



C-CUBE

ZiVA-5 TrueScan™ Progressive-Scan DVD

October 2000

INTRODUCTION

There are basically two video-signaling standards used in televisions today: interlaced signaling and non-interlaced signaling - also called progressive-scan. Interlaced signaling is a legacy technology that was created to solve the technological issues of its time at the cost of picture quality. Picture quality, in the days of VHS and low-resolution broadcast television, was not a concern of most people. In today's world of DVD players and digital set-top boxes, there is demand for better video quality.

DVD-Video players have an inherent video quality improvement over other formats like VHS. Almost all DVD titles sold today are created from progressively scanned sources, such as the original film. However, very few DVD players can take advantage of the superior video quality that is present on the DVD-Video disc; rather, most DVD players today only output the interlaced signaling limited by standard analog televisions. The advent of Digital TV (DTV) enables DVD players to take full advantage of DVD-Video quality. This allows DVD-Video discs to be viewed that have the same quality as the original film.

The complex process of reconstructing and outputting progressive-scan video from the interlaced format found on the DVD disc to progressive-scan capable televisions has been integrated into C-Cube's ZiVA-5 DVD system processor. DVD players based on the ZiVA-5 processor will be fully compatible with DTV 480P and will let viewers enjoy DVD-Video the way it was meant to be.

TECHNOLOGY BACKGROUND

With any new technology and format come new concepts and terminology. Some of these key concepts are explained below:

Telecine

The Telecine process is used to convert 24 frame-per-second film video to interlaced 60 fields-per-second video for use with standard analog NTSC televisions. This process is sometimes called 3:2 pull-down. This is done for all DVD-Video titles from film sources, and is shown in Figure 1.

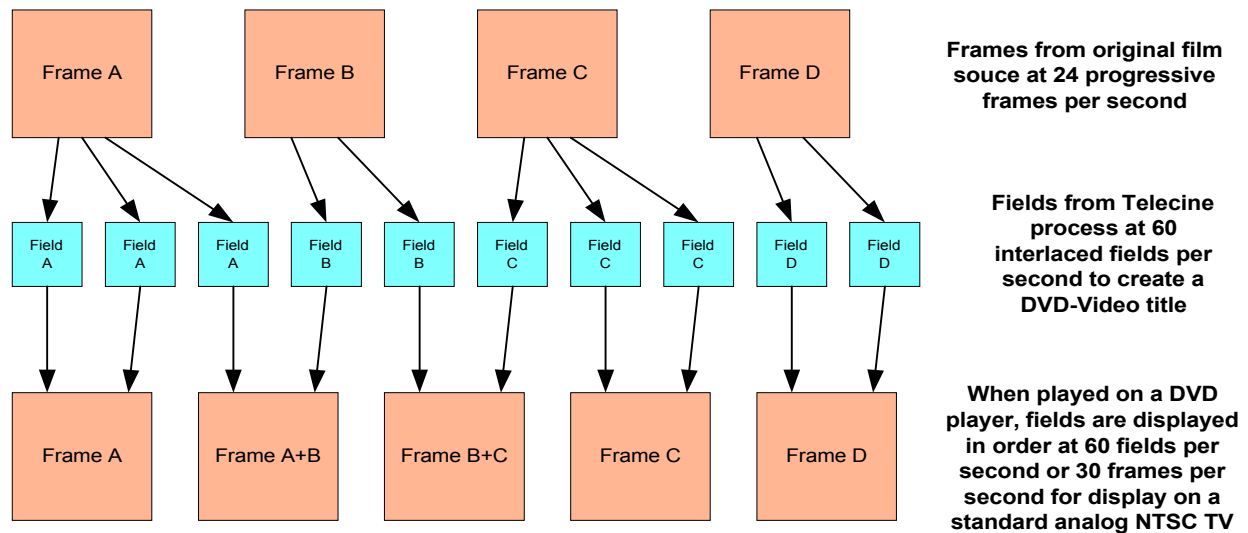


Figure 1: 3:2 Pull-down Process

Interlaced, NTSC Video (480I)

National Television Standards Committee (NTSC) interlaced video, sometimes called 480I or 480-line interlaced, is the television signaling standard used in the USA, Japan and other countries worldwide, to produce 60 fields per second interlaced video. This standard is 50 years old and most televisions manufactured today are based on this technology.

Progressive-scan, 480P Video

480P or 480-line progressive-scan is an Advanced Television Systems Committee (ATSC) television video signaling standard that is part of the Digital Television (DTV) standard for 60 frame-per-second video. On December 24, 1996, the United States Federal Communications Commission (FCC) adopted DTV as the standard for all US broadcast television. Many other countries have joined the DTV initiative. DTV is becoming the standard for digital TV's manufactured for sale worldwide.

De-interlacing

The process of reconstructing 480P frames from 480I fields is called de-interlacing. 480I can either be the result of the Telecine process, originating from film, or from interlaced video sources, such as video cameras. The 480I conversion back to the original-film progressive-scan format has many advantages, such as noticeably sharper images, no flicker, and no scan lines associated with interlaced scanning. Figure 2 illustrates the benefit of progressive-scan.

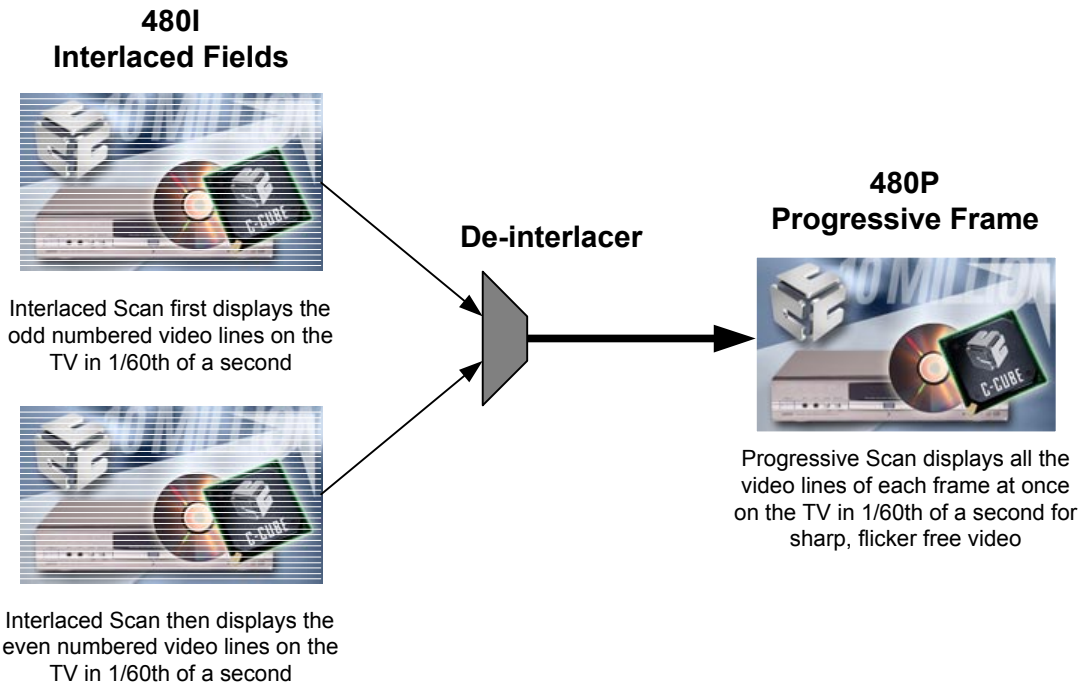


Figure 2: Typical Field to Frame De-interlacing

480I Video

The conversion to interlaced video is necessary for viewing on a standard TV but has negative effects, like loss of resolution, noticeable scan lines and increased flicker, as shown in Figure 3.

Interlaced Video



Interlaced pictures have noticable TV scan lines, flicker and is 1/2 the resolution of the original video

Figure 3: 480I Video Artifacts

Incorrectly Telecine'd or Encoded Video

In some cases the Telecine and/or the video encode process fails. When this occurs, the video (3:2 pull-down) or information in the DVD video stream is incorrect. This typically creates problems for some de-interlacers, causing very unpleasant motion artifacts.

Motion Artifacts

In some progressive-scan solutions artifacts are created when de-interlacers incorrectly pair fields that do not belong to the same original progressive frame. This causes errors in the video, referred to as motion artifacts.

TODAY'S SOLUTIONS

There are two types of 480P reconstruction strategies incorporated in DVD-Video players and as a part of home theater systems today.

- Discrete de-interlacer chipsets
- External de-interlacer system component products

Discrete De-interlacer Chipsets

Digital video from the DVD decoder is processed by an additional de-interlacer chipset, as shown in Figure 4. The de-interlacer chipset typically uses a high-performance, general-purpose video processor that is designed into a DVD player to reconstruct 480P video from the raw interlaced video itself.

Drawbacks of Discrete De-interlacer Chipsets

- General purpose: The processing doesn't have knowledge of the information embedded in the DVD video and thus cannot take advantage of it.
- Additional cost: The cost of the de-interlacer chipset is typically more than the cost of the DVD decoder. A larger, more complex and costly DVD decoder board must also be used. This approach does not enable mainstream consumer price points.

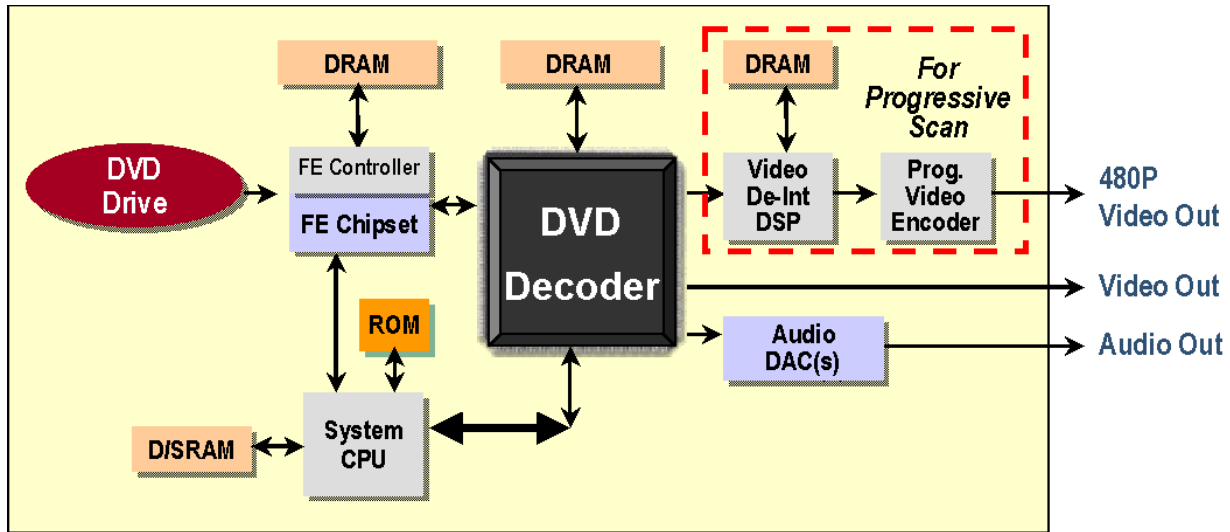


Figure 4: DVD Player Block Diagram with De-interlacer Chipset

Standalone De-interlacer Products

Analog video output from the DVD player is processed in a standalone de-interlacer product or by a display device with a built-in de-interlacer, as shown in Figure 5. The advantage of this class of de-interlacer is that they are usually not constrained by cost or size and can achieve higher performance than that of the discrete de-interlacer chipset based de-interlacer solutions.

Drawbacks for De-interlacer Products

- Additional cost: The cost of the standalone de-interlacer product can be as high or higher than the cost of the DVD player itself.
- Video quality loss: Video quality loss due to the conversion of video from digital to analog, then back to digital for processing, and then finally back to analog for display negatively effects overall video quality.
- General purpose: The processing doesn't have knowledge of the information embedded in the DVD video and thus cannot take advantage of it.

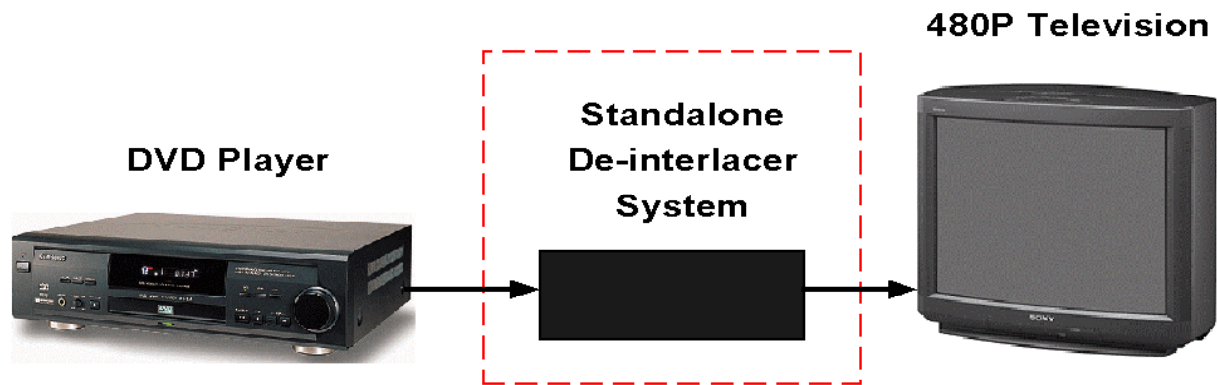


Figure 5: Standalone de-interlacer DVD System Diagram

The ZiVA-5 TrueScan™ De-interlacer Solution

Integrated within the ZiVA-5 DVD system processor is a high-quality, optimized de-interlacer, as shown in Figure 6. This solution allows ZiVA-5 to take advantage of various indicators within the video decode process to determine the existence of progressive video.

Advantages of TrueScan™

- Cost effective – High quality: The DVD video-decoding process allows temporal references without adding field/frame buffers. This allows for a high quality implementation without adding large external memories or high-performance video processors.
- Optimized processing: The DVD video-decoding process provides most of the information needed to properly reconstruct progressive frames without the need for additional high-performance video processors.
- Single chip solution: De-interlacing has been integrated into the ZiVA-5. Single chip means simpler system design, higher quality and lower system cost.

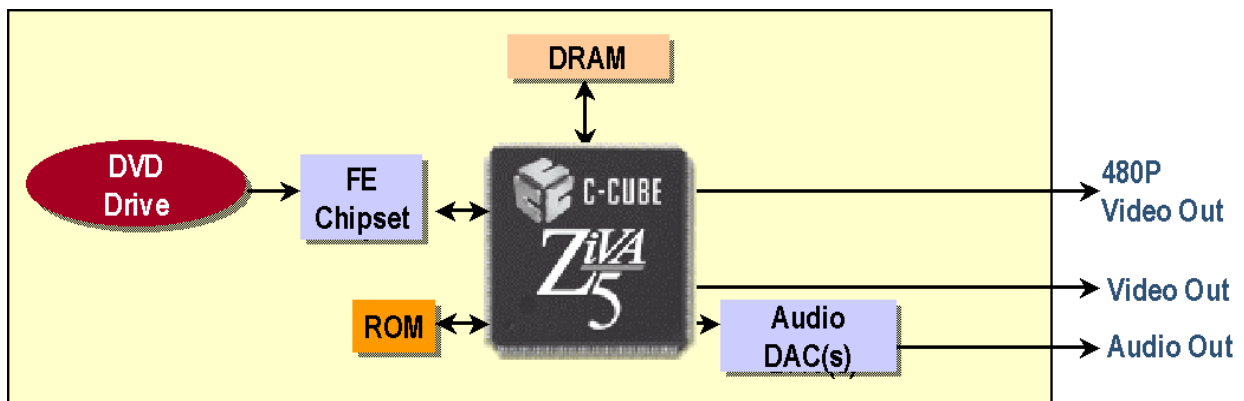


Figure 6: DVD Player Block Diagram with ZiVA-5 TrueScan™ De-interlacer

ZiVA-5 TRUESCAN™ DE-INTERLACING

ZiVA-5's TrueScan™ de-interlacer is optimized for DVD-Video. ZiVA-5 can reconstruct the original progressive video from the interlaced video on the DVD disc to create the ultimate DVD-Video viewing experience, as shown in Figure 7. ZiVA-5 uses proprietary field-adaptive technology to detect the presence of progressive video in the Telecine'd video stream. This detection method allows ZiVA-5 to flawlessly reconstruct 480P video, even in cases where the Telecine or DVD encode process failed.

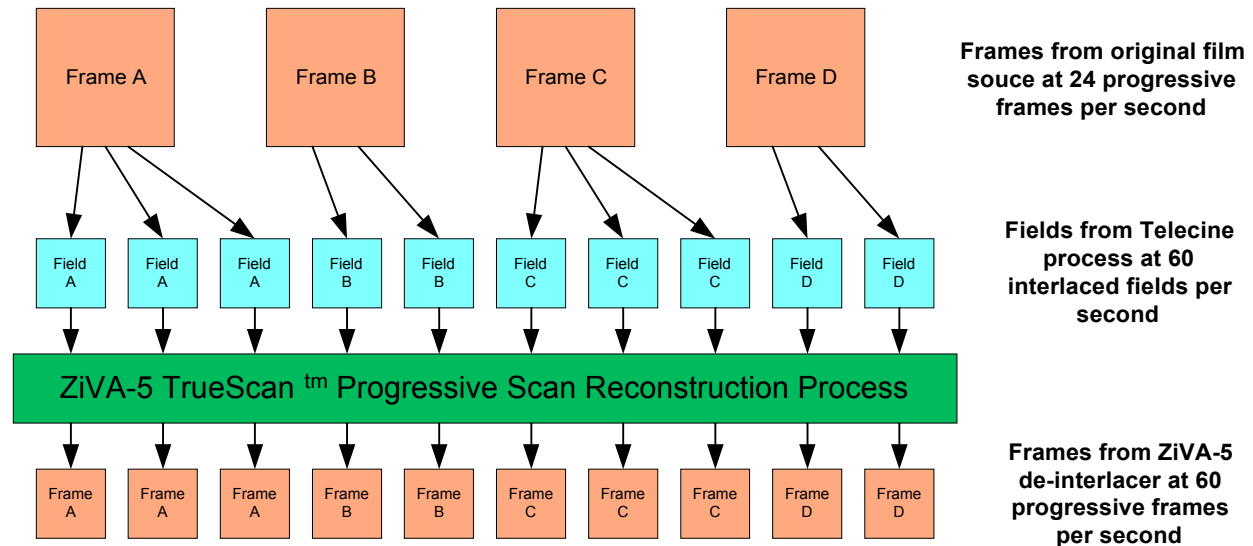


Figure 7: ZiVA-5 TrueScan™ De-interlacer Process

SUMMARY

Today's de-interlacer technology is not cost effective or optimized for DVD applications. Cost effectiveness and high-quality are key to DVD player manufacturers. ZiVA-5 with TrueScan™ offers the best progressive-scan DVD player solution for the DVD market.

ZiVA-5 Progressive Reconstruction is Totally Digital

TrueScan's™ progressive-scan reconstruction is totally digital, so there is no loss from analog-to-digital and digital-to-analog conversion. Standalone de-interlacers have analog inputs that must be converted to digital for progressive-scan processing and then converted back to analog for transmission to the TV. This back and forth conversion process is lossy and negatively effects video quality.

ZiVA-5 Employs a Proprietary De-interlacing Process

TrueScan™ uses unique information only available within the ZiVA-5 DVD processor to determine the correct conversion method every time. This ensures that ZiVA-5 based progressive-scan reconstruction is the best possible with no motion artifacts that may occur on other progressive-scan solutions.

ZiVA-5 is Optimized for DVD-Video

TrueScan™ is optimized for both film and video sources that are found on DVD-Video discs. Other de-interlacing solutions are not optimized for the DVD-Video environment and, as a result, the progressive-scan reconstruction results in lower quality or contains motion artifacts.

In summary, with its TrueScan™ feature, ZiVA-5 provides the highest-quality, most integrated solution for progressive-scan DVD players today.

ABOUT C-CUBE

The company is a worldwide leader in digital media processing and is leading the way with new communication processors and networked consumer products. With a focus on DVD, set-top boxes and codec-enabled products, C-Cube is driving the technology for the “networked digital home”

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