

RF Exposure Evaluation Result

FCC ID: ZO4-M2

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance v05r02 & FCC Part 2 §2.1091

1. FCC Requirement

Systems operating under the provisions of FCC 47 CFR 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.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In according with KDB447498 Sections 7.2. Transmitters used in mobile exposure conditions for simultaneous transmission operations:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

2. Limits

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

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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. 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

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

4. Manufacturing tolerance

802.11b(Average)			
Channel	1	6	11
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0

802.11g(Average)			
Channel	1	6	11
Target (dBm)	10.0	10.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0

2.4G Transmitter (Peak)			
Frequency	2402	2442	2480
Target (dBm)	1.0	4.0	4.0
Tolerance ±(dB)	1.0	1.0	1.0

5. Estimation Result

5.1 Standalone MPE

Mode	Frequency (MHz)	Average Output power (including tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Ratio
		dBm	mW				
11b	2412	16.0	39.81	0	1.00	0.0079	0.0079
	2437	16.0	39.81	0	1.00	0.0079	0.0079
	2462	16.0	39.81	0	1.00	0.0079	0.0079
11g	2412	11.0	12.59	0	1.00	0.0025	0.0025
	2437	11.0	12.59	0	1.00	0.0025	0.0025
	2462	11.0	12.59	0	1.00	0.0025	0.0025
2.4G Transmitter	2402	2.0	1.58	0	1.00	0.0003	0.0003
	2442	5.0	3.16	0	1.00	0.0006	0.0006
	2480	5.0	3.16	0	1.00	0.0006	0.0006

5.2 Simultaneous transmission MPE Considerations

According to KDB447498 :For mobile exposure host platform to qualify for simultaneous transmission MPE test exclusion, all transmitters and antennas in the host must be either evaluated for MPE compliance, by measurement or computational modeling, or qualify for the standalone MPE test exclusion in section 7.1.

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 .

This means that:

$$\sum \text{of MPE ratios} \leq 1.0$$

For DUT can support WLAN and 2.4G transmitter modular, WLAN and 2.4G transmitter share difference transmit modular and difference antenna, WLAN and 2.4G transmitter can transmit signal simultaneously. Thus simultaneous transmission MPE of DUT should also need meet simultaneous transmission MPE limit.

Maximum MPE ratios of WLAN	Maximum MPE ratios of 2.4G Transmitter	$\sum \text{MPE}_{\text{WLAN, BT}}$ ratios	Limit of $\sum$ of MPE ratios	Test Results
0.0079	0.0006	0.0085	1.0	PASS

6. Conclusion

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

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