

Understanding RCD Blinding: Causes and Solutions

Introduction

Electronic equipment operating normally can induce DC earth-leakage current in circuits. EV charging equipment is one common source of DC earth-leakage current.

Type A RCDs typically provide upstream protection for multiple EV chargers. They protect against AC earth-leakage current but do not provide protection from excess DC earth-leakage current. This is not necessary when Type B RCDs are the first line of protection. However, the operating coils of some type A RCDs can be saturated by DC earth-leakage current. This can have an impact on their ability to operate correctly. This phenomenon is known as “blinding”.

Type A RCDs which comply with IEC 61008-1 must be tested for resistance to blinding in the presence of “a half-wave rectified residual current...superimposed by a smooth direct current of 0,006 A” (IEC 61008-1 9.21.1.4). The accumulated DC earth-leakage current from multiple EV chargers commonly exceeds this 6mA value stipulated by the standard.

There are therefore two considerations for earth-leakage protection of such circuits (refer to Figure 1.):

1. Protection from excess DC earth-leakage current in the circuit directly feeding the charger
2. “Blinding” of upstream RCDs caused by DC earth-leakage current in excess of 6mA

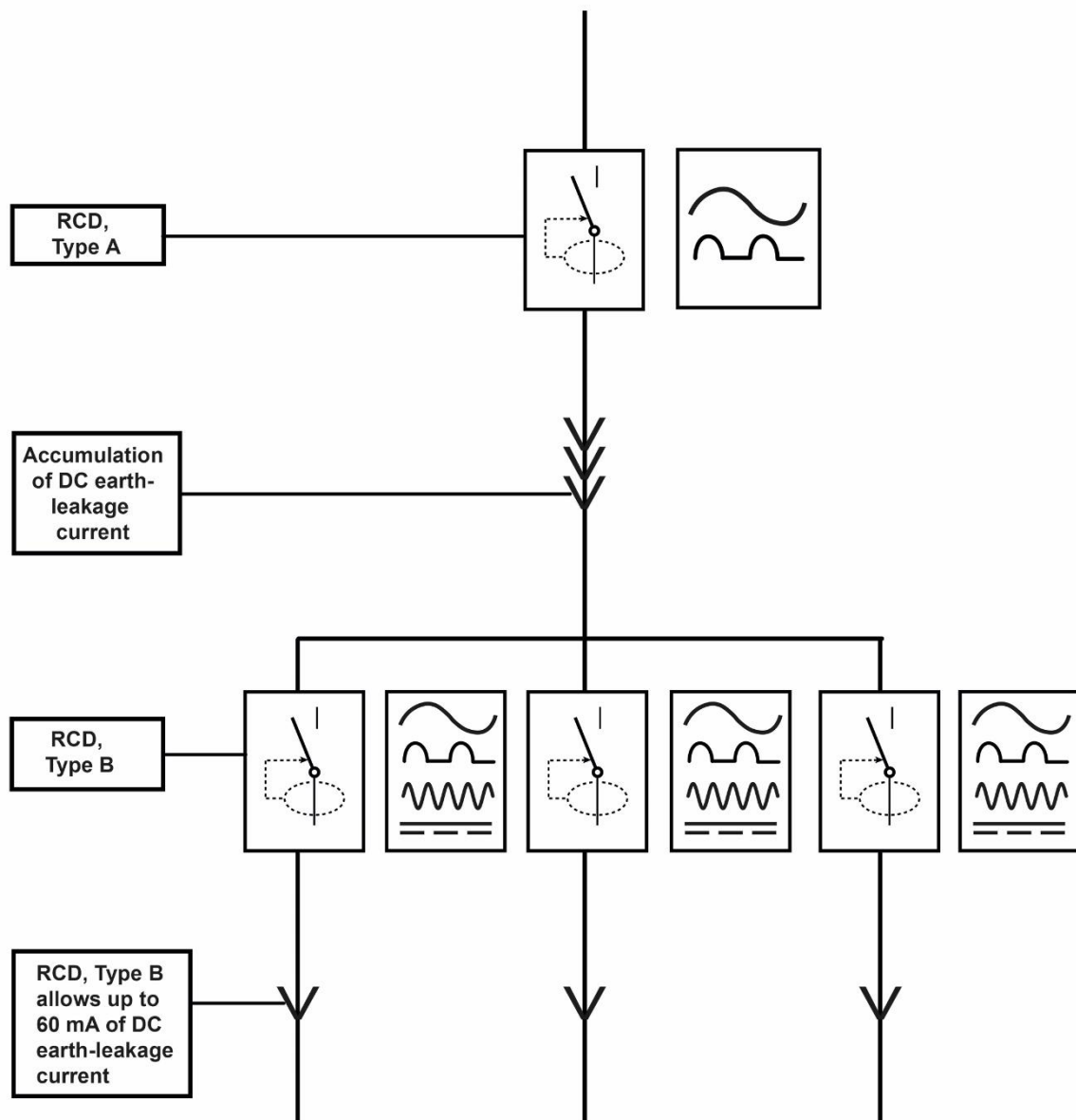
Abbreviations

DC – direct current

EV – electric vehicle

RCD – residual current device, including earth-leakage circuit breakers (ELCBs), circuit breakers with residual current protection (CBRs), residual current circuit breakers (RCCBs) and residual current circuit breakers with overload protection (RCBOs)

Figure 1: Typical Power Supply for EV Charging



Protection from DC earth-leakage in the Charger Circuit

Type B RCDs provide protection from excess DC earth-leakage current. They trip when DC earth-leakage current exceeds a pre-determined threshold: $2 \times I_{\Delta n}$ (usually 60mA for an RCD with 30mA rated sensitivity) allowing DC earth-leakage current below the threshold to pass. Type B RCDs also operate correctly in the presence of DC earth-leakage currents.

Type B RCDs typically provide the first line of protection for EV chargers.

Blinding of upstream RCDs

The accumulation of DC earth-leakage current allowed to pass by multiple Type B RCDs fed from a single type A RCD can cause blinding of the type A RCD if it exceeds the 6mA requirement of IEC 61008-1. This is a risk when there are multiple sources of DC earth leakage current such as multi-point EV chargers where DC earth-leakage current increases as more chargers are added to the scheme.

Why not use type B RCDs upstream? Typically, this would add unnecessary extra cost especially if applied to larger systems. So, a type A RCD upstream which can operate correctly in the presence of DC earth leakage would be most desirable.

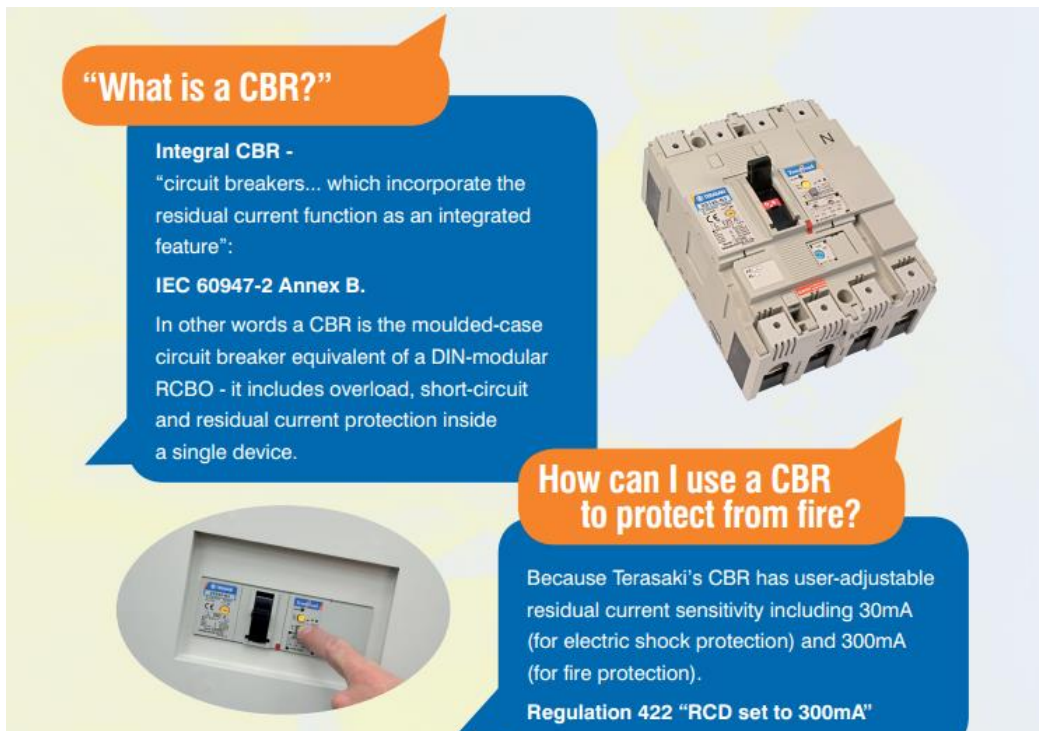
Selection Table

Function	RCD Type	DC earth leakage current protection?	Correct operation in the presence of DC earth-leakage current (resistant to blinding)?
Upstream protection for multiple chargers	A or AC	No, but not necessary with type B RCD downstream	Terasaki CBR: yes; others: consult manufacturer
Downstream charger circuit	B	Yes	Yes
Downstream charger circuit	A or AC	No, not suitable	Not suitable

Solutions for upstream RCDs

Terasaki’s range of Type A CBRs are ideal for providing upstream overload, short-circuit and earth-leakage protection for EV chargers in a single device. Terasaki have tested the CBR for resistance to the blinding phenomenon:

Test Sample	RCD Type	RCD Sensitivity	Resistance to “blinding”
TemBreak 2 CBR	A	30mA, 100mA, 300mA, 500mA, 1000mA, 3000mA (selectable)	Up to 200mA of DC earth-leakage current



“What is a CBR?”

Integral CBR -
 “circuit breakers... which incorporate the residual current function as an integrated feature”:
IEC 60947-2 Annex B.
 In other words a CBR is the moulded-case circuit breaker equivalent of a DIN-modular RCBO - it includes overload, short-circuit and residual current protection inside a single device.

How can I use a CBR to protect from fire?

Because Terasaki’s CBR has user-adjustable residual current sensitivity including 30mA (for electric shock protection) and 300mA (for fire protection).
Regulation 422 “RCD set to 300mA”

Terasaki also offer a range of Type B earth-leakage protection devices which are suitable for the first line of protection in EV charging.

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