

## 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 449) 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 144](#) through [Table 164](#). 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 140](#) through [Table 164](#):

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 164 below is the power compliance margins for the following device

Model Number	Part Number	FCC ID	Industry Canada
C024900P161A	C024900C161A	Z8H89FT0019	109W-0019

Table 163 ePMP 1000 Power compliance margins, 2.4 GHz (FCC)

Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
40/20/10 MHz	Modular Dish, 17 dBi	0.293	50.1	5.348	0.47	1	45.7
40/20/10 MHz	Module Dipole, 2 dBi	0.807	1.6	5.348	0.14	0.3	47.3
5 MHz	Modular Dish, 17 dBi	0.287	50.1	5.348	0.46	1	46.6
5 MHz	Module Dipole, 2 dBi	0.802	1.6	5.348	0.14	0.3	47.6

Table 164 ePMP 1000 Power compliance margins, 2.4 GHz (IC)

Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
40/20/10 MHz	Modular Dish, 17 dBi	0.293	50.1	5.348	0.47	1	45.7
40/20/10 MHz	Module Dipole, 2 dBi	0.807	1.6	5.348	0.14	0.4	84.0
5 MHz	Modular Dish, 17 dBi	0.287	50.1	5.348	0.46	1	46.6
5 MHz	Module Dipole, 2 dBi	0.802	1.6	5.348	0.14	0.3	47.6

Table 165Error! Reference source not found. through Table 168 below are the power compliance margins for the following devices:

Model Number	Part Number	FCC ID	Industry Canada
C058900P082A	C058900C072A	Z8H89FT0031	109W-0031

Table 165 Power compliance margins, 5.1 GHz, SM

Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
10/20/40 MHz	Modular Dish, 22 dBi	0.006	158	9.011	0.09	0.2	45.3
10/20/40 MHz	None, 2 dBi	0.316	2	9.011	0.07	0.2	90.7

**Table 166** Power compliance margins, 5.2 GHz, SM

Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
10/20/40 MHz	Modular Dish, 22 dBi	0.006	158	9.13	0.09	0.2	45.3
10/20/40 MHz	None, 2 dBi	0.316	2	9.13	0.07	0.2	90.7

**Table 167** ePMP 1000 Power compliance margins, 5.4 GHz, SM

Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
10/20/40 MHz	Modular Dish, 22 dBi	0.006	158	9.39	0.09	0.2	45.3
10/20/40 MHz	None, 2 dBi	0.316	2	9.39	0.07	0.2	90.7

**Table 168** ePMP 1000 Power compliance margins, 5.8 GHz, SM

Channel Bandwidth	Antenna	P (W)	G	S (W/m <sup>2</sup> )	d (m)	R (m)	C
10/20/40 MHz	Modular Dish, 22 dBi	0.316	158	9.69	0.64	1	38
10/20/40 MHz	None, 2 dBi	0.316	2	9.69	0.06	0.2	94.7