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 peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the maximum gain of the used antenna is 7dBi, 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	14.88
		2437	14.28
		2462	14.08
Antenna 2		2412	21.13
		2437	20.42
		2462	18.49
Antenna 1	IEEE 802.11g	2412	14.34
		2437	13.46
		2462	13.55
Antenna 2		2412	18.46
		2437	17.62
		2462	16.79
Antenna 1	IEEE 802.11n HT20	2412	12.56
		2437	11.66
		2462	10.77
Antenna 2		2412	17.03
		2437	16.52
		2462	15.41
Antenna 1	IEEE 802.11n HT40	2422	10.11
		2437	9.60
		2452	9.00
Antenna 2		2422	16.56
		2437	16.06
		2452	15.36

4.2 Manufacturing tolerance

IEEE 802.11 b (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	14.0	14.0	14.0	21.0	20.0	18.0
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)	14.0	13.0	13.0	18.0	17.0	16.0
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)	12.0	11.0	10.0	17.0	16.0	15.0
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)	10.0	9.0	9.0	16.0	16.0	15.0
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	15	31.62	7	5.0118723	0.0315
	2437	15	31.62	7	5.0118723	0.0315
	2462	15	31.62	7	5.0118723	0.0315
IEEE 802.11g	2412	15	31.62	7	5.0118723	0.0315
	2437	14	25.12	7	5.0118723	0.0251
	2462	14	25.12	7	5.0118723	0.0251
IEEE 802.11n HT20	2412	13	19.95	7	5.0118723	0.0199
	2437	12	15.85	7	5.0118723	0.0158
	2462	11	12.59	7	5.0118723	0.0126
IEEE 802.11n HT40	2422	11	12.59	7	5.0118723	0.0126
	2437	10	10	7	5.0118723	0.0100
	2452	10	10	7	5.0118723	0.0100

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	22	158.49	7	5.0118723	0.1581
	2437	21	125.89	7	5.0118723	0.1256
	2462	19	79.43	7	5.0118723	0.0792
IEEE 802.11g	2412	19	79.43	7	5.0118723	0.0792
	2437	18	63.10	7	5.0118723	0.0629
	2462	17	50.12	7	5.0118723	0.0500
IEEE 802.11n HT20	2412	18	63.10	7	5.0118723	0.0629
	2437	17	50.12	7	5.0118723	0.0500
	2462	16	39.81	7	5.0118723	0.0397
IEEE 802.11n HT40	2422	17	50.12	7	5.0118723	0.0500
	2437	17	50.12	7	5.0118723	0.0500
	2452	16	39.81	7	5.0118723	0.0397

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	0.0828	1.000	Pass
	2442	0.0658	1.000	Pass
	2462	0.0523	1.000	Pass
IEEE 802.11n HT40	2422	0.0626	1.000	Pass
	2442	0.0600	1.000	Pass
	2452	0.0497	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.