A Family of Single-Phase Hybrid Step-Down PFC Converters

Introduction:

Ever-present trend of size reduction of power supplies requires even higher efficiency and power density. For power supplies above certain power rating, a front-end power factor correction (pfc) converter is necessary to meet the harmonic current and power factor (pf) requirements and energy star specifications. At present, the boost (step-up) converter is the most popular pfc topology due to its simplicity and good performance. However, the output voltage of boost pfc converter should be higher than the maximum input peak voltage.

Existing system:

Using a Buck (step-down) converter as a front-end PFC converter has been introduced. The Buck PFC Converter has higher low-line efficiency and lower electromagnetic interference (EMI) noise compared to the Boost PFC converter.

The traditional Buck PFC converter and its steady-state operation involves that due to the inherent dead time in the input current when the input voltage is lower than the output voltage, the Buck PFC usually has limited PF and high current distortion, which is hard to meet the current harmonic requirements, especially for lighting applications.
Dis-advantages:
- Limited PF
- High current distortion

Proposed system:
A family of hybrid step-down PFC converters based on Buck converter and Buck–Boost (or Flyback) converter is proposed. Two novel hybrid topologies with simple structure and good performance are proposed. Both of the switches in the converters are easy to drive and the EMI filters can be placed in the dc side to improve the power density and conversion efficiency. The main idea is integrating a step-up converter with the Buck converter to compensate the input current during the dead time, which is referred as the hybrid method.

Since the proposed hybrid converter is mainly operated in Buck mode, the switching frequency of Buck mode is much more important for the converter performance. The switching frequency is proportional to the input voltage and inversely proportional to the inductance.

Advantages:
- Output voltage ripples are reduced in the proposed converters.
- The elimination of the input current dead time.

Applications:
- High Power Factor correction applications.
Block Diagram:

Ac input → Hybrid step-down PFC converters → Load

12VDC

Gate driver circuit

5VDC

Buffer circuit

Microcontroller circuit