RF EXPOSURE REPORT

REPORT NO.: SA980610H03
MODEL NO.: MBR1200

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT : Cradlepoint, Inc

ADDRESS : 1199 Shoreline Lane, Suite 301 Boise, ID 83702

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

LAB LOCATION : No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan

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. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. So, this device is classified as **Mobile Device**

6. Test Results

6.1 Antenna Gain

There are two sets antennas provided to this EUT, please refer to the following table:

Set No.	Transmitter Circuit	Antenna Type	Antenna Gain (dBi)	Antenna Connector
Set 1	Chain(0)	PIFA	3.47654	NA
	Chain(1)			
Set 2	Chain(0)	Dipole	4.98	MMCX
	Chain(1)			

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

For Part 802.11b with PIFA:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	65.464	0.029	1.0
6	2437	139.316	0.062	1.0
11	2462	154.170	0.068	1.0

For Part 802.11g with PIFA:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	369.912	0.164	1.0
6	2437	629.476	0.279	1.0
11	2462	387.485	0.172	1.0

DRAFT 802.11n (20MHz) OFDM with PIFA:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	306.642	0.136	1.0
6	2437	521.073	0.231	1.0
11	2462	278.541	0.123	1.0

DRAFT 802.11n (40MHz) OFDM with PIFA:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	232.576	0.103	1.0
4	2437	682.232	0.302	1.0
7	2452	412.126	0.183	1.0

For Part 802.11b with Dipole:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	65.464	0.041	1.0
6	2437	139.316	0.087	1.0
11	2462	154.170	0.097	1.0

For Part 802.11g with Dipole:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	369.912	0.232	1.0
6	2437	629.476	0.394	1.0
11	2462	387.485	0.243	1.0

DRAFT 802.11n (20MHz) OFDM with Dipole:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	306.642	0.192	1.0
6	2437	521.073	0.326	1.0
11	2462	278.541	0.174	1.0

DRAFT 802.11n (40MHz) OFDM with Dipole:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	232.576	0.146	1.0
4	2437	682.232	0.427	1.0
7	2452	412.126	0.258	1.0

With 3.5G Card: KPC650 (Gain: 0dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW) (EIRP)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
777	848.31	338.844	0.067	0.5655

NOTE: Limit of power density = 848.31 (MHz) / 1500 = 0.5655

With 3.5G Card: AirCard 875U (Gain: 0dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW) (EIRP)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
25	1850.25	1023.293	0.204	1.0

With 3.5G Card: AirCard 597E (Gain: 1.3dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW) (EIRP)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
384	836.5	478.630	0.095	0.5577

NOTE: Limit of power density = 8436.5 (MHz) / 1500 = 0.5577

CONCLUSION:

Both of the WLAN and WCDMA can transmit simultaneously, the formula of calculated the MPE is:

$CPD_1 / LPD_1 + CPD_2 / LPD_2$ + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.204 / 1 + 0.427 / 1 = 0.631, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.