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tech tips

Overview Of Computer Monitors

A computer monitor operates much like a television without a tuner or an IF section. Instead of receiving an RF signal, converting it to an IF signal, and detecting the signal to produce video, a monitor receives the video information straight from the computer through red, green, and blue (R,G,B) video lines. Horizontal and vertical synchronizing pulses supplied from the computer lock the picture. There are several types of computer monitors. Each monitor receives an input signal from the computer and converts the signal into a graphic image.

This Tech Tip will familiarize you with the different types of computer monitors, methods of supplying horizontal and vertical sync, and monitor resolution

Monitor Types

There are two common types of monitors: digital and analog. A digital computer monitor receives TLL signal levels and produces colors through combinations of "1's" and "0's" as shown in Figure 1. Monochrome digital monitors have one or two video inputs and display one or two shades of amber, green, or white and black.

Three, four, or six video input lines may be used for color digital computer monitors: red, green, blue, red intensity, green intensity, or blue intensity. The intensity lines are used in digital monitors to vary color saturation. Color digital monitorscan display 8, 16, or 64 colors depending on the number of video inputs. Using TTL signal levels limits the number of colors displayed by the color digital monitor.

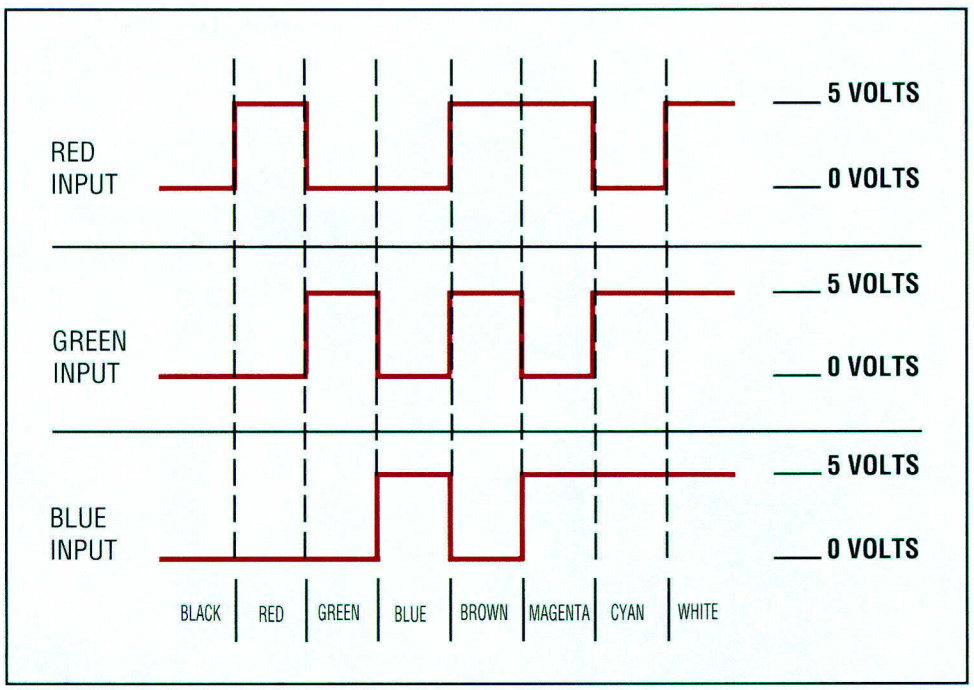

Fig. 1: Alternating TTL levels from 1's and O's produce shades of gray or colors in digital computer monitors.

Three video input lines are used for color analog computer monitors: red, green, and blue. A single input line is used for analog monochrome computer monitors to produce shades of gray. Colors or shades of gray are created by varying a voltage between 0.0 and 0.7 volts peak-to-peak. An infinite number of colors or shades of gray are possible as shown in Figure 2.

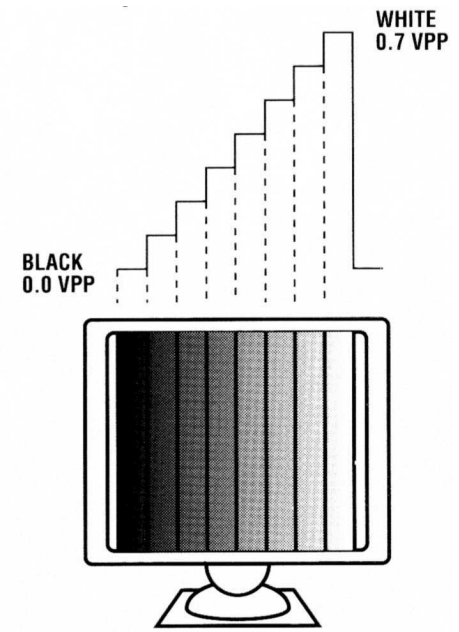

Fig. 2: Varying voltage levels from 0.0 to 0.7 volts peak-to-peak produce infinite shades of gray or colors in an Analog monitor.

Because of the low resolution of early computer montiors, picture quality and clarity was extremely poor. To improve resolution of these monitors, high resolution monitors were developed. These monitors have faster scanning frequencies and more displayed pixels. More pixels are displayed in less time, thus increasing the monitor's bandwidth and vastly improving picture quality. For example, the NTSC television system uses a scanning frequency of

Mode	Horizontal Frequency (kHz)	Vertical Frequency (Hz)	Horizontal Resolution (Pixels)	Vertical Resolution (Lines)
CGA (Color Graphics Adapter)	15.7	60	640	200
MDA (Monochrome Display Adapter)	18.4	50	720	350
HGC (Hercules Graphics Card)	18.4	50	720	350
EGA (Enhanced Graphics Adapter)	21.8	60	640	350
PGC (Professional Graphics Controller)	30.5	60	640	480
VGA (Video Graphics Array) 1	31.5	70	640	350
2	31.5	60	640	480
3	31.5	70	720	400
Apple MAC II	35.5	67	640	480
Super VGA	35.2	56	800	600
8514 A	35.2	87	1024	768
XGA (Extended Graphics Array)	35.2	87	1024	768

Fig. 3: Computer monitor's use higher scan rates and more displayed pixels for improved performance capability.

15.7 kHz and produces a bandwidth of 4.2 MHz. The VGA computer format uses a scanning frequency of 31.5 kHz and produces a bandwidth of 25.2 mHz.

Sync Input Methods

To display an image, a monitor requires two synchronizing signals for the scan circuits: horizontal sync and vertical sync. Computers operate at different scan frequencies for each format as shown in Figure 3.

A multiscan monitor can receive and lock to a range of scanning frequencies within its specifications. The monitor automatically locks to the frequency applied to the input. For example, one multiscan monitor model will sync to horizontal frequencies between 15 kHz and 35 kHz. If this monitor receives an MDA format, (see Figure 3) the horizontal circuits will automatically sync to 18.5 and the vertical circuits will sync to 50 Hz.

Computer monitors use three different sync input schemes. The first method uses separate vertical and horizontal sync inputs. The second method usesavertical and horizontal composite sync input. The third method uses vertical and horizontal composite sync on a video line (usually green). For example, Apple Macintosh@ monitors use a composite sync signal on the green video input line.

Resolution

Resolution refers to the maximum number of light-to-dark transitions a monitor is able to produce. Resolution is measured in pixels or lines. (Horizontal Resolution is almost always defined by pixels, where as vertical resolution may be specified in vertical lines or pixels.)

A pixel (picture element) is the smallest area of light or dark the monitor can produce. The number of pixels displayed from top to bottom of the screen is vertical resolution or vertical lines. The number of pixels displayed across the screen is horizontal resolution.

Good resolution is needed in order to produce a crisp picture. Four factors contribute to a crisp picture:

1. Bandwidth
2. Dot Pitch
3. Refresh Rate
4. Scanning Method (Progressive or Interlace)

The bandwidth of a monitor is the maximum frequency that the video circuits can pass. Bandwidth determines the fine detail of the picture. If the frequency response of the video circuit decreases, the small imagesand fast transitions will appear to be out of focus or blurry.

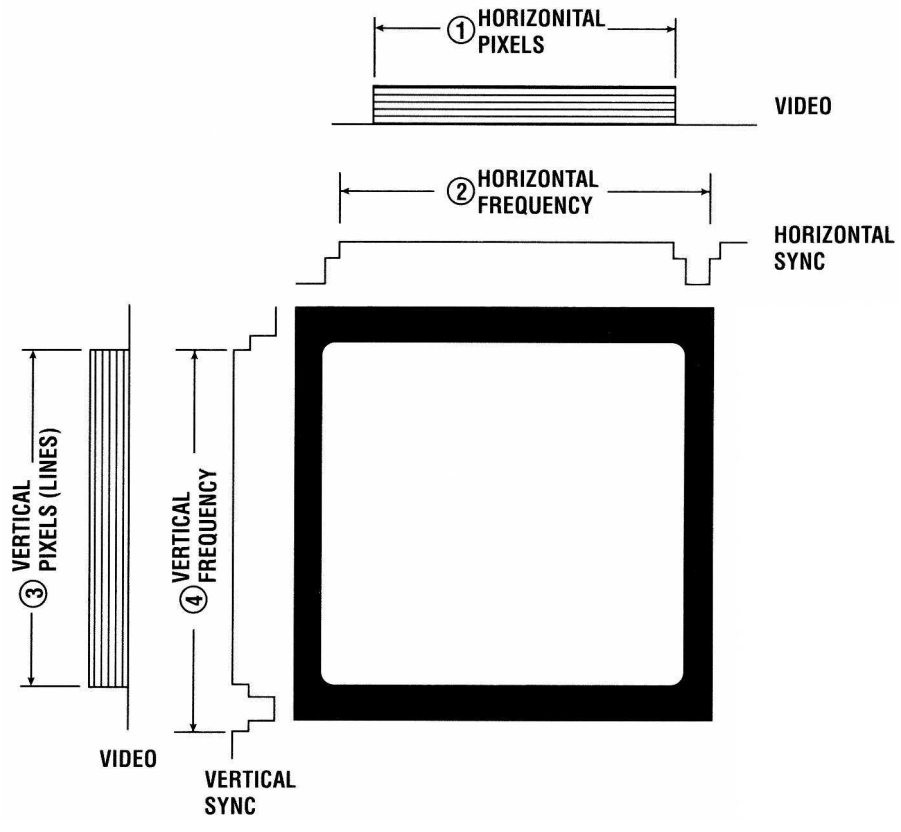

Fig. 4: A monitor's resolution is described in pixels or lines.

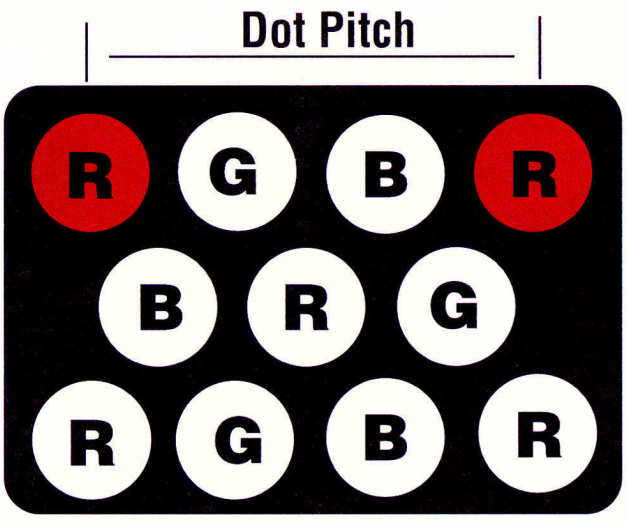

Fig.5 ***Dot*** *pitch is the distance between like colors.*

Dot pitch is the distance between like colors in the shadow mask. For example, the distance between the center of one “red” hole and the next “red” hole as shown in Figure 5. Dot pitch determines the smallest size pixel a color CRT can produce. The smaller the dot pitch, the sharper the image. Typical values of dot pitch are between .26 and .31 mm.

Refresh rate is the time it takes to display a full frame of video information. If the refresh rate of a monitor is 60 Hz, it takes 1/60 of a second to display a full picture.

Two methods may be used forvertical scan: progressive scan or interlace scan. Progressive Scan sweeps the picture tube once to produce a full frame of video. Interlace Scan uses two fields (even and odd) of sweep to produce a full frame of video.

A disadvantage of interlace scan is "half-line” jitterwhich causes the picture to flicker. Interlaced monitors enable high resolutions while keeping the bandwidth lowerthan what would be required by a noninterlaced monitor with the same resolution and vertical scan frequency.

Input Connectors

The input connectors on computer monitors take on a wide variety of wiring configurations and physical shapes and sizes. Some computer monitors take a 9 pin subminiature D (D-Sub) connector, others a 15 pin D-Sub, others a 15 pin high density D-Sub, and still others use BNC connectors (see Figure 6). The CGA, EGA, MDA, and PGC computer monitor formats all use the 9 pin D-Sub, but their wiring configurations are different. Some of the more common connectors are shown in Figure 6.

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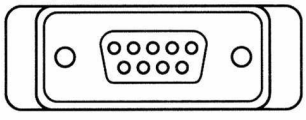
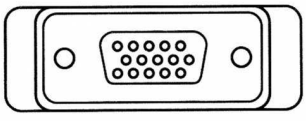
9 Pin Sub Miniature D



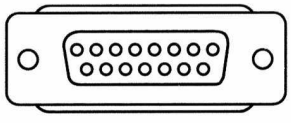
	CGA MDA. HERCULES	EGA	PGC
RED	3	3	1
GREEN	7,4	4	2
BLUE	5	5	3
INTENSITY	6	2	NC
INTENSITY	NC	6	NC
H SYNC	8	8	NC
COMP SYNC	NC	NC	4
GND	1	1	8
RED GND	NC	NC	6
GREEN GND	NC	NC	7
BLUE GND	NC	NC	8
INTENSITY	NC	7	NC
GND	2	NC	NC
V SYNC	9	9	NC
+5 MODE	NC	NC	NC

15 Pin High Density D-Sub



	VGA, SVGA PS/2, XGA
RED	1
GREEN	2
BLUE	3
INTENSITY	NC
INTENSITY	NC
H SYNC	13
COMP SYNC	NC
GND	4.5
RED GND	6
GREEN GND	7
BLUE GND	8
INTENSITY	NC
GND	10.11
V SYNC	14
+5 MODE	NC

15 Pin D-Sub



	APPLE, MAC
RED	2
GREEN	5
BLUE	9
INTENSITY	NC
INTENSITY	NC
H SYNC	NC
COMP SYNC	3
GND	11
RED GND	1
GREEN GND	6
BLUE GND	13
INTENSITY	NC
GND	14
V SYNC	NC
+5 MODE	NC

Fig. 6: Computer monitors use a variety of connectors and wiring configurations ***to*** *hook to the video circuit*

Notes:

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