

RF Exposure evaluation

FCC ID: Q9OWCP1000

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

$$S = \frac{PG}{4\pi R^2}$$

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

WCP-1000 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 BT /2.4GWIFI	2.4G	ceramic antenna	2.4GHz – 2.5 GHz	1.99dBi
5.2GWIFI	5.2G	ceramic antenna	5.0GHz – 5.3GHz	2.90dBi
5.8GWIFI	5.8G	ceramic antenna	5.7GHz – 5.9GHz	3.86dBi

5. Conducted power

[2.4GHz BT]

Mode	Frequency	Peak Output Power (dBm)
GFSK	2402	1.047
	2441	1.123
	2480	1.355
$\pi/4$ -DQPSK	2402	-0.045
	2441	0.018
	2480	0.487
8-DPSK	2402	0.299
	2441	0.366
	2480	0.667

[2.4GHz BT]

Mode	Frequency	Peak Output Power (dBm)
GFSK	2402	0.963
	2440	1.052
	2480	1.224

[2.4GHz WLAN]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)
<i>IEEE 802.11b</i>	1	2412	20.25
	6	2437	20.42
	11	2462	20.29
<i>IEEE 802.11g</i>	1	2412	19.93
	6	2437	20.01
	11	2462	19.11
<i>IEEE 802.11n HT20</i>	1	2412	19.77
	6	2437	19.73
	11	2462	18.94

[5.2GHz WLAN]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
<i>802.11a</i>	36	5180	11.67
	40	5200	12.41
	48	5240	13.23
<i>802.11n(HT20)</i>	36	5180	11.28
	40	5200	12.13
	48	5240	12.90
<i>802.11ac(HT20)</i>	36	5180	11.68
	40	5200	12.21
	48	5240	13.46
<i>802.11n(HT40)</i>	38	5190	12.56
	46	5230	13.38
<i>802.11ac(HT40)</i>	38	5190	12.65
	46	5230	14.12
<i>802.11ac(HT80)</i>	42	5210	14.06

[5.8GHz WLAN]

Mode	Channel	Frequency	Average Conducted Output Power (dBm)
802.11a	149	5745	11.90
	157	5785	11.40
	165	5825	10.30
802.11n(HT20)	149	5745	11.68
	157	5785	11.15
	165	5825	10.16
802.11ac(HT20)	149	5745	11.59
	157	5785	10.35
	165	5825	10.22
802.11n(HT40)	151	5755	12.20
	159	5795	10.93
802.11ac(HT40)	151	5755	12.21
	159	5795	10.97
802.11ac(HT80)	155	5775	11.74

6. Manufacturing Tolerance

BT

GFSK(BLE)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	1.00	1.00	1.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0

BLE

GFSK(Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	1.00	1.00	1.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
$\pi/4$ -DQPSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	0.00	0.00	0.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	0.00	0.00	0.00
Tolerance $\pm$ (dB)	1.0	1.0	1.0

2.4GWiFi

802.11b(PK)			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	20.0	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11g(PK)			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	20.0	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n(HT20)(PK)			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	19.0	19.0	19.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n(HT40)(PK)			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	18.0	18.0	18.0
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)	12.5	12.5	12.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (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 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.5	12.5	12.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	---	Channel 46
Target (dBm)	13.0	---	13.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	---	Channel 46
Target (dBm)	13.5	---	13.5
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 42	---
Target (dBm)	---	13.5	---
Tolerance $\pm$ (dB)	---	1.0	---

[5GWLAN Band 3]

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	11.0
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	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	---	Channel 159
Target (dBm)	11.5	---	11.5
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	---	Channel 159
Target (dBm)	11.5	---	11.5
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 155	---
Target (dBm)	---	12.0	---
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 WIFI antenna is 0dBi, the gain of BT antenna is 0dBi.the RF power density can be obtained.

BT

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
GFSK	2.0	1.5849	1.99	1.5812	0.0005	1.0000
$\pi/4$ DQPSK	1.0	1.2589	1.99	1.5812	0.0004	1.0000
8DPSK	1.0	1.2589	1.99	1.5812	0.0004	1.0000
GFSK BLE	2.0	1.5849	1.99	1.5812	0.0005	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	mW				
IEEE 802.11b	21.0	125.8925	1.99	1.5812	0.0396	1.0000
IEEE 802.11g	21.0	125.8925	1.99	1.5812	0.0396	1.0000
IEEE 802.11n HT20	20.0	100.0000	1.99	1.5812	0.0315	1.0000
IEEE 802.11n HT40	19.0	79.4328	1.99	1.5812	0.0250	1.0000

5.2G WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
802.11a	13.5	22.3872	2.90	1.9498	0.0087	1.0000
802.11n(HT20)	13.0	19.9526	2.90	1.9498	0.0077	1.0000
802.11ac(HT20)	13.5	22.3872	2.90	1.9498	0.0087	1.0000
802.11n(HT40)	14.0	25.1189	2.90	1.9498	0.0097	1.0000
802.11ac(HT40)	14.5	28.1838	2.90	1.9498	0.0109	1.0000
802.11ac(HT80)	14.5	28.1838	2.90	1.9498	0.0109	1.0000

5.8G WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
802.11a	12.0	15.8489	3.86	2.4322	0.0077	1.0000
802.11n(HT20)	12.0	15.8489	3.86	2.4322	0.0077	1.0000
802.11ac(HT20)	12.0	15.8489	3.86	2.4322	0.0077	1.0000
802.11n(HT40)	12.5	17.7828	3.86	2.4322	0.0086	1.0000
802.11ac(HT40)	12.5	17.7828	3.86	2.4322	0.0086	1.0000
802.11ac(HT80)	13.0	19.9526	3.86	2.4322	0.0097	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-----