

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	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.

MPE Calculations : Bluetooth LE

- Frequency Range : 2402 MHz ~ 2480 MHz
- Measured RF Maximum Output Power : -12.35 dBm
- Target Power & Tolerance -13.00 dBm & \pm 1.00 dB
(Maximum : -12.00 dBm & Minimum : -14.00 dBm)
- Maximum Peak Antenna Gain : 2.70 dBi
- **Maximum Output Power for the Calculation : -12.00 dBm**

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the
The MPE Calculations for this exposure is shown below.

<p>- EIRP = P + G</p> <p>= <u>-12.00</u> dBm + <u>2.70</u> dBi</p> <p>= <u>-9.30</u> dBm</p> <p>= <u>0.12</u> mW</p>	<p>- NOTE</p> <p>P : Max tuneup Power (dBm)</p> <p>G : Maximum Peak Antenna Gain (dBi)</p>
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Power Density at the specific separation

<p>- S = EIRP / (4 X R²π)</p> <p>= 0.12 / (4 X 20² X π)</p> <p>= <u>0.000 023</u> mW/cm²</p>	<p>- NOTE</p> <p>S : Maximum Power Density (mW/cm²)</p> <p>EIRP : Equivalent Isotropic Radiated Power (mW)</p> <p>R : Distance to the center of the radiation of the antenna (<u>20</u> cm)</p>
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MPE Calculations : WLAN2.4G

- Frequency Range : 2412 MHz ~ 2462 MHz
- Measured RF Maximum Output Power : 16.74 dBm
- Target Power & Tolerance 16.00 dBm & ± 1.00 dB
(Maximum : 17.00 dBm & Minimum : 15.00 dBm)
- Maximum Peak Antenna Gain : 2.00 dBi
- **Maximum Output Power for the Calculation : 17.00 dBm**

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the
The MPE Calculations for this exposure is shown below.

<p>- EIRP = P + G</p> <p>= <u>17.00</u> dBm + <u>2.00</u> dBi</p> <p>= <u>19.00</u> dBm</p> <p>= <u>79.43</u> mW</p>	<p>- NOTE</p> <p>P : Max tuneup Power (dBm)</p> <p>G : Maximum Peak Antenna Gain (dBi)</p>
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Power Density at the specific separation

<p>- S = EIRP / (4 X R²π)</p> <p>= 79.43 / (4 X 20² X π)</p> <p>= <u>0.015 803</u> mW/cm²</p>	<p>- NOTE</p> <p>S : Maximum Power Density (mW/cm²)</p> <p>EIRP : Equivalent Isotropic Radiated Power (mW)</p> <p>R : Distance to the center of the radiation of the antenna (<u>20</u> cm)</p>
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MPE Calculations : WLAN5G

- Frequency Range : 5180 MHz ~ 5825 MHz
- Measured RF Maximum Output Power : 12.50 dBm
- Target Power & Tolerance 12.00 dBm & ± 1.00 dB
(Maximum : 13.00 dBm & Minimum : 11.00 dBm)
- Maximum Peak Antenna Gain : 2.00 dBi
- **Maximum Output Power for the Calculation : 13.00 dBm**

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the
The MPE Calculations for this exposure is shown below.

<p>- EIRP = P + G</p> <p>= <u>13.00</u> dBm + <u>2.00</u> dBi</p> <p>= <u>15.00</u> dBm</p> <p>= <u>31.62</u> mW</p>	<p>- NOTE</p> <p>P : Max tuneup Power (dBm)</p> <p>G : Maximum Peak Antenna Gain (dBi)</p>
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Power Density at the specific separation

<p>- S = EIRP / (4 X R²π)</p> <p>= 31.62 / (4 X 20² X π)</p> <p>= <u>0.006 291</u> mW/cm²</p>	<p>- NOTE</p> <p>S : Maximum Power Density (mW/cm²)</p> <p>EIRP : Equivalent Isotropic Radiated Power (mW)</p> <p>R : Distance to the center of the radiation of the antenna (<u>20</u> cm)</p>
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MPE Calculations : WLAN+Bluetooth

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the
The MPE Calculations for this exposure is shown below.

simultaneous MPE for Wi-Fi and Bluetooth

Bluetooth LE + WLAN2.4G + WLAN5G

<p>- Total (%) =</p> $ \begin{aligned} & [\text{BLE Result(mW/cm}^2) / \text{Limit(mW/cm}^2)] + \\ & [\text{WLAN2.4G Result(mW/cm}^2) / \text{Limit(mW/cm}^2)] + \\ & [\text{WLAN5G Result(mW/cm}^2) / \text{Limit(mW/cm}^2)] * 100 \\ & = [\underline{0.000\ 023} / 1] + \\ & [\underline{0.015\ 803} / 1] + \\ & [\underline{0.006\ 291} / 1] * 100 \\ & = \underline{2.212} \% \end{aligned} $	<p>- NOTE</p> <p>Bluetooth LE + WLAN2.4G + WLAN5G</p> <p>Bluetooth LE = <u>0.000 023</u> mW/cm²</p> <p>WLAN2.4G = <u>0.015 803</u> mW/cm²</p> <p>WLAN5G = <u>0.006 291</u> mW/cm²</p> <p>Distance to the center of the radiation of the antenna (<u>20</u> cm)</p> <p>Limit : ≤ 100 %</p>
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