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FCC Maximum Permissible Exposure(MPE) Estimation Report

Product Name: 1200Mbps Wireless Router

Model: WS5200

Report No.: SYBH(Z-SAR)20180202009001-2

FCC ID: QISWS5200

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※ ※ **Modified History** ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2018-03-23	Luo Hua

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1 EUT Description

Device Information:			
Product Name :	1200Mbps Wireless Router		
Model :	WS5200		
FCC ID:	QISWS5200		
Device Type :	Mobile Device		
Device Phase:	Identical Prototype		
Exposure Category:	Uncontrolled environment/general population		
Hardware Version :	AMEWS5200M		
Software Version :	8.0.0.1		
Antenna Type :	External Antenna		
Device Operating Configurations:			
Supporting Mode(s)	WiFi 2.4G/5G		
Test Modulation	WiFi(DSSS/OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WiFi 2.4G	2400-2483.5	2400-2483.5
	WiFi 5G	5150-5250 5725-5850	5150-5250 5725-5850

1.1 General Description

The WS5200 is a high-speed wireless router designed for homes and small offices.

Complies with 802.11b/g/n/ac multiple-input multiple-output (MIMO) technology and provides 4 external high-gain antennas. This enhances wireless performance, improves wireless signal stability, increases wireless network range, provides a transmission rate of up to 1200 Mbps.

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	The 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
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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	2018-03-23
End Date of test	2018-03-23

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 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 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

8.1 Operation in WiFi 2.4G SISO

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

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
ANT1 SISO	21.0	4.5	25.5	354.8	20	0.071	1.000	Pass
ANT2 SISO	21.0	4.5	25.5	354.8	20	0.071	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 0.071 mW/cm², which is below the uncontrolled exposure limit, so we can conclude it is into compliance.

8.2 Operation in WiFi 5G SISO

(uplink: 5150-5250MHz, 5725-5850 MHz; downlink: 5150-5250MHz, 5725-5850 MHz)

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
ANT1 SISO	23.0	5.3	28.3	676.1	20	0.135	1.000	Pass
ANT2 SISO	23.0	5.3	28.3	676.1	20	0.135	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 0.135 mW/cm², which is below the uncontrolled exposure limit, 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	WiFi 2.4G MIMO
2	WiFi 5G MIMO
3	WiFi 2.4G ANT1+WiFi 5G ANT1
4	WiFi 2.4G ANT2+WiFi 5G ANT1
5	WiFi 2.4G ANT1+WiFi 5G ANT2
6	WiFi 2.4G ANT2+WiFi 5G ANT2
7	WiFi 2.4G ANT1+WiFi 5G MIMO
8	WiFi 2.4G ANT2+WiFi 5G MIMO
9	WiFi 2.4G MIMO+WiFi 5G ANT1
10	WiFi 2.4G MIMO+WiFi 5G ANT2
11	WiFi 2.4G MIMO+WiFi 5G MIMO

9.1 Estimation for WiFi 2.4G MIMO

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
1	WiFi 2.4G MIMO (WiFi 2.4G ANT1+ANT2)	0.071	1.000	0.142	Pass
		0.071	1.000		

9.2 Estimation for WiFi 5G MIMO

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
2	WiFi 5G MIMO (WiFi 5G ANT1+ANT2)	0.135	1.000	0.270	Pass
		0.135	1.000		

9.3 Estimation for WiFi 2.4G & WiFi 5G

No.	Mode	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
3	WiFi 2.4G ANT1	0.071	1.000	0.206	Pass
	WiFi 5G ANT1	0.135	1.000		
4	WiFi 2.4G ANT2	0.071	1.000	0.206	Pass
	WiFi 5G ANT1	0.135	1.000		
5	WiFi 2.4G ANT1	0.071	1.000	0.206	Pass
	WiFi 5G ANT2	0.135	1.000		
6	WiFi 2.4G ANT2	0.071	1.000	0.206	Pass
	WiFi 5G ANT2	0.135	1.000		
7	WiFi 2.4G ANT1	0.071	1.000	0.341	Pass
	WiFi 5G MIMO	0.270	1.000		
8	WiFi 2.4G ANT2	0.071	1.000	0.341	Pass
	WiFi 5G MIMO	0.270	1.000		
9	WiFi 2.4G MIMO	0.142	1.000	0.277	Pass
	WiFi 5G ANT1	0.135	1.000		
10	WiFi 2.4G MIMO	0.142	1.000	0.277	Pass
	WiFi 5G ANT2	0.135	1.000		
11	WiFi 2.4G MIMO	0.142	1.000	0.412	Pass
	WiFi 5G MIMO	0.270	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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