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## **Plasma Display Panel vs. Liquid Crystal Display Technology: Why Plasma Is Better**

### **Introduction – The Flat Panel Display Market**

As the flat panel television category continues its explosive growth, plasma display panel (PDP) technology remains the benchmark and *de facto* standard that consumers seek when considering the purchase of flat panel home theater display devices. To many consumers, the term “plasma” has become synonymous with all flat panel displays – even though liquid crystal display (LCD) products are also available.

Until recently, the market for direct-view, flat panel televisions was segmented fairly clearly, with LCD sets available only in screen sizes smaller than 30 inches, and PDP products available in larger screen sizes ranging from 42 to 61 inches. Today, the consumer market for these two flat panel technologies is beginning to converge, due to mass production of LCDs in larger screen sizes.

While PDP and LCD offer some shared benefits (their flat, thin form factor and undistorted, fixed-pixel image rendering), significant quality differences remain. Plasma displays continue to best fill the needs of home theater enthusiasts seeking premium-quality large-screen display devices, due to several inherent benefits of the technology.

Fujitsu General America, a global leader in plasma display technology, offers a full line of Plasmavision® SlimScreen® plasma monitors for the consumer and commercial markets, ranging in screen size from 42- to 63-inches (the latter available in January 2004). Fujitsu Plasmavision monitors provide large, theater-like screen sizes; rich, accurate, lifelike colors; high contrast in both light and dark rooms; stunning brightness from any viewing angle; excellent motion handling; and screen integrity over the long haul.

### **Under The Glass: Plasma and LCD in Simple Terms**

Plasma monitors and liquid crystal displays both incorporate fixed matrix technologies, but produce images using very different methods.

A plasma display is comprised of two parallel sheets of glass, which enclose a gas mixture usually composed of neon and xenon (some manufacturers also use helium in the mix) that is contained in millions of tiny cells sandwiched in between the glass. Electricity, sent through an array of electrodes that are in close proximity to the cells, excites the gas, resulting in a discharge of ultraviolet light. The light then strikes a phosphor coating on the inside of the glass, which causes the emission of red, blue or green visible light. (Each cell, or pixel, actually consists of one red, one blue and one green sub-pixel). The three colors in each pixel combine according to the amount of electric pulses fed to each sub-pixel, (which varies according to the signals sent to the electrodes by the plasma display’s internal electronics), to create visible images.

An LCD works entirely differently. An active matrix LCD’s light source is generated by small fluorescent bulbs. The white light from these bulbs is diffused to create a uniform light source by shining it through a polarizer located in the back of the display, which allows light to go through in only one direction. Individual LCD cells in the panel are then turned “on” and “off” by applying a small electric charge to the thin film transistors (TFT), located in each sub-pixel. This charge causes the liquid crystals to twist, allowing white light to be passed through red, green and blue



color filters and a front polarizer in front of the LCD cells. The image is formed according to which crystals twist to let light through or block it.

### Fujitsu General America's Perspective On The Benefits of PDP over LCD

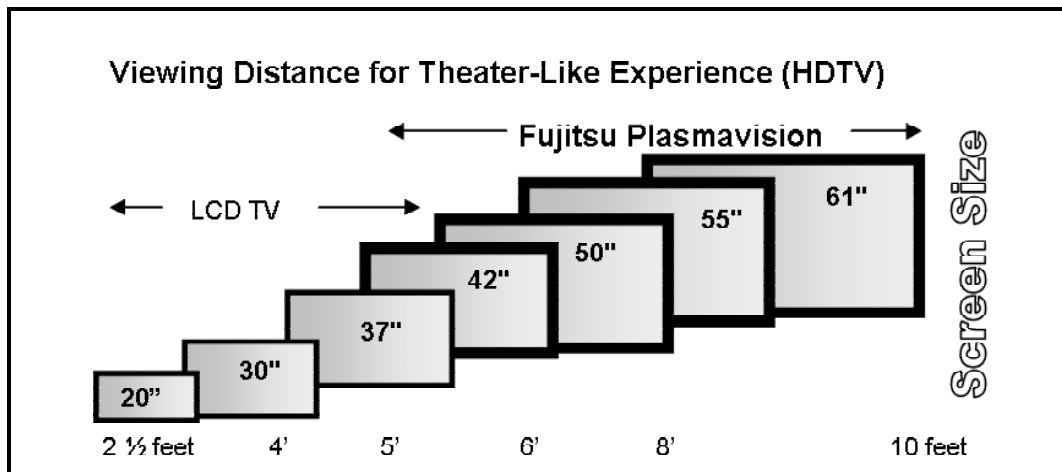
This document outlines the differences between PDP and LCD technology and explains the consumer benefits of PDP as the ultimate technology for home theater use. The benefits of plasma displays can be summarized as follows:

- Larger screen sizes are available in mass production
- More accurate image reproduction with better color accuracy, contrast and brightness
- Superior ability to display moving images without motion artifacts
- Better pixel reliability

#### 1) Larger Screen Sizes Available in Mass Production

Home theater experts agree that a theater-like experience is only achieved when the screen size is large enough with respect to the viewing distance from the screen – generally, when the screen size takes up 30 degrees of viewing angle. For example, a 42-inch plasma monitor seems theater-like in size when seen from seven feet away – a comfortable viewing distance. Larger displays offer even more flexibility for home theater applications.

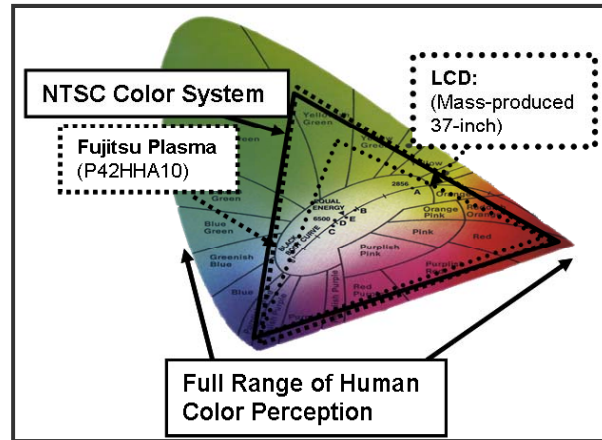
On the other hand, LCD screens have not yet reached these large sizes. At comfortable viewing distances, they look small and do not accurately reproduce a home theater environment.



#### 2) More Accurate Image Reproduction – Color, Contrast and Brightness:

Plasma displays have a much larger color spectrum than LCDs, delivering a more lifelike picture. Most Americans have enjoyed the realistic picture quality of phosphor-based color TV throughout their lives, watching cathode ray tube (CRT)-type sets, and are accustomed to the greater degree of color accuracy. On a properly calibrated CRT-type TV, colors such as flesh tones, blue skies and the greens of a forest are represented accurately. Plasmavision monitors, like CRT sets, also use phosphors to help create an image – and are able to produce vibrant, more accurate colors.

Colors represented on Fujitsu Plasmavision displays are almost identical to those on the NTSC color system chart, reproduced in NTSC broadcasts shown on phosphor-based studio monitors. In comparison, LCD displays are capable of reproducing only a fraction of the rich color range provided by Plasmavision displays, as shown on the diagram below.

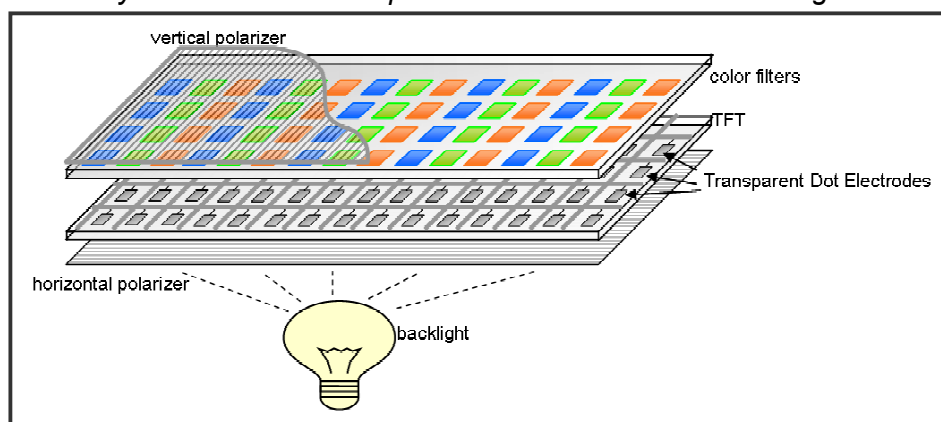


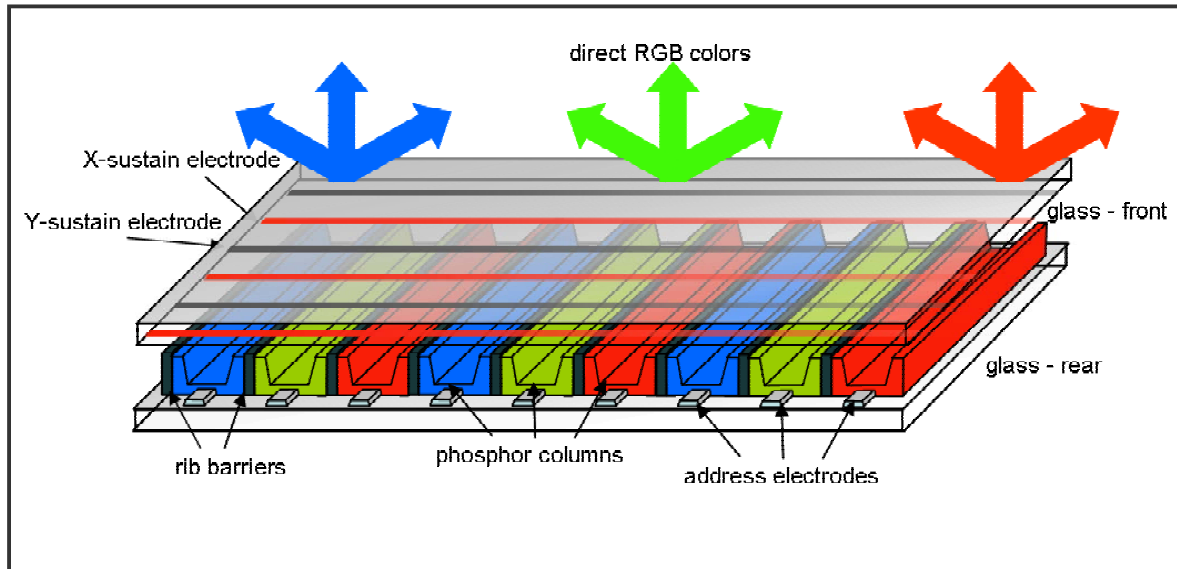
Why is the color reproduction of a Plasmavision monitor more accurate than that of an LCD display? It's because Plasmavision glow red, green and blue and produce these colors directly. It's literally an example of "what you see is what you get." These pure colors also propagate in an omnidirectional manner, so you can view the entire range of colors with full brightness from virtually anywhere in the room.

LCD sub-pixels, on the other hand, use filters to *subtract* wavelengths from a white backlight (white light contains all colors), a process that can only *approximate* true red, green or blue. As a result, the LCD color process is not as precise or as wide-ranging as the PDP color process. Also, because of the nature of the polarized filters used in the process, the resulting black levels and color range are further limited to a narrow viewing angle. Significant black level and color degradation occurs at a viewing angle only 20 degrees off-axis.

In the "real world" of home theater, this means flesh tones on Plasmavision monitors look vibrant and healthy – not robotic, jaundiced or anemic. Golf greens look lush and verdant, and oceans their deepest blue. Viewers can appreciate the superior color rendition of PDP technology from every angle in their home theater, rather than just head-on.

*LCDs rely on color filters and polarizers to convert white backlight into color images.*





*Fujitsu Plasmavision colors originate directly from glowing phosphors. The phosphors shine in every direction, so viewers can enjoy a rich, satisfying big-screen picture from any seat in the home theater.*

### 3) Action-Ready Motion Handling.

Home theater enthusiasts enjoy watching action – whether it's fast-moving sports or high-intensity drama. Nearly every genre of home entertainment relies on motion: sports, movies, variety shows, reality shows, even the news. Plasmavision displays show it all clearly, without the blurry, smearing afterimages that plague LCDs.

LCDs rely on matrix switches within the sub-pixels. These switches need time to cycle through the on-off sequence – more than 1/30 second was confirmed in recent testing. 1/30 second is more time than it takes to display two video fields – so rapidly moving LCD images leave trails behind them. This means that not just on-screen footballs, racehorses and racing cars, for example, are blurry. It also means blurry camera pans and zooms – serious problems that undermine the clarity of motion-based content when viewed on an LCD.

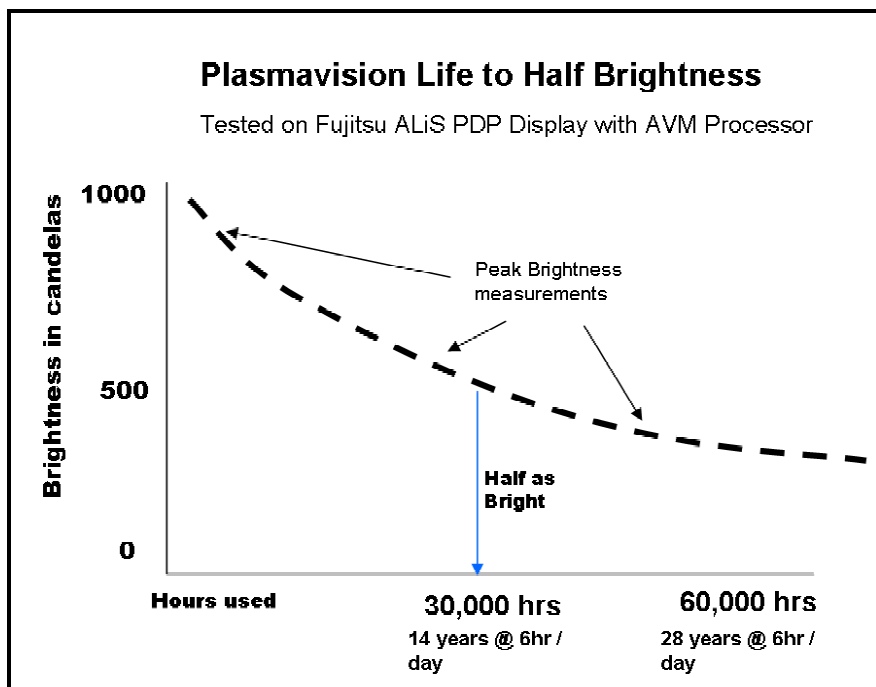
Fujitsu Plasmavision displays, on the other hand, do not suffer from these problems. Fujitsu's proprietary technology for delivering the most realistic action scenes is its Advanced Video Movement (AVM) processor. This exclusive processor virtually eliminates motion artifacts and flicker, improves vertical resolution and reproduces natural movement with ease. In addition, the processor's built-in line doubler converts NTSC signals and uses different types of processing for moving and still pictures, yielding smoother images with more natural movement and without visible scan lines. With AVM, high-definition television (HDTV) and DVD signals are also optimized for the characteristics of the plasma panel, to achieve extraordinary image quality that is noticeably superior to competitive models.

### 4) Screen Life

Consumers investing thousands of dollars in a display device face confusing and conflicting information about how long a plasma display panel lasts and about the possibility of potential damage to the display, compared to other devices. PDPs, like familiar phosphor-based TV sets, gently lose some brightness over the years.



In real life, six-hour-a-day use, Plasmavision sets will be half as bright after about 14 years. They'll lose a bit more brightness in the 14 years after that. When presented with this information, few consumers have any additional concern.



*Plasma displays deliver very bright pictures for a long, long time.*

Another concern among consumers is pixel life. While a pixel or two on a plasma monitor might not light at the time of installation, additional pixel failure *after installation* is virtually unheard of. The reason is the inert nature of the plasma pixel. There are no switches, gates or circuits associated with individual PDP pixels. All of the electronic operations take place in the video boards, display drivers and other components – *not* within the plasma display panel itself. These electronics are all either at the edges of the panel or behind the sealed glass. Qualified service experts can replace these components if they fail.

LCD pixels, by contrast, are prone to failure over the lifespan of the screen. Dot electrodes, located at each of the one-million-plus sub-pixels, control them. Any of these is prone to failure.

### 5) Addressing Burn-in

Plasma screens, like CRTs, can develop permanent on-screen afterimages, if misused. Most often, burn-in occurs on data monitors that display the same information for hours on end – airports, arcades, and lobbies are examples of the application where burn-in would most likely occur. Burn-in is much less likely for home theater users served by custom installation A/V consultants. Fujitsu Plasmavision screens also have burn-in protection that includes a white screen setting (DPMS white screen feature) to automatically whiteout all traces of images before they can damage the display.

## Summary

The characteristics of LCD monitors – small size with high resolution, image lag, low power consumption and ability to show static images for longer times without burn-in – make them suitable for non-residential applications and some small-screen residential applications such as personal computing and keypad controls. But for custom installation home entertainment systems, LCD's fall short in screen size, color accuracy, contrast, peak brightness performance and motion clarity. Clearly, plasma monitors are the only choice for big-screen home theater applications.

The below chart summarizes key benefits specific to Fujitsu Plasmavision monitors over LCD displays for home theater use.

Attribute	Plasmavision Display	TFT LCD	Plasmavision Benefits
Sizes available in mass production	Big screens! 42" to 63"	Small 12" to medium 37"	The home theater experience demands a big screen, seen from a comfortable viewing distance. Plasmavision offers large screen sizes.
Peak brightness level	Very good	Good	Plasmavision displays deliver the visual "punch" home theater enthusiasts demand.
Contrast ratio	Best	Good	Contrast is an essential measure of quality in home theater displays, and Plasmavision delivers superior results.
Color fidelity	Excellent	Limited	Plasmavision displays use a broader color spectrum, to deliver accurate color fidelity as seen on the best direct-view CRTs.
Viewing angle, full color and brightness (degrees)	160	40-70	Everyone can enjoy a Plasmavision monitor's excellent color and brightness from every part of the room.
Non-failure of individual pixels	Excellent	Individual pixels can fail over time	Plasmavision's pixels keep working – individual pixel failure after installation is extremely rare.