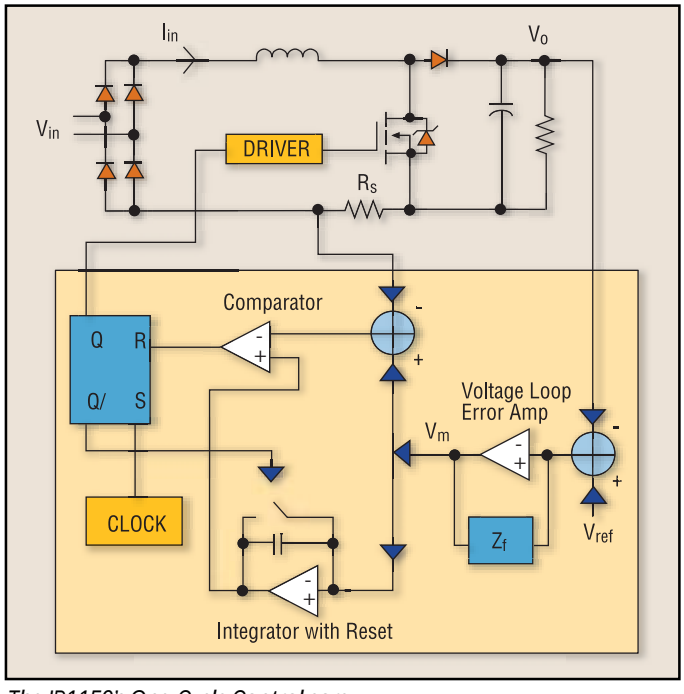
Controllers Build Compact PFC Circuits

By David Morrison, Editor, *Power Electronics Technology*

By applying a novel control technique, a family of power factor correction (PFC) control ICs from International Rectifier simplifies the design of continuous conduction mode (CCM) PFC boost converters. The IR1150 µPFC controllers reduce the number of components required for PFC, shrinking the PFC control board in ac-dc power supplies ranging from 75 W to 4 kW. Designs based on one of these 8-pin SOIC-packaged controllers can achieve a power factor of 0.999 with only 4% total harmonic distortion.



The IR1150's One-Cycle Control core.

The One-Cycle Control (OCC) technique used in the IR1150 is a form of CCM PFC that delivers the performance of CCM PFC operation, but with the simplicity, reliability and low component count of a discontinuous current mode (DCM) circuit. The OCC method eliminates the analog multiplier, input voltage sensing and fixed oscillator ramp found in conventional CCM PFC circuits. So, no ac line sense resistors are required.

With the OCC technique, also known as the integration reset technique, the chip senses the output voltage of the PFC circuit. This voltage is fed to a voltage error amplifier, where it is subtracted from the reference voltage. The output of the error amplifier is then integrated over the PWM switching cycle to produce a variable-slope ramp voltage. That variable-slope ramp voltage is then compared against the output of the error amplifier—minus the current sense signal—to generate the PWM gate drive (see the figure)[REF]. When the two comparator inputs match, the FET gate drive is terminated.

The ramp created by the integrator circuit is reset at the end of each switching cycle, so that it starts from zero in the following switching cycle. This technique provides instantaneous control of the average value of the switched voltage or current. So, unlike in the multiplier method, the duty cycle of the boost converter is controlled in real time so that the average of each cycle in the boost converter's chopped waveform is equal to the control reference.

In a typical high-power system, such as a 1-kW server switched-mode power supply, a µPFC-based design uses 40% fewer resistors and capacitors than a multiplier-based CCM design, and half the usual number of current transformers. This parts reduction cuts the PFC control board's area by 50% versus the multiplier approach. In lower-power applications where power density is critical, an IR1150 controller in CCM mode lowers peak currents and reduces requirements for EMI filtering.

Other controller features include a programmable switching frequency of 50 kHz to 200 kHz, operation from a supply voltage of 13 V to 22 V, a peak gate drive capability of ±1.5 A and a dedicated overvoltage protection pin. The controller also offers enable, micropower start-up and sleep-mode functions to help achieve compliance with energy-efficiency standards, such as 1-W standby, Blue Angel and Energy Star. Options include consumer or industrial operating temperature ranges and RoHS-compliant lead-free packaging.

Available immediately, IR1150 controllers are priced starting at $1.05 each in quantities of 10,000. For additional information, see www.irf.com. **PETech**

Reference

1. *Brown, Ron and Soldano, Marco. "One Cycle Control IC Simplifies PFC Designs." International Rectifier. APEC 2005 Proceedings, paper 21.4.*