

- RF Exposure

1. Regulation

- FCC

According to §15.247(i), 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 of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limits for Maximum Permissible Exposure: RF exposure is calculated.

| Frequency Range | Electric Field Strength [V/m] | Magnetic Field Strength [A/m] | Power Density [mW/cm ²] | Averaging Time [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 ²) | 30 |
| 30 ~ 300 | 27.5 | 0.073 | 0.2 | 30 |
| 300 ~ 1 500 | / | / | f/1 500 | 30 |
| 1 500 ~ 15 000 | / | / | 1.0 | 30 |

f=frequency in MHz, *= plane-wave equivalent power density

MPE (Maximum Permissible Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad (\Rightarrow R = \sqrt{PG/4\pi S})$$

S = power density [mW/cm²]

P = Power input to antenna [mW]

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 [cm]

- IC

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 radiation element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz⁶ 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 $4.49/f^{0.5}$ 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 $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance);
- 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).

2. RF Exposure Compliance Issue

The information should be included in the user's manual:

This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

3. Calculation Result of RF Exposure

- FCC

| Mode | Target power [dBm] | Tune up tolerance [dB] | Max tune up power [dBm] | Max tune up power [mW] | Ant Gain [dBi] | Ant Gain [mW] | Power Density at 20 cm [mW/cm ²] | Limit [mW/cm ²] |
|-----------------------------|--------------------|------------------------|-------------------------|------------------------|----------------|---------------|--|-----------------------------|
| WiFi 2.4 GHz 802.11b_Lowest | 11.00 | ±2.00 | 13.00 | 19.95 | 2.22 | 1.67 | 0.006 62 | 1.000 00 |
| Total | - | | | | | | 0.006 62 | 1.000 00 |

- IC

| Mode | Target Power [dBm] | Tune up Tolerance [dB] | Max tune up Power [dBm] | Ant Gain [dB i] | Max. E.I.R.P [dBm] | Max. E.I.R.P [W] | Limit [W] |
|-----------------------------|--------------------|------------------------|-------------------------|-----------------|--------------------|------------------|-----------|
| WiFi 2.4 GHz 802.11b_Lowest | 11.00 | ±2.00 | 13.00 | 2.22 | 15.22 | 0.033 | 2.68 |
| Total | - | | | | | 0.033 | 2.68 |

Note.

- Regarding to clause 2.5.2 of RSS-102, exemption limits was calculated as below
 $1.31 \times 10^{-2} f^{0.6834} \text{ W} = 1.31 \times 10^{-2} \times 2.412^{0.6834} = 2.68 \text{ W}$

4. Target power and tolerance, Max tuneup power

- DC 5 V

| Mode | Target power [dBm] | Tolerance [dB] | Max tuneup power [dBm] | Average Power [dBm] |
|----------------------|--------------------|----------------|------------------------|---------------------|
| 802.11b_Lowest | 11.00 | ±2.00 | 13.00 | 11.80 |
| 802.11b_Middle | 10.00 | ±2.00 | 12.00 | 11.01 |
| 802.11b_Highest | 10.00 | ±2.00 | 12.00 | 10.76 |
| 802.11g_Lowest | 8.00 | ±2.00 | 10.00 | 8.51 |
| 802.11g_Middle | 9.00 | ±2.00 | 11.00 | 9.50 |
| 802.11g_Highest | 4.00 | ±2.00 | 6.00 | 4.19 |
| 802.11n HT20_Lowest | 7.00 | ±2.00 | 9.00 | 7.26 |
| 802.11n HT20_Middle | 6.00 | ±2.00 | 8.00 | 6.39 |
| 802.11n HT20_Highest | 4.00 | ±2.00 | 6.00 | 5.01 |

- DC 12 V

| Mode | Target power [dBm] | Tolerance [dB] | Max tuneup power [dBm] | Average Power [dBm] |
|----------------------|--------------------|----------------|------------------------|---------------------|
| 802.11b_Lowest | 11.00 | ±2.00 | 13.00 | 11.90 |
| 802.11b_Middle | 10.00 | ±2.00 | 12.00 | 10.88 |
| 802.11b_Highest | 10.00 | ±2.00 | 12.00 | 10.87 |
| 802.11g_Lowest | 8.00 | ±2.00 | 10.00 | 9.07 |
| 802.11g_Middle | 9.00 | ±2.00 | 11.00 | 9.28 |
| 802.11g_Highest | 4.00 | ±2.00 | 6.00 | 4.14 |
| 802.11n HT20_Lowest | 7.00 | ±2.00 | 9.00 | 7.10 |
| 802.11n HT20_Middle | 6.00 | ±2.00 | 8.00 | 6.41 |
| 802.11n HT20_Highest | 4.00 | ±2.00 | 6.00 | 4.91 |

5. RF Exposure Compliance Issue

Therefore, EUT is not required the SAR Evaluation.