



ADVANCED GUIDE

TO LED LIGHTS & DRIVERS

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CONTENTS

1 DRIVERS

- 1.1 Do I need a driver?
- 1.2 How do I know what driver to use?

2 SPECIFICATION

- 2.1 Constant current rating
- 2.2 Forward voltage
- 2.3 Measuring voltage drop

3 ADDITIONAL SPECIFICATION CONSIDERATIONS

- 3.1 Wire length recommendations
- 3.2 Inrush current
- 3.3 LED driver power factor
- 3.4 Multiple switches

4 INSTALLATION

- 4.1 Driver location
- 4.2 Hot-wiring
- 4.3 Polarity and connecting multiple LED lights
- 4.4 Separate mains wiring and LED wiring
- 4.5 Connectors
- 4.6 Two-way switching
- 4.7 PIR/microwave/proximity sensors
- 4.8 Handling
- 4.9 Environmental

5 TROUBLESHOOTING

- 5.1 Flickering or flashing
- 5.2 No light
- 5.3 LED discoloured/blue light
- 5.4 LED fittings vary in brightness
- 5.5 LED fittings are dim
- 5.6 LED glows or flashes after power off
- 5.7 Loading

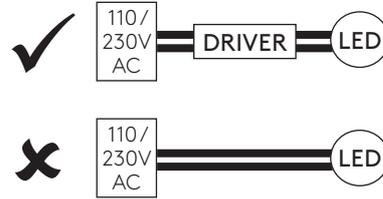
6 ASTRO RECOMMENDS

DRIVERS

DO I NEED A DRIVER?

Only products with integrated LED require drivers

If your integrated LED light is marked or specified as **Class III**, or displays this symbol , **it must not be connected directly to the mains voltage supply** - this will cause permanent damage to the LED, requiring replacement of the entire LED light fitting. A compatible LED driver **must** be used between the switched mains supply and the LED light.



HOW DO I KNOW WHAT DRIVER TO USE?

On our website, we provide an easy-to-use tool to calculate which LED drivers are compatible with our Class III LED lights. This tool can be found on each Class III LED product page. Simply enter the quantity of LED lights and select the type of dimming.

Astro offer LED drivers for use with non-dimming and dimming circuits. The Driver Calculator will list all compatible LED drivers stocked by Astro with the quantity of each required.

Driver calculator

Product qty

Dimming options

NON-DIMMING

CALCULATE

TYPES OF DIMMERS

1. **Leading or trailing edge dimming** (also called **phase-cut**, **TRIAC** or **mains**) is the most common and easiest to install dimming method. There are two types of mains dimming, leading edge and trailing edge. Trailing edge offers superior performance with smoother control and silent running when in operation. Take care to ensure that the dimmer switch is suitable for LED lights by checking with the switch manufacturer.
2. **1-10V dimming** (also called **0-10V**) is an analogue dimming method which requires both mains power and control or signal wires between switch and driver. This type of driver may not be suitable for retro fit, please check with your electrician.
3. **DALI dimming** is a digital programmable dimming method, usually used in large commercial properties. It requires specialist installation and commissioning. DALI also requires both mains power and control or signal wires between switch and driver.

For specialist dimming systems such as **Lutron**, **Rako** or **iLight**, contact the manufacturer for their recommendation on the type of LED driver and confirmation of dimming type.

If you are unsure about which type of dimming you require or already have, consult a qualified electrician or the manufacturer of the dimmer switch or system.

SPECIFICATION

Before specifying the driver to use in an LED lighting project it is important to understand some specific terminology and principles which will assist you in determining the correct model to select.

The following sections identify key points for consideration.

CONSTANT CURRENT RATING

LED products fall into 2 main categories:

- Constant current
- Constant voltage

Constant current products generally use high-brightness LEDs e.g. LED downlights. **Constant voltage** products tend to use a number of low-brightness LEDs e.g. LED tape.

You need to know what the constant current value is of the LED product. This will be given as a rating in milliamps, e.g. 350mA or 700mA. This figure will be on the datasheet of the product.

The constant current rating of the LED product must match the constant current rating of the LED driver.

This guide will focus on constant current products.

FORWARD VOLTAGE

The LED product will have a forward voltage value quoted on the product page on our website.

The LED driver will have an output voltage range (this is usually printed on the driver, indicated by SEC, Vout, Uout or VF min – VF max) and the value for the product must fall within this range. For LED drivers stocked by Astro, you can find this information on our website and the datasheet for each driver. For other LED drivers, contact the manufacturer or supplier.

If you are using multiple LED products connected to one LED driver, you must add all the forward voltages of all the products together. This value must fall within the forward voltage range of the LED driver.

It is good practice not to run too close (e.g. within 10%) to the minimum and maximum output Voltage of the LED driver, as this will help to maximise the life of the LED driver.

EXAMPLE

Voltage range of driver: Min 2V max 10V
Forward voltage (Vf) of LED lamp: 2.85V
No. of luminaires required: 3
So, total Vf = 8.55V (3x 2.85V)

Driver maximum voltage output is 10V, keeping 10% below that maximum would give 9V so in this case you would be able to run the three luminaires.

MEASURING VOLTAGE DROP

For constant current LEDs, the LED driver will increase the voltage to the LED lights to compensate for voltage drop over distances of wire, up to the maximum output voltage. In most cases, the voltage drop is negligible however over long wire lengths, for instance 40m or more, or where the LED driver is run close to its maximum output, this can have the effect of reducing the LED driver maximum output and reducing the number of lights that can be powered by it.

To calculate the voltage drop, use the following formula:

$$\text{VOLTAGE DROP} = \text{TOTAL WIRE LENGTH (m)} \times \text{CURRENT (A)} \times \text{WIRE RESISTANCE } (\Omega/\text{m})$$

For the current, take the constant current value in milliamps stated on the LED driver and LED lights and convert to amps, e.g. for 350mA, use 0.35A.

For the wire resistance, check the specification of the wire you intend to use. Typical resistances are as shown in this table.

AWG	Cross-Sectional Area (mm ²)	Resistance (Ω/m)
12	3.31	0.005211
-	2.5	-
-	1.5	0.01210
16	1.31	0.01317
-	1.0	0.01810
18	0.823	0.02095
-	0.5	0.03620
22	0.326	0.05296

Note that as thinner wire is used, the resistance increases and therefore the voltage drop will increase too. Where low voltage wiring is run beside mains voltage wiring, it should be suitably shielded or separated to avoid interference or induction.

EXAMPLE

You are installing 8 LED lights with typical forward voltage rated at 2.85V at constant current 700mA, using 18AWG wire which has a resistance of 0.02095 Ω/m and the total wire length is 40m. The LED driver maximum output is 23V.

$$\text{VOLTAGE DROP} = \text{TOTAL WIRE LENGTH (m)} \times \text{CURRENT (A)} \times \text{WIRE RESISTANCE } (\Omega/\text{m}) = 40 \times 0.7 \times 0.02095 = 0.5866\text{V}$$

Total forward voltage of the LED lights is $8 \times 2.85 = 22.8\text{V}$
Add the voltage drop to the total forward voltage:
 $22.8 + 0.5866 = 23.3866\text{V}$.

You can see that the total voltage now exceeds the maximum output voltage of the LED driver. To remedy this, reduce the number of LED lights to reduce the voltage, use wire with lower resistance, or an LED driver with a higher maximum output voltage.

ADDITIONAL SPECIFICATION CONSIDERATIONS

WIRE LENGTH RECOMMENDATIONS

Some LED drivers have a recommendation for the maximum length of wire between the driver and the LED. This is to ensure good EMC performance, i.e. to prevent interference from other power sources or equipment from affecting the power going to the LED. See driver datasheets for information.

INRUSH CURRENT

Inrush current, input surge current or switch-on surge is the maximum, instantaneous input current drawn by an electrical device when first turned on. Circuit breakers need to be specified according to the inrush current, and not the operating current of the drivers.

LED DRIVER POWER FACTOR

All LED drivers have a power factor, which is the ratio of the real power (W) supplied to the LED lights to the apparent power (VA) consumed by the circuit (LED driver plus LED lights) and will be between 0 and 1. The higher the power factor, the more efficient the LED driver is.

While the consumer is only billed for the real power, the apparent power affects the circuit protection, size of wires, length of wire run, so should be taken into account.

You will find this data on the driver datasheet.

MULTIPLE SWITCHES

If using multiple switches on a lighting circuit, only one of these can be a dimmable switch.

INSTALLATION

DRIVER LOCATION

Work out as early as possible where the LED driver/s will be located. LED drivers should always be located in an accessible location to ease maintenance and replacement.

If the driver is to be located in the ceiling or wall void, can the driver fit through the aperture for the product so that it can be accessed for maintenance or will it need to be accessed remotely? Most Astro products have been designed so that the driver can be accessed after installation. Refer to our product and driver datasheets for aperture sizes.

If the installation is outdoors, consider whether you need a waterproof enclosure for the driver, and where this will be located.

HOT-WIRING

LED lights must be connected to the driver with the power turned off. Connection while the power is on is known as hot-wiring and is likely to permanently damage the LED.

If the LED driver was previously powered, you must allow several minutes for any residual voltage to disperse before continuing the installation.

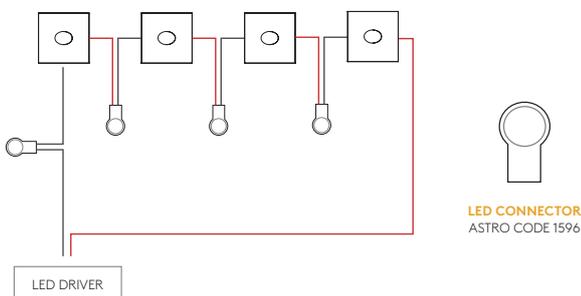
Please ensure all cables from the driver are tightly secured as loose wires or unseated connectors can have the same effect.

Astro will not honour any warranty claim for LED lights that have been hot-wired.

POLARITY AND CONNECTING MULTIPLE LED LIGHTS

LED lights are supplied with positive (+, usually red) and negative (-, usually black) wires. These must be connected to the correct terminals on the LED driver.

If you are connecting several LED lights to one LED driver, these must be wired in series as follows:



SEPARATE MAINS WIRING AND LED WIRING

To avoid any electrical interference or induction affecting LED performance, it is good practice to route mains voltage and low voltage wiring separately.

CONNECTORS

Use connectors appropriate to the wiring. For connections on the secondary (LED) side of the driver, we recommend and stock a **moisture resistant connector (1596)** which can be used with wiring of 19-26AWG.

TWO-WAY SWITCHING

If using multiple switches on the same lighting circuit, ensure that the circuit is designed to prevent residual voltages once all switches are turned off. Residual voltages may result in incorrect operation of LED lights, e.g. being dimly lit even when all switches are turned off.

PIR/MICROWAVE /PROXIMITY SENSORS

Check with the manufacturer of the sensor whether it is suitable for use with LED lights.

HANDLING

Take care to avoid any contact with the LED surface with fingers, tools, contaminants and cleaning products. Any of these could irreparably damage the LED.

ENVIRONMENTAL

Ensure that LED lights and drivers are installed in the appropriate location for their IP rating, with appropriate wiring and connectors. This is particularly important if products are being installed in tropical or frigid environment - as extremes of humidity, heat or cold should be avoided or their effects minimised by suitable air-conditioning or heating.

TROUBLESHOOTING

NOTE THAT ALL ASTRO LED FITTINGS ARE TESTED AT THE FACTORY PRIOR TO PACKING; MOST FAILURES OR ISSUES ARISE FROM INCORRECT SPECIFICATION OR INSTALLATION.

FLICKERING OR FLASHING

- ▶ Incorrect supply voltage
- ▶ Incompatible dimmer – if installing a dimming circuit, check that the LED driver is the correct specification for the dimmer switch
- ▶ Switch or LED driver under-loaded – if using a dimmer switch, PIR or other sensor, check that the minimum load is exceeded
- ▶ Switch or LED driver over-loaded – if using a dimmer switch, PIR or other sensor, check that the maximum load is not exceeded
- ▶ 2-way circuits – on circuits with more than one switch, only one of the switches should be a dimmer; follow the installation instructions for the dimmer switch
- ▶ Dimming circuits – some dimmer switches are only designed to work with one dimmable load; follow the installation instructions for the dimmer switch
- ▶ If products are Class III, check that mains wiring is not being run alongside LED wiring as this can affect performance

NO LIGHT

- ▶ Incorrect wiring – check all electrical connections between the LED and LED driver; constant current products must be wired in series; polarities must be correct; wiring must be done with the power turned off
- ▶ LED damaged – if the LED is visible or exposed, check that the yellow plastic moulding is not damaged or discoloured
- ▶ Driver damaged – check that the driver is correctly wired and was installed with the power off

LED DISCOLOURED/BLUE LIGHT

- ▶ Extreme temperature can adversely affect LED performance and lifetime. If installing a recessed product, ensure there is no insulation too close to the fitting
- ▶ LED damaged – if the LED is visible or exposed, check that the protective covering is not damaged or discoloured

LED FITTINGS VARY IN BRIGHTNESS

- ▶ Incorrect wiring – check that the fittings are wired in series from the LED driver
- ▶ If products are Class III, check that mains wiring is not being run alongside LED wiring as this can affect performance

LED FITTINGS ARE DIM

- ▶ Incorrect wiring – check that the fittings are wired in series from the LED driver
- ▶ Incorrect driver – check that the driver operates at the rated constant current of the products; if it is rated less, the products will be less bright
- ▶ Driver fault – if the fittings previously worked correctly, the driver may be faulty
- ▶ Elevated temperature – check the ambient temperature in the room and whether insulation is too close to the fitting if recessed; elevated temperatures adversely affect LED performance and lifetime
- ▶ Dimmer settings – some dimmer switches can allow the minimum and maximum levels to be configured. Check that this has been done correctly
- ▶ If products are Class III, check that mains wiring is not being run alongside LED wiring as this can affect performance

LED GLOWS OR FLASHES AFTER POWER OFF

- ▶ Multiple switches – if using multiple switches, ensure that the wires are shielded to prevent induced voltages in the circuit

LOADING

- ▶ Most dimmer switches have a minimum and maximum load rating. Many dimmers are designed to work with incandescent lights and therefore have much higher minimum load ratings than could reasonably be achieved using LED lights. Make sure this is taken into account when specifying a dimmer

ASTRO RECOMMENDS

- ✓ Consult a qualified electrician
 - ✓ Consider whether dimming is required at all, as this can add to the cost and complexity of the installation
 - ✓ Refer to our product datasheets and instructions, available for download on our website
 - ✓ Check the installation instructions of the switch or dimming system prior to specifying the LED product and driver if working with existing wiring

 - × Don't attempt to install electrical products unless qualified to do so
 - × Don't mix products of different types, e.g. halogen, fluorescent, LED, on the same switched circuit
- ✓ Use our Driver Calculator to select appropriate LED drivers for your product selection and dimming needs
 - ✓ Ensure that the dimmer and the dimming LED driver are compatible
 - ✓ Ensure LED lights connected to the driver with power are turned off. Connection while the power is on is known as hot-wiring and is likely to permanently damage the LED
 - ✓ Bench-test the intended circuit prior to installation so that any issues can be more easily identified and rectified

 - × Don't specify LED drivers other than those recommended by our Driver Calculator unless you fully understand the specifications and compatibility requirements of each part of the lighting circuit