FCC ID: 2AXDW-PJ1

Maximum Permissible Exposure (MPE)

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) 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
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

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

MPE Calculation Method

E (V/m) = $\frac{\sqrt{30*P*G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = Average 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 = $\frac{30*P*G}{377*D^2}$

From the 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.

Measurement Result

Module 2 BT:

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm^2

Antenna Type: FPCB antenna

WIFI antenna gain: 2dBi;

R=20cm

mW=10^(dBm/10)

antenna gain Numeric=10^(dBi/10)= 10^(2/10)=1.58

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Numeric		
2402	GFSK	2.937	2±1	3	1.995262	1.58	0.00063	1
2441		4.664	4±1	5	3.162278	1.58	0.00099	1
2480		3.435	4±1	5	3.162278	1.58	0.00099	1
2402	π/4-DQPSK,	2.143	2±1	3	1.995262	1.58	0.00063	1
2441		3.799	3±1	4	2.511886	1.58	0.00079	1
2480		2.592	2±1	3	1.995262	1.58	0.00063	1
2402	8DPSK	2.628	3.5±1	4.5	2.818383	1.58	0.00089	1
2441		4.24	3.5±1	4.5	2.818383	1.58	0.00089	1
2480		2.952	3.5±1	4.5	2.818383	1.58	0.00089	1
2402	BLE(GFSK)	2.987	2±1	3	1.995262	1.58	0.00063	1
2440		4.728	4±1	5	3.162278	1.58	0.00099	1
2480		3.451	4±1	5	3.162278	1.58	0.00099	1

Module 2 2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,

WIFI 802.11n HT40:2422-2452MHz

Power density limited: 1mW/ cm^2

Antenna Type: FPCB antenna

WIFI antenna gain: 2dBi;

R=20cm

mW=10^(dBm/10)

antenna gain Numeric=10^(dBi/10)= 10^(2/10)=1.58

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Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Numeric		
2412	802.11b	13.08	13±1	14	25.11886	1.58	0.00790	1
2437		12.23	13±1	14	25.11886	1.58	0.00790	1
2462		12.26	13±1	14	25.11886	1.58	0.00790	1
2412	802.11g	13.19	13±1	14	25.11886	1.58	0.00790	1
2437		12.77	13±1	14	25.11886	1.58	0.00790	1
2462		12.29	13±1	14	25.11886	1.58	0.00790	1
2412	802.11n H20	13.37	13±1	14	25.11886	1.58	0.00790	1
2437		12.33	13±1	14	25.11886	1.58	0.00790	1
2462		12.31	13±1	14	25.11886	1.58	0.00790	1
2422	802.11n H40	12.97	13±1	14	25.11886	1.58	0.00790	1
2437		13.36	13±1	14	25.11886	1.58	0.00790	1
2452		13.49	13±1	14	25.11886	1.58	0.00790	1

Module 1 2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,HT40:2422-2452MHz
Power density limited: 1mW/ cm^2
Antenna Type: FPCB antenna
WIFI antenna gain: 2dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)=10^(2/10)=1.58

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Numeric		
2412	802.11b	12.75	12.5±1	13.5	22.38721	1.58	0.00704	1
2437		13.37	12.5±1	13.5	22.38721	1.58	0.00704	1
2462		11.99	12.5±1	13.5	22.38721	1.58	0.00704	1
2412	802.11g	11.69	12±1	13	19.95262	1.58	0.00627	1
2437		12.14	12±1	13	19.95262	1.58	0.00627	1
2462		11.14	12±1	13	19.95262	1.58	0.00627	1
2412	802.11n H20	11.57	11±1	12	15.84893	1.58	0.00498	1
2437		12	11±1	12	15.84893	1.58	0.00498	1
2462		10.96	11±1	12	15.84893	1.58	0.00498	1
2422	802.11n H40	13.53	13±1	14	25.11886	1.58	0.00790	1
2437		12.44	13±1	14	25.11886	1.58	0.00790	1
2452		12.41	13±1	14	25.11886	1.58	0.00790	1

Module 2 5G WIFI:

Operation Frequency: WIFI 802.11a/ac/n(HT20): 5180-5240MHz;5260-5320MHz,5500-5700MHz,5745-5825MHz;WIFI 802.11ac/n(HT40): 5190-5230MHz;5270-5310MHz,5510-5670MHz5755-5795MHz; WIFI 802.11ac80:5210-5210MHz;5290-5290MHz;5530-5610MHz;5775-5775MHz
Power density limited: 1mW/cm
Antenna Type: FPCB antenna
WIFI antenna1 gain: 2dBi; WIFI antenna2 gain: 2dBi
R=20cm
mW=10^(dBm/10)
antenna1 gain Numeric=10^(dBi/10)= 10^(2/10)=1.58
antenna2 gain Numeric=10^(dBi/10)= 10^(2/10)=1.58
5.2G
SISO

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Numeric		
5180	802.11a	10.3	9.5±1	10.5	11.22018	1.58	0.00353	1
5200		9.22	9.5±1	10.5	11.22018	1.58	0.00353	1
5240		8.65	9.5±1	10.5	11.22018	1.58	0.00353	1
5180	802.11n H20	10.05	9.5±1	10.5	11.22018	1.58	0.00353	1
5200		9.12	9.5±1	10.5	11.22018	1.58	0.00353	1
5240		8.56	9.5±1	10.5	11.22018	1.58	0.00353	1
5190	802.11n H40	9.82	9±1	10	10	1.58	0.00314	1
5230		8.65	9±1	10	10	1.58	0.00314	1
5180	802.11ac 20	9.98	9±1	10	10	1.58	0.00314	1
5200		9.24	9±1	10	10	1.58	0.00314	1
5240		8.47	9±1	10	10	1.58	0.00314	1
5190	802.11ac 40	9.76	9±1	10	10.00	1.58	0.00314	1
5230		9.02	9±1	10	10.00	1.58	0.00314	1
5210	802.11ac 80	9.51	9±1	10	10	1.58	0.00314	1

5.3G

SISO

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Numeric		
5260	802.11a	9.63	9±1	10	10	1.58	0.00314	1
5280		9.21	9±1	10	10	1.58	0.00314	1
5320		8	9±1	10	10	1.58	0.00314	1
5260	802.11n H20	9.49	8.5±1	9.5	8.912509	1.58	0.00280	1
5280		8.99	8.5±1	9.5	8.912509	1.58	0.00280	1
5320		7.95	8.5±1	9.5	8.912509	1.58	0.00280	1
5270	802.11n H40	9.42	9±1	10	10	1.58	0.00314	1
5310		9.73	9±1	10	10	1.58	0.00314	1
5260	802.11ac 20	9.35	8.5±1	9.5	8.912509	1.58	0.00280	1
5280		8.98	8.5±1	9.5	8.912509	1.58	0.00280	1
5320		7.87	8.5±1	9.5	8.912509	1.58	0.00280	1
5270	802.11ac 40	9.42	9±1	10	10	1.58	0.00314	1
5310		9.69	9±1	10	10	1.58	0.00314	1
5290	802.11ac 80	10.22	10±1	11	12.58925	1.58	0.00396	1

5.6G
SISO

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Gain		
5500	802.11a	9.34	9±1	10	10	1.58	0.00314	1
5600		9.68	9±1	10	10	1.58	0.00314	1
5700		9.74	9±1	10	10	1.58	0.00314	1
5500	802.11n H20	9.05	9±1	10	10	1.58	0.00314	1
5600		9.53	9±1	10	10	1.58	0.00314	1
5700		9.63	9±1	10	10	1.58	0.00314	1
5510	802.11n H40	9.02	8.5±1	9.5	8.912509	1.58	0.00280	1
5590		8.98	8.5±1	9.5	8.912509	1.58	0.00280	1
5670		7.69	8.5±1	9.5	8.912509	1.58	0.00280	1
5500	802.11ac 20	9.15	9±1	10	19.95	1.58	0.00627	1
5600		9.68	9±1	10	19.95	1.58	0.00627	1
5700		9.64	9±1	10	19.95	1.58	0.00627	1
5510	802.11ac 40	9	8.5±1	9.5	19.95	1.58	0.00627	1
5590		9.13	8.5±1	9.5	19.95	1.58	0.00627	1
5670		7.8	8.5±1	9.5	19.95	1.58	0.00627	1
5530	802.11ac 80	7.47	8±1	9	19.95	1.58	0.00627	1
5610		8.26	8±1	9	19.95	1.58	0.00627	1

5.8G
SISO

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2	(mW/cm2)
				(dBm)	(mW)	Numeric		
5745	802.11a	8.6	9±1	10	10	1.58	0.00314	1
5785		9.58	9±1	10	10	1.58	0.00314	1
5825		9.35	9±1	10	10	1.58	0.00314	1
5745	802.11n20	8.6	9±1	10	10	1.58	0.00314	1
5785		9.48	9±1	10	10	1.58	0.00314	1
5825		9.16	9±1	10	10	1.58	0.00314	1
5755	802.11n40	8.82	9±1	10	10	1.58	0.00314	1
5795		9.91	9±1	10	10	1.58	0.00314	1
5745	802.11ac 20	8.63	9±1	10	10	1.58	0.00314	1
5785		9.46	9±1	10	10	1.58	0.00314	1
5825		9.2	9±1	10	10	1.58	0.00314	1
5755	802.11ac 40	8.93	9±1	10	10	1.58	0.00314	1
5795		10	9±1	10	10	1.58	0.00314	1
5775	802.11ac 80	8.81	8±1	9	7.94	1.58	0.00250	1

Module 2 WLAN2.4G MIMO

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Calculation result	Conclusion
Ant 1	11.77	2	13.77	23.82	20	0.004739	1	0.011781	Pass
Ant 2	13.49	2	15.49	35.40	20	0.007042	1		

Module 2 WLAN5G MIMO

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Calculation result	Conclusion
Ant 1	9.92	2	11.92	15.56	20	0.003095	1	0.006412	Pass
Ant 2	10.22	2	12.22	16.67	20	0.003317	1		

Conclusion:

The conclusion for MIMO mode should be 0.011781＜1 for Max Power Density, Compliance the RF Exposure requirement.
The 2.4Gwifi module 2 has the maximum Power Density value 0.011781 mW/cm2 in 2.4G MIMO transmitting mode;
The 5Gwifi module 2 has the maximum Power Density value 0.006412 mW/cm2 in 5G MIMO transmitting mode;
Module 1 and Module 2 cannot be transmitted at the same time.

Signature:
Date: 2021-04-19

NAME AND TITLE (Please print or type): alex li/Manager

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