Single-Stage Single-Switch Four-Output Resonant LED Driver with High Power Factor and Passive Current Balancing

Introduction:

The development of high-brightness light-emitting diode (HB-LED) technology, HB-LED has become more and more competitive compared with conventional lighting in lifetime, size, and overall efficiency. HB-LED can be used in street lighting, panel lighting, and backlighting with the replacement of incandescent lamp or gas discharge lamps. Hence, its corresponding driver technology has drawn much attention in recent years.

It is well known that the brightness of LED is directly depended on its forward current. For a single HB-LED, the forward current and forward voltage is limited due to thermal consideration. In order to achieve the required brightness and luminance uniformity, it is necessary to connect multiple LED strings in series or in parallel. However, for high power rating and high-luminance applications, such as street lighting, hundreds of LEDs connected in series lead to very high-output voltage, which is not cost efficient for the design of LED driver. Due to the utilization of high-voltage rating semiconductor devices and passive components.

Existing system:

Power factor correction (PFC) should be used in LED driver to provide sinusoidal input current in high-power
application. Therefore, the solution can only be used as a second power stage in LED driver. Prestage with PFC must be used. Moreover, the two-stage power conversion with PFC pre regulator and dc-to-dc converters suffers from lower efficiency and higher volume and cost.

Single-stage LED driver has been studied in recently years. In, a single-stage multi output asymmetrical half-bridge PFC converter is proposed, but it needs more inductors and switches. In a single-stage dual-output buck-boost PFC converter is proposed. Although the efficiency is improved due to single-stage power conversion and use only one inductor.

Dis-advantages:
- It needs more active switches.
- The control is complex.

Proposed system:
A resonant single-stage single-switch four output LED driver with PFC and passive current balancing is proposed and analyzed. It combines with a single-switch secondary-side resonant PFC converter and passive current balancing circuit composed of resonant capacitors. When magnetizing inductor current operates in critical conduction mode (CRM), unity power factor can be achieved and not affected by the resonant current.
By control output current of one output, the other output currents of the proposed LED driver can be controlled via passive current balancing, which makes the control simple. Furthermore, the proposed LED driver is a single stage single-switch converter. It uses only one active switch and one magnetic component.

**Advantages:**
- It uses only one active switch and one magnetic component.
- Cost saving,
- small size, and light weight of device.

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

AC input → Rectifier → Resonant Single stage LED driver → Load

12VDC → Gate driver circuit

5VDC → Buffer circuit

Buffer circuit → Microcontroller circuit