COMPAQ

Compaq PowerStorm 300/350 Graphics Controllers

Installation Guide

Order Number: EK-CPSGC-IG. D01

This manual describes the installation of the Compaq PowerStorm 300/350 Graphics Controllers in supported Compaq Professional Workstations, Compaq AlphaStations and Compaq AlphaServers.

Compaq Computer Corporation

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Preface

Purpose of This Guide

This guide describes the Compaq PowerStorm 300 AGP and 300/350 PCI graphics controllers, and how to install the graphics controller hardware and software in your system. It includes installation and operation information for the PowerStorm display drivers for Windows NT version 4.0, Compaq Tru64 UNIX™ and Compaq OpenVMS.

Where we reference TRU64 UNIX throughout this manual, in most cases DIGITAL UNIX or COSIX64 may be substituted. Exceptions will be explicitly noted.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

Who Should Use This Guide

This guide is intended for anyone who has purchased a Compaq PowerStorm 300 AGP or 300/350 PCI graphics controller. Users should have a basic understanding of Windows NT, Tru64 UNIX, or OpenVMS before installing PowerStorm 300/350 software.

Structure of This Guide

This guide is organized as follows:

- **Chapter 1, PowerStorm 300 AGP Graphics Controller Overview** - provides an overview of the Compaq PowerStorm 300 AGP graphics controller hardware.
- **Chapter 2, PowerStorm 300 PCI Graphics Controller Overview** - provides an overview of the Compaq PowerStorm 300 PCI graphics controller hardware.
- **Chapter 3, PowerStorm 350 PCI Graphics Controller Overview** - provides an overview of the Compaq PowerStorm 350 PCI graphics controller hardware.

- **Chapter 4, Installation (Windows NT)** - describes how to install the Compaq PowerStorm 300 AGP or 300/350 PCI graphics controller in supported Compaq Professional Workstations running the Windows NT operating system.
- **Chapter 5, Operation (Windows NT)** - describes post-installation tasks and use of the OpenGL drivers using the Windows NT operating system.
- **Chapter 6, Installation (Compaq Tru64 UNIX)** - describes how to install the Compaq PowerStorm 300/350 PCI graphics controllers in supported Compaq Professional Workstations, Compaq AlphaStations, and Compaq AlphaServers running the Compaq Tru64 UNIX operating system.
- **Chapter 7, Operation (Compaq Tru64 UNIX)** - describes post-installation tasks and use of the OpenGL drivers using the Tru64 UNIX operating system.
- **Chapter 8, Installation (Compaq OpenVMS)** - describes how to install the Compaq PowerStorm 300/350 PCI graphics controllers in supported Compaq Professional Workstations, Compaq AlphaStations, and Compaq AlphaServers running the OpenVMS operating system.
- **Chapter 9, Operation (Compaq OpenVMS)** - describes post-installation tasks and use of the OpenGL drivers using the OpenVMS operating system.
- **Appendix A, Video Modes** – Contains tables of the available resolution – refresh rates for PowerStorm 300/350 graphics controllers on various platforms.

Related Documentation

- *Using OpenGL* (DIGITAL part number AA–QMZH*–TK)
- Microsoft Windows NT online help

Conventions Used in This Guide

In this guide, “Windows NT” refers to the Microsoft Windows NT operating system, and "Tru64 UNIX" refers to the Compaq Tru64 UNIX operating system.

This guide also uses the following conventions:

Convention	Meaning
Note	A note calls the reader’s attention to any item of information that may be of special importance.
Caution	A caution contains information essential to avoid damage to the equipment.
italic type	*Italic type* indicates complete titles of manuals.
bold type	**Bold type** indicates text that is highlighted for emphasis.
`Monospaced`	In text, this typeface indicates the exact name of a command, routine, partition, pathname, directory, or file.

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

You are entitled to free hardware technical telephone support for your product for as long you own the product. A technical support specialist will help you diagnose the problem or guide you to the next step in the warranty process.

In North America, call the Compaq Technical Phone Support Center at 1-800-OK-COMPAQ[1]. This service is available 24 hours a day, 7 days a week.

Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for world wide Technical Support Centers are listed on the Compaq website. Access the Compaq website by logging on to the Internet at `www.compaq.com`.

Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial number (s)
- Product model name(s) and numbers(s)

[1] For continuous quality improvement, calls may be recorded or monitored.

- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level
- Detailed, specific questions

Compaq Website

The Compaq website has information on this product as well as the latest drivers and Flash ROM images. You can access the Compaq website by logging on to the Internet at www.compaq.com

Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Chapter 1
PowerStorm 300 AGP Graphics Controller Overview

1.1 Introduction

This chapter provides a brief overview of the PowerStorm 300 AGP graphics controller hardware. The PowerStorm 300 AGP graphics controller is available for Intel platforms only.

1.2 Description

The PowerStorm 300 AGP graphics controller is a single expansion-slot, 32-bit AGP module that provides 2D and 3D graphics acceleration for supported Compaq systems.

The PowerStorm 300 AGP graphics controller includes 16 MB of CDRAM texture memory and is available as a full length ATX or NLX form factor. See Table 1–1 for the part number.

Table 1–1 PowerStorm 300 AGP Graphics Controller Part Number

Compaq Part Number	Description
328778-B21	PowerStorm 300 AGP graphics controller in either full-length ATX or NLX form factor.

Table 1–2 provides software support information for the PowerStorm 300 AGP graphics controller.

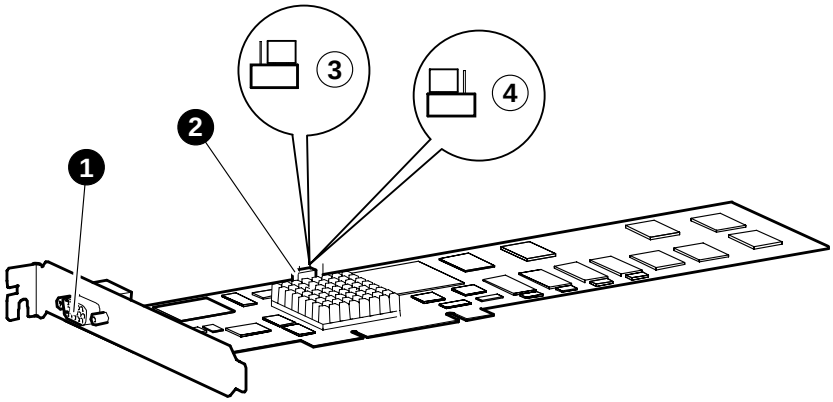
Table 1–2 PowerStorm 300 AGP Software Support

System	Minimum System ROM	O/S Version
Compaq Professional Workstation AP200	4/2/99	Windows NT 4.0
Compaq Professional Workstation AP400	4/24/98	Windows NT 4.0
Compaq Professional Workstation AP500	6/5/98	Windows NT 4.0
Compaq Professional Workstation SP700	11/13/98	Windows NT 4.0

The PowerStorm 300 AGP graphics controller (see Figure 1–1 and Figure 1–2) contains one standard 15-pin VGA connector on the AGP bulkhead.

The graphics controller contains one 3-pin jumper for enabling or disabling the VGA capability when more than one VGA graphics controller is installed in the same system.

Figure 1–1 PowerStorm 300 AGP Graphics Controller (ATX)



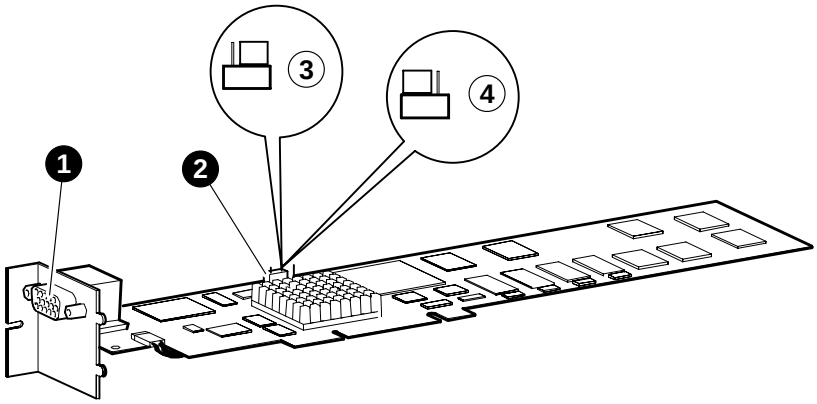
❶ Standard 15-pin VGA connector

❷ VGA enable/disable jumper

③ Shows the jumper set for VGA enabled (default)

④ Shows the jumper set for VGA disabled

Figure 1–2 PowerStorm 300 AGP Graphics Controller (NLX)



❶ Standard 15-pin VGA connector

❷ VGA enable/disable jumper

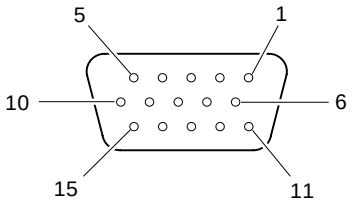
③ Shows the jumper set for VGA enabled (default)

④ Shows the jumper set for VGA disabled

1.3 Connector Pinout

Figure 1–3 contains a listing of the pins and signals found on the standard 15-pin VGA connector.

Figure 1–3 VGA Connector Pinouts



Pin No.	Signal
1	RED VIDEO
2	GREEN VIDEO or COMPOSITE SYNC with GREEN VIDEO
3	BLUE VIDEO
4	NC (no connection)
5	GROUND
6	GROUND
7	GROUND
8	GROUND
9	+5V
10	GROUND
11	NC (no connection)
12	SERIAL DATA
13	HORIZONTAL SYNC or COMPOSITE SYNC
14	VERTICAL SYNC (VCLK)
15	SERIAL CLOCK

1.4 Specifications

Table 1–3 lists the specifications for the PowerStorm 300 AGP graphics controller.

Table 1–3 PowerStorm 300 AGP Graphics Controller Specifications

Resolution	1280 x 1024 (maximum) @ 85 Hz
Color planes	24-bit, double buffered
Overlay planes	8-bit, shared with alpha planes
	4-bit, shared with stencil planes
Stencil planes	4-bit, shared with overlay planes
Alpha planes	8-bit, shared with 8 bit overlay planes
Window ID	4-bit
Z-buffer	24-bit
Total bits/pixel	96
Frame buffer	15 MB
Texture memory	16 MB
Form factor	Single full-length AGP card in ATX or NLX form
AGP	AGP 1X, 32-bit, 66 MHz, 5V signaling
Input voltage	3.3 Vdc, 5 Vdc, +12 Vdc
Power	25 W maximum
Operating temperature	10°C to 35°C (50°F to 104°F)
Relative humidity	10% to 90% noncondensing

Chapter 2
PowerStorm 300 PCI Graphics Controller Overview

2.1 Introduction

This chapter provides a brief overview of the PowerStorm 300 PCI graphics controller hardware. The PowerStorm 300 PCI graphics controller is supported on Alpha platforms only.

2.2 Description

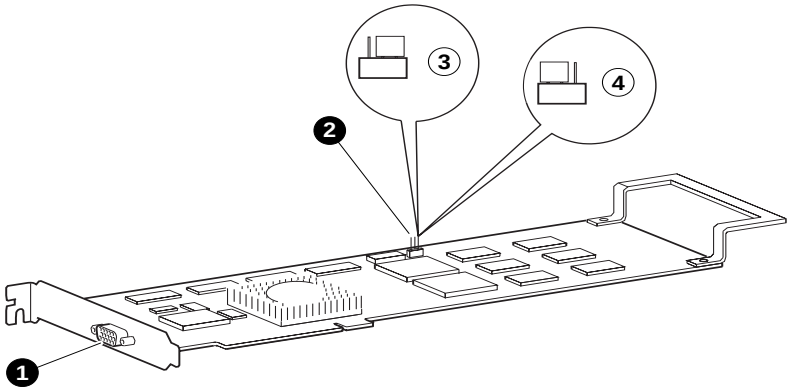
The PowerStorm 300 PCI graphics controller is a single expansion-slot, 32-bit PCI bus module that provides 2D and 3D graphics acceleration for supported Compaq systems. The PowerStorm 300 PCI graphics controller includes 16 MB of CDRAM texture memory.

For PowerStorm 300 PCI graphics controller software support requirements and orderable part numbers, see *PowerStorm 300 Graphics Controller Information*, which came with the controller.

The PowerStorm 300 PCI graphics controller (see Figure 2–1) contains one standard 15-pin VGA connector on the PCI bulkhead.

The graphics controller contains one 3-pin jumper for enabling or disabling the VGA capability when more than one VGA graphics controller is installed in the same system.

Figure 2–1 PowerStorm 300 PCI Graphics Controller



❶ Standard 15-pin VGA connector

❷ VGA enable/disable jumper

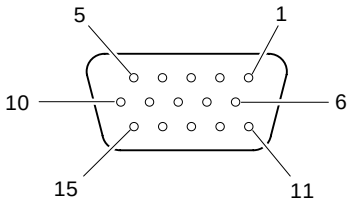
③ Shows the jumper setting for VGA enabled (default)

④ Shows the jumper set for VGA disabled

2.3 Connector Pinout

Figure 2–1 lists the pins and signals found on the standard 15-pin VGA connector.

Figure 2–2 VGA Connector Pinouts



Pin No.	Signal
1	RED VIDEO
2	GREEN VIDEO or COMPOSITE SYNC with GREEN VIDEO
3	BLUE VIDEO
4	NC (no connection)
5	GROUND
6	GROUND
7	GROUND
8	GROUND
9	+5V
10	GROUND
11	NC (no connection)
12	SERIAL DATA
13	HORIZONTAL SYNC or COMPOSITE SYNC
14	VERTICAL SYNC (VCLK)
15	SERIAL CLOCK

2.4 Specifications

Table 2–1 lists the specifications for the PowerStorm 300 PCI graphics controller.

Table 2–1 PowerStorm 300 PCI Graphics Controller Specifications

Resolution	1280 x 1024 (maximum) @ 85 Hz
Color planes	24-bit double buffered
Overlay planes	8-bit, double buffered
Stencil planes	Windows NT: 4-bit Tru64 UNIX: 1-bit
Window ID	4-bit
Z-buffer	24-bit
Total bits/pixel	96
Frame buffer	15 MB
Texture memory	16 MB
Form factor	Single full-length PCI card
PCI	PCI 2.1, 32-bit, 33 MHz, 5V signaling
Input voltage	3.3 Vdc, 5 Vdc, +12 Vdc
Power	25 W maximum
Operating temperature	10°C to 40°C (50°F to 104°F)
Relative humidity	10% to 90% noncondensing

Chapter 3
PowerStorm 350 PCI Graphics Controller Overview

3.1 Introduction

This chapter provides a brief overview of the PowerStorm 350 PCI graphics controller hardware. The PowerStorm 350 PCI graphics controller is available on Alpha platforms only.

3.2 Description

The PowerStorm 350 PCI graphics controller is a single expansion-slot, 32-bit PCI bus module that provides 2D and 3D graphics acceleration for supported Compaq systems. The PowerStorm 350 PCI graphics controller has stereo capability. See Section 4.3.7 for information on setup and rules for stereo operation on the Windows NT operating system. No special setup is necessary on the Tru64 UNIX operating system.

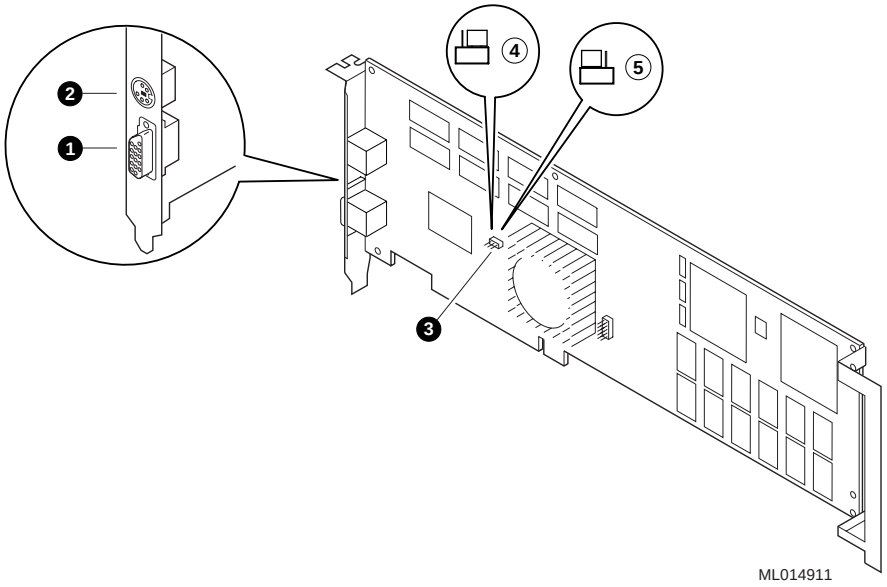
For PowerStorm 350 PCI graphics controller software support requirements and orderable part numbers, see *PowerStorm 350 Graphics Controller Information*, AV-RJ03C-TE, which came with the controller.

The PowerStorm 350 PCI graphics controller includes 32 MB of texture memory and 30 MB of frame buffer memory.

The PowerStorm 350 PCI graphics controller (see Figure 3–1) contains one standard 15-pin VGA connector and one 5-pin mini-DIN StereoVision connector on the PCI bulkhead.

The graphics controller contains one 3-pin jumper for enabling or disabling the VGA capability when more than one VGA graphics controller is installed in the same system.

Figure 3–1 PowerStorm 350 PCI Graphics Controller



❶ Standard 15-pin VGA connector

❷ StereoVision 5-pin circular DIN connector

❸ VGA enable/disable jumper

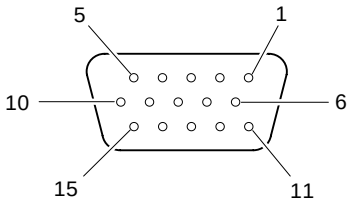
④ Shows the jumper setting for VGA disabled

⑤ Shows the jumper set for VGA enabled (default)

3.3 Connector Pinouts

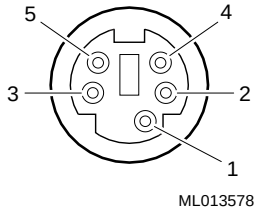
Figure 3–2 shows the pins and signals found on the standard 15-pin VGA connector. Figure 3–3 shows the pins and signals on the stereo connector.

Figure 3–2 VGA Connector Pinouts



Pin No.	Signal
1	RED VIDEO
2	GREEN VIDEO or COMPOSITE SYNC with GREEN VIDEO
3	BLUE VIDEO
4	NC (no connection)
5	GROUND
6	GROUND
7	GROUND
8	GROUND
9	+5V
10	GROUND
11	NC (no connection)
12	SERIAL DATA
13	HORIZONTAL SYNC or COMPOSITE SYNC
14	VERTICAL SYNC (VCLK)
15	SERIAL CLOCK

Figure 3–3 Stereo Connector Pinouts



Pin No.	Signal
1	GROUND
2	GROUND
3	+12 Vdc
4	STEREO OUTPUT
5	GROUND

3.4 Specifications

Table 3–1 PowerStorm 350 PCI Graphics Controller Specifications lists the specifications for the PowerStorm 350 PCI graphics controller.

Table 3–1 PowerStorm 350 PCI Graphics Controller Specifications

Resolution	1920 x 1200 (maximum) @ 75 Hz
Color planes	24-bit, double buffered
Overlay	8-bit, double buffered
Stencil planes	Windows NT: 4-bit Tru64 UNIX: 1-bit
Window ID	4-bit
Z-buffer	24-bit
Total bits/pixel	96
Frame buffer	30 MB
Texture memory	32 MB
Form factor	Single full-length PCI card
PCI	PCI 32-bit, 33 MHz, 5V signaling
Input voltage	3.3 Vdc, 5 Vdc, +12 Vdc
Power	30 W maximum
Operating temperature	10°C to 40°C (50°F to 104°F)
Relative humidity	10% to 90% noncondensing

Chapter 4
Installation (Windows NT)

4.1 Introduction

Chapter 4 pertains to the Windows NT operating system only; if you are running the Compaq Tru64 UNIX or OpenVMS operating systems, see Chapter 6 and Chapter 8 respectively.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

This chapter describes the installation of the PowerStorm 300 AGP and 300/350 PCI graphics controller in supported Compaq Professional Workstations running the Windows NT operating system.

If your PowerStorm 300 AGP or 300/350 PCI graphics controllers came pre-installed, the software is already in place, and you do not need to perform the procedures in this chapter.

Topics included in this chapter are:

- Hardware installation
- Software installation

4.1.1 Unpacking

The graphics controller option kit contains the graphics controller, the associated software, and this installation guide. The PowerStorm 300 AGP and 300/350 PCI software packages include a “break-the-seal” license and a compact disc (CD) containing the PowerStorm 300/350 display drivers.

4.2 Hardware Installation

If you will be installing PowerStorm software during a new installation or upgrade of the entire Windows NT operating system, install the PowerStorm 300 AGP or 300/350 PCI graphics controller hardware first *as described in section)4.2.2. You can then install the Windows NT operating system and display drivers.*

If you are installing a new PowerStorm 300 AGP or 300/350 PCI graphics controller and will be upgrading or installing the display drivers only *(and not reinstalling the operating system), you must install or update the drivers* before *installing the graphics controller. Follow the steps in Section 4.3.5 and install the graphics controller at the end of the procedure (step 17 and Section 4.2.2).*

If a graphics controller other than a PowerStorm 300 AGP or 300/350 PCI graphics controller was previously operating in the system, keep that controller installed and install the PowerStorm display drivers first (refer to Section 4.3.5). If the previously installed graphics controller is not available or it is not operational, install the graphics controller first (refer to Section 4.2.2).

4.2.1 Changing the Bulkhead Bracket, PowerStorm 300 AGP Only

The PowerStorm 300 AGP graphics controller is shipped with the ATX bulkhead bracket attached (see Figure 1-1). The NLX bulkhead bracket (see Figure 1-2) is also included in the option kit and can be switched by the customer or service provider.

If you need the NLX bulkhead bracket on your PowerStorm 300 AGP, use the following procedure to remove the ATX bulkhead bracket and install the NLX bulkhead bracket before performing any other installation procedures:

Static electricity can damage sensitive electronic components. When handling your graphics controller, use an anti-static wriststrap that is connected to a grounded surface on the system. The wriststrap must be worn when handling any graphics controller to prevent damage.

1. Put on an anti-static wriststrap.
2. Use a 3/16-inch nut driver to remove the two nuts, located on either side of the VGA connector, that secure the ATX bulkhead bracket to the PowerStorm 300 AGP graphics controller.
3. Remove the ATX bulkhead bracket.
4. Install the NLX bulkhead bracket onto the graphics controller.
5. Secure the NLX bulkhead bracket to the PowerStorm 300 AGP graphics controller with the two nuts that were removed in step 2.

4.2.2 Installation of the Graphics Controller

The following section describes the installation procedure for the PowerStorm 300 AGP or 300/350 PCI graphics controller. To install the graphics controller, follow these steps:

Before installing the graphics controller, check your monitor specification for signal compatibility and supported features offered by the graphics controller.

Static electricity can damage sensitive electronic components. When handling your graphics controller, use an anti-static wriststrap that is connected to a grounded surface on the system. The wriststrap must be worn when handling any graphics controller to prevent damage.

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1. Shut down the system and disconnect the monitor cable.
2. Disconnect the power cord from the system.
3. Remove the cover from your workstation (refer to your system documentation).
4. Put on an anti-static wriststrap.
5. If your system has an existing graphics controller, remove the screw that secures it and then remove the controller.
6. For the PowerStorm 300 AGP graphics controller, use the AGP slot. For the PowerStorm 300/350 PCI graphics controller, choose a slot on the primary bus. Consult your system documentation to determine which slots reside on which bus.
   (In the XP1000/500, the top 3 slots are on the Primary bus.)
   Remove the slot cover if you are using a new slot.

7. Grasp the top edge of the graphics controller and carefully insert it into the slot, then firmly seat it.
8. Secure the retaining bracket.
9. Replace the system cover.
10. Ensure that the monitor cable is connected to the video output connector located on the back of the graphics controller.
11. Reconnect the power cord, and restart the system.

4.3 Software Installation

This section describes the installation of the Microsoft Windows NT version of the PowerStorm 300 AGP or 300/350 PCI software.

4.3.1 Microsoft Windows NT Software Installation

The PowerStorm 300/350 software is a set of graphics display drivers to provide OpenGL support to enable you to run the PowerStorm graphics controllers. This section explains how to install PowerStorm display drivers on supported Compaq Professional Workstations running Windows NT version 4.0.

Keep this document in case you need to reinstall the PowerStorm 300/350 software for any reason.

If your PowerStorm 300 AGP or 300/350 PCI graphics controller came pre-installed in the system, the display drivers have been pre-installed as well.

4.3.2 PowerStorm 300/350 Software Components

The PowerStorm 300/350 software CD contains 2D drivers and 3D drivers (the Compaq accelerated OpenGL support). See Table 4–1.

Table 4–1 PowerStorm 300/350 Software Components on the CD

Component Description	File Name
GDI display driver	*pbxgdac.dll*
Kernel mode miniport driver	*pbxgdac.sys*
OpenGL driver—client-side file only	*pbxgdacogl.dll*
OpenGL driver—client-side file only (Intel platform only)	*pbxgdacp30gl.dll*
Configuration application	*pbxgdactab.dll*
Release Notes, which can be read using the *Notepad* application in Windows NT. You access this application by selecting *Start, Programs, Accessories, Notepad*.	*readme.txt*
Support for PowerStorm 300/350 in VGA mode (Intel platform only)	*a2100vga.sys*

4.3.3 Before You Begin

The operating system version required is:

Microsoft Windows NT version 4.0, Service Pack3 (SP3) or later.

Please note the following two possible installation sequences:

- **If you are installing a new version of, or upgrading, Microsoft Windows NT,** follow the procedures in Sections 4.3.4 and 4.3.5.
- **If you are upgrading your PowerStorm software display drivers only,** follow the procedure in Section 4.3.5.

4.3.4 New Installation or Upgrade of Windows NT

If a graphics controller other than a PowerStorm 300 AGP or 300/350 PCI graphics controller was previously operating in the system, keep that controller installed and install the PowerStorm display drivers (see Section 4.3.5). If the previously installed graphics controller is not available or it is not operational, follow the procedure in this section.

Before installing PowerStorm software during a Windows NT upgrade or new installation, you must have already installed a PowerStorm 300 AGP or 300/350 PCI graphics controller. You can then install Windows NT according to the Windows NT documentation.

During Windows NT installation, a hardware and software component list similar to the one below is displayed:

Computer: *Compaq Professional Workstation xxx* (*xxx* = CPU type)

Display: *VGA Compatible*

Keyboard: *XT, AT, or Enhanced Keyboard (83-104 keys)*

Keyboard Layout: *US*

Pointing Device: *Mouse Port Mouse*

No Changes: *The above list matches my computer*

When you have completed the Windows NT installation, go to Section 4.3.5.

On the Intel platform, some monitors are unable to display the refresh rate used during a short period of the initial installation of Windows NT 4.0 when using the PowerStorm 300. This occurs after the first part of a fresh installation of Windows NT following the period when the files are copied to the hard drive, but before Windows NT displays the first full color display screen. If you have chosen to use NTFS as your file system you may need to press the Enter key during the period while the screen is black to begin the process of converting the file system from FAT to NTFS.

4.3.5 Installing/Upgrading PowerStorm Software Display Drivers

If you have purchased the PowerStorm 300 AGP or 300/350 PCI graphics controller as an option, you must install the Compaq PowerStorm 300/350 display drivers. To install the 2D and 3D drivers (the Compaq optimized OpenGL support) from the Compaq PowerStorm software CD, follow these steps:

1. Boot the system and log into Windows NT if you have not already done so.
2. From the desktop, choose *My Computer*.
3. Choose Control Panel.
4. Choose *Display*.
5. Choose the *Settings* tab.
6. Choose the *Display Type* button to see the driver and adapter (board) information.
7. Choose *Change*.
8. Choose *Have Disk*.

9. In the Install from Disk dialog box, you are prompted to insert the manufacturer's installation disk into the selected drive. Insert the Compaq PowerStorm Software CD into the CD-ROM drive.
10. Enter the path of the appropriate PowerStorm display driver and choose *OK* to download the driver from the CD.
11. In the Change Display dialog box, the display driver whose path you just defined is displayed. Confirm this choice by choosing *OK*.
12. The display driver name is shown, for example:

    Compaq PowerStorm 300/350 (pbxgdac)

13. When the message displays stating that this is a third party driver, confirm by choosing *Yes*.
14. A status box displays reflecting the progress of the driver installation.
15. When the Compaq PowerStorm 300/350 files have been copied to your hard drive, a dialog box indicating that the driver was successfully installed is displayed. Choose *OK* and remove the CD from the drive.
13. Choose *Close* to close the Display Type dialog box.
14. Choose *Close* to close the Display applet.
15. When a message displays stating that you must restart the system to use the new display driver, choose *No*.
16. Shut down the system by choosing *Shut Down* from the Start menu, then remove power from the system and install the PowerStorm 300 AGP or 300/350 PCI graphics controller as described in Section 4.2.2 if you haven't already done so.
17. After installing the PowerStorm 300 AGP or 300/350 PCI graphics controller, reboot the system to access the new display driver. After the system reboots, a message displays indicating that the default screen resolution and refresh rate are being used. For information on changing these values, see Section 5.2.1.

4.3.6 OpenGL Acceleration

OpenGL functionality is available with the OpenGL display driver provided on the Microsoft Windows NT CD. In addition to this generic OpenGL display driver, you have access to an optimized OpenGL display driver from Compaq (*pbxgdacogl.dll*). This display driver maximizes the performance of applications that are written with OpenGL, and supports OpenGL Version 1.1 and the OpenGL Utility Library (GLU) Version 1.2.

The *pbxgdacogl.dll* file is located in the *%SystemRoot%\system32* directory, where "*%SystemRoot%"* is the environment variable defining the path of the system root directory; for example, *D:\winnt40.* For more information on using the Compaq OpenGL display drivers with the PowerStorm 300 AGP and 300/350 PCI graphics controller, see Section 5.3.

4.3.7 Stereo Capability (PowerStorm 350 PCI Only)

Only the PowerStorm 350 PCI graphics controller supports stereo capability.

In order to activate the stereo feature of the PowerStorm 350 PCI graphics controller, the following steps must be taken prior to running a stereo application:

1. From My Computer, choose *Control Panel.*
2. Choose Display.
3. Choose the REALimage (tm) Settings tab.
4. Check the *Stereo* box.
5. Choose *OK* or *Apply*.
6. When a message displays stating that you must reboot the system to use the new settings, choose *Yes*. (The new settings will not be applied unless you reboot your workstation.)

Once the system is rebooted with the stereo feature turned on, you can run stereo applications. When a stereo application becomes active, all 2D and 3D applications will run in stereo mode. This will affect performance of 2D and non-stereo 3D applications. Stereo mode is turned off once the last 3D stereo application exits.

Please note that the stereo feature is disabled if you are running dual PowerStorm 350 PCI graphics controllers.

Chapter 5
Operation (Windows NT)

5.1 Introduction

This chapter provides information about post-installation tasks and use of the OpenGL display drivers with a PowerStorm 300 AGP or 300/350 PCI graphics controller on either the Intel or Alpha Windows NT platforms.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

5.2 After Installation

After you have installed the PowerStorm 300/350 display driver, you may need to change the screen resolution and refresh rate, manage buffer swap, or identify the display driver version for troubleshooting purposes. The following sections describe how to perform these tasks.

5.2.1 Changing the Screen Resolution and Refresh Rate

The screen resolution and refresh rates are collectively referred to as the *display mode*. Appendix A shows which display modes are supported by the PowerStorm 300 PCI and PowerStorm 350 PCI graphic controllers. Note that the PowerStorm 350 PCI graphics controller has twice as much frame buffer memory, and can thus support some higher resolutions than the PowerStorm 300 PCI graphics controller.

Before changing the display mode, verify that your monitor can handle the new values. Refer to your monitor documentation for this information. Then perform the following steps:

1. From the desktop, choose *My Computer*.
2. Choose *Control Panel*.
3. Choose *Display*.

4. Choose the *Settings* tab.
5. Click on the arrows in the *Desktop Area* to change the screen resolution.
6. To change the refresh rate, choose one of the options in *Refresh Frequency*. (You can also change the resolution and refresh rate by choosing *List All Modes* and the desired mode, and then choosing *OK*.) If the refresh rate selected is not supported by the resolution you chose, the resolution will automatically change to the nearest value supported by that refresh rate, or the refresh rate will change to support the resolution.
7. Choose *Test* to verify that the settings work correctly. A test pattern will be displayed on your monitor for about 5 seconds. You will then see the question, "Did you see the test bitmap properly?"
8. If you are satisfied with the video display, choose *Yes*. Choose *OK* to change the settings.
9. You may have to adjust your monitor to align the new resolution to the monitor. This is typically done by using the controls on the front or side of the monitor.

If you accidentally click OK *for a resolution that your monitor can't support on the Windows NT operating system, you may not be able see the display or navigate the controls to fix the problem. If this happens, you can force the system to come up in VGA mode by using the appropriate following procedure.*

Windows NT Alpha Platform

Reboot the system. During *Startup*, press **F2** to enter setup. Select *Utilities* and *OS Selection Setup*. Add the word *BASEVIDEO* to the OS Options. Complete the boot. The screen is now running in VGA mode. Change the resolution to something you know that the monitor can handle, for example 800x600x60. Reboot again, but this time enter *Setup* and remove the BASEVIDEO option, or the system will come up in VGA mode again. Complete the boot and change the settings to the desired resolution.

Windows NT Intel Platform

Reboot the system. During *Startup*, select *Windows NT Workstation 4.0 [VGA Mode]*. The screen is now running in VGA mode. Complete the boot and change the resolution to something you know that the monitor can handle, for example 800x600x60. Reboot again, but this time select *Windows NT Workstation 4.0*. Complete the boot and change the settings to the desired resolution.

5.2.2 Managing Buffer Swap

In Windows NT version 4.0, you can enable/disable the double-buffer synchronization. In most cases, double-buffer swaps are synchronized with vertical retrace to avoid visual "tearing" effects.

Tearing and flickering can occur for a combination of reasons:

- Many large triangles are being processed.
- A large window is being used.
- High resolution and refresh rate values are defined.

Most applications do not experience visual tearing and could take advantage of the higher frame rates and better performance available when no synchronization is used. Therefore, you should try using this mode.

If unwanted visual effects do occur, however, use the tear-free (sync with refresh) double-buffering mode, choosing the highest vertical refresh rate supported by your monitor at your chosen resolution (see Section 5.2.1).

You can change the double-buffer synchronization mode using the display applet.

Using the Display Applet

To use the display applet, follow these steps:

1. From the desktop, choose *My Computer*.
2. Choose Control Panel.
3. Choose *Display*.
4. Select REALimage Settings.
5. In the REALimage section, select the check box *Minimize Flicker (sync swap with retrace)* to synchronize with the vertical refresh, or turn off the check box to disable it.
6. When prompted, press *OK* to reboot the system.

When you use the REALimage application to set the double-buffer synchronization mode, this definition remains effective across reboots until changed.

5.2.3 Identifying the Display Driver Version

If you encounter a problem with the PowerStorm display driver, you can report it to Compaq. When reporting a problem, you must include the version of the driver with your description of the problem.

To identify the version of the display driver, follow these steps:

1. Select *Start*, *Programs*, and *Windows NT Explorer* to view the files currently installed on your machine.
2. To ensure that all files are listed, select *View*, *Options*, and the *View* tab, and verify that the *Show all Files* box is selected. Choose *OK*.
3. Locate the *pbxgdac.dll* file in the list.
   This file is found in the *%SystemRoot%\system32* directory.
4. Click once on the file name to highlight it.
5. From the File Menu, choose *Properties*.
6. In the Properties dialog box, choose the *Version* tab.
   The Version dialog box displays driver information, including the version and date.

5.3 Using OpenGL

This section describes the PowerStorm OpenGL display driver, which is designed to optimize OpenGL performance on supported Compaq Professional Workstations. This section includes the following topics:

- Using OpenGL Applications, for users running applications developed with OpenGL
- Developing OpenGL Applications, for users developing OpenGL applications

For a more comprehensive discussion of the OpenGL interface, refer to the Microsoft Windows NT OpenGL documentation included in the Microsoft Windows NT version 4.0 Software Developer's Kit (SDK).

5.3.1 Using OpenGL Applications

In addition to a generic OpenGL display driver, Windows NT OpenGL includes a mechanism by which OpenGL rendering can be performed by vendor-supplied display drivers. Compaq provides such an OpenGL display driver in the PowerStorm 300/350 Software product. This driver takes advantage of hardware features that improve rendering performance and quality, and is used with the PowerStorm 300 AGP or 300/350 PCI graphics controller.

When an application requests a pixel format, Windows NT OpenGL will satisfy the request with the pixel format that best fits the description. This pixel format can be one of the following:

- A hardware pixel format, supported by the PowerStorm 300/350 OpenGL driver
- A software pixel format, supported by the generic Windows NT OpenGL driver

5.3.2 Developing OpenGL Applications on Intel Platforms

This section provides information for developing OpenGL applications that optimize the performance of PowerStorm 300 AGP graphics controllers on Intel platforms. If you have a PowerStorm 300/350 PCI graphics controller on a Windows NT Alpha platform, see Section)5.3.3 instead.

Pixel Format Support

The PowerStorm 300 AGP graphics controller and display driver on the Intel platform supports a fully compliant implementation of OpenGL in combination with Windows NT OpenGL. Color index mode support is provided by the Windows NT generic OpenGL implementation, and thus is not hardware-accelerated.

The display driver for the PowerStorm 300 AGP graphics controller on Intel platforms supports the pixel formats listed in Table 5–1.

Table 5–1 Intel-Supported Pixel Formats on the PowerStorm 300 Graphics Controller

Pixel Format	1	2	3	4
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	No	Yes	No	Yes
Stereo	No	No	No	No
Draw to Window	Yes	Yes	Yes	Yes
Draw to Pixmap	No	No	No	No
Swap Layer Buffers	Yes	Yes	Yes	Yes
Support GDI	Yes	Yes	Yes	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Support Overlays (*)	Yes	Yes	Yes	Yes
Generic Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Color Bits	32	32	32	32
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	8	8	8	8
Alpha Shift	24	24	24	24
Accum Bits	0	0	32	32
Depth Bits	24	24	24	24
Stencil Bits (*)	4	4	4	4
Overlay Bits (*)	4	4	4	4
Reserved	1	1	1	1
Auxiliary Buffers	0	0	0	0

* You can only have 4-bit Stencil or 4-bit Overlay, which can be set with the Display Applet.

Performance Considerations

The PowerStorm 300 AGP graphics controller and display driver on the Intel platform accelerate virtually all OpenGL Version 1.1 operations. However, some aspects of OpenGL use can affect performance as described in the following sections.

Texture Mapping

Several aspects of texture mapping can affect application performance. Some of these are under the control of the application user. Others are under the control of the application developer:

- When an application defines textures to OpenGL, it can explicitly specify the resolution (for example, 16 or 32 bits per texel) with which textures are to be stored. Alternatively, the application can leave this decision to OpenGL. In this case, the PowerStorm OpenGL driver will, by default, use 16 bits per texel for RGB and RGBA textures. The application user can override this default behavior by setting the *Texel 32 Bit Default* selection in the Display Applet.
- Allocating 16 bits per texel allows more textures to be stored in the texture cache and may provide slightly higher rasterization rates. On the other hand, using 32 bits per texel provides better texture resolution in the same way that a color frame buffer with 8 bits per color component has better color resolution than a frame buffer with 4 bits per color component.
- The rasterization rate for PowerStorm 300 AGP and 300 PCI graphics controllers and display drivers is twice as fast for bilinear texture filtering as for trilinear texture filtering.
- Software developers should use OpenGL Version 1.1 texture objects when an application has more than one texture.

Overlay Planes

The PowerStorm 300 AGP graphics controller on the Intel platform provides hardware support for 2-bit double-buffered overlay planes. Note that for performance reasons, not all pixel formats support overlay planes. If you do not require overlay planes, selecting a pixel format without overlay support will ensure maximum performance. The availability of pixel formats with overlay planes can be disabled by using the Display Applet.

Stencil Planes

The PowerStorm display driver provides hardware support for a 4-bit stencil buffer. Note that for performance reasons, not all pixel formats support stencil planes. If you do not require stencil planes, selecting a pixel format without stencil planes will ensure maximum performance. The availability of pixel formats with stencil planes can be disabled by using the Display Applet.

SoftImage Customizations

When using the PowerStorm 300 AGP graphics controller on the Intel platform with Microsoft's SoftImage, you should enable *SoftImage Customizations* using the Display Applet. In addition, you also need to enable 4-bit overlay using the Display Applet. Before starting Softimage, you need to make sure that the following environment variable is set:

SI_OVERLAY = USE_ONE_BIT

When *SoftImage Customizations* are enabled, other OpenGL applications may not behave correctly. Therefore it is recommended that *SoftImage Customizations* be disabled before running other OpenGL applications.

5.3.3 Developing OpenGL Applications on Alpha Platforms

This section provides information for developing OpenGL applications that optimize the performance of PowerStorm 300/350 PCI graphics controllers on Windows NT Alpha platforms. If you have a PowerStorm 300 AGP graphics controller on an Intel platform, see Section)5.3.2.

Pixel Format Support

The PowerStorm 300/350 PCI graphics controllers and display drivers for the Windows NT Alpha platform support a fully compliant implementation of OpenGL in combination with Windows NT OpenGL. Color index mode support is provided by the Windows NT generic OpenGL implementation, and thus is not hardware-accelerated.

The display driver on the PowerStorm 300 PCI graphics controller for the Windows NT Alpha platform supports the pixel formats listed in Table 5–2. The display driver on the

PowerStorm 350 PCI graphics controller for the Windows NT Alpha platform supports the pixel formats listed in Table 5–3.

Table 5–2 Alpha-Supported Pixel Formats on PowerStorm 300 PCI Graphics Controller

Pixel Format	1	2	3	4
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	Yes	No	Yes	No
Stereo	No	No	No	No
Draw to Window	Yes	Yes	Yes	Yes
Draw to Bitmap	No	No	No	No
Support GDI	No	Yes	No	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Generic Pixel Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Swap Exchange	Yes	Yes	Yes	Yes
Swap Copy	No	No	No	No
Swap Layer Buffers	No	No	No	No
Generic Accelerated	No	No	No	No
Color Bits	24	24	24	24
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	0	0	0	0
Alpha Shift	0	0	0	0
Accum Bits	48	48	48	48
Depth Bits	24	24	24	24
Stencil Bits (*)	0	0	4	4
Reserved (Support Overlays)	0 (No)	0 (No)	0 (No)	0 (No)
Auxiliary Buffers	0	0	0	0

* Availability of pixel formats with stencil planes can be disabled using the Display Applet.

Table 5-2 Alpha-Supported Pixel Formats on PowerStorm 300 PCI Graphics Controller (cont.)

Pixel Format	5	6	7	8
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	Yes	No	Yes	No
Stereo	No	No	No	No
Draw to Window	Yes	Yes	Yes	Yes
Draw to Bitmap	No	No	No	No
Support GDI	No	Yes	No	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Generic Pixel Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Swap Exchange	Yes	Yes	Yes	Yes
Swap Copy	No	No	No	No
Swap Layer Buffers	Yes	Yes	Yes	Yes
Generic Accelerated	No	No	No	No
Color Bits	24	24	24	24
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	0	0	0	0
Alpha Shift	0	0	0	0
Accum Bits	48	48	48	48
Depth Bits	24	24	24	24
Stencil Bits (*)	0	0	4	4
Reserved (Support Overlays)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)
Auxiliary Buffers	0	0	0	0

* Availability of pixel formats with stencil planes can be disabled using the Display Applet.

Table 5–3 Alpha-Supported Pixel Formats on PowerStorm 350 PCI Graphics Controller

Pixel Format	1	2	3	4
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	Yes	No	Yes	No
Stereo	No	No	No	No
Draw to Window	Yes	Yes	Yes	Yes
Draw to Bitmap	No	No	No	No
Support GDI	No	Yes	No	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Generic Pixel Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Swap Exchange	Yes	No	Yes	No
Swap Copy	No	No	No	No
Swap Layer Buffers	No	No	No	No
Generic Accelerated	No	No	No	No
Color Bits	24	24	24	24
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	0	0	0	0
Alpha Shift	0	0	0	0
Accum Bits	48	48	48	48
Depth Bits	24	24	24	24
Stencil Bits (*)	0	0	4	4
Reserved (Support Overlays)	0 (No)	0 (No)	0 (No)	0 (No)
Auxiliary Buffers	0	0	0	0

* Availability of pixel formats with stencil planes can be disabled using the Display Applet.

Table 5-3 Alpha-Supported Pixel Formats on PowerStorm 350 PCI Graphics Controller (cont.)

Pixel Format	5	6	7	8
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	Yes	No	Yes	No
Stereo	No	No	No	No
Draw to Window	Yes	Yes	Yes	Yes
Draw to Bitmap	No	No	No	No
Support GDI	No	Yes	No	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Generic Pixel Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Swap Exchange	Yes	No	Yes	No
Swap Copy	No	No	No	No
Swap Layer Buffers	Yes	Yes	Yes	Yes
Generic Accelerated	No	No	No	No
Color Bits	24	24	24	24
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	0	0	0	0
Alpha Shift	0	0	0	0
Accum Bits	48	48	48	48
Depth Bits	24	24	24	24
Stencil Bits (*)	0	0	4	4
Reserved (Support Overlays)	1(Yes)	1(Yes)	1(Yes)	1(Yes)
Auxiliary Buffers	0	0	0	0

* Availability of pixel formats with stencil planes can be disabled using the Display Applet.

Table 5-3 Alpha-Supported Pixel Formats on PowerStorm 350 PCI Graphics Controller (cont.)

Pixel Format	9	10	11	12
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	Yes	No	Yes	No
Stereo	Yes	Yes	Yes	Yes
Draw to Window	Yes	Yes	Yes	Yes
Draw to Bitmap	No	No	No	No
Support GDI	No	Yes	No	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Generic Pixel Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Swap Exchange	Yes	No	Yes	No
Swap Copy	No	No	No	No
Swap Layer Buffers	No	No	No	No
Generic Accelerated	No	No	No	No
Color Bits	24	24	24	24
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	0	0	0	0
Alpha Shift	0	0	0	0
Accum Bits	48	48	48	48
Depth Bits	24	24	24	24
Stencil Bits (*)	0	0	4	4
Reserved (Support Overlays)	0 (No)	0 (No)	0 (No)	0 (No)
Auxiliary Buffers	0	0	0	0

* Availability of pixel formats with stencil planes can be disabled using the Display Applet.

Table 5-3 Alpha-Supported Pixel Formats on PowerStorm 350 PCI Graphics Controller (cont.)

Pixel Format	13	14	15	16
Pixel Type	RGBA	RGBA	RGBA	RGBA
Double-Buffered	Yes	No	Yes	No
Stereo	Yes	Yes	Yes	Yes
Draw to Window	Yes	Yes	Yes	Yes
Draw to Bitmap	No	No	No	No
Support GDI	No	Yes	No	Yes
Support OpenGL	Yes	Yes	Yes	Yes
Generic Pixel Format	No	No	No	No
Need Palette	No	No	No	No
Need System Palette	No	No	No	No
Swap Exchange	Yes	No	Yes	No
Swap Copy	No	No	No	No
Swap Layer Buffers	Yes	Yes	Yes	Yes
Generic Accelerated	No	No	No	No
Color Bits	24	24	24	24
Red Bits	8	8	8	8
Red Shift	16	16	16	16
Green Bits	8	8	8	8
Green Shift	8	8	8	8
Blue Bits	8	8	8	8
Blue Shift	0	0	0	0
Alpha Bits	0	0	0	0
Alpha Shift	0	0	0	0
Accum Bits	48	48	48	48
Depth Bits	24	24	24	24
Stencil Bits (*)	0	0	4	4
Reserved (Support Overlays)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)
Auxiliary Buffers	0	0	0	0

* Availability of pixel formats with stencil planes can be disabled using the Display Applet.

Performance Considerations

PowerStorm 300/350 PCI graphics controllers for the Windows NT Alpha platform accelerate virtually all OpenGL Version 1.1 operations. However, some aspects of OpenGL use can affect performance as described in the following sections.

Texture Mapping

Several aspects of texture mapping can affect application performance. Some of these are under the control of the application user. Others are under the control of the application developer.

- When an application defines textures to OpenGL it can explicitly specify the resolution (for example 16 or 32 bits per texel) with which textures are to be stored. Alternatively, the application can leave this decision to OpenGL. In this latter case the PowerStorm 300/350 OpenGL driver will, by default, use 16 bits per texel for RGB and RGBA textures. The application user can override this default behavior by setting the *Texel 32 Bit Default* selection in the Display Applet.

  Allocating 16 bits per texel allows more textures to be stored in the texture cache and may provide slightly higher rasterization rates. On the other hand, using 32 bits per texel provides better texture resolution in just the same way that a color frame buffer with 8 bits per color component has better color resolution than a frame buffer with 4 bits per color component.

- The rasterization rate for PowerStorm 300/350 PCI graphics controllers is twice as fast for bilinear texture filtering as for trilinear texture filtering.

- Software developers should use OpenGL Version 1.1 texture objects when an application has more than one texture.

Alpha Buffers

PowerStorm 300/350 PCI graphics controllers on the Windows NT Alpha platform do not provide an alpha buffer (i.e., it has zero alpha planes). Few applications actually need an alpha buffer. The two operations that depend on the values stored in the alpha buffer are:

- *Storing alpha values so that they can be read later*

  The application needs an alpha buffer if it must store alpha values for later retrieval by the **glReadPixels** function with one of the following formats:

  – GL_ALPHA

  – GL_RGBA

- GL_LUMINANCE_ALPHA

- *Blending, using a destination alpha value*

  The application needs an alpha buffer if it calls the **glBlendFunc** function with one of the following values:

  - DST_ALPHA
  - ONE_MINUS_DST_ALPHA
  - ONE_MINUS_DST_COLOR
  - SRC_ALPHA_SATURATE

In conformance with OpenGL, glReadPixels returns 1.0 for all alpha values, and OpenGL uses 1.0 for all destination alpha values when computing blending factors.

Note that all alpha related aspects of the rasterization and per-fragment portions of the OpenGL pipeline (blending, alpha test, alpha related texturing functionality) are supported by PowerStorm 300/350 PCI graphics controllers on the Windows NT Alpha platform.

If an application calls wglChoosePixelFormat to request a pixel format with alpha planes, a generic pixel format will be chosen. In this case OpenGL operations will not be hardware accelerated, thus severely degrading performance.

Overlay Planes

PowerStorm 300/350 PCI graphics controllers on the Windows NT Alpha platform provide hardware support for 8-bit, double-buffered overlay planes. Note that for performance reasons, not all pixel formats support overlay planes. If you do not require overlay planes, selecting a pixel format without overlay support will ensure maximum performance.

Stencil Planes

The PowerStorm display driver provides hardware support for a 4-bit stencil buffer. Note that for performance reasons, not all pixel formats support stencil planes. If you do not require stencil planes, selecting a pixel format without stencil planes will ensure maximum performance. The availability of pixel formats with stencil planes can be disabled by using the Display Applet.

SoftImage Customizations

When using PowerStorm 300/350 PCI graphics controllers on the Windows NT Alpha platform with Microsoft's SoftImage, you should enable *SoftImage Customizations* using the Display Applet. This will ensure maximum performance and compatibility with SoftImage.

When *SoftImage Customizations* are enabled, other OpenGL applications may not behave correctly. Therefore it is recommended that *SoftImage Customizations* be disabled before running other OpenGL applications.

Chapter 6
Installation (Compaq Tru64 UNIX)

6.1 Introduction

Chapter 6 pertains to the Compaq Tru64 UNIX operating system only; if you are running the Windows NT or OpenVMS operating systems, see Chapter 4 or Chapter 8 respectively.

Where we reference TRU64 UNIX throughout this manual, in most cases DIGITAL UNIX or COSIX64 may be substituted. Exceptions will be explicitly noted.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

This chapter describes the installation of the PowerStorm 300/350 PCI graphics controller in supported Compaq Professional Workstations, Compaq AlphaStations, or Compaq AlphaServers running the Compaq Tru64 UNIX operating system.

If your PowerStorm 300/350 PCI graphics controller came pre-installed, the software is already in place, and you do not need to perform the procedures in this chapter.

Topics included in this chapter are:

- Hardware installation
- Software installation

6.1.1 Unpacking

The graphics controller option kit contains the graphics controller, the associated software (PowerStorm 300/350 UNIX Graphics Support), and this installation guide. The PowerStorm 300/350 PCI software packages include a “break-the-seal” license and a compact disc (CD) containing the PowerStorm 300/350 display drivers.

PowerStorm 300/350 UNIX Graphics Support is a supplemental kit that only supports the PowerStorm 300 and PowerStorm 350 graphics controllers. This kit requires Tru64 UNIX Version 4.0D or later or COSIX64 V5.0 or later, and is only supported on the Compaq Professional Workstation XP1000, Compaq AlphaStations, and Compaq AlphaServers.

This release contains optional support for the OpenGL graphics API.

6.2 Hardware Installation

The following section describes the installation procedure for the PowerStorm 300/350 PCI graphics controller.

6.2.1 Installation of the Graphics Controller

Before installing the graphics controller, check your monitor specification for signal compatibility and supported features offered by the graphics controller.

Static electricity can damage sensitive electronic components. When handling your graphics controller, use an anti-static wriststrap that is connected to a grounded surface on the system. The wriststrap must be worn when handling any graphics controller to prevent damage.

To install the graphics controller, follow these steps:

1. Shut down the system and disconnect the monitor cable.
2. Disconnect the power cord from the system.
3. Remove the cover from the system (refer to your system documentation).
4. Put on an anti-static wriststrap.
5. If the system has an existing graphics controller, remove the screw that secures it and then remove the controller.
6. If you are installing the first graphics controller in your system, choose a slot on the primary PCI bus. Consult the system documentation to determine which slots reside on which bus (in the XP1000/500 and XP1000/667, the top 3 slots are on the primary bus). Remove the slot cover if you are using a new slot.

   If you are installing multiple PowerStorm 300/350 graphics controllers, you may need to choose a slot on the secondary PCI bus. Note that one (and

only one) of the graphics controllers should have its VGA jumper set, and that one *must* be on the primary PCI bus

7. Grasp the top edge of the graphics controller and carefully insert it into the slot, then firmly seat it.
8. Secure the retaining bracket.
9. Replace the system cover.
10. Ensure that the monitor cable is connected to the video output connector located on the back of the graphics controller.
11. Reconnect the power cord, and restart the system.

6.3 Software Installation

This section describes the installation of PowerStorm 300/350 software for the Tru64 UNIX operating system.

6.3.1 Installation Preparation and Information

Required License

PowerStorm 300/350 UNIX Graphics Support software requires an Open3D Product Authorization Key (PAK) for OpenGL server operation. A hardcopy of this PAK is provided with your hardware and should be registered using the License Management Facility (LMF) before you install PowerStorm 300/350 UNIX Graphics Support. If you do not register the PAK before starting the software, the server will run in 2D mode only (without OpenGL server support).

If your PowerStorm 300/350 graphics controller hardware and software came pre-installed, the PAK will already be registered.

For complete information on using the Tru64 UNIX License Management Facility, see the *Software License Management* guide or the `lmf(8)` reference page.

Prerequisite Software

You can install PowerStorm 300/350 UNIX Graphics Support only on systems that are running Tru64 UNIX Version 4.0D or later or COSIX64 V5.0 or later.

Before installing PowerStorm 300/350 UNIX Graphics Support, you must remove all graphics support software from the system. After you have installed PowerStorm 300/350 UNIX Graphics Support, if you upgrade or reinstall the operating system, you must first de-install PowerStorm 300/350 UNIX Graphics Support. Once the operating system update has completed, you may reinstall PowerStorm 300/350 UNIX Graphics Support.

Do not install the Open3D kit in addition to PowerStorm 300/350 UNIX Graphics Support. Installing an Open3D kit after installing PowerStorm 300/350 UNIX Graphics Support may cause unpredictable results.

Alternate Console

Instead of using the graphics display as the system console, it is possible to attach an external ASCII terminal to serial port 1 and have console interactions take place on that device. This is done at the boot prompt (>>>).

To use an external terminal, the commands are:

```
>>> set console serial
>>> init
```

To return to the graphics display as console, the commands are:

```
>>> set console graphics
>>> init
```

Booting Compaq Tru64 UNIX

To begin installation of PowerStorm 300/350 UNIX Graphics Support, you must boot the generic kernel. This is done at the boot prompt (>>>).

```
>>> b -fi genvmunix
```

6.3.2 Installing PowerStorm Display Drivers

You must have super-user ("root") privileges to perform most operations described below. Login as root before continuing.

Copying the Kit from CD-ROM

This section describes the procedure for copying the PowerStorm 300/350 UNIX Graphics Support kit from a CD-ROM distribution. The kit is distributed as a tar file with the extension `tar`.

If you have downloaded the kit from another source, simply copy it into the `/var/tmp/` directory and skip to the next section. The installation instructions below assume the name of the distribution file is `PS3x0UNIX.tar`, *and* that you will be installing the Tru64 UNIX Version 4.0E/F. Installation of the kit for other versions will be similar.

In the following instructions, `rz4` is the CD-ROM disk drive and `/mnt` is a free mount point. Follow these instructions to copy the kit from a CD-ROM drive:

1. Place the CD-ROM media in the appropriate disk drive.
2. Mount the media on a free mount point by entering the following command:

   ```
   # mount -t cdfs -r -o noversion /dev/rz4c /mnt
   ```

3. When you install from a CD-ROM, the CD-ROM disk c partition must be mounted on a free mount point.
4. Copy the kit from the CD-ROM to your local hard drive:

   ```
   # cp /mnt/alpha/unix/ps3x0v14-V40EF.tar /var/tmp/PS3x0UNIX.tar
   ```

5. If this is not the path to the kit on your CD-ROM, you may need to search for the appropriate file on the CD-ROM by looking for the `tar` extension.

Unpacking the Kit

This section describes the procedure for unpacking the compressed kit into a directory structure on your local filesystem. It is assumed that the compressed kit distribution file exists as `/var/tmp/PS3x0UNIX.tar`.

1. Change to the directory where you copied the kit distribution file:

   ```
   # cd /var/tmp
   ```

2. Use `tar` to unpack the tar file into a directory structure:

   ```
   # tar xvf PS3x0UNIX.tar
   ```

This will create the `PS3x0UNIX` directory and populate it with the kit files.

Installing the Kit

This section describes the procedure for installing PowerStorm 300/350 UNIX Graphics Support. It is assumed that the kit has been obtained and unpacked into the /var/tmp/PS3x0UNIX/ directory.

1. Ensure that the system in which you wish to install PowerStorm 300/350 UNIX Graphics Support does not already contain a graphics support kit.

   To determine if graphics support subsets are installed on the system, enter the command:

   ```
   # setld -i | grep –e O3D -e 3X0 -e 4DT | grep installed
   ```

   If any of these subsets are installed, you must de-install them using the `setld -d` command. For example, to remove the OpenGL support files, you might enter:

   ```
   # setld -d O3DDWSGLBASE491
   ```

2. Make sure that you are in the directory where you unpacked the kit:

   # cd /var/tmp/PS3x0UNIX/

3. Start the installation.

   Start the installation by entering the setld command with the -l (load) function, specifying the current directory as the location of the kit:

   ```
   #  setld -l .
   ```

4. Specify the subsets you wish to install.

   The installation procedure displays the list of subsets available for installation and prompts you to choose the desired subsets.

   ```
   *** Enter subset selections ***
   ```

   The following subsets are mandatory and will be installed automatically unless you choose to exit without installing any subsets:

   * PowerStorm 3x0 v1.4 for V4.0E/F Base
   * PowerStorm 3x0 v1.4 for V4.0E/F Config
   * PowerStorm 3x0 v1.4 for V4.0E/F Device

   ```
   The subsets listed below are optional:
        There may be more optional subsets than can be presented on a single
        screen. If this is the case, you can choose subsets screen by screen
        or all at once on the last screen. All of the choices you make will
        be collected for your confirmation before any subsets are installed.
   ```

```
     1) PowerStorm 3x0 v1.4 for V4.0E/F OpenGL
Or you may choose one of the following options:
     2) ALL mandatory and all optional subsets
     3) MANDATORY subsets only
     4) CANCEL selections and redisplay menus
     5) EXIT without installing any subsets
Enter your choices or press RETURN to redisplay menus.
     Choices (for example, 1 2 4-6): 2
```

5. Confirm your subset selection.
   The installation procedure displays a list of the subsets you selected.

```
You are installing the following mandatory subsets:
        PowerStorm 3x0 v1.4 for V4.0E/F Base
        PowerStorm 3x0 v1.4 for V4.0E/F Config
        PowerStorm 3x0 v1.4 for V4.0E/F Device
You are installing the following optional subsets:
        PowerStorm 3x0 v1.4 for V4.0E/F OpenGL
    Is this correct? (y/n): y
```

   Enter 'y' if the subsets you wish to install are those listed. Enter 'n' to specify other subsets.

6. Read the informational messages.
   The installation procedure generates messages as it checks that your system has enough space to install the requested subsets, copies these subsets, and then verifies that they were copied correctly.

```
Checking file system space required to install selected subsets:
File system space checked OK.
4 subset(s) will be installed.
Loading 1 of 4 subset(s)....
PowerStorm 3x0 v1.4 for V4.0E/F Base
   Copying from . (disk)
   Verifying
Loading 2 of 4 subset(s)....
PowerStorm 3x0 v1.4 for V4.0E/F OpenGL
   Copying from . (disk)
   Verifying
Loading 3 of 4 subset(s)....
PowerStorm 3x0 v1.4 for V4.0E/F Device
   Copying from . (disk)
        Working....Mon Jan 10 19:48:52 EST 2000
   Verifying
Loading 4 of 4 subset(s)....
PowerStorm 3x0 v1.4 for V4.0E/F Config
   Copying from . (disk)
   Verifying
4 of 4 subset(s) installed successfully.
Configuring "PowerStorm 3x0 v1.4 for V4.0E/F Base (3X0BASE414)
        Release notes can be found in the /usr/lib/PS3x0/ directory.
        To verify the installation of the 3X0GLBASE414 subset
        after you have rebuilt your kernel and rebooted your system,
        cd to /usr/bin/X11 and issue the command:
        ./gl_ivp
Configuring "PowerStorm 3x0 v1.4 for V4.0E/F OpenGL (3X0GLBASE414)
```

```
Modifying ./usr/var/X11/Xserver.conf
Configuring "PowerStorm 3x0 v1.4 for V4.0E/F Device (3X0DEVICE414)
 **** Installation of 3X0DEVICE414 requires reboot after kit install ****
Configuring "PowerStorm 3x0 v1.4 for V4.0E/F Config (3X0CONFIG414)
      **** Auto Kernel Configuration ****
*** KERNEL CONFIGURATION AND BUILD PROCEDURE ***
    Saving /sys/conf/NODENAME as /sys/conf/NODENAME.bck
```

7. Indicate whether you wish to modify the configuration file.

   ```
   Do you want to edit the configuration file? (y/n) [n]:
   ```

   The configuration file contains a variety of parameters that enable you to define information used by the system at startup.

   Enter 'y' if you wish to edit the configuration file. Press **Return** if you do not wish to edit the configuration file.

```
Do you want to edit the configuration file? (y/n) [n]:
*** PERFORMING KERNEL BUILD ***
        Working....Mon Jan 10 19:50:01 EST 2000
The new kernel is /sys/NODENAME/vmunix
Saved file ./vmunix as ./vmunix.pre.3X0414
Moving new kernel to /vmunix...
Installation of 3X0CONFIG414 Complete.
    **** SHUTDOWN and POWER-CYCLE to enable new kernel ****
```

8. Shutdown and power-cycle the system.

9. Dismount the CD-ROM drive from the mount point.
   For example, to dismount mount point `/mnt`, enter the command:

   ```
   # umount /mnt
   ```

9. Remove the CD from the CD-ROM drive.

   The installation is now completed.

6.4 Configuration Recommendations

Compaq recommends performing the following configuration operations before you use PowerStorm 300/350 UNIX Graphics Support:

- Partitioning Drives

  You should define a minimum of 600 MB pages of swap.

  For any system, you should divide swap space equally across two or more drives. No swap partition should be smaller than 100 MB pages.

  Example 1:

  A system with two drives could be configured to contain the following:

drive1: operating system and swap1
drive2: 3D client application, user data, and swap2

Example 2:

A system with three disks could be configured to contain the following:

drive1: operating system and swap1
drive2: 3D client application, user data, and swap2
drive3: user model data

- Configuring Physical Memory (RAM)

  You should configure enough physical memory for the average workload to reduce paging activity to zero.

  The minimum memory requirements are determined by the size of the data and the application operations. On Tru64 UNIX systems, most three-dimensional graphics applications require an absolute minimum of 128 MB.

6.4.1 Tuning Techniques

When tuning a Tru64 UNIX system, the most important goals are to minimize paging and to use the physical memory as efficiently as possible. If your system has too little physical memory, these goals are extremely difficult to attain.

The recommended method for configuring PowerStorm 300/350 UNIX Graphics Support on Tru64 UNIX is to use the `/sbin/sysconfig` utility. First, you should determine which subsystems are configured:

```
# sysconfig -s
```

You can then display the values set for particular parts of a given subsystem, such as "vm" or "proc", as shown:

```
# sysconfig -q subsystem_name
```

In this command, the value of *subsystem_name* is "`vm`" or "`proc`".

The `/etc/sysconfigtab` configuration file is read during bootup, and sets the values appropriately.

When using CAD/CAM/CAE or similar three-dimensional graphics applications on Tru64 UNIX, one step that frequently helps improve performance is to add the following line to the end of the /etc/sysconfigtab file:

```
vm:
ubc-borrowpercent = 50
```

More advanced tuning of your Tru64 UNIX system depends on the type of user activity and data files. For example, if you perform occasional assembly modeling operations with numerous view and edit operations on individual components, adding the following lines to the end of the /etc/sysconfigtab file can also improve performance:

```
vm:
vm-maxvas = 1610612736

proc:
per-proc-data-size = 268435456
max-per-proc-data-size = 1610612736
per-proc-stack-size = 4194304
max-per-proc-stack-size = 48000000
max-per-proc-address-space = 1610612736
```

This technique is a suggested first level of tuning to try for average workloads. To achieve the best possible performance on your system, however, you should consult the Tru64 UNIX tuning documentation, experiment with the different tuning techniques proposed, and monitor the results while your application is running.

Chapter 7
Operation (Compaq Tru64 UNIX)

7.1 Introduction

This chapter provides information about post-installation tasks and use of the OpenGL drivers with a PowerStorm 300/350 PCI graphics controller on the Compaq Tru64 UNIX platform.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

7.2 After Installation

After you have installed the PowerStorm 300/350 driver, you may wish to adjust the screen resolution and refresh rate, to alter the buffer swap synchronization or the default texel size, or to identify the driver version for troubleshooting purposes. The following sections describe how to perform these tasks.

7.2.1 Changing the Screen Resolution and Refresh Rate

The screen resolution and refresh rates are collectively referred to as the *video mode*.

You may find up to date listings of currently available video modes in the Release Notes located at the following website:

http://www.support.compaq.com/open3d

Appendix A shows which video modes are supported by the PowerStorm 300 PCI and PowerStorm 350 PCI graphic controllers at the time of publication. Note that the PowerStorm 350 PCI graphics controller has twice as much frame buffer memory, and can thus support some higher resolutions than the PowerStorm 300 PCI graphics controller.

The default video mode is 1280x1024 pixels at 75 Hz. Before changing the video mode, verify that your monitor can handle the new parameters. Refer to your monitor documentation for this information. Then perform the following steps:

1. Login to the system as root. Ensure that no other user is currently working locally at the X console or connected remotely to the X server. You may choose to reboot the system in single-user mode before continuing.
2. Edit the file `/usr/var/X11/Xserver.conf`. Save a backup copy.
3. Find the line containing PowerStorm 300/350 X server command-line arguments. Search for the text "PowerStorm 300/350 Server args start" and proceed to the next line where the arguments reside.
4. Append the –screen argument and optionally the –vsync argument to the arguments already present. The screen argument specifies the width and height of the screen in pixels, and the vsync argument specifies the refresh rate in hertz. For example, to set the resolution to 1280x1024 at 85 Hz, alter the arguments to appear as below:

```
! PowerStorm 300/350 Server args start
       -pn –su –bs –nice –2 –screen 1280x1024 –vsync 85
! PowerStorm 300/350 Server args end
```

5. Save your changes to the `/usr/var/X11/Xserver.conf` file.
6. Restart the server. When logged in remotely:

```
> /sbin/init.d/xlogin restart
```

7.2.2 Synchronizing Buffer Swaps

Double-buffer swaps may be synchronized with vertical retrace to avoid visual "tearing" effects. For improved performance, the default behavior is not to synchronize the buffer swaps to the vertical retrace.

Tearing and flickering can occur for a combination of reasons:

- Many large triangles are being processed.
- A large window is being used.
- High resolution and refresh rate values are defined.

Most applications do not experience visual tearing and could take advantage of the higher frame rates and better performance available when no synchronization is used. Therefore, you should try using this mode.

If unwanted visual effects do occur, however, use the tear-free double-buffering mode, and choose the highest vertical refresh rate supported by your monitor at your chosen resolution (see Section 7.2.1).

To enable double-buffer swap synchronization, follow these steps:

1. Login to the system as root. Ensure that no other user is currently working locally at the X console or connected remotely to the X server. You may choose to reboot the system in single-user mode before continuing.
2. Edit the file /usr/var/X11/Xserver.conf. Save a backup copy.
3. Find the line containing PowerStorm 300/350 X server command-line arguments. Search for the text "`PowerStorm 300/350 Server args start`" and proceed to the next line where the arguments reside.
4. Append a –I argument to the list if one is not already present. This indicates the beginning of device-dependent arguments.
5. Append the –riFlipVSync argument to the list as follows:

```
! PowerStorm 300/350 Server args start
       -pn –su –bs –nice –2 –I -riFlipVSync
! PowerStorm 300/350 Server args end
```

6. Save your changes to the /usr/var/X11/Xserver.conf file.
7. Restart the server. When logged in remotely:

```
> /sbin/init.d/xlogin restart
```

To disable the synchronization, follow these same steps, but remove the `–riFlipVSync` argument. If no other device-dependent arguments are present, you may also remove the `–I` flag from the end of the list.

7.2.3 Default OpenGL Texel Size

When specifying a texture in OpenGL, the application may request the use of a particular internal format for GL_RGB and GL_RGBA format textures. If the generic internal format of GL_RGB (3 component) or GL_RGBA (4 component), are requested, the implementation chooses which internal format will be used to store the texture.

The default behavior for our implementation is to use 16-bit texels for these generic formats, as this will effectively double the number of textures that will fit in the texture cache on the PowerStorm 300/350 graphics controllers.

To enable the use of 32-bit texels for these generic three and four component internal formats, follow these steps to add a device-dependent X server argument:

1. Login to the system as root. Ensure that no other user is currently working locally at the X console or connected remotely to the X server. You may choose to reboot the system in single-user mode before continuing.
2. Edit the file `/usr/var/X11/Xserver.conf`. Save a backup copy.
3. Find the line containing PowerStorm 300/350 X server command-line arguments. Search for the text "`PowerStorm 300/350 Server args start`" and proceed to the next line where the arguments reside.
4. Append a –I argument to the list if one is not already present. This indicates the beginning of device-dependent arguments.
5. Append the `–riDefaultTexel32` argument to the list as follows:

```
! PowerStorm 300/350 Server args start
       -pn –su –bs –nice –2 –I –riDefaultTexel32
! PowerStorm 300/350 Server args end
```

6. Save your changes to the `/usr/var/X11/Xserver.conf` file.
7. Restart the server. When logged in remotely:

```
> /sbin/init.d/xlogin restart
```

To disable the use of 32-bit texels, follow these same steps, but remove the `-riDefaultTexel32` argument. If no other device-dependent arguments are present, you may also remove the `–I` flag from the end of the list.

7.2.4 Identifying the Driver Version

If you encounter a problem with the PowerStorm display driver, you can report it to Compaq. When reporting a problem, you must include the version of the driver with your description of the problem.

To identify the version of the display driver, follow these steps:

1. Login to the system. You need not be root.
2. Run setld piped through grep to find installed driver subsets as shown below:

```
> setld –i | grep 3X0 | grep installed
```

3. A list of subsets will be returned if the driver is installed. If no matching driver is installed, the commands above will return nothing.
4. The subset descriptions will be of the form "`PowerStorm 3x0` *`v#.# SubsetName`*". The *v#.#* is the version number.

7.3 Using OpenGL

This section describes the PowerStorm OpenGL driver, which is designed to optimize OpenGL performance on supported Compaq Professional Workstations, Compaq AlphaStations, and Compaq AlphaServers. This section includes the following topics:

- Using OpenGL Applications, for users running applications developed with OpenGL
- Developing OpenGL Applications, for users developing OpenGL applications

7.3.1 Using OpenGL Applications

This section provides information for using OpenGL applications on the Compaq Tru64 UNIX platform. This section includes the following topics:

- OpenGL Visual Support, describing the available visuals and their properties
- Indirect Contexts, GLXPixmaps, and the Software Renderer, describing how to enable GLXPixmap rendering capabilities

OpenGL Visual Support

Unlike Windows NT, Tru64 UNIX does not include a generic OpenGL driver as a fall back to the hardware. On Windows NT, the generic OpenGL driver provides a software fallback for pixel formats (equivalent to visuals on the X Window System) not provided by the hardware-accelerated driver.

For example, on Windows NT, if an application requests a WGL pixel format with an alpha buffer, and the hardware-accelerated driver does not support that pixel format, then the generic software OpenGL driver will be employed, albeit at a significant performance penalty.

On Tru64 UNIX, if a GLX visual with the desired capabilities is not available from the PowerStorm 300/350 driver, the application must either fallback to another supported visual or give up and exit. A benefit of this requirement is that all OpenGL applications that do find a suitable visual are guaranteed to be using a hardware-accelerated visual.

The visuals supported by the PowerStorm 300 PCI graphics controller and PowerStorm 350 PCI graphics controller are listed in Table 7–1 and Table 7–2, respectively. Notice that the PowerStorm 350 PCI graphics controller supports twice as many visuals. This is due to its quad-buffering (stereo) support.

Indirect Contexts, GLXPixmaps, and the Software Renderer

The following section only concerns those who run applications that require GLXPixmap rendering support. Most applications do not fall into this category. Where GLXPixmaps are used for multi-buffering, they should be replaced by OpenGL double-buffering if possible. But if your application requires GLXPixmap support, this section describes how to enable it.

Follow these steps to enable a generic software OpenGL renderer for indirect rendering contexts in the X server, opposed to the hardware-accelerated driver:

1. Login to the system as root. Ensure that no other user is currently working locally at the X console or connected remotely to the X server. You may choose to reboot the system in single-user mode before continuing.
2. Edit the file `/usr/var/X11/Xserver.conf`. Save a backup copy.
3. Find the line containing PowerStorm 300/350 X server command-line arguments. Search for the text "`PowerStorm 300/350 Server args start`" and proceed to the next line where the arguments reside.
4. Append a `–I` argument to the list if one is not already present. This indicates the beginning of device-dependent arguments.
5. Append the –riGLXuseSWindirect argument to the list as follows:

```
! PowerStorm 300/350 Server args start
       -pn –su –bs –nice –2 –I –riGLXuseSWindirect
! PowerStorm 300/350 Server args end
```

6. Save your changes to the `/usr/var/X11/Xserver.conf` file.
7. Restart the server. When logged in remotely:

```
> /sbin/init.d/xlogin restart
```

To disable the generic renderer, follow these same steps, but remove the `-riGLXuseSWindirect` argument. If no other device-dependent arguments are present, you may also remove the `–I` flag from the end of the list.

In addition, you must indicate to the client library that indirect rendering contexts are allowed. Set the ALLOWINDIRECT environment variable in your application's environment before running it, as shown (assuming a csh compatible shell):

```
> setenv ALLOWINDIRECT
```

In most cases, the performance of indirect rendering contexts and the generic software renderer does not come close to that of hardware-accelerated direct rendering. Therefore its use is only recommended when GLXPixmap support is an absolute requirement.

7.3.2 Developing OpenGL Applications on Tru64 UNIX

This section provides information for developing OpenGL applications that optimize the performance of PowerStorm 300/350 PCI graphics controllers on Tru64 UNIX platforms. If you have a PowerStorm 300 AGP or 300/350 PCI graphics controller on a Windows NT platform, see Section 5.3.2.

Table 7–1 Supported GLX Visuals on a PowerStorm 300 PCI Graphics Controller

Visual ID *	0x21	0x22	0x24	0x25	0x28	0x29
Color buffer format	RGB	RGB	CI	CI	CI	CI
Color buffer size	(8,8,8,0)	(8,8,8,0)	8	8	8	8
Overlay planes					X	X
Double-buffered		X		X		X
Stereo						
Z-buffer size	24	24	24	24	N/A	N/A
Stencil planes	1	1	1	1	N/A	N/A
Accum buffer size	(16,16,16,0)	(16,16,16,0)	N/A	N/A	N/A	N/A
X class	TrueColor	TrueColor	PseudoColor	PseudoColor	PseudoColor	PseudoColor
X depth	24	24	8	8	8	8
X colormap size	256	256	256	256	256	256
X RGB masks	(0xff0000, 0xff00, 0xff)	(0xff0000, 0xff00, 0xff)	N/A	N/A	N/A	N/A
X significant bits	8	8	N/A	N/A	N/A	N/A

* Visual IDs listed are for the first screen. Equivalent visuals on additional screens of multihead configurations will have different visual IDs.

Table 7–2 Supported GLX Visuals on PowerStorm 350 PCI Graphics Controller

Visual ID *	0x21	0x22	0x23	0x24
Color buffer format	RGB	RGB	RGB	RGB
Color buffer size	(8,8,8,0)	(8,8,8,0)	(8,8,8,0)	(8,8,8,0)
Overlay planes				
Double-buffered		X		X
Stereo			X	X
Z-buffer size	24	24	24	24
Stencil planes	1	1	1	1
Accum buffer size	(16,16,16,0)	(16,16,16,0)	(16,16,16,0)	(16,16,16,0)
X class	TrueColor	TrueColor	TrueColor	TrueColor
X depth	24	24	24	24
X colormap size	256	256	256	256
X RGB masks	(0xff0000, 0xff00, 0xff)	(0xff0000, 0xff00, 0xff)	(0xff0000, 0xff00, 0xff)	(0xff0000, 0xff00, 0xff)
X significant bits	8	8	8	8

* Visual IDs listed are for the first screen. Equivalent visuals on additional screens of multihead configurations will have different visual IDs.

Table 7-2 Supported GLX Visuals on PowerStorm 350 PCI Graphics Controller (continued)

Visual ID *	0x26	0x27	0x28	0x29	0x2c	0x2d	0x2e	0x2f
Color buffer format	CI	CI	CI	CI	CI	CI	CI	CI
Color buffer size	8	8	8	8	8	8	8	8
Overlay planes					X	X	X	X
Double-buffered		X		X		X		X
Stereo			X	X			X	X
Z-buffer size	24	24	24	24	N/A	N/A	N/A	N/A
Stencil planes	1	1	1	1	N/A	N/A	N/A	N/A
Accum buffer size	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
X class	Pseudo-Color	Pseudo-Color	Pseudo-Color	Pseudo-Color	Pseudo-Color	Pseudo-Color	Pseudo-Color	Pseudo-Color
X depth	8	8	8	8	8	8	8	8
X colormap size	256	256	256	256	256	256	256	256
X RGB masks	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
X significant bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* Visual IDs listed are for the first screen. Equivalent visuals on additional screens of multihead configurations will have different visual IDs.

Performance and Functionality Considerations

The PowerStorm 300/350 PCI graphics controllers and drivers for the Tru64 UNIX platform accelerate virtually all OpenGL Version 1.1 operations. However, some aspects of OpenGL usage can adversely affect performance. Also, the functionality of PowerStorm 300/350 graphics controllers varies among platforms. This section describes these performance and functionality considerations.

Texture Mapping

Several aspects of texture mapping can affect application performance. Some of these are under the control of the application user. Others are under the control of the application developer.

- When an application defines textures to OpenGL it can explicitly specify the resolution (for example 16 or 32 bits per texel) with which textures are to be stored. Alternatively, the application can leave this decision to the OpenGL implementation. In this latter case, the PowerStorm 300/350 OpenGL driver will, by default, use 16 bits per texel for RGB and RGBA textures. The application user can override this default behavior by following the steps in Section 7.2.3.

Allocating 16 bits per texel allows more textures to be stored in the texture cache and may provide slightly higher rasterization rates. On the other hand, using 32 bits per texel provides better texture resolution in just the same way that a color frame buffer with 8 bits per color component has better color resolution than a frame buffer with 4 bits per color component.

- The rasterization rate for PowerStorm 300/350 PCI graphics controllers is twice as fast for bilinear texture filtering as for trilinear texture filtering.
- Software developers should use OpenGL Version 1.1 texture objects when an application uses more than one texture.

Alpha Buffers

PowerStorm 300/350 PCI graphics controllers on the Tru64 UNIX platform do not provide an alpha buffer (i.e., they have zero alpha planes). Few applications actually need an alpha buffer. The two operations that depend on the values stored in the alpha buffer are:

- *Storing alpha values so that they can be read later*

  The application needs an alpha buffer if it must store alpha values for later retrieval by the **glReadPixels** function with one of the following values:

  – GL_ALPHA

  – GL_RGBA

  – GL_LUMINANCE_ALPHA

- *Blending using a destination alpha value*

  The application needs an alpha buffer if it calls the **glBlendFunc** function with one of the following values:

  – DST_ALPHA

  – ONE_MINUS_DST_ALPHA

  – ONE_MINUS_DST_COLOR

  – SRC_ALPHA_SATURATE

In conformance with OpenGL, when an alpha buffer is not present, glReadPixels returns 1.0 for all alpha values, and OpenGL uses 1.0 for all destination alpha values when computing blending factors.

Note that all source-alpha related aspects of the rasterization and per-fragment portions of the OpenGL pipeline (blending, alpha test, alpha related texturing functionality) are supported by PowerStorm 300/350 PCI graphics controllers on the Tru64 UNIX platform.

Stencil Planes

The PowerStorm 300/350 display driver provides support for one stencil plane on Tru64 UNIX. You may notice that on the Windows NT Alpha platform, four stencil planes are available. This is because the Windows NT window system does not have the same high demands for window system functionality, such as simultaneous support of RGB and color-index windows.

Chapter 8
Installation (Compaq OpenVMS)

8.1 Introduction

Chapter 8 pertains to the OpenVMS operating system only; if you are running the Windows NT or Compaq Tru64 UNIX operating systems, see Chapter 4 or Chapter 6 respectively.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

This chapter describes the installation of the PowerStorm 300/350 PCI graphics controller in a Compaq Professional Workstation or AlphaServer running the Compaq OpenVMS Alpha Version 7.1-2 or 7.2-1 operating system. Support for the PowerStorm 300/350 PCI graphics controller is provided in the base operating system in later versions of OpenVMS, so no installation is necessary.

If your PowerStorm 300/350 PCI graphics controller came pre-installed, the software is already in place, and you do not need to perform the procedures in this chapter.

8.1.1 Unpacking

The graphics controller option kit contains the graphics controller, the associated software (PowerStorm 300/350 OpenVMS Graphics Support), and this installation guide. The PowerStorm 300/350 PCI software packages include a break-the-seal license and a CD-ROM containing the PowerStorm 300/350 display drivers.

PowerStorm 300/350 OpenVMS Graphics support is a supplemental kit that only supports the PowerStorm 300 and PowerStorm 350 graphics controllers. This kit requires OpenVMS Alpha Version 7.1-2 or Version 7.2-1, and is supported on the Compaq DS10 (XP900) and XP1000 Professional Workstations.

This kit is also supported on the Compaq AlphaServer DS20 and the Compaq AlphaServer ES40 with the following restriction:

The DECwindows (X11) Server process is constrained to run on CPU 0. This constraint is automatically enforced by the DECW$DEVICE_CONFIG_GB.COM configuration procedure.

This release contains optional support for the OpenGL graphics libraries and API support.

8.2 Hardware Installation

The following section describes the installation procedure for the PowerStorm 300/350 PCI graphics controller.

8.2.1 Installation of the Graphics Controller

Before installing the graphics controller, check your monitor specification for signal compatibility and supported features offered by the graphics controller.

Static electricity can damage sensitive electronic components. When handling your graphics controller, use an anti-static wriststrap that is connected to a grounded surface on your workstation. The wriststrap must be worn when handling any graphics controller to prevent damage.

To install the graphics controller, follow these steps:

1. Shut down your workstation and disconnect the monitor cable.
2. Disconnect the power cord from your workstation.
3. Remove the cover from your workstation (refer to your workstation documentation).
4. Put on an anti-static wriststrap.
5. If your workstation has an existing graphics controller, remove the screw that secures it and then remove the controller.
6. Choose a slot on the primary PCI bus; remove the slot cover if you are using a new slot. Refer to the User Guide for your Alpha system to determine which slots correspond to the primary PCI bus versus the secondary PCI bus.

   In a multihead configuration, the VGA-enabled card must be in the lowest-numbered slot on the primary PCI bus.
7. Grasp the top edge of the graphics controller and carefully insert it into the slot, then firmly seat it.

8. Secure the retaining bracket.
9. Replace the workstation cover.
10. Ensure the monitor cable is connected to the video output connector located on the back of the graphics controller.
11. Reconnect the power cord, and restart your workstation.

8.3 Software Installation Preparation and Information

This section describes the installation of PowerStorm 300/350 software for the OpenVMS Alpha operating system.

8.3.1 Required License

PowerStorm 300/350 OpenVMS Graphics Support software requires an Open3D Product Authorization Key (PAK) for OpenGL server operation. A printed copy of this PAK is provided with your hardware and should be registered using the License Management Facility (LMF) before you install PowerStorm 300/350 OpenVMS Graphics Support. If you do not register the PAK before starting the software, the server will run in 2D mode only (without OpenGL server support).

If your PowerStorm 300/350 graphics controller hardware and software came pre-installed, the PAK will already be registered.

For complete information on using the OpenVMS License Management Facility, see the OpenVMS License Management Utility Manual, which is orderable in printed form, (Order Number AA-PVXUD-TK or later) or on line on the OpenVMS website and on the OpenVMS Documentation CD-ROM.

To access information on LMF through DCL Help, enter the following command at the DCL prompt:

```
$ HELP LICENSE
```

8.3.2 Prerequisite Software

You can install PowerStorm 300/350 OpenVMS Graphics support only on systems that are running OpenVMS Alpha Version 7.1-2 or 7.2-1. Support for the PowerStorm 300/350 PCI graphics controller is provided in the base operating system in later versions of OpenVMS, so no installation is necessary.

Depending on the version you are running, you will need to have the following two remedial kits on your system. The P350.com file automatically installs the kits appropriate to the version of OpenVMS you are running.

For OpenVMS Version 7.1-2:

DEC-AXPVMS-VMS62TO71U2_PCSI-V0200--4.PCSI

DEC-AXPVMS-VMS712_UPDATE-V0300--4.PCSI

For OpenVMS Version 7.2-1:

DEC-AXPVMS-VMS721_PCSI-V0100--4.PCSI

DEC-AXPVMS-VMS721_UPDATE-V0100--4.PCSI

8.3.3 Boot Reset

To ensure proper device initialization, the BOOT_RESET console variable should be set to ON at the boot prompt. Use the following command:

```
>>> set BOOT_RESET ON
```

8.3.4 Alternate Console

Instead of using the graphics display as the system console, it is possible to attach an external ASCII terminal to serial port 1 and have console interactions take place on that device. This is done at the boot prompt (>>>).

Use the following commands, to use an external terminal:

```
>>> set console serial
>>> init
```

Use the following commands, to return to the graphics display as console:

```
>>> set console graphics
>>> init
```

8.3.5 Resource Use by 3D Applications

Each 3D drawing context consumes the following resources:

- 96 pages (approximately 1600 pagelets) of Buffer Object space; this usage is charged against MAXBOBMEM on OpenVMS V7.1-2 and MAXBOBS0S1 on OpenVMS V7.2-1.

In addition, each LOCAL 3D drawing context created consumes the following resources:

- Approximately 2000 Global Pages (i.e., pagelets charged against the GBLPAGES and GBLPAGFIL system parameters)
- Two Global Sections

(A local 3D drawing context is created when the display's transport mechanism is LOCAL, e.g via $ SET DISPLAY/NODE=0/TRANSPORT=LOCAL.)

OpenVMS recommends the following initial settings for SYSGEN parameters:

MAXBOBMEM >= initial MAXBOBMEM + 32000
MAXBOBS0S1 >= initial MAXBOBS0S1 + 32000 (OpenVMS Version 7.2-1 only)
GBLSECTIONS >= 1000
GBLPAGES >= initial GBLPAGES + 32000
GBLPAGFIL >= initial GBLPAGFIL + 2000

On OpenVMS Version 7.2-1 ONLY, MAXBOBMEM should be adjusted to be the sum of MAXBOBS0S1 and MAXBOBS2 (note: MAXBOBS2 is not used by the P350).

These settings allow for approximately 15 simultaneous 3D contexts (independent of the number of graphics heads).

The account quotas specified in SYS$MANAGER:DECW$DEVICE.COM should be adequate for normal operation. If the system is expected to be heavily loaded, especially with multiple simultaneous 3D applications, the following account quotas should be increased accordingly.

Table 8–1 Account Quotas for Multiple 3D Applications

Account Quota Name	Symbol in DECW$DEVICE.COM (Modifiable via DECW$PRIVATE SERVER SETUP.COM
WSDEFAULT	decw$server wsdef
WSQUOTA	decw$server wsquota
WSEXTENT	decw$server wsextent
PGFLQUOTA	decw$server page file

If you see the following error in your server log file, you must increase the GBLPAGES, GBLPAGFIL, and/or MAXBOBMEM/MAXBOBS0S1 parameters:

```
Not enough core
```

You can also use an Indirect Rendering context by using non-LOCAL transport. You can request non-LOCAL transport by specifying the /TRANSPORT=DECNET or /TRANSPORT=TCPIP qualifier to the SET DISPLAY command.

For example:

```
$ SET DISPLAY/NODE=nodename/TRANSPORT=DECNET
```

8.4 Installing PowerStorm Display Drivers

The following section describes how to install the PowerStorm 300/350 OpenVMS Graphics Kit from the CD-ROM.

1. Insert the CD-ROM in the driver and mount it
2. Execute the OpenVMS P350.COM file on the CD-ROM

   For example, on an XP1000:

   ```
   $ mount/over=id/media=cdrom/undefined_fat=stream_lf:99     dqa0
   $ @dqa0:[alpha.openvms]p350
   ```

3. The P350.COM procedure will install the prerequisite PCSI and UPDATE remedial kits for the version of OpenVMS that you are running. The procedure will NOT check whether the kits are already installed. If you have already installed the remedial kits, answer NO when prompted for verification by the PRODUCT command.
4. The P350.COM procedure will install the PowerStorm 300/350 Graphics Support Kit.

Chapter 9
Operation (Compaq OpenVMS)

9.1 Introduction

This chapter provides information about post-installation tasks and use of the OpenGL drivers with a PowerStorm 300/350 PCI graphics controller on the OpenVMS platform.

The examples in this manual show version numbers applicable at publication. To determine the most recent version of the operating system or video driver, see the Release Notes on the CD-ROM or the Compaq website at www.compaq.com.

9.2 Changing the Screen Resolution and Refresh Rate

The screen resolution and refresh rates are collectively referred to as the *video mode*.

You may find up to date listings of currently available video modes in the Release Notes located at the following website:

http://www.support.compaq.com/open3d

Appendix A shows which video modes are supported by the PowerStorm 300 PCI and PowerStorm 350 PCI graphic controllers at the time of publication. Note that the PowerStorm 350 PCI graphics controller has twice as much frame buffer memory, and can thus support some higher resolutions than the PowerStorm 300 PCI graphics controller.

The default video mode is 1280x1024 pixels at 75Hz. Before changing the video mode, verify that your monitor can handle the new parameters. Refer to your monitor documentation for this information. Then perform the following steps:

1. Log in to the system under a privileged account, for example, SYSTEM. Ensure that no other user is currently working locally at the DECwindows X11 console or connected remotely to the DECwindows X11 server.
2. Add the following lines before the "Cluster Common or Standalone Workstation Setup" section to the SYS$STARTUP:DECW$PRIVATE_SERVER_SETUP.COM file.

```
$ define/exec/system/nolog decw$server_refresh_rate <Your desired refresh
rate>

$ decw$xsize_in_pixels == "<X dimension of your desired resolution>"

$ decw$ysize_in_pixels == "<Y dimension of your desired resolution>"
```

Resolutions and refresh rates supported by your monitor are listed in your monitor documentation. Resolutions and refresh rates supported by the P300/P350 are listed in SYS$STARTUP:DECW$DEVICE_CONFIG_GB.COM file.

(Note: do not edit DECW$DEVICE_CONFIG_GB.COM file. Make all modifications to DECW$PRIVATE_SERVER_SETUP.COM file.)

For example, to set the resolution to 1600x1200 at 75 Hz, enter the following commands:

```
$ define/exec/system/nolog decw$server_refresh_rate 75
$ decw$xsize_in_pixels == "1600"
$ decw$ysize_in_pixels == "1200"
```

3. Save your changes and exit the editor.
4. Enter the following command to restart the server:

```
@SYS$STARTUP:DECW$STARTUP RESTART
```

9.3 Basic 2D Support

The default screen resolution for basic 2D support is:

1280 x 1024 @75Hz with 24-bit pixels

If your monitor cannot adjust to this resolution, read the guidelines in the SYS$MANAGER:DECW$DEVICE_CONFIG_GB.COM file. Do not modify this file. Make the adjustments and follow the instructions in the SYS$MANAGER:DECW$PRIVATE_SERVER_SETUP.COM file.

You may also increase the resolution, the refresh rate, or change the default pixel format to 8-bit PseudoColor.

9.4 3D Support

9.4.1 Resource Use by 3D Applications

Each 3D drawing context consumes the following resources:

- 96 pages (approximately 1600 pagelets) of Buffer Object space; this usage is charged against MAXBOBMEM on OpenVMS V7.1-2 and MAXBOBS0S1 on OpenVMS V7.2-1.

In addition, each LOCAL 3D drawing context created consumes the following resources:

- Approximately 2000 Global Pages (i.e. pagelets charged against the GBLPAGES and GBLPAGFIL system parameters)
- Two Global Sections

(A local 3D drawing context is created when the display's transport mechanism is LOCAL, e.g via $ SET DISPLAY/NODE=0/TRANSPORT=LOCAL.)

OpenVMS recommends the following initial settings for SYSGEN parameters:

MAXBOBMEM >= initial MAXBOBMEM + 32000
MAXBOBS0S1 >= initial MAXBOBS0S1 + 32000 (OpenVMS Version 7.2-1 only)
GBLSECTIONS >= 1000
GBLPAGES >= initial GBLPAGES + 32000
GBLPAGFIL >= initial GBLPAGFIL + 2000

On OpenVMS Version 7.2-1 *only*, MAXBOBMEM should be adjusted to be the sum of MAXBOBS0S1 and MAXBOBS2 (note: MAXBOBS2 is not used by the PowerStorm 350 graphics controller).

These settings allow for approximately 15 simultaneous 3D contexts (independent of the number of graphics heads).

The account quotas specified in SYS$MANAGER:DECW$DEVICE.COM should be adequate for normal operation. If the system is expected to be heavily loaded, especially with multiple simultaneous 3D applications, the following account quotas should be increased accordingly:

Table 9–1 Account Quotas for Multiple 3D Applications

Account quota	Symbol in DECW$DEVICE.COM (Modifiable in DECW$PRIVATE SERVERSETUP.COM
WSDEFAULT	decw$server wsdef
WSQUOTA	decw$server wsquota
WSEXTENT	decw$server wsextent
PGFLQUOTA	decw$server page file

If you see the following error in your server log file, you must increase the GBLPAGES, GBLPAGFIL, and/or MAXBOBMEM/MAXBOBS0S1 parameters:

```
Not enough core
```

You can also use an Indirect Rendering context by using non-LOCAL transport. You can request non-LOCAL transport by specifying the /TRANSPORT=DECNET or /TRANSPORT=TCPIP qualifier to the SET DISPLAY command.

For example:

```
$ SET DISPLAY/NODE=nodename/TRANSPORT=DECNET
```

9.4.2 OpenGL Application Development

The PowerStorm 300/350 PCI Graphics Kit includes header files to facilitate the development of OpenGL Version 1.1 applications. Applications developed using only the core OpenGL Version 1.0 functionality will work on all graphics cards. Applications developed using new OpenGL Version 1.1 functionality will not work with older graphics adapters, for example the PowerStorm 3D30/4D20 cards.

The header files needed for developing OpenGL Version 1.1 applications are included in the SYS$COMMON:[DECW$INCLUDE.GL_1_1] directory. You will need to add this directory to your search path for include files in Compaq C by specifying it in the /INCLUDE option to the CC command or by including it in one of the lists recognized by the compiler, for example DECC$USER_INCLUDE.

If you're porting UNIX applications, you may find it useful to define a logical name GL as follows:

```
$ define GL SYS$COMMON:[DECW$INCLUDE.GL_1_1]
```

This definition will allow C/C++ include statements, like the following, to work without modification:

```
#include   <GL/gl.h>
```

In addition, the GL_1_1_SETUP.COM command file in that directory defines logical names that redirect OpenGL- related image names to the corresponding P300/350 specific images. Use the following command prior to linking:

```
$ @SYS$COMMON:[DECW$INCLUDE.GL_1_1]GL_1_1_SETUP.COM
```

This makes it unnecessary to name the P300/350 images specifically in your LINK option files. Usually you will be able to use the same command files, MMS description files, and linker option files without modification to build applications in either environment: 3D30/4D20 and OpenGL Version 1.0 and P300/350 and OpenGL Version 1.1.

Appendix A
Video Display Modes

You may find up to date listings of currently available video modes in the Release Notes located at the following website: http://www.support.compaq.com/open3d

PowerStorm 300 Graphics Controllers

The following tables show the PowerStorm 300 video display modes available at the time of publication. All listed resolutions support 8, 16, or 24 bits per pixel.

Table A–1 PowerStorm 300 Video Display Modes for Alpha Platforms (Windows NT and Tru64 UNIX)

Resolution	Vertical Refresh Rates			
640 x 480	60	72		
800 x 600	60	72		
1024 x 768	70	76		
1280 x 1024	61	66	73	75

Table A–2 PowerStorm 300 Video Display Modes for Alpha Platforms (OpenVMS)

Resolution	Vertical Refresh Rates						
640 x 480	60	72	75	110			
800 x 600	72	75	85				
1024 x 768	70	75	76	85			
1152 x 864	60	75	85				
1280x1024	60	61	66	72	73	75	85

Table A–3 PowerStorm 300 Video Display Modes for Intel Platforms (Windows NT)

Resolution	Vertical Refresh rates				
640 x 400	72				
640 x 480	85				
800 x 600	60	72			
1024 x 768	70	76	85		
1280 x 1024	61	66	73	75	85

PowerStorm 350 Graphics Controllers

The following table shows the PowerStorm 350 video modes available at the time of publication. All listed resolutions support 8, 16, or 24 bits per pixel.

Table A–4 PowerStorm 350 Video Display Modes for Alpha Platforms (Windows NT and Tru64 UNIX)

Resolution	Vertical Refresh rates *										
640 x 480	60	75	85	90	100	110	120	130	140	150	160
800 x 600	60	75	85	90	100	110	120	130	140	150	160
1024 x 768	60	75	85	90	100	110	120	130			
1152 x 864	60	75	85	90	100	118	120				
1280 x 1024	60	85	90	100	110	120					
1600 x 1000 **	60	85									
1600 x 1200 **	85										
1920 x 1200 **	60	75									

* Windows NT: vertical refresh rates 90-160 are only available when stereo is enabled.

** Windows NT: available only when stereo is disabled.

The Alpha NT display control panel shows other available resolutions. These resolutions have not been completely tested and may show unacceptable results.

Table A–5 PowerStorm 350 Video Display Modes for Alpha Platforms (OpenVMS)

Resolution	Refresh Rate						
640 x 480	60	72	75				
800 x 600	72	75	85				
1024 x 768	60	70	75	76	85		
1152 x 864	60	75	85				
1280 x 992	85						
1280 x 1024	60	61	66	72	73	75	85
1600 x 1200	60	75	85				
1920 x 1200	60	75					