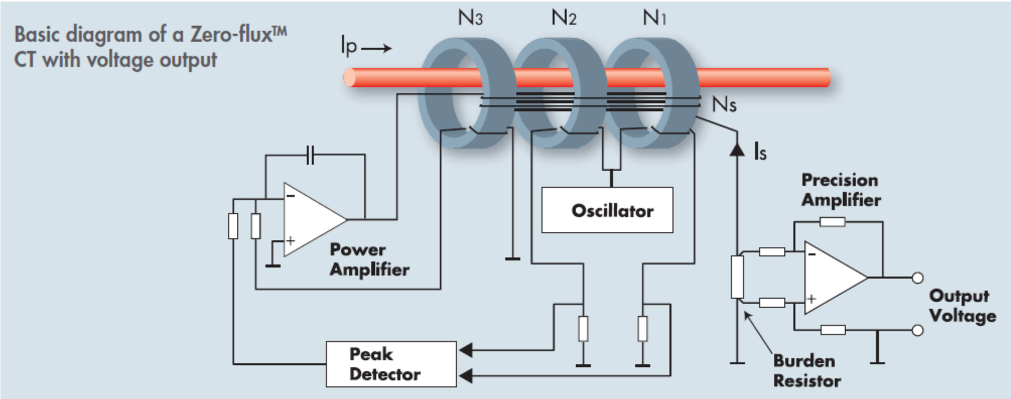
Zero-flux Principle

Accuracy makes the difference



Basic diagram of a Zero-flux™ CT with voltage output

THE BASIC PRINCIPLE

The primary current Ip generates a magnetic flux that will be counteracted by the current Is in the secondary winding (Ns) of the measuring head. Any remaining flux is sensed by three toroidal-wound ring cores located within the secondary winding volume.

Two of them (N1, N2) are used to sense the DC part of the remaining flux. N3 senses the AC part.
An oscillator drives the two DC flux-sensing cores into saturation in opposite directions. The resulting current peaks are equal in both directions if the remaining DC flux is zero. If not zero, their difference is proportional to the residual DC flux. The Zero-flux™ CT has a double peak detector to find this DC flux. After adding the AC component (N3), a control loop is set up to generate the secondary current that makes the flux zero. A power amplifier provides this current Is to the secondary winding Ns. The secondary current, which is a scaled image (1/Ns) of the primary current, is fed to the burden resistor to convert the signal into a voltage. The signal across the burden is amplified to make the signal available for further use. The unique design of the Zero-flux™ CT system provides high accuracy and stability without the need for temperature control devices.

Above several kHz, the power amplifier no longer has active control over its output current, but merely forms a short circuit. The Zero-flux™ CT still performs as a wideband current measuring device, but now with the measuring head as a passive current transformer. The final bandwidth is only limited by the stray reactance and capacitance in the head and interconnecting cable.

In case of a Zero-flux™ CT with current output, the secondary current is the output, omitting in that case the burden resistor and precision amplifier.

If the core saturates due to primary overload, the zero flux condition is lost, and a search cycle is started automatically. This means the secondary current is swept between the minus and plus current limits in a slow triangle until zero flux is detected, and normal tracking continues. The same happens when the auxiliary power is switched-on with primary current present.

THE BURDEN RESISTOR

In view of required measurement precision a four-wire resistor is the best. The power dissipation is kept very low, because the voltage drop across the resistor (usually 0.5V at rated current) is low. The thermal stability of the burden resistor, under normal load conditions, is ensured even over the long time.

THE PRECISION AMPLIFIER

The precision amplifier is a very stable differential amplifier, which delivers a highly accurate output voltage, proportional with the secondary current through the burden resistor. To ensure that the gain factor remains constant, the temperature coefficients of the gain-setting resistors are matched (TC tracking). The offset error is minimized by careful selection of the operational amplifier and fine-tuned during adjustment. The gain, usually 20x, is factory adjusted in order to compensate for tolerances in burden and gain-setting resistors. The output usually delivers 10V at the rated current and may be loaded by up to 5mA.

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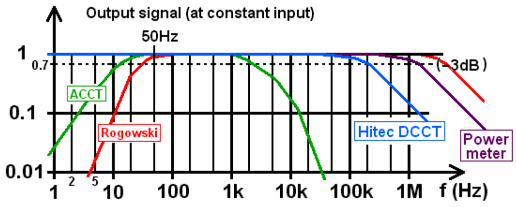
CTs AND DCCTs

Conventional AC measurement Current Transformers (CTs) lack the capability to measure current at low frequencies (for example 5Hz, as found in frequency inverter drives). DC current will not be transformed at all, as it saturates the transformer. AC with some DC might saturate a conventional transformer, or at least strongly distort the current shape.

The Hitec Direct-Current Current Transformer (DCCT), based on the Zero-flux™ principle, is able to measure currents in a wide bandwidth from DC to several kHz with a very high accuracy. Hitec DCCTs eliminate measuring errors which may arise with conventional AC sensors.



Transfer ratio of several current sensors types related to power meter

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