International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BO.1900
(01/2012)

Reference receive earth station antenna pattern for the broadcasting-satellite service in the band 21.4-22 GHz in Regions 1 and 3

BO Series
Satellite delivery

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from http://www.itu.int/ITU-R/go/patents/en where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Recommendations

(Also available online at http://www.itu.int/publ/R-REC/en)

Series	Title
BO	**Satellite delivery**
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R BO.1900

Reference receive earth station antenna pattern for the broadcasting-satellite service in the band 21.4-22 GHz in Regions 1 and 3

(2012)

Scope

This Recommendation provides the reference receiving earth station antenna patterns for the BSS in the band 21.4-22.0 GHz in Regions 1 and 3 for sharing studies.

The ITU Radiocommunication Assembly,

considering

a) the need for detailed information on radiation patterns of receiving earth station antennas for the broadcasting-satellite service (BSS);

b) that the determination of coordination requirements and/or interference assessments between geostationary-satellite systems belonging to the BSS in the band 21.4-22.0 GHz in Regions 1 and 3, as well as between BSS earth stations and other services sharing the same frequency band, significantly depends on the accuracy of reference antenna patterns used in analysis;

c) that measured data in support of an improved receive antenna reference pattern is available;

d) that Recommendation ITU-R S.1717 specifies an electronic data file format for earth station antenna patterns,

recommends

1 that the co-polar and the cross-polar antenna patterns given by formulae provided in Annex 1 should be considered as reference receive earth station antenna patterns for the BSS in the band 21.4-22.0 GHz.

Annex 1

Reference receive earth station antenna patterns for the BSS in the band 21.4-22.0 GHz

Antenna pattern formulae:

These formulae are valid for $D/\lambda \geq 32$[1]:

Co-polar pattern:

$$G_{co}(\varphi) = G_{max} - 2.5\times10^{-3}\left(\frac{D}{\lambda}\varphi\right)^2 \text{ dBi for } 0 \leq \varphi < \varphi_m$$

where:

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

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

$G_{co}(\varphi) = G_1 = 29 - 25\log\varphi_r$ dBi for $\varphi_m \leq \varphi < \varphi_r$ where $\varphi_r = 95\frac{\lambda}{D}$ degrees

$G_{co}(\varphi) = 29 - 25\log\varphi$ dBi for $\varphi_r \leq \varphi < \varphi_b$ where $\varphi_b = 10^{(34/25)}$ degrees

$G_{co}(\varphi) = -5$ dBi for $\varphi_b \leq \varphi < \varphi_c$ where $\varphi_c = 70$ degrees

$G_{co}(\varphi) = 0$ dBi for $\varphi_c \leq \varphi < 180$ degrees

Cross-polar pattern[2]*:*

$G_{cross}(\varphi) = G_{max} - 17$ for $0 \leq \varphi < \varphi_0$ where $\varphi_0 = 2\frac{\lambda}{D}\sqrt{\frac{3}{0.0025}}$ degrees

$= 3$ dB beamwidth

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

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

$G_{cross}(\varphi) = 21 - 25\log\varphi$ for $\varphi_1 \leq \varphi < \varphi_2$ where $\varphi_2 = 10^{(26/25)}$ degrees

$G_{cross}(\varphi) = -5$ dBi for $\varphi_2 \leq \varphi < 70$ degrees

$G_{cross}(\varphi) = 0$ dBi for $70^\circ \leq \varphi < 180$ degrees

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[1] In the band 21.4-22 GHz, the minimum value of D/λ ratios for which antenna measurements were conducted is 32. Further study is needed when using this antenna pattern with antennae having a smaller D/λ ratio.

[2] Further study may be needed to have better characteristics in the vicinity of the boresight.

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

where:

D: circular antenna diameter;[3]

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:

Co-polar:

G_{max} = 38.0 dBi

η = 0.6

D/λ = 32.6

φ_m = 2.79 degrees

φ_r = 2.92 degrees

G_1 = 17.38 dBi

φ_b = $10^{(34/25)}$ degrees

Cross-polar:

φ_0 = 2.13 degrees

φ_1 = 3.39 degrees

φ_2 = $10^{(26/25)}$ degrees

C = –13.25 dB

[3] The mask above is based on measurements on circular reflectors. Additional measurements would be necessary for elliptical antennas.