Which LCD Mode is Best Suited for Digital Signage?

The display technology revolution has led to an abundance of choices from Twisted Neumatic (TN) to Super Vertical Alignment (SVA) to everything in the middle, like In-Plane Switching (IPS) and more, for the buyer. Therefore, buyers often wonder—what is the best, the most optimum, the most robust, and the most fool-proof technological choice?

Well, as with everything important in life, the answer is, “It depends!” Before attempting to debate which is the best LCD technology, it is beneficial to discuss what is the job you want to get done.

In this whitepaper, we focus on the Public Information Display (PID) segment and attempt to weigh the benefits of each technology against the needs of the user (also known as commercial displays or display signage). Why PID? Well, for one, it fulfills unique display needs, and two, it is the fastest growing industry segment. According to DisplaySearch, a global market research and consulting firm, the total public display market was estimated at $3.8 billion in 2014. By 2018, DisplaySearch expects the market to continue to grow and reach $7.6 billion.

As market leaders in the public information display segment for the last nine years, we have had the privilege of speaking with a large number of customers—and here is how they define success for a PID panel:

Outstanding performance

- The display must be clear and capture the audience’s attention
- Be able to display text, graphics and moving images
- Have a wide viewing angle

Superior adaptability

- Be adaptable in brightly lit rooms as well as under low-light conditions
- Allow flexibility of portrait and landscape mode usage

Low total cost of ownership (TCO)

- Long useful life of the product
- Extended warranty
- Low power consumption
- Quality build that combines performance with durability

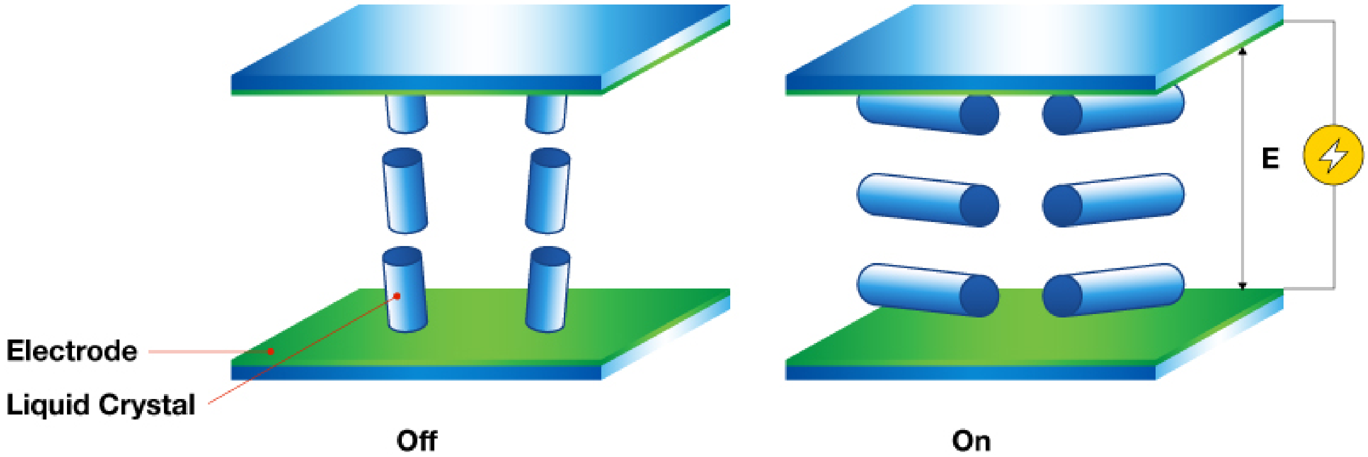
Would you like your display to have these features, too? So with this definition of success, now let's examine the various LCD operation modes. **The liquid crystal operating mode type within the panel is a crucial display panel characteristic that determines its performance and features.** To learn more about LCD technology and panel structure, read this article.

The most relevant today for the large format and commercial display purposes are VA and IPS technologies.

Vertical Alignment (VA)

In vertical alignment (VA) mode, liquid crystals naturally align in a perpendicular or vertical direction to the glass substrate, known as a **homeotropic alignment**. With no external voltage applied, the polarized light passes through the cell without any change in polarization and then is completely blocked by the second polarizer set (located at 90 degrees to the first), creating a perfectly black state. The application of an electric field the causes LC molecules to rotate to a horizontal position allowing the light to fully pass through and create a white display.

When combined with TFT advancements, anti-glare coatings, modern backlight units and pixel designs, VA LCDs yield extra-high contrast ratios and create impressive viewing experiences. As the technology evolved, response times went up substantially with reduced pixel latency eliminating display lag. Frame rates and MPRT became significantly smoother as well. VAs are more resistant to the residual image since liquid crystals operate with much wider and dispersed electrodes than those in IPS. VAs are also able to provide the most impressive contrast, which many display gurus say is their top pick when it comes to the display quality for commercial displays. For this reason, the latest cutting-edge high dynamic range (HDR) TV makers have adopted VA panels.

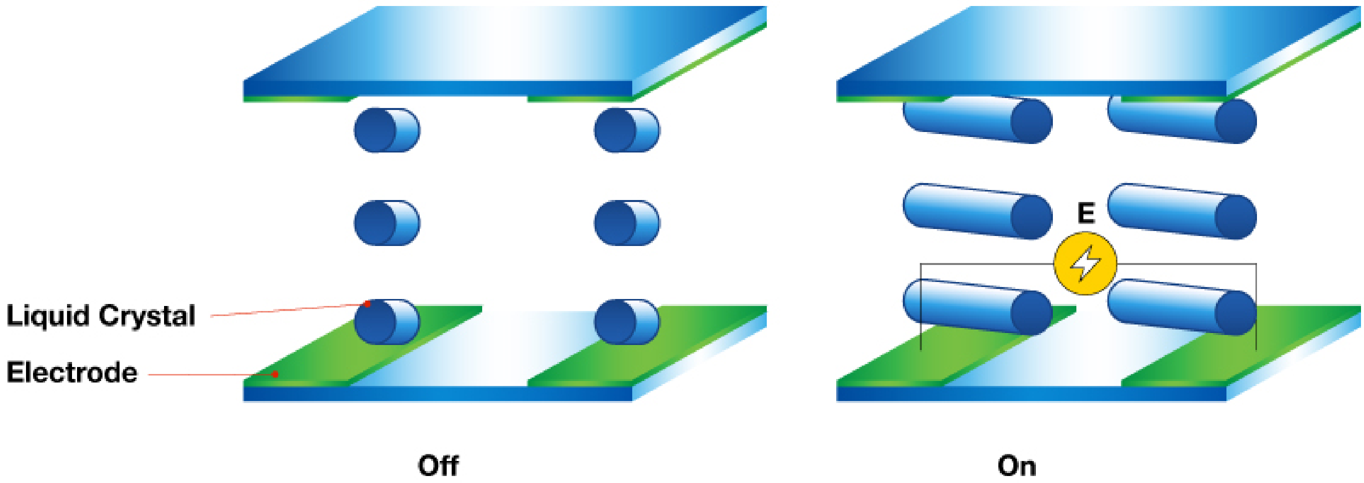


In-Plane Switching (IPS)

Originally developed to overcome some of the narrow viewing angle issues observed in twisted nematic LCDs, In-Plane Switching (IPS) mode is a technology that through changing the applied voltage arranges liquid crystals in a plane parallel to the glass substrates and allows to switch the orientation of LC molecules in the same plane. As the polarizers are located in the same plane, the switching effect is achieved by LC molecules' rotation around the axes perpendicular to their length. Contrary to VA mode, where LC molecules are exceptionally aligned to the polarization axis, LC molecules in IPS are dislocated from the polarization axis.

IPS matrices differ not only by the structure of crystals but also by the placement of electrodes located on one wafer and occupying more space, resulting in a lower contrast and brightness of the screen. Another major shortcoming of the technology was slow response times—sometimes, as slow as 60 ms G-to-G. In its new iterations, the technology was able to reduce these times but is still subpar to the response times achieved by VA panels. Often, this leads to image sticking, especially in retail environments where a stationary graphic may be displayed for the extended period of time, such as for a special offer or deal.

In addition to low contrast ratio, lower black color depth is usually common in IPS LCDs. Modern IPS technology was able to increase transmittance by about 30% compared to the original technology. While this helped boost contrast ratios, they still do not come close to the contrast of the VA panels. Finally, IPS panels are notorious for a distracting white glow from an angle while viewing dark content, referred to as an IPS glow. Also, due to the liquid crystal properties, while IPS maintains color uniformity from angular views, it does suffer from a decrease in brightness from these viewpoints.



Super-VA (SVA)

VA technology was further improved by dividing each pixel into additional domains and having them work synchronously. LC molecules in these domains are oriented at different angles, allowing one domain to pass the light while the neighboring domain will shutter it, allowing for more light diversity and subtler color tones. The more domains the technology employs, the better color performance and image quality render in oblique angles.

The first iteration of VA technology improvement had a four-domain orientation with monolithic sub-pixels divided into four separate multi-pattern domains. Another improvement came from using an anisotropic polymer network oriented in the same direction as the liquid crystal in the dark state, resulting in improved liquid crystal disclination line. With this polymer-stabilized technology, cell transmittance increased substantially, helping to improve on liquid crystal switching speeds and reducing power consumption, while increasing brightness and contrast ratio.

With the introduction of eight-domain orientation, the LC matrix in each of four domains was divided into two zones, creating eight domains for every pixel. Pixel zone's shape, position, and voltage allowed to combat the issue of gamma shift effect when viewed from the side angle.

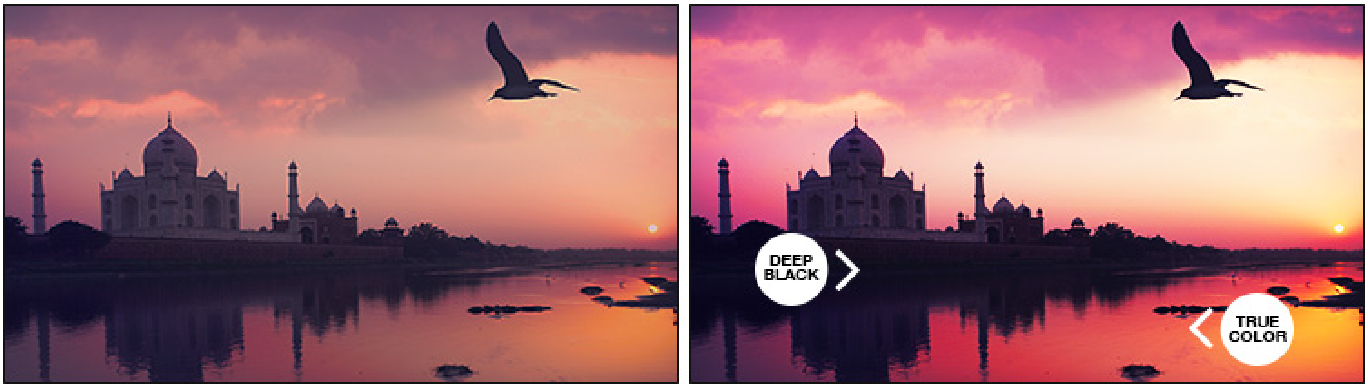
Finally, with Samsung Display's proprietary enhancements of VA technologies, known as Super-VA (SVA), domains with varying orientation of crystals further evolved to allow for maintaining the same color regardless of the viewer's line of sight or viewing angle. With shaping liquid crystal cell structure as a boomerang, further dividing each sub-pixel into two different sections that are oppositely aligned (also referred to as fish-bone structure), viewing angles are no longer an issue with VA technology. SVA is also using polymeric stabilizers, enhancing transmittance and delivering low power consumption.

To summarize, SVA technology now allows for wide viewing angles, improved cell transmittance, and higher brightness at lower equivalent power, as well as better contrast ratio and liquid crystal switching speeds. Most Samsung Display PID products are built using SVA technology. This not only improves upon the standard VA performance but also brings better power efficiency due to higher transmittance and extends the product durability. Super vertical alignment (SVA) improves with highest-in-industry contrast ratios and response times as well as viewing angles. It's particularly suited for use where the display needs to remain readable in direct sunlight, viewed clearly while mounted on a black background, or viewed from various angles.

Key Benefits of VA/SVA over IPS:

- Almost 300% better contrast than IPS panels

Low Contrast Ratio High Contrast Ratio



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- Lower power consumption than IPS panels for similar brightness
- More resistant to image sticking compared to an IPS panel

Image Sticking

No Image Sticking

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- IPS panels suffer from white glow especially in a dark room and from angular views

White Glow

No White Glow

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- 50% faster G-to-G response time ensures better moving picture presentation

Slow Response

Fast Response

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Conclusion

Both VA and IPS are common technologies for wide-view liquid crystals, with each approach differing in how the liquid crystals align with respect to the substrate with the assistance of a polymer alignment layer. Whereas the liquid crystals are aligned horizontally in an IPS-type display, the opposite is true for vertical alignment-type display. Today, VA technology far surpasses that of IPS as further variations on VA, such as SVA (Super-VA), allow for greater performance in the public information display segment.

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- Applications: The future of control room design