

RF Exposure Evaluation

According to KDB 447498 D01 General RF Exposure Guidance v06 and part 2.1091(C), 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

According to KDB 447498 D01 General RF Exposure Guidance v06

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

Where

P_d = power density in mW/cm², **P_{out}** = output power to antenna in mW;

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

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

P_d 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

	Modulation	Frequency MHz	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Max Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
BLE(1M)	GFSK	2402	0.51	0.5 ± 1	1.5	1.412538	0.000404	1.0	PASS
		2440	0.31	0 ± 1	1	1.258925	0.000360	1.0	PASS
		2480	-0.42	-0.5 ± 1	0.5	1.122018	0.000321	1.0	PASS
BLE(2M)	GFSK	2402	0.40	0.5 ± 1	1.5	1.412538	0.000404	1.0	PASS
		2440	0.16	0 ± 1	1	1.258925	0.000360	1.0	PASS
		2480	-0.54	-0.5 ± 1	0.5	1.122018	0.000321	1.0	PASS
Wifi 2.4g	802.11b	2412	24.07	24 ± 1	25	316.227766	0.090517	1.0	PASS
		2437	24.40	24 ± 1	25	316.227766	0.090517	1.0	PASS
		2462	22.72	23 ± 1	24	251.188643	0.071900	1.0	PASS
	802.11g	2412	21.87	22 ± 1	23	199.526231	0.057112	1.0	PASS
		2437	23.51	24 ± 1	25	316.227766	0.090517	1.0	PASS
		2462	24.31	24 ± 1	25	316.227766	0.090517	1.0	PASS
	802.11n(20)	2412	25.40	25 ± 1	26	398.107171	0.113954	1.0	PASS
		2437	23.89	24 ± 1	25	316.227766	0.090517	1.0	PASS
		2462	23.12	23 ± 1	24	251.188643	0.071900	1.0	PASS
	802.11n(40)	2422	21.28	21 ± 1	22	158.489319	0.045366	1.0	PASS
		2437	23.25	23 ± 1	24	251.188643	0.071900	1.0	PASS
		2452	22.96	23 ± 1	24	251.188643	0.071900	1.0	PASS
	802.11ax (20)	2412	25.11	25 ± 1	26	398.107171	0.113954	1.0	PASS
		2437	25.23	25 ± 1	26	398.107171	0.113954	1.0	PASS
		2462	24.46	24 ± 1	25	316.227766	0.090517	1.0	PASS
	802.11ax (40)	2422	20.78	21 ± 1	22	158.489319	0.045366	1.0	PASS
		2437	22.86	23 ± 1	24	251.188643	0.071900	1.0	PASS
		2452	22.48	22 ± 1	23	199.526231	0.057112	1.0	PASS

	Modulation	Frequency (MHz)	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
Wifi5.2g	802.11a20	5180	12.31	12±1	13	19.952623	0.005738	1.0	PASS
		5200	12.57	13±1	14	25.118864	0.007223	1.0	PASS
		5240	12.67	13±1	14	25.118864	0.007223	1.0	PASS
	802.11n20	5180	9.75	10±1	11	12.589254	0.003620	1.0	PASS
		5200	10.31	10±1	11	12.589254	0.003620	1.0	PASS
		5240	9.01	9±1	10	10.000000	0.002876	1.0	PASS
	802.11ac20	5180	9.37	9±1	10	10.000000	0.002876	1.0	PASS
		5200	10.4	10±1	11	12.589254	0.003620	1.0	PASS
		5240	12.28	12±1	13	19.952623	0.005738	1.0	PASS
	802.11ax20	5180	9.3	9±1	10	10.000000	0.002876	1.0	PASS
		5200	11.75	12±1	13	19.952623	0.005738	1.0	PASS
		5240	13.32	13±1	14	25.118864	0.007223	1.0	PASS
	802.11n40	5190	10.09	10±1	11	12.589254	0.003620	1.0	PASS
		5240	12.34	12±1	13	19.952623	0.005738	1.0	PASS
	802.11ac40	5190	10.94	11±1	12	15.848932	0.004558	1.0	PASS
		5240	12.89	13±1	14	25.118864	0.007223	1.0	PASS
	802.11ax40	5190	10.65	11±1	12	15.848932	0.004558	1.0	PASS
		5240	11.09	11±1	12	15.848932	0.004558	1.0	PASS

	Modulation	Frequency (MHz)	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
Wifi5.8g	802.11a20	5745	14.65	15 ± 1	16	39.810717	0.027844	1.0	PASS
		5785	14.43	14 ± 1	15	31.622777	0.022117	1.0	PASS
		5825	13.1	13 ± 1	14	25.118864	0.017568	1.0	PASS
	802.11n20	5745	11.48	11 ± 1	12	15.848932	0.011085	1.0	PASS
		5785	11.4	11 ± 1	12	15.848932	0.011085	1.0	PASS
		5825	8.2	8 ± 1	9	7.943282	0.005556	1.0	PASS
	802.11ac20	5745	11.34	11 ± 1	12	15.848932	0.011085	1.0	PASS
		5785	10.84	11 ± 1	12	15.848932	0.011085	1.0	PASS
		5825	10.52	11 ± 1	12	15.848932	0.011085	1.0	PASS
	802.11ax20	5745	11.83	12 ± 1	13	19.952623	0.013955	1.0	PASS
		5785	10.87	11 ± 1	12	15.848932	0.011085	1.0	PASS
		5825	9.73	10 ± 1	11	12.589254	0.008805	1.0	PASS
	802.11n40	5755	13.78	14 ± 1	15	31.622777	0.022117	1.0	PASS
		5795	14.87	15 ± 1	16	39.810717	0.027844	1.0	PASS
	802.11ac40	5755	14.59	15 ± 1	16	39.810717	0.027844	1.0	PASS
		5795	12.64	13 ± 1	14	25.118864	0.017568	1.0	PASS
	802.11ax40	5755	14.31	14 ± 1	15	31.622777	0.022117	1.0	PASS
		5795	11.96	12 ± 1	13	19.952623	0.013955	1.0	PASS

Remark:

1. BT/wifi2.4g Antenna gain is 1.58 dBi, wifi5g Antenna gain :U-NII Band 1: 1.6 dBi
U-NII Band 3: 5.46 dBi

2. In the case of simultaneous launches for wifi and BT:

The Max Calc. Thresholds :

BLE:0.000404 , Wifi2.4g: 0.113954 , Wifi5g:0.027844

BT and Wifi: 0.000404+0.113954+0.027844 =0.142202 ≤ 1

So a SAR test is not required