MT7932 High Voltage, High Current Bidirectional Load Switch with I2C Interface for USB PD Application

Abstract

As USB Type-C with Power Delivery (PD) becomes the universal interface for high-power (up to 240W) and high-data-rate applications, system designers face critical challenges: managing dynamic and wide range of power contracts, preventing fault propagation, and minimizing solution footprint.

The MT7932 is a high-voltage high-current bidirectional load switch developed by M3TEK for USB Type-C PD applications. This IC features high voltage and current rating at 33V and 5A with integrated ultra-low Rdson power devices， bidirectional power flow, ideal diode true reverse blocking, and I2C digital interface. MT7932 provides comprehensive protection functions including Input voltage surge protection; Input current surge protection; Output constant-current control; Output short-circuit protection; Thermal shutdown protection. Additionally, the I2C interface of the device enables digital control over: Power flow direction control; Fast role swap; Input overvoltage threshold; Output current limit level; Soft-start time; Undervoltage threshold and Discharge time. MT7932 achieves high efficiency, compact footprint, minimal external components, and delivers robust yet flexible protection capabilities.

1. Introduction

USB Type C connectors are evolving into universal connectivity for modern platforms and devices. With smaller, thinner and lighter form factors, faster data transfer speed and high-power delivery capabilities, USB Type C with USB PD helps address many power-hungry applications. With wide range of devices using USB Type C, the capabilities of a USB PD Source and a USB Type C sink varies widely, from default USB Type C 15W (5V/3A) to 240W (48V/5A) in new USB PD 3.1 standard with Extended Power Range. The system could be more complicated with dual role power sources like a notebook computer.

With smaller size, higher voltage, higher power, more complex power flow and wide range of power sources and sinks, systems are calling for a load switch with high efficiency, smaller footprint and other new features, especially flexibility to adjust many protection thresholds on the fly.

The MT7932 is a high-voltage high-current bidirectional load switch developed by M3TEK to meet the need for USB Type-C PD 3.1 applications.

2. MT7932 Description and Application

Figure 1 shows the block diagram and typical application of MT7932.

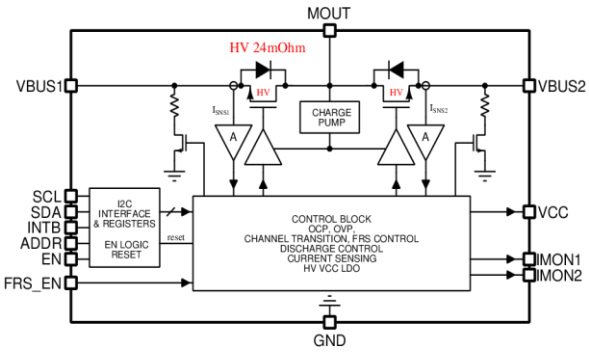

Figure1.a Block diagram of MT7932

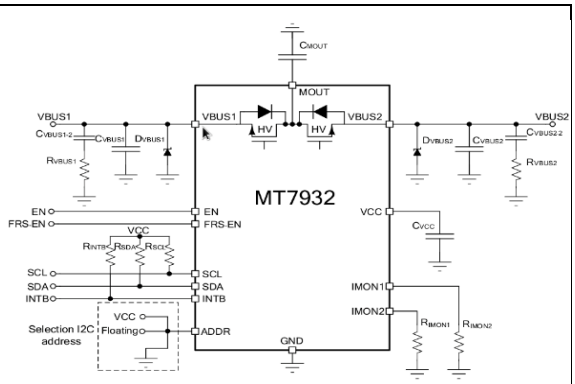

Figure1.b Typical application of MT7932

MT7932 features high voltage and current rating at 33V and 5A, integrated 25mOhm ultra-low Rdson power devices with loss-less current sensing and analog current reporting. MT7932 provides comprehensive protection functions including Input voltage surge protection; Input current surge protection; Output constant-current control; Output short-circuit protection; Thermal shutdown

protection. MT7932 provides a fast role swap (FRS) function to work with dual role power port. Additionally, the I2C interface of the device enables digital control over: Power flow direction, Input overvoltage threshold, Output current limit level, Soft-start time, Undervoltage threshold and Discharge time.

The MT7932 power path consists of two series connected N-MOSFETS (M1 and M2) with common drain output at MOUT. The MOUT pin can serve as the supply rail for other system loads. When implemented in USB HUB applications (as shown in Figure 2), MOUT delivers power to internal controller, peripheral devices through interfaces including USB Type-A ports, DisplayPort (DP) connections and other auxiliary power rails.

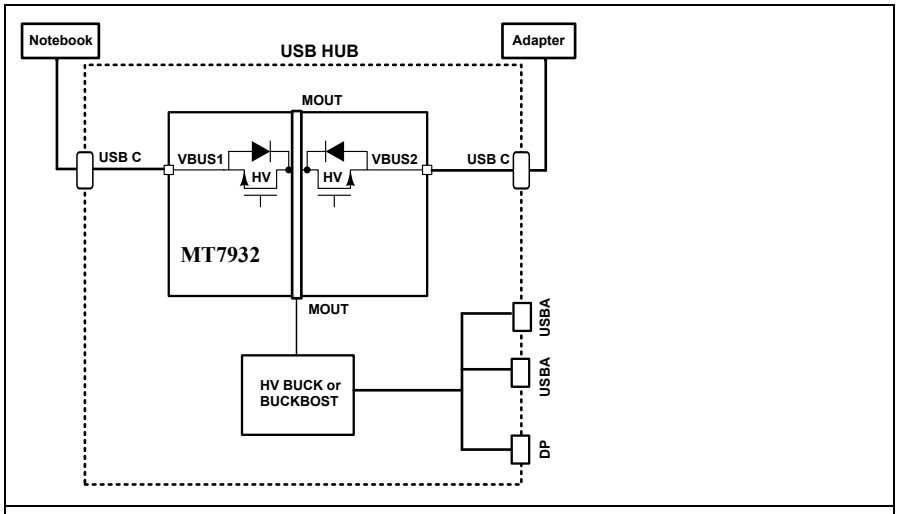

Figure 2. System Architecture of MT7932 in USB Hub Applications

The MT7932 power flow direction and enable can be controlled through I2C digital interface to support bidirectional current function. The FRS_EN pin input is designed for system with Dual-Role power（DRP）devices like notebook computers. In these systems, notebook computers can act as power sink when external adapter is plugged. When the adapter is unplugged, notebook computer needs to quickly change to power source and provide power the hub without interruption to any devices connected to the hub. MT7932 FRS feature greatly simplifies the design of DRP systems with reliable rail power continuity.

For the USB PD system, the current and voltage level available for each port can be negotiated between power source and power sink actively according to PD protocol. With the I2C interface, MT7932 can dynamically adjust output parameters to match negotiated power contracts, including

current protection level and over voltage protection level. MT7932 also provides analog output of current information on IMON1/IMON2 pin with programmable gain through resistors connected to these two pins, which can be used by the PD controller to sense port current without extra current sensing resistor.

MT7932 is available in low profile small 3mm×3mm QFN (as shown in Figure 3) package. With back to back high voltage low Rdson power devices, internal current sensing, I2C programmability and extensive protection, MP7932 eliminating the need for external current sense resistors and TVS diodes. This highly integrated solution greatly reduces external component count, saves 70% PCB area compared to discrete solutions in a USB PD system.

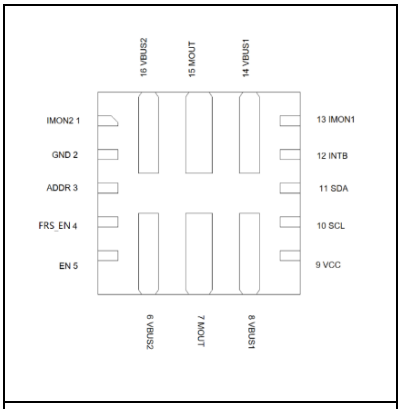

Figure3. MT7932 Package

3. Conclusion

The MT7932 sets a new benchmark for USB-C PD power management, replacing complex discrete solutions with a single IC that delivers flexibility, robustness, and scalability. As USB PD evolves toward higher currents and adaptive voltage scaling, digitally managed load switches will become indispensable for next-gen designs.

4. References

"MT7932 33V 5A Load Switch with I2C Interface and Programmable Over-current Over-voltage protection for USB PD Application" M3TEK Datasheet

5. About the Author

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