Energy-Efficient, Ultra-Thin LED Luminaire

Electricity shortages have affected the United States since the late 1990s. One of the most promising avenues to limiting future electricity shortages is through lighting.

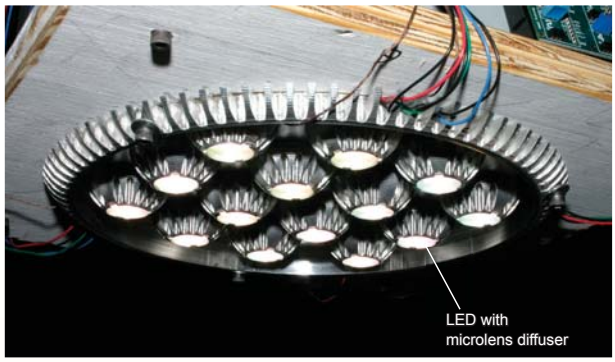
Downlights, accent lights, and wall-wash luminaires using halogen or incandescent lamps are found in 60% of all commercial office buildings and a much higher percentage of retail and residential applications. These luminaires, and the lamps they house, are inefficient and waste a tremendous amount of energy. Another problem with these recessed luminaires is the plenum depth required to accommodate them, often between 6 and 12 inches.

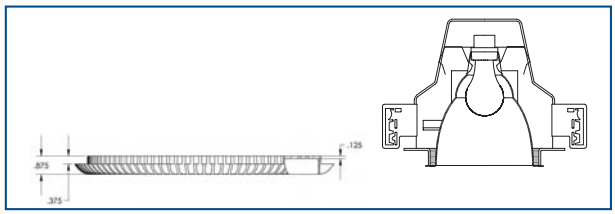
LEDs offer the potential to replace halogen and incandescent luminaires in these applications. The LRC is presently developing a prototype ultra-thin, LED-based luminaire for use in residential and commercial applications.

Project objectives

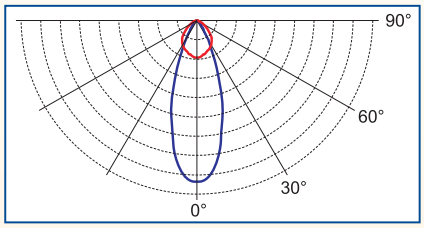
The objectives of this project are to:

- Demonstrate an LED luminaire that allows energy-efficient lighting to be used in a wider array of applications than is possible with current technologies.
- Determine cost-effective manufacturing, assembly, and distribution methods that provide a reasonable payback to the consumer through energy and maintenance savings.
- Develop a benchtop prototype that:
  - Has a total depth of less than one inch
  - Is able to operate on either line voltage or low voltage power supplies
  - Provides a wide range of beam distributions with interchangeable optical micro-lenses
  - Exhibits similar lighting characteristics as luminaires using halogen lamps
  - Provides high luminous efficacy
  - Exhibits long, useful life





The ultra-thin profile of the LED luminaire (left) makes it suitable for applications requiring a shallow plenum. A common incandescent downlight luminaire (right) is shown for comparison.



The ultra-thin LED luminaire can produce a variety of beam distributions by switching the microlens diffuser of each LED. Shown here are 30° (blue) and 80° (red) beam distributions.

Initial prototype performance

LED efficacy (@ 200 mA)	87 lm/W
Lens + diffuser efficiency	85%
Driver efficiency (ac to dc)	81%
Luminaire light output	645 lm
Luminaire input power	11.4 W
System efficacy	57 lm/W
Estimated LED life (L_{70}) (T_{pin} = 39°C)	>50,000 h

Sponsor

California Energy Commission EISG Program

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Lighting Research Center

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