Rocoil
PRECISION ROGOWSKI COILS

ROCOIL 'DIN-RAIL' ROGOWSKI COIL INTEGRATOR WITH 4 - 20mA OUTPUT

FEATURES

- Compact integrator for DIN-rail mounting.
- True RMS measurement with industry-standard 4 - 20mA output
- Measures from less than 20A up to hundreds of kA.
- High crest factor
- Input and output protected against surges.
- Sensitivity can be specified by the user.
- Sensing coils can be replaced without the need for re-calibration.
- Can be used with two coils to give the sum (or difference) of the currents in two conductors.
- Flexible Rogowski coils can be fitted without 'breaking' the conductor
- Powered from an external DC supply.
- Withstands very large overloads for an indefinite time.

1. INTRODUCTION

The **Rocoil**® DIN-rail integrator is a single-channel integrator that can be used in conjunction with either flexible or rigid Rogowski coils to provide accurate current measurement where a 4 - 20mA output is required.

The Rogowski coil sensors provide complete isolation from the circuit being measured and have no effect on the current being measured even for very low-impedance circuits. These integrators measure the true RMS value of the current and provide an output as an industry-standard 4 - 20mA signal. The unit will measure current wave-forms with a high harmonic content and crest factors up to 5.

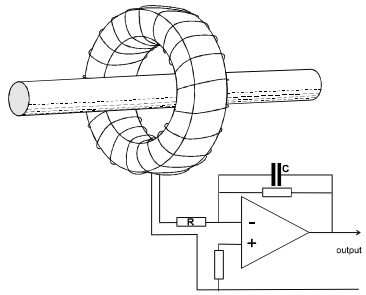
The measuring system cannot be harmed by current overloads. Also, unlike a current transformer, there is no danger from high voltages if the output from the coil is open-circuited.

There are other devices that measure electric current without making electrical contact with the conductor. Many of these, including the conventional current transformer, use a ferromagnetic core and are subject to magnetic saturation effects that limit the range of currents that they can measure. A Rogowski coil, on the other hand, is ‘linear’; it does not saturate and the mutual inductance between the coil and the conductor is independent of the current. Many of the useful features of Rogowski coil systems result from their linearity.

1. They have a wide dynamic range so that the same coil can be used to measure both very small and very large currents.
2. Calibration is easier because the coil may be calibrated at any convenient current level and the calibration will be accurate for all currents including very large ones.
3. Coils can be built which are very compact and can be fitted in confined spaces. They are thus very useful for retro-fit applications.

2. THE ROGOWSKI COIL PRINCIPLE

The coil is an 'air cored' toroidal winding placed round the conductor such that the alternating magnetic field produced by the current induces a voltage in the coil. The coil is effectively a mutual inductor coupled to the conductor being measured and the voltage output direct from the coil is proportional to the rate of change of current. The special design of the coil ensures that its output is not influenced significantly if the conductor is positioned 'off-centre'. The design also ensures that the influence from currents and magnetic fields external to the coil is minimal.



To complete the transducer the coil output voltage is integrated electronically to provide an output which is independent of frequency. By varying the integration parameters (C and R) the sensitivity of the complete measuring system can be varied over about five orders of magnitude. In the DIN1 unit the output of the integrator is converted to a true RMS value which is then converted to a 4 - 20mA DC output.

3. COIL SENSORS (Rogowski Coils)

The integrator can be used with either Flexible or Rigid coils.

3.1 Flexible Coils (Types 1012, 1112, 1232, 4022): Flexible Rogowski coils can be used for measuring electric current in large or awkwardly-shaped conductors, where space round the conductor is limited and for the measurement of very large currents (hundreds of kA).

Flexible coils are suitable for measurements requiring an accuracy of about 1%.

The coil is fitted by wrapping it round the conductor to be measured and bringing the ends together. The ends are fitted with a locating system to ensure that they are aligned correctly. The locating system can be either a 'push-together' type or a 'screw-together' type. Screw-together is more suitable for permanent installations.

Electrical connection to the coil is at one end only. The other end is 'free' to be threaded round awkwardly-shaped conductors or conductors in confined spaces.

It is not necessary to mount the coil so that it is circular nor is it necessary to have the conductor exactly in the centre of the loop. Off-centre operation does not normally introduce errors of more than I - 2%. If the coil is long enough it can be wrapped more than once round the conductor provided the ends are brought together correctly. The output is proportional to the number of wraps.
It may sometimes be necessary to build a framework to support the coil round the conductor. The design of the framework will depend on the conductor configuration.

3.2 Rigid Coils (type 2100): Rigid Rogowski coils have a greater accuracy and stability than flexible coils and excellent rejection of interference caused by external magnetic fields. They are not suitable for large conductors because the maximum aperture is less than 150mm.

3.3 Phasing: If two coils are being used for current summing they should be mounted in the same sense (i.e. with both the output leads coming off clockwise or both anti-clockwise) and the outputs will then add. If the outputs are mounted in the opposite sense the outputs will subtract

3.4 Insulation: Unless otherwise specified it should not be assumed that the coils are insulated against high voltages. Additional insulation should be used with conductors carrying dangerous voltages.

3.5 Connections: The coils are connected to the integrator by a 5mm 'twinax' cable which is normally permanently attached to the coil. The cable length can be at least 100m if required.

3.6 Calibration: The coils can be fitted with calibration resistors to make them interchangeable. An interchangeable coil can be replaced without the need to re-calibrate the whole system.

4. INTEGRATOR

4.1 Integrator Description: The integrator converts the output from the coil to a voltage which accurately reproduces the current waveform. This is converted to a 4 - 20mA DC output which represents the true RMS value of the current being measured.

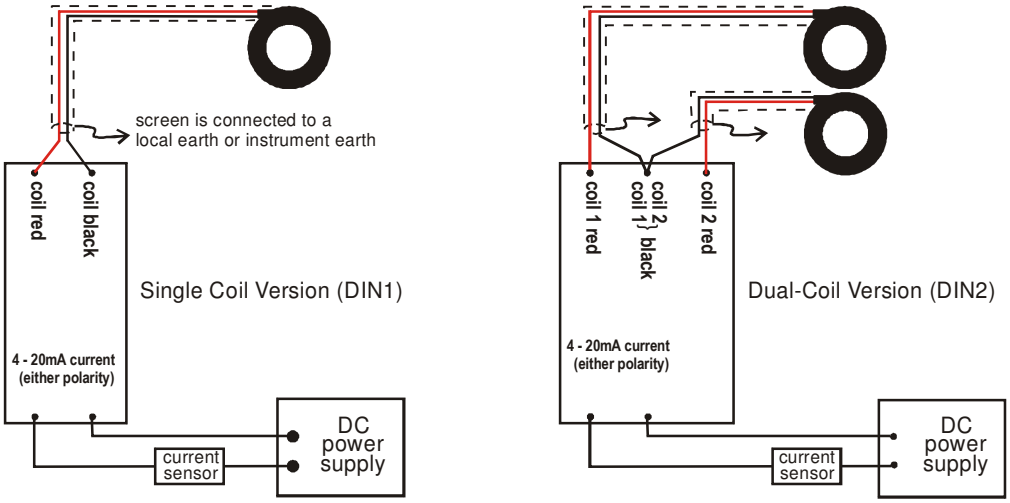
The current required to give 20mA output can be specified by the user.

4.2 Power Supply: The instrument is driven from an external power supply along the current output leads. The supply voltage depends on the load conditions and is calculated as:

9V + 20mA x (Load Resistance) up to a maximum of 36V

4.3 Single / Dual Coil Versions: The single-coil version (DIN1) has an input for one coil only. The dual-coil version (DIN2) can sum the contributions from two coils to give the total current in two separate conductors. This is a true 'algebraic' sum of the two current wave-forms. The RMS conversion takes place after the currents have been summed. When summing currents it is important. to ensure that the coils are connected in the correct phase relative to each other so that their contributions add rather than subtract (section 3.3). A dual-coil version can be used with one coil only. The other input should be left open-circuited.

The figure shows the power supply connections and the method of connecting coils in single coil and dual coil versions. The power supply can be connected either polarity.



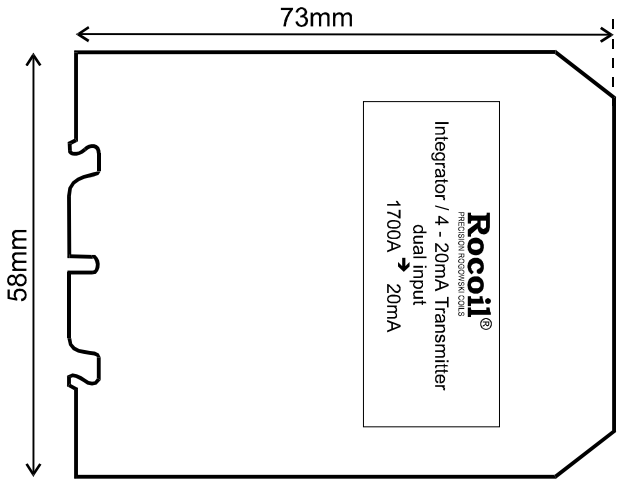
4.4 Frequency Response: The transducer is designed for measurements at power frequency including harmonics up to 10kHz

4.5 Response Time: The output from the integrator responds in about 50ms to a large increase in input current. The response to falling currents is slightly longer. Graphs showing the response time are given on page 5.

4.6 Protection: The integrator inputs incorporate Gas Discharge Tubes (GDT) to protect the input circuitry from transient voltages caused by a fast current edge applied to the Rogowski coil.

The output circuitry uses a Transzorb suppressor to protect against surges induced in the output leads.

4.7 Enclosure: The integrator is housed in a plastic enclosure with dimensions 73 x 58 mm (not including the rail clip). Connections for the coil inputs and current output / power supply are via screw connectors.



Rail mounting clip is not shown

Thicknesses:

Single input version: 16.5mm

Dual input version: 22.5mm

Transient response for the Rocoil DINrail Integrator.

The graphs show the measured response for a transition from zero current to maximum current and vice-versa.

Red trace = current waveform, blue trace = transducer response