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CNAS L0310



FCC Maximum Permissible Exposure(MPE) Estimation Report

Product Name: 1500Mbps Wireless Router
Model: WS7001
Report No.: SYBH(Z-SAR)20210730002001-1
FCC ID: 2ATEYWS7001

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2021-09-13

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※ ※ **Modified History** ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2021-09-13	Dong Jiarui

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1 EUT Description

Device Information:			
Product Name :		1500Mbps Wireless Router	
Model :		WS7001	
FCC ID:		2ATEYWS7001	
Device Type :		Mobile Device	
Device Phase:		Identical Prototype	
Exposure Category:		Uncontrolled environment/general population	
Hardware Version :		AM1TC7001M	
Software Version :		11.0.3.3	
Antenna Type :		External Antenna	
Device Operating Configurations:			
Test Modulation		WiFi(DSSS/OFDM)	
Supporting Mode(s) and Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WiFi 2.4G	2400~2483.5	2400-2483.5
	WiFi 5G	5150~5250	5150~5250
		5725~5850	5725~5850

1.1 General Description

The WS7001 is a high-speed wireless router designed for homes and small offices. Complies with 802.11b/g/n(2.4 GHz, wireless rates up to 300 Mbps), 802.11a/n/ac/ax(5 GHz, wireless rates up to 1201 Mbps) multiple-input multiple-output (MIMO) technology 、 provides 4 external high-gain antennas . This enhances wireless performance, improves wireless signal stability, increases wireless network range, provide a transmission rate of up to 1500 Mbps.

2 Test specification(s)

ANSI Std C95.1-1992 IEEE Std C95.1-1991	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.
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
Fax	+86 769 23837628
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025.

4 Applicant and Manufacturer

Company Name	Huawei Device Co., Ltd.
Address	No.2 of Xincheng Road, Songshan Lake Zone, Dongguan, Guangdong 523808, People's Republic of China

5 Application details

Start Date of test	2021-09-13
End Date of test	2021-09-13

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)

Maximum permissible exposure for controlled environments*

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

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 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
WiFi 2.4G	Ant1	22.50	4.50	27.00	501.19	20.00	0.10	1.00	9.98%
	Ant2	22.50	4.50	27.00	501.19	20.00	0.10	1.00	9.98%
WiFi 5G	Ant3	20.50	5.00	25.50	354.81	20.00	0.07	1.00	7.06%
	Ant4	20.50	5.00	25.50	354.81	20.00	0.07	1.00	7.06%

According to the table above, it can be concluded that the limit percentage of above supporting frequency bands calculation results are less than 1, therefore, the product meets the RF exposure compliance requirements.

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 SISO/MIMO + WiFi 5G SISO/MIMO

Note: There are four WiFi antennas. Ant1 and Ant2 support 2.4G Wi-Fi. Ant3 and Ant4 support 5G Wi-Fi. 2.4G Wi-Fi and 5G Wi-Fi can work at the same time.

9.1 Calculation of WiFi MIMO Transmitters

Mode	Tune-up Power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R (cm)	S (mW/cm ²)	Limit (mW/cm ²)	% of limit	Total exposure ratio (<1)
WiFi 2.4G 2*2 MIMO	24.50	4.50	29.00	794.33	20.00	0.16	1	15.81%	15.81%
WiFi 5G 2*2 MIMO	23.50	5.00	28.50	707.95	20.00	0.14	1	14.09%	14.09%

9.2 Calculation of Co-located Transmitters

NO.	Simultaneous Conditions	Mode/Band (worst case)	% of limit	Total exposure ratio (<1)
1	2.4G WiFi SISO + 5G WiFi SISO	2.4G WiFi SISO	9.98%	17.04%
		5G WiFi SISO	7.06%	
2	2.4G WiFi SISO + 5G WiFi MIMO	2.4G WiFi SISO	9.98%	24.07%
		5G WiFi 2*2 MIMO	14.09%	
3	2.4G WiFi MIMO + 5G WiFi SISO	2.4G WiFi 2*2 MIMO	15.81%	22.87%
		5G WiFi SISO	7.06%	
4	2.4G WiFi MIMO + 5G WiFi MIMO	2.4G WiFi 2*2 MIMO	15.81%	29.90%
		5G WiFi 2*2 MIMO	14.09%	

According to the Table above, it can be concluded that the TER calculation result of all simultaneous transmission possibilities is less than 1, so it is into compliance.

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

End