GATEWAY DEMONSTRATIONS

Residential Undercabinet Lighting with LEDs

Background

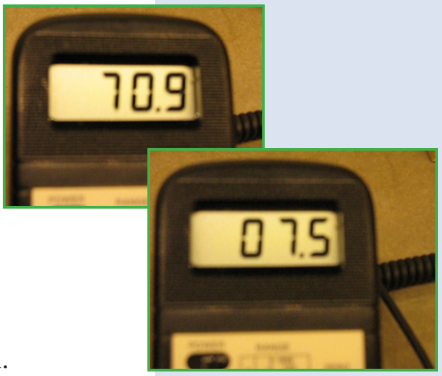
Photo Credit: Osram and Belfer Lighting

Undercabinet lighting fixtures in residential applications typically use halogen or xenon light sources. These sources provide excellent color rendering and light output, but have relatively low energy efficiency.

Until recently, the primary high-efficiency option for undercabinet lighting applications has been fixtures that use linear fluorescent lamps, typically either T-8 or T-5 products. However, for a variety of reasons, including light quality (perceived or real) and limited dimming capability, fluorescent fixtures are not favored by a significant portion of residential users thus limiting the rate of efficiency improvement via fluorescent sources.

Recently, a number of LED undercabinet products have come on the market intended for the residential sector (along with several products for the commercial sector). Even at this early stage, interest in these products is high because LEDs are seen as a viable solution for the continuing market resistance to fluorescent technology.

LED Application



This dimmable HF2Stick XB system is operable from 100% down to approximately 10% as illustrated by the illuminance meter readings in footcandles measured at the countertop.

A few LED undercabinet fixtures currently on the market are comparable to fluorescent products in terms of energy efficiency and lighting performance, but LED technology continues to improve rapidly and will surpass fluorescents in the near term (1 to 2 years). In terms of their economics, several LED products on the market already represent sound investments, especially in cases where fluorescent alternatives are not being considered.

The directionality of light emitted from LEDs makes them particularly well suited for task lighting applications, where illumination is only needed in a limited range of direction. In contrast, light sources that emit in 360 degrees lose a fair portion of their lumen output (typically 30% or higher) in directional lighting applications due to the required reflection (and partial absorption) of those lumens emitted outside of the desired pattern. LEDs can deliver light more efficiently to the desired surface.

Well-designed LED undercabinet lighting fixtures also offer a number of other attributes that are desirable for this application, including

- A low profile, enabling easy concealment beneath the cabinet;
- Low operating temperatures, reducing burn hazards relative to halogen products;
- Dimming capability (a common limitation of inexpensive fluorescent systems);
- Long life, potentially resulting in no further replacement required throughout the life of the kitchen;
- "Sparkle" factor, a more subjective preference pertaining to the way countertops appear under the lighting (and a common complaint associated with fluorescent technology).

Not all LED undercabinet lighting fixtures provide all of the benefits listed above, however. Products must be individually evaluated for a particular application, as performance currently varies widely. The sections below provide some useful information for evaluating LED undercabinet products.

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Performance

The first job of undercabinet lighting is to ensure sufficient illumination for carrying out intended tasks on the work surface immediately beneath, and secondarily, to provide illumination to the backsplash and nearby areas to reduce contrast between light and dark areas. Two measures useful for comparing the ability of different sources to provide this illumination in an efficient manner are luminaire efficacy (total lumens out of the luminaire divided by total input power) and linear flux (lumens applied to the area of interest per linear foot of luminaire). The table below lists these measures along with cost at the time of testing for three LED undercabinet products, plus comparison values for one halogen and two fluorescent products. These results were obtained from independent product tests sponsored by the DOE SSL program, except where noted. While the halogen and fluorescent values in the table will likely continue to be representative of typical products, the LED values are quickly becoming out of date as improvements in both their cost and performance continue.

Photo Credits:
Kichler Lighting

LED undercabinet products are available in a variety of form factors.

Undercabinet Product	Date Tested	Luminaire Efficacy *(lm/W)*	Linear Flux *(lm/foot)*	Color Temperature	Total Equipment Cost *($/foot)*
A – LED	02/2008	34.3	190	2926K	$65.00
B – LED	07/2007	30.5	140	2767K	*
C – LED	07/2007	34.4	225	2800K	$66.67
D – Fluorescent	09/2007	20.2	135	5730K	$37.07
E – Fluorescent **	11/2007	23.2	243	3865K	$21.97
F – Halogen	†	7	230	3000K	$33.26

*Commercial prototype; not purchased.
**ENERGY STAR Qualified.
†Represents a compilation of commonly available products, as reported in http://www.netl.doe.gov/ssl/PDFs/Undercabinet-Ligting.pdf.

ENERGY STAR®

DOE released ENERGY STAR criteria for SSL luminaires, including undercabinet products, in September 2007, scheduled to take effect in September 2008. These criteria call for a minimum of 125 lumens/linear foot and a minimum luminaire efficacy of 24 lm/W for kitchen applications and 29 lm/W for shelf-mounted task lighting. Note that only the LED products in the table above meet both of these criteria.

The ENERGY STAR criteria document can be viewed and downloaded from the DOE SSL website.

DOE Gateway Demonstrations

Technology demonstrations showcase high-performance products in commercial and residential applications and provide real-world experience and data on performance and cost effectiveness. DOE has a number of residential undercabinet application demonstrations underway for 2008-2009, including two involving green builders in the Pacific Northwest. These houses will be featured on a Tour of Green Homes and other publicity events over the next year. Installation of the lighting should occur during home construction in the summer of 2008. Once completed, the results from these demonstrations will be available from the DOE SSL website link to Gateway Demonstrations.

For Program Information on the Web:

http://www.netl.doe.gov/ssl
DOE sponsors a comprehensive program of SSL research, development, and commercialization.

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