

LCD

LCD (liquid crystal display) (from Whatis) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode ([LED](#)) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube ([CRT](#)) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.

An LCD is made with either a passive matrix or an [active matrix display](#) display grid. The active matrix LCD is also known as a thin film transistor ([TFT](#)) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any [pixel](#). An active matrix has a [transistor](#) located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time (your mouse will appear to move more smoothly across the screen, for example). Active matrix is the superior technology.

Color LCD

An LCD that can show colors must have **three subpixels** with red, green and blue color filters to create each color pixel. Through the careful control and variation of the voltage applied, the intensity of each subpixel can range over **256 shades**. Combining the subpixels produces a possible palette of **16.8 million colors** (256 shades of red x 256 shades of green x 256 shades of blue), as shown below. These color displays take an enormous number of transistors. For example, a typical laptop computer supports [resolutions](#) up to 1,024x768. If we multiply 1,024 columns by 768 rows by 3 subpixels, we get 2,359,296 transistors etched onto the glass! If there is a problem with any of these transistors, it creates a "bad pixel" on the display. Most active matrix displays have a few bad pixels scattered across the screen.

LCD Features and Attributes From <http://computer.howstuffworks.com/monitor6.htm>

To evaluate the specifications of LCD monitors, here are a few more things you need to know.

Native Resolution

Unlike CRT monitors, LCD monitors display information well at only the resolution they are designed for, which is known as the native resolution. Digital displays address each individual pixel using a fixed matrix of horizontal and vertical dots. If you change the resolution settings, the LCD scales the image and the quality suffers. Native resolutions are typically:

17 inch = 1024x768

19 inch = 1280x1024

20 inch = 1600x1200

Viewing Angle

When you look at an LCD monitor from an angle, the image can look dimmer or even disappear. Colors can also be misrepresented. To compensate for this problem, LCD monitor makers have designed wider viewing angles. (Do not confuse this with a widescreen display, which means the display is physically wider.) Manufacturers give a measure of viewing angle in degrees (a greater number of degrees is better). In general, look for between 120 and 170 degrees. Because manufacturers measure viewing angles differently, the best way to evaluate it is to test the display yourself. Check the angle from the top and bottom as well as the sides, bearing in mind how you will typically use the display.

Brightness or Luminance

This is a measurement of the amount of light the LCD monitor produces. It is given in nits or one candelas per square meter (cd/m²). One nit is equal to one cd/m². Typical brightness ratings range from 250 to 350 cd/m² for monitors that perform general-purpose tasks. For displaying movies, a brighter luminance rating such as 500 cd/m² is desirable.

Contrast Ratio

The contrast ratio rates the degree of difference of an LCD monitor's ability to produce bright whites and

the dark blacks. The figure is usually expressed as a ratio, for example, 500:1. Typically, contrast ratios range from 450:1 to 600:1, and they can be rated as high as 1000:1. Ratios more than 600:1, however, provide little improvement over lower ratios.

Response Rate

The response rate indicates how fast the monitor's pixels can change colors. Faster is better because it reduces the ghosting effect when an image moves, leaving a faint trail in such applications as videos or games.

Adjustability

Unlike CRT monitors, LCD monitors have much more flexibility for positioning the screen the way you want it. LCD monitors can swivel, tilt up and down, and even rotate from landscape (with the horizontal plane longer than the vertical plane) to portrait mode (with the vertical plane longer than the horizontal plane). In addition, because they are lightweight and thin, most LCD monitors have built-in brackets for wall or arm mounting.

Besides the basic features, some LCD monitors have other conveniences such as integrated speakers, built-in [Universal Serial Bus](#) (USB) ports and anti-theft locks.

LCD Terms

* **Bezel** - This is the metal or plastic frame surrounding the display screen. On LCD displays, the bezel is typically very narrow.

* **Contrast ratio** - The difference in light intensity between white and black on an LCD display is called contrast ratio. The higher the contrast ratio, the easier it is to see details.

* **Ghosting** - An effect of slower response times that cause blurring of images on an LCD monitor, it's also known as latency. The effect is caused by voltage temporarily leaking from energized elements to neighboring, non-energized elements on the display.

* **Luminance** - Also known as brightness, it is the level of light emitted by an LCD display. Luminance is measured in nits or candelas per square meter (cd/m²). One nit is equal to one cd/m².

* **Native resolution** - This actual measurement of an LCD display, in pixels, is given in horizontal by vertical order.

* **Response time** - The speed at which the monitor's pixels can change colors is called response time. It is measured in milliseconds (ms).

* **Stuck pixels** - A pixel that is stuck either 'on' or 'off', meaning that it is always illuminated, unlit, or stuck on one color regardless of the image the LCD monitor displays can also be called a dead pixel.

* **VESA mount** - With this, you can mount a monitor on a desk or wall. It meets recommendations of the Video Electronics Standards Association (VESA).

* **Viewing angle** - It's the degree of angle at which you can view the screen from the sides (horizontal angle) and top/bottom (vertical angle) and continue to see clearly defined images and accurate colors.

Advantages:

- **Thin Profile**

LCDs feature very thin profiles, making them the perfect choice for small work spaces.

- **Standard Screen Sizes**

Unlike CRTs, there is no variance between the monitor size and the screen size. For example, a 17-inch monitor features a 17-inch viewable image.

- **Bright Screens**

LCDs, thanks to the florescent backlight, produce bright, rich images

- **Low Energy Consumption**

In general, LCD monitors consume about half of the energy of standard CRTs.

- **Flicker-Free Refresh Rates**

Refresh rate is less of an issue with LCD monitors. LCDs are designed to have flicker-free refresh rates at 60Hz.

- **High Contrast Ratios**

LCD monitors tend to feature excellent contrast ratios, which insure bright, clear images. Make sure the monitor you purchase has a contrast ratio of at least 400:1 or more.

Disadvantages:

- **Single Resolution**

LCDs are generally designed to work best in a single resolution. They tend not to have the flexibility that CRTs have to display multiple resolutions well.

- **Narrow Viewing Angles**

LCDs tend to have a very narrow viewing angle. As you vary from looking at a LCD straight-on the image gradually degrades. Look for at least a 160° viewing angle.

- **Slow Pixel Response Time**

LCDs tend to have a much slower pixel response time, which can mean image artifacts remaining onscreen after movement. For example, when you move your mouse quickly across the screen you might see the cursor create shadow images of itself briefly. These disappear instantaneously. In order to avoid this try to find a monitor that has a response time of 25 milliseconds or faster.

DVI (Digital Visual Interface):

While most LCDs usually connect via an analog VGA interface, many newer ones feature DVI as an option. The DVI interface provides a stronger, more reliable signal that can be transmitted over a farther distance.

Unfortunately, the DVI interface requires a video card that supports it, which can mean an upgrade in order to take advantage of this feature.

The three types of DVI are:

- **DVI-D**
Digital only
- **DVI-A**
Analog only
- **DVI-I**
Both Digital and Analog

HDMI (High-Definition Multimedia Interface) is a compact audio/video interface for transmitting uncompressed digital data.^[1] It represents a digital alternative to consumer analog standards. Because HDMI is electrically compatible with the signals used by [Digital Visual Interface](#) (DVI), no signal conversion is necessary, nor is there a loss of video quality when a DVI-to-HDMI adapter is used.

1080p is the shorthand name for a category of [HDTV](#) video modes. The number *1080* represents 1,080 rows of pixels, while the letter *p* stands for progressive scan or really just "Full HD" (1920x1080 pixels). Widescreen aspect ratio of 16:9, means 1920 columns of pixels. This creates a resolution of 1920x1080. That is 1920 columns by 1080 rows of pixels.

4K means approximately 4000 columns by approximately 2000 rows. If ratio is 16:9 then resolution is 3840 by 2160 or 2160p.

From book read pages 769-776.