

RF Exposure evaluation

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance v06

FCC Part 2 §2.1091

FCC ID: 2AJAA-R710 (Contains FCC ID: 2AJYB-ST1955)

1. Reference

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

2. Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
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

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

*=Plane-wave equivalent power density

3. MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the center of radiation of the antenna

4. Result

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r=20\text{cm}$, as well as the gain see below table, the RF power density can be obtained.

FCC ID: 2AJAA-R710

Internal Identification	Antenna Identification in Internal photos	Operate frequency band	Maximum antenna gain
PCB Antenna	ANT 1	2.4GHz-2.5GHz	0 dBi

EDR

Freq. (MHz)	Output Power (dBm)	Target power W/ tolerance (dBm)	Max tune up power tolerance (dBm)	Output power to antenna (mW)	Ant Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/c m ²)	Result
GFSK								
2402	6.50	7±1	8	6.310	0	0.0013	1	Pass
2441	6.54	7±1	8	6.310	0	0.0013	1	Pass
2480	7.20	7±1	8	6.310	0	0.0013	1	Pass
$\pi/4$ DQPSK								
2402	8.87	9±1	10	10.000	0	0.0020	1	Pass
2441	8.96	9±1	10	10.000	0	0.0020	1	Pass
2480	9.48	9±1	10	10.000	0	0.0020	1	Pass
8DPSK								
2402	9.63	10±1	11	12.589	0	0.0025	1	Pass
2441	9.56	10±1	11	12.589	0	0.0025	1	Pass
2480	9.42	9±1	10	10.000	0	0.0020	1	Pass

BLE-1M

Freq. (MHz)	Output Power (dBm)	Target power W/ tolerance (dBm)	Max tune up power tolerance (dBm)	Output power to antenna (mW)	Ant Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/c m ²)	Result
GFSK								
2402	5.23	5±1	6	3.981	0	0.0008	1	Pass
2440	5.51	6±1	7	5.012	0	0.0010	1	Pass

2480	6.23	6±1	7	5.012	0	0.0010	1	Pass
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BLE-2M

Freq. (MHz)	Output Power (dBm)	Target power W/ tolerance (dBm)	Max tune up power tolerance (dBm)	Output power to antenna (mW)	Ant Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
GFSK								
2402	5.29	5±1	6	3.981	0	0.0008	1	Pass
2440	5.39	5±1	6	3.981	0	0.0008	1	Pass
2480	6.06	6±1	7	5.012	0	0.0010	1	Pass

The total power density of BT/BLE is: $0.0025 + 0.0010 = 0.0035 \text{ mW/cm}^2$

SAR-based exemption for Module FCC ID: 2AJYB-ST1955

	test report	frequency [MHz]	antenna	output power, conducted [mW]	max. antenna gain [dBi]	max. antenna gain [1]	output power, EIRP [mW]	output power, ERP [mW]	duty cycle [%]	average ERP [mW]	ERP20cm [mW]	fraction of ERP20cm
Bluetooth	FG-21/144	2480		3.98	3.5	2.24	13.93	8.49			3060	0.0028
BLE	FG-21/145	2440		4.27	3.5	2.24	14.95	9.11			3060	0.0030
2.4 GHz Wifi	FG-21/146	2437	1	87.12	3.5	2.24	304.92	185.93			3060	0.0608
2.4 GHz Wifi	FG-21/146	2437	2	99.31	3.5	2.24	347.59	211.94			3060	0.0693
5 GHz U-NII	FG-21/147	5700	1	31.65	4	2.51	126.60	77.20	83.13	64.17	3060	0.0210
5 GHz U-NII	FG-21/147	5700	2	32.35	4	2.51	129.40	78.90	83.13	65.59	3060	0.0214
											Sum	0.1782

According to the Module FCC ID: 2AJYB-ST1955, the total power density is: 0.1782 mW/cm^2 .

Sum_{MAX} = $0.0035 + 0.1782 = 0.1817 \text{ mW/cm}^2$

Note: The estimation distance is 20cm.

5. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.