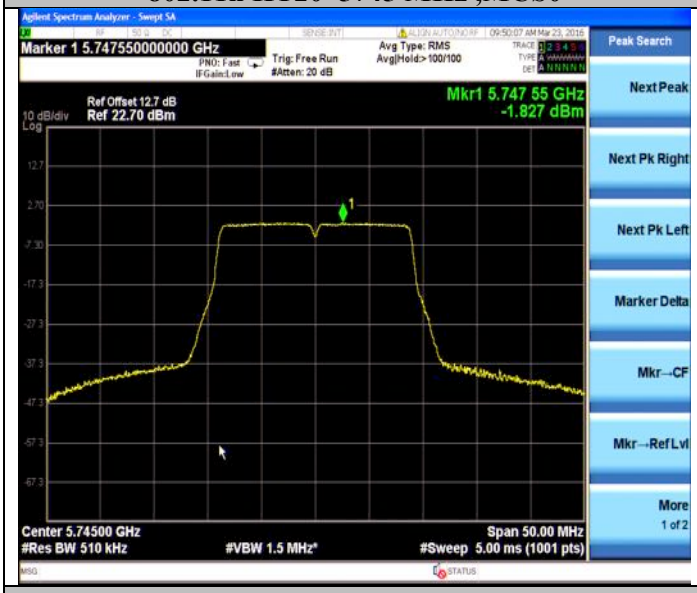
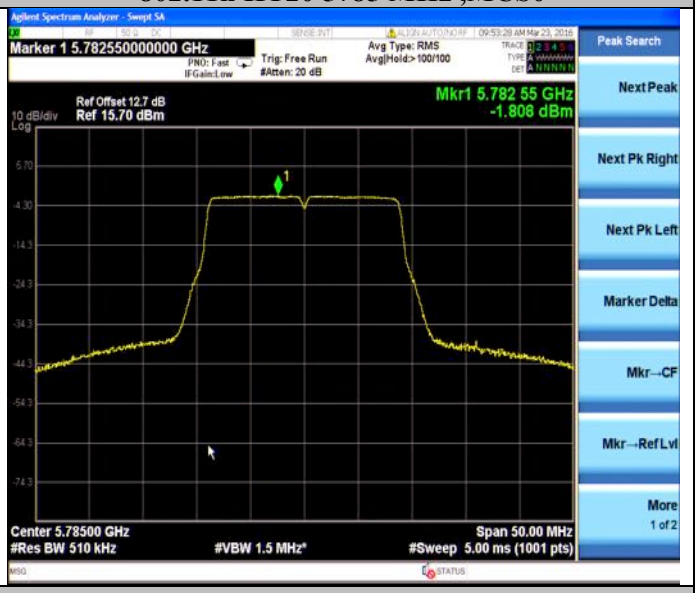
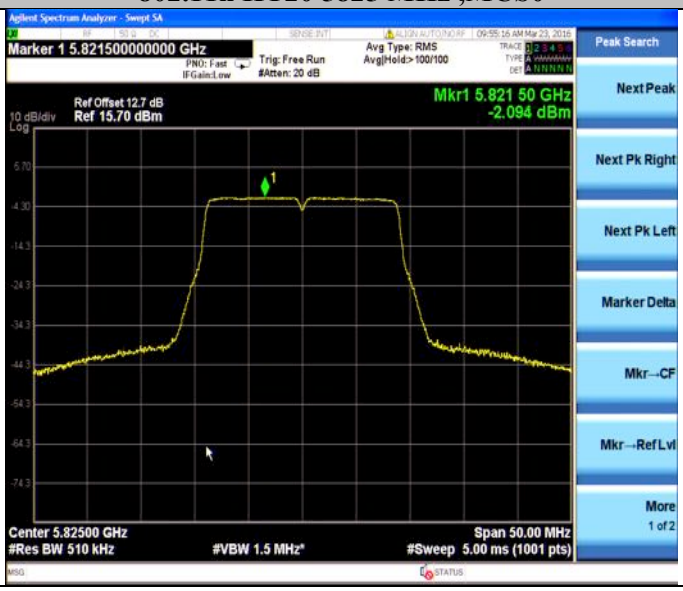
A.4.3 Power Spectral Density Data Table

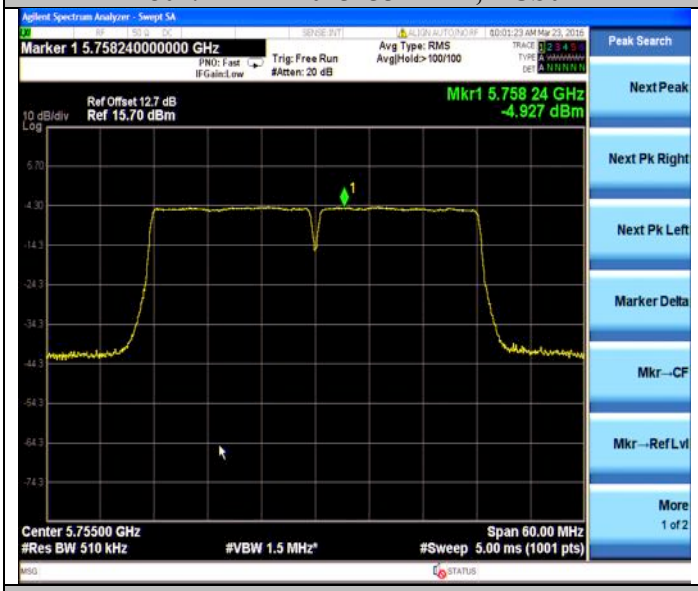
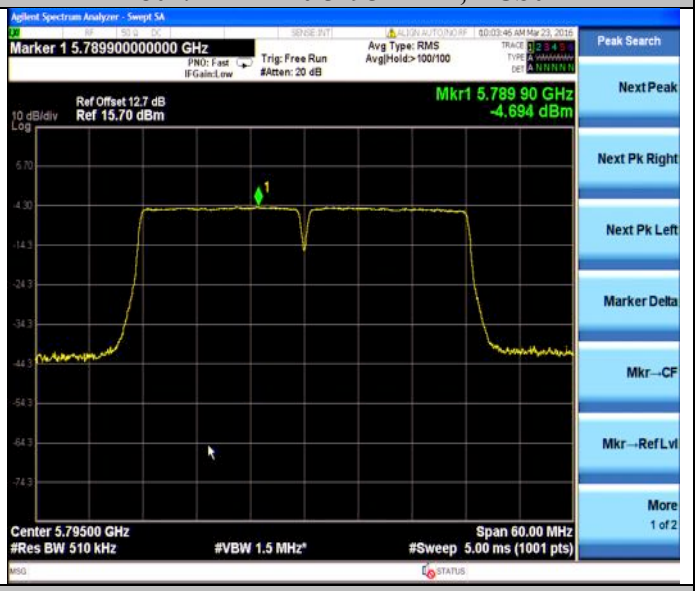
Power Spectral Density							
Channel No	**Frequency (MHz)**	**Correction Factors (dB)**	**Duty Cycle CF (dB)**	**PSD (dBm/ 500 KHz)**	**Corrected PSD (dBm/ 500 KHz)**	**Limits (dBm/ 500 KHz)**	**Results**
Mode#1: 802.11a / 6 Mbps							
149	5745	compensated	0.29	2.097	2.387	30	**Pass**
157	5785	compensated	0.29	1.509	1.799	30	**Pass**
161	5805	compensated	0.29	1.341	1.631	30	**Pass**
Mode#2: 802.11n20 / MCS0							
149	5745	compensated	0.17	-1.827	-1.657	30	**Pass**
157	5785	compensated	0.17	-1.808	-1.638	30	**Pass**
161	5805	compensated	0.17	-2.094	-1.924	30	**Pass**
Mode#3: 802.11n40 / MCS0							
151	5755	compensated	0.32	-4.927	-4.607	30	**Pass**
159	5795	compensated	0.32	-4.694	-4.374	30	**Pass**
Mode#4: 802.11ac80 / MCS0							
155	5775	compensated	1.15	-7.915	-6.765	30	**Pass**

Note: Correction factors of cable losses and ext. attenuator were compensated in the offset function.

A.4.4 Power Spectral Density Graphical Test Results

Power Spectral Density	
802.11a 5745 MHz ,6MBps	**802.11a 5785 MHz ,6MBps**
	
802.11a 5825 MHz ,6MBps	
	

Power Spectral Density	
802.11n HT20 5745 MHz ,MCS0	**802.11n HT20 5785 MHz ,MCS0**
	
802.11n HT20 5825 MHz ,MCS0	
	

Power Spectral Density	
802.11n HT40 5755 MHz ,MCS0	**802.11n HT40 5795 MHz ,MCS0**
	
802.11ac80 5775 MHz ,MCS0	
	

A.5 Band Edge and Out-of-band Emissions

A.5.1 Limits

15.407(b) *Undesirable emission limits.* Except as shown in paragraph (b) (7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

15.407(b) **(4) (i)** For transmitter operating in the 5.725 MHz – 5.850 Mhz 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.

A.5.2 Test Procedure

Ref. 789033 D02 General UNII Test Procedures New Rules v01, section II.G.3

Conducted Band Edge and Out-of-band Test Procedure
1. Connect the antenna port(s) to the spectrum analyzer input. 2. Place the radio in continuous transmit mode. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle. For example, at 50 percent duty cycle, the measurement time will increase by a factor of two relative to measurement time for continuous transmission. 3. Configure Spectrum analyzer as per test parameters below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 4. Place markers at the peak of all measurable emissions. 5. Capture graphs and record pertinent measurement data. 6. Correct all readings with correction factors if applicable (cable loss, ext. attenuators, duty cycle correction factors, etc) to show compliance.

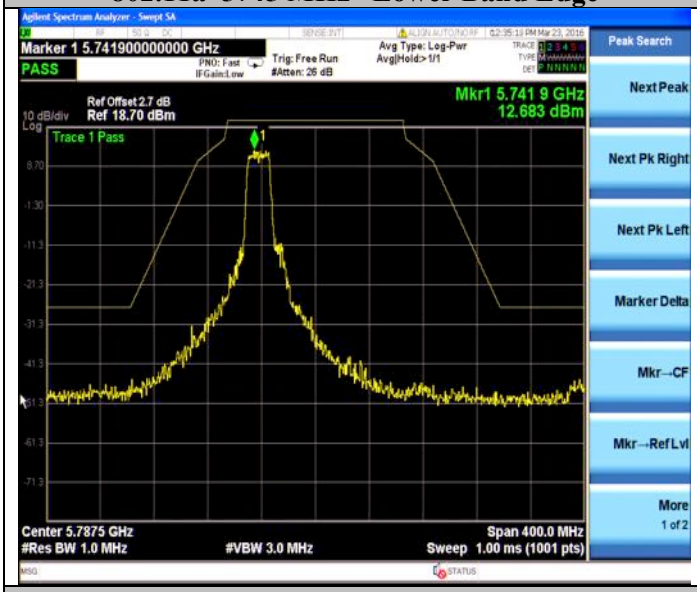
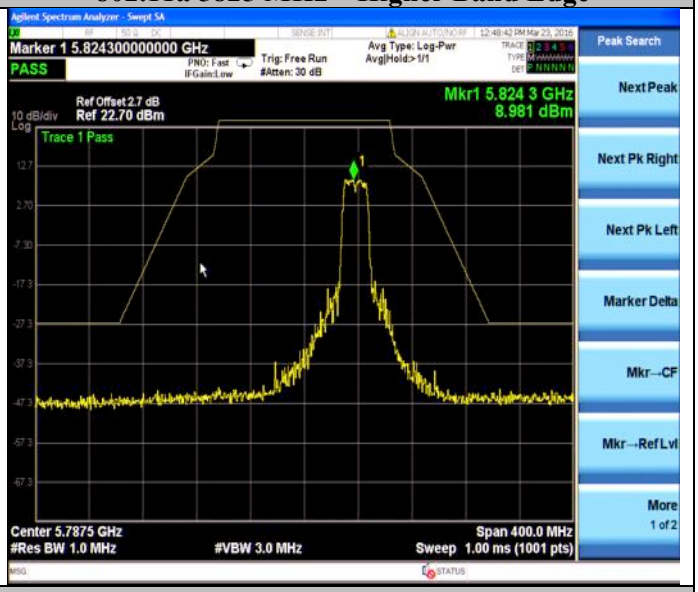
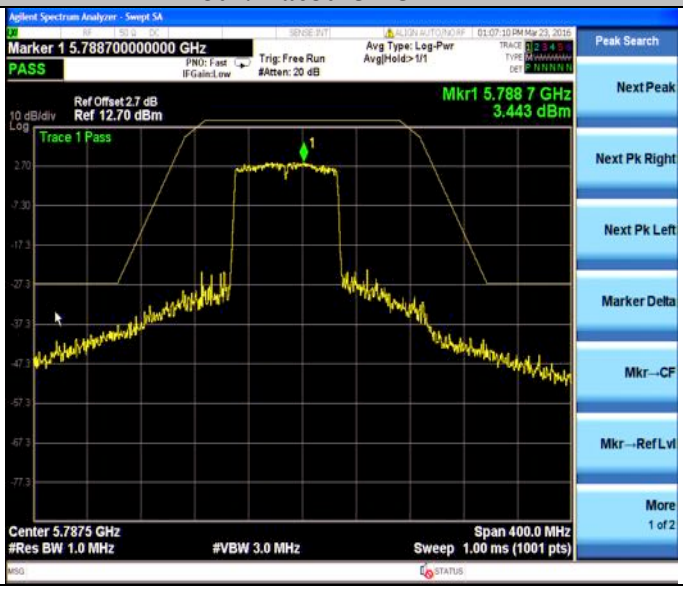
Ref. 789033 D02 General UNII Test Procedures New Rules v01, section II.G.5

Conducted Band Edge and Out-of-band Test parameters
RBW = 1 MHz VBW ≥ 3MHz for Peak Sweep = Auto Detector = Peak Trace = Max Hold.

A.5.3 Conducted Band Edge and Out-of-Band Test Data Table

Operating Frequency (MHz)	Data Rate (Mbps)	Measured Frequency (MHz)	Emission Level (dBm/MHz)	Antenna Gain (dBi)	Detector	E.I.R.P (dBm)	Limit (dBm)	Result
Mode#1: 802.11a								
5745	6	5650 - 5725	-----	3.79	Peak	-----	linear	-----
5745	6	5741.9	12.683	3.79	Peak	16.473	27	Pass
5825	6	5824.3	8.981	3.79	Peak	12.771	27	Pass
5825	6	5850 - 5925	-----	3.79	Peak	-----	linear	-----
Mode#4: 802.11ac80								
5775	MCS0	5650 - 5725	-----	3.79	Peak	-----	linear	-----
5775	MCS0	5788.7	3.443	3.79	Peak	7.233	27	Pass
5775	MCS0	5850 - 5925	-----	3.79	Peak	-----	linear	-----

A.5.4 Conducted Band Edge Graphical Test Results

Conducted Band Edge	
802.11a 5745 MHz –Lower Band Edge	802.11a 5825 MHz – Higher Band Edge
	
802.11ac80 5775 MHz	
	

A.6 Spurious Emissions (Unwanted Emissions)

Spurious emissions are harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

A.6.1 Limits

15.407(b) *Undesirable/Unwanted emission limits.* Except as shown in paragraph (b) (7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

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.

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).

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

Frequency range: Above 1GHz

FCC 15.407 (b) (4): For transmitter operating in the 5.725 MHz – 5.850 MHz band: All emissions above 1000 MHz that are outside of the restricted bands are subject to a maximum emission limit of an e.i.r.p level of -27dBm/MHz at 75 MHz or more above or below the band edge.

A.6.2 Test Procedure

Below 1 GHz

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

Radiated Unwanted Emissions Measurement Test Procedure below 1 GHz
1. Using Vasona software, configure the spectrum analyzer as shown in test parameter table 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) 5. Record at least 6 highest readings for the worst case operating mode.

Ref. ANSI C63.10: 2013 section 4.1.4 (Quasi-Peak)

Radiated Unwanted Emissions Test Parameters below 1 GHz
(i) Span = Entire frequency range or segment if necessary. (ii) Reference Level = 70 dBuV (iii) RBW = 100 kHz (iv) VBW ≥ 3 x RBW (v) Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz);

Above 1 GHz

Ref. 789033 D02 General UNII Test Procedures New Rules v01, section II.G.2/3

Conducted Unwanted Emissions Measurement Test Procedure above 1 GHz
1. Connect the antenna port(s) to the spectrum analyzer input. 2. Place the radio in continuous transmit mode. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle. For example, at 50 percent duty cycle, the measurement time will increase by a factor of two relative to measurement time for continuous transmission. 3. Configure Spectrum analyzer as per test parameters below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 4. Allow sweeps to continue until the trace stabilizes. Use the peak search marker function to determine the maximum amplitude level for all measurable emissions. 5. Capture graphs and record pertinent measurement data. 6. Correct all readings with correction factors if applicable (cable loss, ext. attenuators, duty cycle correction factors, etc) to show compliance.

Ref. 789033 D02 General UNII Test Procedures New Rules v01, section II.G.5

Unwanted Emissions Test Parameters above 1 GHz
RBW = 1 MHz VBW ≥ 3MHz Sweep = Auto Detector = Peak Trace = Max Hold.

Note1: A Notch Filter was used during formal testing above 1 GHz 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.

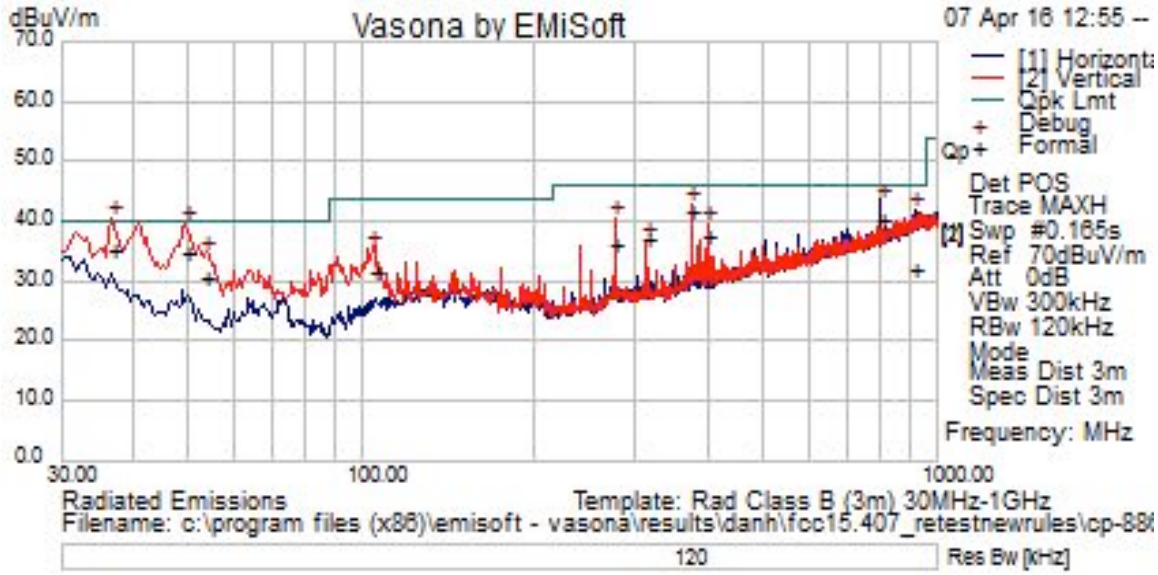
. The system was evaluated up to 40 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

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

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.

A.6.3 Spurious/Unwanted Emissions Test Data and Graphical Test Results

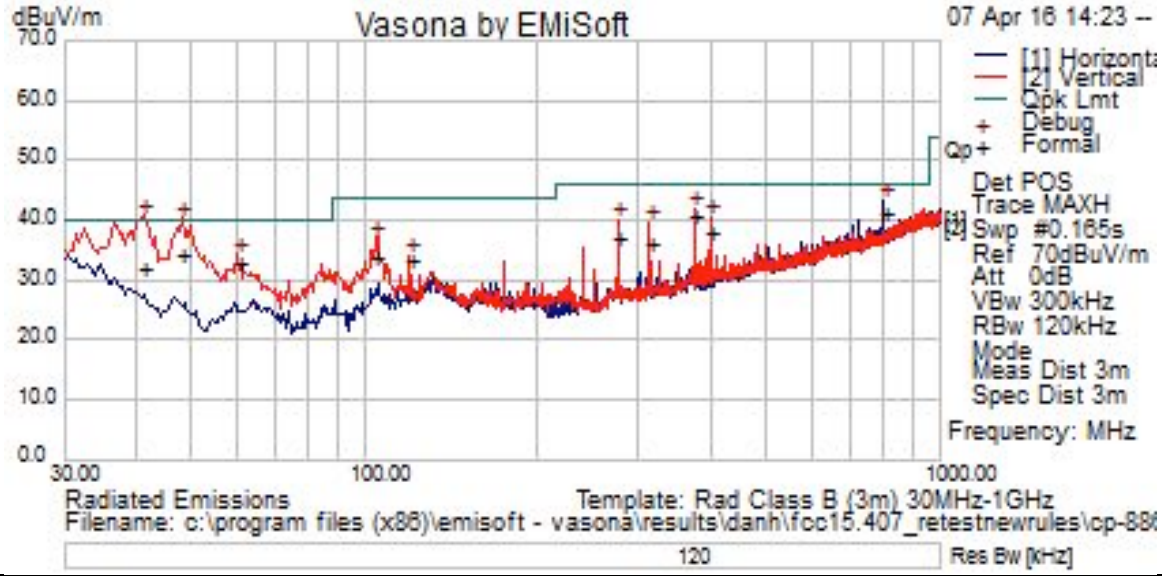
Subtest Date:	07-Apr-2016
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**30MHz - 1GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch149 (5745 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
49.59375	26.37	0.67	8	35.04	Quasi Max	V	119	0	40	-4.96	Pass	Tx/Ch149
313.35	21.12	2.22	13.77	37.11	Quasi Max	V	105	4	46	-8.89	Pass	Tx/Ch149
104.83	19.32	1.27	11.25	31.85	Quasi Max	V	142	270	43.5	-11.65	Pass	Tx/Ch149
36.861	18.84	0.54	16.06	35.44	Quasi Max	V	101	116	40	-4.56	Pass	Tx/Ch149
374.9965	24.63	2.44	15	42.07	Quasi Max	V	154	320	46	-3.93	Pass	Tx/Ch149
276.4505	20.9	2.08	13.3	36.28	Quasi Max	V	171	0	46	-9.72	Pass	Tx/Ch149
915.7433	5.71	3.86	22.51	32.08	Quasi Max	H	135	58	46	-13.92	Pass	Tx/Ch149
53.579	22.63	0.91	7.15	30.68	Quasi Max	V	117	166	40	-9.32	Pass	Tx/Ch149
399.9845	19.48	2.52	15.6	37.61	Quasi Max	V	144	282	46	-8.39	Pass	Tx/Ch149
800.0128	15.66	3.59	21	40.26	Quasi Max	H	178	360	46	-5.74	Pass	Tx/Ch149

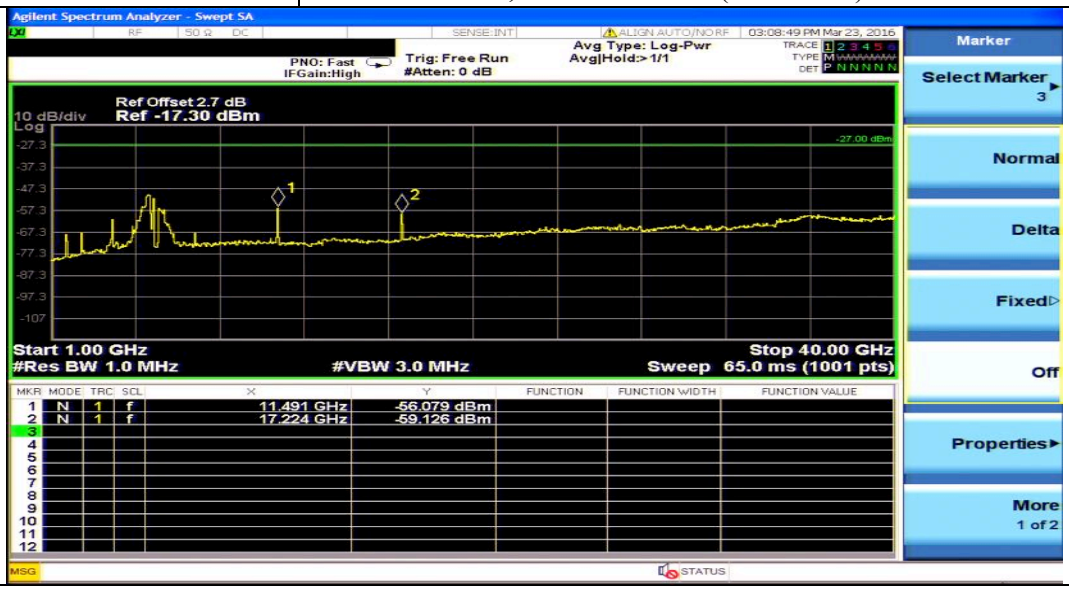
Subtest Date:	07-Apr-2016
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**30MHz - 1GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 165 (5825 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch165 (5825 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
41.07075	18.29	0.6	13.04	31.92	Quasi Max	V	210	0	40	-8.08	Pass	Tx/Ch165
276.4743	21.64	2.08	13.3	37.02	Quasi Max	V	166	20	46	-8.98	Pass	Tx/Ch165
60.0205	25.18	0.96	7.1	33.24	Quasi Max	V	101	40	40	-6.76	Pass	Tx/Ch165
313.338	20.34	2.22	13.77	36.33	Quasi Max	V	108	108	46	-9.67	Pass	Tx/Ch165
120.0075	18.16	1.36	13.8	33.33	Quasi Max	V	127	111	43.5	-10.17	Pass	Tx/Ch165
799.9925	16.66	3.59	21	41.25	Quasi Max	H	107	188	46	-4.75	Pass	Tx/Ch165
47.7135	24.94	0.65	8.96	34.54	Quasi Max	V	116	208	40	-5.46	Pass	Tx/Ch165
399.9898	20.06	2.52	15.6	38.18	Quasi Max	V	148	234	46	-7.82	Pass	Tx/Ch165
374.9845	23.53	2.44	15	40.97	Quasi Max	V	137	256	46	-5.03	Pass	Tx/Ch165
104.6385	21.4	1.27	11.2	33.87	Quasi Max	V	116	288	43.5	-9.63	Pass	Tx/Ch165

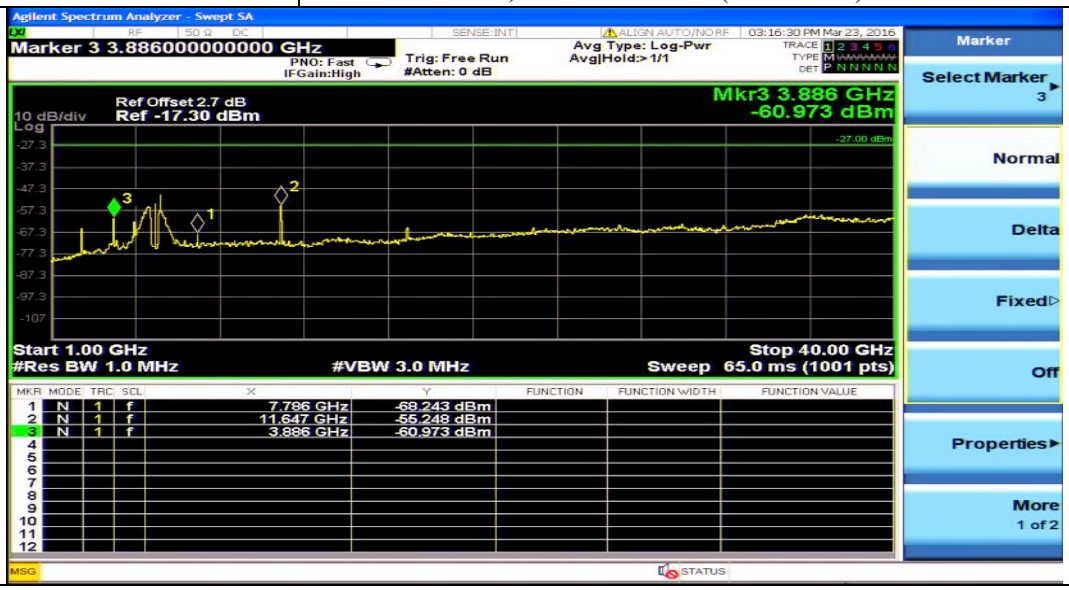
Subtest Date:	23-Mar-2016
Engineer	Ronak Patel
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**1GHz - 40GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)



Title: **TX Spurious Emissions from 1GHz-40GHz – Ch149 (5745 MHz)**

Frequency (MHz)	Raw (dBm)	Cab Loss (dB)	AG (dBi)	EIRP (dBm)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBm)	Margin (dB)	Results Pass / Fail	Comments
1149.1	-56.079	compensated in offset	3.79	-52.289	Peak	N/A	N/A	N/A	-27	25.289	Pass	2nd Harmonic
1722.4	-59.126	compensated	3.79	-55.336	Peak	N/A	N/A	N/A	-27	28.336	Pass	3rd Harmonic

Subtest Date:	23-Mar-2016
Engineer	Ronak Patel
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**1GHz - 40GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 165 (5825 MHz)



Title: **TX Spurious Emissions from 1GHz-40GHz – Ch165 (5825 MHz)**

Frequency (MHz)	Raw (dBm)	Cab Loss (dB)	AG (dBi)	EIRP (dBm)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBm)	Margin (dB)	Results Pass / Fail	Comments
3,886	-60.973	compensated in offset	3.79	-57.183	Peak	N/A	N/A	N/A	-27	-30.183	Pass	
7,786	-68.243	compensated	3.79	-64.453	Peak	N/A	N/A	N/A	-27	-37.453	Pass	
11,647	-55.248	compensated	3.79	-51.458	Peak	N/A	N/A	N/A	27	-24.458	Pass	2nd Harmonic

Note: 802.11a determine to be worst case mode

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

Equip#	Manufacturer/ Model	Description	Last Cal	Next Due
CIS49516	Keysight Agilent/PXA N9030A	PXA Signal Analyzer	10/22/2015	10/22/2016
CIS49516	Agilent/E4440A	PSA Spectrum Analyzer	10/20/2015	10/20/2016
CIS41998	JFW/50HF-010	10dB Attenuator	03/25/2015	03/25/2016
CIS35095	Micro-Coax/UFA147A-00180110200	RF Coax Cable to 40GHz	11/17/2015	11/17/2016
CIS37553	Murata electronics/MXGS83RK3000	RF connector test probe	07/01/2015	07/01/2016
CIS44907	Rohde&Schwarz/ESCI	EMI Receiver	08/12/2015	08/12/2016
CIS30650	Sunol Sciences/JB1	BiLog Antenna	12/4/2015	12/04/2016
CIS024905	Agilent / E4440A	Precision Spectrum Analyzer	12/09/2015	12/09/2016
CIS41202	ETS Lindgren / 3117	Double Ridged Horn Antenna	11/03/2015	11/03/2016
CIS54444	Huber + Suhner / Sucoflex 106PA	N Type Black 7ft cable	12/01/2015	12/01/2016
CIS23697	Micro-Coax /UFB197C-1-3144-504504	RF Coaxial Cable, to 18GHz	01/05/2016	01/05/2017
CIS55294	Huber + Suhner / Sucoflex 106PA	N Type Black 7ft cable	01/15/2016	01/15/2017
CIS37226	Micro-Tronics / BRC50705-02	5.725-5.875GHz Notch Filter	04/05/2016	04/05/2017
CIS055357	Miteq / TTA1800-30-HG-N-M	Preamplifier (1-18GHz)	04/08/2016	04/08/2017

Appendix C: 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 D: Software Used to Perform Testing

Tera Term
Vasona by EMIsoft

Appendix E: Test Procedures

Measurements were made in accordance with

- KDB Publication No.789033 - D02 General UNII Test Procedures New Rules v01
- ANSI C63.10: 2013 American National Standard for Testing Unlicensed Wireless Devices

Test procedures are summarized below:

FCC 5GHz Test Procedures	EDCS # - 1445048

Appendix F: 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

Appendix G: Test Assessment Plan

FCC15.407 new rules Compliance Test Plan (Excel) EDCS- 1509401
Target Power Tables: Based on previous test report under FCC part15.247, reference#EDCS-1393340

Appendix H: 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.