



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 BT and 3.9dBi for 2.4G the RF power density can be obtained.

Frequency Band	Antenna type and antenna number	Maximum antenna gain
BT3.0	FPCB antenna	3.0dBi
2.4G	Integrated antenna	3.9dBi

4. Estimation Result

4.1 Conducted Power Results

Bluetooth

Mode	Channel	Frequency(MHz)	AVG Conducted Output Power (dBm)
GFSK	00	2402	5.20
	39	2441	4.90
	78	2480	4.50
$\pi/4$ DQPSK	00	2402	3.51
	39	2441	2.92
	78	2480	2.18
8DPSK	00	2402	3.60
	39	2441	3.00
	78	2480	2.30

2.4G

Antenna	Frequency(MHz)	AVG Conducted Output Power (dBm)
Antenna 0	2403.35	4.20
	2441.35	3.90
	2477.35	3.10
Antenna 1	2403.35	4.40
	2441.35	4.10
	2477.35	3.40



4.2 Manufacturing tolerance

Bluetooth

GFSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	5.0	4.0	4.0
Tolerance ±(dB)	1.0	1.0	1.0
$\pi/4$DQPSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	3.0	2.0	2.0
Tolerance ±(dB)	1.0	1.0	0.0
8DPSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	3.0	3.0	2.0
Tolerance ±(dB)	1.0	1.0	1.0

2.4G

QPSK						
Frequency (MHz)	Antenna 0			Antenna 1		
	2403.35	2441.35	2477.35	2403.35	2441.35	2477.35
Target (dBm)	4.0	3.0	3.0	4.0	4.0	3.0
Tolerance ±(dB)	1.0	1.0	1.0	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	6.00	3.9811	3.00	1.9953	100%	0.00158	1.0000
$\pi/4$ DPSK	5.00	3.1623	3.00	1.9953	100%	0.00126	1.0000
8DPSK	5.00	3.1623	3.00	1.9953	100%	0.00126	1.0000

2.4G

Antenna 0

Frequency (MHz)	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
2403.35	5.00	3.1623	3.90	2.4547	100%	0.0015	1.0000
2441.35	4.00	2.5119	3.90	2.4547	100%	0.0012	1.0000
2477.35	4.00	2.5119	3.90	2.4547	100%	0.0012	1.0000



Antenna 1

Frequency (MHz)	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
2403.35	5.00	3.1623	3.90	2.4547	100%	0.0015	1.0000
2441.35	5.00	3.1623	3.90	2.4547	100%	0.0015	1.0000
2477.35	4.00	2.5119	3.90	2.4547	100%	0.0012	1.0000

Remark:

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

4.3.2 Standalone MPE

The sample supports 3 antennas, 2 antennas for 2.4G transmit modular, 1 antenna for BT modular, 2.4G transmitter cannot support MIMO technical technology, cannot transmit simultaneous, 2.4G transmit modular can transmit simultaneous with BT antenna. According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
 \sum of MPE ratios \leq 1.0

2.4G transmit modular Antenna 0 and BT Antenna

MPE Antenna0 ratio	MPE BT ratio	\sum MPE ratios	Limit	Results
0.0015	0.00158	0.1	1.0	PASS

2.4G transmit modular Antenna 1 and BT Antenna

MPE Antenna1 ratio	MPE BT ratio	\sum MPE ratios	Limit	Results
0.0015	0.00158	0.1	1.0	PASS

Remark:

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

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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