

Computer Architecture

8. Inputs and Outputs

Lecturer: A.Prof.Dr. Hoàng Xuân Dậu

Email: dauhx@ptit.edu.vn

Faculty of Information Security

Posts & Telecommunications

Institute of Technology

Main topics

- ❑ Introduction to input and output devices / peripherals
- ❑ Input devices
 - Keyboard
 - Mouse
- ❑ Output devices
 - CRT Monitor
 - LCD Monitor
 - Printer

Input and Output Devices

- ❑ Input and output devices (also called peripheral devices) are computer components which are responsible for:
 - Get data from outside world into computer
 - Output data from computer to outside world
- ❑ Input devices:
 - Keyboard, mouse, scanner, barcode reader, CD/DVD Drives, HDDs (Read),...
- ❑ Output devices:
 - Monitor, printer, plotter, CDWR/DVDWR Drives, HDDs (Write),...

Input and Output Devices



A multimedia keyboard



A logitech mouse

Input and Output Devices



A CRT monitor



An LCD monitor

Input and Output Devices



A Laser Printer



A Ink Jet Printer

Communication Ports

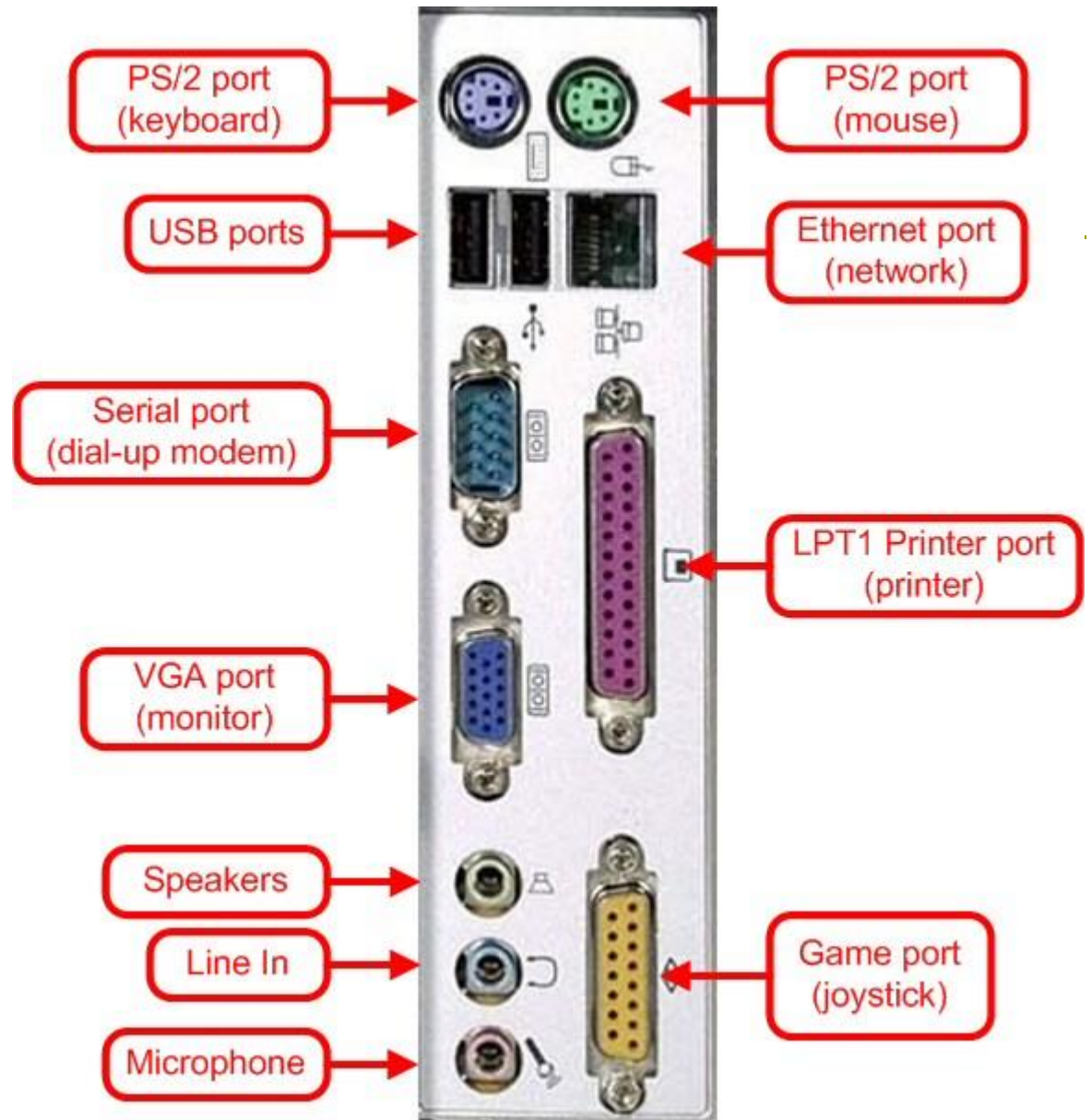
- ❑ Input and output devices usually connect to computer using communication ports.
 - Each port is assigned an unique address
- ❑ Common ports:
 - PS/2: for keyboard and mouse
 - COM and LPT ports
 - USB ports
 - ❑ USB 1.0: 12Mb/s
 - ❑ USB 2.0: 480Mb/s
 - ❑ USB 3.0: 1.5Gb/s

Communication Ports

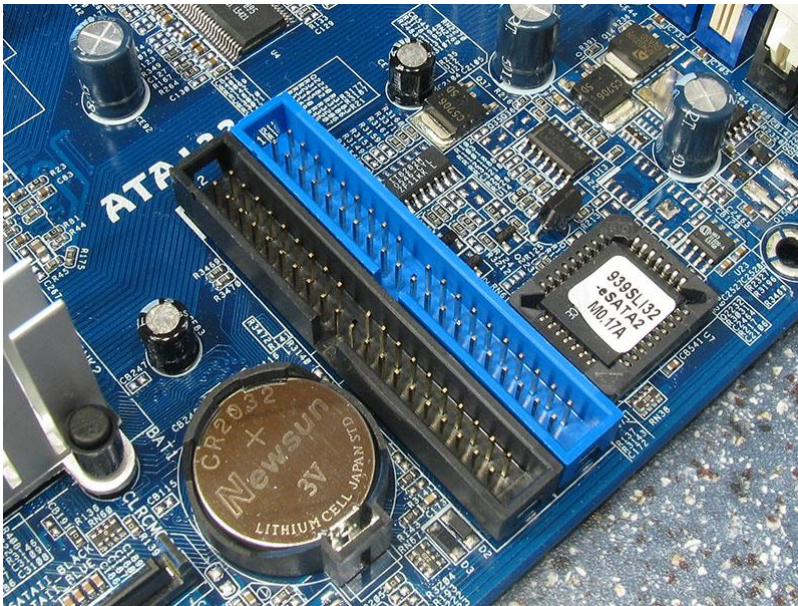
□ Common ports:

- IDE, SATA and E-SATA ports: for disk drives
- LAN ports
- Audio ports
- Card reader ports
- Firewire /IEEE 1394: for external disk drives
- VGA/Video port
- DVI port

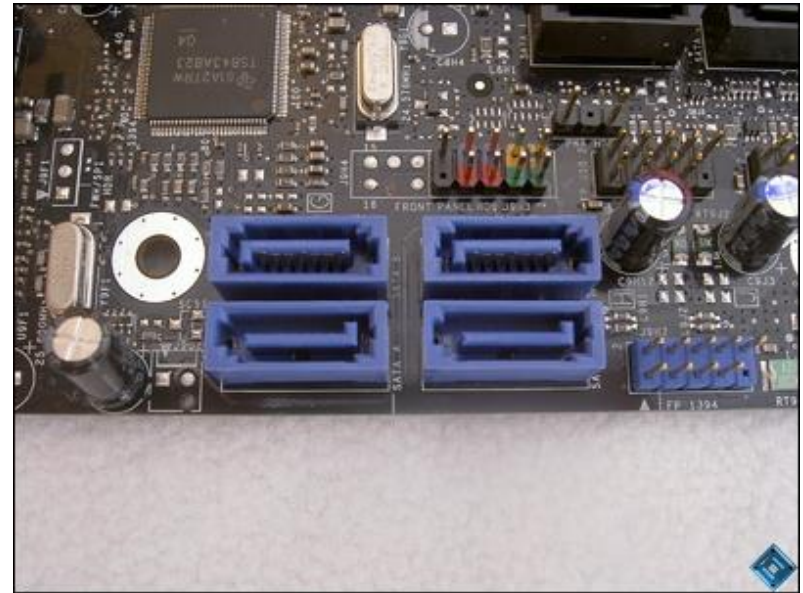
Common PC ports



Communication Ports



IDE Ports

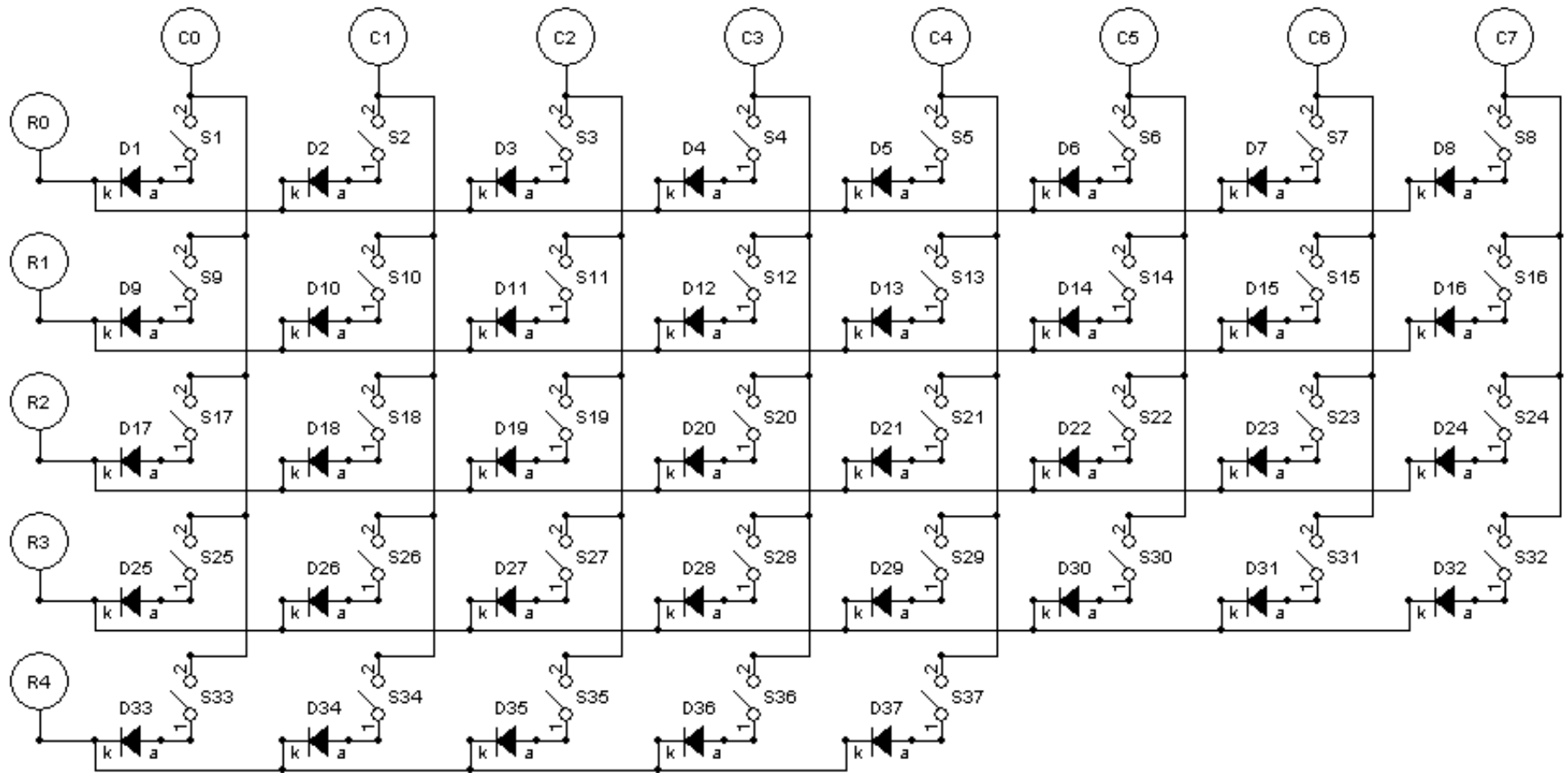


SATA Ports

Keyboards

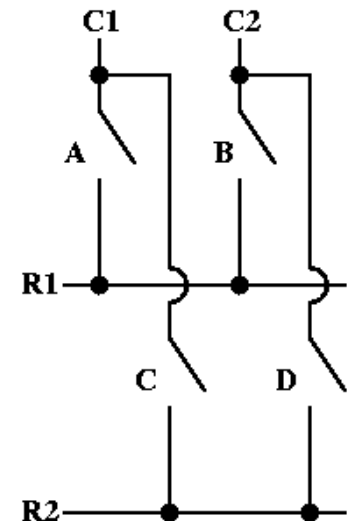
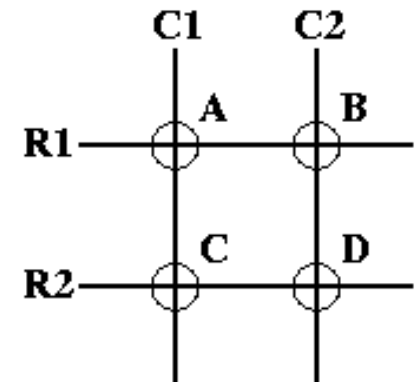
- ❑ Keyboard is the standard input device.
- ❑ Keyboards have two functions:
 - Input data
 - Control
- ❑ Standard keyboards have 101 keys:
 - Alphabetical keys (a-z)
 - Numeric keys (0-9)
 - arithmetic operators: +, -, *, /
 - Functional keys (F1-F12)
 - Control keys: Ctrl, Alt, Shift,
 - Navigation keys: Home, End, Page Up, Page Down, Up, Down, Left, Right, ...

Keyboard Matrix



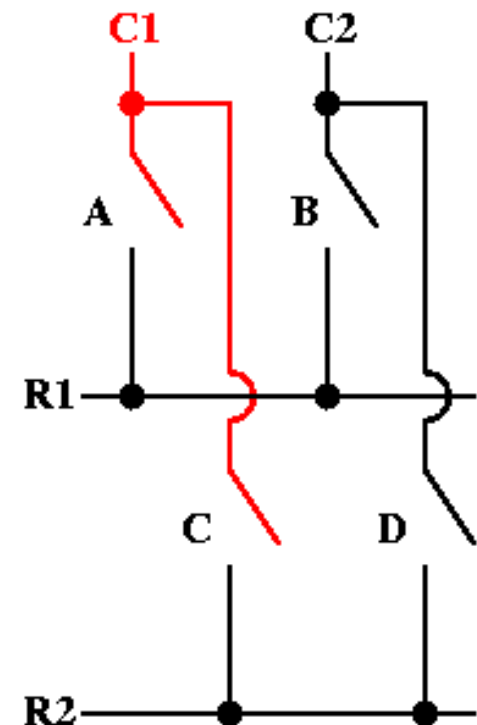
Keyboard Matrix

- Keyboards use a matrix with the rows and columns made up of wires.
 - Each key acts like a switch.
 - When a key is pressed, a column wire makes contact with a row wire and completes a circuit.
 - The keyboard controller detects the closed circuit and registers it as a key press.

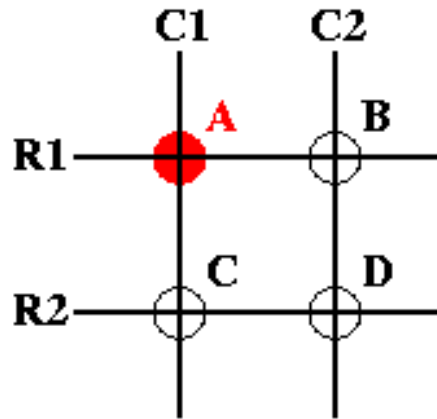


Keyboard - Scan to Detect Key Presses

- In order to detect key presses, the keyboard controller will scan all columns, activating each one by one. When a column is activated, the controller detects which rows are "activated".
- To step through this procedure, the controller activates column C1 and checks rows R1 and R2 for keys pressed (closed circuits).

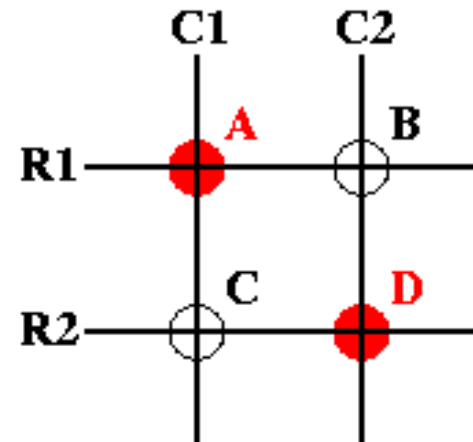
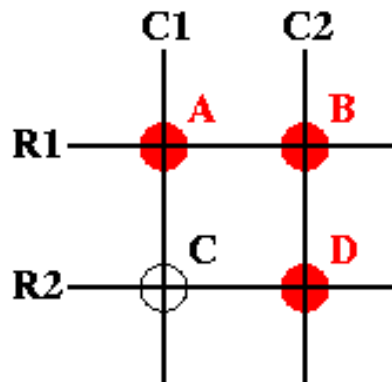


Multiple Keys Pressed



One
key
pressed

Three
key
pressed



Two
key
pressed

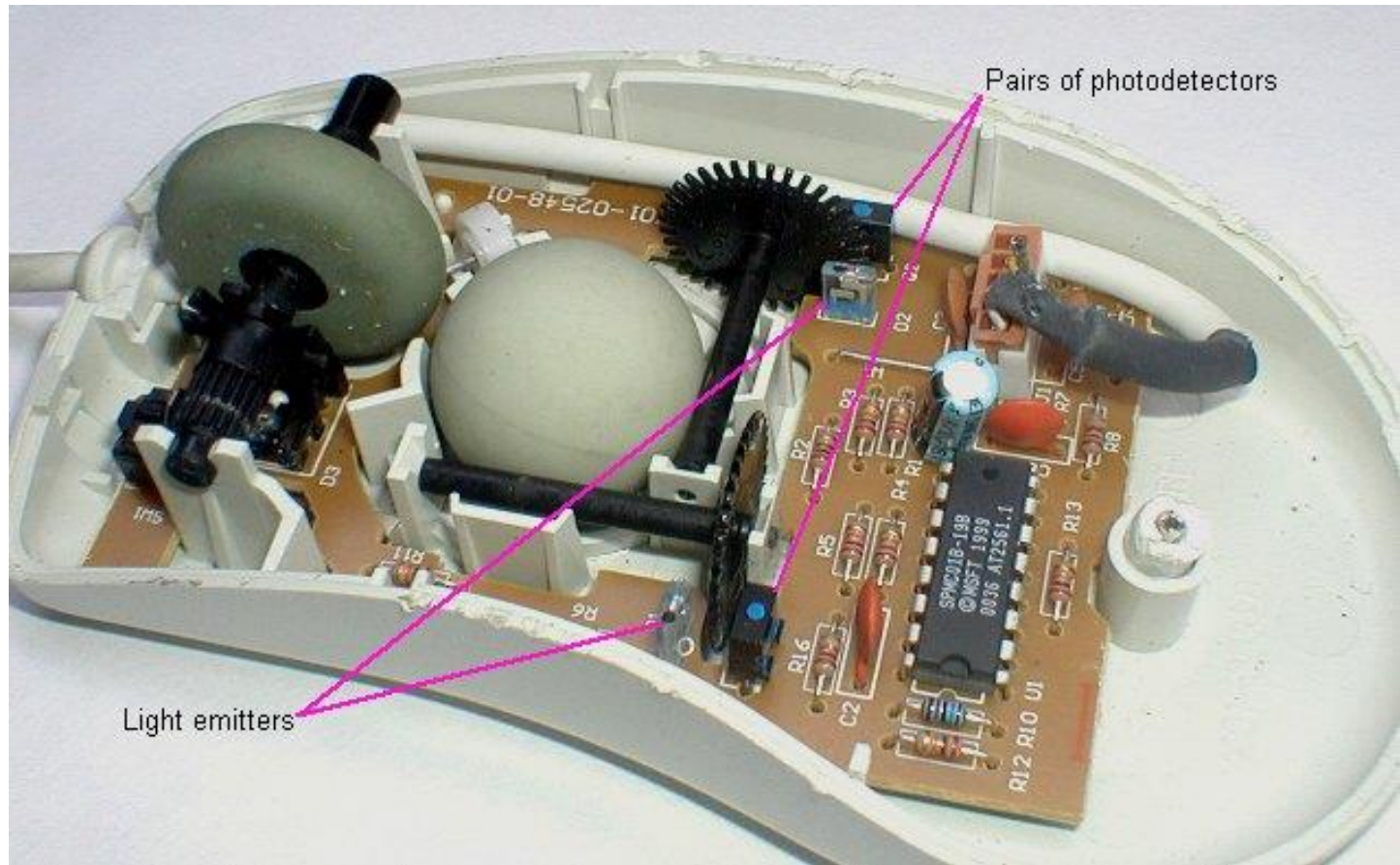
Keyboard Operation

- ❑ When a key is pressed, the keyboard controller detects the event and generate a corresponding “scan code”;
- ❑ An keyboard “interrupt” is sent to computer
- ❑ The computer receiving the interrupt will execute a piece of program to read the scan code and convert it into the corresponding character code (which is usually an ASCII char code).

Computer Mouse / Mice

- ❑ Mouse is one of the most common input device.
 - The mouse function is control
- ❑ Types of mice:
 - Mechanical mouse
 - Optical mouse
 - Laser mouse
 - Wired mouse
 - Wireless mouse
- ❑ Mouse buttons:
 - Common buttons: Left, Right, Scroll
 - Other buttons: Forward, Backward, etc.

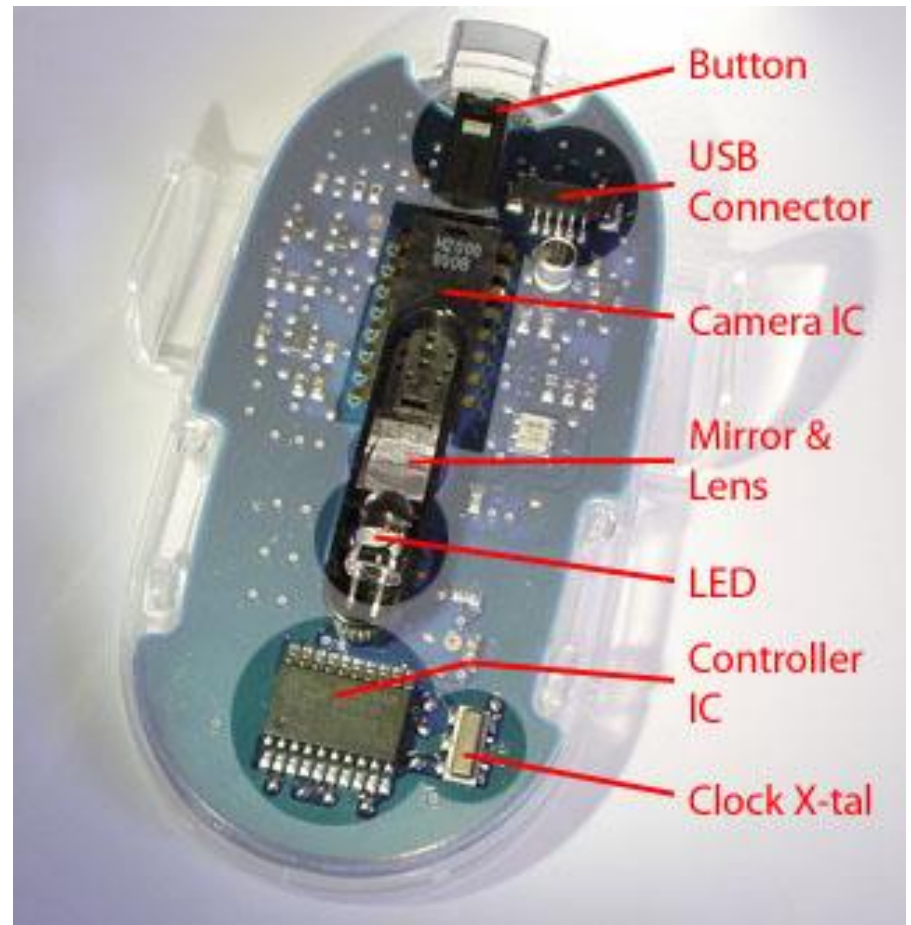
Mechanical Mouse



Mechanical Mouse Working Principle

- ❑ When the mouse moves, its ball is rolling;
- ❑ The ball makes 2 axles with toothed wheels rolling;
 - One axle is used to detect vertical movement
 - One axle is used to detect horizontal movement
- ❑ There are 2 diodes which emit infrared lights through the toothed wheels;
- ❑ The infrared lights are captured by two sensors which convert the lights into electric signals.
- ❑ The signals which represent mouse movement are then sent to computer for further processing.

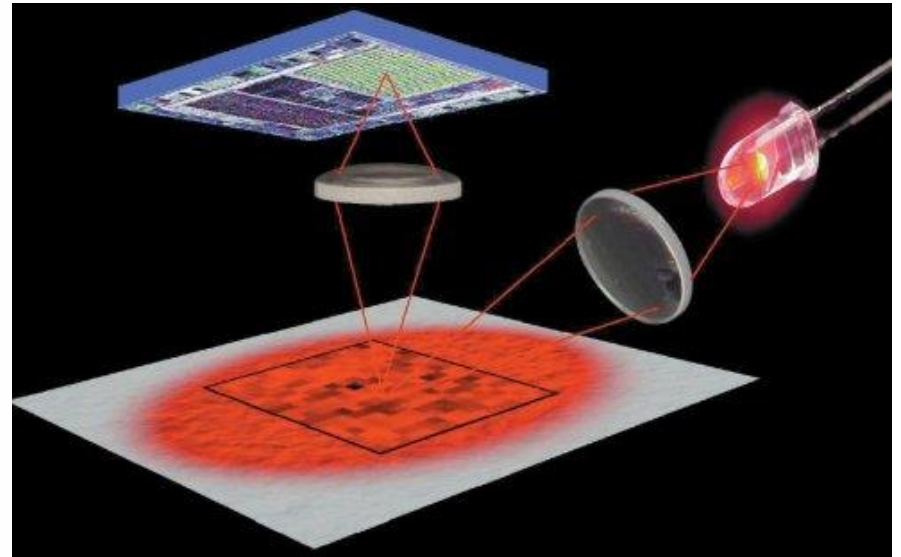
Optical Mouse



Optical Mouse Operation

- ❑ The LED shines a bright red light through the Lens. The light is then reflected down onto the desktop beneath the mouse.
- ❑ The Camera constantly takes pictures of the surface. The rate is about 1500 pictures/sec.
- ❑ The mouse controller processes and compare contiguous pictures to discover the mouse movement.
- ❑ Mouse movement signals are sent to computer for further processing.

Laser Mouse



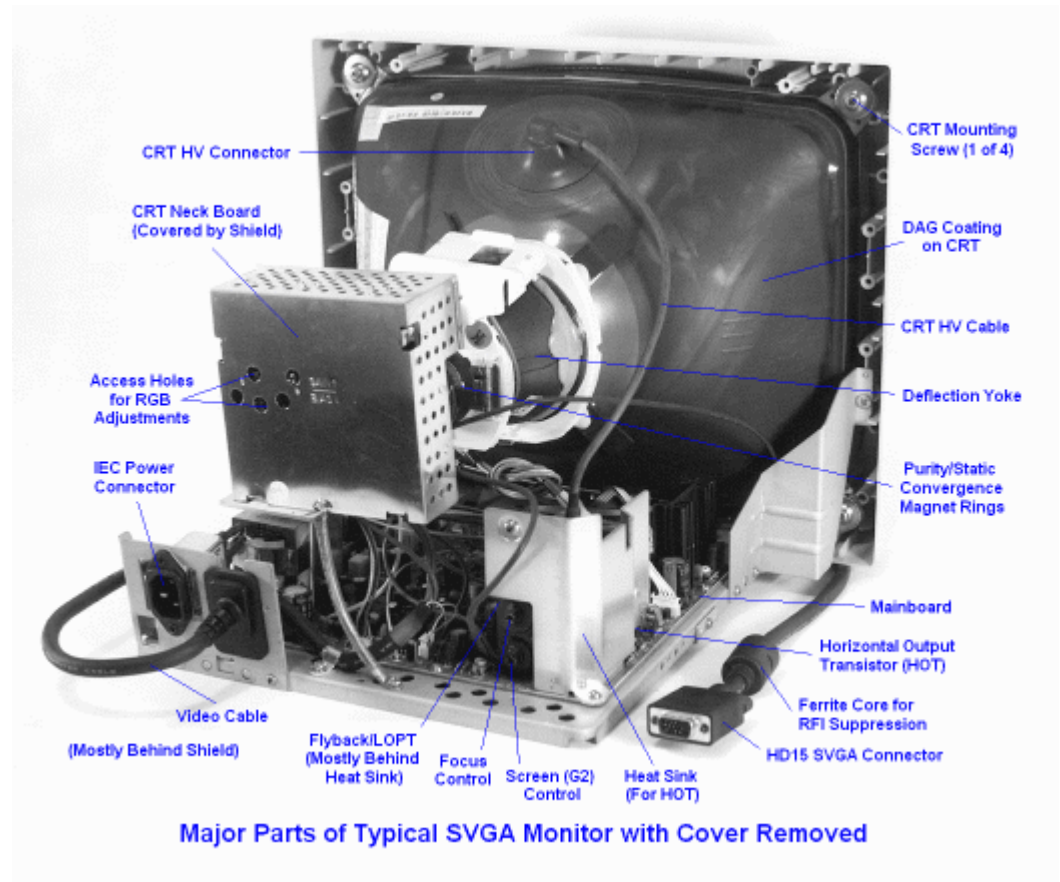
Laser Mouse

- ❑ Laser mouse works on a similar principle as the optical mouse. The differences are:
 - Use laser beam than red beam of optical mouse
 - Its camera takes pictures at much higher rate (about 6000 pictures/sec) than optical mouse's camera.
 - Its sensitivity is higher
 - It can work on almost any surfaces.

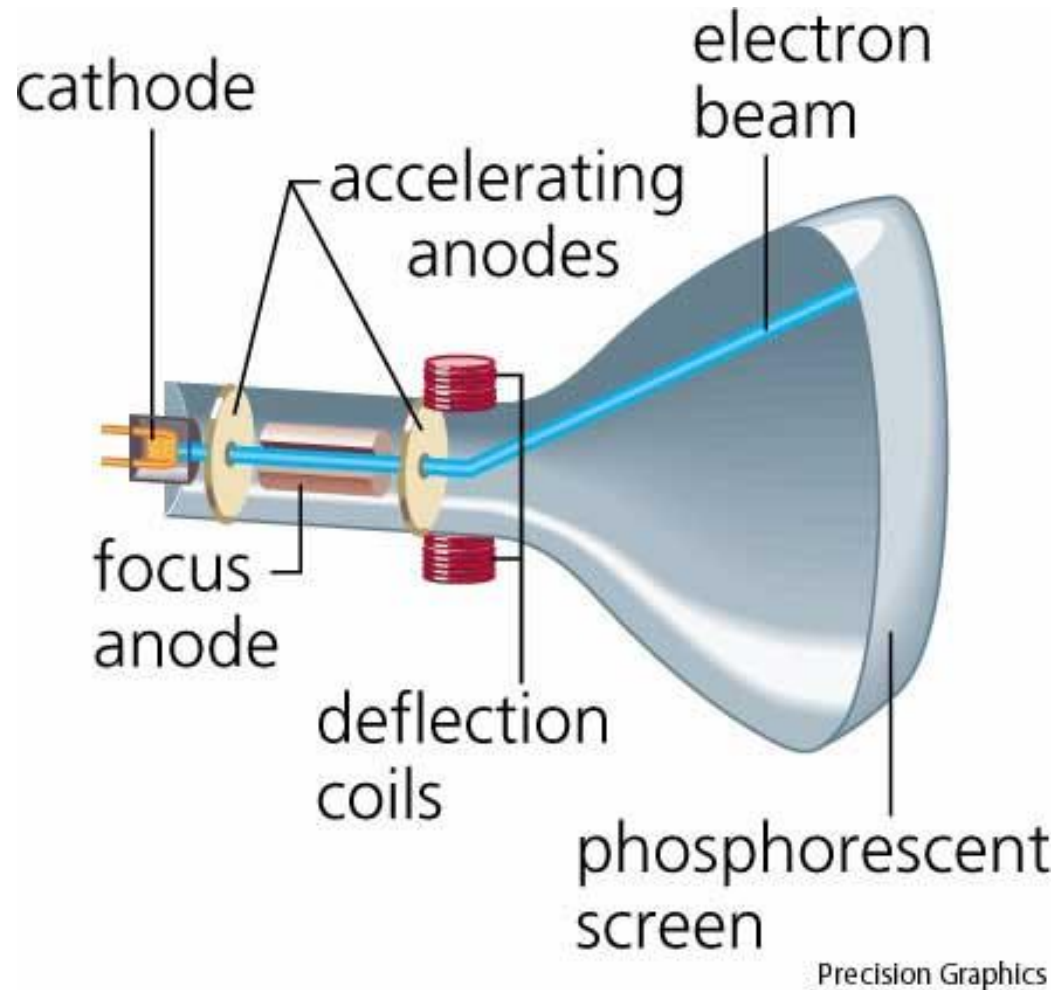
Computer Monitors

- ❑ Monitor is the standard output device
- ❑ Monitor can display text and graphical pictures
- ❑ Types of monitors:
 - CRT monitor
 - LCD monitor
 - Plasma monitor.

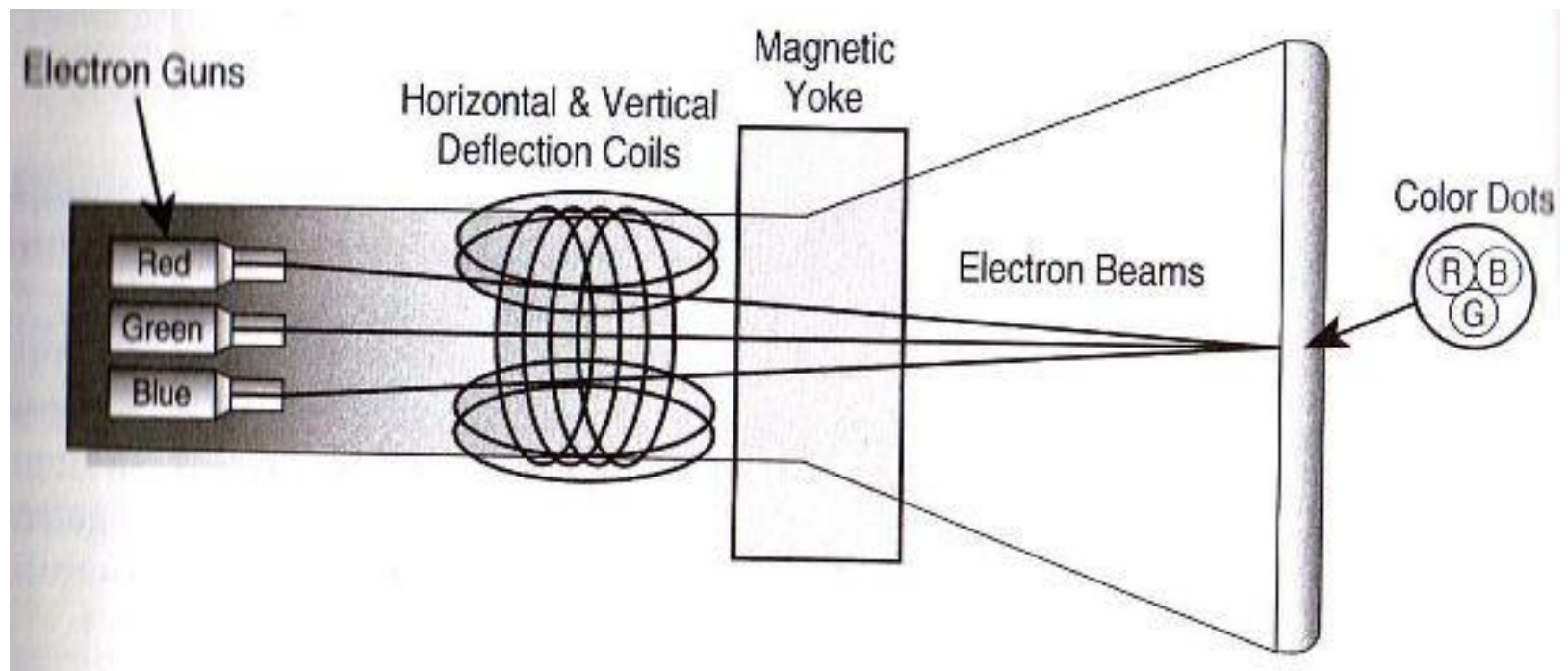
CRT Monitors



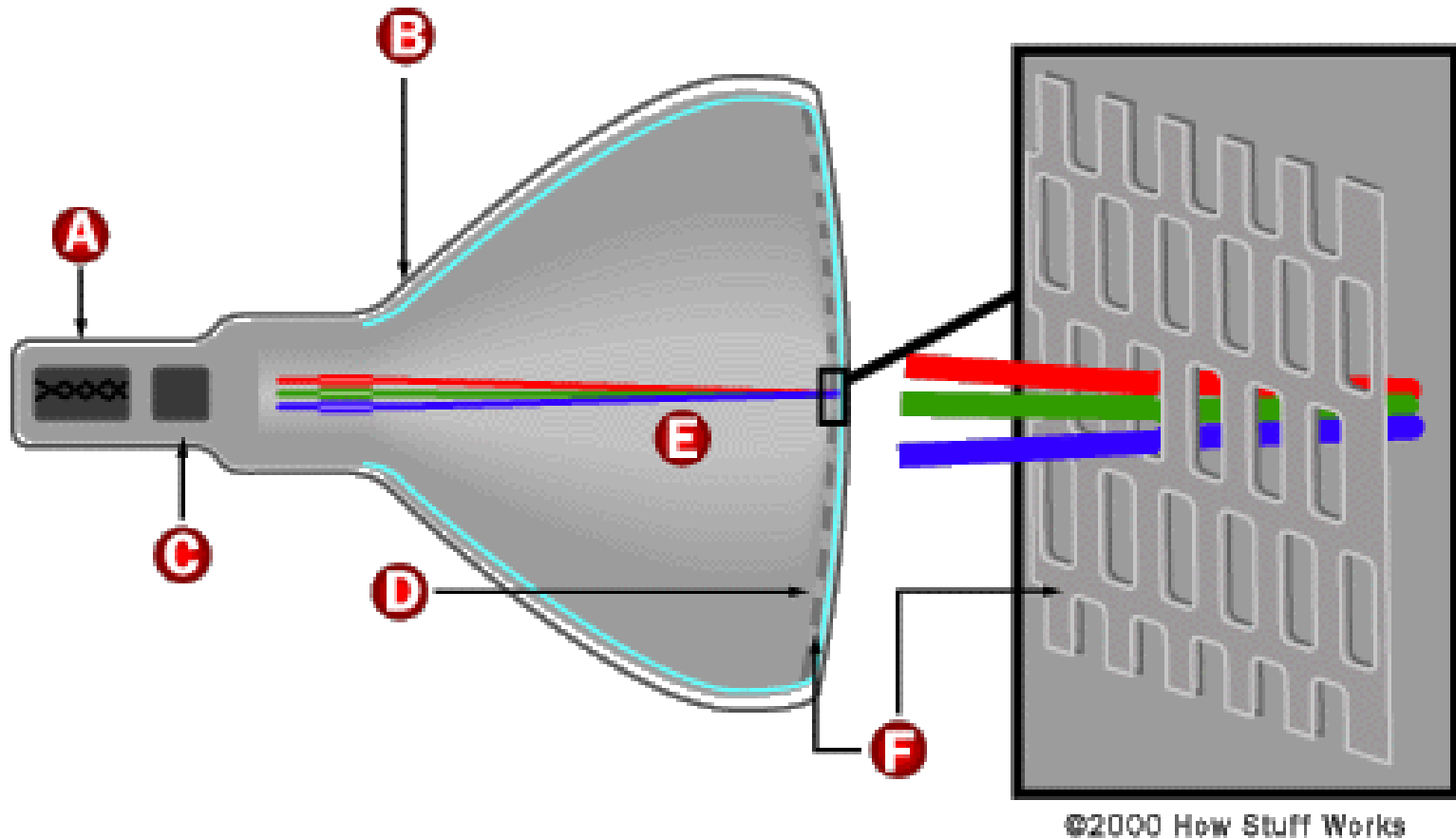
Back & While CRT Monitors



Colour CRT Monitors



CRT Colour Monitors



CRT Monitor – How it works

- ❑ CRT monitor is a Cathode Ray Tube which uses electron beam emitted from Cathode to phosphor layers to create pictures;
- ❑ The electron beam is driven by the vertical and horizontal deflection coils to make the full screen picture. The showing rate is 24 pictures/sec.
- ❑ The video signal is used to control the density of the electron beam;
- ❑ The black & white monitor uses one electron beam while the colour monitor uses 3 electron beams (RGB) to generate a pixel.

LCD Monitors

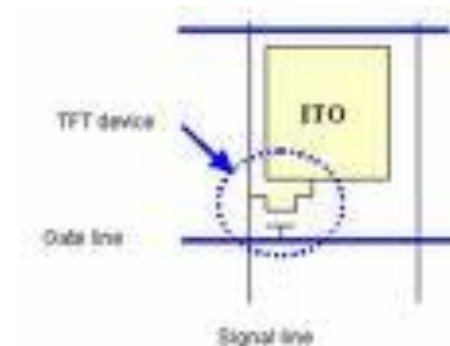
- ❑ LCD stands for Liquid Crystal Display. "Liquid Crystals" are semi-solid substances that are sensitive to temperature and electricity.
- ❑ LCD monitors have some advantages over CRT counterparts:
 - Thinner and lighter → occupy less space
 - Consume less power
 - Larger viewable size
- ❑ LCD monitors also have some drawbacks:
 - Don't support multi-resolutions
 - The picture quality is not so good and response time is usually slow.
 - The view angle is small.

LCD Monitors

- ❑ There are 2 LCD types based on the light sources:
 - Backlit:
 - ❑ The light source is from behind inside the display. Cold Cathode Fluorescent (CCFL) and LED-backlit are most common light sources used in LCD monitors;
 - ❑ Very commonly used for computer displays
 - Reflective:
 - ❑ Commonly used in digital watches (the black coloring of the digits indicates no reflection)
 - ❑ Simpler and inexpensive
 - ❑ Based on the reflection of external source of light.

How LCD Monitors Create Pictures?

- ❑ The Liquid Crystals themselves can not emit light:
 - They can however control the amount of light passing through them depending on the temperature and electricity.
- ❑ Two LCD types based on control methods:
 - Passive matrix LCD
 - ❑ These use electric grids/matrix to define each pixel by row and column
 - ❑ A row-column intersected pixel is activated by applying charge at the corresponding column and grounding the corresponding row
 - Active matrix LCD
 - ❑ Thin Film Transistors (TFT)
 - ❑ TFTs act like switching elements



How LCD Monitors Create Pictures?

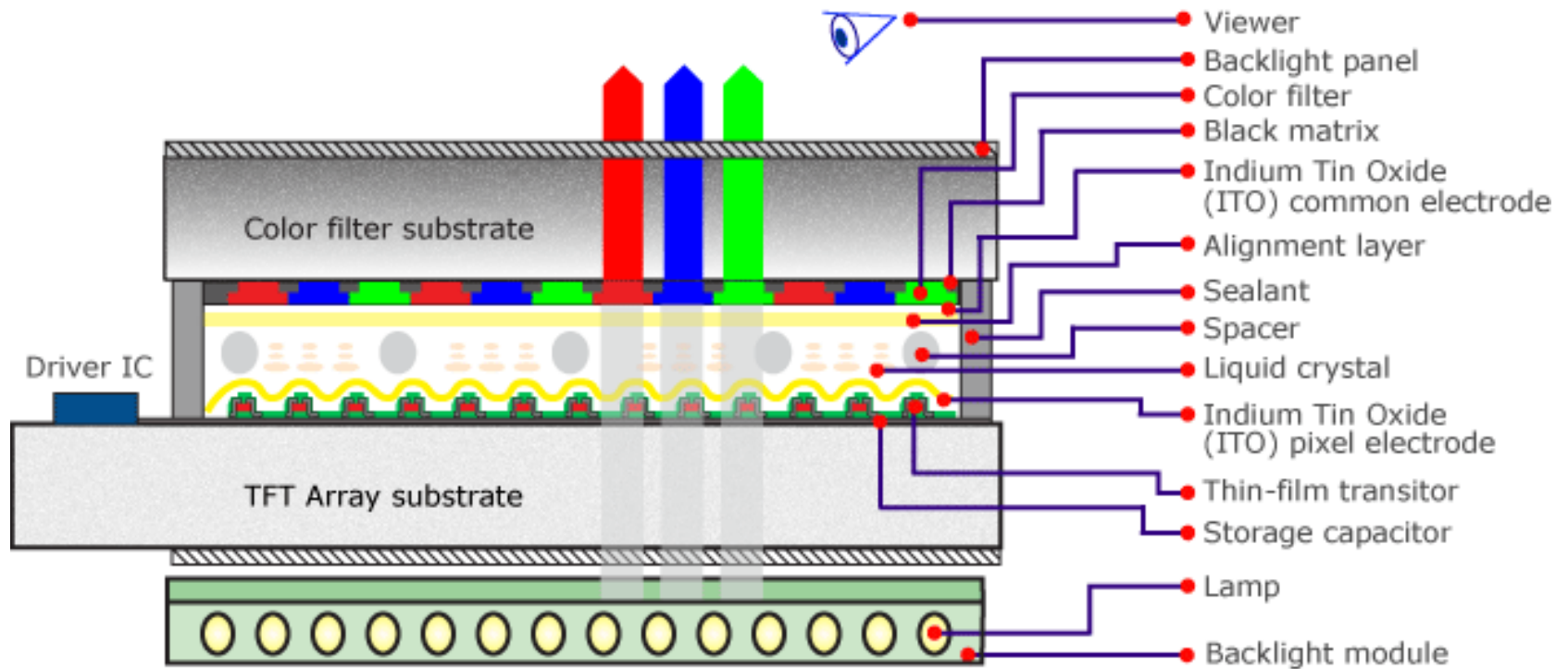


Diagram 1: Structure of TFT-LCD

How LCD Monitors Create Pictures?

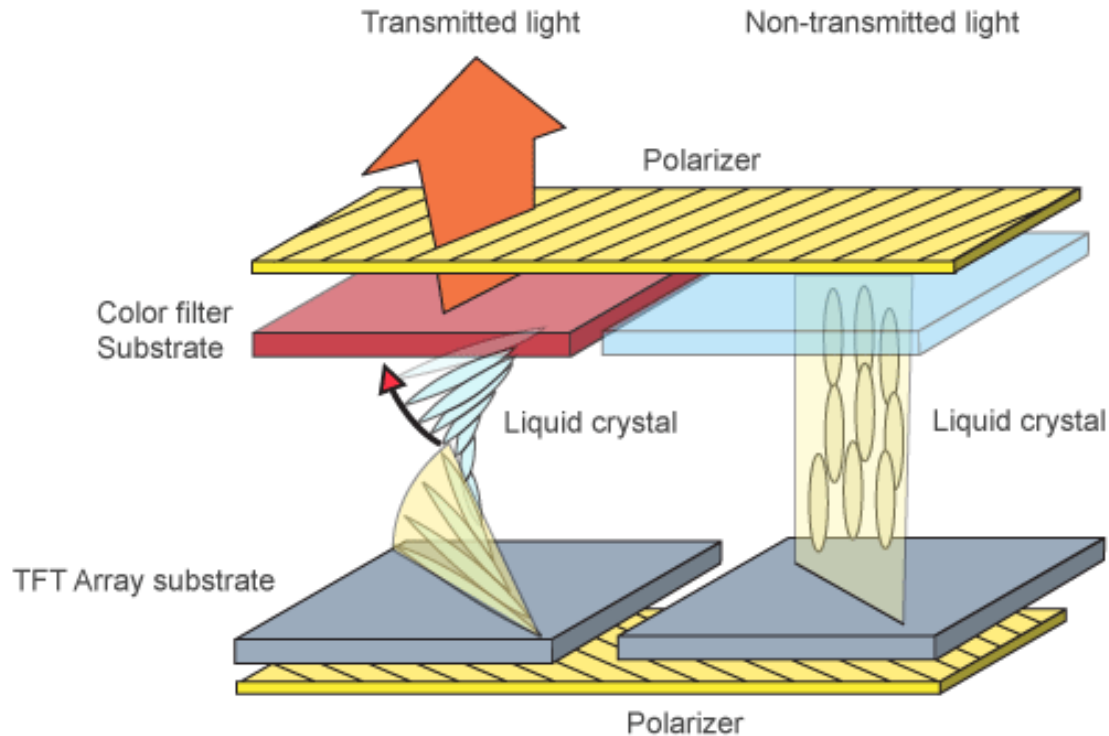


Diagram 2: The Fundamental Photonics of Liquid Crystal (Twisted Nematics)

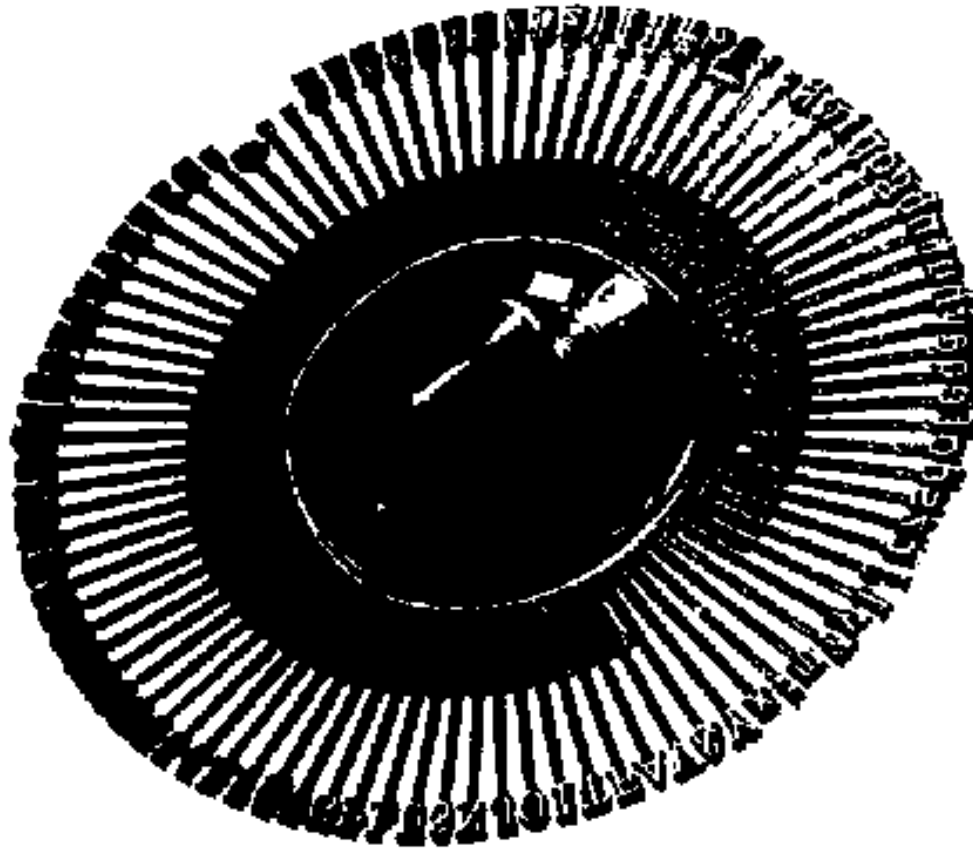
How LCD Monitors Create Pictures?

- ❑ TFT liquid crystal display is a device controlled by electric signals.
- ❑ The liquid crystal sits between two transparent layers of conductive ITO electrodes.
- ❑ Liquid crystal molecules are aligned in different directions by varying the voltage applied to the ITO electrodes.
- ❑ The direction of the LC molecules directly affects the penetration level of the light source, which in turn creates the desired lightness and darkness in the image, also known as grayscale.
- ❑ Color is produced by the color filter substrate.
- ❑ Pixel grayscale is decided by designated voltage levels from the data driver.

Printers

- ❑ Printers are used to output data to papers.
- ❑ Printer types:
 - Typewriter-derived printers (máy in búa)
 - Dot-matrix printers (máy in kim)
 - Laser printers (máy in laser)
 - Inkjet printers (máy in phun mực)
 - Colour printers (máy in màu)
 - Multi-function printers (máy in đa chức năng)

Typewriter-derived printers



Dot-matrix printers

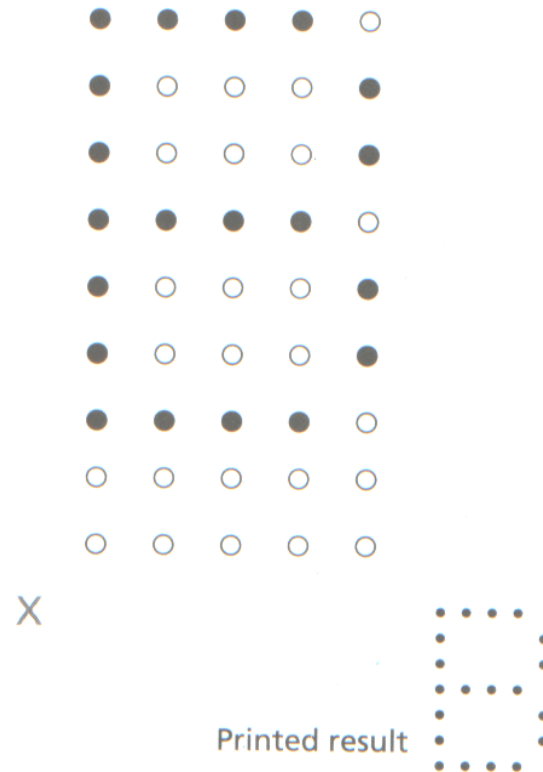
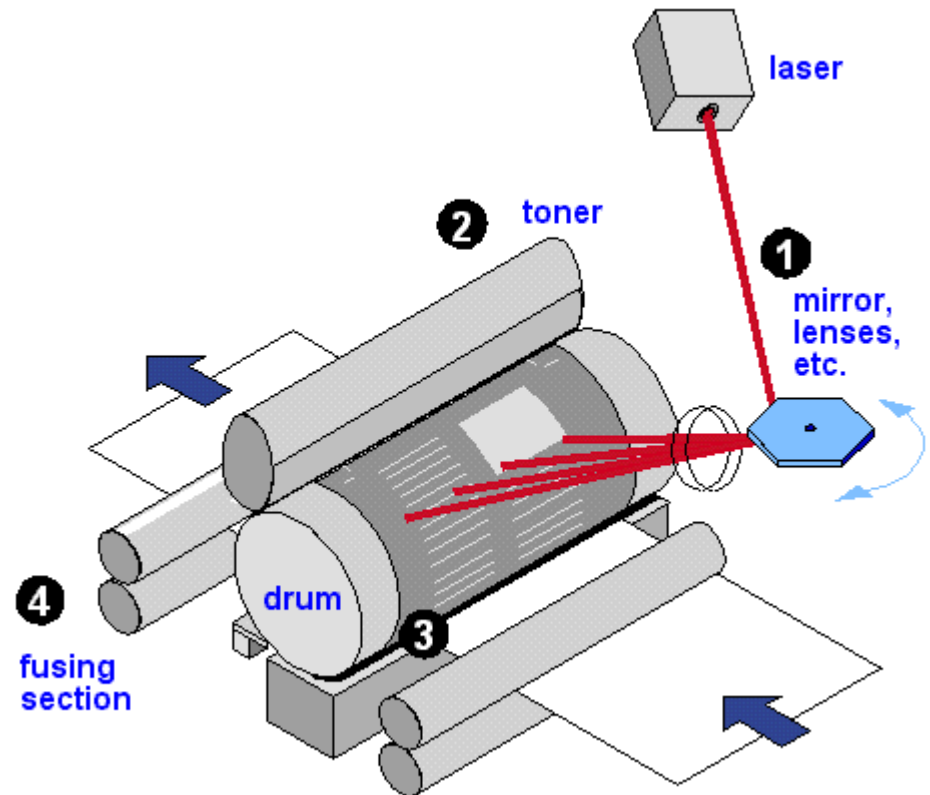
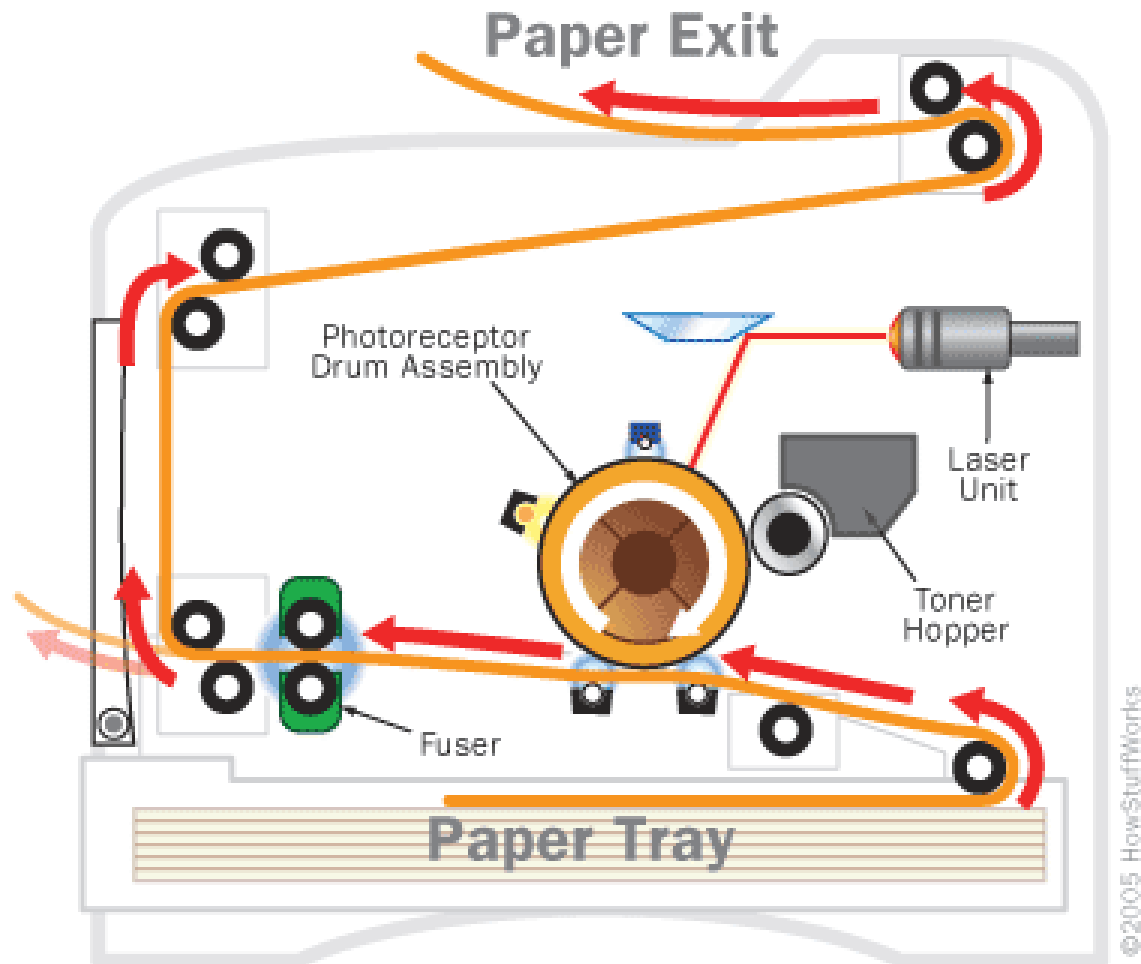


Fig. 5.3 9-pin dot pattern for the letter capital B

Laser printers

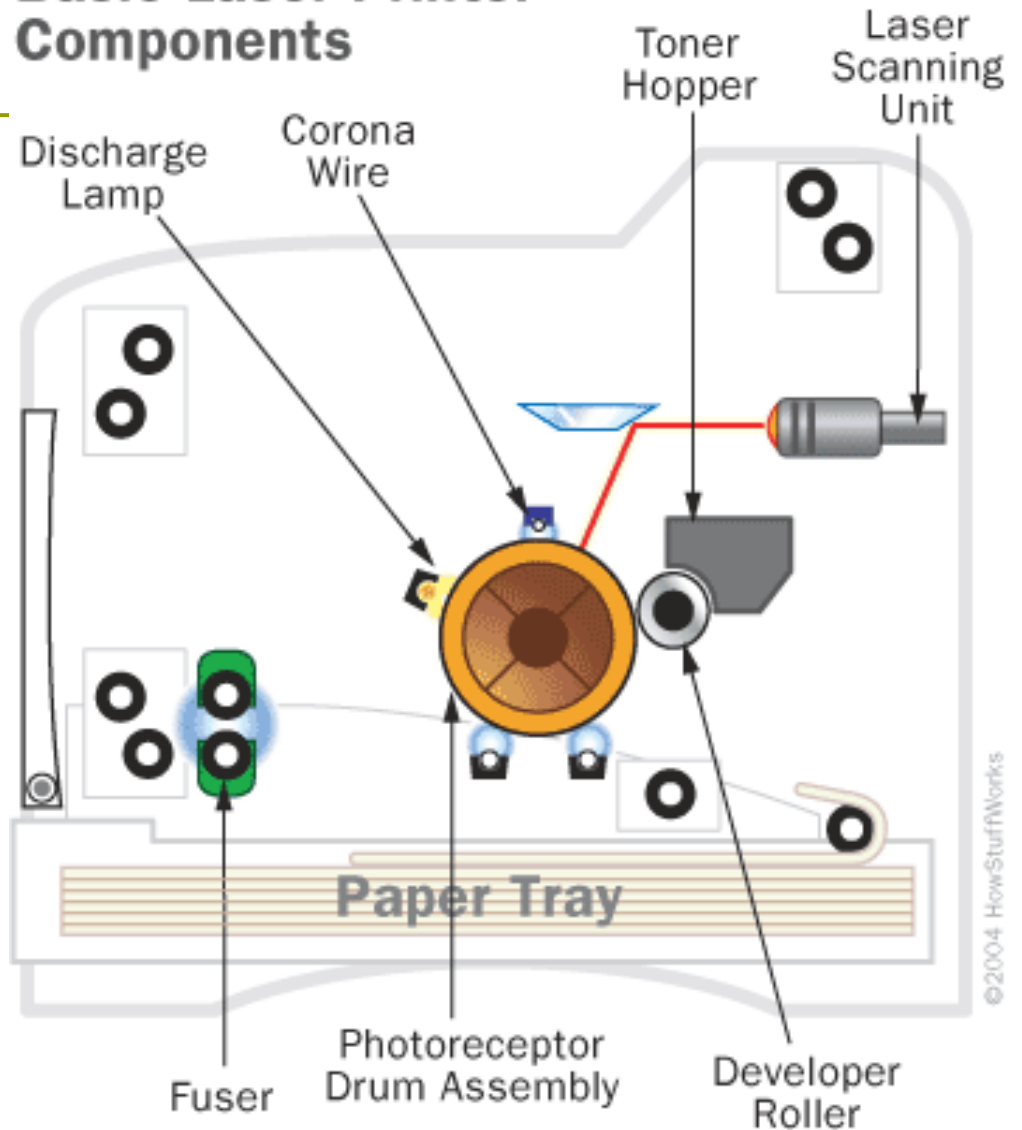


Laser printers



Laser printers

Basic Laser Printer Components



Laser printers - Components

- ❑ Main components of a laser printer:
 - Photosensitive drum
 - Laser light source
 - Rotating mirror and laser modulator
 - Ink pot
 - Electrode charger for drum
 - Electrode charger for paper
 - Drying drum
 - Paper tray

Laser printers – How it works?

- ❑ Laser printers work on the principle of electronic imaging by laser. Specifically:
 - The photosensitive drum is charged with an electrolysis layer by an electrode;
 - The laser from the laser light source passes through a rotating mirror, and the beam modulator is driven by the signal to be printed to the drum;
 - The laser light changes the electrolysis density on the drum surface according to the signal to be printed;

Laser printers – How it works?

- When the photosensitive drum rotates to the toner cartridge, the electrostatic charge on the drum attracts the oppositely charged ink particles. The ink particles attached on the drum represent the negative image of the text/information to be printed;
- The paper from the tray that is pulled up and also charged by the electrode with an opposite electrostatic charge to the electrostatic charge of the ink, so it attracts the ink particles from the photosensitive drum;
- The paper continues to pass through the hot fusing drum causing the ink particles to melt and to be pressed and attached tightly against the paper.

Inkjet printers



Inkjet printers

