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/ cm²)	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/ cm²)	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 (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

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

1. MOTOROLA / AP-8132:

For 5GHz ISM Band:

Radio B (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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
12.77	18.9287	23.22	209.8940	0.351373	1	Complies

For 2.4GHz Band:

Radio A (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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
18.77	75.3356	17.1200	51.5229	0.252275	1	Complies

For 2.4G Dongle:

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

Max Conducted Power : 25.02 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
8.25	6.6834	25.02	317.6874	0.187831	1	Complies

For 5G Dongle:

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

Max Conducted Power : 25.41 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
8.69	7.3961	25.41	347.5362	0.227388	1	Complies

CONCULSION:

Both of the Radio A(2.4G) RF module (FCC ID: UZ7KHAP800), Radio B (5G) RF module (FCC ID: UZ7KHAP800) and 2.4G/5G USB Dongle (FCC ID: UZ7KHUSB600) can transmit simultaneously on the AP (MOTOROLA / AP-8132), the formula of calculatedthe MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

MOTOROLA / AP-8132:

Radio A (2.4G) Panel Antenna+Radio B (5G) Dipole Antenna+USB 2.4G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.351373/1+0.187831/1=0.791478, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

Radio A (2.4G) Panel Antenna+Radio B (5G) Dipole Antenna+USB 5G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.351373/1+0.227388/1=0.831036, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

2. MOTOROLA / AP-8122:

For 5GHz UNII Band:

Radio B (5G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : PIFA Antenna

Max Conducted Power for IEEE 802.11n 40MHz MCS16 (3TX) : 23.92dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.70	2.9512	23.9156	246.3528	0.047253	1	Complies

For 5GHz ISM Band:

Radio B (5G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : PIFA Antenna

Max Conducted Power for IEEE 802.11n 20MHz MCS16 (3TX) : 24.11dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.70	2.9512	24.1091	257.5796	0.049407	1	Complies

For 2.4GHz Band:

Radio A (2.4G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : PIFA Antenna

Max Conducted Power for IEEE 802.11g (2TX) 24.08 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.40	2.7542	24.0771	255.6877	0.045770	1	Complies

CONCULSION:

Both of the Radio A (2.4G) RF module (FCC ID: UZ7KHAP800) and Radio B (5G) RF module (FCC ID: UZ7KHAP800) can transmit simultaneously on the AP (MOTOROLA / AP-8122), the formula of calculatedthe MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

MOTOROLA / AP-8122:

Radio A (2.4G) Panel Antenna+Radio B (5G) Panel Antenna

Therefore, the worst-case situation is 0.045770/1+0.049407/1=0.095177, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

3. MOTOROLA / AP-8163:

For 5GHz ISM Band:

Radio B (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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
12.77	18.9234	23.2200	209.8940	0.258151	1	Complies

For 2.4GHz Band:

Radio A (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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
18.77	75.3356	17.1200	51.5229	0.252275	1	Complies

For 2.4G Dongle:

802.11 a/b/g/n USB Dongle (FCC ID: UZ7KHUSB601)

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11g (1TX): 19.01 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.00	2.5119	19.0100	79.6159	0.012998	1	Complies

For 5G Dongle:

802.11 a/b/g/n USB Dongle (FCC ID: UZ7KHUSB601)

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11n MCS8 40MHz (2TX): 20.57 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
6.35	4.3152	20.5697	114.0169	0.031977	1	Complies

CONCULSION:

Both of the Radio A (2.4G) RF module (FCC ID: UZ7KHAP800), Radio B (5G) RF module (FCC ID: UZ7KHAP800) and 2.4G/5G USB Dongle (FCC ID: UZ7KHUSB601) can transmit simultaneously on the AP (MOTOROLA / AP-8163), the formula of calculatedthe MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

MOTOROLA / AP-8163:

Radio A (2.4G) Panel Antenna+Radio B (5G) Dipole Antenna+USB 2.4G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.258151/1+0.012998/1=0.523424, which isless than “1”.

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

Radio A (2.4G) Panel Antenna+Radio B (5G) Dipole Antenna+USB 5G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.258151/1+0.031977/1=0.542403, which isless than “1”.

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

4. MOTOROLA / AP-8232:

For 5GHz ISM Band:

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

Antenna Type : Panel Antenna

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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
12.50	17.7828	26.4400	440.5549	0.509183	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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
18.77	75.3356	17.1200	51.5229	0.252275	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/cm²)	Limit of Power Density (S) (mW/cm²)	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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
5.87	3.8637	20.2600	106.1696	0.026661	1	Complies

CONCULSION:

Both of the Radio A (2.4G) RF module (FCC ID: UZ7KHAP800), Radio B (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 calculatedthe MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

MOTOROLA / AP-8232:

Radio A (2.4G) Panel Antenna+Radio B (5G) Panel Antenna+USB 2.4G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.509183/1+0.093084/1=0.854542, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

Radio A (2.4G) Panel Antenna+Radio B (5G) Panel Antenna+USB 5G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.509183/1+0.026661/1=0.788119, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

5. MOTOROLA / AP-8222:

For 5GHz ISM Band:

Radio B (5G) RF module (FCC ID: UZ7RAAP800)

Antenna Type : Panel Antenna

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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
12.50	17.7828	26.4400	440.5549	0.509183	1	Complies

For 2.4GHz Band:

Radio A (2.4G) RF module (FCC ID: UZ7KHAP800)

Antenna Type : PIFA Antenna

Max Conducted Power for IEEE 802.11g (2TX) 24.08 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.40	2.7542	24.0771	255.6877	0.045770	1	Complies

CONCULSION:

Both of the Radio A (2.4G) RF module (FCC ID: UZ7KHAP800) and Radio B (5G) RF module (FCC ID: UZ7RAAP800) can transmit simultaneously on the AP (MOTOROLA / AP-8222), the formula of calculatedthe MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

MOTOROLA / AP-8222:

Radio A (2.4G) Panel Antenna+Radio B (5G) Panel Antenna

Therefore, the worst-case situation is 0.045770/1+0.509183/1=0.554953, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

6. MOTOROLA / AP-8263:

For 5GHz ISM Band:

Radio B (5G) RF module (FCC ID: UZ7RAAP800)

Antenna Type : Panel Antenna

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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
12.50	17.7828	26.4400	440.5549	0.509183	1	Complies

For 2.4GHz Band:

Radio A (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/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
18.77	75.3356	17.1200	51.5229	0.252275	1	Complies

For 2.4G Dongle:

802.11 a/b/g/n USB Dongle (FCC ID: UZ7KHUSB601)

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11g (1TX): 19.01 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.00	2.5119	19.0100	79.6159	0.012998	1	Complies

For 5G Dongle:

802.11 a/b/g/n USB Dongle (FCC ID: UZ7KHUSB601)

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11n MCS0 20MHz (2TX): 20.13 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
6.35	4.3152	20.1303	103.0460	0.028901	1	Complies

CONCULSION:

Both of the Radio A (2.4G) RF module (FCC ID: UZ7KHAP800), Radio B (5G) RF module (FCC ID: UZ7RAAP800) and 2.4G/5G USB Dongle (FCC ID: UZ7KHUSB601) can transmit simultaneously on the AP (MOTOROLA / AP-8263), the formula of calculatedthe MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

MOTOROLA / AP-8263:

Radio A (2.4G) Panel Antenna+Radio B (5G) Panel Antenna+USB 2.4G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.509183/1+0.012998/1=0.774456, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

Radio A (2.4G) Panel Antenna+Radio B (5G) Panel Antenna+USB 5G sensor dongle

Therefore, the worst-case situation is 0.252275/1+0.509183/1+0.028901/1=0.790359, which isless than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.