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MuAnalysis look deeper

A19 LED Light Bulbs

Feit 7.5W, Pharox 300, GE Energy Smart, Sylvania Ultra LED and Philips Ambient LED

Teardown and Technology Analysis

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1. Product Identification

The devices subjected to teardown for this work are five A19 LED light bulbs: Feit 7.5W, Pharox 300, GE Energy Smart, Sylvania Ultra LED and Philips Ambient LED. The Philips is a 60W equivalent bulb, others are 40W equivalent.

Standard A19 format light bulbs, found today in most lamps and luminaires, are now available using LED technology. They retail between $20 and $40 per 40W or 60W equivalent light bulb. But why so expensive? Is there real value at this price? Why are some bulbs twice the price of the others? Some bulbs are dimmable, others not, and some only with specific dimmers. They all advertise 25,000 to 50,000 hours expected lifetime. This is based on three to four hours daily usage. If used appropriately and sparingly, you might expect your light bulb to outlive you.

In our scientific quest for answers, we have torn apart five A19 LED light bulbs. The Philips is a 60W equivalent at 12.5W and 800 lumens. The others, Pharox, Feit, Sylvania and GE, are all 40W equivalent bulbs.

	Sylvania Ultra High performance series LED	Philips Ambient LED Household usage	GE (Energy Smart)	Feit (Perfomance LED)	Pharox (300)
Energy Used (W)	8	12.5	9	7.5	6
Lifetime (hrs)	50000	25000	25000	25000	35000
Light Output (lumens)	430	800	450	450	360
Lumens per Watt (efficacy)	54	64	50	60	60
Light Colour	Bright White	Soft White		Soft White	Warm White
Correlated Colour Temperature (K)	3000		3000	3000	2900
Compatible with dimmers	Yes	Yes	No	No	Certain models only
Purchase Price ($)	39.99	39.98	42.89	21.98	24.95

Table 1.1 Purchase parameters.

Figure 1.1. Bulbs subjected to teardown.

Each comes in a specially designed package, unlike tungsten filament and CFL bulbs which come in nondescript shrink wrap. This fancy packaging definitely adds to the overall cost.

2. External Appearance

Philips

Pharox

Sylvania

Feit

GE

Figure 2.1. Illumination pattern of the lamps. As claimed, the GE illuminates more uniformly than others, followed closely by the Philips. The other three illuminate mostly upwards.

Figure 2.2: Five A19 LED light bulbs shown lit and unlit. Both images were taken with the lamps side by side.

For something as simple as a light bulb, each has its own unique appearance. The Philips uses a remote phosphor. The GE has a ceramic neck and fins and a glass bulb, and is more costly than those using plastic and metal. The Sylvania looks yellower than the GE and the Feit, who have also a 3000K color temperature.

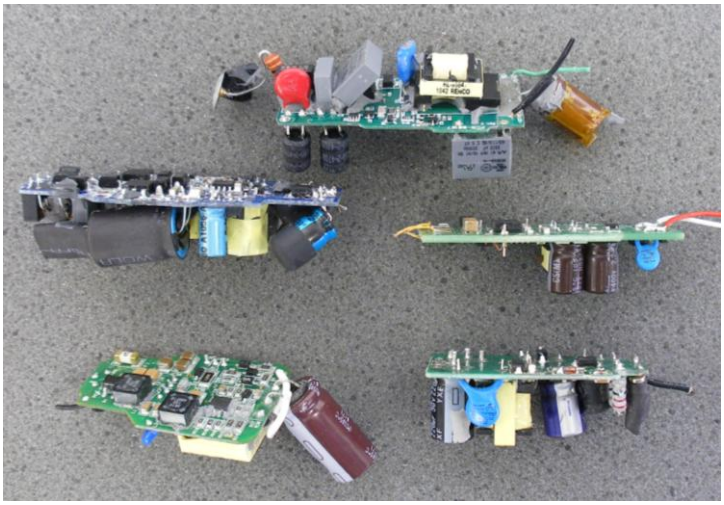

Figure 3.2: Circuitry inside the neck of the bulbs.

All have a small printed circuit board contained within the neck, relying heavily on large electrolytic capacitors and transformers. The reliability factor of LEDs has increased tremendously. But how long will electrolytic capacitors perform under such hot operating conditions?

> **This report shows the construction of the bulbs and includes detailed images of the control circuitry of each. It identifies the selected LED controller chip, including an inside look at the die, as well as other semiconductor devices on the board. It does not include a reverse engineering of the circuit. The report also shows the selected LEDs by manufacturer, configuration, the total LED die area, and the type of phosphor used.**

At what point does the lamp die, given it has dozens of individual LEDs? In all the fancy packaging, warnings, disclaimers, and warranties, nobody defines the point of failure. Twenty five years from now, when your expensive lamp reaches end of life, will it go with a flash? Will it still be useable for its intended purpose until the last second, or will there be a point at which it the light has become so faint that you decide to replace it?

The question is, why so expensive? At 50 to 60 lumens/W, they have the same efficacy as 40W equivalent CFLs (compact fluorescent lights) which typically offer 560 lumens at 10W and can be purchased for a few dollars and should last, so the packaging claims, up to eight years. For the same savings in electricity you will need to purchase two or three additional CFL bulbs over the next twenty-five years. Luckily they are available in packs of two or four!

Light bulbs are a commodity item, no matter how long they last. For all the claims of longevity of CFLs, one has yet to see them reach their expected lifetime. The electronics in the neck is usually what fails, and the situation is likely to be the same for the LED bulbs.

The attraction of LED bulbs is two-fold: they are instant-on, and they are free of mercury. The toxicity of rare earths is low, and so little is used anyway. With CFLs we have traded energy consumption for mercury contamination. Over time LED bulbs will drop in price and provide a cleaner, safer alternative and maybe even a longer life expectancy. We can also expect new features; the door is fully open on that front.