MPE Calculations
FCC ID: XKM-WASP04 and IC: 8472A-WASP04

RF Exposure Requirements:

FCC	Industry Canada
§1.1307(b)(1) and §1.1307(b)(2): Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.	**Health Canada Safety Code 6 clause 2:** In the following sections, the maximum exposure levels for both RF and microwave exposed workers (including occupationally exposed persons) and other individuals (including the general public) are specified. These levels shall not be exceeded.

RF Radiation Exposure Limit, mobile devices:

FCC	Industry Canada
§1.1310 As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter. **KDB447498** clause 7.	**Health Canada Safety Code 6** clause 2.2(b) and Table 5. (b) Where the electromagnetic radiation consists of a number of frequencies in the same or different frequency bands, shown in Column 1 of Table 5, then the ratio of the measured value at each frequency to the limit at that given frequency shown in Column 2, 3, or 4 shall be determined, and the sum of all ratios thus obtained for all frequencies shall not exceed unity when averaged spatially and over time. **RSS-102 Issue 3** clauses 3.2 and 4.4

FCC 1.1310 Table 1(b) and *RSS-102 clause 4.2* RF Field Strength Limits for General Population

Frequency Range (MHz)	Electric Field (V/m rms)		Magnetic Field (A/m rms)		Power Density (mW/m^2)		Averaging Time (minutes)	
	FCC	*IC*	FCC	*IC*	FCC	*IC*	FCC	*IC*
30-300	27.5	*28*	0.073	*0.073*	0.2	*0.2*	30	*6*
300-1500	------	*1.585 $f^{0.5}$*	-------	*0.0042 $f^{0.5}$*	*f*/1500	*f/1500*	30	*6*
1500-10000	------	*61.4*	-------	*0.163*	1	*1*	30	*6*

Note: *f* is frequency in MHz

MPE Limit Calculations:

1) EUT operating frequency band **824.2 – 848.8 MHz**. Highest conducted power is 32.2 dBm (1.66 W). Maximum 0 dBi antenna gain; 25% GPRS source-based, time-averaged maximum duty cycle.

Power Density Determination:
$S = PG / 4\pi R^2$ or $R = \sqrt{(PG / 4\pi S)}$
where, S = Power Density (mW/cm^2)
P = Linear Power Input to antenna in mW (1660 mW peak, 415 mW average)
G = Numerical Antenna Gain (1.0)
R = Radius (20 cm, as noted in installation instructions)
$S = (415*1.0/4\pi 20^2) = (415/5027) = 0.0826$ mW/cm^2 @ 20 cm

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2) EUT operating frequency band **1850.2 – 1909.8 MHz**. Highest conducted power is 29.2 dBm (0.832 W). Maximum 0 dBi antenna gain; 25% GPRS source-based, time-averaged maximum duty cycle.

Power Density Determination:
$S = PG / 4\pi R^2$ or $R = \sqrt{(PG / 4\pi S)}$
where, S = Power Density (mW/cm^2)
P = Linear Power Input to antenna in mW (832 mW peak, 208 mW average)
G = Numerical Antenna Gain (1.0)
R = Radius (20 cm, as noted in installation instructions)
$S = (208*1.0/4\pi 20^2) = (208/5027) = 0.0414$ mW/cm^2 @ 20 cm

3) EUT operating frequency band **902.7 – 927.3 MHz**; highest conducted power = 20 dBm (peak) Maximum antenna gain = 2.2 dBi.

Power Density Determination:
$S = PG / 4\pi R^2$ or $R = \sqrt{(PG / 4\pi S)}$
where, S = Power Density (mW/cm^2)
P = Linear Power Input to antenna (100 mW)
G = Numerical Antenna Gain (1.66)
R = Radius (20 cm, as noted in installation instructions)
$S = (100*1.66/4\pi 20^2) = (166/5027) = 0.033$ mW/cm^2 @ 20 cm

4) Worst-case MPE is simultaneous exposure from both antennas @ 20 cm to the respective limits in their bands;

i) **824.2 – 848.8 MHz** band: MPE limit = f/1500 or 0.557 mW/cm^2 General Population Exposure limit; Calculated MPE/MPE limit = 0.0826/0.557 = **0.148**.

ii) **1850.2 – 1909.8 MHz** band: MPE limit = 1 mW/cm^2 General Population Exposure limit; Calculated MPE/MPE limit = 0.0414/1 = 0.0414.

iii) **902.7 – 927.3 MHz** band: MPE limit = f/1500 mW/cm^2 or 0.61 mW/cm^2 ; General Population Exposure limit; Calculated MPE/MPE limit = 0.033/0.61 = **0.054**.

Worst-case (larger of (i) or (ii) since transmission does not simultaneously in 800 and 1900 MHz bands) and (iii) sum of ratios is 0.148 + 0.054 = 0.202, which is below the relative MPE limit of 1.0 for co- transmitting sources.