

FCC ID : 2BBOU10923

RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density(mW/cm ²)	Average Time
(A) Limits for Occupational/Control Exposures				
300-1500	--	--	F/300	6
1500-100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300-1500	--	--	F/1500	6
1500-100000	--	--	1	30

11.1 Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = Power density in mW/cm²

P_{out} =output power to antenna in mW

G = Numeric gain of the antenna relative to isotropic antenna

π =3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1mW/cm², If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

RF Exposure Information: The radiated output power of this device meets the limits of FCC/IC radio frequency exposure limits. This device should be operated with a minimum separation distance of 20cm between the equipment and a person's body.

11.2 Measurement Result

Primary antenna

WIFI 2.4G

Directional gain:6.9 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
802.11n20	19.03	18 to 20	20	4.9	0.098	1

Primary antenna

WIFI 6E (6ID)

Directional gain power: 6.3 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
U-NII-5: 5955-6415MHz	16.29	15 to 17	17	4.3	0.043	1
U-NII-6: 6435-6515MHz	16.47	15 to 17	17	4.3	0.043	1
U-NII-7: 6535-6865MHz	16.93	15 to 17	17	4.3	0.043	1
U-NII-8: 6885-7115MHz	15.38	14 to 16	16	4.3	0.034	1

Primary antenna

WIFI 6E (6XD)

Directional gain power :6.3 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
U-NII-5: 5955-6415MHz	16.30	15 to 17	17	4.3	0.043	1
U-NII-6: 6435-6515MHz	17.17	16 to 18	18	4.3	0.054	1
U-NII-7: 6535-6865MHz	17.73	16 to 18	18	4.3	0.054	1
U-NII-8: 6885-7115MHz	16.87	15 to 17	17	4.3	0.043	1

CONCLUSION of simultaneous transmitter

Both of the WIFI2.4G module and WIFI 6E module can transmit simultaneously, the formula of calculated the MPE is:

$$CPD1/LPD1+CPD2/LPD2+\cdots\cdots\text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore the worst-case situation is $0.098+0.054=0.152$ which is less than "1",

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

4x4MIMO antenna

WIFI 6E (6ID)

Directional gain power: 4.5 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
U-NII-5: 5955-6415MHz	16.07	15 to 17	17	2.82	0.028	1
U-NII-6: 6435-6515MHz	15.34	14 to 16	16	2.82	0.022	1
U-NII-7: 6535-6865MHz	16.33	15 to 17	17	2.82	0.028	1
U-NII-8: 6885-7115MHz	17.28	16 to 18	18	2.82	0.036	1

4x4MIMO antenna

WIFI 6E (6XD)

Directional gain power :4.5 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
U-NII-5: 5955-6415MHz	16.00	15 to 17	17	2.82	0.028	1
U-NII-6: 6435-6515MHz	16.03	15 to 17	18	2.82	0.035	1
U-NII-7: 6535-6865MHz	17.21	16 to 18	18	2.82	0.035	1
U-NII-8: 6885-7115MHz	15.73	14 to 16	16	2.82	0.022	1

CONCLUSION of simultaneous transmitter

Both of the WIFI2.4G module and WIFI 6E module can transmit simultaneously, the formula of calculated the MPE is:

$CPD1/LPD1+CPD2/LPD2+\dots\text{etc.} < 1$

CPD = Calculation power density

LPD = Limit of power density

Therefore the worst-case situation is $0.098+0.036=0.135$ which is less than "1",

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

Quectel Antenna

WIFI 6E (6ID)

Directional gain power: 6.62 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
U-NII-5: 5955-6415MHz	14.24	13 to 15	15	4.59	0.029	1
U-NII-6: 6435-6515MHz	14.61	13 to 15	15	4.59	0.029	1
U-NII-7: 6535-6865MHz	15.38	14 to 16	16	4.59	0.036	1
U-NII-8: 6885-7115MHz	14.09	13 to 15	15	4.59	0.029	1

Quectel Antenna

WIFI 6E (6XD)

Directional gain power :6.62 dBi

modulation	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
U-NII-5: 5955-6415MHz	14.52	13 to 15	15	4.59	0.028	1
U-NII-6: 6435-6515MHz	13.84	12 to 14	14	4.59	0.023	1
U-NII-7: 6535-6865MHz	13.50	12 to 14	14	4.59	0.023	1
U-NII-8: 6885-7115MHz	12.68	11 to 13	13	4.59	0.018	1

CONCLUSION of simultaneous transmitter

Both of the WIFI2.4G module and WIFI 6E module can transmit simultaneously, the formula of calculated the MPE is:

$$\text{CPD1/LPD1} + \text{CPD2/LPD2} + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore the worst-case situation is $0.098 + 0.036 = 0.134$ which is less than "1",

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