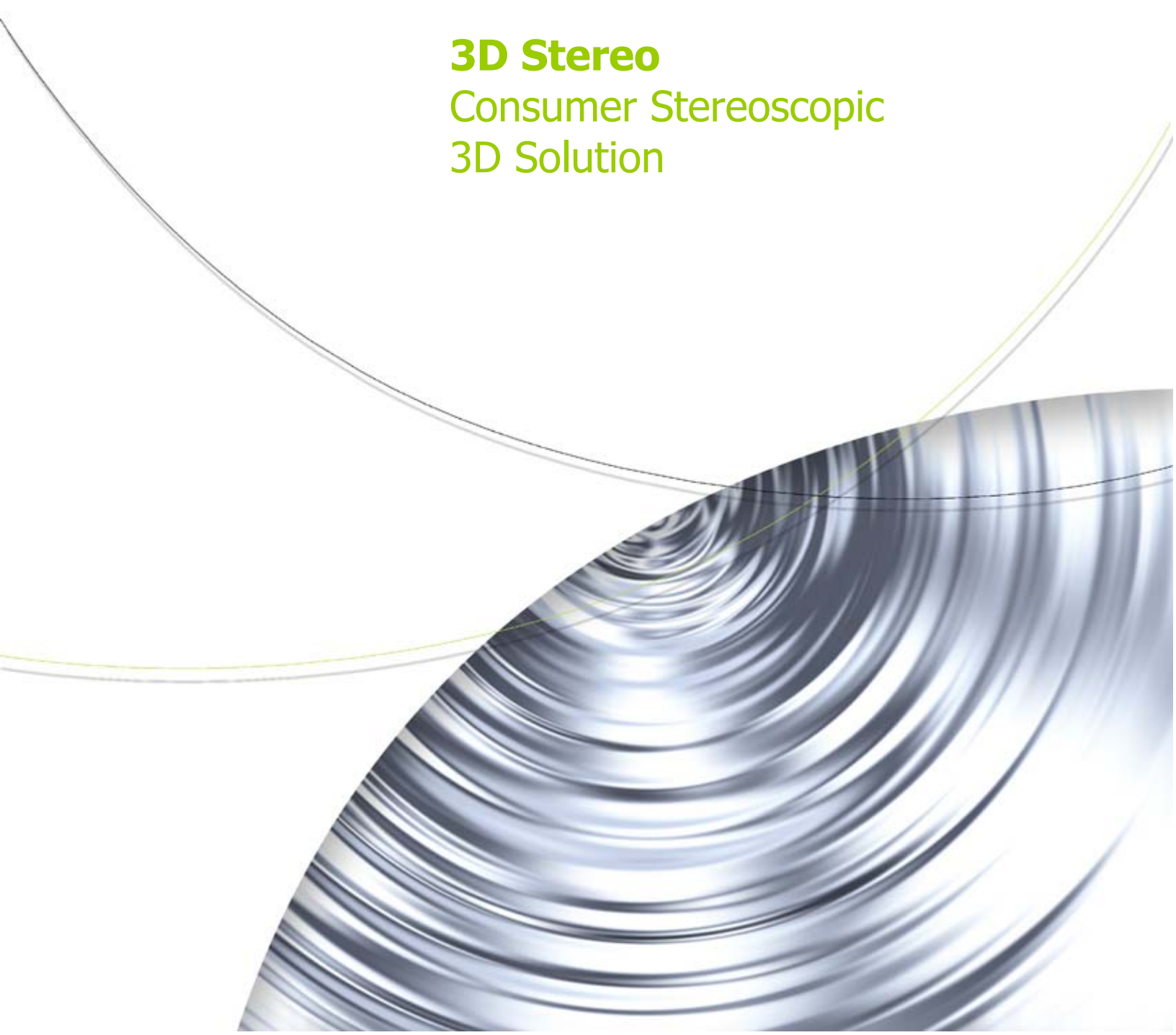




**NVIDIA.**

# Technical Brief

**3D Stereo**  
Consumer Stereoscopic  
3D Solution



# NVIDIA 3D Stereo

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Imagine immersing yourself in the world of 3D content like never before. Monsters, bullets, and landscapes jump out of your flat monitor and into your imagination. You are part of the game! And now, with the NVIDIA® 3D Stereo™ solution, gaming will never be the same.

The tight integration of our drivers, plus NVIDIA's customized stereoscopic 3D support, makes NVIDIA 3D Stereo the fastest consumer 3D stereoscopic solution available today. The result? Games that not only look the best, but also run the fastest.

NVIDIA 3D Stereo is also the most compatible solution ever available. That's because it works on the broadest range of applications. Previous implementations were proprietary to specific graphics cards, stereoscopic glasses, and special versions of games. The new NVIDIA 3D Stereo brings stereoscopic 3D support to graphics cards for NVIDIA TNT™ graphics processing units (GPUs), NVIDIA GeForce™ GPUs, and NVIDIA Quadro™ GPUs. This allows games developed with the Direct3D® application program interface (API) and OpenGL® API to run *without* requiring special versions of your favorites games.

In other words, 3D Stereo works with your existing game library!

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## Background

3D imaging has been around for years, but recent advances in computer graphics hardware have brought it into widespread use. The availability of monitors capable of 100Hz or higher refresh rate, plus lower-cost liquid-crystal display (LCD) shutter glasses and more powerful graphics technologies, has contributed to a better stereoscopic 3D experience.



Four major implementations of stereoscopic 3D technology for gaming have taken place. The *first* generation modified games to make them compatible with stereoscopic 3D. This forced developers to specially modify their game code to work on proprietary LCD glasses, which limited the number of usable games.

The *second* generation, created by Metabyte Inc., was a low-level override in which stereoscopic 3D rendering was executed independent of the game. Metabyte used an over/under approach to cut the vertical resolution in half so that hundreds of

Direct3D and OpenGL games could work in stereo. The disadvantage was slower performance and grainy, low-quality images because of its lower resolution.

The *third* generation of stereoscopic 3D, from ELSA, modified the graphics driver to produce page-flipped stereo. Although it was still an override, it allowed many games to work without cutting the vertical resolution in half. However, there was insufficient compatibility. Still, it was the best implementation at the time, and through our partnership with ELSA, we have been able to improve on this implementation.

NVIDIA Corporation developed the *fourth* generation. Our goal was to offer the fastest solution and the widest compatibility with the broadest range of titles. NVIDIA extended ELSA's implementation by adding custom stereoscopic 3D configurations for each game, producing the optimal 3D imagery possible. Because games are not normally written for stereoscopic 3D, some anomalies can occur with default settings; in most cases, 3D Stereo's custom game configuration settings remove them. The pairing of these custom configurations with high-performing NVIDIA GPUs allows for high-resolution stereo imagery with fast refreshes and frame rates.

These features make NVIDIA's 3D Stereo and GPUs the best solution for stereoscopic 3D gaming available today.

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## How Stereoscopic Viewing Works

Stereoscopic 3D support creates more realistic games by adding true depth to objects. This is accomplished by presenting a unique view to each eye—almost the same way one would view objects in real life.

The difficulty is that the two views, one for the left eye and one for the right eye, must be displayed on a single surface—the monitor. The most economical way to do this is to use a time-based swapping of the views. In other words, one eye view is displayed for a short time, followed by the other eye view. This is done fast enough that the eye does not detect the change.

Figure 1 shows how traditional 2D images are prepared and displayed in 3D stereo.

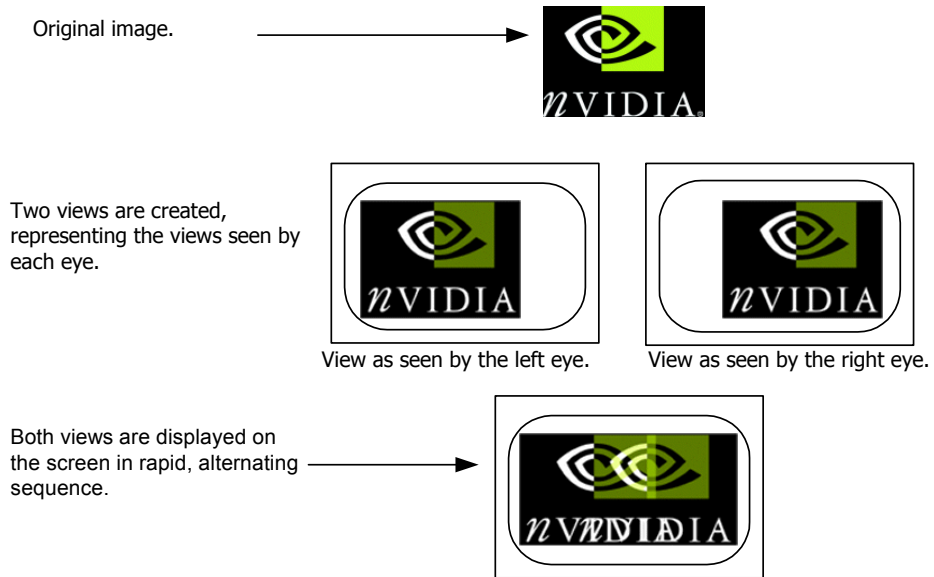


Figure 1. Images Are Prepared and Displayed

To make sure each eye sees only the correct view, NVIDIA incorporated the use of LCD shutter glasses. While one view—say, the left view—is displayed, the shutter glasses block the view of the right eye. Then, while the right view is displayed, the shutter glasses switch and block the left eye view. This happens so fast that the mind cannot detect the two images melding to produce a full-stereo view (Figure 2).

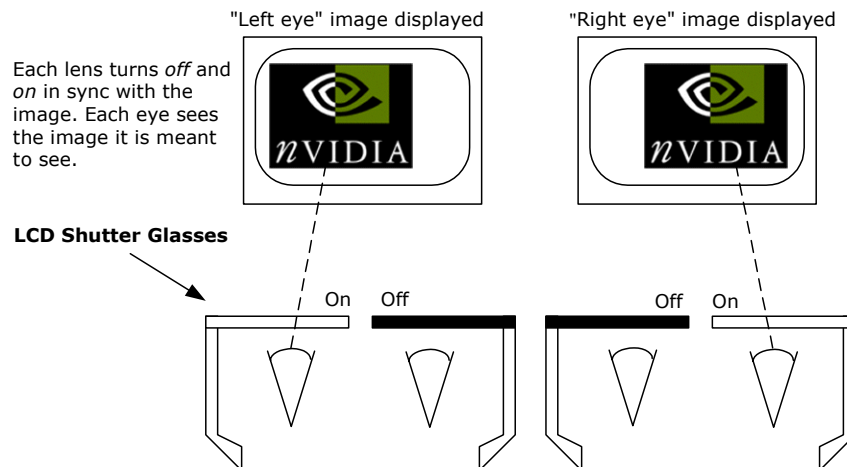


Figure 2. View from Each Eye Is Isolated

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## Better Viewing

Many improvements have made stereoscopic 3D better for consumers:

- ❑ The ability to display images at higher refresh rates because of more capable monitors and more powerful GPUs (typically above 100Hz; ideally, above 120Hz)
- ❑ Better-quality LCD shutter glasses, which overcome side effects such as headaches and eyestrain, and reduce ghosting
- ❑ Fewer stereoscopic 3D anomalies

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## Adapting to Stereoscopic 3D

Even with the very best professional stereoscopic 3D systems, users initially report eyestrain and other negative symptoms that usually go away over a short time. These symptoms are caused by the difference between viewing stereoscopic images in reality, versus viewing them on a monitor.

In real life, your eyes focus on an object at a particular depth, as well as converge on that same object. During normal viewing (Figure 3), these two processes automatically occur at the same time. In viewing stereoscopic 3D on a monitor, however, the focal point is always the same for all objects; that is, the depth of the monitor surface. Thus there is a disconnect between focus and convergence, which is strange initially. The main cause of eyestrain is this disconnect between these processes, which causes viewers to be initially uncomfortable until their eyes and brain have a chance to adjust.

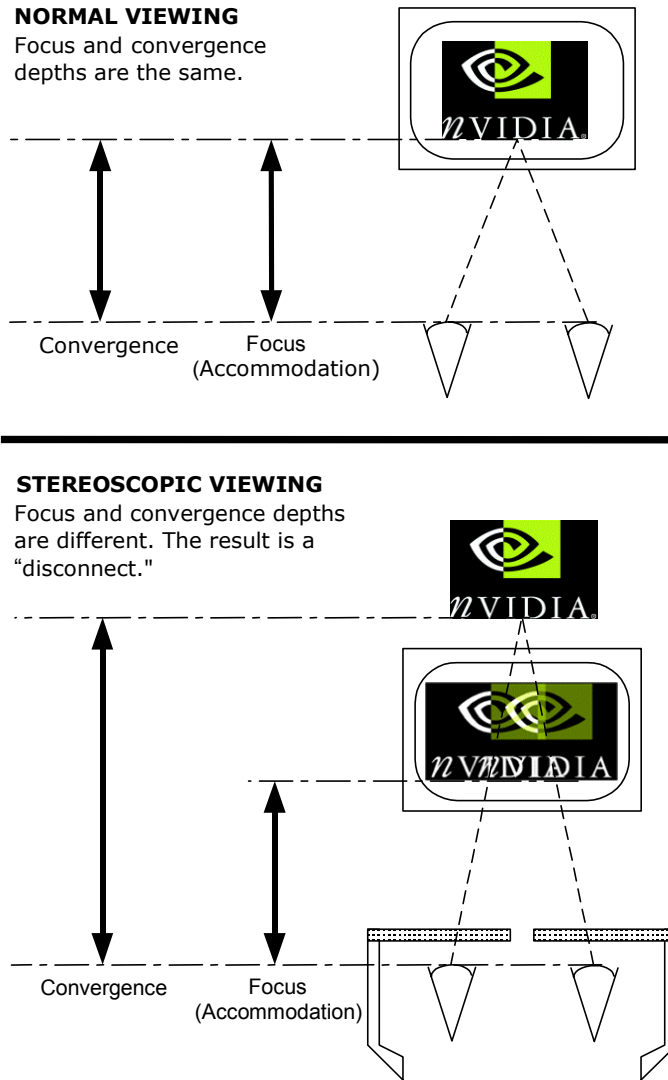


Figure 3. Normal vs. Stereoscopic Viewing

The solution for this disconnect? Reduce the separation (the distance horizontally between the two views) to a more comfortable setting until viewers get used to the two processes running independently. Over time, viewers can increase the separation to improve the perception of depth in the game, enhancing the overall 3D stereoscopic effect.

The 3D Stereo User's Guide provides information on adjusting stereo separation on NVIDIA graphics cards.

### Epilepsy Warning

A small percentage of the population may experience epileptic seizures when viewing certain types of TV images or video games that contain flashing patterns of light.

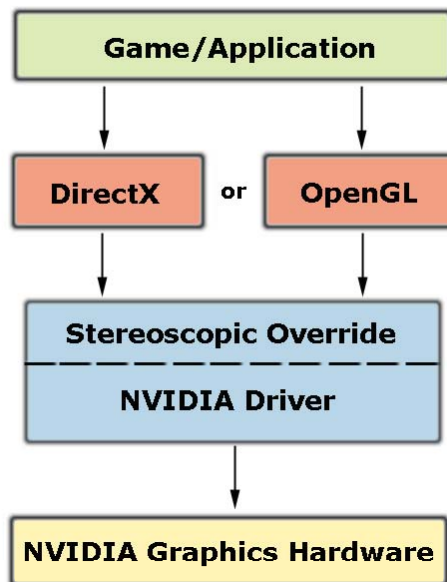
The following users are cautioned to consult a physician before viewing in stereo:

- ❑ Children under 5 years.
- ❑ Anyone with a history of epilepsy, or who has a family member who has a history of epilepsy.
- ❑ Anyone who has ever experienced epileptic seizures or sensory disturbances triggered by flashing light effects.

## No Game Modifications

NVIDIA's method of creating stereoscopic 3D views is an "override," meaning that it is done without modifying the game. Since the data that the graphics driver receives from the game is high level, it's possible to create two eye views without modification to the game.

NVIDIA 3D Stereo supports DirectX and OpenGL APIs for performing this override. The benefit of this approach is that hundreds of games work in stereo without requiring developers to add 3D stereoscopic support (Figure 4).



Since most games were not originally designed with stereoscopic 3D in mind, anomalies may show up that are not evident when viewing in 2D. NVIDIA 3D Stereo resolves this by providing a custom, per-game configuration mechanism that allows us to remove many anomalies and tune the stereo effect optimally. This makes most games very playable in stereoscopic 3D.

A small number of issues, however, cannot be resolved. To address this situation, NVIDIA 3D Stereo uses a rating system for each game that helps users decide whether they should play the game in stereoscopic 3D.

Figure 4. 3D Stereo Driver Model

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## Capabilities

Not only is NVIDIA 3D Stereo the fastest and most compatible solution, due in part to the tight integration of the driver and stereoscopic 3D support, it offers many new capabilities. One new feature—the in-game hot keys for adjusting stereo separation, turning stereo on and off, and adjusting convergence and other parameters—produces optimal stereo effects. Plus, NVIDIA 3D Stereo lets users test their ability to see 3D stereo images and optimally configure their GPU and monitor.

The biggest advantage of NVIDIA 3D Stereo is its custom, per-game settings, which are automatically used when a game starts. These settings configure the optimal stereo effects and fix various stereo anomalies—such as heads-up display (HUD) items being too far forward, or a gun sight located at the depth of the monitor. In addition, users can modify or create their own settings. The Stereoscopic Driver User's Guide provides information for customers to customize a game on their NVIDIA GPUs.

As new games become available, NVIDIA will create settings that optimize stereo for those games available and make them available to the user.

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## NVIDIA Stereo Viewer

Viewing stereo photos is now possible on your GPU. Screenshots you take in your game or with special cameras are now viewable on your computer. The 3D Stereo driver kit ships with a Stereo Viewer application for viewing and manipulating static stereo images. Stereo Viewer displays JPEG Stereo (JPS) images, or standard JPEGs of side-by-side images, including displaying them as anaglyph images.

Use the NVIDIA Stereo Viewer to

- ❑ View still images
- ❑ Change the image display
- ❑ View a set of images as a slide show
- ❑ Move image files

Refer to the 3D Stereo Driver User's Guide for information on the NVIDIA Stereo Viewer.



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## Supported Products

### NVIDIA GPUs

NVIDIA 3D Stereo was designed for everyone, from dedicated 3D gamers to casual users. Stereoscopic 3D support has been added to the Detonator XP software for support of the following NVIDIA products: TNT/TNT2, GeForce 256, GeForce2 GTS/MX/Ultra, GeForce3, Quadro, Quadro2 MXR/Pro, Quadro2 EX, and Quadro DCC graphics solutions.

### Operating Systems

NVIDIA 3D Stereo supports Microsoft® Windows® 95/98/ME, Windows 2000, and Windows XP.

### API

NVIDIA 3D Stereo supports games developed with DirectX and OpenGL APIs. Some games will not work properly with NVIDIA 3D Stereo because of stereoscopic 3D compatibility problems within the game. Please consult the game list contained in the stereo properties Control Panel for details about each game.

OpenGL 3D Stereo is not supported on TNT-based and TNT2-based graphics boards.

## Recommendations and Requirements

To enable NVIDIA 3D Stereo, users must have the following components: Detonator XP software, the 3D Stereo driver kit, and approved 3D monitor or 3D stereo glasses with CRT monitor capable of 100hz.

### 3D Stereo Shutter Glasses

A number of approved 3D stereo glasses have been approved and tested to work with 3D Stereo:

- ❑ i-O Display Systems H3D, and i-glasses 3D (<http://www.i-glasses.com/>)
- ❑ e-LET'S Beautiful 3D (<http://www.e-lets.co.jp/>)
- ❑ ELSA 3D Revelator (<http://www.elsa.com/>)
- ❑ StereoGraphics CrystalEyes3 (<http://www.stereographics.com/>)
- ❑ ASUS GeForce2 GTS Deluxe (<http://www.asus.com/>)

### 3D Stereo Anaglyph Glasses

NVIDIA now provides a low-cost solution for stereo. Using standard anaglyph glasses (red-blue filtered 3D) and the anaglyph mode in our driver, users can play games in 3D stereo for only the cost of the glasses—\$1 to \$5, depending on the quality. The anaglyph mode of the driver can also be used to run games in stereo using LCD flat panels, because higher refresh rates are not required.

Although the stereo effect is essentially the same, the use of red-blue glasses (E3D Stereo-Specs) can be harder on the eyes, so users may choose to upgrade to LCD glasses.

Anaglyph glasses (red-blue) from E3D Stereo-Specs can be obtained from E3DMedia (<http://www.3d-glasses.net/>).

## 3D Stereo Monitors

Dimension Technologies' flat-panel LCD monitors (5.1" LCD and 18.1" 3D LCDs) are specifically designed to support 3D. Please visit their Web site for more information (<http://www.dti3d.com/>).

## Monitors

It is important to select a monitor that works with the unique 3D Stereo setup one has put together.

When using 3D Stereo shutter glasses, NVIDIA recommends monitors that support 100Hz or more at higher resolutions. The optimal setting is 120Hz or higher. Keep in mind that faster GPUs allow games with higher resolutions and refresh rates, so users might consider upgrading their video card. NVIDIA does not recommend LCD flat panels because their low refresh rates do not produce visually pleasing effects when using 3D Stereo shutter glasses.

3D Stereo anaglyph glasses can be used with any type of monitor without any limitation.

3D Stereo Interface	Required Monitor
3D Stereo Shutter Glasses	Analog CRT (non-DVI) that supports 100Hz or higher refresh rate
3D Stereo Anaglyph Glasses	Any type of monitor (analog or digital)
3D Stereo Monitor	N/A


## Performance

NVIDIA 3D Stereo requires double the fill-rate requirements, as compared to games without 3D stereo enabled. Thus, the more powerful the GPU, the better the performance and 3D stereo experience for the user.

## Conclusion

Quite simply, NVIDIA 3D Stereo is the fastest and most compatible consumer stereoscopic 3D solution available today. The combination of NVIDIA Detonator XP software, NVIDIA 3D Stereo driver, and a NVIDIA GPU delivers an unparalleled gaming experience for everyone.

If you are a developer interested in adding or improving the stereoscopic 3D support in your game, please visit the NVIDIA Developer Web site (<http://developer.nvidia.com/>) for more information.



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