

Chapter 11

Directional Overcurrent (67) Element Testing

1. Application

Instantaneous overcurrent (50) and time overcurrent (51) protection can protect equipment from overloads and short circuits, but there are situations where their ability to protect a system is limited. Many applications exist where the direction of current is not fixed due to multiple sources and/or parallel feeders that prevent simple overcurrent protection from adequately protecting the electrical system. Directional overcurrent (67) protection only operates if the current flows in a pre-defined direction to provide more selective and sensitive protection.

Previous generations of directional overcurrent protection were limited by the construction materials available at the time and used different connections to determine the operating direction and sensitivity. Some of their operating parameters were based on power elements. Operating times varied depending on the magnitude of current and the measured phase angle compared to the maximum torque angle (MTA). Modern directional (67) elements operate like standard overcurrent elements (50 or 51) with a switch that turns the protection on if the current flows in the trip direction.

The most common directional overcurrent applications are listed below and described in the next few sections.

- A) Parallel Feeders
- B) Transmission Line Ground Protection
- C) Power Flow

Abb Relay Testing Handbook

Chris Werstiuk



Abb Relay Testing Handbook:

The Relay Testing Handbook #1D Chris Werstiuk,2007 As the first of The Relay Testing Handbook series Electrical Fundamentals for Relay Testing contains the underlying electrical theory that all relay testers should understand This information provides a foundation that all other handbooks in the series use when describing the most common protective elements how they function and the most effective and efficient procedures used to test them Even experienced relay testers can benefit from having this manual on hand as a quick reference when facing an unfamiliar relay testing situation Use the practical examples outlined in this volume to help you Understand the three phase electrical system Create and understand phasor diagrams Apply Delta and Wye connections Understand the power triangle Understand basic transformer theory Understand current and potential transformers and connections Recognize the most common fault types and when to apply them Recognize the most common system grounding techniques Calculate positive negative and zero sequence components Understand why and how protective relays are applied Paperback 102 pages Trim Size 8 5x11 Publisher Valence Electrical Training Services LLC Language English ISBN 13 978 1 934348 04 8 LCCN 2012934170 **The Relay Testing Handbook #9D:** Chris Werstiuk,2012-02-28 The Relay Testing Handbook was created for relay technicians from all backgrounds and provides the knowledge necessary to test most modern protective relays installed over a wide variety of industries Basic electrical fundamentals detailed descriptions of protective elements and generic test plans are combined with examples from real life applications to increase your confidence in any relay testing situation A wide variety of relay manufacturers and models are used in the examples to help you realize that once you conquer the sometimes confusing and frustrating man machine interfaces created by the different manufacturers all digital relays use the same basic fundamentals and most relays can be tested by applying these fundamentals This package provides a step by step procedure for testing the most common distance protection applications used by a variety of manufacturers Each chapter follows a logical progression to help understand why distance protection is used and how it is applied Testing procedures are described in detail to ensure that the distance protection has been correctly applied Each chapter uses the following outline to best describe the element and the test procedures Application Settings Pickup Testing Timing Tests Tips and Tricks to Overcome Common Obstacles Real world examples are used to describe each test with detailed instructions to determine what test parameters to use and how to determine if the results are acceptable Thank you for your support with this project and I hope you find this and future additions of The Relay Testing Handbook to be useful **The Relay Testing Handbook #6D** Chris Werstiuk,2009-08 As modern protective relays become increasingly more powerful and complex many relay testers continue to use test procedures and philosophies that are based on previous generations of relays and their limitations Modern relays have very different characteristics that require a different testing philosophy to ensure that they will operate when required The Relay Testing Handbook Testing Overcurrent Protection 50 51 67 provides step by step procedures for testing the most common

overcurrent protection applications This volume is designed to help you understand and test Instantaneous overcurrent protection 50 Inverse time overcurrent protection 51 Directional overcurrent protection 67 Each chapter explains the following topics for each element with realistic practical examples and detailed instructions Understanding the application Determining which settings are most important Recommended steps to correctly plan perform and evaluate pickup tests Recommended steps to correctly plan perform and evaluate timing tests Preventing interference from other settings inside the relay Tips and tricks to overcome common obstacles This book is included in the hardcover book The Relay Testing Handbook Principles and Practice or it can be ordered by itself as a soft cover book Adobe Acrobat PDF digital download or both Paperback 70 pages Trim Size 8 5x11 Publisher Valence Electrical Training Services LLC Language English ISBN 13 978 1 934348 13 0 LCCN 2012934622 The Relay Testing Handbook #2D Chris Werstiuk,2007-06 As modern protective relays become increasingly more powerful and complex many relay testers continue to use test procedures and philosophies that are based on previous generations of relays and their limitations Modern relays have very different characteristics that require a different testing philosophy to ensure that they will operate when required As the second of The Relay Testing Handbook series Relay Testing Fundamentals builds on the electrical theory principles introduced in the first package Electrical Fundamentals for Relay Testing In this in depth discussion of protective relays you will learn about the history of protective relaying including Electromechanical relays Solid state relays Simple microprocessor relays Multifunction microprocessor relays Relay testers of all skill levels can benefit from a solid foundation of relay testing fundamentals the foundational elements included in this book include Reasons for relay testing Essential relay testing equipment The importance of using different test techniques for various relay generations Traditional test procedures for element testing Logic and dynamic testing Combining test techniques for more efficient and effective relay testing Applying test techniques that take advantage of modern test equipment and software This book is included in the hardcover book The Relay Testing Handbook Principles and Practice or it can be ordered by itself as a soft cover book Adobe Acrobat PDF digital download or both Paperback 86 pages Trim Size 8 5x11 Publisher Valence Electrical Training Services LLC Language English ISBN 13 978 1 934348 05 5 LCCN 2012934618 **The Relay Testing Handbook #8D** Chris Werstiuk,2012-11-08 The Relay Testing Handbook was created for relay technicians from all backgrounds and providesthe knowledge necessary to test most of the modern protective relays installed over a widevariety of industries Basic electrical fundamentals detailed descriptions of protective elements and generic test plans are combined with examples from real life applications to increase yourconfidence in any relay testing situation A wide variety of relay manufacturers and models areused in the examples to help you realize that once you conquer the sometimes confusing andfrustrating man machine interfaces created by the different manufacturers all digital relays use the same basic fundamentals and most relays can be tested by applying these fundamentals This package provides a step by step procedure for testing the most common differential protectionapplications

used by a variety of manufacturers Each chapter follows a logical progression to help understand why differential protection is used and how it is applied Testing procedures are described in detail to ensure that the differential protection has been correctly applied Each chapter uses the following outline to best describe the element and the test procedures 1 Application 2 Settings 3 Pickup Testing 4 Timing Tests 5 Tips and Tricks to Overcome Common Obstacles We will review techniques to test differential relays with 3 or 6 channels so that readers can test nearly any differential application with any modern test set

The Relay Testing Handbook #4D Chris Werstiuk, 2007-10 As modern protective relays become increasingly more powerful and complex many relay testers continue to use test procedures and philosophies that are based on previous generations of relays and their limitations Modern relays have very different characteristics that require a different testing philosophy to ensure that they will operate when required The Relay Testing Handbook Creating and Implementing Test Plans outlines step by step procedures that will enable you to create and implement protective relay test plans for modern relay systems ensuring accurate and efficient relay testing for nearly every application Use the information in this book to Collect and compare drawings settings and engineering studies to evaluate the application Compare all of the available documentation to the manufacturer's literature Prepare to test the relay by correctly isolating it from the rest of the system Establish communication with the relay and apply the settings Properly connect your test set to the relay Perform acceptance tests Design your test plan using conventional test techniques or implement more efficient and effective ones Implement your test plan or apply common test plans for feeder generator or line protection Prepare your report and test sheets This book is included in the hardcover book The Relay Testing Handbook Principles and Practice or it can be ordered by itself as a soft cover book Adobe Acrobat PDF digital download or both Paperback 98 pages Trim Size 8.5x11 Publisher Valence Electrical Training Services LLC Language English ISBN 13 978 1 934348 07 9 LCCN 2012934620 **The Relay Testing Handbook**

#3D: Chris Werstiuk, 2012 As modern protective relays become increasingly more powerful and complex many relay testers continue to use test procedures and philosophies that are based on previous generations of relays and their limitations Modern relays have very different characteristics that require a different testing philosophy to ensure that they will operate when required The Relay Testing Handbook Understanding Digital Logic explains the different forms of relay logic used in modern microprocessor based relays Each type of relay logic is described in detail with practical examples to demonstrate how relay manufacturers use common relay logic principles applied with different style interfaces such as Individual element schemes General Electric SR and Beckwith Electric Company relays Binary relays Alstom and Siemens relays Arithmetic math schemes Schweitzer Engineering Laboratories relays Logic schemes General Electric UR relays Use the practical examples outlined in this volume to help you Understand and use logic gates such as AND OR NOT NOR NAND and more Use logic comparators and timers Convert relay settings from one logic format to another Convert logic schemes into DC schematics to help understand and commission logic systems Understand the protective relay logic used in nearly every in

service relay today This book is included in the hardcover book *The Relay Testing Handbook Principles and Practice* or it can be ordered by itself as a soft cover book Adobe Acrobat PDF digital download or both Paperback 90 pages Trim Size 8 5x11 Publisher Valence Electrical Training Services LLC Language English ISBN 13 978 1 934348 06 2 LCCN 2012934619

[The Relay Testing Handbook #7: End-to-End Testing](#) Chris Werstiuk,2013 This package provides an overview of End to End testing and answers the most common questions a relay tester should ask before performing their first End to End test A basic introduction of this test technique is followed by a step by step procedure for performing a successful end to end test This package also includes an overview of the most common communication assisted protection schemes to help the reader understand how these schemes operate Go to <http://relaytraining.com/product/end-to-end-testing-print> for more information This paper will NOT be part of the final *Relay Testing Handbook* *Standard Handbook for Electrical Engineers Sixteenth Edition* H. Wayne Beaty,Donald Fink,2012-08-30 THE MOST COMPLETE AND CURRENT GUIDE TO ELECTRICAL ENGINEERING For more than a century the *Standard Handbook for Electrical Engineers* has served as the definitive source for all the pertinent electrical engineering data essential to both engineering students and practicing engineers It offers comprehensive information on the generation transmission distribution control operation and application of electric power Completely revised throughout to address the latest codes and standards the 16th Edition of this renowned reference offers new coverage of green technologies such as smart grids smart meters renewable energy and cogeneration plants Modern computer applications and methods for securing computer network infrastructures that control power grids are also discussed Featuring hundreds of detailed illustrations and contributions from more than 75 global experts this state of the art volume is an essential tool for every electrical engineer *Standard Handbook for Electrical Engineers 16th Edition* covers Units symbols constants definitions and conversion factors Electric and magnetic circuits Measurements and instruments Properties of materials Generation Prime movers Alternating current generators Direct current generators Hydroelectric power generation Power system components Alternate sources of power Electric power system economics Project economics Transmission systems High voltage direct current power transmission Power system operations Substations Power distribution Wiring design for commercial and industrial buildings Motors and drives Industrial and commercial applications of electric power Power electronics Power quality and reliability Grounding systems Computer applications in the electric power industry Illumination Lightning and overvoltage protection Standards in electrotechnology telecommunications and information technology [The Relay Testing Handbook #5D](#) Chris Werstiuk,2008-04 As modern protective relays become increasingly more powerful and complex many relay testers continue to use test procedures and philosophies that are based on previous generations of relays and their limitations Modern relays have very different characteristics that require a different testing philosophy to ensure that they will operate when required *The Relay Testing Handbook Testing Voltage Protection* 59 27 81 provides step by step procedures for testing the most common voltage and frequency protective

applications This volume is designed to help you understand and test Overvoltage protection 59 Undervoltage protection 27 Over under frequency protection 81 Each chapter explains the following topics for each element with realistic practical examples and detailed instructions Understanding the application Determining which settings are most important Recommended steps to correctly plan perform and evaluate pickup tests Recommended steps to correctly plan perform and evaluate timing tests Preventing interference from other settings inside the relay Tips and tricks to overcome common obstacles This book is included in the hardcover book *The Relay Testing Handbook Principles and Practice* or it can be ordered by itself as a soft cover book Adobe Acrobat PDF digital download or both Paperback 62 pages Trim Size 8 5x11 Publisher Valence Electrical Training Services LLC Language English ISBN 13 978 1 934348 11 6 LCCN 2012934621

Plant Equipment & Maintenance Engineering Handbook Duncan Richardson,2013-07-22 The Best On the Job Guide to Industrial Plant Equipment and Systems This practical one of a kind field manual explains how equipment in industrial facilities operates and covers all aspects of commissioning relevant to engineers and project managers *Plant Equipment and Maintenance Engineering Handbook* contains a data log of all major industrial and power plant components describes how they function and includes rules of thumb for operation Hundreds of handy reference materials such as calculations and tables plus a comprehensive listing of electrical parts with common supplier nomenclature are also included in this time saving resource FEATURES DETAILED COVERAGE OF Compressors Air conditioning Ash handling Bearings and lubrication Boilers Chemical cleaning and Flushing Condensers and circulating water systems Controls Conveyor systems Cooling towers Corrosion Deaerators Diesel and gas turbines Electrical Fans Fire protection Fuels and combustion Piping Pumps Turbines Vibration Water treatment *The Relay Testing Handbook* InterNational Electrical Testing Association. Conference,Chris Werstiuk,2012 *The Relay Testing Handbook* InterNational Electrical Testing Association. Conference,Chris Werstiuk,2012 This book was created for relay test technicians and provides the knowledge and skills necessary to test most of the modern protective relays installed over a wide variety of industries Basic electrical fundamentals detailed descriptions of protective elements and generic test plans are combined with examples from real life applications to increase your confidence in any relay testing situation A wide variety of relay manufacturers and models are used in the examples to help you realize that once you conquer the sometimes confusing and frustrating man machine interfaces created by the different manufacturers all digital relays use the same basic fundamentals and most relays can be tested by applying these fundamentals By the end of this book you will have the information you need to Evaluate relay applications Review understand and compare the relay settings to the application Create a test plan Test the most commonly applied elements Instantaneous Overcurrent 50 Inverse Time Overcurrent 50 Directional Overcurrent 67 Undervoltage 27 Overvoltage 59 Over Under Frequency 81 Differential 87 With three of six current channels Line Distance 21 Evaluate the test results Provide comprehensive test results and documentation Each chapter is a self contained unit and the chapters are

organized in a logical progression of knowledge to allow readers from different skill sets to focus on or skip to the sections they need without wasting time reading through information they already know We also provide packages for technicians who are looking for specific information only These packages can be downloaded in pdf format for easy viewing and printing as they become available

Engineering Handbook National Association of Broadcasters,1992 **The Relay Testing Handbook** Chris Werstiuk,2020-06-26 Welding and Metal Fabrication ,1989 The Complete Relay Testing Handbook Series Chris Werstiuk,2018 *Water and Energy International* ,2017 *The Relay Testing Handbook #9* InterNational Electrical Testing Association. Conference,Chris Werstiuk,2012-06-01 **The Relay Testing Handbook** InterNational Electrical Testing Association. Conference,Chris Werstiuk,2012

Abb Relay Testing Handbook: Bestsellers in 2023 The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous captivating novels captivating the hearts of readers worldwide. Lets delve into the realm of popular books, exploring the engaging narratives that have charmed audiences this year. Abb Relay Testing Handbook : Colleen Hoover's "It Ends with Us" This touching tale of love, loss, and resilience has gripped readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can succeed. Abb Relay Testing Handbook : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This spellbinding historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids absorbing storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Abb Relay Testing Handbook : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens weaves a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of captivating stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and thrilling novel that will keep you wondering until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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