

Appendix B. Maximum Permissible Exposure

1. Maximum Permissible Exposure

1.1. Applicable Standard

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.35 m normally can be maintained between the user and the device.

(A) Limits for Occupational / Controlled 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)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6

(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

1.2. MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.35m, as well as the gain of the used antenna, the RF power density can be obtained.

1.3. Calculated Result and Limit

For 5GHz UNII Band:

RadioB (5G) RF module (FCC ID: UZ7RAAP800)

Antenna Type : Dipole Antenna

Test Mode : Mode 1

Max Conducted Power for IEEE 802.11n HT40MHz MCS0 (2TX) : 14.92dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
8.00	6.3096	14.9200	31.0456	0.012731	1	Complies

Antenna Type : Panel Antenna

Test Mode : Mode 2

Max Conducted Power for IEEE 802.11n HT40MHz MCS0 (2TX) : 10.49dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
12.50	17.7828	10.4900	11.1944	0.012938	1	Complies

Antenna Type : Yagi Antenna

Test Mode : Mode 3

Max Conducted Power for IEEE 802.11ac VHT40MHz MCS0/NSS3 (3TX) : 14.88dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
8.00	6.3096	14.8800	30.7610	0.012615	1	Complies

Antenna Type : Patch Antenna

Test Mode : Mode 4

Max Conducted Power for IEEE 802.11ac VHT20MHz MCS0/NSS1 (3TX) : 16.99dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2.30	1.6982	16.9900	50.0035	0.005519	1	Complies

Antenna Type : Facade Antenna

Test Mode : Mode 5

Max Conducted Power for IEEE 802.11ac VHT20MHz MCS0/NSS3 (3TX) : 16.99dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2.50	1.7783	16.9900	50.0035	0.005779	1	Complies

Antenna Type : Panel Antenna

Test Mode : Mode 6

Max Conducted Power for IEEE 802.11n HT40MHz MCS0 (3TX) : 13.77dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
9.20	8.3176	13.7700	23.8232	0.012879	1	Complies

Antenna Type : PIFA Antenna

Test Mode : Mode 7

Max Conducted Power for IEEE 802.11n HT40MHz MCS8 (3TX) : 16.95dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5.30	3.3884	16.9506	49.5517	0.014853	1	Complies

For 5GHz ISM Band:

RadioB (5G) RF module (FCC ID: UZ7RAAP800)

Antenna Type :Dipole Antenna

Test Mode : Mode 1

Max Conducted Power for IEEE 802.11n HT20MHz MCS0 (3TX) : 27.72dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
8.00	6.3096	27.7200	591.5616	0.242591	1	Complies

Antenna Type : Panel Antenna

Test Mode : Mode 2

Max Conducted Power for IEEE 802.11a (2TX) : 26.44dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
12.50	17.7828	26.4400	440.5549	0.509183	1	Complies

Antenna Type : Yagi Antenna

Test Mode : Mode 3

Max Conducted Power for IEEE 802.11n HT20MHz MCS0 (3TX) : 27.72dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
8.00	6.3096	27.7200	591.5616	0.242591	1	Complies

Antenna Type : Patch Antenna

Test Mode : Mode 4

Max Conducted Power for IEEE 802.11n HT20MHz MCS0 (3TX) : 27.72dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2.30	1.6982	27.7200	591.5616	0.065294	1	Complies

Antenna Type : Façade Antenna

Test Mode : Mode 5

Max Conducted Power for IEEE 802.11n HT20MHz MCS0 (3TX) : 27.72dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2.50	1.7783	27.7200	591.5616	0.068371	1	Complies

Antenna Type : Panel Antenna

Test Mode : Mode 6

Max Conducted Power for IEEE 802.11ac VHT40MHz MCS0/nss1 (3TX) : 26.79dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
9.20	8.3176	26.7900	477.5293	0.258151	1	Complies

For 2.4GHz Band:

RadioA (2.4G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : Panel Antenna

Max Conducted Power for IEEE 802.11b (3TX) 17.12 dBm

Directional Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
18.77	75.3356	17.1200	51.5229	0.252275	1	Complies

For 5GHz ISM Band 4:

RadioA (5G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11n 20MHz MCS0 (3TX) : 23.22dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
12.77	18.9234	23.2200	209.8940	0.258151	1	Complies

For 5GHz UNII Band 1:

RadioA (5G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : Panel Antenna

Max Conducted Power for IEEE 802.11n 40MHz MCS0 (1TX) : 12.46dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
10.50	11.2202	12.4600	17.6198	0.012849	1	Complies

For 2.4G Dongle:

802.11 a/b/g/n USB Dongle (FCC ID: UZ7KHUSB600)

Antenna Type : PIFA Antenna

Max Conducted Power for IEEE 802.11g: 23.31 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
8.25	6.6834	23.3100	214.2891	0.093084	1	Complies

For 5G Dongle:

802.11 a/b/g/n USB Dongle (FCC ID: UZ7KHUSB600)

Antenna Type : PIFA Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz: 20.26 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5.87	3.8637	20.2600	106.1696	0.026661	1	Complies

CONCLUSION:

Both of the RadioA(2.4G)/(5G) RF module (FCC ID: UZ7KHAP800), RadioB (5G) RF module (FCC ID: UZ7RAAP800) and 2.4G/5G USB Dongle (FCC ID: UZ7KHUSB600) can transmit simultaneously on the AP (MOTOROLA / AP-8232), the formula of calculated the MPE is:

$$CPD1 / LPD1 + CPD2 / LPD2 +etc. < 1$$

CPD = Calculation power density

LPD = Limit of power density

RadioA (2.4G) Panel Antenna+RadioB (5G) with ANT7+USB 2.4G sensor dongle

Therefore, the worst-case situation is $0.252275/1 + 0.509183/1 + 0.093084/1 = 0.854542$, which is less than "1".

This confirmed that the device comply with FCC 1.1310 MPE limit.

RadioA (2.4G) Panel Antenna+RadioB (5G) with ANT7+USB 5G sensor dongle

Therefore, the worst-case situation is $0.252275/1 + 0.509183/1 + 0.026661/1 = 0.788119$, which is less than "1".

This confirmed that the device comply with FCC 1.1310 MPE limit.

RadioA (5G) Yagi Antenna+RadioB (5G) with ANT7+USB 2.4G sensor dongle

Therefore, the worst-case situation is $0.258151/1 + 0.509183/1 + 0.093084/1 = 0.860418$, which is less than "1".

This confirmed that the device comply with FCC 1.1310 MPE limit.

RadioA (5G) Yagi Antenna+RadioB (5G) with ANT7+USB 5G sensor dongle

Therefore, the worst-case situation is $0.258151/1 + 0.509183/1 + 0.026661/1 = 0.793995$, which is less than "1".

This confirmed that the device comply with FCC 1.1310 MPE limit.