Tech-Nique

Kit Sodergren

High Powered Stop Lights for 6 Volt Cars

"You got no taillights!" Every time a helpful motorist shouts this at me, I check my taillights as soon as I get home. Sure enough - they're all working back there, they're just lower and dimmer than modern drivers are used to. The ideal solution would be what is now called a CHMSL or center high mounted stop light. There's room to mount one under the engine deck lid grill, the only question is where is where do you get the light?

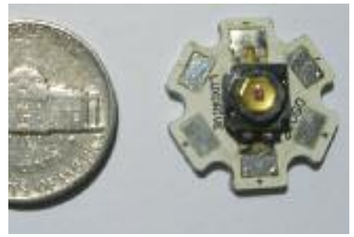
If you have a 12 volt car, it's easy. Just google "trailer light" and you'll find lots of choices, both LED and incandescent. It's not so easy if your car is 6 volt. There just aren't any pre-made 6 volt taillights that I could find. So I decided to make one and that's what this article is about.

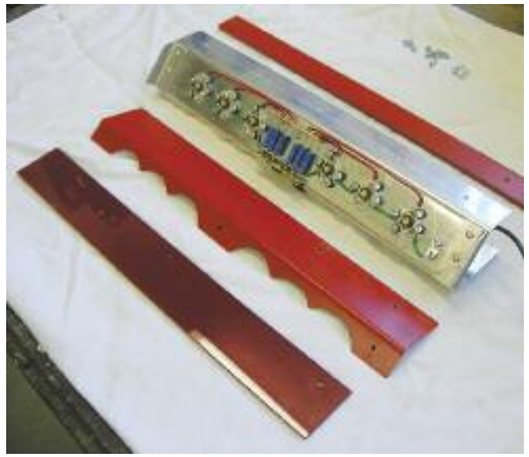
Adding a taillight to a car involves at least three things: the light source itself, the housing for the light(s) and the power supply.

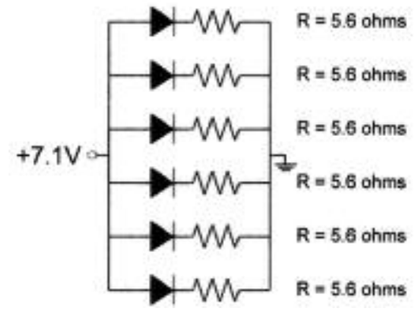
Incandescent vs. LED

Incandescents have the advantage of a simple electrical installation. Run a hot wire, pick up a ground and you're there. But LEDs have some advantages. They come on quicker than incandescents and that difference in reaction time amounts to 22 feet at 60 mph. They're vibration proof and last 100,000 hours! Mostly, though, I like the way the LEDs look on some of the new cars, so that's what I decided to use.

LEDs can be divided into 2 groups: Standard and high power. Standard LEDs are those that fit in a 3 or 5 mm hole and cost anywhere from 9 cents to about $2. Almost all of them draw 20 milliamps (ma) at around 2 volts. The brightness of an LED is determined by the power it consumes and power is amps times volts. Standard LEDs therefore are generally 40 milliwatt devices. (Technically speaking, LED brightness is measured differently than incandescent brightness and involves the amount of light falling on a certain area being illuminated by the LED. That's why you'll see "super bright" and "ultra bright" LEDs. These designs have a focused, very narrow 10º viewing angle. They're not actually putting out any more light, they're just putting it all in a very concentrated area.) High power LEDs, on the other hand, really do put out a lot of light. The LEDs I'm using are called Luxeon K2s and are made by the Netherlands' Philips company. They cost $7.50 each and draw 700 ma at 3.6 volts. That's 2.5 watts or about 60 times more power than standard LEDs. Their viewing angle is a very wide 120º and they're so bright the vendor cautions the user that eye damage may result from looking straight into them!







LEDs have some quirky electrical properties that complicate their installation. The main thing to watch out for is that their resistance changes with temperature. As the voltage increases, the current flow increases and both the brightness and the temperature increase. The temperature increase causes the resistance to decrease, so the current increases some more causing a further increase in temperature and so on until the device destroys itself. The simplest way to protect any LED is with a series resistor. On-line calculators are available, such as www.ledsupply.com/reca.php, for determining the proper resistor values for Luxeon K2s in any circuit of at least 3.6v. A schematic diagram for using 6 Luxeon K2s in a 6 volt car is included in this article. See parts list for vendors and prices.

CHMSL Housing

While the electrical considerations for a 6 volt circuit using LEDs are well defined, the housing for holding the LEDs is not. Any design is possible that meets the following criteria. It must provide at least 9 square inches of heat sink area for each LED and the LED mounting surface should be in the vertical plane (for viewing purposes). Be sure to position the LEDs in between the slats of the engine grille (don't ask me how I figured this out.) Lastly, it should be water resistant if not water proof.

See the accompanying drawing for a workable design. Aluminum rectangular bar, 1x 3/16 in., is bolted between the upper luggage rack mounts as a support for the heat sink, which is made of 0.032 aluminum sheet. The bends in the aluminum sheet for the heat sink can be difficult without a sheet metal brake, but clever mechanics will find ways around this. Transparent red Plexiglass is used as a lens and everything else is painted body color..

Power Supply

A wire from the master cylinder brake light switch is used to trigger the stop light. This wire is used to turn on a relay mounted near the voltage regulator to drive the stop light because the LED array draws over 4 amps. This is too much current for the existing 8 amp fused taillight circuit. The voltage relay BAT connection is an easy place to pick up all the amps you want. I used a 5 volt Magnecraft relay (see parts list). There is no 6 volt version, so a 8.2Ω 1 watt series resistor must be used to protect the coil. With this series resistor the relay can be safely operated between 4.6 and 7.5 volts. An alternative to the Magnecraft relay would be to use a genuine Bosch 6 volt relay from Joe Leoni. Speaking of Joe Leoni, he points out that an alternative is to install a "tee" on the master cylinder with a second brake light switch. This switch could be powered straight off the battery, so the need for the relay would be eliminated.

Notes on Assembly

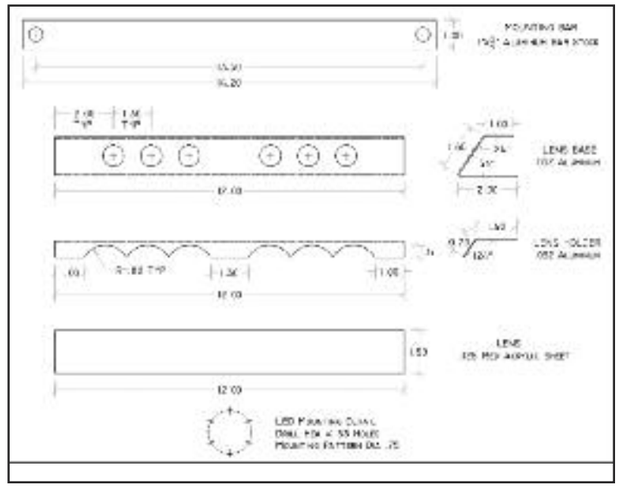
Electrostatic discharge, which causes the shock you get from a car door, can damage LEDs. You can prevent this by grounding yourself occasionally when handling your LEDs. Just touch any bare metal area of an electrical component that is plugged into a 3 wire outlet every few minutes when working with solid state devices.

It's best to solder the lead wires on to the K2 "stars" before they are mounted to the heat sink. Once they're on the heat sink, it's difficult to get the star hot enough for soldering.

With separate leads it's easier to use individual grounds, unlike the schematic and the prototype picture. When soldering the stars before mounting them, it is not necessary to heat sink the LED itself from the star.

There are two approved methods of mounting the stars to the heat sink. One is mechanical mounting using #4 machine screws, which is the method I used. The other is gluing the stars to the heat sink using Arctic Silver Thermal Adhesive. This is an epoxy that conducts heat. Gluing eliminates the need to accurately drill 36 #4 holes in the heat sink. If you choose to use the epoxy, be sure to order Arctic Silver Thermal Adhesive and not Arctic Silver Thermal Compound. The directions for use are on the Arctic Silver website.

Opposite from top: Luxeon K2 LED pre-mounted to star-shaped soldering pad. Tail light components ready for final assembly. Electrical schematic.
Right from top: Tail light installed view. Tail light is hardly noticeable when off. They should be able to see this! Below: Layout of components.



Mission Accomplished

The most common response from people who see this for the first time is "Wow!" One viewer described it as "a barbecue grill on high." And not only are they bright, they're fast. It's really noticeable how long the stock lights take to come on when compared to the LEDs. And I don't have motorists yelling at me anymore. But I still keep an eye on my rear view mirror whenever I slow down. Especially if the car behind me is an SUV and the driver is on the phone.

Questions, comments can be directed to me at kits@omsoft.com.

Part. No.	Description	Cost Ea.	Qty.	Vendor
05027-pd12	Red K2 Star	$7.49	6	ledsupply.com
P-0802H	Terminal Strip	3.75	2	tubesandmore.com
283-5.6-RC	Resistor	0.39	6	mouser.com
534-908	Terminal Lug	0.14	6	mouser.com
281-8.2-RC	Resistor	0.13	1	mouser.com
528-9152-5	5 volt relay	5.04	1	mouser.com
Use the items below for bolting the LEDs to the heat sink				
534-3368	Fiber Wshr#4	0.08	36	mouser.com
532-250	Thermal Cmpd	6.45	1	mouser.com
Use the adhesive below for gluing the LEDs to heat sink				
3089959	Arctic Silver Thermal Adhesive	12.99	1	frys.com