

# IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines

IEEE Power & Energy Society

Sponsored by the  
Power System Relaying Committee

---

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

**IEEE Std C37.104™-2012**  
(Revision of  
IEEE Std C37.104-2002)

6 July 2012

Currently in preview, click buy full version

**IEEE Std C37.104™-2012**

(Revision of  
IEEE Std C37.104-2002)

# **IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines**

Sponsor

**Power System Relaying Committee  
of the  
IEEE Power & Energy Society**

Approved 8 June 2012

**IEEE-SA Standards Board**

**Abstract:** Current reclosing practices for transmission and distribution lines are described. Application considerations and coordination practices of reclosing are also discussed.

**Keywords:** automatic operation, circuit breaker, distribution, IEEE C37.104, reclosing, transmission

---

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

Copyright © 2012 by The Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved. Published 6 July 2012. 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 978-0-7381-7293-4 STD97268  
Print: ISBN 978-0-7381-7345-0 STDPD97268

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.

**Notice and Disclaimer of Liability Concerning the Use of IEEE Documents:** IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. 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.

Use of an IEEE Standard is wholly voluntary. IEEE disclaims liability for any personal injury, property or other damage, of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon any IEEE Standard document.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims any express or implied warranty, including any implied warranty of merchantability or fitness for a specific purpose, or that the use of the material contained in its standards is free from patent infringement. IEEE Standards documents are supplied "AS IS."

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. Every IEEE standard is subjected to review at least every ten years. If 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 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.

**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 the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE. Announcements, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make 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 to ensure that any response 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. Any person who would like to participate in evaluating comments or revisions to an IEEE standard is welcome to join the relevant IEEE working group at <http://standards.ieee.org/develop/wg/>.

Comments on standards should be submitted to the following address:

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

**Photocopies:** Authorization to photocopy portions of any individual standard for internal or personal use is granted by The Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, 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.

## Notice to users

### 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

This document is copyrighted by the IEEE. It is made available 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 this document available for use and adoption by public authorities and private users, the IEEE does not waive any rights in copyright to this document.

### Updating of IEEE 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. 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://standards.ieee.org/index.html> or contact the IEEE at the address listed previously. For more information about the IEEE Standards Association or the IEEE standards development process, visit IEEE-SA Website at <http://standards.ieee.org/index.html>.

### Errata

Errata, if any, for this and all other standards can be accessed 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, with 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.

Currently in preview, click buy full versi

## Participants

At the time this IEEE guide was completed, the D2 Working Group had the following membership:

**Gary L. Kobet**, *Chair*  
**Gregory Sessler**, *Vice Chair*

George Bartok  
Kenneth Behrendt  
Dean Bender  
Martin Best  
Albert N. Darlington  
Alla Deronja  
Dominick Fontana  
Fredric Friend  
Robert Frye  
Gerald Johnson  
Meyer Kao

Don Lukach  
Bruce Mackie  
Walter McCannon  
Michael Meisinger  
Adi Mulawarman  
Pratap Mysore  
James O'Brien  
Russ Patterson  
Claire Patti  
Joe Perez

Ryland Revelle  
Tony Seegers  
Bill Strang  
Charles Sufana  
Philip Tatro  
Quintin Verzosa  
Ilia Voloh  
John Wang  
Phil Waudby  
Thomas Wiedman  
Richard Young

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

William Ackerman  
Satish Aggarwal  
Ali Al Awazi  
Steven Alexanderson  
George Bartok  
David Bassett  
Philip Beaumont  
Kenneth Behrendt  
Steven Bezner  
Stan Billings  
Wallace Binder  
Kenneth Birt  
Thomas Blackburn  
Chris Brooks  
Gustavo Brunello  
Eldridge Byron  
Paul Cardinal  
Stephen Conrad  
James Cornelison  
Randall Crellin  
Randall Cunico  
Kevin Donahoe  
Gary Donner  
Michael Dood  
Ahmed Elmehrik  
Gary Engman  
Dan Evans  
Marcel Fortin  
Fredric Friend  
Doug Galbraith  
Luis Garcia  
David Gilmer  
Mietek Glinkowski  
Jalal Gohari  
Stephen Grier  
Randall Groves  
Wayne Hartmann

Roger Hedding  
Jerry Hohn  
David Horvath  
Joseph Jancauskas  
Gerald Johnson  
Gael Kennedy  
Yuri Khersonsky  
James Kinney  
Gary L. Kobet  
Joseph L. Koepfinger  
Jim Kulchick  
Chung-Yu Liao  
Rahim Laskar  
Alexey Levshitz  
Pedro Lopez  
Greg Luri  
Bruce Mackie  
William McBride  
Walter McCannon  
Michael McDonald  
Nigel McQuin  
Steven Meiners  
Michael Meisinger  
Dean Miller  
Adi Mulawarman  
Jerry Murphy  
R. Murphy  
Arthur Neubauer  
Michael S. Newman  
Joe Nims  
James O'Brien  
Ted Olsen  
Mohamed Omran  
Lorraine Padden  
Mirko Palazzo  
Donald Parker  
Christopher Petrola

Robert Pettigrew  
Farnoosh Rahmatian  
Moises Ramos  
Ryland Revelle  
Michael Roberts  
Charles Rogers  
Bob Saint  
Miriam Sanders  
Bartien Sayogo  
Thomas Schossig  
Tony Seegers  
Gregory Sessler  
Devki Sharma  
Gil Shultz  
James Smith  
Jerry Smith  
Joshua Smith  
Gary Stoedter  
Charles Sufana  
James Swank  
Michael Swearingen  
Richard Taylor  
William Taylor  
Maria Tomica  
Demetrios Tziouvaras  
Eric Udren  
John Vergis  
Quintin Verzosa  
Ilia Voloh  
John Wang  
Solveig Ward  
Yingli Wen  
Kenneth White  
Thomas Wiedman  
Philip Winston  
Richard Young  
Jian Yu

When the IEEE-SA Standards Board approved this guide on 8 June 2012, it had the following membership:

**Richard H. Hulett**, *Chair*  
**John Kulick**, *Vice Chair*  
**Robert M. Grow**, *Past Chair*

Satish Aggarwal  
Masayuki Ariyoshi  
Peter Balma  
William Bartley  
Ted Burse  
Clint Chaplin  
Wael Diab  
Jean-Philippe Faure

Alexander Gelman  
Paul Houzé  
Jim Hughes  
Young Kyun Kim  
Joseph L. Koepfinger\*  
John Kulick  
David J. Law  
Thomas Lee  
Hung Ling

Oleg Logvinov  
Ted Olsen  
Gary Robinson  
Jon Walter Rosdahl  
Mike Seavey  
Yatin Trivedi  
Phil Winston  
Yu Yuan

\*Member Emeritus

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

Richard DeBlasio, *DOE Representative*  
Michael Janezic, *NIST Representative*

Julie Alessi  
*IEEE Standards Program Manager, Document Development*

Soo H. Kim  
*IEEE Client Services Manager, Professional Services*

## Introduction

This introduction is not part of IEEE Std C37.104-2012, IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines.

The art and science of protective relaying for the automatic reclosing of circuit breakers associated with distribution and transmission lines following the clearing of a fault have evolved over many years. This guide is an effort to compile information on the application considerations associated with this practice. The guide presents generally accepted practices for autoreclosing. Its purpose is to describe the methods and considerations associated with situations in which it is desirable to reclose automatically. It is intended for engineers who have a basic knowledge of power system protection. This is an application guide and does not cover all of the requirements for autoreclosing for every situation or protection scheme. Additional reading material is suggested so that the reader can evaluate the application of autoreclosing for the individual situation.

## Contents

1. Overview .....	1
1.1 Scope .....	1
1.2 Purpose .....	1
2. Normative references.....	2
3. Definitions .....	2
4. Fundamentals and applications.....	3
4.1 The autoreclosing function performed by a reclosing relay.....	4
4.2 Autoreclosing nomenclature.....	5
4.3 Autoreclosing circuitry and logic .....	6
4.4 Autoreclosing settings .....	9
4.5 Autoreclosing supervision .....	10
4.6 Autoreclose blocking.....	12
4.7 Application considerations .....	13
4.8 Substation controller.....	19
4.9 SCADA.....	19
5. Autoreclosing for distribution systems.....	19
5.1 Distribution system overview .....	19
5.2 Distribution autoreclosing practices .....	20
5.3 Autoreclosing coordination practices .....	21
5.4 Application considerations .....	25
6. Autoreclosing for transmission systems .....	26
6.1 Transmission systems overview .....	26
6.2 Autoreclosing methods.....	27
6.3 Application considerations .....	30
7. New technologies/special applications.....	44
7.1 Ethernet based applications to autoreclosing.....	44
7.2 Coordination of fast valving and high-speed reclosing .....	45
7.3 Sychrophasor applications .....	46
7.4 Autoreclosing (load restoration) after underfrequency load shedding.....	46
7.5 Point-on-wave (POW) and staggered pole autoreclosing.....	47
7.6 Multi-Phase Autoreclosing (MPAR) .....	47
7.7 Pulseclosing.....	49
Annex A (informative) Bibliography .....	50
Annex B (informative) History of automatic reclosing.....	56
Annex C (informative) Sample method to indicate autoreclosing mode and timing.....	58
Annex D (informative) Index .....	61

# IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines

*IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, 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 documents present practices regarding the application of automatic reclosing control to line circuit breakers. Both transmission and distribution line practices are addressed. The guide is not intended to provide guidance for the operation of the bulk power system in matters of reclosing, such as enabling or disabling automatic reclosing or providing for manual closures following automatic tripping of an element.

### 1.2 Purpose

The guide provides benefits of automatic reclosing and provides application considerations for proper coordination with other system controls (e.g., autosectionalizing, fast-valving, etc). The guide includes a section on emerging technologies (e.g., IEC 61850) and their application to automatic reclosing. Supplementary information is comprised of annexes containing a bibliography of technical literature concerning reclosing as well as a brief history of the use of automatic reclosing.