



LS RESEARCH LLC

Wireless Product Development

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TESTING CERT #1255.01

**TEST REPORT # 312057 FCCIC DTSTX
LSR Job #: C-1562**

Compliance Testing of:

Airborne Enterprise Server and Access Point.

Test Date(s):

January 21st to March 27th 2013

Prepared For:

Attention: Paul Harrington

B&B Electronics

707 Dayton Road PO Box 1040

Ottawa, IL 61350

This Test Report is issued under the Authority of:

Khairul Aidi Zainal, Senior EMC Engineer

Signature:

Date: 04/2/13

Test Report Reviewed by:

Thomas Smith, Manager EMC Test Services

Signature:

Date: 04/02/13

Project Engineer:

Khairul Aidi Zainal, Senior EMC Engineer.

Signature:

Date: 03/31/13

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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 v02
Environmental Classification:	Commercial, Industrial or Business Residential

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 v02	2012	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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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. Accreditation status can be verified at A2LA's web site: www.a2la2.net.

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.

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 - Client Information

Manufacturer Name:	B&B Electronics
Address:	707 Dayton Road PO BOX 1040, Ottawa, IL. 61350
Contact Name:	Paul Harrington

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	Airborne Enterprise Server and Access Point
Model Number:	9768 & 9373 & WLNN-AN-CE551
Serial Number:	04-070,03-065,Unit2, Unit1: Radiated measurements 03-058,03-066,Unit1 : Conducted measurements

2.3 - Associated Antenna Description

The antennas associated with the EUT are:

MFG	P/N:	Peak Gain 2.4G (dBi)	Avg Gain 2.4G (dBi)	Peak Gain 5G (dBi)	Avg Gain 5G (dBi)	Connector Type
Laird	CAF 94505	2.0		4.0		IPEX MHF (U.FL)
Taoglas	GW.71.5153	3.8	-0.7	5.5	0.0	RP-SMA
Taoglas	PC.11.07.0100A	3.0	-0.6	4.5	-0.5	Cable to IPEX MHF (U.FL)
Nearson	T131XX	2.0	N/A	2.0	N/A	RP-SMA
Taoglas	WS.01.B.305151	4.1	-1.6	4.7	-3.0	Cable to RP-SMA
Taoglas	FXP810.07.0100C	2.4	-1.2	5.1	-0.8	Cable to IPEX MHF (U.FL)
Taoglas	FXP.830.07.0100C	2.6	-3.0	5.0	-0.6	Cable to IPEX MHF (U.FL)

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2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2412MHz – 2462MHz (WLAN) 5745MHz – 5825 MHz (WLAN 5.8GHz)
RF Power in Watts (Conducted measurement)	
Minimum:	2.4GHz WLAN 802.11 b: 0.066 watts 802.11 g: 0.050 watts 802.11 n (HT20): 0.035 watts 5.8GHz WLAN: 802.11 a: 0.055 watts 802.11 n (HT20): 0.033 watts
Maximum:	2.4GHz WLAN 802.11 b: 0.100 watts 802.11 g: 0.085 watts 802.11 n (HT20): 0.054 watts 5.8GHz WLAN: 802.11 a: 0.078 watts 802.11 n (HT20): 0.049 watts
Max Conducted Output Power (in dBm)	2.4GHz WLAN 802.11 b: 20.0 dBm 802.11 g: 19.3 dBm 802.11 n (HT20): 17.2 dBm 5.8GHz WLAN: 802.11 a: 18.9 dBm 802.11 n (HT20): 16.9 dBm
Field Strength at 3 meters (Maximum)	Not Applicable
Occupied Bandwidth (99% BW)	2.4GHz WLAN: 16.0MHz 5.8GHz WLAN: 17.6MHz
Type of Modulation	OFDM,DSSS
Occupied Bandwidth (6% BW)	2.4GHz WLAN: 16.1MHz 5.8GHz WLAN: 17.2MHz
Transmitter Spurious (worst case) at 3 meters	45.7dB μ V/m at 11570 MHz
Stepped (Y/N)	Y
Step Value:	1 dBm
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Transceiver and microprocessor Model # (if applicable)	Transceiver: Atheros AR6203 Microprocessor: Atmel AT91SAM9G20
Antenna Information	
Detachable/non-detachable	detachable
Type	Screw mount antenna, PCB dipole, sleeve dipole.
Gain	Peak Gain in 2.4GHz band = 4.1 dBi Peak Gain in 5.0GHz band = 5.5 dBi

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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	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Portable or Mobile?	Mobile	

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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 %

Standard used for evaluation: OET 65

Measurement Distance: 20 cm

2400 to 2483.5 MHz Band

RF Value: 0.511 V/m A/m W/m²
 Measured Computed Calculated

5745 to 5850 MHz Band

RF Value: 0.548 V/m A/m W/m²
 Measured Computed Calculated

2.5 - Product Description

The EUT is an 802.11 a/b/g/n WLAN module that can be used as a client, access point and bridge mode with an Ethernet or UART interface.

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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	Yes
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 digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and 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). The Receiver Test Report is available upon request.

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)

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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.

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EXHIBIT 5. UNWANTED EMISSIONS INTO THE RESTRICTED FREQUENCY BANDS.

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 a terminal program (Hyperterminal).

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

Per **KDB 558074 D01 Measurement Guidance V02 section 10.2**, antenna port conducted measurements and cabinet/case (antenna port terminated) radiated measurements were performed to investigate compliance to the unwanted emissions into the restricted band requirements.

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 40000 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 40 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 40GHz, the sense antenna was raised and lowered between 1 and 1.8 meters in height.

The EUT was positioned in 3 orthogonal orientations.

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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 (dB μ V/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 (dB μ V/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.

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Frequency (MHz)	3 m Limit μ V/m	3 m Limit (dB μ V/m)	1 m Limit (dB μ V/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 (μ V/m to dB μ V/m):
 $\text{dB}\mu\text{V/m} = 20 \log_{10} (100) = 40 \text{ dB}\mu\text{V/m}$ (from 30-88 MHz)

Per KDB 558074 section 10, an EIRP measurement can be converted to field strength using this relationship:

$$\text{EIRP} = E \text{ (electric field strength in dB}\mu\text{V/m)} + 20\log(d) - 104.8$$

$$E = \text{EIRP} - 20\log(d) + 104.8$$

Sample conversion:

For EIRP = -56.6 dBm,

$$E \text{ (dB}\mu\text{V/m)} = -56.6 - 20\log(3m) + 104.8 = 38.7 \text{ dB}\mu\text{V/m}$$

For EIRP = -60.9 dBm,

$$E \text{ (dB}\mu\text{V/m)} = -60.9 - 20\log(3m) + 104.8 = 34.4 \text{ dB}\mu\text{V/m}$$

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5.6 - Data:

5.6.1 Case/Cabinet Radiated Emissions Test Data Chart

Manufacturer:	B&B Electronics								
Date(s) of Test:	January 22 nd to March 27 th 2013								
Project Engineer(s):	Khairul Aidi Zainal								
Test Engineer(s):	Khairul Aidi Zainal, Peter Feilen, Mike Hintzke								
Voltage:	3.3 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 (dB μ V/m)	Q. Peak (dB μ V/m)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Q.P. limit (dB μ V/m)	Avg. limit (dB μ V/m)	Peak Margin (dB)	Q.P. Margin (dB)	Avg. Margin (dB)	Notes
155.27	H	V	1.00	0	19.7	13.4	7.4	N/A	43.0	N/A	N/A	29.6	N/A	1.0
57.66	V	V	1.08	221	23.4	19.1	13.3	N/A	40.0	N/A	N/A	20.9	N/A	
83.29	V	V	1.27	223	26.6	22.0	13.6	N/A	40.0	N/A	N/A	18.0	N/A	
490.90	V	V	1.00	0	28.3	22.3	15.7	N/A	46.0	N/A	N/A	23.7	N/A	1.0
913.20	H	V	1.00	0	33.9	27.4	20.8	N/A	46.0	N/A	N/A	18.6	N/A	1.0
1250.00	H	V	1.00	72	40.5	37.1	32.8	74.0	N/A	54.0	33.5	N/A	21.2	
2034.80	V	V	1.00	0	37.5	33.0	25.1	74.0	N/A	54.0	36.5	N/A	28.9	1.0
3840.90	V	V	1.00	0	45.4	41.2	33.4	74.0	N/A	54.0	28.6	N/A	20.6	1.0
1304.40	V	V	1.00	187	36.5	32.1	24.2	74.0	N/A	54.0	37.5	N/A	29.8	

Notes:

1. Measurement of system noise floor.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.

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RADIATED EMISSIONS DATA CHART (continued)

5.6.1.1 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 (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
4824	1.00	42	54.5	50.6	63.5	12.9	Horizontal	Vertical
12060	Note 3							
14472	Note 3							
19296	Note 3							

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 (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
4874	1.02	336	56.7	53.7	63.5	9.9	Vertical	Side
7311	1.30	345	53.9	41.9	63.5	21.6	Vertical	Vertical
12185	Note 3							
19496	Note 3							

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 (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
4924	1.04	332	53.8	49.3	63.5	14.2	Vertical	Side
7386	Note 3							
12310	Note 3							
19696	Note 3							
22158	Note 3							

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. Measurement buried within system noise floor.
4. Refer to exhibit 5.5 on explanation of how data is reported.

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5.6.1.2 5.8GHz 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 (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
11490	1	25.8	65.6	54.9	63.5	8.6	Horizontal	Side
22980	Note 3							

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 (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
11570	1	39	66.3	55.2	63.5	8.3	Vertical	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 (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
11650	1.02	42	63.1	53.2	63.5	10.3	Vertical	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. Buried within system noise floor.
4. Refer to exhibit 5.5 on explanation of how data is reported.

Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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5.6.2 Antenna port conducted measurement.

5.6.2.1 2.4GHz WLAN

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

Frequency (MHz)	Peak (dBm)	Peak (dB μ V/m)	Average (dBm)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak margin (dB)	Average margin (dB)
4824	-56.6	38.6	-61.3	33.9	74.0	54.0	35.4	20.1
12060		NOTE 1						
14472		NOTE 1						
19296		NOTE 1						

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

Frequency (MHz)	Peak (dBm)	Peak (dB μ V/m)	Average (dBm)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak margin (dB)	Average margin (dB)
4874	-56.8	38.4	-60.1	35.1	74.0	54.0	35.6	18.9
7311	-62.1	33.2	-69.8	25.4	74.0	54.0	40.8	28.6
12185		NOTE 1						
19496		NOTE 1						

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

Frequency (MHz)	Peak (dBm)	Peak (dB μ V/m)	Average (dBm)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak margin (dB)	Average margin (dB)
4924	-57.8	37.4	-61.1	34.1	74.0	54.0	36.6	19.9
7386	-66.8	28.4	-74.5	20.7	74.0	54.0	45.6	33.3
12310		NOTE 1						
19696		NOTE 1						
22158		NOTE 1						

Notes:

1. Emissions buried within system noise floor.
2. Conducted measurements were converted to field strength and compared against the limits. Conversion performed per KDB 558074 D01 DTS measurement Guidance V02. Please refer to Exhibit 5.5 for sample calculation.

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
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5.6.1.2 5.8GHz WLAN

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

Frequency (MHz)	Peak (dBm)	Peak (dB μ V/m)	Average (dBm)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak margin (dB)	Average margin (dB)
11490	-60.9	34.3	-71.8	23.4	74.0	54.0	39.7	30.6
22980		note 1						

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

Frequency (MHz)	Peak (dBm)	Peak (dB μ V/m)	Average (dBm)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak margin (dB)	Average margin (dB)
11570	-61.1	34.1	-70.1	25.1	74.0	54.0	39.9	28.9

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

Frequency (MHz)	Peak (dBm)	Peak (dB μ V/m)	Average (dBm)	Average (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak margin (dB)	Average margin (dB)
11650	-62.2	33.1	-70.2	25.0	74.0	54.0	40.9	29.0

Notes:

1. Emissions buried within system noise floor
2. Conducted measurements were converted to field strength and compared against the limits. Conversion performed per KDB 558074 D01 DTS measurement Guidance V02. Please refer to Exhibit 5.5 for sample calculation.

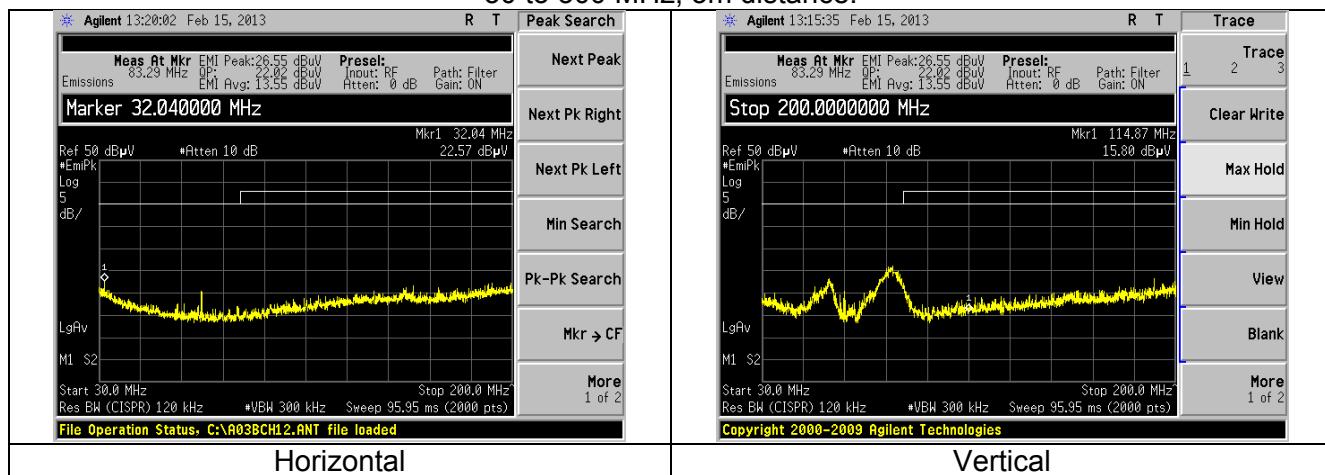
Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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5.7 – Screen Captures.

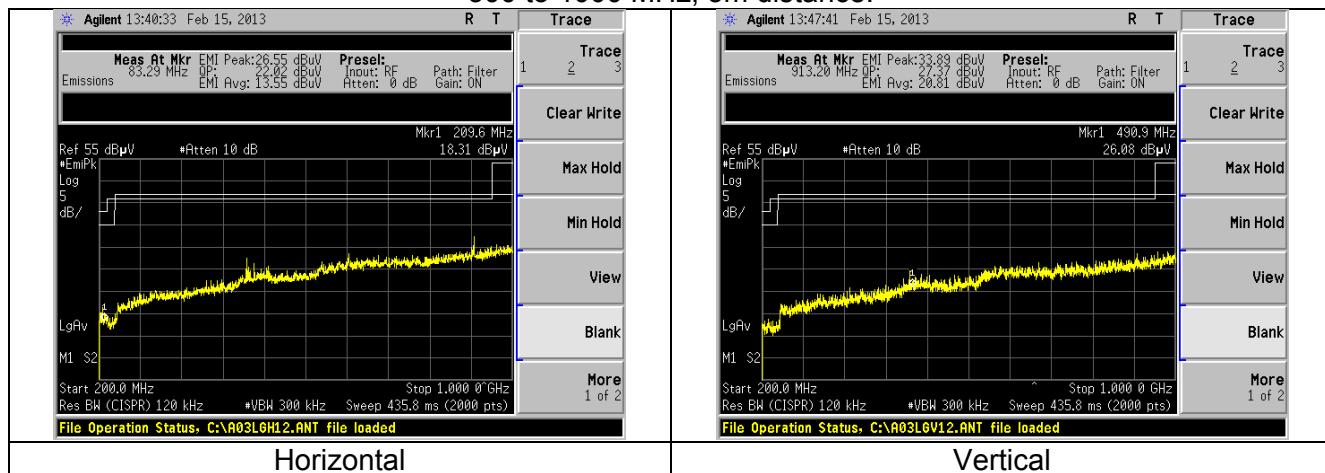
The screen captures below are those using the Peak detector of the analyzer. In addition, the screen captures presented are those which were deemed to be an appropriate representation of the spectrum scan.

5.7.1 Case/Cabinet Radiation:

30 to 300 MHz, 3m distance.

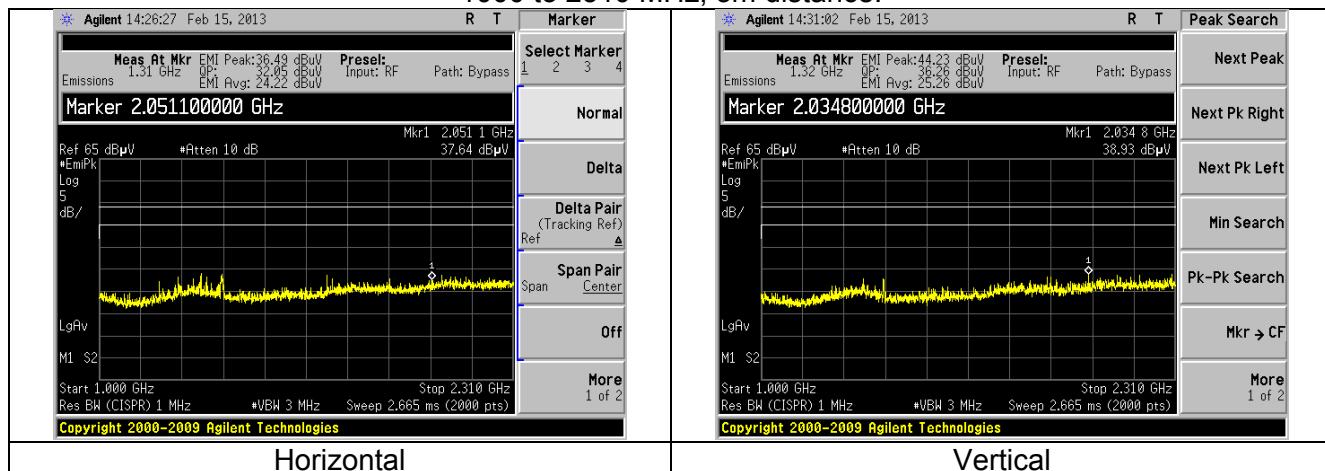


300 to 1000 MHz, 3m distance.

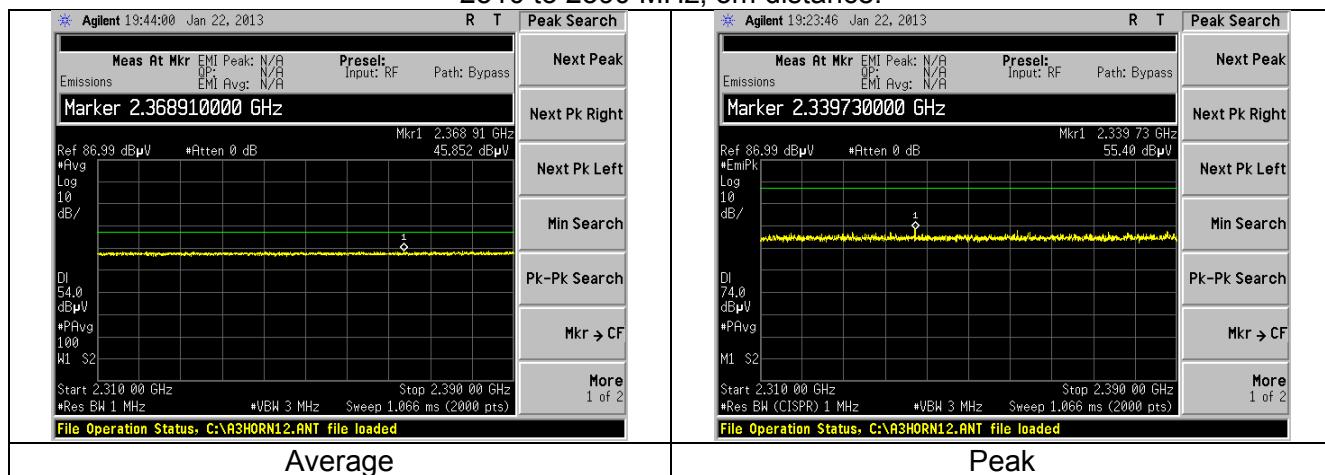


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

1000 to 2310 MHz, 3m distance.



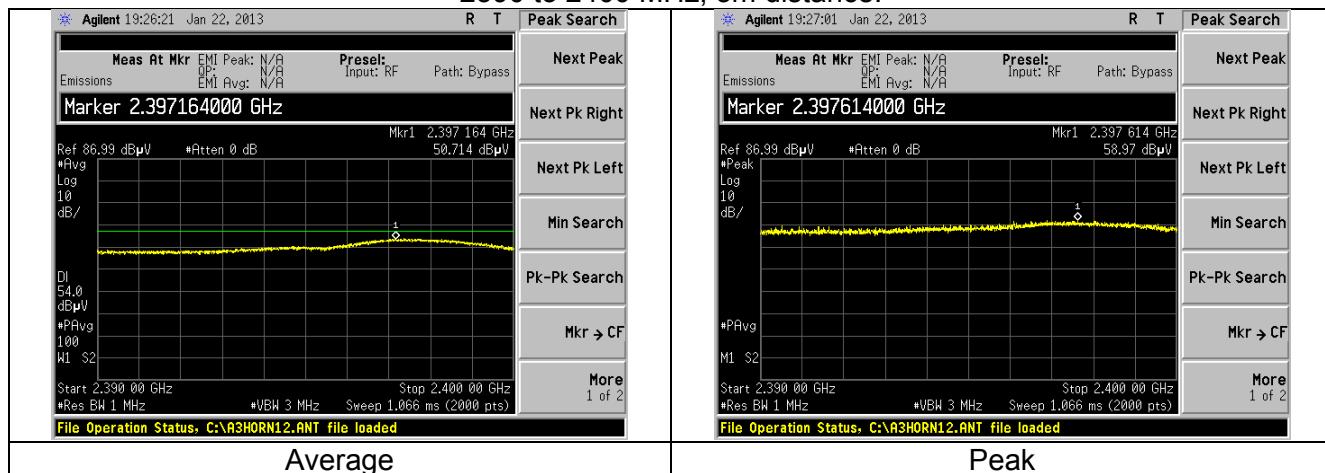
2310 to 2390 MHz, 3m distance.



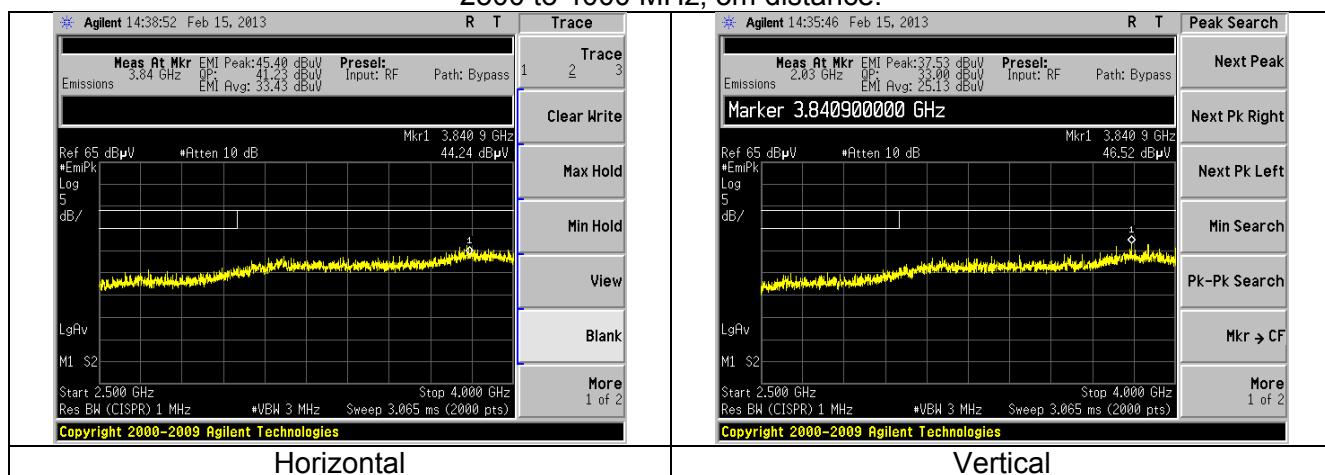
Note: The range 2483.5 to 2500 MHz is in section 8 of this report (Band-edges).

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

2390 to 2400 MHz, 3m distance.

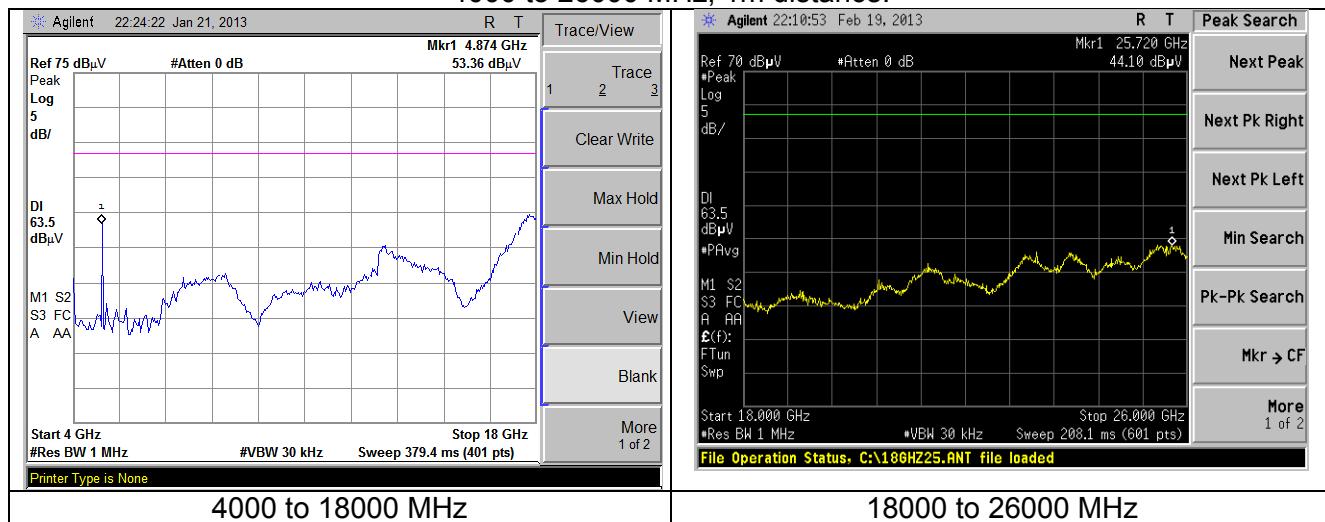


2500 to 4000 MHz, 3m distance.



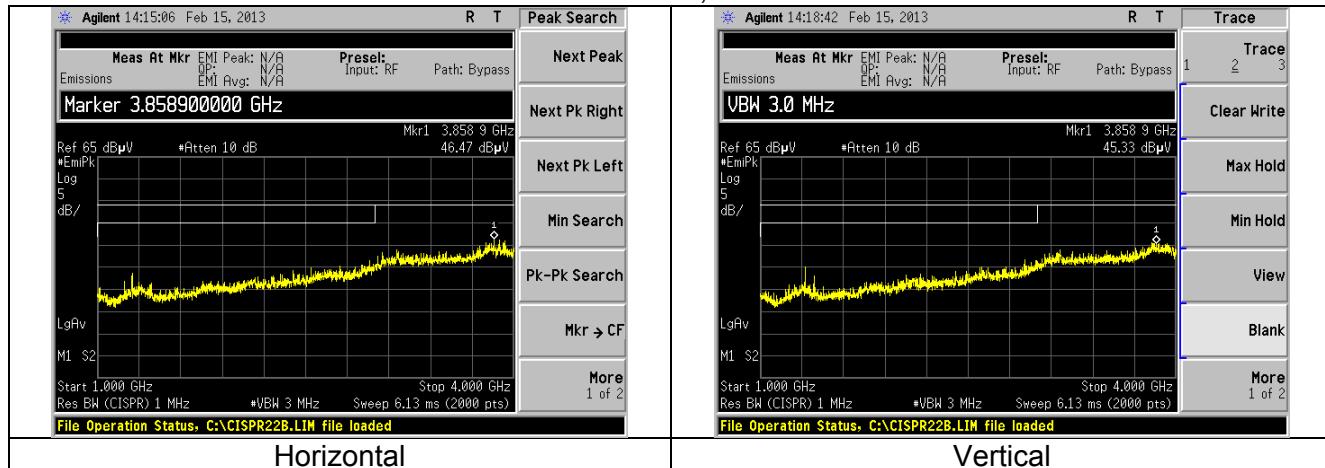
Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

4000 to 26000 MHz, 1m distance.



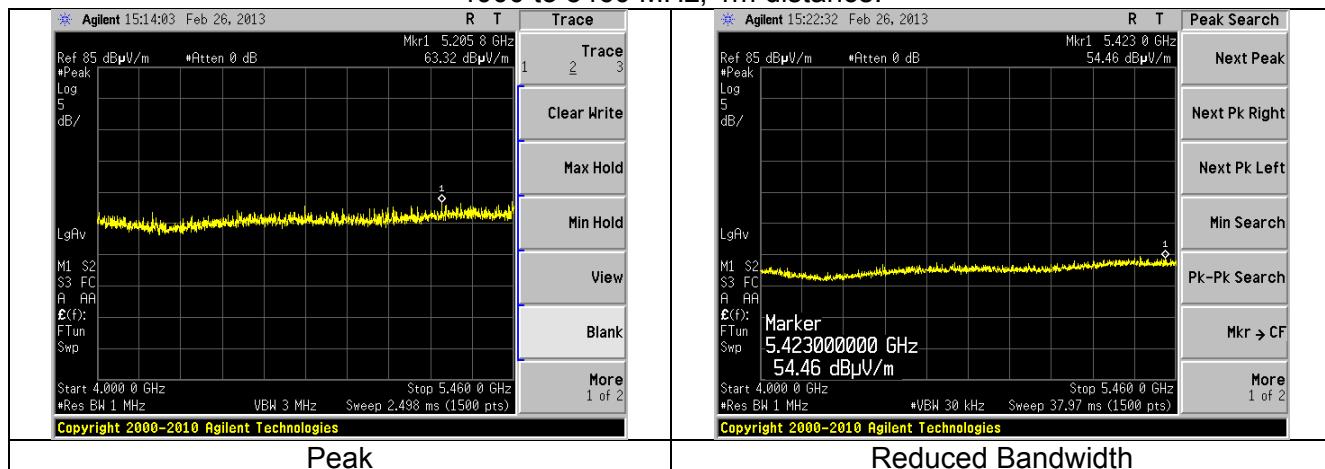
The screen captures below are for the 5.7 GHz WLAN

1000 to 4000 MHz, 3m distance.

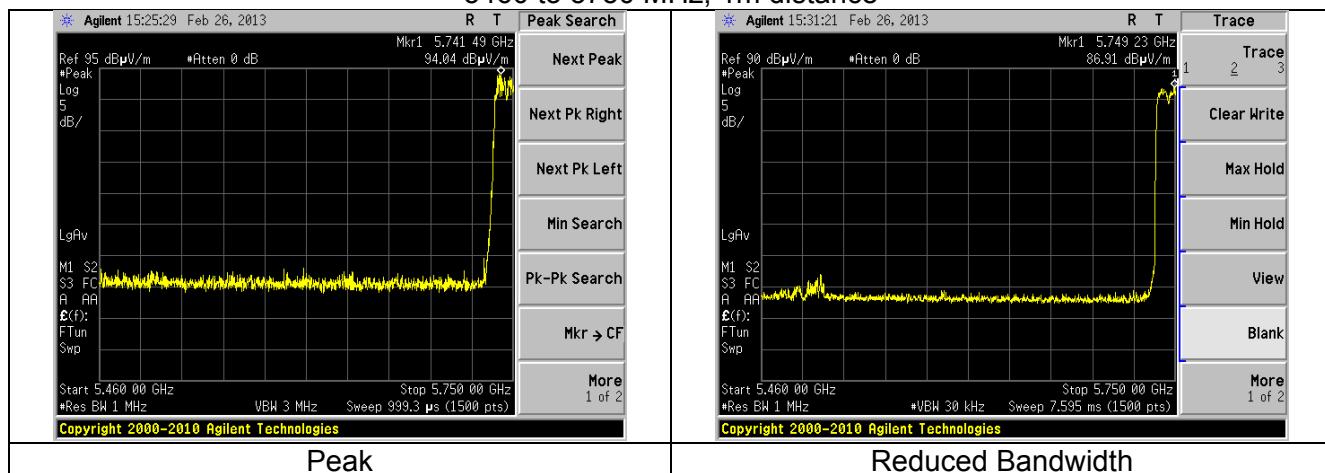


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

4000 to 5460 MHz, 1m distance.

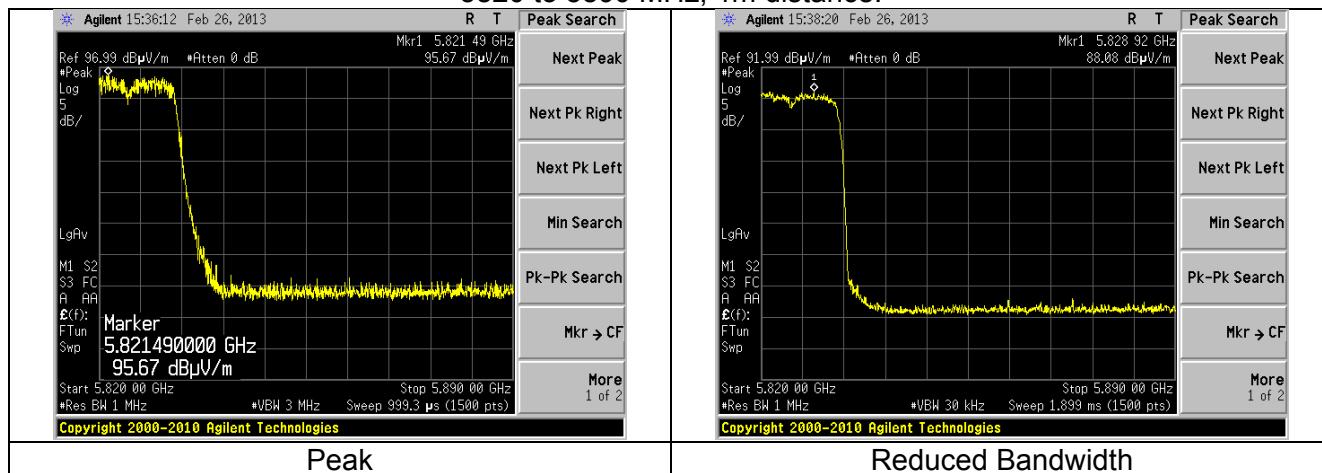


5460 to 5750 MHz, 1m distance

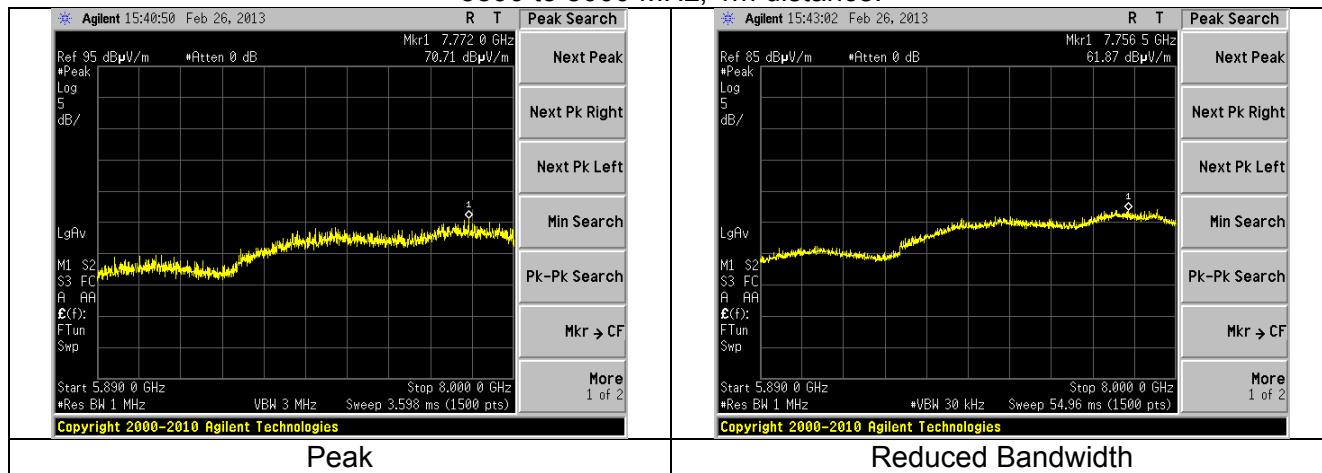


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

5820 to 5890 MHz, 1m distance.

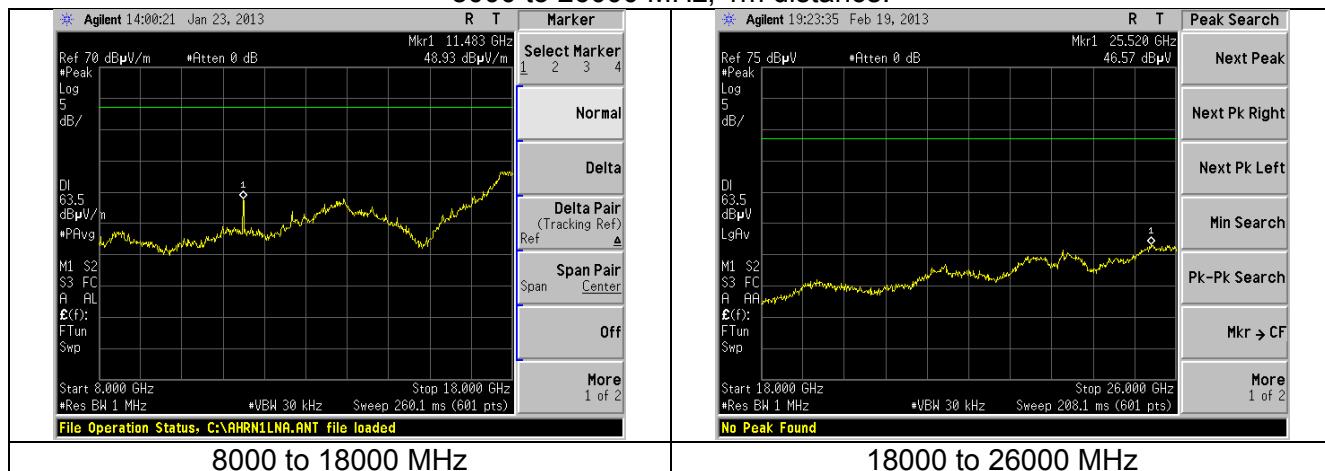


5890 to 8000 MHz, 1m distance.

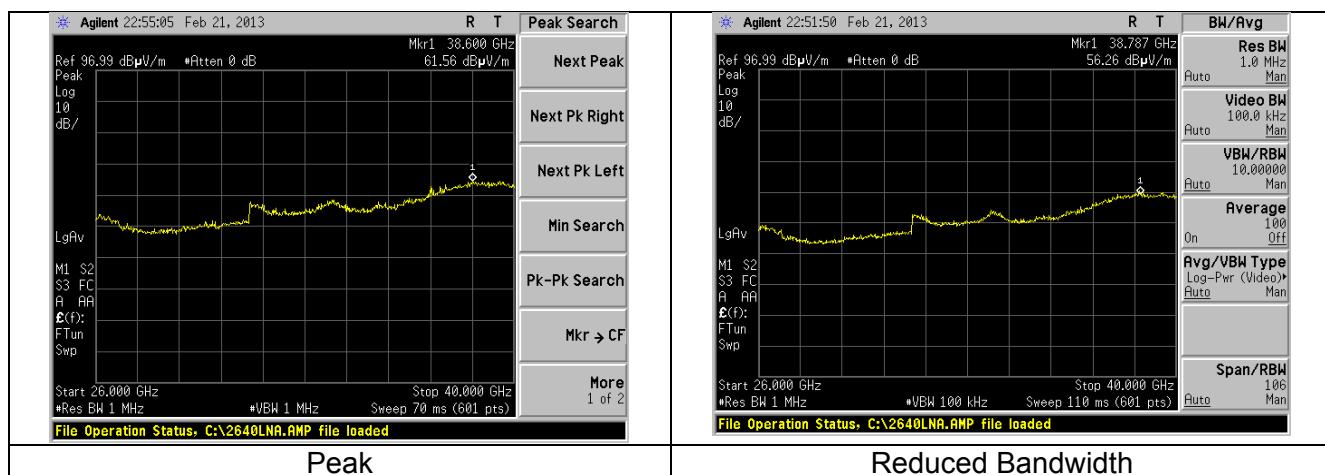


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

8000 to 26000 MHz, 1m distance.

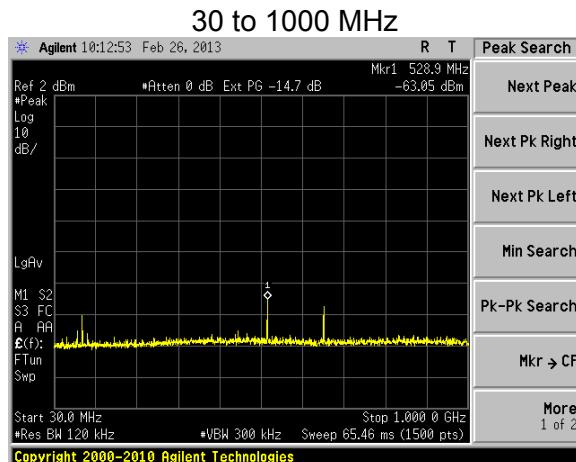


26000 to 40000 MHz, 1m distance.

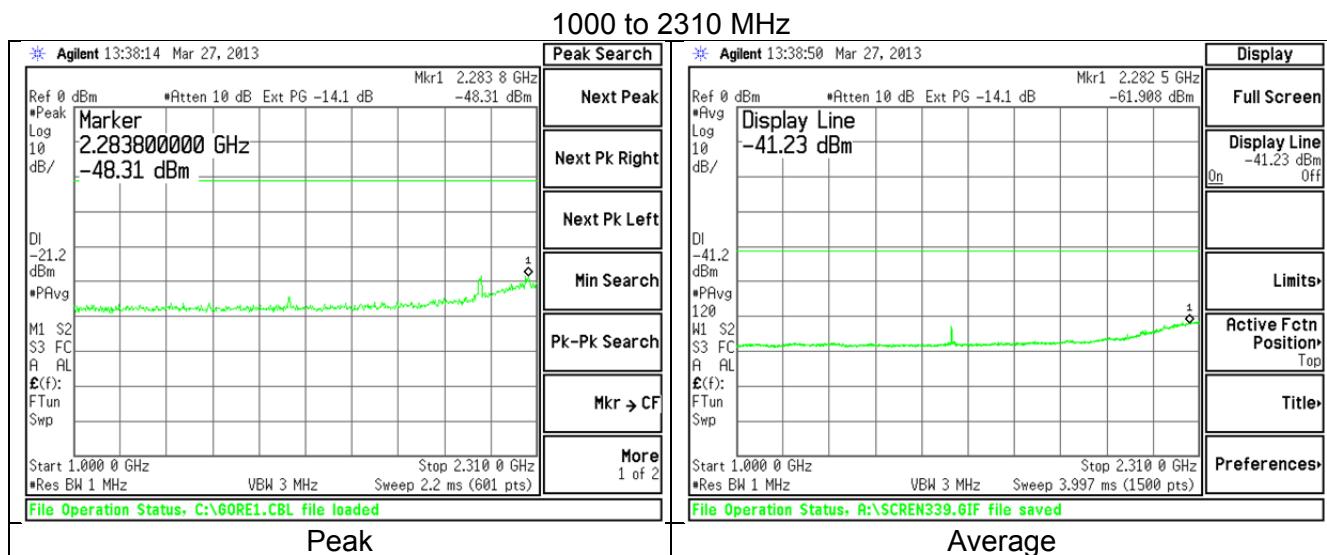


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

5.7.2 Antenna port conducted measurements:

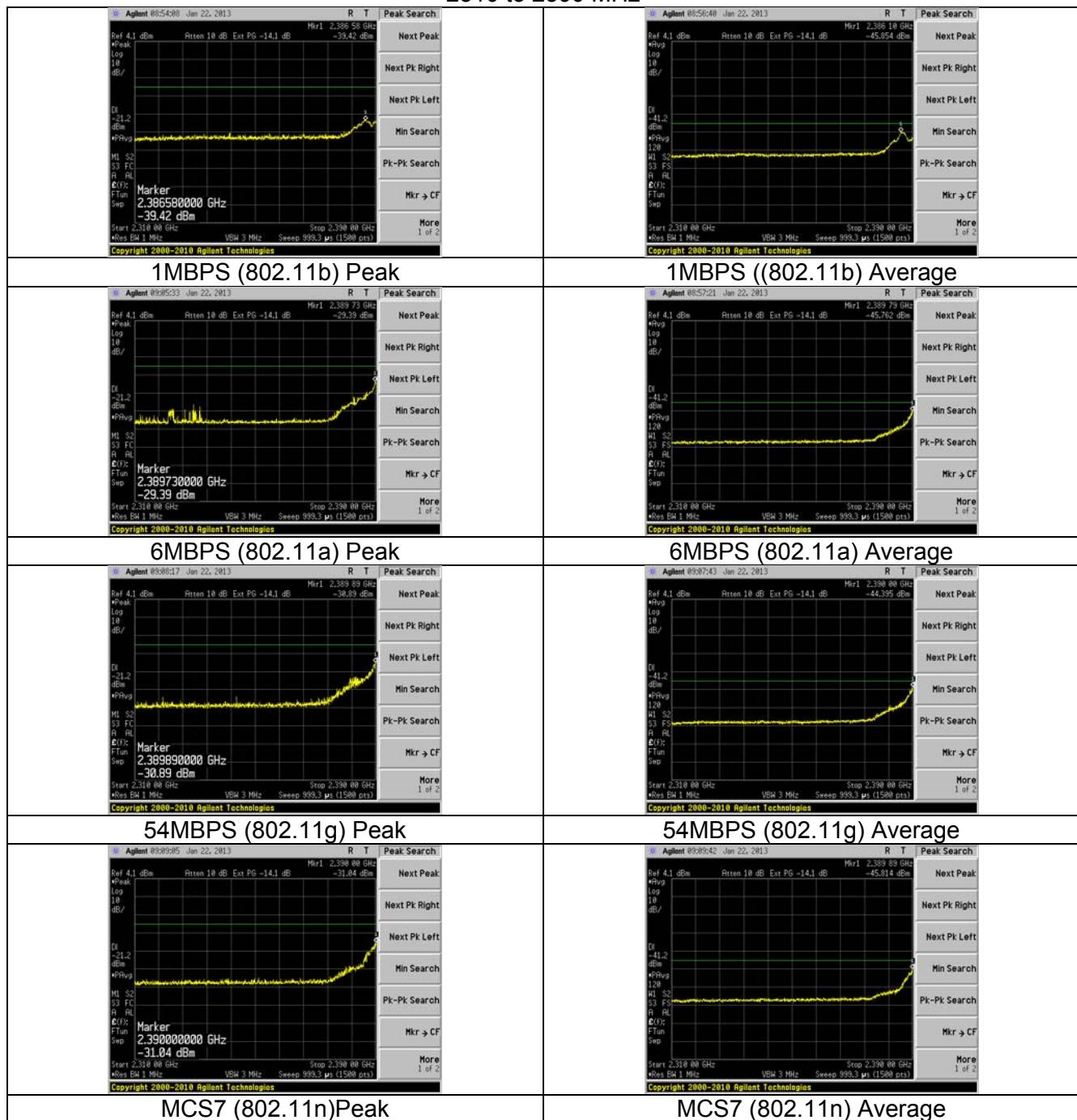


The screen captures below are for the 2.4 GHz WLAN



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

2310 to 2390 MHz



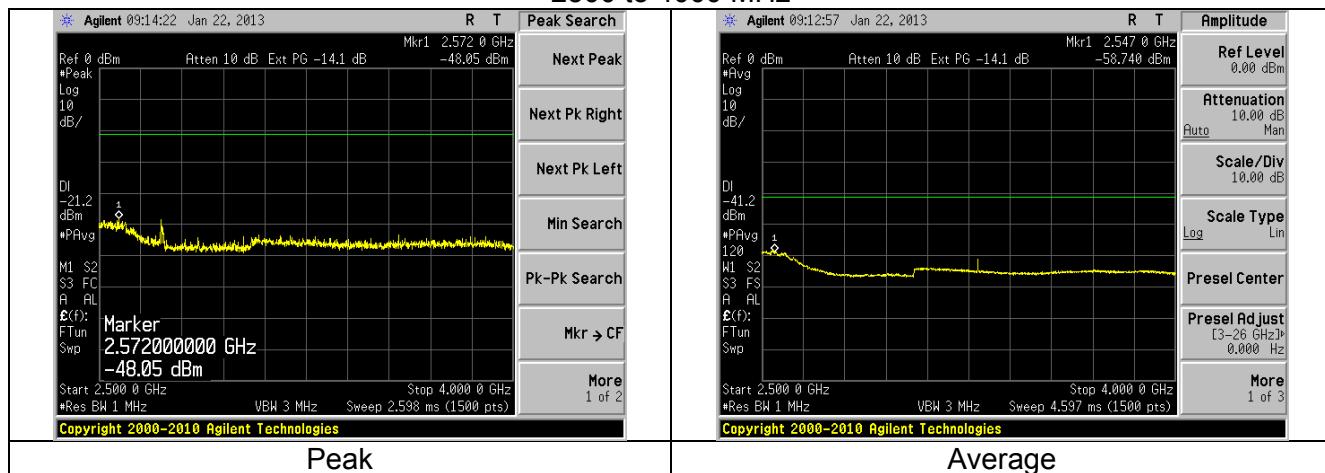
Note: The range 2483.5 to 2500MHz is in section 8 of this report (Band-edges).

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

2457 to 2500 MHz

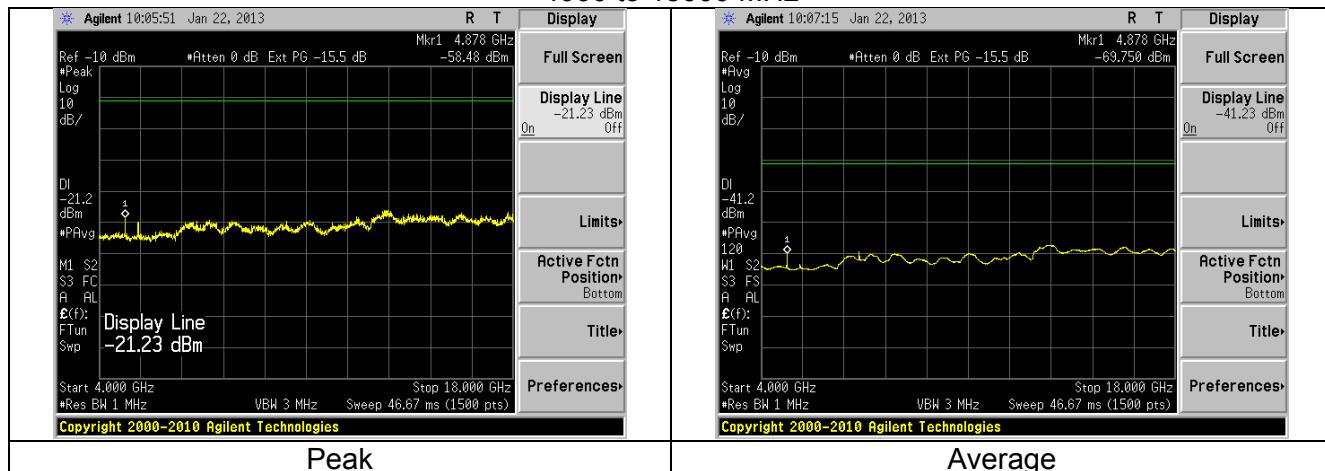


2500 to 4000 MHz

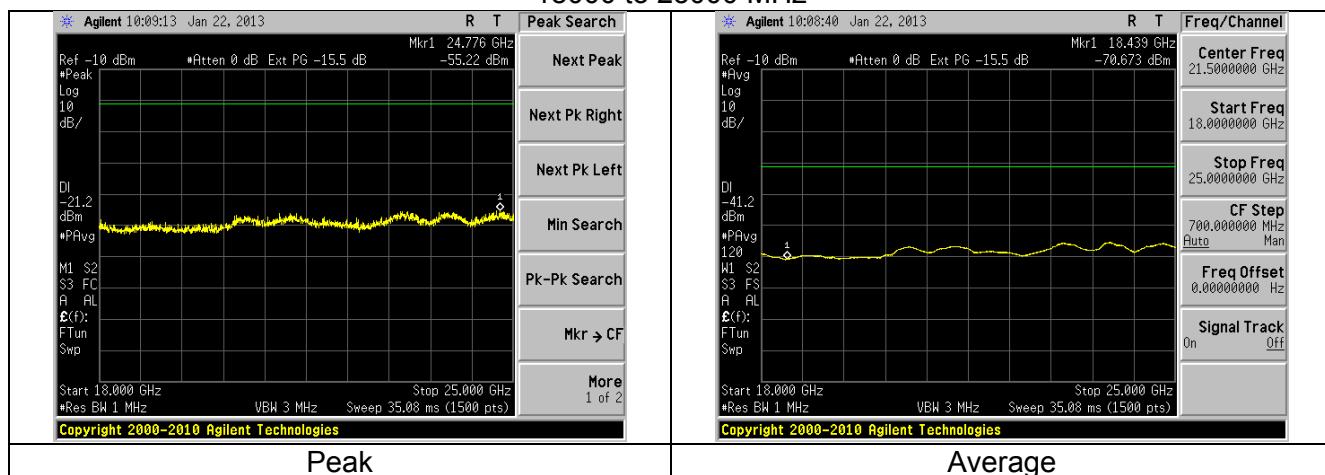


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
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4000 to 18000 MHz



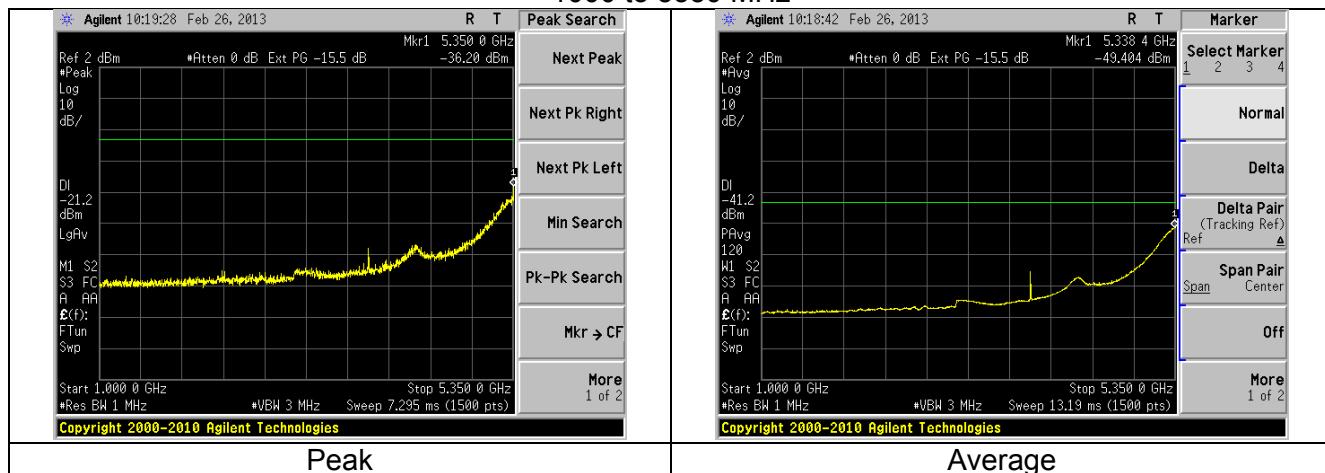
18000 to 25000 MHz



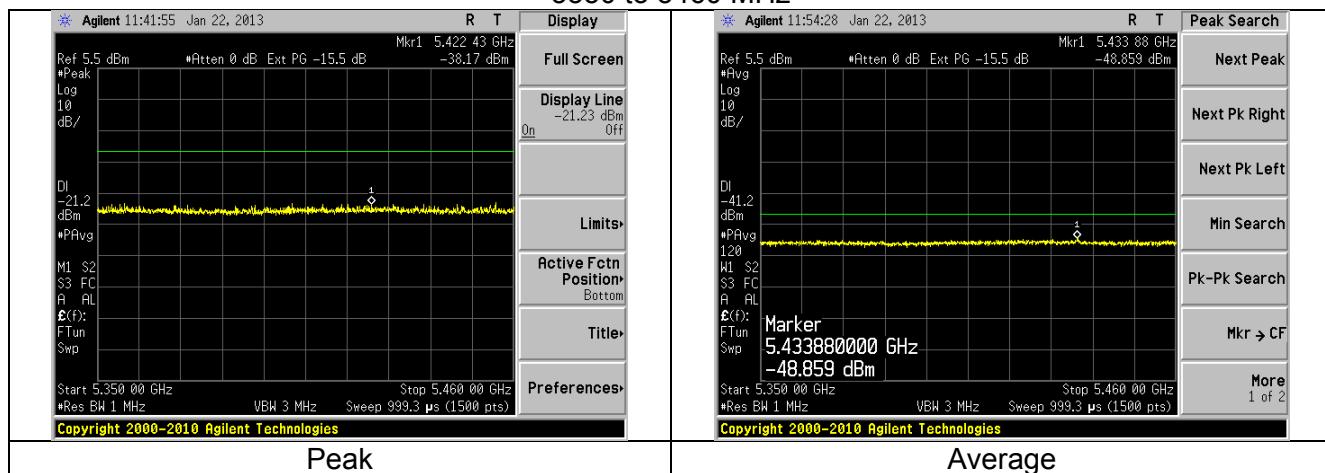
Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

The screen captures below are for the 5.7 GHz WLAN

1000 to 5350 MHz

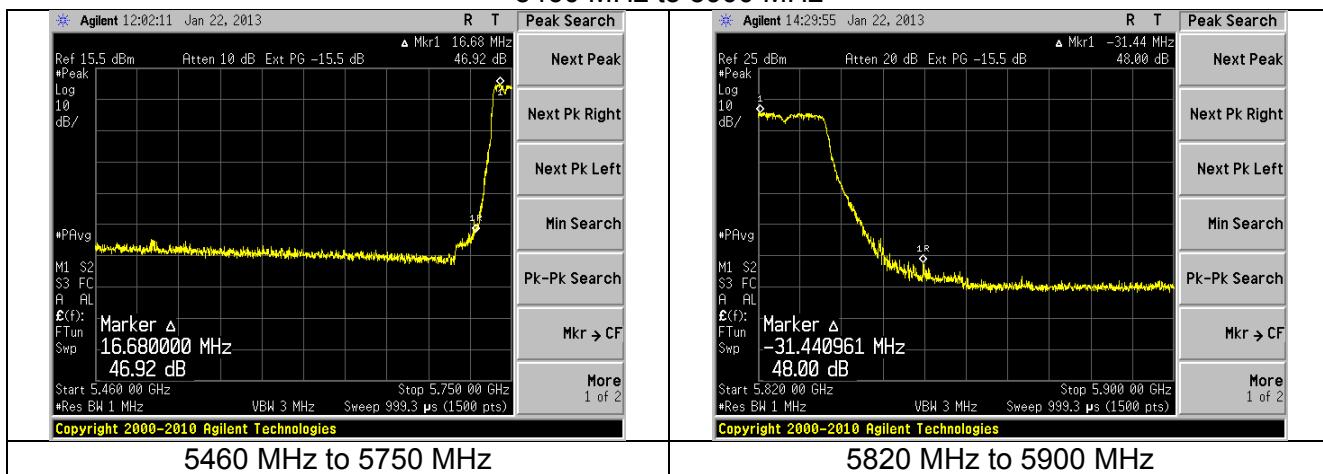


5350 to 5460 MHz

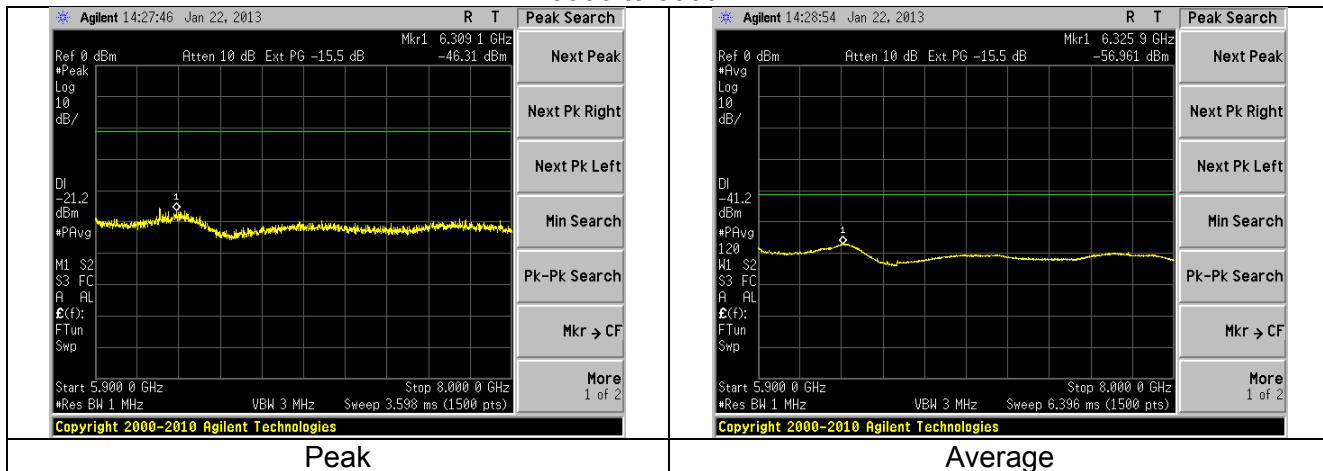


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

5460 MHz to 5900 MHz

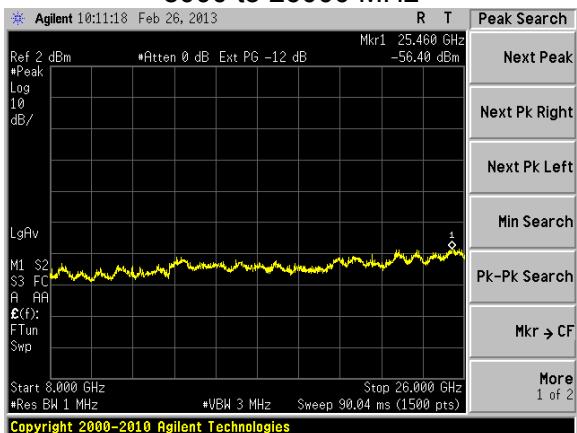


5900 to 8000 MHz



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

8000 to 26000 MHz



25000 to 40000 MHz



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

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 Generic DC 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 7.2.4 for Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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6.5 FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dB μ V)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW \geq 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.

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

6.6

CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz

Manufacturer:	B&B Electronics			
Date(s) of Test:	03/26/13			
Project Engineer:	Khairul Aidi Zainal			
Test Engineer:	Khairul Aidi Zainal			
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

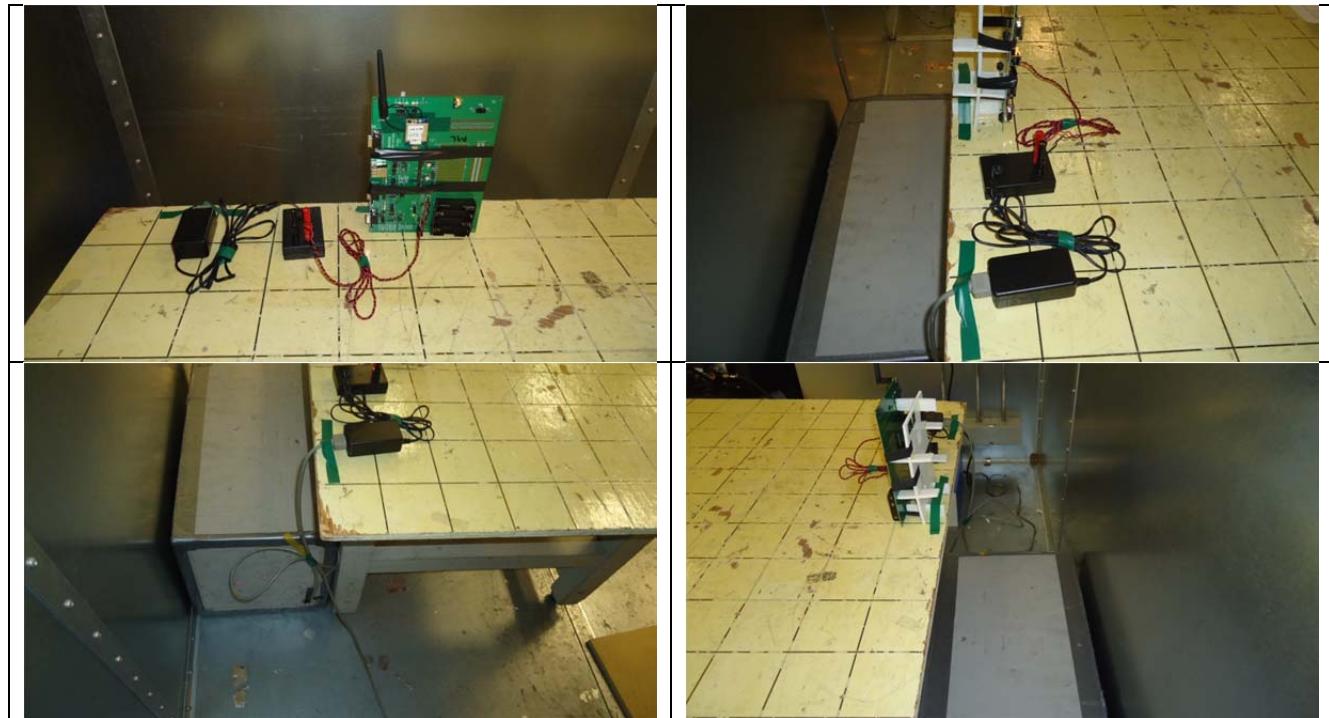
Frequency (MHz)	Line	Quasi-Peak			Average		
		Q-Peak Reading (dB μ V)	Q-Peak Limit (dB μ V)	Quasi-Peak Margin (dB)	Average Reading (dB μ V)	Average Limit (dB μ V)	Average Margin (dB)
0.168	L1	48.5	65.0	16.5	34.7	55.0	20.3
0.227	L1	36.5	62.6	26.1	18.5	52.6	34.1
0.620	L1	41.2	56.0	14.8	37.6	46.0	8.4
18.320	L1	34.8	60.0	25.2	29.3	50.0	20.7
0.171	L2	48.7	64.9	16.2	32.8	54.9	22.1
0.208	L2	40.1	63.3	23.2	20.1	53.3	33.2
0.620	L2	35.1	56.0	20.9	31.3	46.0	14.7
18.060	L2	34.7	60.0	25.3	29.0	50.0	21.0

Notes:

- 1) The emissions listed are characteristic of the power supply used. Changing transmit channels did not change the emissions.

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

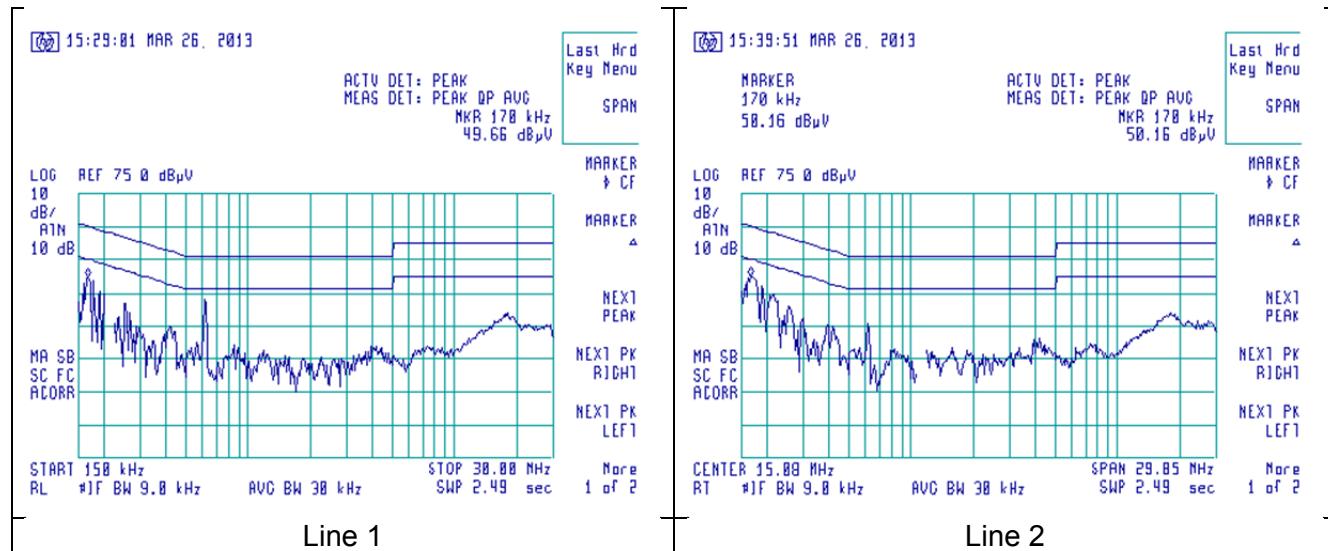
6.7 Test Setup Photo(s) – Conducted Emissions Test



Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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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).



Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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EXHIBIT 7. OCCUPIED BANDWIDTH

Test Engineer(s): Khairul Aidi Zainal

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 thereby 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 **FCC OET KDB 558074 section 7**.

Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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7.3 - Test Data

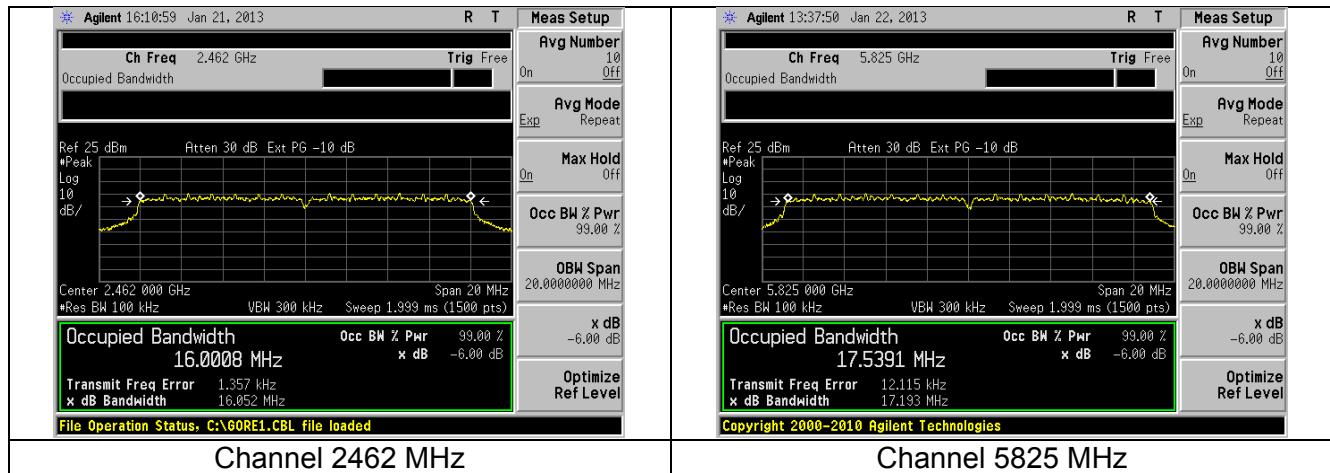
7.3.1 WLAN

Data Rate	Channel	Frequency (MHz)	EBW 6 dB (MHz)	EBW 99% (MHz)
1 Mbps 802.11 b	1	2412	9.2	12.9
	6	2437	9.2	12.9
	11	2462	9.2	12.9
6MBPS 802.11g	1	2412	14.8	14.9
	6	2437	14.8	14.9
	11	2462	14.8	14.9
11 MBPS 802.11 b	1	2412	9.5	12.6
	6	2437	9.5	12.6
	11	2462	9.5	12.6
54 MBPS 802.11g	1	2412	15.0	14.9
	6	2437	15.0	14.9
	11	2462	15.0	14.9
MCS7 802.11n HT20	1	2412	16.1	16.0
	6	2437	16.1	16.0
	11	2462	16.1	16.0
6 MBPS 802.11a	149	5745	16.1	16.3
	157	5785	16.1	16.3
	165	5825	16.1	16.3
12 MBPS 802.11a	149	5745	16.0	16.3
	157	5785	16.3	16.4
	165	5825	16.1	16.4
24 MBPS 802.11a	149	5745	16.4	16.3
	157	5785	16.4	16.4
	165	5825	16.4	16.4
MCS7 802.11n HT20	149	5745	16.9	17.5
	157	5785	17.0	17.6
	165	5825	17.2	17.5

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

7.4 – Screen Captures

7.4.1 WLAN



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

EXHIBIT 8. BAND EDGE MEASUREMENTS

Test Engineer(s): Peter Feilen, 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).

Per FCC KDB 558074 D01 Measurement Guidance V02 (section 10), conducted measurements were performed with 100 kHz bandwidth for all emissions outside of the band of operation while for emissions in the restricted band, a bandwidth of 120kHz (below 1000MHz) and 1MHz (above 1000MHz)

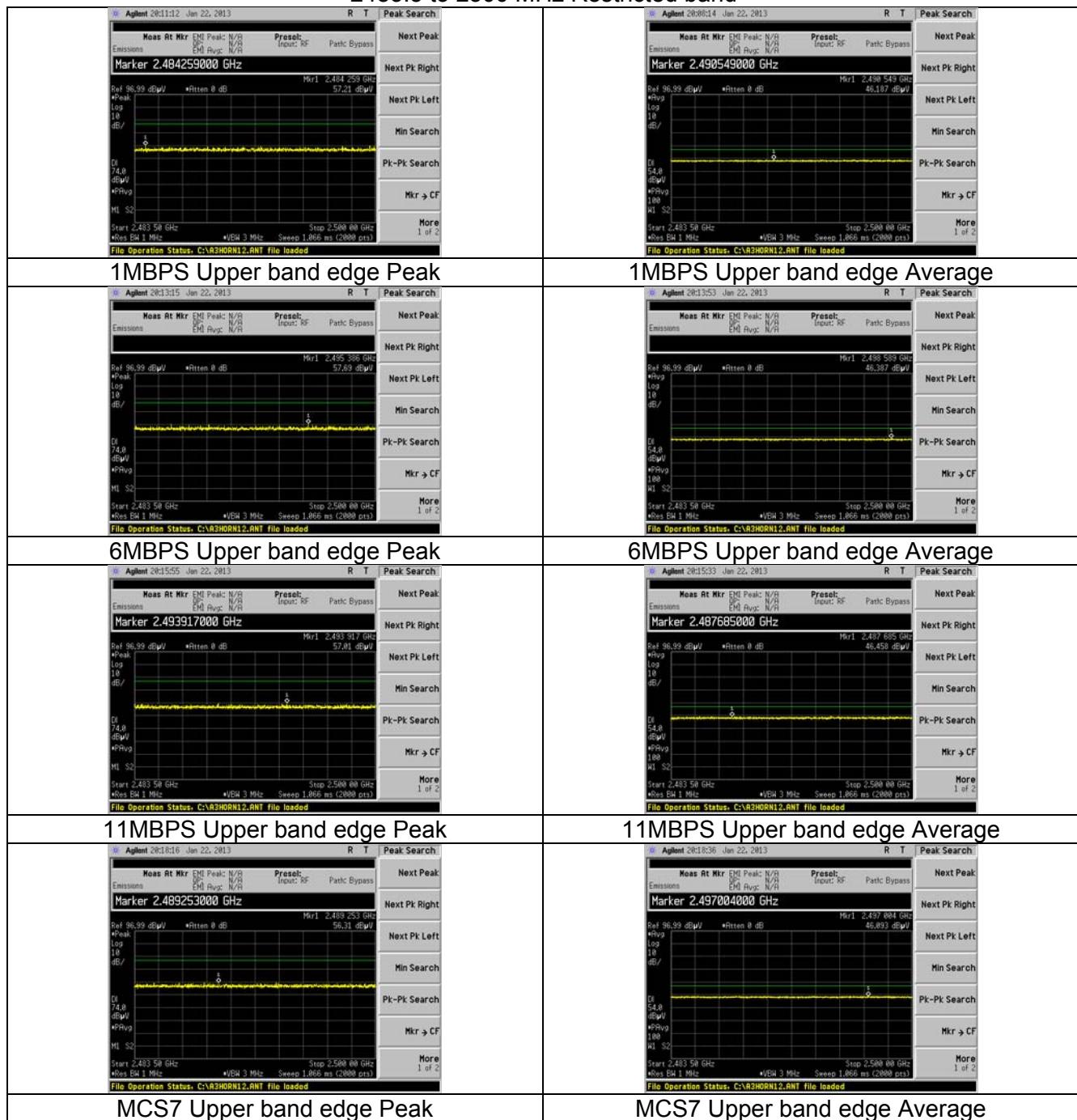
8.2. Band edge screen captures.

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

Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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8.2.1 Band-edge in Restricted Band

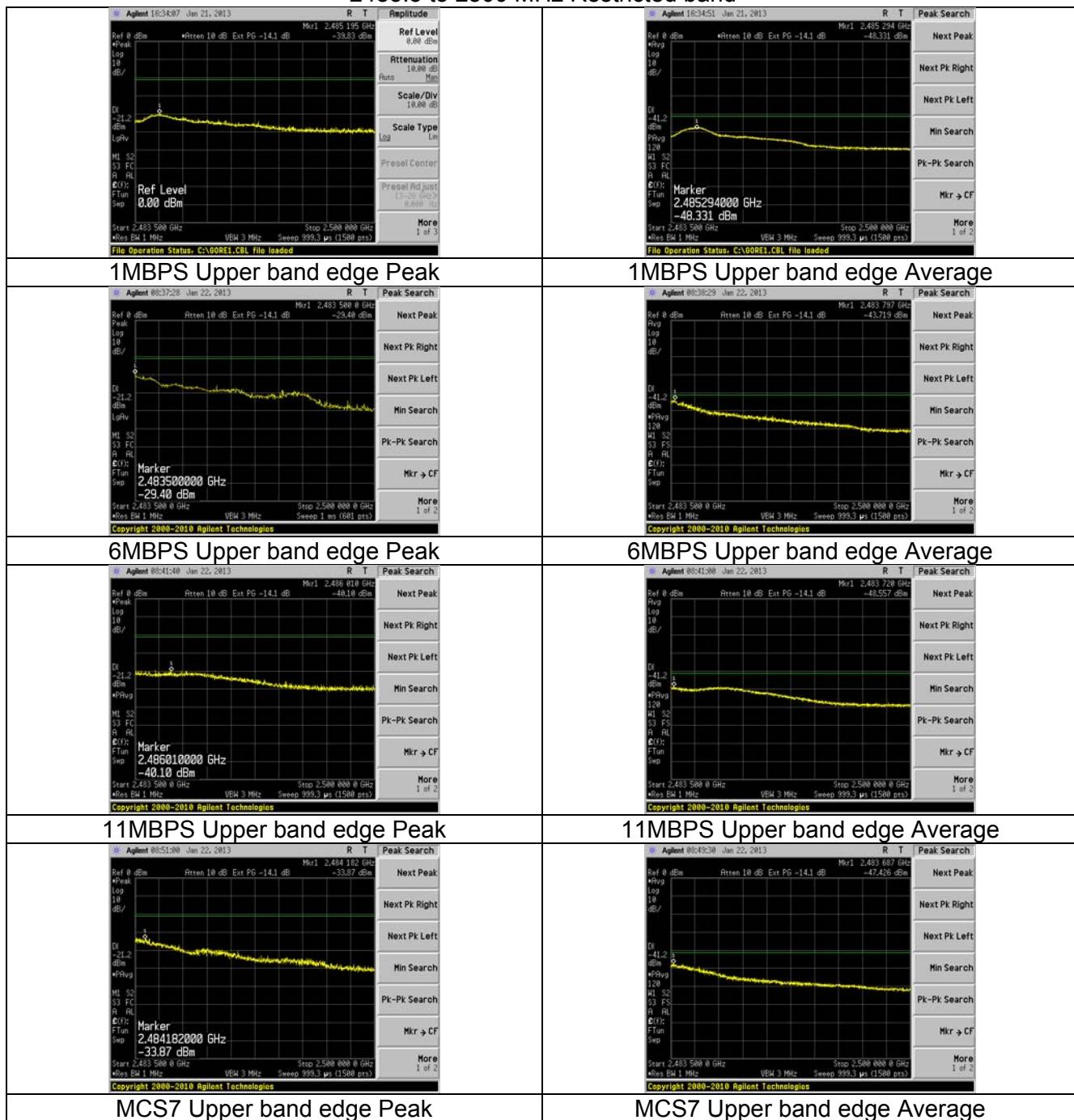
8.2.1.1 Cabinet/case radiated Band-edge in Restricted Band: 2483.5 to 2500 MHz Restricted band



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

8.2.1.2. Antenna port conducted Band-edge in Restricted Band.

2483.5 to 2500 MHz Restricted band



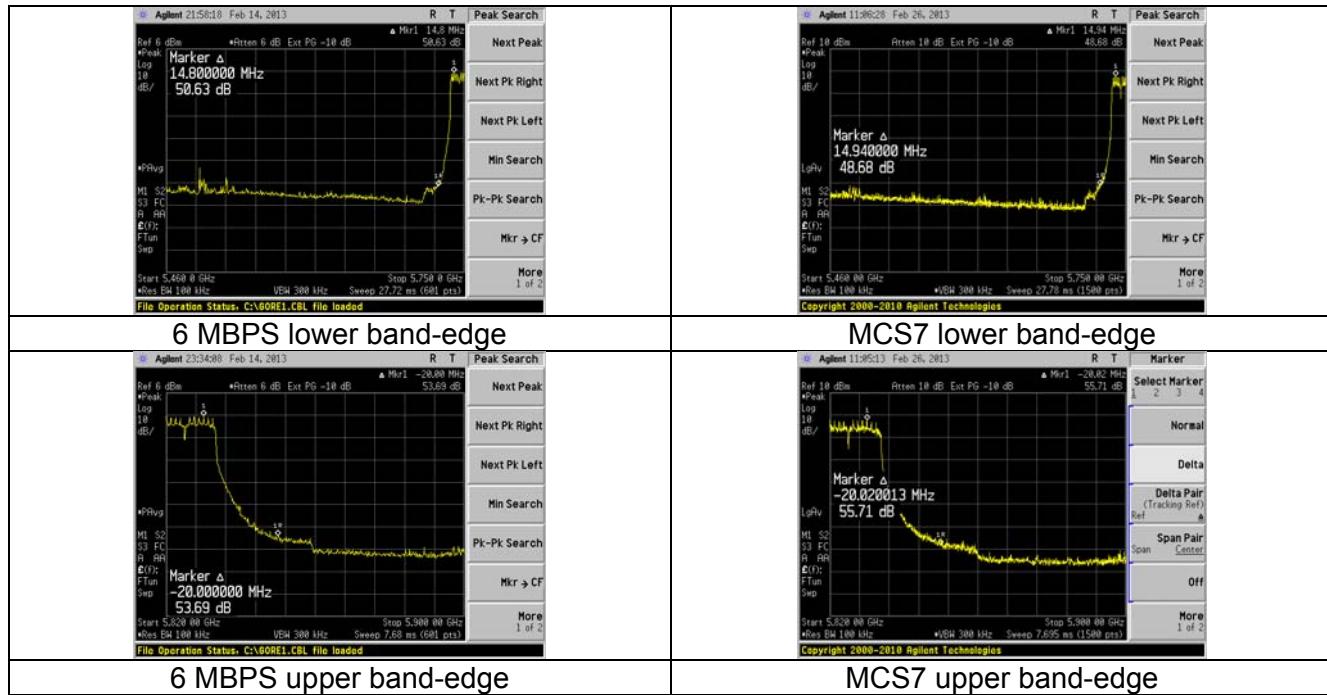
Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

8.2.2 Band-edge in 100kHz bandwidth.

8.2.2.1 2.4GHz WLAN (2390 to 2415 MHz)



8.2.2.1 5.7GHz WLAN



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

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

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

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 Measurement Guidance V02 section 8.

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).

Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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9.2.1 2.4GHz WLAN

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
1 MBPS 802.11b	1	2412	18.7	30.0	11.3
	6	2437	18.8	30.0	11.2
	11	2462	18.2	30.0	11.8

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
6 Mbps 802.11g	1	2412	17.7	30	12.3
	6	2437	19.3	30	10.7
	11	2462	18.3	30	11.7

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
11 MBPS 802.11b	1	2412	19.9	30	10.1
	6	2437	20.0	30	10.0
	11	2462	19.4	30	10.6

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
54 MBPS 802.11g	1	2412	17.0	30	13.0
	6	2437	18.4	30	11.6
	11	2462	17.1	30	12.9

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
MCS 7 802.11n	1	2412	15.4	30	14.6
	6	2437	17.2	30	12.8
	11	2462	16.3	30	13.7

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

9.2.3 5.7GHz WLAN

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
6 Mbps 802.11a	149	5745	18.3	30	11.7
	157	5785	17.6	30	12.4
	165	5825	17.8	30	12.2

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
12 MBPS 802.11a	149	5745	17.8	30	12.2
	157	5785	17.4	30	12.6
	165	5825	17.5	30	12.5

Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
24 Mbps 802.11a	149	5745	18.9	30	11.1
	157	5785	18.3	30	11.7
	165	5825	18.4	30	11.6

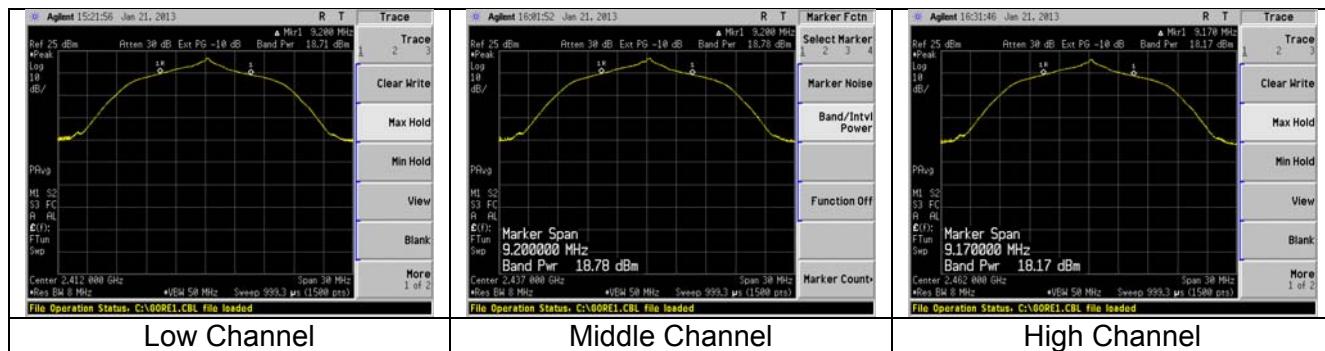
Data Rate	Channel	Frequency (MHz)	Power *PK2 (dBm)	Power Limit (dBm)	Power Margin (dB)
MCS 7 802.11n	149	5745	15.2	30	14.8
	157	5785	16.1	30	13.9
	165	5825	16.9	30	13.1

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

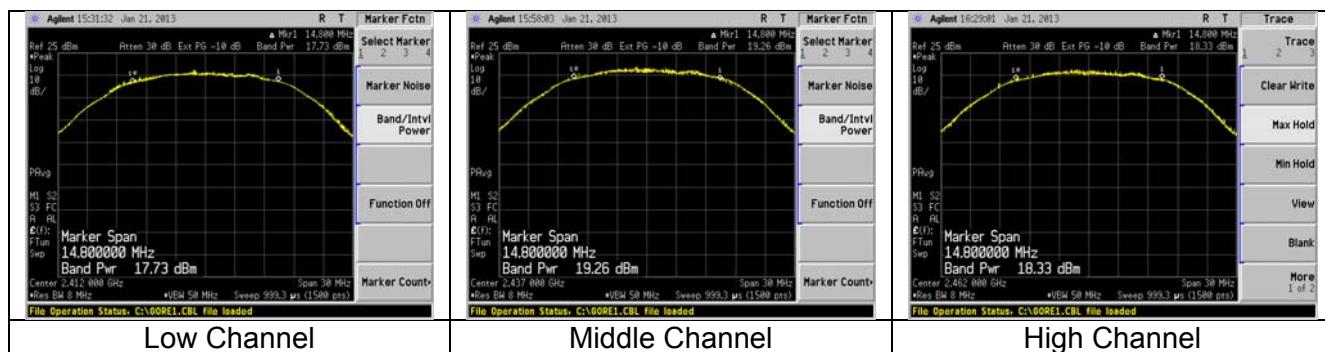
9.3 – Screen Captures.

9.3.2 2.4GHz WLAN

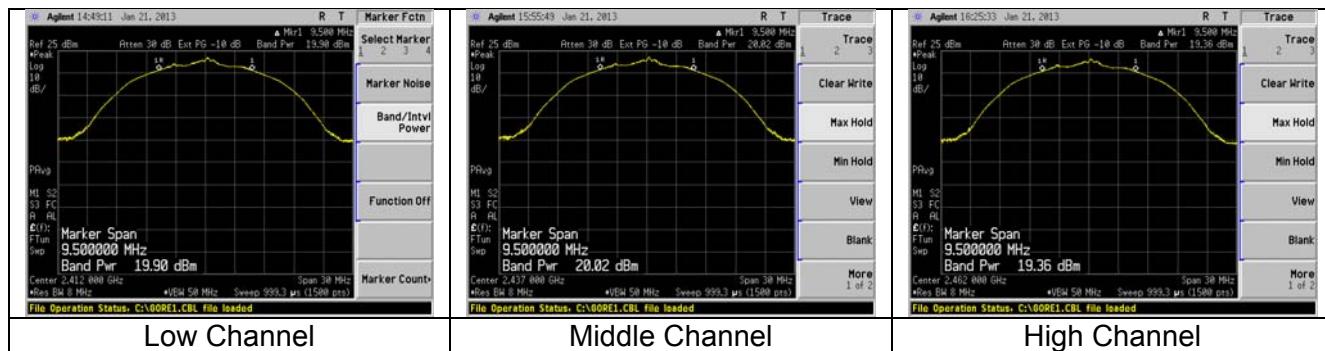
9.3.2.1 1MBPS



9.3.2.2 6MBPS

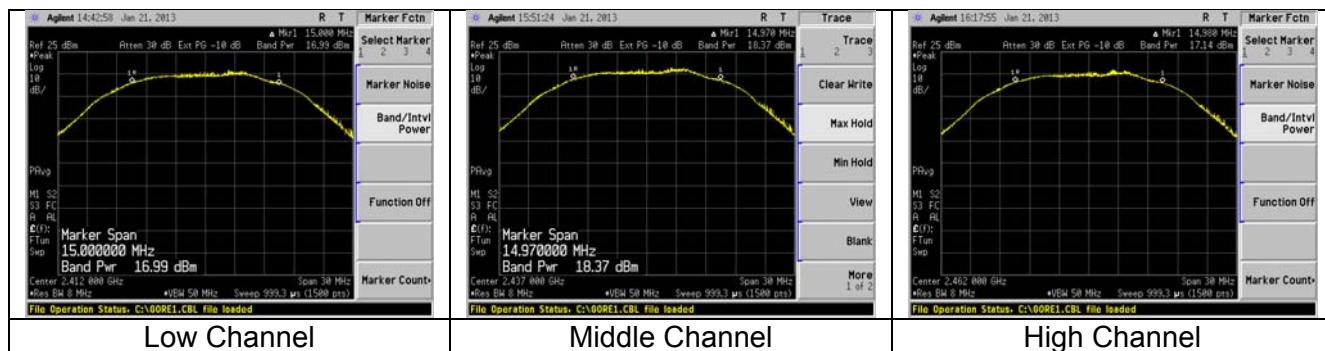


9.3.2.3 11MBPS

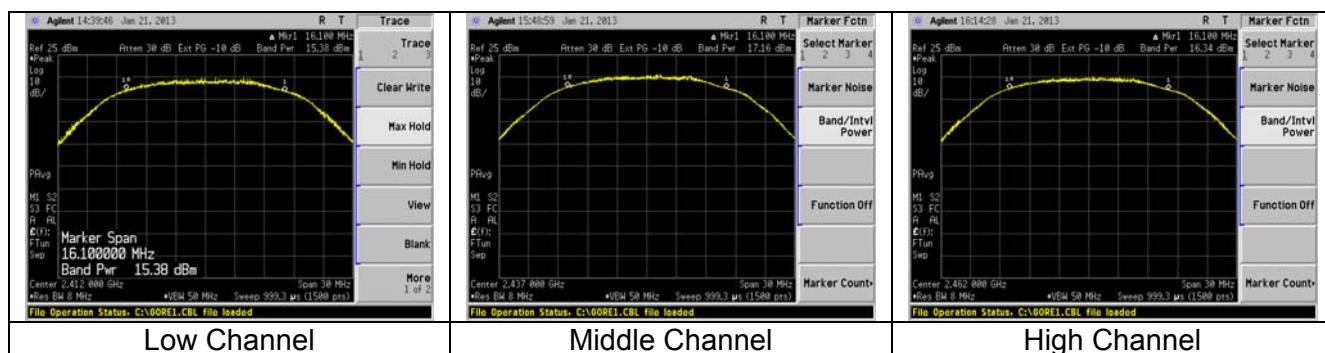


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

9.3.2.4 54 MBPS

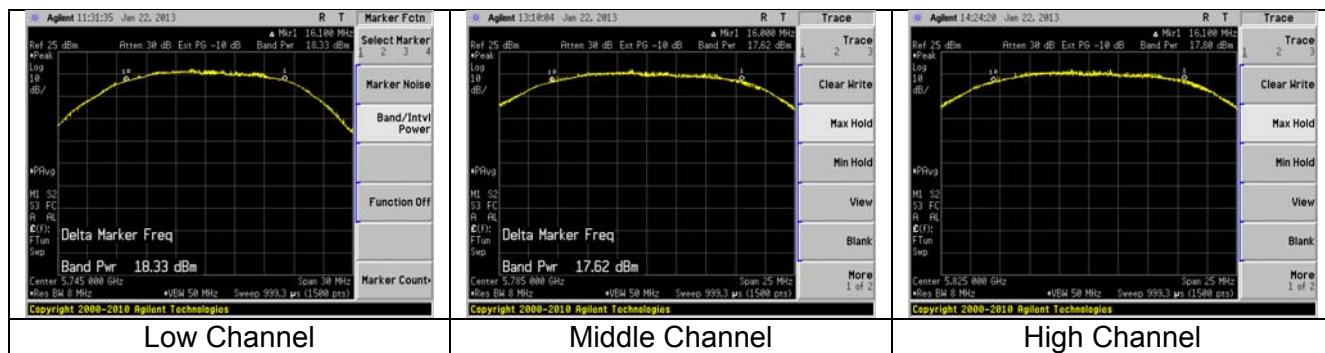


9.3.2.5 MCS7



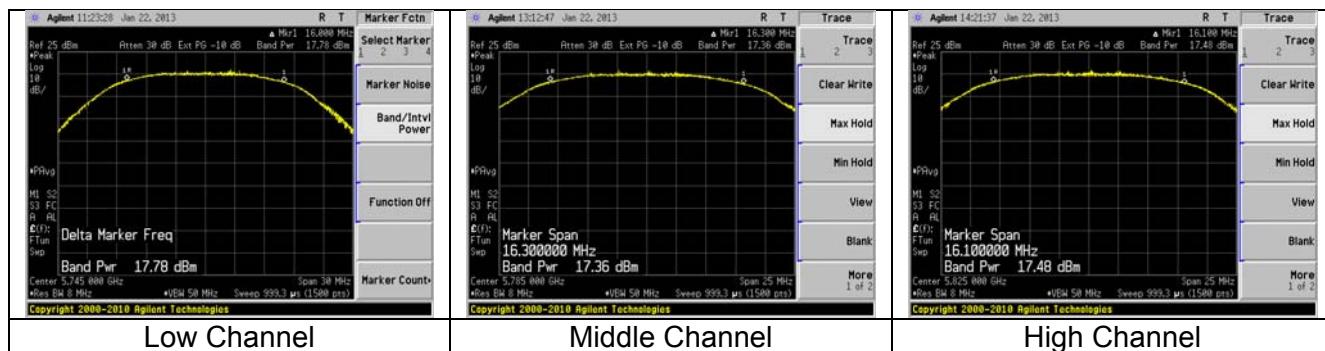
9.3.3 5.7GHz WLAN

9.3.3.1 6MBPS

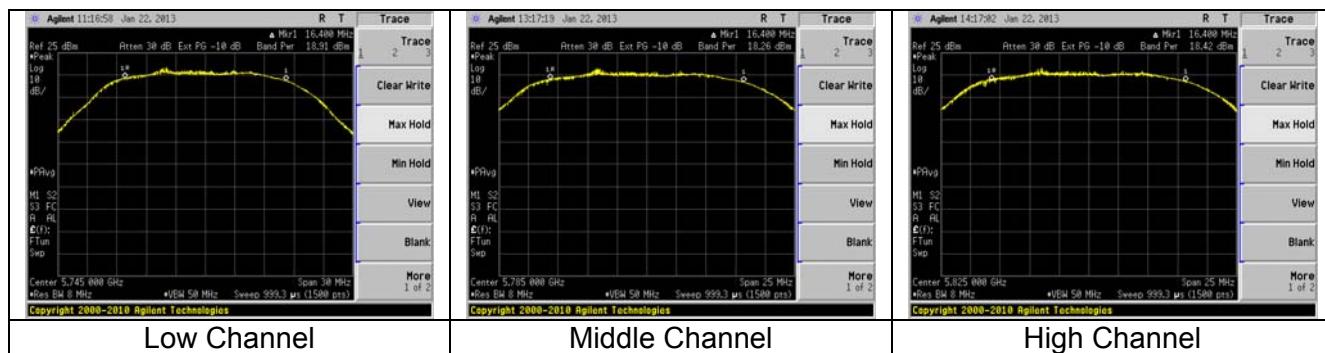


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

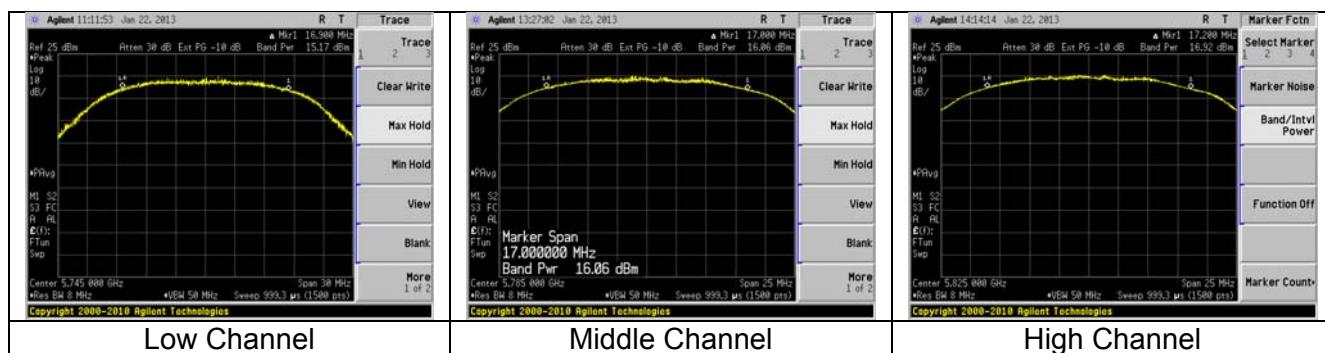
9.3.3.2 12MBPS



9.3.3.3 24MBPS



9.3.3.4 MCS7



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

EXHIBIT 10. CONDUCTED SPURIOUS EMISSIONS: 15.247(d)

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

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 Measurement Guidance V02 section 10.

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).

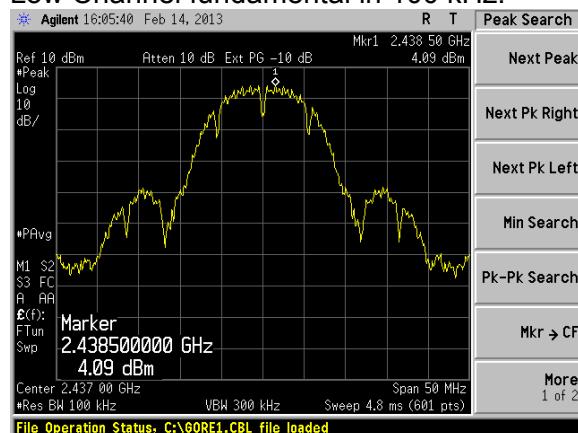
Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

10.3 - Test Data

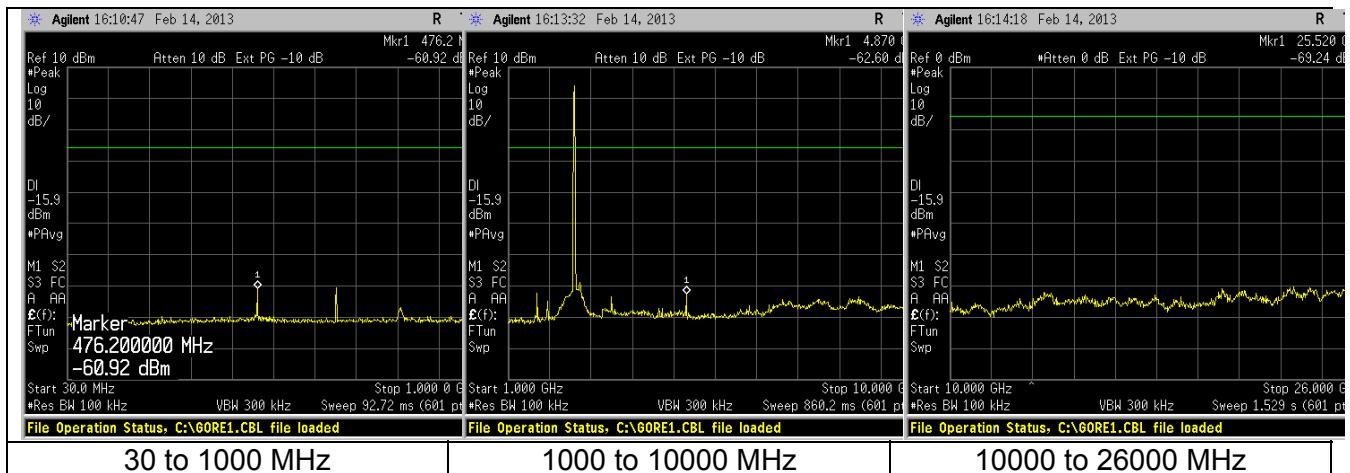
The data presented below are samples selected from the various data rates and channels tested.

10.3.1 2.4GHz WLAN

Low Channel fundamental in 100 kHz:



Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
476.2	-61.2	-15.9	45.3
1630.0	-62.3	-15.9	46.4
4870.0	-63.6	-15.9	47.7

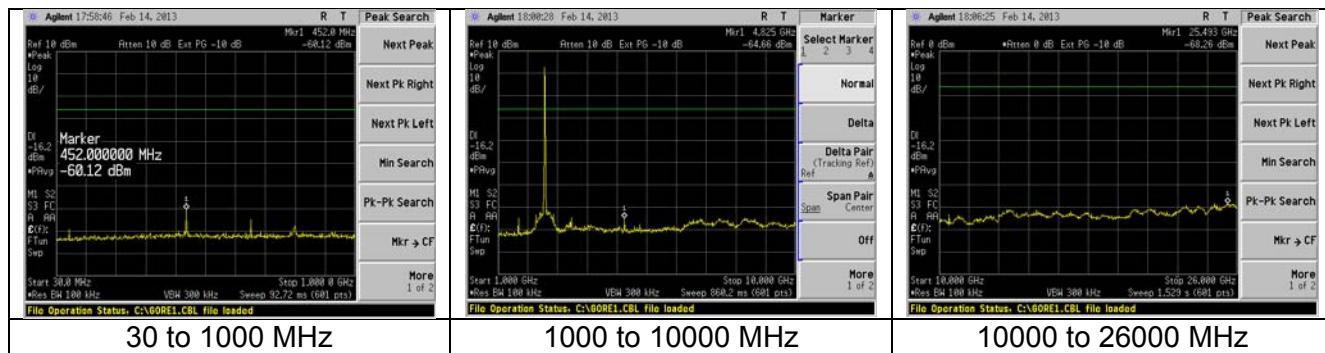


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

Middle Channel fundamental in 100 kHz:



Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
452.0	-60.1	-16.2	44.0
4825.0	-64.7	-16.2	48.5
1615.0	-63.6	-16.2	47.4

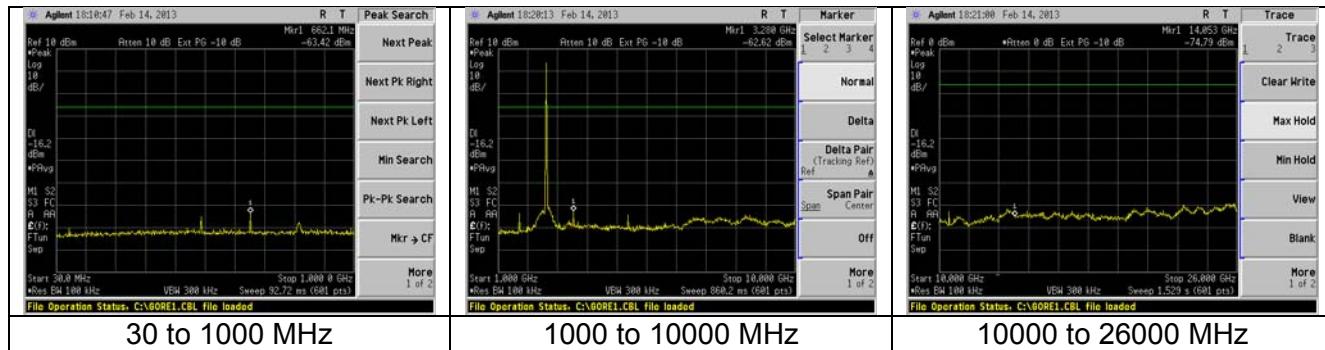


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

High Channel fundamental in 100 kHz:



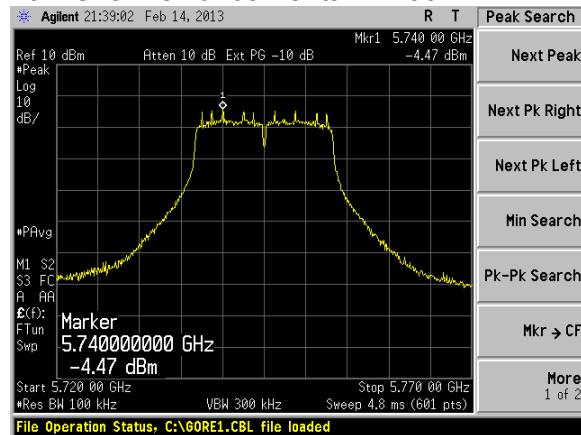
Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
662.1	-63.4	-16.2	47.2
502.1	-64.3	-16.2	48.1
3260.0	-62.6	-16.2	46.4



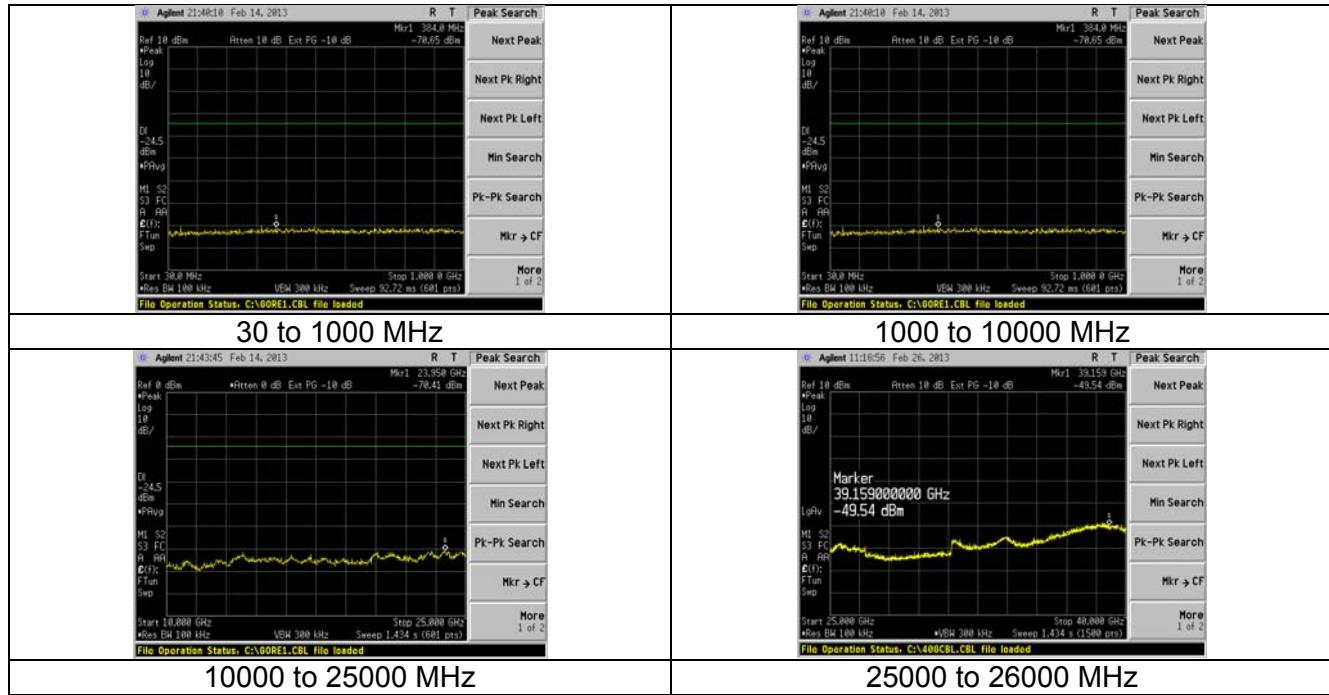
Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

10.3.2 5.7GHz WLAN

Low Channel fundamental in 100 kHz:

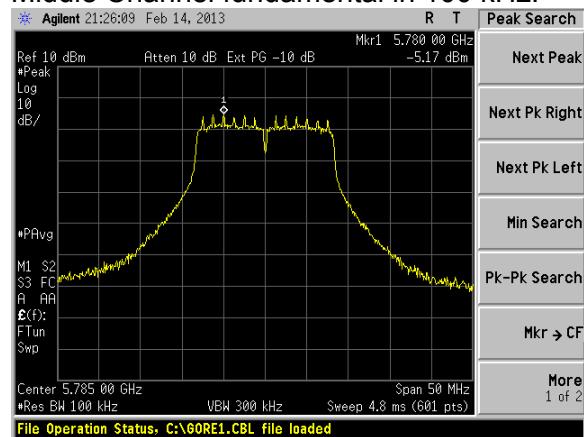


Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
3835.0	-61.7	-24.5	37.2
5305.0	-50.7	-24.5	26.2
5500.0	-51.6	-24.5	27.1

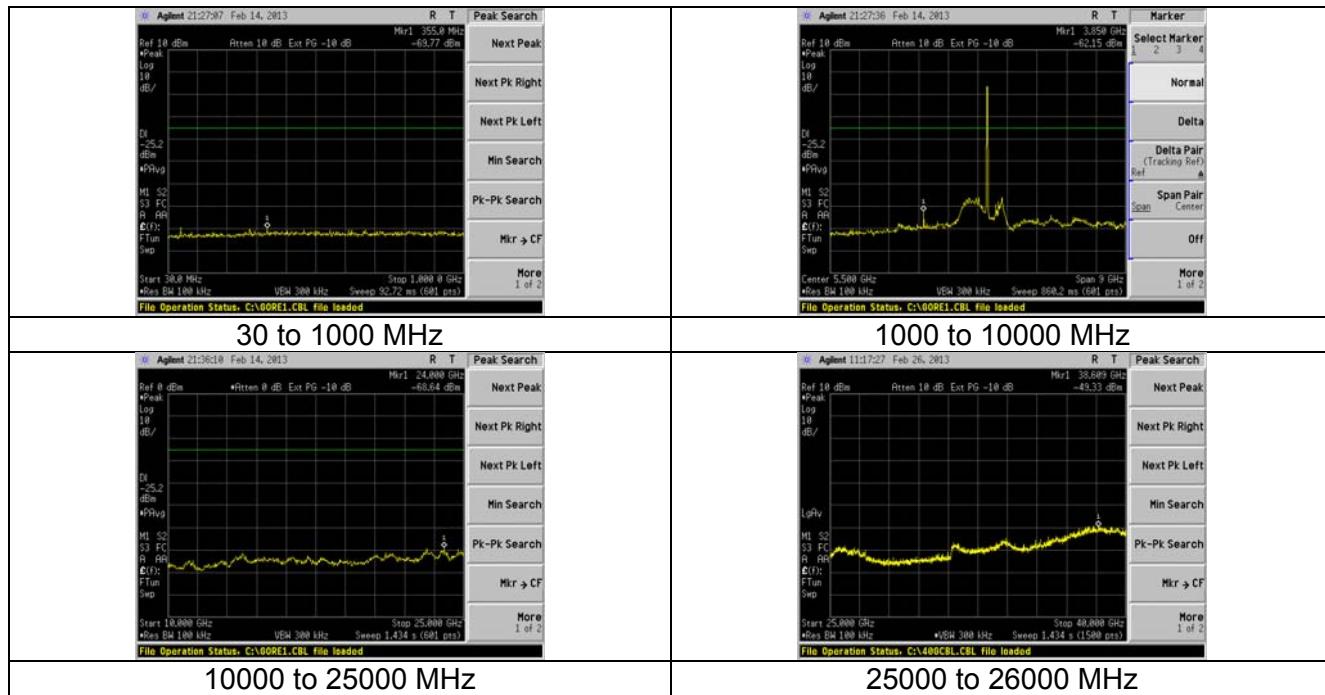


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

Middle Channel fundamental in 100 kHz:

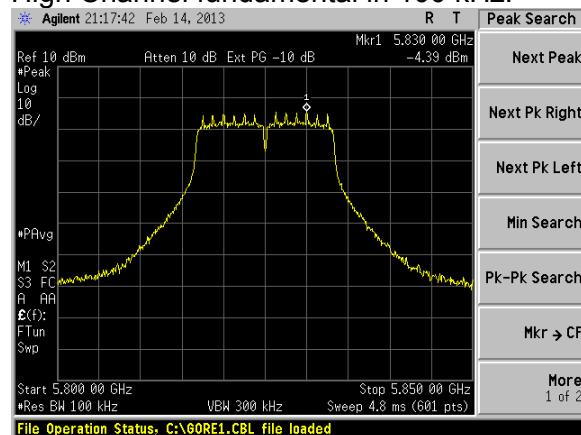


Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
3850.0	-62.2	-25.2	37.0
5500.0	-51.4	-25.2	26.2

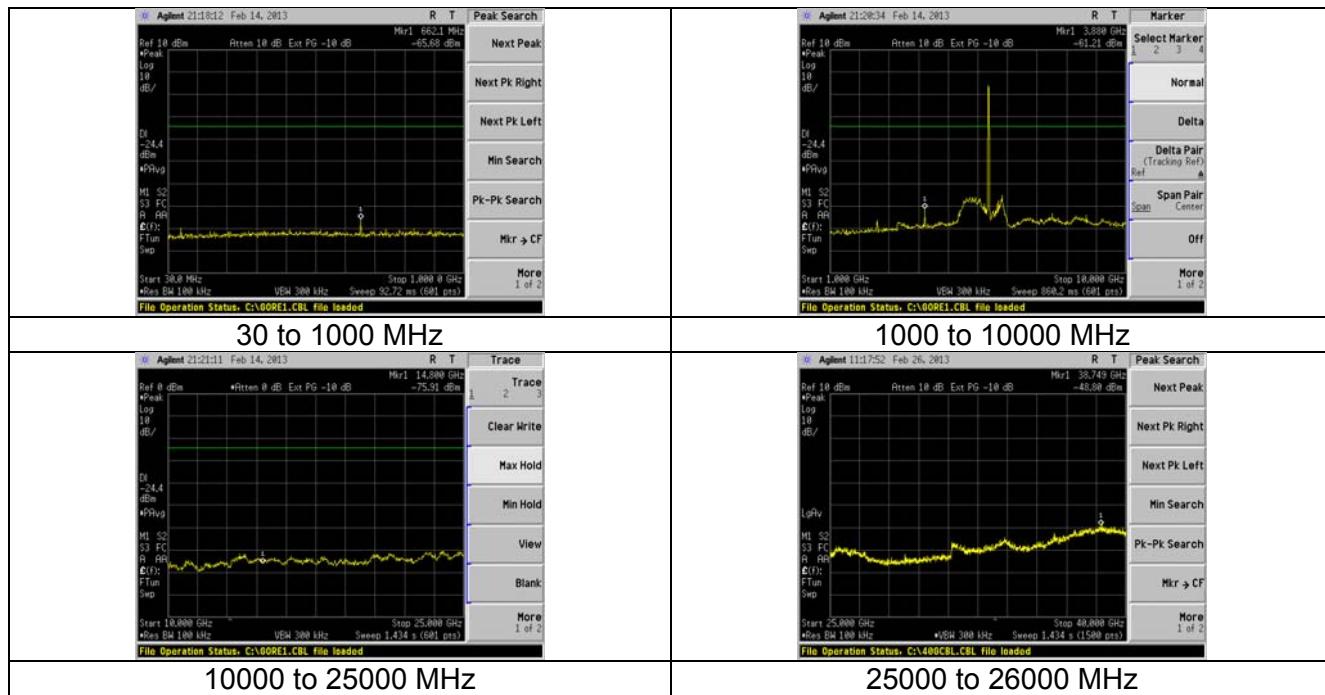


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

High Channel fundamental in 100 kHz:



Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
662.1	-60.1	-24.4	35.7
3880.0	-61.2	-24.4	36.8



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

EXHIBIT 11. POWER SPECTRAL DENSITIES: 15.247(e)

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 Measurement Guidance V02 section 9.

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).

Prepared For: B&B Electronics EUT:Airborne Enterprise Device Server and access Point.	Model #: Refer to Exhibit 2.2 Serial #: Refer to Exhibit 2.2	Report #: 312057 LSR Job #: C-1562
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11.2 Test Data

11.2.1 2.4GHz WLAN

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
1 MBPS 802.11 b	1	2412	-11.8	8	19.8
	6	2437	-11.0	8	19.0
	11	2462	-11.4	8	19.4

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
6 Mbps 802.11 g	1	2412	-19.6	8	27.6
	6	2437	-16.6	8	24.6
	11	2462	-16.8	8	24.8

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
11 MBPS 802.11 b	1	2412	-9.3	8	17.3
	6	2437	-8.4	8	16.4
	11	2462	-9.2	8	17.2

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD 3kHz Limit (dBm)	PKPSD Margin (dB)
54 MBPS 802.11 g	1	2412	-19.8	8	27.8
	6	2437	-18.0	8	26.0
	11	2462	-17.9	8	25.9

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
MCS 7 802.11 n	1	2412	-18.5	8	26.5
	6	2437	-17.9	8	25.9
	11	2462	-18.8	8	26.8

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

11.2.3 5.7GHz WLAN

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
6 Mbps 802.11 a	149	5745	-18.7	8	26.7
	157	5785	-21.0	8	29.0
	165	5825	-19.5	8	27.5

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
12 MBPS 802.11 a	149	5745	-19.6	8	27.6
	157	5785	-20.6	8	28.6
	165	5825	-18.7	8	26.7

Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
24 Mbps 802.11 a	149	5745	-18.9	8	26.9
	157	5785	-20.0	8	28.0
	165	5825	-19.5	8	27.5

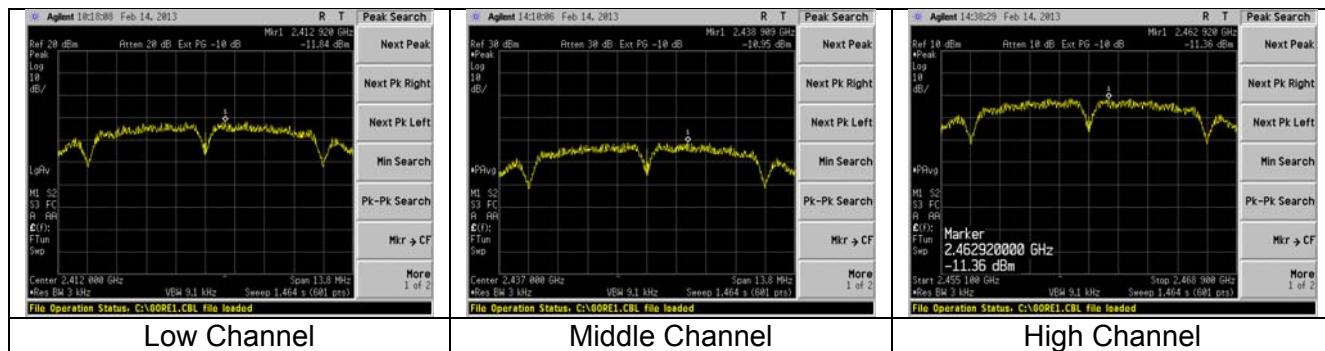
Data Rate	Channel	Frequency (MHz)	PKPSD 3 kHz (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
MCS 7 802.11 n	149	5745	-20.8	8	28.8
	157	5785	-22.3	8	30.3
	165	5825	-20.1	8	28.1

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

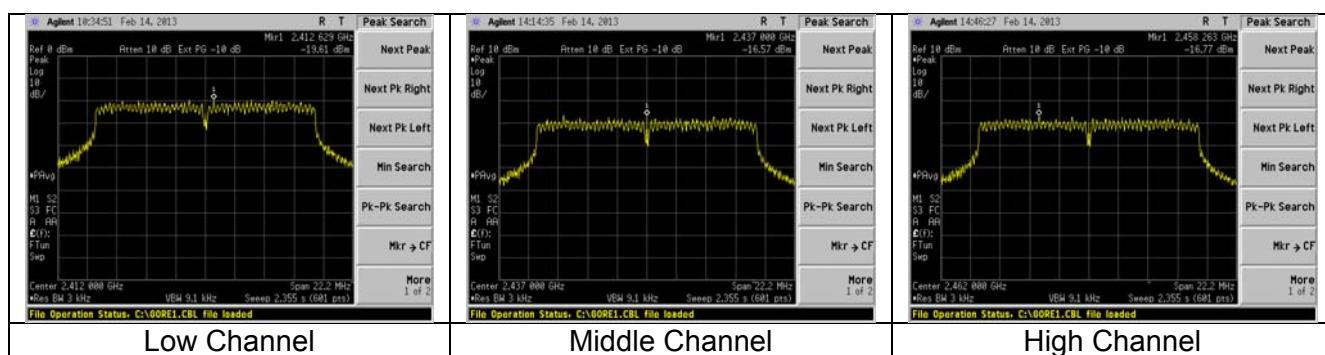
11.3 Screen Captures - Power Spectral Density

11.3.1 2.4GHz WLAN

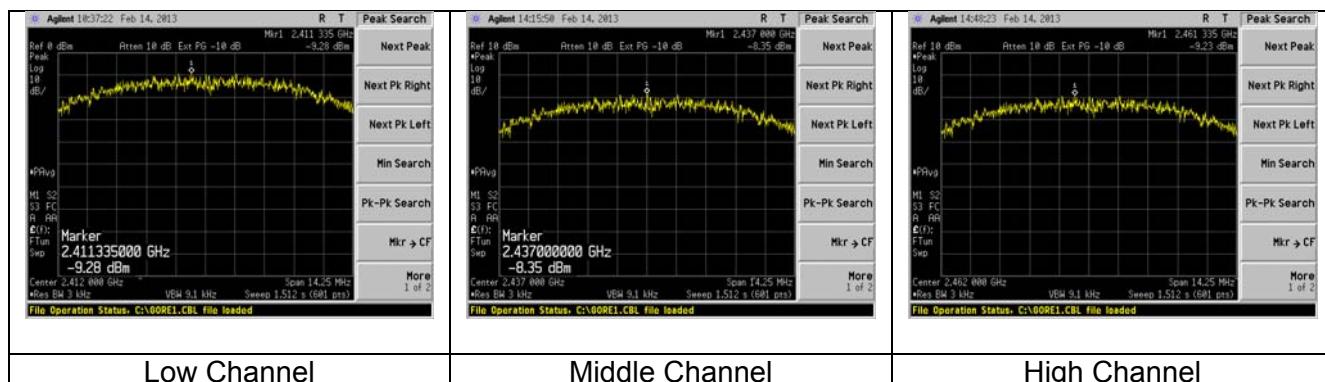
11.3.1.1 1MBPS



11.3.1.2 6MBPS

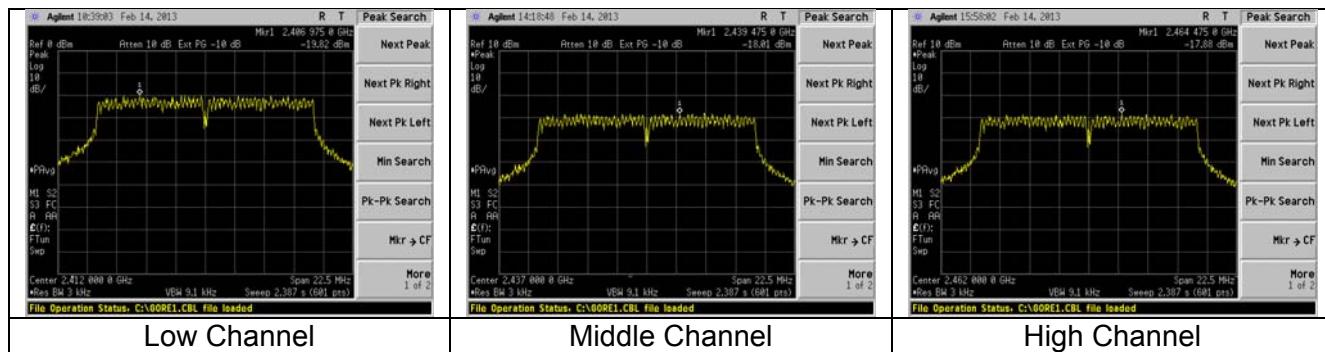


11.3.1.3 11MBPS

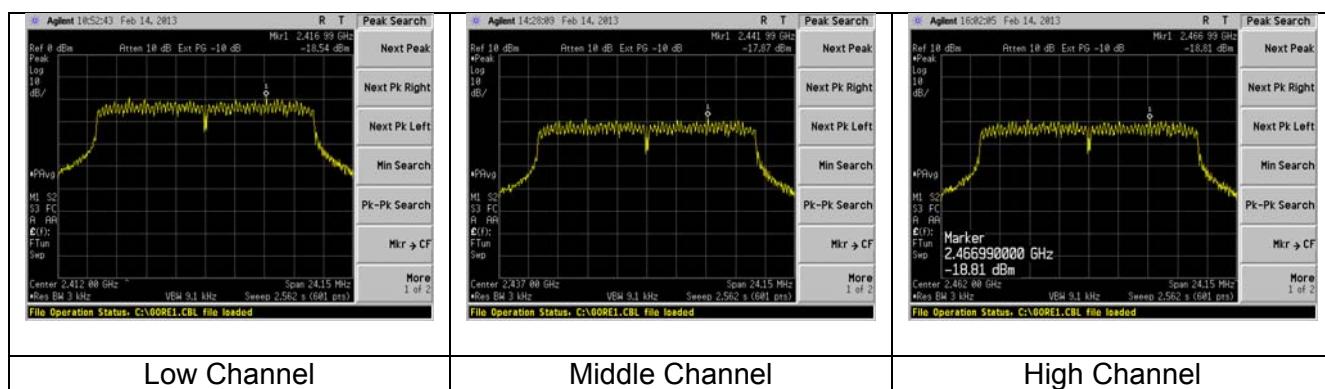


Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

11.3.1.4 54MBPS

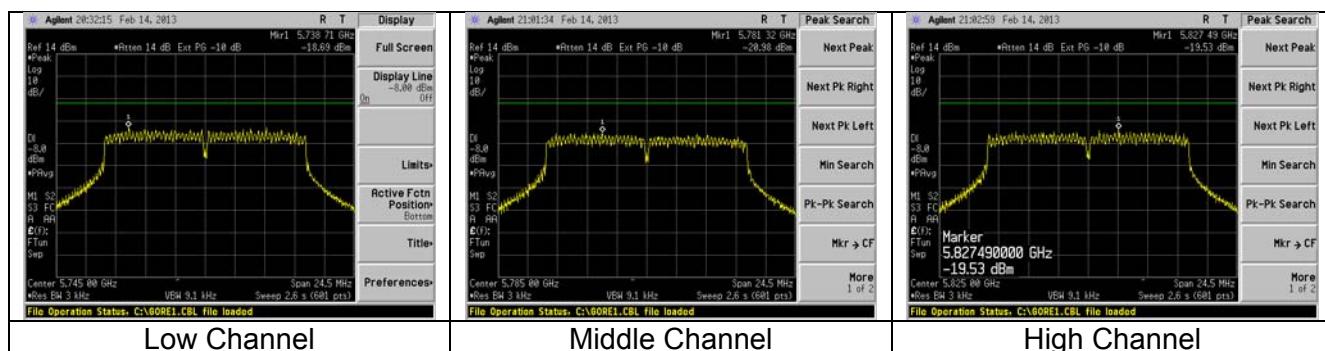


11.3.1.5 MCS7



11.3.2 5.7GHz WLAN

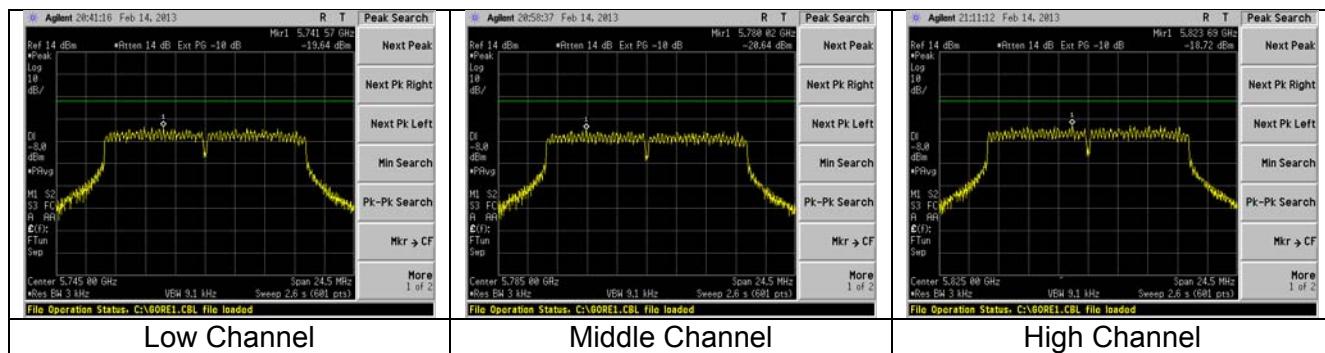
11.3.2.1 6MBPS



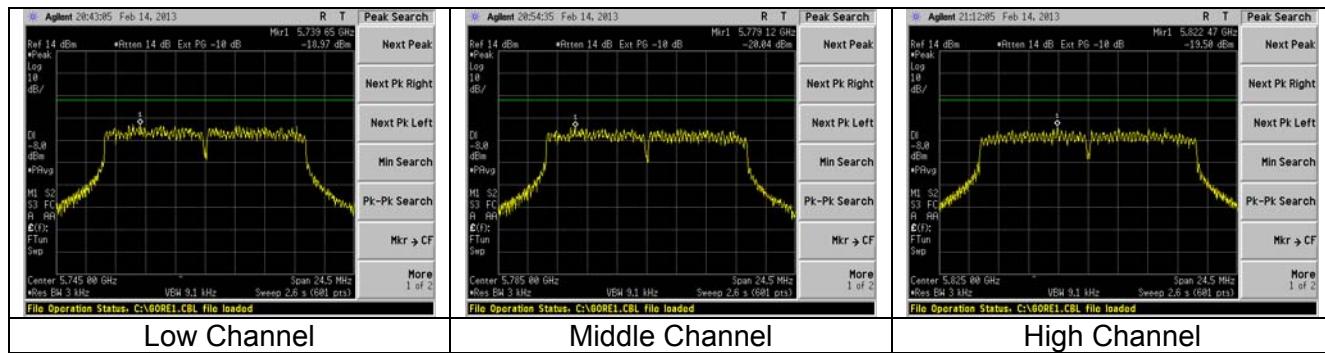
Note: The display line is NOT an indication of the limit

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

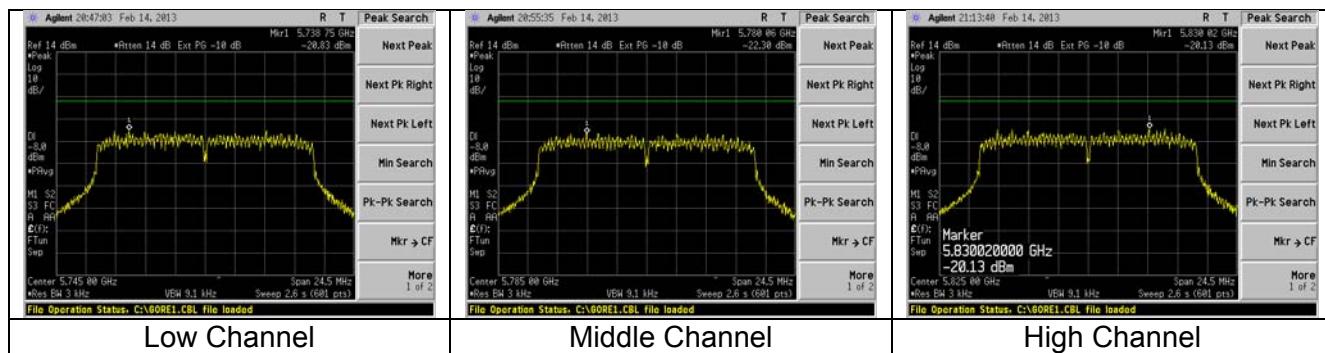
11.3.2.2 12MBPS



11.3.2.3 24MBPS



11.3.2.4 MCS7



Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
EUT:Airborne Enterprise Device Server and access Point.	Serial #: Refer to Exhibit 2.2	LSR Job #: C-1562

EXHIBIT 12. FREQUENCY STABILITY OVER VOLTAGE VARIATIONS

Test Engineer(s): Khairul Aidi Zainal

The 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 $\pm 5\%$ from the nominal which is per EUT data sheet.

Temp	Channel	Nominal Frequency (MHz)	Supply Voltage (V)			LIMIT		Result (Pass/ Fail)
			3.13	3.30	3.46	Lower Frequency (Hz)	Upper Frequency (Hz)	
23°C	36	2412.0	2411977000	2411977000	2411977000	2.41E+09	2.41E+09	Pass
	64	2437.0	2436977000	2436977000	2436977000	2.44E+09	2.44E+09	Pass
	112	2462.0	2461977000	2461977000	2461977000	2.46E+09	2.46E+09	Pass

	Supply Voltage (V)				
	Temp	FREQ	3.13	3.30	3.46
	-40	5785.0	5785005000	5784998000	5785005000
	23	5785.0	5785038000	5785038000	5785038000
	85	5785.0	5784968000	5784968000	5784968000

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.

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EXHIBIT 13. MPE CALCULATIONS

The following MPE calculations are based on a measured conducted RF power of 20.0dBm at 2437MHz and 18.9dBm at 5745MHz as presented to the antenna. The peak antenna gain in the 2.4GHz band is 4.1dBi and 5.5dBi in the 5.7GHz 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: 20.00 (dBm)

Maximum peak output power at antenna input terminal: 100.000 (mW)

Antenna gain(typical): 4.1 (dBi)

Maximum antenna gain: 2.570 (numeric)

Prediction distance: 20 (cm)

Prediction frequency: 2437 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.051136 (mW/cm²)

Maximum allowable antenna gain: 17.0 (dBi)

Margin of Compliance at 20 cm = 12.9 dB

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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: 18.90 (dBm)

Maximum peak output power at antenna input terminal: 77.625 (mW)

Antenna gain(typical): 5.5 (dBi)

Maximum antenna gain: 3.548 (numeric)

Prediction distance: 20 (cm)

Prediction frequency: 5745 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.054794 (mW/cm²)

Maximum allowable antenna gain: 18.1 (dBi)

Margin of Compliance at 20 cm = 12.6 dB

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APPENDIX A - Test Equipment List



Date: 8-Jan-2013

Type Test: Radiated Emissions

Job #: C-1562

Prepared By: Aidi

Customer: B&B Electronics

Quote #: 312057

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960160	0.8-2GHz LNA	Mini-Circuits	ZVA-213X-S+	977711030	9/17/2012	1/10/2013	Active Calibration
2	AA 960007	Double Ridge Horn Antenna	EMCO	3115	93114138	5/16/2012	1/10/2013	Active Calibration
3	AA 960144	Phaseflex	Gore	EK0010010720	5000373	6/12/2011	6/12/2013	Active Calibration
4	AA 960154	2.4GHz High Pass Filter	KWM	HFF-L-14106	7272-02	6/29/2012	6/29/2013	Active Calibration
5	AA 960161	Highpass Filter	KUL Microwave	113110-0000	2	12/13/2012	12/13/2013	Active Calibration
6	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/29/2012	6/29/2013	Active Calibration
7	EE 960158	RF Preselector	Agilent	NS039A	MY46520110	6/29/2012	6/29/2013	Active Calibration
8	EE 960156	100MHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	6/30/2012	6/30/2013	Active Calibration
9	AA 960004	Log Periodic Antenna	EMCO	93146	9512-4276	9/17/2012	9/17/2013	Active Calibration
10	AA 960005	Bi-lobal Antenna	EMCO	931108	9601-2280	6/26/2012	6/26/2013	Active Calibration
11	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration

Project Engineer: Aidi Zainal

Quality Assurance: Thomas T. Smith



Date: 17-Oct-2012

Type Test: Conducted measurements

Job #: C-1562

Prepared By: Aidi Zainal

Customer: B&B Electronics

Quote #: 312057

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration
2	AA 960143	Phaseflex	Gore	EK0010010480	5546519	6/12/2011	6/12/2013	Active Calibration
3	AA 960144	Phaseflex	Gore	EK0010010720	5000373	6/12/2011	6/12/2013	Active Calibration

Project Engineer: Aidi Zainal

Quality Assurance: Thomas T. Smith



Date: 17-Oct-2012

Type Test: AC mains

Job #: C-1562

Prepared By: Aidi Zainal

Customer: B&B Electronics

Quote #: 312057

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	2/11/2013	2/11/2014	Active Calibration
2	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	2/11/2013	2/11/2014	Active Calibration
3	AA 960031	Transient Limiter	HP	11947A	3107A01708	9/2/2012	9/2/2013	Active Calibration
4	EE 960084	LISN	Com-Power	LI-215A	191920	2/20/2013	2/20/2014	Active Calibration

Project Engineer: Aidi Zainal

Quality Assurance: Thomas T. Smith

Prepared For: B&B Electronics	Model #: Refer to Exhibit 2.2	Report #: 312057
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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		

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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

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