RF Exposure evaluation

FCC ID: 2AVVA-1200MZJQ

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

1. Reference

According to §1.1307(b)(1), systems operating under the provisions of this 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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

2. Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
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 Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	$(180/f^2)$*	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

3. MPE 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

4. Antenna Information

1200M-ZJQ can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 0 Antenna 1	5G Wifi	External antenna	5.1GHz – 5.8 GHz	2.00 dBi
Antenna 0 Antenna 1	2.4G Wifi	External antenna	2.4GHz – 2.5 GHz	2.00 dBi

5. Conducted power

[2.4GHz WLAN]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)	
			Antenna0	Antenna1
IEEE 802.11b	1	2412	13.98	15.22
	7	2437	14.16	15.08
	13	2462	14.68	15.36
IEEE 802.11g	1	2412	14.62	14.92
	7	2437	14.09	15.27
	13	2462	14.61	14.99
IEEE 802.11n HT20	1	2412	14.37	15.68
	7	2437	14.42	15.1
	13	2462	14.61	14.88

[5GHz WLAN Band 1]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)	
			Antenna0	Antenna1
IEEE 802.11a	36	5180	16.34	15.99
	40	5200	16.08	15.9
	48	5240	16.43	16.35
IEEE 802.11n HT20	36	5180	15.08	15.02
	40	5200	15.37	15.63
	48	5240	15.57	15.71
IEEE 802.11ac VHT20	36	5180	16.57	16.25
	40	5200	16.49	16.16
	48	5240	14.6	14.78
IEEE 802.11n HT40	38	5190	15.05	14.95
	46	5230	15.51	15.43
IEEE 802.11ac VHT40	38	5190	15.94	16.14
	46	5230	16.5	16.29
IEEE 802.11ac VHT80	42	5210	16.02	16.19

[5GHz WLAN Band 3]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)	
			Antenna0	Antenna1
IEEE 802.11a	149	5745	15.78	14.45
	157	5785	15.25	14.03
	165	5825	15.33	14.22
IEEE 802.11n HT20	149	5745	15.63	14.39
	157	5785	15.62	14.52
	165	5825	15.36	14.23
IEEE 802.11ac VHT20	149	5745	15.76	13.81
	157	5785	14.89	13.99
	165	5825	15.49	14.47
IEEE 802.11n HT40	151	5755	15.62	14.28
	159	5795	15.01	14.35
IEEE 802.11ac VHT40	151	5755	15.36	14.12
	159	5795	15.54	14.4
IEEE 802.11ac VHT80	155	5775	15.62	14.38

6. Manufacturing Tolerance

2.4GHz WLAN

IEEE 802.11b (Peak)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	14.0	14.0	14.0	15.0	15.0	15.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11g (Peak)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	14.0	14.0	14.0	15.0	15.0	15.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	14.0	14.0	14.0	15.0	15.0	15.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0

5GHz WLAN Band 1

IEEE 802.11a (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Target (dBm)	15.0	16.0	16.0	15.0	15.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5190		5230	5190		5230
Target (dBm)	16.0		16.0	16.0		16.0
Tolerance ± (dB)	1.0		1.0	1.0		1.0
IEEE 802.11ac VHT40 (Average)						
Frequency	Antenna 0			Antenna 1		

(MHz)	5190	5230	5190	5230
Target (dBm)	16.0	16.0	16.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT80 (Average)				
Frequency (MHz)	Antenna 0		Antenna 1	
	5210		5210	
Target (dBm)	16.0		16.0	
Tolerance ± (dB)	1.0		1.0	

5GHz WLAN Band 3

IEEE 802.11a (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Target (dBm)	16.0	16.0	16.0	15.0	15.0	15.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Target (dBm)	16.0	16.0	16.0	15.0	15.0	15.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Target (dBm)	15.0	15.0	15.0	14.0	15.0	15.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755		5795	5755		5795
Target (dBm)	15.0		15.0	14.0		14.0
Tolerance ± (dB)	1.0		1.0	1.0		1.0
IEEE 802.11ac VHT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755		5795	5755		5795
Target (dBm)	15.0		15.0	14.0		14.0
Tolerance ± (dB)	1.0		1.0	1.0		1.0
IEEE 802.11ac VHT80 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5775			5775		
Target (dBm)	15.0			14.0		
Tolerance ± (dB)	1.0			1.0		

7. Standalone MPE Result

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna is 2dBi, the RF power density can be obtained.

2.4GHz WLAN

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
IEEE 802.11b	15.0	31.6228	2.00	1.5849	100%	0.0100	1.0000
IEEE 802.11g	15.0	31.6228	2.00	1.5849	100%	0.0100	1.0000
IEEE 802.11n HT20	15.0	31.6228	2.00	1.5849	100%	0.0100	1.0000

Antenna 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
IEEE 802.11b	16.0	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11g	16.0	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11n HT20	16.0	39.8107	2.00	1.5849	100%	0.0126	1.0000

5GHz WLAN Band 1

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
IEEE 802.11a	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11n HT20	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT20	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11n HT40	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT40	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT80	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000

Antenna 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
IEEE 802.11a	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11n HT20	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT20	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11n HT40	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT40	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT80	17.0	50.1187	2.00	1.5849	100%	0.0158	1.0000

5GHz WLAN Band 3

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
IEEE 802.11a	17.00	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11n HT20	17.00	50.1187	2.00	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT20	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11n HT40	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11ac VHT40	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11ac VHT80	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000

Antenna 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
IEEE 802.11a	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11n HT20	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11ac VHT20	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000
IEEE 802.11n HT40	15.00	31.6228	2.00	1.5849	100%	0.0100	1.0000
IEEE 802.11ac VHT40	15.00	31.6228	2.00	1.5849	100%	0.0100	1.0000
IEEE 802.11ac VHT80	15.00	31.6228	2.00	1.5849	100%	0.0100	1.0000

Remark:

1. Output power including turn-up tolerance;

2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;

3. MPE evaluate distance is 20cm from user manual provide by manufacturer.

8. Summary simultaneous transmission results

Antenna 0 and Antenna 1 for 2.4GWLAN

$MPE_{Antenna0}$ (2.4G ant0)	$MPE_{Antenna1}$ (2.4G ant1)	$MPE_{Antenna0}$ (5G ant0)	$MPE_{Antenna1}$ (5G ant1)	∑MPE ratios	Limit	Results
0.01	0.01	0.0158	0.0158	0.0516	1.0	PASS

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

----------THE END OF REPORT----------