HOW AN RCD WORKS

HOW DOES AN RCD KNOW CURRENT IS LEAKING?

"JUST PUT AN RCD ON IT"

Picture a **BS EN 61008** RCD, a **Type AC**. You'll hear "it's got an RCD" or "just put an RCD on it" a lot in the trade. Often that shows the person doesn't really understand what an RCD does.

The question isn't whether there's *an* RCD. It's **which job** the RCD is doing and **what rating** that job needs. That's what this masterclass is about.

There are different **types** of RCD (**AC, A, F and B**). These notes only touch on them at the end (see section 10). The main focus is **when** to use one and **what size**.

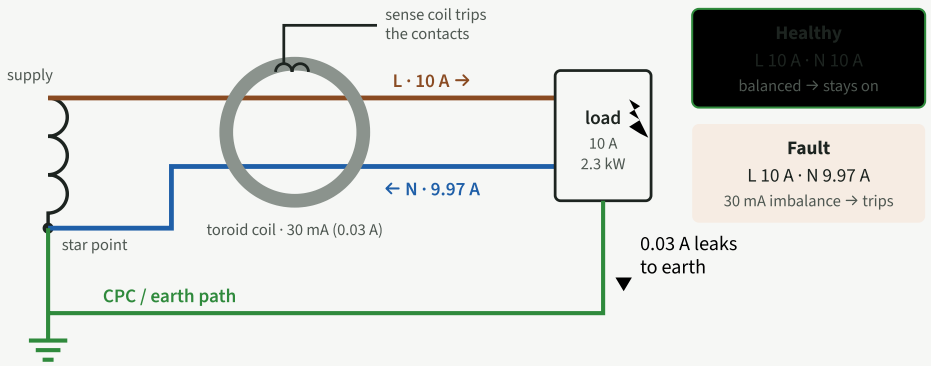
> **Devices that count**
> Everything here applies to **any device that contains an RCD**. An **RCBO** counts, because it's an RCD and a circuit breaker in one unit. So do RCD socket-outlets and RCD fused connection units.

BS EN 61008 · RCCB (RCD without overcurrent protection) · **BS EN 61009** · RCBO

HOW AN RCD WORKS

Inside every RCD or RCBO is a **toroid coil**, a ring-shaped core that the **line and neutral both pass through**. The most common rating is **30 mA**, which is **0.03 A**.

Start with the simplest possible circuit: a supply transformer and its star point, an RCD, and a load. It's **TN-S**, but the system type doesn't matter for how the RCD works. The meter, main switch and consumer unit are left out to keep the RCD as the focus.



Drawn for these notes. Line and neutral both pass through the toroid. If they're equal, nothing happens. If 0.03 A goes missing (here, down the earth path from a damaged outside light), the RCD trips.

BALANCED LINE AND NEUTRAL

Say the load draws **10 A**. Using the power triangle the other way round, that's 230 × 10 = **2.3 kW**. So **10 A goes out on the line** and **10 A comes back on the neutral**. This is **Kirchhoff's current law** (Gustav Kirchhoff, 19th-century physicist): whatever goes out on the line comes back on the neutral.

The RCD works like a **see-saw**. It compares line and neutral. While they're equal it stays balanced. If the neutral suddenly carries less than the line, it's out of balance and it **trips**.

Current doesn't just disappear. If 10 A goes out and less than 10 A comes back, the difference has found **another path to earth**, for example through an exposed-conductive-part that has become live. That's why people say RCDs protect against **electric shock**.

HOW THAT'S DIFFERENT FROM A FUSE OR CIRCUIT BREAKER

Fuses, fuse wire and circuit breakers also disconnect during an earth fault, but they rely on a **very low impedance** between the exposed-conductive-part and the star point. Low impedance means a **high fault current**, and that high current blows the fuse or trips the breaker.

RCDs are more sophisticated. They don't need a big fault current. They only look at whether line and neutral are **equal**, so they can be **very sensitive**.

WORKED EXAMPLE: THE FOOTBALL AND THE OUTSIDE LIGHT

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Outside light on the side of a house, still drawing 10 A (to keep the numbers
Kids kick a football at it and crack the glass slightly
Moisture gets in and reaches the connections

Leakage to earth          = 0.03 A (30 mA)
Line                      = 10 A
Neutral                   = 10 - 0.03 = 9.97 A
Imbalance                 = 0.03 A = the RCD's rating → it trips
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A common assumption is that anything less than the rating (for example 0.02 A) shouldn't trip it. But RCDs can be very sensitive, and a 30 mA RCD you buy may well trip **before** it reaches 30 mA of imbalance. A **ramp test** shows exactly where it trips.

> **Watch out: when a 30 mA RCD must and mustn't trip**The product standards say a 30 mA RCD must **not** trip at **half** its rating (15 mA) and **must** trip at its full rating (30 mA). Anywhere between 15 and 30 mA is allowed. So a 30 mA RCD tripping at 20 mA is **normal**, not a fault. That's the "sensitive" behaviour described above, and the ramp test finds the exact point.

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