FCC ID: 2BB5A-GSS

KDB447498 D01 General RF Exposure Guidance v06

RF EXPOSURE EVALUATION

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

$$E\ (V/m) = \frac{\sqrt{30 * P * G}}{d}$$

$$\text{Power Density: } Pd\ (W/m^2) = \frac{E^2}{377}$$

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

BT
Operation Frequency: 2402MHz~2480MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:2.21dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(2.21/10)=1.66

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	DH5	3.57	4±1	5	3.162	2.21	1.66	0.0010	1
2441		4.28	4±1	5	3.162	2.21	1.66	0.0010	1
2480		3.61	4±1	5	3.162	2.21	1.66	0.0010	1
2402	2DH5	2.08	2±1	3	1.995	2.21	1.66	0.0007	1
2441		2.67	2±1	3	1.995	2.21	1.66	0.0007	1
2480		1.99	2±1	3	1.995	2.21	1.66	0.0007	1
2402	3DH5	2.42	3±1	4	2.512	2.21	1.66	0.0008	1
2441		3.08	3±1	4	2.512	2.21	1.66	0.0008	1
2480		2.34	3±1	4	2.512	2.21	1.66	0.0008	1

BLE
Operation Frequency: 2402MHz~2480MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:2.21dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(2.21/10)=1.66

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	BLE1M	5.92	6±1	7	5.012	2.21	1.66	0.0017	1
2440		6.53	6±1	7	5.012	2.21	1.66	0.0017	1
2480		5.74	6±1	7	5.012	2.21	1.66	0.0017	1
2402	BLE2M	6.06	6±1	7	5.012	2.21	1.66	0.0017	1
2440		6.63	6±1	7	5.012	2.21	1.66	0.0017	1
2480		5.81	6±1	7	5.012	2.21	1.66	0.0017	1

2.4GWIFI
Operation Frequency: 2412MHz~2462MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:2.21dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(2.21/10)=1.66

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2412	802.11b	15.91	16.5±1	17.5	56.234	2.21	1.66	0.0186	1
2437		16.74	16.5±1	17.5	56.234	2.21	1.66	0.0186	1
2462		17.05	16.5±1	17.5	56.234	2.21	1.66	0.0186	1
2412	802.11g	14.48	14±1	15	31.623	2.21	1.66	0.0105	1
2437		14.29	14±1	15	31.623	2.21	1.66	0.0105	1
2462		14.01	14±1	15	31.623	2.21	1.66	0.0105	1
2412	802.11n20	12.9	13±1	14	25.119	2.21	1.66	0.0083	1
2437		13.79	13±1	14	25.119	2.21	1.66	0.0083	1
2462		13.77	13±1	14	25.119	2.21	1.66	0.0083	1
2422	802.11n40	12.41	12±1	13	19.953	2.21	1.66	0.0066	1
2437		11.38	12±1	13	19.953	2.21	1.66	0.0066	1
2452		12.17	12±1	13	19.953	2.21	1.66	0.0066	1
2412	802.11ac20	12.25	13±1	14	25.119	2.21	1.66	0.0083	1
2437		12.82	13±1	14	25.119	2.21	1.66	0.0083	1
2462		13.07	13±1	14	25.119	2.21	1.66	0.0083	1
2422	802.11ac40	12.52	12±1	13	19.953	2.21	1.66	0.0066	1
2437		11.35	12±1	13	19.953	2.21	1.66	0.0066	1
2452		11.63	12±1	13	19.953	2.21	1.66	0.0066	1

5.2GWIFI
Operation Frequency: 5180MHz~5240MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:3.68dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(3.68/10)=2.33

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
5180	802.11a	12.39	12±1	13	19.953	3.68	2.33	0.0093	1
5200		12.44	12±1	13	19.953	3.68	2.33	0.0093	1
5240		11.89	12±1	13	19.953	3.68	2.33	0.0093	1
5180	802.11n20	12.12	12±1	13	19.953	3.68	2.33	0.0093	1
5200		12	12±1	13	19.953	3.68	2.33	0.0093	1
5240		11.93	12±1	13	19.953	3.68	2.33	0.0093	1
5190	802.11n40	12.78	12±1	13	19.953	3.68	2.33	0.0093	1
5230		12.54	12±1	13	19.953	3.68	2.33	0.0093	1
5180	802.11ac20	12.02	12±1	13	19.953	3.68	2.33	0.0093	1
5200		11.99	12±1	13	19.953	3.68	2.33	0.0093	1
5240		11.46	12±1	13	19.953	3.68	2.33	0.0093	1
5190	802.11ac40	12.86	12±1	13	19.953	3.68	2.33	0.0093	1
5230		12.48	12±1	13	19.953	3.68	2.33	0.0093	1
5210	802.11ac80	12.43	12±1	13	19.953	3.68	2.33	0.0093	1
5180	802.11ax20	12.16	12±1	13	19.953	3.68	2.33	0.0093	1
5200		12.37	12±1	13	19.953	3.68	2.33	0.0093	1
5240		11.83	12±1	13	19.953	3.68	2.33	0.0093	1
5190	802.11ax40	12.6	12±1	13	19.953	3.68	2.33	0.0093	1
5230		12.42	12±1	13	19.953	3.68	2.33	0.0093	1
5210	802.11ax80	12.35	12±1	13	19.953	3.68	2.33	0.0093	1

5.3GWIFI
Operation Frequency: 5260MHz~5320MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:3.68dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(3.68/10)=2.33

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
5260	802.11a	11.73	12±1	13	19.953	3.68	2.33	0.0093	1
5280		11.93	12±1	13	19.953	3.68	2.33	0.0093	1
5320		12.09	12±1	13	19.953	3.68	2.33	0.0093	1
5260	802.11n20	11.39	12±1	13	19.953	3.68	2.33	0.0093	1
5280		11.46	12±1	13	19.953	3.68	2.33	0.0093	1
5320		11.59	12±1	13	19.953	3.68	2.33	0.0093	1
5270	802.11n40	12.26	12±1	13	19.953	3.68	2.33	0.0093	1
5310		11.91	12±1	13	19.953	3.68	2.33	0.0093	1
5260	802.11ac20	11.38	12±1	13	19.953	3.68	2.33	0.0093	1
5280		11.5	12±1	13	19.953	3.68	2.33	0.0093	1
5320		11.62	12±1	13	19.953	3.68	2.33	0.0093	1
5270	802.11ac40	12.13	12±1	13	19.953	3.68	2.33	0.0093	1
5310		12.11	12±1	13	19.953	3.68	2.33	0.0093	1
5290	802.11ac80	11.81	12±1	13	19.953	3.68	2.33	0.0093	1
5260	802.11ax20	11.49	12±1	13	19.953	3.68	2.33	0.0093	1
5280		11.82	12±1	13	19.953	3.68	2.33	0.0093	1
5320		11.41	12±1	13	19.953	3.68	2.33	0.0093	1
5270	802.11ax40	11.78	12±1	13	19.953	3.68	2.33	0.0093	1
5310		11.94	12±1	13	19.953	3.68	2.33	0.0093	1
5290	802.11ax80	12.12	12±1	13	19.953	3.68	2.33	0.0093	1

5.6GWIFI
Operation Frequency: 5500MHz~5700MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:3.68dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(3.68/10)=2.33

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
5500	802.11a	12.43	12±1	13	19.953	3.68	2.33	0.0093	1
5600		12.78	12±1	13	19.953	3.68	2.33	0.0093	1
5700		12.17	12±1	13	19.953	3.68	2.33	0.0093	1
5500	802.11n20	11.89	12±1	13	19.953	3.68	2.33	0.0093	1
5600		12.29	12±1	13	19.953	3.68	2.33	0.0093	1
5700		11.87	12±1	13	19.953	3.68	2.33	0.0093	1
5510	802.11n40	12.72	13±1	14	25.119	3.68	2.33	0.0117	1
5590		13.27	13±1	14	25.119	3.68	2.33	0.0117	1
5670		12.88	13±1	14	25.119	3.68	2.33	0.0117	1
5500	802.11ac20	12.26	12±1	13	19.953	3.68	2.33	0.0093	1
5600		12.27	12±1	13	19.953	3.68	2.33	0.0093	1
5700		11.81	12±1	13	19.953	3.68	2.33	0.0093	1
5510	802.11ac40	12.99	13±1	14	25.119	3.68	2.33	0.0117	1
5590		13.19	13±1	14	25.119	3.68	2.33	0.0117	1
5670		13.18	13±1	14	25.119	3.68	2.33	0.0117	1
5530	802.11ac80	12.51	12±1	13	19.953	3.68	2.33	0.0093	1
5610		12.65	12±1	13	19.953	3.68	2.33	0.0093	1
5500	802.11ax20	12.4	12±1	13	19.953	3.68	2.33	0.0093	1
5600		12.13	12±1	13	19.953	3.68	2.33	0.0093	1
5700		12.31	12±1	13	19.953	3.68	2.33	0.0093	1
5510	802.11ax40	12.57	13±1	14	25.119	3.68	2.33	0.0117	1
5590		13.14	13±1	14	25.119	3.68	2.33	0.0117	1
5670		12.65	13±1	14	25.119	3.68	2.33	0.0117	1
5530	802.11ax80	12.88	12±1	13	19.953	3.68	2.33	0.0093	1
5610		12.53	12±1	13	19.953	3.68	2.33	0.0093	1

5.8GWIFI
Operation Frequency: 5745MHz~5825MHz
Power density limited: 1mW/ cm^2
Antenna Type:FPC antenna
Antenna gain:3.68dBi;
R=20cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(3.68/10)=2.33

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
5745	802.11a	12.52	13±1	14	25.119	3.68	2.33	0.0117	1
5785		12.56	13±1	14	25.119	3.68	2.33	0.0117	1
5825		13	13±1	14	25.119	3.68	2.33	0.0117	1
5745	802.11n20	12.21	13±1	14	25.119	3.68	2.33	0.0117	1
5785		12.43	13±1	14	25.119	3.68	2.33	0.0117	1
5825		12.44	13±1	14	25.119	3.68	2.33	0.0117	1
5755	802.11n40	12.8	13±1	14	25.119	3.68	2.33	0.0117	1
5795		13.04	13±1	14	25.119	3.68	2.33	0.0117	1
5745	802.11ac20	11.93	12±1	13	19.953	3.68	2.33	0.0093	1
5785		12.48	12±1	13	19.953	3.68	2.33	0.0093	1
5825		12.64	12±1	13	19.953	3.68	2.33	0.0093	1
5755	802.11ac40	12.66	13±1	14	25.119	3.68	2.33	0.0117	1
5795		13.11	13±1	14	25.119	3.68	2.33	0.0117	1
5775	802.11ac80	12.76	13±1	14	25.119	3.68	2.33	0.0117	1
5745	802.11ax20	12.35	13±1	14	25.119	3.68	2.33	0.0117	1
5785		12.67	13±1	14	25.119	3.68	2.33	0.0117	1
5825		12.76	13±1	14	25.119	3.68	2.33	0.0117	1
5755	802.11ax40	12.47	13±1	14	25.119	3.68	2.33	0.0117	1
5795		12.7	13±1	14	25.119	3.68	2.33	0.0117	1
5775	802.11ax80	12.47	13±1	14	25.119	3.68	2.33	0.0117	1

Antenna Type: FPC antenna
Antenna gain:
GSM:850: 0.99 dBi; 1900: 1.45 dBi;
WCDMA:B2:1.45dBi,B4:1.64dBi,B5:0.99dBi
LTE:Band 2: 1.45 dBi, Band 4: 1.64 dBi, Band 5: 0.99 dBi, Band 12: -0.33 dBi,
Band 13: 0.55 dBi, Band 14: 0.82 dBi, Band41: 2.47 dBi, Band 66: 1.64 dBi
Band 71: -0.20 dBi
R=20cm

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
836.4	GSM850	31.67	31±1	32	1584.893	0.99	1.26	0.3960	0.5576
1909.8	GSM1900	28.88	29±1	30	1000.000	1.45	1.40	0.2778	1
1880	WCDMA B2	22.35	23±1	24	251.189	1.45	1.40	0.0698	1
1752.6	WCDMA B4	22.3	23±1	24	251.189	1.64	1.46	0.0729	1
846.6	WCDMA B5	22.71	23±1	24	251.189	0.99	1.26	0.0628	0.5644
1880	LTE Band 2	23.42	23±1	24	251.189	1.45	1.40	0.0698	1
1720	LTE Band 4	23.39	23±1	24	251.189	1.64	1.46	0.0729	1
844	LTE Band 5	23.54	23±1	24	251.189	0.99	1.26	0.0628	0.5627
707.5	LTE Band 12	23.47	23±1	24	251.189	-0.33	0.93	0.0463	0.4717
784.5	LTE Band 13	23.11	23±1	24	251.189	0.55	1.14	0.0567	0.5230
795.5	LTE Band 14	22.97	23±1	24	251.189	0.82	1.21	0.0604	0.5303
2501	LTE Band 41	22.7	23±1	24	251.189	2.47	1.21	0.0604	1
1770	LTE Band 66	23.49	23±1	24	251.189	1.64	1.77	0.0883	1
688	LTE Band 71	24.11	24±1	25	316.228	-0.2	1.46	0.0918	0.4587

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

Band	Antenna	tune-up power (dBm)	Antenna Gain (dBi)	Separation distance (cm)	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)	Evaluation result	Power density Limits	Verdict
BLE	Ant1	7	2.21	20	0.001659	1	0.903306762	1	PASS
Wi-Fi 2.4G	Ant1	17.5	2.21	20	0.018609	1			
Wi-Fi 5.6G	Ant1	14	3.68	20	0.011661	1			
GSM850	Ant1	32	0.99	20	0.396023	0.5576			
WCDMA B4	Ant1	24	1.64	20	0.072899	1			
LTE 41	Ant1	24	2.47	20	0.088251	1			

Conclusion:
For the max result :0.903306762≤ 1 for Max field strength, compliance RF exposure..

Signature: Alex **Date:** 2025-05-16

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