WARP™ 5

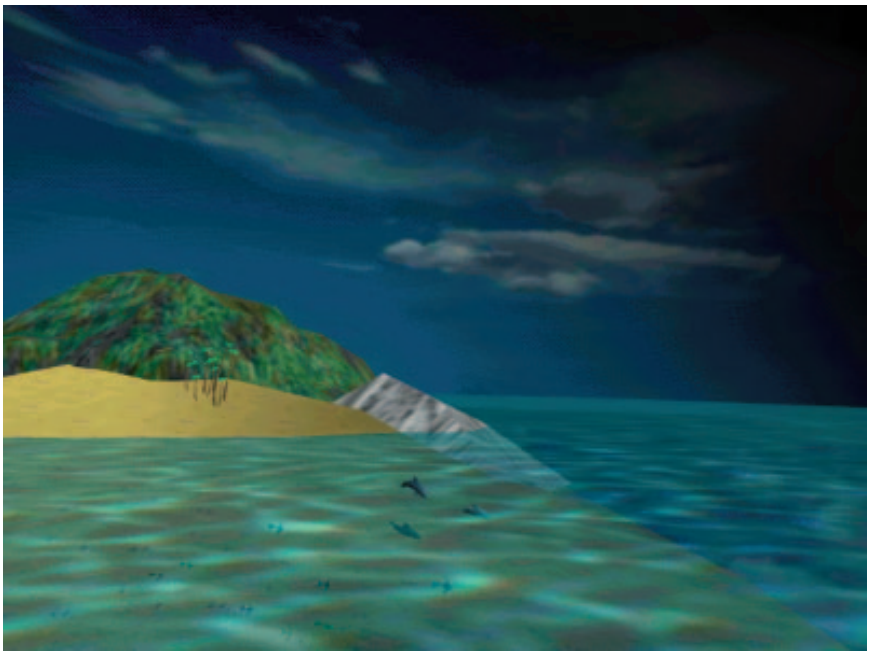
64-bit 3D Graphics Accelerator

The WARP 5 (Windows Accelerator and Rendering Processor) represents a breakthrough in current 3D architectures, setting a new standard for visual realism and performance in 3D graphics.

Utilizing several innovative industry-first techniques, the WARP 5 sets a new benchmark in image quality, delivering flight simulator-like 3D graphics to mainstream PCs. A highly integrated solution, the WARP 5 is a full-featured 3D graphics accelerator that combines a high-performance 2D GUI accelerator, VGA, dual-clock generator, and RAMDAC functions on a single chip. The WARP 5 is fully pin-compatible with Oak's OTI-64217 EON™ 2D GUI accelerator.

Architectural Innovations Deliver Compelling 3D Graphics at Consumer Prices

The WARP 5 has taken a quantum leap over current 3D solutions with its region-based architecture. This approach allows for implementation of advanced flight simulator and workstation-level algorithms on the PC. The WARP 5 divides the screen into small regions, rendering and processing one region at a time. Because the architecture is region-based, Z-values and anti-aliasing information can be stored on the chip at the subpixel level. Since no external storage is involved, memory bandwidth requirements are significantly reduced (by a factor of 16 over traditional architectural approaches).



Scene rendered with WARP 5

product features

- Advanced 3D architecture provides new levels of realism and performance at consumer prices
- 50 million pixels/sec processing — perspective corrected trilinear MIP-map textured, anti-aliased, Z-buffered, Gouraud shaded, and fogged polygons
- Advanced texture techniques: trilinear MIP-mapped filtering, perspective correction
- Subpixel full-scene anti-aliasing
- Memory-less 24-bit floating point Z-buffer
- Simultaneous support for subpixel anti-aliasing and Z-buffering without any external memory
- Order-independent translucency and anti-aliasing
- Specular highlights
- Non-linear fogging for realistic atmospheric effects and depth cueing
- Object morphing provides smooth transition between levels-of-detail of objects
- High depth complexity
- Highly integrated solution — 2D graphics, 3D graphics, and video with on-board 175-MHz RAMDAC and clock generator
- Multiple hardware video windows with bilinear (X/Y) video scaling
- PCI bus mastering with DMA
- Supports single-cycle EDO (up to 8MB of frame buffer)
- Resolutions up to 1600x1200
- Software Drivers:
  Windows 95, Direct3D,
  Windows NT, BRender

OAK TECHNOLOGY®

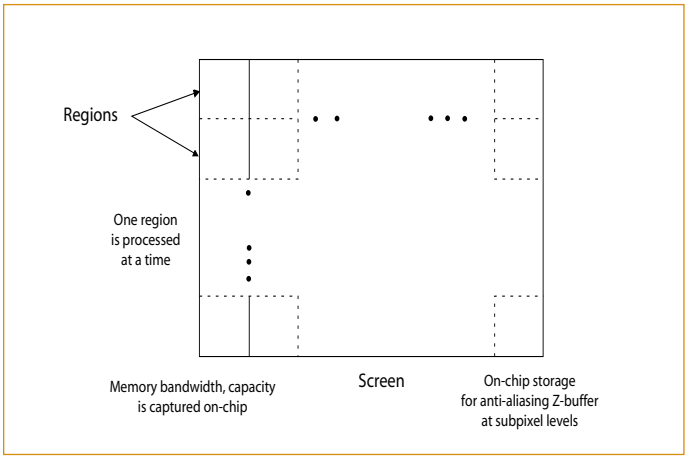
WARP™ 5 Product Brief

Architectural Highlights

For PC OEMs and game developers, the WARP 5's advantages over competitive 3D solutions are highlighted in five unique architectural features that bring arcade-quality 3D to consumer PCs.

1 ESR™ : Full-Scene Anti-Aliasing for Superior Image Quality

The WARP 5 delivers the PC industry's first true edge anti-aliasing support with its ESR (Enhanced Screen Resolution) algorithm. ESR eliminates distracting visual anomalies such as stair-stepping ("jaggies") along polygon edges. This enhances image quality and effectively increases the screen resolution. Anti-aliasing is performed at the subpixel level to yield the best possible results. The benefits of ESR are readily apparent during a dynamic or animated scene where anomalies such as scintillations caused by aliasing artifacts are common. Due to its region-based architecture, the WARP 5 has the additional advantage of not requiring the external subpixel storage associated with traditional anti-aliasing methods, thereby reducing memory costs for OEMs.



Region-based Architecture

2 FreeZe™ : Memory-less Hidden Surface Removal

The WARP 5 supports a hardware Z-buffer with no external memory using an innovative FreeZe algorithm, which allows Z-values to be stored on the chip. In a traditional implementation, the Z-buffer support comes at the expense of texture memory. The WARP 5 eliminates this compromise, freeing up the maximum possible memory for textures, which is a key requirement for visually rich games. The FreeZe offloads the CPU from object sorting to increase system performance and renders interpenetrating objects correctly. Because the Z-buffer is on the chip, no memory bandwidth is wasted for Z accesses.

The FreeZe uses a 24-bit floating point resolution to achieve higher depth precision. Image artifacts associated with inferior 16-bit Z-buffer implementations are absent in the WARP 5. FreeZe also enables order-independent translucency effects, which makes games with transparent objects run faster, and also simplifies the game development process for programmers.

The hidden surface removal process is further optimized in the WARP 5 with another feature called SkipOver™. In a traditional approach, even hidden objects are processed, which wastes valuable memory and processing bandwidth. With SkipOver, however, the hidden objects are not processed and are discarded very early on in the 3D pipeline, thereby significantly increasing performance. The SkipOver technique effectively increases the pixel processing capacity by 50% or more, depending on the polygon overlap and object order.

WARP™ 5 Product Brief

Architectural Highlights

3 TextureMagic™: Realistic Textures for Visually Rich Games

Oak Technology's TextureMagic logic in the WARP 5 utilizes memory- and computer-efficient techniques to deliver high-quality textures without degrading performance. The WARP 5 is optimized for trilinear MIP-mapped filtering, enabling excellent image quality at sustained high frame rates. The on-chip texture cache minimizes accesses to external memory, thereby increasing system performance. The textures are perspectively corrected to eliminate image distortion. TextureMagic also reduces texture sparkles and eliminates annoying visual artifacts (blocky images, image scintillation) associated with inferior texture techniques such as point sampling and bilinear filtering.

4 Industry's First Simultaneous Support for Anti-aliasing and Z-Buffer with No Memory

Another unique architectural feature in the WARP 5 is simultaneous support for subpixel anti-aliasing and a 24-bit floating point Z-buffer without any external memory requirements. As mentioned earlier, both the subpixel information and Z-values are stored on the chip, eliminating the need for external memory. The simultaneous support ensures that scenes rendered with the WARP 5 have excellent image quality and high frame rates, both of which are needed for compelling game play. A traditional implementation for this feature would need 34MB of external memory and over 4.7 GB/sec memory bandwidth for equivalent image quality and performance. The WARP 5's combined implementation of FreeZe and ESR significantly reduces memory cost and memory bandwidth requirements, enabling OEMs to deliver unsurpassed 3D capabilities to PCs at consumer prices.

5 FastAccess™: Memory Bandwidth and Capacity Captured On Chip

The WARP 5 uses FastAccess, an intelligent memory scheme, to deliver very high memory throughput. For pixel updates, a typical graphics controller reads the data, modifies it, then writes it back to memory. These read-modify-write cycles take up more than 50% of total accesses in a graphics system. Read-modify-write cycles also take about twice as much time compared to write-only cycles. Because the architecture on the WARP 5 is region-based, all the information necessary to process pixels in a region are stored on the chip, eliminating the need to access external memory. Hence, read-modify-write operations are not necessary for 3D rendering. After the region is processed on the chip, the WARP 5 writes it to the frame buffer. This results in a considerable performance improvement as wasteful read-modify-write cycles are eliminated. Since memory bandwidth is captured on the chip, the WARP 5 delivers superior performance even with standard EDO memories. Additionally, because there are no Z-buffer accesses to external memory, precious memory bandwidth is not wasted for Z-buffer operations. Competitive 3D solutions in the market have to use expensive SGRAM memories to get a performance boost.

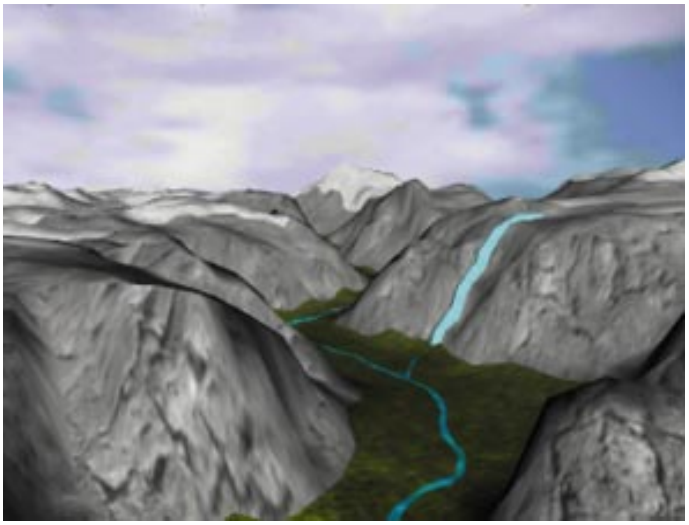
Scene rendered with WARP 5

WARP™ 5 Product Brief

Rich Feature Set

Non-linear Fogging, Translucency, and Gouraud Shading

The WARP 5 offers standard 3D features such as Gouraud shading, fogging, and translucency. It supports non-linear or per-pixel fogging (as opposed to linear or per-vertex fogging) to realistically mimic atmospheric effects like fog on a computer screen. Two types of translucency are supported: texture translucency and polygon translucency. Transparent textures are used to render scene elements that have fuzzy or irregular edges such as trees. Polygon translucency, on the other hand, can be applied to create see-through effects on regular objects. With its FreeZe logic, the WARP 5 supports order-independent (i.e., no object sorting) translucency and anti-aliasing, effectively increasing system performance and easing 3D database development.



Scene rendered with WARP 5

Excellent 2D Acceleration

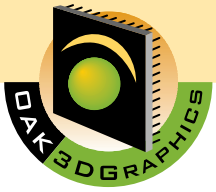
Featuring a radically new drawing engine for Windows 95 and NT acceleration, the WARP 5 provides excellent 2D graphics performance and enhanced video capabilities. The WARP 5 uses Oak Technology's single-clocked, pipelined GrafixPump™ architecture, ensuring the maximum performance from display memory. The GrafixPump is a multiprocessing engine that simultaneously manipulates graphics, live video, and host image data. When coupled with the pipelined architecture of the WARP 5, the GrafixPump exploits the full capabilities of single-cycle EDO.

The WARP 5 also integrates a high-performance 175-MHz triple 8-bit RAMDAC with alpha blending and gamma correction. It has a built-in dual-clock generator to drive the display and frame buffer clocks. This RAMDAC/clock combination delivers screen resolutions up to 1600x1200 and refresh rates up to 100 Hz. The WARP 5 supports memory configurations from 1MB to 8MB and uses EDO, offering system designers a choice of price and performance options.

The WARP 5 is designed to accelerate Microsoft's DirectX architecture, including DirectDraw, ActiveMovie, and Direct3D standards. Transparent BitBLT, hardware windows, enhanced bus mastering, and page-flipping (double buffering) features help accelerate MS Windows DirectDraw API. For ActiveMovie, the WARP 5 utilizes Oak's PixelVu™ scaling technology and is compatible with the new InterCast broadcasting standard. The built-in video scaler (with X/Y interpolation) and YUV-RGB color space converter accelerates video playback with superior video quality. The WARP 5 is optimized to take advantage of Microsoft's Direct3D API.

WARP™ 5 Product Brief

Technical Specifications



PixelVu Video Scaling Hardware

- 8-tap and 4-tap Y bilinear video interpolation and arbitrary scaling removes jagged edges from scaled images
- Uses additional coefficients for image accuracy while maintaining the sharpest, smoothest possible image
- Anti-tearing support via single-command page-flip mechanism
- Back-end color space conversion (YUV-RGB)
- Arbitrary upscaling
- YUV 4:2:2 Packed and YUV 4:2:0 Planar (MPEG) video display support
- Multiple hardware video windows (2 overlay, 2 primary surface)

RAMDAC and Clock Design

- 175-MHz integrated triple 8-bit RAMDAC
- 16-level constant alpha blending of video and graphics
- Gamma correction
- Integrated dual-clock synthesizer for memory and pixel clocks

Package

- 256-pin Ball Grid Array (BGA)

On-Chip Diagnostic

- JTAG Boundary Scan
- Signature analysis

Video Input Support

- YUV 4:2:2 and CCIR 656 (DVCI) video inputs
- Integrated DVCI (Digital Video Camera Interface) for "no-cost" video capture
- Direct interface to MPEG decoders
- YUV 4:2:2 Packed, YUV 4:2:0 Planar (YUV12) video display and capture support

VBI Support

- Intel Intercast support — integrated scan line counter, VBI data stripper
- Closed Caption, teletext enabled (when using appropriate video decoder device)
- Programmable decimation filter with bypass mode (for MPEG-2)
- Capture-while-viewing (for video conferencing)
- Unique TEFRAS™ (Temporal Frame Smoothing) algorithm (for video capture/conferencing) enables low frame rates that are devoid of frame "jumps" and skips

Power Management

- VESA DPMS compliant

Monitor Support

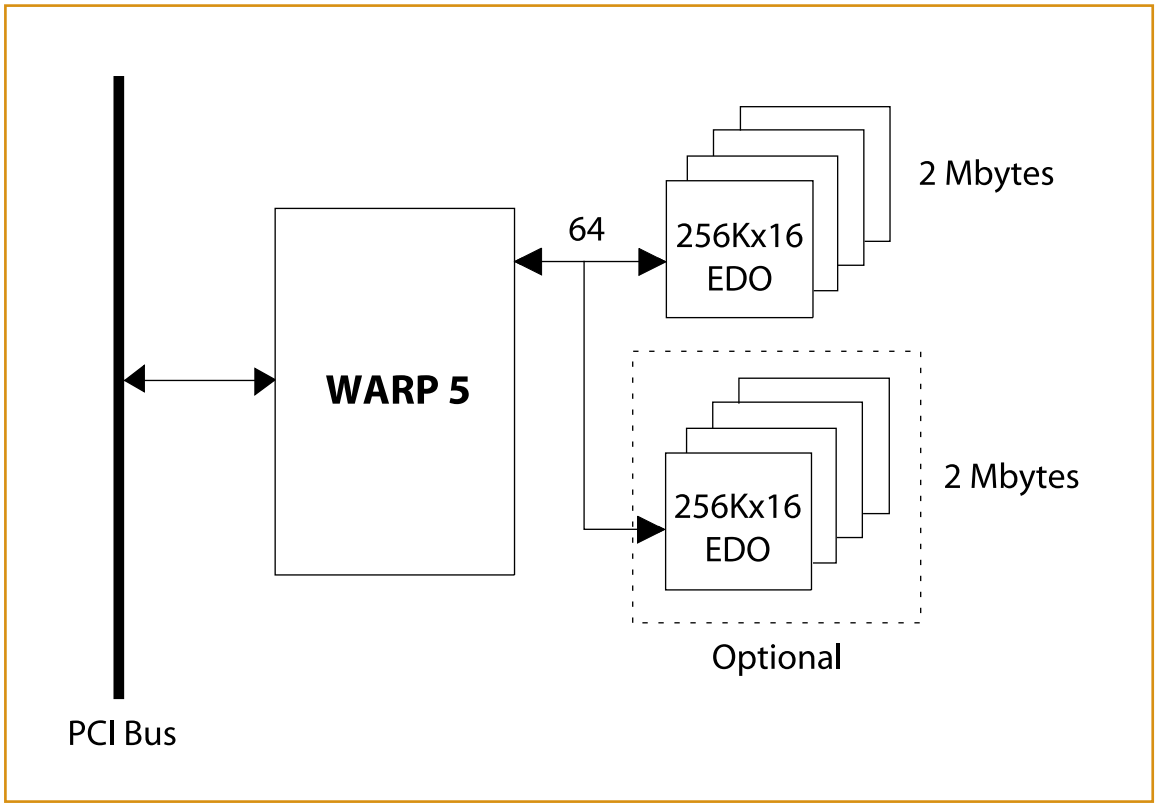
- DDC2B compliant
- VESA DPMS
- True color gamma color correction support

Software and Manufacturing Support

Oak Technology offers comprehensive software support packages for Oak multimedia devices. The WARP 5 software package comes with VESA-compliant BIOS and accelerated display drivers for popular operating systems such as Windows 95 and NT. Microsoft Direct3D API and Argonaut BRender API are also supported. To facilitate early market entry, Oak will supply complete manufacturing reference designs for the WARP 5, as well as daughter cards with ready-to-run applications such as TV tuner, video capture, and video editing.

Typical Design Examples

The WARP 5 integrates all the blocks needed to build a high-performance 3D graphics subsystem. It only requires external frame buffer memory. This makes board design very compact and cost-effective. The WARP 5 supports EDO memory interface (see figure below).



A complete 3D graphics system with WARP 5 - EDO Interface

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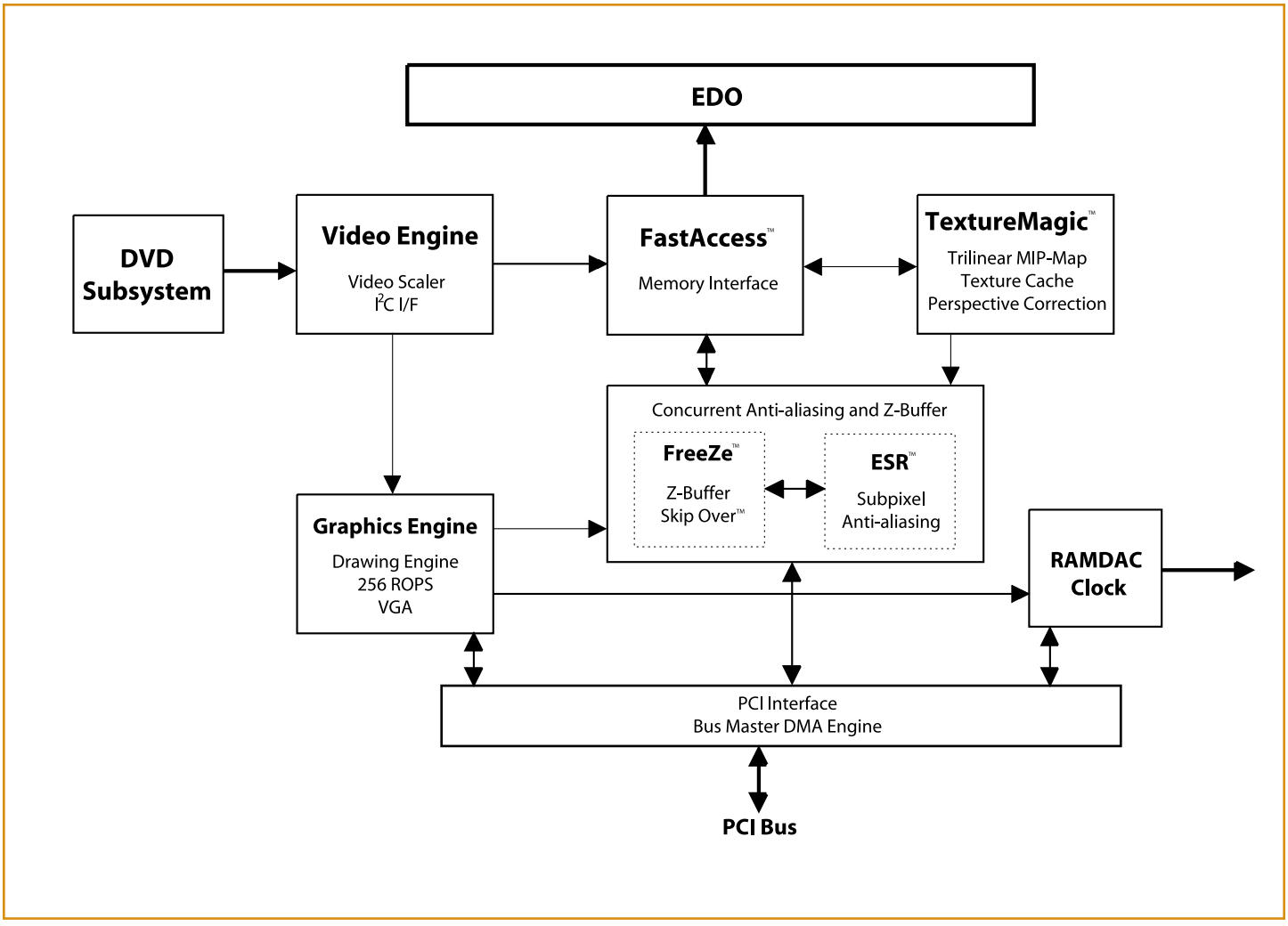
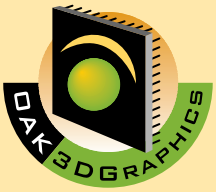
Block Diagram



WARP 5 Block Diagram



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