

## 5.6. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

### 5.6.1. Limits

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

#### Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
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
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## 5.6.2. Method of Measurements

### Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where,  
P: power input to the antenna in mW  
EIRP: Equivalent (effective) isotropic radiated power.  
S: power density mW/cm<sup>2</sup>  
G: numeric gain of antenna relative to isotropic radiator  
r: distance to centre of radiation in cm

## 5.6.3. RF Evaluation

Remark(s):

The EUT contained ZigBee/ BLE and WiFi radio modules with the following operating conditions:

- BLE and WiFi may transmit at the same time
- Zigbee and WiFi may transmit at the same time
- BLE and Zigbee will NOT transmit at the same time

Pursuant to KDB 447498 D01 General RF Exposure Guidance v06, Section 7.2:

*Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.*

The sum of the MPE ratios for all simultaneously transmitting antennas incorporated in the EUT is ≤ 1.0 as calculated in the following table.

EUT Co-located MPE for BLE/Zigbee with WiFi Radio								
Transmitter	Frequency Band (MHz)	Frequency	Max. EIRP (dBm)	Max. EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	Power Density Limit (mW/cm <sup>2</sup> )	Power Density MPE Ratio
BLE	2402-2480	2402	25.53	357.273	20	0.071	1.0	0.071
Zigbee	2405-2480	2405	25.47	352.371	20	0.070	1.0	0.070
802.11b	2412-2462	2412	28.36	685.488	20	0.136	1.0	0.136
802.11g	2412-2462	2412	28.83	763.836	20	0.152	1.0	0.152
802.11n	2412-2462	2412	28.65	732.825	20	0.146	1.0	0.146
Worst Case Combination (BLE with WiFi 802.11g mode) :								0.223

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*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*