LS RESEARCH LLC
Wireless Product Development

ACCREDITED
TESTING CERT #1255.01

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TEST REPORT # 313179 A
LSR Job #: C-1818

Compliance Testing of:
E0150-MOD

Test Date(s):
April 25th 2012, October 11th to November 11th 2013

Prepared For:
Attention: Chris Cartile
Nikon Metrology Canada Inc.
Integrated Systems and Technologies
13-55 Fleming Dr.
Cambridge, Ontario, Canada
NIT 2A9

This Test Report is issued under the Authority of:
Khairul Aidi Zainal, Senior EMC Engineer

Signature: Date: 11/26/13

Test Report Reviewed by:	Project Engineer:
Shane Rismeyer, EMC Engineer	Khairul Aidi Zainal, Senior EMC Engineer.
Signature: Date: 11/26/13	Signature: Date: 11/13/13

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EXHIBIT 1. INTRODUCTION

1.1 - Scope

References:	FCC Part 15, Subpart C, Section 15.247 RSS GEN issue 3 and RSS 210 issue 8 Annex 8
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	FCC KDB 558074 D01 DTS Measurement Guidance v03r01 ANSI C63.10 ANSI C63.4

1.2 – Normative References

Publication	Year	Title
FCC CFR Parts 0-15	2013	Code of Federal Regulations – Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-210 Annex 8	2010	Low-power License-exempt Radio communication Devices (All Frequency Bands): Category I Equipment
RSS-GEN Issue 3	2010	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 558074 D01 DTS Measurement Guidance v03r01	2013	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.3 - LS Research, LLC Test Facility

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) as conforming to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

1.4 – Location of Testing

All testing was performed at the following location utilizing the facilities listed below, unless otherwise noted.

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA,

List of Facilities Located at LS Research, LLC:

Compact Chamber
Semi-Anechoic Chamber
Open Area Test Site (OATS)

1.5 – Test Equipment Utilized

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated by a calibration laboratory accredited to the requirements of ISO/IEC 17025, and traceable to the SI standard.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 – Client Information

Manufacturer Name:	Nikon Metrology Canada, Inc.
Address:	13-55 Fleming Dr. Cambridge, Ontario, Canada. N1t 2A9
Contact Name:	Chris Cartile

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	E0150-MOD
Model Number:	E0150-MOD
Serial Number:	10534

2.3 - Associated Antenna Description

The antenna associated with the module is an Ethertronics Prestta™ WLAN Embedded Antenna. The antenna is a multi-band antenna that operates in the 2.4GHz, 4.9GHz, 5.2GHz and the 5.8GHz bands.

The antenna performance is as listed:

WLAN a/b/g/n + Japan Antenna (GHz)	2.390-2.490 b, g	4.900-5.100 Japan	5.150-5.350 a	5.70-5.900 a
Peak Gain	-0.6dBi	2.5dBi	4.5dBi	3.5dBi
Average Efficiency	55%	71%	75%	65%
VSWR Match	3.0:1 max	2.5:1 max	2.5:1 max	3.0:1 max
Feed Point Impedance	50 Ω unbalanced (other if required)			

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2402MHz – 2480MHz (BLE) 2412MHz – 2462MHz (WLAN) 5745MHz – 5825 MHz (WLAN 5.8GHz)
RF Power in Watts (Conducted measurement)	
Minimum:	2.4GHz WLAN: 802.11b = 0.123 802.11g = 0.138 802.11n = 0.115 5.8GHz WLAN: 802.11a =0.186 802.11n =0.0692 Bluetooth LE = 0.00912
Maximum:	2.4GHz WLAN: 802.11b = 0.288 802.11g = 0.224 802.11n = 0.158 5.8GHz WLAN: 802.11a =0.219 802.11n =0.214 Bluetooth LE =0.00933
Max Conducted Output Power (in dBm)	2.4GHz WLAN: 802.11b = 24.6 802.11g = 23.5 802.11n = 22.0 5.8GHz WLAN: 802.11a = 23.4 802.11n = 23.3 Bluetooth LE = 9.7
Field Strength at 3 meters (Maximum)	Not Applicable
Occupied Bandwidth (99% BW)	2.4GHz WLAN: 802.11b = 14.6 MHz 802.11g = 16.5 MHz 802.11n = 17.7 MHz 5.8GHz WLAN: 802.11a =17.45 MHz 802.11n =18.41 MHz Bluetooth LE =1.23MHz
Type of Modulation	GFSK,OFDM,DSSS
Occupied Bandwidth (6% BW)	2.4GHz WLAN: 802.11b = 10.2 MHz 802.11g = 16.4 MHz 802.11n = 17.0 MHz 5.8GHz WLAN: 802.11a =15.9 MHz 802.11n =17.02 MHz Bluetooth LE =719.13 kHz
Transmitter Spurious (worst case) at 3 meters	53.4 dBµV/m at 2483.7 MHz
Stepped (Y/N)	Y
Step Value:	0.25dBm
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Transceiver Model # (if applicable)	WL1273L
Antenna Information	
Detachable/non-detachable	Detachable
Type	Isolated Magnetic Dipole stamped metal antenna ™.
Gain (From data sheet)	2.4GHz: -0.6 dBi 5.8GHz: 3.5 dBi
EUT will be operated under FCC Rule Part(s)	Title 47 part 15.247
EUT will be operated under RSS Rule Part(s)	RSS 210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
Duty Cycle used in evaluation: 100 %
Document used for evaluation: KDB 447498 D01 General RF Exposure Guidance
Measurement Distance: 20 cm

2400 to 2483.5 MHz Band
RF Value: **0.4997** ☐ V/m ☐ A/m ☒ W/m^2
☐ Measured ☐ Computed ☒ Calculated

5745 to 5850 MHz Band
RF Value: **0.9744** ☐ V/m ☐ A/m ☒ W/m^2
☐ Measured ☐ Computed ☒ Calculated

2.5 - Product Description

The module is a multi-standard module with support for WLAN (802.11 a/b/g/n), Bluetooth 2.1+EDR and Bluetooth 4.0 (LE).

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	70 -71° F
Humidity:	32-42%
Pressure:	728-741mmHg

3.2 - Applicability & Summary Of EMC Emission Test Results

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	Yes
FCC : 15.247 (a)(1) IC : RSS 210 A8.1 (a)	20 dB Bandwidth	N/A
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(d) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(2) IC: RSS 210 A8.2 (a)	6 dB Bandwidth of a Digital Modulation System	Yes
FCC:15.247 (d) IC: RSS 210 A8.2 (b)	Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes
The associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC).		

3.3 - Modifications Incorporated In The EUT For Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations & Exclusions From Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 8 (2010), Annex 8.

Note: If some emissions are seen to be within 3 dB of their respective limits; as these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 - Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode for final testing using power as provided by a bench DC power supply. The unit has the capability to operate on 3 channels, controllable via instructions on:

1. Proprietary LS Research WLAN programming tool for WLAN mode.
2. Proprietary LS Research Bluetooth programming tool for Bluetooth LE mode.

The applicable limits apply at a 3 meter distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels to comply with FCC Part 15.31(m).

5.2 - Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz while a standard gain horn antenna was used in the 18 GHz to 25 GHz range. The maximum radiated RF emissions between 30MHz to 4 GHz were found by raising and lowering the sense antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. Between 4GHz to 25GHz, the sense antenna was raised and lowered between 1 and 1.8 meters in height.

The radiated RF measurements for the Bluetooth Low Energy mode of the EUT was performed with the **antenna connected**. In WLAN mode, the EUT radiated measurements were **cabinet radiation** measurements which are measurements of radiated emissions while the antenna port of the EUT properly terminated.

The EUT was positioned in 3 orthogonal orientations.

In addition, this section includes the antenna port conducted measurements to be paired with the cabinet radiation measurements.

Procedure: FCC OET KDB 558074 D01 Measurement Guidance v03r01 section 12.2.

5.3 - Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a calibration laboratory accredited to ISO 17025, and are traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz).

5.4 - Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-210, Issue 8 (2010), Annex 8 for a DTS transmitter. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 - Calculation of Radiated Emissions Limits and reported data.

Reported data:

For both fundamental and spurious emissions measurement, the data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBµV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor when applicable (dB).

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor) = 35.45 (dBµV/m).

As specified in 15.247 (d) and RSS 210 A8.5, radiated emissions that fall within the restricted band described in 15.205(c) for FCC and section 2.2 of RSS 210 for IC, must comply with the general emissions limit.

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS GEN.

Frequency (MHz)	3 m Limit µV/m	3 m Limit (dBµV/m)	1 m Limit (dBµV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-40,000	500	54.0	63.5

Sample conversion of field strength (µV/m to dBµV/m):
dBµV/m = 20 $\log_{10}$ (100)= 40 dBµV/m (from 30-88 MHz)

5.6 - Radiated Emissions Test Data Chart

Manufacturer:	Nikon Metrology, Inc.						
Date(s) of Test:	October 18th to November 1st 2013						
Project Engineer(s):	Khairul Aidi Zainal						
Test Engineer(s):	Khairul Aidi Zainal, Peter Feilen, Mike Hintzke						
Voltage:	3.6 VDC						
Operation Mode:	continuous transmit, modulated						
Environmental Conditions in the Lab:	Temperature: 70° F Relative Humidity: 32%						
EUT Power:		Single Phase 120VAC		3 Phase ___VAC			
		Battery	X	Other: Bench DC Supply			
EUT Placement:	X	80cm non-conductive pedestal		10cm Spacers			
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	X	Final	
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average	

Emissions that are present but not a function of the transmitter:

Frequency (MHz)	Antenna	EUT	Height (m)	Azimuth (°)	Peak (dBµV/m)	Q.Peak (dBµV/m)	Average (dBµV/m)	Peak limit (dBµV/m)	Q.Peak limit (dBµV/m)	Average limit (dBµV/m)	Peak margin (dB)	Q.Peak margin (dB)	Average margin (dB)	Notes
300.0	H	V	1.00	0	23.3	17.8	11.3	N/A	46.0	N/A	N/A	28.2	N/A	1
933.1	H	V	1.00	0	33.1	27.6	20.9	N/A	46.0	N/A	N/A	18.5	N/A	1
210.4	V	V	1.00	150	24.5	19.1	10.6	N/A	40.0	N/A	N/A	20.9	N/A	2
133.0	H	V	1.00	0	28.5	22.4	16.4	N/A	43.0	N/A	N/A	20.6	N/A	1
85.5	V	V	1.00	0	35.5	30.6	21.8	N/A	40.0	N/A	N/A	9.4	N/A	2
130.4	V	V	1.00	313	29.9	24.5	17.8	N/A	40.0	N/A	N/A	15.5	N/A	2

Notes:

1. Measurement of system noise floor.
2. Emission does not change with channel. Found to be a function of the power supply used.
3. H: Horizontal, V: Vertical, S: Side, F: Flat.
4. Measurement above 4GHz performed at 1m separation distance. The limit value in the table reflects this separation distance.
5. Refer to exhibit 5.5 on explanation of how data is reported.

5.6.1 Bluetooth LE

The following table depicts the level of radiated emissions of channel 2402 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4804	1.00	297	55.1	47.8	63.5	15.8	Horizontal	Side
12010	1.00	131	55.3	44.9	63.5	18.6	Horizontal	Flat
19216	1.00	53	54.0	42.2	63.5	21.3	Horizontal	Side

The following table depicts the level of significant radiated emissions of channel 2440 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4880	1.03	299	57.4	54.4	63.5	9.1	Horizontal	Side
7320	1.06	54	55.7	50.8	63.5	12.7	Horizontal	Flat
12200	1.00	135	60.6	52.8	63.5	10.7	Horizontal	Flat
19520	1.00	291	53.1	41.1	63.5	22.4	Horizontal	Side

The following table depicts the level of significant radiated emissions of channel 2480 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4960	1.14	37	60.0	57.1	63.5	6.4	Horizontal	Vertical
7440	1.00	32	51.7	44.7	63.5	18.8	Horizontal	Vertical
12400	1.00	44	55.8	44.5	63.5	19.0	Vertical	Flat
19840	1.00	288	50.6	39.1	63.5	24.4	Horizontal	Side

Notes:

1. Measurements above 4 GHz were made at 1 meters of separation from the EUT. The limits were adjusted to reflect this measurement distance.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.

5.6.2 2.4GHz WLAN

The following table depicts the level of radiated emissions of channel 2412 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
7236	1.00	202	51.5	45.2	63.5	18.3	Vertical	Side
12060	1.06	326	58.6	51.7	63.5	11.8	Horizontal	Vertical
14472	1.00	216	61.6	55.8	63.5	7.7	Vertical	Flat
19296	1.00	151	52.2	42.8	63.5	20.7	Horizontal	Vertical

The following table depicts the level of significant radiated emissions of channel 2437 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
7311	1.00	156	50.7	43.4	63.5	20.1	Vertical	Side
12185	1.06	317	60.6	53.8	63.5	9.8	Horizontal	Vertical
19496	1.00	6	51.7	42.7	63.5	20.8	Vertical	Side

The following table depicts the level of significant radiated emissions of channel 2462 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
7386	1.00	157	51.1	44.5	63.5	19.0	Vertical	Side
12310	1.04	319	59.8	53.9	63.5	9.7	Horizontal	Vertical
19696	1.00	356	51.5	41.0	63.5	22.6	Vertical	Side
22158	1.00	103	51.2	40.5	63.5	23.0	Horizontal	Vertical

Notes:

1. Measurements above 4 GHz were made at 1 meters of separation from the EUT. The limits were adjusted to reflect this measurement distance.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.
4. Data above are those when the EUT was in 802.11 b mode with 6 MBPS since it was determined to be the worst case mode.

5.6.3 5.7GHz WLAN

The following table depicts the level of radiated emissions of channel 5745 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
11490	1.1	256	57.8	51.9	63.5	11.6	Horizontal	Vertical

The following table depicts the level of significant radiated emissions of channel 5785 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
11570	1.13	244	58.4	52.1	63.5	11.4	Horizontal	Vertical

The following table depicts the level of significant radiated emissions of channel 5825 MHz in the restricted band:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
11650	1.11	241	58.5	53.7	63.5	9.9	Horizontal	Vertical

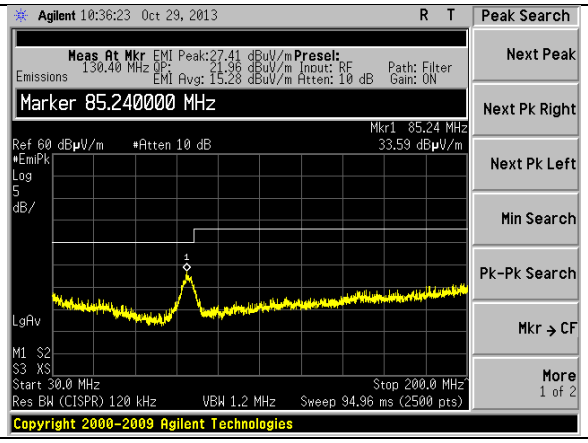
Notes:

1. Measurements above 4 GHz were made at 1 meters of separation from the EUT. The limits were adjusted to reflect this measurement distance.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.

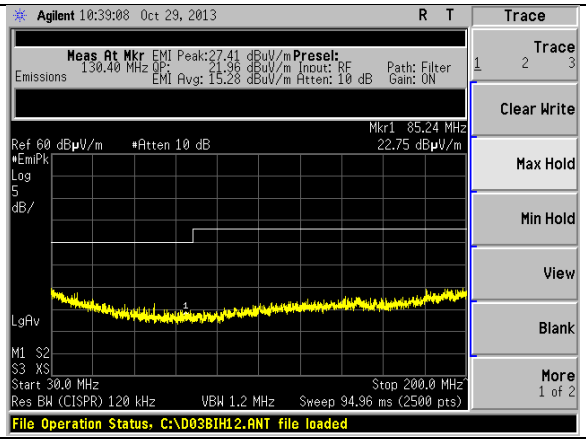
5.7 – Radiated measurements screen Captures.

The screen captures below are those using the Peak detector of the analyzer. In addition, the screen captures presented are those which were deemed to be an appropriate representation of the spectrum scan.

30 to 200 MHz, 3m distance.

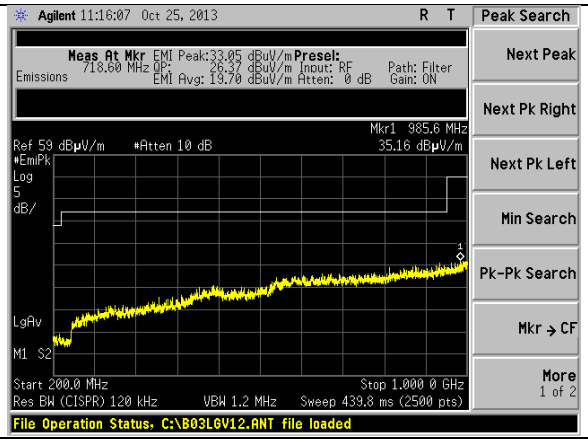


Vertical

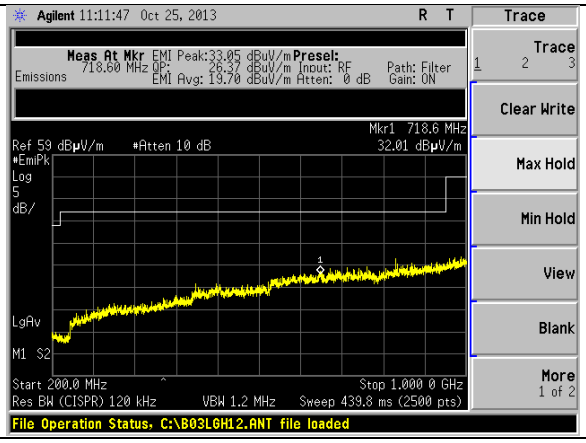


Horizontal

200 to 1000 MHz, 3m distance.



Vertical



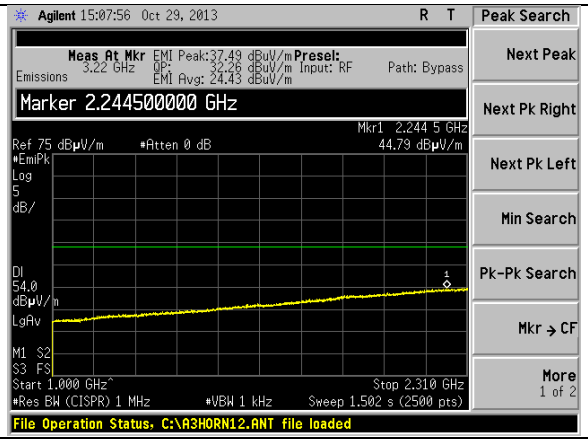
Horizontal

Note:

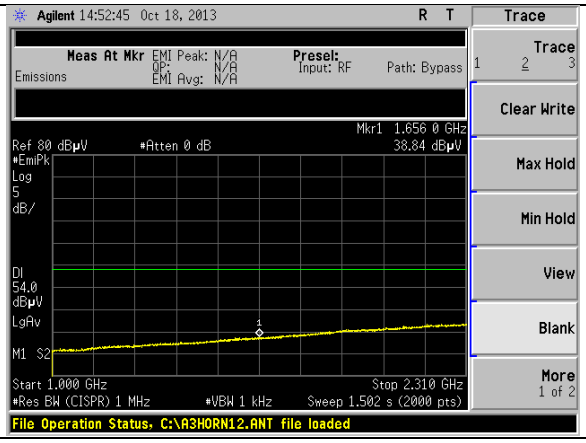
1. The screen captures between 30 MHz to 1000 MHz are common between the 2.4GHz WLAN, 5.8GHz WLAN and the Bluetooth LE. The emissions seen are independent of the mode the module was in.

The screen captures below are for the 2.4 GHz WLAN and Bluetooth LE

1000 to 2310 MHz, 3m distance.

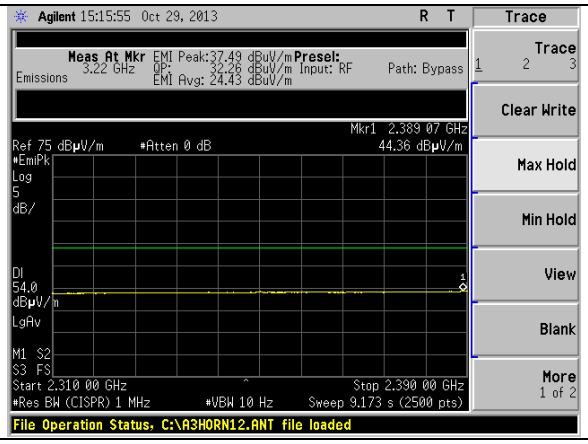


Bluetooth LE (reduced bandwidth)

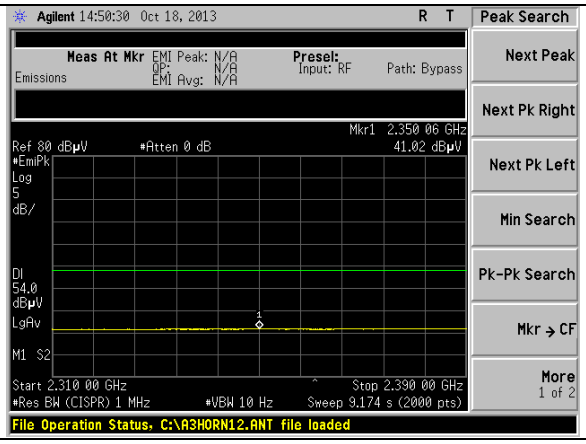


2.4GHz WLAN (reduced bandwidth)

2310 to 2390 MHz, 3m distance.



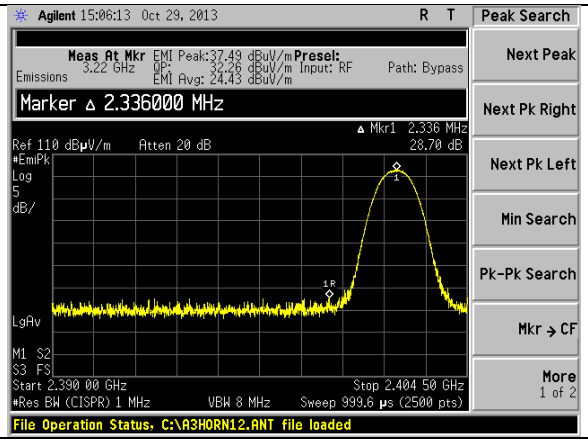
Bluetooth LE



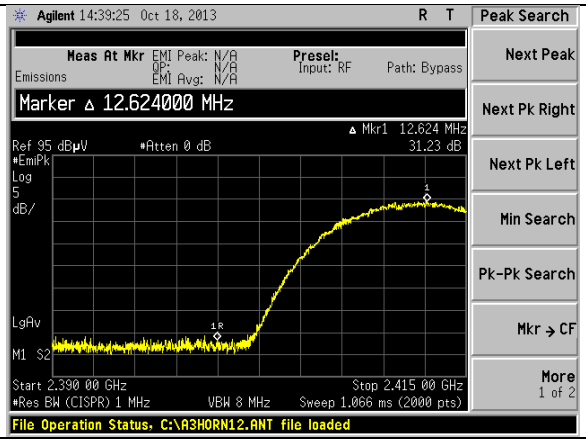
2.4GHz WLAN

Note: The range 2483.5 to 2500 MHz is in section 8 of this report (Band-edges).

2390 to 2400 MHz, 3m distance.

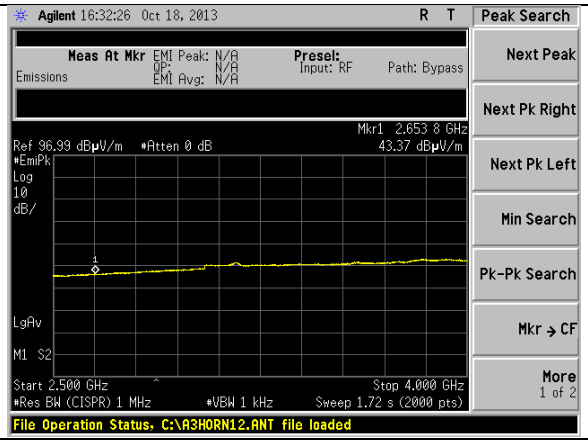


Bluetooth LE

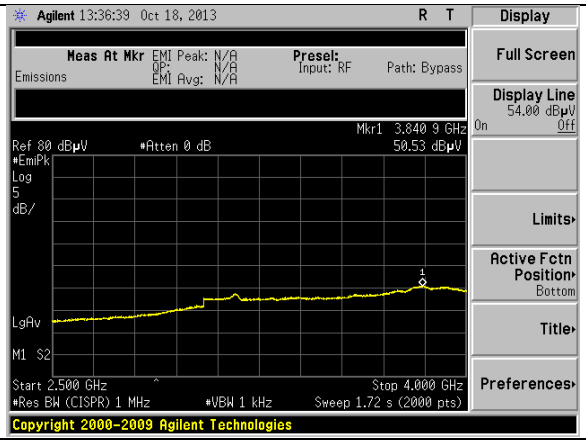


2.4GHz WLAN

2500 to 4000 MHz, 3m distance.

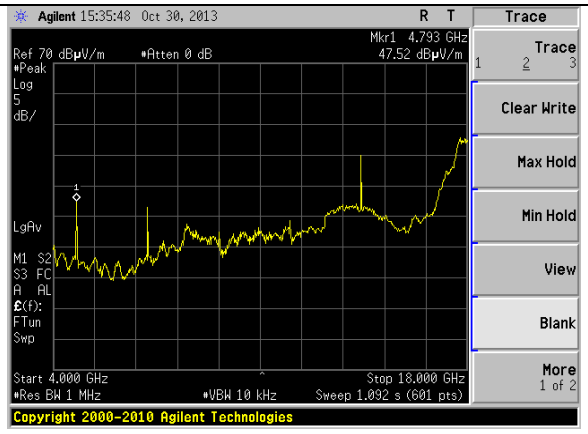


Bluetooth LE

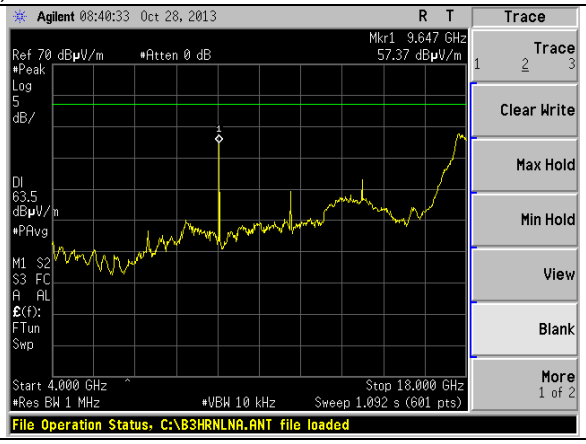


2.4GHz WLAN

4000 to 18000 MHz, 1m distance.

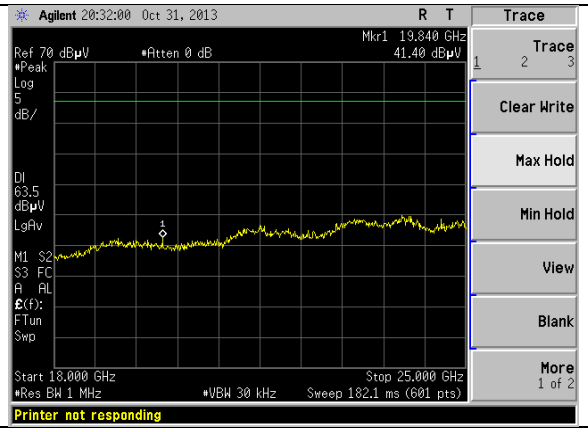


Bluetooth LE

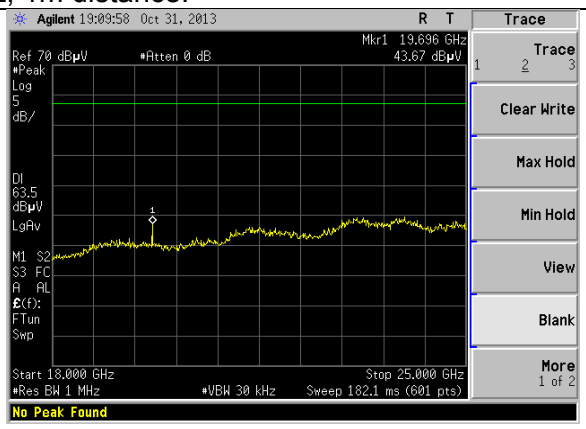


2.4GHz WLAN

18000 to 25000 MHz, 1m distance.



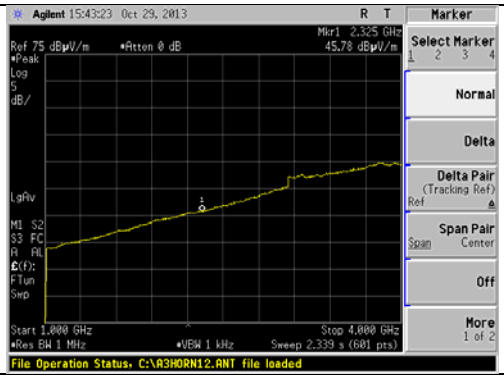
Bluetooth LE



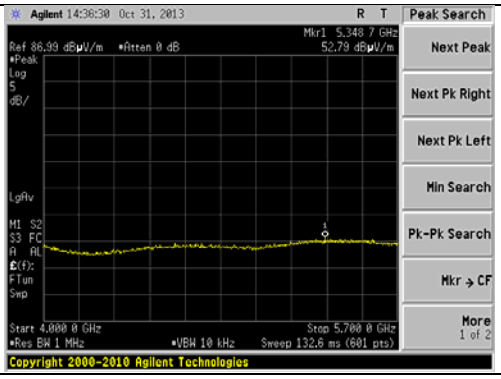
2.4GHz WLAN

The screen captures below are for the 5.8 GHz WLAN

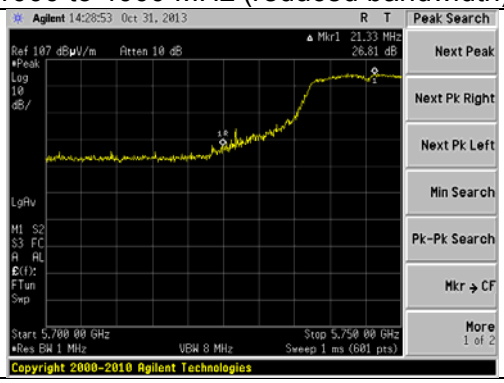
1000 to 8000 MHz, 1m distance.



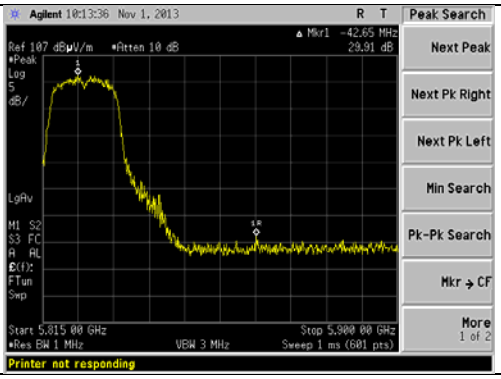
1000 to 4000 MHz (reduced bandwidth)



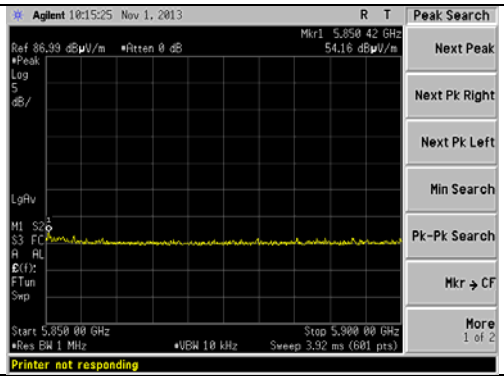
4000 to 5700 MHz



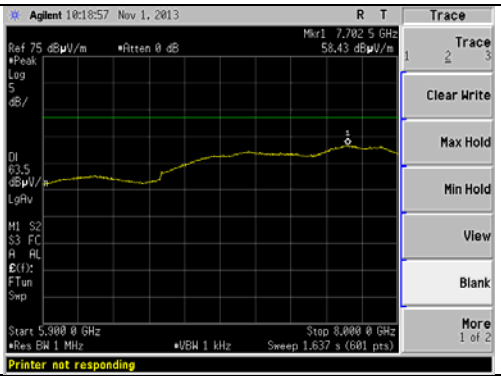
5700 to 5750 MHz



5815 to 5900 MHz



5850 to 5900 MHz



5900 to 8000 MHz

8000 to 26000 MHz, 1m distance.

	
8000 to 18000 MHz	18000 to 26000 MHz

26000 to 40000 MHz, 1m distance.

5.8 – Antenna port conducted measurements

(Data to complement cabinet radiation measurements)

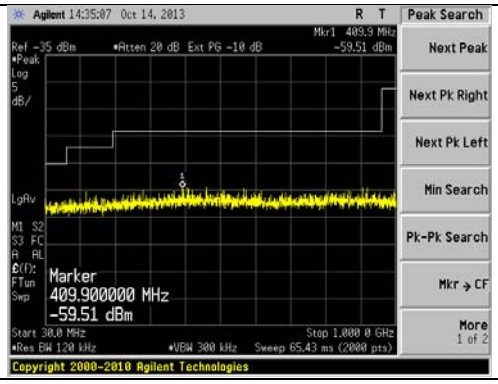
5.8.1 2.4GHz WLAN

Transmit channel	Restricted band emission frequency (MHz)	Peak (dBm)	Average (dBm)	Ground Reflection factor (dB)	Out of band antenna correction (dBi)	Final peak emission (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average emission (dBm)	Average Limit (dBm)	Average Margin (dB)
1	2813.9	-48.6	-56.5	0.0	2.0	-46.6	-21.2	25.4	-54.5	-41.2	13.3
	4824.0	-52.2	-56.3	0.0	2.5	-49.7	-21.2	28.5	-53.7	-41.2	12.5
6	4874.0	-51.8	-56.6	0.0	2.5	-49.3	-21.2	28.1	-53.9	-41.2	12.7
	12185.0	-51.6	-62.9	0.0	2.0	-49.6	-21.2	28.4	-59.7	-41.2	18.5
11	4924.0	-51.8	-56.8	0.0	2.5	-49.3	-21.2	28.1	-54.3	-41.2	13.1
	12310.0	-53.0	-62.6	0.0	2.0	-51.0	-21.2	29.8	-60.6	-41.2	19.4

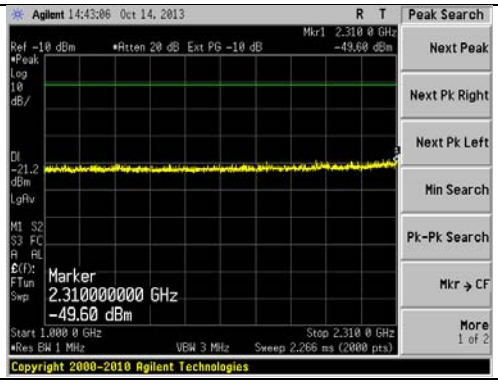
Note:

1. Example calculation:
   Measurement (dBm) + ground reflection factor + out of band antenna correction (dBi)
   = -48.6 + 0 + 2.0 = -46.6 dBm (Peak data at 2813.9MHz,1 MBPS)

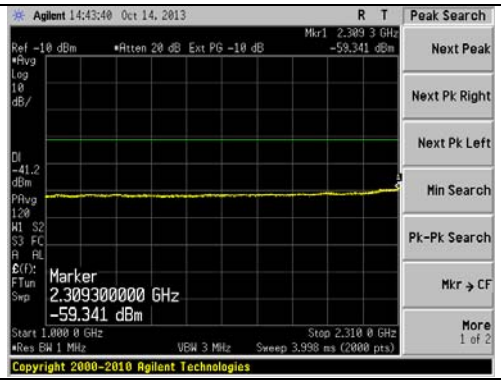
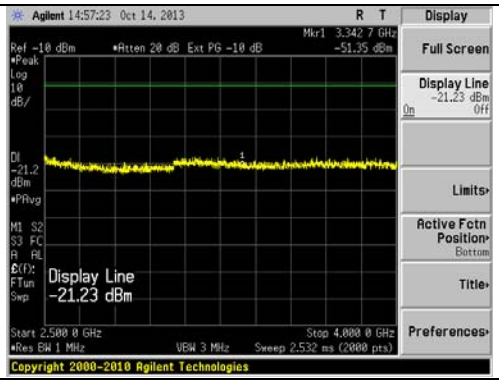
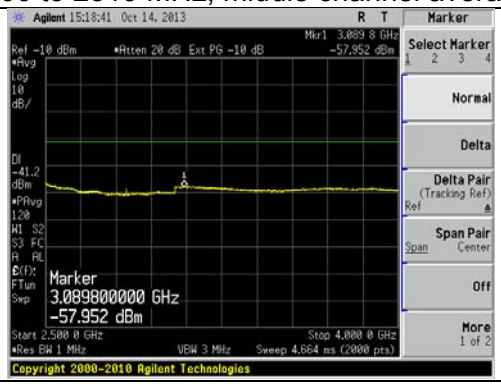
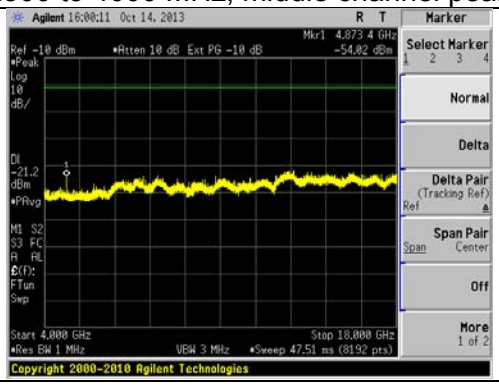
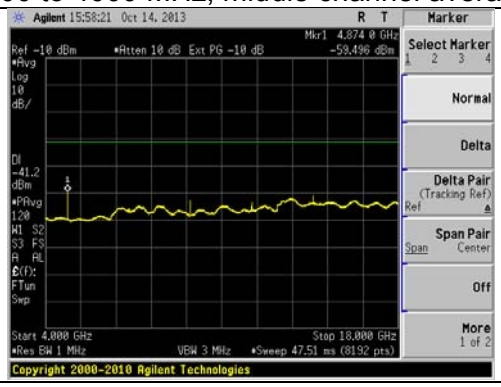
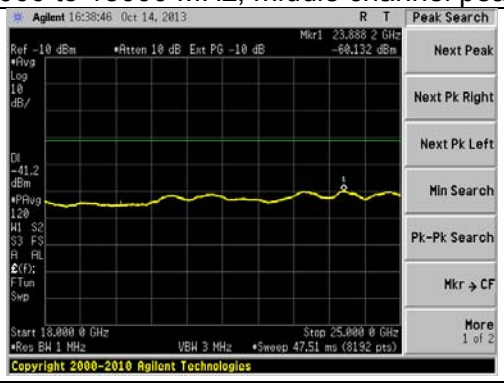
2. Data above are those when the EUT was in 802.11 b mode with 6 MBPS since it was determined to be the worst case mode.



30 to 1000 MHz, middle channel



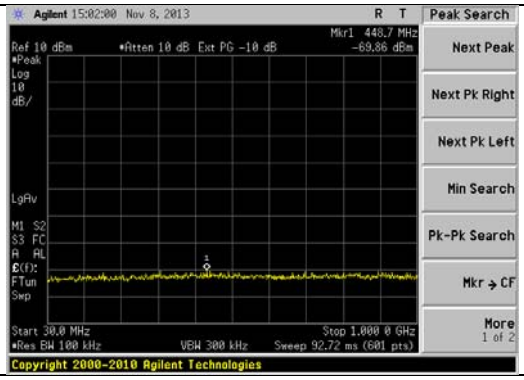
1000 to 2310 MHz, middle channel Peak

	
1000 to 2310 MHz, middle channel average	2500 to 4000 MHz, middle channel peak
	
2500 to 4000 MHz, middle channel average	4000 to 18000 MHz, middle channel peak
	
4000 to 18000 MHz, middle channel average	18000 to 25000 MHz, middle channel average

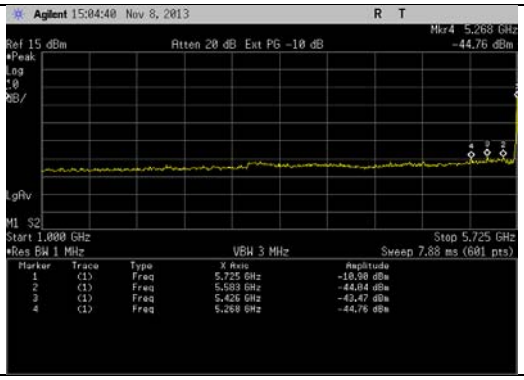
The ranges 2390 to 2400 MHz and 2483.5 to 2500 MHz are in exhibit 8 (band-edges)

5.8. 5.8GHz WLAN

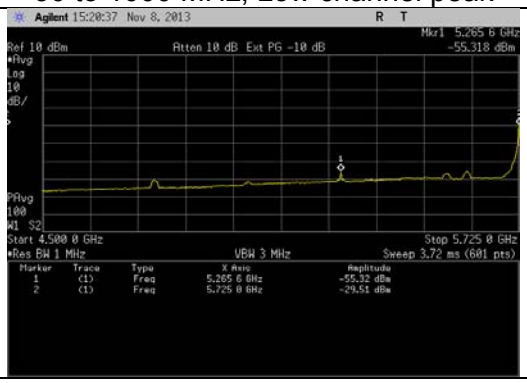
Measurements are those when the EUT was in 802.11 a mode with 6 MBPS since it was determined to be the worst case mode.



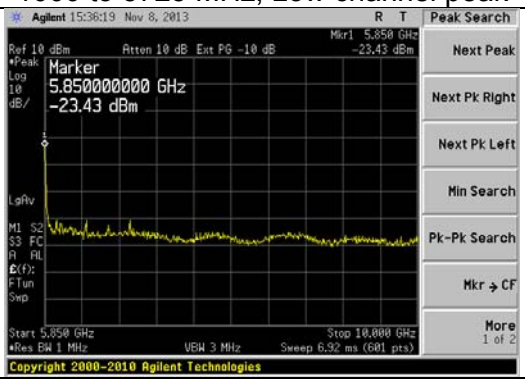
30 to 1000 MHz, Low channel peak



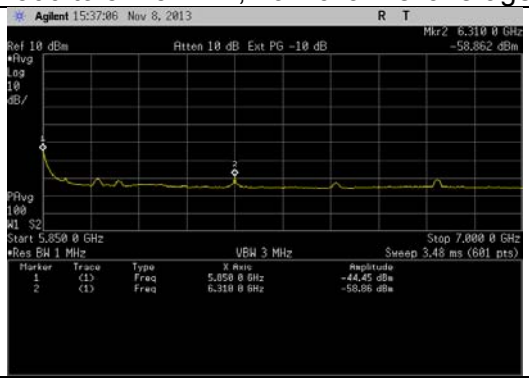
1000 to 5725 MHz, Low channel peak



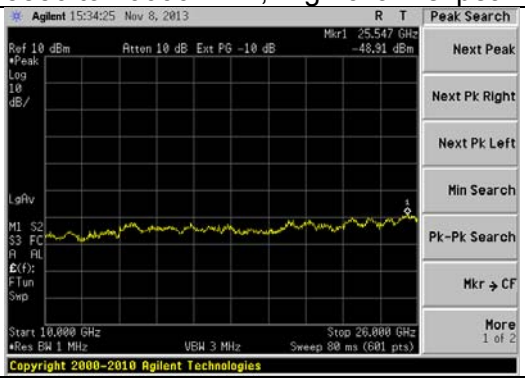
4500 to 5725 MHz, Low channel average



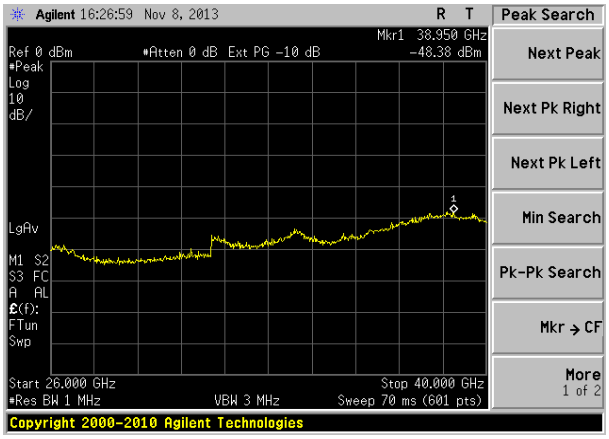
5850 to 10000 MHz, High channel peak



5850 to 7000 MHz, High channel average



10000 to 26000 MHz, High channel Peak



26000 to 40000 MHz,

EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 Test Setup

The test area and setup are in accordance with ANSI C63.4 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT was connected to a USB port of a generic laptop and set to transmit. The Generic laptop power supply was then plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to EMI receiver System. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

This test was performed on the EUT while it was powered using an off-the-shelf wall AC to DC power supply.

6.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI System, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.207 and RSS GEN 7.2.2 for Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

6.5 FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.6 CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz

Manufacturer:	LS Research					
Date(s) of Test:	April 25th 2012					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Mike Hintzke					
Voltage:	120 VAC					
Operation Mode:	Continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 71° F Relative Humidity: 40%					
Test Location:	X	AC Mains Test area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:		Peak	X	Quasi-Peak	X	Average

		Quasi-Peak			Average		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.150	L1	35.2	66.0	30.8	5.2	56.0	50.8
0.302	L1	32.2	60.2	28.0	10.7	50.2	39.5
1.106	L1	27.2	56.0	28.8	-2.7	46.0	48.7
0.150	L2	34.6	66.0	31.4	4.9	56.0	51.1
0.416	L2	20.0	57.5	37.5	-7.0	47.5	54.5
0.295	L2	30.0	60.4	30.4	0.6	50.4	49.8
1.025	L2	27.6	56.0	28.4	-2.4	46.0	48.4
0.618	L2	22.1	56.0	33.9	17.7	46.0	28.3

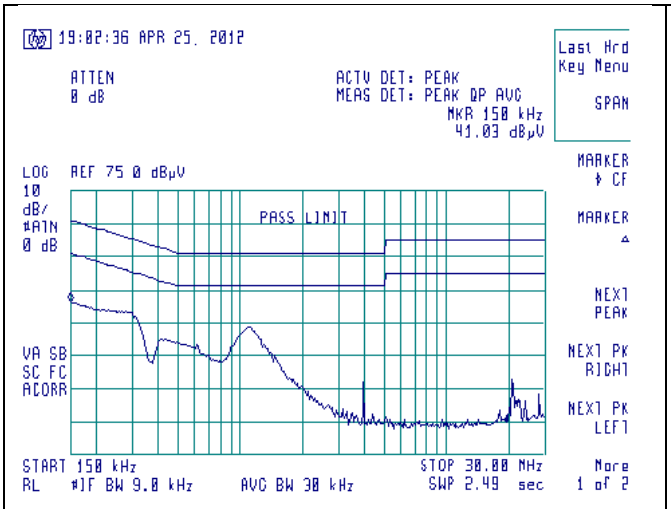
Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

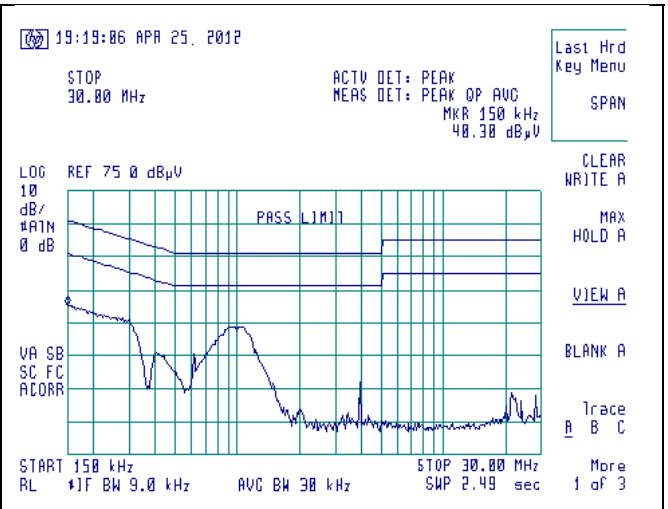
6.7 Test Setup Photo(s) – Conducted Emissions Test

6.8 Screen Captures – Conducted Emissions Test

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS GEN 7.2.2 (Table 2).



Line 1



Line 2

EXHIBIT 7. OCCUPIED BANDWIDTH

Test Engineer(s): Khairul Aidi Zainal and Peter Feilen

7.1 - Limits

For a DTS system operating in the 2400 to 2483.5 MHz and 5725 to 5850 MHz band, the 6dB emission bandwidth limit is 500 kHz.

7.2 - Method of Measurements

Industry Canada (IC RSS GEN 4.6.1) also requires the measurement of the 99% bandwidth in addition to the 6dB emission bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. A bandwidth measurement function that is built into the spectrum analyzer was used to measure the 99 % bandwidth while the 6dB bandwidth was measured using

Procedure: FCC OET KDB 558074 D01 Measurement Guidance v03r01 8.2.

7.3 - Test Data

7.3.1 Bluetooth LE

EUT Mode	Channel	Frequency (MHz)	DTS 6dB (kHz)	99% BW (MHz)
BLE	0	2402	718.23	1.23
	19	2440	715.24	1.23
	39	2480	719.13	1.23

7.3.2 2.4 GHz WLAN

802.11 Standard	Data Rate (MBPS)	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	6dB Bandwidth minimum limit (MHz)
b	1	1	9.6	13.5	0.5
		6	9.6	13.6	0.5
		11	9.6	13.8	0.5
g	6	1	15.2	16.5	0.5
		6	15.2	16.4	0.5
		11	15.2	16.4	0.5
n	MCS0	1	16.1	17.6	0.5
		6	16.1	17.7	0.5
		11	16.2	17.7	0.5
b	11	1	10.2	14.6	0.5
		6	10.1	14.6	0.5
		11	10.1	14.6	0.5
g	54	1	16.4	16.3	0.5
		6	16.4	16.4	0.5
		11	16.4	16.3	0.5
n	MCS7	1	17.0	17.4	0.5
		6	17.0	17.3	0.5
		11	17.0	17.3	0.5

7.3.3 5.8 GHz WLAN

802.11a.

Data Rate	Channel	Frequency (MHz)	DTS 6dB (MHz)	99% BW (MHz)
6 Mbps	149	5745	15.36	16.51
	157	5785	15.13	17.75
	165	5825	15.47	17.42
Data Rate	Channel	Frequency (MHz)	DTS 6dB (MHz)	99% BW (MHz)
12 Mbps	149	5745	15.20	16.59
	157	5785	15.19	17.07
	165	5825	15.46	17.14
Data Rate	Channel	Frequency (MHz)	DTS 6dB (MHz)	99% BW (MHz)
24 Mbps	149	5745	15.90	16.52
	157	5785	15.67	17.15
	165	5825	15.91	17.11

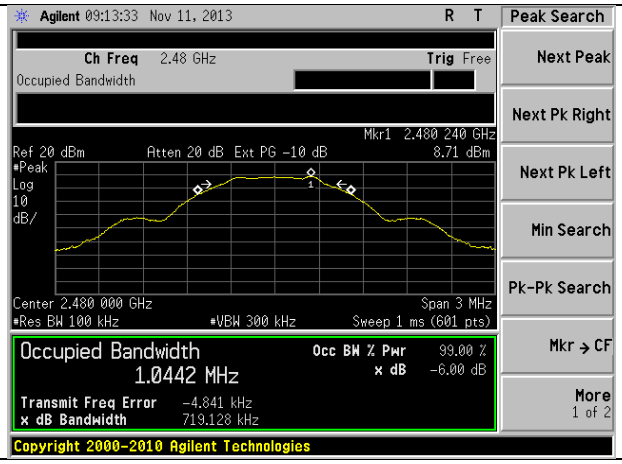
802.11n

Data Rate	Channel	Frequency (MHz)	DTS 6dB (MHz)	99% BW (MHz)
6.5 Mbps (MCS 0)	149	5745	15.19	17.74
	157	5785	15.12	18.41
	165	5825	15.35	18.39
Data Rate	Channel	Frequency (MHz)	DTS 6dB (MHz)	99% BW (MHz)
65 Mbps (MCS 7)	149	5745	16.02	17.75
	157	5785	17.02	17.69
	165	5825	16.01	17.70

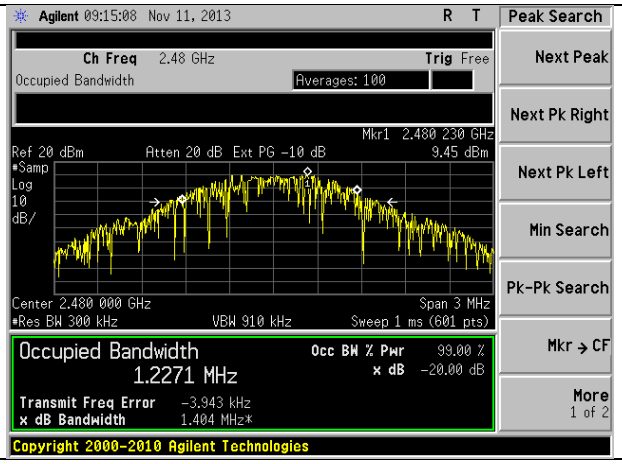
7.4 – Screen Captures

The screen captures below represents the widest band width.

7.4.1 Bluetooth LE



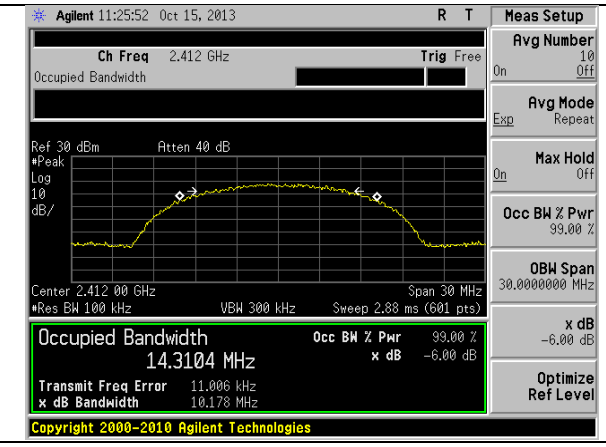
6dB Bandwidth



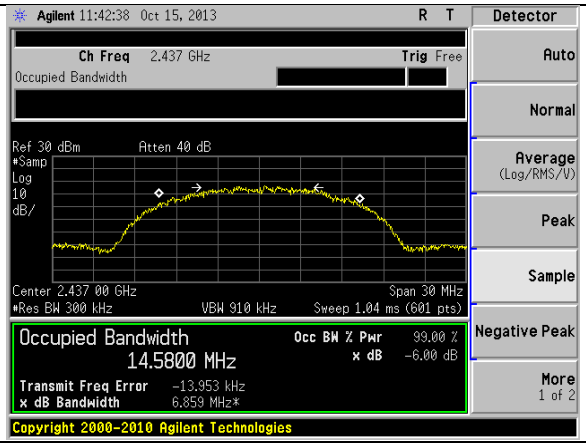
99% Bandwidth

7.4.2 2.4GHz WLAN

802.11b

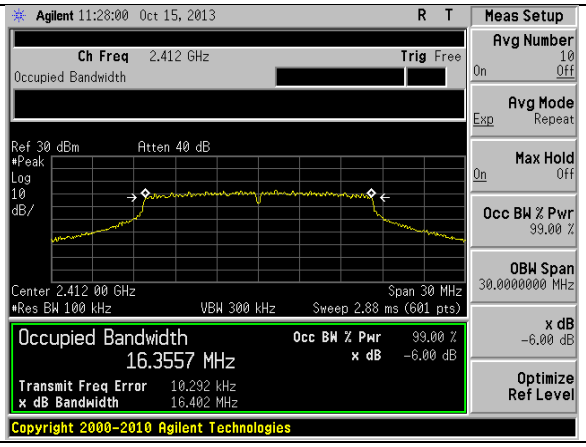


6dB Bandwidth

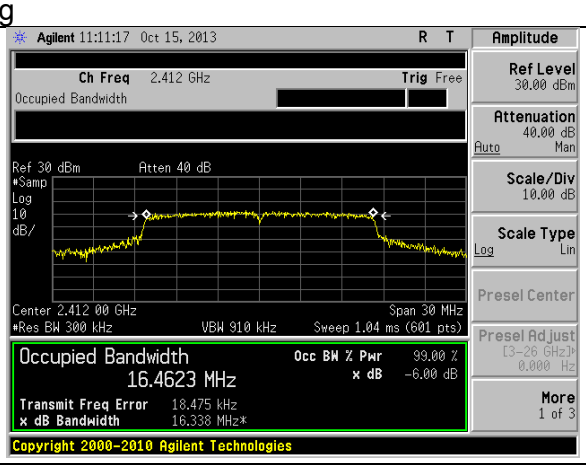


99% Bandwidth

802.11g

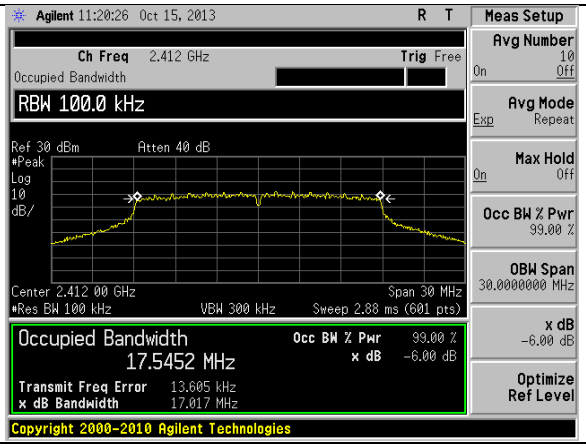


6dB Bandwidth

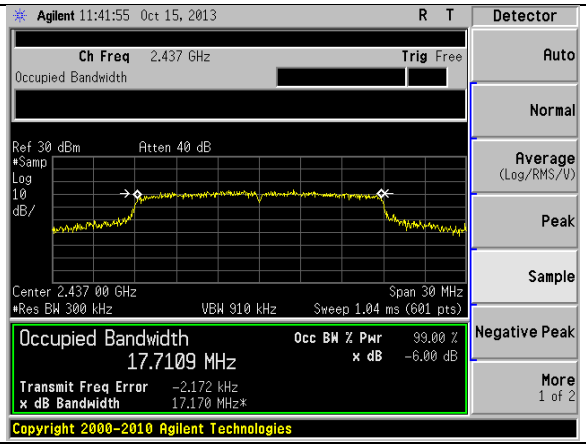


99% Bandwidth

802.11n



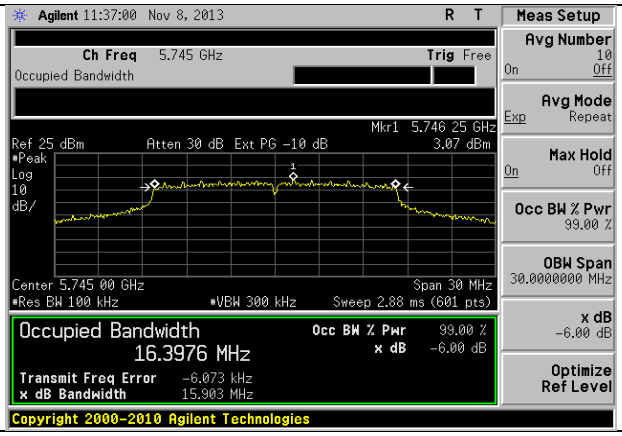
6dB Bandwidth



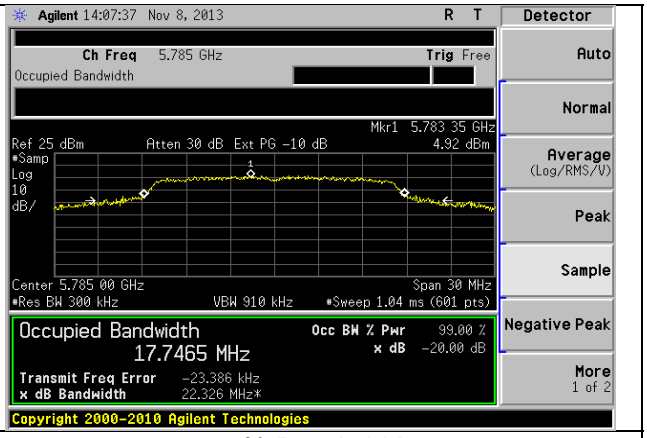
99% Bandwidth

7.4.3 5.8GHz WLAN

802.11a

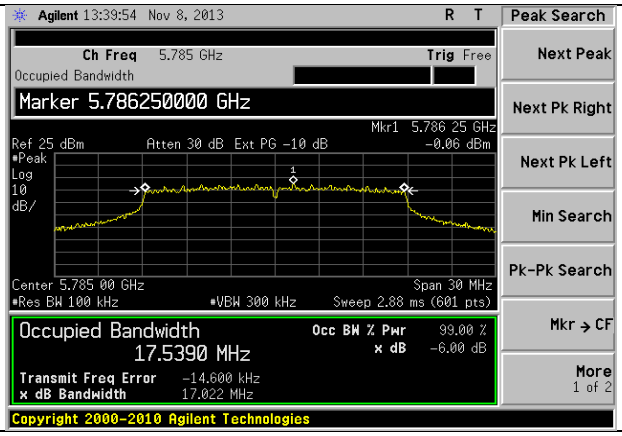


6dB Bandwidth

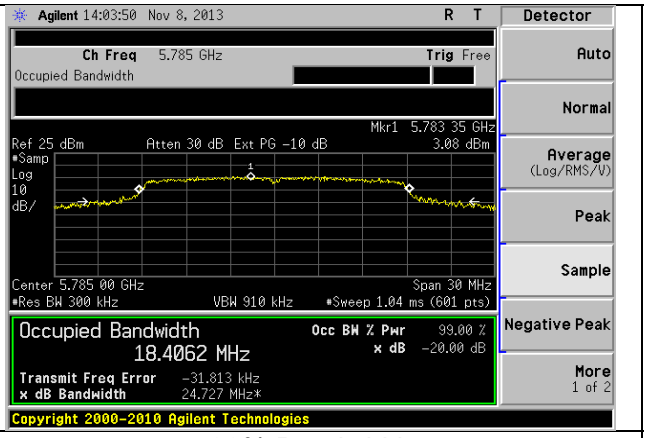


99% Bandwidth

802.11n



6dB Bandwidth



99% Bandwidth

EXHIBIT 8. BAND EDGE MEASUREMENTS

Test Engineer(s): Khairul Aidi Zainal

8.1 - Method of Measurements

FCC 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in RSS GEN and also to the limits in the applicable annex. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

The Band-edge measurements were performed conducted and radiated. The measurement of band-edge was performed to satisfy FCC 15.247(d).

Measurement procedure used was FCC OET KDB 558074 D01 v03r01 sections 11 and 12.

The band-edge measurements for the WLAN mode were performed via antenna port conducted measurements. As required by FCC OET KDB 558074 D01 v03r01, a cabinet radiation measurement was performed to complement the conducted measurement.

Calculations

Conversion of Radiated field strength limits to EIRP:

EIRP (dBm) = E (dBµV/m)+20log (measurement distance)-104.8

Peak EIRP limit (dBm) = 74 + 20log (3m) – 104.8 = **-21.2dBm**
Average EIRP limit (dBm) = 54 + 20log (3m) – 104.8 **= -41.2dBm**

Sample calculation:

Average data at 2484.2 MHz for 802.11g mode:

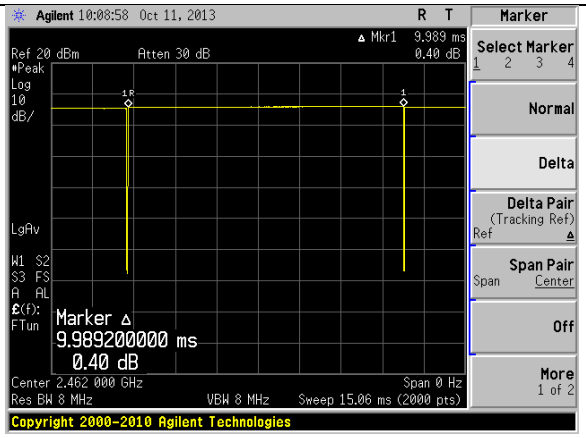
Final average band-edge (dBm) = Average measurement (dBm) + duty cycle correction + antenna Gain (dBi)
= -43.9 dBm + 0.1dB + 2.0 dBi
= -41.8 dBm

Duty Cycle

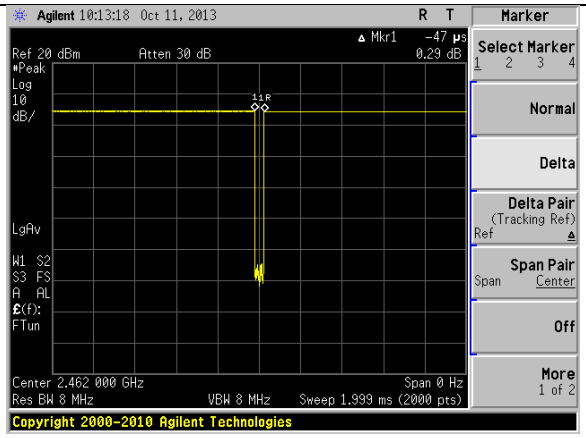
Measurement procedure: FCC OET KDB 558074 D01 v03r01 section 6.

802.11 Standard	Data Rate (MBPS)	TX on time (ms)	TX off time (ms)	Duty Cycle	Duty cycle correction factor (dB)
b	1.0	9.989	0.047	1.00	0.0
g	6.0	1.664	0.052	0.97	0.1
n	MCS1	0.783	0.053	0.94	0.3

802.11b

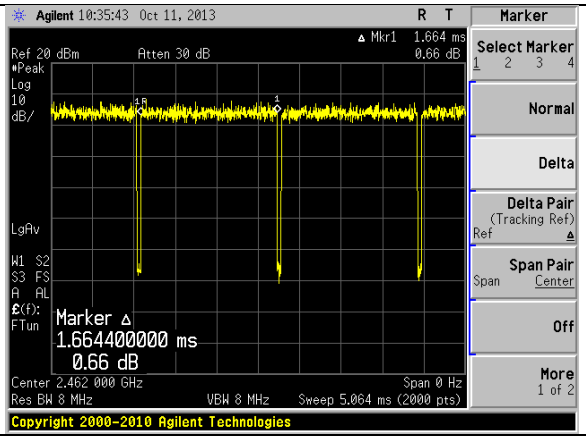


On time

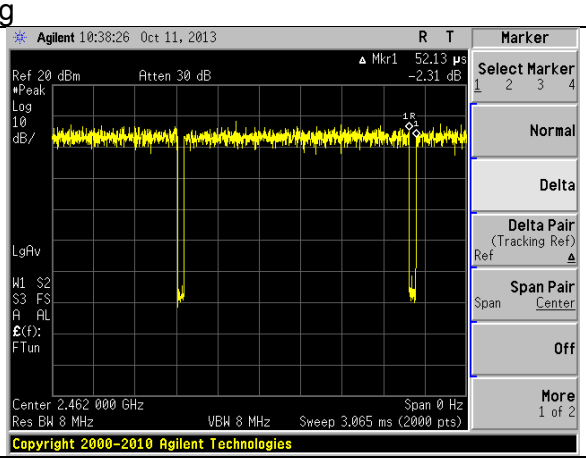


Off time

802.11g

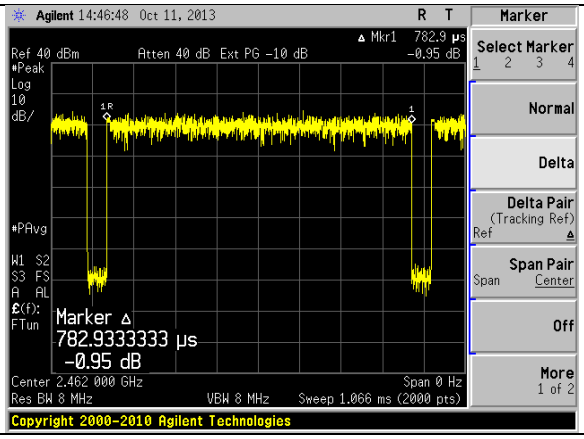


On time

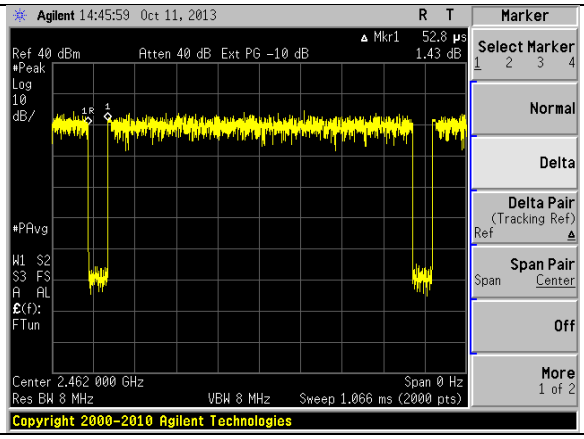


Off time

802.11n



On time

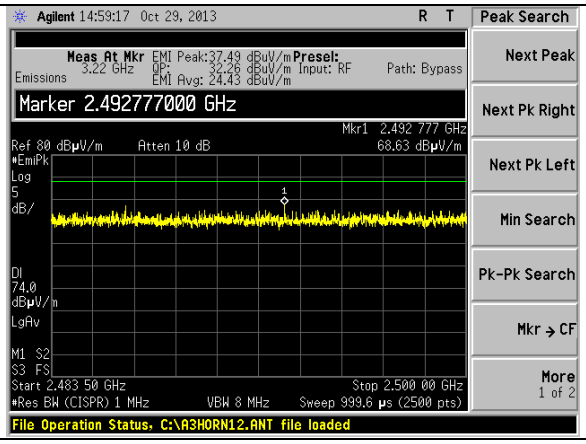


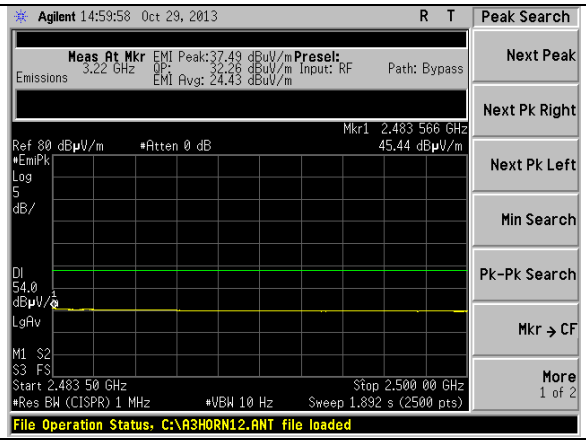
Off time

8.2. Band edge.

8.2.1 Band-edge in Restricted Band:

8.2.1.1 Bluetooth LE





Upper band edge Peak	Upper band edge Average
Radiated band-edge	

8.2.1.2 2.4 GHz WLAN

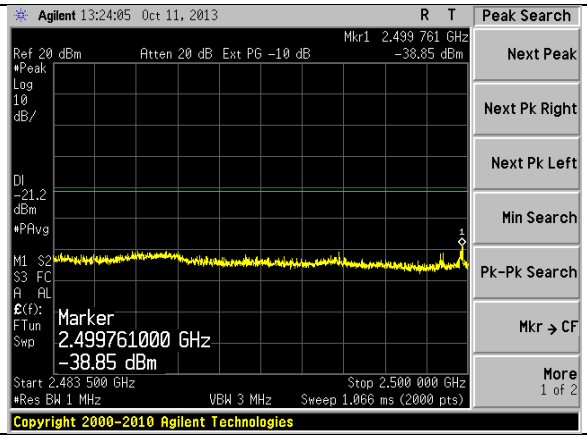
Antenna port conducted measurement data of restricted band band-edge 2483.5 to 2500 MHz:

802.11 Standard	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
b	2499.8	-38.9	2487.3	-51.2	0.0	2.0	-36.9	-21.2	15.6	-49.2	-41.2	8.0
g	2483.7	-24.2	2484.2	-43.9	0.1	2.0	-22.2	-21.2	1.0	-41.8	-41.2	0.6
n	2483.8	-24.9	2484.0	-44.6	0.3	2.0	-22.9	-21.2	1.7	-42.4	-41.2	1.1

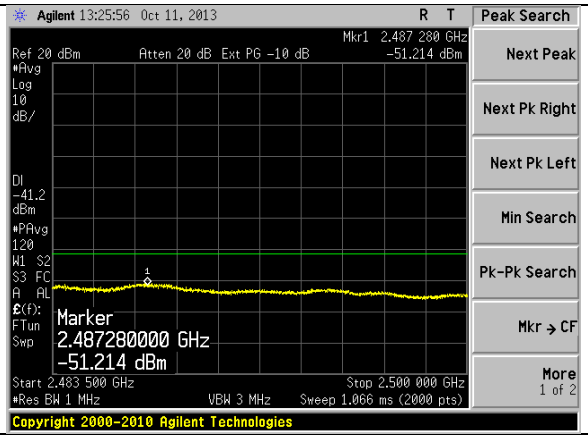
Note:

1. The Duty cycle correction was **added** to the measured value to account for the duty cycle being less than 98%. Refer to duty cycle section in the preceding pages.
2. Refer to calculation section in the preceding pages for sample calculation.
3. Measurements performed with 1MHz RBW.

2.4GHz WLAN 802.11b

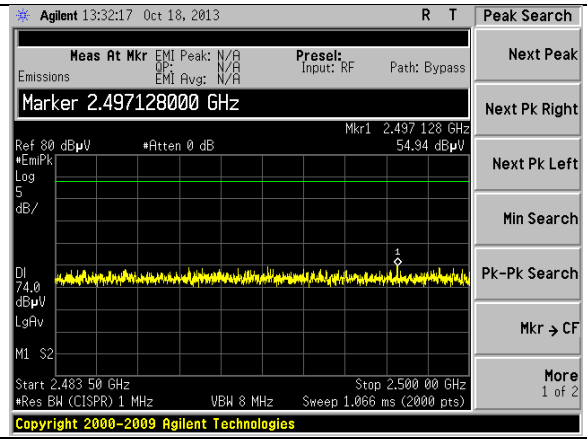


Upper band edge Peak

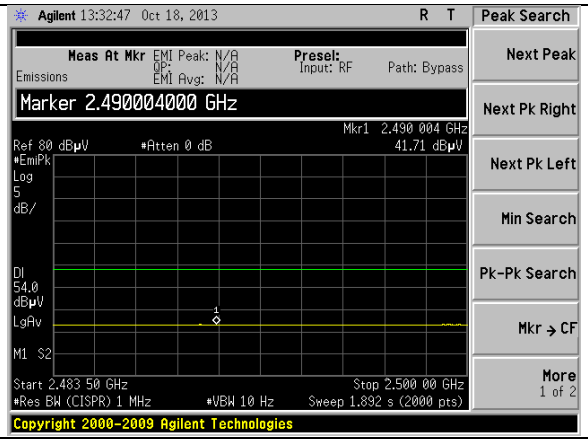


Upper band edge Average

Antenna port conducted measurements



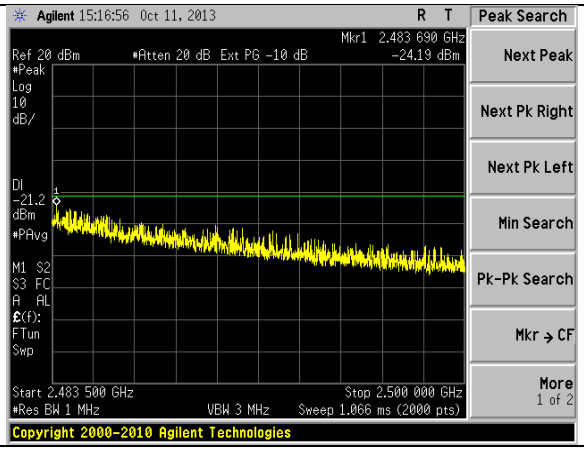
Upper band edge Peak



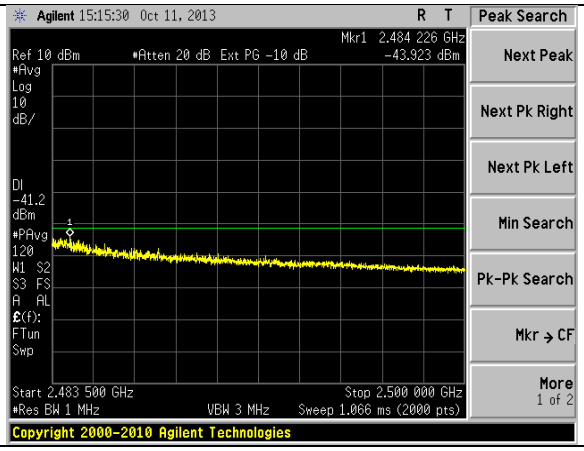
Upper band edge Average

Cabinet radiation band-edge

2.4GHz WLAN 802.11g

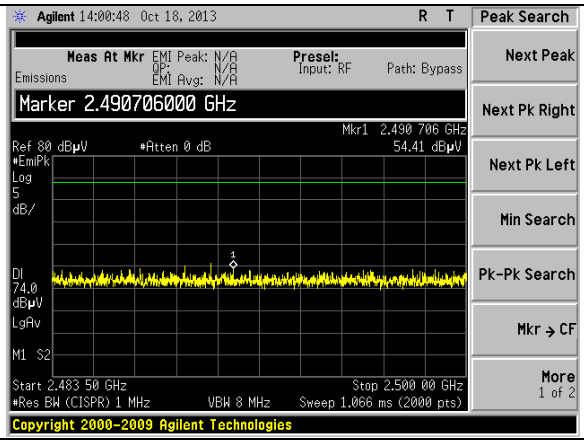


Upper band edge Peak

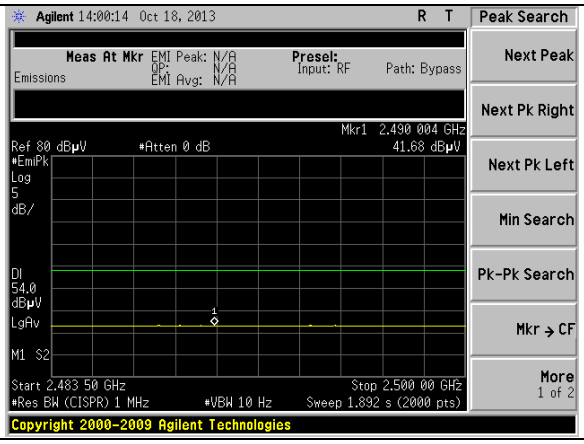


Upper band edge Average

Antenna port conducted measurements



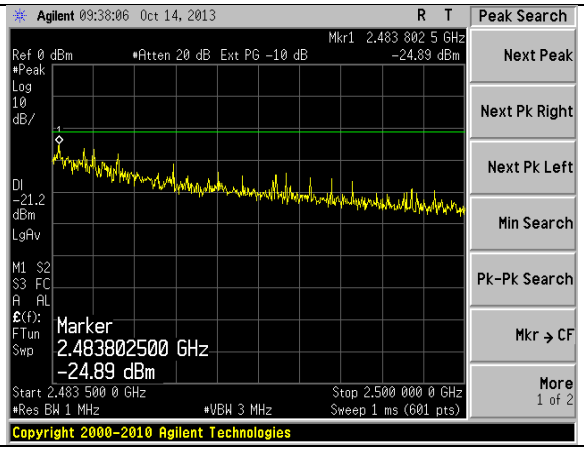
Upper band edge Peak



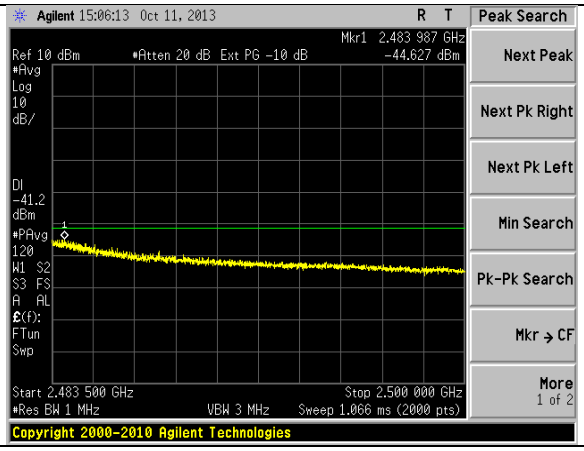
Upper band edge Average

Cabinet radiation band-edge

2.4GHz WLAN 802.11n

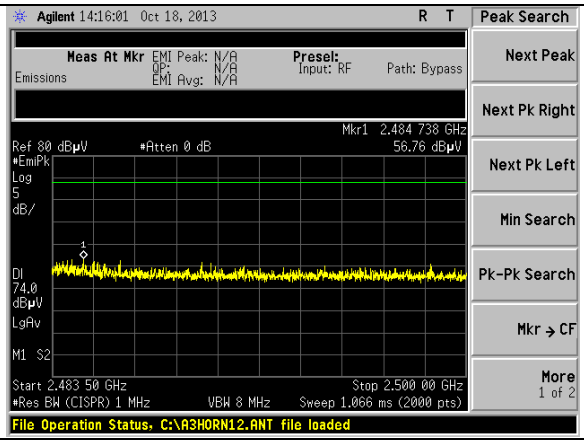


Upper band edge Peak

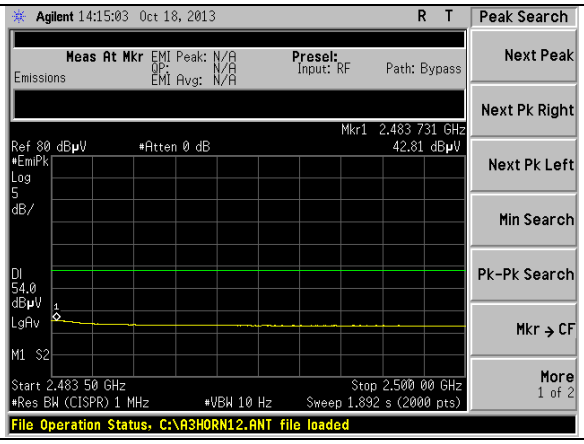


Upper band edge Average

Antenna port conducted measurements



Upper band edge Peak



Upper band edge Average

Cabinet radiation band-edge

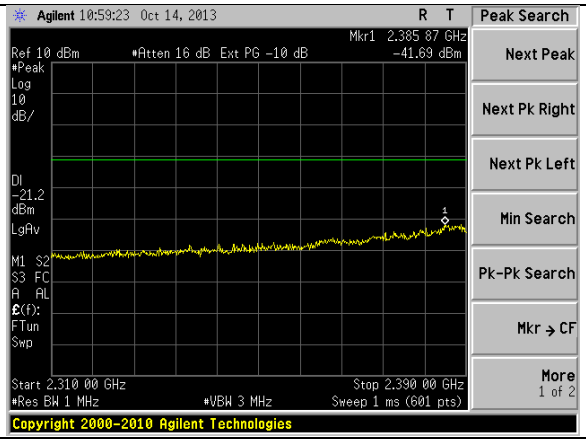
Antenna port conducted measurement data of restricted band 2310 to 2390 MHz:

802.11 Standard	Peak data Frequency (MHz)	Restricted band emission: Peak (dBm)	Average data Frequency (MHz)	Restricted band emission: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak emission (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average emission (dBm)	Average Limit (dBm)	Average Margin (dB)
b	2385.9	-41.7	2386.4	-51.3	0.0	2.0	-39.7	-21.2	18.5	-49.3	-41.2	8.1
g	2390.0	-29.6	2390.0	-44.8	0.3	2.0	-27.6	-21.2	6.4	-42.5	-41.2	1.3
n	2389.2	-31.1	2390.0	-47.5	0.2	2.0	-29.1	-21.2	7.8	-45.3	-41.2	4.0

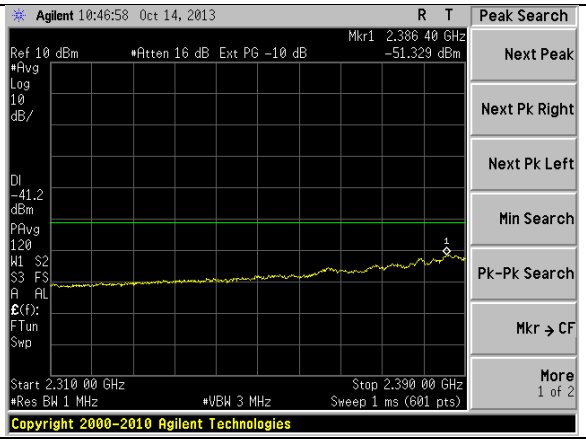
Note:

1. The Duty cycle correction was **added** to the measured value to account for the duty cycle being less than 98%. Refer to duty cycle section in the preceding pages.
2. Refer to calculation section in the preceding pages for sample calculation.
3. Measurements performed with 1MHz RBW.

2.4GHz WLAN 802.11b



Peak

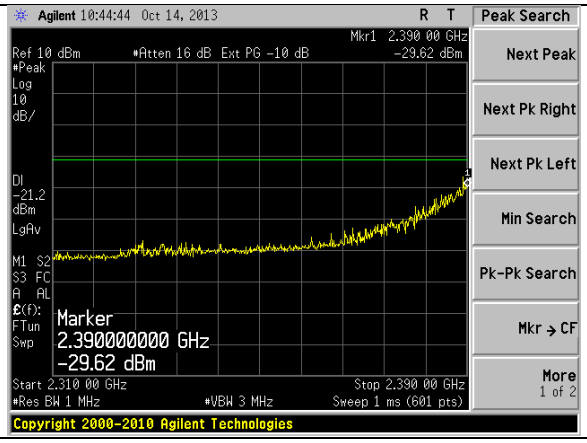


Average

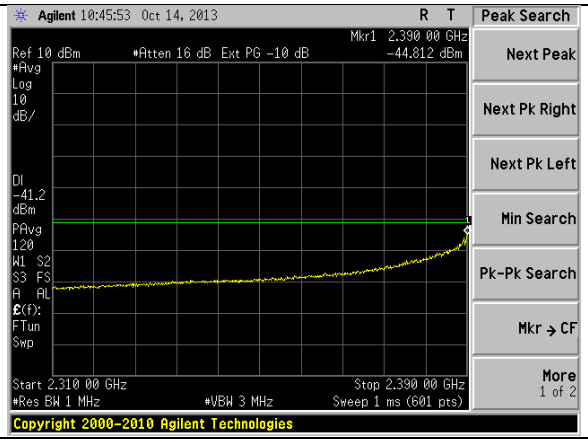
Antenna port conducted measurements

Note: Refer to exhibit 5.7 for cabinet radiation plot for the range of 2310 to 2390MHz

2.4GHz WLAN 802.11b



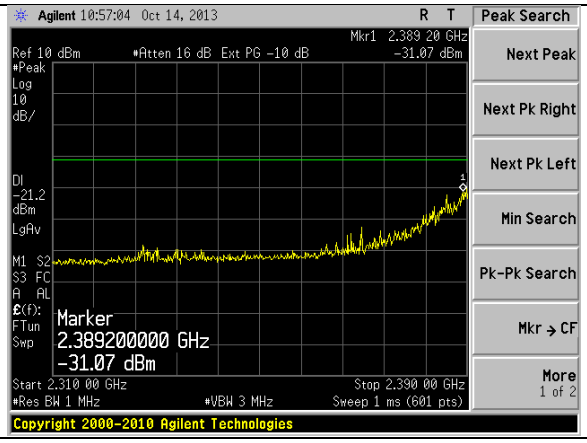
Peak



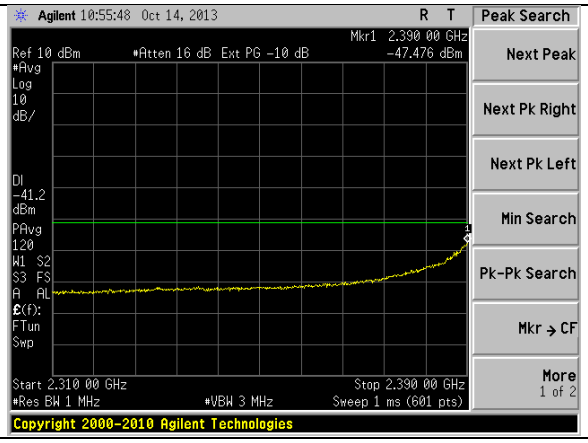
Average

Antenna port conducted measurements

2.4GHz WLAN 802.11n



Peak



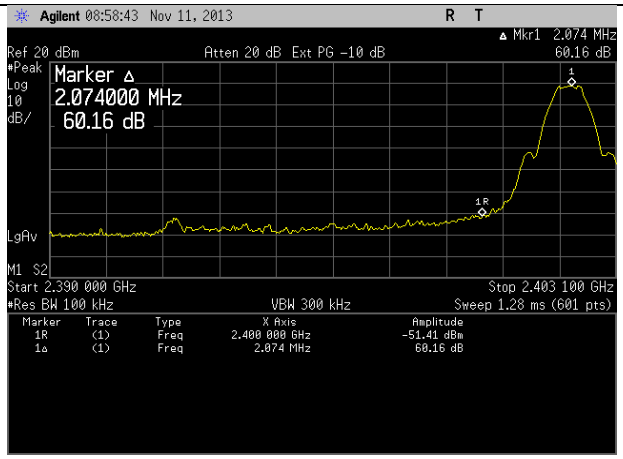
Average

Antenna port conducted measurements

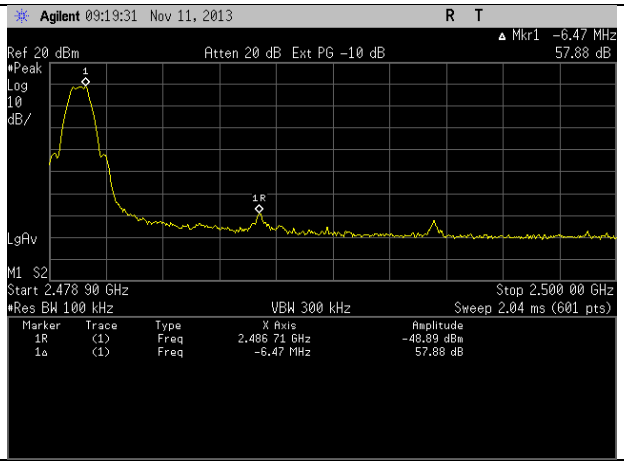
Note: Refer to exhibit 5.7 for cabinet radiation plot for the range of 2310 to 2390MHz

8.2.2 Antenna port conducted measurement in (100 kHz bandwidth) Band-edge:

8.2.2.1 Bluetooth LE



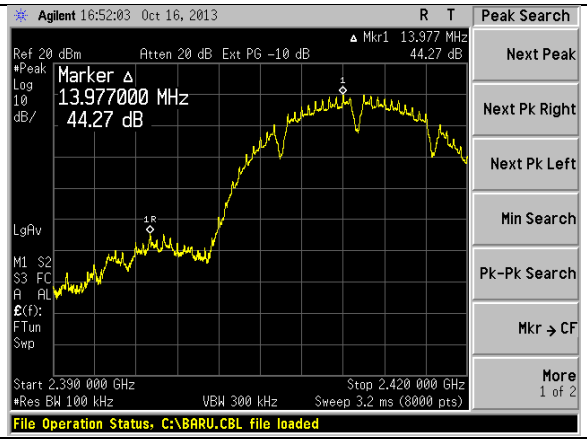
Lower band edge



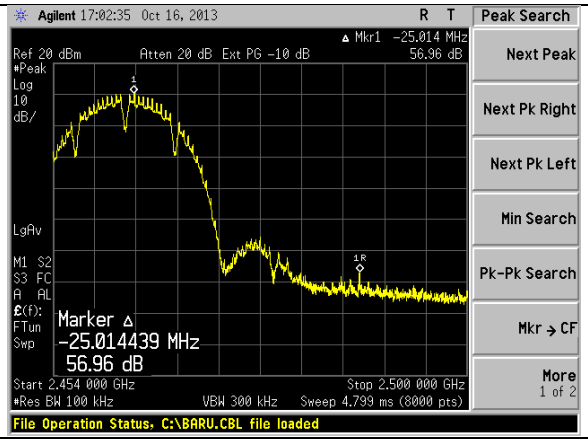
Upper band edge

8.2.2.2 WLAN

2.4 GHz WLAN 802.11b

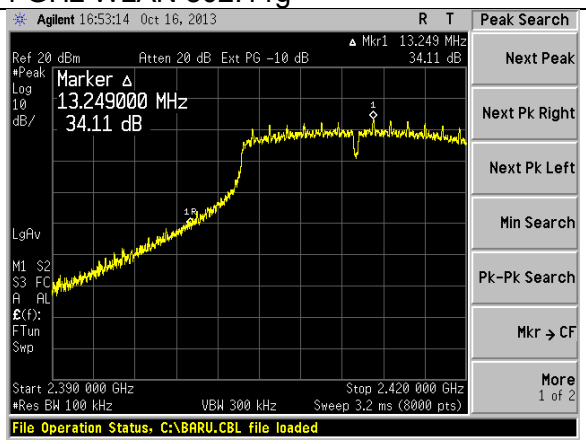


Lower band edge

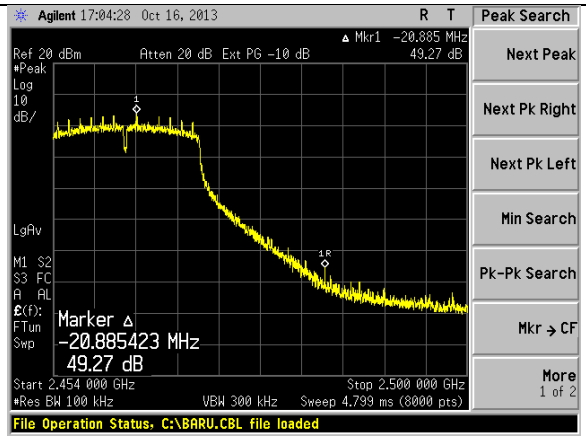


Upper band edge

2.4 GHz WLAN 802.11g

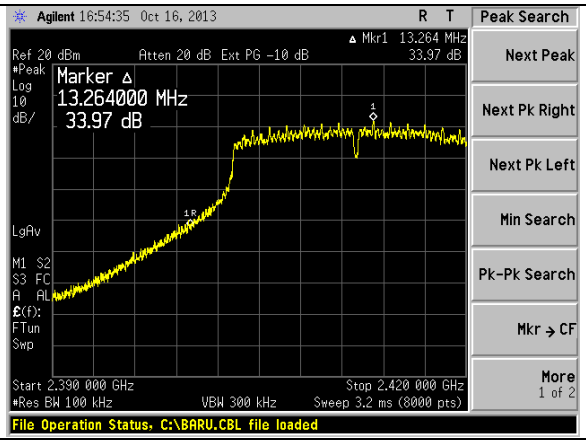


Lower band edge

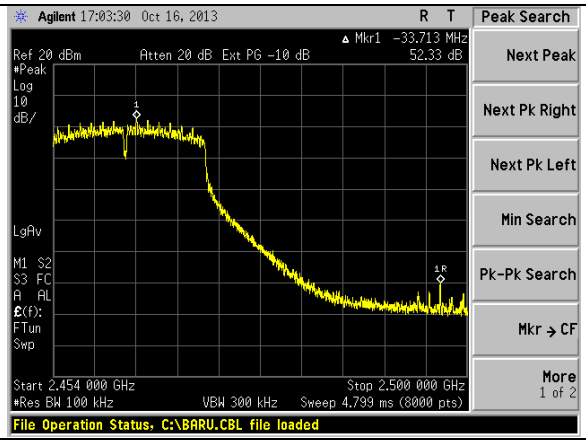


Upper band edge

2.4 GHz WLAN 802.11n

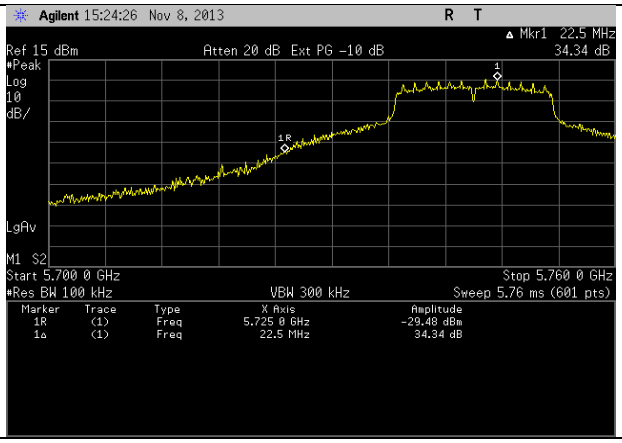


Lower band edge

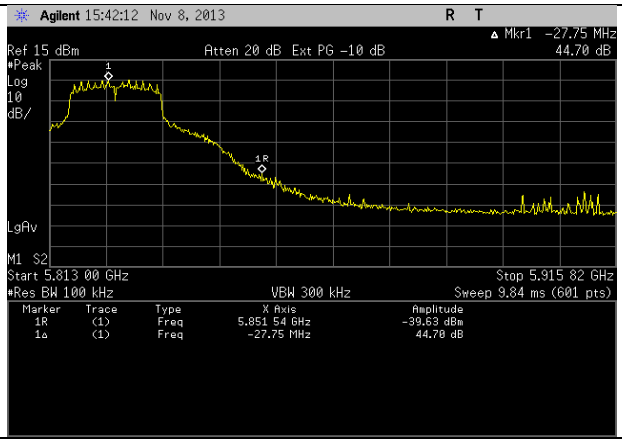


Upper band edge

5.8 GHz WLAN 802.11 a



Lower band edge



Upper band edge

EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

Test Engineer(s): Adam Alger and Khairul Aidi Zainal

9.1 - Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

Measurement procedure used was FCC OET KDB 558074 D01 v03r01 section 9.1.1 and 9.1.2

9.2 - Test Data

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

9.2.1 Bluetooth LE

EUT Mode	Channel	Frequency (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)
BLE	0	2402	9.6	30.0	20.4
	19	2440	9.7	30.0	20.3
	39	2480	9.6	30.0	20.4

9.2.2 2.4GHz WLAN

802.11 Standard	Data Rate (MBPS)	Channel	Maximum Peak Power (dBm)	Power Limit (dBm)	Power margin (dB)
b	1	1	20.9	30.0	9.1
		6	21.1	30.0	8.9
		11	21.4	30.0	8.6
g	6	1	21.4	30.0	8.6
		6	21.7	30.0	8.3
		11	22.0	30.0	8.1
n	MCS0	1	21.5	30.0	8.5
		6	21.8	30.0	8.2
		11	22.0	30.0	8.0
b	11	1	24.1	30.0	5.9
		6	24.3	30.0	5.7
		11	24.6	30.0	5.4
g	54	1	22.7	30.0	7.3
		6	22.9	30.0	7.1
		11	23.5	30.0	6.5
n	MCS7	1	20.6	30.0	9.4
		6	21.1	30.0	8.9
		11	21.4	30.0	8.6

9.2.3 5.7GHz WLAN

802.11 a

Data Rate	Channel	Frequency (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)
6 Mbps	149	5745	22.9	30.0	7.1
	157	5785	23.0	30.0	7.0
	165	5825	23.4	30.0	6.6
Data Rate	Channel	Frequency (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)
12 Mbps	149	5745	22.9	30.0	7.1
	157	5785	22.7	30.0	7.3
	165	5825	23.0	30.0	7.0
Data Rate	Channel	Frequency (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)
24 Mbps	149	5745	23.2	30.0	6.8
	157	5785	23.1	30.0	6.9
	165	5825	23.3	30.0	6.7

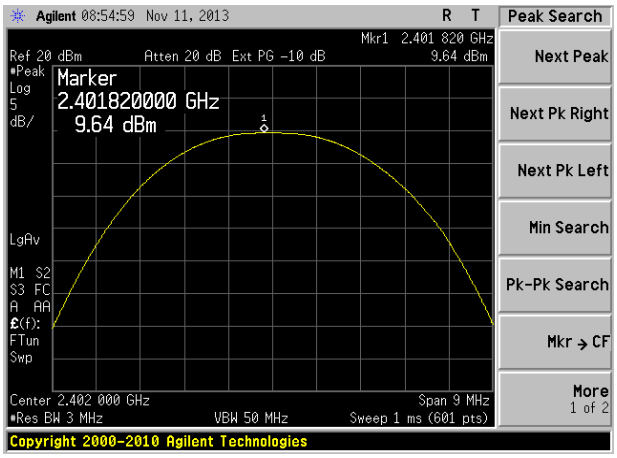
802.11 n

Data Rate	Channel	Frequency (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)
6.5 Mbps (MCS 0)	149	5745	22.7	30.0	7.3
	157	5785	22.6	30.0	7.4
	165	5825	23.3	30.0	6.7
Data Rate	Channel	Frequency (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)
65 Mbps (MCS 7)	149	5745	18.9	30.0	11.1
	157	5785	18.4	30.0	11.6
	165	5825	19.0	30.0	11.0

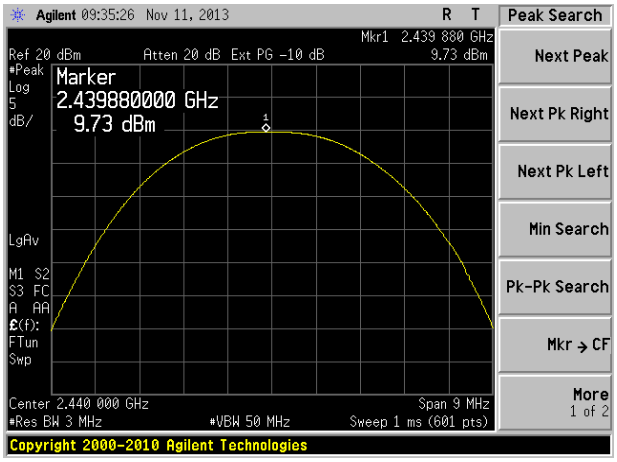
9.3 – Screen Captures.

9.3.1 Bluetooth LE

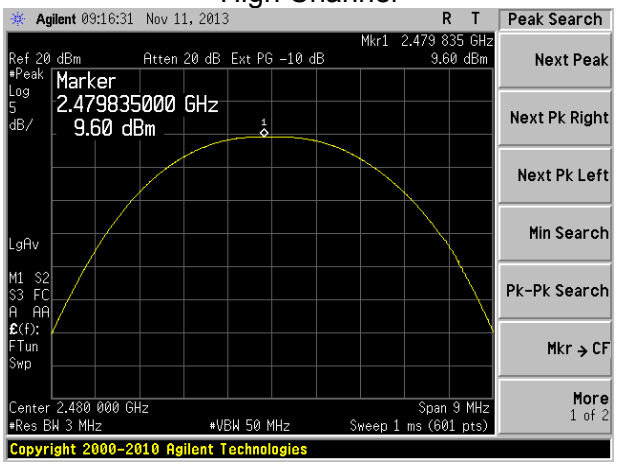
Low Channel



Middle Channel



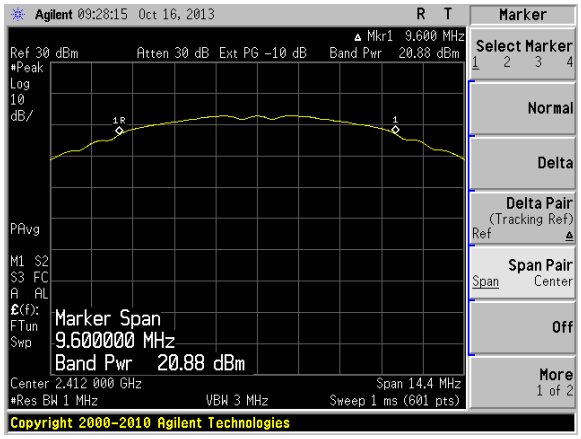
High Channel



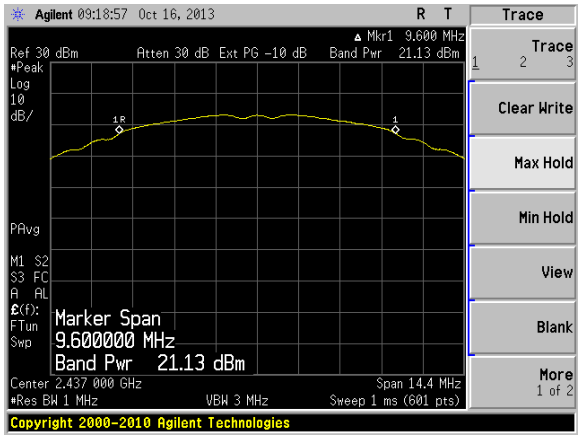
9.3.2 2.4GHz WLAN

9.3.2.1 1MBPS

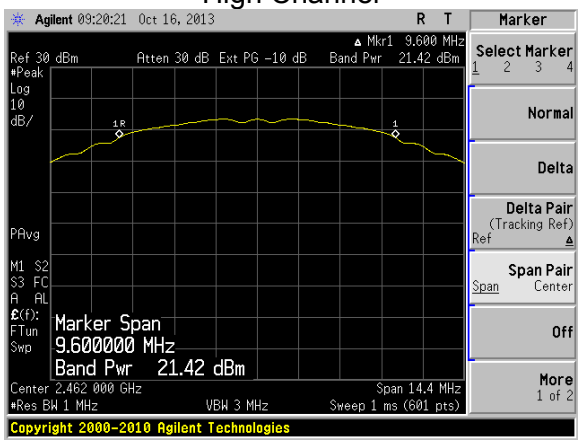
Low Channel



Middle Channel

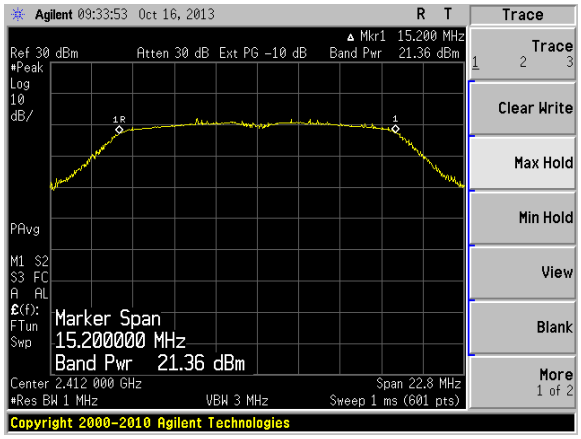


High Channel

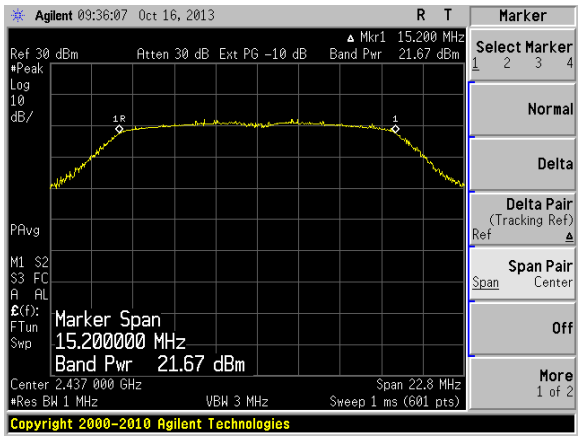


9.3.2.2 6MBPS

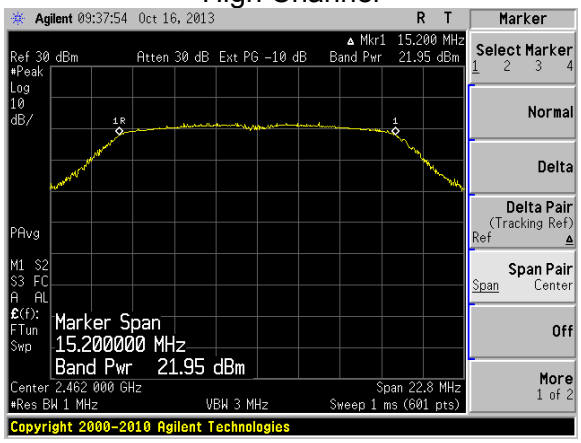
Low Channel



Middle Channel

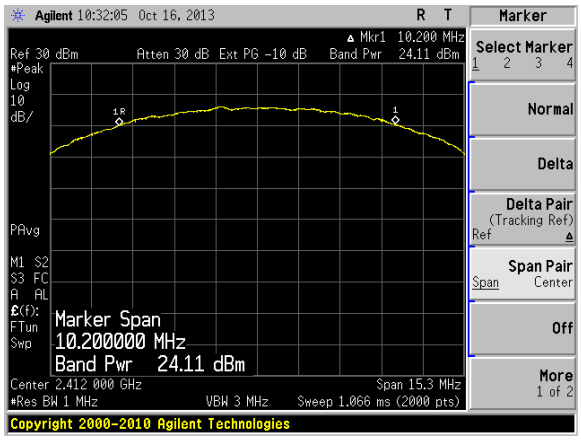


High Channel

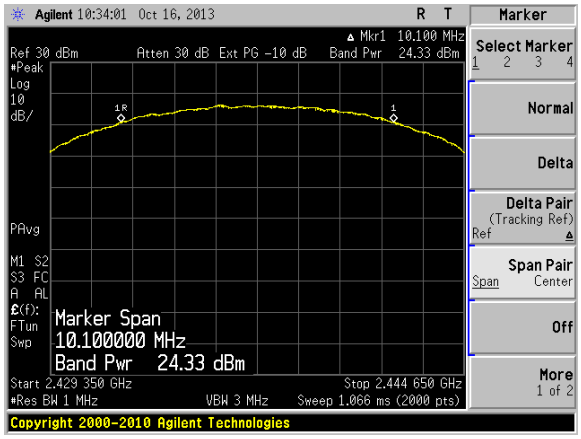


9.3.2.3 11MBPS

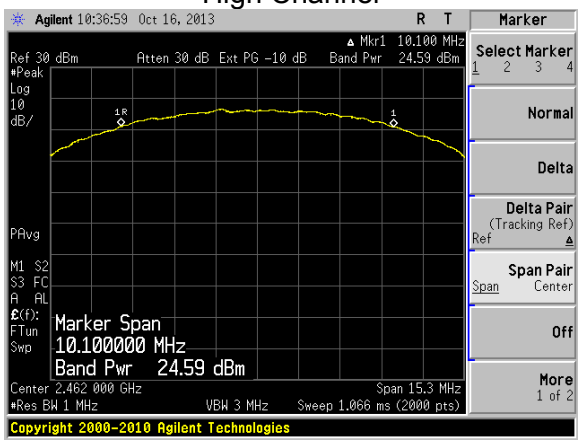
Low Channel



Middle Channel

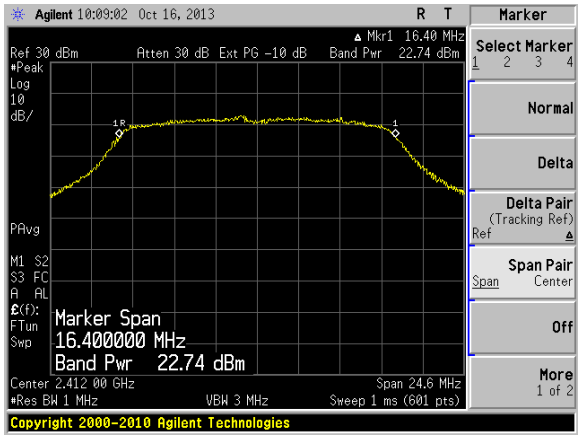


High Channel

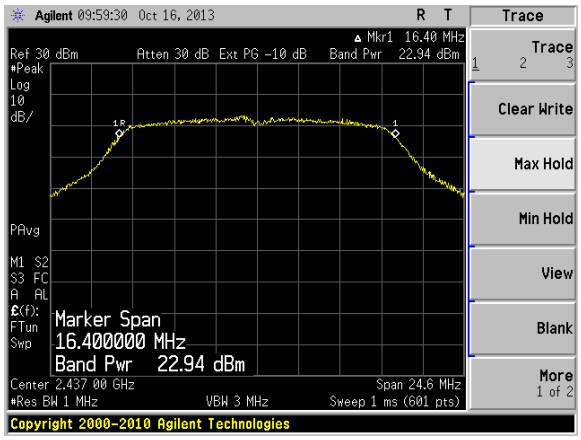


9.3.2.4 54 MBPS

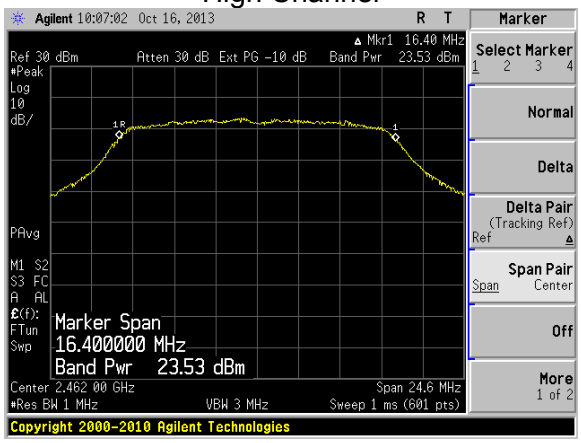
Low Channel



Middle Channel

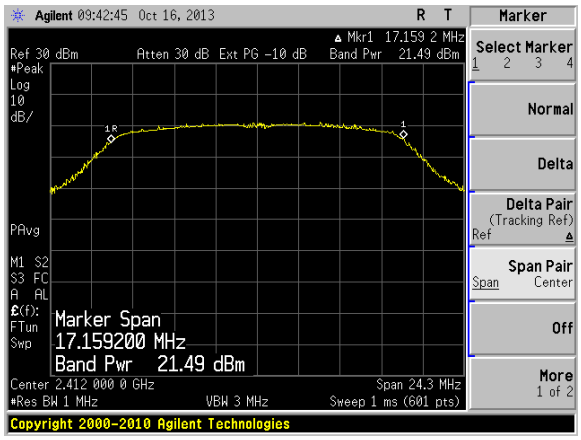


High Channel

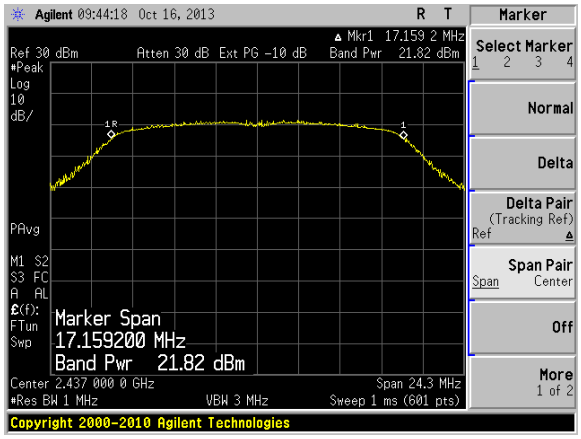


9.3.2.5 MCS0

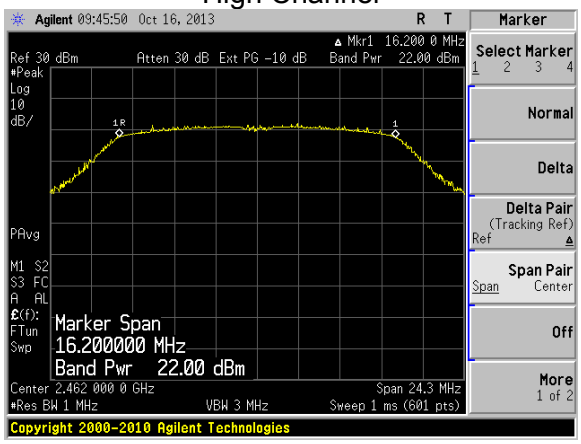
Low Channel



Middle Channel

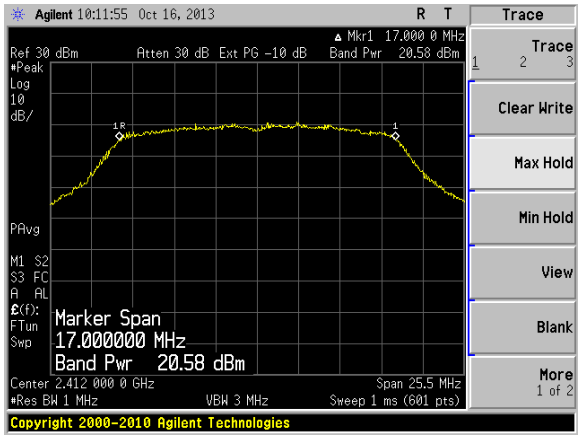


High Channel

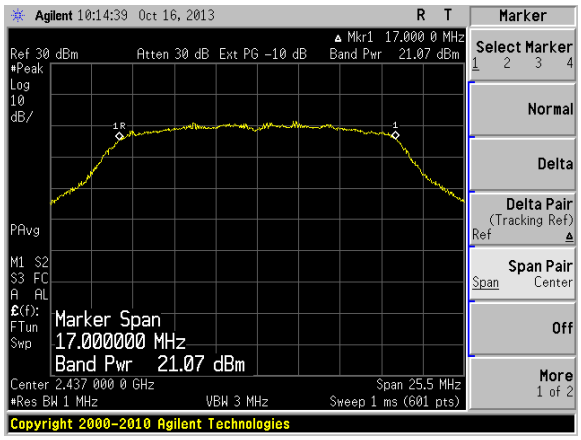


9.3.2.6 MCS7

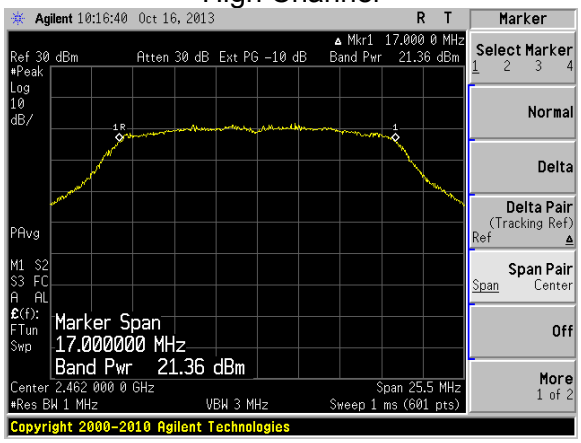
Low Channel



Middle Channel



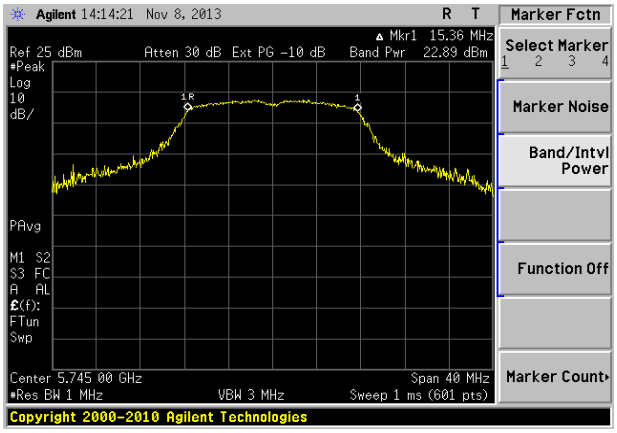
High Channel



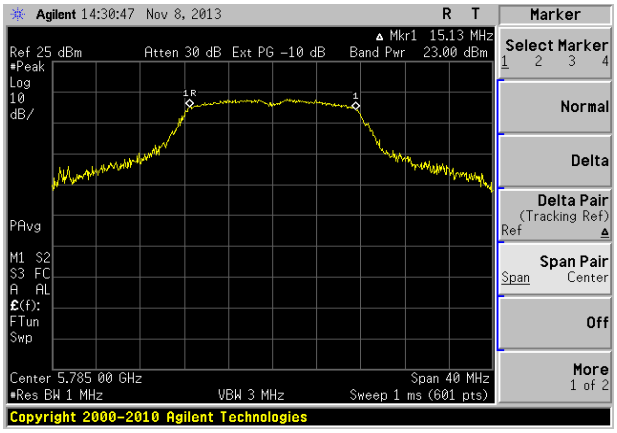
9.3.3 5.7GHz WLAN

9.3.3.1 6MBPS

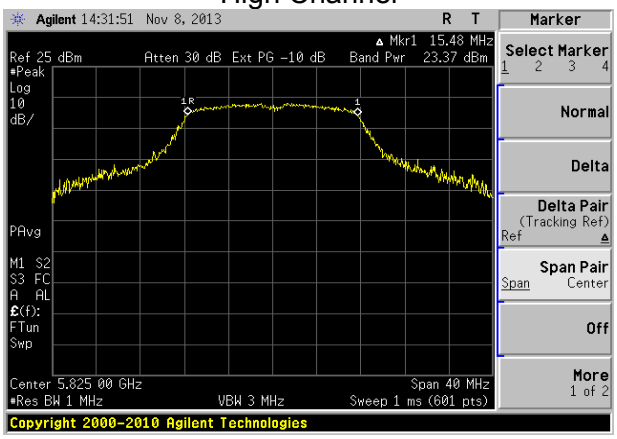
Low Channel



Middle Channel

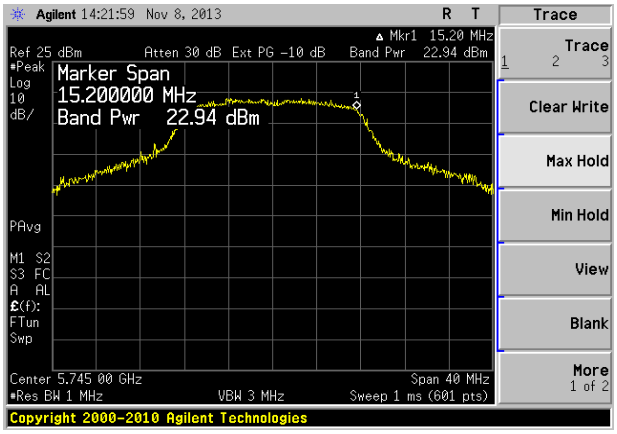


High Channel

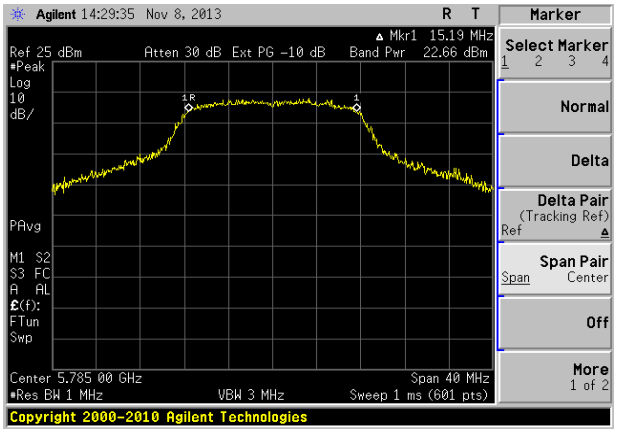


9.3.3.2 12MBPS

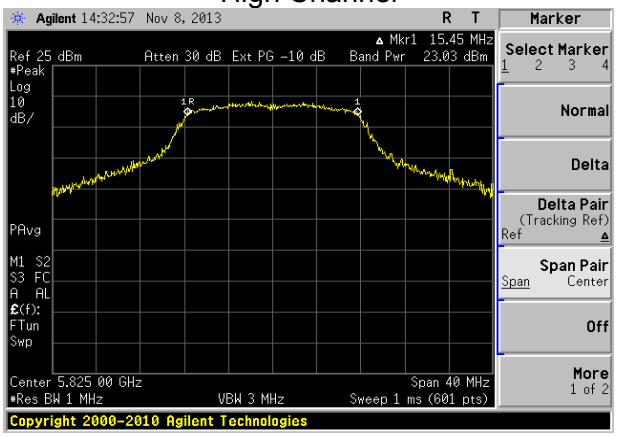
Low Channel



Middle Channel

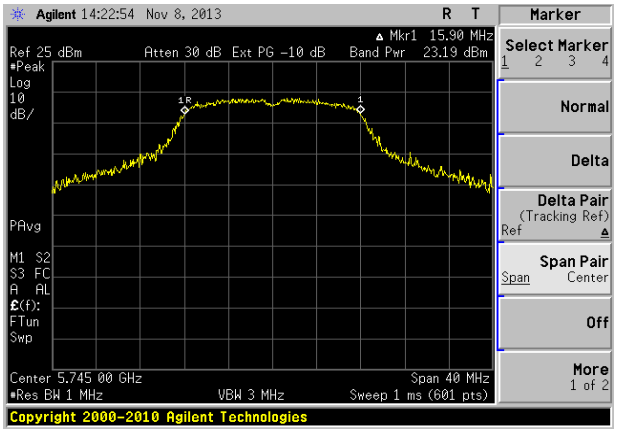


High Channel

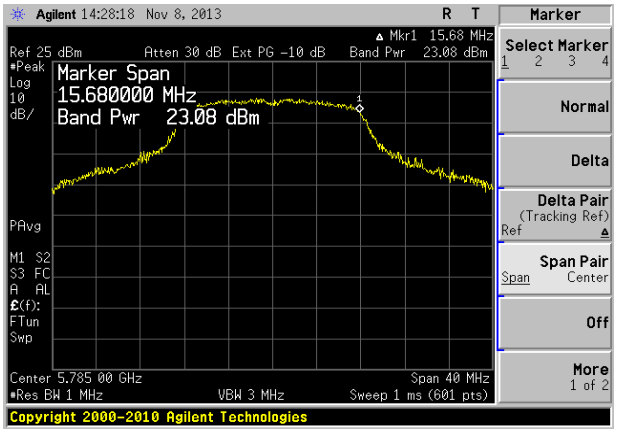


9.3.3.3 24MBPS

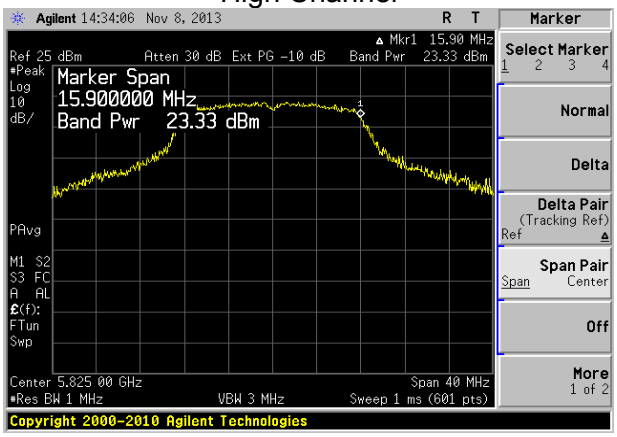
Low Channel



Middle Channel

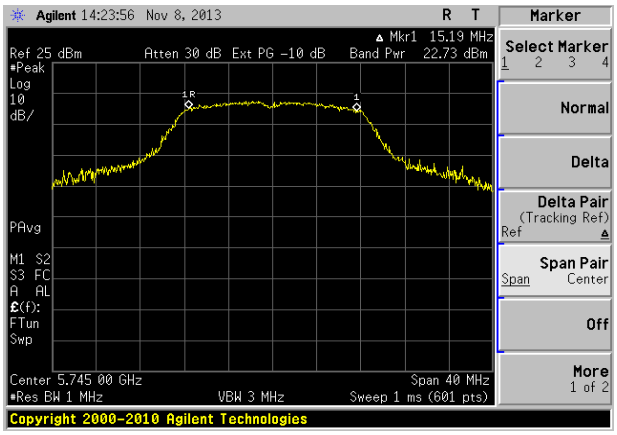


High Channel

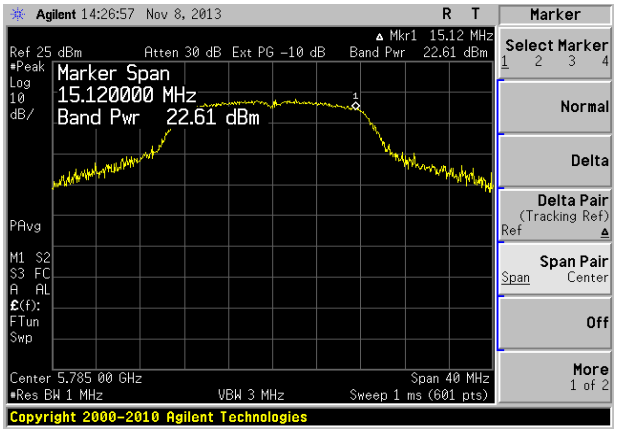


9.3.3.4 MCS0

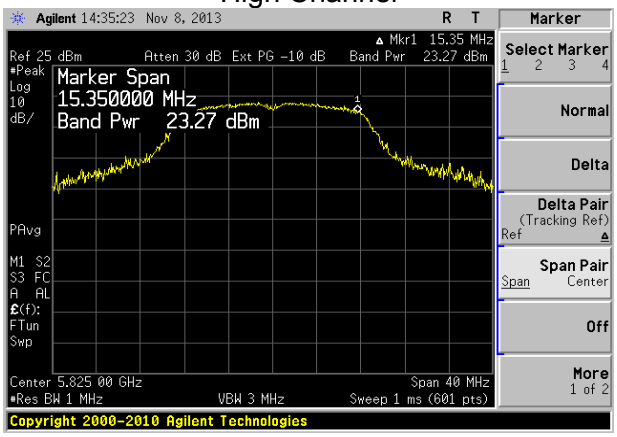
Low Channel



Middle Channel

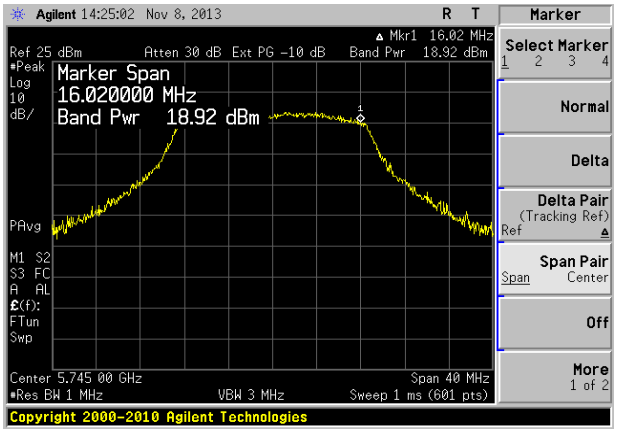


High Channel

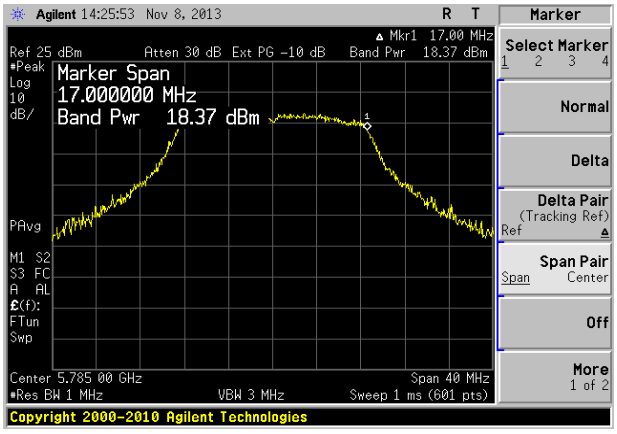


9.3.3.5 MCS7

Low Channel



Middle Channel



High Channel

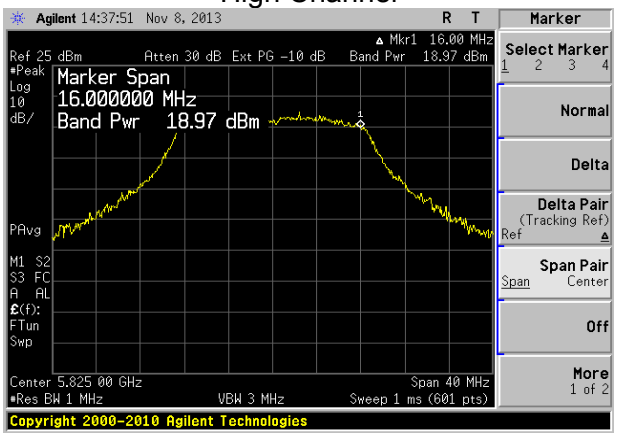


EXHIBIT 10. CONDUCTED SPURIOUS EMISSIONS

Test Engineer(s): Khairul Aidi Zainal

10.1 - Limits

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, based on either an RF conducted or a radiated measurement.

10.2 – Conducted Harmonic And Spurious RF Measurements

FCC Part 15.247(d) and IC RSS 210 A8.5 both require a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct readings of the measurements made without the need for any further corrections. A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

Measurement procedure used was FCC OET KDB 558074 D01 v03r01 section 11

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

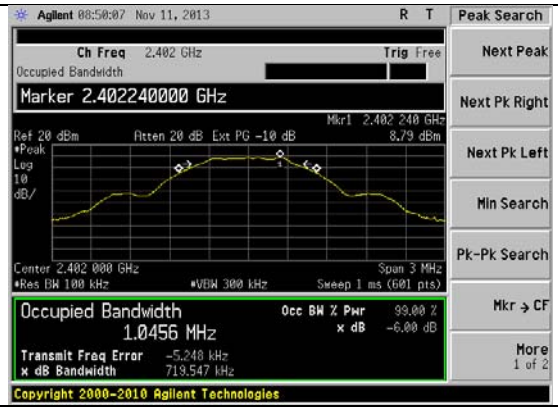
Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

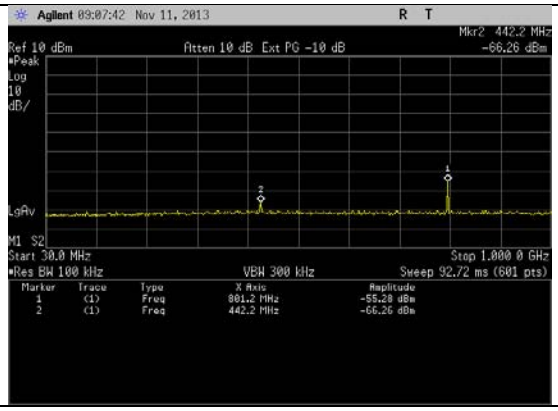
10.3 - Test Data

10.3.1 Bluetooth LE

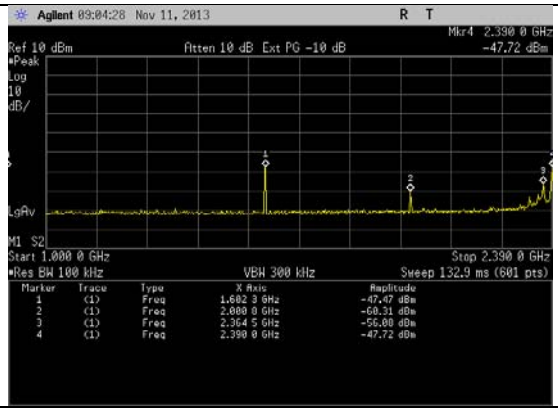
Low channel



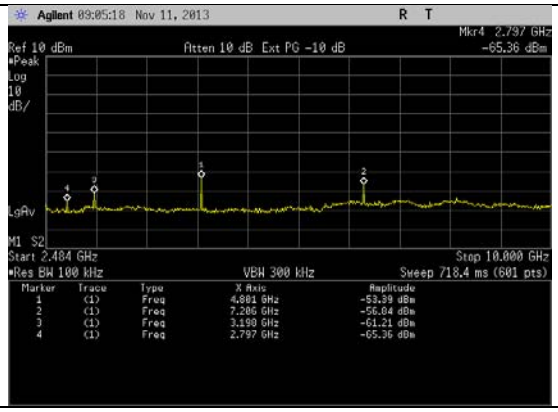
Fundamental



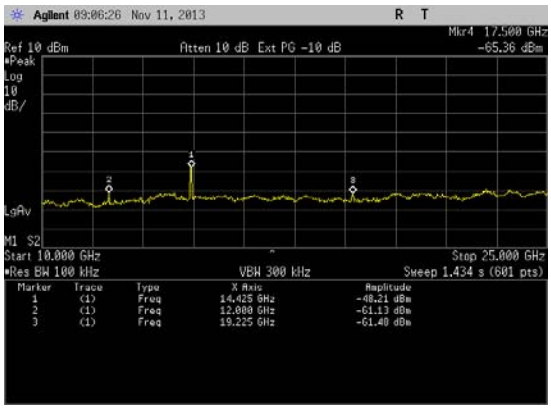
30 to 1000 MHz



1000 to 2390 MHz



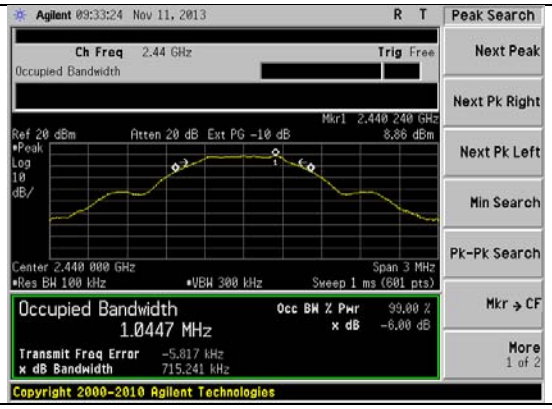
2484 to 10000 MHz



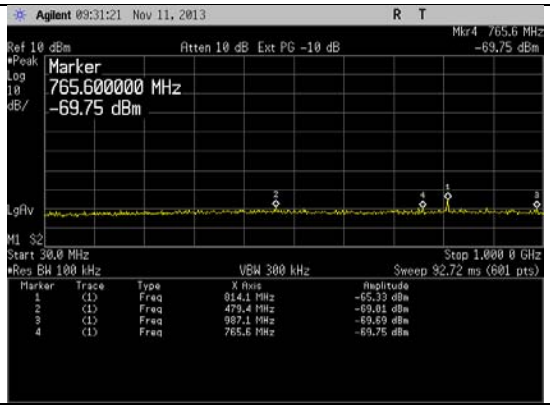
10000 to 25000 MHz

Note: 2390 to 2400 MHz is in Exhibit 8 of this report (band-edges)

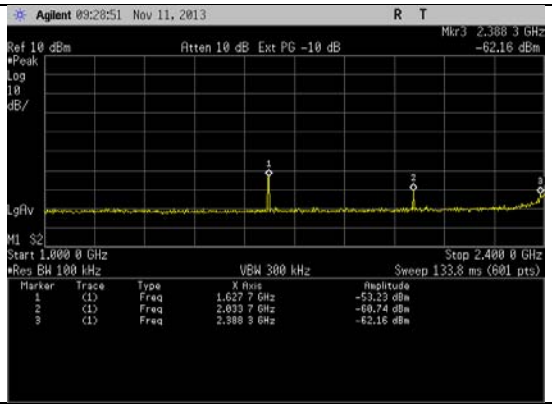
Middle channel



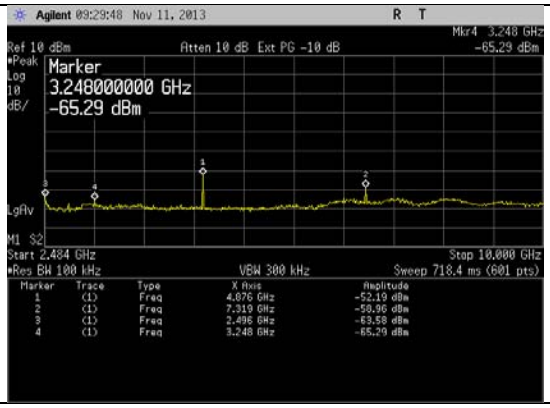
Fundamental



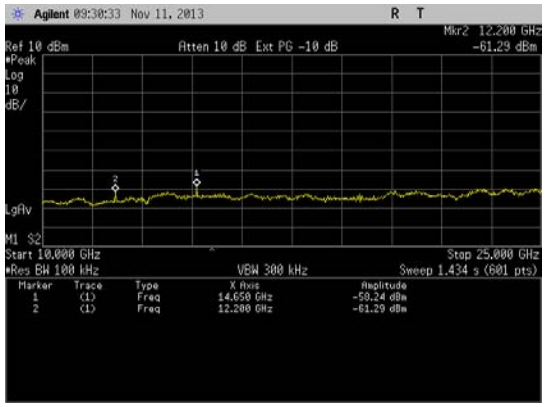
30 to 1000 MHz



1000 to 2400 MHz

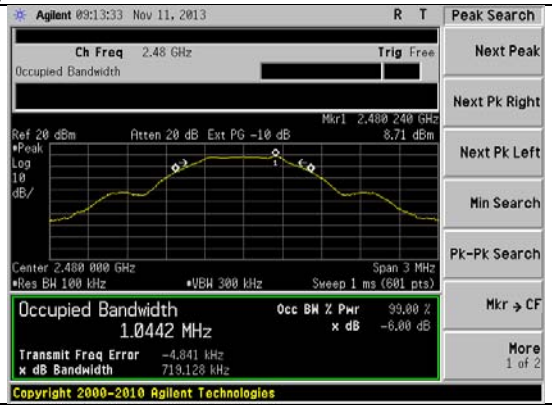


2484 to 10000 MHz

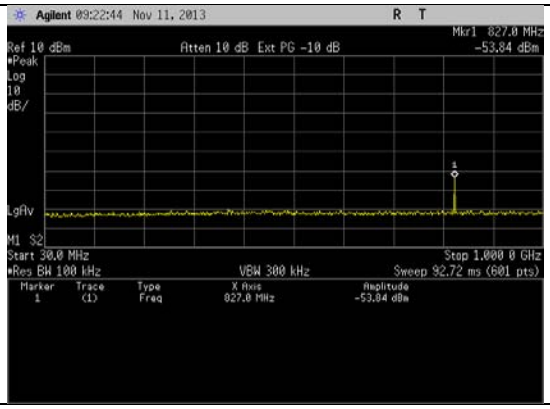


10000 to 25000 MHz

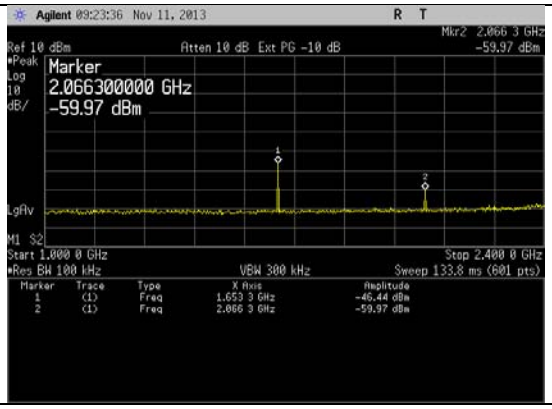
High channel



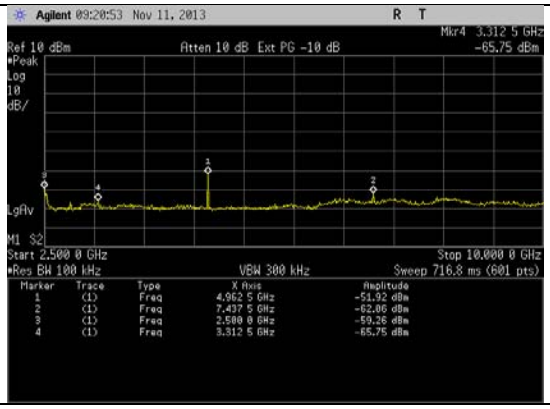
Fundamental



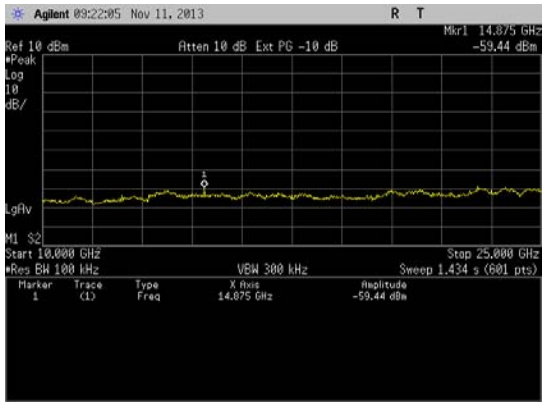
30 to 1000 MHz



1000 to 2400 MHz



2500 to 10000 MHz



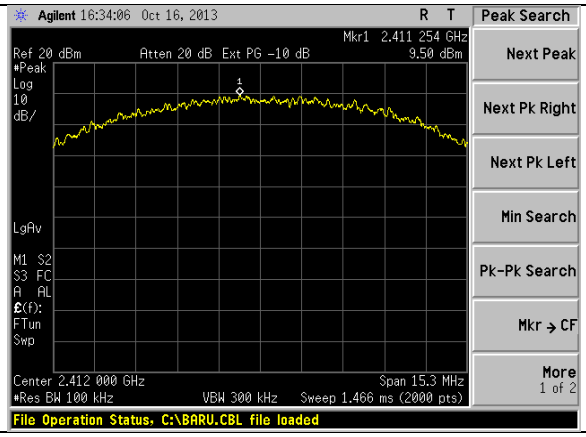
10000 to 25000 MHz

Note: 2483.5 to 2500 MHz is in Exhibit 8 of this report (band-edges)

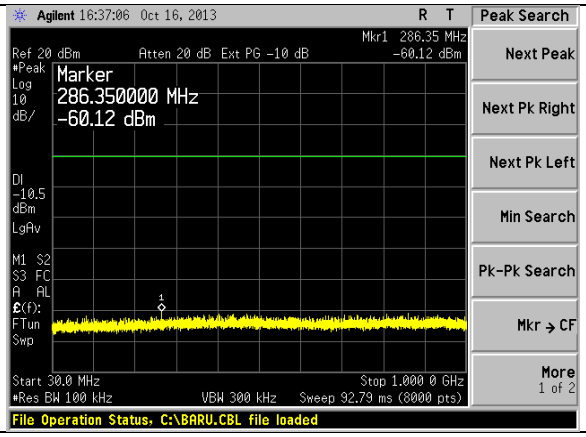
10.3.2 2.4GHz WLAN

The data presented below are samples selected from the various data rates.

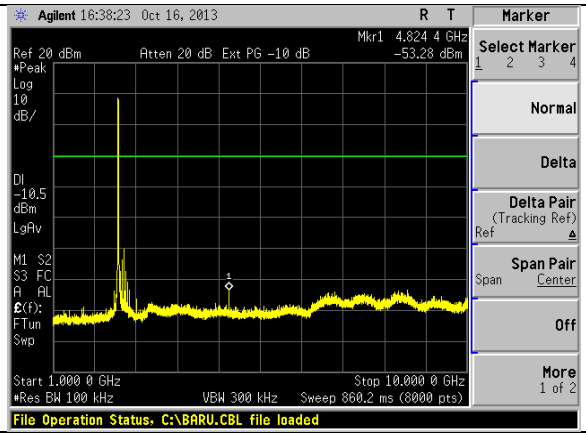
Low channel



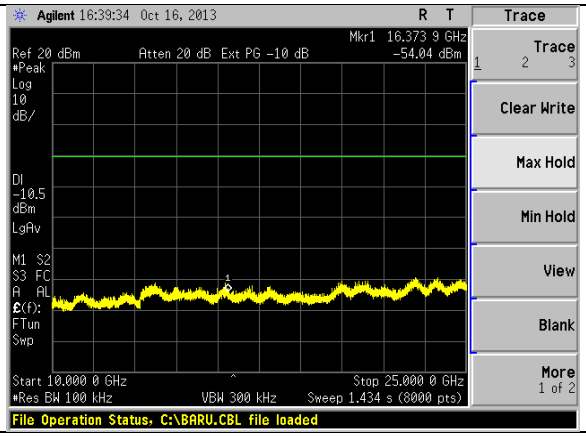
Fundamental



30 to 1000 MHz

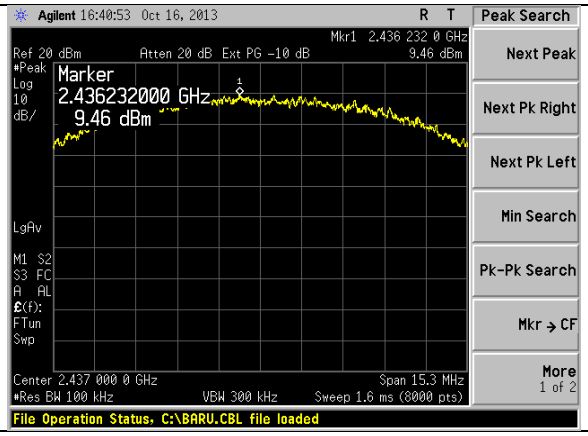


1000 to 10000 MHz

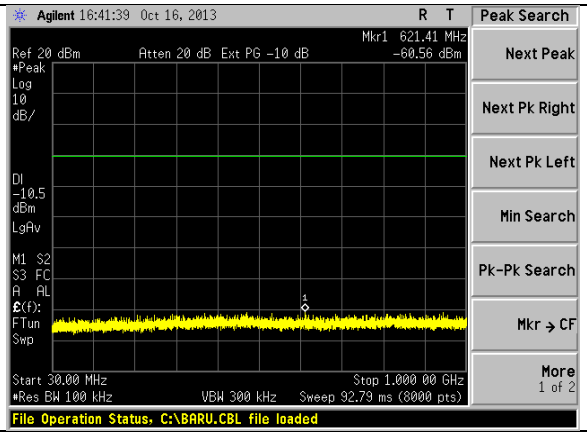


10000 to 25000 MHz

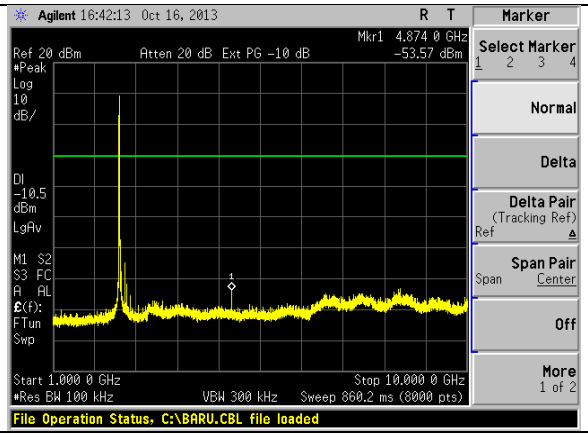
Middle channel



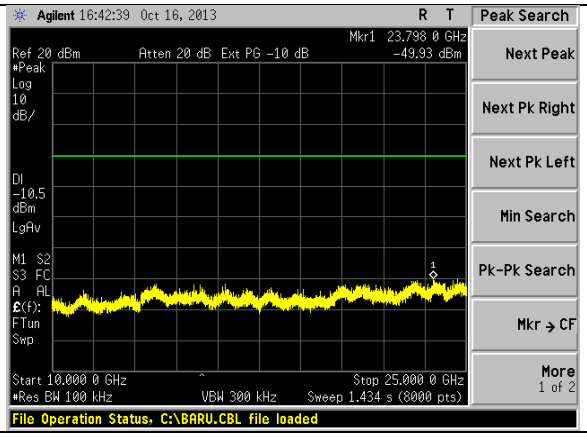
Fundamental



30 to 1000 MHz

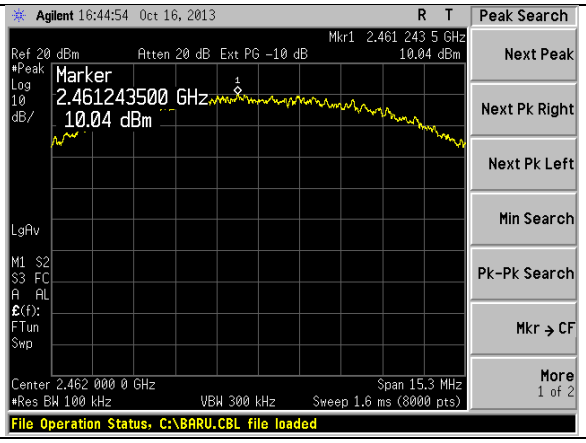


1000 to 10000 MHz

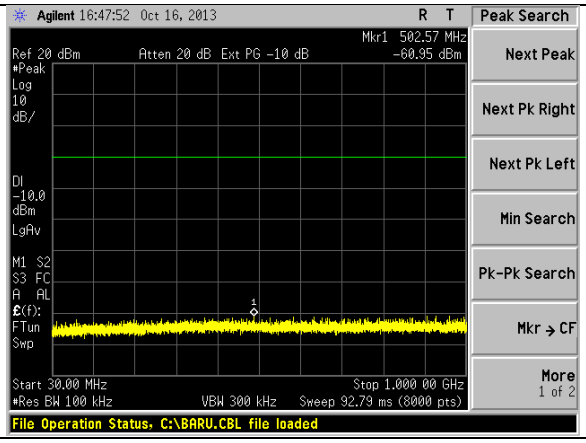


10000 to 25000 MHz

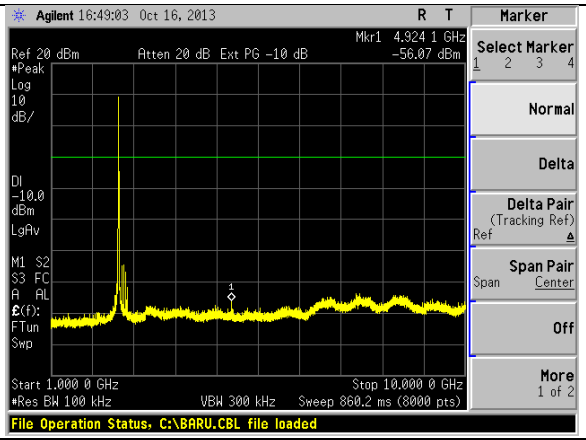
High channel



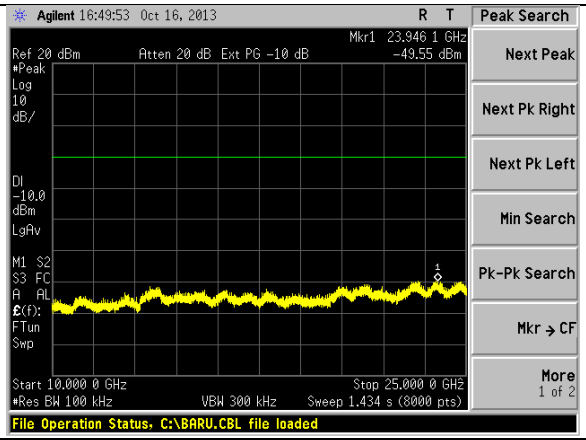
Fundamental



30 to 1000 MHz



1000 to 10000 MHz

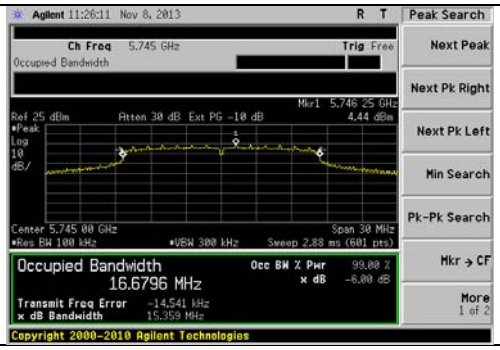
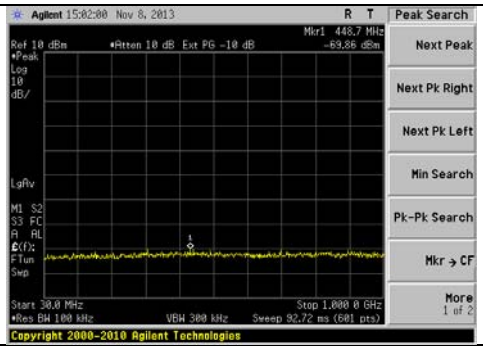
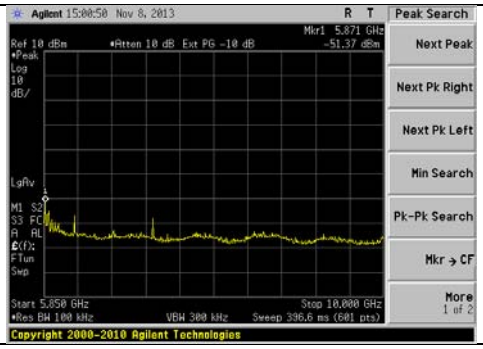
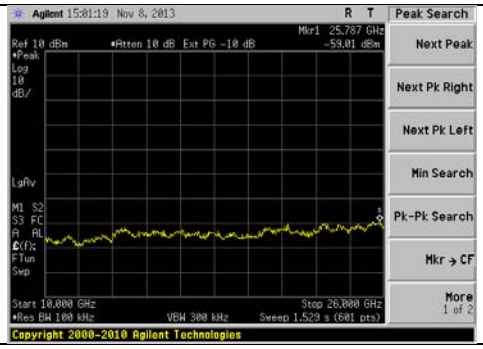


10000 to 25000 MHz

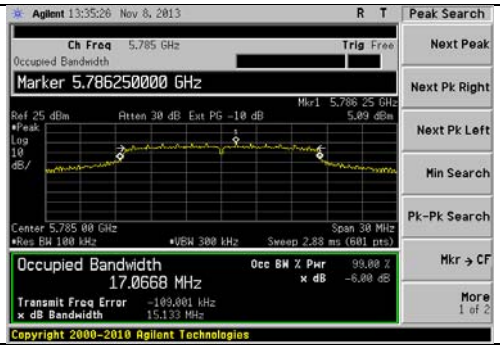
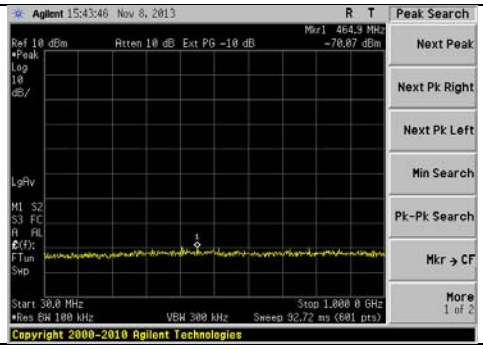
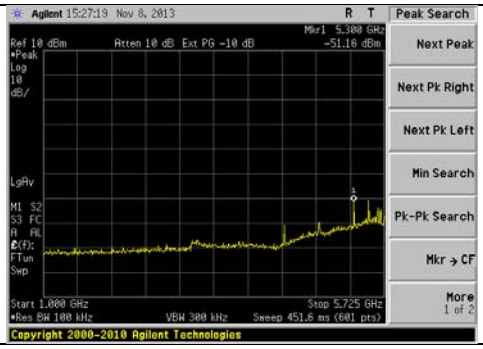
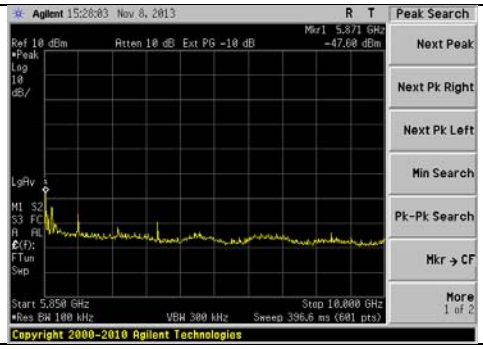
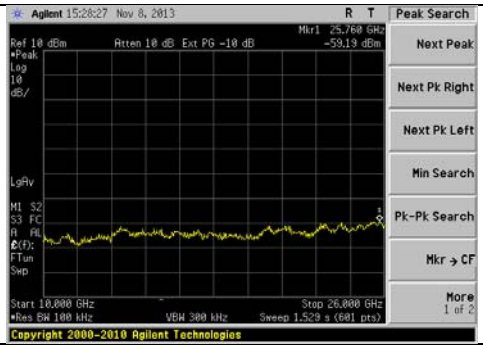
10.3.3 5.8GHz WLAN

The data presented below are samples selected from the various data rates.

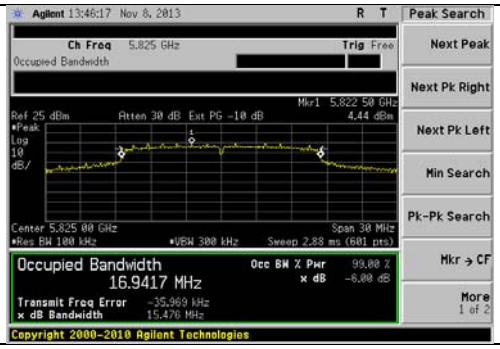
Low channel

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Fundamental</td><td>30 to 1000 MHz</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>1000 to 5725 MHz</td><td>5850 to 10000 MHz</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>10000 to 26000 MHz</td><td>26000 to 40000 MHz</td></tr>
</table>

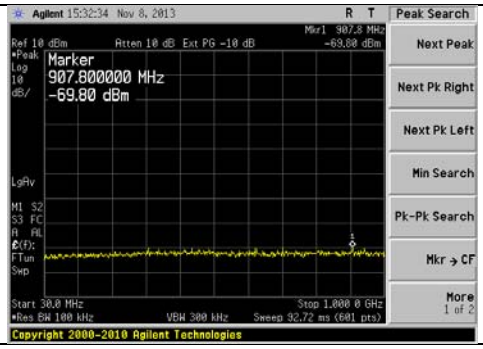
Middle channel

	
Fundamental	30 to 1000 MHz
	
1000 to 5725 MHz	5850 to 10000 MHz
	
10000 to 26000 MHz	26000 to 40000 MHz

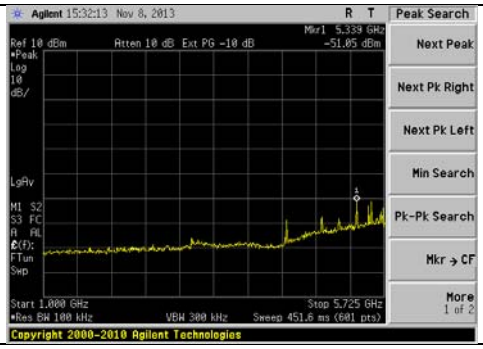
High channel



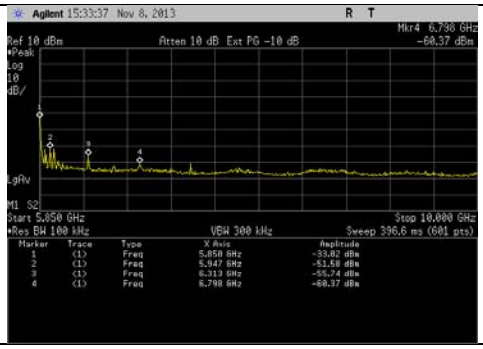
Fundamental



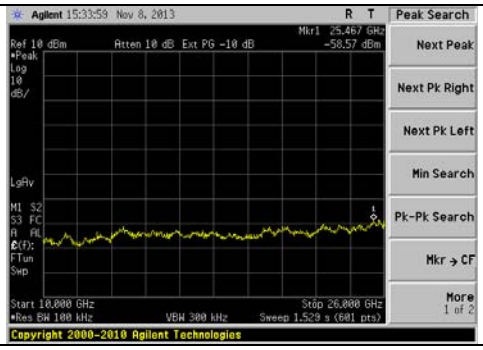
30 to 1000 MHz



1000 to 5725 MHz



5850 to 10000 MHz



10000 to 26000 MHz

26000 to 40000 MHz

EXHIBIT 11. POWER SPECTRAL DENSITY

11.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e) and RSS 210 A8.2(b), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed.

Measurement procedure used was FCC OET KDB 558074 D01 v03r01 section 10.2

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

11.2 Test Data

11.2.1 Bluetooth LE

EUT Mode	Channel	Frequency (MHz)	PPSD (3kHz) dBm	PKPSD Limit (dBm)	PKPSD Margin (dB)
BLE	0	2402	-6.7	8.0	14.7
	19	2440	-6.7	8.0	14.7
	39	2480	-6.7	8.0	14.7

11.2.2 2.4GHz WLAN

802.11 Standard	Data Rate (MBPS)	Channel	Peak PSD in 3kHz (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
b	1	1	-4.0	8.0	12.0
		6	-4.0	8.0	12.0
		11	-3.9	8.0	11.9
g	6	1	-10.6	8.0	18.6
		6	-10.6	8.0	18.6
		11	-9.7	8.0	17.7
n	MCS0	1	-11.1	8.0	19.1
		6	-10.0	8.0	18.0
		11	-10.5	8.0	18.5
b	11	1	-6.1	8.0	14.1
		6	-5.5	8.0	13.5
		11	-5.2	8.0	13.2
g	54	1	-11.9	8.0	19.9
		6	-10.2	8.0	18.2
		11	-9.9	8.0	17.9
n	MCS7	1	-12.7	8.0	20.7
		6	-12.8	8.0	20.8
		11	-12.1	8.0	20.1

11.2.3 5.7GHz WLAN

802.11 a

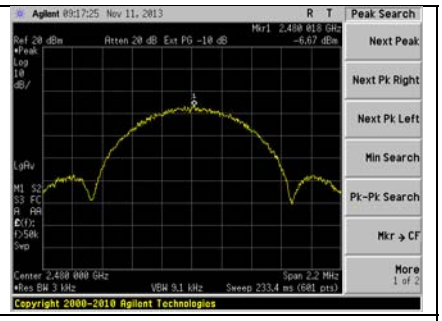
Data Rate	Channel	Frequency (MHz)	PPSD (100kHz) dBm	PKPSD Limit (dBm)	PKPSD Margin (dB)
6 Mbps	149	5745	4.4	8.0	3.6
	157	5785	5.1	8.0	2.9
	165	5825	4.4	8.0	3.6
Data Rate	Channel	Frequency (MHz)	PPSD (100kHz) dBm	PKPSD Limit (dBm)	PKPSD Margin (dB)
12 Mbps	149	5745	1.5	8.0	6.5
	157	5785	4.4	8.0	3.6
	165	5825	5.0	8.0	3.0
Data Rate	Channel	Frequency (MHz)	PPSD (100kHz) dBm	PKPSD Limit (dBm)	PKPSD Margin (dB)
24 Mbps	149	5745	3.1	8.0	4.9
	157	5785	4.5	8.0	3.5
	165	5825	5.5	8.0	2.5

802.11n

Data Rate	Channel	Frequency (MHz)	PPSD (100kHz) dBm	PKPSD Limit (dBm)	PKPSD Margin (dB)
6.5 Mbps (MCS 0)	149	5745	4.7	8.0	3.4
	157	5785	5.0	8.0	3.0
	165	5825	5.6	8.0	2.5
Data Rate	Channel	Frequency (MHz)	PPSD (100kHz) dBm	PKPSD Limit (dBm)	PKPSD Margin (dB)
65 Mbps (MCS 7)	149	5745	-2.0	8.0	10.0
	157	5785	-0.1	8.0	8.1
	165	5825	0.6	8.0	7.4

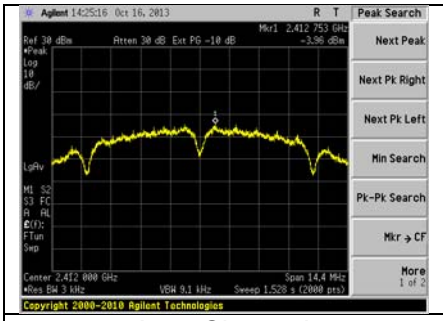
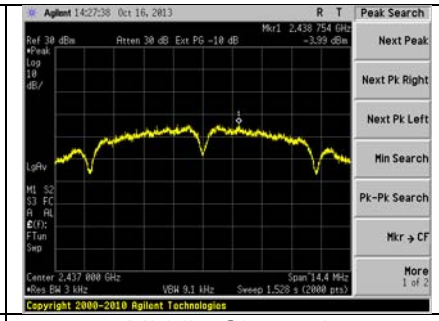
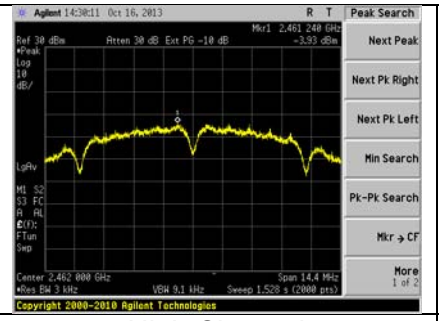
11.3 Screen Captures – Power Spectral Density

11.3.1 Bluetooth LE

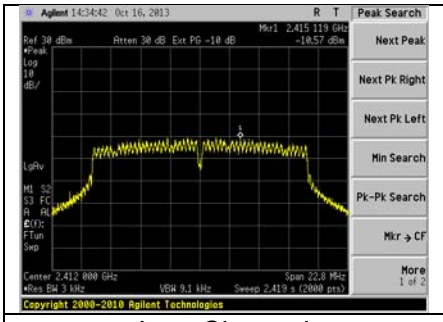
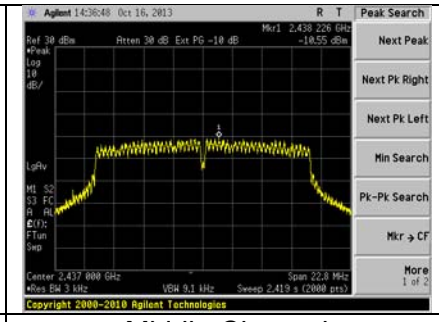
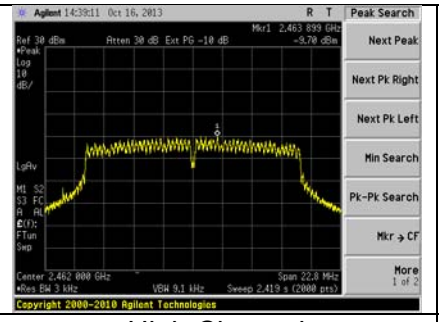
		
Low Channel	Middle Channel	High Channel

11.3.2 2.4GHz WLAN

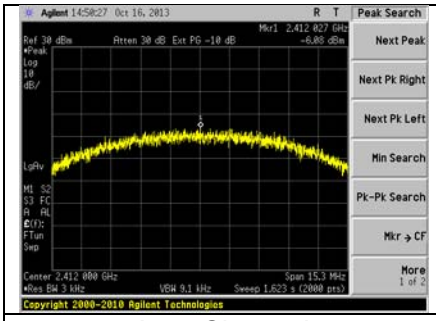
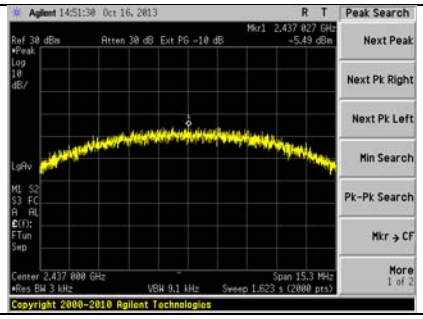
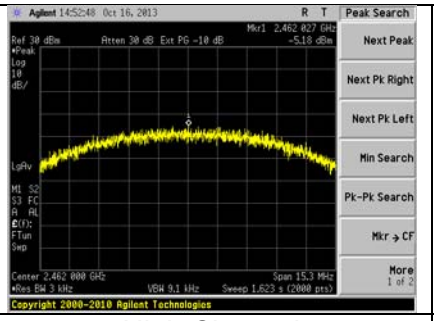
11.3.2.1 1 MBPS

		
Low Channel	Middle Channel	High Channel

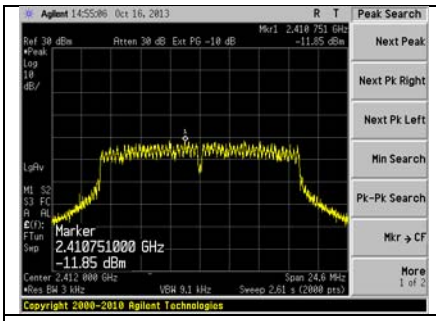
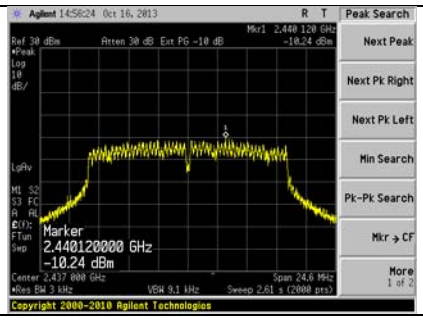
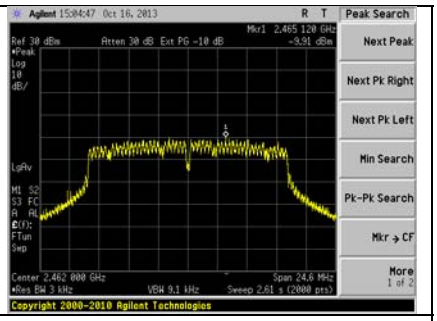
11.3.2.2 6 MBPS

		
Low Channel	Middle Channel	High Channel

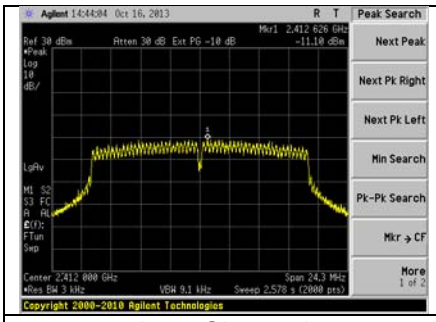
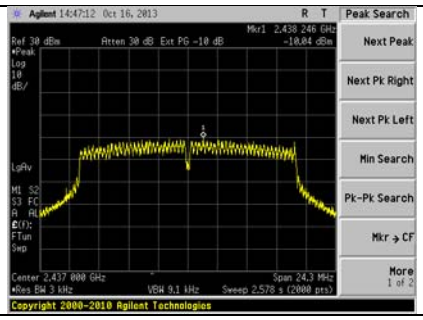
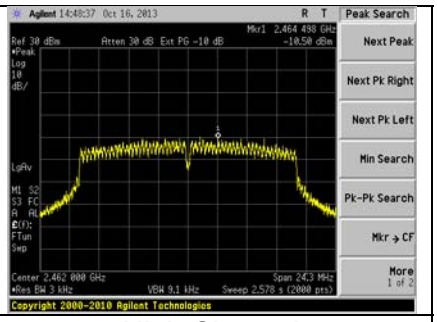
11.3.2.3 11 MBPS

		
Low Channel	Middle Channel	High Channel

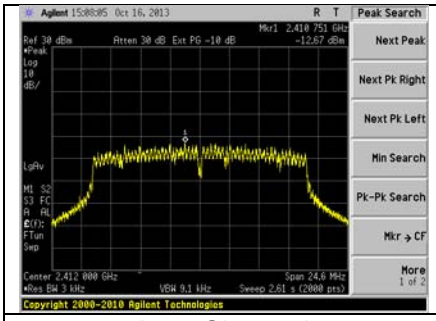
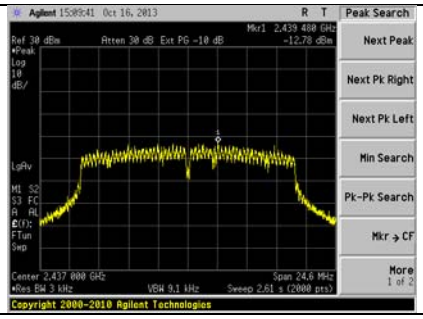
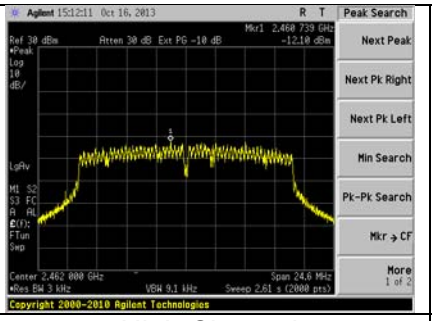
11.3.2.4 54 MBPS

		
Low Channel	Middle Channel	High Channel

11.3.2.5 MCS0

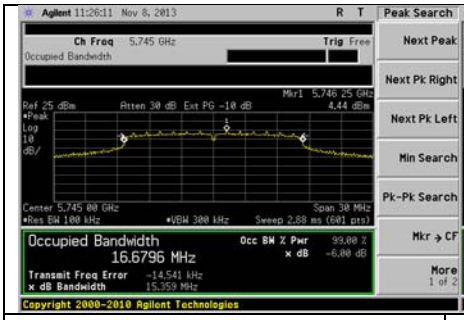
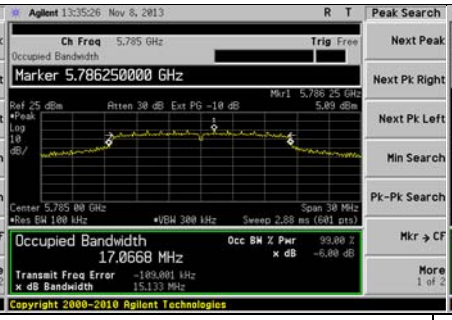
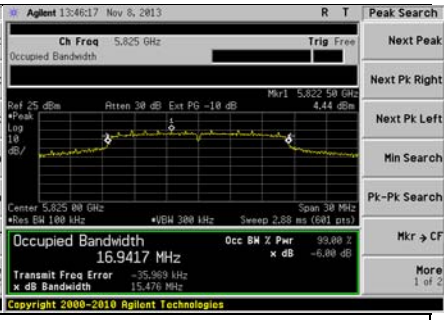
		
Low Channel	Middle Channel	High Channel

11.3.2.6 MCS7

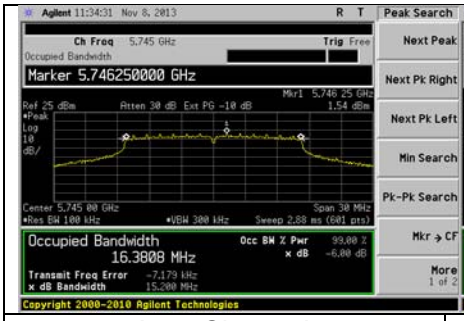
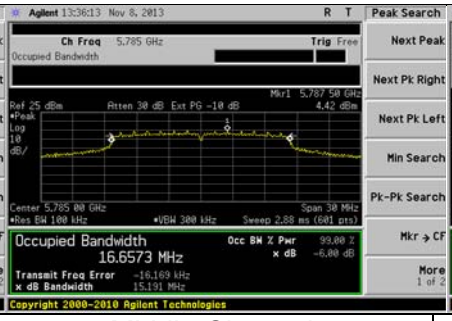
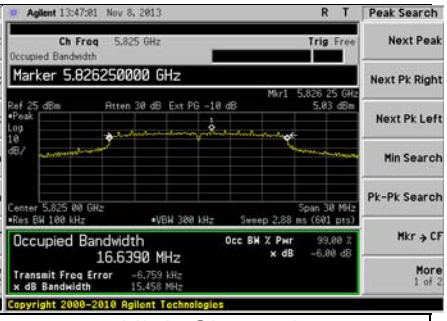
		
Low Channel	Middle Channel	High Channel

11.3.3 5.7GHz WLAN

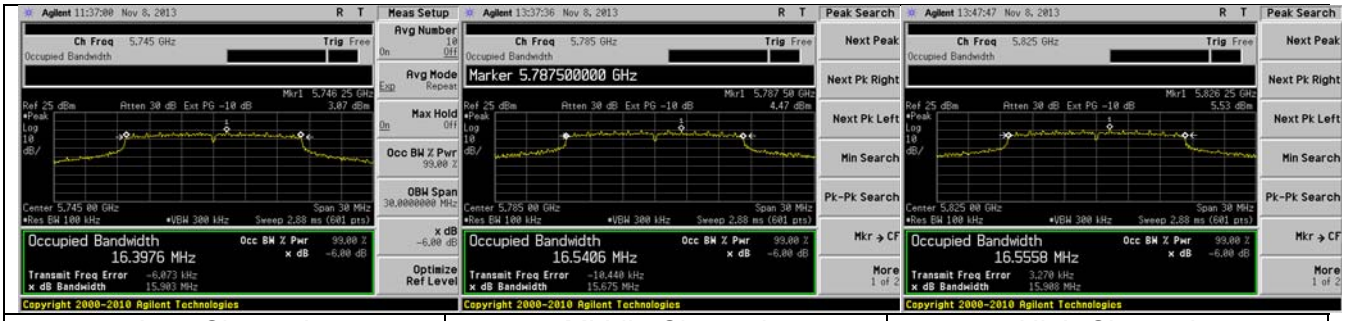
11.3.3.1 6MBPS

		
Low Channel	Middle Channel	High Channel

11.3.3.2 12MBPS

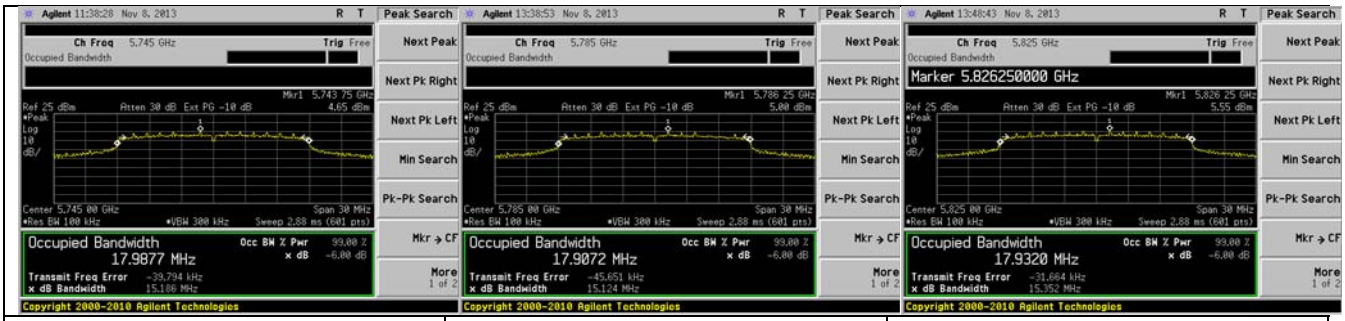
		
Low Channel	Middle Channel	High Channel

11.3.3.3 24MBPS



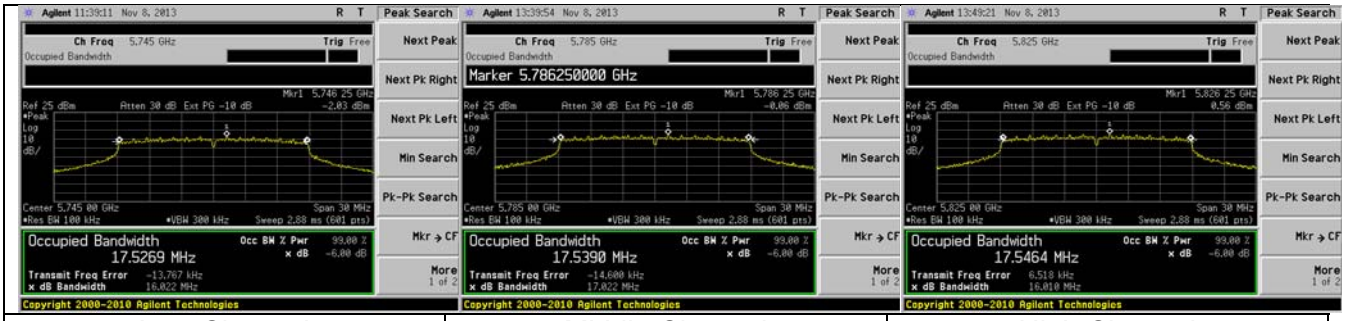
Low Channel	Middle Channel	High Channel

11.3.3.4 MCS0



Low Channel	Middle Channel	High Channel

11.3.3.4 MCS7



Low Channel	Middle Channel	High Channel

EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

Test Engineer(s): Khairul Aidi Zainal

The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied ±15% from the nominal.

BLUETOOTH

	3.06 VDC		3.60 VDC		4.14 VDC			
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)	Pout DRIFT (dBm)
LOW CHANNEL	9.4	2402000459	9.4	2402000479	9.4	2402000479	20	0.0
MID CHANNEL	9.4	2440000560	9.4	2440000560	9.4	2440000539	21	0.0
HIGH CHANNEL	9.2	2480000580	9.2	2480000560	9.2	2480000539	41	0.1

WLAN 2.4 GHZ

	3.06 VDC		3.60 VDC		4.14 VDC			
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)	Pout DRIFT (dBm)
LOW CHANNEL	6.1	2412000969	6.4	2412000990	6.2	2412000990	21	0.3
MID CHANNEL	6.6	2437000920	6.7	2437000940	6.6	2437000960	40	0.1
HIGH CHANNEL	6.5	2462000939	6.6	2462000960	6.7	2462000960	21	0.3

WLAN 5.7 GHZ

	3.06 VDC		3.60 VDC		4.14 VDC			
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)	Pout DRIFT (dBm)
LOW CHANNEL	3.8	5745002200	4.0	5745002300	4.0	5745002340	140	0.3
MID CHANNEL	2.7	5785002280	3.0	5785002360	3.2	5785002280	80	0.5
HIGH CHANNEL	2.1	5825002160	2.4	5825002220	2.6	5825002320	160	0.4

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.

EXHIBIT 13. MPE CALCULATIONS

The following MPE calculations are based on a measured conducted RF power of 24.6dBm at 2462MHz and 23.4dBm at 5825MHz as presented to the antenna. The gain of this antenna, based on the data sheet is -0.6dBi for the 2.4GHz band and +3.5dBi for the 5.8GHz band.

13.1 2400 to 2483.5 MHz Band

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	24.60	(dBm)
Maximum peak output power at antenna input terminal:	288.403	(mW)
Antenna gain(typical):	-0.6	(dBi)
Maximum antenna gain:	0.871	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2405	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)

Power density at prediction frequency: 0.049972 (mW/cm^2)

Maximum allowable antenna gain: 12.4 (dBi)

Margin of Compliance at 20 cm = 13.0 dB

13.2 5725 to 5850 MHz Band

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	23.40	(dBm)
Maximum peak output power at antenna input terminal:	218.776	(mW)
Antenna gain(typical):	3.5	(dBi)
Maximum antenna gain:	2.239	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5825	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.097438	(mW/cm^2)
Maximum allowable antenna gain:	13.6	(dBi)
Margin of Compliance at 20 cm =	10.1	dB

APPENDIX A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 8-Oct-2013 Type Test : Radiated measurements Job # : C-1818

Prepared By: Aidi Zainal Customer : Nikon Metrology Quote #: 313179

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	9/5/2013	9/5/2014	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	9/5/2013	9/5/2014	Active Calibration
3	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	9/5/2013	9/5/2014	Active Calibration
4	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	1/29/2013	1/29/2014	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	6/10/2013	6/10/2014	Active Calibration
6	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	12/10/2012	12/10/2013	Active Calibration
7	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	12/12/2012	12/12/2013	Active Calibration
8	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/28/2013	5/28/2014	Active Calibration
9	AA 960153	2.4GHz High Pass Filter	KWM	HPF-L-14186	7272-04	4/1/2013	4/1/2014	Active Calibration
10	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	2/1/2013	2/1/2014	Active Calibration
11	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	10/27/2013	10/27/2014	Active Calibration
12	EE 960161	26.5-40GHz LNA	Ducommun Technc	ALN-33144030	1103717-01	9/24/2013	9/24/2014	Active Calibration
13	AA 960161	Highpass Filter	K&L Microwave	11SH10-8000	2	12/24/2013	12/24/2014	Active Calibration
14	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/1/2011	7/1/2013	Syatem
15	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMCC	WLA622-4 / 3160-09	123001	9/24/2013	9/24/2014	Active Calibration
16	AA 960137	Standard Gain Horn Ant.	EMCO	3160-10	69259	10/4/2011	10/4/2014	Active Calibration
17	AA 960160	UTIFLEX Cable	Micro-Coax	UFC142A-0-0720-2002	218652-001	9/24/2013	9/24/2014	Active Calibration

Project Engineer: Quality Assurance: Peter Fielen

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 8-Oct-2013 Type Test : Conducted measurements Job # : C-1818

Prepared By: Aidi Zainal Customer : Nikon Metrology Quote #: 313179

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	8/7/2013	8/7/2014	Active Calibration
2	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/1/2011	7/1/2013	System
3	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/28/2013	5/28/2014	Active Calibration
4	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/14/2013	6/14/2015	Active Calibration
5	AA 960160	UTIFLEX Cable	Micro-Coax	UFC142A-0-0720-2002	218652-001	9/24/2013	9/24/2014	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 20-Dec-2011 Type Test : AC mains Job # : C-1371

Prepared By: Aidi Customer : LSR Quote #: 311362

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	11/22/2011	11/22/2012	Active Calibration
2	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	11/22/2011	11/22/2012	Active Calibration
3	AA 960072	Transient Limiter	HP	11947A	3107A02515	11/2/2011	11/2/2012	Active Calibration
4	AA 960075	LISN	EMCO	3810/2NM	9612-1710	9/19/2011	9/19/2012	Active Calibration

Project Engineer: Aidi Quality Assurance: Mike Hintzke

APPENDIX B – Test Standards: CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
ANSI C63.10	2009		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2013		
RSS GEN	2010		
RSS 210	2010		

APPENDIX C - Uncertainty Statement

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	*Particular Configuration*	*Uncertainty Values*
Radiated Emissions	*3 – Meter chamber, Biconical Antenna*	*4.82 dB*
Radiated Emissions	*3-Meter Chamber, Log Periodic Antenna*	*4.88 dB*
Radiated Emissions	*3-Meter Chamber, Horn Antenna*	*4.85 dB*
Radiated Emissions	*10-Meter OATS, Biconical Antenna*	*4.32 dB*
Radiated Emissions	*10-Meter OATS, Log Periodic Antenna*	*3.63 dB*
Absolute Conducted Emissions	*Agilent PSA/ESA Series*	*1.38 dB*
AC Line Conducted Emissions	*Shielded Room/EMCO LISN*	*3.20 dB*
Radiated Immunity	*3 Volts/Meter in 3-Meter Chamber*	*2.05 Volts/Meter*
Conducted Immunity	*3 Volts level*	*2.33 V*
EFT Burst, Surge, VDI	*230 VAC*	*54.4 V*
ESD Immunity	*Discharge at 15kV*	*3200 V*
Temperature/Humidity	*Thermo-hygrometer*	*0.64° / 2.88 %RH*

APPENDIX D – WLAN (802.11x) Channels 12 and 13 data

WLAN Channels 12 and 13 passively scan and will only listen and cannot send a probe request to initiate communication. In the module '.ini' file, the channels are set to a hex value of 80 which sets the channels at the lowest possible output power.

D1. Output Power (Conducted):

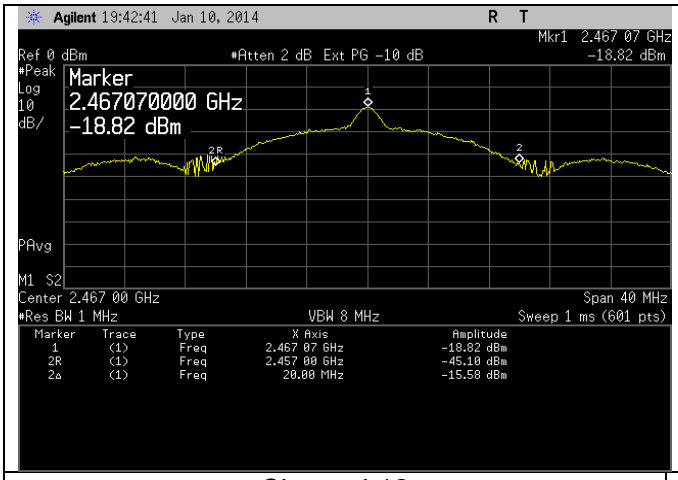
Measurement procedure used was FCC OET KDB 558074 D01 v03r01 section 9.1.1 and 9.1.2

Data:

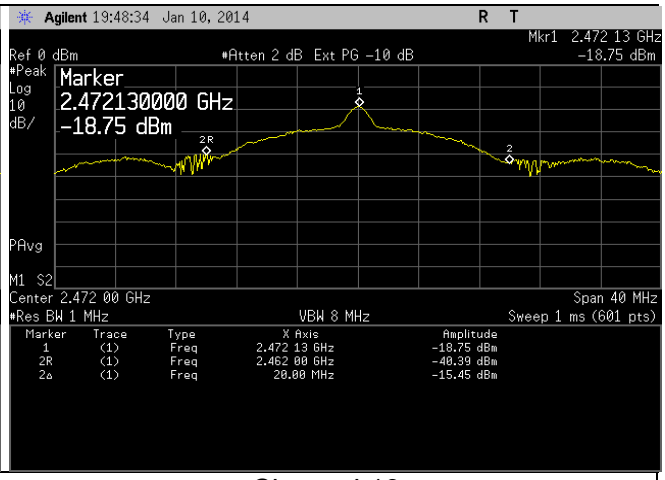
802.11 Standard	Data Rate (MBPS)	Channel	Maximum Peak Power (dBm)
b	1	12	-17.2
		13	-17.3
g	6	12	-13.4
		13	-14.1
n	MCS0	12	-14.1
		13	-13.8
b	11	12	-15.6
		13	-15.5
g	54	12	-14.6
		13	-14.7
n	MCS7	12	-14.6
		13	-14.9

Captures:
The captures presented are representative of worst case between the channels and modulation:

802.11 b

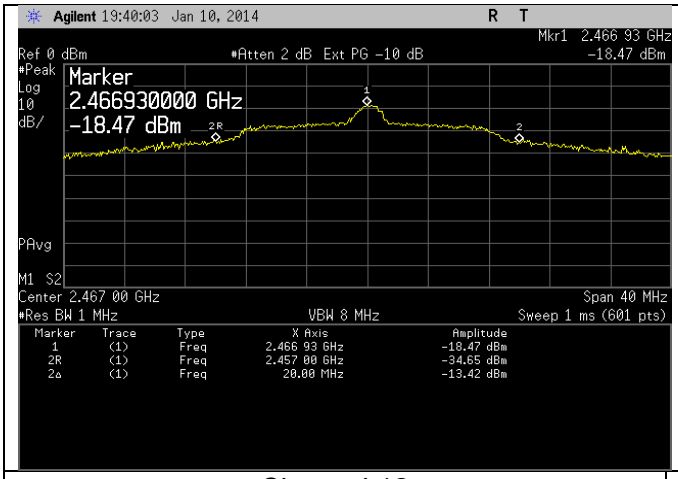


Channel 12

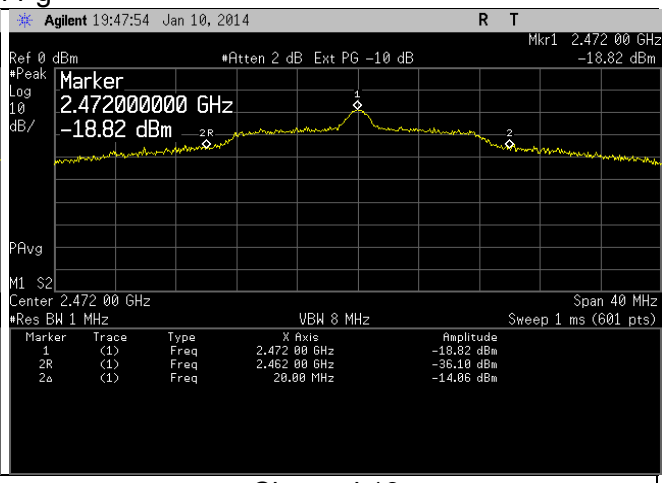


Channel 13

802.11 g

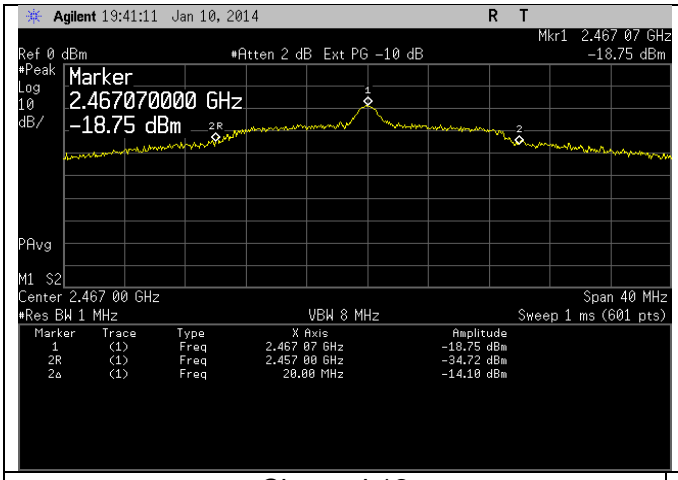


Channel 12

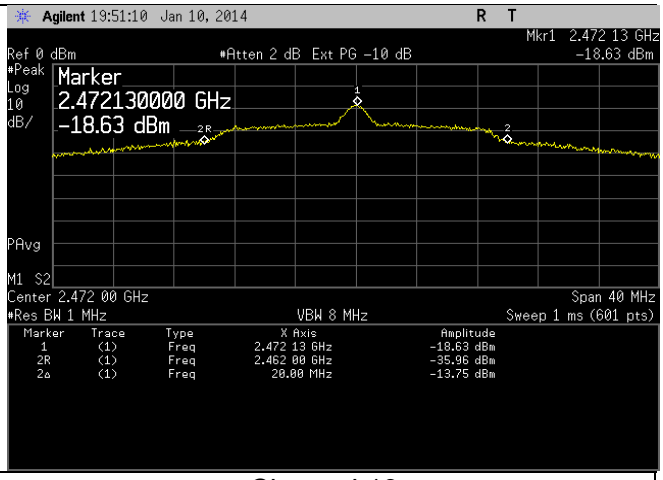


Channel 13

802.11 n



Channel 12



Channel 13

D2. Restricted band Upper Band-edge:

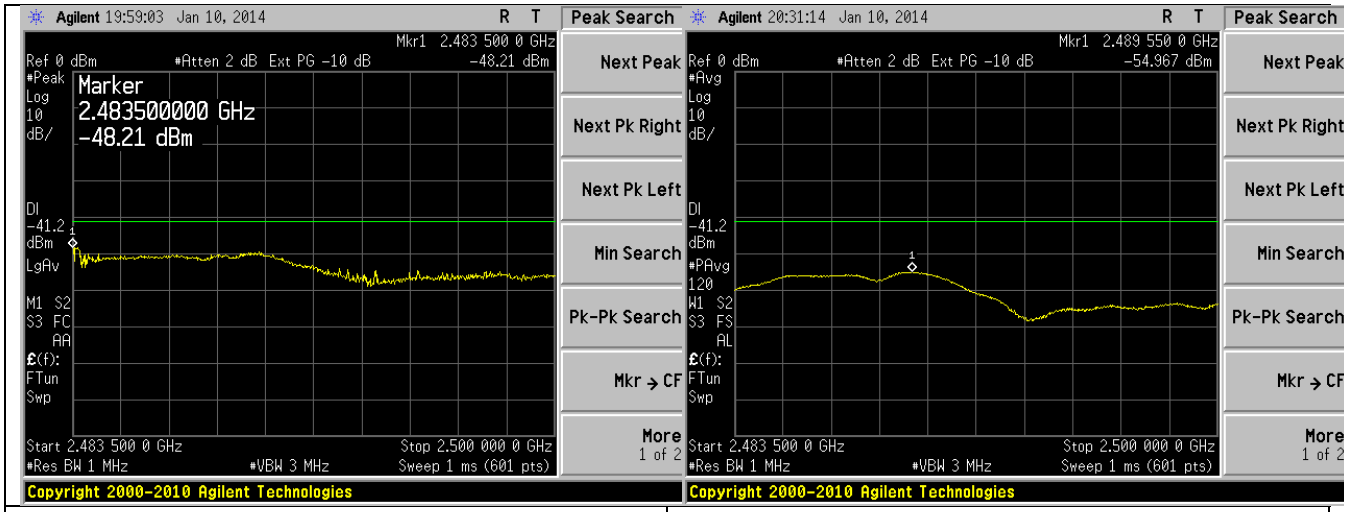
Measurement procedure used was FCC OET KDB 558074 D01 v03r01 sections 11 and 12.

Data:

803.11 Standard	Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
b	1	2483.5	-48.2	2489.6	-55.0	0.0	2.0	-46.2	-21.2	25.0	-53.0	-41.2	11.7
a,g	6	2483.9	-34.6	2484.1	-46.3	0.1	2.0	-32.6	-21.2	11.3	-44.2	-41.2	3.0
a,g	12	2483.7	-36.1	2483.5	-46.6	0.3	2.0	-34.1	-21.2	12.9	-44.3	-41.2	3.1
a,g	24	2484.5	-35.7	2483.6	-47.2	0.5	2.0	-33.7	-21.2	12.5	-44.7	-41.2	3.4
a,g	54	2484.3	-35.8	2483.6	-46.9	1.0	2.0	-33.8	-21.2	12.6	-43.9	-41.2	2.7
n	MCS0	2483.9	-35.1	2483.7	-45.8	0.2	2.0	-33.1	-21.2	11.9	-43.6	-41.2	2.4
n	MCS7	2483.7	-36.7	2484.0	-47.5	1.2	2.0	-34.7	-21.2	13.5	-44.3	-41.2	3.1
n	MCS1	2483.7	-35.7	2483.7	-46.2	0.3	2.0	-33.7	-21.2	12.5	-43.9	-41.2	2.7
n	MCS5	2484.7	-37.1	2484.6	-47.6	0.9	2.0	-35.1	-21.2	13.8	-44.6	-41.2	3.4
a,g	48	2483.6	-35.4	2483.8	-47.3	0.9	2.0	-33.4	-21.2	12.2	-44.4	-41.2	3.2
n	MCS3	2484.6	-35.8	2483.7	-46.7	0.5	2.0	-33.8	-21.2	12.6	-44.2	-41.2	3.0

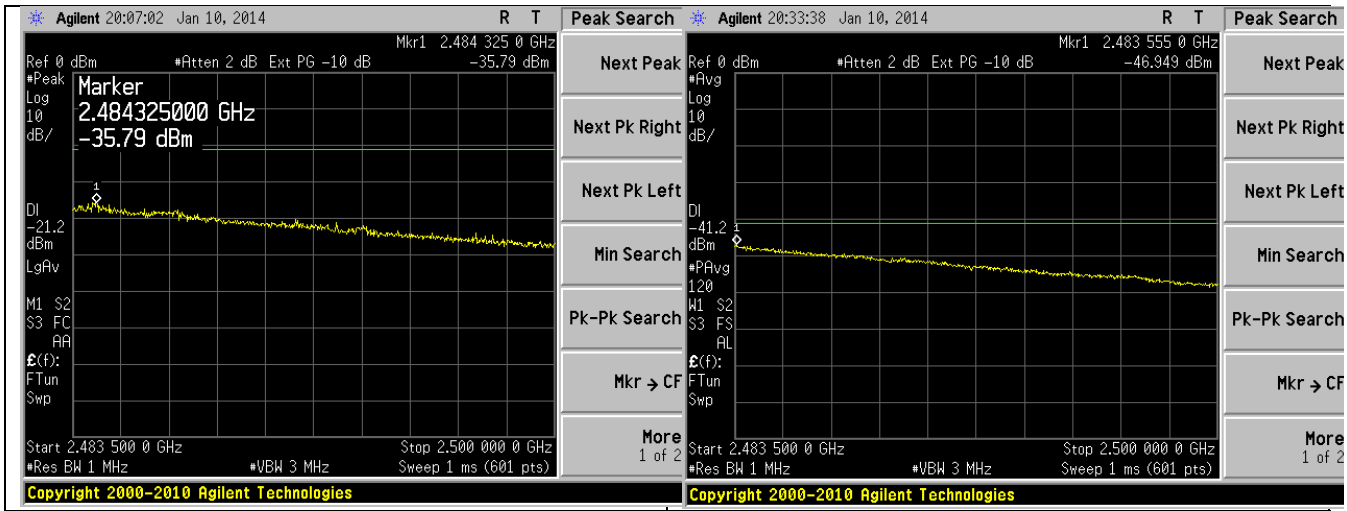
Captures:
The captures presented are representative of worst case between the channels and modulation:

WLAN 802.11b (1 MBPS)



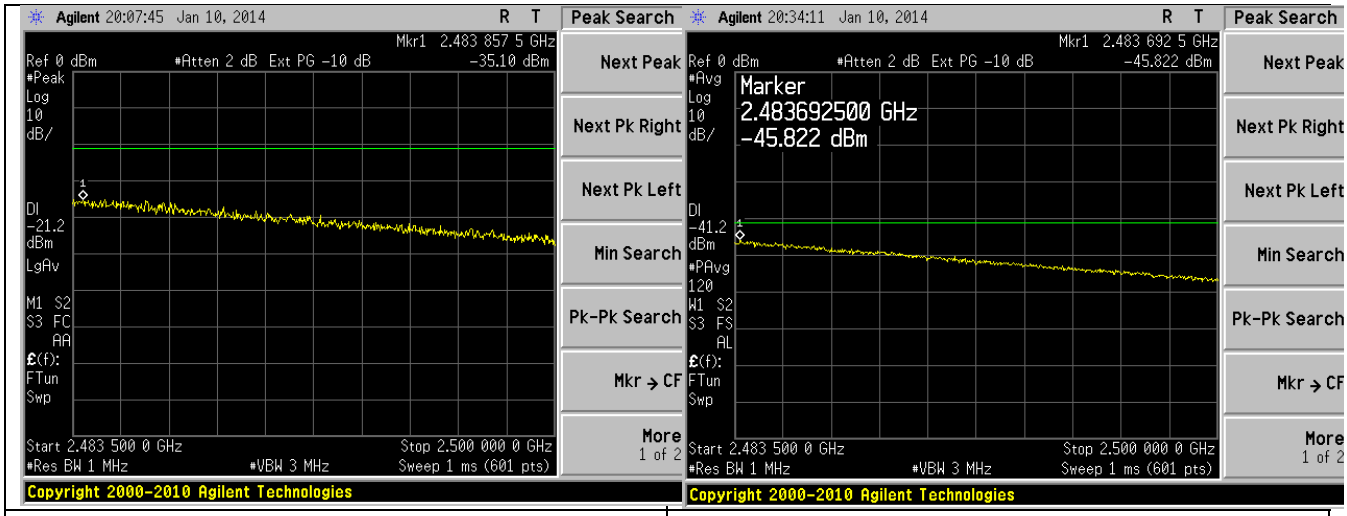
Peak	Average

WLAN 802.11g (54MBPS)



Peak	Average

WLAN 802.11n (MCS 0)



Peak	Average