Master Thesis

Highly Efficient Electrolytic Capacitor free SEPIC based LED Driver with Automatic Power Factor Correction and Low Output Flicker

Highly efficient, low-cost, off-line AC/DC LED drivers are important components for the steadily growing market of LED illumination. However, they have to meet many criteria with regard to power factor correction (PFC), emitted interference (EMI), flicker, cost, size, complexity, durability, and efficiency.

Singe stage approaches provide good efficiency at low complexity while showing a large current ripple at the output, since they only regulate the input current. As a result, flicker can be observed that may causes headache and other complaints. Reducing the current ripple, in particular in applications that require a high output power, can only be performed by bulky electrolytic capacitors. These capacitors, however, limit the lifetime of an LED lamp. Thus, two-stage approaches are used in applications that necessitate high power and low flicker. The first stage equals a PFC boost stage which regulates the input current and stores the transferred energy on an intermediate storage capacitor. Subsequently, the energy is used to power the second stage which generates a constant output current. The approach shows good PFC, low flicker, and acceptable efficiency. Moreover, an electrolytic capacitor is not needed for the implementation. Size and cost, however, are increased due to the advanced regulation approach.

At the Fritz Huettinger Chair of Microelectronics, a single-ended primary inductance converter (SEPIC) based LED driver was developed and evaluated on a printed circuit board (PCB). The regulation is similar to the two-stage approach while fewer components are needed for the implementation. Moreover, due to the inherent PFC, the complexity of the regulation is significantly reduced.

The goal of this thesis is to bring the developed SEPIC based LED driver to the next level by implementing it as an integrated circuit (IC) as illustrated in Fig. 1. Compared with the PCB implementation, the IC provides the opportunity to increase the performance of the regulation and thus the efficiency of the conversion while consuming less power.

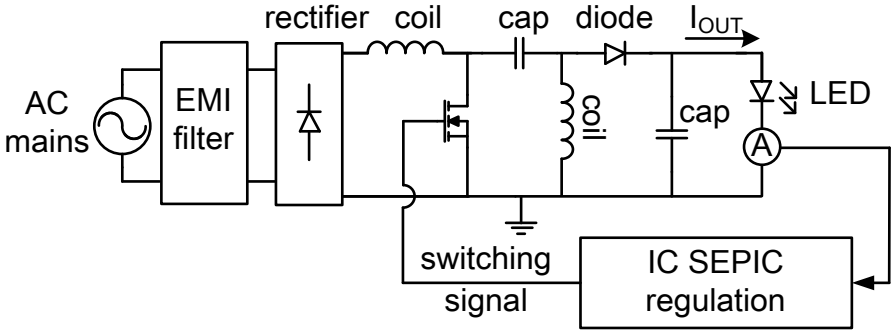

Figure 1: SEPIC converter with integrated circuit based regulation

What we expect
Good understanding and interests in system theory, mathematics, mixed-signal circuit design, autonomous working style, and well documented work.

What we offer
Intensive supervision of the thesis, nice work environment, latest CAD and EDA tools for the design of integrated circuits, well equipped laboratory, and free space for own ideas.

Starting Date: July-August

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