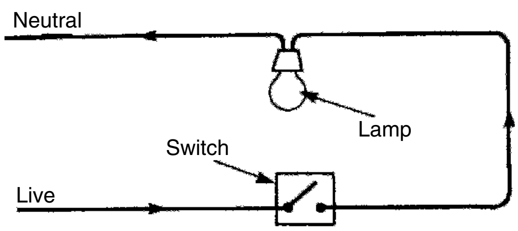
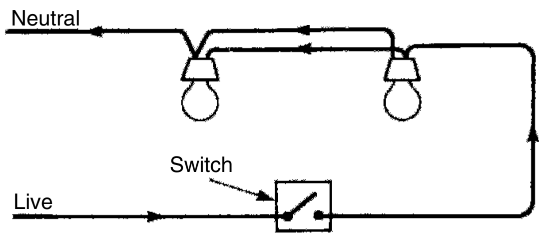
Lighting circuits can incorporate various switching arrangements. In a one-way switch circuit the single-pole switch must be connected to the live conductor. To ensure that both live and neutral conductors are isolated from the supply a double-pole switch may be used, although these are generally limited to installations in larger buildings where the number and type of light fittings demand a relatively high current flow. Provided the voltage drop (4% max., see page 404) is not exceeded, two or more lamps may be controlled by a one-way single-pole switch.

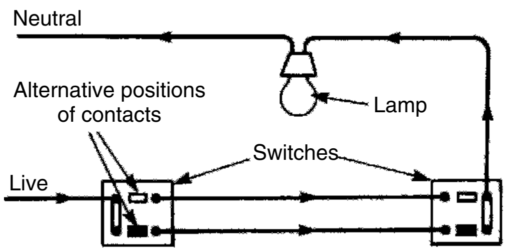
In principle, the two-way switch is a single-pole changeover switch interconnected in pairs. Two switches provide control of one or more lamps from two positions, such as that found in stair/landing, bedroom and corridor situations. In large buildings, every access point should have its own lighting control switch. Any number of these may be incorporated into a two-way switch circuit. These additional controls are known as intermediate switches.



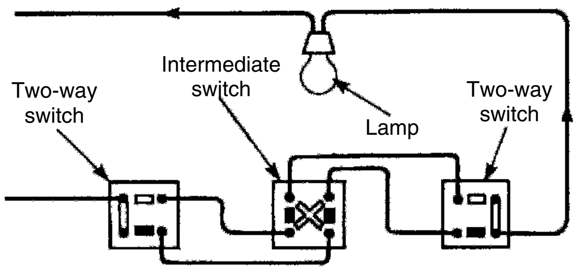
One-way single-pole switch circuit controlling one lamp.



One-way single-pole switch circuit controlling two or more lamps

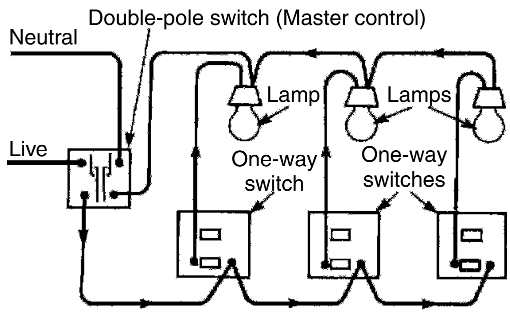


Two-way switching



Two-way switching with one intermediate switch

The purpose of a 'master' switch is to limit or vary the scope of control afforded by other switches in the same circuit. If a 'master' switch (possibly one with a detachable key option) is fixed near the main door of a house or flat, the householder is provided with a means of controlling all the lights from one position.



'Master' control wiring circuit

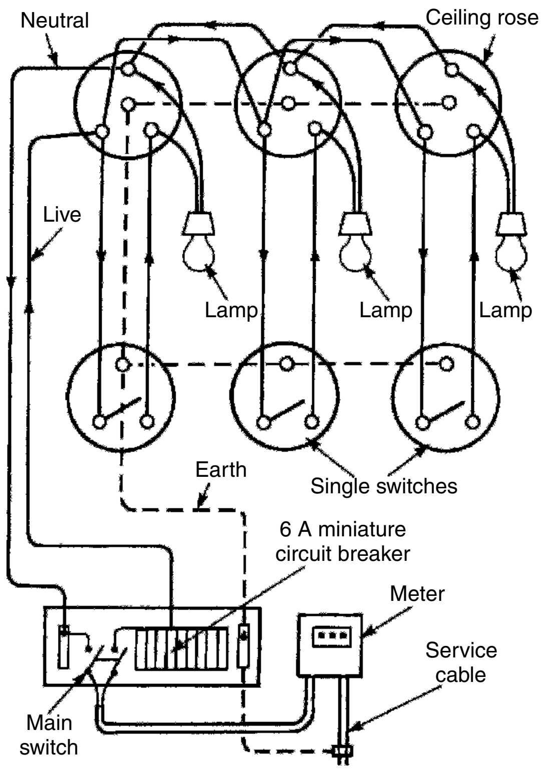
A sub-circuit for lighting is generally limited to a total load of 10, 100 watt light fittings. It requires a 5 amp fuse or 6 amp mcb overload protection at the consumer unit. The importance of not exceeding these ratings can be seen from the simple relationship between current (amps), power (watts) and potential (voltage), i.e. Amps = Watts ÷ Volts. To avoid overloading the fuse or mcb, the limit of 10 lamps @ 100 watts becomes:

Amps = $(10 \times 100) \div 230 = 4{\cdot}3$

i.e. <5 amps fuse protection.

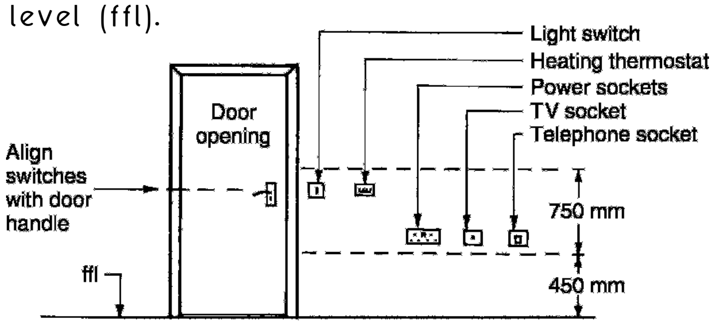
In large buildings higher rated overload protection is often used due to the greater load.

Wiring for lighting is usually undertaken using the 'looping-in' system, although it is possible to use junction boxes instead of ceiling roses for connections to switches and light fittings.



Looping-in system of wiring

The Building Regulations require reasonable provision for people, whether ambulant or confined to a wheelchair, to be able to use a building and its facilities. Facilities include wall-mounted switches and sockets located within easy reach, to be easily operated, visible and free of obstruction.
Dwellings – switches and sockets between 450 and 1200 mm from finished floor level (ffl).



Location of switches and sockets in a dwelling

Non-domestic buildings – basic requirements for switches, outlets and controls:
- Conventional and familiar.
- Contrasting in colour to their surroundings.
- Large push pad preferred or extra wide rocker switches.
- Pictogram to clarify use and purpose where multiple switches occur.
- Separation or gap between individual switches where multiples exist.

Recommendations for location of wall-mounted switches and sockets in non-domestic buildings:
- Sockets for TV, power and telephone: 400 to 1000 mm above ffl and ⩾350 mm from corners. Power socket switches to indicate whether they are 'ON'.
- Switches to permanently wired appliances: 400 to 1200 mm above ffl.
- Controls requiring precise hand movement: 750 to 1200 mm above ffl.
- Push buttons, e.g. lift controls; ⩽1200 mm above ffl.
- Pull cords for emergencies, coloured red and located close to a wall and to have 2, 50 mm diameter bangles set 100 mm and 800–900 mm above ffl.
- Controls that require close visual perception, e.g. thermostat, located 1200–1400 mm above ffl for convenience of people sitting or standing.
- Light switches for general use of the push pad type and located at 900–1100 mm height. Alternatively, a pull cord with 50 mm diameter bangle set at the same height. The pull cord should be distinguishable from any emergency pull.
- Main and circuit isolators to clearly indicate that they are 'ON' or 'OFF'.
- Pattress or front plate to visually contrast with background.
- Operation of switches and controls to be from one hand, unless both hands are required for safety reasons.

Note: Exceptions to the above may occur in unavoidable design situations such as open plan offices with fitted floor sockets.

Refs: Building Regulations, Approved Document M: Access to and use of buildings. Disability Discrimination Act.
BS 8300: Design of buildings and their approaches to meet the needs of disabled people – Code of Practice.

Electrical installations must be protected from current overload, otherwise appliances, cables and people using the equipment could be damaged. Protection devices can be considered in three categories:

1. Semi-enclosed (rewirable) fuses.
2. High breaking or rupturing capacity (HBC or HRC) cartridge fuses.
3. Miniature circuit breakers (mcb).

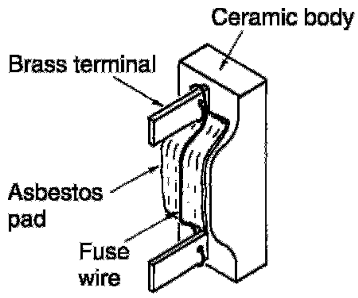
None of these devices necessarily operate instantly. Their efficiency depends on the degree of overload. Rewirable fuses can have a fusing factor of up to twice their current rating and cartridge fuses up to about 1·6. Mcbs can carry some overload, but will be instantaneous (0·01 seconds) at very high currents.

Characteristics:

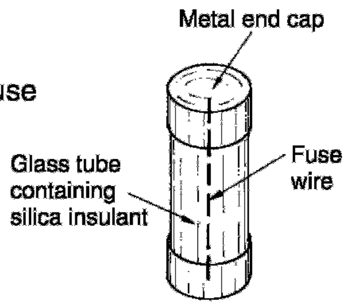
Semi-enclosed rewirable fuse:
Inexpensive.
Simple, i.e. no moving parts.
Prone to abuse (wrong wire could be used).
Age deterioration.
Unreliable with temperature variations.
Cannot be tested.

Cartridge fuse:
Compact.
Fairly inexpensive, but cost more than rewirable.
No moving parts.
Not repairable.
Could be abused.

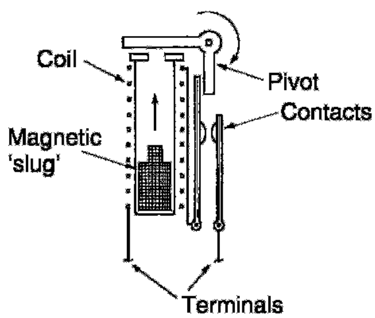
Miniature circuit breaker:
Relatively expensive.
Factory tested.
Instantaneous in high current flow.
Unlikely to be misused.



Rewirable fuse



Cartridge fuse



Electomagnetic mcb

Refs: BS 88-5 and 6: Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 V d.c.
BS 1361: Specification for cartridge fuses for a.c. circuits in domestic and similar premises.
BS EN 60269: Low voltage fuses.
BS EN 60898: Circuit breakers for overcurrent protection for household and similar installations.

Residual Current Devices (RCD) are required where a fault to earth may not produce sufficient current to operate an overload protection device (fuse or mcb), e.g. an overhead supply. If the impedance of the earth fault is too high to enable enough current to effect the overload protection, it is possible that current flowing to earth may generate enough heat to start a fire. Also, the metalwork affected may have a high potential relative to earth and if touched could produce a severe shock.

An RCD has the load current supplied through two equal and opposing coils, wound on a common transformer core. When the live and neutral currents are balanced (as they should be in a normal circuit), they produce equal and opposing fluxes in the transformer or magnetic coil. This means that no electromotive force is generated in the fault detector coil. If an earth fault occurs, more current flows in the live coil than the neutral and an alternating magnetic flux is produced to induce an electromotive force in the fault detector coil. The current generated in this coil activates a circuit breaker.

Whilst a complete system can be protected by a 100 mA (milliamp) RCD, it is possible to fit specially equipped sockets with a 30 mA RCD where these are intended for use with outside equipment. Plug-in RCDs are also available for this purpose. Where both are installed it is important that discrimination comes into effect. Lack of discrimination could effect both circuit breakers simultaneously, isolating the whole system unnecessarily. Therefore the device with the larger operating current should be specified with a time delay mechanism.

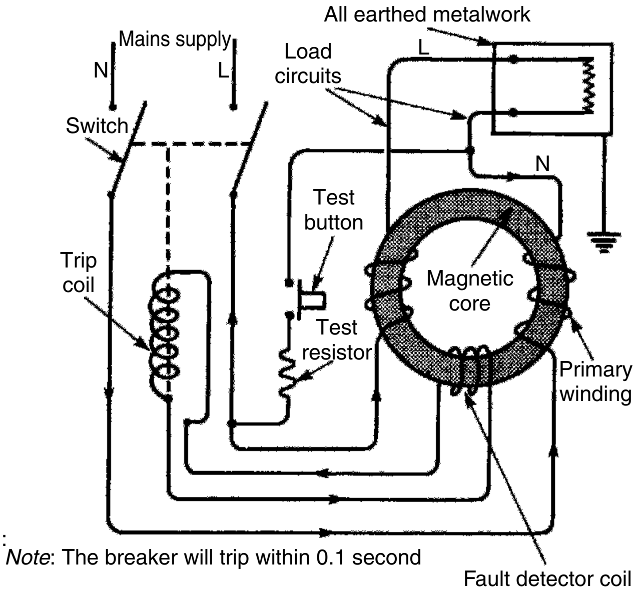
The test resistor provides extra current to effect the circuit breaker. This should be operated periodically to ensure that the mechanics of the circuit breaker have not become ineffective due to dirt or age deterioration. A notice to this effect is attached to the RCD.

Ref: BS ENs 61008 and 61009: Residual current operated circuit breakers.

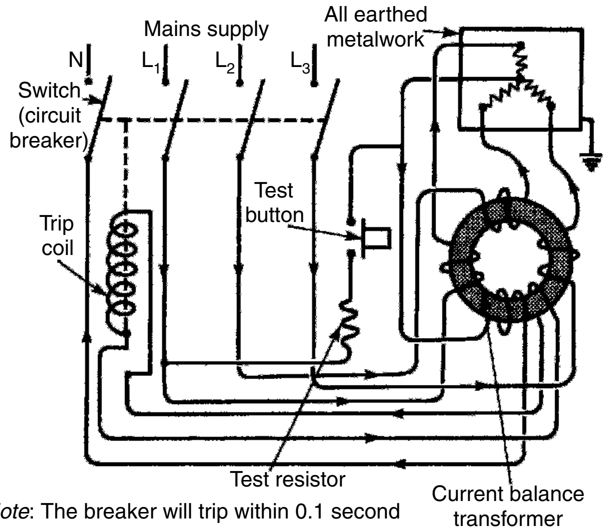
An RCD is not appropriate for use with a TN-C system, i.e. combined neutral and earth used for the supply, as there will be no residual current when an earth fault occurs as there is no separate earth pathway.

They are used primarily in the following situations:

- Where the electricity supply company do not provide an earth terminal, e.g. a TT overhead supply system.
- In bedrooms containing a shower cubicle.
- For socket outlets supplying outdoor portable equipment.



Single-phase RCD



Three-phase RCD

A three-phase device operates on the same principle as a single-phase RCD, but with three equal and opposing coils.