



# Magnetizing Inrush Inhibit Operating Principles

**GE Power Management No. GET-8429**

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## **PROBLEM**

Typical magnetizing inrush current exhibits significant amounts of higher harmonics, with the 2nd harmonic predominating. As such, second harmonic inhibit has traditionally been used for transformer restraint during magnetizing inrush conditions.

Microprocessor-based relays, such as GE Power Management's T60 and 745 relays, use Fourier transforms to estimate (measure, calculate) the second harmonic ratio. Values above a setting of 20% are classified as inrush cases; lower values allow the differential element to operate and trip the breakers.

Modern transformers may cause problems for this traditional approach. In these transformers, the amount of 2nd harmonic may be as low as 7 to 10% for long periods of time during inrush conditions, jeopardizing the security of transformer differential protection.

## **745 SOLUTION**

The 745 Transformer Management Relay copes with this problem by using an algorithm for detecting transformer de-energization. Upon detecting the transformer de-energized, the second harmonic threshold is automatically lowered for subsequent energization and kept low for a period of time – long enough to ensure proper relay operation.

## **T60 SOLUTION**

The T60 relay uses a novel and patented principle for second harmonic restraint. The relay checks not only the ratio between the second and first differential current harmonics, but also analyzes an angular relation (phase shift) between the two harmonics. This phase angle relation maintains certain unique patterns that enable the relay to restrain securely, even during inrush conditions when the ratio drops dramatically. The algorithm does not require any extra settings and is transparent to the user. As such, only traditional second harmonic threshold settings need be entered.