Application Note

Leveraging Multiplexers for Hot Swapping and Hot Insertion

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ABSTRACT

In today's constantly advancing modern industries, any system downtime due to component interconnects failures can results in miscommunication, productivity reduction, and can harm financial growth. In recognizing this increasingly costly unplanned downtime, the industry introduced hot insertion and hot swapping technologies to minimize the impact of any such events. Using power off protected multiplexers in your module enables hot swapping support, and allows network admins to replace a failed units without powering down the system.

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Trademarks

1 Introduction

High-speed data systems continue to drive faster data rates and are expected to support an extremely wide variety of system features, while the levels of reliability they are expected to meet also continue to increase. One of the most common strategies for keeping a system running continuously is live-insertion (also known as hot plugging or insertion or hot swapping). Live-insertion continues to be more prevalent within state-of-the-art systems, however, establishing a high reliability rating for such a system is not easy.

Live-insertion systems require additional care during design to make sure that signal-integrity levels remain acceptable throughout an operating system. In addition to signal-integrity concerns, hot-inserted cards can have adverse effects on other devices, which are caused by quickly changing voltage levels and damaging current flow. Protective components, such as a multiplexer with isolation features can reduce the risks associated with line-insertion operations, as seen in Figure 1-1.

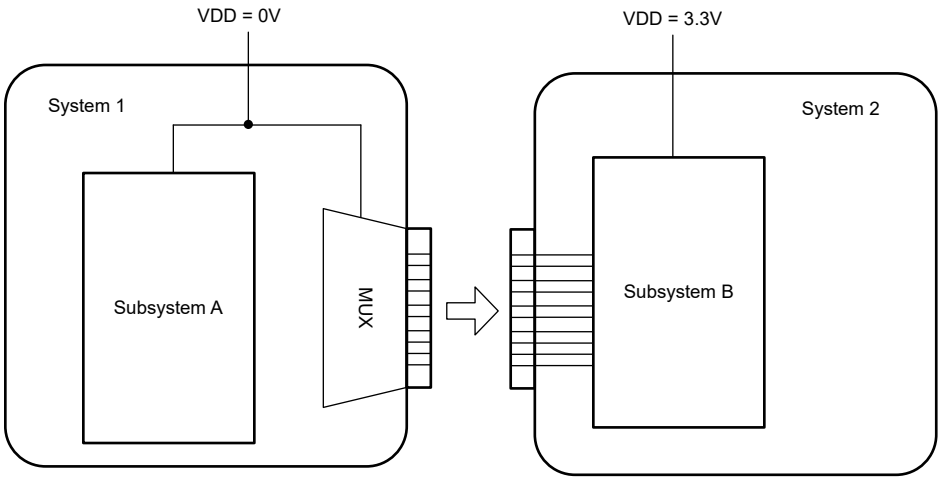

Figure 1-1. Using a Multiplexer in Hot-Insertion Application

2 Electrical Protection Definitions

2.1 Level 0 Isolation

A device with level 0 isolation is incapable of being inserted safely into a backplane without first powering down the host power supply. The device does not have circuitry designed for protection against instantaneous current flow or sudden changes in voltage, and does not have the capability to enter the high-impedance state during a hot-swap event. Damage to the device and other components on the board are almost certain. Also, system glitches and loss of data-signal integrity can occur.

2.2 Level 1 Isolation

A device with level 1 isolation prevents damage to the device by limiting the current transfer between an energized bus and the device input and output when powered down (Vcc = 0V). This static-current limitation allows insertion or removal without interrupting the host system power. However, the host system must suspend signaling during insertion or removal. Ioff circuitry is required for this level of isolation.

2.3 Level 2 Isolation – Also Known as Hot-Insertion

A device that supports hot insertion (level 2 isolation) prevents driver conflict during card insertion or removal. In addition to the level 1 isolation capabilities, the device remains in the high-impedance state from a power-supply voltage of 0V to a specified voltage. Data along the active bus can be corrupted during insertion or removal in accordance to level 2 isolation compliance. Ioff circuitry is required, as well as partial-power-down mode.

2.4 Level 3 Isolation – Also Known as Live-Insertion

A device designed for live insertion allows insertion or removal of a card without limitations, restrictions, or requirements of other circuitry on system power and signaling. Data is not corrupted under any circumstances during the insertion or extraction event. Ioff, partial-power-down mode, and precharged I/Os typically are required to meet these requirements.

3 Isolation Requirements Features

Our multiplexers can be implemented in hot-insertion application with isolation up to level 2. Multiplexers have Ioff circuitry and partial-power-down mode features.

3.1 Ioff

Ioff protection circuitry makes sure that no excessive current is drawn from or to an input, output, or combined I/O that is biased to a specified voltage while the device is powered down. This condition can occur when subsections of a system are powered down (partial power down) to reduce energy consumption.

3.2 Partial-Power-Down Mode

Partial-power-down mode is a system function or capability if wanted to power off some part to conserve power. Because the system coordinates and controls the power-down or power-up sequence, typically the partial-power-down mode is required only to make sure that no circuit (either those that are powered on or those that are powered off) is damaged during the partial-power-off mode. This can be made sure if the circuits to be powered off have input and or output circuits that maintain a high-impedance state while Vcc = 0V.

3.3 Hot Swapping or Insertion With Multiplexers

There are applications where multiplexers need to be inserted into a live system. What features to look for was already explained earlier per each isolation level. Our multiplexers are capable up to level 2 of isolation, meaning they can be used for hot insertion and hot swapping applications. Specifically our bus switches. They have internal Ioff circuitry and partial-power-down features. Another important spec to look for is the maximum continuous current, under the absolute maximum ratings in the data sheet. It shows the highest amount of current a device can handle. This is important, because during an insertion into a live system there will be an inrush of current that might damage the device. Checking the ratings of the device is critical before implementing it into a hot swap application. Multiplexers rated with continuous current of at least 100mA are recommended for implementation.

3.4 Hot-Insertion Hero Devices – Up to Level 2 Isolation Support

Device	Configuration	Voltage Range	Max Continues Current	Ioff Circuitry	Partial-Power-Down Mode
SN74CBTLV3257	2:1 4-channel	2.3V - 3.6V	128mA	Yes	Yes
SN74CBTLV3251	8:1 1-channel	2.3V - 3.6V	128mA	Yes	Yes
SN74CB3T3245	1:1 8-channel	2.3V - 3.6V	128mA	Yes	Yes
SN74CB3T3125	1:1 4-channel	2.3V - 3.6V	128mA	Yes	Yes

4 Summary

The hot-swapping and hot-insertion technologies have raised the level of system availability with zero-downtime support. Therefore, it is possible to have a system that might never need to be shut down for maintenance. These new hardware designs have built-in redundancy and, at the same time, provision for upgrades. Our bus switches can be used as a design for inserting multiplexes into live systems up to level 2 of isolation.

5 References

- Texas Instruments, *Multiplexers and Signal Switches Glossary*, application note.
- Texas Instruments, *Selecting the Correct Texas Instruments Signal Switch*, application note.

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