

## Appendix C. 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 0.4 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 <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** = Peak 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 peak EUT RF output power, the minimum mobile separation distance, d=0.4m, as well as the gain of the used antenna, the RF power density can be obtained.

### 1.3. Calculated Result and Limit

For 5GHz Band:

<For Antenna 1>:

Antenna Type : Omni Antenna

Max Conducted Power for 802.11a Ant. 1-1 + Ant. 1-2 + Ant. 1-3 : 21.84 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 8                  | 6.3096                 | 21.8357                 | 152.6039                 | 0.047913                                | 1  | Complies    |

<For Antenna 2>:

Antenna Type : Panel Antenna

Max Conducted Power for 802.11a Draft n 20MHz Ant. 2-1 + Ant. 2-2 + Ant. 2-3 : 19.66 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 13.5               | 22.3872                | 19.6608                 | 92.4872                  | 0.103032                                | 1  | Complies    |

<For Antenna 3>:

Antenna Type : Panel Antenna

Max Conducted Power for 802.11a Draft n 20MHz Ant. 3-1 + Ant. 3-2 + Ant. 3-3 : 19.66 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 10.7               | 11.7490                | 19.6608                 | 92.4872                  | 0.054072                                | 1  | Complies    |

<For Antenna 4>:

Antenna Type : Panel Antenna

Max Conducted Power for 802.11a Draft n 20MHz Ant. 4-1 + Ant. 4-2 + Ant. 4-3 : 18.09 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 23.5               | 223.8721               | 18.0867                 | 64.3682                  | 0.717070                                | 1  | Complies    |

For 2.4GHz Band:

<For Antenna 1>:

Antenna Type : Omni Antenna

Max Conducted Power for 802.11g Ant. 1-1 + Ant. 1-2 + Ant. 1-3 : 23.64 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 6                  | 3.9811                 | 23.6420                 | 231.3155                 | 0.045824                                | 1  | Complies    |

<For Antenna 2>:

Antenna Type : Panel Antenna

Max Conducted Power for 802.11g Ant. 2-1 + Ant. 2-2 + Ant. 2-3 : 23.64 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 10.9               | 12.3027                | 23.6420                 | 231.3155                 | 0.141610                                | 1  | Complies    |

<For Antenna 3>:

Antenna Type : Panel Antenna

Max Conducted Power for IEEE 802.11 Draft n 20MHz Ant. 3-1 + Ant. 3-2 + Ant. 3-3 : 24.78 dBm

| Antenna Gain (dBi) | Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power ( mW ) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|--------------------|------------------------|-------------------------|--------------------------|---|--|-------------|
| 8                  | 6.3096                 | 24.7835                 | 300.8508                 | 0.094459                                | 1  | Complies    |