
# VolumePro 1000 Specification

80.0009 Rev. A
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# Overview

The TeraRecon VolumePro 1000 product provides high quality, real-time volume rendering capability for PC-class computers and other PCI bus systems. VolumePro 1000 uses a ray casting algorithm to render volumetric data sets of rectangular shape that are up to 8K voxels in any dimension. The resulting two-dimensional (2D) image can be displayed on a conventional PC graphic subsystem.

The VolumePro 1000 product consists of:

A PCI-compatible VolumePro 1000 board, whose rendering features are provided by a custom, TeraRecon designed, ASIC. The VolumePro 1000 board provides 512 Mbytes to 2 Gbytes of DDR-SDRAM memory for volume data storage

Software drivers for Windows NT 4.0, Windows 2000, Solaris, HP-UX, Linux.

The *Volume Library Interface* (*VLI*), a collection of C++ objects that provides the application-programming interface to the volume rendering features.

Both the VolumePro software drivers and VLI are integrated into application software during a product's design phase.

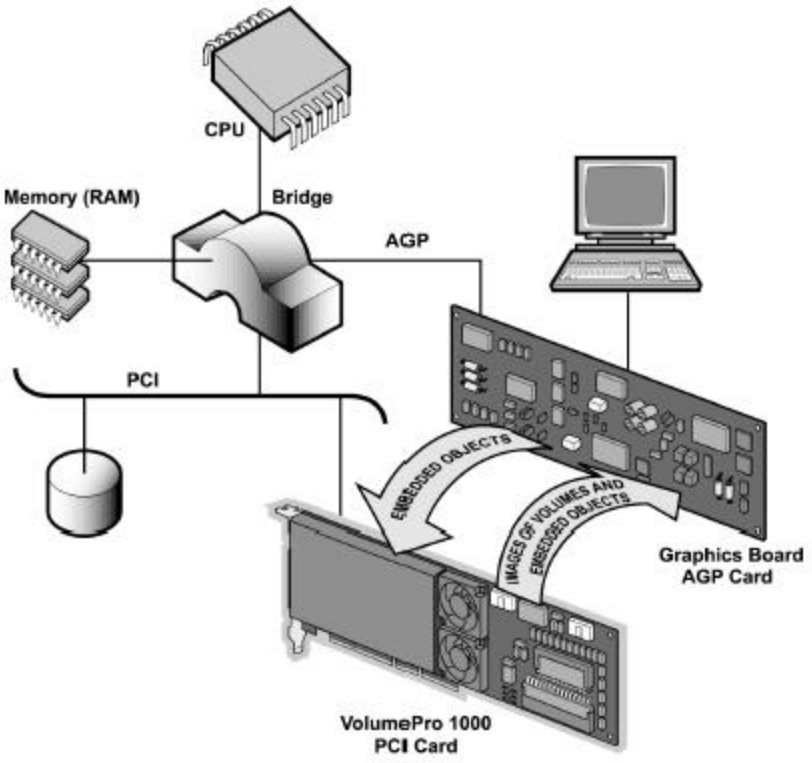


Figure 1: VolumePro 1000 System

## *Key Features of VolumePro 1000*

The VolumePro 1000 provides the following features:

**Full-size PCI board**
VolumePro 1000 uses a 64-bit, 66 Mhz PCI version 2.2 that supports between 512 and 2Gbytes of on-board RAM.

**1000 million tri-linearly interpolated, Phong-shaded samples/second**
VolumePro 1000 can process one billion samples per second for a rendering performance of up to $512^3$ samples in real time.

**Ability to embed opaque and translucent surfaces**
VolumePro 1000 allows the insertion of polygons (for example, drawings of pointers,medical prostheses, or geological information) into volumes. These polygons are drawn using a standard graphics package (such as OpenGL or Direct3D) and are then embedded into the volume data set.

**8-, 16-, and 32-bit voxels with up to four customizable fields**
VolumePro 1000 supports a flexible system of voxel formats. Voxels may be 8-, 16, or 32-bits in size, and may have up to four fields. The interpretation or use of the fields is determined by the applications. Each field can be independently converted to color and opacity values. VolumePro 1000 also provides a powerful mechanism for combining these separate colors of the fields into one final color and opacity.

**Introducing *xy*-image order rendering**
VolumePro 1000 introduces a new method of ray-casting called *xy-image order*. A hybrid between two traditional methods of volume rendering, *xy*-image order provides the speed and performance of object-order methods, such as Shear Warp, while providing the image quality of true image order systems implemented in software.

**Cut, crop and trim planes**
VolumePro 1000 supports the following to allow viewing of only relevant portions of the data:

- Four pairs of oblique cut planes with fall-off
- Three pairs of crop planes
- Three pairs of trim planes

**Multi-pass volume rendering**

- Rendering with embedded objects (one layer at a time)
- Rendering volumes in multiple passes (for example, this allows rendering of one part of an object using one lookup table and rendering of another part of the object using a different lookup table)
- Multiple render steps for complex volume rendering functions

**Depth and image filtering based on opacity, gradient direction, gradient magnitude**
Volume Pro 1000 allows filtering of samples to extract surfaces based on various thresholds.

**Arbitrary supersampling in all three dimensions**
VolumePro 1000 supports ray and sample spacing to a resolution of 1/256 voxel. This allows for a high spatial frequency of sampling, producing a more accurate representation of 2D pixel data.

**Gradients for per-sample illumination**
VolumePro 1000 applies lighting to every sample point in the volume to make the samples look more like surfaces. This can be based on gradients computed by the VolumePro 1000 in real time, or by gradients pre-computed by the application.

**Motion and Interactivity**
The human eye is designed in such a way that it picks up information about the objects being viewed using movement. A person can often better understand what an object is by putting it into motion or by moving his or her eyes. VolumePro 1000 allows applications to interactively put objects into motion. Every time a user of an application moves the mouse, the position of the eye (or the orientation of the object) may be changed. The image is redrawn from that new position very quickly, giving the user immediate feedback and a sense of motion, which helps to perceive objects more clearly. VolumePro 1000 allows applications to change the following attributes interactively:

Viewpoint
Lighting
Classification, including transfer functions
Clipping (trim, crop, and cut planes, and depth testing) and Filtering

**Four 250 MHz pipelines**
VolumePro 1000 has four internal processing pipelines, each operating at 250 MHz, to process one billion samples/second.

**Space-leaping and early-ray termination**
Unlike previous hardware accelerators for volume rendering, VolumePro 1000 can stop processing rays that have reached a threshold of opacity and can “leap” over empty space resulting from clipped or cropped parts of the volume. This can greatly improve the performance on many volume data sets.

**Concurrent volume updating and rendering**
VolumePro 1000 supports rendering of time-varying data in real-time. New data can be collected and downloaded into VolumePro memory while previous data is being rendered.

# System Requirements

This section lists the hardware and software requirements necessary to use a VolumePro 1000 board in an Intel-based, Windows 2000 or Windows NT computer (see figure 2 and 3 below). For Linux, HP-UX, and Sun system requirements contact TeraRecon.

## *Hardware Requirements*

The VolumePro 1000 can be installed into any IBM-compatible PC that meets the following hardware requirements:

Minimum of 300 MHz Pentium II microprocessor
Minimum of 256 Mbytes RAM memory
Minimum of 10 Mbytes free disk space to install the VolumePro 1000 drivers
Computer power supply that can supply 40W (+5V) and an unused peripheral power cable (see power requirements section).

For maximum performance the following hardware is recommended:

66 MHz 64 bit PCI connector
For use with embedded geometry applications, a 3D graphics board with texture mapping on the AGP port with the following characteristics:
- Minimum of 120 Mbytes/second texture download speed
- Minimum of 120 M texels/second texture mapping performance
- Fast color and depth buffer read (For example, a 3Dlabs, Inc. *Oxygen VX1* graphics board).

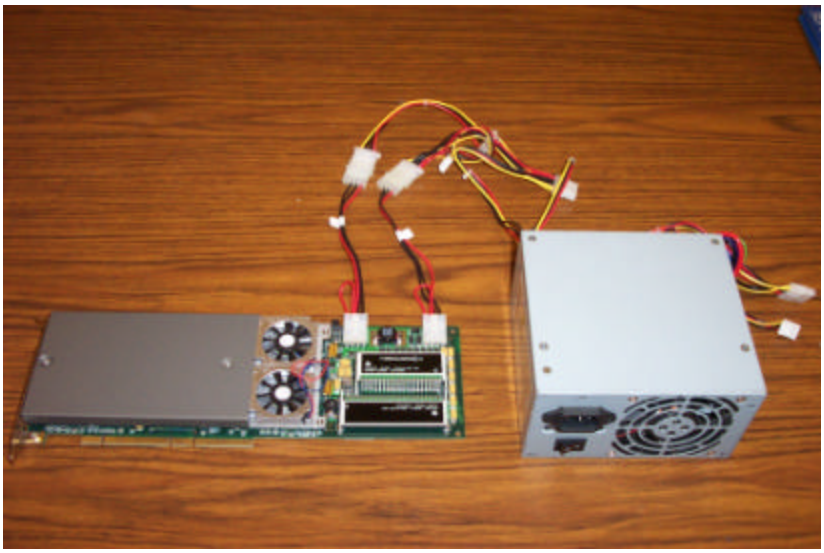

Figure 2: VolumePro 1000 connected to Computer Power Supply

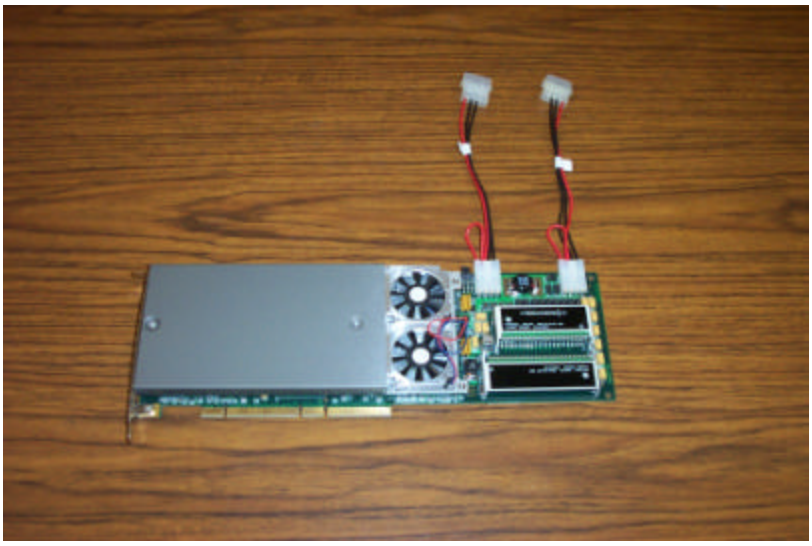

Figure 3: VolumePro 1000

## *Software Requirements*

An IBM-compatible PC must have the following software in order to use the VolumePro 1000 product:

Windows NT V4.0 with Service Pack 6a, or Windows 2000 with Service Pack 2 or later

## *Power Requirements*

VolumePro 1000 can be powered from the following power sources:

Powered internally from the PC power supply through a an unused peripheral power cable

Powered externally

Maximum Power Requirement

| **Supply** | **Tolerance** | **Maximum Current** | **Maximum Power** |
|---|---|---|---|
| 3.3V | +-5% | <1A | 2.5W |
| 5V | +0.25/-0.50V | 8A | 40W |

Internal PC Power Connection Power

| **3.3V – PCI Bus** | **5V – PCI Bus** | **5V Internal Power Supply Connector (J2 & J3)** |
|---|---|---|
| 2.5W | 0W | 40W |

## Environmental Requirements

| | | |
|---|---|---|
| Temperature | Operating<br>Non / Operating | 10 to 45C<br>-20 to 60C |
| Humidity (non-condensing) | Operating<br>Non / Operating | 10% to 90%<br>5% to 95% |

## Board Dimensions

Universal 64-bit PCI Long board:
Height: 4.200 inches (106.68 mm)
Length: 12.283 inches (250.71 mm)
Service Loop for Power Connector: 0.50” (12.7 mm)

Maximum component height:
Primary side will not exceed 0.570 inches (14.48 mm)
Back side will not exceed 0.105 inches (2.67 mm)

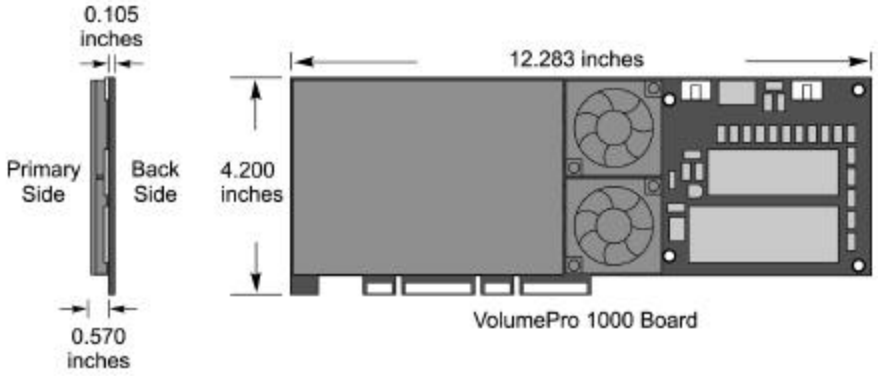


**Figure 4: VolumePro 1000 Board Dimensions**

## Internal Power Connectors (J2 & J3)

Housing Molex 39-01-4040
Female Pin 44476-3112

## Memory Options

VolumePro 1000 is available in three memory configurations:
512 MB
1 GB
2 GB
4 GB (dual board master / slave configuration)

# Supported Operating System Matrix

The VolumePro 1000 product configuration for version 3.0.1 is as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **Kernel** | **Kernel** | **HP UX** | **Solaris** |
| | **NT** | **W2K** | **XP** | **2.4.7-10** | **2.4.9-31** | **10.20** | **8 Forte 6** |
| VLI / Driver | X | X | X | X | X | X | X |
| Multi-Processor | X | X | X | X | X | NA | X |
| Multi-Board | X | X | X | X | X | X | X |
| Sample Code | X | X | X | X | X | X | X |
| Graphics Demo | X | X | X | X | X | X | X |
| Silver | X | X | X | X | X | | X |
| CRevli | X | X | X | NA | NA | NA | NA |
| VPDiag | X | X | X | Note 1 | Note 1 | | Note 1 |
| DataSets | X | X | X | X | X | X | X |
| Release Notes | X | X | X | X | X | X | X |
| Programmers Guide | X | X | X | X | X | X | X |
| System Guide | X | X | Note 2 | Note 2 | | | Note 2 |
| Principles of Operation | X | X | X | X | X | X | x |

Note 1 – included in release 3.0.2
Note 2 – included in June of date of System Guide

# Regulatory Compliance

VolumePro 1000 is classified as a Information technology product and meets following standards:

## *Emissions and Immunity*

FCC 47 CFR, Part 15, Subpart B, Class B, "radiated and conducted emissions requirements for Information Technology Equipment (ITE) [1]
EN55022 (1995), Class B, "radiated and conducted emissions requirements for Information Technology Equipment (ITE)
EN 61000-3-2 Ed. 2:2001 (1995) "Electromagnetic compatibility – Harmonic Emissions
EN 61000-3-3 (1995) "Electromagnetic compatibility - Fluctuations and Flicker
EN 61000-4-2 (1995) "Electromagnetic compatibility – Electrostatic Discharge
EN 61000-4-3 (1995) "Electromagnetic compatibility - Radio Frequency Immunity
EN 61000-4-4 (1995) "Electromagnetic compatibility - Electrical Fast Transient Burst
EN 61000-4-5 (1995) "Electromagnetic compatibility - Surge Immunity
EN 61000-4-6 (1995) "Electromagnetic compatibility – Radio Frequency Common Mode Immunity
EN 61000-4-8 (1995) "Electromagnetic compatibility - Power Frequency Magnetic Field Immunity
EN 61000-4-11 (1995) Electromagnetic compatibility – Voltage Dips and Interrupts

## *Saftey*

EN 60950 (IEC 950)

## *Fire Retardant*

UL 94V-0 fire retardant rating for circuit board

## *Board Markings*

All boards are marked with the following information:
TeraRecon part number, revision level, and serial number
UL fire retardant rating: 94V-0

[1] With internal power

## VLI / Driver License

Both the VolumePro VLI and software drivers are licensed by TeraRecon to the software developer. In consideration of the Software Development Kit fee paid by the software developer, TeraRecon will provide one year, from date of Software Development Kit purchase, of free VLI and software driver updates.

## Production Shipment

All boards will be shipped 5 to a box. Each board will be wrapped in an anti-static bag.