

LCD AND PLASMA DISPLAYS

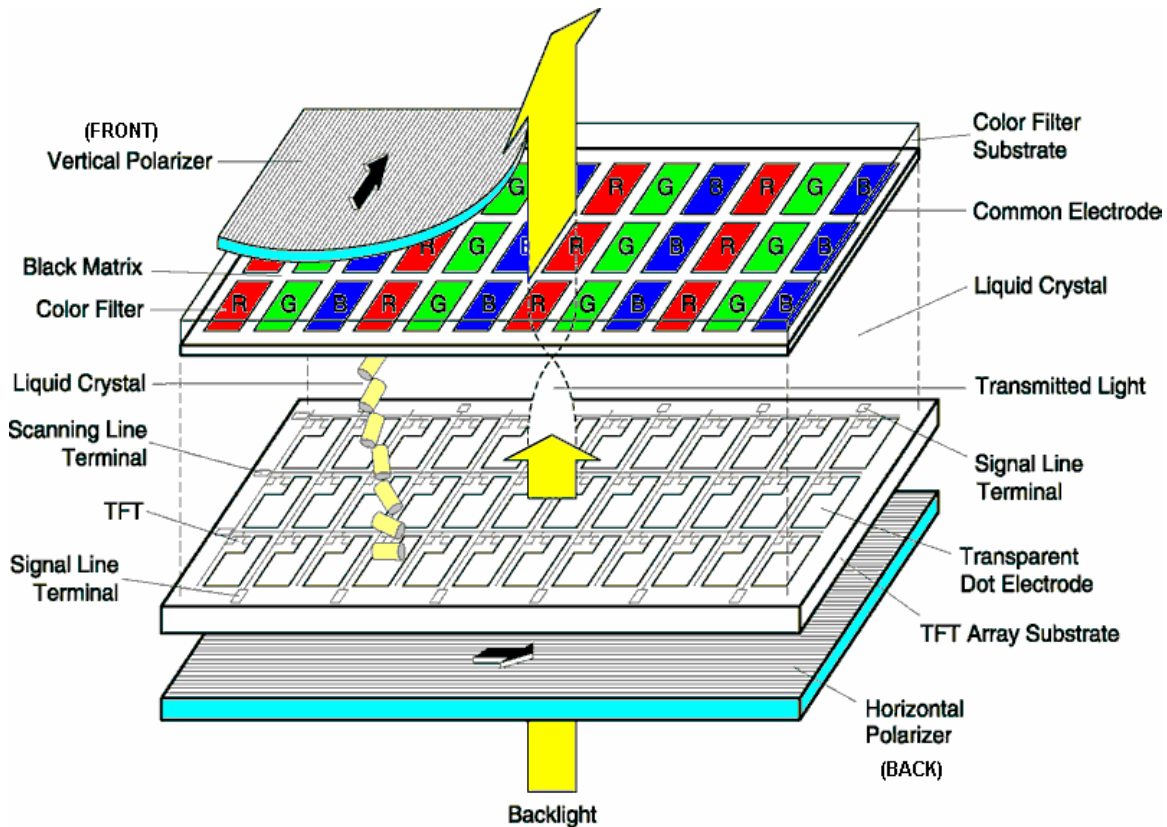
INTRODUCTION

Plasma displays have been utilized for information display applications for many years and have provided users with several benefits. However, with the growing popularity of larger-screen liquid crystal displays (LCDs) in this market, users now have a choice to make for their visual display needs. This paper will explain the many differences between the two technologies and help users make the best purchase decision to meet their needs.

IMAGE PRODUCTION

LCD and plasma displays incorporate different fixed matrix technologies that provide superior clarity and definition when used at their native resolution. How the two displays produce an image, however, is quite different. An active matrix LCD's light source is normally generated by small fluorescent bulbs (Fig. 1). The light from these bulbs is diffused to create uniform light across the back polarizer, which allows light to go in through only one direction. Individual cells are turned "on" and "off" by applying a small electric charge to the thin film transistor (TFT), located in each sub pixel. This small charge causes the liquid crystal to "twist," allowing light to be passed through the color filters and the front polarizer. If the LCD cell is not turned on, then the light doesn't pass through the front polarizer, which is perpendicular in respect to the back polarizer.

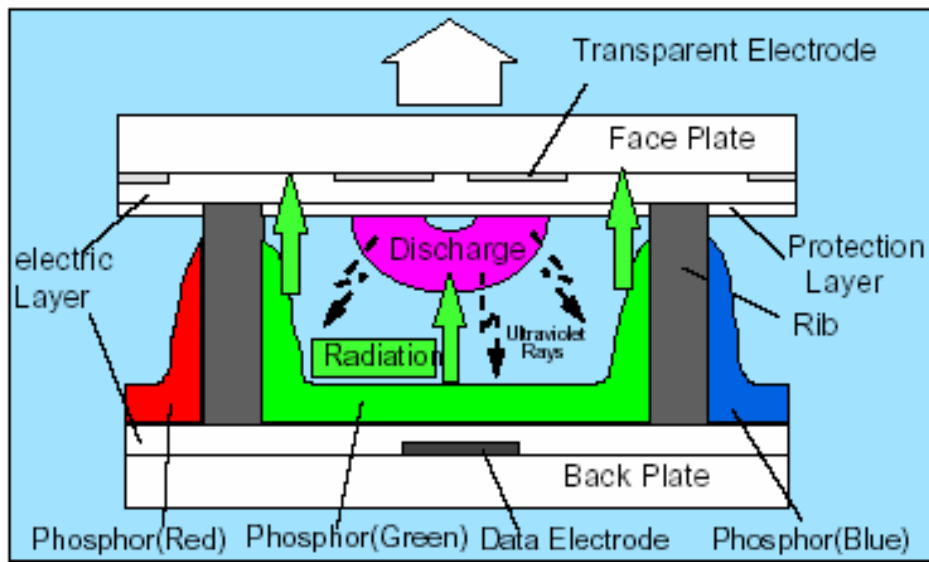
Figure 1. Active matrix LCD structure diagram.



A plasma display (Fig. 2) is composed of two parallel sheets of glass, which enclose a mixture of discharged gases composed of helium, neon or xenon. Dike-like barriers, or ribs, keep the glass plates parallel and separate. Groups of electrodes sit at right angles between the panes, forming rectangular compartments, or cells, between the glass sheets. Phosphors embedded within each cell individually emit red, green or blue light and collectively create a single color pixel when excited.

Selectively applying voltages to the electrodes causes them to generate a discharge in the panel’s dielectric layer and on its protective surface. This generates ultraviolet light that excites the phosphors, stimulating them to emit light. This principle of operation is very similar to that of a fluorescent lamp. In this sense, it is possible to think of a plasma display as a screen incorporating thousands of miniature fluorescent lights of different color.

Figure 2. Plasma display structure diagram.



BRIGHTNESS AND CONTRAST

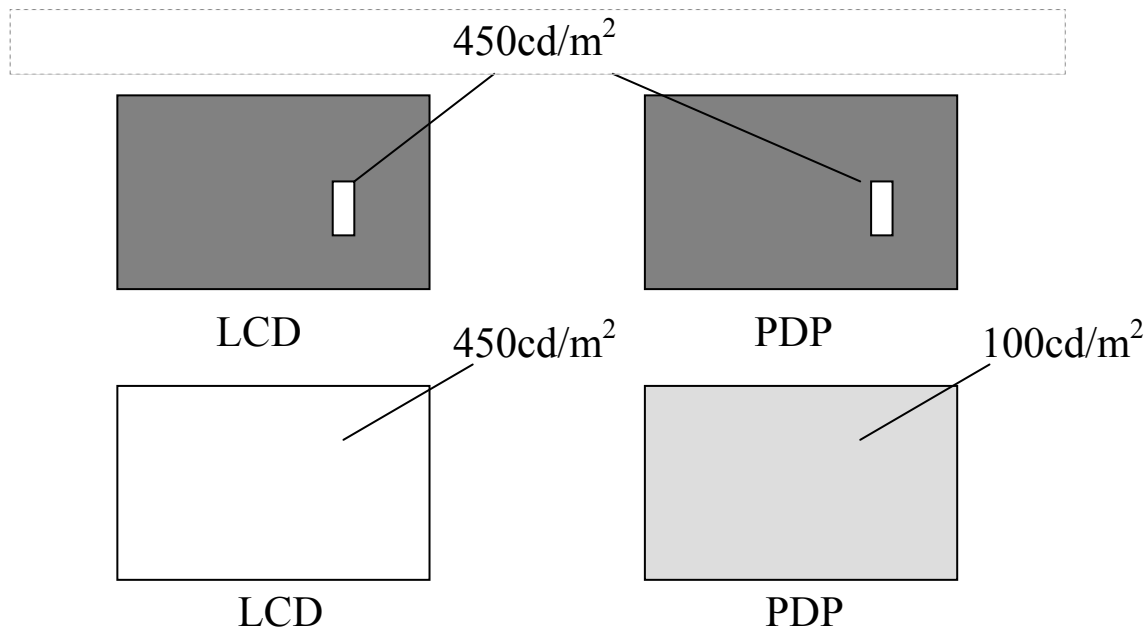
The specifications for LCD and plasma displays are measured differently for brightness and contrast. LCDs measure brightness according to the Video Electronics Standards Association (VESA) Flat Panel Display Measurements (FPDM) Standard Version 2.0 (June 1, 2001), by using a full screen white pattern. Contrast ratio according to the VESA standard is measured as the difference between full screen white and full screen black in a dark room.

Plasma display specifications are measured in the same way a cathode ray tube (CRT) would be measured. The brightness is specified by using a peak value rather than a typical value. This is done by generating a small white square on the screen, concentrating all of the display’s energy in this small area. The contrast ratio is calculated as the difference between the small white area and the black area surrounding it.

The VESA FPDM standard is more of a “real world” test since there aren’t many applications that use a small portion of the screen while leaving the rest blank. In a true comparison using the VESA FPDM standard method (Fig. 3), the results in dark room conditions would be:

	Typical 40” LCD	Typical 42” Plasma
Brightness (full screen white)	450 cd/m ²	100 cd/m ²
Contrast Ratio (full screen white to full screen black)	600:1	200:1

Figure 3. Comparison of LCD and plasma brightness measurements.



LCD displays also perform better than plasma displays under higher ambient-lit conditions (Fig. 4). An LCD display absorbs ambient light while a plasma display reflects it. The contrast of both displays is reduced under these conditions, but it is reduced to a much higher degree for the plasma.

Figure 4. Comparison of LCD (l) and plasma (r) contrast ratio measurements.

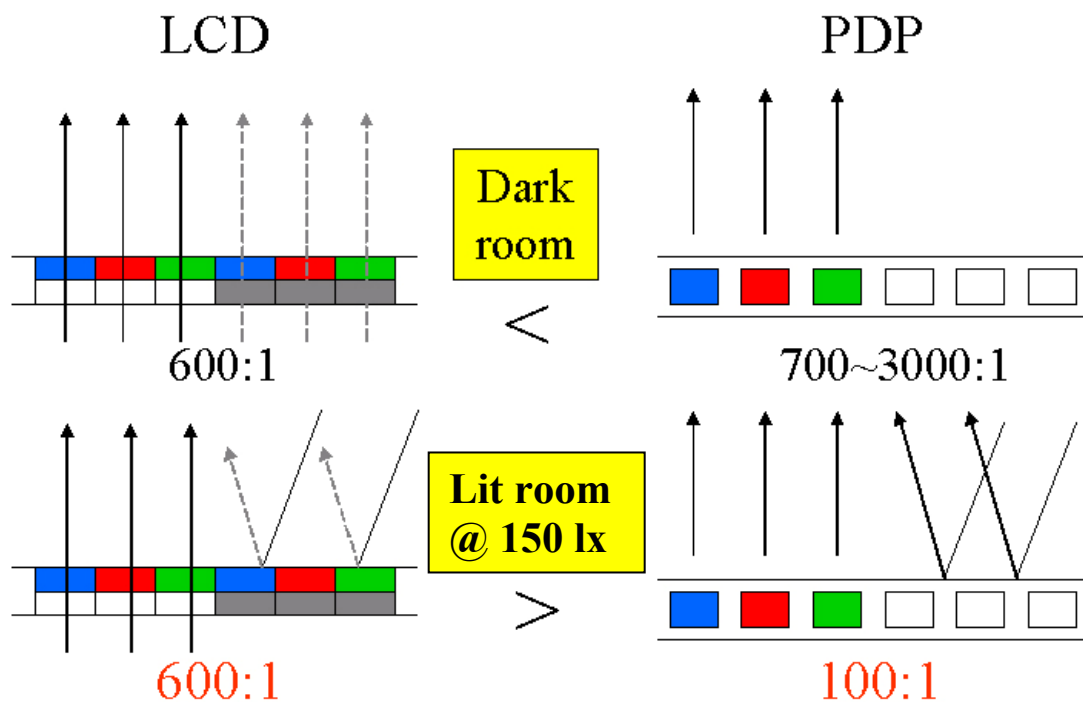


Figure 5. Comparison of LCD and plasma contrast ratios and brightnesses in certain operating environments.

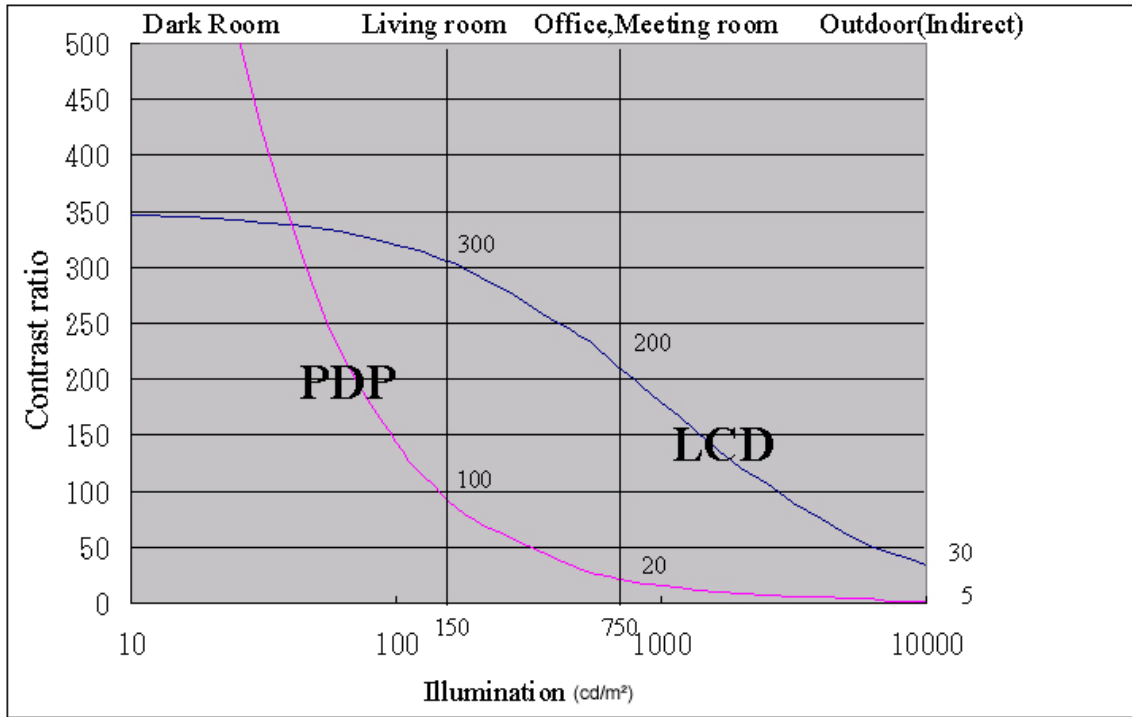


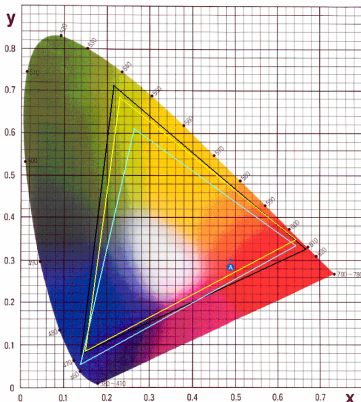
Figure 5 shows that LCD technology surpasses plasma technology in all environments except dark rooms.

COLOR REPRODUCTION

The improvement of the NTSC color spectrum (Fig. 6) has been the target for all display technologies. Currently, plasma displays have a larger color spectrum than LCD displays, but new technologies are being developed that will soon improve the color spectrum of LCDs. With new color filters and backlighting technologies, the color spectrum of an LCD will soon meet or exceed the NTSC color spectrum and thus surpass the plasma color reproduction capability.

The color spectrum of a display affects its ability to reproduce colors accurately. The color spectrum of displays varies between LCD and plasma manufacturers and is also affected by other devices (DVD player, computer video card, etc.) in the graphics system. Based on all of these factors, as well as the perception of the human eye and the application being used, it is usually left to the user to determine their preference and calibration.

Figure 6. Color spectrum for LCD (cyan), plasma (yellow) and the NTSC standard (black). As you can see, the plasma display has better green representation, while the LCD has better red and blue.



BRIGHTNESS AND COLOR UNIFORMITY

Since LCD displays use backlights that consist of many fluorescent bulbs, many precautions have to be designed into the diffusion layer to distribute light evenly. To prevent “shading” or “hot spots,” many bulbs and more than one diffusion layer are used.

The result is a uniform image in both brightness and color, which is different than the LCDs of the past and comparable to the uniformity of a plasma display.

IMAGE RETENTION AND PHOSPHOR BURN-IN

There are many concerns with both LCD and plasma displays when using a static image. LCDs can exhibit a phenomenon known as “image retention.” Image retention is caused by a pixel being in the “on” state for an extended period of time, causing a small charge to remain in the cell in the “off” state, similar to a memory effect. However, this phenomenon is not permanent. To reduce the chance of this phenomenon, many advances have been made in the liquid crystal material itself, and the display may include a “screen saver” pixel-shifting technology to further reduce the risk.

Plasma displays use phosphor and can suffer from phosphor burn-in just like CRT products that use phosphor. Although some manufacturers include pixel-shifting technologies to reduce the chance of this happening, the end result is permanent. When phosphor burn-in occurs, the phosphor material is damaged and this cannot be removed.

The amount of time required for both image retention and phosphor burn-in is almost impossible to calculate because of all the variables involved. The color of the image, the pattern, the display’s brightness setting and many other factors can affect the time before these phenomena appear.

ALTITUDE LIMITATIONS

There are some concerns with using plasma displays at high altitudes. Most plasma manufacturers have an operational altitude specification between 6500 and 9500 feet, while an LCD’s operating altitude specification is more than 13,000 feet. This allows LCD technology to be used and transported in some areas where plasma displays cannot be used because of this limitation to the technology.

POWER CONSUMPTION

The energy cost to operate an LCD or plasma display can be a determining factor in large installations (Fig. 7). The power consumption of desktop displays has always been an advantage for LCDs when compared to CRT technology. Large-screen LCDs continue to be the more cost-effective solution in regards to power consumption when compared to plasma as well. An example of the operational energy costs is given below.

Figure 7. Comparison of LCD and plasma power consumption costs. In the table below, the LCD monitor provides a 36% decrease in wattage and costs for all time lengths listed below compared to the plasma display.

	40” LCD	42” XGA Plasma
Power Consumption	235 Watts	370 Watts
Price per kilowatt	\$ 0.10	\$ 0.10
1 year (8 hrs/day, 260 days/yr)	\$ 48.88	\$ 76.96
3 years (8 hrs/day, 260 days/yr)	\$ 146.64	\$ 230.88
1 year (24hrs/day, 365 days/yr)	\$205.86	\$ 324.12
3 years (24hrs/day, 365 days/yr)	\$ 617.58	\$ 972.36

RESOLUTION

Although the viewable image size of an LCD or plasma may be identical, the native resolution can be quite different. Many of the 40” to 43” plasma displays have a native resolution of 853 x 480, and others have a native resolution of 1024 x 768. LCDs are capable of higher resolutions within the same size parameters and have a native resolution of 1280 x 768. The native resolution affects how much information can be displayed on the screen at one time (Fig 8).

Figure 8. Comparison of LCD (red) and plasma (green and blue) native resolutions. The higher resolution of LCDs allows for clearer text because of the smaller-sized pixels and allows more information to be displayed on the screen.

Providing visual display solutions to a wide variety of users for many years, NEC LCD monitors have set the standard for flat-panel technology and continue to offer new ways to enhance visual experiences. Our visual solutions provide users with a diverse range of options to help them see their digital world more clearly and support them in achieving their goals.

Building on this tradition of quality and innovation, NEC's new 30" (29.5" viewable image size) LCD3000 features the latest in advanced LCD technologies and creates a new option for those in the information display market. As one of the largest screen size LCD displays commercially available, this model carries with it all of the benefits users have come to value in NEC's smaller-sized LCD displays. These benefits now can be enjoyed in a variety of information display applications, including conference rooms, public information kiosks, retail signage, financial exchanges, airports and trade show exhibits. The LCD3000's screen performance brings ideas to life, capturing the attention and imagination of viewers and ensuring that messages reach

Sized to please. Filling the gap between flat panels designed for the desktop and those intended for larger venues, this monitor offers the information display market another option for a variety of visual display needs. It also fills the void left by larger-sized CRT monitors, which are no longer widely available.

Superior screen performance. The LCD3000 takes advantage of the many display technologies that have made LCD monitors so popular over the years and delivers them through an expansive screen featuring a wide aspect ratio. The monitor's 1280 x 768 (WXGA) resolution optimizes on-screen text, images and video with remarkable precision, allowing onlookers to clearly view presentations, charts, advertisements, pricing and other public display information. Further, these applications can be viewed simultaneously utilizing the display's picture-in-picture capability when using the defined combination of video inputs (see User's Manual).

With some screen technologies, leaving the

nently burn the image into the screen. As can be noted with phosphor-based public displays, the image would remain permanently "engraved" into the display, rendering it useless. Since this display does not use phosphors in its construction, the potential for permanent burn-in is significantly decreased, thereby contributing to optimal screen performance and a longer life for the monitor.

In applications where spectators are situated at various angles in front of the screen or where they are passing by the display, the LCD3000 provides an undistorted view of the screen. Using XtraView wide-angle viewing technology, this monitor provides flexible 170° horizontal and vertical viewing angles (85° up, down, left and right) with less glare, reflection and distortion.

With a brightness of 450 cd/m², this display stands out in the crowd, allowing onlookers to view text and graphics with ease and comfort. A 350:1 typical contrast ratio helps the monitor

ore ▶▶ 85x11 in. □ ▶▶ ▶▶

1024 x 768

1280 x 768

This white paper was published in and based on information as of March 2003. Technical information is subject to change.