



# Release 352 Quadro & NVS Professional Drivers for Windows - Version 353.62

RN-WQ353-62-03\_v01 | July 28, 2015  
Windows Server 2008 and Windows Server 2012

## Release Notes



# TABLE OF CONTENTS

<b>1</b>	<b>Introduction to Release Notes</b>	<b>1</b>
	Structure of the Document	1
	Changes in this Edition	1
<b>2</b>	<b>Release 352 Driver Changes</b>	<b>2</b>
	Version 353.62 Highlights	3
	Existing Support	3
	What's New in Version 353.62	3
	What's New in Release 352	4
	Discontinued and Unsupported Features in this Release	5
	Advanced Instructions for this Release	7
	Turning Off V-Sync to Boost Performance	7
	NVIDIA Application Configuration Engine (ACE)	8
	SLI Multi-OS - GPU Assignment in System Virtualization	8
	Using the WDDM Driver Model with Tesla GPU GOMs	11
	Not NVIDIA Issues	13
	Windows Server 2008 R2 and Windows Server 2012 Considerations	13
	Unsupported Features Under Windows Server 2008/Windows Server 2012	14
	OpenGL Application Issues For Windows Server 2008/Windows Server 2012	15
	Known Product Limitations	16
	Some APIs do not Report Total Available Graphics Memory Correctly	17
	Using HDMI/DisplayPort Audio with Displays that have a High Native Resolution	18
	Using HDMI/DisplayPort Displays that do not Support Audio	19
	Using HDMI/DisplayPort Audio in Dualview or Clone Mode Configurations	20
	GPU Runs at a High Performance Level (full clock speeds) in Multi-display Modes	20
	Applying Workstation Application Profiles	21
	1280x1024 @ 60 Hz not Available on BenQ FP241W Monitors	21
	Gigabyte GA-6BX Motherboard	21
	OpenGL Viewport Scaling Problem in Horizontal Span Mode	21
	Image Sharpening Control not Available with Quadro FX 4600 and Later GPUs	22

# TABLE OF CONTENTS

<b>3</b>	<b>The Release 352 Driver</b>	<b>23</b>
	Hardware and Software Support	23
	Supported Operating Systems	23
	Supported NVIDIA Products	24
	Supported Languages	28
	Driver Installation	29
	Minimum Hard Disk Space	29
	Before You Begin	29
	Installation Instructions	31
	<b>Appendix A: Mode Support for Windows</b>	<b>32</b>
	General Mode Support Information	33
	Default Modes Supported by GPU	34
	Understanding the Mode Format	34
	Tesla, Quadro, and NVS Family of GPUs	35
	Modes Supported by TV Encoders	37
	<b>Appendix B: NVIDIA Tesla Compute Cluster Mode</b>	<b>38</b>
	About Tesla Compute Cluster Mode	38
	TCC Overview	38
	Running CUDA Applications	39
	Operating on Systems with non-TCC NVIDIA GPUs	40
	Setting TCC Mode	40

## LIST OF TABLES

Table 1	GOM and Driver Model Compatibility .....	12
Table 3.1	Supported NVIDIA Workstation Products .....	24
Table 3.5	Supported NVIDIA Quadro Plex Products.....	25
Table 3.2	Supported NVIDIA Quadro Sync Products .....	25
Table 3.3	Supported NVIDIA Quadro G-Sync II Products .....	25
Table 3.4	Supported NVIDIA Quadro SDI Products .....	25
Table 3.6	Supported NVIDIA Quadro Notebook Products .....	26
Table 3.7	Supported NVIDIA Quadro Blade/Embedded Graphics Board Series .....	26
Table 3.8	Supported NVIDIA Tesla Products .....	27
Table 3.9	Supported NVIDIA GRID Products.....	27
Table A.1	Modes Supported for High Resolution Displays .....	33
Table A.2	Non-standard Modes Supported .....	33
Table A.3	Mode Support for S-Video and Composite Out .....	37
Table A.4	Mode Support for Component YPrPb Out and DVI Out.....	37
Table B.1	Default TCC Mode .....	40

# 01 INTRODUCTION TO RELEASE NOTES

This edition of *Release Notes* describes the Release 352 family of Quadro, NVS, Tesla, and GRID Drivers (versions 352.xx to 354.xx) for Microsoft® Windows® Windows Server 2008 and Windows Server 2012. NVIDIA provides these notes to describe performance improvements and bug fixes in each documented version of the driver.

## Structure of the Document

This document is organized in the following sections:

- ▶ “[Release 352 Driver Changes](#)” on page 2 gives a summary of changes, and fixed and open issues in this version.
- ▶ “[The Release 352 Driver](#)” on page 23 describes the NVIDIA products and languages supported by this driver, the system requirements, and how to install the driver.
- ▶ “[Mode Support for Windows](#)” on page 32 lists the default resolutions supported by the driver.
- ▶ “[NVIDIA Tesla Compute Cluster Mode](#)” on page 38 describes the Tesla Compute Cluster mode.

## Changes in this Edition

This edition of the *Release Notes* for Windows Server includes information about NVIDIA graphics driver version 353.62, and lists changes made to the driver since version 347.88. These changes are discussed beginning with the chapter “[Release 352 Driver Changes](#)” on page 2.

## 02 RELEASE 352 DRIVER CHANGES

This chapter describes open issues for version 353.62, and resolved issues and driver enhancements for versions of the Release 352 driver up to version 353.62. The chapter contains these sections:

- ▶ “Version 353.62 Highlights” on page 3
- ▶ “Advanced Instructions for this Release” on page 7
- ▶ “Not NVIDIA Issues” on page 13
- ▶ “Known Product Limitations” on page 16

## Version 353.62 Highlights

This section provides highlights of version 353.62 of the NVIDIA Release 352 Driver for Windows Vista/Windows 7.

- ▶ Existing Support
- ▶ What's New in Version 353.62
- ▶ What's New in Release 352
- ▶ Discontinued and Unsupported Features in this Release

### Existing Support

- ▶ This release supports the following APIs:
  - Open Computing Language (OpenCL) 1.2 for Kepler and Maxwell GPUs  
The OpenCL 1.2 drivers are based on the published Khronos Specification, and are expected to pass the Khronos Conformance Testing Process. Current conformance status can be found at [www.khronos.org/conformance](http://www.khronos.org/conformance).
  - OpenGL 4.5
  - DirectX 11
  - CUDA 7.5
- ▶ This driver installs **nView Desktop Manager** version 146.33.

### What's New in Version 353.62

- ▶ This driver offers performance improvements over previous driver versions, including workstation compatibility fixes.

## What's New in Release 352

The section summarizes the following driver changes in Release 352 (since Release 340):

### Quadro ODE Driver

Release 352 is the ninth 'Optimal Drivers for Enterprise'(ODE) branch release. ODE branches are dedicated to relatively long term stability for ISV certification, OEMs, and Enterprise customers.

### New Features Supported

- ▶ CUDA 7.5
- ▶ NVIDIA Enterprise Management Toolkit (NvWMI) version 2.22
- ▶ NVIDIA Control Panel
  - *Display->Set up multiple displays->Smart clone display option*  
Added Mosaic pan and scan with confidence monitor capability.
  - *Display->Change Resolution* page is enhanced with scanout bpp, color space, and color range controls.  
Added 12 bit per color component support over DisplayPort.
  - *Display->Set up G-SYNC* page  
Added **G-SYNC** indicator and support for windowed mode.
  - Moved the **Dynamic RGB Range** controls from the *Adjust Desktop Color Settings* page to the *Change Resolution* page.
- ▶ Mosaic: Added reboot persistence, hotplug/unplug, and undock/dock support for notebook systems.
- ▶ 5k Monitor Support
- ▶ OpenCL 1.2
- ▶ TCC Mode support is expanded to include Quadro products using Kepler and Maxwell GPUs.



## Discontinued and Unsupported Features in this Release

### Discontinued Features

- ▶ The NVIDIA® AutoCAD Performance driver is no longer integrated in the graphics driver.

Standalone versions or version updates can still be downloaded from the NVIDIA driver download page.

- ▶ The following features are removed from the NVIDIA Control Panel
  - The Views option
 

You no longer need to select between Standard and Advanced views for many NVIDIA Control Panel controls.
  - The Profiles menu
- ▶ Support for Quadro SDI products is discontinued for Windows Server 2012 and later operating systems.
- ▶ Legacy Support for Curie generation of Workstation products
 

Beginning with Release 310, the NVIDIA professional drivers no longer support the Curie generation of Workstation products.

NVIDIA Quadro FX 5500
NVIDIA Quadro FX 4500 X2
NVIDIA Quadro FX 4500
NVIDIA Quadro FX 4400
NVIDIA Quadro FX 4400G
NVIDIA Quadro FX 4000
NVIDIA Quadro FX 470
NVIDIA Quadro FX 350
NVIDIA Quadro VX 200
NVIDIA Quadro NVS 440
NVIDIA Quadro NVS 285

Release 304 drivers continue to support Curie generation Workstation products, and NVIDIA will continue to address driver issues for these products in driver branches up to and including Release 304. However, future driver enhancements and optimizations in driver releases after Release 304 will not support Curie generation products.

### ► Legacy Support for Tesla architecture GPUs

Beginning with Release 343, the NVIDIA graphics drivers no longer support the Tesla generation of NVIDIA GPUs. These products are identified in the section [Supported NVIDIA Products](#)

The Release 340 drivers will continue to support these products until April 1, 2016, and the NVIDIA support team will continue to address driver issues for these products in driver branches up to and including Release 340. However, future driver enhancements and optimizations in driver releases after Release 340 will not support these products.

The following is a summary of legacy Workstation products beginning with Release 343 drivers:

- Quadro FX/CX/VX Workstation products
- Select Quadro NVS Workstation products
- Quadro FX and NVS Notebook Products
- Quadro Plex 2200

### Limitations for Windows Server 2008 and Windows Server 2012

The following are features that are not currently supported or have limited support in this driver release:

#### ► NVIDIA Control Panel Display Category

- The Graph tab on the Adjust Desktop Color Settings page is not available.

## Advanced Instructions for this Release

This section clarifies instructions for successfully accomplishing the following tasks:

- ▶ Turning Off V-Sync to Boost Performance
- ▶ NVIDIA Application Configuration Engine (ACE)
- ▶ SLI Multi-OS – GPU Assignment in System Virtualization
- ▶ Using the WDDM Driver Model with Tesla GPU GOMs

### Turning Off V-Sync to Boost Performance

To get the best benchmark and application performance measurements, turn V-Sync off as follows:

- 1 Open the NVIDIA Control Panel and make sure that *Advanced Settings* is selected from the control panel tool bar.
- 2 From the *Select a Task* pane, under 3D Settings, click **Manage 3D Settings**, then click the Global Settings tab.
- 3 From the Global presets pull-down menu, select **Base profile**.
- 4 From the Settings list box, select **Vertical sync** and change its value to **Force off**, then click **Apply**.
- 5 From the Global presets pull-down menu, select **3D App - Default Global Settings** (the driver's default profile) or use the application profile that matches the application you are testing, then click **Apply**.

***Be sure to close the NVIDIA Control Panel completely*** —leaving it open will affect benchmark and application performance.

## NVIDIA Application Configuration Engine (ACE)

This driver includes the NVIDIA Application Configuration Engine (ACE), which automatically detects the workstation application and configures the appropriate profile settings in the NVIDIA Control Panel.

See the *NVIDIA Quadro Professional Drivers: NVIDIA Control Panel Quick Start Guide* for more information about this feature.

## SLI Multi-OS - GPU Assignment in System Virtualization

On systems with two or more graphics cards installed, this driver supports a hypervisor's ability to directly assign GPUs to guest virtual machines (VMs). This direct assignment allows each guest VM to run on their own operating system with their own GPU and driver. The assignment allows full GPU performance and functionality in the guest VM.

### Hardware Platform Requirements

To make use of GPU passthrough with virtual machines running Windows and Linux, the hardware platform must support the following features:

- ▶ A CPU with hardware-assisted instruction set virtualization: Intel VT-x or AMD-V.
- ▶ Platform support for I/O DMA remapping.

On Intel platforms the DMA remapper technology is called Intel VT-d.

On AMD platforms it is called AMD IOMMU.

Support for these feature varies by processor family, product, and system, and should be verified at the manufacturer's website.

### Supported Hypervisors

The following hypervisors are supported:

Hypervisor	Notes
Citrix XenServer	Version 6.0 and later.
VMware vSphere (ESX / ESXi)	Version 5.1 and later.
Parallels Workstation Extreme	Version 4 and later

## Supported Graphics Cards

The following GPUs are supported for device passthrough:

GPU Family	Boards supported
Kepler	<p><u>GRID</u>: K1, K2, K520, K340</p> <p><u>Quadro</u>: K2000, K4000, K5000, K6000</p> <p><u>Tesla</u>: K10, K20, K20x, K20Xm, K20c, K20s, K40m, K40c, K40s, K40st, K40t, K80</p>
Fermi	<p><u>Quadro</u>: 2000, 4000, 5000, 6000</p> <p><u>Quadro-MXM</u>: 1000M, 3000M</p> <p><u>Tesla</u>: C2050, C2075, M2050, M2070, M2070Q</p>

## Notes and Known Issues

### VMware

- PCI I/O hole may need to be changed for Windows 64-bit VMs.  
Windows 64-bit VMs may require that you edit the VM configuration file to configure a larger PCI I/O hole for the GPU.
- Access Control Services is required on some switches.  
Starting with ESX 5.0 Update 1, Access Control Services (ACS) is required on any switches in the PCIe hierarchy above a PCIe device that is to be used for passthrough. If ACS is not present, ESX will not allow the device to be assigned directly to a VM.  
To allow assignment of devices below switches that do not support ACS, you can disable the ACS check as follows:  

```
esxcfg-advcfg -k true disableACSCheck
```
- Configuring passthrough to a Windows Server 2008R2 VM.  
The VMware WDDM driver must be manually installed on Windows Server 2008 R2.  
Follow the steps provided at <http://communities.vmware.com/message/1423263#1425288>.
- MSI translation must be disabled.  
Blue-screen crashes may occur on VMs with assigned GPUs if MSI is initially enabled for passthrough devices.  
To avoid this issue, disable MSI translation by setting `pciPassthru0.msiEnabled = "FALSE"` in the VM's VMX file.

### Citrix XenServer

- XenServer 6.1 workaround for 64-bit MMIO failures on PCI passthrough.

Dom0 kernel may relocate GPU BARs to an invalid location immediately beyond the end of physical RAM. There are two workaround options to address this condition:

**Workaround option #1:** Add 'pci=use\_crs' to the kernel parameters by running the following command in Dom0:

```
/opt/xensource/libexec/xen-cmdline --set-dom0 pci=use_crs
```

**Workaround option #2:** Install the hotfix provided by Citrix at <http://support.citrix.com/article/CTX137645>):

### Multi-Monitor Support on GRID

Multi-monitor support on GRID boards K1 and K2 requires the following VBIOS versions:

- GRID K1: *80.07.AF.00.00 or later*
- GRID K2: *80:04:BA:00.00 or later*

## Using the WDDM Driver Model with Tesla GPU GOMs

### Tesla GPU Operation Modes

Tesla K20X and K20 GPU Accelerators offer the ability to specify the GPU operation mode using NV-SMI/NVML. (refer to: <https://developer.nvidia.com/nvidia-management-library-nvml>).

By setting the GPU operation mode, developers can selectively turn off certain features in the GPU to get the best performance per watt for certain workloads.

The following are the supported GOMs:

- ▶ **Compute-Only:** For running compute tasks only.  
By default the Tesla K20X and K20 accelerator boards ship in this mode.
- ▶ **Low-Double Precision:** For graphics applications that don't require high bandwidth double precision.  
This is recommended for workloads that are not sensitive to double precision but at the same time need graphics capabilities.
- ▶ **All On:** This is recommended only when the workload needs full double precision as well as graphics capabilities.

### WDDM and TCC Driver Models

Along with the GPU operation mode, the developer needs to select the compatible driver model for the Tesla K20X and K20.

- ▶ **Tesla Compute Cluster (TCC):** Optimized for running compute workloads.
- ▶ **Windows Device Driver Model (WDDM):** Designed for graphics application and not recommended for compute workloads.

## Compatibility Between GOM and Driver Models

Table 1 shows which GPU operation modes are compatible with which driver models.

Table 1 GOM and Driver Model Compatibility

GOM	TCC Driver Model	WDDM Driver Model	Use Case Support
All On	YES	YES	All use cases are supported.
Compute-Only	YES	NO	The following are <b>unsupported</b> : X11 and those that require X11 (GLInterop, OCL conformance and VIPER) 32-bit Windows OS
Low Double Precision	YES	YES	All use cases supported.

The compute-only GOM is supported only on the TCC driver model, while the WDDM driver model supports only GOM modes that enable graphics.

The compute-only GOM and WDDM are incompatible and should not be used simultaneously.

***The Tesla K20 Active Accelerators for workstations ship in “compute-only” mode and cannot be modified. Therefore, use only the TCC driver model with these products.***

### Using the WDDM Driver Model

To use the WDDM driver model with Tesla K20x and K20 GPU Accelerators for servers, first switch the GOM mode from compute-only to All On, then switch from TCC to WDDM.

***Do not attempt to specify the driver model by editing the registry.*** Doing so can result in compute-only GOM and WDDM being configured simultaneously, which might require a clean installation of the driver to fix.

***Always use NVIDIA-provided tools to specify a processing mode or to switch between driver models.*** Such tools include nvidia-smi or the NVIDIA Control Panel->Manage Maximus Settings page. These tools provide warnings in the case of a conflict.



## Not NVIDIA Issues

This section lists issues that are not due to the NVIDIA driver as well as features that are not meant to be supported by the NVIDIA driver for Windows Vista/Windows 7.

- ▶ “Windows Server 2008 R2 and Windows Server 2012 Considerations” on page 13
- ▶ “Unsupported Features Under Windows Server 2008/Windows Server 2012” on page 14
- ▶ “OpenGL Application Issues For Windows Server 2008/Windows Server 2012” on page 15

## Windows Server 2008 R2 and Windows Server 2012 Considerations

### Hotplug Action

Unlike the hotplug activity under Windows Server 2008, the default settings are not applied when a new display is hotplugged, and there is no message balloon alert stating that a new display was detected. Under Windows 7, all display connection and detection events are handled through the Windows 7 Connecting and Configuring Displays (CCD) mechanism.

### NVIDIA Control Panel Rotate Display Page

The rotation radio button labels are changed slightly under Windows 7 to be consistent with the Microsoft panel

**Table 2.1** NVIDIA Control Panel Rotation Page Radio Buttons

Clockwise Rotation	Windows 7 Label	Windows Vista Label
0 degrees	Landscape	No rotation (Landscape)
90 degrees	Portrait	90 degrees to the right (Inverted Portrait)
180 degrees	Landscape (flipped)	180 degree rotation (Inverted landscape)
270 degrees	Portrait (flipped)	90 degrees to the left (Portrait)

### Limitation

- ▶ When switching the refresh rate from 59 Hz to 60Hz, the refresh rate remains at 59 Hz.  
*See the Microsoft KB article KB2006076 at <http://support.microsoft.com/kb/2006076>.*

## Unsupported Features Under Windows Server 2008/Windows Server 2012

The following are features and functionality that were available in driver releases supporting Windows XP, but are not—and will not be—available in driver releases for Windows Vista:

- ▶ **High resolution scaling desktop (HRSD)**

- ▶ **MultiView Display Mode** (for NVIDIA Quadro NVS graphics cards)

- ▶ **NVKeystone**

- ▶ **Unified back buffer (UBB) controls**

- ▶ **OpenGL Video Overlays**

This is an operating system limitation.

- ▶ **Overclocking**

GPU overclocking is no longer supported in the default GPU driver control panel. This feature is available in the NVIDIA System Tools software, which you can download from [NVIDIA.com](http://NVIDIA.com).

- ▶ **GPU Temperature Monitoring**

Temperature monitoring is no longer supported in the default GPU driver control panel. This feature is available in the NVIDIA System Tools software, which you can download from [NVIDIA.com](http://NVIDIA.com).

- ▶ **AGP Settings Adjustment**

- ▶ **Video Zoom**

- ▶ **Pan & Scan** - the process of panning across the desktop in order to display a desktop on a monitor with lower resolution

- ▶ **Per-display Desktop Color Setting Adjustments**

For Clone mode, the desktop color setting adjustments through the NVIDIA Control Panel can only be made across all displays in a system, and not on a per-display basis.

- ▶ **Per-display Video Color Setting Adjustments**

For Dualview mode, the video color setting adjustments through the NVIDIA Control Panel can only be made across all displays in a system, and not on a per-display basis.

- ▶ **Edge Blending**

- ▶ **Run display optimization wizard**

- ▶ **Run multiple display wizard**

- ▶ **Run television setup wizard**

- ▶ **nView Horizontal and Vertical Span Modes**

Due to architectural changes in the new Windows Vista Window Display Driver Model (WDDM), span mode cannot be supported in NVIDIA graphics drivers. NVIDIA recommends using the built-in Windows Vista multi-display modes.

- ▶ **Display/Connection Wizard** (such as was provided with Windows Media Center Edition)
- ▶ **DVD/MPEG Extensions** (such as was provided with Windows Media Center Edition)
- ▶ **Audio Extensions** (such as was provided with Windows Media Center Edition)

## OpenGL Application Issues For Windows Server 2008/ Windows Server 2012

The following are known compatibility issues for OpenGL applications developed under Windows Server 2003:

- ▶ Mixed GDI and OpenGL rendering does not work.
  - A number of applications use GDI to render UI components and object highlighting. This is not supported in the Windows Vista driver model.
  - NVIDIA recommends converting GDI rendering to OpenGL.
  - The following are some applications that are known to have this issue:
    - Maya 7.01
- ▶ Applications, Tools, and Benchmarks not Supported Under Windows Vista
  - GLperf
  - 3ds max 8 (later releases may be supported)
  - CATIA V5R15 (V5R16 is supported)
  - PTC's CDRS 2001
- ▶ Front buffered rendering may be slow, especially when DWM is enabled.
  - Flushing the rendering queue while rendering to the front buffer may cause the window manager to recomposite. Applications should therefore minimize the frequency with which they flush the rendering queue.

## Known Product Limitations

This section describes problems that will not be fixed. Usually, the source of the problem is beyond the control of NVIDIA. Following is the list of problems and where they are discussed in this document:

- ▶ “Some APIs do not Report Total Available Graphics Memory Correctly” on page 17
- ▶ “Using HDMI/DisplayPort Audio with Displays that have a High Native Resolution” on page 18
- ▶ “Using HDMI/DisplayPort Displays that do not Support Audio” on page 19
- ▶ “Using HDMI/DisplayPort Audio in Dualview or Clone Mode Configurations” on page 20
- ▶ “GPU Runs at a High Performance Level (full clock speeds) in Multi-display Modes” on page 20
- ▶ “Applying Workstation Application Profiles” on page 21
- ▶ “1280x1024 @ 60 Hz not Available on BenQ FP241W Monitors” on page 21
- ▶ “Gigabyte GA-6BX Motherboard” on page 21
- ▶ “OpenGL Viewport Scaling Problem in Horizontal Span Mode” on page 21
- ▶ “Image Sharpening Control not Available with Quadro FX 4600 and Later GPUs” on page 22

# Some APIs do not Report Total Available Graphics Memory Correctly

## Background-TAG Memory

In the Windows Display Driver Model (WDDM), Total Available Graphics (TAG) memory is reported as the sum of

- Dedicated Video Memory (video memory dedicated for graphics use)
- Dedicated System Memory (system memory dedicated for graphics use), and
- Shared System Memory (system memory shared between the graphics subsystem and the CPU).

The values for each of these components are computed according to WDDM guidelines when the NVIDIA Display Driver is loaded.

## Issue

NVIDIA has found that some TAG-reporting APIs represent video memory using 32-bits instead of 64-bits, and consequently do not properly report available graphics memory when the TAG would otherwise exceed 4 gigabytes (GB). This results in under reporting of available memory and potentially undesirable behavior of applications that rely on these APIs to report available memory.

The reported memory can be severely reduced. For example, 6 GB might be reported as 454 MB, and 8 GB might be reported as 1259 MB.

## NVIDIA Action for Some GeForce-based Systems

For GeForce GPUs with 2.75 GB or less of video memory, the NVIDIA display driver constrains TAG memory to just below 4 GB<sup>1</sup>. In this scenario, the Shared System Memory component of TAG is limited first, before limiting Dedicated Video Memory.

This is a policy decision within the driver, and results in reliable reporting of sub-4 GB TAG memory.

## When TAG Reporting Would Not Be Limited

For GeForce-based GPUs with more than 2.75 GB of video memory, as well as all Quadro and Tesla GPUs, the NVIDIA display driver does not constrain TAG memory reporting.

The disadvantage of constraining TAG on systems with larger amounts of video and system memory is that memory which otherwise would be available for graphics use is

1. The WDDM guidelines dictate minimum and maximum values for the components, but the display driver may further constrain the values that are reported (within the allowed minimum and maximum).

no longer available. Since shared system memory is limited first, driver components and algorithms utilizing shared system memory may suffer performance degradation when TAG is constrained.

Since these and similar scenarios are prevalent in many Workstation applications, the NVIDIA driver avoids constraining TAG on all Quadro and Tesla-based systems. Likewise, the driver does not constrain TAG for GeForce-based systems with more than 2.75 GB of video memory.

## Using HDMI/DisplayPort Audio with Displays that have a High Native Resolution

*To use HDMI/DisplayPort audio with some displays that have a native resolution higher than 1920x1080, you must set the display to a lower HD resolution.*

Some HDMI TV's have a native resolution that exceeds the maximum supported HD mode. For example, TVs with a native resolution of 1920x1200 exceed the maximum supported HD mode of 1920x1080.

Applying this native mode results in display overscan which cannot be resized using the NVIDIA Control Panel since the mode is not an HD mode.

To avoid this situation and provide a better user experience, the driver treats certain TVs—such as the Viewsonic VX2835wm and the Westinghouse LVM- 37w3—as a DVI monitor when applying the native mode. Because the driver does not treat the TV as an HDMI in this case, the HDMI audio is not used.

## Using HDMI/DisplayPort Displays that do not Support Audio

*Some HDMI/DisplayPort displays do not support audio, or have issues with Quadro FX family and earlier NVIDIA graphics cards.*

The NVIDIA driver attempts to identify such displays and automatically disables the audio. For example, the NVIDIA driver disables HDMI audio for all Philips HDMI TVs, as these have been identified as having issues with Quadro FX family and earlier NVIDIA graphics cards.

There may be cases where either the driver disables audio even though there is no problem, or does not disable the audio when in fact the audio does not work. The following sections describe these situations and provides guidance for handling them.

### Corrupted video and no audio

The driver has not disabled audio and the display's audio signal is incompatible with the graphics card, causing video corruption.

With a different display connected in order to establish video, disable audio for the HDMI display using the NVIDIA Control Panel-> Change Resolution page. From the connector list, select **HDMI-HDTV (Audio Disabled)**.

### Video but no audio

- ▶ Check the connector list on the NVIDIA Control Panel->Change Resolution page.
- ▶ If **HDMI-HDTV (Audio Disabled)** is selected and you want to test whether your HDMI audio does, in fact, work, then select **HDMI-HDTV (Audio Enabled)** and the driver will prompt you with instructions for testing HDMI audio with the display.
- ▶ If **HDMI-HDTV (Audio Enabled)** is selected, then the driver has not successfully detected that an incompatible display is connected.

*Future driver versions will properly identify such displays and disable audio.*

- ▶ If there is no HDMI connector option in the NVIDIA Control Panel->Change Resolution page, the display does not support audio and has properly reported this to the NVIDIA driver.

## Using HDMI/DisplayPort Audio in Dualview or Clone Mode Configurations

### Two Audio-enabled Ports

In a multi-display configuration where both HDMI/DisplayPort audio ports are enabled, only the primary display will provide the audio.

### One Audio-enabled Port

In a multi-display configuration where only one audio port is enabled, such as when one display is a DVI display, then the HDMI/DisplayPort display can provide the audio whether is it the primary or secondary display.

## GPU Runs at a High Performance Level (full clock speeds) in Multi-display Modes

This is a hardware limitation and not a software bug. Even when no 3D programs are running, the driver will operate the GPU at a high performance level in order to efficiently drive multiple displays. In the case of SLI or multi-GPU PCs, the second GPU will always operate with full clock speeds; again, in order to efficiently drive multiple displays. Today, all hardware from all GPU vendors have this limitation.



## Applying Workstation Application Profiles

### ► Background

The workstation application profiles are software settings used by the NVIDIA Display Drivers to provide optimum performance when using a selected application. The profile also works around known application issues and bugs.

If there is an available setting for an application, it should be used, otherwise incorrect behavior or reduced performance is likely to occur.

### ► Issues

Configuration changes require that you restart the application.

Once an application is running, it does not receive notification of configuration changes. Therefore, if you change the configuration while the application is running, you must exit and restart the application for the configuration changes to take effect.

## 1280x1024 @ 60 Hz not Available on BenQ FP241W Monitors

Even though the monitor EDID lists 1280x1024 @ 60 Hz, the screen turns blank when using an HDMI connection. This is an issue with the monitor and not the NVIDIA driver.

Because of this issue with the monitor, the NVIDIA driver blocks the problem mode (1280x1024 @ 60 Hz) and makes it unavailable.

## Gigabyte GA-6BX Motherboard

This motherboard uses a LinFINITY regulator on the 3.3-V rail that is rated to only 5 A—less than the AGP specification, which requires 6 A. When diagnostics or applications are running, the temperature of the regulator rises, causing the voltage to the NVIDIA chip to drop as low as 2.2 V. Under these circumstances, the regulator cannot supply the current on the 3.3-V rail that the NVIDIA chip requires.

This problem does not occur when the graphics board has a switching regulator or when an external power supply is connected to the 3.3-V rail.

## OpenGL Viewport Scaling Problem in Horizontal Span Mode

With nView Horizontal Span mode enabled, when opening an OpenGL model in a viewport, the model image is scaled too large to fit in the viewport. The problem occurs with such applications as Maya 5.0 and 3D Studio MAX 4.26.

*This is not an NVIDIA bug, but a limitation in the application's ability to properly maintain the aspect ratio in Horizontal Span mode.*

## Image Sharpening Control not Available with Quadro FX 4600 and Later GPUs

With Quadro FX 4600 and later graphics cards, the **Image sharpening** slider on the NVIDIA Control Panel-> Display->Adjust Desktop Color Settings page is grayed out.

This control is intentionally disabled because image sharpening is not supported on Quadro FX 4600 and later GPUs.

## 03 THE RELEASE 352 DRIVER

This chapter covers the following main topics:

- ▶ “Hardware and Software Support” on page 23
- ▶ “Driver Installation” on page 29

### Hardware and Software Support

#### Supported Operating Systems

The Release 352 driver, version 353.62, has been tested with the following Microsoft operating systems:

- ▶ Windows Server 2008<sup>1</sup>
- ▶ Windows Server 2008 R2 (64-bit)
- ▶ Windows Server 2012

1. SLI mode is not supported under Microsoft Windows Server 2008.

## Supported NVIDIA Products

The following tables list the NVIDIA products supported by the Release 352 driver, version 353.62.

- ▶ “Supported NVIDIA Workstation Products” on page 24
- ▶ “Supported NVIDIA Quadro Sync Products” on page 25
- ▶ “Supported NVIDIA Quadro G-Sync II Products” on page 25
- ▶ “Supported NVIDIA Quadro SDI Products” on page 25
- ▶ “Supported NVIDIA Quadro Plex Products” on page 25
- ▶ “Supported NVIDIA Quadro Blade/Embedded Graphics Board Series” on page 26
- ▶ “Supported NVIDIA Tesla Products” on page 27
- ▶ “Supported NVIDIA GRID Products” on page 27

Table 3.1 Supported NVIDIA Workstation Products

Product	Notes
NVIDIA Quadro K6000	
NVIDIA Quadro K5200	
NVIDIA Quadro K5000	
NVIDIA Quadro K4200	
NVIDIA Quadro K4000	
NVIDIA Quadro K2200	
NVIDIA Quadro K2000	
NVIDIA Quadro K620	
NVIDIA Quadro K600	
NVIDIA Quadro K420	
NVIDIA Quadro 6000	
NVIDIA Quadro 5000	
NVIDIA Quadro 4000	
NVIDIA Quadro 2000D	
NVIDIA Quadro 2000	
NVIDIA Quadro 600	
NVIDIA Quadro 410	
NVIDIA NVS 510	
NVIDIA NVS 315	
NVIDIA NVS 310	

Table 3.2 Supported NVIDIA Quadro Sync Products

Product	Notes
NVIDIA Quadro K6000	
NVIDIA Quadro K5200	
NVIDIA Quadro K5000	
NVIDIA Quadro K4200	

Table 3.3 Supported NVIDIA Quadro G-Sync II Products

Product	Notes
NVIDIA Quadro 6000	
NVIDIA Quadro 5000	

Table 3.4 Supported NVIDIA Quadro SDI Products

Product	Notes
NVIDIA Quadro K6000	
NVIDIA Quadro K5200	
NVIDIA Quadro K5000	
NVIDIA Quadro K4200	
NVIDIA Quadro K4000	
NVIDIA Quadro 6000	
NVIDIA Quadro 5000	
NVIDIA Quadro 4000	



**Note:** Quadro SDI products are not supported under Windows Server 2012.

Table 3.5 Supported NVIDIA Quadro Plex Products

Product	Notes
NVIDIA Quadro Plex 7000	

Table 3.6 Supported NVIDIA Quadro Notebook Products

Product	Notes
NVIDIA Quadro K5100M	
NVIDIA Quadro K5000M	
NVIDIA Quadro K4100M	
NVIDIA Quadro K4000M	
NVIDIA Quadro K3100M	
NVIDIA Quadro K3000M	
NVIDIA Quadro K2100M	
NVIDIA Quadro K2000M	
NVIDIA Quadro K1100M	
NVIDIA Quadro K1000M	
NVIDIA Quadro K610M	
NVIDIA Quadro K510M	
NVIDIA Quadro K500M	
NVIDIA Quadro 5010M	
NVIDIA Quadro 4000M	
NVIDIA Quadro 3000M	
NVIDIA Quadro 2000M	
NVIDIA Quadro 1000M	
NVIDIA Quadro 500M	

Table 3.7 Supported NVIDIA Quadro Blade/Embedded Graphics Board Series

Product	Notes
NVIDIA Quadro K3100M	
NVIDIA Quadro 4000M	
NVIDIA Quadro 3000M	
NVIDIA Quadro 1000M	
NVIDIA Quadro 500M	

Table 3.8 Supported NVIDIA Tesla Products

Product	Notes
Tesla K-Series Products	
NVIDIA Tesla K80	Windows Server 2008 x64 R2 Windows Server 2012 x64
NVIDIA Tesla K40(c/m/s/st)	Windows Server 2008 x64 R2 Windows Server 2012 x64
NVIDIA Tesla K20(x/c/m/Xm/s)	Windows Server 2008 x64 R2 Windows Server 2012 x64
NVIDIA Tesla K10	
Tesla S-Class Products	
NVIDIA Tesla S2050	
NVIDIA Tesla S1070	
Tesla M-Class Products	
NVIDIA Tesla M2090	
NVIDIA Tesla M2070	
NVIDIA Tesla M2070-Q	
NVIDIA Tesla M2050	
Tesla C-Class Products	
NVIDIA Tesla C2075	
NVIDIA Tesla C2070	
NVIDIA Tesla C2050	

Table 3.9 Supported NVIDIA GRID Products

Product	Notes
NVIDIA GRID K1	Windows Server 2008 x64 R2 Windows Server 2012 x64
NVIDIA GRID K2	Windows Server 2008 x64 R2 Windows Server 2012 x64

## Supported Languages

The Release 352 Graphics Drivers supports the following languages in the main driver Control Panel:

English (USA)	German	Portuguese (Euro/ Iberian)
English (UK)	Greek	Russian
Arabic	Hebrew	Slovak
Chinese (Simplified)	Hungarian	Slovenian
Chinese (Traditional)	Italian	Spanish
Czech	Japanese	Spanish (Latin America)
Danish	Korean	Swedish
Dutch	Norwegian	Thai
Finnish	Polish	Turkish
French	Portuguese (Brazil)	



# Driver Installation

## Minimum Hard Disk Space

The hard disk space requirement for 32-bit is minimum 200 MB for English-only, and 275 MB for International.

The hard disk space requirement for 64-bit is minimum 270 MB for English-only, and 365 MB for International.

## Before You Begin

If you have previously installed NVIDIA nTune, NVIDIA recommends that you uninstall nTune before installing this driver. After the driver install is complete, you can reinstall NVIDIA nTune.

## Preserving Settings Before Upgrading Your Software

Before uninstalling or installing software, you can preserve your nView Desktop Manager and/or NVIDIA Display settings by using the nView Desktop Manager Profiles features.



**Note:** Follow the steps below and/or refer to the *NVIDIA nView Desktop Manager User's Guide* for details. Under Windows XP/2000 you must have, at least, Power User access privileges in order to create or save a profile. (Refer to Windows Help if you need an explanation of Power User access rights.)

Follow the steps below and/or refer to the *NVIDIA nView Desktop Manager User's Guide* for details.

- 1 Open the nView Desktop Manager Profiles page (Figure 4.1).
- 2 To preserve your current settings, you can use either the **Save** or the **New** option from the nView Desktop Manager Profiles page:
  - If you want to overwrite the currently loaded profile with your changed settings, use the **Save** option. Notice that a warning message indicates that you are about to overwrite the selected profile.
  - If you want to retain the currently loaded profile and want to save your changed settings to a new file, click the **New** option. Enter a name and description of the profile in the New Profile dialog box. For example, you can name this profile **My Settings**.
- 3 If you are an “advanced” user and want to customize certain settings in the saved profile, click **Advanced** << to expand the dialog box (Figure 4.2).

- 4 To customize the settings, you can select or clear any of the settings check boxes.
- 5 Click **Save** to return to the main Profiles page.

If you created a new profile, you will see the name of the newly created profile in the profiles list.

If you overwrote a current profile, the same profile name is retained in the list.



**Note:** nView Desktop Manager profile (.tvp) files are saved in the Windows\nView directory. Depending on the version of the NVIDIA driver previously installed, profiles may also be saved in the Documents and Settings\All Users\Application Data\nView\_Profiles directory.

- 6 Now you can uninstall your current driver for a driver upgrade.
- 7 After you restart your computer following an NVIDIA new driver install, you can easily load the saved profile from the Profiles page of nView Desktop Manager.

## About Using Saved Profiles in Another Computer

You can easily use any saved profile (.tvp file in the **Windows\nView** directory) from one computer and use it in another computer, if you want. You'll need to copy it to the **Windows\nView** directory of a computer that has the NVIDIA ForceWare graphics display driver, etc. installed properly. Then this profile can be loaded from another computer from the nView Desktop Manager Profiles page just as it can from your original computer.

## Installation Instructions

- 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.
- 3 The license agreement dialog box appears.
- 4 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.
- 5 Extract the zip files to a temporary folder on your PC.
- 6 Open the NVIDIA driver installation .EXE file to launch the NVIDIA InstallShield Wizard.
- 7 Follow the instructions in the NVIDIA InstallShield Wizard to complete the installation.

# APPENDIX A MODE SUPPORT FOR WINDOWS

This chapter details the Windows modes supported by the Release 352 driver for NVIDIA products. It contains these sections:

- ▶ “General Mode Support Information” on page 33
- ▶ “Default Modes Supported by GPU” on page 34
- ▶ “Modes Supported by TV Encoders” on page 37

## General Mode Support Information

The NVIDIA graphics driver includes a standard list of display modes that are supported by default. These modes are listed in the section “[Default Modes Supported by GPU](#)” on page 34.

The actual modes available depend on the capabilities of the display. In addition, the NVIDIA graphics driver has a “dynamic EDID detection” capability and will make available *additional* modes that are listed in the display EDID, provided the graphics hardware can support it.

The NVIDIA graphics driver also supports the high resolutions available with the displays listed in [Table A.1](#) as well as the non-standard modes listed in [Table A.2](#).

Table A.1 Modes Supported for High Resolution Displays

Display	Maximum Resolution
Apple 30" Cinema HD Display (Dual link DVI)	2560x1600 @ 60 Hz
Dell WFP 3007 (Dual Link DVI)	2560x1600 @ 60 Hz
HP LP3065 dual-link DVI flat panel	2560x1600 @ 60Hz.

Table A.2 Non-standard Modes Supported

Resolution		
1680 x 1050		
1366 x 768		

## Default Modes Supported by GPU

This section lists the modes that are included by default in the driver INF for the following product families:

- ▶ “Tesla, Quadro, and NVS Family of GPUs” on page 35

## Understanding the Mode Format

Figure A.1 gives an example of how to read the mode information presented in this section.

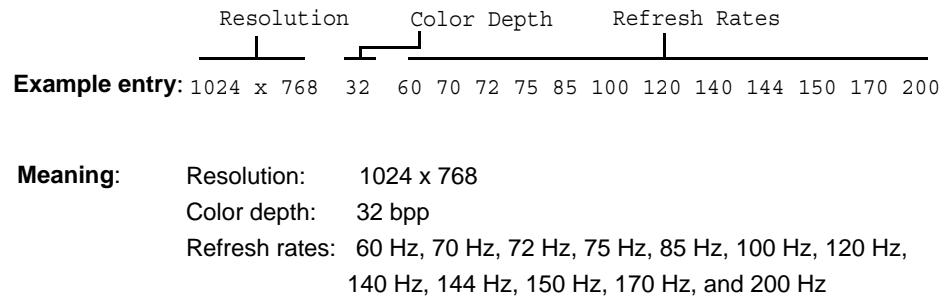


Figure A.1 Mode Format

**Note:**

- Horizontal spanning modes of 3840x1080 and above, and vertical spanning modes of 1920x2160 and above generally require at least 32 MB of video memory at 32 bpp.
- An “i” next to the refresh rate indicates an interlaced refresh rate.

## Tesla, Quadro, and NVS Family of GPUs

This sections lists the supported display resolutions, color depths, and refresh rates for the products listed in [“Supported NVIDIA Products”](#) on page 24.

### Standard Modes

640 x 480	8	60 70 72 75 85 100 120 140 144 150 170 200 240
720 x 480	8	60
720 x 576	8	50
800 x 600	8	60 70 72 75 85 100 120 140 144 150 170 200 240
1024 x 768	8	60 70 72 75 85 100 120 140 144 150 170 200 240
1152 x 864	8	60 70 72 75 85 100 120 140 144 150 170 200
1280 x 720	8	60
1280 x 768	8	60 70 72 75 85 100 120 140 144 150 170
1280 x 800	8	60 70 72 75 85 100 120 140 144 150 170
1280 x 960	8	60 70 72 75 85 100 120 140 144 150 170
1280 x 1024	8	60 70 72 75 85 100 120 140 144 150 170
1360 x 768	8	60 70 72 75 85 100 120 140 144 150 170
1600 x 900	8	60 70 72 75 85 100 120 140 144 150
1600 x 1024	8	60 70 72 75 85 100 120
1600 x 1200	8	60 70 72 75 85 100 120
1680 x 1050	8	60
1920 x 1080	8	60
1920 x 1200	8	60 70 72 75 85 100
1920 x 1440	8	60 70 72 75 85
2048 x 1536	8	60
-----		
640 x 480	16	60 70 72 75 85 100 120 140 144 150 170 200 240
720 x 480	16	60
720 x 576	16	50
800 x 600	16	60 70 72 75 85 100 120 140 144 150 170 200 240
1024 x 768	16	60 70 72 75 85 100 120 140 144 150 170 200 240
1152 x 864	16	60 70 72 75 85 100 120 140 144 150 170 200
1280 x 720	16	60
1280 x 768	16	60 70 72 75 85 100 120 140 144 150 170
1280 x 800	16	60 70 72 75 85 100 120 140 144 150 170
1280 x 960	16	60 70 72 75 85 100 120 140 144 150 170
1280 x 1024	16	60 70 72 75 85 100 120 140 144 150 170
1360 x 768	16	60 70 72 75 85 100 120 140 144 150 170
1600 x 900	16	60 70 72 75 85 100 120 140 144 150
1600 x 1024	16	60 70 72 75 85 100 120
1600 x 1200	16	60 70 72 75 85 100 120
1680 x 1050	16	60
1920 x 1080	16	60
1920 x 1200	16	60 70 72 75 85 100

1920 x 1440	16	60 70 72 75 85
2048 x 1536	16	60
-----		
640 x 480	32	60 70 72 75 85 100 120 140 144 150 170 200 240
720 x 480	32	60
720 x 576	32	50
800 x 600	32	60 70 72 75 85 100 120 140 144 150 170 200 240
1024 x 768	32	60 70 72 75 85 100 120 140 144 150 170 200 240
1152 x 864	32	60 70 72 75 85 100 120 140 144 150 170 200
1280 x 720	32	60
1280 x 768	32	60 70 72 75 85 100 120 140 144 150 170
1280 x 800	32	60 70 72 75 85 100 120 140 144 150 170
1280 x 960	32	60 70 72 75 85 100 120 140 144 150 170
1280 x 1024	32	60 70 72 75 85 100 120 140 144 150 170
1360 x 768	32	60 70 72 75 85 100 120 140 144 150 170
1600 x 900	32	60 70 72 75 85 100 120 140 144 150
1600 x 1024	32	60 70 72 75 85 100 120
1600 x 1200	32	60 70 72 75 85 100 120
1680 x 1050	32	60
1920 x 1080	32	60
1920 x 1200	32	60 70 72 75 85 100
1920 x 1440	32	60 70 72 75 85
2048 x 1536	32	60
-----		



## Modes Supported by TV Encoders

Table A.3 and Table A.4 list the NTSC, PAL, and HDTV TV-Out modes supported by the NVIDIA driver.

Table A.3 Mode Support for S-Video and Composite Out

Resolution	Bit depth	Comments
320x200	8, 16, 32	DirectDraw mode; not selectable as a Windows desktop
320x240	8, 16, 32	DirectDraw mode; not selectable as a Windows desktop
640x400	8, 16, 32	DirectDraw mode; not selectable as a Windows desktop
640x480	8, 16, 32	
720x480	8, 16, 32	Overscans (for video)
720x576	8, 16, 32	Overscans (for video)
800x600	8, 16, 32	
1024x768	8, 16, 32	Conexant 25871 only

Table A.4 Mode Support for Component YPrPb Out and DVI Out

Resolution	Comments
480i (SDTV)	Supported on graphics boards with Conexant 875 or Philips 7108 TV encoders and compatible connectors, and compatible GeForce 8 Series and later GPUs.
480p (EDTV)	
720p (HDTV)	
1080i (HDTV)	
576i (PAL)	
576p (PAL)	

The driver supports manual overscan correction for component and DVI outputs. See the online NVIDIA Control Panel Help for instructions on how to use the overscan correction features.

# APPENDIX B NVIDIA TESLA COMPUTE CLUSTER MODE

This chapter describes the Tesla Compute Cluster (TCC) mode.

- ▶ “About Tesla Compute Cluster Mode” on page 38
- ▶ “Operating on Systems with non-TCC NVIDIA GPUs” on page 40
- ▶ “Setting TCC Mode” on page 40

## About Tesla Compute Cluster Mode

### TCC Overview

Tesla Compute Cluster (TCC) mode is designed for compute cluster nodes that have one or more Tesla or supported Quadro products installed.

### Benefits

- ▶ TCC drivers make it possible to use NVIDIA GPUs in nodes with non-NVIDIA integrated graphics.
- ▶ NVIDIA GPUs on systems running the TCC drivers will be available via Remote Desktop, both directly and via cluster management systems that rely on Remote Desktop.
- ▶ NVIDIA GPUs will be available to applications running as a Windows service (i.e. in Session 0) on systems running the Tesla/Quadro driver in TCC mode.

## TCC Does not Support Graphics Acceleration

- ▶ TCC mode does not provide CUDA–DirectX/OpenGL interoperability. It is a “non-display” driver, and NVIDIA GPUs using this driver will not support DirectX or OpenGL hardware acceleration.

## Running CUDA Applications

- ▶ This release of the Tesla/Quadro driver supports CUDA C/C++ applications and libraries that rely on the CUDA C Runtime and/or CUDA Driver API.
- ▶ NVIDIA GPUs running the Tesla/Quadro driver in TCC mode will be available for CUDA applications running via services or Remote Desktop.
- ▶ In this release, all GPUs will be in compute exclusive mode. As a result, only one CUDA context may exist on a particular device at a time.
- ▶ SDK applications that use graphics will not run properly under TCC mode. The following are examples of CUDA SDK applications that are not supported:

bicubicTexture	boxFilter	cudaDecodeD3D9	smokeParticles
cudaDecodeGL	fluidsD3D9	fluidsGL	SobelFilter
imageDenoising	Mandelbrot	marchingCubes	volumeRender
nbody	oceanFFT	particles	
postProcessGL	recursiveGaussian	simpleD3D10	
simpleD3D10Texture	simpleD3D11Texture	simpleD3D9	
simpleD3D9Texture	simpleGL	simpleTexture3D	

## Operating on Systems with non-TCC NVIDIA GPUs

- ▶ NVIDIA GPUs running under TCC mode may coexist with other display devices.
- ▶ The Tesla/Quadro driver is overinstalled over any NVIDIA display driver in the system—the NVIDIA Tesla driver then becomes the only driver for all NVIDIA GPUs in the system.

If the Tesla/Quadro driver is uninstalled at a later time, the previous driver is not restored.

- ▶ NVIDIA GPUs that do not support TCC mode will appear as “VGA adapters” in the Windows Device Manager and can be used to drive displays.

Non-supported NVIDIA GPUs can still function as CUDA devices, but the GPU’s graphics functionality is not available to applications.

## Setting TCC Mode

To change the TCC mode, use the NVIDIA **smi** utility as follows:

```
nvidia-smi -g (GPU ID) -dm (0 for WDDM, 1 for TCC)
```

The following table shows the default TCC/non-TCC mode for supported products.

Table B.1 Default TCC Mode

Product	Default Mode
K20Xm/c	TCC
K20m	TCC Off
C2075	TCC
C2050	TCC Off
C2070	TCC Off
S2050	TCC
M2050	TCC
M2070	TCC
M2075	TCC
M2070-Q	TCC Off
M2090	TCC
Quadro (Kepler/Maxwell)	TCC Off

## Notice

ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS (TOGETHER AND SEPARATELY, "MATERIALS") ARE BEING PROVIDED "AS IS." NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY, OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE.

Information furnished is believed to be accurate and reliable. However, NVIDIA Corporation assumes no responsibility for the consequences of use of such information or for any infringement of patents or other rights of third parties that may result from its use. No license is granted by implication of otherwise under any patent rights of NVIDIA Corporation. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all other information previously supplied. NVIDIA Corporation products are not authorized as critical components in life support devices or systems without express written approval of NVIDIA Corporation.

## HDMI

HDMI, the HDMI logo, and High-Definition Multimedia Interface are trademarks or registered trademarks of HDMI Licensing LLC.

## Macrovision Compliance Statement

NVIDIA Products that are Macrovision enabled can only be sold or distributed to buyers with a valid and existing authorization from Macrovision to purchase and incorporate the device into buyer's products.

Macrovision copy protection technology is protected by U.S. patent numbers 5,583,936; 6,516,132; 6,836,549; and 7,050,698 and other intellectual property rights. The use of Macrovision's copy protection technology in the device must be authorized by Macrovision and is intended for home and other limited pay-per-view uses only, unless otherwise authorized in writing by Macrovision. Reverse engineering or disassembly is prohibited.

## OpenCL Notice

Portions of the NVIDIA system software contain components licensed from third parties under the following terms:

Clang & LLVM:

Copyright (c) 2003-2008 University of Illinois at Urbana-Champaign.

All rights reserved.

Portions of LLVM's System library:

Copyright (C) 2004 eXtensible Systems, Inc.

Developed by:

LLVM Team

University of Illinois at Urbana-Champaign

<http://llvm.org>

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal with the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimers.

Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimers in the documentation and/or other materials provided with the distribution.

Neither the names of the LLVM Team, University of Illinois at Urbana-Champaign, nor the names of its contributors may be used to endorse or promote products derived from this Software without specific prior written permission.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE CONTRIBUTORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS WITH THE SOFTWARE.

### **Trademarks**

NVIDIA, the NVIDIA logo, NVIDIA nForce, GeForce, NVIDIA Quadro, NVDDVD, NVIDIA Personal Cinema, NVIDIA Soundstorm, Vanta, TNT2, TNT, RIVA, RIVA TNT, VODOO, VODOO GRAPHICS, WAVEBAY, Accuvision, Antialiasing, Detonator, Digital Vibrance Control, ForceWare, NVRotate, NVSensor, NVSync, PowerMizer, Quincunx Antialiasing, Sceneshare, See What You've Been Missing, StreamThru, SuperStability, T-BUFFER, The Way It's Meant to be Played Logo, TwinBank, TwinView and the Video & Nth Superscript Design Logo are registered trademarks or trademarks of NVIDIA Corporation in the United States and/or other countries. Other company and product names may be trademarks or registered trademarks of the respective owners with which they are associated.

### **Copyright**

© 2015 NVIDIA Corporation. All rights reserved.