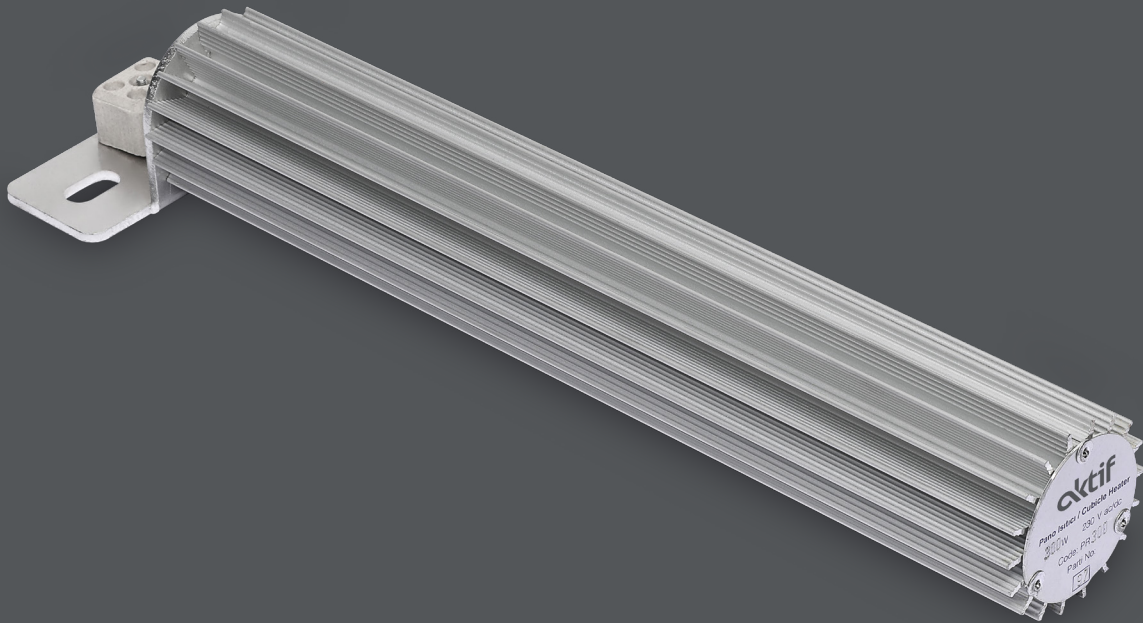


# Ferroresonance (Damping) Resistors



FRD Series

# Ferroresonance (Damping) Resistors

## FRD Series

Ferroresonance is a nonlinear resonance phenomenon that affects power networks. Circuit must contain at least below circuit elements as it can be defined as ferroresonance:

- Non-linear saturable inductance (example; transformer)
- Capacitor
- Resistor

In a circuit consists of these elements; by changing the values of an electrical component, the values of current and voltage values on the terminals at other components change suddenly.

### Applications Areas

- Voltage Transformers

### Standards

- IEC 60664-1
- IEC 60529

### Technical Specifications

Resistance Element	Stainless Steel Wire Wound
Frame Profile	High Cooling Surface Aluminum
Insulation	2 kV 50/60 Hz 1 min.
Protection Degree	IP 5X

### Advantages

- Prevents long-term overvoltages in phase-phase or phase-neutral voltages
- Prevents long-term overcurrents
- Prevents distortions in current and voltage waveforms
- Prevents overheating in transformers under no load

### Ferroresonance On The Voltage Transformers

A good example about Voltage Transformers destruction by ferroresonance is that the primary winding is destroyed and secondary winding remains intact.

However, all of these symptoms are not specific to the ferroresonance. For example, displacement of the neutral point may be the consequence of

a single phase to earth fault an unearthed neutral system. Voltage transformers can be into two different types as inductive and capacitive.

Inductive voltage transformers are more prone to ferroresonance. Because, they have more inductive characters and so they need more capacitance to convert ferroresonance circuit.

### Preventing Ferroresonance On Voltage Transformers

Ferroresonance may cause to overheating of voltage transformers and accordingly damage or over induction. It can be damped only by lowering the voltage or connecting a fixed ohmic resistance.

Although predicting when the ferroresonance might occur, the risk of it can be preventing or reducing by taking precautions in advance. There are some preventive measures for ferroresonance. However, the most practical and the most economical method is using ohmic resistance with open-delta winding on voltage transformers' secondary wirings.

When the voltage transformers' protection windings are used as circuit in Figure-1 (a fixed ohmic resistor is connected to ends of open-delta connection) third harmonic currents flows and thus the resonance is prevented. The advantages of this resistor; it doesn't affect measurement precision and doesn't cause to any loss under normal operation conditions. Open-delta circuit should be grounded from only one point shown as Figure-1. Resistor damps only unbalanced situations. On balanced situations, there is no current flow at open-delta circuit.

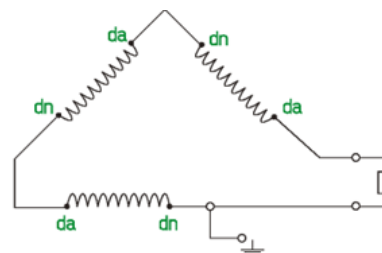


Figure-1



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