



Technical NEWS



Quarterly Technical Newsletter of Australia's leading supplier of low-voltage motor control and switchgear

ISSUE 40 - November 2003

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CONFUSED ABOUT WHICH RCD YOU SHOULD BE CHOOSING?

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Like the famous cricket player that could not bowl or bat, there are earth leakage devices that can't trip on over current, can't break short circuit currents and can't work on half wave leakage currents. But as with the cricket player they are still in the team. How do you pick the correct one for the application and how do you identify it from the device's markings? Unfortunately, some people are confused by the issue and earth leakage devices are being misapplied.

1.0 Types of RCDs

The following devices are all RCDs, equipped with additional functions and features, offering cost effective solutions in different applications.

1.1 Residual Current Circuit breaker (RCCB)

This device is essentially a mechanical switch with the residual current tripping characteristic attached to it. So basically it will only break the circuit when there is a leakage current flowing to earth. The break time is such as to minimise the risk to human life.

As RCCBs are unable to detect or respond to over-currents or short circuits, they must be connected in series with an over current device such as a fuse or MCB (Miniature Circuit breaker). This gives the RCCB and the rest of the circuit the protection required to respond to over currents or short circuits.

RCCBs usually have a fault making and breaking capacity in the order of 1 kA. This means that they can handle a fault of 1 kA on their own if it is a fault to earth. For overloads and line to neutral short circuits, the Wiring Rules require other devices to provide protection. The device used for short circuit protection may improve the short circuit rating of the RCCB when they operate together. This allows an RCCB rated at say



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1000 A to be used in circuits where the actual fault level is higher than 1000 A. Details of suitable devices are required to be listed in the literature provided with the unit and the suppliers catalogue.

In summary, RCCBs provide earth leakage protection, however a major point to remember when applying them is that they must **always** be installed in conjunction with an appropriately rated Short Circuit Protective Device (SCPD).

1.2 RCBO (Residual Current Circuit Breaker with Overload protection)

This is a residual current device that has an MCB built in to it. Effectively, the RCBO is the equivalent to a RCCB + MCB. The main functions that an RCBO is able to provide are:

- (a) Protection against earth fault currents; and
- (b) Protection against overload and short circuit currents

The best way to utilise RCBOs is to use one on each circuit, as this way if one circuit exhibits a fault it will not affect the other circuits. As the price of these devices are decreasing, the RCBO is an effective way of protecting lives and the installation.



1.3 Earth leakage relay

This type of device has been designed to meet the requirements of industry. They suit three phase circuits and high load currents. The residual current threshold and tripping delay is often adjustable thus allowing an earth protection cascade system to be utilised.

Earth leakage relays works in much the same way as the RCCB and as such, must be accompanied by a circuit breaker or fuse.



Phase and neutral conductors are passed through a toroidal transformer, creating a magnetic field proportional to its current. In normal situations the vector sum of the currents is zero even with unbalanced 3 phase loads.

A leakage current towards earth on one or more conductors downstream of the toroid causes an imbalance which is detected in the measurement winding and sent to an amplifier relay.

The amplifier relay receives the signal from the ring current transformer and compares it with the preset threshold value. The relay output is turned on in the case where the detected value is higher than the preset threshold and lasts for a longer time than the preset tripping time value. The output remains in the on state until the relay is reset either manually or electrically. Generally, the relay output is fed to the shunt trip of a protective device (circuit breaker) which isolates the faulted circuit.

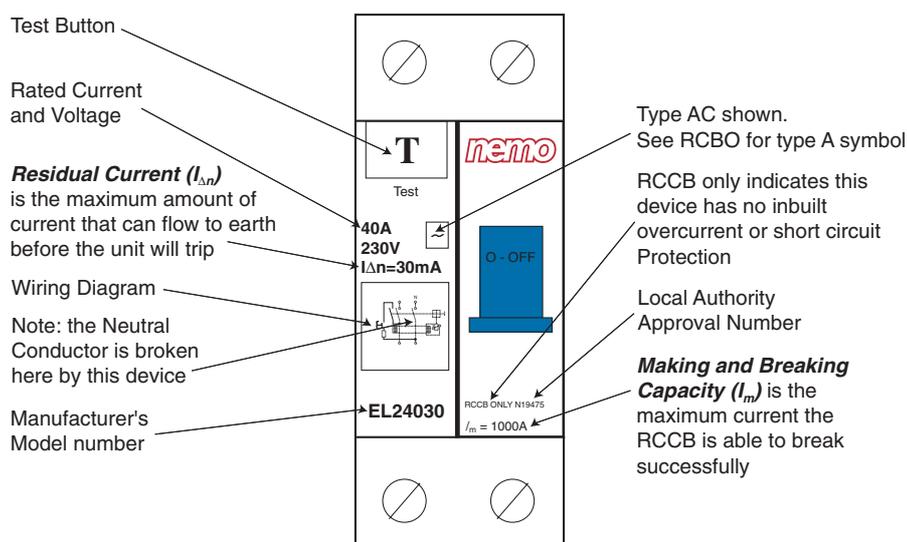
While a relay can offer improved protection against the effects of an electrical fault to earth, most of them are excluded from the performance requirements of an RCD intended for the protection of a

person against the ill effects of an electric shock. The adjustment range offered means they can be set to a level outside the required protective range. If they are not approved for use as a device offering shock protection, they cannot be used to meet the requirements for earth leakage protection as prescribed in the Wiring Rules. They can however, be used to meet the requirements of the Wiring Rules when touch-voltage limits are exceeded, thus requiring automatic disconnection.

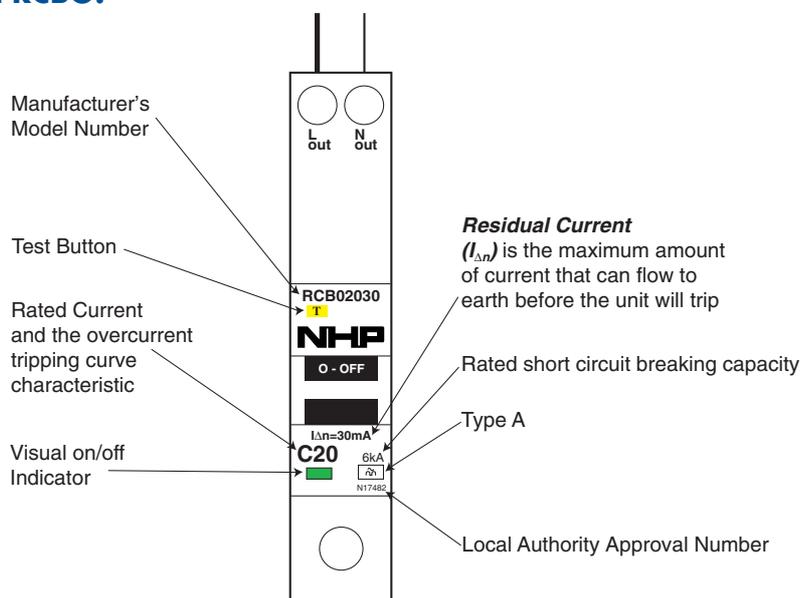
2.0 How to identify an RCD from its markings

Selection of a suitable RCD usually starts with the suppliers catalogue and this should contain all the information required. When a device has been purchased however, it is important that you can understand the markings on it as these have specific meanings and are not as detailed as a catalogue may be. As the standard covering the device has specific-marking requirements, all similar devices from different manufactures will have virtually the same markings.

2.1 Typical RCCB:



2.2 Typical RCBO:



2.3 Further explanation of markings

Type AC



RCDs labelled with the Type AC symbol detect basically sinusoidal residual currents. This is the case in most instances of faults to earth or shocks.

Type A



Some electrical equipment during faults or accidental contact with secondary circuits can be the source of non-sinusoidal earth leakage current (DC) due to power electronic components such as diodes and thyristors. Type A RCDs are designed to ensure that under these conditions, the residual current device operates on sinusoidal residual current and also on residual pulsating direct current (rectified AC). The possibility of getting a shock via a diode or similar device is really theoretical, but in some countries including New Zealand, Type A devices are compulsory. In Australia, Type AC is generally acceptable, however there are special circumstances where Type A is specified as a requirement.

Rated making and breaking capacity (I_m)

The test for rating requires a small residual current to be established to open the device when testing an RCCB. If the fault is active to neutral an RCCB will not open. Back up protection by fuse or MCB is required. An RCBO will trip on this current and protect itself.

Rated residual making and breaking current ($I_{\Delta m}$)

For this rating, the fault current flow is to earth and the leakage detection circuit is stressed. This rating is only required to be stated if different from I_m .

Conditional Short Circuit Current (I_{nc})

This is the value of the prospective fault current an RCCB protected by a short circuit protective device (SCPD) in series, can withstand without impairing its functions. The flow of this current does not represent an input to the earth leakage detection circuits.

Conditional Residual Short Circuit Current ($I_{\Delta c}$)

The AC value of the prospective fault current, which an RCCB protected by a suitable SCPD in series, can withstand when the current flows to earth. In this case, the flow of current stresses the devices leakage detecting circuits.

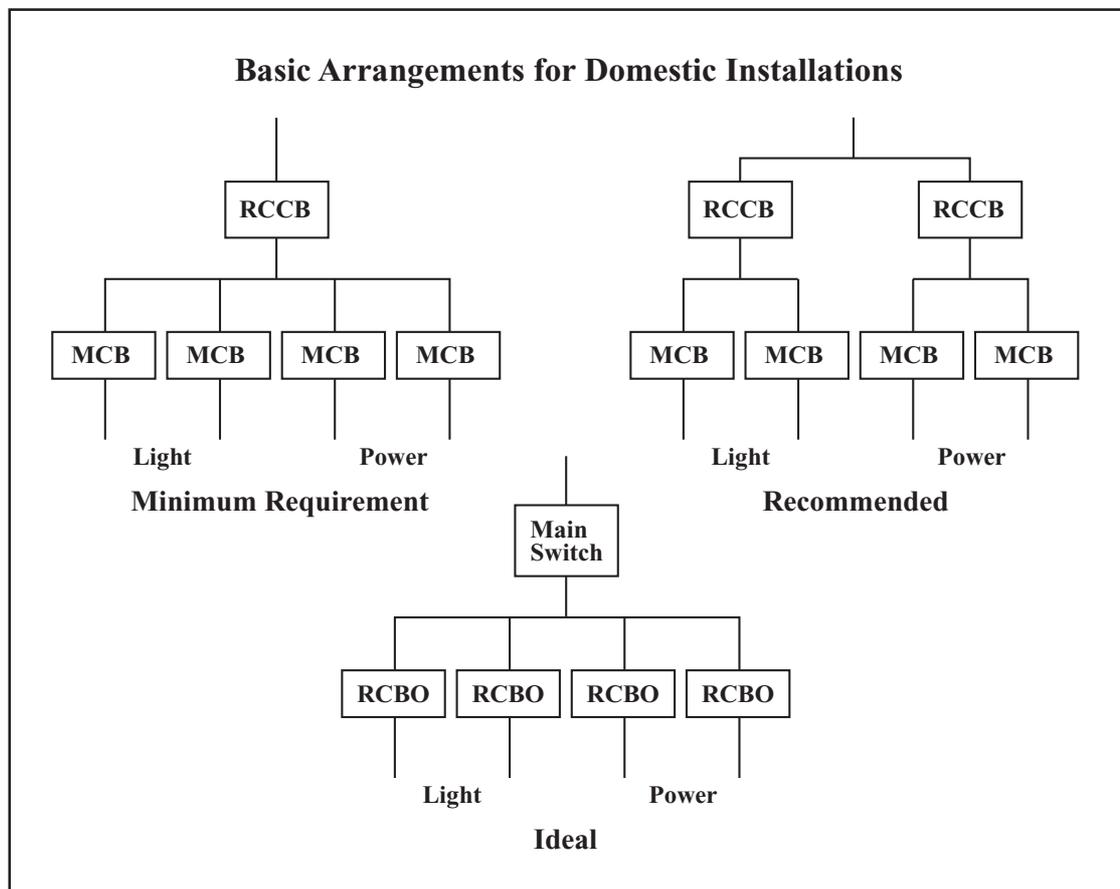
Approval marking

All earth leakage devices designed to provide protection against electric shock are designated as Prescribed Items and are thus required to be approved before they can be sold. The approval number starts with a letter indicating which state electrical authority has granted approval. This is N for NSW and V for Victoria. The approval once granted is applicable for the whole of Australia.

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3.0 Domestic electrical installations

RCDs are required by the Wiring Rules to be installed in light industrial and domestic situations. From an operational point of view, the RCBO is the best type of device to use. It can simply replace the individual circuit breakers on each circuit, and once installed, provides earth leakage, short circuit and overcurrent protection. If an earth leakage occurs, only the faulty circuit will trip, causing the minimum disruption to the overall power supply. Conversely, given that interruptions are normally rare, the whole installation can be protected by one RCCB in conjunction with the series circuit breakers. This will result in a lower installation cost, but if an earth leakage current does trip the RCCB, it can cause considerable inconvenience as all downstream circuits are isolated. A recommended compromise is to provide two RCCBs, one for the lighting circuits and one for the power circuits.



4.0 Conclusion

The use of RCDs is an excellent way to assist in making light industrial and domestic dwellings safer for people, but they are by no means fail-safe. As there are a few types of RCDs available, careful consideration needs to be given to the type of protection required. Caution also needs to be taken when installing these devices to ensure that they function correctly, because there is no use installing a life saving device if it's not properly applied. Understanding the different types and markings on RCDs is



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