

RF Exposure Evaluation

According to KDB 447498 D01 General RF Exposure Guidance v06 and part 2.1091, Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition(s), listed below, is (are) satisfied.

Limits

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: $Pd = (P_{out} * G) / (4 * \pi * r^2)$

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.

Test Result of RF Exposure Evaluation

Operating Mode	Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power Density at R=20cm	Power Density Limit	Result
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/cm ²)	(mW/cm ²)	
BLE	2402-2480	7.52	7 ± 1	8	2.66	0.00232	1.0	PASS
BR&EDR	2402-2480	8.87	8 ± 1	9	2.66	0.00292	1.0	PASS
WiFi 2.4G ANT1	2412-2462	13.635	13 ± 1	14	2.5	0.009	1.0	PASS
WiFi 2.4G ANT2	2412-2462	13.581	13 ± 1	14	2.5	0.009	1.0	PASS
WiFi 5.8G ANT1	5745-5825	14.373	14 ± 1	15	2.51	0.0112	1.0	PASS
WiFi 5.8G ANT2	5745-5825	13.163	13 ± 1	14	2.51	0.0089	1.0	PASS

For the Max simultaneous transmission MPE:

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 in accordance with the provisions of Table (A) and Table (B). To comply with the MPE, the fraction of the MPE in terms of E₂, H₂ (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

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

Technology	Tune up Produce power(dBm)		Maximum Tune-up (dBm)		Antenna Gain(ANT 1/ANT 2) (numeric)	Power Density (S) (mW/ cm2)		MPE Limit (mW/ cm2)	Σ MPE Ratio	Σ MPE Ratio Limit	Result
	ANT 1	ANT 2	ANT 1	ANT 2		ANT 1	ANT 2				
2.4G WIFI MIMO	13 ± 1	13 ± 1	14	14	ANT1: 2.5dBi ANT2: 2.5dBi	0.009	0.009	1	0.018	1	Pass

Techno logy	Tune up Produce power(dBm)		Maximum Tune-up (dBm)		Antenna Gain(ANT 1/ANT 2) (numeric)	Power Density (S) (mW/ cm2)		MPE Limit (mW/ cm2)	Σ MPE Ratio	Σ MPE Ratio Limit	Resu lt
	ANT 1	ANT 2	ANT 1	ANT 2		ANT 1	ANT 2				
5G WIFI MIMO	14±1	12±1	15	13	ANT1:2.51dBi ANT2:2.51dBi	0.011 2	0.007 1	1	0.018 3	1	Pass

Remark:

BT+WIFI supported simultaneous transmission:

BT+2.4GWIFI MIMO: $\Sigma \text{MPE Ratio} = 0.00292/1 + 0.018/1 = 0.02092 \leq 1$,

BT+5GWIFI MIMO: $\Sigma \text{MPE Ratio} = 0.00292/1 + 0.0183/1 = 0.02122 \leq 1$,

So a SAR test is not required