



## A GUIDE TO FLUORESCENT DIMMING

Ensuring good quality fluorescent dimming calls for more than simply using a 'fluorescent' type of dimmer. Many other factors need consideration, as detailed in this guide. Where problems with fluorescent dimming have occurred in the past, these have usually been caused by factors such as incorrect control-gear (ballasts); poor installation; unsatisfactory commissioning; or unsuitable types of lamps (tubes).

Some factors which might not *seem* important often are so. Please therefore observe the guidelines which follow.

### Choice of Tube Type

The type of tube used has a bearing on the quality of dim to be expected, so please refer to the ap-

propriate Section before deciding which type to use:

- For **T12 TUBES** [original style, 38mm (1½ inch) diameter lamps] : see Section 1
- For **T8 TUBES** [the modern 'thin' 26mm (1 inch) diameter lamps] : see Section 2
- **COMPACT FLUORESCENT:** the 2-pin versions of these lamps are inherently non-dimmable. Only the 4-pin version Compact fluorescents have a potential for dimming, though due to the lamp characteristics the quality of dim obtained may be inferior to that which is possible with linear fluorescents.

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## SECTION 1 : Dimming T12 Fluorescent Tubes

Argon filled T12 tubes continue to provide the best quality dim. Tubes which can be dimmed are 2ft, 4ft, 5ft or 6ft versions.

Strand Lighting's "genuine hard-fired" dimmers such as Multidim and Unidim can now dim these lamps right down to extinction in most cases, provided all recommendations are observed. In some installations (or with Microdimmer) it may be necessary to limit the lower level to a few per cent of full output. This is achieved during installation by trimming the dimmer "Bottom Set" adjustment to gain stable operation of the tubes throughout the range.

### Dimming Ballasts For T12 Lamps

It is essential that compatible types of dimmable Ballasts are fitted in the luminaires. For T12 tubes the best way to ensure good results (and of compatibility with the dimmer) is to use Strand Lighting's T12 DIMMABLE BALLASTS. Other manufacturer's dimming ballast may provide satisfactory results, but Strand Lighting cannot offer a guarantee of dimming performance in these circumstances.

The best performance is traditionally obtained with 4ft (1200mm) length tubes, but recent dimmer improvements mean that all lengths will dim very well (usually right down to zero) if these guidelines are fully observed.

### Wiring From The Dimmer

Four conductors are required from the dimmer to the luminaires, as shown below.

These are:

- Lv : Line Variable
- Lf : Line Fixed
- N : Neutral
- E : Earth

\* Terminations within the luminaire should be marked Lf, Lv, N and E

It is most important that the two line conductors are separately identified and it is therefore recommended that these are run in different coloured cables.

### Dimensions Of Ballasts

A T12 Dimming Ballasts is physically quite bulky, so it is advisable to check that it can be accommodated in (or close to) the fitting. Refer to data sheet for dimensions. In the event that T12 Ballasts are too large, the UDT combination (as detailed in Section 2) could be used instead of using T12 Ballasts, although using the UDT/Choke combination does not allow dimming to such low levels.

### Ballast Versions

The correct version must be used for the lamp in question:

Lamp Length	Rated Wattage	Appropriate T12 Ballast for 240 Volt supply & UK type tubes, T12 only.
2FT (600mm)	20W	Each pair requires one 09 320 06
4FT (1200mm)	40W	Single 09 320 06
5FT (1500mm)	65W	Single 09 310 09
6FT (1800mm)	85W or 75W	Single 09 300 01

### Do's and Don'ts

See Section 3 for further recommendations.

## SECTION 2 : Dimming T8 Fluorescent Tubes

T8 (1 inch diameter) lamps are filled with a mixture of argon and krypton gas. The inclusion of krypton makes these lamps more difficult to dim and makes it necessary to use different control-gear in the luminaire. T8 lamps will dim from 100% down to around 10% light as follows.

### UDT Plus Choke

The requirement is that each T8 tube to be dimmed is connected to one Universal Dimming Transformer and a standard Choke.

The same Universal Dimming Transformer (UDT) is used irrespective of tube length, but the standard Choke must be matched (in the normal way) to be tube in question. The standard Choke is an ordinary switch-start choke, (not to be confused with the T12 Ballast). If an ordinary fluorescent fitting is being converted for dimming, the Choke already in the fitting will often be suitable, provided it is of standard type (i.e. Standard Switch Start Ballast of Delta T 50°C).

Note that every lamp needs its own UDT and separate Choke.

Rated Tube Watts	Length	Appropriate Dimmable Control-Gear (240 Volt version)
36W	4FT	UDT (09 212 40) PLUS 36W CHOKE (09 213 14)
58W	5FT	UDT (09 212 40) PLUS 58W CHOKE (09 213 15)
70W	6FT	UDT (09 212 40) PLUS 70W CHOKE (09 213 16)

### Minimum Level For T8s

The UDT will automatically cut out the tube below a certain minimum light level. Although nominally quoted as 10%, this minimum level varies according to the length of tube as follows:

6ft tubes : around 5%      5ft tubes : around 8%  
4ft tubes : around 10%     2ft tubes : around 30%

Note: The 2ft (18W) T8 tube does not dim to very low levels. It is therefore suggested that if possible, 20W (T12) tubes are used instead. As well as providing a dim to much lower levels, using the alternative 20W lamps in pairs (with a T12 Ballast) reduces the cost of dimmable control-gear by a factor of about 4.

### Wiring From The Dimmer

Four conductors are required from the dimmer to the luminaires, as shown below.

These are:

Lv : Line Variable  
Lf : Line Fixed

N : Neutral  
E : Earth

\* Connections within the luminaire should be made as follows: Lf to "L" on the UDT; Lv to one end of the choke; plus N and E

It is most important that the two line conductors are separately identified and it is therefore recommended that these are run in different coloured cables.

### Control-Gear For T8 Tubes

Strand Lighting Catalogue No's for control-gear for these lamps are as follows:

### Do's And Don'ts

See Section 3 for further recommendations.

## SECTION 3 : General "Do's" And "Don'ts"

### 1. Loading

Tube wattages should not be used to calculate dimmer loading. To determine the appropriate dimmer for a particular load, see Section 4.

### 2. Mixing Tube Lengths

Different lengths of tube should not normally be mixed on the same dimmer, as this results in different light outputs between the different lengths.

### 3. Noise

All Ballasts emit some noise and this is marginally increased by dimming. Strand's T12 Ballast is designed to minimise noise, but accidental amplification of any noise that is present can be avoided by choosing luminaires of robust construction and taking sensible account of how the ballast is mounted within the luminaire. The same principle applies to the mounting of UDTs and Chokes. For the majority of applications, the noise levels emitted by the control-gear are of no practical significance. In particularly sensitive quiet areas, remote siting of fluorescent control-gear might be worth consideration.

### 4. MICC Cable

Cable is not recommended for use between dimmer and luminaires, due to its comparatively high capacitance.

### 5. Earthing

An earthed metal surface should be provided to run parallel to each lamp along its full length, as close as possible to the lamp (ideally within 12mm of the tube wall). Many fittings have a gear tray cover which fulfils this condition, but the spacing and the earth continuity need to be verified.

### 6. Emergency Gear

Control gear for Emergency Lighting will not operate correctly from a dimmed supply. It is therefore recommended that Emergency lamps and gear are kept electrically completely separate from the dimmed part of the lighting.

### 7. Starter or Capacitors

No starter or capacitors should be included in the luminaire. See Appendix A for notes on Power Factor correction.

### 8. Lampholders

It is essential that lampholders maintain a firm, low resistance contact with the pins of the lamp. Good quality lampholders are therefore required, otherwise both dimming and performance lamp life may suffer. Push-on lampholders may not provide suitable contact. Lampholders with poor or relaxed springs should be replaced.

### 9. "Burning In" of lamps

New T12 tubes perform better once they have been "burnt in" for a period of time. Ideally, the system should be run at maximum for 100 hours to stabilise the lamps. If not practical to do this, then no damage results and in many cases this stage is found not to be necessary.

### 10. Selection of lamps

Fluorescent lamps are subject to manufacturing variations which may only become apparent when they are dimmed. From any batch of lamps therefore it is not unusual that a small percentage may be rejected for dimming purposes. Tubes of the same colour from the same manufacturer should be used, and preferably from the same production batch.

For matched light output, re-lamping should be carried out at planned maintenance intervals, replacing all lamps.

Versions of T12 tubes are also available (mostly overseas) with high resistance cathodes. These operate on a lower heater voltage and are therefore not suitable for use with standard T12 Dimming Ballasts. For non-standard tubes or non 240 Volt mains supplies, please contact Strand Lighting.

### 11. Insulation Testing

Do not use high voltage test equipment (Meggas etc), either on UDTs or with the dimmer connected in circuit.

## SECTION 4 : Calculating Dimmer Loading

The table below should be used to calculate which dimmer is suitable for a particular lighting load (adding up the tubes rated wattages is not a suitable method). The table takes account of true lamp current when operated with dimming ballasts.

DIMMER RATING	MAXIMUM NUMBER OF TUBES				
	2FT TUBES (600mm)		4FT TUBES (1200mm)	5FT TUBES (1500mm)	6FT TUBES (1800mm)
	T12*	T8	T12/T8	T12/T8	T12/T8
5 AMP	22	13	10	7	6
6 AMP	28	15	14	9	7
10 AMP	40	26	20	16	15
16 AMP	76	42	38	24	20
20 AMP	80	52	40	32	30
32 AMP	142	85	76	48	40

Notes:

1. \*2ft, T12 tubes to be wired as pairs only.
2. Other twin fittings are equivalent to two singles.

## ELECTRONIC HF BALLASTS

Permitted dimmer loading is different for HF electronic ballasts : see the table below for loadings, and refer to Section 5 for further details on commissioning.

Dimmer Loading with ELECTRONIC H.F. Ballasts ONLY PERMITTED LOADING (NO. OF TUBES)								
DIMMER VERSION	18W		36W		58W		70W	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
6 AMP	6	50	4	27	2	18	2	16
16 AMP	18	130	12	76	6	48	6	46
32 AMP	36	260	24	152	12	96	12	92

## SECTION 5 : Special Notes On "High Frequency Ballasts"

Approved type of electronic High Frequency Ballasts can be used with certain of Strand's dimmers but only within strict guidelines as laid out below. Because of the requirements for a special commissioning procedure, this type of Ballast is not Strand's recommended "first choice" (see instead Sections 1 & 2). If HF ballasts are the only alternative, then dimming down to 10% can be accomplished, but the following points must be observed.

At present the only approved types of high frequency dimmable ballasts are Helvar's EL ..... FD range. Due to the characteristics of these ballasts *correct commissioning of the dimmers MUST be carried out to protect lamps and ballasts*. Strand Lighting can provide this (chargeable) service, or it may be carried out by the installer. In the latter case, please note that Strand Lighting cannot be held responsible for any problems resulting from inadequate or incorrect commissioning. Details of this procedure are as follows:

### Commissioning Procedure

(Does not apply for T12 ballasts or UDTs)

The procedure given below applies to Strand Multidim plug-in dimmers although the commissioning process is similar for other Strand dimming products. Details can be found in the appropriate Installation Manual supplied with the equipment.

1. Remove the load cable from the dimmer's LV terminal and temporarily connect it directly to the supply terminal (P).
2. Switch on the supply and check that all fittings give full light : any faults must be cleared before the next step.
3. Preferably using a true RMS volt meter, measure the (full mains) voltage now supplying the fittings.
4. Place a light meter at a fixed central point in the room, wait 4 minutes, then measure the 'full' light output.
5. Switch off and reconnect the load cable onto the LV terminal of the dimmer Base. Cut link LK2 on the rear of the dimmer module.

Plug the dimmer in and use the trimtool provided

to adjust the Bottom Set fully clockwise.

Set the Fast start switch to ENABLE, and apply power.

6. Set dimmer to OFF at the Control Station.

Slowly raise the dimmer level until the internal relay just clicks in. Wait for the right level to stabilise.

7. Now adjust the Bottom Set to give 10% light output compared to 'full' reading measured in Sept 4. (Do not go below this level, as this may shorten tube-life).

8. From the Control Station, set the dimmer to Full, and then tune the dimmers Top Set adjustment anticlockwise and observe the output voltage. As the dimmer "backs off" from full conduction, the output voltage rises above normal Mains. Continue anticlockwise until the output voltage falls just (say 5 volts) below that measured in Step 3.

### Dimming Performance With Hf Ballasts

STARTING FROM "OFF": The dimmer's "Fast-start" facility strikes the tubes at approx. 45% light for about 2 seconds before settling to the fader (or Preset) level. Following this, dimming is possible between 10% and 100% light. This "Fast-start" is required to protect lamps when used with this type of ballast.

## SECTION 6 : Appendices

### APPENDIX A: Power Factor Correction

Normal practice for non-dimmed luminaires is to include capacitors, these being of values chosen to 'counter-balance' the inductive effect of the Choke.

In the case of a dimmed luminaire, these capacitors are not required. (In the dimmed situations, the inductive component needing compensation varies widely according to the point on the dimming curve, which makes it impossible to choose an accurate value of capacitor.)

If on larger projects, power factor correction is called for, the capacitors must be connected at the mains input side of the dimmer. On no account must capacitors be connected to the output terminal Lv of the dimmer. (This applies equally to any capacitors intended for interference suppression.)

### APPENDIX B: Temperature

At low temperatures, fluorescent tubes become difficult to strike; and at high temperatures dimming performance may be impaired. Ideally, the wall of the tube at its midpoint should be within 30°-50°C when in operation. Luminaires should not be installed in an environment where the lamps would be run consistently outside these temperature constraints.

### APPENDIX C: Wiring Checkout

Just one ballast wrongly connected could cause all tubes on a whole circuit to flicker. Before switch-

ing on therefore, it can be useful to carry out the following procedure to verify correct wiring of every fitting.

1. Disconnect the Lv cable at the dimmer or alternatively (in the case of Multidim), switch off the higher rated of the two dimmer MCBs (isolates the Lv output).
2. Switch on and raise the dimmer to some intermediate level between "OFF" and "FULL".
3. In the case of T12 tubes: Every tube heater (both ends) should now show as a dull red glow. Any fitting showing discharge (white light) is liable to have its LV and LF cables transposed. Do not proceed until all heaters are visible.  
  
In the case of T8 tubes: All tubes should be on at approximately 10% light at this stage. Do not proceed until this is the case.
4. Restore the Lv supply and check that all fittings will dim.
5. If necessary, adjust dimmer "Bottom Set" for a smooth dim to "OFF" (T12 tubes only).

*The information contained in this document is for guidance purposes only, based on many years experience in the supply of fluorescent dimming equipment. For full technical specifications of Strand Lighting's dimmer, controls and dimming ballasts, please refer to the appropriate data sheets.*