

## Maximum Permissible Exposure (MPE)

### 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 §2.1091 RF exposure is calculated.

Limits for Maximum Permissive 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

According to RSS 102 issue 5.

### 2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $22.48/f^{0.5} \text{ W}$  (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f^{0.6834} \text{ W}$  (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

## Maximum Permissible Exposure (MPE) Evaluation (BLE)

PCB Antenna

|                                                   |             |                       |
|---------------------------------------------------|-------------|-----------------------|
| Maximum output power at antenna input terminal:   | 8.16        | (dBm)                 |
| Maximum output power at antenna input terminal:   | 6.546361741 | (mW)                  |
| Tune-Up power Tolerance:                          | 1           | dB                    |
| Duty cycle:                                       | 100         | (%)                   |
| Maximum Pav :                                     | 8.24138115  | (mW)                  |
| Antenna gain (typical):                           | 0.51        | (dBi)                 |
| Maximum antenna gain:                             | 1.124604974 | (numeric)             |
| Prediction distance:                              | 20          | (cm)                  |
|                                                   |             |                       |
| MPE limit for uncontrolled exposure at prediction | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm) | 0.0018448   | (mW/cm <sup>2</sup> ) |

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

### Measurement Result:

The predicted power density level at 20 cm is 0.0018448 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup>.

## Maximum Permissible Exposure (MPE) Evaluation

Dipole Antenna

|                                                   |             |                       |
|---------------------------------------------------|-------------|-----------------------|
| Maximum output power at antenna input terminal:   | 8.16        | (dBm)                 |
| Maximum output power at antenna input terminal:   | 6.546361741 | (mW)                  |
| Tune-Up power Tolerance:                          | 1           | dB                    |
| Duty cycle:                                       | 100         | (%)                   |
| Maximum Pav :                                     | 8.24138115  | (mW)                  |
| Antenna gain (typical):                           | 6           | (dBi)                 |
| Maximum antenna gain:                             | 3.981071706 | (numeric)             |
| Prediction distance:                              | 20          | (cm)                  |
|                                                   |             |                       |
| MPE limit for uncontrolled exposure at prediction | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm) | 0.0065306   | (mW/cm <sup>2</sup> ) |

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

### Measurement Result:

The predicted power density level at 20 cm is 0.0065306 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup>.

**Power measurement: (BLE)**

IC EIRP level

PCB Antenna

|                                                 |         |       |
|-------------------------------------------------|---------|-------|
| Frequency:                                      | 2480    | MHz   |
| Maximum output power at antenna input terminal: | 8.16    | (dBm) |
| Tune-Up power Tolerance:                        | 1       | dB    |
| Duty cycle:                                     | 100     | (%)   |
| Antenna gain (typical):                         | 0.51    | (dBi) |
| EIRP:                                           | 9.268   | mW    |
| EIRP:                                           | 0.00927 | W     |
| EIRP Limit                                      | 2.736   | W     |

**Measurement Result:**

The EIRP level is 0.00927W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

IC EIRP level

Dipole Antenna

|                                                 |         |       |
|-------------------------------------------------|---------|-------|
| Frequency:                                      | 2480    | MHz   |
| Maximum output power at antenna input terminal: | 8.16    | (dBm) |
| Tune-Up power Tolerance:                        | 1       | dB    |
| Duty cycle:                                     | 100     | (%)   |
| Antenna gain (typical):                         | 6       | (dBi) |
| EIRP:                                           | 32.810  | mW    |
| EIRP:                                           | 0.03281 | W     |
| EIRP Limit                                      | 2.736   | W     |

**Measurement Result:**

The EIRP level is 0.03281W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

~ End ~