Permedia4®

ARCHITECTURE OVERVIEW

PROPRIETARY AND CONFIDENTIAL INFORMATION

3D*labs*®

Permedia4®

Architecture Overview

PROPRIETARY AND CONFIDENTIAL INFORMATION

Issue 3

Proprietary Notice

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Document	Issue	Date	Change
160.0.2	1	5 Jan 99	First Issue.
160.0.2	2	5 April 99	Engineering updates – memory layouts.
160.0.2	3	24 Aug 99	P4 name change, display resolutions

Contents

1 Introduction

Permedia4 is a high performance AGP graphics processor that balances high quality 3D polygon and textured graphics acceleration, windows acceleration and state-of-the-art MPEG1/MPEG2 playback with a fast integrated SVGA core and integrated RAMDAC. This document provides a high level overview of the architecture of the PERMEDIA4 graphics processor and is intended as an introduction for design engineers and project managers planning the implementation of PERMEDIA4 based systems.

1.1 Permedia4 – Target Markets

PERMEDIA4 targets the following market segments:

- Performance consumer
- Corporate Desktop
- Entry Level Workstation

1.2 Permedia4 Key Features

♥ Full support for Intel's Accelerated Graphics Port (AGP 4X)
- 266 MHz AGP 4X operation
- Low latency command DMA and Execute Mode support
- Sideband addressing

♥ Multiple DMA engines to/from graphics processor and memory and DVD accelerator

♥ Enhanced 3D graphics features and performance (at 125MHz)
- 250M perspective correct, bilinear filtered, dual texture texels/sec
- 125M perspective correct, per pixel MIP-mapped trilinear filtered, texture mapped, depth buffered, fogged and blended pixels/sec
- 8M backface-culled polygons/sec
- 2.5M drawn polygons/sec flat shaded
- 5M backface-culled textured polygons/sec
- 2M drawn texture mapped polygons/sec
- 5M lines/sec flat shaded
- 3.5M textured lines/sec
- True-color 3D graphics
- Standard or non-linear 15, 16, 24 or 32 bit Z buffer
- Anti-aliasing for all primitives and full scene sort-independent anti-aliasing

♥ Enhanced GUI acceleration
- Ultra-fast BLT engine and 2D rasterizer

- Stretch BLTs, monochrome/color expansion and logic ops
- 8, 16 and 32-bit packed framebuffer

♥ MPEG2 compatible Video playback acceleration

- YUV 4:1:1 , YUV 4:2:2 and YUV 4:4:4
- Unlimited multiple playback windows (occluded)
- Motion compensation
- Hardware scaling and filtering
- Video overlay

♥ Integrated geometry pipeline set-up processor

- Backface culling
- D3D and OpenGL conformant – native D3D vertex interface

♥ Integrated true-color 270 MHz RAMDAC

- DPMS, DDC1 and DDC2AB+
- Clock synthesizer and hardware cursor
- 320x200 to 1920x1200

♥ Fast on-chip SVGA

♥ LCD flat panel and TV display support

- 24 bit output port including color lookup and hardware cursor
- 135 MHz output

♥ Flexible multi-function SDRAM or SGRAM memory interface

- 128 bit bus
- Supports 2 to 32 Mbytes of memory

♥ Software Support

- Windows 95/98
- Windows NT/Windows 2000
- DirectX 6 and 7
- OpenGL
- Heidi
- Microsoft PC98/99 compliant

♥ Reference board designs and manufacturing kits

Table 1.1 Permedia4 Key Features

1.3 Chip Level Block Diagram

Permedia4 has been designed as a single low-cost package that combines maximum levels of integration with the demands for flexible multimedia I/O requirements.

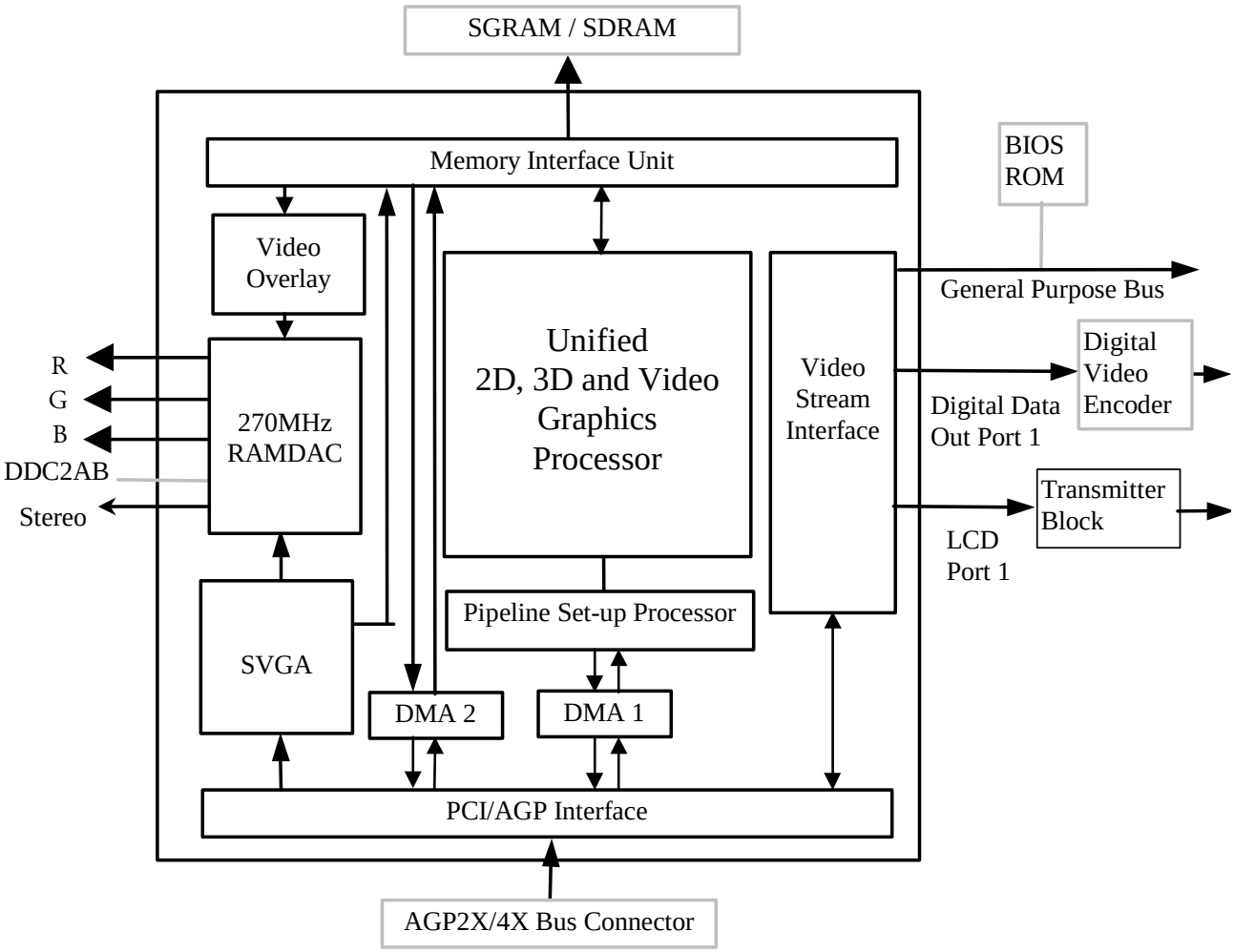

Figure 1.1 Chip Level Block Diagram

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Permedia4 Features

Permedia4 incorporates the following key functions in hardware to provide superior 3D, 2D and video benefits.

2.1 3D Graphics

Supported Function	***Description***
Full primitive support	*Full primitive support: triangle lists, fans and strips. Line lists and strips. Point lists. All either aliased or anti-aliased.*
Efficient processing of small primitives	*Integrated set-up, backface cull calculation, low latency*
High fill rate	*Wide data paths, high performance memory*
Fast buffer clears	*SGRAM block fill for any buffer type. SDRAM block fill emulation with no driver impact.*
Textures	
Efficient texture storage	*Fully flexible formats, internal 256 entry LUT*
AGP textures	*Textures directly from AGP memory*
Dual texture	*One pass dual texture support*
Bump textures	*One pass bump mapping support*
3D textures	*3D volumetric textures*
High quality rendering	*Sub-pixel and sub-texel accurate*
High quality textures	*Accurate perspective correction and trilinear filtering with per pixel MIP-Mapping with true level of detail calculation.*
Lighting/Optical	
High quality lighting	*Interpolated diffuse and specular components*
Extremely realistic special effects	*Interpolated colored fog, fog table and depth-cueing*
Translucent objects and sprites	*Blending/transparency on any primitive. Full dual texture blending. Interpolated alpha with direct support for all DirectX 6, 7 and OpenGL blend modes*
High quality texture cut-outs	*Color key with bilinear filter does not leave edge effects*
Anti-aliased sprites	*Edge anti-aliasing for zoomed sprites*
Fast hidden surface elimination	*Depth (Z) buffering and non-linear Depth (Z) buffering. GID test for per pixel window clipping*
Fast shadow and transparency effects	*Area stippling with no performance cost*
Arbitrary cut-out and multi-pass rendering	*Stencil buffer*
High quality output at any color depth	*Dithering with no performance cost*

Supported Function	*Description*
Fast sprite handling	*Color key, scale, stretch, rotate, mirror*
Seamless integration of video and 3D	*Color key with depth test and perspective correction*
Minimize update area, target selection	*Hardware extent checking and picking*
Improved image quality at lower resolutions	*Full screen sort independent anti-aliasing*
Use of rendered images as textures	*Unified memory- read and write to any buffer*
Full range of double buffer techniques	*Full screen flip, fast BLT, stereo buffers*
Virtual texture map management	*Hardware texture paging from system memory for fine grain management; logical addressing gives better memory utilization*

Table 2.1 3D Hardware Function Descriptions

2.2 2D Graphics

Supported Function	*Description*
Full primitive support	*Points, lines, spans, rectangles, polygons*
Efficient processing of small primitives	*Integrated set-up calculation, low latency*
Window clip	*Hardware rectangle clipping*
Ultra-fast solid fill	*SGRAM block fills. SDRAM block fill emulation with no driver impact.*
Ultra-fast monochrome expansion	*SGRAM block fills with pixel mask. SDRAM block fill emulation with pixel mask with no driver impact.*
High speed color brushes	*Internal pattern RAM*
High speed monochrome brushes	*Internal stipple table*
Raster operations	*Logic op unit*
Fast BLTS	*Wide data path*
Fast upload and download	*Run-length encoded data*
High speed monochrome download	*Bitmask test with SGRAM block fills*
Flexible font caching support	*Byte aligned monochrome bitmaps in local memory*
Color translation	*Through internal LUT*
High speed stretch BLT	*Using texture operations*
Overlays	*Per-pixel main image/overlay selection with color key and alpha blending*
Statistic collection	*Via dedicated StatisticMode register*
Border color	*Standard*
Context save and restore	*Hardware support*

Table 2.2 2D Hardware Function Descriptions

2.3 MPEG2

Supported Function	*Description*
MPEG motion compensation	*Motion compensation calculations performed in hardware*
Support for software decoders	*DMA from system or write directly to local memory*
High speed color space conversion	*YUV to RGB with no performance cost*
Flexible YUV data formats	*4:4:4, 4:2:2, 4:1:1*
Fast arbitrary stretch/shrink with filter	*Bilinear filter at any zoom/shrink factor*
Full featured video effects	*Scale, shrink, stretch, rotate, mirror*

Table 2.3 MPEG2 Functions

2.4 Power Management

Supported Function	*Description*
Clocks can be individually stopped	*Separate clocks for: geometry processor, graphics processor, memory sub-system, video sub-system, video output and AGP*
Automatic frequency reduction	*Reduces average power consumption when idle*
SGRAM power down mode	*Low power while maintaining refresh and screen update*
DPMS	*Power management for monitors*

Table 2.4 Power Management Functions

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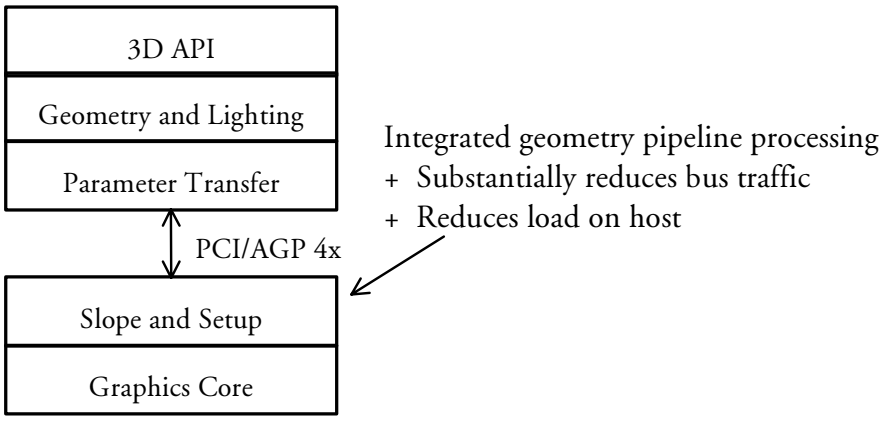
PERMEDIA4 Architecture

The PERMEDIA4 architecture consists of the geometry set-up processor and the main graphics processor augmented by external interfaces, which are described in detail below.

3.1 Geometry Set-up Processing

The on-chip geometry set-up unit is a 300 MFLOPS OpenGL and Direct3D compliant set-up processor, designed to break the 3D bottleneck on PCs that are unable to saturate Permedia4's rendering capabilities. The unit performs fast backface culling, calculates the slope and setup information, and performs high precision floating-to-fixed point conversion. The unit significantly reduces the load on the CPU and the AGP Bus and is general purpose in design to support any 3D API.



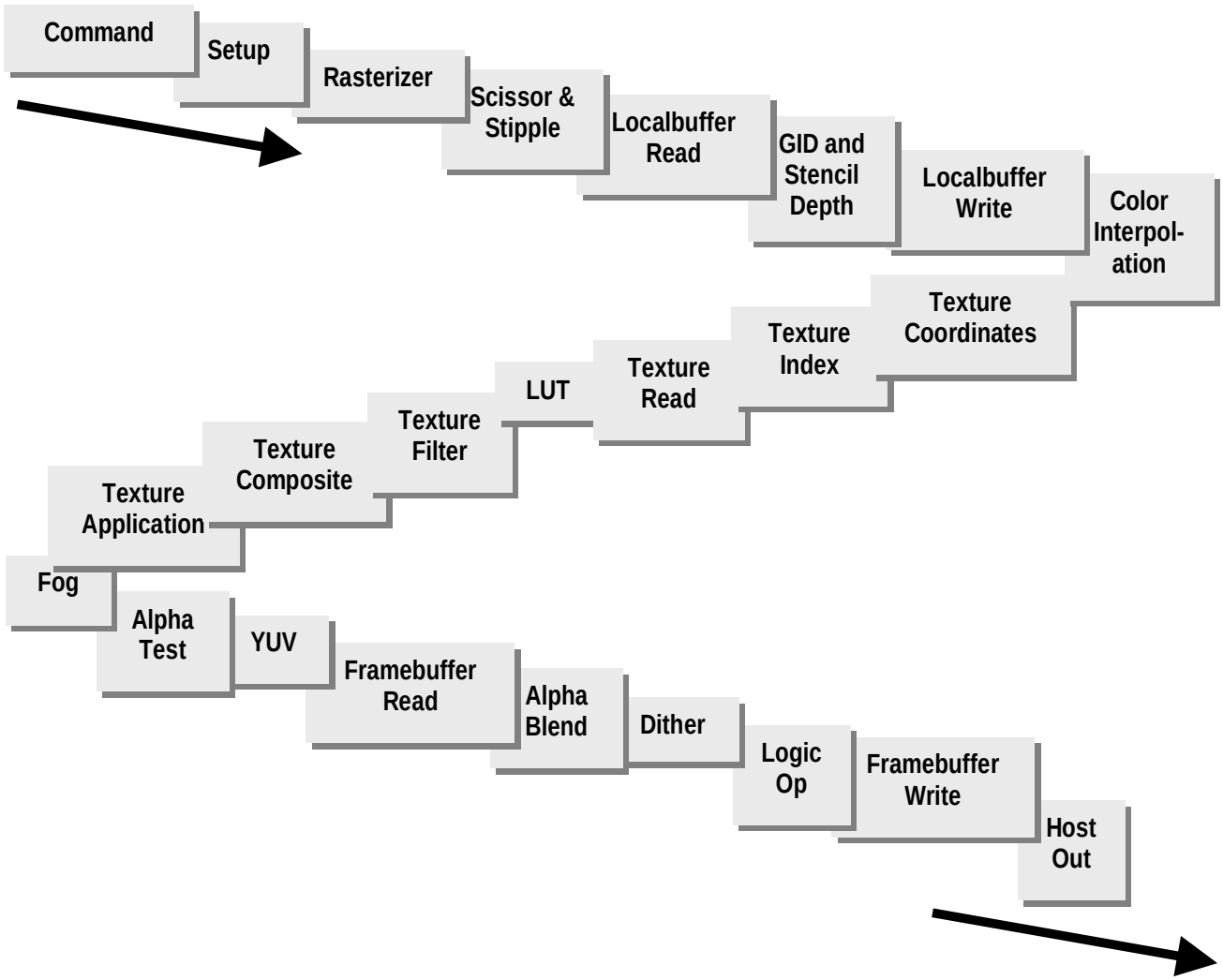
The geometry set-up unit accepts the coordinates of vertices plus color, depth, fog and texture parameters. It accepts the input parameters in IEEE single precision floating point format; internal calculations are performed in floating point format. Vertex sharing for meshes, fans and polylines is supported with the shared vertices being loaded only once. It offers direct support for the Direct3D TLVERTEX data type along with the DirectX 6 and 7 extensions know as "Flexible Vertex Format" (FVF).

3.2 Graphics Processor

The graphics processor unifies 3D, 2D, and video operations into the same processing pipeline. This gives unbeatable flexibility in the way that data may be handled, while ensuring there is no duplication of functions.

The graphics processor rasterizes each primitive to determine the pixels that it covers on the screen. It then processes each pixel through the following sequence of operations:

Figure 3.1 Graphics Processing Pipeline



- Apply stipple pattern
- Perform GID, depth and stencil test
- Update depth and stencil buffer
- Color interpolation
- Calculate texture address, fetch and format texture data
- Color key test
- Texture application
- Fog application
- Transparency application
- Dither to final color format
- Apply logic op
- Update framebuffer
- Update extent and picking statistics

Each stage in the processing pipeline is optional and may be omitted. If a pixel fails any of the tests, it does not take part in any further processing. For example, if a pixel fails the depth test it will not have a texture address calculated for it, nor will it have texture data read from memory and applied. This ensures that processing power is selectively applied to pixels that will actually be used. Furthermore, the pipeline can be reconfigured to optimize primitives using alpha tests. This is particularly useful for billboards since rejected pixels are no longer depth tested and therefore no local buffer read is necessary.

The graphics processor supports a high degree of parallelism, which allows several pixels to be processed at the same time. The design ensures a very high throughput while reducing latency between primitives.

3.3 Host Interfaces

3.3.1 AGP 4X Interface

AGP 4X is Intel's high performance, component level interconnect targeted at 3D display applications which provides significant performance extensions to the PCI specification. The specification for Permedia4's AGP implementation is:

- 266 MHz transfer rate
- DMA and Execute mode support
- Sideband addressing, pipelining

Implementing these features enables Permedia4 to achieve over 1 Gbyte per second bandwidth from the host for instructions, textures and video data (limited by host system throughput).

The add-in slot defined for AGP uses a connector body which is not compatible with the PCI connector, therefore boards designed for use in an AGP slot are not mechanically interchangeable with PCI boards.

AGP4X requires a 1.5VDC signal voltage. Permedia4 implements dual signal voltage supprt (1.5VDC and 3.3VDC) to provide maximum adaptability for AGP2X and 4X board installations.

3.3.1.1 DMA Mode Texturing

Permedia4 has an on-board texture cache to further enhance performance. This treats the local synchronous memory as a working texture store and uses the performance of AGP 4X to access system memory as a high-speed virtual texture store for textures not currently held locally.

A DMA controller optimizes the demand-loaded texture mechanism by transferring data directly into local memory. The caching mechanism places no load on the host CPU and is analogous to an L2 CPU cache.

Virtual texture and demand texture paging offer a number of significant benefits:

- Up to 256MB of addressable virtual texture – larger than graphics memory
- Multiple textures without texture mapping
- Fast texture changes rewriting only selected areas in 4K texture blts
- 4K granularity – minimum texture download bandwidth
- graphics memory functions as fast secondary texture cache for heavily-used textures
- relocatable texture pages do not need to be contiguous in local memory.

3.3.1.2 Execute Mode Texturing

In the AGP execute model, Permedia4 uses both the local memory and the system memory as primary graphics memory. The two memory systems are logically equivalent and textures in system memory are no longer copied to local memory but executed directly from system memory. Using the execute model leverages optimal performance from systems with limited local memory and current-generation fast CPU architectures.

3.3.2 PCI Interface

The host interface on Permedia4 provides continued support for PCI v2.1 and 2.2 and contains both a FIFO and DMA controllers. Control registers for the host interface are memory mapped onto the PCI Bus. The host can read back control and state information from the programmable registers.

Two methods of PCI bus communication are available between the host and Permedia4. Direct to the FIFO, where Permedia4 acts as a PCI slave, or alternatively Permedia4 can be programmed to be a PCI master and use the internal DMA controller to fetch commands into the FIFO.

3.3.3 AGP Interface Characteristics

- Glueless interface - simple and low-cost design-in
- 32-bit Master/Slave - maximum speed
- Big-endian - avoids byte swapping on PowerMacs
- Plug and Play - Revision 2.1 compliant
- Supports dual voltage, 3.3VDC and 1.5VDC signal interfaces

3.3.3.1 DMA1 Controller – System to Graphics Core and Graphics Core to System

- Autonomous - set-up/fetch parallelism
- No wait state - maximum transfer rate
- Programmable block size - large DMA buffers
- Separate DMA controllers for upload and download can run concurrently

3.3.3.2 DMA2 Controller - System to Memory and Memory to System

- Fast texture/image uploads and downloads
- Separate DMA controllers for upload and download can run concurrently
- DMA Controller supports scatter/gather
- Fast software MPEG2 download, fast frame capture

3.3.3.3 Interrupt Controller

- End-of-DMA - allows DMA chaining
- VSYNC - efficient double buffering
- Scanline - special effects
- Texture invalid
- Bypass DMA interrupt
- I2C start condition - alert host to start of I2C transfer
- Sync - indicates graphics core is idle
- Error - e.g. writing to a full FIFO

3.3.3.4 Graphics Processor Bypass to Memory

- Fast access to memory - for software rendering

3.4 Unified Memory Interface

The PERMEDIA4 unified memory subsystem uses Synchronous Graphics RAM (SGRAM) or compatible Synchronous DRAM to supply the memory bandwidth needed for 3D operations and display update. The unified memory interface manages local memory and remote memory respectively. Remote memory is read and written across the bus using AGP 4X (or optionally PCI or AGP2x) protocols.

3.4.1 SDRAM/SGRAM Overview

- 128-bit Synchronous Memory Interface
  - SGRAM for best performance (block fills and write masks)
  - SDRAM with block fill emulation for reduced cost
- 32 Mbytes of memory maximum
  - 2 Mbytes option (64 bits wide)
- 125 MHz operation
- High speed block fill and masked writes
  - two color block write (Siemens SGRAM)

To address all targeted market segments PERMEDIA4 supports 64 and 128 bit wide memory arrays for optimum price/performance positioning. The maximum configuration is 32Mbytes SDRAM or SGRAM, however configurations down to 2MB are still supported. For representative layouts see chapter 5, section 5.4.

- Using two 64Mbit x 32 SDRAM memory devices to give 16 Mbytes on a 64 bit bus is the cost effective, minimum part count memory organization.
- A mid-range memory organization uses four 64 Mbit x 32 SDRAM memory devices to give 32 Mbytes on a 128 bit bus.
- Four banks of devices give 32 Mbyte configurations suitable for smaller SGRAM devices and higher performance needs. Typically, 4 banks of four, 16 Mbit x 32 SGRAM devices give 32 Mbytes on a 128 bit bus.

The memory array requires no external logic and has been designed to deliver optimum performance on low cost boards by minimizing susceptibility to signal skew.

3.4.2 Flexible Multi-function Memory Layout

PERMEDIA4 stores a variety of data and color formats in memory at the same time. The organization of data in memory is unconstrained and allows mixing of buffers of any data type. The color data (ready for display) is referred to as the framebuffer, which in double-buffering applications such as games and animations is made up of a front-buffer and a back-buffer (one being drawn to, the other being displayed).

After these buffers are allocated, the Z-buffer (depth), GID-buffer, stencil-buffer and texture-buffer are stored in the remaining memory. Stereo buffers for driving LCD glasses are supported by splitting the front and back buffer into front left, front right, back left and back right.

The multi-function nature of the memory organization allows Permedia4 to store the different buffers anywhere in the same physical memory, minimizing memory wastage and offering a simplified programming model. It is not necessary to store all data of a particular

type together, so a texture map may be followed by a depth buffer or a framebuffer or another texture map. The SVGA is an independent unit that shares the memory controller to access the framebuffer when active.

3.4.3 Supported Memory Data Formats

A variety of data formats are supported by Permedia4 for storing and retrieving information to be held in the various memory buffers.

3.4.3.1 Framebuffer Color Formats

The PERMEDIA4 supports a number of color formats for the framestore (frontbuffer and backbuffer). Both RGBA and BGRA ordering of pixels are supported.

- 8-bit RGBA 3:3:2:-
- 16-bit RGBA 5:5:5:1 or 5:6:5
- 32-bit RGBA 8:8:8:8
- Color Index (CI) 8:-:-:-

3.4.3.2 Texture Formats

Textures can be stored in memory in the formats described below. These formats are a superset of the framebuffer formats due to the support for 8-bit palletized textures and the YUV formats. The use of palletized textures significantly reduces the texture memory requirements, and enhances performance.

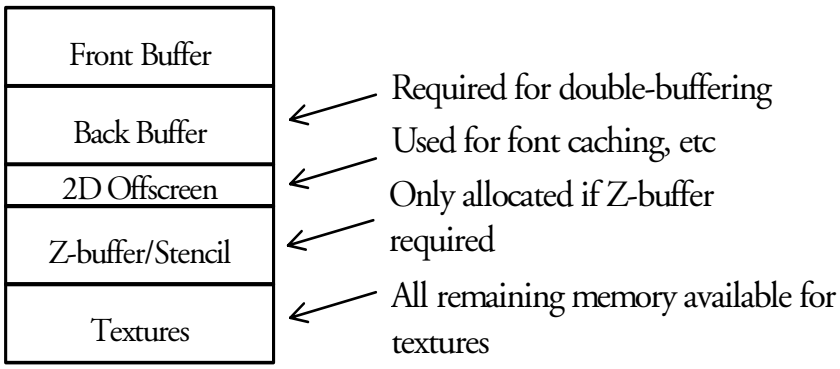
If the texture format is different to the framebuffer format then the graphics core performs the conversion between color formats. If the texture map is 4- or 8-bits palletized, then the user defined on-chip lookup table is used to convert the data into full RGBA.

Supported Texture Formats:

- 8-bit palletized
- 8-bit luminance
- 8-bit luminance alpha 4:4
- 8-bit alpha
- 8-bit RGB 3:3:2:-
- 16-bit luminance alpha 8:8
- 16-bit RGBA 5:5:5:1, 5:6:5:- or 4:4:4:4
- 32-bit RGBA 8:8:8:8
- YUV: 4:2:2, 4:4:4

3.4.3.3 Depth Formats

The use of depth, GID and stencil buffers is optional. Not using depth, GID or stencil buffers increases the memory available to support higher display resolutions and more local texture storage.



- Depth: 15 (stencil is forced to 1 bit), 16, 24, 32-bits linear Z
- Depth: (15, 16, 24) bits non-linear Z

3.4.3.4 Non-linear Z Formats

When storing perspective correct z-values directly into the z-buffer the values are not evenly distributed within the z-buffer range. With a high far/near plane ratio more than 95% of the depth buffer range is spent on the first 5% of the scene depth. This causes artifacts in the rendering of distant objects, especially using 16-bit depth buffers.

The non-linear Z Format introduces a transfer function between the linear interpolated window z-coordinates and their representation in the z-buffer. This transfer function is an inverse of the perspective distortion function given by the perspective transformation. Applying this inverse to the transformed z-values distributes them linearly within the depth buffer range giving the same accuracy regardless of viewer distance.

PERMEDIA4 non-linear Z is flexible and can define the buffer representation of a scene's depth in either OpenGL or Direct3D W-buffer compatible mode.

3.4.3.5 Stencil Formats

Stencil: 0 or 1 (in 16 bit local buffer Z depth must be set to 15), 2, 3, 4, 5, 6, 7, 8

3.4.3.6 Graphics ID (GID)

The 4 bit GID field is used to allow per pixel window clipping. Each window using this facility is assigned one of the GID values, and the visible pixels in the window have their GID field set to this value. This allows per pixel ownership tests so the framebuffer at the given coordinate may not be updated.

- GID: 0, 1, 2, 3, 4

3.5 Video Stream Interface

Permedia4 supports digital video output. The 24-bit streamed output is designed to work with PAL/NTSC encoders or flat panel controllers.

3.5.1 Control Buses

The I2C bus is a two wire serial bus commonly used to control chips on the digital video port.

3.5.2 External ROM

In Permedia4 the external ROM is used to store the Video BIOS and is also used to store the power up configuration information (reducing the need for configuration resistors in board designs). Video output is disabled during access to the ROM. If the ROM fitted is FLASH programmable, the contents may be modified under software control.

3.6 RAMDAC

Permedia4 incorporates a high performance 270MHz RAMDAC.

3.6.1 RAMDAC Characteristics

- High resolution 270 MHz, 128-bit RAMDAC
- Screen resolutions up to 1600x1200@96Hz or 1920x1200@82Hz refresh rate
- Supports packed pixel formats
- Color depths of 8, 16 and 32 bits/pixel
- Dot clock phase-locked loop (PLL)
- Triple 8-bit D/A converters
- 64x64x2-bit cursor array to support a 2, 4 or 16 color hardware cursor with cursor shapes cache

3.6.2 Display Resolutions

Permedia4 supports all the standard screen resolutions at ergonomic refresh rates.
For each resolution and color depth in the table below, the frequency figure represents the refresh rate supported using the VESA generalized Timing formula with 50% of the memory bandwidth used for screen refresh and 50% for drawing assuming a pixel clock of 270MHz.

Resolution	8 bpp	16 bpp	32 bpp
320x200	220 Hz	220 Hz	220 Hz
640x480	220 Hz	220 Hz	220 Hz
800x600	220 Hz	220 Hz	220 Hz
1024x768	217 Hz	217 Hz	217 Hz
1152x864	176 Hz	176 Hz	176 Hz
1280x1024	137 Hz	137 Hz	137 Hz
1600x1200	96 Hz	96 Hz	96 Hz
1920x1080	90 Hz	90 Hz	90 Hz
1920x1200	82.3 Hz	82.3 Hz	82.3 Hz

Table 3.2 Display Resolutions

Resolutions are driver and memory limited. A 32MB framebuffer for example can support 2048x1200 @ 32bit colour, 32bit Z; or 2048x1536 @ 32bit colour, 16bit Z.

3.6.3 Display Data Channels (DDC)

Two control lines are dedicated on Permedia4 to support DDC1 and DDC2AB+ monitor configuration utilities. The DDC2 serial bus is independent of the serial bus in the video stream interface.

3.7 SVGA

The on-chip SVGA unit is register-level compatible with standard VGA devices and requires no software emulation. It supports all standard VGA modes and VESA VBE modes 0x100 up to 0x11B. The SVGA unit is a high performance 32-bit implementation.

In addition to VGA modes the following VESA SVGA modes are supported:

Mode (hex)	Pixels	Colors	Windowed	Linear	Supportable in SVGA	Supportable in GP
0x100	640x400	256	✓	✓	✓	✓
0x101	640x480	256	✓	✓	✓	✓
0x102	800x600	16	✓	×	✓	×
0x103	800x600	256	✓	✓	×	✓
0x104	1024x768	16	✓	×	✓	×
0x105	1024x768	256	✓	✓	×	✓
0x106	1280x1024	16	✓	×	✓	×
0x107	1280x1024	256	✓	✓	×	✓
0x109	320x200	32K (5:5:5:1)	✓	✓	×	✓
0x10D	320x200	64K (5:6:5)	✓	✓	×	✓
0x10F	320x200	16.8M (8:8:8)	✓	✓	×	✓
0x110	640x480	32K (5:5:5:1)	✓	✓	×	✓
0x111	640x480	64K (5:6:5)	✓	✓	×	✓
0x112	640x480	16.8M (8:8:8)	✓	✓	×	✓
0x113	800x600	32K (5:5:5:1)	✓	✓	×	✓
0x114	800x600	64K (5:6:5)	✓	✓	×	✓
0x115	800x600	16.8M (8:8:8)	✓	✓	×	✓
0x116	1024x768	32K (5:5:5:1)	✓	✓	×	✓
0x117	1024x768	64K (5:6:5)	✓	✓	×	✓
0x118	1024x768	16.8M (8:8:8)	✓	✓	×	✓
0x119	1280x1024	32K (5:5:5:1)	✓	✓	×	✓
0x11A	1280x1024	64K (5:6:5)	✓	✓	×	✓
0x11B	1280x1024	16.8M (8:8:8)	✓	✓	×	✓

Table 3.3 VESA VBE Graphics Modes

The following VESA VBE text modes are supportable in the SVGA:

Mode (hex)	Characters (col/row)
0x108	80x60
0x109	132x25
0x10A	132x43
0x10B	132x50
0x10C	132x60

Table 3.4 VESA VBE Text Modes

Permedia4 allows VESA bankswitching to be done through the bypass to enable additional VESA windowed mode support.

ModeX is also supported

4

Software Drivers

3Dlabs have extensive experience and a proven track record in delivering high performance, high quality, ready-to-ship WHQL certified software drivers that extract the maximum performance from both the Permedia4 processor and the entire system.

4.1 2D Windows NT version 4/Windows 2000 with DirectX 6 and 7

Other software drivers may be made available depending on current market requirements.

4.2 3D Drivers

Permedia4 has been designed to accelerate the key consumer focused 3D APIs and drivers. 3Dlabs' processors have become the reference port for many 3D drivers - Microsoft's future OpenGL ICD reference DDK is based on 3Dlabs drivers.

PERMEDIA4 high performance 3D drivers support:

- Direct3D 6 and 7
- OpenGL 1.1 (OpenGL 1.2 when this is supported by Microsoft)
- Autodesk's Heidi for 3D Studio MAX support, including all D3D and OpenGL Depth and Stencil modes.

4.3 SVGA BIOS

- SVGA BIOS based on the proven, industry-standard Phoenix Technologies BIOS core

5

OEM Focused Solutions

A range of PERMEDIA4 based add-in boards and motherboards can be designed to meet the requirements of particular markets and their price/performance criteria. 3Dlabs produce reference designs for many of the more common configurations, all of which can support our full suite of software drivers, including Windows 98, Windows NT version 5.0 (Windows 2000), OpenGL 1.2 and Direct3D 6 and 7.

5.1 Permedia4 for Windows 98 and Windows NT/Windows 2000

For users seeking a 3D accelerator for Windows 98 and Windows NT/Windows 2000 applications based on Direct3D 6 and 7, OpenGL 1.2 or 3D Studio MAX 2, there can be no better solution than a 2 to 32 Mbytes graphics board based on the PERMEDIA4 processor.

The PERMEDIA4 delivers unrivalled 3D and multimedia acceleration for both business and consumer 3D applications such as Web browsers, authoring tools, games and personal design packages.

5.2 Early Access Program

The Permedia4 Early Access Program (EAP) is for Independent Hardware Vendors (IHVs) and OEMs who wish to work closely with 3Dlabs in bringing Permedia4 based designs to market quickly and efficiently. Supporting a close technical and marketing collaboration, the program is open to IHVs committed to developing Permedia4 based solutions. It offers:

- Close technical support and joint marketing and press programs
- Early access to design engineers, design guides and application notes
- Priority supply of sample parts and access to reference board schematics
- Participation in driver Beta programs

To minimize development times 3Dlabs provides Permedia4 EAPs with access to extensive design documentation for the 3Dlabs reference boards including board schematics, ORCAD and Gerber files, design guides, application notes and access to a full suite of device drivers.

5.3 OEM Solution Designs

This section provides sample configurations for various product types. Changes in component availability and pricing will affect the actual target component selection. Configuration descriptions assume 16 or 32 Mbytes RAM and AGP4X bus interface. However 2Mbyte to 8 Mbyte memory configurations, PCI and AGP2x continue to be supported.

5.3.1 Workstation Performance 2D/3D

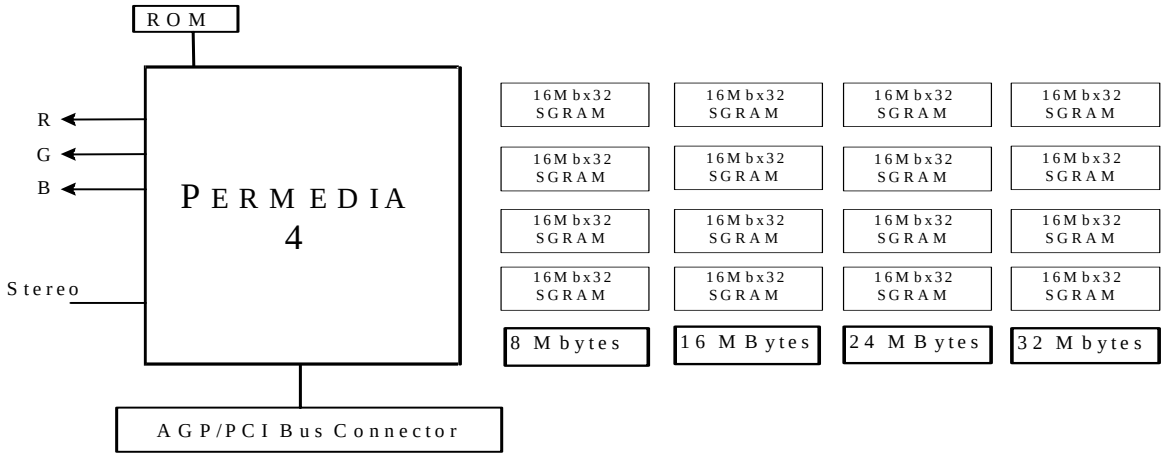


Figure 5.1 CAD/CAE Workstation Solution

Designed for 3D workstation applications such as mechanical design and animation, this reference board features up to 32 Mbytes of memory (using 8 SGRAM devices per block) for high screen resolutions and extended local texture storage. It typically uses the AGP DMA model to transfer textures into local memory where it caches them for higher performance. The LCD output of the Video unit supports 18 or 24 bit flat panel interfaces at 135 MHz.

5.3.2 Desktop Entry Solution

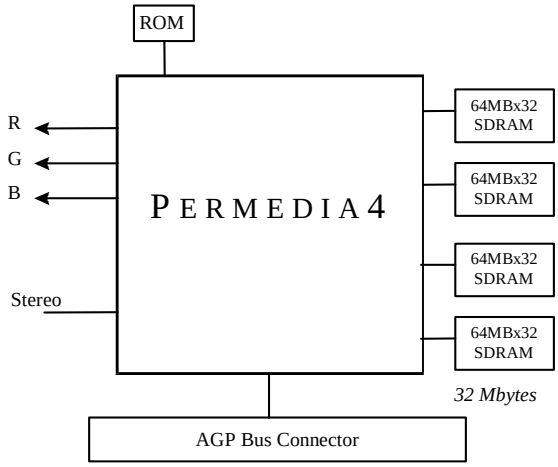


Figure 5.1 Desktop Entry Solution

Designed for the demanding business user or home enthusiast, this reference board features 32 Mbytes of memory for higher screen resolutions and extended local texture storage. This may be either a standard PCI board or an AGP 2x or 4X card. As an AGP card, it uses the DMA model to transfer textures into local memory where it caches them for higher performance. Stereo applications use the extra Stereo pin to drive LCD glasses. For very high resolutions, it has the AGP execute model to avoid storing textures locally.

5.3.3 Home PC Solution

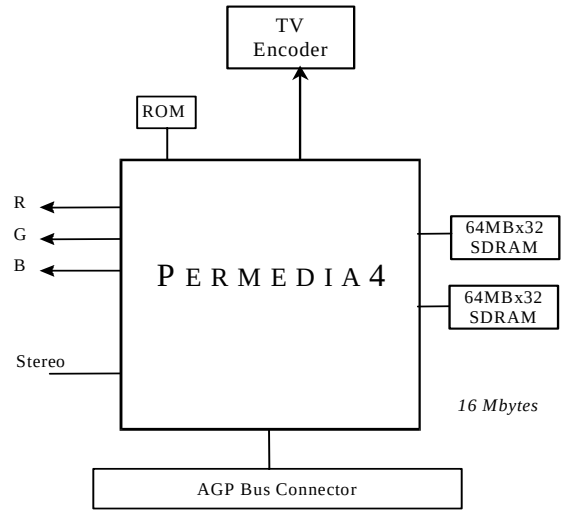


Figure 5.1 Home PC Solution

This reference board based on the Permedia 3D solution adds the necessary hardware to enable TV output.

5.4 Typical Memory Configurations and Resolutions

The following table shows the color and display resolutions and texture storage supported for some typical memory configurations. All 3D content is assumed to be double buffered.

5.4.1 3D Memory Configurations

The texture column indicates the amount of texture memory available after the framebuffer (including backbuffer) and depth buffer have been allocated. Supported lower resolutions and 8 bit framebuffers are not listed in the table below.

Width	Height	Color	Z	Available Texture Memory	
				16Mb card	32 Mb card
640	480	16-bit	0-bit	14.8	30.8
640	480	16-bit	16-bit	14.2	30.2
640	480	16-bit	24-bit	13.7	29.7
640	480	16-bit	32-bit	13.7	29.7
640	480	32-bit	0-bit	13.7	29.7
640	480	32-bit	16-bit	13.1	29.1
640	480	32-bit	24-bit	12.5	28.5
640	480	32-bit	32-bit	12.5	28.5
800	600	16-bit	0-bit	14.2	30.2
800	600	16-bit	16-bit	13.3	29.3
800	600	16-bit	16-bit	12.3	28.3
800	600	16-bit	32-bit	12.3	28.3
800	600	32-bit	0-bit	12.3	28.3
800	600	32-bit	16-bit	11.4	27.4
800	600	32-bit	24-bit	10.5	26.5
800	600	32-bit	32-bit	10.5	26.5
1024	768	16-bit	0-bit	13.0	29.0
1024	768	16-bit	16-bit	11.5	27.5
1024	768	16-bit	24-bit	10.0	26.0
1024	768	16-bit	32-bit	10.0	26.0
1024	768	32-bit	0-bit	10.0	26.0
1024	768	32-bit	16-bit	8.5	24.5
1024	768	32-bit	24-bit	7.0	23.0
1024	768	32-bit	32-bit	7.0	23.0
1280	1024	16-bit	0-bit	11.0	27.0
1280	1024	16-bit	16-bit	8.5	24.5
1280	1024	16-bit	24-bit	6.0	22.0
1280	1024	16-bit	32-bit	6.0	22.0
1280	1024	32-bit	0-bit	6.0	22.0
1280	1024	32-bit	16-bit	3.5	19.5
1280	1024	32-bit	24-bit	1.0	17.0
1280	1024	32-bit	32-bit	1.0	17.0
1600	1200	16-bit	0-bit	8.7	24.7
1600	1200	16-bit	16-bit	5.0	21.0
1600	1200	16-bit	24-bit	1.4	17.4
1600	1200	16-bit	32-bit	1.4	17.4
1600	1200	32-bit	0-bit	1.4	17.4
1600	1200	32-bit	16-bit	-	13.7
1600	1200	32-bit	24-bit	-	10.0
1600	1200	32-bit	32-bit	-	10.0
1920	1080	16-bit	0-bit	8.1	24.1
1920	1080	16-bit	16-bit	4.1	20.1
1920	1080	16-bit	24-bit	0.2	16.2
1920	1080	16-bit	32-bit	0.2	16.2
1920	1080	32-bit	0-bit	0.2	16.2
1920	1080	32-bit	16-bit	-	12.2
1920	1080	32-bit	24-bit	-	8.3
1920	1080	32-bit	32-bit	-	8.3
1920	1200	32-bit	32-bit	-	5.6

Table 5.1 3D Memory Configurations and available Texture Memory

5.4.2 2D Memory Configurations

The following table shows the 2D screen resolutions supported by different amounts of memory.

Width	Height	Color	Memory Configuration	
			16Mb card	32Mb card
512	384	8-bit	✓	✓
512	384	16-bit	✓	✓
512	384	32-bit	✓	✓
640	400	8-bit	✓	✓
640	400	16-bit	✓	✓
640	400	32-bit	✓	✓
640	480	8-bit	✓	✓
640	480	16-bit	✓	✓
640	480	32-bit	✓	✓
800	600	8-bit	✓	✓
800	600	16-bit	✓	✓
800	600	32-bit	✓	✓
1024	768	8-bit	✓	✓
1024	768	16-bit	✓	✓
1024	768	32-bit	✓	✓
1280	1024	8-bit	✓	✓
1280	1024	16-bit	✓	✓
1280	1024	32-bit	✓	✓
1600	1200	8-bit	✓	✓
1600	1200	16-bit	✓	✓
1600	1200	32-bit	✓	✓
1920	1080	8-bit	✓	✓
1920	1080	16-bit	✓	✓
1920	1080	32-bit	✓	✓
1920	1200	8-bit	✓	✓
1920	1200	16-bit	✓	✓
1920	1200	32-bit	✓	✓

Table 5.2 - 2D Memory Configurations

5.5 PC 98 and PC 99 compliance

Permedia4 meets full PC 98 and PC 99 compliance parameters detailed below:

Description	Consumer		Office		Entertain-ment	
	PC 98	PC 99	PC 98	PC 99	PC 98	PC 99
System Requirements for Graphics Adapters						
Graphics adapter uses PCI, AGP, or another high-speed bus	✓	✓	✓	✓	✓[1]	✓ AGP
System provides hardware-accelerated 3D graphics	n/a	✓	n/a	✓[1]	n/a	✓
System uses WC with higher-performance processors	✓	✓	✓	✓	✓	✓
Primary graphics adapter works normally with default VGA mode driver	✓	✓	✓	✓	✓	✓
Adapter and driver support multiple adapters and multiple monitors	✓	✓	✓	✓	✓	✓
Adapter supports television output if system does not include large-screen monitor	✓[1]	✓[1]	✓[1]	✓[2]	✓	✓[1]
Hardware Acceleration for Video Playback						
Adapter supports video overlay surface with scaling	✓	✓	✓	✓	✓	✓
Hardware supports VGA destination color keying for video rectangle	✓	✓[3]	✓[3]	✓[3]	✓	✓
Adapter supports MPEG-2 motion compensation acceleration	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]
Adapter provides the ability to scan at the same frequency as the incoming video	n/a	✓[1]	n/a	✓[1]	n/a	✓[1]
Multiple-Adapter and Multiple-Monitor Support						
Extended resources can be dynamically relocated after system boot	✓	✓	✓	✓	✓	✓
VGA resources can be disabled by software	✓	✓	✓	✓	✓	✓

Table 5.3 - PC 98 and PC 99 compliance

[1] Recommended

[2] Optional

[3] Required for Video

Description	Consumer		Office		Entertain-ment	
	PC 98	PC 99	PC 98	PC 99	PC 98	PC 99
Hardware Acceleration for 2-D Graphics						
Frame buffer can be accessed directly by applications	✓	✓	✓	✓	✓	✓
Adapter and driver support linear-mapped, low-resolution modes	✓	✓	✓	✓	✓	✓
Adapter supports transparent blter	✓	✓	✓	✓	✓	✓
Hardware provides support to prevent tearing	✓	✓	✓	✓	✓	✓
Hardware supports programmable blter stride	✓	✓	✓ [1]	✓	✓	✓
Hardware Acceleration for 3-D Graphics						
Hardware supports RGB rasterization	✓	✓	✓	✓	✓	✓
Hardware supports recommended RGB rasterization features	n/a	✓ [1]	n/a	✓ [1]	n/a	✓ [1]
Hardware supports multi-texturing	✓ [1]	✓ [1]	✓ [1]	✓ [1]	✓	✓
Hardware supports texture formats	✓	✓	✓	✓	✓	✓
Hardware complies with texture size limitations	✓	✓	✓ [1]	✓ [1]	✓	✓
Hardware supports destination RGB alpha blending	✓ [1]	✓ [1]	✓ [1]	✓ [1]	✓ [1]	✓ [1]
Hardware supports Z comparison modes and Direct3D-compatible formats	✓ [1]	✓ [1]	✓ [1]	✓ [1]	✓	✓
Hardware meets PC 98 / PC 99 3-D accelerator performance requirements	✓ [1]	✓ [1]	✓ [1]	✓ [1]	✓	✓
System Requirements for Video Components						
System meets PC 98 / PC 99 requirements for DVD-Video and MPEG-2 playback	✓	✓ [3]	✓	✓ [3]	✓	✓
System supports PC 98 analog video input and capture capabilities	add-on device		add-on device		add-on device	
System includes analog television tuner	n/a [2]		n/a [2]		n/a [2]	
System includes digital broadcast or satellite subsystem	n/a [2]		n/a [2]		n/a [2]	

Table 5.3 - PC 98 and PC 99 compliance

[1] Recommended

[2] Optional

[3] Required for Video

Description	Consumer		Office		Entertain-ment	
	PC 98	PC 99	PC 98	PC 99	PC 98	PC 99
System includes DTV support	n/a [2]		n/a [2]		n/a [2]	
Video input, capture, and broadcast device support is based on DirectX foundation class and WDM Stream class	n/a [2]	n/a [2]	n/a [2]	n/a [2]	n/a [2]	n/a [2]
Hardware MPEG-2 decoder uses Digital data output port for video data	n/a [2]	n/a [2]	n/a [2]	n/a [2]	n/a [2]	n/a [2]
PCI-based tuners and decoders support bus mastering with scatter/gather DMA	n/a [2]	n/a [2]	n/a [2]	n/a [2]	n/a [2]	n/a [2]
Background tasks do not interfere with MPEG-2 playback	✓	✓	✓	✓	✓	✓
All components meet PC 98 / PC 99 general device requirements	✓	✓	✓	✓	✓	✓

Table 5.3 - PC 98 and PC 99 compliance

[1] Recommended

[2] Optional

[3] Required for Video

5.6 Data sheet

Texture Mapping
- True perspective correction
- dual texture engine
- trilinear filtering with p.p. MIP-mapping
- Palletized and RGB textures
- Bump Mapping
- Transparency maps
- Local texture buffer
- Specular highlights
- Fast texture loading
- AGP execute mode or remote texturing
- Color keying

3D Rendering
- Points, lines, triangles & bitmaps
- Gouraud and flat shading
- 8-, 16- or 32-bit RGBA
- Depth (z), GID buffering
- Fogging & depth-cueing
- Alpha blending (flat and Gouraud)
- Full screen anti-aliasing
- Dithering
- Area stippling
- Stencil test and stencil buffer
- Scissors test and logic operations

Display Features
- 8-, 16- or 32-bit RGB
- 8-bit color index
- Double and triple-buffering
- Hardware dithering
- Hardware pan
- Overlays

Fast Video Playback
- MPEG2 playback acceleration
- YUV color space conversion
- Scaling and shrink (bilinear filtered)
- Dithering
- Color keying (blue-screen)
- Alpha overlay blending

GUI Acceleration
- BitBlt with ROPs
- Points, lines, polygons
- Fills and text primitives
- Fast linear framebuffer
- On chip SVGA
- Windows

PCI/AGP Interface
- 32-bit glueless PCI V2.1
- MHz PCI / 266MHz AGP 4X
- Dual 2.5/3.3VDC 4X and 2X compatible
- Target and master support
- DMA mastering
- 256 entry command FIFO
- Big-endian apertures on bus
- Interrupts

Memory Architecture
- 128-bit SGRAM/SDRAM interface
- Single multi-function memory
- Optimal memory usage
- 2-32 Mbytes

Display Resolutions
- 320x200 to 1920x1200
- Ergonomic refresh rates

TV/Video Output
- 270 MHz RAMDAC interface
- LCD flat panel support
- Digital Video output

Power Management
- VESA DPMS
- VESA DDC support
- Separate clocks for all sub-systems
- Automatic frequency reduction when idle
- SGRAM power down mode

Standard BGA Package
- 456-pin BGA)
- 2.5/3.3 V (5V Tolerant PCI/AGP)

Driver Support
- Direct3D and OpenGL
- Windows 95/98, Windows NT/Windows 2000
- Heidi for 3D Studio MAX