

RF Exposure evaluation

FCC ID:2A32K-B2

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

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 1	2.4G/5G Wifi/BT	PCB antenna	2.4GHz – 2.5 GHz	2 dBi
			5.1GHz – 5.8 GHz	2 dBi

5. Conducted power

Bluetooth

Mode	Channel	Frequency(MHz)	Peak Conducted Output Power (dBm)
GFSK	0	2402	6.29
	39	2441	6.33
	78	2480	6.21
$\pi/4$ DQPSK	0	2402	5.35
	39	2441	5.39
	78	2480	4.91
8-DPSK	0	2402	5.7
	39	2441	5.75
	78	2480	5.24
BLE 1M	0	2402	5.67
	19	2440	5.68
	39	2480	5.46
BLE 2M	0	2402	5.97
	19	2440	5.09
	39	2480	4.59

[2.4GHz WLAN]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)
			Antenna1
IEEE 802.11b	1	2412	15.88
	6	2437	16.17
	11	2462	15.88
IEEE 802.11g	1	2412	22.17
	6	2437	22.10
	11	2462	22.22
IEEE 802.11n HT20	1	2412	21.45
	6	2437	21.39
	11	2462	21.52

[5GHz U-NII-1]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
			Antenna1
IEEE 802.11a	36	5180	13.78
	40	5200	13.95
	48	5240	13.77
IEEE 802.11n HT20	36	5180	12.79
	40	5200	12.72
	48	5240	12.56
IEEE 802.11ac VHT20	36	5180	12.71
	40	5200	12.76
	48	5240	12.58
IEEE 802.11n HT40	38	5190	12.69
	46	5230	12.72
IEEE 802.11ac VHT40	38	5190	9.80
	46	5230	9.60
IEEE 802.11ac VHT80	42	5210	9.72

[5GHz U-NII-2A]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
			Antenna1
IEEE 802.11a	100	5260	13.86
	116	5280	13.65
	140	5320	13.50
IEEE 802.11n HT20	100	5260	12.42
	116	5280	12.40

	140	5320	12.14
IEEE 802.11ac VHT20	100	5260	12.41
	116	5280	12.25
	140	5320	12.14
IEEE 802.11n HT40	102	5270	12.45
	134	5310	12.18
IEEE 802.11ac VHT40	102	5270	8.97
	134	5310	8.39
IEEE 802.11ac VHT80	106	5290	8.49

[5GHz U-NII-2C]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
			Antenna1
IEEE 802.11a	100	5500	14.50
	116	5580	14.45
	140	5700	13.71
IEEE 802.11n HT20	100	5500	14.13
	116	5580	14.09
	140	5700	13.16
IEEE 802.11ac VHT20	100	5500	14.17
	116	5580	14.03
	140	5700	13.16
IEEE 802.11n HT40	102	5510	14.30
	118	5590	14.25
	134	5670	13.61
IEEE 802.11ac VHT40	102	5510	10.68
	118	5590	11.38
	134	5670	11.82
IEEE 802.11ac VHT80	106	5530	10.64
	122	5610	11.43

[5GHz U-NII-3]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
			Antenna1
IEEE 802.11a	149	5745	14.27
	157	5785	14.05
	165	5825	14.18
IEEE 802.11n HT20	149	5745	13.74
	157	5785	13.83
	165	5825	13.77
IEEE 802.11ac VHT20	149	5745	13.96
	157	5785	12.46
	165	5825	12.19
IEEE 802.11n HT40	151	5755	13.93
	159	5795	13.76
IEEE 802.11ac VHT40	151	5755	12.39
	159	5795	12.18
IEEE 802.11ac VHT80	155	5775	12.18

6. Standalone MPE Result

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, $r = 20\text{cm}$, the RF power density can be obtained.

Bluetooth

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	W				
GFSK	6.33	0.0043	2	1.5849	0.0135	1.0000
$\pi/4$ DQPSK	5.39	0.0035	2	1.5849	0.0109	1.0000
8-DPSK	5.75	0.0038	2	1.5849	0.0119	1.0000
BLE 1M	5.68	0.0037	2	1.5849	0.0117	1.0000
BLE 2M	5.97	0.0040	2	1.5849	0.0125	1.0000

2.4GHz WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	W				
IEEE 802.11b	16.17	0.0414	2	1.5849	0.1305	1.0000
IEEE 802.11g	22.22	0.1667	2	1.5849	0.5257	1.0000
IEEE 802.11n HT20	21.52	0.1419	2	1.5849	0.4474	1.0000

5GHz U-NII-1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	W				
IEEE 802.11a	13.95	0.0248	2	1.5849	0.0783	1.0000
IEEE 802.11n HT20	12.79	0.0190	2	1.5849	0.0599	1.0000
IEEE 802.11ac VHT20	12.76	0.0189	2	1.5849	0.0595	1.0000
IEEE 802.11n HT40	12.72	0.0187	2	1.5849	0.0590	1.0000
IEEE 802.11ac VHT40	9.80	0.0095	2	1.5849	0.0301	1.0000
IEEE 802.11ac VHT80	9.72	0.0094	2	1.5849	0.0296	1.0000

5GHz U-NII-2A

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	W				
IEEE 802.11a	13.86	0.0243	2	1.5849	0.0767	1.0000
IEEE 802.11n HT20	12.42	0.0175	2	1.5849	0.0550	1.0000
IEEE 802.11ac VHT20	12.41	0.0174	2	1.5849	0.0549	1.0000
IEEE 802.11n HT40	12.45	0.0176	2	1.5849	0.0554	1.0000

IEEE 802.11ac VHT40	8.97	0.0079	2	1.5849	0.0249	1.0000
IEEE 802.11ac VHT80	8.49	0.0071	2	1.5849	0.0223	1.0000

5GHz U-NII-2C

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	W				
IEEE 802.11a	14.50	0.0282	2	1.5849	0.0889	1.0000
IEEE 802.11n HT20	14.13	0.0259	2	1.5849	0.0816	1.0000
IEEE 802.11ac VHT20	14.17	0.0261	2	1.5849	0.0824	1.0000
IEEE 802.11n HT40	14.30	0.0269	2	1.5849	0.0849	1.0000
IEEE 802.11ac VHT40	11.82	0.0152	2	1.5849	0.0479	1.0000
IEEE 802.11ac VHT80	11.43	0.0139	2	1.5849	0.0438	1.0000

5GHz U-NII-3

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	W				
IEEE 802.11a	14.27	0.0267	2	1.5849	0.0843	1.0000
IEEE 802.11n HT20	13.83	0.0242	2	1.5849	0.0762	1.0000
IEEE 802.11ac VHT20	13.96	0.0249	2	1.5849	0.0785	1.0000
IEEE 802.11n HT40	13.93	0.0247	2	1.5849	0.0779	1.0000
IEEE 802.11ac VHT40	12.39	0.0173	2	1.5849	0.0547	1.0000
IEEE 802.11ac VHT80	12.18	0.0165	2	1.5849	0.0521	1.0000

Remark:

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

7. Summary simultaneous transmission information

Synchronization transmit between WIFI and BT

Modulation Type	Modulation Type	Synchronization transmit
IEEE 802.11a	BT	Yes
IEEE 802.11b	BT	Yes
IEEE 802.11g	BT	Yes
IEEE 802.11n HT20	BT	Yes
IEEE 802.11n HT20	BT	Yes
IEEE 802.11n HT40	BT	Yes
IEEE 802.11ac VHT20	BT	Yes
IEEE 802.11ac VHT40	BT	Yes
IEEE 802.11ac VHT80	BT	Yes

8. Summary simultaneous transmission results

Synchronization transmit between WIFI and BT

Max. $\sum MPE_{(wifi)}$ (mW/cm ²)	$MPE_{(BT)}$ (mW/cm ²)	$\sum MPE_{(WIFI+BT)}$ ratios	Limit	Results
0.5257	0.0135	0.5392	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-----