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Power Analysis

Testing Power Transformers

Introduction.

International standards such as IEEE C57 and IEC 76-1 detail many different tests that should be applied to line frequency distribution power transformers. One of those tests is the measurement of no load watts loss and current.

What is measured?

Power (in watts) is measured with no load on the transformer. For an ideal transformer the no-load watts would be zero. The power measured at no load is due to hysteresis and eddy-current losses in the core.

How is the power measured?

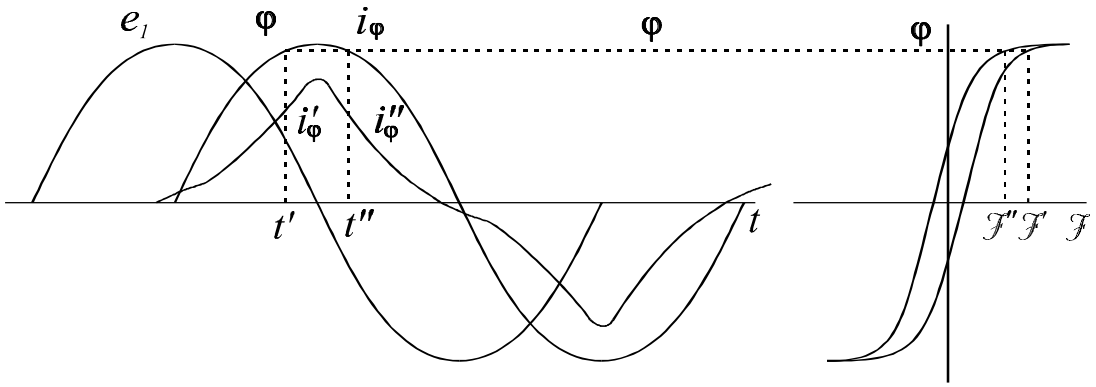
The power is measured by connecting a wattmeter across one winding of the power transformer. If a delta-connected winding is used then connect from line to line, if a star connected winding is used then connect from line to neutral.
The rated voltage and frequency are applied to the winding under test. Whichever winding is used, all others should be open-circuit.

What is special about this measurement?

Under no-load conditions the current drawn by a power transformer (the exiting current) consists of two parts.

1. The magnetizing current which is distorted and lags the voltage by 90°.
2. The core-loss component which is in phase and contributes to the power consumed.

In the following diagram the shape of the magnetizing current waveform, i, is determined graphically from the voltage, e. The instantaneous values of i are determined from the shape of the B-H curve which is a characteristic of the core material used.



Notice that:

- The current waveform (i) is heavily distorted, it is not a sinewave.
- The power factor will be low, typically 0.01
- The in-phase core-loss component of the total exiting current must be accurately determined from this distorted and phase-shifted waveform.
- Simultaneous measurements of rms voltage and mean-sensed rms voltage are required by the standard to compensate for the effects of voltage distortion.

Why is the Voltech PM3000A power analyzer ideal for making power transformer measurements?

1. The analyzer samples voltage and current at high speed and then calculate parameters according to their mathematical definitions. True rms results are displayed irrespective of waveform distortion and without reducing accuracy.
2. The special transformer mode built into the analyzer sets up all the measurements required by the standards in a few simple key pushes. The analyzer samples at 150kHz in this mode, guaranteeing high levels of accuracy and stability even at very low power factors.
3. rms and mean-sensed rms voltage results are calculated ***simultaneously*** from the ***same*** samples. Multiple instruments are not required.
4. k-factor and corrected power are also calculated and may be displayed directly.