

RF Exposure Evaluation

According to KDB447498D01 General RF Exposure Guidance v06 4.3.1. Standalone SAR test exclusion considerations 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 Exclusion Threshold condition, listed below, is satisfied.

Limits

According to FCC Part1.1310: 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 part1.1307(b)

TABLE 1—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 Formula

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 . 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 Result of RF Exposure Evaluation

Antenna Gain: 5dBi, MIMO Gain:8.01 dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Measurement Data

The Max Conducted Peak Output Power data refer to report Report No.: ZKT-211029L5839-01 & ZKT-211029L5839-02

2.4GWIFI:

worst mode and channel						
Test channel	Antenna Output Power (dBm)			Tune up tolerance (dBm)		
	ANT1	ANT2	SUM	ANT1	ANT2	SUM
802.11b-CH06	15.85	16.26	/	16±1	16±1	/
802.11g-CH06	13.80	12.92	/	13±1	13±1	/
802.11n20-CH11	12.94	13.23	16.10	13±1	13±1	16±1
802.11n40-CH06	11.52	11.41	14.48	12±1	12±1	15±1

Test worst case

Test channel	Maximum tune-up Power (dBm)			Maximum tune-up Power (mW)			Calculated value (mW/cm2)	Limit (mW/cm2)
	ANT1	ANT2	SUM	ANT1	ANT2	SUM		
802.11n20-CH11	14	14	17	25.12	25.12	50.24	0.0632	1.0

Remark:

- 1) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (50.24 * 6.324) / (4 * 3.1415 * 20 * 20) = 0.0632$, $G = 10^{gain/10} = 6.324$
- 2) EUT is more than 20cm away from the human body.

5GWIFI:

Mode	Test channel	Antenna Output Power (dBm)			Tune up tolerance (dBm)			Max Tune up (dBm)
		ANT1	ANT2	SUM	ANT1	ANT2	SUM	
802.11a	36	9.166	10.429	/	10±1	10±1	/	11
	40	9.101	10.438	/	10±1	10±1	/	11
	48	8.603	9.47	/	9±1	9±1	/	10
	149	8.496	9.228	/	9±1	9±1	/	10
	157	8.852	9.147	/	9±1	9±1	/	10
	165	8.198	8.296	/	9±1	9±1	/	10
802.11n 20	36	8.107	9.312	11.76	9±1	9±1	12±1	13
	40	7.982	9.318	11.71	8±1	8±1	11±1	12
	48	7.489	8.446	11.00	8±1	8±1	11±1	12
	149	7.578	8.09	10.85	8±1	8±1	11±1	12
	157	7.763	8.006	10.90	8±1	8±1	11±1	12
	165	7.154	7.014	10.09	8±1	8±1	11±1	12
802.11n 40	38	6.913	8.305	10.67	7±1	7±1	10±1	11
	46	6.47	7.236	9.88	7±1	7±1	10±1	11
	151	6.674	7.109	9.91	7±1	7±1	10±1	11
	159	6.823	6.961	9.90	7±1	7±1	10±1	11
802.11ac 20	36	8.12	9.44	11.84	9±1	9±1	12±1	13
	40	8.037	9.252	11.70	9±1	9±1	12±1	13
	48	7.612	8.342	11.00	8±1	8±1	11±1	12
	149	7.606	8.075	10.86	8±1	8±1	11±1	12
	157	7.782	7.922	10.86	8±1	8±1	11±1	12
	165	7.168	7.044	10.12	8±1	8±1	11±1	12
802.11ac 40	38	7.013	8.306	10.72	8±1	8±1	11±1	12
	46	6.586	7.356	10.00	7±1	7±1	10±1	11
	151	6.712	7.152	9.95	7±1	7±1	10±1	11
	159	6.915	7.092	10.01	7±1	7±1	10±1	11
802.11ac 80	42	5.909	6.965	9.48	6±1	6±1	9±1	10
	155	6.245	6.625	9.45	6±1	6±1	9±1	10
802.11ax 20	36	9.344	9.871	12.63	9±1	9±1	12±1	13
	40	9.261	9.789	12.54	9±1	9±1	12±1	13
	48	8.755	9.261	12.03	9±1	9±1	12±1	13
	149	9.511	9.200	12.37	9±1	9±1	12±1	13
	157	9.640	8.821	12.26	9±1	9±1	12±1	13
	165	9.601	8.929	12.29	9±1	9±1	12±1	13
802.11ax 40	38	8.913	8.476	11.71	8±1	8±1	12±1	13
	46	8.224	8.759	11.51	8±1	8±1	12±1	13
	151	8.277	8.631	11.47	8±1	8±1	12±1	13
	159	8.016	8.282	11.16	8±1	8±1	12±1	13
802.11ax 80	42	7.313	7.231	10.28	7±1	7±1	10±1	11
	155	8.483	7.709	11.12	7±1	7±1	10±1	11

Test worst case

Maximum tune-up Power (dbm)	Maximum tune-up Power (mW)	Calculated value (mW/cm ²)	Limit (mW/cm ²)
13	19.953	0.0251	1.0

Remark:

- 1) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (79.62 * 6.324) / (4 * 3.1415 * 20 * 20) = 0.0079$, $G = 10^{gain/10} = 6.324$
- 2) EUT is more than 20cm away from the human body.

Combine 2.4G WIFI + 5G WIFI:

Simultaneous transmission mode	The sum of the ratios	SUM	Limit
2.4GWIFI + 5G WIFI	0.0632+0.0251	0.0883	1.0
conclusion 0.0883<1.0, So there is no sar requirement			

NOTE:1. EUT wifi-5G & wifi-2.4G module is more than 20cm away from the human body.

- 2.The sum of the ratios(2.4GWIFI + 5G WIFI) is less than the limit value of 1.0, so there is no sar requirement.

Conclusion: 2.4Gwifi and 5Gwifi RF exposure evaluation results are less than the limit of 1.0, so there is no sar requirement