

Scene on the screen



Don't cut corners when you choose a monitor — it's probably the most important part of your setup. We've tested a range of units to suit most budgets and put you in the picture about size, type of screen and the latest technology.

It's a sad fact of life that the most important component of any PC is the one that's the first to be compromised when the budget gets squeezed. These days, everybody wants incredibly fast processors and huge amounts of RAM, so that a budget system which is fantastic value is liable to come with a 14in goldfish bowl of a monitor, unfit for any kind of prolonged use since that's where corners can be cut without being too noticeable on the spec sheet.

The fact remains that your monitor is the main interface between you and your machine. Without one, a PC is just an expensive electronic space-heater. Recent research has proved beyond doubt that a decent-quality monitor can have a profound impact on productivity, reducing fatigue and increasing accuracy. You should consider a 17in CRT monitor the minimum requirement if you use your PC for more than an hour at a time.

Here, we've rounded up a variety of monitors of different sizes and price points. So, we have eight 17in CRTs and eight TFTs. We also take a look at 19in units, featuring four monitors representing the four tube technologies, as well as the new breed of flatscreen CRTs. And, in case you were wondering, we explain the difference between display technologies and show how to correctly set up your display for optimum performance, too.

Ratings

- ★★★★★ **Highly recommended**
- ★★★★ **Great buy**
- ★★★ **Good buy**
- ★★ **Shop around**
- ★ **Not recommended**

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♦ *Tested and reviewed by David Fearon*

Setting up **your** monitor

Even if you have the most expensive display on the market, don't assume that it needs no adjustment. All CRT monitors need adjusting, and correct placement of the display is equally important whether you have a CRT or LCD flatpanel screen.

The most basic adjustments that need to be set are the brightness and contrast controls. These are dependent on lighting conditions, so they should be re-adjusted if you move the display. Setting them correctly is a fairly simple task. With a CRT, first turn the contrast down to zero, then turn the brightness up to maximum. Look in the bottom corners of the screen: you should see that the background of the display goes from grey to black where the phosphor coating ends. Turn the brightness down until the interface between the grey and the black just disappears.

It's slightly harder to be precise about contrast. The easiest way is to turn it up until white text looks like true white, but not so far that the edges start to look blurred. You'll generally find that with the brightness correctly adjusted, the

contrast will need to be set quite near the end of its range (between 75 and 90 percent of maximum). Flatpanels often have a more limited adjustment range, but it's generally best to keep the brightness low and the contrast high.

Size and position of the display is also important if you want to get the most out of the available screen area. Some CRT monitors have a button that attempts to automatically adjust the size and position of the image. This doesn't always work correctly though, since a CRT can't sense precisely where the electron beam is hitting the phosphor coating at the front of the tube.

If you want to get the biggest display possible, you can adjust the size of the picture into the corners of the screen but you'll tend to get distortion at the edges. Most CRT monitors will give the best picture when there is a gap of about a centimetre around the edge of the viewable area.

For flatpanels, you need to adjust the clock and phase controls to make sure that the picture covers the entire surface of the display, otherwise you'll get unpleasant bands of aliasing distortion.



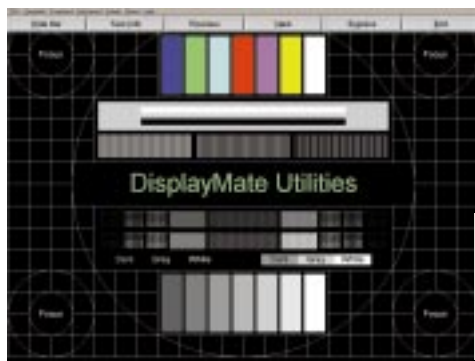
▲ **TAXAN'S**
WINDOWS-DRIVEN
ON-SCREEN DISPLAY

CRT displays also need geometry correction because a CRT display cannot sense exactly where the

beam is going. LCD panels have inherently perfect geometry performance.

The most common forms of geometry distortion are pincushion or barrel distortion, where the side of the picture bows in or out, and trapezoid distortion where the top of the picture is wider or narrower than the bottom. Inaccurate geometry won't cause fatigue or eyestrain though, in the same way as poor focus or resolution.

One of the most important factors in monitor adjustment is placing the display in the best physical position, to lessen fatigue. Until recently, the general advice was that the centre of the screen should be at eye level, so the user was looking straight ahead for most of the time. This advice has now changed for sound physiological reasons: it's more natural to be looking downwards at your hands when focusing on close objects, so have the monitor slightly below you, with the top of the display at eye level.



◀ **DISPLAYMATE,**
A VITAL TOOL FOR
SETTING UP YOUR
MONITOR

CONNECTIVITY

The more expensive monitors have two sets of video inputs. The first is a standard VGA D-type connector — the same as the connector on your graphics card. The second is through BNC connections which separate the components of the video signal into five separate connectors. This decreases interference (crosstalk) since the

components of the signal are shielded from each other. But unless you have a graphics card that also has separate BNC connectors, the benefit will be marginal at best. The advantage of having two inputs is that it allows you to use one monitor with two computers, say a PC and a Mac. If you're going to use this feature, it's useful if the monitor has a dedicated

front-panel button to switch between machines. New to monitors is USB connectivity. This is not a method of transmitting the video signal to the monitor: USB's 12Mbit/sec bandwidth is not high enough. USB connectors are appearing on



monitors because they make an ideal place for a USB hub. A couple of the displays in our group test also allow USB control of the monitor's adjustments in software.

ADI MicroScan GT56



The GT56 is the very latest display from ADI: we managed to get hold of the first and only one in Europe for this group test. It was worth the wait: its colour reproduction is fantastically even and pure. Like the CTX [below] it sports a Trinitron tube but it has the added bonus of four USB ports and a built-in microphone. And although the CTX just beats it when it comes to resolution, if you buy a GT56 you're unlikely to regret it.

★★★★★

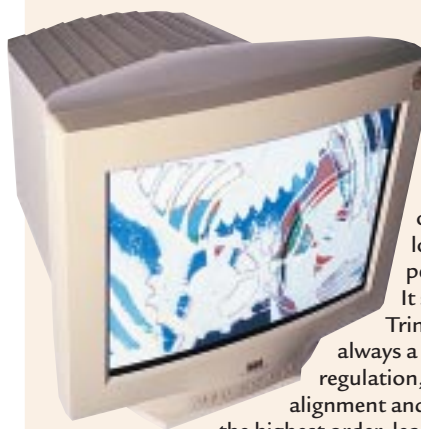
Belinea 10 70 50



When it was originally released, the 10 70 50 represented remarkable value for money for an aperture grille display. But since then, the competition has caught up, with CTX, Viewsonic and ADI vying for the 17in aperture grille crown. This Belinea can still put up a fight though, with the combination of a good tube and electronics for a sharp, clear display with no obvious problems. The OSD is basic though, and there are no extra features such as USB.

★★★

CTX PR710T



In the past, CTX has perhaps been known more for cheap-and-cheerful displays than a presence in the higher echelons. But this has changed. Not only does the PR710T look gorgeous, its performance is stunning. It sports a genuine Sony Trinitron tube, which is always a good sign. Power regulation, resolution, colour alignment and colour purity are all of the highest order, leading to a display that you can see is special straight away. A clear winner.

★★★★★

LG StudioWorks 795SC



The 795SC is a little uninspiring to look at and produces a fairly uninspiring display, too. It's a shadow mask unit with the screen curved in both the horizontal and vertical directions. There's just the one D-SUB input and it doesn't have any USB ports. The OSD is comprehensive and easy to use, and image quality is good but not remarkable. Horizontal resolution was slightly awry, but the LG would make a good, basic office display.

★★

Table of features

MANUFACTURER/MODEL	ADI MicroScan GT56	BELINEA 10 70 50	CTX PR710T	LG STUDIOWORKS 795SC
Price ex VAT	not supplied	£295	£363	£249
Approx street price (ex VAT)	£299 including USB hub	£259	£309	£249
Tel	0181 236 0801	0118 936 2900	01923 810800	01753 500470
URL	www.adiusa.com	www.maxdata.co.uk	www.ctxintl.com	www.lge.co.kr
Visible diagonal	16in	15.9in	16in	15.9in
Tube type	Aperture grille (Trinitron)	Aperture grille (Diamondtron)	Aperture grille	Shadow mask
Max horizontal frequency	95kHz	95kHz	95kHz	100kHz
Max resolution	1600 x 1200 75Hz	1600 x 1200 60Hz	1600 x 1200 72Hz	1600 x 1200 80Hz
Max refresh 1024 x 768	85Hz	85Hz	85Hz	85Hz
Dot/grille pitch	0.25mm	0.25mm	0.25mm	0.26mm
Connections (BNC, DSUB)	D-SUB	BNC, D-SUB	BNC, D-SUB	D-SUB
Dimensions (WxHxD), weight	439 x 441 x 441mm, 21kg	536 x 522 x 565mm, 23kg	418 x 430 x 446.5mm, 21.3kg	416 x 432 x 440mm, 18kg
Power consump max / suspend	140W / <8W	130W / <8W	130W / <10W	130W / <8W
OSD geometry functions	h/v lin, trap, rot, sidepin, pin	pin, trap, par, rot	pin, sidepin, trap, par, rot	pin, sidepin, par, pin s-bow, pin w-bow
Other OSD features	ct, moiré, h/v con	ct, h/v con, moiré, signal select	h/v con, ct	zoom, h/v moiré, h con, col purity, ct
Other features (USB etc)	USB (1 upstr, 4 downstr), mic	-	Front panel signal select	-
Standards compliance	TCO99	TCO95	TCO95	TCO95

OSD key: lin = linearity, trap = trapezoid, rot = rotation, sidepin = side pincushion, pin = pincushion, par = parallelogram, ct = colour temperature, h/v con = horizontal and vertical convergence

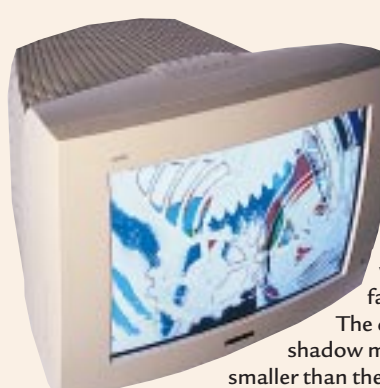
Mag XJ700T



Like the CTX and the ADI, the Mag is fitted with a Sony Trinitron tube. However, it seems to have been rather let down by its supporting electronics. Colour purity is very good, as you'd expect from a Trinitron, but power regulation is appalling, leading to a display that 'bounces' when opening and closing windows. Focus is poor too, presenting a slightly fuzzy picture that gave our testers headaches. It's probably the cheapest Trinitron display around but you can do much better for just a little more money.

★★

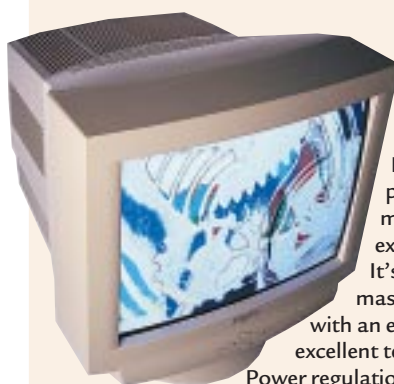
Nokia 447XS



The 447XS has all its controls on the right-hand side, resulting in a reduction in height and making the unit look very squat indeed. It works pretty well though, with the controls falling naturally to hand. The display itself is a shadow mask and slightly smaller than the rest, with a 15.7in viewable diagonal. In use, colours are unusually vibrant for a shadow mask and the display is crisp with no signs of ghosting. Four USB ports nestle in the base.

★★★★

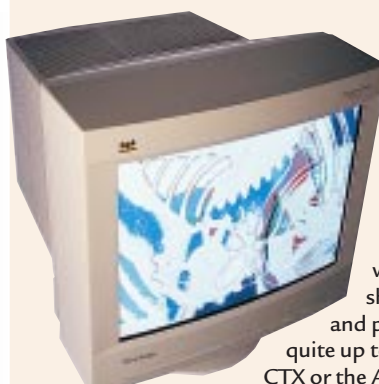
Taxan Ergovision 745 TCO99



While Taxan does make aperture grille monitors, the one the company chose to send for this test has a shadow mask tube. However, many people prefer to use a shadow mask screen. Taxan's expertise shows in the 745. It's easily the best shadow mask display in this group test, with an extremely crisp image and excellent technical performance. Power regulation is superb and there are no signs of unpleasant effects such as ghosting or defocusing. As the name suggests, it conforms to TCO99 standards and sports a USB hub in the base.

★★★★★

ViewSonic PT775



This is one of the more expensive 17in displays in the test but the PT775 is backed by very good performance. It displayed excellent resolution, colour alignment and focus, which add up to a very sharp picture. Vibrancy and purity of colour weren't quite up to the standard of the CTX or the ADI, though. There's no USB support but there are both D-SUB and BNC video inputs. The ViewSonic should definitely be on your 17in shortlist.

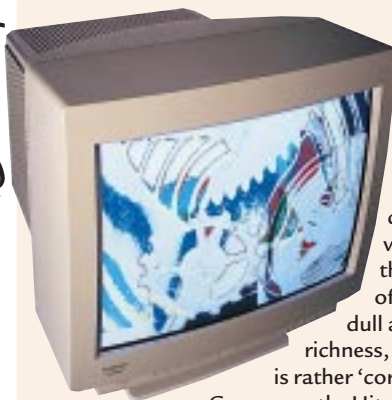
★★★★★

Table of features

MANUFACTURER/MODEL	MAG XJ700T	NOKIA 447XS	TAXAN ERGOVISION 745 TCO99	VIEWSONIC PT775
Price (ex VAT)	£240	£299	£275	not supplied
Approx street price (ex VAT)	£228	£299	£262	£325
Tel	01189 752445	01793 512809	01344 484646	0800 833648
URL	www.magin.co.uk	www.nokia.com	www.taxan.co.uk	www.viewsonic.com/europe
Visible diagonal	16in	15.7in	16in	16in
Tube type	Aperture grille (Trinitron)	Shadow mask	Shadow mask	Aperture grille (SonicTron)
Max horizontal frequency	70kHz	86kHz	95kHz	96kHz
Max resolution	1280 x 1024 60Hz	1280 x 1024 75Hz	1600 x 1200 75Hz	1,600 x 1,200 77Hz
Max refresh 1024 x 768	85Hz	85Hz	85Hz	85Hz
Dot/grille pitch	0.25mm	0.25mm	0.26mm	0.25mm
Connections (BNC, DSUB)	D-SUB	captive cable	D-SUB	BNC, D-SUB
Dimensions (WxHxD), weight	421 x 423 x 433mm, 18.4kg	445 x 372 x 389mm, 18.5kg	412 x 427 x 428mm, 18kg	415 x 427 x 457mm, 21Kg
Power consump max / suspend	<120W / <15W	<100W / <7W	<140W / <8W	<130W / <8W
OSD geometry functions	pin, trap, rot	rot, trap, par, pin, pin side	pin, sidepin, trap, par, rot	pin, sidepin, trap, par, hourglass, hooking, rot
Other OSD features	colour temperature	Auto shape, moiré, ct	zoom, colour temp	h/v con, h/v focus, colour purity, ct, moiré
Other features (USB etc)	-	USB (1 upstr, 4 downstr)	USB (1 upstr, 4 downstr)	-
Standards compliance	TCO92	TCO95	TCO99	TCO95

OSD key: lin = linearity, trap = trapezoid, rot = rotation, sidepin = side pinchusion, pin = pinchusion, par = parallelogram, ct = colour temperature, h/v con = horizontal and vertical convergence

Hitachi CM752ET



Hitachi's shadow mask-based monitor turned in a good all-round performance with sharpness and resolution, power regulation and colour convergence. It's not very exciting to look at, though, either in terms of image, which is a little dull and lacks colour richness, or overall design which is rather 'corporate' and boring.

Consequently, Hitachi is probably selling bundles for the desktops of large corporations, but you'd be better advised to go for one of the superior and much cheaper 19in designs. ★★

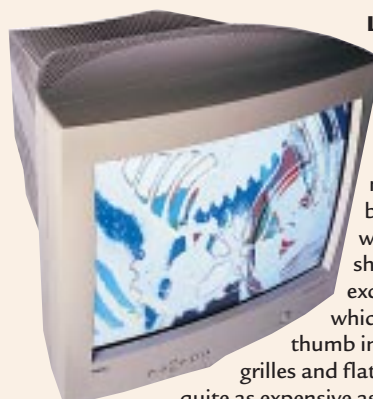
Mitsubishi Diamond Pro 900u



Given that Mitsubishi is the developer of the Diamondtron NF, you'd think the company would keep the best tubes for itself. However, the Diamond Pro 900u is actually slightly less impressive than the Iiyama Vision Master Pro 450 [p189]

when it comes to horizontal resolution and colour purity, but it is excellent nonetheless. It's free of the slight ghosting that the Iiyama showed and has the added bonus of USB, including a front-panel drop-down port. ★★★★★

NEC MultiSync E900+



Like the Hitachi, the NEC, with its ChromaClear tube, is another reasonable all-rounder, although horizontal and vertical resolution was not all it should have been and colour purity was rather lacking. The shadow-mask screen seems excessively curved; a factor which sticks out like a sore thumb in the company of aperture grilles and flat-screen units. It's not quite as expensive as the Hitachi but it's still overpriced in comparison with its competition. Not as impressive as NEC's LCD panel. ★★★★★

Sony Multiscan 420GS



Sony has probably the best reputation in the world when it comes to CRTs — the company invented the Trinitron tube. The 420GS doesn't sit at the top of Sony's 19in range; that space belongs to the more expensive PS series. And in this case, although its picture is undeniably excellent, it's not as sharp as either the Mitsubishi or Iiyama 19in units and to our amazement its colour purity wasn't up to scratch either. A relatively disappointing performance. ★★★★★

Table of features

MANUFACTURER/MODEL	HITACHI CM752ET	MITSUBISHI DIAMOND PRO 900U	NEC MULTISYNC E900+	SONY MULTISCAN 420GS
Price (ex VAT)	£610	not supplied	not supplied	£449
Approx street price (ex VAT)	£500	£435	£578	£449
Tel	0181 849 2000	0800 7311222	0645 404020	0990 424 424
URL	www.hitachi.com	www.meuk.mee.com/monitors	www.euronec.com	www.sony.com
Visible diagonal	18in	18in	18in	18in
Tube type	Shadow mask	Aperture grille (Diamondtron NF)	Shadow mask	Aperture grille (Trinitron)
Max horizontal frequency	101kHz	95kHz	96kHz	96kHz
Max resolution	1600 x 1200 75Hz	1600 x 1200 75Hz	1600 x 1200 75Hz	1600 x 1200 75Hz
Max refresh 1280 x 1024	85Hz	85Hz	85Hz	85Hz
Dot/grille pitch	0.22mm horizontal*	centre 0.25mm, edges 0.27mm	0.26mm	centre 0.25mm, edges 0.27mm
Connections (BNC, D-SUB)	D-SUB	D-SUB, BNC	D-SUB	Captive cable + front panel D-SUB
Dimensions (WxHxD), weight	448 x 454 x 460mm, 25kg	570 x 610 x 585mm, 30kg	447 x 462 x 482mm, 23.8kg	444 x 467 x 455mm, 26kg
Power consump max / suspend	125W / <15W	140W / <8W	150W / <8W	140W / <8W
OSD geometry functions	pin, trap, sidepin, par, rot	pin, sidepin, par, trap, rot	pin, par, trap, rot	pin, sidepin, par, trap, rot
Other OSD features	ct, h/v moiré	ct, moiré, h/v con	ct, moiré, vert linearity, h/v con	zoom, ct, h/v con, moiré
Other features (USB etc)	-	USB (2 upstr, 3 downstr)	-	front panel signal select, autosize
Standards compliance	TCO95	TCO95	TCO95	TCO 95

OSD key: lin = linearity, trap = trapezoid, rot = rotation, sidepin = side pincushion, pin = pincushion, par = parallelogram, ct = colour temperature, h/v con = horizontal and vertical convergence

* Horizontal dot pitch is not equivalent to normal diagonal dot pitch

Flatscreen CRTs

Sony and Mitsubishi, currently the only companies making flatscreen CRTs (cathode ray tubes), haven't begun to do so just for the fun of it. Making a flatscreen tube is a huge technical problem requiring all sorts of highly sophisticated circuitry and production techniques, and only three of the CRT monitors in this month's test have these tubes.

The primary barrier to producing a flat CRT is simply that the edges of the screen are further away from the electron gun than the centre. This means that if the electron beam is correctly focused on the phosphor at the centre of the screen while at the edges, it will be out of focus due to the increased distance. There's also the problem of the beam shape, which will tend to be elliptical when hitting the edges of the tube because it travels through the aperture grille at an angle.

These problems are also present in conventional CRTs but to a lesser extent. And, at the extremely high frequencies at which the electron gun circuitry has to operate, increasing its performance further is no easy matter. It has required the gradual evolution of dynamic beam focusing, shaping and intensity circuitry, as well as the competition from LCD flatpanels, to enable the production of Mitsubishi's Diamondtron NF and Sony's FD Trinitrons.

What are the benefits of having a flat-screen CRT? Well, there's a pretty strong argument for the case that the only reason CRT makers are currently producing them is to stave off competition from the LCD makers, whose products are inherently flat and currently very fashionable. The argument that Sony and Mitsubishi put forward is that a flat screen reduces distracting reflections, boosting

productivity and lessening fatigue because the processing centres of the

brain are not so busy filtering out unwanted information. In principle this is sound, although we have to say that the former argument is more likely the real reason. But there is definitely something about a flat screen which appeals to most people once they have

down. Whatever the theoretical pros and cons though, there is no arguing

that the two monitors we have tested this month which sport Diamondtron NF tubes, the Mitsubishi 900u (reviewed on page 186) and the Iiyama Vision Master Pro 450,

are both superb 19in displays.



► **SONY'S FLAGSHIP MONITOR, THE GDM-F500**



▲ **THE VISION MASTER PRO 450, A SUPERB 19IN DISPLAY**

used one for a while, and of course it won't be too long before the price premium, which is not too bad anyway, comes

► **The Iiyama Vision Master Pro 450**, sporting a 19in Diamondtron NF tube, is an impressive piece of work. Both vertical and horizontal resolution are superb, rendering single-pixel lines in our test patterns with pin-sharp definition. The technical challenges of flatscreen CRTs have not been totally overcome though, with slight convergence difficulties at the edges of the screen where it is hardest to accurately place the electron beams. There was some evidence of ghosting, too, but the 450 is still a superb display.

★★★★★

► **Sony GDM-F500.** The success of the flatscreen CRT and the extent to which CRT technology in general has been refined is best shown in this, Sony's flagship monitor. It has a 21in FD Trinitron tube and the clarity of the images it is capable of producing is quite remarkable. Its aperture grille pitch is just 0.22mm and the electronics are able to drive the unit at a resolution of up to 1880 x 1440 at 80Hz, beyond the capability of most current graphics cards. At a more sensible setting of 1600 x 1200 the picture is nearly flawless and makes up for the slightly disappointing performance of the other two Sony displays we've looked at this month. Not surprisingly, the GDM-F500 is rather a large beast. At 32kg it practically has its own gravitational field. The case itself is not very pretty but one look at the image quality brings home the fact that CRTs are a long way from being trounced by LCD flatpanels.

★★★★★

• **Prices** Sony GDM-F500: £1,526.33 (£1,299 ex VAT). Iiyama Vision Master Pro 450: £511.13 (£435 ex VAT)

Display technologies

Choosing the right monitor is more complicated than just choosing a spec and hoping you like the picture it produces. Quality is a prime consideration, but so also is the kind of monitor you like. Do you choose a 17in CRT or do you need a larger size? Are you tempted by a TFT? To help you choose the right monitor, we tell you everything you need to know about the technology behind each spec so you can make an informed buying decision.

CRT displays

The theory behind cathode ray tubes (CRT) is simple yet actually a little bizarre when you think about it. The first thing that's required is a partially evacuated glass tube with a coating of phosphor at one end. At the opposite end is an arrangement consisting of a heating

steered correctly, by varying the strength of the electromagnets, and scanned from left to right while varying its intensity, a picture can be built up row by row out of the glowing dots of phosphor. To build up a colour picture requires three of these beams, each illuminating different kinds of phosphor which fluoresce with red, green or blue light. To make the beam's transition between adjacent pixels as clean as possible, there is a very fine mask in front of the phosphor. The traditional type of mask is called a shadow mask and consists of a sheet of alloy with extremely fine holes in it.

In the late sixties, Sony invented the Trinitron tube with a different type of mask called an aperture grille. Instead of a sheet of metal, this uses a row of extremely fine vertical wires which perform the same function. But because

and its long-term effects on health. This produced a number of emissions standards, the most stringent being TCO 92, TCO 95 and TCO 99. The overwhelming opinion of the experts is that as long as your monitor conforms to the TCO 92 standard (or the older MPRII) you have nothing to worry about. TCO 95 and 99 are no stricter than TCO 92 where emissions are concerned.

LCD screens

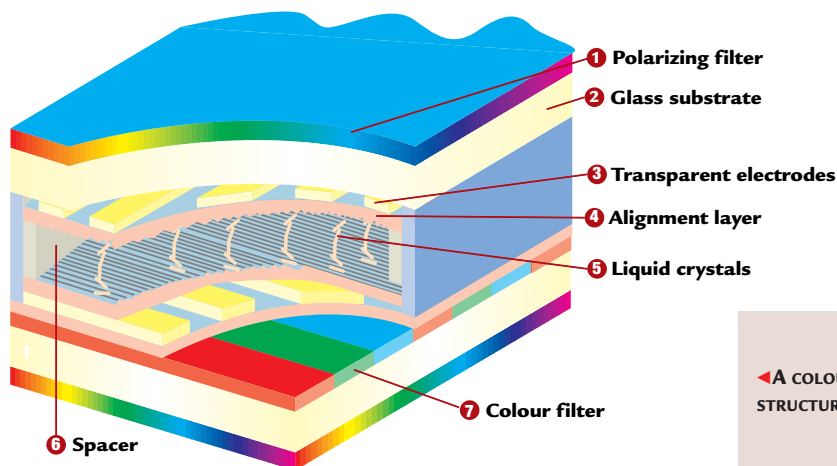
LCD (liquid crystal display) is a transmissive technology. The display works by letting varying amounts of a fixed-intensity white backlight through an active filter. The red, green and blue elements of a pixel are achieved through simple filtering of the white light.

All the LCD displays we've looked at this month use the most advanced flatpanel technology known as active TFT (thin-film transistor). This means that for each pixel there are three tiny transistors (one each for red, green and blue) bonded to the glass of the display — for a 1280 x 1024 resolution display, that's 3.9 million transistors. These all have to be produced on a single, expensive silicon wafer and the presence of more than a couple of impurities means that the whole wafer

must be discarded. This leads to a high wastage rate and is the main reason for the high price of TFT displays. It's also the reason why in any TFT display there are

liable to be a couple of 'dead' pixels where the transistors have failed.

LCD displays work because liquid crystal acts as a polarising filter in conjunction with a second, passive polarising layer. The liquid crystal elements of each pixel are arranged so that in their normal state (with no voltage applied) the light coming through the passive filter is 'incorrectly' polarised and thus blocked. But when a voltage is applied across the liquid crystal elements they twist by up to ninety degrees in proportion to the voltage, changing their polarisation and letting more light through.



◀ A COLOUR LCD STRUCTURE

element and a metal grid (called the cathode) which, when heated, will start to liberate electrons due to their increased energy levels. These electrons are then attracted to a very high voltage anode near the front of the tube.

Between the anode and the cathode in the neck of the tube lies an arrangement of electromagnets which focuses the stream of electrons into a beam. Due to their enormous speed — around one tenth the speed of light — the electrons overshoot the anode and hit the front of the tube. Their energy makes the phosphor coating briefly fluoresce at the point where the beam hits. If the beam is

there's no masking in the vertical direction, more light is let through to enable a brighter, more vivid picture. Since the advent of Trinitron, other manufacturers have developed their own versions of aperture grille technology.

The drawback of aperture grilles is that they require two fine horizontal wires to damp out vibrations in the grille. These can *just* be seen if you look closely at the top and bottom thirds of an aperture grille screen.

The extremely high voltages flying around inside a CRT's casing has led to fears about electromagnetic radiation

The transistors control the degree of twist and hence the intensity of the red, green and blue elements of each pixel forming the image on the display.

LCD flatpanel technology has numerous advantages. Firstly, because each pixel is in a fixed position and not reliant on an imprecise beam scanning the screen, LCDs provide an extremely sharp image with perfect geometry. The fact that the entire area of an LCD's screen can be used means that a 15.1in LCD has almost the same viewable diagonal as a 17in CRT.

Flatpanels are not called that for nothing: most are no more than a couple of inches deep, saving a great deal of desk space and looking extremely chic into the bargain. Furthermore, because high voltages are not required, LCD displays are safer, consume less power and run cooler than CRTs.

Resolutions and refresh rates

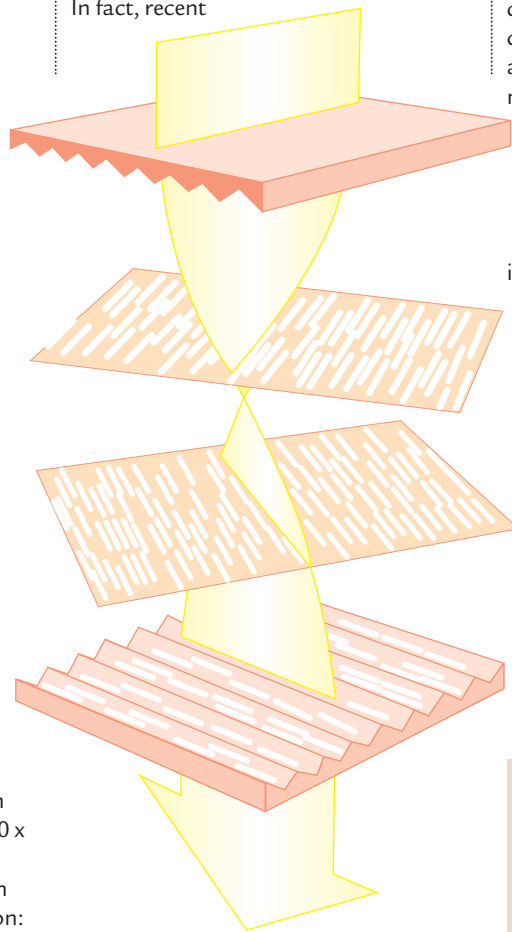
The analogue nature of the electron beam in CRTs means that they can be steered and pointed anywhere on the screen, enabling them to have a stab at displaying any resolution up to the limit of their amplifier electronics. As electronics have advanced, even low-end 17in displays are now capable of being driven at resolutions which a couple of years ago were reserved for the most expensive 21in units. Many 17in CRTs can now be driven at up to 1600 x 1200 pixels. However, only the most sadistic individuals would want to run a 17in display at such a high resolution: apart from the shadow mask or aperture grille not being fine enough to display that many pixels, text and icons would simply be too small. For most people, the optimum resolution of a 17in display is 1024 x 768.

With a higher-end unit you can get away with 1280 x 1024 but that's best reserved for 19in screens.

With LCDs, the story is different. The fixed pixels of a flatpanel make it hard to display lower than native resolutions without aliasing distortion, and impossible to display higher. This is a major limitation of flatpanels. For CRTs, vertical refresh rate is very

important. Remember that a CRT uses a single beam — or more specifically, three convergent beams — which constantly scans from top to bottom. If it scans too slowly, the eye perceives the scanning as fatigue-inducing flicker. For 14in and 15in displays, the magic number at which most people cease to be able to see flicker is 72Hz (cycles per second). For 17in CRTs, this increases to 75Hz. Nineteen and 21in displays ideally need to be refreshed at 85Hz. Above this level you won't see any benefit.

In fact, recent



drive the monitor at an appropriate resolution. This is largely a function of the card's RAMDAC, the part that converts the digital frame buffer into an analogue video signal. Generally speaking, the higher the RAMDAC frequency, the higher the card's maximum resolution and refresh rate.

Which is best?

LCDs certainly aren't superior to CRTs in every respect. For a start, there are no commercially available flatpanels that can run at 1600 x 1200 resolution or above, whereas the best CRTs can now manage 1800 x 1440. Also, the colour rendition of flatpanels cannot currently match the vibrancy of a decent aperture grille CRT. In addition, the colour depth of most panels is limited since each transistor is driven digitally by a 6-bit signal. This only provides 18-bit or 262,000 colours as opposed to the infinite range of which an analogue monitor is capable — 24-bit true colour is emulated in most panels by modulating pixel intensity.

You might think it strange that since most LCD displays are driven by a digital signal, they are fed an analogue signal from the graphics card which was originally digital. You're right, it's absurd, but the huge installed base of analogue graphics cards means that we're stuck with it for now.

The standards war currently raging over digital panel links makes the VHS vs Betamax battle look like a vicar's

◀ **LIGHT TURNS THROUGH 90° AS IT FOLLOWS THE TWISTED ALIGNMENT OF MOLECULES**

research has suggested that going up to around 100Hz possibly leads to problems of its own, as eye movement can create 'interference' which reduces

the speed of visual perception. LCD flatpanel owners will find that flicker is not

an issue. A panel's backlight refreshes at tens of kilohertz, so the frequency of the video signal itself is irrelevant.

When setting resolutions and refresh rates, bear in mind that the monitor is only half the story. Your graphics card needs to be of high enough quality to

tea party. Suffice it to say, there's no universal standard on the horizon.

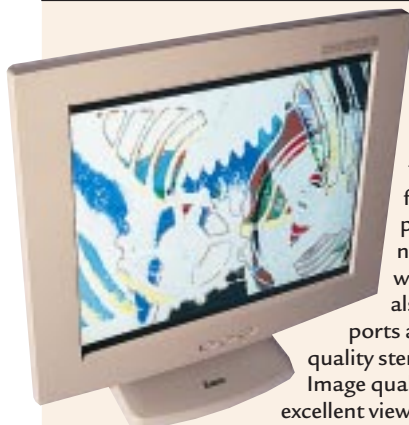
A further disadvantage of flatpanels is the slight time lag as the liquid crystal elements twist and untwist, resulting in smearing of fast-moving animated objects, although with TFT displays this phenomenon is far less obvious than with previous passive matrix technologies.

Finally, and ironically, the imperfect definition of CRTs can often be an advantage, reducing discernible pixellation and making them more suitable for photographic and artwork reproduction. For these reasons, many people still prefer CRT monitors.

Eye movement can create 'interference' which reduces the speed of visual perception

TFT flatpanels

Iiyama Pro Lite 46a



there's no auto adjust option.

The largest flatpanel on test, at 18.1in, the Pro Lite 46a will display an impressive maximum resolution of 1280 x 1024. It has one novel feature: the display can pivot on its base through ninety degrees, letting you work in portrait mode. It also features four USB ports and, surprisingly, high-quality stereo speakers in the base. Image quality is high, with an excellent viewing angle. The three-button OSD is hard to use though, and

★★★★

NEC MultiSync LCD 1500M



the package are four USB ports and stereo speakers, with front-panel buttons for volume and mute functions. One of the best displays here.

★★★★★

Panasonic PanaFlat LC50S



The Panasonic looked remarkably familiar when we unpacked it. In fact, it turned out to be the same display as the NEC 1500M [above], with cosmetic changes. But that's no bad thing, since it's a superb display demonstrating all the advantages of the NEC. The four USB ports add to its appeal, and the auto adjust option in the OSD produced a perfectly adjusted picture — something which cannot be said of some of the other panels in this group test.

★★★★★

Philips Brilliance 151AX



The Brilliance gives a good account of itself in the quality stakes with a vibrant, sharp display. But the viewing angle is not quite as good as the NEC and Panasonic displays, and some streaking effects were present in our tests, although they wouldn't be too noticeable in everyday use. The Brilliance features stereo speakers but a USB hub is an optional extra, fitting into a bay at the back. Overall, this is a good display at a very reasonable price.

★★★

MANUFACTURER/MODEL	Iiyama Pro Lite 46a	NEC MultiSync LCD 1500M	Panasonic PanaFlat LC50S	Philips Brilliance 151AX
Price (ex VAT)	£2,239	not supplied	not supplied	not supplied
Approx street price (ex VAT)	Not available	£647	£690	£585
Tel	01438 745482	0645 404020	0500 404041	0181 689 4444
URL	www.iiyama.co.uk	www.euronec.com	www.panasonic.com	www.monitors.philips.com
Visible diagonal	18.1in	15in	15in	15.1in
Panel type	TFT	TFT	TFT	TFT
Max horizontal frequency	80kHz	61kHz	61kHz	61kHz
Max resolution	1280 x 1024	1024 x 768	1024 x 768	1024 x 768
Connections (BNC, DSub)	D-SUB	D-SUB	D-SUB	D-SUB
Dimensions (WxHxD)mm	471 x 466 x 220	385 x 391 x 200	385 x 391 x 200	402 x 418 x 176
Weight	9.5kg	7.1kg	7.1kg	5.5kg
Power consump max / suspend	70W / 4W	55W / <5W	55W / <5W	<38W / <5W
Other OSD features	clock, phase, colour temp	colour temp, auto adj, volume, clock, phase	colour temp, auto adj, volume, clock, phase	volume, clock, phase, colour temp
Other features (USB etc)	panel rotation, USB (1 upstr, 4 downstr)	front panel mute, volume, speakers, headphone, USBx4	front panel mute, volume, speakers, headphone, USBx4	microphone, speakers, headphone, mute
Standards compliance	TCO99	TCO95	TCO95	TCO95

Table of features

TFT flatpanels

Samsung SyncMaster 520TFT



The only word we can use to describe the Samsung panel is 'disappointing'. Although it has decent looks and integrated speakers, the all-important area of image quality is sadly lacking. The problems manifest themselves as poor contrast, a lack of sharpness, and a general lacklustre look to images in comparison with the competition, which no amount of fiddling with the controls would correct. It seems that the unit's analogue-to-digital conversion circuitry is not up to scratch. We wouldn't go for this one. ★★

Silicon Graphics 1600SW



The highest-resolution flatpanel currently available, the 1600SW will display a fabulous 1600 x 1024 pixels in a wide aspect format, although the Iiyama Pro Lite 46a [p193] has a larger screen area overall. The 1600SW is a serious object of technological desire. Although image quality is superb, it isn't perfect; not quite as bright as the Iiyama, NEC or Panasonic panels. It's the only panel available with an adjustable white point, and it comes with a colour calibration sensor and dedicated Number Nine graphics card for its digital link. ★★★★★

Sony CPD-L150



Although Sony has a huge reputation for its CRT monitors (see the 420GS and GDM-F500 reviews on pages 186 and 189), the company doesn't seem to have too much expertise with flatpanels. The CPD-L150 was rather disappointing, with a relatively restricted viewing angle and some display noise that we couldn't correct. The auto adjust button failed to correctly set up the display and the unit features neither USB nor audio facilities. And, with the relatively high price, we cannot recommend the CDP-L150. ★★

Taxan CrystalVision 660TC095



The Taxan was characterised by its pin-sharp pixel definition. It looked more like a digitally linked panel à la Silicon Graphics than one with an analogue interface. It had a few faults though, with slight but noticeable variations in brightness across the screen, only an average viewing angle and a slightly tricky OSD. The price is also a bit of a sticking point, but if you can find it cheaper, it's a good display overall and well worth consideration nevertheless. ★★★★★

MANUFACTURER/MODEL	SAMSUNG SYNCMASTER 520TFT	SILICON GRAPHICS 1600SW	SONY CPD-L150	TAXAN CRYSTALVISION 660TC095
Price (ex VAT)	£949	£1,920	£999	£1,199
Approx street price (ex VAT)	£869	£1,920	£999	£1,139
Tel	0800 521652	07000 320540	0990 424424	01344 484646
URL	www.samsungelectronics.co.uk	www.sgi.com	www.sony.com	www.taxan.co.uk
Visible diagonal	15in	17.3in	15in	15in
Panel type	TFT	TFT	TFT	TFT
Max horizontal frequency	61kHz	n/a (digital link)	70kHz	61kHz
Max resolution	1024 x 768	1600 x 1024	1024 x 768	1024 x 768
Connections (BNC, DSUB)	D-SUB	36-pin OpenLDI connector	D-SUB	D-SUB
Dimensions (WxHxD) mm	471 x 466 x 220	454 x 467 x 187	398 x 366 x 165	392 x 374 x 160
Weight	9.5kg	7.2kg	5.3kg	5.3kg
Power consump max / suspend	70W, 4W	<30W / <8W	<35W / <4W	30W / <8W
Other OSD features	clock, phase, colour temp	control via software	zoom, colour temp, backlight, auto adjust, clock, phase	clock, phase, colour temp
Other features (USB etc)	speakers, volume control	automatic colour calibration	-	front panel screen adjust button
Standards compliance	TC095	TC095	TC095	TC095

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Editor's Choice

There's no doubt that while they are not as fast-paced as some other areas of the computing world, monitors are still improving. A large measure of the thanks for this goes to the competition from LCD panel makers, who have given the CRT manufacturers a bit of a kick up the backside. When you think that three or four years ago, a decent 17in CRT monitor would have set you back at least £1,000, and it wouldn't have been as good as today's best 17in units costing just £250-£300, you realise that it really is a buyer's market.

The LCD industry is looking strong and prices are coming down, too. But watch out: the disastrous events surrounding Far Eastern economies mean that after a production glut, panels are predicted to be in short supply this year, so prices may rise.

Should you choose an LCD panel or a CRT? We'd say that fashion has tended to cloud people's judgement. CRTs definitely represent

the best value as well as being just as good if not better than LCDs for most uses provided you get a decent one. One thing is for certain: if you're buying a CRT, there's no

point in going for anything less than a 17in unit. It's a false economy, and your eyes and brain will benefit no end from choosing one of our winners rather than a cheap-and-nasty 15-incher. A 19in CRT is a luxury, but research has suggested that they do little to improve productivity. So unless you really need to run at a resolution higher than 1024 x 768, it's not absolutely necessary to go for a 19in display.

Let's look at the overall winners:

✦ LCD panels

In the LCD panel stakes, our **Editor's Choice** for quality combined with value for money goes to the **NEC MultiSync LCD 1500M** (pictured, left). Although practically identical to Panasonic's



panel, it's that little bit cheaper and the quality is superb for the price.

Highly Commended is **Iiyama's Pro Lite 46a**. An expensive panel but its high resolution, attractive design, USB ports and screen rotation feature make it a great choice for the high-end user.

✦ CRT screens

When it comes to the CRTs, we felt the 17in units had the edge over the 19-inchers in terms of value for money, and the quality of the best was simply superb. Best of all is the **CTX PR710T** (pictured, above), our **Editor's Choice**. The clarity of the display and the colour reproduction from its Trinitron tube was brilliant in both senses of the word.

Only fractionally behind the CTX in the quality stakes is **ADI's GT56** which is **Highly Commended**. Its colour rendition was particularly good, and it has those USB ports to its credit.

And finally, even though it is extremely expensive for a CRT, we could not ignore **Sony's GDM F500** for all-out high-end quality. It, too, comes **Highly Commended**.

♦ Our thanks to Atlantic for providing the test systems for this round-up of monitors.

