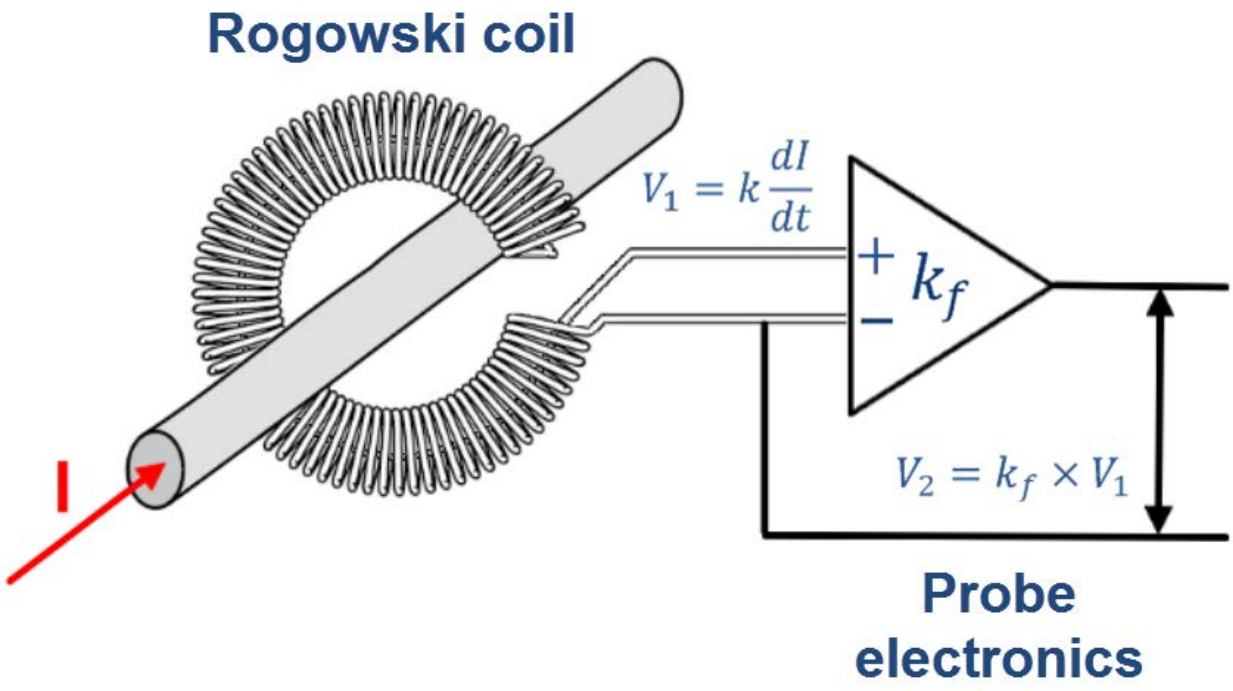
Rogowski Coil Primer

A Rogowski coil is a device for measuring AC current. The coil is a helical winding of wire resembling a large spring, with one end of the wire passed back through the center of the coil (see the illustration below). When the coil is wrapped around a conductor through which current is flowing, voltage directly proportional to the current is induced in the coil.

The AEMC AmpFlex® and MiniFlex® families of AC current probes incorporate Rogowski coils. Some of these probes include electronics to provide a stronger and linearized output signal. The following simplified diagram illustrates how these probes function:



In the preceding diagram, the probe's Rogowski coil has been placed around a conductor. As current (I) flows through the conductor, it induces a voltage (V_1) within the coil. V_1 varies in proportion to two variables:

- Amount of current in the conductor
- AC frequency of the current

Calculating instantaneous current from V_1 requires the following formula:

$$V_1 = k\frac{dI}{dt}$$

…where

- ***k*** is a value derived from the physical characteristics of the coil (loop size, number of turns, length of winding)

- ***dI/dt*** is the change in current over time (this is dependent on the current's frequency).

To convert V_1 to a linear, frequency-independent output voltage (V_2), the probe electronics remove the time/frequency variable from the equation. To do this, the probe electronics automatically adjust the gain in accordance with the current's frequency:

$$V_2 = k_f \times V_1$$

…where k_f is a value derived from the physical characteristics of the coil for a given frequency.

V_2 can then be used to calculate the associated current by applying a scale factor that is independent of frequency, such as 1A = 1mV. For example, the probe can be connected to a digital multimeter or similar measurement instrument to calculate and display the current reading, based on the input voltage and scale factor.

Rogowski coils offer a number of advantages over iron core, Hall effect, and flux gate probes:

- High resistance to electromagnetic interference.
- No saturation when measuring high currents (and therefore little heating).
- Lightweight and flexible.
- Can be wrapped multiple times around a conductor to amplify sensitivity.
- Can be left unterminated without damage or developing hazardous voltage levels

AmpFlex and MiniFlex
The AEMC AmpFlex® and MiniFlex® families of AC current probes enable measurements on conductors where standard clamp-on probes cannot be used.

Digital FlexProbe (a member of the AmpFlex family)

The AmpFlex Shape Memory feature allows you to pre-shape the sensor before inserting it between or around conductors. This feature facilitates positioning the sensor around the conductor, enhances user safety by eliminating the need to reach in to position the sensor, and alleviates the drooping effect associated with other flexible sensors.

AmpFlex and MiniFlex probes are lightweight and can be installed in tight spaces, around cable bundles, around wide or large bus bars, or even wrapped around irregular shapes. Probes create virtually no load to the system under test, have a low phase shift and excellent frequency response, and cannot be damaged by overloads. Probes are insensitive to DC currents; only the AC component of the measured signal is displayed.

MF 300-10-2-10 HF Probe (a member of the MiniFlex family)

These probes have a mV output proportional to the current measured for direct readings on digital multimeters, loggers, and power or harmonic meters. (Models specifically designed with a 1 MHz bandwidth are ideal for oscilloscope use.) Each probe's sensor assembly is insulated for 1000V CAT III (600V CAT IV), meets EN 61010, and is CE marked. Probes come in variety of lengths.

AmpFlex and MiniFlex probes can be used in a wide range of applications, including:

- power measurements
- measurements on switchboards
- measurements on thyristors
- switching measurements (disconnecting switch, etc.)
- display of control signals

For more information about AmpFlex and MiniFlex probes, visit the AEMC web site.