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 2dBi for 5GWLAN and 3.0dBi for 2.4GWLAN, the RF power density can be obtained.

4. Estimation Result

4.1 Conducted Power Results

2.4GHz WIFI

Antenna	Mode	Frequency(MHz)	Average Conducted Output Power (dBm)
Antenna 0	IEEE 802.11b	2412	15.97
		2437	16.40
		2462	16.91
Antenna 1		2412	13.04
		2437	12.80
		2462	13.33
Antenna 0	IEEE 802.11g	2412	16.23
		2437	16.47
		2462	16.80
Antenna 1		2412	13.43
		2437	13.80
		2462	14.24
Antenna 0	IEEE 802.11n HT20	2412	13.43
		2437	13.80
		2462	14.25
Antenna 1		2412	12.80
		2437	13.13
		2462	13.52
Antenna 0	IEEE 802.11n HT40	2422	13.27
		2437	13.68
		2452	13.72
Antenna 1		2422	12.66
		2437	12.84
		2452	13.07

5GHz WIFI

Mode	Frequency(MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	5180	13.81
	5200	13.85
	5240	14.17
	5745	12.63
	5785	13.67
	5825	12.98
IEEE 802.11n HT20	5180	14.16
	5200	14.76
	5240	14.41
	5745	12.34
	5785	13.51
	5825	14.34
IEEE 802.11n HT40	5190	11.37
	5230	14.88
	5755	12.41
	5795	14.79
IEEE 802.11ac 80	5210	11.00
	5775	14.69

4.2 Manufacturing tolerance

2.4GHz WIFI

IEEE 802.11 b (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	16.00	16.00	17.00	13.00	12.00	13.00
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 g (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	16.00	16.00	16.00	13.00	13.00	14.00
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 n HT 20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462

Target (dBm)	13.00	13.00	14.00	12.00	13.00	13.00
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 n HT 40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Target (dBm)	13.00	13.00	13.00	12.00	12.00	13.00
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

5GHz WIFI

IEEE 802.11 a (Average)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	13.00	13.00	14.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5745	5785	5825
Target (dBm)	12.00	13.00	13.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11n HT20 (Average)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	14.00	14.00	14.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5745	5785	5825
Target (dBm)	12.00	13.00	14.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11n HT40 (Average)			
Frequency (MHz)	5190	---	5230
Target (dBm)	11.00		14.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5755	---	5795
Target (dBm)	12.00		14.00

Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11n HT80 (Average)			
Frequency (MHz)	5210	---	5775
Target (dBm)	11.00		14.00
Tolerance ±(dB)	1.0	1.0	1.0

4.3 Measurement Results

2.4GWLAN

Antenna 0

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)
	(dBm)	(mW)				
IEEE 802.11 b	18.0	63.0957	5.0	3.1623	100%	0.0397
IEEE 802.11 g	17.0	50.1187	5.0	3.1623	100%	0.0315
IEEE 802.11 n HT20	15.0	31.6228	5.0	3.1623	100%	0.0199
IEEE 802.11 n HT40	14.0	25.1189	5.0	3.1623	100%	0.0158

Antenna 1

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)
	(dBm)	(mW)				
IEEE 802.11 b	14.0	25.1189	5.0	3.1623	100%	0.0158
IEEE 802.11 g	15.0	31.6228	5.0	3.1623	100%	0.0199
IEEE 802.11 n HT20	14.0	25.1189	5.0	3.1623	100%	0.0158
IEEE 802.11 n HT40	14.0	25.1189	5.0	3.1623	100%	0.0158

5GWLAN

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)
	(dBm)	(mW)				
IEEE 802.11 a	15.0	31.6228	5.0	3.1623	100%	0.0199
IEEE 802.11 n HT20	15.0	31.6228	5.0	3.1623	100%	0.0199
I IEEE 802.11 n HT40	15.0	31.6228	5.0	3.1623	100%	0.0199
IEEE 802.11 ac 80	15.0	31.6228	5.0	3.1623	100%	0.0199

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
$\sum$ of MPE ratios ≤ 1.0

Mode	MPE $_{Antenna\ 0}$ (mW/cm^2)	MPE $_{Antenna\ 1}$ (mW/cm^2)	$\sum$ MPE ratios	Limit	Results

IEEE 802.11b	0.0397	0.0158	N/A	1.000	Pass
IEEE 802.11g	0.0315	0.0199	N/A	1.000	Pass
IEEE 802.11n HT20	0.0158	0.0158	0.0316	1.000	Pass
IEEE 802.11n HT40	0.0158	0.0158	0.0316	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.