Advancing Optical Modules for Data Traffic with MPS Modules

Introduction

Data traffic is the center of modern life, with any mobile phone app nowadays requiring tens of hundreds of megabytes for installation packages. When several software updates are made, it is necessary to be connected to Wi-Fi. Loading a page while online shopping consumes several megabytes of traffic to load a single page, and video calls are prone to freeze if the Internet speed is not fast enough.

Optical Modules Drive Data Traffic

The increasing rate and real-time requirements of data circulation are a test of both carrier networks as well as the data centers of Internet enterprises. From the access network to the intercity network, and from the intercity network to the backbone network, data is transmitted back and forth between routers, switches, and servers. The optical module is the key device in all the links of this circulation process (see Figure 1).

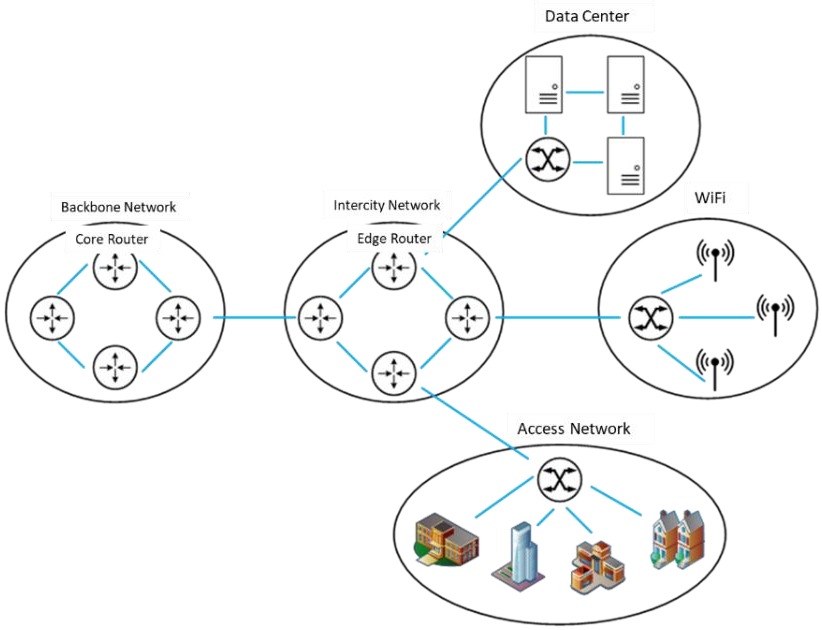

Figure 1: Data Exchange

The optical module is the foundation of optical communication that provides photoelectric conversion (see Figure 2). It receives the optical signal transmitted in the optical fiber and converts it into an electrical signal, then sends this signal to the post-processing chip. Alternatively, the optical module can receive the post-processing chip's electrical signal and convert it into an optical signal that becomes transmitted through the optical fiber. The photoelectric conversion transmission room carries crucial data.

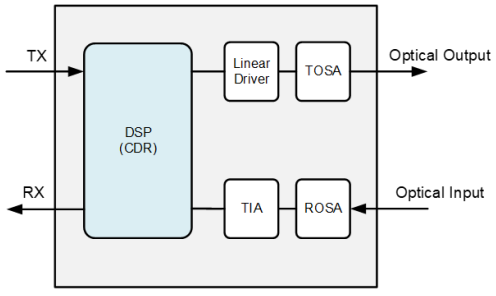

Figure 2: Optical Module Structure

The explosive growth in data traffic demand in recent years has led to rapid iterative upgrades of optical modules with increasing transmission rates. Using more powerful processing chips means greater power consumption and more stringent power requirements, which makes the already compact optical module even more difficult to design. MPS's power module products offer a wide variety of module products with integrated inductors and key components. Advantages include high integration, small size, and high power density that can significantly alleviate challenges with power supply design and enable rapid product development (see Figure 3).

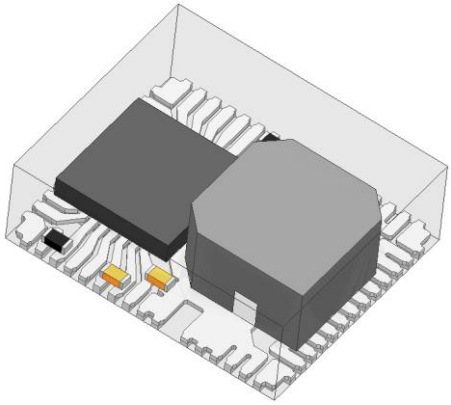

Figure 3: MPS Power Module

Figure 4 shows a typical power supply structure of a 400G optical module. MPS offers a wide range of power products that can provide a complete power supply solution for optical modules with excellent performance.

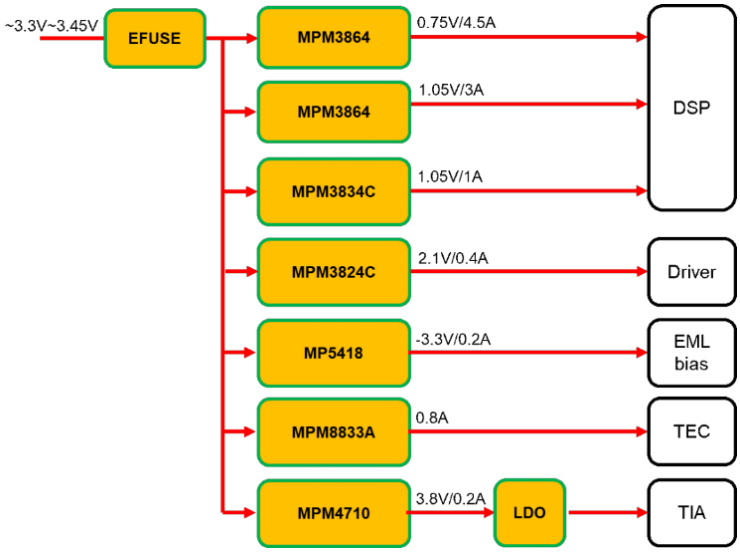

Figure 4: MPS 400G Optical Module Solution

Introducing the MPM38x4C Series

The MPM38x4C series includes three power modules (MPM3814C, MPM3824C, and MPM3834C) that are currently the smallest low-current module products in the industry. The MPM3814C provides up to 1A of continuous output current (I_{OUT}), the MPM3824C provides 2A of continuous I_{OUT}, and the MPM3834C provides 3A of I_{OUT}. The pin distribution, three-dimensional size, and peripheral circuits of these three parts are the same and can be easily replaced with each other. The carefully optimized internal structure also achieves excellent EMC performance (see Figure 5).

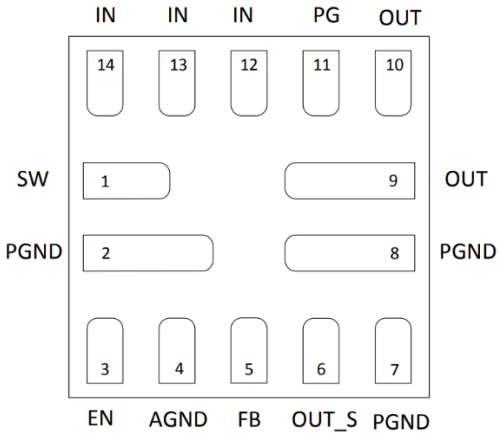

Figure 5: MPM38x4C Series Module Pin Diagram

The MPM38x4C series requires a minimum of four external components, including an input capacitor, an output capacitor, and two voltage divider resistors. When the EN pin receives the enable signal from the previous stage, the module immediately outputs power. A designer can design the power supply by calculating the voltage divider resistance based on the voltage requirements of the power rails provided in the datasheet. This significantly simplifies the overall design process and power supply design. MPS has also optimized the pin layout of the MPM38x4C series, allowing designers to lay out the board according to the layout samples in the manual and greatly reduce their workload (see Figure 6).

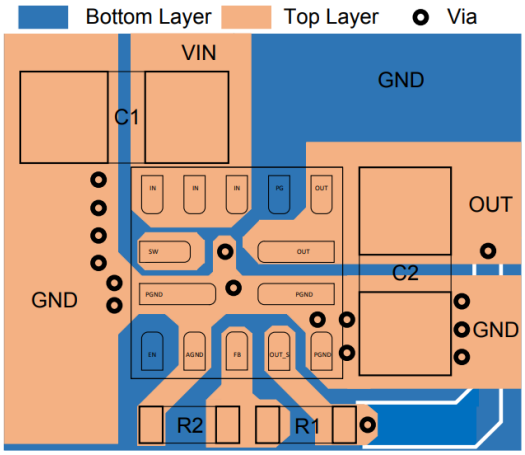

Figure 6: MPM38x4C Series Recommended Layout Example

The key parameters of the MPM38x4C series are described below:

- Compact structure as thin as 1.2mm and three-dimensional size (2.5mmx2.5mmx1.2mm)
- Wide 2.75V to 6V input voltage (V_{IN}) range
- Output voltage (V_{OUT}) as low as 0.6V
- 1.25MHz switching frequency (f_{SW})
- Maximum 1A/2A/3A continuous I_{OUT}
- Complete protection functions, including short-circuit protection (SCP), over-current protection (OCP), and over-temperature protection (OTP)
- Forced continuous conduction mode (FCCM) with minimal output ripple even at light loads
- PG and EN pins for easy sequencing control

Figure 7 shows the typical application circuit of the MPM3814C.

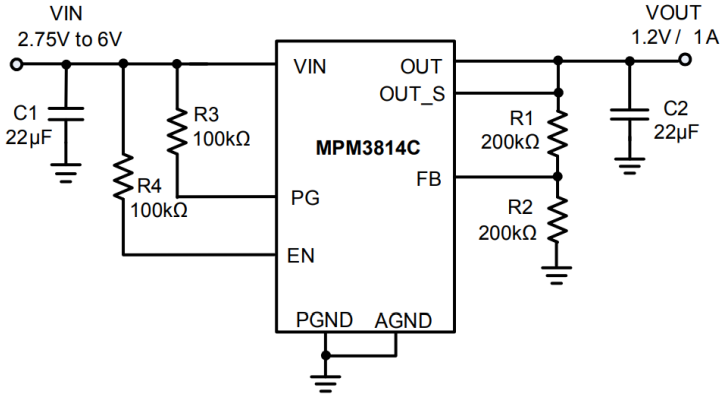

Figure 7: MPM3814C Typical Application Circuit

The MPM38x4C series achieves excellent voltage conversion efficiency in a very small size. Figure 8 shows the efficiency curve of the MPM3814C.

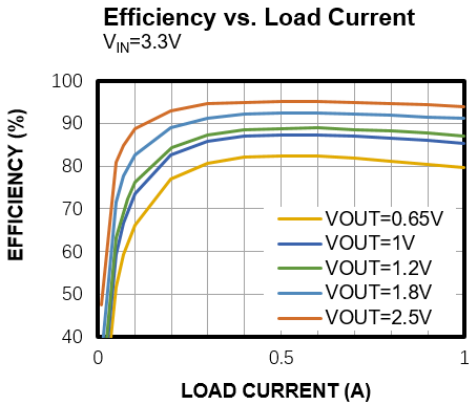

Figure 8: MPM3814C Efficiency Curve

Figure 9 shows the efficiency curve of the MPM3824C.

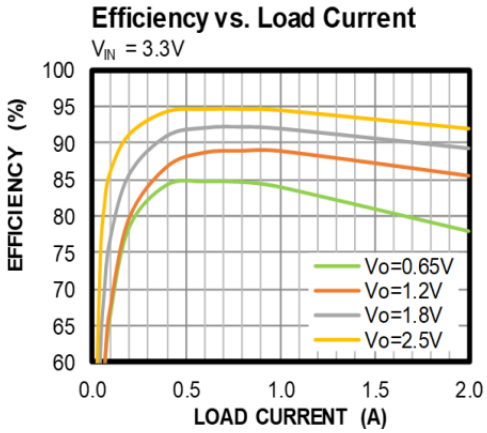

Figure 9: MPM3824C Efficiency Curve

Figure 10 shows the efficiency curve of the MPM3834C.

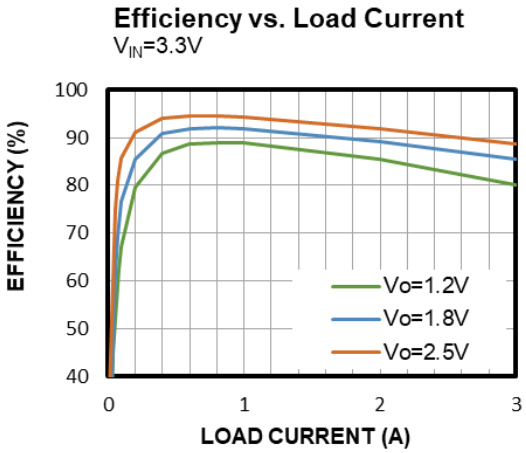

Figure 10: MPM3834C Efficiency Curve

The MPM38x4C series provides ultra-high f_{SW}, with the MPM3814C operating at 2.2MHz, and the MPM3824C and MPM3834C operating at 1.25MHz. Even with a single 22µF output capacitor, the MPM38x4C series still maintains minimal output voltage ripple. Figure 11 shows the output ripple waveforms of the MPM3814C at 5V input and 1.2V output.

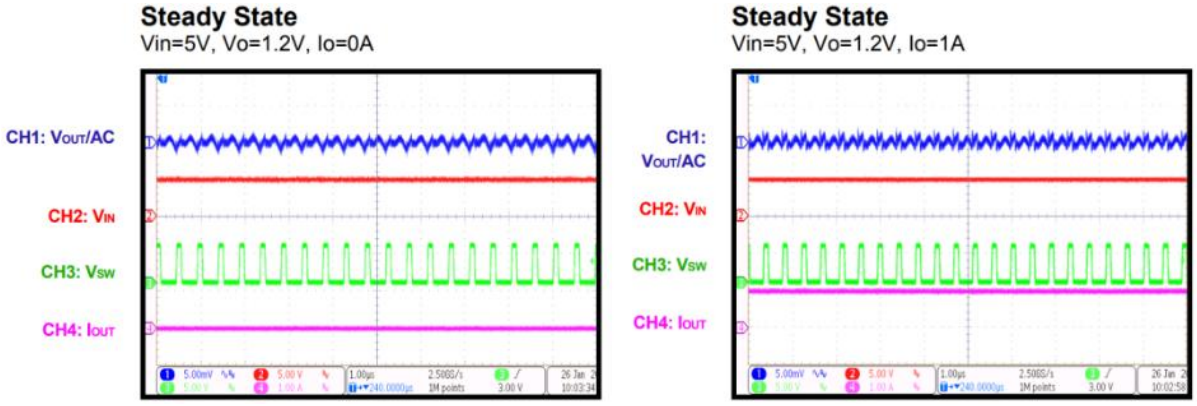

Figure 11: MPM3814C Output Ripple Waveforms

Figure 12 shows the output ripple waveforms of the MPM3824C.

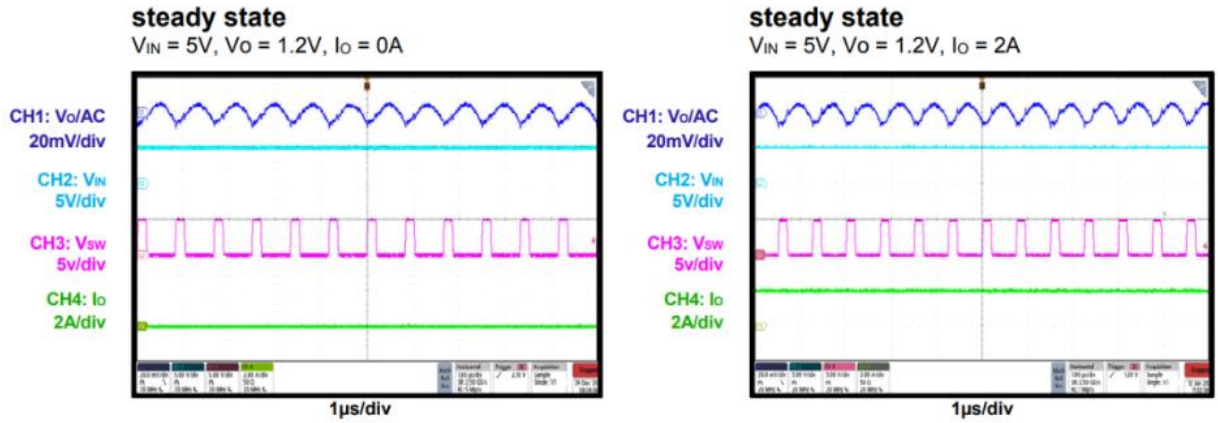

Figure 12: MPM3824C Output Ripple Waveforms

Figure 13 shows the output ripple waveforms of the MPM3834C.

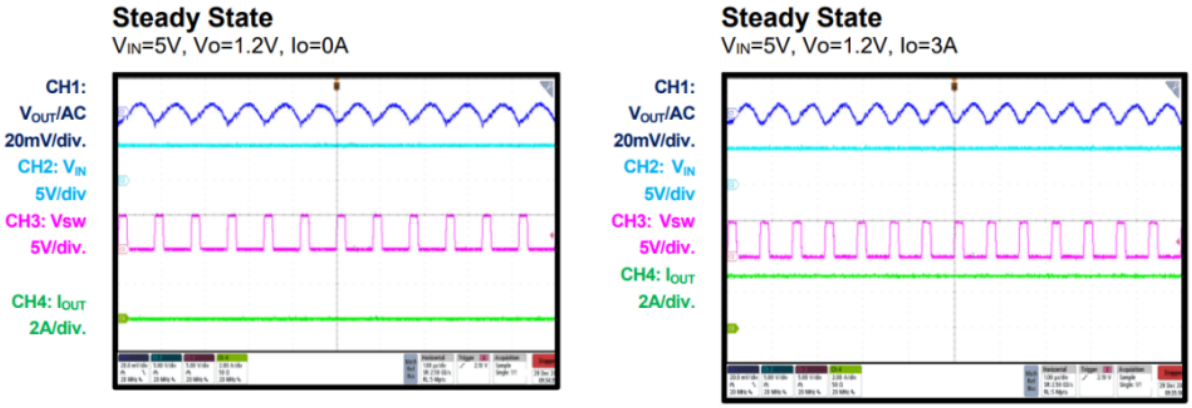

Figure 13: MPM3834C Output Ripple Waveforms

Introducing the MPM3864

The MPM3864 is another power module offered by MPS that delivers impressive performance. The module can achieve a continuous I_{OUT} capability of up to 6A with a compact board area (3mmx3mm), making it the smallest product in its class in the industry. The board layout is extremely simple and requires only a few peripheral components to complete the design.

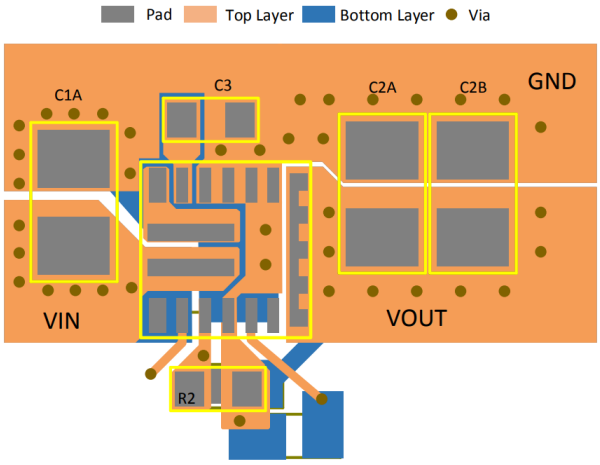

Figure 14: MPM3864 Recommended Layout Example

The MPM3864 provides a built-in inductor and several key components, adopts constant-on-time (COT) control, and operates at a 1.2MHz frequency with excellent dynamic adjustment capabilities. The key parameters are described below:

- Compact structure, with a board area of only 3mmx3mm
- V_{OUT} as low as 0.6V
- Maximum 6A continuous I_{OUT}
- Wide 2.75V to 7V V_{IN} range
- Complete protection functions, including SCP, OCP, output under-voltage protection (UVP), and OTP
- Externally configurable soft-start pin enables the user to set the desired start-up speed
- FCCM with minimal output ripple even at light loads
- PG and EN pins for easy sequencing control

Figure 15 shows the typical application circuit of the MPM3864.

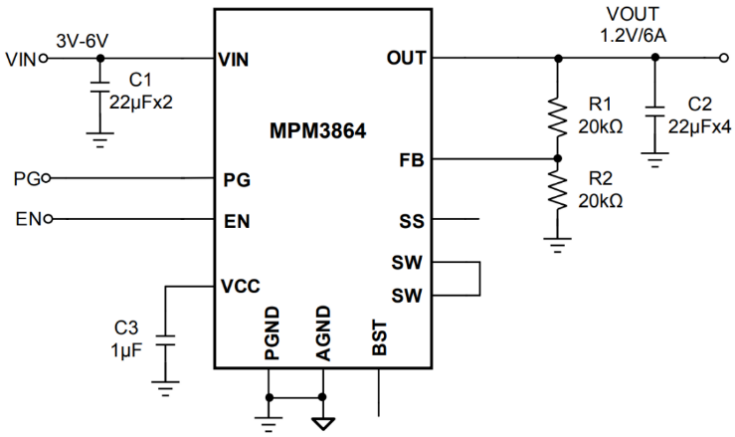

Figure 15: MPM3864 Typical Application Circuit

Figure 16 shows the efficiency curve of the MPM3864.

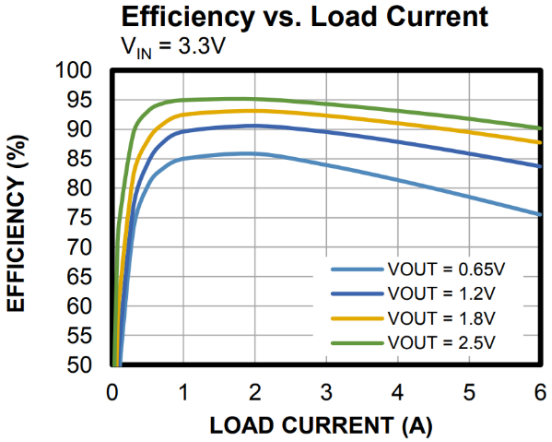

Figure 16: MPM3864 Efficiency Curve

The MPM3864 has minimal output voltage ripple (see Figure 17). When only four 22µF MLCC output capacitors are configured at 5V input and 1.2V output, the peak-to-peak output ripple remains below 10mV, regardless of whether the load current is at 0A or 6A.

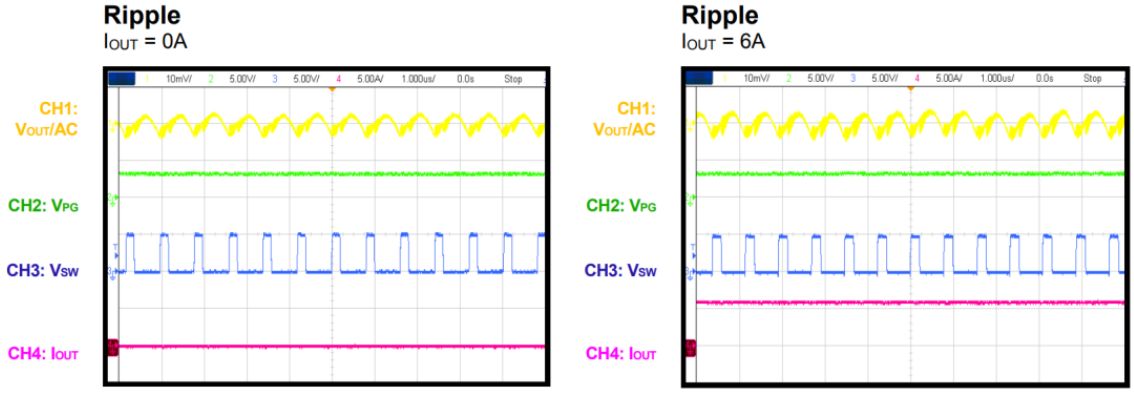

Figure 17: MPM3864 Output Ripple Waveforms

The processing chip in the optical module has high requirements for steady-state ripple as well as strict dynamic ripple requirements. The MPM3864 adopts COT control and offers excellent dynamic response capabilities. At a load jump speed of 2.5A/μs, the total dynamic ripple peak-to-peak value remains below 20mV.

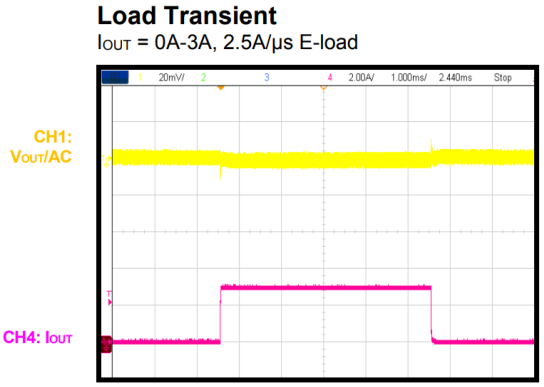

Figure 18: MPM3864 Load Transient Waveform

Conclusion

With the surging demand in data traffic and increasing transmission rates, designers face challenges integrating the stricter power requirements of optical modules. MPS provides a complete power supply solution with the MPM38x4C series (including the MPM3814C, MPM3824C, and MPM3834C) and the MPM3864, achieving excellent EMC performance, excellent voltage conversion efficiency, and minimal output voltage ripple.

For more information, explore MPS's robust selection of power modules.