



# Technical Brief

Enhanced Video  
Processing Engine  
VPE 3.0 for Notebook PCs



# Introduction

The use of notebook PCs for entertainment is one of the contributing factors to the dramatic growth of notebooks in the overall PC market. Whether playing a cool new 3D game, watching DVD movies, playing back TV/PVR shows, or even streaming video content over the Internet, users expect consumer-quality playback that rivals what they get with their home video equipment.

The exciting new NVIDIA® GeForce™ FX Go mobile graphics processor units (GPUs) were designed to exceed users' expectations of video quality in a notebook. Now with the enhanced NVIDIA video processing engine—VPE 3.0—the GeForce FX Go mobile GPUs deliver unparalleled video quality to today's notebook PC users (Figure 1).

NVIDIA, known for delivering the best 2D/3D graphics experience, developed the revolutionary VPE to meet the demand for high-quality PC video. The technology was introduced with the NVIDIA GeForce4 GPU family, and enhanced with the initial launch of the GeForce FX Go family. Now with the GeForce FX Go5700, NVIDIA rolls out VPE 3.0, raising the video-quality standard again by delivering dramatic enhancements such as high-definition component video-out—the ultimate in display quality.



Source: Copyright © Disney/Pixar

Figure 1. Unprecedented Video Display Capabilities for Notebook PCs

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## Highlights

The NVIDIA VPE 3.0 technology combines many technologies:

- ❑ Fully integrated high-definition component video-out display capability.
- ❑ A MPEG-2 decode engine that establishes new highs for smooth and high-quality DVD, HDTV, or streaming-video playback.
- ❑ Adaptive de-interlacing provides the highest-quality playback of interlaced content on notebook LCD panels.
- ❑ Independent and dedicated gamma correction for video eliminates compromised quality for multi-window or multi-display situations.
- ❑ Enhanced scaling, filtering, and sharpening filters deliver vibrant and crisp display quality.
- ❑ MPEG-2 encode assist delivers enhanced PVR display quality.
- ❑ Comprehensive Video Mixing Renderer (VMR) support enables seamless integration of video with other video/2D/3D windows.
- ❑ NVIDIA® Digital Vibrance Control™ 3.0 technology enables tuning display characteristics on a per-display basis for uncompromised quality in all situations.
- ❑ NVIDIA® ForceWare™ application package integrates the previous elements to provide an enhanced multi-display work/play environment.

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## Features and Benefits

The NVIDIA VPE 3.0 technology was carefully designed to achieve one goal: to deliver unparalleled video quality. Each element of this technology specifically addresses user needs.

User needs reflect three rapidly accelerating trends in the notebook PC market:

- ❑ Universal adoption of DVD-ROM drives
- ❑ Built-in support for high bandwidth networkability (wired and wireless)
- ❑ Increased availability of high-definition (HD) content

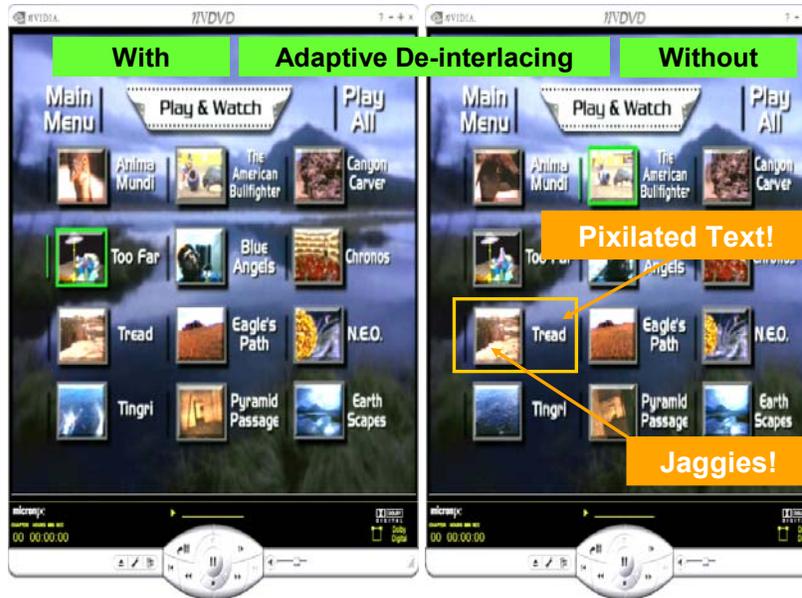
## High-Quality Playback

The expectation for crystal-clear and smooth video playback has significantly increased, whether watching a DVD movie on a transoceanic flight, downloading and playing a video from the Internet, or plugging into an HDTV programming channel.

To meet this challenge, VPE 3.0 applies a sophisticated MPEG-2 decode engine and sets new standards for high-quality DVD playback, streaming-video, and HDTV playback.

## Adaptive De-Interlacing

With the current trend for the playback of more action-packed movies and versatility of multilanguage, subpicturing technologies, improved de-interlacing schemes (beyond the Bob and Weave generation) are a necessity. The VPE 3.0 adaptive de-interlacing feature ensures the highest-quality playback of interlaced content on today's LCD panels (Figure 2).



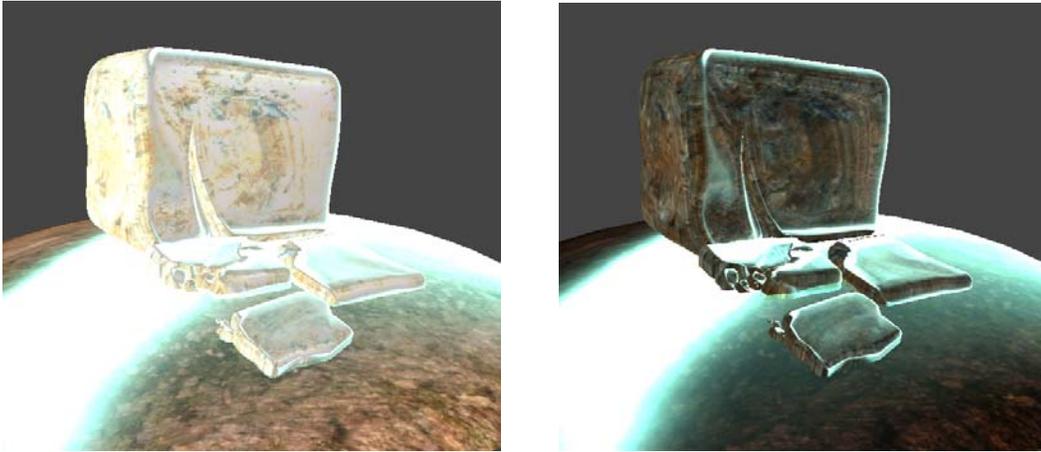
Source: Dell Ultimate DVD Demo disk

Figure 2. NVIDIA VPE 3.0 De-Interlacing

## Gamma Correction

Different display devices (notebook panels, CRTs, TVs), as well as different video content (movies, TV programs, office/home videos), present appealing video quality at differing “gamma-factor settings.”

Eliminating restrictions from the past, VPE 3.0 provides independent and dedicated gamma correction for video, which lets users define two independent gamma-correction settings (Figure 3). Now a user can watch a movie with one setting, while displaying desktop windows with another. Plus, enjoy no-compromise quality for both!



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**Figure 3. NVIDIA VPE 3.0 Gamma Correction**

The image on the right has been gamma-corrected; the image on the left has not.

## Scaling and Filtering

Display-quality enhancement involves a fair amount of “black magic pixel processing,” and VPE 3.0 takes this magic to an unprecedented level. Sophisticated circuitry built into the GeForce FX Go mobile GPUs includes enhanced de-blocking, scaling, filtering, and sharpening filters.

These VPE 3.0 elements, combined with Digital Vibrance Control and NVIDIA® Intellisample™ technology, result in vibrant, crisp display quality and an unprecedented notebook PC user experience.

## PVR Enhancement

As digital video recording becomes more prevalent, many consumers are using their notebook PC as a personal video recorder (PVR). The VPE 3.0 MPEG-2 encode assist feature is specifically designed to enhance the quality of PVR applications.

Enabled by the preprocessing and post-processing of the digital video content that uses circuitry within the GeForce FX Go, the design gives users enhanced display quality for home videos or stored TV programs.

## Video Mixing

Mixing video with other 2D/3D windows is a natural outgrowth of today’s notebook PC uses. When used to superimpose video clips or to place video clips over 2D templates, a notebook PC becomes a video-mixing studio.

The NVIDIA VPE 3.0 technology offers comprehensive VMR support. It enables the seamless integration of video with other video/2D/3D windows and results in visual creativity and pleasing display quality.

## Related NVIDIA Enhancements

VPE 3.0 provides synergy with enhanced ForceWare support. This combination provides an improved multi-display work/play environment.

GeForce FX Go mobile GPUs also introduce Digital Vibrance Control 3.0 technology (Figure 4). DVC 3.0 lets users modify display characteristics and enhance visuals to suit the specific lighting environment and physical attributes of a particular display device (LCD-panel, CRT, or TV).

DVC parameters can be set independently to perfect the performance of each display device. Please refer to the “Digital Vibrance Control: Dynamic Control of Visual Quality” technical brief (TB-00648-001) for complete details of this technology.



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Figure 4. NVIDIA Digital Vibrance Control 3.0  
The right side of the image was adjusted.

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## DVD/HDTV Playback

MPEG-2 content playback, whether for DVD or HDTV, can be separated into navigation, parsing, and video decode modes:

- Navigation refers to the graphical interface that lets users
  - Select play, pause, fast-forward, and reverse operations
  - Select chapters
  - View angles
  - Select a language
  - Use parental controls

Several DVD/HDTV navigation applications are available and have been integrated into the standard desktop user interface.

- ❑ Parsing includes decrypting data from the DVD disc and separating video data from audio data. The audio data is typically decoded by the CPU and represents less than a 5 percent overhead for most current CPUs. The Content Scrambling System (CSS) decryption also represents overhead of less than 5 percent on current CPUs.
- ❑ The video decode function can consume up to 40 percent of the cycles on today's CPUs if handled entirely in software. This would have a detrimental effect on a notebook's battery life because the CPU is a major consumer of power in a notebook platform. With the GeForce FX Go, however, the VPE 3.0 MPEG-2 decode engine can offload the CPU and perform these functions for a fraction of the power. Users also gain a better quality of decode playback.

## Decoding the Video

Efficiently decoding the video is the first stage for creating a great DVD viewing experience. The NVIDIA VPE 3.0 technology features video decoding hardware based on the industry-standard MPEG-2 decode algorithm. This technology includes inverse quantization (IQ), inverse discrete cosine transformation (IDCT), motion compensation, and color space conversion (CSC) functions (Figure 5). VPE 3.0 also supports subpicture alpha blending to overlay navigation controls on the video display.

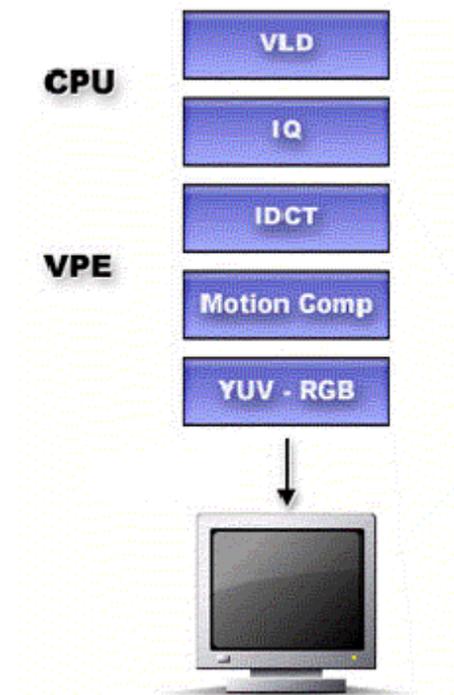


Figure 5. NVIDIA Enhanced Video Processing Engine 3.0

VPE 3.0 also offers an MPEG-2 decode algorithm that is more efficient than those found in previous-generation GPUs. The result is the industry's lowest CPU usage—less than 10 percent—for DVD decode. Reducing CPU use from the highs of the software-handled 40 percent overhead to the lows of hardware-handled 10 percent overhead, results in a lower consumption of system power. This feature makes the difference between watching a whole movie or running out of battery life during a climactic finish.

Clearly, GeForce FX Go mobile GPUs deliver superior battery life for viewing DVDs.

## Displaying the Video

Next, the decoded video has to be displayed with optimal quality. Although DVD format is 720 by 480 pixels, notebook LCD displays range from 1024 by 768 pixels to 1600 by 1200 pixels, with a limited 18-bit color format. So it is critical to provide extremely smooth scaling of the video and to convert millions of colors from a single frame into a high-fidelity image.

To achieve this, NVIDIA VPE 3.0 incorporates a sophisticated scaling engine that takes input from any DVD or HD format and accurately scales it to use the full LCD display with smoothing in the vertical and horizontal domains. Just as antialiasing improves 3D visual quality, smooth scaling reduces the jaggies in video content.

GeForce FX Go mobile GPUs also include a sophisticated dithering circuit to map the full range of colors from a video onto the gamut of colors on the 18-bit LCD displays used exclusively in notebook PCs. Together, the scaling and dither support ensure that the video playback appears smooth, vibrant, and accurate, regardless of the external display used.

The GeForce FX Go5700 GPU is the first member of the family to offer fully and tightly integrated on-chip support for high-definition component video-out display capability. Component video-out is the highest grade of consumer video display output (better than composite and S-video), and is an integral part of the high-definition content specification. The GeForce FX Go5700 enables notebook PCs to now offer this ultimate quality video display-out to users.

# Conclusion

Notebook PCs are fast becoming the primary, and often the only, computer for work, school, and home. This means that in addition to handling documents and spreadsheets, notebooks are now used to run the latest PC games and to watch DVD movies and streaming video content. To make this a truly compelling experience, notebooks need to offer the highest-quality video, on par with what users have come to expect on their desktop PCs and their high-resolution televisions at home.

NVIDIA GeForce FX Go mobile GPUs deliver end-to-end display quality, with VPE 3.0 technology playing a key part in providing this capability. VPE 3.0 brings superior DVD playback quality, true cinematic 3D-graphics video display quality, amazing high-definition component video-out display quality, excellent Internet-streamed video content playback, and crisp, cool, yet vivid 2D/3D display colors for notebook PC users.

The NVIDIA VPE 3.0 technology delivers visual quality that exploits every picture enhancement technique for every display devices, for a never-before-seen level of viewing quality and pleasure.

GeForce FX Go mobile GPUs...enabling the full potential of notebook PCs as true entertainment devices.



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