

- 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 Permissive 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 Permissive 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]
WiFi 2G_802.11g	19	±2.00	21	125.89	2.28	1.69	0.042 34	1.000 00
WiFi 5G_802.11a ANT 1	12	±2.00	14	25.21	3.22	2.10	0.010 49	1.000 00
Bluetooth_GFSK	0	±2.00	2	1.58	2.28	1.69	0.000 53	1.000 00
Bluetooth Low Energy	3	±2.00	5	3.16	2.28	1.69	0.001 06	1.000 00
Total	WiFi 2G + WiFi 5G + Bluetooth + Bluetooth Low Energy						0.054 42	1.000 00

4. Target power and tolerance, Max tuneup power

-WiFi 2G

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11b Lowest_ANT 1	15	±2.00	17	15.67
WiFi_802.11b Middle_ANT 1	15	±2.00	17	15.71
WiFi_802.11b Highest_ANT 1	15	±2.00	17	16.16
WiFi_802.11g Lowest_ANT 1	16	±2.00	18	17.70
WiFi_802.11g Middle_ANT 1	16	±2.00	18	17.64
WiFi_802.11g Highest_ANT 1	16	±2.00	18	17.57
WiFi_802.11n HT20 Lowest_ANT 1	16	±2.00	18	17.55
WiFi_802.11n HT20 Middle_ANT 1	16	±2.00	18	17.56
WiFi_802.11n HT20 Highest_ANT 1	16	±2.00	18	17.49

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11b Lowest_ANT 2	14	±2.00	16	15.05
WiFi_802.11b Middle_ANT 2	14	±2.00	16	15.06
WiFi_802.11b Highest_ANT 2	14	±2.00	16	15.30
WiFi_802.11g Lowest_ANT 2	15	±2.00	17	16.52
WiFi_802.11g Middle_ANT 2	15	±2.00	17	16.45
WiFi_802.11g Highest_ANT 2	15	±2.00	17	16.53
WiFi_802.11n HT20 Lowest_ANT 2	15	±2.00	17	16.39
WiFi_802.11n HT20 Middle_ANT 2	15	±2.00	17	16.38
WiFi_802.11n HT20 Highest_ANT 2	15	±2.00	17	16.44
WiFi_802.11n HT20 Lowest_MIMO (ANT 1+2)	19	±2.00	21	20.24
WiFi_802.11n HT20 Middle_MIMO (ANT 1+2)	19	±2.00	21	20.26
WiFi_802.11n HT20 Highest_MIMO (ANT 1+2)	19	±2.00	21	20.12

-WiFi 5G Band 1

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11a Lowest_ANT 1	9	±2.00	11	9.65
WiFi_802.11a Middle_ANT 1	9	±2.00	11	9.86
WiFi_802.11a Highest_ANT 1	9	±2.00	11	10.39
WiFi_802.11n HT20 Lowest_ANT 1	9	±2.00	11	9.15
WiFi_802.11n HT20 Middle_ANT 1	9	±2.00	11	9.58
WiFi_802.11n HT20 Highest_ANT 1	9	±2.00	11	10.43
WiFi_802.11n HT40 Lowest_ANT 1	6	±2.00	8	6.47
WiFi_802.11n HT40 Middle_ANT 1	6	±2.00	8	7.35
WiFi_802.11a Lowest_ANT 2	8	±2.00	10	8.89
WiFi_802.11a Middle_ANT 2	8	±2.00	10	8.73
WiFi_802.11a Highest_ANT 2	8	±2.00	10	9.05

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11n HT20 Lowest_ANT 2	7	±2.00	9	7.69
WiFi_802.11n HT20 Middle_ANT 2	7	±2.00	9	7.81
WiFi_802.11n HT20 Highest_ANT 2	7	±2.00	9	8.26
WiFi_802.11n HT40 Lowest_ANT 2	5	±2.00	7	6.49
WiFi_802.11n HT40 Middle_ANT 2	5	±2.00	7	5.90
WiFi_802.11n HT20 Lowest_MIMO (ANT 1+2)	12	±2.00	14	12.28
WiFi_802.11n HT20 Middle_MIMO (ANT 1+2)	12	±2.00	14	12.64
WiFi_802.11n HT20 Highest_MIMO (ANT 1+2)	12	±2.00	14	13.23
WiFi_802.11n HT40 Lowest_MIMO (ANT 1+2)	9	±2.00	11	9.35
WiFi_802.11n HT40 Middle_MIMO (ANT 1+2)	9	±2.00	11	9.55

-WiFi 5G Band 4

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11a Lowest_ANT 1	10	±2.00	12	11.98
WiFi_802.11a Middle_ANT 1	10	±2.00	12	11.39
WiFi_802.11a Highest_ANT 1	10	±2.00	12	10.86
WiFi_802.11n HT20 Lowest_ANT 1	8	±2.00	10	9.44
WiFi_802.11n HT20 Middle_ANT 1	8	±2.00	10	8.71
WiFi_802.11n HT20 Highest_ANT 1	8	±2.00	10	8.05
WiFi_802.11n HT40 Lowest_ANT 1	7	±2.00	9	7.64
WiFi_802.11n HT40 Middle_ANT 1	7	±2.00	9	7.59
WiFi_802.11a Lowest_ANT 2	12	±2.00	14	13.44
WiFi_802.11a Middle_ANT 2	12	±2.00	14	13.05
WiFi_802.11a Highest_ANT 2	12	±2.00	14	12.86

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
WiFi_802.11n HT20 Lowest_ANT 2	8	±2.00	10	9.90
WiFi_802.11n HT20 Middle_ANT 2	8	±2.00	10	9.78
WiFi_802.11n HT20 Highest_ANT 2	8	±2.00	10	9.64
WiFi_802.11n HT40 Lowest_ANT 2	8	±2.00	10	9.23
WiFi_802.11n HT40 Middle_ANT 2	8	±2.00	10	8.44
WiFi_802.11n HT20 Lowest_MIMO (ANT 1+2)	7	±2.00	9	8.77
WiFi_802.11n HT20 Middle_MIMO (ANT 1+2)	7	±2.00	9	8.35
WiFi_802.11n HT20 Highest_MIMO (ANT 1+2)	7	±2.00	9	8.05
WiFi_802.11n HT40 Lowest_MIMO (ANT 1+2)	7	±2.00	9	7.45
WiFi_802.11n HT40 Middle_MIMO (ANT 1+2)	7	±2.00	9	7.00

-Bluetooth

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Bluetooth_GFSK Lowest	0	±2.00	2	0.47
Bluetooth_GFSK Middle	0	±2.00	2	0.78
Bluetooth_GFSK Highest	0	±2.00	2	0.37
Bluetooth_8DPSK Lowest	-3	±2.00	-1	-2.61
Bluetooth_8DPSK Middle	-3	±2.00	-1	-2.49
Bluetooth_8DPSK Highest	-3	±2.00	-1	-2.87

- Bluetooth Low Energy

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Bluetooth Low Energy Lowest	3	±2.00	5	4.81
Bluetooth Low Energy Middle	3	±2.00	5	5.11
Bluetooth Low Energy Highest	3	±2.00	5	4.87