Dimmable LED driver P-2013-068

Matan Ben Moshe , Omer Licht

Directed By : Dr. Mor Peretz

1. Abstract

The project's goal is to implement a current source converter from the SwRC (Switched-Resonator converters) family for driving high brightness LEDs (HB LED) which can be dimmed.

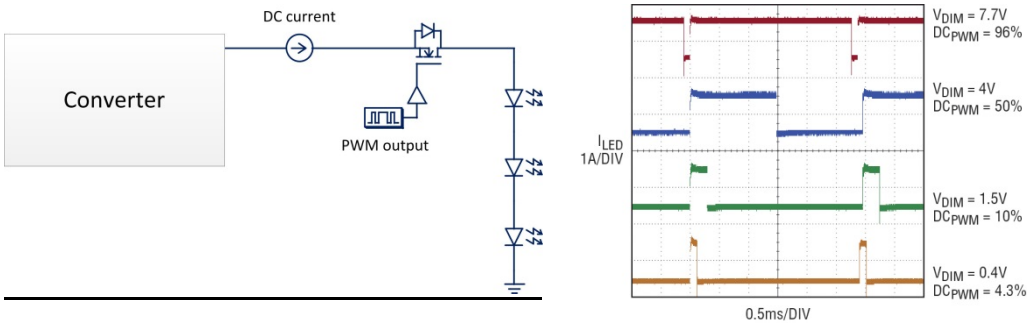
We will attempt to achieve a simple realization design and optimization in terms of power, sizing and cost.

We've realized a current converter from the SwRC family[1] that controls the exact amount energy delivered to the HB LED and will supply the requested brightness.

By controlling the duration of dead time between each charge-discharge cycle we are dimming the level of luminosity to the desired level.

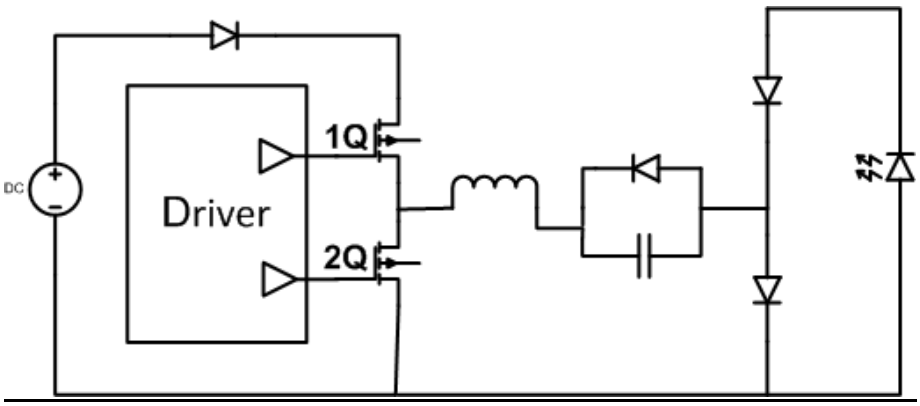
The use of LED lighting is growing in an exponential rate. This converter will be able to be used by a large number of consumers for a variety of applications such as home lighting, street lighting, car lighting and more…

Popular dimming technique -LED driver circuit with PWM output

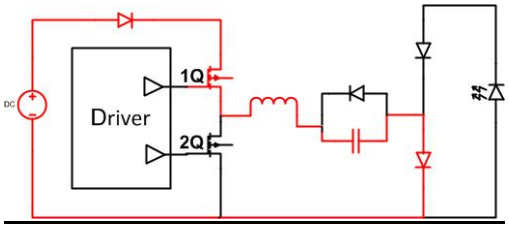


2. Realization

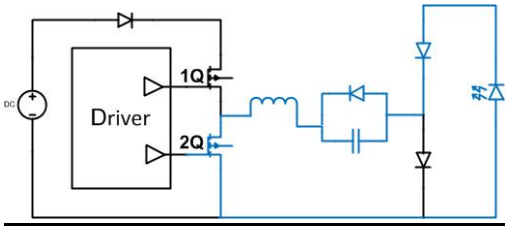
The Power Stage:



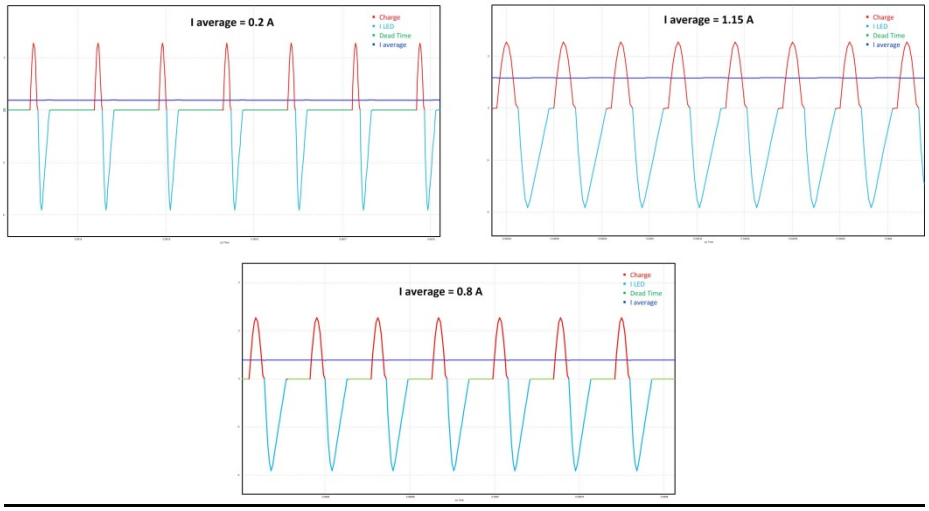
Charge cycle



Discharge / Light cycle

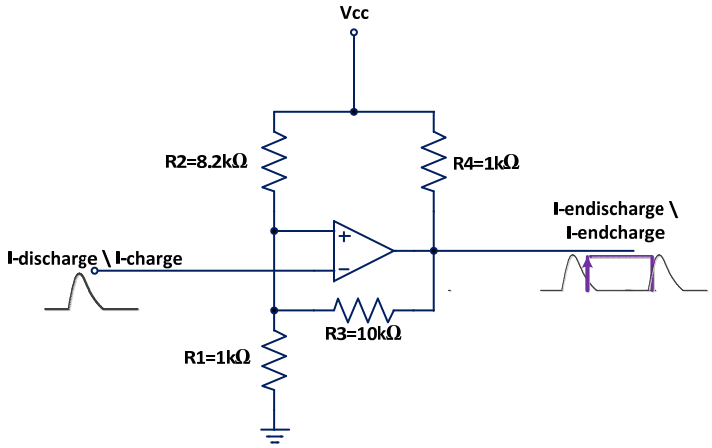


Inductor currents for different dimming levels

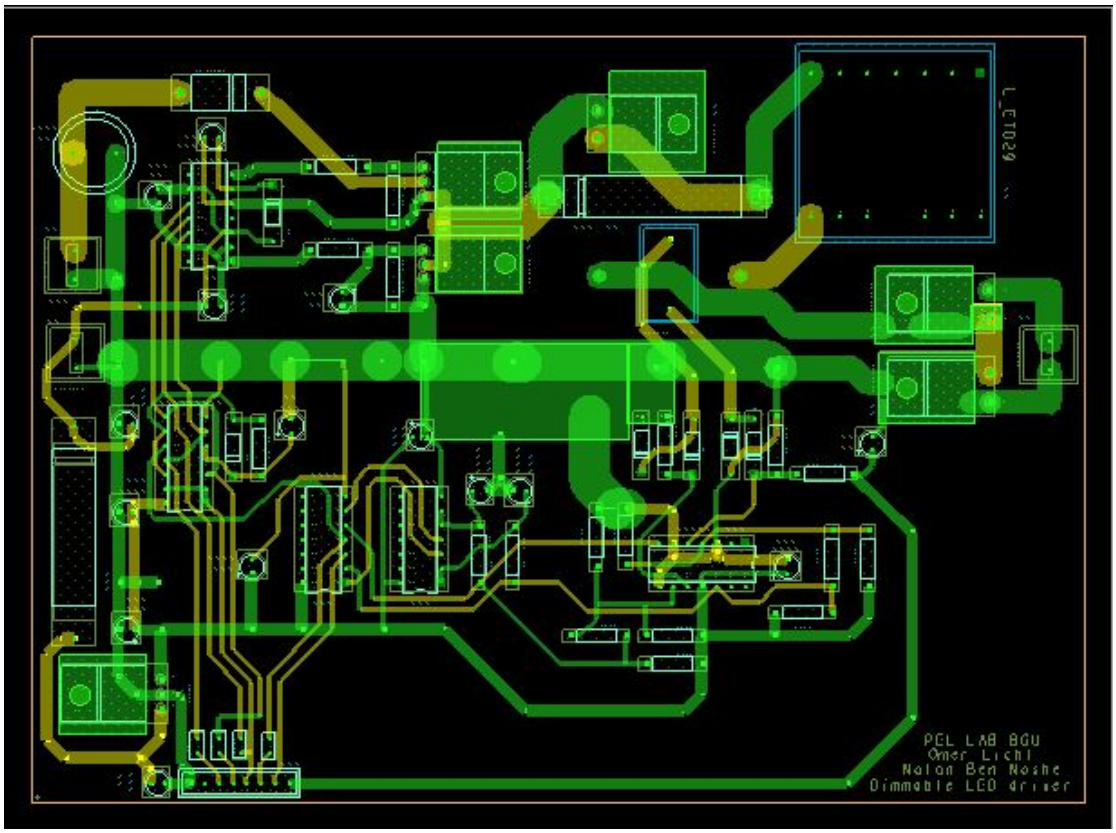


Zero detection

The detection of zero current is implemented with a schmitt trigger connected to a simple logic set to the endpoint of each stage and creates an “end stage” pulse.



Final PCB Layout



3. Advantages

High operating frequency - using soft switching technique enables high frequency switching and operation which allows us to use smaller resonant components significantly reducing board size.

Fine tuning - this convertor allows for high accuracy dimming levels and very fast stabilization thanks to finite control of the dead time between cycles.

Soft Switching - soft switching, zero current switching, reduces the stresses and shocks on the circuit's components, which prolongs the circuit's life and increases reliability. Soft switching enables us to use less costly components and minimize the board. Soft switching reduces switching noise, power dissipation and increases efficiency.

Simple Half-Bridge design - using this simple design allows off the shelf component to be used, making the price even lower.

[1] M. Jabbari, "Unified Analysis of Switched-Resonator Converters", IEEE Power Electronics, May 2011.