A Simple circuit to add Flicker Free Lighting to your Rolling Stock and Locos

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This circuit uses 3 electronic components along with selectable LEDs and wire connectors to allow you to add lighting to your rolling stock including locomotives, passenger cars, cabooses and other wagons. The electronic component items are available in Kit form.*

Components include:
1) a Bridge Rectifier
2) a 1000 uf 16V Electrolytic Capacitor
3) LED Driver IC 20 mamp
4) LED’s

The Bridge Rectifier is used to maintain lighting when the direction of the train is changed to overcome the diode effect of the LED.

The Capacitor is used to maintain voltage when rolling stock crosses a dead zone or train stops. This prevents lights flickering.

The LED Driver integrated circuit provides up to 20 milliamps current over a wide range of Voltage from around 4 to 90 Volts.

The Circuits

Several circuits can be used with these components with LED lights setup singularly or in multiple formats. In the latter the LEDs can be either in series or in parallel. Since a forward voltage drop occurs with each LED added, in-series works best when the track voltage is constant, such as with DCC. The in-parallel format works better with DC variable voltage, the LEDs generally light when track voltage reaches 5-6 volts.

1. Single LED

Used for single light use such as Locomotive headlights or end of train rear red light.

2. In Series arranged LEDs

Used for passenger car lighting, internal cab locomotive lighting. Can also be used for street and building lighting.

Note: Additional LEDs will raise the threshold input voltage needed to turn on the LEDs.
3 LEDs connected in parallel

The LEDs can also be connected in Parallel sequence. This provides a constant voltage to each diode while the LED Driver Chip limits the current up to 20 milliamps. Most LEDs will illuminate adequately at around 5 milliamps. As a result using this circuitry the LEDs light at a lower input voltage than with the in series setup. Best for DC multi LED use in passenger cars and other rolling stock.

A modification of the two circuits is found when a LED strip containing 9 LEDs is used in a sets of 3 LEDs. (see below) The LEDs in the 3 sets are in series with each set having a 100 ohm resistor. The 3 sets are arranged in parallel format. Unfortunately this still will require a higher threshold input voltage. A single set of 3 mini LEDs could be used in DC.

Making the Circuit

Bend the leads of the capacitor over as shown. Straighten the pins labeled (~) on the Bridge Rectifier as shown. Remove the central lead from the LED Driver IC and bend out the outer leads (VA & VB).
<table>
<thead>
<tr>
<th><strong>Solder the Positive (+) terminal of the Bridge Rectifier (BR)</strong></th>
<th><strong>Use a heat sink to avoid damage to the Bridge Rectifier when soldering electrical components.</strong></th>
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<tbody>
<tr>
<td>to the positive lead of the capacitor.</td>
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<tr>
<td>Solder the negative (-) lead of the BR to the negative lead of the capacitor.</td>
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<tr>
<td>Next Solder the VA terminal of the LED Driver Chip to the end of the (+) positive lead connecting the BR and Capacitor.</td>
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<tr>
<td>The VB lead will connect to the LED Circuit as the positive (+) lead.</td>
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<tr>
<th><strong>This photo of the Constant Current unit shows the arrangement of the components.</strong></th>
<th><strong>The 2 pins pointing upward from the Bridge Rectifier will be connected to the track pickup wires.</strong></th>
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<tbody>
<tr>
<td>The VB lead will connect to the positive lead of the LED Circuit and the negative lead of the LED Circuit will connect to the negative terminal of the Capacitor/BR.</td>
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<thead>
<tr>
<th><strong>To connect the Constant Current unit to the LED circuit connector</strong></th>
<th><strong>Wire leads added to connect to LEDs</strong></th>
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<tr>
<td>wires are used to enable separating the leads when disassembling the passenger car. The wires are cut to a desired length based on how they will fit within the cabin. The wires are cut, the end is stripped and tinned. The free ends of the wires with the female connectors are soldered to the VB (+) lead and the other soldered to the Negative side of the constant current unit.</td>
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**Prepare The lighting Setup.**
Cut a strip of clear plastic cut from blister pack plastic packing material to use as a base for installing the LEDs. Two or three soft white LEDs are inserted and soldered to the wire leads in Parallel. Here the red wire connects to the Positive (Anode) leads of each LED. The white wire attaches to the Negative (Cathode) lead of the LEDs. I prefer this format for DC operation as the threshold input voltage to illuminate the LEDs is lower.

<table>
<thead>
<tr>
<th><img src="image1" alt="2 Warm White LEDs set in Parallel" /></th>
<th><img src="image2" alt="Testing the LED Circuit" /></th>
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<tr>
<td>Install the lighting strip into the roof of the passenger carriage. I used Blue Tack adhesive putty (available at Stationary Stores) to hold the strip in place. Connect the Male leads to the female connections coming from the VB (Positive) lead and the Bridge/Rectifier (Negative). Make sure polarity is correct as the LEDs will only light one way.</td>
<td>Connect the male leads from the LED circuit to the LED driver unit as shown. To test the unit apply voltage to the 2 pins on the Bridge Rectifier marked with the Tilde (~) symbol. A 9 volt battery can be used and should adequately light the three LEDs. If not check all connection and polarity.</td>
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Now install the LED Circuit into the roof of the carriage. Secure with adhesive putty (available at stationary stores). The LED driver unit is seated in the carriage cabin and also stabilized using the putty.

**Install the Electric Pickup**
Electrical input is derived from the track via pickup wipers attached to the wheels of the truck or via copper collars. The trucks can be purchased ready made such as these Athearn units. The copper collar method of electric pickup is described in Project 3 at [www.modeltrainsounds.com](http://www.modeltrainsounds.com). These are made using short copper tubing suspended over the axle of the metal wheels. Other designs for the power pickup using phosphor bronze wipers are described on the web.
Athen 33" or 36" Trucks are available. In a 2 pack for $19 / pack and sold at Train Hobby stores or online.

A simplified electric pickup method is described in Project 4 using copper collars to derive current from the wheel axles.

The truck is attached to the carriage and the pickup wires threaded through a hole on the undercarriage. The leads are soldered to the Bridge rectifier leads labeled with the (~) sign. It does not matter which way the pickup leads are attached as the rectifier will adjust the correct polarity in the circuit.

Below is the completed carriage using the 2 LEDs in parallel series. The minimum pickup input voltage to light this was around 6 volts.

* A Lighting kit for 1 passenger carriage containing
1 x 1000uf 16V Capacitors
1 x Bridge Rectifiers
1 x LED Driver Integrated Circuit
2 connecting leads
3 warm white 5mm LEDs
assembly instructions are included.
Available for on eBay. (search HO Passenger Car Lighting Kit) or order direct from www.modeltrainsounds.