

## RF Exposure Evaluation

### Limits

KDB 447498 D01 General RF Exposure Guidance v06

FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

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 <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			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 <sup>2</sup> )	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

Friis transmission formula:  $P_d = (P_{out} * G) / (4 * \pi * r^2)$

Where

**Pd** = power density in mW/cm<sup>2</sup>, **Pout** = output power to antenna in mW;

**G** = gain of antenna in linear scale, **Pi** = 3.1416;

**R** = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

### Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

$$EIRP = E_{Meas} + 20 \log(d_{Meas}) - 104.7$$

EIRP is the equivalent isotropically radiated power, in dBm

E<sub>Meas</sub> is the field strength of the emission at the measurement distance, in dB  $\mu$  V/m

d<sub>Meas</sub> is the measurement distance, in m

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## Test Result of RF Exposure Evaluation

wifi 2.4G mode

Channel	Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
802.11b	16.956	49.6135	0.02256	1.0	PASS
802.11g	13.467	22.2177	0.01010	1.0	PASS
802.11n HT20	14.223	26.4423	0.01202	1.0	PASS
802.11n HT40	13.566	22.7300	0.01034	1.0	PASS

Remark: antenna gain=3.59dBi

wifi 5G mode:

Band	Channel	Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
Band 1	802.11a	10.971	12.5055	0.00750	1.0	PASS
	802.11ac HT20	11.051	12.7380	0.00764	1.0	PASS
	802.11ac HT40	10.965	12.4882	0.00749	1.0	PASS
	802.11n HT20	10.963	12.4825	0.00748	1.0	PASS
	802.11n HT40	10.054	10.1251	0.00607	1.0	PASS

Band	Channel	Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
Band 4	802.11a	8.638	7.3080	0.00438	1.0	PASS
	802.11ac HT20	8.643	7.3164	0.00439	1.0	PASS
	802.11ac HT40	9.062	8.0575	0.00483	1.0	PASS
	802.11n HT20	8.617	7.2728	0.00436	1.0	PASS
	802.11n HT40	9.067	8.0668	0.00484	1.0	PASS

Remark: antenna gain=4.79dBi

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For BLE

Field strength (dBuV/m)	EIRP (dBm)	Max tune-up (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
84.55	-10.61	0.0869	0.00004	1.0	PASS

Remark: antenna gain= 3.59dBi

For EDR

Field strength (dBuV/m)	EIRP (dBm)	Max tune-up (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
85	-10.16	0.0964	0.00004	1.0	PASS

Remark: antenna gain= 3.59dBi

For Simultaneous transmitting, 1): The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.02256/1+0.00764/1+0.00484/1+0.00004/1 = 0.03508 < 1$  Since the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in the device is  $\leq 1.0$ , the EUT is considered to satisfy MPE compliance for simultaneous transmission operations.