

RF Exposure evaluation

FCC ID: 2AVCC-GA1001

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

GA1001 use one antenna certificated as follows provided by manufacturer;

Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna	FPC Antenna	2.4GHz – 2.5 GHz	2.68 dBi
Antenna	FPC Antenna	2.4GHz – 2.5 GHz	2.68 dBi
Antenna	FPC Antenna	5.0GHz – 6.0 GHz	4.33 dBi

5. Conducted power

[BLE-GFSK]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)
BLE-GFSK	00	2402	-0.627
	19	2440	0.228
	39	2480	-0.902

[2.4GHz WLAN]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)
IEEE 802.11b	1	2412	14.42
	6	2437	14.99
	11	2462	14.22
IEEE 802.11g	1	2412	10.87
	6	2437	11.17
	11	2462	10.69
IEEE 802.11n HT20	1	2412	8.71
	6	2437	9.45
	11	2462	8.81

[5GWLAN Band 1]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
<i>IEEE 802.11a</i>	36	5180	12.97
	40	5200	12.2
	48	5240	12.12
<i>IEEE 802.11n HT20</i>	36	5180	10.77
	40	5200	10.31
	48	5240	10.32
<i>IEEE 802.11ac VHT20</i>	36	5180	11.23
	40	5200	10.27
	48	5240	10.39
<i>IEEE 802.11n HT40</i>	40	5190	10.31
	48	5230	9.97
<i>IEEE 802.11ac VHT40</i>	40	5190	10.5
	48	5230	10.23
<i>IEEE 802.11ac VHT80</i>	42	5210	11.3

[5GWLAN Band 2A]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
<i>IEEE 802.11a</i>	52	5260	12.95
	56	5280	12.42
	64	5320	12.3
<i>IEEE 802.11n HT20</i>	52	5260	10.95
	56	5280	10.59
	64	5320	10.51
<i>IEEE 802.11ac VHT20</i>	52	5260	11.32
	56	5280	10.26
	64	5320	10.44
<i>IEEE 802.11n HT40</i>	54	5270	10.73
	62	5310	10.42
<i>IEEE 802.11ac VHT40</i>	54	5270	10.52
	62	5310	10.17
<i>IEEE 802.11ac VHT80</i>	58	5290	11.34

[5GWLAN Band 2C]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
<i>IEEE 802.11a</i>	100	5500	13.12
	132	5660	12.7
	140	5700	11.99
<i>IEEE 802.11n HT20</i>	100	5500	11.08
	132	5660	10.93
	140	5700	10.81
<i>IEEE 802.11ac VHT20</i>	100	5500	10.89
	132	5660	11.02
	140	5700	10.58
<i>IEEE 802.11n HT40</i>	102	5510	11.02
	110	5550	10.9
	134	5670	10.77
<i>IEEE 802.11ac VHT40</i>	102	5510	10.99
	110	5550	10.9
	134	5670	10.95
<i>IEEE 802.11ac VHT80</i>	106	5530	11.65

[5GWLAN Band 3]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
<i>IEEE 802.11a</i>	149	5745	12.74
	157	5785	12.25
	165	5825	12.06
<i>IEEE 802.11n HT20</i>	149	5745	10.79
	157	5785	10.81
	165	5825	10.66
<i>IEEE 802.11ac VHT20</i>	149	5745	11.02
	157	5785	11.09
	165	5825	10.43
<i>IEEE 802.11n HT40</i>	151	5755	10.64
	159	5795	10.59
<i>IEEE 802.11ac VHT40</i>	151	5755	10.87
	159	5795	10.95
<i>IEEE 802.11ac VHT80</i>	155	5775	11.51

6. Manufacturing Tolerance

GFSK(BLE)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	0.0	0.0	0.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

802.11B(2.4G WIFI)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11G(2.4G WIFI)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	10.0	11.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11N20(2.4G WIFI)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

[5GWLAN Band 1]

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	---	Channel 46
Target (dBm)	10.0	---	10.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	---	Channel 46
Target (dBm)	10.0	---	10.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 42	---

Target (dBm)	---	11.0	---
Tolerance $\pm$ (dB)	---	1.0	---

[5GWLAN Band 2A]

IEEE 802.11a (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	10.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	11.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 54	---	Channel 62
Target (dBm)	10.0	---	10.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 54	---	Channel 62
Target (dBm)	10.0	---	10.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 58	---
Target (dBm)	---	11.0	---
Tolerance $\pm$ (dB)	---	1.0	---

[5GWLAN Band 2C]

IEEE 802.11a (Average)			
Channel	Channel 100	Channel 132	Channel 140
Target (dBm)	13.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 100	Channel 132	Channel 140
Target (dBm)	11.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 100	Channel 132	Channel 140
Target (dBm)	10.0	11.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			

Channel	Channel 102	Channel 110	Channel 134
Target (dBm)	11.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 102	Channel 110	Channel 134
Target (dBm)	10.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 106	---
Target (dBm)	---	11.0	---
Tolerance $\pm$ (dB)	---	1.0	---

[5GWLAN Band 3]

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	10.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	---	Channel 159
Target (dBm)	10.0	---	10.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	---	Channel 159
Target (dBm)	10.0	---	10.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 155	---
Target (dBm)	---	11.0	---
Tolerance $\pm$ (dB)	---	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, $r = 20\text{cm}$, as well as the gain of the used antenna is 2dBi , the RF power density can be obtained.

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
BLE GFSK	1.0	1.2589	2.68	1.8535	100%	0.0005	1.0000
IEEE 802.11b	15.0	31.6228	2.68	1.8535	100%	0.0117	1.0000
IEEE 802.11g	12.0	15.8489	2.68	1.8535	100%	0.0058	1.0000
IEEE 802.11n HT20	10.0	10.0000	2.68	1.8535	100%	0.0037	1.0000

[5GWLAN Band 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	13.0	19.9526	4.33	2.7102	100%	0.0108	1.0000
IEEE 802.11n HT20	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT20	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000
IEEE 802.11n HT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT80	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000

[5GWLAN Band 2A]

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	13.0	19.9526	4.33	2.7102	100%	0.0108	1.0000
IEEE 802.11n HT20	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT20	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000
IEEE 802.11n HT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT80	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000

[5GWLAN Band 2C]

Modulation Type	Output power		Antenna Gain	Antenna Gain	Duty Cycle	MPE (mW/cm ²)	MPE Limits
	dBm	mW					

			(dBi)	(linear)			(mW/cm ²)
IEEE 802.11a	14.0	25.1189	4.33	2.7102	100%	0.0136	1.0000
IEEE 802.11n HT20	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000
IEEE 802.11ac VHT20	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000
IEEE 802.11n HT40	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000
IEEE 802.11ac VHT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT80	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000

[5GWLAN Band 3]

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	13.0	19.9526	4.33	2.7102	100%	0.0108	1.0000
IEEE 802.11n HT20	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT20	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000
IEEE 802.11n HT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT40	11.0	12.5893	4.33	2.7102	100%	0.0068	1.0000
IEEE 802.11ac VHT80	12.0	15.8489	4.33	2.7102	100%	0.0085	1.0000

Remark:

- 1. Output power (Peak) 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. 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-----