Choosing the Right Current Transformer (CT) for Metering Projects: Deciding Between Milli-Volt or 5 Amp Current Secondaries for CTs

Scope: This white paper explains what current CTs are and how to select the appropriate CTs for you or your customer's metering projects. It explores the differences between mV and standard Current CTs, i.e., 5 amp CTs.

What is a CT?

A CT transforms a primary input current into a secondary signal. The secondary signal can either be a voltage, typically 333 mV or a current, typically 5 amps. The CT is typically connected to a power cable or busbar. The secondary of the CT is proportional to the primary current and is suitable for measurement by instrumentation.

CTs have a central core, around which the secondary wire is wound. The CT is placed around the primary current conductor – the conductor wire passes through the CT. A magnetic field is generated and the secondary windings "step down" the amperage in the conductor to a proportional amount in the secondary. The number of windings, or secondary turns, determines the ratio of primary to secondary current. Ten windings will produce a 10:1 ratio, while twenty will produce a 20:1 ratio (the first number being the secondary and the second the primary), and so on. The greater the number of windings the greater the accuracy, though other factors, such as noise, can increase and affect the overall accuracy of the CT.

CT ratings are determined by the amount of current the CT can handle. CT accuracy depends on the number of windings, the size of the CT in proportion to the size of the conductor cable, the core material, and other factors.

The typical CT uses a 5 amp secondary current. However, for smaller loads this may not be ideal. For instance, measuring a 100 amp circuit will require only 20 windings with a 5 amp secondary. That type of transformer is difficult to manufacture and generally not as optimally accurate. There is a newer style in which the CT is wound to a lower current and an internal burden resistor transforms the current input to a low voltage output. These are typically referred to as mV CTs.

Low voltage mV CTs are intrinsically safer to work with than the higher current CTs. They only produce a low voltage signal and do not need shorting blocks like a 5 amp secondary CT would. Often the line the customer is monitoring needs to be shut down before the 5 amp CTs are attached and wired to the meter. This is generally not necessary with mV CTs.

What to Consider When Choosing CTs

Metering Application:
When using the meter to measure high amp circuits, i.e., over 400 amps, use standard current CTs. If the meter is being used for submetering applications, residential, or other lower amp circuits, mV CTs may be the best choice.

CT Accuracy:

If the meter is being used for revenue metering, revenue grade CTs with an accuracy of 0.3% or better are required by IEEE standards. Revenue grade CTs will usually be needed for demand metering, tenant submetering, and tenant billing. They are made to be used with revenue grade meters. They generally utilize a 5 amp secondary output. The benefit of the current loop output is that it is more noise-immune and as result, it will provide a better signal for high accuracy measurement.

For lower current measurements, mV CTs are superior since they have significantly more windings and will measure the voltage better. The disadvantages of mV CTs are that they utilize a small voltage signal and so are much more suspectable to noise interference. For this reason, when utility companies meter a commercial load, they will use high accuracy current output CTs. But the mV CTs are useful in smaller current applications.

How Many Amps Are Being Measured (Primary Output)?

A larger amount of current being monitored, e.g., in a utility application, requires the use of standard current input CTs. The mV CTs offer high accuracy at the lower end of the measurement range, i.e., 400 amps and below.

Note that in some utility applications, the secondary may be metered to prevent needing to open the CT circuit to add a meter. The mV CT can be installed on the secondary and attached to the meter.

Size of Installation Space:

A large CT might not be able to fit in small branch circuits or tight panels. For this reason, the more compact mV CTs have an advantage in these smaller enclosures.

Retrofit Installations

Split core CTs can be installed without disrupting existing wiring, which makes them ideal for retrofit applications. mV CTs are generally split-core.

Solid core CTs require that the conductor be disconnected to pass it through the CT window. Typically, this takes longer and requires a complete power shutdown.

Refer to the following table to see the advantages and disadvantages of both types of CTs.

<u>CT Comparison Standard Current CT with 5 Amp Output vs. mV CT with 0.333 V Output</u>

	5 Amp Output	mV Output
Advantages	They are industry standard.	They have a low cost.
	They are widely available.	They have a small size for fitting in switchgear and power panels.
	They have a large current input range.	They have safe outputs due to the low voltage secondary.
	The solid core CTs are low cost.	They do not require a shorting block, which reduces installation time.
	They are superior for revenue grade CTs.	They are more accurate at very low currents. Some mV CTs are revenue grade.
	They are more noise immune.	They can be run long distances.
	Most meter manufacturers accept them.	mV split cores are much less expensive.
Disadvantages	The split core CTs have a high cost.	They require a meter that supports mV inputs.
	Many of them have a large size.	They can have lower accuracy.
	Many of them are heavy.	They have poor phase shift performance.
	They require shorting blocks for safety.	They are typically available in split core only.
	They have limited ranges for small currents of less than 50 amps.	They are more susceptible to noise.