1-8.1.1 Pencil Beam Results of Directivity given Beamwidths

Cardiod pattern $E(\theta) = Cos^N(\theta/2)$ with equal beamwidths in the principal planes as shown in Figure 1-8.1.-1 is converted directivity by the scales below. The program **WIDEDIR** computes directivity in a DOS window given *E*- and *H*-plane beamwidths by using the elliptical approximation of Eq. (1-21).

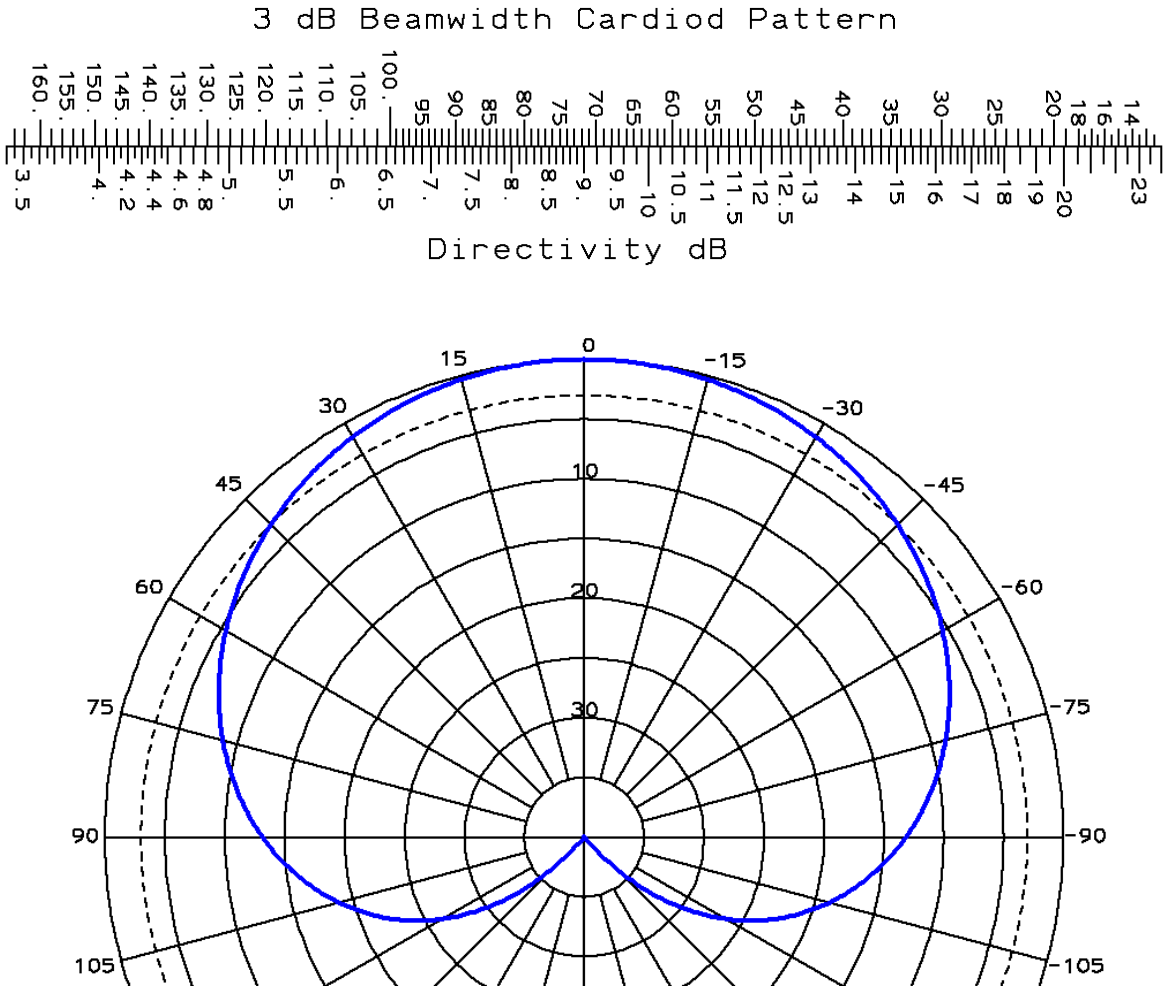
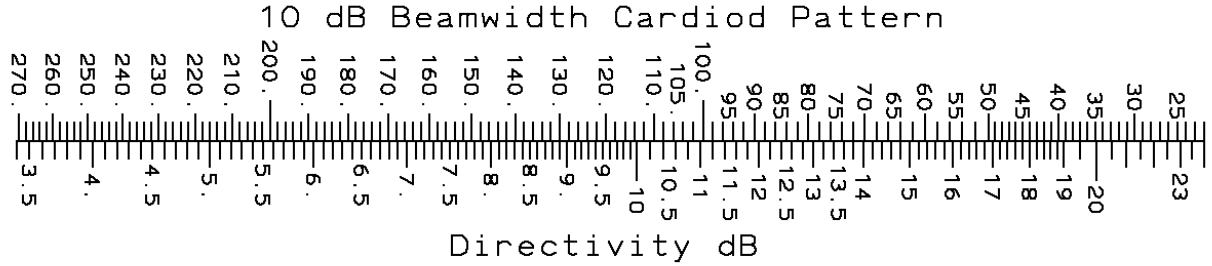


Figure 1-8.1.1-1 Cardiod pattern $E(\theta) = Cos^N(\theta/2)$



Gaussian beam pattern directivity given either 3- or 10-dB beamwidth

The Gaussian beam feed (see Section 7-5) has a more complicated expression that the approximation $E(\theta) = Cos^N(\theta/2)$ and similar looking patterns. However, this feed satisfies the Helmholz equation and gives correct results when using geometry optics analyses for a parabolic reflector. It also has expressions that produce better near-field results. The program **WIDEDIR** computes directivity in a DOS window given *E*- and *H*-plane beamwidths by using the elliptical approximation of Eq. (1-21).

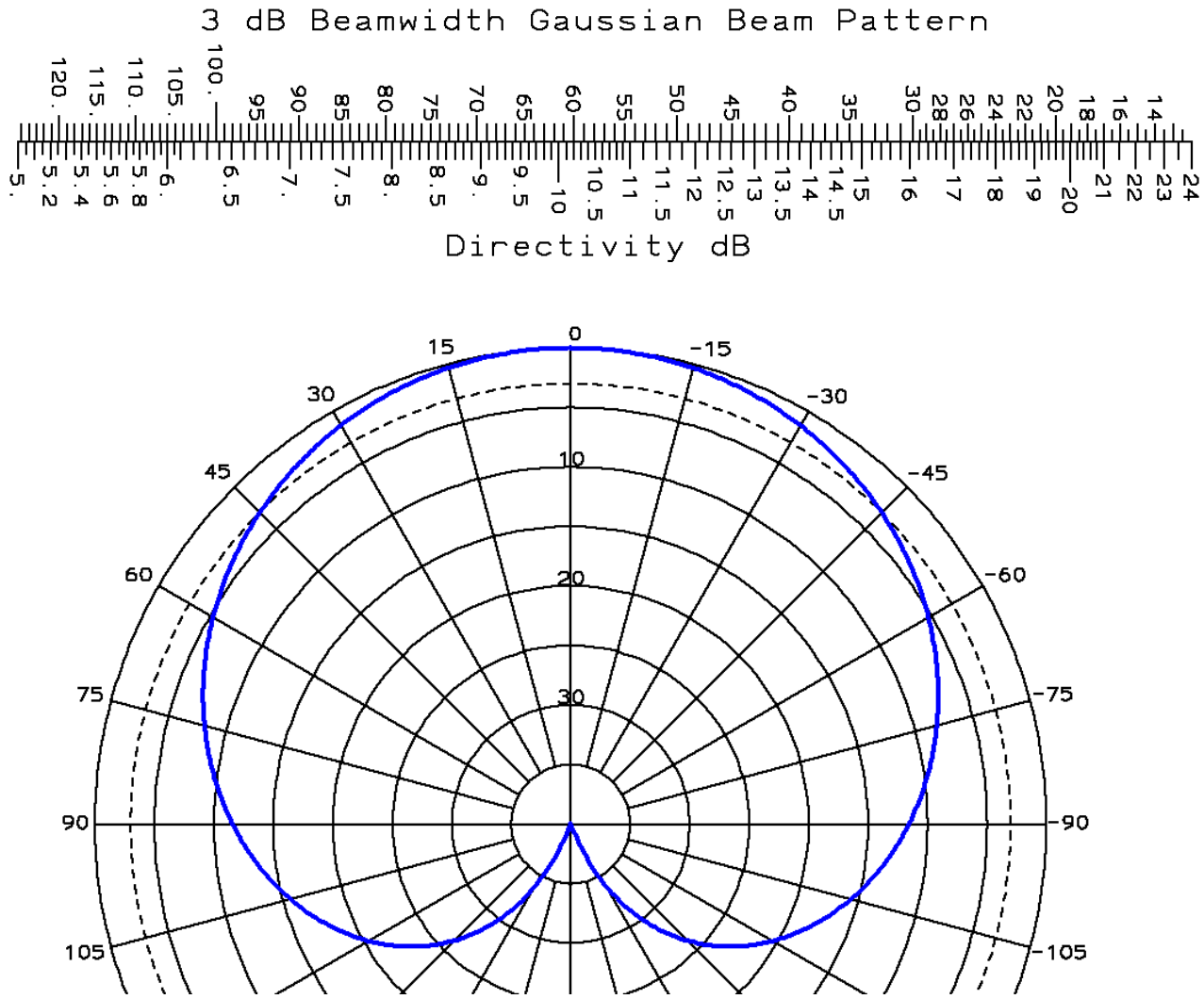


Figure 1-8.1.1-2 Gaussian Beam pattern

Cardiod Pattern with *E*-plane Null (Dipole)

Many antennas produce patterns with a null at $\theta = 90°$ because they are constructed using dipoles or resonant loops. This approximation includes this null.

70° *E*-plane Beamwidth, 100° *H*-plane Beamwidth

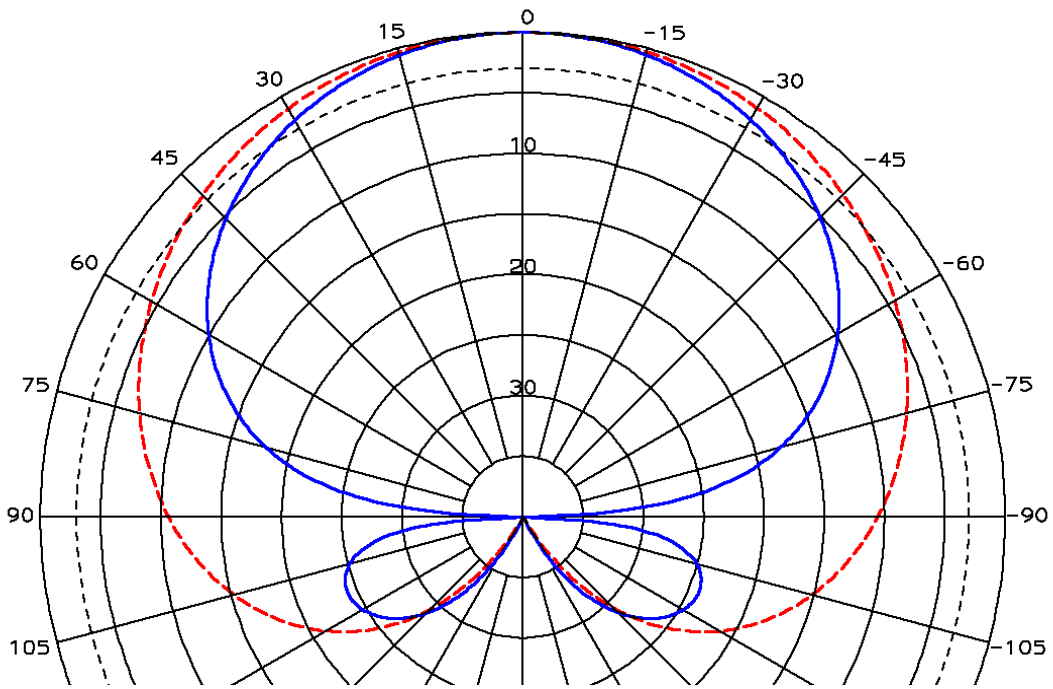


Figure 1-8.1.1-3 Cardiod Beam with *E*-plane Null pattern

Pattern Approximation:

$$E(\theta) = \cos^{N_E}(\theta/2)\cos(\theta) \quad \text{E-plane}$$

$$E(\theta) = \cos^{N_H}(\theta/2) \quad \text{H-plane}$$

E-plane exponent given beamwidth and beamwidth level:

$$N_E = \frac{-Lvl(dB) - 20Log[\cos(beamwidth_{Lvl(dB)} / 2)]}{20Log[\cos(beamwidth_{Lvl(dB)} / 4)]}$$

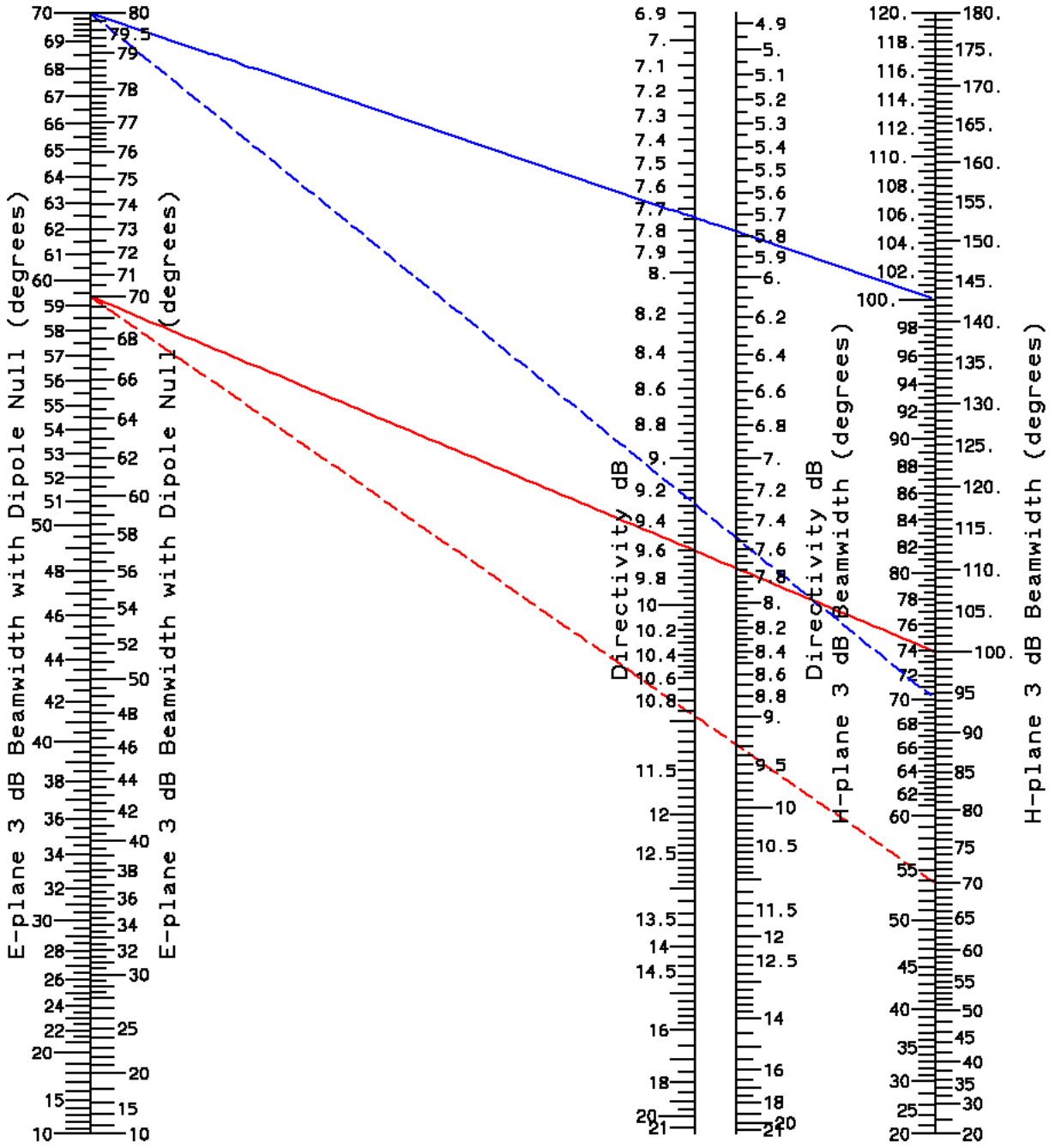
H-plane exponent given beamwidth and beamwidth level:

$$N_H = \frac{-Lvl(dB)}{20Log[\cos(beamwidth_{Lvl(dB)} / 4)]}$$

Directivity (Gain) given exponents:

$$Directivity(ratio) = \frac{2}{\frac{1}{N_E + 1} + \frac{4}{N_E + 2} + \frac{4}{N_E + 2} + \frac{1}{N_H + 1}}$$

Use routine **WIDEDDIR** to compute directivity from beamwidths in DOS window



Red example lines use right scales and Blue example lines use left scales

Figure 1-8.1.1-4 Cardiod Beam with *E*-plane Null pattern Directivity Nomograph

$\text{Cos}^N(\theta)$ pattern with equal beamwidths in the principal planes

This pattern is often used as a feed for a parabolic reflector. This pattern only radiates above $\theta = 90°$ with a null in all planes at $\theta = 90°$. The pattern has a higher directivity for the same beamwidths than the ones given above. The program **WIDEDIR** computes directivity in a DOS window given *E*- and *H*-plane beamwidths by using the elliptical approximation of Eq. (1-21).