

## 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 <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 [http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limités\\_e.html](http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limités_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 Subscriber Modules and fixed terminal Subscriber Modules for wireless telecommunication systems (110 MHz - 40 GHz).
- BS EN 50385:2002 Product standard to demonstrate the compliances of radio base Subscriber Modules and fixed terminal Subscriber Modules 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 <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 ePMP 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 188) is:

- 10 W/m<sup>2</sup> for RF energy in the 5 GHz and 2.4 GHz frequency bands.

### Calculation of power density

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



#### 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.

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

**Where:**

**Is:**

S	power density in W/m <sup>2</sup>
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:

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

### Calculated distances and power compliance margins

The calculated minimum separation distances, recommended distances and resulting margins for each frequency band and antenna combination is shown in [Table 82](#) through [Table 102](#). 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.

Explanation of terms used [Table 78](#) through [Table 102](#):

Tx burst – maximum average transmit power in burst (Watt)

P – maximum average transmit power capability of the radio (Watt)

G – total transmit gain as a factor, converted from dB

S – power density (W/m<sup>2</sup>)

d – minimum distance from point source (meters)

R – recommended distances (meters)

C – compliance factor

**Table 78** and **Table 81** below list the power compliance margins for the following ePMP 2000 devices:

Model Number	Part Number	FCC ID	Industry Canada
C058900P132A	C058900A132A C058900L132A	Z8H89FT0020	109W-0020

**Table 78** ePMP 2000 Power compliance margins, 5.1 GHz, AP

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
PMP PTP	5 MHz	Connectorized Antenna, 17 dBi	0.02	50	9.011	0.10	0.3	-
PMP PTP	40 MHz	Connectorized Antenna, 17 dBi	0.01	50	9.011	0.07	0.3	-

**Table 79** ePMP 2000 Power compliance margins, 5.2 GHz, AP

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
PMP PTP	10 MHz	Connectorized Antenna, 17 dBi	0.017	50	9.13	0.09	0.3	-
PMP PTP	40 MHz	Connectorized Antenna, 17 dBi	0.014	50	9.13	0.08	0.3	-

**Table 80** ePMP 2000 Power compliance margins, 5.4 GHz, AP

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
PMP PTP	10 MHz	Connectorized Antenna, 17 dBi	0.018	50	9.39	0.09	0.3	PMP PTP
PMP PTP	40 MHz	Connectorized Antenna, 17 dBi	0.017	50	9.39	0.09	0.3	PMP PTP

**Table 81** ePMP 2000 Power compliance margins, 5.8 GHz, AP

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
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PMP		Connectorized Antenna, 17						
PTP	5 MHz	dBi	0.069	50	9.011	0.17	0.3	-
PMP		Connectorized Antenna, 17						
PTP	40 MHz	dBi	0.07	50	9.011	0.08	0.3	-

**Table 82** to **Table 85** below are the power compliance margins for the following ePMP 1000 devices:

Model Number	Part Number	FCC ID	Industry Canada
C058900P112A	C058900C112A	Z8H89FT0006	109W-0006

**Table 82** ePMP 1000 Power compliance margins, 5.1 GHz, AP

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
PMP	5/10 MHz	Connectorized Omni, 3 dBi	0.063	2.0	9.011	0.03	0.1	99.8
PMP	5/10 MHz	Connectorized Sector Array, 16 dBi	0.032	39.8	9.011	0.10	0.3	89.8
PTP	5/10 MHz	Connectorized Patch Panel Array, 23 dBi	0.010	199.5	9.011	0.13	0.3	56.7
PTP	5/10 MHz	Connectorized Dish, 30 dBi	0.002	1000.0	9.011	0.13	0.3	56.7
PMP	20/40 MHz	Connectorized Omni, 3 dBi	0.063	2.0	9.011	0.03	0.1	99.8
PMP	20/40 MHz	Connectorized Sector Array, 16 dBi	0.100	39.8	9.011	0.19	0.4	45.5
PTP	20/40 MHz	Connectorized Patch Panel Array, 23 dBi	0.008	199.5	9.011	0.12	0.3	64.3
PTP	20/40 MHz	Connectorized Dish, 30 dBi	0.001	1000.0	9.011	0.11	0.3	80.9

**Table 83** ePMP 1000 Power compliance margins, 5.2 GHz, AP

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
PMP	5/10 MHz	Connectorized Omni, 3 dBi	0.063	2.0	9.130	0.03	0.1	91.1