Controlling consumers' expectations of LED lighting: why dimming is so important

Manufacturers of LED lighting products need to consider the control options for their products and understand the applications in which their products will be used, say CHRIS SALVESTRINI and AMANDA BEEBE.

Why dim?
The US Census Bureau estimated that there are over 75 million owner-occupied homes (2007) and almost 5 million commercial buildings (2003) in the United States. Many of these buildings, both commercial and residential, already have dimmers installed. These existing dimmers are controlling a multitude of light sources, from incandescent to fluorescent and now LEDs, which is why the capacity to dim must be designed into an LED product from the beginning. Consumers, professionals, teachers and occupants expect to have control of their lights, and LEDs must meet this expectation if LED lighting solutions are going to succeed.

Dimming can be a manual choice by a user, a tuning decision by a building owner, or an automatic change due to the amount of sunlight. However, no matter which dimming technique is used, it will save energy. In addition to energy savings, the occupants of these buildings are the same people who expect control in their homes, so why should they sacrifice this control at work? Dimming allows for increased productivity, which is paramount in a working environment. Everyone has different visual abilities and comfort levels, and being able to optimize your environment goes a long way.

FIG. 1. a) Forward phase control and b) reverse phase control. Light blue shows when the control is open (off) and dark blue shows when the control is closed (on).

AMANDA BEEBE is LED product manager and CHRIS SALVESTRINI is a senior design and development engineer with Lutron Electronics (www.lutron.com).
In this control scheme the control begins each half-cycle in the open position and then turns on and remains on for the remainder of the half-cycle. This is illustrated in Fig. 1a, where the light blue shows when the control is open (off) and the dark blue shows when the control is closed (on). This method works well for controlling inductive loads, and as a result forward phase control is required to control magnetic low-voltage lighting transformers. It is also the dominant method used to control incandescent lights.

ii) Reverse phase control: Also called trailing-edge control, it is used to control electronic low-voltage light sources. As shown in Fig. 1b, this is the exact opposite of forward phase control. While this control type can be used on incandescent lights it typically provides the ideal control signal for capacitive loads, such as many LED drivers.

b) Three-wire controls

Three-wire controls are primarily used to control fluorescent light sources because the power requirements of the ballast will not impact the dimming performance of the light source. One of the wires provides power to the light source whenever it is on, regardless of the light level, while the other wire provides the control signal that sets the light level at which the fixture should be operating.

In all of the following approaches (0-10V, DALI, and DMX), the control exists on an isolated low voltage link from the power to the light source. One of the benefits of this is that the system can be interfaced with a variety of other devices such as occupancy sensors, daylight sensors, and infrared receivers.

c) 0-10V control

0-10V control is an analog control that sets the voltage to the light source between 0V (minimum light output) and 10V (maximum light output). IEC standard 60929 specifies exactly what control requirements exist for this control type.

d) Digital control

i) DALI: This Digital Addressable Lighting Interface control standard, which emerged from Europe, allows for digital control of separate fixtures. This added level of control provides increased space flexibility, especially in commercial spaces.

ii) DMX: This digital control type came from theater lighting control, and allows for multiple channels of light (both color and intensity) to be controlled. It is typically used when trying to achieve complicated lighting effects such as LED color mixing.

Conclusion

LEDs are a promising new light source for general illumination, but they will never excel unless manufacturers understand consumer expectations. Having control is a basic human desire, and lighting is no exception. Stereos would be limited without volume controls; ovens would be dysfunctional without temperature controls, so why should lights be used without controls?