FLUORESCENT DIMMERS MAKE LIGHTING MORE VERSATILE

Most lighting installations can benefit from a degree of control. But while dimmers for incandescent lighting are now well established, perhaps not so many people realise that fluorescents can also be controlled.

cost) of the dimmer. On the best and most expensive dimmers, the technique used is known as hard firing.

Hard firing means that there is a voltage applied to the gate of the thyristor, with respect to the cathode, all the time the thyristor should be conducting. The cheapest dimmers provide only a single pulse at the time a thyristor should switch on. When these cheap dimmers are used with fluorescent loads, the current through the thyristor may not reach the latching value before the gate pulse disappears. This means that the thyristor will not conduct for the rest of the mains half cycle.

Hard firing dimmers avoid this problem, which is why hard firing is used in most fluorescent dimmers.

There are some dimmers which are better than the cheapest dimmers but not as good as hard firing dimmers. These dimmers supply the gates of the thyristors with a string of pulses during the periods that the thyristors conduct. If the latching current has not been reached by the time the first gate pulse has finished then there is a second pulse (or third) to get the thyristor to conduct.

One method that is frequently used to ensure that thyristors operate correctly involves loading the dimmer with a resistive ballast, sometimes known as a dummy load. (Do not confuse this ballast with the ballast in the fluorescent fitting.) The size or rating of the ballast fitted depends upon the dimmer and total installation, although generally the lower the resistance of the ballast the better the result.

If a resistive ballast is fitted in an installation, any energy saving that results from dimming will be forfeited by dissipation in the ballast above a certain light level. In the past some installations have had the ballast automatically switched out of circuit above this level. The best type of ballast that can be fitted is a non-linear resistor such as an incandescent lamp. These have the advantage of having a lower resistance at the lower light levels. The trend at the moment is to have dimmers that do not need dummy loads.

When dimming fluorescent tubes it is essential to ensure that the heaters in the tubes are kept hot during the periods that the tubes are at a dimmed level, especially at low light levels. To do this dimmers provide a separate heater feed to the fluorescent fittings. This feed is often known as "line fixed" (LF). The regulated feed to the tubes is known as "line variable" (LV). Some fluorescent dimmers have a relay that switches the heater feed on or off as required. A range of dimmers launched recently by Rank Strand* has the advantage of a delay between switching on the heaters, and driving the tubes. This improves the fade when fading on from cold.

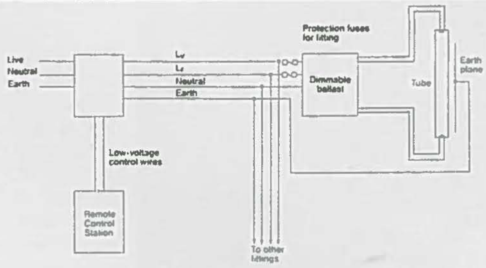

Fig. 1 – Typical wiring for a dimming installation.

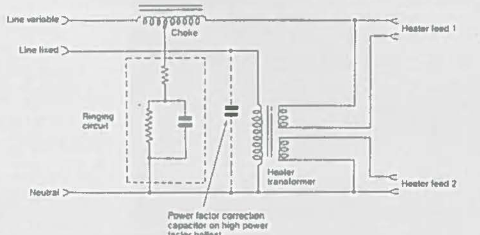

Fig. 2 – Typical circuit for a dimmable ballast.

The same dimmer range also has the option of having the heater feed switched off automatically when the full level is reached. This technique can save around 10W per tube.

Existing fluorescent dimmers can only be used to dim T12 38mm Argon-filled tubes. The 26mm and 38mm Krypton-filled or triphosphor tubes cannot be dimmed satisfactorily because their physics of operation are different. There is also a limitation on the length of tubes: 600mm, 1,200mm and 1,500mm tubes are all suitable for dimming. In some situations 1,800mm tubes can also be dimmed, but not to a particularly low level.

In a dimmed fluorescent installation it is essential that the tubes are in close proximity to an earth plane. The provision of the close earth helps the tube to light on each half cycle. The majority of standard dimmable fittings provide this earth, either by an earthed part of the fitting structure (typically the cover plate) or by a special spring mounted earthed strip that fits along the length of the tube. For fittings that do not provide the earth plane facility, it is possible to obtain special tubes that have a conductive strip painted along their length. The earth connection is made by a small spring clip with an earth wire attached. Another solution, that has the advantage of requiring only standard tubes, uses a fine metal gauze sheath that is slipped over the tube. These sheaths are earthed using spring clips, similar to those used with striped tubes.

Dimmable ballasts

Fluorescent fittings that are to be dimmed have to be equipped with special dimmable ballasts. Most ballast manufacturers produce some form of dimmable ballast.

Dimmable ballasts consist of two main sections: a transformer to provide voltage for the tube heaters (typically about 8V); and a choke used to limit the current passing through the tube (in the same way as the choke in a standard switchstart circuit).

Some manufacturers provide their chokes with a tap. This tap is connected to a resistor/capacitor network, known as a ringing circuit or tickler. The tickler is used to help the tube ignite on each half cycle by putting a higher voltage spike across the tube when a thyristor switches on. Ballasts fitted with ticklers give a better dimming performance, especially at low light levels.†

Some ballasts are specified as being high power factor. These have power factor correction capacitors fitted, but the inclusion of power correction capacitors at the fitting is dubious as the amount of power factor correction required varies considerably depending on the dimmer setting. It is much better, especially with large installations, to have an automatic power factor correction unit fitted to the mains supply.

Solid-state ballasts

Several companies are now selling solid-state (or semiconductor) ballasts. These ballasts are designed to replace the heavy iron-cored inductors of standard ballasts, with the advantages that they are lighter and more efficient (the efficiency is typically 93 per cent). However, they are more expensive, typically about £35.

Most manufacturers claim that the extra expense can be justified by the energy savings made during the first two years of installation. But several of the larger manufacturers expect that solid-state ballasts will only become really cost-effective in about two years' time.

Unfortunately some of the existing units need an extra filter unit installed in the fitting – sometimes weighing and costing almost as much as a conventional ballast!

Not all solid-state ballasts are suitable for dimming. Those that are can be used with a well designed dimmer. Some of the better solid-state ballasts use energy from the variable line of the dimmer to drive the heaters of the tube. This removes the need for a heater feed to the fitting, giving a saving on wire in new installations. It also makes the conversion of non-dimmed installations easier, as there is no need to feed in extra wires. Solid-state ballasts can also get over the problems associated with dimming tubes longer than 1,800mm. Some manufacturers claim that their solid-state ballasts can also be used to dim krypton-filled tubes. Some tube manufacturers are sceptical about this.

In future it is likely that the solid-state ballast will provide the dimming function. There are prototypes around that will already do this successfully.

The first problem is repeatability from one ballast to the next. If a number of tubes are to be dimmed together, they ought to all follow at the same level. The second problem is the interface between remote control stations and the dimming ballasts. Ideally it would be better if there were no need for special control wires between the control stations and the ballasts. This means that the control signals may be superimposed on the mains, which could lead to problems if another mains-borne signalling system is used in the same building, or nearby. ■

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*The Strand "Environ 2" range.

†Strand's "Environ" range of dimmable ballasts follows this design.