

6.3.1 Details of Exposure Separation Distances Calculations and Power Compliance Margins

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at <http://www.fcc.gov>, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See Safety Code 6 on the Health Canada web site at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/index_e.html.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at <http://www.icnirp.de/> and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

The applicable power density exposure limits from the documents referenced above are

- 10 W/m² for RF energy in the 5.4-GHz frequency bands.

Peak power density in the far field of a radio frequency point source is calculated as follows:

$$S = \frac{P \cdot G}{4 \pi d^2}$$

where
 S = power density in W/m²
 P = RMS transmit power capability of the radio, in W
 G = total Tx gain as a factor, converted from dB
 d = distance from point source, in m

Rearranging terms to solve for distance yields

$$d = \sqrt{\frac{P \cdot G}{4 \pi S}}$$

Table 10 shows calculated minimum separation distances d , recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 10: Calculated Exposure Distances and Power Compliance Margins

Frequency Band	Antenna	Variable			d (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	G	S			
5.4 GHz	Integrated, 17 dBi	0.05 W (10 dBm)	50 (17 dB)	10 W/m ²	6 cm	20 cm (8 in)	10
	Connectorized, 17 dBi	0.05 W (10 dBm)	50 (17 dB)	10 W/m ²	6 cm	20 cm (8 in)	10
4.9 GHz	Integrated, 16 dBi	0.063 W (18 dBm)	40 (16 dB)	10 W/m ²	14 cm	20 cm (8 in)	2
	Connectorized, 16 dBi	0.063 W (18 dBm)	40 (16 dB)	10 W/m ²	14 cm	20 cm (8 in)	2

The “Recommended Distances” are chosen to give significant compliance margin in all cases. They are also chosen so that an OFDM module has the same exposure distance as a Canopy module, to simplify communicating and heeding exposure distances in the field.

These are conservative distances:

- They are along the beam direction (the direction of greatest energy). Exposure to the sides and back of the module will be significantly less.
- They meet sustained exposure limits for the general population (not just short term occupational exposure limits), with considerable margin.
- The calculated compliance distance d is overestimated because the far-field equation models the antenna as a point source and neglects the physical dimension of the antenna.

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