

## 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 that distance of at least 0.2 m is normally 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 <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> 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 <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> 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

Exposure Environment: General Population / Uncontrolled Exposure

For EUT (FCC ID: UXX-S4A525A):

For 5GHz Band (NII):

Antenna Type : Dipole Antenna

Conducted Power for IEEE 802.11ac VHT20Hz : 26.34dBm

| Distance (m) | Directional Gain (dBi) | Antenna Gain (numeric) | The maximum combined Average Output Power |          | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------|------------------------|------------------------|-------------------------------------------|----------|-----------------------------------------|--------------------------------------------------|-------------|
|              |                        |                        | (dBm)                                     | (mW)     |                                         |                                                  |             |
| 0.35         | 7.61                   | 5.7688                 | 26.3359                                   | 430.1212 | 0.161269                                | 1                                                | Complies    |

Note:  $DirectionalGain = 10 \cdot \log \left[ \frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$

For 2.4GHz Band:

Antenna Type : Dipole Antenna

Conducted Power for IEEE 802.11 HT20MHz: 29.82 dBm

| Distance (m) | Antenna Gain (dBi) | Antenna Gain (numeric) | The maximum combined Average Output Power |          | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------|--------------------|------------------------|-------------------------------------------|----------|-----------------------------------------|--------------------------------------------------|-------------|
|              |                    |                        | (dBm)                                     | (mW)     |                                         |                                                  |             |
| 0.35         | 3.30               | 2.1380                 | 29.8226                                   | 959.9656 | 0.133392                                | 1                                                | Complies    |

For WWAN Module(FCC ID:N7NMC7355):

| Frequency (MHz) | Average EIRP (dBm) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|-----------------|--------------------|-----------------------------------------|--------------------------------------------------|-------------|
| 824-849         | 33.48              | 0.1448                                  | 0.549                                            | Complies    |
| 824-849         | 28.48              | 0.0458                                  | 0.549                                            | Complies    |
| 824-849         | 28.44              | 0.0454                                  | 0.549                                            | Complies    |
| 824-849         | 28.49              | 0.0459                                  | 0.549                                            | Complies    |
| 1850-1910       | 26.98              | 0.0324                                  | 1.000                                            | Complies    |
| 1850-1910       | 23.98              | 0.0163                                  | 1.000                                            | Complies    |
| 1850-1910       | 23.94              | 0.0161                                  | 1.000                                            | Complies    |
| 1850-1910       | 23.99              | 0.0163                                  | 1.000                                            | Complies    |
| 824-849         | 31.50              | 0.0918                                  | 0.549                                            | Complies    |
| 1850-1910       | 28.00              | 0.0410                                  | 1.000                                            | Complies    |
| 816.0-823.975   | 31.50              | 0.0918                                  | 0.544                                            | Complies    |
| 824-849         | 30.50              | 0.0729                                  | 0.549                                            | Complies    |
| 1710-1755       | 30.00              | 0.0650                                  | 1.000                                            | Complies    |
| 1850-1910       | 27.00              | 0.0326                                  | 1.000                                            | Complies    |
| 704-716         | 33.00              | 0.1297                                  | 0.469                                            | Complies    |
| 777-787         | 33.00              | 0.1297                                  | 0.518                                            | Complies    |
| 824-849         | 30.50              | 0.0729                                  | 0.549                                            | Complies    |
| 1710-1755       | 30.00              | 0.0650                                  | 1.000                                            | Complies    |
| 1850-1910       | 27.00              | 0.0326                                  | 1.000                                            | Complies    |
| 1850-1915       | 27.00              | 0.0326                                  | 1.000                                            | Complies    |

### Conclusion:

Both of the WLAN function WLAN 2.4GHz, WLAN 5GHz, WWAN (slot 1) and WWAN (slot 2) can transmit simultaneously, the formula of calculated the MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is  $0.161269 / 1 + 0.133392 / 1 + 0.1297 / 0.469 + 0.1297 / 0.469 = 0.847753$ , which is less than "1". This confirmed that the device complies.