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 3.02dBi for 2.4GWLAN and the maximum gain of the used 3.01 for 5.8GWLAN, the RF power density can be obtained.

Frequency Band	Antenna type and antenna number	Maximum antenna gain
2.4GHz	WLAN Antenna	3.02dBi
5.8GHz	WLAN Antenna	3.01dBi

4. Estimation Result

4.1 Conducted Power Results

Bluetooth

Mode	Channel	Frequency(MHz)	Peak Conducted Output Power (dBm)
GFSK-BLE	00	2402	6.88
	19	2440	7.54
	39	2480	7.27
GFSK	00	2402	2.46
	39	2441	2.65
	78	2480	2.16
π/4DQPSK	00	2402	1.47
	39	2441	1.57
	78	2480	1.43
8DPSK	00	2402	-1.10
	39	2441	-0.66
	78	2480	-1.14

2.4GHz WIFI

Mode	Frequency(MHz)	Peak Conducted Output Power (dBm)
IEEE 802.11b	2412	16.53
	2437	16.91
	2462	17.11
IEEE 802.11g	2412	23.23
	2437	23.57
	2462	23.94
IEEE 802.11n HT20	2412	23.90
	2437	23.87
	2462	23.88
IEEE 802.11n HT40	2422	18.44
	2437	18.61
	2452	18.30

5GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11a	5180	14.06
	5200	14.01
	5240	14.15
	5745	15.28
	5785	15.60
	5825	15.64
IEEE 802.11n HT20	5180	13.88
	5200	13.77
	5240	13.81
	5745	15.04
	5785	15.27
	5825	15.42
IEEE 802.11n HT40	5190	13.31
	5230	13.21
	5755	14.99
	5795	15.14
IEEE 802.11ac 80	5210	12.73
	5775	14.31

4.2 Manufacturing tolerance

Bluetooth

GFSK-BLE			
Frequency (MHz)	2402	2440	2480
Maximum Output Power (dBm)	8.00	8.00	8.00

GFSK			
Frequency (MHz)	2402	2441	2480
Maximum Output Power(dBm)	3.00	3.00	3.00

π/4DQPSK			
Frequency (MHz)	2402	2441	2480
Maximum Output Power(dBm)	2.00	2.00	2.00

8DPSK			
Frequency (MHz)	2402	2441	2480
Maximum Output Power(dBm)	0	0	0

2.4GHz WIFI

IEEE 802.11 b			
Frequency (MHz)	2412	2437	2462
Maximum Output Power (dBm)	18.00	18.00	18.00

IEEE 802.11 g			
Frequency (MHz)	2412	2437	2462
Maximum Output Power (dBm)	24.00	24.00	24.00

IEEE 802.11 n HT20			
Frequency (MHz)	2412	2437	2462
Maximum Output Power (dBm)	24.00	24.00	24.00

IEEE 802.11 n HT40			
Frequency (MHz)	2422	2437	2452
Maximum Output Power (dBm)	19.00	19.00	19.00

5GHz WIFI

IEEE 802.11 a						
Frequency (MHz)	5180	5200	5240	5745	5785	5825
Maximum Output Power (dBm)	15.00	15.00	15.00	16.00	16.00	16.00

IEEE 802.11n HT20						
Frequency (MHz)	5180	5200	5240	5745	5785	5825
Maximum Output Power (dBm)	14.00	14.00	14.00	16.00	16.00	16.00

IEEE 802.11n HT40						
Frequency (MHz)	5190	---	5230	5755	---	5795
Maximum Output Power (dBm)	14.00	---	14.00	16.00	---	16.00

IEEE 802.11ac 80			
Frequency (MHz)	5210	5775	---
Maximum Output Power (dBm)	13.00	15.00	---

4.3 Measurement Results

4.3.1 Standalone MPE

Bluetooth

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
GFSK-BLE	8.00	6.3096	3.02	2.0045	100%	0.0025	1.0000
GFSK	4.00	2.5119	3.02	2.0045	100%	0.0010	1.0000
π/4DQPSK	3.00	1.9953	3.02	2.0045	100%	0.0008	1.0000
8DPSK	0.00	1.0000	3.02	2.0045	100%	0.0004	1.0000

2.4GWLAN

Mode	Output power		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	3.02	2.0045	100%	0.0252	1.0000
IEEE 802.11 g	24.00	251.1886	3.02	2.0045	100%	0.1002	1.0000
IEEE 802.11 n HT20	24.00	251.1886	3.02	2.0045	100%	0.1002	1.0000
IEEE 802.11 n HT40	19.00	79.4328	3.02	2.0045	100%	0.0317	1.0000

5GWLAN

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
IEEE 802.11 a	16.00	39.8107	3.01	1.9999	100%	0.0158	1.0000
IEEE 802.11 n HT20	16.00	39.8107	3.01	1.9999	100%	0.0158	1.0000
IEEE 802.11 n HT40	16.00	39.8107	3.01	1.9999	100%	0.0158	1.0000
IEEE 802.11 ac 80	15.00	31.6228	3.01	1.9999	100%	0.0126	1.0000

Remark:

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

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

The device support one WLAN/BT modular and one antenna, no need consider simultaneous transmission.

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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