LED theory for the average biker

Pictures and text by Rebel

All Harley-Davidson motorcycles produced today use incandescent lightbulbs for their blinkers. Incandescent lightbulbs are self-destructive. What that means is using them causes them to degrade and then fail. On motorcycles it's worse because we shake the shit out of 'em all the time. We've all had it happen--breakage. We go to start out on a ride, check our bikes and find a blinker bulb has bit the dust. Get used to it, right?

NO!

LED's have been around for about 30 years now. They have changed quite a bit, in construction, since the first feeble LED's were sold. Those LED's, or bulbs since that is the correct term, had very low output levels and were only available in red. The output of an LED by the way is measured in Candela. This is a term related to and based on candlepower. Incandescent bulbs by contrast are rated in Watts. Why you might ask? Good question.

Incandescent bulbs get their ratings in Watts for the simple reason that heat conversion of electrical power is exactly how they produce light. Now you engineers out there just roll with me. We don't all need to know the physics of everything to understand it enough to use it.

When you run current (voltage/resistance) through an incandescent bulb you are running this current through a resistor. In fact it's a piece of wire, that has a specific resistance, and the wire gets hot.

It gets so hot in fact that it starts to glow, just like the embers in a fire.

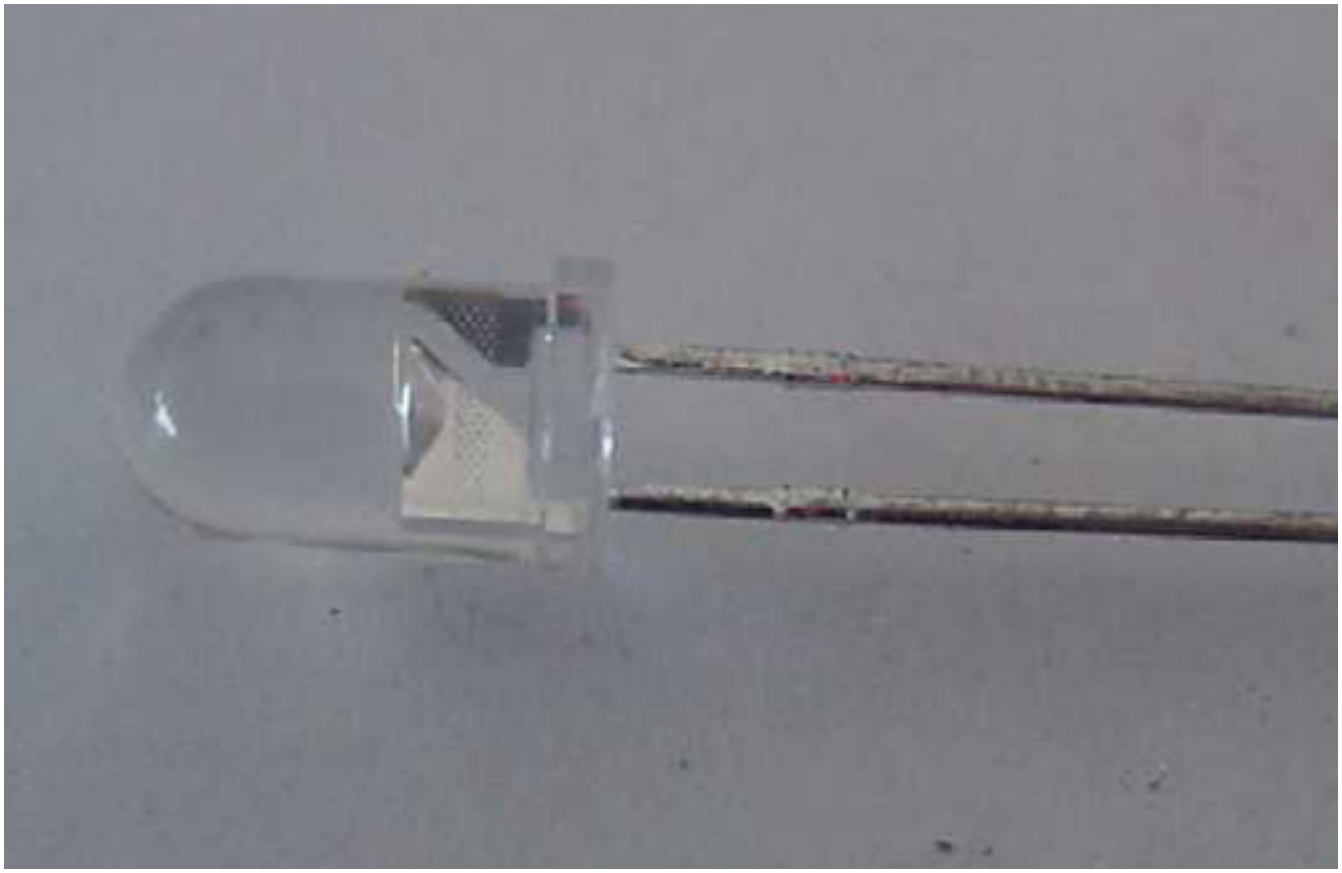
Since there is a lot of power being used up, they glow brightly, and they approach white light in their radiated "glow". If you were to limit the amount of current moving through the filament (the wire) you can change the color. The reason is simple. If you lower the amount of energy being dissipated, you lower the color. Light is just like any other energy. The frequency emitted, or the light color, is dictated by the amount of energy you are using. Less energy and you get a more orange color. More energy you get something closer to white.

Here's an Incandescent blub. The wires are actually resistors that glow.

Confused? Don't worry, you don't need to understand any of this shit. It's just a background explanation. Now let's move on to LED's and why they aren't rated the same way.

An LED does not produce light by dissipating heat. There is some heat produced because nothing is perfect and there is some loss due to efficiency. LED's produce light by a physical reaction to energy crossing a PN junction in a diode. You still don't need to know all this, but if you want to know more there are lots of sites on the Internet which contain sharp explanations.

So, since the LED is not a resistor, it's a diode (Light Emitting Diode) there is no Wattage to use as a measure of output. I suppose you could use watts, but what sense does it make to rate an LED at 1/10th Watts when it produces the same light as a 1W incandescent? Those are not the correct numbers to compare; I just used them to illustrate. The "Power" an incandescent uses is huge compared to an LED. Your stock lights EACH use AMPS of current. An LED gives it's full rated light output at 20mA (0.020 AMPS).



You can’t see the diode, it’s too small. It’s on the big lead.

Now you see the problems and benefits of LED use. They don’t use a lot of power, they last a long time since they are not dying the whole time, but that leads to a problem for us. Not a big one, but a problem just the same.

Blinkers on H-D’s use a lot of current. Since they do, H-D uses that current to make them blink. Reduce the current to nil and the fuckers don’t blink. Here’s why.

The common type blinker "device" in an H-D, or car, is a bi- metallic device. There are two different metals laid on of top of the other. As they heat, the current flows through them too, one side expands at a different rate than the other. It just does. If you heat just about anything it will expand. Same thing here.

Now picture the metals, one expanding fast, one slow. They will tend to bend towards the slower expanding side. This can easily be used to make and break any electrical contact, thus interrupting the current to your blinkers, just long enough for the metals to cool and be the same length again. Now you have contact, now you don’t. That’s how the early stockers worked.

This is the older style, bi-metalic.

As the electronics in flashers got more sophisticated they became more complicated. Here is the flasher from my 2000 Buell M2.

As you can see this one uses electronics.

This one uses electronics instead of basic physics. There is a circuit called a "comparator" which does exactly what it sounds like. It compares two voltages and uses that to switch a relay on and off. This type works with any amount of current. I've used LED blinkers with this setup. The drawback is that you must have a blinker switch that holds the circuit on. The ones on your bike are momentary. They send a short signal while the buttons is being pushed. The Buell turn signal switch latches on, then you have to remember to switch the blinker off.

The modern H-D uses something in the middle. It does work like the modern three terminal does (except it's integrated into a "module"), but it also uses the current through the blinkers to both sense an open bulb and cancel the blinkers for you.

Now say you have a stock H-D and you want to change over to LED blinkers. They only draw about 1/10 the current or less. That fucking "spring" is never going to heat up and bend. That's how the burnt out bulb indicator works. Broken bulb, no current. No current, no heat. No heat, no blinky.

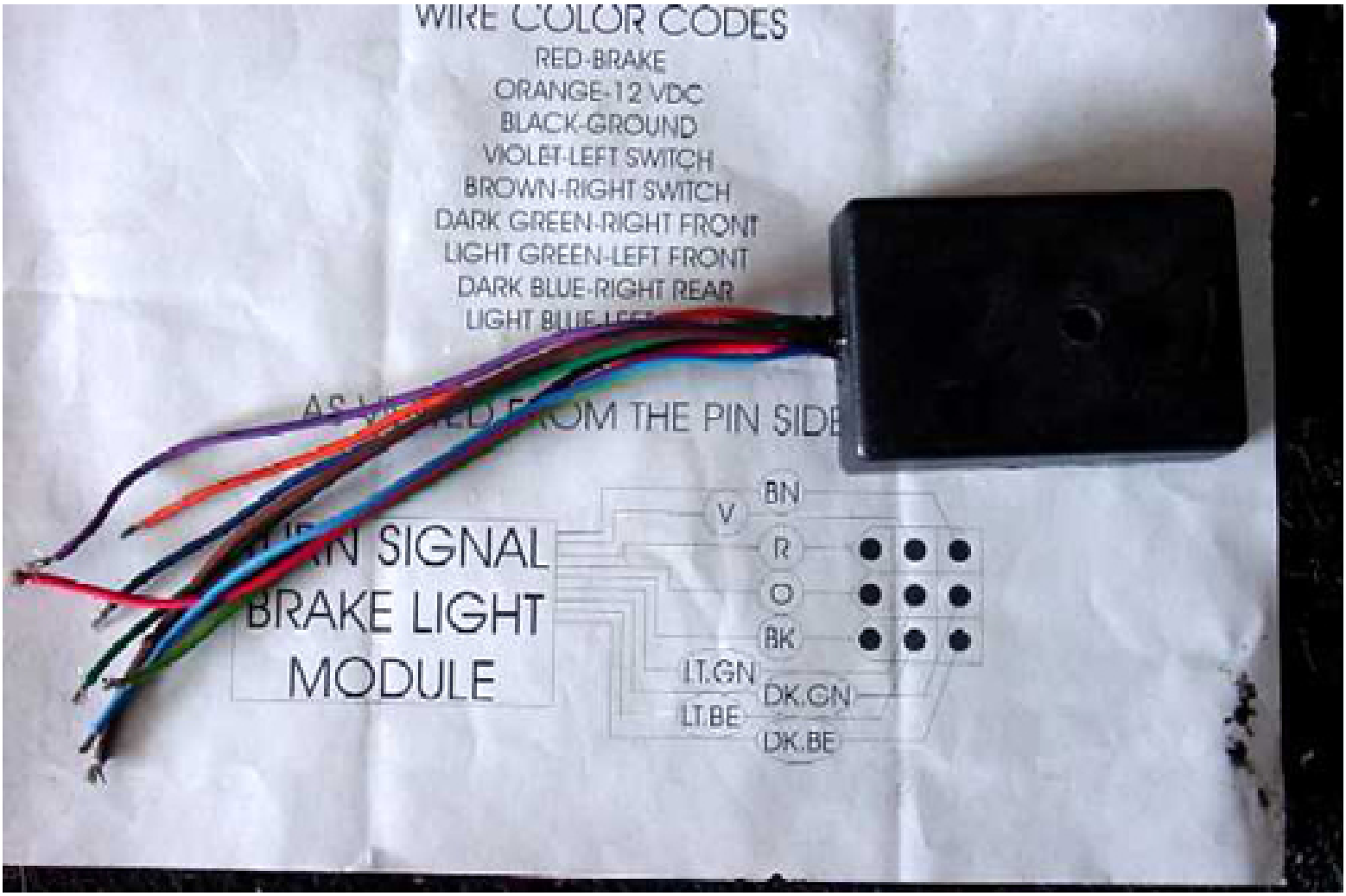
Oh shit, what now Rebel?!

In the beginning there was a crappy solution sold to the public. They are called "Load Equalizers" and they are still sold today. What a crock of shit. All they are is a set of big resistors in a box. You could build them yourself for less than $10, but DON'T. These devices throw away LOTS of heat, all that current you were missing. So instead of heating up the bulbs you are heating up some resistors that do you NO good except make your unmodified H-D blinker circuit blink again. Not to mention they tend to burn up. Great idea--NOT.

There's a better solution. Buy a new blinker module. They aren't that expensive and you will get all the benefits of the LED blinker plus additional features the cheap setup can't offer.

A friend of mine sells a great one. It's called "The Flash'r". His website is motorcycletech.com. Give him a look.

Those of you who have been hanging around San Diego H-D for a bit might remember MC. He is the guy who used to "draw" things with his back tire. He and Valerie live in Louisiana where he runs his own shop. Good mechanic, so if you are in the area and need some help, MC is the man.



"Enter the modern blinker module"

Most of these new blinker modules let you set the blinkers to be auxiliary stoplights. Three times the lights looking back at mister cager sounds like a smart thing to me. Some let you strobe the lights too, or more correctly several flashes to get peoples' attention, then solid. The modules I've seen use a small microcontroller (little computer) and relays. The controller reads a low current signal from your stock blinker switches. Nothing to change there, just wire them up. You can even get away with very small wires now since the current for the controller is almost nothing. I'm using 22AWG for mine. Can you say RCH? You can hide a wire that small anywhere.

The microcontroller controls the blinkers by turning on and off relays. The relays control sending current to your new LED blinkers. You just saved about 5 to 10 Amps.

This is something your charging system doesn't have to produce, which reduces the load on your engine.

Reduced load means more power to go fast and better gas mileage. Can you measure this? I really don't know. But that's not the point. The point is the fucking blinkers will be working next time I want to ride.

What you need:

1. LED blinkers, make your own or buy them. If you make your own buy LED's with at least 4000mCD output or 4 Candela. LED's are diodes. If you allow unlimited current to flow through them they will last a couple milliseconds. You have to limit the current to 20mA's or so. Most can be over driven to get more light but you HAVE to pay attention to the manufacturers specifications.

Sorry, I'm making them, so I won't tell you where to get the LED's. You can find them if you look. They also make white light LED's now so you can light your plates. I've priced them anywhere from $2 to $8 each. So don't burn them up. Find out what the forward bias voltage drop is from the manufacturer. Subtract that from 13.8V and a current limiting resistor must handle the remaining voltage. If that's not enough information, get someone to help. Remember if you use more than one LED to add the voltage drops. If it adds up to 13.8 you don't need a resistor.

2. The blinker module. Ok, there are a lot of choices out there. Do your homework and find one that has all the features you want. The price goes up with the added features. I wish someone would just sell a bare bones module that just runs the blinkers. Should be able to make money off those at $25. I guess I know too much. Anyone want to finance a business? I have both the Lights, front and back, license plate lights, hell you name it. Just need money to get them built

and sell them. What else is new?

3. You can rewire now, if you'd like. You don't have too, but the wires you have are way more than you need. Stock is probably 18AWG. You can use 22AWG. That's the difference between big fat ugly wires and something you can't even see from 10 feet away. It's up to you.