



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



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Report No: C171025Z03-RP1_MPE

FCC ID: 2AGG8HDP3550

Date of Issue: November 6, 2017

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to anisotropic radiator

R=distance to the center of radiation of the antenna

From the EUT RF output power, the minimum mobile separation distance, $d=0.2\text{m}$, as well as the maximum gain of the used as following information, the RF power density can be obtained.

Frequency Band	Antenna type and antenna number	Maximum antenna gain
2.4GHz	BT Antenna	4.0dBi
	WLAN Antenna	4.0dBi

4. Estimation Result

4.1 Conducted Power Results

Bluetooth

Mode	Channel	Frequency(MHz)	AVG Conducted Output Power (dBm)
GFSK-BLE	00	2402	5.57
	19	2440	6.59
	39	2480	6.00
GFSK	00	2402	-10.80
	39	2441	-9.35
	78	2480	-10.95
$\pi/4$ DQPSK	00	2402	-10.58
	39	2441	-9.42
	78	2480	-10.57
8DPSK	00	2402	-10.87
	39	2441	-9.40
	78	2480	-11.03

2.4GHz WIFI

Mode	Frequency(MHz)	Conducted Output Power (dBm)
IEEE 802.11b	2412	13.50
	2437	13.77
	2462	14.28
IEEE 802.11g	2412	13.14
	2437	13.54
	2462	13.84
IEEE 802.11n HT20	2412	12.82
	2437	13.48
	2462	13.63

**4.2 Manufacturing tolerance*****Bluetooth***

GFSK-BLE			
Channel	Channel 00	Channel 19	Channel 39
Maximum Output Power (dBm)	5.57	6.59	6.00

GFSK			
Channel	Channel 00	Channel 39	Channel 78
Maximum Output Power (dBm)	-10.80	-9.35	-10.95

$\pi/4$DQPSK			
Channel	Channel 00	Channel 39	Channel 78
Maximum Output Power (dBm)	-10.58	-9.42	-10.57

8DPSK			
Channel	Channel 00	Channel 39	Channel 78
Maximum Output Power (dBm)	-10.87	-9.40	-11.03

2.4GHz WIFI

IEEE 802.11b			
Frequency (MHz)	2412	2437	2462
Maximum Output Power (dBm)	13.50	13.77	14.28

IEEE 802.11 g			
Frequency (MHz)	2412	2437	2462
Maximum Output Power (dBm)	13.14	13.54	13.84

IEEE 802.11 n HT20			
Frequency (MHz)	2412	2437	2462
Maximum Output Power (dBm)	12.82	13.48	13.63

4.3 Measurement Results***4.3.1 Standalone MPE***

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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	6.59	4.5604	4.00	2.5119	100%	0.0023	1.0000
GFSK	-9.35	0.1161	4.00	2.5119	100%	0.0001	1.0000
$\pi/4$ DQPSK	-9.42	0.1143	4.00	2.5119	100%	0.0001	1.0000
8DPSK	-9.40	0.1148	4.00	2.5119	100%	0.0001	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)					
GFSK-BLE	14.28	26.7917	4.00	2.5119	100%	0.0134	1.0000
GFSK	13.84	24.2103	4.00	2.5119	100%	0.0121	1.0000
$\pi/4$ DQPSK	13.63	23.0675	4.00	2.5119	100%	0.0115	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;

$\sum$ of MPE ratios ≤ 1.0

The BT and WLAN share difference antenna and difference modular, need consider BT and WLAN simultaneous transmission;

Maximum MPE Ratios for BT and 2.4GHz WLAN simultaneous transmission

Maximum MPE Ratio _{2.4GHzBT}	Maximum MPE Ratio _{2.4GHzWLAN}	$\sum$ MPE _{ratios}	Limit	Results
0.0023	0.0134	0.0157	1.000	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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