RF EXPOSURE REPORT

REPORT NO.: SA990903E02

MODEL NO.: AR5BUB173

FCC ID: PPD-AR5BUB173

ACCORDING: FCC Guidelines for Human Exposure

IEEE C95.1

APPLICANT: Atheros Communications, Inc.

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ISSUED BY: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory

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RF Exposure Measurement

1. Introduction

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC) calibrated for antenna measurement in our lab, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

2. RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	…	…	F/300	6
1500-100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	…	…	F/1500	30
1500-100,000	…	…	1.0	30

F = Frequency in MHz

3. Friis Formula

Friis transmission formula : $Pd = (Pout*G) / (4*pi*r^2)$

where
Pd = power density in mW/cm^2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
Pi = 3.1416
R = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, 1 mW/cm^2. If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance 20cm.

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

4. EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

5. Classification

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. So, this device is classified as **Mobile Device**

6. TEST RESULTS

6.1 Antenna Gain

There are four sets of antennas provided to the EUT, please refer to the following table:

Set	Antenna No.	Antenna Type	Gain (dBi)	Antenna Connector	Cable Length
Set 1	Antenna 1	PCB	3.3	IPEX	750mm
	Antenna 1	PCB	3.3	IPEX	750mm
Set 2	Antenna 2	PCB	4.41	IPEX	750mm
	Antenna 2	PCB	4.41	IPEX	750mm
Set 3	Antenna 3	PIFA	2.8	IPEX	350mm
	Antenna 3	PIFA	2.8	IPEX	350mm
Set 4	Antenna 4	PIFA	4.26	IPEX	750mm
	Antenna 4	PIFA	4.26	IPEX	750mm

6.2 Output Power Into Antenna & RF Exposure value at distance 20cm:

For antenna 1: PCB antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	112.2	0.048	1.0
6	2437	107.2	0.046	1.0
11	2462	107.2	0.046	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	109.6	0.047	1.0
6	2437	380.2	0.162	1.0
11	2462	229.1	0.097	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	85.1	0.036	1.0
6	2437	380.2	0.162	1.0
11	2462	213.8	0.091	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	64.6	0.027	1.0
4	2437	134.9	0.057	1.0
7	2452	117.5	0.050	1.0

For antenna 2: PCB antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	112.2	0.062	1.0
6	2437	107.2	0.059	1.0
11	2462	107.2	0.059	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	120.2	0.066	1.0
6	2437	380.2	0.209	1.0
11	2462	114.8	0.063	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	97.7	0.054	1.0
6	2437	380.2	0.209	1.0
11	2462	83.2	0.046	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	56.2	0.031	1.0
4	2437	134.9	0.074	1.0
7	2452	74.1	0.041	1.0

For antenna 3: PIFA antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	112.2	0.043	1.0
6	2437	107.2	0.041	1.0
11	2462	107.2	0.041	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	295.1	0.112	1.0
6	2437	380.2	0.144	1.0
11	2462	251.2	0.095	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	275.4	0.104	1.0
6	2437	380.2	0.144	1.0
11	2462	229.1	0.087	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	208.9	0.079	1.0
4	2437	275.4	0.104	1.0
7	2452	204.2	0.077	1.0

For antenna 4: PIFA antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	102.3	0.054	1.0
6	2437	107.2	0.057	1.0
11	2462	107.2	0.057	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	162.2	0.086	1.0
6	2437	380.2	0.202	1.0
11	2462	158.5	0.084	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	151.4	0.080	1.0
6	2437	380.2	0.202	1.0
11	2462	141.3	0.075	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	64.6	0.034	1.0
4	2437	208.9	0.111	1.0
7	2452	70.8	0.038	1.0

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