RF Exposure Technical Brief ASSESSMENT OF THE XPR MODEL MOBILE RADIO

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This Technical Brief calculates the minimum separation distance from a fixed antenna, connected to the subject mobile radio operated at a fixed station, ensuring that the power density limits listed in RSS-102,[1] Table 4 (uncontrolled environment) and Table 6 (controlled environment), are not exceeded. The analysis is for a typical installation using a fixed antenna.

Within the frequency range that the subject equipment operates (450 MHz – 470 MHz) the power density limits are frequency dependent. Table 1 lists the limits for the lowest and highest operating frequencies. The smaller limit will be used for the separation distance computation.

Table 1 – Applicable Power Density Limits

Frequency	450 MHz	470 MHz
Uncontrolled Environment	1.70 W/m^2	1.75 W/m^2
Controlled Environment	13.70 W/m^2	13.99 W/m^2

Example Minimum Separation Distance Calculations

The example configuration is a single transmit channel site, assuming minimal RF losses, set to zero for this example, between the transmitter output connector and the antenna input connector.

The technical parameters of the RF transmit system and a representative antenna in the example configuration (Commscope DB404-B) are illustrated in Table 2.

Table 2 - Transmitter Configuration

Frequency	450 - 470 MHz
RF Output Power	48 W
RF Network Loss	0 dB
Antenna Gain	5.9 dBi
Antenna Azimuth Beamwidth	360 deg. (Omni)
Antenna Elevation Beamwidth	27 deg.
Antenna Length	1.5 m

[1] Industry Canada (ISED) Spectrum Management and Telecommunications. Radio Standards Specification 102 Radio Frequency (RF) Exposure Compliance of Radiocommunications Apparatus (All Frequency Bands). Issue 5 (2015). Amendment 1 (February 2, 2021)

Tell's cylindrical exposure prediction model[2] is employed to determine the spatially averaged plane-wave equivalent power density parallel to the antenna in the vertical plane, and then multiplied by 2 in order to estimate the peak power density (such an estimate being valid at least one wavelength away from the antenna),[3] using Eq. (1):

$$S_{pk} = 2\frac{P_{net}}{2\pi Rh} = \frac{P_{net}}{\pi Rh} \tag{1}$$

where:

S_{pk} = estimated spatial-peak power density, W/m^2

P_{net} = net input RF power to the antenna, W

R = radial distance from the antenna, m

h = length of the antenna, m

Considering that the maximum wavelength across the operating band is0.67 m, the minimum separation distances for uncontrolled and controlled environments are estimated as follows:

Uncontrolled Environment

$$R = max\left\{\frac{P_{net}}{\pi h S_{pk}}, 0.67\ m\right\} = max\left\{\frac{48}{\pi \cdot 1.5 \cdot 1.70}, 0.67\right\} m = 5.98\ m$$

Controlled Environment

$$R = max\left\{\frac{P_{net}}{\pi h S_{pk}}, 0.67\ m\right\} = max\left\{\frac{48}{\pi \cdot 1.5 \cdot 13.7}, 0.67\right\} m = 0.74\ m$$

[2] US Federal Communications Commission Office of Engineering & Technology, OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 97-01, page 32, Tell's cylindrical model.

[3] R. Cicchetti and A. Faraone, "Estimation of the Peak Power Density in the Vicinity of Cellular and Radio Base Station Antennas," IEEE Transactions on Electromagnetic Compatibility, Vol. 46, No. 2, pp. 275-290, May 2004.