

Display devices

The Video Display

Television and video images are designed to be viewed on a fairly large screen across a room. A typical domestic set will have a picture tube size of around 26 inches across its diagonal. Much larger Plasma Panel and LCDs (Liquid Crystal Displays) with 32, 42 and 50 inch screens have become commonplace over the last few years. Within a lecture theatre a very large image, typically of 12 foot diagonal, is provided by a projection system. The broadcasters have established that a comfortable viewing distance for images is around five to six times the diagonal so for a typical 26 inch screen this equates to about 10-12 foot distance.

Computer Displays

The VDU (Visual Display Unit) is used to view computer images and has a relatively small screen as it is designed to be viewed fairly closely. Either CRT (Cathode Ray Tubes) or active matrix devices such as LCD screens are used. Screen flicker and screen resolution are important considerations with a VDU. The close viewing distance dictates a high picture refresh rate and a fine line structure whereas a domestic television viewed at a much greater distance is not nearly so demanding. Computer images are digital in nature and derived from a matrix of tiny blocks or pixels. Each pixel is addressed individually to define its colour and brightness. With an active matrix device the screen pixels can be switched to correspond exactly to this computer generated image. Horizontal resolution is defined as the number of pixels per picture width, and vertical resolution as the number of pixels per picture height. With CRT displays, an analogue scanning process is employed. The number of horizontal scanned lines per picture varies from 525-2000 and the picture repetition or refresh rate from 75-150 images per second. With VDUs the number of active lines in the picture also defines the vertical resolution, as each scanned line is arranged to overlay a line of pixels.

Analogue display devices

Until relatively recently PC display devices invariably used CRTs which, as analogue devices, required an analogue signal to operate. This meant that the digital signals which generate the elements of a computer display had to be converted (digital to analogue) within the PC before being routed to the CRT. The format used was known as VGA (Video Graphics Array).

- **VGA, SVGA, and SXGA:** VGA is comprised of five separate signals: Red, Green and Blue which define the picture content, together with vertical and horizontal synchronising signals. VGA has a resolution of 640 (picture width) x 480 (picture height) pixels. Developments of VGA to give increased resolution and refresh rate are SVGA (Super VGA) 800 x 600 pixels and SXGA (Super eXtended Graphics Array) 1280 x 1024 pixels. Direct comparison of the picture quality of television and VDU displays is not straightforward because TV images are produced by a scanning process whereas PC

images are switched in discrete blocks or pixels. Generally, however, a VGA image corresponds fairly closely in quality to a standard PAL broadcast signal. SVGA and SXVGA are, however, of higher quality.

Digital Display Devices

As a result of their compactness and low energy requirements, LCDs have made the laptop a reality, and they are now tending to replace CRTs in desktop PCs. They are inherently digital in operation, but due to the universal VGA method of connection, VGA and its derivatives have generally been used to connect LCD screens to the PC. This involved not only coding of the digital elements of the display in the PC to the analogue VGA format but a decoding process in the LCD device to convert VGA back to digital. This extensive and unnecessary signal processing introduced unwanted signal noise, distortion and complexity. To overcome this limitation digital interfaces were developed that enabled direct digital connection between a PC and its VDU. The main interface now used is known as DVI (Digital Video Interface).

Development of the Digital Video Interface

The first digital interface was developed by VESA (Video Electronics Standards Association) in 1997. Known as the D&P interface, it used TMDS (Transmission-Minimised Differential Signalling) digital signalling and included USB, Fire-wire and analogue VGA channels but was unpopular due to its complexity. A simpler derivative developed by the DFP (Digital Flat Panel) group dropped the VGA, USB and Fire-wire streams but was limited by a top resolution of 1280 x 1024 pixels. The DDWG (Digital Display Working Group), formed by manufacturers, designed the DVI standard interface. This is now becoming the de-facto standard, not only for LCD monitor connection, but also between other equipment such as DVD players and high definition viewing screens. DVI has a resolution up to 1920 x 1080 pixels.

The DVI connection has three versions:

- DVI-D that conveys digital signals only
- DVI-A that transfers only analogue signals
- DVI-I (Integrated) that combines digital and analogue in a single connector.

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