

## RCD impedance uplift elimination.

The MFT1741 utilises a brand new loop impedance test technique which provides immunity to the increased impedance effects that RCDs and RCBOs can have on the measurement.

### Applications:

The new MFT 3-wire non-trip loop impedance technique is suitable for use on all low voltage single phase circuits, where the earth loop impedance of the circuit is required to be measured through RCD or RCBO devices.

### The problem:

There is a requirement in electrical installations which stipulates that electricians must verify the loop impedance of all electrical circuits. The loop impedance must be low enough to ensure every circuit breaker protecting a circuit from over-current, both line to neutral and line to protective earth, will disconnect in the required time. These requirements are drawn directly from the IEC 60364 regulations and from domestic implementation of these regulations. On a typical 32 A type B circuit breaker this value should be less than 1.37  $\Omega$ . This is then multiplied by 0.8 to provide a safe margin for error, giving a loop impedance of 1.1  $\Omega$ . We will come back to this later.

Many of these circuits are also protected by an RCD or RCBO downstream of the circuit breaker. The most common of these, the 30 mA RCD or RCBO can influence the loop impedance measured by the MFT by increasing the measured value by more than 0.5  $\Omega$ , the value returned is significantly higher than the expected or calculated value. This can easily push the measured value over the limit, as below:

Basic circuit resistance (continuity) = 0.7  $\Omega$

Measured loop impedance (L-PE) = 1.2  $\Omega$  (remember the limit is 1.1  $\Omega$ )

Uplift created by RCD or RCBO = 1.20 – 0.7 = 0.5  $\Omega$

This uplift of the circuit impedance pushes the measured level over the acceptable limit and now presents a significant problem for electricians.

The uplift is not present on all RCDs or RCBOs and can vary greatly on those devices where it does exist.

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### The cause:

A typical circuit for an RCD is shown in Figure 1:

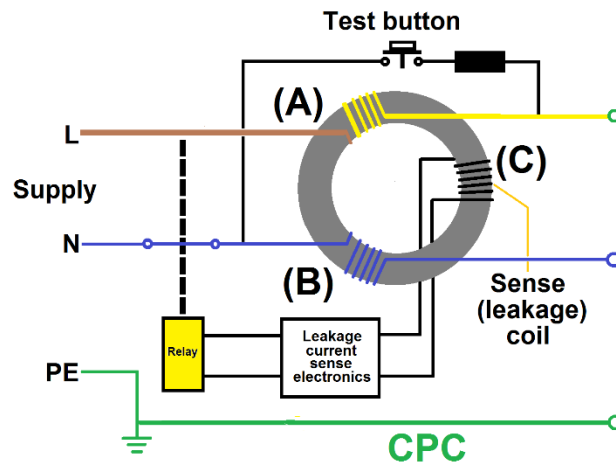


Figure 1. Typical RCD circuit.

Coils (A) and (B) are responsible for creating a current in the ferrite core of the RCD. When the current in (A) and (B) differ, the sense coil (C) detects this current, if the difference is large enough the relay disconnects the supply. It does not matter how much current is flowing in the L-N circuit, just the difference is significant. Too much difference between (A) and (B) will trip the RCD.

The simplified circuit in Figure 2 shows just the 15 mA current induced by the MFT in the L-PE during a non-trip test.

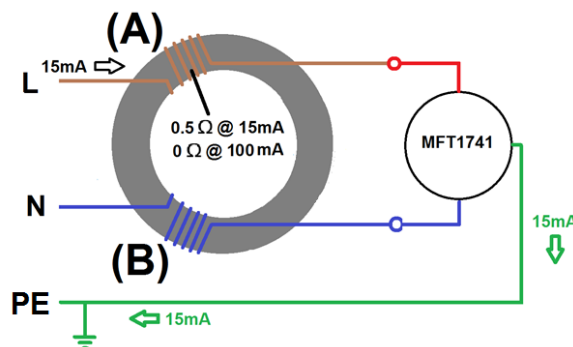


Figure 2. Simplified circuit

This 15 mA current is not enough to trip the RCD. This is a tiny test current, which is why the non-trip test is so difficult for instrument manufacturers to produce successfully.

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Higher currents reduce coil impedance but will cause the RCD to trip, preventing the test from completing. The impedance of the coil (A) at 15 mA is  $0.5 \Omega$ . This value is added to the basic circuit impedance and the total is displayed on the MFT. The MFT cannot distinguish between the impedance of the circuit and that of the coil.

It is irrelevant how much current is flowing in the L-N circuit. The example in Figure 3 shows the test process in a more realistic circuit, with a motor load and a loop impedance test.

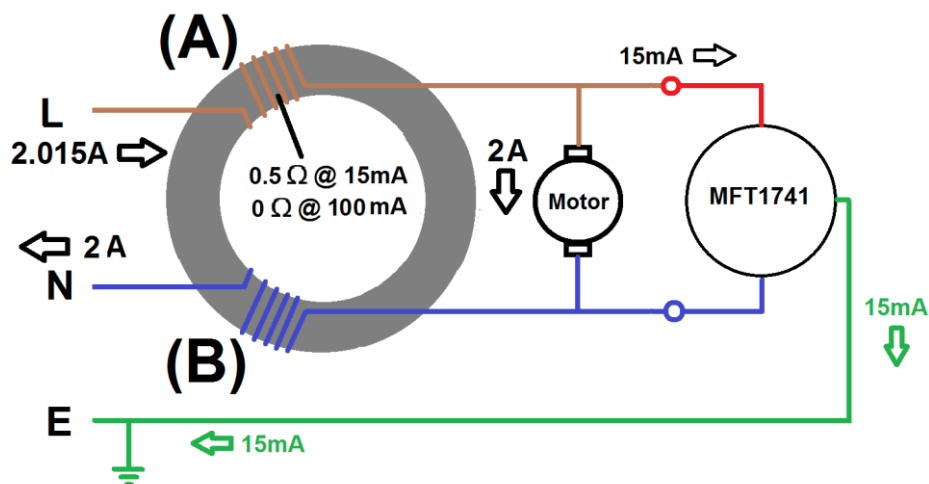


Figure 3. Test process with motor load and loop impedance test.

Still, only the difference of 15 mA is generated, the majority returning down the neutral conductor. However this 15 mA difference is the cause of the additional impedance.

Not all RCDs or RCBOs affect the loop impedance value. However as it is not possible to distinguish which of those devices are suspect the problem can be very confusing, annoying and time consuming.

### The solution:

The new MFT1741 3-wire loop impedance test uses a combination of test currents and measurement methods to ensure the impedance of coil (A) is not added to the circuit impedance.

By developing a range of tests within the 3-wire loop test, not only is the method immune to 30 mA RCDs and RCBOs, the method will also work for 10 mA devices.

The new MFT can be identified by the number MFT1741 for applications in the UK.