



## Introduction

The low-carbon era is leading the development trend for smaller and highly efficient chips. First, switching power supplies replaced linear power supplies in the 1980s; now, the efficiency of power supplies has significantly improved while the overall solution size has been reduced. When considering consumer requirements for portability, switching power supplies continue to become more and more advanced and lightweight for various applications.

This article is the first part in a two-part series to discuss trend-setting AC/DC solutions. Part I will serve 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 their efficiency for space-constrained applications.

In recent years, governments across the world have announced their commitment to reducing their carbon footprint. By 2030, the Biden administration hopes to lower net greenhouse gas pollution between 50% to 52%, when compared to America's 2005 levels. Meanwhile, China has established a comprehensive plan called the 30-60 goal. China is expected to reach peak emissions by 2030 and achieve carbon neutrality by 2060.

To meet the demands of a greener future, energy efficiency standards are becoming more stringent. For example, the six-level energy efficiency standard for the EU's Code of Conduct (CoC) and the U.S. Department of Energy (DoE) have announced requirements for no-load power consumption and improved efficiency to achieve energy conservation and reduce carbon emissions.

## The Escalating Challenges of Switching Power Supplies

For switching power supplies, increasing the switching frequency ( $f_{sw}$ ) can substantially reduce the size of passive components such as inductors, capacitors, and transformers. For offline AC/DC switching power supplies, the input terminal can be 50Hz/60Hz with a 230V<sub>AC</sub> input. The switching speed is limited by the high-voltage, high-frequency switching losses. Traditional 700V silicon power devices have increased from 30kHz to 200kHz, but the silicon bottleneck has imposed restrictions on further improvements.

For AC/DC power supplies, there are switching frequency limitations for high-voltage power devices. The design of high-frequency isolation transformers must also consider safety and efficiency, which might result in a tradeoff between safety and frequency. The increase of heat dissipation per unit volume also drastically restricts high-frequency power supplies.

## Improving the Efficiency of Switching Power Supplies

To improve efficiency, it is necessary to create smaller solutions, since smaller parts reduce loss and heat dissipation. This leads to a demand for high-frequency miniaturization. The heat dissipation per unit volume is only reduced when the efficiency is improved, which means that high-frequency designs with higher power densities are vital to mitigating these issues.

In addition, new switching topologies such as an active-clamp flyback can improve efficiency. These topologies eliminate the start-up loss and achieve leakage inductance recovery for isolation transformers as well as third-generation semiconductor power devices. Fast shutdown switching losses can be reduced to negligible levels. Smaller packages are made possible by improving efficiency and increasing the power supply's frequency.

The [MPX2001](#) is an all-in-one flyback controller that provides the benefits of both primary-side regulation (PSR) and secondary-side regulation (SSR). Without the need for a feedback circuit, the [MPX2001](#) provides a comprehensive solution with reduced BOM and size due to the integrated primary driving circuit, secondary controller, and synchronous rectification (SR) driver. The [MPX2001](#) is available in a SOICW20-19 package and a SOICW20 package for design flexibility. Advanced protections include primary over-current protection (POCP), under-voltage lockout (UVLO), secondary-side output overload



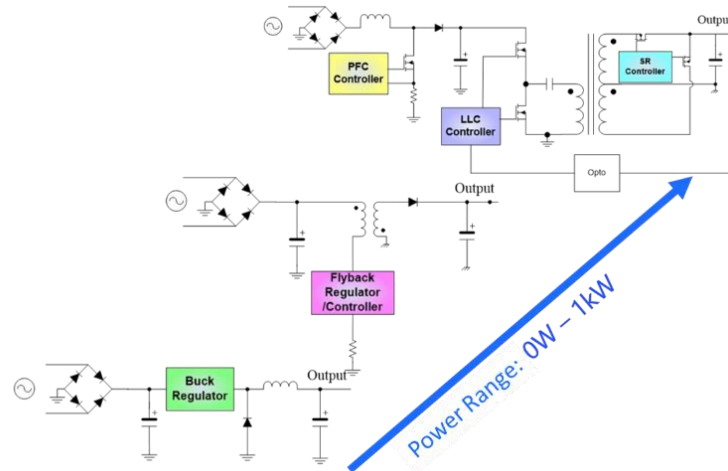


Figure 3: MPS AC/DC Power Solutions

### Conclusion

As the world trends toward carbon neutrality, designers will have to meet increasing demands for highly efficient power supplies that are smaller and more effective. MPS is making it simple to meet these increasingly stringent requirements with our small and efficient AC/DC power supplies, such as the [MPX2001](#). This article introduced the issues faced by power supply designers and a few high-level ways to mitigate these problems. [Part II](#) will discuss how MPS is directly facing these problems with an in-depth look at our latest products.