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IEEE Guide for Application of Optical Instrument Transformers for Protective Relaying

IEEE Power and Energy Society

Sponsored by the
Power System Relaying Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

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IEEE Guide for Application of Optical Instrument Transformers for Protective Relaying

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Abstract: Guidance is offered on the application and use of optical voltage and current sensor systems for protective relaying, covering the selection, installation, testing, and operation of sensors. Information is provided on optical voltage and current-sensing technologies, and a number of performance parameters including: accuracy, bandwidth, noise, stability, and impact of temperature and vibration. Also covered are interface requirements of optical sensor systems, a number of their applications, relevant installation and commissioning, testing, reliability, and redundancy matters, as well as a comprehensive treatment of the relevant industry standards.

Keywords: bandwidth, current sensor, current transformer, fiber optics, IEEE C37.241™, instrument transformer, optical sensors, precision time protocol, voltage sensor, voltage transformer

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

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Introduction

This introduction is not part of IEEE Std C37.241–2017, IEEE Guide for Application of Optical Instrument Transformers for Protective Relaying.

Optical sensor technology for measurement of voltage and current in high-voltage electric power systems has been demonstrated for over 20 years. These sensors use optics and electronics to achieve accuracy, linearity, dynamic range, and efficient installation far beyond the capabilities of familiar electromagnetic and capacitive instrument transformers. Industrial products have been available for most of that time, with a widening array of choices and manufacturers. However, the industry transition to new sensors has been gradual, mostly due to the familiarity and reliability of conventional instrument transformers. Accordingly, the objective of this guide is to provide the reader with a factual understanding of the technical and practical bases for choosing optical instrument transformers (OITs) when familiar sensor technologies remain widely available.

This guide provides information on technologies of optical voltage and current sensors, their performance characteristics, their incorporation in measurement systems for protection and control, installation and maintenance requirements, testing requirements, and application considerations. It also provides information on reliability and redundancy matters, as well as the relevant industry standards.

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IEEE Guide for Application of Optical Instrument Transformers for Protective Relaying

1. Overview

1.1 Scope

This document provides a guide that covers the use of optical voltage and current sensor systems for protective relaying—including selection, installation, testing, and operations.

1.2 Purpose

This document is intended to provide guidance in the application and selection of optical instrument transformers for protective relaying.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI/NCSL Z540-1, Calibration laboratories and measuring and test equipment—General requirements.[1]

IEC 60044-7, Instrument transformers, Part 7: Electronic voltage transformers.[2]

IEC 60044-8, Instrument transformers, Part 8: Electronic current transformers.

IEC 61850-9-2, Communication networks and systems in substations—Part 9–2: Specific communication service mapping (SCSM)—sampled values over ISO/IEC 8802-3.

IEC 61869-6, Instrument transformers, Part 6: Additional general requirements for low-power instrument transformers.

IEC 61869-9, Instrument transformers, Part 9: Digital interface for instrument transformers.

[1]ANSI publications are available from the American National Standards Institute (http://www.ansi.org/).
[2]IEC publications are available from the International Electrotechnical Commission (http://www.iec.ch) and the American National Standards Institute (http://www.ansi.org/).