

# Radio Test Report

For

**CP-DX70**  
**Desktop Telepresence**

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

**FCC ID: LDKDX700976**

**UNII-3 (5725-5850 MHz)**

**Against the following Specifications:**

**CFR47 Part 15.407**



**Cisco Systems**  
170 West Tasman Drive  
San Jose, CA 95134

**Author:** Ronak Patel

**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.



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## **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:**

<b>Specifications</b>
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 <sup>-7</sup>
temperature measurements	± 0.54°.
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
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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.

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### 2.3 Dates of testing

March 15<sup>th</sup> – April 15<sup>th</sup>, 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  
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 part 15.407 (new rules) which was previously tested under FCC part 15.247 rules.

## 2.7 Equipment Assessed (EUT)

CP-DX70

## 2.8 EUT Description

The Cisco DX70 offers uncompromised collaboration for every desk. Experience best in class HD video and expanded collaboration capabilities such as UC features, Android applications and email all within a single integrated device. Now is the time for simple to use Collaboration experience at a price so affordable you can empower every office and home office desktop.

### Technical Specifications

Table 1 Physical and Operating Specifications for Cisco DX Series Devices	
Specification	Value or Range
Physical dimensions (H x W x D)	Cisco DX70: 14.84 in. (377.1 mm) x 13.91 in. (353.1 mm) x 2.45 in. (62.3 mm)
Weight	Cisco DX70: 8.5 lb (3.9 kg)
Operating temperature	32 to 104°F (0 to 40°C)
Operating relative humidity	10 to 95% (noncondensing)
Storage temperature	14 to 140°F (-10 to 60°C)
Power, Cisco DX70	Rated: 3.5A at 12V maximum Low Power Standby mode Integrated EnergyWise support
Connectivity	Internal 2-port Cisco Ethernet switch IEEE 802.11 a/b/g/n Wi-Fi
Audio codec support	Narrowband audio compression codecs: G.711a, G.711u, G.729a, G.729ab, and Internet Low Bitrate Codec (iLBC) Wideband audio compression codecs: G.722, Internet Speech Audio Codec (iSAC), iLBC, and AAC-LD audio compression codecs.
Operating System	Android 4.1.1 (Jellybean)
Processor	Cisco DX70: TI OMAP 4470 1.5GHz dual-core ARM Cortex-A9 processor
Memory	2-GB RAM; Low Power Double Data Rate Synchronous Dynamic Random-Access Memory (LPDDR2 SDRAM)
Storage	8-GB eMMC NAND Flash memory (embedded multimedia card; nonvolatile)



<b>Table 2 Data Rates, Number of Channels, and Modulation Technologies by IEEE Standard</b>				
<b>Item</b>	<b>802.11b</b>	<b>802.11g</b>	<b>802.11a</b>	<b>802.11n</b>
Data rates	1, 2, 5.5, 11 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps	20MHz Channels: 7-72 Mbps 40MHz Channels: 15-150 Mbps
Nonoverlapping channels	3	3	Up to 24	Up to 24
Wireless modulation	DSSS	OFDM	OFDM	OFDM



## Section 3: Result Summary

### 3.1 Results Summary Table

Basic Standard	Technical Requirements / Details	Result
15.407(e)	<b>6 dB Bandwidth:</b> 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)	<b>Output Power:</b> 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)	<b>Power Spectral Density</b> 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)	<b>Band Edge / Out-of-Band Emissions:</b> 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)	<b>Unwanted / Spurious Emissions</b> 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-DX70 Desktop Tele Presence (Charcoal)	FOC1814NHX6	68-5357-01
S02	LITEON PA-1600-2A-LF AC/DC Adapter	LIT1748098P	341-100152-01

### 4.2 Antenna Information

The following antenna is supported by this product series

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain (dBi)
5725-5850	CI4671-15-000-R	Embedded Omnidirectional Dual Band	4.0

### 4.3 System Details

System #	Description	Samples
1	Radio Test Sample and Power Supply	S01 & S02

### 4.4 Mode of Operation Details

Mode#	Description	Comments
1	802.11a/n Test Mode	System is placed in a continuous Transmit Mode at various channels per Test Requirements. Worse Case Data Rate used for emissions test, 802.11a set to 6Mbps.
2	802.11n (HT20)	System is placed in a continuous Transmit Mode at various channels per test requirements, 802.11n (HT20) set to MCS0 (6.5 Mbps).
3	802.11n (HT40)	System is placed in a continuous Transmit Mode at various channels per test requirements, 802.11n (HT40) set to MCS0 (13.5 Mbps).

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	13	16	16
802.11n HT20	13	16	16

Operating Mode	Maximum Channel Power (dBm)	
	Frequency (MHz)	
	5755	5795
802.11n HT40	13	12



## 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:**

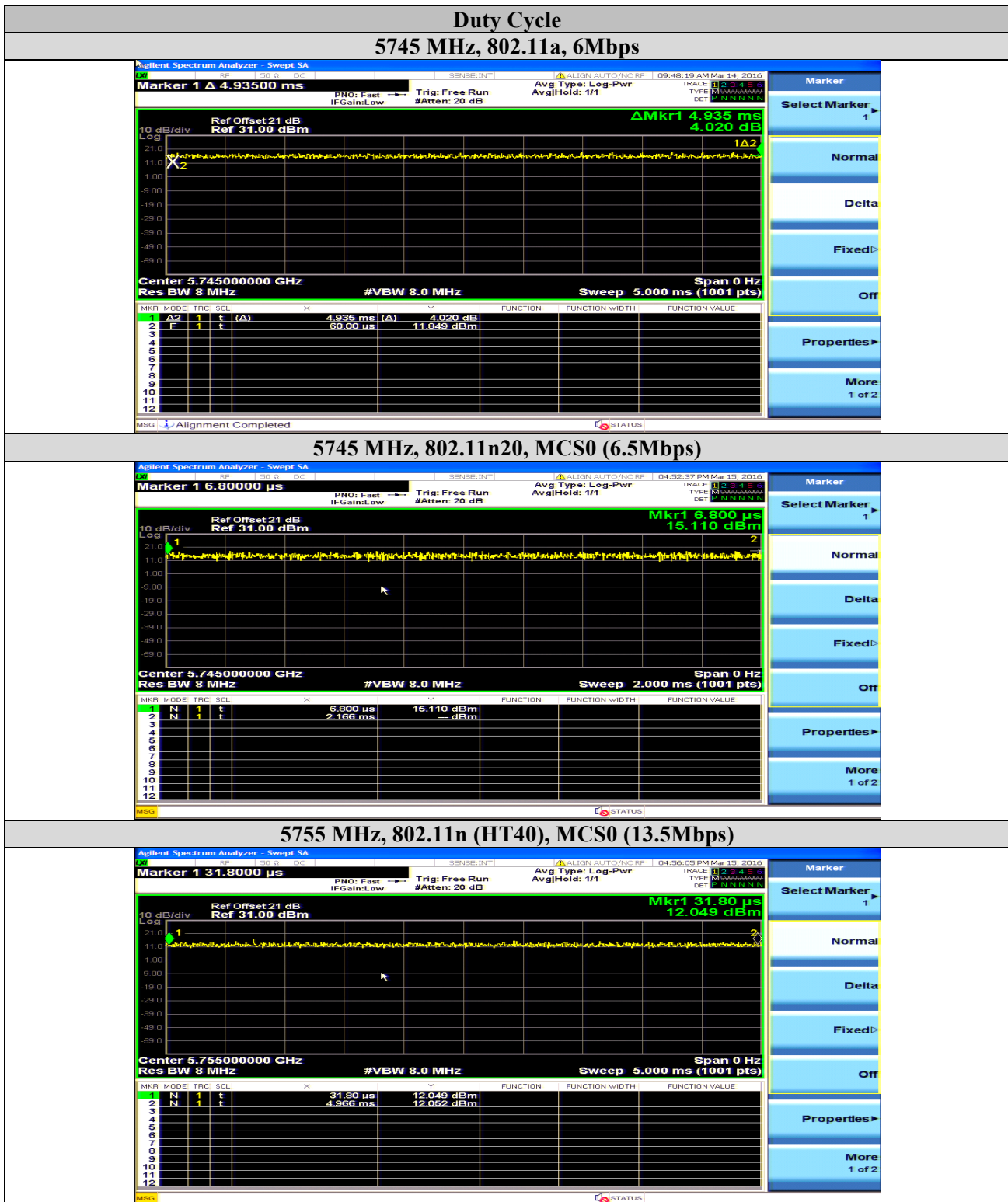
2 (b) The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set  $RBW \geq EBW$  if possible; otherwise, set RBW to the largest available value. Set  $VBW \geq RBW$ . 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  $T \leq 16.7$  microseconds.)

### A.1.3 Duty Cycle Data Table

Mode	Data Rate (Mbps)	On-time (ms)	Total Time (ms)	Duty Cycle (%)	Correction Factor (dB)
802.11a	6	-	-	$\geq 98$	0.00
802.11n20	6.5	-	-	$\geq 98$	0.00
802.11n40	13.5	-	-	$\geq 98$	0.00



A.1.4 Duty Cycle Graphical Test results





## 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)  $\geq 3 \times$  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.



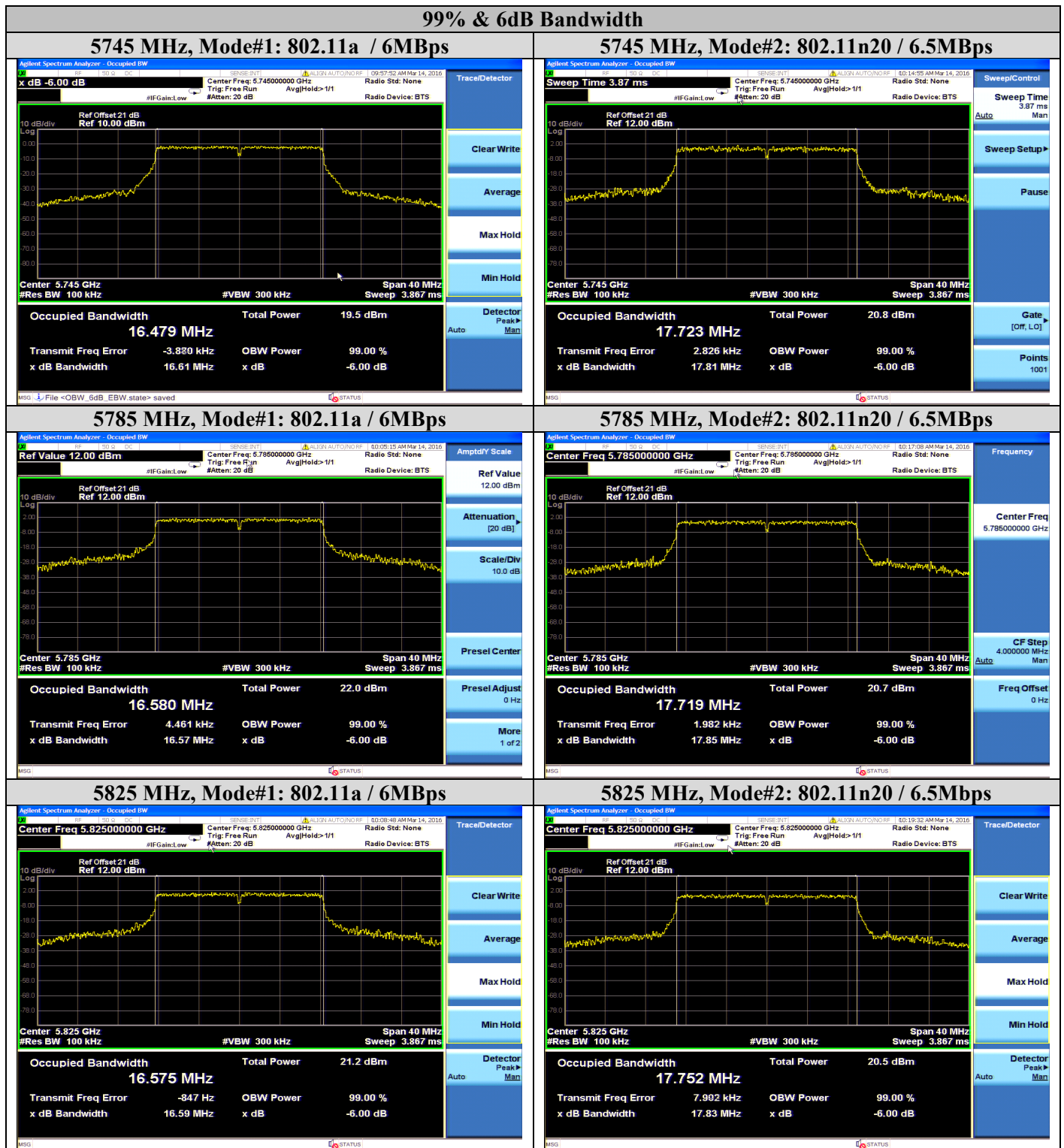


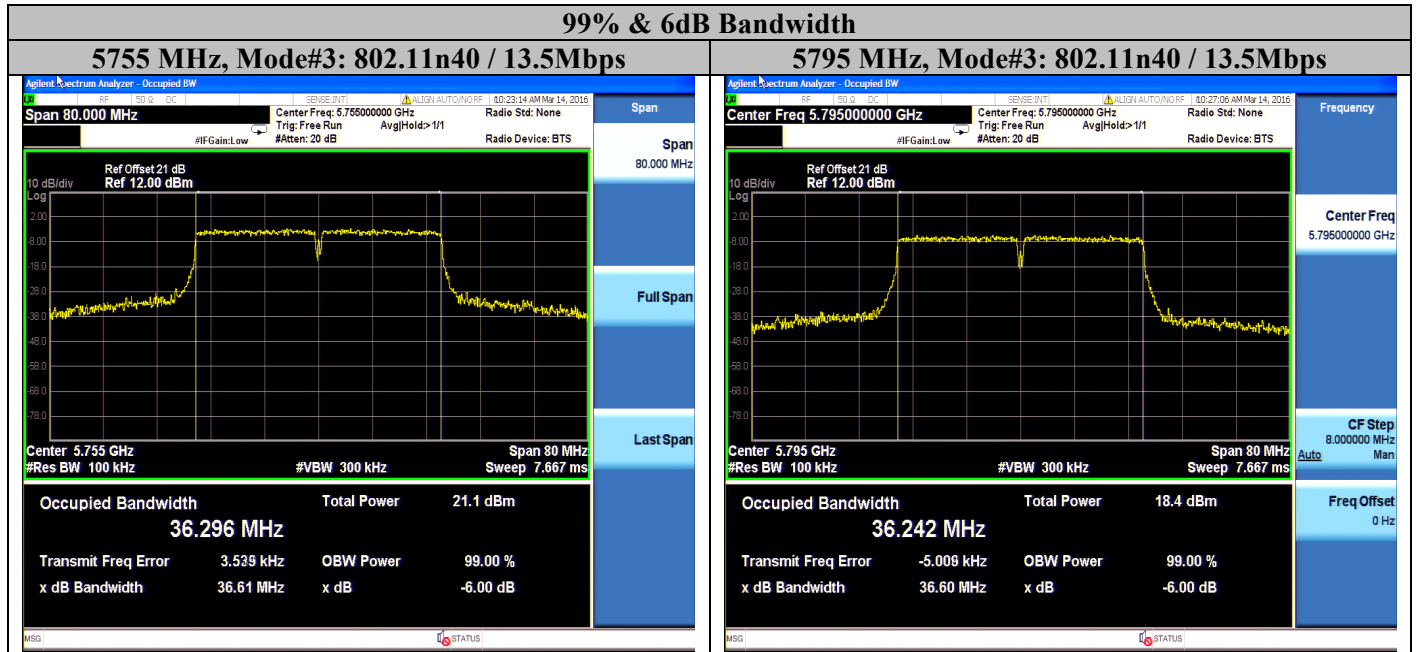
### A.2.3 99% Occupied Bandwidth & 6 dB Emission Bandwidth Data Table

Frequency (MHz)	Mode	Data Rate (Mbps)	99% BW (MHz)	6dB BW (MHz)	Limits (KHz)	Results
5745	802.11a	6	16.480	16.61	≥500	Pass
5785	802.11a	6	16.584	16.57	≥500	Pass
5825	802.11a	6	16.575	16.59	≥500	Pass
5745	802.11n20	15	17.723	17.81	≥500	Pass
5785	802.11n20	15	17.719	17.85	≥500	Pass
5825	802.11n20	15	17.752	17.83	≥500	Pass
5755	802.11n40	15	36.296	36.61	≥500	Pass
5795	802.11n40	15	36.242	36.60	≥500	Pass



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







### 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 (1)

##### 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) (b) SA-1

##### 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  $\geq$  3 MHz
- (iv) Number of points in sweep  $\geq$  2 Span / RBW. (This ensures that bin-to-bin spacing is  $\leq$  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  $\geq$  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.3.3 Maximum Conducted Output Power Data Table

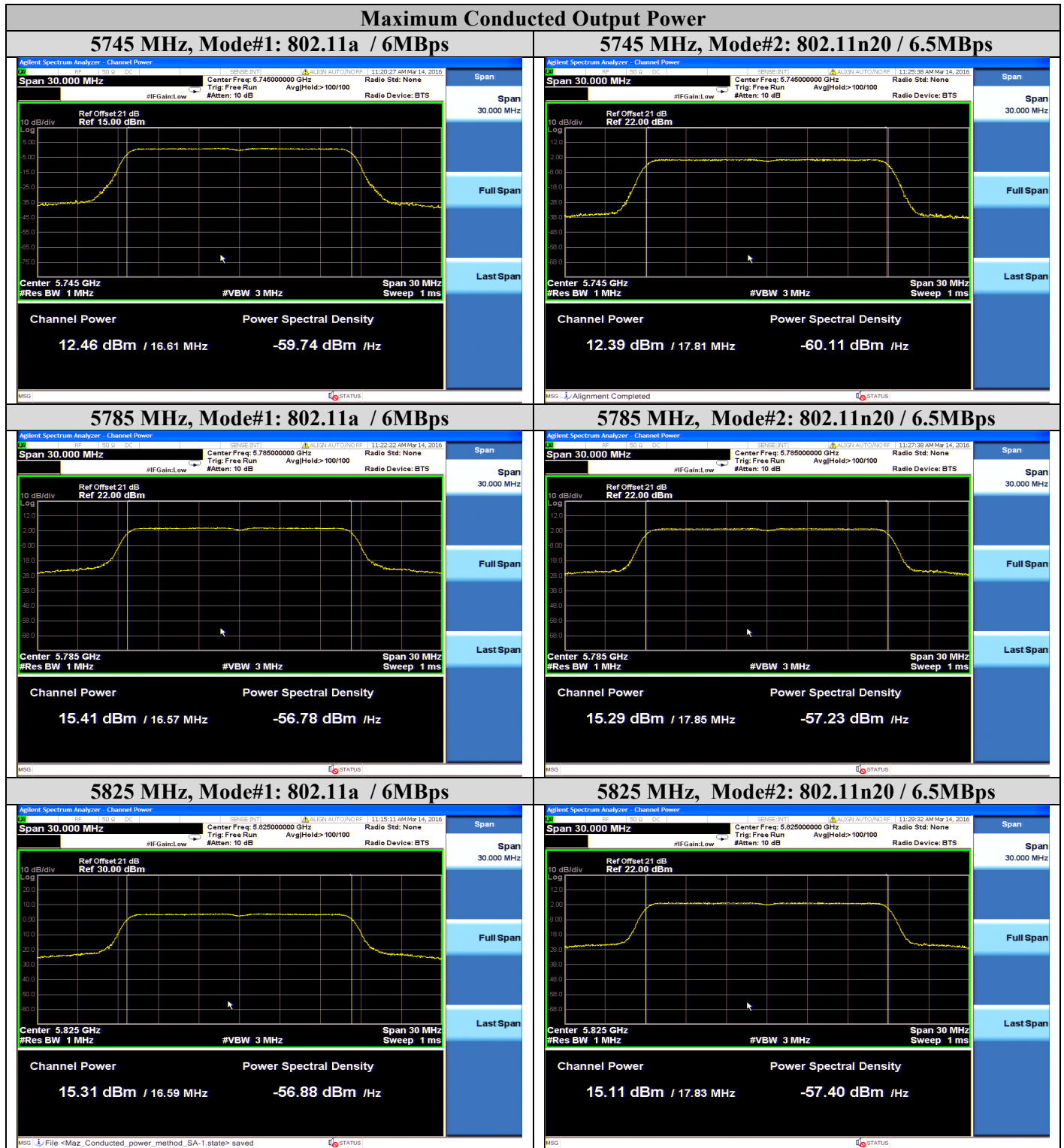
Channel No	Frequency (MHz)	Correction Factors (dB)	Data Rate (Mbps)	Max Output Power (dBm)	Limits (dBm)	Results
<b>Mode#1: 802.11a</b>						
149	5745	compensated	6	12.46	30	<b>Pass</b>
157	5785	compensated	6	15.41	30	<b>Pass</b>
165	5825	compensated	6	15.31	30	<b>Pass</b>
<b>Mode#2: 802.11n20</b>						
149	5745	compensated	15	12.39	30	<b>Pass</b>
157	5785	compensated	15	15.29	30	<b>Pass</b>
165	5825	compensated	15	15.11	30	<b>Pass</b>
<b>Mode#3: 802.11n40</b>						
151	5755	compensated	15	12.42	30	<b>Pass</b>
159	5795	compensated	15	11.92	30	<b>Pass</b>

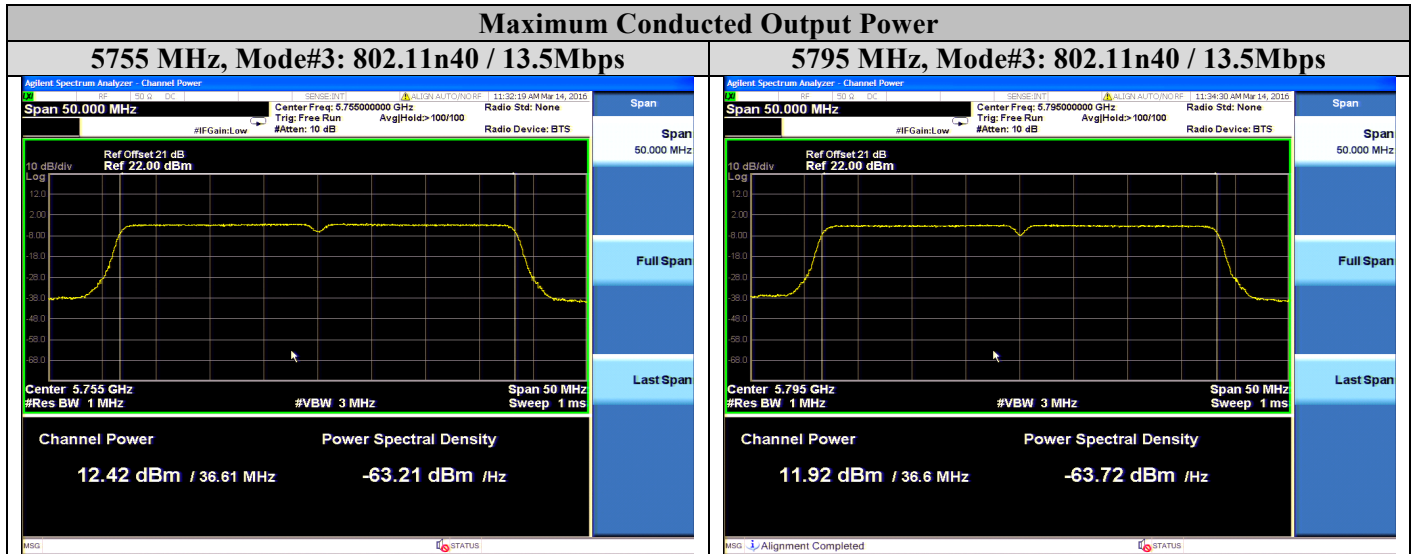
**Note1:** Data rate settings above represent the worst case settings to achieve the highest output power level.

**Note2:** Correction factors of cable losses and ext. attenuator were compensated in the offset function.



### A.3.4 Maximum Conducted Output Power Graphical Test Results









## 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) (b) SA-1

#### 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  $\geq 3 \times$  RBW
- (iv) Number of points in sweep  $\geq 2$  Span / RBW. (This ensures that bin-to-bin spacing is  $\leq$  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  $\geq 98\%$ , 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





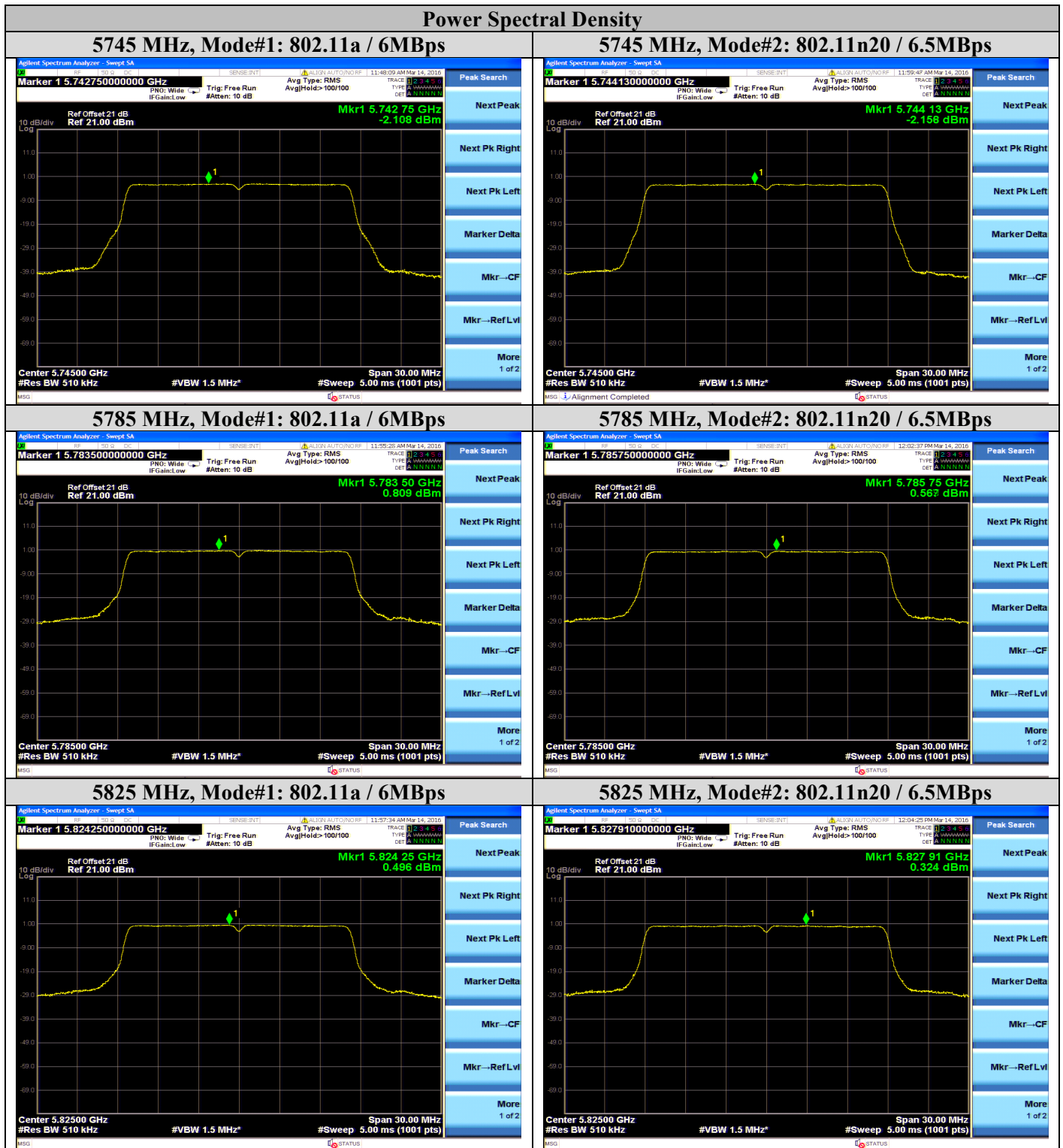
### A.4.3 Power Spectral Density Data Table

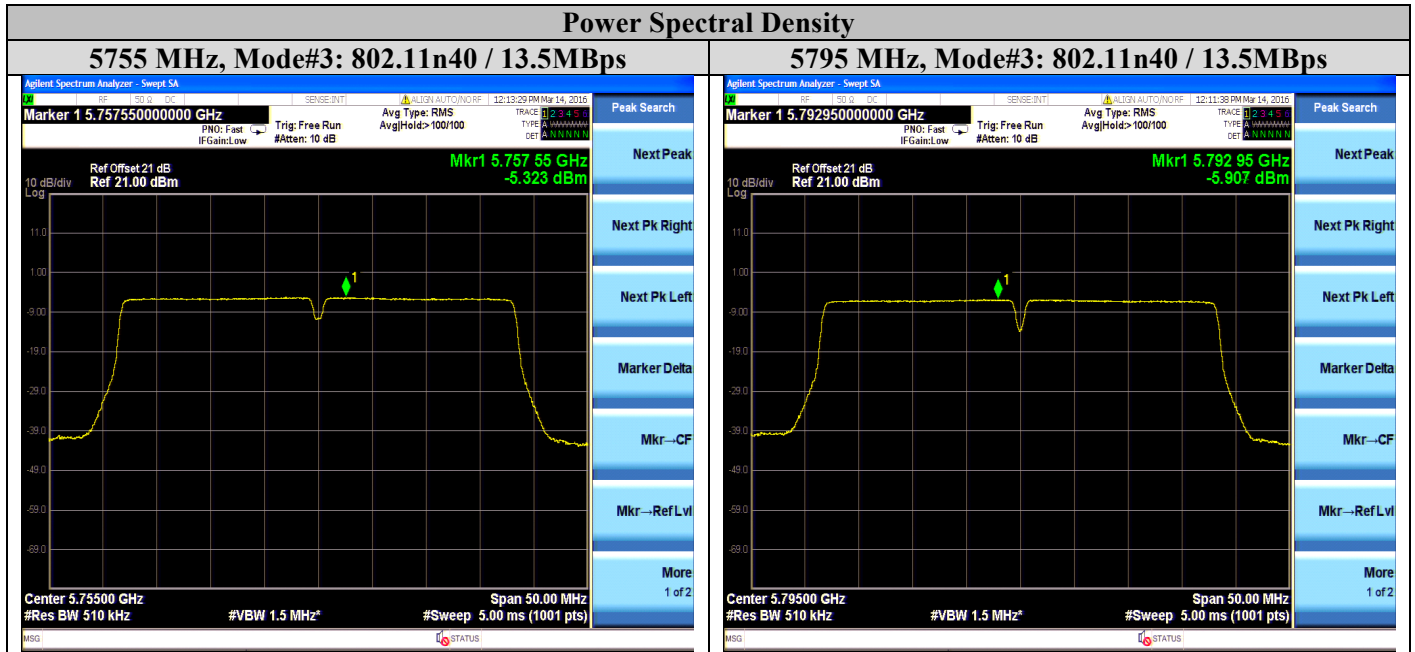
Channel No	Frequency (MHz)	Correction Factors (dB)	Data Rate (Mbps)	PSD (dBm/500 KHz)	Limits (dBm/500 KHz)	Results
<b>Mode#1: 802.11a</b>						
149	5745	compensated	6	-2.108	30	<b>Pass</b>
157	5785	compensated	6	0.809	30	<b>Pass</b>
165	5825	compensated	6	0.496	30	<b>Pass</b>
<b>Mode#2: 802.11n20</b>						
149	5745	compensated	15	-2.156	30	<b>Pass</b>
157	5785	compensated	15	0.567	30	<b>Pass</b>
165	5825	compensated	15	0.324	30	<b>Pass</b>
<b>Mode#3: 802.11n40</b>						
151	5755	compensated	15	-5.323	30	<b>Pass</b>
159	5795	compensated	15	-5.907	30	<b>Pass</b>

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



A.4.4 Power Spectral Density Graphical Test Results







## 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) (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  $\geq$  3MHz for Peak  
Sweep = Auto  
Detector = Peak  
Trace = Max Hold.

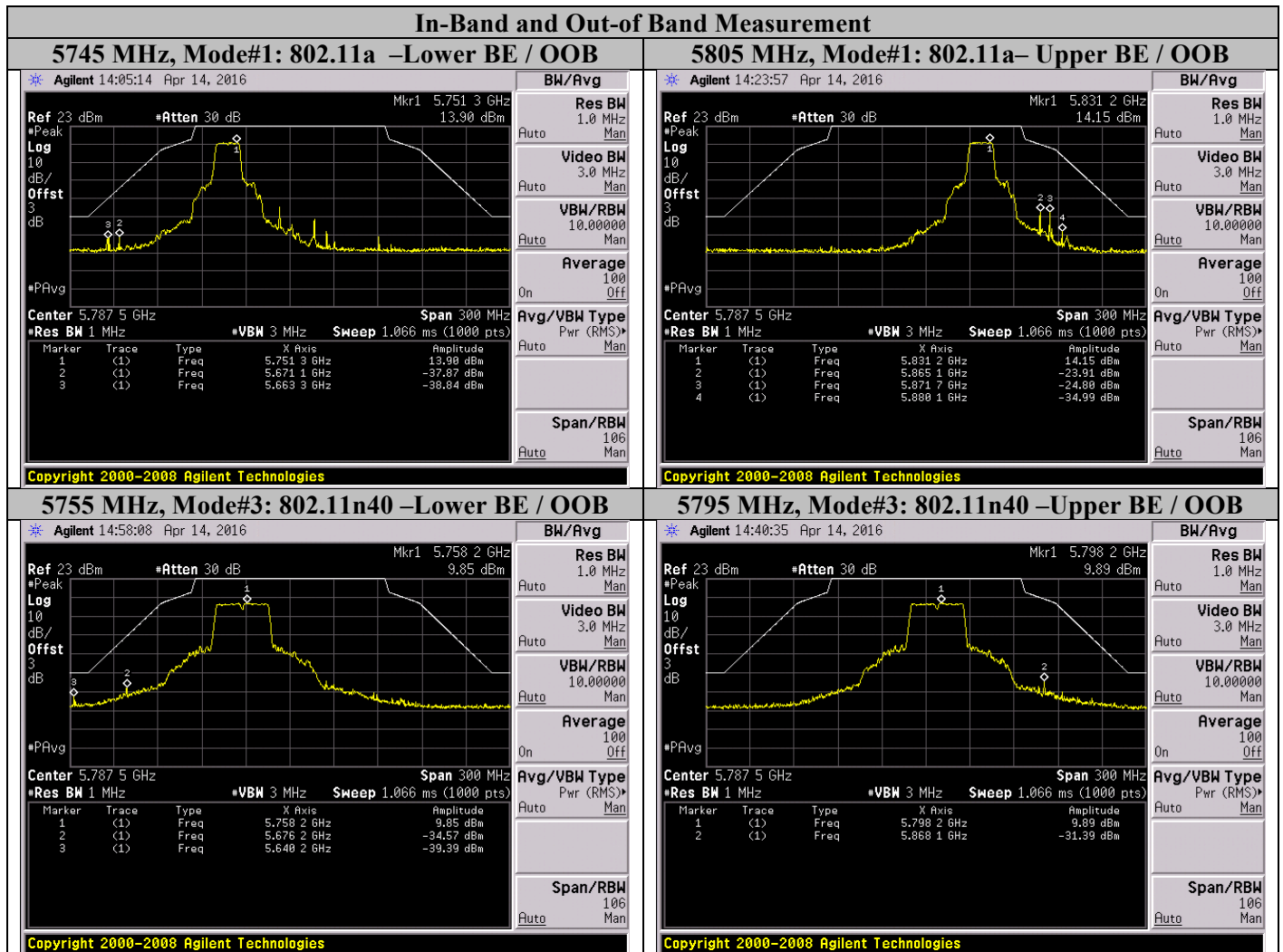


**A.5.3 Conducted Band Edge and Out-of-Band Test Data Table**

Operating Frequency (MHz)	Data Rate (Mbps)	Measured Frequency (MHz)	Emission Level (dBm/MHz)	Antenna Gain (dBi)	E.I.R.P (dBm)	Limit (dBm)	Result
<b>Mode#1: 802.11a</b>							
5745	6	5751.3	13.90	4	17.90	27.0	Pass
5745	6	5671.1	-37.87	4	-33.87	-12.3	Pass
5745	6	5663.3	-38.84	4	-34.84	-16.8	Pass
5825	6	5831.2	14.15	4	18.15	27.0	Pass
5825	6	5865.1	-23.91	4	-19.91	12.8	Pass
5825	6	5871.7	-24.80	4	-20.80	11.0	Pass
5825	6	5880.1	-34.99	4	-30.99	6.50	Pass
<b>Mode#3: 802.11n40</b>							
5755	13.5	5758.2	9.85	4	13.35	27.0	Pass
5755	13.5	5676.2	-34.57	4	-30.57	-7.60	Pass
5755	13.5	5640.2	-39.39	4	-35.39	-27.0	Pass
5825	13.5	5798.2	9.89	4	13.89	27.0	Pass
5825	13.5	5868.1	-31.39	4	-27.39	12.1	Pass



A.5.4 Conducted Band Edge and Out-of-Band Graphical Test Results





## 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 ( $\leq 1\text{GHz}$ )
5. Record at least 6 highest readings for the worst case operating mode.

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

#### 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  $\geq 3 \times$  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  $\geq 3\text{MHz}$   
 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.

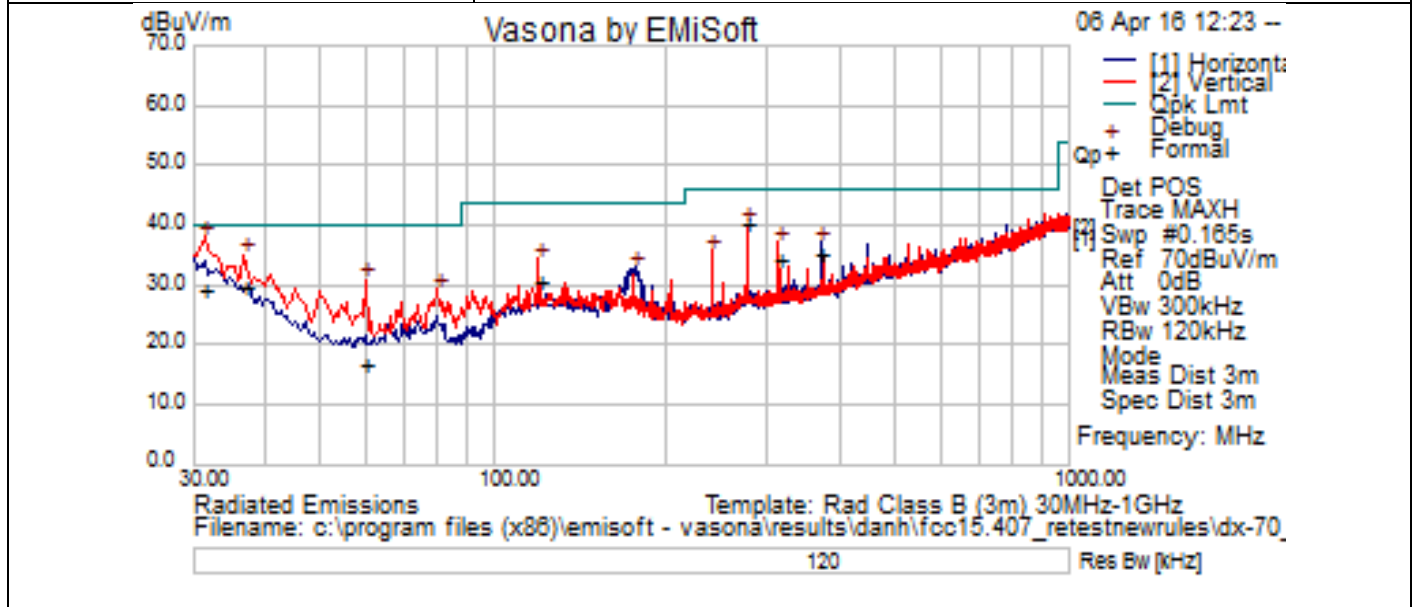
- . The system was evaluated up to 40 GHz but there were no measurable emissions above 18 GHz.
- . These data represent the worst case mode data for all supported operating modes and antennas.
  - For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the 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

<b>Subtest Date:</b>	06-Apr-2016
<b>Engineer</b>	Danh Le
<b>Lab Information</b>	Building N, 5m Anechoic
<b>Subtest Title</b>	Transmitter Spurious Emissions
<b>Frequency Range</b>	30MHz - 1GHz
<b>Comments on the above Test Results</b>	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)

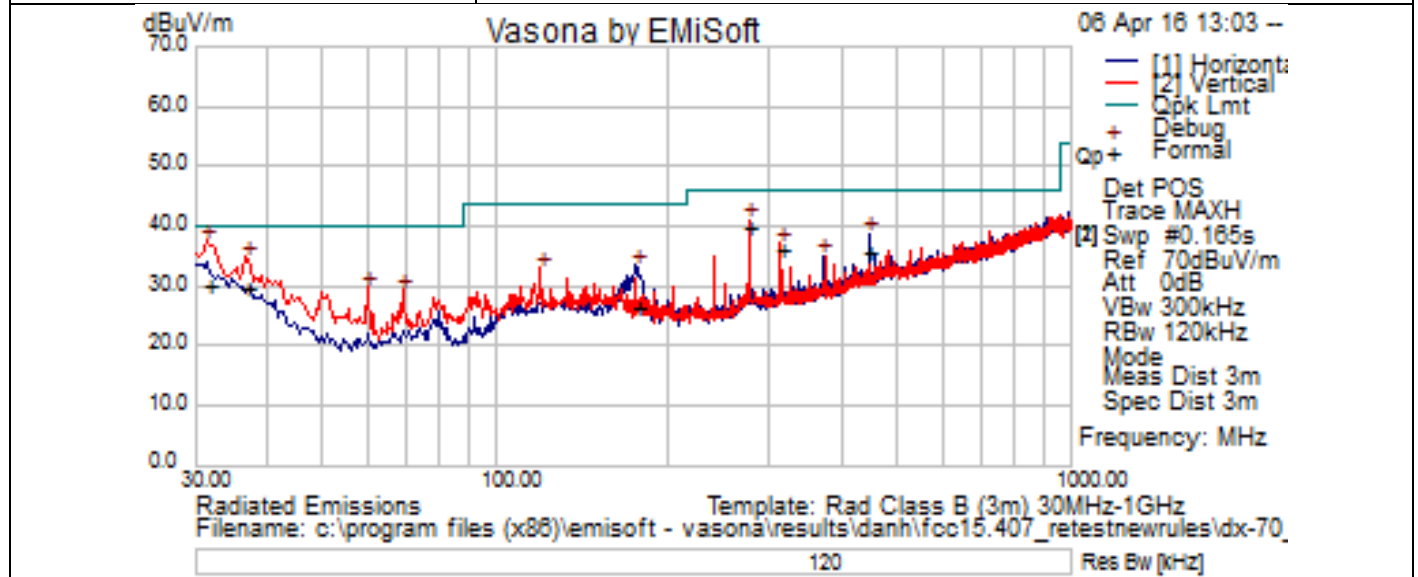


Title: TX Spurious Emissions from 30MHz-1GHz – Ch149 (5745 MHz)

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
371.243	17.83	2.43	15	35.26	Quasi Max	H	112	43	46	-10.74	Pass	Tx/Ch149
59.601	8.86	0.96	7.08	16.9	Quasi Max	V	228	56	40	-23.1	Pass	Tx/Ch149
276.479	25.3	2.08	13.3	40.68	Quasi Max	V	112	86	46	-5.32	Pass	Tx/Ch149
36.878	13.43	0.54	16.05	30.01	Quasi Max	V	177	114	40	-9.99	Pass	Tx/Ch149
119.9748	15.4	1.36	13.8	30.56	Quasi Max	V	146	172	43.5	-12.94	Pass	Tx/Ch149
313.3283	18.56	2.22	13.77	34.55	Quasi Max	V	141	262	46	-11.45	Pass	Tx/Ch149
31.39575	8.78	0.47	20.11	29.36	Quasi Max	V	185	278	40	-10.64	Pass	Tx/Ch149



Subtest Date:	06-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)

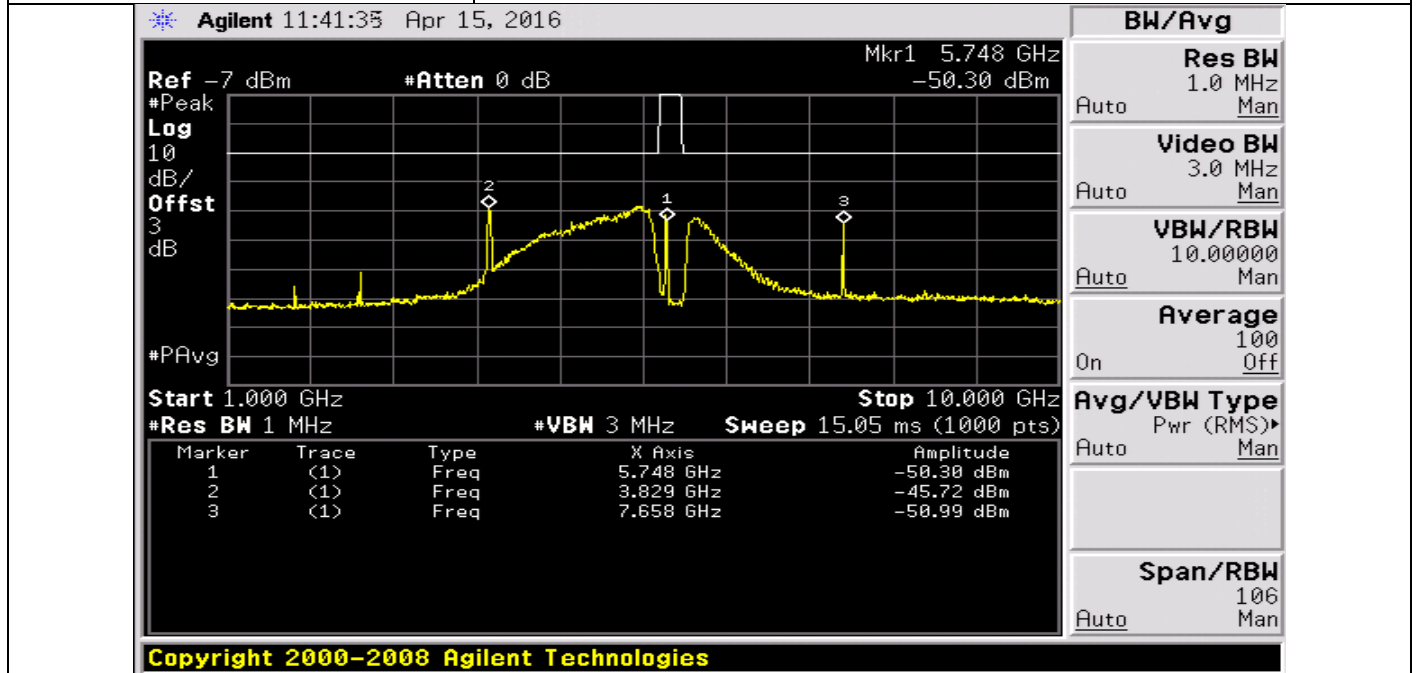


Title: TX Spurious Emissions from 30MHz-1GHz – Ch165 (5825 MHz)

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
313.3443	20.2	2.22	13.77	36.19	Quasi Max	V	120	0	46	-9.81	Pass	Tx/Ch165
276.4595	24.74	2.08	13.3	40.12	Quasi Max	V	107	90	46	-5.88	Pass	Tx/Ch165
31.69325	10	0.48	19.88	30.36	Quasi Max	V	156	95	40	-9.64	Pass	Tx/Ch165
36.8755	13.3	0.54	16.05	29.89	Quasi Max	V	175	126	40	-10.11	Pass	Tx/Ch165
174.932	13.81	1.67	11.2	26.68	Quasi Max	H	125	260	43.5	-16.82	Pass	Tx/Ch165
445.4943	16.25	2.66	16.8	35.71	Quasi Max	H	113	328	46	-10.29	Pass	Tx/Ch165



Subtest Date:	15-Apr-2016
Engineer	Danh Le
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz - 10GHz
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)

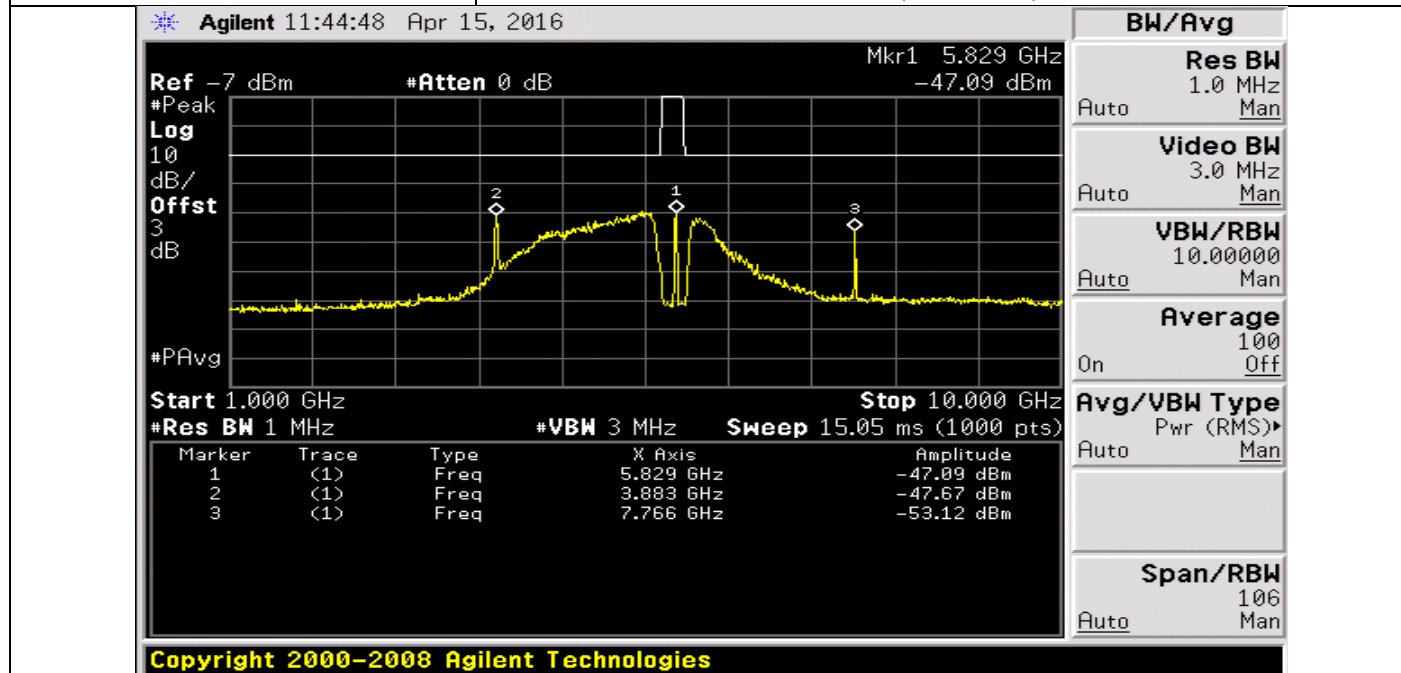


Title: TX Spurious Emissions from 1GHz-10GHz – Ch149 (5745 MHz)

Frequency (MHz)	Raw (dBm)	Cab Loss (dB)	AG (dBi)	EIRP (dBm)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBm)	Margin (dB)	Results Pass / Fail	Comments
5748	-50.30	compensated in offset	4	----	Peak	N/A	N/A	N/A	-27	----	----	Fundamental
3829	-45.72	compensated	4	-41.72	Peak	N/A	N/A	N/A	-27	-14.72	Pass	
7658	-50.99	compensated	4	-46.99	Peak	N/A	N/A	N/A	-27	-19.99	Pass	



Subtest Date:	15-Apr-2016
Engineer	Danh Le
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz - 10GHz
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 165 (5825 MHz)

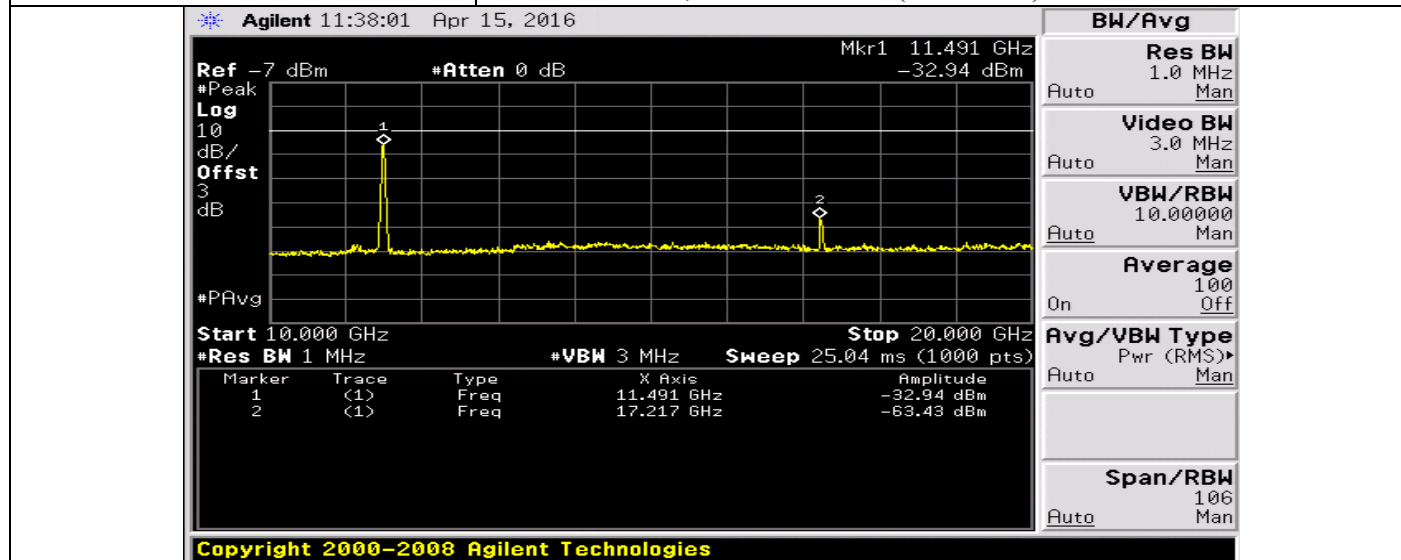


Title: TX Spurious Emissions from 1GHz-10GHz – Ch165 (5825 MHz)

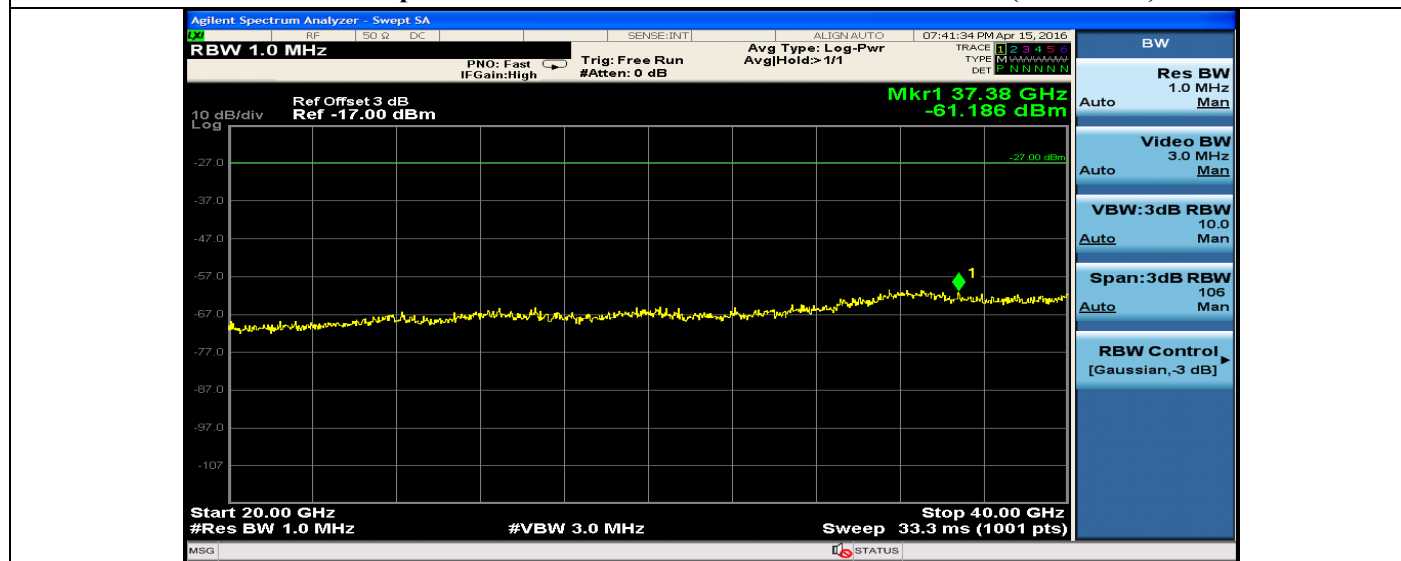
Frequency (MHz)	Raw (dBm)	Cab Loss (dB)	AG (dBi)	EIRP (dBm)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBm)	Margin (dB)	Results Pass / Fail	Comments
5829	-47.09	compensated in offset	4	----	Peak	N/A	N/A	N/A	-27	----	----	Fundamental
3883	-47.67	compensated	4	-43.67	Peak	N/A	N/A	N/A	-27	-16.67	Pass	
7766	-53.12	compensated	4	-49.12	Peak	N/A	N/A	N/A	-27	-22.12	Pass	



Subtest Date:	15-Apr-2016
Engineer	Danh Le
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10GHz - 40GHz
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 149 (5745 MHz)



Title: TX Spurious Emissions from 10GHz-20GHz – Ch149 (5745 MHz)

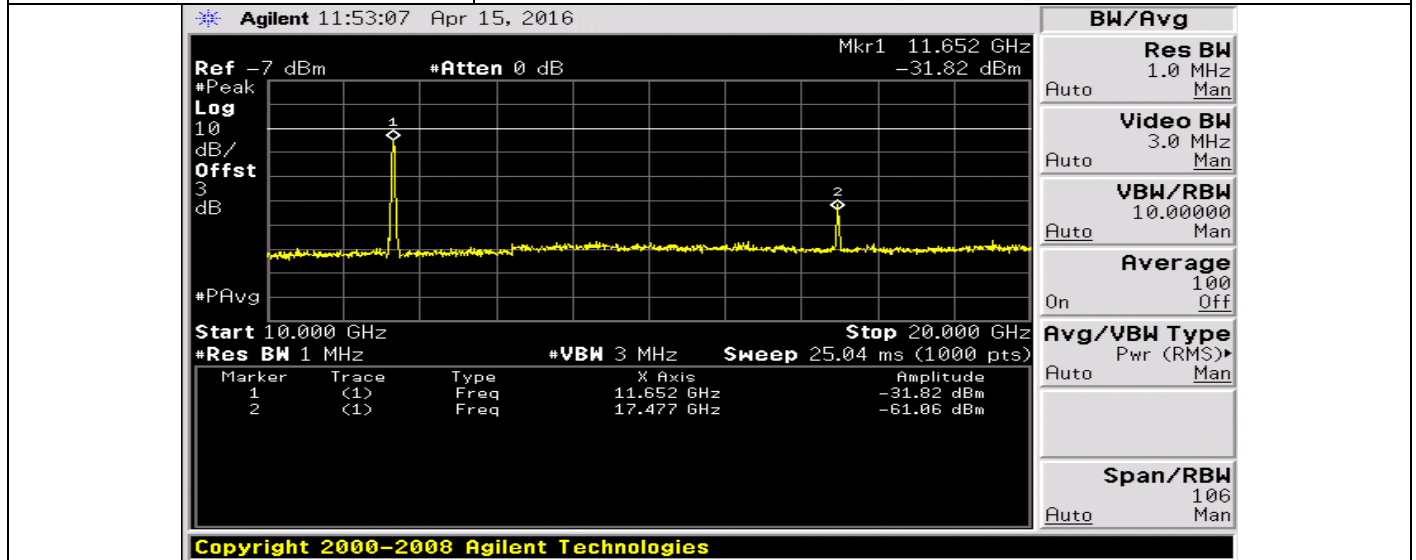


Title: TX Spurious Emissions from 20GHz-40GHz – Ch149 (5745 MHz)

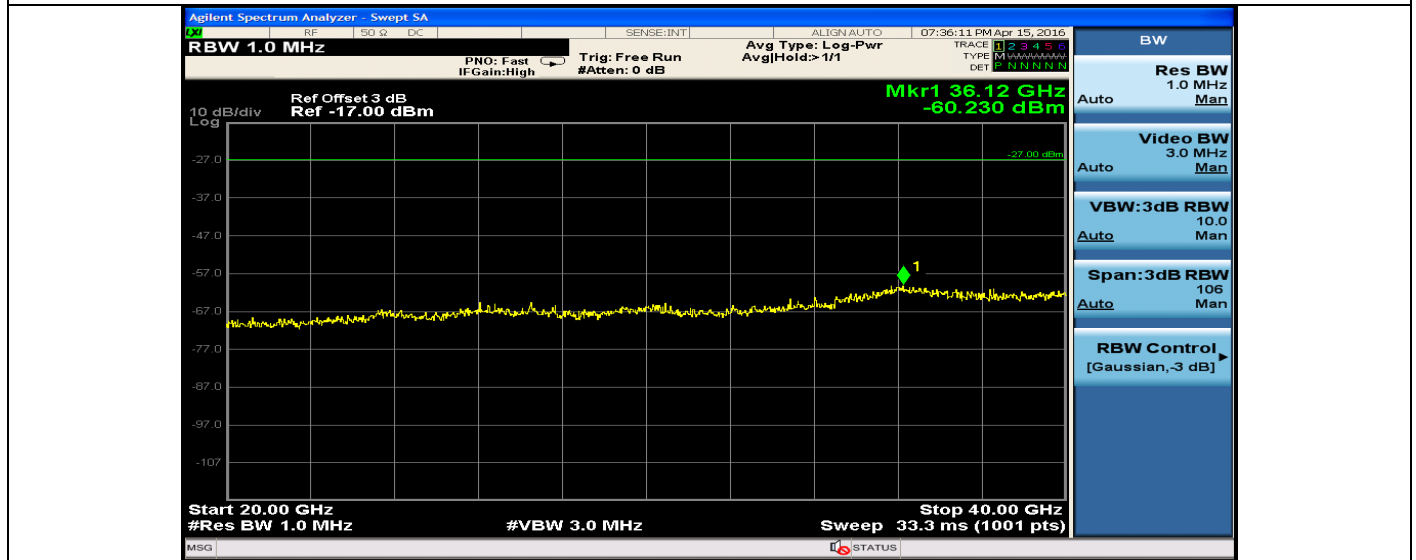
Frequency (MHz)	Raw (dBm)	Cab Loss (dB)	AG (dBi)	EIRP (dBm)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBm)	Margin (dB)	Results Pass / Fail	Comments
11,491	-32.94	compensated	4	-28.94	Peak	N/A	N/A	N/A	-27	-1.94	Pass	2 <sup>nd</sup> harmonic
17,217	-63.43	compensated	4	-59.43	Peak	N/A	N/A	N/A	-27	-20.07	Pass	3 <sup>rd</sup> harmonic



Subtest Date:	15-Apr-2016
Engineer	Danh Le
Lab Information	Building P, Wireless Lab
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10GHz - 40GHz
Comments on the above Test Results	Mode#1: 802.11a, Tx Channel 165 (5825 MHz)



Title: TX Spurious Emissions from 10GHz-20GHz – Ch165 (5825 MHz)



Title: TX Spurious Emissions from 20GHz-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
11,652	-31.82	compensated	4	-27.82	Peak	N/A	N/A	N/A	-27	-0.82	Pass	2 <sup>nd</sup> harmonic
17,467	-61.06	compensated	4	-57.06	Peak	N/A	N/A	N/A	-27	-30.06	Pass	3 <sup>rd</sup> harmonic



## 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 <sup>3</sup> )
EN	European Norm	MHz	MegaHertz (1x10 <sup>6</sup> )
IEC	International Electro technical Commission	GHz	Gigahertz (1x10 <sup>9</sup> )
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 <sup>3</sup> )
L1	Line 1	μV	Microvolt (1x10 <sup>-6</sup> )
L2	Line2	A	Amp
L3	Line 3	μA	Micro Amp (1x10 <sup>-6</sup> )
DC	Direct Current	mS	Milli Second (1x10 <sup>-3</sup> )
RAW	Uncorrected measurement value, as indicated by the measuring device	μS	Micro Second (1x10 <sup>-6</sup> )
RF	Radio Frequency	μS	Micro Second (1x10 <sup>-6</sup> )
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**

Lab tool  
Vasona by EMIssoft



## **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
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## **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#EDCS1404741

## **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.