

RF Exposure Evaluation

Limits

KDB 447498 D01 General RF Exposure Guidance v06 and part 2.1091.

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 Exposures				
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
300–1500			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 ²)	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: $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot r^2)$

Where

Pd = power density in mW/cm², **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/cm². 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_{Meas} is the field strength of the emission at the measurement distance, in dB μ V/m

d_{Meas} is the measurement distance, in m

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 ²)	Limit (mW/cm ²)	Result
802.11b	17.288	53.5550	0.01643	1.0	PASS
802.11g	13.965	24.9172	0.00764	1.0	PASS
802.11n HT20	15.125	32.5462	0.00998	1.0	PASS
802.11n HT40	14.229	26.4789	0.00812	1.0	PASS

Remark: antenna gain=1.88dBi

wifi 5G mode:

Band	Channel	Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
Band 1	802.11a	11.933	15.6063	0.00910	1.0	PASS
	802.11ac HT20	11.556	14.3087	0.00834	1.0	PASS
	802.11ac HT40	10.617	11.5266	0.00672	1.0	PASS
	802.11n HT20	11.595	14.4378	0.00842	1.0	PASS
	802.11n HT40	10.63	11.5611	0.00674	1.0	PASS

Band	Channel	Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
Band 4	802.11a	9.8810	23.7028	0.00576	1.0	PASS
	802.11ac HT20	8.7498	24.8886	0.00510	1.0	PASS
	802.11ac HT40	9.2321	25.4859	0.00538	1.0	PASS
	802.11n HT20	9.8039	27.8869	0.00572	1.0	PASS
	802.11n HT40	9.2512	25.5388	0.00539	1.0	PASS

Remark: antenna gain=4.67dBi

For BLE

Field strength (dBuV/m)	EIRP (dBm)	Max tune-up (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
85.09	-10.07	0.0984	0.00003	1.0	PASS

Remark: antenna gain= 1.82dBi

For EDR

Field strength (dBuV/m)	EIRP (dBm)	Max tune-up (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
86	-9.16	0.1213	0.00004	1.0	PASS

Remark: antenna gain= 1.82dBi

For Simultaneous transmitting, 1): The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.01643/1 + 0.00910/1 + 0.00004/1 = 0.02557 < 1$ Since the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in the device is ≤ 1.0 , the EUT is considered to satisfy MPE compliance for simultaneous transmission operations.