



Introduction

To meet the increasingly stringent requirements for environmentally friendly solutions, MPS's AC/DC power supply products utilize advanced technologies to enhance performance and achieve energy conservation.

This article is the second in a two-part series to discuss trend-setting AC/DC solutions. [Part I](#) served as an introduction for the carbon-free era and the problems that designers face with traditional power supply solutions. Part II will discuss the ways that highly efficient AC/DC solutions can improve efficiency for space-constrained applications.

MPS offers a comprehensive range of integrated power solutions, such as low-dropout (LDO), non-isolated buck solutions with a 1W output, as well as non-isolated buck solutions with a 10W output. For low-power, isolated flyback solutions, MPS provides integrated power transistors and controllers. For high-power LLC solutions above a 75W output, MPS offers independent PFC controllers and LLC controllers for PFC + LLC architectures. A few methods utilized by MPS are described below.

Introducing New Topologies

To improve efficiency, consider a hybrid topology of PFC + LLC with active-clamp flyback and zero-voltage switching (ZVS). This topology helps reduce start-up loss and recycle leakage inductance, enabling efficiency up to 93%.

Fully Integrated Design

Traditional, non-isolated AC/DC solutions typically require multiple chips and a number of external parts (e.g. primary-side controllers, secondary-side controllers, optical isolators), which results in a large board area and high BOM cost. MPS's compact solutions are highly integrated. A single chip can include the primary side and a synchronous controller. An integrated scheme simplifies design, reduces PCB, and is more cost-effective than traditional solutions.

Adapting High-Frequency Chips

Due to their low switching frequency and efficiency, silicon devices are inadequate for the new generation of power devices. The emergence of semiconductor materials such as GaN has effectively improved switching frequency and efficiency such that high-frequency designs can meet power device requirements.

Digital Products

Digital power chips provide strategic advantages, while traditional analog controllers struggle to keep up with constantly evolving demands. Digital products offer more flexibility compared to traditional controllers. MPS products use digital cores and have very rich, configurable features.

Integrated Solution with the MPX2002

The [MPX2002](#) is a fully integrated flyback controller that combines the primary and secondary controllers into one chip. This innovative design significantly simplifies the peripheral circuit design to achieve a small solution size for the fast-charging source.

Figure 1 shows the typical application circuit of the [MPX2002](#), which integrates the primary driving circuit, secondary controller, synchronous rectification (SR) driver, and safety compliance feedback.

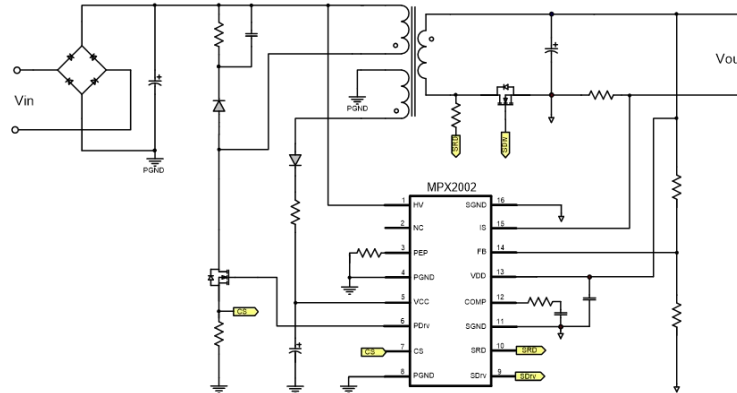


Figure 1: MPX2002 Typical Application Circuit

The [MPX2002](#) can operate in continuous conduction mode (CCM) under heavy loads, then switches to quasi-resonant (QR) operation when the load decreases. If the load is further reduced, the [MPX2002](#) operates in pulse-frequency modulation (PFM) mode. When the device enters burst mode, the switching frequency is fixed at 20kHz to reduce audible noise. With this feature, the [MPX2002](#) can achieve high efficiency under all load conditions, as well as excellent electromagnetic interference (EMI) performance.

Whereas the traditional solution requires four chips (flyback controller, optocoupler, voltage reference, and synchronous rectification controller), the [MPX2002](#) is a single-chip solution that integrates the primary and SR controllers. The simplified design improves efficiency, reduces board area and standby power consumption, and enhances reliability. Furthermore, the [MPX2002](#) does not require optocoupler feedback to prevent optocoupler aging in a high-reliability environment. Highly precise SR control can be easily achieved in CCM.

Figure 2 shows a comparison between the [MPX2002](#) and a traditional solution.

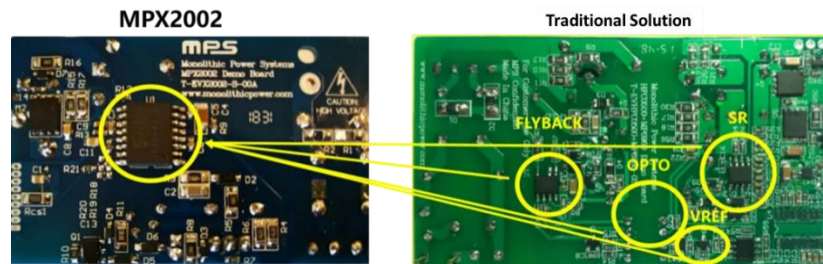


Figure 2: MPX2002 vs. Traditional Solution

Integrated Solution with the HR1211

The [HR1211](#) is a two-in-one controller that integrates multi-mode PFC and current mode LLC. It offers a high-voltage (HV) current source, which can be implemented as a safety-certified, X-capacitor discharger, and a HV drive circuit combining PFC and LLC. As a result, the [HR1211](#) realizes a short peripheral circuit. Figure 3 shows the typical application circuit of the [HR1211](#).

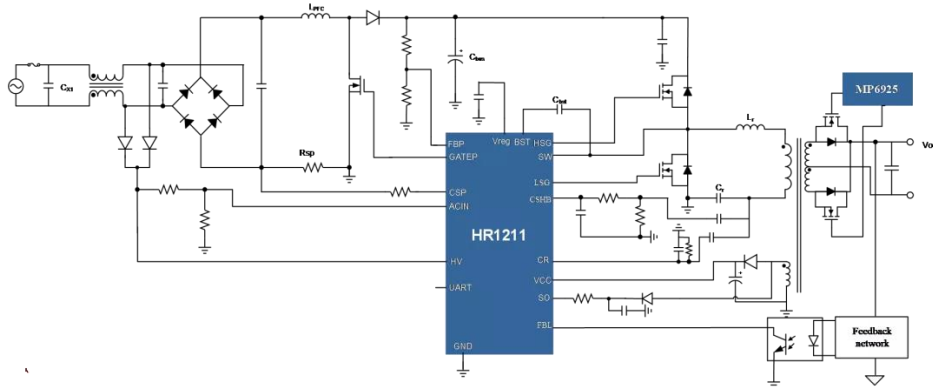


Figure 3: HR1211 Typical Application Circuit

The [HR1211](#)'s digital control core, combined with its multiple-time programmable (MTP) memory, gives the entire solution excellent flexibility. Its UART interface can accomplish the following:

- Enable cooperation between the PFC and LLC two-stage circuits
- Enable switching between different control modes
- Set the switching frequency at key operating points
- Set the thresholds values, times, and recovery methods for the protection functions

Communication using the UART interface is accomplished with a dedicated graphic user interface (GUI).

Figure 4 shows how the [HR1211](#)-based power supply design flexibly adapts to the performance requirements of different applications and designs, such as an [offline 600W battery charger](#) for e-bikes.



Figure 4: HR1211 Application Scenario Examples

Conclusion

MPS has accumulated a comprehensive portfolio of products in the AC/DC field, with popular power solutions such as the [MPX2002](#) and the [HR1211](#). As the requirements of switching power supplies become more complex, MPS will meet consumer demands with increasingly efficient and advanced products. To read about the carbon-free era and the issues designers face in this era, see [Part I](#) of this series.