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FCC Maximum Permissible Exposure(MPE) Estimation Report

Product Name: LTE CPE

Model: B315s-22

Report No.: SYBH(Z-SAR)009012016-2

FCC ID: QISB315S-22

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REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2016-03-07	Sun Shanbin



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1 EUT Description

Device Information:			
DUT Name:	LTE CPE		
Type Identification:	B315s-22		
Device Type :	Mobile Device		
FCC ID:	QISB315S-22		
Device Phase:	Identical Prototype		
Exposure Category:	Uncontrolled environment/general population		
Hardware Version :	WL1B310I		
Software Version :	V100R001		
Antenna Type :	Internal Antenna & External Antenna		
Device Operating Configurations:			
Supporting Mode(s)	GSM850/1900,LTE band VII/XXXVIII, WLAN 2.4G		
Test Modulation	GSM(GMSK/8PSK),LTE(QPSK/16QAM),WLAN(DSSS/OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM850	824-849	869-894
	GSM1900	1850-1910	1930-1990
	LTE Band VII	2500-2570	2620-2690
	LTE Band XXXVIII	2570-2620	2570-2620
	WLAN 2.4G	2400-2483.5	2400-2483.5



1.1 General Description

B315s-22 is a wireless gateway that integrates LTE and high-speed Ethernet uplink access, which provides users with flexible and diversified data access and voice services.; it can be used as a WiFi hotspot based on standard of IEEE802.11b/g/n. It supports GSM/WCDMA /LTE wireless internet accessing function. About GSM wireless mode, it supports GPRS and EDGE, operating in Quad Band; About WCDMA wireless mode, it supports WCDMA/HSDPA/HSUPA/HSPA+/DC-HSDPA, operating in Band1 and Band8 ; and the LTE, operating in Band1,Band3,Band7,band8,band20 and Band38.The WiFi is 2X2 and the frequency are 2.4GHz. B315s-22 supports 1Tx2Rx for 3G WCDMA and 4G LTE.



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	Section G1,Huawei Base Bantian, Longgang District, Shenzhen 518129, P.R. China
Telephone	+86 755 28780808
Fax	+86 755 89652518
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. A2LA CERT #2174.01 CNAS Registration number: L0310

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	2016-03-07
End Date of test	2016-03-07

6 Ambient Condition

Ambient temperature	20°C – 24°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 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



$$\text{EIRP} = P * G$$

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 $R=20\text{cm}$, 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)

Antenna type	Mode	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
Internal antenna	1TS	35.0	1.5	36.5	558.35	20	0.111	0.549	Pass
	2TS	35.0	1.5	36.5	1116.71	20	0.222	0.549	Pass
	3TS	33.2	1.5	34.7	1106.70	20	0.220	0.549	Pass
	4TS	32.0	1.5	33.5	1119.36	20	0.223	0.549	Pass
External antenna	1TS	35.0	3.0	38.0	788.70	20	0.157	0.549	Pass
	2TS	35.0	3.0	38.0	1577.39	20	0.314	0.549	Pass
	3TS	33.2	3.0	36.2	1563.26	20	0.311	0.549	Pass
	4TS	32.0	3.0	35.0	1581.14	20	0.315	0.549	Pass

Note:* - based on the maximum tune-up tolerance limit declared by manufacturer

According to the Table, we can conclude the max power density level at 20 cm is 0.314 mW/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)

Antenna type	Mode	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
Internal antenna	1TS	32.0	2.5	34.5	352.30	20	0.070	1.000	Pass
	2TS	32.0	2.5	34.5	704.60	20	0.140	1.000	Pass
	3TS	30.2	2.5	32.7	698.28	20	0.139	1.000	Pass
	4TS	29.0	2.5	31.5	706.27	20	0.141	1.000	Pass
External antenna	1TS	32.0	3.0	35.0	395.28	20	0.079	1.000	Pass
	2TS	32.0	3.0	35.0	790.57	20	0.157	1.000	Pass
	3TS	30.2	3.0	33.2	783.49	20	0.156	1.000	Pass
	4TS	29.0	3.0	32.0	792.45	20	0.158	1.000	Pass

Note:*- based on the maximum tune-up tolerance limit declared by manufacturer

According to the Table, we can conclude the max power density level at 20 cm is 0.157 mW/cm², which is below the uncontrolled exposure limit of 1mW/cm² at 1850MHz, so we can conclude it is into compliance.

8.3 Operation in LTE Band VII

(uplink: 2500-2570MHz, downlink: 2620-2690MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
Internal antenna	25.7	4.0	29.7	933.25	20	0.186	1.000	Pass
External antenna	25.7	3.0	28.7	741.3	20	0.148	1.000	Pass

Note:*- based on the maximum tune-up tolerance limit declared by manufacturer



According to the Table, we can conclude the max power density level at 20 cm is 0.186 mW/cm², which is below the uncontrolled exposure limit of 1mW/cm² at 2500MHz, so we can conclude it is into compliance.

8.4 Operation in LTE Band XXXVIII

(uplink:2570-2620MHz, downlink: 2570-2620MHz)

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
Internal antenna	25.7	4.0	29.7	933.25	20	0.186	1.000	Pass
External antenna	25.7	3.0	28.7	741.3	20	0.148	1.000	Pass

Note:*- based on the maximum tune-up tolerance limit declared by manufacturer

According to the Table, we can conclude the max power density level at 20 cm is 0.186 mW/cm², which is below the uncontrolled exposure limit of 1mW/cm² at 2570MHz, so we can conclude it is into compliance.

8.1 Operation in WLAN 2.4G SISO

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

Antenna type	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
Antenna 1	19.0	1.0	20.0	100.0	20	0.020	1.000	PASS
Antenna 2	19.0	1.0	20.0	100.0	20	0.020	1.000	PASS

Note:*- based on the maximum tune-up tolerance limit declared by manufacturer

According to the Table, we can conclude the max power density level at 20 cm is 0.020 mW/cm², which is below the uncontrolled exposure limit of 1.000mW/cm² at 2400MHz, so we can conclude 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	WLAN 2.4G MIMO
2	GSM/LTE +WLAN 2.4G SISO
3	GSM/LTE +WLAN 2.4G MIMO

Note:

The GSM/LTE Internal antenna and External antenna cannot transmit simultaneously.



9.1 Estimation for WLAN2.4G MIMO

Antenna type	Tune-up limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
Antenna 1	16.0	1.0	17.0	50.1	20	0.010	1.000	0.02	PASS
Antenna 2	16.0	1.0	17.0	50.1	20	0.010	1.000		

9.2 Estimation for GSM850 & WLAN2.4G

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
1	GSM 850	0.314	0.549	0.592	PASS
	WLAN2.4G SISO	0.020	1.000		
2	GSM 850	0.314	0.549	0.592	PASS
	WLAN MIMO with Antenna 1	0.010	1.000		
	WLAN MIMO with Antenna 2	0.010	1.000		

9.3 Estimation for GSM1900 & WLAN2.4G

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
1	GSM1900	0.157	1.000	0.177	PASS
	WLAN2.4G SISO	0.020	1.000		
2	GSM1900	0.157	1.000	0.177	PASS
	WLAN MIMO with Antenna 1	0.010	1.000		
	WLAN MIMO with Antenna 2	0.010	1.000		

9.4 Estimation for LTE Band VII & WLAN2.4G

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
1	LTE Band VII	0.186	1.000	0.206	PASS
	WLAN2.4G SISO	0.020	1.000		
2	LTE Band VII	0.186	1.000	0.206	PASS
	WLAN MIMO with Antenna 1	0.010	1.000		
	WLAN MIMO with Antenna 2	0.010	1.000		

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 1, so it is into compliance.

Therefore the product also meets the requirements under multiple sources condition.

9.5 Estimation for LTE Band XXXVIII & WLAN2.4G

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
1	LTE Band XXXVIII	0.186	1.000	0.206	PASS
	WLAN2.4G SISO	0.020	1.000		
2	LTE Band XXXVIII	0.186	1.000	0.206	PASS
	WLAN MIMO with Antenna 1	0.010	1.000		
	WLAN MIMO with Antenna 2	0.010	1.000		

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 1, so it is into compliance.

Therefore the product also meets the requirements under multiple sources condition.

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