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Earth Continuity Monitoring

Application

Earth Continuity Monitor (ECM) provides additional protection against electric shock for users and operators of portable appliances by ensuring equipment is always effectively earthed. When used in combination with a suitable circuit disconnector it can provide protection in accordance with BS4444: *Guide to electrical earth monitoring*. When the associated circuit disconnector incorporates a no-volt coil the ECM can prove correct earthing prior to circuit energisation.

If the protective earth conductor becomes disconnected in a connector or portable appliance, or if the impedance in the monitored pilot-earth loop to an appliance rises above a pre-set threshold, the ECM automatically trips the associated circuit disconnector. The ECM thereby provides an electrical interlock preventing the associated circuit disconnector from remaining on until all connectors in the pilot-earth loop circuit are effectively coupled. Electrical interlocking also causes the associated circuit disconnector to open when a plug is withdrawn from a socket on load.

The ECM can also be employed to assist in complying with Automatic Disconnection times for final socket circuits. This is achieved through setting the ECM pilot-earth loop impedance trip factor at a point that should allow sufficient current to flow in the associated phase-earth loop circuit to trip the circuit's over-current protection device within 400 milliseconds of a short circuit to earth. If the pilot-earth loop impedance exceeds the pre-set trip level, the ECM trips the associated circuit disconnector. ECMs are available with standard pilot-earth loop impedance trip levels of 0.3, 0.5, 0.8, 1.1 and 1.5 ohms. The installation designer should refer to the IEE Wiring Regulations for guidance on the maximum total earth fault loop impedance permissible for a circuit. It should be noted that the monitored circuit is the pilot earth loop, not the phase earth fault loop, thus the ECM provides an indication only not a guarantee.

Monitored Earth Sockets

ECMs are most commonly incorporated within socket-outlets installed in electrically hazardous environments, working in combination with overcurrent circuit breakers, contactors and Residual Current Devices. Earth Continuity Monitoring is frequently adopted when the additional protection provided by high sensitivity RCD's is not required.

The benefit of electrical interlocking is a further protection provided by the system in plug and socket applications. However it should be remembered that cables, plugs and sockets all require a separate pilot conductor.

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ECM Design

The basic circuit is designed around the Wheatstone Bridge principle, the pilot-earth loop being one of the Bridge resistors. A voltage of 6 volts A.C. is applied to the Bridge, half-wave rectified by two bridge diodes, one of the diodes being within the pilot-earth loop circuit. An amplifier compares the resulting D.C. levels. If the Bridge imbalance is exceeded by more than the pre-set value the associated circuit disconnector is tripped. The components are housed within an insulated enclosure and provided with terminations for external circuit connections.

Monitored Circuit

The pilot-earth loop normally comprises the following:

- The main earth protective conductor from the control unit to the appliance
- The appliance casing
- A return path, the pilot conductor (P)

The loop is continuously monitored by passing a current at a voltage not exceeding 9 volts peak through the above circuit.

Pilot Core Protection

To protect against the possibility of a short-circuit between pilot and earth conductors a diode should be fitted between the pilot conductor and the appliance casing. If a pilot-earth short circuit occurs the associated circuit disconnector will trip. A suitable diode is supplied with each ECM.

Circuit Selection

A two-position selector switch is incorporated into the ECM

Switch Position	Protection
NORMAL	Normal pilot earth loop monitoring
PILOT CORE PROTECTION	For the addition of pilot core protection

Protection - Pilot Fuse

As the pilot and earth cables function as parallel earth conductors it is necessary to protect the ECM against earth faults or welding currents that may occur in the pilot conductor. Should this happen, a fuse will rupture and the associated circuit disconnector will trip. A replacement fuse is supplied loose with each ECM.