

## White Paper

# Ultra-Fast LCD Panels Breaking the 12ms Barrier

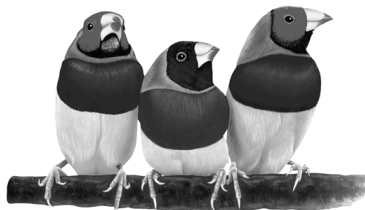
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## Overview

New design materials and a novel manufacturing process are allowing faster LCD displays than ever before. LCD's 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 absolute minimum response needed for acceptable motion video would be in the range of 25ms. This equates to a frame rate of 40fps (frames per second), and means the display would be capable of refreshing the image up to 40 times each second. The next step from here would occur with a frame rate of 60fps. Getting to the >80fps capability requires a response time in the range of 12ms, and this has been a major technology barrier until now.

## Background

The pixel response time measures the time it takes for a pixel to change from one state to another (Figure 1). CRTs have nearly instantaneous pixel response times, but LCD's tend to be much slower. The result is that the 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 comparing to a CRT.

We are now able to produce LCD panels with pixel response time as fast as 12ms. The technology that allows these faster response time panels is two-fold ... The first being a lower viscosity type of Liquid Crystal Material, and the second being a smaller cell gap meaning there is less material to be moved in a given time (Figure 2). The process for a lower cell gap is very critical, as the brightness uniformity must not be compromised in the process. There are also other very specific tradeoffs that need to be considered when implementing these changes, including specifications related to brightness, contrast ratio, and threshold voltage. New manufacturing technologies have allowed this to be implemented effectively for the first time.

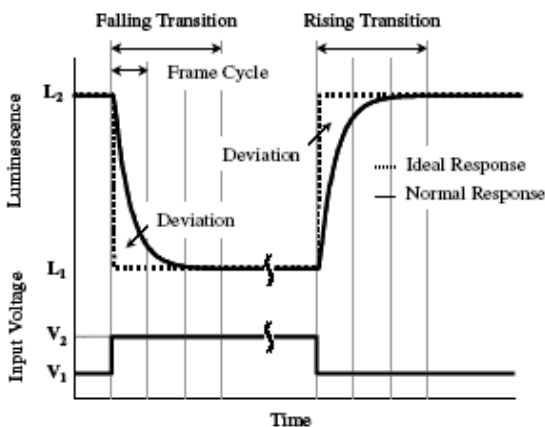


Figure1: Optical Response Waveform

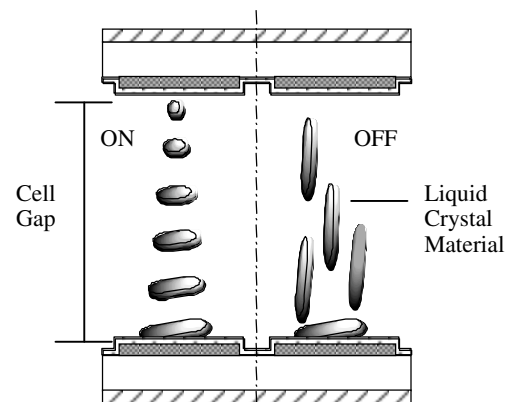


Figure2: LCD Panel Cell

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 Gray-Scale range, not just the White-Black-White transitions. This is important since "Real World" video content contains a combination of grayscale images, and it generally takes longer to transfer to intermediate level of intensity than it does to turn completely black or completely white. This is the reason that ViewSonic's CLEARMOTIV VIDEO TECHNOLOGY with frame rates exceeding 83fps for true digital broadcast-quality video, includes faster response time for both black/white and grayscale transitions.

The following simulation is used to illustrate just how dramatic the difference can be between a typical fast response LCD panel, and a ClearMotiv 12ms panel with Ultra-Fast Response Time.



**Figure 3: Traditional LCD Panel**



**Figure 4: ClearMotiv 12ms Panel**

It is important to note that not all LCD panels can qualify as ClearMotiv 12ms. 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

	<b>Response Time Gray-to-Gray</b>	<b>Response time Black-White-Black</b>
<b>TN Panels</b>	Good	Very Good
<b>IPS Panels</b>	Good	Very Good
<b>SuperClear™ MVA</b>	Very Good	Good

Due to the increased importance of video content in all applications, ViewSonic will continue to actively pursue opportunities for improving the response time, including gray scale 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. This 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 affect 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 display over the next several years.

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 tuner / video processors and high-end speaker solutions to transform the display into a complete entertainment hub. ViewSonic has taken the LCD display monitor to the next level for both data and video performance.

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