

Designing a Better Recessed Downlight Using SPE Technology

Recessed downlighting is one of the fastest-growing luminaire markets in the United States. These fixtures commonly use incandescent lamps or CFLs, neither of which provide superior efficiency or performance in typical downlight applications.

As part of the *Lighting California's Future* project, the LRC developed a highly efficient LED downlight to replace an equivalent 75W incandescent or 26–32W CFL downlight.

Project Objectives

The goal was to develop an advanced, energy-efficient LED lighting system for use in residential and commercial buildings. The objectives were:

- Reduce lighting energy use by 50–70% over current downlight luminaire technologies
- Be cost-effective (initially and ongoing)
- Allow easy and effective use with controls
- Respond to peak demand power reductions

Design Process

The iterative prototype design process included the development of target performance and mechanical specifications; characterization of commercial phosphors, lenses, and blue LEDs; optical modeling to achieve a target chromaticity with optimum luminous efficacy and color rendering; and experimental verification and testing. Scattered photon extraction (SPE), a patented LED packaging method developed at the LRC, was also implemented to improve the light output, efficacy and life. The LRC team created more than 100 SPE lenses for use in seven prototype downlights.

Sponsors

Public Interest Energy Research (PIER) Program
California Energy Commission



Top left: prototype SPE LED downlight; top right: prototype color rendering; bottom left: seven prototypes built for the project; bottom right: six prototypes installed at the LRC.

Prototype Performance

The final prototype system produced similar light output to a 75W BR40 or a 26W CFL downlight, but with only 9.5W of input power. The SPE LED downlight features:

- Lumen output: 720 lm at 9.5 W
- System efficacy: 76 lm/W
- CRI 75 at CCT 3500 K
- Efficient, dimmable driver with three additional settings if a higher light output is desired (up to 1036 lm)
- Life (L70): 50,000 hrs (junction temp = 44°C)
- Light distribution: General diffuse
- One-part reflector and trim in a traditional 6-inch aperture housing that can be installed from below the ceiling (suitable for remodeling and requires a ceiling opening of 7-1/8 inches)
- Installation labor costs are the same as comparable CFL or incandescent luminaires