

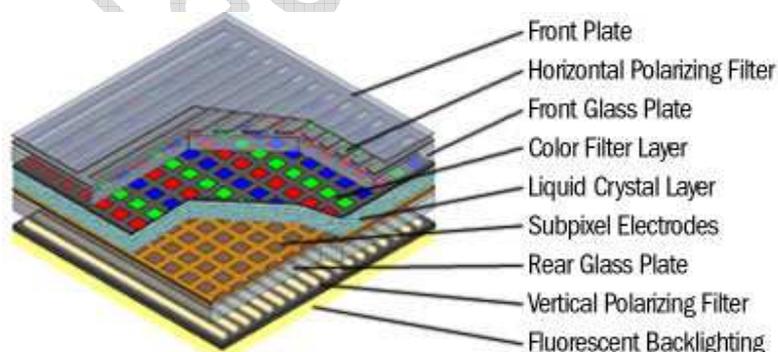
Liquid Crystal Display

An **LCD** basically consists of two glass plates with some liquid crystal material between them. The LCD has an electrically controlled light polarising liquid trapped in cells between two transparent polarising sheets. The **polarising axes** of the two sheets are aligned perpendicular to each other. Each cell in the LCD has electrical contacts that permit an electric field into the liquid present inside the **LCD cell**.

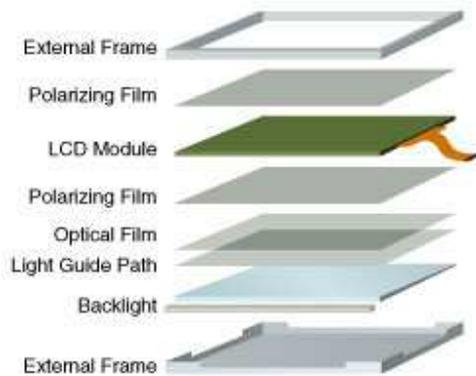
The concept of liquid crystal display was first found out by **Otto Lehmann** in 1904. In 1911, **Charles Mauguin** described structure and properties of Liquid Crystal. The first operational LCD was introduced in 1968 by **George Heilhemer**.

How it Works?

LCD display consists of an array of tiny segments known as pixels. Basically LCD is a thin display made of any number of color or **monochrome pixels** arrayed in front of the light source or reflector. Each pixel has a column of liquid crystal molecules suspended by two transparent electrodes, and two **polarizing filters**, the axes of polarity that are perpendicular to each other. In the television LCD, each individual pixel is divided into three cells or sub pixels that are colored red, green, and blue by additional filter. Each sub pixel can be controlled independently to produce thousands or millions possible colors for each pixel.



The liquid crystal makes the light to pass through the other by twisting the polarization of light entering one filter. By applying a small electric charge to transparent electrodes over each pixels or sub pixels, the molecules of the liquid crystal are twisted by electrostatic forces.



The twist of the light passing through the molecules, allows varying degrees of light to pass or not to pass through the polarizing filter. By controlling the twist of the liquid crystal in each pixel, light can be allowed to pass through in varying amount, in the same way illuminating the pixel.

Before an electric field is applied, the long, thin molecules in the liquid are in a relaxed state. Ridges in the top and bottom sheet encourage polarisation of the molecules parallel to the light polarisation direction of the sheets. Between the sheets, the polarisation of the molecules twists naturally between the two perpendicular extremes. Light is polarised by one sheet, rotated through the smooth twisting of the crystal molecules, then passes through the second sheet. The whole assembly looks nearly transparent. A slight darkening will be evident because of light losses in the original polarising sheet.

When an electric field is applied, the molecules in the liquid align themselves with the field, inhibiting rotation of the polarised light. As the light hits the polarising sheet perpendicular to the direction of polarisation, all the light is absorbed and the cell appears dark.

Types of LCD

Two common types of LCD are

1. Transmissive LCD

The Transmissive LCD is illuminated from one side and viewed from the opposite side. Activated cells appear dark and inactive cells appear bright. One disadvantage of transmissive LCD is that lamp used to illuminate the LCD consumes more power than consumed by the LCD itself.

2. Reflective LCD

This is commonly used in pocket calculators and digital watches. It is viewed by ambient light reflected in a mirror behind the display. They have lower contrast than the transmissive type, because the ambient light passes twice through the display before reaching the viewer. The advantage is that there is no lamp to consume power, so the battery life is long.

LCD TV

Television LCD is the most advance technology that uses active matrix LCD. Here a matrix of Thin-film transistors (TFT) is added to the polarizing and color filters. It is used to rapidly switch the LCD's pixels on and off. Each pixel of the LCD has its own dedicated transistor. This transistor allows each column line to access one pixel. When a row line is activated, all the column lines are connected to a row of pixels and the correct voltage is driven onto all of the column lines. The row line then is deactivated and the next row line is activated. All of the row lines are thus activated in sequence.

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