



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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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, $d=0.2\text{m}$, as well as the maximum gain of the used antenna is 2dBi for Bluetooth, 2.4G 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	BT antenna		2dBi
	WLAN antenna		2dBi
5.8GHz	WLAN antenna		2dBi

4. Estimation Result

4.1 Conducted Power Results

Bluetooth

Mode	Channel	Frequency(MHz)	Peak Conducted Output Power (dBm)
GFSK	00	2402	-6.56
	39	2441	-6.81
	78	2480	-6.91
$\pi/4$ DQPSK	00	2402	-10.75
	39	2441	-10.53
	78	2480	-10.77
8DPSK	00	2402	-10.28
	39	2441	-10.25
	78	2480	-10.56

Mode	Channel	Frequency(MHz)	Peak Conducted Output Power (dBm)
GFSK	00	2402	5.45
	19	2442	6.16
	39	2480	6.28



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2.4GHz WIFI

Mode	Frequency(MHz)	Peak Conducted Output Power (dBm)
IEEE 802.11b	2412	16.33
	2437	16.29
	2462	16.62
IEEE 802.11g	2412	21.75
	2437	22.46
	2462	22.90
IEEE 802.11n HT20	2412	21.17
	2437	21.50
	2462	22.11
IEEE 802.11n HT40	2422	19.87
	2437	20.30
	2452	19.66

**5GHz WIFI**

Mode	Frequency(MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	5180	12.66
	5200	12.72
	5240	13.22
	5260	12.98
	5300	12.82
	5320	12.66
	5500	12.10
	5580	10.95
	5700	10.32
	5745	10.00
	5785	9.67
	5825	9.18
IEEE 802.11n HT20	5180	11.51
	5200	11.64
	5240	11.72
	5260	11.88
	5300	11.71
	5320	11.86
	5500	11.92
	5580	10.51
	5700	10.14
	5745	9.88
	5785	9.47
	5825	9.37
IEEE 802.11n HT40	5190	11.29
	5230	11.53
	5270	11.58
	5310	11.46
	5510	11.45
	5550	10.55
	5670	10.37
	5755	9.68
	5795	9.39
IEEE 802.11ac 80	5210	9.77
	5290	9.95
	5530	10.20
	5775	9.20

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

GFSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	-6.0	-6.0	-6.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
$\pi/4$DQPSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	-10.0	-10.0	-10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	-10.0	-10.0	-10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

GFSK (Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	5.0	6.0	6.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

**2.4GHz WIFI**

IEEE 802.11 b			
Frequency (MHz)	2412	2437	2462
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

IEEE 802.11 g			
Frequency (MHz)	2412	2437	2462
Target (dBm)	21.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

IEEE 802.11 n HT20			
Frequency (MHz)	2412	2437	2462
Target (dBm)	21.0	21.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

IEEE 802.11 n HT40			
Frequency (MHz)	2422	2437	2452
Target (dBm)	19.0	20.0	19.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

**5GHz WIFI**

IEEE 802.11 a (AVG)						
Frequency (MHz)	5180	5200	5240	5260	5300	5320
Target (dBm)	12.0	12.0	13.0	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11 a (AVG)						
Frequency (MHz)	5500	5580	5700	5745	5785	5825
Target (dBm)	12.0	10.0	10.0	10.0	9.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11n HT20 (AVG)						
Frequency (MHz)	5180	5200	5240	5260	5300	5320
Target (dBm)	11.0	11.0	11.0	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (AVG)						
Frequency (MHz)	5500	5580	5700	5745	5785	5825
Target (dBm)	11.0	10.0	10.0	9.0	9.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11n HT40 (AVG)						
Frequency (MHz)	5190	---	5230	5270	---	5310
Target (dBm)	11.0	---	11.0	11.0	---	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (AVG)						
Frequency (MHz)	5510	5550	5670	5755	---	5795
Target (dBm)	11.0	10.0	10.0	9.0	---	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11ac 80 (AVG)						
Frequency (MHz)	5210	---	5290	5530	---	5775
Target (dBm)	9.0	---	9.0	10.0	---	9.0
Tolerance $\pm$ (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 (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
GFSK	-5.0	0.3162	2	1.5849	100%	0.0001	1.0000
$\pi/4$ DQPSK	-9.0	0.1259	2	1.5849	100%	0.0000	1.0000
8DPSK	-9.0	0.1259	2	1.5849	100%	0.0000	1.0000

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
GFSK	7.0	5.0119	2	1.5849	100%	0.0016	1.0000

2.4G WLAN

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
IEEE 802.11 b	17.0	50.1187	2	1.5849	100%	0.0158	1.0000
IEEE 802.11 g	23.0	199.5262	2	1.5849	100%	0.0629	1.0000
IEEE 802.11 n HT20	23.0	199.5262	2	1.5849	100%	0.0629	1.0000
IEEE 802.11 n HT40	21.0	125.8925	2	1.5849	100%	0.0397	1.0000

5G WLAN

Mode	Output power (Including tune-up tolerance)		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)					
IEEE 802.11 a	14.0	25.1189	2	1.5849	100%	0.0079	1.0000
IEEE 802.11 n HT20	12.0	15.8489	2	1.5849	100%	0.0050	1.0000
IEEE 802.11 n HT40	12.0	15.8489	2	1.5849	100%	0.0050	1.0000
IEEE 802.11ac 80	11.0	12.5893	2	1.5849	100%	0.0040	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;



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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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