

(1) Co-polar pattern:

$$G_{CO}(\varphi) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda} \varphi \right)^2 \quad \text{for } 0 \leq \varphi < \varphi_m$$

where:

$$\varphi_m = \frac{\lambda}{D} \sqrt{\frac{G_{max} - G_1}{0.0025}}$$

$$G_{max} = 10 \log \left(\eta \left(\frac{\pi D}{\lambda} \right)^2 \right)$$

$$G_1 = 29 - 25 \log \varphi_r, \text{ and } \varphi_r = 95 \frac{\lambda}{D}$$

$$G_{CO}(\varphi) = G_1 \quad \text{for } \varphi_m \leq \varphi < \varphi_r$$

$$G_{CO}(\varphi) = 29 - 25 \log \varphi \quad \text{for } \varphi_r \leq \varphi < \varphi_b \quad \text{where } \varphi_b = 10^{(34/25)}$$

$$G_{CO}(\varphi) = -5 \text{ dBi} \quad \text{for } \varphi_b \leq \varphi < 70^\circ$$

$$G_{CO}(\varphi) = 0 \text{ dBi} \quad \text{for } 70^\circ \leq \varphi < 180^\circ$$

(2) Cross-polar pattern:

$$G_{cross}(\varphi) = G_{max} - 25 \quad \text{for } 0 \leq \varphi < 0.25 \varphi_0$$

where:

$$\varphi_0 = 2 \frac{\lambda}{D} \sqrt{\frac{3}{0.0025}} = 3 \text{ dB beamwidth}$$

$$G_{cross}(\varphi) = G_{max} - 25 + 8 \left(\frac{\varphi - 0.25 \varphi_0}{0.19 \varphi_0} \right) \quad \text{for } 0.25 \varphi_0 \leq \varphi < 0.44 \varphi_0$$

$$G_{cross}(\varphi) = G_{max} - 17 \quad \text{for } 0.44 \varphi_0 \leq \varphi < \varphi_0$$

$$G_{cross}(\varphi) = G_{max} - 17 + C \left| \frac{\varphi - \varphi_0}{\varphi_1 - \varphi_0} \right| \quad \text{for } \varphi_0 \leq \varphi < \varphi_1 \text{ where } \varphi_1 = \frac{\varphi_0}{2} \sqrt{10.1875}$$

$$\text{and } C = 21 - 25 \log(\varphi_1) - (G_{max} - 17)$$

$$G_{cross}(\varphi) = 21 - 25 \log \varphi \quad \text{for } \varphi_1 \leq \varphi < \varphi_2 \text{ where } \varphi_2 = 10^{(26/25)}$$

$$G_{cross}(\varphi) = -5 \text{ dBi} \quad \text{for } \varphi_2 \leq \varphi < 70^\circ$$

$$G_{cross}(\varphi) = 0 \text{ dBi} \quad \text{for } 70^\circ \leq \varphi < 180^\circ$$

where:

D : equivalent antenna diameter

λ : wavelength expressed in the same unit as the diameter

φ : off-axis angle of the antenna relative to boresight (degrees)

η : antenna efficiency = 0.65