



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 v05r02

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 peak 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, 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	-0.31
	19	2440	1.36
	39	2480	0.46
GFSK	00	2402	5.42
	39	2441	7.04
	78	2480	5.84
8DPSK	00	2402	1.95
	39	2441	3.69
	78	2480	2.27
$\pi/4$ DQPSK	00	2402	4.88
	39	2441	5.15
	78	2480	5.04

2.4GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11b	2412	5.83
	2437	5.77
	2462	5.54
IEEE 802.11g	2412	5.23
	2437	5.13
	2462	5.01
IEEE 802.11n HT20	2412	4.99
	2437	5.23
	2462	4.98



5GHz WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11a	5180	11.97
	5200	11.56
	5240	10.63
	5260	8.32
	5300	7.64
	5320	7.77
	5745	12.03
	5785	12.21
	5825	12.48
IEEE 802.11n HT20	5180	10.82
	5200	11.43
	5240	10.76
	5260	8.25
	5300	7.71
	5320	7.41
	5745	11.64
	5785	12.68
	5825	12.54
IEEE 802.11n HT40	5190	6.71
	5230	7.76
	5270	8.43
	5310	7.81
	5755	8.32
	5795	7.43
IEEE 802.11ac 80	5210	10.55
	5290	7.48
	5775	12.63

4.2 Manufacturing tolerance

Bluetooth

GFSK -BLE(AVG)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	0.0	1.0	0.0
Tolerance \pm (dB)	1.0	1.0	1.0
GFSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78



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Target (dBm)	5.0	7.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0
8DPSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	1.0	3.0	2.0
Tolerance \pm (dB)	1.0	1.0	1.0
π/4DQPSK (AVG)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	4.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0

2.4GHz WIFI

IEEE 802.11 b (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0

IEEE 802.11 g (Average)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0

IEEE 802.11 n HT20 (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	4.0	5.0	4.0
Tolerance \pm (dB)	1.0	1.0	1.0

5GHz WIFI

IEEE 802.11 a (AVG)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	11.0	11.0	10.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11 a (AVG)			
Frequency (MHz)	5260	5300	5320
Target (dBm)	8.0	7.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11 a (AVG)			
Frequency (MHz)	5745	5785	5825
Target (dBm)	12.0	12.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0



IEEE 802.11n HT20 (AVG)			
Frequency (MHz)	5180	5200	5240
Target (dBm)	10.0	11.0	10.0
Tolerance \pm (dB)	1.0	1.0	1.0
Frequency (MHz)	5260	5300	5320
Target (dBm)	8.0	7.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
Frequency (MHz)	5745	5785	5825
Target (dBm)	11.0	12.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0

IEEE 802.11n HT40 (Average)			
Frequency (MHz)	5190	---	5230
Target (dBm)	6.0		7.0
Tolerance \pm (dB)	1.0	1.0	1.0
Frequency (MHz)	5270	---	5310
Target (dBm)	8.0		7.0
Tolerance \pm (dB)	1.0	1.0	1.0
Frequency (MHz)	5755	---	5795
Target (dBm)	8.0		7.0
Tolerance \pm (dB)	1.0	1.0	1.0

IEEE 802.11ac 80 (AVG)			
Frequency (MHz)	5210	5290	5775
Target (dBm)	10.0	7.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0

4.3 Measurement Results***Bluetooth***

Mode	Frequency (MHz)	Output power (Including tune-up tolerance) (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)
GFSK-BLE	2402	1.0	1.2589	3	1.9953	0.0005
	2440	2.0	1.5849	3	1.9953	0.0006
	2480	1.0	1.2589	3	1.9953	0.0005



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GFSK	2402	6.0	3.9811	3	1.9953	0.0016
	2441	8.0	6.3096	3	1.9953	0.0025
	2480	6.0	3.9811	3	1.9953	0.0016
8DPSK	2402	2.0	1.5849	3	1.9953	0.0006
	2441	4.0	2.5119	3	1.9953	0.0010
	2480	3.0	1.9953	3	1.9953	0.0008
$\pi/4$ DQPSK	2402	5.0	3.1623	3	1.9953	0.0013
	2441	6.0	3.9811	3	1.9953	0.0016
	2480	6.0	3.9811	3	1.9953	0.0016

WIFI

Mode	Frequency (MHz)	Output power (Including tune-up tolerance) (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)
IEEE 802.11b	2412	6.0	3.9811	3	1.9953	0.0016
	2442	6.0	3.9811	3	1.9953	0.0016
	2462	6.0	3.9811	3	1.9953	0.0016
IEEE 802.11g	2412	6.0	3.9811	3	1.9953	0.0016
	2442	6.0	3.9811	3	1.9953	0.0016
	2462	6.0	3.9811	3	1.9953	0.0016
IEEE 802.11n HT20	2412	5.0	3.1623	3	1.9953	0.0013
	2442	6.0	3.9811	3	1.9953	0.0016
	2462	5.0	3.1623	3	1.9953	0.0013
	5180	11.0	12.5893	3	1.9953	0.0050
	5200	12.0	15.8489	3	1.9953	0.0063
	5240	11.0	12.5893	3	1.9953	0.0050
	5260	9.0	7.9433	3	1.9953	0.0032
	5300	8.0	6.3096	3	1.9953	0.0025
	5320	8.0	6.3096	3	1.9953	0.0025
	5745	12.0	15.8489	3	1.9953	0.0063
	5785	13.0	19.9526	3	1.9953	0.0079
	5825	13.0	19.9526	3	1.9953	0.0079
IEEE 802.11n HT40	5190	7.0	5.0119	3	1.9953	0.0020
	5230	8.0	6.3096	3	1.9953	0.0025
	5270	9.0	7.9433	3	1.9953	0.0032
	5310	8.0	6.3096	3	1.9953	0.0025
	5755	9.0	7.9433	3	1.9953	0.0032
	5795	8.0	6.3096	3	1.9953	0.0025
IEEE 802.11ac 80	5210	11.0	12.5893	3	1.9953	0.0050
	5290	8.0	6.3096	3	1.9953	0.0025



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	5775	13.0	19.9526	3	1.9953	0.0079
IEEE 802.11a	5180	12.0	15.8489	3	1.9953	0.0063
	5200	12.0	15.8489	3	1.9953	0.0063
	5240	11.0	12.5893	3	1.9953	0.0050
	5260	9.0	7.9433	3	1.9953	0.0032
	5300	8.0	6.3096	3	1.9953	0.0025
	5320	8.0	6.3096	3	1.9953	0.0025
	5745	13.0	19.9526	3	1.9953	0.0079
	5785	13.0	19.9526	3	1.9953	0.0079
	5825	13.0	19.9526	3	1.9953	0.0079

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.