

# RealizM Graphics

## *Hardware User's Guide*

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February 1997

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**INTERGRAPH**  
COMPUTER SYSTEMS

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## **Cautions**

**THIS PRODUCT CONFORMS TO THE APPLICABLE REQUIREMENTS OF 21 CFR SUBCHAPTER J AT DATE OF MANUFACTURE.**

Read all safety and operating instructions before using the equipment. Keep these instructions for future reference. Follow all warnings on the equipment or in the operating instructions.



# Contents

<b>Preface</b> .....	<b>ix</b>
About This Document .....	ix
Document Conventions .....	x
Finding Operating System Information .....	x
Getting Documentation and Training .....	x
Getting Telephone Support .....	xi
Using the Intergraph Bulletin Board Service .....	xi
Using the Intergraph FAXLink.....	xii
Finding Intergraph on the Internet.....	xii
<b>1 Getting Started</b> .....	<b>1</b>
RealiZm Graphics Accelerators .....	1
RealiZm Features and Functions .....	1
RealiZm Configurations .....	2
Starting Windows NT.....	3
RenderGL Run-Time Library .....	3
Configuring Display Properties .....	4
Changing the Default Video Display Driver .....	6
<b>2 Upgrading or Replacing Z10</b> .....	<b>7</b>
Precautions .....	7
Installing a Texturing Accelerator.....	8
Replacing Z10 or Z10-T .....	10
Installing a Dual-Screen Upgrade .....	12
Connecting the Video Cables .....	15
Installing the Video Display Driver.....	17
Troubleshooting .....	18
Diagnostics.....	18
Video Display .....	18
Obtaining a Usable Video Resolution .....	19
Determining a Defective Unit .....	19
<b>3 Upgrading or Replacing Z13, Z25, and V25</b> .....	<b>21</b>
Precautions .....	21
Installing Texture Memory.....	22
Replacing Z13, Z25, V25, or Geometry Accelerator .....	24
Installing a Dual-Screen Upgrade .....	26
Connecting the Video Cables .....	28
Installing the Video Display Driver.....	30

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Troubleshooting.....	31
Diagnostics.....	31
Video Display.....	31
Obtaining a Usable Video Resolution .....	31
Determining a Defective Unit.....	32
<b>4 Technical Description.....</b>	<b>33</b>
Rasterization Accelerator Features .....	33
PCI Bus Interface .....	34
Graphics Engine .....	35
Texture Processor.....	36
Frame Buffer .....	37
Rasterization Accelerator Functions.....	40
Pixelization Accelerator .....	41
Texture Processor.....	42
Frame Buffer .....	42
Geometry Accelerator Features and Functions.....	45
High-Speed Graphics DMA Engine.....	45
MIMD DSP Architecture .....	45
Sequence Controller .....	45
<b>5 Hardware Description.....</b>	<b>47</b>
Rasterization Accelerator Components.....	47
Z10.....	47
Z13.....	48
Z25 and V25.....	49
PCIDMA.....	50
Graphics Engine and Texture Processor.....	50
Z10 Texturing Accelerator .....	52
Texture Memory.....	53
Resolver Architecture.....	53
Video Memory .....	54
Video Selector and Mapper (Z10 Only).....	54
Digital-to-Analog Converter .....	54
Geometry Accelerator Components.....	55
PCIDMA .....	55
I/O FIFO.....	55
DSPs.....	56
Sequence Controller .....	56
<b>6 Specifications .....</b>	<b>57</b>
Cooling System (Z25 and V25).....	57
Texturing System.....	58
Geometry Accelerator Support.....	58
Monitor Resolutions .....	59

Interfaces .....	60
Video Output Port .....	60
VGA Input Port .....	61
Stereo Sync Output Port .....	62
<b>Index .....</b>	<b>63</b>
<b>Returned Goods Authorization (RGA) Form</b>	
<b>Warranty Procedure</b>	
<b>Repair Depot Address Labels</b>	



# Preface

The *RealizM Graphics Hardware User's Guide* provides instructions for installing Intergraph's Z10, Z13, Z25, and V25 three-dimensional (3D) graphics accelerators into Intergraph's 3D graphics workstations. This guide provides hardware and software installation procedures, troubleshooting information, technical and hardware descriptions, and specifications.

## About This Document

The *RealizM Graphics Hardware User's Guide* is organized as follows:

- ◆ Chapter 1, "Getting Started," introduces RealizM graphics accelerators.
- ◆ Chapter 2, "Installing or Replacing Z10," provides static precautions and instructions for installing the optional texturing accelerator onto the Z10 board. It provides replacement instructions for Z10 (and Z10-T) and installing Z10 (or Z10-T) for dual-screen use in a deskside system. It also provides instructions for installing the video display driver and troubleshooting.
- ◆ Chapter 3, "Installing or Replacing Z13, Z25, and V25," provides static precautions and instructions for installing optional texture memory on Z13, Z25, and V25. It provides replacement instructions for the Z13, Z25, V25, or optional Geometry Accelerator and installing Z13 (or Z25, or V25) for dual-screen use in a deskside system. It also provides instructions for installing the video display driver and troubleshooting.
- ◆ Chapter 4, "Technical Description," covers the technical features and functions of the RealizM graphics accelerators.
- ◆ Chapter 5, "Hardware Description," contains a hardware description of the RealizM graphics accelerators.
- ◆ Chapter 6, "Specifications," lists the specifications for the RealizM graphics accelerators.

## Document Conventions

<b>Bold</b>	Commands, words, or characters that you key in literally.
<i>Italic</i>	Variable values that you supply, or cross-references.
Monospace	Output displayed on the screen.
SMALL CAPS	Key names on the keyboard, such as D, ALT or F3; names of files and directories. You can type filenames and directory names in the dialog boxes or the command line in lowercase unless directed otherwise.
CTRL+D	Press a key while simultaneously pressing another key; for example, press CTRL and D simultaneously.
ALT,SHIFT,F	Press keys sequentially; for example, press ALT, then press SHIFT, then press F.

## Finding Operating System Information

For more detailed information on the Windows NT Workstation 4.0 operating system, refer to the printed and online Windows NT documentation from Microsoft:

- ◆ For basic information on using and installing Windows NT Workstation 4.0, refer to *Start Here*, delivered in the Windows NT Workstation software package.
- ◆ For detailed information on using Windows NT Workstation 4.0, refer to Windows NT Workstation Help.

## Getting Documentation and Training

You can purchase additional product documentation from Intergraph.

- ◆ In the United States, contact your sales account representative, call the Intergraph Order Desk at 1-800-543-1054, or send a fax to 1-800-548-3318 to place an order. If you call or fax the Order Desk, have the document numbers ready for the items you wish to purchase.
- ◆ Outside the United States, contact the Intergraph subsidiary or distributor from which you purchased your Intergraph product to place an order.

To find information on training for Intergraph products, or to enroll for an available class, contact Intergraph Training Solutions at 1-800-240-3000.

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## Getting Telephone Support

If you experience problems with your Intergraph product, or have questions about the information in this document, you can contact Intergraph for help.

- ◆ In the United States, call the Customer Response Center at 1-800-633-7248 between the hours of 7:00 a.m. and 7:00 p.m. Central Time, Monday through Friday (except holidays).
- ◆ Outside the United States, contact the Intergraph subsidiary or distributor from which you purchased your Intergraph product.

Have the following information readily available when you call:

- ◆ The product's serial number or your service/CPIN number.
- ◆ The product's name or model number.
- ◆ Your name and telephone number.
- ◆ A brief description of the question or problem.

## Using the Intergraph Bulletin Board Service

Available 24 hours a day, 7 days a week, the Intergraph Bulletin Board Service (IBBS) is an electronic forum for Intergraph customers to exchange information with Intergraph's technical and marketing staff, and with other Intergraph customers. You can use the IBBS to get technical support information, documentation and training information, programs, and software updates and fixes. The IBBS is also available for you to give suggestions, make inquiries, and report problems.

### **To connect to the IBBS:**

1. Set your system's communications protocol for eight (8) data bits, no parity, one (1) stop bit, and any baud rate up to 14,400.
2. Using a modem, dial the IBBS number, 1-205-730-8786. You can dial 1-205-730-6504 if you are using a 2,400 baud connection.

Mirror sites are maintained for locations outside the United States. Information on these sites is available on Intergraph Online, Intergraph's World Wide Web server.

3. When connected, respond to the login request by keying in your user ID. If you have not connected before, key in **new** to create a user ID.

4. Follow the menus to find what you need. If you are new to computer bulletin boards, the IBBS provides clear choices and plenty of online help. A text file that explains IBBS commands and organization is available for you to download.

If you have trouble connecting to or using the IBBS, log a support request through the Customer Response Center (product entry IBBS), send a fax to 1-205-730-1110, or leave a message for the System Operator (Sysop) at 1-205-730-1413.

## Using the Intergraph FAXLink

You can use the Intergraph FAXLink to get technical support information by fax 24 hours a day, 7 days a week. From a touch-tone phone or fax machine phone:

- ◆ Call 1-800-240-4300 to get new user instructions, an index listing of available documents, and an overview of the categories of available information.
- ◆ Call 1-205-730-9000 to order the documents (up to 5 per call).

## Finding Intergraph on the Internet

You can find Intergraph on the Internet in the following ways:

- ◆ If you have a World Wide Web browser, connect to Intergraph Online, Intergraph's World WideWeb server, at **<http://www.intergraph.com>**. From the home page, follow the links to Customer Services for information on available customer services and support options.
- ◆ If you have a File Transfer Protocol (FTP) program, connect to Intergraph at **[ftp.intergraph.com](ftp://ftp.intergraph.com)**.
- ◆ If you have a Gopher program, connect to Intergraph at **[gopher.intergraph.com](gopher://gopher.intergraph.com)**.
- ◆ You can get information from Intergraph's email server at **[info@intergraph.com](mailto:info@intergraph.com)**. Put **help** in the body of the message (the subject line is ignored) to get information on such subjects as Intergraph's online services and where to get World Wide Web browsers.

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# 1 Getting Started

This chapter introduces Intergraph's RealIZm graphics accelerators, and provides information on getting started using an Intergraph 3D graphics workstation equipped with a RealIZm graphics accelerator.

## RealIZm Graphics Accelerators

RealIZm Z10, Z13, Z25, and V25 are high-performance, OpenGL-based, 3D graphics accelerators that include rasterization, optional texturing, and (for Z13, Z25, and V25) optional geometry acceleration:

- ◆ Z10 includes 12 MB of frame buffer memory and supports resolutions up to 1 Mpixels (1152 x 864).
- ◆ Z13 includes 16 MB of frame buffer memory and supports resolutions up to 1.3 Mpixels (1280 x 1024).
- ◆ Z25 includes 32 MB of frame buffer memory and supports resolutions up to 2.5 Mpixels (1824 x 1368).
- ◆ V25 includes 32 MB of frame buffer memory and supports resolutions up to 2.5 Mpixels (1824 x 1368). Texture processing is 20 percent faster than Z25.

## RealIZm Features and Functions

RealIZm graphics accelerators are used in Intergraph's TDZ workstations. These graphics accelerators offer many advanced features and functions, including the following:

- ◆ Hardware support of Windows NT graphics (both GDI and OpenGL graphics operations)
- ◆ Gouraud shading support and antialiased vector support
- ◆ 12 MB (Z10), 16 MB (Z13), or 32 MB (Z25 and V25) of frame buffer memory
- ◆ Industry-standard Peripheral Component Interconnect (PCI) bus interface with high-speed direct memory access (DMA) engine
- ◆ 84 video planes (Z10) or 90 video planes (Z10-T)
- ◆ 128 video planes (Z13, Z25, and V25)
- ◆ Support of industry standard multi-sync monitors

- ◆ Optional hardware texture processing support with 8 MB of texture memory (Z10-T)
- ◆ Optional hardware texture processing support with 4 MB, 16 MB, 32 MB, or 64 MB of texture memory (Z13 and Z25)
- ◆ Optional hardware texture processing support with 16 MB, 32 MB, or 64 MB of texture memory (V25)
- ◆ Optional geometry acceleration for lighting and transformation operations (Z13, Z25, and V25)

Refer to Chapter 4, “Technical Description,” for a full description of the features and functions of RealizM graphics accelerators.

## RealizM Configurations

RealizM graphics configurations are designated by the maximum resolution supported, and by support for texture memory and geometry acceleration:

- ◆ The number denotes the maximum supported resolution. For example, Z25 and V25 indicates support for a maximum resolution of 2.5 Mpixels.
- ◆ The -T suffix denotes support for texture processing.
- ◆ The -G suffix denotes support for geometry acceleration. Geometry acceleration is optional for Z13, Z25, and V25, and is not available for Z10.

The available RealizM graphics configurations are as follows:

<b>Designation</b>	<b>Configuration</b>
Z10	1.0 Mpixels
Z10-T	1.0 Mpixels, texture processing
Z13	1.3 Mpixels
Z13-T	1.3 Mpixels, texture processing
Z13-G	1.3 Mpixels, geometry acceleration
Z13-GT	1.3 Mpixels, geometry acceleration, texture processing
Z25, V25	2.5 Mpixels
Z25-T, V25-T	2.5 Mpixels, texture processing
Z25-G, V25-G	2.5 Mpixels, geometry acceleration
Z25-GT, V25-GT	2.5 Mpixels, geometry acceleration, texture processing

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## Starting Windows NT

After setting up a system equipped with RealIZm graphics, you can power on the system and start the Windows NT operating system.

**CAUTION** Verify that your 3D graphics system is properly set up and ready for use. For Z10, ensure that the VGA loopback cable is connected as described in Chapter 2, "Upgrading or Replacing Z10."

### To start Windows NT:

1. Turn on power to the monitor and to the system base unit.
2. At the boot screen, select the following option:  
Windows NT Workstation Version 4.00
3. When prompted, press CTRL+ALT+DEL.
4. Log on to Windows NT. Refer to the Windows NT documentation for instructions, if necessary.

## RenderGL Run-Time Library

Intergraph's RenderGL run-time library is delivered with your TDZ workstation. This library is delivered as a Dynamic Link Library (DLL) file. If you run an application that requires or uses the RenderGL run-time library, you need to install the RenderGL DLL to your system.

The RenderGL DLL is delivered as follows:

- ◆ Your system may have been delivered with a diskette containing the RenderGL DLL. If so, refer to the README.TXT file on the diskette for installation instructions.
- ◆ If your system was not delivered with a diskette containing the RenderGL DLL, you can use the InterSite Version Manager to create the diskette. Run Version Manager from the Welcome dialog that displays after you set up your TDZ workstation. After you create the diskette, refer to the README.TXT file on the diskette for installation instructions.

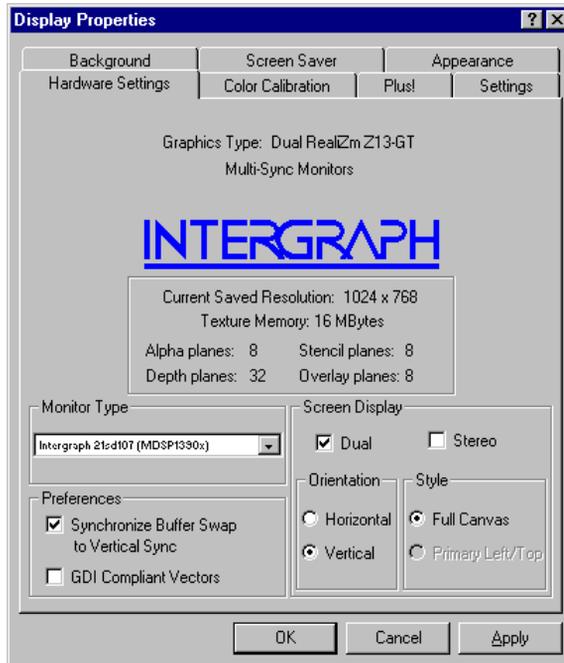
For more information on the RenderGL run-time library, contact Intergraph's Digital Media Division. For more information on the Welcome dialog and Version Manager, refer to your system's hardware documentation and to Version Manager Help.

## Configuring Display Properties

To enable your system to use its installed graphics board, you must configure the video display driver to use the RealIZm graphics accelerator. Intergraph installs the video display driver on the system's hard disk drive. The Display Properties dialog is available from the Windows NT Control Panel to determine the system configuration and installed options. Display Properties allows you to modify the video settings to meet your needs.

### To start the Display Properties dialog:

1. At the screen's bottom left corner, click Start.
2. Under Settings, open the Windows NT Control Panel.
3. In the Control Panel, open Display. The Display Properties dialog displays.
4. Select the Hardware Settings tab. The Hardware Setting page displays.

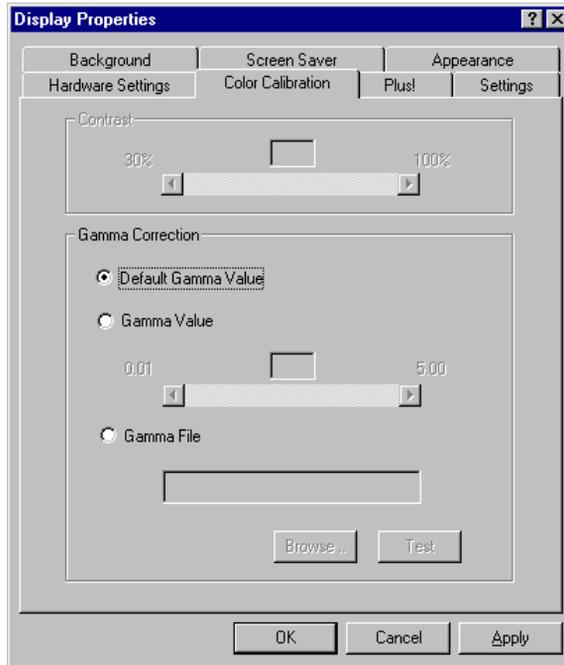


When a supported video display driver is running on your system, the Hardware Settings page displays text describing the graphics hardware and monitor present on your system. The page allows you to review and change the settings of your system's video attributes, such as monitor type, orientation, and other attributes.

### NOTE

If this is your first time to install the video display driver (for example, when re-installing Windows NT), the Hardware Settings and Color Calibration pages do not display until you restart the system.

5. Select and change the supported settings as desired. Refer to Help for information about each setting. Context-sensitive help is available by selecting a setting and pressing F1.
6. Select the Color Calibration tab to change the gamma correction for your monitor, if desired. The Color Calibration page displays.



**NOTE** The Color Calibration page is available only when the driver is running.

The appearance of the Color Calibration page varies, depending on your graphics hardware and selected video display settings. If your system is configured with dual screens, for example, the page displays two monitor icons to indicate a dual-screen desktop. It can also indicate the dual screens in horizontal orientation or vertical orientation (monitors stacked one on top of the other).

7. Select OK to apply the selected video attributes and to close the Display Properties dialog, or select Cancel to close Display Properties without applying the video attributes.
8. If you have changed video attribute settings other than gamma correction, restart the system for the changes to take effect.

## Changing the Default Video Display Driver

Once you have configured the video display as desired, change the default display driver so that the video display driver runs automatically when you start the system.

### **To change the default video display driver:**

1. Open System in the Windows NT Control Panel. The System dialog displays.
2. Under Operating System, select Windows NT Workstation Version 4.00 from the displayed list.

### **NOTE**

Do not select the "VGA mode" version of the operating system. The system operates in VGA mode when the video display driver is not running to accommodate all monitor types.

3. Select OK; then close Control Panel. The system will now use the video display driver by default.

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## 2 Upgrading or Replacing Z10

This chapter describes upgrading or replacing a RealizM Z10 graphics accelerator in a TDZ workstation. It provides instructions for the following:

- ◆ Installing an optional Texturing Accelerator on Z10
- ◆ Replacing Z10 or Z10-T
- ◆ Installing a Z10 or Z10-T dual-screen upgrade
- ◆ Connecting the video cables
- ◆ Installing the video display driver
- ◆ Troubleshooting the installation

Refer to your system's hardware documentation for detailed information on opening and closing the system, avoiding electrostatic discharge, and installing and replacing option boards.

If an item is missing or damaged, notify the Intergraph Customer Response Center at 1-800-633-7248 immediately.

### Precautions

Static electricity can damage the components inside the system base unit, and can damage the graphics accelerator boards. To minimize the possibility of electrostatic discharge, do the following:

- ◆ Do not remove a graphics accelerator board from its antistatic bag until you are ready to install it.
- ◆ Handle a graphics accelerator board as little as possible and by the edges only. Do not drop a graphics accelerator board, and do not expose it to extremes of temperature or moisture.
- ◆ Use an antistatic wrist strap when handling a graphics accelerator board. There is no increased risk of electrical shock when using the wrist strap. If the wrist strap does not snugly contact bare skin, static protection will not be effective.

**To use an antistatic wrist strap:**

1. Remove the antistatic wrist strap from its envelope. Unfold the wrist strap and wrap the exposed adhesive side firmly around your bare wrist.
2. Peel the liner from the wrist strap copper foil; then attach the adhesive side of the copper foil to a bare metal surface (electrical ground) inside the system base unit.

## Installing a Texturing Accelerator

This section describes installing an optional texturing accelerator on a Z10 board. Adding a texturing accelerator creates a Z10-T graphics accelerator with 8 MB of texture memory.

**NOTE** You must remove the Z10 board from the system to install a texturing accelerator.

**To install a texturing accelerator to a Z10 board:**

1. Shut down the system and turn off system power.
2. Disconnect the cables from the Video and VGA ports on the back of the system base unit.
3. Open the system base unit as required to gain access to the PCI option board slots. Slots are identified in “Connecting the Video Cables” later in this chapter.
4. Use a quarter-inch nutdriver to remove the screws that secure the Z10 board to the system chassis. Retain the screws.
5. Remove the Z10 board from the system.

**NOTE** The new Z10-T board set requires two adjacent PCI slots.

6. Use a quarter-inch nutdriver to remove the blanking plates from the following PCI slots:

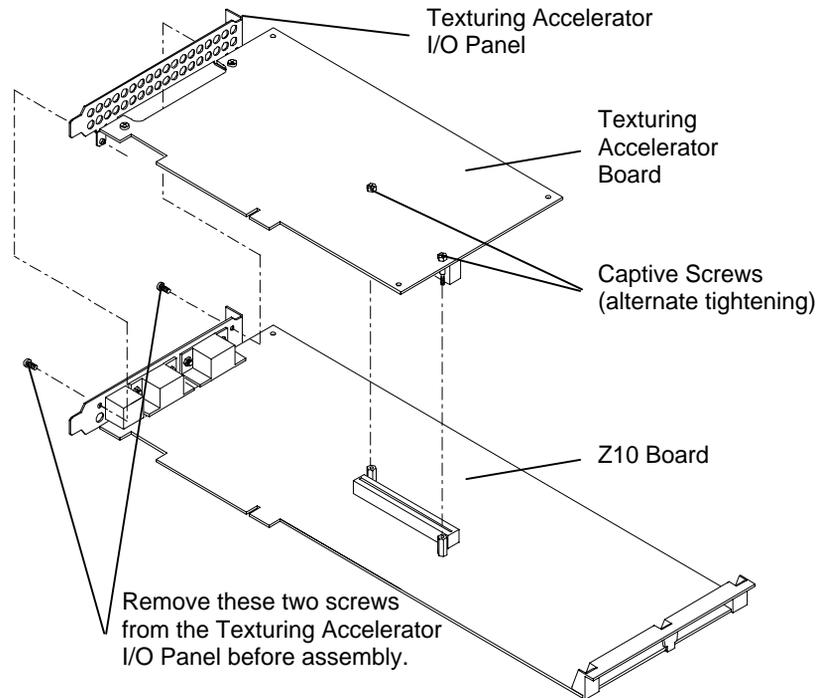
**Z10 board, desktop system:** PCI slot 3

**Z10 board, deskside system:** PCI slot 4

Retain the screws.

7. Remove the texturing accelerator from the antistatic bag.
8. Using a Philips screwdriver, remove the two screws from the Texturing Accelerator I/O panel shown in the following figure.
9. Align the texturing accelerator with the Z10 board. Insert the two captive screws of the texturing accelerator with the standoffs on the Z10 board and tighten the screws. Refer to the following figure.

**CAUTION** When tightening the captive screws, alternate between the screws using two turns each.



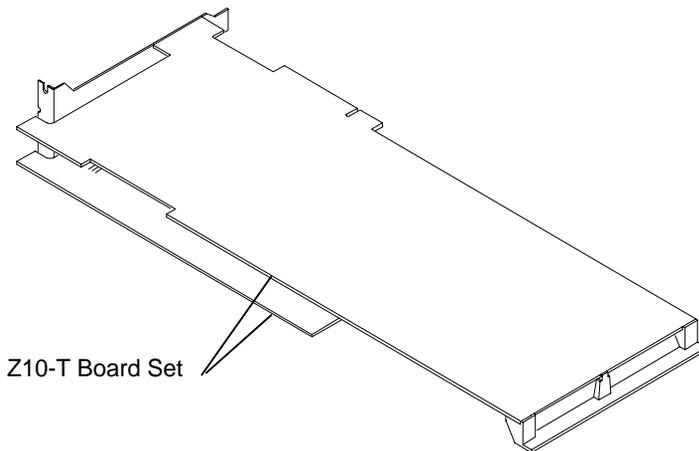
10. Insert the two screws previously removed to secure the two I/O panels together.
11. Install the new Z10-T board set in the open PCI slot and in the slot from which you removed the previously installed Z10 board.
12. Install the screws that were previously removed to secure the Z10-T board set to the system chassis.
13. Close the system base unit.
14. Go to “Connecting the Video Cables” later in this chapter to connect the monitor and VGA loopback cables.
15. Restart the system and log on to the Windows NT operating system.
16. Open Display in the Windows NT Control Panel. The Hardware Settings page of the Display Properties dialog should display GLZ1-T or Z10-T next to Graphics Type. If not, shut down and power off the system. Ensure that the texturing accelerator is properly connected to the Z10 board.

## Replacing Z10 or Z10-T

This section describes replacing a Z10 board or a Z10-T board set in a desktop or desktside TDZ workstation. The procedure also describes replacing a Z10 board with a Z10-T board set.

**NOTE** In a desktop system, you cannot replace two Z10 boards with two Z10-T board sets, or install two Z10-T board sets.

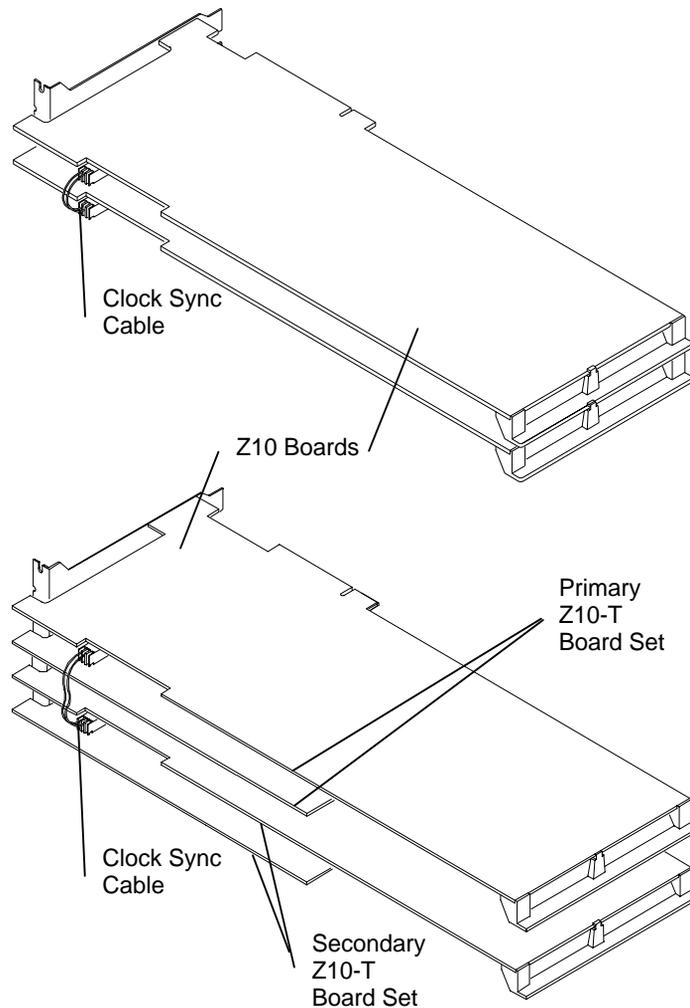
A Z10-T board set consists of two boards joined together as one unit. An installed Z10-T board set requires two adjacent PCI slots. The following figure shows a Z10-T board set.



### To replace Z10 or Z10-T:

1. Shut down the system and turn off system power.
2. Disconnect the cables from the Video and VGA ports on the back of the system base unit.
3. Open the system base unit as required to gain access to the PCI option board slots. Slots are identified in “Connecting the Video Cables” later in this chapter.

4. If replacing Z10 in a dual-screen configuration, remove the clock sync cable from between the Z10 boards or the Z10-T board sets. Refer to the following figures.



5. Use a quarter-inch nutdriver to remove the screws that secure the Z10 board or Z10-T board set to the system chassis. Retain the screws.
6. Remove the Z10 board or Z10-T board set from the system.
7. If replacing a single Z10 board with a Z10-T board set in a desktop system, use a quarter-inch nutdriver to remove the blanking plate from PCI slot 3. Retain the screw.

If replacing two Z10 boards with Z10-T board sets in a desktside system, use a quarter-inch nutdriver to remove the blanking plates from PCI slots 4 and 5. Retain the screws.

8. Install the new Z10 board or Z10-T board set in the slots from which you removed the previously installed Z10 board or Z10-T board set.

If replacing a single Z10 board with a Z10-T board set, install the new Z10-T board set in PCI slots 2 and 3.

If replacing two Z10 boards with Z10-T board sets in a desktside system, install one new Z10-T board set in PCI slots 2 and 3, and the other in PCI slots 4 and 5.

9. If replacing Z10 in a dual-screen configuration, install the clock sync cable between the Z10 boards or Z10-T board sets. Refer to the figures in step 4.

**CAUTION** The clock sync cable installs only one way. Do not force the keyed connector. Ensure pin 1 of both cable connectors engages pin 1 on both board connectors. The black wire connects to pin 1.

10. Install the screws that were previously removed to secure the Z10 board or Z10-T board set to the system chassis.
11. Close the system base unit.
12. Go to “Connecting the Video Cables” later in this chapter to connect the monitor and VGA loopback cables.

## Installing a Dual-Screen Upgrade

A dual-screen upgrade provides components to upgrade a TDZ workstation from a single-screen configuration to a dual-screen configuration. Verify that you have the following items.

- ◆ Z10 board or Z10-T board set
- ◆ Diskette containing Intergraph video display driver software
- ◆ Clock sync cable
- ◆ Antistatic wrist strap

**NOTE** You cannot install a Z10-T dual-screen upgrade in a desktop system.

If an item is missing or damaged, notify the Intergraph Customer Response Center at 1-800-633-7248 immediately.

**To install a dual-screen upgrade:**

1. Shut down the system and turn off system power.
2. Disconnect the cables from the Video and VGA ports on the back of the system base unit.
3. Open the system base unit as required to gain access to the PCI option board slots. Slots are identified in “Connecting the Video Cables” later in this chapter.
4. Use a quarter-inch nutdriver to remove the blanking plates from the following PCI slots:

**Z10 board, desktop system:** PCI slot 2

**Z10 board, deskside system:** PCI slot 3

**Z10-T board set, deskside system:** PCI slots 4 and 5

Retain the screws.

5. Install the new Z10 board or Z10-T board set in the PCI slots opened in the previous step.

In a dual-screen configuration, the primary and secondary graphics accelerators are determined as follows:

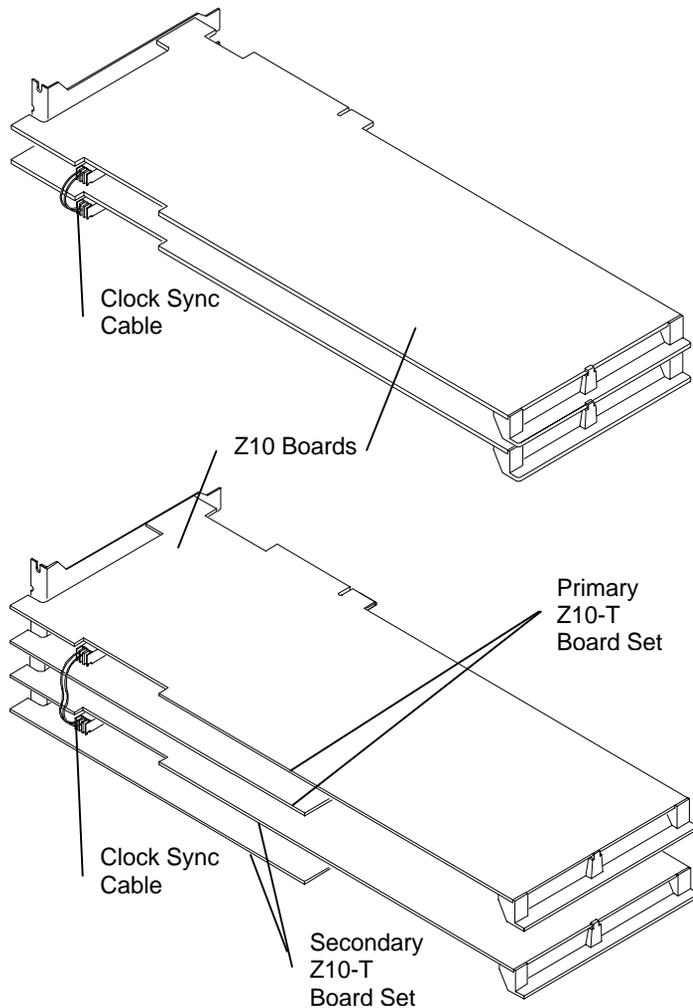
**Z10 boards, desktop system:** Primary in slot 1; secondary in slot 2

**Z10 boards, deskside system:** Primary in slot 2, secondary in slot 3

**Z10-T board sets, deskside system:** Primary in slots 2 and 3; secondary in slots 4 and 5

6. Install the screws that were previously removed to secure the Z10 board or Z10-T board set to the system chassis.
7. Install the clock sync cable between the Z10 boards or Z10-T board sets, as shown in the following figures.

**CAUTION** The clock sync cable installs only one way. Do not force the keyed connector. Ensure pin 1 of both cable connectors engages pin 1 on both board connectors. The black wire connects to pin 1.



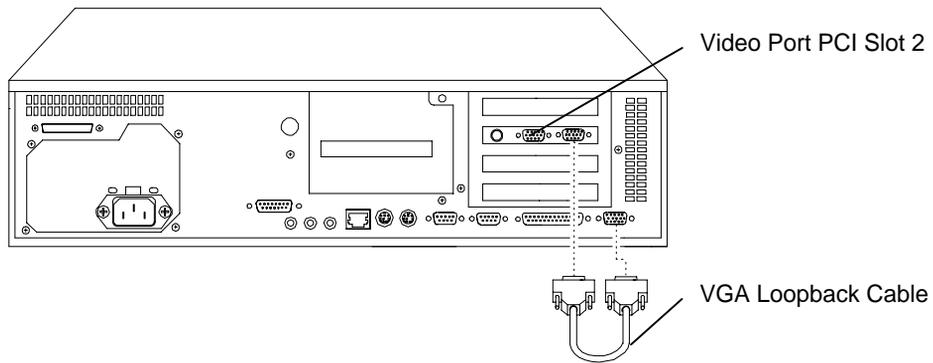
8. Close the system base unit.
9. Go to “Connecting the Video Cables” later in this chapter to connect the monitor and VGA loopback cables.
10. Restart the system and log on to the Windows NT operating system.
11. Use Display in the Windows NT Control Panel to configure the video display driver to recognize dual screens. Refer to Chapter 1 for more information.

## Connecting the Video Cables

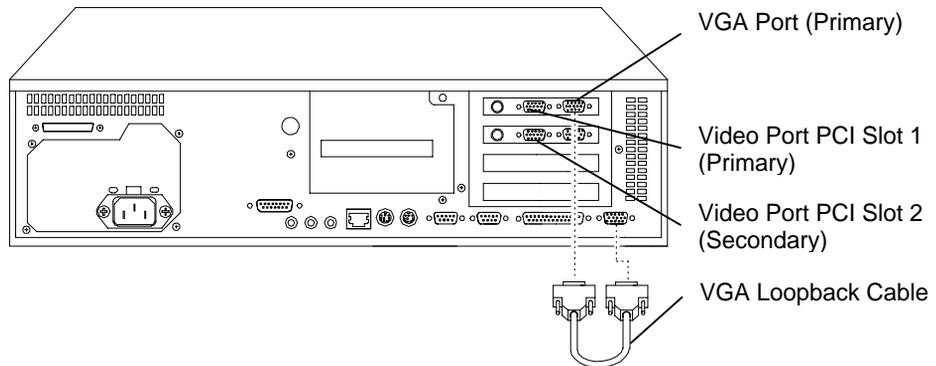
After replacing Z10 or Z10-T or installing a dual-screen upgrade in a TDZ workstation, use the following instructions to connect the monitor cables and VGA loopback cables as required.

**CAUTION** Do not connect a monitor cable to the VGA loopback cable ports. If you do, the system will boot to a blue screen and stop, or the video will not display.

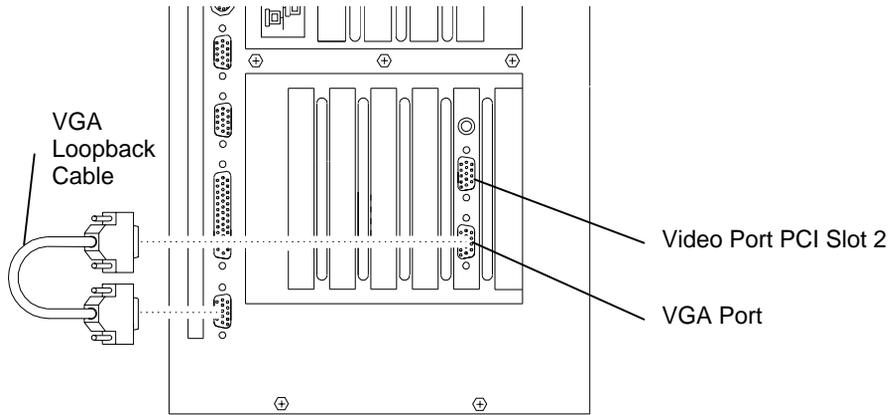
**Single-screen Z10 or Z10-T in a desktop system:** Connect the monitor cable to the Video port, and connect the VGA loopback cable as shown in the following figure.



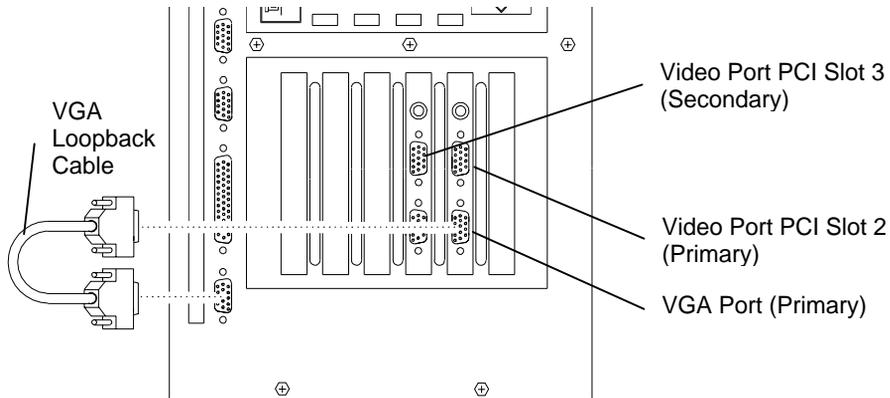
**Dual-screen Z10 in a desktop system:** Connect the monitor cables from the primary monitor and the secondary monitor to the Video ports shown in the following figure. Connect the VGA loopback cable as shown in the following figure.



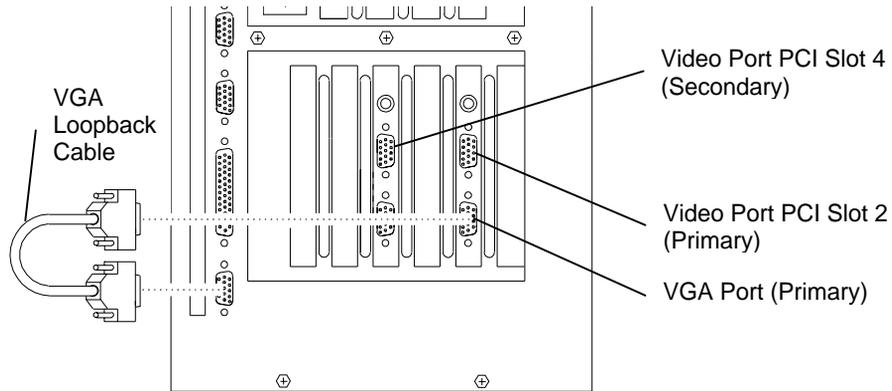
**Single-screen Z10 or Z10-T in a deskside system:** Connect the monitor cable to the Video port, and connect the VGA loopback cable as shown in the following figure.



**Dual-screen Z10 in a deskside system:** Connect the monitor cables from the primary monitor and the secondary monitor to the Video ports shown in the following figure. Connect the VGA loopback cable as shown in the following figure.



**Dual-screen Z10-T in a desktide system:** Connect the monitor cables from the primary monitor and the secondary monitor to the Video ports shown in the following figure. Connect the VGA loopback cable as shown in the following figure.



## Installing the Video Display Driver

As an aid to troubleshooting, or should it become necessary to re-install the video display driver, this section describes installing the Intergraph video display driver for Z10 or Z10-T. The system must be running Windows NT to install the video display driver.

**NOTE** The video display driver for Z10 and Z10-T is different from the video display driver for Z13 and Z25.

### To install the video display driver:

1. Turn on system power and log on to the Windows NT operating system.
2. Open Display in the Windows NT Control Panel. The Display Properties dialog displays.
3. Select the Settings tab. The Settings page displays.
4. Select Display Type. The Display Type dialog displays.
5. Select Change. The Change Display dialog displays.
6. Select Have Disk.
7. Insert the diskette containing the Intergraph video display driver into the floppy disk drive; then, select OK.
8. At Change Display, select OK.
9. At the third-party driver warning, select YES.
10. At the Installing Driver dialog, select OK.

11. At the Display Type dialog, select Close.
12. If desired, configure the video display according to the system configuration and your preferences. Refer to your system documentation, or select a setting and press F1, for more information.
13. Select Apply at the bottom of the dialog to apply the attributes.
14. Remove the diskette from the floppy disk drive.
15. Restart the system.

## Troubleshooting

This section contains troubleshooting procedures to help determine which hardware assembly to return for repair, if you suspect a hardware problem. If problems persist, contact the Intergraph Customer Response Center at 1-800-633-7248.

### Diagnostics

Diagnostic utilities for checking the graphics boards and instructions for using them are available on the Intergraph Bulletin Board Service (IBBS). Refer to the front of this guide for instructions to access the IBBS and obtain files.

### Video Display

The following table lists some common video configuration problems.

<b>Problem</b>	<b>Action</b>
Display is black, not synchronized, or distorted.	Restart Windows NT in VGA mode.
Monitor does not support a selected resolution or refresh rate.	Select a supported resolution and refresh rate.
Two Z10 boards or two Z10-T board sets installed, but you cannot select the Dual Screen option.	Verify proper installation of both Z10 boards or Z10-T board sets (only one board or board set was detected).
A dim line, rolling vertically, is visible on the screen.	Verify proper installation of the clock sync cable.

---

<b>Problem</b>	<b>Action</b>
No VGA bootup screen.	Check the VGA loopback cable. Disconnect the monitor cable from the Video port and connect it to the VGA port. If no display, check the system board, monitor, monitor cable, and power to the monitor.

## Obtaining a Usable Video Resolution

The system operates in VGA mode when the Intergraph video display driver is not running to accommodate all monitor types. VGA mode is used during initial installation of the video display driver and when experiencing video problems.

If you select a resolution that causes the monitor to display incorrectly, do not press CTRL+ALT+DEL to log on to the Windows NT operating system. Instead, use the Last Known Good option to return to the last known good configuration recorded by Windows NT.

### To use the Last Known Good option:

1. Restart the system.
2. Press the space bar at the following prompt:  
Press space bar NOW to invoke the Last Known Good Menu

If using the Last Known Good option fails to correct the video display problems, you can obtain a functional video resolution by restarting the system in VGA mode.

### To restart the system in VGA mode:

1. Restart the system.
2. At the boot screen, select the following option:  
Windows NT Workstation Version 4.00 [VGA mode]

## Determining a Defective Unit

### To determine a defective unit:

1. Save and exit from all files, if possible.
2. Shut down Windows NT, if possible.
3. Turn off the power to the monitor and to the system base unit.

**CAUTION** Always turn off the power to the workstation before connecting or disconnecting the cables.

4. Check and reseat all board and cable connections as needed.

5. Turn on the power to the monitor. If the Power On LED does not illuminate, return the monitor.

**NOTE**

After a period of inactivity, the monitor enters a power saving mode. On Intergraph Multi-sync monitors, the Power On LED on the front of the monitor will change from green to yellow to indicate the power saving mode is active.

6. Turn on the power to the system base unit. If the Power On LED on the base unit does not illuminate or if the BIOS beep codes indicate a failure, return the workstation.
7. If the monitor display is distorted, ensure the software setup is correct for the monitor type.

If the software setup is correct, use a similar type monitor (if available and functioning properly) to determine if the workstation is defective.

# 3 Upgrading or Replacing Z13, Z25, and V25

This chapter describes installing or replacing a RealizM Z13, Z25, or V25 graphics accelerator in a TDZ workstation. It provides instructions for the following:

- ◆ Installing optional texture memory on Z13, Z25, and V25
- ◆ Replacing Z13, Z25, or V25, or installing an optional Geometry Accelerator
- ◆ Installing a Z13, Z25, or V25 dual-screen upgrade
- ◆ Connecting the video cables
- ◆ Installing the video display driver
- ◆ Troubleshooting the installation

Refer to your system's hardware documentation for detailed information on opening and closing the system, avoiding electrostatic discharge, and installing and replacing option boards.

If an item is missing or damaged, notify the Intergraph Customer Response Center at 1-800-633-7248 immediately.

## Precautions

Static electricity can damage the components inside the system base unit, and can damage texture memory or graphics accelerator boards. To minimize the possibility of electrostatic discharge, do the following:

- ◆ Do not remove texture memory or a graphics accelerator board from its antistatic bag until you are ready to install it.
- ◆ Handle texture memory or a graphics accelerator board as little as possible and by the edges only. Do not drop texture memory or a graphics accelerator board, and do not expose either to extremes of temperature or moisture.
- ◆ Use an antistatic foam pad to support a graphics accelerator board when installing texture memory.
- ◆ Use an antistatic wrist strap when handling texture memory or a graphics accelerator board. There is no increased risk of electrical shock when using the wrist strap. If the wrist strap does not snugly contact bare skin, static protection will not be effective.

**To use an antistatic wrist strap:**

1. Remove the antistatic wrist strap from its envelope. Unfold the wrist strap and wrap the exposed adhesive side firmly around your bare wrist.
2. Peel the liner from the wrist strap copper foil; then attach the adhesive side of the copper foil to a bare metal surface (electrical ground) inside the system base unit.

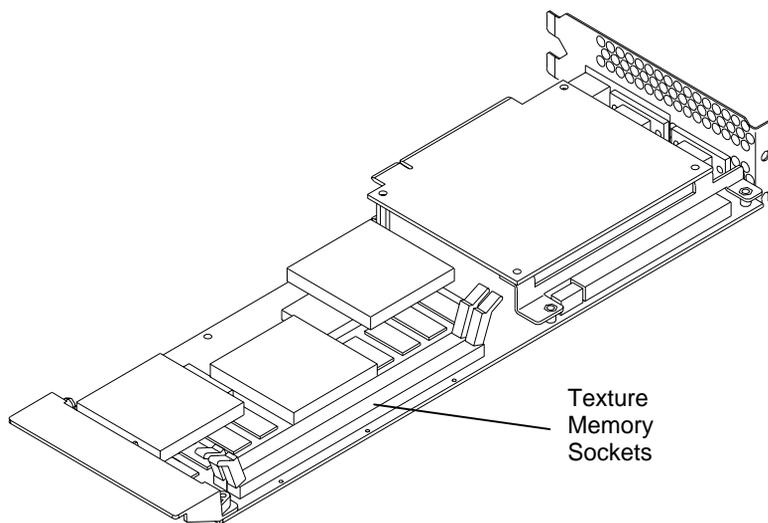
## Installing Texture Memory

This section describes installing texture memory on a Z13, Z25, or V25 board. The texture memory system on a Z13, Z25, or V25 board contains two sockets for dual inline memory modules (DIMMs).

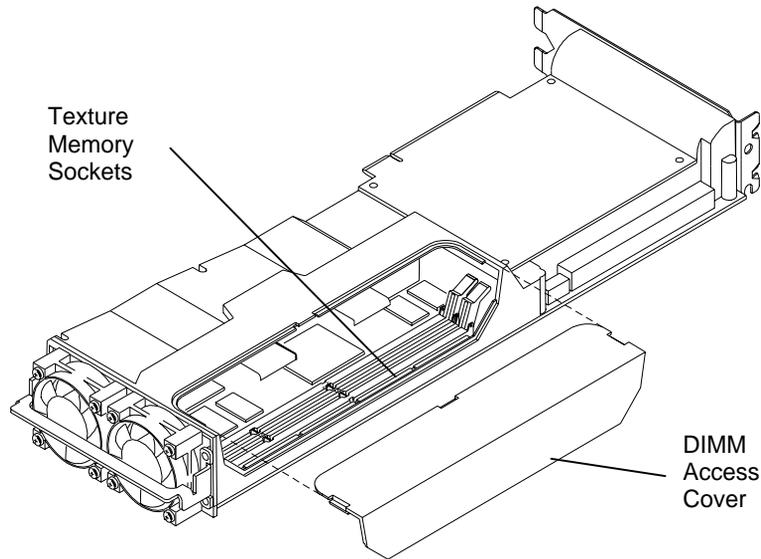
Intergraph upgrade kits are available for 4 MB, 16 MB, 32 MB, and 64 MB of texture memory. Each kit contains two DIMMs, an antistatic foam pad to support the graphics accelerator board, and an antistatic wrist strap. Texture memory for V25 ranges in size from 16 MB to 64 MB.

**NOTE** You must remove the Z13, Z25, or V25 board from the system to install texture memory.

The following figure shows the location of the texture memory sockets on a Z13 board.



The following figure shows the location of the texture memory sockets on a Z25 or V25 board. You must remove the DIMM access cover to install texture memory.



**NOTE** For proper operation, you must install DIMMs of the same memory size, and you must fill both sockets.

**To install texture memory:**

1. Remove the Z13, Z25, or V25 board from the system. Refer to “Replacing Z13, Z25, V25, or Geometry Accelerator” later in this chapter for instructions.
2. Place the board on the antistatic foam pad for protection and support.

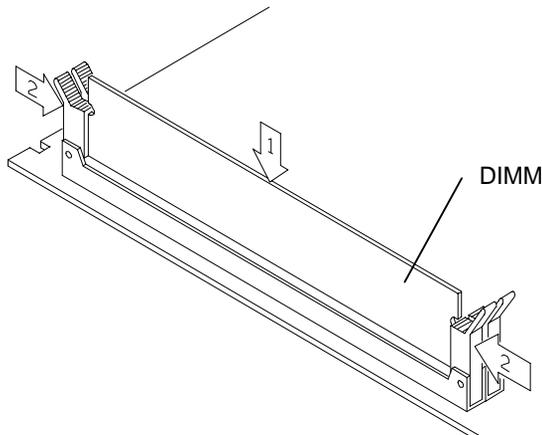
**CAUTION** Failure to use the antistatic foam pad could cause damage to the board.

3. For a Z25 or V25 board, remove the DIMM access cover.
4. Remove a DIMM from its static protective bag.

**CAUTION** Do not bend, twist or drop DIMMs. They may be damaged as a result.

5. Align the DIMM notches with the keys in one of the texture memory sockets on the board, and insert the DIMM into the socket. Refer to the following figure.

6. Push on the top edge of the DIMM until it snaps into the socket. Refer to the following figure.



7. Repeat steps 4 through 6 for the second DIMM.
8. For a Z25 or V25 board, replace the DIMM access cover.
9. Replace the board into the system.
10. Close the system base unit.
11. Turn on system power and log on to the Windows NT operating system.
12. Open Display in the Windows NT Control Panel. The Hardware Settings page of the Display Properties dialog should display the proper texture memory size. If not, shut down and power off the system. Ensure that both DIMMs are properly seated in their sockets, and that both DIMMs are the same memory size.

## Replacing Z13, Z25, V25, or Geometry Accelerator

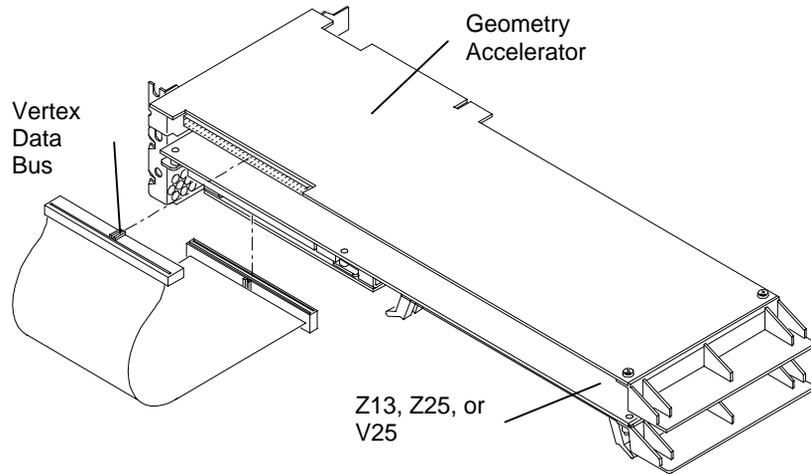
This section describes replacing a Z13, Z25, V25, or optional Geometry Accelerator board in a desktop or desktide TDZ workstation. The procedure also describes installing a new Geometry Accelerator board.

An installed Z13, Z25, or V25 board requires two adjacent PCI slots. An installed Geometry Accelerator board requires one PCI slot.

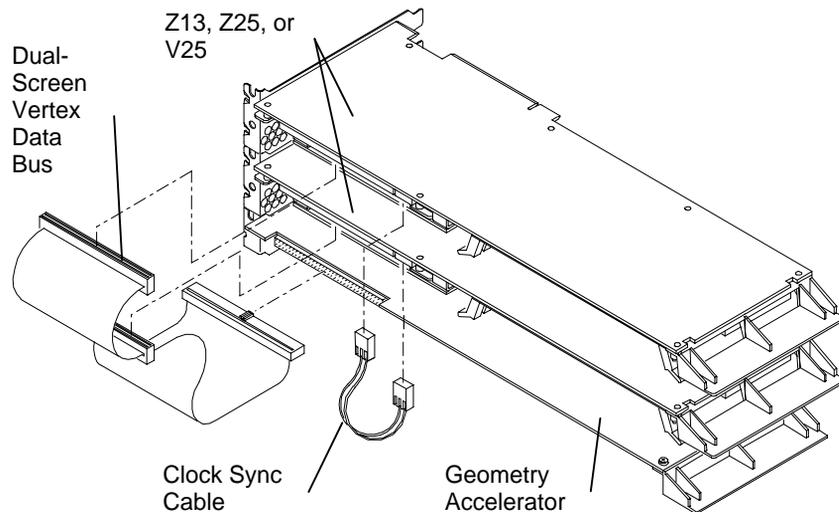
### **To replace a Z13, Z25, V25, or Geometry Accelerator board:**

1. Shut down the system and turn off system power.
2. If replacing a Z13, Z25, or V25 board, disconnect the cables from the Video ports on the back of the system base unit.

3. Open the system base unit as required to gain access to the PCI option board slots. Slots are identified in “Connecting the Video Cables” later in this chapter.
4. If a Geometry Accelerator board is already installed in a single-screen desktop configuration, disconnect the Vertex data bus between it and the graphics board. The following figure shows one Z13, Z25, or V25 board.



If a Geometry Accelerator board is already installed in a dual-screen deskside configuration, disconnect the Vertex data bus between it and the graphics boards; then disconnect the clock sync cable between the graphics boards. The following figure shows two Z13, Z25, or V25 boards.



5. Use a quarter-inch nutdriver to remove the screws that secure the board to the system chassis. Retain the screws.

If installing a new Geometry Accelerator board, use a quarter-inch nutdriver to remove the blanking plate from the following slot:

**Desktop system:** PCI slot 1

**Deskside system:** PCI slot 5

Retain the screw.

6. Remove the installed board from the system.
7. Install the new Z13, Z25, V25, or Geometry Accelerator board in the slots from which you removed the previously installed boards.

If installing a new Geometry Accelerator board, install the board in the PCI slot opened in step 5.

8. Install the screws that were previously removed to secure the Z13, Z25, V25, or Geometry Accelerator board to the system chassis.
9. If a Geometry Accelerator board is installed, connect the Vertex data bus between it and the graphics board(s). Refer to the figures in step 4.

**NOTE** The connector of the Vertex data bus can be installed in only one orientation.

10. If replacing Z13, Z25, or V25 in a dual-screen deskside configuration, connect the clock sync cable between the graphics boards. Refer to the figures in step 4.

**CAUTION** The clock sync cable installs only one way. Do not force the keyed connector. Ensure pin 1 of both cable connectors engages pin 1 on both board connectors. The black wire connects to pin 4.

11. Close the system base unit.
12. Go to “Connecting the Video Cables” later in this chapter to connect the monitor cables.

## Installing a Dual-Screen Upgrade

A dual-screen upgrade provides components to upgrade a TDZ deskside workstation from a single-screen configuration to a dual-screen configuration. Verify that you have the following items.

- ◆ Z13, Z25, or V25 board
- ◆ Vertex data bus for dual-screen configuration (used only if optional Geometry Accelerator is installed)
- ◆ Clock sync cable
- ◆ Antistatic wrist strap

**NOTE** You cannot install a dual-screen upgrade in a desktop system.

If an item is missing or damaged, notify the Intergraph Customer Response Center at 1-800-633-7248 immediately.

**To install a dual-screen upgrade:**

1. Shut down the system and turn off system power.
2. Disconnect the cable from the Video port on the back of the system base unit.
3. Open the system base unit as required to gain access to the PCI option board slots. Slots are identified in “Connecting the Video Cables” later in this chapter.
4. Use a quarter-inch nutdriver to remove the blanking plates from PCI slots 1 and 2. Retain the screws.
5. Install the new Z13, Z25, or V25 board in PCI slots 1 and 2.

In a dual-screen configuration, the primary and secondary Z13, Z25, and V25 graphics accelerators are determined as follows:

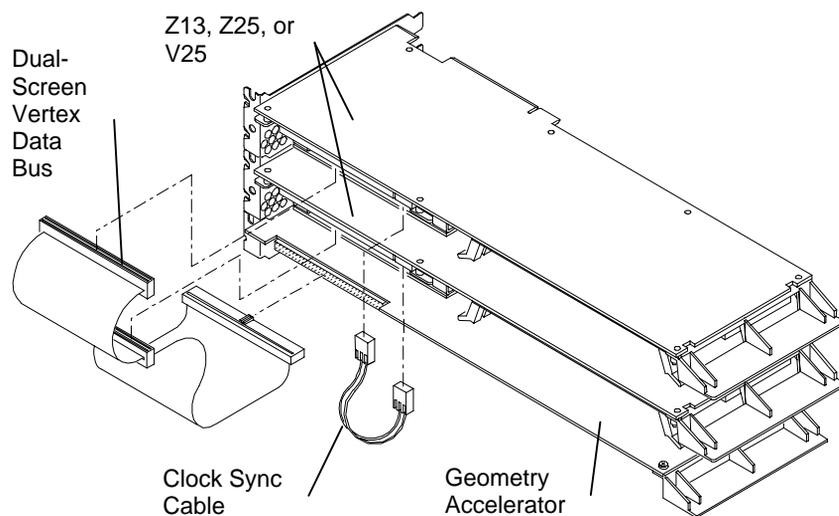
**Primary:** Board installed in PCI slots 1 and 2

**Secondary:** Board installed in PCI slots 3 and 4

6. Install the screws that were previously removed to secure the board to the system chassis.
7. If a Geometry Accelerator board is installed, connect the dual-screen Vertex data bus between it and the graphics boards. The following figure shows two Z13, Z25, or V25 boards.

**NOTE**

The connectors of the dual-screen Vertex data bus can be installed in only one orientation.



8. Install the clock sync cable between the two Z13, Z25, or V25 boards shown in the previous figure.

**CAUTION** The clock sync cable installs only one way. Do not force the keyed connector. Ensure pin 1 of both cable connectors engages pin 1 on both board connectors. The black wire connects to pin 4.

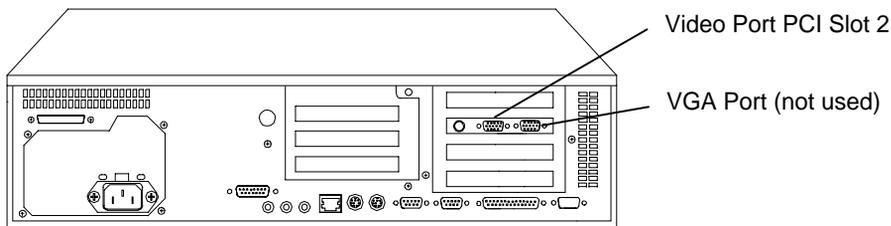
9. Close the system base unit.
10. Go to “Connecting the Video Cables” in this chapter to connect the monitor cables.
11. Restart the system and log on to the Windows NT operating system.
12. Use Display in the Windows NT Control Panel to configure the video display driver to recognize dual screens. Refer to Chapter 1 for more information.

## Connecting the Video Cables

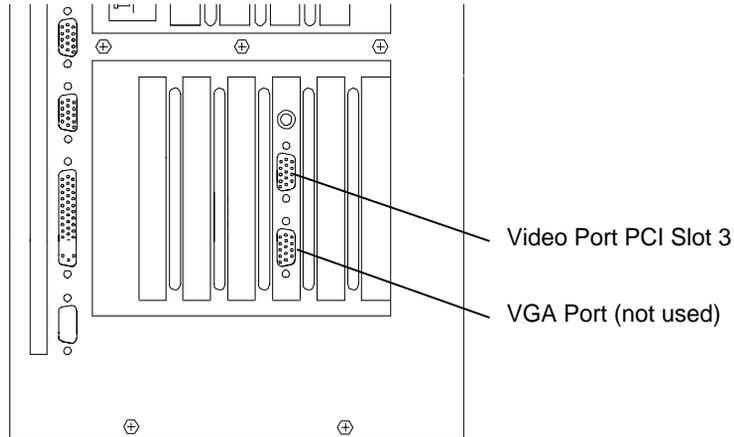
After replacing Z13, Z25, or V25, or installing a dual-screen upgrade in a TDZ workstation, use the following instructions to connect the monitor cables as required.

**CAUTION** Do not connect the monitor cables to the VGA ports. If you do, the video will not display.

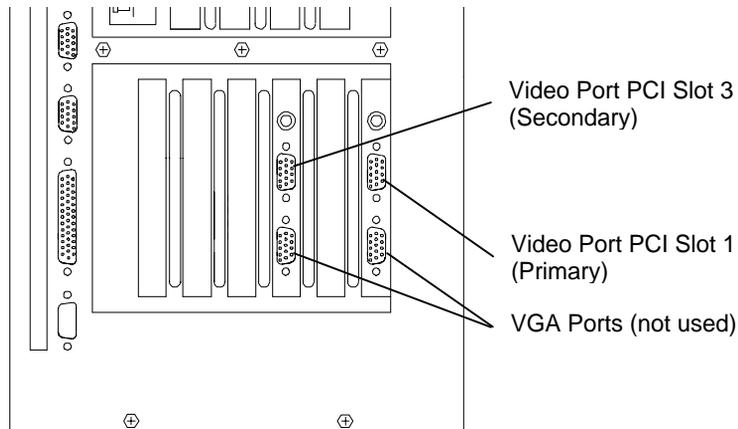
**Z13, Z25, or V25 in a desktop system:** Connect the monitor cable to the Video port shown in the following figure.



**Single-screen Z13, Z25, or V25 in a desktide system:** Connect the monitor cable to the Video port shown in the following figure.



**Dual-screen Z13, Z25, or V25 in a desktide system:** Connect the monitor cables from the primary monitor and the secondary monitor to the Video ports shown in the following figure.



## Installing the Video Display Driver

As an aid to troubleshooting, or should it become necessary to re-install the video display driver, this section describes installing the Intergraph video display driver for Z13, Z25, and V25. The system must be running Windows NT to install the video display driver.

**NOTE** The video display driver for Z13, Z25, and V25 is different from the video display driver for Z10.

### To install the video display driver:

1. Turn on system power and log on to the Windows NT operating system.
2. Open Display in the Windows NT Control Panel. The Display Properties dialog displays.
3. Select Settings. The Settings page displays.
4. Select Display Type. The Display Type dialog displays.
5. Select Change. The Change Display dialog displays.
6. Select Have Disk.
7. Insert the diskette containing the Intergraph video display driver into the floppy disk drive; then, select OK.
8. At Change Display, select OK.
9. At the third-party driver warning, select YES.
10. At the Installing Driver dialog, select OK.
11. At the Display Type dialog, select Close.
12. If desired, configure the video display according to the system configuration and your preferences. Refer to your system documentation, or select a setting and press F1, for more information.
13. Select Apply at the bottom of the dialog to apply the attributes.
14. Remove the diskette from the floppy disk drive.
15. Restart the system.

# Troubleshooting

This section contains troubleshooting procedures to help determine which hardware assembly to return for repair, if you suspect a hardware problem. If problems persist, contact the Intergraph Customer Response Center at 1-800-633-7248.

## Diagnostics

Diagnostic utilities for checking the graphics boards and instructions for using them are available on the Intergraph Bulletin Board Service (IBBS). Refer to the front of this guide for instructions to access the IBBS and obtain files.

## Video Display

The following table lists some common video configuration problems.

<u>Problem</u>	<u>Action</u>
Display is black, not synchronized, or distorted.	Restart Windows NT in VGA mode.
Monitor does not support a selected resolution or refresh rate.	Select a supported resolution and refresh rate.
Two graphics boards installed, but you cannot select the Dual Screen option.	Verify proper installation of all RealIZm graphics boards (only one board was detected).
A dim line, rolling vertically, is visible on the screen.	Verify proper installation of the clock sync cable.

## Obtaining a Usable Video Resolution

The system operates in VGA mode when the Intergraph video display driver is not running to accommodate all monitor types. VGA mode is used during initial installation of the video display driver and when experiencing video problems.

If you select a resolution that causes the monitor to display incorrectly, do not press CTRL+ALT+DEL to log on to the Windows NT operating system. Instead, use the Last Known Good option to return to the last known good configuration recorded by Windows NT.

### To use the Last Known Good option:

1. Restart the system.
2. Press the space bar at the following prompt:

Press space bar NOW to invoke the Last Known Good Menu

If using the Last Known Good option fails to correct the video display problems, you can obtain a functional video resolution by restarting the system in VGA mode.

**To restart the system in VGA mode:**

1. Restart the system.
2. At the boot screen, select the following option:

Windows NT Workstation Version 4.00 [VGA mode]

## Determining a Defective Unit

**To determine a defective unit:**

1. Save and exit from all files, if possible.
2. Shut down Windows NT, if possible.
3. Turn off the power to the monitor and to the system base unit.

**CAUTION** Always turn off the power to the workstation before connecting or disconnecting the cables.

4. Check and reseat all board and cable connections as needed.
5. Turn on the power to the monitor. If the Power On LED does not illuminate, return the monitor.

**NOTE** After a period of inactivity, the monitor enters a power saving mode. On Intergraph Multi-sync monitors, the Power On LED on the front of the monitor will change from green to yellow to indicate the power saving mode is active.

6. Turn on the power to the system base unit. If the Power On LED on the base unit does not illuminate or if the BIOS beep codes indicate a failure, return the workstation.
7. If the monitor display is distorted, ensure the software setup is correct for the monitor type.

If the software setup is correct, use a similar type monitor (if available and functioning properly) to determine if the workstation is defective.

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# 4 Technical Description

This chapter provides a technical description of the RealizM graphics accelerators and the optional Geometry Accelerator.

## Rasterization Accelerator Features

RealizM graphics accelerators include advanced features to accelerate the rasterization of computer graphics and enhance visual impact. The integrated Z10, Z13, Z25, and V25 rasterization accelerators comprise a Peripheral Component Interconnect (PCI) Bus Interface, Graphics Engine, Texture Processor, and Frame Buffer.

The PCI Bus Interface features:

- ◆ PCI compatible bus interface
- ◆ High-speed direct memory access (DMA) engine
- ◆ Interface for Geometry Accelerator (Z13, Z25, and V25)

The Graphics Engine features:

- ◆ High-level vertex interface
- ◆ Gouraud shading support
- ◆ Symbolized vector support
- ◆ Antialiased vector support
- ◆ Sub-pixel accuracy
- ◆ Window clipping (Z13, Z25, and V25)

The Texture Processor features:

- ◆ Advanced texture processor hardware
- ◆ Texture memory
- ◆ MIP-mapping support with trilinear interpolation

The Frame Buffer features:

- ◆ Video planes
- ◆ True-color image buffer
- ◆ High-resolution Z buffer
- ◆ Stencil buffer (Z13, Z25, and V25)
- ◆ Alpha buffer (Z13, Z25, and V25)
- ◆ Multiple video lookup tables
- ◆ Window-mode double buffering
- ◆ Gamma correction
- ◆ Hardware cursor
- ◆ Stereoscopic viewing
- ◆ Multiple video resolutions
- ◆ High-speed screen refresh
- ◆ Genlock support for dual monitors

## PCI Bus Interface

The Z10, Z13, Z25, and V25 graphics accelerators are 32-bit PCI peripherals.

### PCI-Compatible Bus Interface

The PCI direct memory access (PCIDMA) application-specific integrated circuit (ASIC) provides the PCI-compatible bus interface for these accelerators, including bus mastership capability. This interface provides a high-speed, industry-standard connection between the host processor and the graphics accelerator.

### High-Speed DMA Engine

The Rasterization Accelerator uses a high-speed DMA engine to accelerate PCI bus data transfers. The DMA engine transfers data in bursts without intervention from the host processor. These unattended transfers free the host processor from transferring massive amounts of graphics data over the PCI bus.

## **Interface for Geometry Accelerator (Z13, Z25, and V25)**

Geometry calculations, such as lighting and perspective adjustment, are performed either by the host processor or by an optional Geometry Accelerator. If installed, the Geometry Accelerator sends vertex data to the Rasterization Accelerator via a dedicated connector. A direct connection allows data to flow quickly to the Rasterization Accelerator, which enhances performance.

## **Graphics Engine**

The Graphics Engine is the core of the Rasterization Accelerator. It accelerates the translation of high-level graphics requests into pixel-oriented requests through derivative calculations and span iteration. It then coordinates the movement of pixels to the Frame Buffer.

### **High-Level Vertex Interface**

The Rasterization Accelerator allows the software to send vertex data for triangles and vectors in multiple formats. Supported formats include 8-bit packed integer, 16-bit packed integer, 32-bit integer, single-precision floating point, and double-precision floating point.

The host processor achieves higher performance because it does not convert data that is native to a particular application. To conserve bandwidth, the application optionally loads constant color and Z values to avoid sending them with each vertex.

### **Gouraud Shading Support**

The Graphics Engine supports smooth shading of 3D triangle meshes with the Gouraud algorithm. High performance hardware accomplishes the shading of the entire triangle, including color and depth derivative calculations and pixel interpolation. The hardware also allows maximum update rates with minimum load on the host processor.

### **Symbolized Vector Support**

The Graphics Engine supports the application of any user-supplied, two-color pattern onto vectors without performance degradation. Dotted or dashed lines are examples of symbolized vectors.

### **Antialiased Vector Support**

Hardware support of antialiased vectors eliminates the jagged appearance of vectors on standard raster displays.

## **Sub-Pixel Accuracy**

The Graphics Engine uses sub-pixel accuracy for improving the quality of the graphics image. Sub-pixel accuracy ensures adjacent polygons and vectors join smoothly.

## **Window Clipping (Z13, Z25, and V25)**

While rendering triangles and vectors, the Graphics Engine discards pixels that would fall outside the region of the target window. Hardware clipping in this fashion alleviates the burden of checking objects in software before sending them to the graphics system.

## **Texture Processor**

Texturing is available on RealiZm graphics accelerators that have a texturing accelerator (Z10) or texture memory (Z13, Z25, and V25) installed. Texturing is the process of applying a pattern, represented in memory as a two-dimensional array of image color values, to the surface of a 3D graphical object. For example, a wood grain pattern can be texture-mapped to the surface of an object, such as a desk, to enhance realism of the image.

Another example of texture mapping is draping a land image from a satellite over a digital terrain model to create a 3D representation. The Texture Processor module of the RealiZm graphics accelerators provides a dramatic performance increase for advanced texture processing when compared with software algorithms alone.

### **Advanced Texture Processor Hardware**

The Texture Processor has its own ASICs on the Z10, and is integrated into the Graphics Engine/Texture Processor ASIC on the Z13, Z25, and the V25. It supports 32-bit textures, one byte for each of the color components: red, green, blue, and alpha.

### **Texture Memory**

Texture memory is 8 MB in a Z10 with the hardware texture option, providing up to 2 MTexels of texture maps. If installed in a Z13 or Z25, texture memory ranges in size from 4 MB to 64 MB, providing from 1 MTexels to 16 MTexels of texture maps. If installed in V25, texture memory ranges in size from 16 MB to 64 MB, providing from 4 MTexels to 16 MTexels of texture maps.

## MIP-Mapping Support with Trilinear Interpolation

The Texture Processor allows various sizes of texture maps to coexist in texture memory. Different MIP (*multum in parvo* -- many things in a small place) maps allow the appropriate level of detail to be shown based on viewing distance. The Texture Processor chooses four texels nearest the actual texel value from each of the nearest two MIP maps (for a total of eight texels). The Texture Processor blends the eight texels to produce the actual texel value by using trilinear interpolation.

## Frame Buffer

The RealizM Frame Buffers are full-featured: Their deep pixel formats provide a flexible environment for applications with hardware acceleration. For example, double-buffered overlay planes provide the ability to annotate text and graphics over a 3D image in the image buffer. Both image buffers have access to one of four video lookup tables (VLTs). The image VLT selection planes select the VLT to use. The mask planes allow for access control of the various drawing planes (for example, image or overlay). The image and overlay buffer selection control planes determine the buffer to display on a pixel-by-pixel basis. Other features include support of a wide variety of displays operating at high resolution.

## Video Planes

Z10 supports 84 bits-per-pixel plane sets, and Z10-T supports 90 bits-per-pixel configurations, as summarized in the following table:

<u>Video Plane Sets</u>	<u>84 Bits/Pixel</u>	<u>90 Bits/Pixel</u>
Image (red, green, blue), front buffer	24	24
Image (red, green, blue), back buffer	24	24
Overlay, front buffer	1	4
Overlay, back buffer	1	4
Image, VLT selection, front buffer	3	3
Image, VLT selection, back buffer	3	3
Z buffer	24	24
Mask (pixel access control)	2	2
Image, window control	1	1
Overlay, window control	1	1

Z13, Z25, and V25 support two plane set configurations: 100 bits-per-pixel and 128 bits-per-pixel. The 128 bits-per-pixel mode is supported at resolutions slightly less than the maximum. For example, the Z25 supports 128 bits-per-pixel up to maximum resolution of 2 Mpixel (1600 x 1200) and 100 bits-per-pixel for a resolution of 2.5 Mpixel (1824 x 1368).

The following table summarizes the video plane sets for the Z13, Z25, and V25 accelerators.

<b>Video Plane Sets</b>	<b>100 Bits/Pixel</b>	<b>128 Bits/Pixel</b>
Image (red, green, blue), front buffer	24	24
Image (red, green, blue), back buffer	24	24
Overlay, front buffer	4	8
Overlay, back buffer	4	8
Image, VLT selection, front buffer	4	4
Image, VLT selection, back buffer	4	4
Z buffer	24	32
Mask (pixel access control)	2	4
Image, buffer selection control	1	1
Overlay, buffer selection control	1	1
Alpha	0	8
Stencil	6	8
Fast Clear Front Buffer	1	1
Fast Clear Back Buffer	1	1

### **True-Color Image Buffer**

The true-color image buffer is 24 bits and double-buffered. It contains the red, green, and blue components of the image with 8 bits per component to provide 16.7 million colors. There are two copies, or buffers, of image data: a front buffer and a back buffer. Two buffers enhance smooth animation, since applications may update the back buffer while displaying the front buffer.

### **High-Resolution Z Buffer**

The Z buffer holds 24 bits of depth information (Z10) or up to 32 bits of depth information (Z13, Z25, and V25). Depth represents a distance from the observer's eye to an object in a scene. A large Z buffer enables representation of a large number of unique depth values, which provides a more accurate rendering of scenes with large depth separation between objects.

### **Stencil Buffer (Z13, Z25, and V25)**

The stencil buffer holds up to 8-bits of stencil information. This buffer is a general-purpose resource for OpenGL applications. In a typical case, stenciling inhibits writes to portions of an application's window, but allows writes to other portions. The Frame Buffer accelerates building the values in the stencil buffer, and also accelerates the action of inhibiting or allowing writes on a per-pixel basis.

### **Alpha Buffer (Z13, Z25, and V25)**

The alpha buffer holds up to 8-bits of alpha information. Alpha planes and alpha blending logic in the Frame Buffer assist the application in rendering scenes more realistically. Special effects that might result from alpha blending include transparency or tinting.

### **Multiple Video Lookup Tables**

The Frame Buffer includes up to four VLTs. The VLTs provide multiple color palettes simultaneously for color remapping and advanced color refinement.

### **Window-Mode Double-Buffering**

Window-mode double-buffering allows multiple windows to display simultaneously from different buffers.

### **Gamma Correction**

10-bit gamma VLTs and 10-bit digital-to-analog converters (DACs) allow fine control of displayed colors without color degradation.

### **Hardware Cursor**

Hardware superimposes the cursor image over the video stream in real time, minimizing the cursor management tasks required by the host processor.

### **Stereoscopic Viewing**

RealizM graphics accelerators support the display of stereo images. Stereoscopic viewing requires a stereo-ready monitor and infrared shutter glasses with emitter module.

### **Multiple Video Resolutions**

RealizM graphics accelerators include programmable pixel clock generation and video timing logic. This allows support of a wide variety of monitors with multiple video resolutions and refresh rates. Programmable video timing also allows future monitor upgrades with only a software driver change. Supported resolutions range from 640 x 480 up to 1152 x 864 (Z10) or 1280 x 1024 (Z13) or 1824 x 1368 (Z25 and V25). Refer to Chapter 6 for additional information on supported monitor resolutions.

### **High-Speed Screen Refresh**

High-speed screen refresh provides flicker-free displays up to 76 Hz (Z10) or 85 Hz (Z13, Z25, and V25) for most screen resolutions.

### **Genlock Support for Dual Monitors**

A clock sync cable installed between RealizM board sets synchronizes the monitors in a dual-monitor configuration. This Genlock method eliminates the visual beat frequency effect that may occur when placing two monitors close to each other.

## **Rasterization Accelerator Functions**

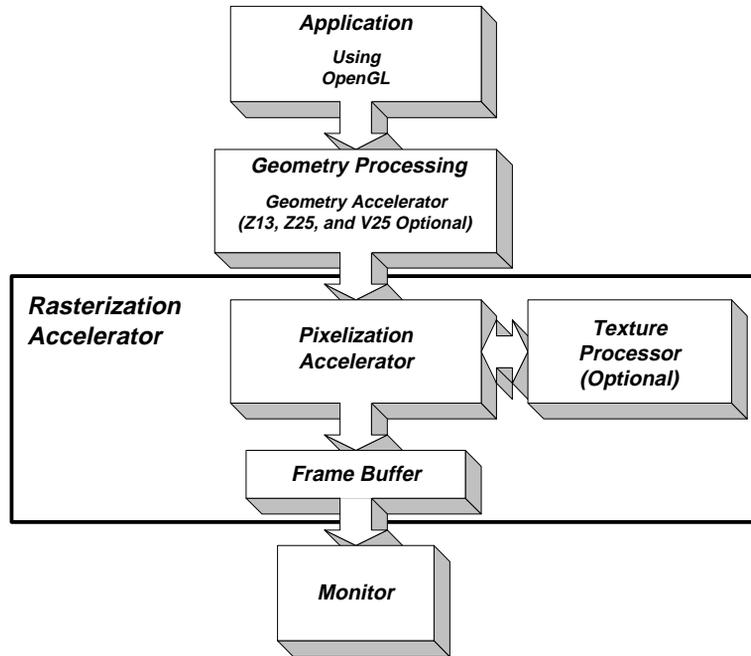
Graphics Device Interface (GDI) is the library of functions that the Windows NT operating system uses to create and manipulate 2D computer images. RealizM rasterization hardware accelerates many GDI functions.

OpenGL is an industry standard library of functions used to create and manipulate 3D computer images. OpenGL functions, as a part of the Windows NT operating system, can be performed by the host processor. RealizM hardware accelerators greatly improve OpenGL performance.

For the Z13, Z25, and V25 accelerators, either the host processor or an optional Geometry Accelerator performs the geometry stage of the OpenGL processing. While the Geometry Accelerator processes OpenGL requests, the host processor is freed to perform application and database operations. This parallel processing results in unprecedented speed to generate and manipulate realistic images.

As shown in the following figure, the Rasterization Accelerator includes:

- ◆ Pixelization Accelerator
- ◆ Texture Processor (optional)
- ◆ Frame Buffer



## Pixelization Accelerator

The Pixelization Accelerator consists of PCIDMA, graphics first-in-first-out (FIFO), and the Graphics Engine. The standard PCI bus provides high bandwidth support for the transfer of graphics data between the host processor and the Rasterization Accelerator. If the Geometry Accelerator is present (for Z13, Z25, and V25), then the system transfers data from the host processor to the Geometry Accelerator, which then transfers data to the Rasterization Accelerator via a dedicated bus.

The Rasterization Accelerator receives GDI or OpenGL element requests from the host processor (or from the Geometry Accelerator, if present), through the PCIDMA and graphics FIFO. Element types include triangles, triangle meshes, lines, line strings, and others. The Graphics Engine ASIC converts the elements to pixels and routes them through the resolvers to video memory.

The Rasterization Accelerator also performs region fills, bit expands, and BIT BLock Transfer (BITBLT) operations. Optional processing of the pixels is performed by the Texture Processor prior to the Graphics Engine sending them to the resolvers.

## Texture Processor

The Texture Processor resides in dedicated ASICs (Z10) or is physically part of the Graphics Engine/Texture Processor ASIC (Z13, Z25, and V25). It supports 32-bit textures: 8 bits for each color component (red, green, blue, and alpha).

The Texture Processor receives two types of setup parameters from the Graphics Engine: one type for triangles and one type for pixel spans within a triangle. The triangle setup parameters consist of texturing control information and texture coordinate derivatives. The pixel span setup parameters consist of initial texture coordinates. These texturing setup parameters control the interpolation of the texture coordinate values. The texture processors correct for perspective during texture coordinate interpolation and thereby reduce image distortion.

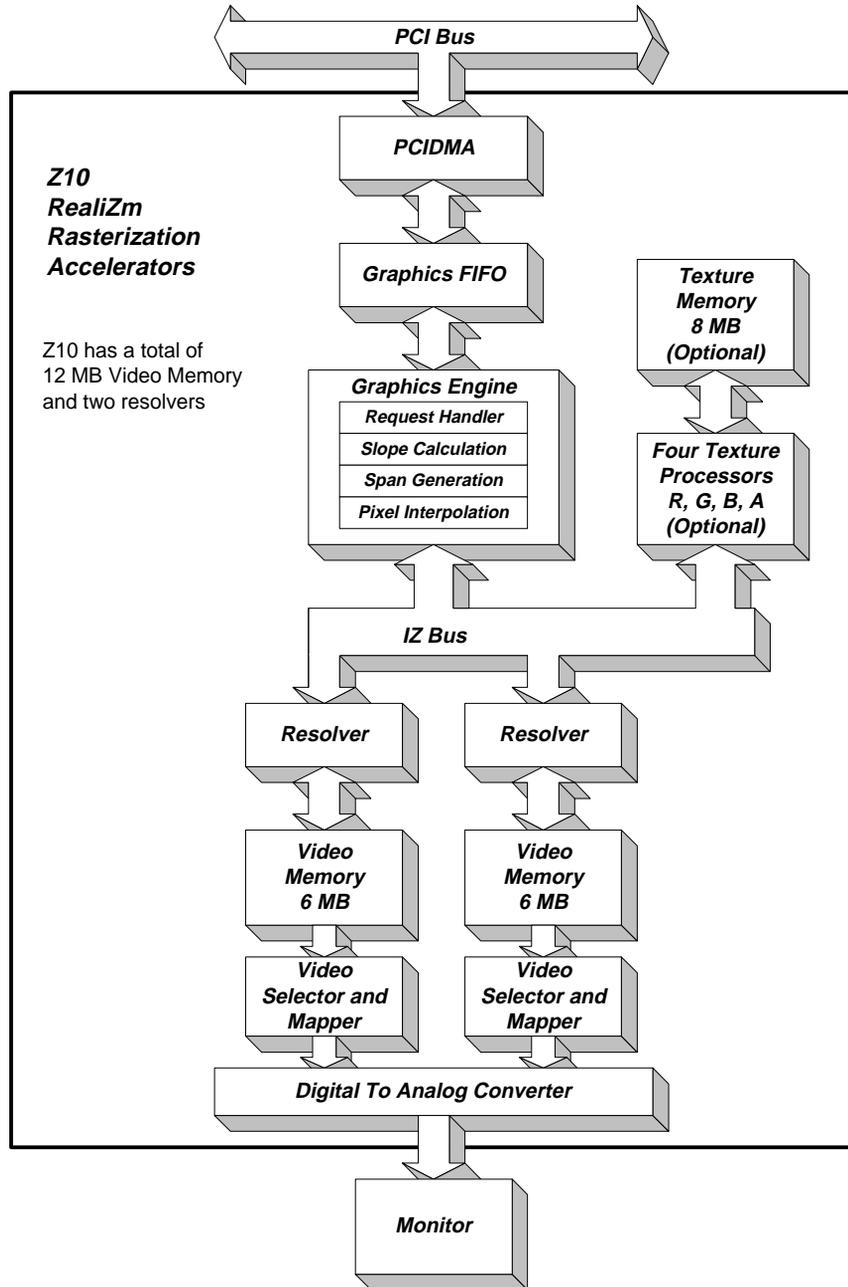
The texture memory is capable of storing several sets of MIP-mapped textures for subsequent texture mapping. In MIP-mapping, software creates smaller-sized versions of a base texture and stores them in texture memory. The smaller versions represent the base texture at varying distances from the viewer's eye.

The Texture Processor chooses eight texels nearest the actual texel value from the nearest two MIP maps. The Texture Processor interpolates these eight texels to produce the actual texel value through the use of trilinear interpolation.

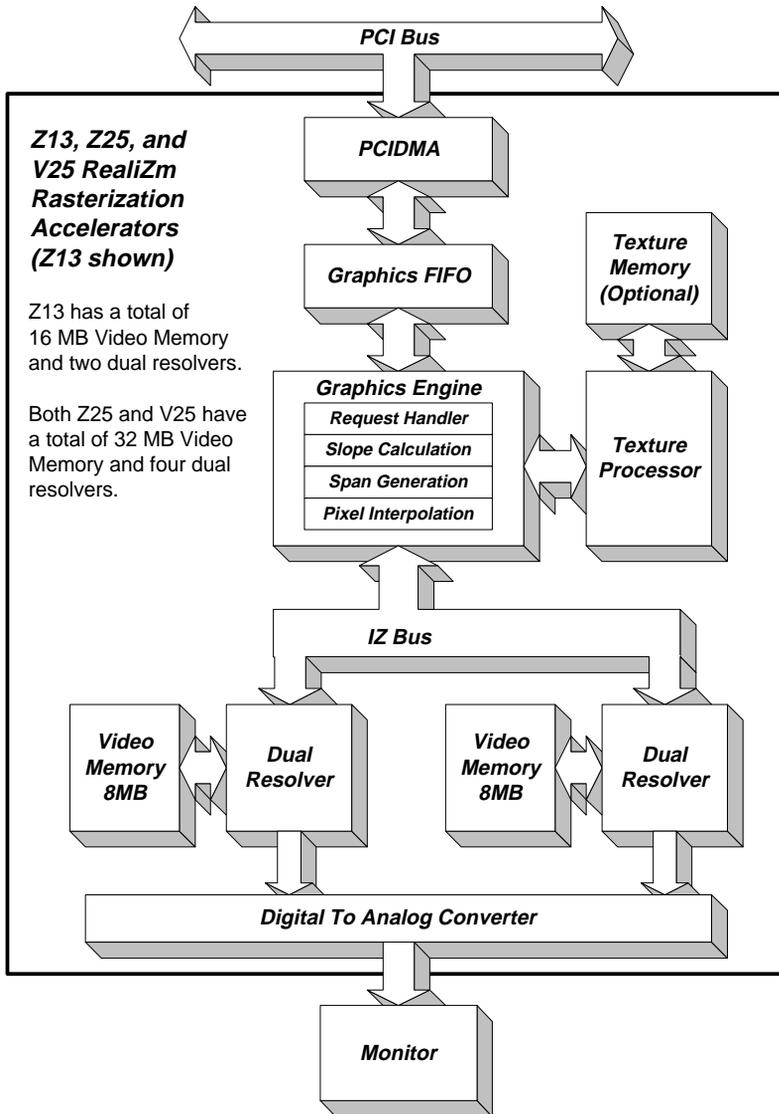
The actual texel value can either replace or blend with the Gouraud shaded pixel value generated by the Graphics Engine. Finally, the Graphics Engine routes the textured pixels from the Texture Processor to the resolvers, which write the textured pixels into video memory.

## Frame Buffer

The Frame Buffer consists of the resolvers, video memory, and a DAC. Z10 resolvers control the flow of digital pixel data from the video memory to the video selector and mappers (VSMs) and then to the DAC where it is converted to an analog voltage and presented to the monitor. Refer to the following figure.



Z13, Z25, and V25 resolvers retrieve digital pixel data from video memory, and send it to the DAC where it is converted to an analog voltage and presented to the monitor.



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# Geometry Accelerator Features and Functions

The Geometry Accelerator available for use with Z13, Z25, and V25 employs the following features and functions to accelerate the geometry processing requirements of computer graphics.

- ◆ High-speed graphics DMA engine
- ◆ MIMD DSP architecture
- ◆ Sequence Controller

## High-Speed Graphics DMA Engine

The Geometry Accelerator uses high-speed DMA engines to accelerate PCI bus data transfers. An independent DMA engine transfers data in bursts and frees the host processor from transferring massive amounts of graphics data over the PCI bus.

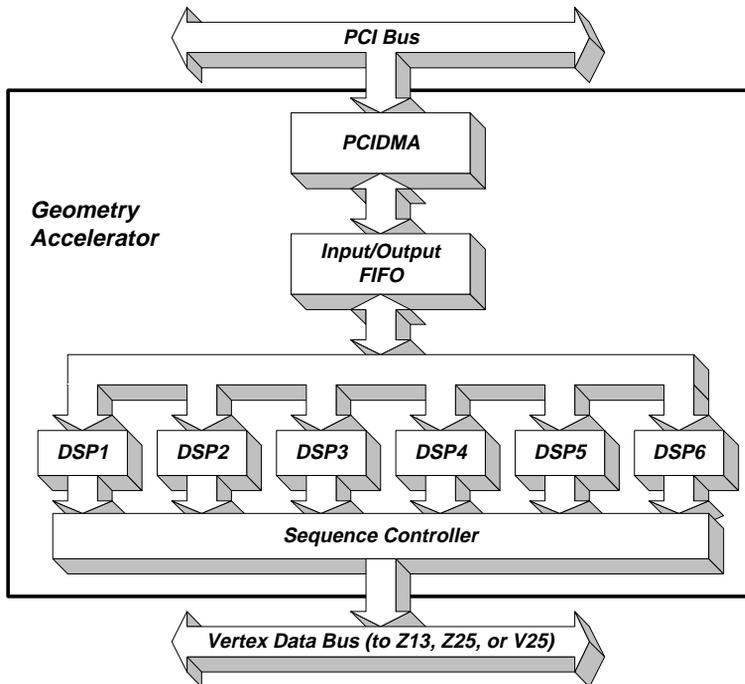
## MIMD DSP Architecture

The Geometry Accelerator features a multiple instruction multiple data (MIMD) architecture to harness the power of six floating-point digital signal processors (DSPs) operating in parallel. The DSPs speed the compute-intensive geometry calculations of 3D graphics. Each DSP can execute 120 million floating point operations per second (MFLOPS), and contains 10 DMA engines to ensure nonstop data flow to the Sequence Controller.

## Sequence Controller

To achieve maximum efficiency in a MIMD architecture, multiple processors operate independently on multiple data sets. The six Geometry Accelerator DSPs process graphics requests in turn and may generate output requests in a different order than the input requests. The Sequence Controller places the output requests into the proper time sequence.

The PCI bus is a high-performance bus capable of operating up to 33 MHz. The Geometry Accelerator is a 32-bit PCI bus peripheral with bus mastership capability, which uses the PCI bus to transfer data from the host processor.



The Geometry Accelerator receives OpenGL requests from the host processor through the PCIDMA and the input/output (I/O) FIFO. The requests are routed to six independent 32-bit floating-point DSPs, which process OpenGL requests in parallel. The output requests from each DSP flow through dedicated ports to the Sequence Controller. The Sequence Controller time-orders and formats the requests, and then writes them to the Z13, or Z25, or V25 input FIFO over the dedicated Vertex data bus.

The processing performed by each of the six DSPs includes coordinate transformations, lighting calculations, and viewport clipping. Clipping is the process of removing elements, or pieces of elements, not contained within the viewing volume (viewport). The Geometry Accelerator processes each element specified by OpenGL as supported by the Rasterization Accelerator.

# 5 Hardware Description

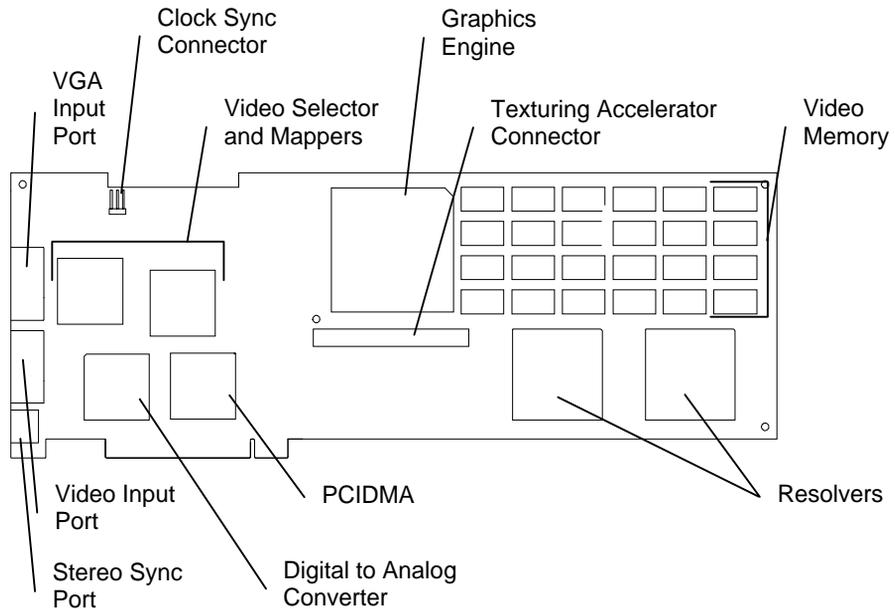
This chapter describes the architecture and hardware implementation of the RealIZm graphics accelerators and the optional Geometry Accelerator.

## Rasterization Accelerator Components

The following figures describe the major components of the Rasterization Accelerator boards for the Z10, Z13, Z25, and V25.

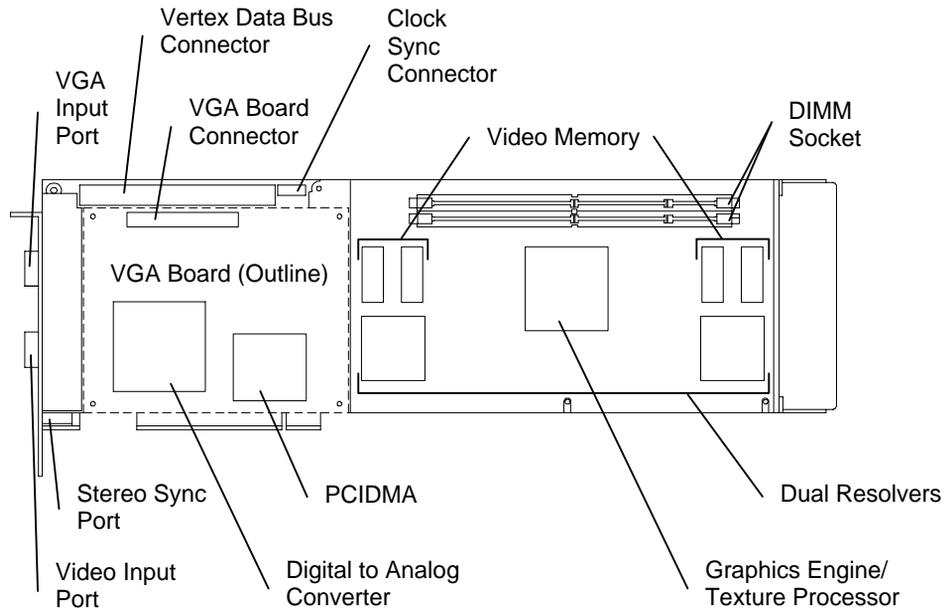
### Z10

The following figure shows the front of a Z10 board:

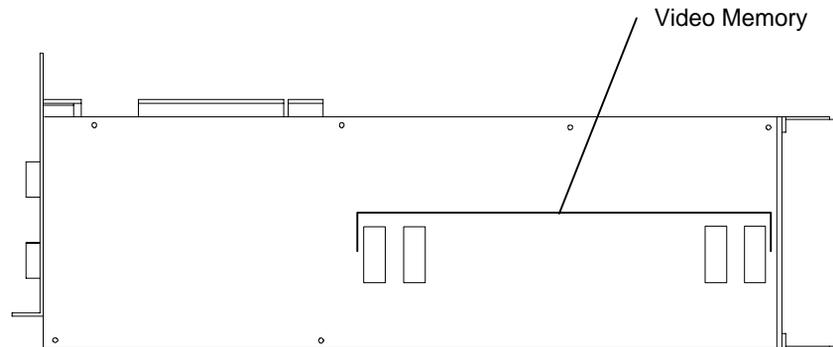


## Z13

The following figure shows the front of a Z13 graphics board:

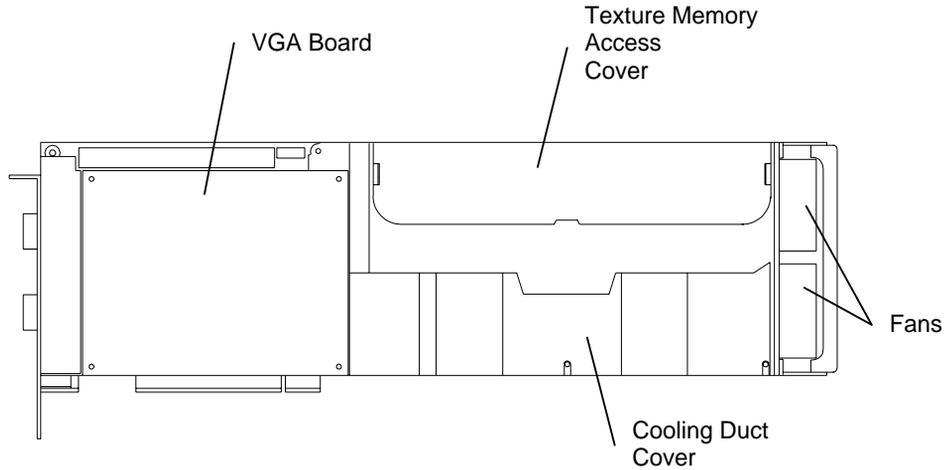


The following figure shows the back of a Z13 graphics board:

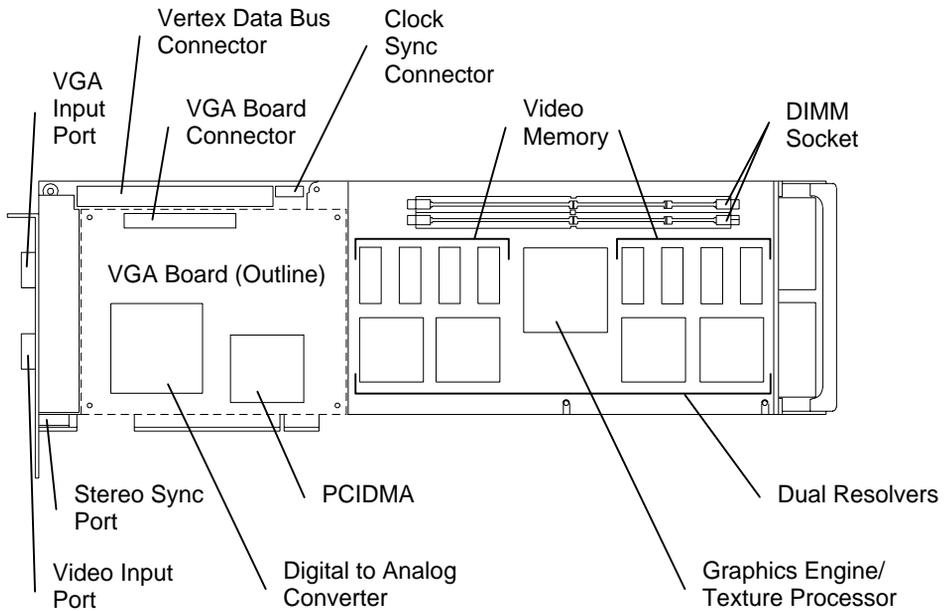


## Z25 and V25

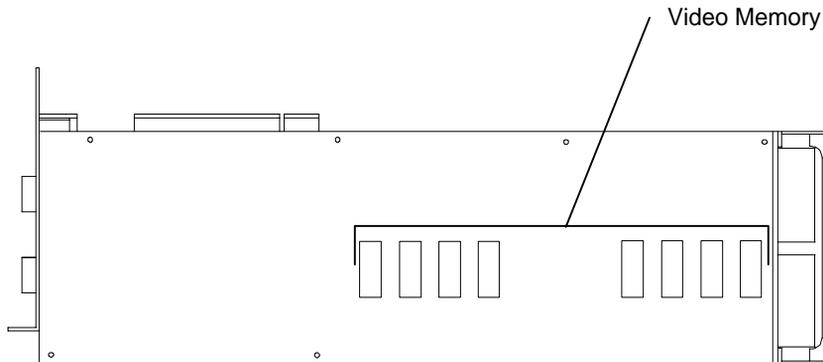
The following figure shows the front of a Z25 or V25 graphics board with covers in place:



The following figure shows the front of a Z25 or V25 graphics board with covers removed:



The following figure shows the back of a Z25 or V25 graphics board:



## PCIDMA

The PCIDMA application-specific integrated circuit (ASIC) is a multichannel, direct memory access (DMA) engine capable of burst transfers. For OpenGL requests, the Rasterization Accelerator uses a DMA to send vertex data through the PCIDMA to the graphics engine first-in-first-out (FIFO).

## Graphics Engine and Texture Processor

The Graphics Engine ASIC and the Texture Processor are physically separate entities for the Z10, and integrated within the same ASIC for the Z13, Z25, and the V25.

The Graphics Engine is the main graphics processor for the graphics board and the core of the Rasterization Accelerator. It takes vertex data from the graphics FIFO and produces spans of pixel data. The Graphics Engine sends the data to the Frame Buffer over a high-speed pixel path called the Image/Z (IZ) bus. If texture memory is present, texturing of the pixels occurs before transfers of data on the IZ bus.

The Graphics Engine uses four major logic blocks to perform the pixel rasterization. They are: (1) request handler, (2) slope calculation, (3) span generation, and (4) pixel interpolation.

## **Request Handler**

The request handler monitors the data output of the graphics FIFO. When data arrives, the request handler analyzes it and writes it to an appropriate processing block. The request handler routes vertex data for triangles and lines to the slope calculation block.

Drawing requests (other than vertex data for triangles and lines) such as blits, fills, and bit expands, bypass the slope calculation and span generation blocks. The request handler routes this data directly to the pixel interpolation block.

## **Slope Calculation**

The slope calculation block performs the slope calculation part of the rasterization process for triangles and lines. Floating-point math ensures the accuracy of triangle edges.

The slope calculation block calculates color derivatives, depth derivatives, and edge slopes. It also adjusts the vertex data to a pixel center for the topmost vertex. The slope calculation block converts all data to a fixed-point format and routes it to the span generation block.

## **Span Generation**

The span generation block performs the span calculation part of the rasterization process for triangles and lines. The span generation block determines the leftmost x and y coordinates for each scanline in a triangle. It also calculates the initial color and depth value for each scanline, and routes the data to the pixel interpolation block.

## **Pixel Interpolation**

The pixel interpolation block is common for all graphics drawing requests. For triangle meshes, the pixel interpolation block expands the data from the span generation block to pixel data by successively adding the x-derivative value to the initial color and depth values (z) for each span.

The pixel interpolation block also sends the (x, y) address and pixel data to the frame buffer over the IZ bus. The IZ bus is a 64-bit bus with a pixel span protocol to facilitate high data throughput. This protocol allows burst transfers of pixel data to occur between the rasterization accelerator and the frame buffer. The maximum burst size is 4096 pixels.

## **Texture Processor**

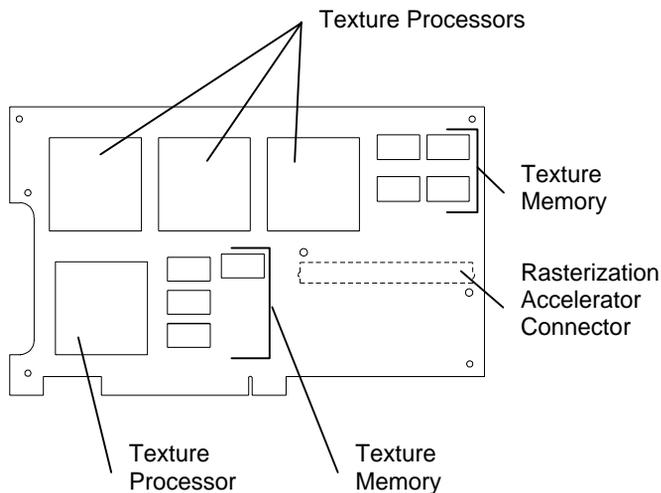
A Texture Processor is contained in the Graphics Engine/Texture Processor ASIC on the Z13, Z25, and V25, and as separate ASICs on the Z10. Texturing is the process of applying texture patterns to the surface of a 3D graphics object to enhance the visual realism of the object, or of an entire scene.

The Texture Processor receives instructions from the Graphics Engine via a high-speed bus and buffers the instructions in a FIFO to enhance performance. The Texture Processor reads the instructions from the FIFO, and then translates them into reads and writes of texture memory. Its primary function is to retrieve a group of texels, interpolate among them, and generate a final color value. This final color value represents the textured color of a pixel. The Texture Processor places this value into its output FIFO. The Graphics Engine transfers the pixel's location and color value from the FIFO to the resolvers for placement into the frame buffer.

## Z10 Texturing Accelerator

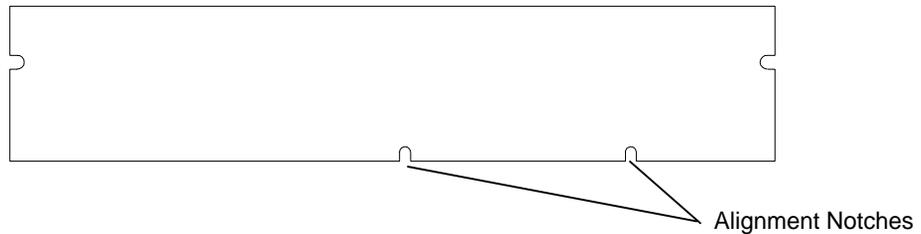
The Z10 Texturing Accelerator board communicates with texture memory via a 256-bit bus, which provides simultaneous access to eight 32-bit texels. Thirty-two bits are essential for storage of true-color texels, including Alpha, to match the frame buffer's true-color pixels.

The following figure shows the front of a Z10 Texturing Accelerator board.



## Texture Memory

Texture memory is capable of storing several sets of MIP-mapped textures for subsequent texture mapping. On the Z10-T, texture memory is fixed at 8 MB. On the Z13, Z25, and the V25, two DIMM sockets may contain texture memory modules. The texture memory socket is keyed for proper installation.



The available options for Z13 and Z25 are:

- ◆ 4 MB (two 2 MB DIMMs)
- ◆ 16 MB (two 8 MB DIMMs)
- ◆ 32 MB (two 16 MB DIMMs)
- ◆ 64 MB (two 32 MB DIMMs)

The available options for V25 are:

- ◆ 16 MB (two 8 MB DIMMs)
- ◆ 32 MB (two 16 MB DIMMs)
- ◆ 64 MB (two 32 MB DIMMs)

## Resolver Architecture

For the Z10, two resolver ASICs perform the memory control function of reading and writing data to the video memory. They also coordinate the movement of data from the video memory to the video selector and mapper (VSM) ASIC and digital-to-analog converter (DAC).

For the Z13, Z25, and the V25, a dual resolver ASIC contains two independent resolver modules and one screen refresh module. Resolvers perform the memory control function for reading and writing to the video memory. The screen refresh modules transfer pixel data from the pair of resolvers to the DAC. A frame buffer consists of two or four dual resolver ASICs.

The Graphics Engine ASIC sends pixel data over the IZ bus to the resolvers' IZ input FIFOs. The FIFOs enable the resolvers to accommodate bursts of pixel data without slowing overall

system performance. The pixel data consists of color (Red, Green, Blue, and Alpha - RGBA) and depth (Z) data.

The resolver examines pixel data from the input FIFO and determines if it should write the pixel data to the video memory. The resolver performs Z, mask, stencil (Z13, Z25, and V25 only), and alpha tests to determine if data should be written.

The resolver can perform an Arithmetic and Logic Unit (ALU) operation between the source data (data from the Graphics Engine) and the destination data (data in video memory). The operations include logical operations and OpenGL style alpha blend operations.

The resolver performs several different types of memory accesses including reads, writes, or read-modify-writes. It conserves memory bandwidth by choosing an appropriate type.

## **Video Memory**

The core of the frame buffer is video memory. Resolvers control the flow of data to and from the video memory. The various implementations of RealIZm accelerators have varying amounts of video memory: 48 VRAMs provide 12 MB of video memory for Z10; 8 SDRAMs provide 16 MB of video memory for Z13; and 16 SDRAMs provide 32 MB of video memory for Z25 and V25.

Video memory stores each pixel with a maximum of 128 bits (Z13, Z25, and V25).

## **Video Selector and Mapper (Z10 Only)**

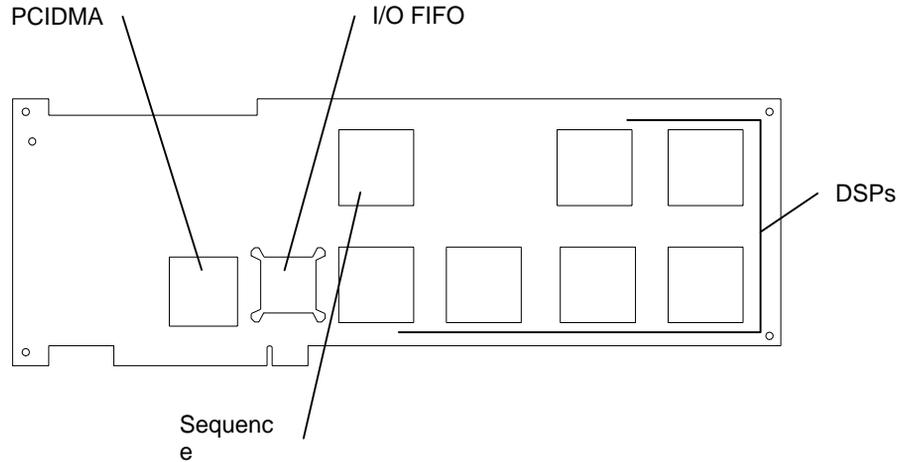
The display subsystem consists of the VSM ASIC and the DAC. The VSM ASIC receives pixel data from the video memory. It selects the buffer (front or back), and the data (image or overlay) to display. The video selection planes select one of the VSM's four video lookup tables (VLTs) to map the image data. The VSM sends the mapped result to the DAC.

## **Digital-to-Analog Converter**

The DAC converts pixel data into an analog voltage and sends it to the monitor for display. The DAC also provides a user-definable 64 x 64 pixel hardware cursor.

# Geometry Accelerator Components

The following describes the major components of the Geometry Accelerator board available for use with Z13, Z25, and V25.



## PCIDMA

The Geometry Accelerator employs the PCIDMA ASIC as the Peripheral Component Interconnect (PCI) bus interface device. This device has an independent DMA engine to accelerate the transfer of OpenGL data between the host processor and the Geometry Accelerator.

The DMA engine transfers data in bursts into the input/output (I/O) FIFO on the Geometry Accelerator. DMA transfers free the host processor from moving massive amounts of graphics data across the PCI bus.

## I/O FIFO

The I/O FIFO is a temporary depository for up to 4 KB of data being moved into the Geometry Accelerator. The I/O FIFO allows DMA transfers to proceed at the maximum speed of the PCI bus or the I/O bus by avoiding stall conditions.

## DSPs

The core of the Geometry Accelerator is six state of the art digital signal processors (DSPs) operating in parallel. These are 32-bit floating point processors, each capable of executing 120 million floating-point operations per second (MFLOPS). Each DSP contains 256 KB of high-speed RAM. Each DSP also has an advanced I/O system with six communication ports and ten DMA engines. This I/O system allows continual flow of data through the multiple DSPs and to the Sequence Controller with minimal host processor overhead.

## Sequence Controller

The multiple instruction multiple data (MIMD) architecture of the Geometry Accelerator allows incoming data to be processed concurrently and independently by each of the six DSPs. This means that the DSP that processes the first input request may not generate the first output request. Data moves through the DSPs at different rates, depending upon the complexity of the request.

Since the order of drawing operations must be maintained, this out of order data must be placed back into the order that it was received. This task is the responsibility of the Sequence Controller. The Sequence Controller receives data from each of the six DSPs via four communication ports. The Sequence Controller time-orders the data, and then uses a DMA to write the data directly to the Rasterization Accelerator via the Vertex data bus. The Sequence Controller also handles some clipping, and controls the flow of data to multiple Rasterization Accelerators for dual screen systems.

## 6 Specifications

Standard specifications for RealiZm graphics accelerators are subject to change without notice.

<b>Graphics Accelerator</b>	<b>Max Screen Resolution</b>	<b>Frame Buffer</b>	<b>Texture Memory</b>	<b>Geometry Acceleration</b>
Z10	1.0 Mpixels	12 MB VRAM		
Z10-T	1.0 Mpixels	12 MB VRAM	8 MB DRAM	
Z13	1.3 Mpixels	16 MB SDRAM		
Z13-T	1.3 Mpixels	16 MB SDRAM	4 - 64 MB SDRAM	
Z13-G	1.3 Mpixels	16 MB SDRAM		✓
Z13-GT	1.3 Mpixels	16 MB SDRAM	4 - 64 MB SDRAM	✓
Z25	2.5 Mpixels	32 MB SDRAM		
Z25-T	2.5 Mpixels	32 MB SDRAM	4 - 64 MB SDRAM	
Z25-G	2.5 Mpixels	32 MB SDRAM		✓
Z25-GT	2.5 Mpixels	32 MB SDRAM	4 - 64 MB SDRAM	✓
V25	2.5 Mpixels	32 MB SDRAM		
V25-T	2.5 Mpixels	32 MB SDRAM	16 - 64 MB SDRAM	
V25-G	2.5 Mpixels	32 MB SDRAM		✓
V25-GT	2.5 Mpixels	32 MB SDRAM	16 - 64 MB SDRAM	✓

### Cooling System (Z25 and V25)

The Z25 and V25 graphics board includes high-power components that require cooling. A duct covers the board and directs air over the components from two fans mounted at one end of the graphics board. Air from inside the assembly moves outside the system at the I/O end of the graphics board.

## Texturing System

Texture mapping capability on the Z10-T is provided by built-in texture memory. The Z13, Z25, and V25 provide texture memory by adding two dual inline memory module (DIMM) sockets. Both DIMM sockets must be populated with the same density DIMM. A slide-out cover on the Z25 and V25 provides easy access to the texture memory sockets.

For Z10-T:

<b>Texture Memory</b>	<b>Bits Per Texel (RGBA)</b>	<b>Total Texels</b>
8 MB	32	2 MTexels

For Z13 and Z25:

<b>Texture Memory</b>	<b>Bits Per Texel (RGBA)</b>	<b>Total Texels</b>
4 MB	32	1 MTexels
16 MB	32	4 MTexels
32 MB	32	8 MTexels
64 MB	32	16 MTexels

For V25:

<b>Texture Memory</b>	<b>Bits Per Texel (RGBA)</b>	<b>Total Texels</b>
16 MB	32	4 MTexels
32 MB	32	8 MTexels
64 MB	32	16 MTexels

## Geometry Accelerator Support

Geometry acceleration for lighting and transformation operations for Z13, Z25, and V25 is provided by the optional Geometry Accelerator board. It uses six digital signal processors (DSPs) to offload the host CPU(s) and provide for higher benchmark and application performance. The Geometry Accelerator board sends data to the graphics board set via a dedicated Vertex data bus, which has the following features:

- ◆ Dedicated 60-pin ribbon cable interface
- ◆ Peak transfer rate of 132 MB per second
- ◆ Up to two graphics board sets can be interfaced to a single Geometry Accelerator board

## Monitor Resolutions

Z10, Z13, Z25, and V25 supports standard multi-sync monitors, including the Intergraph 17-inch and 21-inch monitors, at the following resolutions and maximum refresh rates (Hz).

<b>Resolution</b>	<b>Z10</b>	<b>Z13</b>	<b>Z25/V25</b>
640 x 480	85	85	85
800 x 600	85	85	85
1024 x 768	85	85	85
1152 x 864	76	85	85
1280 x 960		85	85
1280 x 1024		85	85
1600 x 1200			75
1824 x 1368			65

Z13, Z25, and V25 support Intergraph InterVue-27 monitors at the following resolutions and maximum refresh rates (Hz).

<b>Resolution</b>	<b>Z13</b>	<b>Z25/V25</b>
640 x 480	151	151
800 x 600	123	123
1024 x 768	98	98
1280 x 960	79	79
1280 x 1024	74	74
1600 x 1200		64
1600 x 1280		60

# Interfaces

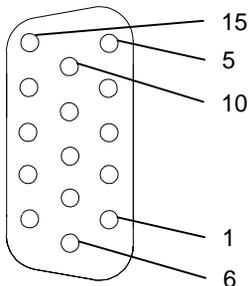
RealizM graphics accelerators have three interface connections: a video output port, a VGA input port, and a stereo sync output port.

## Video Output Port

The video output port provides connection to the monitor. The recommended cable length is less than three meters. The following table provides the pin connections for the video output port.

<u>Z10 Signal Name</u>	<u>Z13/Z25/V25 Signal Name</u>	<u>Pin</u>
Red Analog Video	Red Analog Video	1
Green Analog Video	Green Analog Video	2
Blue Analog Video	Blue Analog Video	3
Ground	Monitor ID [2]	4
Ground	Ground	5
Ground	Ground	6
Ground	Ground	7
Ground	Ground	8
No Connect	Supply +5V	9
Ground	Ground	10
Ground	Monitor ID [0]	11
Ground	Monitor ID [1]	12
Horizontal Sync	Horizontal Sync	13
Vertical Sync	Vertical Sync	14
Ground	Monitor ID [3]	15

The video output port is female, 15-pin, D-Sub as shown in the following figure.

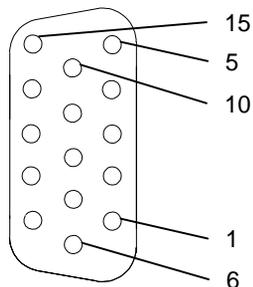


## VGA Input Port

The VGA input port allows connection of a VGA device to be used by the system while in VGA graphics mode. The following table provides the pin connections for the VGA input port.

<u>Z10 Signal Name</u>	<u>Z13/Z25/V25 Signal Name</u>	<u>Pin</u>
Red Analog Video	Red Analog Video	1
Green Analog Video	Green Analog Video	2
Blue Analog Video	Blue Analog Video	3
Ground	Monitor ID [2]	4
Ground	Cable Sense	5
Ground	Ground	6
Ground	Ground	7
Ground	Ground	8
No Connect	No Connect	9
Ground	Ground	10
Ground	Monitor ID [0]	11
Ground	Monitor ID [1]	12
Horizontal Sync	Horizontal Sync	13
Vertical Sync	Vertical Sync	14
Ground	Monitor ID [3]	15

The VGA input port is female, 15-pin, D-Sub as shown in the following figure.

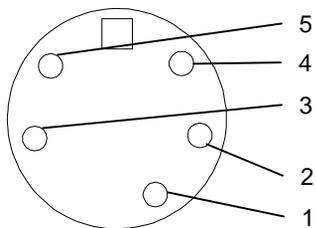


## Stereo Sync Output Port

The stereo sync output port provides connection to the LCD shutter glasses' emitter module. The following table provides the pin connections for the stereo sync output port.

<u>Signal Name</u>	<u>Pin</u>
Ground	1
Ground	2
+12V	3
Stereo Sync	4
No Connect	5

The stereo port is female, 5-pin, mini-DIN as shown in the following figure.



# Index

## A

- About this document, ix
- Advanced texture processor
  - hardware
    - description, 36
- Alpha buffer (Z13, Z25, and V25)
  - description, 39
- Antialiased vector support
  - description, 35
- Antistatic precaution, 7, 21

## C

- Cautions, iii
- Changing
  - default video display driver, 7
- Clock sync cable, 12, 28, 40
  - installing, 14, 26, 28
- Configuring
  - display properties, 4
- Connection
  - deskside
    - dual-screen, 16, 17, 29
    - single-screen, 16, 29
  - desktop
    - dual-screen, 15
    - single-screen, 15, 28
  - Vertex data bus
    - deskside, 25, 28
    - desktop, 25
  - VGA loopback, 19
  - video cables, 15, 28
- Cooling system (Z25 and V25), 57

## D

- Default video display driver
  - changing, 7

## Defective unit

- determining, 19, 32

## Deskside

- clock sync cable
  - installing, 26, 28
- dual-screen
  - connection, 29
- PCI slots, 13, 16, 17, 26, 27, 29
- single-screen
  - connection, 29
- Vertex data bus
  - installing, 28
  - removal, 25

## Desktop

- clock sync cable
  - installing, 14
- PCI slots, 13, 15, 26, 28
- single-screen
  - connection, 28
- Vertex data bus
  - removal, 25

## Diagnostics, 18, 31

## Digital signal processors (DSP)

- description, 56

## Digital-to-analog converter

- description, 54

## DIMM Texture Memory board, 53

## DOC compliance, iii

## Document

- about, ix
- conventions, x

## Documentation, x

## Dual-screen

- upgrade
  - installing, 12, 26

## F

## FAXLink, xii

- FCC compliance, iii
- Frame Buffer, 37, 42
  - alpha buffer (Z13, Z25, and V25), 39
  - gamma correction, 39
  - Genlock support for dual monitors, 40
  - hardware cursor, 39
  - high-resolution Z buffer, 38
  - high-speed screen refresh, 40
  - multiple video lookup tables, 39
  - multiple video resolutions, 39
  - stencil buffer (Z13, Z25, and V25), 38
  - stereoscopic viewing, 39
  - true-color image buffer, 38
  - video plane sets, 37
    - 84/90 bits per pixel, 37
  - window-mode double buffering, 39

## G

- Gamma correction
  - description, 39
- Genlock support for dual monitors
  - description, 40
- Geometry Accelerator, 55
  - block diagram, 46
  - board, 55
  - board installation
    - deskside, 25, 26
    - desktop, 25, 26
  - components, 55
    - DSPs, 56
    - I/O FIFO, 55
    - PCIDMA, 55
    - Sequence Controller, 56

- features and functions, 45
  - high-speed graphics DMA engine, 45
  - MIMD DSP architecture, 45
  - sequence controller, 45
- industry standard PCI bus, 45
- support, 58
- technical description, 45

- Getting started, 1
  - changing default video display driver, 7
  - configuring display properties, 4
- RealizM
  - configurations, 2
  - features and functions, 1
  - graphics accelerators, 1
- RenderGL Run-Time Library, 4
  - starting Windows NT, 3
- Gouraud shading support
  - description, 35
- Graphics acceleration processing
  - block diagram, 41
- Graphics Engine, 35
  - antialiased vector support, 35
  - Gouraud shading support, 35
  - high-level vertex interface, 35
  - sub-pixel accuracy, 36
  - symbolized vector support, 35
  - window clipping (Z13, Z25, and V25), 36
- Graphics Engine and Texture Processor
  - description, 50
  - pixel interpolation, 51
  - request handler, 51
  - slope calculation, 51
  - span generation, 51
  - texture processor, 51

## H

- Hardware cursor

- description, 39
- Hardware description, 47
  - Geometry Accelerator, 55
    - digital signal processors (DSPs), 56
    - I/O FIFO, 55
    - PCIDMA, 55
    - sequence controller, 56
  - Rasterization Accelerator, 47
    - digital-to-analog converter, 54
    - Graphics Engine and Texture Processor, 50
    - PCIDMA, 50
    - resolver architecture, 53
    - video memory, 54
    - video selector and mapper, 54
    - Z10, 47
    - Z13, 48
    - Z25 and V25, 49
    - Texture memory, 53
    - Z10 Texturing Accelerator, 52
- High-level vertex interface
  - description, 35
- High-resolution Z buffer
  - description, 38
- High-speed
  - DMA engine
    - description, 34
  - graphics DMA engine
    - description, 45
  - screen refresh
    - description, 40

## I

- I/O FIFO
  - description, 55
- Industry standard PCI bus
  - description, 45

## Installing

- clock sync cable, 12, 14, 26, 28
- dual-screen upgrade
  - Z10, 12
  - Z13, Z25, or V25, 26
- texture memory, 22
- texturing accelerator, 8
- Vertex data bus, 28
- video display driver, 17, 30
- Z13, Z25, or Geometry Accelerator, 24

## Interfaces, 60

- Geometry Accelerator (Z13, Z25, and V25)
  - description, 35
- stereo sync output port, 62
- VGA input port, 61
- video output port, 60

## Intergraph

- bulletin board service, xi
- FAXLink, xii
- Internet, xii

## Internet, xii

## L

- Last known good, 19, 31

## M

- MIMD DSP architecture
  - description, 45
- MIP-mapping support with trilinear interpolation
  - description, 37
- Monitor resolutions, 59
- Multiple video
  - lookup tables
    - description, 39
  - resolutions
    - description, 39

## O

- Operating system

information, x

## P

### Packing list

- dual-screen option
- verifying, 12, 26

### PCI bus interface

- description, 34
- high-speed DMA engine, 34
- interface for Geometry Accelerator (Z13, Z25, and V25), 35
- PCI-compatible bus interface, 34

### PCI slots

- deskside, 13, 16, 17, 26, 27, 29
- desktop, 13, 15, 26, 28

### PCI-compatible bus interface

- description, 34

### PCIDMA

- description, 50, 55

### Pinouts

- stereo sync output port, 62
- VGA input port, 61
- video output port, 60

### Pixel interpolation

- description, 51

### Pixelization Accelerator, 41

### Port

- stereo sync output, 62
- VGA input, 61
- video output, 60

### Precautions, 7, 21

## R

### Rasterization Accelerator

- components, 47
- features, 33
- functions, 40
- technical description, 33
- Z10, 47
  - block diagram, 43
  - board, 47
- Z13, 48

back view, 48

front view, 48

Z13, Z25, and V25

block diagram, 44

Z25 and V25, 49

back view, 50

front view, 49

### RealizM

- configurations, 2
- features and functions, 1
- graphics accelerators, 1

### Removing

- clock sync cable, 25
- Vertex data bus, 25

### RenderGL Run-Time Library

getting started, 4

### Replacing

- Z10 or Z10-T, 10
- Z13, Z25, or Geometry Accelerator, 24
- Z13, Z25, V25 or Geometry Accelerator, 24

### Request handler

description, 51

### Resolver architecture

description, 53

## S

### Selecting

- last known good, 19, 31
- VGA mode, 19, 32

### Sequence controller

description, 45, 56

### Slope calculation

description, 51

### Span generation

description, 51

- Specifications, 57
    - cooling system (Z25 and V25), 57
    - Geometry Accelerator support, 58
    - interfaces, 60
    - monitor resolutions, 59
      - InterVue-27, 59
      - multi-sync, 59
    - RealIZm graphics accelerators, 57
    - texturing system, 58
  - Stencil buffer (Z13, Z25, and V25)
    - description, 38
  - Stereo sync output port, 62
  - Stereoscopic viewing
    - description, 39
  - Sub-pixel accuracy
    - description, 36
  - Support
    - bulletin board service, xi
    - FAXLink, xii
    - Internet, xii
    - telephone, xi
  - Symbolized vector support
    - description, 35
  - System
    - powering on, 3
- T**
- Technical description, 33
    - Geometry Accelerator features and functions, 45
      - high-speed graphics DMA engine, 45
      - MIMD DSP architecture, 45
      - sequence controller, 45
    - Rasterization Accelerator
      - features, 33
        - Frame Buffer, 37
        - Graphics Engine, 35
        - PCI bus interface, 34
        - Texture Processor, 36
      - Rasterization Accelerator
        - functions, 40
          - Frame Buffer, 42
          - Pixelization Accelerator, 41
          - Texture Processor, 42
    - Telephone support, xi
    - Texture memory
      - description, 36, 53
      - installing, 22
      - socket
        - V25, 23
        - Z13, 22
        - Z25, 23
    - Texture Processor, 36, 42
      - advanced texture processor
        - hardware, 36
      - description, 51
      - MIP-mapping support with trilinear interpolation, 37
      - texture memory, 36
    - Texturing accelerator
      - installing, 8
      - Z10, 52
    - Texturing system, 58
    - Training, x
    - Troubleshooting, 18, 31
    - True-color image buffer
      - description, 38

**U**

    - Upgrading or replacing
      - Z10, 7
      - Z13, Z25, V25, 21
    - Usable video resolution, 19, 31

**V**

    - Vertex data bus
      - deskside, 25, 28
      - desktop, 25
      - installing, 28
      - removal, 25

**VGA**

- connection
  - loopback cable, 19
- mode, 19, 32

**VGA input port, 61**

- pinouts, 61

**Video**

- cables
  - connecting, 15, 28
- display
  - properties, 4
  - troubleshooting, 18, 31
- display driver
  - installing, 17, 30
- memory
  - description, 54
- planes
  - description, 37
- random access memory (VRAM), 54

**resolution**

- usable, 19, 31
- selector and mapper (VSM)(Z10 Only)
  - description, 54

**Video output port, 60**

- pinouts, 60

**W**

- Warnings, iii
- Window clipping (Z13, Z25, and V25)
  - description, 36
- Window-mode double-buffering
  - description, 39
- Windows NT
  - starting, 3
- Windows NT Workstation
  - information, x

**Z**

- Z10 Texturing Accelerator board, 52

## **Returned Goods Authorization (RGA) Form**

---

**Date Returned** \_\_\_\_\_ **Base Serial No.** \_\_\_\_\_

(On white bar code ID plate on back of base unit)

**RGA No.** \_\_\_\_\_ (From Intergraph Customer Response Center)

**From Customer Name** \_\_\_\_\_

**Customer Contact** \_\_\_\_\_ **Phone** \_\_\_\_\_

**Mail Address** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Reason for Return** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**NOTE** All returned equipment MUST be shipped in original Intergraph packaging to obtain warranty service.

**WARNING** Back up disk drives before returning equipment. Intergraph is not responsible for data lost in shipping or repair process.

## **Warranty Procedure**

---

Some malfunctioning equipment cannot be repaired in the field, and you must return it to Intergraph for repair. Follow these steps to obtain a Returned Goods Authorization (RGA) log number and return the malfunctioning equipment.

1. Determine the serial number of the system. The serial number is located on the white bar code identification label on the back of the base unit.
2. Call the Intergraph Customer Response Center at 1-800-633-7248, and identify your call to the operator as a Warranty Call. After giving the operator the serial number of the system, you will be assigned a RGA log number.
3. Complete the RGA Form on the previous page, entering the RGA log number obtained from the Customer Response Center. Ensure that the address in the From section is the location to which you want the equipment to be returned.
4. Place the RGA form in the box containing the equipment. This form must accompany returned equipment.
5. Secure a Repair Depot address label from the next page to the box containing the equipment.
6. Ship the box containing the equipment to Intergraph.

When the service activity has been completed by Intergraph, the repaired or replaced equipment will be shipped to the address listed on the RGA Form.

**NOTE**      Parts damaged during shipping and parts not covered by the warranty are liable for repair charges.

---

**TO Repair Depot RGA No. \_\_\_\_\_**  
**Intergraph Corporation**  
**9805 Kellner Road**  
**Huntsville AL 35894**

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**TO Repair Depot RGA No. \_\_\_\_\_**  
**Intergraph Corporation**  
**9805 Kellner Road**  
**Huntsville AL 35894**

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