

FCC ID:2BCMY-TVI8310X

Maximum Permissible Exposure (MPE)

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) | Averaging time (minutes) |
|--|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| (A) Limits for Occupational/Controlled Exposure | | | | |
| 0.3-3.0 | 614 | 1.63 | *100 | 6 |
| 3.0-30 | 1842/f | 4.89/f | *900/f ² | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1,500 | | | f/300 | 6 |
| 1,500-100,000 | | | 5 | 6 |
| (B) Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3-1.34 | 614 | 1.63 | *100 | 30 |
| 1.34-30 | 824/f | 2.19/f | *180/f ² | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1,500 | | | f/1500 | 30 |
| 1,500-100,000 | | | 1.0 | 30 |

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

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

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

$$Pd = \frac{30 * P * G}{377 * D^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

Measurement Result

BT:

Operation Frequency: 2402MHz~2480MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: FPC antenna

BT antenna gain: 3.69dBi;

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.69/10)}=2.34$

| Channel Freq. (MHz) | modulation | conducted power | Tune-up power | Max | | Antenna | Evaluation result at 20cm | Power density Limits |
|---------------------|-------------|-----------------|---------------|---------------|----------|---------|---------------------------|----------------------|
| | | (dBm) | (dBm) | tune-up power | | Gain | Power density(mW/cm2) | (mW/cm2) |
| | | | | (dBm) | (mW) | Numeric | | |
| 2402 | GFSK | 8.11 | 8±1 | 9 | 7.943282 | 2.34 | 0.00370 | 1 |
| 2441 | | 8.52 | 8±1 | 9 | 7.943282 | 2.34 | 0.00370 | 1 |
| 2480 | | 8.57 | 8±1 | 9 | 7.943282 | 2.34 | 0.00370 | 1 |
| 2402 | π/4-DQPSK, | 6.16 | 6±1 | 7 | 5.011872 | 2.34 | 0.00233 | 1 |
| 2441 | | 6.29 | 6±1 | 7 | 5.011872 | 2.34 | 0.00233 | 1 |
| 2480 | | 6.39 | 6±1 | 7 | 5.011872 | 2.34 | 0.00233 | 1 |
| 2402 | 8DPSK | 6.25 | 6±1 | 7 | 5.011872 | 2.34 | 0.00233 | 1 |
| 2441 | | 6.39 | 6±1 | 7 | 5.011872 | 2.34 | 0.00233 | 1 |
| 2480 | | 6.48 | 6±1 | 7 | 5.011872 | 2.34 | 0.00233 | 1 |
| 2402 | BLE1M(GFSK) | 5.04 | 5±1 | 6 | 3.981072 | 2.34 | 0.00185 | 1 |
| 2440 | | 5.13 | 5±1 | 6 | 3.981072 | 2.34 | 0.00185 | 1 |
| 2480 | | 5.01 | 5±1 | 6 | 3.981072 | 2.34 | 0.00185 | 1 |
| 2402 | BLE2M(GFSK) | 5.07 | 5±1 | 6 | 3.981072 | 2.34 | 0.00185 | 1 |
| 2440 | | 5.14 | 5±1 | 6 | 3.981072 | 2.34 | 0.00185 | 1 |
| 2480 | | 5.04 | 5±1 | 6 | 3.981072 | 2.34 | 0.00185 | 1 |

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n/ax20:2412-2462MHz,n/ax40:2422-2452MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: FPC antenna

WIFI antenna gain1/2: 3.69dBi/4.81dBi

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.69/10)}=2.34$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(4.81/10)}=3.03$

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| Channel Freq. (MHz) | Antenna | modulation | conducted power | Tune-up power | Max | | Antenna | Evaluation result at 20cm | Power density Limits |
|---------------------|---------|-------------|-----------------|---------------|---------------|----------|---------|------------------------------------|-----------------------|
| | | | (dBm) | (dBm) | tune-up power | | Gain | Power density(mW/cm ²) | (mW/cm ²) |
| | | | | | (dBm) | (mW) | Numeric | | |
| 2412 | 1 | 802.11b | 16.62 | 16±1 | 17 | 50.11872 | 2.34 | 0.02333 | 1 |
| 2437 | | | 16.46 | 16±1 | 17 | 50.11872 | 2.34 | 0.02333 | 1 |
| 2462 | | | 16.66 | 16±1 | 17 | 50.11872 | 2.34 | 0.02333 | 1 |
| 2412 | 2 | 802.11b | 16.87 | 16.5±1 | 17.5 | 56.23413 | 3.03 | 0.03390 | 1 |
| 2437 | | | 16.95 | 16.5±1 | 17.5 | 56.23413 | 3.03 | 0.03390 | 1 |
| 2462 | | | 17.04 | 16.5±1 | 17.5 | 56.23413 | 3.03 | 0.03390 | 1 |
| 2412 | 1 | 802.11g | 13.48 | 13±1 | 14 | 25.11886 | 2.34 | 0.01169 | 1 |
| 2437 | | | 13.44 | 13±1 | 14 | 25.11886 | 2.34 | 0.01169 | 1 |
| 2462 | | | 13.59 | 13±1 | 14 | 25.11886 | 2.34 | 0.01169 | 1 |
| 2412 | 2 | 802.11g | 13.57 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2437 | | | 13.79 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2462 | | | 13.87 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2412 | 1 | 802.11n H20 | 12.6 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2437 | | | 12.45 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2462 | | | 12.71 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2412 | 2 | 802.11n H20 | 12.74 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2437 | | | 12.85 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2462 | | | 13.03 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2422 | 1 | 802.11n H40 | 12.81 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2437 | | | 12.6 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2452 | | | 12.68 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2422 | 2 | 802.11n H40 | 12.9 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2437 | | | 13.05 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2452 | | | 13.05 | 13±1 | 14 | 25.11886 | 3.03 | 0.01514 | 1 |
| 2412 | 1 | 802.11ax20 | 12.35 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2437 | | | 12.35 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2462 | | | 12.45 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2412 | 2 | 802.11ax20 | 12.55 | 12±1 | 13 | 19.95262 | 3.03 | 0.01203 | 1 |
| 2437 | | | 12.7 | 12±1 | 13 | 19.95262 | 3.03 | 0.01203 | 1 |
| 2462 | | | 12.79 | 12±1 | 13 | 19.95262 | 3.03 | 0.01203 | 1 |
| 2422 | 1 | 802.11ax40 | 12.51 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2437 | | | 12.32 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2452 | | | 12.49 | 12±1 | 13 | 19.95262 | 2.34 | 0.00929 | 1 |
| 2422 | 2 | 802.11ax40 | 12.72 | 12±1 | 13 | 19.95262 | 3.03 | 0.01203 | 1 |
| 2437 | | | 12.84 | 12±1 | 13 | 19.95262 | 3.03 | 0.01203 | 1 |
| 2452 | | | 12.81 | 12±1 | 13 | 19.95262 | 3.03 | 0.01203 | 1 |

5G WIFI:

Operation Frequency: WIFI 802.11a/ac/n/ax(HT20): 5180-5240MHz; 5745-5825MHz;

WIFI 802.11ac/n/ax(HT40): 5190-5230MHz;5755-5795MHz;

WIFI 802.11ac/ax80:5210-5210MHz;5775-5775MHz

Power density limited: 1mW/cm

Antenna Type: FPC antenna

WIFI antenna1/2 gain: 5.79/5.19dBi;

R=20cm

$mW=10^{(dBm/10)}$

antenna gain Numeric= $10^{(dBi/10)}=10^{(5.79/10)}=3.79$

antenna gain Numeric= $10^{(dBi/10)}=10^{(5.19/10)}=3.3$

5.2G

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| Channel Freq. (MHz) | Antenna | modulation | conducted power | Tune-up power | Max | | Antenna | Evaluation result at 20cm | Power density Limits |
|---------------------|---------|-------------|-----------------|---------------|---------------|-------|---------|------------------------------------|-----------------------|
| | | | (dBm) | (dBm) | tune-up power | | Gain | Power density(mW/cm ²) | (mW/cm ²) |
| | | | | | (dBm) | (mW) | Numeric | | |
| 5180 | 1 | 802.11a | 11.98 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5200 | | | 11.94 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5240 | | | 12.2 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5180 | 2 | 802.11a | 11.33 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5200 | | | 11.2 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5240 | | | 11.12 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5180 | 1 | 802.11n20 | 11.91 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5200 | | | 11.89 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5240 | | | 12.06 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5180 | 2 | 802.11n20 | 11.33 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5200 | | | 11.15 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5240 | | | 10.99 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5190 | 1 | 802.11n 40 | 12.11 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5230 | | | 12.17 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5190 | 2 | 802.11n 40 | 11.38 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5230 | | | 11.2 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5180 | 1 | 802.11ac 20 | 11.84 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5200 | | | 11.9 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5240 | | | 12.07 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5180 | 2 | 802.11ac 20 | 11.27 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5200 | | | 11.06 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5240 | | | 10.94 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5190 | 1 | 802.11ac 40 | 12.19 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5230 | | | 12.15 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5190 | 2 | 802.11ac 40 | 11.35 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5230 | | | 11.22 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5210 | 1 | 802.11ac 80 | 12.23 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5210 | 2 | 802.11ac 80 | 11.53 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5180 | 1 | 802.11ax 20 | 11.64 | 11±1 | 12 | 15.85 | 3.79 | 0.01195 | 1 |
| 5200 | | | 11.65 | 11±1 | 12 | 15.85 | 3.79 | 0.01195 | 1 |
| 5240 | | | 11.87 | 11±1 | 12 | 15.85 | 3.79 | 0.01195 | 1 |
| 5180 | 2 | 802.11ax 20 | 11.02 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5200 | | | 10.9 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5240 | | | 10.8 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5190 | 1 | 802.11ax40 | 11.76 | 11±1 | 12 | 15.85 | 3.79 | 0.01195 | 1 |
| 5230 | | | 11.73 | 11±1 | 12 | 15.85 | 3.79 | 0.01195 | 1 |
| 5190 | 2 | 802.11ax40 | 11.1 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5230 | | | 10.96 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5210 | 1 | 802.11ax 80 | 11.94 | 11±1 | 12 | 15.85 | 3.79 | 0.01195 | 1 |
| 5210 | 2 | 802.11ax 80 | 11.27 | 11±1 | 11 | 12.59 | 3.3 | 0.00827 | 1 |

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|------|---|-------------|-------|------|----|-------|------|---------|---|
| 5755 | 2 | 802.11n 40 | 11.56 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5795 | | | 11.81 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5745 | 1 | 802.11ac 20 | 12.04 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5785 | | | 12.49 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5825 | | | 12.33 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5745 | 2 | 802.11ac 20 | 11.43 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5785 | | | 11.6 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5825 | | | 11.78 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5755 | 1 | 802.11ac 40 | 12.27 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5795 | | | 12.66 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5755 | 2 | 802.11ac 40 | 11.56 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5795 | | | 11.85 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5775 | 1 | 802.11ac 80 | 12.71 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5775 | 2 | 802.11ac 80 | 11.85 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5745 | 1 | 802.11ax 20 | 12.01 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5785 | | | 12.32 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5825 | | | 12.24 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5745 | 2 | 802.11ax 20 | 11.33 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5785 | | | 11.48 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5825 | | | 11.63 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5755 | 1 | 802.11ax4 0 | 12.05 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5795 | | | 12.48 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5755 | 2 | 802.11ax4 0 | 11.37 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5795 | | | 11.57 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5775 | 1 | 802.11ax 80 | 12.49 | 12±1 | 13 | 19.95 | 3.79 | 0.01504 | 1 |
| 5775 | 2 | 802.11ax 80 | 11.57 | 11±1 | 12 | 15.85 | 3.3 | 0.01041 | 1 |
| 5180 | 1 | 802.11a | 10.34 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5200 | | | 10.67 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5240 | | | 10.35 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5180 | 2 | 802.11a | 10.34 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5200 | | | 10.67 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5240 | | | 10.35 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5180 | 1 | 802.11n20 | 10.2 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5200 | | | 10.67 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5240 | | | 10.3 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5180 | 2 | 802.11n20 | 10.2 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5200 | | | 10.67 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5240 | | | 10.3 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5190 | 1 | 802.11n 40 | 10.26 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5230 | | | 9.37 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5190 | 2 | 802.11n 40 | 10.26 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5230 | | | 9.37 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5180 | 1 | 802.11ac 20 | 10.23 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5200 | | | 10.68 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |
| 5240 | | | 10.27 | 10±1 | 11 | 12.59 | 4.07 | 0.01019 | 1 |

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2 , H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i} \leq 1$$

Module 2 WLAN2.4G MIMO

| Antenna | Tune-up power (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm ²) | MPE Limit (mW/cm ²) | Calculation result | Conclusion |
|---------|---------------------|------------|------------|-----------|-------|-------------------------|---------------------------------|--------------------|------------|
| Ant 1 | 12 | 3.69 | 15.69 | 37.07 | 20 | 0.007374 | 1 | 0.016918 | Pass |
| Ant 2 | 12 | 4.81 | 16.81 | 47.97 | 20 | 0.009544 | 1 | | |

Module 2 WLAN5G MIMO

| Antenna | Tune-up power (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm ²) | MPE Limit (mW/cm ²) | Calculation result | Conclusion |
|---------|---------------------|------------|------------|-----------|-------|-------------------------|---------------------------------|--------------------|------------|
| Ant 1 | 12 | 5.79 | 17.79 | 60.12 | 20 | 0.011960 | 1 | 0.022376 | Pass |
| Ant 2 | 12 | 5.19 | 17.19 | 52.36 | 20 | 0.010416 | 1 | | |

Conclusion:

The conclusion should be $0.03390 < 1$ for Max Power Density, Compliance the RF Exposure requirement.

Signature:

Date: 2023-10-09



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