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 v06
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 ≤ 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 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^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ 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 is 4dBi, the RF power density can be obtained.

4. Estimation Result

4.1 Conducted Power Results

Antenna	Mode	Frequency(MHz)	Average Conducted Output Power (dBm)
Antenna 1	IEEE 802.11b	2412	12.22
		2437	12.06
		2462	7.37
Antenna 2		2412	8.36
		2437	8.54
		2462	8.69
Antenna 1	IEEE 802.11g	2412	10.22
		2437	13.56
		2462	8.63
Antenna 2		2412	9.24
		2437	9.20
		2462	9.32
Antenna 1	IEEE 802.11n HT20	2412	10.57
		2437	13.44
		2462	8.55
Antenna 2		2412	9.20
		2437	9.13
		2462	9.16
Antenna 1	IEEE 802.11n HT40	2422	11.92
		2437	13.11
		2452	12.93
Antenna 2		2422	8.62
		2437	8.58
		2452	8.55

4.2 Manufacturing tolerance

IEEE 802.11 b (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	12.0	12.0	7.0	8.0	8.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 g (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	10.0	13.0	8.0	9.0	9.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 n HT 20 (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	10.0	13.0	8.0	9.0	9.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 n HT 40 (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	11.0	13.0	12.0	8.0	8.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

4.3 Measurement Results

Antenna 1

Mode	Frequency (MHz)	Output power (Including tune-up tolerance) (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)
IEEE 802.11b	2412	13	12.22	4	2.5118864	0.0061
	2437	13	12.06	4	2.5118864	0.0060
	2462	8	7.37	4	2.5118864	0.0037
IEEE 802.11g	2412	11	10.22	4	2.5118864	0.0051
	2437	13	13.56	4	2.5118864	0.0068
	2462	9	8.63	4	2.5118864	0.0043
IEEE 802.11n HT20	2412	11	10.57	4	2.5118864	0.0053
	2437	14	13.44	4	2.5118864	0.0067
	2462	9	8.55	4	2.5118864	0.0043
IEEE 802.11n HT40	2422	12	11.92	4	2.5118864	0.0060
	2437	14	13.11	4	2.5118864	0.0066
	2452	13	12.93	4	2.5118864	0.0065

Antenna 2

Mode	Frequency (MHz)	Output power (Including tune-up tolerance) (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)
IEEE 802.11b	2412	9	8.36	4	2.5118864	0.0042
	2437	9	8.54	4	2.5118864	0.0043
	2462	9	8.69	4	2.5118864	0.0043
IEEE 802.11g	2412	10	9.24	4	2.5118864	0.0046
	2437	10	9.2	4	2.5118864	0.0046
	2462	10	9.32	4	2.5118864	0.0047
IEEE 802.11n HT20	2412	10	9.2	4	2.5118864	0.0046
	2437	10	9.13	4	2.5118864	0.0046
	2462	10	9.16	4	2.5118864	0.0046
IEEE 802.11n HT40	2422	9	8.62	4	2.5118864	0.0043
	2437	9	8.58	4	2.5118864	0.0043
	2452	9	8.55	4	2.5118864	0.0043

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

∑ of MPE ratios ≤ 1.0

Mode	Frequency (MHz)	∑ MPE ratios (mW/cm^2)	Limit	Results
Antenna 1 and Antenna 2				
IEEE 802.11b	2412	N/A	1.000	Pass
	2442	N/A	1.000	Pass
	2462	N/A	1.000	Pass
IEEE 802.11g	2412	N/A	1.000	Pass
	2442	N/A	1.000	Pass
	2462	N/A	1.000	Pass
IEEE 802.11n HT20	2412	0.0090	1.000	Pass
	2442	0.0139	1.000	Pass
	2462	0.0071	1.000	Pass
IEEE 802.11n HT40	2422	0.0094	1.000	Pass
	2442	0.0131	1.000	Pass
	2452	0.0111	1.000	Pass

Note: The estimation distance is 20cm

Conclusion

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