MPE Calculations

The device is not a portable device (i.e. intended to be worn on the body or be hand-held), so it is classified as being either a mobile device or a fixed mounted device. With the high gain antennas the module is intended for fixed-mounted operation.

FCC part 1.1310, Table 1 limits the power density for uncontrolled exposure. The power density, P_d (mW/cm^2) calculated from the maximum EIRP, P_t (mW) and the distance, d (m), between the transmitting antenna and the closest person, can be calculated using:

$$P_d = P_t/(4 \pi d^2)$$

Single 2.4GHz module operating with highest gain antenna (3dBi):
The individual modules have a maximum output power of 0.977 Watts (29.98dBm)

Frequency	MPE Limit (mW/cm^2)	Output Power (mW)	Max. Antenna Gain (dBi)	EIRP (mW)	Pd at 20cm (mW/cm^2)	Distance where Pd = limit (cm)
2412 to 2462 MHz	1.00	977	3.0	1949.8	0.4	12.5

Multiple 2.4 GHz modules (maximum of 3):
When multiple modules are installed inside the same host system the total output power from all radios is set to 1 Watt / 30dBm. For example, in a host system containing two modules the output power per module is set to 500mW (refer to the professional installation instructions that are included in the operational description exhibit for more details). Taking a worst-case scenario, with each module connected to the highest gain antenna (3dBi) and with the main beams of all three antennas aligned in the same direction, the total eirp would equal 33 dBm (1.995 Watts).

The minimum separation distance (distance at which the power density is below the limit for uncontrolled exposure) and the power density at 20cm are provided in the table below.

Frequency	MPE Limit (mW/cm2)	Output Power (mW)	Max. Antenna Gain (dBi)	EIRP (mW)	Pd at 20cm (mW/cm^2)	Distance where Pd = limit (cm)
2412 to 2462 MHz	1.00	1000.0	3.0	1995.3	0.4	12.6

As shown in the calculations above, the power density 20cm from the host device is below the maximum permitted level for uncontrolled exposure for any number of modules.

Single 5GHz module operating with highest gain antenna (31.4dBi):
The individual modules have a maximum output power of 0.995 Watts (29.98dBm)

Frequency	MPE Limit (mW/cm^2)	Output Power (mW)	Max. Antenna Gain (dBi)	EIRP (mW)	Pd at 20cm (mW/cm^2)	Distance where Pd = limit (cm)
5745 to 5825 MHz	1.00	995	31.4	1374042.0	273.3	331

Installation instructions for a single module include the instructions for installing antennas to ensure this minimum separation distance.

Multiple 2.4 GHz modules (maximum of 3) and a single 5GHz module:
The rf exposure for up to three 2.4GHz modules the rf exposure for a single 5GHz module are detailed in the previous sections. When the 5GHz module is collocated with one or more of the 2.4GHz modules (to a maximum of 3 modules) the distance at which the rf exposure limits are met is equal to the 5Ghz separation distance of 331 cm.

At 331 cm the values for power density from a single 5GHz module and from up to three 2.4GHz modules are:

Frequency	MPE Limit (mW/cm2)	Output Power (mW)	Max. Antenna Gain (dBi)	EIRP (mW)	Pd at 20cm (mW/cm^2)	Pd at 331cm (mW/cm^2)
2412 to 2462 MHz	1.00	1000.0	3.0	1995.3	0.4 40% of limit	0.001 (0.1% of limit)
5745 to 5825 MHz	1.00	995	31.4	1374042.0	273.3 273.3% of limit	0.998 (99.8% of limit)

The minimum separation distance (distance at which the power density is below the limit for uncontrolled exposure) when a host system contains the 5GHz module and 1, 2 or 3 2.4GHz modules is the same distance as for a host system containing one of the 5GHz modules (331cm or 3.31m).

The installation manual for the host systems containing the 2.4GHz and 5GHz modules includes the appropriate warnings requiring separation distances of > 20cm for configurations containing only the 2.4GHz modules and > 331cm for configurations containing a 5GHz module.

In additional the installation instructions that explain how to set the output power for the 2.4GHz modules when more than one module is installed in a host system are also provided.