- 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 [㎽/㎠]	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/f²)	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 ㎒, *= 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

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

S = power density [㎽/㎠]

P = Power input to antenna [㎽]

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 [㎝]

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 ㎝ 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 [㎽]	Ant Gain [dBi]	Ant Gain [Linear scale]	Power Density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
DC 5 V_Ant 1 (Zigbee_Lowest)	-3.0	±1.0	-2.0	0.63	6.13	4.10	0.000 51	1.000 00
DC 48 V_Ant 1 (Zigbee_Lowest)	-3.0	±1.0	-2.0	0.63	6.13	4.10	0.000 51	1.000 00

4. Target power and tolerance, Max tuneup power

DC 5 V

-Ant 0

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-3.0	±1.0	-2.0	-2.21
Zigbee_Middle	-3.0	±1.0	-2.0	-2.36
Zigbee_Highest	-3.0	±1.0	-2.0	-2.55

-Ant 1

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-3.0	±1.0	-2.0	-2.07
Zigbee_Middle	-3.0	±1.0	-2.0	-2.19
Zigbee_Highest	-3.0	±1.0	-2.0	-2.35

-Ant 2

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-4.0	±1.0	-3.0	-3.06
Zigbee_Middle	-4.0	±1.0	-3.0	-3.16
Zigbee_Highest	-4.0	±1.0	-3.0	-3.26

-Ant 3

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-3.5	±1.0	-2.5	-2.96
Zigbee_Middle	-3.5	±1.0	-2.5	-3.01
Zigbee_Highest	-3.5	±1.0	-2.5	-3.05

DC 48 V

-Ant 0

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-3.0	±1.0	-2.0	-2.46
Zigbee_Middle	-3.0	±1.0	-2.0	-2.53
Zigbee_Highest	-3.0	±1.0	-2.0	-2.67

-Ant 1

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-3.0	±1.0	-2.0	-2.07
Zigbee_Middle	-3.0	±1.0	-2.0	-2.19
Zigbee_Highest	-3.0	±1.0	-2.0	-2.35

-Ant 2

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-4.0	±1.0	-3.0	-3.19
Zigbee_Middle	-4.0	±1.0	-3.0	-3.28
Zigbee_Highest	-4.0	±1.0	-3.0	-3.35

-Ant 3

Mode	Target power [dBm]	Tolerance [dB]	Max tuneup power [dBm]	Average Power [dBm]
Zigbee_Lowest	-3.5	±1.0	-2.5	-2.95
Zigbee_Middle	-3.5	±1.0	-2.5	-3.05
Zigbee_Highest	-3.5	±1.0	-2.5	-3.08