FCC RF EXPOSURE REPORT

FCC ID: QIS-AR1220WIFI

Issued Date : **Apr. 24, 2012**

Project No. : **1204C181**

Equipment : **Access Router**

Model Name : **AR1220VW; AR1220W; AR1220W-S**

Applicant : **Huawei Technologies Co., Ltd.**

Address : **Bantian, Longgang District, Shenzhen China**

Manufacturer : **Huawei Technologies Co., Ltd.**

Address : **Administration Building, Huawei Base, Bantian, Longgang District ,Shenzhen 518129, P.R. China**

According: : **FCC Guidelines for Human Exposure IEEE C95.1**

Neutron Engineering Inc.

No.3, Jinshagang 1st Road, ShiXia, Dalang Town, Dong Guan, China.
TEL : (0769) 8318-3000 FAX : (0769) 8319-6000

RF Exposure Measurement (Mobile Device)

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 ADT Report No.SA110725C08) for WIFI, 3G Modular HUAWEI Report No. 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	6
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

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 r.

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

FOR WLAN FUNCTION:

The maximum Gain measured in Fully Anechoic Chamber is 2.15dBi or 1.734 (numeric).

FOR CDMA FUNCTION:

CDMA 850: Since the maximum erp power is used, so the Gain of the antenna can be assumed as 4.28dBi or 2.68 (numeric).

CDMA 1900: Since the maximum eirp power is used, so the Gain of the antenna can be assumed as 3dBi or 2.0 (numeric).

NOTE: The power as above refers to the FCC part 22 / 24 report of FCC ID: QISEM820W.

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

WLAN 802.11b:

FREQUENCY BAND (MHz)	MAX POWER (mW)	ANTENNA GAIN (mW)	DISTANCE (cm)	POWER DENSITY (mW/cm^2)	LIMIT (mW/cm^2)
2412-2462	73.6	5.2	20	0.048	1.00

Directional gain=gain antenna element+10log(# of TX antenna elements)
Effective Legacy Gain(dBi)=5.2

WLAN 802.11g:

FREQUENCY BAND (MHz)	MAX POWER (mW)	ANTENNA GAIN (mW)	DISTANCE (cm)	POWER DENSITY (mW/cm^2)	LIMIT (mW/cm^2)
2412-2462	788.4	5.2	20	0.519	1.00

Directional gain=gain antenna element+10log(# of TX antenna elements)
Effective Legacy Gain(dBi)=5.2

WLAN 802.11n (20MHz):

FREQUENCY BAND (MHz)	MAX POWER (mW)	ANTENNA GAIN (mW)	DISTANCE (cm)	POWER DENSITY (mW/cm^2)	LIMIT (mW/cm^2)
2412-2462	824.2	2.15	20	0.269	1.00

WLAN 802.11n (40MHz):

FREQUENCY BAND (MHz)	MAX POWER (mW)	ANTENNA GAIN (mW)	DISTANCE (cm)	POWER DENSITY (mW/cm^2)	LIMIT (mW/cm^2)
2422-2452	520.3	2.15	20	0.170	1.00

6.3 Technical Description EM820W

Technical Specification:

Cellular Band

Power at antenna connector BTS: 34.65 dBm(GSM850)/25.00dBm(WCDMA850)
Antenna-cable attenuation: 0 dB
Input power to antenna: 34.65 dBm（2.92W）(GSM850)/ 25.00 dBm（0.32W）

(WCDMA850)
Antenna gain: 4.28 dBi (2.68)

PCS Band

Power at antenna connector BTS: 31.98 dBm(GSM1900)/ 26.47 dBm(WCDMA1900)
Antenna-cable attenuation: 0 dB
Input power to antenna: 31.98 dBm （1.58W）(GSM1900)/ 26.47 dBm（0.443W）

(WCDMA1900)
Antenna gain:3dBi (2.0)

6.4 Estimation of compliance boundary for indoor antenna

1) Cellular Band :

GSM850
For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary should be rather more conservative and on the safe side.
For EUT the following compliance boundary is calculated:

Compliance boundary
For GSM 850MHz band:
When r=20cm and GSM only use one timeslot, so

$$S_{\text{one timeslot}} = \frac{P(W) * G_{numeric}}{8 * 4 * r^2(m) * \pi}$$

$$S_{\text{one timeslot}} = \frac{2920 * 2.68}{8 * 4 * 20^2 * \pi} = 0.195 \text{ mW/cm}^2$$

For GPRS and EDGE, the transmitter support multi-timeslot, but the conducted ERP will decrease 2dB when add one uplink timeslot, so we can get the following conclusion:
The power(dB) decrease 2dB, the power(W) should be divide by 1.58($10^{2/10}$)

Uplink timeslot	Output Power(W)	duty cycle
1	P	0.125
2	P/1.58	0.25
3	P/2.51	0.375
4	P/4	0.5

Note: we assume the output power of GPRS which with one uplink is P(W)

For two timeslot（which duty cycle is 0.25）:

$$S_{\text{two timeslot}}=\frac{P/1.58*G}{8*r^2*\pi}*2 = S_{\text{one timeslot}}*2/1.58=1.27\ S_{\text{one timeslot}}$$

For three timeslot（which duty cycle is 0.375）:

$$S_{\text{three timeslot}}=\frac{P/2.51*G}{8*r^2*\pi}*3 = S_{\text{one timeslot}}*3/2.51=1.2\ S_{\text{one timeslot}}$$

For four timeslot（which duty cycle is 0.5）:

$$S_{\text{two timeslot}}=\frac{P/4*G}{8*r^2*\pi}*4 = S_{\text{one timeslot}}*4/4= S_{\text{one timeslot}}$$

The two timeslot's S is the biggest. And it is same in EDGE.

S_{max}=1.27 $S_{\text{one timeslot}}$=0.248 mW/cm^2< 0.55 mW/cm^2

Because the EDGE's output power is smaller than the GRPS's output power, so here the calculation is abbreviated.

WCDMA850
For EUT the following compliance boundary is calculated:

$$S=\frac{320*2.68}{4*20^2*\pi}=\mathbf{0.171\ mW/cm^2}<0.55\ \mathbf{mW/cm^2}$$

Because the HSDPA's output power is smaller than the WCDMA's output power, so here the calculation is abbreviated.

2) PCS Band

GSM1900
For EUT the following compliance boundary is calculated:

$$S = \frac{1580 * 2}{8 * 4 * 20^2 * \pi} = 0.078 \text{ mW/cm}^2$$

S_{max}=1.27 $S_{one\ timeslot}$ =0.099mW/cm^2< 1 mW/cm^2

WCDMA1900
For EUT the following compliance boundary is calculated:

$$S = \frac{443 * 2}{4 * 20^2 * \pi} = \mathbf{0.173\ mW/cm^2} < 1 \text{ mW/cm}^2$$

The S at the position which is 20cm far from the EUT is smaller than the uncontrolled exposure limit line. So the EUT also complies with the Limits for Occupational/Controlled Exposure.

CONCULSION:

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

$CPD_1 / LPD_1 + CPD_2 / LPD_2 + \ldots\ldots etc. < 1$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.52 / 1+ 0.195 / 0.549 = 0.87519, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.