TECHNICAL RECOMMENDATIONS

DTH Antenna Gain Pattern Mask

This technical recommendation defines the antenna gain pattern mask for DTH reception of ASTRA satellite signals operating in the Ku band. The frequency range in which the antenna shall operate is between 10.70 GHz and 12.75 GHz. The polarisation is orthogonal linear.

The reference antenna gain pattern mask depends on the frequency and must be fulfilled for frequencies in the specified frequency range. Some parts of the mask are relative to the on-axis gain and some others are absolute values.

The required antenna reflector diameter is dependent upon the satellite transponder coverage, the geographical location of the reception antenna and the transponder mode of operation. SES ASTRA footprint maps provide the required nominal antenna diameters.

DTH Antenna Gain Pattern Mask Example

The following figure shows an example of an antenna gain pattern mask for receiving an 11.70 GHz signal with a nominal antenna diameter of 60 cm and a co-polar on-axis gain of 36 dBi.

The co-polar on-axis gain is an input parameter, which is used for the upper limit in the main lobe area. The chosen gain value of 36 dBi is higher than what is expected in practice, but is used here for better understanding the meaning of the upper and lower limits of the co-polar gain.

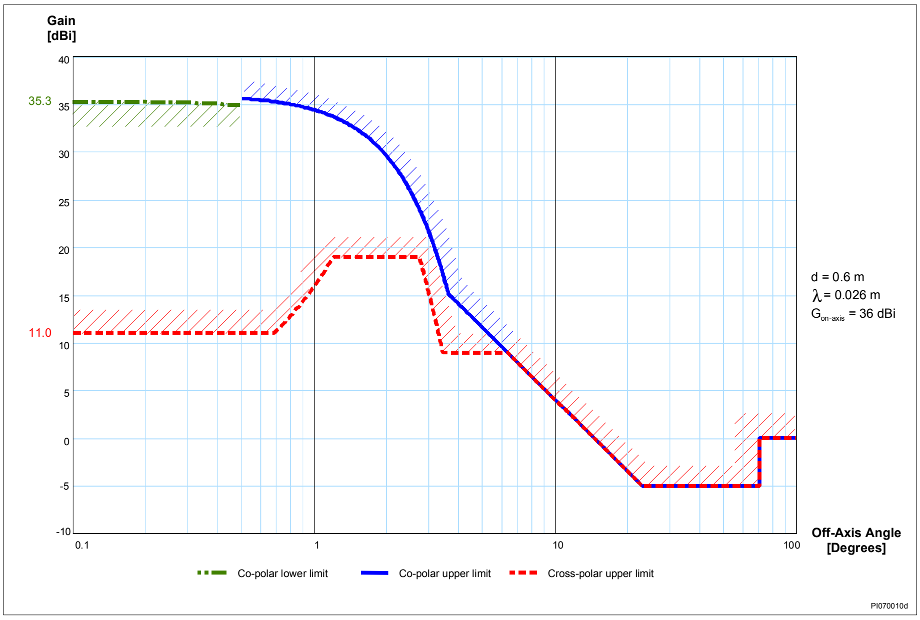

Figure 1: DTH Antenna Gain Pattern Mask Example

Equations

Variables

Φ	Off-axis angle.
$G(\Phi)$	Co-polar gain at particular off-axis angle.
$G_x(\Phi)$	Cross-polar gain at particular off-axis angle.
$G_{on-axis}$	Co-polar on-axis gain.
$G_{min\,on-axis}$	Minimum co-polar on-axis gain.
d	Nominal antenna diameter (This is not the actual reflector diameter of the antenna).
λ	Wavelength.

Units

Angle, gain and length respectively in degree, dBi and meter.

Co-polar Mask

If $0 \le \Phi < 0.5$ then $G(\Phi) \ge G_{min\,on-axis} - 0.00295 \times (\Phi \times \frac{d}{\lambda})^2$

If $0.5 \le \Phi < \Phi_m$ then $G(\Phi) \le G_{on-axis} - 0.00295 \times (\Phi \times \frac{d}{\lambda})^2$

If $\Phi_m \le \Phi < \Phi_r$ then $G(\Phi) \le G_1$

If $\Phi_r \le \Phi < \Phi_b$ then $G(\Phi) \le 29 - 25 \times \log \Phi$

If $\Phi_b \le \Phi < 70$ then $G(\Phi) \le -5$

If $70 \le \Phi < 180$ then $G(\Phi) \le 0$

With:

$$G_{min\,on-axis} = 34.5 + 20 \times \log\left(\frac{0.0467 \times d}{\lambda}\right)$$

$$\Phi_r = 85 \times \frac{\lambda}{d}$$

$$G_1 = 29 - 25 \times \log \Phi_r$$

$$\Phi_m = \sqrt{\frac{G_{on-axis} - G_1}{0.00295}} \times \left(\frac{\lambda}{d}\right)$$

$$\Phi_b = 10^{\frac{34}{25}}$$

Cross-polar Mask

If $\Phi < \Phi_1$ then $G_x \le G_{on-axis} - 25$

If $\Phi_1 \le \Phi < \Phi_2$ then $G_x(\Phi) \le G_{on-axis} - 25 + 40 \times \frac{\Phi - 0.25 \times \Phi_0}{0.95 \times \Phi_0}$

If $\Phi_2 \le \Phi < \Phi_0$ then $G_x \le G_{on-axis} - 17$

If $\Phi_0 \le \Phi < \Phi_3$ then $G_x(\Phi) \le G_{on-axis} - 17 - 40 \times \left(\frac{\Phi}{\Phi_0} - 1\right)$

If $\Phi_3 \le \Phi < \Phi_x$ then $G_x \le G_{on-axis} - 27$

If $\Phi_x \le \Phi < 180$ then $G_x(\Phi) \le G(\Phi)$

With:

$$\Phi_0 = 2 \times \sqrt{\frac{3}{0.00295}} \times \left(\frac{\lambda}{d}\right)$$

$$\Phi_1 = 0.25 \times \Phi_0$$

$$\Phi_2 = 0.44 \times \Phi_0$$

$$\Phi_3 = 1.25 \times \Phi_0$$

$$\Phi_x = 10^{\frac{29+27-G_{on-axis}}{25}}$$

Cross-polar Discrimination

$G(\Phi) - G_x(\Phi) \ge 25$ within the –1 dB $G(\Phi)$ contour.