Single-Switch Coupled-Inductor-Based Two-Channel LED Driver with a Passive Regenerative Snubber

Introduction:

The traditional fluorescent lamps, the light-emitting diodes (LEDs) have been getting more advantages such as long life, compact size, low maintenance, and environmental friendly characteristics. Since the LED forward current is an exponential function of its forward voltage, a little forward voltage variation will result in large change of the LED forward current. The brightness of the LEDs is proportional to the LED forward current. Therefore, it is expected to use constant current control in LED drivers.

For multiple LED strings, the LEDs are formed by connecting them in series and parallel. Therefore, to obtain uniform brightness, the current flowing through each LED string should be identical. Because of the different manufacturing tolerance in LED V-I characteristics and the LED negative temperature coefficient, it is necessary to achieve current balance by using current sharing techniques.

Existing system:

The passive method, featuring a simple structure and low cost, is regarded as a solution to balance the LED currents. The passive balancing methods can be classified into the inductive method and the
capacitive method. In the current sharing transformer is employed to equalize the LED currents. With the 1:1 turn’s ratio of the current sharing transformer, the currents in two windings are equal if the magnetizing inductor current is small as compared to the winding current. However, this method has drawbacks.

First, because of the use of the magnetic components, the size is bulky. Second, the LED current sharing performance is influenced by the coupling coefficient of the current sharing transformer as well as the LED forward voltage mismatch. Third, the magnetizing inductor of the current sharing transformer should be suitably reset during the switch turn off period. Otherwise, a high voltage spike will happen.

**Dis-advantages:**

- The size is bulky.
- Forward voltage mismatch will happen.

**Proposed system:**

A single-switch coupled-inductor-based two-channel light-emitting diode (LED) driver with a passive regenerative Snubber is presented. In the proposed LED driver, the energy-transferring capacitor is not only used to step up the voltage gain but also to achieve the current balance among LED strings. Moreover, a passive regenerative snubber is added not only to recycle the leakage inductance energy but also to improve the voltage gain. The proposed LED driver with a passive regenerative snubber.
The configuration includes one switch $q_1$, one coupled inductor consisting of one primary winding $N_1$ and one secondary winding $N_2$, one energy transferring capacitor $C_b$, two output diodes $D_1$ and $D_2$, one snubber diode $D_{sn}$, one snubber capacitor $C_{sn}$, two output capacitors $C_{o1}$ and $C_{o2}$, and two LED strings $LS_1$ and $LS_2$.

**Advantages:**
- The voltage spike across the switch can be suppressed.
- High voltage gain can be improved.
- The coupled inductor core size can be smaller.

**Applications:**
- LED applications.
Block Diagram:

Dc input → Coupled Inductor based two channel LED Driver → Load

12VDC → Gate driver circuit

5VDC → Buffer circuit → Microcontroller circuit