Sun™ XVR-4000 Graphics Accelerator / Sun Fire™ V880z Visualization System

Just the Facts

Copyrights

Last Update: 2/7/03

Table of Contents

Positioning

Figure 1. Sun™ Fire v880z with Sun™ XVR-4000 graphics accelerator

Introduction

The Sun Fire V880z visualization system with the Sun XVR-4000 Graphics Accelerator is targeted at the Personal Immersive Visualization systems, Small WorkGroup Visualization environments, and the Large WorkGroup Visualization environments for Design/Styling, Virtual Prototyping in the Manufacturing segment, for seismic interpretation in the Oil & Gas segment, and also in the Research/Educational segment for a variety of applications including CAE, CFD, Medical Research, Proteomics, Computational Chemistry. Another target market is the Training/Simulation (eg. flight sim) segment, and especially for the Defense industry.

Most of the SGI-installed base consist of Large Group Visualization Centers which cost upwards of $1M, which typically get used for management presentations and are unavailable most of the time for the designers. Organizations have seen a return on investment on these visualization technologies and wish to make them available across their organizations. So, they have started to roll out Small WorkGroup Visualization systems which use expensive turn-key display systems that can be readily moved into existing conference rooms without real-estate modifications. These display systems are cheaper than the custom-built large display systems. Customers need affordable visualization systems which deliver good perormance along with excellent visual quality for these Small WorkGroup Visualization environments. The V880z visualization system is ideal for these environments.

A V880z system can have up to 4 USIII CPUs, 32 GB memory and dual XVR-4000 Graphics Accelerators; or 6 USIII CPUs, 48 GB memory, and single XVR-4000 Graphics Accelerator. The XVR-4000 Graphics Accelerator's uniqueness is in its back-end anti-aliasing filters, which deliver exceptional visual quality critical for the large display environments. Most commodity graphics cards implement a fairly basic single pixel box filter done by the rasterizer, where as the XVR-4000 Graphics Accelerator has dedicated filter chips which implement a 5 pixel x 5 pixel programmable, radial filter. As

a result, the anti-aliasing filters in the XVR-4000 not only get rid of the jaggies on a 3D surface, but are also capable of precisely rendering complex data with sub-pixel accuracy, providing users more insight into their data. Users don't have to trade-off performance to get this visual quality, in contrast to commodity hardware where there is a more substantial performance trade-off when they turn on anti-aliasing.

The list of the Sun XVR-4000 graphics' high-level features is impressive.

Feature	Sun XVR-4000 Graphics
Frame Buffer Memory	144 MB
Texture Memory	4 x 256 MB
Anti-aliasing	Dedicated, 5 x 5 programmable radial filter chips which compute a weighted average of stochastically jittered samples (maximum of 16 samples/pixel)
Max. 3D Resolution (30-bit color)	1920 x 1200 @ 75 Hz with 4 samples/pixel, or 1280 x 1024 @ 75 Hz with 8 samples/pixel
Max. 3D Stereo Resolution	1280 x 1024@ 112 Hz with 4 samples/pixel
Multi-Display Capability	Dual 1280 x 1024 @ 75 Hz with 4 samples/pixel, or Dual 1280 x 1024 @ 112 Hz (non-antialiased stereo)
Dynamic Video Resizing	Yes (Results in guaranteed frame rate)
S-video output	Yes (can record entire screen in NTSC/PAL format)
Framelock	Synchronize multiple graphics displays
Genlock	Pixel-level synchronization to external video source, or to ensure synchronized buffer swaps between multiple graphics frame-buffers.

Key Messages

The Sun Fire V880z with the XVR-4000 graphics accelerator has three key feature areas: performance, quality, and flexibility/functionality

- **Performance**

  The systems-level and graphics performance ensures interactive visualization of very large datasets, which is needed for Collaborative Visualization environments. Users typically tend to view larger datasets in large screen visualization environments than they would, normally at their desksides.

  - Up to six 900MHz USIII CPUs with single XVR-4000 Graphics Accelerator
  - System memory capacity up to 48 GB with single XVR-4000 Graphics Accelerator
  - Graphics interconnect bandwidth of greater than 2 GB per second, using DMA to download data from system memory to the graphics engines
  - 60 million, lit triangles per second
  - Trilinear texture fill-rate of 300M pixels/sec with 4 samples/pixel (i.e. 1200M samples/pixel)
  - 256MB on-board texture memory per rendering sub-unit (4 x 256MB on board)
  - Programmable MAJC-5200 chip used for geometry & lighting calculations, providing capability to optimize graphics pipeline for special cases (e.g. 2-sided lighting)

- **Quality**

  Visual quality is extremely critical for users of large screen, collaborative visualization. Rendering anomalies and jaggies tend to get magnified and become more visible in the larger screen environments. Especially in 3D stereo mode, without anti-aliasing turned on, sub-pixel data could tend to flash on the screen, causing eye fatigue.

- Rasterizers render up to 16 samples per pixel randomly located in a 64 x 64 sample grid per pixel. Back-end convolve chips compute a weighted average of these samples located in a 5 pixel x 5 pixel area to generate each pixel value. The 5 x 5 convolution filter coefficients are user programmable.
- Leading color fidelity with 30-bit RGB output (10 bit/channel), 12 bit before gamma correction.
- 26-bit floating-point Z-buffer
- Supports up to 1920 x 1200 @ 75 Hz with 4 samples/pixel, or 1280 x 1024 @ 112 Hz with 4 samples/pixel (high resolution display with anti-aliasing)
- 4 x 256 MB of on-board texture memory enabling use of textures representing a high degree of granularity, while still delivering interactive performance.

- **Functionality**

  Several features of this graphics accelerator demonstrate the flexibility and functionality that it delivers to Sun's customers.

  - Dual 13W3 video outputs capable of driving dual 1920 x 1200 3D displays, or dual 1280 x 1024 3D stereo displays.
  - Dual XVR-4000 Graphics Accelerators per V880z system, enabling a single V880z system to drive up to four 1280 x 1024 3D stereo displays without anti-aliasing, or four 1280 x 1024 anti-aliased 3D displays with 4 samples/pixel.
  - Analog S-video output in NTSC or PAL standards for display on a TV monitor or for recording to a VCR. Users can define the entire screen for recording, because the convolve chips can resize the full 1280 x 1024 or 1920 x 1200 display in real-time to the NTSC/PAL resolution.
  - Framelock functionality to synchronize multiple XVR-4000 Graphics Accelerators, combined with the pixel overlap functionality in OpenGL/Xinerama to drive a seamless edge-blended multi-proector display.
  - GenLock functionality to synchronize the XVR-4000 to external video source, and also to synchronize multiple graphics frame-bufers at a pixel level.
  - Dynamic video resizing which enables guaranteed frame rate control. When application is fill rate limited, the 3D image can be rendered to a smaller resolution internally in the frame buffer, and dynamically get resized to the external display resolution.
  - Programmable display resolutions in hardware that let end users select non-standard video resolution output for speciality display output devices, projectors, and future displays devices that may need non-standard resolutions.

Product Family Placement

The Sun Fire V880z system with the Sun XVR-4000 Graphics Accelerator represents a new product-line for Sun. It is targeted at the Collaborative WorkGroup Visualization and Personal Immersive Visualization envronments which include both immersive desksides as well as CAVEs. It complements the Sun Blade™ 2000 with the Sun™ XVR-1000 Graphics Accelerator which is targeted for visualization at a deskside.

Comparison with Sun Blade 2000 system with XVR-1000 Graphics Accelerator

The Sun Fire V880z with XVR-4000 graphics accelerator is for users who need the best possible visual quality for their large display environments. It has more system memory capacity to enable visualization of very large datasets, and support for visualization applications which are multi-threaded to take advantage of multiple CPUs. The Sun Blade 2000 system with XVR-1000 graphics accelerator is for the cost-conscious user who needs to visualize large datasets at their desksides.

The table below shows the key differences between the Sun Fire V880z/XVR-4000 Graphics and the Sun Blade 2000/XVR-1000 Graphics.

Feature	**Sun Blade 2000 with XVR-1000 Graphics***	**Sun Fire V880z with Sun XVR-4000 Graphics***
Number of CPUs	2 USIII CPUs	6 USIII CPUs with 1 XVR-4000
Maximum System Memory	8 GB	48 GB (8 GB per CPU)
Frame Buffer Memory	72 MB	144 MB
Texture Memory	256 MB	4 x 256 MB
Geometry Performance	19.9 M tris/sec. 5.0 M quads/sec. 12.2 M vec/sec.	60 M tris/sec. 15 M quads/sec. 20 M vec/sec.
Texture Fill Rate, Bilinear (Mpixels/sec)	163 (no anti-aliasing (AA))	537 (no AA), 379 (4 samples/pixel)
Texture Fill Rate, Trilinear (Mpixels/sec)	71.7 (no AA)	277 (no AA), 277 (4 samples/pixel)
System Bus Connection	UPA, Programmable I/O for data transfer (800MB/sec BW)	Sun Fire Plane Interconnect, DMA for data transfer (4.8 GB/sec BW)
Video Out Connector	13W3 and HD15/DVI	Dual 13W3
S-Video	Record a 640x480 window in NTSC/PAL	Record entire screen to NTSC/PAL format
Stereo, FrameLock	Yes	Yes
GenLock	No	Yes
Dynamic Video Resizing (Guaranteed frame-rate control)	No	Yes
Multi-Display Support	Dual 3D @ 1280 x 1024, Single 3D Stereo @ 1280 x 1024	Dual 3D @ 1920 x 1200, Dual 3D Stereo @ 1280 x 1024
Anti-aliasing	Single pixel box filter done by rasterizer using off-screen buffer, OpenGL window-based	5 pixel x 5 pixel programmable, radial filter done by 4 convolve chips, works on full-screen
Architecture	Single rendering unit: MAJC-5200 (geom/light) + FBC3 (rasterizer)	Four rendering units: 4 x [MAJC-5200 + FBC3]

- *All Sun XVR-1000 graphics numbers were measured with a 900-MHz Sun Blade 2000 workstation with 2-GB memory running Solaris 8 (4/01) Operating Environment. All the Sun XVR-4000 graphics numbers were measured with a Sun Fire V880z with 4 x 900MHz UIII, 8 GB memory.*

Sun Fire V880z / XVR-4000 Graphics Features and Benefits

Feature	Function	Benefit
• Up to 6x900MHz USIII CPUs with one XVR-4000 Graphics Accelerator	• Execute the visualization application	• Performance scaling of multi-threaded visualization applications
• Up to 48 GB system memory (16 GB maximum per CPU card) with one XVR-4000 Graphics Accelerator	• Store Display Lists and Textures in system memory, instead of having to access the disk	• Can handle very large datasets with high sustained frame rates
• Master controller linked to four pipelines each consisting of MAJC-5200 chip and FBC3 rasterizer, along with 32 MB RDRAM, and 256 MB SDRAM.	• Master controller is the interface chip to the Sun Fire Plane interconnect, providing a single OpenGL pipeline interface to the application. Data is downloaded to Master chip via DMA. • MAJC-5200 chip does the geometry & lighting calculations • FBC3 does the rasterization • RDRAM stores the program and can cache the display-lists • SDRAM stores the textures	• Delivers performance scalability using 4 pipelines, without the programming complexity typically associated with multi-pipe architecture • DMA to Master allows off-loading of CPUs to run the application, and be less occupied with data download.
• 144 MB of frame buffer memory and 4x256 MB of texture memory	• Provides large amounts of dedicated memory for high-resolution displays, and for on-board texture memory	• Increased frame-buffer memory results in support for larger resolutions with more samples / pixel • Larger on-board texture memory enables interactive visualization of larger volume data (3D textures), reducing the number of downloads from system memory; thus allowing representation of a volume at higher degree of granularity

Feature	Function	Benefit
• Dedicated convolve filter chips, on-board	• The convolve chips apply a 5 pixel x 5 pixel programmable, radial filter to the samples (maximum of 16 per pixel) rendered by the rasterizer, and compute a weighted average of the samples to generate each pixel value. The samples are randomly located in a 64 x 64 sample grid per pixel.	• Gets rid of jaggies, improving visual quality and realism, important for large screen displays. • Effectively increases the display resolution without actually increasing the number of projectors in a tiled display, by using multiple samples per pixel; providing users with more insight into their data.
• Stereo	• Provides users with 3D depth perception using stereo glasses.	• Allows users to immerse themselves in their data, and have a more interactive experience with their data.
• Framelock	• Synchronizes multiple graphics frame-buffers for multi-display environments	• Users can deploy a multi-display environment with edge-blended, seamless displays in stereo.
• Genlock	• Synchronizes to external video source, and also enables synchronization of multiple frame-buffers at a pixel level. This can be used in conjunction with framelock, to provide more precise synchronization of multiple graphics frame-buffers.	• Enables synchronized multi-display environments in stereo, providing a better user experience. Also, enables synchronization to external video source such as distortion correction hardware to do real-time image warps for curved screen displays and dome displays.
• Dynamic video resizing as a result of the decoupling of the rendering of samples, and the post-processing step associated with the convolve chips	• Enables dynamic resizing of the rendered image in the display memory to the display output.	• Delivers guaranteed frame rate, by enabling the rasterizers to render to a smaller resolution in the frame-buffer memory when application is fill-rate limited, and dynamically resizing it back to the output display resolution • Allows entire display screen to be dynamically resized to NTSC/PAL format for recording via s-video
• S-video	• Analog S-video output in NTSC or PAL standards for display on a TV monitor or for recording to a VCR	• Using the dynamic video resizing feature, users can record the entire screen to record to a video recording device.
• Support for two asynchronous video streams using dual 13W3 video output with 10-bit per color channel	• With dual cards per system, four 1280 x 1024 stereo displays can be supported from a single V880z system. The two video outputs could also be set to different resolutions.	• Reduces cost and complexity by using single system to drive multiple displays • Increased color precision delivers better visual quality, and eliminates banding typically observed in back-grounds, with lower color precision

Feature	Function	Benefit
• Adjustable gamma correction: 12-bit in, 10-bit out. One 3 x 1024 x 10-bit adjustable gamma correction table for each video stream	• Provides gamma or color correction support to help ensure a truer color representation	• Provides an extra level of color correction compensation for a more accurate color representation on a wider range of displays • Helps ensure data accuracy when color is used to represent data point or to increase the realism of a image
• Multiple hardware color maps: Four 3 x 256 x 10-bit color maps in each video stream	• Allows multiple windows to be opened with different color map requirements, without resulting in color flashing	• Provides better user experience with greater flexibility

Availability

The Sun Fire V880z visualization system with the XVR-4000 graphics accelerator is planned for availability according to the following schedule:

Revenue Release	01/28/03
General Availability	02/11/03

Target Users

The Sun Fire V880z system with the XVR-4000 graphics accelerator is targeted at the high-end users of visualization technology. It is especially targeted at users who tend to use immersive 3D environments to get their jobs done for example, with an immersive deskside, or a CAVE, where users tend to use stereo glasses, 6 degree-of-freedom trackers, and haptic devices. It is also targeted for collaborative visualization environments such as 2 and 3 channel large screen environments (flat, or curved), both for Small WorkGroup or Large Group. This includes customers in the manufacturing sector for design/styling, design review and virtual prototyping; the oil and gas sector for seismic interpretation and reservoir engineering; the research/education sector for scientific visualization, life sciences, and defense research; and also for 3D image analysis in the defense sector. The XVR-4000 also has all the key features needed for the Training/Simulation market such as flight simulation, for both the commercial & defense sectors. These environments (large screen with/without stereo) typically need to display anti-aliased images with very high visual quality, and also tend to visualize extremely large datasets which could otherwise not be visualized in a standard PC or workstation. Interactive, fast response with minimal latency is important, especially when using tracking devices in immersive environments.

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, make optimized decisions, and reduce time-to-market for their solutions. The V880z product is especially targeted at the increased use of Small WorkGroup Visualization environments, which are basically 2-3 channel turn-key display solutions that can be deployed in existing conference room facilities. These display systems are cheaper and require minimal real-estate changes, compared to Large Group Solutions which involve typically customized displays and significant real-estate modifications. We see this trend as organizations who see the benefit of high-end visualization

technologies beyond just for management/customer presentations, want to provide access to these technologies to designers/scientists across their organizations.

Target Markets

The Sun Fire V880z with XVR-4000 Graphics Accelerator is targeted at high-end visualization users in the manufacturing sector for design/styling, design review and virtual prototyping; oil and gas sector for seismic interpretation and reservoir engineering; the research/education sector for scientific visualization, life sciences, and defense research; and also for 3D image analysis in the defense sector. The XVR-4000 also has all the key features needed for the Training/Simulation market such as flight simulation, both for the commercial & defense sector. It is especially targeted at users who tend to use immersive 3D environments to get their jobs done such as an immersive deskside, or a CAVE, where they tend to use stereo glasses, 6 degree-of-freedom trackers, and haptic devices; and for collaborative, visualization environments such as 2-3 channel large screen environments (flat, or curved), both for Small WorkGroup or Large Group.

Market	Applications	Key Features
Manufacturing	• Design/Styling, Design Review and Virtual Prototyping – Dassault's Enovia DMU; EDS-PLM's VisConcept, VisMockup; Opticore's Opus Studio/Realizer; PTC's Division; ICEM-Surf • Visualization of MCAE & CFD Data – CEI's Ensight • Plant Design & Safety	• Stereo, Anti-aliasing • 1-2 channel for Small WorkGroup Viz, 3 channel for Large WorkGroup Viz • FrameLock • Good Geometry Performance • Good Texture Performance (Styling) • Multi-processor system (Multi-threaded apps)
Oil & Gas	• Seismic Data Visualization & Interpretation – Schlumberger: Geoquest's GeoViz, InsideReality's InsideEarth; Paradigm-Geophysical's VoxelGeo; Landmark's OpenVision, EarthCube • Reservoir Engineering – Landmark's StrataModel; TSurf's GoCAD	• Stereo • 1-2 channel for Small WorkGroup Viz, 3 channel for Large WorkGroup Viz • FrameLock • Large Texture Memory with excellent 3D & 2D Texture Performance (seismic data viz) • Good Geometry Performance (reservoir modeling) • Large system memory (up to 48 GB)
Training / Simulation (Commercial/ Defense)	• Flight Simulation/Training • Ground Warfare • Naval Warfare • Urban Landscape Planning/Visualization – Multigen-Paradigm's VegaPrime, VSG; CG2's VTree; Open Scene Graph; Boston-Dynamics' DI-Guy	• Anti-aliasing • 3-16 Displays • Excellent Texture Fill Rate & Texture Download (Fast access to storage) • 60 Hz frame rate (Dynamic Video Resizing) • FrameLock, GenLock • Multi-processor system (MT apps)

Market	Applications	Key Features
Education / Research	• Scientific Visualization, CFD • Weather Modeling • Data mining, Computational Steering • Computational Chemistry • Proteomics • Medical Research (MRI, FMRI) – Sun's OpenGL, Java 3D, Multi Display Utility; VR Juggler; Open Scene Graph; VRCO's CAVElib, trackd; CEI's Ensight; TGS' Amira; VTK; VMD	• Balanced performance & flexibility to handle diverse application set • Stereo • Anti-aliasing (desirable) • Scalability on CPUs, memory, graphics performance (geometry, texture) • Multiple Displays (typically 1-6)
Defense /	• Mission Planning & Rehearsal • Imagery Exploitation, Surveillance Systems • Command & Control Visual Systems – Autometric's EDGE; ERDAS' Imagine; MPI's VegaPrime; Sun's Java Advanced Imaging API	• Large Texture Memory with excellent texture performance • Fast image/texture download from storage to memory to graphics frame-buffer • Excellent image-processing performance • High resolution, multiple tiled displays
BioTech / HealthCare (Commercial)	• Computational Chemistry • Proteomics • Medical imaging and visualization • Surgical preplanning • Computer-assisted surgery	• Stereo, Anti-aliasing • Excellent Geometry Performance • 1-3 channel display

Selling Highlights

Market Value Proposition

The strength of the Sun Fire V880z system with the Sun XVR-4000 Graphics Accelerator is the excellent visual quality of the rendered images because of the sophisticated, programmable anti-aliasing filter chips on-board and increased color precision with 10-bit per color. The other strong point of the V880z system is the price-point which is roughly a third of SGI's Onyx-IR4 solution for an entry system. The Sun XVR-4000 Graphics Accelerator has advanced feature sets such as framelock, genlock, stereo, s-video (record entire screen), and dynamic video resizing, which are attractive for the high-end visualization market. The V880z ystem also provides excellent multiple display capability with support for up to four 1280 x 1024 stereo displays. The V880z system can have 4-6 UltraSPARC-III CPUs which provide performance scalability for multi-threaded visualization applications. The V880z system is also designed to handle visualization of very large datasets with 32-48 GB system memory, 6x73 GB FCAL storage, and the 4.8 GB/s interconnect bandwidth provided by the Sun Fire Plane interconnect which enables rapid data-flow between the CPUs, memory and the graphics engine. Here's the value proposition for the individual target markets:

Manufacturing

The Sun XVR-4000 graphics accelerator will enable automotive/aerospace designers to view their design prototypes in human scale, in a collaborative setting, with the utmost realism and precision, allowing them to catch design flaws early in their manufacturing cycle, by providing the best anti-aliasing implementation in the industry while still providing interactive performance, compared to PC graphics clusters, at a price-point that enables them to deploy this technology for small work-group visualization, across the breadth of their organization. This is in distinct contrast to comparable SGI solutions which are much more expensive.

Oil & Gas

The Sun XVR-4000 graphics accelerator will enable seismic interpreters to visualize larger volumes of their seismic datasets at any given time, in a collaborative setting, with the utmost detail & precision, allowing them to save millions of dollars by making effective drilling decisions. The system provides large system memory (32-48 GB on the V880z system) and the largest amount of on-board texture memory (1 GB) compared to generic PC graphics, at a price-point that enables customers to deploy this technology for small work-group visualization, across the breadth of their organization, unlike comparable SGI solutions which are much more expensive.

Training/Simulation

The Sun XVR-4000 graphics accelerator will enable pilots to experience the utmost realism, allowing them to get effectively flight trained, without going through expensive training exercises by providing the best visual quality at guaranteed frame rates, compared to PC graphics clusters, supported by features like 5 pixel x 5 pixel programmable radial filter for anti-aliasing, increased color precision, dynamic video resizing, and genlock at a price-point that enables them to increase the availability of this system, and increase training time. This is in contrast to more expensive high-end image generators which need to be shared by several pilots.

Research

The Sun XVR-4000 graphics accelerator will enable researchers to interactively visualize very large datasets resulting from large simulations they run, with high precision/detail, in immersive environments. It will enable them to effectively interpret their data by providing excellent geometry performance, 30-bit

RGB representation in frame-buffer memory enabling volumes to be stored at higher precision than in PC graphics clusters, and the ability to drive multiple displays from large compute/visualization servers. This tecnology is available at a price-point that enables customers to deploy this technology across their insititution, unlike more expensive SGI solutions which need to be shared by several groups.

Full-scene Anti-aliasing Through Stochastic Multisampling

Much of today's 3D graphics hardware only provides full-performance antialiasing support for line and dot primitives (if it is provided at all). Though some systems allow the edge of a polygon to be "fuzzed," this technique only applies to polygons that have been presorted in depth, defeating the purpose of having general purpose 3D rendering hardware. Anti-aliasing of polygon edges submitted in an arbitrary order with full performance is supported on only a handful of very expensive systems.

The Sun XVR-4000 accelerator's approach to full-scene antialiasing couples multisampling techniques already in use by the most advanced batch software rendering systems such as Pixar's Renderman with real-time hardware acceleration. It is similar to techniques used by the most advanced batch software rendering systems, such as Pixar's Renderman. Multisampling works with all 3D primitives, including dots, lines, and polygons.

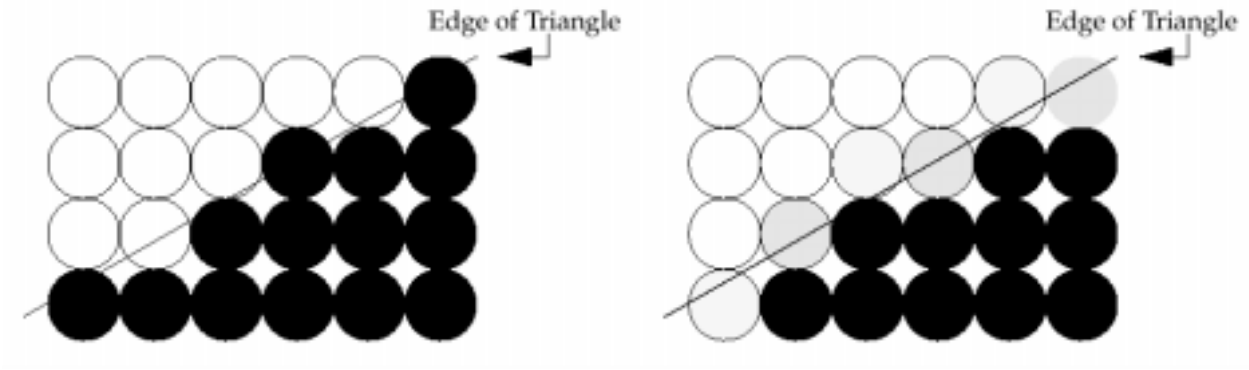


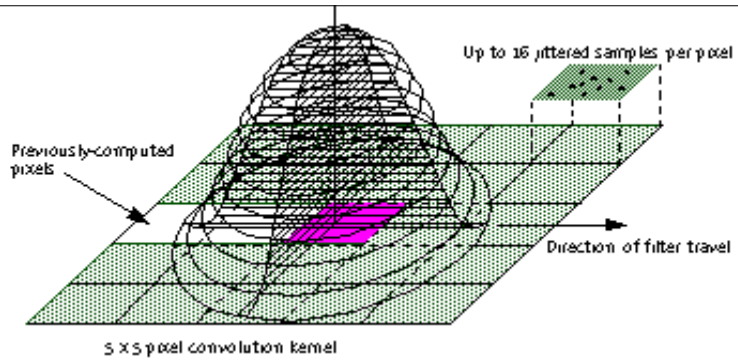
Figure 2. A triangle edge, with and without multisampling

In the first image (without multisampling) of the figure above, pixel color is determined based on whether the pixel lies inside or outside of the polygon's boundaries. The result is a jaggy line. In the multisampled image, the pixel color is determined based on the pixel's proximity to the edge of the triangle, resulting in a smoother, more graded edge to the polygon.

Stochastic Multisampling

In the case of the Sun XVR-4000 graphics accelerator, sampling is handled by the FBC3 ASIC, with up to 16 samples per output pixel (depending on configured resolution). Actual sample values are stored in the frame buffer with final pixel values calculated dynamically at the end of the pipeline.The Convolve ASIC performs the multisample filtering step serially, after the rendering is completed. To avoid visual artifacts (such as Moire patterns), the Sun XVR-4000 graphics accelerator automatically provides stochastic multisampling (pseudo-random sampling within a 64 x 64 sub-pixel grid). The final color at each pixel is determined by application of a 5 x 5 programmable filter in the Convolve ASIC that provides a weighted average filtering of all of the samples within the pixel area (Figure 3)

Figure 3. Convolution Filter



Filtering on the Sun XVR-4000 graphics accelerator is truly zero overhead, unlike other systems that require a separate post-rendering pass to accomplish filtering.

.

Overview

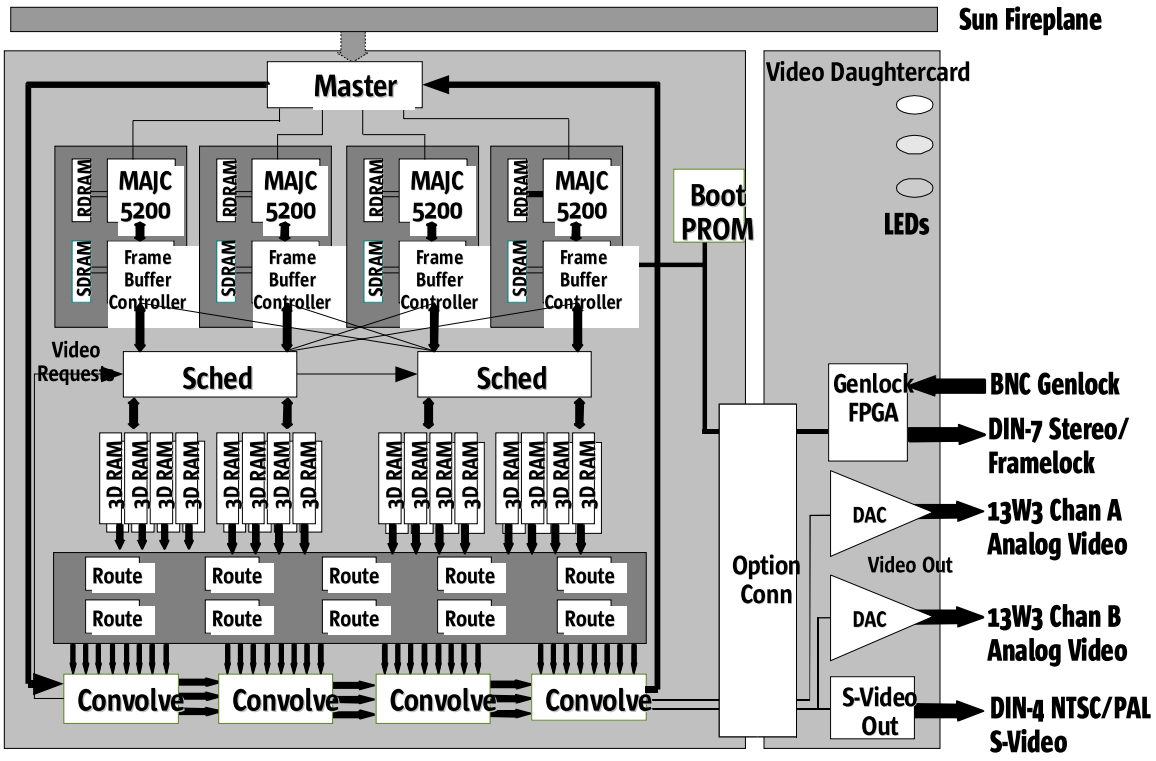


Figure 4: Sun XVR-4000 graphics accelerator logical block diagram

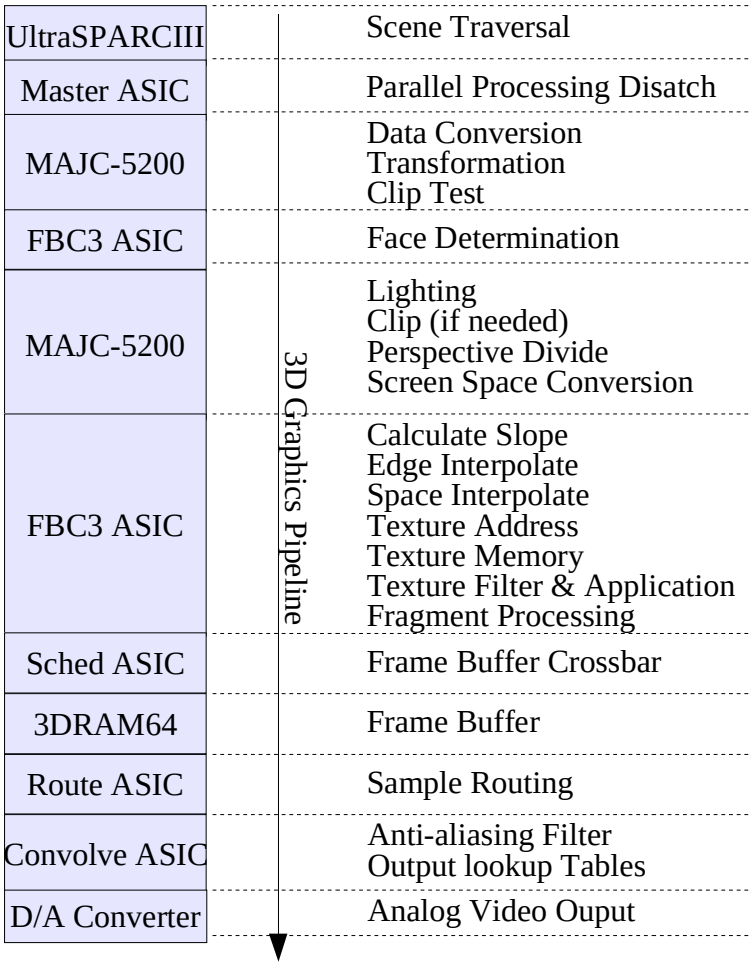


Figure 5: Sun XVR-4000 graphics accelerator uses several custom ASICs to implement the 3D graphics pipeline.

Figure 5 above shows the functionality of the various components of the XVR-4000 Graphics Accelerator as they relate to the graphics pipeline.

The major components in the Sun XVR-4000 system include:

- **Sun Fireplane interconnect** — System interface providing superior memory and I/O bandwidth along with predictable performance and scalability under demanding loads. Features of the Fireplane Interconnect include: A Fast 150 MHz high-performance crossbar switch design allowing simultaneous transfers between processors, memory, and the I/O subsystem; Low latency memory access; Completely separate address/control and data paths for flexible implementation; Out-of-order transaction processing enabling multiple simultaneous transactions on the bus; High throughput paths to memory via 576-bit wide paths (including ECC); Integrated support for multiprocessor configurations. The Sun XVR-4000 graphics accelerator interfaces directly to the Sun Fireplane interconnect, giving it first-class, low-latency, high-bandwidth access to main memory.

- **Master Chip DMA Engine**— Connecting directly to the Sun Fireplane interconnect, the Master chip performs DMA from the host to fetch command and graphics data streams. The master chip reads data directly from host memory using DMA, gathers it into buffers, and load balances graphics streams to the four parallel rendering pipelines within the XVR-4000 accelerator, interfacing directly with the four MAJC-5200 processors. The Master chip also controls all chips in the XVR-4000 graphics accelerator providing for synchronization as necessary.
- **MAJC™-5200 processor** — Within each rendering pipeline in the Sun XVR-4000 graphics accelerator, the MAJC-5200 processor performs transform, clipping and lighting along with other general purpose processing. The MAJC-5200 processor contains a geometry data preprocessor and two processing units (consisting of four function units each), running at 341 MHz. In the Sun XVR-4000 graphics accelerator, the MAJC-5200 processor uses three bus interfaces. The North UPA (NUPA) interface connects directly to the Master chip. A direct Rambus interface supports 32 MB of DRDRAM memory, used for microcode for the MAJC-5200 chip and for display list caching. The South UPA (SUPA) interface allows the MAJC-5200 processor to control the FBC3 ASIC.
- **FBC3 ASIC** — Performs 2D and 3D rasterization, 2D and 3D texturing, pixel transfers, imaging and fragment processing. The FBC3 has four major interfaces. The SUPA interface receives commands from the MAJC-5200 processor. An eight-way interleaved texel bus reads and writes to the SDRAM texture buffer, while a four-way interleaved pixel bus reads and writes to the sched chips and on to the 3DRAM64 sample buffer. The FBC3 ASIC is capable of writing two 66-bit pixels (or samples) in a single frame buffer clock (166 MHz), and can read four pixels (or samples) in two frame buffer clocks.
- **Texture buffer Memory** — Consists of eight SDRAMs with a total capacity of 256 MB within each rendering sub-unit, which is used to store texture maps, image processing buffers and accumulation buffers. FBC3 can read or write 128 bits of texture buffer data at SDRAM clock rates of 166 MHz. Each pair of 16 bit SDRAMs is independently row and column addressed, to allow arbitrary addressing of 2 x 2 texture footprints. In addition, within each pair, the SDRAMs can receive independent column addresses. Because each FBC3 ASIC has its own dedicated 256 MB of user texture memory, textures up to 256 MB in size can be rendered using the four parallel rendering pipelines. The texture memory attached to each FBC3 ASIC can also be combined to support larger textures of up to 1 GB in size, in volume visualization applications that use the Sun OpenGL targeted extension.
- **Sched Chip** — The two sched chips route image samples produced by any of the FBC3 outputs to any pixel interleave of the sample buffer below. As a controller of the 3DRAM64 chips, the sched chips also respond to requests from the Convolve chips for streams of samples to be sent out over the 3DRAM64 video output pins to the parallel Convolve chips to generate the video output.
- **Sample Buffer** — Consists of 32 **3DRAM64s** (144 MB) organized into eight independent interleaves of four chips each. On the input side, four 3DRAM64 chips share a single set of control, address, and data lines to one of four sets of memory interleave pins on a sched chip. On the output side, each 3DRAM64 generates 40-bit samples by double-pumping 20 video output pins. Logically, the sample buffer is organized as a two-dimensional raster of lists of samples. The list-order of a sample implies its sub-pixel location. The memories are interleaved per-sample so that adjacent samples in a list are in different 3DRAM64 packages.
- **3DRAM64** — 3DRAM64 integrates DRAM and an SRAM cache on a single chip along with pixel processors and an on-chip ALU. Since the ALU is implemented directly on the 3DRAM64 chip, the read-modify-write cycles caused by Z-buffering, alpha blending, and stenciling are performed completely inside the 3DRAM64. The external chip interface is converted from the traditional, less efficient, read-modify-write interface into a much faster write-only interface. In addition, the SRAM cache on the chip is multiported to yield enough data paths (3) and enough speed for efficient support of the 166 million samples per second throughput inside the chip. A single 3DRAM64 chip contains all the data for a 3D graphics frame buffer with 640 x 512 pixels and 116 bits per pixel.

- **Route Chips** —The 640 outputs of the sample buffer feed into an array of 10 Route chips. Each Route chip is a 2-bit slice of a router function. Each Route chip connects to two output data pins from each of the 32 3DRAM64 chips, and can redirect this data to any of the four Convolve chips attached to it below.Samples are read from sample buffers in a series of 160-sample bursts that span the vertical swath of the screen assigned to a particular Convolve chip. The route chips absorb these bursts into internal FIFOs, and then redirects them to their destination Convolve chip.
- **Convolve Chips** — The four Convolve chips perform the reconstruction and band limited reconstruction filtering of the raster stream of samples, providing pixels that are fed into the next Convolve chip before final video output. Each chip is assigned a different vertical swath of the screen's samples. Because reconstruction filters of up to 5 pixel x 5 pixel are supported, each of these vertical swaths must overlap their horizontal neighbors by up to 2 pixels. The final video stream is assembled as video is passed from chip to chip, with each Convolve chip inserting its portion of each scan line into the aggregate stream. The last chip delivers the complete video stream as well as an optional second stream. The 5 x 5 filter size also implies that each sample will potentially be used in up to 25 different pixel computations. To avoid re-fetching samples from off-chip, six swath lines worth of sample data is cached on each Convolve chip.
- **Video Output** — As mentioned previously, the Convolve ASICs replace the digital portion of the traditional RAMDAC. Up to two simultaneous, potential asynchronous video rasters can be generated in parallel by partitioning the four Convolve chips into two subsets. Both video streams will emerge from the digital video output ports of the last Convolve chip. These dual outputs serve a variety of functions:
  - Displaying two sides of a shared frame buffer region on two high-resolution monitors or projectors
  - Displaying two independent high-resolution X window system screens on separate displays
  - Display of a high-resolution image on a monitor and a simultaneous NTSC-resolution display of the contents of the high-resolution monitor
  - Supporting immersive per- eye stereo displays where each eye receives the output of a separate video channel

  In addition, the Convolve chip can even be programmed to send the final antialiased image back into the computer through the outer ring bus. This feature is especially useful when performing antialiased rendering intended for later reuse as reflection maps or remote collaboration and visualization over a LAN or WAN.

Output Connectors

The Sun XVR-1000 graphics accelerator provides five output connectors:

- **Dual 13W3 CRT Video Output** provides separate RGB component analog video output to the computer display monitor or projector. Composite and separate sync options are supported. A DDC2B/EDID link is provided for monitor query and control.
- The **S-video Output** provides encoded NTSC or PAL analog video to a television monitor or recorder with an S-video connector.
- A **stereo** connector that supports either a 3- or 7-pin DIN stereo standard is available.
- A **genlock** connector provides pixel level synchronization capability and is used in conjunction with the framelock capability.

Note: Only one of either the S-video, or the second 13W3 display output can be active at any time.

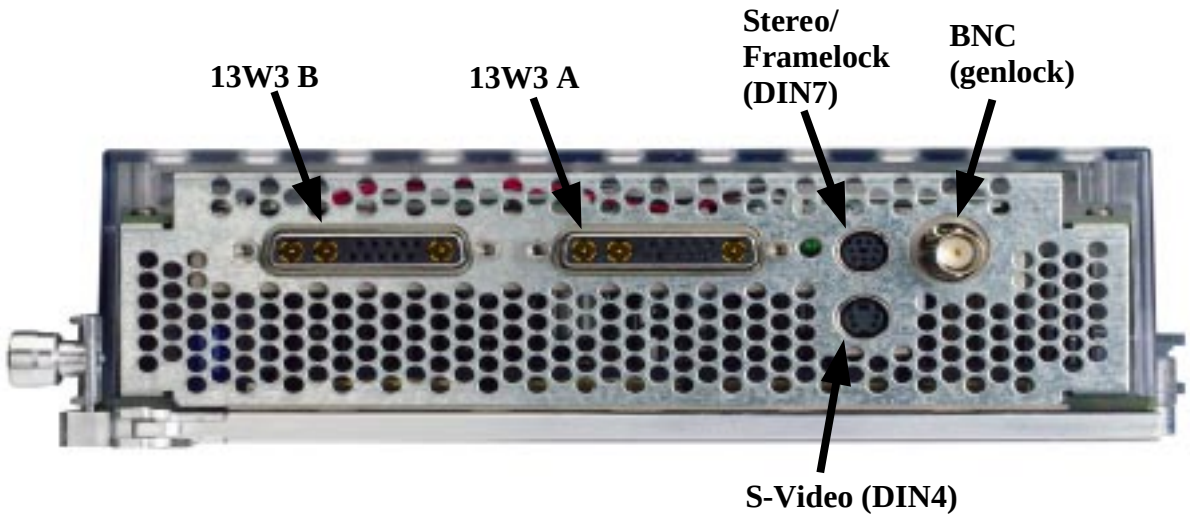


Figure 6. Sun XVR-4000 graphics back panel configuration

Graphic Feature Details

Hardware-Based Texture Mapping Memory

Unlike many other graphics solutions where texture memory is shared with frame buffer memory (a unified memory architecture), Sun™ XVR-4000 graphics has 256 MB of dedicated texture memory associated with each of the four rendering sub-units.

The texture buffer can access 128-bits in one memory clock cycle. Texture maps and images are stored in an interleaved format, allowing high-speed access to neighboring samples in 2 x 2 for 32-bit texels and up to 2 x 2 x 2 for 16-bit texels. All OpenGL® texture formats which require no more than 32 bits and no more than four channels are supported.

Images can be stored at up to 16 bits per channel (12-bits are significant) and up to four channels. The accumulation buffer stores 16 bits each of red, green, and blue. Additional features include:

- 2D texture map storage size of up 4000 x 4000 texels
- 3D texture map storage size of up to 1000 x 1000 x 512 texels
- Proprietary memory mapping organization to increase texture fill rate
- On-chip texture cache to eliminate redundant access
- Lookahead logic to reduce page miss penalty
- Pairing of pixels in order to increase texture fill rate
- Image storage
- 16 bits per channel RGB accumulation buffering (48-bits total)
- 1 or 2 bytes per component per texel
- 2D nearest/linear/mipmapped
- 3D nearest/linear/mipmapped
- 1/2/4/8 bytes/texel
- 1/2/3/4 components/texel
- Texture scale and bias, texture lookup table
- Texture environment blending functions
- Extremely high quality texture filtering (anisotropic, sharpen/detail, filter4)
- 12 bit effective linear light output
- Stencil plane support

2D Operations

The following 2D operations for window system and X11 operations are supported.

- Default visual in 8-bit (256 color) overlay buffer.
- 8- and 24-bit single and double-buffered visuals in primary buffer

- Configuration option to support double-buffered overlay (by sacrificing stored alpha option)
- 15 overlay window IDs, 64 primary window IDs.
- Four 3 x 256 x 10-bit color maps (8-bit pseudo-color or 24-bit direct-color).
- One 3 x 1024 x 10-bit adjustable gamma correction table (true color)
- SOV style transparent overlays ("WID separate" mode only; no "WID combined" mode)
- 2D primitive acceleration includes dots, Bresenham lines, and polygons
- Rectangle fill, Fast Fill and Fast Block Clear, font support, CopyPixWin, CopyWinPix, CopyWinWin (includes VertScroll), Stipple Fill
- Auxiliary clipping hardware for up to eight overlapping windows

3D Image Processing Functions

The Sun XVR-1000 graphics accelerator has optimized support for the OpenGL and Java 3D™ APIs. Hardware support is available for the 3D functionality listed below:

3D Lighting and Rasterization	
• Dots • Large radius dots • Gouraud shaded RBGA triangles • Directional lighting, specular materials • Antialiasing of dots, large and small	• DDA lines • Line stipples • Wide lines • Motion blur and depth of field • Full-scene antialiasing (high speed accumulation of multi-sampled buffers)
Texture Mapping	
• Textured dots and triangles • Advanced texture filters (filter 4, sharpen, detail, anisotropic) • Lit texture	• 3D volume visualization • 2D and 3D texture mapping • Texture scale, bias, loopup, and environment application
Fragment Processing	
• Per-pixel depth-cue (fog) • Transparency (both alpha-blended and screen-door) • Alpha blend, logic, ops, extended blends • Pick hit/occlusion detection	• 32 x 32 pattern support • Alpha, color, stencil, depth, scissor, and ownership fragment tests • Plane masks, plane group selection, buffer selection
Acceleration for Image Processing	
• Transposition • Bicubic scaling filter • Pixel scale and bias • 422 YcrCb to RGB conversion • Histograms	• Bilinear scale, transform filters • 3 x 3, 5 x 5, 7 x 7 general convolution filters • Color matrix • Lookup tables

30-Bit True Color RGB

Unlike all previous Sun graphics accelerators and most others on the market that support 8-bit per channel (24-bit color for RGB), the Sun XVR-4000 graphics accelerator provides 10-bit per color or 30-bit RGB (38-bit RGBA color), which results in higher fidelity color output. Sun's 30-bit color supports

over 1 billion possible colors. Using 24-bit RGB, only 16.8 million colors can be displayed. Compared to 24-bits, the increased detail provided by 30-bits delivers substantially more information. This increased color information means more accurate imaging, fewer banding effects, and crisper detail. Existing applications do not need to be modified to take advantage of this feature.

Display Resolutions

Sun XVR-4000 graphics video timings/monitor screen resolutions are listed below. Sun XVR-4000 graphics supports full 30-bit 2D and 3D (double/Z-buffered) at all supported resolutions.

Display Resolution	Vertical Refresh Rate	Sync Standard	Aspect Ratio	13W3	S-Video	# of Samples (Single Display)	# of Samples (Dual Display)
1920 x 1200	60d Hz	Sun	16:10	X		4	2
1920 x 1200	70, 75 Hz	Sun	16:10	X		4	2
1920 x 1080	60d Hz	Sun	16:9	X		5	3
1920 x 1080	72 Hz	Sun	16:9	X		5	3
1792 x 1344	60, 75 Hz	VESA	4:3	X		4	2
1600 x 1280	76 Hz	Sun	5:4	X		4	1
1600 x 1200	60d Hz	VESA	4:3	X		5	3,2 / 4,1
1600 x 1200	60, 73, 75 Hz	VESA	4:3	X		5	3,2 / 4,1
1600 x 1024	60 Hz			X		6	3
1600 x 1000	66, 76 Hz	Sun	16:10	X		6	3
1440 x 900	76 Hz	Sun	16:10	X		8	4
1280 x 1024	96, 108, 112 Hz	Sun-Stereo	5:4	X		4	2
1280 x 1024	60, 75, 85 Hz	VESA	5:4	X		8	4
1280 x 1024	67, 76 Hz	Sun	5:4	X		8	4
1280 x 800	112 Hz	Sun-Stereo	16:10	X		5	2
1280 x 800	76 Hz	Sun	16:10	X		9	4
1280 x 768	56 Hz	Sun	5:3	X		9	4
1152 x 900	120 Hz	Sun-Stereo	5:4	X		4	2
1152 x 900	66, 76 Hz	Sun	5:4	X		9	4, 5
1024 x 800	84 Hz	Sun	4:3	X		11	4
1024 x 768	96 Hz	Sun-Stereo	4:3	X		6	3
1024 x 768	77 Hz	Sun	4:3	X		11	5
1024 x 768	60, 70, 75 Hz	VESA	4:3	X		11	5
960 x 680	108, 112 Hz	Sun-Stereo	14:10	X		6	3
800 x 600	75 Hz	VESA	4:3	X		15	7
768 x 575	50i Hz	PAL	PAL	X	X	15	7
640 x 480	60fsc Hz			X		16	8
640 x 480	60, 72, 75 Hz	VESA	4:3	X		16	8

Display Resolution	Vertical Refresh Rate	Sync Standard	Aspect Ratio	13W3	S-Video	# of Samples (Single Display)	# of Samples (Dual Display)
640 x 480	60i Hz	NTSC	NTSC		X	16	9
640 x 480	50i Hz	PAL	PAL		X	16	9

Note: *All resolutions marked VESA use separate sync; the remainder use composite sync.*

Dynamic Video Resizing (DVR)

A key feature of the XVR-4000 architecture is that video resolution is determined by the convolution hardware, and not by rendering hardware. In addition, the same hardware used for antialiasing also provides an extremely high-quality video rescaler. Called dynamic video resizing (DVR), this approach provides better filtering quality than is possible with an external scaler because it operates on the original samples, not final pixels. In addition, the Sun XVR-4000 graphics accelerator correctly performs the filtering in linear light space.

DVR can be used to output the entire high-resolution screen to NTSC or PAL video formats. In addition, arbitrary zoomed and panned sub-regions of a higher resolution display can be output in NTSC or PAL video formats as might be used to document a software program. A more important use is in systems with real-time guarantees. To conserve fill rate, the actual size of the image rendered can be dynamically reduced, and then interpolated back up to the fixed video output size. For example, a flight simulator using a 1280 x 1024 video format might actually be set to render at 960 x 768 when under heavy fill requirements, saving nearly half the fill time.

Fully Antialiased Alpha Channel

The Sun XVR-4000 graphics accelerator's sample filtering algorithm operates not only on the RGB channels but also on stored, double-buffered alpha data, if enabled. For example, for virtual set applications the XVR-4000 accelerator automatically generates a very high quality “soft key” signal for blending antialiased edges of virtual objects in front of physical objects, as well as blending variably transparent rendered objects in front of physical objects. Alpha is also computed for each pixel but it is never gamma-corrected. Alpha precision is also 10 bits.

Genlock and Framelock

Genlock and framelock are different methods of accomplishing synchronization of video timing between two computer graphics systems; both are supported by the Sun XVR-4000 accelerator to provide pixel-by-pixel synchronization.

The framelock synchronization feature asychronously resets slave devices so that vertical retracing occurs simultaneously. A framelock cable is used to synchronize two or more Sun graphics accelerators such as Sun XVR-500, Sun XVR-1000, and Sun XVR-4000 graphics accelerators across one or more computer systems. Vertical retrace synchronization eliminates flicker between multi-screen displays but does not guarantee that pixels are aligned in the two streams, possibly resulting in dropped video lines.

Genlock generates its pixel clock from the master video timing signals using Phase Locked Loop (PLL) techniques so that each genlocked accelerator produces pixels at precisely the same rate, even if the master timings change over time. Genlock currently requires that the video formats are identical in resolution and frame rate.

Genlock can be used together with framelock to obtain a pixel-accurate genlock. By combining genlock and framelock, applications that need to mix pixels from different sources (such as a virtual set) obtain pixels that are displayed on the same line at the same time.

Stereo Support

All Sun XVR-4000 systems are stereo-ready, with stereo support in the frame buffer, monitor, and window system, enabling users to view dynamic 3D geometry in stereo by adding the appropriate stereo glasses. A 7-pin mini-DIN connector is provided on the back of the Sun XVR-4000 subsystem to carry a sync signal from the stereo glasses.

S-Video Output

An S-Video connector can be used to output encoded NTSC or PAL analog video to a television monitor or VCR. Together with the dynamic video resizing capability, the S-Video connector can be used to capture the contents of a full high-resolution screen or panned and zoomed sub-regions. If the S-video output is not in use, the second 13W3 output is available to drive a second high-resolution display.

Requirements and Configuration

Supported Systems

The Sun™ XVR-4000 graphics accelerator supports the Sun Fire V880z system, and goes into the center two CPU slots of the V880z system. The Sun Fire V880z system will come in two configurations: (i) 2 x 900MHz USIII, 4 GB memory, 1 x XVR-4000 Graphics, 6 x 73 GB FCAL disks, (ii) 4 x 900MHz USIII, 16 GB memory, 1 x XVR-4000 Graphics, 6 x 73 GB FCAL disks.

Dimensions of Sun Fire V880z & Sun XVR-4000 Graphics Accelerator

Feature	Specifications
Height (Sun Fire V880z)	28.1"/714mm. with casters, 27.6"/700 mm. without casters
Width (Sun Fire V880z)	18.9"/480 mm
Depth (Sun Fire V880z)	32.9"/836 mm.
Weight (Sun Fire V880z)	194 lbs. min. - 299 lbs. fully loaded
Power Requirements (Sun Fire V880z) • Maximum Power • Normal Operation	 • 2,880W • 1,078W (2x900MHz, 4GBmem, 6x73GB FCAL, 1 XVR-4000 Graphics, RSC, 3 power supply)
Board Length (XVR-4000)	20.8"/528.9mm
Board Width (XVR-4000)	2.7"/69.6mm
Board Height (XVR-4000)	9.2"/233mm
Board Weight (XVR-4000)	11.7 lbs
Power Requirements (XVR-4000) • Maximum Power • Normal Operation	 • 315W • 238W

Software Requirements

- OpenBoot 4.7.0, or later (The Sun Fire V80z includes the correct version of OpenBoot)
- Solaris™ 8 2/02 Operating Environment, plus patches (including KU18 patch), and packages for the Sun XVR-4000 Graphics Accelerator
- Sun™ OpenGL® for Solaris™ 1.3 API or later

```
All necessary patches and packages are distributed on the Sun Fire V880z
Operating Environment DVD
```

Supported Options

Order Number	Option Description	Maximum Number Supported per System	Comments
Dual-processor/Memory Module			
X7028A	900 MHz dual-processor/memory module, each processor with 8 MB external (L2) cache. 4 GB of total memory (2 GB per processor) implemented as 4 - (X)7053A options (each consisting of 4 - 256 MB DIMMs) **Note:** All modules within a single system must operate at the same processor speed.	4	All memory DIMM slots fully populated Mixed speed systems not supported.
Memory			
X7053A	1 GB (4 DIMMs of 256 MB each)	4 Groups (16 DIMMs) per module	See memory configuration requirements
X7051A	2 GB (4 DIMMs of 512 MB each)	4 Groups (16 DIMMs) per module	See memory configuration requirements
X7056A	4 GB (4 DIMMs of 1 GB each) **Note:** Supported only on 900 MHz based processor modules.	4 Groups (16 DIMMs) per module	See memory configuration requirements
Internal Storage Expansion			
X6751A	Second storage backplane to accommodate an additional six internal FC-AL disks with 6 - 36.4 GB, 1.0", 10,000 RPM FC-AL disk drives.	1	For 750 or 900 MHz systems with only 6 disks
X6755A	Cable to connect the internal connector of (X)6727A, PCI to dual FC-AL controller, to the alternate/Loop B port of the internal storage array	1	
X6756A	Second storage backplane to accommodate an additional six internal FC-AL disks with 6 - 73 GB, 1.0", 10,000 RPM FC-AL disk drives.	1	For 750 or 900 MHz systems with only 6 disks
Internal Storage Devices			
X6724A	36.4 GB, 1.0", 10,000 RPM, FC-AL disk drive	12	
X6742A	73 GB, 1.0", 10,000 RPM, FC-AL disk drive	12	
X6805A	73 GB, 1.0", 10,000 RPM, FC-AL, multi-sourced disk drive	12	
Internal Removable Storage Devices			
X6283A	12 GB 4mm DDS-3 Tape Drive **Note:** Requires X913A fast wide to narrow SCSI adapter	2	
X6295A	20 GB 4 mm DDS-4 Tape Drive	2	
X6168A	Half-height SCSI DVD Drive	3	
External Storage Interfaces			
X6540A	PCI to dual channel, single-ended UltraSCSI host adapter	9	

X6541A	PCI to dual-channel, differential UltraSCSI host adapter	9	
X6758A	PCI to dual Ultra3SCSI differential host adapter	9	
X6799A	PCI single 1 Gbit FC-AL adapter with one external connector only	6	
Network Interfaces			
	PCI Ethernet Adapters		
X1033A	10/100 Base T Fast Ethernet PCI Adapter	4	
X1034A	10/100 Base T Quad Fast Ethernet PCI Adapter	4	
X1141A	Gigabit Ethernet PCI Adapter	4	
X1150A	Sun Gigabit Ethernet-Cat5 (copper) PCI66 adapter	4	
X1151A	Gigabit Ethernet (fibre)	4	
	PCI to ATM Adapters		
X1157A	Sun ATM-155/Multimode Fibre PCI66 bus adapter	4	
X1158A	Sun ATM-155/UTP 5.0 PCI66 bus adapter	4	
X1159A	Sun ATM-155/P622 Multimode Fibre 5.0 PCI66 bus adapter	4	
	PCI to Synchronous Optical Network		
X4810A	PCI to OC48/Sonet Adapter **Note:** Must be placed within 66 MHz PCI slots for network performance considerations	2	Restricted to 66 MHz PCI slots
	PCI Combination Adapters		
X1032A	PCI to 10/100 Base T plus Single-ended Ultra/Wide SCSI adapter	9	
X2222A	PCI to dual SCSI and dual 1 Gbit Ethernet adapter	4	
	Note: The (X)2069A Gigabit Ethernet plus FC-AL is not supported in UltraSPARC III systems		
PCI Video and Graphics Adapters			
X3668A	PGX32 8/24-bit color graphics frame buffer	4	
X3768A	PGX64 color graphics frame buffer	4	
X3685A	XVR-500 high resolution 2D and 3D Graphics Accelerator, 24-bit color, w/ 32MB graphics memory and 16 MB texture memory **Note:** Please refer to note at the end of this section *PCI Video and Graphics Adapters.*	4	No limitations on PCI slot placement
	Note: The X3684A and X3685A graphics accelerators require the 501-5142-12 or higher I/O board and are supported only within factory shipped 900 MHz based processor systems, i.e. not on upgraded 750 MHz systems. Please contact Sun Enterprise Services for details.		
Power Cords			

X311L	Power Cord Kit, U.S./Asia	3	
X312L	Power Cord Kit, Continental Europe	3	
X386L	Power Cord Kit, Australia	3	
X317L	Power Cord Kit, U.K.	3	
X314L	Power Cord Kit, Switzerland	3	
X384L	Power Cord Kit, Italy	3	
X383L	Power Cord Kit, Denmark	3	
530-3096-01	Power Cord Jumper, extends any geography specific power cord	3	
	Note: One power cord required per power supply, i.e. three per system		To be ordered as a separate line item for each system
Other Options			
	Rackmount Kit		
X9628A	Rackmount kit for Sun Fire Expansion rack, StorEdge Expansion rack and appropriate EIA-310-D-1992 compliant racks		Max. of two systems per rack
	Video Monitors		
X7143A	17-inch entry color monitor, 0.28 mm. dot pitch		
X7137A	18.1 TFT LCD, 20-inch CRT equiv., 1280x1024		
X7146A	21-inch color monitor, .24mm. Dot pitch, 19.8 inch v.a.		
X7134A	24.1-inch :CD 1920x1200 **Note:** Requires X3684A or X3685A for 1920x1080 resolution		For higher end graphics, not as a general console.
	Note: The following have been retired but are supported with PGX64 or PGX32. X7103A - 17-inch entry color monitor X7119A - 19-inch color monitor X7121A - 21-inch color monitor X7124A – 24-inch wide screen color monitor X7126A – 21-inch color monitor, 19.8 inch v.a. X7127A - 19-inch color monitor, 18.1”TFT LCD		Please review product details and requirements.
	Cables and Adapters		
X3872A	Video connector adapter, HD15F/13W3M		
X470A	Video adapter, 13W3F/HD15M		
X985A	Serial port Y/splitter cable		
X913A	Adapter for DDS-3 tape drive to convert from fast wide to narrow SCSI		
X3830A	4-meter SCSI cable, VHDC to 68-pin SCSI, for use with (X)6541A		
X3831A	10-meter SCSI cable, VHDC to 68-pin SCSI, for use with (X)6541A		
X973A	2-meter fibre-optic cable		
X9715A	5-meter fibre-optic cable		
X978A	15-meter fibre-optic cable		

	Racks		
SG-XARY030A	72-inch high Sun StorEdge Expansion cabinet **Note:** Maximum of two Sun Fire V880 systems per rack. When a single system is placed within a rack, it should be at the lowest position in the rack.		Optional front door X9818A
SF-XCAB	Sun Fire Expansion Rack **Note:** Only one Sun Fire V880 server per rack. When a single system is placed within a rack, it should be at the lowest position in the rack for stability. **Note:** Alternate mounting brackets are included wiith X9628A rackmount kit		Requires X4347A Sun Fire Expansion kit to allow rear door of cabinet to close

System Management

Software

The following are components of Sun™ XVR-4000 graphics software:

- Solaris Kernel device driver
- X Window system

  A device-dependent X (DDX) module is provided for the Sun XVR-4000 Graphics Accelerator
- OpenGL® pipeline

  An OpenGL 1.3 device pipeline is provided for the Sun XVR-4000 Graphics Accelerator. Highlights of this version include 2D and 3D texture mapping, directional, infinite-eye lights (up to 32 lights), and retained alpha.
- Configuration tools

  A device-specific module for the Sun XVR-4000 Graphics Accelerator has been provided for the fbconfig command-line configuration and management utility.
- Video output tool — A GUI-driven video output tool is provided to configure and manage the S-video port on the Sun XVR-4000 Graphics Accelerator.

Sun™ OpenGL® for Solaris™ Software

Sun™ OpenGL® for Solaris™ 1.3 software provides a powerful programming environment for developing and deploying interactive 3D applications on SPARC processor workstations. It allows mainstream 3D graphics and visualization applications to be deployed on Sun's workstation graphics and high-end visualization product-line, providing customers with a robust and scalable platform for their 3D graphics needs.

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

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

Widespread multivendor availability of OpenGL software allows source-code portability of 3D graphics applications across platforms. Sun OpenGL for Solaris 1.3 software is a compliant implementation of OpenGL 1.3 specification from the OpenGL Architecture Review Board (ARB) and is source-code compatible with other conformant OpenGL software on the market. Most existing OpenGL applications need only to be recompiled in order to run with Sun OpenGL for Solaris software.

Sun OpenGL for Solaris software is targeted at developers creating interactive 3D graphics applications for technical, creative, and analytical markets. Potential users include those in manufacturing for design/styling and virtual prototyping, scientific research, life sciences, petroleum exploration, training/simulation and global information systems.

The Sun OpenGL for Solaris 1.3 software provides an implementation of OpenGL that incorporates hardware acceleration when used in conjunction with the Sun XVR-4000 graphics accelerator:

- Transformations - 2D (3x2) and 3D (4x4)
- Geometry attributes - color, line type, fill pattern and textures, etc.
- 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)
- Transparency - screen-door and alpha blended transparency
- Anti-aliasing
- Depth cueing - linear and scaled
- Texture mapping - 2D texturing of 3D surfaces (accelerated using VIS™)

The Sun OpenGL for Solaris 1.3 API also includes support for a wide range of extensions beyond what is defined in the standard OpenGL specification, including:

- Cube Map Texture extension — improves the visual effects of reflection mapping using a set of six two-dimensional texture images representing the faces of a cube
- Multi-texture and Texture Dot3 Environment mode — allows multiple textures to be applied to a primitive for various texture effects as well as enabling per-pixel lighting computations for better lighting effects
- Dynamic Video Resolution extension — scales the frame rate by dynamically adjusting framebuffer video resolution
- Gradient Background Clear extension — provides faster clearing of background with gradient colors
- Various Blending extensions — supports new blending operations, enables native support for Porter-Duff blending, etc.
- 3D Texture extension — provides functions for volume rendering/visualization
- Imaging extension — provides functions for image processing operations, such as convolution and histogram
- Global Alpha extension — allows applications to specify an alpha component which can be applied globally to all primitives
- Triangle Mesh and QuadMesh primitive extensions — provides a more efficient way to render multiple triangle-strips or quad-strips (for improved performance)
- Display List Tuning — provides faster display list compilation and rendering

Ordering Information

Part Numbers

Part Number	Description
X6090A	**Sun™ XVR-4000 graphics accelerator** Offered as x-option to enable customer to add support for additional displays, to either of the Sun Fire V880z configurations
A47-USF2-9AA-4G-AL	**Sun™ Fire V880z** V880z with 2x900MHz USIII CPUs, 4 GB memory, 1x XVR-4000 Graphics Accelerator, 6x73GB FCAL
A47-USF4-9AA-16GAL	**Sun™ Fire V880z** V880z with 4x900MHz USIII CPUs, 16 GB memory, 1x XVR-4000 Graphics Accelerator, 6x73GB FCAL
X6091AP	**Sun Fire V880z upgrade kit** This upgrade kit (X6091AP) offered as a promotion for a limited time to existing V880 customers, includes a Sun XVR-4000 Graphics Accelerator (Zulu), new front bezel, Zulu S/W and cables to help a customer upgrade their V880 system to a V880z system. The V880 system would need to be a 2x900MHz USIII, or a 4x900MHz USIII or a 6x900MHz USIII config.

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.

Support Contracts

SunSpectrum program support contracts are available both during and after the warranty program. Customers may choose to uplift the service and support agreement to meet their business needs by purchasing a SunSpectrum contract. For more information on the SunSpectrum program offerings refer to the following URL: `http://intranet.central.sun.com/service/support/sunspectrum`

The four levels of SunSpectrum support contracts are outlined below.

SunSpectrum Program Support

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

Warranty

Sun Fire V880z

Standard warranty features for the Sun Fire V880z include:

- Hardware Support - Three years
- Software installation - 90 days

- Call Response - Eight hours
- Delivery - Second business day, on-site

Sun XVR-4000 Graphics Accelerator

The Sun XVR-4000 graphics accelerator has the standard x-option warranty

– One year return to Sun

– Hardware repair or replacement within fifteen (15) business days.

The XVR-4000 consists of a single field replaceable unit (FRU). If a failure is detected by the Sun XVR-4000 graphics Fcode selftest or SunVTS zulutest, the Sun XVR-4000 graphics board should be replaced and the bad board returned to the Field Service Depot for repair.

For specific warranty terms and conditions, go to the Global Warranty Features by Product web site

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 3D 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.
Depth-cueing	A technique that selectively varies image intensity to create an illusion of depth in a 3D 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.
GLUT	Gamma lookup table.
Gouraud shading	A means of rendering images composed of multifaceted polygons, enabling smoothly shaded surfaces. Rhymes with Thoreau.
Java Advanced Imaging (JAI)	A cross platform foundation imaging-oriented graphics library written in Java providing high functionality and performance to imaging applications.
Java 3D	An API based on the Java™ programming language. It is part of the Java Media Set for writing stand-alone, 3D graphics applications or Web-based 3D applets. Gives developers high-level constructs for creating and manipulating 3D geometry and tools for constructing the structures used in rendering that geometry.
NUPA	North UPA interface. See also SUPA.
OpenGL	A 2D/3D graphics library for geometry applications. Multivendor support.
PLL	Phase-lock loop. A multiplying, phase-locked loop (PLL) frequency synthesizer used to generate the pixel clock.
SUPA	South UPA interface. See also NUPA.
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 2D raster image to each individual 3D facet of an object.
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.
Z-buffering	Additional memory that allows for fast computation and rendering of Z-dimension, or depth, of a 3D solids object. The presence of a Z-buffer typically determines whether a graphics workstation is considered 3D or not.

Materials Abstract

All materials are available on SunWIN except where noted otherwise.

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
References				
– *Sun™ XVR-4000 Graphics Accelerator/Sun Fire V880z Visualization System, Just the Facts*	Reference Guide (this document)	Training, Sales Tool	SunWIN, Reseller Web	367353
– *Sun Fire V880 Server, Just The Facts*	Just The Facts Document for the V880 server which provides the building block for the V880z visualization system	Training, Sales Tool	SunWIN	134456
Presentations				
– *Sun™ XVR-4000 Graphics Accelerator/Sun Fire V880z Visualization System Customer Presentation*	Customer Presentation	Sales Tool	SunWIN, Reseller Web	367354
– *Sun™ XVR-4000 Graphics Accelerator/Sun Fire V880z Visualization System Sales Training Presentation*	Sales Training Presentation	Sales Tool	SunWIN, Reseller Web	367357
– *Sun Fire V880 900MHz Technical Customer Presentation*	Customer Presentation	Sales Tool	SunWIN, Reseller Web	325007
Technical White Papers				
– *Sun XVR-4000 Graphics Accelerator Architecture: Sun Fire V880z Visualization System Technical White Paper*	Technical White Paper	Sales Tool	SunWIN, Reseller Web	367352
– *Sun XVR-1000 Graphics White Paper*	Technical White Paper	Sales Tool	SunWIN, Reseller Web	335932
– *Introduction to Texture Mapping White Paper*	Overview and Description of Various Texture Mapping Techniques	Sales Tool	SunWIN, Reseller Web	67281
Product Literature				
– *Sun Fire V880z / Sun XVR-4000 Graphics Data Sheet*	Data Sheet	Sales Tool	SunWIN, Reseller Web COMAC	367356
– *Sun XVR-1000 Graphics Data Sheet*	Data Sheet	Sales Tool	SunWIN, Reseller Web COMAC	335931

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
– *Sun Visualization Solutions Brochure*	Brochure	Sales Tool	SunWIN, Reseller Web	367355
– *Sun Visualization Solutions Sales Guide*	Sales Guide	Sales Tool	SunWIN	367358

External Web Sites
– *Sun XVR-4000 Graphics Information*
– *Sun XVR-4000 Graphics Software Updates and Patches*
– *Sun Fire V880z Information*
– *Visualization Solutions*
	`http://www.sun.com/servers/entry/V880z/index.html`
	`http://sunsolve.central.sun.com`
	`http://www.sun.com/servers/entry/V880z/index.html`
	`http://www.sun.com/solutions/hpc/visualization.html`			

– – –				