

Module III

Expansion Cards

- >> Circuit boards to expand the capabilities of a computer
- >> Must match with the bus (PCI card on PCI slot, etc)
- >> Four most common type cards: Video, Multimedia, I/O, Communication
- >> **Video Adapters (Graphics Cards):** Enhance the video capabilities and qualities.

Some cards contain processors for extreme graphics and speed.

PCI, AGP and PCIe slots are commonly used for video cards.

- >> **Multimedia cards:** Include sound card, TV tuner cards and video capture cards.

Sound cards: In old systems, sound cards provide the basic sound facilities (headphone output, Auxiliary output and microphone input) and sometimes game ports too.

In newer systems, basic sound capabilities are on board and enhanced sound is provided by special sound cards.

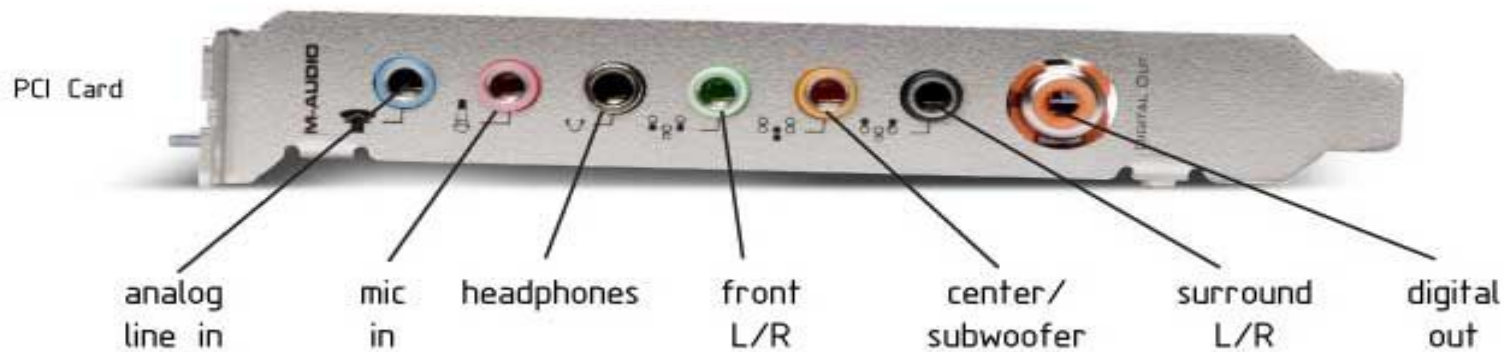
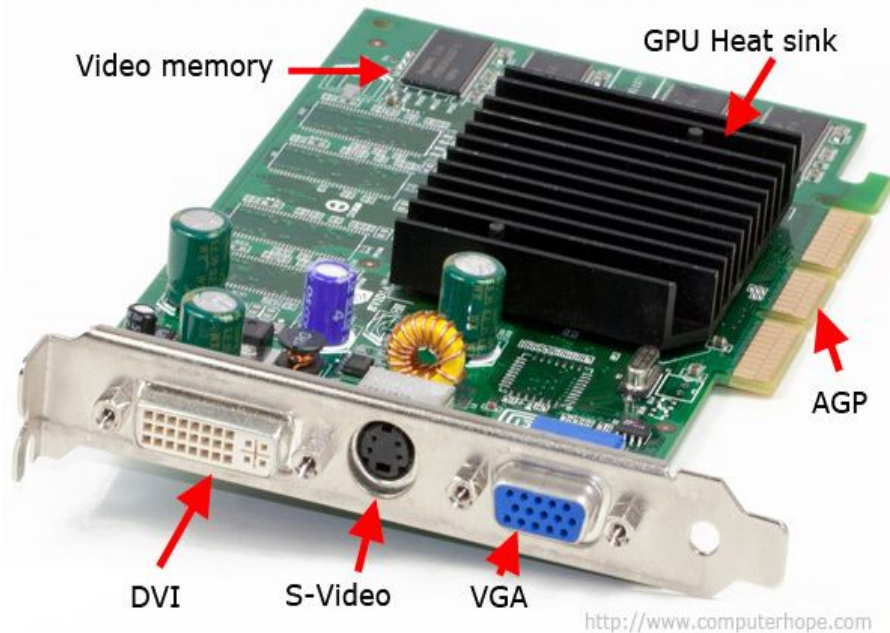
TV Tuner cards: Connect to a broadcast signal such as cable television

Can be internal or external.

Act as video capture card as well.

Comes with softwares to process the video streams.

Internal computer video expansion card



Sound Card



TV Tuner Card – PCI Interface



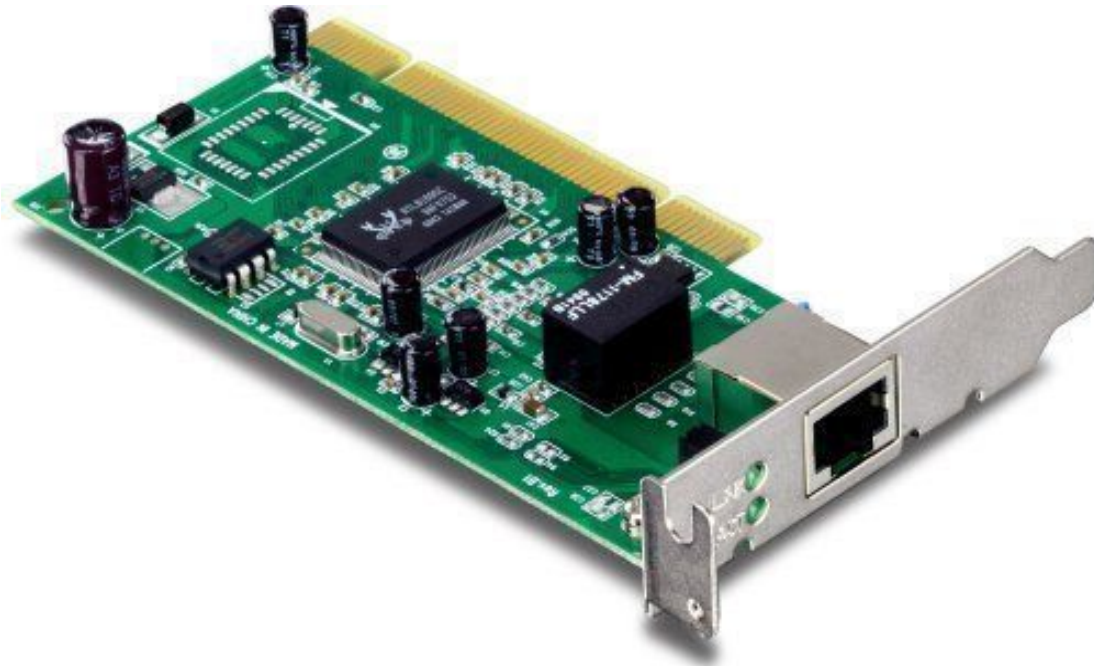
Parallel I/O card



I/O card for additional USB ports

Expansion Cards...

- >> I/O Cards: Serial and parallel ports, drive interfaces and SCSI interfaces.
- >> Communication cards: To communicate with the external networks. NIC, Modem.

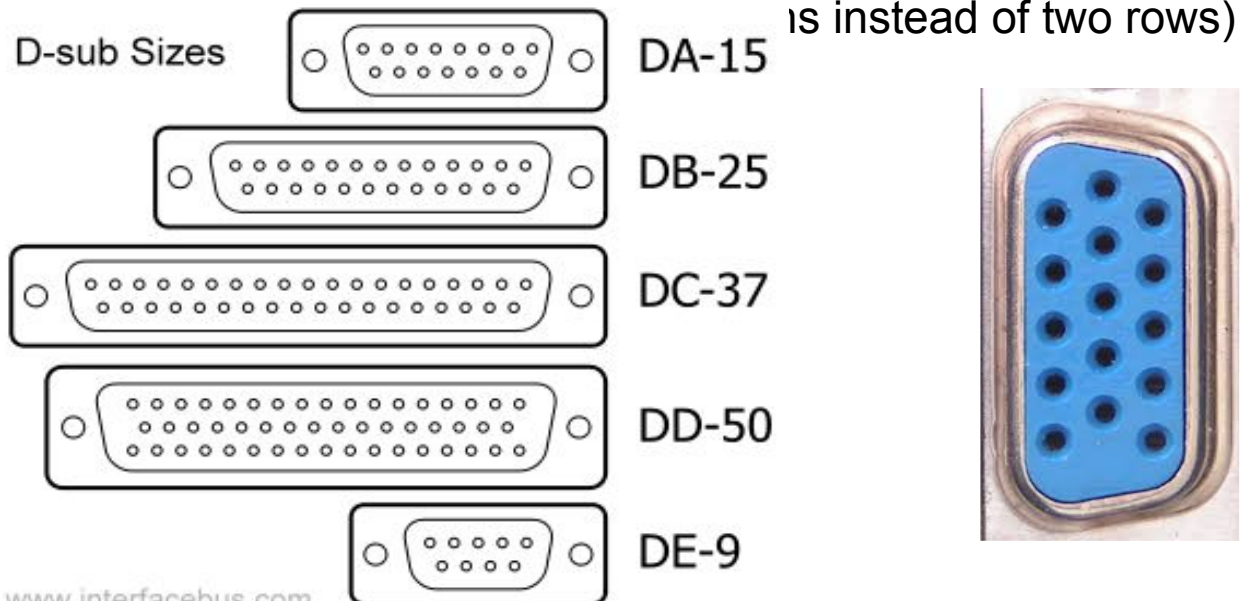


Characteristics of Connectors (ports)

D-subminiature Connectors (D-sub connectors):

- >> D shape to ensure correct orientation; no other keying
- >> Have two or three rows of pins (or holes).
- >> Represented by DXn where X ranges from A to E based on size and 'n' is the number of pins.

Connector	Gender	Use
DE9	Male	Serial port
DB25	Female	Parallel port
DA15	Female	Game port or MIDI port
DE15	Femal	



Characteristics of Connectors (ports)...

RJ-Series:

- >> RJ: Registered Jack
- >> RJ-45: for Ethernet networks that use twisted-pair cabling.
- >> RJ-11: used most often on cables in telephones and in modems.



RJ45



RJ11

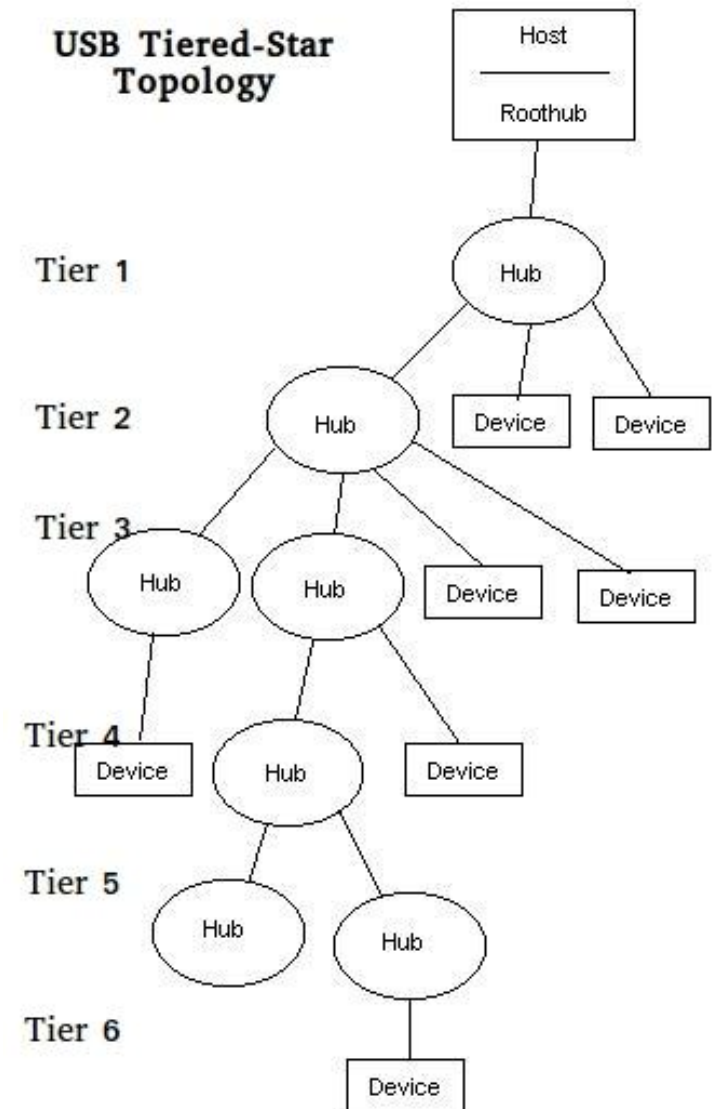


Characteristics of Connectors (ports)...

Universal Serial Bus (USB) port:

- >> Most common port today.
- >> A single USB port can handle upto 127 devices, but shares a common bus.
- >> Supports Plug-n-Play.
- >> Uses 'tiered star topology' with maximum number of levels limited to six.

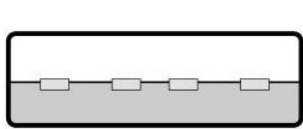
Release name	Release date	Maximum transfer rate
USB 1.0	January 1996	Low Speed (1.5 Mbit/s)
USB 1.1	August 1998	Full Speed (12 Mbit/s)
USB 2.0	April 2000	High Speed (480 Mbit/s)
USB 3.0	November 2008	SuperSpeed (5 Gbit/s)



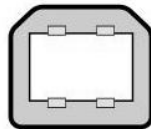
Characteristics of Connectors (ports)...

Universal Serial Bus (USB) port:

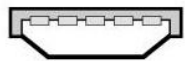
USB 1.1 - 2.0



A



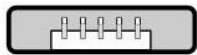
B



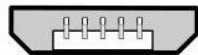
Mini-A



Mini-B

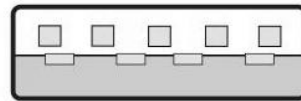


Micro-A

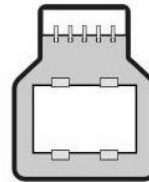


Micro-B

USB 3.0



A



B



Micro-B



Type-C

USB Icons:



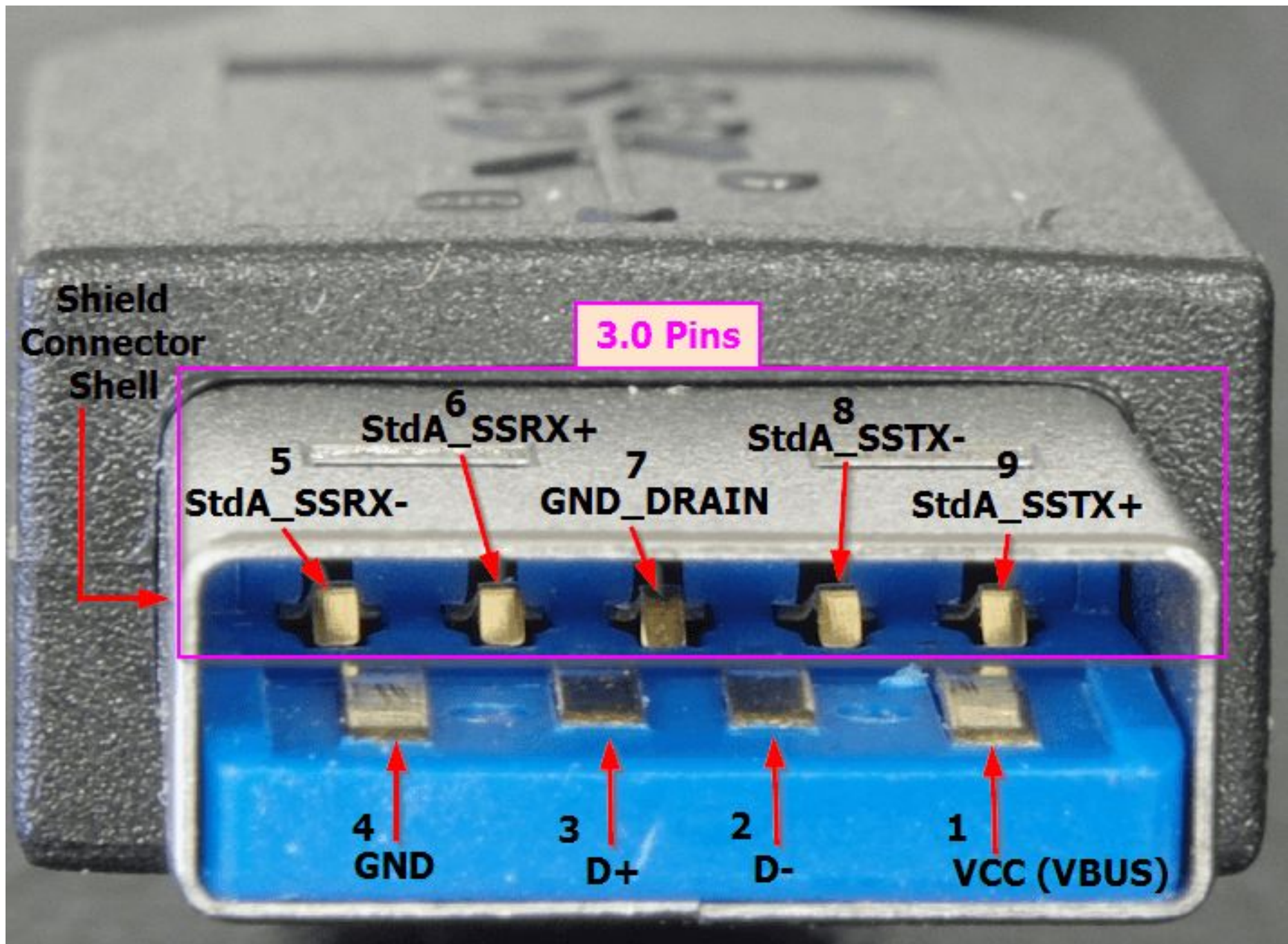
Supports USB 1.x



Supports USB 2.0 and 1.x



SuperSpeed USB 3.0 cable icon.



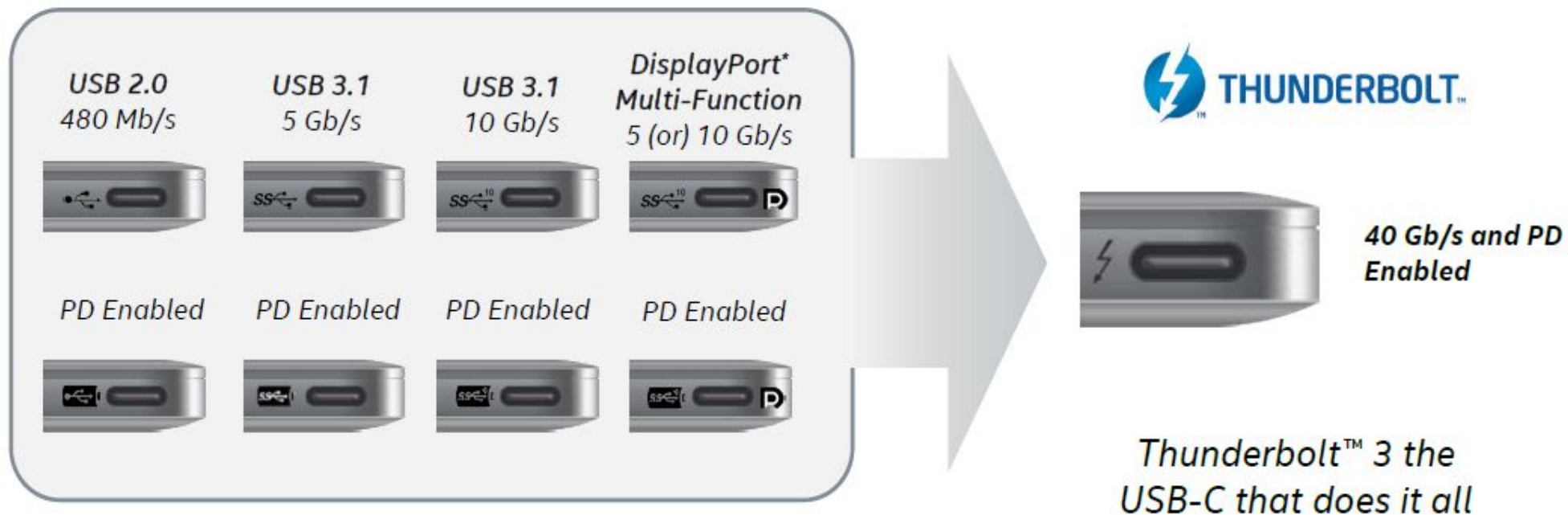
Common peripheral cables and interfaces...

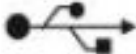


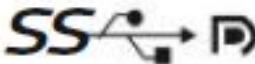




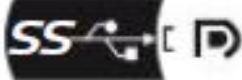


Serial Interfaces: USB

- >> USB 1.0 (1.5Mbps), USB 1.1 (12Mbps), USB 2.0 (480Mbps) and USB 3.0 (5Gbps).
- >> Have types A, B and C
- >> The 24 pin Type-C is a symmetrical connector standard.
- >> A standard cable has Type A on one side and Type B on the other side.
- >> USB hub can be connected to the existing USB port to extend the number of ports.

Specification	Maximum Cable Length	Total Cable with 5 Hubs
USB 1.0 / 1.1	3m	18m
USB 2.0	5m	30m
USB 3.0	3m	18m





		USB 2.0 High Speed 480 MBit/s	USB 3.1 Gen 1 (formerly USB 3.0) Super Speed 5 GBit/s	USB 3.1 Gen 2 (formerly USB 3.1) Super Speed Plus 10 GBit/s
Without Power Delivery	Without DisplayPort			
	With DisplayPort			
With Power Delivery	Without DisplayPort			
	With DisplayPort			
Thunderbolt 3 With Power Delivery and DisplayPort				

Common peripheral cables and interfaces...

Serial Interfaces: USB 2.0 and 3.0 differences

Shielding: In USB 3.0 each pair in the cable assembly be shielded to withstand the electromagnetic interference (EMI) inherent with transmissions at higher frequencies.

Connectors: Although all connectors are compatible with all receptacles, to attain SuperSpeed performance, SuperSpeed connectors with five additional pins must be used on cables and receptacles. These 5 pins sit farther back and are accessible only to compatible interfaces.

Bursting & streaming: USB 3.0 supports continuous bursting & streaming, but USB 2.0 does not.

Duplex: USB 2.0 is a half-duplex technology, but USB 3.0 supports duplex communications.

Media access method: USB 2.0 peripheral devices must wait until polled by the host before transmitting data. USB 3.0 endpoints use an asynchronous transmission mechanism, similar to that of Ethernet, where data is transmitted at will.

Host control: The host (computer system) is the only device in the USB 2.0 specification that can control power management. The endpoints are the only devices that can participate in error detection and recovery as well as flow control. USB 3.0 endpoints can all control when they enter low-power mode to conserve power. Error handling and flow control are performed on each link in USB 3.0, not just at the endpoints.

Power : USB 2.0 provides a maximum of 100 milliamperes (mA) of current at low power and 500mA at high power. USB 3.0 provides 150mA and 900mA.

Characteristics of Connectors (ports)...

IEEE 1394 (FireWire) Port

- >> Developed by Apple.
- >> Serial bus for high-speed communications and real-time data transfer.
- >> peer-to-peer network mode with synchronous clock (hence called **isochronous**).
- >> 400Mbps to 3.2Gbps and highspeed.
- >> Major use by digital video editing tools.
- >> Higher power output, reducing the need for external power to devices such as security cameras.

IEEE 1394(AKA Firewire, I-Link)



6-pin

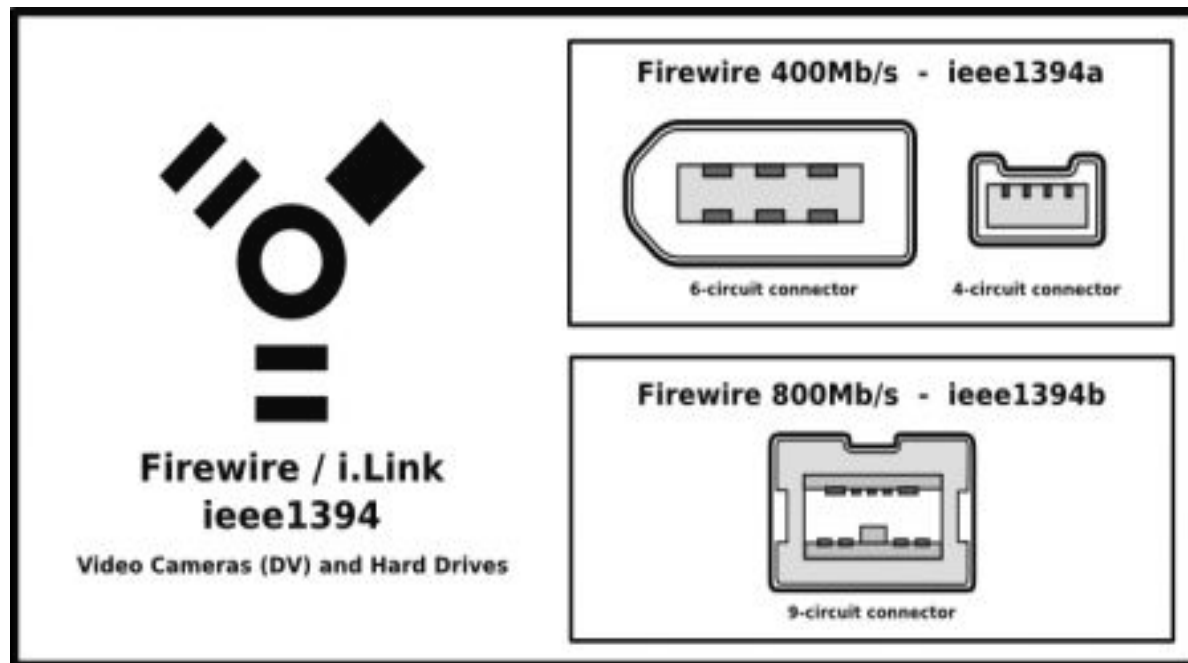


4-pin



Serial Interfaces: FireWire (IEEE 1394)

- >> It can provide 1.5A at up to 30VDC (ie, 45W); no need of external power to the connecting device.
- >> Two variants; FireWire 400 and FireWire 800.
- >> FireWire 400: Speed 400 Mbps. Works in half duplex. Supports 63 devices. Cable 4.5m
- >> FireWire 800 (IEEE 1394b): Speed 800 Mbps. Works in duplex. Supports 63 devices. Cable 4.5m with copper wire and 100m with optical fibre cables (speed upto 3200 Mbps).
- >> IEEE 1394c uses Cat 5e cables and RJ45 pins.



Characteristics of Connectors (ports)...

Infrared Port

- >> Used to communicate via infrared radiation.
- >> Mostly found on older computers.
- >> Very slow. Line-of-sight communication. Short distance.

Audio/Video Jacks:

- >> RCA jacks and connectors are used to transmit video and audio information.
- >> On a video card, a yellow coloured jack is used for composite video.



Characteristics of Connectors (ports)...

PS/2 (Keyboard and Mouse)

>> 6-pin mini-DIN connector



Centronics Port

>> Primarily used in parallel printer connections and SCSI interfaces.

>> The centronics cable is connected to the printer at the centronics port and the other end of the cable to the parallel port of the computer.

>> Developed by the Centronics printer company



Common peripheral cables and interfaces

Parallel Interfaces

- >> DB25 female connector on the computer.
- >> transfers data 8 bits at a time.
- >> faster than the original serial ports (RS232).
- >> generally used for printer communication.
- >> Three major types:
 1. Standard Parallel Ports (SPP): Transfer data in one direction only (from computer).
Found on the original IBM PC, XT, and AT.
150KBps speed at maximum 10 feet distance.
 2. Bidirectional Parallel Ports (BPP): Transmit and receive data.
Used for external CD-ROM drives and external parallel port backup drives.
 3. Enhanced Parallel Ports (EPP or IEEE 1284): Act as an extension to the main bus with the ability to send memory addresses as well as data.
Speed 600KBps to 1.5MBps.
- >> Enhanced Capabilities Port (ECP) can transfer data at 2MBps using DMA and buffering.

Parallel Port (DB25)



ComputerHope.com

Common peripheral cables and interfaces...

Serial Interfaces

>> Three main types:

1. Standard serial (RS-232)
2. Universal Serial Bus (USB)
3. FireWire (IEEE 1394).

>> Standard Serial (RS-232)

Present from the original IBM PC

They have either a DE9 or DB25 male port.

Maximum speed of 57Kbps and a maximum cable length of 50 feet.

Serial cables are of two types: **Standard** and **Null-modem**.

Standard serial cables connects a computer with a modem or printer.

Null-modem cable connects two computers directly without a modem.



Video Display Cables and Connectors

VGA (Video Graphics Array):

>> An analog standard introduced by IBM.

>> It has a 15 pin (3 rows) D-sub connector (DE-15) and cable.

>> The original VGA modes allowed for a maximum graphics resolution of 640×480 in only 16 (4-bit) colors. Today the minimum resolution and color depth (number of colors) is 1024×768 and 32-bit color.

VGA cable



VGA connector



Video Display Cables and Connectors

Digital Visual (or Video) Interface (DVI):

>> A digital standard but support analog standard too.

>> Three types:

DVI-A: Analog. Source and display device must be analog.

DVI-D: Digital. Source and display device must be digital.

DVI-I: Combination of analog/digital. Source and display device must same type.

>> The DVI-D and DVI-I connectors come in two varieties: single link and dual link.

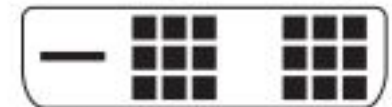
>> DVI-A and DVI-I are superior to VGA. Travel longer distances than VGA and are pin compatible to VGA using passive adapters.



DVI-I (Single Link)



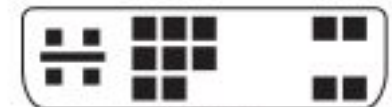
DVI-I (Dual Link)



DVI-D (Single Link)



DVI-D (Dual Link)



DVI-A



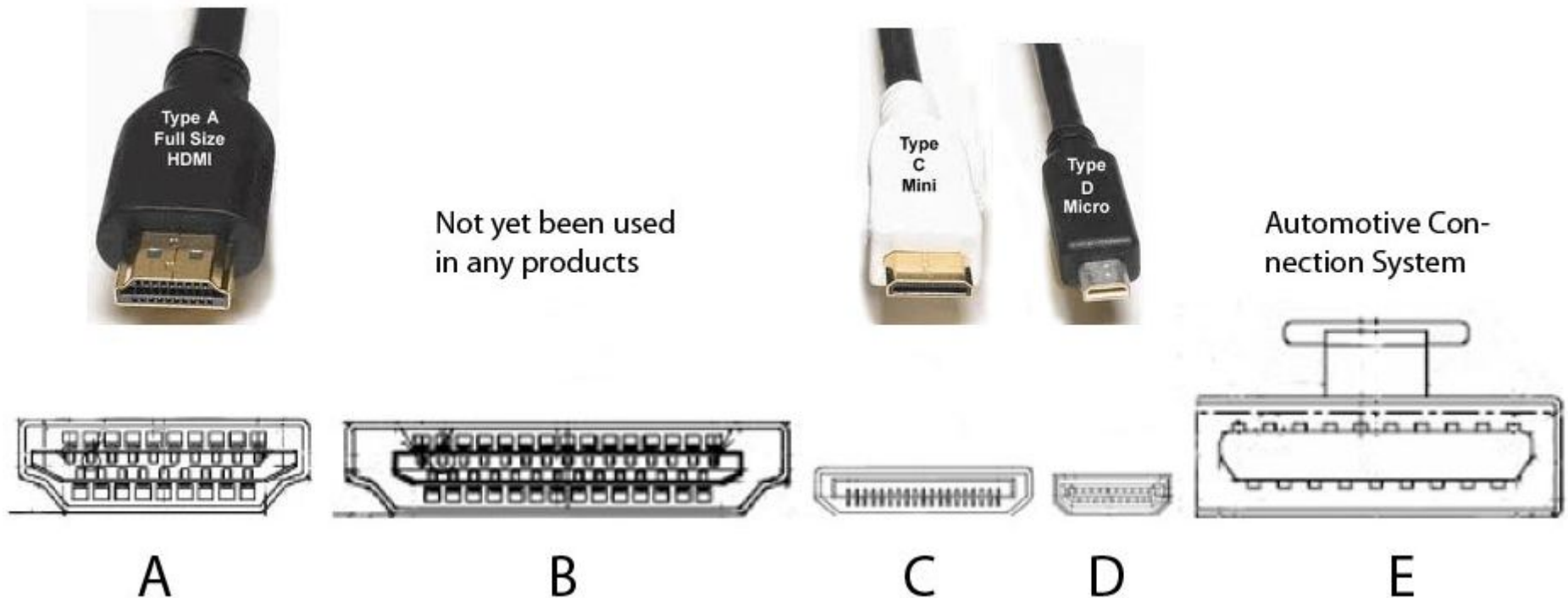
Video Display Cables and Connectors

High-Definition Multimedia Interface (HDMI):

>> A digital video technology that includes high-quality high-resolution uncompressed **video and audio**.

>> Also supports an optional Consumer Electronics Control (CEC) feature that allows all the connected devices to be controlled by a single remote control.

>> Different types: Type A, Type B, Type C (mini HDMI), Type D (micro HDMI) and Type E.



Video Display Cables and Connectors

Component Video:

>> Analog uncompressed video.

>> Transmitting the primary colour components (Red, Blue and Green) through separate wires (with similarly coloured RCA/BNC codes).

>> The brightness (greyscale) part of the signal (called Luma 'Y') is subtracted from Red and Blue ($P_r = R - Y$ and $P_b = B - Y$) and the green wire carries the Luma too.

>> This technology is also called YPbPr.

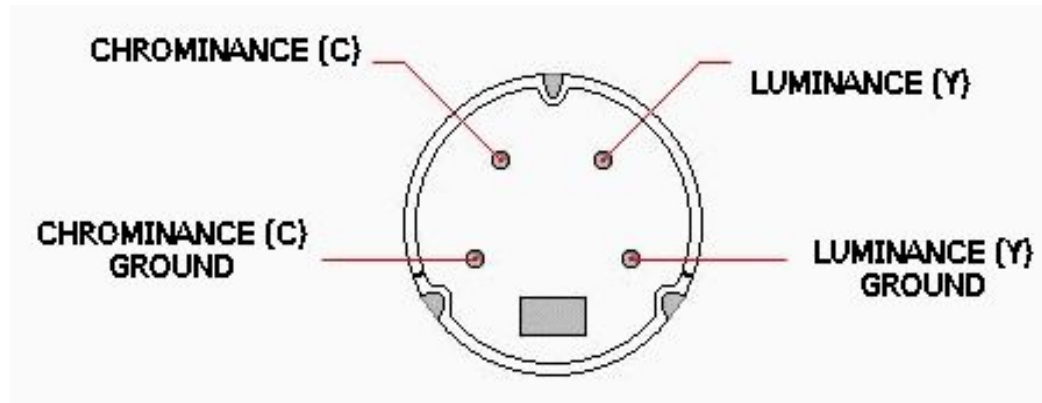
>> A digital version of this is called YCbCr.



Video Display Cables and Connectors

S-video (Separate Video)

- >> Transmits colour (chrominance) and brightness (luminance) separately.
- >> Use 7-pin mini-DIN and 4-pin mini-DIN connectors.
- >> 4-pin male connector is compatible with a 7-pin female connector.



Video Display Cables and Connectors

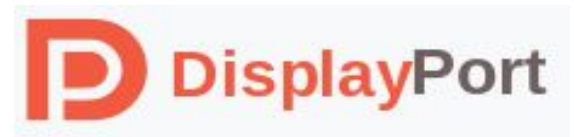
Composite Video:

- >> It combines all luma and chroma leads into one.
- >> It is the bottom type for analog signal; used in most of the T and DVD purposes.
- >> Less quality but great cost efficiency.
- >> Seen as yellow RCA connector.



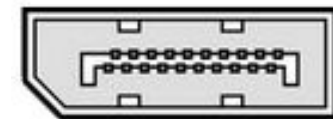
DisplayPort:

- >> By Video Electronics Standards Association (VESA)
- >> Uses less power than other digital interfaces and VGA.
- >> it can also carry audio, USB, and other forms of data.
- >> HDMI and DVI cables can be connected to DisplayPort using passive adapters.
- >> Cable can be 3m; but with cable-power it can be 33m.
- >> Intel and Apple combined DisplayPort and PCIe technologies to form a Thunderbolt Interface.
- >> Thunderbolt cable can be 3m long.
- >> Thunderbolt 1 and 2 use the same connector as Mini DisplayPort (MDP), whereas Thunderbolt 3 uses USB-C.
- >> It has the same label as the Lightning-bolt port.



DisplayPort

Video and Audio Port for
Home Theater Systems



Thunderbolt 3

Video Display Cables and Connectors

Coaxial:

- >> Coaxial cables are used to transfer video signals.
- >> Connectors are RCA, BNC and F connectors.

F Connector



Input Devices: Mouse

>> A hand-fitting device.

>> A motion-detection mechanism translates its physical two-dimensional movement into onscreen cursor motion.

>> Many variations exist, including trackballs, tablets, touchpads and pointing sticks.

>> Invented by Douglas Engelbart; but made the part of computer by Apple in its Macintosh.

>> First there was ball mouse, later came optical mouse.

>> Today wireless mechanism is used.

>> Today's mouse has two buttons, and a scroll wheel which acts as a third button.

>> On laptops, Touch pads (flat panels below the spacebar) and pointing sticks (eraser-like protrusions in the middle of the keyboard; seen in IBM Thinkpad series).

>> There are trackball which has a protruding rotating-ball and buttons on the top of the device to use in a tight space.



Pointing Sticks

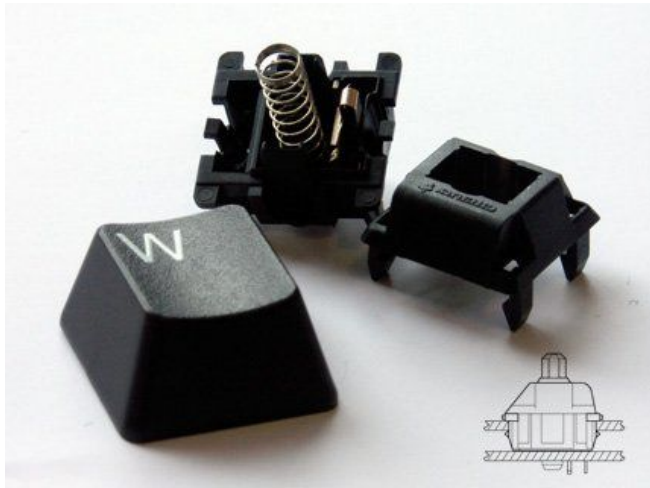


Trackball

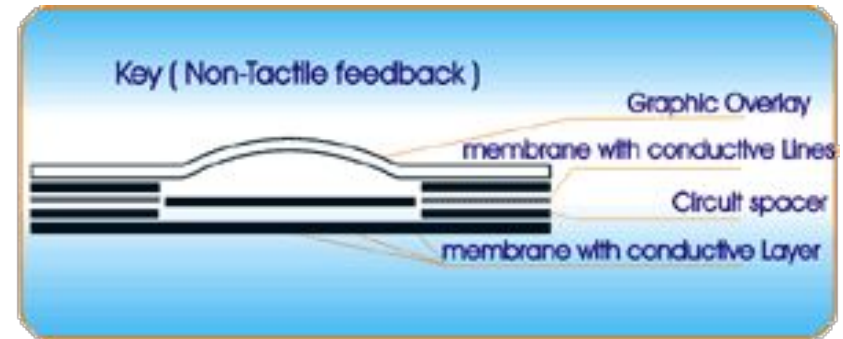
Input Devices: Keyboard

- >> Most common input device.
- >> QWERTY keyboard is widely used.
- >> Different types of keyboard technologies such as dome-switch, membrane type, scissor switch, mechanical switch, capacitive keyboards, etc.
- >> Mechanical switches and membrane type switches are commonly used in keyboards.
- >> Key switches generate typical codes of signal when they are depressed and these signals are sent to the PC.





Mechanical Keyboard key



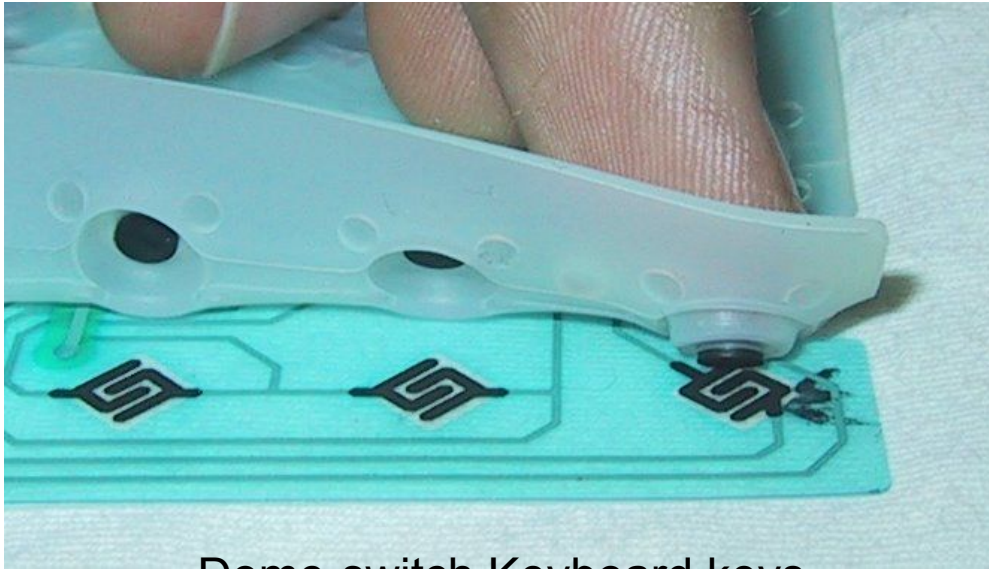
Membrane Keyboard key



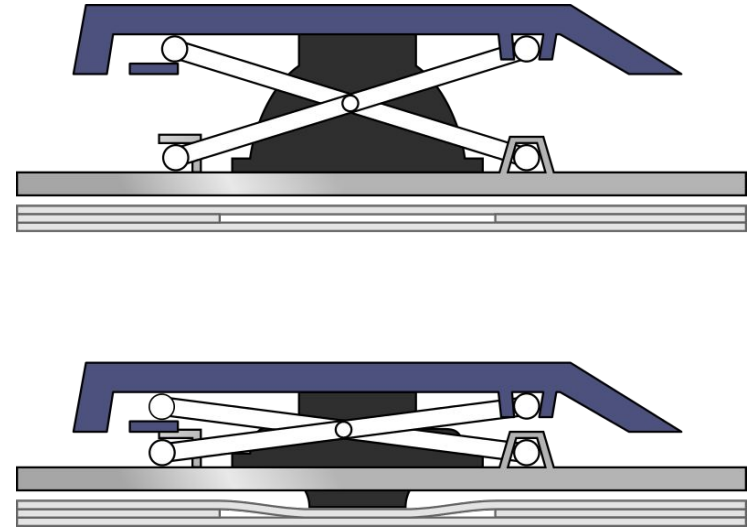
Mechanical Keyboard



Flexible membrane keyboard



Dome-switch Keyboard keys



Scissor-switch keyboard key



Dome-switch Keyboard



Scissor-switch keyboard

Input Devices: Scanner

>> Scans images/documents and sends as digital information to computer.

>> First used SCSI interface, now USB.

>> Working: The document is highlighted using an illumination method, lead the reflected light through a set of mirrors and colour filters to a lens which focuses the light into charge coupled devices (CCD), which converts the captured information into digital form. Here either the document or the head moves to scan the entire document.

>> Three types of scanners:

Flat Bed scanner: The document is placed above a flat surface, the head moves from one end to the other.

Sheet Fed scanner: Head remains stationary and the image is moved in front of the head. It occupies less space and it is less expensive.

Hand Held scanner: Scan-head and the image will not move. The user moves the scanner above the image two-three times to get the full image. Quality low and depends on the skill of the user.



Input Devices: Barcode Reader

>> Commonly used in retail and other industrial sectors that manage inventory.

>> Use LEDs or lasers as light sources and can scan one- or two-dimensional barcodes.

>> Interfaces: RS232 or USB.

>> Commonly used to read product's identification number, a website's URL, a phone number, etc.



Digitizer (Digitizing Tablet)

>> Reproduce incredibly good artwork in digital form.

>> Place the analog artwork on top of a sensor and use a stylus to trace the artwork after choosing an onscreen “crayon” or “pen”.



Biometric Devices

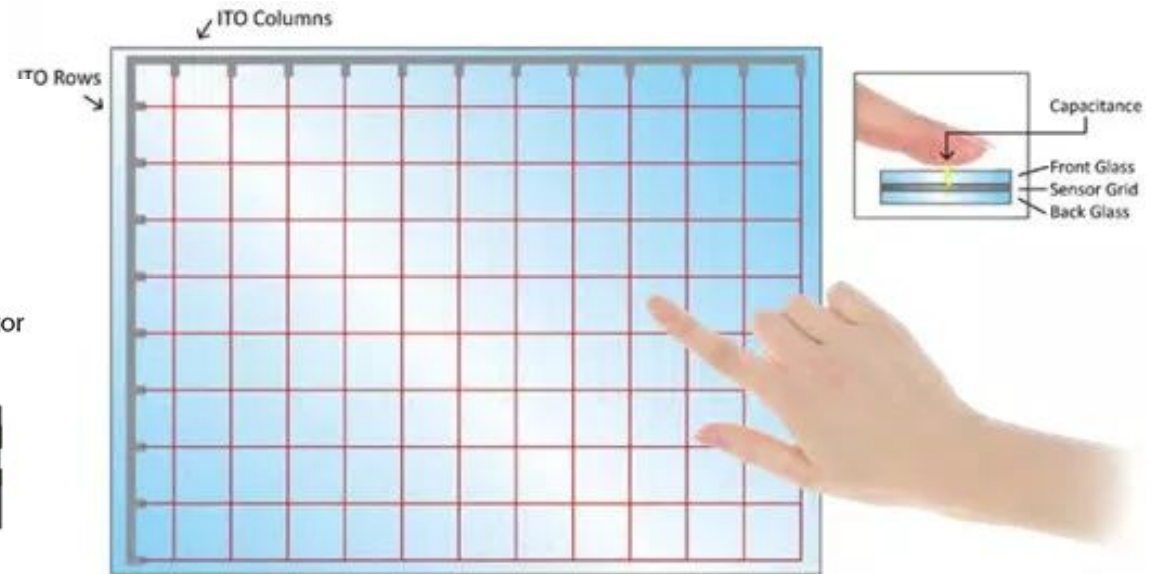
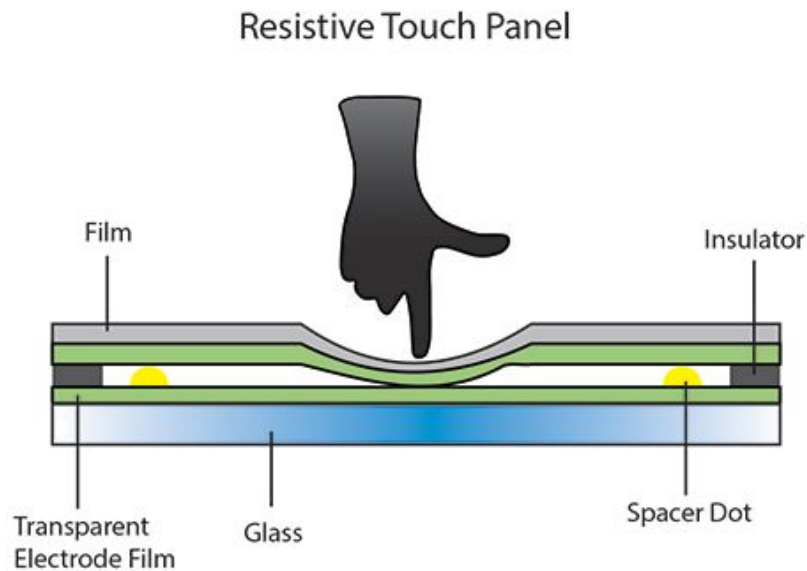
>> Fingerprint scanners, retinal and iris scanners, voice recognition devices, etc.

>> So powerful authentication mechanism that it is used to authenticate the user of a computer.



Input Devices: Touch Screen

- >> input device and output device.
- >> A touch sensitive layer is placed on the top an electronic display.
- >> User can give single- or multi-touch instructions with figures or stylus.
- >> Used in some laptops, mobile phones, ATMs atc.
- >> Two types: resistive and capacitive touch screens.
- >> Capacitive interfaces are generally smoother to the touch than resistive interfaces.
- >> Capacitive touch screens can be controlled by the pad of the finger or a special stylus that mimics this soft part of the fingertip.
- >> Resistive interfaces usually have to be controlled by the fingernail or a plastic or metal stylus.



Input Devices: Gamepads and Joysticks

>> Used in computer games.

>> Connecting interfaces can be DA15 game port, the DB25/DE9 serial port, and the USB port.

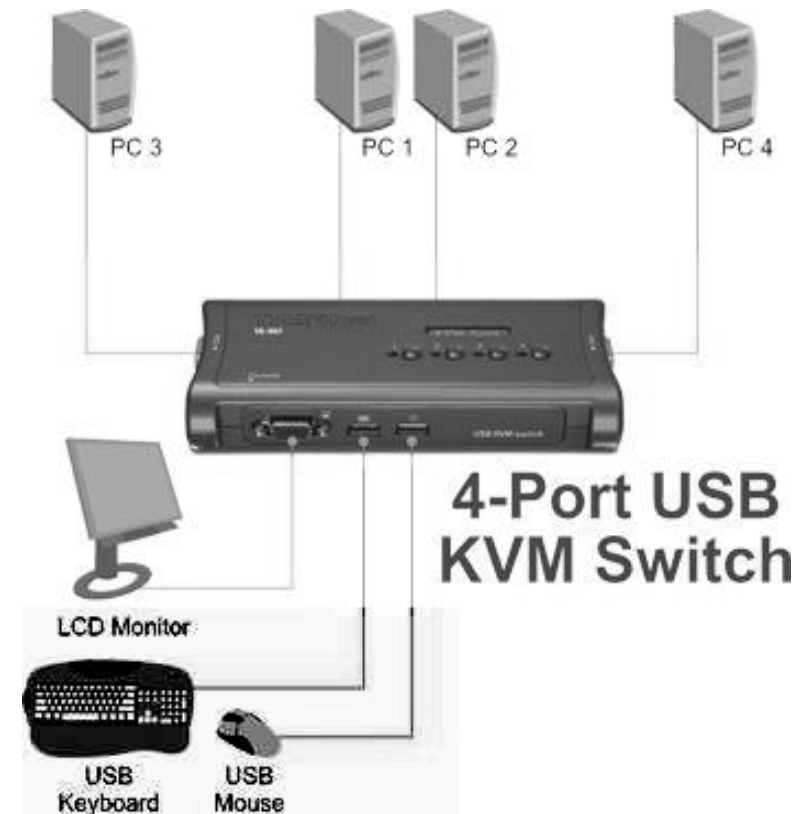


KVM Switch

>> It is not an input device, but it allows to switch between sets of input devices such as Keyboard, Video, and Mouse.

>> It allows to have multiple systems attached to the same keyboard, monitor, and mouse.

>> You can use these three devices with only one system at a time.



Multimedia Input Devices

Multimedia Input Devices:

- Webcams

- MIDI Devices (Musical Instrument Digital Interface)

- Digital Cameras and Camcorders

Output Devices

The major output devices are printers, speakers and display devices.

- >> Printers:

 - Impact printers – Dot matrix printer

 - Non-impact printers – Laser printer, inkjet printer

- >> Speakers

Understanding Display Types and Settings: Video Display Types

The different VDU types are;

- 1) CRT
- 2) Liquid crystal display
- 3) LED displays
- 4) Plasma
- 5) OLED
- 6) Projection systems

CRT (Cathode Ray Tube) Displays

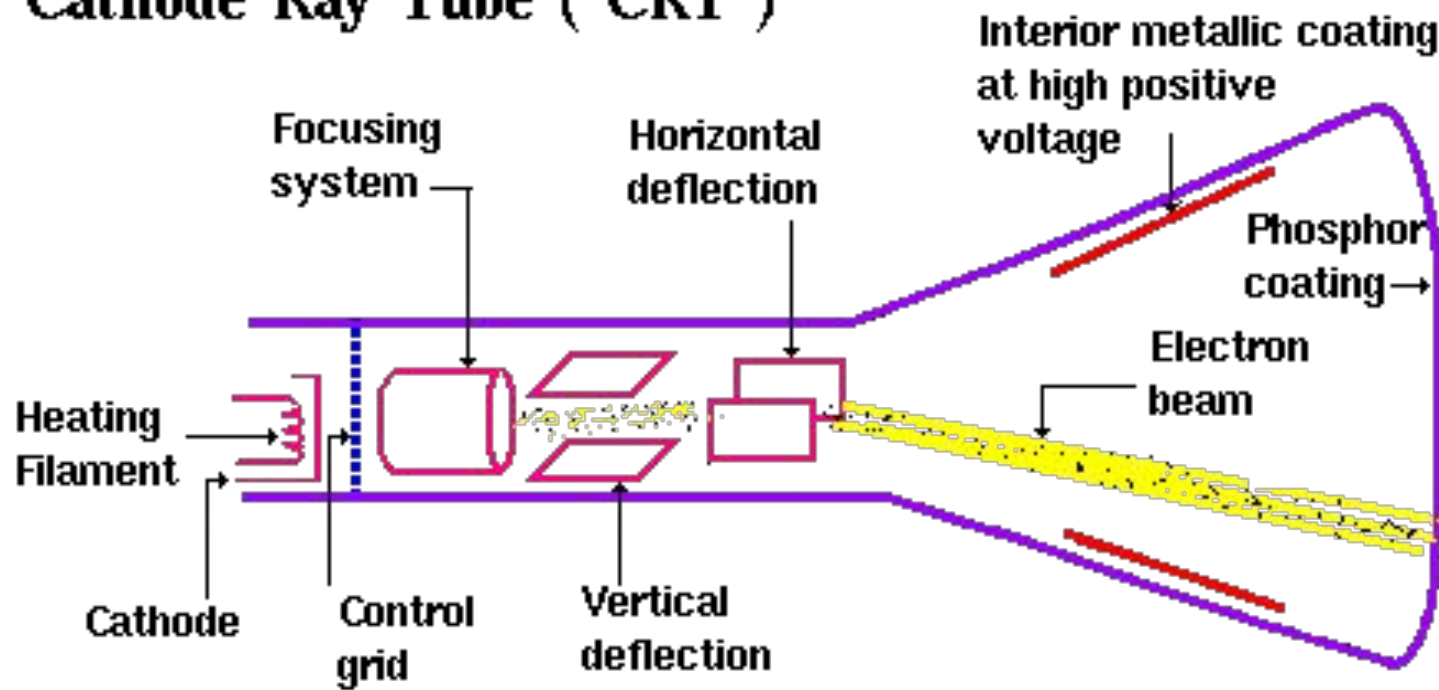
>> Old type of monitors

>> An electron gun shoots a beam of electrons toward the back side of the monitor screen from left to right, line by line, from top to bottom (the process is called scanning).

>> That surface is coated with phosphor particles which emits light based on the intensity with which the electrons strike.

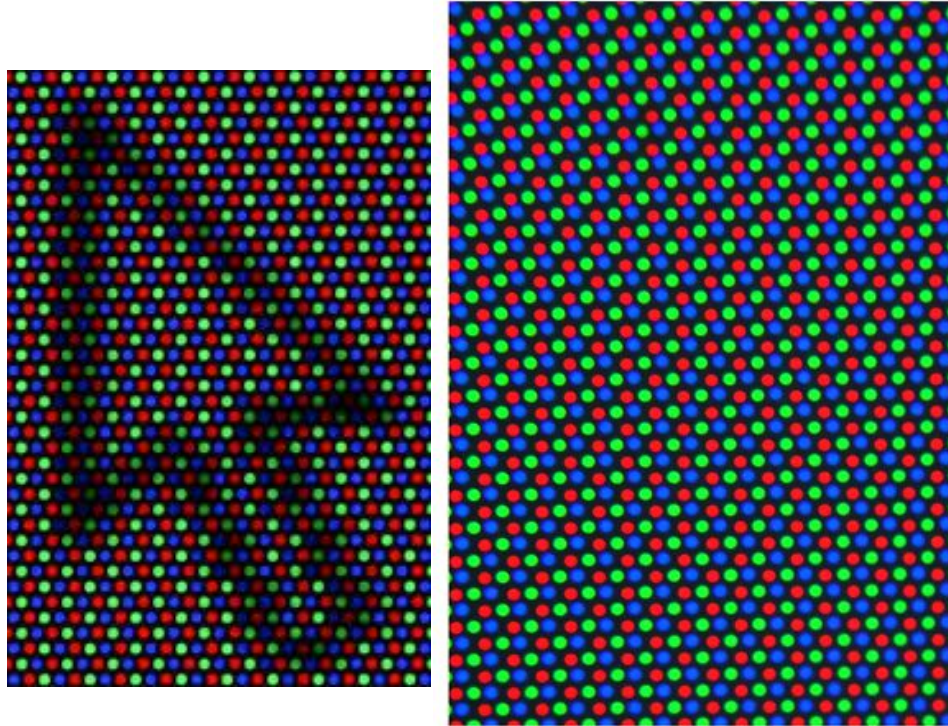
>> Color CRTs often use three guns, one each for red, green, and blue image components and the phosphor dots contains three subdots each with that particular coloured filter.

Cathode Ray Tube (CRT)



CRT (Cathode Ray Tube) Displays

>> The glow of the phosphors decay quickly, hence the scanning is repeated quickly (say 60 times/second) to sustain the glow.



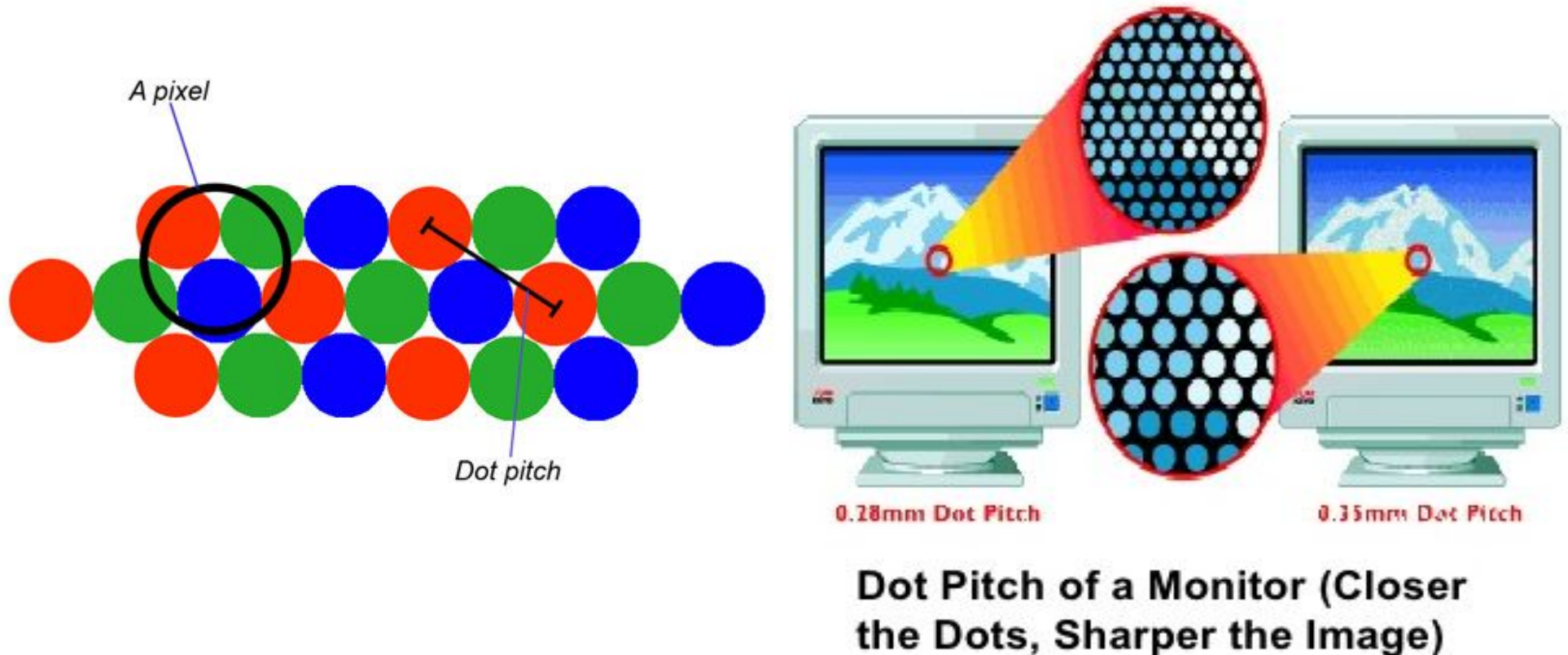
17" PC CRT Display

>> Two ways to measure a CRT monitor's image quality: dot pitch and resolution.

CRT (Cathode Ray Tube) Displays

Dot pitch (Pixel Pitch):

- >> Measurement between the same coloured spot in two vertically adjacent dot trios.
- >> It tells how “sharp” the picture can be.
- >> The lower the measurement in millimeters, the sharper the image can be.
- >> An average dot pitch is 0.28mm to 0.32mm.
- >> It is a physical characteristic of a monitor.



CRT (Cathode Ray Tube) Displays

Resolution:

>> It is defined by how many software picture elements (pixels) are used to draw the screen.

>> High resolution means more information can be displayed in the same screen area.

>> disadvantage is that the same objects and text displayed at a higher resolution appear smaller and might be harder to see.

>> eg: 1024X768 means 1024 pixels across and 768 pixels down.

Colour Depth (bit depth)

The number of bits used to indicate the color of a single pixel.

There are different colour depths, from old days, such as 1bit, 2 bit, 4 bit, 8 bit, 16 bit, 24 bit, 32 bit etc.



32 bit.png
4,294,967,296 colors
98 KB



8 bit.png
256 colors
37 KB (-62%)



4 bit.png
16 colors
13 KB (-87%)



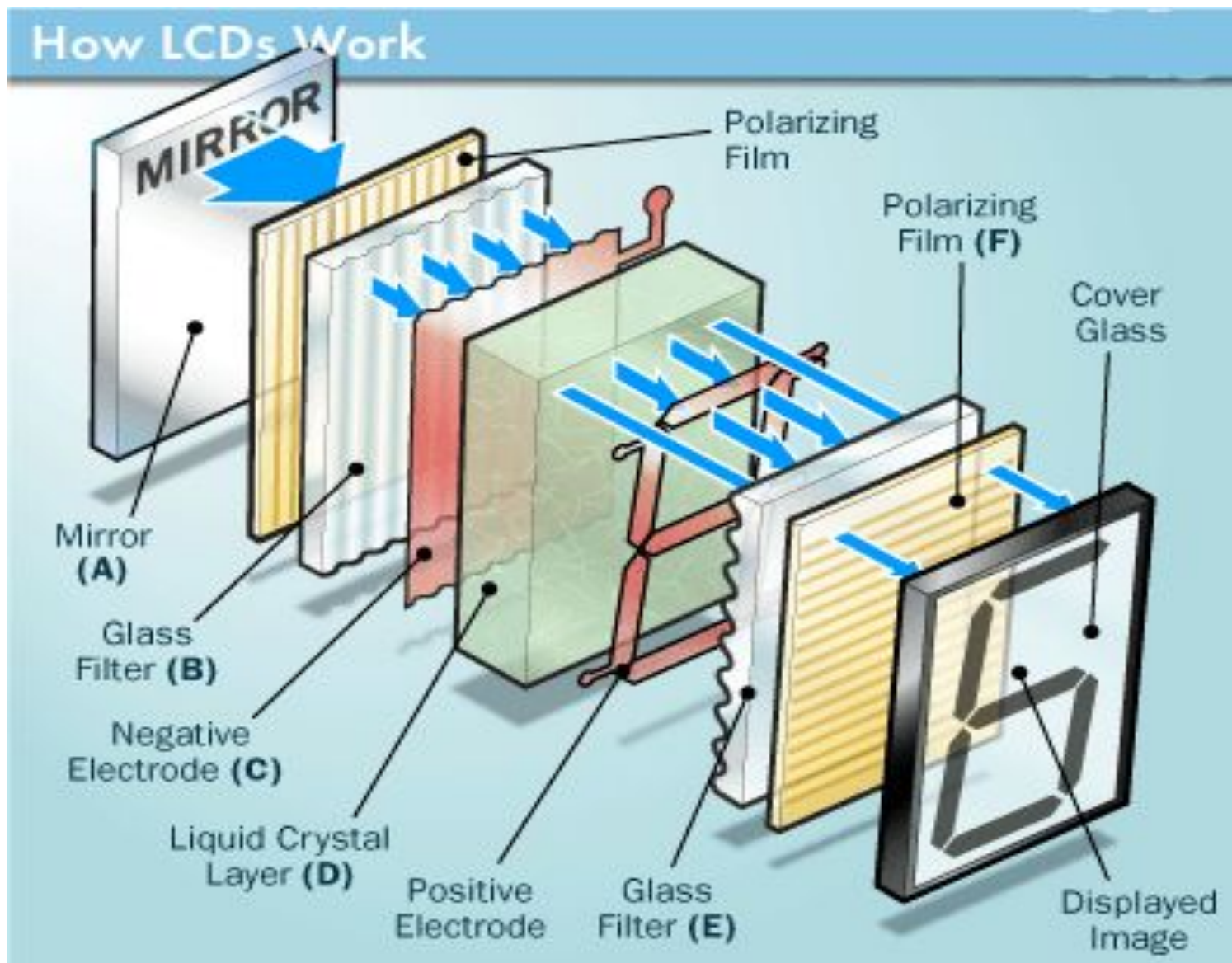
2 bit.png
4 colors
6 KB (-94%)



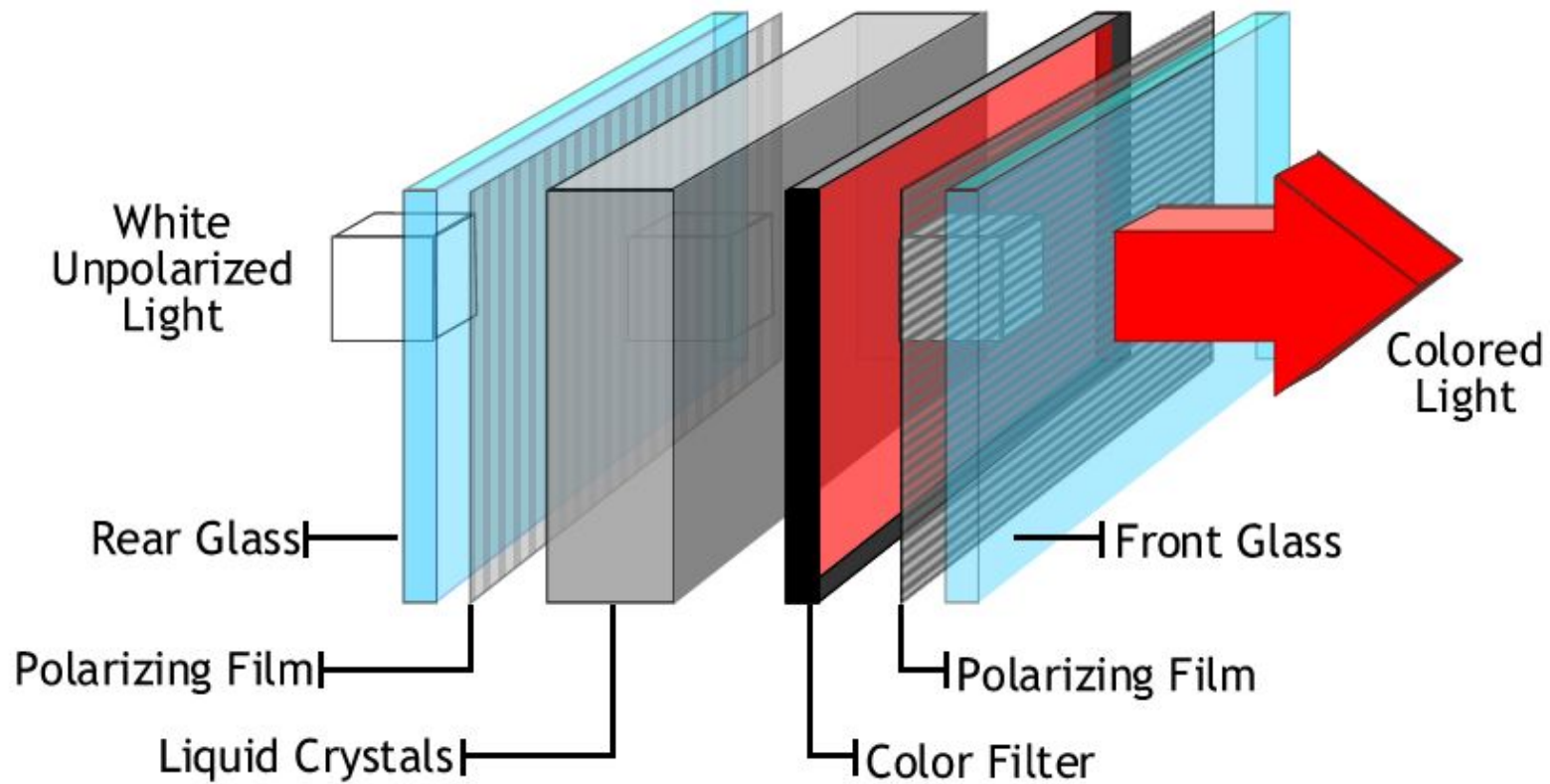
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Liquid Crystal Display (LCD)

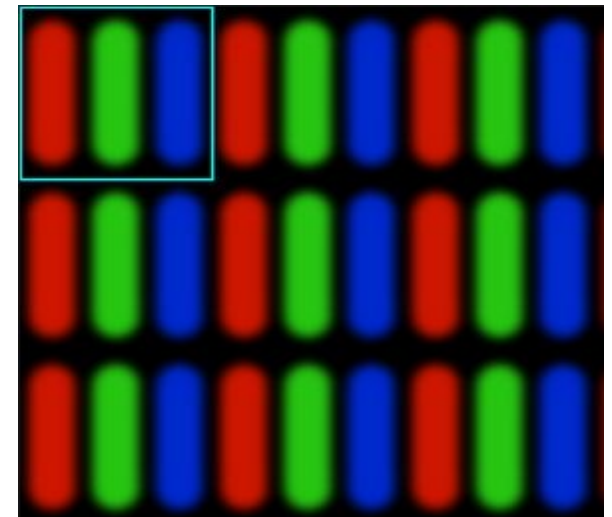
- A flat display technology for displays in digital watches and calculator to laptops.
- LCD screen is made of two sheets of a flexible polarizing material placed at right angle to each other and a layer of liquid crystal solution between the two.
- Passing electricity through the liquid crystal will change its polarization; and thus pass or block light coming from back to front.
- When light is blocked, that part seems black, and when light is passed that part seems bright.
- Calculators use reflections of the outside light as backlight.
- Most of the electronics LCD displays use fluorescent/LED light as back-light.
- Colour LCDs have three sub-pixels (RGB) for each pixel. These sub-pixels show colour because of the presence of colour filters with it.
- LCD monitors use fluorescent light for backlighting.
- Transistors are used to control the current flow through the liquid crystal.
- LCD Monitors are available in either *analog* (VGA) or *digital* interfaces (DVI).
- An LCD is available as a passive-matrix, active matrix or dual-scan.



Calculator LCD parts



© Lon Koenig



LCD monitor subpixels

Liquid Crystal Display (LCD): Passive Matrix LCD

- Has a row of transistors running on the top of the screen (x-axes) as well as the left of the screen (y-axes).
- The number of transistors are defined by the maximum resolution of the monitor (say 800x600).
- For colour monitor, there will be separate transistors for each subpixel (RGB).
- To control each pixel, corresponding x and y transistors are used.
- If any transistor fails, the row or column of pixels will be unusable.
- The screen needs constant refreshing.
- Angles of visibility and response times are lower.
- Less contrast.
- Low response time to ON and OFF the transistor and hence low refresh rate. These bring a 'ghost effect' for moving objects.

Liquid Crystal Display (LCD): Active Matrix LCD (AMLCD)

- A transistor for **each RGB subpixel** of a pixel and turns ON/OFF by selecting corresponding row and column.
- Does not need constant refreshing as the transistor holds electricity until the next image frame appears.
- Brighter screen and colourful display than passive-matrix display.
- Great viewing angle and faster screen updates than passive matrix display.
- But more expensive and consumes more power.
- Since these displays use very thin film of transistors, these displays are also called **Thin Film Transistor (TFT) LCDs**.

Dual Scan LCD:

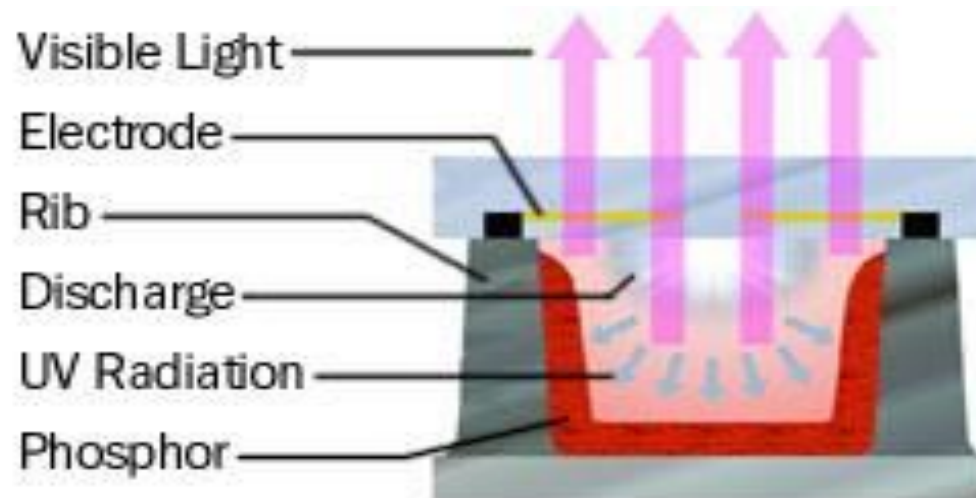
- It is a passive LCD technology in which a screen is divided into two sections which are simultaneously refreshed giving faster refresh rate than traditional passive matrix screens.
- Low power consumption compared to Active Matrix LCDs.
- but less sharpness, brightness and poor display quality.
- Such screens are unsuitable for viewing movies.

LED (Light Emitting Diode) Displays

- They are LCD displays with LED backlight.
- Separate LEDs for each pixel, hence more intelligent backlighting and hence more quality images.
- Since LED used DC voltage, it is easy for use with portable systems like laptop computers which run on DC.

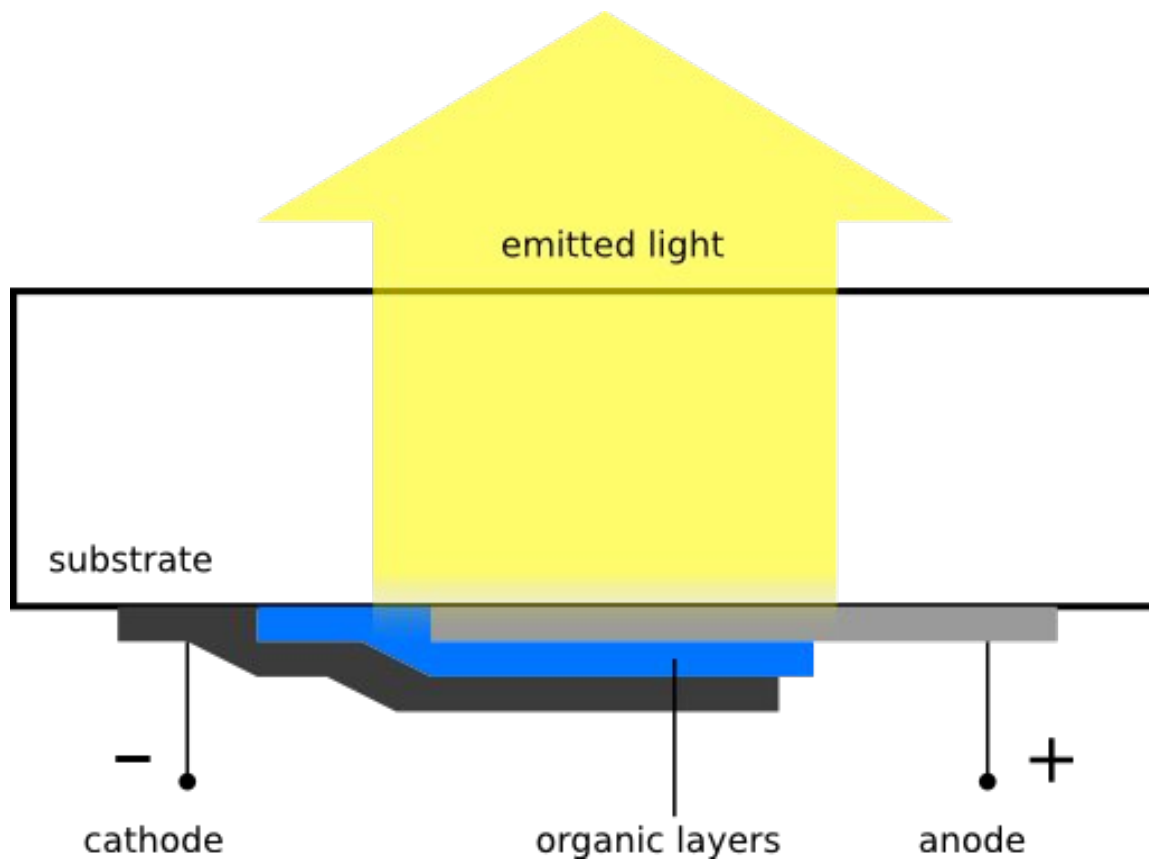
Plasma Display Panels (PDP)

- plasma refers to a cloud of ionized (charged) particles—atoms and molecules with electrons in an unstable state. They emit energy to achieve stable state. This energy hits phosphor particles and emits light.
- Plasma display panels (PDPs) create just such a cloud from an inert gas, such as neon, by placing electrodes in front of and behind sealed chambers full of the gas and vaporized mercury. The chamber is coated inside with phosphor particles.
- Subpixels are provided with RGB filters.
- Does not need backlighting.
- Due to pressurised gas, they are not used in high altitude areas like aircrafts.
- Quality degrades over time.



OLED (Organic Light Emitting Diode) Displays

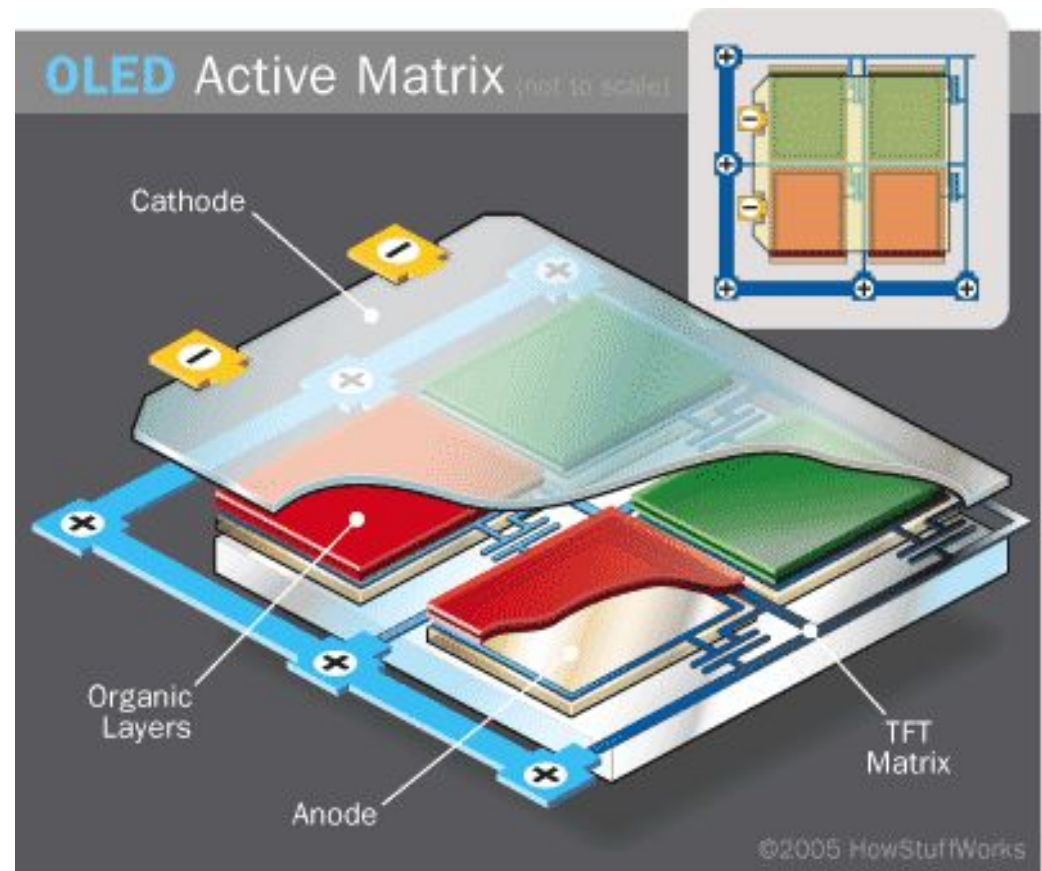
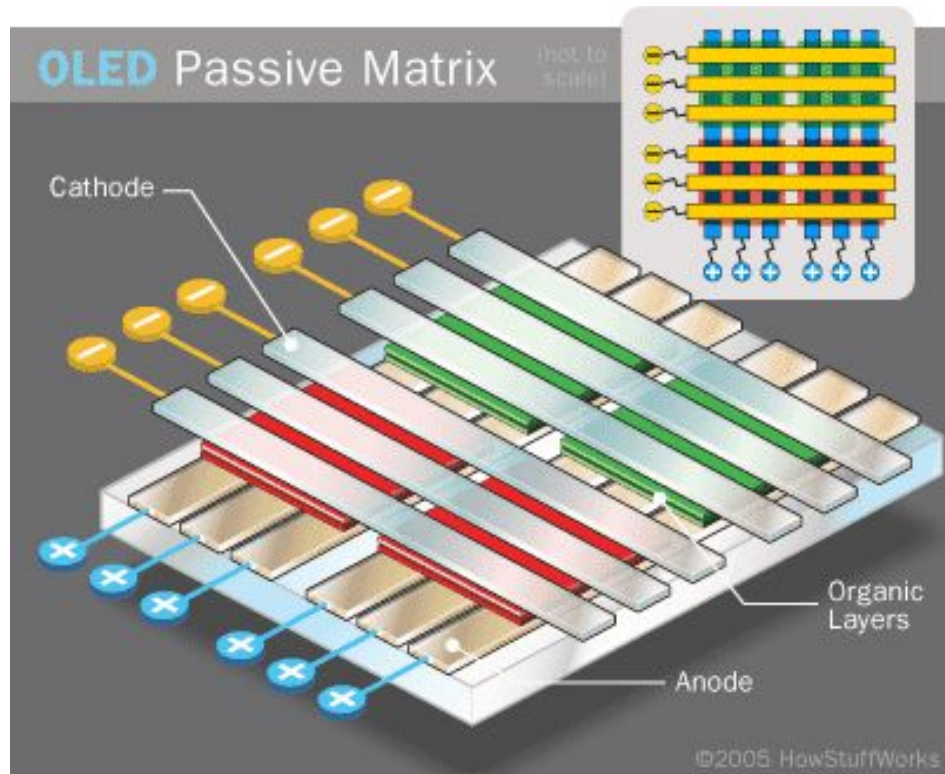
- An Organic light-emitting (electroluminescent) compound is placed in between two electrodes.
- When electricity passes between the electrodes through this compound, it emits light.
- In OLED displays, such very small forms are used for each subpixel (RGB colour with filters) with one opaque electrode at the back and one thin transparent electrode at the front.
- The opaque back electrode allows a rich black display when the OLED cell is not lit.
- Advantages:
 - No backlighting needed.
 - Less power consumption than LED LCD
 - In darker surroundings, OLED displays produce better images than do LCD panels.
- Disadvantages:
 - When the images progress towards all white, the power consumption increases and goes over than that of LED displays.
 - Costly than LCD -LED displays.
- Two types: Active Matrix OLED (AMOLED) and Passive Matrix OLED (PMOLED). AMOLED has better quality than PMOLED but needs more electrodes.
- The electrodes can be made flexible; resulting in **flexible displays**.

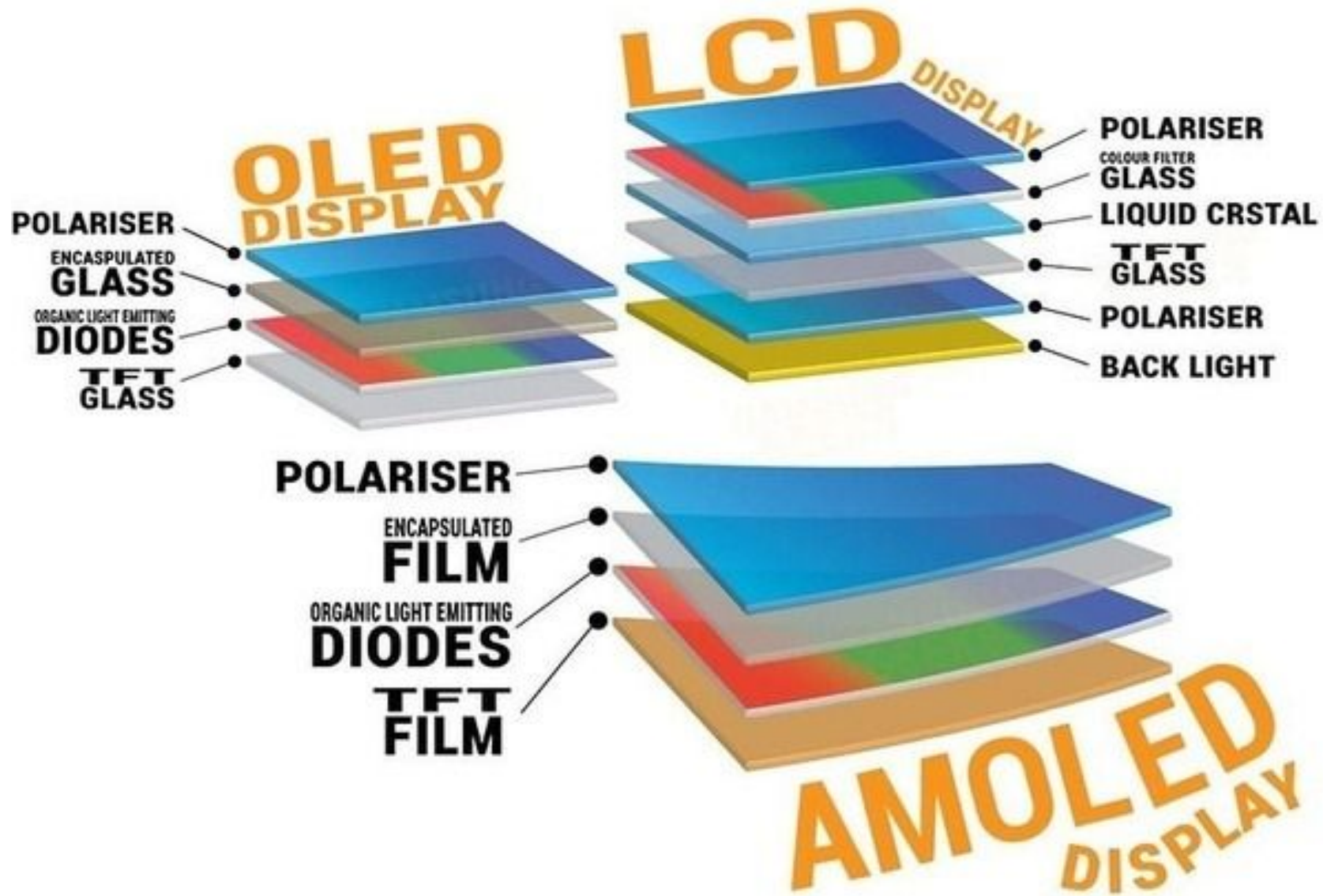


OLED working



Flexible OLED panels





Projection Systems (Projectors)

- Condensed video systems that projects the images onto external screens.
- Can be used as desk-mount or ceiling-mount systems.
- Rear-projection systems are also available which projects the images from the back side of the screen.
- Mainly two types of projectors: DLP (digital light processing), and LCD (liquid crystal display).

Video Settings

Refresh Rate

- It is the vertical scan frequency.
- Specifies how many times in one second the scanning beam of electrons redraws the screen in CRTs.
- Measured in Hertz.
- For small CRT monitors 60Hz to 72Hz, but for larger CRT monitors, it may be 85Hz or higher; it is based on the decay rate of phosphor light-emission
- For LCD, there is no pixel decay, but affects the flow of frames.
- Refresh rate selected must be supported by both the display device and the display adapter.

Video Settings

Resolution

- Number of horizontal dots (pixels) by the number of vertical dots that make up the rows and columns of the display. For example, 640x480 (VGA), 1920x1080 (HD 1080).
- With more pixels, the image can be viewed in greater detail.

Multiple Displays

- For some applications, two monitors on the same computer.
- The adapter must support both displays simultaneously.

Degauss

- In CRT, external magnetic field can affect the image production.
- Degaussing is used to neutralize that effect.
- Not used in LCDs.

Understanding Video Standards and Technologies

- Major differences occurs in two areas:
 1. The highest resolution supported
 2. The maximum number of colors in their palette.
- Both are directly related to the amount of memory on the adapter or used by the adapter.
- Based on evolution, there are five groups of video standards:
 1. Monochrome
 2. CGA (Color Graphics Adapter)
 3. EGA (Enhanced Graphics Adapter)
 4. VGA (Video Graphics Array)
 5. DVI, HDMI, and other modern digital video
- The amount of memory used to implement the pre-VGA adapters was fixed
- Hence the resolution and number of colors supported by these cards was fixed as well.
- Newer standards can change the amount of video memory.

Understanding Video Standards and Technologies

- **Monochrome:**
 - First video technology and the adapter was called Monochrome Display Adapter (MDA).
 - Fine for DOS.
 - Supported text only and the resolution was 720x350.
- **CGA (Color Graphics Adapter):**
 - First colour adapter.
 - CGA displays 16-color text in resolutions of 320x200 (40 columns) and 640x200 (80 columns), but it displays 320x200 graphics with only four colors.
- **EGA (Enhanced Graphics Adapter):**
 - By IBM.
 - EGA could display 16 colors out of a palette of 64.
- **VGA (Video Graphics Array):**
 - By IBM with its PS/2 series computers.
 - VGA uses 6 bits to specify each color, instead of the 8 that is the standard today.
 - 256KB of video memory on board and could display 16 colors at 640x480, 640x350, and 320x200 pixels.

Advanced Video Resolutions and Concepts

- Advancements after the VGA adapter occurred only in the memory and firmware of the adapter, not the connector or its fundamental analog functionality.
- SVGA (Super VGA):
 - By Video Electronics Standards Association (VESA). it could support 16 colors at a resolution of 800x600 (the VESA standard), but it soon expanded to support 1024x768 pixels with 256 colors.
- XGA (Extended Graphics Array):
 - By IBM, but it was available only as a Micro Channel Architecture (MCA) expansion board.
 - XGA could support 256 colors at 1024x768 pixels or 65,536 colors at 800x600 pixels.

Non Adjustable Characteristics

- **Native Resolution**

- One of the peculiarities of LCD, plasma, OLED, and other flat-panel displays is that they have a single fixed resolution, known as the **native resolution**.
- Trying to display a resolution other than the native resolution *may* result in a distortion of the image on the screen.

- **Contrast Ratio**

- Measure of the ratio of the luminance of the brightest color to that of the darkest color the screen is capable of producing.
- A display with a low contrast ratio won't show a "true black" very well the other colors will look washed out when you have a light source nearby.
- Lower contrast ratio mean that you'll have a harder time viewing images from the side as compared with being directly in front of the display.
- Ratios for smaller LCD monitors and televisions typically start out around 500:1
- Common ratios for larger units range from 20,000:1 to 100,000:1

Custom Configuration PCs and Workstations

- **Graphic and CAD/CAM Design Workstations**

- To create high-quality copy consisting of professional text and graphical images.
- This output is used in advertising, marketing, and other forms of specialized documentation.
- Used in the design of engineering and architectural documentation, including blueprints in both two and three dimensions.
- Need-
 - i. CPU enhancements
 - ii. Video enhancements
 - iii. Maximized RAM

- **Audio/Video Editing Workstations**

- Need-
 - i. Video enhancements
 - ii. Specialized audio
 - iii. Specialized drives

- **Virtualization Workstations**

- Need-
 - i. CPU enhancements
 - ii. Maximized RAM

Custom Configuration PCs and Workstations

- **Gaming PCs**

- Need-
 - i. CPU enhancements
 - ii. Video enhancements
 - iii. Specialized audio
 - iv. Enhanced cooling

- **Home Theater PCs (HTPC)**

- Need-
 - i. Video enhancements
 - ii. Specialized audio
 - iii. Special chassis
 - iv. TV tuner requirement

- **Home Server PCs**

- Need-
 - i. Media streaming capabilities
 - ii. File sharing services
 - iii. Print sharing services
 - iv. Gigabit NIC
 - v. RAID array

Standard Thick Clients

- Must meet only the basic standards that any system running a particular operating system and particular applications.
- The operating system requires a certain amount of RAM for its installation and a certain amount of hard drive space.

Thin Clients

- Especially small so that the bulk of the data processing occurs on the server.
- Thin client resembles a dumb terminal, only displaying graphical user interface output to the monitor and relaying input from the mouse and keyboard back to the server.

Printers

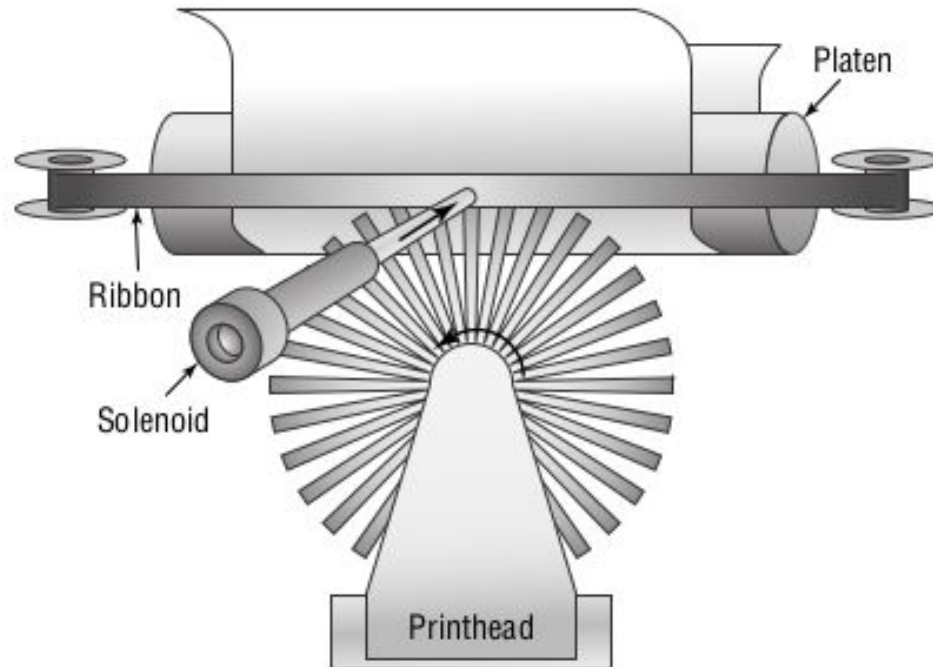
- Electromechanical devices to put information from the computer onto paper.
- Two major classifications
 - Impact printers (Eg: Dot matrix printers)
 - Non-impact printers (Eg: inkjet or bubble-jet, laser printers)

Impact Printers

- Use some form of impact and an inked ribbon to make an imprint on the paper.
- Use a paper feed mechanism called a tractor feed that requires special paper.
- Two major types of impact printers: daisy wheel and dot matrix.

Daisy-wheel Printers

- One of the oldest technologies.
- Contains a wheel with raised letters and symbols on each “petal”.
- When the printer needs to print a character, it sends a signal to the print head mechanism that contains the wheel.
- The print head rotates the daisy wheel until the required character is in place.
- An electromechanical hammer (called a solenoid) then strikes the back of the petal containing the character.
- The character pushes up against an inked ribbon that ultimately strikes the paper, making the impression of the requested character.

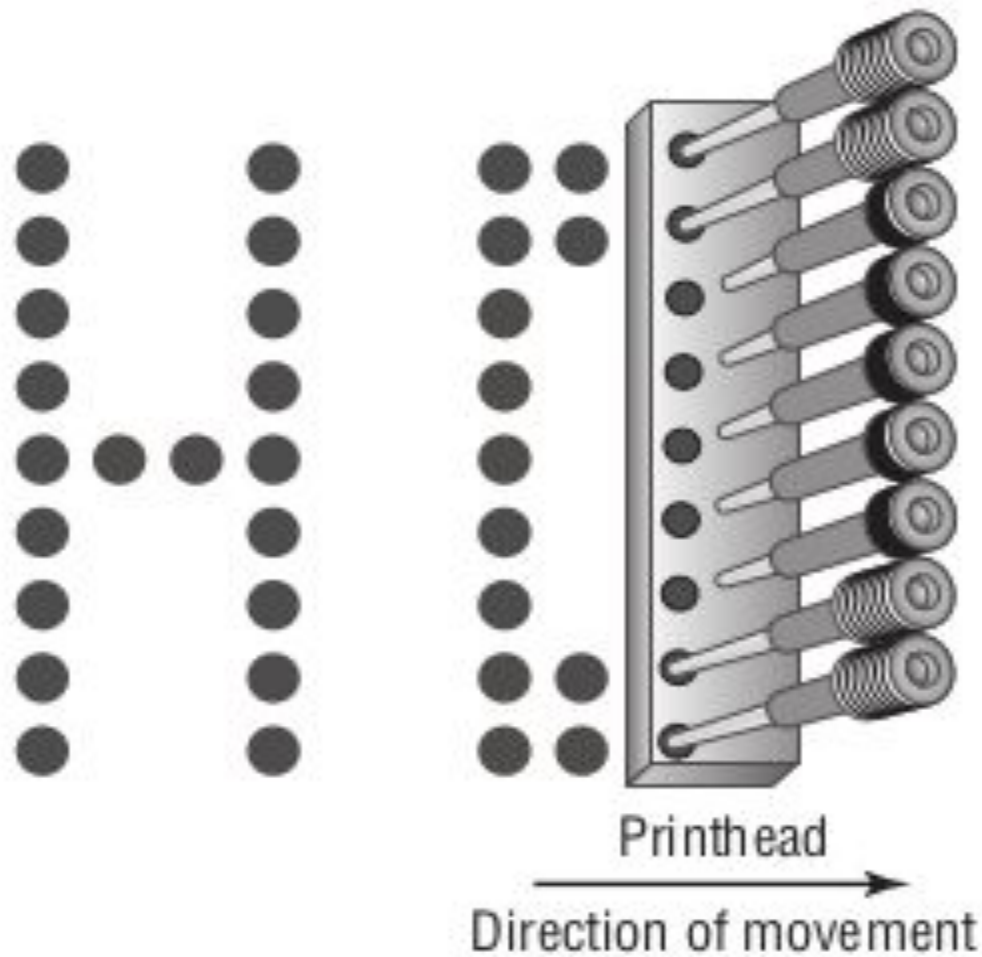


Daisy-wheel Printers

- Speed is rated by the number of characters per second (cps) they can print.
- Disadvantages
 - Print only two to four characters per second.
 - Makes a lot of noise when printing.
- Advantages
 - Can print on multipart forms (like carbonless receipts).
 - Relatively inexpensive

Dot-matrix Printers

- Works just like daisy-wheel printer
- But instead of character-imprinted wheel, the print head contains a row of pins.
- These pins are triggered in patterns that form letters and numbers as the print head moves across the paper.



Dot-matrix Printers

- The pins in the print head are wrapped with coils of wire to create a solenoid and are held in the rest position by a combination of a small magnet and a spring.
- To trigger a particular pin, the printer controller sends a signal to the print head, which energizes the wires around the appropriate print wire.
- This turns the print wire into an electromagnet, which repels the print pin, forcing it against the ink ribbon and making a dot on the paper.
- The arrangement of the dots in columns and rows creates the letters and numbers.
- Disadvantages
 - Less quality than daisy-wheel printers
 - Noisy, but less noise than daisy-wheel
 - Letter quality depends on the number of pins in the head (9 to 24 pins).
- Advantages
 - Faster than daisy-wheel (nearly 72 cps)
 - Use multipart forms

Inkjet (Bubble-Jet)

- Spray ink on the page precisely to form the test or image.
- Parts:
 - Print head/ink cartridge
 - Head carriage, belt, and stepper motor
 - Paper-feed mechanism
 - Control, interface, and power circuitry
- **Print Head/Ink Cartridge**
 - Print head contains many small nozzles (usually 100 to 200) that spray the ink.
 - Print head is part of the ink cartridge, which contains a reservoir of ink.
 - Most color bubble-jet printers include multiple print heads, one for each of the CMYK (cyan, magenta, yellow, and black) print inks
 - When a particular chamber needs to spray ink, an electric signal is sent to the heating element, energizing it. The elements heat up quickly, causing the ink to vaporize. Because of the expanding ink vapor, the ink is pushed out the pinhole.
 - The print cartridge must be replaced as the ink supply runs out.

Inkjet (Bubble-Jet)

- **Head Carriage, Belt, and Stepper Motor**

- The print head carriage is the component that moves back and forth during printing.
- Connected to printhead and ink reservoir.
- The stepper motor and belt make the print head carriage move.

- **Paper-Feed Mechanism**

- The paper-feed mechanism picks up paper from the paper drawer and feeds it into the printer.

Inkjet (Bubble-Jet)

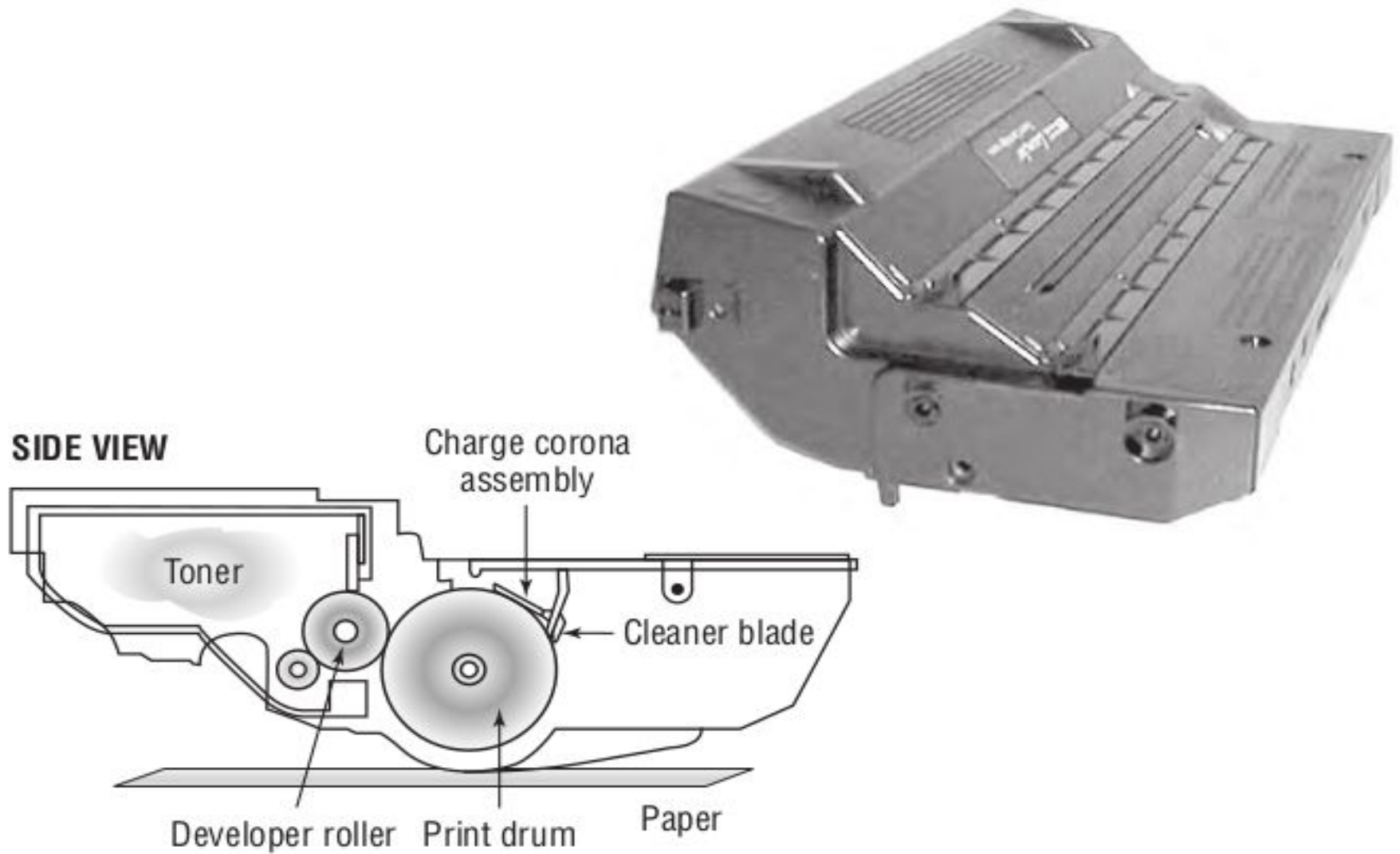
- **Control, Interface, and Power Circuitry**
 - **Control circuitry:**
 - Contains all the circuitry to run the stepper motors.
 - Monitoring the health of the printer and reporting that information back to the PC.
 - **Interface circuitry (port):**
 - Makes the physical connection to whatever signal is coming from the computer
 - Connects the physical interface to the control circuitry.
 - Converts the signals from the interface into the datastream that the printer uses.
 - **Power circuitry:**
 - Converts 110V/220V AC into the voltages the bubble-jet printer uses, usually 12V and 5V, and distribute those voltages to the other printer circuits and devices that need it.

Laser Printers

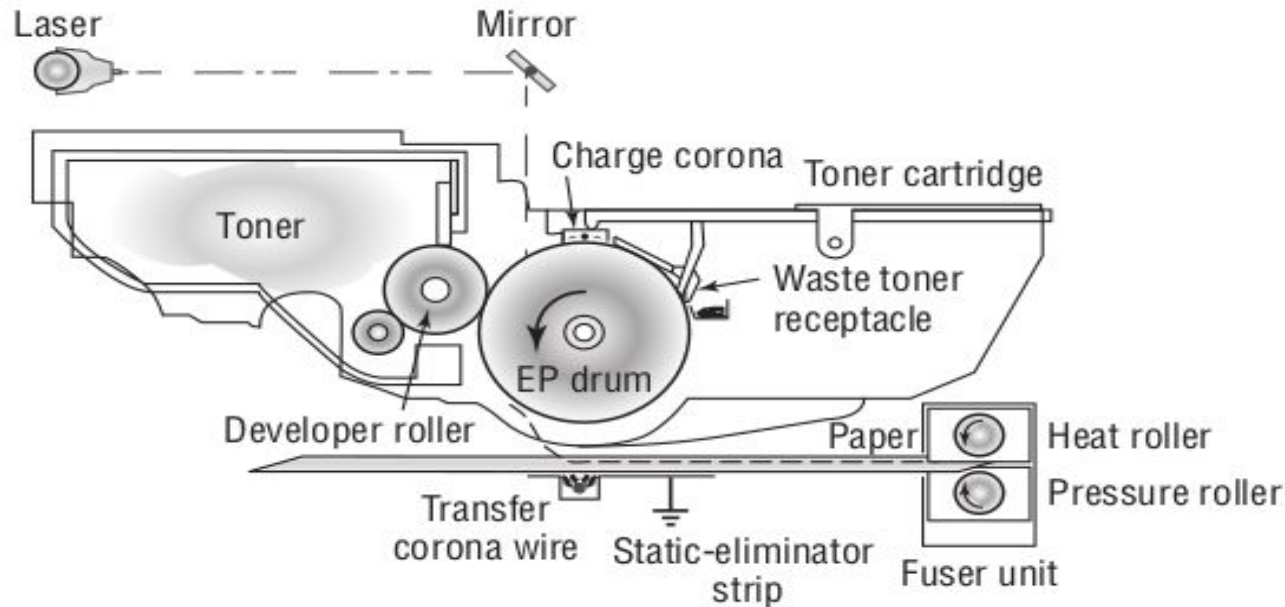
- Use the electrophotographic (EP) printing
- Basic Components:
 - a. the toner cartridge
 - b. laser scanner
 - c. high-voltage power supply
 - d. DC power supply
 - e. paper transport assembly
 - f. transfer corona
 - g. fusing assembly
 - h. printer controller circuitry
 - i. ozone filter

Laser Printers

- The Toner Cartridge



EP Print Process



The printer uses a rubber scraper to clean the photosensitive drum. Then the printer places a uniform -600VDC charge on the photosensitive drum by means of a charging corona. The laser “paints” an image onto the photosensitive drum, discharging the image areas to a much lower voltage (-100VDC). The developing roller in the toner cartridge has charged (-600VDC) toner stuck to it. As it rolls the toner toward the photosensitive drum, the toner is attracted to (and sticks to) the areas of the photosensitive drum that the laser has discharged. The image is then transferred from the drum to the paper at its line of contact by means of the transfer corona wire (or corona roller) with a $+600\text{VDC}$ charge. The static-eliminator strip removes the high, positive charge from the paper, and the paper, now holding the image, moves on. The paper then enters the fuser, where a fuser roller and the pressure roller make the image permanent. The paper exits the printer, and the printer begins printing the next page or returns to its ready state.