Power Mac G4

Technology Overview

August 2002

Contents

3 Introduction

4 Product Overview

5 Dual Processing Xserve-Based Architecture
- 5 Efficient processor design
- 6 Advanced L3 cache
- 7 Balanced overall system

8 Mac OS X and Dual Processing
- 8 Preemptive multitasking
- 8 Symmetric multiprocessing
- 9 Multithreading

10 Cinematic Graphics and Displays
- 10 AGP 4X graphics options
- 12 Advanced graphics in Mac OS X
- 13 Apple all-digital displays
- 13 Dual display support

15 New Enclosure, More Expansion
- 15 Four open PCI slots
- 15 Dual ATA controllers, four internal hard drive bays
- 16 Second optical drive bay
- 16 Network and device connectivity

18 SuperDrive

19 Real-World Performance
- 19 Design and publishing
- 20 Professional video
- 21 DVD authoring
- 22 Music and audio
- 23 Science and technology
- 24 Business and productivity
- 25 Higher education

26 Product Details
- 26 Standard configurations
- 27 Build-to-order options
- 27 Apple displays
- 27 Extended service and support

28 Technical Specifications

Introduction

The new Power Mac G4 is the most powerful desktop computer Apple has ever built. Now with three dual processor configurations, an all-new Xserve-based system architecture, and an operating system that's built from the ground up for dual processing, the Power Mac G4 delivers unprecedented performance.

The Power Mac G4 now features an efficient processor design, an advanced memory architecture, and a balanced overall system, which together provide an ideal hardware platform for creative, scientific, business, and entertainment applications. A sophisticated graphics architecture based on the latest graphics processors from ATI and NVIDIA delivers stunning realism to Apple's all-digital flat-panel displays. The Power Mac G4 has more room for expansion, too, with space for up to 2GB of main memory, two optical drives, and almost half a terabyte of internal storage. Users can add audio, video, and graphics capabilities with integrated PCI expansion—or author professional DVDs using the built-in SuperDrive.[1]

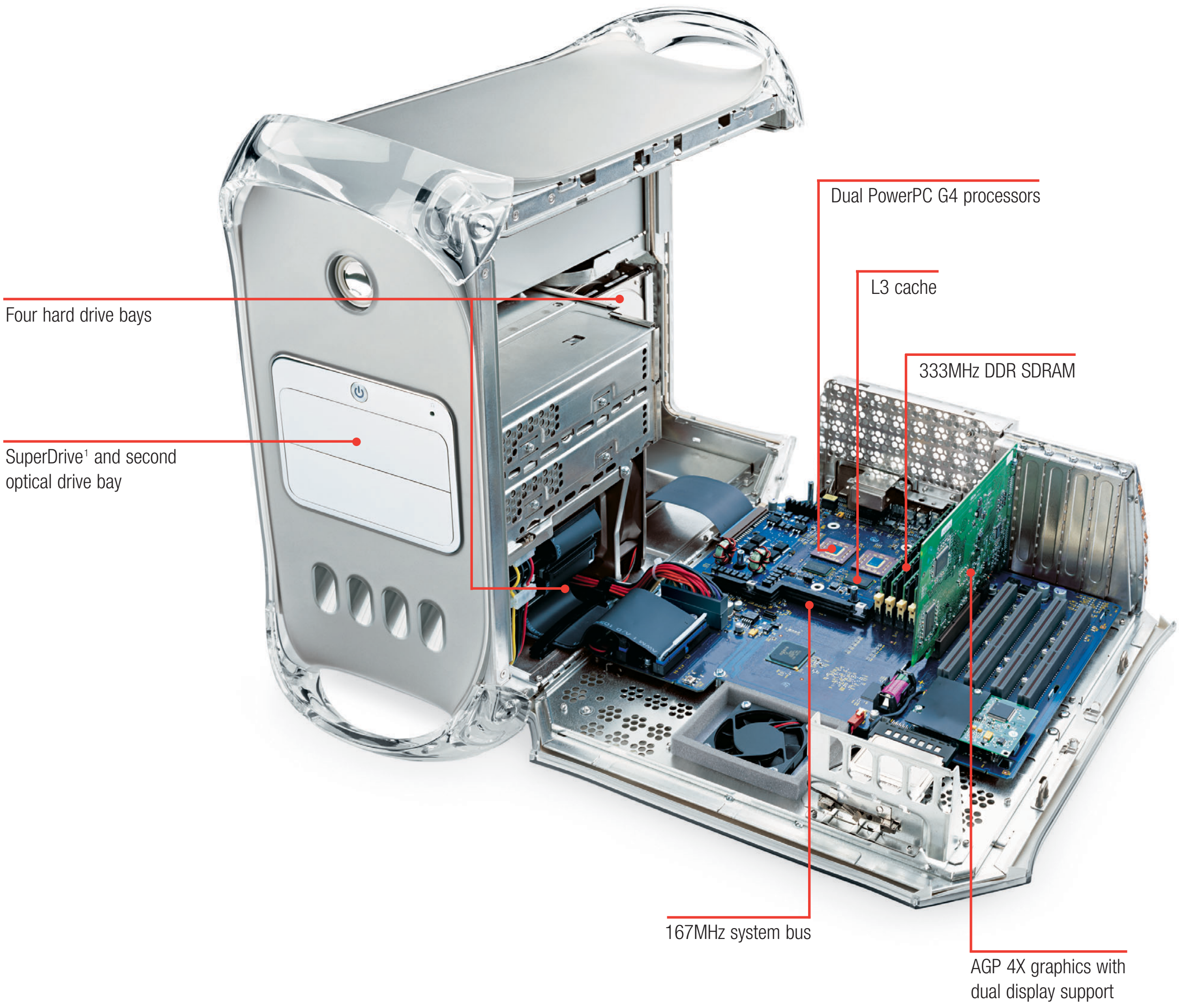
With Mac OS X version 10.2 "Jaguar" preinstalled, the Power Mac G4 features enhanced symmetric multiprocessing and multithreading to elicit maximum performance from each G4 processor. Quartz Extreme, a new Jaguar feature, uses the onboard graphics hardware capabilities to deliver onscreen 3D rendering, compositing, and transparency—unavailable on other operating systems. And standards-based networking enables the Power Mac G4 to work seamlessly with Windows computers, as well as in heterogeneous server environments.

Thousands of applications are now available for Mac OS X and the Power Mac G4. Industry favorites like Adobe Photoshop, Apple's Final Cut Pro, and Microsoft Office include unique Mac OS X features. Because they've been optimized to take advantage of the dual processing capabilities of the Power Mac G4, these applications are faster, more responsive, and more reliable than on other platforms.

With a superfast dual processor architecture, a powerful UNIX-based operating system, and new versions of industry-leading applications, the Power Mac G4 is the perfect solution for creative departments, publishing shops, research centers, video and audio houses, and businesses everywhere.

Product Overview

The Power Mac G4 features a new Xserve-based architecture, optimized to meet the needs of high-performance desktop computer users.


Dual PowerPC G4 processors
L3 cache
333MHz DDR SDRAM
Four hard drive bays
SuperDrive¹ and second optical drive bay
167MHz system bus
AGP 4X graphics with dual display support

Dual Processing Xserve-Based Architecture

For the ultimate in computing power, all new Power Mac G4 systems are based on the highly acclaimed Xserve architecture, including dual PowerPC G4 processors, Double Data Rate main memory, and a unique low-latency system architecture. With an efficient processor design, advanced L3 cache, and balanced overall system, the new Power Mac G4 delivers fast results and improved productivity.

Efficient processor design

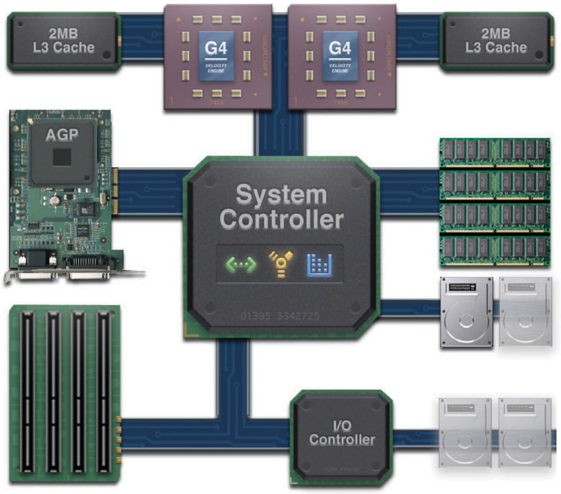
The Power Mac G4 was designed for maximum efficiency, with a short seven-stage pipeline and the Velocity Engine vector processing unit.

Short pipeline. The length of the processor pipeline refers to the number of processing steps, or stages, it takes to accomplish a task. Examples of stages include fetching data, decoding data, executing instructions, and storing data. The PowerPC G4 processor has seven stages, while the Pentium 4 processor has 20 stages. Because of its efficient seven-stage design, the PowerPC G4 can accomplish the same task in 13 fewer steps than the Pentium 4.

Adobe Photoshop performance
All three Power Mac G4 models outperform the fastest Pentium 4–based PCs on the market. The dual 1.25GHz Power Mac G4 is up to 90 percent faster than a 2.53GHz Pentium 4–based PC in Adobe Photoshop 7 tests. See page 20 for more details.

A short processor pipeline enables each processor to recover from changing data dependencies in less time. All advanced processors try to increase performance by guessing what they'll need to do next. This is called speculative operation. Of course, the processor doesn't always guess correctly, and it often has to clear the pipeline and start over when it's wrong. Periods of time when no data is available for processing, known as bubbles, leave the processor idle while it waits for new data. Because the PowerPC G4 pipeline is short, the processor can recover from bubbles very quickly, resulting in higher processor utilization. With fewer processing steps, faster recovery, and higher utilization, processor output is maximized.

Velocity Engine. The PowerPC G4 processor improves efficiency further with a specialized vector processing unit called the Velocity Engine. The Velocity Engine uses SIMD (single instruction multiple data) technology, which is the application of a single instruction to multiple data at the same time in a single operation, to accelerate data processing. Software programs that use vector processing typically transform large sets of data as they edit an image or render a video effect. For example, when a filter is used to apply a motion blur to an image, each pixel of the image must be changed according to the same set of instructions—a highly repetitive processing task. The Velocity Engine accelerates this task by modifying the image in large 128-bit chunks. And since the Velocity Engine is a separate processing unit, it can work on an intensive task while the other functional units in the processor are crunching other data.



The Power Mac G4 system architecture is optimized for performance with dedicated L3 cache, Double Data Rate main memory, and a faster system bus.

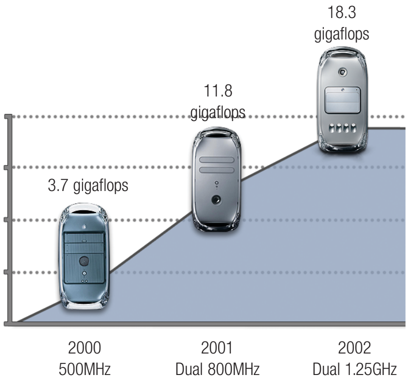
Advanced L3 cache

An efficient processor alone doesn't guarantee results with real-world applications. The system architecture needs to make the most of the processor's computing power by providing fast access to the data and application code it uses. The Power Mac G4 maximizes the efficiency of the PowerPC G4 processor through its unique cache memory architecture.

In standard computer architecture, the processor accesses data from the hard drive and main memory. It takes a long time to get data from the hard drive, while accessing data from main memory is significantly faster—which is why users working with huge data sets prefer to equip their systems with large amounts of RAM. The new Power Mac G4 architecture takes this concept one step further with an even faster level of memory called L3 cache.

L3 cache is high-speed Double Data Rate memory (DDR SRAM). It provides fast access to data and application code, because it has a dedicated bus to the processor, providing throughput of up to 4 GBps with no bottlenecks caused by other data transfers. The high speed of L3 cache, with its dedicated bus, allows the processor to receive data over five times faster than from main memory, with its lower speed and shared bus. Because of this low latency, the processor is constantly fed with data—so it doesn't sit idle, waiting for the next set of data to arrive. Each processor in the new Power Mac G4 has its own L3 cache, enabling the two processors to share data seamlessly with each other without pausing to update main memory.

With up to 2MB of dedicated memory, the L3 cache can store large portions of active application code and data. When a user runs an application, most of the active program code and user data is in the L3 cache. This keeps the most important information close to the processor and quickly accessible. (The concept is similar to caching web pages on the hard drive. If you click the Back button on your web browser, your computer will use the data you recently downloaded, rather than load the same data again.) In contrast, on standard PC architecture, data travels from main memory to the processor through the system controller, where data and instructions from other subsystems are also moving. Congestion among these various data streams causes slowdowns in the overall transfer rate, which in turn hampers application performance.



Gigaflop test
The PowerPC G4 processor is the chip that put supercomputing power on the desktop with the original Power Mac G4. What makes a supercomputer "super" is its ability to execute at least one billion floating-point operations per second, or one gigaflop. To illustrate the advance in the processing power of the Power Mac G4, we compared the new dual 1.25GHz Power Mac G4 to previous systems, starting with the original single-processor 500MHz Power Mac G4.

Balanced overall system

Optimum performance demands efficient operation from all aspects of the system architecture. The new Power Mac G4 architecture is designed to accommodate the high volume of system traffic required for complex processing. The major features of this balanced design include a faster system bus, DDR main memory, dual ATA hard drive controllers, a direct PCI bus, and integrated high-speed I/O controllers.

Faster system bus. A new system controller, first introduced in the Xserve, integrates all the components of the Power Mac G4 and transfers data among them. The speed of the system bus sets the pace for data transfer speed across the entire system. Power Mac G4 customers can choose a 133MHz system bus or a 167MHz system bus for high-speed performance.

Double Data Rate (DDR) main memory. New Power Mac G4 systems feature Double Data Rate synchronous dynamic random access memory (DDR SDRAM). DDR SDRAM allows the system to read and write data to and from memory on both the rising and falling edge of each clock cycle. It provides twice the throughput of Single Data Rate (SDR) SDRAM, which reads and writes only on the rising edge of the clock cycle. The resulting throughput between main memory and the system controller is 2.7 GBps, more than double the throughput of the previous dual 1GHz Power Mac G4.

DDR SDRAM also increases memory bandwidth to the processors and all other elements of the system. Direct memory access (DMA) allows system elements, such as a hard drive controller or a graphics processing unit, to send and receive data directly from main memory, without going through the processors. The added memory bandwidth allows system elements to function independently at high data rates, boosting total system performance.

Dual ATA hard drive controllers. The Power Mac G4 now includes one ATA/100 bus and a second ATA/66 bus. With two drives on each bus, users can install up to 480GB of internal storage.[2] For maximum bandwidth, two drives can be distributed across the storage subsystem, with one drive on each ATA bus. In addition, Mac OS X RAID allows multiple hard drives to be striped for faster performance or mirrored for data redundancy. (All standard systems ship with a 7200-rpm hard drive on the ATA/100 bus.)

Direct PCI bus. The new Power Mac G4 optimizes PCI performance by connecting directly to the 667-MBps internal bus of the system controller, for a maximum throughput of 266 MBps. In a typical PC architecture, PCI is connected to the I/O controller through a bridge—a stage in the data path where speeds are normalized, causing a slowdown of data. This constrains throughput to 133 MBps and limits the speed of otherwise fast PCI devices. In contrast, the direct bus to the PCI slots on the Power Mac G4 guarantees high throughput and low congestion. The Power Mac G4 also supports write combining, which allows write instructions to be grouped into one large instruction, further increasing data throughput.

Integrated high-speed I/O. FireWire and Gigabit Ethernet are high-performance technologies for connecting to the latest peripherals and high-speed networks. On PCs, these features are often installed as PCI cards, causing additional data congestion for the PCI bus and I/O controller. On the Power Mac G4, FireWire and Gigabit Ethernet are integrated directly into the system controller. This dedicated connection reduces PCI congestion and guarantees low latency, resulting in optimal FireWire and Ethernet performance.

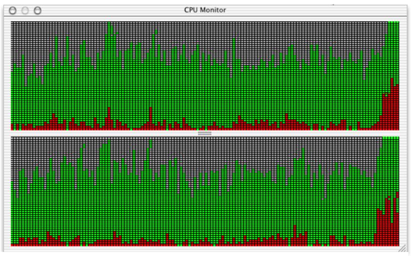
Mac OS X and Dual Processing

Mac OS X was designed for multiprocessor computing. With enhanced preemptive multitasking, symmetric multiprocessing, and multithreading capabilities that speed up individual applications and provide true multitasking, it includes features that weren't available in Mac OS 9. Now with dual processors powering every system, all Power Mac G4 users receive the unique performance benefits that Mac OS X can deliver.

Preemptive multitasking

Preemptive multitasking allows the operating system to dynamically adjust processing priorities between tasks and applications based on individual application needs and user requirements. This means users can run several processor-intensive applications at the same time. For example, users can burn a DVD in the background while they are editing an image and checking email. Mac OS X is always in control of the computer's priorities, so the user interface is consistently responsive.

In contrast, Mac OS 9 was designed for cooperative multitasking, which allowed processor-intensive applications to take control of the operating system, making the user interface unresponsive. This meant that users could virtually go out for a cup of coffee until their DVD project was completely encoded and burned to disk.



Users can watch dual processors in action using CPU Monitor, located in the Utilities folder. The even distribution of processing across both processors illustrates the effectiveness of symmetric multiprocessing in Mac OS X.

Symmetric multiprocessing

Symmetric multiprocessing takes the preemptive multitasking concept to the next level by managing processing priorities between two processors. In symmetric multiprocessing, the operating system sees each processor as a resource that can be used for either operating system or application needs—and arranges tasks between processors for maximum efficiency. For example, Mac OS X could encode video for a DVD on one processor, while an email application and an image-editing application run primarily on the second processor. This enables tasks to be completed simultaneously, making the system more responsive to the user. Any application can be assigned to any processor, and no special optimization is required for applications to take advantage of this feature. In Mac OS 9, applications had to be specially written to use a limited set of multiprocessor APIs in order to access the second processor in a dual processor system.

Multithreading

For maximum efficiency, processes can be broken down into subprocesses called threads, which can then be arranged between processors for maximum performance. Mac OS X and many applications have been written to be multithreaded to achieve this benefit. For example, if you were creating a transition between two clips of video, the process would include decoding the first clip, decoding the second clip, rendering the transition, and re-encoding the transition into the original format. In Mac OS X, the two clips can be decoded at the same time, one on each processor. Afterwards, while the transition is rendering on one processor, finished frames can be re-encoded on the second processor. Because threads are processing in parallel, the process is completed in significantly less time.

Because Mac OS X itself is a multithreaded operating system, system processes can also be dispatched between processors. For example, a networking thread can execute on one processor while a Finder thread executes on the other. The result is faster operating system performance and improved user interface response. Because Mac OS 9 is not a multithreaded operating system, it always runs on a single processor, and only certain applications can take advantage of the second processor.

Symmetric multiprocessing lets you run multiple tasks at the same time.

Multithreading means faster operating system and application performance.

Preemptive multitasking ensures that the user interface is always responsive.

Cinematic Graphics and Displays

The Macintosh is the premier platform for graphics processing. The new Power Mac G4 features the latest in high-performance graphics processors from NVIDIA and ATI, a powerful AGP 4X graphics bus, and a full-time hardware-accelerated graphics pipeline in Mac OS X v10.2 called Quartz Extreme. For expansive viewing, Apple's all-digital flat-panel displays complete the picture; and support for dual displays—including two Apple flat panels—is built into every new Power Mac G4.

AGP 4X graphics options

The new Power Mac G4 ships with a choice of AGP 4X graphics cards: the NVIDIA GeForce4 MX, the ATI Radeon 9000 Pro, or—the ultimate graphics accelerator—the NVIDIA GeForce4 Titanium for incredible game play and stunning visualization. With full support for dual display capabilities, all three cards feature ADC and DVI connectors and include a DVI to VGA adapter.

NVIDIA GeForce4 MX. The GeForce4 MX is NVIDIA's latest-generation graphics processor. Based on NVIDIA's Lightspeed Memory Architecture II, it offers performance that was previously available only on high-end visualization workstations. Featuring 32MB of DDR memory and capable of 1.1 billion textured pixels per second, the GeForce4 MX supports large textures for realistic 3D graphics in today's games and professional visualization applications.

ATI Radeon 9000 Pro. The Radeon 9000 Pro is an advanced graphics card with a 64MB DDR SDRAM frame buffer and flexible dual display support. It features Smartshader technology, allowing users to experience complex, movie-quality effects for ultrarealism in next-generation 3D games and applications. In addition, ATI's Smoothvision technology enhances image quality by eliminating jagged edges and bringing out fine texture detail—without compromising performance. This card is ideal for high-performance gaming and design applications. And for the first time, the Radeon 9000 Pro brings programmability into the Power Mac line as a standard feature.

NVIDIA GeForce4 Ti. For the ultimate graphics experience, Power Mac G4 customers can choose the NVIDIA GeForce4 Titanium as a build-to-order option. Based on NVIDIA's fourth-generation graphics processing unit, this card delivers unprecedented visual effects and frame rates—for the most artistic, interactive, and immersive experience available on any personal computer. The GeForce4 Ti uses 128MB of fast DDR SDRAM and the Lightspeed Memory Architecture II, enabling it to process more 3D data to the screen. This dramatically improves frame rates for games as well as manipulation of large 3D objects in professional applications.

In addition, the GeForce4 Ti uses the all-new nFiniteFX II engine for graphics programmability. Previously reserved for dedicated graphics workstations in commercial visualization environments, programmability allows developers of games and 3D graphics applications to achieve new levels of realism. With virtually limitless control over vertex and pixel shaders, developers can work with an infinite number of special effects possibilities.

Graphics card specifications

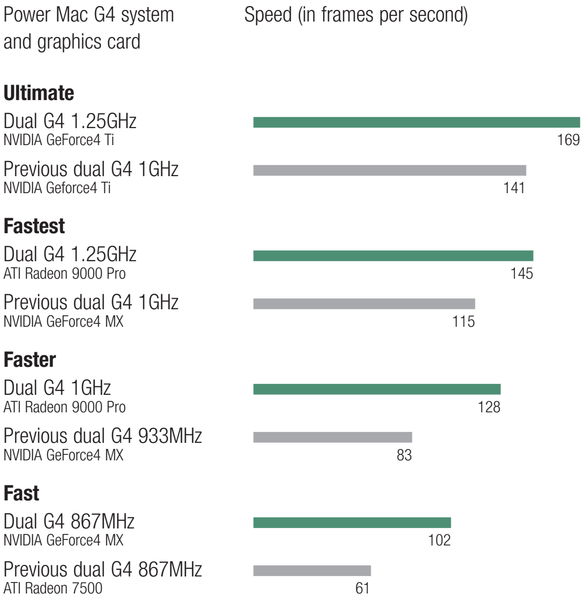
	NVIDIA GeForce4 MX	**ATI Radeon 9000 Pro**	**NVIDIA GeForce4 Ti**
Memory architecture	Lightspeed Memory Architecture II	Quad pipe memory architecture	Lightspeed Memory Architecture II
Effects engine		Smartshader effects engine	nFiniteFX II engine
Anti-aliasing	Accuview anti-aliasing	Smoothvision anti-aliasing	Accuview anti-aliasing
Frame buffer memory	32MB	64MB	128MB
Texels per second	1.1 billion	1.1 billion	4.8 billion
Triangles per second	34 million	43 million	136 million
Memory bandwidth	6.4 GBps	8.8 GBps	10.4 GBps

All cards include integrated hardware transform and lighting engines

Quake test

To demonstrate the relative performance of the graphics cards, we ran the Quake III Arena demo test on the current Power Mac G4 configurations as well as the previous generation. Built into Quake III Arena, the demo test runs itself at the fastest possible speed with no user intervention. Quake offers two modes of play: normal and high quality. We compared the cards using the more demanding high-quality mode. The high-quality setting (1024-by-768 resolution with a pixel depth of 32 bits) draws a Finder image and applies more complex texture mapping, providing a more realistic and computationally more intense image.

Quake performance



As shown here, the new Power Mac G4 delivers outstanding performance from the entry level on up, with all cards exceeding 100 frames per second. The performance of the new Power Mac G4 is up to 67 percent faster than the previous generation. This level of performance was available only on top-of-the-line cards just a year ago.

Advanced graphics in Mac OS X

Mac OS X is built on the Quartz graphics engine, which integrates with OpenGL technology for high-quality rendering of 2D and 3D graphics and with QuickTime for displaying crisp video content. Quartz Extreme—new in Mac OS X v10.2—leverages the power of the advanced graphics cards in the new Power Mac G4, so onscreen graphics are faster and more responsive than ever before.

Quartz. Quartz is a powerful 2D graphics engine that delivers on-the-fly rendering, anti-aliasing, and compositing for pristine onscreen graphics. It features built-in support for the Portable Document Format (PDF), providing the power to embed and manipulate PDF data—and even save to PDF—with any application built for Mac OS X. Mac OS X v10.2 uses the full, open-standard PDF 1.3 imaging model to render high-quality, anti-aliased text, bitmap and vector graphics, and gradients and patterns onscreen and in print. It enables any Mac OS X application to save a color-managed PDF file. Quartz also supports ColorSync, Apple's color management technology, and provides native support for TrueType, Type 1, and OpenType fonts.

OpenGL. OpenGL is the industry's most widely used and supported 3D graphics technology. Its high-performance visualization capabilities make it ideal for gaming, 3D modeling, graphic design applications, and special effects. Mac OS X boosts the performance of OpenGL to a new level, making the Mac the ultimate personal computer platform for 3D graphics.

QuickTime 6. Mac OS X includes Apple's industry-standard QuickTime technology, the Internet standard for digital media and the engine that powers Apple's iMovie and Final Cut Pro applications. QuickTime Player provides sophisticated capabilities that let users play back full-screen video, watch live events over the Internet, view 360-degree Cubic VR, and open video, still images, and audio files in more than 30 standard formats, including the new MPEG-4 standard for streaming media.

Quartz Extreme. Mac OS X is the only operating system with a composited windowing system, seamlessly blending 2D, 3D, and QuickTime content for vastly improved graphics performance. The window compositor taps the powerful graphics processing unit on each graphics card to efficiently render and composite graphics to the screen, resulting in high-frame-rate animation, transparency, and responsiveness. This work is handled by the graphics processor, freeing up the main processors for other tasks. With Quartz Extreme, the graphics processor essentially works as a third processor on the dual processor Power Mac G4.

Responsive user interface
3D rendering effects
Transparency
2D image
QuickTime content
Reduced processor utilization

Quartz Extreme taps the power of the graphics card to composite 2D images, 3D rendering, video, and other effects—right on the desktop.

Apple all-digital displays

An Apple display is an essential component of the Power Mac G4 user experience. Apple offers a lineup of pure-digital flat-panel displays that provide superior image quality and vivid color. The level of integration and the elegance of these displays present Power Mac G4 users with the best possible window on their work.

All Apple displays deliver the benefits of thin and light LCD technology, with twice the brightness, twice the sharpness, and twice the contrast of a standard CRT display. They can be calibrated for color-managed workflow environments and maintain consistent color and quality without requiring frequent recalibrations. Apple displays feature an adjustable base that allows users to adjust the viewing angle effortlessly.

Apple offers four displays:

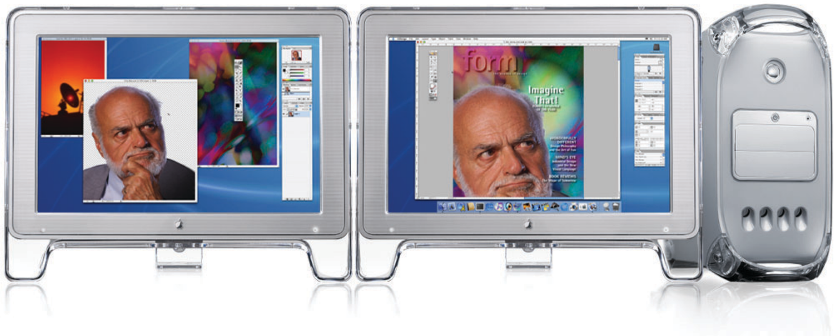
- The 15-inch Apple Studio Display, a beautiful and affordable flat-panel display with 1024-by-768-pixel resolution
- The 17-inch Apple Studio Display with 1280-by-1024-pixel resolution, an ideal alternative to a large CRT display
- The award-winning 22-inch Apple Cinema Display for a 1600-by-1024-pixel panoramic view
- The 23-inch Apple Cinema HD Display, offering full high-definition resolution at 1920 by 1200 pixels

The Apple Cinema HD Display is the newest member of Apple’s all-digital flat-panel lineup. This stunning 23-inch LCD offers 1920-by-1200-pixel resolution, enough to support high-definition video content with room to spare. Even with such a wide viewing space, text remains sharp and colors are vivid and distortion free from edge to edge. The Apple Cinema HD Display is perfect for editing video or enhancing large graphics—enabling high-performance image manipulation in gorgeous, richly saturated, flicker-free color.

For more information about Apple displays, visit www.apple.com/displays.

Dual display support

Dual display capabilities are now built into every Power Mac G4, making it easier and more cost-effective to add a second display. Two displays are useful for creative professionals, video editors, 3D designers, and scientific researchers who multitask between applications, often working with rich content and complex applications that include floating palettes and long timelines.



All Power Mac G4 systems now support two Apple flat-panel displays.

All new Power Mac G4 systems support both extended desktop and video mirroring modes. Extended desktop mode lets users distribute work across two displays. For example, Adobe Photoshop users could view an image on the primary display while spreading out their tools and palettes on the secondary one. In contrast, video mirroring mode displays the same information on both displays. This enables a presenter to monitor and control a presentation on one display, while the audience watches it on a second display or projector.

All Power Mac G4 systems are equipped with an ADC port for connecting an Apple display and a DVI port for a second digital display. A DVI to VGA adapter is included for connecting to VGA displays. In addition, Apple offers a DVI to ADC adapter so users can connect two Apple displays to their new Power Mac G4.

Apple DVI to ADC Adapter

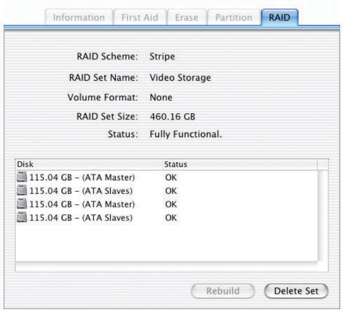
New Enclosure, More Expansion

The Power Mac G4 is designed for maximum expansion and flexibility to meet the requirements of professional users and computer enthusiasts alike. The swing-open side door provides quick access to slots and bays, making it easy to add specialized processing capabilities, increase storage, add memory, or install an AirPort wireless networking card. With onboard Ethernet and built-in FireWire and USB ports, Power Mac G4 users can create a system that is ideal for their work.

Mac OS X is designed to integrate external devices into the computing experience seamlessly, so users can “plug and play” their devices instead of figuring out how to make the system work with them. For example, the icon for a FireWire hard drive automatically appears on the desktop as soon as the drive is connected, and iPhoto automatically opens when a digital camera is plugged in. In addition, with Rendezvous technology, Mac OS X v10.2 users can instantly discover Rendezvous-enabled networked printers, as well as available wireless networks.

Four open PCI slots

All Power Mac G4 models feature four unoccupied 64-bit, 33MHz PCI slots, so it’s easy to add multiple PCI cards for specialized high-performance tasks. For example, recording artists depend on digital audio cards for music production tools, and filmmakers often fill PCI slots with video capture cards, signal processor cards, and SCSI cards.

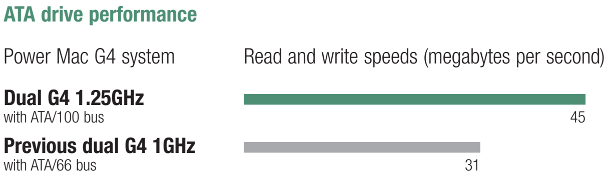


RAID Scheme: Stripe
RAID Set Name: Video Storage
Volume Format: None
RAID Set Size: 460.16 GB
Status: Fully Functional.

Disk	Status
115.04 GB – (ATA Master)	OK
115.04 GB – (ATA Slaves)	OK
115.04 GB – (ATA Master)	OK
115.04 GB – (ATA Slaves)	OK

Dual ATA controllers, four internal hard drive bays

For the greatest flexibility in internal storage, the new Power Mac G4 comes with dual ATA buses: one ATA/100 bus and one ATA/66 bus. One ATA/100 hard drive is preinstalled, with a ribbon cable for connecting a second drive. The ATA/66 bus can also connect to two hard drives. Using all four drive bays, the Power Mac G4 supports up to 480GB of internal storage—nearly half a terabyte of information. With an Ultra160 SCSI PCI card, the Power Mac G4 also supports SCSI drives in any or all of the four drive bays. Mac OS X includes built-in RAID functionality, so Power Mac G4 users can use multiple hard drives for data redundancy, known as mirroring, or increased drive performance, known as striping.

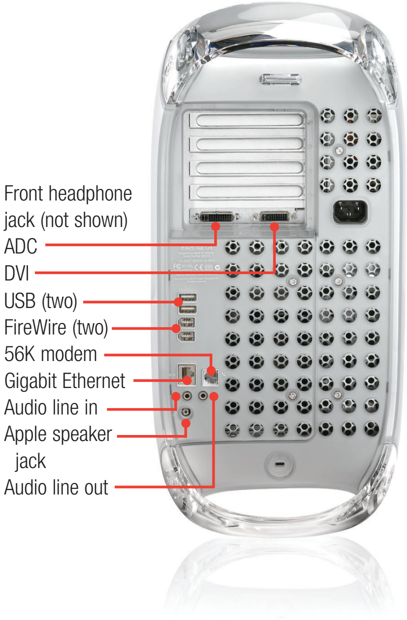


Drive throughput tested using StoneCutter, an internal drive performance test tool, and Bonnie, a Linux drive performance test.

With the new ATA/100 bus, drive performance increased by 45 percent.

Second optical drive bay

All Power Mac G4 systems include a second bay for an optional full-height optical drive. This makes it easy to install a high-speed Combo drive (DVD-ROM/CD-RW) for ultrafast CD burning or accessing archived files.



Network and device connectivity

The Power Mac G4 has easy-to-access ports for connecting to high-speed networks and attaching professional devices.

Gigabit Ethernet. Standard on all Power Mac G4 systems, Gigabit Ethernet provides a theoretical raw data bandwidth of 1000 Mbps, or 1 gigabit per second. Gigabit Ethernet is based on the IEEE 802.3ab standard.

On Mac systems, Gigabit Ethernet resides on the logic board rather than on a PCI card, as is typical of Pentium-based systems. With Mac OS X, users gain the added benefit of an advanced I/O operating system architecture and standards-based BSD networking.

Gigabit Ethernet uses Category 5 and 6 twisted-pair copper cabling, which has been widely installed for 100BASE-T Ethernet networks. Organizations can easily implement Gigabit Ethernet by simply purchasing new hubs, switches, or routers and connecting the Power Mac G4. The Ethernet interface built into the Power Mac G4 operates at 10, 100, or 1000 Mbps, automatically sensing and adjusting to the user's network type.

Modem. All new Power Mac G4 systems include a built-in 56K modem, and Mac OS X v10.2 supports V.92 modem functionality.[3] The V.92 standard provides the following features to enhance the Internet experience for users with dialup connections.

- *Modem on Hold* allows an Internet connection to be placed on hold to answer an incoming telephone call.
- *PCM Upstream* provides digital upstream transmission of data for faster uploading of files and email attachments.
- *Quick Connect* enables a faster hardware handshake with frequently used ISP numbers to shorten connect times.

Wireless networking. AirPort is an easy and affordable way to set up new networks and expand existing ones without installing new cabling or outlets. The AirPort antenna and card slot are built into the Power Mac G4, so users can surf the web without wires by installing an AirPort Card and connecting an AirPort Base Station to a phone jack or Ethernet network.[4] With AirPort wireless networking, up to 50 AirPort-enabled iBook, eMac, iMac, PowerBook, or Power Mac G4 computers can simultaneously connect to the Internet or join a wireless local area network from almost anywhere within a 150-foot radius of the base station. For more information about AirPort technology, visit www.apple.com/airport.

FireWire. FireWire is today's industry I/O standard for multimedia peripherals, including DV camcorders and hard drives that require high-bandwidth data exchange. The Power Mac G4 is equipped with two FireWire ports delivering up to 400-Mbps bandwidth.[5] FireWire is easy to use, operates in real time, and includes cross-platform, industry-standard device interoperability. On the Power Mac G4, FireWire provides up to 15 watts of power to charge external devices, such as the iPod. For more information about FireWire tools and technology, visit www.apple.com/firewire.

USB. The Power Mac G4 includes two 12-Mbps USB ports in the rear I/O panel and two USB ports on the keyboard. Users can connect a wide variety of USB-based printers, keyboards, microphones, speakers, and digital cameras to the Power Mac G4 with plug-and-play convenience. For example, website designers can connect as many input devices, such as a graphics tablet or removable media devices, as they need. For more information about USB technology, visit www.apple.com/usb.

Audio. The Power Mac G4 features dedicated stereo audio line in and line out ports for connecting professional devices such as tape decks and amplifiers. It's also equipped with an Apple speaker minijack for attaching Apple Pro Speakers and powering them with a built-in 10-watt-per-channel digital amplifier. A convenient headphone port is located on the front of the system, along with an internal mono speaker.

Audio specifications

Audio output	Line out connector	Headphone jack	Apple speaker minijack
Power		40 milliwatts (mW)	10 watts per channel
Full-scale amplitude	$1.5V_{rms}$ for load greater than 1 kOhm		
Frequency response	8Hz to 20kHz (load independent)	40Hz to 20kHz	20Hz to 20kHz
Signal-to-noise ratio	Greater than 100 dB	Greater than 96 dB	Greater than 90 dB
Total harmonic distortion	Less than 0.004 percent		Less than 0.1 percent
Load		32 Ohm	8 Ohm

Audio input	Line in connector
Data format	24-bit stereo, 44.1kHz audio sample rate
Maximum amplitude	$2V_{rms}$
Frequency response	5Hz to 20kHz
Signal-to-noise ratio	Greater than 100 dB
Total harmonic distortion	Less than 0.005 percent

SuperDrive

Authoring CD and DVD media is fast and easy with the SuperDrive, a combination CD-RW and DVD-R drive.[1] With the SuperDrive and Mac OS X, digital media authoring and data archiving are available to all users. Apple integrates disc burning into applications such as iDVD, DVD Studio Pro, and iTunes and enables data archiving to CD and DVD right from the Finder.

All Power Mac G4 systems come with iTunes software for converting CDs to MP3s, organizing an entire music collection, creating custom playlists, and burning them to CD.[6] Power Mac G4 systems with SuperDrive also come with iDVD, Apple's revolutionary application for creating DVD titles. iDVD lets video novices produce professional-quality DVDs for playback on most standard DVD players. Video professionals will want to upgrade to Apple's DVD Studio Pro for a complete set of interactive DVD authoring and production tools. DVD Studio Pro takes over where Final Cut Pro leaves off, handling MPEG encoding, menu creation, asset organization, linking, and output formatting for DVD-Video discs.

The SuperDrive is also ideal for backup. CDs can hold up to 650MB of data, more than 450 times as much as a floppy disk. DVDs can store 4.7GB of data, the equivalent of about seven CDs, about 18 Zip 250 disks, or about 3200 floppy disks. With this kind of capacity, users can easily back up entire digital photo collections or a thousand MP3 files—and keep them safe for years.

The SuperDrive is an industry-standard drive that reads dozens of standard CD and DVD formats. It writes DVD-R discs at 2x speed, reads DVDs at 6x speed, writes CD-R discs at 8x speed, writes CD-RW discs at 4x speed, and reads CDs at 24x speed. Completely integrated with iTunes, iDVD, and DVD Studio Pro, the SuperDrive is the easiest way to author CDs and DVDs for use in most professional or consumer players.

SuperDrive lets you read, author, and burn CDs and DVDs.

A second drive bay allows users to add another optical drive. Users who burn many CDs, for example, may want to add a Combo drive for fast CD burning.

Real-World Performance

The Power Mac G4 has been widely recognized as the computer of choice for creative professionals, and it is equally compelling for those in scientific, business, and education environments. What they have in common is the need for a fast, efficient digital workflow for accessing or importing data, editing and rendering it, previewing the results, and outputting to various formats. This workflow concept can be broadly applied to print, web, video, audio, imaging, and other media. The Power Mac G4 delivers fast application performance and easy workflow integration.

Design and publishing

From designing internationally recognized magazines to building content-rich websites, the Power Mac G4 is central to the design and publishing process. For conceptual work, such as copywriting or layout and design, to production processes involving precision layouts or output for archiving and repurposing, it delivers results faster and more reliably than any other desktop computer.

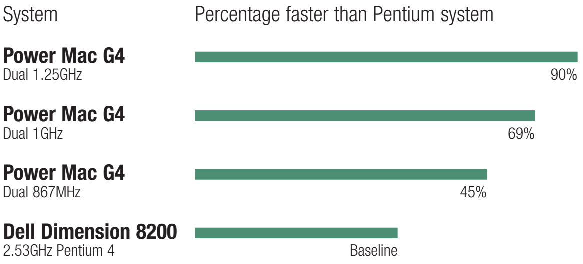
Design and publishing professionals will appreciate the features offered by the Power Mac G4 and Mac OS X:

- **Faster processing.** High-performance dual processing ensures maximum productivity in fast-paced production environments, resulting in greater profitability.
- **True multitasking.** Because Mac OS X was designed for dual processing, users benefit from its symmetric multiprocessing and multithreading capabilities. Now they can run several applications at once reliably and at unprecedented speeds.
- **Better, faster printing.** Mac OS X v10.2 brings a standards-based, professional-level printing system to the desktop, delivering industrial-strength configurability, compatibility, and reliability and enabling Mac OS X users to print to practically any printer, anywhere.
- **Comprehensive graphics solutions.** Mac OS X includes ColorSync for color management from image capture to output, broad font support, and integrated PDF support. Combined with Apple flat-panel displays and the latest graphics cards, Mac OS X gives users high-quality color and image production and consistent color-managed images onscreen and in print.
- **CD and DVD data burning.** The SuperDrive provides convenient, inexpensive, and long-lasting solutions for archiving and sharing large files.
- **Enhanced workflow.** Gigabit Ethernet, the fastest networking available, enhances workflow by speeding file transfer at every step.
- **Task automation.** AppleScript lets users automate routine tasks, from reformatting large groups of images for the web to building an entire online catalog with content from servers located across the globe.

Photoshop performance

We illustrate the superiority of the Power Mac G4 with Adobe Photoshop, the most common creative application used in this field. Photoshop is an effective cross-platform measure of system performance because it is optimized for both the Macintosh and Windows platforms. It even takes advantage of the latest processor technologies on both platforms: SSE2 on the Pentium 4 and Velocity Engine and multiprocessing on the Macintosh. The Photoshop test comprises nine commonly used actions and filters that stress overall system performance, including the processor, memory, system bus, and hard drive. This test compares the new dual processor Power Mac G4 lineup to the fastest Pentium 4–based PC on the market.

Test results



Longer bars indicate better performance.

The Power Mac G4 with dual 1.25GHz processors is 90 percent faster than a PC with a 2.53GHz Pentium 4 processor. In fact, even the entry-level 867MHz Power Mac G4 outperforms a PC with a Pentium 4 processor running at more than twice the megahertz. This test demonstrates why megahertz alone is an incomplete measure of system performance.

Professional video

Video professionals direct films, create programming, and produce commercials. Power Mac G4 systems and Apple's Final Cut Pro software are used today for postproduction of prime-time television and advertising. In addition, companies such as Avid, Media 100, and Pinnacle have built their high-end professional video solutions on the Power Mac G4 platform.

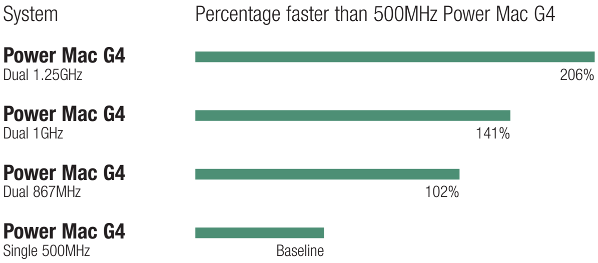
Power Mac G4 and Mac OS X features that enhance the workflow of digital video professionals include the following:

- **Faster processing.** High-performance dual processing makes editing and rendering high-bandwidth video quicker and easier.
- **Real-time editing and effects.** Quartz Extreme composites 2D, 3D, and QuickTime content into a single desktop scene.
- **Dual Apple display capabilities.** Connecting two displays to one graphics card gives video professionals more room to spread out assets, timelines, and video windows.
- **Massive expansion.** Specialized editing solutions, real-time processing cards, and I/O and SCSI devices can be added, as well as up to 480GB of internal storage with built-in RAID support. Fast USB, FireWire, and Gigabit Ethernet provide connectivity to professional devices, high-speed networks, and massive storage solutions.
- **DVD authoring.** The SuperDrive allows authors to create a compact, durable, high-quality medium for presenting and distributing video.

Final Cut Pro 3 performance

This test measures how well the Power Mac G4 performs with a high-bandwidth medium like video using Apple's Final Cut Pro 3. Final Cut Pro is an effective illustration of dual processor performance because it is multithreaded, allowing both processors to work simultaneously on the same application in parallel. The test protocol times common effects such as transitions, text over video, color balance, scaling, frame blending, and Gaussian blur.

Test results



Longer bars indicate better performance.

By using both processors in parallel, today's new dual 1.25GHz system outperforms the original 500MHz Power Mac G4, the system that introduced many professionals to video editing on the Mac, by 206 percent, or three times faster. The dual 1GHz and dual 867MHz Power Mac G4 systems completed this test more than twice as fast as the 500MHz Power Mac G4. Video editors will prefer a dual processor Power Mac G4 for a performance boost that goes beyond megahertz alone: They'll also realize time savings that can be used to get more work done or to discover new creative solutions.

BLAST OFF
Play Movie
Scene Select
Bonus Material

DVD authoring

DVD professionals produce feature film DVDs, educational courses, promotional materials, and other products that combine video, images, and sound into a high-quality interactive multimedia experience. While they use the tools of the creative professional for creating their work, they also produce high-quality final output for duplication or distribution.

The Power Mac G4 and Mac OS X enhance the workflow of DVD professionals with:

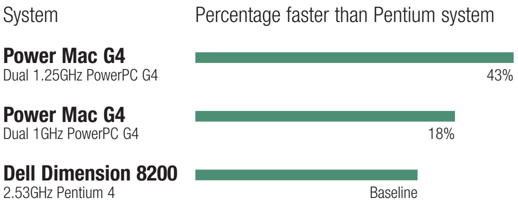
- **Fast processing.** High-performance dual processors enable fast, high-quality MPEG-2 encoding, ensuring professional DVD results.
- **Software solutions.** iDVD, included with every SuperDrive-equipped system, allows users who are new to the medium to get started, while DVD Studio Pro provides a full-fledged DVD production environment.
- **Comprehensive graphics solutions.** High-quality graphics and displays enable DVD professionals to view and manipulate content, with comprehensive color management and font support.
- **Industry-standard networking and I/O.** Support for Windows, Linux, and UNIX network environments is built into Mac OS X, and easy device connectivity makes importing and archiving assets fast and easy.
- **DVD authoring.** The fast, versatile SuperDrive and an optional second optical drive let DVD professionals author, archive, and proof their productions.

DVD encoding test

This test measures the effectiveness of the Power Mac G4 when encoding video, which is the most time-consuming part of burning a DVD. The test involves encoding a clip of video from digital video (DV) into MPEG-2 format. DV is the format used by standard DV cameras as well as by DVD Studio Pro and iDVD for creating and editing DVDs. MPEG-2 is the format used for high-quality television display by consumer DVD players. Both DVD Studio Pro and iDVD create final output in MPEG-2 format.

We compared the new dual Power Mac G4 to one of the few PC-based DVD editing solutions on the market, the 2.53GHz Pentium 4–based Dell Dimension 8200 running Sonic DVDit Professional Edition with the Ligos encoder.

Test results



Longer bars indicate better performance.

The dual 1.25GHz Power Mac G4 encodes video 43 percent faster than the 2.53GHz Dell solution. This illustrates that the unique system architecture of the Power Mac G4 delivers real-world performance gains that are unmatched by traditional Pentium 4–based PCs. The test also demonstrates the performance advantage of dual processors for computationally intense tasks such as video encoding: The dual 1.25GHz Power Mac G4 is 337 percent faster than the first Power Mac featuring the SuperDrive (a single 733MHz system).

Emagic Logic Audio for Mac OS X will be available in late 2002.

Music and audio

Audio professionals use MIDI and electronic music creation tools to compose and arrange music and audio on the Power Mac G4. Examples include soundtracks for film, advertising, television, radio, and music recording. As software becomes more advanced and digital rendering of sounds becomes more sophisticated, processing power is a critical tool for the audio and music professional.

Audio professionals benefit from the following Power Mac G4 and Mac OS X features:

- **Professional-quality sound.** Mac OS X provides high-definition 32-bit, 96kHz digital audio, including DSP and virtual instrument plug-ins.
- **Fast processing.** Dual processor configurations support more simultaneous channels, plug-ins, and polyphony than ever before.
- **Seamless connectivity.** Users can connect multichannel audio and MIDI devices over USB and FireWire or stereo audio using analog in and out.
- **PCI expansion.** The Power Mac G4 can be equipped with specialized digital signal processor cards or the latest input and output technologies.

Science and technology

Power Mac G4 users in the life sciences and physical sciences use UNIX applications that have been developed to accomplish specific research tasks like mapping and analyzing the genomes of human, animal, and plant DNA. These applications benefit from the multiprocessor and vector processing capabilities of the Power Mac G4. The typical researcher's desktop has two or more computers: one UNIX workstation for research applications and one PC or Mac that runs mainstream applications for visualization, documentation, and presentation. The Power Mac G4 with Mac OS X runs all the tools this kind of user needs in a single computer: It offers built-in vector processing for scientific applications, it runs industry-specific UNIX applications, and it runs mainstream applications like Microsoft Office—and it's available at desktop computer prices.

Scientific professionals benefit from:

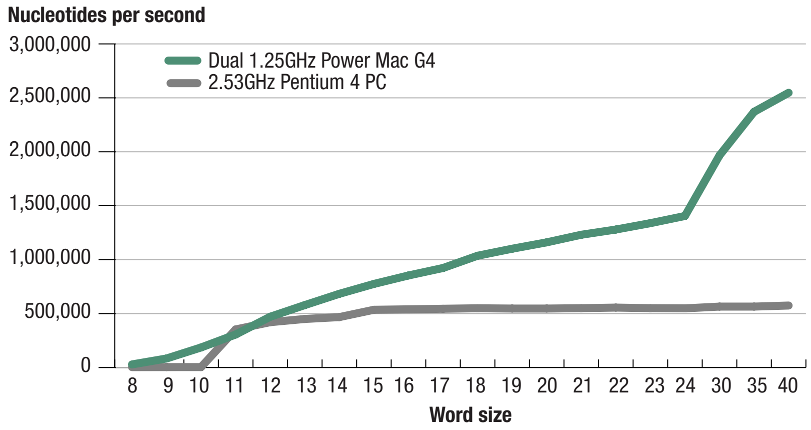
- **Fast processing.** Powerful dual processors and the Velocity Engine speed up the computing, analysis, and display of scientific data.
- **High-performance graphics.** Apple displays and the latest graphics cards combine with Quartz, OpenGL, QuickTime, and Quartz Extreme to enhance scientific data imaging operations.
- **Flexible, UNIX-based operating system.** Mac OS X allows users to run UNIX, vector processing, and productivity applications like Microsoft Office, all on one system.
- **Enhanced workflow.** Gigabit Ethernet lets users transfer files quickly in high-speed network environments.

BLAST performance

To demonstrate the performance advantages of the Power Mac G4 for processor-intensive scientific analysis, we used BLAST (Basic Local Alignment Search Tool), the popular open source biotechnology application used by life science researchers to find similarities in DNA and protein sequences. As a research tool, BLAST is used for a broad variety of purposes, including the development of drug and gene therapies.

BLAST does its work by finding matches in DNA sequences and is typically very processor intensive. Searches in BLAST are based on word size, or the number of nucleotide pairs specified by the researcher to register as a match. For example, a word size of 40 means that two sets of genetic code have 40 nucleotides in common. Different word sizes are used for different kinds of research, and users can adjust word size to the sensitivity appropriate to their needs. Using dual processors, the Velocity Engine, and the UNIX-based power of Mac OS X, BLAST is accelerated to make a wide variety of searches available at higher speeds on the Power Mac G4. We compared the performance of the dual 1.25GHz Power Mac G4 running A/G BLAST to a Linux workstation with a 2.53GHz Pentium 4 processor running NCBI BLAST.

Test results



Long word size (high performance). With long-word-size (high-performance) searches, the researcher is looking for similarities between DNA sequences that are nearly identical—for example, comparing DNA samples from two different mice. In common searches using a word size of more than 11, the dual 1.25GHz Power Mac G4 running A/G BLAST performs 440 percent faster than a PC with a 2.53GHz Pentium 4 processor running Linux and NCBI BLAST.

Short word size (high sensitivity). For short-word-size searches (less than 11), the researcher is comparing more distantly related sequences, such as mouse versus human DNA. These searches require high resolution in order to find the small matches between these dissimilar sequences. Before A/G BLAST on the Power Mac G4, this kind of search was impractical using BLAST because of the enormous amount of time it required. The new Power Mac G4 makes these searches practical with performance up to 42 times faster than the PC.

For more information on A/G BLAST, the PowerPC G4–optimized version of NCBI BLAST that was developed by Apple in collaboration with Genentech, and the Power Mac G4 in science and technology, visit www.apple.com/scitech.

Business and productivity

The Power Mac G4 gives small business workers the power to run their business. Whether it's a hot ad shop or a biotech startup, the Power Mac G4 provides front office and back office capabilities for a total small business solution. Many people use the Mac to make their living, whether in the creative fields, medicine, law, or healthcare. But the Power Mac G4 does more than run the applications that help make money for these kinds of operations; it also runs back office solutions that make managing a small business efficient. Back office solutions for the Power Mac G4 include accounting, database, customer relationship management, marketing, backup, utility, and support software. And as the business grows, the Power Mac G4 can grow too, with Mac OS X Server solutions like mail, database, and web serving that connect employees and customers.

The Power Mac G4 offers small business workers these advantages:

- **Power and graphics performance.** The latest in processors, graphics, and display technologies support leading creative and scientific applications that are the core of their business.
- **Scalability.** Robust expansion, networking, and connectivity features allow the Power Mac to grow along with the business.
- **Business applications.** Mac OS X supports industry-standard back office applications for running a business, managing a network, and serving files.
- **Advanced server solutions.** Businesses can add Mac OS X Server for comprehensive file sharing, email services, web hosting, and more.

Higher education

Colleges and university departments of education, art and design, science and technology, and computer science understand that Apple provides cutting-edge solutions for these fields of study. When students use creative tools like Photoshop in commercial art classes, Final Cut Pro in film classes, or research tools like BLAST in biology research, they experience the ultimate in digital workflow technology. In addition, Mac OS X puts Apple squarely into the field of UNIX development in computer science departments.

University faculty and IT departments look to the Power Mac G4 for these benefits:

- **The ultimate in processing, graphics, and expansion.** Dual processing, massive expansion, AGP 4X graphics, and dual display support provide the best platform for creative and scientific applications.
- **UNIX-based operating system.** Mac OS X with FreeBSD 4.4 and GCC 3, the latest open source compiler, make the Power Mac G4 the clear choice for programmers, scientists, and digital content creators.
- **Easy integration and management.** The combination of Mac OS X v10.2, Mac OS X Server, and the interoperability of Open Directory make it easy to install, integrate, and manage Power Mac G4 systems on any network.
- **Easy connectivity.** Ethernet, FireWire, and USB enable simple, standard integration into the networked school and university environment.
- **Complete server solution.** Mac OS X Server provides powerful services for Internet and web serving, file and printer sharing, networking, and workgroup management.
- **Windows compatibility.** Mac OS X v10.2 makes the Mac a first-class citizen in any Windows environment by providing Windows file sharing, secure remote access, and integration with Active Directory.
- **Authentication in heterogeneous environments.** Mac OS X v10.2 includes support for Kerberos, LDAP, Active Directory, and smart cards.

Product Details

Standard configurations

Apple offers systems to meet the needs of business professionals, educators, and home computer enthusiasts. The new Power Mac G4 is available in three standard configurations through the Apple Store and authorized Apple resellers.

Order no.	**M8787LL/A**	**M8689LL/A**	**M8573LL/A**
Processor	Dual 867MHz PowerPC G4	Dual 1GHz PowerPC G4	Dual 1.25GHz PowerPC G4
L3 cache	1MB DDR SRAM per processor	1MB DDR SRAM per processor	2MB DDR SRAM per processor
System bus	133MHz	167MHz	167MHz
Main memory (2GB maximum[7])	256MB PC2100 (266MHz) DDR SDRAM	256MB PC2700 (333MHz) DDR SDRAM	512MB PC2700 (333MHz) DDR SDRAM
Hard drive[2]	60GB Ultra ATA/100; 7200 rpm	80GB Ultra ATA/100; 7200 rpm	120GB Ultra ATA/100; 7200 rpm
Optical drive	Combo (DVD-ROM/CD-RW)	SuperDrive (DVD-R/CD-RW)	SuperDrive (DVD-R/CD-RW)
Graphics support	NVIDIA GeForce4 MX with 32MB of DDR SDRAM	ATI Radeon 9000 Pro with 64MB of DDR SDRAM	ATI Radeon 9000 Pro with 64MB of DDR SDRAM
Expansion	Four open 64-bit, 33MHz PCI slots; AGP 4X slot with graphics card installed; four internal hard drive bays (one occupied); two optical drive bays (one occupied)		
Ports	Two FireWire, four USB, front headphone minijack and speaker, rear Apple speaker minijack, audio line in, audio line out, ADC and DVI connectors		
Networking	Built-in 10/100/1000BASE-T Ethernet and 56K modem[3]; AirPort ready[4]		
Software	Mac OS X, Mac OS 9, QuickTime, iChat, iMovie, iPhoto, iTunes, iDVD (requires SuperDrive), DVD Player, Mac OS X Mail, Microsoft Internet Explorer, EarthLink (includes 30 days of free service), Acrobat Reader, Art Director's Toolkit, FAXstf, FileMaker Pro Trial, Graphic Converter, OmniGraffle, OmniOutliner, PixelNhance, Snapz Pro, Developer Tools		
Service and support	90 days of free telephone support and one-year limited warranty		
Included	Apple Pro Keyboard, Apple Pro Mouse, DVI to VGA adapter, modem cable		

Internet access requires a compatible Internet service provider; fees may apply. Product contains electronic documentation. Backup copy of software is provided on CD-ROM.

Build-to-order options

Customers can order a custom-configured computer from the Apple Store or an authorized Apple reseller. Build-to-order options can include the following.

- **Processor:** Dual 867MHz, dual 1GHz, dual 1.25GHz
- **Memory** (PC2100 or PC2700 DDR SDRAM): 256MB, 512MB, 1GB, 1.5GB, 2GB
- **Hard drives:** 60GB Ultra ATA/100 (7200 rpm), 80GB Ultra ATA/100 (7200 rpm), 120GB Ultra ATA/100 (7200 rpm), 36GB Ultra160 SCSI (10,000 rpm), 72GB Ultra160 SCSI (10,000 rpm)[2]
- **Optical drives:** SuperDrive (DVD-R/CD-RW), Combo drive (DVD-ROM/CD-RW)
- **Graphics:** NVIDIA GeForce4 MX with 32MB DDR SDRAM, ATI Radeon 9000 Pro with 64MB DDR SDRAM, NVIDIA GeForce4 Ti with 128MB DDR SDRAM
- **Audio:** Apple Pro Speakers, Apple iPod, Harman Kardon iSub, Harman Kardon SoundSticks
- **Other:** AirPort Card, AirPort Base Station, Ultra SCSI PCI card, Ultra160 SCSI PCI card, Bluetooth adapter, DVD-R Media Kit

Apple displays

To complete their Power Mac G4 system, users can choose from a family of all-digital displays.

Product	Order no.
Apple Studio Display (15-inch flat panel)	M7928ZM/A
Apple Studio Display (17-inch flat panel)	M7649ZM/A
Apple Cinema Display (22-inch flat panel)	M8058ZM/A
Apple Cinema HD Display (23-inch flat panel)	M8537ZM/A
Apple DVI to ADC Adapter	M8661LL/A

Extended service and support

With the AppleCare Protection Plan, customers can extend their service and support to three full years. This comprehensive plan includes telephone support, Apple-certified repairs, web-based support resources, and powerful diagnostic tools. No other service and support program can provide peace of mind about the Apple system for such a small investment. Visit www.apple.com/support/products or call 800-823-2775 for more information.

Technical Specifications

Processing and memory

- Dual 867MHz, 1GHz, or 1.25GHz PowerPC G4 processors
- Velocity Engine vector processing unit
- Full 128-bit internal memory data paths
- Powerful floating-point unit supporting single-cycle, double-precision calculations
- Data stream prefetching operations supporting four simultaneous 32-bit data streams
- 256K on-chip L2 cache running at processor speed
- Up to 2MB DDR SRAM L3 cache per processor with up to 4-GBps throughput
- Up to 167MHz system bus supporting over 1.3-GBps data throughput
- 256MB or 512MB of PC2100 or PC2700 DDR SDRAM main memory supporting up to 2.7-GBps throughput
- Four DIMM slots supporting up to 2GB of DDR SDRAM using one of the following[7]:
  - — 256MB DIMMs (64-bit-wide, 128-Mbit)
  - — 512MB DIMMs (64-bit-wide, 256-Mbit)

Graphics and display support

- One of the following graphics cards installed in a dedicated AGP 4X graphics slot:
  - — NVIDIA GeForce4 MX graphics card with 32MB of DDR SDRAM
  - — ATI Radeon 9000 Pro graphics card with 64MB of DDR SDRAM
  - — NVIDIA GeForce4 Ti graphics card with 128MB of DDR SDRAM (build-to-order option)
- Support for digital resolutions up to 1920 by 1200 pixels and analog resolutions up to 1600 by 1200 pixels
- ADC and DVI connectors; DVI to VGA adapter included
- Dual display support for extended desktop and video mirroring modes
- Support for up to two Apple displays (second display requires Apple DVI to ADC Adapter, sold separately)

Storage and expansion

- Four 3.5-inch hard drive expansion bays
  - — One 7200-rpm Ultra ATA/100 drive preinstalled in standard configurations: 60GB, 80GB, or 120GB[2]
  - — Support for up to four internal ATA drives (two Ultra ATA/100 and two Ultra ATA/66)
  - — Support for up to four internal SCSI drives (requires PCI SCSI card, sold separately)
  - — Support for a combination of internal ATA and SCSI drives (total of four)
- One of the following optical drives:
  - — SuperDrive (DVD-R/CD-RW); writes DVD-R discs at 2x speed, reads DVDs at 6x speed, writes CD-R discs at 8x speed, writes CD-RW discs at 4x speed, reads CDs at 24x speed

— Combo drive (DVD-ROM/CD-RW); reads DVDs at 8x speed, writes CD-R discs at 16x speed, writes CD-RW discs at 10x speed, reads CDs at 32x speed
— Optional Combo drive in second optical drive bay
- Four open full-length 64-bit, 33MHz PCI slots
- One AGP 4X slot with graphics card installed

Communications
- 10/100/1000BASE-T Ethernet connector (RJ-45)
- Built-in antennas and card slot for optional 11-Mbps AirPort Card; IEEE 802.11b compliant[4]
- Built-in 56K V.92 modem[3]

Peripherals and audio
- Two 400-Mbps FireWire ports[5] (15W total power)
- Four USB ports (two on system, two on keyboard)
- Front headphone jack
- Built-in speaker
- Stereo audio line in and line out minijacks
- Apple speaker minijack for connection to optional Apple Pro Speakers

Electrical and environmental requirements
- Meets ENERGY STAR requirements
- Line voltage: 100–125V AC or 200–240V AC
- Frequency: 50Hz to 60Hz, single phase
- Maximum current: 6.5A (low-voltage range) or 7.5A (high-voltage range)
- Operating temperature: 50° to 95° F (10° to 35° C)
- Storage temperature: –40° to 116° F (–40° to 47° C)
- Relative humidity: 5% to 95% noncondensing
- Maximum altitude: 10,000 feet

Size and weight
- Height: 17.0 inches (43.2 cm)
- Width: 8.9 inches (22.7 cm)
- Depth: 18.4 inches (46.8 cm)
- Weight: 42 pounds (19.1 kg)[8]

For More Information

For more information about this product or to purchase Apple products, visit the Apple Store online (www.apple.com or 800-MY-APPLE), an Apple Store near you, or an authorized Apple reseller.

Apple
1 Infinite Loop
Cupertino, CA 95014
408-996-1010
www.apple.com

---

[1] Selected models. [2] 1GB = 1 billion bytes; actual formatted capacity less. [3] Appropriate ISP and telephone services are required. Your ISP may not support all V.92 features. Modem will function according to V.90 standards if V.92 services are not available. Actual modem speeds lower; speed depends on connection rate and other factors. [4] Wireless Internet access requires AirPort Card, AirPort Base Station, and Internet access (fees may apply). Some ISPs are not currently compatible with AirPort. Range may vary with site conditions. [5] Actual rates will vary. [6] iTunes is for legal or rightholder-authorized copying only. Don’t steal music. [7] 999MB maximum per application in Mac OS 9. [8] Weight varies by configuration and manufacturing process.

© 2002 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, AirPort, Apple Cinema Display, AppleScript, Apple Store, Apple Studio Display, ColorSync, Final Cut Pro, FireWire, iBook, iMac, Mac, Macintosh, PowerBook, Power Mac, QuickTime, and TrueType are trademarks of Apple Computer, Inc., registered in the U.S. and other countries. DVD Studio Pro, eMac, Finder, iChat, iMovie, iPhoto, iPod, iTunes, Quartz, Rendezvous, SuperDrive, Velocity Engine, and Xserve are trademarks of Apple Computer, Inc. AppleCare is a service mark of Apple Computer, Inc., registered in the U.S. and other countries. Acrobat and Adobe are trademarks or registered trademarks of Adobe Systems Incorporated in the U.S. and/or other countries. ENERGY STAR is a U.S. registered mark. FileMaker is a trademark of FileMaker, Inc., registered in the U.S. and other countries. GeForce4 is a trademark of NVIDIA Corporation. OpenGL is a registered trademark of Silicon Graphics, Inc. PowerPC is a trademark of International Business Machines Corporation, used under license therefrom. Other product and company names mentioned herein may be trademarks of their respective companies. Product specifications are subject to change without notice. This material is provided for information purposes only; Apple assumes no liability related to its use.

August 2002 L22815A