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IEEE Guide for Measurements of Electromagnetic Properties of Earth Media

IEEE Antennas and Propagation Society

Developed by the
Antennas and Propagation Standards Committee

IEEE Std 356™-2020
(Revision of IEEE Std 356-2010)

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Approved 24 September 2020

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Abstract: Measurements of the electrical properties of naturally occurring solids are covered in the scope of this guide. Not covered are methods that rely on mapping earth structure anomalies unless directly related to electrical properties. Coverage of numerical methods for forward/inverse modeling is limited.

Keywords: conductivity, earth materials, electromagnetic measurement techniques, IEEE 356™, permittivity, resistivity

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Participants

At the time this guide was submitted to the IEEE SA Standards Board for approval, the Measurement of Electromagnetic Properties of Earth Media Working Group had the following membership:

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The following members of the individual Standards Association balloting group voted on this guide. Balloters may have voted for approval, disapproval, or abstention.

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Introduction

This introduction is not part of IEEE Std 356-2020, IEEE Guide for Measurements of Electromagnetic Properties of Earth Media.

This guide represents a total rewrite of IEEE Std 356-1974, IEEE Guide for Radio Methods of Measuring Earth Conductivity [B8], which had been prepared by J. T. deBettencourt, D. Davidson, and J. R. Wait.[1] Prior attempts to revise this guide by committees led by Dr. John Cavanaugh and Mr. George Hagn were merged into IEEE Std 356-2001. This latest version was prepared by a subcommittee of the Antennas and Propagation Standards Committee (APSC) of the IEEE Antennas and Propagation Society, chaired by Prof. Vikass Monebhurrun of CentraleSupélec. The individuals with primary responsibility for this version as well as those who contributed or made useful comments are acknowledged in the participants' section. An invitation is extended to users of the guide to contribute to the next revision whenever they see deficiencies or have ideas for an improvement by communicating with the APS/SC Chair via email.[2]

The current guide covers the theory, field methodology/measurement techniques, suggestions for further reading, and a list of references for each of the several field and laboratory techniques covered. The frequency range of applicability and the geographical extent of applicability are indicated.

The current version of this standard retains the same number, IEEE Std 356, and is a guide that describes recommended practices rather than a standard in the strict sense of the word. It is designed to be of use to those who plan and/or make laboratory and/or field measurements of the macroscopic electromagnetic parameters (i.e., the effective conductivity in S/m, and the effective relative permittivity ε_r) of earth media including surface soil, rocks, and ice.

[1] The numbers in brackets correspond to those of the bibliography in Annex B.

[2] Contact the APS/SC Chair at vikass.monebhurrun@centralesupelec.fr.

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IEEE Guide for Measurements of Electromagnetic Properties of Earth Media

1. Overview

1.1 Scope

The scope of the project is to cover measurements of the electrical properties of naturally occurring solids. Not covered are methods that rely on mapping earth structure anomalies unless directly related to electrical properties. There is limited coverage of numerical methods for forward/inverse modeling.

1.2 Purpose

This document is needed for ground plane assessment for locating antennas; formation mapping to obtain geological information; assessment of ore-grade quality; moisture content, salinity; propagation prediction and studies; aquifer studies for water search, nuclear waste disposal, dam location; ground-penetrating radar research; prospecting.

1.3 Word usage

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The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

[3] The use of the word *must* is deprecated and cannot be used when stating mandatory requirements, *must* is used only to describe unavoidable situations.
[4] The use of *will* is deprecated and cannnot be used when stating mandatory requirements, *will* is only used in statements of fact.