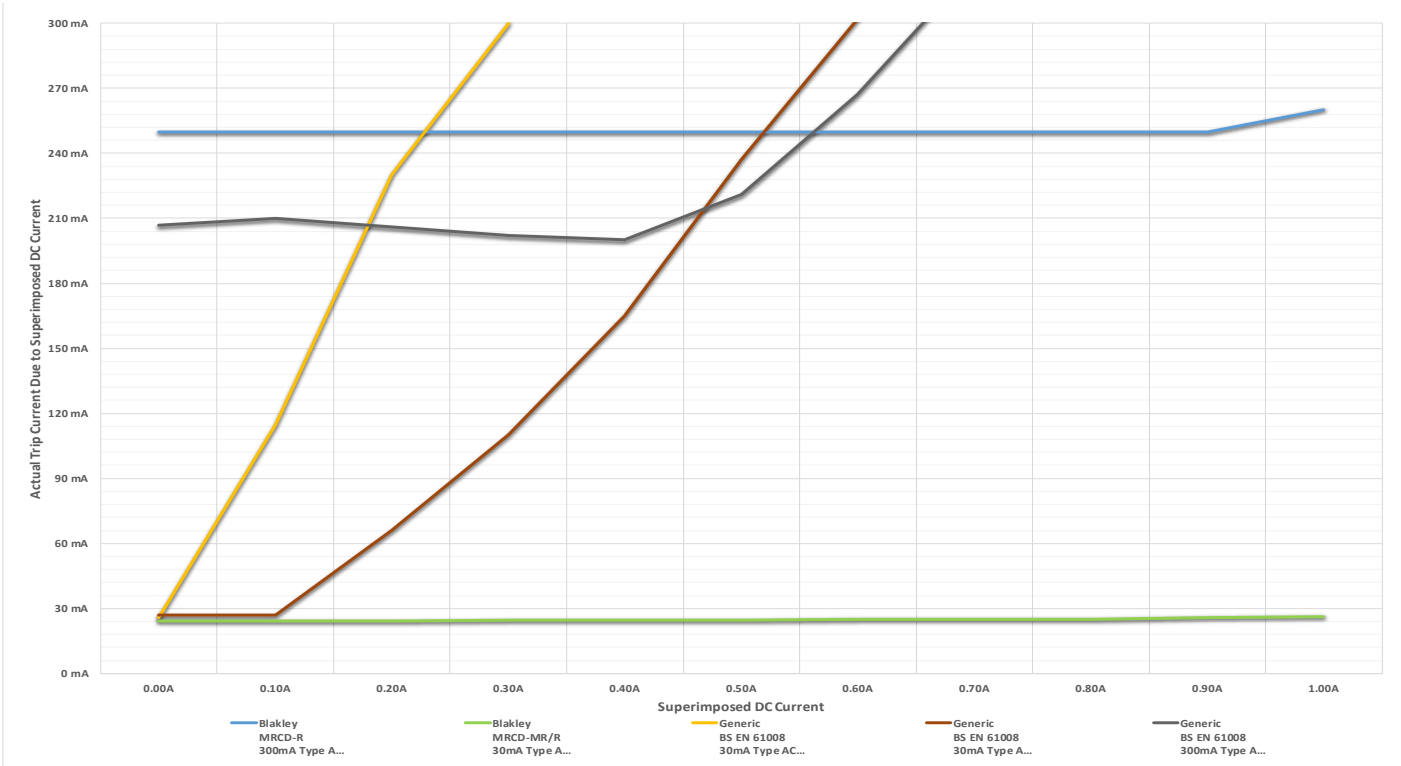
Blakley Electrics DC Immune RCDs for Third Rail / DC Electrified Locations

DC leakage currents, present in Third Rail DC electrified locations, can reach levels which will either permanently saturate the magnetic circuit of a non-DC immune RCD or dramatically increase the intended point of trip of the device. Saturation by DC current will prevent a non-DC immune RCD from correctly responding to an additional AC imbalance / fault current. If exposed only to AC currents (which naturally alternate) a non-DC immune device will have tripped before the AC current can cause saturation. However, due to the constant nature of DC, the non-DC immune RCD will remain permanently saturated and be unable to provide the intended level of protection. Rail standards such as RSSB GL/RT1255:2009 and Network Rail NR/GN/ELP/27247:2005 and NR/SP/ELP/27242:2005 recognise that DC leakage or stray DC currents can affect the operation of RCDs and recommend that only RCDs with a high immunity to DC leakage are used in DC electrified locations. Blakley Electrics RCD protection assemblies incorporate the Blakley Electrics range of MRCDs (Modular Residual Current Devices), these possess a high level of immunity to the effect of DC currents, are manufactured in accordance with BS EN 60947-2 Annex M and are suitable for Network Rail Third Rail / DC electrified locations.

The Effect of DC leakage / Stray currents

As previously stated, DC leakage currents can saturate the magnetic circuit of non-DC immune or ‘standard’ RCDs. The saturation results in a dramatic increase in the RCD’s rated operating / trip current. This is contrary to the common belief that the presence of DC sensitises a standard RCD and will contribute to nuisance tripping. Rather than sensitising the standard RCD, the presence of DC decreases the sensitivity, so that the standard device no longer offers the intended level protection and will trip at a potentially far greater current level.
The chart below illustrates the dramatic effects of relatively low levels of DC current on the operating / trip current of a non-DC Immune RCD, in comparison to Blakley Electrics DC immune RCD protection assemblies of different sensitivities. See page 4 of this document for further information on core saturation.



Network Rail DC Immune RCD Equipment

Blakley Electrics earth leakage sensors are recognised by Network Rail as satisfying the DC immunity requirements of RSSB GL/RT1255:2009 and Network Rail document NR/GN/LP/27247:2005 and NR/SP/ELP/27242:2005. Our sensors work in conjunction with a double-pole, triple-pole or four pole MCB or MCCB and are available in overcurrent ratings ranging from 1A to 1000A and beyond. Both fixed instantaneous 30mA MRCDs and MRCDs with adjustable sensitivity (30mA to 30A) and time delay (0 to 10s) are available.

We offer individual and multi-way DC Immune RCD assemblies. Individual assemblies can have one or more incoming and outgoing circuit, whilst multi-way units incorporate an incoming isolator and function as an MCB distribution board with DC immune RCD protection of each outgoing way. We are also able to produce custom / bespoke assemblies incorporating DC immune RCDs. For further details please contact our technical sales department.

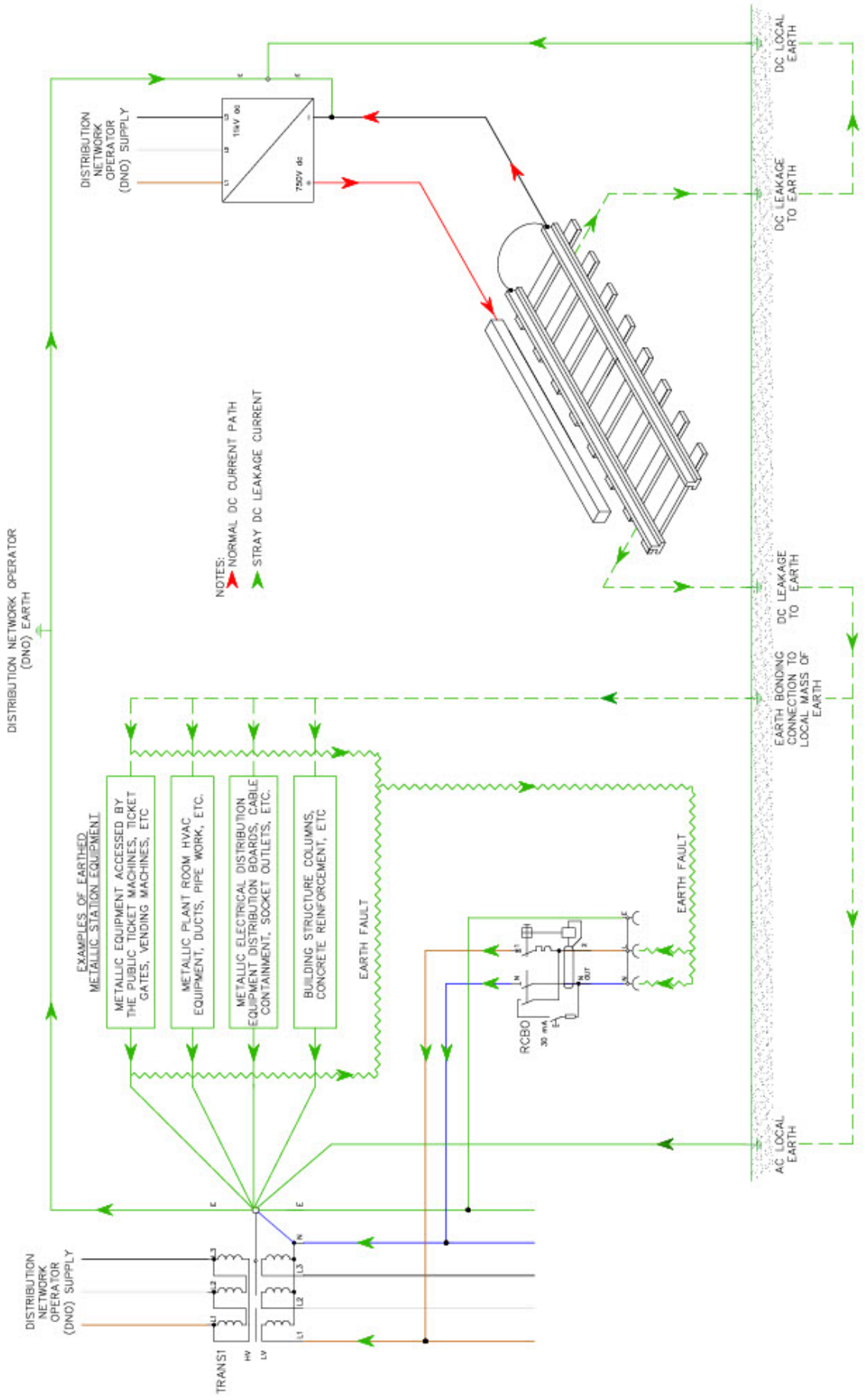
Multiway DC Immune RCD Assembly, 30mA Fixed

SRC series 100A 4P DC Immune Variable RCD

ELE Series Type A
RCD Assemblies,
Double Pole or 4 Pole,
Fixed or Variable Sensitivity,
up to 125A rating

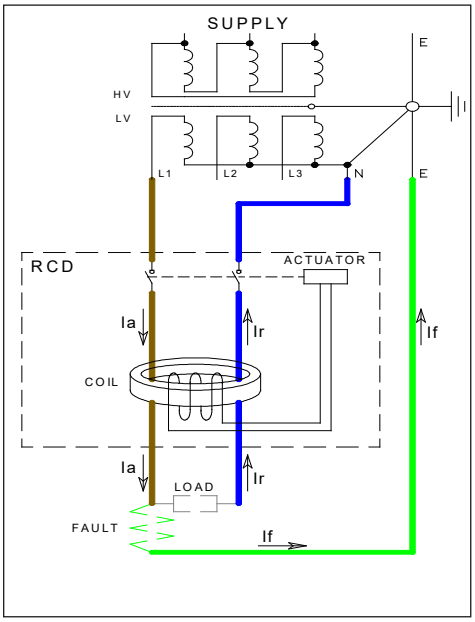
ARC series 160A 4P DC Immune Variable RCD

Typical Network Rail 750V DC third rail electrification and low voltage AC distribution network, illustrating how DC traction current can unintentionally be superimposed on cables passing through an RCD.



RCD Theory

Basic Operation



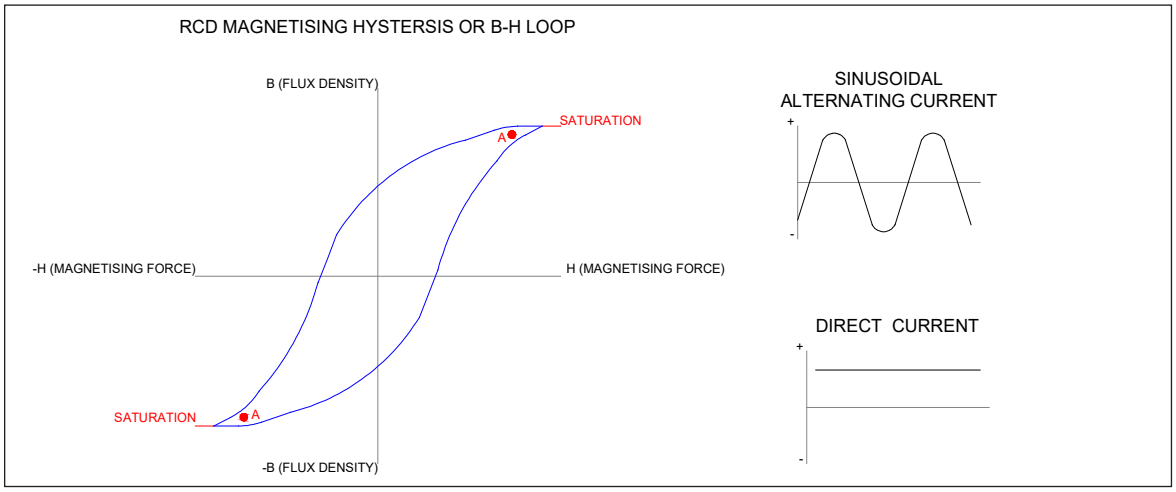
In normal conditions the currents Ia and Ir (illustrated opposite) are equal and this balance in currents prevents a magnetic flux from being induced in the sensing coil of the RCD.

If current flowing in Ia fails to return along Ir and by-passes the sensing coil of the RCD by taking fault path If, this will create an imbalance which will induce a magnetic flux in the sensing coil of the RCD. Once this imbalance reaches a predefined magnitude (the point of trip of the RCD), the device will operate and disconnect the load from the supply.

RCDs are designed to operate when they detect a fault current which is greater than 50% but no greater than 100% of their rated tripping current (IΔn). In practice, the point of trip of many RCDs is closer to 50% than 100% of the rated tripping current, which can lead to nuisance tripping. Blakley fixed sensitivity MRCD-Rs are designed to trip at 75% of their rated tripping current and Blakley adjustable sensitivity MRCD-Rs are designed to trip at 80% when set at 30mA and 90% when set at greater than 30mA. Both fixed and adjustable Blakley devices will help reduce the potential for nuisance tripping.

RCD point of Trip / Trip Characteristics

The point of trip of an RCD depends upon the hysteresis loop of the ferromagnetic material used in the construction of the RCD's sensing coil. The hysteresis loop details the relationship between the induced magnetic flux density (B) and the magnetising force (H) and is often referred to as the B-H loop as detailed below.



The above loop illustrates that the greater the amount of current applied (H) the stronger the magnetic field (B). However, as the magnetic field reaches point 'A' any additional increase in current (H) produces an increasingly smaller and smaller magnetic flux, until the material reaches the point of magnetic saturation. In non-DC immune RCDs, low levels of DC can saturate a sensing coil, with the result that the RCD may fail to operate completely or the point of trip of the device may increase dramatically i.e. the RCD becomes desensitised and cannot provide the intended level of protection.

Common Types of Non-DC Immune RCDs

There are a number of different RCD types offered by the major switchgear manufacturers. Some of these may have DC properties although they are very different to the DC immunity of Blakley Electrics RCDs.

AC Type – operates to residual sinusoidal alternating currents.

A Type – operates to residual sinusoidal alternating currents and pulsating direct currents.

B Type – operates to residual sinusoidal alternating currents, pulsating direct currents and pure direct currents.

S Type – Selective or time delayed device.

Immune to Pulsating DC – Some manufactures offer RCDs immune to pulsating DC which are typically AC type devices immune to very low levels of pulsating DC and not immune to pure DC.