2.4 GHz Wi-Fi Radio Test Report
DTS
For
CP-8821 IP Phone with

2.4GHz / 5.0GHz Wi-Fi Radio 802.11a/ac/b/g/n + Bluetooth v3.0

FCC ID: LDK88211296
IC ID: 2461B-88211296

Against the following Specifications:
47 CFR 15.247
47 CFR 15.209
47 CFR 15.205
RSS-Gen issue 4
RSS-247 issue 1

Cisco Systems
EMC Laboratory
170 West Tasman Drive
San Jose, CA 95134

ACCREDITED

Author: Ronak Patel
Approved by: EDCS
Title: See EDCS
Revision: See EDCS

This report replaces any previously entered test report under EDCS – **1533998**. This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 1526148

SECTION 1: OVERVIEW **4**

1.1 TEST SUMMARY 4

SECTION 2: ASSESSMENT INFORMATION **5**

2.1 GENERAL 5
2.2 UNITS OF MEASUREMENT 5
2.3 DATE OF TESTING 7
2.4 REPORT ISSUE DATE 7
2.5 TESTING FACILITIES 7
2.6 EQUIPMENT ASSESSED (EUT) 9
2.7 EUT DESCRIPTION 9

SECTION 3: RESULT SUMMARY **10**

SECTION 4: SAMPLE DETAILS **12**

4.1 SAMPLE DETAILS 12
4.2 ANTENNA INFORMATION 12
4.3 MODE OF OPERATION DETAILS 12

APPENDIX A: CONDUCTED TEST RESULTS **13**

A.1 DUTY CYCLE **14**

A.1.1 DUTY CYCLE TEST METHOD 14
A.1.2 DUTY CYCLE DATA TABLE 15
A.1.3 DUTY CYCLE GRAPHICAL TEST RESULTS 16

A.2 99% AND 6DB BANDWIDTH **17**

A.2.1 LIMIT 17
A.2.2 TEST PROCEDURE 17
A.2.3 99% AND 6DB OCCUPIED BANDWIDTH DATA TABLE 18
A.2.4 99% & 6DB OCCUPIED BANDWIDTH GRAPHICAL TEST RESULTS 19

A.3 MAXIMUM CONDUCTED OUTPUT POWER AND E.I.R.P **21**

A.3.1 LIMITS 21
A.3.3 MAXIMUM CONDUCTED OUTPUT POWER DATA TABLE 22
A.3.4 MAXIMUM CONDUCTED OUTPUT POWER GRAPHICAL TEST RESULTS 23

A.4 POWER SPECTRAL DENSITY **25**

A.4.1 LIMITS 25
A.4.2 TEST PROCEDURE 25
A.4.3 POWER SPECTRAL DENSITY DATA TABLE 26
A.4.4 POWER SPECTRAL DENSITY GRAPHICAL TEST RESULTS 27

A.5 CONDUCTED BAND EDGE **29**

A.5.1 LIMITS 29
A.5.2 TEST PROCEDURE 29
A.5.3 CONDUCTED BAND EDGE RECORDED TEST DATA 30

A.5.4 CONDUCTED BAND EDGE GRAPHICAL TEST RESULTS 31

A.6 RESTRICTED BANDS 33

A.6.2 TEST PROCEDURE 33
A.6.3 RECORDED TEST DATA 34
A.6.4 GRAPHICAL TEST RESULTS FOR RESTRICTED BANDS 35

APPENDIX B: RADIATED TEST RESULTS 40

B.1 TRANSMITTER SPURIOUS EMISSIONS & RESTRICTED BANDS 40

B.1.1 LIMITS 41
B.1.2 TEST PROCEDURE 42
B.1.3 TRANSMITTER SPURIOUS EMISSIONS GRAPHICAL DATA RESULTS 43

B.2 RECEIVER SPURIOUS EMISSIONS 50

B.2.1 LIMITS. 50
B.2.2 TEST PROCEDURE 51
B.2.3 RECEIVER SPURIOUS EMISSIONS GRAPHICAL DATA RESULTS 52

B.3 AC POWER LINE CONDUCTED EMISSIONS 54

B.3.1 LIMITS. 54
B.3.2 TEST PROCEDURE 55
B.3.3 RECORDED TEST DATA AND GRAPHICAL TEST RESULTS 57

APPENDIX C: LIST OF TEST EQUIPMENT USED TO PERFORM THE TEST 58

APPENDIX D: ABBREVIATION KEY AND DEFINITIONS 59

APPENDIX E: SOFTWARE USED TO PERFORM TESTING 60

APPENDIX F: TEST PROCEDURES 61

APPENDIX G: SCOPE OF ACCREDITATION (A2LA CERTIFICATE NUMBER 1178-01) 62

APPENDIX H: TEST ASSESSMENT PLAN 63

APPENDIX I: WORST CASE JUSTIFICATION 63

Section 1: Overview

1.1 Test Summary

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

Emission	Immunity
CFR47 Part 15.247 CFR47 Part 15.209 CFR47 Part 15.205 RSS-Gen Issue 4 RSS 247 Issue 1	N/A

Measurements were made in accordance with

- ANSI C63.10:2013, Procedure for Compliance Testing of Unlicensed Wireless Devices
- KDB 558074 D01 DTS Meas Guidance v03r03
- RSS Gen Issue 4 General Requirements for Compliance of Radio Apparatus

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 Date of testing

September 08 2015 to June 01 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 for Industry Canada

Cisco System Site	Address	Site Identifier
Building P, 10m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-2
Building P, 5m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-1
Building I, 5m Chamber	285 W. Tasman Drive San Jose, California 95134	Company #: 2461M-1
Building N, 5m Chamber	125 Rio Robles, San Jose, California 95134	Company #: 6111A

Test Engineer

Danh Le

2.6 Equipment Assessed (EUT)

CP-8821

2.7 EUT Description

The CP-8821 is the next generation IP Phone with Wi-Fi (802.11a/ac/b/g/n) and Bluetooth module support. The specification is applied to IEEE802.11a/ac/b/g/n + Bluetooth Basic rate/ EDR

Here is a brief summary of the Heracles hardware:

- IEEE 802.11 a/b/g/n/ac compliant wireless LAN
- USB 2.0/OTG interface (Shared with docking connector)
- 2.4-inch TFT LCD display, with 240 x 320 pixels, 16M colors
- Capacitive standard 12-key backlit keypad, 2 soft keys, volume and ringer control hard keys, mute hard Key, speakerphone hard key, push-to-talk hard key, dedicated end call button (shared with power-on and off function) and send/dial button, 5-way joystick/navigation keys
- 512MB LPDDR2 RAM, 4GB eMMC flash storage, version4.41
- 2020 mAh removable standard battery
- Ring, Wireless low signal, battery condition and MWI LED
- Shared antenna for 802.11a/b/g/n/ac and Bluetooth Basic rate /EDR.
- Separate ringer and voice speaker
- 3.5 mm headset interface
- Vibrate alert support
- Two Digital Microphone & Two loud speaker Interface
- Audio codec support, MP3, WAV, AAC etc.
- IP67 certified water and dust proof.

Section 3: Result Summary

Conducted Emissions

Standard(s)	Test Details / Comments	Result
FCC15.247 **RSS-247**	**Max. Conducted Output power**: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **Transmitter Output Power and e.i.r.p:** Except as provided in Section 5.4 (5), the e.i.r.p. shall not exceed 4 W. Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.	Pass
FCC15.247 **RSS-247**	**99% & 6dB Bandwidth**: The minimum -6 dB bandwidth shall be at least 500 kHz.	Pass
FCC15.247 **RSS-247**	**Spectral Density:** The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.	Pass
FCC15.247 **RSS-247**	**Conducted Band Edge & Out of band Emissions:** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC§15.209(a) & RSS-Gen is not required.	Pass
FCC15.247/205 **RSS-Gen 8.10**	**Conducted Restricted Bands:** Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). **RSS-Gen**: Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits of Table 4 specified in RSS-Gen 8.9.	Pass

Conducted Emissions (Continue)

Standard(s)	Test Details / Comments	Result
FCC15.207 **RSS-Gen 8.8**	**AC Power Line Conducted Emissions:** **FCC**: (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). **RSS**: Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits table 3 shown in section 8.8	**Pass**

Radiated emissions

Basic Standard	Test Details / Comments	Result
FCC15.209/205 **RSS-Gen6.13/8.1**	**TX Spurious Emissions and Restricted Bands:** 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) and in RSS-Gen 8.9.	**Pass**
RSS-Gen 5.0	**RX Spurious Emissions:** Receivers are required to comply with the limits of spurious emissions as set out in this section. Receiver emission measurements are to be performed as per the normative test method referenced in Section 3.	**Pass**

Section 4: Sample Details

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

4.1 Sample Details

Sample No.	Equipment Details	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01 (Radiated)	CP-8821	Cisco Systems, Inc.	01	Sip8821.10-3-2 HER-157 dev	Rootfs8821.10-3 -2HER-157-dev	FCH192180BK
S02 (Conducted)	CP-8821	Cisco Systems, Inc.	01	Sip8821.10-2-1-HE1-3.1-diagnostics	Sip8821.10-2-1-HE1-3.1-diagnostics	FCH18528TEU

4.2 Antenna Information

The following antennas are supported by this product series.

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain (dBi)
2400-2483.5	Internal	Monopole	2.4

4.3 Mode of Operation Details

Mode#	Description	Comments
1	Diagnostic	Diagnostic version allows to do conducted testing at antenna port of EUT. Image version : **Sip8821.10-2-1-HE1-3.1-diagnostics**

Measurements were made in accordance with

- ANSI C63.10:2013
- KDB 558074 D01 DTS Meas Guidance v03r03
- RSS Gen Issue 4 General Requirements for Compliance of Radio Apparatus

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)		
	2412	2437	2462
802.11b	17	17	17
802.11g	15	15	15
802.11n VHT20	11	13	10

Operating Mode	Maximum Channel Power (dBm)		
	Frequency (MHz)		
	2422	2437	2452
802.11n HT40	11	13	11

A.1 Duty Cycle

Duty Cycle Test Requirement
From KDB 558074 D01 DTS Meas Guidance v03r03
B. Duty Cycle (x), Transmission Duration (T), and Maximum Power Control Level

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

A.1.1 Duty Cycle Test Method

From KDB 558074 D01 DTS Meas Guidance v03r02
B. Duty Cycle (x), Transmission Duration (T), and Maximum Power Control Level

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

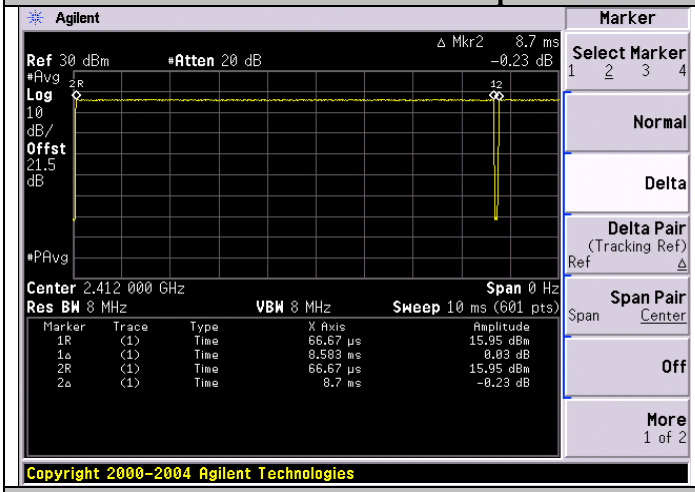
A.1.2 Duty Cycle Data Table

Mode	Data Rate	On-time (ms)	Total on+off Time (ms)	Duty Cycle (%)	Correction Factor (dB)
802.11b	1	8.583	8.7	98.655	0.059
802.11g	6	1.425	1.533	92.955	0.317
802.11n20	MCS0	1.333	1.433	93.022	0.314
802.11n40	MCS0	1.267	1.367	92.685	0.330

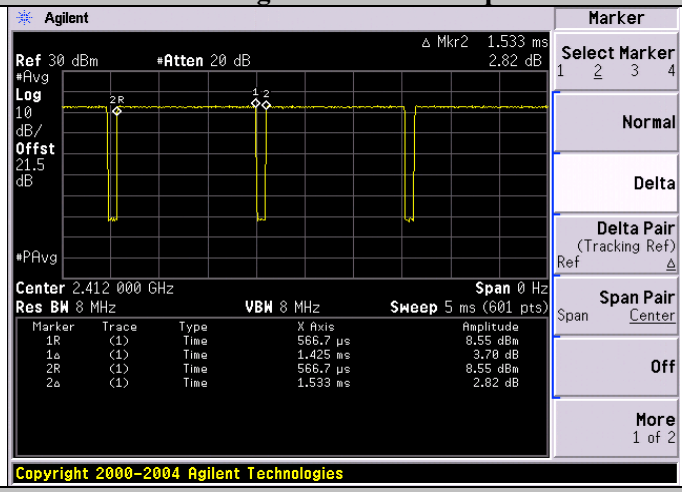
A.1.3 Duty Cycle Graphical Test results

Duty Cycle

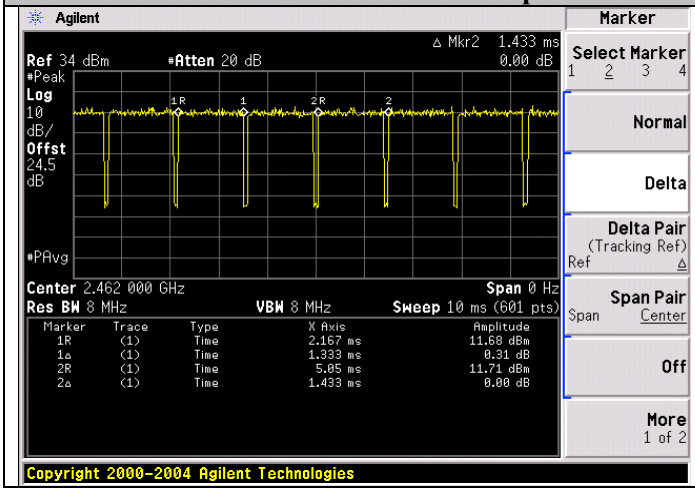
802.11b 2412 MHz 1MBps



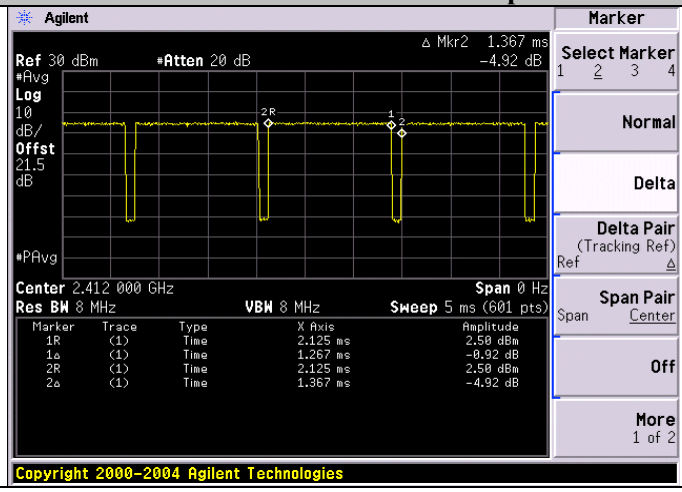
802.11g 2437 MHz 6MBps



802.11n20 2462 MHz 7.2MBps



802.11n40 2412 MHz 15MBps



A.2 99% 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 bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 6 dB below the maximum in-band spectral density of the modulated signal.

A.2.1 Limit

FCC 15.247(a) (2); RSS-247 5.2(1)
The minimum 6 dB bandwidth shall be at least 500 kHz.

A.2.2 Test Procedure

Ref. KDB 558074 DTS Meas Guidance v3r3 section 8.1 Option 2 / RSS-Gen issue 4 section 6.6

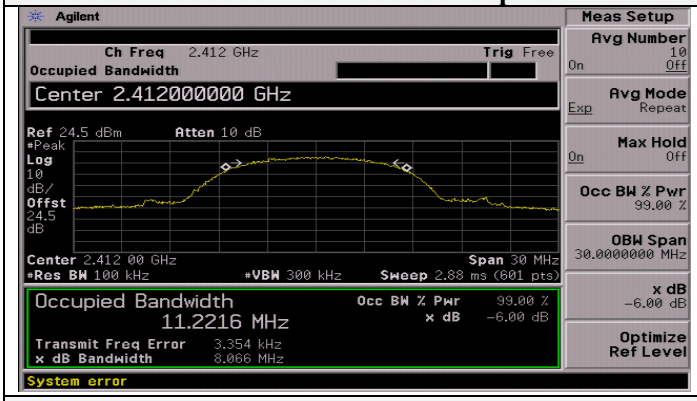
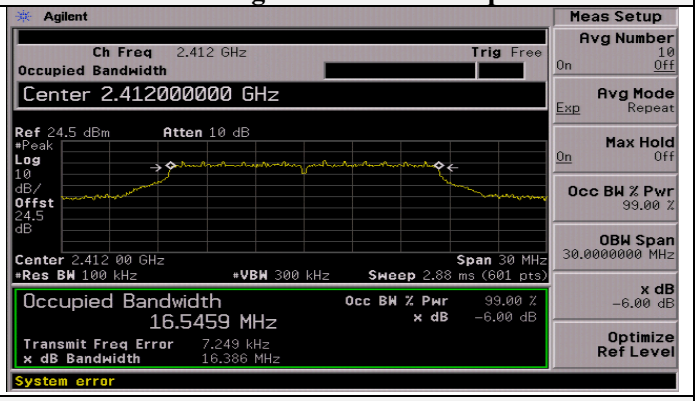
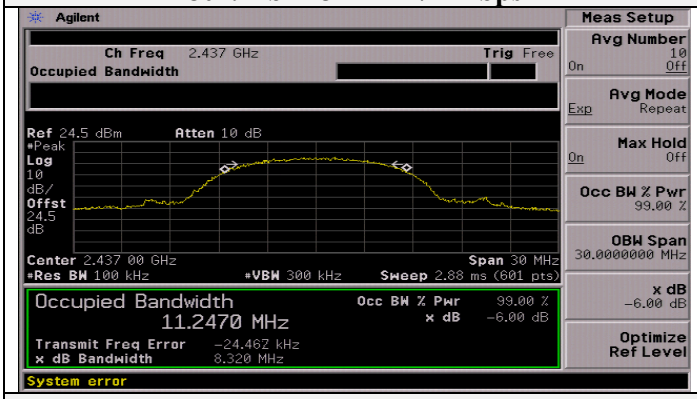
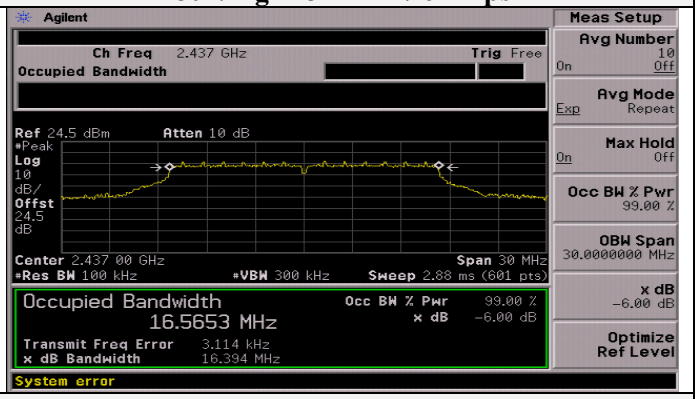
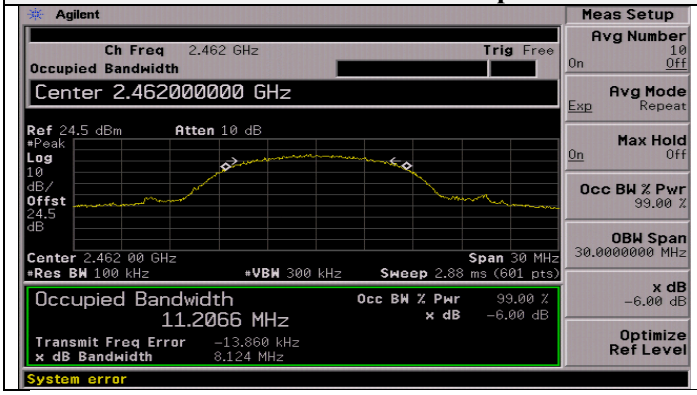
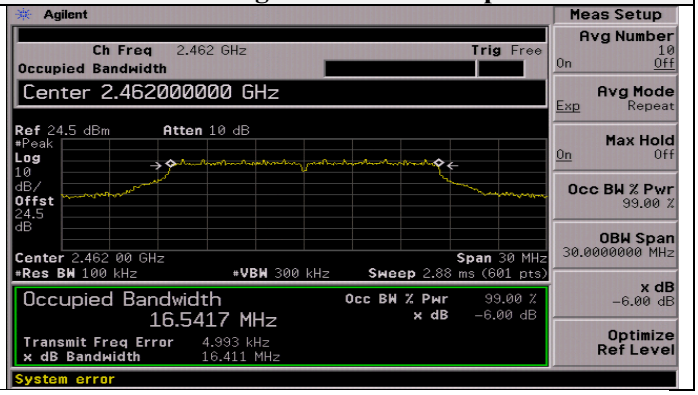
99% BW and EBW (6dB) Test Procedure
1. The radio is configured in the continuous transmitting mode. 2. Allow the trace to stabilize. 3. Setting the x-dB bandwidth mode to -6dB and OBW power function to 99% within the measurement set up function. 4. Select the automatic OBW measurement function of an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

99% BW and EBW (6dB) Test parameters
Span =Wide enough to capture the entire emission bandwidth RBW =100 kHz VBW ≥ 3 x RBW Detector =Peak Trace = Max. Hold Sweep = Auto couple

A.2.3 99% and 6dB Occupied Bandwidth Data Table

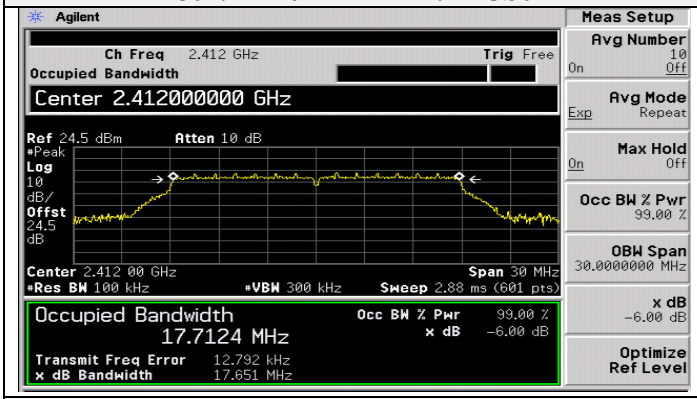
99% and 6dB Bandwidth					
Frequency (MHz)	**Data Rate (Mbps)**	**99% BW (MHz)**	**6dB BW (MHz)**	**Limit 6dB BW (KHz)**	**Result**
802.11b					
2412	1	11.22	8.06	≥ 500	Pass
2437	1	11.25	8.32	≥ 500	Pass
2462	1	11.21	8.12	≥ 500	Pass
802.11g					
2412	6	16.55	16.39	≥ 500	Pass
2437	6	16.56	16.39	≥ 500	Pass
2462	6	16.54	16.41	≥ 500	Pass
802.11n20					
2412	MCS0	17.72	17.65	≥ 500	Pass
2437	MCS0	17.71	17.64	≥ 500	Pass
2462	MCS0	17.72	17.66	≥ 500	Pass
802.11n40					
2422	MCS0	36.11	36.44	≥ 500	Pass
2437	MCS0	36.13	36.43	≥ 500	Pass
2452	MCS0	36.16	36.49	≥ 500	Pass

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

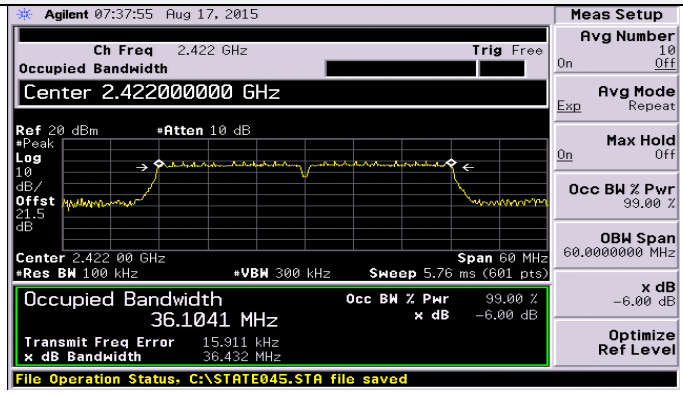
99% & 6dB Occupied Bandwidth	
802.11b 2412MHz / 1Mbps	802.11g 2412MHz / 6MBps
	
802.11b 2437MHz / 1Mbps	802.11g 2437MHz / 6MBps
	
802.11b 2462MHz / 1MBps	802.11g 2462MHz / 6MBps
	

99% & 6dB Occupied Bandwidth

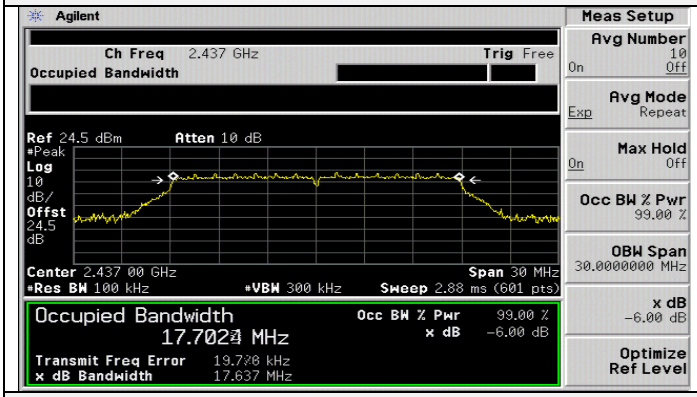
802.11n20 2412MHz / MCS0



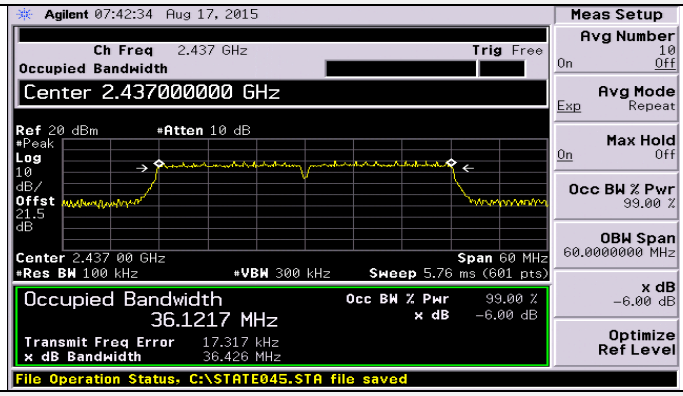
802.11n40 2422MHz / MCS0



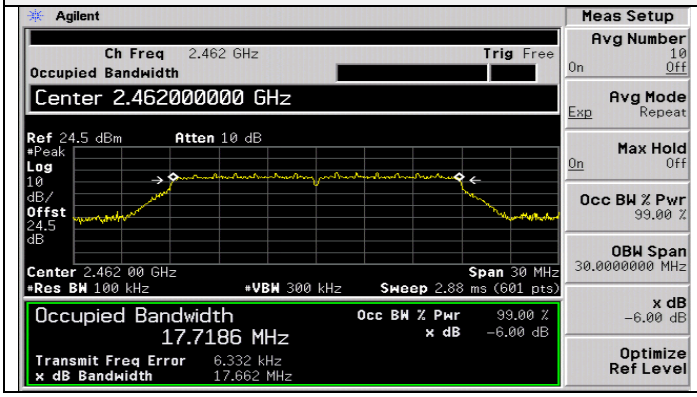
802.11n20 2437MHz / MCS0



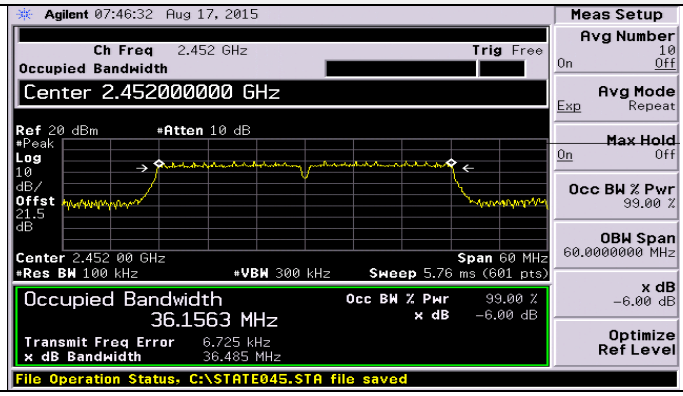
802.11n40 2437MHz / MCS0



802.11n20 2462MHz / MCS0



802.11n40 2452MHz / MCS0



A.3 Maximum Conducted Output power and E.I.R.P

The maximum conducted output power is the totals transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

A.3.1 Limits

FCC15.247 (b) (3): The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 5.4 (4): For systems employing digital modulation techniques operating in the bands 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section 5.4 (5), the e.i.r.p. shall not exceed 4 W.

A.3.2 Test Procedure

Ref. KDB 558074 DTS Meas Guidance v3r3 section 9.2.2.4

Max. Conducted Output Power Test Procedure
1. Set the radio in the transmitting mode. 2. Compute power by integrating the spectrum across the 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 OBW band edges. 3. 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). 4. Capture graphs and record pertinent measurement data.

Test parameters
Span ≥ 1.5 times the OBW RBW = 1 – 5% of the OBW, not to exceed 1 MHz VBW ≥ 3 x RBW Detector = RMS Trace Average ≥ 100 Sweep = Auto Sweep Points ≥ 2 x span/ RBW.

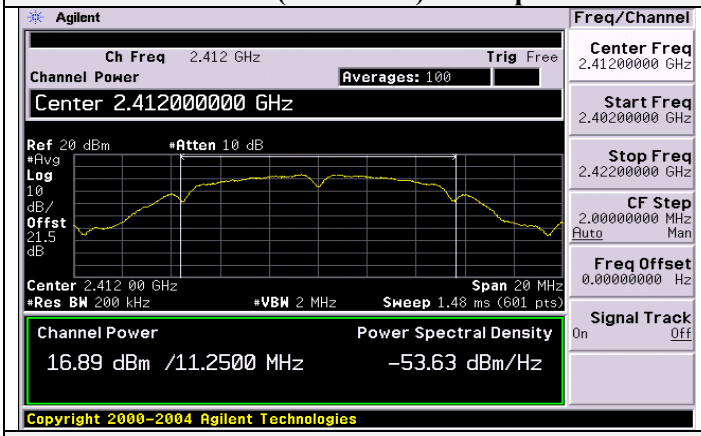
A.3.3 Maximum Conducted Output Power Data Table

Frequency (MHz)	Data Rate (Mbps)	DCCF (dB)	Maximum Conducted Output Power (dBm)	Corrected Output Power (dBm)	Conducted Output Power Limit (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
802.11b mode									
2412	1	0	16.89	16.89	30	2.4	19.29	36	Pass
2437	1	0	16.95	16.95	30	2.4	19.35	36	Pass
2462	1	0	17.19	17.19	30	2.4	19.59	36	Pass
802.11g mode									
2412	6	0.317	15.24	15.557	30	2.4	17.957	36	Pass
2437	6	0.317	15.89	16.207	30	2.4	18.607	36	Pass
2462	6	0.317	15.19	15.507	30	2.4	17.907	36	Pass
802.11n (HT20) mode									
2412	MCS0	0.314	11.70	12.014	30	2.4	14.414	36	Pass
2437	MCS0	0.314	14.35	14.664	30	2.4	17.064	36	Pass
2462	MCS0	0.314	9.83	10.144	30	2.4	12.544	36	Pass
802.11n (HT40) mode									
2422	MCS0	0.330	12.10	12.43	30	2.4	14.83	36	Pass
2437	MCS0	0.330	13.82	14.15	30	2.4	16.55	36	Pass
2452	MCS0	0.330	11.03	11.36	30	2.4	13.76	36	Pass

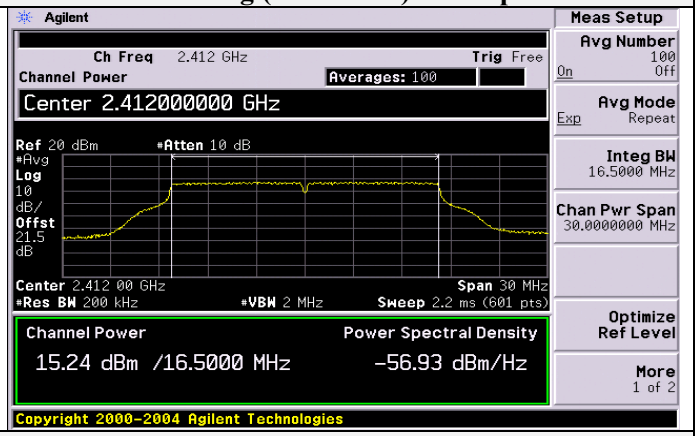
A.3.4 Maximum Conducted Output Power Graphical Test Results

Maximum Conducted Output Power

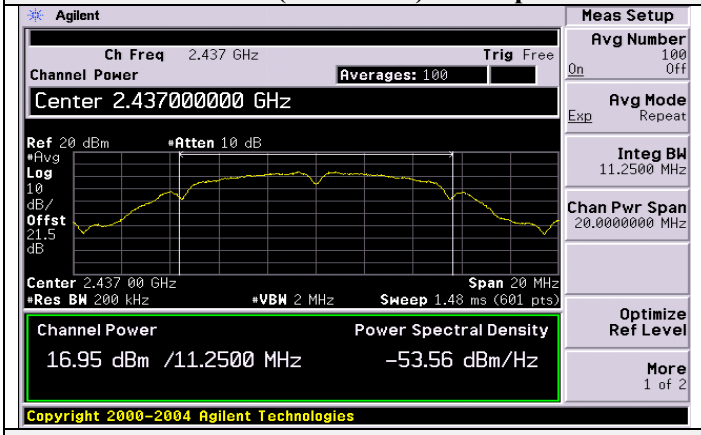
802.11b (2412 MHz) / 1 Mbps



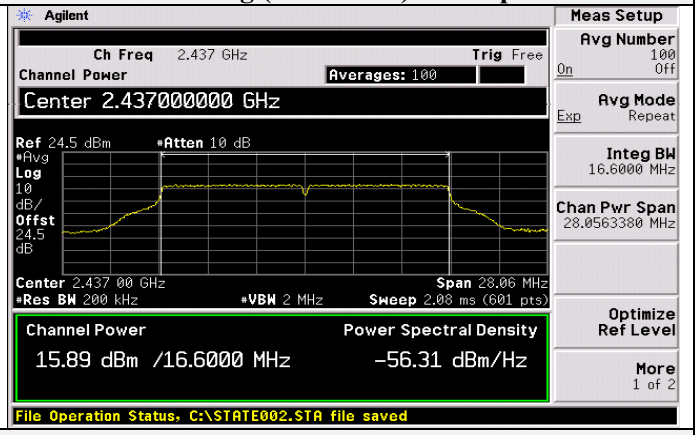
802.11g (2412 MHz) / 6 Mbps



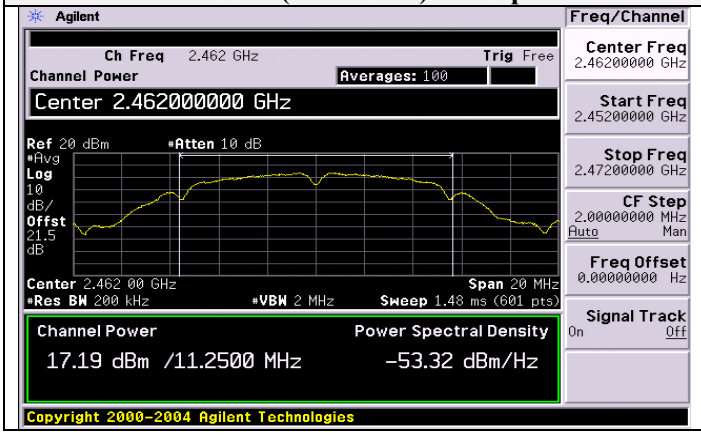
802.11b (2437 MHz) / 1 Mbps



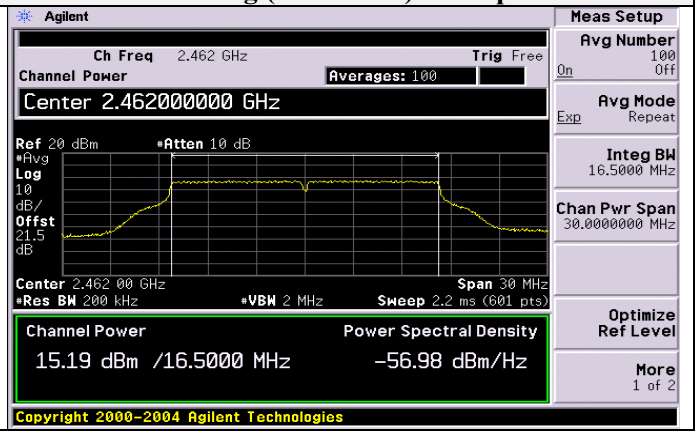
802.11g (2437 MHz) / 6 Mbps



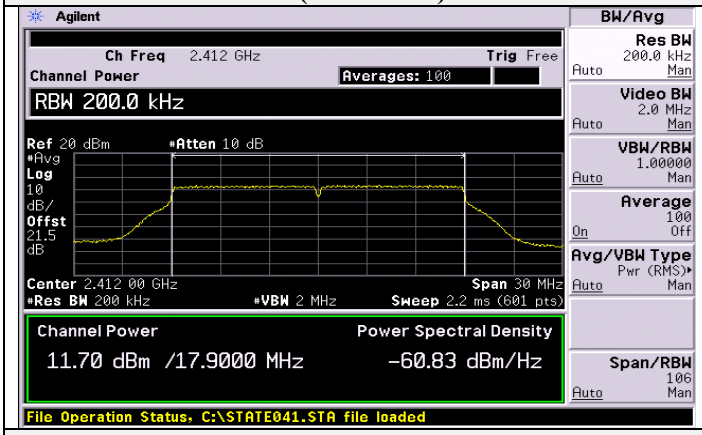
802.11b (2462 MHz) / 1Mbps



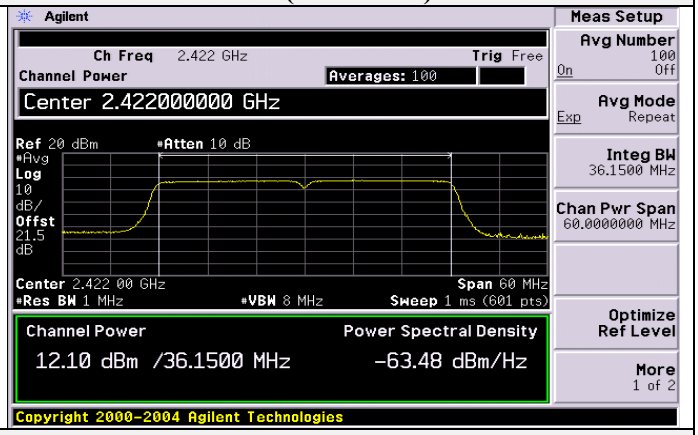
802.11g (2462 MHz) / 6Mbps



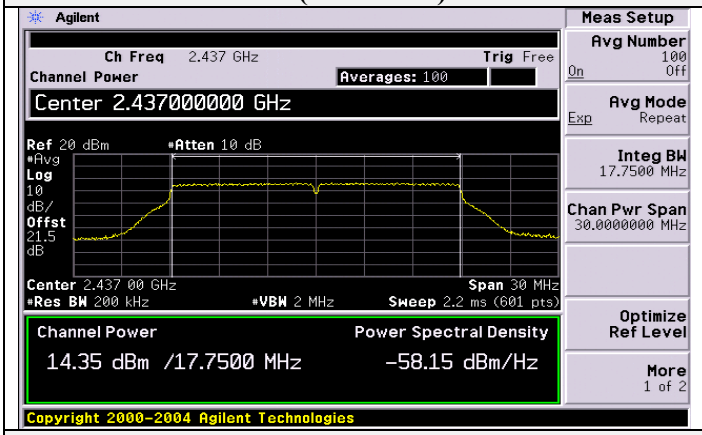
802.11n20 (2412 MHz) / MCS0



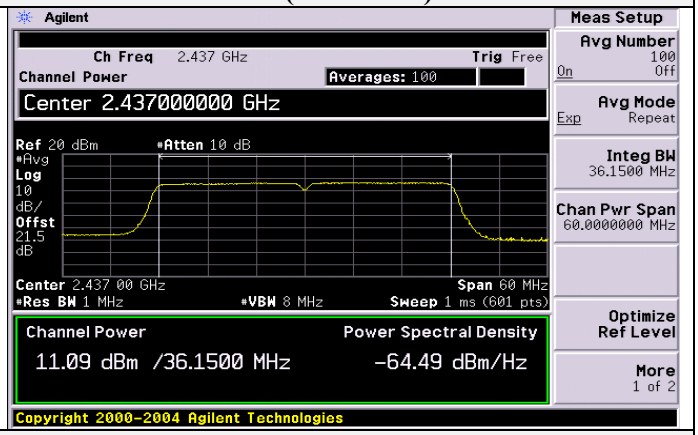
802.11n40 (2422 MHz) / MCS0



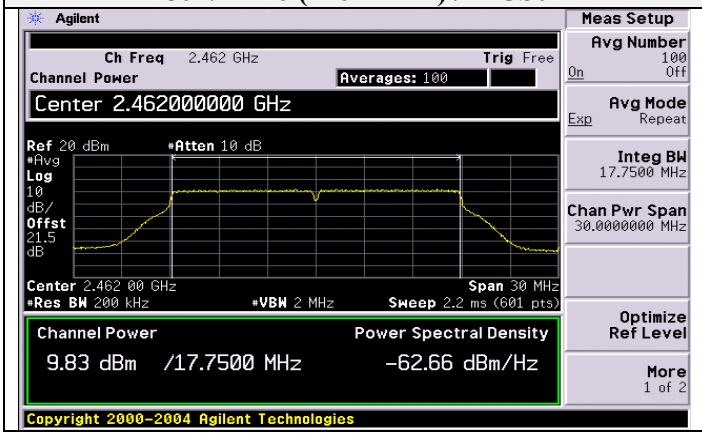
802.11n20 (2437 MHz) / MCS0



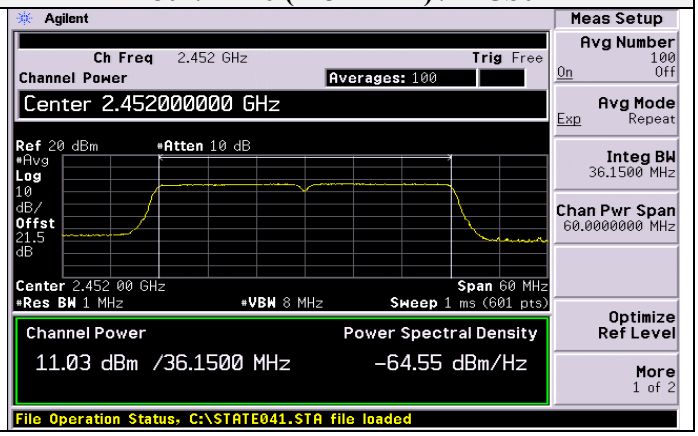
802.11n40 (2437 MHz) / MCS0



802.11n20 (2462 MHz) / MCS0



802.11n40 (2452 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 15.247(e); RSS-247 5.2(2)
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

A.4.2 Test Procedure

Ref. KDB 558074 DTS Meas Guidance v3r3 section 10.5

Power Spectral Density Test Procedure
1. Set the radio in the transmitting mode. 2. Set instrument center frequency to the DTS channel center frequency. 3. Do not use sweep triggering. Allow sweep to "free run" 4. Use the peak marker function to determine the maximum amplitude level. 5. Add 10 log (1/x), where x is the duty cycle, to the measured PSD to compute the average PSD during the actual transmission time. 3. Capture graphs and record pertinent measurement data

Power Spectral Density Test parameters
Span ≥ 1.5 times the OBW RBW ≥ 3 kHz VBW ≥ 3 x RBW Detector = RMS Trace Average ≥ 100 Sweep time = Auto couple Sweep Points ≥ 2 x span/ RBW

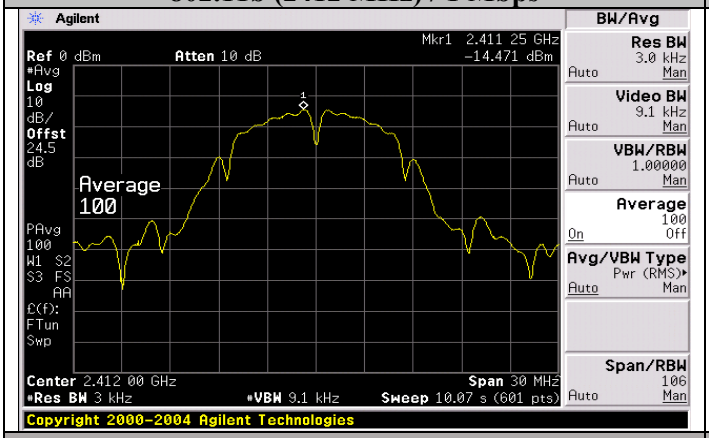
A.4.3 Power Spectral Density Data Table

Power Spectral Density						
Frequency (MHz)	**Data Rate (Mbps)**	**DCCF (dB)**	**Power Spectral Density (dBm)**	**Corrected PSD (dBm)**	**Limit (dBm/3KHz)**	**Results**
802.11b						
2412	1	0	-14.48	-14.48	8	Pass
2437	1	0	-14.52	-14.52	8	Pass
2462	1	0	-14.82	-14.82	8	Pass
802.11g						
2412	6	0.317	-17.22	-16.903	8	Pass
2437	6	0.317	-17.34	-17.023	8	Pass
2462	6	0.317	-17.25	-16.933	8	Pass
802.11n (HT20)						
2412	MCS0	0.314	-22.14	-21.826	8	Pass
2437	MCS0	0.314	-22.26	-21.946	8	Pass
2462	MCS0	0.314	-22.24	-21.926	8	Pass

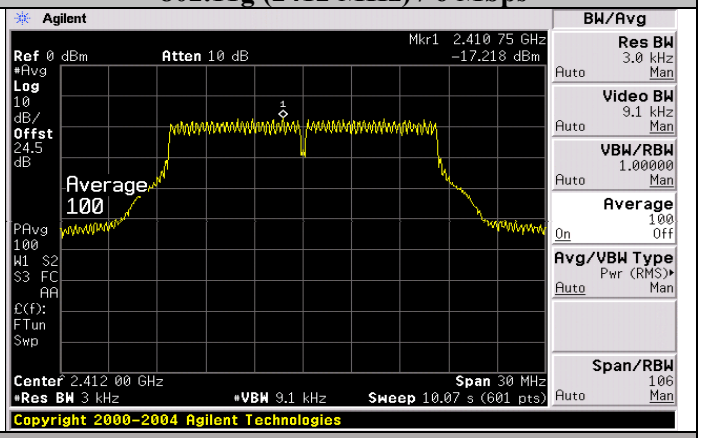
A.4.4 Power Spectral Density Graphical Test Results

Power Spectral Density

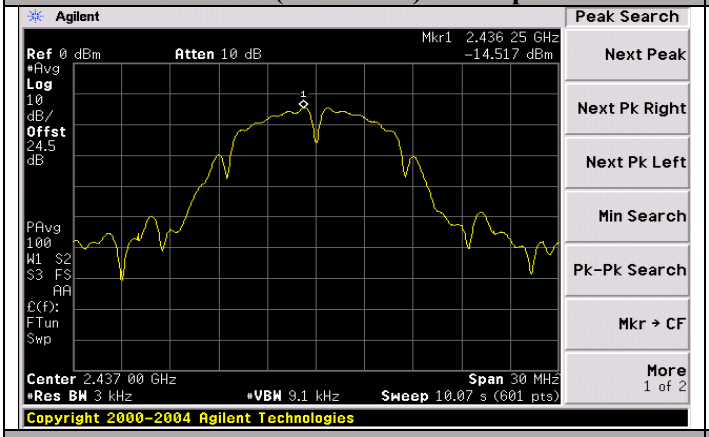
802.11b (2412 MHz) / 1 Mbps



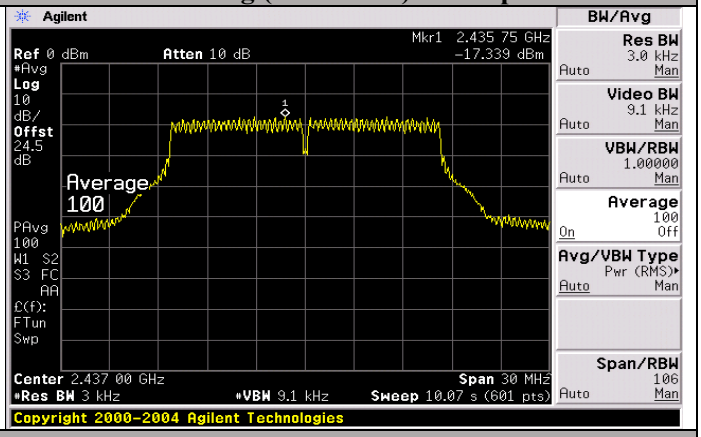
802.11g (2412 MHz) / 6 Mbps



802.11b (2437 MHz) / 1 Mbps

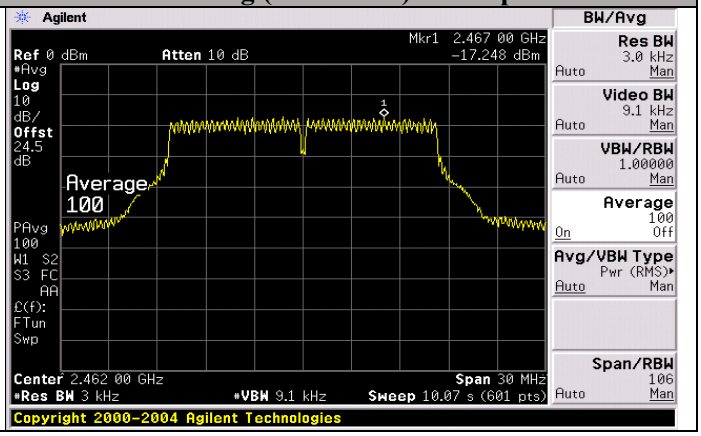


802.11g (2437 MHz) / 6 Mbps

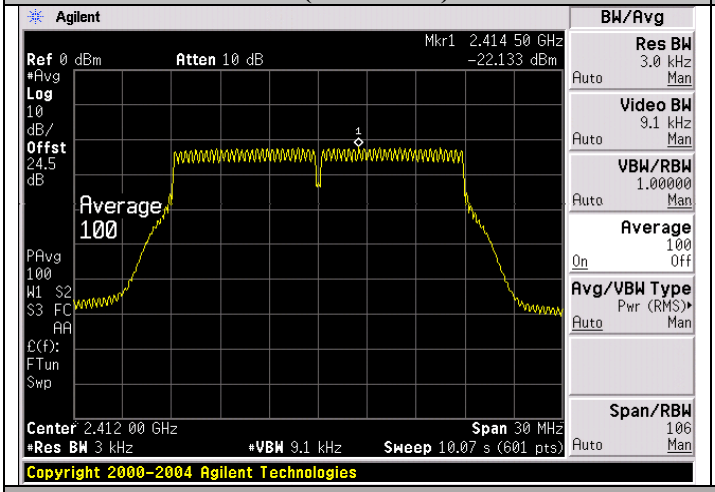


802.11b (2462 MHz) / 1 Mbps

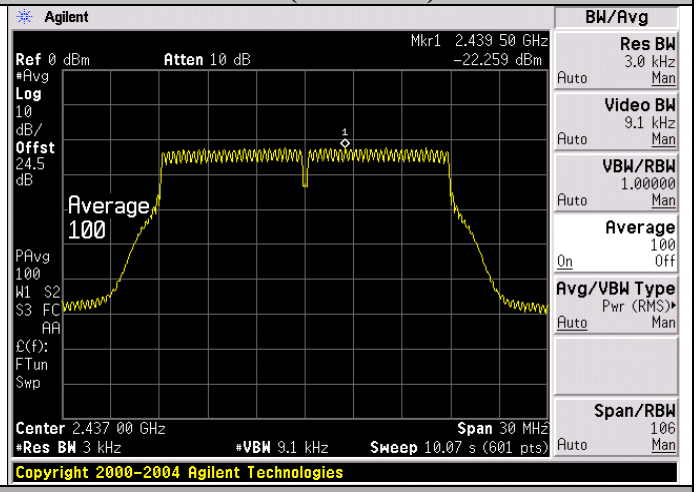
802.11g (2462 MHz) / 6 Mbps



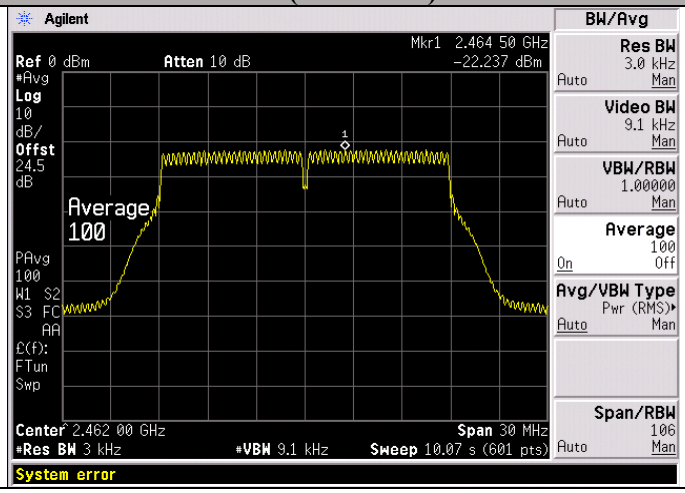
802.11 n20 (2412 MHz) / MCS0



802.11 n20 (2437 MHz) / MCS0



802.11 n20 (2462 MHz) / MCS0



A.5 Conducted Band Edge

A.5.1 Limits

FCC 15.247(d); RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC§15.209(a) & RSS-Gen is not required.

A.5.2 Test Procedure

Ref. KDB 558074 DTS Meas Guidance v3r3 section 11.1(b)

Reference Level Measurement & Emission Level Measurement Test Procedure
1) If maximum conducted (average) output power was used to demonstrate compliance as described in A.3 , then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). 2) Allow the trace to fully stabilize 3) Use the peak marker function to determine the maximum PSD level.

Ref. KDB 558074 DTS Meas Guidance v3.3 section 11.2 &11.3

Reference and Emission Level Measurement Test parameters
Span ≥ 1.5 times the DTS bandwidth RBW ≥ 100 kHz VBW ≥ 3 x RBW Detector = Peak Sweep = Auto Trace Mode = Max. Hold

A.5.3 Conducted Band Edge Recorded Test Data

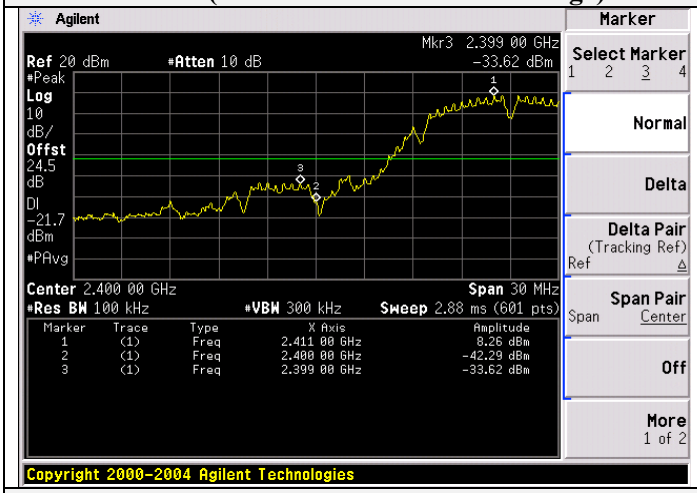
Frequency (MHz)	Data Rate (Mbps)	Power Level @Band Edge (dBm)	Limit (-30dBc)	Results
802.11b Band Edge				
2412	1	-33.62	-21.7	Pass
2462	1	-43.99	-20.30	Pass
802.11g Band Edge				
2412	6	-32.52	-25.80	Pass
2462	6	-32.21	-24.30	Pass
802.11n20 Band Edge				
2412	MCS0	-37.16	-29.40	Pass
2462	MCS0	-35.03	-27.80	Pass
802.11n40 Band Edge				
2412	MCS0	-38.35	-32.10	Pass
2462	MCS0	-40.70	-32.50	Pass

Note: correction factors (ext. attenuation + cable loss) are compensated in the offset function of the Spectrum Analyzer.

A.5.4 Conducted Band Edge Graphical Test Results

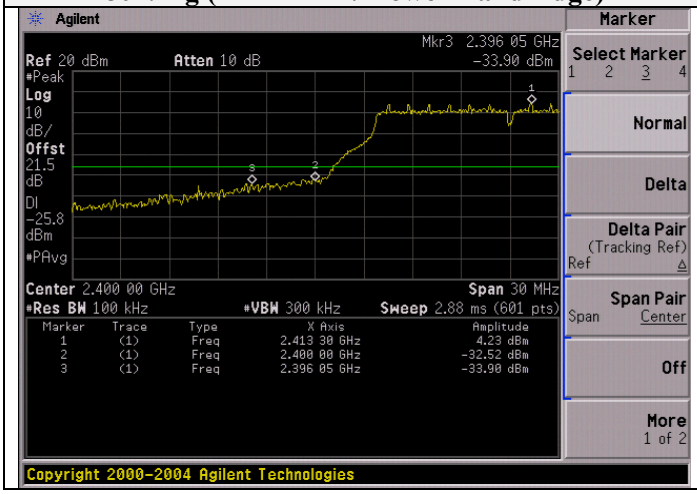
Conducted Band Edge

802.11b (2412 MHz / Lower Band Edge)

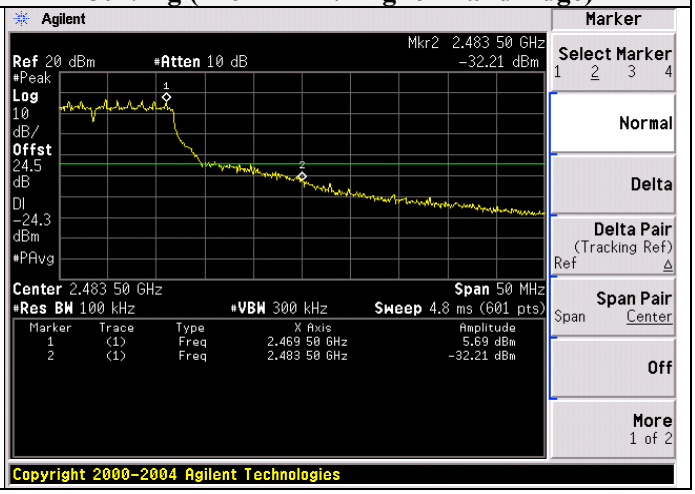


802.11 b (2462 MHz / Higher Band Edge)

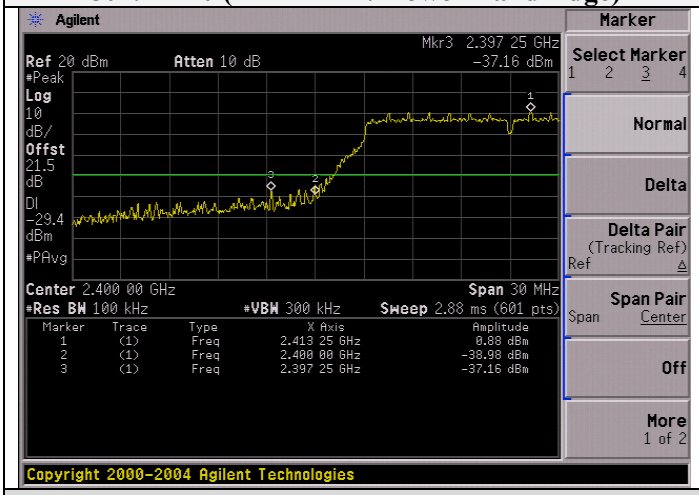
802.11g (2412 MHz / Lower Band Edge)



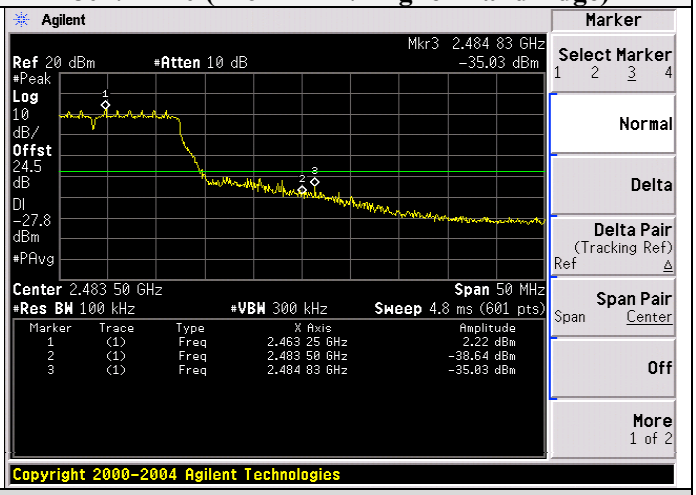
802.11g (2462 MHz / Higher Band Edge)



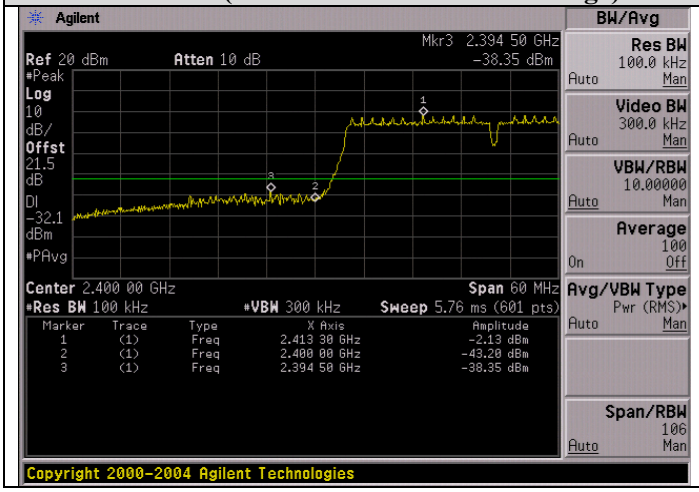
802.11n20 (2412 MHz / Lower Band Edge)



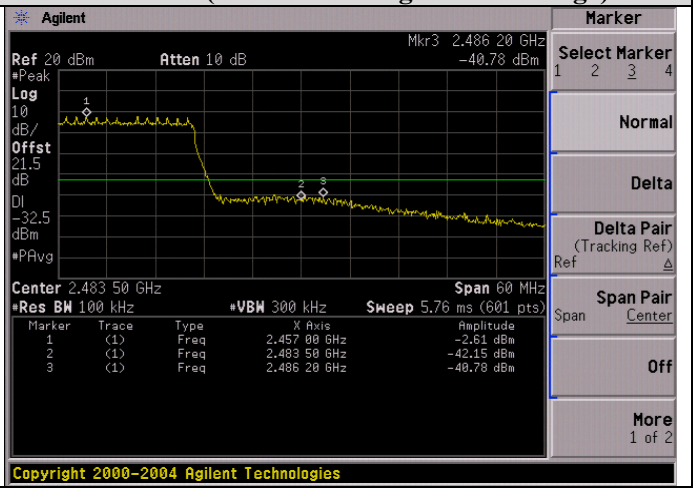
802.11n20 (2462 MHz / Higher Band Edge)



802.11n40 (2412 MHz / Lower Band Edge)



802.11n40 (2462 MHz / Higher Band Edge)



A.6 Restricted Bands

A.6.1 Limits

FCC 15.247(e); RSS-Gen 8.10

FCC: Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a).

RSS: Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen

A.6.2 Test Procedure

Ref. KDB 558074 DTS Meas Guidance v3r3 section12.2.4 / 12.2.5.2

Test Procedure
1. The radio is configured in the continuous transmitting mode. 2. Allow trace to fully stabilize. 3. Use marker peak search function to determine the maximum emissions amplitude within the restricted band. 4. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows: 5. If power averaging (RMS) mode was used, then add the applicable correction factor is 10 log (1/x), where x is the duty cycle. 6. Capture the transmitter waveforms on the spectrum analyzer, and record pertinent measurement data.

Ref. KDB 558074 DTS Meas Guidance v3.3 section12.2.4

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

Ref. KDB 558074 DTS Meas Guidance v3.2 section12.2.5.2

Restricted Bands Average Measurement Test parameters
Span = Enough to capture the full restricted band of interest RBW = 1 MHz VBW ≥ 3 x RBW Detector = RMS Averaging Type = Power average (RMS) Trace Average ≥ 100 Sweep time = Auto
Allow trace to fully stabilize. Use marker peak search function to determine the maximum emissions amplitude within the restricted band. Record data.

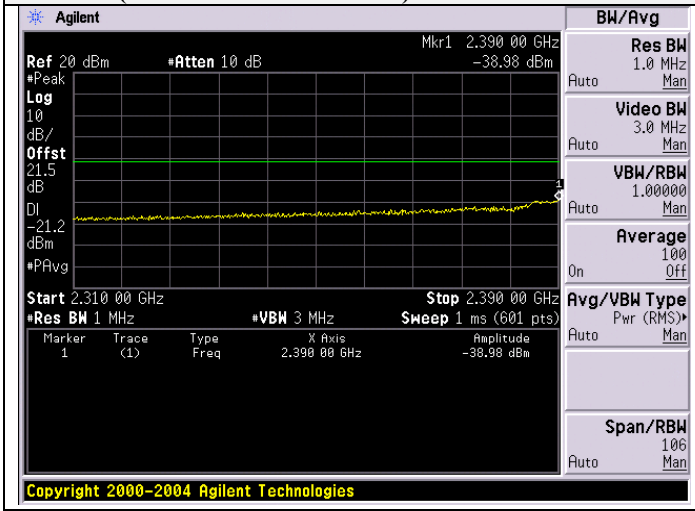
A.6.3 Recorded Test Data

Frequency (MHz)	Data Rate (Mbps)	DCCF (dB)	A.G (dBi)	Restricted Bands (MHz)	Max. Power Level (dBm)	E.I.R.P (dBm)	Limit (dBm)	Result
802.11b								
2412	1	0	2.4	2310–2390	-39.98	-37.58	-21.2	Pass
2412	1	0	2.4	2310–2390	-46.47*	-44.07*	-41.2	Pass
2462	1	0	2.4	2483.5-2500	-37.24	-34.84	-21.2	Pass
2462	1	0	2.4	2483.5-2500	-44.94*	-42.54*	-41.2	Pass
802.11g								
2412	6	0.317	2.4	2310–2390	-27.17	-24.453	-21.2	Pass
2412	6	0.317	2.4	2310–2390	-44.67*	-41.953*	-41.2	Pass
2462	6	0.317	2.4	2483.5-2500	-23.98	-21.263	-21.2	Pass
2462	6	0.317	2.4	2483.5-2500	-44.88*	-42.163*	-41.2	Pass
802.11n20								
2412	MCS0	0.314	2.4	2310–2390	-25.89	-23.176	-21.2	Pass
2412	MCS0	0.314	2.4	2310–2390	-49.48*	-46.766*	-41.2	Pass
2462	MCS0	0.314	2.4	2483.5-2500	-25.08	-22.366	-21.2	Pass
2462	MCS0	0.314	2.4	2483.5-2500	-54.13*	-51.416*	-41.2	Pass
802.11n40								
2422	MCS0	0.330	2.4	2310–2390	-24.9	-22.17	-21.2	Pass
2412	MCS0	0.330	2.4	2310–2390	-44.49*	-41.76*	-41.2	Pass
2452	MCS0	0.330	2.4	2483.5-2500	-24.22	-21.49	-21.2	Pass
2452	MCS0	0.330	2.4	2483.5-2500	-47.99*	-45.26*	-41.2	Pass

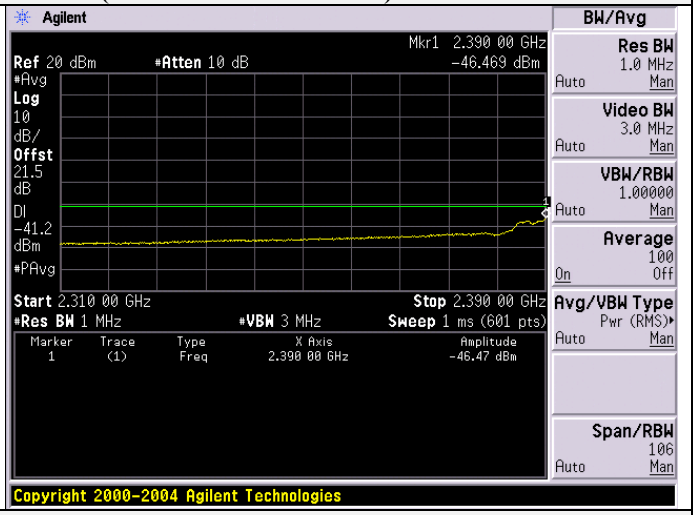
Note: Correction factors (ext. attenuation + cable loss) are compensated in the offset function of the measuring instrument. The readings with * at the end represent measurements in average.

A.6.4 Graphical Test Results for Restricted Bands

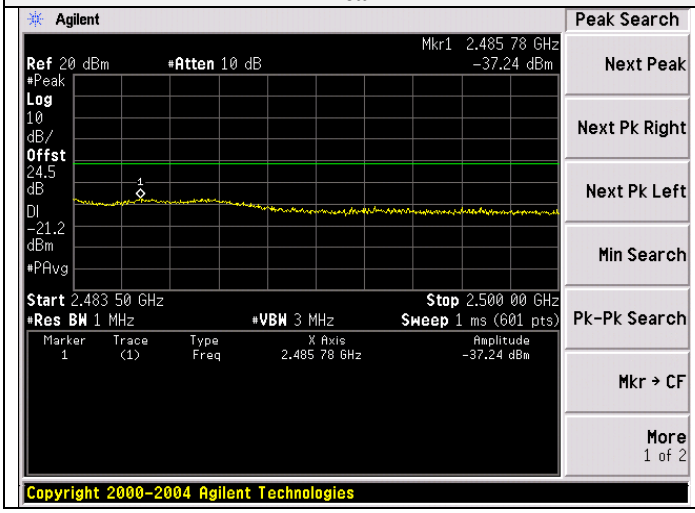
802.11b (Lower Restricted Bands) : 2310 – 2390MHz Peak



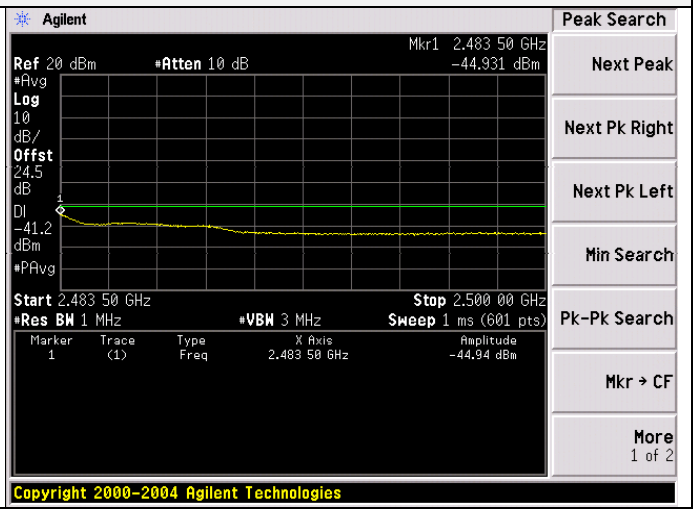
802.11b (Lower Restricted Bands) : 2310-2390MHz Ave

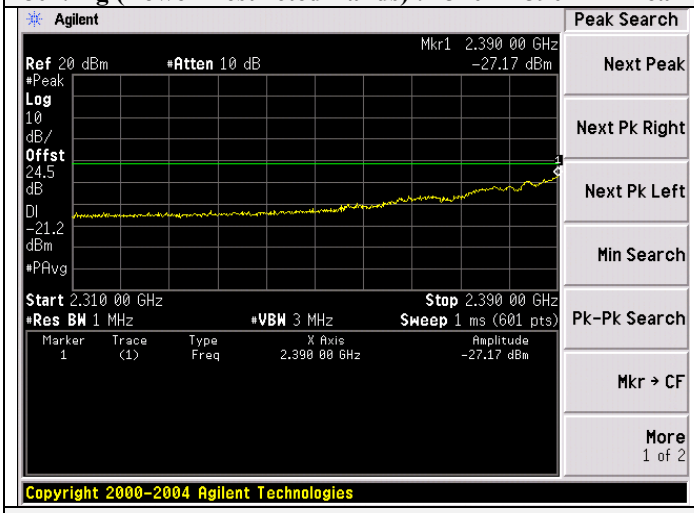
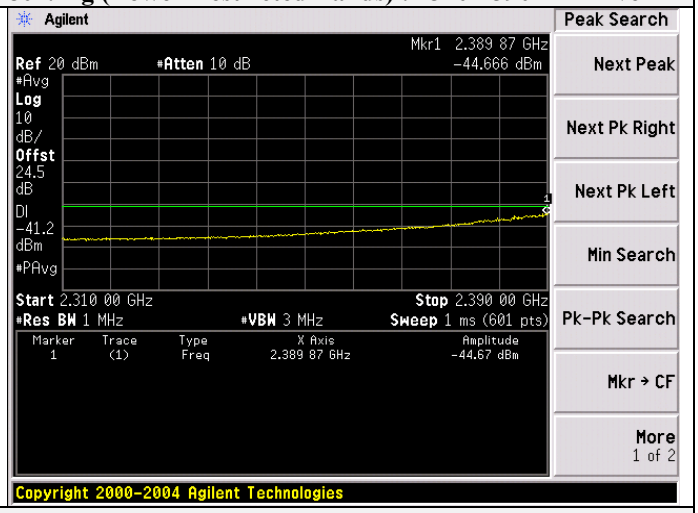
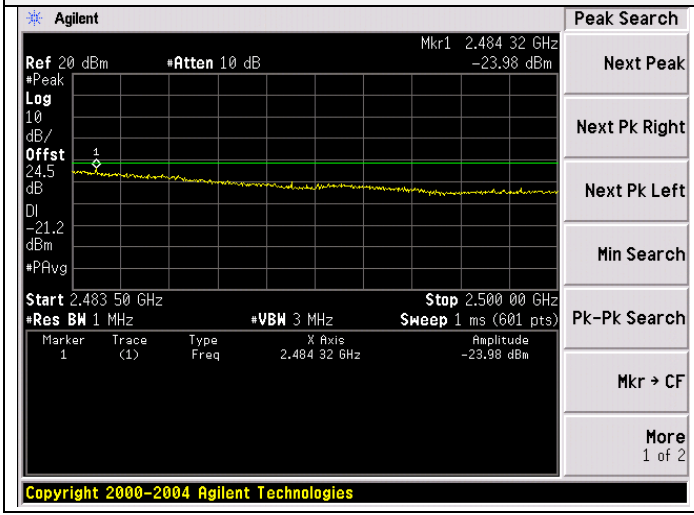
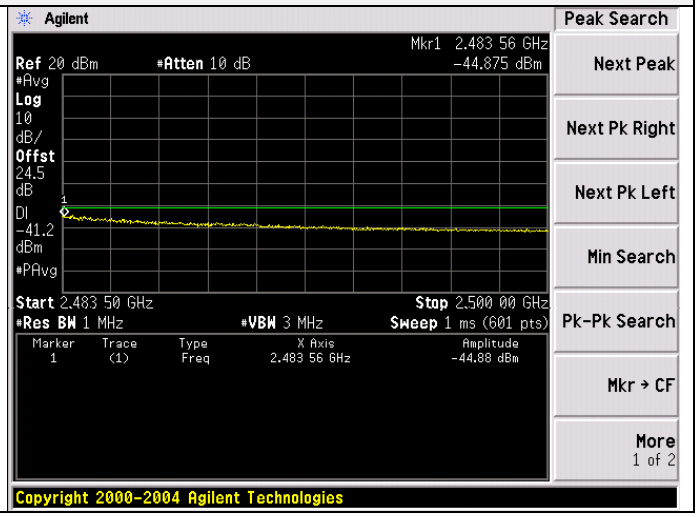


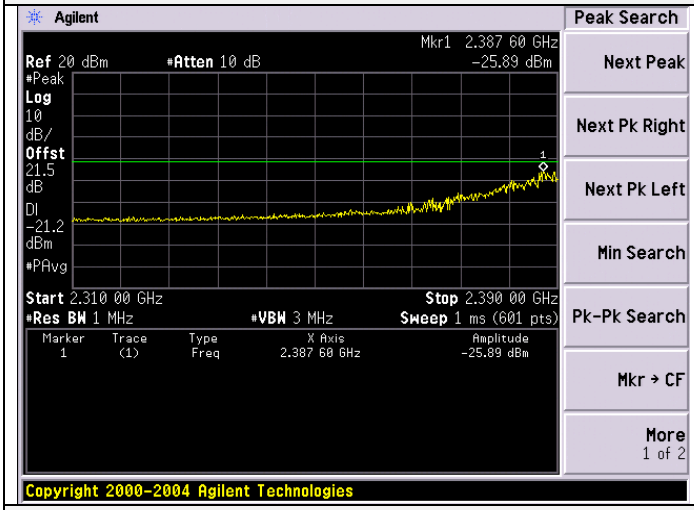
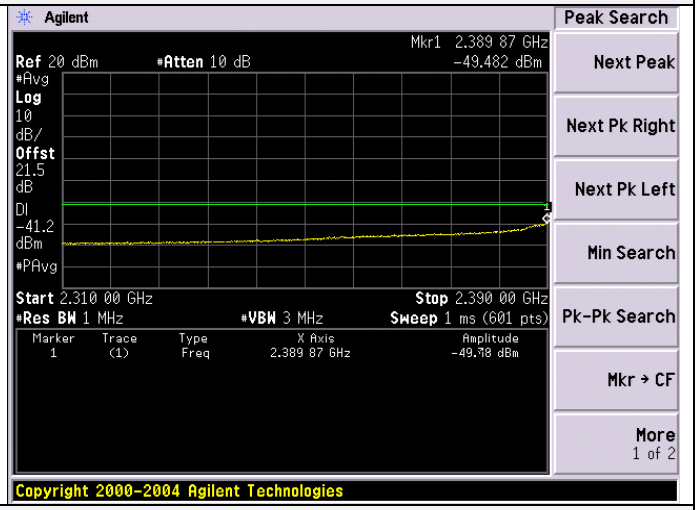
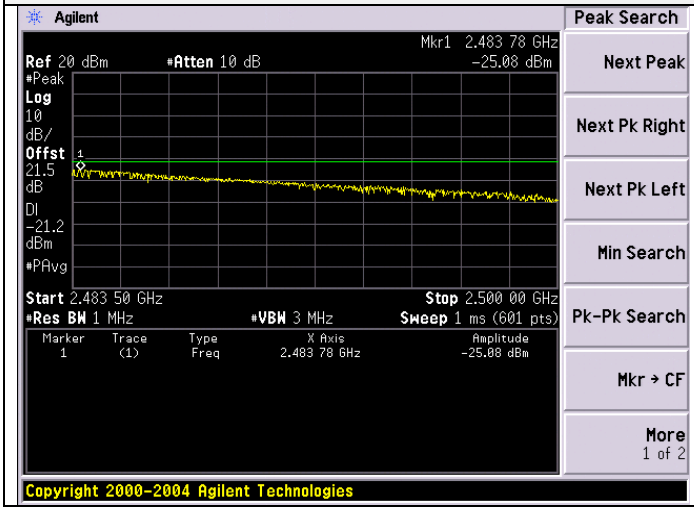
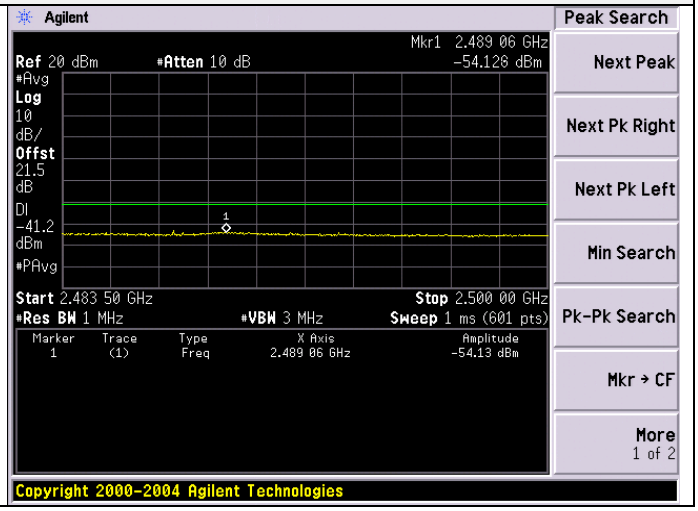
802.11b (Higher Restricted Bands):2483.5 – 2500MHz Peak

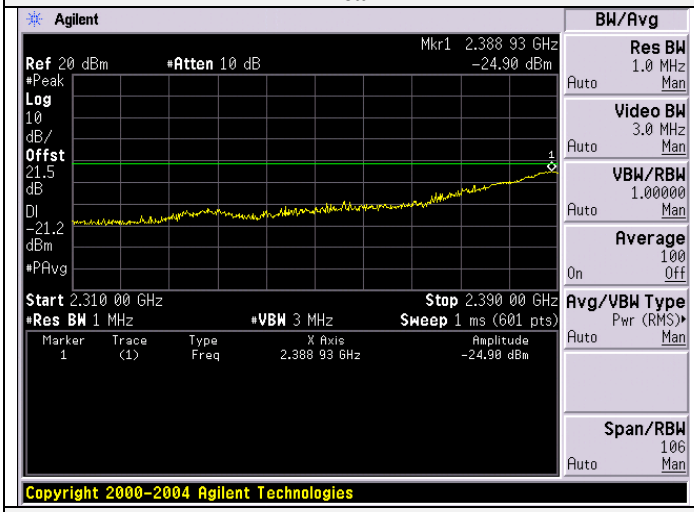
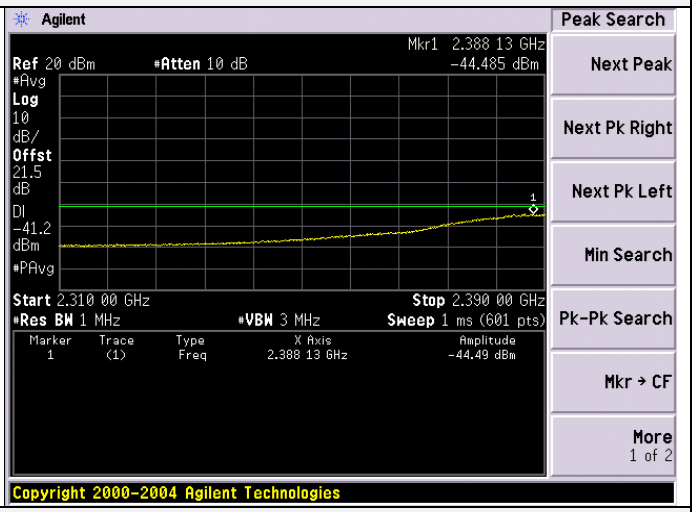
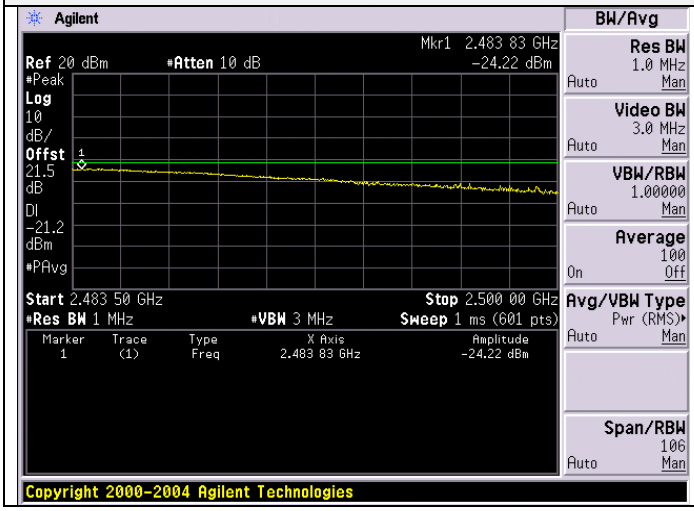
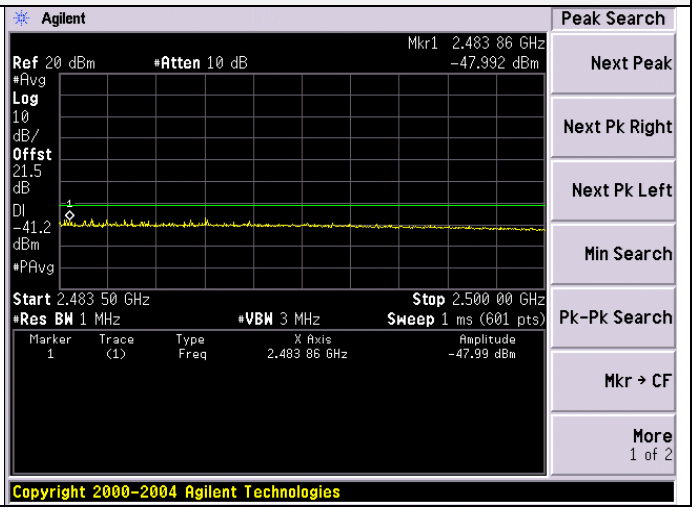


802.11b (Higher Restricted Bands): 2483.5-2500MHz Ave



802.11g (Lower Restricted Bands) : 2310 – 2390MHz Peak	802.11g (Lower Restricted Bands) : 2310-2390MHz Ave
	
802.11g (Higher Restricted Bands):2483.5 – 2500MHz Peak	**802.11g (Higher Restricted Bands): 2483.5-2500MHz Ave**
	

802.11n20 (Lower Restricted Bands):2310 – 2390MHz Peak	802.11n20 (Lower Restricted Bands) : 2310-2390MHz Ave
	
802.11n20 (Higher Restricted Bands):2483.5–2500MHz Pk	**802.11n20 (Higher Restricted Bands):2483.5-2500MHz Ave**
	

802.11n40 (Lower Restricted Bands):2310 – 2390MHz Peak	802.11n40 (Lower Restricted Bands): 2310-2390MHz Ave
	
802.11n40 (Higher Restricted Bands):2483.5– 2500MHz Pk	**802.11n40 (Higher Restricted Bands):2483.5-2500MHz Ave**
	

Appendix B: Radiated Test Results

B.1 Transmitter Spurious Emissions & Restricted Bands

FCC 15.209; RSS-Gen 8.9 Issue 4

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) and in RSS-Gen 8.9.

Restricted Bands

RSS-Gen 8.10 (**b**) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and (**c**) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6 Restricted Bands

MHz	MHz	GHz
0.090-0.110	74.8-75.2	9.0-9.2
2.1735-2.1905	108-138	9.3-9.5
3.020-3.026	156.52475-156.52525	10.6-12.7
4.125-4.128	156.7-156.9	13.25-13.4
4.17725-4.17775	240-285	14.47-14.5
4.20725-4.20775	322-335.4	15.35-16.2
5.677-5.683	399.9-410	17.7-21.4
6.215-6.218	608-614	22.01-23.12
6.26775-6.26825	960-1427	23.6-24.0
6.31175-6.31225	1435-1626.5	31.2-31.8
8.291-8.294	1645.5-1646.5	36.43-36.5
8.362-8.366	1660-1710	Above 38.6
8.37625-8.38675	1718.8-1722.2	*
8.41425-8.41475	2200-2300	
12.29-12.293	2310-2390	
12.51975-12.52025	2655-2900	
12.57675-12.57725	3260-3267	
13.36-13.41	3332-3339	
16.42-16.423	3345.8-3358	
16.69475-16.69525	3500-4400	
16.80425-16.80475	4500-5150	
25.5-25.67	5350-5460	
37.5-38.25	7250-7750	
73-74.6	8025-8500	

B.1.1 Limits

Radiated emissions which fall in the restricted bands, as defined in FCC Section 15.205(a) and RSS-Gen Section 8.10, must also comply with the radiated emission limits specified in FCC Section 15.209(a) and RSS-Gen Section 8.9.

15.209 (a) except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following 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

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz However, operation within These frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

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

B.1.2 Test Procedure

Ref. C63.10-2013 section 6.5 & 6.6

Test Procedure
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) 4. Record at least 6 highest readings for the worst case operating mode.

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

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

. The system was evaluated up to 26 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.

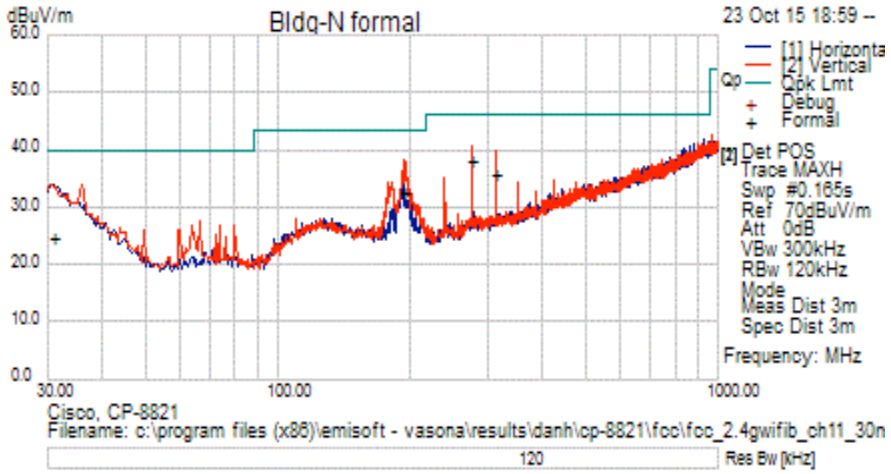
- For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function 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 an average detector with a minimum Resolution bandwidth of 1 MHz

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

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

B.1.3 Transmitter Spurious Emissions Graphical Data Results

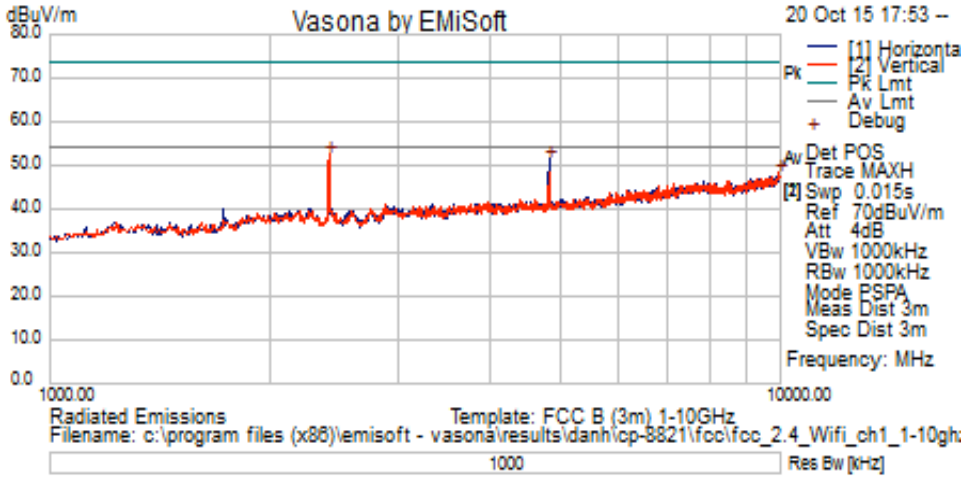
Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz-1GHz
Comments on the above Test Results	802.11b, Tx Channel 11 (2462 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch11 (2462 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
276.4848	22.91	2.11	13.3	38.32	Quasi Max	V	125	18	46	-7.68	Pass	Tx/Ch11
193.6783	19.72	1.77	11.4	32.88	Quasi Max	V	118	182	43.5	-10.62	Pass	Tx/Ch11
31.128	4.14	0.71	20.01	24.86	Quasi Max	H	266	182	40	-15.14	Pass	Tx/Ch11
313.3575	19.99	2.25	13.77	36	Quasi Max	V	115	218	46	-10	Pass	Tx/Ch11

Subtest Date:	20-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	802.11b, Tx Channel 1 (2412 MHz)



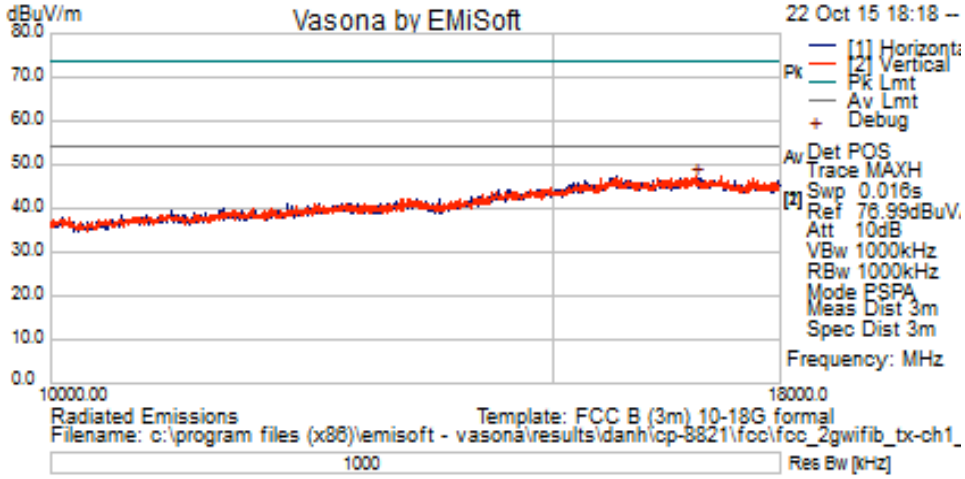
Title: **TX Spurious Emissions from 1-10GHz – Ch1 (2412 MHz)**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
2411.875	57.21	6.52	-11.33	52.4	Peak	V	250	8	54	-1.6	Pass	Tx/Ch1
4825	50.77	9.51	-8.9	51.38	Peak	H	225	229	54	-2.62	Pass	Tx/Ch1
9988.75	36.35	14.53	-2.66	48.22	Peak	V	325	327	54	-5.78	Pass	Tx/Ch1

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

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	802.11b, Tx Channel 1 (2412 MHz)



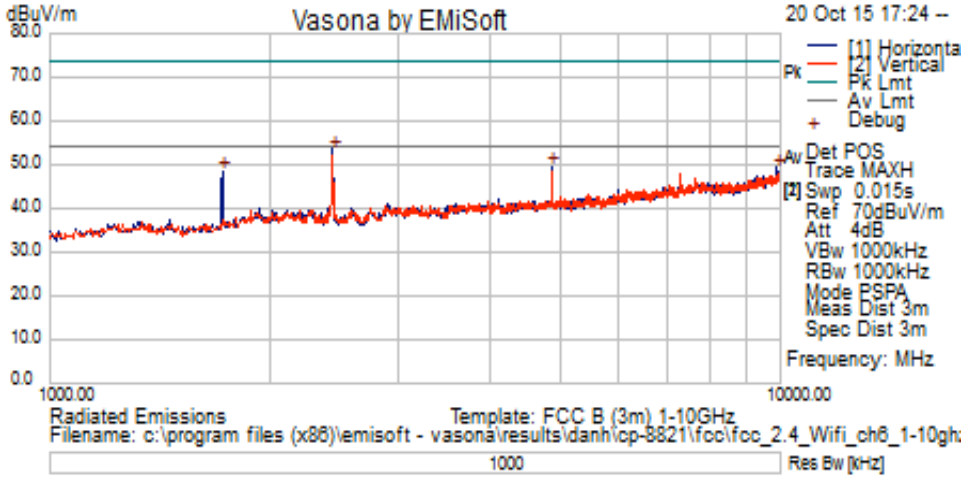
Title: **TX Spurious Emissions from 10-18GHz – Ch1 (2412 MHz)**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
16815	40.25	19.59	-12.57	47.26	Peak	V	175	108	54	-6.74	Pass	Tx/Ch1

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

Subtest Date:	20-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	802.11b, Tx Channel 6 (2437 MHz)



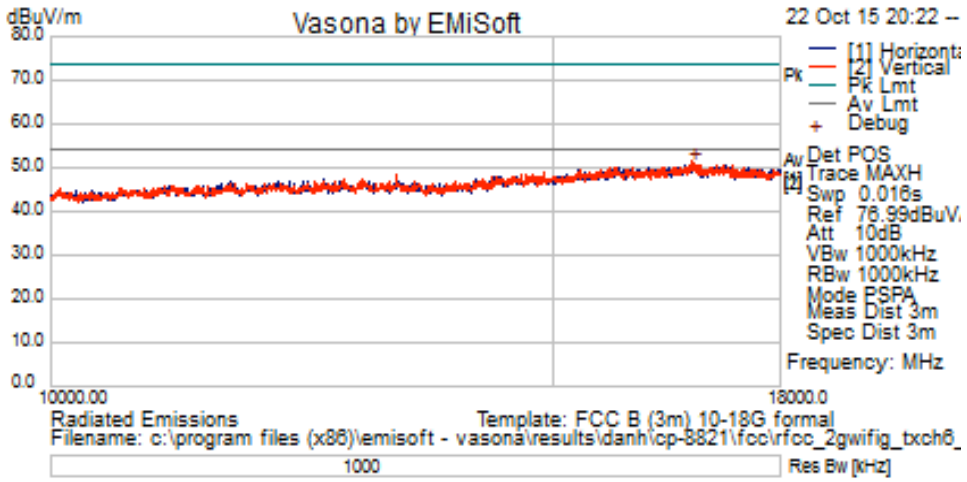
Title: **TX Spurious Emissions from 1-10GHz – Ch 6 (2437 MHz)**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
2440	58.1	6.57	-11.15	53.52	Peak	H	275	178	54	-0.48	Pass	Tx/Ch6
4875.625	49.14	9.6	-9.06	49.68	Peak	H	225	253	54	-4.32	Pass	Tx/Ch6
9921.25	37.66	14.49	-2.78	49.37	Peak	H	125	135	54	-4.63	Pass	Tx/Ch6
1720	57.61	5.44	-14.48	48.57	Peak	H	200	100	54	-5.43	Pass	Tx/Ch6

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

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	802.11b, Tx Channel 6 (2437 MHz)



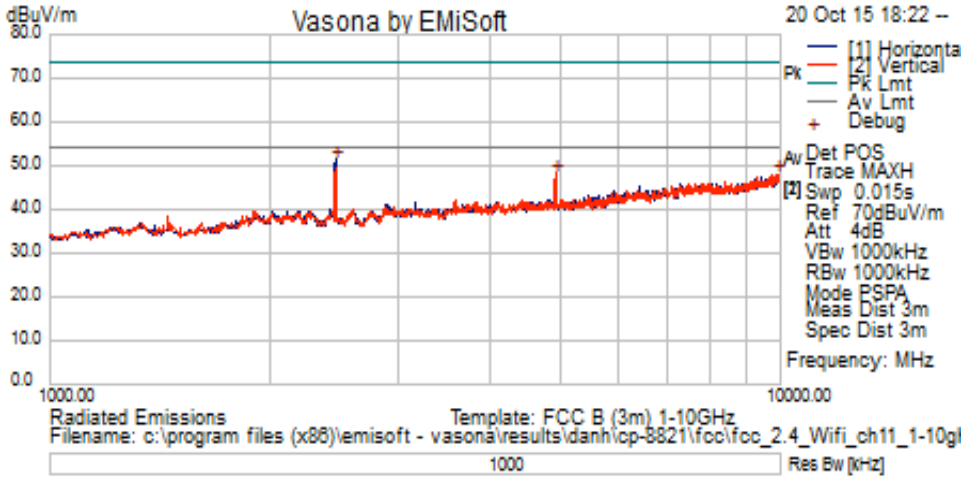
Title: **TX Spurious Emissions from 10-18GHz – Ch 6 (2437 MHz)**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
16780	43.9	19.61	-12.18	51.33	Peak	V	300	349	54	-2.67	Pass	Tx/Ch6

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

Subtest Date:	20-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	802.11b, Tx Channel 11 (2462 MHz)



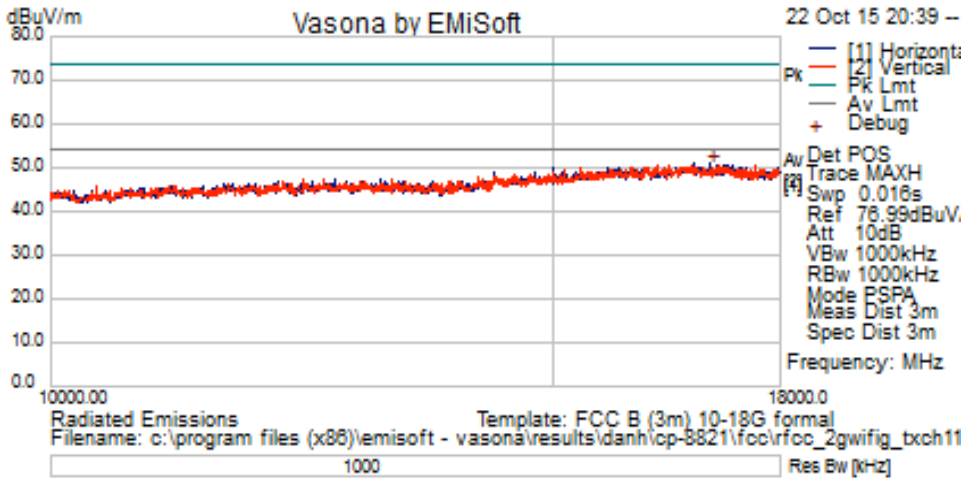
Title: **TX Spurious Emissions from 1-10GHz – Ch 11 (2462 MHz)**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
2462.5	55.66	6.61	-10.92	51.34	Peak	H	300	134	54	-2.66	Pass	Tx/Ch11
4926.25	47.26	9.65	-8.76	48.14	Peak	V	225	119	54	-5.86	Pass	Tx/Ch11
9966.25	36.17	14.49	-2.63	48.04	Peak	H	275	354	54	-5.96	Pass	Tx/Ch11

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

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	802.11b, Tx Channel 11 (2462 MHz)



Title: **TX Spurious Emissions from 10-18GHz – Ch 11 (2462 MHz)**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
17020	43.67	19.77	-12.64	50.8	Peak	H	225	245	54	-3.2	Pass	Tx/Ch11

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

B.2 Receiver Spurious Emissions

Those emissions generated in receiver and radiated from the receiver either via the antenna path or via the control power, and audio cables that may be used with the receivers

RSS-GEN: Receivers are required to comply with the limits of spurious emissions as set out in this section. Receiver emission measurements are to be performed as per the normative test method referenced in Section 3.

B.2.1 Limits.

RSS-Gen Section 5.0 / 7.1: The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate. And spurious emissions from the receivers shall not exceed the radiated limits shown in the table 2 in section 7.1.2 of RSS-Gen.

Table 2: Radiated Limits of Receiver Spurious Emissions

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

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 6.5.

This report represents the worst case data for all supported operating modes and antennas. There are no measurable emissions above 18 GHz.

B.2.2 Test Procedure

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator frequency, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 5 times the highest turntable or local oscillator frequency whichever is higher, without exceeding 40 GHz.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater than the applicable CISPR quasi-peak bandwidth or 1 MHz bandwidth, respectively.

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

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

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

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

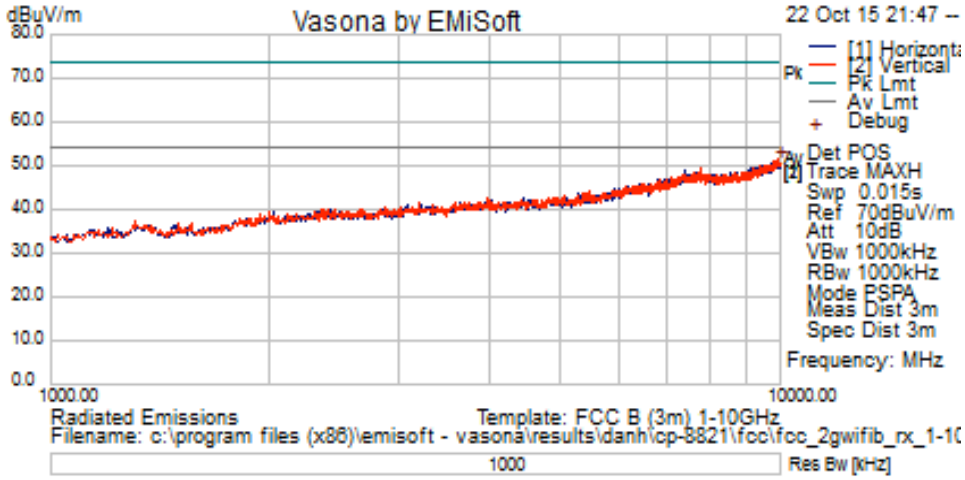
. The system was evaluated up to 40 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

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

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

B.2.3 Receiver Spurious Emissions Graphical Data Results

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Receiver Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	Rx mode

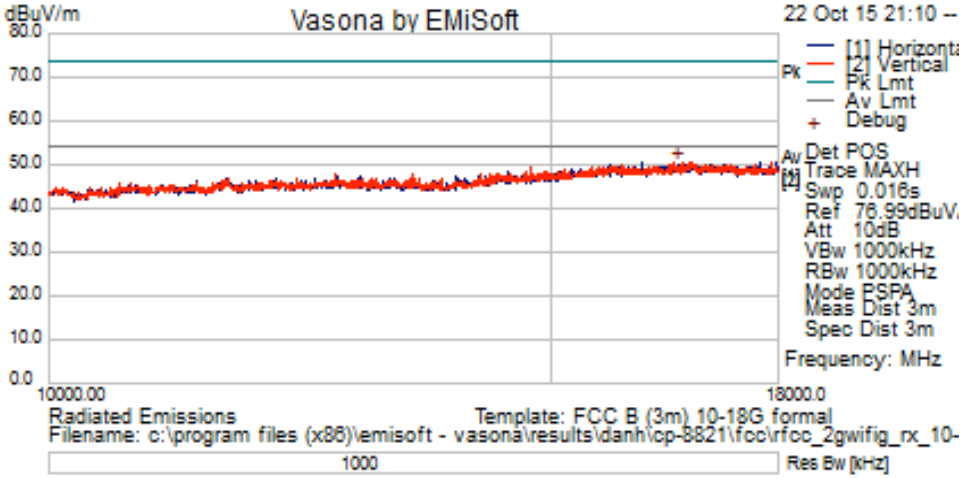


Title: **Rx Spurious Emissions from 1-10GHz**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

Note: No receiver spurious emissions has been notified that's why there is no peak or average value

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic room
Subtest Title	Receiver Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	Rx mode



Title: **Rx Spurious Emissions from 10-18GHz**

Legend: —— 74dBµV/m (Peak); —— 54 dBµV/m (Average);

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
16565	43.55	19.39	-12.18	50.76	Peak	V	275	90	54	-3.25	Pass	Rx mode

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

B.3 AC Power Line Conducted emissions

B.3.1 Limits.

FCC 15.207

Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table in these sections. The more stringent limit applies at the frequency range boundaries.

RSS-Gen 8.8 Issue 4

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.

B.3.2 Test Procedure

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

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

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

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

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

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

Ref. C63.10:2013, section 6.2

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

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

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

B.3.3 Recorded Test Data and Graphical Test results

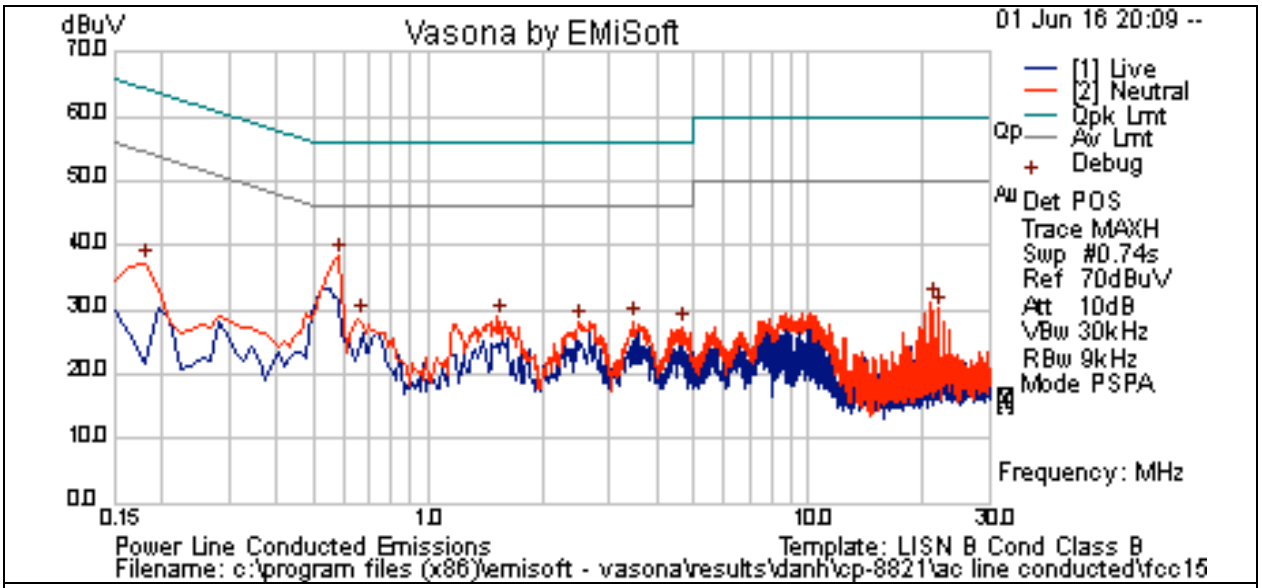
AC Conducted Emissions Test Result Tables for 802.11b (TX Ch6/ Quasi-Peak & Average)

Subtest Date:	01-Jun-2016
Engineer	Danh Le
Lab Information	Building N, formal immunity room
Subtest Title	Conducted Emissions
Frequency Range	150 kHz - 30 MHz
Comments on the above Test Results	TX Ch6 (2437 MHz) with DBPSK modulation – 1 Mbps

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	Factors (dB)	Level (dBuV)	Detector	Lines (Live/Neutral)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
0.582825	18.32	20.04	0.04	38.4	Peak [Scan]	Neutral	46	-7.6	Pass	TX / Ch6
1.5231	8.79	19.99	0.05	28.83	Peak [Scan]	Neutral	46	-17.17	Pass	TX / Ch6
0.17985	16.32	20.93	0.05	37.3	Peak [Scan]	Neutral	54.49	-17.19	Pass	TX / Ch6
0.65745	8.55	20.03	0.04	28.62	Peak [Scan]	Neutral	46	-17.38	Pass	TX / Ch6
3.46335	8.25	20.02	0.05	28.32	Peak [Scan]	Neutral	46	-17.68	Pass	TX / Ch6
2.493225	7.91	19.99	0.04	27.94	Peak [Scan]	Neutral	46	-18.06	Pass	TX / Ch6
4.672275	7.26	20.05	0.06	27.36	Peak [Scan]	Neutral	46	-18.64	Pass	TX / Ch6
21.08978	10.61	20.44	0.13	31.18	Peak [Scan]	Live	50	-18.82	Pass	TX / Ch6
21.85095	9.47	20.5	0.15	30.12	Peak [Scan]	Neutral	50	-19.88	Pass	TX / Ch6

AC Conducted Graphical Test Results for 802.11b Mode:

Note: The data displayed on the plots detailed in this section were measured using a 'Peak Detector'.
Please refer to the results table for the detectors used during final measurements.
When Peak readings are lower than Quasi-Peak & Average limits, it is not necessary to measure in Quasi-peak and Average.



Title: **TX Conducted Emissions from 150kHz – 30MHz – Ch6 (2437 MHz) - Peak**

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

Equip#	Manufacturer/ Model	Description	Last Cal	Next Due
CIS004882	EMC Test Systems / 3115	Double Ridged Guide Horn Antenna	19-AUG-15	19-Aug-16
CIS041944	Sunol Sciences / JB1	Combination Bi-Log Antenna, 30MHz-2GHz	21-JUL-15	21-JUL-16
CIS18313	HP / 8447D OPT 011	Dual Amplifier (0.1 – 13000 MHz)	28-APR-15	28-APR-16
CIS005691	Miteq / NSP1800-25-S1	Broadband Preamplifier (1-18GHz)	26-Jun-15	25-JUN-16
CIS39123	Cisco / THO118	Broadband Preamplifier (1-18GHz)	31-Mar15	31-Mar-16
CIS008100	Cisco / NSA 5m Chamber	NSA 5m Chamber	26-AUG-15	26-AUG-16
CIS035624	Rohde & Schwarz / ESCI	EMI Test Receiver	04-JUN-15	04-JUN-16
CIS024905	Agilent / E4440A	Precision Spectrum Analyzer	25-SEP-15	25-SEP-16
CIS44907	Rohde & Schwarz / ESCI	EMI Test Receiver	14-AUG-15	14-AUG-16
CIS08191	Fisher Custom Comm / FCC-450B-2.4-N	Pulse Limiter	07-JUL-15	07-JUL-16
CIS019208	TTE / H785-150K-50-21378	High Pass Filter 150KHz	09-DEC-15	09-DEC-16
CIS006565	Fisher Custom Com / 50/250-50-2-02	LISN (9kHz-30MHz)	03-MAR-16	03-MAR-17
CIS023911	Fisher Custom Com / 50-2-RA-NEMA-5-20R	LISN Receptacle Adaptor	03-MAR-16	03-MAR-17
CIS008531	Huber + Suhner / RG-223	25 ft RG-223 Cable	10-NOV-15	10-NOV-16
CIS051784	Huber+Suhner / Sucoflex 106PA	RF antenna Coaxial Cable, to 18GHz	06-JAN-15	06-JAN-16
CIS023697	Micro-Coax / UFB197C-1-3144-504504	RF Coaxial Cable, to 18GHz, 314.4 in	06-JAN-15	06-JAN-16
CIS008023	Huber+Suhner /Sucoflex SF106A	3 meter Sucoflex cable	06-JAN-15	06-JAN-16
CIS006697	Lufft / 5063-33W	Temperature/Humidity Gauge	09-MAR-15	09-MAR-16
CIS054416	Huber + Suhner/ Sucoflex 106PA	Sucoflex N Type Blue 3ft cable	28-APR-15	28-APR-16
CIS040503	Agilent Technologies / E4440A	Precision Spectrum Analyzer	10-JUN-15	10-JUN-16

Appendix D: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

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

Appendix E: Software Used to Perform Testing

EMIsoft Vasona, version 6.024

Appendix F: Test Procedures

Measurements were made in accordance with

- ANSI C63.10:2013 Procedure for Compliance Testing of Unlicensed Wireless Devices
- KDB 558074 D01 DTS Meas Guidance v03r03
- RSS Gen Issue 4 General requirements for Compliance of Radio Apparatus

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

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

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

Appendix H: Test Assessment Plan

Compliance Test Plan (Excel) EDCS#-1534002
Target Power Tables EDCS#-882940

Appendix I: Worst Case Justification

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

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

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

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

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