VIDEO 101
LCD MONITOR OVERVIEW

This provides an overview of the monitor nomenclature and specifications as they relate to ***TRU-Vu*** industrial monitors. This is an ever changing industry and as such all specifications are subject to change.

LCD TECHNOLOGY

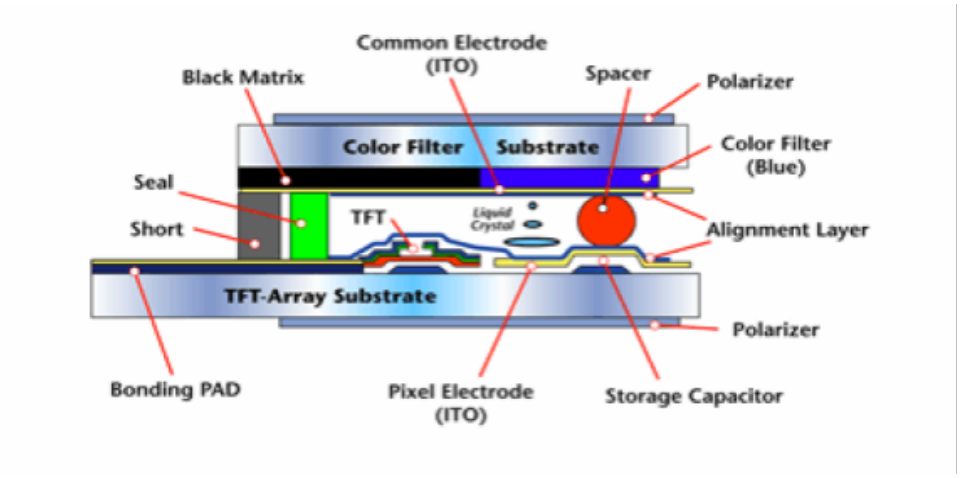
The LCD monitor represents the display technology of choice for the current applications targeted by ***TRU-Vu*** monitors. LCD offers the best compromise between performance, price, and reliability.

LCD Advantages:

- Will not burn in the image. This is critical when viewing static images
- Thin and lightweight
- Perfect geometry of the image
- Superior focus across the entire image
- Reliability

HOW LCD'S WORK

LCD stands for Liquid Crystal Display. It utilizes liquid crystals sandwiched between two layers of glass, that when energized allow light to pass through. In the "off" state, a liquid crystal will block light. Think of an LCD as a shutter that controls the passage of light. There is a fluorescent or LED backlight behind the LCD that is constantly on. The light from the backlight is passed through the LCD module, where the amount of light is modulated by each individual pixel to create various levels of brightness. In the front pane of glass are color filters. These are vertical stripes of Red, Green, and Blue that when combined form a pixel and can produce any color of the spectrum. White is achieved by opening all colors, black by blocking all colors. The location of each individual pixel is fixed with an LCD, as compared with a CRT where the pixel location is determined by the location of the electron beam.



COMPONENTS OF AN LCD DISPLAY

Compared with a CRT monitor, the LCD display is a much simpler device. This relates to less components used and therefore higher reliability.

LCD Panel
The glass display window. This is a light shutter that varies the amount of light allowed through a given color of sub-pixel to create an overall image. There are approximately six major manufacturers of LCD panels, with another half-dozen smaller, specialized LCD producers. The LCD module typically includes the backlight as part of a complete assembly. All LCD modules have polarizers to direct the light, and diffusers to eliminate bright spots where the lamps are.

Backlight
The light source is behind the LCD Shutter. This is typically made of CCFL fluorescent lamps or an array of LED's. There are Direct backlight and Edge backlight configurations. Most backlights are CCFL Fluorescent, but LED's are making major inroads.
Fluorescent lamps are typically rated at 50,000 hours, but temperature (both internal and external) has a huge effect on the actual life. LED's are 100,000+ hours.

Inverter
An electronic ballast to drive the fluorescent lamps of the LCD module. A high-voltage, low current device, it is critical that the inverter be matched to the LCD for maximum lamp life. Typically converts 12V to 400 to 600V for the lamps.

A/D Controller Board
The brains of the unit. The controller board converts either an analog or digital signal from the camera/computer to the digital signal the LCD module requires. This board also controls all other aspects of the signal and display quality such as the On Screen Display function, Scaling, and audio.

OSD Board
On-Screen Display board. A switch board to control the parameters of the display such as power, brightness, contrast, color, image sizing, sound volume, etc. LED's indicate monitor status:
Green = Signal Received; Amber = No Video Signal Being Received

Power Supply
LCD's are typically powered internally by 12 or 24 VDC. To operate the display, an AC/DC transformer is required. The transformer can be either internal or external to the display. An external transformer would be the "Power Brick" that is common on smaller sized displays, while the internal style would have a power cord with IEC-320 style plug that connects directly to a wall outlet. There are advantages to both types; the external does not induce heat to the monitor, while the internal is more convenient.

RESOLUTION

The resolution of the display is determined by the quantity of horizontal and vertical pixels. An LCD has a "Native" resolution, which is the fixed quantity of horizontal and vertical pixels. Through scaling of the graphics chip, the LCD can display many resolutions other than the native resolution. For example, when the signal source is putting out 640x480 resolution on a 15" LCD (native is 1024x768), it will expand the image to fill the entire screen rather than showing a reduced size image in the center of the screen. There are VESA standards of resolution that are typically used for display properties. Occasionally, there will be proprietary signals that are not compatible with standard LCD displays. These proprietary signals can be especially difficult for an LCD to resolve. Due to the LCD using digital logic, they typically require a very structured signal.

VESA Standard Resolutions:

VGA:	640 x 480 pixels
SVGA:	800 x 600
XGA:	1024 x 768
WXGA:	1280 x 768
WXGA:	1366 x 768
WXGA+:	1440 x 900
SXGA:	1280 x 1024
WSXGA+:	1680 x 1050
UXGA:	1600 x 1200
FULL HD:	1920 x 1080

These represent the standard sizes as dictated by VESA (Video Electronics Standard Assoc.); there are others available in specialty markets. Often the resolution will be referred to as X mega-pixels (MP); this refers to the quantity of total pixels on the display in millions, multiplying the Horizontal x Vertical. Example SXGA = 1280 (H) x 1024 (V), or 1.3MP; UXGA is 1600 x 1200, or 2MP.
Note: Most LCD panels can up-convert a low-res signal and display it, but few can down-convert a higher-resolution signal and display it.

Note about HD resolution: As many consumers have learned the hard way, there are different levels of HD resolution. Full HD, or 1080p, has 1920 x 1080 pixel resolution. 1080i also has 1920 x 1080 resolution, but it is an interlaced signal, not progressive scan, so you actually get 2 fields of 1920 x 540. 720p has a pixel resolution of 1280 x 720. Thus, 720p provides higher vertical resolution than 1080i (720 lines vs. 540 lines) and is preferable for displaying fast-moving action.

BRIGHTNESS

The brightness off the monitor is measured in nits.

1 Nit = 1 candela/meter^2 (cd/m^2)

1 Nit = 3.42 foot lamberts

A typical laptop has a brightness of around 150-250 nits. Standard ***TRU-Vu*** 12-20” monitors will have a brightness of 250-400 nits; some up to 550 nits. 26” to 52” monitors average around 500 nits. “Sunlight Readable” displays will be 1000 nits, to as high as 1700 nits.

ASPECT RATIO

There are two basic aspect ratios available: 4:3 (standard) and 16:9 (widescreen). The 4:3 aspect ratio displays (nearly square) are slowly being replaced by widescreen displays, driven by the HD television market. Standard aspect ratio displays are only available in sizes of 20.1" and smaller. Note: 5:4 aspect ratios are common with 17” and 19” displays. Widescreen (16:9 and 16:10) aspect ratio displays are available in a wide range of sizes.

VIDEO CONNECTIONS

There are different input connections for LCD monitors, typically associated with given resolutions. There are other, less common connectors, but the following are the most prevalent in the industry.

Analog

BNC Composite/CVBS (Composite Video Blanking and Sync) BNC connectors twist and lock on securely. Typically associated with NTSC and PAL, analog resolution, interlaced signals. Has video, color, and sync signals combined in one carrier.

RCA (Radio Corporation of America) Traditional plug connector for audio or video. Still prevalent with audio; not as popular as BNC for video, due to its inability to lock on. Carries same signals as BNC.

S-Video (Separate Video) Four-Pin Mini-Din connector. An analog signal that separates the Brightness and Color components of the video signal. Slightly better than Composite for image quality; associated with NTSC, PAL, and SECAM interlaced signals..

VGA (Video Graphics Array) Standard computer monitor interface. HD-15 D-Sub connector. Analog signal capable of running from VGA through UXGA (1600x1200) resolutions. Utilizes separate R, G, B color and Horizontal and Vertical sync signals.

Digital

DVI-D (Digital Visual Interface- Digital) 24-Pin D-shaped connector, compatible with DVI-I connector from a mechanical standpoint. Pure digital signal, no analog component transmitted. Not as common as the DVI-I signal due to the universality of the DVI-I signal.

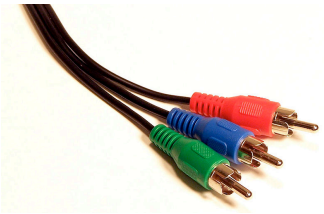
DVI-I (Digital Visual Interface- Integrated) 27-Pin D-shaped connector. This has both the digital and analog components of the signal. The analog portion allows the signal to work with VGA connections when a DVI-to-VGA adaptor is used.

HDMI (Hi-Definition Multimedia Interface) 19-Pin connector, similar in size to a USB connector. Uncompressed Digital signal for video and audio. Capable of displaying up to Full HD signals. Typically used in consumer HD applications. All manufacturers must pay a royalty to offer HDMI. Three types of connectors: Type A (standard), Type C (mini) and Type D (micro). Adapter available to connect to DVI.

DISPLAY-PORT Developed by VESA; royalty-free. Has 20 pins and is available in 2 sizes: DisplayPort and Mini DisplayPort. Locking connector. At 21.6 GB, it has more than double the bandwidth of HDMI. DisplayPort 1.2 can carry video resolutions of up to 3840 x 2160 pixels, at a refresh rate of 60 Hz. It can also carry multichannel digital audio. Adapter available to connect to VGA, DVI or HDMI.

HD-SDI (Hi-Definition Serial Digital Interface) BNC connector. Popular in the Broadcast Industry.

YCbCr (Color Component Video) Uses a 6-pin Mini-Din connector. The digital signal is separated into Y (the luma/brightness), Cb (the blue minus luma) and Cr (red minus luma). The difference between YCbCr and RGB is that YCbCr represents brightness and two color difference signals, while RGB represents color as red, green and blue only. YbCbCr takes advantage of the fact that the eye is more discriminating of brightness than color.



MOUNTING

Most LCD monitors use standard VESA mounting hole patterns. These standard patterns allow compatibility between the various monitor and mounting hardware manufacturers.

TRU-Vu Mounting Patterns are:

75mm x 75mm 8.4”-19”
100mm x 100mm 20”-42”
200mm x 100mm 26”-42”
Screws are M4, 8 mm long. 42” and larger monitors use M6 screws

The larger displays (32”+) also utilize a method of mounting directly to the LCD module for greater stability.

PROTECTIVE GLASS

A standard LCD panel has a very matte finish and produces excellent image quality. However, sometimes the LCD surface needs to be protected from potential damage. ***TRU-Vu*** offers both Anti-Glare and Anti-Reflective protective glass. The AG glass will diffuse ambient light reflections, but has reduced contrast. AR glass offer better image contrast, but suffers from more reflections.

24VDC OPERATION

Several ***TRU-Vu*** monitors operate on 24vdc. This enables them to be mounted a greater distance away from the display. By remotely mounting the power supply, there are large savings in installation costs when the display is to be located in an area where AC power is not readily available. 24VDC operation allows smaller gauge wire to be run to the display versus 12VDC operation.

ASPECT CORRECTION

TRU-Vu 26” and 32” widescreen displays have a unique Aspect Correction feature to display the correct aspect ratio of a 4:3 camera image on a 16:9 display. It actually increases the H and V signals (in a 1:1 ratio), then drops off the top and bottom portions of the image. This feature does not distort the image horizontally (stretching) to fill the screen width, and there are no black bars on the sides. This is exclusive to ***TRU-Vu*** monitors. Ideal for metrology and gauging applications requiring larger monitors.

SETTING UP AN LCD DISPLAY

Typically an LCD display will have a very good image as it comes from the box. Additional improvements can be made to the display by adjusting the settings. The ideal tool to use is a grayscale pattern such as the SMPTE in Video Generator 640 x 480 pattern or equivalent. This will allow the Brightness and Contrast to be set correctly without guessing.

1. With a representative image on the screen, have the display "Auto Adjust". This will set the majority of the adjustments to their optimal level.
2. Set Brightness: With an image that displays Black portions, set the Brightness control to adjust these black portions so they appear black and not gray. Set too low, and the whole image will appear too dark, set too high and the image will appear washed out.
3. Set Contrast: With an image that has White portions, set the Contrast so that the whites are bright without becoming over saturated. There should be some definition between white and slightly darker regions of the image.
4. Once the Brightness and Contrast are set, the color temperature can be set. Choose 9300k (Cool) for a bluer image, 6500K (Warm) for a redder image, or USER to custom set the color temperature. Some displays offer an intermediate color temperature of 7500k. Color temperature can be subjective and greatly depends on the desired representation of the image.

SERVICE

While ***TRU-Vu*** monitors are extremely reliable, an occasional issue may arise. All ***TRU-Vu*** monitors are serviced right here in Illinois. Turn around time is typically less than one week; advanced replacement monitors may be available.

TECHNICAL SUPPORT

The ***TRU-Vu*** Technical Support team is comprised of technicians with over 15 years each in the Engineering/Technical Department. When you call with a question, the techs are on site and know the product first-hand.

CUSTOM PRODUCTS

With our vast array of available options and engineering capabilities, we can provide custom ***TRU-Vu*** monitors with all the features and functionality you need, at very competitive prices. LCD panels, enclosures, video connections, special features, private-labeling, custom mounting, and integrated accessory devices are all available to meet your precise OEM requirements.