Radio Test Report

For

CP-9971

2.4 GHz/5.0 GHz Wi-Fi Radio 802.11a + Bluetooth v2.0

FCC ID: LDK7925G0269

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.

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 (initial sample receipt date to last date of testing)

April 21st – May 5th, 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
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-9971

2.8 EUT Description

The CP-9971- is the next generation desktop Wireless IP Phone that supports Wi-Fi 802.11a/b/g in addition to Ethernet as Network interface.

The WLAN subsystem of CP-9971 will comprise of the MuRata LEH1WULQC module with support for TNET1253 for WLAN and BRF6350 for Bluetooth support also using WP Wireless dual-band SMD antenna p/n: WPIANTFRCUS03A20/C

CP-9971-C-K9: Cisco Unified IP Endpoint 9971, Charcoal, Thick Handset
CP-9971-CL-K9: Cisco Unified IP Endpoint 9971, Charcoal, Thin Handset
CP-9971-W-K9: Cisco Unified IP Endpoint 9971, White, Thick Handset
CP-9971-WL-K9: Cisco Unified IP Endpoint 9971, White, Thin Handset

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)	**Maximum Conducted 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)(3) (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 Number	Equipment Details	Serial Number	Part Number
S01	CP-9971 desktop Wireless IP Phone	FCH181587NB	CP-9971-CK9V11

4.2 Antenna Information

The following antenna are supported by this product series.

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain (dBi)
5725-5850	Internal	Dual Band	3.0

4.3 System Details

System #	Description	Samples
1	Radio Test Sample	S01
2	Power Supply	BT-AG4404GE

4.4 Mode of Operation Details

Mode#	Description	Comments
1	802.11a Test Mode	System is placed in a continuous Transmit Mode at various channels per test requirements with 802.11a running at 6Mbps

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	5805
802.11a	17	18	17

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.)

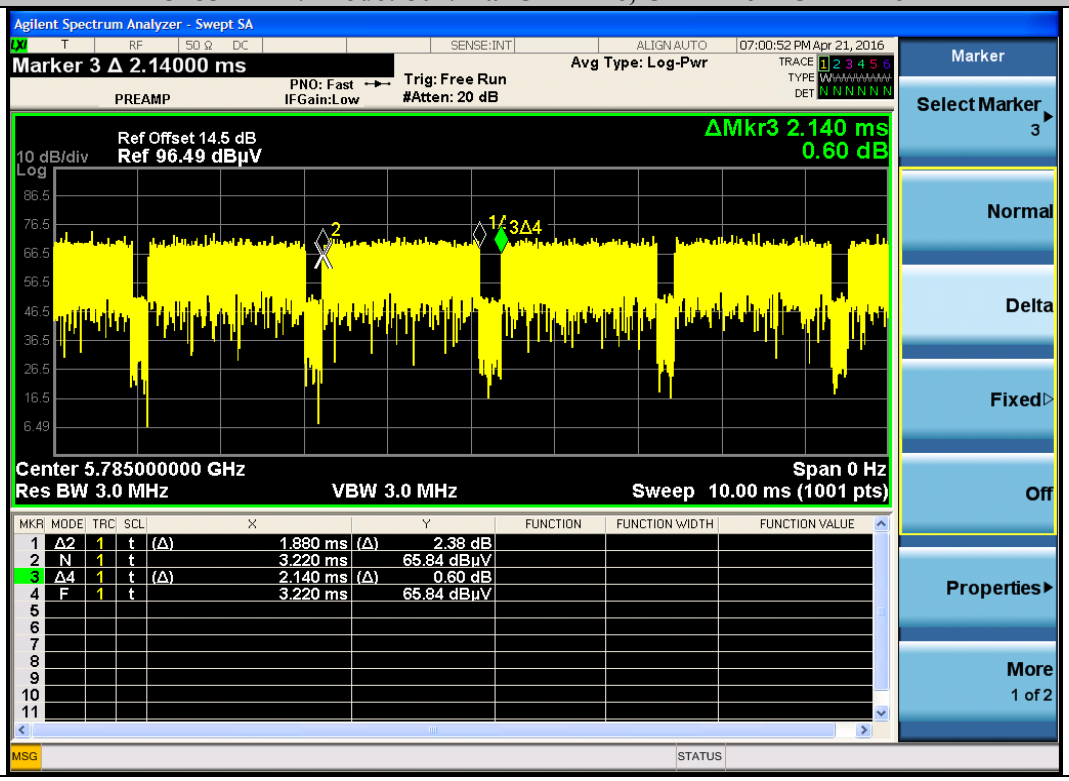
A.1.2 Duty Cycle Data Table

Mode	Data Rate (Mbps)	On-time (ms)	On-time + Off-time (ms)	Duty Cycle (%)	Correction Factor (dB)
802.11a	6	1.88	2.14	88	0.56

Duty Cycle Correction Factor = 10 log (Txon / Txon+Txoff)
Duty Cycle % = (Txon / Txon+Txoff) * 100 = 1.8/2.14 * 100 = 88%
DCCF = 10 (log 1/DC) = 10 (log (1/ 0.88) = 0.56 dB

A.1.3 Duty Cycle Graphical Test results

Duty Cycle
5785 MHz / Mode: 802.11a On-Time, On-Time + Off-Time



On-Time = 1.88 ms, Off-Time = 2.14 ms

X = On-Time / On-Time + Off-Time

Duty Cycle % = On-Time / On-Time + Off-Time x 100 = **(1.88 / 2.14) x 100 = 0.88 x 100 = 88%**

DCCF = 10 log (1/x) = **0.56 dB**

A.2 99% occupied bandwidth and 6dB 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% BW and EBW (-6dB) 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% BW and EBW (-6dB) 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.

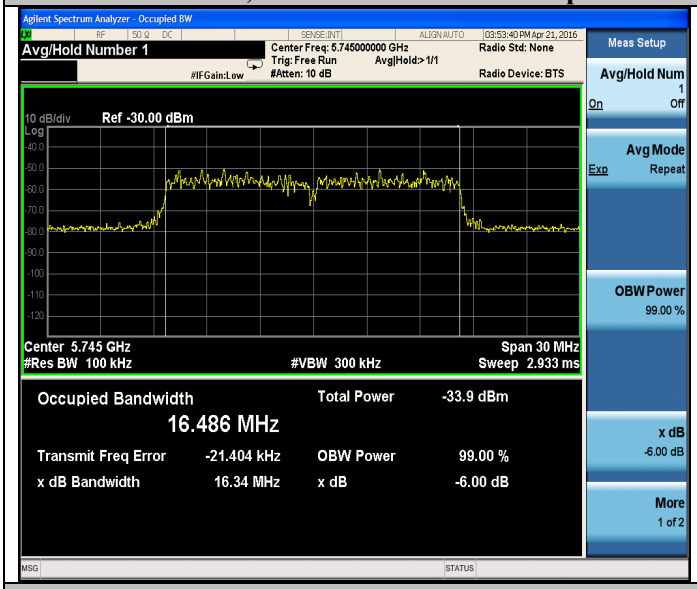
A.2.3 99% Occupied & 6dB Bandwidth data table

Frequency (MHz)	Mode	Data Rate (Mbps)	99% BW (MHz)	6dB BW (MHz)	Limits (KHz)	Results
5745	802.11a	6	16.49	16.34	≥500	Pass
5785	802.11a	6	16.37	16.12	≥500	Pass
5805	802.11a	6	16.38	15.86	≥500	Pass

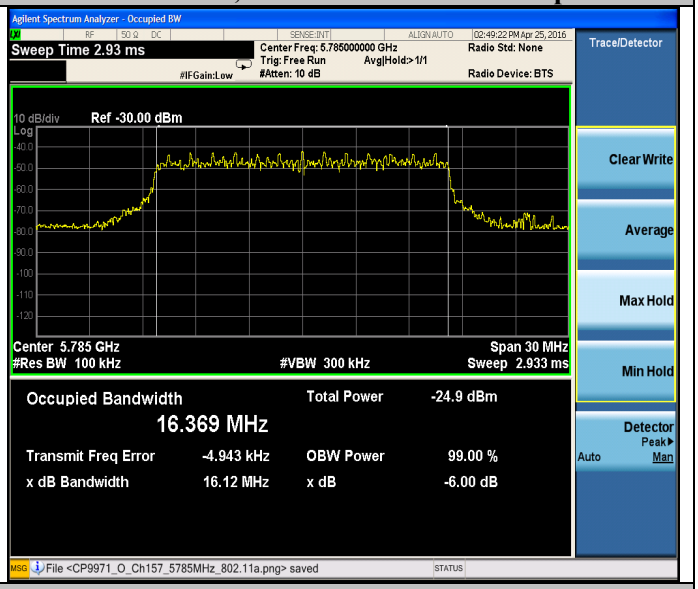
A.2.4 99% Occupied Bandwidth & 6dB Emission Bandwidth Graphical Test Results

99%&6dB Occupied Bandwidth

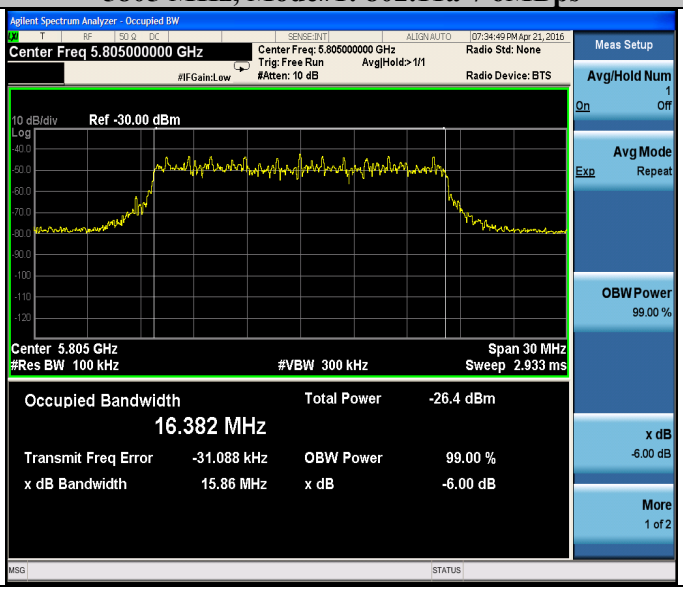
5745 MHz, Mode#1: 802.11a / 6MBps



5785 MHz, Mode#1: 802.11a / 6MBps



5805 MHz, Mode#1: 802.11a / 6MBps



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.

Ref. FCC 15.407(a) (3)

30dBm

A.4.2 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 measured power, by adding duty cycle correction factor to the measured value using the formula 10 log (1/x), where x is the duty cycle.

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

A.3.3 Maximum Output Power Data Table

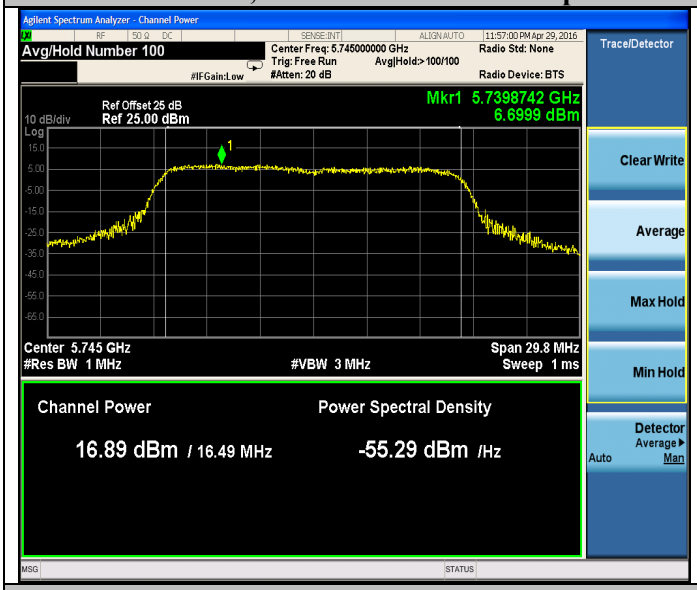
Maximum Conducted Output Power							
Mode: 802.11a							
Frequency (MHz)	**Cable Loss (dB)**	**Ext. Attenuator (dB)**	**Measured Output Power (dBm)**	**Duty Cycle Correction Factor (dB)**	**Corrected Output Power (dBm)**	**Limit (dBm)**	**Results Pass / Fail**
5745	5*	20*	16.89	0.56	17.45	30	Pass
5785	5*	20*	16.97	0.56	17.53	30	Pass
5805	5*	20*	16.54	0.56	17.10	30	Pass

Note:*represents the compensated correction factors of cable losses (5 dB) and external attenuator (20 dB) in the offset function of measuring instrument.

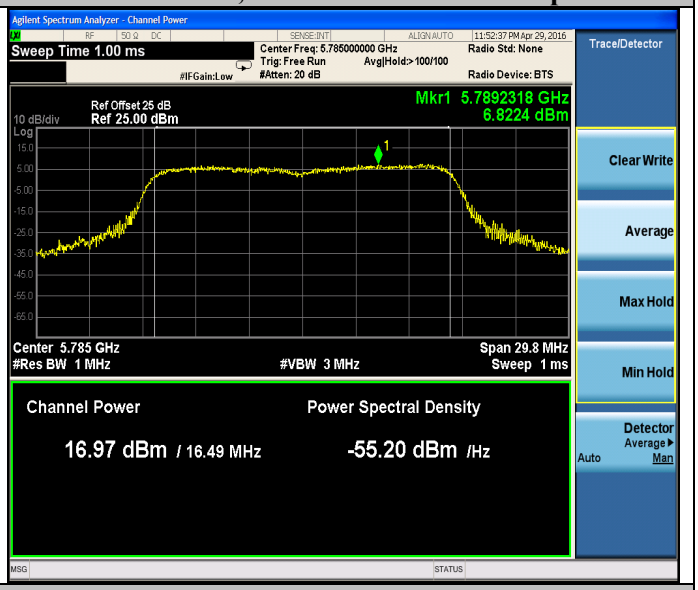
A.3.4 Maximum Conducted Power Graphical Test Results

Maximum Conducted Output Power

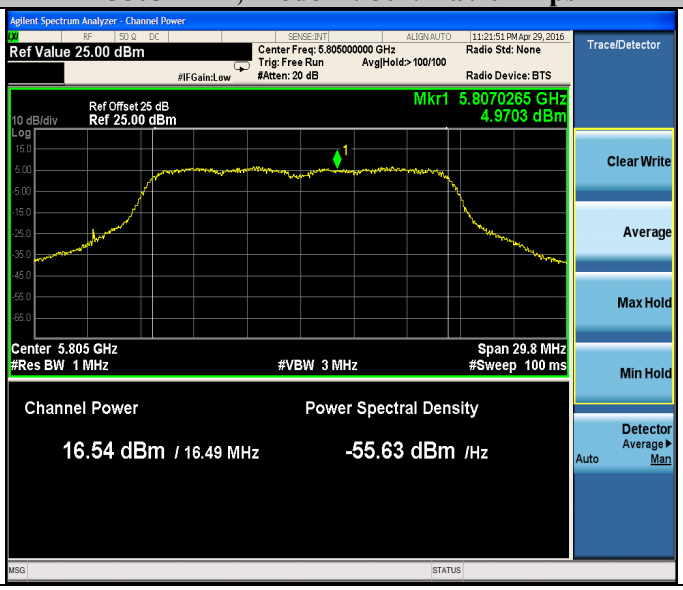
5745 MHz, Mode#1: 802.11a / 6MBps



5785 MHz, Mode#1: 802.11a / 6MBps



5805 MHz, Mode#1: 802.11a / 6MBps



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.
3. Capture graphs and record pertinent measurement data.
4. Make the following adjustments to the value by adding duty cycle correction factor to the measured value
5. 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) (b) SA-2

Test parameters
(i) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal. (ii) Set RBW = 500 KHz (iii) Set VBW ≥ 3 X RBW (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) If transmit duty cycle < 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run." (viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.

A.4.3 Power Spectral Density Data Table

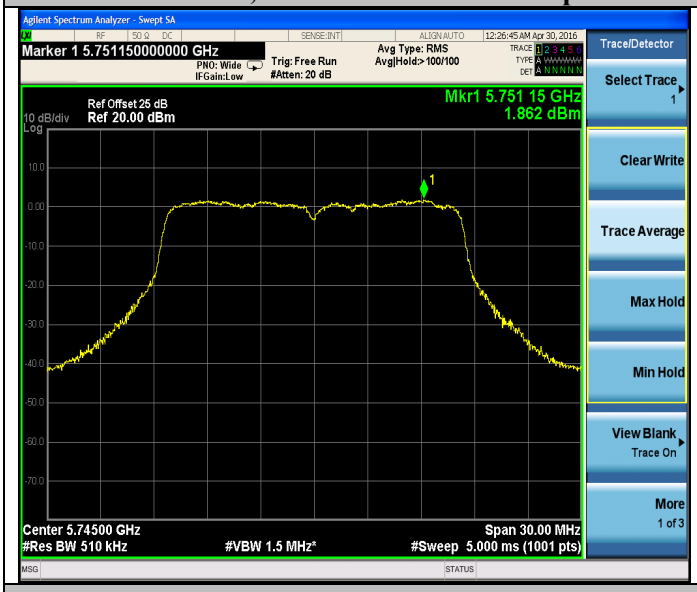
Power Spectral Density							
Mode: 802.11a							
Frequency (MHz)	**Cable Loss (dB)**	**Ext. Attenuator (dB)**	**Measured PSD (dBm)**	**Duty Cycle Correction Factor (dB)**	**Corrected PSD (dBm/500 KHz**	**Limits (dBm/500 KHz)**	**Results Pass / Fail**
5745	5*	20*	1.862	0.56	2.422	30	Pass
5785	5*	20*	1.982	0.56	2.542	30	Pass
5805	5*	20*	1.986	0.56	2.542	30	Pass

Note:*represents the compensated correction factors of cable losses (5 dB) and external attenuator (20 dB) in the offset function of measuring instrument.

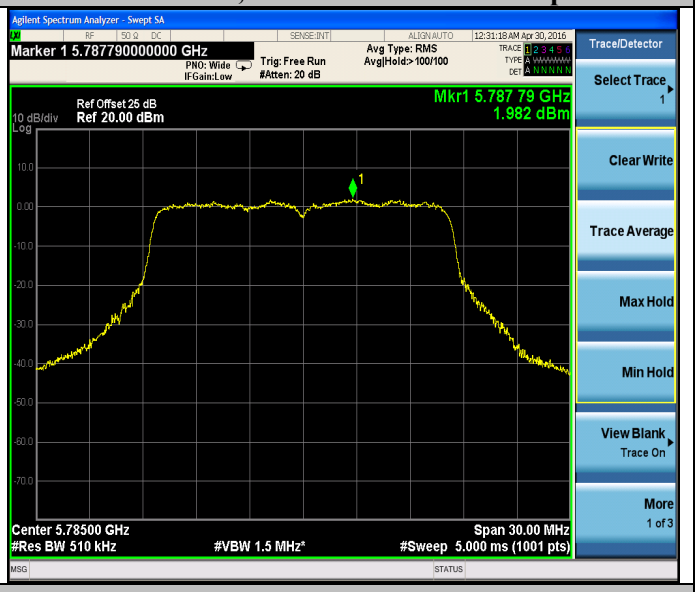
A.4.4 Power Spectral Density Graphical Test Results

Power Spectral Density

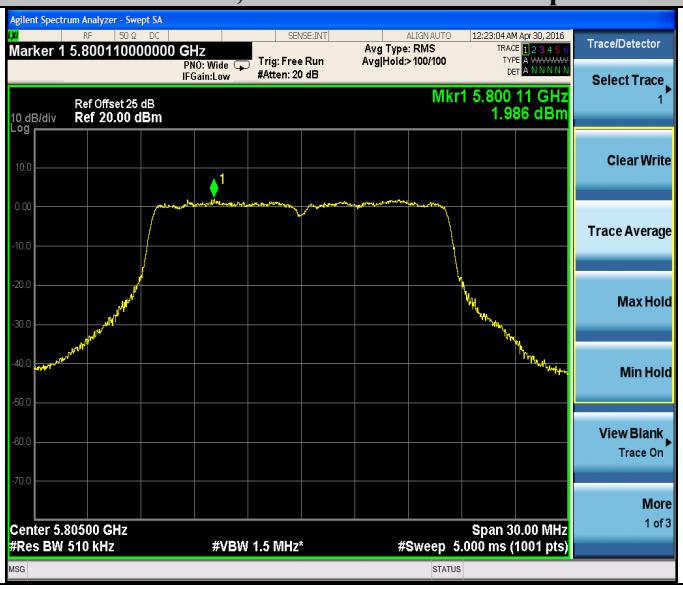
5745 MHz, Mode#1: 802.11a / 6MBps



5785 MHz, Mode#1: 802.11a / 6MBps



5805 MHz, Mode#1: 802.11a / 6MBps



A.5 Band Edge and Out-of-band

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)** 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.

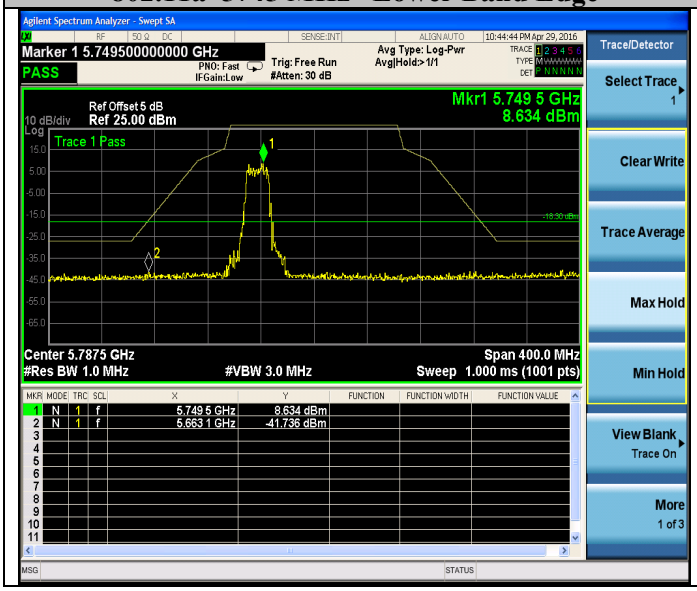
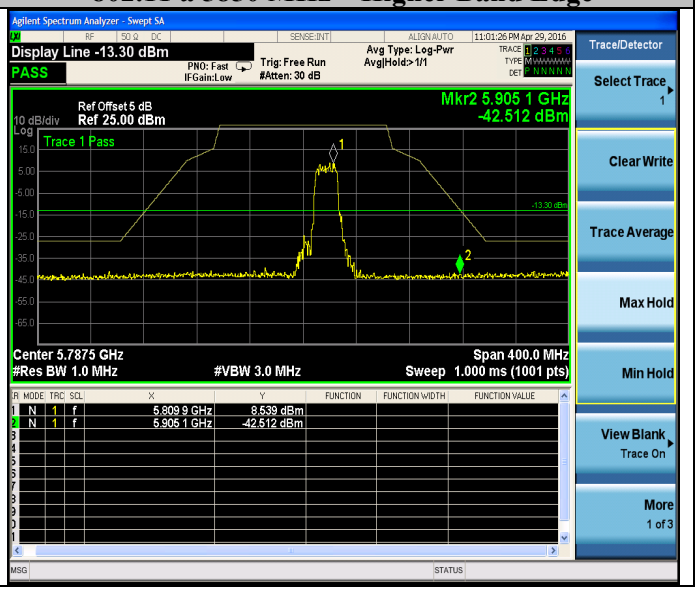
Ref. 789033 D02 General UNII Test Procedures New Rules v01, section II.G.5

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 Radiated Band Edge and Out-of-Band Test Data

Operating Frequency (MHz)	Data Rate (Mbps)	Measured Frequency (MHz)	Emission Level (dBm/MHz)	Antenna Gain (dBi)	E.I.R.P (dBm)	Limit (dBm)	Result
Mode#: 802.11a							
5745	6	5749.5	8.634	3.11	11.744	27	Pass
5745	6	5663.1	-41.736	3.11	-38.626	-18.3	Pass
5825	6	5809.9	8.539	3.11	11.649	27	Pass
5825	6	5905.1	-42.512	3.11	-39.402	-13.3	Pass

A.5.4 Conducted Band Edge Graphical Test Results

Conducted Band Edge	
802.11a 5745 MHz –Lower Band Edge	802.11 a 5850 MHz – Higher Band Edge
	

A.6 Unwanted/ Spurious 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) *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): Unwanted emissions above 1000 MHz that are outside of the restricted bands are subject to a maximum emission limit of -27dBm/MHz.

Limit Conversion

When the DUT power is measured using a radiated test configuration, the EIRP can be directly determined using the power (logarithmic) 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

(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) = 20 Log (0.0026) + 120 = **68.23/m @ 3 meter**

BA.6.2 Test Procedure

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

Unwanted Emissions Test Procedure below 1 GHz
1. Using Vasona software, configure the spectrum analyzer as shown above (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.

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

From 18 GHz – 40 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
(i) RBW = 1 MHz (ii) VBW ≥ 3MHz (iii) Sweep = Auto (iv) Detector = Peak (v) 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.

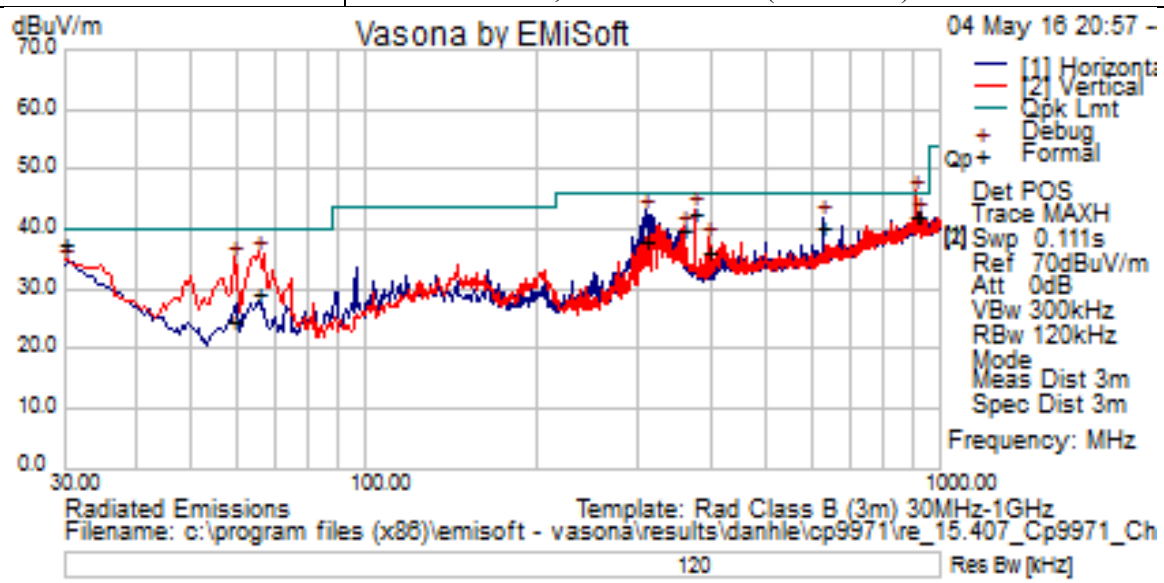
. The system was evaluated up to 40 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

- 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 Unwanted/ Spurious Emissions Test Data and Graphical Test Results

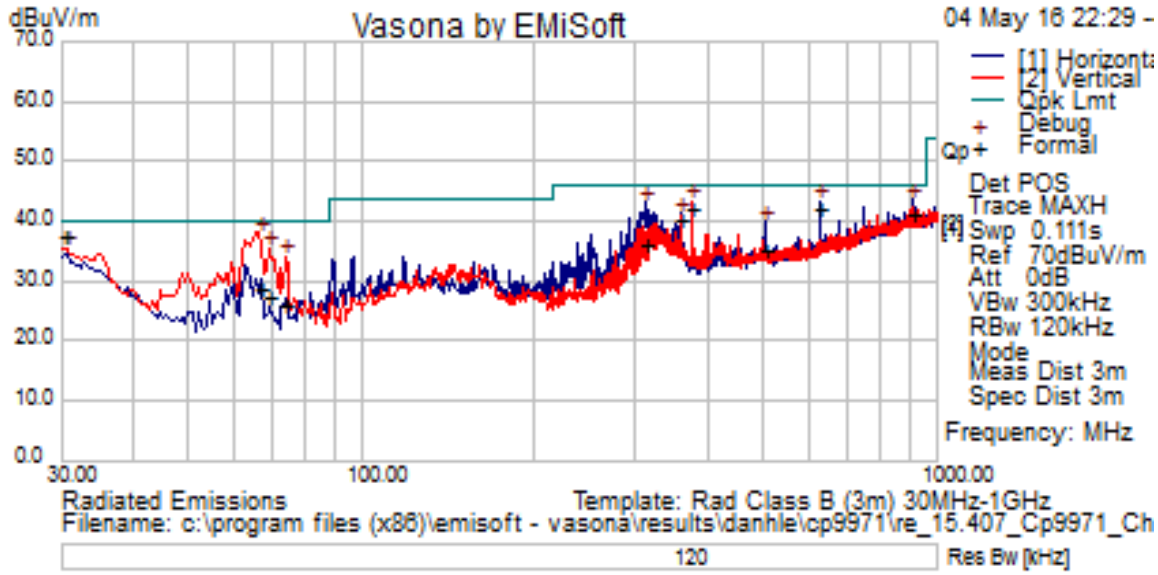
Subtest Date:	04-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**30MHz - 1GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)



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
917.7456	16.84	2.9	22.35	42.1	Quasi Max	H	328	14	46	-3.9	917.745	Tx/Ch149
64.95938	20.55	0.77	8.1	29.42	Quasi Max	V	117	86	40	-10.58	64.9593	Tx/Ch149
375.0322	25.94	1.83	15	42.77	Quasi Max	H	226	125	46	-3.23	375.032	Tx/Ch149
625.0881	18.83	2.37	19.3	40.5	Quasi Max	H	104	152	46	-5.5	625.088	Tx/Ch149
396.0234	19.09	1.88	15.26	36.23	Quasi Max	V	108	157	46	-9.77	396.023	Tx/Ch149
358.3491	23.59	1.79	14.73	40.11	Quasi Max	V	115	161	46	-5.89	358.349	Tx/Ch149
59.18938	16.64	0.73	7.44	24.81	Quasi Max	V	217	161	40	-15.19	59.1893	Tx/Ch149
308.3609	23	1.65	13.63	38.29	Quasi Max	H	111	210	46	-7.71	308.360	Tx/Ch149
30.0023	15.94	0.49	21.3	37.73	Quasi Max	V	307	258	40	-2.27	30.0023	Tx/Ch149
907.2631	16.98	2.89	22.4	42.26	Quasi Max	V	169	258	46	-3.74	907.263	Tx/Ch149

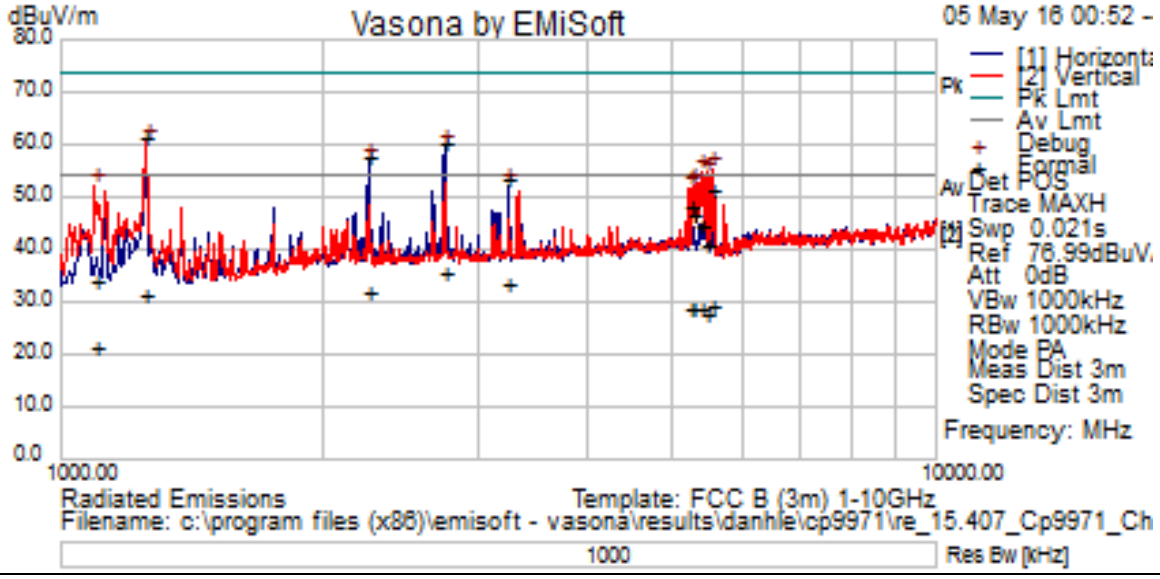
Subtest Date:	04-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**30MHz - 1GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 161 (5805 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch161 (5805 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
909.2809	16.22	2.89	22.4	41.51	Quasi Max	H	221	0	46	-4.49	Pass	Tx/Ch161
503.0403	15.76	2.12	17.7	35.58	Quasi Max	H	226	15	46	-10.42	Pass	Tx/Ch161
374.9569	25.49	1.83	15	42.32	Quasi Max	V	116	125	46	-3.68	Pass	Tx/Ch161
73.51156	16.8	0.82	8.43	26.06	Quasi Max	V	136	130	40	-13.95	Pass	Tx/Ch161
68.92781	18.28	0.8	8.42	27.5	Quasi Max	V	176	139	40	-12.5	Pass	Tx/Ch161
66.61188	19.83	0.78	8.23	28.84	Quasi Max	V	104	139	40	-11.16	Pass	Tx/Ch161
624.9772	20.78	2.37	19.3	42.45	Quasi Max	H	112	157	46	-3.55	Pass	Tx/Ch161
312.0059	20.92	1.66	13.78	36.36	Quasi Max	H	106	185	46	-9.64	Pass	Tx/Ch161
30.37094	16.12	0.49	20.99	37.6	Quasi Max	V	148	221	40	-2.4	Pass	Tx/Ch161
358.3525	23.96	1.79	14.73	40.49	Quasi Max	H	106	267	46	-5.51	Pass	Tx/Ch161

Subtest Date:	05-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**1GHz - 10GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)



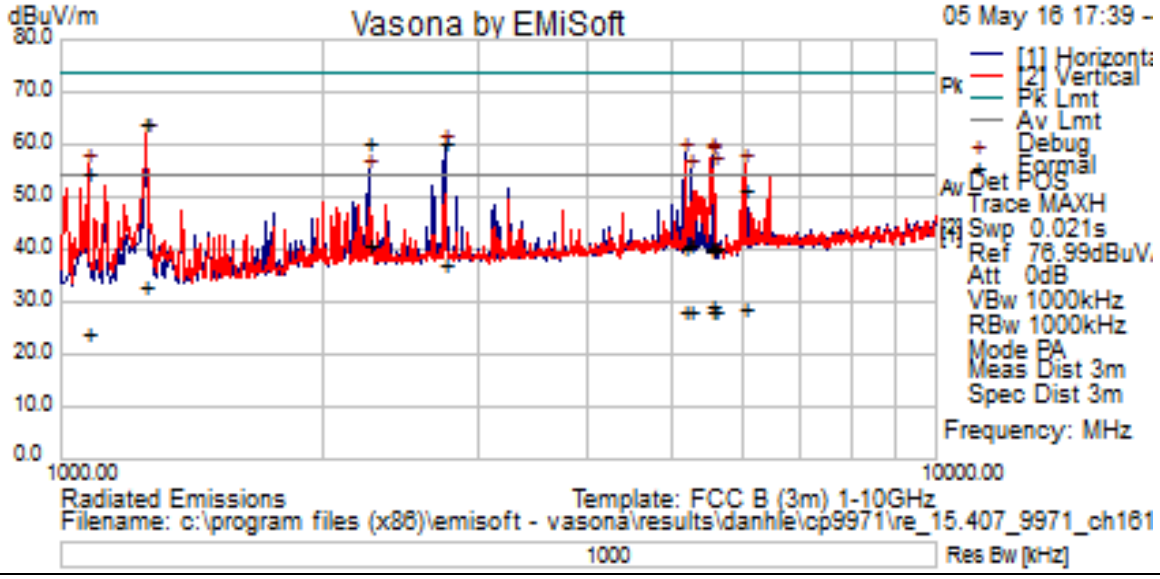
Title: **TX Spurious Emissions from 1GHz-10GHz – Ch149 (5745 MHz)**

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
1095.27	46.57	3.17	-15.73	34.01	Peak Max	V	185	112	74	-39.99	Pass	Tx/Ch149
5242.923	48.35	7.56	-7.68	48.23	Peak Max	V	187	141	74	-25.78	Pass	Tx/Ch149
2749.493	65.13	5.24	-10	60.37	Peak Max	H	166	174	74	-13.63	Pass	Tx/Ch149
3249.068	57.49	5.79	-9.86	53.42	Peak Max	H	117	178	74	-20.58	Pass	Tx/Ch149
2248.515	64.84	4.66	-11.39	58.1	Peak Max	H	132	191	74	-15.9	Pass	Tx/Ch149
1251.21	72.8	3.41	-14.88	61.32	Peak Max	V	185	286	74	-12.68	Pass	Tx/Ch149
5546.08	51.27	7.78	-7.52	51.54	Peak Max	V	115	328	74	-22.46	Pass	Tx/Ch149
5285.623	47.17	7.61	-7.77	47.02	Peak Max	V	210	328	74	-26.98	Pass	Tx/Ch149
5410.815	44.4	7.69	-7.59	44.5	Peak Max	V	226	328	74	-29.5	Pass	Tx/Ch149
5482.493	40.81	7.8	-7.77	40.84	Peak Max	V	358	328	74	-33.16	Pass	Tx/Ch149
1095.27	34.22	3.17	-15.73	21.66	Average	V	185	112	54	-32.34	Pass	Tx/Ch149
5242.923	28.97	7.56	-7.68	28.85	Average	V	187	141	54	-25.15	Pass	Tx/Ch149
2749.493	40.5	5.24	-10	35.74	Average	H	166	174	54	-18.26	Pass	Tx/Ch149
3249.068	37.74	5.79	-9.86	33.67	Average	H	117	178	54	-20.33	Pass	Tx/Ch149
2248.515	38.68	4.66	-11.39	31.94	Average	H	132	191	54	-22.06	Pass	Tx/Ch149

Subtest Date:	05-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**1GHz - 10GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)

1251.21	42.88	3.41	-14.88	31.4	Average	V	185	286	54	-22.6	Pass	Tx/Ch149
5546.08	28.91	7.78	-7.52	29.18	Average	V	115	328	54	-24.83	Pass	Tx/Ch149
5285.623	29.02	7.61	-7.77	28.86	Average	V	210	328	54	-25.14	Pass	Tx/Ch149
5410.815	28.52	7.69	-7.59	28.62	Average	V	226	328	54	-25.38	Pass	Tx/Ch149
5482.493	27.87	7.8	-7.77	27.9	Average	V	358	328	54	-26.1	Pass	Tx/Ch149

Subtest Date:	05-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**1GHz - 10GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 161 (5805 MHz)



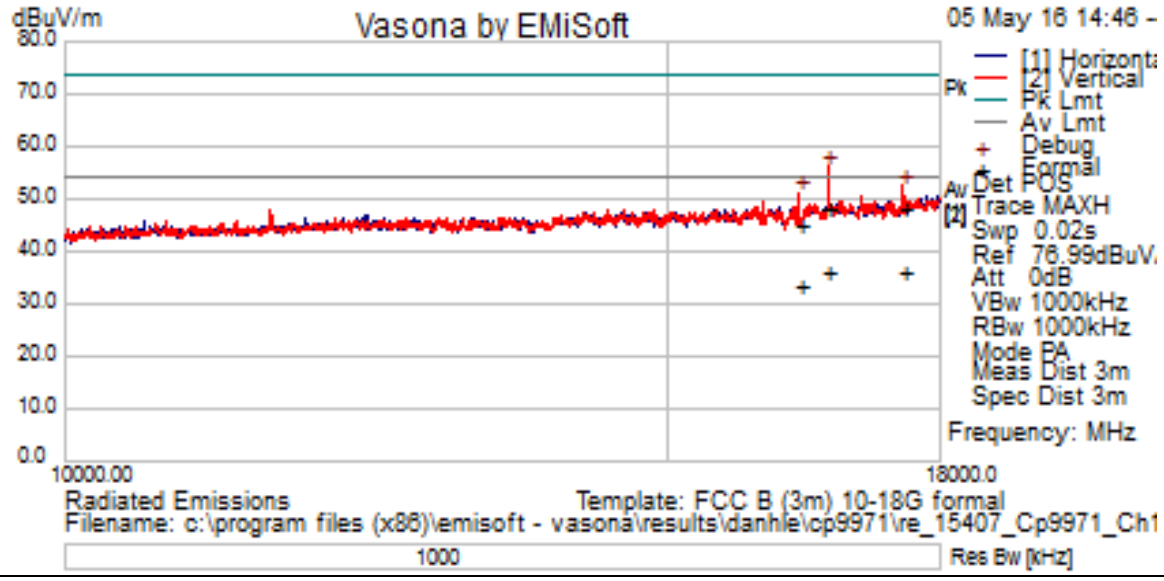
Title: **TX Spurious Emissions from 30MHz-1GHz – Ch161 (5805 MHz)**

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
5585.133	39.99	7.86	-7.3	40.55	Peak	V	307	27	74	-33.45	Pass	Tx/Ch161
1074.995	67.01	3.13	-15.64	54.5	Peak	V	260	86	74	-19.5	Pass	Tx/Ch161
5164.313	40.58	7.51	-7.87	40.22	Peak	H	162	119	74	-33.78	Pass	Tx/Ch161
5539.595	40.16	7.78	-7.61	40.33	Peak	V	197	145	74	-33.67	Pass	Tx/Ch161
2250.155	67.02	4.66	-11.39	60.29	Peak	H	134	153	74	-13.71	Pass	Tx/Ch161
6063.365	49.19	8.16	-5.87	51.49	Peak	V	106	166	74	-22.52	Pass	Tx/Ch161
2750.515	65.49	5.24	-10.01	60.73	Peak	H	147	177	74	-13.27	Pass	Tx/Ch161
5561.71	39.5	7.8	-7.31	39.99	Peak	H	202	254	74	-34.01	Pass	Tx/Ch161
1251.56	75.63	3.41	-14.88	64.16	Peak	V	138	273	74	-9.84	Pass	Tx/Ch161
5247.753	40.9	7.56	-7.7	40.77	Peak	H	392	308	74	-33.23	Pass	Tx/Ch161
5585.133	27.87	7.86	-7.3	28.44	Average	V	307	27	54	-25.57	Pass	Tx/Ch161
1074.995	36.75	3.13	-15.64	24.24	Average	V	260	86	54	-29.76	Pass	Tx/Ch161
5164.313	28.68	7.51	-7.87	28.32	Average	H	162	119	54	-25.68	Pass	Tx/Ch161
5539.595	29.09	7.78	-7.61	29.27	Average	V	197	145	54	-24.73	Pass	Tx/Ch161
2250.155	47.56	4.66	-11.39	40.83	Average	H	134	153	54	-13.17	Pass	Tx/Ch161

Subtest Date:	05-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**1GHz - 10GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 161 (5805 MHz)

6063.365	26.71	8.16	-5.87	29	Average	V	106	166	54	-25	Pass	Tx/Ch161
2750.515	41.93	5.24	-10.01	37.16	Average	H	147	177	54	-16.84	Pass	Tx/Ch161
5561.71	27.68	7.8	-7.31	28.17	Average	H	202	254	54	-25.83	Pass	Tx/Ch161
1251.56	44.59	3.41	-14.88	33.12	Average	V	138	273	54	-20.88	Pass	Tx/Ch161
5247.753	28.62	7.56	-7.7	28.48	Average	H	392	308	54	-25.52	Pass	Tx/Ch161

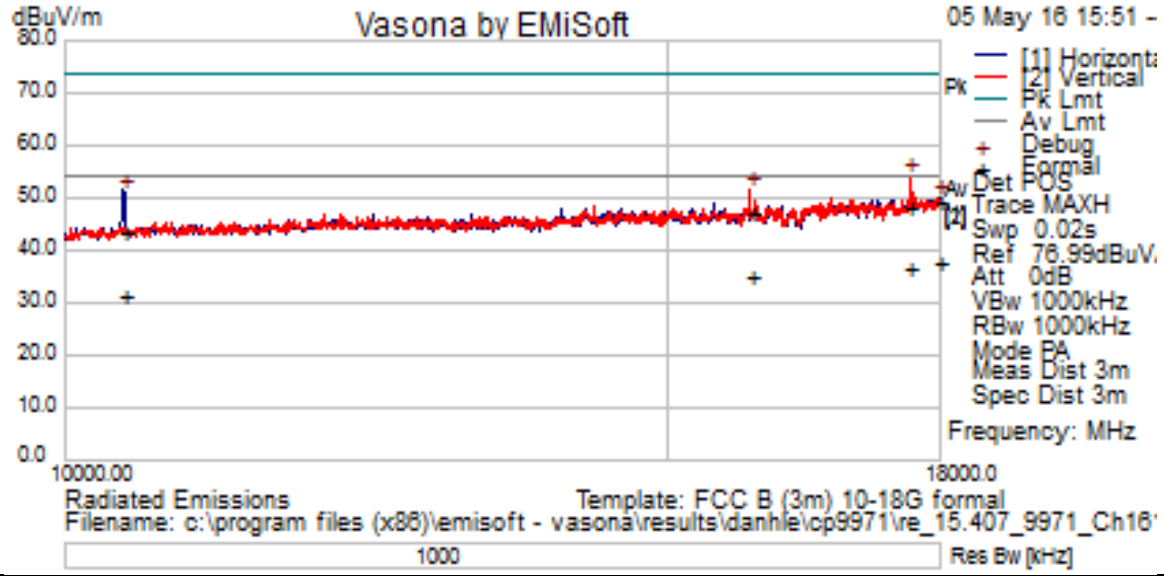
Subtest Date:	05-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**10GHz - 18GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)



Title: **TX Spurious Emissions from 10GHz-18GHz – 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
17565.58	40.31	16.7	-8.7	48.31	Peak	V	221	176	74	-25.69	Pass	Tx/Ch149
16701.01	42.11	16.23	-9.83	48.51	Peak	V	250	195	74	-25.49	Pass	Tx/Ch149
16378.75	39.98	15.63	-10.28	45.32	Peak	V	386	326	74	-28.68	Pass	Tx/Ch149
17565.58	28.38	16.7	-8.7	36.39	Average	V	221	176	54	-17.61	Pass	Tx/Ch149
16701.01	29.92	16.23	-9.83	36.31	Average	V	250	195	54	-17.69	Pass	Tx/Ch149
16378.75	28.01	15.63	-10.28	33.36	Average	V	386	326	54	-20.64	Pass	Tx/Ch149

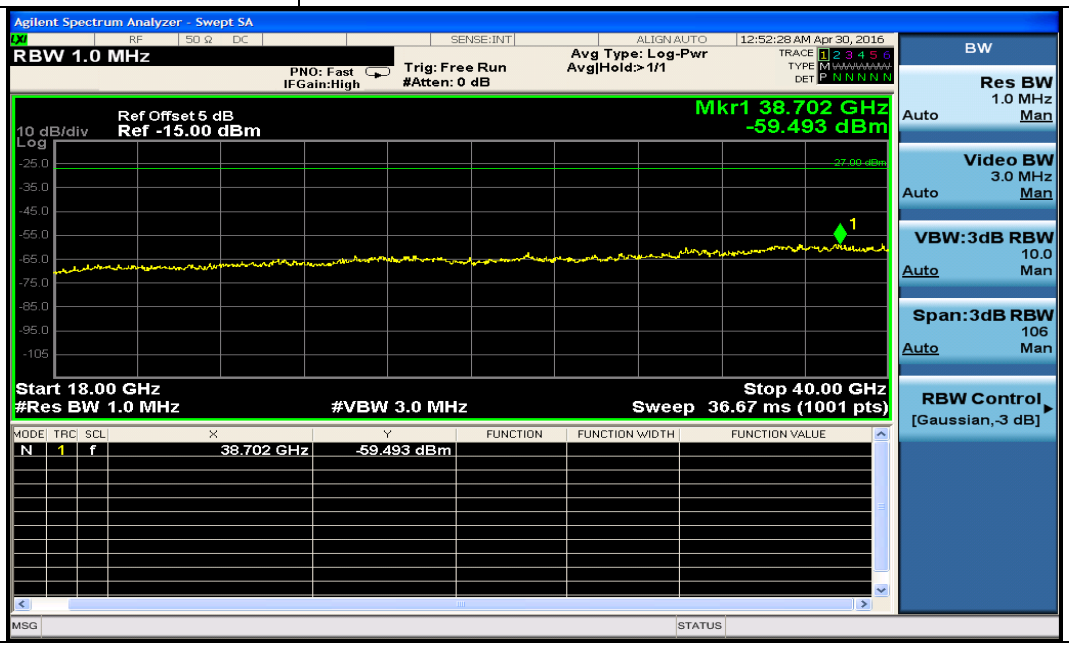
Subtest Date:	05-May-2016
Engineer	Danh Le
Lab Information	Building P, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**10GHz - 18GHz**
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 161 (5805 MHz)



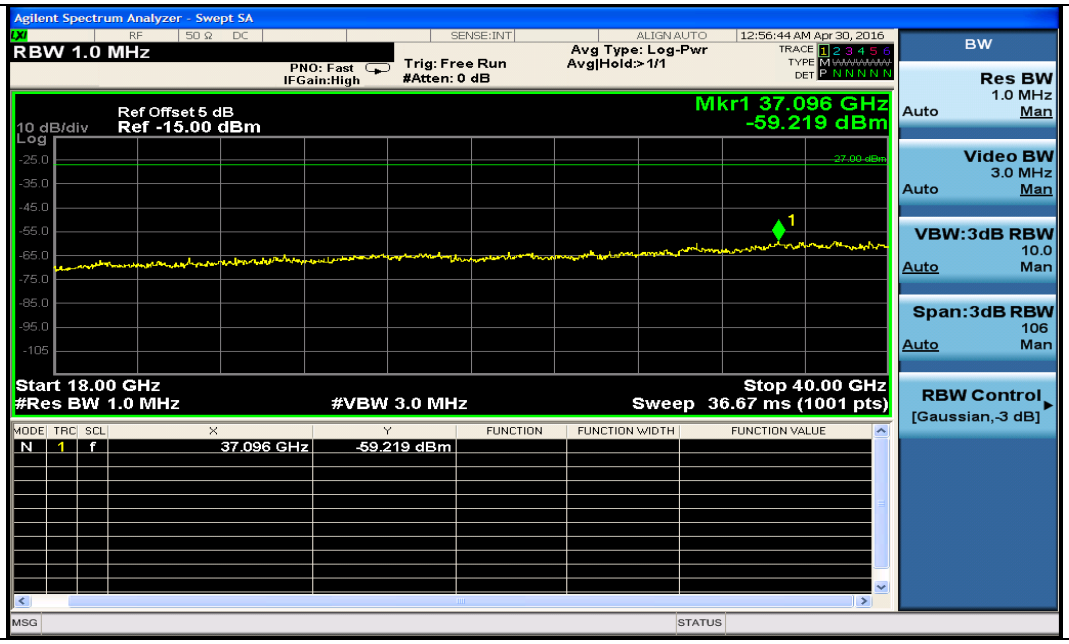
Title: **TX Spurious Emissions from 10GHz-18GHz – Ch161 (5805 MHz)**

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
10403.02	45.89	11.57	-13.85	43.62	Peak	H	194	118	74	-30.38	Pass	Tx/Ch161
17643.14	39.64	16.79	-8.2	48.23	Peak	V	157	121	74	-25.77	Pass	Tx/Ch161
17983.94	40.12	17.03	-7.51	49.64	Peak	H	346	132	74	-24.36	Pass	Tx/Ch161
15851.44	42.46	15.41	-10.43	47.44	Peak	V	153	176	74	-26.56	Pass	Tx/Ch161
10403.02	33.91	11.57	-13.85	31.63	Average	H	194	118	54	-22.37	Pass	Tx/Ch161
17643.14	28.14	16.79	-8.2	36.73	Average	V	157	121	54	-17.27	Pass	Tx/Ch161
17983.94	28.42	17.03	-7.51	37.93	Average	H	346	132	54	-16.07	Pass	Tx/Ch161
15851.44	30.05	15.41	-10.43	35.03	Average	V	153	176	54	-18.97	Pass	Tx/Ch161

Subtest Date:	30-Apr-2016
Engineer	Danh Le
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	**18GHz - 40GHz**
Comments on the above Test Results	Mode#1: 802.11a



Title: **TX Spurious Emissions from 18GHz-40GHz – Ch149 (5745 MHz)**



Title: **TX Spurious Emissions from 18GHz-40GHz – Ch161 (5805 MHz)**

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
CIS49496	JFW / 50HF-020	20dB SMA Attenuator	10/16/2015	10/16/2015
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

Monta Vista Linux terminal
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#EDCS784430

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.