Indigo^2 IMPACT™ Channel Option Installation Guide

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For regulatory and compliance information, see Appendix B.

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Introduction

This guide explains how to install and configure the Indigo^2 IMPACT™ Channel Option (ICO) board.

The Indigo^2 IMPACT Channel Option board enables a single Indigo^2 IMPACT workstation to provide different data to multiple displays simultaneously. The ICO formats include support for up to four simultaneous displays for both field parallel and field sequential formats.

The field parallel format allows your Indigo^2 IMPACT workstation to support lower resolution formats than are available on the main monitor, including VGA, SVGA, and RS170 timing. The field sequential formats are suitable for use with many head mounted displays. ICO provides two channels of output for head mounted displays: one for the left eye, and one for the right eye.

- Chapter 1 provides instructions for installing and removing the Indigo^2 IMPACT Channel Option board in an Indigo^2 IMPACT workstation.
- Chapter 2 provides information about the breakout box cable, which provides the interface between the Indigo^2 IMPACT Channel Option board and the monitors or projection devices.
- Chapter 3 provides information about configuring the Indigo^2 IMPACT Channel Option board.
- Chapter 4 provides troubleshooting information.
- Appendix A provides illustrations of the Indigo^2 IMPACT Channel Option Board and the Indigo^2 Solid IMPACT™, Indigo^2 High IMPACT™, and Indigo^2 Maximum IMPACT™ graphics board sets.
- Appendix B provides instructions for downloading your Declaration of Conformity and affixing any regulatory label, as well as other Regulatory information.

See Chapters 2 and 3 for information on monitors and monitor formats.

Read this guide once all the way through before you start to work. You will become familiar with the Indigo^2 IMPACT system and the parts with which you will be working. If you find a term you are not familiar with, check the glossary at the end of this guide.

If you need additional information about your workstation, refer to the *Indigo^2 IMPACT Workstation Owner's Guide*.

It's always a good idea to back up your system. If you have not backed up your system recently, take this opportunity to do so. For instructions on backing up your system, see your *Personal System Administration Guide*. It is located on your desktop in the Toolchest under Help, Online Books.

Product Support

Silicon Graphics® Inc. provides a comprehensive product support and maintenance program for its products. If you are in North America and would like support for your Silicon Graphics supported products, contact the Technical Assistance Center at 1-800-800-4SGI or your authorized service provider. If you are outside North America, contact the Silicon Graphics subsidiary or authorized distributor in your country.

Chapter 1

Installing and Removing the Indigo^2 ICO Board

This chapter covers installing and removing the Indigo^2 IMPACT Channel Option (ICO) board in your Indigo^2 IMPACT workstation.

The following topics are covered in this chapter:

Installing a New Version of the IRIX Operating System

Before shutting down your system and installing the ICO board, check to be sure you have the current version of the IRIX™ operating system installed on your system. Install the operating system that came with your ICO board before installing the hardware.

Installing the Software

Read the flier on software that comes with this package. Also read the release notes on the CD for detailed information about the software.

Checking the Indigo^2 IMPACT Channel Option Board Package Components

Figure 1-1 shows the components included in the Indigo^2 ICO board package.

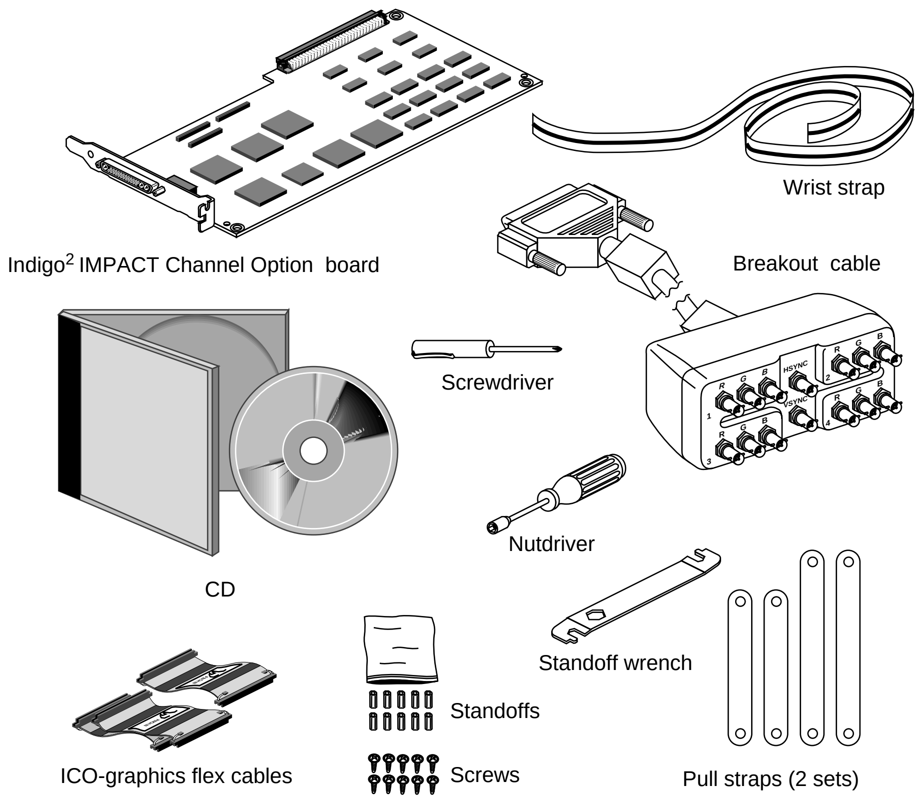

Figure 1-1 Indigo^2 IMPACT Channel Option Board Package Components

Preparing to Install the Indigo^2 ICO Board

Before you can install the Indigo^2 ICO board, turn off the power, remove the cover, and remove the graphics board set and any attached option boards. (See the option board manual or the *Indigo^2 IMPACT Workstation Owner's Guide* for instructions on removing attached option boards.) You will attach the ICO board to the graphics board set. Depending on your system, the graphics board set in your workstation may consist of an Indigo^2 Solid IMPACT (single), Indigo^2 High IMPACT (double) or Indigo^2 Maximum IMPACT (triple) board set. See Appendix A, "Identifying Graphics and Option Boards."

The installation procedure is the same for a single, double, or triple graphics board set.

Turning Off the Power

To turn off the system power, follow these steps:

1. Save your current work and then shut down the system by choosing "System Shutdown" from the System menu in the Toolchest.
2. Open the front cover, as shown in Figure 1-2.
3. Press and release the power button on the front of the system to turn off the power. The power indicator light turns off. See Figure 1-2.
4. If you have a lockbar installed, remove it.

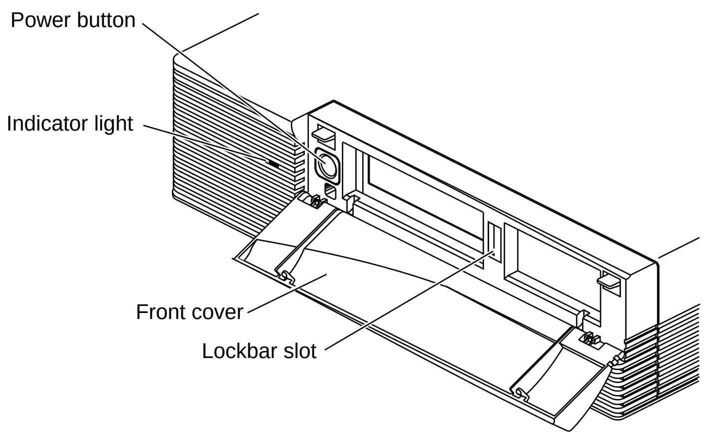

Figure 1-2 Turning Off the Power

Removing the Cover

You must remove the bezel before you can remove the cover. Follow these steps:

1. Disconnect the cables connected to EISA boards and the graphics boards on the back of the workstation. Unplug the power cable.
2. Remove the bezel.
   - Press down on the tabs on each side of the bezel See Figure 1-3.

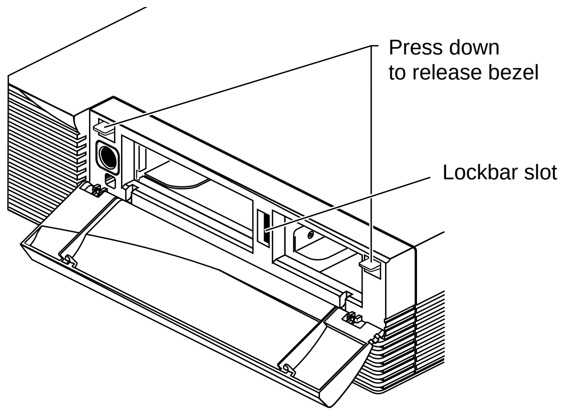

Figure 1-3 Releasing the Bezel

   - Pull the bezel down and away from the chassis. See Figure 1-4.

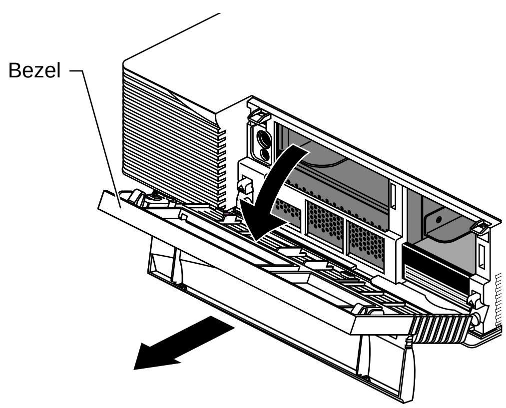

Figure 1-4 Removing the Bezel

3. Remove the cover.
   - Press up on the tabs on each side of the drive openings. See Figure 1-5.

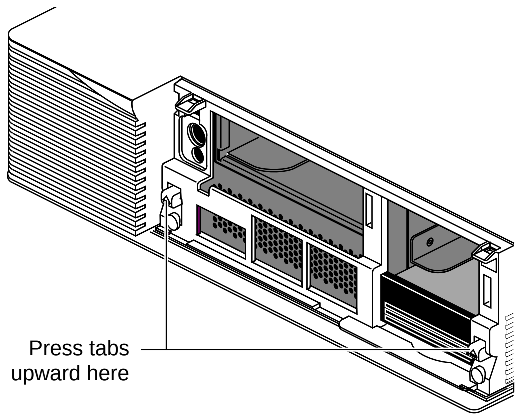

Figure 1-5 Pressing Up the Tabs

   - Pull up on the cover and rotate it back and away from the chassis. See Figure 1-6.

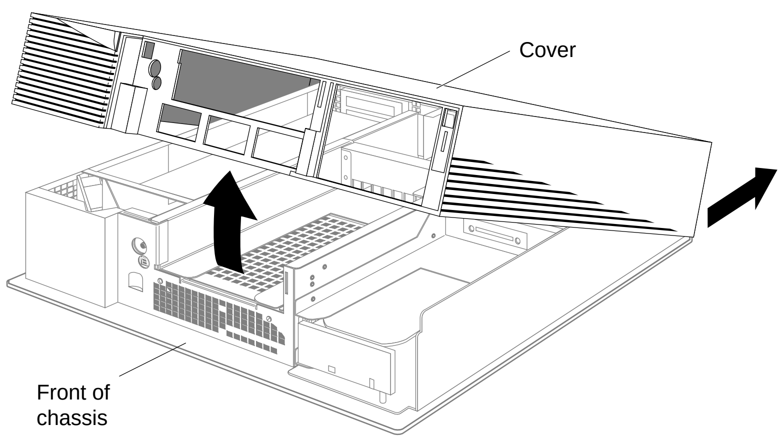

Figure 1-6 Removing the Cover

Tip: If the cover is difficult to raise, check the locking levers of the drives to be sure that they are completely locked. The lever should be pushed all the way to the right.

Removing the Graphics Board Set

Before installing the Indigo^2 ICO board, you must remove the graphics board set.

Caution: If your workstation has been turned on, the heat sink on the graphics board becomes hot. Wait a few minutes for the heat sink to cool before removing the graphics board set.

Attaching the Wrist Strap

Wear the wrist strap to prevent the flow of static electricity, which can damage the board.

Caution: The components inside the Indigo^2 IMPACT workstation are extremely sensitive to static electricity; you must wear the wrist strap while replacing parts inside the workstation.

To attach the wrist strap, follow these steps:

1. Unwrap the first two folds of the band and wrap the exposed adhesive side firmly around your wrist.
2. Unroll the rest of the band and peel the liner from the copper foil at the opposite end.
3. Attach the copper foil to a convenient and exposed electrical ground, such as a metal part of the Indigo^2 IMPACT workstation.

To remove the graphics board set, follow these steps:

1. Open the metal panel by pulling up and then lowering it. See Figure 1-7.

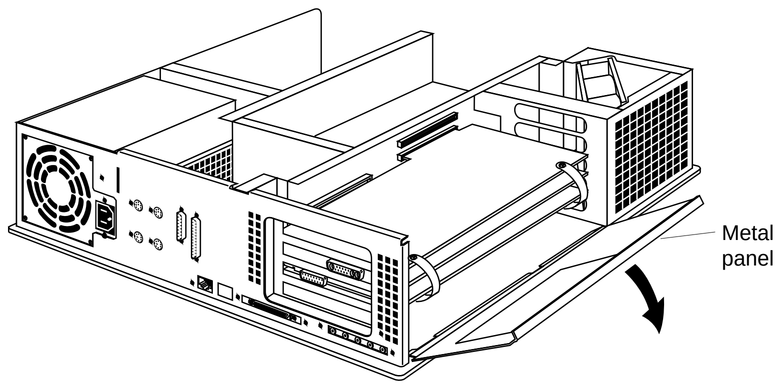

Figure 1-7 Opening the Metal Panel

Note: The illustrations in this chapter (with certain exceptions) are of the Indigo^2 Maximum IMPACT graphics board set. Except as noted, the installation procedures are the same for all three Indigo^2 IMPACT graphics board sets.

2. Remove the retention pin that secures the graphics board set. See Figure 1-8.

Tip: Note the position of the retention pin. It sits in front of the board, not beside it.

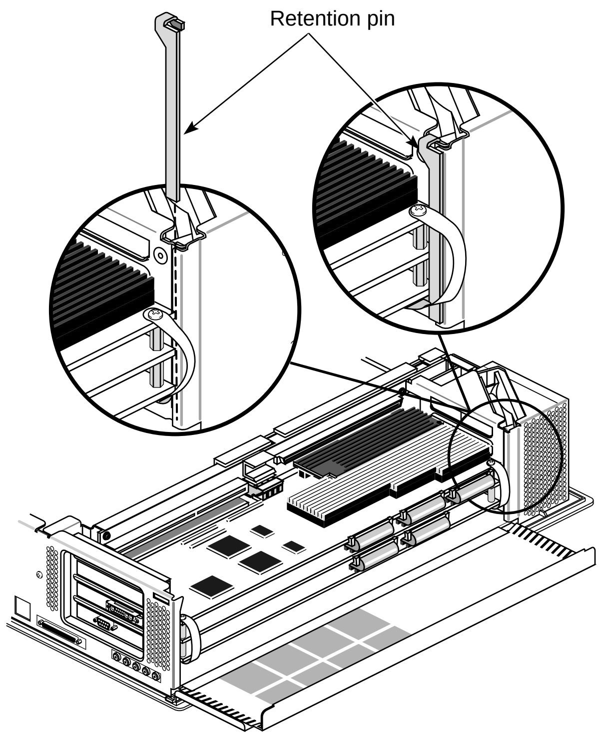

Figure 1-8 Removing the Retention Pin

3. Locate the slot directly above the top graphics board slot currently being used. This is the slot you will use to install the Indigo^2 ICO board.
4. Remove the screws that attach the I/O blank panel and the graphics boards to the chassis. See Figure 1-9.

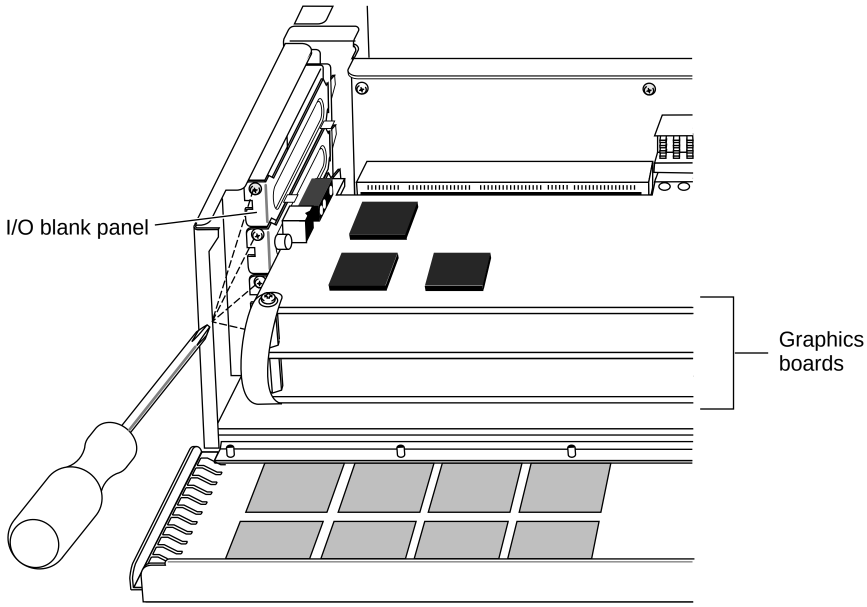

Figure 1-9 Removing the Slot Cover Screws

5. Pull the straps to remove the graphics board set from the chassis. See Figure 1-10.

Tip: It may take some pressure to detach the boards from the midplane connectors. Place your thumbs against the chassis for added leverage while you pull.

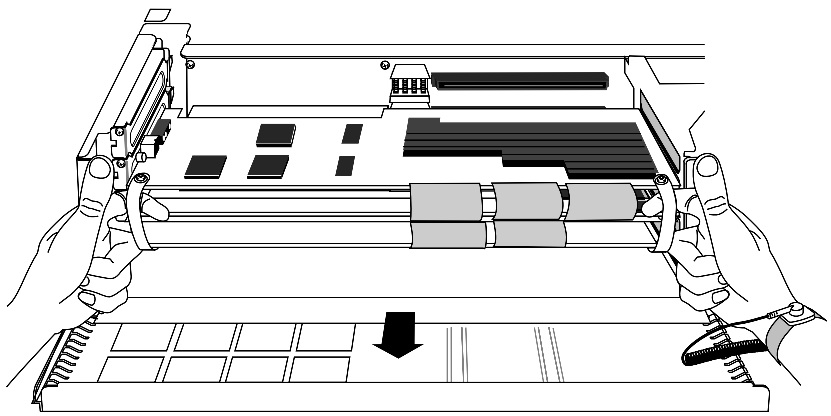

Figure 1-10 Removing the Graphics Board Set

6. Place the board set on a flat, antistatic surface. An empty antistatic bag or a clean, dry desktop works well.

Installing the Indigo^2 ICO Board

This section describes how to install the Indigo^2 ICO board. Below is an overview of the process:

1. Attach the Indigo^2 ICO board to the graphics board set.
2. Replace the pull straps.
3. Reinstall the board set into the system.
4. Replace the cover.

Each step is described more fully in the following section.

Attaching the Indigo^2 ICO Board to the Graphics Board Set

This section describes how to attach the Indigo^2 ICO board to the graphics board set.

1. Locate a Phillips screwdriver, a hex nut removal tool, and the board's standoffs, screws, and pull straps.
2. Identify your board set:
   - If you have an Indigo^2 Solid IMPACT graphics board, go to step 9.
   - If you have an Indigo^2 High IMPACT or Indigo^2 Maximum IMPACT graphics board set, go to step 3.

Note: See Appendix A if you need help identifying the board set.

If you have an Indigo^2 High IMPACT or Indigo^2 Maximum IMPACT graphics board set, remove the four screws from the corners. See Figure 1-11.

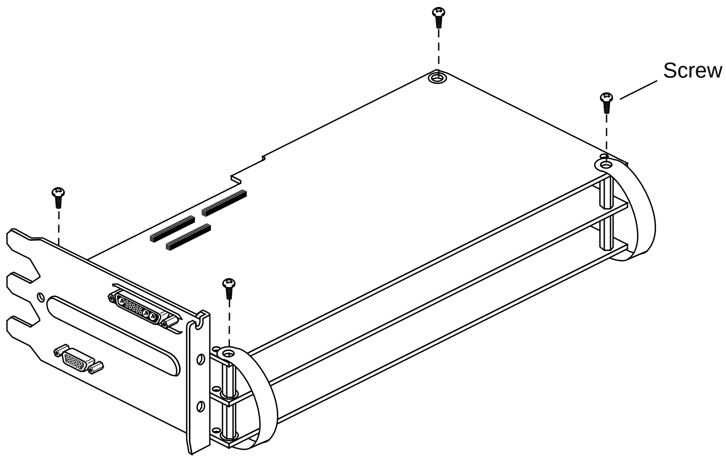

Figure 1-11 Removing Graphics Board Set Screws

3. Install the four (female/male) standoffs in the same corner screw holes from which you removed the screws. See Figure 1-12.

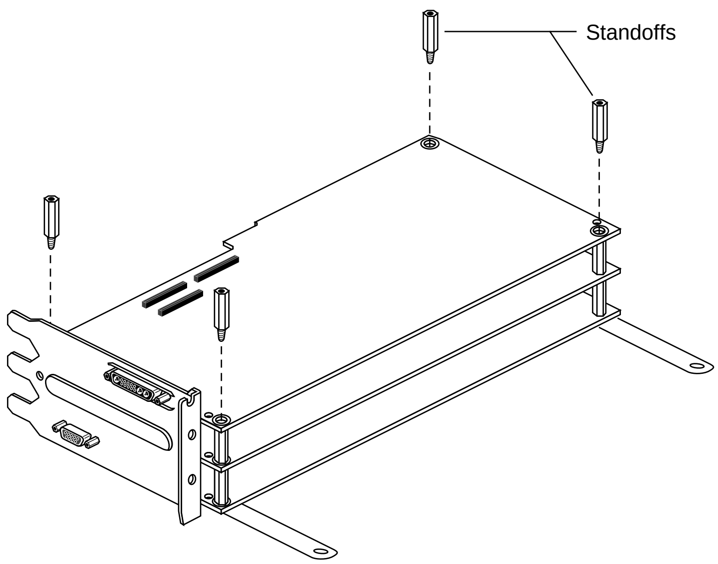

Figure 1-12 Installing the Standoffs

4. Remove the screws that attach the pull straps to the bottom of the graphics board set. See Figure 1-13. You can turn the board set upside down and rest the board on the standoffs to replace the pull straps.
5. Remove the pull straps and throw them away.

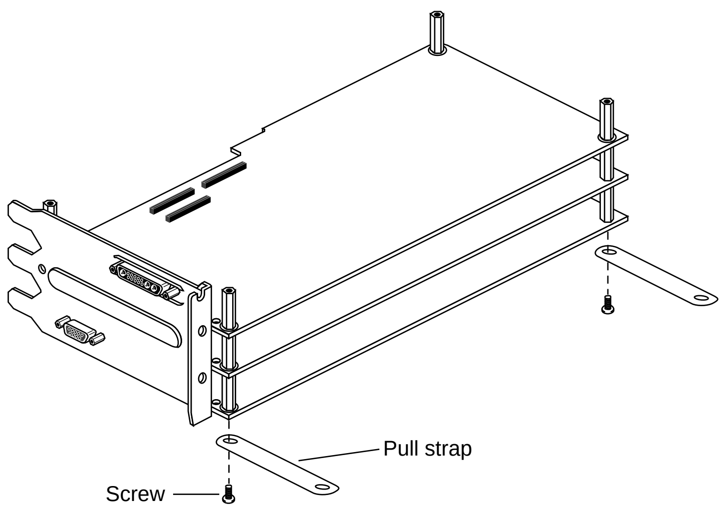

Figure 1-13 Removing the Screws That Attach the Pull Straps

6. Select the pull straps for the graphics board set:
   - If you have an Indigo^2 High IMPACT graphics board set with two boards, select the three-board pull straps.
   - If you have an Indigo^2 Maximum IMPACT graphics board set with three boards, select the four-board pull straps.
7. Attach the pull straps to the bottom of the graphics board set.
   - Pull the plastic strip off the adhesive on the end of the pull strap.
   - Line up the hole in the pull strap and the hole in the board and attach the pull strap to the bottom of the board.
   - Replace the screws. See Figure 1-13.
8. Skip to "Installing the ICO-Graphics Flex Cables" on page 17.

9. If you have an Indigo[2] Solid IMPACT graphics board, follow these steps to remove the pull straps:
   - Remove the two screws that pass through the pull straps. See Figure 1-14.
   - Detach the pull strap only from the top of the board.

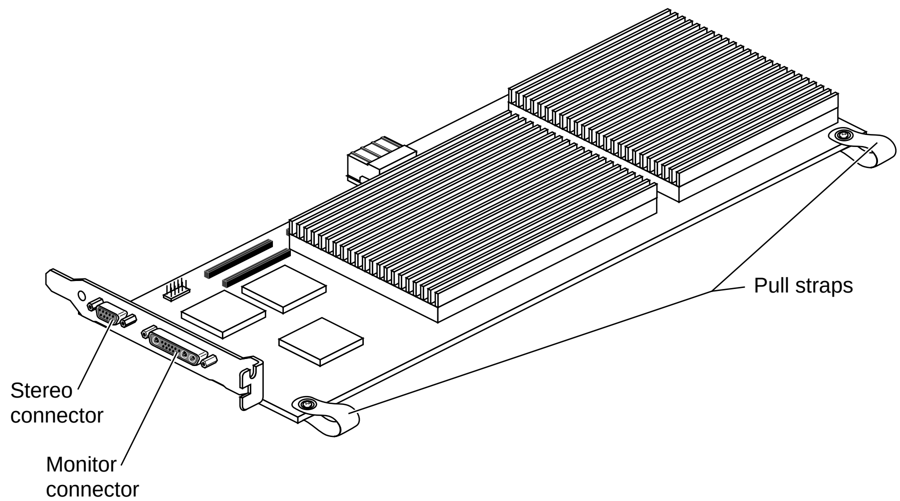

Figure 1-14 Removing the Pull Straps From the Indigo[2] Solid IMPACT Graphics Board

Note: Should the pull straps become detached from the bottom of the board, use the three-board pull straps included with your ICO board.

10. Insert the screws through the bottom of the board and pull straps. See Figure 1-15.

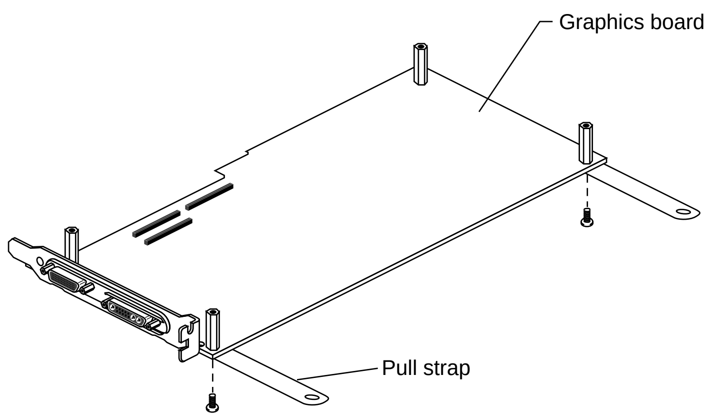

Figure 1-15 Inserting the Screws and Attaching the Standoffs

11. Install two (female/female) standoffs onto the screws.
12. Locate holes on the rear two corners of the board and insert a screw from beneath the board through each hole.
13. Install two standoffs onto the screws you just placed through the holes.

Installing the ICO-Graphics Flex Cables

The following instructions apply to the Indigo[2] Solid IMPACT, Indigo[2] High IMPACT, and Indigo[2] Maximum IMPACT graphics board sets.

1. Attach the two ICO-graphics cables to the graphics board connectors. See Figure 1-16 and Figure 1-17.
   - Attach one end of the single cable to the single connector on the graphics board.
   - Attach the two connectors from one end of the double cable to the pair of connectors on the graphics board.

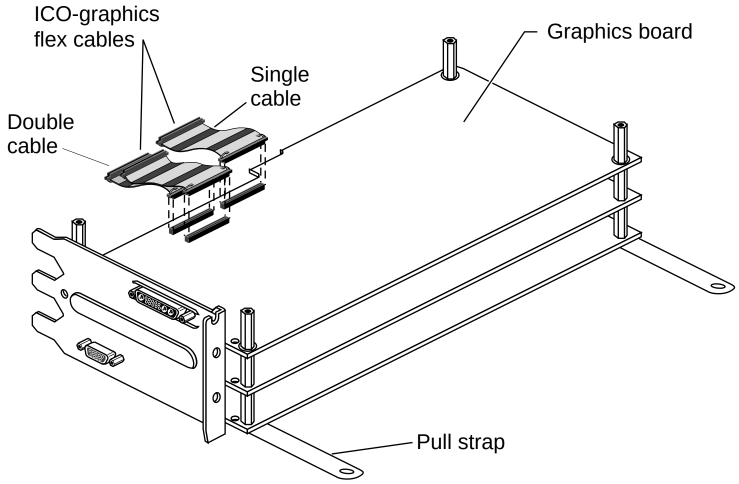

Figure 1-16 Attaching the ICO-Graphics Cables to the Graphics Board

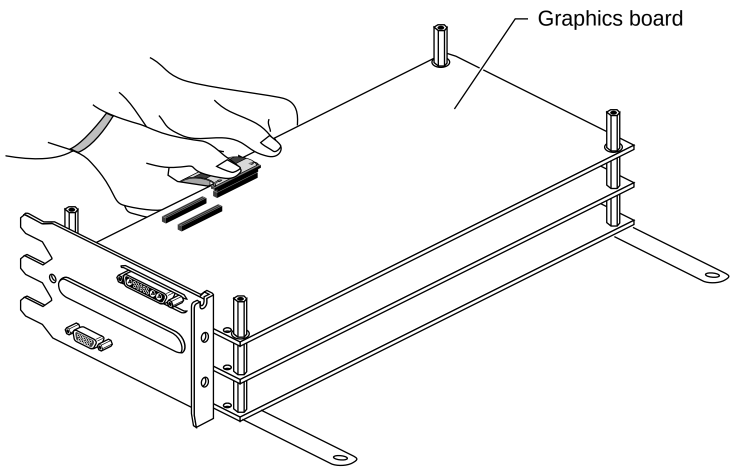

Figure 1-17 Inserting the ICO-Graphics Cables Into the Connectors

Tip: Use your thumb and fingers to squeeze the cable connectors into the connectors on the board. See Figure 1-17.

Attach the connectors one at a time. Figure 1-18 provides a side view of a correctly and incorrectly seated cable connector.

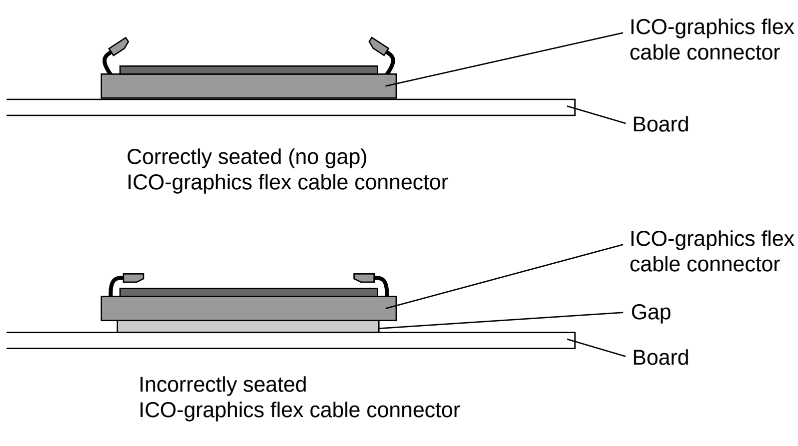

Figure 1-18 Seating the ICO-Graphics Flex Connectors

2. Slip the inner cable through the levers of the outer cable of the two-cable set. See Figure 1-19.

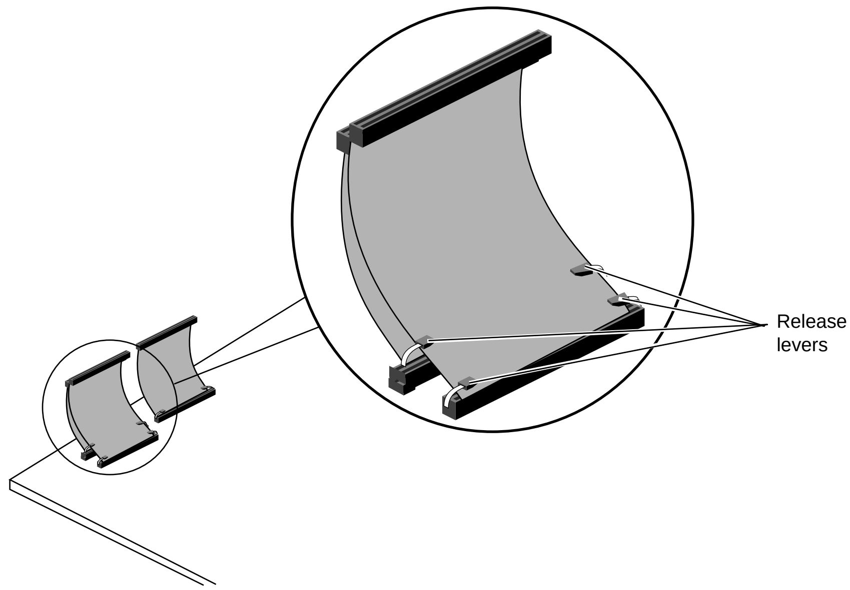

Figure 1-19 Slipping the Inner Cable Through the Outer Cable Levers

3. Align the Indigo^2 ICO board with the graphics board set and place it on the standoffs. See Figure 1-20.
4. Insert two screws through the Indigo^2 ICO board into the rear standoffs.
5. Attach the pull straps to the top of the Indigo^2 ICO board.
   - Remove the plastic strip from the adhesive at the end of the pull strap.
   - Align the holes of the pull strap with the holes in the board and press firmly to attach.
6. Insert the remaining two screws through the pull straps and into the standoffs.

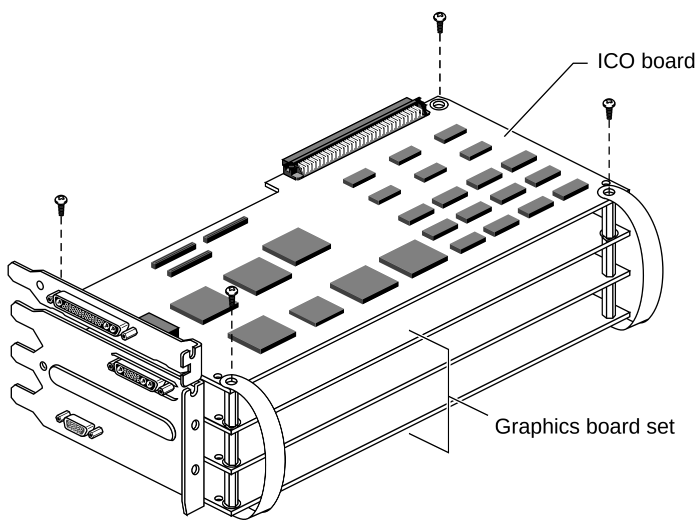

Figure 1-20 Aligning and Attaching the ICO Board to the Graphics Board Set

7. Attach the single ICO-graphics cable to the corresponding connector on the ICO board. See Figure 1-21.
8. Attach the lower or outside ICO-graphics flex connector of the double-cable set to the connector on the ICO board.
9. In the double-cable set, slip the upper cable through the lower cable's release levers. See Figure 1-21.
10. Attach the upper ICO-graphics flex cable connector to the connector on the ICO board.

Note: If the upper cable slips out from between the levers of the lower cable, detach the cable connector, reposition the upper cable, and reattach the connector.

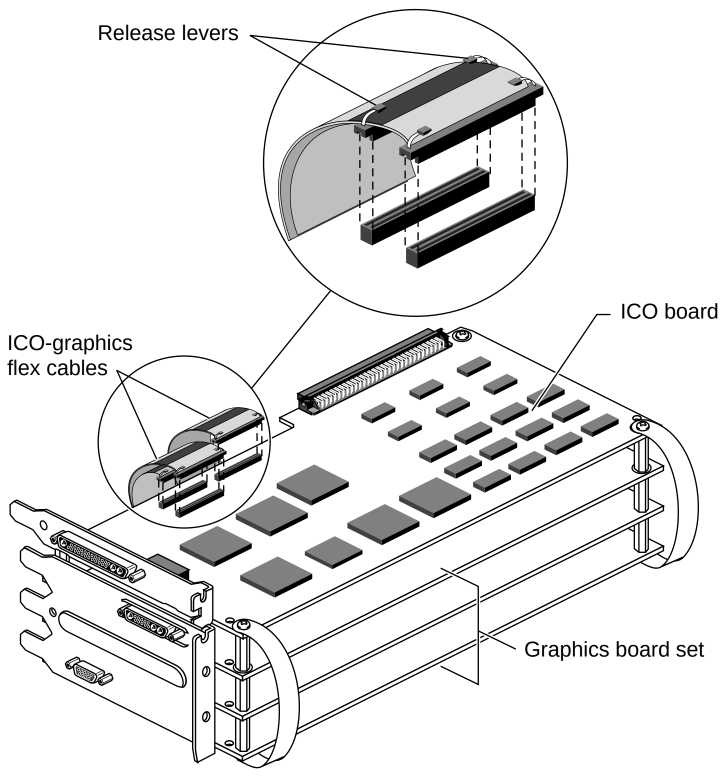

Figure 1-21 Attaching the ICO-Graphics Cables to the ICO Board

Installing the Indigo^2 ICO Board and the Indigo^2 IMPACT Graphics Board Set

Install the graphics and ICO board set in the same slot from which you removed the graphics board. If you need help determining which slots to use, see the following tables. Otherwise, skip to step 1.

See Figure 1-22 for the locations of the slots. Check your option board manual for any additional information.

Table 1-1 Placement of Indigo^2 Solid IMPACT and Indigo^2 ICO Board

If you have this configuration:	Use these slots:
Indigo^2 Solid IMPACT board/Indigo^2 ICO board	Indigo^2 Solid IMPACT board/Indigo^2 ICO board in Slots B and C
Indigo^2 Solid IMPACT board/Indigo^2 ICO board and 1 EISA option board	Indigo^2 Solid IMPACT board /Indigo^2 ICO board in Slots B and C, and the EISA option board in Slot A
Indigo^2 Solid IMPACT board /Indigo^2 ICO board and 2 EISA option boards	Indigo^2 Solid IMPACT board /Indigo^2 ICO board in Slots C and D and the EISA option boards in Slots A and B
Indigo^2 Solid IMPACT board/Indigo^2 ICO board and an Indigo^2 Solid IMPACT board (Dual Head Configuration)	Indigo^2 Solid IMPACT board /Indigo^2 ICO board in Slots B and C and second Indigo^2 Solid IMPACT board in Slot D
Indigo^2 Solid IMPACT board /Indigo^2 ICO board and a standalone GIO option board	Indigo^2 Solid IMPACT board/Indigo^2 ICO board in Slots B and C and the standalone GIO option board in Slot D

Table 1-2 Placement of Indigo^2 High IMPACT and Indigo^2 ICO Board

If you have this configuration:	Use these slots:
Indigo^2 High IMPACT board/Indigo^2 ICO board	Indigo^2 High IMPACT board/Indigo^2 ICO board in Slots A, B, and C
Indigo^2 High IMPACT board/Indigo^2 ICO board and 1 EISA option board	Indigo^2 High IMPACT board/Indigo^2 ICO board in Slots B, C, and D and the EISA board in Slot A
Indigo^2 High IMPACT board/Indigo^2 ICO board and an Indigo^2 Solid IMPACT board (Dual Head Configuration)	Indigo^2 High IMPACT board/Indigo^2 ICO board in Slots A, B, and C, and an Indigo^2 Solid IMPACT board in Slot D
Indigo^2 High IMPACT board/Indigo^2 ICO board and a standalone GIO option board	Indigo^2 High IMPACT board/Indigo^2 ICO board in Slots A, B, and C and the standalone GIO option board in Slot D

Note: All slots are utilized in the Indigo^2 Maximum IMPACT/Indigo^2 ICO board configuration.

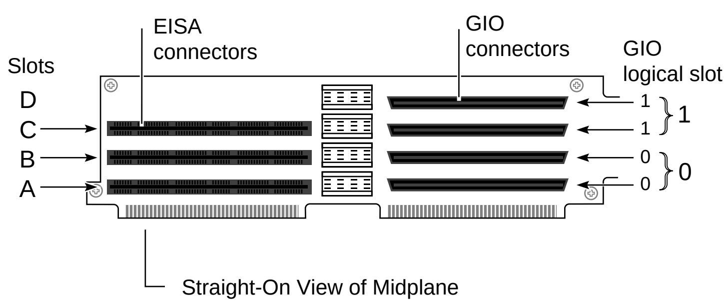

Figure 1-22 Locating Graphics and Option Board Slots

1. Align the board set with the slots on the left side of the chassis See Figure 1-23.

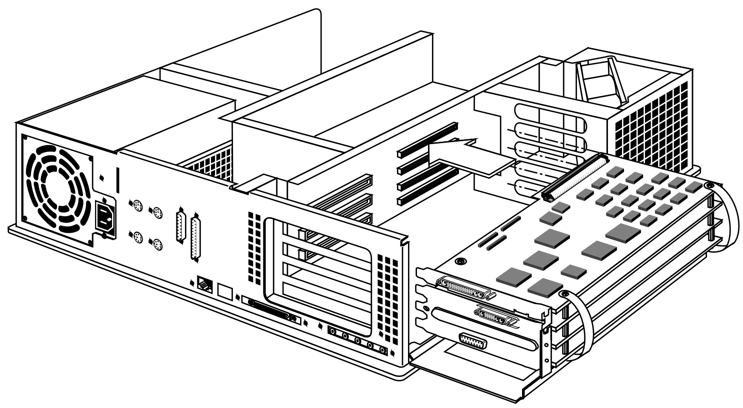

Figure 1-23 Aligning the Board Set With the Chassis

2. Slide the boards into the chassis and push the board connectors into the corresponding midplane connectors. See Figure 1-24. Putting pressure on the topmost board of the set helps to seat the boards completely.

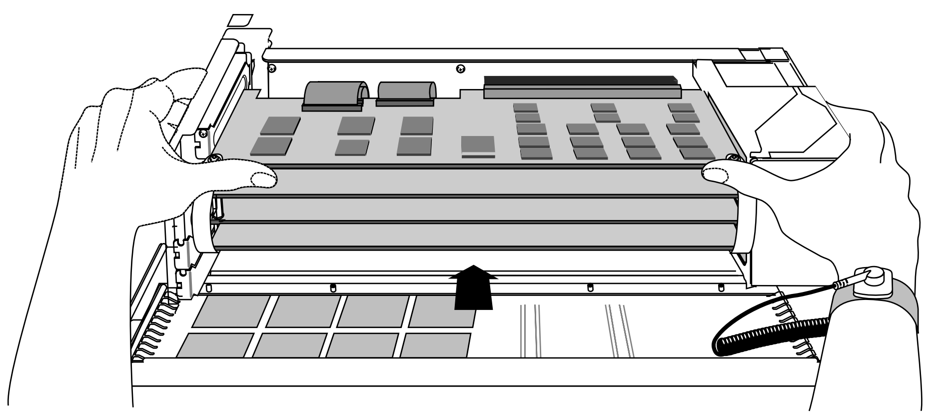

Figure 1-24 Inserting the Board Set Into the Chassis

You must use a great deal of pressure to push the board connectors completely into the midplane connectors. When the connectors are completely seated, the metal panels on the left should be flush with the chassis.

Figure 1-25 provides a top-down view of a GIO connector that is seated correctly and one that is not. A correctly seated connector has no gap between the connector on the ICO board and the connector on the midplane.

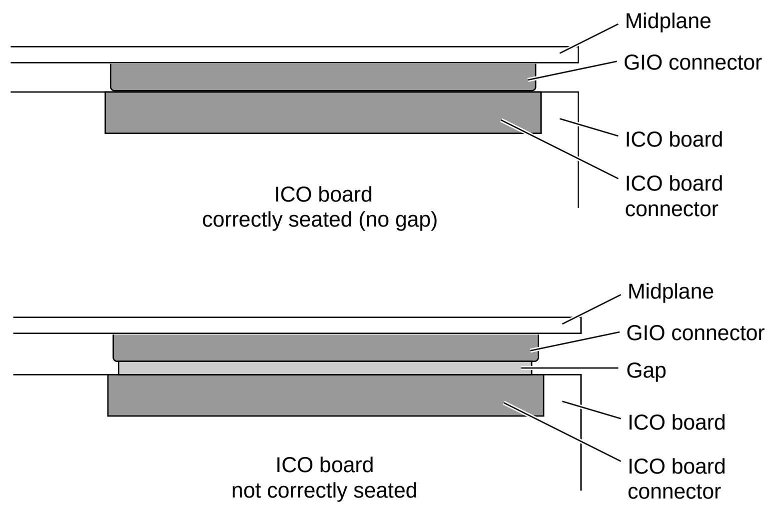

Figure 1-25 Checking the Seating of the GIO Connector

3. Install the screws that secure the graphics boards and ICO board to the chassis.

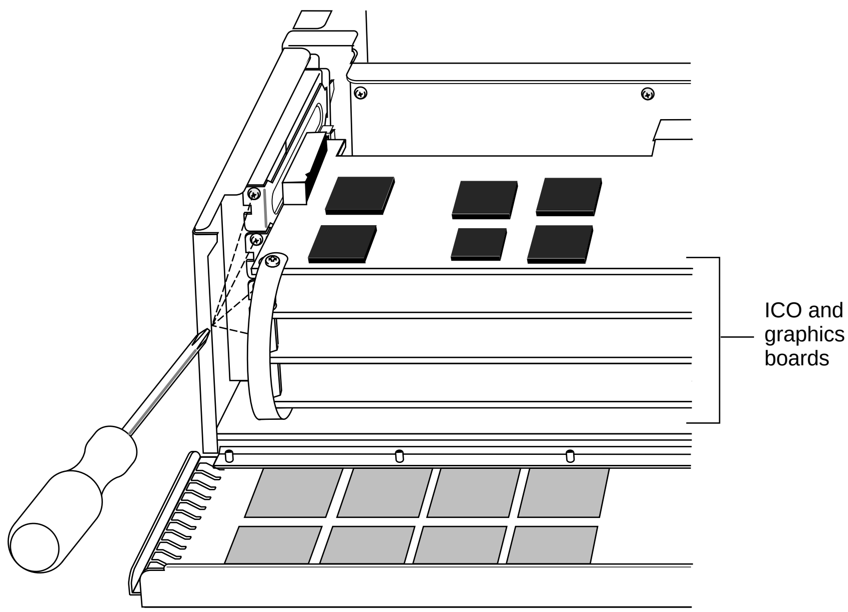

Figure 1-26 Attaching the Graphics Board Set to the Chassis

4. Replace any standalone option boards.

5. Replace the retention pin.

Tip: Use the retention pin as a plumb line to determine if the board set is properly seated. If the pin is tilted, push on the board set until it is properly connected.

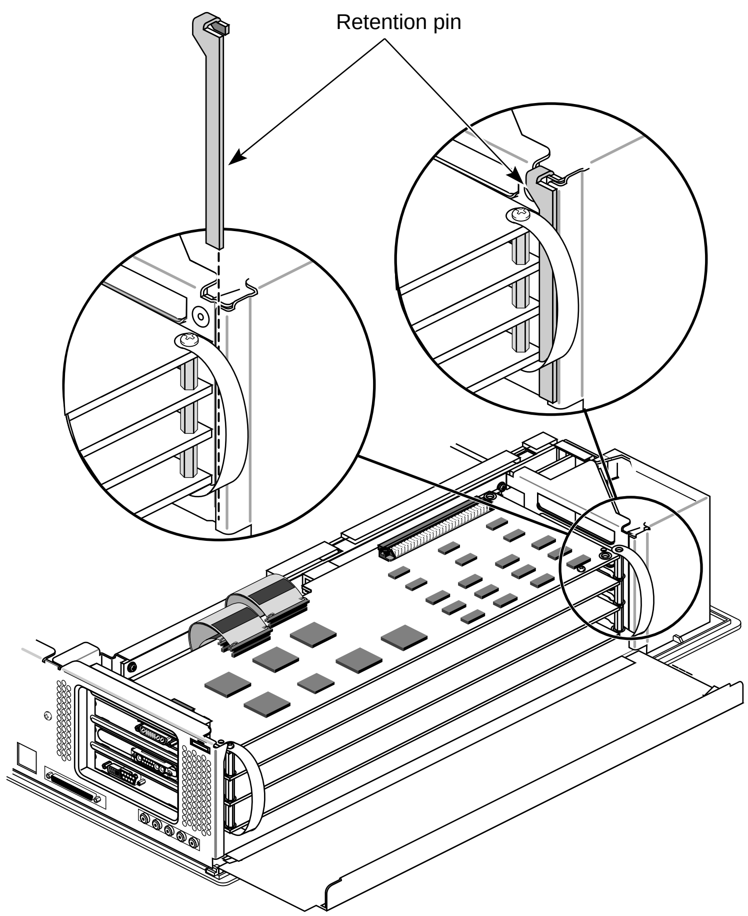

Figure 1-27 Replacing the Retention Pin

6. Lift the metal panel and snap it down into place. See Figure 1-28.

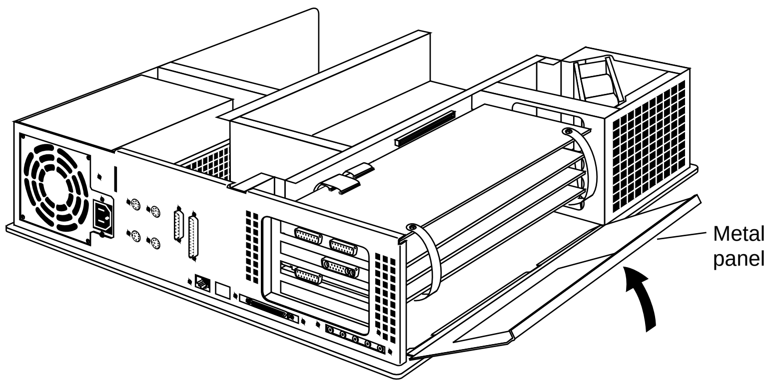

Figure 1-28 Closing the Metal Panel

7. Remove the antistatic wrist strap.

Congratulations! You are finished installing your Indigo^2 ICO board.

To replace the cover see, “Replacing the Cover” on page 34.

Removing the Indigo^2 ICO Board

To remove the Indigo^2 ICO board, you must shut down the system, remove the cover, remove the board set, detach the ICO board, replace the graphics board set, and replace the cover. The steps below describe this process in detail:

1. Go to “Turning Off the Power” on page 3 and follow the steps through step 10.

   Tip: To identify the ICO board and graphics board sets, check the illustrations in Appendix A, “Identifying Graphics and Option Boards,” page 97.

2. Remove the flex cables from the top of the ICO board. See Figure 1-29 and Figure 1-30.

   - Press down on the release levers at the end of each connector.

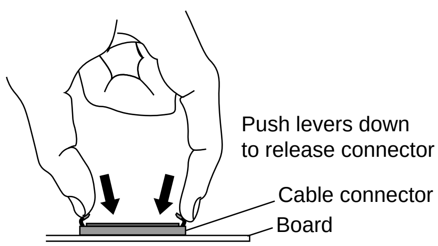

Figure 1-29 Pressing the Release Levers on the Flex Connectors

- Pull each flex cable connector up and off the board.

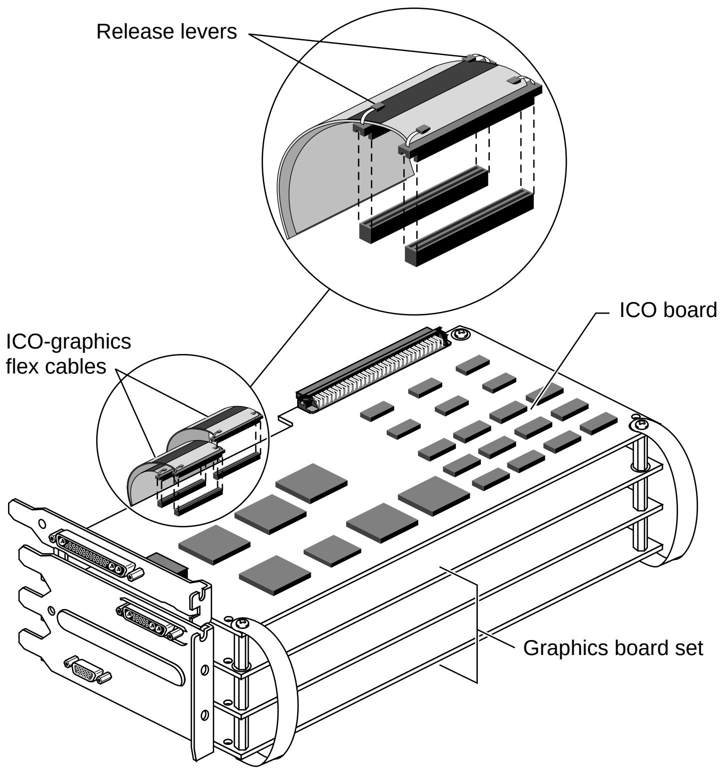

Figure 1-30 Removing Standoff and Pull Strap Screws

3. Remove the screws from the four corners of the Indigo^2 ICO board. See Figure 1-31.

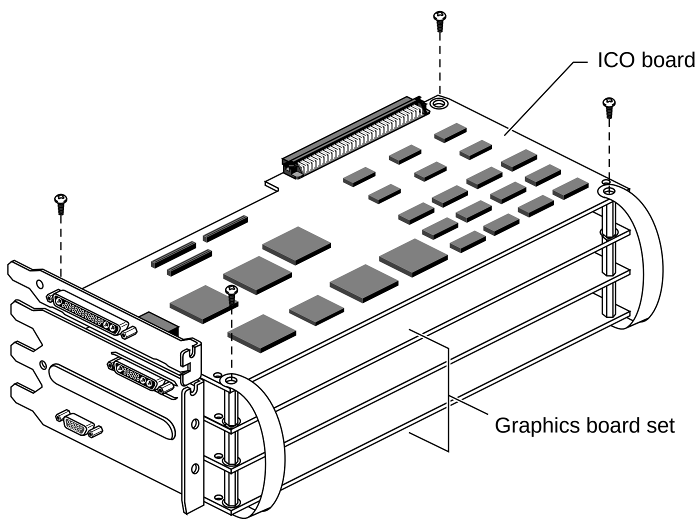

Figure 1-31 Removing the Standoff and Pull Strap Screws

4. Detach the adhesive-backed pull straps only from the top of the ICO board.
5. Lift the Indigo^2 ICO board off the standoffs and place it on an antistatic surface.

6. Remove the flex cables from the top of the graphics board set.
   - Press down on the release levers at the end of each connector.
   - Pull each flex cable connector up and off the board.
7. Remove the standoffs from the top of the graphics board set. See Figure 1-32.

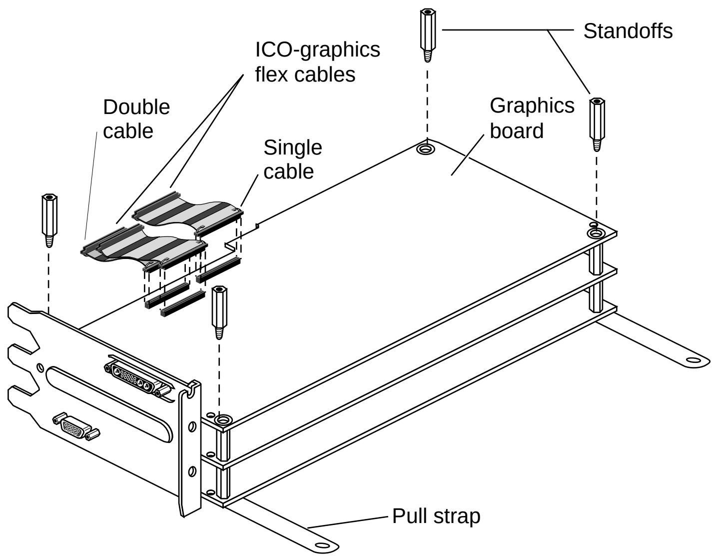

Figure 1-32 Removing the Flex Cables and Standoffs From the Graphics Board

8. Attach the pull straps on the top of the graphics board set. See Figure 1-33.

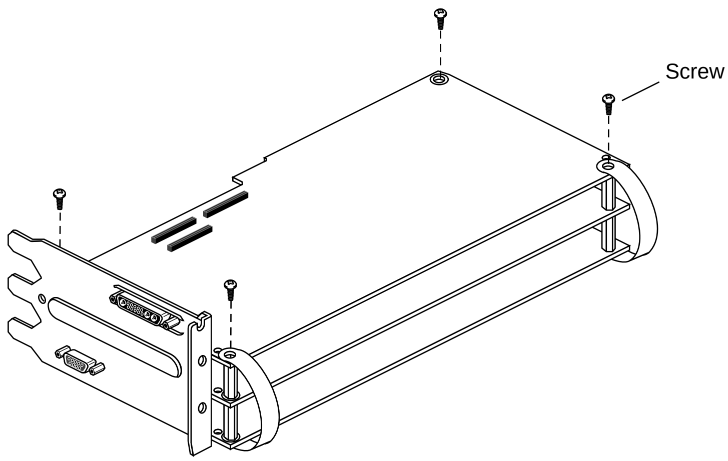

Figure 1-33 Attaching the Pull Straps

9. Insert the screws into the four corners of the top graphics board.
   - Insert the rear screws and tighten.
   - Insert the front screws through the pull straps and tighten.
10. To replace the board set, see the instructions beginning on page 24. Follow the instructions to the end of the section.
11. To replace the cover, turn to page 34.

Replacing the Cover

To replace the top cover, follow these steps:

1. Locate the tabs on the inside and back of the top cover and the slots on the back of the workstation. See Figure 1-34.
2. Face the front of the workstation. Look through the slots as you lower the cover and move the tabs into place.
3. Insert the locator tabs into the holes. Rotate the cover forward and push it down until it snaps into place. See Figure 1-34. The cover fits tightly over the workstation.

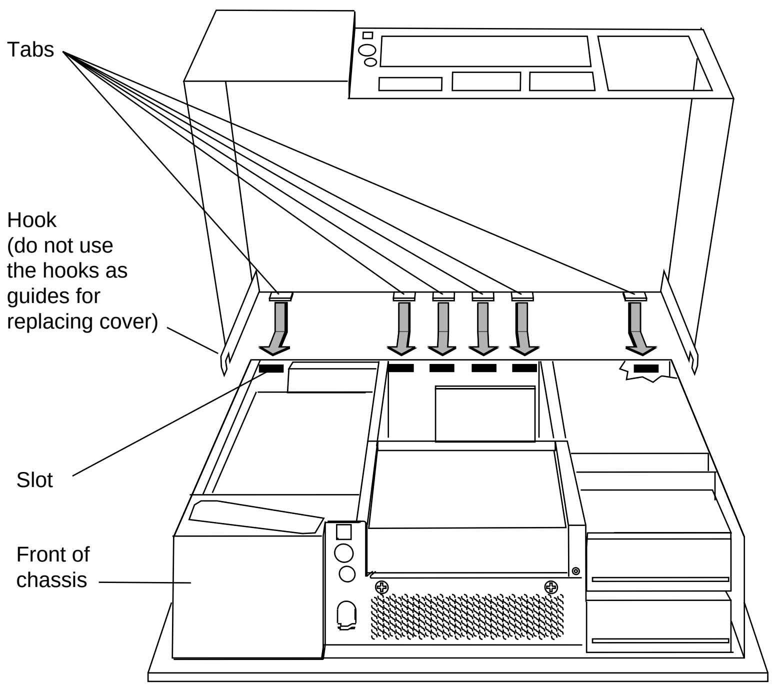

Figure 1-34 Replacing the Cover

4. Replace the bezel. See Figure 1-35.
   - Insert the tabs on the bottom of the bezel into the grooves.
   - Pull up the bezel and snap it into place.
5. Replace the lockbar if you removed it.
6. Close the front cover of the bezel.

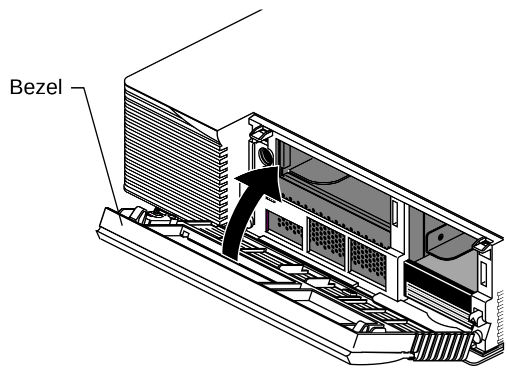

Figure 1-35 Replacing the Bezel

To install the ICO cable breakout box, see Chapter 2.

Chapter 2

Connecting to the Breakout Box

This chapter provides information about connecting the breakout box to the monitors or head mounted display, placement of monitors, and cursor flow between monitors.

The following topics are covered in this chapter:

Connecting the Breakout Box Cable

To connect the breakout box cable to the Indigo[2] IMPACT Channel Option board I/O connector, follow these steps:

1. Attach the breakout box cable connector to the connector on the ICO board. See Figure 2-1.
2. Tighten the thumbscrews on the side of the breakout box connector.

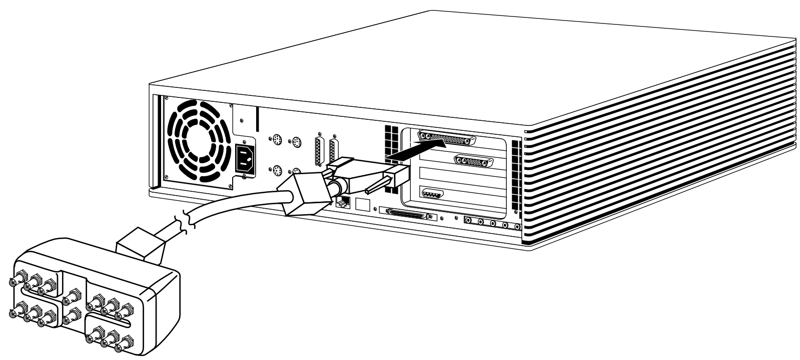

Figure 2-1 Attaching the Breakout Box Cable Connector to the ICO Board I/O Connector

Note: Note: When the ICO board is active, the main monitor is blank. The main monitor cable does not have to be disconnected from the workstation when the breakout box cable is installed.

Connecting the Monitors or Head Mounted Display

The breakout box (cable) allows multiple monitors or a head-mounted display to be connected to the ICO board.

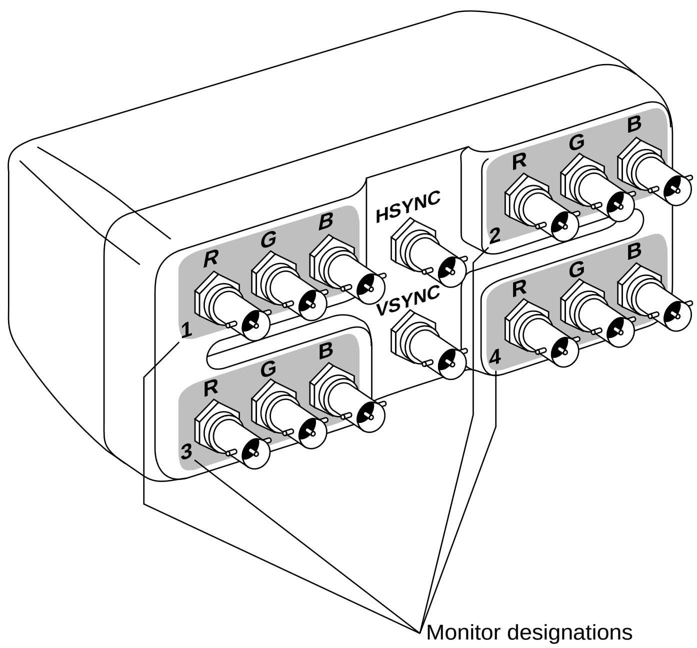

Figure 2-2 Connecting the Breakout Box to Four Monitors

The breakout box consists of four sections each with three connectors. Typically each set of connectors provides red (R), green (G), and blue (B) signals for the monitors. (The exception to this rule is the field sequential formats described in “Connecting the Head-Mounted Display” on page 50.) The section number (also the monitor designation) is in the bottom left corner of each section. When a monitor is connected to the pins in Section 1, the monitor is designated Monitor 1. The monitor connected to Section 2 becomes Monitor 2, etc.

The shading around the RGB pins (or the shading of each section) tells you which group of pins to use for each configuration.

Using the Four-Screen Mode

The Indigo^2 IMPACT frame buffer assumes the monitors are stacked in a square-shaped configuration, and sends information to the monitors as indicated in Figure 2-3. However, the monitors may be set up in any alignment. See “Setting Up Four Monitors in a Stacked Configuration” on page 40 and “Setting Up Four Monitors in a Side-by-Side Configuration” on page 43.

Setting Up Four Monitors in a Stacked Configuration

To set up four monitors in a stacked configuration, follow these instructions:

1. Place the four monitors in a stacked, square-shaped configuration.

Caution: Do not rest the upper two monitors on the lower two monitors. Place the upper monitors on a bookshelf or similar structure above the lower monitors.

- Connect the monitor in the upper left corner to Section 1 of the breakout box.
- Connect the monitor in the upper right corner to Section 2 of the breakout box.
- Connect the monitor in the lower left corner to Section 3 of the breakout box.
- Connector the monitor in the lower right corner to Section 4 of the breakout box.

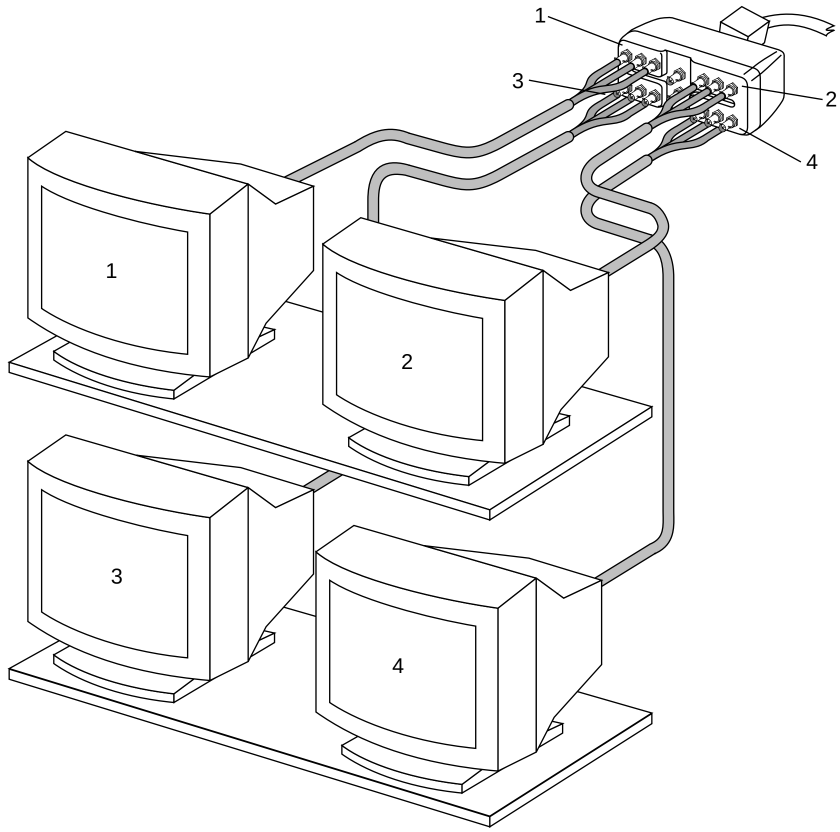

Figure 2-3 Connecting the Four Monitors to the Breakout Box

2. Connect the power cord of each monitor to an electrical outlet.
3. Connect the power cord of the Indigo^2 IMPACT to an electrical outlet.

Congratulations! You are finished setting up the monitors and are ready to power on the workstation.

To configure the ICO board, see “Using setmon to Configure the IMPACT Channel Option Board” on page 58.

Moving the Cursor Between Four Stacked Monitors

The cursor movement between stacked monitors is shown in Figure 2-4. The cursor from Monitor 1, for example, always exits and enters from the right side or from the bottom. Monitor 1 always receives the cursor from Monitor 2 from the right side of Monitor 1, and always receives the cursor from Monitor 3 from the bottom of its screen.

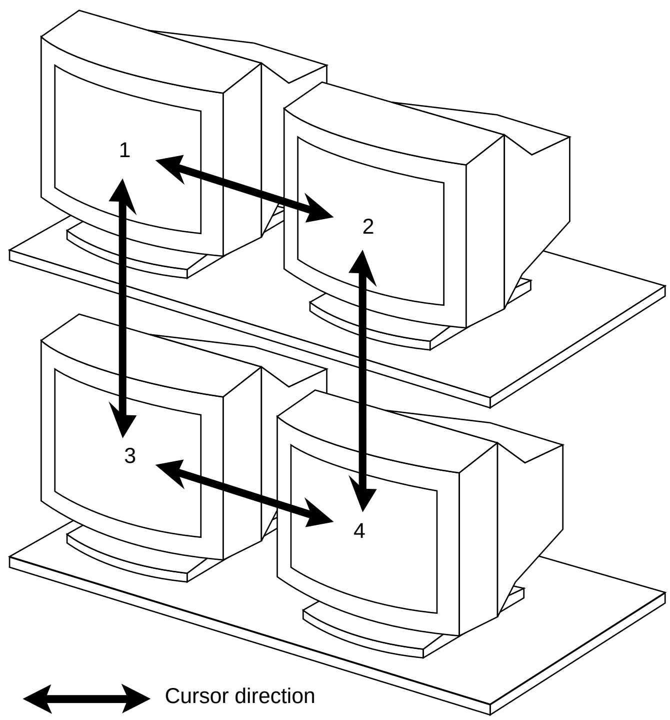

Figure 2-4 Moving the Cursor Between Monitors

Note: You cannot change the exit or entry points of a cursor.

Setting Up Four Monitors in a Side-by-Side Configuration

To set up four monitors in a side-by-side configuration, follow these instructions:

1. Arrange the monitors in the order you choose. A sample arrangement is shown in Figure 2-5.
2. Connect the monitors to the breakout box. The monitor attached to breakout box Section 1 is considered Monitor 1, etc. See Figure 2-5.
3. Connect the power cord of each monitor to an electrical outlet.
4. Connect the power cord of the Indigo^2 IMPACT to an electrical outlet.

Congratulations! You are finished setting up the monitors and are ready to power on the workstation.

To configure the ICO board, see “Using setmon to Configure the IMPACT Channel Option Board” on page 58.

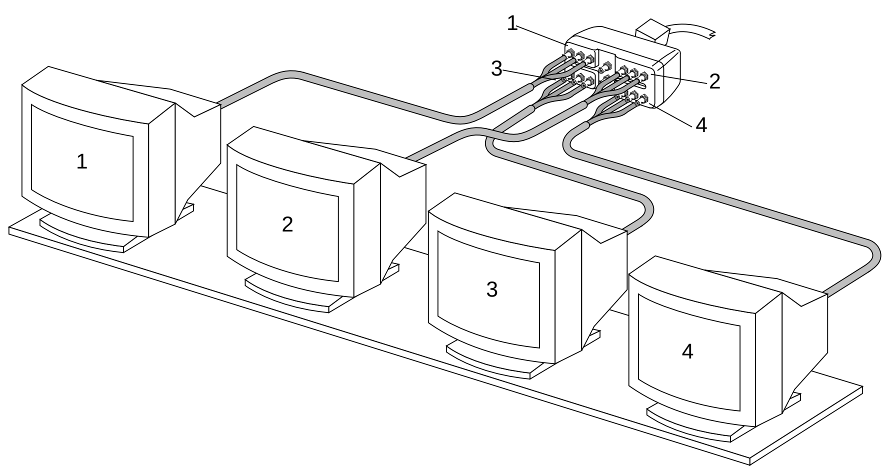

Figure 2-5 Arranging Four Monitors in a Side-by-Side Configuration

Note: If you have a dual head system, with another graphics board and monitor, reconnect any cables you may have disconnected for the ICO board installation.

Moving the Cursor Between Four Side-by-Side Monitors

The cursor movement between monitors is shown in Figure 2-6. The cursor from Monitor 1, for example, always exits and enters from the right side or from the bottom. Monitor 1 always receives the cursor from Monitor 2 from the right side of Monitor 1, and always receives the cursor from Monitor 3 from the bottom of its screen.

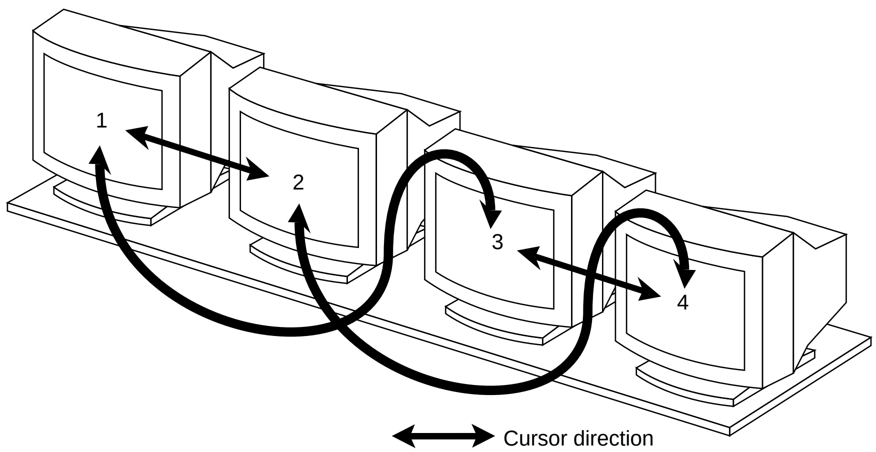

Figure 2-6 Moving the Cursor Between Four Side-by-Side Monitors

In the example in Figure 2-6, the cursor cannot directly move from Monitor 3 to Monitor 2. It must go through either Monitor 1 or Monitor 4 before entering Monitor 2.

Note: You cannot change the exit or entry points of the cursor.

Using the Two-Screen Mode

The frame buffer assumes the monitors are stacked one above the other, and sends information to the monitors in the pattern shown in Figure 2-7. Monitor 1 is always the monitor in the upper position.

Setting Up Two Monitors in a Stacked Configuration

To connect two stacked monitors to the breakout box, follow the steps below:

1. Place the two monitors in a stacked configuration.

Caution: Do not rest the upper monitor on the lower monitor. Place the upper monitor on a bookshelf or similar structure above the lower monitor.

- Connect the upper monitor to Section 1 of the breakout box.
- Connect the lower monitor to Section 2 of the breakout box.

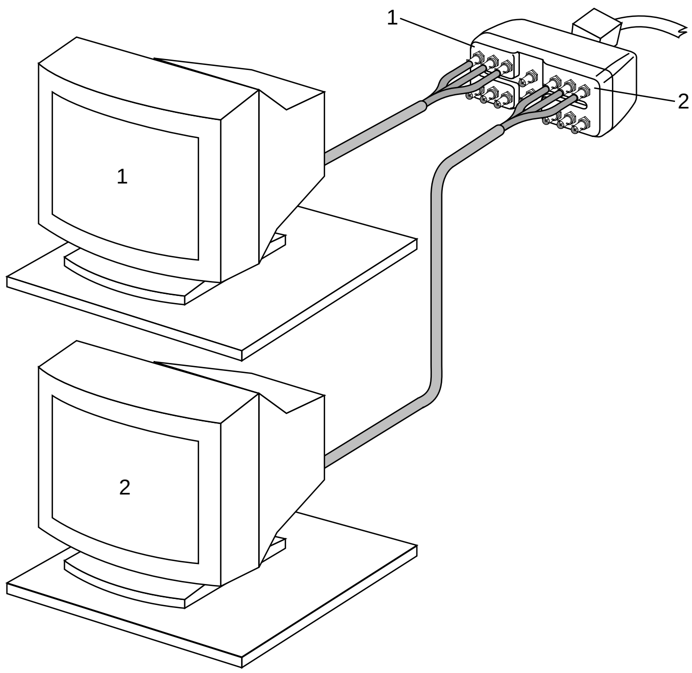

Figure 2-7 Connecting the Two Stacked Monitors to the Breakout Box

2. Connect the power cord of each monitor to an electrical outlet.
3. Connect the power cord of the Indigo^2 IMPACT to an electrical outlet.

Congratulations! You are finished setting up the monitors and are ready to power on the workstation.

To configure the ICO board, see “Using setmon to Configure the IMPACT Channel Option Board” on page 58.

Moving the Cursor Between Two Stacked Monitors

The cursor movement between monitors is shown in Figure 2-8. The cursor from Monitor 1 always exits and enters from the bottom. The cursor from Monitor 2 always exits and enters from the top.

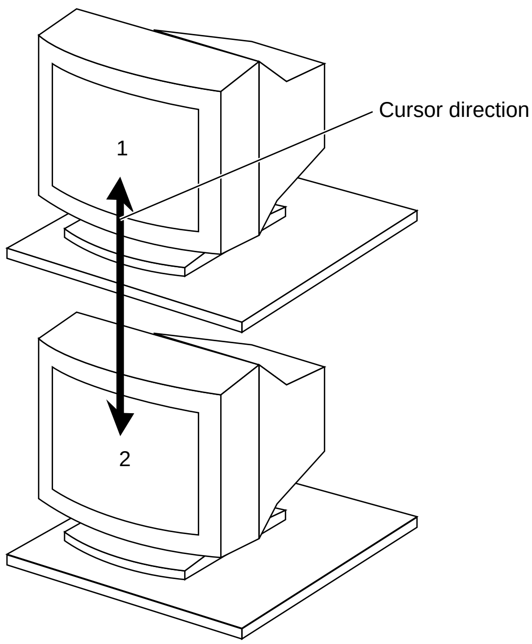

Figure 2-8 Moving the Cursor Between Two Stacked Monitors

Note: You cannot change the exit or entry points of a cursor.

Setting Up Two Monitors in a Side-by-Side Configuration

To set up two monitors in a side-by-side configuration, follow these instructions:

1. Arrange the monitors in the order you choose. A sample arrangement is shown in Figure 2-9.
2. Connect the monitors to the breakout box. The monitor attached to breakout box Section 1 is considered Monitor 1, etc. See Figure 2-9.
3. Connect the power cord of each monitor to an electrical outlet.
4. Connect the power cord of the Indigo^2 IMPACT to an electrical outlet.

Congratulations! You are finished setting up the monitors and are ready to power on the workstation.

To configure the ICO board, see “Using setmon to Configure the IMPACT Channel Option Board” on page 58.

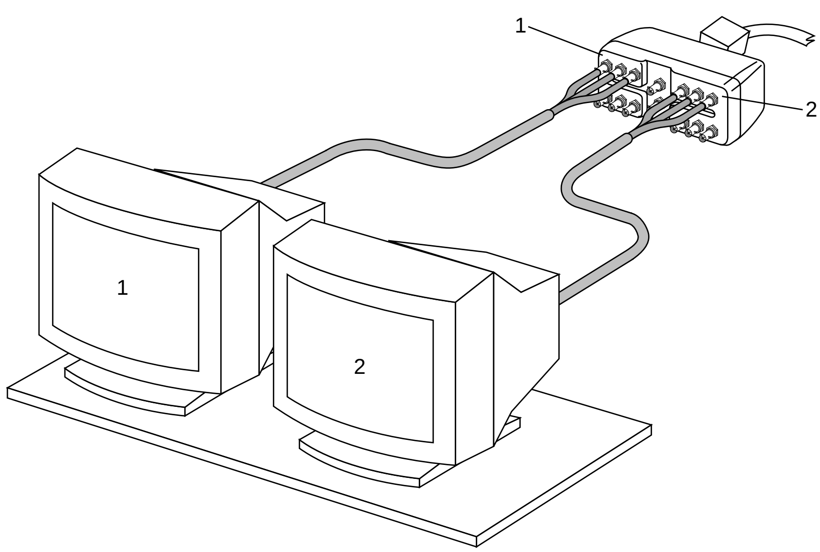

Figure 2-9 Arranging Two Monitors in a Side-by-Side Configuration

Moving the Cursor Between Two Side-by-Side Monitors

The cursor movement between monitors is shown in Figure 2-10. The cursor from Monitor 1 always exits and enters from the bottom. Monitor 2 always receives the cursor from Monitor 1 at the top.

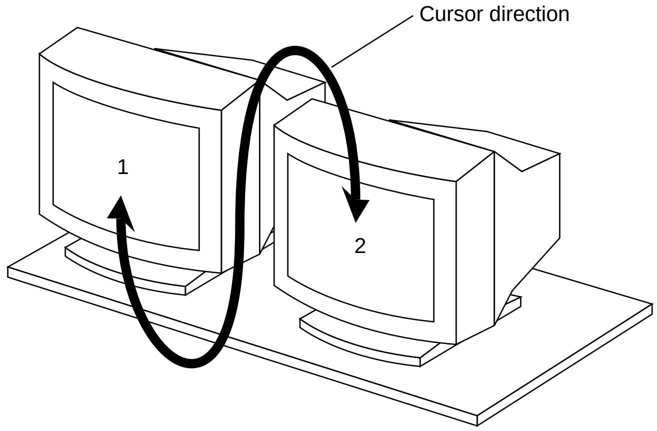

Figure 2-10 Moving the Cursor Between Two Side-by-Side Monitors

Note: You cannot change the exit or entry points of a cursor.

Connecting the Head-Mounted Display

In a typical video (field parallel) format, the data is generated on three output wires, with the red data on one wire, the green data on another, and the blue data on a third. Many head-mounted displays require that the video data is given in field sequential format as opposed to field parallel format.

In field sequential format all image and timing information is output on a single wire. The red data for an image is output first, then the green data, and finally the blue data. ICO uses the red and green outputs from Channel 1 in the field sequential format to output the information to the head-mounted display. The data for the right eye is present on Channel 1-Red, and the data for the left eye is present on Channel 1-Green.

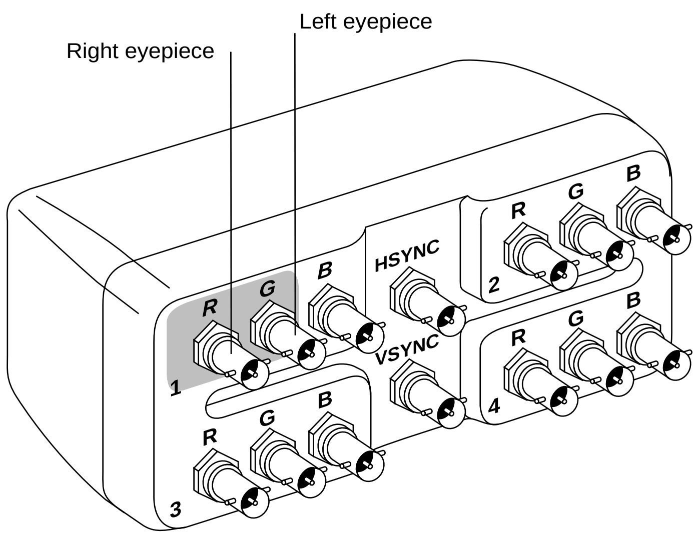

Figure 2-11 Identifying the Section for the Head Mounted Display

To connect a Head-Mounted Display to the breakout box, follow the steps below:

1. Connect the cable for the right eyepiece to the *R* channel of Section 1.
2. Connect the cable for the left eyepiece to the *G* channel of Section 1.

Connecting to a Single Monitor: The Minify Mode

Using the minify mode allows an image to be reduced, resulting in a softened image. The reduced image is sent to a single monitor. The minify mode also prevents image shimmering or crawling.

To configure the ICO board, see “Using setmon to Configure the IMPACT Channel Option Board” on page 58.

Connect the single monitor used for the minify mode to the three channels in Section 4. See Figure 2-12.

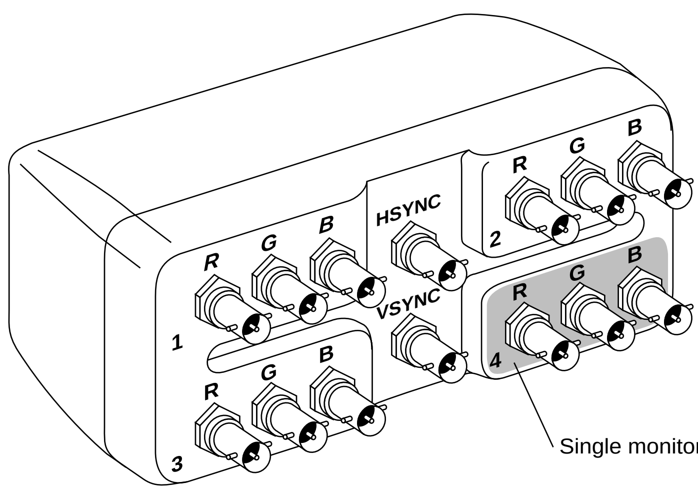

Figure 2-12 Identifying the Section for the Minify or Single Monitor Mode

Using the HSYNC or VSYNC Connectors

The HSYNC and VSYNC connectors provide external horizontal and vertical sync signals. These signals are locked to all active ICO outputs for a given mode, and can be used with monitors requiring separate sync inputs.

Note: Only one monitor can be connected to these outputs at a time.

Monitors should be used that have sync on green as a built-in feature rather than monitors that require external inputs. If more than one monitor requiring external inputs must be connected to the HSYNC and VSYNC connectors, a customer supplied distribution amplifier should be used.

To use the HSYNC and VSYNC connectors, choose one of the following options:

- Connect a single monitor to the HSYNC and VSYNC connectors on the breakout box
- Connect two or more monitors to a distribution amplifier that is connected to HSYNC and VSYNC.

To configure the ICO board, see"Using setmon to Configure the IMPACT Channel Option Board" on page 58.

Configuring the IMPACT Channel Option Board

The IMPACT Channel Option (ICO) board allows you to transmit video output to multiple monitors from a single IMPACT system. Each monitor is assigned a different portion of the IMPACT frame buffer so that each monitor displays a unique image. You can use ICO to drive up to four monitors with RS170, VGA, or SVGA timing. Also, you can use the ICO board to produce timing formats not supported by IMPACT graphics alone. For example, while the standard field parallel formats, such as VGA, transmit data to a monitor on red, green, and blue wires, ICO can produce field sequential formats that transmit all data on a single wire. These formats provide two channels of information needed to produce stereoscopic displays on many common head-mounted displays. Also, you can use ICO to “minify” a high resolution image, and produce a softened, lower resolution image.

Before continuing to configure the ICO, make sure that you also have installed the following:

- the ICO board (see “Installing the Indigo2 ICO Board” on page 11 for installation information)
- the breakout box (see “Connecting the Breakout Box Cable” on page 38 for instructions)
- the monitor(s) to the breakout box (see “Connecting the Monitors or Head Mounted Display” on page 39)

You can install one ICO board for each Indigo^2 IMPACT system. The ICO board can drive up to four independent channels from a single workstation.

This chapter describes how to configure the video formats that the ICO outputs. Specifically, this chapter covers the following topics:

If you have a duel-head system and want to move windows from one head to another, see *Indigo² IMPACT Dual Head Installation Guide and Notes for Developers*.

The IMPACT Channel Option Board and the Graphics Subsystem

The ICO video output is easy to configure. Just specify the number of channels and the size of the video image. You can use the standard system command, *setmon*, to specify the output format (see “Using the setmon Command” on page 58 for more information). If you are writing code for an application, use **XSGIvc()** to control the video output formats (for more information, see “Writing a Programmatic Interface for ICO” on page 77).

This section explains the following topics:

- “ICO Graphics Integration” on page 54
- “ICO Video Output Formats” on page 56
- “ICO Video Output Format Specifications” on page 57

ICO Graphics Integration

Figure 3-1 shows how the IMPACT Channel Option board is integrated into the graphics subsystem. The ICO subsystem interprets your video output specifications and converts the incoming digital information per your specifications. Video comes in to the ICO subsystem where it is scaled and/or partitioned into the number and size of screens you have specified. Next, it goes to the framebuffer and then to the crossbar, which acts as a switch. Lastly, the crossbar routes the analog video signals to the appropriate monitors.

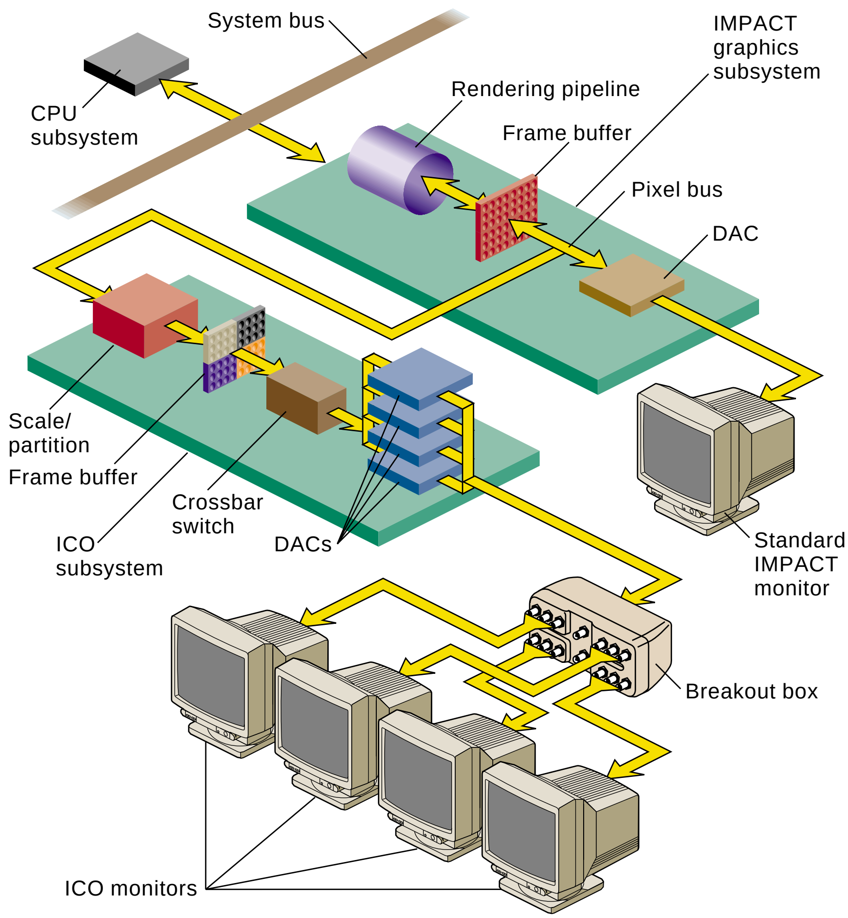

Figure 3-1 IMPACT Channel Option Board and Graphics Subsystem

The number of screens into which the IMPACT Channel Option board divides the display surface is determined by several factors, including the ICO configuration that you specify and the graphics bandwidth of the Indigo^2 IMPACT graphics system.

ICO Video Output Formats

Table 3-1 lists the number of ICO channels, format resolution, and timing.

Table 3-1 ICO Video Output Channels, Format, and Timing

Number of Channels	Format	Timing
4	640 x 486 Interlaced	RS-170 (NTSC RGB)
4	640 x 480 Non-interlaced	VGA
2	640 x 480 Non-interlaced	Field sequential
1	640 x 480 Non-interlaced	VGA (filtered minify mode)
2	800 x 486 Interlaced	RS-170 Field sequential
2	800 x 486 Interlaced	RS-170 Field parallel component
2[a]	800 x 600 Non-interlaced	SVGA
2[a]	880 x 808 Interlaced	Field sequential
2[a]	1024 x 946 Interlaced	Field sequential
2[a]	1160 x 960 Interlaced	Field sequential

a. These modes are supported only on systems with Maximum IMPACT graphics.

Note: VGA-to-NTSC converters produce composite NTSC.

For information on cable connections between the ICO board and ICO output monitors, see “Connecting the Monitors or Head Mounted Display” on page 39. For details on the breakout box connection to a head-mounted device, see “Connecting the Head-Mounted Display” on page 50. For information on the breakout box connection for minify mode, see “Connecting to a Single Monitor: The Minify Mode” on page 51.

ICO Video Output Format Specifications

Video output format specifications are listed in Table 3-2.

Table 3-2 Video Output Format Specifications

Format Specification	Active Area
4@640x486_30i	Four screens, each 640 x 486, at 30 Hz, interlaced RS-170 (NTSC RGB)
4@640x480_60	Four screens, each 640 x 480, at 60 Hz, non-interlaced (VGA)
2@640x480_60q	Two screens, each 640 x 480, at 60 Hz, non-interlaced, field sequential
1@640x480_60	One screen, 1281 x 961 minified to 640 x 480, at 60 Hz, non-interlaced (VGA)
2@800x486_30qi	Two screens, each 800 x 486, at 30 Hz, interlaced, field sequential
2@800x486_30i	Two screens, each 800 x 486, at 30 Hz, interlaced, field parallel
2@800x600_60[a]	Two screens, each 800 x 600, at 60 Hz, non-interlaced (SVGA)
2@880x808_30qi[a]	Two screens, each 880 x 808, at 30 Hz, interlaced, field sequential
2@1024x946_30qi[a]	Two screens, each 1024 x 946, at 30 Hz, interlaced, field sequential
2@1160x960_30qi[a]	Two screens, each 1160 x 960, at 30 Hz, interlaced, field sequential

a. These modes are supported only on systems with Maximum IMPACT graphics.

Note: ICO does not support an external genlock source. However, when ICO is in multi-screen mode, the outputs are synchronized with each other.

For information on cable connections between the ICO board and ICO output monitors, see “Connecting the Breakout Box Cable” on page 38. For details on the breakout box connection to a head-mounted display, see “Connecting the Head-Mounted Display” on page 50. For information on the breakout box connection for minify mode, see “Connecting to a Single Monitor: The Minify Mode” on page 51. For information on HSYNC and VSYNC, see “Using the HSYNC or VSYNC Connectors” on page 52.

Using the setmon Command

You can set the IMPACT Channel Option board's output video formats by using the *setmon* command, the same command you use to select the formats of IMPACT graphics.

This section covers the following topics:

- "Using setmon to Configure the IMPACT Channel Option Board" on page 58
- "Turning Off the ICO and Returning to the Standard IMPACT Monitor" on page 60
- "Using gfxinfo to List Graphics Information" on page 60

Note: Silicon Graphics recommends that you use the X extension, **XSGIvc**, when writing a program that controls the video output formats. See "Writing a Programmatic Interface for ICO" on page 77 for more information. Also, use a dumb terminal or remotely log in over the network to switch video modes between standard and ICO modes.

For information on moving the cursor from screen to screen, see "Using the Four-Screen Mode" on page 40.

Using setmon to Configure the IMPACT Channel Option Board

To configure and turn on the IMPACT Channel Option board, follow these steps:

1. If your Silicon Graphics system is powered off, follow the steps in the *Indigo*^{2} *IMPACT Owner's Guide* to plug in the system and power it on.
2. Log in to your account on the system.
3. Open a shell window, if necessary, by selecting "Unix Shell" from the Desktop Toolchest. Move the cursor inside the shell window.
4. Execute the *setmon* command and with the **–S** option. The format is

   `setmon -S` *format*

   The option **–S** is required; note that it is uppercase. The *format* is the specification of the desired video output format. For example, suppose you want two screens at an 800 x 486 resolution; the format specification is **`2@800x486_30i`**. So, to display this video format, enter:

   `setmon -S 2@800x486_30i`

This specification sets up ICO multi-channel mode for two monitors, each at 800 x 486 pixels. The timing is 30 Hz and is interlaced (more than one vertical scan is used to reproduce a complete image).

To turn on ICO multi-channel mode, see “Turning On the ICO” on page 60. Output formats are listed in “ICO Video Output Format Specifications” on page 57.

Note: ICO does not support an external genlock source. However, when ICO is in multi-screen mode, the outputs are synchronized with each other.

Using setmon to Delay the Loading of the Video Format

You can delay loading the video format by using the **–x** option to *setmon*. Note that you must be the superuser (**su**) to use the **–x** option. For example:

```
su
setmon -x -S 2@800x486_30i
```

The **–x** option saves the specified format to be used the next time the X server is started. This format does not take effect immediately; it is loaded the next time you restart graphics, or reboot the system. For information on starting the X server and graphics mode, see “Turning On the ICO” on page 60.

For details on this command and its options, see the setmon(3) reference page.

Turning On the ICO

It's best to remotely log in over the network or use a dumb terminal when switching video modes between standard graphics and ICO modes.

To switch to ICO multi-channel mode, stop and restart the graphics subsystem:

```
/usr/gfx/stopgfx ; /usr/gfx/startgfx
```

Note: It is possible to switch to/from ICO multi-channel mode without stopping and restarting the graphics subsystem if the new framebuffer screen size is less than or equal to the old screen size.

If you wish, you can confirm that the ICO is active; for more information, refer to the section "Using gfxinfo to List Graphics Information" on page 60.

Note: When the ICO is active, IMPACT graphics do not output to the standard IMPACT monitor (1280 x 1024).

Turning Off the ICO and Returning to the Standard IMPACT Monitor

After a power-off, system reset, or reboot, the system remains in multi-channel mode. To turn off ICO and return to standard graphics mode, enter:

```
setmon -x format
/usr/gfx/stopgfx
/usr/gfx/startgfx
```

The *format* is the output format of the screen when not in multi-channel mode, for example, **1280x1024_60**.

Using gfxinfo to List Graphics Information

You can use the *gfxinfo* command to display information about the graphics subsystems installed in your system. Enter the following:

```
setenv DISPLAY :0
/usr/gfx/gfxinfo -v
```

First, set up your environment so that the information is displayed on the screen from which you are typing the *gfxinfo* command. The **–v** option to *gfxinfo* specifies verbose output.

An example of *gfxinfo* output for the format, **`2@800x486_30i`**, looks like this:

```
Graphics board 0 is “IMPACT” graphics.
   Managed (“:0.0”) 800x972
   Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
   MGRAS revision 3, RA revision 5, RB revision 4
   HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
   VC3 rev A, CMAP rev D, MC rev C
   19” monitor (id 0x1)
   ICO board present (rev 2)

   Input Sync: Voltage - Video level, Source-Internal,Genlocked-False
  Channel 1:
    Origin = (0,0)
    Video Output Size: 800 pixels, 486 lines, 30.00Hz (2@800x486_30i)
  Channel 2:
    Origin = (0,486)
    Video Output Size: 800 pixels, 486 lines, 30.00Hz (2@800x486_30i)
```

The output tells you that the ICO board is installed and its revision number: `ICO board present (rev 2)`. You also see statistics for each channel: the origin of each viewport (`0,0` for Channel 1 and `0,486` for Channel 2) and the video output size, timing, and format (`800 pixels, 486 lines, 30.00Hz (2@800x486_30i)`).

ICO Display Viewports

The X display surface for IMPACT Channel Option board video formats is determined by the mode in which ICO is operating. The ICO places the origin of the first viewport starting at 0,0 in the upper left corner of the window.

This section provides examples of the screen origins for various output formats:

- "4@640x486_30i, Component NTSC/RS-170 (RGB)" on page 63
- "4@640x480_60, VGA" on page 64
- "2@640x480_60q, Field Sequential" on page 66
- "1@640x480_60, VGA Minify" on page 67
- "2@800x486_30qi, RS170-Field Sequential" on page 69
- "2@800x600_60, SVGA" on page 70
- "2@880x808_30qi, Field Sequential" on page 72
- "2@1024x946_30qi, Field Sequential" on page 73
- "2@1160x960_30qi, Field Sequential" on page 75

Note: For more information on origins and display surface sizes, see "Using gfxinfo to List Graphics Information" on page 60 and the gfxinfo(3G) reference page. Consult the *gfxinfo* output before using any formats. Silicon Graphics reserves the right to change origins as needed.

For video output channels, formats, and timing information, see Table 3-1. A programmatic interface is shown in the example program in "ICO Programming Example" on page 78.

4@640x486_30i, Component NTSC/RS-170 (RGB)

Figure 3-2 shows the maximum single display surface and origins for the viewports for the output format 4@640x486_30i. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 1280 x 972 pixels.

This format divides the frame buffer into four independent channels. The size and location of each channel are shown in the figure. Each channel is 640 x 486 pixels and is output on the R, G, and B connectors on the breakout box. The timing for these signals is compatible with RS-170. If you require a composite signal, you must use an external encoder.

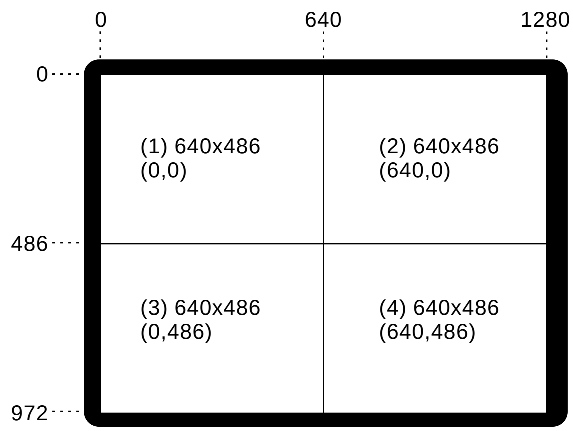

Figure 3-2 Display Surface for 4@640x486_30i Output Format

The output of **gfxinfo -v** for this format is

```
Graphics board 0 is “IMPACT” graphics.
   Managed (“:0.0”) 1280x972
   Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
   MGRAS revision 3, RA revision 5, RB revision 4
   HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
   VC3 rev A, CMAP rev D, MC rev C
   19” monitor (id 0x1)
   ICO board present (rev 2)

   Input Sync:  Voltage-Video level, Source-Internal, Genlocked-False
  Channel 1:
    Origin = (0,0)
    Video Output Size: 640 pixels, 486 lines, 30.00Hz (4@640x486_30i)
  Channel 2:
    Origin = (0,486)
    Video Output Size: 640 pixels, 486 lines, 30.00Hz (4@640x486_30i)
  Channel 3:
    Origin = (640,0)
    Video Output Size: 640 pixels, 486 lines, 30.00Hz (4@640x486_30i)
  Channel 4:
    Origin = (640,486)
    Video Output Size: 640 pixels, 486 lines, 30.00Hz (4@640x486_30i)
```

4@640x480_60, VGA

Figure 3-3 shows the maximum single display surface and origins for the viewports for the output format 4@640x480_60. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 1280 x 960 pixels.

This format divides the frame buffer into four independent channels. The size and location of each channel are shown in the figure. Each channel is 640 x 480 pixels and is output on the R, G, and B connectors on the breakout box. This format is non-interlaced with a 60Hz frame update rate. The timing for these signals is compatible with VGA resolution. Typically, this mode is used with sync-on-green. The monitors that are used with this format must be able to accept sync-on-green rather than external H and V sync. ICO can produce one channel of separate H and V sync, which is timed correctly for any of the ICO channels.

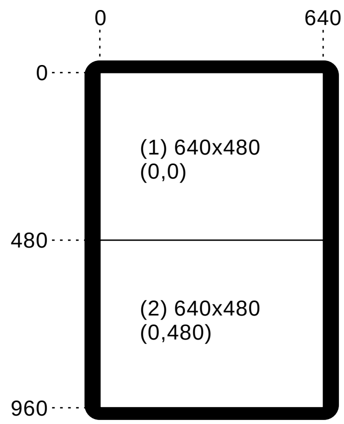

Figure 3-3 Display Surface for 4@640x480_60 Output Format

The output of **`gfxinfo -v`** for this format is

```
Graphics board 0 is “IMPACT” graphics.
    Managed (“:0.0”) 1280x960
    Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
    MGRAS revision 3, RA revision 5, RB revision 4
    HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
    VC3 rev A, CMAP rev D, MC rev C
    19” monitor (id 0x1)
    ICO board present (rev 2)

    Input Sync: Voltage-Video level, Source-Internal, Genlocked-False
  Channel 1:
    Origin = (0,0)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (4@640x480_60)
  Channel 2:
    Origin = (0,480)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (4@640x480_60)
  Channel 3:
    Origin = (640,0)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (4@640x480_60)
  Channel 4:
    Origin = (640,480)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (4@640x480_60)
```

2@640x480_60q, Field Sequential

Figure 3-4 shows the maximum single display surface and origins for the viewports for the output format 2@640x480_60q. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 640 x 960 pixels.

This format divides the frame buffer into two independent channels. The size and location of each channel are shown in the figure. Each channel is 640 x 480 pixels and is output on the R and G connectors for Channel 1 of the breakout box. This format is a non-interlaced field sequential format with a 60Hz update rate.

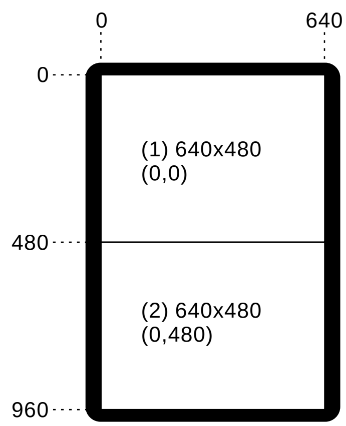

Figure 3-4 Display surface for 2@640x480_60q Output Format

The output of **gfxinfo -v** for this format is

```
Graphics board 0 is "IMPACT" graphics.
   Managed (":0.0") 640x960
   Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
   MGRAS revision 3, RA revision 5, RB revision 4
   HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
   VC3 rev A, CMAP rev D, MC rev C
   19" monitor (id 0x1)
   ICO board present (rev 2)

   Input Sync:  Voltage - Video level, Source-Internal, Genlocked-False
  Channel 1:
    Origin = (0,0)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (2@640x480_60q)
  Channel 2:
    Origin = (0,480)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (2@640x480_60q)
```

1@640x480_60, VGA Minify

Minify mode produces a smooth image, without jagged or broken surfaces. This mode uses a rendering technique that takes a portion of a group of pixels and "minifies" them to produce a clear, smooth representation of the original image. For example, a video game developer can create a video game on an IMPACT system and output the game in ICO minify mode to see what it looks like on a typical VGA or TV screen.

Figure 3-5 shows the maximum single display surface (shaded area, 1288 x 962) and origins for the viewport (unshaded area, 1281 x 962) for the output format 1@640x480_60. The IMPACT viewport (1281 x 961) displays as 640 x 480 on the ICO monitor. Note that seven pixels at the end of each line and the bottom line on the screen are not displayed (as shown in the shaded area in Figure 3-5).

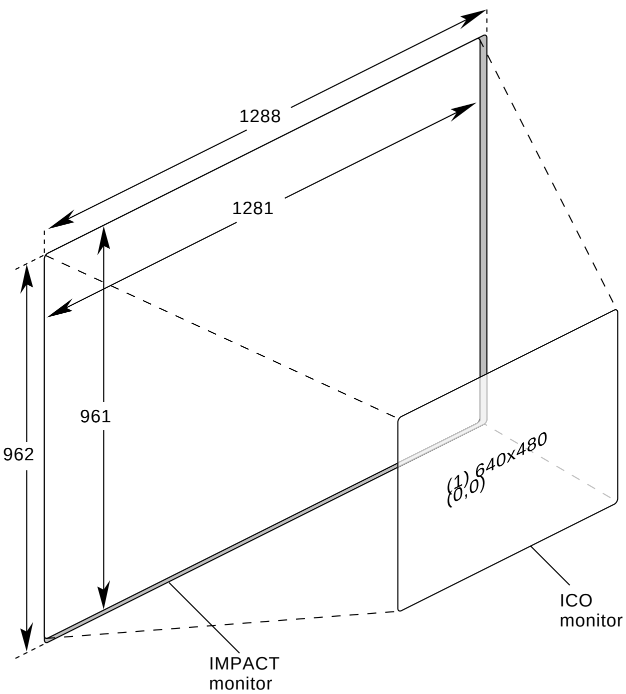

Figure 3-5 Display Surface for 1@640x480_60 Output Format

The output of **`gfxinfo -v`** for this format is

```
Graphics board 0 is “IMPACT” graphics.
   Managed (“:0.0”) 1288x962
   Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
   MGRAS revision 3, RA revision 5, RB revision 4
   HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
   VC3 rev A, CMAP rev D, MC rev C
   19” monitor (id 0x1)
   ICO board present (rev 2)

   Input Sync:  Voltage - Video level, Source-Internal, Genlocked-False
  Channel 4:
    Origin = (0,0)
    Video Output Size: 640 pixels, 480 lines, 60.00Hz (1@640x480_60)
```

2@800x486_30qi, RS170-Field Sequential

Figure 3-6 shows the maximum single display surface and origins for the viewports for the output format 2@800x486_30qi. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 800 x 972 pixels.

This format divides the frame buffer into two independent channels. The size and location of each channel are shown in the figure. Each channel is 800x 486 pixels and is output on the R and G connectors for Channel 1 of the breakout box. This format is an interlaced, field sequential format with a 30Hz update rate.

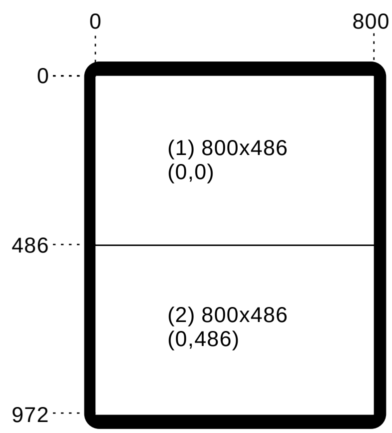

Figure 3-6 Display Surface for 2@800x486_30qi Output Format

The output of **gfxinfo -v** for this format is

```
Graphics board 0 is “IMPACT” graphics.
   Managed (“:0.0”) 1280x1024
   Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
   MGRAS revision 3, RA revision 5, RB revision 4
   HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
   VC3 rev A, CMAP rev D, MC rev C
   19” monitor (id 0x1)
   ICO board present (rev 2)

   Input Sync:  Voltage-Video level, Source-Internal, Genlocked-False
  Channel 1:
    Origin = (0,0)
    Video Output Size: 800 pixels, 484 lines, 30.00Hz (2@800x486_30qi)
  Channel 2:
    Origin = (0,484)
    Video Output Size: 800 pixels, 484 lines, 30.00Hz (2@800x486_30qi)
```

2@800x600_60, SVGA

Figure 3-7 shows the maximum single display surface and origins for the viewports for the output format 2@800x600_60. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 800 x 1200 pixels.

This format divides the frame buffer into two independent channels. The size and location of each channel are shown in the figure. Each channel is 800 x 600 pixels and is output on the R, G, and B connectors on the breakout box. This non-interlaced format has a 60Hz frame update rate. The timing for these signals is compatible with SVGA resolution. Typically, this mode is used with sync-on-green. The monitors that are used with this format must be able to accept sync-on-green rather than external H and V sync. ICO can produce one channel of separate H and V sync, which is timed correctly for any of the ICO channels.

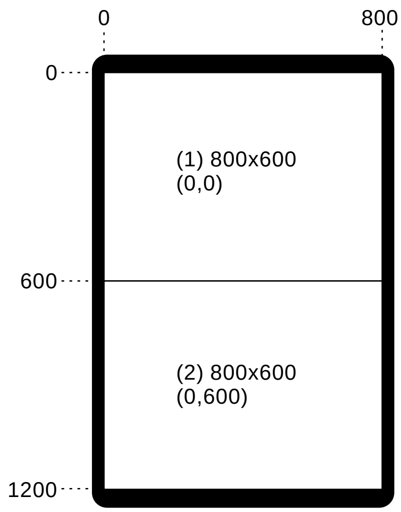

Figure 3-7 Display Surface for 2@800x600_60 Output Format

The output of **gfxinfo -v** for this format is

```
Graphics board 0 is "IMPACT" graphics.
   Managed (":0.0") 800x1200
   Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
   MGRAS revision 3, RA revision 5, RB revision 4
   HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
   VC3 rev A, CMAP rev D, MC rev C
   19" monitor (id 0x1)
   ICO board present (rev 2)

   Input Sync:  Voltage-Video level, Source-Internal, Genlocked-False
  Channel 1:
    Origin = (0,0)
    Video Output Size: 800 pixels, 600 lines, 60.10Hz (2@800x600_60)
  Channel 2:
    Origin = (0,600)
    Video Output Size: 800 pixels, 600 lines, 60.10Hz (2@800x600_60)
```

2@880x808_30qi, Field Sequential

Figure 3-8 shows the maximum single display surface and origins for the viewports for the output format 2@880x808_30qi. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 880 x 1616 pixels.

This format divides the frame buffer into two independent channels. The size and location of each channel are shown in the figure. Each channel is 880 x 808 pixels and is output on the R and G connectors for Channel 1 of the breakout box. This format is an interlaced, field sequential format with a 30Hz update rate.

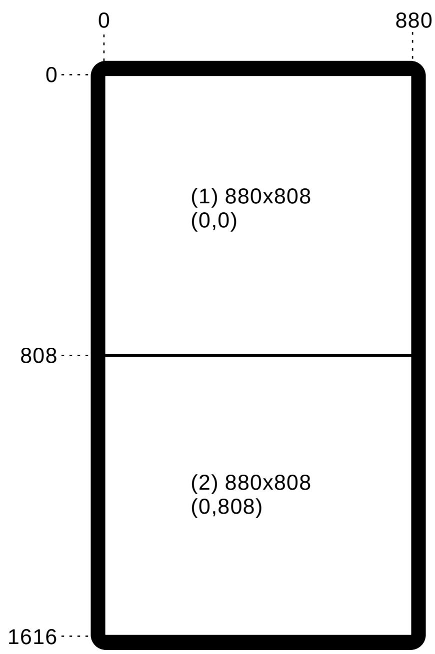

Figure 3-8 Display Surface for 2@880x808_30qi Output Format

The output of **gfxinfo -v** for this format is

```
Graphics board 0 is “IMPACT” graphics.
  Managed (“:0.0”) 880x1616
  Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
  MGRAS revision 3, RA revision 5, RB revision 4
  HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
  VC3 rev A, CMAP rev D, MC rev C
  19” monitor (id 0x1)
  ICO board present (rev 2)

  Input Sync:  Voltage-Video level, Source-Internal, Genlocked-False
 Channel 1:
   Origin = (0,0)
   Video Output Size: 880 pixels, 808 lines, 30.00Hz (2@880x808_30qi)
 Channel 2:
   Origin = (0,808)
   Video Output Size: 880 pixels, 808 lines, 30.00Hz (2@880x808_30qi)
```

2@1024x946_30qi, Field Sequential

Figure 3-9 shows the maximum single display surface and origins for the viewports for the output format 2@1024x946_30qi. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 1024 x 1892 pixels.

This format divides the frame buffer into two independent channels. The size and location of each channel are shown in the figure. Each channel is 1024 x 946 pixels and is output on the R and G connectors for Channel 1 of the breakout box. This format is an interlaced field sequential format with a 30Hz update rate.

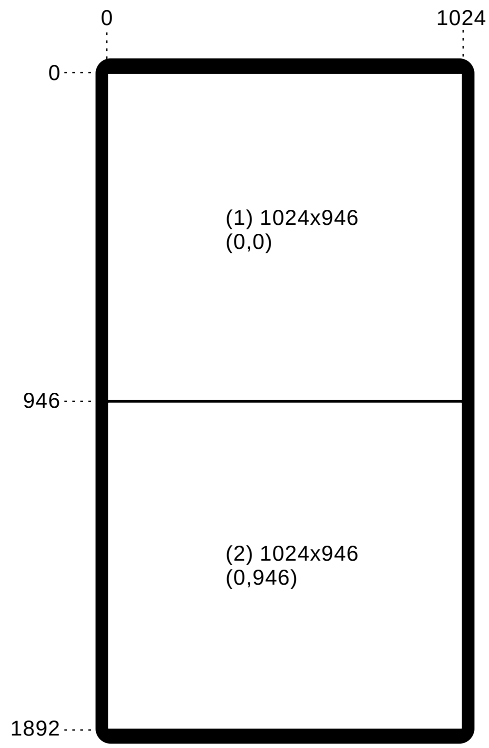

Figure 3-9 Display Surface for 2@1024x946_30qi Output Format

The output of **`gfxinfo -v`** for this format is

```
Graphics board 0 is “IMPACT” graphics.
  Managed (“:0.0”) 1024x1892
  Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
  MGRAS revision 3, RA revision 5, RB revision 4
  HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
  VC3 rev A, CMAP rev D, MC rev C
  19” monitor (id 0x1)
  ICO board present (rev 2)

  Input Sync:  Voltage-Video level, Source-Internal, Genlocked-False
 Channel 1:
   Origin = (0,0)
   Video Output Size: 1024 pixels, 946 lines, 30.00Hz (2@1024x946_30qi)
 Channel 2:
   Origin = (0,946)
   Video Output Size: 1024 pixels, 946 lines, 30.00Hz (2@1024x946_30qi)
```

2@1160x960_30qi, Field Sequential

Figure 3-10 shows the maximum single display surface and origins for the viewports for the output format 2@1160x960_30qi. The actual display surface is the largest rectangular area that encloses the viewports. Its size is 1160 x 1920 pixels.

This format divides the frame buffer into two independent channels. The size and location of each channel are shown in the figure. Each channel is 1160 x 960 pixels and is output on the R and G connectors for Channel 1 of the breakout box. This format is an interlaced field sequential format with a 30Hz update rate.

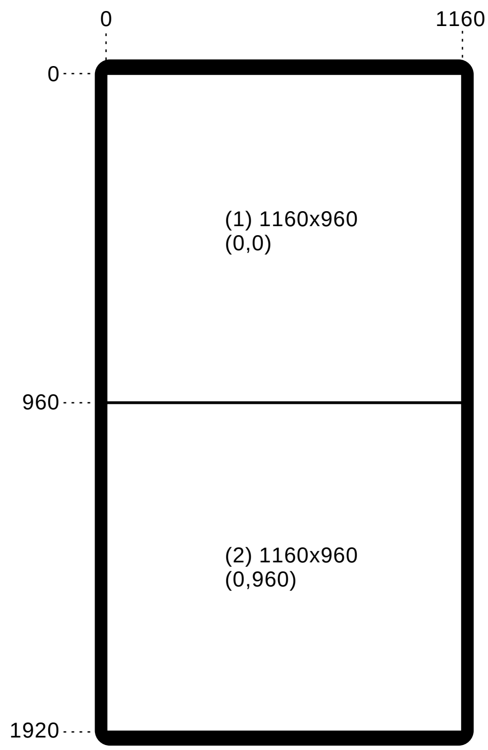

Figure 3-10 Display Surface for 2@1160x960_30qi Output Format

The output of **gfxinfo -v** for this format is

```
Graphics board 0 is “IMPACT” graphics.
  Managed (“:0.0”) 1160x1920
  Product ID 0x0, 2 GEs, 2 REs, 1 TRAM
  MGRAS revision 3, RA revision 5, RB revision 4
  HQ rev A, GE11 rev B, RE4 rev A, PP1 rev A,
  VC3 rev A, CMAP rev E, MC rev C
  19” monitor (id 0x1)
  ICO board present (rev 2)

 Channel 1:
   Origin = (0,0)
   Video Output: 1160 pixels, 960 lines, 30.00Hz (2@1160x960_30qi)
 Channel 2:
   Origin = (0,960)
   Video Output: 1160 pixels, 960 lines, 30.00Hz (2@1160x960_30qi)
```

Writing a Programmatic Interface for ICO

This section provides an example program for ICO video output. Specifically, this section describes how to use **XSGIvc()** to

- retrieve video format information
- load video formats
- query for channel information
- draw to each channel specified by the video output formats

Using XSGIvc

XSGIvc() is an X extension that provides a range of services to permit programmatic control of video operations. For details on this extension, see the XSGIvc(3) reference page.

ICO Programming Example

The programming example below uses **XSGIvc()** to display information about channels and their setup. Specifically, this example:

- Prints the XSGIvc information for a specified pipe
- Prints the input sync information
- Prints the XSGIvc information for one channel
- Prints the XSGIvc information for one channel's gamma

```
/*
 * xvcinfo.c
 *
 * Display information about xvc channels, setup.
 *
 *
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 *
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 * rights reserved under the Copyright Laws of the United States.
 */

#ident "$Revision: 1.0 $"

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/param.h>
#include "xvcinfo.h"


#define ARRAY_COUNT(arr)          ((int) (sizeof(arr) / sizeof(arr[0])))
```

```
static const char * const pcUnknown = "Unknown";
static const char * const pcTrue = "True";
static const char * const pcFalse = "False";
static const char * const pcRed = "Red";
static const char * const pcGreen = "Green";
static const char * const pcBlue = "Blue";
static const char * const pcAlpha = "Alpha";


/*
 * Forward function declarations
 */
static void xvcInputSyncInfo(Display *dpy, int iScreen);
static void xvcChannelInfo(int bVerbose, Display *dpy, int iScreen,
     int iChannelNo, const XSGIvcChannelInfo *pChannelInfo);
static void xvcChannelGamma(Display *dpy, int iScreen, int iChannelNo,
     const XSGIvcChannelInfo *pChannelInfo);
static void xvcChannelMonitor(Display *dpy, int iScreen, int iChannelNo,
     const XSGIvcChannelInfo *pChannelInfo);

/*
 * Function: xvcinfo
 *
 * Description:  Prints the XSGIvc information for a specified pipe.
 *
 * Parameters:
 *
 * iBoardnum - the pipe number for which information should be printed.
 *
 * iVerbose - short or lengthy display.
 *
 * printchannel - a user-defined function of type fChannelInfoProc
 * which will be called for each channel.  Pass NULL if the standard
 * channel display is desired.
 *
 *
 * Return: (void)
 */
void printXvcInfo(int iBoardnum, int bVerbose, fChannelInfoProc printchannel)
{
    Display        *dpy = 0;
```

```
    /* Supply the default channel printer */
    if (!printchannel)
        printchannel = xvcChannelInfo;

    /*
     * It is possible the user will run gfxinfo without an X server
     * running.  Allow this behavior, exiting silently if not present.
     */
    {
          /* Construct the display name from the board number */
          char            cDisplayName[MAXHOSTNAMELEN + 10];
          char *          pcTestMachine = getenv("XVCTESTMACHINE");

          sprintf(cDisplayName, "%s:0.%d", (pcTestMachine ? pcTestMachine : ""),
                 iBoardnum);
          dpy = XOpenDisplay(cDisplayName);
    }

    if (dpy) {
        Status          sQueryStatus;
        XSGIvcScreenInfo siScreenInfo;
        int             iScreen = DefaultScreen(dpy);

        /* Get the screen information from the server */
        sQueryStatus =
            XSGIvcQueryVideoScreenInfo(dpy,
                  iScreen,
                  &siScreenInfo);

if (sQueryStatus == False) {
    fprintf(stderr,
           "Could not get video screen info, screen %d\n",
           iScreen);
 } else {
     if (bVerbose) {
         xvcInputSyncInfo(dpy, iScreen);
     }

     /*
      * Print information for each channel.
      */
     {
          int             iChannelIndex;
```

```
 for (iChannelIndex = 0; iChannelIndex < siScreenInfo.numChannels;
       iChannelIndex++) {
      XSGIvcChannelInfo *pciChannelInfo = 0;

      sQueryStatus =
         XSGIvcQueryChannelInfo(dpy,
               iScreen,
               iChannelIndex,
               &pciChannelInfo);

      if (sQueryStatus == False) {
        fprintf(stderr,
            "Could not get channel info, screen %d, channel %d\n",
                 iScreen,
                 iChannelIndex);
      } else {
         /*
          * Call the user-specified function to print the channel info
          */
         (*printchannel) (bVerbose, dpy, iScreen, iChannelIndex, pciChannelInfo);
         XFree(pciChannelInfo);
      }
     }
    }
   }
   XCloseDisplay(dpy);
  }
}

/*
 * Function: xvcInputSyncInfo
 *
 * Description:  Prints the input sync information.
 *
 * Parameters:
 *
 * dpy - Display pointer
 *
 * iScreen - Screen number used in XSGIvc calls
 *
 *
 * Return: (void)
 */
static void xvcInputSyncInfo(Display *dpy, int iScreen)
{
```

```
    int iSyncVoltage = 0;
    int iSyncSource = 0;
    Bool bIsGenlocked = False;
    Status          sQueryStatus;

    sQueryStatus =
        XSGIvcQueryScreenInputSyncSource(dpy,
                iScreen,
                &iSyncVoltage,
                &iSyncSource,
                &bIsGenlocked);
    if (sQueryStatus == False) {
        fprintf(stderr,
                 "Could not get input sync source info, screen %d\n",
                 iScreen);
    } else {
         const char *pcSyncVoltage = pcUnknown;
         const char *pcSyncSource = pcUnknown;

         switch(iSyncVoltage) {
             case XSGIVC_SYNC_VOLTAGE_VIDEO:
                  pcSyncVoltage = "Video";
                  break;
             case XSGIVC_SYNC_VOLTAGE_TTL:
                  pcSyncVoltage = "TTL";
                  break;
         }
         switch(iSyncSource) {
             case XSGIVC_SYNC_SOURCE_INTERNAL:
                  pcSyncSource = "Internal";
                  break;
             case XSGIVC_SYNC_SOURCE_EXTERNAL:
                  pcSyncSource = "External";
                  break;
             }

         printf("\tInput Sync:  Voltage - %s level, Source - %s,
                    Genlocked - %s\n",
                pcSyncVoltage,
                pcSyncSource,
                bIsGenlocked ? pcTrue : pcFalse);
       }
   }

/*
```

```
 * Function: xvcChannelInfo
 *
 * Description:  Prints the XSGIvc information for one channel.
 *
 * Parameters:
 *
 * bVerbose - short or lengthy display.
 *
 * dpy - Display pointer
 *
 * iScreen - Screen number used in XSGIvc calls
 *
 * iChannelNo - the channel number to display
 *
 * pChannelInfo - the XSGIvcChannelInfo structure for this channel.
 *
 *
 * Return: (void)
 */
static void xvcChannelInfo(int bVerbose, Display *dpy, int iScreen,
          int iChannelNo, const XSGIvcChannelInfo *pChannelInfo)
{
    if (pChannelInfo->active) {
        printf("\tChannel %d", iChannelNo);
        if (iChannelNo != pChannelInfo->physicalID) {
            printf(" (physical port %d)", pChannelInfo->physicalID);
    }
    printf(":\n");

    /* The video format */
    {
       int    bFBSizeChanged; /* Frame buffer size differs from format? */

       bFBSizeChanged =
          (pChannelInfo->source.height != pChannelInfo->vfinfo.height) ||
          (pChannelInfo->source.width != pChannelInfo->vfinfo.width);

      if (bFBSizeChanged) {
          /* Prefix the line */
          int   iWidth = pChannelInfo->source.width;
          int   iHeight = pChannelInfo->source.height;
          printf("\t Channel's Source Size: %d pixels, %d lines;",
                iWidth,
                iHeight);
      } else
```

```
            /* Indent the next line */
            printf("\t");
        {
            int     iX = pChannelInfo->source.x;
            int     iY = pChannelInfo->source.y;

            printf(" Origin = (%d,%d)\n",
                   iX,
                   iY);
        }
        printf("\t Video Output Size: %d pixels, %d lines, %.2fHz (%s)\n",
               pChannelInfo->vfinfo.width,
               pChannelInfo->vfinfo.height,
               pChannelInfo->vfinfo.verticalRetraceRate,
               pChannelInfo->vfinfo.name);
    }

    if (bVerbose) {
        {
            int      bFlagPrinted = False;

            printf("\t Video Format Flags:");
            if (pChannelInfo->vfinfo.formatFlags & XSGIVC_VFIStereo) {
                printf("  Stereo");
                bFlagPrinted = True;
            }
            if (pChannelInfo->vfinfo.formatFlags & XSGIVC_VFIFieldSequentialColor) {
                printf("  Field Sequential");
                bFlagPrinted = True;
            }
            if (pChannelInfo->vfinfo.formatFlags & XSGIVC_VFIFullScreenStereo) {
               printf("  Full-Screen Stereo");
               bFlagPrinted = True;
            }

            if (!bFlagPrinted)
                printf("  (none)");
            printf("\n");
         }

         /* Sync output information */
#if 0 /* Enable this when the function works properly */
       xvcSyncInfo(dpy, iScreen, iChannelNo, pChannelInfo);
#endif
       xvcChannelGamma(dpy, iScreen, iChannelNo, pChannelInfo);
```

```
       xvcChannelMonitor(dpy, iScreen, iChannelNo, pChannelInfo);
     }
   }
}

/*
 * Function: xvcChannelGamma
 *
 * Description:  Prints the XSGIvc information for one channel’s gamma.
 *
 * Parameters:
 *
 * dpy - Display pointer
 *
 * iScreen - Screen number used in XSGIvc calls
 *
 * iChannelNo - the channel number to display
 *
 * pChannelInfo - the XSGIvcChannelInfo structure for this channel.
 *
 *
 * Return: (void)
 */


static void xvcChannelGamma(Display *dpy, int iScreen, int iChannelNo,
                const XSGIvcChannelInfo *pChannelInfo)
{
    int   iGammaMap = 0;
    Status          sQueryStatus;

    sQueryStatus =
         XSGIvcQueryChannelGammaMap(dpy,
                iScreen,
                iChannelNo,
                &iGammaMap);
    if (sQueryStatus == False) {
        fprintf(stderr,
                “Could not get gamma info, screen %d, channel %d\n”,
                iScreen,
                iChannelNo);
    } else {
         printf(“\t Using Gamma Map %d\n”, iGammaMap);
    }
}
```

ICO Programming Example for Performer

This section includes a sample program written for Performer that displays ICO viewports.

Performer Library Routines

The example program (that follows) uses Performer library routines including:

```
extern int pfuGetMCOChannels(pfPipe *p);
extern void pfuConfigMCO(pfChannel **chn, int nChans);
extern int pfuIsImpact();
extern int pfuGetICOChannels(pfPipe *p);
extern void pfuConfigICO(pfChannel **chn, int nChans);
```

The **pfuGet** routines return the number of channels the display option is currently driving. For ICO, the **XSGIvc** extension is used to query the server for the number of channels that are actively being driven. For MCO, this is done by deducing the VOF from the display area managed by the X server.

The **pfuConfig** routines set the viewports for an array of channels. ICO infers the tiling from the number of channels requested, with one caveat. The ICO hardware is queried via a **XSGIvc** extension. If ICO is inactive, then the requested channels are tiled horizontally across the framebuffer.

When **pfuConfigICO** is called, it first determines the actual number of active channels. If only one channel is actively being driven, then the requested number of channels are tiled horizontally across the screen to allow debugging of multi-channel applications without having ICO hardware. When the number of active channels is greater than 1, **pfuConfigICO** assumes that the caller is making a reasonable request; that is, that a 2-channel VOF is active when asking for two channels, or a 4-channel VOF is active when asking for 3 or 4 channels.

pfuIsImpact is a boolean expression that determines the GFX hardware type. It returns 0 for FALSE, and 1 for TRUE.

pfuGetMCOChannels calls **pfuIsImpact** and then **pfuGetICOChannels**, if required.

pfuConfigMCO calls **pfuIsImpact** and then **pfuConfigICO**, if required. Thus, the MCO routines are more portable; use them unless you intend your application only for IMPACT/ICO.

Performer Programming Example

```
/*
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 *
 * This is UNPUBLISHED PROPRIETARY SOURCE CODE of Silicon Graphics, Inc.;
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 *
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 * and Computer Software clause at DFARS 252.227-7013, and/or in similar or
 * successor clauses in the FAR, DOD or NASA FAR Supplement. Unpublished -
 * rights reserved under the Copyright Laws of the United States.
 */

#include <stdlib.h>
#include <Performer/pf.h>
#include <Performer/pfutil.h>
#include <Performer/pfdu.h>

static void OpenPipeWin(pfPipeWindow *pw);
static void DrawChannel(pfChannel *chan, void *data);

/*
 *   Usage() -- print usage advice and exit. This
 *   procedure is executed in the application process.
 */
static void
Usage (void)
{
  pfNotify(PFNFY_FATAL, PFNFY_USAGE, “Usage: multichan file.ext ..\n”);
  exit(1);
}

static int maxChan = 0;

int
main (int argc, char *argv[])
{
    float           t = 0.0f;
    pfScene         *scene;
```

```
pfPipe          *p;
pfPipeWindow    *pw;
/* MCO does 6 channels max; ICO does 4 channels max */
pfChannel       *chan[6];
pfNode          *root=NULL;
pfSphere        bsphere;
int             loop;
char            str[PF_MAXSTRING];
pfFrameStats    *fstats;

if (argc < 2)
    Usage();

/* Initialize Performer */
pfInit();
pfuInitUtil();

/* Use default multiprocessing mode based on no. of processors.*/
pfMultiprocess(PFMP_DEFAULT);

/* Load all loader DSOs before pfConfig() forks */
pfdInitConverter(argv[1]);

/* Configure multiprocessing mode and start parallel
 * processes.
 */
pfConfig();

/* Attach loaded file to a pfScene. */
scene = pfNewScene();

/* Append to PFPATH additional standard directories where
 * geometry and textures exist
 */
pfFilePath(“.:/usr/share/Performer/data”);

/* Read a single file, of any known type. */
if ((root = pfdLoadFile(argv[1])) == NULL)
{
    pfExit();
    exit(-1);
}

/* determine extent of scene’s geometry */
pfGetNodeBSphere (root, &bsphere);
```

```
pfAddChild(scene, root);

/* Create a pfLightSource and attach it to scene. */
pfAddChild(scene, pfNewLSource());

/* Configure and open GL window */
p = pfGetPipe(0);
pw = pfNewPWin(p);
sprintf(str, "IRIS Performer");
pfPWinName(pw, str);
pfPWinFullScreen(pw);
pfPWinConfigFunc(pw, OpenPipeWin);
pfConfigPWin(pw);

/* Create and configure pfChannel(s). */
maxChan = pfuGetMCOChannels(p);
pfNotify(PFNFY_NOTICE, PFNFY_PRINT, "detected %d active channels",
                        maxChan);
/*
** You can also use pfuGetICOChannels(p);
** if you will run the program only on IMPACT/ICO systems.
** pfuGetMCOChannels will call pfuGetICOChannels internally
** if required and is thus more general.  pfuGetICOChannels will
** correctly handle the case of IMPACT without an ICO.
**
** Use pfuIsImpact() to determine if the GFX hardware is IMPACT.
** It returns 1 if true or 0 if false.
*/
for (loop=0; loop < maxChan; loop++)
{
    chan[loop] = pfNewChan(p);
    /*
    **  Make chan[0] the channel group master; since we don't set a
    **  view offset, they'll all look at the same thing.
    */
    if (loop)
    {
        pfAttachChan(chan[0], chan[loop]);
    }
    else
    {
        pfChanTravFunc(chan[loop], PFTRAV_DRAW, DrawChannel);
        pfChanScene(chan[loop], scene);
        pfChanNearFar(chan[loop], 1.0f, 10.0f * bsphere.radius);
        pfChanFOV(chan[loop], 45.0f, 0.0f);
```

```
        }
        fstats = pfGetChanFStats(chan[loop]);
        pfFStatsClass(fstats, PFSTATS_ENGFX, PFSTATS_ON);
    }

/*now set channel viewports appropriately for active VOF */
pfuConfigMCO(chan, maxChan);
/*
** You can also use pfuConfigICO(chan, maxChan);
** if you're sure you're on an IMPACT/ICO.
** pfuConfigMCO checks internally to see if it's running on
** IMPACT/ICO and calls pfuConfigICO if so....
** Thus pfuConfigMCO is more general with almost zero overhead.
*/

/* Simulate for twenty seconds. */
while (t < 20.0f)
{
    float      s, c;
    pfCoord    view;

    /* Go to sleep until next frame time. */
    pfSync();

    /* Compute new view position. */
    t = pfGetTime();
    pfSinCos(45.0f*t, &s, &c);
    pfSetVec3(view.hpr, 45.0f*t, -10.0f, 0);
    pfSetVec3(view.xyz, 2.0f * bsphere.radius * s,
             -2.0f * bsphere.radius *c,
             0.5f * bsphere.radius);

    for (loop=0; loop < maxChan; loop++)
    {
         pfChanView(chan[loop], view.xyz, view.hpr);
         /*pfDrawChanStats(chan[loop]);*/
    }
    /* Initiate cull/draw for this frame. */
    pfFrame();
}

/* Terminate parallel processes and exit. */
pfExit();

return 0;
```

```
}


/*
 * OpenPipeWin() -- create a GL window: set up the window system,
 * IRIS GL, and IRIS Performer. This procedure is executed
 * for each window in the draw process for that pfPipe.
 */

static void
OpenPipeWin(pfPipeWindow *pw)
{
    pfLight *Sun;

    pfOpenPWin(pw);

    /* Create a light source in the “south-west” (QIII). */
    Sun = pfNewLight(NULL);
    pfLightPos(Sun, -0.3f, -0.3f, 1.0f, 0.0f);
}

static void
DrawChannel (pfChannel *channel, void *data)
{

    static pfVec4 clr[] = {{1.0f, 0.0f, 0.0f, 1.0f},
                          {0.0f, 1.0f, 0.0f, 1.0f},
                          {0.0f, 0.0f, 1.0f, 1.0f},
                          {1.0f, 1.0f, 1.0f, 1.0f}};
    static int i=0;

    /* Erase framebuffer and draw Earth-Sky model. */
    pfClear(PFCL_COLOR | PFCL_DEPTH, clr[i]);
    i++;
    if (i == maxChan) i = 0;

    /* Invoke Performer draw-processing for this frame. */
    pfDraw();

}
```

Chapter 4

Troubleshooting

This chapter contains information on what to do if your system or installation experiences problems. Each section describes a problem and provides instructions on how to solve the problem. Product support information is at the end of this chapter.

Accessing gfxinfo

Using the gfxinfo command accesses information about the number of channels and their configurations that exist in an Indigo^2 IMPACT workstation with an ICO board installed.

Follow these steps to use gfxinfo:

1. Go to the Toolchest.
2. Click "Desktop", and then "Unix Shell" to open a shell.
3. On the command line, enter **`/usr/gfx/gfxinfo`**

The listing provided by gfxinfo includes the following information:

- the recognition (or lack) of the presence of an ICO board
- the recognition of a video format successfully loaded into the system
- the recognition of the number of screens to be used, and their size and position

For more information about the gfxinfo command, see Chapter 3, "Using gfxinfo to List Graphics Information" on page 60.

ICO Board Not Recognized

If the ICO board is not listed by gfxinfo, the problem may be that the single flex connector between the ICO board and the graphics board is not properly seated. See Chapter 1 for instructions on removing and installing the ICO board and seating the flex connectors.

Main Monitor Screen Blank

When the ICO board is active, the main monitor is deactivated. Information to the monitor(s) is sent through the breakout box cable.

Blank Screens or Faulty Images

If gfxinfo recognizes the ICO board, but no images or faulty images appear on the screens, the problem might be that the double flex connectors between the ICO board and graphics board are not properly connected. See Chapter 1 for instructions on removing and installing the ICO board and seating the flex connectors.

If, in a multiple screen mode, one screen has blank or faulty images and gfxinfo recognizes the proper configurations, swap the screen cables and screens. If the problem stays with the swapped screen, the screen is faulty. If the problem stays with the channel, the problem is with the ICO board. Call your authorized service representative for help with ordering or replacing parts.

Check the monitor cables. If non-standard cables are used, faulty images may appear on the screen. Use cable with 75 ohm impedance that is six feet or shorter.

Vertical Stripes

If vertical stripes, approximately four pixels apart, appear on all of the ICO monitors, but not the main monitor, check the ICO-graphics board double flex cable connector for a bent pin. If you find a bent pin, contact your service provider.

Checking Connections and Installation

Use the following troubleshooting checklist to determine an installation problem.

1. Check that the power cables are connected to the workstation and the monitors or head-mounted display.
2. Check that the breakout box cable connector at the chassis I/O panel is seated and the thumb screws are tightened.
3. Check that the cable connections from the breakout box to the monitors or head mounted display are connected.
4. Open the chassis and check that the ICO board and graphics board set are properly seated in the chassis. Follow instructions in Chapter 1 for opening the chassis.
5. Remove the ICO and graphics board set and check to be sure the flex cables connecting the ICO board and the graphics board set are properly seated.
6. Check that the appropriate operating system and software have been installed. See the software CD and release notes that came with your shipment.
7. Check your monitor specifications to ensure you have installed the correct monitor.

Product Support

Silicon Graphics®, Inc., provides a comprehensive product support and maintenance program for its products. If you are in North America and would like support for your Silicon Graphics supported products, contact the Technical Assistance Center at 1-800-800-4SGI or your authorized service provider. If you are outside North America, contact the Silicon Graphics subsidiary or authorized distributor in your country.

Identifying Graphics and Option Boards

This appendix provides illustrations of the Indigo^2 IMPACT Channel Option board and of the three Indigo^2 IMPACT graphics boards: Solid IMPACT, High IMPACT, and Maximum IMPACT.

Impact Channel Option Board

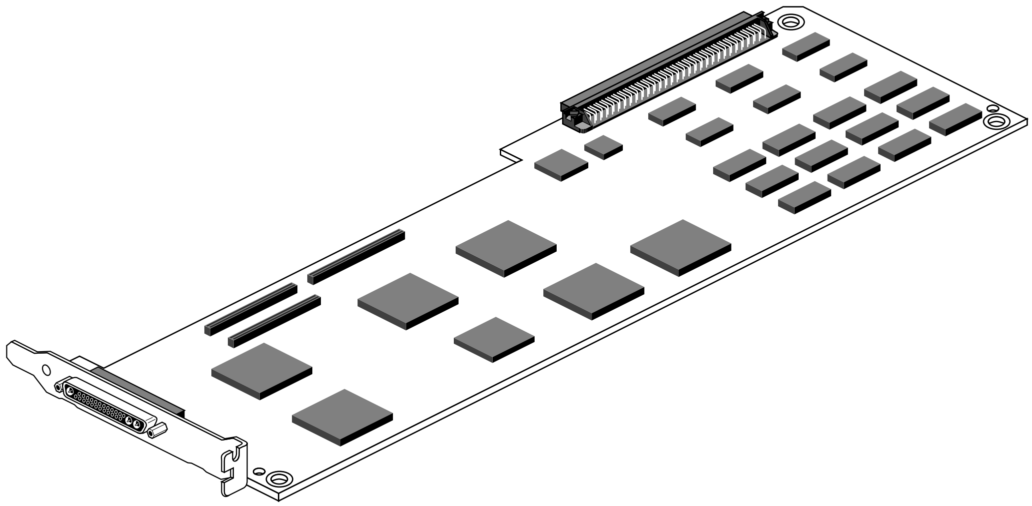

Figure A-1 Impact Channel Option Board

IMPACT Graphics Boards

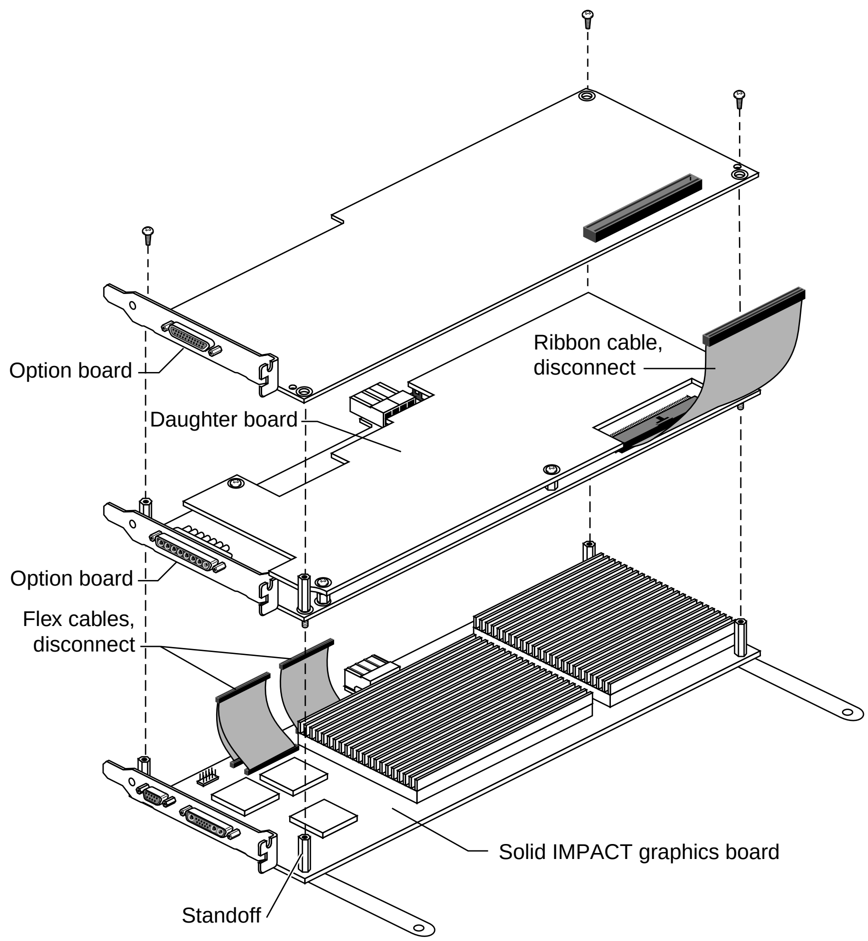

Figure A-2 Solid IMPACT Graphics Board With Option Boards

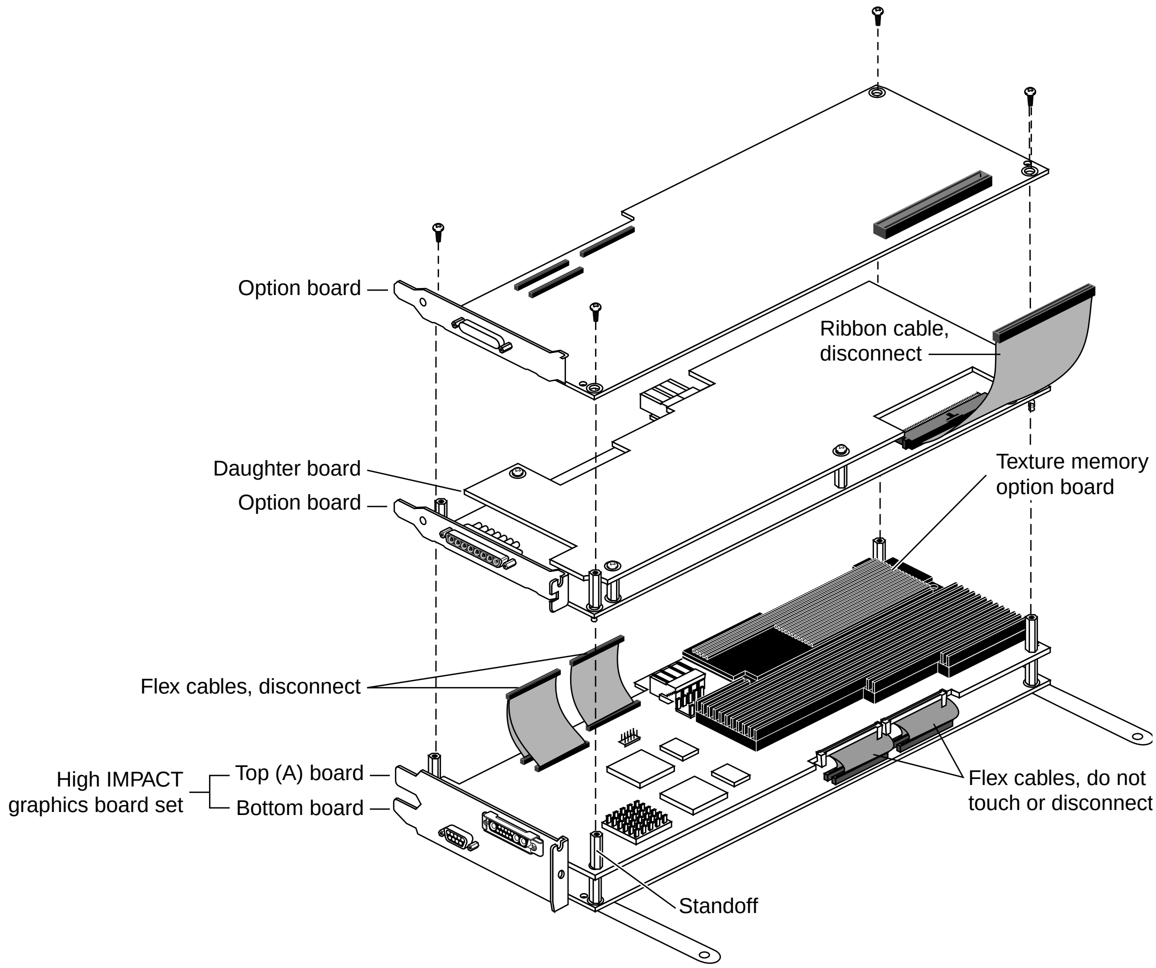

Figure A-3 High IMPACT Graphics Board Set With Option Boards

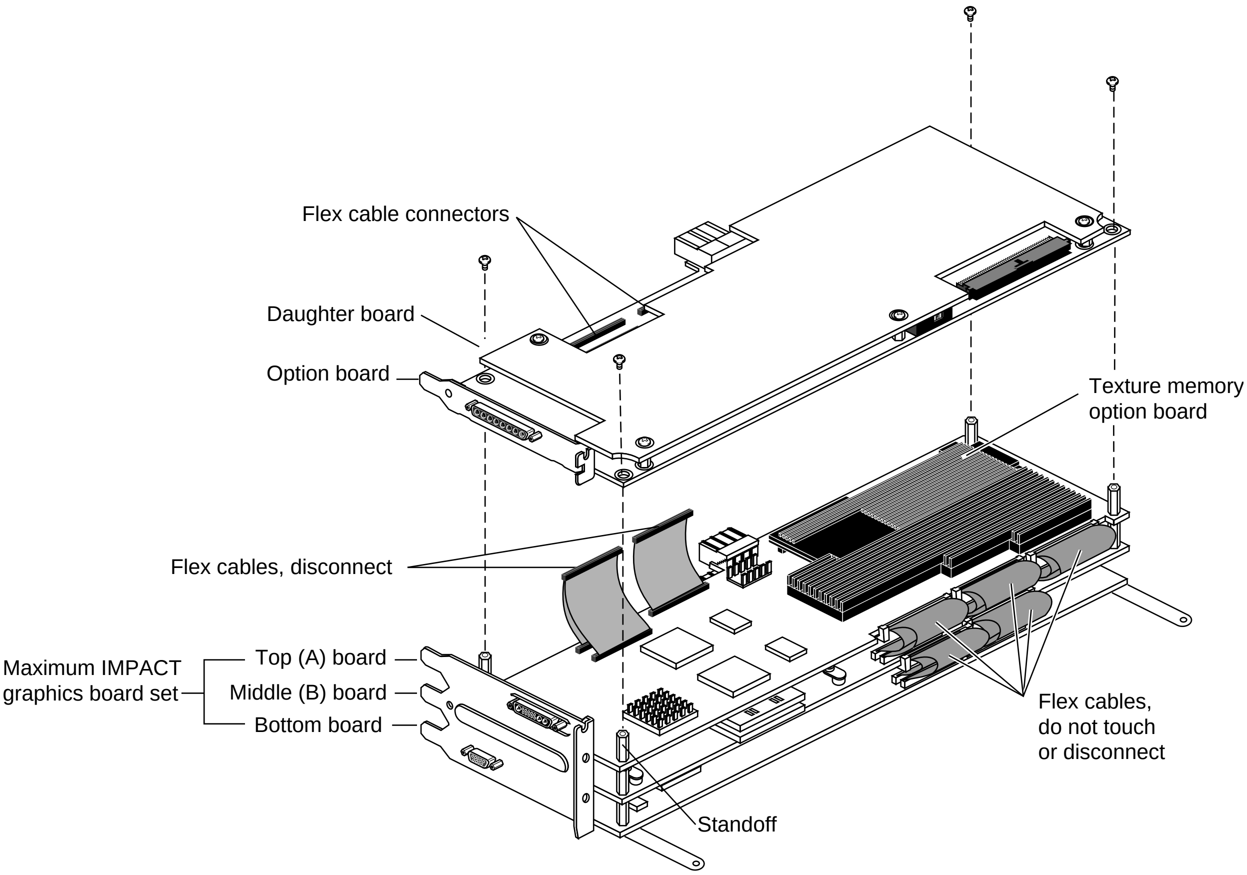

Figure A-4 Maximum IMPACT Graphics Board Set With Option Boards

Regulatory Information

This chapter provides regulatory information about your workstation.

This chapter contains information on the following topics:

Manufacturer's Regulatory Declarations for the Indigo^2 IMPACT Graphics Boards

Note: Your workstation has several governmental and third-party approvals, licenses, and permits. Do not modify this product in any way that is not expressly approved by Silicon Graphics. If you do, you may lose these approvals and your governmental agency authority to operate this device.

The Indigo^2 IMPACT graphics boards conform to several national and international specifications and European Directives listed on the "Manufacturer's Declaration of Conformity." The CE mark insignia displayed on each device is an indication of conformity to the aforementioned European requirements.

Manufacturer’s Declaration of Conformity

A “Manufacturer’s Declaration of Conformity” is available on the World Wide Web. Look on the system (regulatory) label on the rear of your workstation to determine your CMN (model) number, which you will need to identify your Declaration of Conformity. See Figure B-1 (Exterior of Workstation) at the end of this chapter for the location of your system label.

To locate the information on the World Wide Web, enter the following in your Web browser location window:

`http://www.sgi.com/Products/compliance/index.html`

Locate and print or save your Declaration of Conformity. For future reference, make a note of your CMN number and the date on the Declaration of Conformity here:

____

Regulatory Label

If you received a regulatory label with a graphics board upgrade, place the label below the logos and over the lower portion of the regulatory label on the rear of your workstation. See Figure B-1 for placement of the upgrade regulatory label.

Electromagnetic Emissions

This device complies with the Class A limits of Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

This device complies with Class A electromagnetic emissions limits of C.I.S.P.R. Publication 22, Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment, Germany's BZT Class A limits for Information Technology Equipment, and with Japan's VCCI Class 1 limits.

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取扱説明書に従って正しい取り扱いをして下さい。

Radio and Television Interference

The equipment described in this guide generates and uses radio frequency energy. If it is not installed and used in accordance with the instructions in this guide, it can cause radio and television interference.

This equipment has been tested and complies with the limits for a Class A computing device in accordance with the specifications in Part 15 of FCC rules. These specifications are designed to provide reasonable protection against such interference in an industrial or office installation. However, there is no guarantee that the interference will not occur in a particular installation. This system is not certified for home use.

You can determine whether your system is causing interference by turning it off. If the interference stops, it was probably caused by the workstation or one of the peripherals. To tell if the interference is caused by one of the peripherals, try disconnecting one peripheral at a time to see if the interference stops. If it does, that peripheral is the cause of the interference.

If your workstation does cause interference to radio or television reception, try to correct the interference by using one or more of the following suggestions:

- Turn the television or radio antenna until the interference stops.
- Move the workstation to one side or the other of the radio or television.
- Move the workstation farther away from the radio or television.
- Plug the workstation into an outlet that is on a different circuit from the radio or television. (That is, make certain the workstation and the radio or television are on circuits controlled by different circuit breakers or fuses.)

Shielded Cables

The Indigo^2 IMPACT workstation is FCC-compliant under test conditions that include the use of shielded cables between Indigo^2 IMPACT workstation and its peripherals. Your Indigo^2 IMPACT workstation and any peripherals you purchase from Silicon Graphics have shielded cables. Shielded cables reduce the possibility of interference with radio, television, and other devices. If you use any cables that are not from Silicon Graphics, make sure they are shielded. Telephone cables do not need to be shielded.

In Germany, a shielded cable must be used on the Ethernet 10-BASE T port.

The monitor cable supplied with your system uses additional filtering molded into the cable jacket to reduce radio frequency interference. Always use the cable supplied with your system. If your monitor cable becomes damaged, a replacement cable should be obtained from Silicon Graphics.

Electrostatic Discharge

Silicon Graphics designs and tests its products to be immune to effects of electrostatic discharge (ESD). ESD is a source of electromagnetic interference and can cause problems ranging from data errors and lockups to permanent component damage.

It is important that while you are operating your Indigo^2 you keep all the covers and doors, including the plastics, in place. The shielded cables that came with the workstation and its peripherals should be installed correctly, with all thumbscrews fastened securely.

An ESD wrist strap is included with some products, such as memory and graphics upgrades. The wrist strap is used when installing these upgrades to prevent the flow of static electricity, and it should protect your system from ESD damage.

Exterior of Workstation

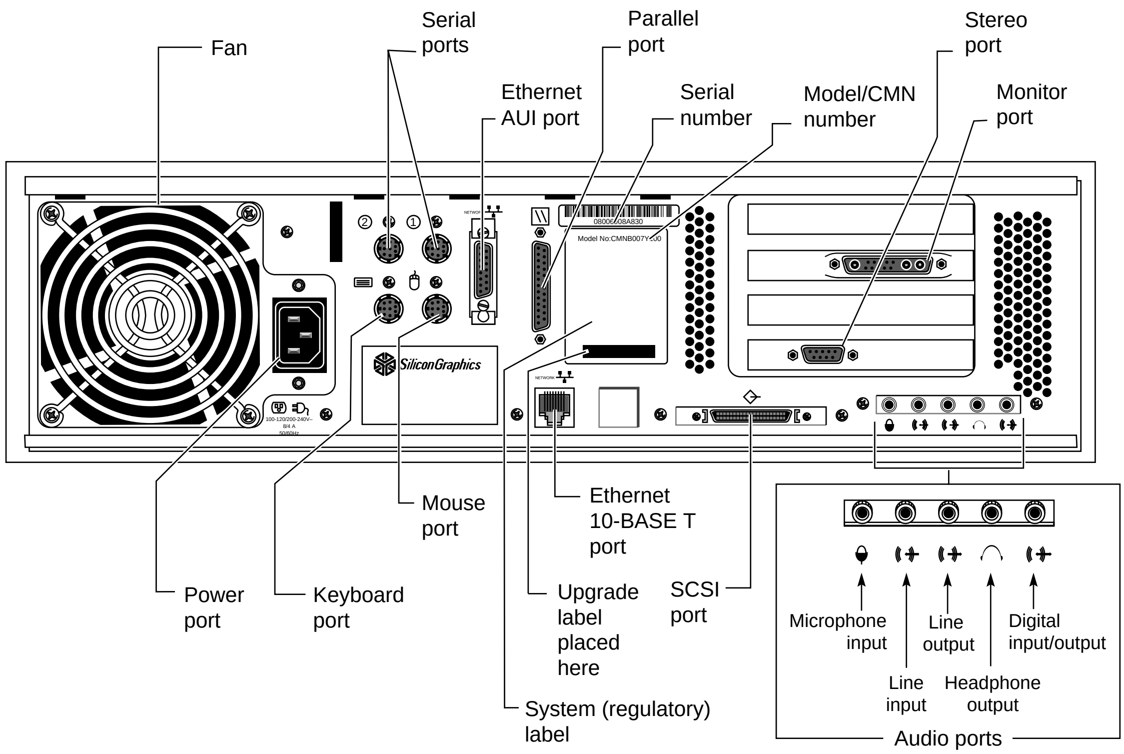

Figure B-1 Exterior of Workstation

Glossary

active video

The portion of the video signal having the chrominance or luminance information; also, all video lines not in the vertical blanking signal that contain the chrominance or luminance information. *See also* chrominance, composite video, horizontal blanking interval, luminance, and video waveform.

aliasing

A rendering technique that assigns to pixels the color of the primitive being rendered, regardless of whether that primitive covers all of the pixel's area or only a portion of the pixel's area. This results in jagged edges, or jaggies. In video systems, aliasing results when an image is sampled that contains frequency components above the Nyquist limit for the sampling rate. *See also* Nyquist limit.

antialiasing

A rendering technique that assigns pixel colors based on the fraction of the pixel's area that's covered by the primitive being rendered. Antialiased rendering reduces or eliminates the jaggies that result from aliased rendering.

artifact

In video systems, an unnatural or artificial effect that occurs when the system reproduces an image; examples are aliasing, pixellation, and contouring.

aspect ratio

The ratio of the width to the height of an image. For example, the standard aspect ratio for television is 4:3. Maintaining the original aspect ratio of an image prevents it from being distorted.

back porch

The portion of the horizontal pedestal that follows the horizontal synchronizing pulse. In a composite signal, the color burst is located on the back porch, but is absent on a YUV or GBR signal. *See also* blanking level, video waveform.

bit map

A region of memory that contains the pixels representing an image. The pixels are arranged in the sequence in which they are normally scanned to display the image.

bit plane

A rectangular array of bits mapped one-to-one with pixels. The framebuffer is a stack of bit planes.

black burst

Active video signal that has only black in it. The black portion of the video signal, containing color burst. *See also* color burst.

black level

In the active video portion of the video waveform, the voltage level that defines black. *See also* horizontal blanking interval and video waveform.

blanking level

The signal level at the beginning and end of the horizontal and vertical blanking intervals, typically representing zero output (0 IRE). *See also* video waveform and IRE units.

breezeway

In the horizontal blanking part of the video signal, the portion between the end of the horizontal sync pulse and the beginning of the color burst. *See also* horizontal blanking and video waveform.

buffer

See framebuffer.

chroma

See chrominance.

chrominance

In an image reproduction system, a separate signal that contains the color information. Black, white, and all shades of gray have no chrominance and contain only the luminance (brightness) portion of the signal. However, all colors have both chrominance and luminance.

Chrominance is derived from the I and Q signals in the NTSC television system and the U and V signals in the PAL television system. *See also* luminance.

color burst

The segment of the horizontal blanking portion of the video signal that is used as a reference for decoding color information in the active video part of the signal. The color burst is required for synchronizing the phase of the 3.58 MHz oscillator in the television receiver for correct hues in the chrominance signal.

In composite video, the image color is determined by the phase relationship of the color subcarrier to the color burst. The color burst sync is 8 to 11 cycles of 3.58 MHz color subcarrier transmitted on the back porch of every horizontal pulse. The hue of the color sync phase is yellow-green.

Also called burst and burst flag. *See also* color subcarrier and video waveform.

color space

A space defined by three color components, such as R, G, and B.

color subcarrier

A portion of the active portion of a composite video signal that carries color information, referenced to the color burst. The color subcarrier's amplitude determines saturation; its phase angle determines hue. Hue and saturation are derived with respect to the color burst. The color subcarrier's frequency is defined as 3.58 MHz in NTSC and 4.43 MHz in PAL. *See also* color burst.

component video

A color encoding method for the three color signals—R, G, and B; Y, I, and Q; or Y, U, and V—that make up a color image. *See also* RGB, YIQ, and YUV.

composite video

A color encoding method or a video signal that contains all of the color, brightness, and synchronizing information in one signal. The chief composite television standard signals are NTSC, PAL, and SECAM. *See also* NTSC, PAL, and SECAM.

field

One of two (or more) equal parts of information into which a frame is divided in interlace scanning. A vertical scan of a frame carrying only its odd-numbered or its even-numbered lines. The odd field and even field make up the complete frame. *See also* frame and interlace.

field averaging

A filter that corrects flicker by averaging pixel values across successive fields. *See also* flicker.

field parallel

Typical video format data (Red, Green, and Blue) output in parallel through three wires.

field sequential

Video format data (Red, Green, and Blue) output sequentially through a single wire. This format is used, for example, in head mounted displays.

flicker

The effect caused by a one-pixel-deep line in a high-resolution graphics frame that is output to a low-resolution monitor, because the line is in only one of the alternating fields that make up the frame. This effect can be filtered out by field averaging. *See also* field and frame.

frame

The result of a complete scanning of one image. In television, the odd field (all the odd lines of the frame) and the even field (all the even lines of the frame) make up the frame. In motion video, the image is scanned repeatedly, making a series of frames.

framebuffer

The individual pixel output of the raster subsystem is written to the framebuffer. Here the information associated with each pixel is stored in a form easily read by the display subsystem. Information associated with each pixel includes image planes, depth planes, stencil planes, overlay and/or underlay planes, and window clipping planes. The complexity of the graphics subsystem determines which of these planes are present in the system. *See also* pixel.

frequency

Signal cycles per second.

front porch

The portion of the video signal between the end of active video and the falling edge of sync. *See also* back porch, horizontal blanking interval, and video waveform.

gamma correction

A function applied to colors stored in the framebuffer to correct for the nonlinear response of the eye (and sometimes of the monitor) to linear changes in color-intensity values.

genlocking

Synchronizing with another video signal serving as a master timing source. The master timing source can be a composite video signal, a video signal with no active video (only sync information), or, for video studio, a device called house sync. When no master sync is available, VideoFramer, for example, can be set to “free run” (or standalone) mode, so that it becomes the master timing device to which other devices sync. *See also* line lock.

horizontal blanking interval

Also known as the horizontal retrace interval, the period when a scanning process is moving from the end of one horizontal line to the start of the next line. This portion of the signal is used to carry information other than video information. *See also* video waveform.

horizontal drive

The portion of the horizontal blanking part of the video signal composed of the sync pulse together with the front porch and breezeway; that is, horizontal blanking minus the color burst. *See also* video waveform.

horizontal sync

The lowest portion of the horizontal blanking part of the video signal; it provides a pulse for synchronizing video input with output. Also known as hsync. *See also* horizontal blanking interval and video waveform.

hue

The designation of a color in the spectrum, such as cyan, blue, magenta. Sometimes called tint on NTSC television receivers. The varying phase angles in the 3.58 MHz (NTSC) or 4.43 MHz (PAL) C signal indicate the different hues in the picture information.

hue-saturation-intensity

A tristimulus color system based on the parameters of hue, saturation, and intensity luminance). Also referred to as HSI or HSV.

image processing

Manipulating an image by changing its color, brightness, shape, or size.

interlace

A technique that uses more than one vertical scan to reproduce a complete image. In television, the 2:1 interlace used yields two vertical scans (fields) per frame: the first field consists of the odd lines of the frame, the other, the even lines. *See also* field and frame.

IRE units

A scale for measuring analog video signal levels, normally starting at the bottom of the horizontal sync pulse and extending to the top of peak white. Blanking level is 0 IRE units and peak white level is 100 IRE units (700 mV). An IRE unit equals 7.14 mV (+100 IRE to -40 IRE = 1 V). IRE stands for Institute of Radio Engineers, a forerunner of the IEEE.

leading edge of sync

The portion of the video waveform after active video, between the sync threshold and the sync pulse. *See also* video waveform.

level

Signal amplitude.

line

The result of a single pass of the sensor from left to right across the image.

line lock

Input timing derived from the horizontal sync signal and implying that the system clock (the clock being used to sample the incoming video) is an integer multiple of the horizontal frequency and that it is locked in phase with the horizontal sync signal. *See also* video waveform.

linear matrix transformation

The process of combining a group of signals through addition or subtraction; for example, RGB signals into luminance and chrominance signals.

luma

See luminance.

luminance

The perceived brightness of a surface. Typically refers to a weighted average of red, green, and blue color values that gives the perceived brightness of the combination. For video systems, luminance is the video signal that describes the amount of light in each pixel. *See also* chrominance and Y signal.

multiburst

A test pattern consisting of sets of vertical lines with closer and closer spacing; used for testing horizontal resolution of a video system.

NTSC

A color television standard or timing format encoding all of the color, brightness, and synchronizing information in one signal. Used in North America, most of South America, and most of the Far East, this standard is named after the National Television Systems Committee, the standardizing body that created this system in the U.S. in 1953. NTSC uses a total of 525 horizontal lines per frame, with two fields per frame of 262.5 lines each. Each field refreshes at 60 Hz (actually 59.94 Hz).

Nyquist limit

The highest frequency of input signal that can be correctly sampled without aliasing. The Nyquist limit is equal to half of the sampling frequency.

overscan

To scan a little beyond the display raster area of the monitor so that the edges of the raster are not visible. Television is overscanned; computer displays are underscanned.

PAL

A color television standard or timing format developed in West Germany and used by most other countries in Europe, including the United Kingdom but excluding France, as well as Australia and parts of the Far East. PAL uses a total of 625 horizontal lines per frame, with two fields per frame of 312.5 lines per frame. Each field refreshes at 50 Hz. PAL encodes color differently from NTSC. PAL stands for Phase Alternation Line or Phase Alternated by Line, by which this system attempts to correct some of the color inaccuracies in NTSC. *See also* NTSC and SECAM.

pedestal

See setup and video waveform.

pixel

Picture element. Either the smallest addressable spatial element of the computer screen, or the smallest reproducible element in analog video. A pixel can have red, blue, and green color values, an alpha component, and other information associated with it. (Pixels are referred to as having a color component even if they're gray-scale or monochrome.) The bits at location (x, y) of all the bit planes in the framebuffer constitute the single pixel (x, y). In OpenGL window coordinates, each pixel corresponds to a 1.0x1.0 screen area. The coordinates of the lower left corner of the pixel named *x,y* are (x, y), and of the upper right corner are (x+1, y+1). *See also* alpha value and component video.

pixel map

A two-dimensional piece of memory, any number of bits deep. *See also* bit map.

raster

The scanning pattern for television display; a series of horizontal lines, usually left to right, top to bottom. In NTSC and PAL systems, the first and last lines are half lines.

raster operation, raster op

A logical or arithmetic operation on a pixel value.

resolution

Number of horizontal lines in a television display standard; the higher the number, the greater a system's ability to reproduce fine detail.

RGB

Red, green, blue—the basic component set used by graphics systems and some video cameras in which a separate signal is used for each primary color.

sample

To read the value of a signal at evenly spaced points in time; to convert representational data to sampled data (that is, synthesizing and rendering).

sampling rate

The number of times per second (measured in kHz, where 1 kHz = 1000 times per second) the system reads the file when outputting audio. The greater the sampling rate, the larger the file and the better the quality of the audio output.

saturation

Color intensity; zero saturation is white (no color) and maximum saturation is the deepest or most intense color possible for that hue. In signal terms, saturation is determined by the ratio between luminance level and chrominance amplitude. *See also* hue.

scaling

Changing the size of an image.

scan

To convert an image to an electrical signal by moving a sensing point across the image, usually left to right, top to bottom.

SECAM

Sequentiel Couleur avec Memoire, the color television system developed in France and used there as well as in eastern Europe, the Near East and Mideast, and parts of Africa and the Caribbean.

setup

The difference between the blackest level displayed on the receiver and the blanking level. A black level that is elevated to 7.5 IRE instead of being left at 0.0 IRE is the same as the lowest level for active video. Because the video level is known, this part of the signal is used for black-level clamping circuit operation. Setup is typically used in the NTSC video format and is typically not used in the PAL video format; it was originally introduced to simplify the design of early television receivers, which had trouble distinguishing between video black levels and horizontal blanking. Also called pedestal. *See also* video waveform.

subcarrier

A portion of a video signal that carries a specific signal, such as color. *See also* color subcarrier.

subpixel

A unit derived from a pixel by using a filter for sizing and positioning.

sync information

The part of the television video signal that ensures that the display scanning is synchronized with the broadcast scanning. *See also* video waveform.

sync tip

The lowest part of the horizontal blanking interval, used for synchronization. *See also* video waveform.

threshold

In a digital circuit, the signal level that is specified as the division point between levels used to represent different digital values. For example, the sync threshold is the level at which the leading edge of sync begins. *See also* video waveform.

time-base errors

Analog artifacts caused by nonuniform motion of videotape or of the tape head drum. Time-base errors usually cause horizontal display problems, such as horizontal jitter.

time-delay equalization

Frame-by-frame alignment of all video inputs to one sync pulse, so that all frames start at the same time. This alignment is necessary because cable length differences cause unequal delays. *See* time-base errors.

transducer

A microphone, video camera, or other device that can convert sounds or images to electrical signals.

underscan

To scan a television screen so that the edges of the raster are visible. *See also* overscan.

vertical blanking interval

The blanking portion at the beginning of each field. It contains the equalizing pulses, the vertical sync pulses, and vertical interval test signals (VITS). Also the period when a scanning process is moving from the lowest horizontal line back to the top horizontal line.

video level

Video signal amplitude.

video signal

The signal from a video device, such as a camera, VCR, or other scanning image sensor.

video waveform

The main components of the video waveform are the active video portion and the horizontal blanking portion. Certain video waveforms carry information during the horizontal blanking interval.

white level

In the active video portion of the video waveform, the 1.0-Volt (100 IRE) level. *See also* video waveform.

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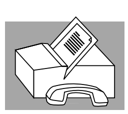

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