

How to Select a Power Supply for LED Lighting

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The factors influencing the choice of an LED power supply (or in lighting parlance, LED driver) are similar to buying a power supply for most other applications. However, there are also some application-specific factors that require careful consideration.

Users should first review some of the choices that are available and how they might fit in various lighting applications. Then consider the critical topic of reliability and life, where it is important to examine and understand the design capabilities of potential suppliers along with that supplier's ability to provide support over the long life of this type of product.

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Current driver or constant voltage supply

Take a step back and consider what is required of a LED driver, power supply or power system. Emerson Network Power intentionally broadens the scope to "power system" because the drive electronics sometimes consists of multiple modules which can be packaged and located separately. Together these separate elements form a power system.

Whether a single supply/driver or multiple-element system is being considered, the primary goal is to deliver a reliable, predictable and regulated supply of current to the LEDs or LED modules.

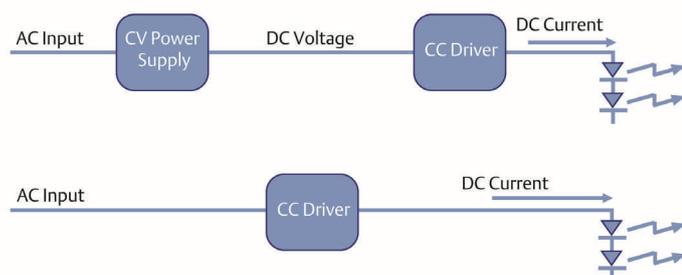


Figure 1: Constant current and constant voltage modes

A single module solution provides an output whose current is regulated to directly drive the LEDs. This type is often referred to as constant current (CC) driver.

At higher power levels, the CC function may be implemented separately and a constant-voltage (CV) power supply feeds the CC driver (see Figure 1).

Some drivers/supplies can support both CC and CV modes, providing the user with a single solution that can be re-used across multiple lighting platforms. A typical characteristic, as implemented in Emerson's LDS family of drivers, is illustrated in Figure 2.

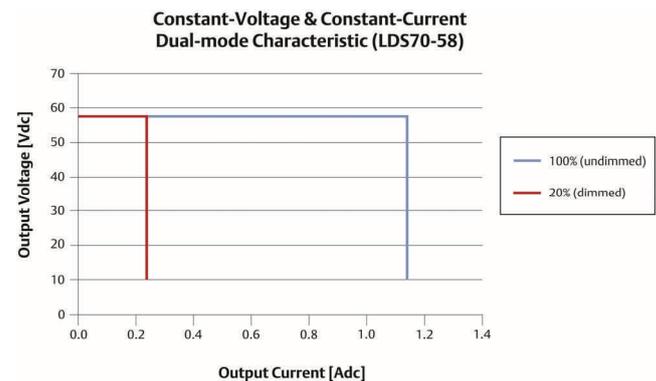


Figure 2: Dual mode characteristics

Power levels

Power levels associated with LED lighting can vary from less than 1 watt, e.g. flashlights, to several hundred watts, e.g. warehouse or street lights. Across this power range, package size and shape will vary significantly as will features and functions.

For example, a driver to power a recessed "can" light might be approximately 25W and require triac-compatible dimming whereas a

parking lot light might be 60-100W and require only a simple two-level dimming circuit.

Efficiency improvements in LEDs, optics and power supplies will result in a downward trend in power consumption for a given light level.

Environmental considerations

Another important consideration is the environment in which the power supply will be used. The supply will be required to operate over a defined temperature range, sometimes as low as -20°C or -40°C, and sometimes as high as 60°C or even 80°C.

These extreme temperature ranges can even apply to indoor applications – high end because of enclosed spaces which trap heat, and at the low end in refrigeration applications.

The application may also require a sealed power supply to protect against dust, moisture and water. This will be specified in the context of ingress protection (IP), e.g. IP64 which protects against dust and splashing water.

Whether a product is being applied indoors or outdoors can also affect its exposure to electrical surges due to power line disturbances or natural phenomena such as lightning strikes.

Power supplies are specified for operation in various surge environments. Higher levels of protection may require the addition of external surge components.

Custom or standard

Many factors need to be considered for any discussion of custom versus standard solutions and a detailed discussion would require an article of its own. The number of standard (off-the-shelf) products continues to increase and provide solutions for a wide-range of lighting

applications. Custom solutions are still required in those applications with unique requirements, including form-factor constraints or special performance or functionality.

Custom solutions may also be considered in high volume applications where functions and parameters can be optimized to minimize cost.

Reliability and useful life

The penetration of LED lighting is driven primarily by two factors. The first is the energy efficiency of the lighting. We have already touched on this when discussing power levels and noting the downward trend in power consumption as the efficiency of system components improve.

The other primary driver is the suitability of LEDs to reliably perform over a long period of time. But LED reliability and long life are not sufficient by themselves.

The other components in the system must also have matching reliability and life characteristics.

For example, if the optical systems discolor over time, light output is reduced and performance will disappoit.

Similarly, the power supply/driver must continue to perform as specified for the life of the lighting fixture. To further abuse an over-used cliché “the chain is only as strong as the weakest link”.

It should be noted here that reliability and life are not the same. Reliability is a measure of ongoing failures rates attributable to random component failures, batch problems and/or manufacturing issues.

This is reflected on the flat part of the well-known 'bath-tub' curve (see Figure 3).

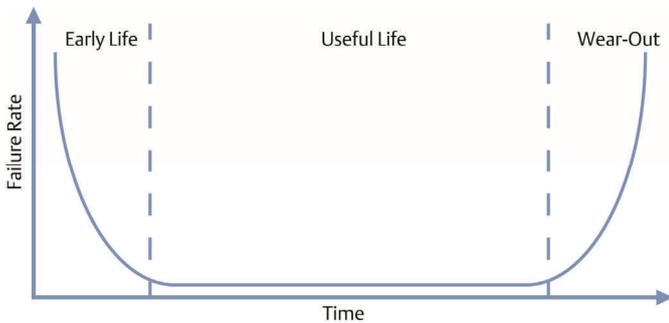


Figure 3: Reliability is a measure of ongoing failures

The ideal situation of no failures would be indicated by this part of the curve lying on the x-axis.

Product life, on the other hand, is a function of predictable wear-out mechanisms. In the case of LED drivers, this is usually driven by electrolyte loss in certain capacitors.

Good design practices can ensure that this does not incur within the specified life time of the LED driver. On the 'bath-tub' curve this is reflected by the rising part of the curve indicating the end of useful life.

This is the area where it is important to evaluate your power supplier's capabilities.

Everything in the design and manufacturing process must be geared towards high reliability and long life. It is not effective to start with a poor design and then screen or test for reliability.

It must start with how the power supply designer chooses components, how these components are derated, how the design is qualified and proven and ultimately how the product is manufactured.

High quality suppliers will be readily able to address these topics. Their goal is constant improvement of the performance of power supply reliability as characterized by the 'bath-tub' curve.

Warranties

The ability of a supplier to offer and support a warranty depends on their ability to control failure rates and design for an adequate useful life.

But these warranties may also vary significantly depending on application – some applications are relatively benign, others extremely harsh; some applications may be predictable, others highly unpredictable.

You can expect a good supplier partner to ask questions in that regard to better understand the application and how it affects the details of the warranty.

Suppliers who don't ask these questions and don't understand these issues may not be in a position to support the offered warranties.

Summary

Although the choices of power supply are many in LED lighting applications, they can be narrowed quickly through matching the power supply or driver specifications and functionality to the application.

Multiple suppliers can be narrowed further by critical evaluation of their design and manufacturing processes.

This will ensure that the power supply not only works as required but will also provide a reliable solution for the life of the lighting fixture.

Emerson Network Power LED Drivers and Power Supplies

Emerson Network Power produces high-quality and long-life [power conversion solutions for LED lighting applications](#).

Common to all platforms are Emerson's stringent design, quality and manufacturing processes enabling system life in excess of 50k hours.

The company's driver and power supply portfolio addresses both indoor and outdoor environments and are manufactured with Ingress Protection (IP) ratings, up to and including IP67.

The range of products also covers operating temperatures from -40°C to $+90^{\circ}\text{C}$. Dimming control is available on many enabling system-level lumen and energy management.

To address the variety of applications, current and voltage combinations enable solutions for different combinations of LED strings.



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Emerson Network Power, a business of Emerson (NYSE:EMR), is the global leader in enabling *Business-Critical Continuity™*. The company is the trusted source for adaptive and ultra-reliable solutions that enable and protect its customers' business-critical technology infrastructures.

The Embedded Power business of Emerson Network Power, which embraces the well-known Astec and Artesyn brands, is one of the world's largest and most successful power supply companies.

The company's standard ac-dc product portfolio covers a power range of 25 watts to 5 kilowatts and includes open-frame and enclosed models, highly configurable modular power supplies, rack-mounting bulk power units, DIN rail power supplies and external power adapters. Many of these products are available in medically approved versions and a large number of the higher power models feature extensive built-in intelligence. A wide range of dc-dc power conversion products includes isolated dc-dc converters, covering industry standard sixteenth- to full-brick form factors and power ratings from 3 watts to 700 watts, and three application-optimized families of non-isolated dc-dc converters.

Renowned for their outstanding performance, reliability and cost effectiveness, Emerson power supplies are used extensively by OEMs and system integrators for diverse applications in the healthcare, communications, computing, storage, test and measurement, instrumentation, military (COTS), aerospace, LED lighting and industrial equipment industries.

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