

## 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 <sup>2</sup> ]	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 <sup>2</sup> )	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 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/cm<sup>2</sup>]

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(worst case : GFSK)

- Frequency Range : 2402 MHz ~ 2480 MHz
- Measured RF Maximum Output Power : 6.14 dBm
- Target Power & Tolerance 6.00 dBm &  $\pm$  1.00 dB  
( Maximum : 7.00 dBm & Minimum : 5.00 dBm )
- Maximum Peak Antenna Gain : 0.47 dBi
- Maximum Output Power for the Calculation : 7.00 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.

$  \begin{aligned}  - \text{EIRP} &= P + G \\  &= \underline{7.00} \text{ dBm} + \underline{0.47} \text{ dBi} \\  &= \underline{7.47} \text{ dBm} \\  &= \underline{5.58} \text{ mW}  \end{aligned}  $	<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

$  \begin{aligned}  - S &= \text{EIRP} / (4 \times R^2 \pi) \\  &= 5.58 / (4 \times 20^2 \times \pi) \\  &= \underline{0.001\ 111} \text{ mW/cm}^2  \end{aligned}  $	<p>- NOTE</p> <p>S : Maximum Power Density (mW/cm<sup>2</sup>)</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 : Bluetooth LE

- Frequency Range : 2402 MHz ~ 2480 MHz
- Measured RF Maximum Output Power : 7.12 dBm
- Target Power & Tolerance 6.50 dBm &  $\pm$  1.00 dB  
( Maximum : 7.50 dBm & Minimum : 5.50 dBm )
- Maximum Peak Antenna Gain : 0.47 dBi
- Maximum Output Power for the Calculation : 7.50 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 Calculations for this exposure is shown below.

$  \begin{aligned}  - \text{EIRP} &= P + G \\  &= \underline{7.50} \text{ dBm} + \underline{0.47} \text{ dBi} \\  &= \underline{7.97} \text{ dBm} \\  &= \underline{6.27} \text{ mW}  \end{aligned}  $	<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

$  \begin{aligned}  - S &= \text{EIRP} / (4 \times R^2 \pi) \\  &= 6.27 / (4 \times 20^2 \times \pi) \\  &= \underline{0.001\ 247} \text{ mW/cm}^2  \end{aligned}  $	<p>- NOTE</p> <p>S : Maximum Power Density (mW/cm<sup>2</sup>)</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 : Bluetooth(GFSK)+Bluetooth LE

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

### simultaneous MPE for Bluetooth and Bluetooth LE

Bluetooth(GFSK)+Bluetooth LE

<p>- Total (%) =</p> $[ \text{Bluetooth Result(mW/cm}^2] / \text{Limit(mW/cm}^2] +$ $[ \text{Bluetooth LE Result(mW/cm}^2] / \text{Limit(mW/cm}^2] * 100$ $= [ \frac{\text{Bluetooth Result(mW/cm}^2)}{\text{Limit(mW/cm}^2}} + \frac{\text{Bluetooth LE Result(mW/cm}^2)}{\text{Limit(mW/cm}^2}} * 100$ $= [ \frac{0.001\ 111}{1} + \frac{0.001\ 247}{1} ] * 100$ $= 0.236 \%$	<p>- NOTE</p> <p>Bluetooth(GFSK)+Bluetooth LE</p> <p>Bluetooth(GFSK) = <u>0.001 111</u> mW/cm<sup>2</sup></p> <p>Bluetooth LE = <u>0.001 247</u> mW/cm<sup>2</sup></p> <p>Distance to the center of the radiation of the antenna ( <u>20</u> cm )</p> <p>Limit : <math>\leq 100 \%</math></p>
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