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POWER CONSUMPTION OF DATA CENTERS DRIVING CHANGE

While requirements for power supplies have been steadily increasing, the need to address space and heat limitations is taking on greater importance.

BUSINESS CHALLENGE

More companies are looking for insights from data via artificial intelligence, machine learning, and deep learning techniques--this boom is driving dramatic increases in computing capacity. Massive numbers of specialized ASICs, GPUs, FGPAs and classic CPUs are being deployed for model training and inference. With the increase in computing capacity, there is a proportional increase in power density per square foot of data center floor.

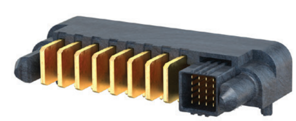
Today across the world, there are nearly 90 million internet transactions conducted per minute. All of these emails, app downloads, video streams, social media interactions, retail purchases and more are processed through a network of worldwide data centers. These data centers contain tens to hundreds of thousand servers supported by a network of switches, routers and cooling equipment—all of which rely on an increasing amount of electricity.

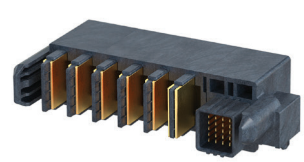
International Data Corp. reports that energy consumption per server is growing 9% per year globally as the demand for energy increases with the growth in performance. In the U.S., data center power consumption is projected to double every five years.

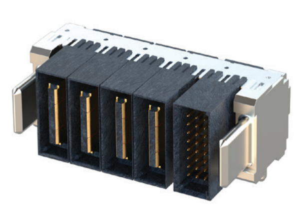
Power is delivered to data centers via the same grid that provides power to homes and businesses; however, while U.S. homes generally receive power at 220V, data centers typically receive power at 10kV+ to accommodate the massive amount of power needed to run the processors that are at the very heart of the computing power driving the internet.

Bulk power is delivered to racks containing 30-50 1U servers that are increasingly being powered by 3kW power supply units (PSUs) in Rack Scale Architectures, power shelves aggregate power supplies to meet the needs components inside servers and switches in the rack.

While the requirements for power supplies have been steadily increasing, the space allotted for both the power supply and the critical output connector has not changed. Going back to the early days of server development, Server System Infrastructure (SSI) requirements called for 400 to 600W power supplies and the power I/O would use four to six power blades rated at 30A per blade to deliver the required power out to servers. Today, connector companies are being asked for power I/Os to carry triple the current in the same space.







SOLUTION

Connector designers are now being forced to come up with creative solutions to manage heat and current. When rating power connectors, measuring the current is straight forward. However, measuring temperature rise (T-rise) gets complicated. Issues such as location of thermocouples within the connector can impact temperature measurement. Consideration in the design of the PSU PCB with copper layers, layer thicknesses and footprint design can contribute to T-rise.

To carry more current, you simply need more copper. Advances are being made in copper alloys to allow increased conductivity, but these advances will not keep up with the demand for higher current densities. Likewise, improvements in contact design can improve the typical power loss found in the interface between the PSU and the connection point, whether it is the mating half of the interconnect or sometimes a PCB card edge, but these improvements cannot be relied upon to provide significant gains in current density.

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For the past 40 years, connector development has centered around higher densities. The industry is approaching the point at which it must consider more space for more power or examine the conventions used to evaluate and rate connector performance. Power contacts have evolved from the original Intel SSI (Server System Infrastructure) specification that had a current rating of 30A per blade to new solutions like the EXTreme Ten60Power High-Current Connector which delivers 60A per blade at 30°C temperature rise. For the next evolution, Molex will begin offering an 80A connector that is 12mm tall. With the added height, compared to a traditional 10mm connector, some of the airflow through the power supply is restricted and a pressure drop results and components in the rear may receive less cooling.

With the electric consumption of data centers receiving more and more attention from facility owners footing the bill, utility providers that must supply the power on demand, and government officials concerned with the wide-ranging effects of the massive power generation required, there is growing interest in considering more space for more power as well as examining the conventions used to evaluate and rate connector performance. A 1% improvement in data center electrical efficiency has been projected to result in millions of dollars in energy savings.

CONCLUSION

Improvements in copper alloys and contact design cannot be relied upon exclusively to provide significant enough gains in current density to handle the rising computing power necessary to sustain the internet-connected world. The massive power generation required is driving a need to re-evaluate packaging requirements and develop new ideas to manage heat and current.

To learn more www.molex.com/ab/extremepower.html

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