



**Recommendation ITU-R RS.1813-1**  
(02/2011)

**Reference antenna pattern for passive sensors operating in the Earth exploration-satellite service (passive) to be used in compatibility analyses in the frequency range 1.4-100 GHz**

**RS Series**  
**Remote sensing systems**

## 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.

## Policy on Intellectual Property Right (IPR)

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
<b>BO</b>	Satellite delivery
<b>BR</b>	Recording for production, archival and play-out; film for television
<b>BS</b>	Broadcasting service (sound)
<b>BT</b>	Broadcasting service (television)
<b>F</b>	Fixed service
<b>M</b>	Mobile, radiodetermination, amateur and related satellite services
<b>P</b>	Radiowave propagation
<b>RA</b>	Radio astronomy
<b>RS</b>	<b>Remote sensing systems</b>
<b>S</b>	Fixed-satellite service
<b>SA</b>	Space applications and meteorology
<b>SF</b>	Frequency sharing and coordination between fixed-satellite and fixed service systems
<b>SM</b>	Spectrum management
<b>SNG</b>	Satellite news gathering
<b>TF</b>	Time signals and frequency standards emissions
<b>V</b>	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 RS.1813-1

**Reference antenna pattern for passive sensors operating in the Earth  
exploration-satellite service (passive) to be used in compatibility  
analyses in the frequency range 1.4-100 GHz**

(2009-2011)

**Scope**

This Recommendation provides a reference antenna pattern for Earth exploration-satellite service (EESS) passive sensors to be used in compatibility studies in the frequency range 1.4-100 GHz when no other information is available on actual sensor antennas.

The ITU Radiocommunication Assembly,

*considering*

- a) that reference satellite antenna patterns, which reflect to the maximum extent possible the actual antenna gain, are desirable for use in compatibility studies in the case of aggregate interference from multiple sources;
- b) that antennas used for spaceborne passive sensors in the Earth exploration-satellite service (EESS) (passive) are usually designed to maximize main beam efficiency and minimize energy received through antenna side lobes;
- c) that the impact of a dominating interference source on single pixel measurements or peak interference assessments may require consideration of maxima in the antenna side lobe pattern,

*noting*

- a) that characteristics of passive sensors operating between 1.4 GHz and 100 GHz have been taken into account for the derivation of the proposed antenna pattern,

*recommends*

**1** that, in the absence of an actual antenna pattern, the following equations for the average antenna pattern of a spaceborne passive sensor should be used, for antenna diameters greater than 2 times the wavelength:

$$G(\varphi) = G_{max} - 1.8 \times 10^{-3} \left( \frac{D}{\lambda} \varphi \right)^2 \quad \text{for } 0^\circ \leq \varphi \leq \varphi_m$$

$$G(\varphi) = \max \left( G_{max} - 1.8 \times 10^{-3} \left( \frac{D}{\lambda} \varphi \right)^2, 33 - 5 \log \left( \frac{D}{\lambda} \right) - 25 \log(\varphi) \right) \quad \text{for } \varphi_m < \varphi \leq 69^\circ$$

$$G(\varphi) = -13 - 5 \log \left( \frac{D}{\lambda} \right) \quad \text{for } 69^\circ < \varphi \leq 180^\circ$$

In the case of  $G(\varphi) < -23$  dBi, the value  $-23$  dBi is to be used, where:

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

$$\varphi_m = \frac{22\lambda}{D} \sqrt{5.5 + 5 \log \left( \frac{D}{\lambda} \eta^2 \right)}$$

$G_{max}$ : maximum antenna gain (dBi)

$G(\varphi)$ : gain (dBi) relative to an isotropic antenna

$\varphi$ : off-axis angle (degrees)

$D$ : antenna diameter (m)

$\lambda$ : wavelength (m)

$\eta$ : antenna efficiency (if  $\eta$  is unknown, 60% can be assumed as a representative value);

2 that in cases where a few interference sources dominate, or where peak interference values are required in the analysis, the following equations for the antenna pattern for spaceborne passive sensors should be used, for antenna diameters greater than 2 times the wavelength:

$$G(\varphi) = G_{max} - 1.8 \times 10^{-3} \left( \frac{D}{\lambda} \varphi \right)^2 \quad \text{for } 0^\circ \leq \varphi \leq \varphi_m$$

$$G(\varphi) = \max \left( G_{max} - 1.8 \times 10^{-3} \left( \frac{D}{\lambda} \varphi \right)^2, 40 - 5 \log \left( \frac{D}{\lambda} \right) - 25 \log(\varphi) \right) \quad \text{for } \varphi_m < \varphi \leq 69^\circ$$

$$G(\varphi) = -6 - 5 \log \left( \frac{D}{\lambda} \right) \quad \text{for } 69^\circ < \varphi \leq 180^\circ$$

In the case of  $G(\varphi) < -23$  dBi, the value  $-23$  dBi is to be used, where:

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

$$\varphi_m = \frac{22\lambda}{D} \sqrt{5.5 + 5 \log \left( \frac{D}{\lambda} \eta^2 \right)}$$


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