

MPE Calculations

XN Series of 802.11abgn Arrays

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/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:

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

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 maximum eirp is limited by the FCC/Industry Canada rules:

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 the eirp of 23dBm would be 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

5.25 GHz Band				
Four non-overlapping 20MHz channels available or two 40MHz channels. EIRP in the band is restricted to 30.0dBm. Output power per radio is reduced as soon as the eirp of 30dBm would be exceeded.				
Mode	# of TxRx (Correction)	Output Power per Tx/Rx	Antenna Gain	Total EIRP
802.11a 1xMISO	1	19.3	6	22.3
	2	19.3	6	28.3
	3 +	-	6	29.8
802.11a 2x MIMO	1	18.1	9	27.1
	2 +	-	9	30.0
802.11n20 2x MIMO	1	18.2	6	24.2
	2	18.2	6	27.2
	3	18.2	6	29.0
	4	17.0	6	29.0
802.11n40 2x MIMO	1 (0dB)	17.8	6	22.7
	2	17.8@5270MHz 9.8@5310MHz 18.5dBm total	6	24.5

5.47 GHz Band				
Eleven non-overlapping 20MHz channels or five 40MHz channels. EIRP in the band is restricted to 30.0dBm. Output power per radio is reduced as soon as the eirp of 30dBm would be exceeded.				
Mode	# of TxRx (Correction)	Output Power per Tx/Rx	Antenna Gain	Total EIRP
802.11a 1xMISO	1	16.0	6	22.0
	2	16.0	6	25.0
	3	16.0	6	26.8
	4	16.0	6	28.0
	5	16.0	6	29.0
	6	16.0	6	29.8
	7+	-	6	30.0
802.11a 2x MIMO	1	17.6	9	26.6
	2	17.6	9	29.6
	3+	-	9	30.0
802.11n20 2x MIMO	1	18.8	6	24.8
	2		6	27.8
	3		6	29.6
	4+		6	30.0
802.11n40 2x MIMO	1	17.3	6	23.3
	2	17.3	6	26.3
	3	17.3	6	28.1
	4	17.3	6	29.3
	5	15.3	6	28.3

The 15 channels with the highest total eirp from the system are sorted below.

	Band	EIRP		Mode
		mW	dBm	
1	2400-2483.5MHz	1412.54	31.5	802.11b 3x
2	2400-2483.5MHz	1412.54	31.5	802.11b 3x
3	2400-2483.5MHz	1174.93	30.7	802.11b 3x
4	5250-5350MHz	512.86	27.1	802.11a 2x
5	5250-5350MHz	487.14	26.9	802.11a 2x
6	5470-5725MHz	457.1	26.6	802.11a 2x
7	5470-5725MHz	454.9	26.6	802.11a 2x
8	5725-5850MHz	446.68	26.5	802.11a 2x
9	5725-5850MHz	446.68	26.5	802.11a 2x
10	5725-5850MHz	446.68	26.5	802.11a 2x
11	5725-5850MHz	446.68	26.5	802.11a 2x
12	5725-5850MHz	446.68	26.5	802.11a 2x
13	5150-5250MHz	186.21	22.7	802.11n 20MHz
14	5470-5725MHz	88	19.4	802.11a 2x
15	5150-5250MHz	13.79	11.4	802.11n 20MHz

The highlighted EIRPs show instances where the addition of another radio operating in a band causes the output power per radio to be reduced. The power listed is the incremental eirp within the band. For example, when the third 802.11b radio is turned on (line item 3) the total power in the 2.4Ghz band goes from 2825mW to 4000mW.

The XN8 has 4 radios that can operate in the 5GHz and 4 that operate in either the 5GGHz or the 2.4GHz bands. The highest eirp from the XN8 is determined by the top 8 channels, i.e. **6358.69 mW**.

The XN12 has 8 radios that can operate in the 5GHz and 4 that operate in the 2.4GHz. Of the 4 2.4GHz radios, one is in a receive-only monitoring mode, so the highest eirp from the XN12 is determined by the top 11 channels, i.e. **7698.73 mW**.

The XN16 has 12 radios that can operate in the 5GHz and 4 that operate in the 2.4GHz. Of the 4 2.4GHz radios, one is in a receive-only monitoring mode, so the highest eirp from the XN16 is determined by the top 15 channels, i.e. **8433.41mW**.

The rf exposure calculations below give the minimum separation distance for each device assuming all transceivers are operational within the device and based on the channel allocations for each transceiver that result in the highest total eirp. The user's manual requires a minimum separation of more than **26cm**.

Device	Frequency	MPE Limit (mW/cm ²)	EIRP (mW)	Pd at 20cm (mW/cm ²)	Distance where Pd = limit (cm)
XN8	2400 to 5725 MHz	1.00	6358.69	1.27	22.5
XN12			7698.73	1.53	24.8
XN16			8433.41	1.68	25.9

This estimate is conservative as it assumes all transmitting radios would be transmitting continuously and simultaneously. It also considers the total eirp to be sourced from a single point when the actual sources are distributed in a circle with a diameter that exceeds 20cm.