

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 0.2 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=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

1.3. Calculated Result and Limit

For WLAN function:

Max Conducted Power for IEEE 802.11n MCS0 20MHz: 16.29 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 | 3.1623 | 16.2938 | 42.5970 | 0.026812 | 1 | Complies |

For WWAN Module (FCC ID: N7NMC7355):

| Frequency (MHz) | Average Output Power (dBm) | Antenna Gain (dBi) | Power Density (S) (mW/cm ²) | Limit of Power Density (S) (mW/cm ²) | Test Result |
|-----------------|----------------------------|--------------------|---|--|-------------|
| 824-849 | 33.48 | 6.5 | 0.443 | 0.549 | Complies |
| 824-849 | 28.48 | 6.5 | 0.140 | 0.549 | Complies |
| 824-849 | 28.44 | 6.5 | 0.139 | 0.549 | Complies |
| 824-849 | 28.49 | 6.5 | 0.141 | 0.549 | Complies |
| 1850-1910 | 26.98 | 3.0 | 0.099 | 1.000 | Complies |
| 1850-1910 | 23.98 | 3.0 | 0.050 | 1.000 | Complies |
| 1850-1910 | 23.94 | 3.0 | 0.049 | 1.000 | Complies |
| 1850-1910 | 23.99 | 3.0 | 0.050 | 1.000 | Complies |
| 824-849 | 31.50 | 6.5 | 0.281 | 0.549 | Complies |
| 1850-1910 | 28.00 | 3.0 | 0.126 | 1.000 | Complies |
| 816.0-823.975 | 31.50 | 6.5 | 0.281 | 0.544 | Complies |
| 824-849 | 30.50 | 6.5 | 0.223 | 0.549 | Complies |
| 1710-1755 | 30.00 | 6.0 | 0.199 | 1.000 | Complies |
| 1850-1910 | 27.00 | 3.0 | 0.100 | 1.000 | Complies |
| 704-716 | 33.00 | 9.0 | 0.397 | 0.469 | Complies |
| 777-787 | 33.00 | 9.0 | 0.397 | 0.518 | Complies |
| 824-849 | 30.50 | 6.5 | 0.223 | 0.549 | Complies |
| 1710-1755 | 30.00 | 6.0 | 0.199 | 1.000 | Complies |
| 1850-1910 | 27.00 | 3.0 | 0.100 | 1.000 | Complies |
| 1850-1915 | 27.00 | 3.0 | 0.100 | 1.000 | Complies |

CONCLUSION:

Both of the WLAN function and WWAN function can transmit simultaneously, the formula of calculated the MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.026812 / 1 + 0.443 / 0.549 = 0.833734$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.