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Antenna Vertical Field Interference Calculation

The free-space formula for distance D_1 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:

$$D_1 = \frac{7.01\sqrt{P}}{E}$$

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_1. Using Ohm's law and realizing that the term (7.01) already accounts for the impedence 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:

$$D_a = \frac{7.01\sqrt{P f_a^2}}{E} = \left(\frac{7.01\sqrt{P}}{E}\right)(f_a)$$

$$D_a = D_1 f_a$$

$$\frac{D_a}{D_1} = f_a$$

Thus given an antenna pattern, once D_1 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_1 by f_a. When the angles a are elevation angles, the vertical componenent of the distance, D_{av}, from the radiation center to the field strength E is:

$$\frac{D_{av}}{D_1} = f_a \sin a$$

The maximum value of the ratio above for any angle, denoted here as $\boldsymbol{VDR_{max}}$ (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_1 = 10 meters, would reduce the downward interference distance from 10 meters to 4.03 meters in consideration of its vertical field pattern.