

Relay protection open delta



AI Overview

Open delta connections use two single-phase transformers to provide three-phase voltage inputs to relays, primarily for earth fault and vector sum protection, with specific testing and measurement considerations.

Overview of Open Delta Connection

An open delta connection (also called V-V connection) uses two single-phase transformers to supply a three-phase system instead of the usual three transformers in a closed delta. This configuration is often used in emergency situations or for relay protection purposes when full three-phase transformers are not available. In relay protection, open delta PTs are commonly employed to:

- Detect earth faults in delta-connected windings.
- Measure the vector sum of phase voltages, which is zero under balanced conditions.
- Provide inputs to natural displacement relays or other protective relays for delta winding protection.

How Relays Interpret Open Delta Voltages

In an open delta PT setup: The relay receives phase-to-phase voltages from the two transformers. One PT end is often grounded near the relay for safety. The relay defines a reference voltage ($V_{NRELAY} = 0\text{ V}$), and measures V_{ARELAY} and V_{BRELAY} relative to this reference. From these two measured voltages, the relay calculates the remaining phase-to-phase voltages (V_{BC} , V_{CA}) using phasor relationships. This allows the relay to simulate a full three-phase measurement even though only two transformers are used, enabling detection of faults such as line-to-ground or earth faults in ungrounded or delta systems.

Applications in Protection

Open delta PTs are particularly useful for:

- Earth fault protection in delta-connected generator windings or ungrounded systems.
- Natural displacement relays, which rely on the vector sum of phase voltages to detect abnormal conditions.
- Overvoltage detection in ungrounded systems, where single line-to-ground faults cause the unfaulted phase-to-ground voltages to rise, which can be monitored via the open delta PT configuration.

Testing and Simulation

Testing relays connecte...

Article Content

What is an open delta voltage transformer used for?

The open delta voltage transformer reduces the AC voltage and large current proportionally to a value that can be directly measured by the meter

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 systems. They are intended to quickly identify a fault and isolate it so the

Protection for Unexpected Delta Sources

Under worst-case scenarios, without proper protection, the customer generation may keep the faulted utility circuit energized even after the utility source breakers have opened. This

47 Relay PT Connection: Open-Delta vs Wye for Negative Sequence

Open-delta PT connections are fully acceptable—and commonly specified—for 47 negative-sequence overvoltage relay applications. The relay's reliance on V1 and V2 (both phase-to

The Current Situation and Emerging Trends in Relay

Explore the latest trends in relay protection, including innovations in relay test set technology, the shift to digital relays, and tools like the secondary

Microsoft PowerPoint

First winding measuring second winding residual Damping resistor R is connected into one side of open delta.

Delta-Wye Transformer Protection Relay Settings

Learn about protection relay settings for delta-wye power transformers, including CT connections and phase shift compensation. Electrical Engineering guide.

Transformer Open Delta | Information by Electrical Professionals for ...

Open-Delta Power Transformers or Open-Delta VT's? There appears to be confusion between a power system supplied by open-delta connected power transformers and low voltage

Open Delta & Broken Delta Configuration

Mostly, this kind of configuration is used in Natural displacement relays to protect the delta winding against earth faults. Two single phase voltage transformer uses

Ground Fault Protection Using Open Break Delta Grounding

This paper presents a method for ground fault protection system scheme is used overvoltage relays and open break delta transformers, whereas for fault location detection using voltage transformers in star

Tech Brief #2: The Problem with Open-Delta Potential

Open-delta potential transformers (PTs) are used frequently in medium-voltage switchgear projects. When given the choice a protection

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

Test Set Configuration for Open-Delta PT Connection

This application note explains how to inject the proper phase-to-phase voltages to test a relay that is connected to an open-delta PT. SEL recommends grounding the B-phase near the relay

Earth Fault Protection

This will, with an open delta winding with 110V secondary, mean a percentage voltage of 1.6%, i.e. the polarizing sensitivity of directional ground fault relays must be high. In an open delta secondary

Transformer Protection Application Guide

This guide focuses primarily on application of protective relays for the protection of power transformers, with an emphasis on the most prevalent protection schemes and transformers.

Open Delta Transformer Connection: Calculation

What is an Open Delta Connection Transformer? An open delta connection transformer uses two single-phase transformers to supply a three

Broken Delta

Broken delta can also detect double line to ground fault if the relay is set sensitively. An engineering review will be needed to arrive at suitable relay

Evaluation of Distance and Directional Relay Elements on Lines With ...

For phase fault protection using directional overcurrent elements, we evaluate the performance of elements that apply:

CONNECTION DIAGRAM_FT-1

* For relay voltage connections shown set Analog input Voltage "VT connection" setting to Wye" for metering to work correctly. Refer to application manual for alternate connections to relay for open

OPEN DELTA PT for protection applications and how to ...

Protection relays has evolved from magnetic beam based electro-magnetic principles to modern digitized Intelligent devices which are multi functional, even though protection philosophy and ...

Evaluation of Distance and Directional Relay Elements on Lines With ...

This paper discusses the performance of popular distance and directional elements for several system configurations. In particular, it addresses the application of distance and directional relays for line

Open Delta Transformer Connection: Calculation

An open delta connection transformer uses two single-phase transformers to supply a three-phase load. Also known as a V-V system, this

Delta Transformer Open Phase: Why Protection Misses It

Standard protection systems—differential, overcurrent, earth fault, and overheating—failed to detect the fault. This case study examines the root cause and explains why

Open-delta vs wye-connected potential transformers

As three wye-connected PTs measure line-to-neutral voltage, they are a good selection for these types of applications. Use three wye-connected

Open-delta vs wye-connected potential transformers

Use three wye-connected potential transformers when using voltage as part of the ground fault protection. The line-to-neutral wye-connection on all

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