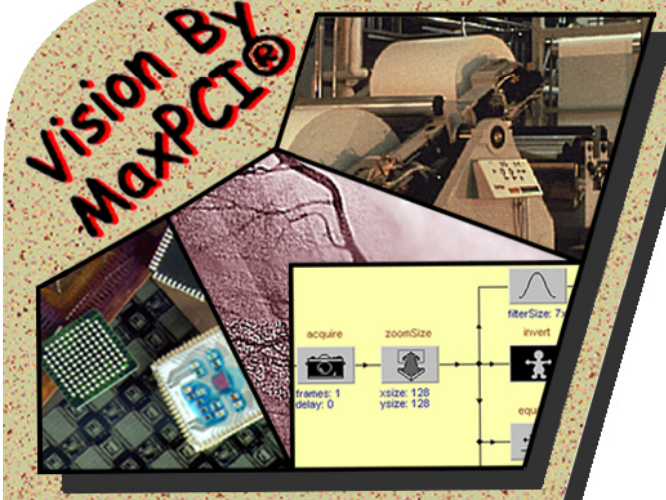
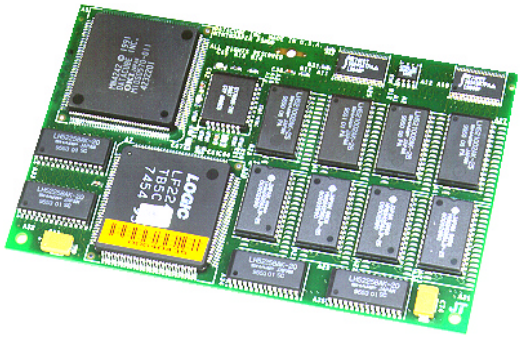
MiniWarper PSMOD
Image Warping in Real-Time





- Economical first and second order image warping
- Image translation, rotation, and scaling capabilities
- Non-linear correction, aspect angle distortion adjustment, and curvature compensation
- Available with 1 MB or 4 MB of image memory

The MiniWarper PSMOD (processing and storage module) is a high-speed, image warping module. It provides resampling and sub-pixel interpolation operations for distortion or sensor correction, scan conversion, image translation, rotation, aspect ratio transformation, and zoom.

It performs first and second order polynomial spatial rendering at 20 MHz. A single MiniWarper PSMOD is capable of pipelined warping at 10 MPel/sec. Greater throughput can be achieved with multiple modules (e.g., two for 20 MPel/sec. or four for 40 MPel/sec.).

Performance of the MiniWarper PSMOD is significantly faster than software-only solutions. It is also flexible, with variable settings for data precision, interpolation, filter aperture, and coefficient precision. 8-bit data is warped in one pass, while multiple pass techniques are employed to warp 12-bit data. A high render rate makes multiple-pass techniques on the MiniWarper PSMOD a practical alternative to more costly hardware approaches.

Its first order image translation, rotation, and scale capabilities significantly improve the performance of applications such as imaging workstation window manipulation. Second order warping applications, including sensor non-linearity correction, aspect angle distortion adjustment, and earth curvature compensation, are also greatly accelerated.

The MiniWarper PSMOD creates a warped target image that faithfully represents the transformed source image, eliminating distortion and unwanted artifacts with sophisticated interpolation techniques. Target pixels are created by interpolating between several pixels near the source. The interpolation algorithms are performed with sub-pixel precision.

Features

- 20, 40, or 80 MB/sec. input data rate
- Warps 8-bit data in one pass using 8-bit coefficients
- Data and coefficient precision expandable to 12 bits (multiple passes)
- 20 MPel/sec., 2x2 (bi-linear) interpolation render rate
- 6 Watts maximum power consumption
- I/O mapped to CPU
- Fast CPU access (approx. 10 MPel/sec.) to image memory surface store
- 256 KB (8-bit) coefficient store, I/O mapped to CPU
- Filter aperture expandable to non-separated 8x8 kernel (multiple passes)

Address Generation

- First and second order bi-quadratic, 20 MHz address generator for polynomial warps
- X and Y sub-pixel addressing to 1/16th pixel
- 32-bit precision address generation coefficients provide smooth continuous adjustment
- External memory auxiliary addressing information supports arbitrary warp transforms

Specifications

- **Performance:** Target pixels rendered at 20 MHz for first and second order linear warps using address generation capabilities, or for nth-order and non-linear warps, using auxiliary addressing feature. Example render times:

512x512	16 mS
1024x1024	66 mS
2048x2048	266 mS

- **Internal Addressing:** Cascaded forward difference method with 32-bit and 40-bit integer accumulators. Evaluates two 2nd-order quadratic polynomials at 20 MHz.
- **External Addressing:** Two 14-bit linear interpolators convert two 10 MHz external addressing streams to two 20 MHz streams. External address translated to sub-pixel resolution. Separate input path for external address generation enables forward-mapping write operation with application software (not supplied).
- **Render Rate:** 20 MB/second
- **Input Bandwidths:** 20 MB/second (non-interleaved), 40 MB/sec. (interleaved 2:1H or 2:1V), 80 MB/second (interleaved H/V)
- **Filter Processing Rate:** 80 million multiply-accumulates/sec.
- **Filter Aperture:** 2x2, expandable in multiple passes
- **Numeric Precision:** 8 bits data and coefficient, expandable to 12 bits in multiple passes
- **Result Precision:** 16-bit convolver output

- **Data Memory Size:** 1 MB or 4 MB, 8-bit; I/O mapped to CPU
- **Coefficient Memory Size:** 256 KB, 8-bit; I/O mapped to CPU

Host Bus Specifications:

The MiniWarper PSMOD is accessed via the PSMOD interface.

Power Specification

+5 Volts (±5%) 1.2 Amps (Max)
6.00 Watts Total (typical)

Environmental Specifications

Operating Temperature: 32° to 131° F (0° to 55° C)

Maximum Chip Case Temp: 85° C (185° F)

Storage Temperature: -40° to 212° F (-40° to 100° C)

Relative Humidity: 10% to 90% (non-condensing)

Air Flow Requirement: 25 LFPM (min)

Additional Information

For related product information, refer to the following Datacube literature:

MaxPCI Data Sheet
DatacubeWiT Datasheet
PC ImageFlow Data Sheet

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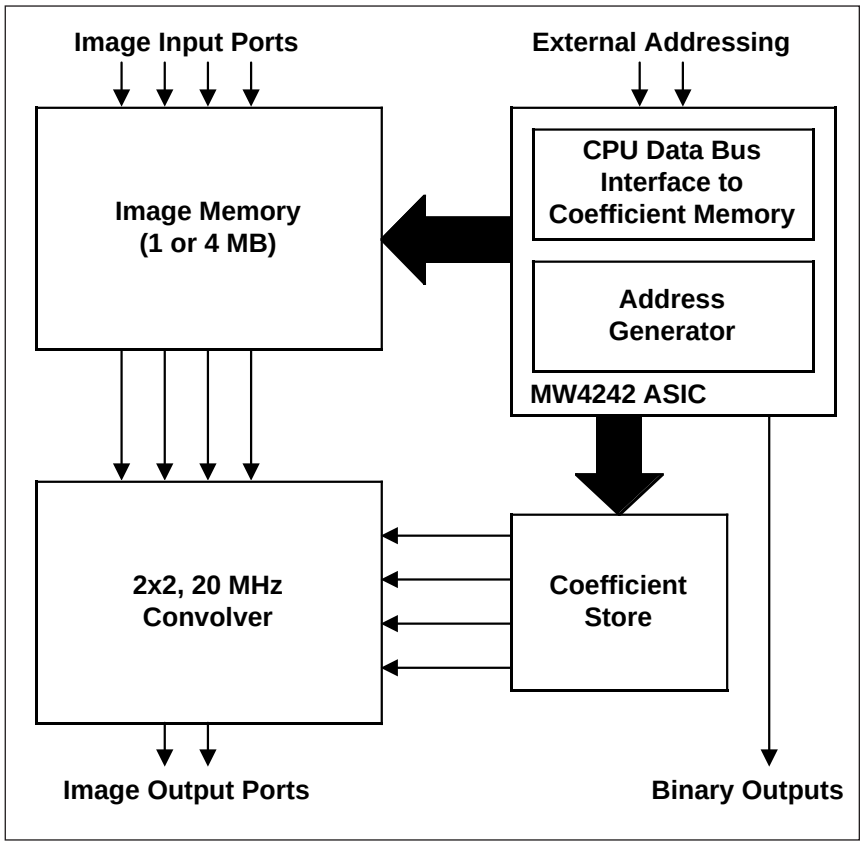
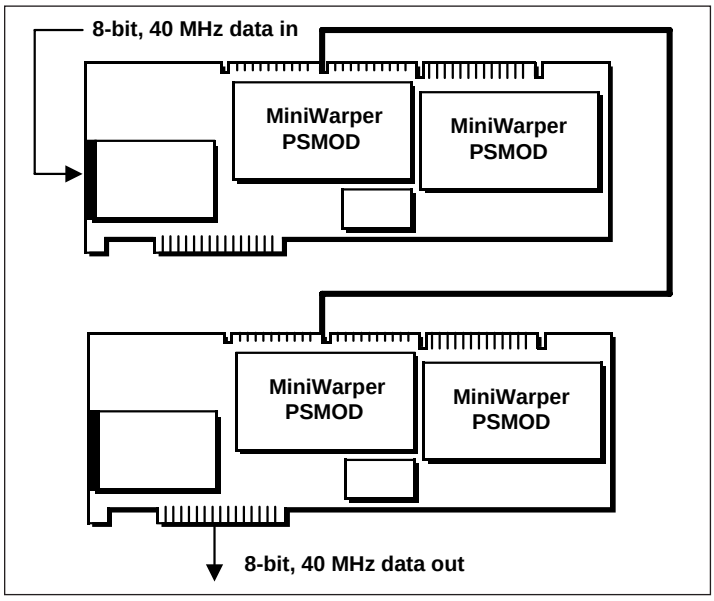
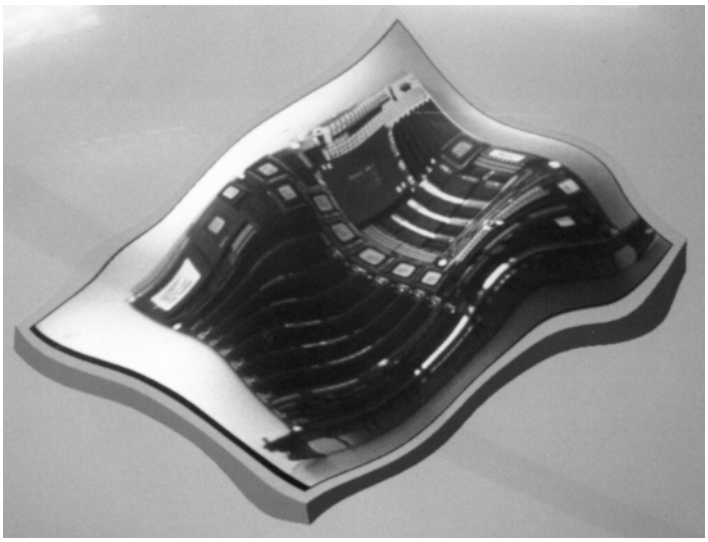


Simplified block diagram of the MiniWarper PSMOD



By connecting two MaxPCI boards, each carrying two MiniWarper PSMODs, you can achieve pipelined warping at 40MPel/sec.



An example of the MiniWarper PSMOD's image warping capabilities. The application that created this image was developed by the Austrian Research Center, Seibersdorf.

DATACUBE - High Performance Imaging

North America East
Phone: 978-777-4200
Fax: 978-777-3117

North America West
Phone: 408-451-5950
Fax: 408-451-5959

Europe
Phone: +44 1582-461515
Fax: +44 1582-467478

Web Site: www.datacube.com
Email: info@datacube.com