

FCC ID: 2A9FT-Z400-H

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

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

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.

BT:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: External antenna

Antenna gain:3.58dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(3.58/10)}=2.28

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	DH5	8.66	8±1	9	7.943	3.58	2.28	0.0036	1
2441		8.8	8±1	9	7.943	3.58	2.28	0.0036	1
2480		8.35	8±1	9	7.943	3.58	2.28	0.0036	1
2402	2DH5	7.9	8±1	9	7.943	3.58	2.28	0.0036	1
2441		8.03	8±1	9	7.943	3.58	2.28	0.0036	1
2480		7.64	8±1	9	7.943	3.58	2.28	0.0036	1
2402	3DH5	7.87	8±1	9	7.943	3.58	2.28	0.0036	1
2441		8.02	8±1	9	7.943	3.58	2.28	0.0036	1
2480		7.64	8±1	9	7.943	3.58	2.28	0.0036	1

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
2402	GFSK(1M)	-4.15	-3.5±1	-2.5	0.562	3.58	2.28	0.0003	1
2440		-3.48	-3.5±1	-2.5	0.562	3.58	2.28	0.0003	1
2480		-4.01	-3.5±1	-2.5	0.562	3.58	2.28	0.0003	1
2402	GFSK(2M)	-4.21	-3.5±1	-2.5	0.562	3.58	2.28	0.0003	1
2440		-3.52	-3.5±1	-2.5	0.562	3.58	2.28	0.0003	1
2480		-4.01	-3.5±1	-2.5	0.562	3.58	2.28	0.0003	1

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: External antenna

Antenna gain: 3.58dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.58/10)}=2.28$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
				(dBm)	(mW)	(dBi)	Numeric		
2412	802.11b	17.73	17.5±1	18.5	70.795	3.58	2.28	0.0321	1
2437		17.81	17.5±1	18.5	70.795	3.58	2.28	0.0321	1
2462		18.08	17.5±1	18.5	70.795	3.58	2.28	0.0321	1
2412	802.11g	15.58	15±1	16	39.811	3.58	2.28	0.0181	1
2437		15.78	15±1	16	39.811	3.58	2.28	0.0181	1
2462		15.92	15±1	16	39.811	3.58	2.28	0.0181	1
2412	802.11n H20	14.89	14.5±1	15.5	35.481	3.58	2.28	0.0161	1
2437		15.28	14.5±1	15.5	35.481	3.58	2.28	0.0161	1
2462		15.41	14.5±1	15.5	35.481	3.58	2.28	0.0161	1
2422	802.11n(H T40)	15.17	14.5±1	15.5	35.481	3.58	2.28	0.0161	1
2437		14.88	14.5±1	15.5	35.481	3.58	2.28	0.0161	1
2452		14.98	14.5±1	15.5	35.481	3.58	2.28	0.0161	1

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: External antenna

Antenna gain:5.29dBi;

R=20cm

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

antenna gain Numeric= $10^{(dBi/10)}=10^{(5.29/10)}=3.38$

5.2G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
5180	a	11.37	11±1	12	15.849	5.29	3.38	0.0107	1
5200	a	12.2	11±1	12	15.849	5.29	3.38	0.0107	1
5240	a	12.34	11±1	12	15.849	5.29	3.38	0.0107	1
5180	n20	11.32	11±1	12	15.849	5.29	3.38	0.0107	1
5200	n20	12.17	11±1	12	15.849	5.29	3.38	0.0107	1
5240	n20	11.29	11±1	12	15.849	5.29	3.38	0.0107	1
5190	n40	9.11	9±1	10	10.000	5.29	3.38	0.0067	1
5230	n40	9.9	9±1	10	10.000	5.29	3.38	0.0067	1
5180	ac20	10.35	11±1	12	15.849	5.29	3.38	0.0107	1
5200	ac20	11.75	11±1	12	15.849	5.29	3.38	0.0107	1
5240	ac20	11.75	11±1	12	15.849	5.29	3.38	0.0107	1
5190	ac40	10.1	10±1	11	12.589	5.29	3.38	0.0085	1
5230	ac40	11	10±1	11	12.589	5.29	3.38	0.0085	1
5210	ac80	9.86	9±1	10	10.000	5.29	3.38	0.0067	1

5.3G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density (mW/cm2)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5260	a	15.51	15±1	16	39.811	5.29	3.38	0.0268	1
5280	a	15.42	15±1	16	39.811	5.29	3.38	0.0268	1
5320	a	14.27	15±1	16	39.811	5.29	3.38	0.0268	1
5260	n20	14.29	14.5±1	15.5	35.481	5.29	3.38	0.0239	1
5280	n20	15.33	14.5±1	15.5	35.481	5.29	3.38	0.0239	1
5320	n20	14.72	14.5±1	15.5	35.481	5.29	3.38	0.0239	1
5270	n40	12.55	12±1	13	19.953	5.29	3.38	0.0134	1
5310	n40	11.54	12±1	13	19.953	5.29	3.38	0.0134	1
5260	ac20	14.32	14±1	15	31.623	5.29	3.38	0.0213	1
5280	ac20	14.26	14±1	15	31.623	5.29	3.38	0.0213	1
5320	ac20	14.71	14±1	15	31.623	5.29	3.38	0.0213	1
5270	ac40	12.6	12±1	13	19.953	5.29	3.38	0.0134	1
5310	ac40	12.1	12±1	13	19.953	5.29	3.38	0.0134	1
5290	ac80	11.64	11±1	12	15.849	5.29	3.38	0.0107	1

5.6G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
5500	a	13.93	13.5±1	14.5	28.184	5.29	3.38	0.0190	1
5600	a	14.04	13.5±1	14.5	28.184	5.29	3.38	0.0190	1
5700	a	12.63	13.5±1	14.5	28.184	5.29	3.38	0.0190	1
5500	n20	13.71	13±1	14	25.119	5.29	3.38	0.0169	1
5600	n20	13.79	13±1	14	25.119	5.29	3.38	0.0169	1
5700	n20	12.6	13±1	14	25.119	5.29	3.38	0.0169	1
5510	n40	10.55	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5590	n40	12.24	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5670	n40	12.31	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5500	ac20	13.83	13±1	14	25.119	5.29	3.38	0.0169	1
5600	ac20	13.87	13±1	14	25.119	5.29	3.38	0.0169	1
5700	ac20	12.63	13±1	14	25.119	5.29	3.38	0.0169	1
5510	ac40	10.56	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5590	ac40	12.16	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5670	ac40	12.37	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5530	ac80	10.98	11.5±1	12.5	17.783	5.29	3.38	0.0120	1
5610	ac80	12.39	11.5±1	12.5	17.783	5.29	3.38	0.0120	1

5.8G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5745	a	14.27	14±1	15	31.623	5.29	3.38	0.0213	1
5785	a	14.46	14±1	15	31.623	5.29	3.38	0.0213	1
5825	a	14.79	14±1	15	31.623	5.29	3.38	0.0213	1
5745	n20	14.18	14±1	15	31.623	5.29	3.38	0.0213	1
5785	n20	14.25	14±1	15	31.623	5.29	3.38	0.0213	1
5825	n20	14.66	14±1	15	31.623	5.29	3.38	0.0213	1
5755	n40	14.84	14±1	15	31.623	5.29	3.38	0.0213	1
5795	n40	14.42	14±1	15	31.623	5.29	3.38	0.0213	1
5745	ac20	14.12	14±1	15	31.623	5.29	3.38	0.0213	1
5785	ac20	14.42	14±1	15	31.623	5.29	3.38	0.0213	1
5825	ac20	14.76	14±1	15	31.623	5.29	3.38	0.0213	1
5755	ac40	14.86	14±1	15	31.623	5.29	3.38	0.0213	1
5795	ac40	14.4	14±1	15	31.623	5.29	3.38	0.0213	1
5775	ac80	14.95	14±1	15	31.623	5.29	3.38	0.0213	1

GSM/WCDMA/LTE

Antenna Type: External antenna Gain:1dBi

modulation	Max		Antenna		Evaluation result	Power density Limits
	tune-up power		Gain		(mW/cm2)	(mW/cm2)
	(dBm)	(mW)	(dBi)	Numeric		
GSM850	33	1995.262	1	1.26	0.4997	0.549
PCS1900	30.5	1122.018	1	1.26	0.2810	1.000
WCDMA Band 2	25	316.228	1	1.26	0.0792	1.000
WCDMA Band 4	25	316.228	1	1.26	0.0792	1.000
WCDMA Band 5	24.5	281.838	1	1.26	0.0706	0.551
LTE Band 2	24.5	281.838	1	1.26	0.0706	1.000
LTE Band 4	24.5	281.838	1	1.26	0.0706	1.000
LTE Band 5	24	251.189	1	1.26	0.0629	0.550
LTE Band 7	25	316.228	1	1.26	0.0792	1.000
LTE Band 12	24	251.189	1	1.26	0.0629	0.466
LTE Band 13	24	251.189	1	1.26	0.0629	0.520
LTE Band 14	23.5	223.872	1	1.26	0.0561	0.527
LTE Band 17	23.5	223.872	1	1.26	0.0561	0.471
LTE Band 25	24.5	281.838	1	1.26	0.0706	1.000
LTE Band 26A	24	251.189	1	1.26	0.0629	0.543
LTE Band 26B	24	251.189	1	1.26	0.0629	0.550
LTE Band 38	25	316.228	1	1.26	0.0792	1.000
LTE Band 41	25	316.228	1	1.26	0.0792	1.000
LTE Band 66	23	199.526	1	1.26	0.0500	1.000
LTE Band 71	24	251.189	1	1.26	0.0629	0.444

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2 , H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i} \leq 1$$

Max. SIMULTANEOUS TRANSMISSIONS MODE

Band	SISO					MIMO		Verdict
	Max Power	Antenna	Separation distance (cm)	Evaluation result	Power density	Evaluation result	Power density Limits	
	(dBm)	Gain		(mW/cm2)	(mW/cm2)			
		(dBi)						
Wi-Fi 2.4G + GSM 850	18.08	3.58	20	0.012786	1	0.701673	1	PASS
	32.79	1	20	0.378199	0.549			

Signature:

Date: 2023-06-06

Alex

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