



## Technofile: flat-panels & CRT monitors

It's one of those decisions that keeps PC users umming and ahing for months. Should you fork out the extra cash and opt for a slimline flat-panel or save your pennies for a rainy day and stick with a bulky CRT? Robin Morris looks at the technology behind the two monitors

For some users, the lure of the flat-panel display is too great to resist. And it's not just these screens' captivating looks or increased portability that convinces buyers to spend over twice as much on an eye-catching 17in TFT model than they would on a bulky CRT (cathode ray tube) monitor; many users argue that reclaiming acres of desk space is worth the asking price on its own. Then there's the sharper image quality and huge savings in energy consumption. And, of course, the lack of interference and flicker prevents less headaches and eyestrain.

But are these legitimate reasons for shelling out on a flat-panel display, or is the industry filling its coffers by selling us a dream? We're going to explain exactly how the flat-panel compares to the CRT monitor – where does it outclass its chunky counterpart and in which areas does it fail to measure up?

### Size is everything

Let's start with the obvious. Flat-panel displays are slim, stylish and bound to draw murmurs of approval from onlookers – especially if you're lucky enough to own a 'designer' model.

Sony's classic black SDM range is the epitome of desktop cool, while Samsung's SyncMaster 171P benefits from modern curves that are the work of luxury car manufacturer Porsche.

Such looks are practical as well. Flat-panels are light so they're easy to move from location to location. An average 15in flat-panel weighs around 3kg and even 18in models rarely tip the scales at more than 8.5kg. Compare this to the hefty 17-25kg bulk most 17in and 19in CRT monitors carry and you'll see why a flat-panel's beauty doesn't just run screen deep.

A flat-panel display also has a much smaller footprint than a CRT so in theory

replacing an older monitor should increase your workspace. Remember, though, that you're losing depth, not width, as the average CRT stretches back about twice as far as a flat-panel. There's virtually no difference in screen width.

So if desk space is one of the key reason for buying a flat-panel then check your measurements carefully and decide whether you are going to make practical use of the additional space.

More usable screen space is a given in the flat-panel market. CRT monitors derive their image from a CRT tube, only part of which will be visible. If you're using a 17in CRT, for instance, the actual picture will be no greater than 16in.

On a 19in monitor the actual picture size could be as small as 17.5in. In contrast, on a flat-panel display what you get is what you see. This means that a 17.4in flat-panel and 19in CRT offer virtually the same size picture.

## Defective pixels

In the flat-panel market a large number of displays tend to develop faults during manufacturing due to defective pixels. Each pixel is accompanied by an individual transistor but this transistor may short-out or remain open, preventing the pixel from displaying the correct colour.

A 'dead' or 'stuck' pixel will remain permanently white, while a 'lit' pixel will show up as red, blue or green. It's only when the LCD panel has been completed that it can be assessed for defective pixels and corrective measures are few and far between. In the case of lit pixels the transistor can be switched off, but this will merely result in the pixel being displayed as a constant black dot.

Defective pixels are very common, but the lighter the image the harder it should be to see the faults. Since most Windows programs display black text over a white background, a small number of defective pixels are often deemed acceptable by manufacturers. Most screens comply

with ISO specification 13406-2, which demands the flat-panel has no more than an 'acceptable' number of pixel faults.

However, mere compliance is no measure of quality. The 13406-2 standard is divided into four classes and at the lowest (class IV), as many as 500 pixel faults are allowed. Ideally, you want to aim for class II (between one and five faults) or class I (no faults). The latter is particularly rare, although some companies do offer such promises.

CTX, for example, guarantees no defective pixels on its S530 flat-panel. If your model comes with imperfections you have 101 days in which to swap it for another flawless screen.

Not everybody will be bothered by faulty pixels, while some users will find their viewing experience is ruined by just one or two defects. The best solution is to see the flat-panel in operation before purchasing it. Insist on viewing the screen when it's displaying completely white and completely black backgrounds so that you can look for impurities.



← With less casing needed on a flat-panel display, the visible screen area is much larger than on a same-size CRT

flat-panels habitually boast smaller pixel pitches (0.264mm) than 18in models (usually between 0.27 and 0.28mm).

The CRT equivalent to pixel pitch is dot pitch. This measures the difference between the dots used to define the image and the smaller the dot pitch the better. Whatever the screen size look for at least 0.25mm, with 0.24mm better still.

Whereas CRT monitors work at various resolutions, flat-panels are built to run at one 'native' resolution. Most 15in flat-panels run at 1,024x768, while 17in and 18in models tend to have native resolutions of 1,280x1,024.

If you run the display on a non-native resolution it will use an algorithm to scale the image – the result is blocky text and jagged lines. It's best to choose a flat-panel with a native resolution that you're comfortable using. Before rejecting a flat-panel on the grounds of poor image quality, check that it's operating at the correct resolution. Many high-street PC stores have demonstration flat-panels running at non-native resolutions thus showing them in a poor light.

One thing flat-panel buyers won't have to worry about is the screen's refresh rate since LCD technology is built to run at low

refresh rates. In CRT monitors, though, this figure is very important. Measured in hertz, the refresh rate illustrates how frequently the screen is refreshed – the higher the figure the smoother the results.

Irrespective of the monitor's resolution, ensure that the refresh rate is at least 75Hz with 85Hz better still. Do not run the monitor at an 'interlaced' refresh rate (65Hz and below) as the resulting flickering can cause eyestrain.

### A screen with a view

A CRT monitor uses 'emissive' technology that generates its own light, allowing the image to be viewed from almost any angle. Flat-panel displays, on the other hand, need backlights to supply the illumination. The onscreen image is visible while sitting directly in front of the monitor, but it quickly deteriorates or even disappears completely if you move to the left or right of the screen.

Theoretically, the viewing angle measures in degrees how far you can move around the screen before the image starts to deteriorate. Take this figure with a pinch of salt, though. It's usually written in the form '140°/120°', where the two numbers refer to the horizontal and the vertical viewing angles respectively. In some cases only the horizontal figure is given.

Regardless of format, the viewing angle is only useful when comparing different

### Talking 'bout resolution

Whether you're buying a CRT monitor or a flat-panel display, resolution support is key. The resolution size measures the number of pixels used to generate the image; the higher the resolution the more detailed the picture. Don't settle for less than XGA (1,024x768) or SXGA (1,280x1,024), although 19in-plus screens can offer UXGA (1,600x1,200).

A flat-panel's pixel pitch, measured in millimetres, tells you how large each pixel is. The smaller the pixels, the finer and less blocky the image will be. It's interesting to note that, although both 17in and 18in flat-panels tend to have a resolution of 1,280x1,024, the smaller display usually offers the better picture. This is because 17in

## And the winner is...

Category	Winner	Comment
Size/dimensions	Flat-panel displays	Flat-panels are obviously slimmer and lighter – CRT monitors are frequently four or five times heavier. How much space you save will depend on the layout of your desk and the depth of the flat-panel, so measure up before purchasing.
Resolution support	CRT monitors	CRT monitors are better at handling a selection of different resolutions. With flat-panels you'll get the best results by using the screen with its native resolution. Expect a resolution of 1,024x768 on 15in displays, 1,280x1,024 on 17in and 18in screens, and 1,600x1,200 on 19in-plus models.
Text quality	Flat-panel displays	To generate sharp text, flat-panels use cleaner LCD technology and often superior brightness levels (look for 250-300cd/m <sup>2</sup> ). An increasing number of CRT monitors are bridging the gap, however, providing switches that boost the brightness (often to a flat-panel standard) when displaying text and high-detail applications.
Graphics quality	CRT monitors	This is where CRTs fight back, offering richer colour schemes and better response times than flat-panels, resulting in clear, unblurred graphics. If images are an important part of your PC experience and you're set on buying a flat-panel, look for a contrast ratio of at least 400:1. Gamers will require a response time of 25 milliseconds or less.
Viewing angle	CRT monitors	CRT monitors retain their image quality whatever angle you view them from, whereas an image on a flat-panel tends to disappear if you're not directly in front of the screen. To assess the viewing angle, physically test the monitor before buying.
Running costs	Flat-panel displays	Flat-panels undoubtedly use less power than CRTs (often two to three times less), but with the relatively low cost of electricity you're going to have to run the display for an awfully long time to make up the difference in purchase price.
Price	CRT monitors	Always a victory for CRT technology. Flat-panels may have fallen in price but they're still expensive alternatives.



models from the same manufacturer. If possible, the best method of measuring the viewing angle is to experiment with the screen before you buy.

### Text at its best

A good-quality flat-panel working at its native resolution is arguably superior at displaying text than a CRT monitor. This is due to smaller pixels, the precision of LCD technology and the extra brightness or luminance that a flat-panel offers.

Measured in candelas per square metre, or cd/m<sup>2</sup> (sometimes also referred to as nits), this reflects the brightness of the screen; the higher the measurement, the better. A figure of 230cd/m<sup>2</sup> or above

← Offering superior brightness and luminance, a flat-panel's the ideal screen for displaying text

is more than acceptable. In CRT monitors the figure tends to be much lower – generally no more than 100cd/m<sup>2</sup>. The exception to this is the new breed of CRT monitors with optional 'enhanced brightness' controls.

For example, models equipped with NEC-Mitsubishi's SuperBright Diamondtron tubes (which are included in most of its new Diamond Pro and Diamond Plus monitors), have a SuperBright switch that can boost the brightness to 300cd/m<sup>2</sup>. Iiyama's OPQ feature, meanwhile, can generate 250cd/m<sup>2</sup>.

Such a feature isn't necessary for most tasks, but when it comes to high-detail office applications the extra brightness results in a sharper and more legible picture.

Offering a steadier and flicker-free picture, flat-panels are easier on the eyes. However, don't think eyestrain is a thing of the past – even a high-end display can cause discomfort after a long session. Remember to take an hourly rest for several minutes.

If you have Windows XP, you could also try out Microsoft's ClearType utility. Aimed at flat-panel users, this tool offers improved font resolution and cleaner text.

See [www.microsoft.com/typography/cleartype](http://www.microsoft.com/typography/cleartype) for more details.

### Generating graphics

If you've already made up your mind that the flat-panel route is for you then here's the bad news: you'll get richer colours from a high-calibre CRT monitor and unfortunately there's no way round this. CRT technology generates not just a greater intensity of colour, but it also produces many more of them.

The gap can be reduced by buying a flat-panel with a high contrast ratio. Measuring the ratio between the lightest white and the darkest black, a high contrast ratio tells you the screen can support a greater depth of colour. Look for a contrast ratio of at least 400:1.

Even if this will satisfy graphics enthusiasts, gamers are out of luck. Traditionally, flat-panels have been built with relatively static Windows applications in mind. Display anything with fast movement – for example, games or video playback – and the most glorious of images can turn into a blurred mess. Much of this can be attributed to the response time.

Measured in milliseconds, the response time (or response rate) indicates how quickly the flat-panel or CRT can respond to changes. The onscreen image is constantly being refreshed so the faster

## Features comparison: CRT monitors and flat-panel displays

	Product	Supplier telephone	Website	Price (ex VAT)	Stated screen size	Actual viewable area	Resolution	Dot/pixel pitch	Viewing angle	Response time	
CRT monitors	Mitsubishi Diamond Pro 750SB	0845 121 9200	www.mitsubishi-monitors.com	£139	17in	16in	1,600x1,200	0.25mm	n/a	around 8-12ms	
	Mitsubishi Diamond Plus 93SB	0845 121 9200	www.mitsubishi-monitors.com	£179	19in	18in	1,600x1,200	0.25mm	n/a	around 8-12ms	
flat-panel displays	CTX S530	01923 810 800	www.ctxeurope.com	£249	15in	15in	1,024x768 (native)	0.297mm	120°/100°	40ms	
	LG L1710B	0870 607 5544	www.lge.co.uk	£304	17in	17in	1,280x1,024	0.264mm	140°/110°	20ms	
	Samsung SyncMaster 181T	0800 521 652	www.samsungelectronics.com	£475	18.1in	18.1in	1,280x1,024 (native)	0.281mm	170°/170°	25ms	



← If your budget is tight, a CRT monitor's still the best bet right now, though flat-panels are getting more affordable

You may see the response time written as a ratio – for example, 12:4. The first figure is the 'rise' time and indicates how quickly each pixel can change from black to white. The second figure is the 'fall' time and does the same action converting white back to black. To get the total response time simply add these two figures

the response time the quicker the monitor can clear one image before refreshing it with a new one.

Standard Windows applications – for instance, a word processor – won't need a fast response. But on a fast moving game, where something new is happening every second, a slow response time means that the monitor won't have had time to clear one image before drawing the next. To the user the effect is double-vision, watching several different images at once.

CRT monitors are ideally suited to playing games since their response times are extremely fast – usually between eight and 12ms. Flat-panels tend to lag behind. High-quality models offer times between 16 and 25ms, but it's not uncommon to see up to 40ms. If you'll mainly be using a flat-panel for office applications this figure won't be important to you. If games or full-screen video play a large role in your PC activities then go for as fast a response time as possible – certainly no more than 25ms.

together. In our example, the ratio 12:4 equates to a response time of 16ms.

Modern flat-panels are a vast improvement over their predecessors and there are plenty of avid gamers who find this display type adequate for their purposes. However, if games or video are your forte a CRT monitor is still the best bet.

### Costly affair

Lower running costs are often quoted as a reason for buying a flat-panel display. In terms of power consumption, the gaping chasm that appears on paper may only amount to a small difference in the real world. Depending on electricity costs, running a 120W monitor for seven hours a day will cost you around £15 over a 50-week period. In

contrast, a 45W flat-panel display will cost you just over a third of this amount.

Considering a flat-panel's prohibitively high price tag compared to bargain CRTs, any savings in running costs are a mere drop in the ocean.

### And the rest...

You shouldn't discount the range of extras bundled with both CRT and flat-panel monitors. USB is a useful addition – many displays are equipped with two or four downstream USB ports into which you can plug USB devices such as printers, cameras and portable hard drives. These are particularly convenient if your PC lacks front-mounted USB ports.

Since flat-panels are designed to save desk space, it makes sense to give yourself even more room and invest in a model with built-in speakers. The trade-off is that audio quality isn't as good as it would be from standalone speakers.

However, if you'll mainly be using the



← Some flat-panels have hardware pivot facilities so they can be manually rotated between portrait and landscape views



	Contrast ratio	Dimensions (wxdxh)	Weight	Brightness	Digital	Power consumption
	n/a	397x415x392mm	17.2kg	around 100cd/m2 as standard, up to 300cd/m2 with SuperBright	no	66W
	n/a	442x448x443mm	23kg	around 100cd/m2 as standard, up to 300cd/m2 with SuperBright	no	88W
	300:1	372x171x355mm	3.7kg	250cd/m2	no	35W
	500:1	370x223x421mm	6.6kg	250cd/m2	yes	40W
	500:1	398x208x443mm	5.8kg	250cd/m2	yes	40W

monitor for work purposes the sound quality will be adequate. CRT monitors can also be supplied with onboard speakers, however they add to the overall bulk.

Some flat-panels (although no CRT monitors) are supplied with a hardware pivot feature. Most screens are wide rather than tall, so while you can fit a lot of characters on to one line you can't fit many lines on to one screen, and this is a waste of screen space.

With the hardware pivot facility, though, you are able to manually rotate the screen through 90 degrees. You'll get almost as many characters going across the screen, but you'll also get far more lines running down it. Particularly suited for activities

such as word processing and web surfing, this is the perfect way to use your workspace to the full.

### CRT or flat-panel?

So which monitor should you choose? To give you an idea of how the two technology types match up, we've compared some of the top models from both camps (see the table above).

There's no comparison on price. For only marginally more than the cost of the 17in LG, you could buy both Mitsubishi's CRT monitors. And with their rich colours and fast response times these CRTs easily lead flat-panels in graphics applications. Text quality is also good, although even

with the SuperBright facility activated CRTs lose out marginally to flat-panels.

These slimline displays also win out due to lack of bulk – the 15in CTX S530 weighs a mere sixth of the 19in Mitsubishi 93SB. The CTX's sharp text output makes it a good choice for professionals, although gamers shouldn't consider this model due to its 40ms response time.

If you're willing to shell out a few extra pounds for a flat-panel display then you might as well pay a little more and invest in LG's L1710B with its expansive 17in workspace. This model's text output and resolution support are strong, while the 20ms response rate and 500:1 contrast ratio almost rival the CRT's graphical capabilities.

For crystal-clear text and excellent portability, the flat-panels rule the roost. However, if you're in any doubt we recommend sticking with a good-quality CRT. Equipped with the most versatile technology, these monitors can produce a fantastic viewing experience at a bargain-basement price. And if you do find the size a problem, you could always use the monitor as a coffee table. ■



Unsure of a technical term? Find out exactly what it means in our searchable Glossary which is on the cover disc

## Digital vs analogue

**C**omputers communicate using digital signals but to convert these signals into an image that we can see and interact with, the computer has to pass the information to a CRT monitor. Since the latter uses analogue signals, getting it to understand the PC is no easy task.

This is the job of the Ramdac (random access memory digital-to-analogue converter), a chip which is usually integrated within the graphics card and contains a look-up table that's stored in the RAM. It uses this table to match each part of the digital signal to a command that tells the CRT monitor which colour to use.

While this process works reasonably well in practice, especially with faster 400MHz Ramdacs, it's equivalent to using a translator to speak to another person. Of course, it would be so much easier if we could all speak the same language, and the solution is to invest in a flat-panel display with a digital interface. This way the PC can bypass the Ramdac and send the information directly to the screen, thus producing a smoother and more faithful picture.

So why aren't digital facilities an essential purchase? Despite the obvious logic, pure digital images don't look significantly better than digital-to-analogue conversions. And since it's necessary to have digital connectors on both the flat-panel and the graphics card, only a select number of users have bothered to make the conversion.

Having said that, a flat-panel will be futureproofed for several years while analogue will begin to die out, so it makes sense to stump up the extra cash now. An analogue connection or converter will be supplied with the screen, so you will be able to use it even with a non-digital graphics card.

Make sure you get the mainstream DVI (digital visual interface) connector rather than M1-DA (formerly known as P&D or Plug & Display). These are mostly found on projectors, but they aren't directly compatible with DVI and might not be fully supported in the future.

You can tell the difference by counting the number of pins – P&D will have three rows of 10 pins, whereas DVI will never have more than three rows of eight pins.