

RF Exposure

1. Regulation

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]

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

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_GFSK	-3	±2	-1	0.79	-4.50	0.35	0.000 06	1.000 00
Bluetooth Low Energy	7	±1	8	6.31	-4.50	0.35	0.000 45	1.000 00
WiFi_802.11b	12.5	±1	13.5	22.39	-4.50	0.35	0.001 58	1.000 00
WiFi_802.11a_5 150 Band	-4	±1	-3	0.50	-3.50	0.45	0.000 04	1.000 00
Total	-						0.00213	1.000 00

4. Target power and tolerance, Max tuneup power

- Bluetooth

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Bluetooth_GFSK Lowest	-3	±2	-1	-2.01
Bluetooth_GFSK Middle	-3	±2	-1	-1.82
Bluetooth_GFSK Highest	-3	±2	-1	-2.24
Bluetooth_π/4DQPSK Lowest	-6	±2	-4	-4.71
Bluetooth_π/4DQPSK Middle	-6	±2	-4	-4.52
Bluetooth_π/4DQPSK Highest	-6	±2	-4	-5.02
Bluetooth_8DPSK Lowest	-5	±2	-3	-4.32
Bluetooth_8DPSK Middle	-5	±2	-3	-4.16
Bluetooth_8DPSK Highest	-5	±2	-3	-4.59

- WiFi 2.4 GHz

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11b Lowest	12.5	±1	13.5	13.38
WiFi_802.11b Middle	12.5	±1	13.5	13.11
WiFi_802.11b Highest	12.5	±1	13.5	12.76
WiFi_802.11g Lowest	12	±1	13	12.64
WiFi_802.11g Middle	12	±1	13	12.29
WiFi_802.11g Highest	12	±1	13	12.08
WiFi_802.11n HT20 Lowest	11	±1	12	11.51
WiFi_802.11n HT20 Middle	11	±1	12	11.25
WiFi_802.11n HT20 Highest	11	±1	12	10.93

- WiFi 5.0 GHz

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11a 5 150 Band_Lowest	-4	±1	-3	-3.42
WiFi_802.11a 5 150 Band_Middle	-4	±1	-3	-4.03
WiFi_802.11a 5 150 Band_Highest	-5	±1	-4	-5.03
WiFi_802.11a 5 250 Band_Lowest	-5	±1	-4	-5.31
WiFi_802.11a 5 250 Band_Middle	-5	±1	-4	-5.67
WiFi_802.11a 5 250 Band_Highest	-6	±1	-5	-6.12
WiFi_802.11a 5 470 Band_Lowest	-6	±1	-5	-6.38
WiFi_802.11a 5 470 Band_Middle	-8	±1	-7	-7.81
WiFi_802.11a 5 470 Band_Highest	-8	±1	-7	-8.80
WiFi_802.11a 5 725 Band_Lowest	-7	±1	-6	-7.36
WiFi_802.11a 5 725 Band_Middle	-7	±1	-6	-7.02
WiFi_802.11a 5 725 Band_Highest	-7	±1	-6	-6.71

- Bluetooth Low Energy

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Bluetooth Low Energy_ Lowest	7	± 1	8	6.90
Bluetooth Low Energy_ Middle	7	± 1	8	7.20
Bluetooth Low Energy_ Highest	7	± 1	8	6.90