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| **Radiocommunication Study Groups** |  |
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| Source: Document 4A/TEMP/172  Reference: Document 4A/338  Subject: Questions ITU-R 21/6, ITU-R 22-1/6,  ITU-R 104/6, WRC-12 Agenda item 1.13 | **Annex 7 to Document 4A/368-E** |
| **23 April 2010** |
| **English only** |
| Annex 7 to Working Party 4A Chairman’s Report | |
| WORKING DOCUMENT TOWARDs A PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R BO.[BSS\_ANT\_PATT | |
| Reference receiving earth station antenna pattern for the broadcasting-satellite service in the band 21.4-22 GHz in Regions 1 and 3 | |

Working Party 4A, at its March/April 2010 meeting, received one contribution (Document [4A/338](http://www.itu.int/md/R07-WP4A-C-0338/en)) concerning a reference receiving earth station antenna pattern for the broadcasting-satellite service (BSS) in the band 21.4-22 GHz in Regions 1 and 3. The input contribution also contained a number of measurements of antennas ranging in size from 45 cm to 120 cm in diameter for the purpose of the eventual development of a reference receiving antenna pattern for the BSS in the 21.4-22 GHz band. Currently, there is no established reference receiving earth station antenna pattern in this band. Therefore, Working Party 4A agreed to the creation of a working document towards the eventual development of a new Recommendation for a reference receiving earth station antenna pattern.

Working Party 4A agreed to use the input document as a framework towards a new Recommendation and encourage Administrations to contribute towards the development of a reference receiving earth station antenna pattern in the 21.4-22.0 GHz band and to contribute measurement data in effort to establish a basis for the reference antenna pattern.

The Attachment contains the proposed framework for the reference receiving earth station antenna pattern. Measurement data for antennas is contained in Appendix 1 of the Attachment.

**Attachment**: 1

**Attachment**

WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R BO.[BSS\_ANT\_PATT]

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

(WRC-12 Agenda item 1.13)

Scope

This Recommendation addresses the reference receiving earth station antenna pattern for the BSS in the band 21.4-22.0 GHz in Regions 1 and 3.

The ITU Radiocommunication Assembly,

considering

a)

b)

c)

recommends

**1** that the co-polar antenna pattern given by formulae provided in Annex 1 should be recognized as reference earth station antenna pattern for the BSS in the 21.4-22.0 GHz band.

**2**

Annex 1

Antenna pattern formulae:

These formulae are valid for *D*/λ ≥ [11]:

 dBi for [A] ≤ ϕ < ϕ*m*

*Editor’s Note: A is the lower limit of off axis angle to be applied for the antenna pattern. This value should be specified in the future.*

where:





*Gco* (ϕ)  dBi for ϕ*m* ≤ ϕ < ϕ*r*where *r* =

*Gco* (ϕ)  dBi for *r*  *b* where *b* =

*Gco* (ϕ)  dBi for *b*   *c* where *c* =

*Gco* (ϕ)  dBi for *c*    180º

where:

*D*: equivalent antenna diameter;

λ: wavelength expressed in the same unit as the diameter;

: off-axis angle of the antenna relative to boresight (degrees);

η: antenna efficiency.

*Examples:*

Appendix 1  
  
Measured receiving earth station antenna patterns in the 21GHz band  
for linear and circular polarization

# 1 Conditions for the measurement

The conditions for the measurement of antenna patterns in the 21 GHz band are shown in Table 1.

TABLE 1

The conditions for the measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Antenna type | Reflector and feed horn | | |
| Diameter of the reflector D | 45 cm | 60 cm | 120 cm |
| Focal length of the reflector F | 20.8 cm | 28.2 cm | 56.6 cm |
| Frequency f | 21.7 GHz | | |
| Polarization | Linear (horizontal, vertical) Circular (Right-hand) | | |
| Beamwidth of the feed horn (Linear pol., co-pol.) | 43° (E-plane), 46° (H-plane) | | |
| Planar angle of the antenna in the measurement | 0° (horizontal) | | |

# 2 Measured antenna patterns

The summary of the measured antenna patterns in the 21 GHz band is given in Table 2. In Table 2, it is seen that the antenna gain for each antenna is slightly low (the efficiency lies between 50% - 60%) while the antenna efficiency in the12 GHz band is assumed to be 65% in 2.4.1 of Annex 3 to RR Appendix 30. The efficiency of 60% seems to be more appropriate for the 21 GHz band.

TABLE 2

The summary of the measured antenna gain

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Diameter of the reflector *D* | 45 cm | | | 60 cm | | | 120 cm | | |
| Polarization | H | V | RHC | H | V | RHC | H | V | RHC |
| Antenna gain *Gmax* | 37.95  dBi | 37.85  dBi | 37.95  dBi | 40.45  dBi | 40.65  dBi | 40.25  dBi | 45.55  dBi | 45.35  dBi | 45.25  dBi |

The individual antenna patterns are shown in Fig. 1 (45 cm), Fig. 2 (60 cm) and Fig. 3 (120 cm).

The Co-polar antenna pattern masks based on the Recommendation ITU-R BO.1213 in Figs. 1, 2 and 3 are expressed as follows (Note that the antenna gain G is expressed in dBi and the angle ϕ in degree. and the frequency is 21.7 GHz and the efficiency is assumed to be 60%):

*Gco* ()  *G*1  29 – 25 log *r* for *m*  ϕ < ϕ*r* where   
 and 

If m is less than 1, then this mask applied from 1 degree.

*Gco* ()  29 – 25 log  for *r*  ϕ < ϕ*b* where ϕ*b* = 10(34/25)

*Gco* ()  –5 for *b*    70

*Gco* ()  0 for 70    180

where 0

  3 dB beamwidth

The all measured patterns in Figs. 1, 2 and 3 lie under the antenna pattern masks given by the above equations. The reason why the antenna pattern mask starts from 1 degree instead of 0 degree is that the foreign interference waves come from outside of the boresight. The antenna pattern in Recommendation ITU-R S.580 is also specified from the off axis angle of 1 degree at the minimum.

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| Co-polar pattern (45 cm, H) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 1-1a | FIGURE 1-1b |



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| Co-polar pattern (45 cm, V) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 1-2a | FIGURE 1-2b |



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| Co-polar pattern (45 cm, RHC) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 1-3a | FIGURE 1-3b |



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| Co-polar pattern (60 cm, H) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 2-1a | FIGURE 2-1b |



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| Co-polar pattern (60 cm, V) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 2-2a | FIGURE 2-2b |



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| --- |
| Co-polar pattern (60 cm, RHC) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 2-3a | FIGURE 2-3b |



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| Co-polar pattern (120 cm, H) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 3-1a | FIGURE 3-1b |



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| Co-polar pattern (120 cm, V) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 3-2a | FIGURE 3-2b |



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| Co-polar pattern (120 cm, RHC) (measured vs. example mask based on Recommendation ITU-R BO.1213) |
| FIGURE 3-3a | FIGURE 3-3b |

