

MPE Calculations

The device is classified as a mobile device. The user’s manual specifies a minimum separation distance of at least 25cm, consistent with this classification. As shown in the calculations below, the power density 25cm from the device is below the maximum permitted level for uncontrolled exposure with one or more radios active.

FCC part 1.1310, Table 1 limits the power density for uncontrolled exposure. The power density, P_d (mW/cm²) 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:

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

The maximum eirp in each band is shown in the following tables for all modes of operation. The total eirp is calculated for a single radio in the band and for multiple radios in the band. For the multiple radio scenarios the correction factor of $10\log(n)$, where n is the number of active transceivers, is add to the output power for the single-radio.

The maximum number of radios in each band is limited by the number of non-overlapping channels available in that band. The highest eirp in each band with the maximum number of radios operational is highlighted.

2.4GHz Band				
Three non-overlapping 20MHz channels available, or one 40MHz and 1 20MHz channel				
Mode	# of TxRx (Correction)	Output Power per Tx/Rx	Antenna Gain	Total EIRP
802.11b 1xMISO	1 (0dB)	19.5	3.0	22.5
	2 (3.0dB)	19.5	3.0	25.5
	3 (4.77dB)	19.5	3.0	27.3
802.11g 1xMISO	1 (0dB)	18.4	3.0	21.4
	2 (3.0dB)	18.4	3.0	24.4
	3 (4.77dB)	18.4	3.0	26.2
802.11b 3x MIMO	1 (0dB)	23.7	7.77	31.5
	2 (3.0dB)	23.7	7.77	34.5
	3 (4.77dB)	23.5	7.77	36.0
802.11g 3x MIMO	1 (0dB)	22.9	7.77	30.7
	2 (3.0dB)	22.9	7.77	33.7
	3 (4.77dB)	22.9	7.77	35.4
802.11n20 3x MIMO	1 (0dB)	23	3.0	26.0
	2 (3.0dB)	23	3.0	29.0
	3 (4.77dB)	23	3.0	30.8
802.11n40 3x MIMO	1 (0dB)	22.6	3.0	25.6

5.7GHz Band				
Five non-overlapping 20MHz channels available, or two 40MHz channels				
Mode	# of TxRx (Correction)	Output Power per Tx/Rx	Antenna Gain	Total EIRP
802.11a 1xMISO	1 (0dB)	15.1	6.0	21.1
	2 (3.0dB)	15.1	6.0	24.1
	3 (4.77dB)	15.1	6.0	25.9
	4 (6.0dB)	15.1	6.0	27.1
	5 (7.0dB)	15.1	6.0	28.1
802.11a 2xMIMO	1 (0dB)	17.5	9.0	26.5
	2 (3.0dB)	17.5	9.0	29.5
	3 (4.77dB)	17.5	9.0	31.3
	4 (6.0dB)	17.5	9.0	32.5
	5 (7.0dB)	17.5	9.0	33.5
802.11n20 2x MIMO	1 (0dB)	17.4	6.0	23.4
	2 (3.0dB)	17.4	6.0	26.4
	3 (4.77dB)	17.4	6.0	28.2
	4 (6.0dB)	17.4	6.0	29.4
	5 (7.0dB)	17.4	6.0	30.4
802.11n40 2x MIMO	1 (0dB)	17.2	6.0	23.2
	2 (3dB)	17.2	6.0	26.2

5.15 GHz Band				
Four non-overlapping 20MHz channels available, or two 40MHz channels. Total EIRP in the band is restricted to 23.0dBm. output power per radio is reduced as soon as more than one radio is operational in the band to ensure the 23dBm eirp is not exceeded.				
Mode	# of TxRx (Correction)	Output Power per Tx/Rx	Antenna Gain	Total EIRP
802.11a 1xMISO	1 (0dB)	16.3	6	22.3
	2+	-	6	23.0
802.11a 2x MIMO	1 (0dB)	13.3	9	22.3
	2+	-	9	23.0
802.11n20 2x MIMO	1 (0dB)	16.7	6	22.7
	2+	-	6	23.0
802.11n40 2x MIMO	1 (0dB)	16.7	6	22.7
	2	13.6	6	22.6

From the previous tables there can only be a maximum of 12 radios operational at any time (3 in the 2.4 GHz band, 5 in the 5.7GHz band and 4 in the 5.15 GHz band). The 8 channels that give the highest total eirp from the system would be the 5 channels in the 5GHz DTS and the three channels in the 2.4GHz DTS bands. The total eirp (worst case for 8 radios operational) from these two bands is calculated below.

# Radios and Band	EIRP (dBm)	EIRP (mW)
3 radios in 2.4 GHz band	36	3981.072
5 radios in 5.7 GHz band	33.5	2238.721
Total EIRP	37.98	6219.8

The rf exposure calculation using an EIRP of 37.9 dBm gives a minimum separation distance of 22.2cm (see below). The user's manual requires a minimum separation of more than 25cm.

Frequency	MPE Limit (mW/cm ²)	EIRP (dBm)	EIRP (mW)	Pd at 20cm (mW/cm ²)	Distance where Pd = limit (cm)
2400 to 5725 MHz	1.00	37.9	6219.8	1.2	22.2