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 2.4GWLAN, 4dBi for 5GWLAN the RF power density can be obtained.

Frequency Band	Antenna type and antenna number	Maximum antenna gain
2.4GHz	WLAN Antenna	2dBi
5.8GHz	WLAN Antenna	4dBi

4. Estimation Result

4.1 Conducted Power Results

2.4GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11b	2412	17.63
	2437	17.90
	2462	17.97
IEEE 802.11g	2412	15.85
	2437	15.95
	2462	16.17
IEEE 802.11n HT20	2412	14.23
	2437	14.56
	2462	14.51
IEEE 802.11n HT40	2422	13.55
	2437	13.56
	2452	13.51

5GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11a	5180	11.67
	5200	11.23
	5240	11.24
	5260	15.91
	5300	15.73
	5320	15.94
	5500	16.31
	5580	15.66
	5700	15.66

	5745	16.56
	5785	16.07
	5825	16.24
IEEE 802.11 HT20	5180	11.64
	5200	11.42
	5240	11.28
	5260	15.96
	5300	15.99
	5320	15.86
	5500	16.31
	5580	15.87
	5700	15.46
	5745	16.05
	5785	16.11
	5825	16.15
IEEE 802.11n HT40	5190	14.62
	5230	14.49
	5270	13.95
	5310	13.88
	5510	15.43
	5550	15.06
	5670	14.54
	5755	15.08
	5795	14.72
IEEE 802.11ac 80	5210	14.47
	5290	13.85
	5530	15.14
	5775	15.07

4.2 Manufacturing tolerance

2.4GHz WIFI

IEEE 802.11 b (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	17.00	17.00	17.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 g (Average)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	15.00	15.00	16.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 n HT20 (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	14.00	14.00	14.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 n HT40 (AVG)			
Frequency (MHz)	2422	2437	2452
Target (dBm)	13.00	13.00	13.00
Tolerance ±(dB)	1.0	1.0	1.0

5GHz WIFI

IEEE 802.11 a (AVG)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	11.00	11.00	11.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5260	5300	5320
Target (dBm)	15.00	15.00	15.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5500	5580	5700
Target (dBm)	16.00	15.00	15.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5745	5785	5825
Target (dBm)	16.00	16.00	16.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11n HT20 (AVG)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	11.00	11.00	11.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5260	5300	5320
Target (dBm)	15.00	15.00	15.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5500	5580	5700
Target (dBm)	16.00	15.00	15.00
Tolerance ±(dB)	1.0	1.0	1.0

Frequency (MHz)	5745	5785	5825
Target (dBm)	16.00	16.00	16.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11n HT40 (Average)			
Frequency (MHz)	5190	---	5230
Target (dBm)	14.00		14.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5270	---	5310
Target (dBm)	13.00		13.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5510	5550	5670
Target (dBm)	15.00	15.00	14.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5755	---	5795
Target (dBm)	15.00		14.00
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11ac 80 (Average)			
Frequency (MHz)	5210	---	5290
Target (dBm)	14.00		13.00
Tolerance ±(dB)	1.0	1.0	1.0
Frequency (MHz)	5530	---	5775
Target (dBm)	15.00		15.00
Tolerance ±(dB)	1.0	1.0	1.0

4.3 Measurement Results

4.3.1 Standalone MPE

2.4GWLAN

Mode	Output power (Including tune-up tolerance		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
IEEE 802.11 b	18.00	63.0957	2	1.5849	100%	0.0199	1.0000
IEEE 802.11 g	17.00	50.1187	2	1.5849	100%	0.0158	1.0000
IEEE 802.11 n HT20	15.00	31.6228	2	1.5849	100%	0.0100	1.0000
IEEE 802.11 n HT20	14.00	25.1189	2	1.5849	100%	0.0079	1.0000

5GWLAN

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
IEEE 802.11 a	17.00	125.3141	4	2.5119	100%	0.0251	1.0000
IEEE 802.11 n HT20	17.00	128.2331	4	2.5119	100%	0.0251	1.0000
IEEE 802.11 n HT40	16.00	151.3561	4	2.5119	100%	0.0199	1.0000
IEEE 802.11 ac 80	16.00	177.0109	4	2.5119	100%	0.0199	1.0000

4.3.2 Maximum Simultaneous transmission MPE Ratio for 2.4GWLAN and 5GWLAN

Maximum MPE ratio 2.4GWLAN	Maximum MPE ratio 5GWLAN	∑MPE ratios	Limit	Results
0.0199	0.0251	0.0450	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.

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