OPERATION MANUAL FOR THE ROCOIL RAIL CURRENT TRANSDUCER

1. INTRODUCTION

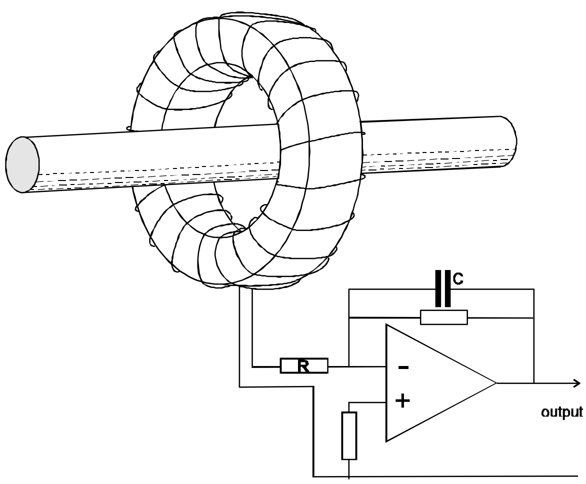
The **Rocoil**® Rail Current Transducer can be used to provide accurate measurement of the current in a railway line in a compact and portable measuring system which is simple to use.
There are other devices that measure electric current without making electrical contact with the conductor. Many of these, including the conventional current transformer, use a ferro-magnetic 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, does not saturate and is 'linear' over an enormous range of currents 'from milliamps to millions of amps'. This feature enables the accurate measurement of very low currents at certain selected frequencies in the presence of extremely large currents at other frequencies.

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.

In an ideal situation the coil should completely encircle the conductor being measured. This is not possible with the rail transducer and the coil is in the form of an inverted 'U' which encircles roughly half of the rail. The output of such a coil can be sensitive to the distribution of current in the rail and the current distribution is a function of the frequency. The dimensions of the coil have been carefully chosen to minimise the effect of this change in current distribution with frequency.

To complete the transducer the coil output voltage is integrated electronically to provide an output that reproduces the current waveform. This combination of coil and integrator provides a system where the output is independent of frequency. In the Rail Transducer additional filtering has been built into the electronics to. provide a frequency characteristic with excellent rejection of 50Hz currents but with a flat frequency response for frequencies above 1.3kHz. The output from the integrator can be used with any form of high-impedance electronic indicating device such as a voltmeter, oscilloscope, or spectrum analyser.

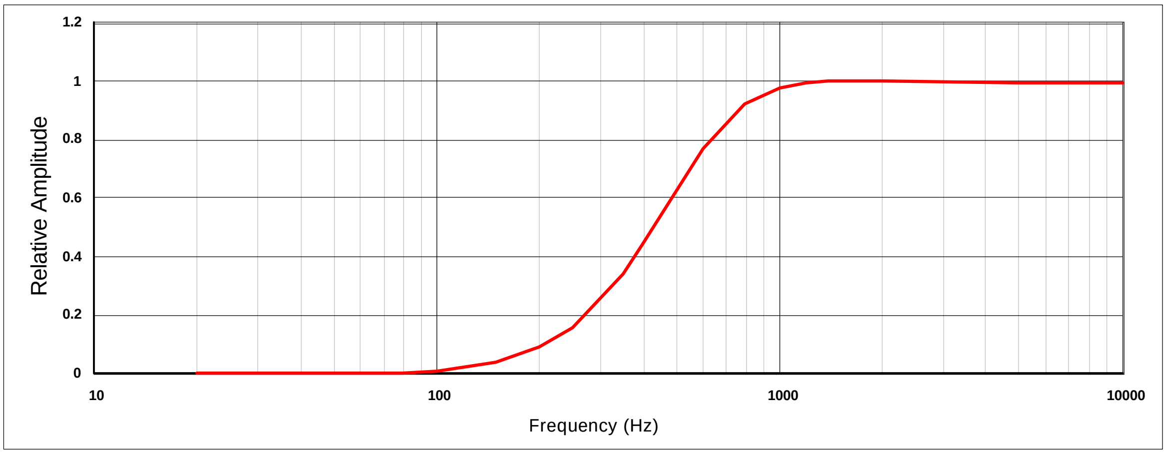


Schematic Arrangement of a Rogowski Coil and Integrator

3. SPECIFICATION

3.1 Frequency Response:

This transducer has been designed to have a flat frequency response in the frequency range above 1.3 kHz but with good rejection of signals at lower frequencies, particularly 50 Hz and DC. The graph shows the measured frequency response normalised to the output at 1.5kHz.



The rejection of 50 Hz currents is particularly good. In actual tests it was possible to measure 1.5 kHz currents using the 1A/Volt sensitivity range in the presence of a superimposed 50Hz current greater than 500A. The measuring capability of this transducer will not be affected by large DC currents.

3.2 Sensitivity:

There are two sensitivity ranges selected by a switch.
10A/volt, maximum current 65A peak
1A/Volt, maximum current 6.5A peak.

The maximum current refers to currents in the frequency range greater than 1.3kHz with the transducer powered from fresh batteries. At lower frequencies the maximum current can be larger in accordance with the frequency response curve shown above. The Transducer has been calibrated for use on Flat Bottom rail type. The calibration is sensitive to the rail type. For example with London Underground Bull-Head rail it will read about 10% higher.

3.3 Overloads.

A red LED on the top of the transducer indicates when the transducer is near the overload condition. This LED lights before the overload condition is reached so if it indicates a marginal overload with the LED flickering there is no real overload. When the transducer is first switched on the overload LED lights for about two seconds. Prolonged operation in the overload condition will not harm the transducer but there will be an increased battery consumption.

3.4 Output connections

Output is via 4mm sockets.

3.5 Enclosure

The Transducer is enclosed in a plastic box which ensures that the internal circuitry cannot make contact with a live rail. If the enclosure is damaged particularly along the inside surfaces of the 'legs' it may not be safe to use this unit.

3.6 Electromagnetic Compatibility

The transducer has no oscillitory circuits and there are no internal fast-edge transitions that could cause harmful emissions. The enclosure is screened internally to minimise interference from external sources of radiation.

4 POWER SUPPLY

4.1 Batteries

The transducer is powered from two PP3 batteries. These are accessed in compartments in the side of the transducer and can be changed without removing the lid of the transducer. NOTE the battery holders are mounted up-side down. This is to prevent rain water collecting in the battery trays.

4.2 Battery Monitor

When the switch is turned to TEST an LED labelled BATTERY TEST indicates the approximate state of the combined battery voltage as follows:

Green:	combined battery voltage greater than 14V
Flashing red / green	combined battery voltage in the range 11 - 14V
Red	combined battery voltage less than 11V

4.3 Battery Life

Estimated to be greater than 80 hours continuous use when alkaline batteries are used.

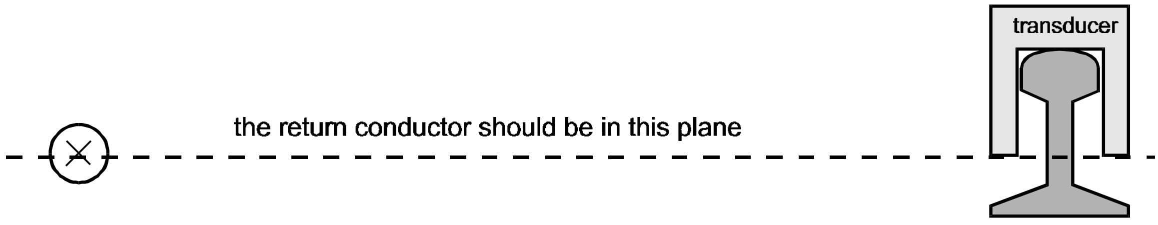
5 OPERATION

The transducer is placed over the rail preferably in a central position. There should be no packing between the transducer and the rail as this will affect accuracy. The transducer should be positioned approximately mid way between rail supports.

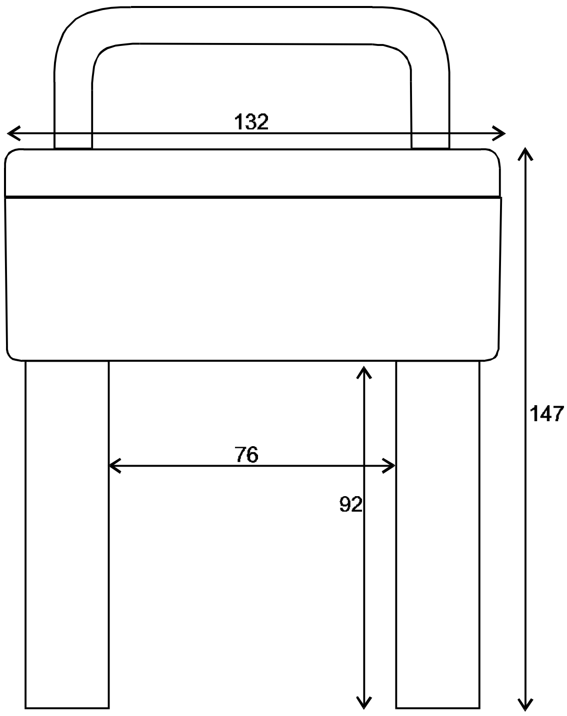
The transducer is switched on using a rotary switch having positions OFF, TEST, 10A, 1A. When the transducer is switched from TEST to 10A the overload LED lights for about 2 seconds. Apart from this the transducer requires no ‘settling time’.

6 TESTING

If the transducer is to be tested in a laboratory some precautions are necessary to ensure accurate results.
The transducer should be tested on a section of rail of the correct cross section.
The ‘return conductor’ should be in a plane as shown in the figure below.



If the return conductor is in a different position, the transducer will be affected by the current in the return conductor and give an inaccurate reading.



Approximate dimensions. Case material: black plastic