Exceeding Modern Energy Standards with "Always On" PFC and LLC Controllers

Efficiency and standby power have become greater points of emphasis in grid-connected applications as product regulations continue to demand enhanced performance in these key areas. This is especially true in the personal electronics space for applications such as digital TV, desktop computing, AC adapters, and gaming consoles. The following a summary of a few energy standards in use today.

DOE Level VI (50 W to 249 W)	
Standby Power Requirement	<210 mW
Regulates Efficiency Performance at:	25%, 50%, 75%, 100% of Full Load
Minimum 4 Point Efficiency Average	88%

CoC Tier II (50 W to 249 W)	
Standby Power Requirement	<150 mW
Regulates Efficiency Performance at:	10%, 25%, 50%, 100% of Full Load
Minimum 5 Point Efficiency Average	88%

80 Plus Gold (115V Non-Redundant)	
Power Factor Requirement	0.9 at 50% of Full Load
Regulates Efficiency Performance at:	20%, 50%, 100% of Full Load
Efficiency Requirement	87% at 20% Load, 90% at 50% Load, 87% at 100% Load

80 Plus Gold (230V Redundant)	
Power Factor Requirement	0.9 at 50% of Full Load
Regulates Efficiency Performance at:	20%, 50%, 100% of Full Load
Efficiency Requirement	87% at 20% Load, 90% at 50% Load, 87% at 100% Load

These regulations have led to a surge in complex power sequencing strategies to shut down portions of the power system to elevate light load efficiency. While effective, shutting down sections of the power system such as the PFC stage requires the downstream isolated DC/DC converter to be designed to operate over a wide input voltage range. In addition, circuitry to enable the PFC stage must cross over the isolation boundary, adding significant cost to AC-DC systems.

Efficiency

The UCC28056X, a 6-pin transition mode PFC controller, features a highly advanced burst mode feature that significantly improves light load efficiency and reduces no load standby power to a minimum. When paired with a UCC25630x LLC controller, an AC-DC design can achieve less than 60 mW of no load standby power at 115 V ac and less than 80 mW of no load standby power at 230 VAC while both the PFC and LLC converters are enabled. The advanced features of both the UCC28056X and UCC25630x enable AC-DC designs to satisfy modern energy standards with ease.

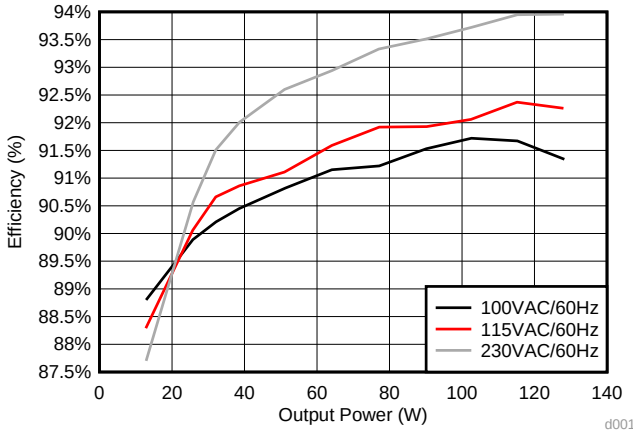

Figure 1. UCC28056 and UCC25630x Efficiency

An AC-DC system using the UCC28056X and UCC25630x chipset has many advantages. The light load and standby power performance of the UCC28056X enables applications to keep the PFC always on while still meeting the efficiency and standby targets of DOE Level VI and CoC Tier II. Keeping the PFC on eliminates the need for an auxiliary flyback converter as well as small signal and isolation circuitry to enable and disable the PFC, saving size, cost, and complexity. In addition, keeping the PFC on allows the system to instantaneously deliver full load power as the LLC converter no longer needs to wait for the PFC bulk capacitance to charge.

Simplified System Solution

Figure 2 illustrates how the UCC28056 and UCC25630x chipset simplifies AC-DC power supply design without compromising functionality or performance. The superior light load performance of the UCC28056X and UCC25630x eliminates the need

for an auxiliary flyback to meet light-load power targets. In addition, the rich feature set of the UCC28056X and UCC25630x greatly reduces the amount of external circuitry needed to realize a complete AC-DC power supply as shown in Figure 2.

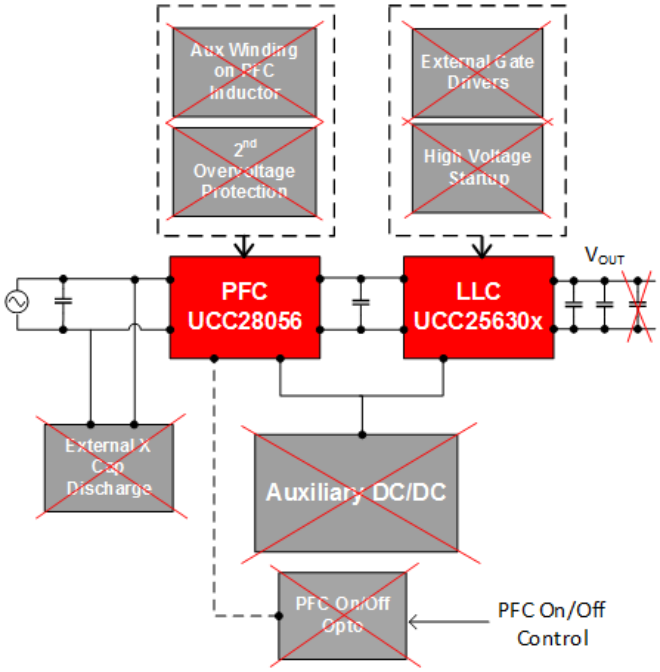

Figure 2. Complete AC-DC Power Supply

Elimination of the auxiliary DC/DC supply not only yields great cost savings, but also reduces solution size and BOM count, which items of great importance for high power density applications. The elimination of the aux winding allows for cheaper magnetics as well as greater freedom in layout. The unique hybrid hysteretic control method of the UCC25630x offers superior load transient response, requiring less output capacitance to meet a desired output regulation requirement.

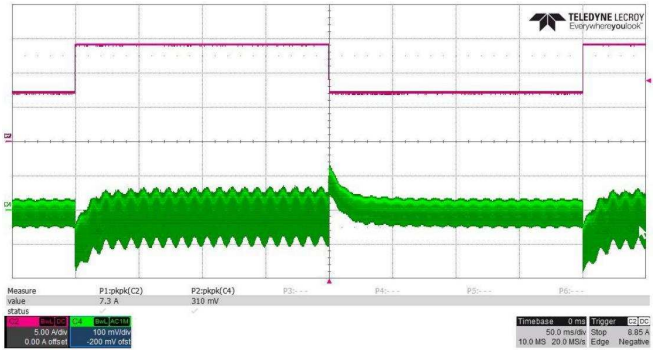

Figure 3. PMP21098 7 A to 14.2 A Transient Response

The UCC28056X and UCC25630x chipset enable robust AC-DC designs that not only meet modern energy standards, but also reduce complexity and component count, as well as enable greater power density.

Related Documentation

- TIDA-01557, >92% Efficiency, 200 W, <125 mW Standby, Fast Transient, Desktop PC PSU Reference Design
- PMP21098, 170 W Auxless AC/DC Power Supply Reference Design with 80 PLUS Gold Compatible Performance
- PMP21251, Less than 90 mW Ultra-low Standby Power Auxless AC-DC Power Supply Reference Design
- SLUA865, Optimizing Efficiency and Standby Power With the UCC28056X in Offline Applications
- SLUA834, Improving Transient Response in LLC Converters Using Hybrid Hysteretic Control

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