

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

	Modulation	Frequency MHz	Output power to antenna (dBm)	Target power W/toler ance (dBm)	Max Output power to antenna (dBm)	Max Output power to antenna (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/ cm2)	Result
Wifi 2.4g	802.11b	2412	22.35	22±1	23	199.52623	0.06603	1.0	PASS
		2437	21.73	22±1	23	199.52623	0.06603	1.0	PASS
		2462	21.38	21±1	22	158.48932	0.05245	1.0	PASS
	802.11g	2412	20.62	21±1	22	158.48932	0.05245	1.0	PASS
		2437	20.32	20±1	21	125.89254	0.04166	1.0	PASS
		2462	20.09	20±1	21	125.89254	0.04166	1.0	PASS
	802.11n(20)	2412	20.78	21±1	22	158.48932	0.05245	1.0	PASS
		2437	20.39	20±1	21	125.89254	0.04166	1.0	PASS
		2462	20.03	20±1	21	125.89254	0.04166	1.0	PASS
	802.11n(40)	2422	19.87	20±1	21	125.89254	0.04166	1.0	PASS
		2437	19.59	20±1	21	125.89254	0.04166	1.0	PASS
		2452	19.44	19±1	20	100.00000	0.03309	1.0	PASS

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Wifi 5.2g	802.11a	5180	15.53	16±1	17	50.118723	0.015479	1.0	PASS
		5200	15.14	15±1	16	39.810717	0.012295	1.0	PASS
		5240	14.98	15±1	16	39.810717	0.012295	1.0	PASS
	802.11n(20)	5180	13.85	14±1	15	31.622777	0.009766	1.0	PASS
		5200	14.63	15±1	16	39.810717	0.012295	1.0	PASS
		5240	13.77	14±1	15	31.622777	0.009766	1.0	PASS
	802.11n(40)	5190	12.37	12±1	13	19.952623	0.006162	1.0	PASS
		5230	14.75	15±1	16	39.810717	0.012295	1.0	PASS
	802.11ac(20)	5180	14.66	15±1	16	39.810717	0.012295	1.0	PASS
		5200	15.87	16±1	17	50.118723	0.015479	1.0	PASS

		5240	15.09	15±1	16	39.810717	0.012295	1.0	PASS
	802.11ac(40)	5190	12.41	12±1	13	19.952623	0.006162	1.0	PASS
		5230	13.51	14±1	15	31.622777	0.009766	1.0	PASS
	802.11ac(80)	5210	13.6	14±1	15	31.622777	0.009766	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
Wifi5.3g	802.11a20	5260.00	14.68	15±1	16	39.810717	0.012295	1.0	PASS
		5300.00	14.02	14±1	15	31.622777	0.009766	1.0	PASS
		5320.00	14.14	14±1	15	31.622777	0.009766	1.0	PASS
	802.11n20	5260.00	13.07	13±1	14	25.118864	0.007758	1.0	PASS
		5300.00	13.05	13±1	14	25.118864	0.007758	1.0	PASS
		5320.00	13.07	13±1	14	25.118864	0.007758	1.0	PASS
	802.11ac20	5260.00	13.21	13±1	14	25.118864	0.007758	1.0	PASS
		5300.00	12.55	13±1	14	25.118864	0.007758	1.0	PASS
		5320.00	12.98	13±1	14	25.118864	0.007758	1.0	PASS
	802.11n40	5270.00	13.63	14±1	15	31.622777	0.009766	1.0	PASS
		5310.00	13.17	13±1	14	25.118864	0.007758	1.0	PASS
	802.11ac40	5270.00	12.55	13±1	14	25.118864	0.007758	1.0	PASS
		5310.00	12.26	12±1	13	19.952623	0.006162	1.0	PASS
	802.11ac80	5290.00	11.88	12±1	13	19.952623	0.006162	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
Wifi5.6g	802.11a20	5500	14.94	15±1	16	39.810717	0.012295	1.0	PASS
		5600	14.09	14±1	15	31.622777	0.009766	1.0	PASS
		5700	12.44	12±1	13	19.952623	0.006162	1.0	PASS
	802.11n20	5500	13.76	14±1	15	31.622777	0.009766	1.0	PASS
		5600	13.59	14±1	15	31.622777	0.009766	1.0	PASS
		5700	12.57	13±1	14	25.118864	0.007758	1.0	PASS

	802.11ac20	5500	13.62	14 ± 1	15	31.622777	0.009766	1.0	PASS
		5600	13.22	13 ± 1	14	25.118864	0.007758	1.0	PASS
		5700	12.6	13 ± 1	14	25.118864	0.007758	1.0	PASS
	802.11n40	5510	12.42	12 ± 1	13	19.952623	0.006162	1.0	PASS
		5590	13.82	14 ± 1	15	31.622777	0.009766	1.0	PASS
		5670	13.73	14 ± 1	15	31.622777	0.009766	1.0	PASS
	802.11ac40	5510	12.38	12 ± 1	13	19.952623	0.006162	1.0	PASS
		5590	12.97	13 ± 1	14	25.118864	0.007758	1.0	PASS
		5670	12.64	13 ± 1	14	25.118864	0.007758	1.0	PASS
	802.11ac80	5530.00	11.55	12 ± 1	13	19.952623	0.006162	1.0	PASS
		5610.00	13.35	13 ± 1	14	25.118864	0.007758	1.0	PASS

	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/cm2)	Limit (mW/ cm2)	Result
Wifi 5.8g	802.11a	5745	14.76	15 ± 1	16	39.81072	0.01230	1.0	PASS
		5785	15.01	15 ± 1	16	39.81072	0.01230	1.0	PASS
		5825	14.55	15 ± 1	16	39.81072	0.01230	1.0	PASS
	802.11n(20)	5745	13.97	14 ± 1	15	31.62278	0.00977	1.0	PASS
		5785	14.04	14 ± 1	15	31.62278	0.00977	1.0	PASS
		5825	13.54	14 ± 1	15	31.62278	0.00977	1.0	PASS
	802.11n(40)	5755	14.2	14 ± 1	15	31.62278	0.00977	1.0	PASS
		5795	14.46	14 ± 1	15	31.62278	0.00977	1.0	PASS
	802.11ac(20)	5745	12.82	13 ± 1	14	25.11886	0.00776	1.0	PASS
		5785	12.62	13 ± 1	14	25.11886	0.00776	1.0	PASS
		5825	12.96	13 ± 1	14	25.11886	0.00776	1.0	PASS
	802.11ac(40)	5755	13.27	13 ± 1	14	25.11886	0.00776	1.0	PASS
		5795	13.21	13 ± 1	14	25.11886	0.00776	1.0	PASS
	802.11ac(80)	5775	13.63	14 ± 1	15	31.62278	0.01046	1.0	PASS

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BLE	GFSK	2402	8.26	8 ± 1	9	7.94328	0.00095	1.0	PASS

(1M)		2440	8.60	9±1	10	10.00000	0.001196	1.0	PASS
		2480	9.12	9±1	10	10.00000	0.001196	1.0	PASS
BLE (2M)		2402	8.28	8±1	9	7.94328	0.00095	1.0	PASS
		2440	8.57	9±1	10	10.00000	0.001196	1.0	PASS
		2480	9.15	9±1	10	10.00000	0.001196	1.0	PASS
BR/EDR	GFSK	2402	8.29	8±1	9	7.9433	0.000950	1.0	PASS
		2441	8.42	8±1	9	7.9433	0.000950	1.0	PASS
		2480	9.11	9±1	10	10	0.001196	1.0	PASS
	Π/4-DQPSK	2402	7.78	8±1	9	7.9433	0.000950	1.0	PASS
		2441	8.05	8±1	9	7.9433	0.000950	1.0	PASS
		2480	8.66	9±1	10	10	0.001196	1.0	PASS
	8DPSK	2402	8.34	8±1	9	7.9433	0.000950	1.0	PASS
		2441	7.95	8±1	9	7.9433	0.000950	1.0	PASS
		2480	8.61	9±1	10	10	0.001196	1.0	PASS

Remark: 1. BT Antenna gain is -2.21dBi, wifi 2.4g Antenna gain is 2.21dBi
wifi 5g Antenna gain is 1.91dBi

BT and wifi can transmit at the same time

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

The Max Calc. Thresholds : BT:0.001196 Wifi 2.4g:0.06603

wifi 2.4g and Wifi 5g: $0.06603 + 0.001196 = 0.067226 \leq 1$

So a SAR test is not required