Technical Article

Addressing challenges in data-center power delivery with 800V high-voltage DC architectures

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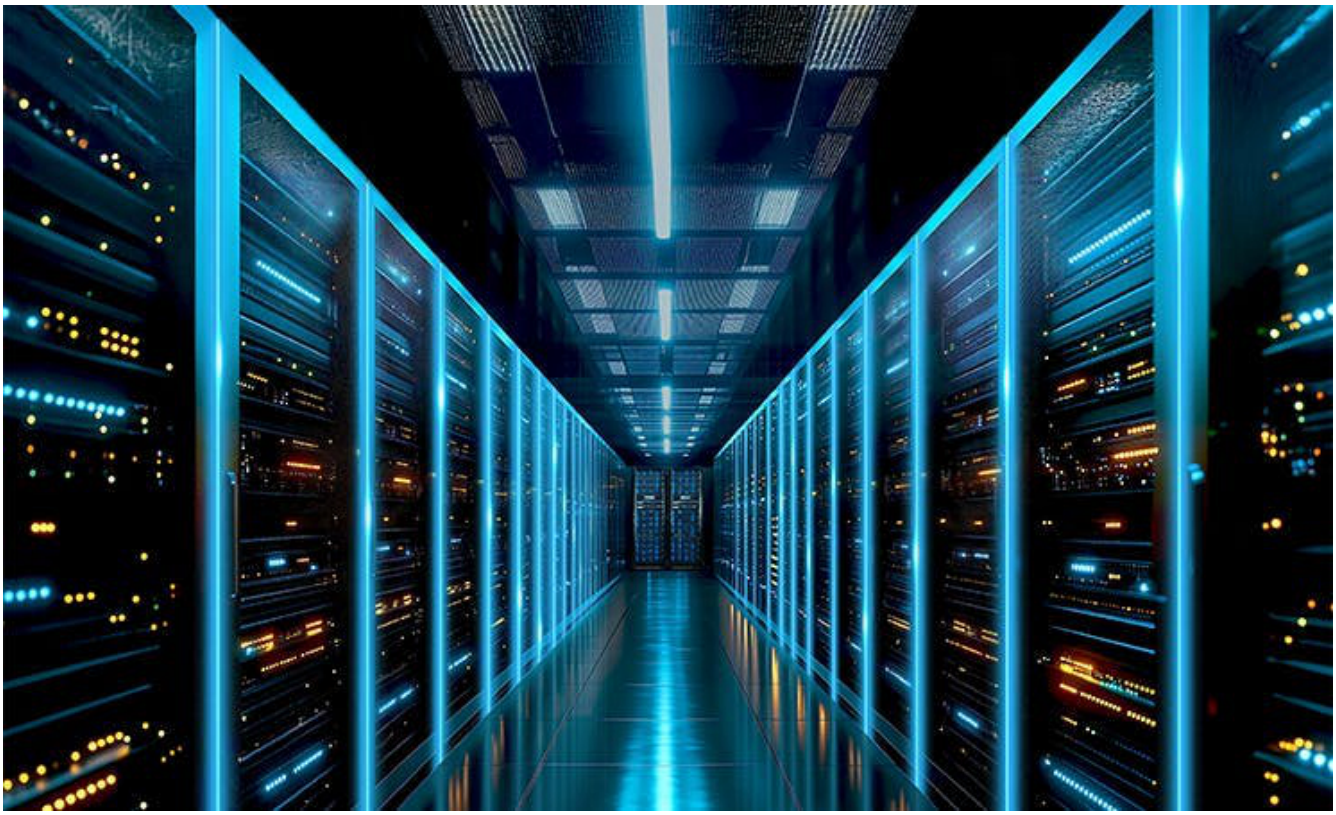

Given rapid growth in the server and artificial intelligence (AI) markets, the amount of energy required per rack is increasing from 100kW to >1MW. This increase requires designers to fundamentally reimagine the entire data center's power delivery path, from the grid to the gates of processors.

While 48V infrastructures were "the next big challenge" just a few years ago, using 48V distribution with a 1MW rack would require almost 450lbs of copper to maintain distribution losses – an unsustainable amount in both weight and cost. Today, TI's power-management and sensing technology can enable DC architectures as high as 800V. That's why we're working with Nvidia to codevelop an 800V high-voltage DC distribution ecosystem to enable further scaling of computing needs and power.

800V_{DC} distribution

High-voltage power conversion is the heart of future AI data center power delivery architectures. Technologies such as gallium nitride (GaN) enable power density and conversion efficiency in these systems.

Furthermore, enabling safe operation of 800V_{DC} systems requires high-voltage sensing, protection and safety isolation. An 800VDC high-voltage system architecture needs products and technologies such as solid-state relays, high-voltage hot swaps, high-accuracy battery monitors for battery backup units and central battery units, isolated gate drivers, isolated current sensors, and voltage sensors, as shown in Figure 1.

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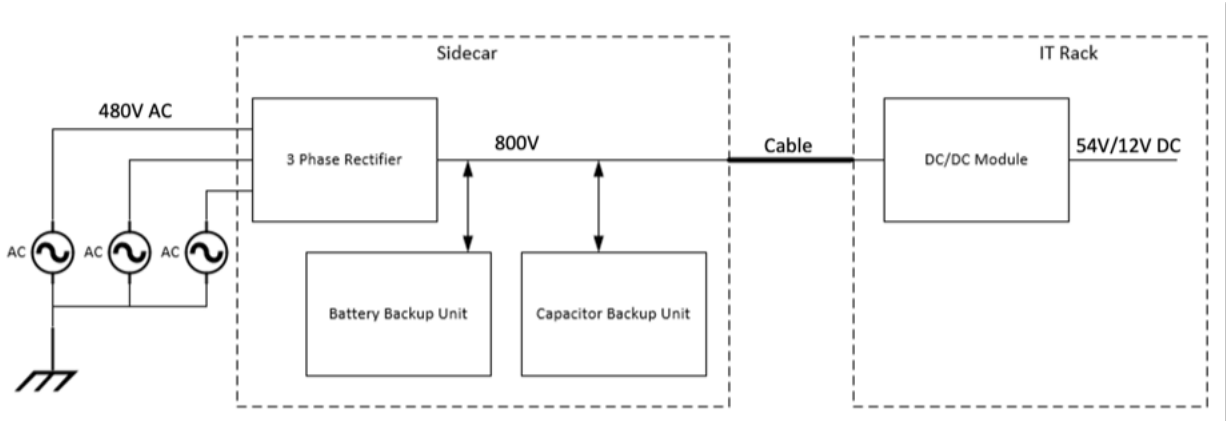

Figure 1. A 800V high-voltage DC system architecture

This type of system architecture can deliver high-reliability, energy-efficient power distribution across data centers.

The next generation of AI processors

Beyond high-voltage DC distribution, improving power density and thermal management at the 48V and processor power levels requires additional innovations. Fundamentally, while power requirements are increasing, racks and trays are not getting bigger. The power solutions must evolve to become denser and more efficient.

TI's 100V mid-voltage GaN technology helps support the 48V trend toward higher efficiency and density, enabling greater integration, higher efficiency, and smaller overall solution size. Our integrated GaN solutions simplify previously more complex, higher-density and higher-efficiency intermediate bus-converter architectures.

Processing the >1,000A required in today's systems demands high-frequency multiphase processor power. TI's high-performance bipolar complementary metal-oxide semiconductor (CMOS) double-diffused MOS (DMOS) power process enables less multiphase processor power. In this regard, TI is also working closely with Nvidia to codefine next-generation multiphase solution requirements to support >1MW rack trends.

Conclusion

As technologies evolve and demands grow more complex, TI's collaboration with Nvidia is positioned to deliver integrated, high-performance solutions for tomorrow's systems, combining world-class energy and AI expertise to drive real, transformative progress.

Additional resources

- Learn more about our data center and enterprise computing.
- Watch our "Powering data centers: From the grid to the gate" video.
- Check out Nvidia's blog post, "Nvidia 800 V HVDC Architecture Will Power the Next Generation of AI Factories."

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