Human exposure to radio frequency energy

Standards

Relevant standards (USA and EC) applicable when working with RF equipment are:

- ANSI IEEE C95.1-1991, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC) and respective national regulations.
- *Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004* on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).
- 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 the Health Canada web site at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limites_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz).
- BS EN 50385:2002 Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz) – general public.
- 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.

Power density exposure limit

Install the radios for the PMP 450 family of PMP wireless solutions so as to provide and maintain the minimum separation distances from all persons.

The applicable power density exposure limit from the standards (see Human exposure to radio frequency energy on page 4-11) is:

- **10 W/m^2** for RF energy in the 5.4-GHz and 5.8-GHz frequency bands.

Calculation of power density

> **NOTE**
> The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst case analysis. Details of the assessment to EN50383:2002 can be provided, if required.

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

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

Where:	Is:
S	power density in W/m^2
P	maximum average 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:

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

Calculated distances and power compliance margins

Table 38 shows calculated minimum separation distances, recommended distances and resulting margins for each frequency band and antenna combination. These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

PMP 450 equipment adheres to all applicable EIRP limits for transmit power when operating in MIMO mode. Separation distances and compliance margins include compensation for both transmitters.

Explanation of terms used in Table 38:

Tx burst – maximum average transmit power in burst (Watt)
P – maximum average transmit power capability of the radio (Watt) (combined transmitters)
G – total transmit gain as a factor, converted from dB
S – power density (W/m^2)
d – minimum distance from point source (meters)
R – recommended distances (meters)
C – compliance factor

Table 38 Power Compliance Margins

Freq. Band	Antenna	Variable			*d*	Recom-mended Separation Distance	Power Compliance Margin
		P	G	S			
2.4/5.4/5.8 GHz OFDM	Integrated SM, 9 dBi patch	0.158 W (22 dBm)	7.9 (9 dB)	10 W/m2 or 1 mW/cm2	10 cm	20 cm (8 in)	40.27
	Integrated SM, 9 dBi patch with 8 dBi CLIP (5 GHz only)	0.158 W (22 dBm)	50 (17 dB)	10 W/m2 or 1 mW/cm2	25 cm	50 cm (20 in)	39.7
	Integrated SM, 9 dBi patch with 5.5 dBi LENS (5 GHz only)	0.158 W (22 dBm)	28 (14.5 dB)	10 W/m2 or 1 mW/cm2	18.7 cm	50 cm (20 in)	71.01
	Integrated SM, 9 dBi patch with 14 dBi Reflector Dish	0.158 W (22 dBm)	199 (23 dB)	10 W/m2 or 1 mW/cm2	50 cm	100 cm (40 in)	40
	Connectorized AP, with 17 dBi Sector Antenna	0.158 W (22 dBm)	50 (17 dB)	10 W/m2 or 1 mW/cm2	25.1 cm	50 cm (20 in)	39.8

NOTE

Gain of antenna in dBi = 10*log(G).

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

If there are no EIRP limits in the country of deployment, use the distance calculations for FCC 5.8 GHz for all frequency bands.