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 3dBi for 2.4G wifi and 5.8G WLAN, the RF power density can be obtained.

Frequency Band	Antenna type and antenna number	Internal Identification	Maximum antenna gain
2.4GHz	FPC antenna	Antenna 1	3dBi
		Antenna 2	3dBi
5.8GHz	FPC antenna	Antenna 3	3dBi
		Antenna 4	3dBi

4. Estimation Result

4.1 Conducted Power Results

2.4GHz WIFI

Antenna	Mode	Frequency(MHz)	Conducted Output Power (dBm)
Antenna 1	IEEE 802.11b	2412	15.00
		2437	15.10
		2462	14.90
Antenna 2		2412	14.70
		2437	14.80
		2462	14.50
Antenna 1	IEEE 802.11g	2412	15.30
		2437	15.40
		2462	15.30
Antenna 2		2412	14.90
		2437	14.90
		2462	14.90
Antenna 1	IEEE 802.11n HT20	2412	15.20
		2437	15.50
		2462	15.10
Antenna 2		2412	14.80
		2437	14.80
		2462	14.70

5GHz

Antenna 3

	Frequency(MHz)	Average Conducted Output Power (dBm)
OFDM	5745	9.45
	5777	11.10
	5810	11.39

Antenna 4

	Frequency(MHz)	Average Conducted Output Power (dBm)
OFDM	5745	10.87
	5777	9.51
	5810	10.70

4.2 Manufacturing tolerance

2.4GHz WIFI

IEEE 802.11 b						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	15.0	15.0	14.0	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 g						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	15.0	15.0	15.0	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11 n HT20						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	15.0	15.0	15.0	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

5GHz

Antenna 3

OFDM			
Frequency (MHz)	5745	5777	5810
Target (dBm)	9.0	11.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0

Antenna 4

OFDM			
Frequency (MHz)	5745	5777	5810
Target (dBm)	10.0	9.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0

4.3 Measurement Results

4.3.1 Standalone MPE

2.4G WIFI

Antenna 1

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	16.0	39.8107	3	1.9953	100%	0.0158	1.0000
IEEE 802.11 g	16.0	39.8107	3	1.9953	100%	0.0158	1.0000
IEEE 802.11 n HT20	16.0	39.8107	3	1.9953	100%	0.0158	1.0000

Antenna 2

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	15.0	31.6228	3	1.9953	100%	0.0126	1.0000
IEEE 802.11 g	15.0	31.6228	3	1.9953	100%	0.0126	1.0000
IEEE 802.11 n HT20	15.0	31.6228	3	1.9953	100%	0.0126	1.0000

5G WLAN

Antenna 3

	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
OFDM	12.0	15.8489	3	1.9953	100%	0.0063	1.0000

Antenna 4

	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
OFDM	11.0	12.5893	3	1.9953	100%	0.0050	1.0000

Remark:

1. *Maximum average 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;
∑ of MPE ratios ≤ 1.0

Antenna 1 and Antenna 2 for 2.4GWLAN

Band	Mode	MPE Ratio Antenna 0	MPE Ratio Antenna 1	∑ MPE ratios	Limit	Results
2.4G	IEEE 802.11b	0.0158	0.0126	N/A	1.000	Pass
	IEEE 802.11g	0.0158	0.0126	N/A	1.000	Pass
	IEEE 802.11n HT20	0.0158	0.0126	0.0284	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for 2.4GHz WLAN and 5GHz Transmitter

Maximum MPE ratio $_{2.4GWLAN}$	Maximum MPE ratio $_{5G}$	∑ MPE ratios	Limit	Results
0.0284	0.0063	0.1	1.0	Pass

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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