Power Control Design Key to Realizing InfiniBand Benefits

Jonathan M. Bearfield
High Performance Analog
Power Management Products

ABSTRACT

As a new interface, InfiniBand\textsuperscript{SM} presents a lot of expansion opportunities. However, in most new specifications, the true implementation details for the power requirements are either limited or lack clear associations between truly related parameters. Not only do you need to know the power requirements for the module and the system, you need to know how to manage that power in a hot-swappable environment. Controlling inrush, power transients, and load changes are now part of the game, and the solutions are simpler if you consider them up front. This application note presents a power control design idea.

Design Idea

The InfiniBand technology is a modularly scalable switched-fabric architecture. It currently uses a 2.5-Gbit/sec bidirectional serial point-to-point interface, whose roadmap extends from 500 Mbit/sec out to 6 Gbit/sec, with auto-speed sensing. It was defined to solve many of the problems seen in the parallel interconnects of today’s servers and system area networks, and a great deal of time and effort has gone into defining the digital interface and control structure. However, the details of implementing appropriate power control have been left up to the designer.

From a power perspective, InfiniBand is a true hot-plug implementation. Not only is power applied to the main system during module insertion and removal, but power is also actually present at the connector. This is not true for compact PCI, PCIx, PCMCIA or most other hot-plug applications. The fact that this is a truly hot-swappable socket creates significant hurdles and places several limitations on the power interface designers. There is a need to manage and optimize inrush currents, system voltage droops, and module and backplane capacitance. The designer also needs to determine the level of fault protection required in both the system and the module.

The InfiniBand specification defines two power connections for the modules. The first is bulk power. It is a 12-V ±2-V, 2.5-A supply that is intended for all of the major functions of the module. The other is auxiliary power. It is a 5-V ±5%, 260-mA supply intended for standby or configuration modes of operation, but it can be implemented as the only supply required by the card for operation. Due to its low power, the auxiliary power rail is a rather straightforward implementation, especially since the card is always allowed to draw power from it. On the other hand, the bulk power rail can provide up to 50 watts to a module, depending on the module’s size and power configuration. Along with this, there are several modes of operation where the bulk power load on the card must be turned off.

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In order for the bulk power hot-swap power management (HSPM) solution to be effective, it must have logic level controls and reporting capabilities. It is important for the HSPM to control the rise times of the power FETs in the circuit (limiting the inrush current di/dt to 40A/ms for VB and 0.1A/ms for VA), limit current to the load, and report overloaded conditions to the system. Maintaining a clean and stable power rail on the card may require considerable capacitance. This means that the HSPM selected must be able to turn on into a highly capacitive load and manage the di/dt demand characteristics of the circuit.

Managing the 12-V bulk power rail during the hot insertion and removal of modules is, however, only half of the solution. As most circuitry no longer runs at 12 V, it will be necessary to efficiently regulate 12 V down to 3.3 V, 1.8 V or whatever other voltages the card requires. The switching regulator topology selected may add to the bulk capacitance required in the module and may also demand specific voltage ramp rates or enabling sequences for proper operation.

In looking into various options for InfiniBand bulk power management, one solution that takes into consideration all of the hurdles and requirements mentioned uses an HSPM, such as TPS2330, and a power supply controller, such as TPS5102 (see Figure 1). With minimum external circuitry, other than discrete components, a truly effective solution is possible. The TPS2230 HSPM is designed to manage voltage rails with a nominal value from 2.7 V to 13.5 V. Its gate pins implement a voltage ramp drive topology, which provides a very graceful turnon for the external FETs. It also has an integrated adjustable circuit breaker and a power good reporting function for system status updates. The TPS5102 is a high-efficiency dual-output power controller. Its topology requires minimal input and output capacitance, and its operating frequency reduces the size requirements of other external components. It has several system control features that benefit InfiniBand such as independent standby and soft-start configurations.

Conclusion

Designing your system and then trying to define the power management solution creates a difficult task. The power management should be considered up front, and perhaps more so, the hot-swap power management solution. Regulating the 5-V Aux rail down to 3.3 V, or the 12-V rail down to 5 V, 3.3 V, or lower is rather straight forward. However, designing the InfiniBand module to work properly in a hot-swap environment requires a complete understanding of the system’s limitations. Meeting the specific di/dt requirements of the InfiniBand specification, or designing with the limited input capacitance allowed, drives your power management topology choices, and could impact the overall performance of your design. This application note presented a simple design approach to managing these issues for the Vbulk voltage rail.

References

1. InfiniBand Specification, Volume 2, Rev 1
2. Solutions for InfiniBand Bulk Power: Application Note; Texas Instruments; Literature No. SLVA093, October, 2000
A 15-V zener diode may be required to limit the line transient voltage within the maximum voltage range of the TPS2330.

**Figure 1. InfiniBand Bulk Power Solution Schematic**
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Mailing Address:
Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

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