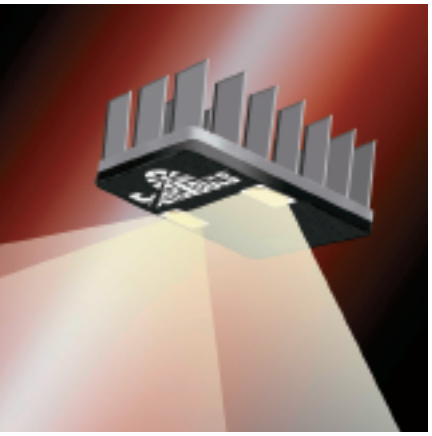
# Plug replacement LED

BY TIM QUEENEY

When you look at this device closely you see a multifaceted block of aluminum with rows of cooling fins, small yellow circles and multiple electrical leads. It suggests a complex electronic brain that should be plugged into the back of your nav station. This little block of aluminum and silicon does plug in, but not where you might expect. The Sensibulb from Sailor's Solutions, is an LED replacement for a standard incandescent bulb.



Courtesy Sailor's Solutions

The Sensibulb from Sailor's Solutions is an LED-based light source designed as a plug-compatible replacement for incandesent bulbs. The unit comes with adapters that allow it to fit most lamp sockets.

The Sensibulb has all the advantages we have come to expect from LED lights: it uses less electricity and lasts longer than the typical "better at producing heat than light" incandescent bulb. And the folks at Sailor's Solutions have done some impressive developmental work to produce a unit that is optimized for temperature and light color output. "We started out not satisfied with the basics of LED performance," said Nick Cancro, president of Sailor's Solutions in Northport, N.Y. "We started a two-year program to develop a better LED." One interesting aspect of the Sensibulb development was being chosen to participate in NASA's Space Alliance Technology Outreach Program (SATOP). NASA sees SATOP as a way to transfer space technology to small business. Business projects are assigned to NASA labs and NASA contractors do free development work on promising new technology products. Sailor's Solutions' Sensibulb project was paired with the Johnson Space Flight Center and Boeing Aerospace. Boeing engineers developed the original Sensibulb's aluminum extrusion heat sink, while Cancro and others at Sailor's Solutions worked on the Sensibulb's active thermal circuit that compensates for temperature. To see why temperature compensation is important, we need to look at how an LED produces light versus a traditional tungsten bulb.

An LED makes light using a silicon circuit — technically a P-N junction semiconductor. As electrons move across the circuit junction from the anode (P side) to the cathode (N side), they fall into "holes" on the cathode side of the junction. When an electron moves into one of these holes, it loses energy and emits a photon. As long as current is applied across the junction, the LED will produce a stream of photons — also known as light.

The advantage of this approach over incandescent bulbs is obvious when you realize that an incandescent bulb produces light by passing current through a tungsten filament. The filament has enough resistance to the current to glow white hot. In fact, the filament gets sufficiently hot to "boil" away molecules of tungsten. The result is a progressively thinner filament that eventually shatters.

With no tungsten filament to degrade and fail an LED can theoretically produce light indefinitely. However, since no material is 100-percent efficient at passing electrical energy — short of a superconductor plunged into a beaker of liquid helium — even LEDs produce some

heat. And they are susceptible to heat in their environment. An LED in a warmer environment will soak up heat from its surroundings, which, according to Cancro, can degrade its performance. "If they get too hot they can dim or even burn out," Cancro said. That is why, according to Cancro, the Sensibulb electronic driver circuit actively monitors and adjusts the power going to the LEDs to keep them at peak performance based on temperature.

A big rap on LED-driven lights has been the narrowly focused beam that an LED normally produces. Cancro and his crew have improved on that by giving the Sensibulb a 120° cone of light.

Yet another aspect of LED bulbs that has been a drawback for many users was the color of the light produced. For years, LEDs came in single colors like red, green, yellow or blue. Now LED manufacturers can make LEDs that produce white light. The color of this white light tends to be shifted toward the higher color temperatures, giving the light a bluish cast. However, for most people the optimum light color is something with less blue and slightly more yellow cast, the color that more nearly matches the light produced by an incandescent bulb.

The Sensibulb unit has LEDs that have been manufactured with a modified chemistry that blocks the higher temperature blue light and allows the lower temperature light through. Cancro worked with his LED manufacturer to get the colorcast right. After receiving the samples from the manufacturer, Cancro and friends performed some light tests. "We got together and we turned lights on inside boats. And we brought other people to see what kind of color they liked." The result was an LED bulb with a more pleasing color temperature.

Another useful aspect to the Sensibulb is its built-in dimmer capability. Cancro and his circuitry designers took advantage of the Sensibulb's thermal management circuit to add a dimming capability. When fully dimmed, the light operates at 25 milliamps. Using two dimmed Sensibulbs belowdecks at night would only require 50 milliamps, a low draw on the precious electricity in your voyaging boat's battery banks.

Now Sailor's Solutions has developed a second generation Sensibulb that places the components directly on the aluminum heat sink, bypassing the need for circuit boards. This process allows for improved heat transfer and allows the overall size of the unit to be reduced. This second generation unit will be introduced at the Miami Boat Show in February (see rendering of new bulb on facing page).

The only real downside to this product is the cost. Sensibulbs are not cheap at $39.95 each. Of course, the attraction is that once you have replaced the incandescent bulbs on your boat, you will be reducing the electricity and presumably cash in the long run, as you will not have to replace scores of incandescent bulbs. ■