

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

BT Antenna Gain: 0dBi, 2.4GWIFI Antenna Gain: 0dBi, 5GWIFI Antenna Gain: 3dBi,

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-220222L0952-01, ZKT-220222L0952-02, ZKT-220222L0952-03, ZKT-220222L0952-04

BT&BLE:

Frequency (MHz)	Max Power (dBm)	Tune up tolerance (dBm)	Max tune-up Power (dBm)	Max tune-up Power (mW)
2402MHz	0.98	1±1	2	1.585

Test worst case

Maximum tune-up Power (dBm)	Maximum tune-up Power (mW)	Calculated value (mW/cm ²)	Limit (mW/cm ²)
2	1.585	0.00032	1.0

Remark:

1)The Max Conducted Peak Output Power data refer to report Report No.: ZKT-220110L0221-01

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (1.585 * 1) / (4 * 3.1415 * 20 * 20) = 0.0251$, $G = 10^{gain/10} = 1$

2.4GWIFI:

Test channel	Antenna Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power (dBm)
802.11b- CH01	18.52	18±1	19
802.11b-CH06	17.51	18±1	19
802.11b-CH11	17.16	18±1	19
802.11g- CH01	17.97	17±1	18
802.11g CH06	16.73	17±1	18
802.11g CH11	16.26	17±1	18
802.11n20-CH01	17.90	17±1	18
802.11n20-CH06	16.71	17±1	18
802.11n20-CH11	16.20	17±1	18
802.11n40- CH03	16.32	16±1	17
802.11n40-CH06	16.39	16±1	17
802.11n40-CH9	16.07	16±1	17

Test worst case

Maximum tune-up Power (dBm)	Maximum tune-up Power (mW)	Calculated value (mW/cm ²)	Limit (mW/cm ²)
19	79.433	0.0158	1.0

Remark:

1)The Max Conducted Peak Output Power data refer to report Report No.: ZKT-220110L0221-01

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (79.433 * 1) / (4 * 3.1415 * 20 * 20) = 0.0251$, $G = 10^{gain/10} = 1$

5GWIFI:

Mode	Test channel	Antenna Output Power (dBm)	Tune up tolerance (dBm)	Max Tune up (dBm)
802.11a	36	2.28	2±1	3
	40	1.61	2±1	3
	48	1.30	2±1	3
	149	7.11	7±1	8
	157	7.12	7±1	8
	165	7.78	7±1	8
802.11n20	36	2.16	2±1	3
	40	1.85	2±1	3
	48	1.10	2±1	3
	149	6.10	7±1	8
	157	6.92	7±1	8
	165	6.75	7±1	8
802.11n 40	38	0.97	0±1	1
	46	0.28	0±1	1
	151	5.38	5±1	6
	159	5.50	5±1	6
802.11ac20	36	2.15	2±1	3
	40	1.91	2±1	3
	48	1.01	2±1	3
	149	7.07	7±1	8
	157	7.31	7±1	8
	165	6.83	7±1	8
802.11ac40	38	1.02	0±1	1
	46	0.34	0±1	1
	151	5.40	6±1	7
	159	6.13	6±1	7
802.11ac80	42	-0.78	0±1	1
	155	4.56	4±1	5

Test worst case

Maximum tune-up Power (dbm)	Maximum tune-up Power (mW)	Calculated value (mW/cm2)	Limit (mW/cm2)
8	6.310	0.0315	1.0

Remark:

1)The Max Conducted Peak Output Power data refer to report Report No.: ZKT-220110L0221-02

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (6.310 * 1.995) / (4 * 3.1415 * 20 * 20) = 0.01$, $G = 10^{\frac{gain}{10}} = 1.995$

EUT RF Exposure Evaluation simultaneous transmission operations

According to 865664D02 2.2 d) 1):

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits :

Simultaneous transmission mode	SUM	Limit
BT+BLE+2.4GWIFI+5GWIFI	≈ 0.048	1.0
conclusion : $0.048 < 1.0$, So there is no sar requirement		

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

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