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 Bluetooth / 2.4GWLAN / 5.8GWLAN, the RF power density can be obtained.

4. Estimation Result

4.1 Conducted Power Results

Bluetooth

Mode	Channel	Frequency(MHz)	AVG Conducted Output Power (dBm)
GFSK-BLE	00	2402	2.25
	19	2440	3.20
	39	2480	1.85
GFSK	00	2402	-6.87
	39	2441	-5.87
	78	2480	-7.24
π/4DQPSK	00	2402	-10.08
	39	2441	-9.47
	78	2480	-11.11
8DPSK	00	2402	-9.73
	39	2441	-9.05
	78	2480	-10.79

2.4GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11b	2412	6.49
	2437	6.52
	2462	6.55
IEEE 802.11g	2412	6.07
	2437	6.54
	2462	6.48
IEEE 802.11n HT20	2412	5.58
	2437	5.54
	2462	5.68

5GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11a	5180	8.65
	5200	8.40
	5240	7.73
IEEE 802.11 HT20	5180	6.68
	5200	6.69
	5240	6.15
IEEE 802.11n HT40	5190	6.80
	5230	6.44
IEEE 802.11ac 80	5210	6.71

LTE

Mode	Max Turn-up Power (dBm)
WCDMA (Band V)	23.5
WCDMA (Band II)	23.5
LTE (Band II)	24
LTE (Band IV)	24
LTE (Band XII)	24

4.2 Manufacturing tolerance

Bluetooth

GFSK -BLE(AVG)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	2.0	3.0	1.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	-6.0	-5.0	-7.0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	-10.0	-9.0	-11.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	-9.0	-9.0	-10.0
Tolerance ±(dB)	1.0	1.0	1.0

2.4GHz WIFI

IEEE 802.11 b (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 g (Average)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 n HT20 (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	5.0	5.0	5.0
Tolerance ±(dB)	1.0	1.0	1.0

5GHz WIFI

IEEE 802.11 a (AVG)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	8.0	8.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 HT20 (Average)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11 n HT40 (AVG)			
Frequency (MHz)	5190	---	5230
Target (dBm)	6.0	---	6.0
Tolerance ±(dB)	1.0	---	1.0

IEEE 802.11ac 80 (AVG)			
Frequency (MHz)	5210	---	---
Target (dBm)	6.0	---	---
Tolerance ±(dB)	1.0	---	---

LTE			
Mode	WCDMA (Band V)	---	WCDMA (Band II)
Target (dBm)	23	---	23

Tolerance ±(dB)	1.0	---	1.0

LTE			
Mode	LTE (Band II)	LTE (Band IV)	LTE (Band XII)
Target (dBm)	24	24	24
Tolerance ±(dB)	1.0	1.0	1.0

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-LE	4.00	2.5119	2	1.5849	100%	0.0008	1.0000
GFSK	-4.00	0.3981	2	1.5849	100%	0.0001	1.0000
π/4DQPSK	-8.00	0.1585	2	1.5849	100%	0.0000	1.0000
8DPSK	-8.00	0.1585	2	1.5849	100%	0.0000	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	7.00	5.0119	2	1.5849	100%	0.0016	1.0000
IEEE 802.11 g	7.00	5.0119	2	1.5849	100%	0.0016	1.0000
IEEE 802.11n HT20	6.00	3.9811	2	1.5849	100%	0.0013	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	9.00	7.9433	2	1.5849	100%	0.0025	1.0000
IEEE 802.11n HT20	7.00	5.0119	2	1.5849	100%	0.0016	1.0000
IEEE 802.11n HT40	7.00	5.0119	2	1.5849	100%	0.0016	1.0000
IEEE 802.11ac 80	7.00	5.0119	2	1.5849	100%	0.0016	1.0000

LTE

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	(dBm)	(mW)					
WCDMA (Band V)	24	251.1886	1	1.2589	100%	0.0629	1.0000
WCDMA (Band II)	24	251.1886	1	1.2589	100%	0.0629	1.0000
LTE (Band II)	25	316.2278	1	1.2589	100%	0.0792	1.0000
LTE (Band IV)	25	316.2278	1	1.2589	100%	0.0792	1.0000
LTE (Band XII)	25	125.3141	1	1.2589	100%	0.0314	1.0000

Maximum Simultaneous transmission MPE Ratio for WLAN and BT and LTE

Maximum MPE ratio $_{WLAN}$	Maximum MPE ratio $_{BT}$	Maximum MPE ratio $_{LTE}$	∑ MPE ratios	Limit	Results
0.0025	0.0008	0.0792	0.0825	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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