

Calculation formula for three stages of relay protection



Article Overview

Three-stage relay protection involves Stage I instantaneous, Stage II time-delayed, and Stage III inverse-time or definite-time overcurrent protection, each with specific current settings and time delays to ensure selective and reliable fault clearance.

Stage I: Instantaneous Overcurrent Protection

Stage I is designed for immediate tripping of severe faults near the relay, typically covering up to 80–85% of the line length (). Calculation steps:

- Determine the maximum fault current at the relay location, $I_{3k.max}$.
- Set the pickup current using a reliability factor K_{rel} (typically 1.2–1.3):

$$I_{set1} = K_{rel} \times I_{3k.max}$$

- Trip time is set to less than 30 ms, with no intentional delay.
- Stage I does not cover the entire line to maintain selectivity with downstream relays ().

Stage II: Time-Delayed Overcurrent Protection

Stage II acts as local backup for Stage I and protects the remaining portion of the line. It introduces a short intentional delay (0.3–0.5 seconds) to coordinate with Stage I (). Calculation steps:

- Determine the downstream Stage I setting, $I_{set1,downstream}$.
- Set the Stage II pickup current with a reliability factor:

$$I_{set2} = K_{rel} \times I_{set1,downstream}...$$

Article Content

Nov 18, 2025

A Guide for Calculating Step Distance Relay Settings

Calculating & Storing Relay Setting Philosophy Utilities can use a Word document or spreadsheets to document the step-by-step

Sep 11, 2025

Relay Setting Calculation Overview

The document provides calculations for relay settings for different components in a power system network. It calculates the fault

Nov 26, 2025

Distribution Automation Handbook

Time-graded protection is implemented using overcurrent relays with either definite time characteristic or inverse time characteristic.

Sep 30, 2025

Research on the Power Line Three-stage Over-current Protection Simulation

The simulation results show that the simulation analysis can achieve better power line three-stage over-current protection under

Jul 16, 2026

Power System Protective Relays: Principles & Practices

Abstract: Protective relays and devices have been developed over 100 years ago to provide “last line” of defense for the electrical

Jan 21, 2026

Relay Setting Calculations Guide | PDF | Relay | Transformer

The document outlines the steps for performing setting calculations, including determining required technical data, protection

Dec 24, 2025

doi: 10.1007/978-3-319-20919-7_3

Verify by simulation that the relays operate as expected. Model malfunctioning of the protective equipment and verify operation of the

Jul 15, 2026

FEEDER PROTECTION CALCULATIONS & SETTINGS

Relay 8 backs up relays 6 and 7, and should be co-ordinated with the slowest of these two relays. Relay 7 has an instantaneous

Jun 04, 2026

RELAY SETTING CALCULATION

To determine stability voltage for through fault V_s'' Voltage across the relay at IFS (VS) CT Resistance (RCT)

May 24, 2026

Setting Calculation Method and Protection Coordination for Relay ...

Then, the electrical engineering software is used to perform a more accurate setting calculation and protection coordination. Also, the

Apr 26, 2026

ThreeStage Overcurrent Protection: Purpose, Coordination, and

Threestage overcurrent protection (I, II, III) ensures selective, fast, and reliable fault clearance in power systems.

Apr 16, 2026

Protection Basics

Protection System Elements Protective relays Circuit breakers CTs and VTs (instrument transformers) Communications channels

Apr 18, 2026

Relay Setting in Real Power System

Relay setting plays an important role in maintaining the reliability of a Power System. Read this blog to find out more

Feb 10, 2026

Relay Setting Calculation Overview | PDF | Volt | Relay

The calculations are performed to determine appropriate relay settings that ensure protection and coordination within the power

Feb 07, 2026

Relay Protection in HV/MV Substations: Calculations, Settings ...

Relay protection for transformers involves calculations for differential current thresholds, through-fault stability, inrush

Mar 13, 2026

The fundamentals of protection relay co-ordination and time ...

Among the various possible methods used to achieve correct relay co-ordination are those using either time or

Feb 20, 2026

Distribution Automation Handbook

Figure 8.2.1 shows a time-graded protection arrangement in a radial network. In the example network, three-stage protection is

Feb 06, 2026

Basics of Protective Relaying and Design Principles

Particularly, the following issues are re-enforced: load flow and short-circuit calculations, selecting the protective equipment, setting

Mar 27, 2026

Relay Protection Settings (PSM, TSM, EL, OL, MF)

Time Setting Multiplier (TSM) scales the base time calculated from the relay's characteristic curves. The curve

Aug 21, 2025

Three-Step Current Protection: Introduction, Functions, and Working ...

Three-Step Current Protection is a fundamental protection relay system for power networks. This protection relay

Aug 09, 2025

Relay Time Calculation Formulas | True Geometry's Blog

The formula for operating time is a simplified representation and might vary depending on the specific relay

Sep 10, 2025

Relay Settings Calculations

Protection selectivity is partly considered in this report, and could be also reevaluated. Names of parameters in this calculation may

Feb 25, 2026

Relay Settings Calculations

Introduction This technical report refers to the electrical protections of all 132kV switchgear. All calculations are based on the

Mar 27, 2026

Relay Protection in HV/MV Substations: Calculations, Settings ...

Protection engineers calculate the maximum load current, the minimum fault current, and the full range of possible

Apr 06, 2026

Module 6 : Distance Protection

Typically, distance relays are provided with multiple zones of protection to meet the stringent selectivity and sensitivity requirements.

Dec 22, 2025

Protection Relay Settings Calculations Made Easy

Power System Protection Setting Calculations The electrical grid is a vast and intricate system designed to ensure the

Oct 05, 2025

Distance Protection

Such protection relays are known as “distance protection relays” and only function in case of faults that occur between the location of

Apr 26, 2026

Protective Relay Basics

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

Feb 24, 2026

Relay Setting Calculation for Motors Electrical Engineering

Maximum value on secondary is $15250 / 250 = 61$ Earth fault relay for the Transformer Neutral CT Ratio 250 / IA 100 to 2000ms Set

Feb 20, 2026

Phase Fault Detection Setting Calculator | True Geometry's Blog

Overcurrent Protection Setting Calculation This calculator determines the appropriate overcurrent protection setting

Dec 27, 2025

CALCULATION AND SETTING OF RELAYS IN TRANSMISSION

Abstract. This article deals with the issue of protective relays in terms of protecting high voltage lines. At the beginning of the article it

Jun 27, 2026

Setting the generator protective relay functions

Protective relay functions and data This technical article will cover the gathering of information needed to calculate

Jul 04, 2026

Protection Relay Setting Interactive Calculator | FIRGELLI

With this Protection Relay Setting Calculator, you'll be able to work out pickup current, time multiplier settings (TMS),

Jun 17, 2026

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

May 19, 2026

Overcurrent Protection Settings Guide | PDF | Relay | Engineering

The document discusses overcurrent protection calculations and settings for a power system network. It provides a single line

Jul 29, 2025

Relay Settings Calculations - Electrical Engineering

This technical report refers to the electrical protection of all 132kV switchgear. These settings may be re-evaluated during the

Contact Us

For more information, pricing, or custom solutions, please contact us:

Website: <https://www.greatpremiersolutions.co.za>

Email: sales@greatpremiersolutions.co.za

Phone: +27 82 914 3675

Address: Unit 5, Silicon Heights, 22 Electron Avenue, Cape Town, 8001, South Africa

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