

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

2.4G-WIFI ANT1: 1.5dBi; 2.4G-WIFI ANT2: 2.3dBi ; MIMO:5.31 dBi

5G-WIFI ANT1: 1.8dBi; 5G -WIFI ANT2: 2.7dBi ; MIMO:5.71dBi

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-220426L2746-01 & ZKT-220426L2746-02 & ZKT-220426L2746-03 & ZKT-220426L2746-04

BT/BLE-worst mode and channel:

Test channel	Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power		Calculated value
			(dBm)	(mW)	
(BT) 8-DPSK Lowest channel	-0.208	1±1	2	1.585	0.000445
(BLE)GFSK Lowest channel	1.026	1±1	2	1.585	0.000445
Limit: 1.0					

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	The sum of the ratios	SUM	Limit
BT+ BLE	0.000445+0.000445	0.00089	1.0
conclusion : 0.00089<1.0, So there is no sar requirement			

2.4GWIFI:

Test channel	Antenna Output Power (dBm)			Tune up tolerance (dBm)		
	ANT1	ANT2	SUM	ANT1	ANT2	SUM
802.11b –2412MHz	17.342	16.367	/	/	/	/
802.11b –2412MHz	16.626	16.433	/	/	/	/
802.11b –2412MHz	16.858	16.886	/	/	/	/
802.11g –2412MHz	17.705	17.108	/	/	/	/
802.11g –2412MHz	17.82	17.084	/	/	/	/
802.11g –2412MHz	16.841	16.637	/	/	/	/
802.11n –2412MHz	15.965	15.812	18.90	16±1	16±1	19.01±1
802.11n –2412MHz	16.147	15.95	19.06	16±1	16±1	19.01±1
802.11n –2412MHz	15.224	15.48	18.36	16±1	16±1	19.01±1
802.11n40 –2412MHz	14.569	14.894	18.29	14±1	14±1	17.01±1
802.11n40 –2412MHz	14.557	14.077	17.33	14±1	14±1	17.01±1
802.11n40 –2412MHz	13.663	13.402	16.54	14±1	14±1	17.01±1

Test worst case

Maximum tune-up Power (dBm)			Maximum tune-up Power (mW)			Calculated value (mW/cm2)	Limit (mW/cm2)
ANT1	ANT2	SUM	ANT1	ANT2	SUM	/	/
17	17	20.01	50.119	50.119	100.238	0.0677	1.0

Remark:

1)The Max Conducted Peak Output Power data refer to report Report No.: ZKT-220426L2746-03

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (100.238 * 3.396) / (4 * 3.1415 * 20 * 20) = 0.0677$, $G = 10^{gain/10} = 3.396$

5GWIFI- worst mode and channel:

Mode Test channel	Antenna Output Power (dBm)			Tune up tolerance (dBm)			Max Tune up (dBm)
	ANT1	ANT2	SUM	ANT1	ANT2	SUM	
802.11a-5180MHz	7.28	7.227	/	/	/	/	/
802.11a-5200MHz	8.182	7.927	/	/	/	/	/
802.11a-5240MHz	8.394	8.225	/	/	/	/	/
802.11a-5745MHz	10.082	11.889	/	/	/	/	/
802.11a-5785MHz	10.938	11.202	/	/	/	/	/
802.11a-5825MHz	10.22	11.017	/	/	/	/	/
802.11n-5180MHz	5.034	5.779	8.43	6±1	6±1	9.01±1	10.01
802.11n-5200MHz	6.114	6.806	9.48	6±1	6±1	9.01±1	10.01
802.11n-5240MHz	6.539	6.332	9.45	6±1	6±1	9.01±1	10.01
802.11n-5745MHz	9.617	10.145	12.90	10±1	10±1	13.01±1	14.01
802.11n-5785MHz	10.005	10.40	13.22	10±1	10±1	13.01±1	14.01
802.11n-5825MHz	9.17	10.184	12.72	10±1	10±1	13.01±1	14.01
802.11n40-5190MHz	5.705	6.676	9.23	6±1	6±1	9.01±1	10.01
802.11n40-5230MHz	6.481	5.395	8.98	6±1	6±1	9.01±1	10.01
802.11n40-5755MHz	8.479	8.806	11.66	9±1	9±1	12.01±1	13.01
802.11n40-5795MHz	8.77	8.883	11.84	9±1	9±1	12.01±1	13.01
802.11ac-5180MHz	5.309	5.70	8.52	5±1	5±1	8.01±1	9.01
802.11ac-5200MHz	5.749	4.813	8.32	5±1	5±1	8.01±1	9.01
802.11ac-5240MHz	6.485	6.893	9.70	6±1	6±1	9.01±1	10.01
802.11ac-5745MHz	8.001	8.679	11.36	8±1	8±1	11.01±1	12.01
802.11ac-5785MHz	8.405	8.826	11.63	8±1	8±1	11.01±1	12.01
802.11ac-5825MHz	7.844	8.736	11.32	8±1	8±1	11.01±1	12.01
802.11n40-5190MHz	5.418	5.448	8.44	6±1	6±1	9.01±1	10.01
802.11n40-5230MHz	6.035	5.331	8.71	6±1	6±1	9.01±1	10.01
802.11n40-5755MHz	7.512	7.692	10.61	8±1	8±1	11.01±1	12.01
802.11n40-5795MHz	7.879	7.176	10.55	8±1	8±1	11.01±1	12.01
802.11n80-5210MHz	3.031	2.637	5.85	3±1	3±1	6.01±1	7.01
802.11n80-5755MHz	6.249	5.545	8.92	6±1	6±1	9.01±1	10.01

Test worst case

Maximum tune-up Power (dbm)	Maximum tune-up Power (mW)	Calculated value (mW/cm ²)	Limit (mW/cm ²)
14.01	25.177	0.019	1.0

Remark:

1)The Max Conducted Peak Output Power data refer to report Report No.: ZKT-220426L2746-04

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (25.177 * 3.724) / (4 * 3.1415 * 20 * 20) = 0.019$, $G = 10^{gain/10} = 3.724$

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	The sum of the ratios	SUM	Limit
BT+2.4G WIFI + 5G WIFI	0.00089+0.0677+0.019	0.08759	1.0
conclusion : 0.08759 < 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(2.4GWIFI + 5G WIFI+BT) is less than the limit value of 1.0, so there is no sar requirement.