FCC RF EXPOSURE EVALUATION REPORT

FCC ID: 2ABZMEP9

Project No.	**: 1809C096**
Equipment	**: AC1200 Enterprise Mesh WiFi System**
Model	**: EP9**
Applicant	**: SHENZHEN IP-COM NETWORKS CO.,LTD**
Address	**: Room 101, Unit A, First Floor, Tower E3, No. 1001, Zhongshanyuan Road, Nanshan District, Shenzhen, China. 518052**
Exposure category	**: General population/uncontrolled environment**
EUT Type:	**: Production Unit (Engineer Sample)**
Device Type	**: Mobile Device**

1. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.
In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.
In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

2. Limits for General Population/Uncontrolled Exposure

(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 $\|E\|^2$,$\|H\|^2$ or S (minutes)
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

Note: f = frequency in MHz ; *Plane-wave equivalent power density

3. Refer Evaluation Method

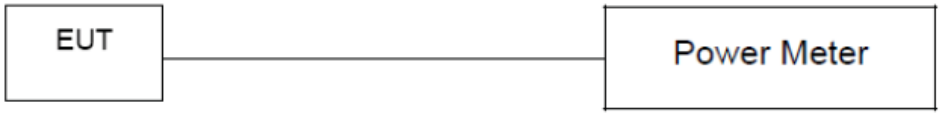
ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
FCC KDB publication 447498 D01 General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.
FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.
FCC CFR 47 part2 2.1093: Radiofrequency radiation exposure evaluation: portable devices

4. Calculation Method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01
$S=PG/4\pi R^2$
Where:
S=power density
P=power input to antenna
G=power gain of the antenna in the direction of interest relative to an isotropic radiator
R=distance to the center of radiation of the antenna

5. Conducted Power Results

5.1 Test Setup



5.2 Test Equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	ANRITSU	ML2495A	1128009	Mar. 11, 2019
2	Pulse Power Sensor	ANRITSU	MA2411B	1027500	Mar. 11, 2019

Remark: all calibration period of equipment list is one year.

5.3 Test Procedure

a. The EUT was directly connected to the power meter and antenna output port as show in the block diagram Test Setup.
b. Setup EUT work at duty cycle more than 98%;
c. Read power sensor values in Peak detector;

5.4 Test Results and Manufacturing Tolerance

Mode	Frequency Band	Maximum Peak power declared by Manufacturer	
		Antenna 1	Antenna 2
IEEE 802.11b	2.4G	≤ 28.50	≤28.50
IEEE 802.11g	2.4G	≤ 28.50	≤28.50
IEEE 802.11n HT20	2.4G	≤ 23.50	≤24.00
IEEE 802.11n HT40	2.4G	≤23.00	≤23.50
IEEE 802.11a	5G Band 1	≤26.00	≤26.00

	5G Band 3	≤26.00	≤26.00
IEEE 802.11n HT20	5G Band 1	≤24.50	≤23.50
	5G Band 3	≤23.50	≤23.50
IEEE 802.11n HT40	5G Band 1	≤23.50	≤16.00
	5G Band 3	≤23.50	≤23.50
IEEE 802.11ac VHT20	5G Band 1	≤25.00	≤23.50
	5G Band 3	≤23.50	≤23.50
IEEE 802.11ac VHT40	5G Band 1	≤23.00	≤22.50
	5G Band 3	≤23.50	≤23.50
IEEE 802.11ac VHT80	5G Band 1	≤14.50	≤13.50
	5G Band 3	≤23.00	≤23.00

6. Antenna Information

2.4G

Antenna	Manufacturer	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)
Antenna 1	N/A	N/A	PCB	N/A	4.5
Antenna 2	N/A	N/A	PCB	N/A	4.5

Note:
(1) This EUT supports MIMO 2X2, any transmit signals are correlated with each other, so Directional gain = GANT+10log (N) dBi, that is Directional gain=4.5+10log (2) dBi=7.51; so, The output power limit is 30-7.51+6=28.49, the power density limit is 8-7.51+6=6.49.
(2) Beamforming Gain: 3 dBi, Directional gain=3+4.5=7.50. So, the output power limit is 30-7.50+6=28.50, the power density limit is 8-7.50+6=6.50.

5G

Antenna	Model Name	Antenna Type	Connector	Maximum Peak Gain (dBi)	Note
Antenna 3	N/A	PCB	N/A	4.0	UNII-1
Antenna 3	N/A	PCB	N/A	4.5	UNII-3
Antenna 4	N/A	PCB	N/A	4.0	UNII-1
Antenna 4	N/A	PCB	N/A	4.5	UNII-3

Note:
(1) This EUT supports MIMO 2X2, any transmit signals are correlated with each other, so, Directional gain = GANT+10log (N) dBi.
For UNII-1, Directional gain=4.0+10log (2) dBi=7.01, the UNII-1 output power limit is 30-7.01+6=28.99, power density limit is 17-7.01+6=15.99.
For UNII-3, Directional gain = 4.5+10log (2) dBi=7.51, the UNII-1 output power limit is 30-7.51+6=28.49, power density limit is 30-7.51+6=28.49.
(2) Beamforming Gain: 3.0 dBi.
For UNII-1, Directional gain=3.0+4.0dBi=7.0. Then, the UNII-1 output power limit is 30-7.0+6=29.00, power density limit is 17-7.0+6=16.00.
For UNII-3, Directional gain=3.0+4.5dBi=7.5. Then, the UNII-3 output power limit is 30-7.5+6=28.50, power density limit is 30-7.5+6=28.50.

7. Evaluation Results

7.1 Standalone

Antenna 1

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (W/m^2)	MPE Limits (W/m^2)
	(dBm)	(W)					
IEEE 802.11b	28.50	0.7079	4.50	2.8184	100%	0.3971	1.0000
IEEE 802.11g	28.50	0.7079	4.50	2.8184	100%	0.3971	1.0000
IEEE 802.11n HT20	23.50	0.2239	4.50	2.8184	100%	0.1256	1.0000
IEEE 802.11n HT40	23.00	0.1995	4.50	2.8184	100%	0.1119	1.0000

Antenna 2

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (W/m^2)	MPE Limits (W/m^2)
	(dBm)	(W)					
IEEE 802.11b	28.50	0.7079	4.50	2.8184	100%	0.3971	1.0000
IEEE 802.11g	28.50	0.7079	4.50	2.8184	100%	0.3971	1.0000
IEEE 802.11n HT20	24.00	0.2512	4.50	2.8184	100%	0.1409	1.0000
IEEE 802.11n HT40	23.50	0.2239	4.50	2.8184	100%	0.1256	1.0000

Antenna 3

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (W/m^2)	MPE Limits (W/m^2)
	(dBm)	(W)					
IEEE 802.11a	26.00	0.3981	4.00	2.5119	100%	0.1990	1.0000
IEEE 802.11n HT20	24.50	0.2818	4.00	2.5119	100%	0.1409	1.0000
IEEE 802.11n HT40	23.50	0.2239	4.00	2.5119	100%	0.1119	1.0000
IEEE 802.11ac VHT20	25.00	0.3162	4.00	2.5119	100%	0.1581	1.0000
IEEE 802.11ac VHT40	23.50	0.2239	4.00	2.5119	100%	0.1119	1.0000
IEEE 802.11ac VHT80	23.00	0.1995	4.00	2.5119	100%	0.0998	1.0000

Antenna 4

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (W/m^2)	MPE Limits (W/m^2)
	(dBm)	(W)					
IEEE 802.11a	26.00	0.3981	4.50	2.8184	100%	0.2233	1.0000
IEEE 802.11n HT20	23.50	0.2239	4.50	2.8184	100%	0.1256	1.0000
IEEE 802.11n HT40	23.50	0.2239	4.50	2.8184	100%	0.1256	1.0000
IEEE 802.11ac VHT20	23.50	0.2239	4.50	2.8184	100%	0.1256	1.0000
IEEE 802.11ac VHT40	23.50	0.2239	4.50	2.8184	100%	0.1256	1.0000
IEEE 802.11ac VHT80	23.00	0.1995	4.50	2.8184	100%	0.1119	1.0000

Remark:

1. *Maximum power including tune-up tolerance;*
2. *EIRP including tune-up tolerance;*
3. *MPE use distance is 20cm from manufacturer declaration of user manual.*

7.2 Simultaneous Transmission for SAR Exclusion

The sample support one WLAN modular and 2T2R MIMO antennas (only IEEE 802.11n support MIMO), need consider simultaneous transmission;

Antenna 1 and Antenna 2 for 2.4GWLAN

Band	Mode	MPE Ratio Antenna 1	MPE Ratio Antenna 2	∑ MPE ratios	Limit	Results
2.4G	IEEE 802.11b	0.3971	0.3971	-/-	1.0	PASS
	IEEE 802.11g	0.3971	0.3971	-/-	1.0	PASS
	IEEE 802.11n HT20	0.1256	0.1409	< 0.3	1.0	PASS
	IEEE 802.11n HT40	0.1119	0.1256	< 0.3	1.0	PASS

Antenna 3 and Antenna 4 for 5GWLAN

Band	Mode	MPE Ratio Antenna 1	MPE Ratio Antenna 2	∑ MPE ratios	Limit	Results
5G	IEEE 802.11a	0.1990	0.2233	-/-	1.0	PASS
	IEEE 802.11n HT20	0.1409	0.1256	< 0.3	1.0	PASS
	IEEE 802.11n HT40	0.1119	0.1256	< 0.3	1.0	PASS
	IEEE 802.11ac VHT20	0.1581	0.1256	< 0.3	1.0	PASS
	IEEE 802.11ac VHT40	0.1119	0.1256	< 0.3	1.0	PASS
	IEEE 802.11ac VHT80	0.0998	0.1119	< 0.3	1.0	PASS

Maximum MPE Ratios for dual-mode WLAN simultaneous transmission

Maximum MPE Ratio $_{2.4GWLAN}$	Maximum MPE Ratio $_{5GWLAN}$	∑ MPE ratios	Limit	Results
0.3971	0.3837	0.8	1.0	PASS

Remark:

1. *Maximum power including tune-up tolerance;*
2. *EIRP including tune-up tolerance;*
3. *MPE use distance is 20cm from manufacturer declaration of user manual.*

8. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.