

## The Real Benefit of dimming LED's

Most modern homes, boardrooms and even offices nowadays consider the ability to dim lights and even groups of lights within the same room to be a necessity. This is mainly for the aesthetic value that dimming adds to the living or working environment.

Justifiably, during earlier times when the National Grid was not under pressure, electricity prices were of less concern and conventional lamps were cheap to replace, it was not necessary to consider the possible added benefits that the dimming of lamps can provide. This has now all changed. Our Grid is constantly under pressure, electricity prices are sky rocketing and even conventional lamps are becoming expensive.

Fortunately the LED revolution came to the rescue and due to its very low energy consumption provides some relief from high electricity costs. However since dimmable LED lamps are slightly more expensive than their non-dimmable counterpart, buyers now have to decide whether they actually want to dim the lights or not. However if the "nonvisual" benefits, especially the additional energy savings possibilities and the increased lamp lifetime, of the dimming LED lamps are considered, it might be much a easier decision whether to dim or not.

Figure 1 shows the measured energy consumption versus measured light level of a conventional 50W GU10 halogen lamp, a typical 10W GU10 LED lamp and a typical 10W MR16 LED lamp with an electronic transformer. It can be seen that, besides the obviously much higher energy consumption of the halogen lamp and much lower initial light output, it's consumption curve when dimming is very non-linear. The LED lamps on the other hand not only show a much higher initial (non-dimmed) light output, but also exhibit a virtually linear consumption curve as the lamp are dimmed.

In order to better appreciate the implication of these characteristics, Figure 2 shows the energy savings as a percentage of the initial (non-dimmed) energy consumption versus the percentage of measured light output. It can be seen that if the lamps are dimmed to 50% lux output, the halogen lamp saves only 26% energy, very little considering that it consumes close to 50W when not dimmed. This is due to the fact that the majority of the energy is used to ignite the gas and produce heat - the visible light output is only a small percentage of total consumption. LED's are however an electronic component which has an inherent non-linear energy consumption versus light output which is the opposite to that of a halogen or incandescent lamp. With LED light sources, the energy savings is remarkable when dimming as can be seen from Figure 2. When dimmed to 50% light output, the 10W GU10 LED saves a staggering 62% energy, effectively consuming only 3.8W. Due to the losses associated with the electronic transformer, the 10W MR16 LED performs less efficiently but still saves a very respectable 48% energy when dimmed to 50%, effectively then only consuming 5.2W. Results will differ from brand to brand and even possibly between different models within a brand, but the general tendency will be the same or very similar for all LED lamps.

Interestingly, due to the high lumen output of the LED lamps, the MR16 measures around 400 lux (1m from source) and the GU10 approximately 450 lux compared to the a very low 150 lux of the halogen lamp when dimmed to 50%.

When an LED is dimmed, the current through the module reduces and the junction temperature correspondingly reduces (typically non-linear). This has a **profound** effect on the lumen maintenance of the LED as can be seen from Figure 3, which shows a graph of the expected LED module lifetime versus its internal temperature. Additionally, the driver built into the LED lamp also suffers degradation due to increased temperature but dimming the lamp reduces the overall temperature. A measurement of a typical 10W GU10 LED showed that the aluminium housing temperature reduced from about 40°C above ambient when at full intensity to about 5°C above ambient when dimmed to its lowest intensity – this much reduced temperature has an obviously beneficial implication on the lifetime of the lamp's driver.

Thus, the energy savings is real when you dim LED's - the more you dim, the more you save. The more you dim, the cooler the lamp operates resulting in reduced lumen depreciation as well as a longer lifetime of the LED's driver.

However, always ensure that the correct dimmer type is used for dimming a particular LED. If a dimmer is not matched or approved for a specific LED it can result in reduced product lifetime.

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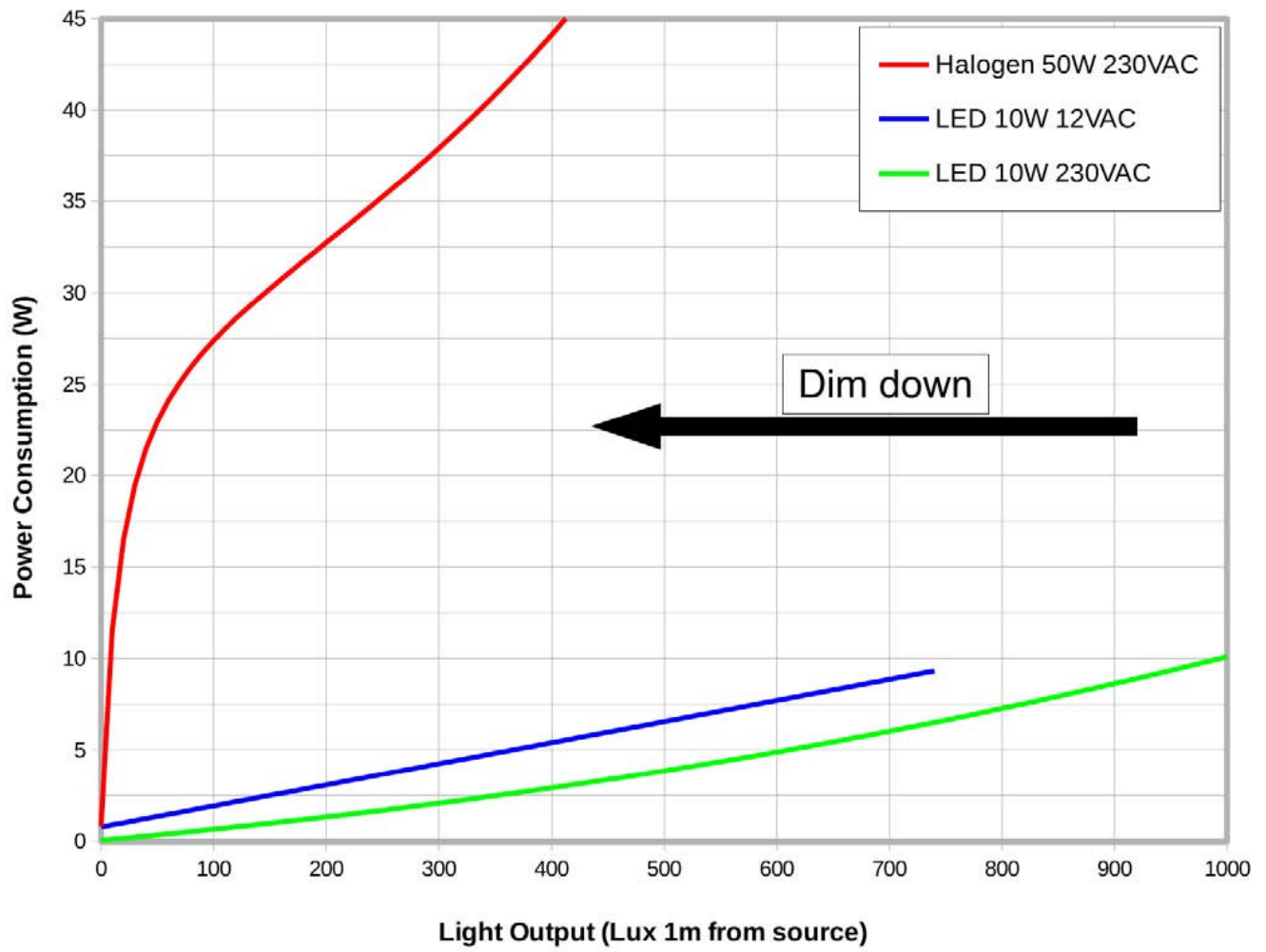


Figure 1: Measured light output versus energy consumption of halogen and LED lamps

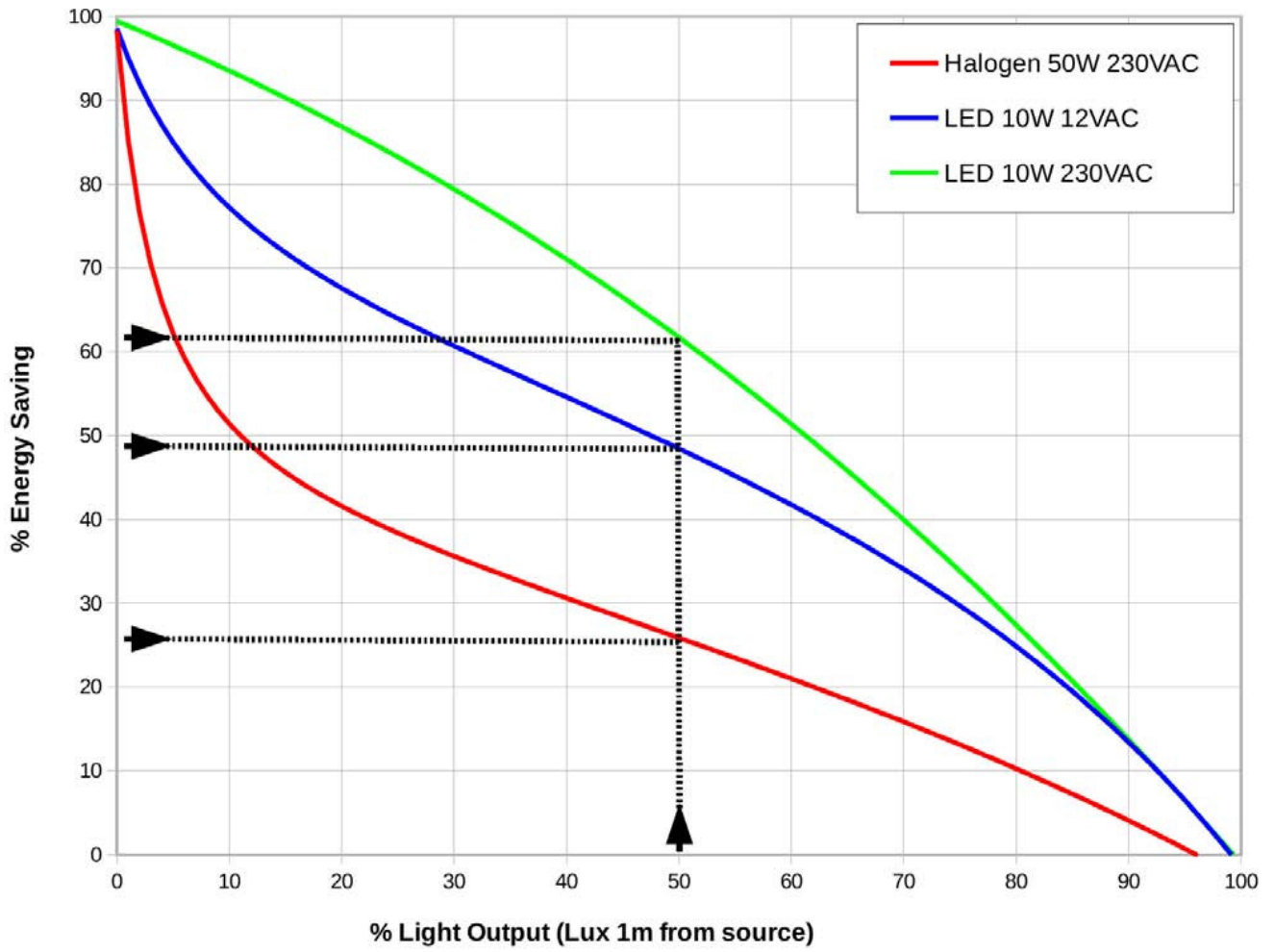


Figure 2: Measured energy savings versus light output of halogen and LED lamps

Cree XLamp XR-E White L<sub>70</sub> Lifetime Prediction  $T_{AIR} = 45^{\circ}C$

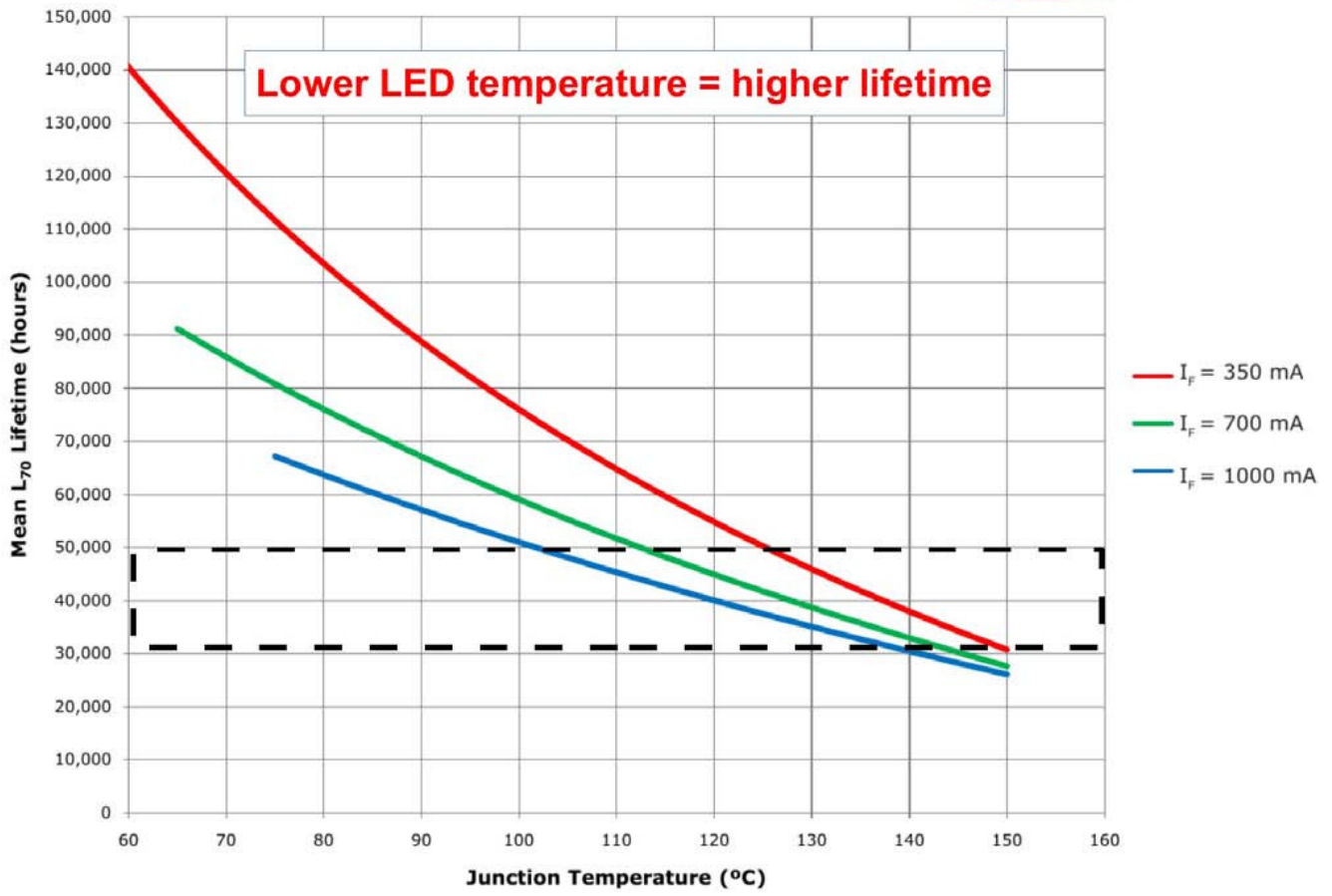


Figure 3: LED module lifetime versus temperature