Athena Energy Corp.
High Performance, Wide Bandwidth
Rogowski Coil and Amplifier

Instructions for Use

Micro-Rogowski Coil
Athena Energy Corp.
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Owner’s Manual

Athena Energy’s Rogowski current transducer combines high bandwidth, low-insertion impedance, and flexibility. It is well suited for measurement of pulse currents, switching waveforms and general purpose power semiconductor characterization.

Safety and Use

- Athena Energy accepts no responsibility for any accidents or damage resulting from misuse, damage, and/or poor maintenance of this measurement system.
- The integrity of the insulation around the coil itself should be visually inspected before use. The wire coil is directly connected to the measurement electronics and a breach of the insulation could transfer dangerous voltages from a circuit under test to the oscilloscope input.
- Bending the sensor coil around a current-carrying conductor requires care to avoid tight turns and sharp corners that could cut the insulation.
- The voltage rating of the sensing coil is written on the cable and must be followed to assure safe operation.
- The free-end of the sensing coil must be inserted into the socket to maximize accuracy and avoid voltage-based insulation failure.

Warranty

A one-year warrantee from date of purchase applies to defects in workmanship or operational problems not attributed to misuse or mechanical damage to the coil and its insulation. This warrantee covers the coil and electronics in good physical condition.

Handling Instructions for Accurate Measurement

The Rogowski coil consists of a sleeved antenna that must form a closed circle around the conductor to be measured. This coil should be pressed into the barb to complete the antenna circuit to maximize the accuracy of the current measurement.

Switching it on

A single push-button switch allows the user to turn-on the device. If the signal is inverted, the probe has been inserted backwards. This does not affect the accuracy of the measurement in any way, though it is important to keep in mind that the Rogowski coil measures positive current flow relative to its insertion in the circuit being measured. Many oscilloscopes provide an invert function, so in most cases the probe does not need to be removed and re-inserted.

Battery

The amplifier box uses 3-AA batteries and a dual switching supply to power the unit. These have a limited life, indicated by the power LED on the power switch. If the LED is not lit during operation, there is not enough battery voltage to sustain correct operation of the measurement system.

Please remove dead batteries to avoid their leakage and measurement system damage.

Output cabling and oscilloscope settings

The output cable for this system is optimized for shorter runs of RG-58 cable in order to guarantee frequency response. Longer distances than 6ft will reduce the frequency response of the measurement system to values less than 20MHz.

Returning the Rogowski Current Sensor for Calibration or Repair

Please contact Athena Energy at contact@athenaenergycorp.com to get a return authorization.

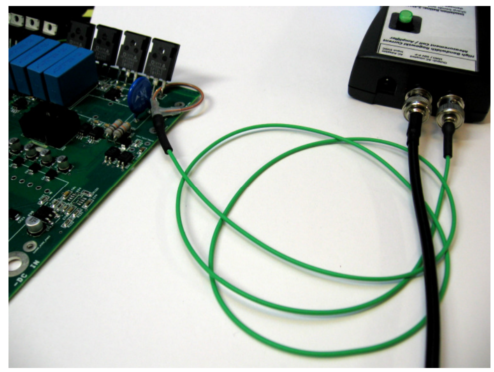
Our shipping address is:

13602 Ulysses Ct.
Bowie, MD 20720

Athena will cover shipment costs for systems that are defective. Please contact us for details.

Handling the Coil

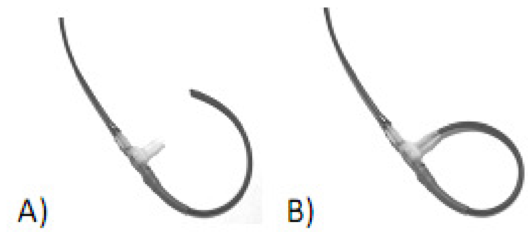
The operation of a Rogowski coil current measurement system is designed with high performance digital oscilloscopes in mind. The input impedance of typical oscilloscopes is 1MΩ and 28pF. Bandwidth and scaling changes and is reduced for low impedance inputs such as a 50Ω load or higher capacitance inputs. Long cable runs greater than 2m will also reduce bandwidth.



The front of the amplifier box contains the AC adaptor input, BNC Rogowski coil input, and BNC output jack to the oscilloscope.

The input power jack is setup for center conductor (+) input with 4-6 VDC supplied. Regulation is provided internally so a simple DC rectified source is all that is necessary.

Rogowski coils are designed to feed oscilloscopes setup for AC coupled inputs. This insures that the signal is on-screen for any measurement sensitivity. Also important in high accuracy measurement is the encirclement of the conductor by the Rogowski coil. This is facilitated by the T-connector housing. The free end of the coil: (A) can be plugged into the T-connector: (B) in order to simplify closing the circle around the conductor.



As long as the conductor under measurement is within this coil circle, an accurate current measurement can be carried out.

Specifications

Model	Output: mV/A	Imax (A)	LF Bandwidth (-6dB)	HF Bandwidth (-6dB)
1000A	10	1200	50Hz	10MHz
200A	50	240	1kHz	30MHz
100A	100	120	50Hz	15MHz
50A	200	60	60Hz	15MHz

Parameter	Value
Peak di/dt (A/ns)	2
Noise (mV pp)	5
Calibration	Within +/- 1%
Linearity	+/- 0.05%
Coil Operation Temperature Range (Standard Coil)	0-70°C
Coil Operation Temperature Range (High Temperature Coil)	-60-200°C
Output volts	+/- 12V
Output Connector	1m BNC (Frequency response drops with length)
Coil (Standard and High Voltage Models)	1m BNC
Coil (High Frequency Model)	.5m BNC
Battery	3-AA Alkaline or equivalent (~15h operating time)
DC Input	4-6V

Rogowski Coil Theory of Operation

The Rogowski coil is an electrical device for non-invasive monitoring and measuring of alternating-current (AC) or high-speed current pulses through a conductor. The coil is wrapped around a conductor to be measured, where changing currents induce an electrical field in the coil. The induced voltage (EMF) is proportional to the *change* in the current passing through a wire according to Faraday's law.

The Rogowski coil can be made open-ended and flexible, allowing it to be wrapped around a live conductor without disturbing it. Unlike conventional iron-core transformers, our Rogowski coil uses an air core, providing low insertion impedance along with no danger of saturating the core.

The voltage induced in the coil is proportional to the rate of change (time derivative) of current in the conductor. The input is integrated and amplified in order to provide an output signal that is proportional to current in the primary conductor. Figure 1 provides a simplified block diagram of a system using a rogowski coil to measure changes in current which converts it to a representative voltage output.

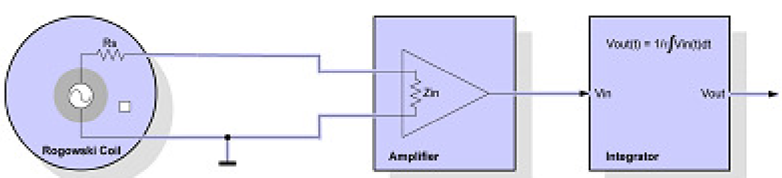


Figure 1: Simplified diagram of Rogowski coil connected to an amplifier and integrator.

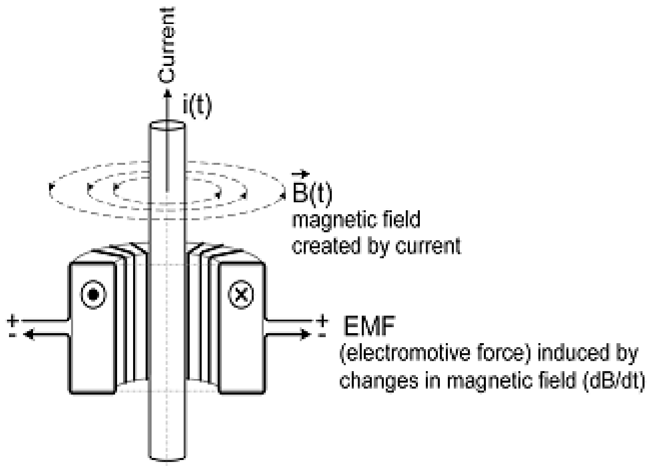


Figure 2: Inside a Rogowski coil.

From Faraday's law of induction illustrated in Figure 2, the EMF (which represents the output signal of a Rogowski current sensor) is proportional to the derivative of the current, the number of turns in the coil, and their area. The equation that models the output signal of N-turn rectangular Rogowski coil is given as:

$$\varepsilon = \frac{\mu N L}{2\pi} \ln\left(\frac{c}{b}\right)\frac{di(t)}{dt}$$

Where L, b, and c are height, inner and outer diameter of the coil respectively.

Producing precision Rogowski coils depends on the ability to control the physical dimensions of the coil and the precise stabilization, calibration, and application specific implementation of the integrator.