WHITE PAPER

August 1998

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Contents

Compaq Professional Workstation AP400 Key Technologies White Paper

The purpose of this paper is to provide an overview of the Key Technologies incorporated into the Compaq Professional Workstation AP400. This paper concentrates on covering those features and technologies that have unique customer benefits. The objective is to provide the technical information and benefits of these features, so that geographic regions can market them successfully.

For more information about our graphics offering refer to:
http://www.compaq.com/products/workstations/graphics

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Document ECG027/0698

NEW COMPAQ PROFESSIONAL WORKSTATION AP400

The Compaq Professional Workstation AP400 is a powerful, industry standard workstation specifically designed for professionals using mainstream CAD/CAE applications, applications found on the financial trading floor, mainstream digital content creation, network management consoles applications, select EDA applications, and software development applications.

Compaq Professional Workstations are backed by strong partnerships with leading ISVs to provide highly integrated and optimized solutions, which can be confidently deployed in the most demanding, business critical environments. The Compaq Professional Workstation AP400 combines powerful industry standard components, strong partnerships with leading ISVs, and traditional Compaq quality and reliability, giving users the time-to-market advantage they need to succeed.

The AP400 features a slim, desktop form factor with tool-less entry and dimensions identical to the Compaq Professional Workstation 5100 (5.0 x 19.9 x 17.5 in/12.7 x 50.5 x 44.5 cm). This small form factor is a key benefit for financial trading customers who have very limited desk space.

INTEL® PENTIUM® II PROCESSOR

The Compaq Professional Workstation AP400 uses the newest Intel Pentium II 350-MHz, 400-MHz and 450-MHz processors, featuring MMX technology and 100-MHz Front Side Bus. The Front Side Bus is the processor-to-memory bus. Previous Pentium II processors supported 66-MHz Front Side Bus. The Pentium II bus speeds have now increased to 100-MHz Front Side Bus, which provides greater processor-to-memory bandwidth and faster performance. Systems based on older versions of the Pentium II processor were limited to 512 MB of maximum memory support. The Compaq Professional Workstation AP400, with the new versions of the Pentium II processor, can support up to 1 GB of maximum memory. Like the previous version of Pentium II processor, the new processor ships as a single module that contains the CPU chip, the cache tag, and the L2 cache packaged in a Single Edge Connect Cartridge (SECC).

The Intel Pentium II processor features 512 KB of integrated non-blocking L2 cache and a dedicated 64-bit cache bus, which improves performance by reducing average memory access time. The Pentium II processor's L2 cache scales with the processor core frequency. Higher core frequencies will require a 100-MHz Front Side Bus (FSB), which in turn will require a new chipset, memory, and system board. The faster system bus and memory will significantly increase overall PC performance.

CUSTOMER BENEFITS

- ***Major leaps in processor power***. The Pentium II 350-MHz, 400-MHz and 450-MHz processors provide a significant increase in processing power over previous Intel processors. The new Pentium II 450-MHz processors deliver up to a 28% performance boost over the Pentium II 350-MHz processors in certain integer or multimedia benchmarks.
- ***Improved overall system performance***. Introduction of the new 100-MHz FSB improves the overall performance of the PC system by enhancing the speed at which data is transferred between the processor and other parts of the system.
- ***Improved value.*** The new Pentium II processors deliver a great value by delivering higher performance at an affordable price.

MMX

Similar to the previous Pentium II processors, the new Pentium II 350-MHz, 400-MHz and 450-MHz processors have MMX technology. MMX (MultiMedia Extensions) is the name for the 57 multimedia instructions Intel has added to its processors. These multimedia extension instructions significantly improve performance on CPU-intensive multimedia applications.

For additional information on MMX, please access the Intel web site at http://developer.intel.com/drg/mmx/Support/faq.htm.

INTEL 440BX CHIPSET

The AP400 uses the Intel 440BX chipset. The Intel BX chipset was designed as a follow on to the 440LX, which had replaced the previous generation of 440FX chipsets used with Pentium Pro and early Pentium II processors. Chipsets include technologies that allow processors, memory, I/O, graphics and other devices to communicate and work together in a computer.

The 440LX was Intel's first chipset designed specifically for more advanced Pentium II systems, providing built-in support for SDRAM, Ultra ATA hard drives, and Accelerated Graphics Port (AGP) technology. (More information on AGP later in this paper). The Intel 440BX chipset also supports these features as well as a 100-MHz FSB. As mentioned earlier, the benefits of the 100-MHz FSB are greater processor-to-memory bandwidth and faster performance.

The 440BX supports the 100-MHz FSB, an upgraded infrastructure designed to support clock speeds of 350 MHz and above in the more advanced Pentium II processors. This additional 100-MHz FSB support is the key difference between the BX and the LX chipsets.

The following table shows how the BX chipsets compare to the LX technology.

Key Features Supported by Intel Pentium II Chipsets		
Feature	**440LX Chipset (440LX/PIIX-4)**	**440BX Chipset (443BX/PIIX-4)**
Processor FSB	66 MHz	66 MHz or 100 MHz
Memory – Max/type	512-MB SDRAM ECC supported	1-GB SDRAM ECC supported
IDE	UltraDMA/33	UltraDMA/33
AGP	Yes	Yes
USB	2 ports	2 ports
ACPI	Yes	Yes

CUSTOMER BENEFITS

- ***Performance.*** Support for up to 1 GB of SDRAM provides support for memory intensive applications and data files. This increases system performance.
- ***Speed.*** Clock speeds of 350 MHz and above are possible with support for the 100-MHz Front Side Bus.
- ***Support for better, faster graphics***. Brings built-in support for Accelerated Graphics Port (AGP) technology.
- ***ACPI-ready.*** ACPI defines a hardware interface that allows a standard way to integrate power management features throughout the workstation system. Since the workstation ships standard with the ACPI hardware, you will be able to utilize ACPI features once future ACPI-enabled Microsoft® operating systems become available.

Q. Does the Compaq Professional Workstation AP400 use the Highly Parallel System Architecture?

A. No. The Compaq Professional Workstation AP400 does not use the Highly Parallel System Architecture.

Q. Why is Compaq not using the Highly Parallel System Architecture for this product?

A. In keeping with our strategy of optimizing our product lines to meet the needs of specific target markets, we use the Compaq Highly Parallel System Architecture in our high-performance line of products, since the applications targeted for this line are most apt to benefit from the technology. The Compaq Professional Workstation AP400 is targeted at price/performance-conscious users in the workstation market who must balance their desire for performance with a desire for value.

MEMORY

The Compaq Professional Workstation AP400 uses 100-MHz Registered ECC Synchronous DRAM (SDRAM). SDRAM is designed to accommodate higher processor speeds and provides faster memory operation with burst data rates of up to four times that of standard page-mode DRAMs. The new burst mode addresses an entire block of data rather than one piece at a time. Most importantly, SDRAM is synchronized with the CPU system clock to allow continuous data flow. Estimated performance increases are 2% for cached systems and 10% for non-cached systems.

100-MHz SDRAM is required to work with the new 100-MHz Front Side Bus (FSB) that will be an integral part of high-speed systems. This 100-MHz SDRAM is designed to accommodate higher microprocessor speeds and to provide faster memory operation.

CUSTOMER BENEFITS

There are clear benefits to SDRAM compared to the previous memory technology, EDO (extended data output) DRAM. Some key benefits are*:*

- ***Increased performance***. Customers will experience greater CPU responsiveness with SDRAM technology. 100-MHz SDRAM will support high-speed Pentium II 350-MHz, 400-MHz and 450-MHz technologies that EDO DRAM cannot support.
- ***Faster bus speeds***. SDRAM can run up to 100 MHz, while the maximum bus speed that EDO DRAM can run is 66 MHz.
- ***Perfect match for demanding applications***. As graphics and software programs become more and more complex, SDRAM is better suited to handle these advances compared to EDO SDRAM because of its higher bus speed.

Q. The Compaq Professional Workstation AP400 uses registered memory. What is the difference between registered and unregistered memory?

A. Registered memory is buffered memory. Buffered DIMMs use buffer logic chips on their control lines to reduce loading on the system board. This buffering action increases the maximum size of DIMM module sockets on the system board. Unbuffered DIMMs do not use any buffer logic chips, thus achieving slightly faster operation due to the elimination of the propagation delay of the logic buffer. The increase in speed comes at the tradeoff of reducing the maximum memory capacity. The benefit to the Professional Workstation AP400 is the ability to offer up to 1 GB of memory.

Q. Is the memory on the Compaq Professional Workstation AP400 interchangeable with other Compaq workstations?

A. The Compaq Professional Workstation A4500 uses the same memory as the Compaq Professional Workstation AP500; however, the AP400 memory is not interchangeable with the AP200, 5000, 5100, 6000, or 8000 products. The AP200 uses unregistered DIMMS, and the remaining products use 66-MHz EDO memory.

ULTRA ATA

The Professional Workstation AP400 offers 6.4-GB Ultra ATA hard drive models in addition to SCSI hard drive models. Ultra ATA is a definition for an ATA data transfer protocol. The Ultra ATA protocol is included in the ATA-4 specification, an industry-wide specification designed to provide firm guidelines to hardware developers and manufacturers. The development of the transfer protocol "Ultra ATA" hard drives (also known as UDMA, UATA, Ultra DMA, Ultra DMA-33) has increased the burst data transfer rate to 33.3 MB/s compared to Fast ATA, effectively doubling the transfer rate versus Fast ATA. Because of the faster transfer rates, Ultra ATA technology can process the data twice as fast and therefore cut the time to empty the buffer from 250 ms to 125 ms. This savings in time allows the time to empty the buffer (400 ms) to equal the buffer fill time, thus eliminating the bottlenecks experienced with Fast ATA.

CUSTOMER BENEFITS

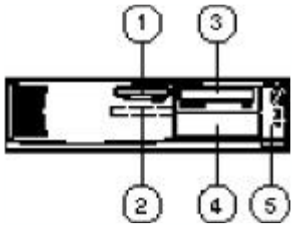
- ***Extends the data transfer rate.*** Provides improvement over Fast ATA speed of 16.6 MB per second to 33.3 MB per second.
- ***Provides improved signal integrity through CRC (Cyclical Redundancy Check).*** Checks to verify the integrity of the data transferred by validating all data transferred across the cable.
- ***Fully backward compatible.*** Uses the same electrical connection as Fast ATA, and can run in standard EIDE mode with old ATA chipsets. Ultra ATA devices can also operate on an ATA bus with non-Ultra ATA devices.

Q. Why does the Compaq Professional Workstation AP400 use Ultra ATA drives as well as Wide Ultra SCSI drives?

A. The Compaq Professional Workstation AP400 will attract different users. Some may need the higher speed 40-MB per second data transfer rate of Wide-Ultra SCSI for extra performance. For those who find the 33.3-MB per second data transfer rate satisfactory, Ultra ATA drives provide excellent price/performance, with almost no difference when using business productivity applications.

WIDE-ULTRA SCSI HARD DRIVES

Standard SCSI hard drive configurations for the Compaq Professional Workstation AP400 include a one-inch 4.3-GB 7200 rpm or 10,000 rpm hard drive, depending on the model. Five drive bays are provided in the AP400, two are available to add drives. The integrated Wide-Ultra SCSI controller (with an external Wide-Ultra SCSI connector) supports external SCSI devices for users who require even more storage. The following table describes the available hard drive configurations:



Bay	Bay Width	Bay Height	Device configuration
1	3.5 inch	Third	Supports a 1.0-inch storage device. A 3.5-inch diskette drive is standard.
2	3.5 inch	Third	(Internal) Supports a 1.0" hard drive
3	5.25 inch	Half	Supports 1.0 or 1.6-inch device. A CD-ROM drive is shipped in Bay 3 (available on select models)
4	5.25 inch	Half	Supports 1.0-inch (with bracket) or a 1.6-inch storage device. If installing 10,000 rpm hard drives, a 10K Mounting/Cooling Kit is required (part number 329302-B21).
5	3.5 inch	Half	(Internal) Supports 1.0-inch or a 1.6-inch storage device. If installing 10,000 rpm hard drives, a 10K Mounting/Cooling Kit is required (part number 329302-B21)

ACCELERATED GRAPHICS PORT (AGP)

Today's three-dimensional graphic applications consume large amounts of memory bandwidth. Consequently, the proliferation of 3D applications is increasing the need for high-speed access to larger amounts of graphics memory. AGP is an industry standard solution to improve the bandwidth between the graphics accelerator and the system memory so that a portion of the 3D rendering data structures can be shifted into main memory. The higher bandwidth of AGP (compared to PCI) also improves sharing rendering tasks between the system processor and the graphics accelerator.

AGP improves system performance by establishing pipelined access to the system's main memory and effectively reducing latency. AGP also transfers data up to four times faster than PCI, utilizing the bandwidth of a 100-MHz system memory bus more efficiently. The maximum data transfer rate of AGP is 533 MB/s, compared to 133 MB/s for PCI. The bus acts as a dedicated port for the graphics accelerator into main memory.

CUSTOMER BENEFITS

Some specific applications that can benefit from AGP include:

- Video applications, like conferencing or DVD playback, where a steady stream of images must be sent from system memory to the graphics frame-buffer for display.
- Graphics command lists, such as lengthy data sets defining vertices for 3D objects
- Texture memory for 3D rendering, where textures are overlaid on 3D objects for realistic effects. To improve realism, texture sizes will grow to 32 MB and beyond in 1999.

  Note: 3D texture data is the most immediate and important target opportunity for AGP. By shifting texture data to system memory, bandwidth load and memory size can be balanced between system and local graphics frame-buffer memory. The bandwidth and space required for textures are split between the heavily loaded frame-buffer and the (comparatively) lightly loaded system memory. Since texture data is not persistent (unlike display buffers), system memory used for texture data is returned to the free memory heap when a 3D application concludes.

To gain the full benefit of AGP performance, the system must have the following features:

- Pentium II class microprocessors

  Note: While AGP could be adapted to Pentium-class processors, the floating point and processing power of the Pentium II class products are a better fit.
- AGP Sideband and Pipeline functions in the core logic, which improve data transfer efficiency
- 100-MHz system memory architecture to meet system processor and AGP bandwidth demands
- Microsoft Windows® 95 OSR2.1, Windows 98, or Windows NT® 5.0 operating systems to provide necessary memory management services

  Note: Windows NT 4.0 can operate AGP subsystems as PCI 66MHz-type devices only.

AGP promises to enable photo-realistic 3D rendering and other high-performance 3D graphics capabilities. The cutting edge graphics performance of AGP will benefit 3D content providers by enabling a much wider market for their products.

GRAPHICS

Five graphics solutions are available for the Compaq Professional Workstation AP400. Three use PCI local bus implementations designed to maximize system performance. A new AGP controller has been added to the mix to take advantage of main memory for texture mapping operations. All controllers have been tested to ensure optimum compatibility and reliability.

For 2D applications, the Compaq Professional Workstation AP400 includes the Matrox Millennium II graphics controller. The Millennium II provides fast 2D windowing for applications, such as financial analysis and software development. It comes standard with 4 MB of WRAM and is upgradeable to either 8 MB or 16 MB of WRAM.

For 2D and entry 3D applications, the Compaq Professional Workstation AP400 includes the ELSA GLoria Synergy+. The ELSA GLoria Synergy+ comes standard with 4 MB of SGRAM and is upgradeable to 8 MB. It provides fast 2D windowing and is a great low-cost 3D solution for CAD and DCC applications.

For multiple display requirements, the Compaq Professional Workstation AP400 includes a model using the STB MVP Pro-128 graphics controller. Ideal for financial markets, the STB MVP Pro-128 controller can support four displays in a single PCI slot. The included drivers allow control over dialog box positioning and windows display management. There are a total of four ports on each controller. Two controllers can be added to the system for support of up to 8 displays (2 controllers, 4 ports each). Multiple GLoria Synergy or Matrox Millennium II controllers can also be used for environments using 1 to 4 displays.

For 3D graphics needs, the Compaq Professional Workstation AP400 includes models with the Diamond Fire GL 4000 and the Compaq PowerStorm 300 graphics controllers. The Fire GL 4000 is a high-performance, 3D graphics solution for users working in demanding, true color environments. The Fire GL 4000 uses the high-performance REALimage rendering engine from Evans and Sutherland along with specialized graphics memory from Mitsubishi. This controller comes standard with the maximum memory configuration, which is 15-MB 3D-RAM for frame buffer and Z-buffer and 16 MB of Cache DRAM (CDRAM) for texture memory. It provides true color resolution (16 million colors) at up to 1280 x 1024 resolution. The Compaq PowerStorm 300 features the next generation high-performance rendering engine based on the Evans and Sutherland REALimage 2000 architecture. This controller has 15-MB 3D-RAM for frame buffer and Z-buffer, and 16-MB CDRAM (cache DRAM) for fast texture buffering.

Compaq Graphics Driver Compatibility

All controllers are high-performance graphics solutions, optimized for Windows NT applications that require up to 16.7 million color processing and high resolutions. The drivers for each are developed by their respective manufacturers and have been thoroughly tested by Compaq to ensure compatibility with existing applications.

Matrox Millennium II

The Compaq Professional Workstation uses the Matrox Millennium II graphics controller to provide fast 2D performance for applications such as software development, electronic design automation (EDA), financial planning, and digital editing and compositing.

Color and Resolution Support

Maximum Color Support Millennium II Single-Buffer Mode			
Resolution	**4-MB WRAM**	**8-MB WRAM**	**16-MB WRAM**
1800 x 1440	256	65,536	65,536
1920 x 1200	256	65,536	65,536
1920 x 1080	65,536	16.7 million	16.7 million
1920 x 1035	65,536	16.7 million	16.7 million
1600 x 1200	65,536	16.7 million	16.7 million
1600 x 1024	65,536	16.7 million	16.7 million
1280 x 1024	16.7 million	16.7 million	16.7 million
1152 x 882	16.7 million	16.7 million	16.7 million
1024 x 768	16.7 million	16.7 million	16.7 million
800 x 600	16.7 million	16.7 million	16.7 million
640 x 480	16.7 million	16.7 million	16.7 million

Features and Technical Specifications

The following features are included in the Matrox Millennium II:

- PCI 2.1 compliant
- PC 97 compliant
- 3D texture mapping
- 16-bit or 32-bit z buffer
- 250-MHz RAMDAC to support resolution up to 1920 x 1200 at 75 Hz
- Memory expandability up to 16-MB WRAM for higher 3D resolution
- Bus mastering with scatter/gather to free-up the CPU for other processing tasks and improve overall system performance in a multitasking environment
- Larger PCI input FIFO buffer for improved 2D and 3D performance (32 double word versus 64 double word FIFO)
- Supports the Compaq P1610 24-inch monitor
- 4-MB WRAM standard, upgradeable to 16-MB WRAM for greater color depth and higher resolutions
- Multiple display support using additional controllers
- Drivers for Windows NT 4.0, Windows NT 3.51, Windows 95, AutoCAD, and Heidi

Features	Technical Specifications
Controller	Matrox MGA-2164W
Bus Type	PCI
RAMDAC	TVP 3026 250 MHz
Memory Type	WRAM
Memory Amount	4 + 4 or 12 MB
Max Memory	16 MB
Memory Speed	50 ns
Data Path	64-bit
Controller Clock Speed	66 MHz with 4MB base
Max Vertical Refresh Rate	200 Hz
Max Horizontal Scan Rate	114 kHz
Max Pixel Clock	250 MHz
Video Features: • Interface • Multimedia Connector • MPEG HW Acceleration • Scaling • Color Space Conversion	 VGA Feature Connector Optional Multimedia module* Yes – on the optional module* Yes Yes
Engine Acceleration: • BitBLT • Line Draw • Polygon • 3D • Autodesk Display list driver • Heidi drivers support for 3D StudioMAX	 Yes Yes Yes Yes Yes Yes
Operating Systems	Windows 95 Windows NT 3.51/4.0 Windows 98

* Available from Matrox

3D Capabilities

Although the Millennium II has improved its 3D capabilities as compared to the original Millennium graphics controller, there are significant differences between it and other 3D graphics controllers offered on the Compaq Professional Workstation AP400. The new features in the Millennium II support texture mapping and Gouraud shading along with 32-bit Z-buffering. The Millennium II does not support fogging, alpha-blending, depth-queuing, MIP-mapping, anti-aliasing and bilinear interpolation making it inappropriate for applications in the CAD and DCC segments that require this level of 3D functionality.

Additionally, the Millennium II 3D capabilities are implemented mainly through software (for example, drivers). Thus, those functions not supported by the hardware graphics controller must be emulated in software and processed by the CPU. This has a significant impact on performance and makes it far slower than a hardware-based implementation. The Millennium II 3D graphics capabilities make it appropriate for 3D games, viewing 3D web sites, and entry-level CAD where rudimentary, low-cost 3D capabilities are needed.

ELSA GLoria Synergy+ (AGP) Graphics Controller

The ELSA GLoria Synergy+ (AGP) graphics controller in the Compaq Professional Workstation AP400 is a low-cost, high-performance leader in the 2D/entry 3D segment. Users requiring fast windowing and menu level performance, as well as robust 3D rendering capabilities, use 2D/3D graphics.

Requirements for the 2D/3D graphics segment include exceptional 2D/3D-vector performance, 3D shading and lighting, and texture mapping support. These features, used by mainstream OpenGL- and Heidi-based applications, typically offer great price and performance without sacrificing required functionality. This combination is important for mainstream CAD applications, such as AutoCAD, Microstation, and SolidWorks, which have recently integrated 3D techniques into their environment. It is also useful in DCC where 2D and 3D animation applications are used in the same environment. Financial analysis and trading environments can benefit from the 2D performance provided by these solutions. Graphics controllers in this segment also provide investment protection as financial analysis application developers add 3D modeling to their environment in FY98.

The ELSA GLoria Synergy+ (AGP) graphics controller is based on the Permedia-2A graphics engine from 3Dlabs. It provides the 2D performance of a Matrox Millennium II while adding a robust 3D environment that rivals the performance of previous GLINT Delta/TX controllers, such as the GLoria-L. The GLoria Synergy+ is the perfect low-cost solution for mainstream CAD, web authoring, pre-print, and 2D/3D animation applications that do not require greater than 1024x768 resolution for true-color rendering. The GLoria Synergy+, as an AGP device, can also take advantage of main memory for texture mapping operations. This is a feature that will be supported in Windows NT 5.0 from Microsoft.

Color and Resolution Support

Maximum Color Depth Single-Buffer Mode			
Resolution	**4-MB SGRAM**	**8-MB SGRAM**	**Max Refresh Rate**
1920 x 1200	256	32,768	75 Hz
1920 x 1080	256	32,768	80 Hz
1600 x 1280	32,768	32,768	75/85 Hz
1600 x 1200	32,768	32,768	85 Hz
1600 x 1000	32, 768	32,768	100 Hz
1536 x 1152	32,768	32,768	85 Hz
1280 x 1024	32,768	16.7 million*	100/80 Hz
1152 x 864	16.7 million	16.7 million	100 Hz
1024 x 768	16.7 million	16.7 million	100 Hz
800 x 600	16.7 million	16.7 million	100 Hz
640 x 480	16.7 million	16.7 million	100 Hz

* 1280 x 1024 can run in a double-buffered visual if it is reduced to 32,768 colors.

Features and Technical Specifications

The following features are included in the ELSA GLoria Synergy+ (AGP):

- Provides 2D windowing performance equivalent to the Matrox Millennium II
- A low-cost solution for professional 3D applications, such as AutoCAD, Microstation, SolidWorks, and 3D StudioMAX
- Supports a wide range of resolutions and color depths for flexibility and performance in a variety of 3D graphics environments
- Supports up to 4 displays using additional GLoria Synergy (PCI) controllers
- Uses 3Dlabs Permedia-2A processor for highly integrated 2D and robust 3D rendering requirements
- Comes standard with 4 MB of SGRAM, upgradeable to a maximum of 8 MB
- Supports up to 1920x1200 resolution at 16 bbp (requires 4-MB upgrade)
- Provides a 16-bit double buffered environment at 1024x768 resolution (16-bit/single buffer at 1280x1024 including a 16-bit Z-buffer)
- Optimized graphics drivers for OpenGL and Heidi under Windows NT 4.0 and 3.51, display list drivers for AutoCAD, and Direct3D driver for Windows 95

Features	Technical Specifications
Controller	3Dlabs Permedia-2A
Bus Type	AGP
RAMDAC	Integrated 250 MHz
Memory Type	SGRAM
Memory Amount	4 MB standard (4-MB optional upgrade)
Memory Speed	8 ns
Data Path	64-bit
Controller Clock Speed	90 MHz
Max Vertical Refresh Rate	219 Hz
Max Horizontal Scan Rate	281 kHz
Max Pixel Clock	250 MHz at 8 bpp and 16 bpp/5:5:5 145 MHz at 32 bpp/8:8:8
Video Features: Interface	 VGA
3D Graphics Features: • Integrated geometry pipeline setup processor • True-color 3D graphics • Polygon based with Z-buffer • Texture decompression • Full scene anti-aliasing • Enhanced GUI Acceleration: • Ultra-fast BLT engine and 2D rasterizer • Stretch BLTs, monochrome/color expansion and logic ops • Fast on-chip SVGA • Autodesk Display list driver • Heidi drivers support for 3D StudioMAX	 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes
Operating Systems	Windows 95, Windows 98 Windows NT 3.51/4.0

STB MVP Pro-128 Graphics Controller

For enhanced multiple display requirements, the Compaq Professional Workstation AP400 includes a model using the new STB MVP Pro-128 graphics controller. The STB MVP Pro-128 controller is designed to drive multiple displays simultaneously from a single PCI. Using the STB MVP Pro-128 controller, the Compaq Professional Workstation AP400 can support up to four displays using a single PCI slot. The STB MVP Pro-128 is based on the NVIDIA RIVA 128 processor for fast 2D performance. The new and improved STB Mediator II utility allows control of dialog box positioning and size and placement of application windows.

The STB MVP Pro-128 controller for the Compaq Professional Workstation AP400 comes standard with 16 MB of SGRAM (4 MB per port). The Compaq Professional Workstation AP400 will support up to two STB MVP Pro-128 graphics controllers for environments using up to 8 displays.

Color and Resolution Support

Resolution; Max Colors	Max Hz Refresh
1600 x 1200; 64K	85
1280 x 1024; 64K	85
1152 x 864; 16.7M	85
1024 x 768; 16.7M	85
800 x 600; 16.7M	140
640 x 480; 16.7M	160

Features and Technical Specifications

The following features are included in the STB MVB Pro-128:

- Multi-display support in a single PCI slot (1 to 4 displays)
- Full Video Graphics Array (VGA) compatibility
- Full VESA (Video Electronics Standards Association) compatibility
- 128-bit Graphics Engine for improved display performance
- 4 MB of on-board SGRAM per port
- Integrated DAC to support resolutions up to 1600 x 1200 at 64K colors
- Included STB Mediator II application controls dialog box and application window positioning

Features	Technical Specifications
Controller	NVIDIA RIVA 128
Bus Type	PCI
RAMDAC	Integrated 230 MHz
Memory Type	SGRAM
Memory Amount	16 MB (4 MB per port)
Memory Speed	10 ns
Data Path	128-bit
Max Vertical Refresh Rate	160 Hz
Max Pixel Clock	230 MHz
Video Features: • Interface • MPEG HW Acceleration	 VGA Feature Connector Yes
Engine Acceleration: • BitBLT • Line Draw • Polygon • 3D	 Yes Yes Yes No
Operating Systems	Windows NT 4.0 or 3.51

Diamond Fire GL 4000

Select models of the Compaq Professional Workstation AP400 include the Diamond Fire GL 4000 graphics controller, which delivers high-performance 3D graphics capabilities for users working in demanding, true color environments, such as 3D animation, visualization, simulation, and mechanical CAD.

The Fire GL 4000 uses the REALimage rendering technology from Evans & Sutherland to deliver a very high level of 3D performance. It provides hardware acceleration for OpenGL 1.0 (NT 3.51 only), OpenGL 1.1 (NT 4.0 only), and Heidi (NT 3.51 and 4.0). Support for Direct3D and Heidi under Windows 95 will be available at a later date.

The Fire GL 4000 delivers industry-leading 3D graphics performance by combining a comprehensive set of hardware acceleration features including rasterization, texture mapping and triangle set-up with the new 3D-RAM and CDRAM memory architectures.

3D-RAM from Mitsubishi is used for the frame buffer and Z-buffer memory on the Fire GL. This design includes a small arithmetic logic unit in the DRAM that performs a number of the calculations locally. This improves performance by reducing traffic to and from memory.

The Fire GL uses Mitsubishi CDRAM (Cache DRAM) for the texture memory. This technology provides a small SRAM cache built into the DRAM. This high-speed cache provides a buffer for texture between the controller and the DRAM memory, which reduces data access times and ultimately increases graphics performance.

With all of the Fire GL's high-performance features, it can deliver performance exceeding the throughput capabilities of the PCI bus.

The Fire GL 4000 comes standard with 15 MB of 3D-RAM for frame buffer and Z-buffer memory, 16 MB of CDRAM for texture memory, and 1-MB DRAM frame buffer memory for the CIRRUS Logic 5446 VGA controller. The maximum resolutions, colors, and refresh rates are outlined in the following table; other resolutions are selectable.

Color and Resolution Support

Double-Buffered Capabilities Resolution; Max Colors	Max Hz
1280 x 1024; 16.7M	85
1024 x 768; 16.7M	100
800 x 600; 16.7M	120
640 x 480; 16.7M	120

Features and Technical Specifications

Features of the Fire GL 4000 graphics controller include:

- Support for major industry 3D APIs, including:
  - OpenGL – Open Graphics Library is a software interface to graphics hardware developed by Silicon Graphics Inc. The Fire GL supports OpenGL 1.0 under Windows NT 3.51 only and OpenGL 1.1 under Windows NT 4.0 only.
  - Direct3D – A set of APIs for real-time 3D graphics that are an addition to the Microsoft DirectX interactive media technologies. They provide a comprehensive 3D solution for software developers building interactive media programs and games. Fire GL 4000 support for this API under Windows 95 will be provided at a later date.
  - Heidi – 3D API from Kinetix (an AutoDesk company) that provides an immediate 2D and 3D mode drawing interface for 3D StudioMAX. Support for Windows NT 3.51 and 4.0 are available immediately. Support for Windows 95 will be provided at a later date.
  - BigFocus Display list drivers – Provide performance acceleration for AutoCAD R13.
  - 3D-Win – 3D viewer software for AutoCAD R13, Windows NT and OpenGL
- On-board VGA support with a CIRRUS Logic 5446 VGA chip for full-screen DOS box support on Windows NT Workstation 3.51 and 4.0.
- Hardware accelerated 3D, 24-bit Z-buffering for realistic depth perception and texture mapping.
- Full, 32-bit RGBA double buffering for smooth animation by allowing the next image to be created in off-screen memory while displaying the current image.
- Gouraud shading for smooth surfaces.
- Texture mapping for creating realistic images.
- Fog for fading effects, atmospheric effects, and depth-queuing.
- Anti-aliasing to provide smooth colors and removes jagged lines for high-quality, realistic rendered scenes.
- Alpha-blending for creating transparent effects such as an object behind a window.
- Bilinear and trilinear mip mapping
- 2 million Gouraud shaded, textured polygons per second (25 pixel triangles) with lighting, z-buffering, blending, and fogging enabled.

- 60 million bilinear MIP-mapped pixels per second.
- 30 million trilinear textured pixel per second.

Features	Technical Specifications
3D Controller	Evans & Sutherland REALimage
VGA Controller	CIRRUS Logic 5446
Bus Type	PCI
RAMDAC	220 MHz Texas Instruments TVP3026
Memory Type	3D-RAM and CDRAM
Frame Buffer and Z-buffer Memory Amount	15-MB 3D-RAM
Texture Mapping Memory Amount	16-MB CDRAM
Memory Throughput	3D-RAM, 10 ns CDRAM, 15 ns
Data Path	64-bit (3Dpro) 32-bit (CIRRUS)
Controller Clock Speed	70 MHz
Max Vertical Refresh Rate	120 Hz
Max Pixel Clock	220 MHz
Hardware Accelerated 3D: • 32-bit Z-buffering • Gouraud shading • Stencils • Texture mapping • Trilinear mip mapping	 Yes Yes Yes Yes Yes
Operating Systems	Windows NT 3.51/4.0 Windows 95*

***** Available at a later date.

Compaq PowerStorm 300 (AGP) Graphics Controller

Standard on certain models of the Compaq Professional Workstation AP400 is the Compaq PowerStorm 300 (AGP) graphics controller. The Compaq PowerStorm 300 provides a high-performance, mid-range, 3-dimensional graphics solution at a very competitive price.

Professionals that use more demanding workstation applications require the performance of mid-range 3D graphics solutions. CAD and CAE applications, such as Pro/E, take advantage of this graphics controller to provide a high-performance rendering solution for solids modeling and visual data analysis. The PowerStorm 300 also provides superior performance and visual quality for DCC applications, such as 3D StudioMAX. System performance is key for these applications where the graphics controller must not be perceived as a bottleneck.

The PowerStorm 300 is an optimized, high-performance solution for mid-range 3D graphics requirements in these segments. Based on the next-generation REALimage 2000 architecture from Evans and Sutherland, it provides the fastest 3D-application performance in its class. The PowerStorm 300 is the graphics controller to use when up against other non-geometry accelerated solutions, such as the Intergraph 3400T (VX113T).

Color and Resolution Support

Maximum Color Depth Single-Buffer Mode			
Resolution	**3D Acceleration with Double Buffering, Colors Supported**	**Texture Memory**	**Max Refresh Rate**
640 x 480	16.7 million	16 MB	85 Hz
800 x 600	16.7 million	16 MB	85 Hz
1024 x 768	16.7 million	16 MB	85 Hz
1280 x 1024	16.7 million	16 MB	85 Hz

Features and Technical Specifications

The following features are included in the Compaq PowerStorm 300:

- Optimized solution at 1280 x 1024, true-color double buffered for demanding solids modeling, animation, and visualization applications
- Next-generation high-performance rendering engine based on the Evans and Sutherland REALimage 2000 architecture
- 15-MB 3D-RAM for frame buffer and Z-buffer, 16-MB CDRAM (cache DRAM) for fast texture buffering
- Dual display support using an additional PCI controller

Features	Technical Specifications
Controller	Evans and Sutherland REALimage 2100
Bus Type	AGP
RAMDAC	IBM 640
Memory Type	3D RAM and CDRAM
Memory Amount	15-MB 3D RAM, 16-MB CDRAM
Memory Speed	10-ns 3D RAM, 15-ns CDRAM
Data Path	64-bit
Controller Clock Speed	100 MHz
Max Vertical Refresh Rate	120 Hz
Max Pixel Clock	220 MHz

Features	Technical Specifications
Hardware Accelerated 3D:	
• 24-bit Z-buffering	Yes
• Gouraud Shading	Yes
• Stencils	Yes
• Texture Mapping (bilinear and trilinear)	Yes
Performance:	
• Random 10-Pixel Solid Lines	4 million/s
• Filled 25-Pixel Triangles	4 million/s
Pixel Fill Rates:	
• Bilinear	90 million/s
• Trilinear	45 million/s
Operating Systems	Windows NT 3.51/4.0

INTEGRATED NETWORK INTERFACE CONTROLLER (NIC)

With its new Compaq Fast Ethernet Embedded NIC NC3121 (10/100 Mbps), Compaq dramatically simplifies the network management task and lowers the total cost of ownership in today's businesses. The product's Wake-on-LAN (WOL) feature enables remote system power-up and maintenance during nonwork hours, making it easy to perform routine updates, audits, and other management operations without interrupting end users. Moreover, because the new NIC operates at both 10 and 100 Mb/s, it is an ideal solution for environments that are migrating towards Fast Ethernet.

For maximum flexibility in designing your business' network, the NC3121 NIC conforms to the full range of today's industry standards, including PC97. It is compatible with both Compaq and Intel Fast Ethernet drivers, allowing MIS departments to standardize on one set of drivers. The SNMP-compliant NC3121 can be remotely monitored with Compaq's Insight Manager, Compaq's CNMS network management software, HP Openview, or any other SNMP compliant management solution.

Performance and connectivity are further enhanced by the NC3121's 10/100 autosensing, auto-negotiating feature, which enables the NIC to automatically negotiate between 10 and 100 Mb/s and achieve the highest common speed on the network. Full duplex support allows the controller to transmit and receive data simultaneously for data rates up to 20 Mb/s for Ethernet and 200 Mb/s for Fast Ethernet, and 6-KB buffer memory produces low CPU utilization at high throughputs.

Features	Technical Specifications
Compliance	IEEE 802.2, 802.3, and 802.3µ
Data Transfer	32-bit bus-master PCI, 10 or 100 Mb/s, autonegotiating
Connector	RJ-45
Buffer Memory	6 KB
Communication Processor	Intel 82558 chipset
Operating System Support	Microsoft Windows 95 and Windows NT, ODI 16-bit and ODI 32-bit (Novell NetWare), NDIS 2.0 (most operating systems), and SCO UNIX

Q. What is the purpose of Intel driver compatibility?

A. Because the NC3121 NIC is compatible with both Compaq and Intel drivers, MIS departments can standardize on one set of drivers while using both Compaq and Intel NICs.

Q. What is the relationship between Intel and Compaq with regard to Compaq NICs?

A. The relationship between Compaq and Intel allows the two companies to speed the deployment and evolution of new networking technologies. With technology licensing and cooperative engineering and product development, the two companies can generate more affordable, efficient, and interoperable networks.

Q. Is this NIC standards-based?

A. Yes. The NIC works with any standards-based system. It is PC 97 compliant, Windows 98 compatible, and fully compliant with IEEE 802.2, 802.3, and 802.3µ. The product also complies with "Blue Angel" standards to make it compatible with the latest German environmental requirements.

32X MAXIMUM CD-ROM

The Compaq Professional Workstation AP400 features a 5.25", half-height tray-load 32X Maximum CD-ROM Drive using the new Constant Angular Velocity (CAV) technology. Previous CD-ROM technology used Constant Linear Velocity (CLV) technology, which allowed the disc to rotate at a faster rate while reading the inner tracks and a slower rate when reading the outer tracks. Conversely, CAV technology spins the disc at a fixed rate and the data transfer rate increases as it moves toward the outer tracks. This is the same technology that is used for hard drives where it has demonstrated excellent performance in high data transfer and fast access times. Using this technology enables reliable CD-ROM speeds above 8X. The 32X CAV CD-ROM dramatically increases the access time performance of the CD-ROM in the Compaq Professional Workstation AP400.

Features	Technical Specifications
Access Time	Random = <100 ms Full Stroke = <150 ms
Variable Transfer Rate	2100 - 4800 KB/s

PREMIERSOUND™ AUDIO

The Compaq Professional Workstation AP400 PremierSound audio system is a solution optimized for workstations. The signature performance characteristics of a PremierSound audio system are exceptional sound output and clarity from a completely integrated, "no desktop clutter," audio solution.

The PremierSound audio system is comprised of several subsystems, each individually optimized to work as a complete solution.

CUSTOMER BENEFITS

- ***"No desktop clutter."*** Compaq PremierSound is integrated in the AP400, this provides more free space on desktops.
- ***High-performance loudspeaker with long excursion***. Provides crisp, clean, wide-bandwidth audio from a small-integrated solution. The voice clarity and low frequency output of the speaker is dramatically better than current integrated computer office products.
- ***Low distortion.*** PremierSound utilizes an audio power amplifier that delivers a clean, undistorted signal. This amplifier is conservatively rated at 5 Watts RMS and is designed to take full advantage of the loudspeaker's output capability by providing a large, low distortion, audio output signal.

- ***Five stages of fixed equalization.*** The five stages of fixed equalization incorporated in the electronics are used to "shape" the system frequency response in various listening positions. The system frequency response is manipulated to provide smooth, natural voice reproduction and high-quality CD playback.
- ***Electrical system gain staging***. Gain staging is a key process in transforming the individual piece parts into a unified audio system. Gain staging allows Compaq to compensate for the different input levels that are generated by a number of different audio sources, such as CD-ROM, wavetable, and line in.

The end result of the interaction between the susbystems is a well balanced, "no desktop clutter," audio system capable of delivering clean, undistorted output at a level needed to support an office environment.

UNIVERSAL SERIAL BUS (USB)

The Compaq Professional Workstation AP400 includes two Universal Serial Bus (USB) ports.

USB is a peripheral bus standard developed by a group of PC and telecom industry leaders including Compaq, DEC, IBM, Intel, Microsoft, NEC and NORTEL. USB enables hot plug and play of computer peripherals outside of the workstation eliminating the need to install boards into expansion slots and then having to reconfigure the system. Workstations equipped with USB allow peripheral devices to be automatically configured as soon as they are physically attached - without the need to reboot or run setup. USB also allows up to 127 devices to run simultaneously with peripherals such as monitors and keyboards acting as additional plug-in sites or hubs.

USB peripherals include telephones, modems, keyboards, mice, CD-ROM drives, joysticks, tape and diskette drives, scanners, and printers. USB has a 12 Mbits/sec data rate, compared to 115.2 Kb/s for serial ports and 2 Mb/s for enhanced parallel ports. This improved transfer rate will accommodate a new generation of peripherals, including MPEG-2 (compressed data) video-based products and digitizers.

Drawing its intelligence from the host workstation, USB detects when devices are added and removed. USB automatically determines what host resource each peripheral needs, including driver software and bus bandwidth, and makes those resources available without user intervention.

Currently, there are different ways to implement USB. The Compaq Professional Workstation AP400 implements the OpenHCI USB interface. OpenHCI reduces CPU overhead for USB devices compared to other implementations and is fully compatible with UniversalHCI.

Currently, Microsoft Windows NT Workstation 4.0 does not support USB, but future versions are expected to include USB drivers that will allow the workstation to recognize USB peripherals.

MONITORS

The recommended monitors for the Professional Workstation AP400 are the Compaq P75 (17-inch), V90 (19-inch), P110 (21-inch), and P1610 (24-inch), and the Compaq TFT500 and TFT450 Flat Panel Monitors.

	P75	V75	V90	P110	P1610
Viewable image	16.0 inches	16.0 inches	18.0 inches	21.0 inches	24.0 inches
Screen type	.25 mm stripe pitch	.26 mm dot pitch	.26 mm dot pitch	.25 to .27 mm variable aperture grille pitch	.25 to .28 mm variable aperture grille pitch
Top Resolution	1280 x 1024	1280 x 1024	1600 x 1200	1600 x 1200	1920 x1200
Refresh rate at top resolution	75 Hz	75 Hz	75 Hz	85 Hz	76 Hz
TCO 95 Compliant	Yes	Yes	Yes	Yes	Yes
Plug and Play	Yes	Yes	Yes	Yes	Yes
Microsoft 97 compliant	Yes	Yes	Yes	Yes	Yes

	TFT450	TFT500
Viewable image	14.5 inches	15.0 inches
Screen type	Thin Film Transistor (TFT)	Thin Film Transistor (TFT)
Plug and Play	Yes	Yes
Microsoft PC97	Yes	Yes
Horizontal viewing angle	120 °	120°
Vertical viewing angle	105°	80°

For a more complete overview of Compaq monitors, please refer to the monitor area on Compaq's web site: http://www.compaq.com/products/monitors.

WORKSTATION SOFTWARE PLATFORM

Microsoft Operating System Compatibility

The Compaq Professional Workstation AP400 is designed to comply with the requirements of the PC97 Hardware Design Guide. In support of this initiative, the AP400 meets the hardware compatibility requirements for the Windows NT Workstation operating system and has been verified, tested, and certified as "Designed for Windows NT" in Microsoft's logo program.

Intelligent Manageability

Intelligent Manageability is the Compaq management solution that gives customer's day one ROI by making Compaq Workstations more manageable from a single point on the network. The Compaq Workstation family can be integrated into a broad range of LAN and enterprise management applications. Workstation products are easy to troubleshoot because the hardware has built-in instrumentation to detect potential failures and allow for rapid recovery if problems occur. Fundamental benefits include the ability to protect data and minimize end-user downtime, thus increasing the productivity of both the end-user and the IT organization. End-users can feel more secure knowing that systems and data are protected while the IT organization benefits from smoother and faster service call resolution. This is a key benefit for organizations with limited technical support resources.

Most fault management features (local and remote) require that the Compaq Management Agent be running on the Workstation. This agent is available on the Compaq Management CD, which is provided with the AP400. Key Intelligent Manageability features for the Professional Workstation AP400 include:

Initial Configuration and Deployment

- Remote System Installation (Remote Boot Capability)
- Replicated Setup
- Compaq SmartStart for Workstations

Asset Tracking and Security

- AssetControl
- System, monitor, hard drive, memory, serial number, model, and manufacturer
- ROM and system board revision level
- DMI 2.0 Support
- Memory Change Alert
- Ownership Tag
- Smart Cover Sensor notifies the administrator that the unit has been opened
- Standard security features include power-on password, setup password, and media and port input/output control

Software Updating and Management

- Compaq Info Messenger
- Compaq SmartStart for Workstations
- Remote Security Management
- Remote ROM Flash
- Remote Wakeup/Remote Shutdown
- Support Software CD and Compaq Web site

Fault Notification and Recovery

- ECC Memory, Fault Prediction, and Pre-failure Warranty
- SMART Drives, Proactive Backup, and Pre-failure Warranty
- Surge Tolerant Power Supply
- Thermal Sensor
- Ultra ATA Integrity Monitoring
- Diagnostics for Windows

Other Features

- ACPI-ready Hardware
- Dual-State Power Button

Support Software CD and the Compaq Web Site

The Compaq Support Software CD and Compaq's Web site (www.compaq.com) provide software updates, device drivers, tools, and other value adds that allow customers to achieve optimum performance and the best manageable workstation. Through both of these mediums, a customer can easily customize the software that comes pre-installed on each Professional Workstation AP400. These instruments, which are updated monthly, provide easy installation of the most current device drivers and other value-added software. The Support Software CD is available by subscription.

SmartStart for Workstations

All Compaq Professional Workstations ship standard with SmartStart for Workstations. SmartStart for Workstations enables re-installation of the operating system and drivers in the event that the customer experiences hard drive failure or chooses to perform a custom installation of the systems software and operating system.

For more information about the software platform, please refer to the Compaq Professional Workstation Software area on the Workstation web site:

http://www.compaq.com/products/workstations/software-platform/index.html.