

How to calculate the relay protection action time

Article Overview

Relay protection time is calculated using the relay's pickup current, plug setting multiplier (PSM), and time multiplier setting (TMS) applied to the relay's characteristic curve to determine the operating time for a given fault current.

Key Concepts

Pickup Current (I_p): The minimum current at which the relay starts to operate. It is usually set above the maximum load current to avoid nuisance tripping and is calculated as a percentage of the load current or using the CT ratio and plug setting multiplier (PSM). **Plug Setting Multiplier (PSM):** The ratio of fault current to the relay's pickup current. It determines how much the fault current exceeds the pickup threshold and is used in the time-current characteristic formula. **Time Multiplier Setting (TMS):** A numerical factor applied to the relay's characteristic curve to adjust the operating time. Increasing TMS increases the relay's operating time, while decreasing TMS reduces it. TMS ensures proper coordination between downstream and upstream relays.

Operating Time Calculation

For IEC Standard Inverse Relays, the operating time t is calculated as:

$$t = TMS \times K(PSM)^{-1}$$

Where K and γ are constants depending on the relay curve type (e.g., Standard Inverse, Very Inverse, Extremely Inverse). For example, for a Standard Inverse curve, $K=0.14$ and $\gamma=0.02$. For IEEE curves, the formula is slightly different:

$$t = TDS \times (A(PSM)^p - 1 + B)$$

Here, TDS (Time Dial Setting) is equivalent to TMS, and A , B , p are constants defined by the specific IEEE curve.

Step-by-Step Calculation

- o **Determine Pickup Current:** Set above maximum load current, e.g., 125% of load current, then adjust using standard plug settings.
- o **Calculate PSM:** Divide the fault current by the pickup current.
- o **Select Relay Curve:** Choose IEC or IEEE curve type based on system requirements.
- o **Apply TMS:** Multiply the characteristic curve time by the TMS to get the actual operating time.
- o **Check Coordination:** Ensure downstream relays operate first, and upstream relays have slightly longer operating times to provide backup.

Practical Example

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If a relay has a pickup current of 200 A, a fault current of 400 A, and a TMS of 0.5 on a Standard Inverse curve:

o $PSM = 400 / 200 = 2$

o Operating time $t = 0.5 \times 0.142 \times 0.02^{-1} \times 3.4$ seconds This ensures the relay trips in coordination with other relays in the network .

Summary

Relay protection time calculation involves pickup current, PSM, TMS, and the relay's time-current characteristic curve. Proper calculation ensures selective tripping, minimizes equipment damage, and maintains system stability. Tools like online calculators can simplify these calculations for IEC and IEEE standard relays .

The Relay Setting Calculator is based on the inverse time-current characteristics defined by IEC (International

ResearchGate

Our Overcurrent Relay Setting Calculator will accurately calculate your overcurrent relay settings. Enter rated current,

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

These relays are usually instantaneous in action, with no intentional time delay, closing as soon after pickup as the mechanical

In these cases, the use of inverse time relays in favor of definite time relays can usually speed up the operating time of the protection

PSM and TMS settings that are Plug Setting Multiplier and Time Multiplier Setting are the settings of a relay used to

Calculate time overcurrent relay settings with IEEE & IEC standards. Learn IDMT relay formulas, TMS/TD settings

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

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within the power

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

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The relay operate time is a relatively small part of the required improvement, since the circuit breaker interrupting time

PROTECTION RELAY TESTING AND COMMISSIONING The testing and verification of protection devices and arrangements

Perform power system simulations of selected faults and observe how a given protection principle (overcurrent, impedance, and

Professional protection relay calculator for electrical engineers -- overcurrent trip time, transformer differential (87T), short circuit

The Inverse Time Over Current (TOC/IDMT) relay trip time calculator calculates the protection trip time according to IEC 60255 and

Web: <https://www.in-au.co.za>

