



*Osram Sylvania A-Line LEDs were developed to provide improved dimming functionality with traditional incandescent technologies.*

# CONTROL TWEAKS

LEDs are more compatible than you think

**T**HE MANY ADVANTAGES of light-emitting diodes (LEDs) for general illumination have outweighed their limitations, except when it comes to dimming. Though they have not been without challenges in the area of controls, new solid-state lighting standards and expanded retrofit dimming capabilities are designed to position LEDs for greater compatibility as incandescent technologies phase out of existence.

Performance enhancement, industry experts contend, will not be a quantum leap. LEDs are functionally friendly with controls in two important ways. First, LED luminaires are high-efficiency, instant-on devices. The lamps are rated at hours per start and can be switched on and off repeatedly without affecting their lamp life, unlike compact fluorescent lamps (CFLs) or high-intensity discharge (HID) lamps; these lamps' rated life is an average that decreases as switching frequency increases.

Secondly, LEDs are easy to dim if equipped with a compatible driver that can perform dimming control. When engineered for retrofit integration, the LED lamp can dim to as low as 1 percent with little color shift, and efficiency stays constant over most of the dimming wave. Additionally, when LEDs are dimmed, they operate cooler, extending their service life.

There is a wide range of LED-based lighting product types, and not all are created equal. Some commercial and residential owners have migrated to LEDs and have experienced some issues with controls compatibility when used with certain standard incandescent dimmers. Until the day that LED lamps and dimmers

completely replace incandescent technologies, electrical contractors (ECs) who are consulting with customers on the integration of LEDs can benefit from understanding operational considerations, guidelines and solutions for controls performance.

## Considerations before expectations

According to Amanda Beebe, LED and ballast product manager at Lutron Electronics Co., the widespread adoption of LEDs requires reliable high-performance dimming. Controlling LEDs is not as simple as controlling an incandescent light. There are a number of factors to consider to ensure that an installation of dimmed LED fixtures or lamps performs to expectations.

"Many LED luminaire manufacturers are new to the lighting industry and are not familiar with the multitude of control types and the corresponding product design requirements that accompany them. This has resulted in 'dimmable' products that do not work as claimed, that never turn off completely or that flicker," Beebe said.

Luminaires are a key factor in the consideration of dimmable LEDs. LED luminaires come in two distinct types: an LED bulb (also called an LEDi or retrofit lamp) and LED fixtures. LED lamps, Beebe said, can be designed with traditional Edison base sockets for replacement of screw-in CFL bulbs or standard incandescents. The base of these bulbs house integral drivers, which distinguish their dimming performance.

LED fixtures, which can vary from cove lights to downlights, are engineered with an external driver (either constant-voltage or constant-current types). The drivers cannot be interchanged, and selection depends on the LED array design. Some fixture manufacturers offer multiple driver options on the same fixture to support different control technologies or applications (such as dimmable versus nondimmable or dimmable through a 0 to 10V signal or DALI system).



*New solid-state lighting standards and expanded retrofit dimming capabilities are positioning LEDs for greater usage, such as in office-based conference rooms.*

ECs must consider the control technology—the signal and wiring between the control on the wall and the fixture or lamp—when retrofitting LEDs to work with incandescent dimmers.

“LED retrofit lamps generally only use forward- or reverse-phase control methods. LED fixtures may use any method, and it is independent of the driver type,” Beebe said.

The ultimate compatibility of a dimmer with a particular LED fixture depends on the control method. These control technologies are used in stand-alone applications and control systems as well as in wired and wireless lighting control systems. Beebe suggests that those using phase control for a lamp may also employ a wireless technology to communicate between loads or within a lighting control system.

Beebe pointed out that the best way to confirm if an LED lamp or fixture is compatible with a particular dimmer is to perform a compatibility test. That assessment could be in the form of a mockup application or in compatibility trials conducted by the manufacturer. Regardless, testing can help determine if unde-

sirable behavior, such as flicker, dropout, pop-on or dead travel will occur. Beebe warns that it is impossible to visually determine what the inrush current of an LED product is, so it is incumbent on ECs to refer to a manufacturer’s data. The EC could also limit the number of lamps to avoid overloading the dimmer.

“It is up to you to determine if that manufacturer’s assessment of ‘good dimming’ will meet your customer’s needs,” Beebe said, adding that the industry is already working through critical product development transitions to improve compatibility, so this process should become easier with time.

## **New compatibility guidelines**

The U.S. National Electrical Manufacturer’s Association (NEMA) is taking a comprehensive approach to addressing LED control integration with the release of two new solid-state lighting (SSL) standards directed toward designers, manufacturers and users of SSL products. SSL 6-2010 Solid State Lighting for Incandescent Replacement—Dimming, produced by NEMA’s



*Lutron C-L transitional dimmers are engineered to control a wide range of lamps due to proprietary circuitry, voltage compensation circuitry and adjustment dial.*

PHOTOS COURTESY OF LUTRON



Sylvania Ultra LED retrofit lamps

*The industry effort to address line-voltage LED control issues is accelerated by national legislation that will begin mandatorily phasing out 100-watt incandescent lamps, with the full market removal of 75-, 60- and 40-watt versions by 2014. The initiative started in California earlier this year.*

Lighting Controls and Solid State Lighting sections, focuses on integrated LED lamps intended for retrofit into systems that previously used incandescent screw-base lamps.

The SSL 6 standard addresses dimming of these products and the interaction between the dimmer and the lamp. It introduces requirements to help ensure good dimming performance and to prevent damage to either component. This standard provides interface recommendations for dimming control of integrated LED lamps intended for replacement of general service incandescent lamps operating at 120 volts but does not address LEDs intended to operate at 12 volts.

SSL 6 Working Group Leader Robert Nachtrieb of Lutron Electronics said products that meet SSL 6 will provide optimum performance if they are engineered to be dimmable.

"The major deficiencies that we're hoping to avoid where the inrush current would perhaps compromise the dimmer or the LED itself should be satisfied with SSL 6. We are looking for performance that customers are used to with incandescents and halogens," Nachtrieb said, adding that building on the industry consensus forged for SSL 6, NEMA will continue to develop standards for other applications of LED dimming including low-voltage compatibility.

SSL 1 was produced by NEMA's Solid State Lighting section and covers electronic drivers for SSL and LED-based products. Electronic drivers use semiconductors to control and supply DC power for LED starting and operation. Topics covered include ratings, performance and marking. According to NEMA, SSL 1 also provides specifications guidance for electromagnetic immunity, audible noise and efficiency calculations.

Robert Hick of Leviton, a member of both sections and chair of the Solid State Lighting section, said NEMA's development of these standards demonstrates the lighting industry's commitment to streamlined design and energy-efficient SSL technology.

"Standardization of evolving technology is essential to ensuring harmonization across brands, exceptional performance and customer satisfaction. With future additions to this series, NEMA will continue to identify and eliminate gaps in guidance without discouraging innovation within the industry," Hick said.



"The idea is we're in a transition," Nachtrieb said. "There are a lot of LED products already out there that work with the installed base, and if manufacturers can sell those, it will promote market adoption the quickest."

## Dimmable transition solutions

Several products have already been developed to either dim LEDs or be dimmed properly. For instance, Lutron's C•L dimmers will help facilitate the compatibility transition from incandescent controls to LED controls. They are engineered to control a wide range of lamps due to proprietary circuitry and include voltage compensation circuitry and an adjustment dial. Since performance varies by lamp and manufacturer, the adjustment dial is designed to set the bottom of the dimming range for a particular lamp.

The C•L is capable of multiple dimming responsibilities for LEDs and CFLs, as well as standard incandescents and halogens, and a mixed load of these light sources on the same circuit. As required by Underwriters Laboratories (UL), Lutron must test each lamp to ensure its compatibility with the dimmers. A complete list of compatible lamps is available on the company's website.

Osram Sylvania identified dimmable LED retrofit issues early and introduced its ultra high performance series for commercial and residential applications. This LED-based series of dimmable lamps includes replacements for the 40W and 60W A-line incandescents as well as halogens and CFLs. As a second-generation technology, these lamps are developed to provide improved dimming functionality, along with increased lumen output and indoor/outdoor ratings.

Many would argue that the LED retrofit lamp market is the fastest growing application for LED lighting today. The reason, lighting industry experts say, is largely due to the fact that LEDs don't require a new electrical infrastructure such as cabling, transformers, dimmers, and sockets. This is viewed as a significant advantage for LED technology.

**MCCLUNG**, owner of Woodland Communications, is a construction writer from Iowa. She can be reached at [mclung@iowatelecom.net](mailto:mclung@iowatelecom.net).