**CT TECH NOTE 04-07: Influence of DC primary Current on Lower Cut-off Frequency and Droop Rate**

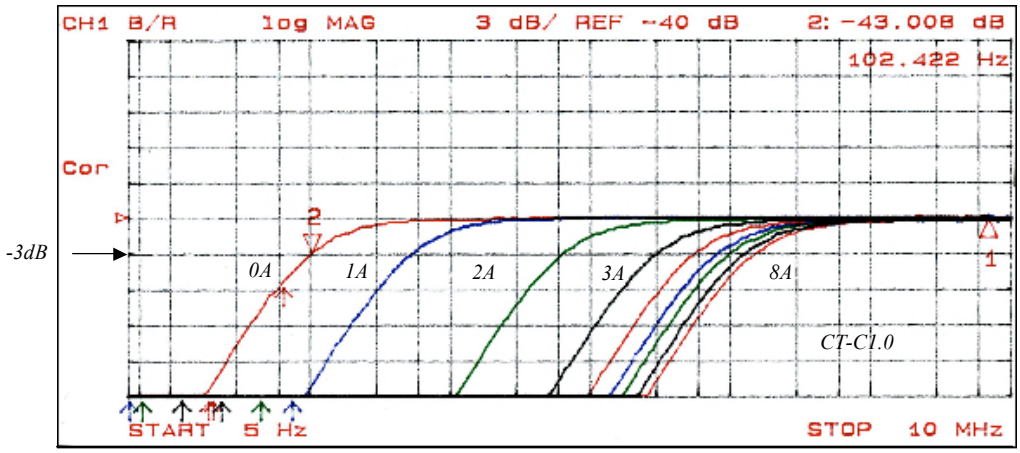
*Instrumentation*

The purpose of this technical note is to expose the effect of a DC primary current on the current transformer measurement. Primary DC current can either be the primary current DC component or a DC bias current applied to the CT primary to increase its I.t product.

Any DC primary current influences the transformer droop and lower cut-off frequency (see technical note CT TECH NOTE 03-07 for a discussion on droop). The droop and the -3dB lower cut-off frequency are linked by the relation:

$$\text{Droop} = 2\pi\ f_{low} = R/L$$

The CT magnetic core is composed of many small magnetic domains. Initially, they are not oriented. A DC current applied to the transformer primary causes the magnetic domains to get oriented along the magnetic field lines. As the DC current increases, more magnetic domains get oriented. When all magnetic domains are oriented, the core is saturated. The core useful magnetic cross section is the sum of all non-oriented domains. When their number decreases, the winding inductance decreases because it is proportional to the available magnetic cross section. The droop is inversely proportional to the winding inductance; therefore, a DC current applied to the transformer primary increases its droop. This is illustrated by the next figure:




*Lower cut-off frequency dependence to DC primary current*

| DC Bias (A) | Lower cut-off Frequency (- 3dB) kHz | Ratio |
|---|---|---|
| 0 | 0.102 | 1 |
| 1 | 0.530 | 5.2 |
| 2 | 6.420 | 63 |
| 3 | 29.90 | 293 |
| 4 | 56.20 | 550 |
| 5 | 81.07 | 795 |
| 6 | 100.4 | 984 |
| 7 | 128.5 | 1260 |

The DC current increases the CT lower cut-off frequency but does not change the high frequency response.
The CT droop and -3dB lower cut-off frequency are typically multiplied by 10 each time the DC component doubles.



Bergoz Instrumentation
156, rue du Mont Rond 01630 Saint Genis Pouilly, France
Tel: +33.450.426.642 Fax: +33.450.426.643 e-mail: info@bergoz.com
http://www.bergoz.com