SENSELEQ

Switchable current transformers and an alternative

Roland BUERGER

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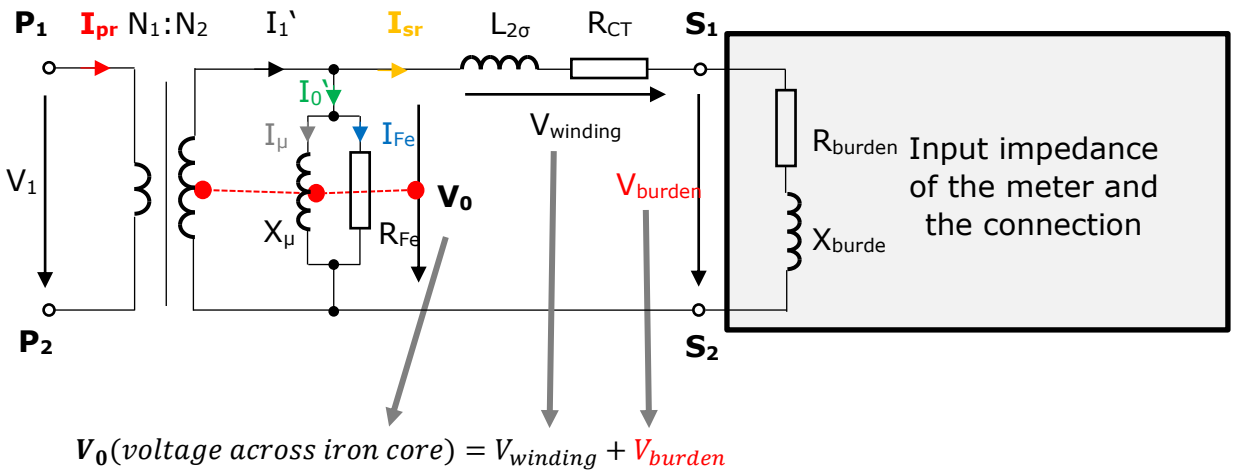
Introduction

The current transformer is often described in the literature as a non-linear measuring device. This is because the amplitude error is not constant in most cases. The magnetizing current of the core, which is mainly responsible for the undesired amplitude error and phase displacement, is the reason.



magnetic flux density in Tesla [T]

$$B_{peak} = \frac{\sqrt{2} \times \boldsymbol{V_0} \times 10^4}{2\pi \times f \times A_{Fe} \times f_U \times (number\ of\ secondary\ windings)}$$

cross-section iron core

filling factor iron

Figure 1: Electrical equivalent circuit of an inductive current transformer

The voltage drop $\mathbf{V_0}$ across the core is responsible for the actual magnetic operating point of the current transformer. The voltage is determined by the magnitude of the secondary current and the resulting voltage drops across the secondary winding (copper resistance) and the input impedance of the meter.

In the lower range of the current transformer, a larger proportion of the secondary current is often required for the magnetization of the core. Thus, larger percentage errors occur in the lower current range of the current transformer. This relationship becomes clear in the defined accuracy classes in the current transformer standard IEC 61869-2. For example, if the primary current is less than twenty percent of the nominal value, the accuracy class 0.5S allows larger percentage deviations.

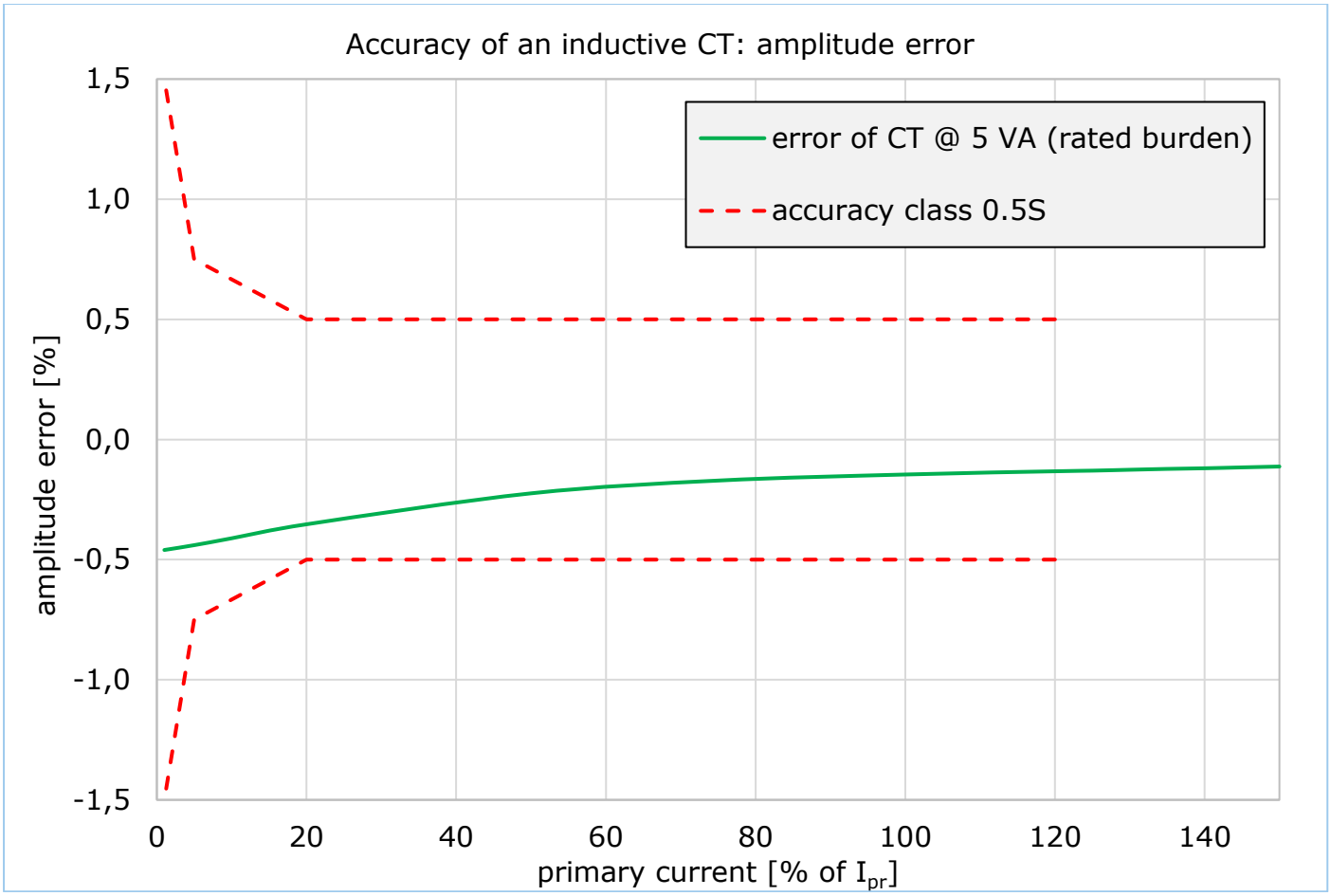


Figure 2: Accuracy plot of an inductive current transformer

To prevent inaccuracies at smaller current amplitudes, there are switchable current transformers. On the primary side, the rated primary current can be chosen by different configurations of the input terminals.

Primary switching capability: Current transformer with 2 x 100/1 A (CT error is the same for both ratios!)

Primary terminals open
The terminals C1 and C2 are isolated. The primary connections P1 and P2 are not connected. The primary current is not able to flow through the CT!

Circuit for 100/1 A (1 x I_{pr})
C1 is connected to C2. 2 x 100 A flow through the current transformer. This circuit is for the transformation ratio 100/1 A (**1 x I_{pr}**)

Circuit for 200/1 A (2 x I_{pr})
C1 is connected to P1. C2 is connected to P2. 200 A of primary current flows through the current transformer. This circuit is for the transformation ratio 200/1 A (**2 x I_{pr}**)

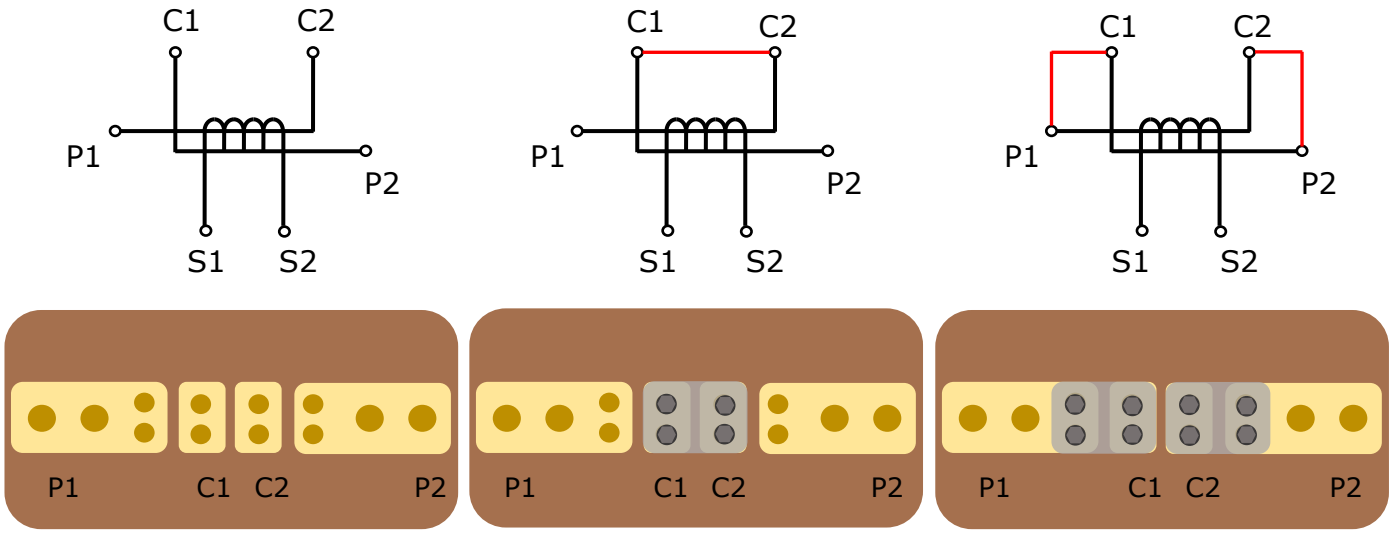


Figure 3: Current transformer (medium voltage block design) with switching capability

All the inner wounded cores have the ratio of 200/1 A. The aim of this instrument transformer concept is to keep the primary current close to the rated current of the current transformer.

With electronic current transformers from SENSELEQ, the problem of larger percentage errors or phase displacements at lower current amplitudes no longer exists. The following diagrams demonstrate the high accuracy of this measuring system.

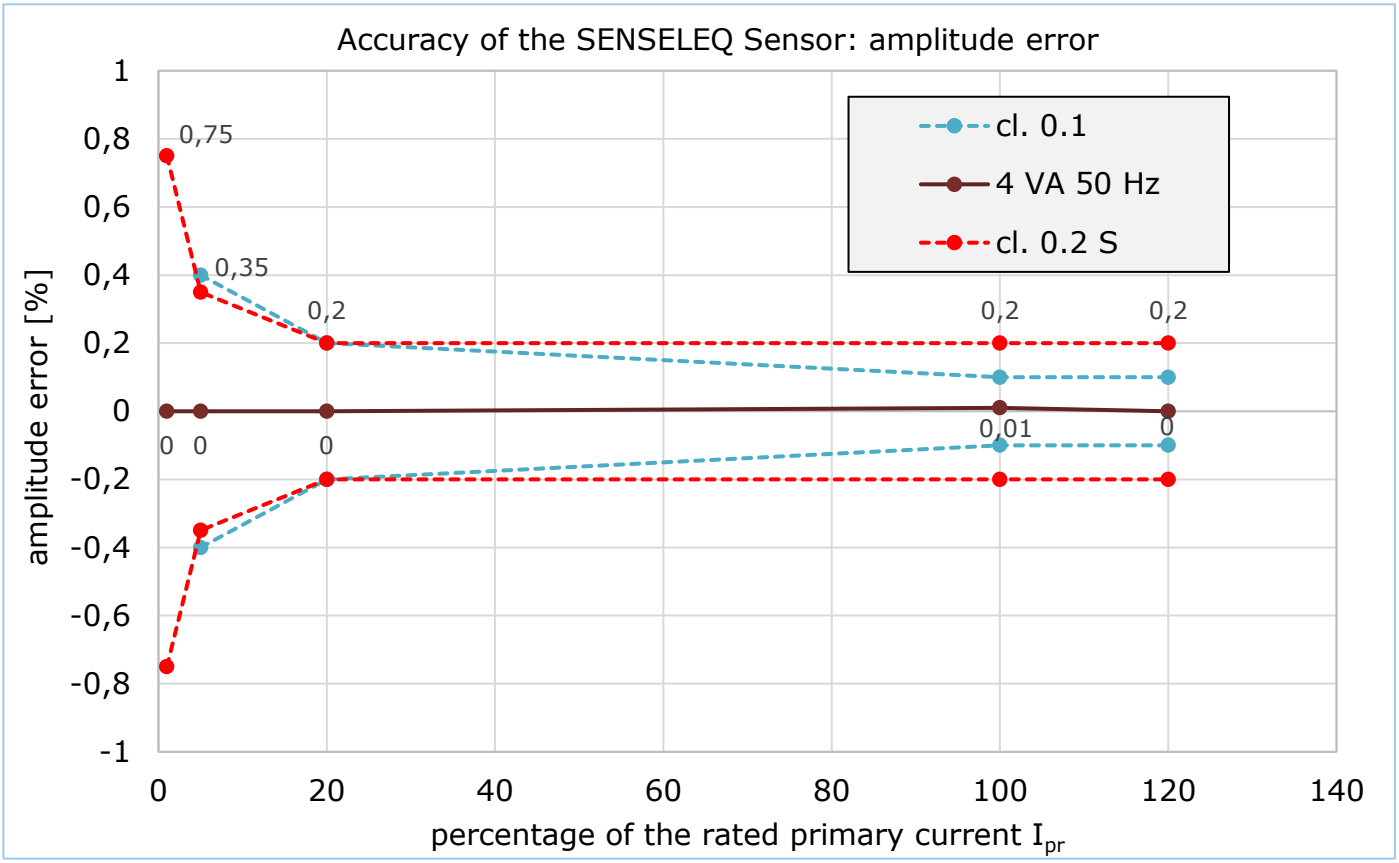


Figure 4: Amplitude error of fluxgate sensor with ratio 2500:1

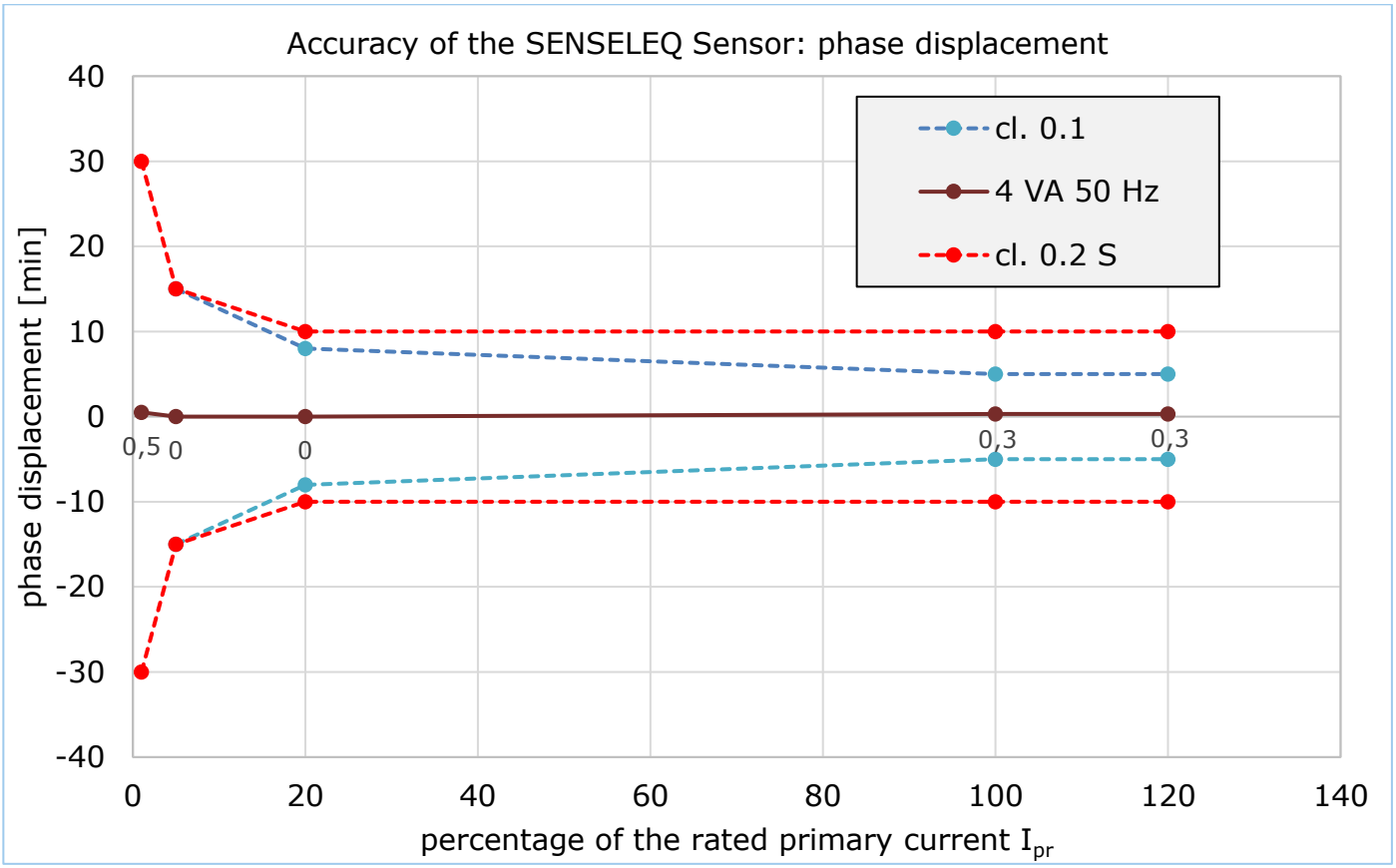


Figure 5: Phase displacement of a fluxgate transducer with ratio 2500:1

In addition to the high accuracy, the error path is always the same for all loads in the range from 0 to 4 VA, in contrast to the inductive current transformer.

Contact

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