MicroTCA power modules

By Per-Johan Wiberg

Per-Johan presents an overview in this article of a key element of the popular MicroTC A architecture, the power module.

MicroTCA maintains much of the same functionality of AdvancedTCA but with different system partitioning and with optimization to support systems with lower power levels. AdvancedTCA boards are 8U high and approximately 280 mm deep, operating from -48 V and containing both power control/conversion circuitry and the payload electronics. Such a board may also be a carrier for one, or several, AdvancedMC modules. With MicroTCA, AdvancedMC modules are connected via a common backplane and housed in an enclosure that provides similar functionalities to those of a carrier board. These mezzanine modules are identical to those used with AdvancedTCA systems, leveraging development costs between the two architectures, establishing a migration path, and creating economies of scale for the production of AdvancedMC modules.

MicroTCA places a significant amount of functional content into the power module. Some of the functions included in the power module are:

- Input power ORing functionality (if appropriate)
- Hot-swap control for inrush current limiting
- EMI filtering
- Hold-up capacitance
- 48 V to 12 V DC/DC conversion (payload power) and galvanic isolation
- 12 V to 3.3 V DC/DC conversion (management power)
- Payload and management power distribution

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- Hot-swap control for multiple AdvancedMC modules
- Output power monitoring, control, and protection circuitry

Funneling power handling circuitry and system level control/management functionality from the large AdvancedTCA carrier board into the relatively small MicroTCA power module makes power module design, performance, and reliability crucial to the success of the overall system. Figures 1 and 2 (block diagram and photograph) show a typical MicroTCA power module.

The MicroTCA architecture offers several advantages for its intended markets. The smaller form factor and lower hardware cost of the MicroTCA make it attractive for systems that require less processing power within an enclosure, for example, for edge and access applications. Reliability and availability requirements for MicroTCA systems are typically just as stringent as those for equipment implemented with AdvancedTCA. MicroTCA's

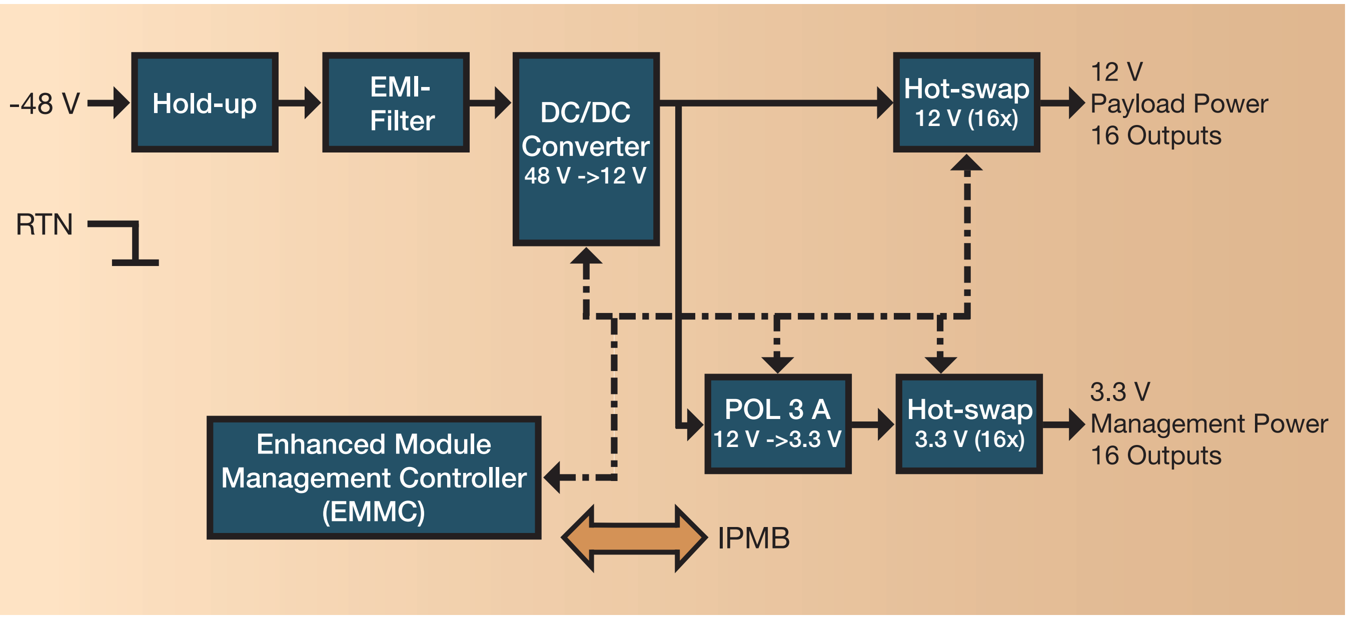

Figure 1

Figure 2

physical partitioning offers opportunities for enhanced power system availability compared with those operating from a traditional -48 V backplane, even if the failure rates of similar components remain the same.

A typical AdvancedTCA system features redundant -48 V power feeds but includes only one -48 V to a low voltage DC/DC converter on each board. This DC/DC converter represents a single-point-failure source with no redundancy within a given board. Providing redundancy in the form of a second DC/DC converter on each board would be cost and space-prohibitive.

MicroTCA provides a neat and effective solution for the dilemma of nonredundant -48 V DC/DC conversion. MicroTCA equipment racks normally allow for two power modules. Feeding each power module position from a separate -48 V power feed enables the power modules to be easily configured into a redundant arrangement. Complete redundancy is provided for the functions of loss of one power feed, input power protection/management, conversion from -48 V to 12 V, and control/monitoring of payload and management power for every AdvancedMC in the system. This can all be accomplished with only one additional power module unit, rather than the multiple additional high power DC/DC converters on each payload board that would be required in a traditional -48 V backplane power system. This approach gives OEMs using MicroTCA an opportunity to offer complete power system redundancy and extremely high rack-level system availability all within a small enclosure and at a reasonable cost.

Another potential advantage of MicroTCA is that all load electronics reside on AdvancedMC modules, and all onboard power conversion within these modules occurs with input voltages of 12 V or 3.3 V. The failure rate of high power -48 V input DC/DC converters is typically somewhat higher than those of lower power converters operating from lower input voltages. A potential reliability and replacement rate advantage exists for load electronics in the MicroTCA environment.

Since the ratification of the MicroTCA specification by PICMG in July 2006, manufacturers have begun to offer power modules to support MicroTCA equipment design, as evidenced by the products in this issue's *MicroTCA Product Guide.*

Interoperability testing, to assure that power modules interface and operate properly with other system components, is an ongoing effort that is an important part of the system design process. One certainty is that MicroTCA power modules will continue to evolve as OEM demands and available technology solutions change. As advanced semiconductors and thermal packaging become available, power densities are expected to increase. Higher levels of silicon integration and increased user demand should also serve to lower prices over time. For example, hot-swap controller chips that can handle a larger number of output channels than today's chips may be marketed. Another possible future enhancement could be increased flexibility with regard to input voltage. The present power module offerings operate from traditional -48 V input telecom power. Power modules, however, are expected to be offered for operation from a universal AC input source or from +24 V input power, expanding the market for MicroTCA systems.

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