Sun™ Elite3D Graphics

Just the Facts

Copyrights

Positioning

Introduction

The Sun™ Elite3D graphics product line keeps Sun firmly in the high-performance mid-range graphics workstation segment, and has launched Sun into the superworkstation and graphics server market segments. Applications ranging from computer-aided design and analysis packages to systems that model complex virtual worlds are placing increasing demands on graphics hardware. Computationally expensive techniques like imaging, texture mapping, and complex lighting are becoming commonplace as more users strive for visual realism. At the same time, high-performance 3-D systems must be available at a reasonable cost for deployment on a large number of desktops and in highly configurable Sun Enterprise™ server systems to handle the most complex and compute-intensive problems.

Sun Elite3D graphics provides impressive, high-end, 3-D graphics performance in a range of cost-effective desktop, deskside, and Sun Enterprise server systems, underscoring Sun's commitment to providing the most powerful and affordable technical UNIX® workstations and servers available. Its extensive feature set and high performance are derived from an innovative approach to graphics, in concert with a balanced system design. 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, fast 8-bit and 24-bit windowing and imaging performance, along with acceleration for decompression and display of compress digital video.

New hardware-supported features include:

- High-performance geometry acceleration needed for handling large 3-D data sets
- Antialiased dots and vectors for improved visualization
- Improved depth cueing of primitives, which increases perceptual realism rendered with no performance penalty
- New hardware acceleration for lighting
- 16 x 16-pixel hardware texture cache for texture mapping
- Adjustable gamma correction
- Four 8-bit color maps
- Two frame-buffer serial ports
- Acceleration for OpenGL®

Product Family Placement

Sun Elite3D graphics meets the needs of high-performance 3-D graphics users. For customers and ISVs, Sun Elite3D graphics is software-compatible, maintaining full API-layer software compatibility with current Creator Graphics products, and it retains all the 3-D hardware features of Creator Graphics, while providing additional features.

The Sun Elite3D family consists of Sun Elite3D m3 graphics and Sun Elite3D m6 graphics. The Sun Elite3D m3 graphics is the power entry-to mid-range 3-D graphics option. It has all of the imaging features of Creator, but with three on-board graphics floating-point engines, Sun Elite3D m3 graphics provides twice the 3-D graphics performance of Creator3D Series 3 graphics. Sun Elite3D m3 graphics is available for Ultra™ 10, Ultra 30, and Ultra 60 workstations.

The Sun Elite3D m6 graphics is the power mid- to high-end 3-D graphics option—Sun's highest-performance graphics option. It has all the imaging features of Creator, but with six on-board graphics floating-point engines, Sun Elite3D m6 graphics provides four to five times the overall 3-D performance of Creator3D Series 3 graphics. Sun Elite3D m6 graphics is available for Ultra 2, Ultra 30, Ultra 60, and Ultra 450 workstations as well as the Sun Enterprise 3500, Sun Enterprise 4500, Sun Enterprise 5500, and Sun Enterprise 6500 servers.

Key Messages

- Sun is introducing a high-volume, high-performance 3-D product line to address the needs of performance-hungry users and environments—a strategy that Sun intends to continue into the future.
- Sun is strengthening its move into becoming the dominant graphics systems provider.
- Sun Elite3D graphics brings powerful 3-D graphics to the volume desktop.
- The Sun Elite3D graphics family introduces better than four to five times overall 3-D graphics performance over Creator3D graphics with additional features and functionality while maintaining full API-layer software compatibility.
- Sun Elite3D graphics is a price/performance winner. Sun has added often costly high-end, 3-D graphics performance support for a variety of platforms that meet a broad range of customer requirements. These new offerings give customers unprecedented 3-D price/performance and choice. Sun Elite3D graphics is available for:
  - Compute and resource-intensive multi-CPU servers (Sun Enterprise 3500, Sun Enterprise 4500, Sun Enterprise 5500, and Sun Enterprise 500 servers)
  - High-performance, mid-range workstations (Ultra 450 and Ultra 60)
  - Affordable entry-level, 3-D graphics workstations (Ultra 10)
- Sun Elite3D graphics adds an important dimension to the Sun workstation and server product lines: it raises the bar on graphics performance, further differentiating Sun graphics systems from PC graphics.
- Sun Elite3D graphics is an important part of Sun's overall scalability, upgradability, and "headroom" story. The Ultra 10 workstation, for example, can go from an 8-bit graphics machine, to a Creator3D MCAD design station, to a Sun Elite3D m3 high-performance design and visualization station. Customers can easily upgrade from Creator3D graphics to Sun Elite3D graphics on Ultra 30 or Ultra 60 workstations. For even higher performance and scalability, Ultra 450 and Enterprise server systems provide multiple Sun Elite3D m6 frame buffer support coupled with multiple CPU support, larger memory footprints, and higher performance I/O subsystems. Customers have plenty of room to grow without changing their software or incurring expensive downtime costs.

Availability

February 24, 1998	Sun Elite3D m6—Horizontal board orientation (Ultra 2)
March 16, 1998	Sun Elite3D m3—Vertical board orientation (Ultra 10, Ultra 30, and Ultra 60)
	Sun Elite3D m6—Vertical board orientation (Ultra 30 and 60)
July 10, 1998	Sun Elite3D m6—Horizontal board orientation (Ultra 450)
November 10, 1998	Sun Elite3D m6—Low-profile, horizontal board orientation (Sun Enterprise 3500–6500)

Target Users

Sun Elite3D graphics falls within the traditional workstation and technical markets, and addresses graphics market requirements from the mid-range workstation, the superworkstation, and the technical server segments. It is targeted at users who need more 3-D performance to get their jobs done. These users are typically expensive resources, and companies need to make them more productive to meet the market demands for better quality, lower costs, and lower time-to-market.

Typical users include:

- Product design engineers and designers in MCAD/MCAE, who can benefit from working with whole subassemblies rather than individual parts, and who need to discover problems and issues at the design stage rather than in production.
- Petroleum engineers and professionals who work with large amounts of seismic data for drilling, exploration, and recovery purposes.
- Technical directors needing to animate and render characters and scenes in real-time in order to meet their production deadlines.
- Surgeons and medical professionals who need to capture, process and visualize tissue and internal structures for planning and diagnostics prior to surgery.
- People who need to be highly trained before getting into aircraft or handling hazardous equipment or materials.

No matter what the market or application area, the need to understand, simulate, and visualize complex problems and data is increasing as users rely more and more on computers as tools to gain insight and understanding, and improve accuracy, safety, and reliability.

Ultra Workstations

Ultra 10 Workstation with Sun Elite3D m3 Graphics

The Ultra 10 workstation with Sun Elite3D m3 or Sun Elite3D m6 graphics is targeted at the power entry 3-D segment. Customers in this group need to balance performance against budgets. This will be a great MCAD or animator's workstation, or a low-cost visualization system for medicine and science. It is targeted at users who have constrained budgets, as they are buying multiple systems but need high-performance graphics.

Unique product features include:

- Price point
- Performance at Ultra 10 workstation price point
- Easy, cost-effective upgrade to Sun Elite3D m3 or Sun Elite3D m6 graphics

Ultra 2 Workstation with Sun Elite3D Graphics

The Ultra 2 workstation with Sun Elite3D m6 graphics is targeted at users who have multiprocessor and memory footprint requirements, but also have SBus I/O needs. It is targeted at design and analysis customers who, for example, want multiprocessing to do simultaneous CAD design while running an analysis application in the background on the second CPU.

Unique product features include:

- Last SBus-based platform for applications and customers who have investments in SBus-based peripherals and applications
- Low-cost, multiprocessing-capable workstation for multiprocessing and multithreaded application environments
- Upgradeable CPU modules

Ultra 60 Workstation with Sun Elite3D Graphics

Ultra 60 workstations with Sun Elite3D m3 or Sun Elite3D m6 graphics, like the Ultra 2, are targeted at the high-performance compute and graphics-intensive segment of its target markets. These markets include high-end MCAD/MCAE, oil and gas, simulation and visualization applications, and command and control. Customers in this group need as much performance as possible, including multiprocessing capabilities, high memory capacity, and I/O bandwidth.

Unique product features include:

- Maximum CPU performance
- PCI-based expansion capability with dual PCI-bus interfaces, with one 66-MHz PCI slot
- Large memory footprint with up to 2 GB of memory
- Two UPA slots capable of supporting two high-performance graphics frame buffers: one Sun Elite3D m6 graphics frame buffer and either a Sun Elite3D m3 or Creator3D frame buffer or two Sun Elite3D m3 graphics frame buffers

Sun Enterprise 3500–6500 Servers with Sun Elite3D Graphics

The Sun Enterprise server family with Sun Elite3D m6 graphics is targeted at strategic markets, including: manufacturing, government, education, health care, design automation, and earth sciences. The following sections describe how each server in the Sun Enterprise family has different characteristics and is therefore deployed in a different capacity within the target markets.

Platform and Configuration	**Number of Sun Elite3D m6 Frame Buffers**	**Max Number of CPUs**
Ultra 450 Sun Elite3D	2	4
Sun Enterprise 3500 Sun Elite3D (5 slots)	3	4
Sun Enterprise 4500 Sun Elite3D (6 slots)		
• Config 1	3	10
• Config 2	4	8
Sun Enterprise 6500 Sun Elite3D (16 slots)		
• Config 1	1	30
• Config 2	3	26
• Config 3	6	20
• Config 4	8	16

The target markets for the Sun Enterprise servers include:

- Design automation
- MCAE (sweet spot of 4-8 processors)
- High-end MCAD
- Visualization/simulation
- Cave/virtual portals
- Large screen displays for viewing
- Earth resources
- Oil and gas
- Education/training
- Aerospace
- Defense
- Digital content creation
- Real-time animation review
- Virtual prototyping
- Command and control
- R and D

Sun Enterprise 3500 Server with Sun Elite3D Graphics

The Sun Enterprise 3500 server with Sun Elite3D m6 graphics is targeted at users who have multiprocessor and memory footprint requirements as well as extremely demanding I/O needs. It is targeted at design and analysis customers who, for example, want to use a multiprocessing system to perform CAD design work while running an analysis application in the background.

The Sun Enterprise 3500 server is an affordable server with unprecedented power and reliability in its class. The Sun Enterprise 3500 server enables customers to deploy sophisticated technical applications with the kind of performance and reliability previously available only in very expensive large-scale systems.

The Sun Enterprise 3500 server is ideal for customers who need application servers with tremendous network throughput and processing power, in addition to high reliability, availability, and serviceability. The Sun Enterprise 3500 server is ideal for price-sensitive customers who need integrated storage or want the investment protection offered by an expandable family of servers. The Sun Enterprise 3500 server with Sun Elite3D graphics can be used for running dedicated, compute-intensive and high-end graphics applications.

In its line of Sun™ HPC Servers, Sun offers the Sun HPC 3500 server, which combines the Sun Enterprise 3500 server with high-performance computing (HPC) software that allows the platform to scale in the most demanding technical and supercomputing environments.

Unique product features include:

- Low-cost server for multiprocessing and multithreaded application environments
- Multiple frame buffer support with three Sun Elite3D m6 frame buffers and four CPUs, or one Sun Elite3D m6 frame buffer and up to ten high-performance UltraSPARC CPUs
- Upgradeable CPU modules
- Integrated storage

Sun Enterprise 4500 Server with Sun Elite3D Graphics

The Sun Enterprise 4500 server is a versatile server with exceptional value for companies requiring affordable servers with tremendous computational power, and the ability to scale system performance and capacity as their needs grow. The Sun Enterprise 4500 server with Sun Elite3D m6 graphics is targeted at users who have multiprocessor and memory footprint requirements as well as extremely demanding I/O needs.

The Sun Enterprise 4500 server is ideal for customers who need an enterprise-wide application server with high reliability, availability, and serviceability. Typical Sun Enterprise 4500 server customers use their servers to provide access to large CAD databases, product data management systems, decision support applications, or visual simulation applications.

The Sun Enterprise 4500 server is recommended over the Sun Enterprise 3500 server if the customer's I/O and CPU growth requirements go beyond the capacity of the Sun Enterprise 3500 server.

Unique product features include:

- High-performance server for multiprocessing and multithreaded application environments
- Compact packaging
- Upgradeable CPU modules

Sun Enterprise 5500 Server with Sun Elite3D Graphics

The Sun Enterprise 5500 server is a scalable and reliable data center server capable of running mission-critical applications. The Sun Enterprise 5500 server is ideal for customers who have mainframe-class system requirements. With features previously only in fault-tolerant and mainframe systems, the Sun Enterprise 5500 server has a comprehensive set of uptime features. The Sun Enterprise 5500 server is recommended over the 4500 server if the customer needs a rackmount system with integrated mass storage.

Unique product features include:

- Rackmountable
- Comprehensive set of uptime features

Sun Enterprise 6500 Server with Sun Elite3D Graphics

The Sun Enterprise 6500 server is ideal for customers who need to build network computing applications of a size and scale that previously required mainframes or supercomputers. The customer receives the benefits of improved data access and flexibility even as data grows to multiple terabytes. The Sun Enterprise 6500 server offers more than twice the CPU, memory, and Sun Elite3D graphics expandability of the Sun Enterprise 5500 server. The Sun Enterprise 6500 server should be recommended when the Sun Enterprise 5500 server does not offer enough expandability.

This product is targeted at users that need the high performance of Enterprise server systems and who need CPU, memory, I/O, and other server support features.

Unique product features include:

- Most expandable, multiprocessing-capable graphics server for multiprocessing and multithreaded application environments
- Up to eight Sun Elite3D m6 frame buffers
- Upgradeable CPU modules

Target Markets

Sun Elite3D graphics addresses the high-performance graphics requirements of Sun's traditional technical workstation markets such as MCAD/MCAE, earth resources, medical, and R and D. Additionally, Sun Elite3D graphics allows expansion into new high-growth markets and areas such as digital content creation

and visualization/ simulation. Visualization/simulation is being used more and more by companies who are turning to computers for complete digital mock-ups of products and to gain insight and understanding of very complex problems and data. These people need power to perform.

Users in these markets have an ever-increasing need to work with more and more information and data with shorter turnaround, shorter time frames, and shrinking budgets and resources. Within each of these markets, there is a class of users who always need more performance and scale their projects to the hardware they can afford.

New ISVs and applications have been ported to Sun within these markets that previously ran only on competitive systems from companies such as SGI and IBM, or even only on PCs. More applications are coming. See the partial list in the following *Selling Highlights* section.

Here are some of the target markets for Sun Elite3D graphics and the key features in that market.

Market	**Applications**	**Key Features**
MCAD/MCAE	• High-end mechanical design • Styling and design • Visualization and simulation • Analysis	• High-performance 3-D graphics and CPUs • Visual quality • Key software availability • Multiple frame-buffer support • MP configurations for high application • Stereoscopic support
Earth Resources Oil and Gas Geo Engineering GIS	• Visual simulation, modeling and analysis • Leading number of third-party software applications	• Sun Elite3D, high-performance frame buffers • Sun OpenGL 1.1.2 for Solaris™ imaging extensions • Multiprocessing • No-cost texture mapping • Ability to handle very large texture maps using main memory
Health Care	• Medical imaging and visualization • Surgical preplanning • Computer-assisted surgery	• Integrated 3-D and imaging • High-speed interconnect to main memory for very large texture and image capacity • High I/O bandwidth • Accelerated processing with MP and RIP capabilities • Stereoscopic support • Adjustable gamma correction • Multiple frame-buffer support
Digital Content Creation Entertainment	• Animation/modeling and layout • Film and broadcast media production • Corporate communications • Game development	• High-performance 3-D graphics • Visual quality • Multiple frame buffer support • Integrated imaging and video playback • High rendermark/cubic foot density • Cost

Market	Applications	Key Features
Visualization/ Simulation	• Education and training • Classified defense • VR applications • Increasing component of other technical markets • Insight, comprehension, understanding	• High-performance Sun Elite3D graphics • Visual quality • Multiple frame-buffer support • High I/O bandwidth • MP capabilities • Texture mapping • Stereoscopic support • Peripheral support
General Science	• Visualization	• MP capabilities • High-performance 3-D graphics

Sun Elite3D graphics provides an opportunity to increase Sun's marketshare in its traditional markets while capturing new applications and market share in high-growth markets, such as digital content creation and visualization/simulation. Sun Elite3D graphics strengthens Sun's product offerings in current accounts and provides opportunities to displace seats from traditional competitors such as SGI. Spurred by high-growth of 3-D applications and the need to reduce cost and time-to-market and to increase worker productivity, the need for high performance 3-D graphics will continue to increase.

Installed-base opportunities include upgrades or replacement of SPARCstation™ systems and even Ultra 1 systems that are up for replacement after three years. Take note of pockets of competitive systems from SGI, DEC, IBM, and even HP, or whole departments. Expand into new applications, such as auto-styling; analysis through simulation of crash testing; flight simulation; design review theatres; and so on.

Selling Highlights

Market Value Proposition

Sun™ Elite3D systems provide an affordable high-performance graphics solution for demanding 3-D graphics applications. Rather than forcing users to share a single expensive resource, Sun Elite3D graphics expands the graphics performance previously available to only a select few in the superworkstation segment, squarely into the mid-range segment, allowing the same performance to be put on the desktops of entire teams. Affordable high-performance graphics allows users to work more efficiently, enabling greater productivity. Ultimately, it helps reduce the time required to complete tasks and makes better use of expensive resources by making them more productive. This new level of performance and price point enables people to accomplish things they could not do before.

Visualization continues to be a key technology associated with CAD/CAM/CAE and PDM markets. Sun Elite3D graphics allows users to develop digital models that emulate all aspects of their product designs. Lower cost, higher quality designs and time to market continue to drive the need for improved CAD/CAM/CAE and PDM technologies. Working in a team environment has emerged as the preferred method of achieving product design goals. Sun Elite3D graphics is an excellent choice with customers requiring high-performance, but affordable computing, that enables greater team participation and work flow.

For ISVs and Software Developers

Sun Elite3D graphics shows that Sun is in the graphics game and is a clear alternative to SGI for customers' high-performance graphics needs. Many customers want their solutions running on Sun systems. For visualization, simulation, and high-performance computing ISVs, Sun Elite3D graphics expands the potential customer base by making their solutions and applications affordable to a much larger audience.

For Sun Sales Representatives and Resellers

There is a huge opportunity to go into accounts and replace competitive systems. Sun Elite3D graphics widens opportunities in existing accounts to get into new groups and areas. Sun Elite3D graphics helps to maintain total account control by providing a high-end graphics solution, helping to eliminate the need to buy competitive products such as SGI systems. Sun Elite3D graphics expands the prospect base into new areas of visualization and simulation, VR, and digital content creation. Sun Elite3D graphics raises the bar differentiating workstations and PCs. With the new Sun Elite3D graphics in Sun Ultra™ and Sun Enterprise™ platforms with new applications available, new sales opportunities are waiting.

Compatibility

Complementary to Sun's existing Creator Graphics product line, Sun Elite3D graphics maintains full API-layer compatibility with Creator and transparently accelerates the same set of 3-D graphics APIs. Because Sun Elite3D graphics is binary-compatible with Creator Graphics, application qualification should be relatively straightforward.

Applications

Target Market	ISV	Software Applications
MCAD/MCAE	Computervision	CADDS 5, Medusa
	Dassault	Catia, Catia Studio
	EDS/Unigraphics	Unigraphics
	Parametric Technology Corp	Pro Engineer, ProDesigner, TrueGrid
	SDRC	I-Deas Master Series
	Technomatix	ROBCAD
	Altair	Hypermesh
	Mechanical Dynamics	ADAMS
	Matra Datavision	Euclid-IS, Prelude
	Marc Analysis	MARC
	MacNeal-Schwendler	NASTRAN, PATRAN III, Conceptstation
	Ansys	Ansys
	Tripos Inc.	Unify
	Bentley Systems	Microstation
Earth Resources **Oil and Gas** **GIS**	Advanced Visual Systems	AVS Express, Toolmaster, AVS5
	Cognesis	VoxelGeo
	GeoQuest	GeoViz, Charisma
	Landmark Graphics	ProMax, Seisworks, Strata Model, Earth Cube
	Geovision	Vision
	Shell Oil	VolumeViewer
	ERDAS	ER Mapper, ERDAS Imagine
	ESRI	ArcView, ARCInfo
	Cognisies	
	Paradyme Geophysical	
		VoxelGeo
Health Care	Cemax	VIP 2.0
	Context Vision	Imaging processing for refining MR data
	ISG	Silohet
	Virtual Vision Software	C-MED
	Visualization Technologies	
	Sensible Technologies	PHANToM (haptic peripheral device)

Target Market	ISV	Software Applications
Digital Content Creation Entertainment/ Animation	Adobe	PhotoShop
	NewTek	Lightwave 3-D
	Electric Image	Electric Image
	Lightwork	Kinetix (rendering tool kit)
	Nichimen	NWorld
	XaosTools	Pandemonium
	ArSciMed	Kinema/Sim
	Mental Images	Mental Ray
	SoftImage	SoftImage 3-D
	Radiance Software International	Ez3d VRML Author Pro
	Apunix Computer Services	Apunix Openscan
	Engineering Animation Inc.	VisProducts
	Pixar	Renderman
Visualization/ Simulation	Advanced Visual Systems	AVS Express, Toolmaster AVS5
	Engineering Animation Inc.	VisProducts, VisMockUp,VisFly
	Sense8	WorldUp, Sense8 World Tool Kit
	Autometrics	Edge and Soft Plotter
	Division	dVise, dVise Flythru
	ArSciMed	Kinema/Sim
	Parametric Technology Corp	ProFlythrough
	Facet	Facet
	Template Graphics	OpenInventor
	Muse Technology	MuSE
	IBM	IBM Visualization Data Explorer
	Sensible Technologies	PHANToM (haptic peripheral device)
	US Department of Defense	Battlefield Visualization
	Fluent	Fluent, Rampant, Nekton
	Compuflow	Flotran
	Vital Images	Voxelmath
	Visual Numerics	PV Wave, Exponent Graphics
	Fluid Dynamics International	Fidep
	Woltham Research	Mathmatica
	SAS Institute	SAS
	Lockheed-Martin Federal Systems	Power Image
Molecular Biology	MSI Biodesign	Piograf, NMRgraf
	Biosym Technology	Discover, Insight II
	Molecular Simulations	CHARM, Quanta
	Genasys II	Genemap, Genacell

Sun™ Elite3D Graphics Enabling Technology

Technology Overview

Graphics has become a key feature in the definition of a workstation, and the need to understand it is becoming more important to sell effectively in Sun's traditional technical markets. As performance has increased, so has the complexity of the underlying technology, and Sun™ Elite3D graphics is no exception.

Sun Elite3D is a highly integrated graphics frame buffer with state-of-the-art components and packaging design. Two basic versions of the Sun Elite3D subsystem are available: Sun Elite3D m3 graphics and Sun Elite3D m6 graphics. The Sun Elite3D m6 graphics subsystem is implemented in a two-card set which plugs into an available UPA graphics connector on the Ultra™ system and is available in both horizontal and vertical configurations to accommodate a multiple-platform chassis. Sun Elite3D m3 graphics is available as a single card, and is available only in the vertical form-factor.

Sun Elite3D graphics uses custom ASICs: *AFB-Command*, *AFB-Float*, and *AFB-Draw*, all using 0.35-micron technology for higher component density and lower power consumption. Sun Elite3D graphics also uses a new generation of 3D-RAM and the new highly integrated Pacifica II RAMDAC jointly developed by Sun and Brooktree.

Sun Elite3D graphics greatly accelerates the rendering of 3-D primitives, such as triangles, vectors and dots, over what is possible with Creator or a raw CPU. The design challenge for Sun in creating Sun Elite3D graphics was to bring vertex-processing and pixel-drawing rates into line with other components of the system. This is accomplished by using the dedicated, on-board graphics floating-point units and powerful pixel-drawing chips on the Sun Elite3D graphics subsystem. These powerful custom circuits enable Sun Elite3D graphics to fully realize the significant performance enabled by a 3D-RAM-based frame buffer.

Like Creator3D graphics, the Sun Elite3D graphics subsystem uses 12 3D-RAM chips to provide 1280 x 1024 double-buffered frame buffer with 28-bit depth buffer (Z-buffer). The Sun Elite3D architecture uses a new generation of 3D-RAM chip (Creator3D Series 3 graphics uses the same 3D-RAM chip). This chip speeds up a VRAM read/modify/write pixel access from 160 nanoseconds to 10 nanoseconds, changing all of the rules about graphics pipeline behavior. Sun Elite3D graphics is the first design to fully realize the performance of 3D-RAM.

Sun Elite3D systems provide 96-bit planes, including 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 of 3-D objects. Sun Elite3D graphics is fully compatible with Sun's Creator3D systems and does not compromise window-system, 2-D graphics, imaging, or video performance. Sun Elite3D graphics simply adds significant performance gains for 3-D applications.

Visual Quality Improvements

A number of features have been added to improve Sun Elite3D graphics performance and visual quality. The graphics subsystem supports anti-aliased dots and vectors needed for MCAD and visualization. A big dot primitive allows antialiased dots up to 10 pixels in diameter for use in particle systems, star fields, or where more accurate representations of light intensities are needed.

Depth cueing of primitives, which increases perceptual realism, is rendered with no performance penalty. Sun Elite3D graphics has four depth-cue ramps, as compared to one in Creator, allowing for closer approximations to exponential and other depth-cue functions.

To eliminate the banding effect that often occurs with dark, smooth-shaded objects, dithering of 12-bit color values to 8-bit values, per color component has been added to Sun Elite3D graphics.

Because Sun Elite3D graphics has been designed to accelerate OpenGL®, it was necessary to change the Z-buffer comparison logic to allow all combinations of equal, less than, and greater than. The Z-buffer is extended from 24 bits to 28 bits and gets the optional “stubby floating-point” format, effectively giving the range of a 39-bit integer Z-buffer.

OpenGL also requires an interpolated alpha value (that is, an alpha channel), so Sun Elite3D graphics keeps track of alpha throughout the accelerator pipeline. Alpha is treated similarly to the RGB color components, except that no computations are performed on alpha in the floating-point section, and alpha affects blending operations (as opposed to being affected by them) in the drawing section.

Sun Elite3D graphics provides hardware acceleration for OpenGL SOV and stencil support. The non-destructive 8-bit SOV overlay in Sun Elite3D systems has full access to the color maps in the RAMDAC, allowing the default visual (and therefore the window system) to run in the 8-bit overlay. This allows 8-bit graphics or windows to be drawn over the complex 24-bit imagery or graphics without damaging the underlying visual.

The Pacifica II RAMDAC jointly developed by Sun and Brooktree integrates functionality that is frequently spread throughout the system in other designs. The integrated approach produces considerable cost savings. Integrated into the RAMDAC are:

- Multiple pixel paths to enable applications to fine-tune their color selection mechanisms and avoid overhead
- Programmable gamma correction
- A hardware cursor
- A programmable video timing generator

The RAMDAC features four hardware color lookup tables. Each color lookup table consists of three 8-bit RAMs. This feature will allow users to run their window systems in 8-bit mode, nearly eliminating color-flashing problems when using color-intensive applications such as Netscape Navigator™ or Adobe® FrameMaker. A Window ID lookup table is also part of the RAMDAC, providing per-pixel ID for association with particular window and pixel display modes. This enables multiple windows of mixed visual types.

Sun Elite3D graphics also features programmable gamma correction. Gamma correction is needed for linear pixels used in synthetic images such as 3-D graphics and ray tracing. The gamma lookup table allows the compensation required to match the logarithmic response of the CRT monitor. In the event gamma correction is required, one of the four color lookup tables is used in the RAMDAC.

Acceleration for Lighting

With today’s more sophisticated lighting models, lighting calculations are beginning to dominate computation time. To accommodate this development, a separate lighting module has been added to AFB-Float, tuned for lighting calculations. Using smaller and simpler fixed-point numbers, it can perform three calculations at once: one each for red, green, and blue or for X, Y, and Z. Lighting is done in parallel with other floating-point operations such as transformations and setup on the multiple float engines. Its dedicated graphics floating point allows more lights to be turned on for enhanced visual display without encountering a performance penalty. The number of lights directly affects the number of shaded triangles processed by other frame buffers. Specular lighting causes an observable slowdown and point and spot lights cause even bigger slowdowns.

With a total of six dedicated lighting units, Sun Elite3D graphics is capable of lighting over 18 million vertices per second, using directional lights with full specular highlights at full hardware speed. More lights can be turned on for enhanced visual display without encountering large performance penalties. Sun Elite3D graphics supports up to 32 lights.

Texture Mapping

Because texture mapping implies a potentially different color for each rendered pixel, it must be performed within the 3-D pipeline, requiring fast access to the potentially large images. As a result, most vendors have added dedicated texture-storage memory to their accelerators in order to increase texture mapping performance. While this approach can produce the best performance for small textures, it adds cost and enforces a hard limit on the size and/or quantity of textures that can be used.

Overall, texture mapping is a feature that is used or is starting to be used in some applications and markets, while other markets and applications such as EDA, MCAD, and MCAE do not currently use texture mapping and refuse to pay for expensive texture memory and hardware support. Even markets and applications that use large numbers of textures, such as animation, have very large texture-mapping requirements that surpass the capability of any frame buffer today and can be met only by using precomputed images from renderfarms.

Textures too large or too numerous to fit into a system's dedicated texture memory can cause the entire application to be relegated to a much slower software pipeline (often rendering the application unusable). Additionally, since the texture memory is often located remotely from the system processor and memory, invalidating and reloading the texture content can cause significant delays. This side effect alone can easily neutralize the performance normally recognized for smaller texture maps.

Sun addresses these issues in Sun Elite3D graphics by using main memory to store texture images. While this approach may not provide the fastest point cases for small 2-D texture maps, it provides a much better overall performance curve since there is no real limit to texture size. This is beneficial for applications like seismic and medical imaging which generally require a large number of large textures.

Sun Elite3D graphics is able to use general-purpose memory to store textures effectively because of its location on the UPA system bus with fast access to the processor and system memory. Sun Elite3D graphics provides a texture pixel ("texel") processor in each of the two AFB-Draw ASICs. This texel processor performs texture calculations and controls the lookup of texels in a 16 x 16-texel cache, providing performance of up to 25–30 million textured pixels per second. This level of texture mapping meets the needs of many applications at a very attractive price point—free. It is not intended to address markets needing very high-performance, real-time texture mapping for applications such as very high-end flight simulators.

Overview

While Sun™ Elite3D graphics leverages components and technologies similar to Creator, it is architecturally different in the way it implements the graphics pipeline. On Creator3D systems, the 3-D graphics pipeline is handled by both the UltraSPARC™ CPU and the Creator Graphics frame buffer, with the UltraSPARC CPU doing the front portion and processing (transform, lighting, and clipping) of the pipeline. On Sun Elite3D systems, the entire graphics pipeline is handled directly by the dedicated hardware located on the Sun Elite3D graphics subsystem.

The AFB-Command chip handles data input from the system processor. The AFB-Float ASIC handles such floating point intensive operations as transformations, clip tests, face determination, lighting, perspective divide, conversion to screen space coordinates, and setup.

The two AFB-Draw ASICs allow Sun Elite3D graphics to draw into the frame buffer at a very high speed. The 3D-RAM and RAMDAC components are the same as in Creator3D graphics-based systems.

Figure 1 contains a chip-level block diagram showing the logical partitioning of the Sun Elite3D system.

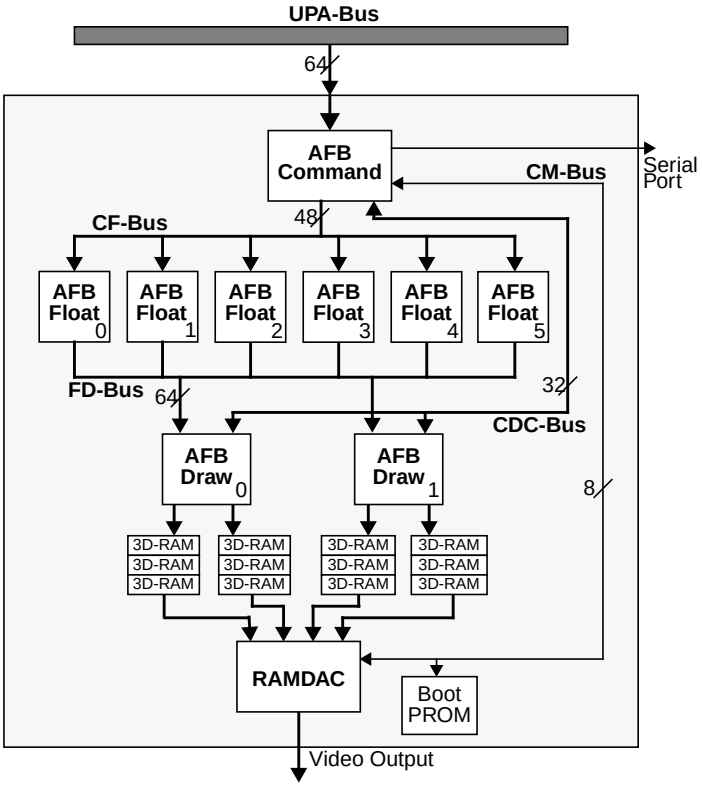


Figure 1. Sun Elite3D m6 chip-level diagram

The Sun Elite3D graphics subsystem is comprised of a number of specialized ASICs: AFB-Command, AFB-Float, and AFB-Draw, all using 0.35-micron technology.

- The **AFB-Command** chip controls the transfer of data between the other Sun Elite3D chips and is the interface to the rest of the workstation via the UPA64S bus. AFB-Command preprocesses triangle and vector data before distributing it to the floating-point section below.

- The three or six **AFB-Float** chips perform transformation, clipping, lighting and set-up operations on the geometry data. Each AFB-Float is connected to a 32 KB x 36-bit SRAM for microcode and data storage.
- The two **AFB-Draw** chips perform screen space rendering of the various graphics primitives, sequencing the completed pixels into the 3D-RAM array. Each AFB-Draw chip is connected to two banks of three 3D-RAM chips, which together form the 1280 x 1024 by 96-bit-deep frame buffer.
- The Pacifica **RAMDAC** contains a programmable video timing generator and programmable pixel clock synthesizer, along with cross-bar functions, as well as the traditional color look-up tables and triple video DAC circuits.
- The **Boot PROM** contains 256 KB x 8 bits of system initialization and frame-buffer control code.

AFB-Command, at the interface level, contains a superset of the 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 geometry data without stopping the pipeline. Additional functionality includes complete binary compatibility with Creator3D graphics' register set and functions, support for OpenGL®, and a geometry decompression mode.

AFB-Float enhances performance by providing multiple algorithm-specific circuits dedicated to just one or a few stages of the graphics pipeline, each capable of working in parallel. The float ASIC is divided into three mathematical computation units consisting of F-Core for all floating-point-intensive operations (transformation, clip test, face determination, perspective division, and screen space conversion), L-Core for fixed-point lighting, and S-Core for fixed-point computation to setup calculations for all geometric primitives.

The key to Sun Elite3D graphics' performance is the rate at which the AFB-Draw ASICs can render 24-bit depth-cued pixels into the 3D-RAM-based frame buffer (400 million pixels per second). To achieve these high rates, the 3D-RAM is four-way interleaved, and the two identical AFB-Draw chips each control two of these interleaves. This results in performance that is four times greater than Creator3D graphics.

Both Sun Elite3D graphics and Creator3D graphics share the same Bt498+ RAMDAC design.

The Sun Elite3D design uses unidirectional point-to-point buses for all three of its high-speed interconnects on the graphics subsystem. The result is that each bus is now made up of multiple smaller data paths where one output pin is connected to one input pin. This moves bus arbitration inside the chips and eliminates any "dead" cycles between primitives. The CF-Bus transfers primitives between the AFB-Command chip and the six AFB-Float chips at 600 MB per second. The FD-Bus transfers primitives from the six AFB-Float chips to the two AFB Draw chips at 800 MB per second. The CDC-Bus transfers data from the AFB-Command chip to the AFB-Draw chip and back on two separate buses at 400 MB per second in each direction. All CD-bus transfers are completely independent of accelerator port graphics pipeline transfers. The CM-Bus transfers data back and forth between the AFB-Command chip and the other miscellaneous chips such as the RAMDAC and Boot PROM and runs at 25 MB per second.

Sun Elite3D Graphics Features and Benefits

Features	Benefits
• Integrated imaging	• Can do fast imaging and 3-D on unified frame buffer
• Very-high-performance, accelerated, 24-bit, double-buffered 3-D graphics	• Smooth animation and interactivity of 3-D graphics
• 28-bit Z-buffer	• Improves visual quality and depth accuracy
• 8-bit overlay plane	• 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
• Gouraud shading	• Allows smooth shading of solid geometry
• Alpha blending and screen door transparency	• Simulates transparent materials such as glass
• Line and big dot antialiasing	• Needed in MCAD and visualization for better visual quality
• Per-pixel depth cueing	• More accurate depth cueing or fog
• Per-pixel alpha interpolation	• Variable transparency
• 4-bit stencil support with hardware acceleration of OpenGL stencil functions	• Enables hardware acceleration for OpenGL
• Accelerated lighting	• More lights can be turned on for enhanced visual display without encountering large performance penalties
• Four 8-bit color maps	• Dynamic color map segment allocation when running 8-bit window systems should eliminate color flashing problems
• Adjustable gamma correction	• Allows users to gamma-correct visuals for enhanced visual quality
• NTSC/PAL video timing support	• Supports frame buffer to video timing
• Stereo 960 x 680 at 112 Hz supported with 21-inch monitor	• With frame buffer, monitor, and window systems support for stereo, users can see better representation of 3-D data
• 1280 x 1024 at 76-Hz resolution standard	• High-resolution display quality
• Two serial-port connectors	• For VR peripherals
• Dual-headed support: one Sun Elite3D m6 frame buffer and an additional Sun Elite3D m3 or Creator/Creator3D frame buffer	• 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
• OpenGL 1.1.1, XGL™ 3.0, XIL™, X, Java 3D™ support	• A choice of APIs
• Binary compatibility with Creator Graphics product family	• Interoperability with existing applications and users

Requirements and Configuration

System Requirements

Sun™ Elite3D graphics is supported by the Solaris™ 2.5.1 Hardware: 11/97, Solaris 2.6 Hardware: 3/98, and Solaris 7 operating environments. Sun Elite3D driver support is unbundled with Solaris 2.5.1 and requires the *"Sun Elite3D System Software for Solaris 2.5.1 and Solaris 2.6"* supplemental CD.

Software packages needed to support Sun Elite3D graphics include:

- `SUNWafb.u`
- `SUNWafbw`
- `SUNWsfbxg`
- `SUNWafbcf`
- `SUNWafbmn`
- `SUNWafbog`
- `SUNWvlxil`

Sun Elite3D graphics does not support the 1920 x 1200 mode of the Sun 24-inch monitor. Unlike Creator3D graphics, the Sun Elite3D architecture does not allow the remapping of the 3D-RAM used for double- and Z-buffering to support a high-resolution, single-buffered configuration due to Sun Elite3D graphics' interleaving of the memory. The maximum resolution is 1280 x 1024. Because Sun Elite3D graphics is designed for high-performance 3-D, and an additional 30 MB of 3D-RAM would be required for double- and z-buffering in order to use the 24-inch monitor, it is not cost effective to use Sun Elite3D graphics as a high-resolution, single-buffered frame buffer when a less costly Creator3D frame buffer would be more appropriate.

In the Ultra™ 2 workstation, the two stacked SBus slots adjacent to the UPA connector are required to accommodate the double-wide, two-card Sun Elite3D m6 horizontal form factor. The remaining two SBus slots are available for I/O expansion.

System Configuration

Multi-head support is provided on Ultra 30 and Ultra 60 workstation-based systems with two UPA connectors. A Sun Elite3D m6 graphics card can be placed in the second UPA slot with a Sun Elite3D m3 or Creator3D frame buffer residing in the first UPA slot.

A good rule of thumb to use when adding frame buffers in the Sun Enterprise servers is to configure no more than one frame buffer for each CPU.

- A Sun Enterprise™ 3500 server (five slots) can have three Sun Elite3D frame buffers (three slots, one slot per frame buffer and graphics I/O card) and four CPUs (two CPU cards with two CPUs per card).
- A Sun Enterprise 4500 server (six slots) can have four frame buffers (four slots, one slot per frame buffer and graphics I/O card) and four CPUs (two CPU cards with two CPUs per card).
- A Sun Enterprise 6500 server (16 slots total) can have up to eight Sun Elite3D frame buffers (eight slots, one slot per frame buffer and graphics I/O card) and 16 CPUs (eight CPU cards with two CPUs per card).

The table below shows possible frame-buffer/CPU configuration available for the Sun Enterprise servers.

Platform	**Number of Sun Elite3D m6 Frame Buffers**	**Max Number of CPUs**
Sun Enterprise 3500 Sun Elite3D (5 slots)	3	4
Sun Enterprise 4500 Sun Elite3D (6 slots)		
• Config 1	1	10
• Config 2	2	8
• Config 3	3	6
• Config 4	4	4
Sun Enterprise 6500 Sun Elite3D (16 slots)		
• Config 1	1	30
• Config 2	2	28
• Config 3	3	26
• Config 4	4	24
• Config 5	5	22
• Config 6	6	20
• Config 7	7	18
• Config 8	8	16

Software

For customers and ISVs, Sun™ Elite3D graphics is software-compatible with current graphics products, allowing the use of the same code for window system and XIL™ software. Sun Elite3D graphics' software interface support includes Sun's XGL™ 3.1 and 3.2, (and the planned single vertex enhancements for XGL), XIL, DSP, and Xlib. The hardware is also designed to work efficiently with OpenGL® software. Compatibility with Sun's API libraries means that applications will only need to be qualified and tested.

OpenGL 1.1.2 for Solaris™ Software

OpenGL for Solaris™ software provides a complete solution for developing and deploying interactive 3-D applications across SPARC™ processor-based workstations. It enables mainstream, industry-leading 3-D graphics and visualization applications to be deployed on Sun's Ultra™ workstations with Creator3D graphics and Sun Elite3D graphics at a compelling price-to-performance ratio. OpenGL is an application programming interface (API) that provides 2-D and 3-D graphics functions, including modeling, transformations, color, lighting, and smooth shading, as well as advanced features such as texture mapping, NURBS, fog, alpha blending, and motion blur. OpenGL works in both immediate and non-editable display-list graphics modes.

OpenGL is targeted at developers creating interactive 3-D applications for the enterprise, the intranet, and the Internet. These developers are affiliated with ISVs or VEUs in technical markets or in research labs. 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.

Widespread multivendor availability of OpenGL allows source-code portability of 3-D graphics clients. OpenGL 1.1.2 for Solaris software is a compliant implementation of OpenGL 1.2 from the OpenGL Architecture Review Board (ARB) and is, therefore, source-code compatible with other OpenGL-conformant applications on the market. Most existing OpenGL applications need only to be recompiled in order to run with OpenGL 1.1.2 for Solaris software.

OpenGL 1.1.2 for Solaris software is available for the Creator and Sun Elite3D graphics product families, where the OpenGL functionality is accelerated in hardware.

OpenGL 1.1.2 for Solaris Software New Features and Benefits

Features	Function
• 64-bit OpenGL libraries	• Allows OpenGL applications to take advantage of the full 64-bit addressing in the Solaris 7 operating environment
• Occlusion culling test extension	• Enables applications to trivially reject occluded objects in a scene, resulting in big improvements in interactive rendering performance for visualization of large models
• Improvements in DPA rendering support	• Enables OpenGL rendering on Ultra 5 and Ultra 10 systems using the PGX™ or PGX24™ frame buffers

- Constant texture data extension
- General performance improvements

- Reduces texture mapping memory utilization and loading time
- Enables better performance for all supported graphics cards; in particular, there have been some substantial performance gains for Sun Elite3D frame buffers—for some applications over 100 percent

Sun™ Elite3D Graphics Ordering Information

Sun™ Elite3D Graphics Workstations

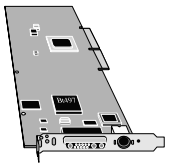
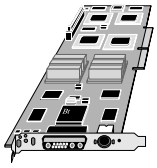
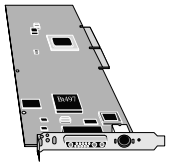
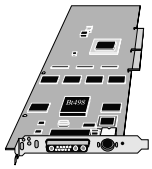
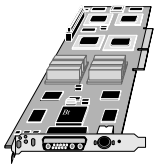
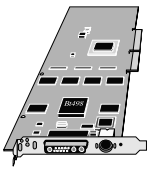
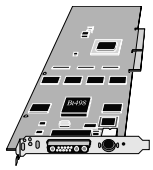
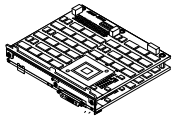
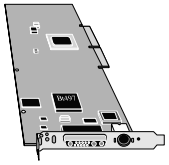
See the specific workstation's or server's *Just The Facts* or *Sun Intro* for configured systems.

Sun Elite3D X-options

Order Number	Option Description	Maximum Number Supported	Comments
X3664A	Sun™ Elite3D m3 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable.	1 (Ultra™ 10) 2 (for Ultra 30 and Ultra 60)	
X3665A	Sun Elite3D m6 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable.	1 (for Ultra 30 and Ultra 60)	Can have an additional Sun Elite3D m3 or Creator3D
X3667A	Sun Elite3D m6 24-bit color, double-buffered graphics accelerator, low-profile horizontal board orientation, and cable.	1 (Ultra 2) 3 (Sun Enterprise™ 3500) 4 (Sun Enterprise 4500 and 5500) 8 (Sun Enterprise 6500)	

Upgrades

Upgrade Paths

From	Receive	Return
 Upgrade from any Creator or Creator3D Graphics, vertical form factor	 Sun™ Elite3D m3, 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable	 Creator Graphics, vertical form factor
 Upgrade from any Creator3D Graphics, vertical form factor	 Sun Elite3D m6 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable	 Creator3D Graphics, vertical form factor
 Upgrade from any Creator or Creator3D Graphics, horizontal form factor	 Sun Elite3D m6, 24-bit color, double-buffered graphics accelerator, horizontal board orientation, and cable	 Creator Graphics, horizontal form factor (Need to replace drawing with Creator Horizontal image. This is a Elite3D m6)

Upgrade Ordering

Order Number	Title and Description
UG-FFB-AFB-M3-V	Upgrade from Creator Graphics to Sun Elite3D m3 graphics double-buffered graphics accelerator, vertical board orientation, and cable (for Ultra™ 10, Ultra 30, and Ultra 60 workstations)
UG-FFB-AFB-M6-V	Upgrade from Creator3D Graphics to Sun Elite3D m6 graphics, double-buffered graphics accelerator, vertical board orientation, and cable (for Ultra 30 and Ultra 60 workstations)
UG-FFB-AFB-M6-H	Upgrade from Creator3D Graphics to Sun Elite3D m6 graphics, double-buffered graphics accelerator, horizontal board orientation, and cable (for Ultra 2 workstations)

Service and Support

The SunSpectrum℠ 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 Solaris™ operating environment software, and telephone support for Sun™ 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.

FEATURE	SUNSPECTRUM PLATINUM℠ Mission-critical Support	SUNSPECTRUM GOLD℠ Business-critical Support	SUNSPECTRUM SILVER℠ Systems Support	SUNSPECTRUM BRONZE℠ Self Support
Systems Features				
Systems approach coverage	Yes	Yes	Yes	Yes
System availability guarantee	Customized	No	No	No
Account Support Features				
Service account management team	Yes	No	No	No
Personal technical account support	Yes	Yes	No	No
Account support plan	Yes	Yes	No	No
Software release planning	Yes	No	No	No
On-site account reviews	Monthly	Semiannual	No	No
Site activity log	Yes	Yes	No	No
Coverage / Response Time				
Standard telephone coverage hours	7 day/24 hour	7 day/24 hour	8 a.m.–8 p.m., Monday–Friday	8 a.m.–5 p.m., Monday–Friday
Standard on-site coverage hours	7 day/24 hour	8 a.m.–8 p.m., Monday–Friday	8 a.m.–5 p.m., Monday–Friday	N/A
7-day/24-hour telephone coverage	Yes	Yes	Option	No
7-day/24-hour on-site coverage	Yes	Option	Option	N/A
Customer-defined priority setting	Yes	Yes	Yes	No
• Urgent (phone/on-site)	Live transfer/ 2 hour	Live transfer/ 4 hour	Live transfer/ 4 hour	4 hour / N/A
• Serious (phone/on-site)	Live transfer/ 4 hour	2 hour/next day	2 hour/next day	4 hour / N/A
• Not critical (phone/on-site)	Live transfer/ customer convenience	4 hour/ customer convenience	4 hour/ customer convenience	4 hour / N/A
Additional contacts	Option	Option	Option	Option

FEATURE	SUNSPECTRUM PLATINUM[SM] Mission-critical Support	SUNSPECTRUM GOLD[SM] Business-critical Support	SUNSPECTRUM SILVER[SM] Systems Support	SUNSPECTRUM BRONZE[SM] Self Support
Enhanced Support Features				
Mission-critical support team	Yes	Yes	No	No
Sun Vendor Integration Program (SunVIP[SM])	Yes	Yes	No	No
Software patch management assistance	Yes	No	No	No
Field change order (FCO) management assistance	Yes	No	No	No
Remote Systems Diagnostics				
Remote dial-in analysis	Yes	Yes	Yes	Yes
Remote systems monitoring	Yes	Yes	No	No
Remote predictive failure reporting	Yes	Yes	No	No
Software Enhancements and Maintenance Releases				
Solaris enhancement releases	Yes	Yes	Yes	Yes
Patches and maintenance releases	Yes	Yes	Yes	Yes
Sun unbundled software enhancements	Option	Option	Option	Option
Internet and CD-ROM Support Tools				
SunSolve[SM] license	Yes	Yes	Yes	Yes
SunSolve EarlyNotifier[SM] Service	Yes	Yes	Yes	Yes

Warranty

Standard Sun warranty, return to factory.

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.
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.
CDRS-03	Viewperf benchmark as one indicator of graphics performance—however, this is not a true test. This benchmark will go away completely in 1999 as it has been “broken” by vendors who are designing high CDRS-03 benchmark machines that do not deliver real graphics applications performance.
Depth-cueing	A technique that selectively varies image intensity to create an illusion of depth in a 3-D model. Accomplished in hardware through the use of a Z-buffer.
Double buffering	Additional frame-buffer memory that allows smooth, continuous motion of objects moving on the screen. Two buffers: one for rendering and updating, the other for display.
Gouraud shading	A means of rendering images composed of multifaceted polygons, enabling smoothly shaded surfaces. Rhymes with Thoreau.
Java 3D™	A new API based on the Java™ programming language. It is part of the Java Media Set for writing stand-alone, 3-D graphics applications or Web-based 3-D applets. Gives developers high-level constructs for creating and manipulating 3-D geometry and tools for constructing the structures used in rendering that geometry.
OpenGL®	A 2-D/3-D graphics library for geometry applications. Multivendor support.
PLBwire93	Picture Level Benchmark for wireframe performance. A benchmark standardized by the National Computer Graphics Association’s GPC committee. The geometric mean performance on several commonly used 3-D wireframe operations.
PLBsurf93	Picture Level Benchmark for wireframe performance. A benchmark standardized by the National Computer Graphics Association’s GPC committee. The geometric mean performance on several commonly used 3-D surface operations.
Transparency	A method of rendering objects that provides the appearance of transparency. Common approaches include the use of mesh, through which a portion of the pixels are rendered, and blending, whereby background and object pixels are blended together.
Texture mapping	A technique for enhancement of surface details on a geometric object without having to compute the geometry of those details. Texture mapping is accomplished by mapping a 2-D raster image to each individual 3-D facet of an object.
XGL™	A foundation geometry-oriented 2-D/3-D graphics library providing high functionality and performance to geometry applications and application program interfaces (APIs).

XIL™	A foundation imaging-oriented graphics library providing high functionality and performance to imaging applications
Z-buffering	Additional memory that allows for fast computation and rendering of Z-dimension, or depth, of a 3-D solids object. Presence of a Z-buffer typically determines whether a graphics workstation is considered 3-D or not.

Materials Abstract

All materials are available on SunWIN except where noted otherwise.

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
Powerpack				
– *Sun Elite3D Graphics Just the Facts*	Reference Guide for Sun Elite3D Graphics Family	Training Sales Tool	SunWIN, Reseller Web	75245
– *Sun Graphics Product Customer presentation*	Presentation on Sun's Graphics Solutions Including Sun Elite3D graphics; Slide Notes for Presentation	Sales Tool	SunWIN, Reseller Web	75254
References				
– *Sun Product Intro—Sun Elite3D m6 Graphics Support in Sun Enterprise 3000–6000 and 3500-6500 Systems, 11/98.*	Introduction E-mail Including Sun Elite3D Graphics	Sales Tool	SunWIN, Reseller Web, E-mail	94261
– *Sun Workstation Graphics Quick Reference Card*	Summary of Graphics Products, Features, and Benchmarks	Sales Tool	SunWIN, Reseller Web, First Resort	24507
Presentations				
– *Sun in EDA*	Customer Presentation	Sales Tool	SunWIN, Reseller Web	59078
– *Sun in MCAD/MCAE*	Customer Presentation	Sales Tool	SunWIN, Reseller Web	59074
– *Sun in Geotechnical*	Customer Presentation	Sales Tool	SunWIN, Reseller Web	60292
– *Sun in Digital Content Creation*	Customer Presentation	Sales Tool	SunWIN, Reseller Web	75241
Product Literature				
– *Graphics Brochure—Imagine It*	Graphics Product Information	Sales Tool	SunWIN, Reseller Web COMAC	60585 BE508-3
– *Ultra™ Desktop Family Brochure*	Workstation with Graphics Section Product Information	Sales Tool	SunWIN, Reseller Web COMAC	69376 BE604-3
– *Ultra 10 Workstation Data Sheet*	Product Information with Sun Elite3D Graphics	Sales Tool	SunWIN, Reseller Web COMAC	69377 DE778-2
– *Ultra 60 Workstation Data Sheet*	Product Information with Sun Elite3D Graphics	Sales Tool	SunWIN, Reseller Web COMAC	71413 DE782-1
– *Ultra 450 Workstation Data Sheet*	Product Information with Elite Graphics	Sales Tool	SunWIN, Reseller Web COMAC	60641 DE720-2

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
Technical White Papers				
– *Sun Elite3D Graphics Technical White Paper*	Technical Architectural White Paper	Sales Tool	SunWIN, Reseller Web	75265
– *Introduction to Texture Mapping White Paper*	Overview and Description of Various Texture Mapping Techniques	Sales Tool	SunWIN, Reseller Web	67281
Competitive				
– *Competitive Summary—Workstations*	Quick Reference Card with Graphics Sections		SunWIN, Reseller Web, First Resort	12259
Success Stories				
– *Graphics Solution Guide*			SunWIN	75271
Videos				
– *Rocketman Animation*	Animation Using Lightwave 3D on Sun Cut Together as a Movie Trailer	Sales Tool	SunWIN COMAC	74302 ME1581-0
– *Brigham & Womens Hospital*	Medical Application Using Sun	Sales Tool	SunWIN COMAC	80550 ME1628-0
External Web Sites				
– *Desktop Product Line Overviews*	`http://www.sun.com/desktop`			
– *Technical Computing Introduction*	`http://www.sun.com/Technical-Computing`			