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FCC Maximum Permissible Exposure(MPE) Estimation Report

Product Name: LTE CPE

Model: B311-521

Report No.: SYBH(Z-SAR)20191011017001-2

FCC ID: QISB311-521

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DATE	2019-11-12	2019-11-12

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※ ※ Modified History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2019-11-12	Zhang Zufu

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1 EUT Description

Device Information:			
Product Name :	LTE CPE		
Model :	B311-521		
FCC ID:	QISB311-521		
Device Type :	Mobile Device		
Device Phase:	Identical Prototype		
Exposure Category:	Uncontrolled environment/general population		
Hardware Version :	WL4B311SW		
Software Version :	10.0.2.1(H190SP8C00)		
Antenna Type :	Internal Antenna/ External Antenna		
Device Operating Configurations:			
Supporting Mode(s)	UMTS Band II/IV/V, LTE Band 2/4/5/7/66,WiFi 2.4G		
Test Modulation	UMTS(QPSK),LTE(QPSK/16QAM), WiFi(DSSS/OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	UMTS Band II	1850-1910	1930-1990
	UMTS Band IV	1710-1755	2110-2155
	UMTS Band V	824-849	869-894
	LTE Band 2	1850-1910	1930-1990
	LTE Band 4	1710-1755	2110-2155
	LTE Band 5	824-849	869-894
	LTE Band 7	2500-2570	2620-2690
	LTE Band 66	1710-1780	2110-2180
	WiFi 2.4G	2412-2462	2412-2462

1.1 General Description

The HUAWEI LTE CPE B311-521 is a Long Term Evolution (LTE) wireless gateway for multiple users in household or small office environments. It enables users to access the Internet, supports 3GPP Release 9 with UE downlink/uplink category 4. Working band: LTE: B2/B4/B5/B7/B66, UMTS: B2/B4/B5, Wi-Fi: 2.4 GHz 802.11b/g/n 2x2 MIMO up to 300Mbps. Maximum Users: 32

2 Test specification(s)

ANSI Std C95.1-1992	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-1991)
KDB 447498 D01	General RF Exposure Guidance v06

3 Testing laboratory

Test Site	Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	NO.2 New City Avenue Songshan Lake Sci. & Tech. Industry Park, Dongguan, Guangdong, P.R.C
Telephone	+86 769 23830808
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State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310 A2LA TESTING CERT #2174.01 & 2174.02 & 2174.03

4 Applicant and Manufacturer

Company Name	HUAWEI TECHNOLOGIES CO., LTD
Address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

5 Application details

Start Date of test	2019-11-12
End Date of test	2019-11-12

6 Ambient Condition

Ambient temperature	18°C – 25°C
Relative Humidity	30% – 70%

7 RF Exposure Requirements

An estimation of MPE in this application for product is used to ensure if it complies with 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 cannot exercise control over their exposure.

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

EIRP = P * G

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.

7.1 FCC MPE Limits

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC 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	

8 RF Exposure Evaluation (FCC)

8.1 Calculation of Power Density for Single Chain Transmitters

Band	Antenna	Tune-up Power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R (cm)	S (mW/cm ²)	Limit (mW/cm ²)	% of limit
UMTS Band II	Internal Antenna 1	24.5	1.10	25.6	363.1	20	0.072	1.000	7.23%
UMTS Band II	External Antenna 1	24.5	1.00	25.5	354.8	20	0.071	1.000	7.06%
UMTS Band II	External Antenna 2	24.5	3.00	27.5	562.3	20	0.112	1.000	11.19%
UMTS Band IV	Internal Antenna 1	24.5	0.30	24.8	302.0	20	0.060	1.000	6.01%
UMTS Band IV	External Antenna 1	24.5	1.00	25.5	354.8	20	0.071	1.000	7.06%
UMTS Band IV	External Antenna 2	24.5	3.00	27.5	562.3	20	0.112	1.000	11.19%
UMTS Band V	Internal Antenna 1	25.0	1.80	26.8	478.6	20	0.095	0.549	17.35%
UMTS Band V	External Antenna 1	25.0	1.00	26.0	398.1	20	0.079	0.549	14.43%
UMTS Band V	External Antenna 2	25.0	3.00	28.0	631.0	20	0.126	0.549	22.88%
LTE Band 2	Internal Antenna 1	24.0	1.10	25.1	323.6	20	0.064	1.000	6.44%
LTE Band 2	External Antenna 1	24.0	1.00	25.0	316.2	20	0.063	1.000	6.29%
LTE Band 2	External Antenna 2	24.0	3.00	27.0	501.2	20	0.100	1.000	9.98%
LTE Band 4	Internal Antenna 1	24.0	0.30	24.3	269.2	20	0.054	1.000	5.36%
LTE Band 4	External Antenna 1	24.0	1.00	25.0	316.2	20	0.063	1.000	6.29%
LTE Band 4	External Antenna 2	24.0	3.00	27.0	501.2	20	0.100	1.000	9.98%
LTE Band 5	Internal Antenna 1	24.0	1.80	25.8	380.2	20	0.076	0.549	13.78%
LTE Band 5	External Antenna 1	24.0	1.00	25.0	316.2	20	0.063	0.549	11.47%
LTE Band 5	External Antenna 2	24.0	3.00	27.0	501.2	20	0.100	0.549	18.17%
LTE Band 7	Internal Antenna 1	24.5	1.60	26.1	407.4	20	0.081	1.000	8.11%
LTE Band 7	External Antenna 1	24.5	1.00	25.5	354.8	20	0.071	1.000	7.06%
LTE Band 7	External Antenna 2	24.5	3.00	27.5	562.3	20	0.112	1.000	11.19%
LTE Band 66	Internal Antenna 1	24.5	0.30	24.8	302.0	20	0.060	1.000	6.01%
LTE Band 66	External Antenna 1	24.5	1.00	25.5	354.8	20	0.071	1.000	7.06%
LTE Band 66	External Antenna 2	24.5	3.00	27.5	562.3	20	0.112	1.000	11.19%
WiFi 2.4G	Internal Antenna 2	20.5	4.17	24.7	293.1	20	0.058	1.000	5.83%
WiFi 2.4G	Internal Antenna 3	17.5	3.40	20.9	123.0	20	0.024	1.000	2.45%

Note:

1)* based on the maximum tune-up tolerance limit declared by manufacturer

According to the power density calculations with a distance from the point to the antenna 20cm above, all values meet the limit specified in section 7, so it is into compliance.

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 product also has multiple transmitters The Simultaneous Transmission Possibilities are as below:

Simultaneous Tx Combination	Configuration
1	WiFi 2.4G MIMO
2	UMTS/LTE +WiFi 2.4G

9.1 Calculation of WiFi MIMO Transmitters

Mode	Antenna	Tune-up Power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R (cm)	S (mW/cm ²)	Limit (mW/cm ²)	% of limit
WiFi 2.4G 2*2 MIMO	Internal Antenna 2 & Internal Antenna 3	19.5	1.24	20.7	118.6	20	0.024	1.000	2.36%

9.2 Estimation of Co-located Transmitters

NO.	Simultaneous Conditions	Max. PD Mode/Band	% of limit	Total exposure ratio (<1)
1	UMTS/LTE +WiFi 2.4G	UMTS Band V External Antenna 2	22.88%	28.71%
		WiFi 2.4G Internal Antenna 2	5.83%	

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 100%, so it is into compliance. Therefore the product also meets the requirements under multiple sources condition.

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