

Summary of the Idea

LED driver with a controlled active filter which is activated by a secondary-side phase detection circuit to enable the controlled active filter during low conduction angles of a dimmer circuit, such as a TRIAC dimmer.

The controlled active filter can reduce shimmer and flicker of an LED load due to the asymmetry of TRIAC dimmers. The controlled active filter can be used with single-staged LED drivers with power factor correction (PFC).

Description

Dimmable LED drivers can use a TRIAC dimmer to phase-cut the ac input voltage V_{AC} to dim the output provided to an LED load. However, the phase-cutting of the TRIAC dimmer is usually asymmetric. Power transferred by the LED driver is proportional to the input voltage V_{IN} . Any asymmetry in the input voltage as a result of the TRIAC dimmer can result in unbalanced output current to the LED load and

unwanted shimmering and flicker, especially at low conduction angles. In addition, LED drivers with PFC are especially susceptible to the asymmetric qualities of a TRIAC dimmer due to the smaller input capacitor.

The proposed LED driver includes a controlled active filter which is activated below a conduction angle threshold. The conduction angle threshold can be detected by a phase detection circuit coupled to the secondary winding of a transformer.

Figure 1 illustrates a functional block diagram of a dimmer circuit, LED driver, and LED load. The LED driver is shown as a flyback power converter. The controlled active filter is coupled between the output diode D1 and the LED load. The phase detection circuit is coupled to the secondary winding of transformer T1 to determine if the dimmer circuit is operating below the conduction angle threshold.

Figure 2 illustrates an example circuit implementation of the controlled active filter and the phase detection circuit with example component values shown in Table 1.

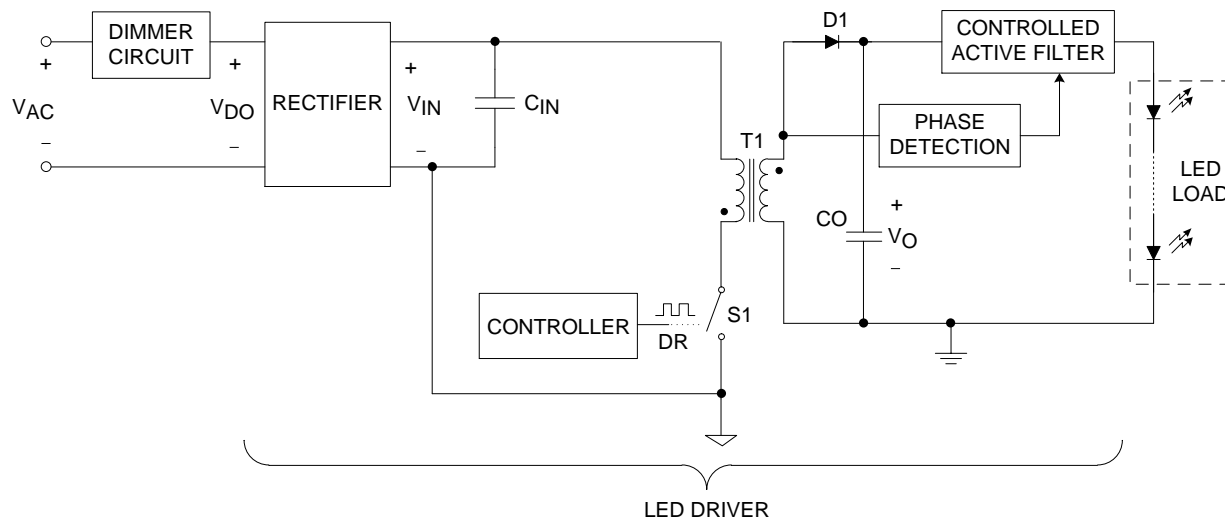


Figure 1. Example dimmer circuit, LED driver, and LED load. The LED driver includes a phase detection circuit and controlled active filter

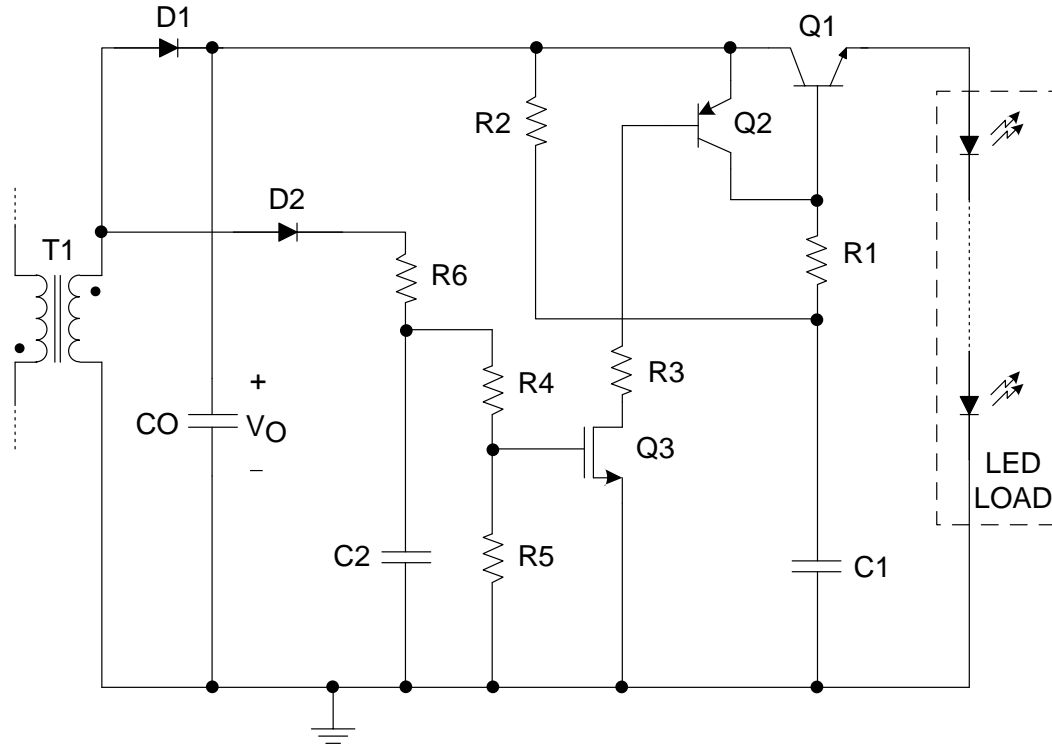


Figure 2. Example circuitry for the phase detection circuit and controlled active filter. Components Q1, Q2, R1, R2, and C1 form the controlled active filter while D2, R3, R4, R5, R6, C2 and Q3 form the phase detection circuit

Proposed Component Values for Controlled Active Filter and Phase Detection Circuit

R1	100 Ω
R2	10 k Ω
R3	1 k Ω
R4	1 k Ω
R5	10 k Ω
R6	10 k Ω
C1	100 μ F
C2	1 μ F

Table 1. Proposed component values for the controlled active filter and phase detection circuit of Figure 2