

Maximum Permissible Exposure (MPE) Evaluation Report

Report No. : TS08090052-EME
Model No. : NBG-460NH, X-550NH,
NBG-460N, X-550N
Issued Date : Sep. 19, 2008

Applicant: ZyXEL Communications Corporation.
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**Test Method/ FCC 1.1310 and Safety Cord 6
Standard:**

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Table of Contents

Summary of Tests 3

1. Introduction 4

2. RF Exposure Limit 4

3. RF Exposure calculations 5

4. Test results 6



Summary of Tests

MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-1999 and IC Safety Code 6

**High-gain Wireless N Gigabit Router -Model: NBG-460NH
FCC ID: I88X550NHV2**

Test	Reference	Results
MPE Evaluation	FCC Guidelines for Human Exposure IEEE C95.1 and IC Safety Code 6	Complies

The customer confirmed the models listed as below are series model to model NBG-460NH (EUT), the difference between main model and series model are listed as below.

Model Number

NBG-460NH

X-550NH

NBG-460N

X-550N

Different

Collocated with 6dBi antenna

Same as NBG-460NH

Collocated with 1.8dBi antenna

Same as NBG-460N

1. Introduction

The EUT operates in the 2.4GHz ISM band. Due to the EUT (include antenna) at its normal operation distance is at least 20 cm from the human body, the EUT was defined as a Mobile Device.

The reason to do the MPE Evaluation is to avoid the RF hazard to human body. The maximum output power and gain of the antenna were used to calculate the limited Power density (S) at 20cm distance away from the product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and Safety Cord 6 are followed.

According to 1.1307 (b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

2. RF Exposure Limit

For FCC:

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				
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
(B) Limits for General Population / Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30

F= Frequency in MHz

For IC:

Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers
(Including the General Public)

Frequency Range (MHz)	Electric Field Strength; rms (V/m)	Magnetic Field Strength; rms (A/m)	Power Density (W/m ²)	Average Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	30
300-1500	1.585f ^{0.5}	0.0042f ^{0.5}	F/150	30
1500-15000	61.4	0.163	10	30
15000-150000	61.4	0.163	10	616000/f ^{1.2}
150000-300000	0.158 f ^{0.5}	4.21 × 10 ⁻⁴ f ^{0.5}	6.67 × 10 ⁻⁵ f	616000/f ^{1.2}

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.

2. A power density of 10W/m² is equivalent to 1 mW/cm².

3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

3. RF Exposure calculations

From §FCC 1.1310 table 1 and §Safety Code 6 table 5, the maximum permissible RF exposure for an uncontrolled environment is 1mW/(cm²) (or 10 W/m²)*

* 10 W/m² = 1mW/ (cm²)

Power density (S) is calculated by the following formula:

$$S = (P * G)/4\pi R^2$$

where, S = Power density (mW/cm²)

P = Output power to antenna (mW)

R = Distance between radiating structure and observation point (cm)

G = Gain of antenna in numeric

π = 3.1416

Example:

Assume a mobile device operates at 2412MHz and its maximum output power is 50mW, and the maximum gain of antenna is 1 (numeric) /0dBi.

then the power density (S) = (50 * 1)/4*π*20² = 0.00995 (mW/cm²) (or = 0.0995 W/m²)

4. Test results

Test Mode: 802.11b mode

Channel	Channel Frequency (MHz)	Maximum antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
1 (lowest)	2412	3.98	298.90	0.236990067	1.0
6 (middle)	2437	3.98	287.00	0.227368420	1.0
11 (highest)	2462	3.98	289.12	0.228944463	1.0

Test Mode: 802.11g mode

Channel	Channel Frequency (MHz)	Maximum antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
1 (lowest)	2412	3.98	851.67	0.674109030	1.0
6 (middle)	2437	3.98	963.42	0.763361310	1.0
11 (highest)	2462	3.98	959.21	0.759853984	1.0

Test Mode: 802.11n HT20 mode

Channel	Channel Frequency (MHz)	Maximum antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
1 (lowest)	2412	3.98	685.43	0.542912880	1.0
6 (middle)	2437	3.98	968.46	0.766884826	1.0
11 (highest)	2462	3.98	804.49	0.637867015	1.0

Test Mode: 802.11n HT40 mode

Channel	Channel Frequency (MHz)	Maximum antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
3 (lowest)	2422	3.98	180.02	0.142472205	1.0
6 (middle)	2437	3.98	384.50	0.304600172	1.0
9 (highest)	2452	3.98	174.94	0.138589442	1.0

The Notice in Installation Manual has been stated as below:

While installing and operating this transmitter, the radio frequency exposure limit of 1mW/ (cm²) may be exceeded at distances close to the transmitter. therefore, the user must maintain a minimum distance of 20 cm from the device at all time.