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Figure 8.22 shows a typical emergency lighting circuit for a maintained luminaire. Two additional components are required, an inverter and a battery pack, and the inverter controls the circuit. Under normal conditions with a mains supply present the inverter supplies the ballast with a phase supply from the mains, and the lamp is driven from the ballast, via the inverter. When the mains supply fails the lamp is driven from the inverter, which receives power from the battery pack.

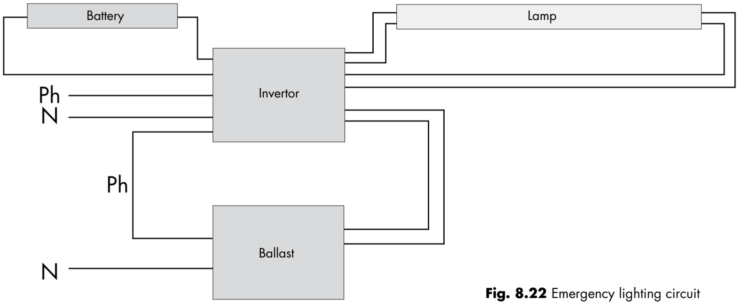

Fig. 8.22 Emergency lighting circuit

For circuits with more than one lamp only the lamp used in emergency mode is connected to the inverter, additional lamps being connected directly to the ballast. As the ballast receives no power supply during mains failure these lamps are extinguished and again the emergency lamp is lit using a supply from the batteries via the inverter.

8.14 Properties of electronic ballasts

With the implementation of European Directive 2000/55/EC on energy efficiency requirements for ballasts for fluorescent lighting and the Energy using Products Directive 2005/32/EC type C and D magnetic ballasts are banned for sale within the European Union. The benefits of using electronic technology over magnetic ballasts are:

- Energy savings 1. Energy costs are cut by using electronic control gear, and further savings may be made using presence detection and dimming technology to ensure that light is not wasted by lighting empty spaces or over lighting an area.

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- Energy saving 2. Using less energy reduces the heating effects in a space due to the installed lighting. This reduces the load on air-conditioning and ventilation equipment.
- Fewer components. Using electronic control gear removes the need for starter switches and power factor correction capacitors.
- Reduced maintenance costs. Using control gear with cathode pre-heating ensures that the length of life of lamps in a luminaire is maximised, reducing the frequency of re-lamping and therefore maintenance costs.
- Flicker free light. Electronic control gear operates at high frequencies, producing flicker free light. Flicker from lights has been shown to be a cause of headaches and discomfort.
- Low noise operation. Electronic control gear ensures quiet operation with quiet starting and no background hum as may be produced by magnetic gear.
- Fault detection. In the event of a fault occurring in a circuit, such as a lamp failing, electronic ballasts may automatically shut off a faulty lamp, or switch off in the event of a more general fault. This prevents flickering lamps staying active or fault conditions causing a potentially dangerous situation.

For control of electronic control gear for dimming etc. three main methods of control are used

Analogue

This uses a 1-10V analogue signal as a control input to the ballast. The main restriction on this method is interference caused by cable length or mains interference.

DSI

This uses an 8-bit digital signal as a control input to the ballast. The use of a digital signal helps ensure interference free reliable communications, and also helps prevent wiring faults as the digital control wires are polarity reversible, unlike an analogue input signal. Grouping of luminaires depends upon the hard-wiring of the control lines.

As DSI allows bidirectional communication it is possible to interrogate luminaires about their current operating state, fault conditions, etc., and to use a computer based graphical interface to control installations.

DALI

DALI uses a digital communications protocol but is almost a programming language for lighting control gear, allowing complete flexibility of control of lighting units. Grouping of luminaires is via software as every luminaire is individually addressable. As DALI allows bidirectional communication it is possible to interrogate luminaires about their current operating state, fault conditions, etc., and to use a computer based graphical interface to control installations.

8.15 Voltage drop

When designing cabling for installation of luminaires it should be remembered that there will be a voltage drop along the length of the cable. This is due to the electrical resistance of the cable and means that the voltage measured at the end of the cable will be less than that measured at the start of the cable. The voltage drop for a given current carried is related to the cable materials and manufacturing process and is therefore individual to each cable type and manufacturer. Values are normally quoted in terms of voltage drop per ampere per metre. Note that the wiring regulations give limits on permissible voltage drop.

In the absence of manufacturers data the following formula for calculating voltage drop may be used.

$$\Delta_U = \frac{2(I \times 0.0175 \times L)}{A}$$

where Δ_U is the voltage drop across the length of the cable in volts
I is the current being carried by the cable in amps
L is the length of the cable in metres
A is the cross-sectional area of a single conductor in mm^2

Note this formula is for a twin copper conductor (phase and neutral) at 15°C.

This can have a major effect upon the lighting installation as a relatively small voltage drop can reduce the light output of the luminaire or for larger voltage drops can even prevent the luminaire from operating. An effect of this, especially for