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The Polymorphous Landscape Of Bus Voltages

Voltages are bussed around all the time, but the applications and voltage levels are many and diverse. One of the high-voltage apps du jour, for example, is the data center.

Everybody knows about the phenomenal rise of the Internet over the last few years, but few think much about how all of the generated data gets stored and distributed. To enable this capability, the emergence and growth of datacenters or server farms—and the power they increasingly demand—are following the same track as the Internet.

Incidentally, bus converters are available now that can take high voltage directly down from 300 V down to 48 or 12 V in one stage. Bus converters for the most part have been 48 down to 12 V. But you've got to get from high voltage down to 48 V, and then you've got to go from 48 to 12 V. And every time you do a conversion stage, that's a hit on the efficiency and more heat is dissipated. So making it in one jump from 350 to 12 V is attractive.

HOW DO YOU DO IT?

At the low end of the bus voltage spectrum, digital electronics, especially microprocessors, are operating from increasingly lower voltages for the advantages they bring. The non-isolated point-of-load buck converter, used as part of the Intermediate Bus Architecture (IBA), is the most popular, low-cost, high-efficiency device to produce these low voltages *(see the figure)*.

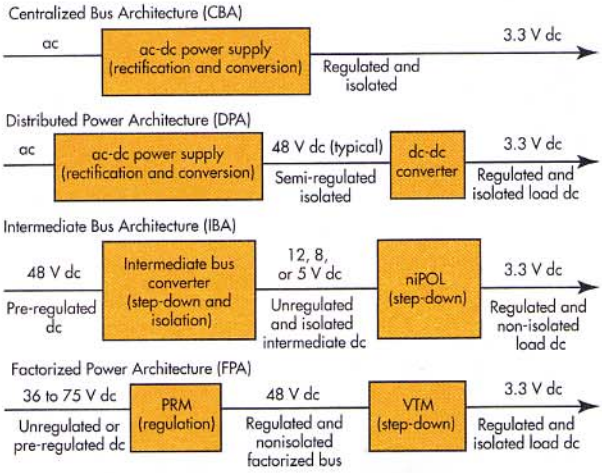
If a low (1 or 2 V) output voltage is needed, however, it's not advantageous to be working off a 12-V bus. The trend for the Intermediate Power Architecture, which has become so popular over the last five years, has been for the intermediate bus voltage to migrate from 12 V, which was standard, to lower voltages like 9.6, 8, or 6 V.

The Achilles heel of the non-isolated point-of-load converters (niPOLs) comes from being able to use them at a duty cycle that are high enough to keep efficiency as high as possible. Cost is also very important, and buck converters are becoming dirt cheap.

The rub is keeping system cost down while keeping efficiency up and minimizing power dissipation and heat. It's advantageous to use IBA because the trend for digital voltages is toward lower voltages, and the mindset is to accommodate the niPOLs by lowering the bus voltage.

IN THE REAL WORLD

But the bus voltage landscape is more complex and interesting than just the bus voltages at the high end and the low end. We routinely encounter a wide range of bus voltage requirements, from the lower voltages to those at 12, 24, 28, 36, 48, 150, 300, and 375 V. All of these bus voltages depend on the application and other factors: the market, what the systems are, size, cost, weight, performance—real-world considerations, including "that's the way we've always done it."



Designers have their choice of several power architectures. The non-isolated point-of-load converter (niPOL) is key to the operation of the Intermediate Bus Architecture, which is popular in applications that need to keep system cost down while maintaining efficiency and minimizing power dissipation and heat.

It can depend on how bus voltage is defined. Is a bus voltage just what is distributed around a system as a common source? Because you could have an ac input and then a dc input that feed together to a common bus. That could be really desirable to have for a military application, such as a radio application that could be plugged into the electrical system in a building or in a vehicle using an on-board power bus.

It sometimes gets lost in the sauce that we think people think more about it sometimes than they really do. The real world can be pretty enlightening. A design engineer at a customer site said when he designs a product, he wants something he can get in a day or two.

So, he would buy whatever is available and make his system work with that. Because he wants a number of sources, he wants it quick, and he wants it cheap. So in his case, he would use whatever voltage was the most commonly available at the power level and price he needed. Go figure.

TOM CURATOLO holds a BSEE from Worcester Polytechnic Institute, Worcester, Mass. Look for more Power Design columns from him in print and online.