RECOMMENDATION ITU-R BO.1445

IMPROVED PATTERNS FOR FAST ROLL-OFF SATELLITE TRANSMIT ANTENNAS OF THE REGIONS 1 AND 3 BSS PLANS OF RR APPENDIX S30

(Question ITU-R 93/11)

(2000)

The ITU Radiocommunication Assembly,

considering

a) that Resolution 532 (WRC-97) (World Radiocommunication Conference (Geneva, 1997)) invites ITU-R to study the possibilities to improve the efficiency of the Appendix S30 Plan of the RR by taking due account of the technical progress;

b) that the existing RR Appendix S30 Regions 1 and 3 satellite transmitting antenna patterns with roll-off in the main beam can be improved to reflect technical progress;

c) that the use of antennas with improved radiation patterns will lead to a more efficient use of the radio spectrum and the GSO,

recognizing

a) that the adoption of improved satellite transmitting antenna patterns with fast roll-off in the main beam does not prevent the use of other antennas that have been coordinated or will be coordinated in the future on the basis of different patterns;

b) that the next competent conference may include these patterns into Annex 5 of RR Appendix S30,

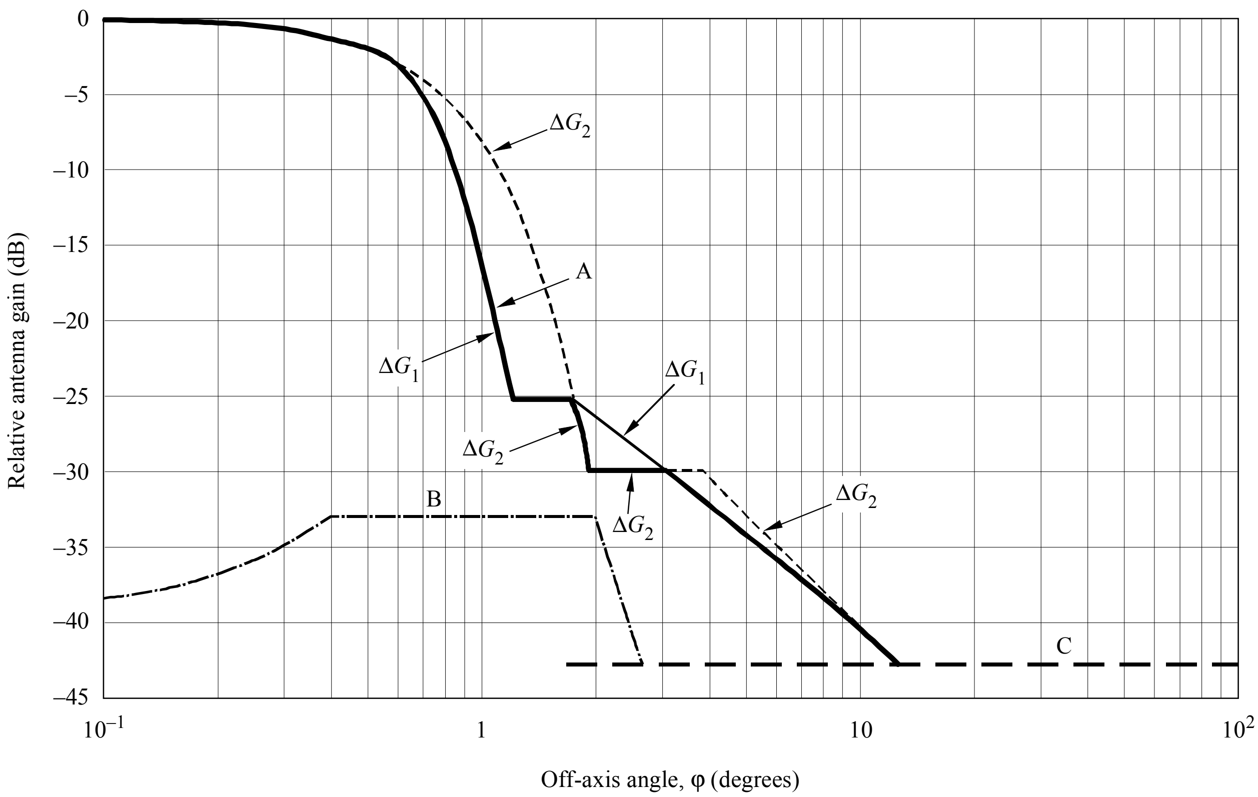
recommends

1 to use the improved satellite antenna co-polar and cross-polar patterns with fast roll-off in the main beam as provided in Annex 1, for elliptical beams of fast roll-off when such fast roll-off antenna is required, e.g. in studies in accordance with Resolution 532 (WRC-97).

ANNEX 1

FIGURE 1

Improved fast roll-off satellite transmitting antenna patterns for Regions 1 and 3



Regions 1 and 3 transmitting fast roll-off co-polar (Curve ΔG_1)

Improved fast roll-off co-polar (Curve A defined as ΔG below)

Regions 1 and 3 transmitting co-polar (Curve ΔG_2)

Improved fast roll-off cross-polar (Regions 1 and 3 transmitting cross-polar) (Curve B)

Curve C (minus the on-axis gain)

Note 1 – The diagram gives the example curves in case of a satellite antenna beamwidth of $\varphi_0 = 1.2°$ (circular).

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Curve A: co-polar relative gain $\Delta G = \min(\Delta G_1, \Delta G_2)$ (dB):

where:

$$\Delta G_1 = -12(\varphi/\varphi_0)^2 \qquad \text{for } 0 \le (\varphi/\varphi_0) \le 0.5$$

$$\Delta G_1 = -12\left(\frac{\frac{\varphi}{\varphi_0} - x}{\frac{B_{min}}{\varphi_0}}\right)^2 \qquad \text{for } 0.5 < (\varphi/\varphi_0) \le \left(\frac{1.45}{\varphi_0}B_{min} + x\right)$$

$$\Delta G_1 = -25.3 \qquad \text{for } \left(\frac{1.45}{\varphi_0}B_{min} + x\right) < (\varphi/\varphi_0) \le 1.45$$

$\Delta G_1 = -(22 + 20 \log(\varphi / \varphi_0))$ for $(\varphi/\varphi_0) > 1.45$

$\Delta G_1 = -(G_{on-axis})$ after intersection with Curve C

$\Delta G_2 = -12(\varphi / \varphi_0)^2$ for $0 \le \varphi \le 1.58\ \varphi_0$

$\Delta G_2 = -30$ for $1.58\ \varphi_0 < \varphi \le 3.16\ \varphi_0$

$\Delta G_2 = -(17.5 + 25 \log(\varphi / \varphi_0))$ for $\varphi > 3.16\ \varphi_0$

$\Delta G_2 = -(G_{on-axis})$ after intersection with Curve C

Curve B: cross-polar relative gain (dB):

$-\left(40 + 40 \log\left|\frac{\varphi}{\varphi_0} - 1\right|\right)$ for $0 \le \varphi \le 0.33\ \varphi_0$

-33 for $0.33\ \varphi_0 < \varphi \le 1.67\ \varphi_0$

$-\left(40 + 40 \log\left|\frac{\varphi}{\varphi_0} - 1\right|\right)$ for $\varphi > 1.67\ \varphi_0$

$-(G_{on-axis})$ after intersection with Curve C

Curve C: minus the on-axis gain (Curve C in this Figure illustrates the particular case of an antenna with an on-axis gain of 42.773 dBi)

where:

φ: off-axis angle (degrees)

φ_0: cross-sectional half-power beamwidth in the direction of interest (degrees)

B_{min}: 0.6° for Regions 1 and 3

$x = 0.5\left(1 - \frac{B_{min}}{\varphi_0}\right)$

The relationship between the maximum gain of an antenna and the half-power beamwidth can be derived from the expression:

$$G_{max} = \frac{27\,843}{a\,b}$$

where:

a and *b* are the angles (degrees) subtended at the satellite by the major and minor axes of the elliptical cross-section of the beam; an antenna efficiency of 55% was assumed.