Improving Isolated Power Modules with the MID06W0505A Series

Introduction

Power modules form a core part of power electronics applications. In particular, micro-power power modules are widely used to power various signal isolator applications, such as RS485, CAN, and RS232. Industry applications — such as industrial automation, electric vehicle battery management systems (BMS), and charging piles — continue to increase standards for safety, power density, and reliability.

To improve power electronics and industry applications, MPS launched isolated DC/DC converters and modules, such as the MID06W0505A series (including the MID06W0505A-3, MID06W0505A-2, EV1W0505A-Y-00A, and EV06W0505A-Y-00B), an isolated power module in an SOIC-16 (10.3mmx10.3mmx2.5mm), chip-scale package (see Figure 1).

Figure 1: MID06W0505A Power Module

Traditional power modules are typically assembled by PCBs, capacitors, resistors, transformers, and ICs, and then encased in plastic shells. MPS uses a chip-level SOIC-16 package that is convenient for soldering, significantly reduces board space, and provides excellent performance.

This article will explore the advantages of the MID06W0505A-3.

Package and Reliability

Figure 2 shows a traditional module.

Figure 2: Traditional Power Module

With a traditional module, the potting glue is prone to aging because air bubbles can be mixed in during the potting process. Bubbles can be removed by placing the module in a box with a low atmosphere pressure to release the mixed air, but there is still a margin for error, so aging can still occur. This can lead to potting glue cracks and shell bulging. Even if most of the bubbles are extracted, the internal bubbles repeatedly expand and shrink during use, which also ages the potting glue. Aged potting glue significantly impacts the device by reducing the module's reliability. It can also lead to primary and secondary insulation failures, which can be dangerous for users.

In addition, traditional power modules generally operate in a narrow -40°C to +85°C temperature range. The plug-in package is easily deformed, the pins are not able to achieve automatic welding, and the efficiency is low. Traditional modules can also be difficult to implement in space-constrained applications due to their height.

The MID06W0505A-3 addresses the shortcomings of traditional power modules with the following features:

- High pressure is used to encapsulate the plastic. This chip-level packaging system prevents bubbles from being created while improving reliability and pressure resistance
- -40°C to +125°C operating temperature range
- Convenient, ultra-thin 2.5mm SOICW-16 package for SMT automation improves production efficiency and achieves the stringent product height demands

Magnetic Field Immunity

When a product is exposed to a strong magnetic field, it can experience communication anomalies or even be burnt. These issues are often due to magnetic interference within the power field.

Figure 3 shows an experiment in which magnets were placed above a module to create interference.

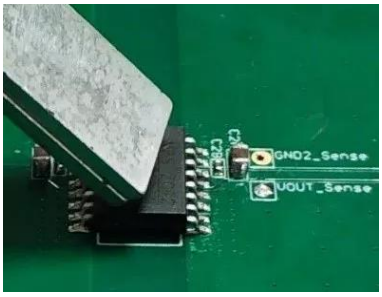

Figure 3: Interference Experiment Using Magnets

Figure 4 shows the stable output of the MID06W0505A-3.

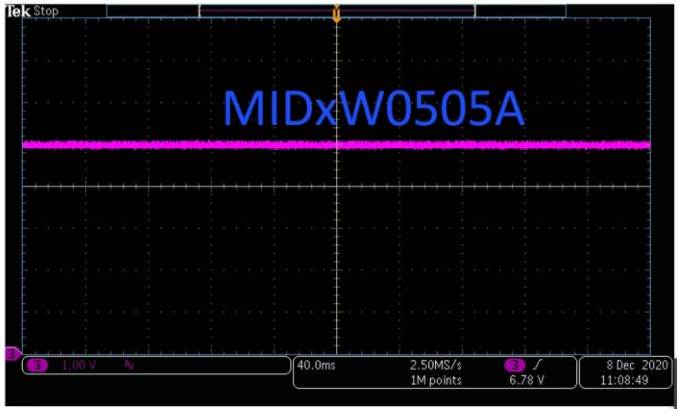

Figure 4: Stable Output of the MID06W0505A-3

These results contrast with traditional power modules, which can experience severe oscillations. For a traditional solution, a 5V output could overshoot to 7.8V, which could damage the subsequent circuit (see Figure 5).

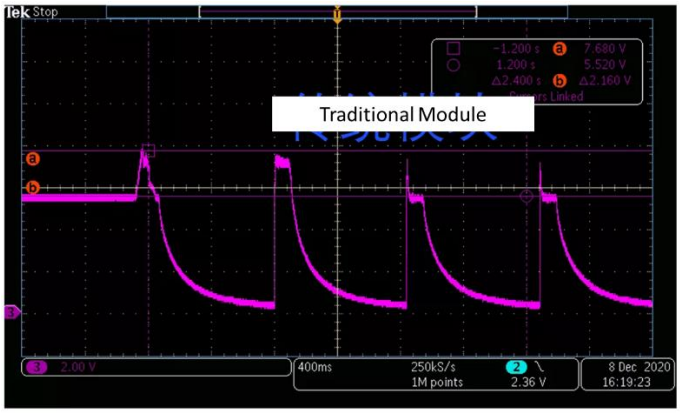

Figure 5: Output of a Traditional Module

The abnormal output is due to open-loop control. When subjected to external interference, the module's internal circuit cannot be adjusted by close-loop regulation, and the output voltage (V_{OUT}) fails to regulate. The MID06W0505A-3 uses advanced isolation feedback technology to provide real-time feedback on the external interference, which achieves closed-loop control and stabilizes V_{OUT}.

Output Voltage Adjustments

In some cases with more stringent requirements for voltage regulation, a traditional power supply module has an unregulated V_{OUT} that fluctuates significantly with the input voltage (V_{IN}) and load. In particular, when V_{IN} is at a maximum and there is no load, V_{OUT} fluctuates and rises to a substantial level. In this scenario, it is recommended to connect a dummy load at 10% of the rated load.

V_{OUT} regulation can affect the subsequent stage circuit's system stability, which can result in relatively high static power consumption. The MID06W0505A-3 features internal closed-loop control, a stable V_{OUT}, no minimum load requirements, and a stable output while the static power consumption is low.

Figure 6 shows a comparison between a traditional module's load regulation and the MID06W0505A-3's load regulation.

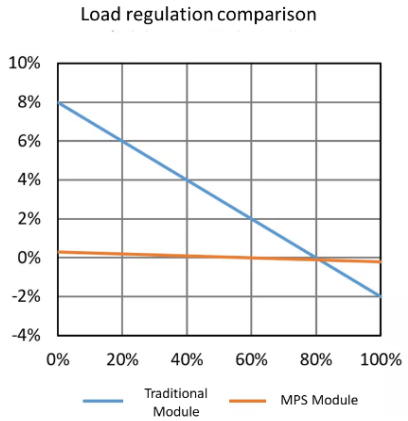

Figure 6: Load Regulation Comparison

Figure 7 shows a comparison between a traditional module's linear adjustment rate and the MID06W0505A-3's linear adjustment rate.

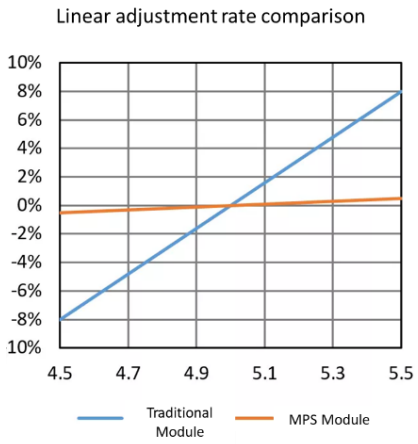

Figure 7: Linear Adjustment Rate Comparison

The MID06W0505A-3 is evidently more robust than traditional modules. Its unique features and leading performance indicators include:

- 4.5V to 5.5V V_{IN} range
- 5V regulated V_{OUT}, with excellent dynamic performance
- Typical 0.2% load regulation and 0.1% line regulation
- Up to 0.6W output rated power (1W optional)
- Supports continuous short-circuit protection (SCP), and over-temperature protection (OTP)
- $3KV_{DC}$ isolation voltage
- Meets CISPR32 Class B EMI test
- Certification according to IEC62368-1

Figure 8 shows the concise peripheral circuit of the MID06W0505A-3.

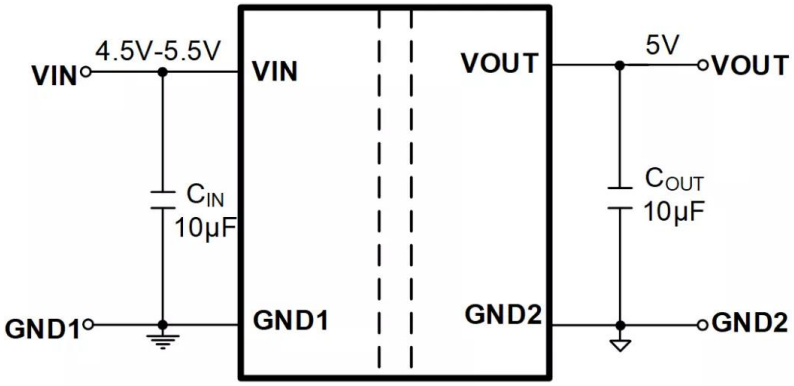

Figure 8: MID06W0505A-3 Peripheral Circuit

Conclusion

MPS is committed to introducing isolated power modules that meet the growing demands for safety, power density, and reliability. In this article, we discussed how the MID06W0505A-3 overcomes the limitations of traditional power modules, in addition to addressing challenges such as magnetic interference and fluctuating V_{OUT}. These are all key considerations for powering various signal isolator and industry applications.