

# Cool Power

## *Increase airflow with the right connector*

*With data centers continuing to grow in size and energy consumption, server manufacturers try to squeeze as much efficiency out of their systems as possible. A new approach to low profile connectors enables a greater airflow through the power supply.*

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### Why suffocate your power supply?

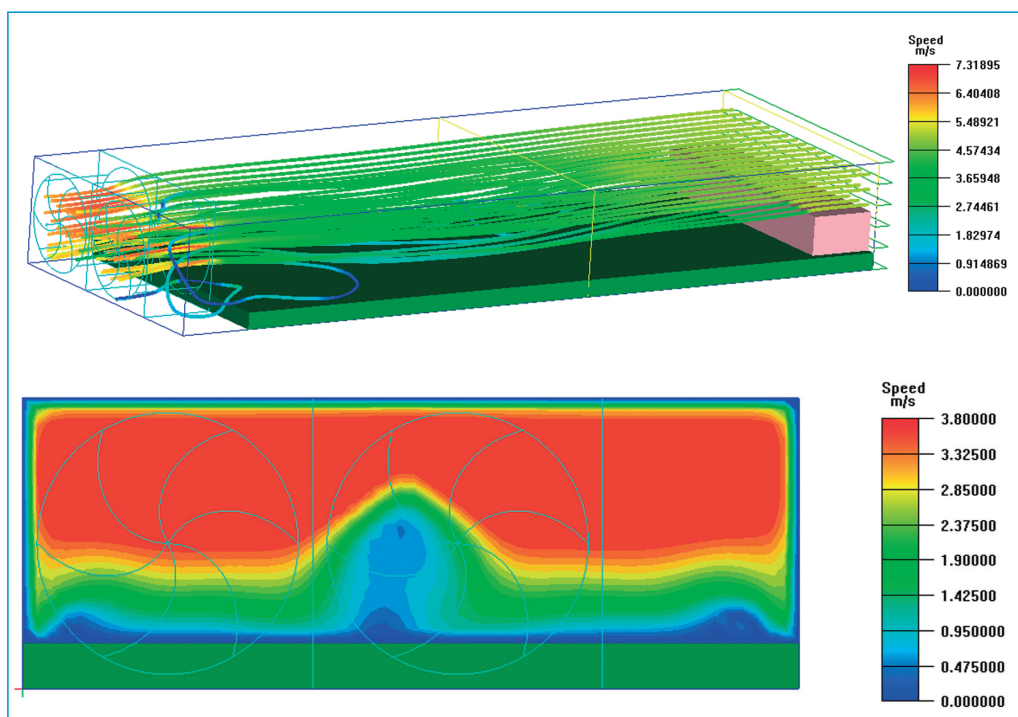
System cooling is one of the biggest challenges facing server architectures today. For every 100 watts generated to power the system, another 50 watts is consumed just to cool it. In the average high-capacity server, microprocessors, chassis fans, and power supply losses combine to account for 50%-80% of the total server energy used. If better cooling efficiencies could be implemented, companies, cities, and nations could benefit immensely from major cost savings in energy usage, and drastically reduced carbon dioxide (CO<sub>2</sub>) emissions.

Power supplies are often a key part of the system cooling equation and a critical part of the thermal development, as they are not only heat generators by necessity, but they also have to provide cooling for themselves as well as other system components. If power supplies are an integral part of the thermal dynamics of the overall system, then the power connector becomes a very key consideration, directly linked to the efficiency and cooling of the power supply. In this case, the connector becomes a critical part of the power supply thermal design, since it can enable better cooling of both the power supply enclosure

and the connector itself.

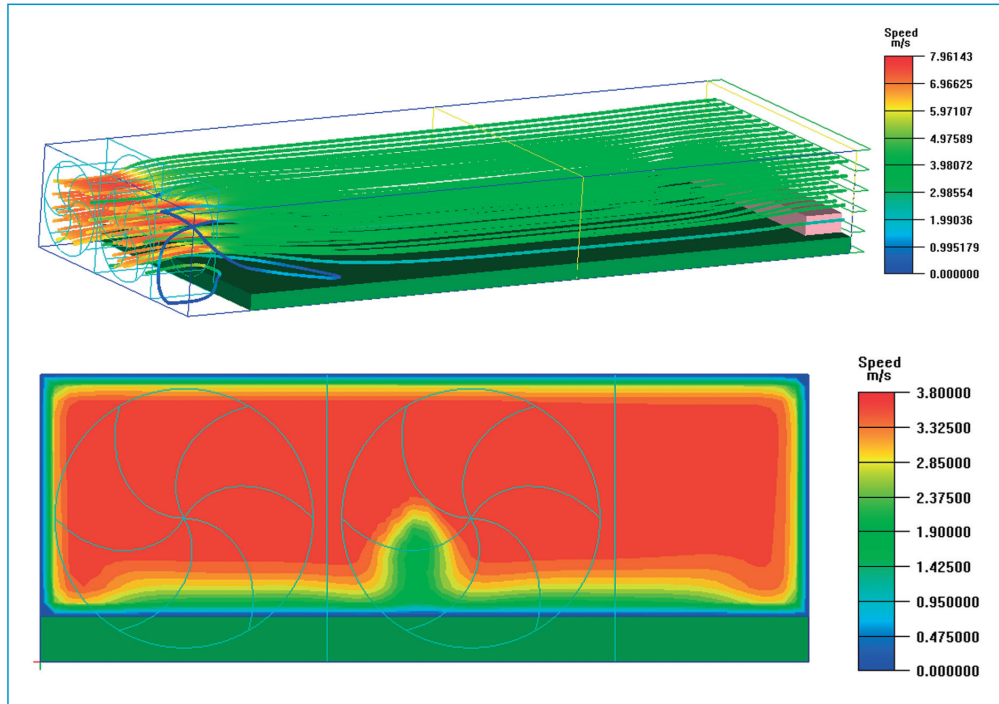
How does the connector play such an important role? The size (height profile and length) of the connector, which also determines current densities, can have a profound effect on airflow within a power supply enclosure. It seems simple yet very logical, that the flow of air must not be interrupted by the connector. The stronger the airflow, the more cooling that will take place. If the flow is not allowed to enter (or exit) the enclosure uninhibited, recirculation increases, static air mounts, and draft is limited. Without the proper connector, at best, only limited cooling of internal components takes place.

Let's put some numbers to this important theory to reinforce the importance of correct connector selection for energy savings and efficiency. First however, we must create a "typical" power supply, and let's say this is an 1800 watt, 12.0V power supply with an 87% efficiency rating running two parallel 40mm fans. The enclosure size is 295.0mm long x 106.0mm wide x 40.0mm high. The two connectors we will compare both have 10 power blades and 32 signal pins integrated into a single housing. One connector is a standard SSI type (Molex EXTreme PowerPlus



Molex EXTreme PowerPlus™.

## Special Report – Green Power



Molex EXTreme LPHPower™.

™) which is 100.3mm long x 14.5mm high. The other connector is a low profile version by Molex called EXTreme LPHPower™ that is only 92.3mm long x 7.5mm high. Note that LPH is half the height profile of the standard connector, and that difference in height will prove to be a big advantage in airflow.

We set up both thermal models with a 60% free air ratio at the non EMC boundary grate over and around each connector, which would be typical on a given power supply. At 1800 watts and 87% efficiency, there are 200 watts of heat to exhaust from the power supply enclosure ((watts/efficiency)-watts). Since many manufacturers target 20°C temperature rise for rating (safety) purposes, one can calculate the basic airflow required to meet the intended design specifications. The calculation for CFM using heat to be dissipated and desired temperature rise is:

$$Q = 1.76 \text{ W} / T_c$$

Where:

Q = Airflow required (in CFM)

W = Heat to be dissipated (in watts)

T<sub>c</sub> = Temperature rise above ambient

1.76 = slope

So in our example above, the required airflow should be 23.67 CFM to meet

our design goal. Let's take a look at how our two different connectors contribute to our airflow requirements.

The first example of the EXTreme PowerPlus (SSI type) indicates 22.70 CFM at the measurement point, midway through the power supply, which is shy of the goal to cool the system. This requires the fans to run at full RPM to cool the supply, not allowing any additional system cooling – using more energy than needed.

Something else you will notice is the draft of the airflow. The taller connector tends to keep the movement of air to the upper half of the enclosure, producing stagnant and recirculated air to the bottom of the supply. Recirculation may be desirable for large computer cabinets, but in small enclosures such as power supplies, most, if not all, of the airflow can be lost due to recirculation. The cross-sectional view you see above demonstrates how much airflow blockage takes place with the traditional connector, based on velocity contours. The red indicates areas of high velocity, which is most desirable.

Our second example is of the Molex EXTreme LPHPower™ connector used in the same environment. The LPH connector, being half the height of the

SSI style, indicates airflow of 25.90 CFM – an increase of 14% over the taller connector. That may not seem like a lot, but think about the fact that you could increase your power supply to 2000 watts while keeping to your 20°C temperature rise without changing your thermal specifications or connector. The extra airflow headroom also allows the power supply to pull through additional system cooling.

Our contour plot of velocity for LPH shows that draft is also vastly improved and promotes greater air circulation and velocity to reach the lower extremes of the enclosure, meaning more components will get cooled more efficiently.

The effects you see above are even greater on the smaller sized 850 watt to 1200 watt power supplies where you may only have a single 40.0mm fan squeezed next to the standard AC input IEC connector. In these cases, the Molex LPH connector can gain up to 25% better airflow with much better draft through the enclosure over the traditional style power connectors.

### Conclusion

All the current industry trends of more performance in less space will continue to adversely affect thermal performance and cooling efficiencies. Smaller power supply enclosures lead to smaller, higher speed fans needed to get the heat out, which increases energy consumption, noise, and reduces MTBF of the fans and other internal components. The connector selection is a critical aspect of the overall design and performance specification on each power supply. EXTreme LPHPower is an excellent solution to enable better power supply performance over current connectors in the market. In fact, Molex has introduced a whole family of space-saving, high current density power connectors in the EXTreme Power™ family to help solve the mounting energy consumption and thermal design challenges you face every day.

[www.molex.com/link/ext-power.html](http://www.molex.com/link/ext-power.html)