FCC Maximum Permissible Exposure(MPE) Estimation Report

Product Name: LTE CPE

Model: B593u-12

Report No.: SYBH(Z-SAR)007052012-2

FCC ID: QISB593U-12

	APPROVED	CHECKED	PREPARED
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DATE	2012-05-23	2012-05-23	2012-05-23

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※ ※ Modified History ※ ※

REV.	DESCRIPTION	ISSUED	REMARK
Rev.1.0	Initial Test Report Release	2012-05-11	Yang Hang
Rev.1.1	Modified base on TCB reviewer's comment as belows. 1. Change the title of the Table in section 8.2 on Page 10 2. Change the calculation equation and result in section 9 from Page 12 to Page 13	2012-05-23	Yang Hang

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1 EUT Description

Device Information：			
DUT Name:	B593u-12		
Type Identification:	LTE CPE		
IMEI No:	N4Y7NA1231500057		
Device Type :	Fixed device		
Exposure Category:	Uncontrolled environment/general population		
Hardware Version :	B593RW2A MD1EM92012UM		
Software Version :	V100R001		
Antenna Type :	Internal antenna , external antenna optional		
Device Operating Configurations:			
Supporting Mode(s)	GSM850/1900,WiFi		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM850	824-849	869-894
	GSM1900	1850-1910	1930-1990
	WiFi	2400-2483.5	2400-2483.5

1.1 General Description

B593u-12 LTE/WCDMA/GSM three mode 11 bands CPE is subscriber equipment in the LTE/UMTS/GSM system. But only GSM850、PCS1900 and WiFi test results including in this reports. B593u-12 implement such functions as RF signal receiving/transmitting, LTE/WCDMA/GSM protocol processing, data service etc. WIFI including 11b/g/n provides an wireless access. Externally it provides USB interface (to connect to the printer etc.), USIM card interface ， RJ45 Ethernet interface and RJ11 telephone interface. B593u-12 has two internal antenna and two External Antenna，can automatic switch.

2 Test specification(s)

SUPPLEMENT C Edition 01-01 to OET65c	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields – Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions
IEEE Std C95.1-1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields,3 kHz to 300GHz
KDB 447498 D01	Mobile Portable RF Exposure Procedures and Equipment Authorization Policies

3 Testing laboratory

Test Site	Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	Section K3,Bantian, Longgang District, Shenzhen, P.R.China
Telephone	+86-755-28785513
Fax	+86-755-36834474
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310

4 Applicant and Manufacturer

Company Name	HUAWEI TECHNOLOGIES CO., LTD
Address	Huawei Base, Bantian, Longgang District, Shenzhen, P.R.China

5 Application details

Start Date of test	2012-05-09
End Date of test	2012-05-11

6 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

7 FCC RF Exposure Requirements

A estimation of MPE in this application for product is used to ensure if it comply to the rules of the standard in the regulation list above.

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in 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.

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

Table: Limits For Maximum Permissible Exposure (MPE)

(A) 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)	Averaging Time (minute)|E|^2,|H|^2 or S
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f^2)*	6
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				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm^2)	Averaging Time (minute)|E|^2,|H|^2 or S
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30
f=frequency in MHz			*Plane-wave equivalent power density	

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

Where:

S = power density

P = power input to the antenna

G = numeric gain of the antenna in the direction of interest relative to an isotropic radiator

R= distance to the centre of radiation of the antenna

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

8 RF Exposure Evaluation

8.1 Operation in GSM850

(uplink: 824-849MHz, downlink: 869-894MHz)

Estimation with internal antenna

Mode	P(dBm)	P (mW)	G (dBi)	G	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
1TS	$32.63 \times \frac{1}{8}$	229.04	1	1.26	20	0.057	0.549	**PASS**
2TS	$30.46 \times \frac{2}{8}$	277.93	1	1.26	20	0.070	0.549	**PASS**
3TS	$29.78 \times \frac{3}{8}$	356.48	1	1.26	20	0.089	0.549	**PASS**
4TS	$29.11 \times \frac{4}{8}$	407.35	1	1.26	20	0.102	0.549	**PASS**

Due to the Table, we can conclude the max power density level at 20 cm is 0.102mW/cm², which is below the uncontrolled exposure limit of 0.549mW/cm² at 824MHz, so we can conclude it is into compliance.

Estimation with external antenna

Mode	P(dBm)	P (mW)	G (dBi)	G	R(cm)	S (mW/cm2)	MPE Limit (mW/cm2)	Conclusion
1TS	$32.63 \times \frac{1}{8}$	229.04	1	1.26	20	0.057	0.549	**PASS**
2TS	$30.46 \times \frac{2}{8}$	277.93	1	1.26	20	0.070	0.549	**PASS**
3TS	$29.78 \times \frac{3}{8}$	356.48	1	1.26	20	0.089	0.549	**PASS**
4TS	$29.11 \times \frac{4}{8}$	407.35	1	1.26	20	0.102	0.549	**PASS**

Due to the Table, we can conclude the max power density level at 20 cm is 0.102mW/cm², which is below the uncontrolled exposure limit of 0.549mW/cm² at 824MHz, so we can conclude it is into compliance.

8.2 Operation in GSM1900

(uplink: 1850-1910MHz, downlink: 1930-1990MHz)

Estimation with internal antenna

Mode	P(dBm)	P (mW)	G (dBi)	G	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
1TS	$29.98 \times \frac{1}{8}$	124.43	3	2.00	20	0.050	1.0	**PASS**
2TS	$28.45 \times \frac{2}{8}$	174.96	3	2.00	20	0.070	1.0	**PASS**
3TS	$27.43 \times \frac{3}{8}$	207.51	3	2.00	20	0.083	1.0	**PASS**
4TS	$26.25 \times \frac{4}{8}$	210.85	3	2.00	20	0.084	1.0	**PASS**

Due to the Table, we can conclude the max power density level at 20 cm is 0.084mW/cm², which is below the uncontrolled exposure limit of 1.0mW/cm² at 1850MHz, so we can conclude it is into compliance.

Estimation with external antenna

Mode	P(dBm)	P (mW)	G (dBi)	G	R(cm)	S (mW/cm2)	MPE Limit (mW/cm2)	Conclusion
1TS	$29.98 \times \frac{1}{8}$	124.43	2	1.58	20	0.040	1.0	**PASS**
2TS	$28.45 \times \frac{2}{8}$	174.96	2	1.58	20	0.055	1.0	**PASS**
3TS	$27.43 \times \frac{3}{8}$	207.51	2	1.58	20	0.066	1.0	**PASS**
4TS	$26.25 \times \frac{4}{8}$	210.85	2	1.58	20	0.066	1.0	**PASS**

Due to the Table, we can conclude the max power density level at 20 cm is 0.066mW/cm², which is below the uncontrolled exposure limit of 1.0mW/cm² at 1850MHz, so we can conclude it is into compliance.

8.3 Operation in WiFi 2.4G

(uplink: 2400-2483.5MHz, downlink: 2400-2483.5MHz)

Estimation with internal antenna

Mode	Antenna	P (dBm)	P (mW)	G (dBi)	G	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
WiFi 2.4G	1	21.42	138.68	2	1.58	20	0.044	1.0	**PASS**
	2	21.60	144.54	2	1.58	20	0.045	1.0	**PASS**

Due to the Table, we can conclude the max power density level at 20 cm is 0.045mW/cm², which is below the uncontrolled exposure limit of 1.0mW/cm² at 2400MHz, so we can conclude it is into compliance.

Note: The device can transmit in WiFi mode only with internal antenna.

9 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table(A) and Table(B). To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leq 1$$

The device can simultaneous transmit at GSM850&WiFi SISO, GSM1900&WiFi SISO, WiFi MIMO, GSM850&WiFi MIMO, GSM1900&WiFi MIMO. GSM850&GSM1900 can not work at the same time, because they share the same antenna.

9.1 Estimation for GSM850&WiFi SISO

Mode	Max Power Density (mW/cm^2)	Calculation result	Conclusion
GSM850	0.102	0.231	**PASS**
WiFi	0.045		

Due to the Table, we can conclude sum of the ratios of the power density to the corresponding MPE is less than unity, so it is into compliance.

9.2 Estimation for GSM1900&WiFi SISO

Mode	Max Power Density (mW/cm^2)	Calculation result	Conclusion
GSM1900	0.084	0.129	**PASS**
WiFi	0.045		

Due to the Table, we can conclude sum of the ratios of the power density to the corresponding MPE is less than unity, so it is into compliance.

9.3 Estimation for WiFi MIMO

Mode	Antenna	P (dBm)	P (mW)	G (dBi)	G	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Calculation result	Conclusion
MIMO	1	20.55	113.50	2	1.58	20	0.036	1.0	0.073	**PASS**
	2	20.65	116.14	2	1.58	20	0.037	1.0		

Due to the Table, we can conclude sum of the ratios of the power density to the corresponding MPE is less than unity, so it is into compliance.

9.4 Estimation for GSM850&WiFi MIMO

Mode	Max Power Density (mW/cm^2)	Calculation result	Conclusion
GSM850	0.102	0.259	**PASS**
WiFi with Antenna 1	0.036		
WiFi with Antenna 2	0.037		

Due to the Table, we can conclude sum of the ratios of the power density to the corresponding MPE is less than unity, so it is into compliance.

9.5 Estimation for GSM1900&WiFi MIMO

Mode	Max Power Density (mW/cm^2)	Calculation result	Conclusion
GSM1900	0.084	0.157	**PASS**
WiFi with Antenna 1	0.036		
WiFi with Antenna 2	0.037		

Due to the Table, we can conclude sum of the ratios of the power density to the corresponding MPE is less than unity, so it is into compliance.

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