Powertek

RCT*rms* Accuracy

A ***typical accuracy of 1% of full-scale at 25°C*** is described on the datasheet. This value is derived from various non-linearity, offset and gain adjust errors inherent in both the Rogowski coil and integrator and the signal conditioner. These errors are not affected by ambient conditions or the measured waveform.

The value of typical accuracy also makes assumptions about the errors arising as a result of the following

1. Variation of conductor position in the Rogowski loop
2. Frequency
3. Crest factor
4. External currents and voltages to the Rogowski loop
5. Temperature drift

It is important to understand these errors to obtain the best use from the RCT*rms* current transducer.

Conductor position in the Rogowski loop

Due to small variations in the winding density and coil cross sectional area the transducer output varies slightly depending on the position of the current in the loop and also the size of the current conductor relative to the loop.

A given bus-bar conductor of area ($140mm^2$) is moved around the Rogowski loop as shown in Figure 1.The Rogowski coil is calibrated with the conductor central in the Rogowski loop. The deviation in reading relative to the calibrated value, as the conductor is moved around the loop, is shown in Table 1.

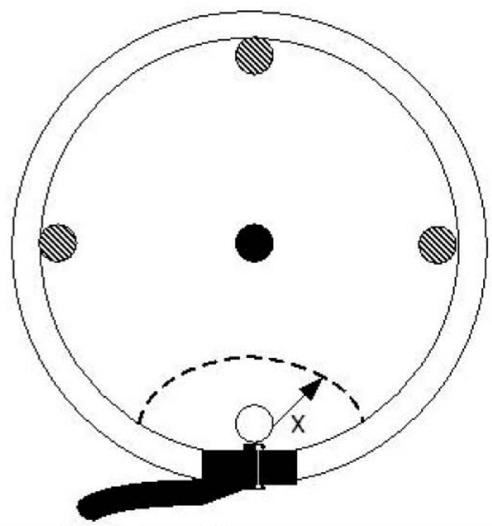
The positional variation is at its worst where the coil clips-together, every effort must be made to keep the conductor away from this area.

The Rogowski loop circumference is 700mm

	Conductor Position	Typical Error (%)
◍	Adjacent to the inside coil edge	**< 1%**
○	Adjacent to the clip together mechanism	**< 3%**
●	Central in the Rogowski loop	**0.2%**

x is a radius of 20mm from the clip-together mechanism to keep the positional error less than 1% for this given bus-bar size.

Note that with a larger conductor the variation of error with conductor position will decrease and approach the calibrated value.



Relative accuracy for positions of the conductor within the Rogowski loop

The value for typical accuracy assumes the current is central in the Rogowski loop

Temperature

The variation in accuracy of the RCT*rms* with temperature results from

1. Expansion of the plastic former onto which the Rogowski coil is wound. This reduces the sensitivity of the Rogowski coil.
2. Drift with temperature of the passive component values that set the integrator time constant
3. Drift with temperature of the true rms conversion. This increases the sensitivity and to some extent balances the effect of the former expansion.
4. Sensitivity drift with temperature in the voltage to current conversion process

To overcome these problems the Rogowski coil is wound onto a plastic former with a very low coefficient of expansion, and high stability resistors and capacitors set the integrator time constant. Both the rms to dc and voltage to current converters use high stability resistors.

The typical values for the various sources of error resulting from temperature change are as follows

	Drift %/^{o}C
Coil expansion	-0.01
Integrator drift	±0.013
RMS to DC converter drift	+0.005
Volt to current sensitivity drift	±0.011

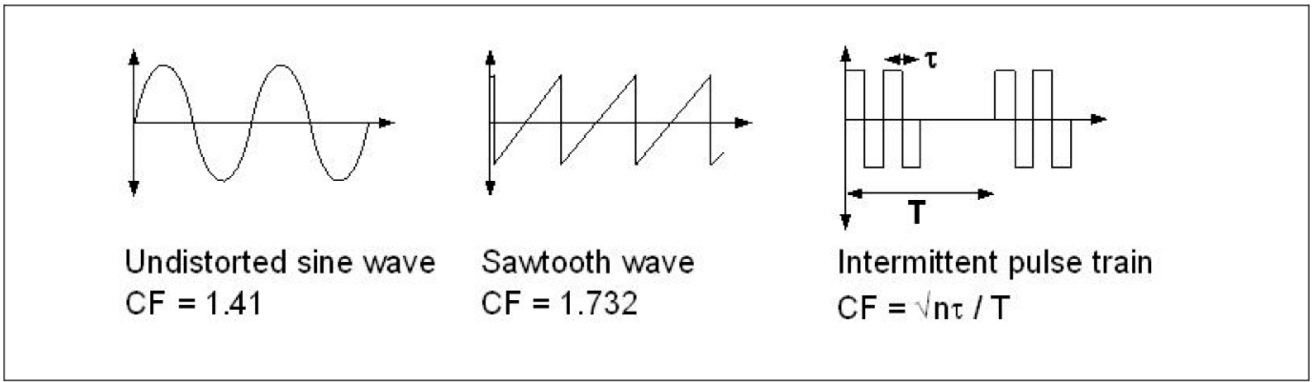
Sources of variation of accuracy with temperature

This gives rise to the typical temperature coefficients quoted on the datasheet of
-0.01 (Rogowski coil) ±0.02 %/°C of reading (for a 0-5Vdc output)
-0.01 (Rogowski coil) ±0.03 %/°C of reading (for a 4-20mA output)

Crest Factor

Crest factor is defined as the ratio of the peak value of the measured current to the rms value of the measured current.

For example the Figure below shows the crest factors of a few commonly encountered waveforms:



Crest factor (CF) of some common waveforms

As the crest factor of the measured current increases the accuracy of the measurement is reduced according to the table below. The RCT*rms* is capable of measuring waveforms with crest factors up to 5.

Crest factor	Error (%) of reading
2	0.2
3	0.8
4	1.5
5	2.5

Additional error due to crest factors > 1.

The value for typical accuracy assumes a crest factor of < 2.

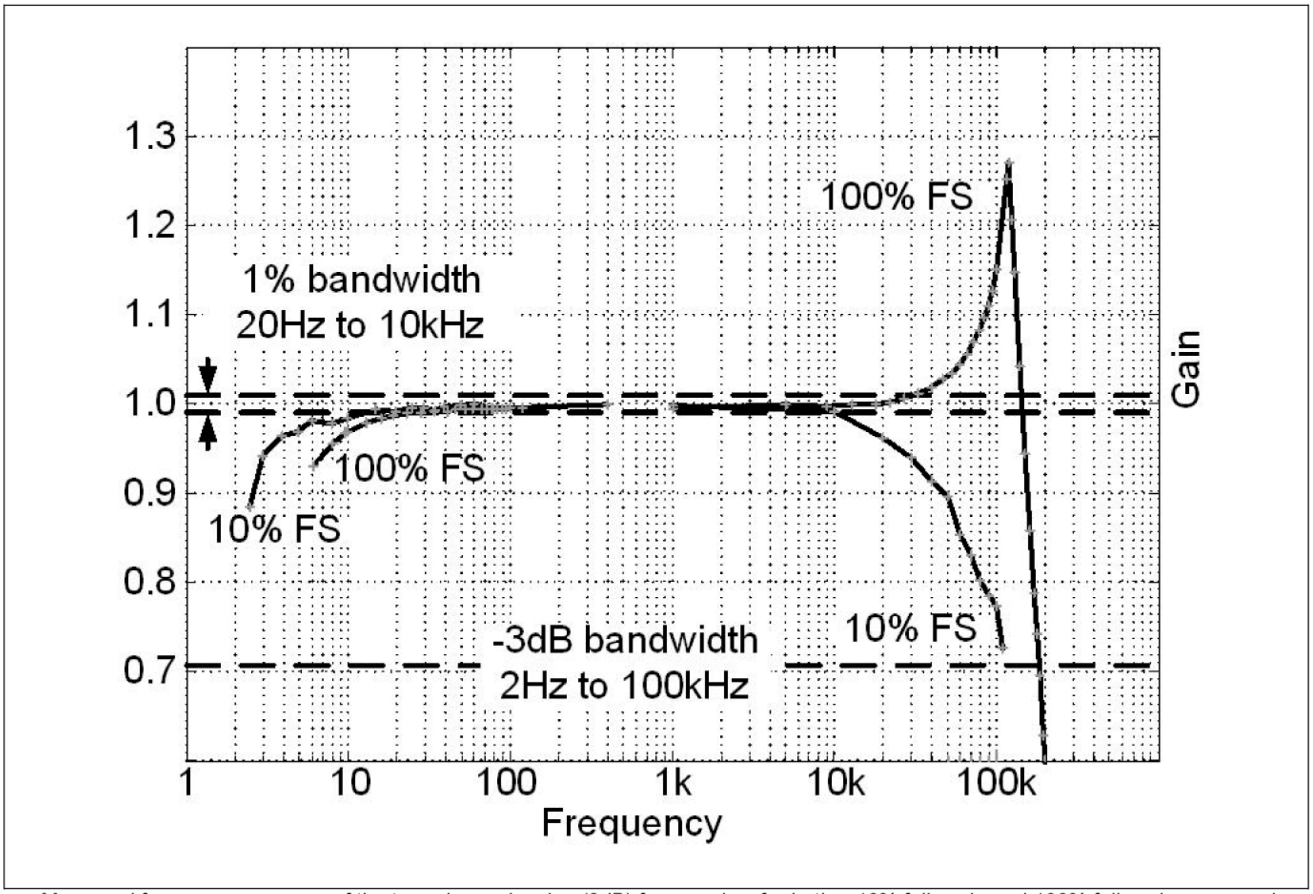
Frequency

The bandwidth is defined as the range of frequencies for which the measurement of a steady state sinusoidal current will remain within 3dB of its specified sensitivity (V/A).

Unlike PEM's other Rogowski current transducers it is the process of true rms conversion that limits the bandwidth.

As a result of the method of true rms conversion employed, the bandwidth varies with measured current magnitude. For example the frequency response in the figure overpage shows the bandwidth for both a measured current of 10% full scale and a measured current of 100% full scale.

The value for bandwidth (3dB) quoted on the short-form datasheet is based on the worst case i.e. 10% full scale.



Measured frequency response of the transducer showing (3dB) frequencies, for both a 10% full scale and 100% full scale measured current

External currents and voltages

Error can also arise due to the presence of currents close to but outside the Rogowski coil loop. A current of magnitude 100A close to the side of the coil will contribute an error of up to ±1A to the reading. This error will significantly decrease as the external current becomes more distant from the coil.

If the external current (outside the coil loop) is much greater than the current being measured (inside the coil loop) then the error may be significant. This is particularly relevant if the external current is flowing in a nearby multi-turn coil.

Similarly if there is a surface with a high voltage very close to the coil, and the voltage is subject to high rates of change (e.g. several 100 V/µs) or high frequency oscillations in the MHz range, then measurement error can arise due to capacitive coupling to the coil.

As a check for the effect of external currents or voltages the user should place the Rogowski coil in approximately the same position as used for measuring the desired current, but not looped around the desired current. Ideally there should be no measured signal. If there is interference then the same interference will be superimposed on the current waveform when it is measured and this can be taken into account when interpreting the measurement.

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