

Antenna Vertical Field Interference Calculation

The free-space formula for distance D_l in meters to the main lobe of a dipole with effective radiated power P in watts to a given field strength E in volts/meter is:

$$D_l = \frac{7.01 \sqrt{P}}{E}$$

Manufacturers specify antenna patterns as a series of angles a and relative electrical field strengths f_a . The relative field strength $f = 1.0$ is equivalent to the dipole gain above and the respective distance is denoted here as D_l . Using Ohm's law and realizing that the term (7.01) already accounts for the impedance of free space, the effective radiated power with a relative field strength f_a is:

$$P_a = P(f_a^2)$$

The distance D_a is therefore given by:

$$\begin{aligned} D_a &= \frac{7.01 \sqrt{P f_a^2}}{E} = \left(\frac{7.01 \sqrt{P}}{E} \right) (f_a) \\ D_a &= D_l f_a \\ \frac{D_a}{D_l} &= f_a \end{aligned}$$

Thus given an antenna pattern, once D_l is computed (and it is available from software such as RFree), the distances at each angle of the antenna pattern to the field strength of interest E are trivially available by multiplying D_l by f_a . When the angles a are elevation angles, the vertical component of the distance, D_{av} , from the radiation center to the field strength E is:

$$\frac{D_{av}}{D_l} = f_a \sin a$$

The maximum value of the ratio above for any angle, denoted here as **VDR_{max}** (Vertical Distance Relative maximum) is a simple single number, independent of power or field strength, for characterizing an antenna in terms of its ability to reduce interference in the vertical direction. In this case E is the field strength at the edge of an undesired-to-desired interference zone when considering a non-population interference waiver exhibit.

As an example, an antenna with $VDR_{max} = 0.403$ with an interference distance $D_l = 10$ meters, would reduce the downward interference distance from 10 meters to 4.03 meters in consideration of its vertical field pattern.