

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 : WLAN Worst Case

- Frequency Range : 2 412 MHz ~ 2 462 MHz
- Measured RF Output Power (Peak) : 15.90 dBm
- Target Power & Tolerance 15.00 dBm & \pm 1.00 dB
(Maximum : 16.00 dBm & Minimum : 14.00 dBm)
- Maximum Peak Antenna Gain : 3.20 dBi
- Maximum Output Power for the Calculation : 16.00 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 calculation for this exposure is shown below.

- EIRP = P + G = <u>16.00</u> dBm + <u>3.20</u> dBi = <u>19.20</u> dBm = <u>83.18</u> mW	- NOTE P : Max tuneup Power (dBm) G : Maximum Peak Antenna Gain (dBi)
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Power Density at the specific separation

- S = EIRP / (4 X R ² π) = <u>83.18</u> / (4 X 20 ² X π) = <u>0.016 547</u> mW/cm ²	- NOTE S : Maximum Power Density (mW/cm ²) EIRP : Equivalent Isotropic Radiated Power (mW) R : Distance to the center of the radiation of the antenna (<u>20</u> cm)
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RF Exposure Compliance Issue

Therefore, EUT is not required the SAR Evaluation.

MPE Calculations : Bluetooth Worst Case

- Frequency Range : 2 402 MHz ~ 2 480 MHz
- Measured RF Output Power (Peak) : 2.79 dBm
- Target Power & Tolerance 2.00 dBm & \pm 1.00 dB
(Maximum : 3.00 dBm & Minimum : 1.00 dBm)
- Maximum Peak Antenna Gain : 3.20 dBi
- Maximum Output Power for the Calculation : 3.00 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 calculation for this exposure is shown below.

<p>- EIRP = P + G</p> <p>= <u>3.00</u> dBm + <u>3.20</u> dBi</p> <p>= <u>6.20</u> dBm</p> <p>= <u>4.17</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>= <u>4.17</u> / (4 X 20² X π)</p> <p>= <u>0.000 829</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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RF Exposure Compliance Issue

Therefore, EUT is not required the SAR Evaluation.

MPE Calculations : Bluetooth BLE

- Frequency Range : 2 402 MHz ~ 2 480 MHz
- Measured RF Output Power (Peak) : 1.08 dBm
- Target Power & Tolerance 0.50 dBm & \pm 1.00 dB
(Maximum : 1.50 dBm & Minimum : -0.50 dBm)
- Maximum Peak Antenna Gain : 3.20 dBi
- Maximum Output Power for the Calculation : 1.50 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 calculation for this exposure is shown below.

<p>- EIRP = P + G</p> <p>= <u>1.50</u> dBm + <u>3.20</u> dBi</p> <p>= <u>4.70</u> dBm</p> <p>= <u>2.95</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>= <u>2.95</u> / (4 X 20² X π)</p> <p>= <u>0.000 587</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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RF Exposure Compliance Issue

Therefore, EUT is not required the SAR Evaluation.

MPE Calculations : WLAN 2G + 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 calculation for this exposure is shown below.

Simultaneous MPE for Wi-Fi and Bluetooth

Wifi+BT

<p>- Total (%) =</p> $[\text{Wifi Result(mW/cm}^2) / \text{Limit(mW/cm}^2)] +$ $[\text{BT Result(mW/cm}^2) / \text{Limit(mW/cm}^2)] * 100$ $= [\underline{0.000\ 829} / 1] +$ $[\underline{0.000\ 829} / 1] * 100$ $= \underline{0.166} \%$	<p>- NOTE</p> <p>Wifi+ BT</p> <p>Wifi = <u>0.000 829</u> mW/cm²</p> <p>BT= <u>0.000 829</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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RF Exposure Compliance Issue

Therefore, EUT is not required the SAR Evaluation.