ForceWare Graphics Drivers

NVIDIA Quadro FX 4500 SDI User's Guide

Version 1.0

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Table of Contents

CHAPTER 1

ABOUT NVIDIA GRAPHICS TO SDI

Serial Digital Interface (SDI) is a digital, uncompressed high quality video format used for film and video post production and broadcast applications. The NVIDIA Quadro® FX 4500 SDI graphics card converts composited video and graphics to uncompressed 8-bit, 10-bit, or 12-bit SDI output.

About This Document

This manual explains the graphics-to-SDI functionality of the NVIDIA Quadro FX 4500 SDI graphics card and software, described in the following sections:

- "NVIDIA Graphics-to-SDI" on page 3 lists the supported SDI features and explains the basic operation in a broadcast environment.
- "Windows–Using the Graphics to SDI Control Panel" on page 15 describes how to use the Display Properties control panel to set up and start the SDI output under Windows.
- "Linux—Using the Graphics to Video Out Control Panel" on page 31 describes how to use the Display Properties control panel to set up and start the SDI output under Linux.
- "API Control" on page 43 gives an overview of API control of the SDI functions.

For instructions on installing the graphics card and drivers, refer to the documentation that accompanies your NVIDIA Quadro FX 4500 SDI graphics card.

Other Documents

For details on using the NVIDIA Display Properties control panel, see the *NVIDIA Quadro Workstation User's Guide*.

System Requirements

- The following operating systems are supported:
  - Windows® 2000 or Windows® XP.
  - Linux
- NVIDIA Quadro FX 4500 SDI Graphics Card
- NVIDIA Forceware Graphics Driver
  - For Windows, version 83.61 or later.
  - For Linux, version 83.21 or later.

Revision History

Revision	Date	Description
1.0	1/27/06	Initial Release.

CHAPTER

2

NVIDIA GRAPHICS-TO-SDI

This chapter provides an overview of the NVIDIA graphics-to-SDI functionality, described in the following sections:

- "Feature Overview" on page 4 lists the hardware connections, supported SDI formats, and additional SDI support features of the NVIDIA Quadro FX 4500 SDI graphics card.
- "Installing and Preparing the NVIDIA Quadro FX 4500 SDI" on page 6 describes how to install the NVIDIA Quadro FX 4500 SDI card and prepare it for use.
- "Operating NVIDIA SDI" on page 10 provides an overview of SDI operation.

Feature Overview

Output Connections

- Two BNC connections that can be configured for fill + key dual-link SDI outputs, or for single-link SDI outputs
- One DVI video monitoring output
- BNC connections for external sync signals

Supported SDI Signal Formats

- Standard Definition (SD) Modes
  - 487i @ 59.95 Hz (SMPTE259) NTSC
  - 576i @ 50.00 Hz (SMPTE259) PAL
- High Definition (HD) Modes
  - 720p @ 23.97 Hz, 24.00 Hz, 25.00 Hz, 29.97 Hz, 30.00 Hz, and 50.00 Hz[1]
  - 720p @ 59.94Hz, 60.00 Hz (SMPTE296)
  - 1035i @ 59.94 Hz, 60.00 Hz (SMPTE260)
  - 1080i @ 50.00 Hz (SMPTE295)
  - 1080i @ 50.00 Hz, 59.94 Hz, 60.00 Hz (SMPTE274)
  - 1080PsF @ 24.00 Hz, 23.976 Hz[2]
  - 1080PsF @ 25.00 Hz, 29.97 Hz, 30 Hz (SMPTE274)
  - 1080p @ 23.976 Hz, 24.00 Hz, 25.00 Hz, 29.97 Hz, 30.00 Hz (SMPTE274)
  - 2048x1080p @ 23.976 Hz, 24.00 Hz, 25.00 Hz, 29.97 Hz, 30.00 Hz, 47.96Hz, 48Hz, 60Hz (SMPTE272)

Supported SDI Color Formats

- RGB 4:4:4
- YCrCb 4:2:2 or 4:4:4
- RGBA 4:4:4:4
- YCrCbA 4:2:2:4

1. The 720p modes in this bullet entry are available with firmware revision 6 or later.
2. The 1080PsF modes in this bullet entry are available with firmware revision 6 or later.

Supported Output Modes

- Transparent Clone Mode
  See "Windows–Using the Graphics to SDI Control Panel" on page 15.
- Transparent Dualview Mode
  See "Dualview Mode" on page 53.
- Extended Mode using NVIDIA SDI APIs
  See "API Control" on page 43.

Desktop Region Adjustment Capability

Lets you define a portion of the desktop to convert to SDI output.

Genlock and Frame Lock Capability

Lets you synchronize the SDI output to an external digital or analog sync source.

Note: The NVIDIA Quadro FX 4500 SDI card does not support SLI mode at this time.

Installing and Preparing the NVIDIA Quadro FX 4500 SDI

About Your NVIDIA Quadro FX 4500 SDI

The following describes the components included in your NVIDIA Quadro FX 4500 SDI product package:

Cards

The NVIDIA Quadro FX 4500 SDI consists of the following two cards:

- NVIDIA Quadro FX 4500 Graphics Card
- NVIDIA SDI Output Card

Cables

In addition, you need the following cables, which should be provided with your NVIDIA Quadro FX 4500 SDI package:

- (Qty 1 ea.) 14-Pin Ribbon Cable

  This cable connects the NVIDIA Quadro FX 4500 card to the SDI Output card for genlock and frame-lock functionality.

- (Qty 1 ea.) DVI-to-DVI Cable

  This cable connects the video output from the graphics card to the SDI output card.

- (Qty 4 ea.) SMA-to-BNC Cable

  These cables convert the SMA connectors on the SDI card to standard BNC connectors.

Cable Bands Kit

A package of cable bands of various colors is provided to distinguish the individual SMA--to-BNC cables after installation.

Installing the NVIDIA Quadro FX 4500 SDI

Step 1: Install the NVIDIA Quadro FX 4500 SDI

1 Power down the system and open the chassis cover.

2 Install the NVIDIA Quadro FX 4500 card

a Insert the graphics card into the x16 PCI-express slot and use a screw to secure the card's bracket to the system chassis.

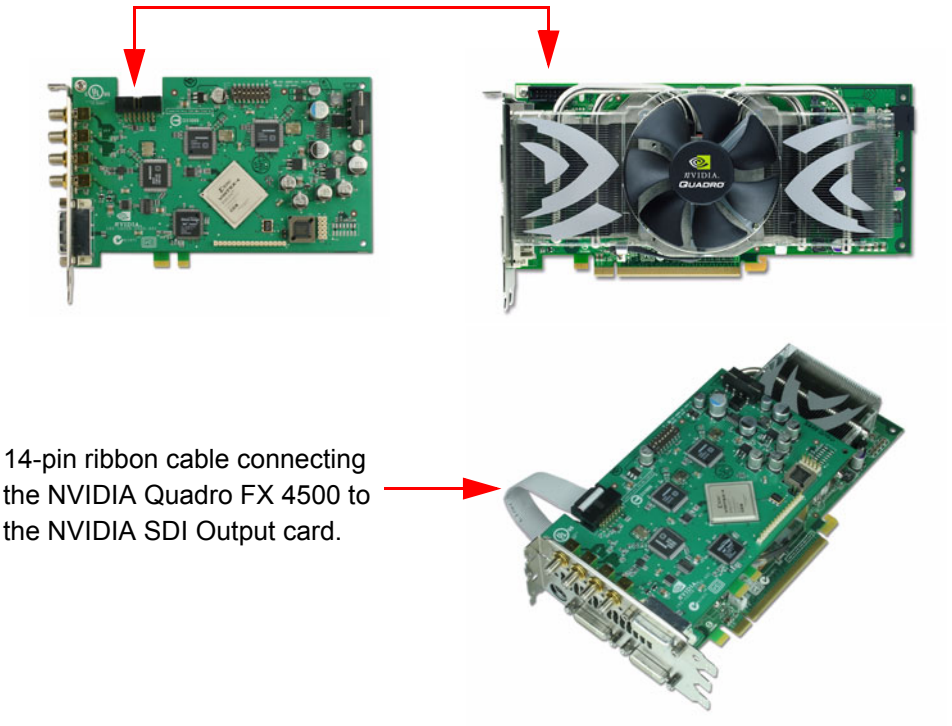
b Connect the auxiliary power connector.

3 Install the NVIDIA SDI Output card.

Insert the NVIDIA SDI Output card into any available expansion slot within six inches of the NVIDIA Quadro FX 4500 G-Sync connector, and use a screw to secure the card's bracket to the system chassis.

Power to the auxiliary power connection is not needed at this time. NVIDIA recommends not connecting power to this connection.

4 Connect one end of the 14-pin ribbon cable to the G-Sync connector on the NVIDIA Quadro FX 4500 card, and the other end to the NVIDIA SDI Output card.



5 Close the chassis cover.

Step 2: Connect the Auxiliary Cabling and Monitor

1 (Optional) Install the identification color bands.

Use the provided color bands to assist in properly identifying the function associated with each SMA-to-BNC cable.

a Using a different color for each SMA-to-BNC cable, place the band over the SMA-connector end (the smaller end) and push up to the BNC-connector end.

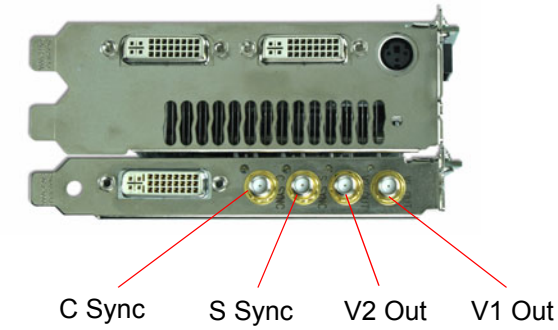
b Position the band snugly over the wide portion of the insulation next to the BNC connector.

2 Connect the SMA-to-BNC Cables.

Screw the male SMA connector onto the female SMA connector on the SDI output card.

Note: Use care when connecting, disconnecting, or handling the cables that you do not break the center conductor on the SMA connector.

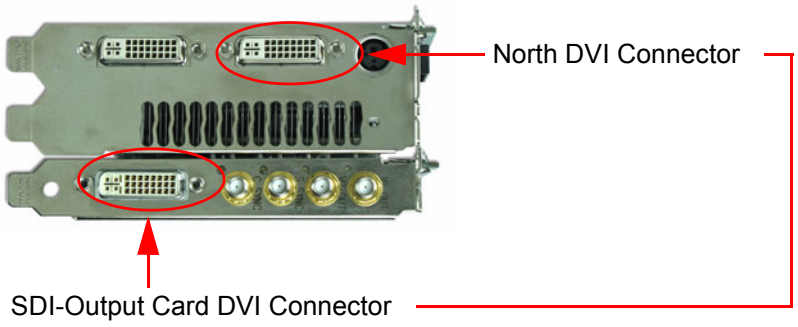
3 Record which color corresponds to the individual connector:



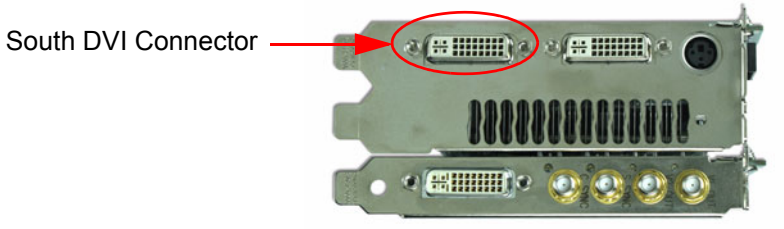
4 Connect the DVI Connectors.

Connect one end of the DVI cable to the DVI connector on the SDI Output card, and the other end to the "north" DVI connector on the NVIDIA Quadro FX 4500 card.

The cable must be connected to the "north" DVI connector. The NVIDIA Quadro FX 4500 SDI will ***not*** work properly if the cable is connected to the "south" DVI connector.



5 Connect your display to the “south” DVI connector on the graphics card.



Step 3: Install the NVIDIA ForceWare Graphics Drivers

If you will be installing new graphics drivers for the NVIDIA Quadro FX 4500 SDI card, it is highly recommended that you uninstall any previous version of the NVIDIA ForceWare graphics driver software before installing updated graphics drivers.

1 Follow the instructions on the NVIDIA.com Web site driver download page to locate the appropriate driver to download, based on your hardware and operating system.

2 Click the driver download link.

The license agreement dialog box appears.

3 Click **Accept** if you accept the terms of the agreement, then either open the file or save the file to your PC and open it later.

Opening the EXE file launches the NVIDIA InstallShield Wizard.

4 Follow the instructions in the NVIDIA InstallShield Wizard to complete the installation.

Operating NVIDIA SDI

The following sections provide an overview of SDI operation:

Understanding the Connections

Figure 2.1 shows the available SDI and external sync connectors on the NVIDIA Quadro FX 4500 SDI.

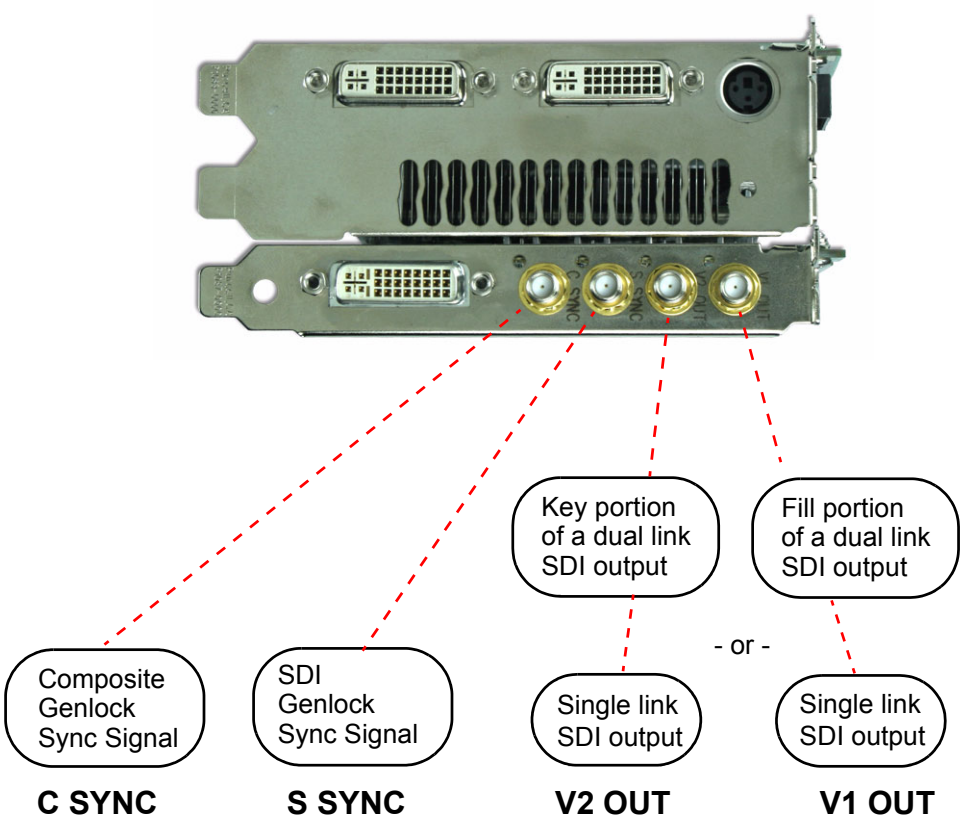


Figure 2.1 NVIDIA Quadro FX 4500 SDI Connectors

Connecting the SDI Video Output

Refer to Figure 2.1.

- 4:4:4/4:2:2:4/4:4:4:4 dual-link signals are sent to the **V1 Out** and **V2 Out** connectors (corresponding to the fill + key signals respectively).
- 4:2:2 single-link signals are sent to the **V1 Out** connector only.

  In application control mode, using the APIs, an additional 4:2:2 signal can be sent to the **V2 Out** connector.

Connecting to an External Sync Source

- You can genlock the output to an external digital or analog sync source.

  NVIDIA Genlock supports the following two external synchronization signal types:

  - SDI
  - Composite, which can be one of the following:

    Composite Bi-level (NTSC or PAL sources use bi-level composite signals.)

    Composite Tri-level (HDTV sources commonly use tri-level composite signals.)
- To use an external sync source, connect the sync signal to the appropriate BNC connector as indicated in Figure 2.1.

  You can connect to both types of sync sources at the same time. The software gives precedence to the SDI signal, but you can use the control panel to choose which signal to use (see "Synchronizing the SDI Output to an External Source" on page 22.)

About the Software

The NVIDIA SDI software lets you specify the

- SDI signal format
- Color formats
- Synchronization method
- Gamma correction

Graphics-to-SDI functionality can be set up and controlled in two basic ways—using the NVIDIA control panel or using the NVIDIA SDI API.

Using the SDI APIs

The SDI application programming interface allows OpenGL applications to have full and exclusive control of the SDI output. This is also known as extended mode.

When the SDI output is under application control, you can use the NVIDIA **Graphics to SDI** property page to view the SDI hardware status.

- See the chapter "API Control" on page 43 for a description of the graphics-to-video-out API calls.
- Also, refer to the document *Programming the NVIDIA Quadro FX 4000/4500 SDI* for instructions on using the APIs.

Using the Control Panel

When the SDI output is not being controlled by an application, you can use the NVIDIA graphical user interface to

- Specify the SDI signal format, output format, and then enable the SDI output.
- Configure the external synchronization signal if needed.

This is also known as transparent mode. In this mode, the SDI software works on top of existing applications, and the active workstation desktop or full screen application display is automatically forwarded to the SDI video outputs.

- For detailed intructions under Windows, see the chapter "Windows–Using the Graphics to SDI Control Panel" on page 15.
- For detailed instruction under Linux, see the chapter "Linux—Using the Graphics to Video Out Control Panel" on page 31.

Recommended Operating Practices

This section provides some basic operating practices to follow in order to obtain the best SDI performance for your application.

Initial On-Air Broadcast

When starting a live broadcast of SDI video, follow the sequence below to ensure proper allocation of system resources and to prevent visual disturbances in the on air broadcast.

1. Set up the SDI format settings and start the SDI output
2. Start the application to be broadcast
3. Verify the video quality
4. Close the Graphics to SDI control panel
5. Go on air

   To avoid visual disturbances while broadcasting live, DO NOT

   - Start or stop the graphics or video application
   - Turn on or off the SDI output
   - Make changes to the SDI signal format

Changing Applications

To avoid visual disturbances while switching applications, observe the following sequence:

1. Stop the live broadcast (go off air)
2. Stop the application
3. Start the new application
4. Verify video quality
5. Resume the live broadcast

Changing Video Formats

When changing any of the SDI settings, visual disturbances might occur as the video resets to the new settings. To prevent such disturbances from being visible to the public or from being recorded, observe the following sequence when making changes to any SDI setting:

1. Stop the live broadcast (go off air)
2. Change video format or SDI settings
3. Verify video quality
4. Resume the live broadcast

When Using the Control Panel

NVIDIA recommends the following

- Set the desktop to the same or higher resolution than the SDI output for better image quality.
- Close all background applications—such as virus scan, backup, and archiving applications—before starting the SDI output and going on air.
- Close the Display Properties panel before going on air.
- When running multiple OpenGL applications, tearing may occur if the applications are not synchronized.

  In general, NVIDIA does not recommend running multiple OpenGL applications when starting the SDI output or when going live.

Running Multiple OpenGL Applications

To maximize the system resources and bandwidth available for converting graphics to SDI output, NVIDIA recommends broadcasting only one OpenGL application at a time.

CHAPTER

3

WINDOWS–USING THE GRAPHICS TO SDI CONTROL PANEL

This chapter explains how to set up the NVIDIA Quadro FX 4500 SDI graphics card under Windows using the NVIDIA **Graphics to SDI** properties page—also known as transparent mode. It contains the following sections:

How to Set Up the SDI Output

Basic SDI Setup

To ensure proper operation, NVIDIA recommends the following -

- ***Set the desktop resolution to be the same or larger than the SDI output for better image quality***
- ***Stop background applications—such as virus scan, backup and archiving applications—prior to starting SDI output and going on air.***
- ***Close the control panel before going on air.***
- ***When running multiple OpenGL applications, synchronize them, otherwise tearing may occur.***

Step 1: Enable the Graphics to SDI Property Page

1 Open the NVIDIA **Graphics to SDI** property page.

a Right click the desktop, then from the pop-up menu, click **NVIDIA Display**->[your monitor].

b Click the **Graphics to SDI** tree item from the slide-out tray.

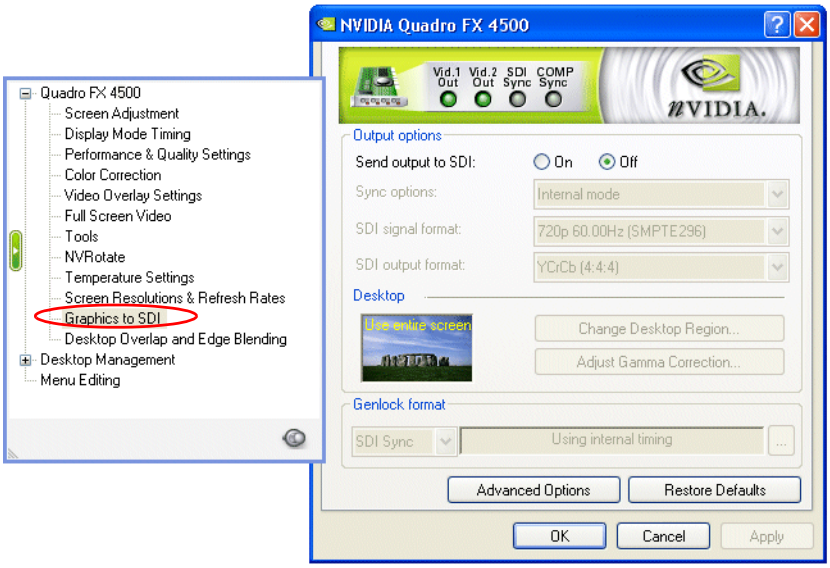


Figure 3.1 Graphics to SDI Page

2 In the **Output Options** group box, click **On** for **Send Output to SDI**.

If you have enabled Dualview mode, this option is grayed out and the panel says "Send SDI output to: NVIDIA SDI". See "Dualview Mode" on page 53 for instructions on enabling Dualview mode.

Step 2: Choose a Synchronization Method

Click the **Sync Option** arrow and then click the method you want to use to synchronize the SDI output:

- **Internal:** The SDI output will be synchronized with the timing chosen from the SDI signal format list.
- **Genlock:** The SDI output will be synchronized with the external sync signal.
- **Frame Lock:** The SDI output will be synchronized with the timing chosen from the SDI signal format list.

  This list is limited to timings that can be synchronized with the detected external sync signal.

For more information regarding genlock and frame lock, see the section "Synchronizing the SDI Output to an External Source" on page 22.

Step 3: Specify the SDI Signal Format

The SDI signal format controls the video resolution, field rate, and SMPTE signalling standard for the outgoing video stream.

Click the **SDI signal format** arrow and then click the signal format you want to use.

Note: Your options for this setting depend on which Sync option you chose in the previous step.

- If you chose *genlock synchronization*, the sync source controls the SDI signal format. The list box will be grayed out, preventing you from choosing another format.
- If you chose *frame lock synchronization*, only those modes that are compatible with the detected sync signal will appear in the SDI signal format list.

Step 4: Specify the SDI Output Format

The SDI output format controls the color model, data packing, and alpha or z components in the outgoing video stream.

Click the **SDI output format** arrow and then click the color format you want to use.

Step 5: Apply and Verify the Changes

Click **OK** or **Apply** to put the new settings into effect.

The Graphics to SDI property page banner indicates the status of the SDI output as well as the external synchronization signals. Figure 3.2 shows the correlation between the indicators on the banner and the actual connectors..

Figure 3.2 Connection Status Indicators

The activity of the LED graphics indicates the signal status as follows:

- **Vid. 1 Out** or **Vid. 2 Out**

Status	Meaning
Off (gray)	SDI output is not in use
Blinking Green	SDI output is active and is in HD mode.
Blinking Yellow	SDI output is active and is in SD mode.

- **SDI Sync**

Status	Meaning
Off (gray)	SDI synchronization signal is not present or not detected.
Blinking Green	SDI synchronization signal is detected in HD mode.
Blinking Yellow	SDI synchronization signal is detected in SD mode.
Steady Yellow	SDI synchronization error has occurred.

- **COMP Sync**

Status	Meaning
Off (gray)	Composite synchronization signal is not present or not detected.
Blinking Green	Composite synchronization signal is detected.

Advanced Adjustments

This section describes the following additional settings that you can control using the Graphics to SDI page:

- "Adjusting the Desktop Area" on page 19
- "Applying Gamma Correction" on page 21

Adjusting the Desktop Area

By default, the entire desktop is converted to SDI output. If the desktop is smaller than the size of the SDI output, it will be scaled to fit. If the desktop is larger than the SDI output, it will be cropped to fit.

Instead of using the entire desktop, you can specify a region of the desktop to convert to SDI output as follows:

1 In the **Desktop** group box, click **Change Desktop region**.

The display property page minimizes and the SDI Output dialog box appears. Superimposed over the desktop is a rectangular outline that shows the region that will be used for SDI output.

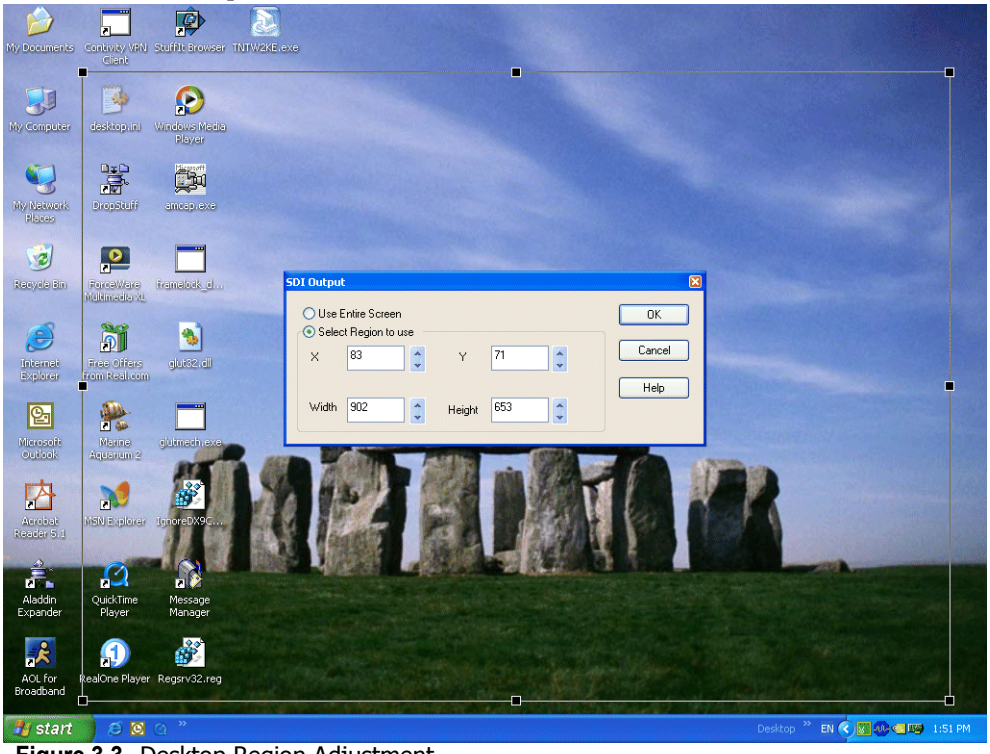


Figure 3.3 Desktop Region Adjustment

2 Click the **Select Region to use** option.

3 Adjust the region size.

- Click and drag within the rectangular outline to adjust the position on the desktop.
- Click and drag the appropriate corner or side grab handles to resize.
- You can also adjust the region by specifying the **X**, **Y**, **Width**, and **Height** values in the **SDI Output** dialog box. Either enter pixel values directly into the corresponding text boxes or click the up and down arrows by the appropriate box.

Note: The **X** and **Y** values indicate the pixel distance of the upper left corner of the output box from the upper left corner of the desktop.

4 Click **OK** when finished.

The desktop graphic image shows a thumbnail preview of the desktop region that you have set up for SDI output.

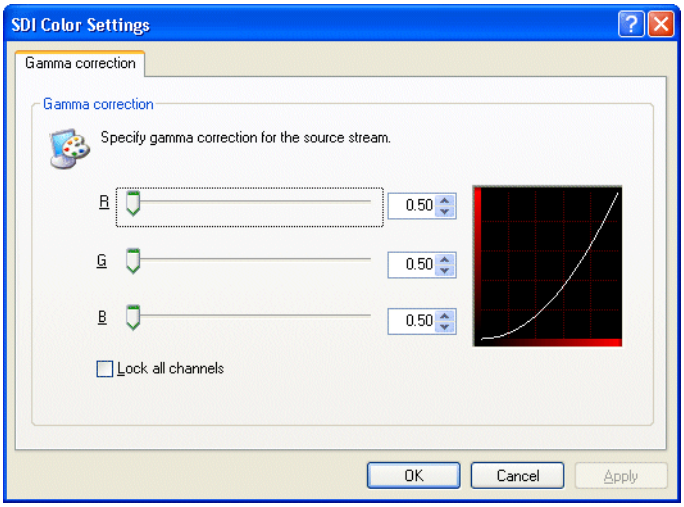
5 Click **OK** or **Apply** to put the settings into effect.

Applying Gamma Correction

To specify the gamma correction to use for the source stream:

1 In the Desktop group box, click Adjust Gamma Correction.

The SDI Color Settings dialog box appears.



2 Specify the RGB Gamma values using one or more of the following methods:.

- Click and drag the slider for the appropriate R, G, or B setting
- Specify the R, G, or B gamma value by entering a value in the text box or using the up and down arrows.
- Click and drag the handle in the graphic.
- To keep all gamma channels at the same value while you adjust them simultaneously, click the **Lock all channels** option.

3 Click **OK** when finished.

Synchronizing the SDI Output to an External Source

You can synchronize the SDI output with other equipment in a broadcast or post production environment.

Genlock Versus Frame Lock

The **Graphics to SDI** page provides two methods for synchronizing the SDI output to a common sync source—Genlock and Frame lock.

Using Genlock

Genlock synchronizes the pixel scanning of the SDI output to an external synchronization source.

When using genlock, the SDI refresh rate is determined by the sync source, so any refresh rates that you may have chosen in the **SDI signal format** list do not apply.

Using Frame Lock

Frame lock synchronizes the frame rate of the SDI output to an external synchronization source.

When using frame lock, only modes that are valid for the frame rate of the sync source can be used for the SDI output. The valid modes will appear in the **SDI signal format** list.

Supported Synchronization Signals

NVIDIA Genlock supports the following external synchronization signal types:

- SDI
- Composite Bi-level (NTSC or PAL sources use bi-level composite signals.)
- Composite Tri-level (HDTV sources commonly use tri-level composite signals.)

Synchronization Instructions

Basic Setup Summary

The following are the basic steps to synchronize the SDI output.

1 Connect the external sync source to the appropriate BNC connector on the graphics card.

See "Understanding the Connections" on page 10 for instructions on connecting the external sync signal to the graphics card.

2 Configure the sync source.

Use the **NVIDIA Graphics to SDI** property page to configure the SDI output synchronization.

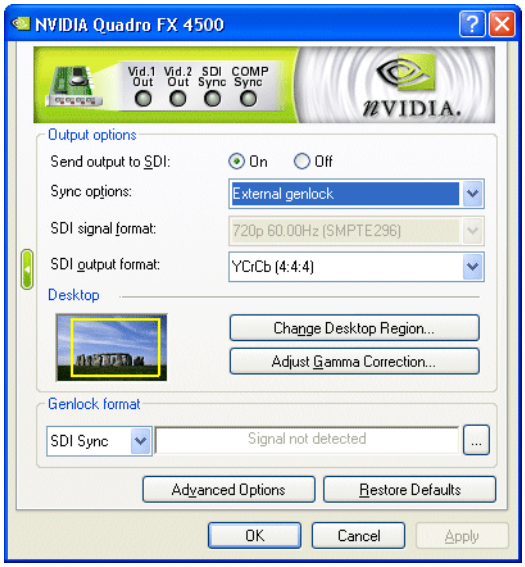


Figure 3.4 Graphics to SDI Page—Configuring an External Sync Source

a Click the **Sync Options** list arrow and then click either **External genlock** or **External framelock** synchronizing modes.

b If you chose external frame lock synchronization, click the **SDI signal format** arrow and then click the signal format you want to use.

Only those modes that are compatible with the detected sync signal will appear in the SDI signal format list.

c Click **Apply**.

Detecting the External Sync Signal Source

The software should automatically detect the external sync signal. When it does, the sync format information appears in the **Genlock/Framelock format** text box.

If you have both SDI and Composite signals connected -

- The software automatically chooses the SDI signal.
- If you want to switch to the composite signal, click the arrow in the **Genlock/ Framelock format** group box and then click COMP Sync.

If the software fails to automatically detect the signal -

-  If the software loses the external sync signal or does not detect it automatically, click the signal detect button to force detection of the sync signal.
- For composite signals, if the software is unable to automatically detect the correct signal type–either bi-level or tri-level– click the **Genlock/Framelock format** list box arrow and then click the COMP option corresponding to your sync source.

Adding a Delay to the Signal

You can introduce a slight delay in the genlocked or frame locked SDI output. For example, if delivery of video from other equipment is delayed because of greater cable length, you can introduce a delay in the SDI output from this card so that both deliveries are in sync. To introduce a synchronization delay:

1 Click **Advanced Options** from the **Graphics to SDI** page.

The **SDI Advanced Options** window appears.

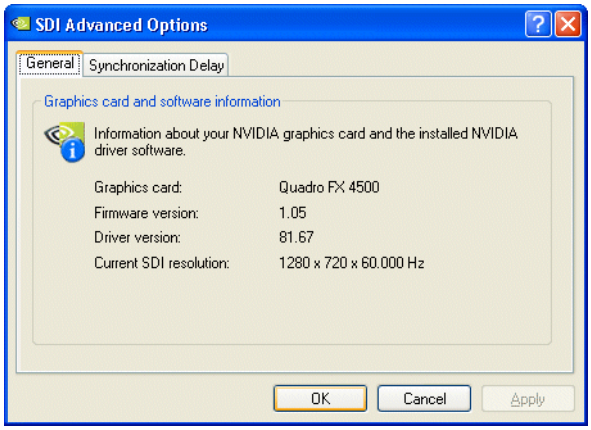


Figure 3.5 SDI Advanced Options Window

2 Click the **Synchronization Delay** tab.

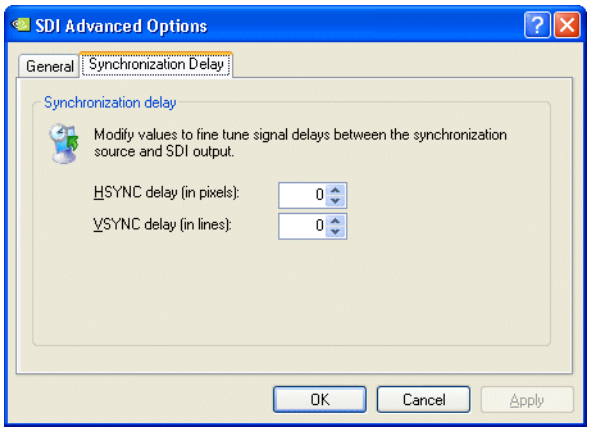


Figure 3.6 Synchronization Delay Page

3 Introduce delays in the HSYNC and VSYNC signals as needed by clicking the appropriate up and down arrows.

You can also enter values directly into the text boxes.

4 Click **OK** or **Apply** when finished.

Viewing System Information

To view information about the graphics card and the installed driver software, click **Advanced Options** from the **Graphics to SDI** page.

The **General tab** shows the graphics card model, firmware version, driver version and current SDI resolution.'

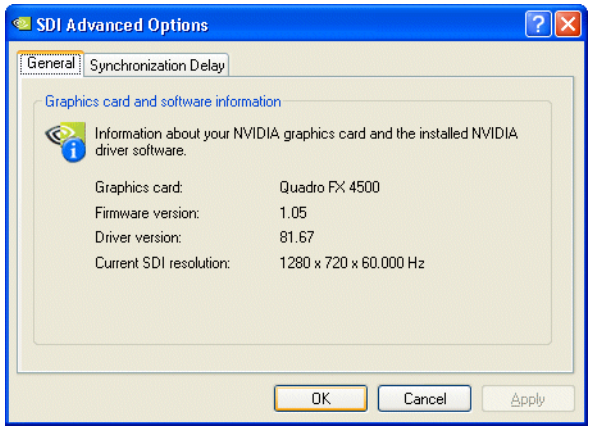


Figure 3.7 SDI Advanced Options—General tab

Using SDI Under Dualview

In the default configuration, the SDI output is a clone of the display output. The NVIDIA Quadro FX 4500 SDI graphics card also supports Dualview mode, where the desktop extends across two monitors.

About Dualview Mode

Under Dualview mode, you can define one large desktop that extends from the display to the SDI output. This lets you move windows between the SDI output and the graphics (DVI) display part of the extended desktop.

With applications that use video overlay or Microsoft VMR, you can also display the video full-screen on the SDI output.

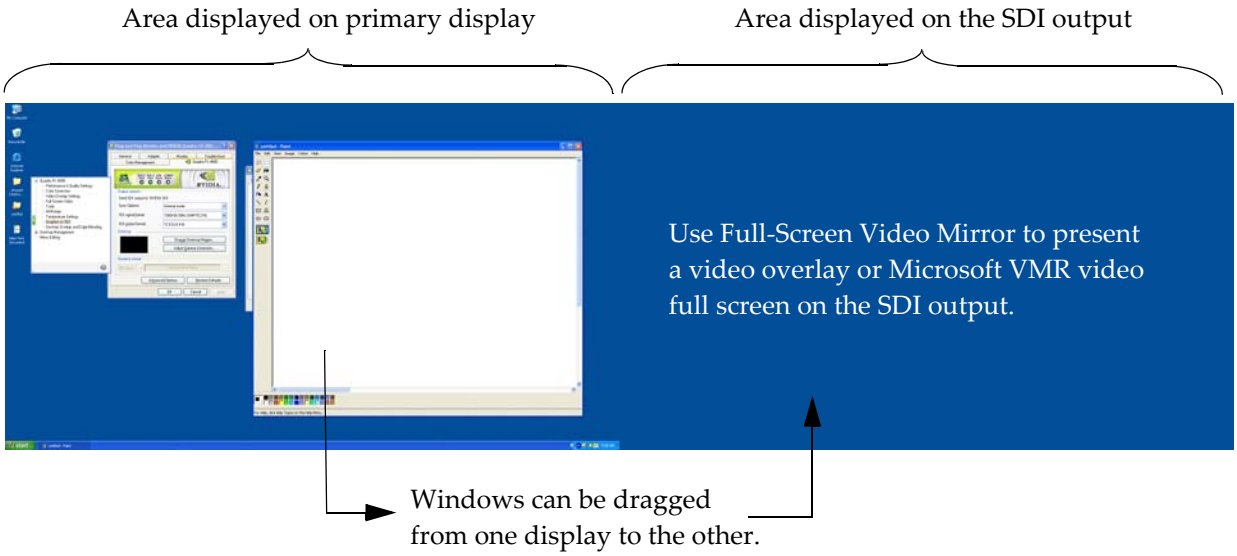


Figure 3.8 Extended Desktop with Dualview Mode

The display and the SDI output do not need to be the same resolution and refresh rate.

Refer to the document *Quadro Workstation User's Guide* for more information regarding Dualview mode and the NVIDIA graphics drivers.

How to Enable Dualview Mode

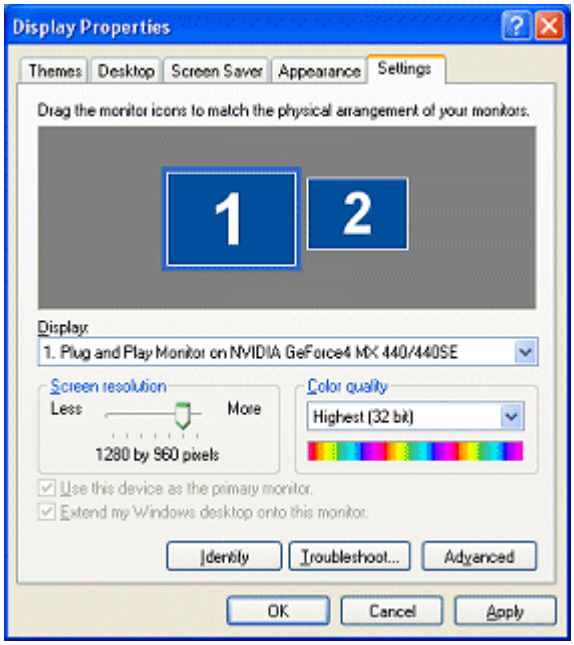
To enable Dualview mode:

1 Right-click the desktop, then from the pop-up menu, click **Properties.**

The Display Properties page appears.

2 From the Display Properties page, click the Settings tab.

The Settings page appears.



3 Click the monitor icon that is grayed (not attached) and then check the **Extend my Windows desktop onto this monitor** check box.

4 Click **OK** or **Apply**.

The SDI settings last set in the Graphics to SDI control panel are preserved under Dualview mode.

Changing SDI Settings Under Dualview

To change the SDI settings once Dualview is enabled,

1. Open the Microsoft Display Properties Settings page as described in steps 1 and 2 above
2. Right-click Display #2, then from the pop-up menu click Properties.
3. Click the Quadro FX 4000/4500 SDI tab and then click the **Graphics to SDI** tree item from the side menu.

You can now change the SDI settings for the 2nd display, or SDI output. Because Dualview is enabled, the Enable/Disable controls are not available and the panel says "Send SDI output to: NVIDIA SDI".

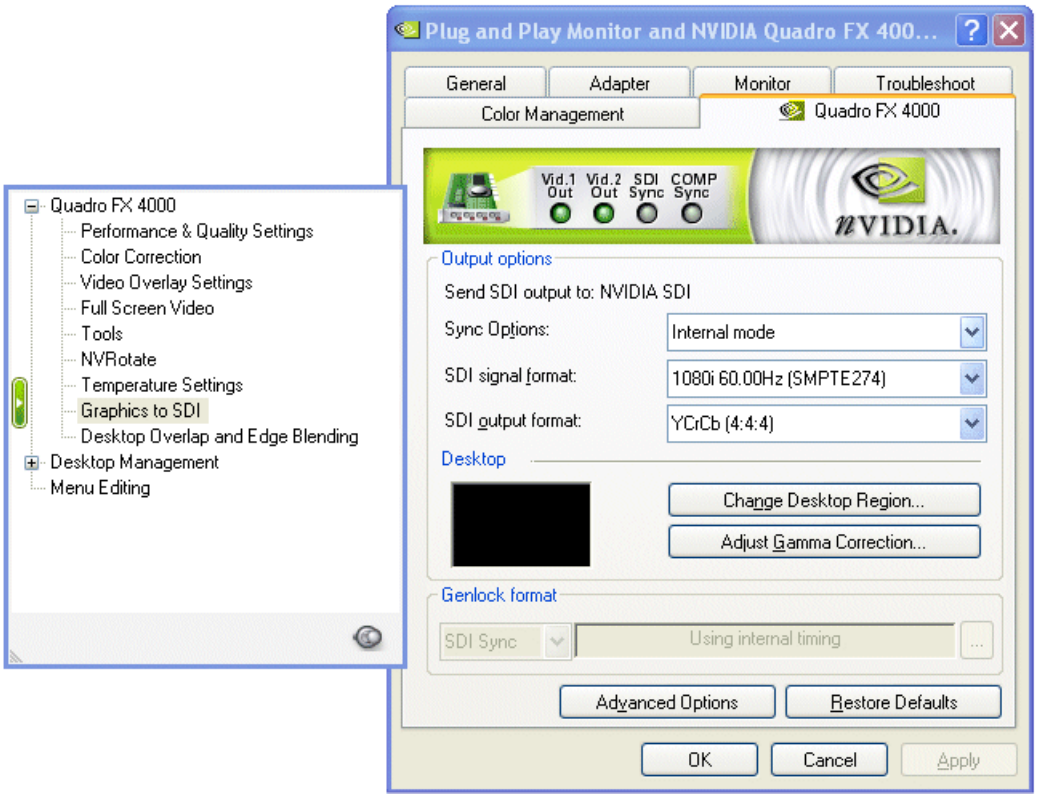


Figure 3.9 Graphics to SDI Page with Dualview Enabled

CHAPTER

4

LINUX—USING THE GRAPHICS TO VIDEO OUT CONTROL PANEL

This chapter explains how to set up the NVIDIA Quadro FX 4500 SDI graphics card under Linux using the NVIDIA **Graphics to Video Out** properties page[1].

It contains the following sections:

- "How to Set Up the SDI Output" on page 32 provides step-by-step instructions for using the control panel to set up the SDI output.
- "Synchronizing the SDI Output to an External Source" on page 38 explains in more detail the genlock and frame lock features.

1. This method of controlling the SDI output is also known as 'transparent mode'.

How to Set Up the SDI Output

Basic SDI Setup

To ensure proper operation, NVIDIA recommends the following -

- ***Set the desktop resolution to be the same or larger than the SDI output for better image quality***
- ***Stop background applications—such as virus scan, backup and archiving applications—prior to starting SDI output and going on air.***
- ***Close the control panel before going on air.***
- ***When running multiple OpenGL applications, synchronize them, otherwise tearing may occur.***

Step 1: Open the NVIDIA Graphics to Video Out Property Page

1 From the command line, enter "**`nvidia-settings`**"

The NVIDIA X Server Settings page appears.

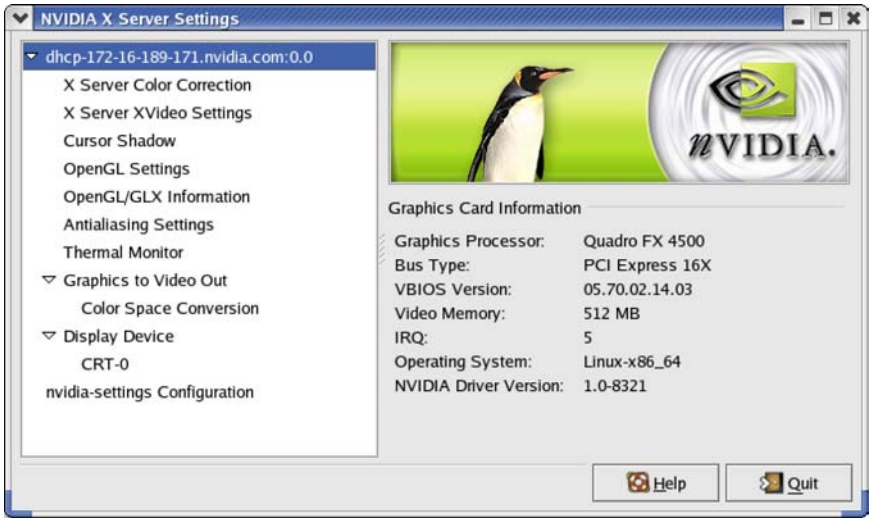


Figure 4.1 NVIDIA X Server Settings Page

2 Click the **Graphics to Video Out** tree item from the side menu.

The **Graphics to Video Out** page appears.

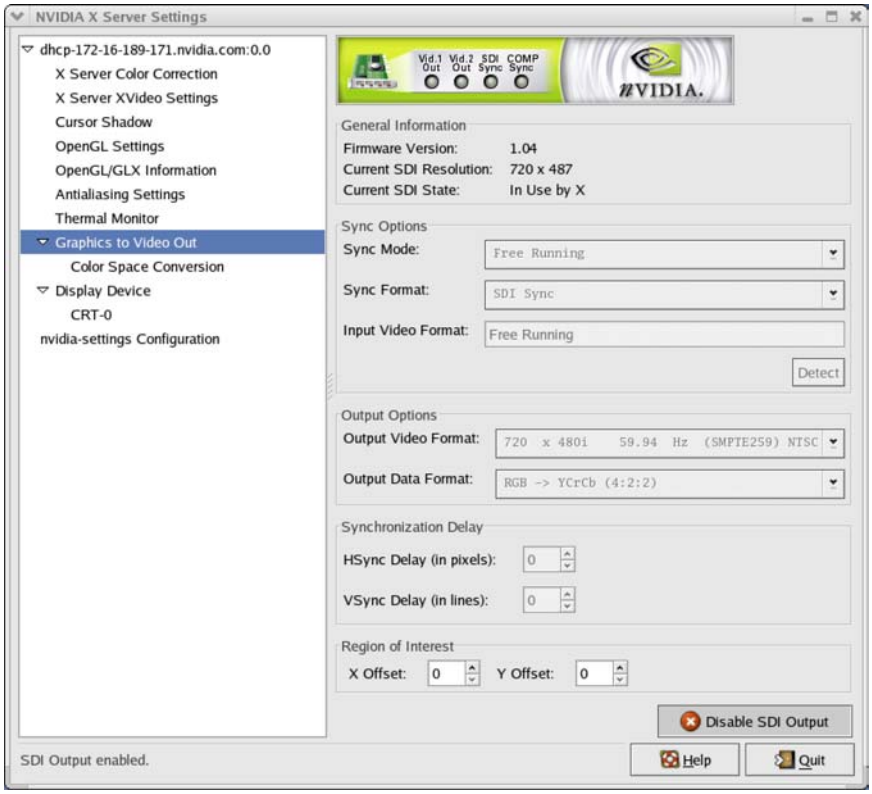


Figure 4.2 Graphics to Video Out Page

Step 2: Choose a Synchronization Method

From the **Sync Options** group box, click the **Sync Mode** list arrow and then click the method you want to use to synchronize the SDI output:

- **Free Running:** The SDI output will be synchronized with the timing chosen from the SDI signal format list.
- **Genlock:** The SDI output will be synchronized with the external sync signal.
- **Frame Lock:** The SDI output will be synchronized with the timing chosen from the SDI signal format list.

  This list is limited to timings that can be synchronized with the detected external sync signal.

For more information regarding genlock and frame lock, see the section "Synchronizing the SDI Output to an External Source" on page 38.

Step 3: Choose the Output Options

- **Output Video Format** controls the video resolution, field rate, and SMPTE signalling standard for the outgoing video stream.
- **Output Data Format** controls the color model, data packing, and alpha or z components in the outgoing video stream.

1 Specify the Output Video Format

From the **Output Options** group box, click the **Output Video Format** arrow and then click the signal format you want to use.

Note: Only those resolutions that your monitor supports appear in the Output Video Format list. Your options for this setting also depend on which Sync option you chose in the previous step.

- If you chose *genlock synchronization*, the sync source controls the output video format. The list box will be grayed out, preventing you from choosing another format.
- If you chose *frame lock synchronization*, only those modes that are compatible with the detected sync signal will appear in the Output Video Format list.

2 Specify the Output Data Format

From the **Output Options** group box, click the **Output Data Format** arrow and then click the color format you want to use.

Step 4: Verify the Changes

The settings go into effect immediately.

The Graphics to SDI property page banner indicates the status of the SDI output as well as the external synchronization signals. Figure 4.3 shows the correlation between the indicators on the banner and the actual connectors.

Figure 4.3 Connection Status Indicators

The activity of the LED graphics indicates the signal status as follows:

- **Vid. 1 Out** or **Vid. 2 Out**

Status	Meaning
Off (gray)	SDI output is not in use
Blinking Green	SDI output is active and is in HD mode.
Blinking Yellow	SDI output is active and is in SD mode.

- **SDI Sync**

Status	Meaning
Off (gray)	SDI synchronization signal is not present or not detected.
Blinking Green	SDI synchronization signal is detected in HD mode.
Blinking Yellow	SDI synchronization signal is detected in SD mode.
Steady Yellow	SDI synchronization error has occurred.

- **COMP Sync**

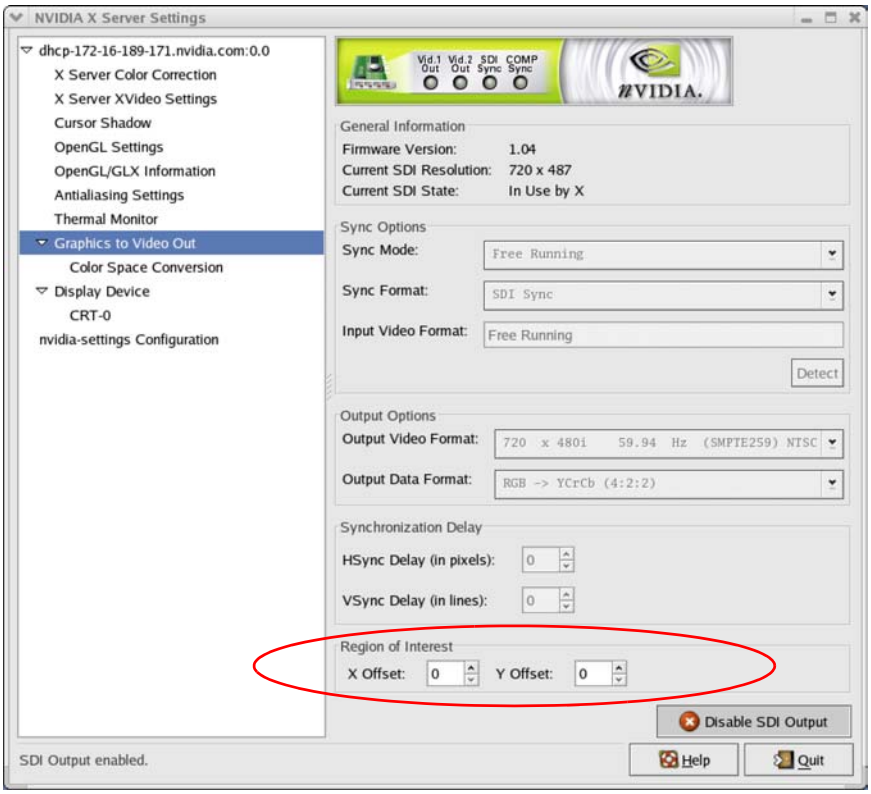
Status	Meaning
Off (gray)	Composite synchronization signal is not present or not detected.
Blinking Green	Composite synchronization signal is detected.

Advanced Adjustments

This section describes the following additional settings that you can control using the Graphics to SDI page:

Adjusting the Desktop Area

By default, the entire desktop is converted to SDI output. If the desktop is smaller than the size of the SDI output, it will be scaled to fit. If the desktop is larger than the SDI output, it will be cropped to fit. Instead of using the entire desktop, you can specify a region of the desktop to convert to SDI output as follows:



In the Region of Interest group box, adjust the region size by specifying the **X Offset** and **Y Offset** values. Either enter pixel values directly into the corresponding text boxes or click the up and down arrows by the appropriate box.

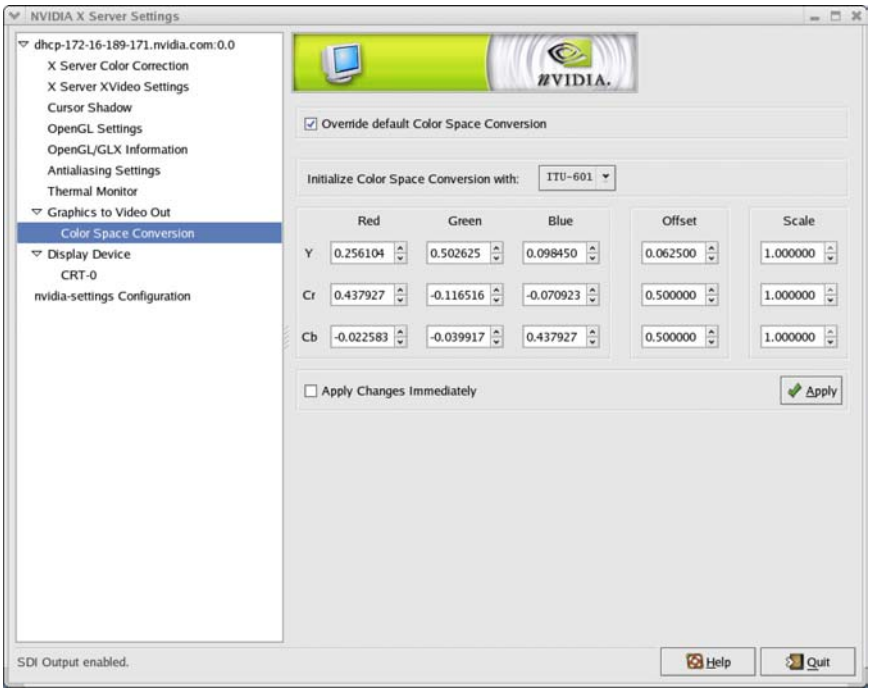
Note: The **X** and **Y** values indicate the pixel distance of the upper left corner of the output box from the upper left corner of the desktop.

Customizing the Color Space Conversion

To set your own RGB color space conversion:

1 Click the **Color Space Conversion** tree item from the side menu.

The Color Space Conversion page appears.



2 Check **Override default Color Space Conversion**.

3 Click the **Initialize Color Space Conversion with** list arrow and then click one of the standards to use as a starting point: ITU-601, 709, 177, or Identity.

4 Either enter values directly in the text boxes or use the corresponding up and down arrows to change any of the settings.

5 Click **Apply** to apply the settings.

To apply the settings as you change them, check **Apply Changes Immediately**.

Synchronizing the SDI Output to an External Source

You can synchronize the SDI output with other equipment in a broadcast or post production environment.

Genlock Versus Frame Lock

The **Graphics to SDI** page provides two methods for synchronizing the SDI output to a common sync source—Genlock and Frame lock.

Using Genlock

Genlock synchronizes the pixel scanning of the SDI output to an external synchronization source.

When using genlock, the SDI refresh rate is determined by the sync source, so any refresh rates that you may have chosen in the **Output Video Format** list do not apply.

Using Frame Lock

Frame lock synchronizes the frame rate of the SDI output to an external synchronization source.

When using frame lock, only modes that are valid for the frame rate of the sync source can be used for the SDI output. The valid modes will appear in the **Output Video Format** list.

Supported Synchronization Signals

NVIDIA Genlock supports the following external synchronization signal types:

- SDI
- Composite Bi-level (NTSC or PAL sources use bi-level composite signals.)
- Composite Tri-level (HDTV sources commonly use tri-level composite signals.)

Synchronization Instructions

Basic Setup Summary

The following are the basic steps to synchronize the SDI output.

1 Connect the external sync source to the appropriate BNC connector on the graphics card.

See "Understanding the Connections" on page 10 for instructions on connecting the external sync signal to the graphics card.

2 Configure the sync source.

a Open the **Graphics to Video Out** page and click **Enable SDI Output**.

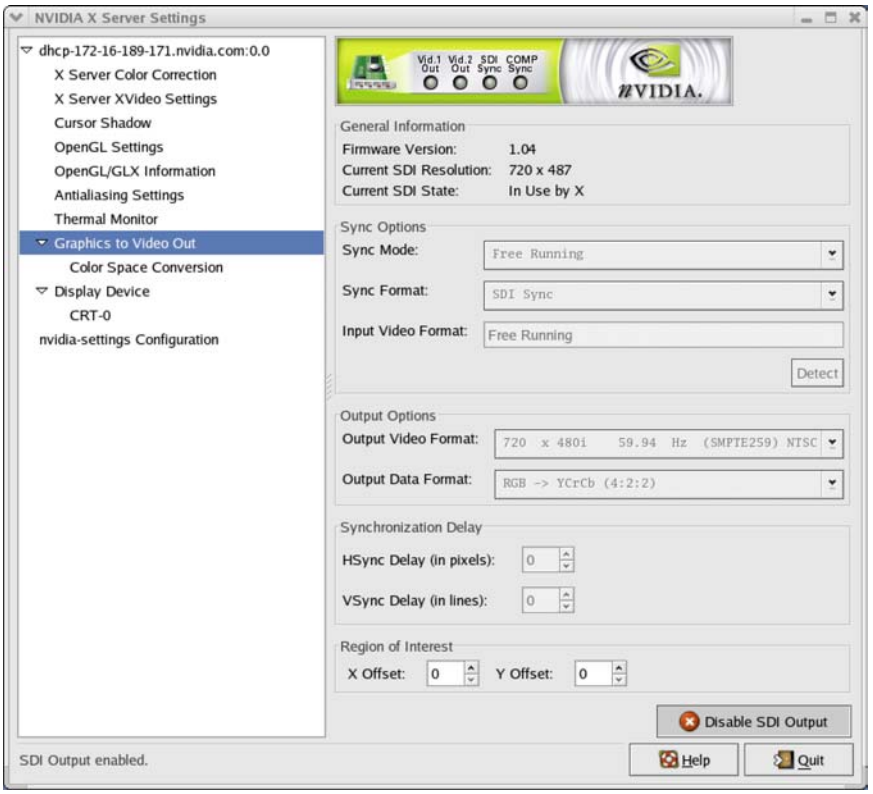


Figure 4.4 Graphics to Video Out Page

a Click the **Sync Mode** list arrow and then click either **Genlock** or **Framelock** synchronizing modes.

b If you chose frame lock synchronization, click the **Output Video Format** list arrow and then click the signal format you want to use.

Only those modes that are compatible with the detected sync signal will appear in the SDI signal format list.

Detecting the External Sync Signal Source

The software should automatically detect the external sync signal. When it does, the sync format information appears in the **Input Video Format** text box.

If you have both SDI and Composite signals connected -

- The software automatically chooses the SDI signal.
- If you want to switch to the composite signal, click the **Sync Format** list arrow and then click COMP Sync.

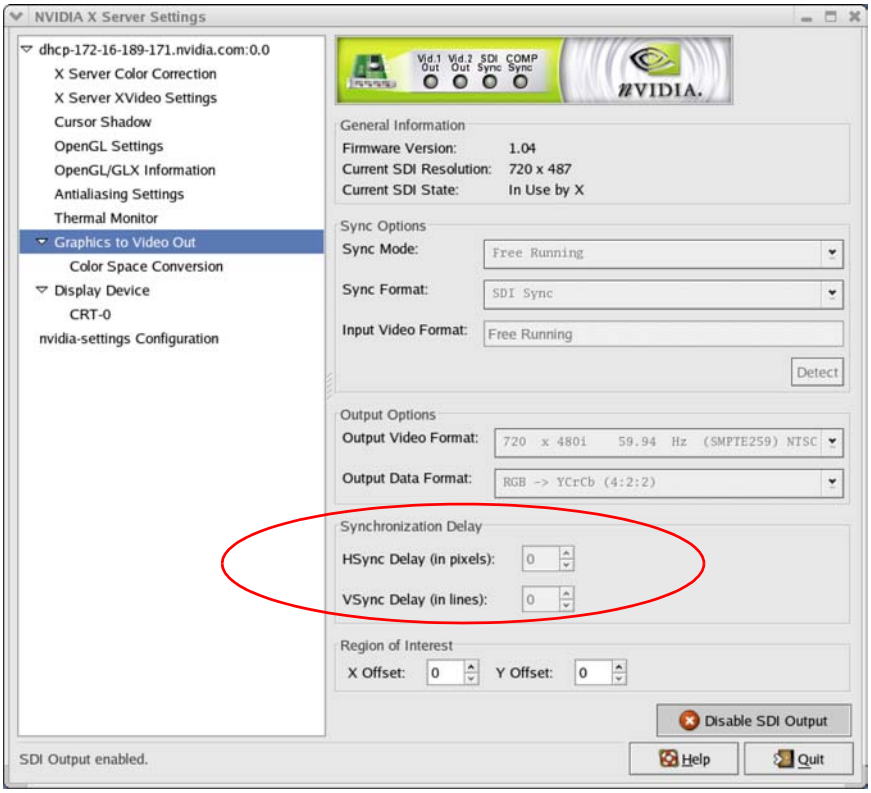
If the software fails to automatically detect the signal -

- Detect If the software loses the external sync signal or does not detect it automatically, click **Detect** to force detection of the sync signal.
- For composite signals, if the software is unable to automatically detect the correct signal type–either bi-level or tri-level– click the **Sync Format** list arrow and then click the COMP option corresponding to your sync source.

Adding a Delay to the Signal

You can introduce a slight delay in the genlocked or frame locked SDI output. For example, if delivery of video from other equipment is delayed because of greater cable length, you can introduce a delay in the SDI output from this card so that both deliveries are in sync. To introduce a synchronization delay:

1 Open the **Graphics to Video Out** page and click **Enable SDI Output**.



2 In the Synchronization Delay group box, introduce delays in the HSYNC and VSYNC signals as needed by clicking the appropriate up and down arrows.

You can also enter values directly into the text boxes.

CHAPTER

5

API CONTROL

The SDI application programming interface allows OpenGL or Direct3D applications to have full and exclusive control of the SDI output. This method of controlling the SDI output is also known as extended mode.

This chapter gives a brief introduction to this method of implementing graphics to SDI, and includes the following sections:

Refer to the following documents for additional information on using the APIs:

- *Programming the NVIDA Quadro FX 4000/4500 SDI*
- The *NVGVOSDK* , which can be obtained from NVIDIA.

SDI Application Programming Overview

Application programming of the NVIDIA Quadro FX 4000/FX4500 SDI consists of two principle parts–device control and data transfer.

- **Device contro**l handles the hardware configuration as well as the starting and stopping of data transfers.

  This chapter covers the APIs related to data control.

- **Data transfer** is the sequence of operations that send graphics data to the video device for output.

Under WindowsXP

- **Device control** is handled by the NvGvo API, described in this chapter.
- **Data transfer** operations are performed by the OpenGL extension WGL_NV_video_out.

Under Linux

- **Device control** is handled by the NV-CONTROL X extension, described in this chapter.
- **Data transfer** operations are performed by the OpenGL extension GLX_NV_video_output.

Windows XP NvGvo API Description

This section describes the NvGvo APIs inthe following sections:

Viewing the SDI Hardware Status

When the SDI output is under application control, you can use the NVIDIA **Graphics to SDI** property page to view the SDI hardware status.

To view the SDI status using the NVIDIA **Graphics to SDI** property page

1 Open the Windows Display Properties control panel, click **Settings>Advanced,** and then click the Quadro FX 4500 tab to open the NVIDIA graphics card display properties page.

2 Click the **Graphics to SDI** tree item from the slide-out tray.

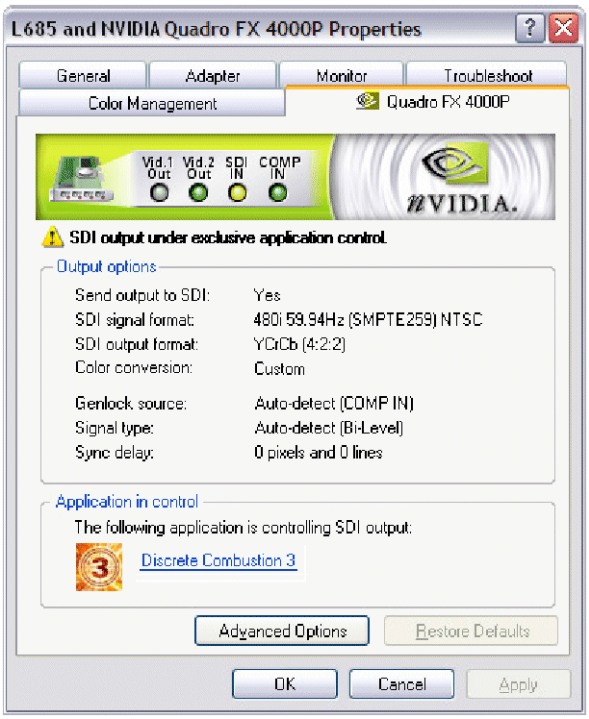


Figure 5.1 Graphics to SDI Page—Application Control

NvGvo Function Description

Table 5.1 NvGvo Function Index

Call	Description
NvGvoCaps()	Determine the graphics-to-video capabilities of the graphics card.
NvGvoOpen()	Open the graphics card for graphics-to-video operations using the OpenGL application interface.
NvGvoClose()	Close the graphics card for graphics-to-video operations using the OpenGL application interface.
NvGvoDesktopOpen()	Open the graphics cards for graphics-to-vVideo operations using the Desktop transparent mode interface.
NvGvoDesktopClose()	Close the graphics cards for graphics-to-video operations using the Desktop transparent mode interface.
NvGvoStatus()	Get the graphics-to-video status.
NvGvoSyncFormatDetect()	Detect the video format of the iincoming sync signal.
NvGvoConfigGet()	Get the current graphics-to-video configuration.
NvGvoConfigSet()	Set the graphics-to-video configuration.
NvGvoIsRunning()	Determine if there is an SDI out video stream.
NvGvoStart()	Start the SDI out video stream.
NvGvoStop()	Stop the SDI out video stream.
NvGvoEnumSignalFormats()	Enumerate the supported SDI signal formats.
NvGvoIsFrameLockModeCompatible()	Verify whether a mode is compatible with frame lock mode.
NvGvoEnumDataFormats()	Enumerate the supported SDI data formats.

NvGvoCaps()

```
//--------------------------------------------------------------------
// Function:    NvGvoCaps
// Description: Determine  graphics adapter Graphics to Video capabilities.
// Parameters:  nAdapterNumber  - Graphics adapter number
//              nReserved       - Reserved (must be set to zero)
//              pAdapterCaps    - Pointer to receive capabilities
// Returns:     NV_OK           - Success
//              NV_NOTSUPPORTED - Graphics to Video not supported
//--------------------------------------------------------------------
```

```
NVRESULT NVAPIENTRY NvGvoCaps(UINT       nAdapterNumber IN,
                              UINT       nReserved      IN,
                              NVGVOCAPS* pAdapterCaps   OUT);
```

NvGvoOpen()

```
//---------------------------------------------------------------------
// Function:    NvGvoOpen
// Description: Open graphics adapter for Graphics to Video operations
//              using the OpenGL application interface.  Read operations
//              are permitted in this mode by multiple clients, but Write
//              operations are application exclusive.
// Parameters:  nAdapterNumber  - Graphics adapter number
//              nReserved       - Reserved (must be set to zero)
//              dwClass         - Class interface (NVGVOCLASS_* value)
//              dwAccessRights  - Access rights (NVGVO_O_* mask)
//              phGvoHandle     - Pointer to receive handle
// Returns:     NV_OK           - Success
//              NV_ACCESSDENIED - Access denied for requested access
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoOpen(UINT                 nAdapterNumber IN,
                              UINT                 nReserved      IN,
                              DWORD                dwClass        IN,
                              DWORD                dwAccessRights IN,
                              NVGVOHANDLE*         phGvoHandle    OUT);
```

NvGvoClose()

```
//---------------------------------------------------------------------
// Function:    NvGvoClose
// Description: Closes graphics adapter for Graphics to Video operations
//              using the OpenGL application interface.  Closing an
//              OpenGL handle releases the device.
// Parameters:  hGvoHandle - Handle to graphics adapter
// Returns:     NV_OK      - Success
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoClose(NVGVOHANDLE hGvoHandle IN);
```

NvGvoDesktopOpen()

```
//---------------------------------------------------------------------
// Function:    NvGvoDesktopOpen
// Description: Open graphics adapter for Graphics to Video operations
//              using the Desktop transparent mode interface.  Read
//              operations are permitted in this mode by multiple clients,
//              but write operations are application exclusive.
// Parameters:  nAdapterNumber  - Graphics adapter number
//              nReserved       - Reserved (must be set to zero)
//              dwClass         - Class interface (NVGVOCLASS_* value)
//              dwAccessRights  - Access rights (NVGVO_O_* mask)
//              phGvoHandle     - Pointer to receive handle
// Returns:     NV_OK           - Success
//              NV_ACCESSDENIED - Access denied for requested access
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoDesktopOpen(UINT                nAdapterNumber IN,
                                     UINT                nReserved      IN,
                                     DWORD               dwClass        IN,
                                     DWORD               dwAccessRights IN,
                                     NVGVOHANDLE*        phGvoHandle    OUT);
```

NvGvoDesktopClose()

```
//---------------------------------------------------------------------
// Function:    NvGvoDesktopClose
// Description: Closes graphics adapter for Graphics to Video operations
//              using the Desktop transparent mode interface.
// Parameters:  hGvoHandle  - Handle to graphics adapter
//              bGvoRelease - TRUE to release device when handle closes
//                            FALSE to remain in desktop mode when handle
//                                  closes (other clients can open using
//                                  NvGvoDesktopOpen and release using
//                                  NvGvoDesktopClose)
// Returns:     NV_OK       - Success
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoDesktopClose(NVGVOHANDLE hGvoHandle IN,
                                      BOOL        bRelease   IN);
```

NvGvoStatus()

```
//--------------------------------------------------------------------
// Function:    NvGvoStatus
// Description: Get Graphics to Video status.
// Parameters:  hGvoHandle - Handle to graphics adapter
// Returns:     NV_OK      - Success
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoStatus(NVGVOHANDLE  hGvoHandle IN,
                                NVGVOSTATUS* pStatus    OUT);
```

NvGvoSyncFormatDetect()

```
//--------------------------------------------------------------------
// Function:    NvGvoSyncFormatDetect
// Description: Detects Graphics to Video incoming sync video format.
// Parameters:  hGvoHandle - Handle to graphics adapter
//              pdwWait    - Pointer to receive milliseconds to wait
//                           before NvGvoStatus will return detected
//                           syncFormat.
// Returns:     NV_OK - Success
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoSyncFormatDetect(NVGVOHANDLE hGvoHandle IN,
                                          DWORD*      pdwWait    OUT);
```

NvGvoConfigGet()

```
//--------------------------------------------------------------------
// Function:    NvGvoConfigGet
// Description: Get Graphics to Video configuration.
// Parameters:  hGvoHandle - Handle to graphics adapter
//              pConfig    - Pointer to Graphics to Video configuration
// Returns:     NV_OK      - Success
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoConfigGet(NVGVOHANDLE  hGvoHandle IN,
                                   NVGVOCONFIG* pConfig    OUT);
```

NvGvoConfigSet()

```
//---------------------------------------------------------------------
// Function:    NvGvoConfigSet
// Description: Set Graphics to Video configuration.
// Parameters:  hGvoHandle      - Handle to graphics adapter
//              pConfig         - Pointer to Graphics to Video config
// Returns:     NV_OK           - Success
//              NV_ACCESSDENIED - Access denied (no write access)
//              NV_RUNNING      - Requested settings require NvGvoStop
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoConfigSet(NVGVOHANDLE        hGvoHandle IN,
                                   const NVGVOCONFIG* pConfig    IN);
```

NvGvoIsRunning()

```
//---------------------------------------------------------------------
// Function:    NvGvoIsRunning
// Description: Determine if Graphics to Video output is running.
// Parameters:  hGvoHandle      - Handle to graphics adapter
// Returns:     NV_RUNNING      - Graphics-to-Video is running
//              NV_NOTRUNNING   - Graphics-to-Video is not running
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoIsRunning(NVGVOHANDLE hGvoHandle IN);
```

NvGvoStart()

```
//---------------------------------------------------------------------
// Function:    NvGvoStart
// Description: Start Graphics to Video output.
// Parameters:  hGvoHandle      - Handle to graphics adapter
// Returns:     NV_OK           - Success
//              NV_ACCESSDENIED - Access denied (no write access)
//              NV_RUNNING      - Graphics to Video already running
//---------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoStart(NVGVOHANDLE hGvoHandle IN);
```

NvGvoStop()

```
//--------------------------------------------------------------------
// Function:    NvGvoStop
// Description: Stop Graphics to Video output.
// Parameters:  hGvoHandle      - Handle to graphics adapter
// Returns:     NV_OK           - Success
//              NV_ACCESSDENIED - Access denied (no write access)
//              NV_NOTRUNNING   - Graphics to Video not running
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoStop(NVGVOHANDLE hGvoHandle IN);
```

NvGvoEnumSignalFormats()

```
//--------------------------------------------------------------------
// Function:    NvGvoEnumSignalFormats
// Description: Enumerate signal formats supported by Graphics to Video.
// Parameters:  hGvoHandle          - Handle to graphics adapter
//              nEnumIndex          - Enumeration index
//              bByEnum             - TRUE nEnumIndex is NVSIGNALFORMAT_*
//                                    FALSE nEnumIndex is 0..n-1
//              pSignalFormatDetail - Pointer to receive detail or NULL
// Returns:     NV_OK               - Success
//              NV_NOMORE           - No more signal formats to enumerate
//              NV_NOTSUPPORTED     - Unsupported NVSIGNALFORMAT_ enumeration
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoEnumSignalFormats(NVGVOHANDLE       hGvoHandle       IN,
                                           int               nEnumIndex       IN,
                                           BOOL              bByEnum          IN,
                                           NVGVOSIGNALFORMATDETAIL*
pSignalFormatDetail OUT);
```

NvGvoIsFrameLockModeCompatible()

```
//--------------------------------------------------------------------
// Function:    NvGvoIsFrameLockModeCompatible
// Description: Checks whether modes are compatible in framelock mode
// Parameters:  hGvoHandle          - Handle to graphics adapter
//              nSrcEnumIndex       - Source Enumeration index
//              nDestEnumIndex      - Destination Enumeration index
//
//              pbCompatible        - Pointer to receive compatability
// Returns:     NV_OK               - Success
//              NV_NOTSUPPORTED     - Unsupported NVSIGNALFORMAT_ enumeration
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoIsFrameLockModeCompatible(NVGVOHANDLE
hGvoHandle          IN,
                                                   int
nSrcEnumIndex       IN,
                                                   int
nDestEnumIndex      IN,
                                                   BOOL*
pbCompatible        OUT);
```

NvGvoEnumDataFormats()

```
//--------------------------------------------------------------------
// Function:    NvGvoEnumDataFormats
// Description: Enumerate data formats supported by Graphics to Video.
// Parameters:  hGvoHandle        - Handle to graphics adapter
//              nEnumIndex        - Enumeration index
//              bByEnum           - TRUE nEnumIndex is NVDATAFORMAT_*
//                                  FALSE nEnumIndex is 0..n-1
//              pDataFormatDetail - Pointer to receive detail or NULL
// Returns:     NV_OK             - Success
//              NV_NOMORE         - No more data formats to enumerate
//              NV_NOTSUPPORTED   - Unsupported NVDATAFORMAT_ enumeration
//--------------------------------------------------------------------
NVRESULT NVAPIENTRY NvGvoEnumDataFormats(NVGVOHANDLE         hGvoHandle      IN,
                                         int                 nEnumIndex      IN,
                                         BOOL                bByEnum         IN,
                                        NVGVODATAFORMATDETAIL* pDataFormatDetail
OUT);
```

NvGvo Structures, Enumerations, and Defines

Miscellaneous Defines

```
typedef UINT NVGVOHANDLE;        // Handle from NvGvoOpen() or NvGvoDesktopOpen()
#define INVALID_NVGVOHANDLE   0  // Invalid NVGVOHANDLE

typedef DWORD NVGVOOWNERID;      // Unique identifier for owner of Graphics to
                                    Video output (process identifier or
                                    NVGVOOWNERID_NONE)
#define NVGVOOWNERID_NONE     0  // Unregistered ownerId


enum NVGVOOWNERTYPE              // Owner type for device
{
    NVGVOOWNERTYPE_NONE       ,  // No owner for device
    NVGVOOWNERTYPE_OPENGL     ,  // OpenGL application owns device
    NVGVOOWNERTYPE_DESKTOP    ,  // Desktop transparent mode owns device

// Access rights for NvGvoOpen() or NvGvoDesktopOpen()
#define NVGVO_O_READ                 0x00000000      // Read access
#define NVGVO_O_WRITE_EXCLUSIVE      0x00010001      // Write exclusive access
```

Video Signal Format and Resolution Enumeration

```
enum NVGVOSIGNALFORMAT
{
    NVGVOSIGNALFORMAT_ERROR = -1              ,  // Invalid signal format
    NVGVOSIGNALFORMAT_487I_5994_SMPTE259_NTSC , // 01  487i  59.94Hz   (SMPTE259)
                                                                        NTSC
    NVGVOSIGNALFORMAT_576I_5000_SMPTE259_PAL  , // 02  576i  50.00Hz   (SMPTE259)
                                                                        PAL
    NVGVOSIGNALFORMAT_720P_5994_SMPTE296      , // 03  720p   59.94Hz  (SMPTE296)
    NVGVOSIGNALFORMAT_720P_6000_SMPTE296      , // 04  720p   60.00Hz  (SMPTE296)
    NVGVOSIGNALFORMAT_1035I_5994_SMPTE260     , // 05  1035i  59.94Hz  (SMPTE260)
    NVGVOSIGNALFORMAT_1035I_6000_SMPTE260     , // 06  1035i  60.00Hz  (SMPTE260)
    NVGVOSIGNALFORMAT_1080I_5000_SMPTE295     , // 07  1080i  50.00Hz  (SMPTE295)
    NVGVOSIGNALFORMAT_1080I_5000_SMPTE274     , // 08  1080i  50.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080I_5994_SMPTE274     , // 09  1080   59.94Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080I_6000_SMPTE274     , // 10  1080i  60.00Hz  (SMPTE274)
```

```
    NVGVOSIGNALFORMAT_1080PSF_23976_SMPTE274  , // 11 1080PsF 23.976Hz (SMPTE274)
    NVGVOSIGNALFORMAT_1080PSF_2400_SMPTE274   , // 12 1080PsF 24.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080PSF_2500_SMPTE274   , // 13 1080PsF 25.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080PSF_3000_SMPTE274   , // 14 1080PsF 30.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080P_23976_SMPTE274    , // 15  1080p  23.976Hz (SMPTE274)
    NVGVOSIGNALFORMAT_1080P_2400_SMPTE274     , // 16  1080p  24.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080P_2500_SMPTE274     , // 17  1080p  25.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080P_2997_SMPTE274     , // 18  1080p  29.97Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080P_3000_SMPTE274     , // 19  1080p  30.00Hz  (SMPTE274)
    NVGVOSIGNALFORMAT_1080PSF_2997_SMPTE274   , // 20 1080PsF 29.97Hz  (SMPTE274)

    NVGVOSIGNALFORMAT_720P_5000_SMPTE296      , // 21  720p   50.00Hz  (SMPTE296)
    NVGVOSIGNALFORMAT_720P_3000_SMPTE296      ,  // 22  720p   30.00Hz (SMPTE296)
    NVGVOSIGNALFORMAT_720P_2997_SMPTE296      ,  // 23  720p   29.97Hz (SMPTE296)
    NVGVOSIGNALFORMAT_720P_2500_SMPTE296      ,  // 24  720p   25.00Hz (SMPTE296)
    NVGVOSIGNALFORMAT_720P_2400_SMPTE296      ,  // 25  720p   24.00Hz (SMPTE296)
    NVGVOSIGNALFORMAT_720P_2398_SMPTE296      ,  // 26  720p   23.98Hz (SMPTE296)

    NVGVOSIGNALFORMAT_1080I_4800_SMPTE274     ,  // 27  1080i  48.00Hz (SMPTE296)
    NVGVOSIGNALFORMAT_1080I_4796_SMPTE274     ,  // 28  1080i  47.96Hz (SMPTE296)
    NVGVOSIGNALFORMAT_1080PSF_2398_SMPTE274   ,  // 29 1080PsF 23.98Hz (SMPTE296)

    NVGVOSIGNALFORMAT_2048P_3000_SMPTE372     ,  // 30  2048P  30.00Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048P_2997_SMPTE372     ,  // 31  2048P  29.97Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048I_6000_SMPTE372     ,  // 32  2048I  60.00Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048I_5994_SMPTE372     ,  // 33  2048I  59.94Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048P_2500_SMPTE372     ,  // 34  2048P  25.00Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048I_5000_SMPTE372     ,  // 35  2048I  50.00Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048P_2400_SMPTE372     ,  // 36  2048P  24.00Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048I_4800_SMPTE372     ,  // 37  2048I  48.00Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048P_2398_SMPTE372     ,  // 38  2048P  23.98Hz (SMPTE372)
    NVGVOSIGNALFORMAT_2048I_4796_SMPTE372     ,  // 39  2048I  23.98Hz (SMPTE372)

    NVGVOSIGNALFORMAT_END                        // 40  To indicate end of signal
                                                        format list
};
```

SMPTE Standards Format Enumeration

```
enum NVVIDEOSTANDARD
{
    NVVIDEOSTANDARD_SMPTE259                , // SMPTE259
    NVVIDEOSTANDARD_SMPTE260                , // SMPTE260
    NVVIDEOSTANDARD_SMPTE274                , // SMPTE274
    NVVIDEOSTANDARD_SMPTE295                , // SMPTE295
    NVVIDEOSTANDARD_SMPTE296                , // SMPTE296
    NVVIDEOSTANDARD_SMPTE372                , // SMPTE372
};
```

HD or SD Video Type Enumeration

```
enum NVVIDEOTYPE
{
    NVVIDEOTYPE_SD                          ,   // Standard-definition (SD)
    NVVIDEOTYPE_HD                          ,   // High-definition     (HD)
};
```

Interlace Mode Enumeration

```
enum NVINTERLACEMODE
{
    NVINTERLACEMODE_PROGRESSIVE             ,   // Progressive               (p)
    NVINTERLACEMODE_INTERLACE               ,   // Interlace                 (i)
    NVINTERLACEMODE_PSF                     ,   // Progressive Segment Frame (psf)
};
```

Video Data Format Enumeration

```
enum NVGVODATAFORMAT
{
    NVGVODATAFORMAT_R8G8B8_TO_YCRCB444      , // R8:G8:B8     => YCrCb  (4:4:4)
    NVGVODATAFORMAT_R8G8B8A8_TO_YCRCBA4444  , // R8:G8:B8:A8  => YCrCbA (4:4:4:4)
    NVGVODATAFORMAT_R8G8B8Z10_TO_YCRCBZ4444 , // R8:G8:B8:Z10 => YCrCbZ (4:4:4:4)
    NVGVODATAFORMAT_R8G8B8_TO_YCRCB422      , // R8:G8:B8     => YCrCb  (4:2:2)
    NVGVODATAFORMAT_R8G8B8A8_TO_YCRCBA4224  , // R8:G8:B8:A8  => YCrCbA (4:2:2:4)
    NVGVODATAFORMAT_R8G8B8Z10_TO_YCRCBZ4224 , // R8:G8:B8:Z10 => YCrCbZ (4:2:2:4)
    NVGVODATAFORMAT_R8G8B8_TO_RGB444        , // R8:G8:B8     => RGB    (4:4:4)
    NVGVODATAFORMAT_R8G8B8A8_TO_RGBA4444    , // R8:G8:B8:A8  => RGBA   (4:4:4:4)
    NVGVODATAFORMAT_R8G8B8Z10_TO_RGBZ4444   , // R8:G8:B8:Z10 => RGBZ   (4:4:4:4)
```

```
    NVGVODATAFORMAT_Y10CR10CB10_TO_YCRCB444 , // Y10:CR10:CB10 => YCrCb  (4:4:4)
    NVGVODATAFORMAT_Y10CR8CB8_TO_YCRCB444   , // Y10:CR8:CB8   => YCrCb  (4:4:4)
    NVGVODATAFORMAT_Y10CR8CB8A10_TO_YCRCBA4444     , // Y10:CR8:CB8:A10
                                                        => YCrCbA (4:4:4:4)
    NVGVODATAFORMAT_Y10CR8CB8Z10_TO_YCRCBZ4444     , // Y10:CR8:CB8:Z10
                                                        => YCrCbZ (4:4:4:4)
    NVGVODATAFORMAT_DUAL_R8G8B8_TO_DUAL_YCRCB422   , // R8:G8:B8 + R8:G8:B8
                                                        => YCrCb  (4:2:2 + 4:2:2)
    NVGVODATAFORMAT_DUAL_Y8CR8CB8_TO_DUAL_YCRCB422 , // Y8:CR8:CB8 + Y8:CR8:CB8
                                                        => YCrCb  (4:2:2 + 4:2:2)
    NVGVODATAFORMAT_R10G10B10_TO_YCRCB422   , // R10:G10:B10   => YCrCb  (4:2:2)
    NVGVODATAFORMAT_R10G10B10_TO_YCRCB444   , // R10:G10:B10   => YCrCb  (4:4:4)
    NVGVODATAFORMAT_Y12CR12CB12_TO_YCRCB444 , // Y12:CR12:CB12 => YCrCb  (4:4:4)
    NVGVODATAFORMAT_Y12CR12CB12_TO_YCRCB422 , // Y12:CR12:CB12 => YCrCb  (4:2:2)
};
```

Video Output Area Enumeration

```
enum NVGVOOUTPUTAREA
{
    NVGVOOUTPUTAREA_FULLSIZE      , // Output to entire video resolution
                                      (full size)
    NVGVOOUTPUTAREA_SAFEACTION    , // Output to centered 90% of video resolution
                                      (safe action)
    NVGVOOUTPUTAREA_SAFETITLE     , // Output to centered 80% of video resolution
                                      (safe title)
};
```

Synchronization Source Enumeration

```
enum NVGVOSYNCSOURCE
{
    NVGVOSYNCSOURCE_SDISYNC        ,   // SDI Sync  (Digital input)
    NVGVOSYNCSOURCE_COMPSYNC       ,   // COMP Sync (Composite input)
};
```

Composite Synchronization Type Enumeration

```
enum NVGVOCOMPSYNCTYPE
{
    NVGVOCOMPSYNCTYPE_AUTO         ,   // Auto-detect
    NVGVOCOMPSYNCTYPE_BILEVEL      ,   // Bi-level signal
```

```
    NVGVOCOMPSYNCTYPE_TRILEVEL     ,   // Tri-level signal
};
```

Video Output Status Enumeration

```
enum NVGVOOUTPUTSTATUS
{
    NVGVOOUTPUTSTATUS_OFF       ,  // Output not in use
    NVGVOOUTPUTSTATUS_ERROR     ,  // Error detected
    NVGVOOUTPUTSTATUS_SDI_SD    ,  // SDI output (standard-definition)
    NVGVOOUTPUTSTATUS_SDI_HD    ,  // SDI output (high-definition)
};
```

Synchronization Input Status Enumeration

```
enum NVGVOSYNCSTATUS
{
    NVGVOSYNCSTATUS_OFF         ,  // Sync not detected
    NVGVOSYNCSTATUS_ERROR       ,  // Error detected
    NVGVOSYNCSTATUS_SYNCLOSS    ,  // Genlock in use, format mismatch with output
    NVGVOSYNCSTATUS_COMPOSITE   ,  // Composite sync
    NVGVOSYNCSTATUS_SDI_SD      ,  // SDI sync (standard-definition)
    NVGVOSYNCSTATUS_SDI_HD      ,  // SDI sync (high-definition)
};
```

Device Capabilities Defines

```
#define NVGVOCAPS_VIDOUT_SDI     0x00000001  // Supports Serial Digital Interface
                                               (SDI) output
#define NVGVOCAPS_SYNC_INTERNAL  0x00000100  // Supports Internal timing source
#define NVGVOCAPS_SYNC_GENLOCK   0x00000200  // Supports Genlock timing source
#define NVGVOCAPS_SYNCSRC_SDI    0x00001000  // Supports Serial Digital Interface
                                               (SDI) synchronization input
#define NVGVOCAPS_SYNCSRC_COMP   0x00002000  // Supports Composite
                                               synchronization input
#define NVGVOCAPS_OUTPUTMODE_DESKTOP   0x00010000   // Supports Desktop
                                                       transparent mode
#define NVGVOCAPS_OUTPUTMODE_OPENGL    0x00020000   // Supports OpenGL
                                                       application mode
#define NVGVOCLASS_SDI           0x00000001  // SDI-class interface:
                                              SDI output with two genlock inputs
```

Device Capabilities Structure

```
typedef struct tagNVGVOCAPS
{
    WORD      cbSize;         // Caller sets to sizeof(NVGVOCAPS)
    char      szAdapterName[NVADAPTERNAME_MAXLEN];  // Graphics adapter name
    DWORD     dwClass;        // Graphics adapter classes (NGVOCLASS_* mask)
    DWORD     dwCaps;         // Graphics adapter capabilities (NVGVOCAPS_* mask)
    DWORD     dwDipSwitch;          // On-board DIP switch settings bits
    DWORD     dwDipSwitchReserved;  // On-board DIP switch settings reserved bits
    struct                                  //
    {         // Driver version
        WORD         wMajorVersion;         //  Major version
        WORD         wMinorVersion;         //  Minor version
        WORD         wRevision;             //  Revision
        WORD         wBuild;                //  Build
    } Driver;                               //
    struct                                  //
    {           // Firmware version
        WORD          wMajorVersion;        //  Major version
        WORD          wMinorVersion;        //  Minor version
    } Firmware;                             //
    NVGVOOWNERID    ownerId;        // Unique identifier for owner of video
                                       output (NVGVOOWNERID_NONE if free running)
    NVGVOOWNERTYPE  ownerType;     // Owner type for video output
                                       (OpenGL application or Desktop mode)
} NVGVOCAPS;
```

Device Status Structure

```
typedef struct tagNVGVOSTATUS
{
    WORD              cbSize;       // Caller sets to sizeof(NVGVOSTATUS)
    NVGVOOUTPUTSTATUS vid1Out;     // Video 1 output status
    NVGVOOUTPUTSTATUS vid2Out;     // Video 2 output status
    NVGVOSYNCSTATUS   sdiSyncIn;   // SDI sync input status
    NVGVOSYNCSTATUS   compSyncIn;  // Composite sync input status
    BOOL              syncEnable;  // Sync enable (TRUE if using syncSource)
    NVGVOSYNCSOURCE   syncSource;  // Sync source
    NVGVOSIGNALFORMAT syncFormat;  // Sync format
    NVGVOOWNERID      ownerId;     // Unique identifier for owner of video output
```

```
    NVGVOOWNERTYPE    ownerType;   // Owner type for video output
                                      (OpenGL application or Desktop mode)
    BOOL     bframeLockEnable;              // Framelock enable flag
    BOOL     bOutputVideoLocked;            // Output locked status
    int      nDataIntegrityCheckErrorCount;  // Data integrity check error count
    BOOL     bDataIntegrityCheckEnabled;   // Data integrity check status enabled
    BOOL     bDataIntegrityCheckFailed;    // Data integrity check status failed
} NVGVOSTATUS;
```

Output Region Structure

```
typedef struct tagNVGVOOUTPUTREGION
{
    WORD              x;               // Horizontal origin in pixels
    WORD              y;               // Vertical origin in pixels
    WORD              width;           // Width of region in pixels
    WORD              height;          // Height of region in pixels
} NVGVOOUTPUTREGION;
```

Gamma Ramp (8-bit Index) Structure

```
typedef struct tagNVGAMMARAMP8
{
    WORD              cbSize;         // Caller sets to sizeof(NVGAMMARAMP8)
    WORD              wRed[256];      // Red channel gamma ramp
                                         (8-bit index, 16-bit values)
    WORD              wGreen[256];    // Green channel gamma ramp
                                         (8-bit index, 16-bit values)
    WORD              wBlue[256];     // Blue channel gamma ramp
                                         (8-bit index, 16-bit values)
} NVGAMMARAMP8;
```

Gamma Ramp (10-bit Index) Structure

```
typedef struct tagNVGAMMARAMP10
{
    WORD              cbSize;         // Caller sets to sizeof(NVGAMMARAMP10)
    WORD              wRed[1024];     // Red channel gamma ramp
                                         (10-bit index, 16-bit values)
    WORD              wGreen[1024];   // Green channel gamma ramp
                                         (10-bit index, 16-bit values)
    WORD              wBlue[1024];    // Blue channel gamma ramp
```

```
                                                (10-bit index, 16-bit values)
} NVGAMMARAMP10;
```

Sync Delay Structure

```
typedef struct tagNVGVOSYNCDELAY
{
    WORD              wHorizontalDelay;     // Horizontal delay in pixels
    WORD              wVerticalDelay;       // Vertical delay in lines
} NVGVOSYNCDELAY;
```

Video Mode Information Structure

```
typedef struct tagNVVIDEOMODE
{
    DWORD            dwHorizontalPixels;   // Horizontal resolution (in pixels)
    DWORD            dwVerticalLines; // Vertical resolution for frame (in lines)
    NVFLOAT          fFrameRate;           // Frame rate
    NVINTERLACEMODE  interlaceMode;        // Interlace mode
    NVVIDEOSTANDARD  videoStandard;        // SMPTE standards format
    NVVIDEOTYPE      videoType;            // HD or SD signal classification
} NVVIDEOMODE;
```

Signal Format Details Structure

```
typedef struct tagNVGVOSIGNALFORMATDETAIL
{
    WORD              cbSize;             // Caller sets to
                                             sizeof(NVGVOSIGNALFORMATDETAIL)
    NVGVOSIGNALFORMAT signalFormat;       // Signal format enumerated value
    char              szValueName[NVVALUENAME_MAXLEN];
                      // Signal format name, in the form:
                      //  <name>\t<rate>\tHz\t(<standard>)[\t<description>]
                      //  "480i\t59.94\tHz\t(SMPTE259)\tNTSC"
                      //  "1080i\t50.00\tHz\t(SMPTE274)"
    char              szAlternateName[NVVALUENAME_MAXLEN];
                      // Signal format alternate name (or empty string):
                      //  "1080PsF\t25.00\tHz\t(SMPTE274)"
    NVVIDEOMODE       videoMode;          // Video mode for signal format
} NVGVOSIGNALFORMATDETAIL;
```

P-Buffer Format Defines

```
#define NVGVOPBUFFERFORMAT_R8G8B8                0x00000001   // R8:G8:B8
#define NVGVOPBUFFERFORMAT_R8G8B8Z24             0x00000002   // R8:G8:B8:Z24
#define NVGVOPBUFFERFORMAT_R8G8B8A8              0x00000004   // R8:G8:B8:A8
#define NVGVOPBUFFERFORMAT_R8G8B8A8Z24           0x00000008  // R8:G8:B8:A8:Z24
#define NVGVOPBUFFERFORMAT_R16FPG16FPB16FP       0x00000010  // R16FP:G16FP:B16FP
#define NVGVOPBUFFERFORMAT_R16FPG16FPB16FPZ24    0x00000020
                                                   //  R16FP:G16FP:B16FP:Z24
#define NVGVOPBUFFERFORMAT_R16FPG16FPB16FPA16FP  0x00000040
                                                   // R16FP:G16FP:B16FP:A16FP
#define NVGVOPBUFFERFORMAT_R16FPG16FPB16FPA16FPZ24 0x00000080
                                                   // R16FP:G16FP:B16FP:A16FP:Z24
```

Data Format Details Structure

```
typedef struct tagNVGVODATAFORMATDETAIL
{
    WORD              cbSize;               // Caller sets to
                                               sizeof(NVGVODATAFORMATDETAIL)
    NVGVODATAFORMAT   dataFormat;           // Data format enumerated value
    DWORD             dwCaps;               // Data format capabilities
                                              (NVGVOCAPS_* mask)
    struct
    {
        DWORD         dwPbufferFormats;     // Supported p-buffer formats
                                               (NVGVOPBUFFERFORMAT_* mask)
        DWORD         dwPbufferCount;      // Number of p-buffers
        char          szValueName[NVVALUENAME_MAXLEN];
                      // Data format input name, in the form:
                      //  <name>
                      //  "R8:G8:B8:A8"
    } in;
    struct
    {
        char          szValueName[NVVALUENAME_MAXLEN];
                      // Data format output name, in the form:
                      //  <name>\t<format>
                      //  "YCrCbA\t(4:2:2:4)"
    } out;
} NVGVODATAFORMATDETAIL;
```

Device Configuration Defines

These are `dwFields` masks indicating NVGVOCONFIG fields to use for `NvGvoGet/Set/Test/CreateDefaultConfig()`.

```
#define NVGVOCONFIG_SIGNALFORMAT        0x00000001  // dwFields: signalFormat
#define NVGVOCONFIG_DATAFORMAT          0x00000002  // dwFields: dataFormat
#define NVGVOCONFIG_OUTPUTREGION        0x00000004  // dwFields: outputRegion
#define NVGVOCONFIG_OUTPUTAREA          0x00000008  // dwFields: outputArea
#define NVGVOCONFIG_COLORCONVERSION     0x00000010  // dwFields: colorConversion
#define NVGVOCONFIG_GAMMACORRECTION     0x00000020  // dwFields: gammaCorrection
#define NVGVOCONFIG_SYNCSOURCEENABLE    0x00000040  // dwFields: syncSource and
syncEnable
#define NVGVOCONFIG_SYNCDELAY           0x00000080  // dwFields: syncDelay
#define NVGVOCONFIG_COMPOSITESYNCTYPE   0x00000100  // dwFields:
                                                       compositeSyncType
#define NVGVOCONFIG_FRAMELOCKENABLE     0x00000200  // dwFields: EnableFramelock
#define NVGVOCONFIG_422FILTER           0x00000400  // dwFields: bEnable422Filter
#define NVGVOCONFIG_COMPOSITETERMINATE  0x00000800  // dwFields:
                                                       bCompositeTerminate
#define NVGVOCONFIG_DATAINTEGRITYCHECK  0x00001000  // dwFields:
                                                       bEnableDataIntegrityCheck
#define NVGVOCONFIG_CSCOVERRIDE         0x00002000  // dwFields:
                                                       colorConversion override
#define NVGVOCONFIG_ALLFIELDS   ( NVGVOCONFIG_SIGNALFORMAT          | \
                                  NVGVOCONFIG_DATAFORMAT            | \
                                  NVGVOCONFIG_OUTPUTREGION          | \
                                  NVGVOCONFIG_OUTPUTAREA            | \
                                  NVGVOCONFIG_COLORCONVERSION       | \
                                  NVGVOCONFIG_GAMMACORRECTION       | \
                                  NVGVOCONFIG_SYNCSOURCEENABLE      | \
                                  NVGVOCONFIG_SYNCDELAY             | \
                                  NVGVOCONFIG_COMPOSITESYNCTYPE     | \
                                  NVGVOCONFIG_FRAMELOCKENABLE       | \
                                  NVGVOCONFIG_422FILTER             | \
                                  NVGVOCONFIG_COMPOSITETERMINATE    | \
                                  NVGVOCONFIG_DATAINTEGRITYCHECK    | \
                                  NVGVOCONFIG_CSCOVERRIDE)
```

Device Configuration Structure

```
typedef struct tagNVGVOCONFIG
{
    WORD              cbSize;           // Caller sets to sizeof(NVGVOCONFIG)
    DWORD             dwFields;         // Caller sets to NVGVOCONFIG_* mask for
fields to use

    NVGVOSIGNALFORMAT signalFormat;     // Signal format for video output
    NVGVODATAFORMAT   dataFormat;       // Data format for video output
    NVGVOOUTPUTREGION outputRegion;     // Region for video output (Desktop
mode)
    NVGVOOUTPUTAREA   outputArea;       // Usable resolution for video output
(safe area)

    struct          //  Color conversion:
                    //  Output[n] = Input[0] * colorMatrix[n][0] +
                    //  Input[1] * colorMatrix[n][1] + Input[2] *
                    //  colorMatrix[n][2] + OutputRange * colorOffset[n]
                    //  Where OutputRange is the standard magnitude of
                    //  Output[n][n] and colorMatrix and colorOffset values are
                    //  within the range -1.0 to +1.0

    {               //
        NVFLOAT      colorMatrix[3][3];
        NVFLOAT      colorOffset[3];    //
        NVFLOAT      colorScale[3];     //
                                        //
                                        //
       BOOL          bCompositeSafe;    //  bCompositeSafe constrains luminance
                                            range when using composite output
    } colorConversion;                  //

    union           // Gamma correction:
    {               //  cbSize field in gammaRamp describes type
        NVGAMMARAMP8  gammaRamp8;    //  Gamma ramp (8-bit index, 16-bit values)
        NVGAMMARAMP10 gammaRamp10;   //  Gamma ramp (10-bit index, 16-bit values)
    } gammaCorrection;

    BOOL              syncEnable;    // Sync enable (TRUE to use syncSource)
    NVGVOSYNCSOURCE   syncSource;    // Sync source
    NVGVOSYNCDELAY    syncDelay;      // Sync delay
```

```
    NVGVOCOMPSYNCTYPE compositeSyncType;   // Composite sync type
    BOOL              frameLockEnable;     // Flag indicating whether framelock
                                              was on/off
    double            fGammaValueR;        // Red Gamma value within gamma
                                              ranges. 0.5 - 6.0
    double            fGammaValueG;        // Green Gamma value within gamma
                                              ranges. 0.5 - 6.0
    double            fGammaValueB;        // Blue Gamma value within gamma
                                              ranges. 0.5 - 6.0
    BOOL              bPSFSignalFormat;    // Indicates whether contained format
                                              is PSF Signal format
    BOOL              bEnable422Filter;    // Enables/Disables 4:2:2 filter
    BOOL              bCompositeTerminate; // Composite termination
    BOOL              bEnableDataIntegrityCheck; // Enable data integrity check:
                                                    // true - enable, false - disable
    BOOL              bCSCOverride;        // Use provided CSC color matrix to
                                              overwrite
    BYTE              reservedData[256];   // Indicates last stored SDI output
                                              state TRUE-ON / FALSE-OFF
} NVGVOCONFIG;
```

Device Configuration–Revision 0 Structure

```
typedef struct tagNVGVOCONFIG_REV_0
{
    WORD              cbSize;        // Caller sets to sizeof(NVGVOCONFIG)
    DWORD             dwFields;      // Caller sets to NVGVOCONFIG_* mask for
fields to use

    NVGVOSIGNALFORMAT signalFormat;  // Signal format for video output
    NVGVODATAFORMAT   dataFormat;    // Data format for video output
    NVGVOOUTPUTREGION outputRegion;  // Region for video output (Desktop mode)
    NVGVOOUTPUTAREA   outputArea;    // Usable resolution for video output (safe
area)

    struct           // Color conversion:
                     // Output[n] =  Input[0] * colorMatrix[n][0] + Input[1] *
                     // colorMatrix[n][1] + Input[2] * colorMatrix[n][2] +
                     // OutputRange * colorOffset[n]
                     // Where OutputRange is the standard magnitude of
                     // Output[n][n] and colorMatrix and colorOffset
                     //   values are within the range -1.0 to +1.0
```

```
    {                //
        NVFLOAT       colorMatrix[3][3];   //
        NVFLOAT       colorOffset[3];      //
        BOOL          bCompositeSafe;      // bCompositeSafe constrains luminance
                                              range when using composite output
    } colorConversion;                     //

    union             // Gamma correction:
    {                 // cbSize field in gammaRamp describes type
        NVGAMMARAMP8  gammaRamp8;    //  Gamma ramp (8-bit index, 16-bit values)
        NVGAMMARAMP10 gammaRamp10;   //  Gamma ramp (10-bit index, 16-bit values)
    } gammaCorrection;

    BOOL              syncEnable;          // Sync enable
                                             (TRUE to use syncSource)
    NVGVOSYNCSOURCE   syncSource;          // Sync source
    NVGVOSYNCDELAY    syncDelay;           // Sync delay
    NVGVOCOMPSYNCTYPE compositeSyncType;   // Composite sync type
    BOOL              frameLockEnable;     // Flag indicating whether framelock
                                              was on/off
    double            fGammaValueR;        // Red Gamma value within gamma
                                              ranges. 0.5 - 6.0
    double            fGammaValueG;        // Green Gamma value within gamma
                                              ranges. 0.5 - 6.0
    double            fGammaValueB;        // Blue Gamma value within gamma
                                              ranges. 0.5 - 6.0
    BOOL              bPSFSignalFormat;    // Indicates whether contained format
                                              is PSF Signal format
    BYTE              reservedData[256];   // Indicates last stored SDI output
                                              state TRUE-ON / FALSE-OFF
} NVGVOCONFIG_REV_0;
```

Linux CONTROL X Extension API

This section describes the NvGvo APIs inthe following sections:

Using the NV-CTRL X APIs

The NV_CTRL_GVO* integer attributes are used to configure GVO (graphics to video out) functionality on the Quadro FX 4500 SDI graphics board.

The following is a typical usage pattern for the GVO attributes:

- Query NV_CTRL_GVO_SUPPORTED to determine if the X screen supports GV0.
- Specify NV_CTRL_GVO_SYNC_MODE (either FREE_RUNNING, GENLOCK, or FRAMELOCK).

  If you specify GENLOCK or FRAMELOCK, you should also specify NV_CTRL_GVO_SYNC_SOURCE.
- Use NV_CTRL_GVO_SYNC_INPUT_DETECTED and NV_CTRL_GVO_SDI_SYNC_INPUT_DETECTED to detect what input syncs are present.

  If no analog sync is detected but it is known that a valid bi-level or tri-level sync is connected, set NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE appropriately and retest with NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECTED.
- If syncing to input sync, query theNV_CTRL_GVO_INPUT_VIDEO_FORMAT attribute.

  The input video format can only be queried after SYNC_SOURCE is specified.
- Specify the NV_CTRL_GVO_OUTPUT_VIDEO_FORMAT.
- Specify the NV_CTRL_GVO_DATA_FORMAT.
- Specify any custom Color Space Conversion (CSC) matrix, offset, and scale with XNVCTRLSetGvoColorConversion().
- If using the GLX_NV_video_out extension to display one or more pbuffers, call glXGetVideoDeviceNV() to lock the GVO output for use by the GLX client, then bind the pbuffer(s) to the GVO output with glXBindVideoImageNV() and send pbuffers to the GVO output with glXSendPbufferToVideoNV().

  See the GLX_NV_video_out spec for more details.

- If, rather than using the GLX_NV_video_out extension to display GLX pbuffers on the GVO output, you wish display the X screen on the GVO output, set NV_CTRL_GVO_DISPLAY_X_SCREEN to NV_CTRL_GVO_DISPLAY_X_SCREEN_ENABLE.

- Setting most GVO attributes only causes the value to be cached in the X server.

  The values will be flushed to the hardware either when NV_CTRL_GVO_DISPLAY_X_SCREEN is enabled, or when a GLX pbuffer is bound to the GVO output (with glXBindVideoImageNV()).

- GLX_NV_video_out and NV_CTRL_GVO_DISPLAY_X_SCREEN are mutually exclusive.

  If NV_CTRL_GVO_DISPLAY_X_SCREEN is enabled, then glXGetVideoDeviceNV will fail. Similarly, if a GLX client has locked the GVO output (via glXGetVideoDeviceNV), then NV_CTRL_GVO_DISPLAY_X_SCREEN will fail. The NV_CTRL_GVO_LOCKED event will be sent when a GLX client locks the GVO output.

NV_CTRL_GVO Attributes

NV_CTRL_GVO_SUPPORTED

```
/*
 * NV_CTRL_GVO_SUPPORTED - returns whether this X screen supports GVO;
 * if this screen does not support GVO output, then all other GVO
 * attributes are unavailable.
 */

#define NV_CTRL_GVO_SUPPORTED                                   67  /* R-- */
#define NV_CTRL_GVO_SUPPORTED_FALSE                             0
#define NV_CTRL_GVO_SUPPORTED_TRUE                              1
```

NV_CTRL_GVO_SYNC_MODE

```
/*
 * NV_CTRL_GVO_SYNC_MODE - selects the GVO sync mode; possible values
 * are:
 *
 * FREE_RUNNING - GVO does not sync to any external signal
 *
 * GENLOCK - the GVO output is genlocked to an incoming sync signal;
 * genlocking locks at hsync.  This requires that the output video
```

```
 * format exactly match the incoming sync video format.
 *
 * FRAMELOCK - the GVO output is framelocked to an incoming sync
 * signal; framelocking locks at vsync.  This requires that the output
 * video format have the same refresh rate as the incoming sync video
 * format.
 */

#define NV_CTRL_GVO_SYNC_MODE                                   68  /* RW- */
#define NV_CTRL_GVO_SYNC_MODE_FREE_RUNNING                      0
#define NV_CTRL_GVO_SYNC_MODE_GENLOCK                           1
#define NV_CTRL_GVO_SYNC_MODE_FRAMELOCK                         2
```

NV_CTRL_GVO_SYNC_SOURCE

```
/*
 * NV_CTRL_GVO_SYNC_SOURCE - if NV_CTRL_GVO_SYNC_MODE is set to either
 * GENLOCK or FRAMELOCK, this controls which sync source is used as
 * the incoming sync signal (either Composite or SDI).  If
 * NV_CTRL_GVO_SYNC_MODE is FREE_RUNNING, this attribute has no
 * effect.
 */

#define NV_CTRL_GVO_SYNC_SOURCE                                 69  /* RW- */
#define NV_CTRL_GVO_SYNC_SOURCE_COMPOSITE                       0
#define NV_CTRL_GVO_SYNC_SOURCE_SDI                             1
```

NV_CTRL_GVO_OUTPUT_VIDEO_FORMAT

```
/*
 * NV_CTRL_GVO_OUTPUT_VIDEO_FORMAT - specifies the output video
 * format.  Note that the valid video formats will vary depending on
 * the NV_CTRL_GVO_SYNC_MODE and the incoming sync video format.  See
 * the definition of NV_CTRL_GVO_SYNC_MODE.
 *
 * Note that when querying the ValidValues for this data type, the
 * values are reported as bits within a bitmask
 * (ATTRIBUTE_TYPE_INT_BITS); unfortunately, there are more valid
 * value bits than will fit in a single 32-bit value.  To solve this,
 * query the ValidValues for NV_CTRL_GVO_OUTPUT_VIDEO_FORMAT to check
```

```
 * which of the first 31 VIDEO_FORMATS are valid, then query the
 * ValidValues for NV_CTRL_GVO_OUTPUT_VIDEO_FORMAT2 to check which of
 * the VIDEO_FORMATS with value 32 and higher are valid.
 */

#define NV_CTRL_GVO_OUTPUT_VIDEO_FORMAT                         70  /* RW- */

#define NV_CTRL_GVO_VIDEO_FORMAT_NONE                           0
#define NV_CTRL_GVO_VIDEO_FORMAT_480I_59_94_SMPTE259_NTSC       1
#define NV_CTRL_GVO_VIDEO_FORMAT_576I_50_00_SMPTE259_PAL        2
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_59_94_SMPTE296            3
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_60_00_SMPTE296            4
#define NV_CTRL_GVO_VIDEO_FORMAT_1035I_59_94_SMPTE260           5
#define NV_CTRL_GVO_VIDEO_FORMAT_1035I_60_00_SMPTE260           6
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_50_00_SMPTE295           7
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_50_00_SMPTE274           8
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_59_94_SMPTE274           9
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_60_00_SMPTE274           10
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_23_976_SMPTE274          11
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_24_00_SMPTE274           12
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_25_00_SMPTE274           13
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_29_97_SMPTE274           14
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_30_00_SMPTE274           15
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_50_00_SMPTE296            16
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_24_00_SMPTE274           17 //deprecated
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_48_00_SMPTE274           17
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_23_98_SMPTE274           18 //deprecated
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_47_96_SMPTE274           18
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_30_00_SMPTE296            19
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_29_97_SMPTE296            20
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_25_00_SMPTE296            21
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_24_00_SMPTE296            22
#define NV_CTRL_GVO_VIDEO_FORMAT_720P_23_98_SMPTE296            23
#define NV_CTRL_GVO_VIDEO_FORMAT_1080PSF_25_00_SMPTE274         24
#define NV_CTRL_GVO_VIDEO_FORMAT_1080PSF_29_97_SMPTE274         25
#define NV_CTRL_GVO_VIDEO_FORMAT_1080PSF_30_00_SMPTE274         26
#define NV_CTRL_GVO_VIDEO_FORMAT_1080PSF_24_00_SMPTE274         27
#define NV_CTRL_GVO_VIDEO_FORMAT_1080PSF_23_98_SMPTE274         28
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_30_00_SMPTE372           29
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_29_97_SMPTE372           30
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_30_00_SMPTE372           31
```

```
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_29_97_SMPTE372           32
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_25_00_SMPTE372           33
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_25_00_SMPTE372           34
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_24_00_SMPTE372           35
#define NV_CTRL_GVO_VIDEO_FORMAT_1080P_23_98_SMPTE372           36
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_24_00_SMPTE372           37
#define NV_CTRL_GVO_VIDEO_FORMAT_1080I_23_98_SMPTE372           38
```

NV_CTRL_GVO_INPUT_VIDEO_FORMAT

```
/*
 * NV_CTRL_GVO_INPUT_VIDEO_FORMAT - indicates the input video format
 * detected; the possible values are the NV_CTRL_GVO_VIDEO_FORMAT
 * constants.
 */

#define NV_CTRL_GVO_INPUT_VIDEO_FORMAT                          71  /* R-- */
```

NV_CTRL_GVO_DATA_FORMAT

```
/*
 * NV_CTRL_GVO_DATA_FORMAT - This controls how the data in the source
 * (either the X screen or the GLX pbuffer) is interpretted and
 * displayed.
 */

#define NV_CTRL_GVO_DATA_FORMAT                                 72  /* RW- */
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8_TO_YCRCB444              0
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8A8_TO_YCRCBA4444          1
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8Z10_TO_YCRCBZ4444         2
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8_TO_YCRCB422              3
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8A8_TO_YCRCBA4224          4
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8Z10_TO_YCRCBZ4224         5
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8_TO_RGB444                6
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8A8_TO_RGBA4444            7
#define NV_CTRL_GVO_DATA_FORMAT_R8G8B8Z10_TO_RGBZ4444           8
#define NV_CTRL_GVO_DATA_FORMAT_Y10CR10CB10_TO_YCRCB444         9
#define NV_CTRL_GVO_DATA_FORMAT_Y10CR8CB8_TO_YCRCB444           10
#define NV_CTRL_GVO_DATA_FORMAT_Y10CR8CB8A10_TO_YCRCBA4444      11
#define NV_CTRL_GVO_DATA_FORMAT_Y10CR8CB8Z10_TO_YCRCBZ4444      12
#define NV_CTRL_GVO_DATA_FORMAT_DUAL_R8G8B8_TO_DUAL_YCRCB422    13
```

```
#define NV_CTRL_GVO_DATA_FORMAT_DUAL_Y8CR8CB8_TO_DUAL_YCRCB422  14
#define NV_CTRL_GVO_DATA_FORMAT_R10G10B10_TO_YCRCB422           15
#define NV_CTRL_GVO_DATA_FORMAT_R10G10B10_TO_YCRCB444           16
#define NV_CTRL_GVO_DATA_FORMAT_Y12CR12CB12_TO_YCRCB444         17
#define NV_CTRL_GVO_DATA_FORMAT_R12G12B12_TO_YCRCB444           18
```

NV_CTRL_GVO_DISPLAY_X_SCREEN

```
/*
 * NV_CTRL_GVO_DISPLAY_X_SCREEN - enable/disable GVO output of the X
 * screen.  At this point, all the GVO attributes that have been
 * cached in the X server are flushed to the hardware and GVO is
 * enabled.  Note that this attribute can fail to be set if a GLX
 * client has locked the GVO output (via glXGetVideoDeviceNV).  Note
 * that due to the inherit race conditions in this locking strategy,
 * NV_CTRL_GVO_DISPLAY_X_SCREEN can fail unexpectantly.  In the
 * failing situation, X will not return an X error.  Instead, you
 * should query the value of NV_CTRL_GVO_DISPLAY_X_SCREEN after
 * setting it to confirm that the setting was applied.
 */

#define NV_CTRL_GVO_DISPLAY_X_SCREEN                            73  /* RW- */
#define NV_CTRL_GVO_DISPLAY_X_SCREEN_ENABLE                     1
#define NV_CTRL_GVO_DISPLAY_X_SCREEN_DISABLE                    0
```

NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECTED

```
/*
 * NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECTED - indicates whether
 * Composite Sync input is detected.
 */

#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECTED               74  /* R-- */
#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECTED_FALSE         0
#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECTED_TRUE          1
```

NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE

```
/*
```

```
 * NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE - get/set the
 * Composite Sync input detect mode.
 */

#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE           75  /* RW- */
#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE_AUTO      0
#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE_BI_LEVEL  1
#define NV_CTRL_GVO_COMPOSITE_SYNC_INPUT_DETECT_MODE_TRI_LEVEL 2
```

NV_CTRL_GVO_SYNC_INPUT_DETECTED

```
/*
 * NV_CTRL_GVO_SYNC_INPUT_DETECTED - indicates whether SDI Sync input
 * is detected, and what type.
 */

#define NV_CTRL_GVO_SDI_SYNC_INPUT_DETECTED                    76  /* R-- */
#define NV_CTRL_GVO_SDI_SYNC_INPUT_DETECTED_NONE               0
#define NV_CTRL_GVO_SDI_SYNC_INPUT_DETECTED_HD                 1
#define NV_CTRL_GVO_SDI_SYNC_INPUT_DETECTED_SD                 2
```

NV_CTRL_GVO_VIDEO_OUTPUTS

```
/*
 * NV_CTRL_GVO_VIDEO_OUTPUTS - indicates which GVO video output
 * connectors are currently outputing data.
 */

#define NV_CTRL_GVO_VIDEO_OUTPUTS                              77  /* R-- */
#define NV_CTRL_GVO_VIDEO_OUTPUTS_NONE                         0
#define NV_CTRL_GVO_VIDEO_OUTPUTS_VIDEO1                       1
#define NV_CTRL_GVO_VIDEO_OUTPUTS_VIDEO2                       2
#define NV_CTRL_GVO_VIDEO_OUTPUTS_VIDEO_BOTH                   3
```

NV_CTRL_GVO_FPGA_VERSION

```
/*
 * NV_CTRL_GVO_FPGA_VERSION - indicates the version of the Firmware on
 * the GVO device.  XXX would this be better as a string attribute?
```

```
 */

#define NV_CTRL_GVO_FIRMWARE_VERSION                          78  /* R-- */
```

NV_CTRL_GVO_SYNC_DELAY_PIXELS

```
/*
 * NV_CTRL_GVO_SYNC_DELAY_PIXELS - controls the delay between the
 * input sync and the output sync in numbers of pixels from hsync;
 * this is a 12 bit value.
 */

#define NV_CTRL_GVO_SYNC_DELAY_PIXELS                         79  /* RW- */
```

NV_CTRL_GVO_SYNC_DELAY_LINES

```
/*
 * NV_CTRL_GVO_SYNC_DELAY_LINES - controls the delay between the input
 * sync and the output sync in numbers of lines from vsync; this is a
 * 12 bit value.
 */

#define NV_CTRL_GVO_SYNC_DELAY_LINES                          80  /* RW- */
```

NV_CTRL_GVO_INPUT_VIDEO_FORMAT_REACQUIRE

```
/*
 * NV_CTRL_GVO_INPUT_VIDEO_FORMAT_REACQUIRE - must be set for a period
 * of about 2 seconds for the new InputVideoFormat to be properly
 * locked to.  In nvidia-settings, we do a reacquire whenever genlock
 * or framelock mode is entered into, when the user clicks the
 * "detect" button.  This value can be written, but always reads back
 * _FALSE.
 */

#define NV_CTRL_GVO_INPUT_VIDEO_FORMAT_REACQUIRE              81  /* -W- */
#define NV_CTRL_GVO_INPUT_VIDEO_FORMAT_REACQUIRE_FALSE        0
#define NV_CTRL_GVO_INPUT_VIDEO_FORMAT_REACQUIRE_TRUE         1
```

NV_CTRL_GVO_LOCKED

```
/*
 * NV_CTRL_GVO_LOCKED - indicates that GVO configurability is locked;
 * this occurs when the GLX_NV_video_out function calls
 * glXGetVideoDeviceNV().  All GVO output resources are locked until
 * either glXReleaseVideoDeviceNV() is called or the X Display used
 * when calling glXGetVideoDeviceNV() is closed.
 *
 * When GVO is locked; all GVO NV-CONTROL attributes are read only.
 */

#define NV_CTRL_GVO_GLX_LOCKED                                  82  /* R-- */
#define NV_CTRL_GVO_GLX_LOCKED_FALSE                            0
#define NV_CTRL_GVO_GLX_LOCKED_TRUE                             1
```

NV_CTRL_GVO_VIDEO_FORMAT_{WIDTH,HEIGHT,REFRESH_RATE}

```
/*
 * NV_CTRL_GVO_VIDEO_FORMAT_{WIDTH,HEIGHT,REFRESH_RATE} - query the
 * width, height, and refresh rate for the specified
 * NV_CTRL_GVO_VIDEO_FORMAT_*.  So that this can be queried with
 * existing interfaces, XNVCTRLQueryAttribute() should be used, and
 * the video format specified in the display_mask field; eg:
 *
 * XNVCTRLQueryAttribute (dpy,
 *                        screen,
 *                        NV_CTRL_GVO_VIDEO_FORMAT_480I_59_94_SMPTE259_NTSC
 *                        NV_CTRL_GVO_VIDEO_FORMAT_WIDTH,
 *                        &value);
 *
 * Note that Refresh Rate is in 1/1000 Hertz values
 */

#define NV_CTRL_GVO_VIDEO_FORMAT_WIDTH                          83  /* R-- */
#define NV_CTRL_GVO_VIDEO_FORMAT_HEIGHT                         84  /* R-- */
#define NV_CTRL_GVO_VIDEO_FORMAT_REFRESH_RATE                   85  /* R-- */
```

NV_CTRL_GVO_X_SCREEN_PAN_[XY]

```
/*
 * NV_CTRL_GVO_X_SCREEN_PAN_[XY] - when GVO output of the X screen is
 * enabled, the pan x/y attributes control which portion of the X
 * screen is displayed by GVO.  These attributes can be updated while
 * GVO output is enabled, or before enabling GVO output.  The pan
 * values will be clamped so that GVO output is not panned beyond the
 * end of the X screen.
 */

#define NV_CTRL_GVO_X_SCREEN_PAN_X                              86  /* RW- */
#define NV_CTRL_GVO_X_SCREEN_PAN_Y                              87  /* RW- */

/*
```

NV-Control X Functions

Table 5.2 NV-Control X Function Index

Call	Description
XNVCTRLQueryExtension()	Queries for the existence of the Nv_Gvo extensions
XNVCTRLQueryVersion()	Queries the extension version
XNVCTRLIsNvScreen()	Queries whether the specified screen is controlled by the NVIDIA driver.
XNVCTRLSetAttribute()	Sets the specified attribute to the specified value.
XNVCTRLSetAttributeAndGetStatus()	Same as XNVCTRLSetAttribute().
XNVCTRLQueryAttribute()	Queries the value of the specified attribute
XNVCTRLQueryStringAttribute()	Queries the value of the specified string attribute
XNVCTRLSetStringAttribute()	Set the specified string attribute with the specified string.
XNVCTRLQueryValidAttributeValues()	Queries the valid values for the specified attribute
XNVCTRLSetGvoColorConversion()	Sets the color conversion matrix
XNVCTRLQueryGvoColorConversion()	Queries the color conversion matrix

XNVCTRLQueryExtension()

```
Bool XNVCTRLQueryExtension (
    Display *dpy,
    int *event_basep,
    int *error_basep
);
```

This function returns **True** if the extension exists, **False** otherwise. **`event_basep`** and **`error_basep`** are the extension event and error bases. Currently, no extension specific errors or events are defined.

XNVCTRLQueryVersion()

```
Bool XNVCTRLQueryVersion (
    Display *dpy,
    int *major,
    int *minor
```

```
);
```

This function returns **True** if the extension exists, **False** otherwise. **major** and **minor** are the extension's major and minor version numbers.

XNVCTRLIsNvScreen()

```
Bool XNVCTRLIsNvScreen (
    Display *dpy,
    int screen
);
```

This function returns **True** is the specified screen is controlled by the NVIDIA driver, otherwise **False**.

XNVCTRLSetAttribute()

```
void XNVCTRLSetAttribute (
    Display *dpy,
    int screen,
    unsigned int display_mask,
    unsigned int attribute,
    int value
);
```

This function sets the attribute to the given value. Not all attributes require the display_mask parameter. See "NV_CTRL_GVO Attributes" on page 67 for details.

Possible errors:

- BadValue - The screen or attribute doesn't exist.
- BadMatch - The NVIDIA driver is not present on that screen.

XNVCTRLSetAttributeAndGetStatus()

```
Bool XNVCTRLSetAttributeAndGetStatus (
    Display *dpy,
    int screen,
    unsigned int display_mask,
    unsigned int attribute,
    int value
```

```
);
```

This function is the same as XNVCTRLSetAttribute(), and returns **True** if the operation succeeds, otherwise **False**.

XNVCTRLQueryAttribute()

```
Bool XNVCTRLQueryAttribute (
    Display *dpy,
    int screen,
    unsigned int display_mask,
    unsigned int attribute,
    int *value
);
```

This function returns **True** if the attribute exists, otherwise **False**.

If XNVCTRLQueryAttribute returns True, value will contain the value of the specified attribute. Not all attributes require the display_mask parameter. See "NV_CTRL_GVO Attributes" on page 67 for details.

Possible errors:

- BadValue - The screen doesn't exist.
- BadMatch - The NVIDIA driver is not present on that screen.

XNVCTRLQueryStringAttribute()

```
Bool XNVCTRLQueryStringAttribute (
    Display *dpy,
    int screen,
    unsigned int display_mask,
    unsigned int attribute,
    char **ptr
);
```

This function returns **True** if the attribute exists, otherwise **False**.

If XNVCTRLQueryStringAttribute returns True, *ptr will point to an allocated string containing the string attribute requested. It is the caller's responsibility to free the string when done.

Possible errors:

- BadValue - The screen doesn't exist.
- BadMatch - The NVIDIA driver is not present on that screen.
- BadAlloc - Insufficient resources to fulfill the request.

XNVCTRLSetStringAttribute()

```
Bool XNVCTRLSetStringAttribute (
    Display *dpy,
    int screen,
    unsigned int display_mask,
    unsigned int attribute,
    char *ptr
);
```

Returns **True** if the operation succeeded, otherwise **False**.

Possible X errors:

- BadValue - The screen doesn't exist.
- BadMatch - The NVIDIA driver is not present on that screen.
- BadAlloc - Insufficient resources to fulfill the request.

XNVCTRLQueryValidAttributeValues()

```
Bool XNVCTRLQueryValidAttributeValues (
    Display *dpy,
    int screen,
    unsigned int display_mask,
    unsigned int attribute,
    NVCTRLAttributeValidValuesRec *values
);
```

This function returns **True** if the attribute exists. otherwise **False**. If XNVCTRLQueryValidAttributeValues returns True, values will indicate the valid values for the specified attribute.

See the description of NVCTRLAttributeValidValues in NVCtrl.h.

XNVCTRLSetGvoColorConversion()

```
void XNVCTRLSetGvoColorConversion (
   Display *dpy,
   int screen,
   float colorMatrix[3][3],
   float colorOffset[3],
   float colorScale[3]
);
```

This function sets the color conversion matrix, offset, and scale that should be used for GVO (Graphic to Video Out).

The Color Space Conversion data is ordered as follows:

- colorMatrix[0][0] // r.Y
- colorMatrix[0][1] // g.Y
- colorMatrix[0][2] // b.Y

- colorMatrix[1][0] // r.Cr
- colorMatrix[1][1] // g.Cr
- colorMatrix[1][2] // b.Cr

- colorMatrix[2][0] // r.Cb
- colorMatrix[2][1] // g.Cb
- colorMatrix[2][2] // b.Cb

- colorOffset[0] // Y
- colorOffset[1] // Cr
- colorOffset[2] // Cb

- colorScale[0] // Y
- colorScale[1] // Cr
- colorScale[2] // Cb

where the data is used according to the following formulae:

- Y = colorOffset[0] + colorScale[0] *
  (R * colorMatrix[0][0] + G * colorMatrix[0][1] + B * colorMatrix[0][2]);

- Cr = colorOffset[1] + colorScale[1] *
  (R * colorMatrix[1][0] + G * colorMatrix[1][1] + B * colorMatrix[1][2]);
- Cb = colorOffset[2] + colorScale[2] *
  (R * colorMatrix[2][0] + G * colorMatrix[2][1] + B * colorMatrix[2][2]);

Possible errors:

- BadMatch - The NVIDIA driver is not present on that screen.
- BadImplementation - GVO is not available on that screen.

XNVCTRLQueryGvoColorConversion()

```
Bool XNVCTRLQueryGvoColorConversion (
    Display *dpy,
    int screen,
    float colorMatrix[3][3],
    float colorOffset[3],
    float colorScale[3]
);
```

This function retrieves the color conversion matrix and color offset that are currently being used for GVO (Graphic to Video Out). The values are ordered within the arrays according to the comments for XNVCTRLSetGvoColorConversion().

Possible errors:

- BadMatch - The NVIDIA driver is not present on that screen.
- BadImplementation - GVO is not available on that screen.

APPENDIX

A

ONBOARD DIP SWITCH

The Quadro FX 4500 SDI graphics card has an onboard dip switch, located on the SDI output card, that determines the default SDI operating mode. Subsequent software changes override these settings.

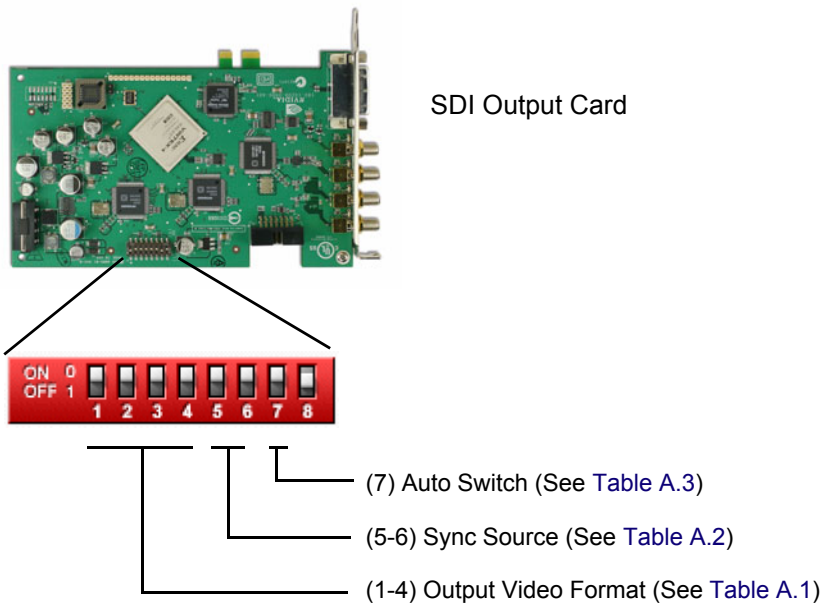


Figure 1.1 Onboard DIP Switch Positions

In the following tables, a “0” value corresponds to the “ON” switch position, and a “1” value corresponds to the “OFF” switch position.

Table A.1 Output Video Format Switch Settings

Switch Position	
1234	**Video Format**
0000	Reserved
1000	SMPTE 259 NTSC, 1440x487, 30/1.001 Hz, Interlace
0100	SMPTE 259 PAL, 1440x576, 25 Hz, Interlace
1100	SMPTE 260, 1920x1035, 30 Hz, Interlace
0010	SMPTE 260, 1920x1035, 30/1.001 Hz, Interlace
1010	SMPTE 295, 1920x1080, 25 Hz, Interlace
0110	SMPTE 274, 1920x1080, 30 Hz, Interlace
1110	SMPTE 274, 1920x1080, 30/1.001 Hz, Interlace
0001	SMPTE 274, 1920x1080, 25 Hz, Interlace
1001	SMPTE 274, 1920x1080, 30 Hz, Progressive
0101	SMPTE 274, 1920x1080, 30/1.001 Hz, Progressive
1101	SMPTE 274, 1920x1080, 25 Hz, Progressive
0011	SMPTE 274, 1920x1080, 24 Hz, Progressive
1011	SMPTE 274, 1920x1080, 24/1.001 Hz, Progressive
0111	SMPTE 296, 1280x720, 60 Hz, Progressive
1111	SMPTE 296, 1280x720, 60/1.001 Hz, Progressive

Table A.2 Sync Source Switch Settings

Switch Position	
56	**Sync Source**
00	Internal (free running)
10	Synchronize to SDI sync source
01	Synchronize to Composite sync source
11	Reserved

Table A.3 Auto Switch Settings

Switch Position	
7	**Auto Switch Setting**
0	Do not auto switch
1	Automatically switch to the new video format based on the source sync.