



Recommendation ITU-R P.368-10
(08/2022)

**Ground-wave propagation prediction
method for frequencies between
10 kHz and 30 MHz**

P Series
Radiowave propagation



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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 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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**Ground-wave propagation prediction method for frequencies
between 10 kHz and 30 MHz**

(1951-1959-1963-1970-1974-1978-1982-1986-1990-1992-2005-2007-2022)

Scope

This Recommendation provides information on the field strength and its dependence on ground characteristics due to ground-wave propagation at frequencies less than 30 MHz.

Keywords

Ground-wave propagation, Low Frequency, High Frequency

Related ITU-R Recommendations and Handbook

Recommendation ITU-R P.341

Recommendation ITU-R P.525

Recommendation ITU-R P.526

Recommendation ITU-R P.527

Recommendation ITU-R P.684

Recommendation ITU-R P.1321

Handbook on Radiometeorology (Edition 2013)

NOTE – The latest revision/edition of the Recommendation/Handbook should be used.

List of symbols in Annexes 1 and 2

ϵ_r	Relative permittivity
λ	Wavelength
σ	Conductivity
L_b, A_i	Basic transmission loss
E	Field strength
k	Wavenumber
S_i	i^{th} Section
d_i	length of the i^{th} section
σ_i	Conductivity of the i^{th} section
ϵ_i	Permittivity of the i^{th} section
E_R	Field strength calculated from receiver
E_T	Field strength calculated from transmitter
E_X	Field strength on mixed path