FCC 47 CFR MPE REPORT

CTOUCH Europe B.V.

WIFI MODULE

Model Number: WIM000AS

FCC ID: 2APQQ-WIM000AS

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Maximum Permissible Exposure

1. Applicable Standards

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 limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2m normally can be maintained between the user and the device.

1.1. Limits for Maximum Permissible Exposure (MPE)

(a) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Times $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-10000			5	6

(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 Times $\|E\|^2$, $\|H\|^2$ 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
1500-10000			1.o	30

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

1.2. MPE Calculation Method

$$E\ (V/m) = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power Density: } Pd\ (W/m^2) = \frac{E^2}{377}$$

E = Electric Field (V/m)

P = Peak RF output Power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

2. Conducted Power Result

Antenna 1

Mode	Frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Target power (dBm)	Antenna gain	
					(dBi)	(Linear)
GFSK	2402	9.48	8.8716	9±1	2	1.58489
	2441	9.51	8.9331	9±1	2	1.58489
	2480	8.85	7.6736	8±1	2	1.58489
8-DPSK	2402	10.08	10.1859	10±1	2	1.58489
	2441	10.08	10.1859	10±1	2	1.58489
	2480	9.62	9.1622	9±1	2	1.58489
BLE GFSK	2402	9.42	8.7498	9±1	2	1.58489
	2440	9.46	8.8308	9±1	2	1.58489
	2480	8.84	7.6560	8±1	2	1.58489
IEEE 802.11b	2412	16.98	49.8884	16±1	2	1.58489
	2437	17.32	53.9511	17±1	2	1.58489
	2462	17.42	55.2077	17±1	2	1.58489
IEEE 802.11g	2412	18.62	72.7780	18±1	2	1.58489
	2437	18.87	77.0903	18±1	2	1.58489
	2462	19.15	82.2243	19±1	2	1.58489
IEEE 802.11n HT20(2.4G)	2412	16.13	41.0204	16±1	2	1.58489
	2437	16.24	42.0727	16±1	2	1.58489
	2462	16.38	43.4510	16±1	2	1.58489
IEEE 802.11n HT40 (2.4G)	2422	15.84	38.3707	15±1	2	1.58489
	2437	16.28	42.4620	16±1	2	1.58489
	2452	16.41	43.7522	16±1	2	1.58489
IEEE 802.11a	5180	13.99	25.0611	13±1	2	1.58489
	5200	14.25	26.6073	14±1	2	1.58489
	5240	12.56	18.0302	12±1	2	1.58489
	5745	6.64	4.6132	6±1	2	1.58489
	5785	7.00	5.0119	7±1	2	1.58489
	5825	5.86	3.8548	5±1	2	1.58489

Mode	Frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Target power (dBm)	Antenna gain	
					(dBi)	(Linear)
IEEE 802.11n HT20 (5G)	5180	12.28	16.9044	12±1	2	1.58489
	5200	12.31	17.0216	12±1	2	1.58489
	5240	10.82	12.0781	10±1	2	1.58489
	5745	6.72	4.6989	6±1	2	1.58489
	5785	6.83	4.8195	6±1	2	1.58489
	5825	5.71	3.7239	5±1	2	1.58489
IEEE 802.11ac VHT20	5180	12.34	17.1396	12±1	2	1.58489
	5200	12.35	17.1791	12±1	2	1.58489
	5240	10.78	11.9674	10±1	2	1.58489
	5745	6.74	4.7206	6±1	2	1.58489
	5785	7.08	5.1051	7±1	2	1.58489
	5825	5.85	3.8459	5±1	2	1.58489
IEEE 802.11n HT40 (5G)	5190	9.56	9.0365	9±1	2	1.58489
	5230	12.00	15.8489	12±1	2	1.58489
	5755	7.53	5.6624	7±1	2	1.58489
	5795	7.20	5.2481	7±1	2	1.58489
IEEE 802.11ac VHT40	5190	9.40	8.7096	9±1	2	1.58489
	5230	11.96	15.7036	11±1	2	1.58489
	5755	7.37	5.4576	7±1	2	1.58489
	5795	7.20	5.2481	7±1	2	1.58489
IEEE 802.11ac VHT80	5210	5.39	3.4594	5±1	2	1.58489
	5775	7.19	5.2360	7±1	2	1.58489

Antenna 2

Mode	Frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Target power (dBm)	Antenna gain	
					(dBi)	(Linear)
IEEE 802.11b	2412	17.09	51.1682	17±1	2	1.58489
	2437	17.04	50.5825	17±1	2	1.58489
	2462	16.91	49.0908	16±1	2	1.58489
IEEE 802.11g	2412	18.81	76.0326	18±1	2	1.58489
	2437	18.80	75.8578	18±1	2	1.58489
	2462	18.72	74.4732	18±1	2	1.58489
IEEE 802.11n HT20(2.4G)	2412	16.23	41.9759	16±1	2	1.58489
	2437	16.67	46.4515	16±1	2	1.58489
	2462	16.64	46.1318	16±1	2	1.58489
IEEE 802.11n HT40(2.4G)	2422	16.13	41.0204	16±1	2	1.58489
	2437	16.38	43.4510	16±1	2	1.58489
	2452	16.03	40.0867	16±1	2	1.58489
IEEE 802.11a	5180	15.05	31.9890	15±1	2	1.58489
	5200	14.99	31.5500	14±1	2	1.58489
	5240	14.40	27.5423	14±1	2	1.58489
	5745	4.51	2.8249	4±1	2	1.58489
	5785	4.60	2.8840	4±1	2	1.58489
	5825	3.40	2.1878	3±1	2	1.58489
IEEE 802.11n HT20 (5G)	5180	13.03	20.0909	13±1	2	1.58489
	5200	12.89	19.4536	12±1	2	1.58489
	5240	12.63	18.3231	12±1	2	1.58489
	5745	4.43	2.7733	4±1	2	1.58489
	5785	4.18	2.6182	4±1	2	1.58489
	5825	3.28	2.1281	3±1	2	1.58489
IEEE 802.11ac VHT20	5180	12.96	19.7697	12±1	2	1.58489
	5200	12.95	19.7242	12±1	2	1.58489
	5240	12.52	17.8649	12±1	2	1.58489
	5745	4.80	3.0200	4±1	2	1.58489
	5785	4.74	2.9785	4±1	2	1.58489
	5825	3.38	2.1777	3±1	2	1.58489

Mode	Frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Target power (dBm)	Antenna gain	
					(dBi)	(Linear)
IEEE 802.11n HT40 (5G)	5190	9.74	9.4189	9±1	2	1.58489
	5230	13.46	22.1820	13±1	2	1.58489
	5755	5.19	3.3037	5±1	2	1.58489
	5795	4.51	2.8249	4±1	2	1.58489
IEEE 802.11ac VHT40	5190	9.82	9.5940	9±1	2	1.58489
	5230	13.37	21.7270	13±1	2	1.58489
	5755	5.20	3.3113	5±1	2	1.58489
	5795	4.48	2.8054	4±1	2	1.58489
IEEE 802.11ac VHT80	5210	6.13	4.1020	6±1	2	1.58489
	5775	4.35	2.7227	4±1	2	1.58489

3. Calculated Result and Limit

Antenna 1

Mode	Target power (dBm)	Antenna gain		Power Density (S) (mW/cm^2)	Limited of Power Density (S) (mW/cm^2)	Test Result
		(dBi)	(Linear)			
2.4G Band						
GFSK	10	2	1.58489	0.00315	1	Compiles
8-DPSK	11	2	1.58489	0.00397	1	Compiles
BLE GFSK	10	2	1.58489	0.00315	1	Compiles
IEEE 802.11b	18	2	1.58489	0.01989	1	Compiles
IEEE 802.11g	20	2	1.58489	0.03153	1	Compiles
IEEE 802.11n HT20	17	2	1.58489	0.01580	1	Compiles
IEEE 802.11n HT40	17	2	1.58489	0.01580	1	Compiles
5G Band						
IEEE 802.11a	15	2	1.58489	0.00997	1	Compiles
IEEE 802.11n HT20	13	2	1.58489	0.00629	1	Compiles
IEEE 802.11ac VHT20	13	2	1.58489	0.00629	1	Compiles
IEEE 802.11n HT40	13	2	1.58489	0.00629	1	Compiles
IEEE 802.11ac VHT40	12	2	1.58489	0.00500	1	Compiles
IEEE 802.11ac VHT80	8	2	1.58489	0.00199	1	Compiles

Antenna 2

Mode	Target power (dBm)	Antenna gain		Power Density (S) (mW/cm^2)	Limited of Power Density (S) (mW/cm^2)	Test Result
		(dBi)	(Linear)			
2.4G Band						
IEEE 802.11b	18	2	1.58489	0.01989	1	Compiles
IEEE 802.11g	19	2	1.58489	0.02505	1	Compiles
IEEE 802.11n HT20	17	2	1.58489	0.01580	1	Compiles
IEEE 802.11n HT40	17	2	1.58489	0.01580	1	Compiles
5G Band						
IEEE 802.11a	16	2	1.58489	0.01255	1	Compiles
IEEE 802.11n HT20	14	2	1.58489	0.00792	1	Compiles
IEEE 802.11ac VHT20	13	2	1.58489	0.00629	1	Compiles
IEEE 802.11n HT40	14	2	1.58489	0.00792	1	Compiles
IEEE 802.11ac VHT40	14	2	1.58489	0.00792	1	Compiles
IEEE 802.11ac VHT80	7	2	1.58489	0.00158	1	Compiles

Antenna 1+2

Mode	Directional AntennaGain (Numeric)	Peak Output Power (mW)	Power Density (S) (mW/cm^2) Total	Limited of Power Density (S) (mW/cm^2)	Test Result
2.4G Band					
IEEE 802.11n HT20	3.170 (5.01dBi)	89.6	0.05650	1	Compiles
IEEE 802.11n HT40	3.170 (5.01dBi)	85.9	0.05417	1	Compiles
5G Band					
IEEE 802.11n HT20	3.170 (5.01dBi)	37.0	0.02333	1	Compiles
IEEE 802.11ac VHT20	3.170 (5.01dBi)	37.0	0.02333	1	Compiles
IEEE 802.11n HT40	3.170 (5.01dBi)	38.0	0.02396	1	Compiles
IEEE 802.11ac VHT40	3.170 (5.01dBi)	37.4	0.02358	1	Compiles
IEEE 802.11ac VHT80	3.170 (5.01dBi)	8.0	0.00504	1	Compiles

Note: 2.4 and 5GHz bands are share an antenna, Cann't both the 2.4 and 5 GHz bands operate simultaneously.

End of Test Report