RECOMMENDATION ITU-R BO.1213-1

Reference receiving earth station antenna pattern for the broadcasting-satellite service in the 11.7-12.75 GHz band

(Question ITU-R 73/6)

(1995-2005)

Scope

This Recommendation intends to establish reference earth station co-polar and cross-polar antenna patterns for the broadcasting-satellite service (BSS) in the 11.7-12.75 GHz band.

The ITU Radiocommunication Assembly,

considering

a)   that a common reference antenna pattern was used at WRC-97 and WRC-2000 for revising the Regions 1 and 3 broadcasting-satellite service (BSS) Plan;

b)   that this same reference antenna pattern was used at WRC-03 for revising the inter and intraregional/inter- and intraservice sharing criteria contained in Appendix 30 of the Radio Regulations (RR);

c)   that data from measurements of BSS receiving antennas support this same reference antenna pattern[1];

d)   that this same reference antenna pattern may be useful for interservice sharing between the BSS and other services and for other coordination purposes,

recommends

1   that the co-polar and cross-polar antenna patterns given by formulae provided in Annex 1 should be recognized as reference earth station antenna patterns for the BSS in the 11.7-12.75 GHz band.

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[1]   It should be noted that the antenna measurements were performed on single-feed antennas.

Annex 1

Antenna pattern formulae:

These formulae are valid for $D/\lambda \geq 11$:

Co-polar pattern:

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

where:

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

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

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

$G_{co}(\varphi) = G_1$	for $\varphi_m \leq \varphi < \varphi_r$
$G_{co}(\varphi) = 29 - 25\log\varphi$	for $\varphi_r \leq \varphi < \varphi_b$ where $\varphi_b = 10^{(34/25)}$
$G_{co}(\varphi) = -5$ dBi	for $\varphi_b \leq \varphi < 70°$
$G_{co}(\varphi) = 0$ dBi	for $70° \leq \varphi < 180°$

Cross-polar pattern:

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

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

$$= 3\text{ dB beamwidth}$$

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

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

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

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

$G_{cross}(\varphi) = 21 - 25\log\varphi$	for $\varphi_1 \leq \varphi < \varphi_2$ where $\varphi_2 = 10^{(26/25)}$
$G_{cross}(\varphi) = -5$ dBi	for $\varphi_2 \leq \varphi < 70°$
$G_{cross}(\varphi) = 0$ dBi	for $70° \leq \varphi < 180°$

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* The value of C must be less than 0 for any combination of antenna efficiency (η) and D/λ.

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.

Examples:

For the 60 cm reference antenna pattern used at WRC-03 for revising the interregional/interservice sharing criteria contained in RR Appendix 30, the following parameters apply:

Co-polar:

G_{max} = 35.5 dBi

η = 0.65

D/λ = 23.4 (assumed frequency is 11.7 GHz)

φ_m = 3.98°

φ_r = 4.06°

G_1 = 13.78 dB

φ_b = $10^{(34/25)}$
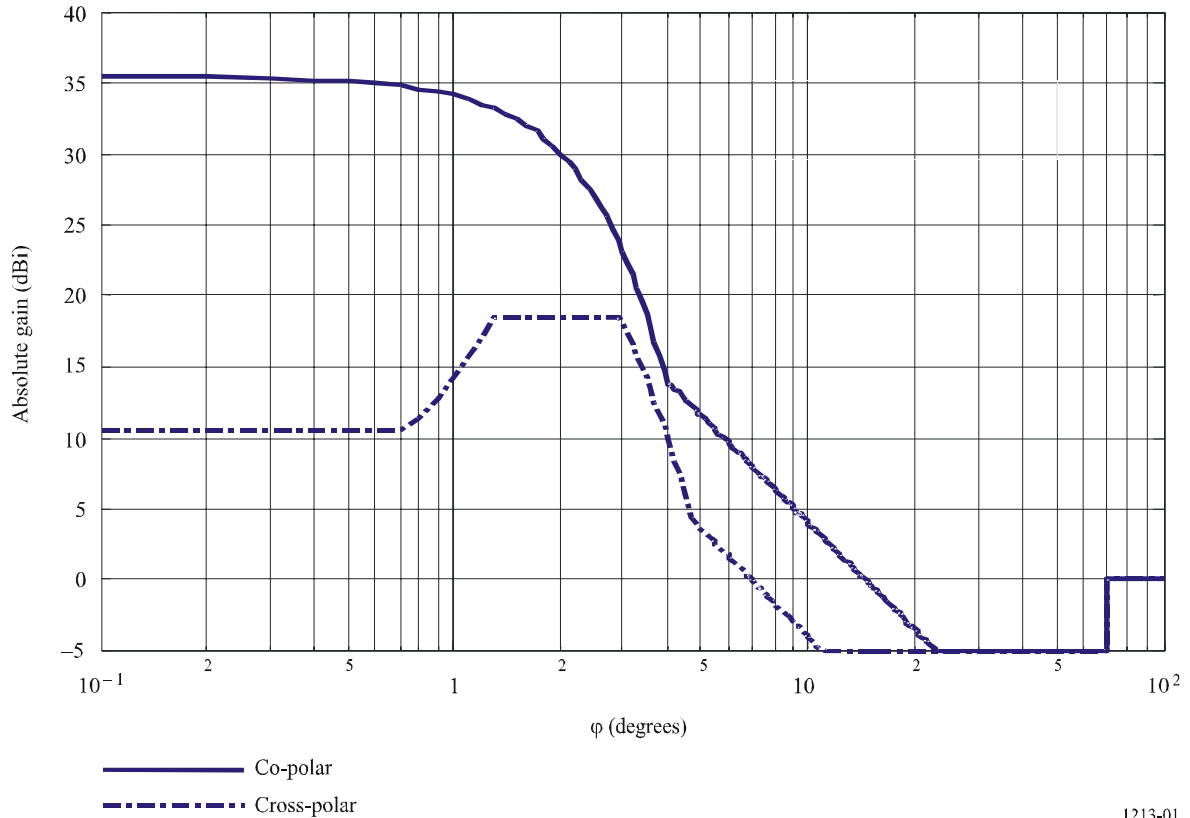
Cross-polar:

φ_0 = 2.96°

φ_1 = 4.73°

φ_2 = 10.96°

C = −14.36 dB

The corresponding reference antenna pattern is given in Fig. 1.

FIGURE 1

60 cm antenna: reference receiving earth station antenna patterns

Co-polar

Cross-polar

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For the 45 cm reference antenna pattern used at WRC-03 for revising the interregional/interservice sharing criteria contained in RR Appendix 30, the following parameters apply:

Co-polar:

G_{max} = 33.3 dBi

η = 0.65

D/λ = 18.3 (assumed frequency is 12.2 GHz)

φ_m = 5.15°

φ_r = 5.19°

G_1 = 11.12 dB

φ_b = $10^{(34/25)}$

Cross-polar:

φ_0 = 3.79°

φ_1 = 6.04°

φ_2 = 10.96°

C = −14.83 dB

The corresponding reference antenna pattern is given in Fig. 2.

FIGURE 2

45 cm antenna: reference receiving earth station antenna patterns

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