



Release 370 Graphics Drivers for Windows, Version 372.54

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Windows 10 / Windows 8.1 / Windows 8 / Windows 7

Release Notes



TABLE OF CONTENTS

1 Introduction to Release Notes	1
Structure of the Document	1
Changes in this Edition	1
2 Release 370 Driver Changes	2
Version 372.54 WHQL Highlights	2
What's New in Version 372.54 WHQL	3
What's New in Release 370	5
Limitations in This Release	5
Advanced Driver Information	5
Changes and Fixed Issues in Version 372.54	10
Version 372.54 Fixed Issues	10
Open Issues in Version 372.54 WHQL	11
Windows 10 Issues	11
Windows 8.1 Issues	12
Windows 8 Issues	12
Windows 7 Issues	13
Issues Not Caused by NVIDIA Drivers	14
Windows 7 Considerations	14
Unsupported Features	14
OpenGL Application Issues	16
Operating System Issues	16
Known Product Limitations	17
GPU Temperature Reported Incorrectly on Optimus Systems	17
Damaged or Missing WMI Service Prevents NVIDIA Driver Installation ..	18
Screen Turns Black During Clean Overinstall of NVIDIA Drivers on Windows 8.1 Optimus Notebook	18
Total Available Graphics Memory Reported Incorrectly	20
Increasing 4-way SLI/Multi-GPU Performance	21
3D Vision USB Driver Does Not Get Installed	21
No PhysX Acceleration Using the GPU	22
NVIDIA PhysX System Software Cannot Be Installed or Uninstalled in Windows Safe Mode	22
3DMark 11 Does Not Run in Stereoscopic 3D Mode	22

TABLE OF CONTENTS

- Do Not Use Windows Rollback for Graphics Drivers 23
- Uninstalling Drivers Using Device Manager is Not Supported 23
- Changing Primary Display Across SLI GPUs Takes Longer Than Expected 23
- Understanding the DirectX Version Shown in the NVIDIA System Information Window 24
- Using HDMI Audio with Displays That Have a High Native Resolution... 24
- Using HDMI/DisplayPort Audio in Dualview or Clone Mode 25
- Flat Panel Scaling Controls Not Functional for Some TV Modes in Some Displays..... 25
- GPU Runs at a High Performance Level (full clock speeds) in Multi-display Modes 26
- 1280 × 1024 @ 60 Hz Not Available on BenQ FP241W Monitors 26
- Image Sharpening Control Not Available with GeForce 8 Series and Later GPUs 26
- 3 The Release 370 Driver 27**
 - About the Release 370 Driver 27
 - Hardware and Software Support..... 27
 - Supported Operating Systems..... 28
 - Support for OpenCL 1.2..... 28
 - Supported NVIDIA Desktop Products 28
 - Supported NVIDIA Notebook Products 30
 - Supported Languages..... 33
 - Driver Installation 33
 - Minimum Hard Disk Space 33
 - Before You Begin 34
 - Installation Instructions..... 34
 - General Mode Support Information..... 37
 - Understanding the Mode Format 38
 - GeForce 1000, 900, 700, 600, 500, and 400 Series GPUs 39
 - GeForce 900M, 800M, 700M, 600M, 500M, and 400M Series GPUs (Notebooks) 40

LIST OF TABLES

Table 3.1 Supported NVIDIA Desktop GPUs	34
Table 3.2 Supported NVIDIA Notebook GPUs	36
Table 3.3 Supported NVIDIA NVS and Quadro NVS M GPUs.....	38
Table 3.4 Supported NVIDIA Quadro M and Quadro FX M GPUs.....	38
Table A.1 Modes Supported for High Resolution Displays	42
Table A.2 Non-standard Modes Supported	42
Table A.3 Mode Support for S-Video and Composite Out	48
Table A.4 Mode Support for Component YPrPb Out and DVI Out.....	48

1 INTRODUCTION TO RELEASE NOTES

This edition of *Release Notes* describes the Release 370 family of graphics drivers (versions 370.xx) for Microsoft® Windows® 7 and later¹. 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 370 Driver Changes](#)” on page 2 gives a summary of changes, and fixed and open issues in this version.
- ▶ “[The Release 370 Driver](#)” on page 27 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 36 lists the default resolutions supported by the driver.

Changes in this Edition

This edition of the *Release Notes* for Windows includes information about NVIDIA graphics driver version 372.54 WHQL, and lists changes made to the driver since driver version 368.81. These changes are discussed beginning with the chapter “[Release 370 Driver Changes](#)” on page 2.

1. Includes Windows 7, Windows 8, Windows 8.1, and Windows 10.

2 RELEASE 370 DRIVER CHANGES

This chapter describes open issues for version 372.54 WHQL, and resolved issues and driver enhancements for versions of the Release 370 driver up to version 372.54 WHQL.

The chapter contains these sections:

- ▶ “Version 372.54 WHQL Highlights” on page 2’
- ▶ “Changes and Fixed Issues in Version 372.54” on page 10
- ▶ “Open Issues in Version 372.54 WHQL” on page 11
- ▶ “Issues Not Caused by NVIDIA Drivers” on page 14
- ▶ “Known Product Limitations” on page 17

Version 372.54 WHQL Highlights

This section provides highlights of version 372.54 WHQL of the NVIDIA Release 370 Driver for Windows 7, Windows 8, Windows 8.1, and Windows 10.

- ▶ What’s New in Version 372.54 WHQL
- ▶ What’s New in Release 370
- ▶ Limitations in This Release
- ▶ Advanced Driver Information

What's New in Version 372.54 WHQL

Game Ready Drivers provide the best possible gaming experience for all major new releases, including Virtual Reality games. Prior to a new title launching, our driver team works up until the last minute to ensure every performance tweak and bug fix is included for the best gameplay on day one.

Game Ready

Provides the optimal experience for [No Man's Sky](#), [Deus Ex: Mankind Divided](#), [Obduction](#), [F1 2016](#), and the Open Beta for [Paragon](#)

Gaming Technology

Supports the new [GeForce GTX 10-series GPUs](#) powering the ultimate gaming notebooks

New Features

- ▶ Support for updated BatteryBoost technology.
- ▶ Enabled mclk switches on 144 Hz G-SYNC monitors in multi-monitor use cases in order to lower power consumption.
- ▶ Support OpenGL VR SDK 1.4 (Windows).
- ▶ Added a Windows cross-API interop between Vulkan and DirectX 11. This enables Vulkan app compatibility with existing DirectX 11-based HMD runtimes.
- ▶ Added driver support for DXGI 2 VR.

Application SLI Profiles

Added or updated the following SLI profiles:

- **Deus Ex: Mankind Divided** - *added DirectX 11 SLI profile*
- **No Man's Sky** - *added (Beta) SLI profile*
- **Space Engineers** - *added DirectX 11 SLI profile*

3D Vision Profiles

Added or updated the following 3DV profiles:

- **Deus Ex: Mankind Divided** - *fair*
- **F1 2016** - *not recommended*
- **Obduction** - *excellent*
- **Riptide GP: Renegade** - *excellent*

- **World of Warcraft - updated Beta EXEs**

3D Compatibility Mode Profiles

These games must be run in DirectX 10/11 mode to see improvements and are not compatible with 3D Vision Surround mode. See [“3D Compatibility Mode” on page 6](#) for more information.

Added or updated the following compatibility mode profiles:

- **Mirror’s Edge Catalyst - excellent**
- **Overwatch - good**
- **TotalWar: Warhammer - good**

Software Module Versions

- **NView - 148.03**
- **HD Audio Driver - 1.3.34.15**
- **NVIDIA PhysX System Software - 9.16.0318**
- **GeForce Experience - 2.11.4.0**
- **CUDA - 8.0**

Fixed Issues

See [“Changes and Fixed Issues in Version 372.54” on page 10](#) for a list of other changes and resolved issues in this driver version.

What's New in Release 370

For these release notes, the new items are the same as those documented under [What's New in Version 372.54 WHQL](#).

Note: Windows Vista support was deprecated in Release 367, and Windows XP is deprecated in Release 370. Driver releases for older systems can be found on the [NVIDIA website](#).

Application SLI Profiles

The SLI profiles are the same as those documented under [What's New in Version 372.54 WHQL](#).

3D Vision Profiles

The 3D Vision profiles are the same as those documented under [What's New in Version 372.54 WHQL](#).

3D Compatibility Mode Profiles

The compatibility mode profiles are the same as those documented under [What's New in Version 372.54 WHQL](#).

Limitations in This Release

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

► **Crescent Bay and OSVR Headsets on Multiple GPU Systems**

With Release 367 and future NVIDIA drivers, Crescent Bay and Open Source Virtual Reality development kit headsets will not work with VRWorks Direct Mode in systems that contain GPUs from multiple vendors (for example, NVIDIA and Intel). For such systems, please disable the Intel integrated graphics (from the system BIOS) in order to use Direct Mode.

► **Negative LOD Bias Clamp**

Negative LOD bias clamp for DirectX applications is not supported on Fermi-based GPUs and later.

Advanced Driver Information

This section contains the following additional information about the driver:

- [Differing GPU Voltages in SLI Mode](#)
- [3D Compatibility Mode](#)
- [Help for Resizing Your HDTV Desktop](#)

- ▶ Understanding the DirectX Information Shown in the NVIDIA System Information Window

Differing GPU Voltages in SLI Mode

When non-identical GPUs are used in SLI mode, they may run at different voltages. This occurs because the GPU clocks are kept as close as possible, and the clock of the higher performance GPU is limited by that of the other. One benefit is that the higher performance GPU saves power by running at slightly reduced voltages.

An end-user gains nothing by attempting to raise the voltage of the higher performance GPU because its clocks must not exceed those of the other GPU.

3D Compatibility Mode

3D Compatibility Mode is an NVIDIA proprietary rendering mode for 3D Vision that improves the 3D experience for many key DirectX 10 and 11 games. NVIDIA continues to add game support with new driver versions.

Requirements and Compatibility

- ▶ Games must be run in DirectX 10 or DirectX 11 mode.
- ▶ Not compatible with 3D Vision Surround.

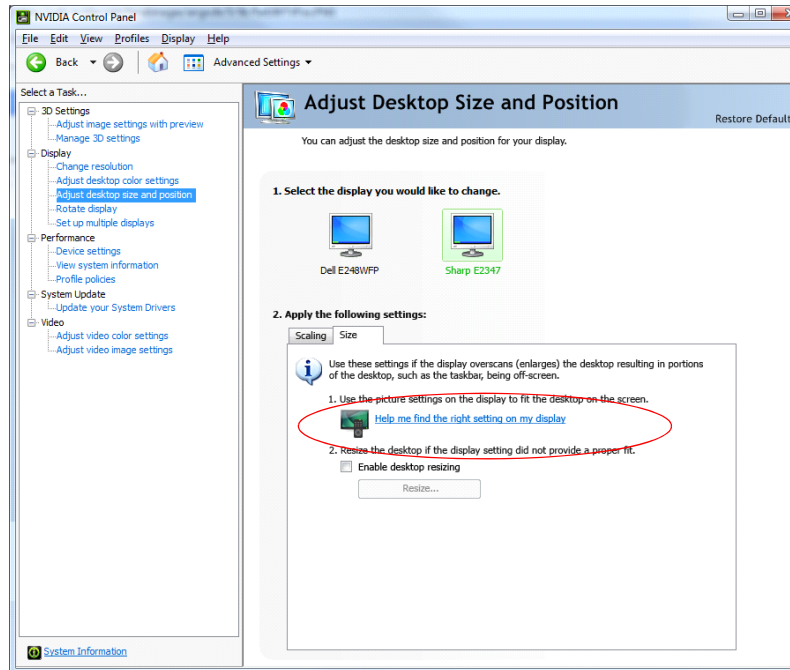
Switching Compatibility Modes

Games with 3D Compatibility Mode will launch in this mode by default. You can switch between 3D Compatibility mode and standard 3D Vision mode as follows:

- 1 Before starting the game, enable Advanced In-game Settings in the NVIDIA Control Panel:
 - a Open the NVIDIA Control Panel and navigate to the *Stereoscopic 3D->Set up stereoscopic 3D* page and click **Set Keyboard Shortcuts**.
 - b Click the *Show advanced in-game settings* arrow if the section is not expanded, then select **Enable advanced in-game settings**.
 - c Click **OK**.
- 2 Press Ctrl+Alt+F11 during the game to toggle between 3D Compatibility mode and standard 3D Vision mode.

Help for Resizing Your HDTV Desktop

The best way to resize the screen in order to view the entire content is to use the controls provided by the display hardware. Click the link on the Size tab to view a guide to changing the settings on your display hardware.

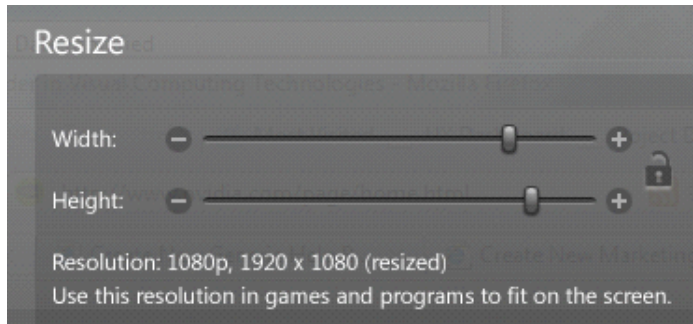


The resize controls on the NVIDIA Control Panel are provided in case satisfactory results cannot be achieved using the controls on the display.

After resizing the HDTV desktop using the NVIDIA Control Panel Resize controls, the new custom resolution created is now added to the list of available resolutions for that display, and also added to the resolution list within the game or application.

The method for resizing the HDTV desktop was improved to provide better image quality when applying underscan. This method results in a new custom resolution being created which needs to be selected from games or applications to apply the resizing. In the example displayed in the following screen shot, the underscan has created a new resolution (1216 × 682). Although this resolution looks different, it is still in HD format.

Remember to select this resolution in your game or other application in order to take advantage of it.



Note: Some games or applications may not support the new resolution.

Understanding the DirectX Information Shown in the NVIDIA System Information Window

The System Information window—accessed by clicking **System Information** at the bottom left corner of the NVIDIA Control Panel—provides technical information about the NVIDIA graphics cards and driver installed in the system.

It also provides the following system information:

- ▶ **Operating system:** For example, “Windows 7 Enterprise, 64-bit”
- ▶ **DirectX runtime version:** For example, “11.0”

In order to use the version of DirectX reported in the System Information window, the NVIDIA GPU and graphics driver must also support that DirectX version.

This information is provided in the *Graphics card information* section of the System Information window as follows:

- ▶ **DirectX support**

(Provided in previous driver versions)

This is the DirectX version that is supported by the NVIDIA graphics hardware and driver.

- ▶ **Direct3D API version**

(Provided in later driver versions, for Windows 7 and later.)

This is the Direct3D version that is supported by the NVIDIA graphics hardware and driver. The API version is expressed in terms of Direct3D – the graphics subsystem component of DirectX.

► **Direct3D feature level**

(Provided in later driver versions, for Windows 7 and later)

Direct3D feature levels describe a subset of features within the Direct3D API version that are supported by the NVIDIA graphics hardware and driver.

Changes and Fixed Issues in Version 372.54

The following sections list the important changes and the most common issues resolved in this version. This list is only a subset of the total number of changes made in this driver version. The NVIDIA bug number is provided for reference.

Version 372.54 Fixed Issues

- ▶ [368.69, GP104] Corrected high DPC latency. [1785539]
- ▶ [Space Engineers] Need SLI profile for DirectX 11 version. [1771135]
- ▶ [Mac OS X] Higher quality CUDA icon needed to take advantage of Retina display. [1595778]
- ▶ [368.69, GeForce GTX 1080] CUDA 7.5 and CUDA 8.0RC fail bandwidth test. [1786668]
- ▶ [SLI, Witcher 3] Shadow darkness intensity changes randomly during gameplay. [200104130]
- ▶ [368.81, Windows 10 x64] Netflix Windows Store app stutters in full-screen mode. [1789185]
- ▶ [GeForce GTX 980 Ti, Windows 10 x64] Low GPU usage/scaling in Guild Wars 2 with SLI + Surround. [1773887]
- ▶ [Call of Duty: Black Ops III] Illegal instruction crashes occur on NVIDIA hardware. [1702129]
- ▶ [Quadro K5000, Windows 10 x64] Hyper-threading performance loss of 4–16 times with recent Quadro drivers compared to 354.56. [1783097]
- ▶ [364.51, Windows 10] After driver update, Steam controller on-screen keyboard shows only white screen. [1741160]
- ▶ [SLI, 368.39, GP104] GTX 1080 SLI can't be enabled if third graphics card installed in system. [1776930]
- ▶ High GPU idle clocks occur with two DisplayPort displays. [1739442]
- ▶ [Steam VR] Vive on the Link Box mini-DisplayPort is not detected after a sleep/resume or a hot unplug/plug. [200217566]
- ▶ RFE: Vulkan ability to auto-promote border-less full screen to full-screen exclusive. [1777202]
- ▶ [368.39, Windows 10, Windows 8] Micro-stuttering and lower OpenGL performance compared to Windows 7 occurs on Optimus notebooks. [1775631]

Open Issues in Version 372.54 WHQL

As with every released driver, version 372.54 WHQL of the Release 370 driver has open issues and enhancement requests associated with it. This section includes lists of issues that are either not fixed or not implemented in this version. Some problems listed may not have been thoroughly investigated and, in fact, may not be NVIDIA issues. Others may have workaround solutions.

For notebook computers, issues can be system-specific and may not be seen on your particular notebook.

- ▶ “Windows 10 Issues” on page 11
- ▶ “Windows 8.1 Issues” on page 12
- ▶ “Windows 8 Issues” on page 12
- ▶ “Windows 7 Issues” on page 13

Windows 10 Issues

- ▶ [Project Cars VR] A TDR is observed when launching the game while forcing AFR from the NVIDIA Control Panel. [200216714]

The issue only occurs on desktop systems when the game is launched from the Oculus store. The issue does not occur when the game is launched from an HMD.
- ▶ Assassins Creed - Syndicate shows intermittent flickering black or white patches on game character faces. [200211264]
- ▶ [Surround] Surround Display icon disappears after rotate mode set to portrait. [200201040]
- ▶ [SLI] Street Fighter V performance drop (pause and play) observed when the game is played at 4K resolution with SLI enabled. [200172046]
- ▶ [SLI] Blank display is observed on disabling SLI with two displays connected. [200168702]
- ▶ [Luxmark 3.0] Display driver stopped responding while running benchmark LuxBall HDR (Simple Benchmark:217K triangles). [200153736]
- ▶ Driver installation will fail if GeForce Experience is a selected component and the system is either in safe mode or without a network connection. [200151914]
- ▶ [347.09, GM204] Blank screen observed on an ASUS Tiled display when system resumes from shutdown or hibernation with Fast boot option enabled from BIOS. [1591053]
- ▶ [SLI, UEFI] Event Viewer error 14 points to `nvlddmkm` when the system is rebooted. [1309257]

Windows 8.1 Issues

- ▶ [SLI] Mirrors Edge: Catalyst crashes with DirectX error on launch. [1773411]
- ▶ [3DVision] While a stereoscopic 3D video with stereoscopic 3D enabled is played, the monitor refresh rate switches to 60 Hz after changing the resolution using the Windows control panel. [1314811]
- ▶ [SLI, UEFI] Event Viewer error 14 points to `nvlddmkm` when the system is rebooted. [1309257]

Windows 8 Issues

- ▶ [Optimus, Notebook] After installing the driver, the Device Manager includes an entry for the NVIDIA Virtual Audio Device but the entry has a yellow bang.
The NVIDIA Virtual Audio Device is not needed nor used on Optimus notebooks, so there is no effect on your notebook function. To remove the yellow bang, reboot your notebook.
- ▶ With a 3DTV connected and the resolution set to an HD3D resolution through the NVIDIA Control Panel, the display flickers constantly after installing the driver via INF over driver version 320.49. [1315116]
- ▶ [SLI, UEFI] Event Viewer error 14 points to `nvlddmkm` when the system is rebooted. [1309257]
- ▶ [Video, Notebook, Hulu Desktop] When attempting to play videos using Hulu Desktop, there is audio but no video. [1000017]
- ▶ [Video, Notebook, Internet Explorer, YouTube] The NVIDIA Control Panel video color settings have no effect on YouTube flash video playback within Internet Explorer 10. [999485]
- ▶ [SLI, GeForce 500 series, DirectX 11, Dragon Age II] Shadows flicker in the cutscene when SLI is enabled. [849235]

Windows 7 Issues

- ▶ [SLI] Street Fighter V performance drop (pause and play) observed when the game is played at 4K resolution with SLI enabled. [200172046]
- ▶ Driver installation will fail if GeForce Experience is a selected component and the system is either in safe mode or without a network connection. [200151914]
- ▶ [3DVision] While a stereoscopic 3D video with stereoscopic 3D enabled is played, the monitor refresh rate switches to 60 Hz after changing the resolution using the Windows control panel. [1314811]
- ▶ [GeForce 500 series, Need for Speed: The Run] During the race the sun flickers and there are bright blips and black patches. [909577]
- ▶ [SLI, Company of Heroes: Tales of Valor] With SLI enabled, there is heavy flickering in the game after switching from windowed mode to full-screen mode. [892264]
- ▶ [NVS 4200M, Optimus, F1 2011] The game hangs while selecting **Quit To Main Menu** during gameplay. [879537]
- ▶ [SLI, GeForce 500 series, DirectX 11, Dragon Age II] Shadows flicker in the cutscene when SLI is enabled. [849235]
- ▶ [GeForce 400 series, Total War: Shogun 2] The sun and surrounding area within the game flicker. [807036]

Issues Not Caused by NVIDIA Drivers

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 7.

- ▶ “Windows 7 Considerations” on page 14
- ▶ “Unsupported Features” on page 14
- ▶ “OpenGL Application Issues” on page 16
- ▶ “Operating System Issues” on page 16

Windows 7 Considerations

Hotplug Action

Under Windows 7, 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. 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 consistent with the Microsoft panel

Table 2.1 NVIDIA Control Panel Rotation Page Radio Buttons

Clockwise Rotation	Windows 7 Label
0 degrees	Landscape
90 degrees	Portrait
180 degrees	Landscape (flipped)
270 degrees	Portrait (flipped)

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

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 7:

- ▶ **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.

Windows 7 window manager features will provide new ways of accomplishing overlays, but will require application porting.
- ▶ **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.
- ▶ **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.
- ▶ **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 of the Windows Window Display Driver Model (WDDM), span mode cannot be supported in NVIDIA graphics drivers. NVIDIA recommends using the built-in Windows 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)
- ▶ **NVIDIA nView Desktop Manager**

The nView Desktop Manager will not be included in drivers for GeForce products.

OpenGL Application Issues

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

- ▶ 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 starting with the WDDM 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 that are not supported after Windows XP:
 - 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.

Operating System Issues

Windows 8

- ▶ When upgrading from Windows 7 to Windows 8, the system fails to retrieve the installed WHQL display driver. [1024416]
 - See the Microsoft KB article KB2743349 <http://support.microsoft.com/kb/2743349>.

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:

- ▶ “GPU Temperature Reported Incorrectly on Optimus Systems” on page 17
- ▶ “Damaged or Missing WMI Service Prevents NVIDIA Driver Installation” on page 18
- ▶ “Screen Turns Black During Clean Overinstall of NVIDIA Drivers on Windows 8.1 Optimus Notebook” on page 18
- ▶ “Total Available Graphics Memory Reported Incorrectly” on page 20
- ▶ “Increasing 4-way SLI/Multi-GPU Performance” on page 21
- ▶ “3D Vision USB Driver Does Not Get Installed” on page 21
- ▶ “No PhysX Acceleration Using the GPU” on page 22
- ▶ “NVIDIA PhysX System Software Cannot Be Installed or Uninstalled in Windows Safe Mode” on page 22
- ▶ “3DMark 11 Does Not Run in Stereoscopic 3D Mode” on page 22
- ▶ “Do Not Use Windows Rollback for Graphics Drivers” on page 23
- ▶ “Uninstalling Drivers Using Device Manager is Not Supported” on page 23
- ▶ “Changing Primary Display Across SLI GPUs Takes Longer Than Expected” on page 23
- ▶ “Understanding the DirectX Version Shown in the NVIDIA System Information Window” on page 24
- ▶ “Using HDMI Audio with Displays That Have a High Native Resolution” on page 24
- ▶ “Using HDMI/DisplayPort Audio in Dualview or Clone Mode” on page 25
- ▶ “Flat Panel Scaling Controls Not Functional for Some TV Modes in Some Displays” on page 25
- ▶ “GPU Runs at a High Performance Level (full clock speeds) in Multi-display Modes” on page 26
- ▶ “1280 × 1024 @ 60 Hz Not Available on BenQ FP241W Monitors” on page 26
- ▶ “Image Sharpening Control Not Available with GeForce 8 Series and Later GPUs” on page 26

GPU Temperature Reported Incorrectly on Optimus Systems

Issue

On Optimus systems, temperature-reporting tools such as Speccy or GPU-Z report that the NVIDIA GPU temperature is zero when no applications are running.

Explanation

On Optimus systems, when the NVIDIA GPU is not being used then it is put into a low-power state. This causes temperature-reporting tools to return incorrect values.

Waking up the GPU to query the temperature would result in meaningless measurements because the GPU temperature change as a result.

These tools will report accurate temperatures only when the GPU is awake and running.

Damaged or Missing WMI Service Prevents NVIDIA Driver Installation

Issue

“Install failed” or “Install Failed, could not find compatible graphics hardware” message may appear during installation, even if the system has a compatible graphics card. This can occur when installing the NVIDIA driver or GeForce Experience software.

Cause

This issue could be the result of a corrupt WMI service on your system. The NVIDIA Installer requires the WMI service to properly install the driver or other NVIDIA software.

Resolution

You must repair the WMI service on your system in order to successfully install NVIDIA drivers. A future driver release will alert the user during installation that there is a problem with the WMI service on the system.

Screen Turns Black During Clean Overinstall of NVIDIA Drivers on Windows 8.1 Optimus Notebook

Issue

After installing a Release 325 driver earlier than version 326.09 on an Optimus notebook running Windows 8.1, a subsequent clean overinstall of a later driver results in a black screen. The screen turns black when the driver uninstalls the older driver.

Typically, you may encounter this when attempting to upgrade the NVIDIA driver after installing Windows 8.1. While installing Windows 8.1, Windows Update installs NVIDIA driver version 326.01, then during the clean overinstall the black screen occurs as the older driver is uninstalled.

Workaround - Prevention

To avoid the issue during the initial installation of Windows 8.1, do not reboot the system after Windows Update installs the NVIDIA driver. Then perform the custom clean overinstall of the newer driver.

Resolution

This issue does not occur after installing an NVIDIA driver version 326.09 or later for Windows 8.1. When driver version 326.09 or later is installed, performing a clean overinstall with a newer driver will not result in a black screen.

Total Available Graphics Memory Reported Incorrectly

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

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 under reporting can be extreme. For example, 6 GB might be reported as 454 MB, and 8 GB might be reported as 1259 MB.

Driver Action for GeForce-based Graphics Systems

On graphics systems with less than 2.75 GB of advertized physical memory, the NVIDIA display driver typically limits the Shared System Memory to maintain a TAG memory value of less than 4 GB¹.

- ▶ This results in reliable reporting of sub-4 GB TAG memory on systems with less than 2.75 GB of advertised physical memory.
- ▶ On systems with 2.75 GB or more of advertized physical memory, you may see different reported TAG memory values between the NVIDIA Control Panel and other reporting APIs.

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).

Increasing 4-way SLI/Multi-GPU Performance

Issue

With some games and applications, you may experience little to no performance gain or even a performance drop with 4-way SLI or multi-GPU configurations.

Resolution

- 1 Open the NVIDIA Control Panel, then click **Manage 3D Settings** from the navigation pane.
- 2 Click the *Global Settings* tab, then scroll to the *Power management mode* feature, click the corresponding list arrow and select **Prefer maximum performance**, then click **Apply**.

3D Vision USB Driver Does Not Get Installed

Issue

After installing the NVIDIA graphics driver, if the 3D Vision USB emitter was not plugged in, the 3D Vision USB Controller driver does not get installed. If you plug in the emitter after installing the driver, the indicator light on the emitter will flash red and will not turn green.

Resolution

To fix this issue, NVIDIA recommends performing a driver re-install with the 3D Vision USB emitter connected. Please download the latest drivers and follow these steps:

- 1 Plug in the 3D Vision USB emitter.
- 2 Re-install the NVIDIA driver.
Select **Custom (Advanced)** and then select **Perform a clean Installation** during the driver installation.
- 3 Reboot.

No PhysX Acceleration Using the GPU

If after installing the PhysX System Software you find that there is no PhysX acceleration on supported applications, repeat the PhysX setup as follows:

- 1 Reboot the PC.
- 2 Open the NVIDIA Control Panel and then, under 3D Settings, click **Set PhysX configuration** to open that page.
- 3 Under **Select a PhysX processor**, verify that either **auto-select** or a specific NVIDIA GPU is selected.
- 4 Click **Apply**.

NVIDIA PhysX System Software Cannot Be Installed or Uninstalled in Windows Safe Mode

Issue

The NVIDIA PhysX System Software is not included in the NVIDIA driver installation/uninstallation under safe mode.

Explanation

The NVIDIA PhysX System Software installer is not compatible with Microsoft's policy for Windows Safe Mode. Consequently, installation or uninstallation of the PhysX System Software under safe mode would fail. To allow installation or uninstallation of the graphics driver under safe mode, the NVIDIA PhysX System Software is blocked from the process.

3DMark 11 Does Not Run in Stereoscopic 3D Mode

Issue

When attempting to run 3DMark 11 with NVIDIA 3D Vision enabled, the benchmark may hang, present a black screen, or in other ways not appear correctly.

Explanation

3DMark 11 is not compatible with running in stereoscopic 3D. To facilitate running the benchmark, recent drivers will run it in monoscopic mode, even with 3D Vision enabled.

Do Not Use Windows Rollback for Graphics Drivers

To reinstall a previous or older NVIDIA graphics driver, do not use the Windows rollback feature. This method will not reliably restore all the previous driver files.

Instead, use the Windows Add and Remove programs to remove the current driver, and then install the older driver using setup.exe.

Uninstalling Drivers Using Device Manager is Not Supported

Issue

On all supported versions of Microsoft Windows, uninstalling the NVIDIA driver using the Windows Device Manager may not remove associated files or applications.

Explanation

Microsoft has confirmed that this behavior is by design. If you wish to uninstall the NVIDIA driver, it is recommended that you do so using Add and Remove programs.

See the [Microsoft KB article 2278714](#).

Changing Primary Display Across SLI GPUs Takes Longer Than Expected

Issue

On an SLI system, switching the primary (or SLI focus) display when each display in the SLI group is connected to a different GPU takes longer than expected.

Explanation

On an SLI system with each SLI GPU driving a display, the display connected to the slave GPU is the primary display (also the SLI focus display). In order to switch the primary display to the one connected to the other GPU, the master and slave GPU configuration must also switch. In order to reassign which GPU is the master and which is the slave, the driver must be reloaded. It is the process of reloading the driver that takes the additional time.

Understanding the DirectX Version Shown in the NVIDIA System Information Window

The System Information window—accessed by clicking **System Information** at the bottom left corner of the NVIDIA Control Panel—provides technical information about the NVIDIA graphics cards and driver installed in the system.

It also provides information about the Windows version as well as the DirectX version that is installed.

However, in order to use the version of DirectX reported in the System Information window, the NVIDIA GPU and graphics driver must also support that DirectX version.

For example, NVIDIA graphics cards starting with the GeForce 400 Series released in 2010, support DirectX 11, so your system must have one of these cards installed in order to take advantage of DirectX 11 performance.

Using HDMI Audio with Displays That Have a High Native Resolution

To use HDMI audio with some displays that have a native resolution higher than 1920 × 1080, you must set the display to a lower HD resolution.

Some HDMI displays have a native resolution that exceeds the maximum supported HD mode. For example, displays with a native resolution of 1920 × 1200 exceed the maximum supported HD mode of 1920 × 1080.

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 Audio in Dualview or Clone Mode

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.

Flat Panel Scaling Controls Not Functional for Some TV Modes in Some Displays

The NVIDIA Control Panel flat panel scaling controls on the “Adjust Size & Position” page are not intended to be used for TV modes, and normally the controls are not available for TV or HDTV displays.

However, Microsoft requires that certain TV/HDTV modes be available for all digital displays, including DVI and HDMI, even if they are not HDTV.

While the NVIDIA flat panel scaling controls are available for those displays, they will not be functional for the TV modes that appear in compliance with the Microsoft requirements. The affected modes are as follows:

- ▶ 1920 × 1080i @ 50/59.94/60 Hz
- ▶ 1280 × 720p @ 50/59.94/60 Hz
- ▶ 720 × 480p @ 59.94/60 Hz
- ▶ 720 × 576p @ 50 Hz

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

This is a hardware limitation with desktop and older notebook GPUs, and not a software bug. When multiple displays are connected and active, the GPU will always operate with full clock speeds in order to efficiently drive multiple displays—even when no 3D programs are running.



Note: NVIDIA notebook GeForce 5xxM series and later GPUs do not have this limitation. For those GPUs the driver can adjust the performance level, depending on demand, even when driving multiple displays.

1280 × 1024 @ 60 Hz Not Available on BenQ FP241W Monitors

Even though the monitor EDID lists 1280 × 1024 @ 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 (1280 × 1024 @ 60 Hz) and makes it unavailable.

Image Sharpening Control Not Available with GeForce 8 Series and Later GPUs

With GeForce 8 Series and later graphics cards, image sharpening is not supported.

3 THE RELEASE 370 DRIVER

This chapter covers the following main topics:

- ▶ “About the Release 370 Driver” on page 27
- ▶ “Hardware and Software Support” on page 27
- ▶ “Driver Installation” on page 33

About the Release 370 Driver

This driver release is from the Release 370 family of drivers (versions 370.xx). This driver package supports GeForce 400, 500, 600, 700, 900, and 1000-series GPUs. See “Supported NVIDIA Desktop Products” on page 28 and “Supported NVIDIA Notebook Products” on page 30 for current products supported in this release.

As part of the NVIDIA Notebook Driver Program, this is a reference driver that can be installed on supported NVIDIA notebook GPUs. However, please note that your notebook original equipment manufacturer (OEM) provides certified drivers for your specific notebook on their website. NVIDIA recommends that you check with your notebook OEM about recommended software updates for your notebook. OEMs may not provide technical support for issues that arise from the use of this driver.

Hardware and Software Support

- ▶ “Supported Operating Systems” on page 28
- ▶ “Support for OpenCL 1.2” on page 28
- ▶ “Supported NVIDIA Desktop Products” on page 28
- ▶ “Supported NVIDIA Notebook Products” on page 30
- ▶ “Supported Languages” on page 33

Supported Operating Systems

This Release 370 driver includes drivers designed for the following Microsoft® operating systems:

- ▶ Microsoft Windows® 10, supporting both 32-bit and 64-bit versions.
- ▶ Microsoft Windows® 8.1, supporting both 32-bit and 64-bit versions.
- ▶ Microsoft Windows® 8, supporting both 32-bit and 64-bit versions.
- ▶ Microsoft Windows® 7, supporting both 32-bit and 64-bit versions.

Support for OpenCL 1.2

Kepler Maxwell, and Pascal GPUs are supported.

Supported NVIDIA Desktop Products

The following table (from <http://www.geforce.com/hardware>) lists current NVIDIA desktop products supported by version 372.54 WHQL of the Release 370 driver. For information about desktop products not shown, please see <http://www.geforce.com/hardware/desktop-gpus>.

Table 3.1 Supported NVIDIA Desktop GPUs

Consumer Products	Architecture
NVIDIA Titan X	Pascal
GeForce GTX 1080	Pascal
GeForce GTX 1070	Pascal
GeForce GTX 1060	Pascal
GeForce GTX TITAN X	Maxwell
GeForce GTX TITAN Z	Kepler
GeForce GTX TITAN Black	Kepler
GeForce GTX TITAN	Kepler
GeForce GTX 980 Ti	Maxwell
GeForce GTX 980	Maxwell
GeForce GTX 970	Maxwell
GeForce GTX 960	Maxwell
GeForce GTX 950	Maxwell
GeForce GTX 780 Ti	Kepler
GeForce GTX 780	Kepler
GeForce GTX 770	Kepler

Table 3.1 Supported NVIDIA Desktop GPUs

Consumer Products	Architecture
GeForce GTX 760	Kepler
GeForce GTX 760 Ti (OEM)	Kepler
GeForce GTX 750 Ti	Maxwell
GeForce GTX 750	Maxwell
GeForce GTX 745	Maxwell
GeForce GT 740	Kepler
GeForce GT 730	Fermi/Kepler
GeForce GT 720	Kepler
GeForce GT 710	Kepler
GeForce GT 705	Fermi
GeForce GTX 690	Kepler
GeForce GTX 680	Kepler
GeForce GTX 670	Kepler
GeForce GTX 660 Ti	Kepler
GeForce GTX 660	Kepler
GeForce GTX 650 Ti BOOST	Kepler
GeForce GTX 650 Ti	Kepler
GeForce GTX 650	Kepler
GeForce GTX 645	Kepler
GeForce GT 645	Fermi/Kepler
GeForce GT 640	Fermi/Kepler
GeForce GT 635	Kepler
GeForce GT 630	Fermi/Kepler
GeForce GT 620	Fermi
GeForce GT 610	Fermi
GeForce 605	Fermi
GeForce GTX 590	Fermi
GeForce GTX 580	Fermi
GeForce GTX 570	Fermi
GeForce GTX 560 Ti	Fermi
GeForce GTX 560 SE	Fermi
GeForce GTX 560	Fermi
GeForce GTX 555	Fermi
GeForce GTX 550 Ti	Fermi
GeForce GT 545	Fermi

Table 3.1 Supported NVIDIA Desktop GPUs

Consumer Products	Architecture
GeForce GT 530	Fermi
GeForce GT 520	Fermi
GeForce 510	Fermi
GeForce GTX 480	Fermi
GeForce GTX 470	Fermi
GeForce GTX 465	Fermi
GeForce GTX 460 SE v2	Fermi
GeForce GTX 460 SE	Fermi
GeForce GTX 460	Fermi
GeForce GTS 450	Fermi
GeForce GT 440	Fermi
GeForce GT 430	Fermi
GeForce GT 420	Fermi

Supported NVIDIA Notebook Products

The following table lists current NVIDIA notebook products supported by version 372.54 WHQL of the Release 370 driver. For information about notebook products not shown, please see <http://www.geforce.com/hardware/notebook-gpus>.



Note:

- The following Sony VAIO notebooks are supported: Sony VAIO F Series with GeForce GT 425M, GeForce GT 520M or GeForce GT 540M. Other Sony VAIO notebooks are not supported. (Please contact Sony for driver support.)
- Fujitsu notebooks are not supported. (Fujitsu Siemens notebooks are supported.)

Table 3.2 Supported NVIDIA Notebook GPUs

Consumer Products	Architecture
GeForce GTX 1080	Pascal
GeForce GTX 1070	Pascal
GeForce GTX 1060	Pascal
GeForce GTX 980 for notebooks	Maxwell
GeForce GTX 980M	Maxwell
GeForce GTX 970M	Maxwell

Table 3.2 Supported NVIDIA Notebook GPUs (continued)

Consumer Products	Architecture
GeForce GTX 965M	Maxwell
GeForce GTX 960M	Maxwell
GeForce GTX 950M	Maxwell
GeForce 945M	Maxwell
GeForce 940MX	Maxwell
GeForce 940M	Maxwell
GeForce 930MX	Maxwell
GeForce 930M	Maxwell
GeForce 920MX	Maxwell
GeForce 920M	Kepler
GeForce 910M	Kepler
GeForce GTX 880M	Kepler
GeForce GTX 870M	Kepler
GeForce GTX 860M	Kepler/Maxwell
GeForce GTX 850M	Maxwell
GeForce 840M	Maxwell
GeForce 830M	Maxwell
GeForce 820M	Fermi
GeForce 800M	Fermi
GeForce GTX 780M	Kepler
GeForce GTX 770M	Kepler
GeForce GTX 765M	Kepler
GeForce GTX 760M	Kepler
GeForce GT 755M	Kepler
GeForce GT 750M	Kepler
GeForce GT 745M	Kepler
GeForce GT 740M	Kepler
GeForce GT 735M	Kepler
GeForce GT 730M	Kepler
GeForce GT 720M	Fermi
GeForce 710M	Fermi
GeForce 705M	Fermi
GeForce GTX 680MX	Kepler
GeForce GTX 680M	Kepler
GeForce GTX 675MX	Kepler

Table 3.2 Supported NVIDIA Notebook GPUs (continued)

Consumer Products	Architecture
GeForce GTX 675M	Fermi
GeForce GTX 670MX	Kepler
GeForce GTX 670M	Fermi
GeForce GTX 660M	Kepler
GeForce GT 650M	Kepler
GeForce GT 645M	Kepler
GeForce GT 640M LE	Kepler
GeForce GT 640M	Kepler
GeForce GT 635M	Fermi
GeForce GT 630M	Fermi
GeForce GT 625M	Fermi
GeForce GT 620M	Fermi
GeForce GT 610M	Fermi
GeForce GTX 580M	Fermi
GeForce GTX 570M	Fermi
GeForce GTX 560M	Fermi
GeForce GT 555M	Fermi
GeForce GT 550M	Fermi
GeForce GT 540M	Fermi
GeForce GT 525M	Fermi
GeForce GT 520MX	Fermi
GeForce GT 520M	Fermi
GeForce GTX 485M	Fermi
GeForce GTX 480M	Fermi
GeForce GTX 470M	Fermi
GeForce GTX 460M	Fermi
GeForce GT 445M	Fermi
GeForce GT 435M	Fermi
GeForce GT 425M	Fermi
GeForce GT 420M	Fermi
GeForce GT 415M	Fermi
GeForce 410M	Fermi
GeForce 405M	Fermi

Supported Languages

The Release 370 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

Desktop

The hard disk space requirement for 32-bit is minimum 220 MB for English-only, and 300 MB for International.

The hard disk space requirement for 64-bit is minimum 320 MB for English-only, and 400 MB for International.

Notebook

The hard disk space requirement for 32-bit is minimum 300 MB.

The hard disk space requirement for 64-bit is minimum 400 MB.

Before You Begin

nTune

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.

Notebooks

- ▶ Check to make sure that your notebook has a supported GPU (see “[Supported NVIDIA Notebook Products](#)” on page 30).
- ▶ It is recommended that you back up your current system configuration.
- ▶ If you own a Dell Inspiron 1420, Dell XPS M1330, Dell XPS M1530, or Dell Latitude D630 or D630c, it is highly recommended that you first install this [Dell software update](#).

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** From the driver download page, click the **Download** button.
The *Download Confirmation* page appears.
- 3** If you agree to the “License For Customer Use of NVIDIA Software”, click the **Agree & Download** button to begin the download.
The *File Download* dialog appears.
- 4** Either click **Save** to save the file and then run it from your PC, or click **Run**.
An extraction path dialog appears prompting you to specify where on your PC you want the driver files to be installed.
- 5** Click **OK** to use the default location, or click the folder icon and specify an alternate location to install the driver files.
The files are extracted and then the NVIDIA Installer is launched automatically.
- 6** At the *License Agreement* page of the Installer, click **Agree and Continue**.

7 Follow the instructions in the NVIDIA Installer to complete the installation.



Note: The driver presents game screenshots while the driver is installing. If you are not connected to the internet during the installation, you may see a “Navigation to the webpage was cancelled” message instead. The message can be ignored and does not affect the installation. The message won’t appear if the browser cache is cleared.



Note: The NVIDIA PhysX System Software will not be included in the installation if the same version or a later version is already installed.



Note: After the driver installation, Windows 7 may default to 16-bpp color and disable the Desktop Window Manager (DWM). To work around this issue, set the color to 32-bpp and then reboot the PC.

See also the installation/uninstallation considerations explained in [“Known Product Limitations”](#) on page 17.

APPENDIX A MODE SUPPORT FOR WINDOWS

This chapter details the Windows modes supported by the Release 370 driver for NVIDIA products. It contains these sections:

- ▶ “General Mode Support Information” on page 37
- ▶ “Default Modes Supported by GPU” on page 38

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 38.

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)	2560 × 1600 @ 60 Hz
Dell WFP 3007 (Dual Link DVI)	2560 × 1600 @ 60 Hz
HP LP3065 dual-link DVI flat panel	2560 × 1600 @ 60 Hz

Table A.2 Non-standard Modes Supported

Resolution		
1680 × 1050		
1366 × 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:

- ▶ “GeForce 1000, 900, 700, 600, 500, and 400 Series GPUs” on page 39
- ▶ “GeForce 900M, 800M, 700M, 600M, 500M, and 400M Series GPUs (Notebooks)” on page 40

Understanding the Mode Format

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

Mode entry	1600 x 1024	8,16,32,64	60	70	72	75	85	100	120
Meaning	Resolution:	1600 × 1024							
	Color depths:	8, 16, 32, 64 bpp							
	Refresh rates:	60, 70, 72, 75, 85, 100, 120 Hz							

Figure A.1 Mode Format

Note:

- Horizontal spanning modes of 3840 × 1080 and above, and vertical spanning modes of 1920 × 2160 and above generally require at least 32 MB of video memory at 32 bpp.

GeForce 1000, 900, 700, 600, 500, and 400 Series GPUs

This section lists the supported display resolutions, color depths, and refresh rates for the products listed in [“Supported NVIDIA Desktop Products”](#) on page 28.

Standard Modes

640 x 480	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200 240
720 x 480	8,16,32,64	60
720 x 576	8,16,32,64	50 60
800 x 600	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200 240
1024 x 768	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200 240
1152 x 864	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200
1280 x 720	8,16,32,64	60
1280 x 768	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1280 x 800	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1280 x 960	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1280 x 1024	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1360 x 768	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1600 x 900	8,16,32,64	60 70 72 75 85 100 120 140 144 150
1600 x 1024	8,16,32,64	60 70 72 75 85 100 120
1600 x 1200	8,16,32,64	60 70 72 75 85 100 120
1680 x 1050	8,16,32,64	60
1920 x 1080	8,16,32,64	60
1920 x 1200	8,16,32,64	60 70 72 75 85 100
1920 x 1440	8,16,32,64	60 70 72 75 85
2048 x 1536	8,16,32,64	60

GeForce 900M, 800M, 700M, 600M, 500M, and 400M Series GPUs (Notebooks)

This section lists the supported display resolutions, color depths, and refresh rates for the products listed in “Supported NVIDIA Notebook Products” on page 30.

Standard Modes

640 x 480	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200 240
720 x 480	8,16,32,64	60
720 x 576	8,16,32,64	50 60
800 x 600	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200 240
1024 x 768	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200 240
1152 x 864	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170 200
1280 x 720	8,16,32,64	60
1280 x 768	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1280 x 800	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1280 x 960	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1280 x 1024	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1360 x 768	8,16,32,64	60 70 72 75 85 100 120 140 144 150 170
1600 x 900	8,16,32,64	60 70 72 75 85 100 120 140 144 150
1600 x 1024	8,16,32,64	60 70 72 75 85 100 120
1600 x 1200	8,16,32,64	60 70 72 75 85 100 120
1680 x 1050	8,16,32,64	60
1920 x 1080	8,16,32,64	60
1920 x 1200	8,16,32,64	60 70 72 75 85 100
1920 x 1440	8,16,32,64	60 70 72 75 85
2048 x 1536	8,16,32,64	60

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