

Maximum Permissible Exposure (MPE) Evaluation Report

Report No. : TS10100037-EME
Model No. : WR5205G
Issued Date : May 09, 2011

Applicant: AboCom System, Inc.
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Test Method/ Standard: FCC 1.1310

Test By: Intertek Testing Services Taiwan Ltd.
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Summary of Tests

MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-2005

**Wireless 11n Giga Router -Model: WR5205G
FCC ID: MQ4WR5205G**

Test	Reference	Results
MPE Evaluation	FCC Guidelines for Human Exposure IEEE C95.1	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: 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 a Wireless 11n Giga 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) Antenna 1

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) Antenna 2

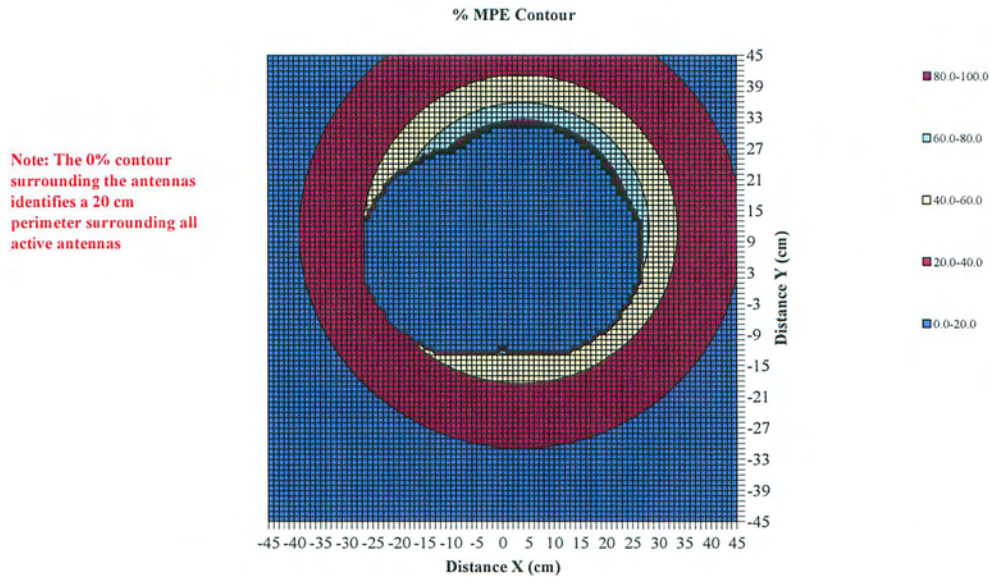
The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

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

5. Test results

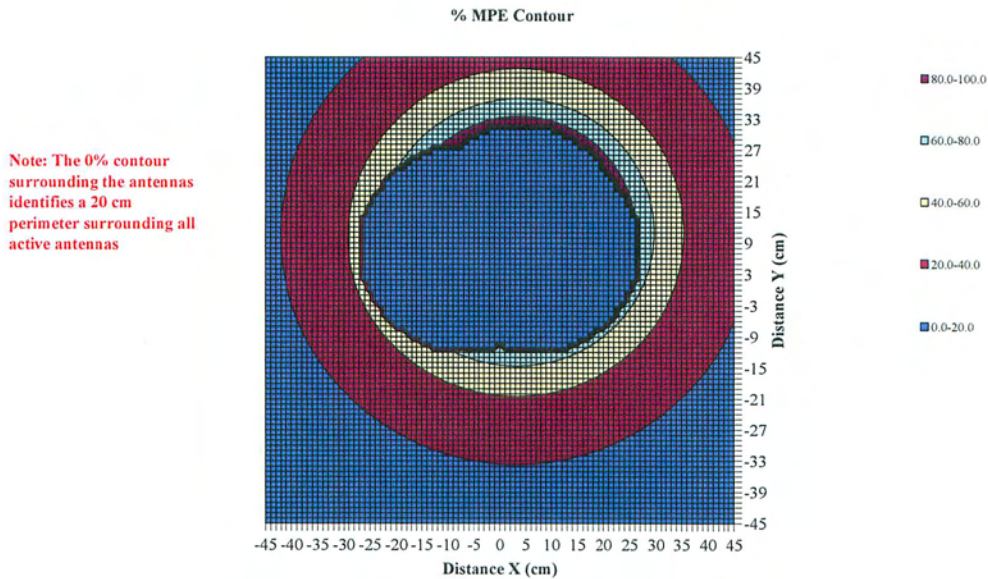
Antenna 1

Antenna No.		Total	1	2	3	4	5	6
Tx Status			On	On	On	Off	Off	Off
Frequency	MHz		850	2450	2450	2450	2450	5800
MPE Limit	mW/cm ²		0.57	1.00	1.00	0.00	0.00	0.00
Max % MPE	%	86.2	77.8	5.0	6.4	0.0	0.0	0.0
Power	(W)	2.122	1.760	0.159	0.203	0.000	0.000	0.000
Antenna Gain	dBi		1.00	2.00	2.00	5.00	5.00	1.00
EIRP	(W)	2.79	2.216	0.252	0.321	0.000	0.000	0.000
X	(cm)		4.0	-7.0	7.0	-6.0	6.0	8.0
Y	(cm)		12.0	7.0	7.0	8.0	8.0	0.0
Sector			FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Arc			FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
θ_1	degs	input	180	180	180	0.001	0.001	0.001
θ_2			179	179	179	0.001	0.001	0.001
θ_1	degs	actual	180	180	180	0	0	0
θ_2			179	179	179	-180	-180	-180



Antenna 2

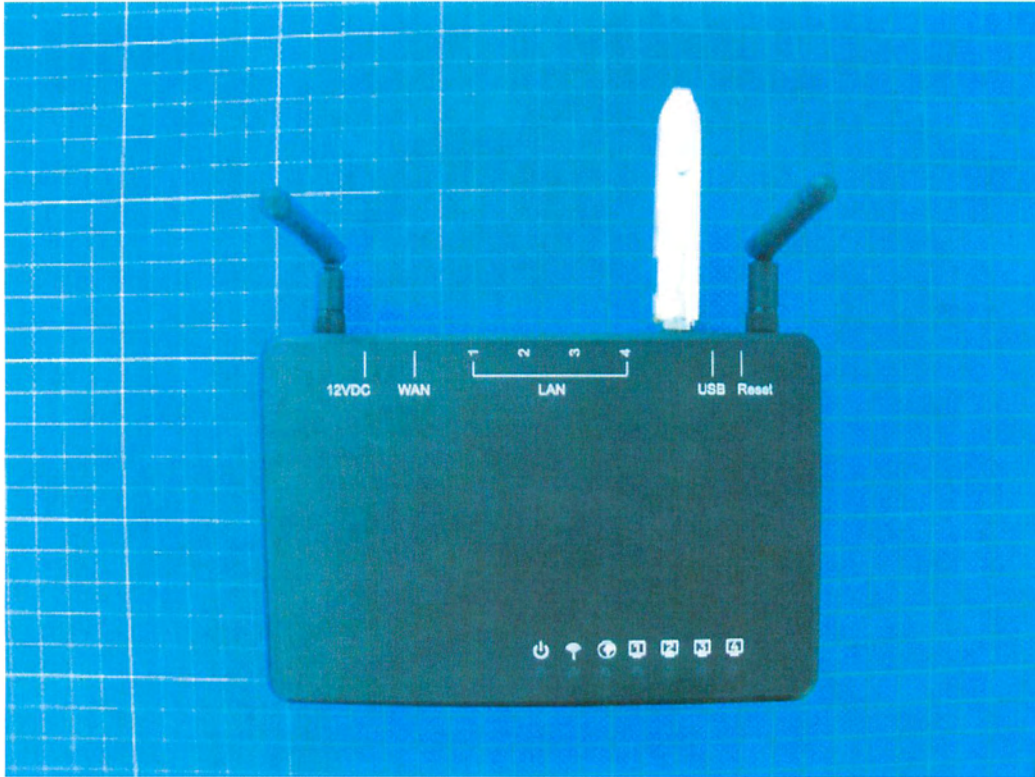
Antenna No.		Total	1	2	3	4	5	6
Tx Status			On	On	On	Off	Off	Off
Frequency	MHz		850	2450	2450	2450	2450	5800
MPE Limit	mW/cm ²		0.57	1.00	1.00	0.00	0.00	0.00
Max % MPE	%	95.9	77.8	10.0	12.8	0.0	0.0	0.0
Power	(W)	2.122	1.760	0.159	0.203	0.000	0.000	0.000
Antenna Gain	dBi		1.00	5.00	5.00	5.00	5.00	1.00
EIRP	(W)	3.36	2.216	0.502	0.641	0.000	0.000	0.000
X	(cm)		4.0	-7.0	7.0	-6.0	6.0	8.0
Y	(cm)		12.0	8.0	8.0	8.0	8.0	0.0
Sector			FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Arc			FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
θ ₁	degs	input	180	180	180	0.001	0.001	0.001
θ ₂			179	179	179	0.001	0.001	0.001
θ ₁	degs	actual	180	180	180	0	0	0
θ ₂			179	179	179	-180	-180	-180



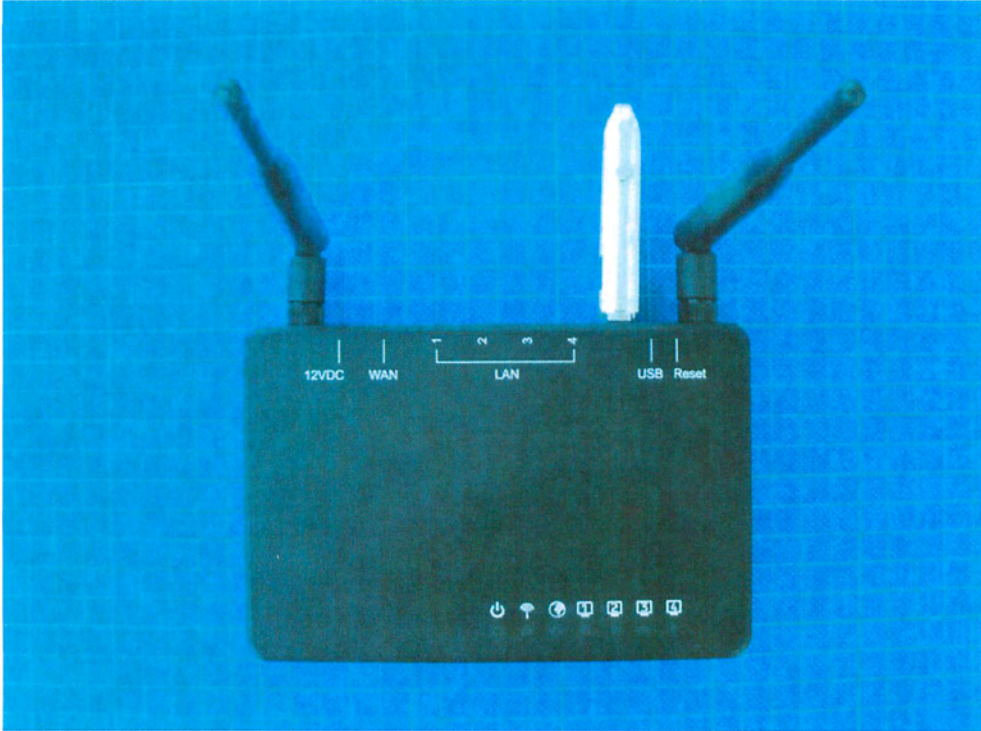
The Notice in Installation Manual has been stated as below:
 While installing and operating this transmitter, the radio frequency exposure limit of 1 mW/ (cm²) may be exceeded at distances close to the transmitter. Therefore, the user must maintain a minimum distance of 20 cm from the device at all time.

6. Set-up Photo

Antenna 1



Antenna 2



Annex

3G USB Router Co-located with WR5205G

Applicant Name: Huawei Technologies Co., Ltd.

Model: E169

FCC ID: QISE169



Maximum Permissible Exposure (MPE) Estimation for E169/E169G

1 Introduction

HUAWEI E169/E169G HSDPA/UMTS/EDGE/GPRS/GSM dual mode 4 BAND USB Stick is subscriber equipment in the UMTS/GSM system. The WCDMA frequency is Band I and Band VIII. The GSM/GPRS/EDGE frequency band includes GSM850, EGSM900, DCS1800 and PCS1900, E169/E169G implements such functions as RF signal receiving/transmitting, HSDPA/WCDMA and EDGE/GPRS/GSM protocol processing, data service etc. Externally it provides USB interface (to connect to the notebook etc.), USIM card interface and antenna interface. E169/E169G has an internal antenna as default.

E169G is the USB stick which changes some component from E169.

The PCB and antenna are the same.

The differences between E169 and E169G are:

1. E169 support WCDMA band 8. E169G do not support and clear the WCDMA 900M component on the PCB.
2. E169 supports TF card and external antenna. E169G do not supports the external interface and the TF interface.

There are 3 kind of external color for both of them. They are silver, white and black.

2 Limits and Guidelines on Exposure to Electromagnetic Fields

According to the FCC Part 2.1091, we know: mobile device (transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitters radiating structure(s) and the body of the user or nearby persons). And the Cellular radiotelephone service and PCS services are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more. The radiated power of 850M/1900M for E169/E169G is 2W/1W, so for E169/E169G only the 850M band is need to be subjected to routine the environmental evaluation for RF exposure.

Uncontrolled limits are used for general public. General population/uncontrolled exposure apply in situations is which the general public may be exposed, or in which persons that

are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure. The exposure levels can be expressed in terms of power density, electric field strength, or magnetic field strength, as averaged over 30 minutes for the general public and 6 minutes for trained personnel. The exposure criterion is frequency dependent, and a chart covering the range from 3 kHz to 100 GHz can be found in NCRP No.86 (references IEEE C95.1-1999).

Below are the limits.

Limits for Occupational/Controlled Exposure			
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)
0.003-0.1	614	163	(100)*
0.1-3.0	614	16.3/f	(100)*
3.0-30	1842/f	16.3/f	(900/f ²)*
30-100	61.4	16.3/f	1.0
100-300	61.4	0.163	1.0
300-3000	--	--	f/300
3000-15,000	--	--	10
15,000-100,000	--	--	10

Limits for General Population/Uncontrolled Exposure			
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)
0.003-0.1	614	163	(100)*
0.1-1.34	614	16.3/f	(100)*
1.34-3.0	823.8/f	16.3/f	(180/f ²)*
3.0-30	823.8/f	16.3/f	((180/f ²))*
30-100	27.5	158.3 / f1.668	0.2
100-300	27.5	0.0729	0.2
300-3000	--	--	f/1500
3000-15,000	--	--	f/1500
15,000-100,000	--	--	10

Power density S [mW/cm²] for controlled area at 850 MHz , (TX: 824MHz – 849MHz)

$$S = \frac{f(\text{MHz})}{300} = \frac{824}{300} = 2.75 \text{ mW/cm}^2$$

Power density S [mW/cm²] for uncontrolled area at 850 MHz



$$S = \frac{f(\text{MHz})}{1500} = \frac{824}{1500} = 0.55 \text{ mW/cm}^2$$

$$S = 0.55 \text{ mW/cm}^2 = 5.5 \text{ W/m}^2 \text{ for uncontrolled exposure}$$

Reference levels are provided for exposure assessment to determine whether the basic restrictions on exposure of humans to electromagnetic fields are exceeded. The basic restrictions on exposure to electromagnetic fields are based directly on established health effects and biological considerations.

3 Location of EUT

The EUT uses one monopole antenna. The source of the radiation is mounted on terminal; generally the direction of the antenna position is uprightness tabletop. The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

4 Prediction of the Exposure to Electromagnetic Fields

Calculations can be made on a site by site basis to ensure the power density is below the limits given above, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning. The calculations are based on FCC OET 65 Appendix B.

4.1 Calculation of the Safe Distance

Below method describes a theoretical approach to calculate possible exposure to electromagnetic radiation around a base station transceiver antenna. Precise statements are basically only possible either with measurements or complex calculations considering the complexity of the environment (e.g. soil conditions, near buildings and other obstacles) which causes reflections, scattering of electromagnetic fields.

The maximum output power (given in EIRP) of a base station is usually limited by license conditions of the network operator.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation. The calculations are based on FCC OET 65 Appendix B.

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

Whereas:



P = Maximum output power in W of the site

G numeric = Numeric gain of the antenna relative to isotropic antenna

R = distance between the antenna and the point of exposure in meters

4.2 Technical Description E169/E169G

Technical Specification:

Output power:	2W (33 dBm) for GSM850MHz
Transmitter frequency band	GSM850
Number of antenna ports:	1
Frequency range:	850M: Uplink:824 M~849M; Downlink:869 M~894M
Gain:	<1dBi (GSM850)
Mechanical specification (Height)	19.2mm for GSM850

4.3 Estimation of compliance boundary for indoor antenna

GSM 850M:

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:

Power at antenna connector BTS: **32.54 dBm**

Antenna-cable attenuation: **0 dB**

Input power to antenna: **32.54 dBm (1.76W)**

Antenna gain: **1 dBi (1.26)**

Compliance boundary

For GSM 850MHz band:

When r=20cm

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$



$$S = \frac{1.76 * 1.26}{4 * 0.2^2 * \pi} = 4.41 \text{ W/m}^2 < 5.5 \text{ W/m}^2$$

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.