

# INTRODUCTION TO GRAPHIC COMMUNICATIONS Section No.

# COMPUTER MONITORS 605

The following excerpt was extracted from C|NET Tech Trends. It is provided as an assistance to help clarify some of the questions some students have expressed regarding how to select this major computer component. It is provided for informational purposes only.

## TERMS YOU SHOULD KNOW

**LCD:** a liquid-crystal display is created by sandwiching an electrically reactive substance between two electrodes. LCDs can be darkened or lightened by applying and removing current. Large numbers of LCDs grouped closely together can act as pixels in a flat-panel display.

**TFT:** the prevalent technology for building the LCD screens for both desktop displays and laptops. TFT screens are brighter and more readable than dual-scan LCD screens but consume more power and are generally more expensive.

**native resolution:** the setting for LCD monitors that produces the sharpest picture. Unlike CRTs, LCDs work best at one resolution because there are a set number of pixels on the screen.

**nits:** short for candelas per square meter, a unit of measure for brightness.

**stuck/dead pixel:** a pixel on an LCD screen that is either permanently on (stuck) or permanently off (dead).

Rhoda Alexander has a healthy disrespect for monitor numbers even though she analyzes them for a living. As director of research for Stanford Resources/iSuppli, the leading display research firm, she realizes that certain monitor specs objectively describe better hardware. But there's no accounting for taste when it comes to something as personal as a screen that will sit in front of your face many hours a day. "Put the spec sheet aside," she says, "and look at the monitor."

Unfortunately, that's easier said than done. Unlike Ms. Alexander, few of us have the luxury of a controlled environment where we can compare monitors properly. In a computer store, you'll often see monitors stacked on a rack and connected to a signal splitter that degrades image quality (with the cheapest monitors on top catching the most glare). Or you'll find monitors scattered throughout the store, subjected to a variety of lighting conditions that may have dramatic effects on viewability. More to the point, many savvy buyers shop on-line exclusively, which obviously makes it impossible to look before you buy.

Fortunately, if you're a smart shopper, monitor specifications really can help you choose the right model. Just keep in mind that some specs are more useful than others, and they can vary in importance depending on the type of user you are. We've done our best to sharpen the focus in this fuzzy area, squinting at dozens of monitors and poring over the fine print of product literature to highlight the specs worth considering—and to alert you to those that mislead.

Let's start with the numbers that will help answer the first question you come to when buying a monitor: should you buy a flat, liquid-crystal display (LCD) monitor or an old-fashioned cathode ray tube (CRT) monitor?

### *Chic flat-panel vs. CRT workhorse*

LCD monitors were once the pride of professional day traders and well-heeled executives. Today, the technology has improved, and prices for small, 15-inch displays have dipped to about \$300. That low price point makes sleek flat-panels a viable alternative to standard CRT monitors, whose technology has undergone few fundamental changes since Philo Farnsworth patented television in 1930.

Not that LCD monitors can compete with tried-and-true CRT monitors on price alone. You'll find wide variance, but 15-inch LCD monitors tend to sell for about the same as 19-inch CRT monitors on average. However, money isn't everything. In order of importance, here are the top five numbers to look at when choosing between LCD and CRT:

**Dimensions.** A slim profile has traditionally been the main justification for getting an LCD monitor. A typical 17-inch CRT monitor is a 17-inch, 35-pound cube. Although the stand for a 17-inch LCD monitor might be 9 or 10 inches deep, the panel itself measures just a couple of inches thick, and the

whole assembly typically weighs less than 20 pounds. Just ask yourself what would fit better on your desk: a bulky microwave oven or a butcher-block cutting board standing on edge, and you'll start to see the allure of the LCD.

**Refresh rate.** Measured in hertz (Hz), low refresh rates on a CRT result in annoying flicker. You won't find a refresh rate specified for LCDs, mainly because flicker isn't an issue. (Flicker is caused by the scanning pattern of a CRT's electron gun, which LCDs don't have—the pixels are either on or off.) While almost all modern CRTs run at 75Hz or higher at any resolution you're likely to use—too fast for flicker to be noticeable—LCDs are simply easier on the eyes than CRTs.

**Colors.** With LCD monitors, there's a hard limit on colors, typically 16.7 million (also known as 24-bit color). CRTs have no such limit, which in itself is no big deal since few applications go beyond 24-bit color. The real difference is in color accuracy, a quality not reflected in manufacturer specs. CRT monitors far outperform LCD monitors when it comes to color. A graphic designer, for example, wouldn't touch an LCD monitor. Colors on any kind of monitor are created by varying the intensity of red, green, and blue dots in the millions of triads that make up an image. CRTs control color by varying the intensity of the electron beam as it strikes each color dot. To vary the transmission of light through color filters, LCDs use magnetic fields to twist particles floating in a liquid—an inherently less precise process.

**Response time.** LCDs are slower than CRTs. Typically, it takes 20-50 milliseconds (ms) for an LCD pixel to respond, while it takes a CRT 8-12ms. The difference shows up in DVD movies, where fast-moving objects—particularly dark objects across a light background—may leave a slight trail of ghost images on an LCD. If you plan to do a lot of movie viewing or video editing, get a CRT monitor.

**Power consumption.** LCD panels draw less than half the power a CRT does.

Behind monitor numbers, there are always intangibles. For example, though the contrast and brightness of LCDs now approach those of CRTs, the latter generally handle environments with excessive ambient light better. On the other hand, many people feel that text looks sharper on LCDs than on CRTs—one reason 17-inch LCDs are typically run at a crisp 1,280x1,024 resolution and 17-inch CRTs at a more pedestrian 1,024x768. And the coolness factor? LCDs win, hands down. They're sleek, lightweight, and so stylish they've almost completely displaced CRTs from executive desktops.

### ***Reading between the lines on CRTs***

CRT monitors suffer more than their share of misleading specifications. The good news is that if you're not picky, virtually any monitor on the market today will provide a stable, acceptable image for most applications. But if you're hard to please, beware, because it's easy to get obsessive over tiny differences in image quality.

Before we do the numbers, let's consider more important stuff, such as the choice of CRT type. The Sony Trinitron CRT (Mitsubishi licenses this technology under the Diamondtron brand) uses a fundamentally different technology—an aperture grille—and costs a little more than most other CRTs. Colors, particularly reds, tend to be slightly richer and the screen a bit brighter, but tiny text may be a little less crisp. On the other hand, the two hairlines that are visible near the top and bottom of the screen can be distracting to sensitive eyes. For this basic decision—Trinitron or not?—

Schlep down to the computer store and look for yourself. If the two horizontal lines drive you crazy, then you will want to look for a shadow mask CRT.

Another crucial nonnumerical issue: the shape of the screen. You might consider paying extra for a so-called flat-flat or true-flat CRT. A flat screen drastically cuts glare, the enemy of comfortable viewing. “Flat-square” CRTs actually have a slight curvature—but they’re often brighter and slightly sharper around the edges of the screen than perfectly flat screens. Again, let your eyes be the judge.

Now, the numbers. Remember the old cliché, “Lies, damn lies, and statistics”? Keep it in mind as you ponder the monitor specs salespeople throw at you:

**Resolution.** Higher resolution means sharper images, right? True, but at maximum resolution, most CRT monitors shrink Windows text, buttons, and bars to the point where they’re too small to view or click comfortably, and the refresh rate may slip to the point where flicker becomes irritating. This table shows the optimum resolutions for three popular monitor sizes. Any monitor worth considering should be able to produce these resolutions at a refresh rate of 75Hz or higher, which these days includes nearly every monitor sold. So, for most of us, more is just wasted capacity and expense. The exception: CAD/CAE users and graphic artists who need exceptionally crisp, fine lines.

**Dot pitch.** DisplayMate Technologies, which develops the leading monitor-testing software, refers to dot-pitch promotion as “the great dot-pitch swindle.” Dot pitch, measured in fractions of a millimeter—typically from 0.20 to 0.28mm—most commonly refers to the distance between any two dots of the same color (triads of red, green, and blue phosphor dots make up the pixels that form a CRT image). Theoretically, smaller dot pitches

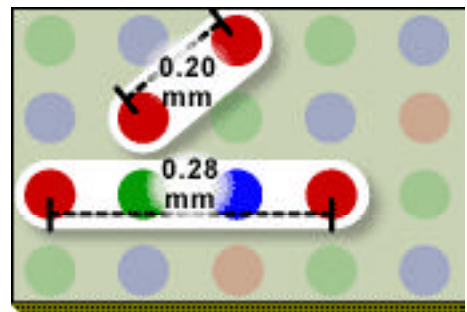


Size	Native resolution
17"	1024x768
19"	1280x1024
21"	1600x1200

Popular CRT monitor sizes.

mean crisper images. But vagaries in how manufacturers measure dot pitch mean you can't rely on this number for CRT comparisons. The rule of thumb: Avoid 17-inch monitors coarser than 0.28mm and 19-inch monitors coarser than 0.26mm. Also, graphics pros should consider a CRT with a 0.20mm or 0.22mm dot pitch, because this indicates a CRT that uses Enhanced Dot Pitch technology, which produces exceptionally clean vertical lines.

**Viewable screen area.** The viewable area of CRT monitors measures slightly smaller than the advertised diagonal CRT size; a 19-inch CRT, for example, generally gives you an 18-inch screen area (because the measurement includes the plastic casing around the outside of the screen, called a bezel, or frame). But picky buyers should check this number carefully; some monitors vary by as much as an inch and a half.



Dot pitch measurement isn't precise and is often measured in different ways.

**Horizontal scanning frequency.** This key number, measured in Kilohertz

(KHz), indicates how high you can push the refresh rate at any resolution. Some people are highly sensitive to flicker, so watch the horizontal scanning frequency if you crave a rock-solid image; an 85Hz refresh rate should be enough for anyone. Here are the horizontal scan rates necessary to achieve 85Hz at the following resolutions:

In rare cases, a monitor won't run at an 85Hz refresh rate even if the horizontal scanning frequency is high enough to support it. The moral: if you care about higher-than-normal refresh rates, double-check the specs to make sure that the manufacturer explicitly supports the refresh rate you want at the resolution you'll be using. And the vertical scan frequency that's always listed next to the horizontal scan frequency range? That's just another way of saying refresh rate.

Warranty. Anything less than three years is suspect. Three is the norm; some manufacturers offer up to five years. The warranty should cover parts for the entire period and labor for at least the first year. Also, look for a 30-day money-back guarantee (with no restocking charge) to cover the off chance that you'll get caught with a lemon.

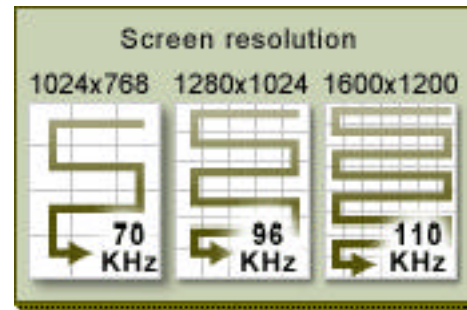
**The Lowdown on LCD monitors**

The bottom line with LCD monitors is that few of us can afford anything larger than a 15-inch model, which at this writing typically costs between \$300 and \$500. Opt for a 17-inch model, and the price doubles, while an 18-incher easily triples the price. Cost of manufacture remains fairly high across the board, but, according to Stanford Resources, because of excess inventory, many manufacturers are actually selling 15-inch LCDs at a loss.

Compare these prices to CRT prices, and you'll see why so many desks still are giving up lots of real estate to clunky CRTs. Remember, however, that LCD dimensions measure the viewable area (diagonally), while CRT dimensions include the bezel.

All is not always what it seems in LCD land. For example, you'll see LCDs driven by a digital signal advertised as superior to those fueled by an analog signal. But the gap has closed dramatically, to the point where you have to look very closely to tell the difference. To run a panel in digital mode, you need a special graphics card with a digital video interface (DVI) port and a special cable, so most people don't bother. According to Stanford Resources, about 64 percent of LCD monitors accept analog input only, 29 percent support analog and digital, and 7 percent take digital only.

Expect more variation in price and image quality among LCDs than among CRTs; LCD technology is newer than the trusty cathode-ray tube and is still evolving. You're even more strongly advised to have a look before



To maintain a flicker-free 85 Hz refresh requires increasingly faster horizontal scans as resolution increases.

Size	CRT	LCD
15"	\$100-\$200	\$300-\$500
17"	\$150-\$300	\$550-\$900
18-19"	\$250-\$500	\$900-\$1,500

LCD monitors are more expensive than their CRT counterparts.

you buy. Again, the specs tell you only so much. If you choose an LCD that claims high-end numbers for all of the following parameters, you'll very likely get a better view, but you'll probably pay a lot more.

**Resolution.** Due to superior LCD sharpness, smaller screens look better at higher resolutions than CRTs can comfortably display. In the LCD world, the optimum resolution is termed the native resolution, which correctly implies that any other resolution may not be a smart idea. Here are the native resolutions for the three most common LCD monitor sizes:

Why do 17- and 18-inch monitors share the same native resolution? Mainly because some people find text at 1,280x1,024 a little small on a 17-inch LCD—and 18 inches isn't large enough for 1,600x1,200 resolution.

Because you can't count on a crisp image at any resolution besides the native one, make sure a panel's native resolution pleases you. In inexpensive, 15-inch models, the scaler chip, which maps the screen to alternate resolutions, may be particularly weak and yield blurry images at anything but native resolution.

**Luminance.** The luminance (or brightness) of LCD panels is measured in candelas per square meter (cd/m<sup>2</sup>, otherwise charmingly known as nits). This is not an easy number to find, but it's worth digging up on a manufacturer's Web site since more nits generally mean a more pleasing image, particularly in harsh lighting conditions. The range stretches from around 170 nits for a cheap panel to around 300 nits for the best—equal to a bright CRT.

**Pixel response rate.** This is another buried yet telling spec. It refers to the amount of time it takes for a pixel to turn on or off. (See illustration on the next page). If you're serious about watching or editing movies on your LCD, you might even want to call the manufacturer and get the number, or numbers, since the manufacturer may give you a rise time and a fall time. Movie mavens should look for a rise time of 10-20ms, while the fall time should be no more than 35-40ms.

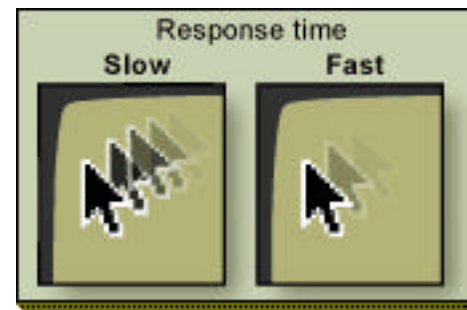
**Contrast ratio.** If manufacturers used consistent methods to measure this spec, it might be a good indicator of image quality. Manufacturer-claimed contrast ratios, which describe the difference between the darkest and the lightest areas of a test screen, range from 200:1 to 500:1. But when you add a little ambient light to the equation, contrast decays dramatically. Better screen coatings can help stave off this decline, however, which is the main reason this spec is largely irrelevant.

**Viewing angle.** This is actually two numbers: the horizontal viewing angle and the vertical viewing angle. You don't need to worry much about this spec unless you plan to use your LCD for desktop presentations, in which case, you should insist on viewing angles of at least 120 degrees horizontal



Size	Native resolution
15"	1024x768
17"	1280x1024
18"	1280x1024

Common LCD monitor sizes.

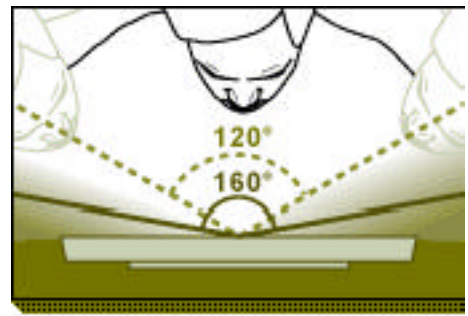


Slow pixel response rates results in ghosting of fast-moving images.

and 100 degrees vertical. About the widest you'll find on an LCD is 160 degrees for both horizontal and vertical viewing angles—a number many LCDs claim these days.

**Warranty.** Two points: First, as soon as you take your LCD monitor out of the box, load a blank white page and check the screen carefully for stuck pixels (tiny spots that stay black, white, or some fixed color no matter how the image changes). Try the test again

with a black screen and look for pixels that stay lit, although dead or black pixels are the most frequent problem. You can probably live with one or two stuck pixels, but a cluster of them is unacceptable—and some retailers' money-back guarantees last for a week rather the usual 30 days. Second, although the usual LCD monitor warranty lasts three years, make sure that it also covers the backlight, because backlights have a relatively high failure rate.



The wider the viewing area, the more people can see from different angles.