

IEEE Guide for Methods of Power-Factor Measurement for Low-Voltage (1000 V AC or lower) Inductive Test Circuits

IEEE Power and Energy Society

Sponsored by the
Switchgear Committee

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

IEEE Std C37.26™-2014
(Revision of
IEEE Std C37.26-2003)

Currently in preview, click buy full version

IEEE Guide for Methods of Power-Factor Measurement for Low-Voltage (1000 V AC or lower) Inductive Test Circuits

Sponsor

Switchgear Committee
of the
IEEE Power and Energy Society

Approved 21 August 2014

IEEE-SA Standards Board

Abstract: Methods for determining the value of the power factor for inductive low-voltage (1000 V ac and lower) test circuits are provided. These methods are used in determining the power factor during short-circuit current tests in high-power laboratories. It is preferred that these methods be used during short-circuit current testing. Alternatively, other methods (including use of computerized or digital techniques) may be used, but the method used shall have been validated as producing results equivalent to those obtained using the methods in this guide. The methods described are intended for use in low-voltage test circuits (under 1000 V ac) but may also be used for higher voltages.

Keywords: IEEE C37.26™, inductive test circuits, power factor

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

Copyright © 2014 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 3 October 2014. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-0-7381-9326-7 STD98799
Print: ISBN 978-0-7381-9327-4 STDPD98799

IEEE prohibits discrimination, harassment, and bullying.

For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html>.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Standards Documents.”

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE-SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”) which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at <http://ieeexplore.ieee.org/xpl/standards.jsp> or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at <http://standards.ieee.org>.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <http://standards.ieee.org/findstds/errata/index.html>. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at <http://standards.ieee.org/about/sasb/patcom/patents.html>. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, on reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this IEEE guide was completed, the IEEE C37.26 Working Group had the following membership:

T. W. Olsen, Chair
Keith Flowers, Vice Chair

R. Paul Barnett
Douglas J. Edwards

Louis Grahor
Randall Groves

Chad Kennedy
Albert Livshitz

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

R. Paul Barnhart
William Bloethe
Ted Burse
Carl Bush
William Bush
William Byrd
Eldridge Byron
Gary Donner
Randall Dotson
Douglas J. Edwards
Keith Flowers
Doaa Galal
Louis Grahor
Randall Groves

Ajit Gwal
Gary Heuston
Harry Josten
Laszlo Kadar
John Kay
Yuri Khersonsky
Jim Kulchisky
Chung-Yiu Lam
Albert Livshitz
John McClelland
T. David Mills
Daleep Mohla
Charles Morse

Michael Newman
T. W. Olsen
Amit Patel
Bansi Patel
Ron Peters
Michael Roberts
Richard Rohr
Bartien Sayogo
Nikunj Shah
Michael Swearingen
John Vergis
Yingli Wen
Larry Yonce
Jian Yu

When the IEEE-SA Standards Board approved this guide on 21 August 2014, it had the following membership:

John Kulick, Chair
John Rosdahl, Vice Chair
Rich Hulett, Past Chair
Konstantinos Karachalios, Secretary

Peter Balma
Farooq Bari
Ted Burse
Clint Chaplin
Stephen Duke
Jean-Philippe Faucher
Gary Hoffman

Mike Janezic
Jeffrey Katz
Joseph Koepfinger*
David Law
Hung Ling
Oleg Logvinov
T. W. Olsen
Glenn Parsons

Ron Petersen
Adrian Stephens
Peter Sutherland
Yatin Trivedi
Phil Winston
Don Wright
Yu Yuan

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Dick DeBlasio, *DOE Representative*
Mike Janezic, *NIST Representative*

Michelle Turner
IEEE-SA Content Publishing

Erin Spiewak
IEEE-SA Standards Technical Community

Currently in preview, click buy full version

Introduction

This introduction is not part of IEEE Std C37.26™-2014, IEEE Guide for Methods of Power-Factor Measurement for Low-Voltage (1000 V AC or lower) Inductive Test Circuits.

This guide covers methods used to measure the power factor in low-voltage test circuits. Because the power-factor measurement for high-capacity test circuits is particularly difficult and different methods may yield different results, the methods that are least likely to yield error are recommended in this guide for any particular circuit condition.

This low-voltage guide was originally created and issued in 1972 as a compatible companion to the high-voltage American National Standards Institute (ANSI) C37.05-1964 (R1969), American National Standard Methods for Determining the Values of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage for AC High-Voltage Circuit Breakers, and ANSI C37.5-1969, American National Standard Methods for Determining Values of a Sinusoidal Current Wave, Normal-Frequency Recovery Voltage, and a Guide for Calculation of Fault Currents for Application of AC High-Voltage Circuit Breakers Listed on a Total Current Basis.

The original guide served for many years, as use of the methods in this guide over several decades demonstrated the validity of the methods. It was revised in 2003 with few, if any, fundamental changes. This revision again makes only minor changes, as the underlying physics have not changed. Where possible, references have been changed to undated references (so that the latest revision always applies); to coordinate with this change, references to specific clauses or tables in other standards have been changed to refer to the subject instead of the precise clause number. Changes have also been made in selected word usage.

It is recognized that laboratories may utilize computer-based data acquisition and analysis programs that may calculate values of the test power factor. Such programs should be validated to assure that the results obtained are consistent with values obtained using the methods in this guide.

Contents

1. Overview	1
1.1 Scope	1
1.2 Purpose	2
1.3 Alternative methods.....	2
2. Normative references.....	2
3. Definitions	2
4. Ratio method	3
4.1 General	3
4.2 Procedures for determining the power factor.....	3
5. DC decrement method.....	6
5.1 General	6
5.2 Procedure for determining the power factor	7
6. Phase relationship method.....	8
6.1 General	8
6.2 Procedure for determining the power factor	8
Annex A (informative) Bibliography	10

IEEE Guide for Methods of Power-Factor Measurement for Low-Voltage (1000 V AC or lower) Inductive Test Circuits

IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/IPR/disclaimers.html>.

1. Overview

1.1 Scope

This guide describes three methods used in the measurement of the power factor of inductive low-voltage (1000 V and lower) test circuits. These methods may be used at any frequency; however, the values in the tables are specifically for 60-Hz test circuits. These methods are as follows:

- a) Ratio method
- b) DC decrement method
- c) Phase relationship method

Table 1 lists the preferred methods to be used for different levels of test currents and for different levels of power factor. While this guide is primarily intended for use on low-voltage test circuits, the methods discussed are also usable at higher voltages.