



## MPE Report

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance D01

FCC Part 2 §2.1091

### 1. Evaluation method

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 accordance with KDB447498D01 for 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  $\leq 1.0$ . 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 Peakd 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 for General Population/Uncontrolled Exposure

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: 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 EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the maximum gain of the used antenna as follow table, the RF power density can be obtained.

Frequency Band	Antenna type and antenna number	Maximum antenna gain
2.4GHz	Antenna 0, Internal Antenna	5dBi
	Antenna 1, Internal Antenna	5dBi



#### 4. Estimation Result

##### 4.1 Conducted Power Results

##### *2.4GHz WIFI*

Antenna	Mode	Frequency(MHz)	Peak Conducted Output Power (dBm)
Antenna 0	IEEE 802.11b	2412	20.52
		2437	20.72
		2462	19.77
Antenna 0	IEEE 802.11g	2412	19.65
		2437	20.07
		2462	18.01
Antenna 1		2412	19.19
		2437	19.03
		2462	17.67
Antenna 0	IEEE 802.11n HT20	2412	16.77
		2437	16.44
		2462	15.84
Antenna 1		2412	14.78
		2437	14.28
		2462	11.15
Antenna 0	IEEE 802.11n HT40	2422	21.90
		2437	21.74
		2452	19.09
Antenna 1		2422	22.75
		2437	22.66
		2452	19.16



#### 4.2 Manufacturing tolerance

##### 2.4GHz WIFI

IEEE 802.11 b						
Frequency (MHz)	Antenna 0					
	2412	2437	2462	2412	2437	2462
Target (dBm)	20.0	20.0	19.0	19.0	19.0	19.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11 g						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	19.0	20.0	18.0	19.0	19.0	17.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11 n HT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	16.0	16.0	15.0	14.0	14.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11 n HT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	2422	2437	2452	2422	2437	2452
Target (dBm)	21.0	21.0	19.0	22.0	22.0	19.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0



### 4.3 Measurement Results

#### 4.3.1 Standalone MPE

#### 2.4GWLAN

##### Antenna 0

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	(dBm)	(mW)					
IEEE 802.11 b	21.00	125.8925	5	3.1623	100%	0.0792	1.0000
IEEE 802.11 g	21.00	125.8925	5	3.1623	100%	0.0792	1.0000
IEEE 802.11 n HT20	17.00	50.1187	5	3.1623	100%	0.0315	1.0000
IEEE 802.11 n HT40	22.00	158.4893	5	3.1623	100%	0.0998	1.0000

##### Antenna 1

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	(dBm)	(mW)					
IEEE 802.11 g	20.00	100.0000	5	3.1623	100%	0.0629	1.0000
IEEE 802.11 n HT20	15.00	31.6228	5	3.1623	100%	0.0199	1.0000
IEEE 802.11 n HT40	23.00	199.5262	5	3.1623	100%	0.1256	1.0000

*Remark:*

1. Maximum Peak power including tune-up tolerance;
2. MPE use distance is 20cm from manufacturer declaration of user manual.

#### 4.3.2 Simultaneous transmission MPE

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$\sum$  of MPE ratios  $\leq 1.0$



**4.3.2.1 2.4GWLAN simultaneous transmission**

We all conditions, recorded worst case at 2 antenna at 2.4GWLAN simultaneous.

**Antenna 0 and Antenna 1 for 2.4GWLAN**

Mode	MPE <sub>Antenna 0</sub> (mW/cm <sup>2</sup> )	MPE <sub>Antenna 1</sub> (mW/cm <sup>2</sup> )	$\Sigma$ MPE ratios	Limit	Results
IEEE 802.11b	0.0792	N/A	N/A	1.0	Pass
IEEE 802.11g	0.0792	0.0629	N/A	1.0	Pass
IEEE 802.11n HT20	0.0315	0.0199	0.0514	1.0	Pass
IEEE 802.11n HT40	0.0998	0.1256	0.2254	1.0	Pass

**Conclusion**

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

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