Creator Graphics

Just the Facts

(SunWIN token# 70123)

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Creator Graphics Positioning

Introduction

Creator Graphics Series 2 is the next generation of the Creator Graphics accelerator. It provides fast, high-quality geometry transformation and display of 3-D solid and wireframe objects. It also accelerates 2-D objects that meet the X11 rules.

Creator Graphics is designed to match or exceed the UltraSPARC™ CPU performance increase to 300 MHz and beyond. The original generation of 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.

Creator Graphics is available in two configurations:

- Single-buffered, for hardware acceleration of 2-D graphics
- Double-buffered, for increased 3-D graphics acceleration or support for high-resolution monitors

What's New?

Creator Graphics Series 2 has evolved from the initial generation of Creator Graphics and, therefore, shares many of the characteristics of the original Creator and Creator3D series. The new features provided in the second generation of the product on both the single-buffered and double-buffered cards are:

- Faster video decompression (playback) by YCC to RGB color space conversion
- Imaging and windowing support, including contrast stretch and consecutive block prefetch for SFB reads
- Increased video and monitor support
  - Line doubling for interlaced video writes
  - DDC2B monitor serial communication, with EDID default resolution support in the Creator bootprom
  - Provides a utility to change the resolution within the upper and lower limits of what the new Creator Graphics boards can easily support

For the double-buffered, Creator3D option, the following additional features are new:

- Buffer B addressing for stateless (DFB) and video accesses
- Single-buffered, high-resolution (2.3 M pixels) support:
  - 1920 x 1200 landscape mode (HDTV-style)

Creator Graphics Series 2 will keep the Creator and Creator3D names for the single- and double-buffered configurations, respectively. The phrase "Series 2" may be used to distinguish Creator Graphics, Series 2, from the original fast frame buffer.

This document describes both generations of Creator Graphics but focuses on the new products.

Creator Graphics Positioning *(cont.)*

Key Messages

- **Extremely high performance**

  Creator Graphics Series 2 performance is based upon the Creator approach to designing graphics.

  - **UltraSPARC CPU**

    Creator Graphics relies on the power of the UltraSPARC CPU for floating point calculations, and on the Visual Instruction Set (VIS™) to accelerate imaging-related operations. This eliminates the need for a dedicated graphics processor, and results in a significant cost advantage with Creator Graphics.

  - **UPA high-speed interconnect for graphics**

    UPA provides a high-speed, high-bandwidth interconnect between the CPU, 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 Creator Graphics directly to the CPU and memory, and delivers greater bandwidth by orders of magnitude.

  - **Creator-rendering ASIC (FBC2)**

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

  - **3D-RAM graphics memory**

    A 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 Creator Graphics takes advantage of general system performance enhancements and is expected to 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 Creator Graphics products come with high-resolution and 24-bit true color standard, as well as an 8-bit overlay plane. Creator3D supports 2 x 24-bit double buffer and a 28-bit Z-buffer. In addition, stereo output support is built-in. Creator Graphics has established a new standard for workstation graphics functionality.

  Creator Graphics Series 2 also adds support for high-resolution monitors and hardware acceleration of color-space conversion during video playback.

- **Fully compatible with existing APIs**

  Creator Graphics accelerates existing APIs, including OpenGL®, X11, XIL™, and XGL™ graphics libraries.

Availability

- Scheduled availability is Q1FY98

Creator Graphics Positioning *(cont.)*

Creator Graphics Systems

A broad family of Creator Graphics systems is available which is designed to handle a wide range of applications. As shown in the table below, configurations are available from single-processor desktop workstations to powerful multiprocessor systems with multiple screens powered by Creator Graphics acceleration.

System	Maximum Number of Processors	Maximum Number of Creator Frame Buffers	Graphics Version	
			Creator	Creator3D
Ultra™ 1	1	1	Series 1	Series 2
Ultra 2	2	1	Series 1	Series 2
Ultra 30	1	2	Series 2	Series 2
Ultra 4000	14	4	N/A	Series 2

Creator Graphics Models

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

Creator	Creator3D
• Limited 3-D acceleration	• Full 3-D acceleration
• Suited for 2-D, windowing, and imaging applications including: CASE, EDA, medical imaging, and general research	• Ideal for 3-D graphics and solids in MCAD and MCAE, as well as high-end imaging applications
• 24-bit true color, single-buffered	• 2 x 24-bit true color, double-buffered
• 8-bit overlay and visual planes	• 8-bit overlay and visual planes • 28-bit Z-buffer
• Stereo display up to 960 x 680 at 112 Hz non-interlaced	• Stereo display up to 960 x 680 at 112 Hz non-interlaced, double- and Z-buffered
• 5 MB of 3D-RAM memory	• 15 MB of 3D-RAM memory
• 1280 x 1024 at 76 Hz standard with programmable bootprom resolution	• 1280 x 1024 at 76 Hz standard with programmable bootprom resolution
• 64-bit DAC	• 128-bit DAC
• High resolution (1280 x 1024 at 76 Hz)	• Single-buffered, high-resolution monitor support (up to 1920 x 1200 with Sun™ 24-inch, wide-screen monitors with Creator3D Series 2)

Creator Graphics Positioning *(cont.)*

Target Markets

Here are some of the target markets for Creator Graphics and the key features in that market.

Market	Applications	Key Features
Oil and gas	• Visual simulation, modeling and analysis	• Creator3D, high-performance frame buffers • Solaris™ OpenGL • Multi-processing • Leading number of third-party software applications
Entertainment	• Animation/model building • Corporate communications	• Creator3D graphics and texture mapping • High rendermark/cubic foot density
Compute-intensive MCAE	• Design automation and simulation • Graphics imaging	• High-performance Creator3D graphics • MP configurations for high application performance • Key software availability
Health care	• Medical imaging	• VIS • Fast image display with Creator Graphics • High I/O bandwidth • Accelerated processing with MP, RIP capabilities • High local storage capacity
EDA	• Chip design and simulation • Telecommunications	• MP capabilities • High-performance 2-D graphics • Configurations with Creator Graphics
Publishing	• Newspaper/magazine production	• High-performance graphics and imaging • MP and RIP capabilities
MCAD	• Mechanical design • High-end mechanical design • Design automation	• Configurations with Creator3D graphics
CASE	• In-house software development • ISV development	• High-performance Solaris environment • Easy development of graphics applications
Finance	• Stock and commodity trades • Banks	• Compact design • Multimedia capabilities, video playback

Key Third-Party Applications

Target Market	ISV — Software Applications	
Entertainment/animation	Adobe	Photoshop
	AriSciMed	Kinema/Sim
	Lightwork	N/A Lightwork's rendering tool kit
EDA	Avant!/ISS	DRC/ERC product
	Avant!/Meta Software	HSpice
	Cadence Design	Vampire
	Compass Design	Pathfinder
	K2 Technologies	Mask Compose and QuickView
	Mentor Graphics	Caliber ICVerify Checkmate
	Mentor/Precedence	Co-Simulation Backplane Simulators
	Silvaco	Atlas Athena Spice
	SpeedSim	SpeedSim
	Systems Science	Vera
	Viewlogic/Vantage Analysis	SpeedWave MT
	Simplex	Thunder and Lightning Fire and Ice
	Silvaco	Virtual Wafer Fab Automation Tools
	For general information see: `http://www.dacafe.com:80/DACafe/CORPORATE/corpeda.html`	
Health care	Cemax	VIP 2.0 (`www.cemax-icon.com`)
	Context Vision	Imaging processing for refining MR data
	ISG	Silohet (`www.isgtec.com`)
	Virtual Vision Software	
MCAE	ANSYS, Inc.	ANSYS
	Livermore Software Technology Corporation (LSTC)	LSDyna 3D
	Computational Dynamics, Inc.	StarCD
	EXA Corporation	Powerflow
	Fluent, Inc.	Fluent/Fluent UNS/Rampant
	Fluid Dynamics, Inc. (FDI)	FIDAP
	Hibbitt, Karlsson & Sorensen, Inc. (HKS)	ABAQUS
	MARC Analysis Research Corp	Mentat/MARC
	MacNeal-Schwendler (MSC)	PATRAN/NASTRAN
	ESI	Pam-Crash
Oil and gas	Cognesis	Charisma
	GeoQuest	ProMax
	Landmark Graphics	Seisworks

Compatibility

Creator Graphics Series 2 is totally software-compatible with the previous version of Creator Graphics on an API level. However, the new generation of boards also introduces a new physical form-factor. Boards in this new form-factor are designed to optimally fit in the Ultra™ 30 workstations and therefore are designed for vertical mounting in the system.

Please see the Figure 1 and 2 below for a view of the differences.

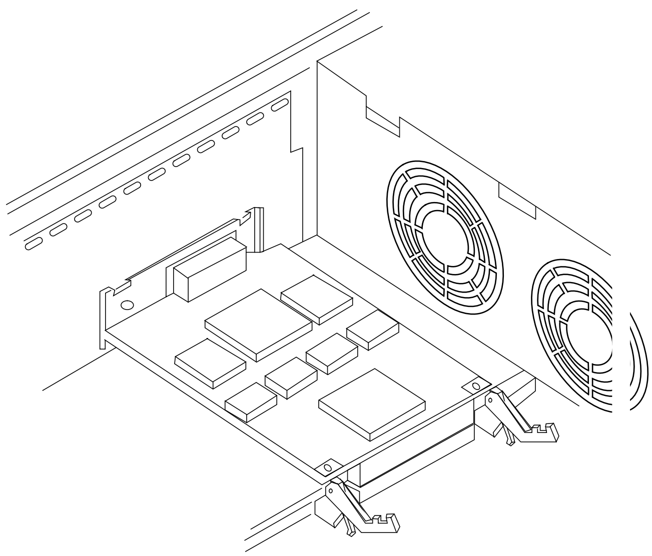

Figure 1. View of horizontal board

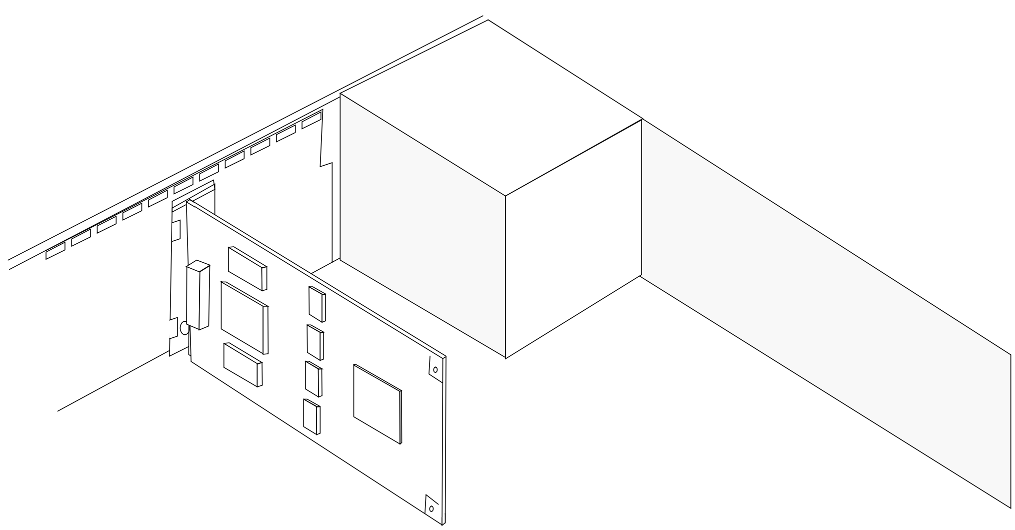

Figure 2. View of vertical board

Technology Overview

Graphics Integration

Over the last decade, graphics has emerged as a very important element in the use of computing. Driven by the increasing sophistication of the applications and users, as well as by broad trends in hardware performance and cost reduction, graphics has become an integral part of technical computing today.

Despite these advances, most graphics subsystems are an afterthought. Their architecture, limited integration, and emphasis on performing specific subsets of graphics functionality reveal that they are designed without consideration of the overall system architecture.

Sun Microsystems is the established volume leader in graphics UNIX® workstation shipments for most technical markets. From ECAD, MCAD, and GIS, to UNIX-based publishing and graphic arts, Sun workstations represent the largest single-vendor platform in use today.

Sun has gained leadership in these markets because of its single-minded focus on platform integration, working towards its intended goal of providing the best price/performance in workstation-class desktop solutions available. Sun's revolutionary Creator Graphics-based systems are based on the powerful UltraComputing™ product line, the industry's most innovative system platforms available. Designed as part of the overall Ultra™ system architecture, Creator Graphics incorporates the best features of Sun's previous accelerators and frame buffers, at a fraction of the cost and with almost twice the performance.

The usual bottleneck for 3-D graphics hardware has been the rate at which pixels can be rendered into a frame buffer for Z-buffered rendering. Historically, the performance of hidden-surface-removal algorithms has been limited by the pixel fill rate of 2-D projections of 3-D primitives. Solutions to these limitations are dependent on an appropriate memory architecture.

Most common computer memory technologies present serious trade-offs when they are used for implementing high-speed, low-cost frame buffers for today's volume systems. Some of the most common memory architectures and implementations of frame buffer and general-purpose memory include:

- **Dynamic RAM (DRAM)**

  DRAM provides the best density and has the best-understood technology curve, but is generally too slow.

- **Video RAM (VRAM)**

  Dual-ported VRAM offers improved bandwidth over DRAM. However, over the past five years, VRAM performance has improved by only about 30 percent.

- **Static RAM (SRAM)**

  SRAM provides fast cycle times but is too expensive to implement economically in a desktop system.

Technology Overview *(cont.)*

Graphics Integration *(cont.)*

Exotic architectures, such as massive DRAM interleaving, are also available, but they are not practical for cost-effective desktop systems.

Another problem with conventional memory architectures is the number of read-modify-write transactions that result from 3-D graphics applications. To maximize performance, read-modify-write operations should be avoided since they can take up to four times longer to complete than a pure write transaction.

A-buffering, as required for 3-D hidden-surface removal, is the main operation that causes expensive read-modify-write transactions. The graphics application's Z-coordinate data must traverse the pins of the chip twice: once to read out the old Z value, and a second time to write the new Z value if a new value is selected. Additionally, window ID compares, stenciling, antialiasing, and blending operations can cause expensive read-modify-write transactions.

Working together, Sun Microsystems and Mitsubishi Electronics have created breakthrough technologies that allow implementation of fast, inexpensive 3-D graphics buffers which address many of the cost and performance issues. Mitsubishi developed a memory technology which incorporated DRAM and SRAM on a single chip while Sun developed a new concept for high-performance 3-D frame buffer design. The result of this collaboration is known as 3D-RAM.

3D-RAM integrates DRAM and SRAM cache on a single chip along with an on-chip arithmetic logic unit (ALU). Since the ALU was implemented directly on the 3D-RAM chip, Z-buffering and the read-modify-write cycle it causes are performed completely inside the 3D-RAM.

The result is a 10-Megabit part that handles 3-D graphics ten times faster than conventional VRAM, at a lower system cost.

Technology Overview *(cont.)*

Texture Mapping

Sun's Ultra Creator3D graphics systems feature a highly integrated approach that connects powerful UltraSPARC™ processors with advanced Creator3D accelerator modules over a high-speed packet-switched memory interconnect known as the Ultra Port Architecture (UPA).

This innovative approach allows textures to be stored in general-purpose system memory where they are operated on by powerful multimedia instructions in the UltraSPARC CPU. Known as the Visual Instruction Set (VIS™), these instructions provide key mathematical and multimedia instructions, many of which are useful for texture-mapping operations.

This approach has key advantages for texture mapping.

- **Low system cost**

  Leveraging system memory for texture storage keeps system costs low since system memory represents a shared resource. When not in use for texture-mapping applications, memory is still usable for other applications.

- **Large texture storage**

  Extremely large textures can be accommodated in system memory since it represents a virtual address space. Applications like 3D texture mapping which use very large textures can be supported with no additional hardware costs.

- **Scalable performance**

  Because texture mapping is performed in the UltraSPARC processor, texture mapping can benefit from the stability gained by adding faster UltraSPARC processors.

- **Other interesting texture mapping applications**

  By locating textures in main memory, other interesting texture mapping applications are available, such as performing image processing functions on textures and using texture-mapped video rather than static images.

In recent years, advanced graphics technologies such as texture mapping have moved from specialized niche applications to general-purpose usage in broad consumer-oriented markets. Entertainment, animation, simulation, and even graphic arts have benefited from the low cost of texture-capable desktop systems. Together with advances in texture-mapping algorithms and low-cost devices, the sophistication and general-purpose application of texturing technology is enabling increased realism in rendering across virtually all segments of graphics use.

Technology Overview *(cont.)*

Texture Mapping *(cont.)*

Sun Microsystems is the largest provider of UNIX graphics systems for most technical market segments. Long heralded as a leader in platform and graphics device integration, Sun and its third parties provide the UNIX workstation industry's broadest of family solutions. Regardless of what level of performance or cost a customer requires, these solutions enable the effective use of texture-mapping technology and free the user to focus on results rather than on the intricacies of the application.

Particularly exciting is the use of texture mapping in extremely price-sensitive environments where the cost per seat is paramount. Sun's highly integrated, low-cost Ultra Creator3D graphics systems enable users to apply texturing to their data with a minimal impact on their budget.

Sun Microsystems' open-systems philosophy and wide support for third-party products and industry standards such as PHIGS and OpenGL® further broaden the choices for end users, thus enabling them to implement cross-platform-capable applications without compromising portability or performance.

Technology Overview *(cont.)*

24-inch HDTV Color Display Monitor

The new Sun™ 24-inch wide-screen color monitor is a high-resolution Trinitron display with digital multiscan capabilities. The monitor features front-panel controls with on-screen display in two modes (normal and expert), Moire cancellation, VESA DDC interface, power management, tilt-swivel capabilities, 13W3 and HD15 connector capabilities and a conductive AR film coating to minimize glare.

Supported resolutions/timings (16:10 aspect ratio/ non-interlaced)	1920 x 1200 @ 70 Hz (maximum) 1600 x 1000 @ 66 Hz 1280 x 800 @ 76 Hz	1600 x 1000 @ 76 Hz 1440 x 900 @ 76 Hz

Note: *The monitor is also capable of running any standard 4:3 aspect ration resolution such as VGA, SVGA< 1152 x 900, 1280 x 1024, and so on. However, to fully utilize the wide-screen format, Sun recommends using one of the 16:10 resolutions listed above.*

Picture tube size	24 inches diagonally	
Viewable image size	22.5 inches diagonally	
Dot pitch	Variable 0.26 mm (center), 0.29 mm (corner)	
Deflection frequency	Horizontal: 30 to 96 kHz Vertical: 50 to 160 Hz	
Input connectors	13W3 captive cable connector HD15-pin video input interfaces (Front-panel switch allows users to select connector type)	
Front-panel connectors	Brightness Size Geometry (pincushion, tilt, and so on) Moire cancellation Color temperature Reset	Contrast Center Convergence Beam landing DeGauss
AC input voltage/current	100–240 volts, 50/60 Hz, 2.2–1.4 amps	
Power consumption (normal operation)	200 watts maximum 170 watts typical	
Operating temperature	10 to 35˚C	
Operating humidity	10 to 80 percent (non-condensing)	
Altitude range	Sea level to 3,048 meters (10,000 feet)	
Compliant standards	UL 1950 TUV/GS CB Scheme EN 29241-3/ISO9241-3 PTB FCC Class B VCCI Class 2 TCO '92	SCA C22.2, No. 950 EMKO-TSE (74-SEC) 207 ZH1/618 DHHS CE IC Class B MPR II EPA Energy Star / NUTEK
Dimensions	580 x 500 x 548 mm (W/H/D)	
Weight	41 kg (90 lbs., 6 oz.) approximately	
Face plate treatment	Conductive AR film coating	

Creator Graphics Architecture

Technology Overview

The Creator Graphics architecture is designed to solve two key issues in graphics design: bandwidth and performance. Since graphics-rendering performance is highly dependent on the system's bandwidth, heavy emphasis is placed on designing a system interconnect that can handle high-speed data traffic. It is also considered key to increase the speed at which graphics computation and display rendering are performed.

The architecture of Creator Graphics relies heavily on the use of a very high-speed conduit between the system's CPU, memory, and graphics subsystem. The Ultra Port Architecture (UPA) crossbar interconnect incorporates a high-speed, packet-switched design that provides the necessary bandwidth to the Creator Graphics module.

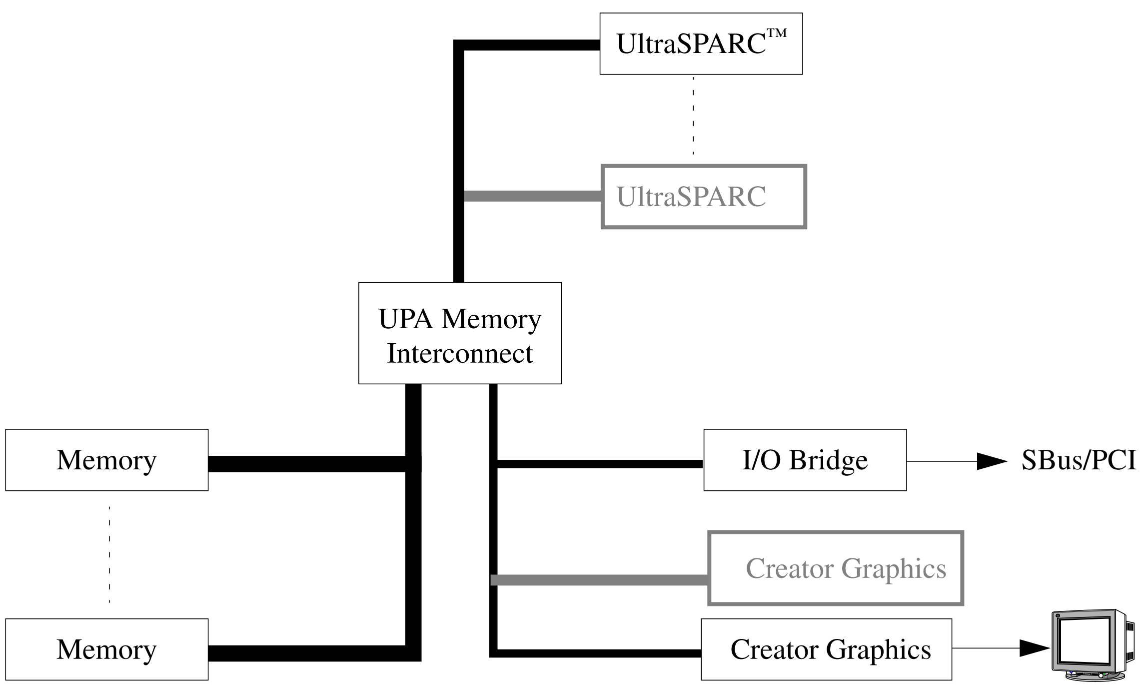

Figure 1. Ultra™ system block architecture diagram

The Creator Graphics module attaches directly to the UPA crossbar interconnect using a 64-bit interface. This direct connection is evidence of the importance of graphics in the overall design of Ultra™ systems. Creator and Creator3D share the same basic design. Creator3D differs in that it contains more 3D-RAM frame buffer memory to provide double-buffer and Z-buffer functionality. A slightly different RAMDAC packaging is also required by Creator3D to provide support for its additional features.

Sun™ Graphics Accelerator Configurations

Parameter	TurboGX™ TurboGXplus™	Creator Series 1, Creator3D Series 2		Creator Series 2, Creator3D Series 2
		Ultra 1	Ultra 2	Ultra 30
Resolution and visual capabilities	1024 x 768 @ 60 Hz or 77 Hz 1152 x 900 @ 66 Hz or 76 Hz 1280 x 1024 @ 67 Hz or 76 Hz	NTSC, PAL 1152 x 900 @ 66Hz or 76 Hz 1280 x 1024 @ 67 Hz or 76 Hz Stereo (960 x 680 @ 112 Hz) *24-inch monitor and Creator3D series 2*: 1280 x 800@ 76 Hz, 1440 x 900 @ 76 Hz,* 1600 x 1000 @66 Hz,* 1920 x 1200 @70 Hz*		
Color planes	8-bit, 8-bit double buffer	24-bit; 24-bit double buffer**;8-bit overlay		
Z-buffer	—	28 bit		
Xmark93	13.59	22.6	29.3	30.2
2-D vectors/sec.	1,520,000***	3,000,000	4,020,000	4,060,000
3-D performance – 3-D vectors/sec. – 3-D mesh/sec. – 3-D quads/sec.	 506,000	 3,700,000** 994,000** 338,000**	 3,700,000** 1,400,000** 450,000**	 3,700,000** 1,400,000** 458,000**
GPC PLB – PLBwire93 – PLBsurf93	 23.8/31.0***	 169.1 225.6**	 218.8 308.9**	 225 317.1**
OpenGL® – CDRS-03 – DX-03	 — —	 38.5** 7.0**	 50.5** 9.0**	 50.67** 9.49**
Imaging speed – Fill – Pan and copy – Convolve (3 x 3)	 — — —	 539/48 139/54 16/2.1	 835/71 165/61 40/5	 835/71 165/61 40/5
Special features	Accelerated text, windows; 2-D and 3-D vectors; double buffering; high resolutions	Accelerated imaging and advanced 3-D graphics with Gouraud shading, line anti-aliasing, per-pixel depth cueing, subpixel addressing, transparency, stereo viewing with monitor		
Monitors	17- and 20-inch color	17-, 20-inch color		17-, 20-, and 24-inch color monitors
Software interfaces: OpenGL, XGL™, XIL™, SunPHIGS™, PEXlib				

Metrics defined:
- 2-D vectors: 10 pixels long, X11 performance numbers
- 3-D vectors: 10 pixels long, depth-cured, clip tested, perspective projection, solid line through XGL
- 3-D mesh: 25-pixel triangle mesh, one light source
- 3-D quads: 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 XGL
- Imaging speed: Mpixels/sec. (8-bit and 32-bit)

* Single-buffer mode
** Numbers achieved with a Creator3D graphics board
*** Numbers achieved with a TurboGXplus graphics board

Software Interfaces

Creator Graphics systems support all Solaris™ 2.5.1 graphics and window system APIs, including OpenGL®, XGL™, XIL™, and Display PostScript™. A large number of Sun™ and third-party graphics APIs are also supported, including IRIS GL, GKS, HOOPS, and PHIGS. Industry-standard X-extension libraries, such as Xlib and PEXlib, are available and are accelerated via the XGL and XIL foundation graphics libraries.

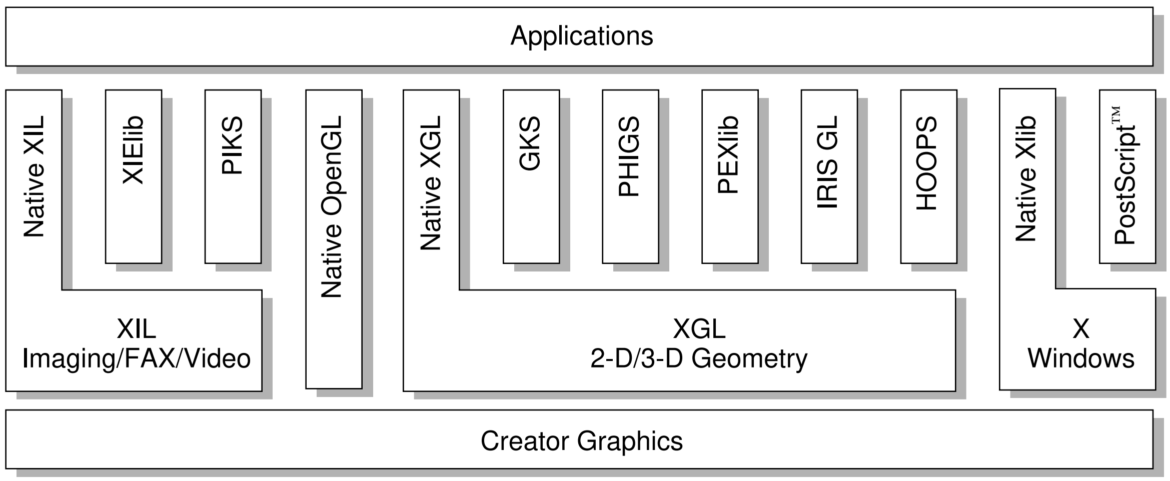

Figure 1. Solaris foundation graphics libraries and layered interfaces

Because Creator Graphics platforms provide windowing, imaging, and geometry acceleration, they enhance the performance of all of the APIs mentioned above.

The OpenWindows™ and the Common Desktop Environment (CDE)

The OpenWindows™ environment is an MIT X Window System (X11 R5) compliant server. Applications that use the X protocol, running both locally or remotely, will receive acceleration from Creator Graphics. The industry-standard Display PostScript environment (DPS) is provided within OpenWindows to support on-screen rendering of documents and images written within Adobe® PostScript™ page description language. Many of the OpenWindows management functions have been optimized to take advantage of the Creator Graphics architecture, including rectangle fills, line rendering, text rendering, vertical scrolling, and raster operations.

The XIL™ Imaging and Video Library

The XIL library is a foundation-level imaging interface that provides the common functions required by many imaging and video application. As a foundation software layer for imaging applications, the XIL library defines how imaging operations, such as display, image manipulations, and compression and decompression are carried out.

The XIL library contains three primary components: a programming interface specification for basic imaging functionality, a high-performance implementation of the specification, and a standard hardware interface specification, which enables third-party hardware developers to readily support the XIL library and applications built upon it.

Creator Graphics and Software *(cont.)*

The XGL™ Geometry Library

The XGL library is the Solaris foundation geometry library that provides the functionality and performance required by applications requiring geometry manipulation and display. The XGL library provides for the optimization of 2-D and 3-D rendering, including high-quality lighting and shading, and advanced primitives (such as NURBS and meshes, texture mapping, antialiasing, and transparency), and a flexible geometry pipeline. The XGL library includes sophisticated state-of-the-art features, such as dynamic tessellation of NURBS surfaces, as well as flexible pipelines for lighting and transformation.

Creator Graphics systems provide acceleration for many XGL functions:

- 2-D (3 x 2) and 3-D (4 x 4) transformations
- Geometry attributes (color, line type, fill pattern, textures, and so on)
- Lighting and shading (flat and Gouraud, as well as up to 32 light sources—positional, directional, spot, and ambient)
- Non-uniform rational B-splines (NURBS)
- Screen-door and alpha-blended transparency
- Antialiasing
- Linear and scaled depth cueing
- Texture mapping (2-D texturing of 3-D surfaces)

OpenGL® Geometry Library

The OpenGL graphics application programming interface is an industry-standard, vendor-neutral software interface that operates independently of operating and window system platforms. Based upon its proprietary predecessor, GL, OpenGL provides a broad set of 2-D and 3-D graphics functions for modeling transformations, color, lighting, shading, and advanced features such as texture mapping.

The OpenGL Architecture Review Board is responsible for defining OpenGL's characteristics and features, and for providing conformance testing, release approval, and specification definition. Like Sun's XGL graphics library, OpenGL is independent of any underlying window system, and display of rendered graphics occurs through either extensions to the graphics library or through direct window system calls.

Sun has provided Solaris OpenGL: Ultra™ Creator3D Edition since July 1996, specifically for use on Creator3D Graphics systems. A new version of OpenGL is now available that is highly accelerated by Creator3D and also supported on many other graphics cards, including Creator (single-buffer) cards.

Ordering Information

Creator Graphics Accelerator Options

Part Number	Descriptions	Comments
Graphics boards		
X3653A	Creator, Series 1, 24-bit color, single-buffered graphics accelerator, horizontal board orientation, and cable	
X3657A	Creator3D, Series 2, 24-bit color, double-buffered graphics accelerator, horizontal board-orientations, and cable	For all Ultra™ platforms, except for Ultra 30
X3658A	Creator, Series 2, 24-bit color, single-buffered graphics accelerator, vertical board orientation, and cable	For Ultra 30
X3659A	Creator3D, Series 2, 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable	For Ultra 30
X3660A	PGX color frame buffer and cable	For PCI-based Ultra systems
Monitors		
X267A	20-inch color monitor	
X7124A	Wide-screen 24-inch color monitor	

Configuration Information

The following table indicates the number of Creator Graphics accelerators and monitors the different Ultra workstations support:

System	Maximum Number of Creator Frame Buffers	Board Orientation	Graphics Version	
			Creator	Creator3D
Ultra 1	1	Horizontal	Series 1	Series 2
Ultra 2	1	Horizontal	Series 1	Series 2
Ultra 30	2	Vertical	Series 2	Series 2
Ultra 4000	4	Horizontal	N/A	Series 2

Frame Buffer and Monitor Table

Monitors Type		17-inch Entry	19-inch Color	20-inch Color	24-inch Color
Graphics Cards	**Order#**	**X7103A**	**X7119A**	**X267A**	**X7124A**
TurboGX™ frame buffer	X7110A	•	•	•	
TurboGXplus™ frame buffer	X3655A		•	•	
Creator, Series 1, horizontal board	X3653A			•	
Creator3D, Series 2, horizontal board	X3657A			•	• *
Creator, Series 2, vertical board	X3658A			•	
Creator3D, Series 2, vertical board	X3659A			•	•
PGX frame buffer	X3660A	•	•	•	• **
Video Connector Adapter, HD 15F to 13W3M ***	X3872A	•			

* Maximum resolution of 1920 x 1200 @ 70 Hz singled-buffered, 24-bit color mode, preferred where high display quality is required, such as with imaging and full-color prepress applications

** Maximum resolution of 1600 x 1000 @ 76 Hz singled-buffered, 8-bit color mode, preferred for desktop publishing, text editing, and 8-bit windowing applications

*** Required for 13W3-based platforms, included in X7110A and X3660A

Creator Graphics Upgrades

Part Number	Description
UG-FFB-FFB2DB-H	Upgrade from any Creator Graphics board to Creator3D, Series 2, 24-bit color, double-buffered graphics accelerator, horizontal board orientation, and cable (X3657A)
UG-FFB-FFB2SB-V	Creator, Series 2, 24-bit color, single-buffered graphics accelerator, vertical board orientation, and cable (X3658A)
UG-FFB-FFB2DB-V	Upgrade from any Creator Graphics board to Creator3D, Series 2, 24-bit color, double-buffered graphics accelerator, vertical board orientation, and cable (X3659A)
UG-MON-24	Any previous-generation monitor upgrade to 24-inch color monitor

Service and Support

SunSpectrum℠ 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. SunSpectrum provides a simple pricing structure in which a single fee covers support for an entire system, including related hardware and peripherals, the Solaris™ operating system software, and telephone support for Sun™ software packages. The majority of Sun's customers today take advantage of the SunSpectrum program, underscoring the value it represents. Customers should check with their local SunService℠ representative for program/feature variance and availability in their area.

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	Semi-annual	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 AM–8 PM, Monday–Friday	8 AM–5 PM, Monday–Friday
Standard on-site coverage hours	7 day/24 hour	8 AM–8 PM, Monday–Friday	8 AM–5 PM, 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 Mission-Critical Support	SUNSPECTRUM GOLD Business-Critical Support	SUNSPECTRUM SILVER Systems Support	SUNSPECTRUM BRONZE Self Support
Enhanced Support Features				
Mission-critical support team	Yes	Yes	No	No
Sun Vendor Integration Program (SunVIP™)	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™ license	Yes	Yes	Yes	Yes
SunSolve EarlyNotifier℠ Service	Yes	Yes	Yes	Yes

Glossary

24-bit color	The ability to render objects using 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	A new architecture for 3-D frame buffers. A memory technology that incorporates DRAM and SRAM on a single chip along with an on-chip arithmetic logic unit.
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	A standardized benchmark for OpenGL®. Represents the mean performance of several commonly used 3-D graphics operations.
FBC-2	Frame Buffer Controller, Series 2. Performs the set up, edge interpolation, and span interpolation functions in the 3-D graphics pipeline. It also performs pixel processing to accelerate high-end 3-D functionality, such as hidden-surface removal, smooth shading, transparency, and antialiasing.
GRU	Graphics Unit. A dedicated graphics unit as a part of the floating-point unit for operating directly on graphics data. The UltraSPARC™ processor incorporates a comprehensive set of graphics instructions that provide fast hardware support for 2-D and 3-D graphics, image manipulation and compression, and video and audio processing.
OpenGL®	The standard software interface for graphics hardware that allows programmers to create interactive 3-D applications. OpenGL provides a full-featured, network-transparent application programming interface.
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.
RAMDAC	Converts digital data (in frame buffer memory) to the analog signals required to drive the CRT display.
UPA	Ultra™ Port Architecture. A high-speed, crossbar-oriented, packet-switched motherboard interconnect.

VIS™	Visual Instruction Set. The UltraSPARC processor implements a special instruction set that is aimed primarily at image and video processing. Some of the instructions allow the CPU to access and operate on image data directly 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.
XGL™	A foundation geometry-oriented 2-D/3-D graphics library that provides 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.