

Simple, Efficient, High-Brightness-LED Control

LEDs are also less vulnerable to moisture ingression

A variety of lighting applications are adopting HBLEDs (high-brightness light-emitting diodes), making them the fastest growing light source worldwide. Today's advanced devices boast luminous efficacies in the 35-to-50-lm/W (lumens-per-Watt) range. Prototype devices emit more than 100 lm/W.

By Peter Green, International Rectifier

Current trends suggest that ongoing improvements in LED technology can produce devices with greater luminous efficacy than fluorescent lamps and eventually, will match HID lamp outputs. HBLEDs already surpass incandescent and halogen lamps' and provide longer life, greater reliability, smaller size, and superior low-temperature characteristics. Additionally, LEDs are solid-state devices containing neither toxic gases nor filaments.

Designers are increasingly using HBLEDs in architectural lighting, street lighting, decora-

tive lighting, signage, and backlighting for high-end televisions and monitors. These applications must derive a regulated DC current from the AC line or DC-voltage supply.

International Rectifier's IRS2540 control IC implements a constant-current source for non-isolated applications. These include, for example, where a low-voltage isolated power supply already exists or where a class-2 fixture houses the LEDs in an inaccessible location, as is the case with traffic lights. This arrangement is similar to electronic ballasts for fluorescent or HID lamps, which typically do not provide galvanic isolation.

Buck converters are suitable for applications where the input voltage is greater than the output voltage, which includes most signage, decorative, and architectural lighting. Typical arrays use series-connected LED stacks to ensure equal current through all devices (Figure 1).

The series connection avoids the additional circuitry that would otherwise be necessary to maintain equal currents in parallel strings. Nonetheless, large arrays require parallel strings when the forward voltage across a single series stack would exceed either the available compliance voltage or the converter's maximum operating voltage.

The most common LED failure mode is a short circuit. When an LED fails in a series string, the others will all continue to operate normally. A failure of LEDs in parallel, however, prevents the remaining LEDs from operating. The combined forward voltage drop for series LEDs varies with temperature and with LED color. The forward voltage also has a wide tolerance in production.

Many applications require dimming. Combinations of primary-color LEDs can create any color in the spectrum by adjusting the intensities of each color, allowing many possibilities for display lighting, signage, and mood lighting. A buck regulator system based on the IRS2540 can dim over the full range from a logic-level PWM control signal.

The low-frequency PWM signal switches the average LED current by driving the converter in burst mode, changing the light intensity (Figure 2).

Unlike current modulation, PWM accomplishes the dimming without changing the LED's color. The PWM frequency is sufficient to prevent visible flicker.

HBLEDs enable architects, designers, specifiers, and manufacturers to create never-before-possible lighting effects and design luminaires for theaters, studios, nightclubs, restaurants, and other high-visibility venues. Digital scene controls and protocols such as DMX512 provide means for dramatic and dynamic lighting displays. The IRS2540 suits these applications allowing simple interfacing with microcontroller-based dimming circuitry.

LED light sources also naturally lend themselves to landscape and outdoor lighting, offering longer life correspondingly lower maintenance costs than incandescent and fluorescent lamps. LEDs are also less vulnerable to moisture ingression. Unlike conventional bulbs, LEDs have no fragile components to break, even when roughly handled. Flexible digital-control systems can produce dramatic lighting effects as they do in interior applications. Lighting schemes can change without rewiring or installing new systems.

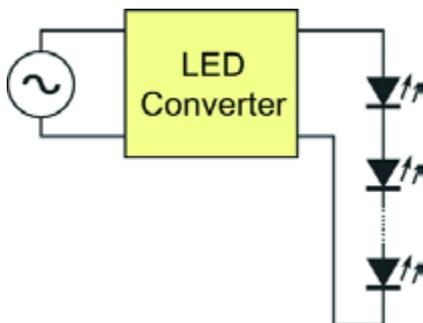


Figure 1: A basic LED converter provides constant current to series strings of LEDs.

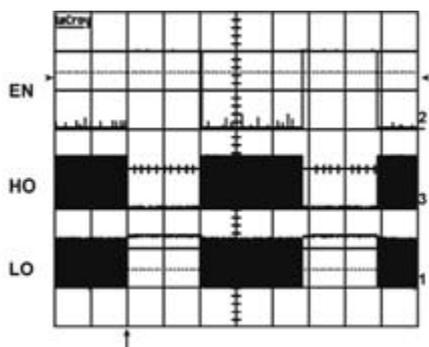


Figure 2: Burst-mode dimming provides excellent control of the LED string's light output while maintaining excellent color fidelity.

