



# INSTRUCTIONS

## TYPE HCZ IMPEDANCE RELAY

**Caution:** Before putting protective relays into service, readers and shipping units may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

### APPLICATION

The Type HCZ relay is a combination of the instantaneous impedance and directional elements of the Type HE relay and the distance element of the Type DE relay. This relay is used for high speed clearing of phase faults on transmission systems. It gives instantaneous protection over 80 to 90% of the protected section, and protection over the remaining 10 to 20% of the protected section, and the adjacent sections with adjustable time delay increasing with distance. (Figure 1).

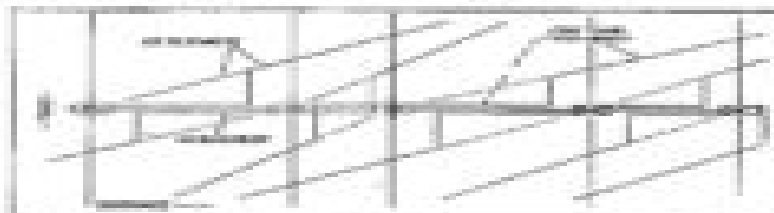


Fig. 1—Typical Resistance Characteristics of the Type HCZ Relay

### CONSTRUCTION AND OPERATION

The Type HCZ relay contains an instantaneous impedance (HI) element, a distance (DI) element, a directional element, a fault detector element, auxiliary contact elements, and operating mechanisms all mounted in a single case. The construction and operation of each of these elements is as follows:

#### Instantaneous Impedance (HI) Element

This element is similar to the first impedance element of the Type HE relay. It consists of a balanced beam pivoted at the center (Figure 2) and pulled downward by a current coil on the forward end to close the relay contacts. This pull is opposed by two voltage coils acting on the other end of the beam. The forces set up by these two potential coils are equalized out of phase with respect to each other so that a balance between current and voltage forces can be held within desirable limits for all phase angles.

A leaf screw on the front of the element permits changing the number of turns on the current coil, and a wire screw on the bottom of the element changes an air gap in the magnetic path. These two adjustments make it possible to set the impedance element so that it will operate instantaneously for all faults occurring within 80 to 90% of the protected line section. For a fault at the balance point of the element (determined by setting) the pull of the voltage coil, which measures the IR drop from the fault to the relay, will just equal the pull of the current coil, which receives the fault current. If the fault occurs inside the balance point, the IR voltage pull will be less than the I current pull and the beam will trip closing its contacts. Conversely, if the fault occurs outside the relay-balance point, the IR voltage pull will be greater than the I current pull and the beam will not trip.

A rectangular silver contact is flexibly fastened on the forward end of the beam. As the beam trips, the contact bridges two silver-plated hemispherical contacts mounted on the free end of a short leaf spring. A small

# Impedance Relay Manual

**DP Hallahan**

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the author's name.

## **Impedance Relay Manual:**

Electric Relays Vladimir Gurevich, 2018-10-03 Electric relays pervade the electronics that dominate our world. They exist in many forms, fulfill many roles, and each has its own behavioral nuances and peculiarities. To date, there exists no comprehensive reference surveying the broad spectrum of electric relays, save one: *Electric Relays Principles and Applications*. This ambitious work is not only unique in its scope but also in its practical approach that focuses on the operational and functional aspects rather than on theory and mathematics. Accomplished engineer Dr. Vladimir Gurevich builds the presentation from first principles, unfolding the concepts and constructions via discussion of their historical development from the earliest ideas to modern technologies. He uses a 'show, not tell' approach that employs nearly 1300 illustrations and reveals valuable insight based on his extensive experience in the field. The book begins with the basic principles of relay construction and the major functional parts, such as contact and magnetic systems. Then it devotes individual chapters to the various types of relays. The author describes the principles of function and construction for each type, as well as features of several relays belonging to a type that operate on different principles. Remarkably thorough and uniquely practical, *Electric Relays Principles and Applications* serves as the perfect introduction to the plethora of electric relays and offers a quick reference guide for the experienced engineer.

**Power Control Circuits Manual** R. M. Marston, 2016-01-22 *Power Control Circuits Manual* presents a comprehensive review of electronic power control. The book is comprised of eight chapters that deal with a specific aspect of power control. The text first discusses the basic principles of electrical/electronic power control and then proceeds to presenting practical control circuits using conventional switches and relays. Chapter 3 discusses ways of using CMOS devices as low power electronic switches, while Chapters 4 and 5 deal with AC and DC power control systems. Next, the book presents ways of controlling DC motors, and the remaining two chapters deal with audio power control and DC power supply systems, respectively. The book will be of great use to design engineers and technicians. Undergraduate students of electronics-related degrees will also find this book interesting.

**Technical Manual** United States War Department, 1959 *Technical Manual* United States Department of the Army, 1954 *Power Systems Protection, Control & Automation* Maty Ghezelayagh, 2020-03-05 This book provides practical applications of numerical relays for protection and control of various primary equipment, namely distribution and transmission networks, HV and EHV transformers, and busbars, reactive and active power plants. Unlike other books, attempts have been made to address the subject from a practical point of view rather than a theoretical one, which can otherwise be found in most of the other text books. The setting, design, and testing philosophy of numerical relays, as discussed in this book, have been successfully applied in the field on various projects and consequently can be used as a practical guideline for implementation on future projects. The book covers the following subjects: Fundamental concepts in the field of power system protection and control; Required system modelling and fault level analysis for the design and setting of protection and control devices; Setting and design

philosophy of numerical relays of different primary equipment Practical application of anti Islanding schemes for two different systems namely distribution generation DG and transmission generation TG Challenges and solutions which are encountered during secondary equipment refurbishment replacement in brown field substations with inclusion of two practical case studies Required tests for factory acceptance tests FAT site acceptance tests SAT and commissioning tests of numerical relays in conventional and digital substations Causes analysis and proposed mitigation techniques of more than 100 worldwide disturbances which have occurred in different type of primary equipment which have resulted to major system black out or plant explosion or even fatality and New and future trend of application of numerical relays including application of super IED for protection and control of multi primary equipment implementation of digital substation remote integrations self and remote testing of IED distribution networks fault location techniques and fault locators using travelling waves synchro phasors time domain line protection using travelling waves adaptive slope characteristics of differential protection protection and control schemes of micro grids mitigation technique for prevention of loss of reactive power plants and transformers due to solar storms

**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

**Protection Technologies of Ultra-High-Voltage AC Transmission Systems** Bin Li, Yongli Li, Jiali He, Yuping Zheng, 2020-01-28 Protection Technologies of Ultra High Voltage AC Transmission Systems considers the latest research on UHV UHV transmission line electromagnetic field transmission line parameters and tower structures with a focus on protective relaying of UHV transmission systems This book gives insights into protective relaying of UHV AC transmission systems and sheds light on the conundrum of protective relaying for the EHV systems In addition it elaborates on both

traditional relaying and the application of new type current differential protection distance protection and automatic reclosing as well as protective schemes for transformers and reactors in UHV transmission systems This resource will serve as an important reference for technical personnel in network design and operation as well as students and engineers in related engineering areas

**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 #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 ApplicationSettingsPickup TestingTiming TestsTips and Tricks to Overcome Common ObstaclesReal 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 #8D** Chris Werstiuk, 2012-11-08 The Relay Testing Handbook was created for relay technicians from all backgrounds and provides the knowledge 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. This package provides a step by step procedure for testing the most common differential protection applications 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.

**Field and Depot Maintenance Manual**, 1989 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.

*Switchgear and Power System Protection* Ravindra P. Singh, 2009-12 Besides the book contains a detailed treatment of protective schemes used to encounter fault conditions that may occur individually in generators, motors, transformers, busbars and distribution circuits. Protection against switching surges and lightning is also discussed. The final chapter on power system management provides a simple introduction to that important area in order to emphasize the importance of optimal economic operation of power systems in which protective schemes under fault conditions play a crucial role towards continuity of electrical supply with minimum damage to life equipment and property.

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 #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

**Manual of Recommended Practice** Association of American Railroads. Signal Section, 1925 **Direct Support and General Support Maintenance Manual (including Repair Parts and Special Tools List)**, 1972 *Federal Airways Manual of Operations* United States. Civil Aeronautics

Administration, 1946 Protective Relay Principles Anthony M. Sleva, 2018-09-03 Improve Failure Detection and Optimize Protection In the ever evolving field of protective relay technology an engineer's personal preference and professional judgment are as important to power system protection as the physical relays used to detect and isolate abnormal conditions Invaluable Insights from an Experienced Expert *Protective Relay Principles* focuses on probable power system failure modes and the important characteristics of the protective relays used to detect these postulated failures The book presents useful

new concepts in a way that is easier to understand because they are equally relevant to older electromechanical and solid state relays and newer more versatile microprocessor based relays It introduces the applications considerations and setting philosophies used in transmission line distribution line and substation applications covering concepts associated with general system operations and fault detection Topics include relay load limits cold load pickup voltage recovery and arc flash The author also delves into the philosophies that engineers employ in both urban and rural areas with a detailed consideration of setpoint function Analysis of Key Concepts That Are Usually Just Glossed Over This versatile text is ideal for new engineers to use as a tutorial before they open the instruction manuals that accompany multi function microprocessor based relays Guiding readers through the transient loading conditions that can result in relay misoperation the author elaborates on concepts that are not generally discussed but can be very helpful in specific applications Readers will come away with an excellent grasp of important design considerations for working with overcurrent over and undervoltage impedance distance and differential type relay functions either individually or in combination Also useful for students as a textbook this book includes practical examples for many applications and offers guidance for more unusual ones     Manual of Electrical Control Frank Edgar Reeves,1951

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