

## 5.10. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1307(b)(1) & 2.1093]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

### FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency range<br>(MHz)                                       | Electric field<br>strength<br>(V/m) | Magnetic field<br>strength<br>(A/m) | Power density<br>(mW/cm <sup>2</sup> ) | Averaging time<br>(minutes) |
|--|-------------------------------------|-------------------------------------|--|-----------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                                     |                                     |  |                             |
| 0.3–3.0 .....  | 614                                 | 1.63                                | *(100)                                 | 6                           |
| 3.0–30 .....   | 1842/f                              | 4.89/f                              | *(900/f <sup>2</sup> )                 | 6                           |
| 30–300 .....   | 61.4                                | 0.163                               | 1.0                                    | 6                           |
| 300–1500 .....   | .....                               | .....                               | f/300                                  | 6                           |
| 1500–100,000 .....   | .....                               | .....                               | 5                                      | 6                           |
| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                                     |                                     |  |                             |
| 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                          |
| 1500–100,000 .....   | .....                               | .....                               | 1.0                                    | 30                          |

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

### 5.10.1. Method of Measurements

Refer to Sections 1.1310, 2.1091.

Spread spectrum transmitters operating under section 15.247 are categorically excluded from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance (As indicated in Section 15.247(b)(4), these transmitters are required to operate in a manner that ensures that exposure to public users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

Refer to FCC @ 1.1310 and 2.1091

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:
  - (1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
  - (2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
  - (3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
  - (4) Any other RF exposure related issues that may affect MPE compliance

**Calculation Method of RF Safety Distance:**

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where:

- P: power input to the antenna in mW
- EIRP: Equivalent (effective) isotropic radiated power.
- S: power density mW/cm<sup>2</sup>
- G: numeric gain of antenna relative to isotropic radiator
- r: distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$$r = \sqrt{\frac{PG}{4\pi \cdot S}} = \sqrt{\frac{EIRP}{4\pi \cdot S}}$$

### 5.10.2. Test Data

#### Antenna Gain Limit specified by Manufacturer:

| <sup>(1)</sup> Lowest Frequency (MHz) | Measured Peak RF Conducted Power (dBm) | Calculated EIRP (dBm) | Exposure Condition | Calculated Minimum RF Safety Distance r (cm)* |
|---------------------------------------|--|-----------------------|--------------------|---|
| 2462 (802.11g)                        | 14.73                                  | 3.8                   | General Population | 2.5   |

#### RF EXPOSURE DISTANCE LIMITS

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

$$(S_{\text{Limit}}) = 1.0 \text{ mW/cm}^2$$

$$(\text{Maximum EIRP Measured}) = 18.53 \text{ dBm} \approx 10^{1.853} = 71.28 \text{ mW}$$

$$(\text{Minimum Safe Distance, } r) = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{71.28}{4 \cdot \pi \cdot 1.0}} \approx 2.4 \text{ cm}$$

| Evaluation of RF Exposure Compliance Requirements  |   |
|--|---|
| RF Exposure Requirements   | Compliance with FCC Rules   |
| Minimum calculated separation distance between antenna and persons required: <b>*2.4 cm</b>  | Manufacturer' instruction for separation distance between antenna and persons required: <b>20 cm.</b>   |
| Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement | N/A   |
| Caution statements and/or warning labels that are necessary in order to comply with the exposure limits  | Refer to User's Manual for RF Exposure Information.   |
| Any other RF exposure related issues that may affect MPE compliance  | User manual confirms that "The two radios co-located within the device doesn't transmit simultaneously" |

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*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*