White Paper

Ultra-Fast LCD Displays
Breaking the 2ms Barrier

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Overview

New design materials and novel manufacturing processes are allowing faster LCD displays than ever before. LCDs are up to three times faster than they were just a couple of years ago. Even so, an LCD is still capable of producing visible smearing with fast moving images. Video is measured in terms of the number of frames per second (fps). Smearing occurs if the LCD panel's response time can't keep up with the number of frames per second. The minimum response needed for acceptable motion video is in the range of 25ms. This equates to a frame rate of 40 fps and means the display is capable of refreshing the image up to 40 times each second. The next milestone occurred with a response time of 16ms, equating to a frame rate of 60 fps. It was quickly discovered that simply achieving a response time equal to the recommended frames per second was not good enough for some motion-intensive applications such as gaming. Rather, it is equally important that all pixel transitions be completed in the shortest time possible within a given frame. This means further improvements in response time were needed well beyond 12ms, 8ms, 4ms, 2ms, etc. …

Background

The pixel response time measures the time it takes for a pixel to change from one brightness level to another (Figure 1). Response time is one of the few areas remaining where the performance of traditional CRTs still holds an advantage over LCD displays. CRTs have nearly instantaneous pixel response times, but LCDs tend to be much slower. The result is that the LCD user might see ghosting or other visual artifacts when there is movement on the screen. A typical LCD monitor today has a response time of 25 milliseconds or faster, which is still slow when compared to a CRT. For the first time, we are now able to produce LCD displays with response times as fast as 2ms, thanks to improved technology and manufacturing techniques.

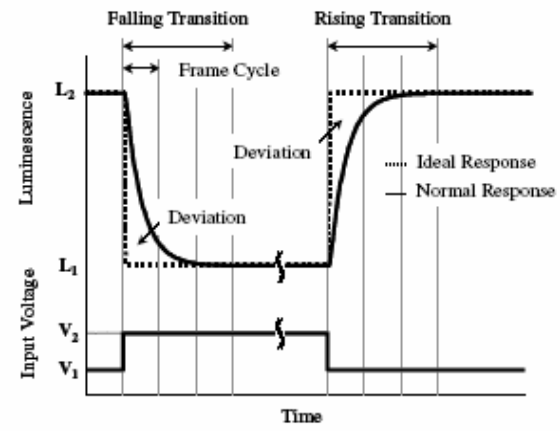

Figure1: Optical Response Waveform

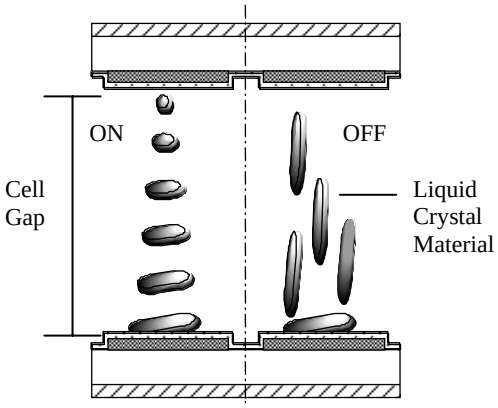

Figure2: LCD Panel Cell

ViewSonic has employed these new manufacturing capabilities to bring its **ClearMotiv**™ performance to the next level, with the introduction of two new **ClearMotiv 2ms** technologies. The first of these is **Dynamic Structure**™ **Technology**, which targets the raw materials and structure of the LCD panel to achieve the fastest possible response times. ViewSonic's Dynamic Structure Technology uses innovative lower viscosity liquid crystal material and reduced cell gap thickness to accelerate video response at frame rates up to 500 fps.

One of the benefits of the improved LC material and reduced cell gap is that the relative response time improvement is reflected across the entire grayscale range, not just the black/white transitions. This is an important point since real-world video content contains a combination of grayscale images, and it generally takes longer to transfer to an intermediate level of intensity than it does to turn completely black or completely white. This is the reason why ViewSonic's **CLEARMOTIV 2ms** with the capability to show true digital broadcast-quality video with frame rates up to 500 fps, includes faster response time for both black/white and grayscale transitions.

The second **ClearMotiv™ 2ms** technology is ViewSonic's **Amplified Impulse™ Technology**. This technology supercharges the relative improvements in grayscale transitions brought to us by Dynamic Structure™. This intelligent overdrive technique works by applying a "full-white" drive signal, for a brief duration, in order to give the pixels a "jump-start". Amplified Impulse Technology allows gray-to-gray transitions to be completed up to 12 times faster than typical "fast-response" LCD displays. With no tradeoffs other than manufacturing cost, Amplified Impulse Technology provides for dramatic improvement in gray-to-gray response time and motion video performance.

The following figure illustrates how Amplified Impulse uses variable signal modulation to accelerate grayscale transitions for superior motion video and gaming. The dotted lines represent an idealized response, the black lines represent the response from a traditional LCD, and the red lines represent the expected improvement from Amplified Impulse Technology.

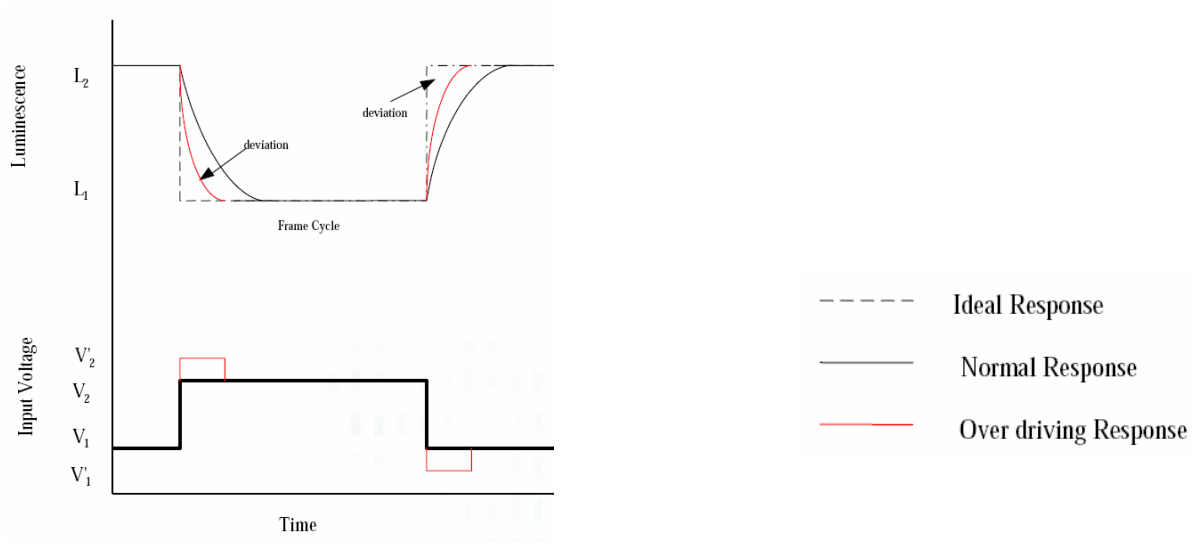

Figure 3: Amplified Impulse Overdrive Scheme

It is important to note that not all LCD panels can qualify as ClearMotiv 2ms. The following chart is therefore intended as an aid to provide a general guideline for different panel technologies (individual panels will vary):

Technology Comparison Chart

The following test results illustrate the dramatic effect that ClearMotiv 2ms has on all the possible transitions.

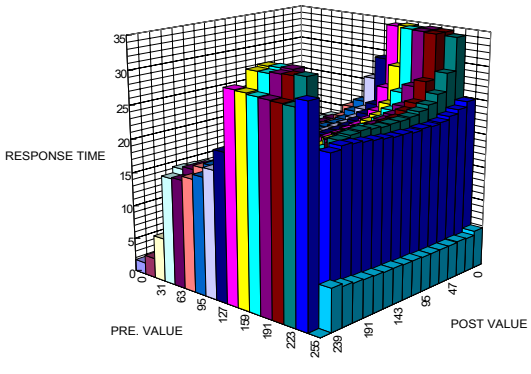

Figure 4: Traditional 8ms Fast Response LCD Panel

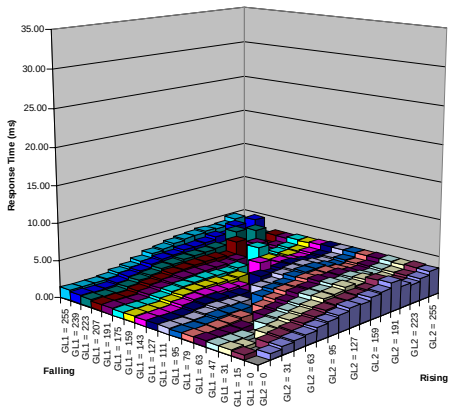

Figure 5: ClearMotiv 2ms Fast Response Panel

Due to the increased importance of video content in all applications, ViewSonic will continue to actively pursue opportunities for improving the response time, including grayscale performance, for each of our new models.

What does this mean for me and my customer?

An ultra-fast response time is one important consideration when making your LCD purchase decision. Response time is a key factor in determining how good a display will look when combined with moving images. Imagine playing a fast action game and seeing blurring and trails every time there was a quick movement. The same effect holds true while watching any type of motion video. Even if these applications are not critical to you or your customer now, you still may want to consider the future usage and upgrade potential of the LCD display over the next several years.

The following simulation is used to illustrate just how dramatic the difference can be between a typical fast response LCD and a **ClearMotiv™ 2ms** model with **Amplified Impulse™ Technology**.

Figure 6: Traditional 8ms LCD vs ClearMotiv 2ms (10 pixels per frame)

As a full service technology solution provider, ViewSonic offers everything necessary to bring you the most pleasurable viewing experience. In addition to our compelling LCD displays incorporating ultra-fast response panels, we have stand-alone TV tuners/video processors and high-end speaker solutions to transform the display into a complete entertainment hub. ViewSonic has taken the LCD display to the next level for both data and video performance.

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