Application Note

Bourns® Multifuse® PPTC Resettable Fuses for USB OTG (On the Go) Port Protection

Introduction:

After the success of the USB 2.0 standard, the USB Implementers Forum, Inc. developed a complementary standard called USB OTG (On the Go). USB OTG was developed to allow peripheral devices to communicate directly with each other without going through a traditional PC host. This smart communication standard allows direct communication between peripheral devices and a multitude of new products, which will require overcurrent protection on the USB OTG enabled ports.

USB 2.0 vs. USB OTG:

USB 2.0 traditionally consisted of a host/periphery topology where a PC was the host and the peripheral communicated only through the host device (see Figure 1). USB OTG was introduced to supplement USB 2.0 to allow existing mobile devices to communicate in a point-to-point manner without the traditional host (PC).

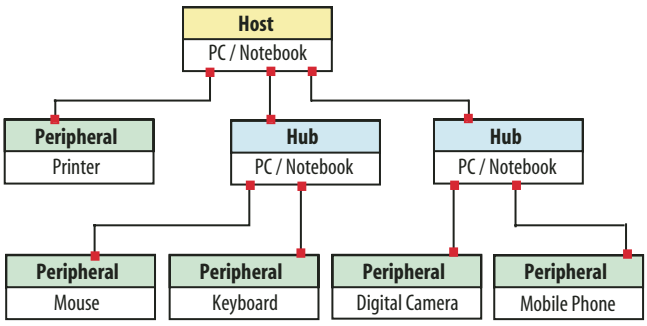


Figure 1. Example of a USB 2.0 Host / Periphery Topology

Under USB 2.0, portable computing devices such as PDAs, cell phones and digital cameras connect to a PC as a USB peripheral whereas USB OTG allows such portable devices to connect directly with each other. USB OTG therefore adds host functions to peripheral devices. Peripheral devices that are USB OTG enabled have the ability to be either a host or a peripheral (dual role devices) and dynamically switch between the two. USB OTG is not designed to eliminate the need for a PC; it is intended to complement the concept of the "extended PC" where the PC is at the center of the consumer's extended world of digital devices. USB OTG is designed to give limited host functions to peripherals in order to perform basic functions. A USB OTG topology is illustrated in Figure 2.

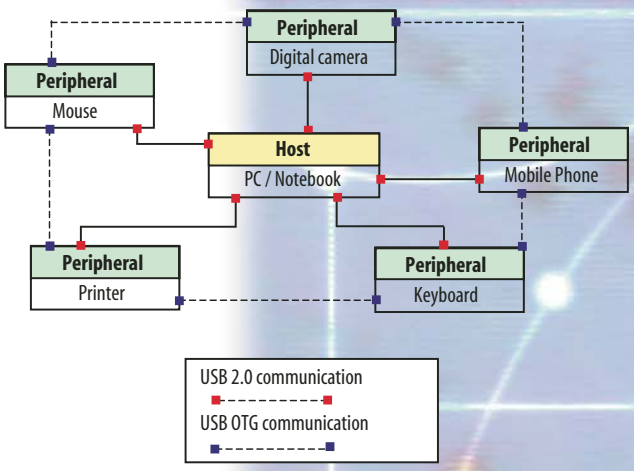
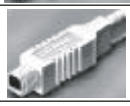
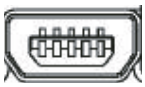


Figure 2. Example of a USB OTG Host / Periphery and Periphery / Periphery Topology

Overcurrent Protection:

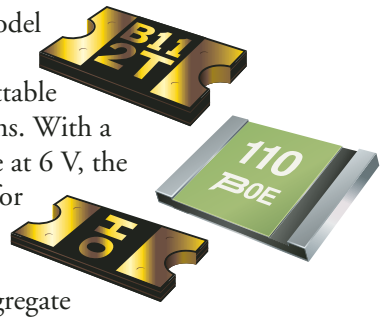
In USB 2.0, overcurrent protection is a requirement and is specified for self-powered hubs and hosts. The standard uses an example of a PPTC as a possible overcurrent protection device. A Bourns® Multifuse® PPTC resettable fuse such as the MF-MSMD110 or MF-MSMF110 is a commonplace solution for many USB 2.0 compliant ports. The reason PPTC resettable fuses are specified is in case the aggregate current drawn by a gang of downstream facing ports exceeds a preset value of 5 A. In this example, the PPTC resettable fuse trips, removing or reducing the current from all the affected downstream facing ports.

However, in the new USB OTG standard, any peripheral device that is designed to act as a limited host (A-device) must be able to transmit and receive power. In such equipment, if the current rating per port of the A-device is greater than 100 mA, then the voltage regulation is required to be between 4.75 V and 5.25 V, and the A-device is required to meet USB 2.0 specification requirements for power providers. Therefore, it should require overcurrent protection. Again, a Bourns® Multifuse® PPTC resettable fuse such as the MF-MSMD110 or MF-MSMF110 is a possible solution. Many peripheral devices are handheld equipment, such as mobile phones, PDAs and digital cameras. In such uses, a smaller device may be desirable such as the 1206-sized MF-NSMF110 or MF-NSMF150.

Plug and Receptacle	Example	Overcurrent Protection
Standard A-plug and receptacle. USB 2.0. Located upstream at the host (PC / Notebook).		Required
Standard B-plug and receptacle. USB 2.0. Located downstream at the peripheral.		Not Required
Mini B-plug and receptacle. USB 2.0. Located downstream at the peripheral, smaller version of standard B. Used in portable equipment.		Required
Mini A-plug and receptacle. USB OTG. Mini A-plug fits into mini-A receptacles (upstream) to portable devices acting as a limited host. The Mini A-plug also fits into mini-AB receptacles.		Required
Mini-AB receptacle. USB OTG. The Mini-AB receptacle can accept either a mini-A plug or a mini-B plug and is used on portable devices that could act as either a peripheral or a limited host. This is for dual role devices that are important to USB OTG.		Required

USB 2.0 and USB OTG Plugs and Receptacles

Bourns® Multifuse® MF-MSMF110 & MF-NSMF150:



The Bourns® Multifuse® Model MF-MSMF110 is an ideal current limiting PPTC resettable fuse for USB 2.0 applications. With a maximum operating voltage at 6 V, the MF-MSMF110 is suitable for the full voltage range of the USB 2.0 circuits, 4.75 V to 5.25 V. In the case of an aggregate current draw by a gang of downstream facing ports exceeding 5 A, the PPTC trips, removing or reducing power from all affected downstream facing ports. The MF-MSMF110 trips (I_{trip}) at 2.2 A and has an operating current (I_{hold}) of 1.10 A at room temperature.

As USB OTG ports are being used in small portable equipment, mini-AB receptacles are also being used. Bourns recognizes that space is at a premium in such equipment. The MF-NSMF150, a 1206 sized PPTC resettable fuse, was designed for these applications. The MF-NSMF150 has a maximum operating voltage at 6 V, making it suitable for the full voltage range of 4.75 V to 5.25 V. This small sized device trips (I_{trip}) at 3 A and has an operating current (I_{hold}) of 1.50 A at room temperature.

Conclusion:

The continued development of the USB standards to meet new consumer demands has lead to the user-friendly standards USB 2.0 and USB OTG. The proliferation of these ports across consumer electronic equipment shows that these standards are sufficiently robust to meet global demand. As these ports continue to be used in more and more equipment, the need for safe and reliable overcurrent protection grows. Bourns® Multifuse® PPTC resettable fuses continue to develop and adapt in response to new USB standards.

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