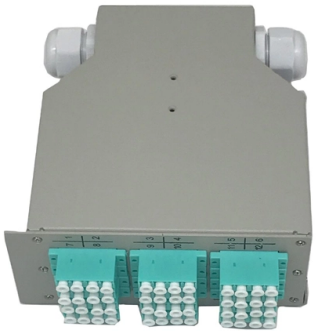
Relay Protection and Current Starting



Overview

Semi-conductor fuses (High speed fuses) are the only type of fuses that are fast enough to achieve a fully type 2 coordination when using a soft starter.

Key Takeaways

Relay protection ensures motors are safeguarded against overloads and faults, while motor starting current represents the high inrush current drawn when a motor begins operation.

Motor Starting Current

Motor starting current, also called inrush current or locked-rotor current (LRC), is the initial surge of current drawn by a motor when it starts with the rotor stationary. This current can be 5 to 8 times the motor's full-load current, depending on motor type and load conditions, and lasts for a brief period until the motor reaches operating speed. High starting currents can cause voltage drops, nuisance tripping of protection devices, and stress on electrical components.

Proper sizing of circuit breakers and protective relays is essential to handle this surge without compromising protection.

Relay Protection Basics

Protective relays are devices that detect abnormal conditions, such as overcurrent or short circuits, and initiate disconnection to protect equipment. Key concepts include: Pickup Current: The minimum current at which a relay begins to operate, overcoming the controlling force of the relay coil. Current Setting: Adjusts the relay's pickup current, often expressed as a percentage of the CT's rated secondary current.

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Plug Setting Multiplier (PSM): Ratio of fault current to relay pickup current, critical for determining relay operation. Time Setting Multiplier (TSM): Adjusts the relay's operating time, allowing coordination with upstream devices. When the actuating current exceeds the pickup current, the relay contacts move, triggering circuit breakers or other protective devices to isolate the fault.

Coordination with Motor StartingBecause motors draw high inrush currents, relay settings must distinguish between normal startup and fault conditions. Strategies include: Time-Delayed Overcurrent Relays: Allow brief overcurrent during startup without tripping. Type 2 Coordination: Achieved with fast-acting semiconductor fuses in combination with overload relays, suitable for soft starters.

Type 1 Coordination: Achieved with MCCBs or MMS, providing basic protection but may not fully coordinate with soft starters. Proper coordination ensures that overload relays protect the motor while upstream breakers handle larger system faults, preventing unnecessary shutdowns and equipment damage. Practical ConsiderationsDirect-On-Line (DOL) Starting: Simple and cost-effective, but results in high inrush current (5–8 times rated current) and requires careful relay coordination.

Soft Starters or Star-

Delta Starters: Reduce inrush current, allowing relays to operate closer to full-load settings without nuisance trips. Voltage Drop and System Capacity: Multiple motors starting simultaneously can exceed transformer or feeder capacity, so relay and breaker settings must account for cumulative inrush. By understanding motor starting characteristics and relay settings, engineers can design protection schemes that safeguard motors, maintain system stability, and minimize downtime.

Article Content

Motor Starting Current and Protection: Complete Guide

This comprehensive guide covers motor starting current fundamentals, NEC Article 430 requirements, protection device selection, and

Motor Starting, Protection and Control

Semi-conductor fuses (High speed fuses) are the only type of fuses that are fast enough to achieve a fully type 2 coordination when using a soft starter. A separate overload relay for the motor protection

Pick Up Current | Current Setting | Plug Setting ...

PDF file

Power System Protective Relays: Principles & Practices

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These curves can be used in conjunction with the motor time-current curve for a normal start to set protective relays and breakers for motor thermal protection during starting and running conditions.

Types of Electrical Protection Relays or Protective Relays

□□ Key learnings: Protective Relay Definition: A protective relay is an automatic device that senses abnormal conditions in electrical circuits and triggers actions to isolate faults. Types of

Motor protection and control

The protection relays provide main protection for synchronous and asynchronous motors. They can be used for circuit-breaker and contactor-controlled motors in a variety of drive applications, such as,

Protection Basics

Ground fault protection for these systems is usually provided by residual protection, either calculated by relay or by external CT residual connection to IN input

ETAP Relay Coordination Tutorial | Time-Current Curve Setup Guide ...

ETAP relay coordination tutorial covering time-current curve setup, protective device settings, and system modeling for power protection studies.

Practical handbook for relay protection engineers | EEP

Relay protection circuitry This handbook covers the code of practice in protection circuitry including standard lead and device numbers, mode of

Comprehensive Guide to Overload Relays: Motor Protection,

What is an Overload Relay? An overload relay is like a safety net for the motor. It allows for brief inrush currents, like the surge of current that occurs when the electric motor starts up, without triggering the

SEL-351 Protection System | Schweitzer Engineering Laboratories

The SEL-351 Relay has built-in Ethernet and IEEE C37.118 synchrophasors, and is ideal for directional overcurrent applications. Optional Mirrored Bits® communications and power quality monitoring add

SEL-387E Current Differential and Voltage Relay

The SEL-387E Current Differential and Voltage Relay provides protection to two- or three-winding power transformers. Voltage inputs for power metering, overexcitation protection, and over-/underfrequency

Power System Protective Relays: Principles & Practices

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Abstract: Protective relays and devices have been developed over 100 years ago to provide “last line” of defense for the electrical systems. They are intended to quickly identify a fault and isolate it so the

How to choose high-capacity relays for inrush current prevention ...

This guide provides detailed information on high-capacity relays that are perfect for inrush current protection and discharge circuits, which is important for ensuring safety during use in energy storage

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

Circuit Breakers (CBs), as well as Voltage and Current Transformers (VTs and CTs), are modeled as ideal elements. Appropriate relays are modeled using their generic description. The protective

Types and Applications Of Overcurrent Relay

The protection should not operate for starting currents, permissible overcurrent, current surges. To achieve this, the time delay is provided (in case of inverse relays).

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.

MRAC22e design sample

Motor winding protection is typically found in HVACR motors to safeguard against overheating due to over-current and/or high ambient temperature conditions. Split-phase motor starting devices include

Setting the generator protective relay functions

Protective relay functions and data This technical article will cover the gathering of information needed to calculate protective relay settings, the setting calculations for the various

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