Introduction to Dimming

Light Level and Perception

As light sources are dimmed, light output decreases but the human eye may perceive a higher light output and light level than is present. For example, dimming to 25% appears to be about 50% of full light level.

Another aspect is whether users detect automatic dimming. Research suggests a 15-20% reduction in light level is undetectable by a majority of users. Another study showed users were less likely to notice and more likely to accept deep light level reductions in spaces with above-average levels of daylight.

Approaches

Dimming may be step or continuous. Step dimming offers a limited choice of light levels, with two or more preset increments between Off and full output. Typically, there is no fade between these points. It is typically used for energy management.

Continuous dimming enables light levels to be raised or lowered across a specified range, with smooth transitions. It is typically used for visual needs as well as energy management enacted in occupied spaces.

Dimming Range

The dimming range expresses how low the driver or ballast can dim the connected light source—e.g., 100 to 5% means it can dim from full to 5% of full output. Ranges of 100-20% and 100-1% are available, depending on what's needed and cost.

LED Lighting

LED lighting is inherently dimmable, resulting in a majority of LED products being offered with dimming as a standard feature or low-cost option. The product (driver) should be verified as dimmable. The removal of the traditional cost premium for dimming dramatically expanded its use. For some LED products, color control is enabled via relative dimming of different-color LED arrays. This allows color tuning, tunable-white, and dim-to-warm, where the LED dims from a cooler to a very warm color temperature similar to incandescent/halogen.

The driver dims the LEDs using either pulse-width modulation (PWM) or pulse-amplitude modulation (PAM). The driver can be integrated with the power supply or remotely mounted. Reduction in light output and power are fairly proportional, meaning dimming to 50% will result in a 50% reduction in light level and approximate 50% reduction in power. Because dimming reduces internal temperatures, it may have a positive impact on product life. Choosing high-quality drivers and ensuring product compatibility minimizes the possibility of undesirable flicker.

Other Light Sources

Other light sources behave differently than LED when dimmed. Check out EE103, Section 1, Part 1 for more information.