

A quick introduction to LEDs



LED downlight with substantial rear heat-sink for genuine halogen equivalence.



An LED light module that produces consistent white light.



A typical GU10 halogen LED replacement that may produce less light than expected.

1. What is an LED?

A Light Emitting Diode is a semiconductor light source – it is not a lamp. It is a chip created from a wafer that is grown through a process called epitaxy. Wafers are typically 50-100mm diameter and yield thousands of 1mm² chips.

2. How is an LED lighting product made?

An LED chip (or chips) is typically made into a package with electrical connections, a primary heat sink and optics to direct the emitted light. These packages are usually sold on reels to manufacturers of light engines, who mount them on circuit boards and add heat sinks and sometimes the electrical gear needed for the correct electrical supply (called drivers, which are similar to a transformer). Light engines are then sold on to light fitting manufacturers who build them into metal bodies suited to installation into buildings.

3. What are the advantages of LEDs?

There are several theoretical advantages of the technology:

- The efficiency of converting electricity into light is potentially very high
- There is the potential to create long life low maintenance fittings
- Colour and quality is more flexible than other sources.
- They can be smaller than other conventional light fittings
- They are 'instant on' and should work well in low ambient temperatures.
- They have lower toxic content than many conventional light sources

4. What are the disadvantages of LEDs?

Disadvantage is probably the wrong word – more correctly it is worth thinking in terms of dangers and most of these relate not to the technology, but more to the quality of design and engineering of the LED product, which is quite often poor. Like many new technologies – it is sometimes oversold with poor products being sold by people with limited knowledge. The results are:

- The products are not as efficient as claimed with inaccurate comparison data.
- The product lifetime information is misleading.
- There is a lack of colour and quality consistency across products.
- The small light source can create excessive glare
- The ambient working temperature may be above that designed for the product.
- There may be incompatibility between drivers and control systems.

5. What are the issues of colour with LEDs?

The process of making LEDs produces chips of different colours and in particular different colour whites, between warm colours (<3500k CCT), cool (3500-5000k) and daylight colours (>5000k). LED manufacturers typically sell LEDs in bins which all sit within a range of specified colour coordinates. An individual product might require only LEDs from a single bin otherwise the product will have noticeable appearance difference. Fine binning and other methods of achieving colour consistency tend to add cost to the product, but without them, the result can be poor, both in appearance and light quality.

6. How should LED products be compared?

There are several key criteria:

- Colour appearance (CCT) in colour temperature.
- Lumen output (exit lumens – not raw lumens)
- Beam angle
- Dimmability
- Colour rendering Index (CRI)
- Power consumption (watts)
- Appearance/build quality

Once you have a similar product comparison, you can work out the value of an illumination product on a pence/lumen basis. Simply divide the cost of the fitting in pence by the lumen output and you should have figure between 1 and 20 with 1 being much better than 20.

7. What about drivers?

It is important in any product comparison to include the energy consumed by the driver. The driver has to last as long as the LED and needs to be supply the right power to the fitting. On the primary side drivers must be matched to the right protocol from the dimming switch or control system. Drivers often need to last as long as the fitting and generally do not like heat – therefore external drivers are often better. Products with integral drivers will tend to have shorter lives because of their higher operating temperature. The common dimming protocols are Phase dimming (leading or trailing edge) for domestic projects and 1-10v, DALI or DMX for commercial projects.

8. What is the value of a product guarantee?

Not as much as you might think. Most suppliers will offer some form of guarantee and some will offer up to 5 years. However some guarantees are rich with qualifications and nearly all are 'back to base' only. That means the customer bears the cost of removing the fitting from the building and sending it back to the supplier and then installing the replacement – and this is likely to be the main cost of any product failure. Consider how established a supplier is before accepting their guarantee and even then it is best to fully evaluate the product rather than rely on a guarantee for reassurance.

9. Is it possible to future proof products?

LEDs change very fast and in a single year it is not unusual for several generations of product to be created. This means it can be hard to buy the same product two years apart. Using established form factors, is probably the best approach. Leading companies are making products with similar sizes and protocols so that they will be more interchangeable in the future. Many of these products will follow the established lamp formats of the conventional lighting they are replacing even though these may not be ideal for LEDs. Staying with one of the larger brands of lamp replacement/module types is the best approach to future proofing.

10. What is an OLED?

An Organic LED (OLED) uses several layers on glass substrate to create a light emitting surface. At present these products are mainly very small and the technology is around 5 years behind that of LED chips, but it will eventually produce large surface area products. Polymer (POLEDs) variants may allow flexible "light emitting wallpaper" style products at lower cost, although the potential energy efficiency of such products is as yet unclear. All OLED products are in their early stages of evolution and not recommended for standard applications.