



Technofile: monitors

You stare at the screen for hours on end, but most PC users tend to overlook this most important component. David Fearon explains the technology behind the two choices – the trusted but cumbersome CRT and the slender but pricey flat-panel display. Plus, we discuss what size screen best suits your needs and budget

These days, even budget PC specifications are pretty impressive. But spare a thought for your monitor. Things have moved forward enormously from the days when a 14in screen was bundled with all but the most high-end PCs. A 17in monitor is now the norm, but when a manufacturer is producing PCs to a price point, the display is still the first component to suffer. Unfortunately, these vendors choose to ignore that the monitor is the most important part of your PC – providing visual access to the information on your system. Indeed, every second you spend at your PC, you're staring at the monitor.

Investing in a better display is the most important upgrade you can make to your system, but the choice can be bewildering. There's the traditional CRT (cathode ray tube) monitor, which ranges in size from 17in to 22in. Or you can opt for a slimline LCD (liquid crystal display) flat-panel, with screen sizes reaching 18in and even 19in, but for a price.

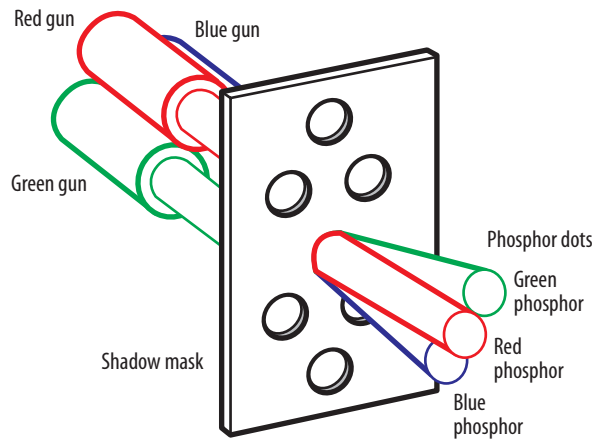
To help you choose the best screen for your needs, we are going to look at the main differences between the two display types and, once you have opted for a CRT or flat-panel monitor, we'll explore the variations available.

CRT variants

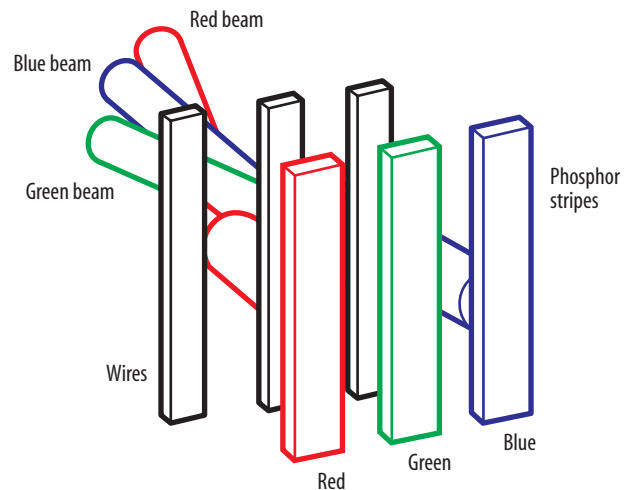
The picture on the left shows a shadow mask, where electron beams are directed on to the screen via a thin sheet of metal perforated with thousands of holes. The image on the right illustrates aperture grille technology – here fine strips of metal

are used to guide the beams on to the screen. Each method has its fans and detractors; shadow mask offers a less bright image, but in the latter method two thin horizontal wires, which hold the metal strips in place, are often faintly visible.

Shadow mask CRT



Aperture grille CRT



CRT technology

CRT displays work on the same principle as a television. Electrons are fired through a glass vacuum tube on to a screen, where they stimulate dots or stripes of red, green and blue phosphor to create the image.

- **Shadow mask** There are several tube types, the oldest being shadow mask (see diagram above left). This refers to a metal sheet (the mask) with thousands of fine holes in it, through which the electron beams pass just before reaching the screen. The mask blocks stray electrons, increasing image sharpness. However, it also blocks a significant percentage of the energy in the electron beam, taking away some of the image's brightness.

- **Aperture grille** To avoid the problems of shadow mask Sony, and later Mitsubishi, developed the aperture grille (see diagram above). In this design, the stray electrons are filtered out by very fine vertical wires, which preserve the image's brightness but don't remove as much of the beam's energy. This means aperture grille screens produce brighter images with a darker-tinted screen, which affords higher contrast.

- **Dot pitch** There are plenty of factors other than screen type that determine the quality of a screen. One of these is dot pitch – a measure of the distance between two adjacent dots or stripes of phosphor of the same colour. The smaller the pitch the finer the detail the monitor reproduces. Dot pitch can be a general quality indicator – you shouldn't consider one with a figure above 0.26mm – but it's not an absolute measure of quality.

- **Maximum resolution** Related to dot pitch is the maximum resolution – in other words, the number of pixels the monitor can display at once. The more pixels, the more information you can display on screen. The usual Windows desktop resolution for 17in monitors is 1,024 pixels horizontally by 768 vertically. Higher-quality monitors are

capable of increasing that to 1,280x1,024, 1,600x1,200 or even higher. But as pixel resolution increases, the apparent size of graphics and text decreases, so only the larger monitors are practical for displaying high resolutions.

- **Refresh rate** With CRTs, the concept of refresh rate is vital. Because the phosphor glows for just a fraction of a second, the monitor's electron beams must constantly redraw the image. The refresh rate is the number of times per second the monitor can do this. It's important because below a certain rate the display will appear to flicker, leading to headaches and fatigue. You need a minimum refresh rate of 75Hz (75 redraws per second) to avoid visible flicker, but most modern monitors push this up to 85Hz and more.

Flat-panel displays

LCDs, or flat-panels, work on a different principle to CRTs. Bright white fluorescent tubes provide backlighting, and transistor-driven liquid crystal elements filter and block the light to produce an image.

- **Native resolution** Unlike CRT monitors, a flat-panel can only effectively display one particular screen resolution, known as the native resolution. You can view images at resolutions lower than this, via some



← When choosing a CRT monitor make sure you look for higher maximum resolutions and refresh rates, and lower dot pitch values

clever circuitry, but it's impossible to go above it. This limitation is also the source of a panel's major advantage – the position of each pixel is fixed, so you get an absolutely sharp image at native resolution, with none of the variability or picture distortions that can affect CRTs. A flat-panel display will also never flicker, because the light is provided by constant fluorescent tubes rather than fast-fading phosphor.

- **Screen size** A flat-panel's screen size is measured differently from a CRT's. As the whole area of the screen is used, a panel of a given size will have a viewable area equivalent to a CRT with a rated size an inch or two larger. So, for example, a 15in panel gives about the same screen size as a 17in CRT, a 17in panel is roughly equivalent to a 19in CRT and so on.



← Flat-panels offer a more dependable image, avoiding the possible distortions common with CRT monitors and removing flicker from the equation

- **DVI connector**
A final point to consider is that to get the best out of an LCD display you should use a digital











connection between the panel and the PC. To do this, you need a DVI connector on both your graphics card and flat-panel display. This allows the entire path of the image to remain digital, rather than the more traditional method of translating images from analogue to digital.

Making your mind up: beginner

At a low price point, the choice is likely to be between a 17in CRT monitor or, for those pressed for desk space, one of the smaller flat-panel displays. Once you have decided to upgrade your screen there are some extras to look for that might make it that bit more attractive.

- **USB hub** If you are finding yourself short of USB ports, upgrading to a better-quality CRT monitor with an integrated USB hub is a good idea. CTX's PR711F would fit the bill here, combining the good picture quality of the FD Trinitron flat-screen tube with the convenience of a four-port hub.
- **DVD viewing** A common complaint with budget monitors comes when watching DVD movies. The sharp, slightly muted image that monitors are designed to produce doesn't sit very well with the demands of movie watching. The upshot? A picture that seems dull compared to your TV. The new Diamondtron M2 tube has a special high-brightness mode to compensate. The M2 currently features in Iiyama, Mitsubishi and NEC models – the best of these is Iiyama's Vision Master Pro 413, which grabbed the Best Buy award in last month's monitor round-up (see chart below).

Features comparison

	Product	Telephone	Website	Price ex VAT	Warranty	Viewable area	Dimensions	Weight	Max resolution @ refresh rate	Environmental compliance	High brightness mode	Tube type	Dot/pixel pitch	DVI input	USB hub
	CRT MONITORS														
	CTX PR711F	01923 810 800	www.ctxeurope.com	£218	3-year onsite	16in	412x415x425mm	17.6kg	1,600x1,200@77Hz	TCO 99	N	FD Trinitron	0.24mm	N/A	Y
	Iiyama Vision Master Pro 413	01438 745 482	www.iiyama.co.uk	£185	3-year onsite	16in	408x430x420mm	16.5kg	1,600x1,200@75Hz	TCO 99	Y	Diamondtron M2	0.25mm	N/A	N
	CTX PR960F	01923 810 800	www.ctxeurope.com	£285	3-year onsite	18in	460x469x485mm	26kg	1,600x1,200@87Hz	TCO 99	N	FD Trinitron	0.24mm	N/A	Y
	CTX PR1400F	01923 810 800	www.ctxeurope.com	£599	3-year onsite	19.8in	514x528x515mm	38kg	2,048x1,536@77Hz	TCO 99	N	FD Trinitron	0.24mm	N/A	Y
	Iiyama Vision Master Pro 512	01438 745 482	www.iiyama.co.uk	£545	3-year onsite	20in	493x485x500mm	29.5kg	2,048x1,536@85Hz	TCO 99	N	Diamondtron NF	0.24mm	N/A	Y
	FLAT-PANEL DISPLAYS														
	LG RE-15LA30	01753 500 470	www.lge.co.uk	£605	1-year return to base	15.1in	394x413x194mm	7.9kg	1,024x768	TCO 99	N/A	TFT LCD	0.30mm	N	N
	LG Flatron LCD 782LE	01753 500 470	www.lge.co.uk	£502	1-year return to base	17in	399x235x427mm	7.3kg	1,280x1,024@N/A	TCO 99	N/A	TFT LCD	0.26mm	Y	Y
	LG Flatron L1800P	01753 500 470	www.lge.co.uk	£806	1-year return to base	18.1in	397x237x428mm	8.5kg	1,280x1,024@N/A	TCO 99	N/A	TFT LCD	0.28mm	Y	Y
	Eizo FlexScan L685	01483 719 500	www.eizo.co.uk	£989	3-year onsite	18.1in	399x404x203mm	8kg	1,280x1,024@N/A	TCO 99	N/A	TFT LCD	0.28mm	Y	Y
	Philips Business 201B	020 8689 2166	www.philips.co.uk	£469	3-year onsite	20in	480x470x440mm	24kg	1,800x1,350@75Hz	TCO 99	N	TFT LCD	0.25mm	N/A	optional

Ergonomic issues

The theory of monitor ergonomics, in particular the advice on the best screen position, has changed over the years. Once upon a time it was advised that the monitor should be positioned with the centre of the screen at eye height. These days, though, the advice is that you should have the top of the screen at roughly the same height as your eyes, so you're looking slightly downwards at your work. The idea behind this is that in everyday life you're usually focusing on something in the distance when your line of sight is horizontal, thus having a completely level head when you're looking at a monitor two feet away is

unnatural. It all adds up to a little less mental fatigue and a slighter chance of a throbbing head come half past five.

For monitors to have passed TCO 99 (see *Monitor standards* on page 84) they must have an effective antireflection coating, but you should still position the screen so there are as few noticeable reflections as possible. If the monitor is near a window then arrange things so the screen is neither directly facing nor directly in front of it. The best ergonomic advice we can offer, however, is to make sure you take a few minute's break from the screen every hour or two.

- **Flat-panel entertainment** With the prices of flat-panel displays falling steadily, upgrading to an LCD is becoming a more realistic option. Another enticement is the restyling of the PC as a home entertainment device, exemplified by LG's latest offering, the RE-15LA30. For £605 you get not only a 15.1in flat-panel, but a remote-control colour TV too (the unit has a built-in TV tuner). It's alluringly finished in silver, and could be just the ticket if you're looking to bring the PC into the living room. There's no DVI input, though.

Making your mind up: enthusiast

Unlike the beginner, experienced users will usually have developed a more discerning eye for quality. There's a definite choice to be made here between CRTs and LCDs, aside from the cost and desk space issues.

- **Working with words** If you read large amounts of text onscreen and use office applications regularly, an LCD panel is the best choice, as its super-sharp rendition of text and absence of flicker makes it easy on the eye. Our Best Buy flat-panel (see

the chart on page 142), LG's LCD 782LE, would be ideal, with its 17in screen, 1,280x1,204 resolution and excellent price.

- **Gunning for graphics** For graphics and digital photography users, the smooth, vivid photo reproduction of a good CRT display still has the edge over the clinical sharpness of a flat-panel. We recommend CTX's PR960F, which came top of our 19in Monitor chart (see page 142), particularly if you enjoy digital photography. The CTX's FD Trinitron tube has slightly superior contrast than Mitsubishi's Diamondtron NF. This is important for getting the correct tonal range in photos.

- **Bigger is better** Digital photographers usually work with toolbar-heavy packages like Photoshop. If you find your 17in monitor a bit cramped, it's time for a bigger screen that will let you run more appropriate resolutions. While the highest resolution that most people are comfortable with on a 17in CRT is 1,024x768, a 19in screen is big enough to take 1,280x1,024.
- **Tweaking the settings** Larger monitors also offer more control – for example, the facility for adjusting horizontal and vertical colour convergence (the relative alignment of the red, green and blue electron beams). If convergence isn't correct, apparent sharpness is reduced and fine detail lost.

Geometry control is important if the shape of the image is distorted, but if that's the case the monitor's probably faulty. With most decent 19in monitors all that should be required is a little pincushion adjustment – moving the image edges in and out. Fine adjustments, such as corner controls, shouldn't be needed unless you're doing CAD (computer-aided design) or similar tasks.

Moiré correction is also a source of confusion. A CRT that occasionally exhibits moiré – an oil-film effect on the display –

Monitor standards

- **EnergyStar** The American environmental standard covers the reduction of power consumption and as such is about protecting the planet rather than the user. EnergyStar has been around for years and covers only basic limits on maximum power consumption, dictating that equipment should be able to go into low-power sleep modes when idle to save energy. Any monitor that complies to TCO 95 or TCO 99 standards will also cover all the EnergyStar bases.
- **ISO 13406-2** The most up-to-date ergonomic standard, developed specifically for flat-panel displays, defines the maximum number of dead or inactive pixels a TFT (thin-film transistor) display can have. Previously, manufacturers could wriggle out of responsibility by saying that 'some' inactive pixels were inevitable. Thanks to this standard, if they exceed the numbers specified, you have a comeback. It also covers viewing angle, which isn't such a big problem now as it used to be.
- **MPRII** The original Swedish CRT (cathode ray tube) monitor safety standard, covering EMI (electromagnetic interference) emissions. It was introduced in the 1980s in response to fears that there may be health implications connected to the low frequency electromagnetic waves produced by CRTs, particularly for pregnant women. An MPRII-compliant monitor is generally considered free from the vast majority of EMI emissions.
- **TCO 99** The TCO standard was originally a more rigorous version of MPRII that specified emissions controls, but was later extended to cover more general ergonomic and environmental issues – for instance, screen reflections, user controls and power consumption. TCO 99 has become the de facto standard for manufacturers to live up to, and any monitor that bears it is likely to be a good one.
- **VESA DPMS** The Video Electronic Standards Association display power management signalling standard makes sure that the monitor will understand the special power management signals that Windows sends to it. For example, you can set the power management applet to switch the monitor off after 10 minutes.

isn't defective. In fact, the sharper the monitor, the more likely moiré will be – it's an unavoidable fact of physics. A moiré reduction control works by making the picture slightly fuzzier so, whenever possible, leave it switched off.

Making your mind up: professional

There are two reasons why you might want to ignore the large 19in CRTs and 17in flat-panel displays and head straight to the world of 21in CRTs and 18in LCDs. You're either a computing professional or you need a big display to use in a business environment for presentation work.

• **Computing professional** For a professional user, a 21in CRT is not the place to start trying to save money. If your budget is a consideration, it's far better to go for a decent 19in screen than plumping for a cheap 21in device. Unlike smaller screens, there are still some cheaper shadow mask-based 21in displays around – for instance, Philips' 201B. Some manufacturers claim that shadow mask displays give better colour reproduction,

but that's not really an argument that stands up any more, particularly with the introduction of sRGB (see below).

If you're a serious user who depends on your monitor for a living, high resolution will probably be the attribute that you crave most, which is where CRTs still have a big lead over LCDs. You can run a good 21in CRT at 1,600x1,200 for stacks of screen space, and with the better models you can get up to 1,800x1,440 or higher – and they still cost less than an 18in flat-panel. Our top choice in this category would be Iiyama's Vision Master Pro 512, although CTX's PR1400F is also a fine unit.

A perennial problem for graphics professionals is colour matching – that is, making sure the onscreen image matches the final output from the printer or repro house. Colour matching is a complicated subject, but it's helped by the sRGB standard, to which digital camera and monitor manufacturers are starting to adhere. The tubes in CTX, Iiyama and Mitsubishi screens are all sRGB profile compliant, but this doesn't help with



↑ For a slick, up-to-the-minute profile in the office or meeting room, nothing can beat the slimline frame of the latest flat-panel monitor

printed output – for that you still need a calibration system from a company such as ColorVision (www.colorcal.com).

• **Business presentations** In a business environment, a 21in CRT is not the most attractive option – you won't look very elegant lugging it to the meeting room. The CTX 1400F, for instance, weighs 38kg. Business use means flat-panel displays, and for presentations it's size that counts.

For maximum impact go for an 18in panel, which offers good looks as well as functionality. The slim bezels on the Eizo FlexScan L685 and LG Flatron L1800P look the part, and both displays give great quality. If you need more screen size than that, you should consider a projector.

Verdict

As a beginner, the temptation to switch to an LCD display is probably outweighed by their relatively high prices – you get more bangs per buck with a good 17in CRT monitor. The enthusiast market is much broader, although for most uses we'd still go with the better value of a 19in CRT such as the CTX PR960F.

For professional users, things are less clear cut; the cost implications of an LCD may well be outweighed by its more modern appearance and business-like image. For corporate customers who have to buy hundreds of screens, the heat and emission saving offered by going down the flat-panel route are attractive, though again CRTs will still be cheaper. ■



Read all about our Best Buy and Recommended Monitors and Flat-panels on pages 120 and 142 respectively