Ultrathin & High Power µModule Regulators Are Ideal for Communications Systems

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Introduction

Telecom equipment manufacturers are continually being pushed to increase the data throughput and performance of their systems as well as add functionality and features. At the same time, pressure is being applied to decrease the systems overall power consumption. For example, a typical challenge is to reduce overall power consumption by rescheduling the work flow and moving jobs to underutilized servers, thereby enabling shutdown of other servers. To meet these demands, it is essential to know the power consumption of the end-user equipment. Thus, a properly designed digital power management system (DPSM) can provide the user with power consumption data, allowing for smart energy management decisions to be made.

A principal benefit of DPSM is reduced design cost and faster time to market. Complex multi-rail systems can be efficiently developed using a comprehensive development environment with intuitive graphical user interface (GUI). Such systems also simplify in-circuit testing (ICT) and board debug by enabling changes via the GUI instead of soldering in “white wire” fixes. Another benefit is the potential to predict power system failures and enable preventive measures, thanks to the availability of real-time telemetry data. Perhaps most significantly, DC/DC converters with digital management functionality allow designers to develop “green” power systems that meet target performance (compute speed, data rate, etc.) with minimum energy usage at the point of load, board, rack and even installation levels, reducing infrastructure costs and the total cost of ownership over the life of the product.

Many telecom systems are powered via a 48V backplane. This voltage is normally stepped down to a lower intermediate bus voltage of typically 12V to 3.3V to power the racks of boards within the system. However, most of the sub-circuits or ICs on these boards are required to operate at voltages ranging from sub-1V to 3.3V at currents ranging from tens of milliamps to hundreds of amps. As a result, point-of-load (POL) DC/DC converters are necessary to step down from the intermediate bus voltage to the desired voltage required by the sub-circuits or ICs. These rails have strict requirements for sequencing, voltage accuracy, margining and supervision.

There can be as any many as 50 POL voltage rails in a telecom system and system architects need a simple way to manage these rails with regards to their output voltage, sequencing and maximum allowable current. Certain processors demand that their I/O voltage rise before their core voltage, alternatively certain DSPs require their core voltage rise before their I/O. Power down sequencing is also necessary. Designers need an easy way to make changes to optimize system performance and to store a specific configuration for each DC/DC converter in order to simplify the design effort.

Moreover, the systems architects still need to have relatively simple power converters to satisfy the various other power rails on their boards but have an ever shrinking board area on which to place them. This is due, in part, to not being able to fit these converters on the underside of their circuit boards due to a 2mm maximum component high restriction forced on them due to the multiple boards placed side-by-side in a rack mounted configuration. What they would really like to have is a complete power supply in a small form factor, which does not exceed 2mm when mounted onto a printed circuit board (PCB).

Solutions

Linear Technology's µModule® (micromodule) products are complete System in a Package (SiP) solutions that minimize design time and solve the common problem of board space and density issues commonly found in communications systems. These µModule products are complete power management solutions with integrated DC/DC controller, power transistors, input and output capacitors, compensation components and inductor within a compact, surface mount BGA or LGA packages. Designing with Linear's µModules products can significantly reduce the amount of time needed to complete the design process by up to 50% depending on the complexity of the design. The µModule family transfers the design burden of component selection, optimization and layout from designer to device, shortening overall design time, system troubleshooting and ultimately improving time to market.

Linear's µModule solutions integrate key components commonly used in discrete power, signal chain and isolated designs within a compact, IC-like form factor. Supported by Linear Technology's rigorous testing and high reliability processes, the µModule product portfolio simplifies the design and layout of power conversion designs.

The µModule family of products embraces a wide range of applications including point of load regulators, battery chargers, LED drivers, power system management (PMBus digitally-managed power supplies), isolated converters, battery chargers and LED driver. As highly integrated solutions with PCB Gerber files available for every device, µModule power products address time and space constraints while delivering a high efficiency, reliable and with select products a low EMI solution compliant with EN55022 class B standards.

As design resources become stretched by increased system complexity and shortened design cycles the focus falls on development of the key intellectual property of the system. This often means the power supply gets put to one side until late in the development cycle. With little time and perhaps limited specialist power design resource, there is pressure to come up with a high efficiency solution with the

smallest possible footprint; while potentially utilizing the underside of the PCB as well for maximum space utilization.

This is where the µModule regulator provides an ideal answer; the concept is complex on the inside, simple on the outside – the efficiency of a switching regulator and the design simplicity of a linear regulator. Careful design, PCB layout and component selection are very important in the design of a switching regulator and many experienced designers have smelt the distinctive aroma of burning circuit board in the earlier days of their career. When time is short or power supply design experience is limited, the readymade µModule regulator saves time and reduces risk to the program.

A recent example of an ultrathin µModule solution is our LTM4622. This is a dual 2.5A, or single two-phase 5A output step-down power regulator in a 6.25mm x 6.25mm x 1.8mm ultrathin LGA package. At nearly the height of a soldered down 1206 case size capacitor, its ultrathin height allows mounting on the topside of the board. The thin profile allows it to meet demanding height restrictions such as those required by PCIe and advanced mezzanine cards in embedded computing systems, as shown in Figure 1 below.

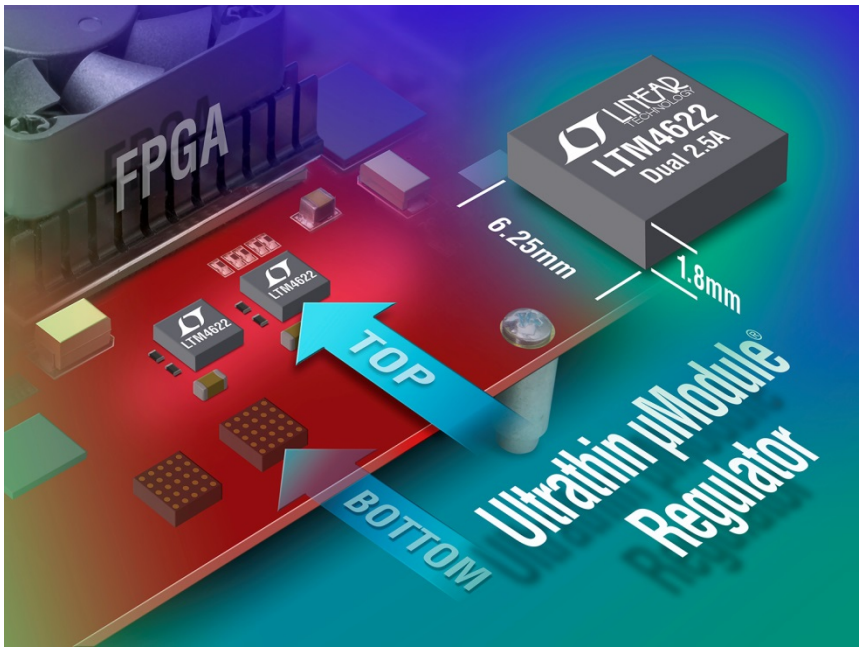

Figure1. LTM4622 can be mounted on the underside of a PCB.

Linear's µModule DC/DC regulators also provide a simple way to deliver both high power and DPSM capability. Since many of the µModule regulators can be paralleled for high load current with precision current matching (within a nominal 1% of each other), thereby mitigating the potential for hot spots. Moreover, only one of the µModule regulators needs to contain DPSM capability, since it can supply the complete digital interface even if the rest of the µModule devices in parallel do not have DPSM capability. Figure 2 shows an application schematic of one LTM4677 (36A DPSM µModule regulator) in parallel with 3 LTM4650s (50A µModule regulators) for an 180A plus DPSM PoL solution.

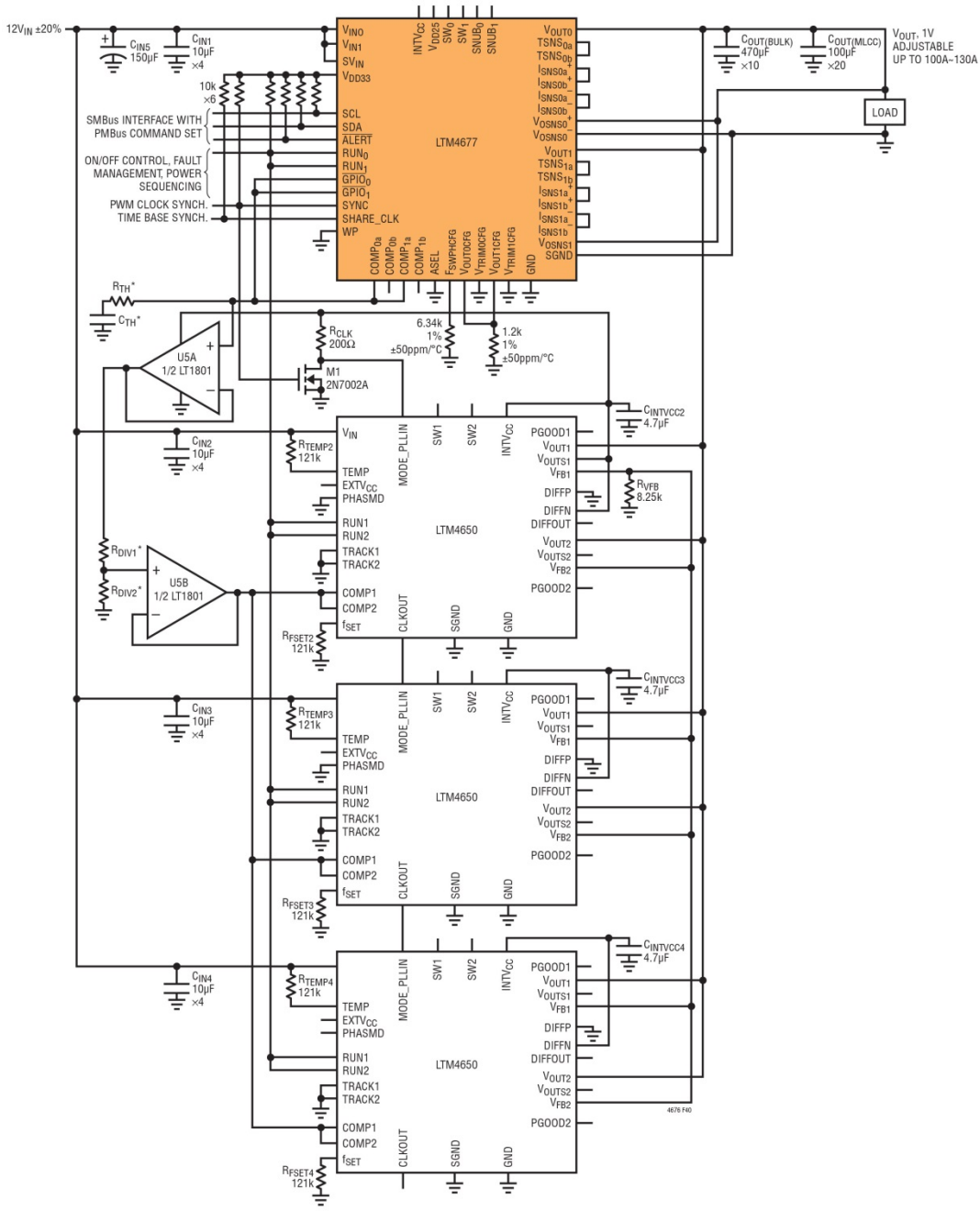

Figure 2. A Combination of 1 LTM4677 DPSM µModule & 3 LTM4650 µModule regulators delivers 186A at 1V from a nominal 12V input.

Conclusion

Having DPSM capability and ultrathin profiles in today's communications systems provides a power supply designer with a simple and powerful ways to deliver high power outputs to nominal 1.0V core voltages such as those commonly found on the newest sub-20nm ASICs, GPUs and FPGAs. With an ultrathin profile of less than 2mm when mounted on the board, the LTM4622 allows the use of board space on the underside which would otherwise be left underutilized. This not saves expensive PCB real estate, but reduces the amount of required cooling due to its overall operating efficiency.

Finally, using µModule regulators make sense in these types of environments since they can significantly reduce the debug time and allow for great board area usage. This reduces infrastructure costs, as well as the total cost of ownership over the life of the product.