

Maximum Permissible Exposure (MPE) Evaluation Report

Report No. : TS12040196-EME
Model No. : NBG-419N v2
Issued Date : Apr. 23, 2012

Applicant: ZyXEL Communications Corporation
6, Innovation Rd II, Science-Based Industrial Park, Hsin-Chu,
Taiwan

Test Method/ Standard: FCC 1.1310 and Safety Code 6

Test By: Intertek Testing Services Taiwan Ltd.
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,
Shiang-Shan District, Hsinchu City, Taiwan

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The test report was prepared by: Sign on File
Jill Chen / Assistant

These measurements were taken by: Sign on File
Hugo Yeh / Engineer

The test report was reviewed by:

Name Jimmy Yang
Title Engineer



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Summary of Tests

**MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-2005 and IC
Safety Code 6**

**Wireless N NetUSB Router -Model: NBG-419N v2
FCC ID: I88NBG-419NV2**

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

1. Introduction

The EUT operates in the 2.4 GHz 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 20 cm distance away from the product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and Safety Code 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

According to FCC 1.1310 and Safety Code 6: 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

3. RF Exposure calculations

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

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

$\pi = 3.1416$

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) = $(50 * 1) / 4 * \pi * 20^2 = 0.00995$ (mW/cm²) (or = 0.0995 W/m²)

4. Description of EUT

The EUT is Wireless N NetUSB Router, and was defined as information technology equipment.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"

4.1 Antenna description

1. Invax 2 dBi Antenna

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 2 dBi
Antenna Type : Dipole antenna
Connector Type : SMA reverse

2. SAYTEC 2 dBi Antenna

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 2 dBi
Antenna Type : Dipole antenna
Connector Type : SMA reverse

3. Invax 5 dBi Antenna

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 5 dBi
Antenna Type : Dipole antenna
Connector Type : SMA reverse

5. Test results

1. Antenna : Invax 2 dBi

Mode	Channel Frequency (MHz)	Antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
802.11b	2412	1.58	55.34	0.017447377	1.0
	2437	1.58	133.05	0.041949824	1.0
	2462	1.58	69.82	0.022015581	1.0
802.11g Chain 0	2412	1.58	137.40	0.043324159	1.0
	2437	1.58	174.18	0.054919951	1.0
	2462	1.58	85.11	0.026836764	1.0
802.11g Chain 1	2412	1.58	193.64	0.061056252	1.0
	2437	1.58	182.81	0.057640819	1.0
	2462	1.58	125.31	0.039512103	1.0
802.11n HT20	2412	1.58	22.15	0.006983994	1.0
	2437	1.58	22.62	0.007132187	1.0
	2462	1.58	20.64	0.006507885	1.0
802.11n HT40	2422	1.58	18.06	0.005694399	1.0
	2437	1.58	21.88	0.006898862	1.0
	2452	1.58	18.19	0.005735389	1.0

2. Antenna : SAYTEC 2 dBi

Mode	Channel Frequency (MHz)	Antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
802.11b	2412	1.58	69.34	0.021864026	1.0
	2437	1.58	120.50	0.037995323	1.0
	2462	1.58	50.23	0.015839087	1.0
802.11g Chain 0	2412	1.58	200.91	0.063347597	1.0
	2437	1.58	176.60	0.055683964	1.0
	2462	1.58	84.92	0.026775041	1.0
802.11g Chain 1	2412	1.58	171.79	0.054166421	1.0
	2437	1.58	212.32	0.066946850	1.0
	2462	1.58	131.83	0.041565226	1.0
802.11n HT20	2412	1.58	23.70	0.007472716	1.0
	2437	1.58	22.94	0.007233085	1.0
	2462	1.58	20.04	0.006318702	1.0
802.11n HT40	2422	1.58	17.45	0.005502063	1.0
	2437	1.58	22.40	0.007062820	1.0
	2452	1.58	19.89	0.006271406	1.0

3. Antenna : Invax 5 dBi

Mode	Channel Frequency (MHz)	Antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
802.11b	2412	3.16	51.17	0.032190680	1.0
	2437	3.16	90.36	0.056849958	1.0
	2462	3.16	72.78	0.045785730	1.0
802.11g Chain 0	2412	3.16	114.29	0.071900208	1.0
	2437	3.16	151.36	0.095220431	1.0
	2462	3.16	117.49	0.073914585	1.0
802.11g Chain 1	2412	3.16	126.18	0.079383482	1.0
	2437	3.16	160.32	0.100862597	1.0
	2462	3.16	106.41	0.066946850	1.0
802.11n HT20	2412	3.16	21.01	0.013217709	1.0
	2437	3.16	22.44	0.014117344	1.0
	2462	3.16	20.28	0.012758455	1.0
802.11n HT40	2422	3.16	18.22	0.011462478	1.0
	2437	3.16	22.02	0.013853116	1.0
	2452	3.16	17.85	0.011229705	1.0

The Notice in Installation Manual has been stated as below:

While installing and operating this transmitter, the radio frequency exposure limit of 1 mW/(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.