CELMA

Federation of National Manufacturers Association for Luminaires and Electrotechnical Components for Luminaires in the European Union

CELMA Guide
Selection of Control Gears (drivers) for LED Light sources and LED Luminaires

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Introduction

This document is designed to provide basic guidance in the type of drivers (control gear) used to power and control LED light sources (i.e. LED lamps or LED modules) and LED luminaires for lighting applications. This guidance document only covers LED light source requiring external control gear and does not cover self-ballasted LED lamps or LED modules which can be connected directly to mains voltage.

1. LED Control Gear (Drivers)

For proper operation of LED lamps and LED modules, an appropriate control gear is required. This control gear or driver (the word "driver" is often used as a synonym) is a power supply device which may provide additional functions like dimming control or interfaces for comprehensive light management systems. For safe operation and optimum performance of a LED lighting application, the LED control gear has to fulfill the relevant lighting standards, which are different to "off the shelf" power supplies and match with the specific conditions and components of that application. Selection of correct driver should be done carefully.

There are two distinct methods in providing power for LED products along the following categories:

- **Constant Current control gear:** these are mainly designed for power LED light sources with a constant current, typically 350mA or 700mA. The current depends on the specification for the LEDs which are operated. In case of multi-chip packages, these forward currents can also be much higher. If the current output of the driver does not match the rated current of the LED light source, lumen output and lifetime can be negatively affected. It is also important that the output voltage range of the constant current control gear is in line with the forward voltage of the light source. The total forward voltage of the LED light source depends on the number of LEDs connected in series as well as their forward voltage distribution at the chosen current. The maximum outdoor power alone is not adequate in order to ensure that LEDs and control gear match with each other

- **Constant Voltage control gear:** these are designed to supply a specific voltage to the LED light source. Accordingly, they are suitable for LED lamps and modules which can be operated on constant voltage supplies. This type of LED light source is provided with an internal current regulator to provide the correct current to the LEDs. When using this type of driver, it is important that a unit with the correct voltage is used. If several voltage driven LED modules are connected in parallel, the driver must have sufficient current (output power) capacity for all the modules connected to it. Care should also be taken in considering that, if an output voltage of greater than 25Vrms (34Vpeak) is required, the lumi-

naire has to fulfil certain additional requirements concerning wiring, creepage distances, clearances and isolation (electric strength test). There are different requirements specified for the insulation of SELV systems depending on the voltage (34Vpeak, 60V DC, 120V DC), which lead to reduced requirements concerning the isolation levels.

The effect of power factor correction should also be clarified for the actual combination of control gear and luminaire(s) respectively lighting system. A driver designed to operate multiple and/or different LED modules may not have the same power factor over this entire output power range. In commercial buildings the power factor may affect the maximum demand tariffs. You should refer to the manufacturer's minimum and maximum power loading recommendations to ensure best operation of the driver.

2. Energy Efficiency

Drivers have an important impact on the system efficacy of a luminaire. Individual LEDs and modules are quoted as "x" lumens per watt, referring directly to the wattage of the LED and not the total circuit wattage of the system. What is important is the total lumen per watt output available from the LED luminaire. This will take into account the losses in the control gear in addition.
Note that generally the control gear efficiency is indicated for full load conditions. It could decrease significantly in case it is operated at lower loads, hence in this case particular information from the supplier or own tests are requisite.

The key is to ensure that the system specification clearly states the power requirements that have been allowed for at the project design stage and that the correct driver (control gear) type, current and voltage are matched to the LED luminaire or module.

3. Dimming and colour control

Commercial LED control gears commonly use one of two methods to dim LEDs:

- Continuous (analogue) current reduction (CCR), which decreases the forward current, or
- Pulse-width modulation (PWM), which changes the duty cycle of the applied current at a modulation frequency of several hundred Hz. PWM is necessary for LEDs in case a wide dimming range and a linear relationship between light output and duty cycle is required.

There are now many systems available to control lumen output and colour change. These include DMX, DALI, DSI, 1-10 volt, and it is important to ensure that the end product or installation uses a matched set of LED's drivers (control gear) of the correct type and control to ensure compatibility of the system.

4. Complete System Operation

Care should be taken not to overload the control gear as LED control gear are rated for a maximum load and output voltage. One of the most common mistakes is to connect too many LEDs in series. The wiring topology of whether to use a Series or Parallel circuit should also be confirmed prior to installation.

The IP rating of the control gear should be specified to suit the actual mounting location and that the thermal characteristics of the driver (control gear) are suitable for the chosen location. It is also advisable to position drivers (control gear) in a location that will allow ease of maintenance.

5. Lifetime

The lifetime of the LED system is not only limited by the lifetime of the LEDs, but also by the electronic circuits and corresponding lifetime of the control gear.
Maximum life of the LEDs will only be achieved with appropriate heat sinking. Safe operation and maximum lifetime of the driver may also require respecting certain temperature limits. A validation of the driver's case temperature Tc in the assembled luminaire is necessary.

It is therefore important to carefully study corresponding recommendations and instructions of the module and driver manufacturer and to correctly identify the life of the system (and not the LED alone).

6. Electro Magnetic Compatibility (EMC) compliance

As the EMC compliance is highly dependent on the interaction between the luminaire and the control gear it is extremely difficult to predict the EMC compliance of a luminaire system, even if the control gear itself has a large margin. Hence it is generally recommended to test the complete system in order to validate if the control gear is an appropriate solution for a particular luminaire design.

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