Compliance with MPE limits

Rule: FCC part 2.1091,(b),(c),(d)(2),(d)(3).
Maximum Standard: FCC part 1.1310 table 1 [B]
                                Frequency range: 300-1500 MHz   values: 806-824MHz (max Tx freq)
                                Power Density   f/1500 mW/cm^2 0.5373-0.5493 mW/cm^2
                                The exposure should not exceed 0.537 mW/cm^2

MPE information   Dataradio Inc. neither manufactures nor supplies specific antennas. Therefore the MPE compliance
                                will be demonstrated through evaluation of the RF field density at the closest point from the antenna
                                someone can reach unintentionally. Information concerning minimum separation distances from
                                transmitting structures and proper installation of antennas are provided in Installation Guide. The
                                installations should be made by trained personnel.

Calculus Result: The unit respects the MPE limit at 75cm (2.5ft) having an radiant system not exceeding 6dB gain.
                                Calculated RF Field value: W=0.4527mW/cm^2.

                                 The distance vs. gain chart in order to accomplish maximum RF exposure at 20% Tx duty cycle is
                                shown below.

Max G(dB) vs distance to accomplish MPE limits
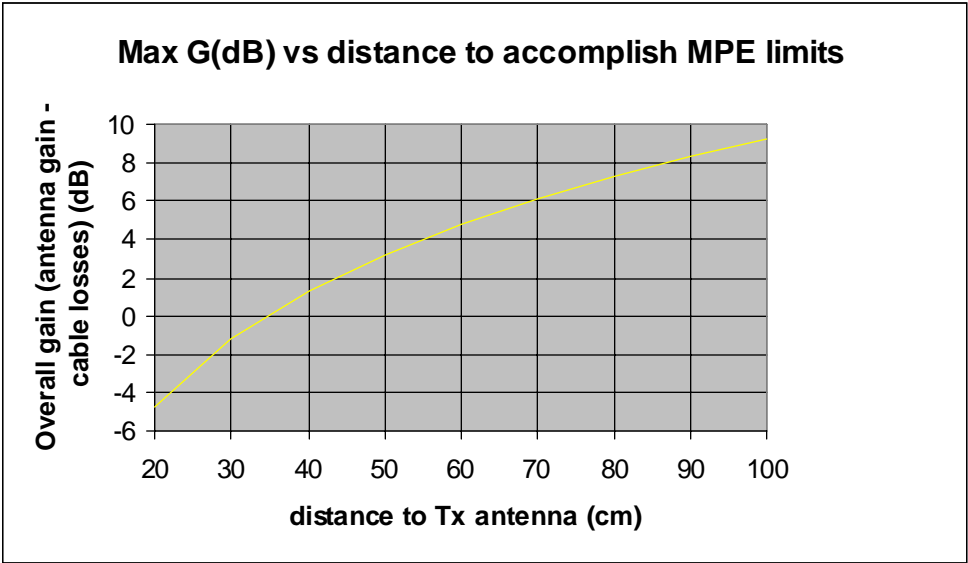
Calculations Performed by ._____   date Mar 17, 2000
                                                    Constantin Pintilei

Note: Calculation details are on following page.

Source-based time-averaging provisions **2.1091 (d)(2)**. Both network protocol and hardware limitations apply.

   a)network protocol. Gemini/PD family uses DBA protocol over the wireless networks. DBA (Dynamic Bandwidth Allocation) is a 5:1 TDMA protocol optimized for public utilities and public safety markets. The "theoretical" maximum transmit time for mobile is 20% from total time (1 time slot from 5 successive time slots).

   As we mentioned in our previous answer, the maximum actual Tx duty cycle is less than 1%, this provides considerable additional margin in meeting MPE requirements.

   b) hardware. The design specification for Tx duty cycle has been set to 20%. Accordingly the PA circuitry and heat dissipation calculations have been done to keep the temperature balance. The temperature limiting loop is described in attachment "Description of circuitry", PA circuit board chapter, PA temperature sense paragraph (pag1). Loop back limits maximum PA temperature to 100^0C by switching off the PA power line and has a hysteresis between 90^0Cand 100^0C for switch back on.

Minimum distance provisions. **2.1091(b**). Gemini/PD has an external transceiver antenna that is recommended to be mounted on the centerline of the roof. The general public would find it difficult to get within 75cm (2.5 ft) of antenna. For other mounting positions the maximum gain vs. minimum distance chart is supplied to permit calculation of the maximum gain allowed to accomplish MPE limits.

The calculation follows the model in **OET Bulletin 65, Edition 97-01**.
consider the worst case for RF exposure as follow:

f=806 MHz

$\lambda = 3*10^8(\text{m/s})/806*10^6(\text{Hz}) = 0.372\text{m}$

r=0.75m=75 cm - person standing next to the car.

P_T=40W=40,000mW -maximum transmitted power

G=6dB=4x - maximum allowed (gain antenna gain- cable loses) - for worst case.

single radiating antenna

20% Tx duty cycle (see comments above about source-based time-averaging).

Formulas:

Far-field region power density: $S = \dfrac{PG}{4\pi * r^2}$ Time - averaged power density: $S_{ef} = 20\% * S$;

For an 20% Tx duty cycle

$$S_{ef} = 0.2 * \frac{40.000 * 4}{4\pi * 75^2} = 0.45271 \ \text{mW/cm}^2$$

The aforementioned graph "Maximum G(dB) vs. distance to accomplish MPE limits" is based on the following formula:

$$G = 10\log_{10}(\frac{S_{ef}\max*4\pi*r^2}{0.2*P_T}) = 10\log_{10}(\frac{0.537*4\pi}{0.2*40,000}r^2) = -30.73 + 20\log_{10} r$$