

## 14 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### 14.1 Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissible Exposure (MPE)

| Frequency Range<br>(MHz)                            | Electric Field<br>Strength (V/m) | Magnetic Field<br>Strength (A/m) | Power Density<br>(mW/cm <sup>2</sup> ) | Averaging Time<br>(minute) |
|-----------------------------------------------------|----------------------------------|----------------------------------|----------------------------------------|----------------------------|
| 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 <sup>2</sup> )                 | 30                         |
| 30-300                                              | 27.5                             | 0.073                            | 0.2                                    | 30                         |
| 300-1500                                            | /                                | /                                | F/1500                                 | 30                         |
| 1500-15000                                          | /                                | /                                | 1.0                                    | 30                         |

F = frequency in MHz

\* = Plane-wave equipment power density

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## 14.2 Maximum Permissible Exposure (MPE) Evaluation

### 802.11b Power Table

| Frequency (MHz) | Reading Power (dBm) |
|-----------------|---------------------|
| 2412.00         | 12.64               |
| 2437.00         | 12.46               |
| 2462.00         | 12.43               |

### MPE Prediction (802.11b)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4\pi R^2$$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

|                                                   |             |                       |
|---------------------------------------------------|-------------|-----------------------|
| Maximum average output power at antenna input     | 12.64       | (dBm)                 |
| Maximum average output power at antenna input     | 18.36538343 | (mW)                  |
| Duty cycle:                                       | 96.7        | (%)                   |
| Maximum Pav :                                     | 17.75932578 | (mW)                  |
| Antenna gain (typical):                           | 3.22        | (dBi)                 |
| Maximum antenna gain:                             | 2.098939884 | (numeric)             |
| Prediction distance:                              | 20          | (cm)                  |
| Prediction frequency:                             | 2412        | (MHz)                 |
|                                                   |             |                       |
| MPE limit for uncontrolled exposure at prediction | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm) | 0.007420    | (mW/cm <sup>2</sup> ) |

### Measurement Result

The predicted power density level at 20 cm is 0.007420mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2412MHz.

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**802.11g Power Table**

| Frequency<br>(MHz) | Reading Power<br>(dBm) |
|--------------------|------------------------|
| 2412.00            | 12.28                  |
| 2437.00            | 12.37                  |
| 2462.00            | <b>12.43</b>           |

**MPE Prediction (802.11g)**

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4\pi R^2$$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

|                                                   |              |                       |
|---------------------------------------------------|--------------|-----------------------|
| Maximum average output power at antenna input     | <b>12.43</b> | (dBm)                 |
| Maximum average output power at antenna input     | 17.49846689  | (mW)                  |
| Duty cycle:                                       | <b>95.3</b>  | (%)                   |
| Maximum Pav :                                     | 16.67603894  | (mW)                  |
| Antenna gain (typical):                           | <b>3.22</b>  | (dBi)                 |
| Maximum antenna gain:                             | 2.098939884  | (numeric)             |
| Prediction distance:                              | 20           | (cm)                  |
| Prediction frequency:                             | <b>2462</b>  | (MHz)                 |
|                                                   |              |                       |
| MPE limit for uncontrolled exposure at prediction | 1            | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm) | 0.006967     | (mW/cm <sup>2</sup> ) |

**Measurement Result**

The predicted power density level at 20 cm is 0.006967mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2462.

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**802.11n\_20M (2.4G) Power Table**

| Frequency (MHz) | Reading Power (dBm) |
|-----------------|---------------------|
| 2412.00         | 12.38               |
| 2437.00         | <b>12.32</b>        |
| 2462.00         | 12.11               |

**MPE Prediction (802.11n\_20M (2.4G))**

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4 \pi R^2$$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

|                                                   |              |                       |
|---------------------------------------------------|--------------|-----------------------|
| Maximum average output power at antenna input     | <b>12.32</b> | (dBm)                 |
| Maximum average output power at antenna input     | 17.06082389  | (mW)                  |
| Duty cycle:                                       | <b>94.9</b>  | (%)                   |
| Maximum Pav :                                     | 16.19072187  | (mW)                  |
| Antenna gain (typical):                           | <b>3.22</b>  | (dBi)                 |
| Maximum antenna gain:                             | 2.098939884  | (numeric)             |
| Prediction distance:                              | 20           | (cm)                  |
| Prediction frequency:                             | <b>2437</b>  | (MHz)                 |
|                                                   |              |                       |
| MPE limit for uncontrolled exposure at prediction | 1            | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm) | 0.006764     | (mW/cm <sup>2</sup> ) |

**Measurement Result**

The predicted power density level at 20 cm is 0.006764mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2437.

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**802.11n\_40M (2.4G) Power Table**

| Frequency (MHz) | Reading Power (dBm) |
|-----------------|---------------------|
| 2422.00         | 11.24               |
| 2437.00         | 11.15               |
| 2452.00         | 10.89               |

**MPE Prediction (802.11n\_40M (2.4G))**

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4 \pi R^2$$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

|                                                   |             |                       |
|---------------------------------------------------|-------------|-----------------------|
| Maximum average output power at antenna input     | 11.24       | (dBm)                 |
| Maximum average output power at antenna input     | 13.30454418 | (mW)                  |
| Duty cycle:                                       | 92          | (%)                   |
| Maximum Pav :                                     | 12.24018065 | (mW)                  |
| Antenna gain (typical):                           | 3.22        | (dBi)                 |
| Maximum antenna gain:                             | 2.098939884 | (numeric)             |
| Prediction distance:                              | 20          | (cm)                  |
| Prediction frequency:                             | 2422        | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm) | 0.005114    | (mW/cm <sup>2</sup> ) |

**Measurement Result**

The predicted power density level at 20 cm is 0.005114mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2422.

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