



RF Exposure Evaluation Report

APPLICANT : Atheros Communications, Inc.
EQUIPMENT : AR5BHB116 2x2 802.11n PCIe module
BRAND NAME : Atheros
MODEL NAME : AR5BHB116
FCC ID : PPD-AR5BHB116
IC : 4104A-AR5BHB116
FILING TYPE : Certification
STANDARD : OET Bulletin 65 Supplement C (Edition 01-01)

We, SPORTON INTERNATIONAL INC., would like to declare that the device has been evaluated in accordance with FCC OET Bulletin 65 Supplement C (Edition 01-01), and pass the limit. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

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Revision History



1. General Description

1.1 Applicant

Company Name	Atheros Communications, Inc.
Address	1700 Technology Drive, San Jose, CA 95110

1.2 Manufacturer

Company Name	Atheros Communications, Inc.
Address	1700 Technology Drive, San Jose, CA 95110

1.3 Testing Laboratory

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978



2. Equipment Under Test

2.1 General Information of EUT

Product Feature & Specification	
EUT Type	AR5BHB116 2x2 802.11n PCIe module
Brand Name	Atheros
Model Name	AR5BHB116
FCC ID	PPD-AR5BHB116
IC	4104A-AR5BHB116
Tx/Rx Frequency Range	802.11b/g/n : 2400 MHz ~ 2483.5 MHz 802.11a/n : 5150 MHz ~ 5350 MHz 5470 MHz ~ 5725 MHz 5725 MHz ~ 5850 MHz
Antenna Type	PIFA Antenna
HW Version	051
Test SW Version	1.8
Type of Modulation	802.11b : DSSS 802.11a/g/n : OFDM
EUT Stage	Engineering Prototype

Remark: The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

2.2 Antenna Information

The device is 2x2 configuration and 2 PIFA antennas are utilized for radiation emission testing. The antenna composite gain on different frequency range is shown in the following table:

Brand / Model Name	Type	Frequency Range (MHz)	Antenna Gain (dBi)	Composite Gain (dBi)
Winstron Neweb Corporation / EBJ Main + EBJ Aux.	PIFA	2400 ~ 2500	3.0/3.62	6.33
Winstron Neweb Corporation / EBJ Aux. + EBJ Aux.	PIFA	5150 ~ 5350	3.08	6.08
Winstron Neweb Corporation / EBJ Main + EBJ Main	PIFA	5470 ~ 5725	4.76	7.77
Winstron Neweb Corporation / EBJ Main + EBJ Main	PIFA	5725 ~ 5850	4.76	7.77



3. RF Exposure Introduction

➤ Requirements

Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile and portable and are defined as follows:

▪ Fixed installation:

Fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.

▪ Mobile Devices:

A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitters's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR 2.1091.

▪ Portable Devices:

A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR 2.1093)

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

**▪ Occupational/controlled Exposure:**

In general, occupational/controlled exposure limits are applicable to situation in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.

▪ General Population/Uncontrolled Exposure:

The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category and the general population/uncontrolled exposure limits apply to these devices.



4. RF Exposure Evaluation

4.1 Radio Frequency Radiation Exposure Evaluation

According to 1.1310 of the FCC rules, the power density limit for General Population/Uncontrolled Exposure is $f/1500$ mW/cm² for 300 MHz to 1500 MHz and 1.0 mW/cm² for 1500 MHz to 100000 MHz. As this is a mobile application the MPE shall be calculated at 20 cm to show compliance with the power density limit. The following formula was used to calculate the Power Density:

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

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna

This device has been evaluated as mobile device, as well as portable device with general population/uncontrolled exposure condition.

For this device, the calculation is as follows:

Wireless LAN operated in IEEE 802.11b mode (Tx/Rx: 2400~2483.5MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
1	2412	6.33	4.30	22.19	165.58	0.14	1.00
6	2437	6.33	4.30	23.18	207.97	0.18	1.00
11	2462	6.33	4.30	22.89	194.54	0.17	1.00

**Wireless LAN operated in IEEE 802.11g mode (Tx/Rx: 2400~2483.5MHz):**

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
1	2412	6.33	4.30	23.51	224.39	0.19	1.00
6	2437	6.33	4.30	27.19	523.60	0.45	1.00
11	2462	6.33	4.30	22.72	187.07	0.16	1.00

Wireless LAN operated in IEEE 802.11n HT-20 mode (Tx/Rx: 2400~2483.5MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
1	2412	6.33	4.30	23.48	222.84	0.19	1.00
6	2437	6.33	4.30	26.86	485.29	0.41	1.00
11	2462	6.33	4.30	21.94	156.31	0.13	1.00

Wireless LAN operated in IEEE 802.11n HT-40 mode (Tx/Rx: 2400~2483.5MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
3	2422	6.33	4.30	21.88	154.17	0.13	1.00
6	2437	6.33	4.30	24.70	295.12	0.25	1.00
9	2452	6.33	4.30	21.43	139.00	0.12	1.00

Wireless LAN operated in IEEE 802.11a mode (Tx/Rx: 5150~5250MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
36	5180	6.08	4.06	14.65	29.17	0.02	1.00
44	5220	6.08	4.06	14.39	27.48	0.02	1.00
48	5240	6.08	4.06	14.74	29.79	0.02	1.00

**Wireless LAN operated in IEEE 802.11n HT-20 mode (Tx/Rx: 5150~5250MHz):**

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
36	5180	6.08	4.06	14.43	27.73	0.02	1.00
44	5220	6.08	4.06	15.32	34.04	0.03	1.00
48	5240	6.08	4.06	16.41	43.75	0.04	1.00

Wireless LAN operated in IEEE 802.11n HT-40 mode (Tx/Rx: 5150~5250MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
38	5190	6.08	4.06	13.76	23.77	0.02	1.00
46	5230	6.08	4.06	16.89	48.87	0.04	1.00

Wireless LAN operated in IEEE 802.11a mode (Tx/Rx: 5250~5350MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
52	5260	6.08	4.06	17.78	59.98	0.05	1.00
60	5300	6.08	4.06	17.42	55.21	0.04	1.00
64	5320	6.08	4.06	16.73	47.10	0.04	1.00

Wireless LAN operated in IEEE 802.11n HT-20 mode (Tx/Rx: 5250~5350MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
52	5260	6.08	4.06	16.99	50.00	0.04	1.00
60	5300	6.08	4.06	17.52	56.49	0.05	1.00
64	5320	6.08	4.06	16.77	47.53	0.04	1.00

**Wireless LAN operated in IEEE 802.11n HT-40 mode (Tx/Rx: 5250~5350MHz):**

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
54	5270	6.08	4.06	15.39	34.59	0.03	1.00
62	5310	6.08	4.06	11.47	14.03	0.01	1.00

Wireless LAN operated in IEEE 802.11a mode (Tx/Rx: 5470~5725MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
100	5500	7.77	5.98	17.89	61.52	0.07	1.00
120	5600	7.77	5.98	16.85	48.42	0.06	1.00
140	5700	7.77	5.98	17.73	59.29	0.07	1.00

Wireless LAN operated in IEEE 802.11n HT-20 mode (Tx/Rx: 5470~5725MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
100	5500	7.77	5.98	17.99	62.95	0.07	1.00
120	5600	7.77	5.98	16.93	49.32	0.06	1.00
140	5700	7.77	5.98	17.77	59.84	0.07	1.00

Wireless LAN operated in IEEE 802.11n HT-40 mode (Tx/Rx: 5470~5725MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
102	5510	7.77	5.98	16.96	49.66	0.06	1.00
118	5590	7.77	5.98	17.09	51.17	0.06	1.00
134	5670	7.77	5.98	18.38	68.87	0.08	1.00

**Wireless LAN operated in IEEE 802.11a mode (Tx/Rx: 5725~5850MHz):**

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
149	5745	7.77	5.98	23.69	233.88	0.28	1.00
157	5785	7.77	5.98	23.50	223.87	0.27	1.00
165	5825	7.77	5.98	23.30	213.80	0.25	1.00

Wireless LAN operated in IEEE 802.11n HT-20 mode (Tx/Rx: 5725~5850MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
149	5745	7.77	5.98	23.76	237.68	0.28	1.00
157	5785	7.77	5.98	23.41	219.28	0.26	1.00
165	5825	7.77	5.98	23.18	207.97	0.25	1.00

Wireless LAN operated in IEEE 802.11n HT-40 mode (Tx/Rx: 5725~5850MHz):

Channel Number	Frequency (MHz)	Composite Antenna Gain (dBi)	Composite Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure (mW/cm ²)	Limit (mW/cm ²)
151	5755	7.77	5.98	23.47	222.33	0.26	1.00
159	5795	7.77	5.98	23.25	211.35	0.25	1.00

This device can pass RF exposure limit.