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# RF EXPOSURE REPORT

**REPORT NO.:** SA990415E05

**MODEL NO.:** MAX-207HW2R, IX280P-5-1420JMDL-A,  
MAX-207HW2R1, MAX-207HW2R2,  
MAX-207HW2R3, MAX-207HW2R4

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

**APPLICANT:** ZyXEL Communications Corporation

**ADDRESS:** No. 6, Innovation Road II, Science-Park, Hsin-Chu,  
300, Taiwan

**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 <sup>2</sup> )	Average Time (minutes)
<b>(A)Limits For Occupational / Control Exposures</b>				
300-1500	...	...	F/300	6
1500-100,000	...	...	5	6
<b>(B)Limits For General Population / Uncontrolled Exposure</b>				
300-1500	...	...	F/1500	30
1500-100,000	...	...	1.0	30

F = Frequency in MHz

### 3. FRIIS FORMULA

Friis transmission formula :  $P_d = (P_{out} * G) / (4 * \pi * r^2)$

where

$P_d$  = power density in  $mW/cm^2$

$P_{out}$  = 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

$P_d$  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 client enabled the EUT to transmit and receive data at specific channel frequencies 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 **Temporary Fixed Device**

## 6. TEST RESULTS

### 6.1 Antenna Gain

The antennas provided to this EUT, please refer to the following table:

#### For WiMAX:

Antenna	Antenna Type	Antenna Connector	Gain (dBi)	Cable loss (dB)	Net Gain (dBi)	Cable Length (cm)	Frequency range (MHz)	Diversity Function
1	Dipole	I-PEX	6.7	0.5	6.2	29	2500~2700	YES
2	Dipole	I-PEX	6.7	0.5	6.2	29	2500~2700	YES

#### For Wi-Fi:

Antenna Type	Antenna Connector	Antenna Gain (dBi)	Cable loss(dB)	Net Gain (dBi)	Cable Length (cm)	Frequency range (MHz)	Diversity Function
PIFA	I-PEX	1.6	0.5	1.1	15	2400~2483	N/A

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

#### For WiMAX:

##### CHANNEL BANDWIDTH: 5MHz

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
Low	2505	489.779	0.406	1.0
Middle	2590	457.088	0.379	1.0
High	2685	436.516	0.362	1.0

##### CHANNEL BANDWIDTH: 10MHz

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
Low	2505	426.580	0.354	1.0
Middle	2590	407.380	0.338	1.0
High	2685	467.735	0.388	1.0

**For Wi-Fi:  
802.11b**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	102.3	0.026	1.0
6	2437	134.9	0.035	1.0
11	2462	102.3	0.026	1.0

**802.11g:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	257.0	0.066	1.0
6	2437	275.4	0.071	1.0
11	2462	263.0	0.067	1.0

**CONCLUSION:**

Both of the WiMAX and Wi-Fi can transmit simultaneously, the formula of calculated the MPE is:

$$CPD_1 / LPD_1 + CPD_2 / LPD_2 + \dots \text{etc.} < 1$$

**CPD = Calculation power density**

**LPD = Limit of power density**

Therefore, the worst-case situation is  $0.406 / 1 + 0.071 / 1 = 0.477$ , which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

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