Lead Lag Luminaires

The power factor (for a lamp together with its ballast under normal operating conditions) is always indicated on a ballast (Fig. 1). In fact a luminaire with a lamp rated 58 W and a magnetic ballast has an overall reactive power intake between 64 W and 70 W therefore in the commercial and industrial sectors compensation is required – Power Factor Correction.

Method 1 – Parallel capacitor connected between L & N
It is common practice with ballasts to compensate the reactive power at the place of origin, where this is most effectively done - within the luminaire. The usual method is to parallel the (approximately) ohmic-inductive load of the ballast by a capacitance as can be seen in figure 1. Ballast manufacturers mark, on the ballast, the value of the parallel capacitor required to provide adequate power factor correction (compensation).

There are disadvantages with this form of compensation, capacitive reactance drops proportionally as frequency rises, so capacitors may be overloaded as there are a lot of harmonics and other frequencies higher than the mains frequency rating superimposed upon the line voltage. A parallel capacitor adds a significant amount of distortion (higher frequency constituents) to the overall current and although the capacitance is properly dimensioned, the reactive current cannot be brought to zero – this is a disadvantage with the Parallel Capacitor Method.

Despite the disadvantages of Parallel Capacitor Compensation it is an effective way of Power Factor Correction (compensation) because it is simple and inexpensive. In most cases the advantages are far more significant than the disadvantages.

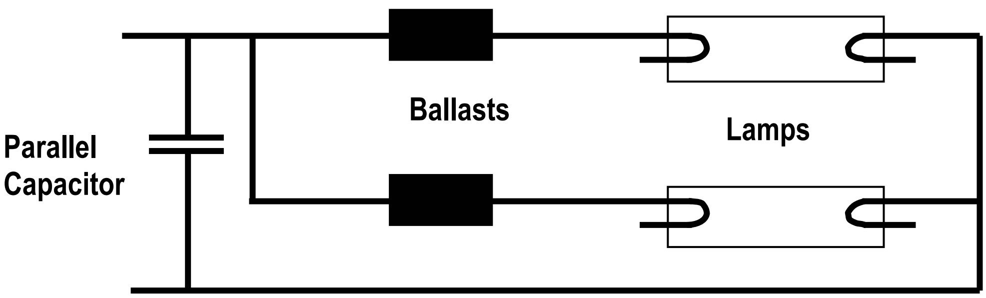

Figure 1

Summary - the reactive power of the ballast lamp combination (e.g. 0.5 leading) corrected by a parallel capacitor and typically delivers a PF of 0.9-0.95 (Unity or 1 is an ideal PF).

Method 2 – Series capacitor connected between L and the input terminal of one ballast in a twin lamp luminaire (applies only to fittings with 2 ballasts e.g. 2 x 36W & 2 x 58W)

An un-compensated a ballast lamp combination has significant reactive power component – poor power factor (e.g. 0.45). We can use this situation to our advantage by adding a series capacitor between the L and the input of only one ballast in a twin ballast luminaire. In this scenario every second lamp-and-ballast unit is (over-)compensated with a serial capacitor dimensioned – in theory – precisely in such a way as to make the current magnitude equal to that in an uncompensated lamp. The phase angle will then also be of the same absolute magnitude but with opposite sign – the result is a unity power factor.

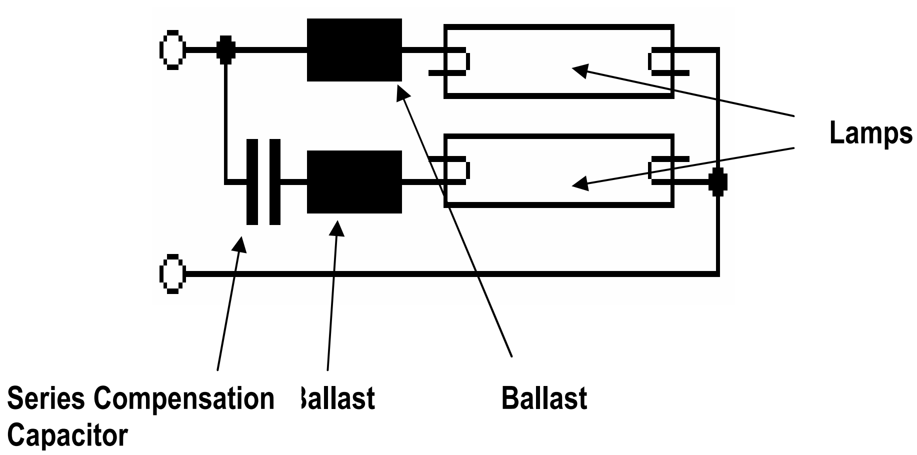

Figure 2

With series compensation all the disadvantages of parallel compensation are avoided – minimal current distortion. As a side effect, the compensated ballast/lamp is much less sensitive to voltage variances, flicker and direct voltages superimposed upon the feeding voltage, which otherwise, even if minimal in magnitude, may heavily affect inductive components.

Despite the advantages mentioned above there are some series disadvantages and consequences associated with this form of compensation. A bit of over- or under-compensation does not matter much in parallel compensation, but in series compensation it means incorrect lamp current, possibly lamp, capacitor and ballast overload or at least either higher loss level than necessary and premature failure or reduced light output. Therefore the tolerance rating of the series capacitor should be just 2%.

Another disadvantage, not of the principle but in common practice, is that the currents in each half of the luminaire, with and without serial compensation, are not really equal due to slight variations in the lamps and ballasts. This again affects the value of the series capacitor required and can introduce further error. Incorrect dimensioning of the capacitor by 20% produces an error of 32%.

Finally it is no longer common practice for the German ballast manufacturers to print the series compensation capacitor values on ballasts perhaps due to the possible errors (and consequences) associated with this method even through it is theoretically superior.

For our 2 x 36W Lead Lag Batten (FBS236-DIF-LLAG)_we use an ATCO, CS3.2-02, 3.2uF, 450VAC, 50/60Hz capacitor with a tolerance of +/- 5% (Syteline P/N: 9604200).

Summary – Integral Energy may prefer this method because it should result in less current distortion and associated harmonics.