

FCC ID: 2AV7T-PD1

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

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

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 A BT:

Operation Frequency: 2402MHz~2480MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: Built-in helical antenna

WIFI antenna gain: 1.0dBi;

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(1/10)}=1.26$

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/cm^2)	(mW/cm2)
				(dBm)	(mW)	Numeric		
2402	GFSK	5.692	5±1	6	3.981072	1.26	0.00100	1
2441		4.48	5±1	6	3.981072	1.26	0.00100	1
2480		4.824	5±1	6	3.981072	1.26	0.00100	1
2402	π/4-DQPSK,	5.358	5±1	6	3.981072	1.26	0.00100	1
2441		4.154	5±1	6	3.981072	1.26	0.00100	1
2480		4.428	5±1	6	3.981072	1.26	0.00100	1
2402	8DPSK	5.706	5±1	6	3.981072	1.26	0.00100	1
2441		4.457	5±1	6	3.981072	1.26	0.00100	1
2480		4.686	5±1	6	3.981072	1.26	0.00100	1
2402	BLE(GFSK)	0.518	0±1	1	1.258925	1.26	0.00032	1
2440		-0.216	0±1	1	1.258925	1.26	0.00032	1
2480		0.122	0±1	1	1.258925	1.26	0.00032	1

Module A 2.4G WIFI:

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

WIFI 802.11n HT40:2422-2452MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: Built-in helical Antenna

WIFI antenna gain: 1.0dBi;

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(1/10)}=1.26$

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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/cm^2)	(mW/cm2)
				(dBm)	(mW)	Numeric		
2412	802.11b	10.49	10±1	11	12.58925	1.26	0.00316	1
2437		10.25	10±1	11	12.58925	1.26	0.00316	1
2462		9.53	10±1	11	12.58925	1.26	0.00316	1
2412	802.11g	9.89	10±1	11	12.58925	1.26	0.00316	1
2437		10.11	10±1	11	12.58925	1.26	0.00316	1
2462		9.2	10±1	11	12.58925	1.26	0.00316	1
2412	802.11n H20	9.99	10±1	11	12.58925	1.26	0.00316	1
2437		10.24	10±1	11	12.58925	1.26	0.00316	1
2462		9.54	10±1	11	12.58925	1.26	0.00316	1
2422	802.11n H40	9.73	10.5±1	11.5	14.12538	1.26	0.00354	1
2437		11.24	10.5±1	11.5	14.12538	1.26	0.00354	1
2452		10.08	10.5±1	11.5	14.12538	1.26	0.00354	1

Module B 2.4G WIFI:

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

Power density limited: 1mW/ cm²

Antenna Type: Built-in helical Antenna

WIFI antenna gain: 1.0dBi;

R=20cm

$mW=10^{(dBm/10)}$

antenna gain Numeric= $10^{(dBi/10)}=10^{(1/10)}=1.26$

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	11.39	10.5±1	11.5	14.12538	1.26	0.00354	1
2437		9.89	10.5±1	11.5	14.12538	1.26	0.00354	1
2462		10.87	10.5±1	11.5	14.12538	1.26	0.00354	1
2412	802.11g	10.91	10.5±1	11.5	14.12538	1.26	0.00354	1
2437		9.5	10.5±1	11.5	14.12538	1.26	0.00354	1
2462		10.42	10.5±1	11.5	14.12538	1.26	0.00354	1
2412	802.11n H20	10.83	10±1	11	12.58925	1.26	0.00316	1
2437		9.17	10±1	11	12.58925	1.26	0.00316	1
2462		10.15	10±1	11	12.58925	1.26	0.00316	1

Module A 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: Built-in helical Antenna

WIFI antenna1 gain: 2.0dBi; WIFI antenna1 gain: 3.0dBi

R=20cm

$mW=10^{(dBm/10)}$

antenna gain Numeric= $10^{(dBi/10)}=10^{(1/10)}=2$

5.2G

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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		
5180	802.11a	12.17	12±1	13	19.95262	2	0.00794	1
5200		12.66	12±1	13	19.95262	2	0.00794	1
5240		11.92	12±1	13	19.95262	2	0.00794	1
5180	802.11n H20	13.66	13±1	14	25.11886	2	0.00999	1
5200		12.63	13±1	14	25.11886	2	0.00999	1
5240		12.01	13±1	14	25.11886	2	0.00999	1
5190	802.11n H40	9.16	9±1	10	10	2	0.00398	1
5230		9.26	9±1	10	10	2	0.00398	1
5180	802.11ac 20	13.55	13±1	14	25.11886	2	0.00999	1
5200		12.1	13±1	14	25.11886	2	0.00999	1
5240		12.75	13±1	14	25.11886	2	0.00999	1
5190	802.11ac 40	8.45	8±1	9	7.943282	2	0.00316	1
5230		8.25	8±1	9	7.943282	2	0.00316	1
5210	802.11ac 80	10.47	10±1	11	12.58925	2	0.00501	1

5.3G

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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		
5260	802.11a	13.62	13±1	14	25.11886	2	0.00999	1
5280		13.72	13±1	14	25.11886	2	0.00999	1
5320		12.4	13±1	14	25.11886	2	0.00999	1
5260	802.11n H20	13.39	13±1	14	25.11886	2	0.00999	1
5280		13.7	13±1	14	25.11886	2	0.00999	1
5320		12.37	13±1	14	25.11886	2	0.00999	1
5270	802.11n H40	10.44	10±1	11	12.58925	2	0.00501	1
5310		9.6	10±1	11	12.58925	2	0.00501	1
5260	802.11ac 20	12.87	12±1	13	19.95262	2	0.00794	1
5280		12.91	12±1	13	19.95262	2	0.00794	1
5320		11.75	12±1	13	19.95262	2	0.00794	1
5270	802.11ac 40	10.85	10±1	11	12.58925	2	0.00501	1
5310		10.18	10±1	11	12.58925	2	0.00501	1
5290	802.11ac 80	8.71	8±1	9	7.943282	2	0.00316	1

5.6G

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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)	Gain		
5500	802.11a	12.9	13±1	14	25.11886	2	0.00999	1
5600		13.29	13±1	14	25.11886	2	0.00999	1
5700		11.75	13±1	14	25.11886	2	0.00999	1
5500	802.11n H20	13.67	13±1	14	25.11886	2	0.00999	1
5600		13.13	13±1	14	25.11886	2	0.00999	1
5700		11.74	11±1	12	15.84893	2	0.00631	1
5510	802.11n H40	12.02	12±1	13	19.95262	2	0.00794	1
5590		12.85	12±1	13	19.95262	2	0.00794	1
5670		11.53	12±1	13	19.95262	2	0.00794	1
5500	802.11ac 20	10.64	10±1	11	19.95262	2	0.00627	1
5600		10.39	10±1	11	19.95262	2	0.00627	1
5700		9.73	10±1	11	19.95262	2	0.00627	1
5510	802.11ac 40	10.08	11±1	12	19.95262	2	0.00627	1
5590		11.87	11±1	12	19.95262	2	0.00627	1
5670		10.18	11±1	12	19.95262	2	0.00627	1
5530	802.11ac 80	8.6	9±1	10	19.95262	2	0.00627	1
5610		9.78	9±1	10	19.95262	2	0.00627	1

5.8G
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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/cm ²)	(mW/cm ²)
				(dBm)	(mW)	Numeric		
5745	802.11a	13.65	13±1	14	25.11886	2	0.00999	1
5785		13.34	13±1	14	25.11886	2	0.00999	1
5825		13.28	13±1	14	25.11886	2	0.00999	1
5745	802.11n20	13.82	13±1	14	25.11886	2	0.00999	1
5785		13.12	13±1	14	25.11886	2	0.00999	1
5825		13.42	13±1	14	25.11886	2	0.00999	1
5755	802.11n40	13.83	13±1	14	25.11886	2	0.00999	1
5795		13.34	13±1	14	25.11886	2	0.00999	1
5745	802.11ac 20	13.1	13±1	14	25.11886	2	0.00999	1
5785		12.52	13±1	14	25.11886	2	0.00999	1
5825		12.61	13±1	14	25.11886	2	0.00999	1
5755	802.11ac 40	12.72	12±1	13	19.95262	2	0.00794	1
5795		12.44	12±1	13	19.95262	2	0.00794	1
5775	802.11ac 80	12.43	12±1	13	19.95262	2	0.00794	1

Module A 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	10.58	1	11.58	14.39	20	0.0286	1	0.0319	Pass
Ant 2	11.24	1	12.24	16.75	20	0.0033	1		

Module A 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	13.83	2	15.83	38.28	20	0.0076	1	0.0166	Pass
Ant 2	13.57	3	16.57	45.39	20	0.0090	1		

Conclusion:

For the max result : $0.00999 \leq 1.0$ for Max Power Density, Compliance the RF Exposure requirement.

The 2.4Gwifi moduleA has the maximum Power Density value 0.0319 mW/cm² in 2.4G MIMO transmitting mode;

The 5Gwifi module has the maximum Power Density value 0.166 mW/cm² in 5G MIMO transmitting mode;

Module A and Module B cannot be transmitted at the same time.

Signature:
Date: 2020-05-18

A handwritten signature in black ink that reads "Alex". The letters are cursive and fluid, with a long horizontal stroke for the 'x'.

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