

Parallelogram Characteristics of Relay Protection



Overview

Figure 5.1 shows the parallelogram characteristics of a distance protection relay in R-X plane, which is used to protect the OHE.

Key Takeaways

Parallelogram characteristics in relay protection define a polygonal operating zone on the R-X plane to accurately detect faults while avoiding maloperation due to load encroachment.

Overview

Parallelogram characteristics are used in impedance-based distance protection relays to define the relay's operating region on the resistance-reactance (R-X) plane. This polygonal shape allows the relay to distinguish between normal load conditions and actual fault conditions, ensuring selective and reliable tripping of circuit breakers.

Key Features

Polygonal Operating Zone: The parallelogram defines a forward and reverse reach for the relay, with adjustable resistance (R) and reactance (X) limits. The relay trips only when the measured impedance falls within this zone. **Load Encroachment Prevention:** During normal operation, the load impedance may approach the relay's characteristic.



The parallelogram shape allows a margin for load impedance, preventing false tripping under heavy load conditions. Directional Sensitivity: The parallelogram can be oriented to provide forward and backward fault detection, enhancing selectivity in complex networks. Adjustable Parameters: Both the resistance and reactance boundaries are individually settable, allowing customization for specific line parameters and system conditions.

Integration with Digital Relays: Modern digital relays implement parallelogram characteristics using vectorial impedance measurements, comparing current and historical samples to determine fault conditions while filtering out harmonics and transient effects.

Practical Application

In A

C traction systems, such as those protected by the A22R Delta-I relay, the parallelogram characteristic is applied to: Continuously measure the impedance of overhead lines. Compare measured impedance against the set polygonal zone. Generate a trip signal only if the impedance falls within the fault characteristic, avoiding maloperation due to load or harmonic content.

Similarly, in general power systems, parallelogram characteristics are used in distance protection relays to provide fast, selective tripping for phase-to-phase and phase-to-ground faults while maintaining stability during normal load flow.

Advantages

Enhanced Selectivity: Reduces false trips caused by load currents or harmonics.

Flexibility: Adjustable R-X boundaries allow adaptation to different line lengths and system impedances.

Compatibility with Digital Relays: Easily implemented in modern numerical relays with event recording and SCADA integration.

Conclusion

The parallelogram characteristic is a critical feature in modern protective relays, particularly for distance and impedance-based protection. By defining a polygonal operating zone on the R-X plane, it ensures accurate fault detection, load encroachment immunity, and directional selectivity, making it a reliable choice for both industrial and traction power systems.

Article Content

Electric Traction Over Head Equipment Protection Using Intelligent ...

Figure 5.1 shows the parallelogram characteristics of a distance protection relay in R-X plane, which is used to protect the OHE. The relay is equipped with three zones of protection in single phase mode

DELTA – I PROTECTION RELAY : A22R

Relay is equipped with backup distance protection function based on impedance using parallelogram characteristic (on R-X plane) to avoid malfunction of relay due to load encroachment.

Fundamentals of Distance Protection

The principle of distance protection is based on the determination of the fault impedance from the measured short-circuit voltage and current at the relay location as illustrated in figure 1.

Characteristics of Protective Relay

Characteristics of Protective Relay elements using different operating principles. These principles and design criteria determine how well the basic function is

Feeder Protection Relay: A Comprehensive Guide

Quadrilateral Characteristic: Uses a parallelogram-shaped graph to define protection zones, providing flexibility and accuracy in fault detection. Zones of Operation: Distance protection

Principles and Characteristics of Distance Protection

Such a relay is described as a distance relay and is designed to operate only for faults occurring between the relay location and the selected reach point, thus giving discrimination for faults

Fundamentals of Modern Protective Relaying

A primary motor protective element of the motor protection relay is the thermal overload element and this is accomplished through motor thermal image modeling. This model must account for thermal

Protective Relaying Philosophy and Design Guidelines

It should be recognized that details associated with effective application of protective relays and other devices for the protection of shunt reactors is a subject too broad to be covered in detail in this

Principles and Characteristics of Distance Protection

Distance relays characteristics may be Mho, Quadrilateral, Offset Mho, etc. In the case of the quadrilateral characteristic or long reaching mho

Fundamentals of Modern Protective Relaying

Curve type is selected so the characteristic of the relay best matches characteristics of downstream and upstream overcurrent devices. Time dial adjusts time delay of characteristic to achieve coordination

Distance Protection Relay Overview

This document provides an introduction to distance relaying. It discusses how distance protection provides more accurate, directional, and fast fault detection compared to overcurrent protection. It

Protective Relaying Principles and Applications

Protective Relaying Principles and Applications The article provides an overview of protective relaying principles and their applications for high-voltage power system components. It covers the protection

Protective Relay Basics

Traditionally, protective relays were electromechanical devices utilizing induction disk, coils, contacts, and solenoid elements to determine protective characteristics.

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Verify by simulation that the relays operate as expected. Model malfunctioning of the protective equipment and verify operation of the back-up protection functions.

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Electric Traction Over Head Equipment Protection Using Intelligent ...

Abstract Protection relays used in traction system application utilize impedance protection having parallelogram characteristics with three zones of protection comprising independent R, X values with

The fundamentals of protection relay co-ordination and

Among the various possible methods used to achieve correct relay co-ordination are those using either time or overcurrent, or a combination of both.

Relays Part 4: The Protective Relay Basic Theory

The types of protective relays that exist are overcurrent, electromechanical, directional, distance, pilot, and differential relays. The circuit diagram of the protective relay is made up of current

Functional characteristics of Protection Relays

that all the components of the protection from the voltage and current signals to the dc power supply for the trip circuit to the internal components of the relay are checked for for functionality and integrity.

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