Comparison of LCD Display Technologies

Active Matrix (TFT) vs. Passive Matrix (STN)

Introduction

Technically there is not a comparison between TFT and STN. TFT stands for Thin Film Transistor and is a technology used on active matrix LCD panels to control the crystals. STN stands for super twisted nematics and is a type of crystal used in both active and passive matrix displays. However, most HMI control specifications will list STN as one version and TFT as another more pricy version. The confusion arises because the term STN is commonly used in place of passive matrix. This most likely happened because STN crystals were first controlled using simple passive matrix technology and the advanced TFT Active Matrix came later. Some vendors will state passive matrix along with STN but this might confuse us even more. All we really want to know is the differences when it is listed in a vendor specification so we know what we are getting that cost us more or less money. If we know the differences then we are certain we are comparing apples to apples.

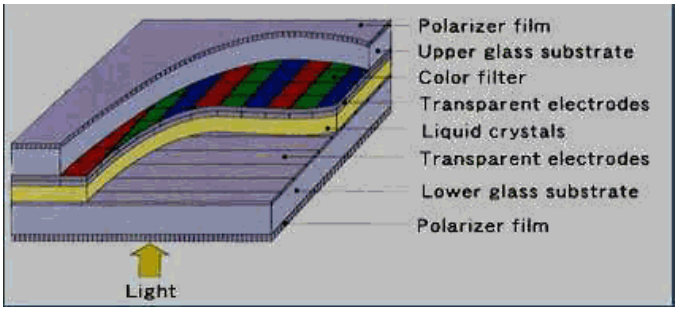
If you really want to learn about LCD technology then you can find a more detailed write up at http://www.kth.se/fakulteter/tfy/kmf/lcd/lcd~1.htm. I reference information in this document from this website and also from www.howstuffworks.com. However I do it in 2 pages while the above documents total 50 pages. It is pretty interesting reading given the breadth of LCD technology in our lives.

Types of Crystals

You may recall that LCD's are simple voltage controlled crystals that either pass light or don't pass light thus giving us a display. Of course it gets a little more complex when going from your simple calculator or watch display to the computer screen you are probably looking at Sixteen hours a day. There are several crystal types with the most common being TN and STN. TN stands for twisted nematics and STN stands for super twisted nematics. Again the name tells us a lot about what the crystals actually do. The crystal is naturally twisted and when a voltage is applied the crystal untwist. A TN will provide a 90° rotation while a STN provides a 270° rotation when the crystal untwists. The better rotation of the STN provides for a better viewing display. In simple terms TN is used for those really basic displays used on microwaves, watches, and calculators. TN is very cost effective and easy to manufacture and requires simple technologies. There are several other types of crystals that are in development or use but are not available for mass consumption. These include FLC, PDLC, ECB, and NCPT. The above link provides the details on these crystal types.

Reflective and Backlit Lighting

The crystals are sandwich between layers of glass and electronics which makes the LCD panel. The panels require a light source for viewing the displays. Calculators, watches, and microwaves all use reflective light which is supplied by the ambient light around you. Or these types of devices have a little light attached to the front that shines light on the device. Backlit means the light is placed behind the device. The light can be placed directly behind the device display or it can be placed on the top and bottom of the display. Placing the light on the top and bottom makes for easier removal and installation. A white background is placed behind the display and the light is shined unto the background providing even disbursement of the light. Fluorescent tube lighting is usually used for the light source.



Active and Passive Matrix Displays

Active and Passive Matrix is where you end up paying more or less for your LCD Display Panel and getting more or less capabilities. Passive matrix is easier to manufacture because it has less components and is a simple technology. Passive matrix uses a simple grid to supply the charge to a particular pixel on the display using a series of rows and columns. Where a row intersects with a column is where the charge is applied. This charge causes the STN or TN crystal to untwist. This is a very simple technology making it very cost effective to produce and sell but has some downsides. The passive matrix has slow response time and large voltage control deviations. The slow response times means any kind of motion on the display, such as a quick move of the mouse pointer, will be fuzzy. The voltage control deviations also mean a pixel does not hold a consistent position for very long. This will cause distortions in the picture. Advances have been made using Dual Scan Passive Matrix or Dual STN (DSTN). Dual Scan is realized by having two displays with one directly behind the other providing twice the rows and columns.

Active Matrix use thin film transistors (TFT's) to control every pixel. TFT's are tiny switching transistors and capacitors. The capacitor is able to hold the charge for a specific pixel until the next display scan while the transistors are used to switch the voltage on and off. Active Matrix displays have much faster response time and better voltage control which means better all around performance than the passive (STN) matrix display. However this comes at a slightly higher manufacturing cost. Currently, the manufacturing cost for TFT displays is being offset by the large demand and volume of TFT displays being produced for the consumer and industrial market. This makes it very cost effective for a customer to buy a TFT over a STN and get all the added benefits.

Comparisons of Active vs. Passive

Type	Passive	Active
Contrast	10-20	100+
Viewing Angle	Limited	Wide
Gray Scale	16	256
Response Time	100-200ms	<50ms
Multiplex Ratio	~480	>1000
Size	Up to 19"	<14
Manufacturability	Simple	Complex
Cost	Moderate	High

Active Matrix Graphic