FLUKE®

Testing RCDs with the Fluke 1650 Series

Application Note

Residual Current Operated Devices (RCDs) are often fitted in electrical installations to provide additional protection against fire and electrical shocks. Verifying the correct and safe operation of RCDs involves a number of dedicated tests, all of which can be carried out using the new Fluke 1650 Series Multifunction Installation Testers.

Why use RCDs?

An RCD detects fault currents flowing to earth that are too small to trip over-current protection devices (such as fuses), but are still sufficient to cause a dangerous electric shock or an electrical fire. Verifying their operation is critical for safety, and is covered in IEC 60364 (and its various national equivalent standards). This standard specifies the requirements for fixed electrical installations in buildings.

Why do we test RCDs?

Most RCDs have an integral test button, but even a successfully completed test using this facility does not necessarily confirm that the RCD is working correctly. Additional tests to measure tripping time are necessary to verify that the RCD will perform correctly under fault conditions, while extra tests may also be carried out to determine the actual tripping current.
In standard regulations, testing RCDs fall under 'Verifying protection by automatic supply disconnection'. Depending on the type of system, that is TN, TT or IT, various test procedures are used. These include measurement of the fault loop impedance, measurement of the earth-electrode resistance for exposed-conductive-parts of the installation, and measurement or calculation of the first fault current.

In all these procedures, verifying the characteristics and operation of protective devices such as circuit breakers, fuses and RCDs is critical.

Different tests the Fluke 1650 Series can perform

Basic testing of RCDs involves determining the tripping time (in milliseconds) by inducing a fault current in the circuit. In this test using a Fluke 1650 Series Multifunction Installation Tester, a calibrated fault current is induced in the circuit, causing the RCD to trip. The instrument measures and displays the time taken for the RCD to trip.

This test can be performed at distribution panels with test leads or at socket outlets using the mains cord supplied with the instrument. When connecting at distribution boards, connections are made to the line, neutral and earth conductors at convenient points on the load side of the RCD. Note that the test is performed with a live circuit with the load disconnected. The 1650 Series testers also perform a pre-test to determine if the actual test will cause a fault voltage exceeding the 50 V or 25 V limit. To avoid having an inaccurate trip time for S type (time delay) RCDs, a 30 second delay is activated between the pre-test and the actual test.

Manual measurement of RCD tripping time

To manually measure the tripping time, a number of parameters must be entered in the installation tester using the function softkeys. The following need to be set:

- RCD trip-current rating (typically 10, 30, 100, 300, 500 or 1000 mA)
- Test current multiplier ($x^1/_2$, x1, x5 or auto)
- RCD type (Standard AC RCD, DC sensitive RCD*, Delayed response AC RCD, or Delayed response DC RCD*)
- Test-current phase setting (0° or 180°).

** Models 1652 and 1653 only*

Note that because some RCDs are more sensitive in one half cycle of the mains supply waveform than the other, the test must be carried out for both zero and 180 degree phase settings, and the longest time should be recorded. The default setting for the test current multiplier is 'x1' (the 1651 base model has this setting only), and this tests RCDs at their rated trip current. The measured tripping time can be compared with the maximum time permitted by local Regulations or Standards for that type of device.

Auto testing

To simplify and speed up testing, the 1652 and 1653 models have an auto mode for measuring RCD tripping time in which six tests ($x^1/_2$, x1 and x5 at 0° and 180°) are automatically carried out in sequence. This eliminates the need for the test engineer or his assistant to keep returning to the installation tester after resetting a tripped RCD. This feature saves a considerable amount of time on site.

To measure RCD tripping time using Auto mode on the 1652 and 1653 models, the RCD current rating is again entered with softkeys and the Auto mode selected using the function softkeys. After entering the RCD type and initiating the test, the sequence starts by applying x1/2 the RCD's current rating for a predetermined period (310, 510 or 2000 ms – depending on local regulations).

If the RCD trips, the test is terminated. If not, the instrument automatically reverses the phase and repeats the test. Again, if the RCD trips, the test is terminated. If not, the instrument supplies x1 the RCD's current rating for 2000 ms. The RCD should now trip and the time is displayed and stored in memory. After the RCD has been reset, the instrument reverses phase and repeats the x1 test. The sequence is repeated with x5 the RCD's current rating to complete the auto test cycle.

The instrument 'senses' when the RCD has been manually reset and initiates the next test in the sequence. Results are held in temporary memory, and viewed by stepping through with the arrow buttons. The 1653 also has an internal memory for storing results for later recall or importing into a report made using FlukeView™ Forms software.

Ramp RCD testing

In addition to measuring trip time, the 1652 and 1653 models can also measure RCD tripping current by gradually increasing an applied current until the RCD trips. This is commonly referred to as a ramp RCD test. Once again, the RCD trip current rating, RCD type, and test current phase must be selected using softkeys before commencing the test.

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