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/f2)	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

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

S = power density [mW/cm^2]
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 (Ant1)

- Frequency Range : 2 402 MHz ~ 2 480 MHz

- Measured RF Maximum Output Power (Avg.) : -1.79 dBm

- Target Power & Tolerance -2.50 dBm & ± 1.00 dB

(Maximum : -1.50 dBm & Minimum : -3.50 dBm)

- Maximum Peak Antenna Gain : 3.30 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 Calculations for this exposure is shown below.

- EIRP = P + G = -1.50 dBm + 3.30 dBi = 1.80 dBm = 1.51 mW	- NOTE P : Max tuneup Power (dBm) G : Maximum Peak Antenna Gain (dBi)

Power Density at the specific separation

- S = EIRP / (4 X $R^2\pi$) = 1.51 / (4 X 20^2 X π) = **0.000 301** 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 (20 cm)

MPE Calculations : Bluetooth LE (Ant2)

- Frequency Range : 2 402 MHz ~ 2 480 MHz

- Measured RF Maximum Output Power (Avg.) : -4.50 dBm

- Target Power & Tolerance -5.20 dBm & ± 1.00 dB

(Maximum : -4.20 dBm & Minimum : -6.20 dBm)

- Maximum Peak Antenna Gain : 3.80 dBi

- Maximum Output Power for the Calculation : -4.20 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.

- EIRP = P + G = -4.20 dBm + 3.80 dBi = -0.40 dBm = 0.91 mW	- NOTE P : Max tuneup Power (dBm) G : Maximum Peak Antenna Gain (dBi)

Power Density at the specific separation

- S = EIRP / (4 X $R^2\pi$) = 0.91 / (4 X 20^2 X π) = **0.000 181** 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 (20 cm)

MPE Calculations : WLAN+Bluetooth LE1+Bluetooth LE2

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 BLE1/BLE2

WLAN802.11n_HT20 + Bluetooth LE1 + Bluetooth LE2

- Total (%) = [BLE1 Result(mW/cm2) / Limit(mW/cm2)] + [BLE2 Result(mW/cm2) / Limit(mW/cm2)] + [WLAN Result(mW/cm2) / Limit(mW/cm2)] * 100 = [**0.000 301** / 1] + [**0.000 181** / 1] + [**0.064 060** / 1] x 100 = **6.424** %	- NOTE WLAN802.11n_HT20 + BLE1 + BLE2 WLAN802.11n_HT20 = 0.064 060 mW/cm2 Bluetooth LE1 = 0.000 301 mW/cm2 Bluetooth LE2 = 0.000 181 mW/cm2 Distance to the center of the radiation of the antenna (20 cm) Limit : ≤ 100 % *In the case of WLAN, Power Density value of the module report was used. FCCID : 2AC7Z-ESPWROOM02