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Introduction

In today's global business and trade environment, power and global warming are becoming greater concerns for the worldwide community. With the explosive growth of the Internet, digital computing and global IT infrastructures, the rise of large-scale data centers has led to an increasing awareness of their impact on power consumption. Correspondingly, the millions of consumer electronics in use today, including PCs and laptops, only add to the drain on power infrastructures. As a result, what was once largely the domain of home appliance manufacturers—developing energy-efficient washers and dryers, heaters, and refrigerators—has now become a much larger concern for the IT industry.



In recent history, the United States' power grid has been taxed by wide-scale power emergencies on the East Coast in 2003 and in California in the early 2000s. With concerns about decreasing oil reserves, energy price spikes and global warming, the IT industry has begun to place greater emphasis

on reducing power consumption in data centers and in the hardware used by business customers. To address these power reduction efforts, Hitachi Global Storage Technologies (Hitachi GST) introduced the Deskstar™ P7K500 and 7K1000.B hard drives, both offering the industry's lowest power consumption among hard drives in their class. The P7K500 and 7K1000.B improve operational power consumption by 40 percent over prior generations, positively impacting total PC system power requirements.

Power Efficiency Helps Manufacturers Deliver ENERGY STAR® 4.0 Compliant Systems

To date, the primary focus in the IT industry has been on power consumption within the data center. More companies are opting to locate data centers near sources of inexpensive energy, such as hydroelectric power. In an August 2007 report to the U.S. Congress, the Environmental Protection Agency (EPA) recommended a series of efficiency opportunities and policies that could drive a potential \$4 billion savings in annual electricity costs related to data centers.¹

PC power consumption is also a significant expense for corporations and, in July 2007, the EPA released its ENERGY STAR 4.0 specification addressing this issue. The ENERGY STAR rating² has been more closely associated with major home appliances and heating and cooling systems. The previous ENERGY STAR 3.0 specification for PCs only addressed “sleep” power, not actual power during use. Thus, nearly all PCs, including powerful gaming systems, could easily meet the requirements. This disparity resulted in an inability to differentiate energy-efficient products from standard or even power-guzzling products.

The new ENERGY STAR 4.0 specification calls for an 80 percent minimum power-supply efficiency and sets maximum values for standby, sleep and idle power for desktop PCs that vary depending on the performance level of the system. Tier-1 specifications in effect in 2007 are designed so that approximately 25 percent of PCs will meet requirements. A Tier-2 specification, to be released on July 1, 2009, will set additional standards for PCs that don't meet the strict Tier-1 requirements.

PCs that meet the new ENERGY STAR 4.0 requirements will become increasingly popular with corporations and government agencies. Corporations may choose to purchase ENERGY STAR PCs as part of their “green” initiatives. The U.S. government signed an executive order on January 24, 2007, mandating that federal agencies must purchase PCs that meet ENERGY STAR 4.0 requirements. Similarly, the European Parliament voted on July 10, 2007 to apply energy-efficiency criteria no less stringent than ENERGY STAR requirements for the purchase of all public sector office equipment, including PCs, within the European Union.

Hitachi Reduces Hard-Drive Power Consumption

Desktop hard disk drives (HDDs) from Hitachi have incorporated Advanced Power Management capabilities to reduce power consumption, beginning with the Deskstar 120GXP hard drive, which was seven product generations ago. With the introduction of the Deskstar P7K500 drive in 2007, Hitachi took taken power efficiency one step further while maintaining 7200 RPM performance. The Deskstar 7K1000.B improves power efficiency even more.

The Deskstar P7K500 and 7K1000.B hard drives provide customers with industry-leading power consumption — up to a 40-percent improvement over prior generation products — by reducing power in both idle and active modes. These reductions were achieved by using the same system-on-chip (SOC) designs that are used in the Hitachi Travelstar™ 2.5-inch mobile product line, where low power has long been a key design attribute to maximize battery life in notebook PCs. These SOCs incorporate Hitachi Voltage Efficiency Regulator Technology (HiVERT™) where switching regulators are used in place of the less-power-efficient linear regulators in the voltage reduction processes. Also included in the SOC is a more power-efficient module for the Serial-ATA and Parallel-ATA interfaces.

Combining the new technologies incorporated into the Deskstar P7K500 and 7K1000.B HDDs with its Advanced Power Management capabilities, Hitachi has reduced the overall power consumption of the HDD to industry-leading levels. Through the use of Hitachi-patented load/unload technology, the Deskstar P7K500 and 7K1000.B HDDs allow for additional power reductions:

- **Unload idle** — The heads are safely unloaded to the ramp and the servo is shut off; this mode delivers power savings of more than 10 percent better than idle mode.³
- **Low RPM idle** — The heads are safely unloaded to the ramp, the servo is shut off and the spindle motor RPM is reduced; this setting achieves power savings of more than 40 percent better than idle mode.³

When Advanced Power Management is enabled, the hard drive can automatically enter the lower-power idle states described above, at intervals based on the time since the host system last accessed the hard drive. A 320GB Deskstar 7K1000.B can transition from normal idle (3.6W power) to unload idle (3.1W) to low RPM idle (1.9W) during periods of inactivity and return to normal operation automatically whenever the host system accesses it again. These transitions to lower-power idle states are done without intervention from the host system.

Leaving More Power for Advanced Features

The largest benefit of reducing the power consumption of the HDD in a desktop PC comes not from the savings in operating cost, but from the additional power margin in designing to the strict ENERGY STAR 4.0 requirements on idle power. Figure 2 shows a typical power partitioning for a basic ENERGY STAR system with a 50W idle power maximum.⁴ Designing a 320GB Deskstar 7K1000.B into this system with 3.6W idle power instead of this typical HDD with 7W idle power eliminates 3.4W of nonproductive power that can instead be used to provide additional features and functions on the PC. As an example, a systems designer could add an additional optical drive (1.3W), increase the system RAM by 1GB DDR2 SDRAM (1.5W) and still have 0.8W of power that could be allocated to additional ports on the motherboard.

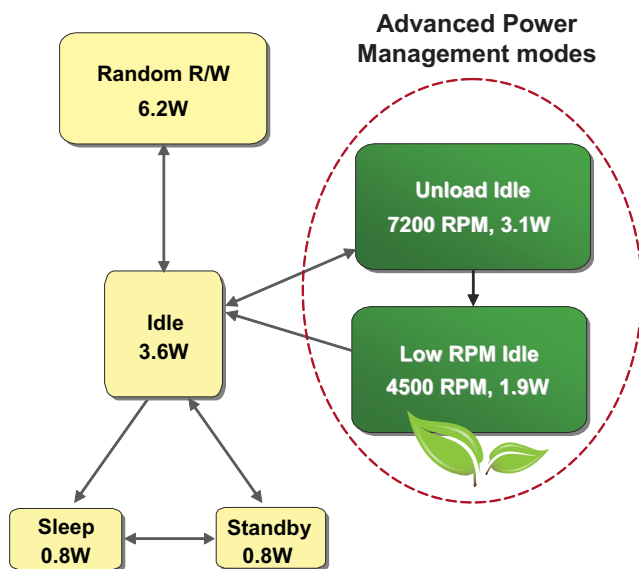
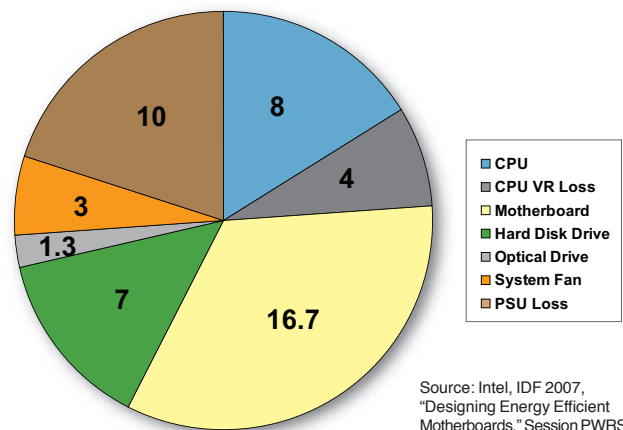


Figure 1: Power data for 320GB Deskstar 7K1000.B



Source: Intel, IDF 2007, "Designing Energy Efficient Motherboards," Session PWRS005

Figure 2: Typical power partitioning for a 50W ENERGY STAR system

Conclusion

The trend toward the "greening" of IT will continue to be a driving force behind IT product development efforts as PC and server OEMs build products to comply with global energy-rating programs. Every component within these systems must also be specified to contribute to reductions in overall power consumption.

Hitachi has led HDD development efforts aimed at reduced power consumption during the past seven generations of Deskstar products, and has had industry-leading power specifications in its Travelstar mobile HDDs for many product generations. These technologies have converged in the Deskstar P7K500 and 7K1000.B hard drives to provide up to a 40-percent reduction in power consumption over prior generation products, resulting in the industry's most energy-efficient desktop hard drives, and enabling positive effects on overall power consumption within the PC system.

Footnotes

¹“Report to Congress on Server and Data Center Energy Efficiency” by EPA, August 2007.

²ENERGY STAR is a government program that offers businesses and consumers energy-efficient solutions, making it easy to save money while protecting the environment for future generations. The EPA's ENERGY STAR partnership for businesses offers a proven energy management strategy that helps in measuring current energy performance, setting goals, tracking savings and rewarding improvements. EPA provides an innovative energy performance rating system, which businesses have already used for more than 26,000 buildings across the country. The EPA also recognizes top-performing buildings with the ENERGY STAR.

³Based on power specifications for the SATA interface (3.6W idle and 3.2W unload idle for an 11 percent reduction and 2.0W unload idle for a 44 percent reduction for the one-disk, 250GB SATA model).

⁴Huard, D. (2007, September). Designing Energy Efficient Motherboards. Presented at Intel Developer Forum, San Francisco, CA.

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