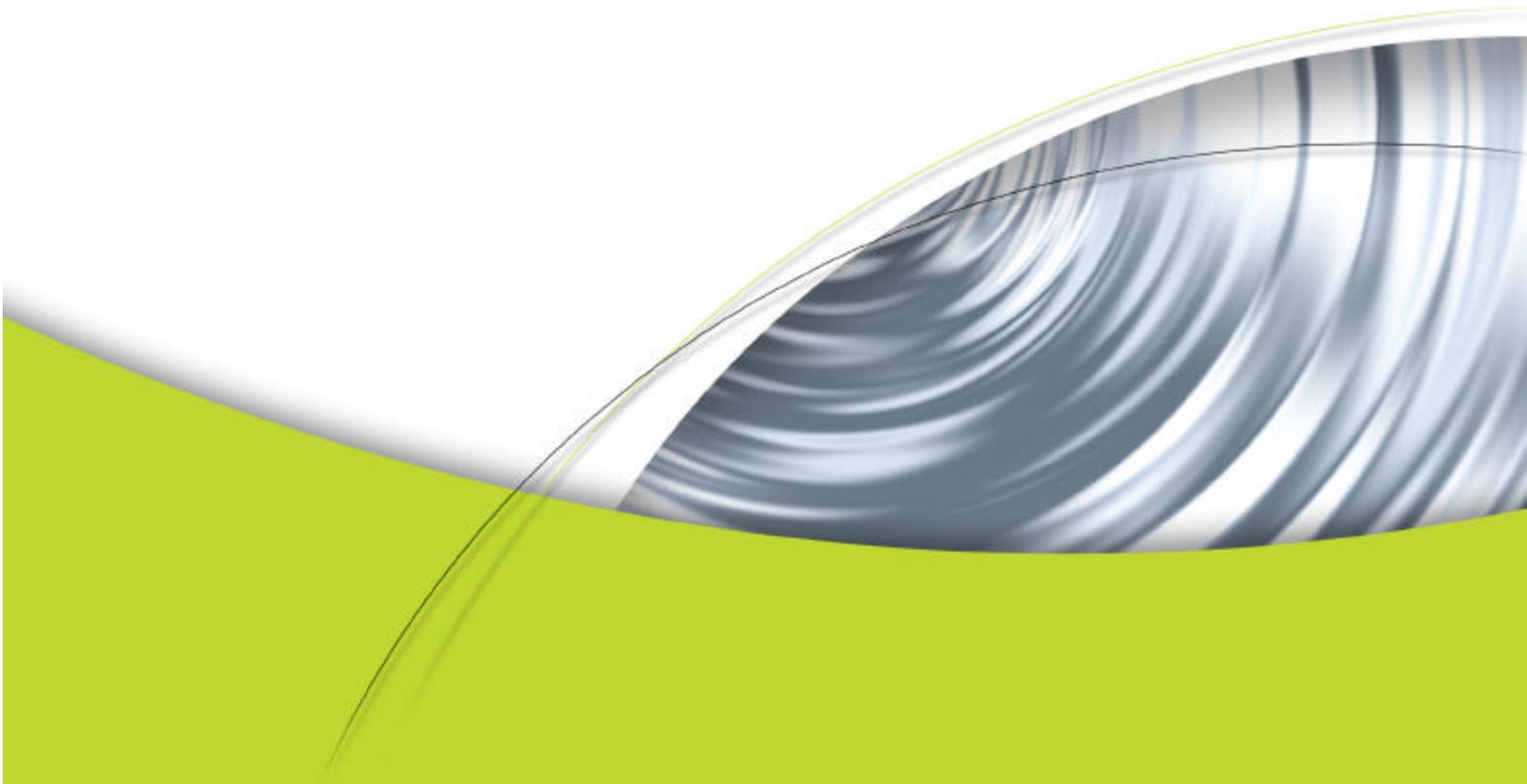




Technical Brief

NVIDIA Storage Technology
Confidently Store Your Digital
Assets





Confidently Store Your Digital Assets

The massive growth in broadband connections is fast enabling consumers to turn to legal music download services as a simple means for getting the latest hot MP3. Hear the song, buy the song. It's that simple. At the same time, digital cameras are now so common that snapping family pictures and quickly sharing them with relatives and friends is only a quick e-mail away. Consumer concerns are not about buying MP3s or sharing digital pictures—it's about keeping them safe. What do you do if your computer disk crashes? It is remarkable to think that the cost of the MP3s stored on your hard disk is now greater than the cost of the hard disk itself.

On another front, PC video gaming has evolved to a point where the game play and imagery is so remarkably real and engaging that the experience is like being in a movie. A growing complaint is that changing levels within a game is too slow and the feeling of immersion is lost. Bottom line—the gaming experience is negatively affected. Why does this happen? It simply takes too long to load the next game level from the hard disk drive.

NVIDIA's new storage solution addresses these problems. Want your MP3s and digital photos protected? Use the NVIDIA storage solution to set it up. Want to shorten the wait when loading new game levels? The NVIDIA storage solution has the answer.

NVIDIA is making this possible by bringing the very technology used by the world's businesses for quickly accessing and protecting their most important data—known as Redundant Array of Independent Disks (RAID) technology—to the common PC desktop. NVIDIA uniquely offers a simple management interface that allows you to easily configure or change your multi-disk arrays. Do you want data protection? Simply set up one disk as a mirrored copy of the first. You can provide further protection by assigning dedicated spare disks that are ready to be automatically used as backups should one of the mirrored disks with your digital assets fail. Another NVIDIA innovation alerts you when a disk does fail and shows you which one to replace. Do you want faster access to your stored assets? Set up two disks to operate in parallel (known as striping) by clicking a button on the storage management user interface.

This paper is an overview of the advantages and specifics of the NVIDIA storage solution, and describes the applications and computing environments that will benefit.

Industry-Defined Multi-Disk Techniques

Multi-disk techniques were first published in 1988 by a multivendor consortium—the RAID (Redundant Array of Independent Disks) Advisory Board. Each multi-disk technique was divided into different categories or levels. Originally, multi-disk techniques focused on improving resiliency or data availability. As additional techniques were defined, one was introduced for improving performance. For all levels, multi-disk techniques optimize storage solutions by grouping disks together and treating them as a single storage resource.

Disk Striping: Delivers Unmatched Storage Performance and Scalability

Disk striping, also known as RAID 0, is a multi-disk scheme that improves the disk read and write times for many applications, improving overall storage performance in a system. Data is “striped” across multiple disks in an array. In this manner, reads and writes to multiple drives can be carried out in parallel, improving the overall access time for disk operations (Figure 1).

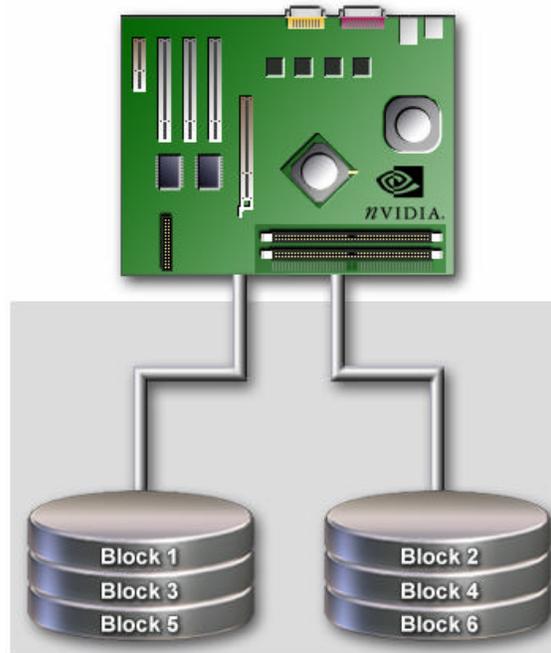


Figure 1. Disk Striping (RAID 0)

Disk Mirroring: Added Protection for Your Most Important Digital Assets

Disk mirroring, also known as RAID 1 (Figure 2), is a multi-disk scheme targeted for those that want to easily back up their important assets. Every write is actually carried out twice, in parallel. The mirrored, or backup, copy of the data can reside on the same disk or on a second redundant drive in the multi-disk configuration. Disk mirroring provides a hot-standby copy of data if the active volume or drive is corrupted or becomes unavailable because of a hardware failure. Disk mirroring techniques can be applied for high-availability solutions, or as a form of automatic backup that eliminates tedious manual backups to more expensive and less reliable media.

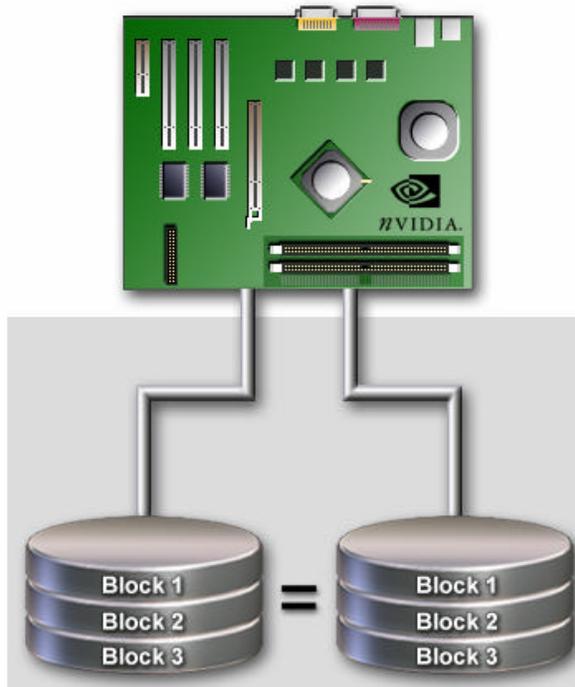


Figure 2. Disk Mirroring (RAID 1)

Disk Striping and Mirroring: For Performance and Protection

Disks that are striped (RAID 0) can be mirrored using disk mirroring (RAID 1) techniques. A disk striping and mirroring (RAID 0+1) configuration provides improved performance and added protection (Figure 3).

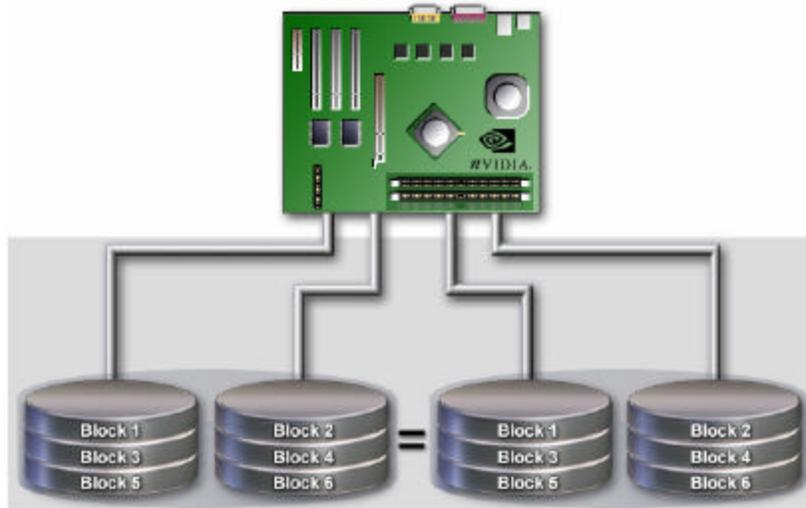


Figure 3. Disk Striping and Mirroring (RAID 0+1)

NVIDIA Storage

NVIDIA storage technology implements standard disk striping, disk mirroring, and disk stripe/mirroring techniques to optimize the use of your storage assets. NVIDIA storage technology additionally introduces many innovations that simplify and optimize the management of multi-disk features and disk resources.

Serial ATA 3Gb/s (SATA2)

SATA 3Gb/s is the next-generation storage technology offering greater disk bandwidth that overcomes the growing limitations of the older Ultra ATA and SATA 1.5Gb/s technologies. SATA 3Gb/s offers double the speed over current SATA technology, more efficient bus utilization, faster data backup and retrieval, faster recovery from signal drop/failure (asynchronous signal recovery), and overall improved system responsiveness.

Disk Failure Identification

Most multi-disk users purchase several identical hard drives to take full advantage of their disk array. If an array fails, the only way they can identify their failed drive is by locating a serial number, thereby limiting the users' ability to correctly identify a failed drive.

The NVIDIA Disk Alert System facilitates identification by going a step further. An alert will display an image of the system motherboard and highlight the failing port, providing a visual indication so you know exactly which hard drive to replace (Figure 4).

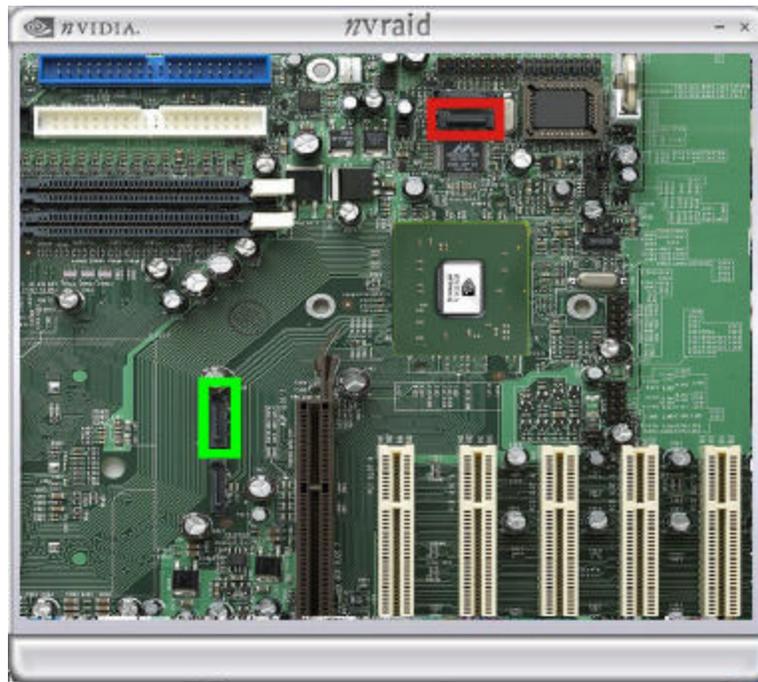


Figure 4. NVIDIA RAID's Disk Alert System Shows Which SATA Connector the Failed Drive Is Connected To

Spare Disk Allocation

Disk mirroring techniques let users designate spare drives that can be configured as hot standbys, protecting the disk array in the event of a disk failure. A *shared spare* can protect multiple arrays of drives, or a *dedicated spare* can serve as a hot standby for a particular drive array.

The spare disk feature, which offers protection that goes beyond mirroring data, has traditionally been limited to high-end multi-disk systems. The NVIDIA storage solution brings this high-end capability to the PC. A dedicated spare can take over for a failed disk until the repair is completed—giving support teams the flexibility to choose convenient repair times.

Morphing

In a traditional multi-disk user environment, users who want to change the current state of a disk or the current multi-disk array must back up the data, delete the array, reboot the PC, and then reconfigure the new array. During this process, the user has to go through multiple steps just to simply reconfigure a new array.

The NVIDIA storage solution, however, allows users to change the current state of the disk or array to another with a one-step process called “morphing.” Morphing lets users upgrade their current disk or array for more performance, higher security, and higher capacity. More importantly, the upgrade is accomplished without going through multiple steps. The morphing feature offers an upgradeable option to easily manage storage.

Cross-Controller RAID

Unlike competitive multi-disk (also known as “RAID”) solutions, the NVIDIA storage solution uniquely supports both Serial ATA (SATA) and parallel ATA disk devices within a single multi-disk array (Figure 5). Users need not know the semantics of each disk drive—individual setup differences are transparent to the user.

A single setup procedure applies to all drives, shortening the learning curve for users who have a variety of disk drives in their computing environment. This flexibility also makes it possible to use all the storage resources and lets users easily expand the number of drives in a particular array.

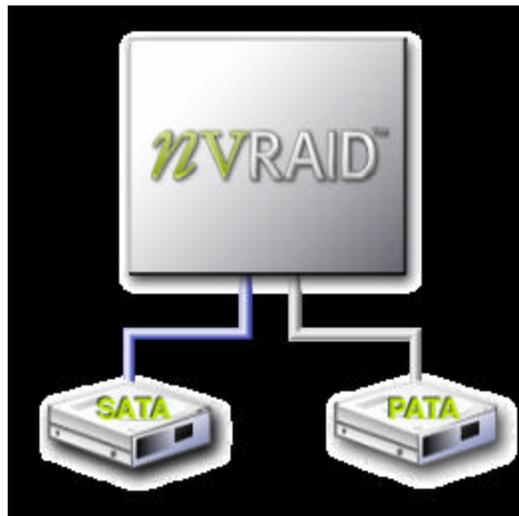


Figure 5. NVIDIA Storage Solution Supports the Simultaneous Use of Both SATA and PATA Hard Drives in a Single Array

Booting from a Multi-Disk Array

The NVIDIA storage solution fully supports the use of a multi-disk array for loading the operating system at power-up. This means that all available disk drives can be included in the array for optimal performance and protection of all storage.

On-the-Fly Rebuilds

If a disk fails, disk mirroring techniques allow continuous operation by taking advantage of the mirrored data copy in the array. The NVIDIA storage solution offers more—it lets a user rebuild a new mirrored copy for the data while the system is up and running, without disrupting user and application access to the data set. Rebuilding on the fly eliminates down time and maximizes protection for critical storage resources.

Hot-Plug

The NVIDIA storage solution includes hot-plug support for SATA drives. In the case of a failed drive, the “hot-plug” feature let users swap out the failed hard drive without powering down the system, and replacing it with a new one.

The NVIDIA User Interface

Using the intuitive user interface, anyone—including users without experience setting up multi-disk arrays—can apply and manage the NVIDIA storage (also known as NVIDIA RAID) technology. Point-and-click operations lead users through the steps to specify which disks to configure in an array, turn on striping, and build mirroring volumes. Configuration changes can be quickly and easily carried out at any time, using the same interface (Figure 6).

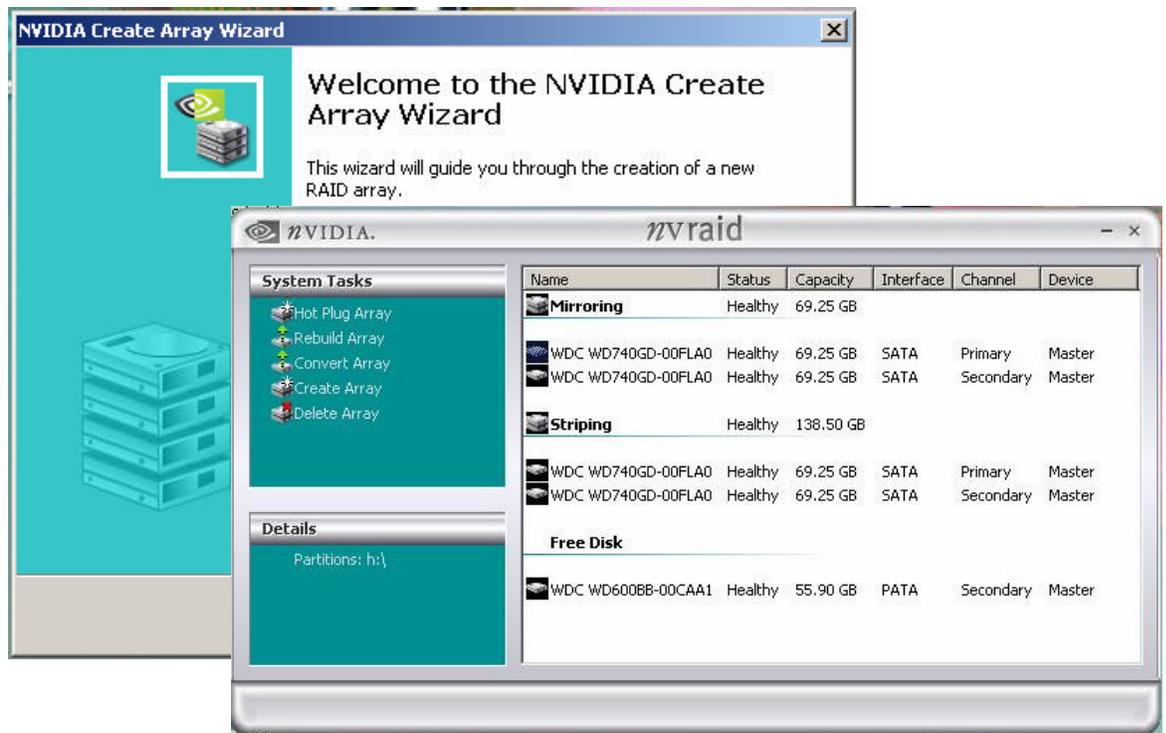


Figure 6. NVIDIA's Interface: Easy Setup and Management of Disk Storage Resources (Mirroring)

Applications

Multi-disk solutions deliver several categories of benefits to various applications:

- ❑ Performance optimization
Disk striping techniques result in higher throughput to and from an array of disk drives.
- ❑ Data protection
Data is mirrored to a second drive, so the probability of data loss because of drive failures is zero.
- ❑ Data availability
NVIDIA storage technology implements multi-disk techniques in a manner that minimizes downtime for individual drives and the entire array.
- ❑ Automated backups
For users who do not have the staff or expertise to perform regular backups and manage data restores in the event of failures, multi-disk techniques offer a cost-effective alternative. The NVIDIA storage solution uniquely simplifies the process with an intuitive interface for setting up and managing multi-disk arrays.

Applications and users that can benefit from NVIDIA storage solutions are identified in the following paragraphs.

Archiving Videos and Photos: Performance, Data Protection

Personal archiving of family videos and photos is a growing application area for home computing. As families opt for the convenience of online storage, editing, and file sharing with friends and relatives, the storage requirements have expanded. The requirements now include adequate performance when sharing large files, and protection (backup) for priceless family history. NVIDIA storage technology addresses all these requirements, without requiring the home user to become a storage expert.

Multiple drives can be easily configured to mirror (or back up) critical data and support striping for enhanced performance to avoid dropped frames during video editing operations. As disk storage continues to drop in price, this alternative has become a very practical solution within home computing environments.

Architectural: Data Protection, Automated Backups

Small engineering firms typically cannot afford a dedicated IT support team, but must somehow ensure the availability and protection of valuable engineering drawings and project files. The NVIDIA storage technology provides an affordable and easy-to-use solution with immediate benefits to these types of small businesses.

- ❑ Disk mirroring ensures the *availability* of stored files.
- ❑ Mirroring also provides an *automatic backup* copy, eliminating the need for time-consuming copying of files to expensive tapes or other media.
- ❑ Disk striping can be implemented to *shorten the access times* for large engineering files, and to improve productivity, especially for projects that require collaborative efforts and file sharing.

Manufacturing: Data Availability

Any production line incurs a cost (lost revenue) when operation is disrupted. The PCs controlling the line must have constant access to critical program and data files to avoid downtime. Disk mirroring techniques can be applied in these types of mission-critical situations to affordably gain high availability and protection for critical storage resources.

Multithreaded Client/Server Applications: Performance

Multithreading, a popular programming technique for large software applications, puts an increased burden on a storage system. Multiple active program paths generate additional disk accesses and can quickly bog down a single drive. Similarly, many server applications result in overly taxed PC clients, plus increased loads on the desktop storage devices.

Multi-disk techniques, by striping data across multiple drives, can increase the throughput of a desktop storage solution and ensure the performance required for today's complex applications.

Conclusion

The NVIDIA storage technology, a standard feature in the latest NVIDIA nForce™ MCPs, provides a cost-effective foundation for reliable, highly available, and optimized data storage solutions. With an easy-to-use interface, the NVIDIA solution removes the barriers associated with multi-disk management in the past. NVIDIA's storage technology shifts the scale back in the direction of reliability and stability, and lowers the total cost of ownership for optimized, highly available data storage solutions.



Notice

ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS (TOGETHER AND SEPARATELY, "MATERIALS") ARE BEING PROVIDED "AS IS." NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE.

Information furnished is believed to be accurate and reliable. However, NVIDIA Corporation assumes no responsibility for the consequences of use of such information or for any infringement of patents or other rights of third parties that may result from its use. No license is granted by implication or otherwise under any patent or patent rights of NVIDIA Corporation. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. NVIDIA Corporation products are not authorized for use as critical components in life support devices or systems without express written approval of NVIDIA Corporation.

Trademarks

NVIDIA, the NVIDIA logo, and NVIDIA nForce are trademarks or registered trademarks of NVIDIA Corporation in the United States and other countries. Other company and product names may be trademarks of the respective companies with which they are associated.

Copyright

© 2004 by NVIDIA Corporation. All rights reserved.



NVIDIA.

NVIDIA Corporation
2701 San Tomas Expressway
Santa Clara, CA 95050
www.nvidia.com