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Instrumentation

TECH NOTE CT-04/10
Current Transformer

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Safety

For personnel and equipment safety and measurement accuracy, current measurements on conductors at high voltage should be made only with a conducting shield cylinder placed inside the CT aperture. There should be a low electrical impedance connection from one end only to a reliable local ground. An inner insulating cylinder of adequate voltage isolation should be between the shield cylinder and the conductor at high voltage. Any leakage, induced or breakdown current between the high voltage conductor and the ground shield will substantially pass to local ground rather than through the signal cable to signal ground. Do not create a "current loop" by connecting the shield cylinder to ground from both ends. Current flowing in this loop will also be measured by the CT.

CT output signal termination

The CT output coaxial cable should preferably be terminated in 50 ohms. CT characteristics are guaranteed only when CT is terminated in 50 ohms. The termination should present sufficient power dissipation capability. When CT output is terminated in 50 ohms, its sensitivity is half that when terminated in a high-impedance load.

Installation recommendations

When the current to be measured is at high voltage, capacitive coupling between the high voltage conductor and the CT must be minimized. This becomes a critical issue when a low-sensitivity CT is used. In this context, CTs with less than 0.5 V/A in high-impedance output are considered “low sensitivity”.
The CT couples with the primary current conductor in two modes:
a) Magnetic coupling, which measures the current. This is the only desirable coupling.
b) Capacitive coupling with the conductor high voltage, which is undesired coupling.
Magnetic coupling and the capacitive coupling can be identified:
The CT output resulting from magnetic coupling changes polarity when the current direction changes.
The CT output resulting from capacitive coupling does not change when the current direction changes.
Therefore, to identify the signal caused by unwanted capacitive coupling, compare the CT output when the current conductor passes thru CT in one direction, then in the other direction: The output signal is the sum from magnetic coupling and capacitive coupling: the signal from magnetic coupling has changed polarity, while the signal from capacitve coupling has not changed polarity.
To minimize unwanted capacitive coupling:
a) Install common-mode filters on the CT output cable. To realize simply a common-mode filter, use a ferrite (or better: nanocrystalline) core and pass the coaxial cable 6 to 8 times thru the core. It will constitute an excellent common-mode filter.
b) Install a cylindrical shield between the current carrying conductor and the CT. The shield must be grounded with a low-impedance grounding wire. The shield must be grounded on one side only. If it were grounded on two sides, it would constitute a one-turn short around the CT (to be avoided!)
c) When possible, maximize the "good" signal from magnetic coupling, by using the most sensitive possible CT. To determine the most sensitive model which can be used, take into consideration:
- The CT I x t product must be higher than the primary pulse charge.
- Higher sensitivity CTs also have higher droop. The CT output signal droop must be acceptable in consideration of the duration of the signal to observe. CT output does not droop when the current is nil, in-between pulses.
- Short pulses (<50ns) peak current can be up to 4 times the CT maximum current. SMA and BNC connectors can withstand repetitive 3000 volts peak for short time. If the CT output signal is too high, attenuators can be used.