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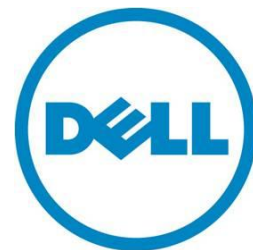
# Increasing Energy Efficiency through Modular Infrastructure

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*This technical white paper addresses energy efficiencies created by the combination of Dell's Chassis Management Controller and modular infrastructure*

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# Executive summary

Because of rising power costs, energy efficiency is growing as a top of concern of data center managers. The M1000e thermal design and the 2700W power supply meet these concerns head on. This technical white paper addresses how the Dell™ PowerEdge™ M1000e infrastructure directly improves the energy efficiency of current and future data centers through a combination of hardware and software improvements.

Through higher power density, load balancing, and improved energy efficiency, hardware directly affects a data center’s operating cost. The Dell Chassis Management Controller (CMC), which is a critical part of all Dell blade servers, provides software features that help the 2700W power supply perform at maximum efficiency. Features such as dynamic power supply engagement (DPSE), maximum power conservation mode, and power monitoring help data center managers push the limits of the M1000e modular blade server enclosure.

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## Introduction

With data centers increasing in density and requiring more performance per watt, more power at a higher efficiency is required. The Dell PowerEdge M1000e infrastructure meets the demand of the modern data center and pushes power supply technology to the cutting edge.

Higher AC-DC conversion efficiency, extreme capacity, and innovative algorithms have ushered the 2700W power supply to the next level of modular infrastructure. The AC-DC conversion has reached a new high of 94% efficiency. With an increase of up to 13% in power output over prior Dell modular power supplies<sup>1</sup>, this efficiency advantage lays the foundation for reducing power consumption. When these modular hardware advantages are coupled with the power features in the Dell Chassis Management Controller (CMC), the amount in power efficiency is impressive.

## Efficiency of the 2700W power supply

The 2700W power supply is designed to improve performance per watt for Dell's modular solutions. One key to improving the ratio is to maximize the amount of energy applied to the modular servers when converting AC power to DC power.

The AC-DC efficiency conversion is engineered to meet certification levels that are maintained by an industry consortium run by the Environmental Protection Agency (EPA). This consortium, called 80 PLUS, is an initiative by the technology industry driven by the government to promote advancements in energy efficiency in power supplies. With over 200 power supplies certified by 80 PLUS, this initiative has helped drive efficiency levels from 89% to 96% over the years. Dell's 2700W power supply meets the 80 PLUS Platinum level, which is a peak efficiency of 94%. Table 1 lists the certification categories and their associated efficiency levels.

Table 1. 80 PLUS certification

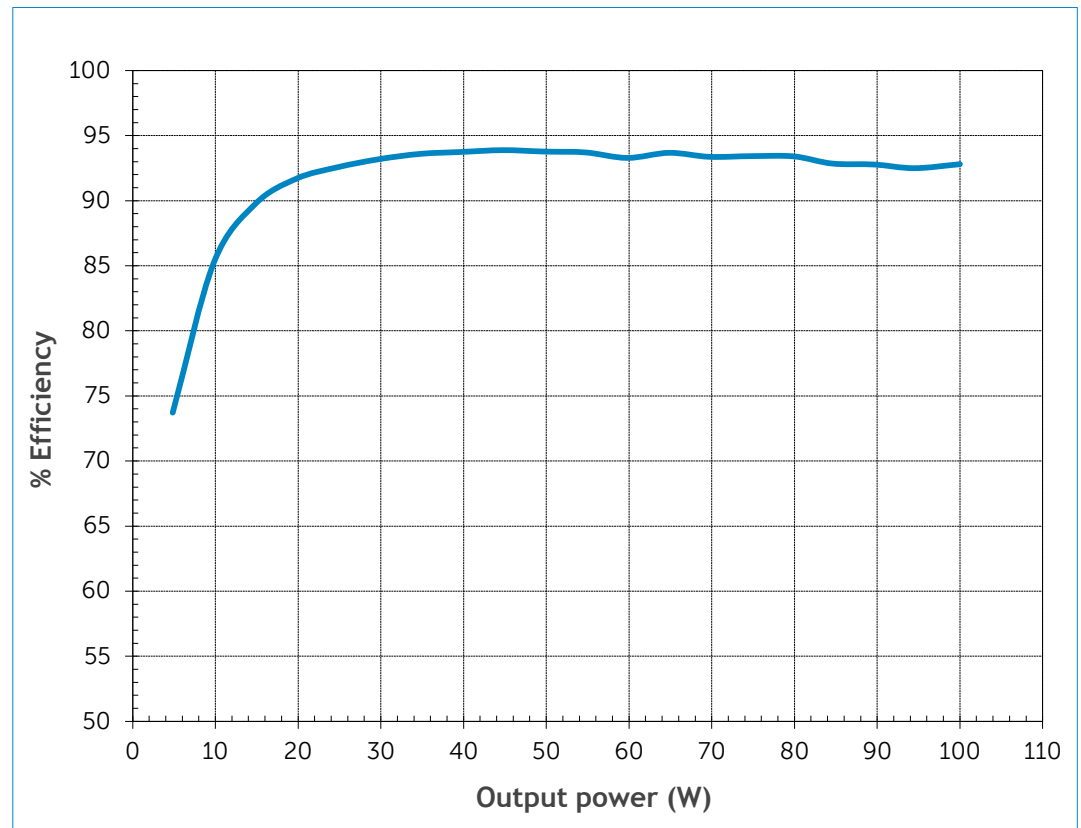
80 PLUS certification	230V internal redundant			
% of rated load	10%	20%	50%	100%
80 PLUS	N/A			
80 PLUS Bronze	---	81%	85%	81%
80 PLUS Silver	---	85%	89%	85%
80 PLUS Gold	---	88%	92%	88%
80 PLUS Platinum	---	90%	94%	91%

<sup>1</sup> Global Ad # G12000112

The incentive to push technology boundaries in energy efficiency helped create the 80 PLUS industry standard. By developing cutting-edge power supplies, Dell assisted the 80 PLUS consortium in developing requirements for the certification levels for more efficient power supplies.

The 80 PLUS Platinum status of the 2700W power supply indicates that Dell has maximized the AC-DC conversion with today's technology. For every watt a power supply uses, 0.94 of that watt is used by the server. Excellent power supply efficiency is maintained over various workloads, and not just the three points required by 80 PLUS. The efficiency curve of the 2700W power supply is shown in Figure 1.

Figure 1. Efficiency vs. output power



## Advantages of high capacity power supplies

One of the main advantages of modular systems is the shared resources and infrastructure. This infrastructure includes fans, power supplies, and switches. As the blades, switches, and fans create a power draw, each power supply contributes more power for better asset utilization.

The higher power density enables higher-density in the newest generation of blade servers. For example, Dell's current blade servers offer 24 DIMMs in half-height blades compared to 16 DIMMs in just the previous generation. Full-height blades have 48 DIMMs with four processors. Not only is the DIMM and processor density higher, but both items are consuming more power through products like the Intel® Turbo Boost Technology, which allows processor cores to run faster than base operating frequency.

Higher capacity allows IT managers to take advantage of dynamic loading and turbo boost created by processors. Dynamic loading can happen any time. When a workload for a high performance compute cluster starts—for example, the public is looking at breaking news—this surge on blade servers and blade switches creates a sharp rise in the load on power supplies. The M1000e with the 2700W power supply can handle the load with efficiency and elegance.

Load balancing is one method the power supplies use to handle power surges neatly. All power supplies in the M1000e provide the same amount of power, which adds to the longevity of the power supplies and helps maintain power redundancy.

Another advantage of high capacity supplies is that the 2700W power supply has been built with additional ride-through capability for situations where power is momentarily lost. It can act as a buffer while the data center back-up power comes on line. This feature complements data center infrastructure like uninterruptible power supplies (UPS) by providing power quickly in the event of a brown out or power grid glitch.

## The role of the Chassis Management Controller

The Dell CMC, which manages the M1000e infrastructure, implements various power features to ensure the 2700W power supply is used most efficiently. These features include the following:

- Dynamic power supply engagement (DPSE) mode
- Maximum power conservation mode
- Power monitoring

For DPSE, the CMC monitors total enclosure power allocation and moves the power supplies that are not required into standby state, causing the total power allocation of the chassis to be delivered through fewer power supplies. This improves asset utilization of the online power supplies, and at the same time improving the longevity of the standby power supplies.

With the maximum power conservation mode feature of CMC, you can place the M1000e into the lowest power consumption mode possible. This mode is used in combination with DPSE and the 2700W power supplies. In this mode, the system can place all but one power supply into standby during periods of low utilization, saving power by turning other power supplies off.

Power monitoring provides information on system input power, peak system power, minimum system power, and many more valuable power statistics.

Since the 2700W power supply increased power to the chassis by 13% over the 2360W, the CMC increased the power cap to match. The increased power cap enables the chassis to accept any power load. Table 2 lists the power cap values for past and current CMC versions.

Table 2. CMC power cap values

CMC revision	Watts AC (user selectable)	Watts DC (translated)	BTU/hr (user selectable)
< CMC 2.3	7928	6759	27051
CMC 3.0	11642	9922	39724
CMC 3.02	11642	9922	39724
CMC 3.1	11642	9922	39724
>=CMC 3.2	16685	14226	56931

## Benefits of the M1000e thermal design

One of the advantages of the M1000e is its thermal design. The thermal architecture within the system ranges from the layout of each blade to optimized fans, and also includes the CMC that manages the infrastructure cooling. The architecture focuses on air management that provides parallel air paths for ambient air to cool blades, switches, power supplies, and other infrastructure hardware. Because ambient air is delivered to the infrastructure with minimal preheating, the amount of power required by the M1000e's nine fans to cool the system is minimized.

As energy efficiency improvements are a primary goal of many data centers, Dell's latest modular fan improves on the initial M1000e fan design by reducing the maximum DC (per fan) power from 82W to 64W (22% reduction). For all nine fans running in the chassis, there is a DC power savings of 162W while maintaining the same high-level of airflow performance.<sup>2</sup>

## Conclusion

The M1000e infrastructure is designed with industry leading features that place it among the highest energy efficient systems in the server market. Features like ground up thermal design, unique air management, 80 PLUS Platinum level, load balancing, and high-power density provide immediate benefits for the current data center and lay the foundation for the next. With increasing power costs as a primary concern for data center managers, power supplies that have up to 94% efficiency will directly improve the operating cost as well as the reduction in power consumption by the fans. The software features provided by the CMC also help to decrease operating costs. The direct benefit

<sup>2</sup> For more information, see the Dell enterprise whitepaper, "Thermal Design of the Dell PowerEdge M-Series," on [Dell.com/downloads/global/products/pedge/en/pedge\\_mseries\\_thermal\\_design.pdf](http://Dell.com/downloads/global/products/pedge/en/pedge_mseries_thermal_design.pdf).

of dynamically adjusting the power supplies through the CMC DPSE allows the power supplies to maintain the highest efficiency, maximizing the AC-DC power conversion. These modular hardware improvements, coupled with software power features of the CMC, create a system of unprecedented energy efficient levels.

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