Washington Laboratories, Ltd.
www.wll.com
7560 Lindbergh Drive Gaithersburg, MD 20879
301.216.1500 : info@wll.com

FCC Permissive Class 2 Test Report

For the

B&B Electronics Inc.

Airborne WLAN Module

FCC ID: F4AWLNG551

IC: 3913A-WLNG551

WLL JOB# **12627-01 Rev 0**
August 30, 2012

Prepared for:

B&B Electronics
707 Dayton Road, Ottawa,
IL, 61350

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ACCREDITED TESTING

Testing Certificate AT-1448

FCC Permissive Class 2 Test Report
For the
B&B Electronics Inc.
Airborne WLAN Module

FCC ID: F4AWLNG551
IC: 3913A-WLNG551

WLL JOB# **12627-01 Rev 0**
August 30, 2012

Prepared by:

Steven Dovell
Compliance Engineer

Reviewed by:

Steven D. Koster
Vice President

Abstract

This report has been prepared on behalf of B&B Electronics to support the attached Class 2 permissive change. The Permissive Class 2 Test Report for a Direct Sequence Spread Spectrum Transmitter under Part 15.247 (10/2010) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 issue 8 of Industry Canada. This Certification Test Report documents the test configuration and test results for the B&B Electronics Airborne WLAN Module.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The B&B Electronics Airborne WLAN Module complies with the limits for a Direct Sequence Spread Spectrum Transmitter under FCC Part 15.247 and Industry Canada RSS-210.

.

Revision History	Description of Change	Date
Rev 0	Initial Release	August 30,2012

Table of Contents

List of Tables

1 Introduction

1.1 Reason for Class 2 Permissive Change

This class 2 permissive change is being generated in order to add the ANT-2.4-WRT-UFL antenna for use with this module.

1.2 Compliance Statement

The B&B Electronics Airborne WAN Module remains in compliance with the limits for a modular Direct Sequence Spread Spectrum device under FCC Part 15.247 (10/2010).

1.3 Test Scope

Tests for radiated emissions and power verification (at antenna terminal) were performed. All measurements were performed in accordance with FCC Public Notice FCC97-114, Guidance on Measurements for Direct Sequence Spread Spectrum Systems & KDB558074: "Measurement of Digital Transmission Systems operating under Section 15.247." The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Contract Information

Customer:	B&B Electronics 707 Dayton Road Ottawa, IL, 61350
Quotation Number:	66889

1.4 Test Dates

Testing was performed on the following date(s):	8/29/12

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Client Representative	Javan Sheneman

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The Airborne WLAN Module is an industrialized 802.11b/g radio module for integration into an OEM's electronics.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	B&B Electronics
FCC ID:	F4AWLNG551
IC:	3913A-WLNG551
Model:	Airborne WLAN Module (Model Number: 930-8090-01C-G)
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	2412 – 2462MHz
Maximum Output Power:	19.1 dBm (81.3mW) Peak
Modulation:	802.11b-DSSS, 802.11g- OFDM
Occupied Bandwidth:	802.11b-13.11MHz, 802.11g- 16.67MHz
Maximum Spurious TX:	140.8uV/m @3m – 264.6MHz
Maximum Spurious RX:	127.6uV/m @3m -1320.7MHz
Emission Designator:	13M1G1D, 16M7G1D
Keying:	Automatic
Type of Information:	Data
Number of Channels:	11
Antenna Connector	CN1 & CN2 antenna ports, U.FL connectors
Antenna Type	See Below- Highest Gain 5.5dBi
Power Output Level	Fixed
Interface Connector:	CN3 connector 36 pins, Hirose type DF12B
Power Source & Voltage:	3.3Vdc nominal, 3.0-3.6Vdc min-max.

2.2 Antenna Listings

The antenna listed below is proposed by the manufacturer for use with this device.

Name/Description	Gain	Man/Model Number	Part Number
2.4 GHz 0dBi U.FL/MHF Wireless LAN Antenna	0dBi	Antenna Factor ANT-2.4-WRT-UFL	ANT-2.4-WRT-UFL

2.3 Test Configuration

The Airborne WLAN Module was configured as a standalone unit. 3.6VDC power was applied to the module from the support motherboard (via a 120VDC to 5VDC adaptor) that held the RF WLAN module. Onboard regulators on the module reduce the voltage to 3.3VDC

2.4 Testing Algorithm

The Airborne WLAN Module was programmed with command line entries via a support laptop Tera term communications program to transmit continuously at one of three channels, 2412MHz, 2437MHz, and 2462MHz. Worst case emission levels are provided in the test results data.

Worst case emission levels are provided in the test results data.

2.5 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.6 Measurements

2.6.1 References

FCC OET 996369 D01 Module Certification Guide v01r03 Dated 7/12/2011

FCC OET 558074 D01 DTS Meas Guidance v01 Dated 1/18/2012

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

2.7 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$div_{a,\ b,\ c}$ = the individual uncertainty element divisor based on the probability distribution

divisor = 1.732 for rectangular distribution

divisor = 2 for normal distribution

divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

where U = expanded uncertainty

k = coverage factor

k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	4.55 dB

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3. Test Equipment List

Test Name: **Conducted Emissions Voltage**		Test Date: **8/29/30**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
605	AGILENT HP - N1911A	POWER METER	4/30/2014
000606	AGILENT HP - N1921A	POWER SENSOR	4/30/2014
HNS H-D61476	HP - 8563E	ANALYZER SPECTRUM	03/31/2013

Test Name:- **Radiated Emissions**		Test Date: **08/29/2012**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
HNS H-D61476	HP - 8563E	ANALYZER SPECTRUM	03/31/2013
69	HP - 85650A	ADAPTER QP	6/27/2013
71	HP - 85685A	PRESELECTOR RF	6/27/2013
73	HP - 8568B	ANALYZER SPECTRUM	6/27/2013
282	ITC - 21X-3A1	WAVEGUIDE 6.8-15GHZ	5/29/2014
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	5/29/2014
337	WLL - 1.2-5GHZ	FILTER BAND PASS	4/19/2014
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	5/24/2013
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	1/12/2013
425	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	9/7/2013

4 Test Summary

The Table Below shows the results of testing for compliance with a DSSS Transmitter in accordance with FCC Part 15.247 andRSS210 issue 8. Full results are shown in section 5.

Table 4. Test Summary Table

FCC Rule Part	Industry Canada Rule Part	Description	Result
15.247 (a)(2)	A8.2 (a)	6dB Bandwidth	Pass
15.247 (b)(3)	A8.4 (4)	Transmit Output Power	Pass
15.205 15.209	RSS-GEN issue 3, 7.2.2	General Field Strength Limits (Restricted Bands Limits)	Pass

5 Test Results

5.1 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. The method used is in accordance with FCC OET 558074 D01 DTS Meas Guidance v01 section 5.1.1.

For DSSS Transmitter, FCC Part 15.247 requires the maximum 6 dB bandwidth be greater or equal to 500kHz.

This test as performed in order to determine the proper Power Measurement Technique.

At full modulation, the occupied bandwidth was measured as shown:

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
2437MHz	16.9MHz	≥500kHz	Pass

5.2 RF Power Output: (FCC Part §2.1046)

To measure the output power the radio was transmitting on 2437MHz. The module is provided with a U.FL/MHF compatible connector. The antenna removed and replaced by a short (<10cm) temporary SMA connector port. The output from the transmitter was connected to an attenuator and then to the input of a wideband power meter. Both antenna ports were tested by switching the software command to select either antenna 1 or antenna 2. The power meter offset was adjusted to compensate for the attenuator in the system. This is performed in accordance with FCC procedures (Note the FCC has allowed the use of power meters for this measurement with corrected draft OET procedure 558074 DTS Meas Guidance DR01 and Test Methods of C63.10:2009).

The final result was compared to the previous grant listing for this device to ensure that the output was within +/-1dB (without exceeding the rule part limit of +30dBm).

The unit was within the acceptable tolerance for this permissive change.

Table 6: Data Channel RF Power Output

Channel and/or Frequency	Peak Measured Level (dBm)	Peak Measured Level (Watts)	Present Grant Level (dBm)	Present Grant Level (Watts)
2437MHz (ant Port 1)	19.1	0.0813	0.0813	0.0813
2437MHz (ant Port 2)	19.1	0.0813	19.1	0.0813

5.3 Radiated Spurious Emissions: (FCC Part §15.205 & §15.209)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.3.1 Test Procedure

The EUT was fitted with the new antenna then was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The unit was pre-scanned in 3 orthogonal positions with full testing performed in the worst case position.

The emissions were measured using the following resolution bandwidths:

Table 7: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Worst case emissions are presented.

The unit was tested in 3 orthogonal positions with the worst case data presented.

Testing was performed in the 802.11b 11Mbps mode.

Table 8: Radiated Emission Test Data < 1GHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
72.84	V	180.00	1.00	4.40	9.4	4.9	100.0	-26.2	
111.64	V	100.00	1.40	12.50	15.2	24.2	150.0	-15.8	
132.28	V	175.00	1.24	5.00	14.8	9.8	150.0	-23.7	
150.07	V	0.00	1.00	4.40	14.1	8.4	150.0	-25.1	
264.56	V	190.00	1.00	21.30	16.2	74.7	200.0	-8.6	
330.70	V	90.00	1.00	12.40	18.0	33.1	200.0	-15.6	
74.50	H	270.00	4.00	10.70	9.4	10.1	100.0	-19.9	
108.80	H	180.00	4.00	23.20	14.4	75.5	150.0	-6.0	
149.87	H	180.00	2.88	8.00	14.0	12.6	150.0	-21.5	
156.41	H	185.00	2.47	10.50	14.2	17.2	150.0	-18.8	
264.60	H	340.00	2.00	26.80	16.2	140.8	200.0	-3.1	
330.71	H	280.00	1.50	17.50	18.0	59.6	200.0	-10.5	

Table 9: Radiated Emission Test Data Band edge

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2390.00	V	270.00	2.27	42.50	-3.5	88.9	5000.0	-35.0	Peak
2390.00	V	270.00	2.27	32.60	-3.5	28.4	500.0	-24.9	Average
2483.50	V	270.00	2.27	43.60	-2.8	110.2	5000.0	-33.1	Peak
2483.50	V	270.00	2.27	33.80	-2.8	35.7	500.0	-22.9	Average
2390.00	H	90.00	2.44	45.60	-3.5	127.0	5000.0	-31.9	Peak
2390.00	H	90.00	2.44	34.50	-3.5	35.4	500.0	-23.0	Average
2483.50	H	90.00	2.44	47.80	-2.8	178.8	5000.0	-28.9	Peak
2483.50	H	90.00	2.44	35.60	-2.8	43.9	500.0	-21.1	Average

Table 10: Radiated Emission Test Data > 1GHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
1575.80	V	300.00	2.13	65.50	-7.9	761.3	5000.0	-16.3	Peak
1575.80	V	300.00	2.13	46.50	-7.9	85.4	500.0	-15.3	Average
1689.17	V	300.00	2.10	67.50	-7.4	1016.5	5000.0	-13.8	Peak
1689.17	V	300.00	2.10	43.20	-7.4	62.0	500.0	-18.1	Average
4874.00	V	185.00	1.91	42.00	3.8	194.4	5000.0	-28.2	Peak
4874.00	V	0.00	0.00	32.50	3.8	65.1	500.0	-17.7	Average
7311.00	V	95.00	1.71	50.80	10.2	1116.4	5000.0	-13.0	Peak
7311.00	V	0.00	0.00	28.00	10.2	80.9	500.0	-15.8	Average
12185.00	V	165.00	1.48	43.00	19.5	1330.7	5000.0	-11.5	Peak
12185.00	V	165.00	1.48	28.97	19.5	264.6	500.0	-5.5	Average
1323.13	H	0.00	2.33	45.30	-8.4	70.3	5000.0	-37.0	Peak
1323.13	H	0.00	2.33	37.20	-8.4	27.7	500.0	-25.1	Average
1575.80	H	270.00	1.91	49.67	-7.9	123.0	5000.0	-32.2	Peak
1575.80	H	270.00	1.91	42.33	-7.9	52.8	500.0	-19.5	Average
1689.17	H	270.00	1.93	54.30	-7.4	222.4	5000.0	-27.0	Peak
1689.17	H	270.00	1.93	34.70	-7.4	23.3	500.0	-26.6	Average
4874.00	H	180.00	1.74	45.20	3.8	281.0	5000.0	-25.0	Peak
4874.00	H	180.00	1.74	31.50	3.8	58.0	500.0	-18.7	Average
7311.00	H	160.00	1.73	40.20	10.2	329.5	5000.0	-23.6	Peak
7311.00	H	160.00	1.73	27.20	10.2	73.8	500.0	-16.6	Average
12185.00	H	190.00	1.46	41.30	19.5	1094.2	5000.0	-13.2	Peak
12185.00	H	190.00	1.46	28.50	19.5	250.7	500.0	-6.0	Average

