Your Guide to LED Drivers

General

All LED drivers are either constant voltage (CV) or constant current (CC). This refers to the LED driver's output and is the first option you should determine when choosing the right LED driver for your application. **Using the wrong choice of LED driver is likely to cause damage to it, any connected lighting and maybe hazardous.**

What is meant by constant voltage?

Constant voltage (CV) LED drivers are power supplies. They have a set voltage that they supply to the electronic circuit.

You would use CV LED drivers to run multiple LEDs in parallel, for example LED strips.

CV power supplies can be used with LED strips that have a current limiting resistor, which most do. The voltage output must meet the voltage requirement of the entire LED string.

CV drivers can also be used for LED light engines which have a driver IC on board.

Typical uses for CV LED drivers:-

- Low power LED signage backlighting modules, edge lighting modules, LED tapes including dimming and RGB colour-changing systems

Oshino LEDs for Signs products using CV LED drivers

⇒ **B-LED**
⇒ **F-LED**
⇒ **FlexiLED**
⇒ **H-LED**
⇒ **M-LED**
⇒ **Mini Orbis LED**
⇒ **PinPoint**
⇒ **SE-LED**

What is meant by constant current?

Constant current (CC) LED drivers keep a constant electric current throughout an electronic circuit by having a variable voltage.

CC drivers are often the most popular choice for LED applications other than signage LED.

CC LED drivers can be used for individual bulbs or a chain of LEDs in series. A series means that the LEDs are all mounted together in line, for the current to flow through each one.

The disadvantage is that, if the circuit is broken, none of your LEDs will work. However they generally offer better control and a more efficient system than constant voltage.

Typical uses for CC LED drivers:-

- Commercial and industrial LED lighting including flat ceiling panels (tiles), downlight-ers, warehouse high bay / low bay and street lighting columns

- High power LED signage backlighting modules, dimming, floodlights, wall washers, grow lights

Oshino LEDs for Signs products using CC LED drivers

⇒ **Super Orbis LED modules**

Factors you need to consider

Here are some basic factors you need to consider when selecting a constant voltage (CV) LED driver

Output Power (W) What is the power requirement of your LEDs? You need to choose a driver that provides at least that value and we recommend no exceeding 85%

Output Voltage (V) Find the voltage requirement for your LED(s). The output voltage of the driver needs to match the voltage required by your LED module or LED tape

Dimming Is it 0-10V, 1-10V, DALI, PWM, TRIAC, DMX or potentiometer?

Form factor How big can your driver be? Make sure the dimensions are going to fit as some applications can have limited space. Termination method flying leads or screw down terminals

IP Rating (IP) Where will your driver be going? Normal indoor applications (IP20), normal outdoor weatherproof applications (IP65) or exposed outdoor e.g. immersion (IP67) submersion in water (IP68)

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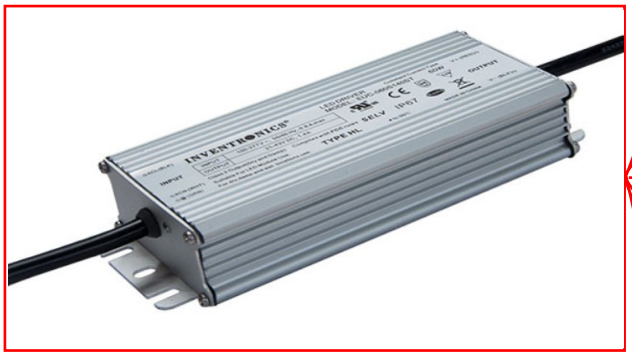

Output Power (W) What is the power requirement of your LEDs? You need to choose a driver that provides at least that value and we recommend no exceeding 85%

Output Voltage (V) Find the voltage requirement for your LED(s). The output voltage of the driver needs to exceed the voltage required by your complete LED string (sum of Vfs)

Output Current (mA) What current does your LED(s) need? If your LED needs 700mA your driver needs to have that output too.

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What does this mean?

Output Power (W)

This value is given in watts (W). Use an LED driver with at least the same value as your LED(s). The driver must have a higher output power than your LEDs require for extra safety. If the output is equivalent to the LED power requirements, it is running at full power. Running at full power may cause the driver to have a shorter life span. Similarly the power requirement of the LEDs is given as an average. With tolerance added on top for multiple LEDs, you need a higher output power from the driver to cover this

Output Voltage (V)

This value is given in volts (V). For constant voltage drivers, it requires the same output as your LEDs' voltage requirements. For multiple LEDs, each LED voltage requirement is added together for a total value. If you are using constant current, the output voltage must exceed the LED requirements.

Output Current (mA)

When using a Constant Current LED driver, observe the current requirements of your chosen LED(s). The CC driver should then reflect that value output. LEDs data sheets state what they require, with the value given in amps (A) or milliamps (mA).
1 A = 1000 mA There are also variable and selectable output current drivers. They give either a range, for example 0 mA to 500 mA, or stepped values like 350 mA, 500 mA, 700 mA. Your LED must fall within the chosen value(s). LEDs can be run at a lower current to help extend its life expectancy. Using a higher current could reduce LED lift expectancy greatly.

Dimming Options

If you require a dimming function with your LED driver there are several options to choose from. Here are some of the possible dimming options you will come across. Note that some of the dimming options will require that the LED driver will work with an external part. It is not necessarily a function of the driver itself. See the next page for an explanation of these.

Form Factor

Do you need an LED driver within an enclosure? Or will it be built into a system? Open frame LED drivers are more compact and can be designed into your application. Encapsulations provide IP ratings and protection for stand-alone LED drivers. How will you connect your LED driver to your chosen application? Some LED drivers come with flying wires attached. Alternatively you could need to purchase wires separately. Screw terminal or push-wire connectors also exist for quick mounting of cables to the driver.

IP Rating

How water/dust resistant does your LED driver need to be? If your driver is going somewhere where it may come into contact with water/dust, you could use an IP65 rated driver. This means it is protected from dust and any water projected at it. If you need something water-tight, you might need a driver with an IP67 or IP68 rating. The IP rating is given as a number. The first digit represents solid objects and the second is liquids. See the next page for a table of definitions.

Dimming Options

Also known as analogue or low-voltage dimming could be seen as the most common dimmable LED driver option for simple lighting.

Both can appear on LED dimming drivers with either a analogue (current limited) or a PWM (Pulse-Width Modulation) output.

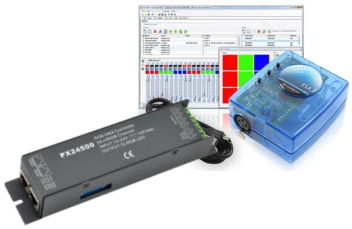
They can control lighting efficiently with smooth dimming and they are usually cheaper that other methods.

Choose either 0-10V for a 0-100% a dimming range where ‘0’ is completely off or 1-10V dimming (more common) with a 10-100% dimming range where On / Off is via the normal switched live usually incorporated with the same switch e.g. rotary plus push on / push off.

A 1-10V dimmer switch can be used with a 1-10V and 0-10V LED drivers but without the ability to dim to zero. Match a 0-10V dimming switch to a 0-10V dimming LED driver has mostly disappeared replaced by 1-10V which is safer and more reliable.

DMX

Digital Multiplex (DMX) dimming methods are ideal for entertainment and architectural lighting due to their ability to control coloured lighting. They provide control of light intensity and fast colour changing. DMX is great for RGB, RGBW and tuneable white LED applications.



POTENIOMETER

Some drivers are potentiometer dimmable, meaning they are programmed to work with separate potentiometer dimmers (pictured). The potentiometer can be connected directly to an input on the driver to control it internally. This is usually a simple and cost-effective way to provide a dimming function. E.g. 100KΩ resistor (RS Stock No. 249-9238). On / Off is via the normal switched live.

Digital Addressable Lighting Interface is not a single component but a range of features that, when combined together, create an intelligent and flexible lighting control system. DALI LED drivers enable communication each way between the lighting fixtures and the controller. This allows the controller to monitor and control each light. It is also used to connect equipment from different manufacturers. DALI controllers can have up to 64 devices. Some DALI networks also have the capacity to communicate wirelessly. DALI is ideal for driving and controlling multiple light sources individually, within one circuit.

TRIAC

This form of ‘Mains’ dimming is commonly used in applications including retrofit because the additional 2-wires required for signal based system are unnecessary. You will often see TRIAC phase control in dimmer switches used in houses. Only some LED drivers are TRIAC dimmable, meaning they are programmed to work with TRIAC dimmers. They transform the AC power from the TRIAC dimmer into something that the LED driver can understand. The TRIAC dimmer would sit between the power supply and the LED driver to control the voltage that goes into the LED driver.

PWM

Dimming option utilises a PWM (Pulse-Width Modulation) additive 10V PWM signal generated by a dimmer switch or other controller. Note that this does not make the driver have a PWM output (instead of analogue) like a power supply, but rather just controls the light output via the dimming wires. Some drivers include a PWM control method combined with other dimming options built-in.

Notes: All Oshino LED drivers are for connection to the normal 230V a.c. 'Mains' supply.

Drivers for dimming applications also available. Drivers should never be immersed or exposed to direct rainfall. Do not connect with reverse polarity. See data sheet for full information – available on request. *Warranty period starts on date of invoice and is subject to our Terms and Conditions of Sale and observance of manufacturers' installation and operation instructions. **Guidance on loading:** Drivers with constant voltage 12V or 24V output – do not load above 85% of rated Wattage. Super Orbis and Super Orbis LED Gen2 : it is important to observe our limits for the minimum and maximum number of modules that can be connected to a particular driver.

Damage to our products caused by the inappropriate use of drivers e.g. wrong type, erroneous connection, omission or substitution with a user supplied alternative, is not covered by our warranty.

Classification

Class: Class I ⏚ and Class II ⧈ are both specified in the EN-60950-1 *(the European standard titled Information technology equipment - Safety - Part1: General requirements).* The former requires a ground connection which is done via a green & yellow protective Earth wire/cable established so the extra current generated in the fault condition can be quickly shunted to ground without damage to property or people. Circuit protection is to be provided by a suitable residual current circuit breaker with overcurrent Protection (RCBO). The latter calls for a double insulation on the primary and the secondary side of the power supply if the ground connection is missing. Class II power supplies are typically used in the telecommunication industry, in many consumer electronics products as well at the lighting and signage industries.

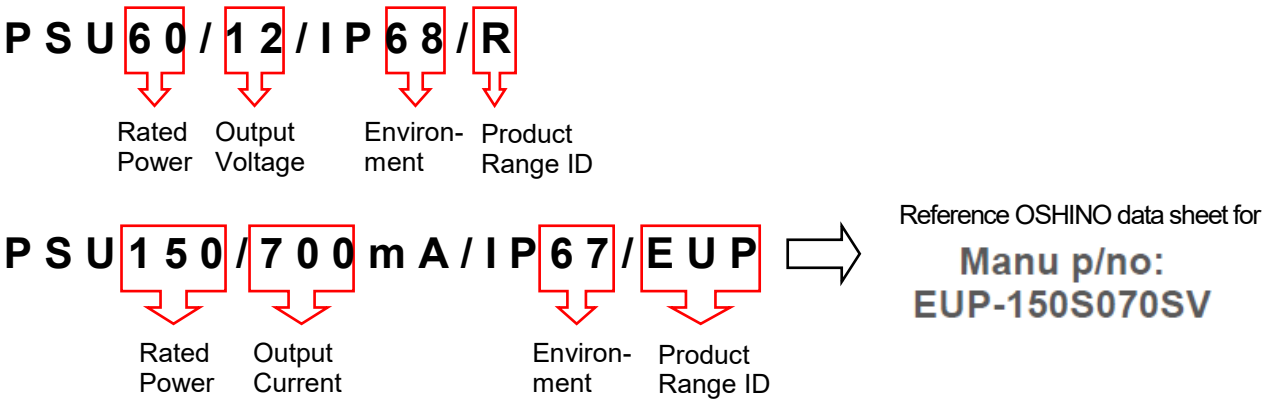
Special note: Class II (Roman) and Class 2 (Numeric). These have entirely different meanings and should not be confused. Class 2 (Numeric 2 and not II Roman) denotes compliance with UL standard 1310. The main focus of UL-1310 is to ensure the output from each channel of the power supply cannot exceed 100 Watts (or five times output voltage if is it is lower than 20V) in any given circumstances, such as the rated working temperature, start-up or shut down process and the faulty conditions. These are devices designed for the U.S. market, are lower power and therefore inherently less efficient and not as convenient or economical to use as other types offered by Oshino.

Class I: Signs, sign boxes, luminaires in this class have basic insulation and are fitted with an earthing point (identified) for the connection of all those exposed metal parts that could conceivably become live in the presence of a fault. Where the Class I luminaire is provided with a flexible power lead, it must include an earth wire.

Class II: Signs, sign boxes, luminaires in this class are designed and constructed in such a way that exposed metal parts cannot become live. This can be achieved by means of either reinforced or double insulation, but without a provision for protective earthing.

Class III: Signs, sign boxes, luminaires in this class are those in which protection against electric shock relies on supply at Safety Extra-Low Voltage (SELV), typically 12V or 24V, and in which voltages higher than those of SELV (50V a.c. r.m.s.) are not generated. A Class III sign, sign box, luminaire should not be fitted with a facility for protective earthing. A Class III sign, sign box, luminaire will have its SELV output driver mounted remotely.

Decoding OSHINO nomenclature



Essential quality and safety features included with every Oshino LED driver

⇒ The approval of a recognised certification body to apply a relevant product standard such as EN61347-2-13: particular safety requirements for electronic control gear for LED modules

All Oshino LED drivers comprise automatic self-protection features built-in designed to prevent premature failures and defects on site

⇒ Over-Current Protection[1]
⇒ Short-Circuit Protection
⇒ Over-Voltage Protection
⇒ Over-Temperature Protection[2]

These important features protect your sign, its installation, reliability and safety

About rated (labelled) power and loading

Rated power is the maximum power in Watts at which an LED driver will output. Power is a combination of its output voltage and output current i.e. Volts x Amps = Watts

All Oshino LED drivers are capable of operating at full rated (labelled) power. However, please see the relevant data sheet for recommended maximum output power and other specifications, warranty period and the applicable terms and conditions available at our website here https://www.oshino-lamps.co.uk/legal-pages/terms-conditions.html

About rated (labelled) power and loading (cont.')

It is common for manufacturers to recommend users underload or 'derate' the rated power of an LED driver by utilising between just 50 and 85% of its rated power. This is because an excessively high operating temperature reduces the life of electronic componentry.

t_c = case temperature: The temperature of a reference point on the electronic control gear enclosure

t_a = ambient temperature: a The temperature range of the air surrounding the electronic control gear declared by the manufacturer

⇒ Excessive current loading will cause the LED driver's *Over-Current Protection*[1] feature to activate. This results in a strobing lit effect from the sign or fixture designed to indicate to the user that a overload error has occurred. Gross overload may cause the LED driver to shutdown altogether. Either way a power off—on cycle will be necessary to recover. A heavily or excessively loaded LED driver will be caused to produce more self-heating which will reduce service life, and...

⇒ Excessive operating temperature will cause the LED driver's *Over-Temperature Protection*[2] feature to activate. This will cause the LED driver to shutdown altogether requiring a power off—on cycle to recover. LED drivers are marked with their max Ta (ambient) and Tc (measure point on case) temperature in degrees centigrade. Whether or not an LED driver will exceed its Tc max depends on a combination of factors: how the LED driver is loaded, how efficiently it converts electrical power into lighting power, it's construction and the ambient temperature it is operated in free and how well heat dissipated through conduction and convection to free air.

Voltage-drop and cable distance

Basic voltage drop Law Vdrop = IR where:-

I: is the current through the object, measured in amperes
R: is the resistance of the wires, measured in ohms

DC resistance of a conductor depends upon the conductor's length, cross-sectional area, type of material, and temperature. These are important safety considerations. It is important to use the right gauge of wire when connecting LEDs for Signs modules and drivers. Excessive volt drop will result in lighting that is dim. Excessive voltage drop can cause loss of efficiency in operation of lighting and cause unreliability issue in other devices e.g. dimming / dimmers / RGB controllers etc.

Cable selection is guided by two main principles. Cable should be able to carry the current load imposed on it without overheating. It should be able to do this in the most extreme conditions of temperature it will encounter during its working life.

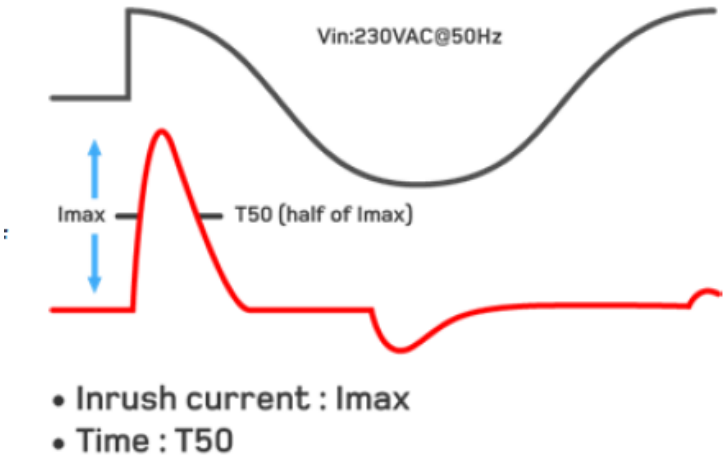
In-rush current and nuisance tripping of MCBs

Inrush current is due to the EMC filter on the input and bulk capacitor on the boost circuit and is inherent to LED driver technology.

It is generally known that where there are a number of LED drivers in a sign, the max peak inrush current and it's duration may be additive. However, it is not an exact mathematical calculation i.e. for "N" drivers connected in parallel does not equal exact "N" times the inrush current for one driver or N times the T50 time for one driver. It depends on the impedance of each driver and the line impedance. Earth leakage: Philips state 0.7 (max) mA. This is approximately additive.

This diagram shows the nature of the inrush current and its peak, IMAX. T50 is the time duration in which the inrush current pulse is equal to 50% of IMAX. It shows an example of inrush current (IMAX) and T50 times for a typical LED driver.

The line impedance has a significant effect on the peak and duration of the inrush current. Transformer type and size, wire size, length of runs, and other devices in the circuit path are a few things that could lead to high impedance.



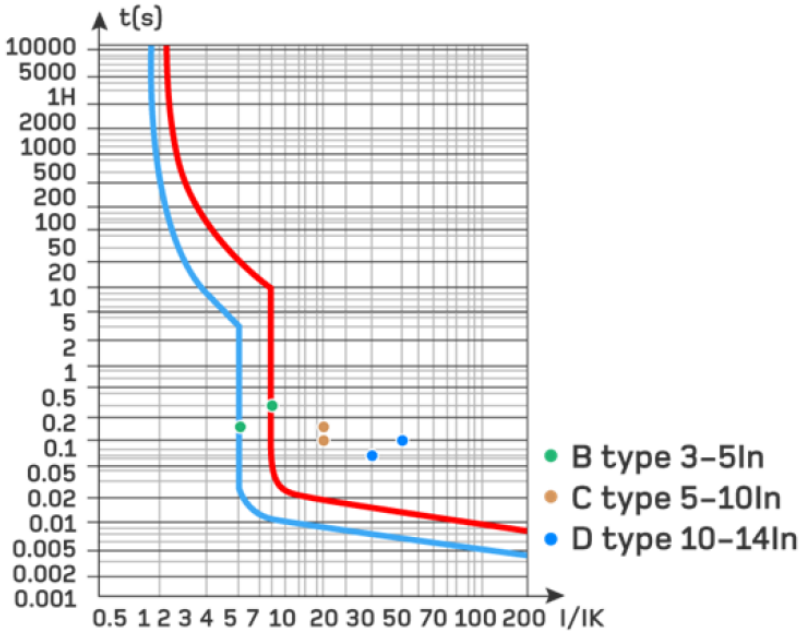
In-rush current and nuisance tripping of MCBs (cont'.)

A general recommendation is to use C curve circuit breaker with the highest current rating that is allowed by the circuit cable size. The MCB used needs to have sufficient clearing time for the in-rush current to clear, without creating the nuisance tripping on power up.

This will give protection from a short circuit and prevent overheating of wiring and connections. MCBs operate by tripping open on detection of an overload or short circuit condition. The tripping point relates to the magnitude of electrical energy being passed – and this in turn depends significantly on both the inrush current peak value and its time duration. Accordingly, an MCB could be tripped either by a high peak of short duration, or a lower peak of longer duration. In either case, the objective is to ensure that the MCB trips before passing excessive energy, yet does not trip and cause sign lighting blackouts, when it does not need to. time required for a circuit breaker to trip, at a given overcurrent level.

These curves differ from manufacturer to manufacturer and from type to type.

Typically, the B type MCB curve has the operating range of 3 to 5 In and is normally suitable for domestic installations, C type has 5 to 10In and is suitable for most commercial and industrial installations and D type has 10-14 In. D type is only suitable for particular circuit protection requirements with exceptionally high capacitive and in-rush characteristics.



Our Design Guide is for reference only and the ideal appearance should be checked with a lit trial | Dimensions in millimetres | Data subject to our Terms and Conditions and are liable to change without notice | E&OE | © Oshino 5/2020

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