

Sun Ultra™ 60 Workstation

Just the Facts



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Positioning

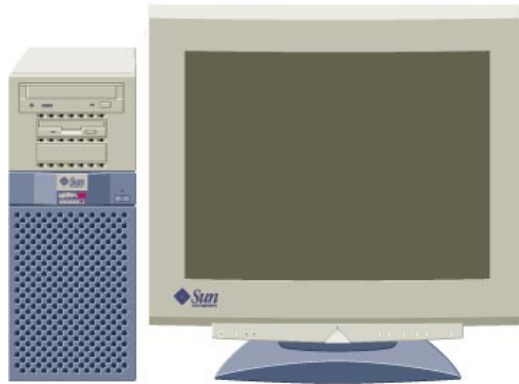


Figure 1. Sun Ultra™ 60 system

Multiprocessing Power on the Desktop

The Sun Ultra™ 60 workstation brings multiprocessing power, industry-standard PCI I/O, and dual-UPA graphics capability to the desktop. This next-generation workstation uses the processing power of UltraSPARC™-II processors, Sun™ Creator3D, Sun Expert3D, and Sun Expert3D-Lite graphics technology, UltraSCSI disks, and the innovative high-performance peripheral component interconnect (PCI) I/O bus. With the minitower system enclosure, Sun Ultra 60 workstation provides all the modular and expandable features that users have grown to expect from Sun Workstation™ systems. Sun's commitment to high-performance computing means the Ultra 60 workstation delivers increasing levels of excellent performance and preserves 100 percent binary compatibility with application software.

Sun Ultra 60 workstations are available with one (Model 1450) or two (Model 2450) 450-MHz processors. Model 1450 is easily upgraded to its dual-processor counterpart, Model 2450, by adding a second processor.

New Features

Sun is announcing new Ultra 60 workstation configurations including Sun Expert3D-Lite graphics cards. Sun Expert3D-Lite graphics is the latest Sun graphics offering to feature onboard texture mapping memory plus hardware-accelerated geometry and texture mapping acceleration.

Sun Expert3D-Lite graphics offers many of the same features of Sun Expert3D graphics including 32-bit RGBA double-buffering/32-bit Z-buffering (3-D) support at resolutions of up to 1920 x 1080, stereoscopic video graphics support at up to 1280 x 800@122 Hz or 1152 x 900@120 Hz, and multi-display support. Up to four Sun Expert3D-Lite graphics accelerators are supported in the Ultra 60 workstation.

Product Family Placement

The Ultra 60 workstation is an advanced member of the current desktop product family, which scales from the entry-level Ultra 5 and mid-range Ultra 10 workstations, up to the multiprocessor Ultra 60 and 80 workstations.



Ultra systems have several things in common, including:

- The UltraSPARC processor
- 100 percent binary compatible from the low end to the high end, including Sun's server family
- Scalable from the low-end uniprocessor systems to the 64-way Sun Enterprise™ 10000 (Starfire™) server
- Modular—easy-to-swap components
- Excellent price/performance in their class

Workstation	Target Users and Markets
Ultra 5 and Ultra 10	Designed as a low-cost desktop solution, the Ultra 5 and 10 systems appeal to customers looking for a low-priced system offering accelerated graphics, expandability, fast application performance, and investment protection. The Ultra 5 and 10 workstations are well suited for many different customers, from those who require low-cost imaging solutions to those who demand intensive graphics and expansion capabilities. Target markets include software development, financial, government, telecommunications, manufacturing, and education.
Ultra 60, Ultra 80, and Sun Blade™ 1000	The Ultra 60, Ultra 80, and Sun Blade 1000 workstations are designed for the technical user who requires high performance and multiprocessing capability. They also address the needs of graphics intensive users and continue to support and build upon the upgradability features to which Ultra workstation users have grown accustomed. With the 450-MHz UltraSPARC-II processor with 4 MB of Level 2 cache, these workstations are the performance leaders for Sun's workstation family. The target customer is the traditional "power desktop" user who has performance and expansion requirements that exceed the capabilities of the Ultra 5 and Ultra 10 systems. This includes both technical and commercial users who need the large number of applications and the functional capabilities of the Solaris™ Operating Environment, the high-performance of the UltraSPARC-II CPU, dual-headed graphics, and excellent throughput.

Key Messages

The Sun Ultra 60 workstation is a high-end member of the UltraSPARC processor-based workstation family. UltraComputing™ technology has evolved to new levels of performance and technology innovation.

- **Innovative minitower system design provides modularity for flexibility, maximum system growth, and expansion potential**
 - The Ultra 60 workstation offers the flexibility of starting with a single CPU and adding a second CPU later as compute needs grow
 - Memory capacity to 2 GB maximum (16 slots using existing 16-, 32-, 64-, or 128-MB DIMMs)
 - Supports 9.1-, 18.2, and 36.4-GB drive options (supports 1-inch or 1.6-inch high UltraSCSI disk drives)
 - Two UPA graphics slots able to support two Sun Creator3D, Sun Elite3D m3, or a single Sun Elite3D m6 graphics card paired with either a Sun Creator3D or Sun Elite3D m3 card. (See the Compatibility section under System Architecture for allowable combinations.)
 - Ability to support two PCI-based Sun Expert3D graphics boards or three Sun Expert3D-Lite boards



- Expanded front access capabilities: power switch, 5-inch removable media bay for options such as 10X DVD-ROM, 32X CD-ROM or tape options. Optional front access floppy plus second 3.5-inch front access bay for options that can interface using the PCI slots such as PCMCIA adapters
- High I/O expansion with four full-sized, industry-standard PCI bus slots
- **Support for high-power Sun Elite3D graphics provides high-end graphics for a mid-range price**
 - Sun Elite3D m3 graphics is Sun's high-power, mid-range 3-D graphics option in the Sun Elite3D graphics product line, offering more than twice the 3-D performance of Sun Creator3D graphics
 - Sun Elite3D m6 graphics is Sun's high-power, high-end 3-D graphics option in the Sun Elite3D graphics product line, offering 4 to 5 times the 3-D performance of Sun Creator3D graphics
- **Support for high-power Sun Expert3D graphics family provides very high-end graphics for an excellent price**
 - Sun Expert3D graphics provides similar 3-D performance of Sun Elite3D m6 graphics along with exceptional texture mapping performance
 - Sun Expert3D-Lite graphics provides a high-performance, entry-level graphics option
 - Designed for those applications that require texture mapping for large data sets, such as in the oil and gas, GIS, and MCAD markets
 - 3-D support for 24-inch monitors
- **High-performance UltraSPARC-II CPU processor module**
 - 64-bit SPARC version 9 at 450 MHz; with 4 MB of second-level cache memory
 - 100 percent binary compatibility with current Solaris Operating Environment
 - Runs 32-bit applications unmodified from the earlier Solaris 2.3 and Solaris 2.4 Operating Environments
 - Easy-to-upgrade processor modular design offers customers easy performance upgrades to their existing 300-MHz and 360-MHz models
- **Excellent throughput**
 - UPA provides a crossbar-oriented interconnection establishing a 144-bit wide, ECC-protected data path to the CPU
 - Clocked at up to 120 MHz, the UPA crossbar gives a peak throughput of 1.9 GB/second
 - Memory subsystem offers a 576-bit-wide memory path
 - Architecture allows memory to be installed in fours to take advantage of 576-bit-wide memory path
 - UltraSCSI is integrated on the motherboard, offering double the disk performance (40 MB/second) of the Ultra 1 or Ultra 2 systems
 - A second UltraSCSI channel is available, allowing external devices to be connected to separately, further improving I/O throughput
- **One of the industry leaders for networking, connectivity, and I/O performance ratings**
 - 100 Mbps Fast Ethernet through twisted pair is a standard feature on all Ultra 60 workstations, but the system also maintains connectivity with 10 Mbps networking technology through an autosensing speed switch feature
 - Standard MII port connects to external transceivers, which provide connectivity to media other than the standard integrated 100/10BASE-T twisted pair



- Advanced networking options include FDDI and additional Fast Ethernet ports through industry-standard PCI option cards
- Innovative multiple-channel industry standard PCI I/O bus provides sustained high throughput on all four full-sized PCI slots
- One of the industry's first 66-MHz PCI I/O slots capable of delivering 200 MB/second throughput ideal for high-performance networking requirements

Sun Ultra 60 System Models

The Sun Ultra 60 workstation comes in two models that differ only in the number of installed processor modules. Both models support up to two 450-MHz UltraSPARC-II CPUs.

Sun Ultra 60	Model 1450	Model 2450
Processor speed	1 x 450 MHz (can upgrade to two processors)	2 x 450 MHz
UPA speed	112.5 MHz	112.5 MHz
Graphics configured	Sun Creator3D Sun Elite3D Sun Expert3D Sun Expert3D-Lite	Sun Creator3D Sun Elite3D Sun Expert3D Sun Expert3D-Lite
SPECint_95 *	19.7	19.7
SPECfp_95 *	27	32.7

* SPECint_95 and SPECfp_95 results using SPARCompiler™ version 5.0.

Availability

Models 1450 and 2450 of the Sun Ultra 60 workstation are available now.

Target Users

The Ultra 60 workstation is designed for the technical user who requires high performance and multiprocessing (MP) capability. Ultra 60 workstation also addresses the needs of users with graphics-intensive applications and continues to support and build upon the upgradability features with which Ultra 2 system users have grown accustomed.

The target customer is the "power desktop" user who has performance and expansion requirements that exceed the capabilities of the Ultra 2 system. This includes both technical and commercial users who need the large number of applications and the functional capabilities of the Solaris Operating Environment, the high-performance of the UltraSPARC-II CPU, dual-headed graphics, and excellent throughput.



Target Markets

Industry	Key Features to Highlight
Electronic Design (EDA) <ul style="list-style-type: none"> • Chip designers, board designers • System houses • Telco 	<ul style="list-style-type: none"> • High-performance CPUs • High-memory capacity • Availability of applications
Financial <ul style="list-style-type: none"> • Stock and commodity traders • Banks 	<ul style="list-style-type: none"> • High performance • Compact design • Multimedia capabilities
Mechanical Design (MCAD/MCAE) <ul style="list-style-type: none"> • Automotive • Aerospace • Defense industry • Mechanical equipment designers 	<ul style="list-style-type: none"> • High-performance CPUs • High-end graphics performance and functionality • Availability of applications
Oil and Gas <ul style="list-style-type: none"> • 2-D, 3-D, and 4-D seismic analysis • Production engineering • Reservoir engineering 	<ul style="list-style-type: none"> • High-performance CPUs • High-end performance and functionality for both graphics and imaging operations • Dual-headed monitor capability • 3D support for 24-inch displays
Publishing and Imaging <ul style="list-style-type: none"> • Newspapers • Magazines • Image banks • Advertising agencies 	<ul style="list-style-type: none"> • High-performance CPUs • High-end performance and functionality for both graphics and imaging operations • Dual graphics monitor capability
Research and Development <ul style="list-style-type: none"> • In-house development • Research institutions 	<ul style="list-style-type: none"> • High computing performance • Feature-rich Solaris Operating Environment
Software Development (CASE) <ul style="list-style-type: none"> • ISVs • In-house development at large organizations 	<ul style="list-style-type: none"> • High-performance Solaris Operating Environment • Availability of applications • Multithreaded application development
Visualization and Simulation <ul style="list-style-type: none"> • Scientific visualization • Technical simulation 	<ul style="list-style-type: none"> • High-performance CPUs • High-end performance and functionality for both graphics and imaging operations • Sun Expert3D graphics with high-end texture mapping • Dual monitor capability

Compatibility

The Ultra 60 workstation runs the Solaris 2.5.1, 2.6, 7, and 8 Operating Environments. It can also run 32-bit applications unmodified from the Solaris 2.3 Operating Environment, making these systems compatible with previous systems and software.



Enabling Technologies

UltraSPARC™-II Processor

The Sun Ultra™ 60 workstation is a shared-memory, multitasking system built around the UltraSPARC™-II microprocessor. The UltraSPARC-II processor is Sun's latest generation of the SPARC™ processor family and the second generation of 64-bit UltraSPARC chips. The Ultra 60 workstation can use up to two 300-MHz, 360-MHz, or 450-MHz UltraSPARC-II processors.

- Modules have the 64-bit SPARC V9 architecture
- Systems have up to 4 MB of Ecache per CPU—eight times the cache size of the Ultra 1 workstation
- As a member of the UltraSPARC family of CPUs, full binary compatibility is assured

PCI Technology

System I/O for the Ultra 60 workstation is provided by two industry-standard peripheral component interconnect (PCI) data buses. All PCI buses in the Ultra 60 workstation comply with the 2.1 revision of the PCI specification, released in March 1995.

- Sun leads the industry with PCI/66, which has twice the throughput of standard PCI
- Two independent PCI buses deliver outstanding I/O bandwidth, sustained throughput of up to 200 MB/second

Sun™ Elite3D Graphics Series 2

Sun™ Elite3D graphics represents a high-powered graphics subsystem for the 3-D graphics market. Sun Elite3D graphics retains the basic underlying architecture of Sun Creator graphics while maintaining full API layer compatibility and transparent acceleration of 3-D graphics APIs. Like the Sun Creator graphics, Sun Elite3D graphics incorporates the visual instruction set (VIS™ software). Sun Elite3D graphics comes in two models: Sun Elite3D m3 graphics offers users twice the performance of Sun Creator3D graphics while Sun Elite3D m6 graphics can provide four to five times the performance of Sun Creator3D graphics.

Sun Elite3D graphics provides very fast, high-quality transformation and display of 3-D solid and wireframe objects, and dramatically accelerates high-end functionality, such as double-buffering, triangle and quad rendering, and lighting and shading. At the same time, Sun Elite3D graphics accelerates 2-D objects that meet X11 rules. Fast 8-bit and 24-bit window system and imaging performance are provided. Sun Elite3D graphics systems provide 96-bit planes, including full 24-bit double-buffer planes required for smooth animation. A 28-bit Z-buffer is included to provide hardware assistance for hidden surface removal and dynamic rendering for 3-D objects. Sun Elite3D graphics accelerates 2-D objects, fast 8-bit and 24-bit windowing and imaging performance, along with acceleration for decompression and display of compressed digital video.

Sun Elite3D graphics systems utilize 3D-RAM technology. This technology is responsible for implementing fast, inexpensive 3-D frame buffers. In addition, Sun Elite3D graphics has three or six (depending on the model) on-board floating-point processors that speed up floating-point-intensive operations such as transformations, clip tests, face determinations, and lighting.



Sun Elite3D graphics is fully compatible with Sun Creator3D graphics accelerators, and does not compromise the windowing system, 2-D graphics, imaging, or video performance. Sun Elite3D graphics simply adds significant performance gains for 3-D applications.

Sun Expert3D Graphics

Sun Expert3D graphics is Sun's latest high-end graphics product. It complements Sun Elite3D graphics, adding hardware-accelerated texture mapping required by many 3-D graphics applications in all of Sun's technical markets. The Sun Expert3D frame buffer provides Sun's most complete acceleration of the OpenGL API to date, including 2-D and 3-D texture mapping, image processing, the OpenGL[®] for Sun[™] Solaris 1.2.1 API, and a significant number of extensions beyond this API.

The Sun Expert3D frame buffer has similar geometry performance to Sun Elite3D m6 graphics, but its 64 MB of texture memory and hardware texture mapping provide up to 7 times the performance of Sun Elite3D graphics in rendering 25-pixel, trilinear-textured, Z-buffered, and Gouraud-shaded triangles. The 64 MB of frame buffer memory allow high-resolution (1920 x 1200), double-buffered displays and 1280 x 1024 stereo displays. Sun Expert3D frame buffer hardware supports full-scene antialiasing, but software support for this feature is not part of the initial release. Wide lines and polygon offset are fully accelerated by the hardware.

The Sun Expert3D frame buffer is a PCI 64-bit/66-MHz graphics card. The bus interface ASIC provides the host bus (64-bit PCI) interface for the graphics card. A geometry accelerator ASIC performs transform, clipping, and lighting, and a rasterization engine ASIC performs 2-D and 3-D rasterization, 2-D and 3-D texturing, pixel transfers, imaging, and fragment processing.

Up to two Sun Expert3D frame buffers are supported in the Ultra 60 and 80 workstations, which is a big advantage over competitive systems allowing only one high-powered graphics board per system. In addition, the Sun Expert3D frame buffer provides support for 24-inch (1920 x 1200 resolution) monitors.

Sun Expert3D-Lite Graphics

Sun Expert3D-Lite graphics is a derivative product based on the Sun Expert3D graphics board. Sun Expert3D-Lite graphics offers many of the same features as its predecessor, but at a lower cost. Features include on-board 3-D geometry acceleration, hardware-based texture mapping, and high-resolution, 24-bit, 3-D support for most of Sun's workstations and PCI-based workgroup servers.

Sun Expert3D-Lite graphics accelerates 3-D geometry at up to 4 million triangles/sec. and provides up to three times the texture mapping performance of Sun Elite3D m3 graphics, at a much lower price.



System Architecture

Technology Overview—More Than Just a Fast Processor

Good performance through advanced applications typically demands excellent performance from more than one part of the system. Most often, an application consists of data fetching, computation, and presentation. Unless the system is designed to address all of these, it will always be limited by the weakest link in the chain.

The Sun Ultra™ 60 workstation is designed for balanced system performance, accelerating applications at every step. Faster I/O and networking, together with the UPA interconnect, allow fast data fetching. The UltraSPARC™ CPU provides supercomputing power, and moves data through the UPA at high speed. Tightly integrated Sun™ Creator, Sun Elite3D, Sun Expert3D, and Sun Expert3D-Lite graphics provide high-end graphics functionality and performance for the Ultra 60 workstations.

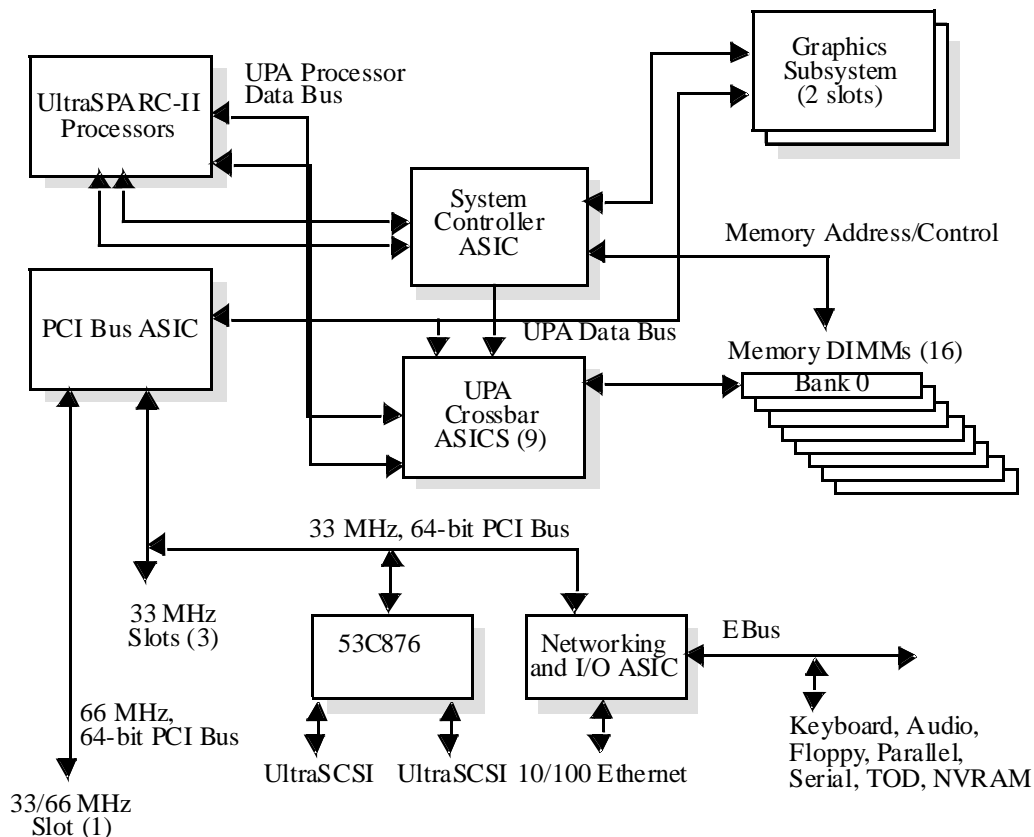


Figure 2. Architecture of the Ultra 60 system

The Sun Ultra 60 workstation has an integrated Ultra Port Architecture (UPA). This is based on a packet-switched, crossbar architecture. Sun is the one of the first manufacturers to provide such an architecture on the desktop. The Sun Ultra 60 workstation has nine buffered crossbar-switched processors that allow the memory and the graphics to interconnect. This architecture is the basis for high-powered computing and graphics.



Key Facts

- High performance uniprocessor and multiprocessor Sun workstation; uses the 450-MHz UltraSPARC-II processor
- High-end graphics functionality and performance at entry-level prices with Sun Creator3D, Sun Elite3D, Sun Expert3D, and Sun Expert3D-Lite graphics
- Balanced system design
 - Very fast UPA at 120-MHz or 1.9 GB/second throughput
 - Matching performance enhancement in I/O, networking, and memory access
 - Application performance without compromise

Technical Fact Summary

- Higher performance system bus provides fast access to memory and graphics
- Flexible hard disk expandability
 - Up to two internal UltraSCSI disks; either 9.1-, 18.2-, or 36.4-GB disks
 - Over 900 GB of total disk storage is supported
- High-performance memory subsystem
 - Up to 2 GB using 16 x 128-MB DIMMs, installed in sets of four
 - Supports Ultra 1 and Ultra 2 workstation and SPARCstation™ 20 system DIMMs for compatibility and investment protection
- High-performance I/O
 - Two channels at 40 MB/second UltraSCSI, one internal, and one external
 - Innovative high-performance PCI I/O bus offering dual independent PCI buses, plus 66-MHz PCI support
- Designed for interactive media applications
 - Integrated visual instruction set (VIS™ software) in the UltraSPARC CPU
 - Advanced 24-bit accelerated Sun Creator3D graphics standard
 - 10X DVD-ROM, photo-CD compatible
- Expansion to advanced networking
 - Fast Ethernet, 100BASE-T, autosensing, and autoswitching to 10BASE-T for backward compatibility
 - MII connector to Fast Ethernet for connection to other types of Ethernet transceivers and media
 - PCI networking options include Gigabit Ethernet, ATM, token ring, and FDDI
- System enclosure
 - Cost-effective minitower enclosure offering flexible expansion

UltraSPARC Processor

The Ultra 60 workstation is a high-performance, multiprocessing system built around the UltraSPARC-II microprocessor. The UltraSPARC-II processor is Sun's latest generation of the SPARC™ processor



family and the second generation of 64-bit UltraSPARC chips. It utilizes the latest 0.35-micron technology (compared to the UltraSPARC-I CPU's 0.5-micron technology), which shrinks the die size to 149² mm (from 218² mm). This reduced die size is the key to UltraSPARC-II CPU's higher clock rates and increased performance. This smaller die size also enables the UltraSPARC-II processor to operate at a core voltage of 2.5 volts, rather than UltraSPARC-I CPU's 3.3 volts. This lower voltage reduces power consumption and allows the chip to operate at higher frequencies without increasing total power requirements or heat dissipation—both major design issues in today's high performance systems.

The UltraSPARC-II processors used in the Ultra 60 workstation are individually mounted on 4- x 6-inch, field-installable module cards along with associated UPA data buffers and up to 4 MB of high-speed SRAM external cache memory. These modules are the same as those used in the Ultra 2 workstation. This modular design facilitates easy system processor upgrades (to next generation UltraSPARC processors), and system service.

Features

- 450-MHz performance
- Integrated VIS instruction set software
- Multilevel trap handling
- Utilizes the latest 0.35 micron technology, which greatly decreases the die size
- CPU is mounted on field-installable module card with associated UPA data buffers and 4 MB of Ecache

Benefits

- Fast application performance
- Ready for increased performance on multimedia and networking operations
- Efficient process handling
- Results in a significant increase performance and a significant decrease in power consumption (due to a lower core voltage of 2.5 volts)
- Facilitates easy system processor upgrades and system service

UPA System Bus

The Ultra 60 workstation processors, memory, and I/O subsystems are interconnected by the high-speed Ultra Port Architecture (UPA) crossbar datapath. This is an enhanced implementation of the same UPA design used in the Ultra 1 and Ultra 2 workstations. The CPU datapaths are 144-bits wide, with 128 bits for data and 16 bits for error correcting code (ECC). The UPA data path that support system I/O is 72 bits wide, with 64 bits for data and 8 bits for ECC. The memory interface supports a single 576-bit-wide datapath.

With the 450-MHz CPU installed (Models 1450 and 2450), the Ultra 60 workstation runs the UPA at 112.5 MHz (up to 1.8 GB/second throughput).

Features

- Single 576-bit-wide, high-speed memory bus
- 112-MHz UPA

Benefits

- High-performance memory access
- Flexibility in memory expansion options
- Able to use advanced UltraSPARC-II processors

Memory

The Ultra 60 workstation supports up to 2 GB of 60-ns, 5-volt, dynamic RAM memory. Dual in-line memory modules (DIMMs) used by the Ultra 60 workstation are the same type as those used in the



Ultra 1 and Ultra 2 workstations. Memory is organized into four banks of four DIMMs. DIMMs must be installed in sets of four identical DIMMs.

Feature

- Uses the same type of memory as Ultra 1 and Ultra 2 workstations

Benefit

- Helps protect customer's investment and enhances upgradability

Storage

Internal data storage for the Ultra 60 workstation is provided by up to two 36.4-GB, 10000-rpm UltraSCSI disk drives on models 1450 and 2450 (9.1- and 18.2-GB drives are supported). These 10000-rpm drives offer a peak data transfer rate of 40 MB/second, or twice the transfer rate of fast/wide SCSI controllers.

In addition to its internal and external high-speed fixed storage capabilities, the Ultra 60 workstation provides an optional 32X CD-ROM drive and a 1.44-MB, 3.5-inch, manual-eject floppy drive for software installation and system management.

Features

- 40 MB/second UltraSCSI
- 36.4-GB, 10000-rpm disk drives

Benefits

- Fast access and retrieval of mass storage data
- Flexibility in internal disk expansion and high internal capacity

The Ultra 60 workstation minitower accommodates front-access peripheral expansion through one 1.6-inch drive half-height 5.25-inch bay, and two 3.5-inch bays for a diskette drive, PCMCIA adapter, or other options.



Figure 3. Ultra 60 workstation chassis with access panel removed, provides full access to internal options

System I/O—High-Performance PCI Technology

System I/O for the Ultra 60 workstation is provided by two industry-standard peripheral component interconnect (PCI) data buses. Both PCI buses in Ultra 60 workstations comply with the 2.1 revision of the PCI specification, released in March 1995.

- PCI slot 1 operates at 33-MHz or 66-MHz and supports either a 32-bit or 64-bit, 3.3-volt or universal PCI card
- PCI slots 2 through 4 operate at 33-MHz and provide for 32- or 64-bit, 5-volt or universal PCI cards

Slots	Slot Width	Clock Rate	Card Input Voltages Supported
1	32 or 64 bits	33 or 66-MHz	3.3 volt or universal
2-4	32 or 64 bits	33-MHz only	5 volt or universal

In addition to the I/O capabilities available through PCI option cards, the Ultra 60 workstation provides the following I/O channels directly from the main system board:

- Two (1 internal/1 external) 40-MB UltraSCSI channels with an external 68-pin SCSI connector
- One external 10/100BASE-T autoselect Ethernet port (supports either a Cat-5 UTP, RJ45 connector, or 40-pin miniature "D" MII connection)
- Two external EIA-232D or EIA-423 serial ports via two DB25 connectors (support EIA-423 synchronous data rates from 50 baud to 384 Kbps, and asynchronous data rates from 50 baud to 460.8 Kbaud)
- One external 2-MB Centronics-compatible, bidirectional, EPP parallel port with one DB25 connector
- One external standard Sun keyboard/mouse port (mini DIN-8 connector)

Features

- One of the industry's first 66-MHz PCI with 200 MB/second bandwidth (sustained)
- Two independent PCI buses
- Two independent UltraSCSI buses

Benefits

- High performance I/O throughput
- Access to many third-party solutions
- High, sustained I/O throughput
- Higher performance throughput through the use of independent busses

SunPCi™ IIpro PC Coprocessor Card

The SunPCi™ IIpro coprocessor card is a cost-effective hardware and software product that provides PC compatibility to customers who wish to run PC applications on Sun workstations using Solaris™ Operating Environment software. The SunPCi IIpro card brings together the ease of use of Microsoft Windows programs and the powerful features of the Solaris Operating Environment, giving users access to powerful workstation technology without sacrificing access to Microsoft Windows applications.

The SunPCi IIpro card is integrated with the workstation in which it is installed. It uses the workstation's keyboard, mouse, floppy drive, and Ethernet port as if they were its own, and it uses files from the Solaris file system to emulate C:\ and D:\ drives. If the VGA port on the card is not used for a second display, the video from the SunPCi IIpro card is routed to an X11 window on the workstation's monitor.



Other Solaris Operating Environment services are available to the SunPCi Iipro card. Any file system which is mounted on the hosting workstation, local or networked, including CD-ROMs, can be mapped to a network drive symbol on the PC. In addition, the SunPCi Iipro coprocessor card can access printers connected to a Solaris Operating Environment network.

Nearly any Solaris Operating Environment service for which there is a Microsoft Windows client can be used from the SunPCi Iipro card. The SunPCi Iipro card must be assigned its own IP address, and the SunPCi Solaris Operating Environment drivers select net traffic addressed to the card and pass it to the card. This is transparent to the SunPCi Iipro card.

If users experience colormap flashing on the workstation when running SunPCi Iipro in an X window within the Solaris desktop, users should alter the following settings:

- Check available color depths using the `xdpyinfo` command. If a 24-bit truecolor visual is available then change the SunPCi Iipro display driver to use 16 million colors. This avoids colormap flashing inside Windows, but not in DOS, or when the machine is booting.

```
Run: /usr/openwin/bin/xdpyinfo|grep depths
```

If one of the depths is 24, your system is 24-bit capable.

- If no 24-bit truecolor visuals are available, or if you must run the SunPCi Iipro card at 8-bits per pixel, run the appropriate framebuffer `config` utility (`ffbconfig`, `afbconfig`, `m64config`, and so on) to determine if the framebuffer can be configured to display 24-bit. If it can, then rerun the `config` utility to make 24-bit the default, and make the modifications described to the X servers file below:

```
Create: mkdir -p /etc/dt/config
```

```
Copy: cp /usr/dt/config/Xservers /etc/dt/config/Xservers
```

```
Edit: /etc/dt/config/Xservers
```

```
Add: -dev /dev/fb defdepth 24
```

```
      -dev /dev/fb defclass TrueColor
```

```
      to the line beginning :0 Local
```

User should now restart the X server.



Features and Benefits of the Sun PCI Iipro Coprocessor Card

Features

- Solaris Operating Environment/PC interoperability
- 733-MHz Celeron processor
- Two memory slots available; 128-MB to 1-GB RAM supported on-card
- USB, parallel, and serial ports
- 24-bit graphics, HD-15 VGA monitor port
- SoundBlaster-compatible sound
- Audio in/out ports
- Slimmer PCI form factor

Benefits

- Integrates Sun systems with available PCI slot into heterogeneous enterprise environments
- Increases productivity by allowing access to technical and productivity applications via the same monitor, keyboard, and mouse
- Allows sharing of files, data, and copy/paste functions between the Solaris Operating Environment and PC environments
- Uses Solaris Operating Environment resources and peripherals from within PC environment: Ethernet networking (file, printers, and so on), Solaris Operating Environment file system, removable media (CD-ROM, floppy, and so on), shared monitor
- Saves desktop real estate with all-in-one design
- Provides power and performance to run demanding productivity and technical applications at native speeds
- Runs multiple PC applications without memory constraints
- Provides dedicated memory for PC applications
- Expandable to grow with customers' needs
- Standard ports to connect to devices new and old: keyboards, mice, multimedia devices, printers, and so on
- Drives an optional second monitor dedicated to PC environment in 24-bit, 1280 x 1024 graphics
- Audio performance for running multimedia PC applications
- Supports stereo speakers, microphone in
- PC coprocessor supports all of Sun's PCI-based Ultra™ 5, 10, 60, and 80 workstations and Sun Blade™ workstations, as well as Sun Enterprise 220R, 250, 420R, 450, and Sun Fire 280R workgroup servers
- When second backplate is not installed, half-length PCI cards and most full-length Sun NICs and host adapter cards will fit into the adjacent PCI slot

Note: A Microsoft Windows license is not included with the SunPCi Iipro coprocessor card.

Sun PGX64 Graphics

Sun PGX64 graphics is the next generation low-cost PCI graphics product in the PGX™ family. It is the PGX32™ graphics successor. Sun PGX64 graphics provides Sun with a very low-cost, flexible 24-bit, 2-D graphics board supporting the widest range of Sun systems and supporting up to four boards in systems that can accommodate four PCI boards. Sun PGX64 graphics is a PCI-based graphics board



providing support for all Sun PCI-based workstations ,workgroup and enterprise servers including the Sun Blade 100, 1000, Ultra™ 5, 10, 60, and 80 workstations, Sun Enterprise™ 250, 220R, 420R, and 450 workgroup servers and Sun Enterprise 3500, 4500, 5500 and 6500 mid-range servers as well as future workstations and workgroup servers supporting PCI.

Sun PGX64 graphics include the following features:

- ATI's RageXL graphics processor
 - 2-D graphics acceleration
 - 8-MB SGRAM
 - 24-bit-only true color video support up to 1920 x 1200
 - 8-bit-only pseudo color video support up to 1600 x 1000
- 33-MHz, 32-bit, 5-volt PCI card, short form factor (< 7-inch length)
- Low power consumption (< 8 watts)
- HD15 video connector on the motherboard supports composite and separate video sync timing
- Compatible with OpenWindows™ environment, CDE windowing, and supports the following APIs: X11, Motif, JDK, XGL, XIL and OpenGL API via a software pipeline.
- Backwards compatibility with Sun's PGX24™ and PGX32 graphics accelerators (including MUX support, support for VESA/Sun resolutions, flexibility, and so on)
- Support for all Sun monitor products released since 1995
- A HD15-to-13W3 vide connector cable is included to connect to monitors with the 13W3 interface.

Sun PGX64 graphics supports the resolutions shown in the table below.

Display Resolution	Vertical Refresh Rate	Sync Standard	Aspect Ratio	Color Depth
1920 x 1200	70 Hz	Sun	16:10	8-bit
1920 x 1080	72 Hz	Sun	16:9	24-bit
1600 x 1280	76 Hz	Sun	5:4	24-bit
1600 x 1200	75 Hz	VESA	4:3	8-bit
1600 x 1000	66, 76 Hz	Sun	16:10	24-bit
1440 x 900	76 Hz	Sun	16:10	24-bit
1280 x 1024	60, 75, 85 Hz	VESA	5:4	24-bit
1280 x 1024	67, 76 Hz	Sun	5:4	24-bit
1280 x 800	76 Hz	Sun	16:10	24-bit
1152 x 900	66, 76 Hz	Sun	5:4	24-bit
1152 x 864	75 Hz	VESA	4:3	24-bit
1024 x 768	60, 70, 75, 85 Hz	VESA	4:3	24-bit
800 x 600	56, 60, 72, 75, 85 Hz	VESA	4:3	24-bit
720 x 400	85 Hz	VESA	9:5	24-bit
640 x 480	60, 72, 75, 85 Hz	VESA	4:3	24-bit

Note: 8-bit color support is via emulation in 24-bit window. Sun PGX64 graphics outputs separate sync for VESA resolutions and composite sync for Sun resolutions.



Sun PGX64 graphics supports 64-bit/66-MHz, 64-bit/33-MHz, or 32-bit/33-MHz PCI slots in all PCI-based Sun workstations and servers, as indicated in the following table.

System	Standard Configuration?	X-option?	Max. Number of Boards per System	Slot Configuration	Number Supported, if UPA Graphics also Configured
Sun Ultra 5		Yes	3		NA
Sun Ultra 10		Yes	4		1
Sun Ultra 60		Yes	4	1 in 66-MHz slots; 3 in 33-MHz slots	2
Sun Ultra 80		Yes	4	1 in 66-MHz slots; 3 in 33-MHz slots	1 or 2
Sun Blade™ 100	on-board version	Yes	3		NA
Sun Blade 1000	ATO	Yes	4	1 in 66-MHz slots; 3 in 33-MHz slots	1 or 2
Sun Enterprise 250, 450, 220R, 420R	ATO	Yes	4	1 in 66-MHz slots; 3 in 33-MHz slots	NA
Sun Enterprise 280R		Yes	4	1 in 66-MHz slots; 3 in 33-MHz slots	1 or 2
Sun Enterprise 3500, 4500, 5500, 6500	ATO	Yes	4		N/A

On the Ultra 60, Ultra 80, and Sun Blade 1000 systems, the Sun PGX64 graphics board cannot be installed if there is a double-wide UPA frame buffer (Sun Elite3D m6 graphics) installed in the adjacent UPA slot.

In addition, it is suggested for the Sun Enterprise server systems that at least one CPU be installed for each Sun PGX64 card.

Sun Creator Graphics Series 3 Overview

Sun Creator graphics series 3 is the latest generation of the Sun Creator graphics family of accelerators. With one architecture it can accelerate and support diverse types of graphic needs ranging from 8-bit and 24-bit windowing to high-end 3-D graphics.

Sun Creator graphics is designed as an integral part of Sun Ultra workstations or Sun Enterprise servers and is, therefore, designed to take advantage of the UltraSPARC CPU performance increases to 300 MHz and beyond. The original generation of Sun Creator graphics has a single graphics/frame buffer clock for all on-board logic. This new generation has one clock for the internal graphics processing and another clock for the frame buffer. This design makes it possible to drive each part at its maximum speed.

Until May 1999, Sun Creator graphics was available in two configurations:

- The single-buffered configuration (known as Sun Creator) supports hardware acceleration of 2-D graphics.
- The double-buffered configuration (known as Sun Creator3D) is used for fast, high-quality transformation and display of 3-D solid and wireframe objects. It also provides support for high-resolution (1920 x 1200) monitors such as the Sun 24-inch, wide-screen display.



Only the double-buffered configuration (Sun Creator3D) is now available.

Sun Creator3D graphics series 3 is available for most Ultra workstations (except the Ultra 5 workstation) as well as the mid-range Sun Enterprise servers (Sun Enterprise 3500–6500 servers).

Sun Creator Graphics Models

The two models, Sun Creator and Sun Creator3D, are physically different boards. A Sun Creator board cannot be upgraded to a Sun Creator3D board by adding more 3D-RAM memory. An upgrade is performed by changing the graphics board.

Sun Creator (no longer available)	Sun Creator3D
<ul style="list-style-type: none"> • Full 2-D imaging and windowing acceleration • Suited for 2-D, windowing, and imaging applications including: CASE, color publishing, EDA, medical imaging, and general research • 24-bit true color, single-buffered • 8-bit overlay and visual planes • Stereo display up to 960 x 680 at 112 Hz non-interlaced • 5-MB 3D-RAM memory • 1280 x 1024 at 76 Hz standard with programmable bootprom resolution • NTSC/PAL video timings • 64-bit DAC 	<ul style="list-style-type: none"> • Full 2-D imaging and windowing acceleration, plus full 3-D acceleration • Ideal for high-end 2-D, mid-range 3-D graphics, and solids in MCAD and MCAE, as well as high-end imaging and color publishing applications • 24-bit true color, double-buffered up to 1280 x 1024 • 28-bit Z-buffer • 8-bit overlay and visual planes • Stereo display up to 960 x 680 at 112 Hz non-interlaced, double- and Z-buffered • 15-MB 3D-RAM memory • 1280 x 1024 at 76 Hz standard with programmable bootprom resolution • NTSC/PAL video timings • 128-bit DAC • High resolution 1920 x 1200 at 70 Hz (single buffered) supporting 24-inch wide screen display series 2 and series 3

Key Messages

• High-performance graphics

Sun Creator graphics performance is based upon the Sun Creator approach to designing graphics. In series 3, the Sun Creator graphics technology is enhanced, with up to 50 percent graphics performance improvement over series 1.

– UltraSPARC CPU

Sun Creator graphics relies on the power of the UltraSPARC CPU for floating point calculations, and on the visual instruction set (VIS software) to accelerate imaging-related operations. This eliminates the need for a dedicated graphics processor, and results in a significant cost advantage.

– Ultra port architecture (UPA) high-speed interconnect for graphics

UPA provides a high-speed, high-bandwidth interconnect between the CPU, Sun Creator graphics, and main memory. It raises overall graphics performance while maintaining a balanced throughput.



Unlike the peripheral buses, such as SBus or PCI, the UPA interconnect ties Sun Creator graphics directly to the CPU and memory, and delivers greater bandwidth by orders of magnitude.

UPA also allows Sun Creator3D to utilize main system memory for texturing, allowing large texture mapping possibilities.

– Sun Creator-rendering ASIC (FBC2)

A completely new ASIC, FBC2 renders graphic primitives at very high speeds. FBC2 accelerates fills, scrolling, text, lines, and polygon rendering.

– 3D-RAM graphics memory

This new generation of the 3D-RAM breakthrough in graphic memory provides high-bandwidth and built-in acceleration for 3-D graphics.

- **Scalable performance**

The performance of Sun Creator graphics takes advantage of general system performance enhancements and will scale up with increases in CPU clock rate, making it unnecessary to upgrade graphics as new generations of CPUs become available.

- **More standard functionality**

All Sun Creator graphics products come standard with high resolution and 24-bit true color, as well as an 8-bit overlay plane. Sun Creator3D supports 24-bit double buffering and a 28-bit Z-buffer. In addition, stereo output support is built-in. Sun Creator graphics has established a new standard for workstation graphics functionality.

Sun Creator3D graphics series 2 and series 3 also add support for high-resolution monitors (up to 1920 x 1200) and hardware acceleration of color-space conversion during video playback.

Four 8-bit color maps for dynamic color-map segment allocation within the 8-bit color overlay plane and support for adjustable gamma correction give applications greater access to colors even in 8-bit mode and give the user the ability to color adjust (gamma correct) for optimal display quality.

- **Fully compatible with existing APIs**

Sun Creator graphics accelerates existing APIs, including OpenGL® and X11 graphics libraries.



Sun Elite3D Graphics Overview

Sun Elite3D graphics greatly accelerates the rendering of 3-D triangles, vectors, and texture maps over what is possible with Sun Creator or a raw CPU. It does this by adding specialized graphics floating-point units and more powerful pixel-drawing chips. It supports a 1280 x 1024 96-bit-deep frame buffer, configured the same as the double-buffered and Z-buffered Sun Creator3D. The 96-bit pixels support two 24-bit color buffers, an 8-bit pseudo-color overlay buffer and a 28-bit Z buffer, plus some miscellaneous control planes.

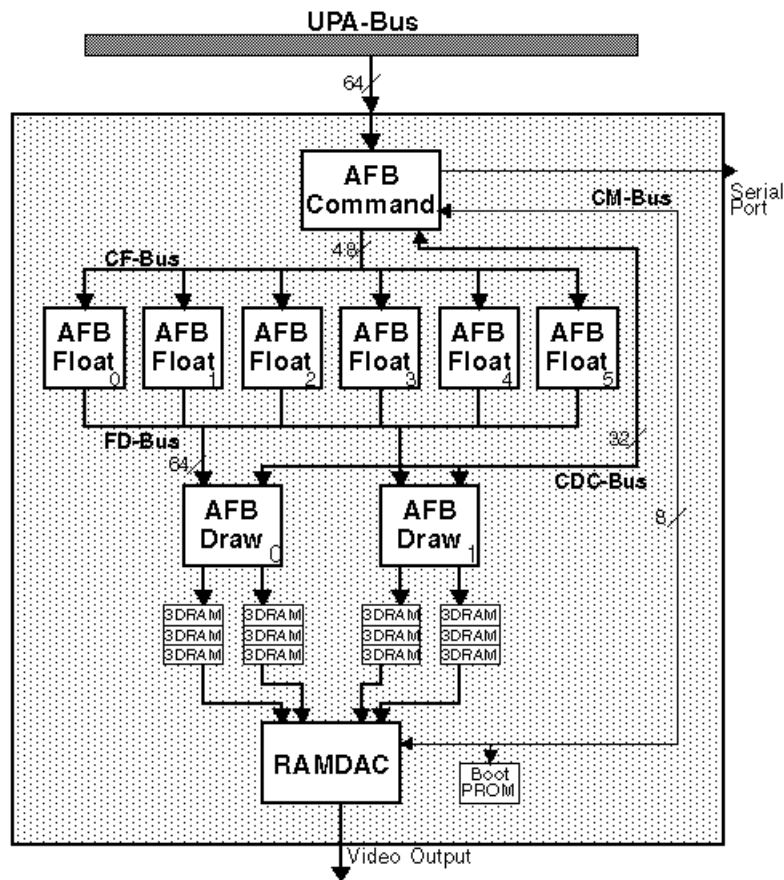


Figure 4. Sun Elite3D m6 graphics chip-level diagram

Sun Elite3D graphics has a highly parallel and efficient graphics pipeline. The Sun Elite3D graphics architecture uses a new generation of 3D-RAM chip. This chip speeds up a read/modify/write pixel access from 160 ns to 10 ns, changing all of the rules about graphics pipeline behavior.

AFB-Command, at the interface level, is a superset of the Sun Creator ASIC chip. The additional functionality supports rendering of model space geometry. The main change is to allow the most important bits to be packaged up into single-header words that can be passed down with the geometric data without stopping the pipeline. Additional functionality includes complete binary compatibility with the register set and functions of Sun Creator3D graphics and support for the OpenGL platform.

Given the technological changes brought on by 3D-RAM, the primary justification for the existence of a 3-D graphics accelerator is to deliver an order of magnitude more floating-point performance than a contemporary general purpose RISC CPU, at a price less than that of a single CPU and cache.



Sun Elite3D Graphics Features and Benefits

Features

- Integrated imaging
- Very-high-performance, accelerated, 24-bit, double-buffered 3-D graphics
- 28-bit Z-buffer
- 8-bit overlay plane

- Gouraud shading
- Acceleration for geometry decompression

- Alpha blending and screen door transparency
- Line and big dot antialiasing

- Per-pixel depth cueing
- Per-pixel alpha interpolation
- 4-bit stencil support with hardware acceleration of OpenGL stencil functions
- Accelerated lighting

- Four 8-bit color maps

- Adjustable gamma correction

- NTSC/PAL video timing support
- Stereo 960 x 680 at 112-Hz resolution supported with 21-inch monitor

- 1280 x 1024 at 76-Hz resolution standard
- Two serial-port connectors
- Dual-headed support: one Sun Elite3D m6 frame buffer and an additional Sun Elite3D m3 or Sun Creator/Sun Creator3D frame buffer

Benefits

- Can do fast imaging and 3-D on unified frame buffer
- Smooth animation and interactivity of 3-D graphics

- Improves visual quality and depth accuracy
- Allows overlay of 8-bit windows on top of the 24-bit visuals without damaging the underlying visual. This allows seamless integration and manipulation of windows

- Allows smooth shading of solid geometry
- Allows complex compress geometry to be decompressed at hardware rates.

- Simulates transparent materials such as glass

- Needed in MCAD and visualization for better visual quality
- More accurate depth cueing or fog
- Variable transparency
- Enables hardware acceleration for OpenGL API

- More lights can be turned on for enhanced visual display without encountering large performance penalties
- Dynamic color map segment allocation when running 8-bit window systems should eliminate color flashing problems

- Allows users to gamma-correct visuals for enhanced visual quality

- Supports frame buffer to video timing
- With frame buffer, monitor, and window systems support for stereo, users can see better representation of 3-D data

- High-resolution display quality
- For VR peripherals

- For users who need to be able to do multiple things simultaneously, such as command and control applications, 3-D and video playback for animators, design and analysis for engineers, and so on



Features

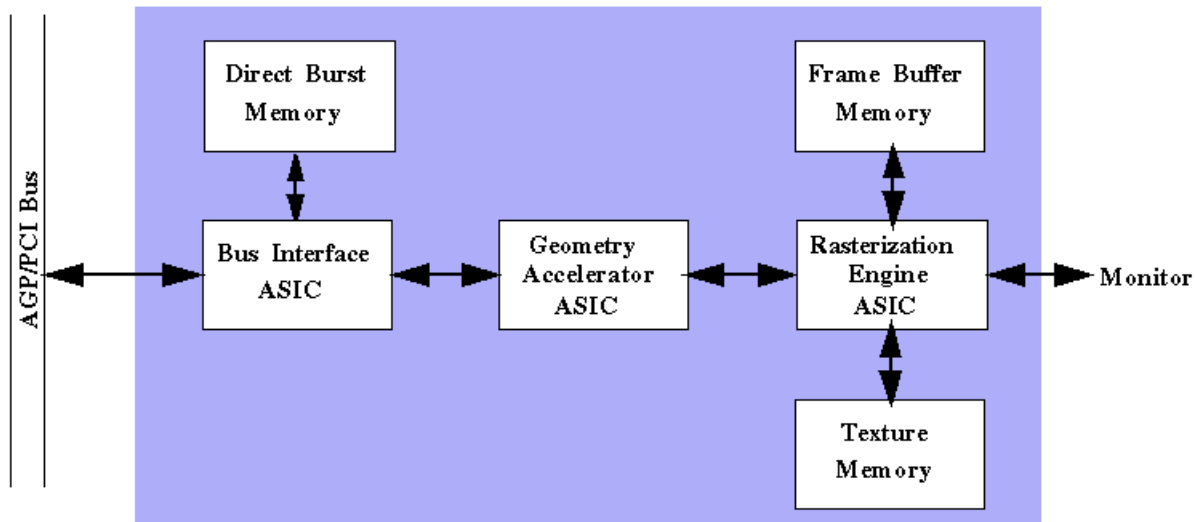
- OpenGL® for Sun™ Solaris 1.2.1, X, and Java 3D™ API support
- Binary compatibility with Sun Creator graphics product family

Benefits

- A choice of APIs
- Interoperability with existing applications and users

Sun Expert3D Graphics Overview

The Ultra 60 workstation configurations with Sun Expert3D graphics offer a high-performance graphics adapter with on-board texture mapping memory. This PCI graphics adapter provides an outstanding and affordable high-performance graphics solution for demanding 2-D and 3-D graphics applications that specifically require hardware-based texture mapping acceleration.



Other features of the Sun Expert3D frame buffer include double-buffering/Z-buffering (3-D) support at super high resolutions of 1920 x 1200, stereo-video mode support at 1280 x 1024, and hardware support for 3-D SuperScene antialiasing.

The Sun Expert3D frame buffer is ideal for all Sun Microsystems customers and resellers in the technical marketplace. The Ultra 60 workstation configurations with Sun Expert3D graphics are especially appropriate for customers working with CAD wire-frame models or highly textured seismic data, such as that used in the oil and gas industry.

Sun Expert3D Graphics Features and Benefits

Features

- On-board 64-MB texture-mapping memory
- On-board 64-MB framebuffer memory

Benefits

- Accelerates applications requiring texture maps
- Provides support for 24-bit truecolor 2-D and 3-D up to 1920 x 1200, supporting Sun's 24-inch display



Features

- Supports double-buffering and Z-buffering at up to 1920 x 1200 resolution
- Supports stereo mode graphics at 1280 x 1024 resolution
- Supports SuperScene antialiasing
- Graphics framelock support

Benefits

- Allows customers to use large screen monitors including Sun's 24-inch monitor to display their 2-D and 3-D data
- Allows customers to display 3-D data in stereo mode at higher resolutions, providing enhanced realism for immersive applications
- Improves rendered image quality
- Enables multiple graphics framebuffers to be used in single or multiple systems to render to very high-screen resolutions

Sun Expert3D-Lite Graphics

Sun Expert3D-Lite graphics is a derivative product based on the Sun Expert3D graphics board. Sun Expert3D-Lite graphics offers many of the same features as its predecessor, but at a lower cost. Features include on-board 3-D geometry acceleration, hardware-based texture mapping, and high-resolution 24-bit, 3-D support for all of Sun's PCI-based workstations and workgroup servers.

Sun Expert3D-Lite graphics accelerates 3-D geometry at up to 4 million triangles/sec. and provides up to three times the texture mapping performance of Sun Elite3D m3 graphics, at a much lower price.

Sun Expert3D-Lite graphics is a single, full-length, 64-bit PCI board. It is a 66-MHz card, and operates at 66 MHz when plugged into a 66 MHz-capable slot and at 33 MHz when plugged into a 33-MHz slot. Up to four Sun Expert3D-Lite graphics cards are supported in the Ultra 60 workstation.

Key Features and Benefits

Features

- High-performance 3-D graphics and texture mapping performance at an affordable entry-level cost—provides great geometry performance of up to 4 million triangles/sec. with up to 60 Mpixels/sec. of texture fill rate
- High resolution 24-bit 3-D double-buffering with 32-bit Z-buffer, up to 1920 x 1080 HDTV (16:9 aspect ratio) resolution
- Hardware-accelerated texture mapping with 16 MB of dedicated on-board texture memory

Benefits

- Aggressive price/performance allows users to capitalize on 3-D application functionality in a cost-effective manner
- Supports 24-bit, 2-D and 3-D graphics on all of Sun's displays including the 24-inch color monitor. With the 24-inch monitor, users can display many applications windows with little or no overlap
- Provides high-performance for texture mapping operations
- Large texture storage accelerates complex 2-D and 3-D texturing
- No trade-offs between resolution support and texture storage capabilities



Features

- Stereoscopic graphics support at 960 x 680, 1152 x 900, and 1280 x 800 resolutions
- Support for up to four Sun Expert3D-Lite boards in a single system (depending on system)
- 32-bit Z-buffer at all supported resolutions
- Full acceleration support of OpenGL 1.2.1 and Java 3D™ APIs

Benefits

- Allows customers to use stereoscopic viewing for immersive applications, which enhances data comprehension
- Enables applications to take advantage of more screen real estate
- Provides high level of three-dimensional accuracy, eliminating anomalies such as the flickering of objects when moving around a 3-D image
- Applications automatically receive performance benefits of these APIs. Single application binary for Sun graphics options

Sun Expert3D-Lite Graphics Specifications

- On-board geometry accelerator ASIC performs transform, clipping, and lighting
- On-board rasterization ASIC performs 2-D/3-D rasterization, 2-D/3-D texturing, pixel transfers, imaging and fragment processing
- High-resolution DAC with 10-bit RGB analog video at dot rates up to 350 MHz.
- Memory
 - 56-MB total on-board memory
 - 8-MB direct burst memory
 - 16-MB dedicated texture memory
 - 32-MB dedicated frame buffer memory
- Standard HD15 video connector with support for Composite and Separate sync provides support for a DDC link for monitor query and control.
- VESA Standard 3-pin mini-DIN stereo connector

Sun Expert3D-Lite and Sun Expert3D Graphics Comparison

Feature	Sun Expert3D-Lite	Sun Expert3D
Maximum 3-D resolution	1920 x 1080	1920 x 1200
Maximum 3-D stereo resolution	1280 x 800	1280 x 1024
Total board memory	48 MB	128 MB
Frame buffer memory	32 MB	64 MB
Texture memory	16 MB	64 MB
Geometry acceleration	4M tris/sec.	6M tris/sec.
Texture fill rate performance	60 Mpixels/sec.	110 Mpixels/sec.
Superscene antialiasing support	No	Yes
Frame lock sync	No	Yes



Feature	Sun Expert3D-Lite	Sun Expert3D
Multiview (syncing for stereo)	No	Yes
Display connector	HD15	High-quality 13W3

Display Resolutions

Sun Expert3D-Lite graphics supports the resolutions shown in the table below.

Display Resolution	Vertical Refresh Rate	Sync Standard	Aspect Ratio Format
1920 x 1080	72 Hz	Sun	16:9
1600 x 1280	76 Hz	Sun	5:4
1600 x 1200	75 Hz	VESA	4:3
1600 x 1000	66, 76 Hz	Sun	16:10
1440 x 900	76 Hz	Sun	16:10
1280 x 800	112 Hz	Sun-Stereo	16:10
1280 x 800	76 Hz	Sun	16:10
1280 x 1024	60, 75, 85 Hz	VESA	5:4
1280 x 1024	67, 76 Hz	Sun	5:4
1152 x 900	120 Hz	Sun-Stereo	5:4
1152 x 900	66, 76 Hz	Sun	5:4
1024 x 800	84 Hz	Sun	5:4
1024 x 768	75 Hz	VESA	4:3
1024 x 768	60, 70, 77 Hz	Sun	4:3
960 x 680	108, 112 Hz	Sun-Stereo	Sun-Stereo
768 x 575	50i Hz	PAL	PAL
640 x 480	60 Hz	VESA	4:3
640 x 480	60i Hz	NTSC	NTSC

Compatibility

Sun Expert3D-Lite graphics is a full size, single slot width, 64-bit/66-MHz PCI board and can plug into a 64-bit/66-MHz, or 64-bit/33-MHz slot of the Ultra 60 system. When Sun Expert3D-Lite graphics is plugged into a 64-bit/33-MHz or 32-bit/33-MHz slot, the slower bus lowers peak performance by between 20 and 40 percent.

Sun Expert3D-Lite frame buffers can be combined with UPA graphics in the same Ultra 60 system in the configurations shown in the table below.



System	Max. # of Sun Expert3D-Lite Graphics	Max. # of UPA Graphics
Ultra 60 workstation	4	0
	3	1
	1 or 2	2

Sun Ultra 60 Workstation Graphics Performance

Benchmarks	450-MHz Ultra 60 Workstation				
	Sun Creator3D	Sun Expert3D-Lite	Sun Elite3D m3	Sun Elite3D m6	Sun Expert3D
Xmark93	35.4	20.0	31.9	39.2	22.4
2-D Vectors/sec.	5.1 M	6.8 M	5.0 M	5.0 M	8.0 M
3-D Performance					
• 3-D vectors/sec.	3.7 M	8.2 M	4.9 M	8.8 M	10.5 M
• 3-D triangles/sec.	1.5 M	4.1 M	3.0 M	5.9 M	6.0 M
• 3-D quads/sec.	607 K	2.0 M	1.5 M	1.3 M	3.0 M
• 3-D tex. fill pix/sec.	7.6 M	88 M	—	54 M	118 M
ViewPerf 6.1.1					
• ProCDRS-02	8.7	23.0	13.5	20.6	28.8
• DX-05	12.8	37.2	27.8	30.0	39.5
• AWadvS-03	11.6	43.2	—	13.6	42.6
ViewPerf 6.1.2					
• ProCDRS-03	4.9	13.4	—	11.1	16.7
• DX-06	3.9	9.6	—	8.1	10.0
• AWadvS-04	11.0	43.9	—	14.0	50.8
Standard Color Monitors Supported	17-, 19-, and 21-inch monitors, and 18-inch flat panel	17-, 19-, 21-, and 24-inch monitors, and 18-inch flat panel	17-, 19-, and 21-inch monitors, and 18-inch flat panel		17-, 19-, 21-, and 24-inch monitors, and 18-inch flat panel

Notes: Performance data as of December 2000; Configuration for timing includes Solaris™ 8 Operating Environment and OpenGL 1.2.1 API. Performance data is subject to change. Please see Sun's web site at <http://www.sun.com/desktop> for the latest performance numbers.

Metrics Defined

- 2-D vectors are 10 pixels long, X11 perf numbers
- 3-D vectors are 10 pixels long, depth cued, clip tested, perspective projection, solid line through OGL
- 3-D triangles are 25 pixel triangle mesh, one light source
- 3-D quads are 100 pixel, independent quadrilaterals, with one directional light source
- Both 3-D mesh and quads are Gouraud shaded, randomly oriented, transformed, clip tested, with perspective projection and Z-buffered through OGL



- Configuration with 24-inch monitor use Sun Creator3D graphics in high-resolution, single-buffer mode

Special Features

- Accelerated imaging and advanced 3-D graphics with Gouraud shading, line antialiasing, per-pixel depth cueing, subpixel addressing, transparency, stereo viewing with monitor
- Sun Creator graphics series 3 and Sun Elite3D graphics utilize a new connector for stereo viewing synchronization, a 7-pin mini-DIN style of connector (StereoGraphics Corporations sells a cable adapter for connecting the old and new styles of connectors. It can be ordered from them using the part number ESUN.)

Sun Ultra 60 Workstation Configuration

Product Highlights	Sun Ultra 60 Workstation
Dimensions (H x W x D)	45 cm x 19 cm x 49.8 cm (17.7 in. x 7.5 in. x 19.6 in.)
Weight	23.6 kg (50 pounds)
CPU and UPA	
• Architecture	UltraSPARC-II
• Clock rate	450 MHz
• Processor slots	2
• Number of processors	1 = Model 1450; 2 = Model 2450
• Cache on chip	32 KB
• External cache	4 MB
• UPA speed	112.5 MHz
Memory	
• Memory type	ECC
• Number of slots	16
• Capacity	64 MB to 2 GB
• DRAM speed	60 ns
• Bus width	576 bits
• DIMM sizes	16, 32, 64, and 128 MB
Storage	
• Maximum internal	2 x 36.4-GB disks = 72.8-GB capacity
• Maximum total	218.4 GB
I/O Interfaces	
• UltraSCSI	40 MB/sec. UltraSCSI (SCSI-3), 2 channels (1 internal, 1 external)
• Serial ports	Two RS-232C/RS423 DB25
• Parallel port	Centronics compatible (DB25)
• PCI I/O bus	Four full-size PCI slots (version 2.1): Three at 33 MHz; one at 33 MHz or 66 MHz
Networking Ports	TP Ethernet 10/100BASE-T or MII port



Product Highlights	Sun Ultra 60 Workstation
Backup and Distribution <ul style="list-style-type: none"> Floppy CD-ROM Internal External 	<p>Optional 3.5-inch floppy</p> <p>SunCD™ 644-MB, SunCD 32X, 10X DVD-ROM</p> <p>Optional 12-GB to 24-GB DDS-3 4-mm; 14-GB 8-mm, up to two 9.1-, 18.2-, or 36.4-GB disks</p> <p>Sun StorEdge™ UniPack, FlexiPack, and MultiPack storage devices; Sun StorEdge A1000, D1000, A3500, and A5X00 arrays; Sun StorEdge L1000 and L3500 tape libraries</p>

Sun Ultra 60 System Graphics Configuration

Product Highlights	Sun Creator3D	Sun Expert3D-Lite	Sun Elite3D	Sun Expert3D
Operating Environment	Solaris 2.5.1 Hardware: 11/97 Solaris 2.6 Hardware: 3/98 Solaris 7 Solaris 8			
Monitors <ul style="list-style-type: none"> 17-inch 21-inch color 24-inch wide-screen color 	1280 x 1024 at 76 Hz 1152 x 900 at 76 Hz and other programmable resolutions High-resolution support: 1920 x 1200 at 70 Hz* 1600 x 1000 at 76 or 66 Hz* 1440 x 900 at 76 Hz* 1280 x 800 at 76 Hz		1280 x 1024 at 76 Hz 1152 x 900 at 76 Hz and other programmable resolutions N/A	Full high-resolution support: 1920 x 1200 at 70 Hz
Graphics <ul style="list-style-type: none"> Slots Graphics supported Color planes and visual capabilities 	Two UPA graphics slots Sun Creator3D frame buffer NTSC/PAL timing 24-bit plus 8-bit overlay Stereo 960 x 680 at 112 Hz		Two UPA graphics slots Sun Elite3D m3 frame buffer or Sun Elite3D m6 frame buffer ‡ NTSC/PAL timing 24-bit plus 8-bit overlay Stereo 960 x 680 at 112 Hz	Two 64-bit PCI slots Sun Expert3D frame buffer Stereo 1280 x 1024



Product Highlights	Sun Creator3D	Sun Expert3D-Lite	Sun Elite3D	Sun Expert3D
<ul style="list-style-type: none"> • Double buffer • Z-buffer • Multimedia features 	8-bit/24-bit —/28-bit 24-bit true color accelerated video playback		24-bit 28-bit 24-bit true color accelerated video playback	24-bit 28-bit
Graphics Market Positioning <ul style="list-style-type: none"> • Windowing and 2-D • 3-D wireframe • 24-bit and imaging • 3-D solids • Multimedia • 3-D texture mapping 	<ul style="list-style-type: none"> ✓ ✓ ✓ ✓ ✓ 		<ul style="list-style-type: none"> ✓ ✓ ✓ ✓ ✓ 	<ul style="list-style-type: none"> ✓ ✓ ✓ ✓ ✓
✓ = Primary application * = Sun Creator3D graphics in single buffer mode ‡ = Only one Sun Elite3D m6 graphics frame buffer per Ultra 60 workstation				



System Management

System Administration

Sun Ultra™ 60 workstations deliver the power and graphics needed by the customers who use heavy compute-intensive applications. Customers who run these compute-intensive applications require a system like the Solaris™ Operating Environment that can provide a highly reliable, available, fast and safe desktop computing environment. Built into the Solaris Operating Environment are systems management and security features that will help deliver the computing environment demanded by these customers. Sun also offers unbundled systems management products that will supplement the systems management features in the Solaris 8 Operating Environment. Together, the Solaris Operating Environment management features and Sun's unbundled systems management products create one of the most stable and available desktop computing environments in the industry.

Solstice AdminTools™ Software

Solstice AdminTools™ software is a set of GUI-based administration tools that have been shipping since the Solaris 2.2 Operating Environment release and can be used to provide local systems administration. Solstice AdminTools software can be used to manage user accounts, groups, hosts, printers, serial ports, and installation/removal of software.

SunVTS™ Diagnostics Tool

The SunVTS™ system exerciser is a graphically oriented UNIX® application that permits the continuous exercising of system resources and internal and external peripheral equipment. Used to determine if the system is functioning properly, SunVTS software incorporates a multifunctional stress test of the system through operating-system-level calls, and allows the addition of new tests as they become available.

Solaris Web Start Software

Solaris Web Start software is an easy-to-use Java™ technology-based application that guides users through the installation of both the Solaris Operating Environment and copackaged application software with a single on-screen button. Its graphical user interface facilitates file system configuration. It also features a built-in suite of on-line information and answers questions about the product itself, the software it installs, and the hardware platform it supports.

Solstice Enterprise Agents™ Software

Solstice Enterprise Agents™ software allows the workstation to be managed from simple network management protocol (SNMP)-based system/network management tools. Solstice Enterprise Agents software is based on the new extensible agent technology or manager/subagent technology. The Manager agents receive and respond to SNMP or desktop management interface (DMI) requests. After retrieving the appropriate values from the respective subagents, responses are sent. The subagents manage information bases (MIBs or MIFs) designed for specific components and applications.

Solaris Desktop Extensions Software

Solaris Desktop Extensions software features ideal systems management tools for those non-UNIX platform users who want to quickly view processes and system resources. The process manager in



Solaris Desktop Extensions software is a GUI-based tool that enables users to quickly identify, sort, suspend, and eliminate processes based on attributes such as CPU consumption and time elapsed.

Solaris Desktop Extensions software also features a GUI-based performance monitor, enabling users to quickly monitor some of the key system resources such as CPU, load, disk, page, context, job swaps, interrupts, packets, collisions, and errors.

ShowMe How™ Software: State-of-the-Art Installation and Maintenance Instruction

ShowMe How™ software is a documentation system that presents information in a highly understandable multimedia format. Installation and service tutorials as well as reference information provide users with comprehensive, easy-to-use instruction. ShowMe How software streamlines installation and maintenance to help lower service costs and maximize system uptime. Some of the features of this tool are:

- Distributed on CD-ROM
- Movies of installation and replacement procedures played through ShowMe TV™ software packaged with application
- Photo sequences with narrated installation and replacement procedures
- Text-based instructions can be viewed on-line and printed, excerpted from standard Sun documentation
- Photos with active callouts link to more detailed photos and text-based reference information

The Solaris 8 Operating Environment

The Ultra 60 workstation runs the Solaris 2.5.1, 2.6, 7, and 8 Operating Environments. It can also run 32-bit applications unmodified from the Solaris 2.3 Operating Environment, making these systems compatible with previous systems and software.

The Solaris 8 Operating Environment is the latest release of one of the industry's leading enterprise operating environments. The Solaris 8 Operating Environment contains the complete functionality required for all Sun Workstation™ systems. The Solaris 8 Operating Environment is a solid, scalable, 32-bit and 64-bit Operating Environment.

The Solaris 8 Operating Environment includes:

- Reliable, Internet-ready operating environment for 32- and 64-bit SPARC™ processor-based platforms and Intel platforms
- Enhanced ease of use and PC-interoperability features
- Integrated, high-performance Java technology and tools
- Robust software developer environment
- Advanced, standards-based networking
- Improved systems installation and management tools
- Enterprise-class directory services
- Enhanced desktop tools, I/O standards, and security

The Solaris Operating Environment delivers a competitive advantage to businesses through networked computing, scalability, and multiarchitecture support. The Solaris Operating Environment provides an advanced solution for all customer IT needs, both technical and business. With its strength in enterprise-class reliability, scalability, and performance, the Solaris Operating Environment is an industrial-grade solution with the quality and robustness required to deliver mission-critical computing.



Sun Ultra 60 systems are supported by Solaris 2.5.1 Hardware: 11/97, Solaris 2.6 Hardware: 3/98, Solaris 7, and Solaris 8 Operating Environment.

Solaris Operating Environment Features and Benefits

Features

- 100 percent binary compatibility
- Reliability, availability, and serviceability (RAS)
- 64-bit computing
- 64-bit compilers
- Java 2 SDK
- IPv6/IPsec/Mobile IP
- Scale from 1 to 512 processors per node
- LDAP directory services
- System management tools

Benefits

- Software investment protection—all of today's Solaris Operating Environment-certified 32-bit applications continue to run on Solaris 8 Operating Environment without modification
- Less downtime, more productivity, and faster project completion
- Higher performance, capacity, and precision on 64-bit SPARC processor-based systems and Intel systems with full 32-bit binary compatibility
- Compliant with UNIX 98 and the Aspen Group LP64 standards
- Quickly develop and certify 64-bit applications for SPARC and IA-64 processors using Solaris Operating Environment APIs, 64-bit C/C++ and FORTRAN compilers, and ABI certification tools
- Provides a high-performance, scalable Java virtual machine that offers improved memory management, optimized JIT compiler and faster Java thread synchronization
- Helps increase addressing range, provides better authentication and privacy, and enables new quality of service capabilities. Mobile IP permits intermittent connection to the Internet with no data loss
- Seamlessly increases compute resources as needs grow—expand to four processors on the desktop, or use up to 64 processors per server, with up to eight servers per cluster
- High-speed, enterprise-class directory service, using the Solaris 8 Operating Environment LDAP client and the iPlanet™ Directory Server, supports your most complex, data intensive network applications.; includes Microsoft Active Directory support
- Helps reduce the time spent on system administration duties using Web-based wizards and Java technology-powered graphical interfaces



Features

- Desktop management and productivity tools
- Extended device support
- Internationalization
- X11R6.4
- Real Time application
- Enhanced security features

Benefits

- Helps increase productivity with intuitive Printer, Desktop, PDA sync, HotKey, and CDE 1.4 control panel tools and features
- The StarOffice™ productivity suite easily handles Microsoft Office documents, and creates complex documents, spreadsheets, and presentations; use PC Launcher and the SunPCi™ Iipro card to run Windows, Lotus 1-2-3, and AutoCAD applications on Sun workstations
- Connect using your favorite devices, including DVD, Zip and Jaz drives, video cameras, USB, 1394, SCSI, UPA, and PCI buses
- The Solaris 8 Operating Environment is a comprehensive, global product which supports 37 languages and over 90 locales, the euro currency symbol, and complex text formats for the Arabic, Thai, and Hebrew languages. New language installation tools, expanded Unicode support, and improved data interoperability utilities greatly simplify the development and testing of applications for international markets
- Run X applications in a web browser and display a single logical screen across multiple displays
- Supports guaranteed interrupt response times and priority inheritance for synchronization by multithreaded real-time applications, including simulation, telemetry, data acquisition, signal processing and video-on-demand
- Helps increase support for security protocols and new technologies including IPSec, AMI, Kerberos v5, and smart cards to enhance application and system security

Key Features in the Solaris 8 Operating Environment

The Solaris 8 Operating Environment is Sun's latest release in this product family. The Solaris 8 Operating Environment continues the tradition of reliability, availability, and scalability (RAS) of the earlier operating environment releases, including features such as X11R6.4, IPv6/IPsec/Mobile IP, realtime application support, filesystem logging, and remote console. Existing applications which adhere to the Solaris application binary interface (ABI) will run unmodified with Solaris 8 Operating Environment software on both SPARC processor-based platforms and Intel platforms. In addition, Sun provides an easy-to-use AppCert testing tool for developers, so they can verify existing Solaris application binaries and report any potential incompatibilities.

• Productivity features

Solaris 8 software offers enhanced diagnosing capabilities, availability, scalability, performance, Java technology, and graphics. With the Solaris 8 Operating Environment, you get a full suite of integrated tools for browsing, collaborating, and interoperating with PCs. The Solaris 8 Operating Environment provides a 32-bit and 64-bit UNIX platform that provides customizable workspaces, graphical system monitoring, and business/office productivity tools, including the free StarOffice productivity suite.



- **Advanced networking**

Demonstrating continued leadership in networking technologies, support for IPv6 in the Solaris 8 Operating Environment is seamlessly integrated with NFS, RPC, NIS, NIS+, and DNS. The IPsec features enable secure virtual private networks and network access control, while Mobile IP provides Internet disconnect/reconnect capabilities with no data loss.

- **Bundled software**

The Solaris 8 Operating Environment ships with support for a number of software components which extend user and system functionality, including Solaris Resource Manager™ software for fine-grained control of system resources, the Java technology-based database server Oracle 8i, `lxrun` for Linux application compatibility (for Solaris on Intel), Apache Webserver, Netscape™ Communicator, iPlanet Directory Server, `gzip` compression, and the `bash` and `tcsh` shells.

- **Enhancements to the Common Desktop Environment (CDE)**

The latest generation of the Common Desktop Environment (CDE) comes standard, providing workstation users with an easy-to-use, open, secure platform. Enhanced X11R6.4 support allows the viewing and use of X applications in a browser window, and the use of a single logical screen across multiple displays. Personal digital assistant (PDA) support synchronizes data from most Palm Computing devices with the CDE calendar, mail, memo, and address book. CDE now features streaming video using MPEG-1, MPEG-2, Quicktime, and AVI formats as well as MIDI audio using the Java Media Framework (JMF) player.

- **Improved system error messages, system debugging capabilities, and a new remote console capability**

Enables you to apply scarce system expertise remotely across the enterprise.

- **File system logging**

Logging file system features and parallel SCSI probes make rebooting even faster.

- **Live Upgrade**

Allows Solaris 8 software to be installed on a separate partition from the currently running version of the operating environment. When installation is complete, a simple reboot enables the Solaris 8 Operating Environment to take control. Since Live Upgrade includes a version migration and fallback feature, you can also fallback to the previous release—through a simple reboot—without losing administration information.

- **Real-time video creation and broadcast support**

The new Java Media Framework (JMF) player provides access to the latest industry-standard audio and video files, including MPEG-1, MPEG-2, Quicktime, VIVO, AVI, AIFF, GSM, WAV, RMF, AU, and MIDI.

Solaris 7 Operating Environment 11/99 New Features

A number of features were added to the Solaris 7 Operating Environment in November 1999. They are:

- **Netscape application launcher**—Enables users to easily access and launch Netscape files and associated Netscape applications such as Composer automatically. This new Netscape application launcher virtually eliminates the need to run the entire Netscape environment, making access to Netscape applications simpler than ever.
- **PDASync (Personal Digital Assistant) support**—A Java technology-based application for professionals on the go. Enables users to easily synchronize their desktop calendar, mail, address book, and memos with their PDA.



- **X11R6.4 support**—A new enhanced version of XServer delivers key new features that increase user productivity and mobility. These are:
 - **Web-enabled X application**—Access on any browser-based desktop. Provides access to corporate X applications for remote users through the Internet or intranet
 - **Xinerama support**—Provides one logical screen image support that can be displayed across multiple monitors
 - **Color utilization policy (CUP) support**—Minimizes color-map flashing
 - **XPrint extension**—Provides a framework for X applications to render on non-display devices, such as printers and facsimile machines
 - **EnergyStar support**—Built-in power management controls to conserve workstation power
 - **Developer toolkit**—Includes new public APIs and documentation for Xinerama, XPrint, XKB, DPMS, and CUP extensions

Graphics Software Interfaces

The Ultra 60 system supports all Solaris 8 Operating Environment graphics and window system APIs, including OpenGL® and Display PostScript™. A large number of Sun and third-party graphics APIs are also supported, including IRIS GL, OpenGL, GKS, HOOPS, and Java 3D™ software. Industry-standard X-extension libraries, such as Xlib and PEXlib, are available.

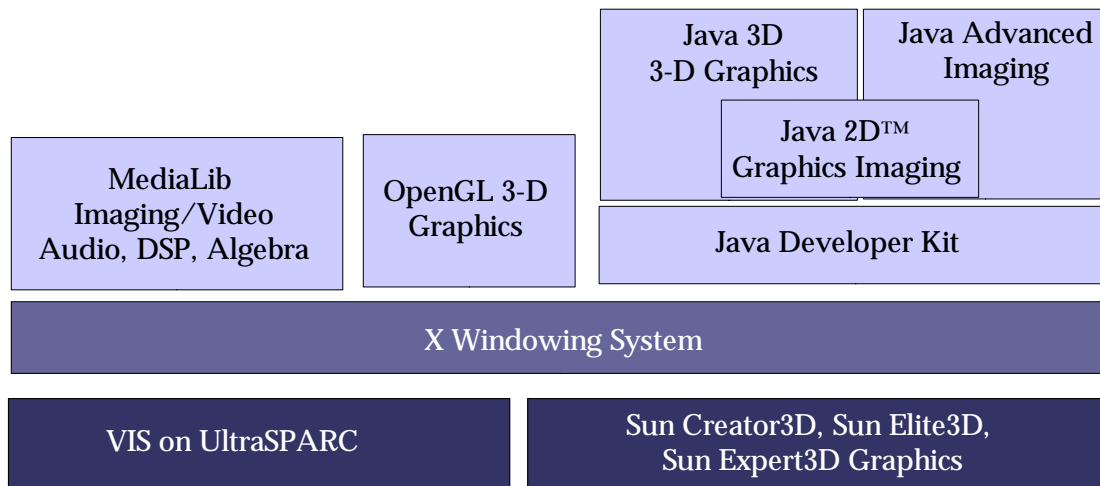


Figure 5. Graphics software interfaces

Solaris Operating Environment System Requirements

Disk Space	End user: 25 MB Developer: 40 MB (runtime binaries and header files)
Memory	64-MB minimum 128-MB or higher recommended for serious applications



Solaris Operating Environment Licensing and Usage

All Sun system and system-board products include a Solaris Operating Environment license. The type of Solaris license(s) shipped with each platform reflects the way in which that system is most commonly used. Additional Solaris licenses are available to allow increased usage of the software.

Ultra 60 workstations come with a Solaris Desktop license. This license is limited and does not provide several of the services provided by the Solaris Server license, such as:

- Allowing more than two users to be directly connected
- Providing database or compute services for more than two continuous users
- Providing swap-disk space for any other system
- Providing home-directory space for any other system

If a system shipped with a Solaris Desktop license will be used as a server (requires services listed above), the system must be upgraded to a Solaris Server license. The Solaris 8 Operating Environment ships with both desktop and server licensing usage included.

OpenGL® for Sun™ Solaris 1.2.1 Software

OpenGL® for Sun™ Solaris 1.2.1 software provides a powerful programming environment for developing and deploying interactive 3-D applications on SPARC workstations. It allows mainstream 3-D graphics and visualization applications to be deployed on Sun's Ultra family of graphics workstations at a compelling price-to-performance ratio.

OpenGL for Sun Solaris 1.2.1 software is an application programming interface (API) that provides 2-D and 3-D graphics features. Features include modeling, transformations, color, lighting, and smooth shading, as well as advanced features such as texture mapping, NURBS, fog, alpha blending, and motion blur. OpenGL for Sun Solaris 1.2.1 software works in both immediate and non-editable display-list modes.

Using the Xinerama X window extension available in Solaris 8 or Solaris 7 Operating Environment (release 11/99 or later), users can configure their systems to utilize multiple frame buffers as one large, super-high resolution, virtual display. OpenGL for Sun Solaris 1.2.1 software allows existing OpenGL API-based applications to run virtually without change in a multi-screen Xinerama environment.

Widespread multivendor availability of OpenGL software allows source-code portability of 3-D graphics applications across platforms. OpenGL for Sun Solaris 1.2.1 software is a compliant implementation of OpenGL 1.2 specification from the OpenGL Architecture Review Board (ARB) and is source-code compatible with other conformant OpenGL software on the market. Most existing OpenGL applications need only to be recompiled in order to run with OpenGL for Sun Solaris 1.2.1 software.

OpenGL for Sun Solaris 1.2.1 software is targeted at developers creating interactive 3-D graphics applications for technical, creative, and analytical markets. Potential users include those in computer-aided design and manufacturing, global information systems, simulation, industrial design and modeling, entertainment, biochemistry, and petroleum exploration market segments.

OpenGL for Sun Solaris 1.2.1 software is compatible with and accelerated for Sun's Ultra workstation systems with the Sun Creator, Sun Creator3D, Sun Elite3D, and Sun Expert3D graphics products. It is also compatible with all legacy SPARCstation™ systems equipped with SX, ZX, GX, GXplus, TurboGX™, TurboGXplus™, S24™, TCX, or FSV frame buffers.



Features and Benefits

OpenGL for Sun Solaris 1.2.1 software provides the following features:

Features

- Multi-screen rendering for super-high resolution 3-D visualization (Xinerama)
- 64-bit OpenGL library support
- New interface imaging and 3-D texturing
 - Texture level of detail control
 - BGRA and packed-pixel formats
 - Texture specular color
 - Texture edge clamping
 - Constant texture data extension
- General performance improvements
 - Improved drivers
 - Occlusion culling test extension
- New extensions
 - Triangle list primitive
 - Vertex extension
 - Global alpha extension

Benefits

- Users no longer need to rewrite their 3-D applications to take advantage of the multiple screens
- Allows OpenGL applications to take advantage of the full 64-bit addressing in the Solaris Operating Environment
- Offers a more portable interface for imaging operation during 3-D texture mapping
 - Offers better texture memory utilization
 - Supports more file- and hardware-data types
 - Allows more realistic lighting effects with texturing
 - Avoids blending border and image texels during texturing
 - Helps reduce texture mapping memory utilization and loading time
- Enables better performance for all supported graphics cards; in particular, there has been some substantial performance gains for Sun Elite3D frame buffers—for some applications over 100 percent
- Enables applications to trivially reject occluded objects in a scene, resulting in big improvements in interactive rendering performance for visualization of large models
- Allows multiple triangle strips or fans to be specified within a single `glBegin glEnd` pair; improves performance
- Allows applications to specify all vertex data (color, normal, coordinates, and so on) in a single function call; saves function call overhead
- Allows applications to specify an alpha component which can be applied globally to all primitives; useful for cases where many vertices share the same alpha value because the application does not have to send an alpha component for each vertex



OpenGL for Sun Solaris 1.2.1 Software Tech Facts

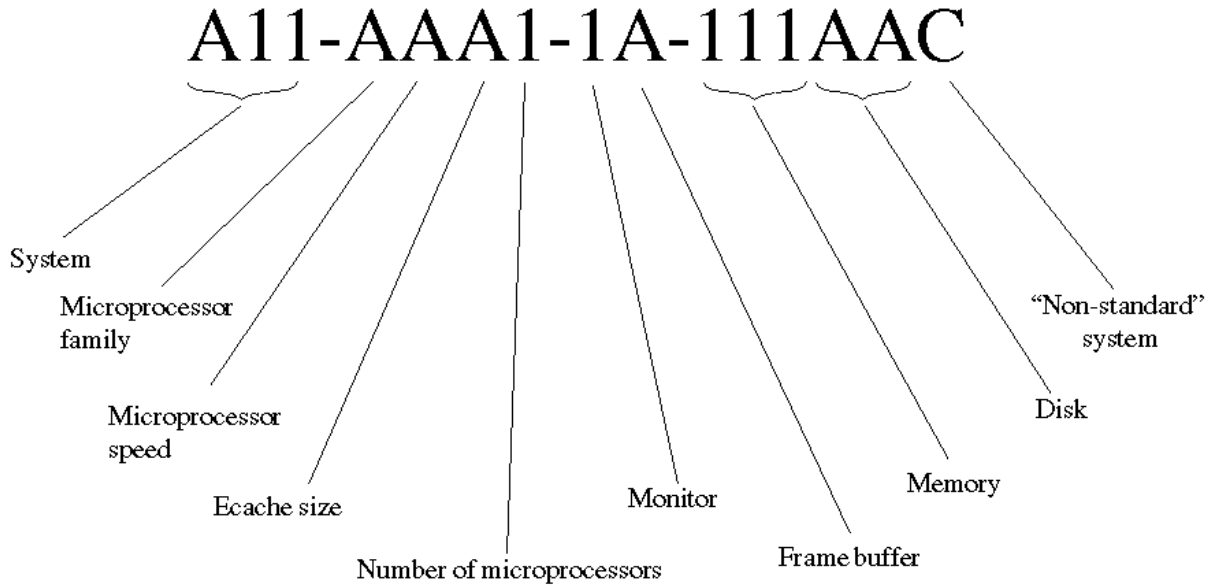
OpenGL for Sun Solaris 1.2.1 software system requirements are shown in the following table.

Platforms	UltraSPARC™ and SPARC processor-based systems using Sun Elite3D, Sun Creator, Sun Creator3D, Sun Expert3D, PGX, ZX, GX, TCX, SX, and S24 frame buffers
Operating environments supported	Solaris 2.5.1 Solaris 2.6 Solaris 7 Solaris 8 Note: Multi-display Xinerama support requires Solaris 7 Operating Environment (11/99 or later) or the Solaris 8 Operating Environment.
Recommended patches	
<ul style="list-style-type: none">Using PGX graphics on an Ultra™ 5 or 10 workstation	Solaris 2.5.1: patch 103792-19 (or later) Solaris 2.6: patch 105362-19 (or later)
<ul style="list-style-type: none">Using Sun Elite3D graphics	Solaris 2.5.1: patch 105791-16 (or later) Solaris 2.6: patch 105362-19 (or later) Solaris 7: patches 106148-03 and 106144-05 (or later)
Window system supported	CDE or OpenWindows™ environment
Disk space	
<ul style="list-style-type: none">For end-user runtimes	32 MB for 32 bit; 55 MB for 64 bit
<ul style="list-style-type: none">For ISV developers (total to build examples)	54 MB for 32 bit; 77 MB for 64 bit
Memory	64 MB minimum with 128 MB or more recommended



Ordering Information

The Sun Ultra™ systems use a marketing part number scheme that is designed to provide greater flexibility and expandability. This page explains how to read the part numbering scheme. "N" means "Not available" or "Not applicable."



(Note: A = alpha character, 1 = numeric character, C = optional alpha or numeric character)

Model Key (Subset of Part Number Definitions)

<p>System A23 = Sun Ultra 60 workstation</p> <p>Microprocessor Family U = UltraSPARC™</p> <p>Microprocessor Speed L = 450-MHz UltraSPARC-II</p> <p>Ecache Size D = 4 MB</p>	<p>Monitor 9 = No monitor configured</p> <p>Frame Buffer A = Sun™ Expert3D-Lite L = Sun Creator3D series 3 V = Sun Expert3D Y = Sun Elite3D m3 Z = Sun Elite3D m6 series 2</p> <p>Memory 512 = 512 MB 1024 = 1024 MB</p>	<p>Disk AQ = 18.2-GB, 10000-rpm drive AV = 36.4-GB, 10000-rpm drive DD = DVD-ROM and 36.4-GB, 10000-rpm drive EL = DVD-ROM and two 36.4-GB, 10000-rpm drives NN = Diskless</p>
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Sun Ultra 60 Workstation Model 1450

Part Number	System
	One 450-MHz UltraSPARC-II processor with 4-MB Ecache and 36.4-GB, 10000-rpm internal hard drive standard
A23-ULD1-9A-512AV	512-MB memory, Sun Expert3D-Lite graphics
A23-ULD1-9L-512AV	512-MB memory, Sun Creator3D series 3 double-buffer graphics
A23-ULD1-9V-512AV	512-MB memory, Sun Expert3D graphics
A23-ULD1-9Y-512AV	512-MB memory, Sun Elite3D m3 series 2 graphics
A23-ULD1-9L-512DD	512-MB memory, Sun Creator3D series 3 double-buffer graphics, 10X DVD-ROM drive, manual-eject floppy

Sun Ultra 60 Workstation Model 2450

Part Number	System
	Two 450-MHz UltraSPARC-II processors with 4-MB Ecache and 36.4-GB, 10000-rpm internal hard drive standard
A23-ULD2-9A-512AV	512-MB memory, Sun Expert3D-Lite graphics
A23-ULD2-9L-512AV	512-MB memory, Sun Creator3D series 3 double-buffer graphics
A23-ULD2-9V-512AV	512-MB memory, Sun Expert3D graphics
A23-ULD2-9Z-512AV	512-MB memory, Sun Elite3D m6 series 2 graphics
A23-ULD2-9L-1024EL	1-GB memory, Sun Creator3D series 3 double-buffer graphics, 10X DVD-ROM drive, 2 x 36.4-GB drives
A23-ULD2-9V-1024EL	1-GB memory, Sun Sun Expert3D graphics, 10X DVD-ROM drive, 2 x 36.4-GB drives

Ordering Guidelines and Notes

- **Discontinued Models 1360 and 2360**

Models 1360 and 2360 with the 360-MHz processor are being discontinued. The transition schedule is as follows:

Last order date:	September 7, 2001
Last ship date:	December 7, 2001



- **Memory**

- The Ultra 60 workstation supports 2 GB of main memory. The DIMMs are of the same type as those used in the SPARCstation™ 20, Ultra 1, and Ultra 2 systems. This architecture currently accepts 32-MB, 64-MB, or 128-MB memory modules.
- The Ultra 60 workstation can accommodate up to 16 DIMM modules in increments of four. DIMM modules within each set *must* be of the same type. DIMM module sets of four may be mixed.

- **Graphics**

- All configurations with Sun Elite3D m3 graphics are being transitioned on the following schedule:

Last order date:	May 25, 2001
Last ship date:	August 24, 2001

- The Ultra 60 workstation has two UPA graphics slots that support Sun Creator, Sun Creator3D, and Sun Elite3D graphics accelerators. A customer can mix and match any of these accelerators within the Ultra 60 workstation with one exception: *only one Sun Elite3D m6 board can be supported by the Ultra 60 workstation with either a Sun Creator3D or Sun Elite3D m3 graphics adapter.*

- **Monitors**

- Monitors are not included with any Ultra 60 systems.
- A monitor must be purchased with an Ultra 60 workstation.
- Only the Sun Creator3D and Sun Expert3D graphics accelerators support 1920 x 1200 resolution for 24-inch monitors. In addition, Sun Creator3D graphics provides single-buffered, *not* double-buffered support at this resolution. Single-buffering does not provide high-performance 3-D graphics imaging; therefore, 3-D intensive applications are not recommended with this configuration.

- **SCSI**

- The internal SCSI host controller operates in Fast-20 (UltraSCSI) mode by default. Installation of non-FAST-20 devices, although allowed, will decrease overall SCSI performance.
- The total combined SCSI cable length must not exceed three meters for fast/wide operation or 1.5 meters for Fast-20 (UltraSCSI) operation.
- To achieve Fast-20 speeds on all devices on the bus, it is recommended that:
 - A maximum of two Sun StorEdge™ UniPack systems using Fast-20 cables be connected to the external connector.
 - All devices on the SCSI bus should be Fast-20 devices. (Non-Fast-20 devices may cause the internal devices to run at fast/wide speeds, but are supported.)

- **Keyboard**

- Ultra 60 workstations come with Type 6 keyboards.
- Type 4 keyboards are not supported on the Ultra 60 workstation. Order Type 5 keyboards, when applicable.



Options

Below is a comprehensive list of system expansion, networking, graphics, and multimedia options that are supported by Sun Ultra 60 systems. Refer to the Sun Price Book and configuration guides for currently available option listings, configuration notes, and ordering information. When no maximum number is listed, refer to ordering or configuration notes for that option.

Note: *Options listed in italics are supported by the Ultra 60 workstation, but are no longer available for purchase from Sun. These are listed only for reference purposes.*

Part Number	Option Description	Maximum Number Supported	Comments
Processors			
X1195A	450-MHz UltraSPARC-II CPU, 4-MB Level 2 cache	2	
X1192A	360-MHz UltraSPARC-II CPU, 4-MB Level 2 cache	2	
X1191A	300-MHz UltraSPARC-II CPU, 2-MB Level 2 cache	2	
Memory			
X7003A	128-MB, 60-ns DIMM memory expansion (2 x 64 MB)	8	These are all pairs of DIMM units
X7004A	256-MB, 60-ns DIMM memory expansion (2 x 128 MB)	8	
X7043A	128-MB, 60-ns DIMM memory expansion (2 x 64 MB), 5V	8	
X7001A	32-MB, 60-ns DIMM memory expansion (2 x 16 MB)	8	
X7002A	64-MB, 60-ns DIMM memory expansion (2 x 32 MB)	8	
Mass Storage Internal			
X5234A	9.1-GB, 10000-rpm fast/wide UltraSCSI 1-inch high disk	2	
X5237A	18.2-GB, 10000-rpm fast/wide UltraSCSI disk	2	
X5242A	36-GB, 10000-rpm fast/wide UltraSCSI disk	2	
X5229A	9.1-GB, 7200-rpm fast/wide UltraSCSI disk, 1-inch high	2	
X5232A	18.2-GB, 7200-rpm fast/wide UltraSCSI disk, 1.6-inch high	2	
Mass Storage Removable Media			
X6004A	Internal 3.5-inch, 1.44-MB manual-eject floppy drive (triple density)	1	
X6168A	Internal 10X DVD-ROM	1	
X6212A	Internal 7-GB to 14-GB, 8-mm tape drive	1	
X6282A	Internal 12-GB to 24-GB, 4-mm DDS-3 tape drive	1	
X6295A	Internal 20-GB, 4-mm DDS-4 tape drive	1	
X5214A	4.2-GB, 7200-rpm fast/wide UltraSCSI disk	2	
X6106A	4-GB to 8-GB SLR tape drive	1	
X6166A	SunCD™ 32X CD-ROM drive with cable (for FlexiPack)	1	
X6203A	14-GB, 8-mm tape drive	2	



Part Number	Option Description	Maximum Number Supported	Comments
X6520A	2.1-GB, 7200-rpm fast/wide UltraSCSI disk	2	
X5251A	9.1-GB, 7200-rpm fast/wide UltraSCSI disk	1	
X6153A	SunCD 4X CD-ROM	1	
X6161A	SunCD 12X CD-ROM drive with cable (for FlexiPack)	1	
X6256A	4-GB 4-mm DDS tape drive	1	
X6203A	14-GB 8-mm tape drive	1	
Mass Storage External			
X814A	5.0-GB, 8-mm tape backup drive, desktop storage module	2	
X827A	20-GB, 4-mm tape autoloader, desktop storage module	2	
X580A	535-MB Fast SCSI-2 desktop disk pack	4	
X545A	1.05-GB Fast SCSI-2 desktop disk pack	4	
X567A	2.1-GB Fast SCSI-2 desktop disk pack	4	
X737A	2.1-GB Fast SCSI-2 desktop disk pack	4	
X579A	SunCD 2Plus™, desktop storage pack	2	
X660A	150-MB QIC tape drive, desktop storage pack	2	
X822A	5.0-GB, 4-mm tape drive, desktop storage pack	2	
X834A	10-GB, 8-mm backup tape drive, desktop storage module	2	
X844A	14.0-GB, 8-mm tape drive, desktop storage pack	2	
Mass Storage Sun StorEdge UniPack (68-pin SCSI)			
SG-XTAP4MM-012A	20-GB, 4-mm DDS-4 tape drive in a UniPack desktop enclosure.	2	
SG-XMED4MMDDS410	4-mm 190-meter DDS-4 tapes, package of 10		
SG-XDSK010C-9G	9.1-GB, 7200-rpm UniPack	16	
SG-XDSK010C-18G	18.2-GB, 7200-rpm UniPack	16	
SG-XTAP4MM-011A	12-GB to 24-GB, 4-mm DDS-3 tape drive UniPack desktop enclosure	2	
SG-XTAP8MM-010A	7-GB to 14-GB, 8-mm drive in a UniPack desktop enclosure	2	
SG-XTAP8MM-011A	20-GB to 40-GB, 8-mm drive in a UniPack desktop enclosure	2	
SG-XDSK010A-4G	4.2-GB, 7200-rpm UniPack	16	
SG-XTAPMLR-310A	25-GB to 50-GB MLR tape drive in a UniPack desktop enclosure	2	
SG-XTAPSLR-010A	4-GB to 8-GB SLR tape drive UniPack	2	
SG-XTAP-8MM-020A	20-GB to 40-GB, 8-mm tape UniPack, desktop	2	



Part Number	Option Description	Maximum Number Supported	Comments
X6101A	2.5-GB QIC tape UniPack	1	
X5101A	1.05-GB, 7200-rpm fast/wide SCSI-2 disk UniPack		
X5151A	2.1-GB, 7200-rpm fast/wide SCSI-2 disk UniPack		
X5209A	4.2-GB, 7200-rpm fast/wide SCSI-2 disk UniPack		
X5253A	9.1-GB, 7200-rpm fast/wide SCSI-2 disk UniPack		
X6208A	14-GB, 8-mm tape UniPack	2	
X6251A	5-GB, 4-mm tape UniPack	2	
X6261A	4-GB to 8-GB, 4-mm DDS-2 drive	2	
X6157A	SunCD 12X CD-ROM UniPack	1	
X6151A	SunCD 4X CD-ROM UniPack	1	
Mass Storage Sun StorEdge UniPack (54-pin SCSI)			NOTE: 68-pin is required on the Ultra 60; these options supported if the correct cable is substituted
X5102A	1.05-GB, 7200-rpm fast/wide SCSI-2 disk UniPack	4	
X5152A	2.1-GB, 7200-rpm fast/wide SCSI-2 disk UniPack	4	
X5204A	2.1-GB, 7200-rpm fast/wide SCSI-2 disk UniPack	4	
X5213A	4.2-GB, 7200-rpm fast/wide SCSI-2 disk UniPack	2	
X5254A	9.1-GB, 7200-rpm fast/wide SCSI-2 disk UniPack	2	
X6152A	SunCD 4X CD-ROM UniPack	1	
X6158A	SunCD 12X CD-ROM UniPack	2	
X6102A	2.5-GB QIC tape UniPack	2	
X6202A	14-GB, 8-mm tape UniPack	2	
X6209A	14-GB, 8-mm tape UniPack	2	
X6252A	5-GB, 4-mm tape UniPack	2	
X6262A	4-GB to 8-GB, 4-mm DDS-2 tape drive	2	
X6281A	12-GB to 24-GB, 4-mm DDS-3 tape drive	2	
X6231A	20-GB to 40-GB, 8-mm tape drive	2	
Mass Storage MultiDisk Pack			
X569A	4.2-GB SCSI MultiDisk Pack (2 x 2.1-GB Fast SCSI-2 disk)	2	
X570A	8.4-GB SCSI MultiDisk Pack (4 x 2.1-GB Fast SCSI-2 disk)	1	
X739A	8.4-GB, 7200-rpm MultiDisk Pack (4 x 2.1-GB Fast SCSI-2 disk)	1	
X748A	8.4-GB SCSI MultiDisk Pack (2 x 4.2-GB Fast SCSI-2 disk)	2	
X749A	16.8-GB SCSI MultiDisk Pack (4 x 4.2-GB Fast SCSI-2 disk)	1	



Part Number	Option Description	Maximum Number Supported	Comments
X771A	2.1-GB SCSI MultiDisk Pack (2 x 1.05-GB)	2	
X5211A	8.4-GB (2 x 4.2 GB), 7200-rpm fast/wide SCSI-2 MultiPack	2	
X5212A	16.8-GB (4 x 4.2 GB), 5400-rpm fast/wide SCSI-2 MultiPack	1	
X738A	4.2-GB, 7200-rpm MultiDisk Pack (2x2.1 GB)	2	
Mass Storage Sun StorEdge FlexiPack	<i>The following FlexiPack options come with a 68-68 pin SCSI cable:</i>		
SG-XTAP-DLT-021A	35-GB to 70-GB, DLT 7000 tape, desktop	2	
SG-XTAP-4MM-021A	12-GB to 24-GB, 4-mm DDS-3 tape FlexiPack	2	
SG-XTAP-4MM-031A	72-GB to 144-GB, 4-mm DDS-3 tape FlexiPack, desktop autoloader	2	
SG-XTAP-8MM-020A	14-GB, 8-mm tape FlexiPack	2	
SG-XTAP-8MM-021A	20-GB to 40-GB, 8-mm tape FlexiPack, desktop	2	
SG-XTAP-DLT-020A	20-GB to 40-GB, DLT 4000 tape, desktop	2	
SG-XTAP-SLR-020A	4-GB SLR tape FlexiPack	2	
SG-XTAP-MLR-320A	25-GB to 50-GB MLR drive FlexiPack, desktop	2	
SG-XTAP-8MM-011A	7-GB to 14-GB, 8-mm tape FlexiPack, desktop	2	
X6106A	4-GB to 8-GB SLR internal tape drive		
X6122A	25-GB MLR internal tape FlexiPack or Sun Enterprise server systems		
X6284A	112-GB to 24-GB, 4-mm DDS-3 tape FlexiPack	2	
X6264A	4-GB to 8-GB, 4-mm DDS-3 tape FlexiPack	2	
X6159A	SunCD 12X CD-ROM FlexiPack	2	
X6058A	DLT 4000	2	NOTE: These options require a 58-pin to 68-pin cable
X6061A	DLT 7000	2	
X6291A	72-GB to 144-GB, 4-mm DDS-3 autoloader tape FlexiPack	2	
X6285A	12-GB to 24-GB, 4-mm DDS-3 tape FlexiPack	2	
X6265A	4-GB to 8-GB, 4-mm DDS-3 tape FlexiPack	2	
X6233A	20-GB to 40-GB, 8-mm tape FlexiPack	2	
X6211A	14-GB, 8-mm tape FlexiPack	2	
X6150A	SunCD 12X CD-ROM FlexiPack	2	



Part Number	Option Description	Maximum Number Supported	Comments
Mass Storage Sun StorEdge MultiPack			
SG-XDSK020A-18G	18.2-GB (2 x 9.1-GB) 10000-rpm MultiPack	8	
SG-XDSK020B-36G	36.4-GB (2 x 18.2-GB) 10000-rpm MultiPack	8	
SG-XDSK040A-36G	36.4-GB (4 x 9.1-GB) 10000-rpm MultiPack	8	
SG-XDSK040B-72G	72.8-GB (4 x 18.2-GB) 10000-rpm MultiPack	8	
SG-XDSK060A-54G	54.6-GB (6 x 9.1-GB) 10000-rpm MultiPack	8	
SG-XDSK060B-109G	109.2-GB (6 x 18.2-GB) 10000-rpm MultiPack	8	
SG-XLIBDLT1-280G	280-GB to 560-GB DLT 7000 tape autoloader (desktop)	1	
SG-XLIBDLT2-280G	280-GB to 560-GB DLT 7000 tape autoloader (rackmount)	1	
<i>SG-XDSK020A-8G</i>	<i>8.4-GB (2 x 4.2-GB) 7200-rpm MultiPack</i>	<i>1</i>	
<i>SG-XDSK040A-16G</i>	<i>16.8-GB (4 x 4.2-GB) 7200-rpm MultiPack</i>	<i>1</i>	
<i>SG-XDSK060A-25G</i>	<i>25.2-GB (6 x 4.2-GB) 7200-rpm MultiPack</i>	<i>1</i>	
X5511A	<i>4.2-GB (2 x 2.1-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5512A	<i>12.6-GB (6 x 2.1-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5513A	<i>25.2-GB (12 x 2.1-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5514A	<i>8.4-GB (2 x 4.2-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5515A	<i>25.2-GB (6 x 4.2-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5516A	<i>50.4-GB (12 x 4.2-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5501A	<i>8.4-GB (2 x 4.2-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5502A	<i>16.8-GB (4 x 4.2-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5503A	<i>25.2-GB (6 x 4.2-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5504A	<i>18.2-GB (2 x 9.1-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5505A	<i>36.4-GB (4 x 9.1-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X5506A	<i>54.6-GB (6 x 9.1-GB), 7200-rpm fast/wide SCSI-2 MultiPack</i>	<i>1</i>	
X6528A	<i>18.2-GB MultiPack (2 x 9.1-GB), 7200-rpm UltraSCSI</i>	<i>1</i>	
X6529A	<i>36.4-GB MultiPack (4 x 9.1-GB), 7200-rpm UltraSCSI</i>	<i>1</i>	
Mass Storage Sun StorEdge Tape Libraries			
SG-XLIBDLT1-1TB-2	L1000 tape library, 1-TB native capacity, 1 DLT 7000 tape drive (desktop)	1	
SG-XLIBDLT4-1TB-2	L1000 tape library, 1-TB native capacity, 4 DLT 7000 tape drive (desktop)	1	



Part Number	Option Description	Maximum Number Supported	Comments
SG-XLIBDLT1R-1TB-2	L1000 tape library, 1-TB native capacity, 1 DLT 7000 tape drive (rackmount)	1	
SG-XLIBDLT4R-1TB-2	L1000 tape library, 1-TB native capacity, 4 DLT 7000 tape drive (rackmount)	1	
X6079A	L3500 tape library, 3.5-TB native capacity, 2 drive	1	
X6080A	<i>L3500 tape library, 3.5-TB native capacity, 7 drive</i>	1	
<i>SG-XLIB8MMB-400G</i>	<i>400-GB to 800-GB 8-mm Sun StorEdge L400 tape library tower, 1 tape drive</i>	<i>1</i>	
<i>SG-XLIB8MM1-400G</i>	<i>400-GB to 800-GB 8-mm L400 tape library tower, 2 tape drives</i>	<i>1</i>	
<i>SG-XLIB8MMC-400G</i>	<i>400-GB to 800-GB 8-mm Sun StorEdge L1000 tape library rackmount, 2 tape drives</i>	<i>1</i>	
X6227A	<i>140-GB L140, tower, one drive</i>	<i>1</i>	
<i>SG-XLIB-8MM1-400G</i>	<i>400-GB L400, tower, two drives, barcode</i>	<i>1</i>	
<i>SG-XLIB-DLT1-280G</i>	<i>Sun StorEdge L280 autoloader, desktop</i>	<i>1</i>	
X849A	<i>SPARCstorage™ Library Model 8/140, 140-GB, 8-mm stackable unit</i>	<i>1</i>	
X867A	<i>SPARCstorage Library Model 8/140, 140-GB, 8-mm, two drives and barcode reader, tower unit</i>	<i>1</i>	
X869X	<i>SPARCstorage Library Model 8/140, 140-GB, 8-mm, two drives and barcode reader, stackable unit</i>	<i>1</i>	
Mass Storage Sun StorEdge A1000 Arrays			
SG-XARY144A-36G	36-GB Sun StorEdge A1000 tabletop array (4 x 9.1-GB, 10000-rpm disks)	8	
SG-XARY144A-109G	109-GB Sun StorEdge A1000 tabletop array (12 x 9.1-GB, 10000-rpm disks)	8	
SG-XARY151A-72G	72-GB Sun StorEdge A1000 tabletop array (4 x 18-GB, 10000-rpm disks)	8	
SG-XARY151A-218G	218-GB Sun StorEdge A1000 tabletop array (12 x 18.2-GB, 10000-rpm disks)	8	
SG-XARY161A-145G	145-GB Sun StorEdge A1000 tabletop array (4 x 36.4-GB, 10000-rpm disks)	1	
SG-XARY161A-291G	291-GB Sun StorEdge A1000 tabletop array (8 x 36.4-GB, 10000-rpm disks)	1	



Part Number	Option Description	Maximum Number Supported	Comments
SG-XARY146A-36G	36-GB Sun StorEdge A1000 rackmountable array (4 x 9.1-GB, 10000-rpm disks)	1	
SG-XARY152A-72G	72-GB Sun StorEdge A1000 rackmountable array (4 x 18-GB, 10000-rpm disks)	1	
SG-XARY162A-145G	145-GB Sun StorEdge A1000 rackmountable array (4 x 36.4-GB, 10000-rpm disks)	1	
NS-XARY151A-72GAC	72-GB Netra™ st A1000 rackmountable telecom storage array	1	
Mass Storage Sun StorEdge D1000 Arrays			
SG-XARY145A-36G	36-GB Sun StorEdge D1000 tabletop array (4 x 9.1-GB, 10000-rpm disks)	8	
SG-XARY145A-109G	109-GB Sun StorEdge D1000 tabletop array (12 x 9.1-GB, 10000-rpm disks)	8	
SG-XARY153A-72G	72-GB Sun StorEdge D1000 tabletop array (4 x 18-GB, 10000-rpm disks)	8	
SG-XARY153A-218G	218-GB Sun StorEdge D1000 tabletop array (12 x 18.2-GB, 10000-rpm disks)	8	
SG-XARY163A-145G	145-GB Sun StorEdge D1000 tabletop array (4 x 36.4-GB, 10000-rpm disks)	1	
SG-XARY163A-291G	291-GB Sun StorEdge D1000 tabletop array (8 x 36.4-GB, 10000-rpm disks)	1	
SG-XARY147A-36G	36-GB Sun StorEdge D1000 rackmountable array (4 x 9.1-GB, 10000-rpm disks)	1	
SG-XARY154A-72G	72-GB Sun StorEdge D1000 rackmountable array (4 x 18-GB, 10000-rpm disks)	1	
SG-XARY164A-145G	145-GB Sun StorEdge D1000 rackmountable array (4 x 36.4-GB, 10000-rpm disks)	1	
NS-XARY153A-72GAC	72-GB Netra st D1000 rackmountable telecom storage array	1	



Part Number	Option Description	Maximum Number Supported	Comments
Mass Storage Sun StorEdge A3500FC Arrays			Purchase of one or more controller modules required
X6537A	Sun StorEdge A3500 controller module		
X6538A	Fibre Channel controller module, rackmountable for A3500, supports D1000 disk trays		
X6729A	PIC FC-AL single-loop host adapter 1000 MB/sec. optical interface		
SG-XARY164A-145G	145-GB Sun StorEdge D1000 rackmount tray with 4 x 36.4-GB, 10000-rpm disks		
SG-XARY360B-545G	545-GB Sun StorEdge A3500FC array (60 x 9.1-GB, 10000-rpm disks), 5 trays in Sun StorEdge expansion cabinet, FC-AL controller module	8	
SG-ARY366A-72G	72-GB Sun StorEdge A3500 Light array (8 x 9.1-GB, 10000-rpm disks), 5 trays in Sun StorEdge expansion cabinet		
SG-ARY370A-91G	91-GB Sun StorEdge A3500 array (10 x 9.1-GB, 10000-rpm disks), 5 trays in Sun StorEdge expansion cabinet		
SG-ARY372A-182G	182-GB Sun StorEdge A3500 array (20 x 9.1-GB, 10000-rpm disks), 7 trays in Sun StorEdge expansion cabinet		
SG-ARY374A-273G	273-GB Sun StorEdge A3500 array (30 x 9.1-GB, 10000-rpm disks), 15 trays in two Sun StorEdge expansion cabinets		
SG-ARY380A-182G	182-GB Sun StorEdge A3500 array (10 x 18.2-GB, 10000-rpm disks), 5 trays in Sun StorEdge expansion cabinet		
SG-XARY380B-1092G	1092-GB Sun StorEdge A3500FC array (60 x 18.2-GB, 10000-rpm disks), 5 trays in Sun StorEdge expansion cabinet, FC-AL controller module	8	
SG-XARY381B-1456G	1456-GB Sun StorEdge A3500FC array (40 x 36.4-GB, 10000-rpm disks), 5 trays in two Sun StorEdge expansion cabinets, FC-AL controller module		
SG-ARY382A-364G	364-GB Sun StorEdge A3500 array (20 x 18.2-GB, 10000-rpm disks), 7 trays in Sun StorEdge expansion cabinet		
SG-ARY384A-546G	546-GB Sun StorEdge A3500 array (20 x 18.2-GB, 10000-rpm disks), 15 trays in two Sun StorEdge expansion cabinets		
SG-ARY381A-364G	364-GB Sun StorEdge A3500 array (10 x 36.4-GB, 10000-rpm disks), 5 trays in Sun StorEdge expansion cabinet		
SG-ARY383A-728G	728-GB Sun StorEdge A3500 array (20 x 36.4-GB, 10000-rpm disks), 7 trays in Sun StorEdge expansion cabinet		



Part Number	Option Description	Maximum Number Supported	Comments
SG-ARY385A-1092G	1092-GB Sun StorEdge A3500 array (30 x 36.4-GB, 10000-rpm disks), 15 trays in two Sun StorEdge expansion cabinets		
SG-XARY147A-36G	36-GB Sun StorEdge D1000 rackmount tray with 4 x 9.1-GB, 10000-rpm disks		
SG-XARY154A-72G	72-GB Sun StorEdge D1000 rackmount tray with 4 x 18.2-GB, 10000-rpm disks		
Sun StorEdge A5X00 Arrays			
6729A	S/B PCI FC-AL single-loop host adapter		
SG-XARY550A-182G	182-GB Sun StorEdge 5100 tabletop array (5 x 36.4-GB, 10000-rpm disks)	2	
SG-XARY550A-509G	509-GB Sun StorEdge 5100 tabletop array (14 x 36.4-GB, 10000-rpm disks)	2	
SG-XARY553A-1019G	1.0-TB Sun StorEdge 5100 cabinet, two 509.6-GB arrays (14 x 36.4-GB, 10000-rpm disks)		
SG-XARY553A-3057G	3.0-TB Sun StorEdge 5100 cabinet, six 509.6-GB arrays (14 x 36.4-GB, 10000-rpm disks)		
SG-ARY553A-509G	509-GB Sun StorEdge 5100 factory configured hubless array (14 x 36-GB, 10000-rpm disks)	2	
SG-XARY551A-509G	509-GB Sun StorEdge 5100 rackmountable array (14 x 36-GB, 10000-rpm disks)	2	
SG-XARY552A-509G	509-GB Sun StorEdge 5100 rackmountable array (14 x 36-GB, 10000-rpm disks)	2	
SG-XARY520A-63G	63.7-GB Sun StorEdge 5200 tabletop array (22 x 9-GB, 10000-rpm disks)	2	
SG-XARY520A-200G	200-GB Sun StorEdge 5200 tabletop array (7 x 9-GB, 10000-rpm disks)	2	
SG-XARY521A-200G	200-GB Sun StorEdge 5200 rackmountable array (22 x 9-GB, 10000-rpm disks) for Sun StorEdge expansion cabinet	2	
SG-XARY522A-200G	200-GB Sun StorEdge 5200 rackmountable array (22 x 9-GB, 10000-rpm disks) for Enterprise system cabinet	2	
SG-XARY523A-1200G	1.2-TB Sun StorEdge 5200 array (9-GB, 10000-rpm disks)		
SG-XARY540A-127G	127-GB Sun StorEdge 5200 tabletop array (7 x 18.2-GB, 10000-rpm disks)	2	
SG-XARY540A-400G	400-GB Sun StorEdge 5200 tabletop array (22 x 18-GB, 10000-rpm disks)	2	
SG-XARY541A-400G	400-GB Sun StorEdge 5200 rackmountable array (22 x 18-GB, 10000-rpm disks) for Sun StorEdge expansion cabinet	2	



Part Number	Option Description	Maximum Number Supported	Comments
SG-XARY542A-400G	400-GB Sun StorEdge 5200 rackmountable array (18-GB, 10000-rpm disks) for Enterprise system cabinet	2	
SG-XARY543A-800G	800-GB Sun StorEdge 5200 array (18-GB, 10000-rpm disks)	1	
SG-XARY543A-2400G	2.4-TB Sun StorEdge 5200 array (18-GB, 10000-rpm disks)	1	
Input Devices			
X180A	SunButtons™ 32-key function I/O device	1	
X190A	SunDials™ 8-dial interactive graphics I/O device for 3-D	1	
PCI Expansion Cards			
X1032A	10/100BASE-T Ethernet with SunPCI UltraSCSI	4	
X1033A	10BASE-T Sun FastEthernet PCI adapter with MII interface	4	
X1034A	Sun Quad FastEthernet™ PCI Card (QFE)	2	
X1152A	SunFDDI™ single-attach PCI bus interface adapter 2.0	3	
X1153A	SunFDDI dual-attach PCI bus interface adapter 2.0	3	
X2154A	SunLink™ token ring interface/PCI adapter 5.0 for Solaris 8 and earlier releases	2	
X1155A	High-speed serial interface PCI adapter 2.0	3	Universal
X2156A	Serial asynchronous interface PCI adapter 3.0 for Solaris 8 and earlier releases	4	
X1141A	Sun GigabitEthernet PCI adapter 2.0	1	
X2069A	Sun GigabitEthernet FC-AL combo adapter, PCI	1	
X1157A	SunATM™-155/MFiber PCI adapter 4.0	2	
X1158A	SunATM-155/UTP PCI adapter 4.0	2	
X1159A	SunATM-622/MFiber PCI adapter 4.0	1	
X2132A	SunPCi™ II 733-MHz coprocessor card, 64-MB memory	1	
X6540A	Dual-channel, single-ended UltraSCSI controller	2	
X6541A	Dual-channel, differential UltraSCSI controller	3	
X6729A	S/B PCI FC-AL single-loop host adapter		
X6799A	Sun StorEdge PCI single Fibre Channel network adapter	3	
X7042A	128-MB SODIMM memory expansion for SunPCi Iipro card	1	
X7044A	256-MB SODIMM memory expansion for SunPCi Iipro card	1	
X1089A	SunVideo Plus™ 3.1 video/audio capture	3	
X499A-EU	PCI Multimedia Kit, SunVideo Plus 1.3, a PAL SunCamera™ II, Sun Microphone™ II, and documentation (Continental Europe), supports SunForum™ 3.0		



Part Number	Option Description	Maximum Number Supported	Comments
X499A-UK	PCI Multimedia Kit, SunVideo Plus 1.3, a PAL SunCamera II, Sun Microphone II, and documentation (U.K.), supports SunForum 3.0		
X499A	PCI Multimedia Kit, SunVideo Plus 1.3, a NTSC SunCamera II, Sun Microphone II, and documentation (U.S.), supports SunForum 3.0		
X1131A-64.2	<i>SunPCi 400-MHz K6-2 coprocessor card, 64-MB memory</i>	1	
X1131A-64.1	<i>SunPCi 300-MHz K6-2 coprocessor card, 64-MB memory</i>	1	
X7041A	<i>64-MB DIMM memory expansion (1 x 64 MB) for SunPCi coprocessor card</i>		
X7035A	<i>128-MB DIMM memory expansion (1 x 128 MB) for SunPCi coprocessor card</i>		
X1035A	<i>SunFDDI single-attach PCI adapter (SAS/5.0)</i>	4	
X1036A	<i>SunFDDI dual-attach PCI adapter (DAS/5.0)</i>	4	
X1066A	<i>SunATM/P-155 Multimode Fiber</i>	2	
X1067A	<i>SunATM/P-155 Cat-5 UTP</i>	2	
X1068A	<i>SunATM/P-622 Multimode Fiber</i>	1	
Graphics			
X3768A	Sun PGX64 graphics card	4	
X3670A	Sun Creator3D series 3, 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable	2	
X3679A	Sun Elite3D m6 series 2 graphics accelerator	1	
X3678A	Sun Expert3D graphics accelerator	2	
X3684A	Sun Expert3D-Lite graphics accelerator	4	
X3677A	Sun Elite3D m3 series 2 graphics accelerator	2	
X3668A	<i>PGX32™ 8- and 24-bit color graphics PCI adapter frame buffer, CD, and cable</i>	3	
X3660A	<i>PGX™ 8-bit color graphics PCI adapter frame buffer and cable</i>	3	
X3664A	<i>Sun Elite3D m3 graphics accelerator</i>		
X3665A	<i>Sun Elite3D m6 graphics accelerator</i>		
X3662A	<i>Sun Creator series 3, single-buffered graphics</i>	2	
X3663A	<i>Sun Creator3D series 3, 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable</i>	2	
X3672A	<i>Sun Creator series 3, single-buffered graphics</i>	2	
Monitors			
X7126A	17-inch color monitor		
X7127A	18.1-inch TFT LCD color monitor		



Part Number	Option Description	Maximum Number Supported	Comments
X7136A	21-inch flat screen color Trinitron monitor		
X7124A	Wide-screen 24-inch color monitor		
X3872A	HD15-pin video output (for 17-inch and 19-inch monitors)		
X7103A	<i>Entry-level 17-inch color monitor</i>		
X328A	<i>17-inch color monitor</i>		
X7119A	<i>19-inch color monitor</i>		
X267A	<i>20-inch color monitor</i>		
X7121A	<i>21-inch color monitor</i>		
X7135A	<i>19-inch flat screen color Trinitron monitor</i>		
Miscellaneous			
X2087A	Ultra 60/Ultra 30 No-noise kit	1	



Upgrades

Sun™ upgrades offer customers outstanding investment protection for their existing Sun equipment.

Key Messages

- Sun offers customers a variety of flexible upgrade paths to the most popular Sun systems
- Choose from chassis-only to full-system upgrades
- Sun upgrades allow as many components as possible to be carried forward, to protect the customer's hardware investment
- Existing investments in non-Sun hardware can be preserved by upgrading to Sun through competitive full-system upgrades
- SPARCstation™ 20 or Ultra™ workstation upgrades offer excellent value by allowing the migration of memory to Sun Ultra 60 systems

Sun Upgrade Allowance Program (Sun UAP)

Under the Sun UAP program, allowance codes or part numbers have been created and the percentage allowance is built into this part number (see below). These allowance codes replace the previous UG/CU marketing codes used for all desktop upgrades.

Allowance codes can be found in the Sun Pricebook starting with the September 2000 version. Please note that allowance codes apply to configured systems and **cannot be applied to X-options , other than monitors** (see ordering notes below).

Allowance Code Numbering Scheme

Below is an example allowance code, along with a breakdown of the components.

Allowance code = ALW-15-T-D-A23-P2

- **ALW**= Upgrade identifier (All allowance codes start with ALW.)
- **15** = Allowance percentage—Percentage is applied to the list price of a standard marketing part number . "15" means 15% off of list price , "08" means 8% off of list price, and so on.
(Note: Any other discounts such as volume discounts should also be taken off the list price and not the net of the above.)
- **T** = Desktop upgrades, S for server upgrades, and D for storage upgrades.
- **D** = Indicates the residue group—a way of grouping system in the Sun installed base. The letters A through X are reserved for Sun systems. The letter, Z is used for competitive systems.
- **A23** = Identifies the product family that the customer is purchasing.
- **P2** = Promotion code—used for tracking corporate sponsored and other types of promotions.



How to Determine the Right Allowance Code

Scenario: My customer has a SPARCstation 10 workstation and would like to upgrade to an Ultra 60 workstation. What allowance part number should I select?

1. From left hand column select the platform the **customer has**.
2. From the top row select the platform the customer would like to **UPGRADE TO**.
3. Where the UPGRADE FROM column and the UPGRADE TO row intersect (noted with **) is the allowance part number that is applied to the list price of the standard marketing part number.

DESKTOP SYSTEM MIGRATION AND ALLOWANCE MATRIX

UPGRADE TO:	Ultra 5 (A21)	Ultra 10 (A22)	Ultra 60 (A23)	Ultra 80 (A27)
FROM:				
Early Sun SPARCstation systems	ALW-08-T-A-A21	ALW-08-T-A-A22	ALW-08-T-A-A23	ALW-06-T-A-A27
SS4, 5, 10, or 20**	ALW-12-T-B-A21	**ALW-12-T-B-A22	ALW-10-T-B-A23	ALW-08-T-B-A27
UltraSPARC™ 1,5,10, and 30	ALW-14-T-C-A21	ALW-16-T-C-A22	ALW-16-T-C-A23	ALW-12-T-C-A27
UltraSPARC 2 and 60	ALW-14-T-D-A21	ALW-16-T-D-A22	ALW-18-T-D-A23	ALW-16-T-D-A27
Non-Sun workstations	ALW-10-T-Z-A21	ALW-12-T-Z-A22	ALW-10-T-Z-A23	ALW-10-T-Z-A27

Answer: Allowance part number ALW-10-T-B-A23 should be selected. Your customer gets a 10 percent allowance off the list price of any Ultra 60 workstation configuration for returning the SPARCstation 10 system.

Upgrade Ordering Notes

- Memory migrates from Ultra 1 and Ultra 2 workstations; disks do not migrate
- 300-MHz modules from the Ultra 2 and Ultra 30 workstations will migrate
- Graphics cards from A12 and A14 do not migrate to the Ultra 60 workstation
- Monitors
 - Monitors are not included with any Ultra 60 system upgrades
 - Sun branded 17-inch and 20-inch monitors migrate from previous generation Sun systems
 - For some monitors, a video adapter may be required. Please order the correct adapter (example: a 21-inch color monitor with on-board 8-bit graphics requires X471A). Adapter choices are:
 - X3872A—HD15F to 13W3 video adapter
 - X471A—13W3F to HD15M video adapter (10-inch cable)
 - If a monitor is needed, order an X-option or refer to monitor upgrade section of price book



- Country kits
 - Type-4 keyboards are not supported on the Ultra 60 workstation
 - Type-5 keyboards can migrate to the Ultra 60 workstation

Service and Support

The SunSpectrumSM program is an innovative and flexible service offering that allows customers to choose the level of service best suited to their needs, ranging from mission-critical support for maximum solution availability to backup assistance for self-support customers. The SunSpectrum program provides a simple pricing structure in which a single fee covers support for an entire system, including related hardware and peripherals, the SolarisSM Operating Environment software, and telephone support for SunTM software packages. The majority of Sun's customers today take advantage of the SunSpectrum program, underscoring the value that it represents. Customers should check with their local Sun Enterprise Services representatives for program and feature availability in their areas.

Support Contracts

SunSpectrum program support contracts are available both during and after the warranty program. Customers may choose to uplift the service and support agreement to meet their business needs by purchasing a SunSpectrum contract.

The four levels of SunSpectrum support contracts are outlined below.

SunSpectrum Program Support

Program	Description
Mission-Critical SunSpectrum PlatinumSM Support	Designed to support client-server, mission critical solutions by focusing on failure prevention, rapid recovery and year round technical services planning. Support is provided 24 x 7.
Business-Critical SunSpectrum GoldSM Support	Includes a complete package of proactive and responsive services for customers who require maximum uptime for their strategic business-critical systems. Support is provided 24 x 7.
System Coverage SunSpectrum SilverSM Support	Combines the service expertise, responsive on-site support and technical support by telephone and SunSolve TM CD/on-line services. Support is provided 8 a.m. to 8 p.m. Mon. through Fri.
Self-Directed SunSpectrum BronzeSM Support	Provided for customers who rely primarily upon their own in-house service capabilities. Enables customers to deliver high quality service by giving them access to UNIX [®] expertise, Sun certified replacement parts, software releases and technical tools. Support is provided 8 a.m. to 5 p.m. Mon. through Fri.



SunClientSM Support Program

The SunClientSM support program is a suite of offerings that is separate, yet complementary to the SunSpectrum program. This program helps reduce hardware and software support costs for the UltraTM 60 workstations. SunClient support provides:

- A choice for optimizing low-cost workstation support
- Flexibility to select only the services needed
- Administrative simplicity, saving time and money
- Access to world-class UNIX[®] networking experts

FEATURE	SunClient Maintenance	SunClient Central Maintenance	SunClient Software Tech Support Option*
Systems approach coverage	*	*	
Solaris and unbundled software technical support	—	—	*
9 a.m.–5 p.m., Monday–Friday telephone coverage	*	*	*
9 a.m.–5 p.m., Monday–Friday on-site coverage	*†‡	*‡	—
Response times (phone/onsite)	4 hour callback/next business day response	4 hour callback/second business day response	4 hour callback
Centralized on-site repair of multiple units	—	*	Not Applicable
Patches	Not Applicable	Not Applicable	*
SunSolve license	Not Applicable	Not Applicable	*
SunSolve EarlyNotifier SM Service	Not Applicable	Not Applicable	*
Software updates	Not Applicable	Not Applicable	Not Applicable
* Can only be sold as an option to SunClient Maintenance or SunClient Central Maintenance.			
† Next business day on-site response requires that the request for service be received by 3:00 p.m. If the call is received after 3:00 p.m., service will be provided on the second business day.			
‡ Customers located more than 50 miles from an authorized service provider or reseller will be charged an additional fee for service activity.			



Features and Benefits of the SunClient Program

Features

- Unbundled hardware and software support
- Next business day (SunClient Maintenance) or second business day (SunClient Central Maintenance) on-site response
- Single contract with choice of automatic warranty upgrade
- SunClient Central Maintenance
- Service delivery by Sun experts

Benefits

- *Flexibility*
Select the type and amount of coverage needed for desktop systems, so service dollars are targeted where they are needed most.
- *Cost savings*
Pay only for the support services needed.
- *Cost efficiency*
Because Sun can more efficiently manage spare inventory and labor scheduling, the savings can be passed on to the customer.
- *Simplicity*
One contract covers a predefined number of systems at one low price. New systems acquired can be upgraded to the SunClient service level.
- *Cost savings*
Sun realizes an economy of scale by repairing multiple systems with one visit and leverages existing support infrastructures, so cost efficiency is maximized while duplication of effort is virtually eliminated.
- *Consistency*
Selected desktops can be deployed virtually anywhere with enabling cost-effective, quality service and support.

For more information, visit the SunClient support web site at:
<http://www.sun.com/service/support/sunclient>



Glossary

24-bit color	The ability to render objects from a palette of 16.7 million colors. It is often referred to as true color and results in much more realistic shading of 3-D objects for enhanced image quality.
3D-RAM	Dual-ported video memory with graphics functionality built into the memory chip.
100BASE-T	<i>See</i> Fast Ethernet.
Antialiasing	A graphics technique that greatly enhances the quality of images by eliminating many of the inaccuracies ("jaggies") inherent to rendering on a raster display. Typically found only in high-end graphics systems.
DIMM	Dual inline memory module. A memory unit that can come in a variety of sizes, such as 16, 32, 64, and 128 MB.
Fast Ethernet	IEEE standard for 100-Mb Ethernet. This technology supports a data transfer rate of 100 megabits/second over special grades of twisted-pair wiring.
MII	Media independent interface. Used for connecting external transceivers to Fast Ethernet.
ODBC	Open database connectivity.
OpenGL®	The de facto standard software interface for graphics hardware that allows programmers to create interactive 3-D applications. The OpenGL API provides a full-featured, network-transparent application programming interface.
PCI	Peripheral component interconnect. A industry standard for connecting peripherals such as disk drives, tapes drives, and other devices used in the PCs.
PLBwire93	The Picture Level Benchmark for wireframe performance. A benchmark standardized by the National Computer Graphics Associated GPC committee. The value represents the geometric mean performance on several commonly used 3-D wireframe operations.
PLBsurf93	The Picture Level Benchmark for 3-D surface performance. A benchmark standardized by the National Computer Graphics Associated GPC committee. The value represents the geometric mean performance on several commonly used 3-D surface operations.
UPA	Ultra™ port architecture. A high-speed, crossbar-oriented, packet-switched mother board interconnect.
V9	Version 9 of the SPARC™ definition.

VIS™

Visual instruction set. The UltraSPARC™ processor implements a special instruction set that is primarily aimed at image and video processing. Some of the instructions allow the CPU to directly access and operate on image data with a high degree of parallelism. Other instructions provide facilities for formatting and moving data at very high rates of speed both within the CPU, and between the CPU and the other system components.



Materials Abstract

All materials are available on SunWIN except where noted otherwise.

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
PowerPack				
– <i>Sun Ultra™ 60 Workstation, Just the Facts</i>	Reference Guide (this document)	Training Sales Tool	SunWIN, Reseller Web	75244
– <i>Sun Ultra Workstations Customer Presentation</i>	Presentation with Slide Notes	Sales Tool	SunWIN, Reseller Web	111990
References				
– <i>Sun Ultra 60 Workstation Data Sheet</i>	Data Sheet	Sales Tool	SunWIN, Reseller Web	71413
– <i>Sun Ultra 60 Workstation Architectural White Paper</i>	Technical Brief	Sales Tool	SunWIN, Reseller Web	75264
– <i>SunVideo Plus™ Subsystem, Just the Facts</i>	Reference Guide	Training Sales Tool	SunWIN	75247
– <i>Sun™ Elite3D Graphics: Just the Facts</i>	Reference Guide	Training Sales Tool	SunWIN, Reseller Web	75245
– <i>Sun Elite3D Graphics White Paper</i>	Technical Brief	Sales Tool	SunWIN, Reseller Web	75265
– <i>Sun Creator Graphics series 3, Just the Facts</i>	Reference Guide	Training Sales Tool	SunWIN, Reseller Web	75246
– <i>Sun Expert3D Frame Buffer, Just the Facts</i>	Reference Guide	Training Sales Tool	SunWIN, Reseller Web	114214
– <i>Sun Expert3D-Lite Graphics, Just the Facts</i>	Reference Guide	Training Sales Tool	SunWIN, Reseller Web	125033
– <i>Graphics Solution Guide</i>	Graphics Overview	Sales Tool	SunWIN	75271
Presentations				
– <i>Sun in EDA Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	59078
– <i>Sun in MCAD/MCAE Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	59074
– <i>Sun in Software Development Customer Presentation</i>	Presentation (with slide notes)	Sales Tool	SunWIN, Reseller Web	59375
– <i>Sun in Geotechnical Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	60292
– <i>Sun in Digital Content Creation, Customer Presentation</i>	Presentation	Sales Tool	SunWIN	75241
– <i>Graphics Overview Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	75254



Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
Quick Reference Cards				
– <i>Quick Reference Card Sun Workstation™ Product Line Overview</i>	Quick Reference Card	Sales Tool	SunWIN, Reseller Web, First Resort	10826
– <i>Quick Reference Card Sun Workstation Graphics Products Overview</i>	Quick Reference Card	Sales Tool	SunWIN, Reseller Web, First Resort	24507
– <i>Quick Reference Card Competitive Summary Workstations</i>	Quick Reference Card	Sales Tool	SunWIN, Reseller Web, First Resort	12259
– <i>Quick Reference Card Upgrade Paths</i>	Quick Reference Card	Sales Tool	SunWIN, Reseller Web, First Resort	24513
Upgrade Return Matrices				
– <i>Desktop Matrix</i>	Product Line Matrix		SunWIN	94726
– <i>Component Matrix</i>	Product Line Matrix		SunWIN	108142
– <i>Desktop Product Return Matrix</i>	Return Matrix		SunWIN	92856
External Web Sites				
– <i>General Information on Sun's Desktop Line</i>	http://www.sun.com/desktop			
– <i>Detailed Information on the Ultra 60 Workstation</i>	http://www.sun.com/desktop/products/Ultra60			

