



Implementing point-of-load power architectures: an overview of recent products and technologies

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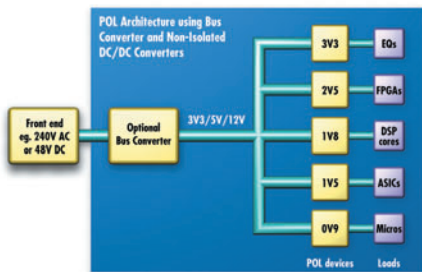


Fig.1: a typical distributed power architecture using a bus converter to driver a number of point-of-load regulators

Much has been written about distributed power architectures and point-of-load power conversion in recent years, so we won't dwell on the detailed reasons for their growing popularity, other than to give a very brief overview of a typical architecture, as shown in Fig.1. An input converter, typically either with a universal AC input or 48V DC input, feeds an optional bus converter or a number of non-isolated DC/DC converters close to the load. A bus converter will normally be used when the backplane bus voltage is relatively high, perhaps 48V or 24V, because it is more efficient to step down to a lower voltage to drive the point-of-load converters than to try to achieve something like 48V to 1.8V conversion in a single step. In addition, some applications benefit from the additional isolation between system PCB cards and backplanes that a bus converter provides.

Because power conversion takes place in two or more different locations within a system using point-of-load architecture, finding products with the highest possible efficiency at every stage is essential if much of the input power is not to be lost as heat. Excessive heat impacts overall system reliability with MTBF (mean time between failures) halving for every 10 °C temperature rise in temperature. It can also lead to costly and complex forced-air cooling arrangements being required. We now look at some of the latest products from a variety of power supply vendors that can be used to implement high-efficiency point-of-load power systems. All of the products described meet major international specifications for safety and EMC/EMI, and all have integral overload and over-temperature protection. They represent current best-in-class performance for power density and efficiency for each stage of a distributed power system.

AC input converters

Shelf-mounted AC/DC switching converters in the 40W to 200W range are at the front-end of many distributed power systems. Small differences in efficiency can have the highest impact here. The difference between 80% and 85% efficiency may not, at first glance, seem particularly important. However, the 5% difference in efficiency equates to a 25% difference in the amount of heat generated – an additional 10W to be removed from around a 200W power supply, for example. For 1U high racks, the most efficient AC/DC switchers currently available are 125W and 160W power supplies from US manufacturer, N2Power. Both the XL125 and XL160 are open frame switching power supplies with very compact 3" x 5" footprints that achieve efficiencies up to 92%, depending on the model. They have integral power factor correction to comply with European legislation. The compact size equates to a power density of 8.5W/in³, compared with a typical figure of 3W/in³ -5W/in³ for most products of this type. There are single-, triple- and quad-output versions, and N+1 power sharing is possible for systems that need parallel redundancy, the single output modules have a built in diode so no external components are required for the units to current share. At only 6" x 3", the XL250, 250W single output modules will soon be available. Like the XL125 and XL160, this product will fit into 1U systems.

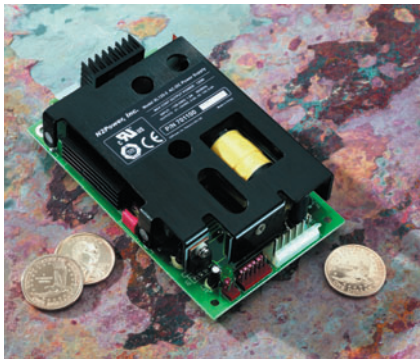


Fig.2: N2Power AC/DC switchers offer up to 92% efficiency

Stepping down from 48V

Capable of delivering up to 240W without a heatsink, and up to 360W with a heatsink, SynQor's BusQor family of isolated converters can be used to provide a 12V or 9.6V output from a 42V to 53V input for driving point-of-load converters. They achieve efficiencies up to 97% with power densities of 167W/in³ and come in industry-standard quarter-brick and half brick formats. Instead of using relatively lossy Schottky diodes in the output, these converters use MOSFET-based synchronous rectification to improve efficiency. Their ability to deliver high power without a heatsink means that board spacing within an equipment shelf can be minimized and the overall system size considerably reduced as a result. These board-mounted converters have 2000Vdc input-to-output isolation and can current share without any external components.

As either bus converters or point-of-load devices, eighth and quarter brick units from Synqor and Lambda should be considered. These are board-mounted, isolated converters that can handle a DC input range from either 18-36V or 36V to 75V. Output voltages can be 12V, for driving further point-of-load regulators, or

from 0.8V to 5V for use as point-of-load power sources in their own right. Maximum output currents reach 25A in eighth-brick and 60A in quarter-brick formats. As in most DC/DC converters, efficiency is higher the higher the output voltage. For example, Lambda PAE converters reach 89% full-load efficiency at 12V output, falling to 71% at 0.8V output.

Other point-of-load regulators

The choice of point-of-load converter is largely driven by the required output current. At low power, with up to 4A output, single-in-line and dual-in-line non-isolated regulators in moulded or resin-filled packages are available from CTC (Coil Technology Corporation) with up to 96% efficiency. There are several product families. The CPT52xx, 53xx and 54xx range provide single, widely adjustable outputs from 1.2V to 5V nominal at up to 4A from inputs of 4.5V to 18V. The wide ranging voltage adjustment means that the most efficient converter can be selected for each application because the higher the nominal output voltage, the more efficient the regulator. CTC regulators include a remote on-off function and they come in 12-pin single-in-line packages. All of the converters have the same board footprint so, if a processor change means that more power is required, the regulator can be easily changed without any board changes. A standard application circuit is shown in Fig.3. The company also produces the CPT61xx and CPT62xx series. These can handle a wider range of input voltages, from 9V to 28V, and have outputs from 3.3V to 12V at 1A or 2A. The single-in-line packages for both of these product ranges can be specified as vertically or horizontally mounted.

Where the load requirement is in the 4A to 10A range, the Lambda Tarka series should be considered. These non-isolated regulators are between 83% and 97% efficient and are available in two families with input voltages of 3V to 5.5V or 5V to 13V. Each has a single selectable output from 0.9V to 3.3V and features both remote on-off and remote sense to facilitate sensing of, and compensating for, voltage variations at the load.

For higher power applications, where up to 15A is needed, SynQor's NiQor product families will almost certainly meet the requirements. These vertically mounted SIP packaged modules come in three main versions: 3V- 3.6V input, 3V to 5.5V input and 12V input. Output voltages are from 0.9V to 5V and all devices can deliver up to 15A with no heatsinks and, as in the SynQor bus converters described, synchronous rectification is used to achieve high efficiency. A 12V input surface mount unit capable of delivering 16A is also available. In the case of these product families, efficiency is up to 93% at full rated load. The modules include on-board input and output filter capacitors to minimise external component count and their open-frame construction maximises air-flow and cooling effectiveness. These products are based on fixed-frequency buck-converter topology that provides predictable EMI performance.

Summary

The products described represent the leading technologies available today for each part of a distributed power architecture using point-of-load regulation. Once the voltage/current requirements have been decided, design consideration must then be given to product size and, above all, efficiency. It's not just a matter of saving energy, the overall power system efficiency will be a key determinant of final size, cooling system requirements and, crucially, reliability.

It is now accepted that POL converters offer distinct advantages over discrete designs, not least that at the higher current levels they are unbeatable in saving board space. They also offer significant savings on design time, improving time-to-market. POL converters are tried and tested designs, whereas OEMs designing their own DC/DC converters often have to try a variety of designs to achieve the required outputs. In addition, all the POL converters discussed above have a second source, a luxury not afforded when using discrete switching regulators that often have unique footprints. Finally, system designers should take account of the fact that POL converters are available in small quantities, whereas many components used for discrete designs are only available in reels of 1000's, with the potential for high inventory wastage.

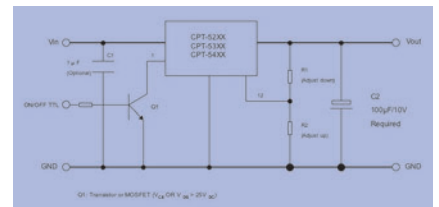


Fig.3: CTC point-of-load regulators have variable outputs that are set using this standard application circuit



Fig.4.: CTC converters are available for vertical or horizontal mounting



Fig.5: SynQor's vertically-mounted NiQor regulators deliver up to 15A

Power Division

CTC:



- Industry standard 1/2W to 8W DC/DC converters
- High voltage programmable DC/DC converters
- 4 wk max lead-time (Newport & Traco x-ref available)

Elec & Eltek:



- Transformers
- Wound components

Lambda:



- AC/DC switch mode & linear PSUs
- DC/DC converters 1.5W to 600W
- POL DC/DC converters

N2Power:



- AC/DC SMPS, 125W & 160W versions
- 5" x 3" <1U high size, up to 92% efficient
- N+1 capability with no external parts required

Papst:



- DC fans, 25mm2 to 135mm2, axial & radial
- AC fans, 80mm2 to 135mm2, axial & radial
- Custom options available for full range

Ricoh:



- Voltage regulators, DC/DC converters
- Voltage supervisors, battery management

SynQor:



- DC/DC modules, 50W to 200W, 24Vin to 48Vin
- High efficiency: 1/8 , 1/4 and 1/2 brick formats
- POL DC/DC converters (15Amp)