



# RF EXPOSURE REPORT

**REPORT NO.:** SA971002H04

**MODEL NO.:** NWD672NU

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

**APPLICANT:** ZyXEL Communications Corporation

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**ISSUED BY:** Bureau Veritas Consumer Products Services (H.K.)  
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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 ADT, 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	6
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 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

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

No	Model No.	Antenna Gain	For 2.4GHz Gain (dBi)	For 5.15~ 5.25GHz Gain (dBi)	For 5.725~ 5.850GHz Gain (dBi)	Antenna Type	Connector
1	C034-510656-A (SSR-72241)	Gain (dBi)	3.66	2.61	2.91	Dipole	SMA Plug Reverse
		Cable Loss (dB)	1.18	2.06	2.56		
		Net Gain (dB)	2.48	0.55	0.35		
2	N2480-100C	Gain (dBi)	6.00	5.10	8.00	Monopoles with reflectors	I-PEX
		Cable Loss (dB)	1.00	1.00	1.00		
		Net Gain (dB)	5.00	4.10	7.00		

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

**For 15.247(2.4GHz) :**

**Antenna 1**

**For Part 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	84.528	0.030	1.0
6	2437	93.325	0.033	1.0
11	2462	97.724	0.034	1.0

**For Part 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	196.789	0.069	1.0
6	2437	183.231	0.065	1.0
11	2462	190.985	0.067	1.0

**DRAFT 802.11n (20MHz) OFDM**

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	366.98	0.129	1.0
6	2437	406.53	0.143	1.0
11	2462	226.51	0.080	1.0

**DRAFT 802.11n (40MHz) OFDM**

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	2422	326.03	0.115	1.0
4	2437	340.42	0.120	1.0
7	2452	329.18	0.116	1.0

**Antenna 2**  
**For Part 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	84.528	0.053	1.0
6	2437	93.325	0.059	1.0
11	2462	97.724	0.061	1.0

**For Part 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	196.789	0.124	1.0
6	2437	183.231	0.115	1.0
11	2462	190.985	0.120	1.0

**DRAFT 802.11n (20MHz) OFDM**

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	366.98	0.231	1.0
6	2437	406.53	0.256	1.0
11	2462	226.51	0.143	1.0

**DRAFT 802.11n (40MHz) OFDM**

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	2422	326.03	0.205	1.0
4	2437	340.42	0.214	1.0
7	2452	329.18	0.207	1.0

**For 15.247(5GHz) :**

**Antenna 1**

**For Part 802.11a:**

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	5745	578.096	0.125	1.0
3	5785	553.350	0.119	1.0
5	5825	547.016	0.118	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

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	5745	467.79	0.101	1.0
3	5785	484.55	0.104	1.0
5	5825	473.24	0.102	1.0

**DRAFT 802.11n (40MHz) OFDM**

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	5755	499.70	0.108	1.0
2	5795	540.28	0.117	1.0

**Antenna 2**
**For Part 802.11a:**

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	5745	578.096	0.576	1.0
3	5785	553.350	0.552	1.0
5	5825	547.016	0.545	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

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	5745	467.79	0.466	1.0
3	5785	484.55	0.483	1.0
5	5825	473.24	0.472	1.0

**DRAFT 802.11n (40MHz) OFDM**

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	5755	499.70	0.498	1.0
2	5795	540.28	0.539	1.0



**For 15.407(5GHz) :**

**Antenna 1**

**For Part 802.11a:**

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	5180	15.276	0.003	1.0
2	5200	15.996	0.004	1.0
4	5240	16.255	0.004	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

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	5180	28.20	0.006	1.0
2	5200	25.27	0.006	1.0
4	5240	26.02	0.006	1.0

**DRAFT 802.11n (40MHz) OFDM**

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	5190	23.16	0.005	1.0
2	5230	45.92	0.010	1.0

**Antenna 2**
**For Part 802.11a:**

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	5180	15.276	0.008	1.0
2	5200	15.996	0.008	1.0
4	5240	16.255	0.008	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

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	5180	28.20	0.014	1.0
2	5200	25.27	0.013	1.0
4	5240	26.02	0.013	1.0

**DRAFT 802.11n (40MHz) OFDM**

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	5190	23.16	0.012	1.0
2	5230	45.92	0.023	1.0