

The Lighting Buyer's Technical Reference Guide

A primer on
choosing, specifying
and designing with
LED lighting



Brilliant Lighting is one of the UK's leading residential lighting design specialists. We created the Brilliant Lighting online store to offer the same high quality professional products we use in our own schemes to a wider market.

Each of the products we supply has been tested and passed for quality, value and suitability for purpose. This reference guide is designed to help you choose the right LED fittings for your project.

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How to use this guide

This buyer's guide is structured to help you choose the right LED lighting for your projects. It covers the benefits and watch-outs of LED lighting, choosing the best LED lighting based on our quality criteria and how to select and specify the fittings, drivers and dimmers that will give you the best results. The illustrative photographs are all from Brilliant Lighting design projects.

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Brilliant Lighting project photography by Simon Warren and Charlotte Gale
Product photographs courtesy of ACDC, Orluna & LightGraphix

Why use LED?

Why Use LED Lighting?

Efficiency concerns and regulatory demands have fuelled the rise of LED

Good quality LED light fittings produce beautiful quality light; all of the fittings in the Brilliant Lighting project photos below are LED. Good quality LED fittings are energy-efficient and very long lasting, significantly reducing maintenance issues. They may be more expensive to buy but they are a lot cheaper to run than halogen or other incandescent sources.



“Using high quality LED fittings is essential if you want to make the most of your lighting design”



What's so special about our LED range?

They're predominantly aimed at the professional lighting market which is perceived to be more demanding than the consumer market. We think consumers deserve the same level of quality. After all, lighting is probably the most important element in your house after the architecture. The purpose of this document is so that you can be both demanding and informed.

The LED fittings that we have on the website are a small selection from the range that we use to create fabulous results in our bespoke projects. As with all the fittings that we use they have been selected for quality and 'lifetime' value for money.

What we look for in LED lighting

- Quantity and quality of light
- Colour temperature and colour rendering
- Reliability and longevity
- Great design, track record & country of origin

Why use LED?

Dedicated LED Fittings vs Retrofit Lamps

The differences between a dedicated LED fitting and a replacement LED lamp

A dedicated LED fitting is one in which the LED chip is an integral part of the fitting; you don't change it like a lamp (or light bulb). A retrofit LED lamp (or light bulb) is an LED lamp which looks like a traditional incandescent or halogen lamp and is inserted in to the fitting in the same way. It is separate to and replaceable from the fitting.

Where possible we'd recommend using dedicated LED fittings to be the 'backbone' of a scheme.

Why might you use a dedicated LED fitting?

We strongly recommend using dedicated LED fittings for the core of any architectural lighting scheme. They are ideal for downlighting, uplighting, wall/step lighting, coffer lighting etc.

The superior thermal management of a dedicated fitting allows much higher output: many of the dedicated LED downlights we use and supply achieve 900+ lumens, which is comparable to a 12v 50w halogen lamp. A retrofit LED lamp is doing well if it achieves 450 lumens.

The same thermal management enables a longer life; all the dedicated LED fittings we use have a life expectancy of 50,000 hours. A top quality retrofit lamp has a life expectancy of c.35-40,000 hours, and many lamps are around 15,000 hours.

There are more and better ways of dimming (eg; 0-10v, DALI, DMX), not just mains trailing edge. This makes dedicated LED fittings more flexible as a light source and ideal as the backbone of your architectural lighting.



When might you use a retrofit LED lamp?

The obvious application for retrofit LED is to replace an old incandescent or halogen lamp within a light fitting that you already have, but there are other applications.



We all like decorative fittings which are designed around the traditional form factors of incandescent or halogen lamps, and a retrofit LED lamp is often the best energy efficient light source for these. Decorative fittings are often used for their aesthetic contribution rather than a primary light source. Because LED lamps vary slightly in size/shape it is important to check that the lamp you would like to use actually fits in to the fitting.

Retrofit lamps can be a cheaper route; in areas where the lights aren't used often and/or the quantity and quality of light is secondary (e.g. garages, stores, small secondary rooms) a fitting with a retrofit lamp might be the best route to go.

Really good thermal management is critical to the longevity of an LED, both to keep it working at all and also to maintain light output and colour consistency.

“Really good thermal management is critical to the longevity of an LED”



The diodes in a LED fitting do not have enough material or surface area to be able to dissipate heat away from the centre (or ‘junction point’). They must therefore be bonded to other thermally conductive material to remove heat from the diodes. The higher the light output, the more heat is generated and the more thermal management is required.

Being physically larger you can get better thermal management in a dedicated LED fitting rather than a retrofit LED lamp, which is one reason why you get more light and a longer life from a dedicated LED fitting.

Like fluorescent, the light output from an LED will decline over time. The dedicated LED fittings we use and sell have superb longevity and reliability with an expected lifespan of 50,000 hours. If used for an average of 6 hours per day every day, this equates to nearly 23 years.

Definition of LED lifetime

LED lifetime is commonly defined as being to the point when a fitting delivers 70% of its original lumen output (L₇₀)

Retrofit LED lamps have a shorter life but again we use the best available, typically c.35,000 - 40,000 hours.

“Cheap as Chips”

Cheap LED lamps can often be a false economy.

“Which?” Magazine (January 2014) found that nearly 30% of the lamps they tested didn’t last the claimed 15,000 hours. We’ve been told of cheap lamps lasting 28 minutes. This really is an area where you get what you pay for.



We select fittings not only for their technical excellence but also their aesthetics and build quality. Low glare is always important, and then, depending on the interior design, fittings should be discrete or statement, round or square, contemporary or suited to sitting comfortably in a historic house etc. We constantly review the market and assess new products against our core range.



“We look for the best and most interesting designs with excellent build quality ”

Whilst we source fittings based on the best quality and value, we prefer to source fittings made in the UK or the EU. Not only is this good for the wider economy but it means that we are closer to the supply chain and have a direct dialogue with our suppliers about product developments. We're also able to maintain strong working relationships with their technical support teams.

All of our dedicated LED fittings are made in the UK, many from components (heatsinks, bodies, optics etc.) also predominantly made in the UK.

Our decorative fitting manufacturers are predominantly in the UK, and if not the UK then the EU.

Common myths around LEDs

LEDs are “fit and forget”

Whilst a good quality fitting should give you years (or decades) of service, everything expires eventually. Installation location and method should be done with this in mind.

All LEDs are energy efficient

Not all LED lamps or fittings are highly efficient and meet the Part L Building Regulation requirements of 45 lumens per circuit watt. All the ones that we use and specify do.

LED's give off a horrible light

Poor quality LEDs can. The high quality fittings we use offer super quality light and we can tune the characteristics of each fitting for a truly bespoke look .



Historically we used to get a sense of light output by measuring the amount of power that went in e.g. if you used a 50w mains halogen lamp the amount of light produced was pretty consistent and '50w' gave you an idea of what sort of light should come out.

With LED this is very different.

LED chips vary hugely in output, even within the LEDs produced by one manufacturer. One of the very reputable chip manufacturers, Cree, produces 1w LEDs in a choice of 40, 60 or 90 lumens. The performance and price difference is huge.

The optical design of the fitting then has a significant impact on the actual amount of light delivered; good optical design using high quality materials can ensure that up to 90% of the light generated is used, and it can be directed to the desired location. Bad optical design and poor materials can absorb 50% of the light produced. Beware, some manufacturers claim lumen values which are measured before these losses.

We use dedicated fittings which have fabulous performance and efficiency so if required they really are comparable in output to halogen lamps. The LED retrofit lamps we use are the best available on the market. It's really important that you look at the delivered lumens output from an LED fitting or a retrofit LED lamp, decide a short list of potential fittings/lamps and ideally test them out vs. traditional sources.

Output in Lumens from "traditional" sources

35w low voltage (12v) halogen spot	c.550 - 600
50w GU10 mains voltage halogen spot	c.600
50w low voltage (12v) halogen spot	c.800-950
40w GLS incandescent candle lamp	c.450
60w GLS incandescent candle lamp	c.750



Measures of light you may come across

Lumens

In simple terms, the amount of light given out by a light source in a defined beam or angle. This makes lumens the easiest measure to relate LED output back to traditional GLS and Halogen lamps.

Lux

A measure of the amount of light falling on a surface. It equals 1 lumen per square metre. Lux is affected by distance from the light source and beam width: a fitting with a narrower beam will deliver a higher lux value over a smaller area than a fitting with the same lumen output but a broader beam width.

When manufacturers claim that their LED lamps or fittings are 'equivalent to a 50w halogen lamp' it's strongly advisable to check this claim out more carefully.

Checklist

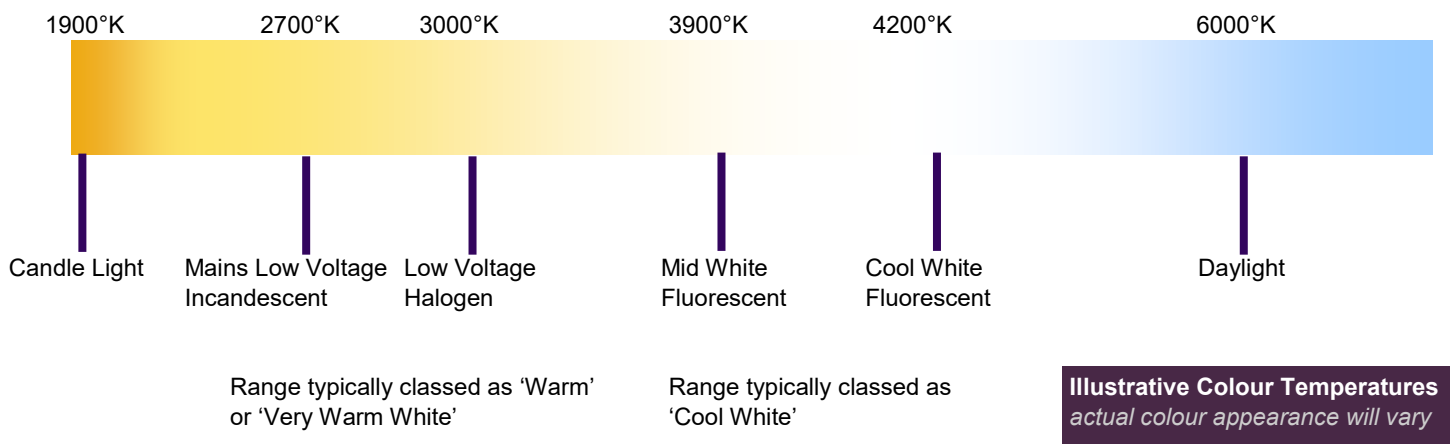
- ☒ Check the 'delivered lumens' output for a better comparison.
- ☒ Even better, test the LED fitting or lamp in a side-by-side comparison vs a halogen lamp. If a downlight use a 50w low voltage (12v) halogen lamp as a comparative benchmark.

The lamps or fittings you are comparing should have similar beam widths otherwise this will distort your conclusions.

Choosing LED

Colour

Colour temperature and colour rendering



Everyone has seen very cold blue-white light from LED lights but the better quality manufacturers are producing chips in a lovely range of warm whites. The ones we use and sell are genuine alternatives to halogen.

Colour temperature is measured in degrees Kelvin (K). The lower the value, the warmer and more golden the light will appear; the higher the value, the cooler, more blue the light will look.

Whilst colour temperature should be a consistent measure in reality it's not. One company's 2700K can look like another company's 3000K, or a 3000k can look pinker or greener. This is particularly true at the cheaper end of the market and is a good reason for not buying LED fittings or lamps without testing out a few first, and ideally only buying from a top quality supplier.

Colour consistency amongst a batch of fittings or lamps is another differential between high and low quality LED. The manufacturers of our fittings 'colour bin' the LEDs very precisely resulting in no noticeable colour difference between the LEDs in any batch.

Finally, as LED fittings age there is a significant risk that their light colour will change if the heat the LED generates is not dissipated correctly. Our suppliers go to great lengths to ensure their fittings stay cool, giving excellent colour consistency over time.

Colour Binning

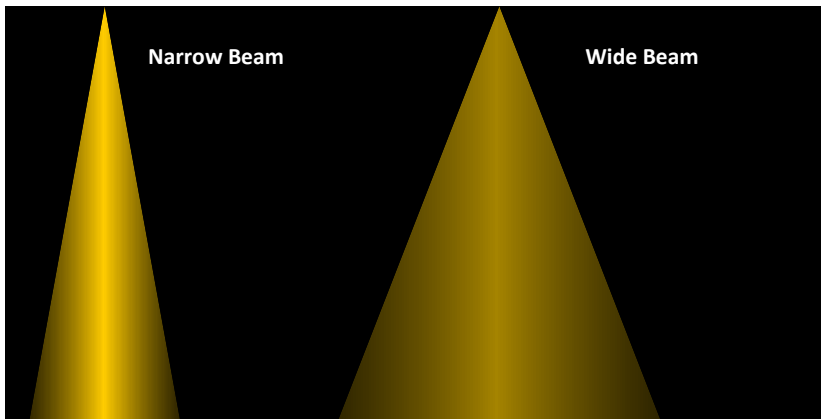
This is the process by which LEDs of a similar colour are 'binned' together, using a scale called MacAdam Ellipses. The eye can perceive very small differences in colour: we use manufacturers who bin their chips very tightly, to 2 MacAdam Ellipses or less.

Colour Rendering

This is a measure of how good the light source is at making colours look 'true.' Whilst nothing can beat daylight the best quality LED fittings have a CRI (Colour Rendering Index) of 95+



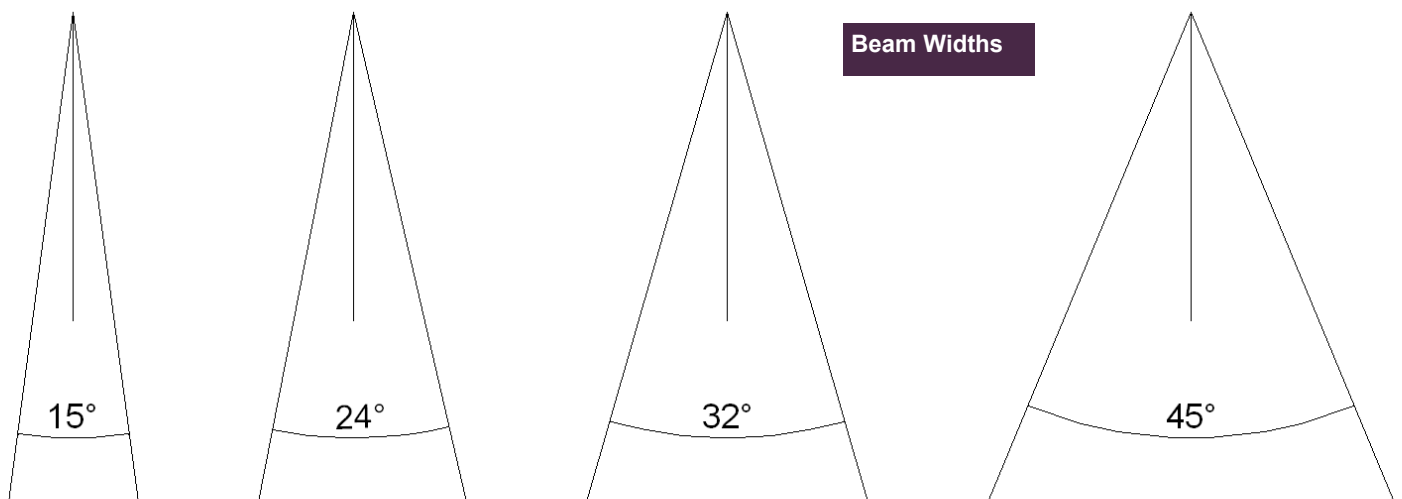
It is possible to select the fittings available in a number of different beam widths. There is always a trade off between the amount of light spread you get versus the intensity of the beam.



By selecting different beam widths for fittings you control the spread and dispersion of light.

Beam width is measured as the spread from one extent of the beam to the other.

The distribution of light will not usually be spread evenly across the beam, with the centre being brighter.



Varying your selected beam width can be very effective, for example: using a very narrow beam (c.8-15 degrees) to uplight a column or using a wide beam to create broad pools of soft light in living areas.

For general lighting, if you have very low ceilings you may want a broader beam width (c.45 degrees), and if you have very tall ceilings you may want to err on the side of using a narrower beam (c.20-24 degrees).



The effect you are trying to create drives the choice of fitting type

You might want a punchy downlight for task lighting, a small uplight for accent lighting or maybe a low level fitting giving a broad wash of light across the floor. Having chosen your fitting type you need to decide how will control it.

I have chosen my fitting type

Do you want to be able to dim the lighting?

Dimming is a key contributor to altering the mood in a room. It is less critical for 'task only' circuits or where fittings are low output anyway.

No I don't need to be able to dim the lighting

If you don't need the ability to dim the lighting then you simply need to pair your LED fitting(s) with non-dim driver(s) of the right capacity.

We recommend: Use a non-dimming driver

Yes I want to be able to dim the lighting

There are a variety of dimming methods available including mains trailing edge, 0-10v, DMX and DALI. Each has its own characteristics and these need to be considered alongside how you are going to control the lights. A lighting control system such as Lutron or Rako offers the widest range of control options for LED, rather than conventional dimming.

Are you using a lighting control system?

Lighting control systems make different lighting 'scenes' instantly available from intuitive keypads, smartphones or tablets and, when appropriately specified, are the best way to dim LED lighting.

No I want to use conventional dimming

If you can run 0-10v control cable between the drivers and a 0-10v rotary dimmer on the wall, this is the best option. All the LED fittings we sell can be dimmed well this way, with a 0-10v driver.

If 0-10v isn't possible then use mains trailing edge dimming, but this can be very problematic. The exception to this is the Quad range of fittings with their matched trailing edge drivers and dimmers, which are excellent. (As at June 2016).

We recommend: Use 0-10v dimming for maximum flexibility. Or Quad range with recommended dimmer for mains trailing

Yes I'm using a lighting control system

A lighting control system can provide fantastic dimming results with all the control protocols plus non-dimming circuits. Which you choose depends on the application and how the project is wired. A lighting control system offers you the ability to dim using:

0-10v (requires 0-10v control cabling)

Mains Trailing Edge

DMX (requires DMX signal control cabling. NB. For expert users only)

DALI (requires DALI signal control cabling. NB. for expert users only)

We recommend: Use a lighting control system for maximum flexibility in dimming control including easy to manage colour change

Important things to remember

Retrofit LED lamps can only be mains dimmed and most work best with trailing edge dimming

Linear 12v or 24v constant voltage fittings are almost always only dimmable by 0-10v or DALI.

The best way to check compatibility between fittings, drivers and dimmer is to test them together.

Whichever dimming route you choose it's vital to observe both minimum and maximum loads.

Do you want colour changing lighting

Yes I want to be able to control and manage colour

The DMX control protocol offers the best way to control RGB and RGBW (Red, Green, Blue, White) LEDs, incorporated in a control system.

We recommend: Use colour changing fittings paired with a DMX driver of the right capacity plus a DMX control interface.

Need more help?

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Dedicated LED fittings require a driver, which looks a bit like a transformer. There is a huge variety of drivers; we have selected a range of drivers for each fitting, but the final choice of driver will be project and application specific.

Depending on the type of fitting there may be several different considerations:



	Using one driver per fitting <i>usually high output fittings e.g. Downlights</i>	Using one driver for multiple fittings <i>usually lower output fittings for accent lighting</i>
Driver Current (mA)	We don't usually offer a choice here: we recommend the current for maximum light output	For some fittings there may be a choice of current. Select the higher driver current for more light output.
Driver Capacity	We recommend the driver with the correct capacity	There may be a choice depending on how many fittings you want to run off one driver. It is important to observe both minimum and maximum loading (LED Count). All our LED fittings display LED Count per fitting
Dimming Types	There is always a choice. Different dimming types depend on the effect, how the wiring is run and whether or not you are using a control system	There is always a choice. Different dimming types depend on the effect, how the wiring is run and whether or not you are using a control system

Driver current influences light output from a given fitting

Some LED fittings have a choice of how 'hard' you run them, e.g. they can be run at 350mA, 500mA or 700mA. Essentially, the higher the mA the harder they are run the more power they use and the more light they give out. They also generate more heat which is why there are limits – for example if you ran a fitting at 700mA when its thermal management was only designed to take 350mA you would significantly reduce the life of the fitting.

The product data sheet for your selected LED fitting will give you information as to driver options and impact on light output. Where the fitting supports a choice of outputs we make that clear on both the fitting and the associated driver on the product details page on the website.

LED drivers come in different capacities, it's essential to select the correct capacity

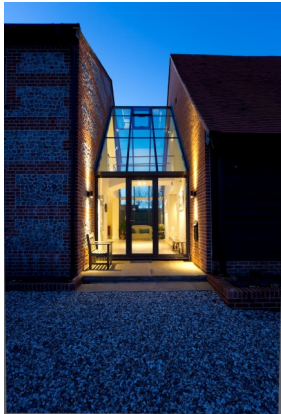
Like transformers, drivers come in different capacities.

Where one driver per fitting is required we recommend drivers at the right capacity for this fitting.

Where multiple fittings can be run off one driver we recommend a range of potential drivers, including drivers at different capacities. Each of which will have a minimum and maximum number of fittings they will be able to drive

When designing with LED lighting technology, more attention needs to be paid to the way light fittings are controlled. Switching LEDs is very straightforward but dimming is more complicated.

There are different dimming methods and the type of LED driver needs to be matched to the dimmer or control system in use. Unless we have specifically recommended components which work together, we recommend that you always test fittings, drivers and dimmers together.



Dedicated LED fittings and drivers (and many retrofit LED lamps) aren't generally compatible with the rotary type resistive dimmers commonly installed in residential properties, resulting in odd flashing and flickering behaviour. Almost all fittings and drivers can be dimmed using an appropriately specified lighting control system (e.g. Lutron or Rako), and some can be dimmed using specific rotary dimmers (mains trailing or 0-10v) which look like conventional ones but which have been designed for LEDs.

Different Dimming Methods

Why might you use it?

Non Dimming

Non dimmed LED fittings will work with conventional on/off light switches or lighting control systems.

You don't need to be able to dim your LED fitting.

Mains Trailing Edge

Mains Trailing Edge dimming can be used to dim dedicated LED fittings when coupled to a mains dimmable driver and to either:

- A trailing edge rotary dimmer
- A trailing edge or phase adaptive lighting control system module (e.g. Lutron, Rako).

No extra control cable is required. This dimming method can be very problematic but it works with conventional wiring.

If you want to dim LED fittings and your cable infrastructure is wired conventionally.

We don't recommend this route unless using a lighting control system or the Quad range of fittings with appropriate rotary driver.

0-10v or 1-10v Dimming

This protocol can dim dedicated LED fittings very well. Dimming is typically smoother and goes lower than with mains dimming. Use with a 0 or 1-10v driver and:

- A 0-10v rotary dimmer
- A 0-10v lighting control system module (e.g. Lutron, Rako).

It requires a separate 'control' cable to be run from the controller to the fittings driver.

If you are rewiring or starting from scratch and you don't need colour change control this may be your best dimming method.

0-10v dimming has been the protocol most widely used in our LED projects.

Different Dimming Methods

Why might you use it?

DMX

DMX is commonly used for colour programmable RGB or RGBW (Red, Green, Blue, White) fittings. The DMX signal is generated by a lighting control system and requires dedicated cabling between the controller and a DMX driver. DMX is generally used with professionally designed lighting control systems.

You want to be able to control colour change on RGB or RGBW colour-change LED fittings.

DALI (Digital Addressable Lighting Interface)

This method has been more commonly found in commercial environments. We are increasingly using DALI in residential for its superior dimming, flexibility and cost-effectiveness. It is very flexible in its deployment and use and can simplify wiring infrastructure. As with the 0-10V system it requires a control cable to the DALI driver. DALI is generally used with professionally designed lighting control systems.

You want a flexible cabling structure for large-scale deployments, you want a fine level of control of individual fittings on a single circuit or you want a much simpler wiring scheme.

We can help

We'll be pleased to help you specify the best fittings, drivers and control methods to suit what you are trying to do so please call us.

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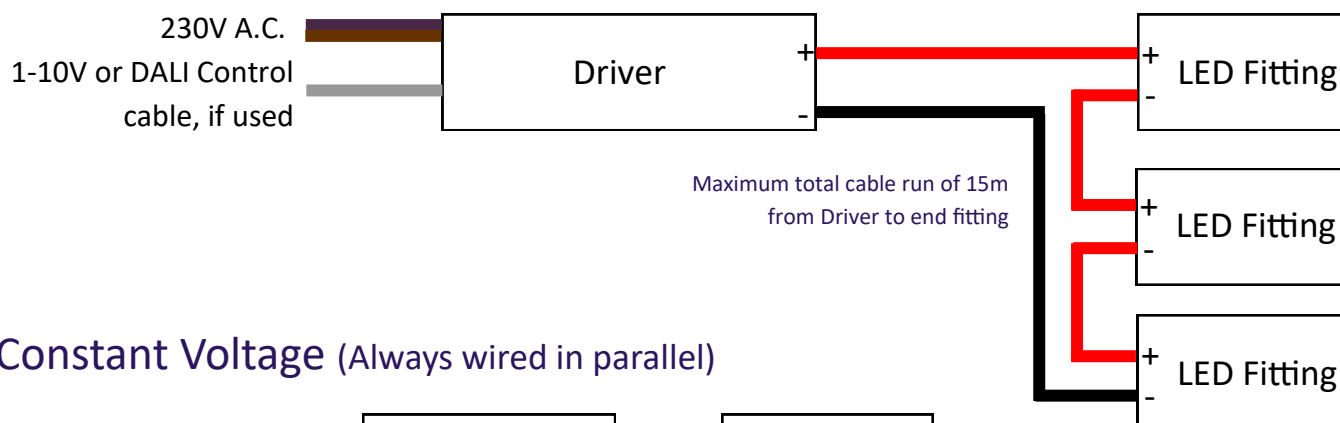
Dedicated LED fittings require a different wiring method to halogen or retrofit LED fittings. The fittings will generally come with a separate 'driver' which is similar in concept to a 'transformer' used with low voltage Halogen fittings. It is not uncommon for multiple LED fittings to be connected to one driver.

The driver can be located remotely from the fittings (see cable distances below) but it must be accessible for future maintenance and in a ventilated space to keep it from overheating.

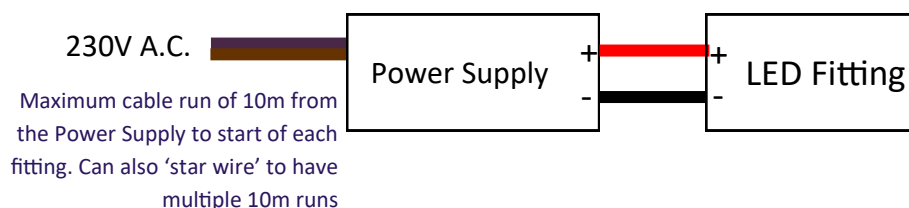
Fittings must never be connected to the driver whilst it is powered and/or not discharged as this will result in the LEDs in the fitting being damaged beyond repair.

The way in which LED fittings are wired depends upon whether they are constant current fed (eg; 350mA, 500mA or 700mA fitting input) or constant voltage fed (12V or 24V fitting input). Polarity (+ or -) is very important when wiring LEDs and should always be checked.

Constant Current (Shown with multiple fittings– Always wired in series)



Constant Voltage (Always wired in parallel)



Constant Voltage Dimmed (Shown with multiple fittings - Always wired in parallel)

