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IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes (Excluding Antennas) from 9 kHz to 40 GHz

IEEE Electromagnetic Compatibility Society

Sponsored by the
Standards Development Committee

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USA

IEEE Std 1309™-2013
(Revision of
IEEE Std 1309-2005)

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Abstract: Consensus calibration methods for electromagnetic (EM) field sensors and probes are provided. Data recording and reporting requirements are given, and methods for estimating measurement uncertainty are specified.
Keywords: calibration, electric field measurement, electromagnetic, field probe, field sensor, IEEE 1309™, instrumentation measurement uncertainty

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Introduction

This introduction is not part of IEEE Std 1309-2013, IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes (Excluding Antennas) from 9 kHz to 40 GHz.

This standard provides calibration methods for electromagnetic (EM) field sensors and probes, excluding antennas *per se*, for the frequency range of 9 kHz to 40 GHz. The original version of this standard was developed and released in 1996 in response to need within the electromagnetic compatibility (EMC) test and measurement community for standard (consensus) methods of calibration for commonly used EM field sensors and probes. The 2005 version of the standard provided updates to the original 1996 version to clarify items that some users may have found difficult to understand, to expand details and examples with respect to estimating and expressing calibration uncertainty, and to present additional technical background information. Also, the 2005 version inserted calibration methods for field probes used for specific types of commercial electronic products radiated immunity testing i.e., IEC 61000-4-3:2006 [B48][a], and H-field probe calibrations applicable for ANSI C63.19-2007 [B3] hearing aid and wireless communication device compatibility testing. The 2013 version of the standard consolidates field generation setups and calculation methods with test methods specified in probe calibrations for typical commercial electronics products radiated immunity setups, and improves consistency in primary field calculations, especially for TEM cells. The 2013 version also adds specific guidance about calculating measurement uncertainties for TEM cell and Helmholtz coil methods. A new section is now included on minimizing measurement uncertainties during end uses of calibrated probes. An informative annex is introduced with basic information about probe types and uses for measuring various types of signals. Other changes include new definitions of probe alignment with respect to the incident electromagnetic field, and extraction of subclauses about grades of calibrations and time domain calibration procedures, due to their limited and specific applications of these subjects.

This standard provides calibration methods that are appropriate to various frequency ranges and user requirements. Methods for creating standard electric and magnetic fields used for calibration are presented. Because the specific calibration needs for a particular field probe or sensor depend on its intended use, guidelines to specify and communicate calibration requirements are provided. This standard also provides details for estimating and expressing calibration measurement uncertainties.

[a] Numbers in brackets correspond to the numbers of the bibliography in Annex F.

Contents

IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes (Excluding Antennas) from 9 kHz to 40 GHz

1. Overview

1.1 Scope

This standard includes calibration methods for electromagnetic field sensors and probes, excluding antennas per se, for the frequency range from 9 kHz to 40 GHz. The standard defines the characteristics, use and measurement uncertainties for electromagnetic field sensors and field probes. Areas described include: anisotropy effects, temperature effects, probe linearity effects, modulation effects, source and conductor proximity (near-field) effects, response in multi-frequency fields, partial- vs. full-immersion of probe/meter, non-purity and harmonic field effects caused by amplifiers. Specific instructions are provided for proper calibration of probes for different applications.

1.2 Purpose

This standard provides consensus calibration methods for electromagnetic field sensors and probes. Calibration organizations and other users need uniform calibration methods to obtain consistent results. The