



1. We need an MPE calculation to prove that the device is safe at 20cm.

The power density associated with a particular electric field intensity is:

$$W = \frac{|E|^2}{h} = \frac{|E|^2}{120p} = \frac{|E|^2}{377} \cdot \frac{(V/m)^2}{Ohms} = \frac{Watts}{m^2}$$

The power density at a distance from an isotropic radiating source is:

$$W(r) = \frac{W_t}{4\pi r^2} ; \frac{Watts}{m^2}$$

If identical isotropic transmitting and receiving antennas are used, the received power at a distance from an isotropic radiating source is:

$$P(r) = W(r) \cdot A = \frac{W_t \cdot A}{4\pi r^2} = \frac{P_t}{4\pi r^2} ; Watts$$

Solving for transmit power and expressing the received power in terms of received electric field intensity:

$$P_t = P(r)4\pi r^2 = \frac{|E|^2}{120p} 4\pi r^2 ; Watts$$

Since the electric field intensity is specified at a 3 meter distance and we are interested in the effective transmit power in dBm:

$$r = 3 \text{ meters}$$

$$P(W) = P(mW) \times 1000$$

$$E(V) = E(uV) \times 10^{-6}$$



$$P_t = 10 \log_{10} \left(\frac{|E|^2}{30} 3^2 \cdot 1000 \right) = 20 \log_{10}(|E|) + 20 \log_{10}(3) + 10 \log_{10}(1000) - 10 \log_{10}(30) \text{ dBm}$$

$$P_t = 20 \log_{10}(|E_{mV}|) - 20 \log_{10}(10^{-6}) + 20 \log_{10}(3) + 10 \log_{10}(1000) - 10 \log_{10}(30) \text{ dBm}$$

$$P_t = 20 \log_{10}(|E_{mV}|) - 120 + 9.54 + 30 - 14.77 \text{ dBm}$$

$$P_t = 20 \log_{10}(|E_{mV}|) - 95.23 \text{ dBm}$$

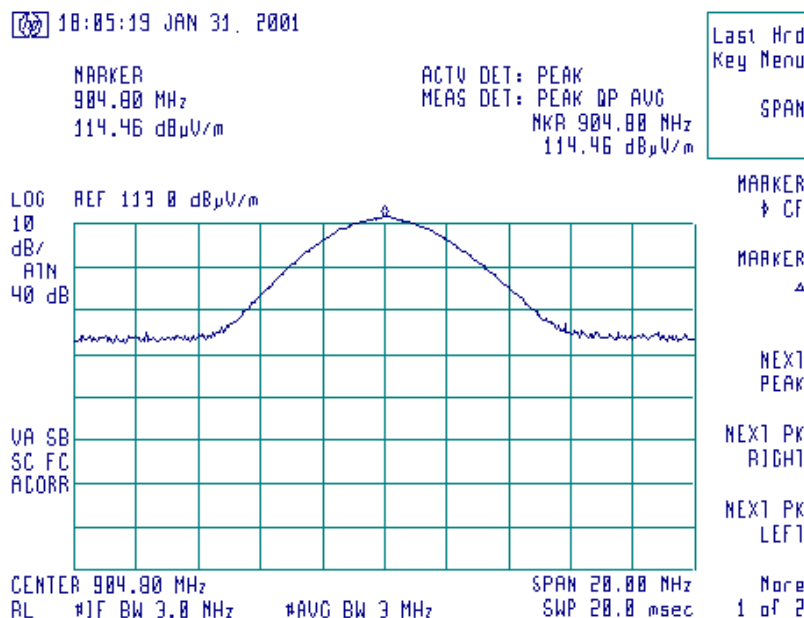
The conversion between effective radiated power and the magnitude of the electric field intensity at a 3 meter distance from the transmitting source are related by:

$$P_t = |E_{dBmV}| - 95.23 \text{ dBm}$$

The reported intentional emissions of the base-station are as follows.

channel 1	114.5 dBuV/m
channel 9	114.1 dBuV/m
channel 13	113.5 dBuV/m

The worst case is channel 1. A graph of the actual test indication is presented below for reference:



The effective radiated power for this worst case emission is:

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$$P_t = 114.5 \frac{dBmV}{m} \bigg|_{r=3m} - 95.23 = 19.27 \text{ dBm}$$

The expected power density at a 20 centimeter distance is:

$$W(r) = \frac{W_t}{4\pi r^2} = \frac{10^{\left(\frac{19.27 \text{ dBm}}{10}\right)} \cdot 10^{-3} \text{ mW}}{4\pi (20 \times 10^{-2} \text{ m})^2} = 168.2 \frac{\text{mW}}{\text{m}^2}$$

Re-normalizing this power density on a per square centimeter basis:

$$W(r) = 168.2 \frac{\text{mW}}{\text{m}^2} \cdot \frac{10^{-4} \text{ m}^2}{\text{cm}^2} = 16.82 \frac{\text{mW}}{\text{cm}^2}$$

The limit for Maximum Permissible Exposure (MPE) given in Table 1 of §1.1310 is given as

$$W_{\max}(r) = \frac{f(\text{MHz})}{1500 \frac{\text{MHz} \cdot \text{cm}^2}{\text{mW}}} = \frac{928 \text{ MHz}}{1500 \frac{\text{MHz} \cdot \text{cm}^2}{\text{mW}}} = 618.7 \frac{\text{mW}}{\text{cm}^2}$$

The base-station uses a Time-Division-Duplex Protocol where the transmitter has a constant duty factor of 50%. Section 2.1091 allows for time averaging of the transmit power for the purposes of the MPE calculations. This fact would reduce the average power to one-half the constantly transmitting value:

$$W(r) = 8.41 \frac{\text{mW}}{\text{cm}^2}$$

Since:

$$W(r) = 8.41 \frac{\text{mW}}{\text{cm}^2} < W_{\max}(r) = 618.7 \frac{\text{mW}}{\text{cm}^2}$$

Therefore, the device in question meets the MPE requirement.

5. The output power needs to be measured with a bandwidth which captures the full power of the signal. A power meter is the preferred

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