

- 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]

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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 x 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

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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]
Bluetooth Low Energy_Middle	-1.00	±2.00	1.00	1.26	-8.64	0.14	0.000 03	1.000 00
Total	-						0.000 03	1.000 00

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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]
Bluetooth Low Energy_Middle	-1.00	±2.00	1.00	-8.64	-7.64	0.0002	2.74
Total	-					0.0002	2.74

Note.

- Regarding to clause 2.5.2 of RSS-102, exemption limits was calculated as below

$$1.31 \times 10^{-2} f^{0.6834} W = 1.31 \times 10^{-2} \times 2480^{0.6834} = 2.74 W$$

4. Target power and tolerance, Max tuneup power

- FCC

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Bluetooth Low Energy_Lowest	-1.00	±2.00	1.00	-0.13
Bluetooth Low Energy_Middle	-1.00	±2.00	1.00	-0.08
Bluetooth Low Energy_Highest	-1.00	±2.00	1.00	-0.60