Computer Hardware Essentials

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Computer-Generations

Computer

A computer is a programmable machine designed to perform arithmetic and logical operations automatically and sequentially on the input given by the user and gives the desired output after processing.

- ❑ Computer components are divided into two major categories namely hardware and software.

- ❑ ***Hardware*** is the machine itself and its connected devices such as monitor, keyboard, mouse etc.

- ❑ ***Software*** are the set of programs that make use of hardware for performing various functions.

Characteristics of Computers

- **Speed**
  Computers work at an incredible speed. A powerful computer is capable of performing about 3-4 million simple instructions per second.
- **Accuracy**
  In addition to being fast, computers are also accurate. Errors that may occur can almost always be attributed to human error
- **Diligence**
  Unlike human beings, computers are highly consistent. They do not suffer from human traits of boredom and tiredness resulting in lack of concentration. Computers, therefore, are better than human beings in performing voluminous and repetitive jobs.
- **Versatility**
  Computers are versatile machines and are capable of performing any task as long as it can be broken down into a series of logical steps. The presence of computers can be seen in almost every sphere – Railway/Air reservation, Banks, Hotels, Weather forecasting and many more.
- **Storage Capacity**
  Today's computers can store large volumes of data. A piece of information once recorded in the computer, can never be forgotten and can be retrieved almost instantaneously.

Computer Organization

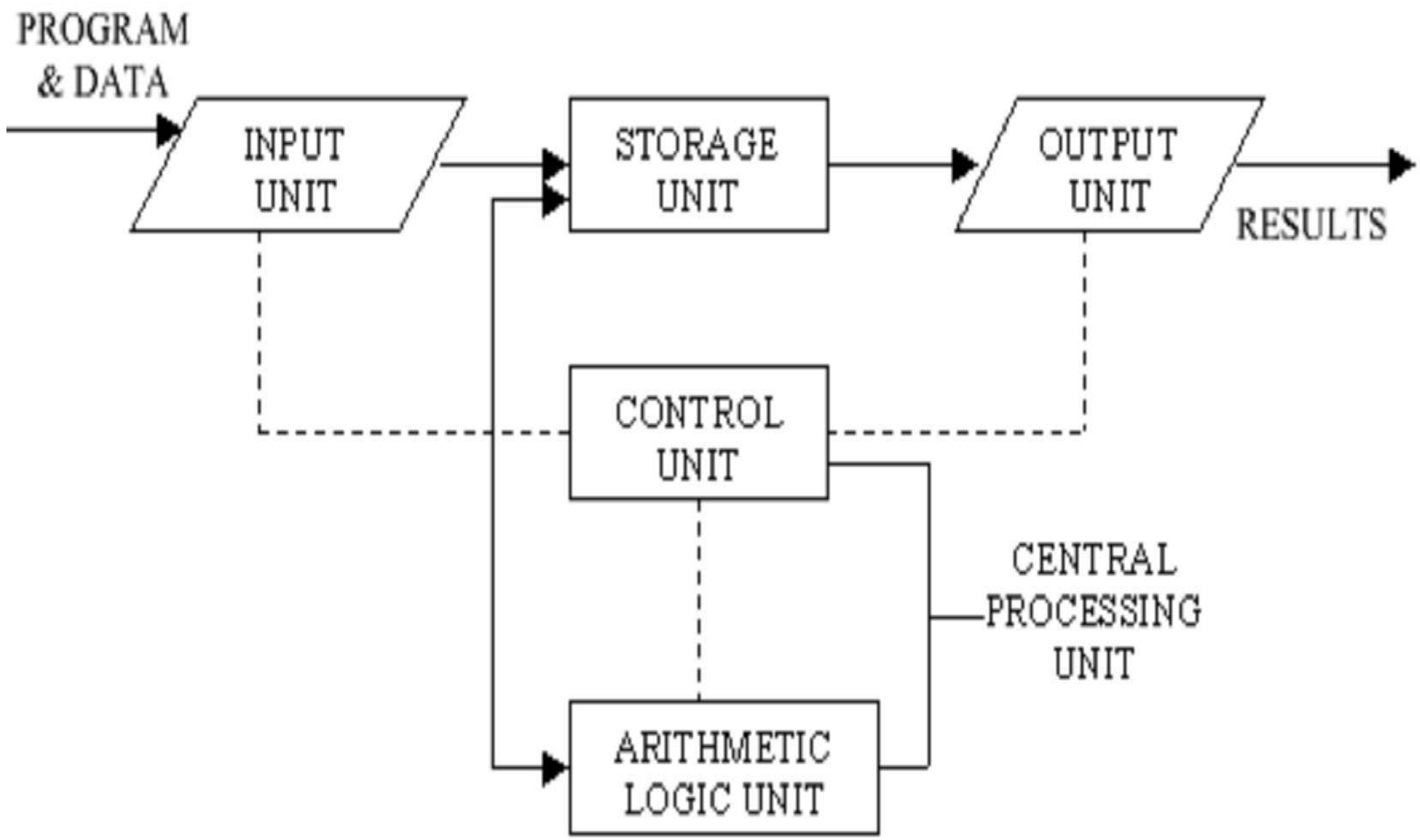
- A computer system consists of mainly four basic units namely
  - Input unit,
  - Storage unit,
  - Central Processing Unit
  - Output unit.

Central Processing unit further includes Arithmetic logic unit and control unit.

A computer performs five major operations or functions irrespective of its size and make. These are

- It accepts data or instructions as input,
- It stores data and instruction
- It processes data as per the instructions,
- It controls all operations inside a computer, and
- It gives results in the form of output.

Functional Units



Input Unit:

- This unit is used for entering data and programs into the computer system by the user for processing.

Storage Unit:

- The storage unit is used for storing data and instructions before and after processing.

Output Unit:

- The output unit is used for storing the result as output produced by the computer after processing.

Processing:

- The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided.It is then sent back to the storage unit. CPU includes Arithmetic logic unit (ALU) and control unit (CU)

Central Processing Unit (CPU)

Arithmetic Logic Unit:

- All calculations and comparisons, based on the instructions provided, are carried out within the ALU. It performs arithmetic functions like addition, subtraction, multiplication, division and also logical operations like greater than, less than and equal to etc.

Control Unit:

- Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.

Generation of Computers

- The first electronic computer was designed and built at the University of Pennsylvania based on vacuum tube technology.

- Vacuum tubes were used to perform logic operations and to store data.

- Generations of computers has been divided into five according to the development of technologies used to fabricate the processors, memories and I/O units.

  - First Generation : 1945 – 55

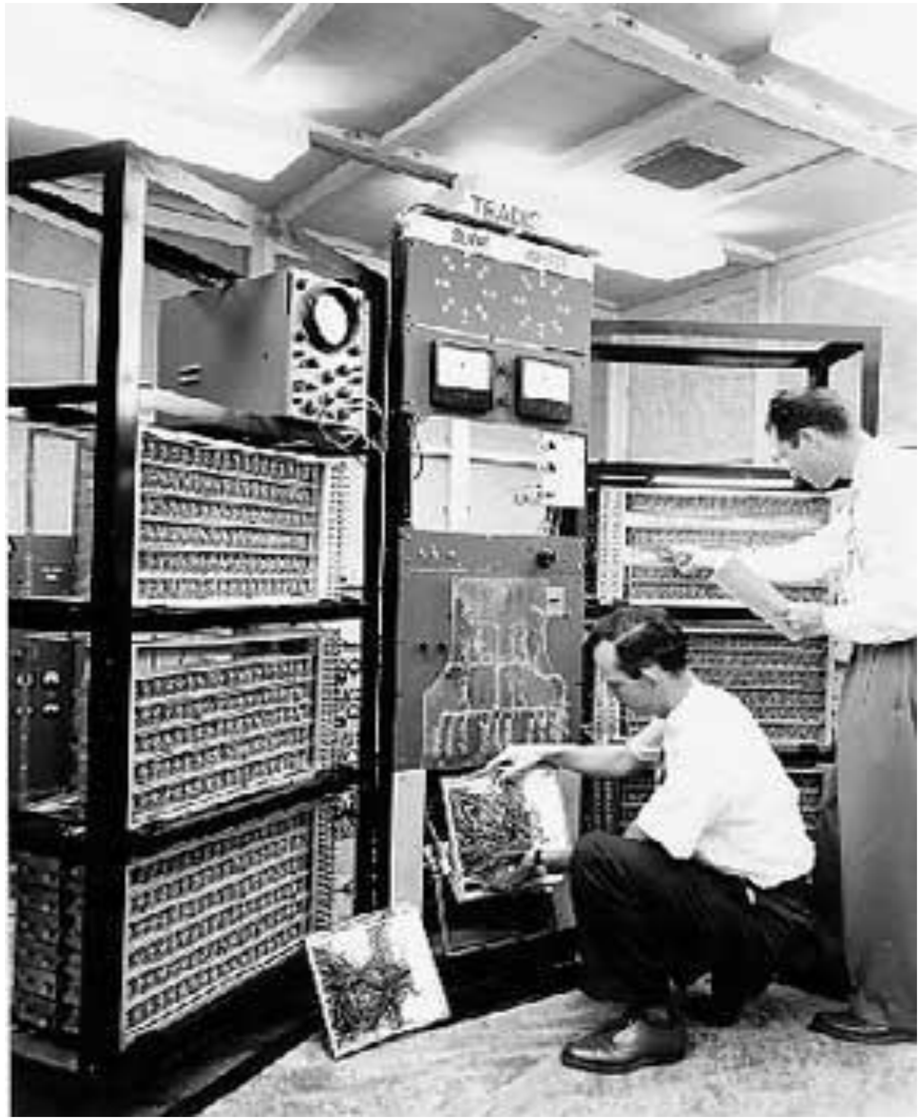
  - Second Generation : 1955 – 65

  - Third Generation : 1965 – 75

  - Fourth Generation : 1975 – 89

  - Fifth Generation : 1989 to present

First Generation



First Generation

- ENIAC - Electronic Numerical Integrator And Calculator
- EDSAC – Electronic Delay Storage Automatic Calculator
- EDVAC – Electronic Discrete Variable Automatic Computer
- UNIVAC – Universal Automatic Computer
- IBM 701

- Vacuum tubes were used – basic arithmetic operations took few milliseconds
- Bulky and High cost
- Consume more power with limited performance
- Uses assembly language – to prepare programs. These were translated into machine level language for execution.
- Mercury delay line memories and Electrostatic memories were used
- Fixed point arithmetic was used
- 100 to 1000 fold increase in speed relative to the earlier mechanical and relay based electromechanical technology
- Punched cards and paper tape were invented to feed programs and data and to get results.
- Magnetic tape / magnetic drum were used as secondary memory
- Mainly used for scientific computations.

Second Generation

Second Generation

(Manufacturers – IBM 7030, Digital Data Corporation's PDP 1/5/8 Honeywell 400)

- Transistors were used in place of vacuum tubes. (invented at AT&T Bell lab in 1947)
- Small in size
- Lesser power consumption and better performance
- Lower cost
- Magnetic ferrite core memories were used as main memory which is a random-access nonvolatile memory
- Magnetic tapes and magnetic disks were used as secondary memory
- Hardware for floating point arithmetic operations was developed.
- Index registers were introduced which increased flexibility of programming.

- High level languages such as FORTRAN, COBOL etc. were used - Compilers were developed to translate the high-level program into corresponding assembly language program which was then translated into machine language.

- Separate input-output processors were developed that could operate in parallel with CPU.

- Punched cards continued during this period also.

- 1000 fold increase in speed.

- Increasingly used in business, industry and commercial organizations for preparation of payroll, inventory control, marketing, production planning, research, scientific & engineering analysis and design etc

Third Generation

Third Generation

System 360 Mainframe from IBM, PDP-8 Mini Computer from Digital Equipment Corporation

- ICs were used
- Small Scale Integration and Medium Scale Integration technology were implemented in CPU, I/O processors etc.
- Smaller & better performance
- Comparatively lesser cost
- Faster processors
- In the beginning magnetic core memories were used. Later they were replaced by semiconductor memories (RAM & ROM)
- Introduced microprogramming

- Microprogramming, parallel processing (pipelining, multiprocessor system etc.), multiprogramming, multi-user system (time shared system) etc. were introduced.

- Operating system software were introduced (efficient sharing of a computer system by several user programs)

- Cache and virtual memories were introduced (Cache memory makes the main memory appear faster than it really is. Virtual memory makes it appear larger)

- High level languages were standardized by ANSI eg. ANSI FORTRAN, ANSI COBOL etc.

- Database management, multi-user application, online systems like closed loop process control, airline reservation, interactive query systems, automatic industrial control etc. emerged during this period.

Fourth Generation

Fourth Generation

Intel's 8088,80286,80386,80486 .., Motorola's 68000, 68030, 68040, Apple II, CRAY I/2/X/MP etc.

- Microprocessors were introduced as CPU– Complete processors and large section of main memory could be implemented in a single chip
- Tens of thousands of transistors can be placed in a single chip (VLSI design implemented)
- CRT screen, laser & ink jet printers, scanners etc were developed.
- Semiconductor memory chips were used as the main memory.
- Secondary memory was composed of hard disks – Floppy disks & magnetic tapes were used for backup memory
- Parallelism, pipelining cache memory and virtual memory were applied in a better way

- LAN and WANS were developed (where desktop work stations interconnected)
- Introduced C language and Unix OS
- Introduced Graphical User Interface
- Less power consumption
- High performance, lower cost and very compact
- Much increase in the speed of operation

Fifth Generation

Fifth Generation

IBM notebooks, Pentium PCs-Pentium 1/2/3/4/Dual core/Quad core.. SUN work stations, Origin 2000, PARAM 10000, IBM SP/2

- Generation number beyond IV, have been used occasionally to describe some current computer system that have a dominant organizational or application driven feature.
- Computers based on artificial intelligence are available
- Computers use extensive parallel processing, multiple pipelines, multiple processors etc
- Massive parallel machines and extensively distributed system connected by communication networks fall in this category.
- Introduced ULSI (Ultra Large Scale Integration) technology – Intel's Pentium 4 microprocessor contains 55 million transistors millions of components on a single IC chip.

- Superscalar processors, Vector processors, SIMD processors, 32 bit micro controllers and embedded processors, Digital Signal Processors (DSP) etc have been developed.

- Memory chips up to 1 GB, hard disk drives up to 180 GB and optical disks up to 27 GB are available (still the capacity is increasing)

- Object oriented language like JAVA suitable for internet programming has been developed.

- Portable note book computers introduced

- Storage technology advanced – large main memory and disk storage available

- Introduced World Wide Web. (and other existing applications like e-mail, e Commerce, Virtual libraries/Classrooms, multimedia applications etc.)

- New operating systems developed – Windows 95/98/XP/…, LINUX, etc.

- Got hot pluggable features – which enable a failed component to be replaced with a new one without the need to shutdown the system, allowing the uptime of the system to be very high.

- The recent development in the application of internet is the Grid technology which is still in its upcoming stage.

- Quantum mechanism and nanotechnology will radically change the phase of computers.

Computer Components

Hardware:

- Computer hardware is the collection of physical elements that constitutes a computer system. Computer hardware refers to the physical parts or components of a computer such as the monitor, mouse, keyboard, computer data storage, hard drive disk (HDD), system unit (graphic cards, sound cards, memory, motherboard and chips), etc.

Software

- Software is a generic term for organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific functions of the computer, and application software which is used by users to accomplish specific tasks.

Software Types

A. System software is responsible for controlling, integrating, and managing the individual hardware components of a computer system so that other software and the users of the system see it as a functional unit without having to be concerned with the low-level details such as transferring data from memory to disk, or rendering text onto a display. Generally, system software consists of an operating system and some fundamental utilities such as disk formatters, file managers, display managers, text editors, user authentication (login) and management tools, and networking and device control software.

B. **Application software** is used to accomplish specific tasks other than just running the computer system. Application software may consist of a single program, such as an image viewer; a small collection of programs that work closely together to accomplish a task, such as a spreadsheet or text processing system; a larger collection of related but independent programs and packages that have a common user interface or shared data format, such as Microsoft Office, which consists of closely integrated word processor, spreadsheet, database, etc.; or a software system, such as a database management system, which is a collection of fundamental programs that may provide some service to a variety of other independent applications.

System Software	Application Software
Computer software, or just software is a general term primarily used for digitally stored data such as computer programs and other kinds of information read and written by computers. App comes under computer software though it has a wide scope now.	Application software, also known as an application or an "app", is computer software designed to help the user to perform specific tasks.
1) Microsoft Windows 2) Linux 3) Unix 4) Mac OSX 5) DOS	1) Opera (Web Browser) 2) Microsoft Word (Word Processing) 3) Microsoft Excel (Spreadsheet software) 4) MySQL (Database Software) 5) Microsoft PowerPoint (Presentation Software) 6) Adobe Photoshop (Graphics Software)
Generally, users do not interact with system software as it works in the background.	Users always interact with application software while doing different activities.
System software can run independently of the application software.	Application software cannot run without the presence of the system software.

Computers Classification

Computers can be generally classified by size and power as follows, though there is Considerable overlap:

- **Personal computer:** A small, single-user computer based on a microprocessor. In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data.
- **Workstation :** A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.
- **Minicomputer :** A multi-user computer capable of supporting from 10 to hundreds of users simultaneously.
- **Mainframe :** A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.
- **Supercomputer :** An extremely fast computer that can perform hundreds of millions of instructions per second.

Motherboard

Mother Board

- The main printed circuit board in a computer is known as the motherboard. Other names for this central computer unit are system board, mainboard, or printed wired board (PWB). The motherboard is sometimes shortened to Mobo.

- Numerous major components, crucial for the functioning of the computer, are attached to the motherboard. These include the processor, memory, and expansion slots.

- The motherboard connects directly or indirectly to every part of the PC.

- The type of motherboard installed in a PC has a great effect on a computer's system speed and expansion capabilities.

- At a minimum it includes one or more Central Processing Units (CPU), and the main processing activity of the computer takes place on it.

- However, other connected printed circuit boards may contain their own pre-processing or post-processing CPUs, to take some of the load off of the motherboard; these, together with other

Mother Board Cont..,

- The motherboard is the main circuit board inside the PC. It holds the CPU and memory, provides expansion slots for peripherals, and, whether directly or indirectly, connects to every part of the PC.

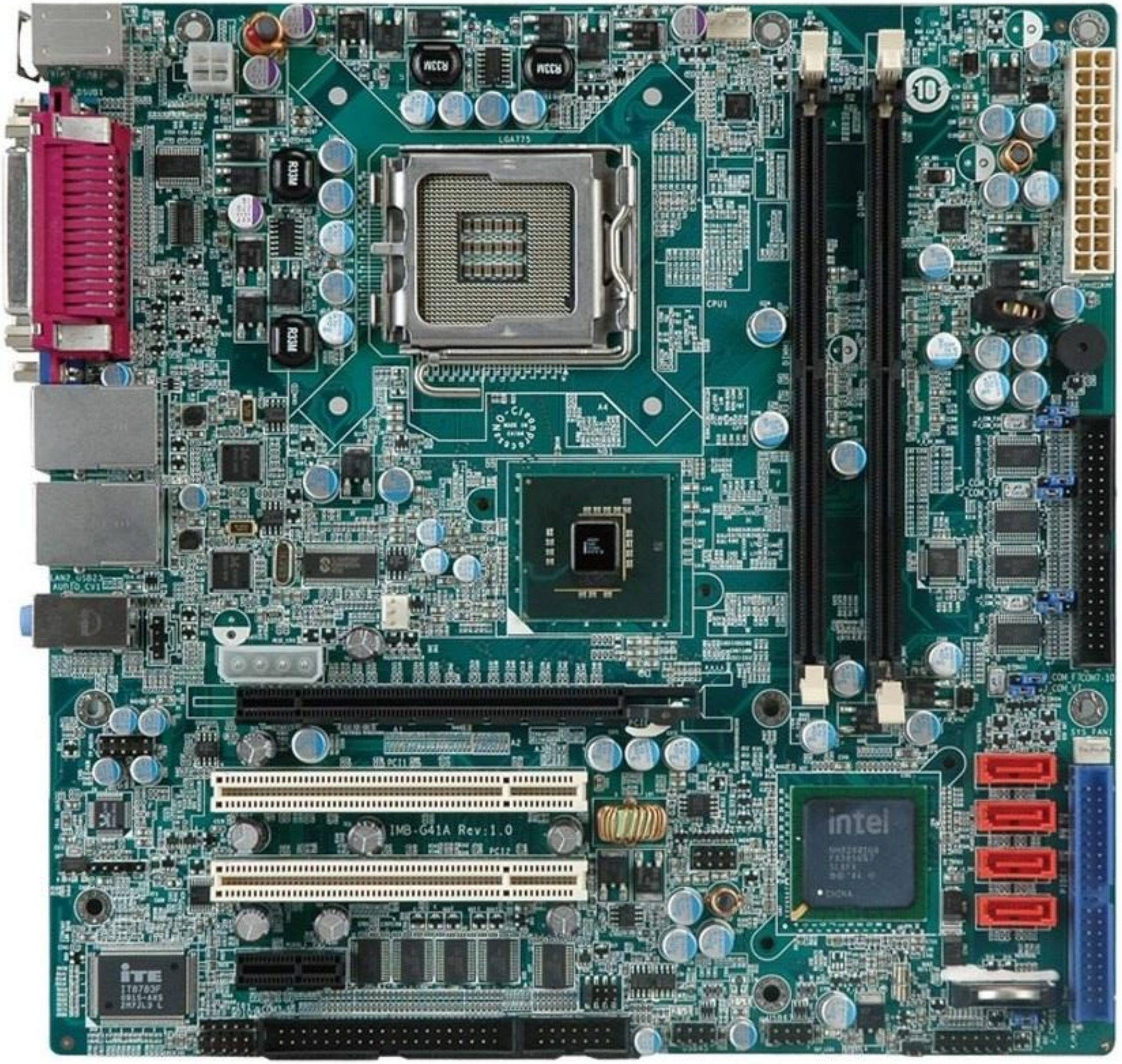
- The essential motherboard make-up includes the chipset (known as the “glue logic”), some code in ROM and the various wired interconnections between the components know as buses.

- The chipset is fundamental, and controls how the motherboard interacts with everything else in the system. A good chipset can be more important than the power of CPU or the amount of RAM.

- The ROM code includes the BIOS, which has user-changeable options for how the motherboard operates with integral and connected devices.

- The buses are the electrical wires that connect everything together. Motherboard designs use many different buses to link their various components. For instance, wide, high-speed buses are difficult and expensive to produce.

Mother Board Cont..,



Motherboard-Form Factors

Baby AT (BAT) Motherboard Form Factor

- The Baby AT (BAT) format reduced the dimensions of the motherboard to a typical 9in wide by 10in long, and BAT motherboards are generally characterised by their shape, an AT-style keyboard connector soldered to the board and serial and parallel port connectors which are attached using cables between the physical ports mounted on the system case and corresponding connectors located on the motherboard.

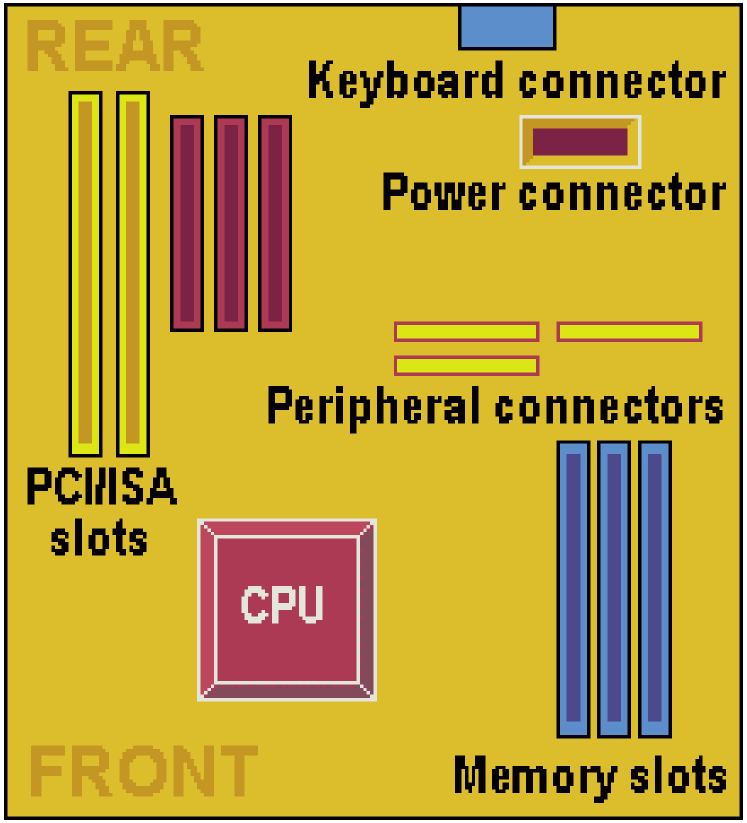
- With the BAT design the processor socket is located at the front of the motherboard, and full-length expansion cards are intended to extend over it. This means that removing the processor requires the removal of some or all expansion cards first.

- Problems were exacerbated by the increasing speeds of Pentium-class processors. System cooling relied on the AT power supply blowing air out of the chassis enclosure and, due to the distance between the power supply and the CPU, an additional chassis fan or active heatsink became a necessity to maintain good airflow across the CPU.

- AT power supplies only provide 12V and 5V outputs to the motherboard, requiring additional regulators on the motherboard if 3.3V components (PCI cards or CPUs) are used.

- Sometimes a second heatsink was also required on these voltage regulators and together the various additional heat dissipation components caused serious obstruction for expansion slots.

- Some BAT designs allow the use of either AT or ATX power supplies, and some ATX cases might allow the use of a Baby-AT motherboard.



LPX – Low Profile eXtension motherboard form factor

- The LPX format is a specialised variant of the Baby-AT used in low profile desktop systems and is a loose specification with a variety of proprietary implementations.
- Expansion slots are located on a central riser card, allowing cards to be mounted horizontally.
- However, this arrangement can make it difficult to remove the motherboard, and the more complex engineering required adds to system costs.
- As the riser card prevents good airflow within the system case, additional chassis fans are almost always needed.
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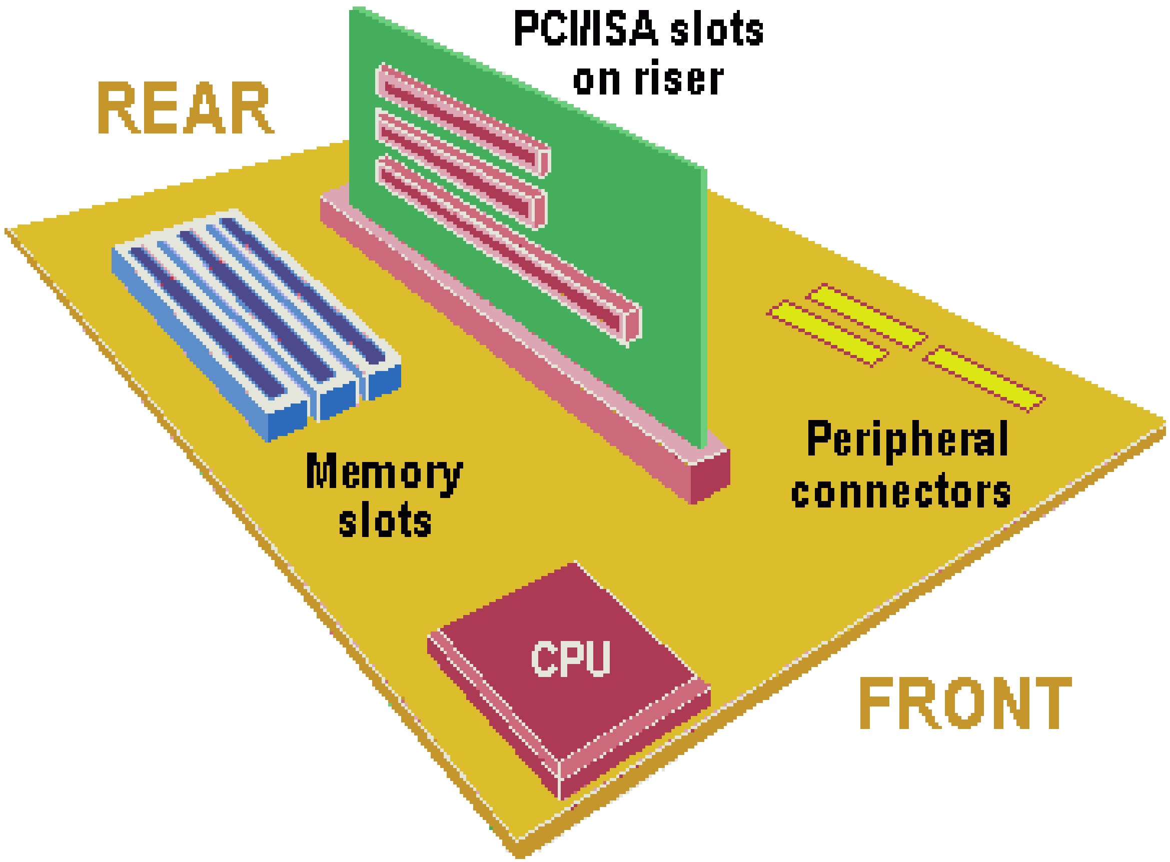
- The extra space and cooling required for these components highlighted the LPX's problems

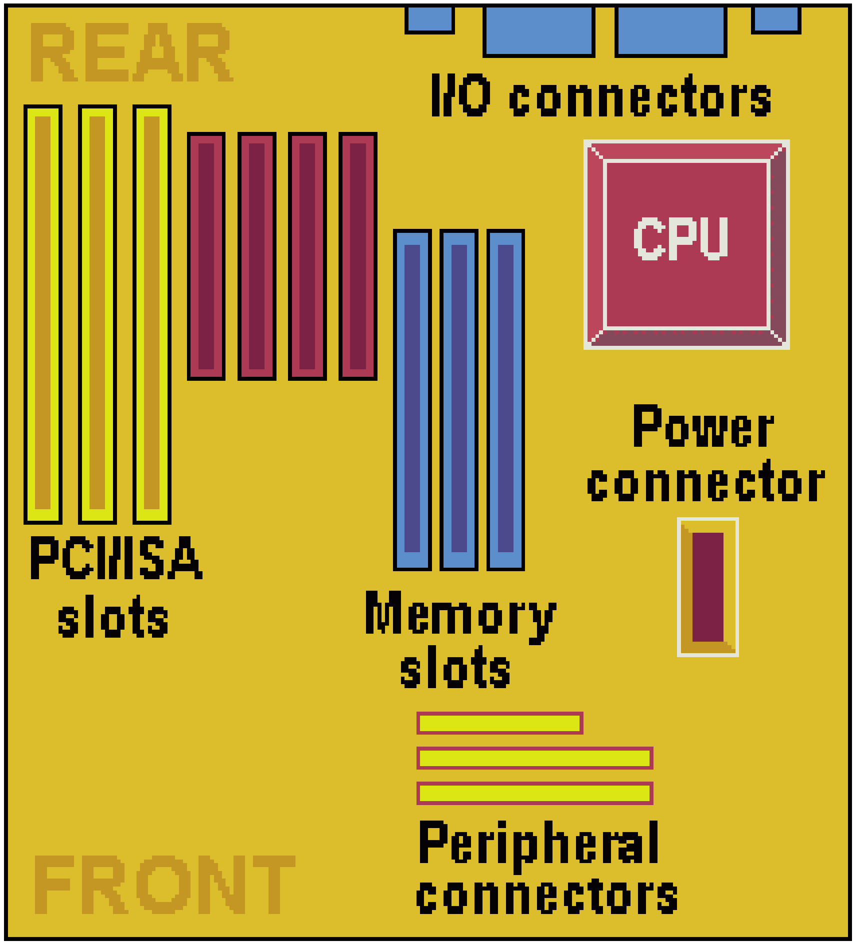


ATX form factor

- The Intel Advanced/ML motherboard, launched in 1996, was designed to solve issues of space and airflow that the Pentium II and AGP graphics cards had caused the preceding LPX form factor.
- As the first major innovation in form factors in years, it marked the beginning of a new era in motherboard design.
- Its size and layout are completely different to the BAT format, following a new scheme known as ATX. The dimensions of a standard ATX board are 12in wide by 9.6in long; the mini ATX variant is typically of the order 11.2in by 8.2in.
- The ATX design gets round the space and airflow problems by moving the CPU socket and the voltage regulator to the right-hand side of the expansion bus.
- Room is made for the CPU by making the card slightly wider, and shrinking or integrating components such as the Flash BIOS, I/O logic and keyboard controller.
- This means the board need only be half as deep as a full size Baby AT, and there's no obstruction whatsoever to the six expansion slots (two ISA, one ISA/PCI, three PCI).

- An important innovation was the new specification of power supply for the ATX that can be powered on or off by a signal from the motherboard. At a time when energy conservation was becoming a major issue, this allows notebook-style power management and software-controlled shutdown and power-up.
- A 3.3V output is also provided directly from the power supply. Accessibility of the processor and memory modules is improved dramatically, and relocation of the peripheral connectors allows shorter cables to be used.
- This also helps reduce electromagnetic interference. The ATX power supply has a side vent that blows air from the outside directly across the processor and memory modules, allowing passive heatsinks to be used in most cases, thereby reducing system noise.
- Mini-ATX is simply a smaller version of a full-sized ATX board. On both designs, parallel, serial, PS/2 keyboard and mouse ports are located on a double-height I/O shield at the rear. Being soldered directly onto the board generally means no need for cable interconnects to the on-board I/O ports.

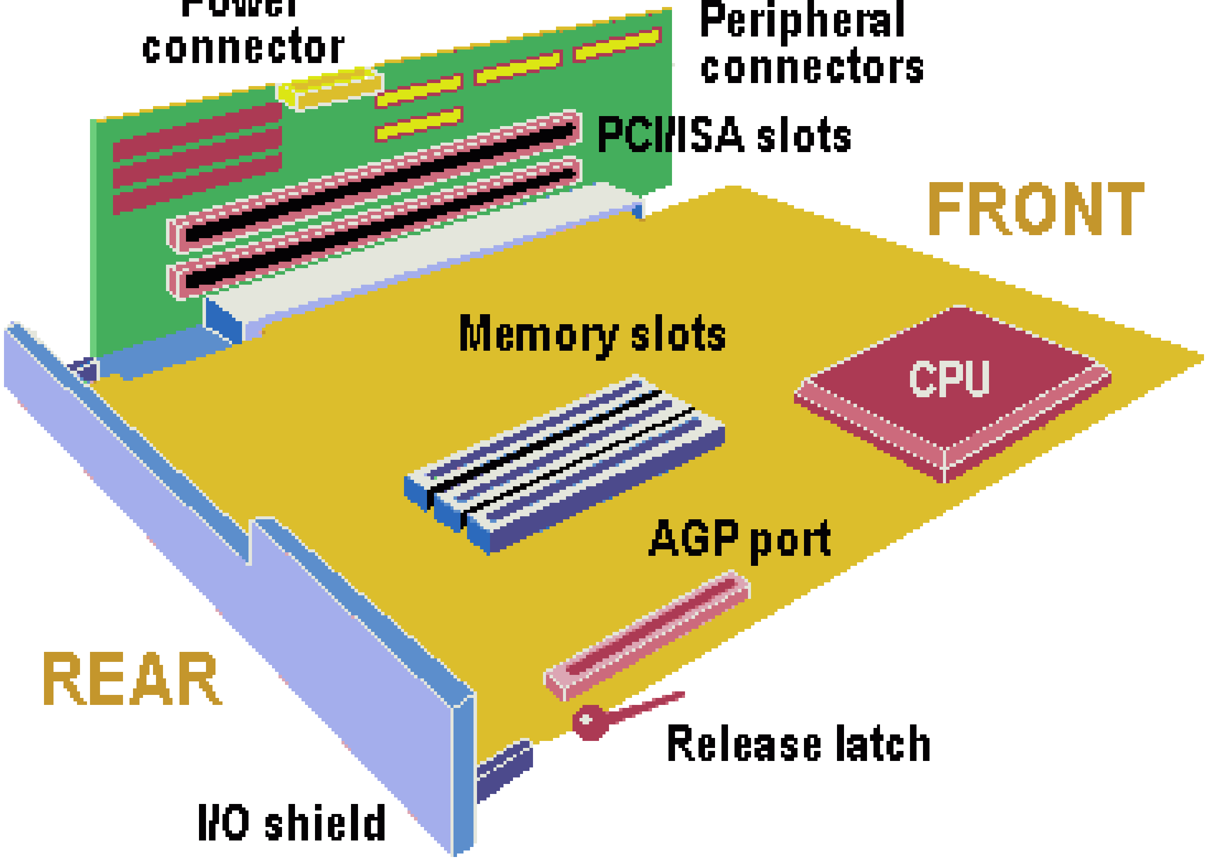
- A consequence of this, however, is that the ATX needs a newly designed case, with correctly positioned cut-outs for the ports, and neither ATX no Mini-ATX boards can be used in AT-style cases.



NLX – New Low profile eXtended

Intel's NLX design, introduced in 1997, is an improvement on the LPX design for low-profile systems, with an emphasis on ease of maintenance.

The NLX format is smaller, typically 8.8in wide by 13in long, so well suited for low-profile desktop cases.



- All expansion slots, power cables and peripheral connectors are located on an edge-mounted riser card, allowing simple removal of the main motherboard, which is mounted on rails in the chassis.

- It uses a full-width I/O shield to allow for different combinations of rear-panel I/O. The design allows for use of an AGP card, but the slot must be on the motherboard, which reduces the ease of maintenance when such a card is implemented.

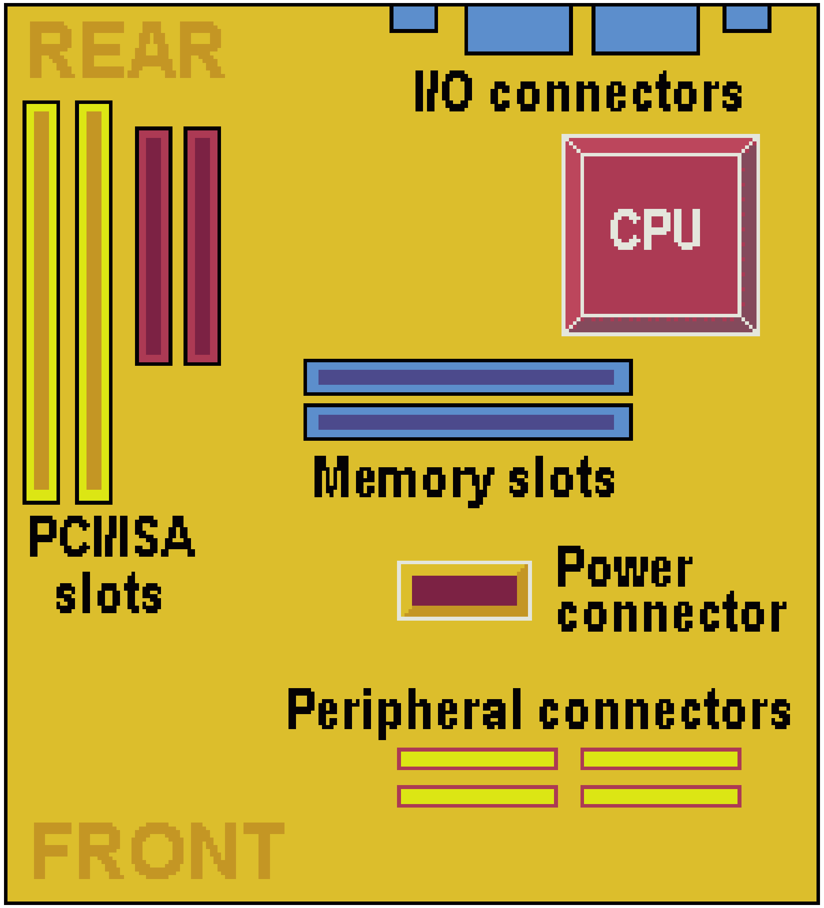
Micro ATX motherboard form factor

- Introduced in the late 1990s, the MicroATX is basically a smaller version of Intel's ATX specification, intended for compact, low-cost consumer systems with limited expansion potential.

- The maximum size of the board is 9.6in square, and its designed to fit into either a standard ATX case or one of the new micro-tower desktop designs.

- The double-decker I/O shield is the same as that on the ATX design, but there's only provision for up to four expansion slots as opposed to the seven that ATX allows.

- The microATX also allows use of a smaller power supply, such as the SFX design, which is reduced in both size and power output.


REAR
I/O connectors
CPU
PCI/ISA
slots
Memory slots
Power
connector
Peripheral connectors
FRONT

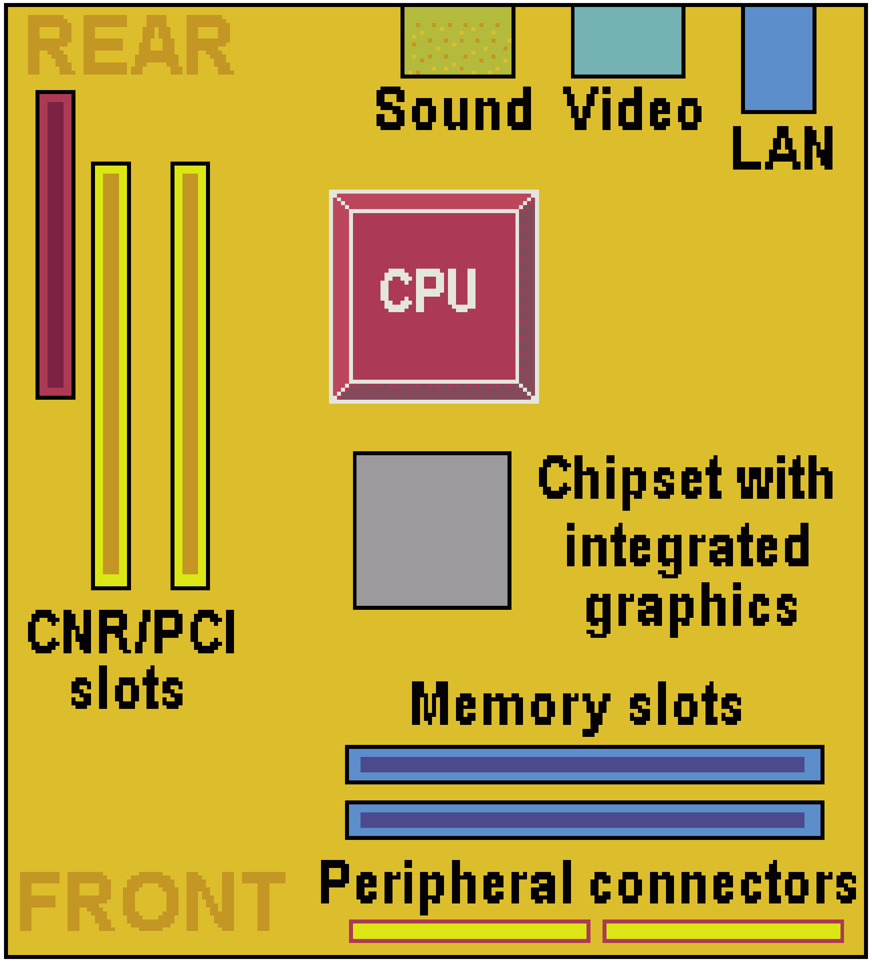
Flex ATX motherboard form factor

- The FlexATX is a natural evolution of the Intel's microATX form factor which was first unveiled in late 1999.
- The FlexATX addendum to the microATX specification addresses the requirements of only the motherboard and not the overall *system* solution.
- As such, it does not detail the interfaces, memory or graphics technologies required to develop a successful product design.
- These are left to the implementer and system designer. The choice of processor is, however, limited to socket-only designs.
- The principal difference between FlexATX and microATX is that the new form factor reduces the size of the motherboard – to 9in x 7.5in. Not only does this result in lower overall system costs, it also facilitates smaller system designs.
- The FlexATX form factor is backwards compatible with both the ATX and micro-ATX specifications – use of the same motherboard mounting holes as both of its predecessors avoids the need to retool existing chassis.

- In the spring of 2000 VIA Technologies announced an even smaller motherboard than the FlexATX.
- At 8.5in x 7.5in, the company's ITX form factor is half and inch less wide than its Intel competitor.
- The key innovation that allows the ITX to achieve such a compact form is the specially designed slimline power unit with built in fan.
- Its dimensions of 174mm long x 73mm wide x 55mm high compare with a standard ATX power supply unit measuring 140mm x 150mm x 86mm.

Form Factor	Max. Width (mm)	Max. Depth (mm)
MicroATX	224	244
FlexATX	229	191
ITX	215	191

Flex ATX motherboard form factor



BTX – Balanced Technology eXtended

- Intel has been promoting its Balanced Technology Extended specification for a while before the company began, in late 2004, to push in earnest to establish the BTX form factor as the replacement for the aging ATX motherboard and chassis specification.

- The BTX form factor is a scalable form factor that allows for a wide range of system sizes and profiles.

- There are several benefits associated with a properly designed BTX system over designs from previous form factor specification generations.

- These benefits include scalability in system design, improvements to system power delivery and power dissipation, acoustics, board layout and routing, high volume manufacturing costs, and structural integrity.

- A BTX motherboard positions its internal components in such a way as to as to allow the CPU heat sink and other hot-running chips to be cooled by a single airflow stream. The idea is that, in addition to the power supply’s internal fan, it should be possible to cool an entire system with just a single chassis fan.

- BTX refers to this new heat-sink-and-fan combination as a Thermal Module. A typical thermal module includes a heatsink for the processor, an air mover such as an axial fan and a duct to isolate and direct airflow through the system.

Since the required direction of airflow is from front to back, the design required that particular attention be paid to acoustic management strategies so as to compensate for the fan now being a noise source that is generally directly in front of the system user.

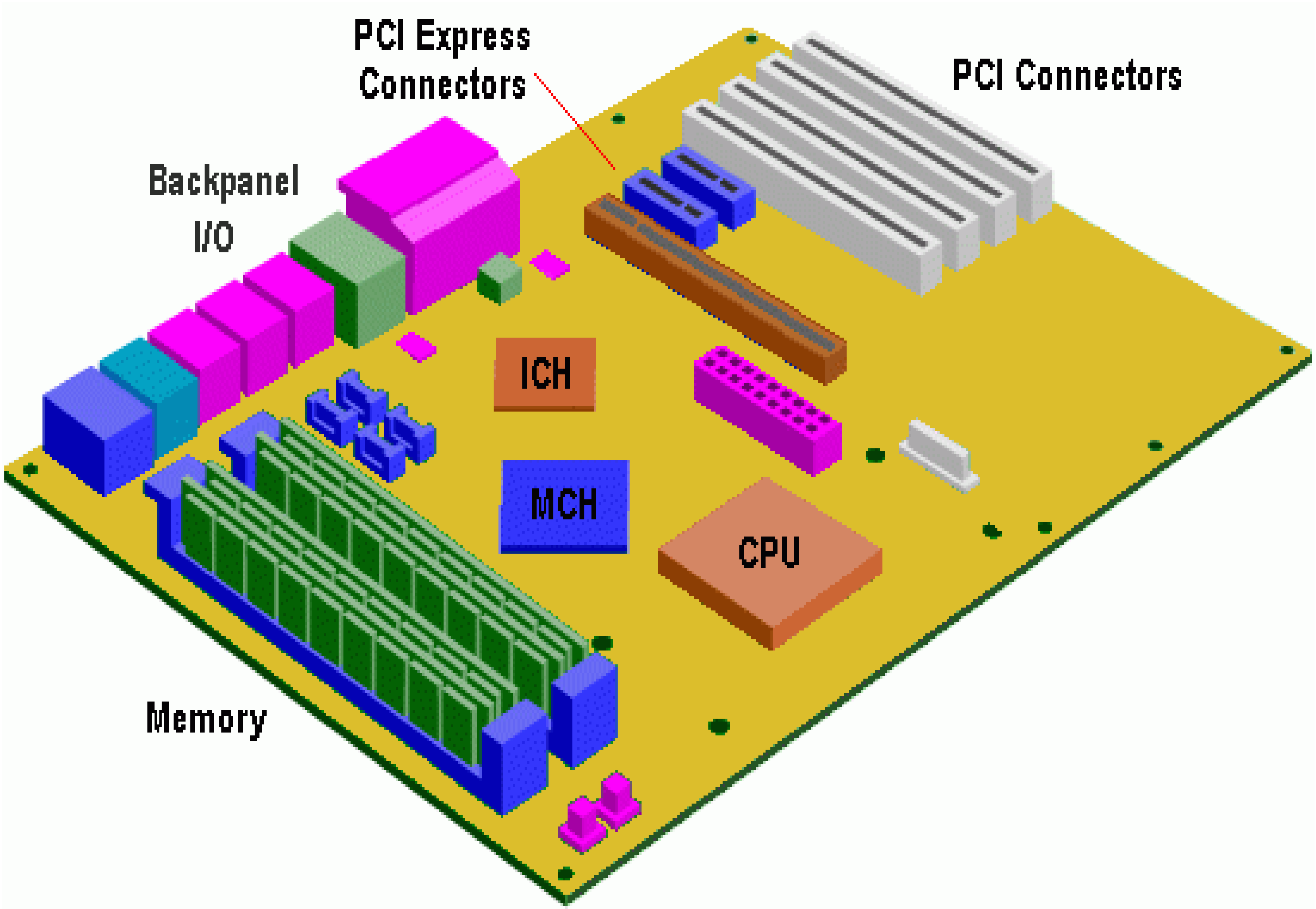
- The BTX specification is designed to encompass a family of board sizes for a range of system sizes. It's like having ATX, microATX, and FlexATX form factors all being covered by a single specification.

- A standard BTX design measures 325mm x 266mm and supports up to seven add-in card slots.

- For sizing down to smaller form factors, Intel is providing two different designs: a microBTX, measuring 264mm x 266mm with up to 4 add-in card slots and a picoBTX measuring 203mm x 266mm with up to 1 add-in card slot.

- In fact, the BTX specification offers even greater flexibility than ATX family of form factors, supporting not only different board sizes, but also different system heights.

- The standard height is similar to the height defined in the ATX-family form factor. An additional, lower profile height is defined for use where it is important to reduce the overall size of the system.



Processor Slots/Sockets

CPU interfaces – Slots and Sockets for AMD and Intel Processors

- Intel and AMD have created a set of socket and slot designs for their processors.
- Each socket or slot is designed to support a different range of original and upgrade processors.
- A CPU socket is a single connector between a microprocessor and motherboard. A CPU socket is a distinct mount used only for the CPU on the motherboard to ensure correct circuit chip insertion.
- It facilitates CPU access and prevents damage when a unit is inserted or removed. A CPU socket also has a lock to prevent CPU movement, and its design helps secure heat sink placement above the CPU.
- Most PCs and a variety of server systems have CPU sockets. Some laptops and certain types of servers do not use a CPU socket but have a totally different processor style. Generally, CPU socket platforms are keyed for correct insertion.
- A CPU socket is also known as a CPU slot.

- Modern CPU sockets and processors are based on a pin grid array (PGA) architecture. PGA is a type of packaging used for integrated circuits (IC), such as a microprocessor.
- It is basically a square with pins that are organized below the packaging.
- Pins are spaced approximately 0.1 inches (2.54 mm) apart to cover a portion or entire underside of the package.
- A CPU socket is shaped like a square or rectangle and made of durable and heat-resistant plastic and metal contacts for pins or lands, in addition to a metal latch or lever.
- Hundreds of tiny holes cover the plastic casing's surface, and the plastic color is usually light tan or burgundy, depending on the manufacturer.
- Chips with high numbers of pin-outs often use land grid array (LGA) or zero insertion force (ZIF) sockets.
- LGA sockets apply firm force with a surface plate, and ZIF sockets apply compression force with a handle.

- Each method ensures that upon insertion, the pins are not damaged or broken.

- A CPU socket is specifically designed for a particular CPU and is usually not interchangeable with other types of processors. In many cases, manufacturers classify sockets into groups.

- A socket may be identified on its side by a three-five digit ID number. The ID number ensures that the CPU uses the correct CPU socket.

- A CPU socket is made of plastic, a lever or latch, and metal contacts for each of the pins or lands on the CPU.

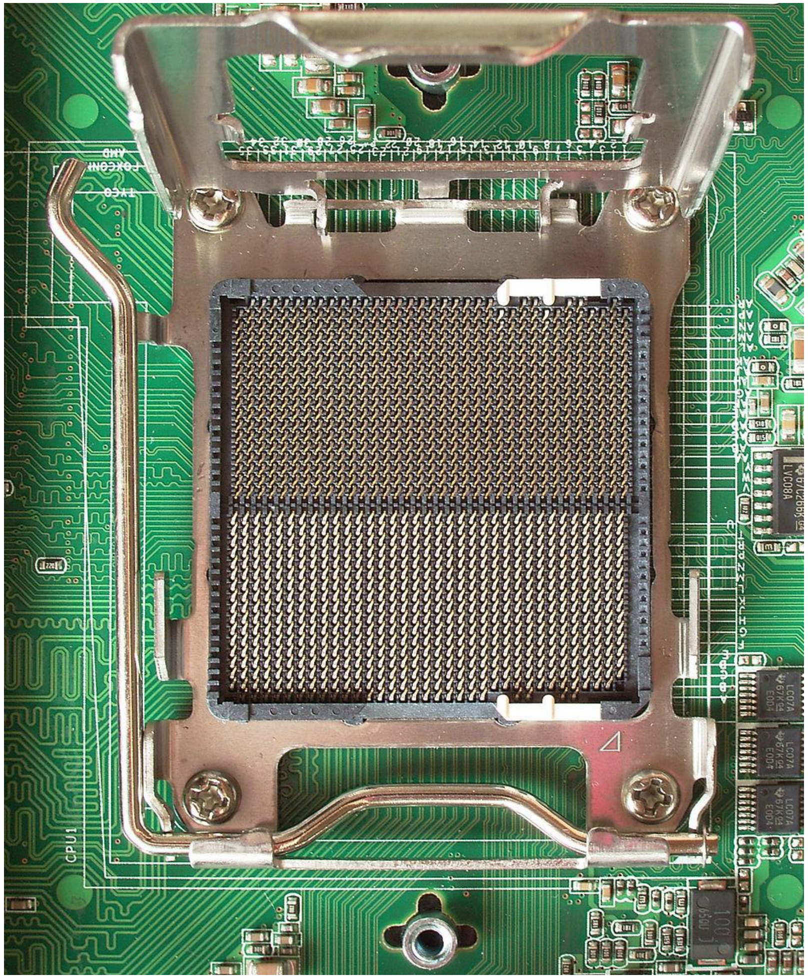
- Many packages are keyed to ensure the proper insertion of the CPU. CPUs with a PGA (pin grid array) package are inserted into the socket and the latch is closed.

- CPUs with an LGA package are inserted into the socket, the latch plate is flipped into position atop the CPU, and the lever is lowered and locked into place, pressing the CPU's contacts firmly against the socket's lands and ensuring a good connection, as well as increased mechanical stability.

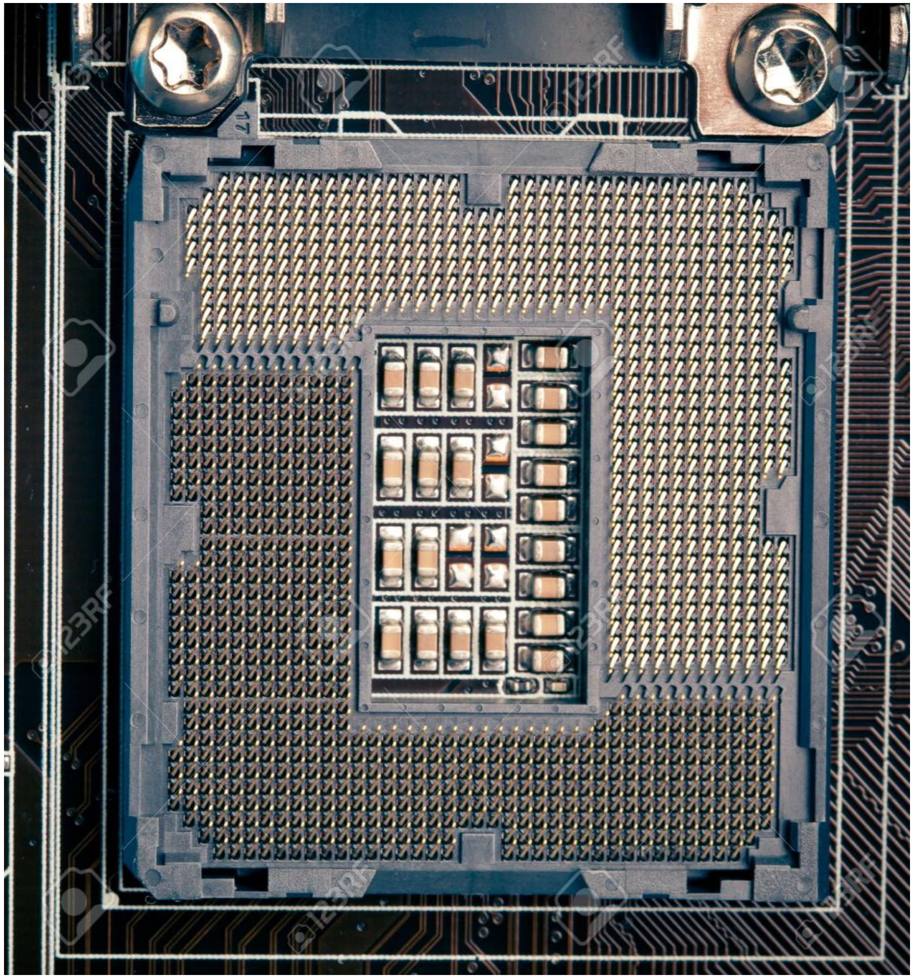
Chip Class	Socket	Pins	Layout	Supported Processors	Introduced
Intel P4/Core	423	423	39x39 SPGA	Pentium 4 FC-PGA	Nov. 2000
	478	478	26x26 mPGA	Pentium 4/Celeron FC-PGA2, Celeron D	Oct. 2001
	T (LGA 775)	775	30x33 LGA	Pentium 4/Extreme Edition, Pentium D, Celeron D, Pentium dual-core, Core2 Duo	June 2004
	LGA 1156 (Socket H)	1156	40x40 LGA	Pentium, Core i3/i5/i7, Xeon	Sept. 2009
	LGA 1136 (Socket B)	1366	41x43 LGA	Core i7, Xeon	Nov. 2008
	LGA 1155 (Socket H2)	1155	40x40 LGA	Core i7, i5, i3	Jan. 2011
	LGA 2011	2011	58x43 hexLGA	Core i7	Nov. 2011

Chip Class	Socket	Pins	Layout	Supported Processors	Introduced
AMD K8	754	754	29x29 mPGA	Athlon 64	Sept. 2003
	939	939	31x31 mPGA	Athlon 64 v.2	June 2004
	940	940	31x31 mPGA	Athlon 64 FX, Opteron	Apr. 2003
	AM2	940	31x31 mPGA	Athlon 64/64FX/64 X2, Sempron, Opteron, Phenom	May 2006
	AM2+	940	31x31 mPGA	Athlon 64/64 X2, Opteron, Phenom X2/X3/X4, II X4	Nov. 2007
	AM3	9412	31x31 mPGA	Athlon II, Phenom II, Sempron	Feb. 2009
	AM3+	9412	31x31 mPGA	"Bulldozer" Processors	Mid-2011
	F (1207 FX)	1207	35x35 LGA	Athlon 64 FX, Opteron	Aug. 2006
AMD A	FM1	905	31x31 LGA	A4, A6, A8, Athlon II, E2, Sempron	Jul. 2011
	FM2	904	31x31 LGA	A4, A6, A8, A10	Sept. 2012

AMD Processor Socket



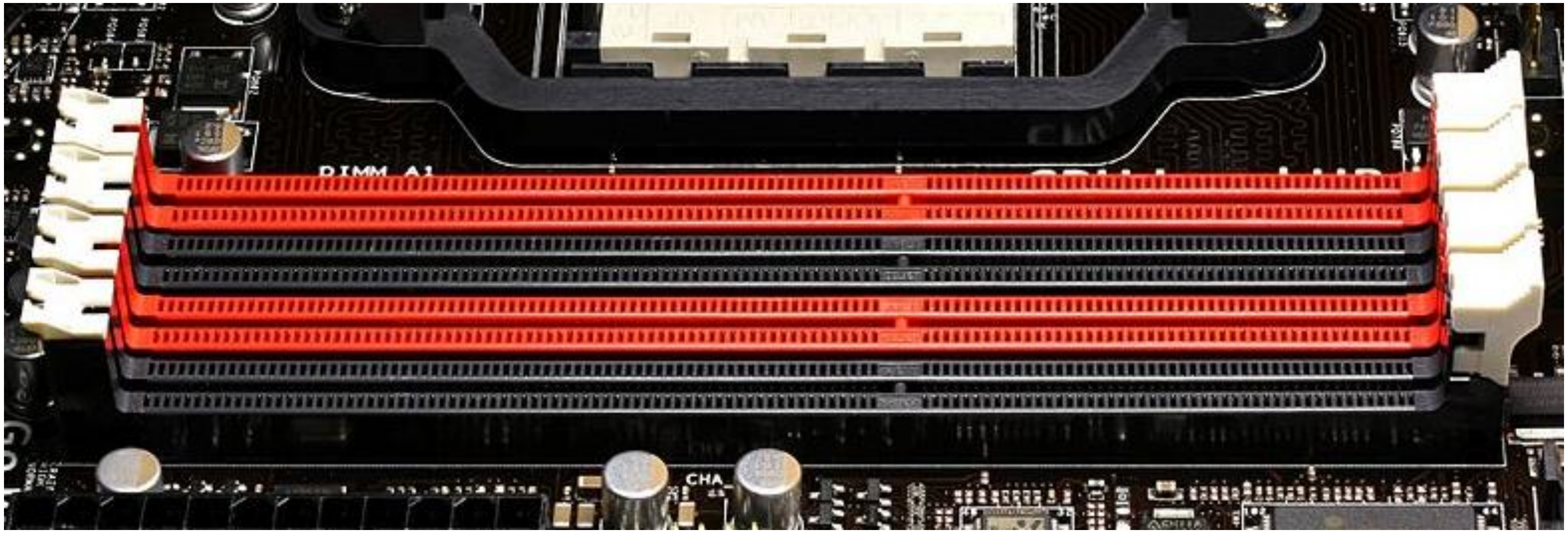
Intel Processor Socket



Motherboard – On board Ports-Interfaces

Memory Slots

- Motherboard memory slots are nothing more than the interface mechanism between RAM and the rest of a computer.
- A memory slot or RAM slot is what allows computer memory (RAM) chip/stick to be inserted into the computer.
- Depending on the motherboard, there will usually be 2 to 4 memory slots and are what determine the type of RAM used with the computer.
- The most common types of RAM are SDRAM and DDR for desktop computers and SODIMM for laptop computers, each having various types and speeds.
- Tabs at either end of each slot hold the memory module in place and ensure a consistent connection between the memory and the motherboard.
- To remove memory, you simply push each tab away from the memory module and pull the memory out.
- To replace a memory module, you simply push the memory firmly into the slot and push the tabs toward the memory module until they snap into place.

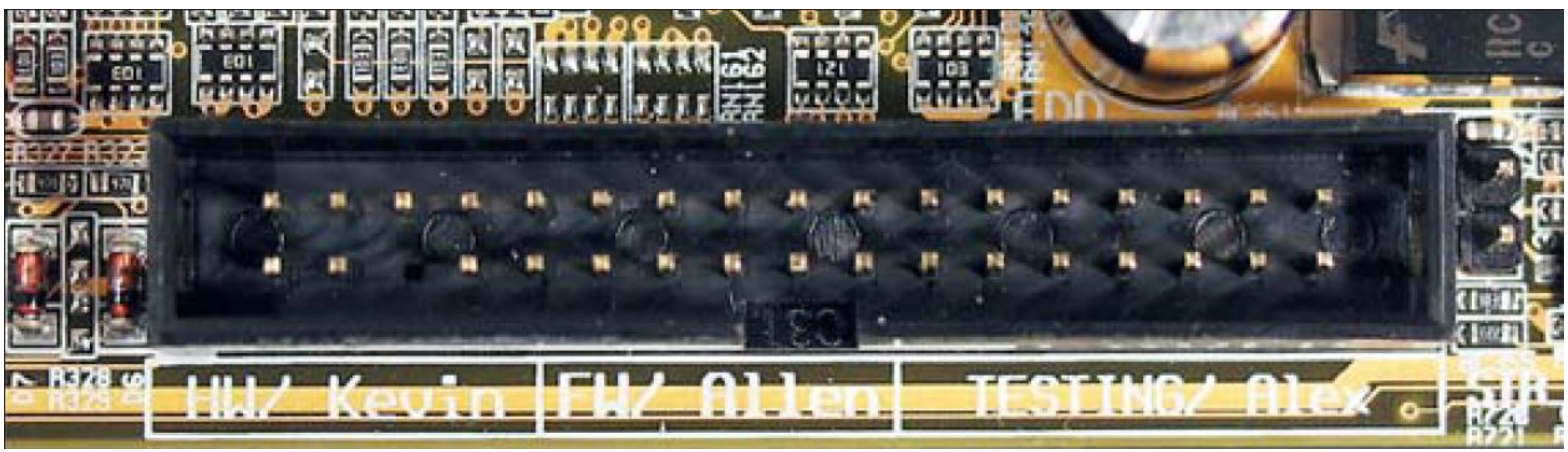

DIMM_A1
CHA_

FDD Port

- FDD stands for floppy disk drive. Although most computers no longer use floppy drives, the FDD connector is still present on many motherboards.

- The FDD connector contains 34-pins, and uses a FDD ribbon cable to connect to a 3 ½" floppy disk drive.

- Identify this cable by the twist between the first and second set of connectors, which allocates the drive at the end of the cable as FDD A, and the drive in the middle as FDD B.



IDE Interfaces

- One of the earliest and most significant standards introduced into PC hardware was IDE (Integrated Drive Electronics), a standard which controls the flow of data between the processor and the hard disk.

- The term IDE itself is not an actual hardware standard, but the proposals were incorporated into an industry-agreed interface specification known as ATA (AT Attachment).

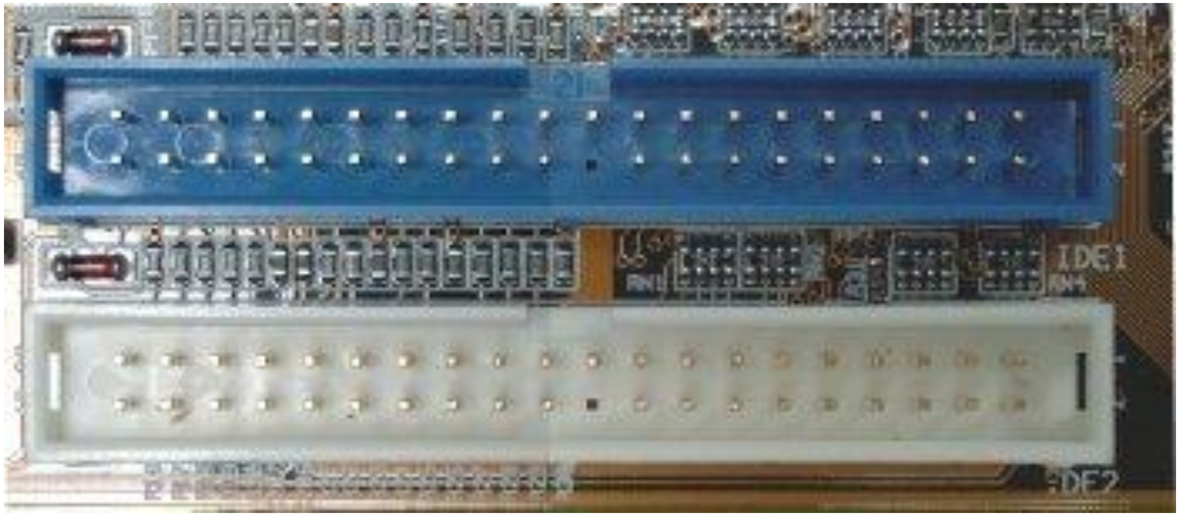
- The parallel ATA standard evolved from the original IBM Advanced Technology (AT) interface and defines a command and register set for the interface, creating a universal standard for communication between the drive unit and the PC.

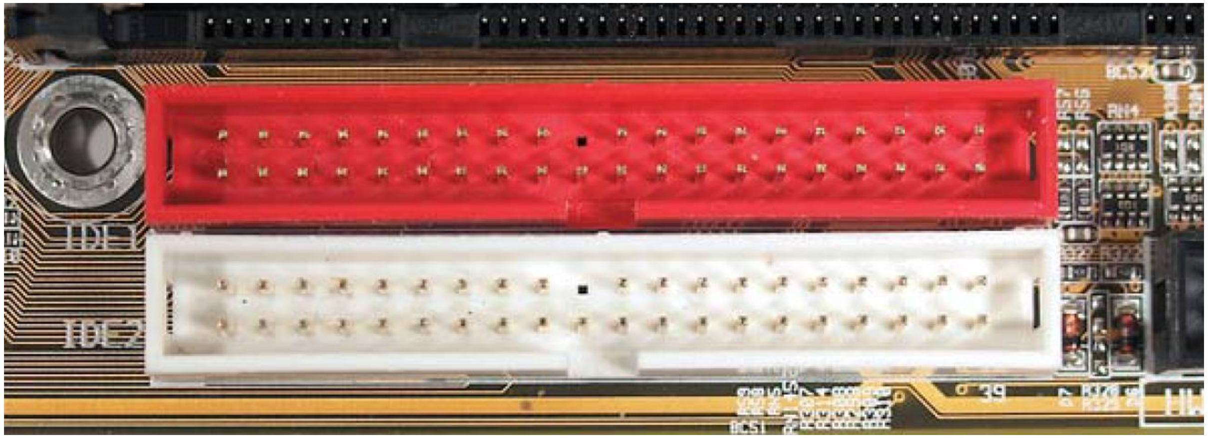
- One of the major innovations introduced by IDE was the integration of the disk controller functions onto the disk drive itself.

- The separation of the controller logic from the interface made it possible for drive manufacturers to enhance the performance of their drives independently – there were no performance-boosting features incorporated into the ATA interface itself

- . IDE drives connect straight to the system bus with no need for a separate controller on the bus, thereby reducing overall cost.

- Since the implementation of the ATA standard, the PC has changed dramatically.





Serial ATA (SATA) Interface

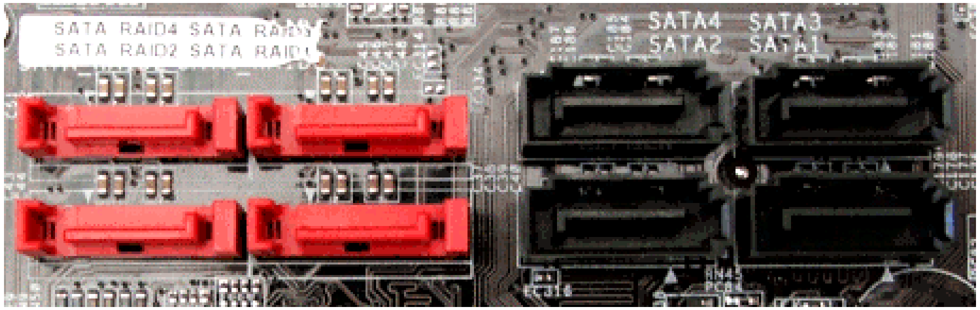
- Stands for "Serial Advanced Technology Attachment," or "Serial ATA." It is an interface used to connect ATA hard drives to a computer's motherboard.
- For one, SATA drives each have their own independent bus, so there is no competition for bandwidth like there is with Parallel ATA. They also use smaller, thinner cables, which allows for better airflow inside the computer.
- SATA cables can be as long as one meter, while PATA cables max out at 40cm. This gives manufacturers more liberty when designing the internal layout of their computers.
- First-generation Serial ATA support for data transfer rates of up to 150 MB/s (1.5Gb/s).
- Subsequent versions of the specification, increasing performance to support data transfer rates of 300 MB/s (3Gb/s), have led manufacturers to implement varied and often awkward fixes for compatibility, usually involving motherboard or device jumper settings.
- This represents a backward step, especially as SATA has led to the first jumperless hard drives. However, the advantages of SATA have made it the industry standard for ATA connectivity.

SATA Benefits

Reductions in voltage and pin count: Serial ATA's low-voltage requirement (500 mV peak-to-peak) will effectively alleviate the increasingly difficult-to-accommodate 5-volt signaling requirement that hampers the Parallel ATA interface.

Smaller, easier-to-route cables: Elimination of the cable-length limitation: The Serial ATA architecture replaces the wide Parallel ATA ribbon cable with a thin, flexible cable that can be up to 1 meter in length. The serial cable is smaller and easier to route inside a PC's chassis and eliminates the need for the large and cumbersome 40/80-wire connectors required by Parallel ATA. The small-diameter cable also helps improve air flow inside the PC system chassis and facilitates designs of smaller PC systems.

Improved data robustness: Serial ATA offers more thorough error checking and error correcting capabilities than Parallel ATA. The end-to-end integrity of transferred commands and data can be guaranteed across the serial bus.



Small Computer Systems Interface (SCSI)

- A small computer systems interface (SCSI) is a standard interface for connecting peripheral devices to a PC. SCSI (pronounced "skuzzy") is supported by all major operating systems.

- Depending on the standard, generally it can connect up to 16 peripheral devices using a single bus including one host adapter.

- SCSI is used to increase performance, deliver faster data transfer transmission and provide larger expansion for devices such as CD-ROM drives, scanners, DVD drives and CD writers.

- SCSI is also frequently used with RAID, servers, high-performance PCs and storage area networks SCSI has a controller in charge of transferring data between the devices and the SCSI bus.

- It is either embedded on the motherboard or a host adapter is inserted into an expansion slot on the motherboard.

- The controller also contains SCSI basic input/output system, which is a small chip providing the required software to access and control devices.

- Each device on a parallel SCSI bus must be assigned a number between 0 and 7 on a narrow bus or 0 and 15 on a wider bus. This number is called an SCSI ID.

- Newer serial SCSI IDs such as serial attached SCSI (SAS) use an automatic process assigning a 7-bit number with the use of serial storage architecture initiators.

- Peripheral devices are attached to the CPU through buses and interfaces, and SCSI is the most common interface for attaching these devices.

- SCSI's efficiency is the main reason it is so widespread. SCSI was revolutionary in regards to data transfer and compatibility when compared to the parallel data transfer interfaces used in earlier days.

- SCSI also allows backward compatibility where devices were compatible with earlier version of SCSI.

- These devices can still be attached to a newer version of SCSI, but the data transfer rate will be slower. The original SCSI used a SCSI parallel bus.

- All SCSI devices and the host adapter support a single daisy chain. A daisy chain connects the devices in a series of nodes one after the other by using hardware configuration.

- The SCSI interface supports various devices depending on the SCSI version. The advantage of a daisy chain is the ability to add an additional node anywhere on the chain.

- Each device in the chain can adjust one or more signals before transmitting to the next device.

- The SCSI-2 supports 16 devices, ultra SCSI supports 5 to 8 and the ultra-320 SCSI supports 16.

- The serial attached SCSI adapted in 2010, can support up to 16,256 addressable devices per port with a transfer rate up to 3 Gbps.

SCSI Versions

- **SCSI-2: 8-bit bus, s**ix meter cable length, 5-10 MBps; connects 8 or 16 devices. 50-pin connector.

- **Wide SCSI-2: Received its name from the wider 168 line** cable with 68-pin connectors to accommodate the 16-bit bus. 3 meter cable; 20 MBps transfer rate; connected 16 devices.

- **Fast SCSI-2:** 8-bit bus, but double the clock speed of SCSI-2 allowing transfers of 10-20 MBps. 3 meter cable; connects 8 devices.

- **Fast Wide SCSI-2:** 6-bit bus; 3 meter cable; 20 MBps; 16 devices.

- **Ultra SCSI-3:** 8-bit and 16-bit versions, both with 1.5 meter cable length. The 8-bit version supports data rates of 20 MBps and connects 8 devices. The 16-bit version doubled the transfer rate and number of devices.

- **Ultra-2 SCSI:** 8-bit bus; 12 meters; 40 MBps; 8 devices.

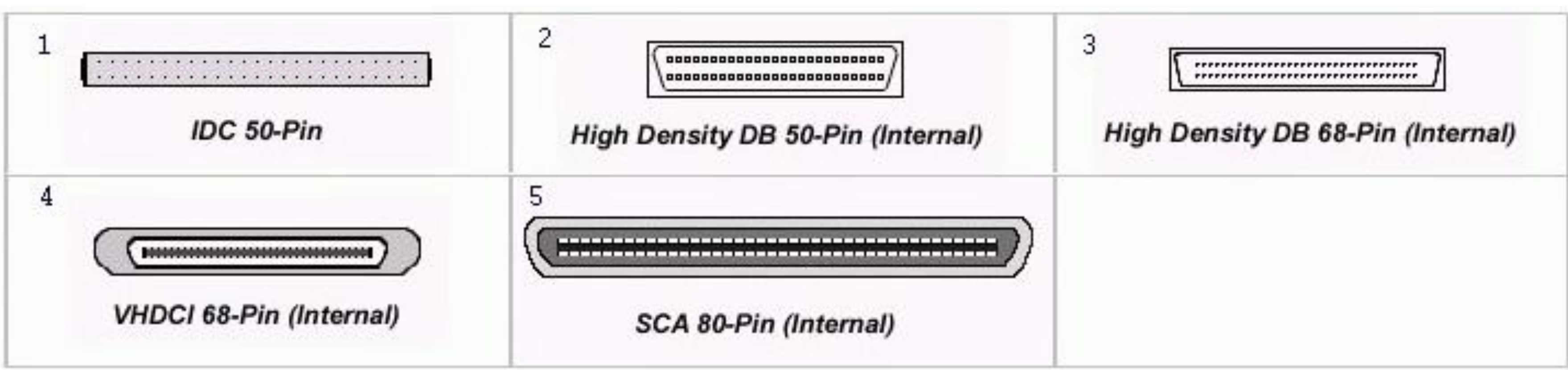
- **Wide Ultra-2 SCSI:** 16-bit bus; 12 meters; 80 MBps; 16 devices.

50 PIN SCSI Connector

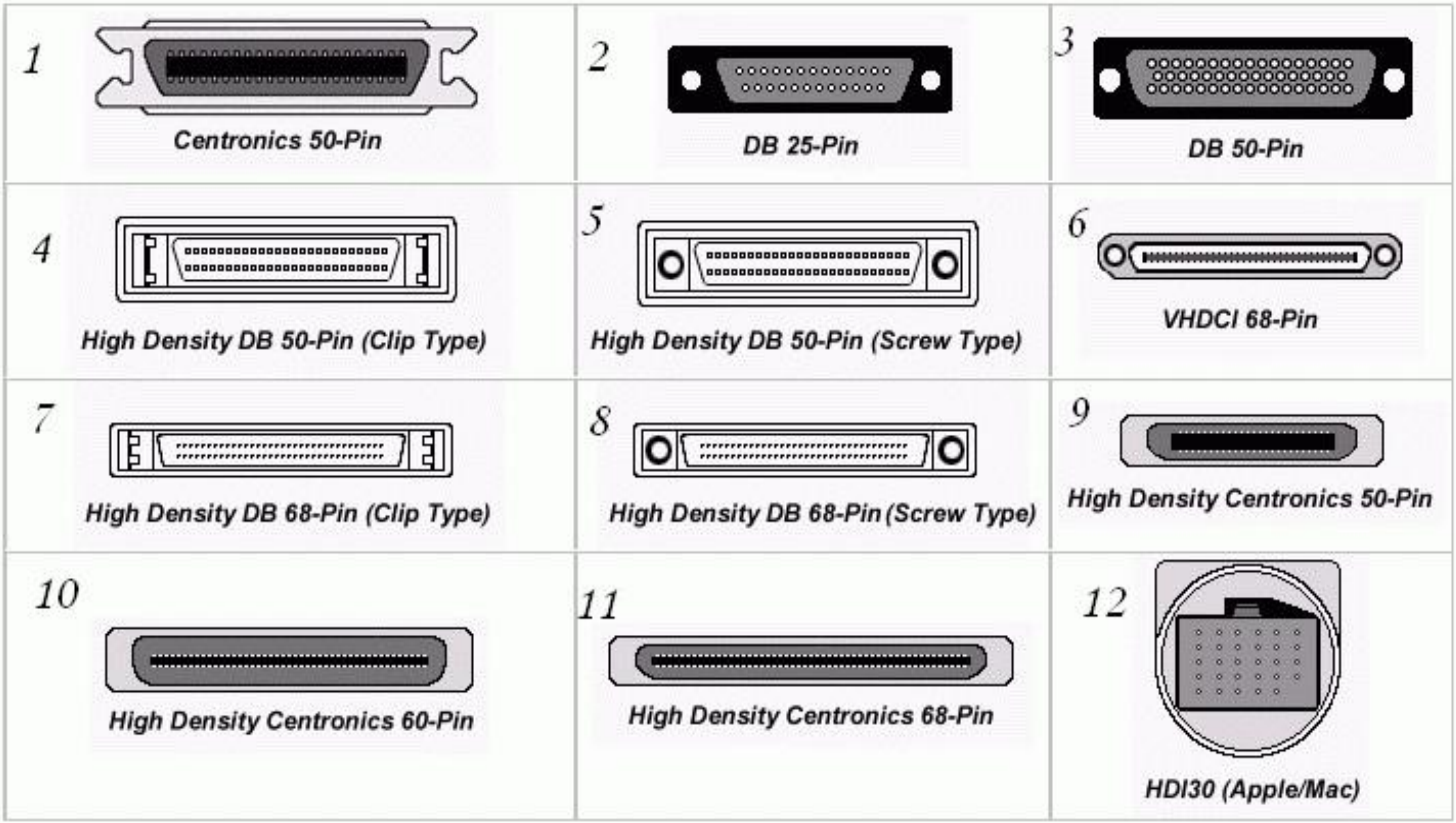
Male Connector

Female Connector

SCSI Internal Connector



External SCSI Connector



CMOS-BIOS

CMOS

- Motherboards also include a separate block of memory made from very low power consumption CMOS (complementary metal oxide silicon) RAM chips, which is kept alive by a battery even when the PC's power is off.

- This is used to store basic information about the PC's configuration: number and type of hard and floppy drives, how much memory, what kind and so on. All this used to be entered manually, but modern auto-configuring BIOSes do much of this work, in which case the more important settings are advanced settings such as DRAM timings.

- The other important data kept in CMOS memory is the time and date, which is updated by a Real Time Clock (RTC).

- The CMOS memory is usually located with the real-time clock in the motherboard chipset or in a separate real-time clock chip. The PC reads the time from the RTC when it boots up, after which the CPU keeps time – which is why system clocks are sometimes out of sync. Rebooting the PC causes the RTC to be reread, increasing their accuracy.

CMOS

- In modern-day PCs the nonvolatile BIOS memory is generally an EEPROM or Flash memory chip. There is still a backup battery involved, but its role is not to maintain the data stored in the RAM, only to keep the RTC chip operational.

BIOS

- BIOS stands for Basic Input/Output System.
- BIOS is a "read-only" memory, which consists of low-level software that controls the system hardware and acts as an interface between the operating system and the hardware.
- BIOS is essentially the link between the computer hardware and software in a system.
- All motherboards include a small block of Read Only Memory (ROM) which is separate from the main system memory used for loading and running software.
- On PCs, the BIOS contains all the code required to control the keyboard, display screen, disk drives, serial communications, and a number of miscellaneous functions.
- The system BIOS is a ROM chip on the motherboard used during the startup routine (boot process) to check out the system and prepare to run the hardware.
- The BIOS is stored on a ROM chip because ROM retains information even when no power is being supplied to the computer.

- All motherboards include a small block of Read Only Memory (ROM) which is separate from the main system memory used for loading and running software.

- The BIOS will most likely be stored in a 32-pin chip, which can typically be identified by a silver or gold sticker that shows the name of the BIOS company – such as AMIBIOS, AWARD or Phoenix – and a code that indicates the version of code it contains.

- If its rectangular in shape, it’s what is known as a DIP (Dual In-line Package) chip. Older motherboards may have 28-pin DIP BIOS chips. If your BIOS chip is square with connections on all four sides, it is in a PLCC (Plastic Leaded Chip Carrier) package. A locating notch indicates the orientation of pin 1.

- Modern-day BIOSes are flash upgradeable, meaning they may be updated via a floppy disk or, sometimes, through Windows, to ensure future compatibility with new chips, add-on cards and so on.

- The BIOS comprises several separate routines, serving different functions. The first part runs as soon as the machine is powered on. It inspects the computer to determine what hardware is fitted and then conducts some simple tests to check that everything is functioning normally – a process called the power-on self test (POST).

- If any of the peripherals are plug and play devices, it's at this point that the BIOS assigns their resources within the system. There's also an option to enter the Setup program, allowing the user to tell the PC what hardware is fitted.

- Some BIOS's also allow booting from a hard disk drive other than the primary IDE drive. In this case it would be possible to have different operating systems – or separate instances of the same OS – on different drives.

- Many BIOSes allow the start-up process to be interrupted to specify the first boot device without actually having to enter the BIOS setup utility itself. If no bootable drive is detected, a message is displayed indicating that the system requires a system disk.

CMOS Battery

- Motherboards also include a small separate block of memory made from CMOS RAM chips which are kept alive by a battery (known as a CMOS battery) even when the PC's power is off.

- This prevents reconfiguration when the PC is powered on.

- CMOS devices require very little power to operate.

- The CMOS RAM is used to store basic Information about the PC's configuration for instance:-
  - Floppy disk and hard disk drive types
  - Information about CPU
  - RAM size
  - Date and time
  - Serial and parallel port information
  - Plug and Play information
  - Power Saving settings

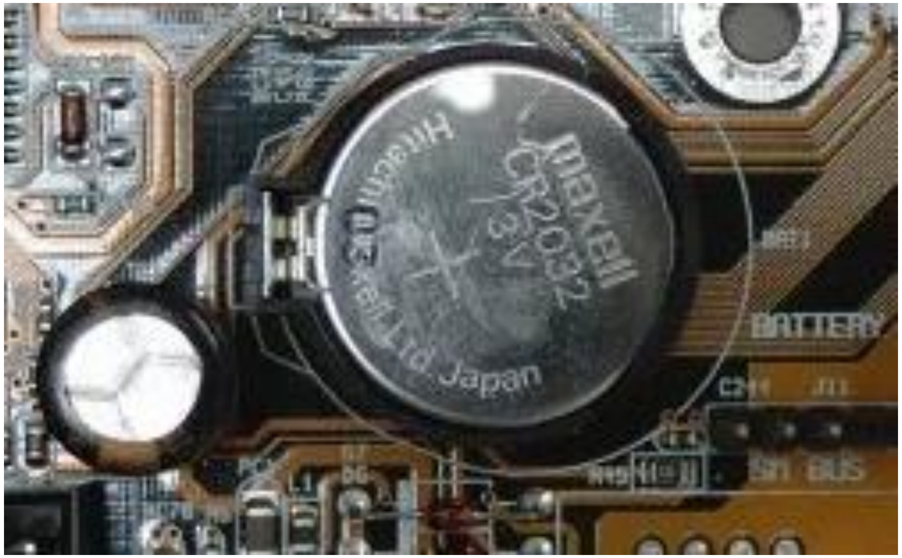
- Other Important data kept in CMOS memory is the time and date, which is updated by a Real Time Clock (RTC).

CMOS Battery

- The standard lifetime of a CMOS battery is around 10 Years. However, this can vary depending on the use and environment in which the computer resides.

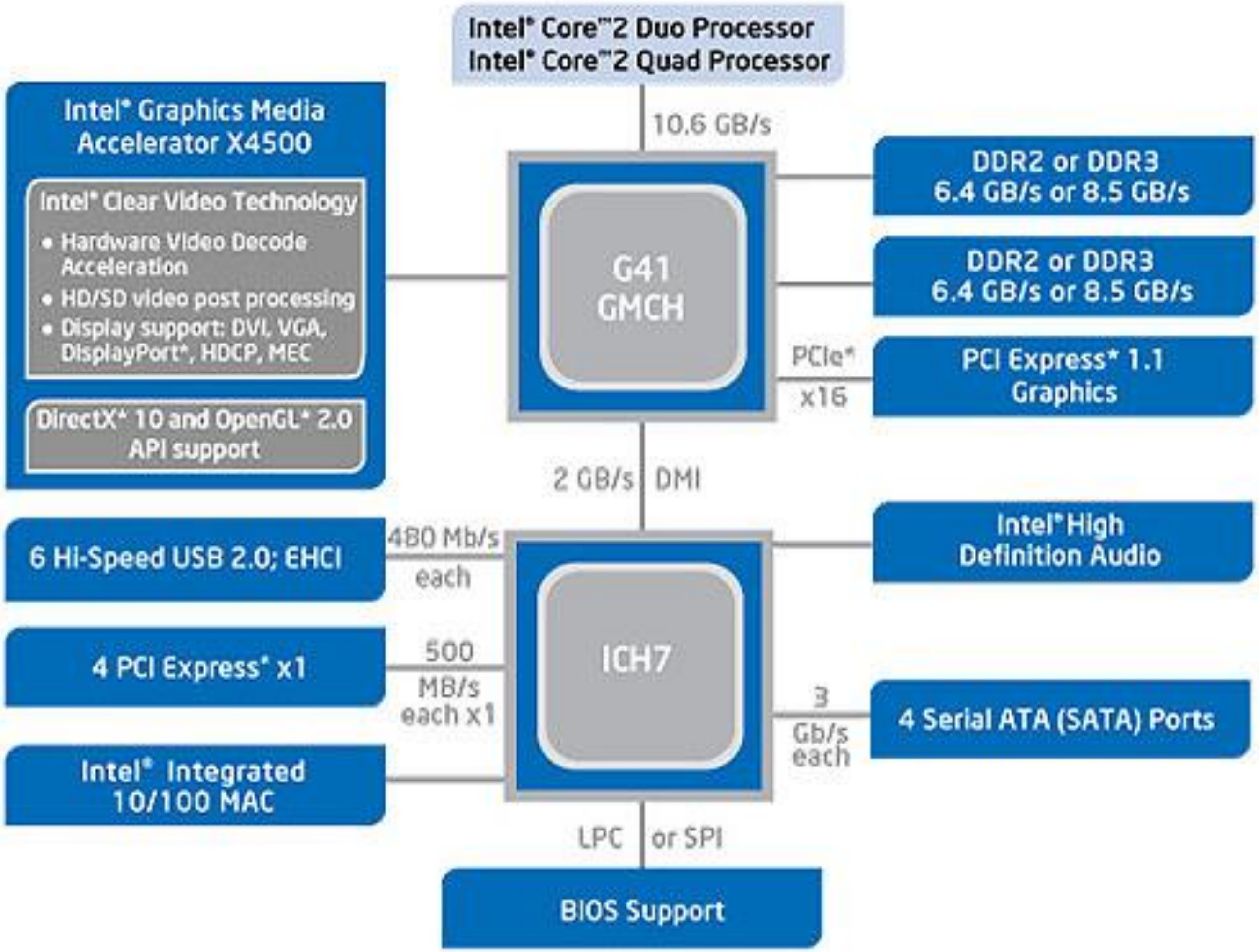
- If the CMOS battery is failing, the computer cannot keep the correct time or date on the computer after it's turned off.

- The CMOS battery is a Lithium-ion battery about the size of a coin. If your CMOS battery dies, your BIOS settings will reset to their defaults when your computer is turned off.



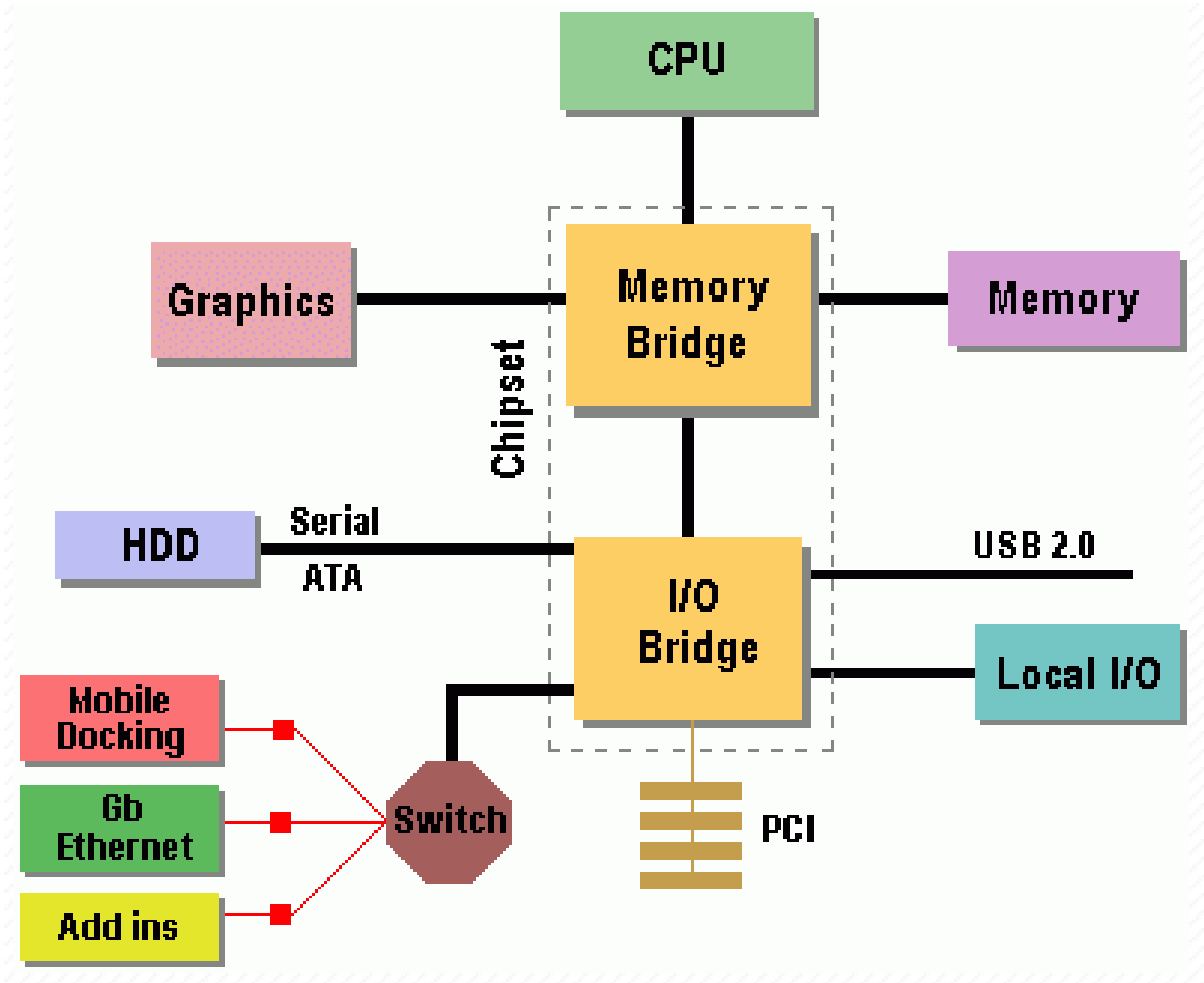
Motherboard-Chipset

Chipset



Intel® Core™2 Duo Processor
Intel® Core™2 Quad Processor
10.6 GB/s
Intel® Graphics Media Accelerator X4500
Intel® Clear Video Technology
• Hardware Video Decode Acceleration
• HD/SD video post processing
• Display support: DVI, VGA, DisplayPort*, HDCP, MEC
DirectX* 10 and OpenGL* 2.0 API support
G41 GMCH
DDR2 or DDR3 6.4 GB/s or 8.5 GB/s
DDR2 or DDR3 6.4 GB/s or 8.5 GB/s
PCIe* x16
PCI Express* 1.1 Graphics
2 GB/s DMI
6 Hi-Speed USB 2.0; EHCI
480 Mb/s each
4 PCI Express* x1
500 MB/s each x1
Intel® Integrated 10/100 MAC
ICH7
Intel® High Definition Audio
3 Gb/s each
4 Serial ATA (SATA) Ports
LPC or SPI
BIOS Support

Chipset



CPU
Graphics
Memory Bridge
Memory
Chipset
HDD
Serial
ATA
USB 2.0
I/O Bridge
Local I/O
Mobile Docking
Gb Ethernet
Add ins
Switch
PCI

Chipset

- The chipset is an integral part of the motherboard and without it, a motherboard just wouldn’t work. Chipsets have so far in generally been comprised of two parts, although they might go under slight different names, but they are commonly known as the northbridge and southbridge.

- A chipset is a group of small circuits that coordinate the flow of data to and from a PC's key components. These key components include the CPU itself, the main memory, the secondary cache, and any devices situated on the buses.

- A chipset also controls data flow to and from hard disks and other devices connected to the IDE channels.

- This includes the CPU itself, the main memory, the secondary cache and any devices situated on the ISA and PCI buses.

- While new microprocessor technologies and speed improvements tend to receive all the attention, chipset innovations are, in fact, equally important.

- A chipset is specifically designed for a motherboard. The chipset and motherboard must be compatible with the CPU to prevent system failover.

- Most chipset drivers are manually updated and installed.

- A chipset and device drivers are compatible when an operating system is initially installed. However, device drivers eventually become outdated due to subsequent hardware and software installations.

- Outdated or incompatible device drivers create compatibility issues, lack of features and sub-par device performance.

- A chipset has two sections – southbridge and northbridge – with specific sets of functions that communicate between the CPU and external devices.

North Bridge

- The northbridge connects the southbridge to the CPU. It is often referred to as the memory controller hub.

- Some north bridges also contain integrated video controllers, also known as a Graphics and Memory Controller Hub (GMCH) in Intel systems.

- It handles the faster components on the motherboard, including RAM, ROM, basic input/output system (BIOS), accelerated graphics port (AGP), PCI Express, and the southbridge chip as well as the CPU.

- It also controls the CPU cache, if it is located on the motherboard.

- In some instances the Northbridge and Southbridge functions were combined.

South Bridge

- The southbridge, which is not directly connected to the CPU, is also known as the input/output controller hub.
- Southbridge handles the motherboard's slower connections, including input/output (I/O) devices and computer peripherals like expansion slots and hard disk drives.
- Bridge connection from Northbridge to slower devices like USB devices, PCI, IDE(SATA/PATA), BIOS, onboard sound ,Ethernet and more .
- The southbridge connects to the northbridge via a custom high-speed interface, although in the case of most Intel chipsets this bus is called DMI (Direct Media Interface).

Difference between Southbridge and Northbridge

- North and south bridge refer to the data channels to the CPU, memory and Hard disk data goes to CPU using the Northbridge. And the mouse, keyboard, CD ROM external data flows to the CPU using the Southbridge.

- The Northbridge is the portion of the chipset HUB that connects faster I/O buses (for example, an AGP bus) to the system bus. Northbridge SI also bigger looking then the Southbridge chip. The Southbridge is the HUB that connects to slower I/O buses (for example, An ISA bus) to the system bus.

- The Northbridge and the Southbridge are known as the chipset on the Motherboard. These set of chips collectively control the memory cache, external bus, and some peripherals. There is a fast end of the hub, and there is a slow end of the hub. The fast end of the hub is the Northbridge, containing the graphics and memory controller connecting to the system bus. The slower end of the hub is the Southbridge, containing the I/O controller hub.

Expansion Slots/Buses

Expansion Buses / Slots

- An expansion bus is an input/output pathway from the CPU to peripheral devices and it is typically made up of a series of slots on the motherboard.

- Expansion boards (cards) plug into the bus Expansion buses enhance the PCs capabilities by allowing users to add missing features in their computers by slotting adapter cards into expansion slots.

Expansion Bus Types

- ISA- Industry Standard Architecture
- VESA-Video Electronic Standard Association
- PCI-Peripheral Component Interconnect
- AGP-Accelerated Graphics Port
- PCIE-Peripheral Component Interconnect Express

ISA Bus – Industry Standard Architecture

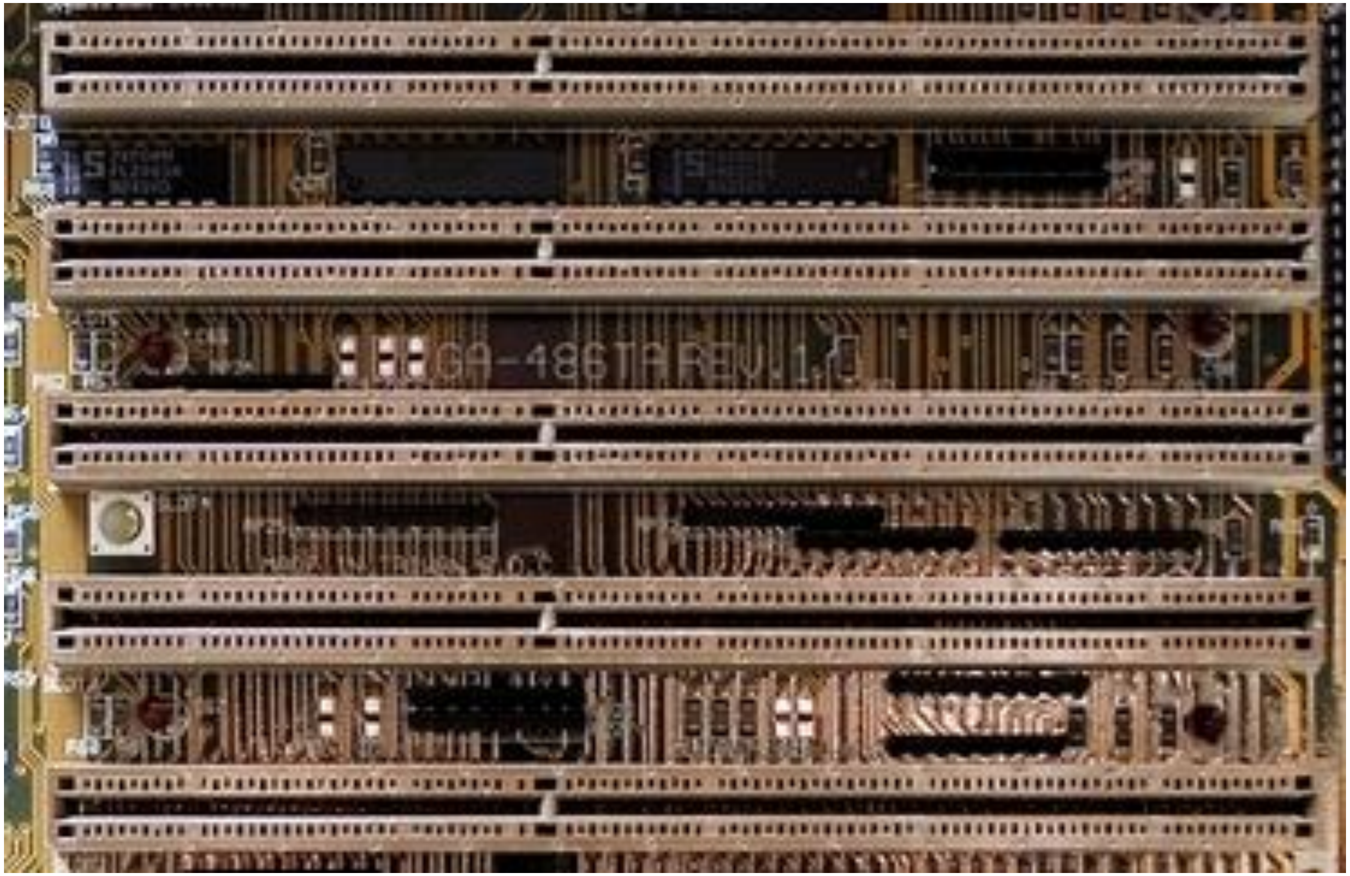
- Stands for "Industry Standard Architecture." ISA is a type of bus used in PCs for adding expansion cards.
- An earlier hardware interface for connecting peripheral devices in PCs.
- The oldest expansion slot that is configured in 8-Bit and 16-Bit slots.
- Originally called the "AT bus" and introduced with the IBM PC AT in 1984, the AT/ISA bus extended the PC bus from 8 to 16 bits.
- Operates at 8MHz, although some manufacturers reliably achieve a throughput of 10 MHz.
- Some motherboards provided a mix of both 8-bit and 16-bit ISA slots
- Although there are still a few motherboards being made with ISA slots, these are generally referred to as the legacy bus motherboards.

ISA Bus – Industry Standard Architecture

VESA-Local Bus

- The VESA-Local Bus, or VL-Bus, is connected straight to the CPU's own internal bus, hence the name "local". VL-Bus is short for VESA local bus (VLB). VESA is an acronym that stands for the Video Electronics Standards Association.
- The VLB is not a replacement for the expansion bus, but is instead an addition to it.
- The VLB was widely used on 486 motherboards, providing a wider bandwidth for peripheral data transfer than the traditional ISA bus.
- VLB products focused primarily on video cards and disk controllers, two areas that benefit from the faster local bus access.
- Using a VLB video card and I/O controller greatly increases system performance over an ISA-only system.
- he VLB provides a high-speed data path between the CPU and peripherals (video, disk, network, etc.) running at the speed of the processor.
- The VLB is a 32-bit bus that supports bus mastering and runs at speeds up to 40MHz.

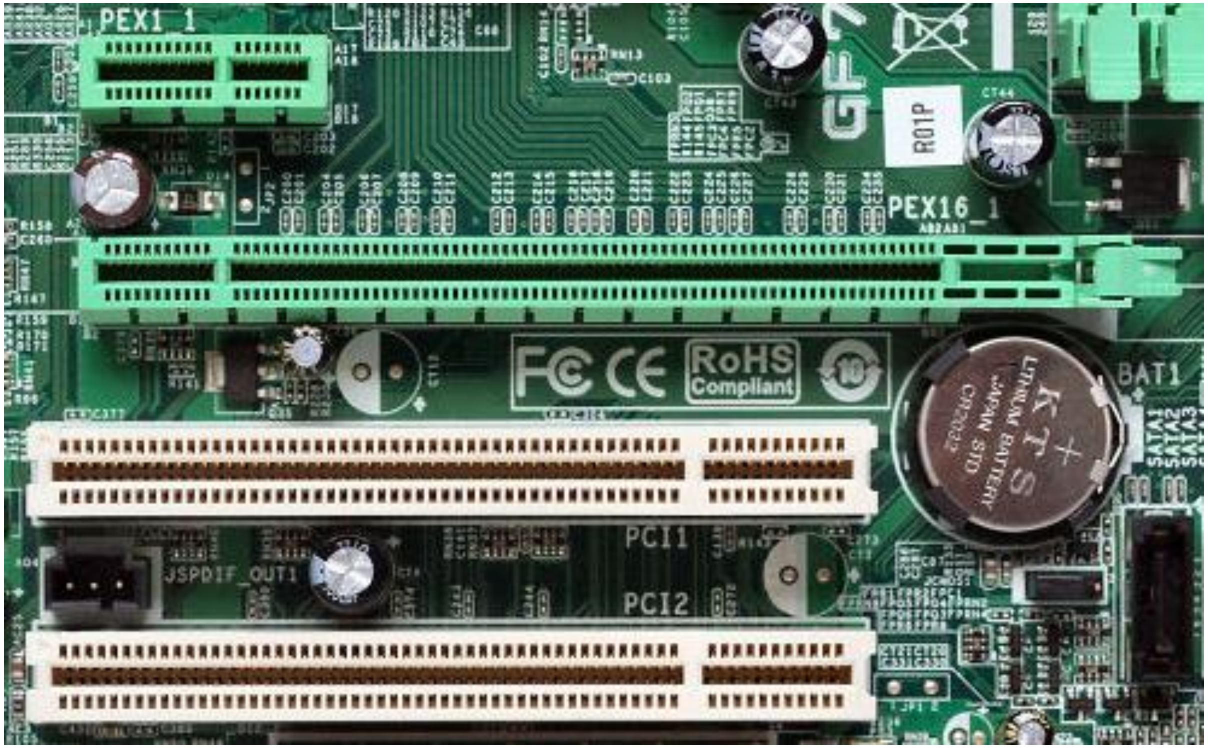
VESA –Local Bus



PCI – Peripheral Component Interconnect

- This bus allowed multiple packets of information from different sources to travel down it simultaneously.
- Previously it was used to connect to the graphics card and this setup meant that information from the graphics card travelled through the bus along with any other information coming from a device connected to the PCI.
- When all the information arrived at the CPU, it had to wait in line to get time with the CPU.
- This system worked well for many years, but eventually the PCI bus could not keep up.
- The Internet and most software were more and more graphically oriented, and the demands of the graphics card needed priority over all other PCI devices.
- This is now a **legacy** technology and is used for functions that do not require great quantities or speed in data transmissions.
- PCI slots were mainly used for network, graphics and sound cards.

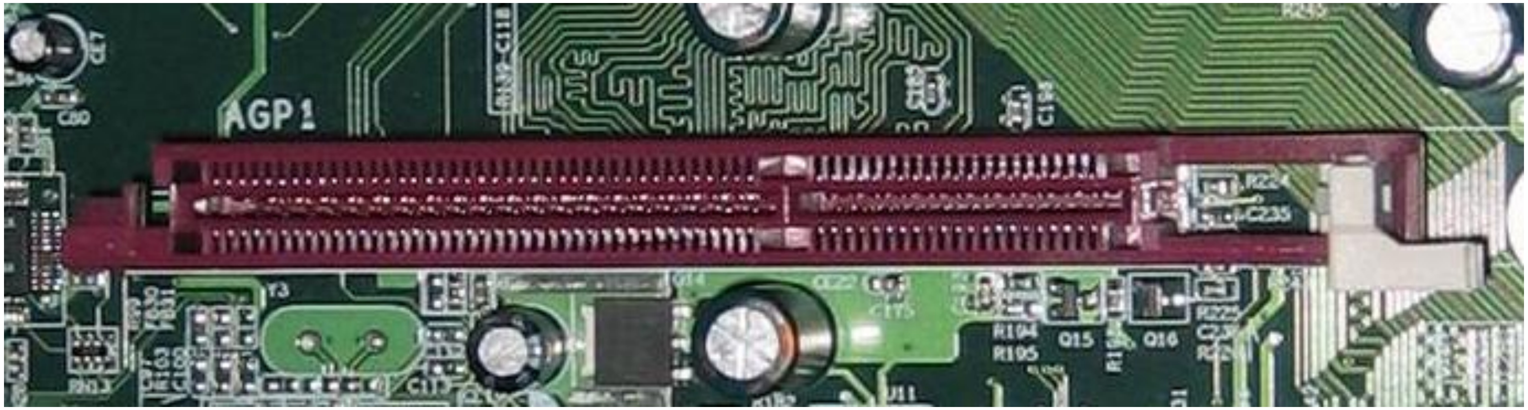
PCI – Peripheral Component Interconnect

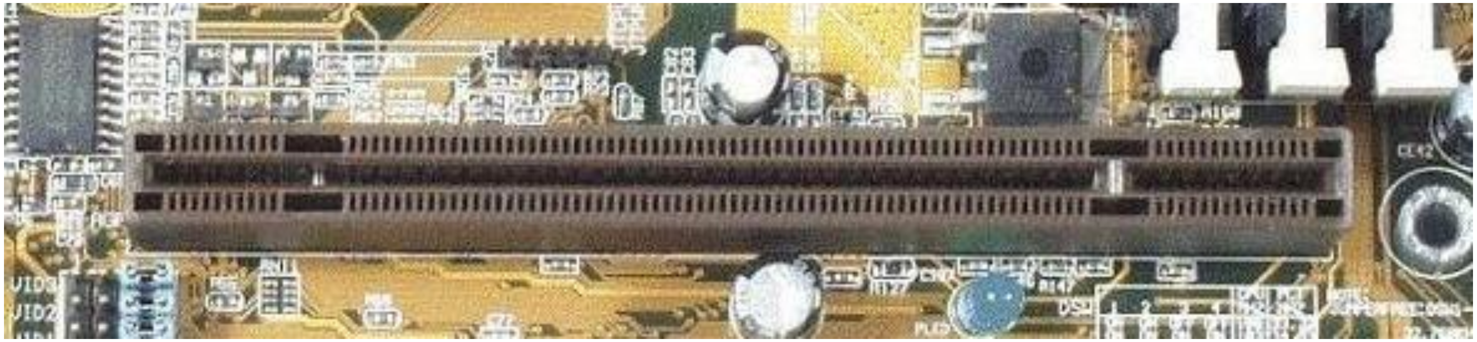


AGP-Accelerated Graphics Port

- AGP as a more efficient way to deliver streaming video and real-time-rendered 3D graphics that were becoming more prevalent in all aspects of computing to and from the CPU.
- AGP is based on the design of the PCI bus; but unlike a bus, it provides a **dedicated point-to-point connection** from the graphics card to the CPU.
- With a clear path tothe CPU and system memory, AGP provided a much faster, more efficient way for a computer to get the information it needed to render complex graphics.
- An AGP, or **accelerated graphics port**, allowed the operating system to designate RAM for use by the graphics card on the fly.
- AGP started with a bandwidth of 266 MB/s; AGP 2x -> 533 MB/s; AGP 4x -> 1066 MB/s; AGP 8x -> 2133 MB/s.
- However, AGP then became overtaken by the newer PCI-Express slots, which come in several denominations to make them the do-all, fit-all slot for every expansion board, not just graphics.

AGP



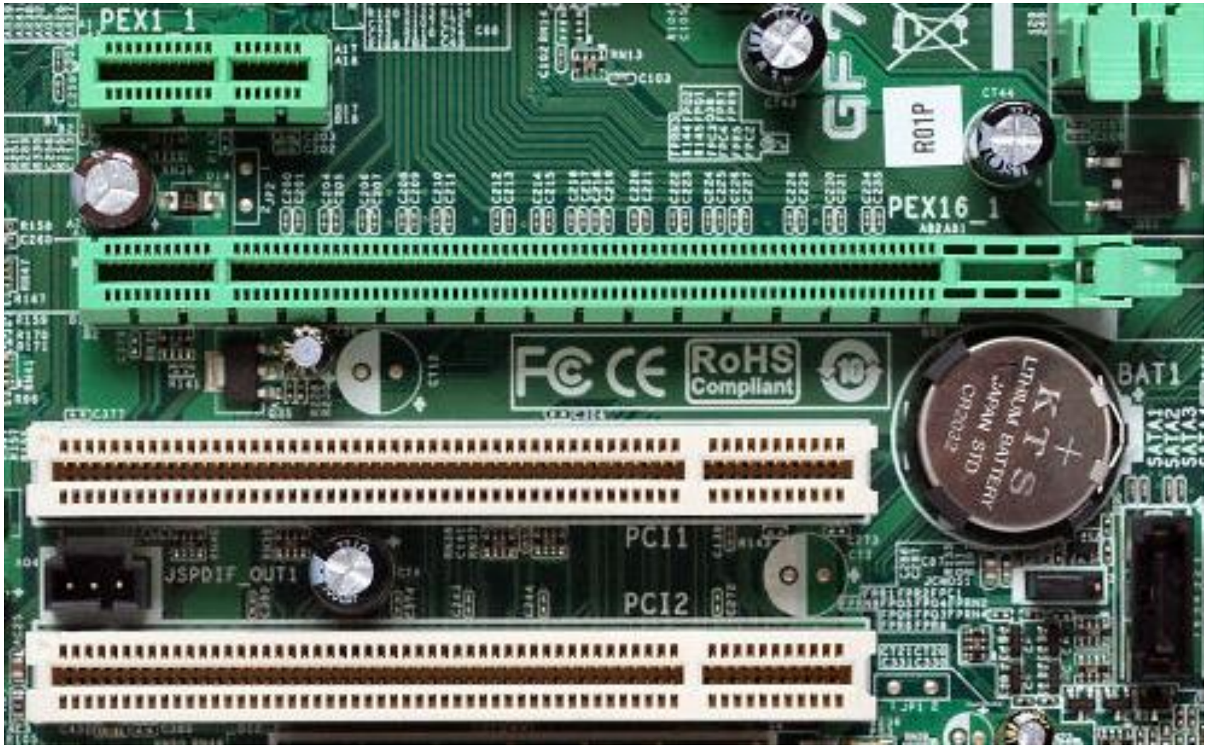


PCI Express

- The shorter ones (shown below) are **xl PCIe** slots and are common to all PCI Express slots. PCI-Express slots will also accept older PCI cards.
- To handle graphics and sound data faster, the PCIe slot can be expanded to **x2**, **x4**, **x8**, or, **x16** slots, where the numbers represent multiples of the speed of an **xl** PCIe slot.
- Their ability to move datais indicated by the multiplier factor in their designations.New computer applications, such as streaming video and photo editing, put new demands on PCs to move vast amounts of data ever quicker.
- Even the fastest of them, AGP 8x, which spewed out 2.133 GB/s, was not good enough for the demands of real-time-photorealistic animation that needs values for the colors of millions of pixels pushed through the circuits 60 times or more each second.
- The solution is a bus architecture that uses both parallel and serial transfers.
- PCI-E 1.0 allows for a total combined transfer rate of 8 GB/s in each direction. That gives a single channel nearly twice the bandwidth of the older PCI and an eight lane slot a data rate comparable to the fastest version of AGP.

PCI Express

- You can identify the expansion slots with the increased bandwidth by comparing the slots' lengths. The basic PCIe **x1** slot is about 24.5mm long.
- Each 13.5mm added to other slots represents another 250MB added to their bandwidth.



Motherboard Power Connectors

- Every PC power supply has connectors that attach to the motherboard, providing power to the motherboard, processor, memory, chipset, integrated components (such as video, LAN, universal serial bus [USB], and FireWire), and any cards plugged into bus slots.

- These connectors are important; not only are these the main conduit through which power flows to your system, but attaching these connectors improperly can have a devastating effect on your PC, including burning up both your power supply and motherboard.

- Just as with the mechanical shape of the power supply, these connectors are usually designed to conform to one of several industry-standard specifications, which dictate the types of connectors used as well as the pin outs of the individual wires and terminals.
- Every PC power supply has special connectors that attach to the motherboard, giving power to the system processor, memory, and all slotted add-on boards (ISA, PCI, AGP).

- Attaching these connectors improperly can have a devastating effect on your PC, including burning up both your power supply and motherboard.

ATX Main Board/SMPS Connector Pin Details

Color	Signal	Pin	Pin	Signal	Color
Orange*	+3.3V	13	1	+3.3V	Orange
Blue	–12V	14	2	+3.3V	Orange
Black	GND	15	3	GND	Black
Green	PS_On	16	4	+5V	Red
Black	GND	17	5	GND	Black
Black	GND	18	6	+5V	Red
Black	GND	19	7	GND	Black
White	–5V	20	8	Power Good	Gray
Red	+5V	21	9	+5VSB (Standby)	Purple
Red	+5V	22	10	+12V	Yellow
Red	+5V	23	11	+12V1	Yellow
Black	GND	24	12	+3.3V	Orange

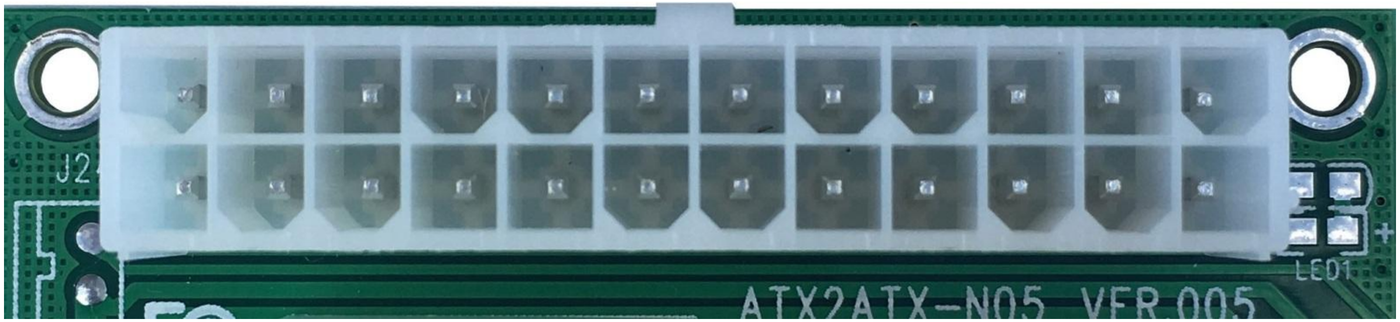
- Connects to the 24-pin ATX power cable of a power supply unit which supplies power to the motherboard.

- The ATX main power connector is either a 20-pin or 24-pin connector, which, if standard terminals are used, is rated for up to six amps of current per terminal.

- If the connector were upgraded to HCS terminals, the rating would increase to nine amps per terminal, and if upgraded to Plus HCS terminals, the rating would increase further to 11 amps per terminal.

- The 3.3-volts and 5-volts are typically used by digital circuits, while the 12-volt is used to power fans and motors in disk drives.

- The main specification of a power supply is in **watts**. A watt is the product of the voltage in volts and the current in amperes or **amps**.



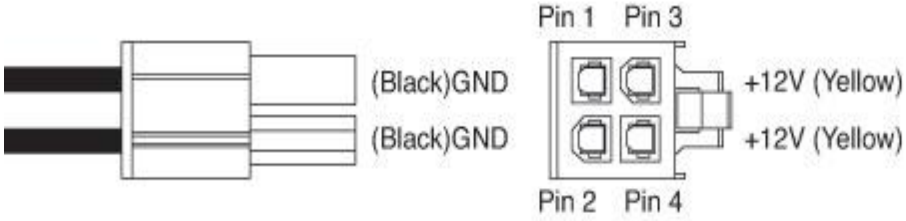
ATX12V Connector

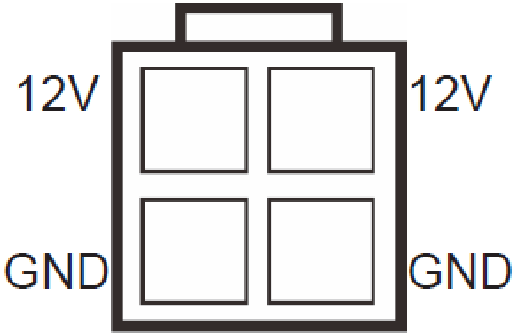
- Power for the processor comes from a device called the voltage regulator module (VRM), which is built into most modern motherboards.
- This device senses the CPU voltage requirements (usually via sense pins on the processor) and calibrates itself to provide the proper voltage to run the CPU.
- The design of a VRM enables it to run on either 5v or 12v for input power. Most have used 5v over the years, but many are now converting to 12v because of the lower current requirements at that voltage. In addition, the 5v already might be loaded by other devices, whereas, typically, only drive motors use the 12v.
- Whether the VRM on your board uses 5v or 12v depends on the particular motherboard or regulator design.
- Many modern voltage regulator ICs are designed to run on anything from a 4v to a 36v input, so it is up to the motherboard designer as to how they will be configured.
- Although most motherboard VRM designs up through the Pentium III and Athlon/Duron use 5v-based regulators, a transition is underway to use 12v-powered regulators. This is because the higher voltage will significantly reduce the current draw.

Levels of Draw at Various Voltages and Connector

Watts	Volts	Amps	Amps at 75% Regulator Efficiency
65	1.8	36.1	—
65	3.3	19.7	26.3
65	5.0	13.0	17.3
65	12.0	5.4	7.2

Color	Signal	Pin	Pin	Signal	Color
Yellow	+12V	3	1	Gnd	Black
Yellow	+12V	4	2	Gnd	Black

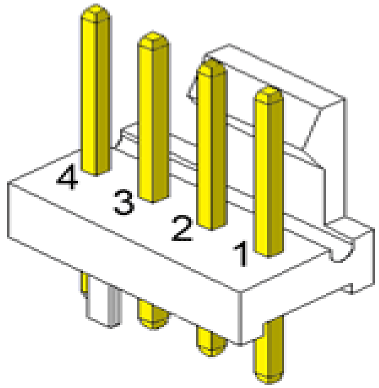




CPU FAN Header

Supplies power to the CPU heat sink fan and computer case fans.

4-Wire Pulse Width Modulation (PWM) Controlled Fans

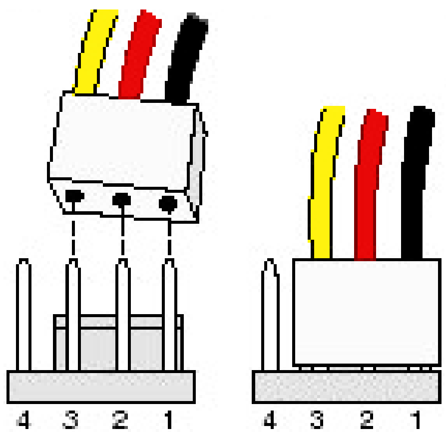


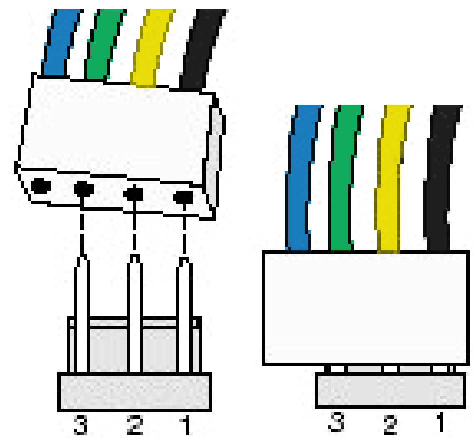
Motherboard CPU Fan 4 Pin header Connector Cable color coding for Intel and AMD.

Pin	Name	Color
1	GND	black
2	+12VDC	yellow
3	Sense	green
4	Control	blue

Pin	Name	Color
1	GND	black
2	+12VDC	red
3	Sense	yellow
4	Control	blue

- Chassis and CPU fans may use either 3-pin or 4-pin power connectors. 3-pin connectors are usually used for the smaller chassis fans with lower power consumption.
- 4-pin connectors are usually used by CPU fans with higher power consumption. Fans and on-board fan headers are backwards compatible.
- Proper fan connector placement is shown in the figures below:
  - Fan has a 3-pin power connector; desktop board has a 4-pin fan header:
  - Fan has a 4-pin power connector; desktop board has a 3-pin fan header:





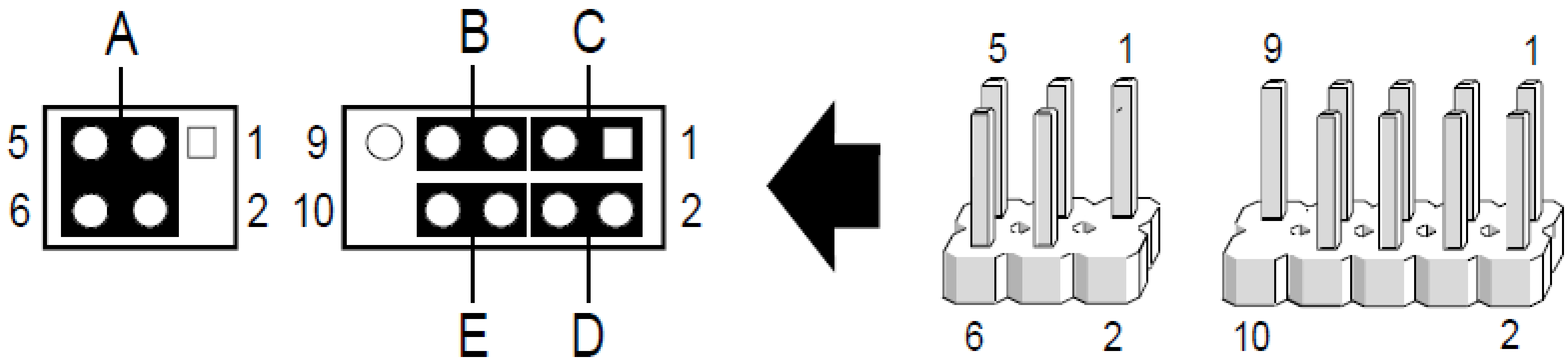
Note: when using a 3-pin power connector with a 4-pin fan header, the fan will always be on; there is no fan control.

Front Panel Connectors/Indicators

Onboard Headers, Connectors and Jumpers

Front Panel Connectors

Connects to the power switch, reset switch, power LED, hard drive LED and front audio ports of a computer case.
A: IR Header
B: Front panel connector

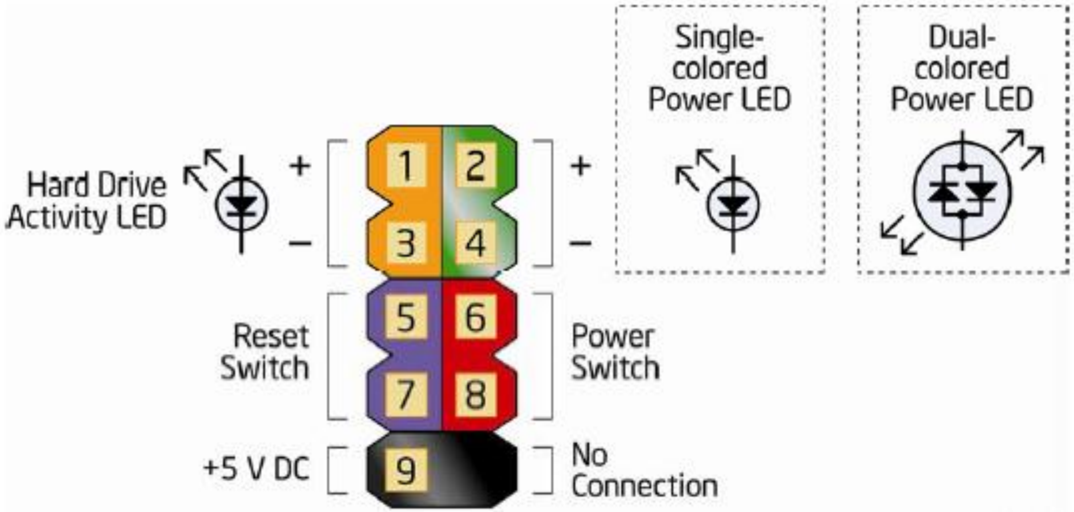


A: IR Header

Pin	Signal	In/Out	Description	Pin	Signal	In/Out	Description
1	Not assigned	N/A	Not assigned	2	(No pin)	N/A	Key
3	+5 V	Out	IR Power	4	GND		Ground
5	IRTX	Out	IrDA serial output	6	IRRX	In	IrDA serial input

B: Front panel connector

Pin	Signal	Description
1	HD_LED_P	Hard disk LED pullup (330 ohm) to +5 V
2	FP PWR/SLP	MSG LED pull-up (330 ohm) to +5 V
3	HD_LED_N	Hard disk active LED
4	FP PWR/SLP	MSG LED pull-up (330 ohm) to +5 V
5	RST_SW_N	Reset Switch low reference pull-down (100 ohm) to GND
6	PWR_SW_P	Power Switch high reference pull-up (10000 ohm) to +5 V
7	RST_SW_P	Reset Switch high reference pull-up (1000 ohm) to +5 V
8	PWR_SW_N	Power Switch high reference pull-down (100 ohm) to GND
9	RSVD_DNU	Reserved. Do not use



Hard Drive Activity LED

- Connecting pins 1 and 3 to a front panel mounted LED provides visual indication that data is being read from or written to the hard drive.
- For the LED to function properly, an IDE drive should be connected to the onboard IDE interface.
- The LED will also show activity for devices connected to the SCSI (hard drive activity LED) connector.

Power / Sleep / Message Waiting LED

- Connecting pins 2 and 4 to a single- or dual-color, front panel mounted LED provides power on/off, sleep, and message waiting indication

Reset Switch

- Supporting the reset function requires connecting pins 5 and 7 to a momentary-contact switch that is normally open. When the switch is closed, the board resets and runs POST.

Power Switch

- Supporting the power on/off function requires connecting pins 6 and 8 to a momentary-contact switch that is normally open.
- The switch should maintain contact for at least 50 ms to signal the power supply to switch on or off.
- The time requirement is due to internal debounce circuitry. After receiving a power on/off signal, at least two seconds elapses before the power supply recognizes another on/off signal.

LED Indications (Single Color)

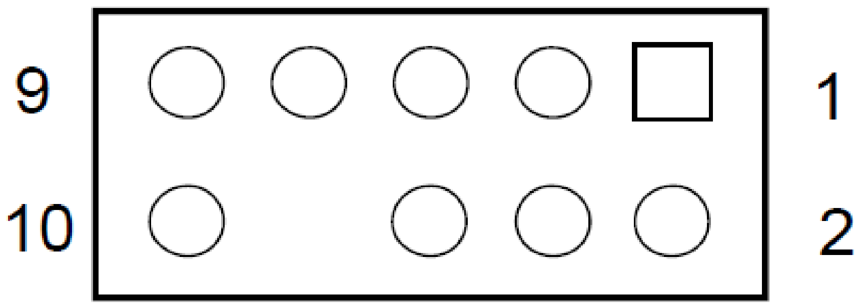
LED State	Description	ACPI State
Off	Sleeping or power off (not running)	S1, S3, S5
Steady Green	Running	S0
Blinking Green	Running/message waiting	S0

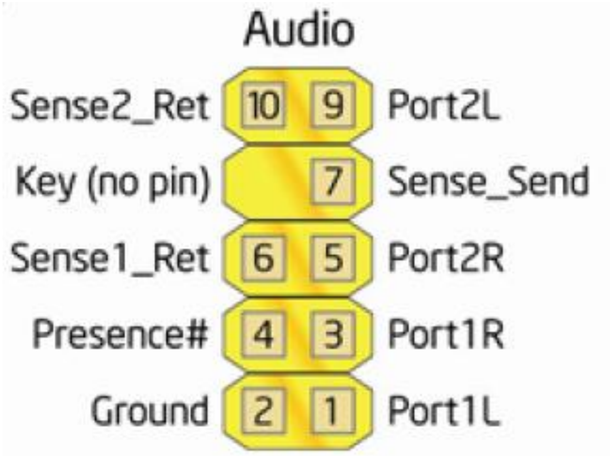
LED Indications (Dual Color)

LED State	Description	ACPI State
Off	Power off	S5
Steady Green	Running	S0
Blinking Green	Running/message waiting	S0
Steady Yellow	Sleeping	S1, S3
Blinking Yellow	Sleeping/message waiting	S1, S3

Front Panel Audio Header

- The front panel audio connector is designed to support stereo audio output (headphone or amplified speakers) and a microphone input (mono).
- The microphone inputs (mono) connect to a 1/8-inch ring-tip-sleeve mini-phone jack mounted on the front panel.
- The tip provides the Microphone In signal, and the ring provides the Audio Microphone Bias signal.





Pin	Signal Name	Description
1	AUD_MIC	Front Panel Microphone input signal
2	AUD_GND	Ground used by Analog Audio Circuits
3	AUD_MIC_BIAS	Microphone Power
4	AUD_VCC	Filtered +5 V used by Analog Audio Circuits
5	AUD_FPOUT_R	Right Channel Audio signal to Front Panel
6	AUD_RET_R	Right Channel Audio signal Return from Front Panel
7	HP_ON	RSVD for future use to control Headphone Amplifier
8	KEY	No Pin
9	AUD_FPOUT_L	Left Channel Audio signal to Front Panel
10	AUD_RET_L	Left Channel Audio signal Return from Front Panel

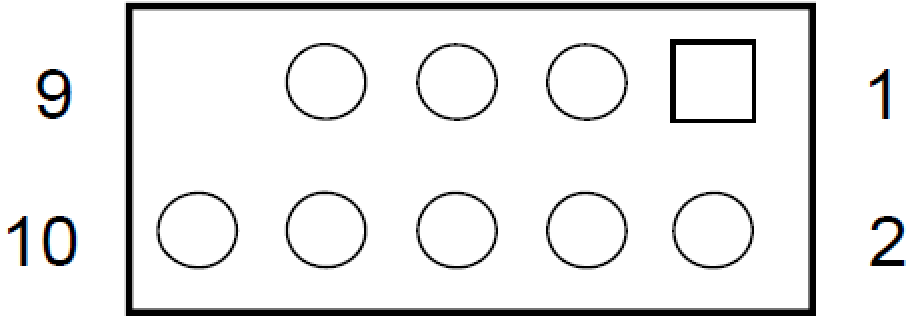
- The two front panel audio output sends (AUD_FPOUT_L and AUD_FPOUT_R) and the two front panel audio returns (AUD_RET_L and AUD_RET_R) connect to a switching-type, 1/8-inch ringtip- sleeve mini-phone jack mounted on the front panel. The signal path is such that the mainboard output amplifier feeds the front panel jack via the AUD_FPOUT_L and AUD_FPOUT_R.

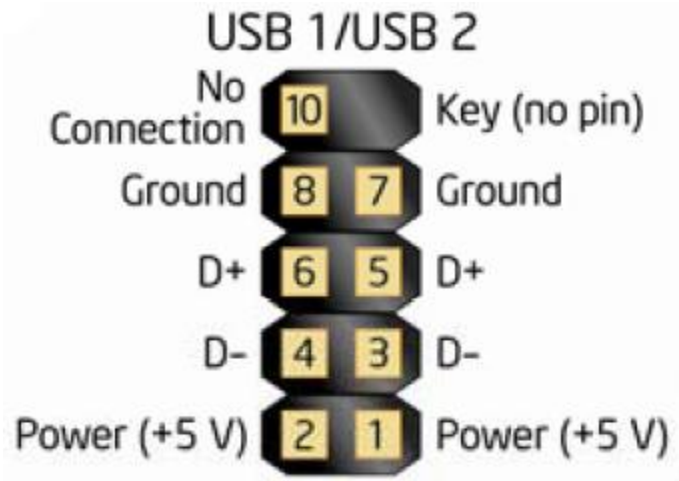
- The signal passes through the front panel jack to the back panel jack via the AUD_RET_L and AUD_RET_R signal when the front panel jack is not in use. When headphones are plugged into the front panel jack, the return signals (AUD_RET_L and AUD_RET_R) that feed that back panel jack are disconnected muting the back panel output.

- Note that the mainboard should not leave the back panel signal floating when front panel devices are connected. Allowing the back panel signals to float could result in excessive noise at the back panel jack when the front panel jack is in use.

- The mainboard designer should put in weak pulldown on the AUD_RET_L and UD_RET_R (10 k for example). The designer needs to make sure that these resistors are post output capacitor if using a single supply for the output amplifier. Doing so will avoid loading the amplifier bias down.

Front Panel USB Connectors





Pin	Signal names	Description
1	VREG_FP_USBPWR0	Front Panel USB Power (Ports 0,1)
2	VREG_FP_USBPWR0	Front Panel USB Power (Ports 0,1)
3	USB_FP_P0-	Front Panel USB Port 0 Negative Signal
4	USB_FP_P1-	Front Panel USB Port 1 Negative Signal
5	USB_FP_P0+	Front Panel USB Port 0 Positive Signal
6	USB_FP_P1+	Front Panel USB Port 1 Positive Signal
7	Ground	
8	Ground	
9	Key	
10	USB_FP_OC0	Front Panel USB Overcurrent signal (Ports 0,1)

Features

- The USB front panel can support multiple USB ports (USBFP_0,1.USBFP_N) that can be routed via a cable to the front panel. Each 2x5 header supports two ports. For an odd number of ports the lower numbered or even port should be enabled, PORT0, 2, 4, etc.

- In the physical layout where a dual-stack USB connector is used, arranging the ports such that the lower connector is the first Port (0) to be enabled allows for a single-port, single-connector implementation without modifying the electrical design. The connector fully supports UHCI.

USB features include:

- Support for self-identifying peripherals that can be connected or disconnected while the computer is running Automatic mapping of function to driver and configuration
- Support for isochronous and asynchronous transfer types over the same set of wires
- Support for up to 127 physical devices
- Guaranteed bandwidth and low latencies appropriate for telephony, audio, and other applications
- Error-handling and fault-recovery mechanisms built into the protocol

IEEE-1394 Connector

- IEEE-1394 connectivity allows for data transfer between the PC and consumer electronic devices such as digital cameras and camcorders.

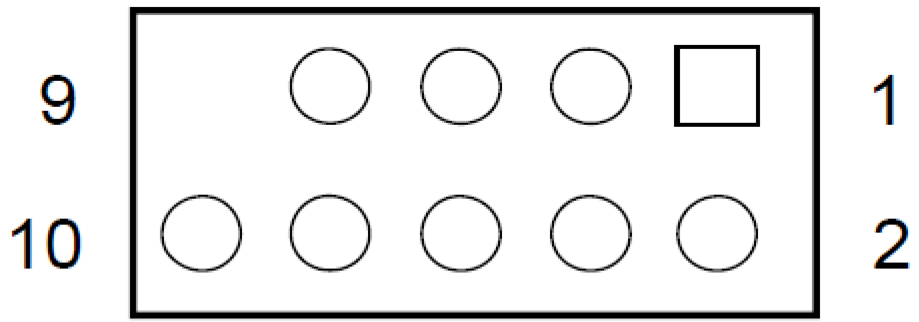
Features:

- The IEEE 1394 high-speed serial bus complements USB by providing enhanced PC connectivity for a wide range of devices, including consumer audio/video (A/V) components, storage peripherals, other PCs, and portable devices.

- IEEE 1394 has been adopted by the consumer electronics industry and is expected to provide a volume, Plug and Play-compatible expansion interface for the PC.

- The 100-Mb/s, 200-Mb/s, and 400-Mb/s transfer rates currently specified in IEEE 1394 are well suited to multi-streaming I/O requirements. Figure 4 and Table 8 show the header and pin assignments.

IEEE 1394 Header

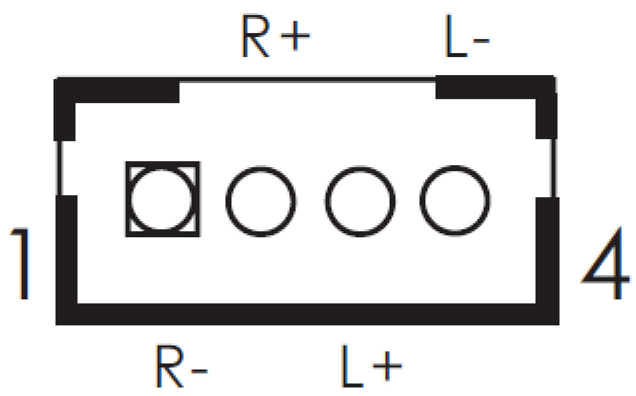


IEEE 1394 Pin Assignments

Pin	Signal Name	Pin	Signal Name
1	TPA+	2	TPA-
3	Ground	4	Ground
5	TPB+	6	TPB-
7	+12V (Fused)	8	+12V (Fused)
9	Key (no pin)	10	Ground

Speaker Connector

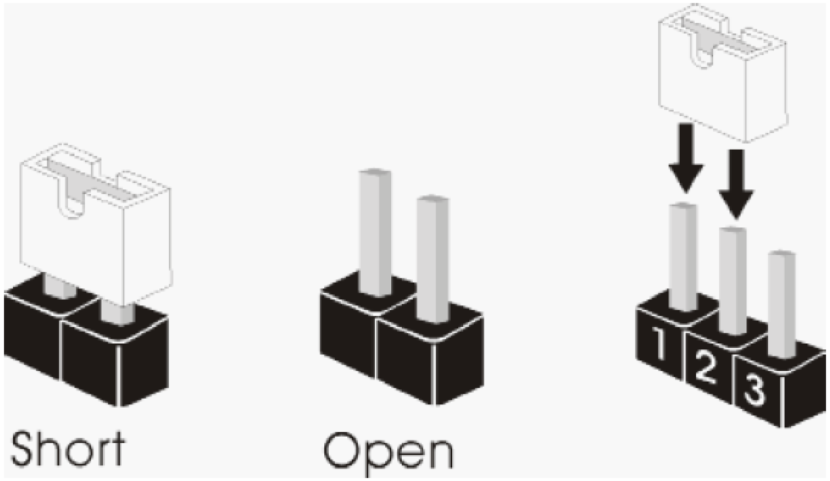
- This 4 Pin connector is for the chassis mounted system warning speaker
- The speaker allows to hearing beep and warnings
- It will indicates the errors

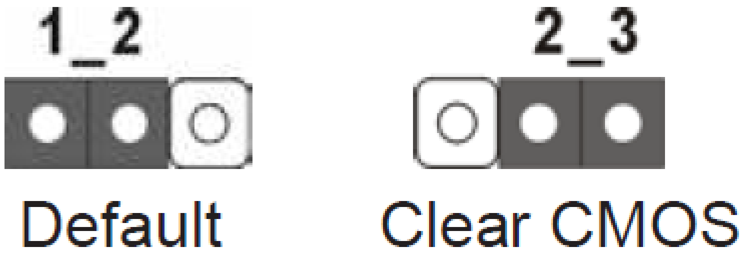


1: Speaker R-
2: Speaker R+
3: Speaker L+
4: Speaker L-

Clear CMOS Jumper

The illustration shows how jumpers are setup. When the jumper cap is placed on pins, the jumper is “Short”. If no jumper cap is placed on pins, the jumper is “Open”. The illustration shows a 3-pin jumper whose pin1 and pin2 are “Short” when jumper cap is placed on these 2 pins.





- CLRCMOS allows you to clear the data in CMOS.
- To clear and reset the system parameters to default setup, please turn off the computer and unplug the power cord from the power supply. After waiting for 15 seconds, use a jumper cap to short pin2 and pin3 on CLRCMOS for 5 seconds.
- However, please do not clear the CMOS right after you update the BIOS. If you need to clear the CMOS when you just finish updating the BIOS, you must boot up the system first, and then shut it down before you do the clear-CMOS action.
- Please be noted that the password, date, time, user default profile and MAC address will be cleared only if the CMOS battery is removed.

Rear Panel Ports/Connectors

Rear Panel Connectors/Ports

- Ports are used by a motherboard to interface with electronics both inside and outside of the computer.

- *Integrated ports* are those that are part of, directly wired to, the motherboard.

- *Internal* integrated ports are used to connect devices inside the system unit.

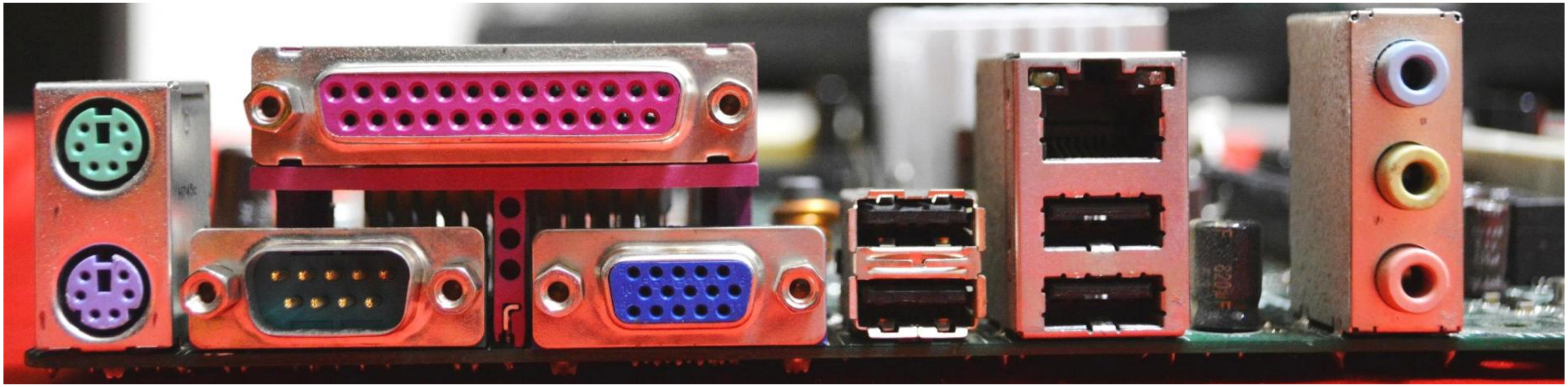
- *External* ports may be connected to the motherboard directly (integrated) or by *circuit boards* that are inserted into slots on the motherboard.

- It is often possible to add new external ports by inserting such a circuit board into an open slot.

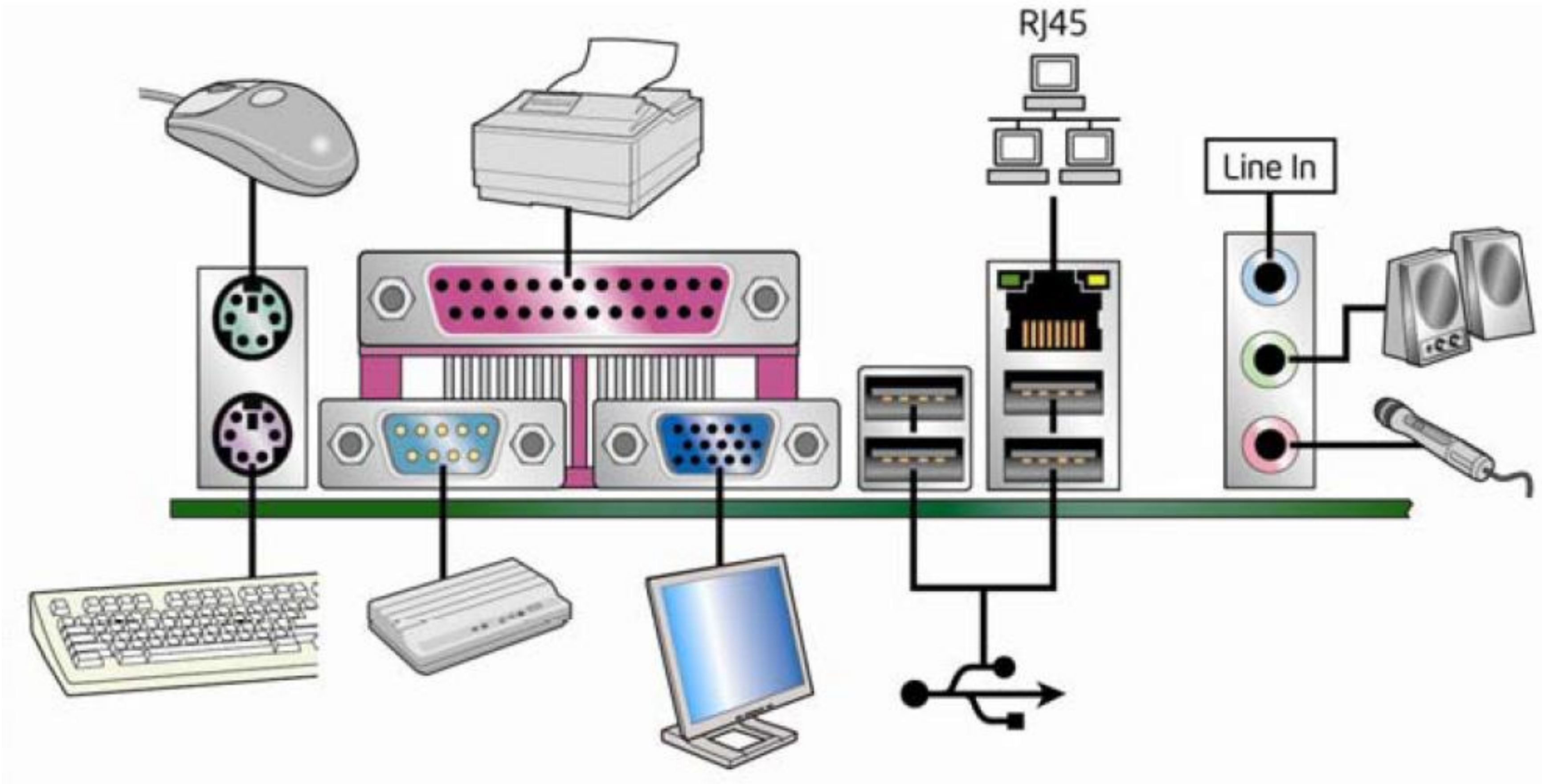
- ATX motherboards have a series of external port connections attached to one edge that poke through the back of the PC case when the motherboard is installed.

- These connectors enable you to attach external devices to the PC, such as a mouse and keyboard.
- Different motherboards vary in the number and type of some of the connectors, but most have a fairly standard set

Rear Panel Connection



Rear Panel Connection



PS/2:

- PS/2 connector is developed by IBM for connecting mouse and keyboard. It was introduced with IBM's Personal Systems/2 series of computers and hence the name PS/2 connector.

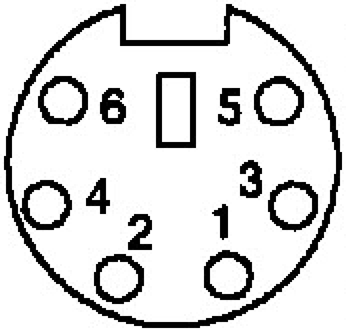
- PS/2 connectors are color coded as purple for keyboard and green for mouse.

- PS/2 ports were for connecting peripherals such as your mouse (1 *above*) and keyboard (2 *above*) to the computer, but are now outdated.

- PS/2 based mice and keyboards have now been replaced by USB ports as the popular standard. This trend for USB over PS/2 started in circa 2004.

- Even though the pinout of both mouse and keyboard PS/2 ports are same, computers do not recognize the devise when connected to wrong port.

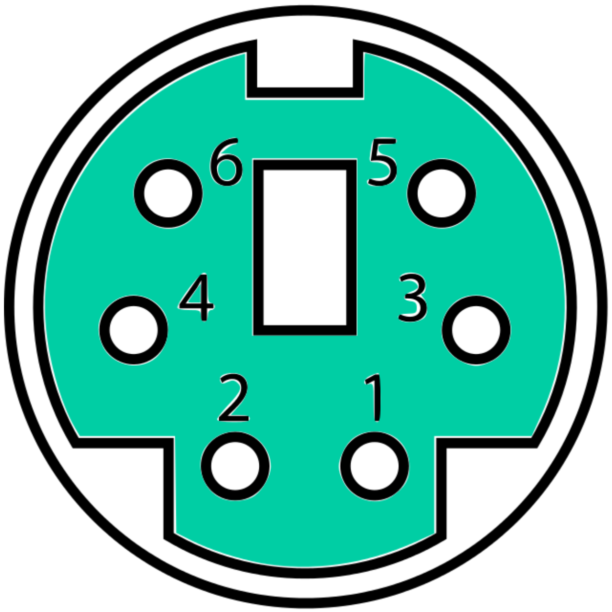
- PS/2 is a 6-pin DIN connector. The pin out diagram of a PS/2 female connector is shown in next page.



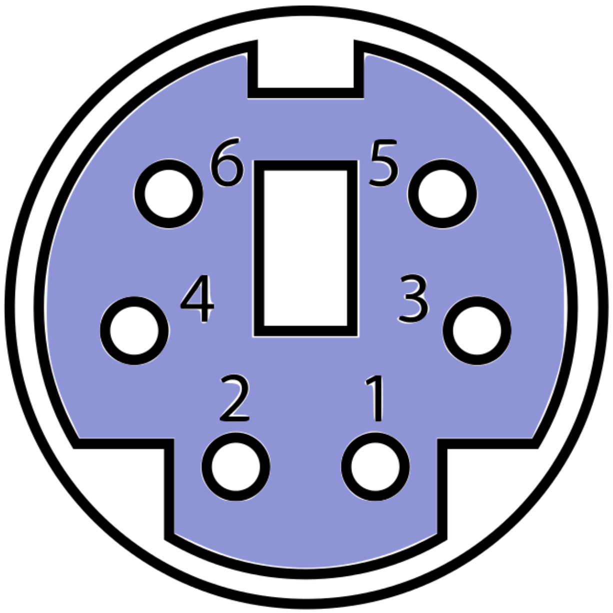
Pinout on Female Port

Pin Number	*Description*
1	Data
2	No Connection
3	Ground
4	+5V
5	Clock
6	No Connection

PS/2 Mouse



PS/2 Keyboard



Serial Port

- A serial port is an interface that allows a PC to transmit or receive data one bit at a time. It is one of the oldest types of interfaces and at one time was commonly used to connect serial devices to a PC.

- It is sometimes called a COM port or an RS-232 port, which is its technical name. Modern serial ports are used in scientific instruments, shop till systems such as cash registers and applications like industrial machinery systems.

- The term Serial Port is used to refer the interface that is compliant to RS-232 standard. There are two types of serial ports that are commonly found on a computer: DB-25 and DB-9.

- DE-9 is the main port for RS-232 serial communication. It is a D-sub connector with E shell and is often miscalled as DB-9.

- A DB-9 port is also called as a COM port and allows full duplex serial communication between the computer and it’s peripheral.

- Some of the applications of DB-9 port are serial interface with mouse, keyboard, modem, UPS and other external RS-232 compatible devices

- System resource configurations are chosen for each port and are identified by COM1, COM2, COM3, COM4, and so forth.

- Each COM position represents an input/output (I/O) and an interrupt request (IRQ) address.

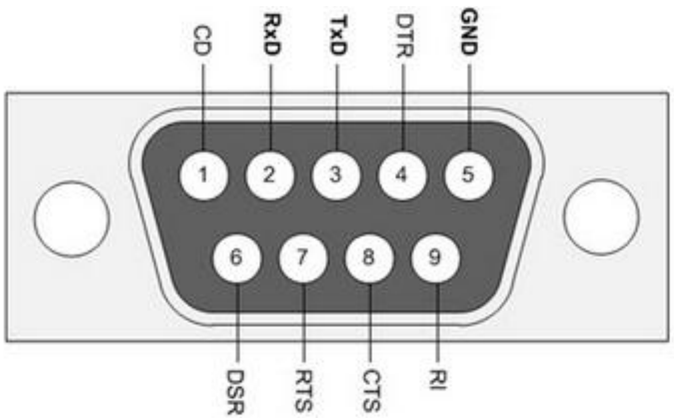
- The I/O address transfers and receives data to and from a peripheral device such as a mouse or keyboard.

- Originally, the standard used 25 pins. Because many of the pins were unused and were quite bulky, the smaller DE-9 connector became popular.

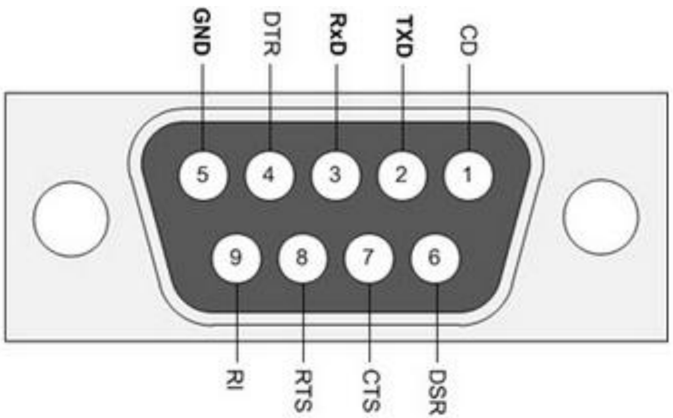
- This standard is used for transmitting serial communication between devices, which are usually called data communications equipment (DCE) and data terminal equipment (DTE).

Serial Port Connectors

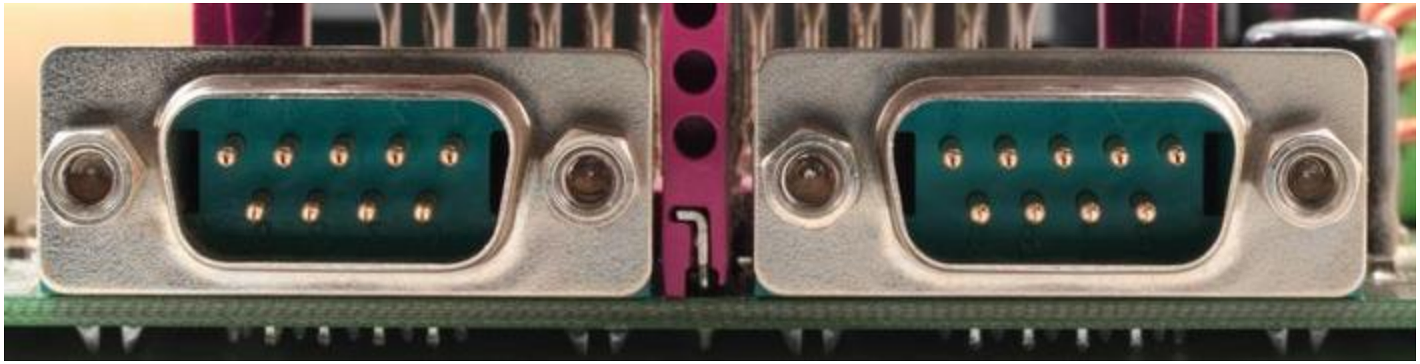
Male Connector



Female Connector



Serial port

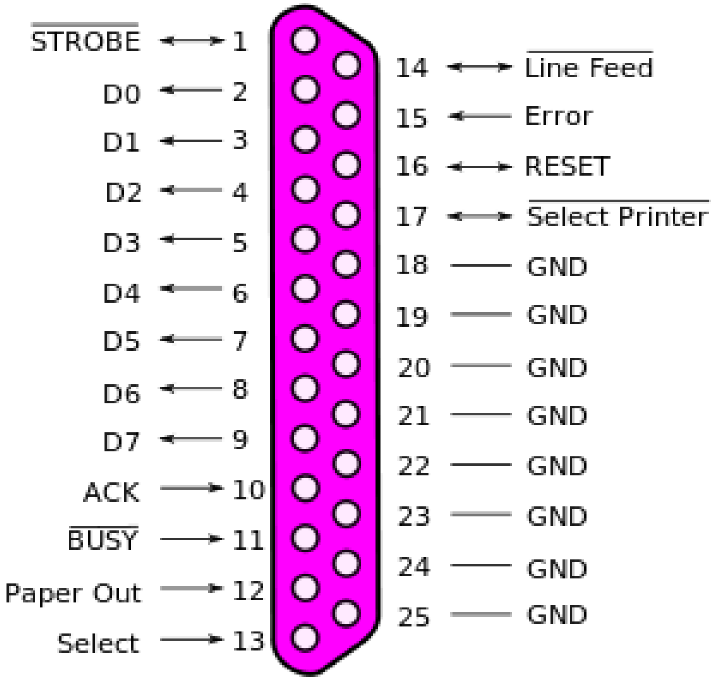


Parallel Port

- Parallel port is an interface between computer and peripheral devices like printers with parallel communication.
- A standard parallel port connector has two rows of 25 total pins surrounded by a metal casing.
- Before the wide use of USB ports, parallel ports are very common in printers. The Centronics port was later replaced by DB-25 port with parallel interface.
- Parallel ports are used to connect other peripherals such as joysticks, and more commonly, printers.
- Similar to the serial port, this technology is slowly being phased out in favor of USB. Parallel ports can still be found in many motherboards today.
- The **parallel port** is found on the back of IBM compatible computers and is a 25-pin (type **DB-25**) computer interface commonly used to connect printers to the computer.
- The original parallel port standard was unidirectional and could transmit data at a maximum speed of 150 kbps.

- The Centronics port is a 36 pin port that was developed as an interface for printers and scanners and hence a parallel port is also called as a Centronics port.
- It was eventually superseded by USB, which provides a smaller connection and significantly faster data transfer rates.
- A newer type of parallel port, which supports the same connectors as the Centronics interface, is the EPP (Enhanced Parallel Port) or ECP Extended Capabilities Port.
- Both of these parallel ports support bi-directional communication and transfer rates ten times as fast as the Centronics port.
- A standard parallel port transmits 8 data bits at a time.
- LPT port is simply a parallel port interface set to LPT, with an I/O address and IRQ channel assigned to it.
- You can normally assign up to 3 LPT ports, depending on which operating system you are using, with each port being assigned their own name LPT1, LPT2 and LPT3.

Parallel Port – Pin Configuration



Universal Serial Bus Port

- A Universal Serial Bus (USB) is a common interface that enables communication between devices and a host controller such as a personal computer (PC). It connects peripheral devices such as digital cameras, mice, keyboards, printers, scanners, media devices, external hard drives and flash drives.

- Because of its wide variety of uses, including support for electrical power, the USB has replaced a wide range of interfaces like the parallel and serial port.

- A USB is intended to enhance plug-and-play and allow hot swapping. Plug-and-play enables the operating system (OS) to spontaneously configure and discover a new peripheral device without having to restart the computer.

- Another USB feature is the use of direct current (DC). In fact, several devises use a USB power line to connect to DC current and do not transfer data.

- It enables you to plug in up to 127 different devices at the same time.

- USB is **hot swappable** which means that devices can be connected and disconnected without turning off the computer system, something that should never be attempted with parallel or serial devices.

USB-A, USB-B, and USB-C Port Types

USB-A (Type A): The rectangular USB Type A Connector approximately 1.4 cm (9/16 in) length by 0.65 cm (1/4 in) height is typically used for wired mice and keyboards. USB sticks normally feature USB-A connectors also.

USB-B (Type B): Less common than type A, USB B devices are nearly square in shape and are commonly found on routers, computers, printers, and game consoles.

Micro USB: So-called *Micro USB* versions of both USB-A and USB-B also exist - smaller versions than their base counterparts, popular on mobile devices. Older but now obsolete "mini USB" versions can also be found on many old devices.

USB Type C: With dimensions of 0.84 cm by 0.26cm, this newer standard is designed to replace both A and B with smaller ports to better support the thinner form factors of mobile devices.

USB standards

There are different USB standards in use:

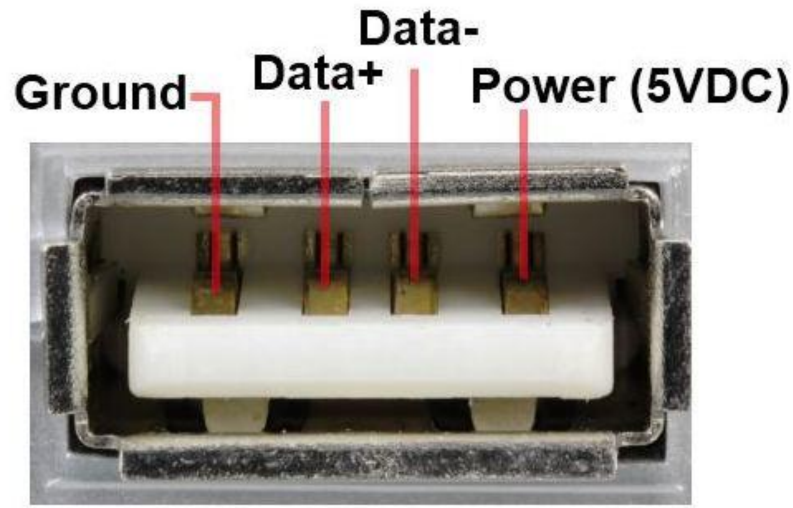
- **USB 1**: This is the original standard and can transfer data at **1.5MBps**. This is too slow for external hard disks with capacities of 500GB or more.

- **USB 2**: This is forty times faster than USB1 and has a data transfer rate of **60MBps**. This is the current standard.

- **USB3**: this is tem times faster than USB2 and 400 times faster than the original USB1. it has a data transfer rate of **600MBps** and will be common on new computer systems in 2009.

USB Version – Pin Details

Pin	Signal	Color	Description
1	VCC		+5V
2	D-		Data -
3	D+		Data +
4	GND		Ground



USB Version	Low Speed Transfer Rate	High Speed Transfer Rate	Max Cable Length
1.0	1.5 Mbit/s	12 Mbit/s	16 ft.
1.1	1.5 Mbit/s	12 Mbit/s	16 ft.
2.0	60 Mbit/s	480 Mbit/s	16 ft.
3.0	60 MB/s	5 Gbit/s	9 ft.

Fire Wire / IEEE -1394

- It Alternatively referred to as **IEEE-1394**.
- **FireWire** is a digital bus with a bandwidth of 400-800 Mbps and higher.
- It can handle up to 63 units on the same bus, is hot swappable, and supports PnP (plug and play) devices.
- FireWire has dozens of different devices, such as removable drives and cameras.
- Fire wire is another popular connector for adding peripherals to your computer. Fire wire is most often used to connect digital camcorders, external hard drives, and other devices that can benefit from the high transfer rates (up to 480 Mbps) supported by the Fire wire connection.
- Fire wire has the advantage of being able to transfer power to the device through the same cable that does the data transfer. A disadvantage of Fire wire is that cables tend to be more expensive.

Fire Wire Versions

There are multiple FireWire specifications and versions.

- **FireWire 400 (IEEE-1394)** - The original specification, capable of data transfer speeds of 100, 200, and 400 Mbps; released in 1995.

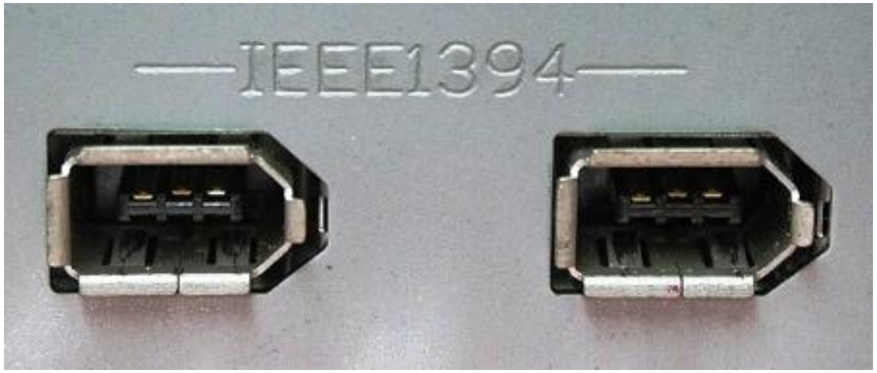
- **IEEE-1394a** - An improvement over FireWire 400, adding support for asynchronous streaming, packet concatenation, and a suspend mode for reduced power consumption; released in 2000.

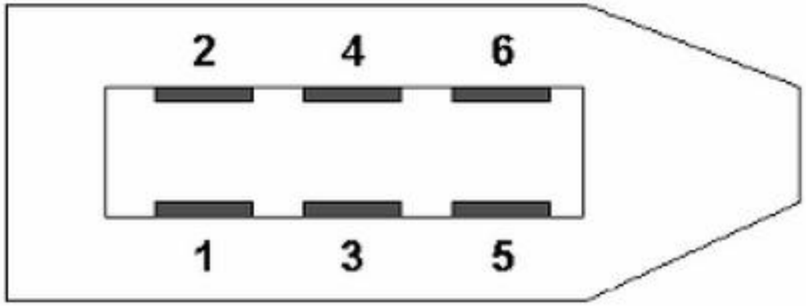
- **FireWire 800 (IEEE-1394b)** - Increased data transfer rate of up to 3200 Mbps using "beta mode" or using an optical cable; released in 2002.

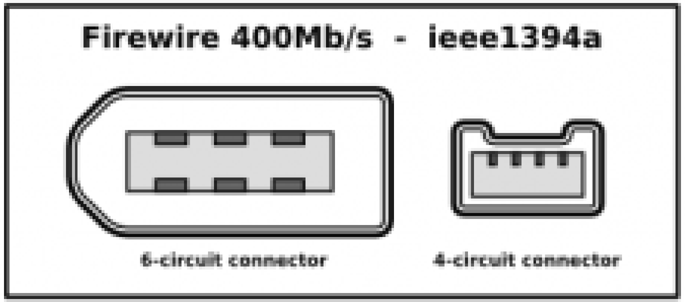
- **FireWire S800T (IEEE-1394c)** - Technology improvements to provide 800 Mbps data transfer rate using the same connection as a Cat 5e cable; released in June 2007.

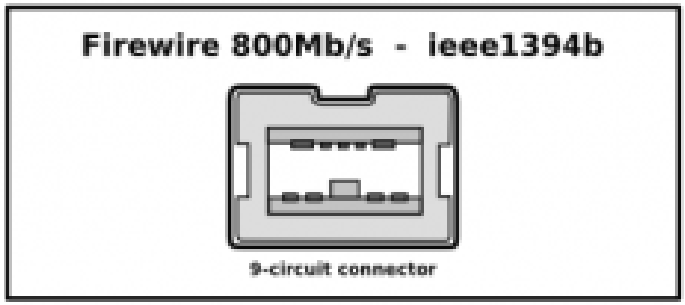
- **FireWire S1600 and S3200** - Capable of data transfer speeds of 1.57 Mbps and 3.14 Mbps respectively, and are compatible with FireWire S400 and S800 devices; announced in December 2007.

Fire Wire Pin Configuration









Pin	Signal
1	Power (8–40 VDC, 1.5 A)
2	Ground
3	Twisted pair B -
4	Twisted pair B +
5	Twisted pair A -
6	Twisted pair A +

RJ-45 –Ethernet Port

- Ethernet is a networking technology that is used to connect your computer to Internet and communicate with other computers or networking devices.

- The interface that is used for computer networking and telecommunications is known as Registered Jack (RJ) and RJ – 45 port in particular is used for Ethernet over cable. RJ-45 connector is an 8 pin – 8 contact (8P – 8C) type modular connector.

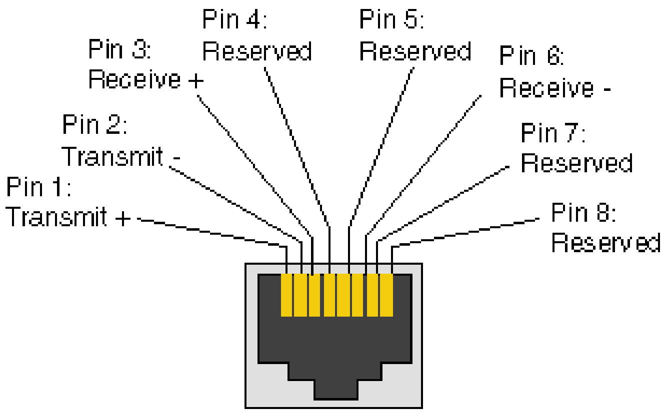
- The latest Ethernet technology is called Gigabit Ethernet and supports a data transfer rate of over 10Gigabits per second.

- Many modern motherboards come equipped to connect directly to a local network or to the Internet via a standard *RJ-45* port.

- They can either be part of the motherboard or on an expansion card.

- The two led lights will blink when the port is active.

- An Ethernet port accepts a cable that has an RJ-45 connector.

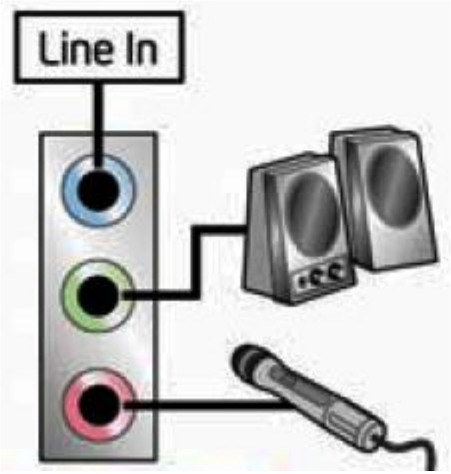

Pin 1:
Transmit +
Pin 2:
Transmit -
Pin 3:
Receive +
Pin 4:
Reserved
Pin 5:
Reserved
Pin 6:
Receive -
Pin 7:
Reserved
Pin 8:
Reserved

Audio ports

These ports are used to input and output audio from the computer system. The standard is three mini jack ports but there may be more.

The three ports are:

- **Light blue**: Line in - this is used for connecting stereo systems, tape cassette players, record players, radios etc. You can record what is being played on the connected device.
- **Lime**: Connect the speakers to this port.
- **Pink**: Connect a microphone to this port.



Display Ports / Connectors

Video Graphics Array (VGA)

- A video graphics array (VGA) connector is a 15-pin D-subminiature set of male and female electrical connectors that relays data from a computer to an output device.

- VGA connectors are used for LCD monitors, projectors, high definition televisions and so on.

- IBM designed the D-subminiature 15-pin VGA connector in 1987, and it became the standard connector for VGA output devices.

- A VGA connector is also known as HD-15, HDB-15, DB-15, DE-15, D-sub 15 and RGB connector.

- VGA connectors contain 15 pins that are designed in three parallel rows with 5 pins each, and each pin has a unique specification.

- VGA connectors and VGA cables are used to carry analog component red, green, blue, horizontal sync and vertical sync (RGBHV) video signals.

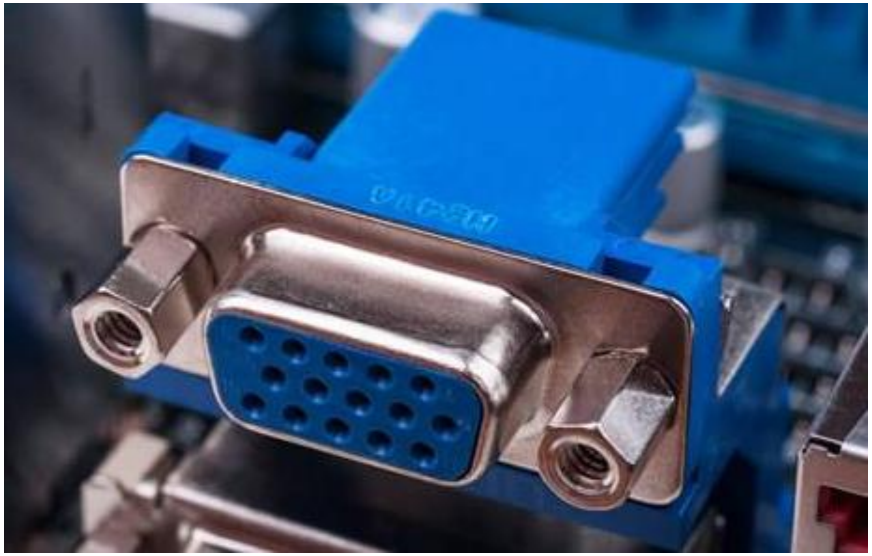
- VGA cables and VGA connectors are also used to carry video electronics standards association (VESA) display data channel (DDC) data.

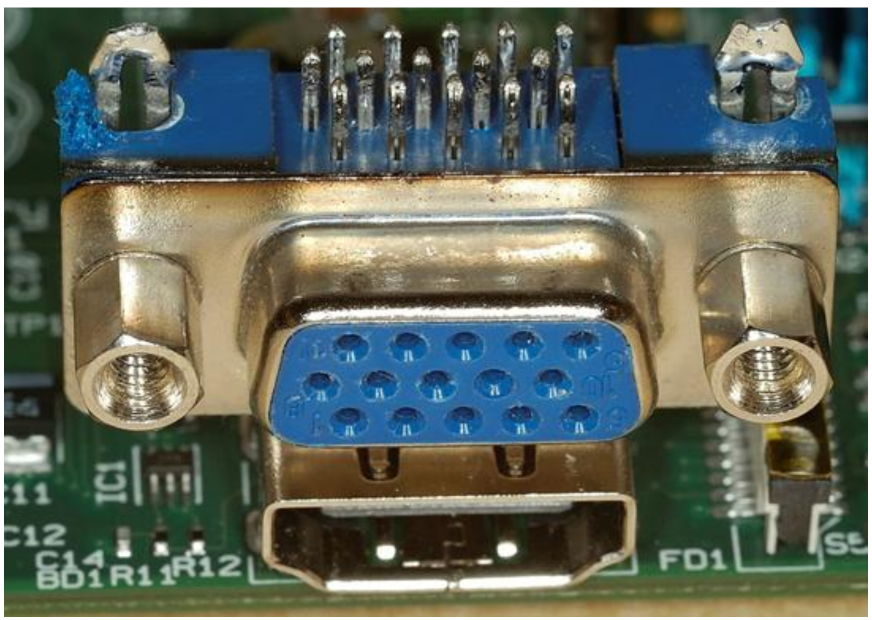
- The VGA connector attached with the VGA cable is a pin-out male connector while the VGA connector with the display hardware, both display card and output device, is a female connector.

- The analog successors for VGA connectors are super video graphics array (SVGA) and extended graphics array (XGA).

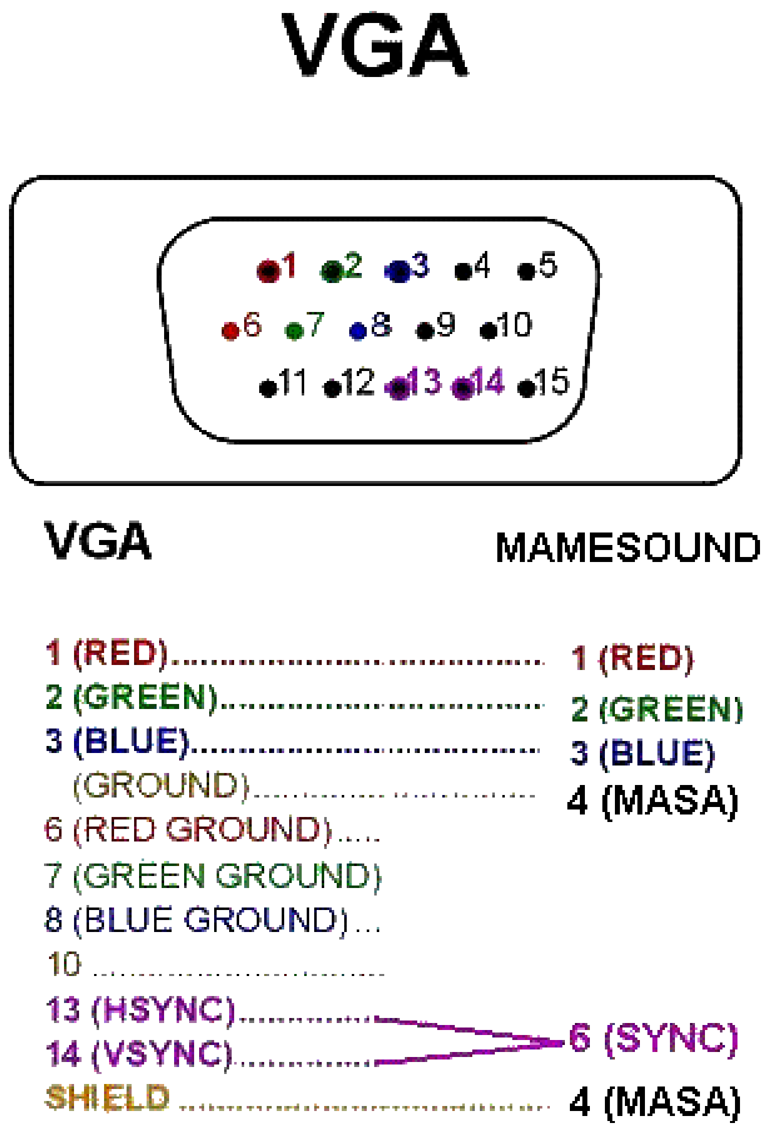
- The digital visual interface (DVI) connector has superseded the VGA connector because the DVI connector is designed to provide a very high video quality on digital display devices.

- VGA connectors are generally used as an analog technology, while the DVI connector is designed to provide uncompressed digital video data to output devices.

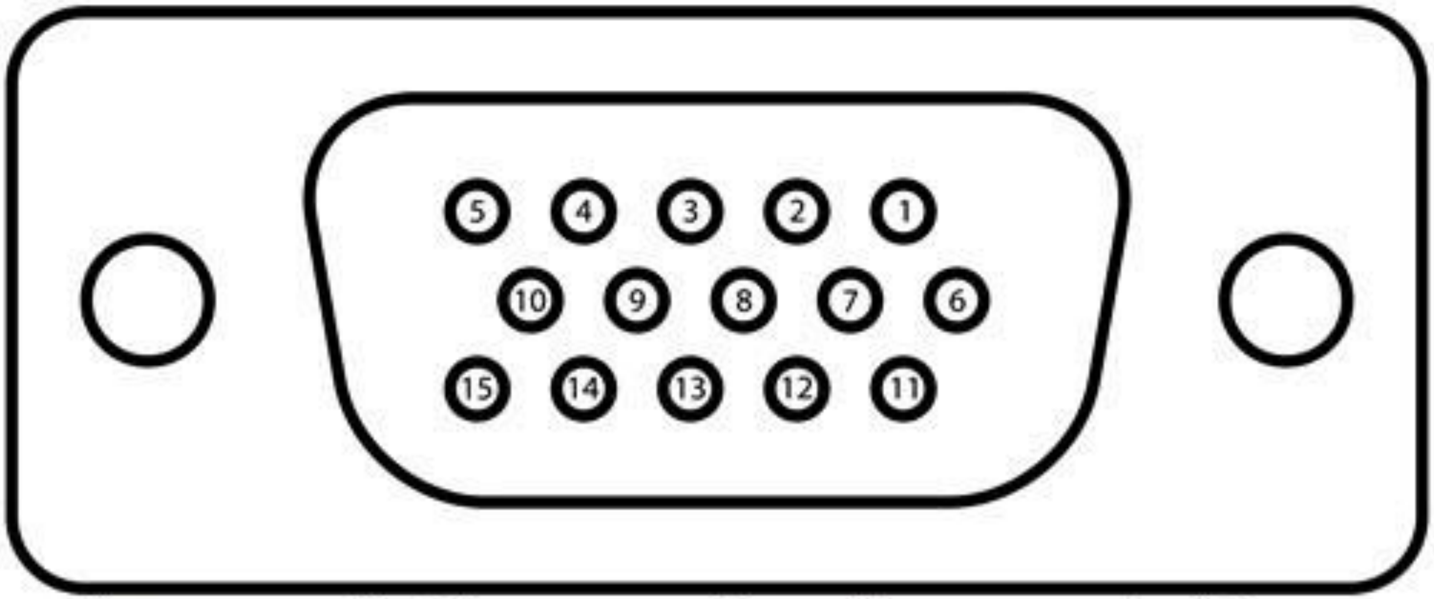




IC1
C11
C12
C14
BD1
R11
R12
FD1



VGA
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
VGA
MAMESOUND
1 (RED)................................ 1 (RED)
2 (GREEN).............................. 2 (GREEN)
3 (BLUE)............................... 3 (BLUE)
(GROUND)............................... 4 (MASA)
6 (RED GROUND).....
7 (GREEN GROUND)
8 (BLUE GROUND)...
10 ....
13 (HSYNC)............
14 (VSYNC)............ 6 (SYNC)
SHIELD .... 4 (MASA)



Pin no	*Name*	*Description*
Pin 1	RED	Red video
Pin 2	GREEN	Green video
Pin 3	BLUE	Blue video
Pin 4	ID2/RES	formerly Monitor ID bit 2, reserved since E-DDC
Pin 5	GND	Ground
Pin 6	REDGND	Red GND
Pin 7	GREENGND	Green GND
Pin 8	BLUEGND	Blue GND

Pin no	*Name*	*Description*
Pin 9	KEY/PWR	formerly key, now +5V DC
Pin 10	GND	Ground (VSync, DDC)
Pin 11	ID0/RES	formerly Monitor ID bit 0, reserved since E-DDC
Pin 12	ID1/SDA	formerly Monitor ID bit 1, I²C data since DDC2
Pin 13	HSync	Horizontal sync
Pin 14	VSync	Vertical sync
Pin 15	ID3/SCL	formerly Monitor ID bit 3, I²C clock since DDC2

Digital Video Interface (DVI)

- DVI is a high speed digital interface between a display controller like a computer and a display device like a monitor.

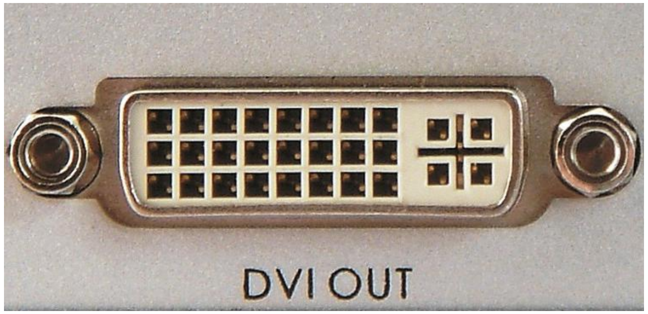
- It was developed with an aim of transmitting lossless digital video signals and replace the analogue VGA technology.

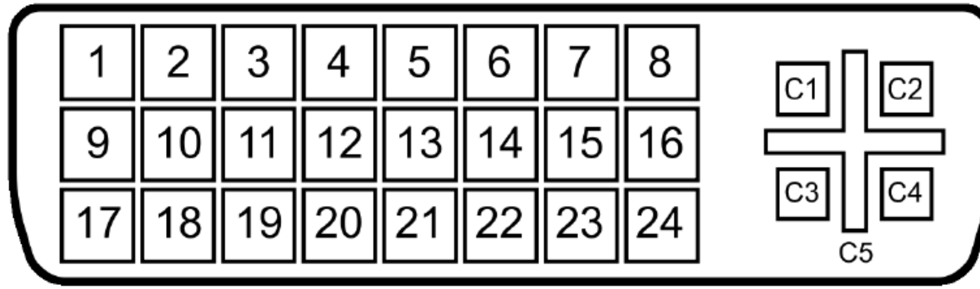
- There are three types of DVI connectors based on the signals it can carry: DVI-I, DVI-D and DVI-A. DVI-I is a DVI port with integrated analogue and digital signals.

- DVI-D supports only digital signals and DVI-A supports only analogue signals.

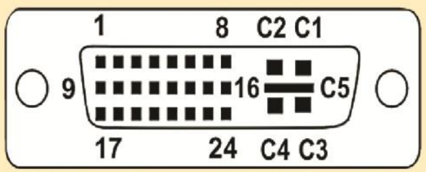
- The digital signals can be either single link or dual link where a single link supports a digital signal up to 1920X1080 resolution and a dual link supports a digital signal up to 2560X1600 resolution.

- The following image compares the structures of DVI-I, DVI-D and DVI-A types along with the pinouts.



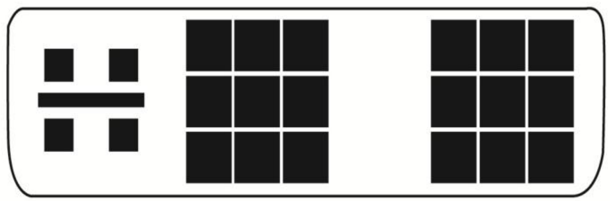


DVI

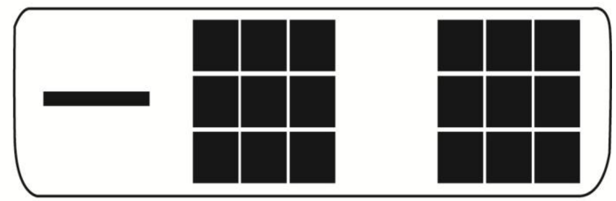


Mating face of DVI female

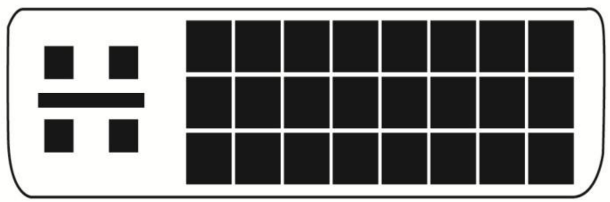
PIN#	SIGNAL	PIN#	SIGNAL
1	T.M.D.S DATA 2 -	16	HOT PLUG DETECT
2	T.M.D.S DATA 2 +	17	T.M.D.S DATA 0 -
3	T.M.D.S DATA 2/4 SHIELD	18	T.M.D.S DATA 0 +
4	T.M.D.S DATA 4 -	19	T.M.D.S DATA 0/5 SHIELD
5	T.M.D.S DATA 4 +	20	T.M.D.S DATA 5 -
6	DDC CLOCK	21	T.M.D.S DATA 5 +
7	DDC DATA	22	T.M.D.S CLOCK SHIELD
8	ANALOG VERT. SYNC	23	T.M.D.S CLOCK +
9	T.M.D.S DATA 1 -	24	T.M.D.S CLOCK -
10	T.M.D.S DATA 1 +		
11	T.M.D.S DATA 1/3 SHIELD	C1	ANALOG RED
12	T.M.D.S DATA 3-	C2	ANALOG GREEN
13	T.M.D.S DATA 3+	C3	ANALOG BLUE
14	+5V POWER	C4	ANALOG HORZ SYNC
15	GND	C5	ANALOG GROUND



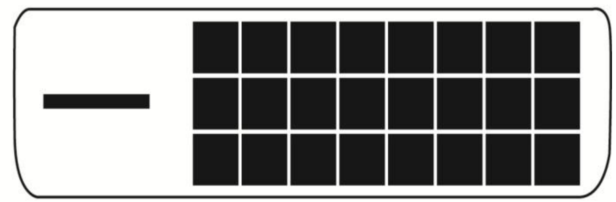
DVI-I (Single Link)



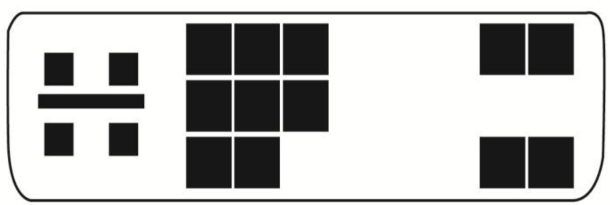
DVI-D (Single Link)



DVI-I (Dual Link)



DVI-D (Dual Link)

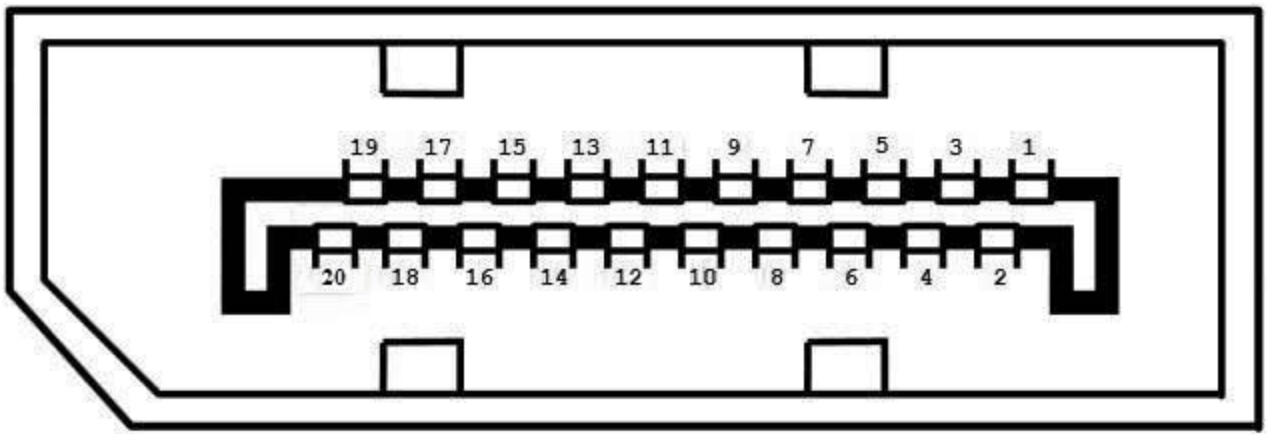


DVI-A (Analog)

Display Port

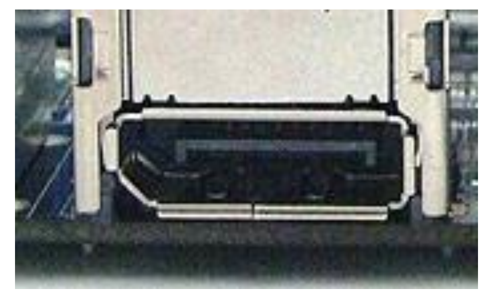
- Display Port is a digital display interface with optional multiple channel audio and other forms of data.
- Display Port is developed with an aim of replacing VGA and DVI ports as the main interface between a computer and monitor.
- The Display Port has a 20 pin connector, which is a very less number when compared to DVI port and offers better resolution.
- It's capable of 3,840x2,160-pixel resolution at 60fps, if you have at least DisplayPort 1.2 and the Multi-Stream Transport feature.
- DisplayPort can also carry audio.
- There are two sizes available: the standard DisplayPort and a smaller alternative made by Apple called Mini DisplayPort.
- The maximum bandwidth to be sent through a **DP 1.2 cable is 17.28 Gbps**.

Display Port Pin Assignments



Pin NO	*Pin Name*	*Description*
Pin 1	ML_Lane 0 (p)	Lane 0 (positive)
Pin 2	GND	Ground
Pin 3	ML_Lane 0 (n)	Lane 0 (negative)
Pin 4	ML_Lane 1 (p)	Lane 1 (positive)
Pin 5	GND	Ground
Pin 6	ML_Lane 1 (n)	Lane 1 (negative)
Pin 7	ML_Lane 2 (p)	Lane 2 (positive)
Pin 8	GND	Ground
Pin 9	ML_Lane 2 (n)	Lane 2 (negative)
Pin 10	ML_Lane 3 (p)	Lane 3 (positive)

Pin NO	*Pin Name*	*Description*
Pin 11	GND	Ground
Pin 12	ML_Lane 3 (n)	Lane 3 (negative)
Pin 13	CONFIG1	connected to Ground1)
Pin 14	CONFIG2	connected to Ground1)
Pin 15	AUX CH (p)	Auxiliary Channel (positive)
Pin 16	GND	Ground
Pin 17	AUX CH (n)	Auxiliary Channel (negative)
Pin 18	Hot Plug	Hot Plug Detect
Pin 19	Return	Return for Power
Pin 20	DP_PWR	Power for connector (3.3 V 500 mA)



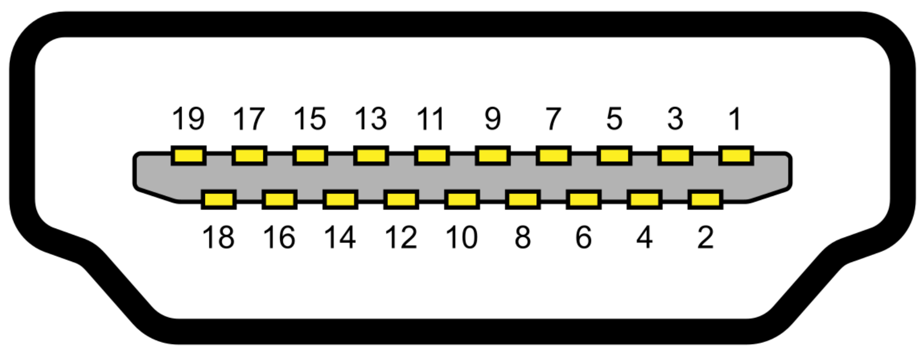
HDMI - Port

- **HDMI** is a connector and cable capable of transmitting high-quality and high-bandwidth streams of audio and video between devices.

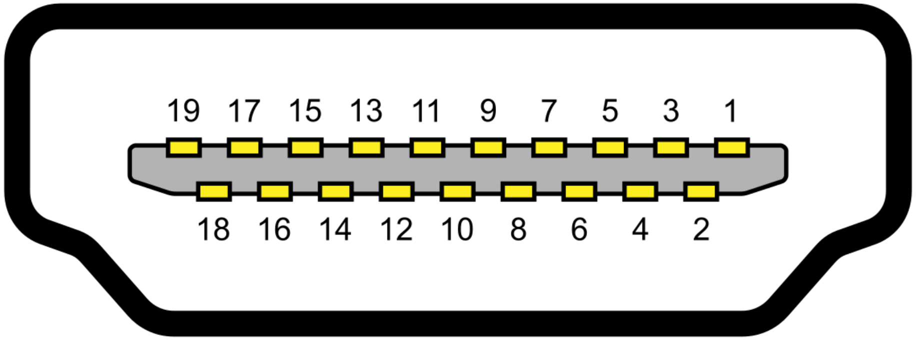
- The HDMI standard was developed by multiple companies, including Hitachi, Philips, Sony, and Toshiba.

- A single HDMI cable replaces the three composite audio/video cables, making it easier to connect two devices together for transmitting audio and video signals.

- HDMI is capable of transmitting standard, enhanced, and high-definition video signals, as well as up to 8-channels of digital audio signals.



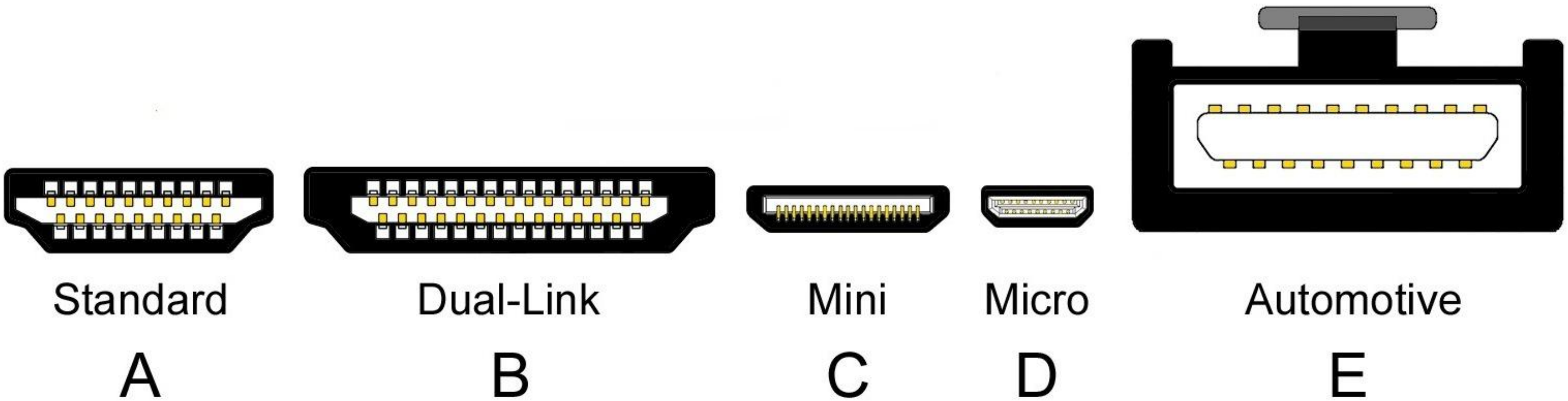
HDMI – Port Pin Configuration



Pin#	Signal	Pin#	Signal
1	TMDS data 2+	11	TMDS clock shield
2	TMDS data 2 shield	12	TMDS clock-
3	TMDS data 2-	13	CEC
4	TMDS data 1+	14	No connected
5	TMDS data 1 shield	15	DDC clock
6	TMDS data 1-	16	DDC data
7	TMDS data 0+	17	Ground
8	TMDS data 0 shield	18	+5V power
9	TMDS data 0-	19	Hot plug detect
10	TMDS clock+		

HDMI – Connector Types

There are five types of connector used with HDMI. Although the main type seen on televisions and other domestic AV equipment is the most widely used, other types exist for other applications as well.



HDMI Type A connector: This connector was launched with the original standard and has been the mainstay of the HDMI standard since then. The plug or male connector has outside dimensions of 13.9 mm × 4.45 mm, and the receptacle or female connector has inside dimensions of 14 mm × 4.55 mm.

HDMI Connector Diagram There are 19 pins and the bandwidth is able to carry all SDTV, EDTV, HDTV, UHD, and 4K modes. This connector type is electrically compatible with single-link DVI-D.

HDMI – Connector Types

HDMI Type B connector: This connector was also launched with the original standard in 2002 and it is aimed at carrying dual link DVD-I video. The connector has never been used in products because with the introduction of HDMI 1.3, the speed of a single link exceeded that of the old dual link.

As the connector is larger than the single link standard style, there has been no reason for its use. However it is still retained within the specifications.

This type of HDMI connector measures 21.2 mm × 4.45 mm and has 29 pins, carrying six differential pairs instead of three.

HDMI Type C connector: This is the mini-HDMI connector and is smaller than the Type A connector, measuring 10.42 mm × 2.42 mm but still retaining the 19-pin configuration. It was introduced in HDMI Version 1.3.

There are differences in the connector configuration: all positive signals of the differential pairs are swapped with their corresponding shield, the DDC/CEC Ground is assigned to pin 13 instead of pin 17, the CEC is assigned to pin 14 instead of pin 13, and the reserved pin is 17 instead of pin 14.

The HDMI Type C connector can be connected to a type A connector but it requires the use of a type A-to-type C cable.

HDMI Type D connector: The size of the HDMI Type D connector is very similar to the micro-USB connector and as a result the Type D is often known as a micro HDMI. The measurements are just 6.4 mm × 2.8 mm and within this outline the micro-HDMI retains the 19 pins of the other connectors, although the pin assignments are different. This connector was introduced with HDMI Version 1.4.

HDMI Type E connector: The Type E HDMI connector is aimed at automotive applications. This connector was introduced with HDMI Version 1.4.

Processor

Processor

- CPU stand for: Central Processing Unit, Also known as a Microprocessor
- The CPU is the computer's brain.
- A CPU is a complex integrated circuit made of silicon.
- It is responsible for fetching, decoding, and executing program instructions as well as performing mathematical and logical calculations.
- The processor chip is identified by the processor type and the manufacturer.
- This information is usually inscribed on the chip itself.
- For example, Intel 386, Advanced Micro Devices (AMD) 386, Cyrix 486, Pentium MMX, Intel Core 2Duo, or iCore7. etc.
- If the processor chip is not on the motherboard, you can identify the processor socket as socket 1 to Socket 8, LGA 775 among others.
- This can help you identify the processor that fits in the socket.

- A modern CPU can have billions of microscopic transistors mounted on it. The CPU is typically enclosed by a metallic heat spreader which allows for better heat dissipation.
- A (single core) CPU has to process these instructions one by one in sequence.
- You can picture a dual core CPU as having two separate processing units squeezed into a single chip.
- Instead of having to process instructions one at a time, a dual core CPU will be able to handle two instructions simultaneously.
- This vastly improves its multitasking capabilities and allows it to run multithreaded applications faster.
- Multithreaded applications are programs written to take advantage of two or more CPU cores at the same time.
- Many modern software are able to make use of two cores while demanding games can use up to four cores.

- Certain CPU-intensive processes such as image editing, video editing and virtualization can utilize eight cores or more at the same time.

FSB- Front Side Bus

- Overall processor performance relies on other *internal* and *external* factors, one of which is the processor's **front side bus** (**FSB**) speed.

- The **front side bus** consists of two *channels*, one for transferring data and one for indicating the memory address where the data is to be retrieved from or stored.

- The front side bus transfers data between the processor and the computer's other components such as memory and hard drives.

- The FSB will have a certain width (measured in bits) which dictates how many bits can be transferred at any one time. The FSB also has a clock cycle frequency indicating how fast the data can be transferred.

- For example a processor having a FSB width of 32-bits and running at 533MHz, can transfer a set of 32-bits of data, 533,000,000 times a second.

Intel – AMD Processor

Cooling Mechanism

Cooling System

- The more your computer processes, the more heat it generates. The CPU and other components can handle a certain amount of heat.

- However, if a PC isn't cooled properly, it can overheat, causing costly damage to its components and circuitry. Fans are the most common device used to cool a PC.

- In addition, the CPU is covered by a metallic block called a heat sink, which draws heat away from the CPU.

- Some serious computer users, such as gamers, sometimes have more expensive heat management solutions, like a water-cooled system, designed to deal with more intense cooling demands.

Heat Sinks -Fans

- As processors, graphics cards, RAM and other components in computers have increased in speed and power consumption, the amount of heat produced by these components as a side-effect of normal operation has also increased.

- These components need to be kept within a specified temperature range to prevent overheating, instability, malfunction and damage leading to a shortened component lifespan.

- Other devices which need to be cooled include the power supply unit, optoelectronic devices such as higher-power lasers and light emitting diodes (LEDs) and hard disks.

- A heat sink is a heat exchanger component attached to a device used for **passive cooling**. It is designed to increase the surface area in contact with the cooling fluid surrounding it, such as the air thus allowing it to remove more heat per unit time.

- Other factors which improve the thermal performance of a heat sink are the approach air velocity, choice of material – usually an aluminum alloy due to its high thermal conductivity values (229 W/mºK), fin (or other protrusion) design and surface treatment.

- The approach air velocity depends on the attached or nearby fan. When there is no air flow around the heat sink, energy cannot be transferred.

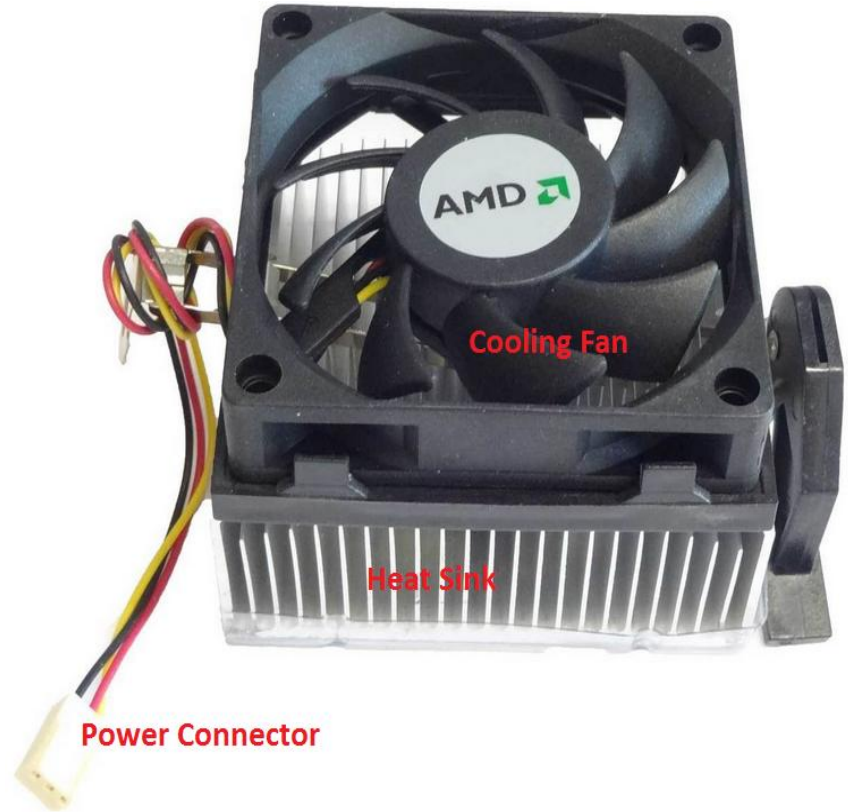
- A computer fan is any fan inside, or attached to, a computer case used for **active cooling**, and may refer to fans that draw cooler air into the case from the outside, expel warm air from inside , or move air across a heat sink to cool a particular component.

- a fan is often used in combination with the heat sink to keep both the CPU and heat sink at an acceptable temperature. This combination is creatively called a "heat sink and fan," or HSF.

- The fan moves cool air across the heat sink, pushing hot air away from the computer. Each CPU has a thermometer built in that keeps track of the processor's temperature. If the temperature becomes to hot, the fan or fans near the CPU may speed up to help cool the processor and heat sink.

- The heat sink is usually made from a high-temperature conductive material such as aluminum and copper, and the fan is a DC brushless fan, which is the standard used for computer systems.

Heat Sinks -Fans



Memory

Memory

- The system memory is the place where the computer holds current programs and data that are in use. There are various levels of computer memory, including ROM, RAM, cache, page and graphics, each with specific objectives for system operation.

- Although memory is used in many different forms around modern PC systems, it can be divided into two essential types: RAM and ROM.

- ROM, or Read Only Memory, is relatively small, but essential to how a computer works. ROM is always found on motherboards, but is increasingly found on graphics cards and some other expansion cards and peripherals.

- Generally speaking, ROM does not change. It forms the basic instruction set for operating the hardware in the system, and the data within remains intact even when the computer is shut down.

- It is possible to update ROM, but it’s only done rarely, and at need. If ROM is damaged, the computer system simply cannot function.

- RAM, or Random Access Memory, is “volatile.” This means that it only holds data while power is present. RAM changes constantly as the system operates, providing the storage for all data required by the operating system and software.

- Because of the demands made by increasingly powerful operating systems and software, system RAM requirements have accelerated dramatically over time.

- For instance, at the turn of the millennium a typical computer may have only 128Mb of RAM in total, but in 2007 computers commonly ship with 2Gb of RAM installed, and may include graphics cards with their own additional 512Mb of RAM and more.

- The trouble is, storing and retrieving data from a large block of memory is more time-consuming than from a small block.

- With a large amount of memory, the difference in time between a register access and a memory access is very great, and this has resulted in extra layers of cache in the storage hierarchy.

- When accessing memory, a fast processor will demand a great deal from RAM. At worst, the CPU may have to waste clock cycles while it waits for data to be retrieved.

- CPU architecture has also evolved to include ever larger internal caches. The organisation of data this way is immensely complex, and the system uses ingenious electronic controls to ensure that the data the processor needs next is already in cache, physically closer to the processor and ready for fast retrieval and manipulation.

L1 Cache Memory

- The Level 1 cache, or primary cache, is on the CPU and is used for temporary storage of instructions and data organised in blocks of 32 bytes. Primary cache is the fastest form of storage. Because it's built in to the chip with a zero wait-state (delay) interface to the processor's execution unit, it is limited in size.

- Level 1 cache is implemented using Static RAM (SRAM) and until recently was traditionally 16KB in size. SRAM uses two transistors per bit and can hold data without external assistance, for as long as power is supplied to the circuit.

- The second transistor controls the output of the first: a circuit known as a flip-flop – so-called because it has two stable states which it can flip between. This is contrasted to dynamic RAM (DRAM), which must be refreshed many times per second in order to hold its data contents.

- For all L1 cache designs the control logic of the primary cache keeps the most frequently used data and code in the cache and updates external memory only when the CPU hands over control to other bus masters, or during direct memory access by peripherals such as optical drives and sound cards.

L2 Cache Memory

- Most PCs are offered with a Level 2 cache to bridge the processor/memory performance gap. Level 2 cache – also referred to as secondary cache) uses the same control logic as Level 1 cache and is also implemented in SRAM.

- Level 2 cache typically comes in two sizes, 256KB or 512KB, and can be found, or soldered onto the motherboard, in a Card Edge Low Profile (CELP) socket or, more recently, on a COAST ("cache on a stick") module.

- The latter resembles a SIMM but is a little shorter and plugs into a COAST socket, which is normally located close to the processor and resembles a PCI expansion slot. The Pentium Pro deviated from this arrangement, siting the Level 2 cache on the processor chip itself.

- The aim of the Level 2 cache is to supply stored information to the processor without any delay (wait-state). For this purpose, the bus interface of the processor has a special transfer protocol called burst mode. A burst cycle consists of four data transfers where only the address of the first 64 are output on the address bus. The most common Level 2 cache is synchronous pipeline burst.

- To have a synchronous cache a chipset, such as Triton, is required to support it. It can provide a 3-5% increase in PC performance because it is timed to a clock cycle. This is achieved by use of specialised SRAM technology which has been developed to allow zero wait-state access for consecutive burst read cycles.

RAM / Main Memory

- A PC's third and principal level of system memory is referred to as main memory, or Random Access Memory (RAM). It is an impermanent source of data, but is the main memory area accessed by the hard disk. The more data it is possible to have available in the RAM the faster the PC will run.

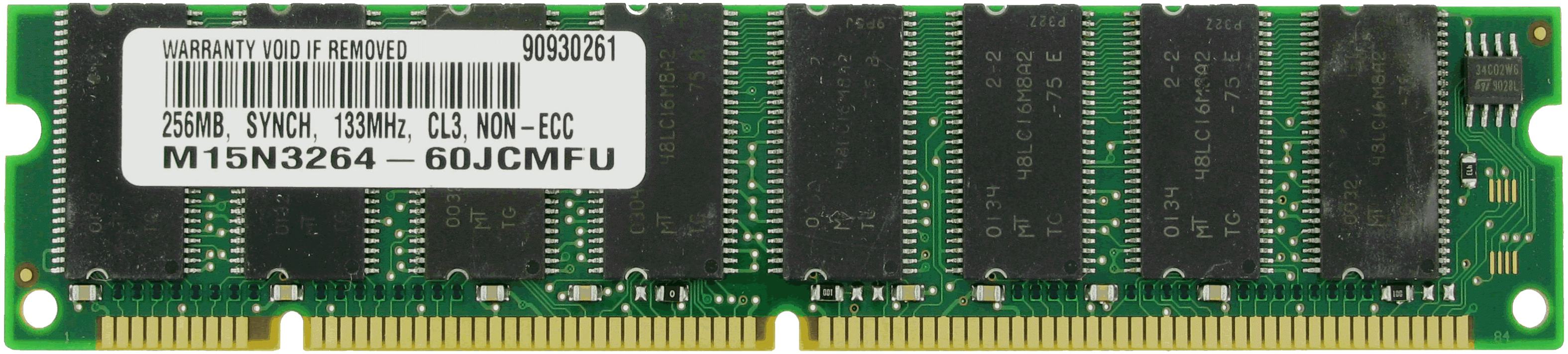
- Main memory is attached to the processor via its address and data buses. Each bus consists of a number of electrical circuits or bits. The width of the address bus dictates how many different memory locations can be accessed, and the width of the data bus how much information is stored at each location. Every time a bit is added to the width of the address bus, the address range doubles.

- Each transaction between the CPU and memory is called a bus cycle. The number of data bits a CPU is able to transfer during a single bus cycle affects a computer's performance and dictates what type of memory the computer requires.

- Main memory is built up using DRAM chips, short for Dynamic RAM. DRAM has been developed over the years on two main fronts: to be more compact, and to be faster to access.

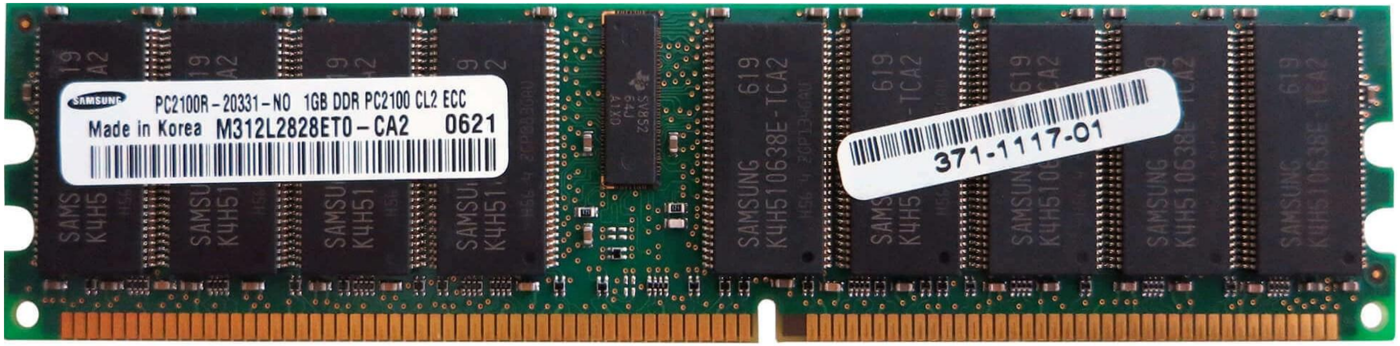
SDRAM

- Synchronous Dynamic Random Access Memory, or SDRAM was developed in the 1990s as one of the first types of RAM which allowed the process of accessing this type of memory to be sped up greatly and allow for easier and quicker processing by devices.
- It allowed computers to use a queue system to process memory searches and responses one after the other while others were still ongoing.
- It could however only process one request at a time.
- SDRAM (Synchronized Dynamic Random Access Memory)has 168 pin DIMM and operates with 3.3 volts. Its run at clock speed, meaning it synchronizes with the bus speed



DDR

- Double Data Rate RAM, or DDR RAM was developed to have twice the memory power of a typical SDRAM chip.
- It does this by supporting the transfer of data by programs two at a time on both sides of what is known as the clock cycle.
- DDR ram requires less processing power than SDRAM and is more energy efficient, as well as being quicker and more suited to devices which need to process things quickly.
- DDR (Double Data Rate)is a type of SDRAM in which information is sent on both the rise and fall of the clock signal.
- It is 2x the speed of SDRAM (double pumping). It operates at 2.5 volts and 184 pins



DDR2

- Double Data Rate 2 RAM, or DDR2 RAM was developed after DDR to keep up with quickly developing technology with higher demands.
- It is able to transfer data more quickly and efficiently than its predecessor.
- DDR2 can transfer more data at once (64 bits twice each clock cycle) and is not compatible with previous DDR RAM slots.
- DDR2 has a higher clock cycle rate than DDR, and offers a higher bandwidth to users as well as its other benefits.
- DDR2 iseven faster than DDR (2x). They have 240 pin DIMM (**Dual In-line Memory Module)**

DDR3

- Double Data Rate 3 RAM, or DDR3 RAM was developed after DDR2 to keep up with even more developments in technology with increased demands.

- It is the current industry standard after first being developed in 2007 and is the fastest RAM available to the public today.

- DDR3 has double the clock cycle rate of DDR2, and can transfer double the amount of data at a faster speed. 4x faster than DDR

- This type of RAM also uses far less processing power than the previous types which came before it. DDR3 is twice as fast as the DDR2.Italso has 240 pin DIMM

- The next upgrade of RAM, known as DDR4 is currently in development and expected to begin appearing in products soon.

SODIMM

- Small Outline Dual In-Line Memory Module, or SODIMM is a type of chip used for RAM computer memory circuits.
- They are a smaller alternative for computers which may find DIMM chips use too much processing power or take up too much space to install.
- They are generally around half the size of DIMMs, with a different number of pins and notches that make the two not interchangeable.
- These type of chips are often found in devices such as routers, printers and notebook or netbook computers and laptops.
- SODIMM is significantly smaller (68mm x 32mm) .

RAMBUS

- Rambus Direct RAM, often also called RDRAM, is a type of dynamic RAM developed by the company Rambus Inc. in the 1990s.
- This was developed around the same time as SDRAM and was also intended to speed up the processing of memory by devices with increased technological demand.
- RDRAM and SDRAM became tangled in a format war, both competing for the same audience of customers with fairly similar products.
- However, SDRAM proved to be a more cost-effective option and showed better performance, leading to it becoming the industry standard quite quickly. Devices which supported RDRAM stopped being produced in around 2001.

DIMM

- Dual In-Line Memory Module, or DIMM is a type of chip used for RAM computer memory circuits. They replaced Single In-Line Memory Modules as the industry standard when processors became more complex and able to cope with more RAM.
- DIMMs use a circuit board to organise RAM circuits and have a different amounts of pins and notches to SODIMMs.
- DIMMs usually run 64-bit data transfer, making them more efficient than their predecessor, and are often found in devices such as PCs, servers and workstations.

Storage Device

Hard Disk Drives

- Hard disk drives are non volatile magnetic storage devices capable of remembering vast amounts of data.
- An electromagnet in the read/write head charges the disk's surface with either a positive or negative charge, this is how binary 1 or 0 is represented.
- The read/write head is then capable of detecting the magnetic charges left on the disk's surface, this is how data is read.
- The disk surface is divided into concentric circles (tracks) and sectors (wedges).
- Dividing the surface in this way provides physical addresses to remember where data is saved.
- A circuit board carefully co-ordinates the rotating disk and swinging actuator arm to allow the read/write head to access any location very quickly.
- Typical HDD capacities are measured in Terabytes (TB).

- Hard disks are magnetic disks. They have much larger storage capacities than floppy disks. Data can be transferred to and from a hard disk much more quickly than from a floppy disk.

- Hard disks are usually fixed inside a computer and can not be moved between different machines. Some expensive hard disks can be moved between computers. These are called exchangeable hard drives.

- A hard disk is made of a rigid disk which is coated with a magnetisable material. The magnetic material used is of a much higher quality than that found on floppy disks.

- Hard disks spin much more quickly than floppy disks and the disk head is positioned very close to the disk. Because the disk head is positioned so close to the disk hard drives can easily be damaged by dust or vibration.

- Therefore the disk, the drive head and all the electronics needed to operate the drive are built together into a sealed unit.

- **Fixed Hard disk:** Used to store operating systems, software and working data. Any application which requires very fast access to data for both reading and writing to. Not for applications which need portability. Used for on-line and real time processes requiring direct access. Used in file servers for computer networks.

- **Portable Hard Disk:** Used to store very large files which need transporting from one computer to another and price is not an issue. More expensive than other forms of removable media.

- These hard drives are connected to the motherboard using the power cable and either of the ATA, SATA or SCSI cables via the back end ports. The exact cable to b used will depend on the type of HDD and usually included with the HDD.

Hard Disk Drive Cross Sectional View

Hard Disk Operation

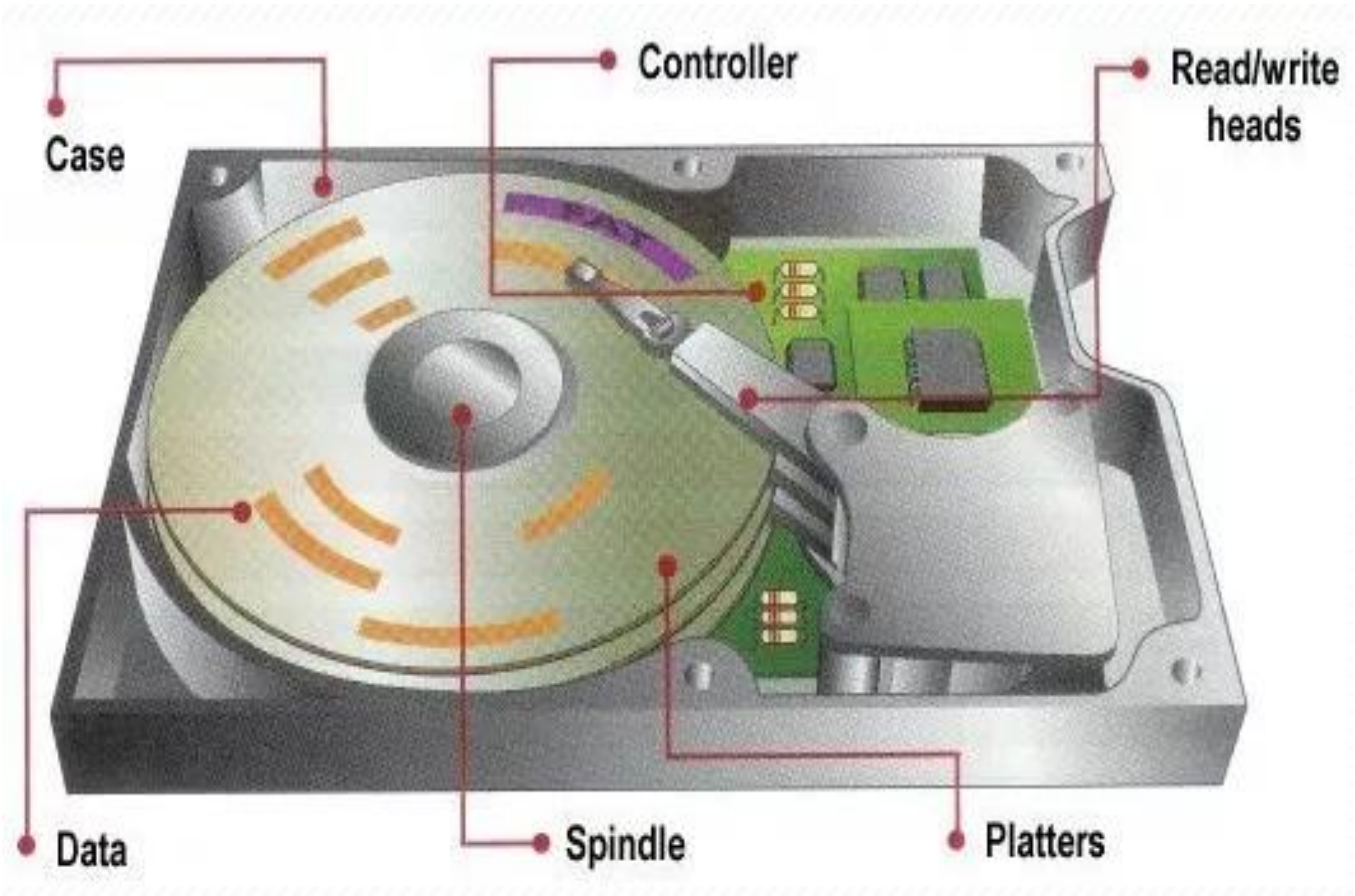
- The disc platters are mounted on a single spindle that spins at a typical 10,000rpm. On EIDE and SCSI drives the disk controller is part of the drive itself. It controls the drive’s servo-motors and translates the fluctuating voltages from the head into digital data for the CPU.
- Data is recorded onto the magnetic surface of a platter in exactly the same way as it is on floppies or digital tapes. Essentially, the surface is treated as an array of dot positions, with each domain’ of magnetic polarisation being set to a binary 1 or 0.

- The position of each array element is not identifiable in an absolute sense, and so a scheme of guidance marks helps the read/write head find positions on the disk. The need for these guidance markings explains why disks must be formatted before they can be used.

- When it comes to accessing data already stored, the disk spins round very fast so that any part of its circumference can be quickly identified. The drive translates a read request from the computer into reality.

- There was a time when the cylinder/head/sector location that the computer worked out really was the data’s location, but today’s drives are more complicated than the BIOS can handle, and they translate BIOS requests by using their own mapping.

Hard Disk Drive Cross Sectional View



Typical applications for hard disk drives

- Desktop computers
- Laptop computers
- TV and satellite recorders
- Servers and mainframes
- Portable (external) drives are sometimes used to backup home computers or transfer large files

Benefits of hard disk drives

- Capable of holding vast amounts of data at affordable prices
- Fast read and write speeds
- Reliable technology
- Relatively small in size

Drawbacks of hard disk drives

- Due to the nature of its moving parts, they will eventually wear and break
- Although very fast, waiting for the moving parts means it will never perform as fast as solid state drives
- More fragile and less robust than a SSD
- Higher power consumption than a SSD
- Some noise is created by the moving parts

Floppy Disks

- Floppy disks are magnetic disks. They are portable (can be moved between computers) but have a small storage capacity. Reading and writing data from a floppy disk is very slow.
- The most common type of floppy disk is the 3.5" disk that can store 1.44Mb of data when it is used on a PC (enough to store about 350 pages of A4 text). Older disks were 5.25“ or 8" in size but could store much less data.

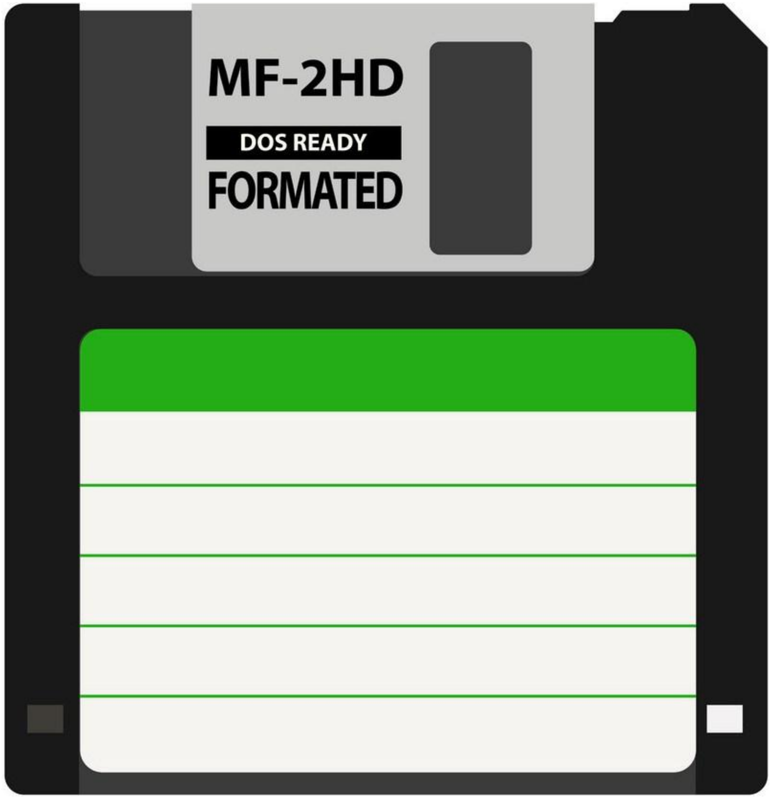
- A floppy disk is manufactured from a flexible plastic disk. This disk is coated with a magnetisable material. For protection the disk is encased in a plastic shell. All sizes of floppy disk have a write protect tab built into the shell. If this tab is set then data can be read from the disk but not written to it.

- The write protect tab can be used as a security measure to prevent important data being deleted or changed accidentally.

- Most disks are now sold already formatted for PC's. Floppy disks are useful for transferring data between computers and for keeping a back-up of small files.

- Some hardware companies now produce storage devices which are very similar to floppy disks but can store 100/250Mb (ZIP) or even 1/2 Gb (JAZ) of data. These devices are also much faster than standard floppy disk drives.

- ZIP AND JAZ drives are similar to floppy drives because the individual disks are removable and portable but they hold much larger amounts of data.



Floppy Disk Types

Capacity	Sides	Tracks	Sectors / Track	Bytes / Sector	Tracks/Inch(TPI)
360 Kb	2	40	9	512	48
1.2 Mb	2	80	15	512	96
720 Kb	2	80	9	512	135
1.44 Mb	2	80	18	512	135

Disk Capacity Calculation

Note: 360 bytes=0.3 Kbytes

Calculation of disk capacity (in Kbytes)= No. of Sides x No. of Tracks x Sectors/track x Kbytes/sector

Example- 720Kb: 2 x 80 x 9 x 0.512=720Kb (values taken from above Table)

Different types of sensors in Floppy Disk Drive

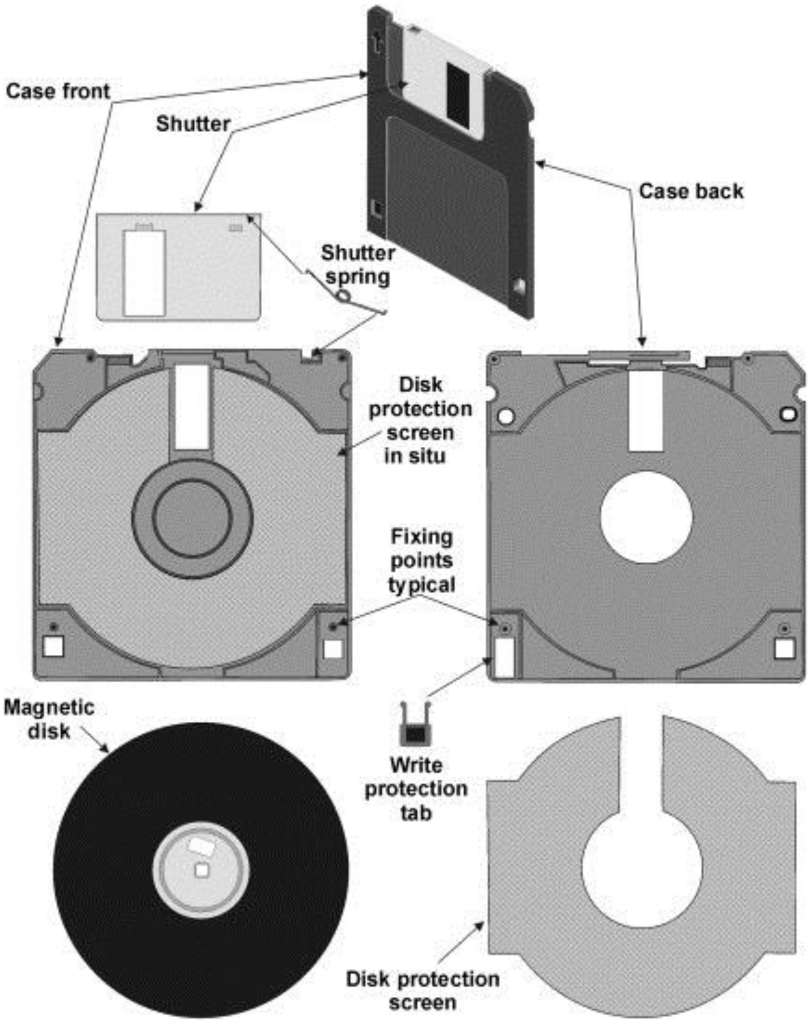
- **Media Sensor.** Media sensor is used to detect whether the floppy is inside the drive or out. For earlier disks size of 5.25 Inches, this sensor is of optical type and the floppy disks with 3.5 inches of size, the same sensor works on magnetic principle.

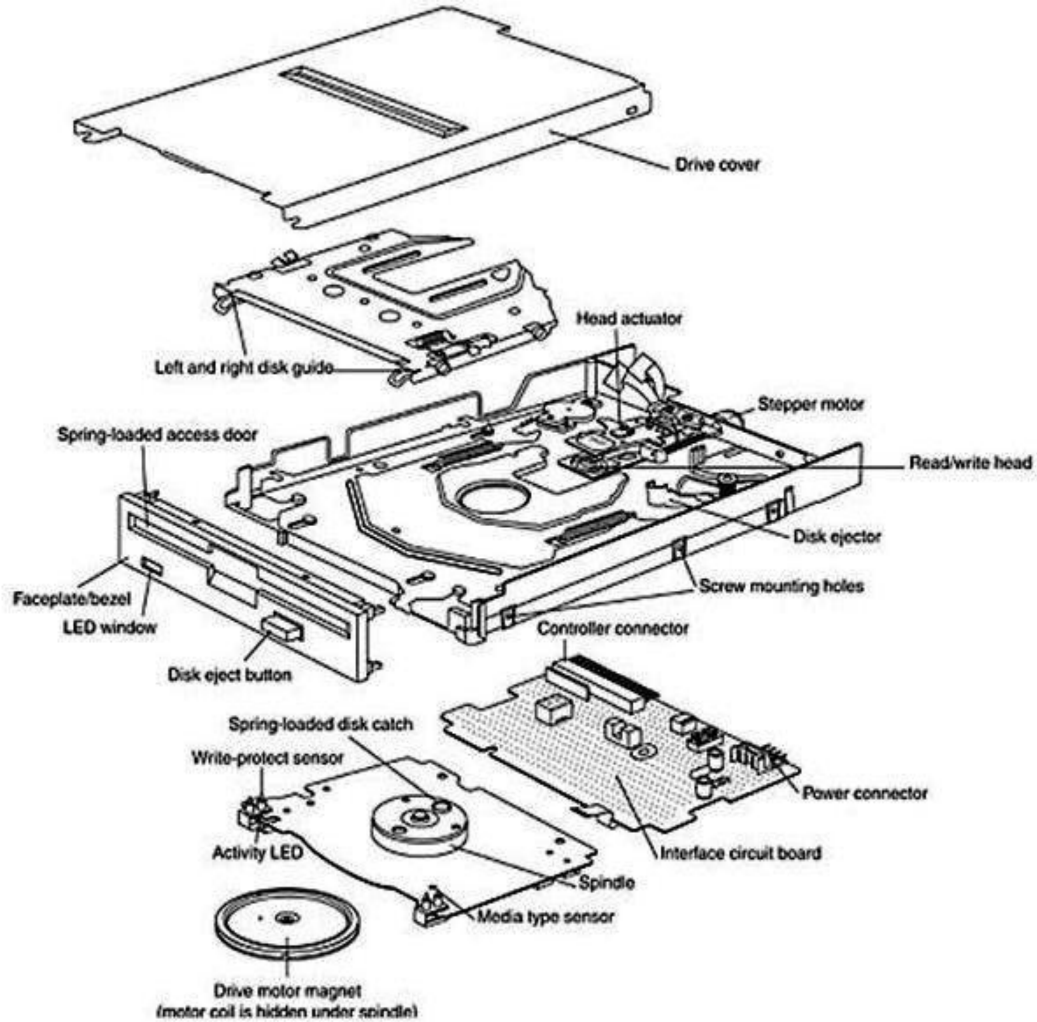
- **Track 0 Sensor.** Whenever the head touches the first track that is track 0, this optical sensor gets activated.

- **Index Hole Sensor.** If the light manages to get passed through this small hole, it means the head has moved to the next track. The Index Hole sensor then the status signal to the electronics controller chip.

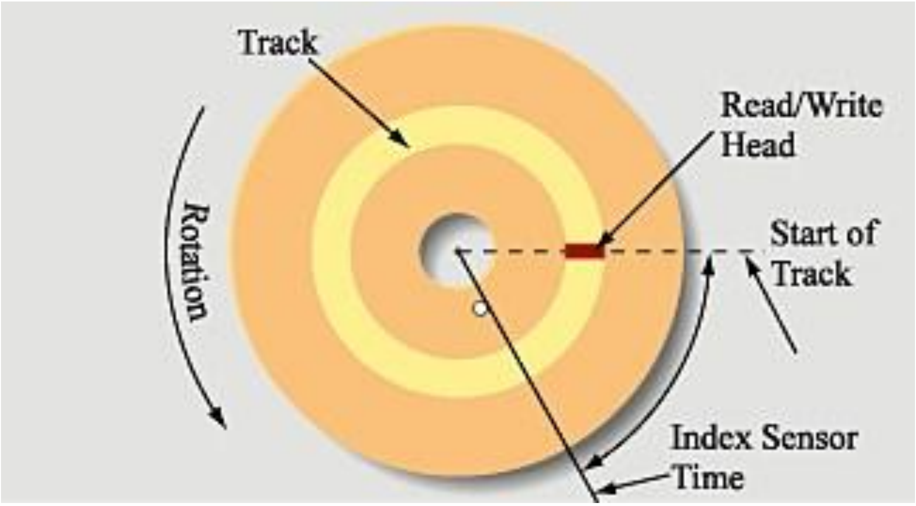
- **Write Protect Sensor.** Write Sensor is used to enable or disable writing the data on floppy. If the sensor is ON, you can write data and prevents writing if this sensor is in Off position.

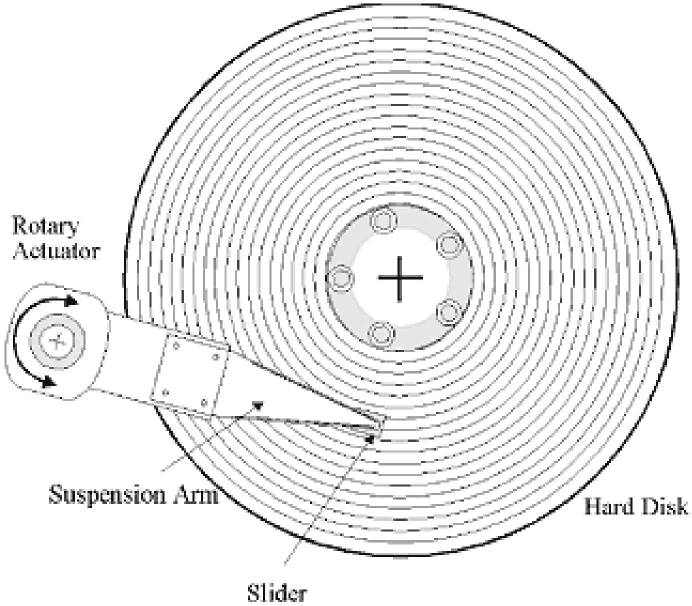
Working Principle





Working Principle





Working Principle

- When the floppy disk drive is first powered up, the rotary actuator and the index sensor both work together to place the read/write heads over track 0 (starting track on a floppy disk). Once the sensor has reached this starting track, the computer is now ready to retrieve or write files onto the floppy disk.

- The read/write heads are precise instruments, and head misalignment is a common problem in many floppy disk drives. The radial positioning of the head is the most common type of misalignment. By radial, it means that the head is displaced along the radius of the disk.

- The head is considered out of specification if it is displaced from the nominal standard more than +/- 600 millionths of an inch. Another type of misalignment which occurs in floppy disks concerns the azimuth of the head, which is the angular alignment on its vertical axis.

- These two alignment factors are critical in reading and writing onto disks, because if either the radial or azimuth are off specification, floppy disks which have received information from this drive may be unreadable on other drives.

- As the drive begins to receive information from the computer, or from the disk when retrieving files, the rotary actuator moves the suspension arm out track by track depending on the number of step signals it receives from the computer system.

- The floppy drive system is blind, and relies on these signals to place it over the correct track on the floppy disk. If one of the above mentioned misalignments occurs, the magnetic head wouldn’t know any better, and therefore would read/write information in the wrong place. The heads are spring loaded using a head flexure to help them stay in physical contact with the spinning disk.

- The motor spindle is probably one of the most important parts in the reading and writing process of a floppy disk drive. It serves as an indicator of the spinning disk's speed, which is expressed in revolutions per minute. The spindle must rotate the disk at 300 RPM to be sure the recorded data will arrive at the floppy controller with the correct frequency.

- If the disk spins too slow, the frequency will be too low, and would be unreadable by the magnetic floppy disk. If the motor were to spin too fast, the frequency would be too high, and when information is being written, the writer would not be able to store all the information necessary on the given track after one revolution.

Optical Disks - CD - DVD

- Optical disks store data by changing the reflective properties of a plastic disk.
- Like floppy disks, optical disks can be moved from one computer to another.
- They have much larger storage capacities than floppy disks but can not store as much data as a hard disk.
- Data can be read from an optical disk more quickly than from a floppy disk but hard disks are much quicker.
- As with a hard disk the drive head in an optical drive can move directly to any file on the disk so optical disks are direct access.

There are five types of optical disks that are currently in use. They are:

CD-ROM (Compact Disk - Read Only Memory)

- This is by far the most widely used type of optical disk. A CD-ROM disk can store up to 650/700Mb of data. The data is written onto the CD-ROM disk before it is sold and can not be changed by the user. Because of this CD-ROMs are often described as Write Once Read Many times (WORM) disks.
- CD-ROMs are used for applications such as distributing software, digital videos or multimedia products. They are also known as optical disks because the data is read by a laser beam reflecting or not reflecting from the disk surface.

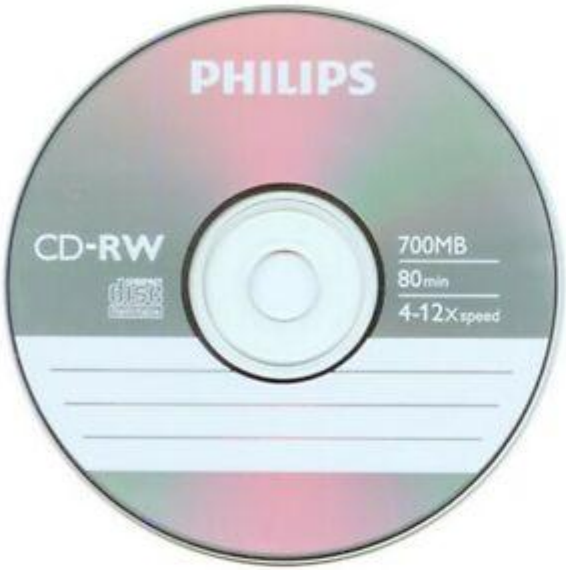
CD's are available in 3 formats:

CD-ROM's - ROM means Read Only Memory and this means you can only read from the disc, not write or store data onto it. This is the way most software programs are now sold.

CD-R (Compact Disc - Recordable): A CD-R disk can store up to 650Mb of data. A CD-R disk is blank when it is supplied. The user can write data to it just once. After data has been written to the disk it can not be changed. A special CD-R drive which contains a higher powered laser than a CD-ROM drive is required to write to the disk. CD-Rs are often used for making permanent backups of data and distributing software when only a small number of copies are required.

These CDs are initially blank but you can use a special read/write CD drive unit to store programs and data onto the disc but they can only be written to once.

CD-RW (Compact Disc - Rewriteable): A CD-RW disk can store up to 650/700Mb of data. CD-RW disks can be read from and written to just like a hard disk. CD-RWs can be used for any application that a hard disk can be used for but the time taken to access data is much longer than that for a hard disk. CD-RW - these are similar to the ‘R’ type above but you can read, write and delete files from the disc many times, just like a hard disk.



DVD-ROM (Digital Versatile Disk - Read Only Memory):

- DVD is the new standard for optical disks. By using a shorter wavelength laser, storing data on both sides of the disk and having more than one layer of data on each side of a disk. DVD disks are able to store much more data than CD disks. The DVD standard includes disk capacities up to 18Gb.

- Current DVD disks store far less than this. Because of their high capacity, DVD-ROM disks are used to store high quality video such as complete movies. Often extra data such as information about the making of the film or the actors and actresses who star in it are also stored on the disk.

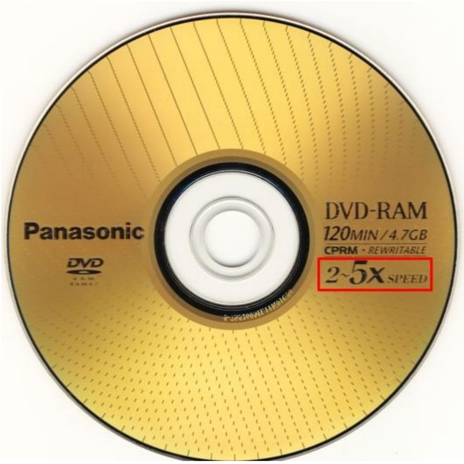
- Unlike movies recorded on video tape, DVD-ROM movies can be interactive. The user can make selections on the screen and change what they see. DVD drives are now replacing CD drives in computers due to the huge memory capacity of the disk and the high quality of stored images.

- A DVD single sided, single layer DVD can store up to 4.7 GB of data, the equivalent of 26 CD-ROMS. This means full-motion films with sound tracks and subtitles in multiple languages can easily be stored on one DVD disk.

- A film stored on a DVD has significant advantages over magnetic VHS video tape because the digital images and sound tracks are of a higher quality and do not deteriorate with constant use. The user can also move to any part of the film immediately (random access). Multi-layer and double sided DVD's can hold up to 17GB of data.

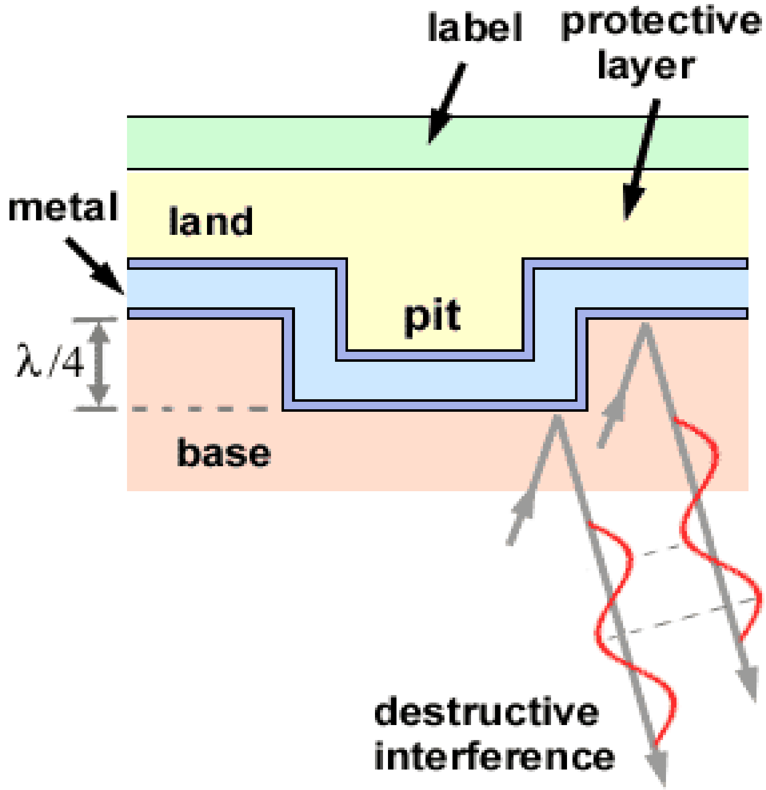
DVD-RW drives (writable drives) are still quite expensive but may eventually replace home CD systems and VHS tapes as a way of recording films and music.

DVD-RAM (Digital Versatile Disk - Random Access Memory): DVD-RAM disks have all of the benefits of DVD-ROM disks and can be written to as well. These very high capacity disks are ideal for producing backups. In the next five years they may replace video tapes for recording television programmes.



Working Principle

- The information to be stored is digitized, that is, the data can be represented by binary numbers, which are made up of '1' and '0' digits. This information is stored on the metal layer. The data is represented using pits (1) and space between pits is called land (0).



- Laser beam is used for storing data on CD-ROM. Data is stored on a single spiral track. Each track is divided into sector. The track has length of 5 km and 650 mb of data can be stored. The tracks have high density with a gap of 1.6 microns.

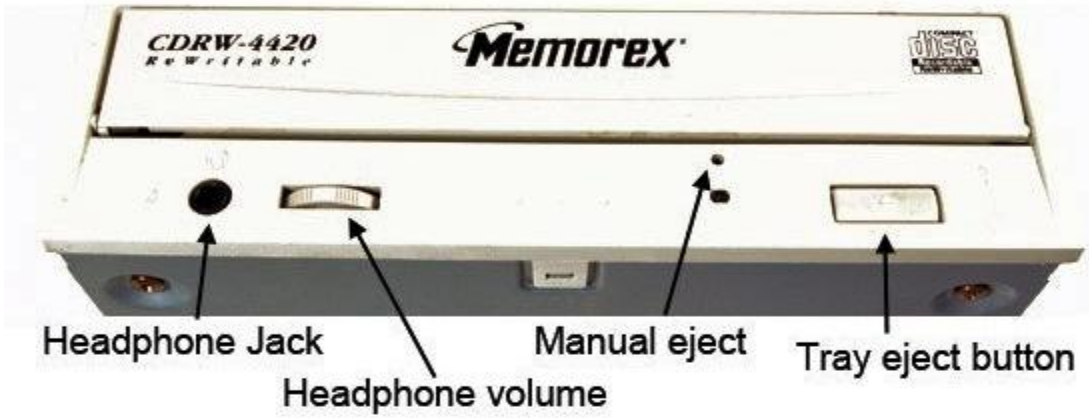
- Laser beam is used to read the data from compact disk. CD is moving on a head at very high rpm. A laser is shone onto the reflective surface of the disc to read the pattern of pits (1) and lands (0).

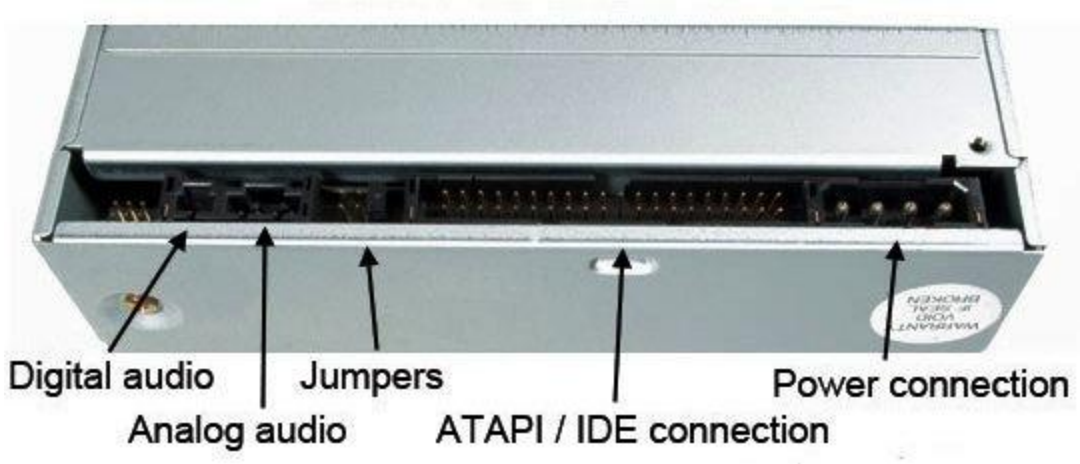
- The depth of the pits is approximately one-quarter to one-sixth of the wavelength of the laser light used to read the disc. The laser rays reflected by the pits and the lands have a path difference of half the wavelength.

- It leads to destructive interference, means, the two rays cancel each other and no reflected ray is resulted, and this produces a '1' digit.

- The path difference is zero for two rays both reflected by the pits, or both by the lands. No destructive interference occurs and we say it is a '0' digit. Therefore we have digit '1' at the edge of pits and digit '0' elsewhere.

Front and Back Panel of Optical Drive

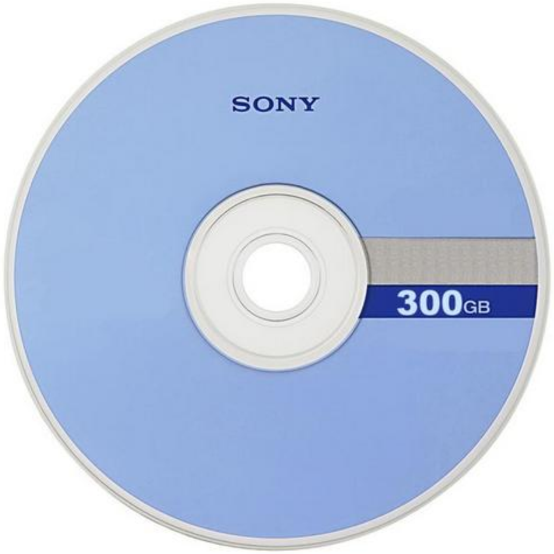




Optical Drives Blue Ray

- A Blue-ray disk (BD) is a high-capacity optical disc for high-definition (HD) movies. Developed primarily by Sony, Blu-ray and DVD discs have the same diameter and look similar, but Blu-ray's blue-violet laser reads pits a third the size of a DVD on tracks packed much tighter together. Blu-ray players support DVDs and CDs.

- A BD comes in ROM (read-only memory), R (recordable) and RE (rewritable) formats. Blu-ray disks can hold up to 300GB.



Optical Drives

Solid State Drive

A Solid-State Drive is a storage device that stores data persistently on solid-state flash storage. It is non-volatile storage device so; data is safely stored even when the power is turned off. Hard drive have moving parts like platters with read/write head. But SSD have no any moving part, that is the reason why SSD stay long than a traditional Hard drive. A SSD is also known as Solid-state disk.

Topic	SSD	HDD
Access time	An SSD has access speeds of 35 to 100 microseconds, which is nearly 100 times faster. This faster access speed means programs can run more quickly, which is very significant, especially for programs that access large amounts of data often like your operating system.	A typical HDD takes about 5,000 to 10,000 microseconds to access data.
Price	The price of a solid-state drive is higher than an HDD, which is why most computers with an SSD only have a few hundred gigabytes of storage. Desktop computers with an SSD may also have one or more HDDs for additional storage.	HDD is considerably cheaper than SSD, especially for drives over 1 TB.
Reliability	The SSD has no moving parts. It uses flash memory to store data, which provides better performance and reliability over an HDD.	The HDD has moving parts and magnetic platters, meaning the more use they get, the faster they wear down and fail.
Capacity	Although there are large SSDs, anything over 1 TB SSD is usually outside of most people's price range.	Several terabyte hard disk drives are available for very reasonable prices.

Topic	SSD	HDD
Power	The SSD uses less power than a standard HDD, which means a lower energy bill over time and for laptops, an increase in battery life.	With all of the parts required to spin the platters, the HDD uses more power than an SSD.
Noise	With no moving parts, SSD generates no noise.	With the spinning platters and moving read/write heads, an HDD can sometimes be one of the loudest components in your computer.
Size	SSD is available in 2.5", 1.8", and 1.0", increasing the available space available in a computer, especially a desktop or server.	HDDs are usually 3.5" and 2.5" in size for desktop and laptops respectively, with no options for anything smaller.
Heat	Because there are no moving parts and due to the nature of flash memory, the SSD generates less heat, helping to increase its lifespan and reliability.	With moving parts comes added heat which can slowly damage electronics over time, so the higher the heat, the greater the potential for wear and damage.
Magnetism	SSD is not affected by magnetism.	Because a hard drive relies on magnetism to write information to the platter, information could be erased from an HDD using strong magnets.

Flash Memories and Memory Sticks

Flash memory

- Flash memory is non-volatile computer memory that can be electrically erased and reprogrammed. It is a technology that is primarily used in memory cards and USB flash drives for general storage and transfer of data between computers and other digital products.

- Flash memory is non-volatile, which means that no power is needed to maintain the information stored in the chip. In addition, flash memory offers fast read access times (although not as fast as volatile DRAM memory used for main memory in PCs) and better kinetic shock resistance than hard disks.

- These characteristics explain the popularity of flash memory in portable devices. Another feature of flash memory is that when packaged in a "memory card," it is enormously durable, being able to withstand intense pressure, extremes of temperature, and even immersion in water.

- A USB flash drive is a flash memory data storage device integrated with a USB (universal serial bus) connector. USB flash drives are typically removable and rewritable, much shorter than a floppy disk (1 to 4 inches or 2.5 to 10 cm), and weigh less than 2 ounces (60 g). Storage capacities typically range from 64 MB to 1TB

- USB flash drives offer potential advantages over other portable storage devices, particularly the floppy disk. They are more compact, faster, hold much more data, have a more durable design, and are more reliable for lack of moving parts. Additionally, it has become increasingly common for computers to ship without floppy disk drives.

- A flash drive consists of a small printed circuit board typically in a plastic or metal casing and more recently in rubber casings to increase their robustness. To access the data stored in a flash drive, the drive must be connected to a USB port through either a host controller built into a computer, a USB hub, or some other device designed to access the data, such as an mp3 player with a USB-in port.

Memory Stick

- Memory Stick is a removable flash memory card format, launched by Sony, and is also used in general to describe the whole family of Memory Sticks Typically, Memory Sticks are used as storage media for a portable device, in a form that can easily be removed for access by a personal computer.

- For example, Sony digital compact cameras use Memory Sticks for storing image files. With a Memory Stick-capable reader (typically a small box that connects via USB or some other serial connection), a user can copy the pictures taken with the Sony digital camera onto his or her computer. Sony uses and has used Memory Sticks in digital cameras, digital music players, PDAs, cellular phones, the PlayStation Portable (PSP), and in other devices, and the Sony VAIO line of personal computers has long included Memory Stick slots.

Memory cards

- Memory cards are used in everything from cameras to mobile phones as well as a host of other electronic equipment and gadgets.

- These memory cards use what is termed Flash technology and store the data even when the power is removed. As such these memory cards have become invaluable for storing everything from photos to Apps and programming data to . . well almost anything.

Typical Memory Card Applications

Memory Card/Device	SD	SDHC	SDXC	MicroSD	Compact Flash
Mobile Phones				✔	
Digital Cameras	✔	✔	✔	✔	
Laptop/Computers	✔	✔	✔		
Tablets				✔	
DSLR Cameras		✔	✔		✔

Types of Memory Cards

SD memory card:

- This is the basic format for the SD card. The standard SD card has dimensions of 32 mm by 24 mm by 2.1 mm, a storage capacity of up to 4 GB. Typical levels of performance are not as high as the other types of SD memory card mentioned below.

SDHC memory card:

- SDHC (Secure Digital High Capacity) was introduced to meet the growing demand for HD video and high resolution image recording now used in many SD-enabled devices. SDHC cards are the same physical size and shape as standard SD but meets the new SD specification of version 2.0. If the SD card is 4GB or above, it is classed as a SDHC card. Currently, SDHC specifications allow for memory cards of a capacity between 4GB and 32GB. If you are buying an SDHC card, check that the device in which it will be used can accept an SDHC.

SDXC memory card :

- SDXC, Secure Digital eXtended Capacity. SDXC cards are essentially a higher capacity version of the SDHC card. SDXC cards start at capacities of 64GB and can grow to a maximum theoretical capacity of 2TB.

MicroSD memory card :

- As the name indicates, the microSD memory cards are much smaller than the basic SD card. Accordingly they find many uses in portable equipment like mobile phones.

microSDHC :

- microSDHC cards, the newer version of microSD, were introduced in 2007. They can contain up to 32 GB of data and have a transfer rate of up to 10 MB per second. microSDHC cards are not backwards compatible with older microSD devices.

microSDXC :

- Like the SDXC card, microSDXC cards have a storage capacity between 32 GB and 2 TB. The card has a faster data transfer speed compared to the microSD and microSDHC. It is only compatible with devices containing a microSDXC-compatible slot.

Compact Flash card:

- This type of memory card is physically larger than an SD card and it has many more connections. They are not as commonly used as SD cards, but have often have large capacities and some can run at very high speeds. They are generally used by professional photographers.

Memory Card Applications

Capacity (GB)	Hours of MP3 music	Photos (12MP JPEG format)	Photos (20MP JPEG format)	Photos (20MP RAW format)	Standard HD Video Recording (9Mbps)	Full HD Video Recording (13 Mbps)
16	270	3800	2660	260	240mins	160mins
32	545	7600	5330	520	480mins	320mins
64	1090	15200	10660	1040	960mins	640mins
128	2145	30400	21320	2080	1920mins	1280mins

Add-on Cards /Daughter boards

Add on Cards /Daughter Boards/Expansion Cards/Interface cards

- In computing, an expansion card is defined as a specific type of circuit board that is inserted into a computer to provide extra features, facilities or memory.

- Expansion cards are inserted into an expansion slot on the computer's motherboard and create an electronic link between the two with edge connectors so data can be communicated across.

- They became popular soon after they were first introduced and remain popular to this day due to the opportunities they offer users to fully customise their computing experience.

- An add-on is either a hardware unit that can be added to a computer to increase its capabilities or a program utility that enhances a primary program.

- Special expansion cards are one way to add new types of ports to an older computer or to expand the number of ports on your computer.

- Like other expansion cards, these cards clip into an open **expansion slot** on the motherboard.

VGA Card

- A **dedicated** video card (or video adapter) is an expansion card installed inside your system unit to translate binary data received from the CPU or GPU into the images you view on your monitor.

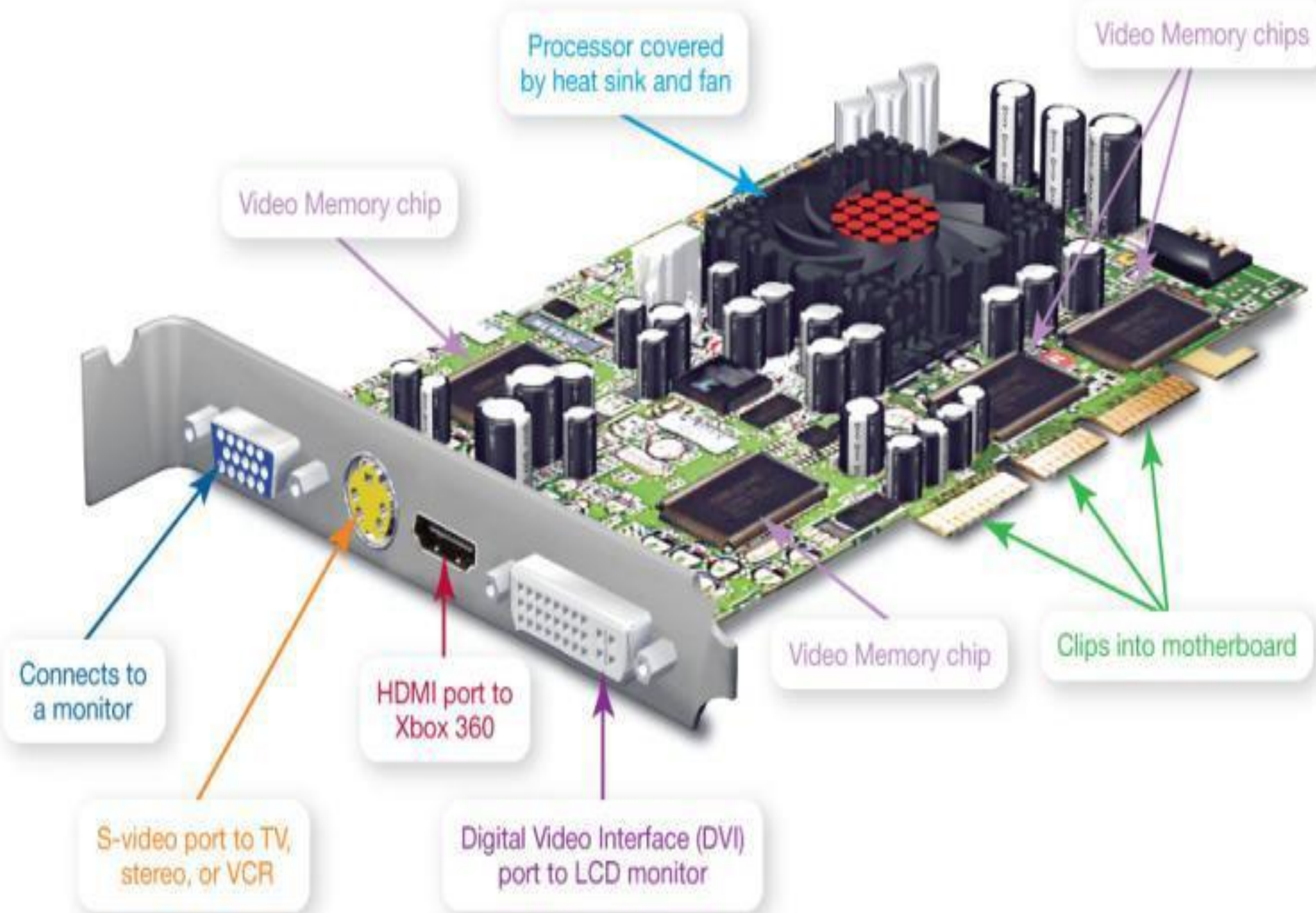
- It is an alternative to the **integrated** graphics chip. Modern video cards include ports allowing you to connect to different video equipment; also they contain their own RAM, called **video memory**.

- Video cards also come with their own **processors** or **GPUs**. Calls to the CPU for graphics processing are redirected to the processor on the video card, significantly speeding up graphics processing.

- Updating to a dedicated graphics card offloads work from the CPU and system RAM, so not only will graphics processing be faster, but the system's overall performance will improve.

- The video card also controls the number of colors your monitor can display. The number of bits the video card uses to represent each pixel on the monitor (referred to as the **bit depth**) determines the color quality of the image displayed. The more bits available, the better the color detail of the image

VGA Card


Processor covered by heat sink and fan
Video Memory chips
Video Memory chip
Connects to a monitor
HDMI port to Xbox 360
Video Memory chip
Clips into motherboard
S-video port to TV, stereo, or VCR
Digital Video Interface (DVI) port to LCD monitor

Sound Cards

- Also known as an audio card, this type of expansion card deals with everything to do with sounds and audio signals within the computer that are under the control of programs on the computer.

- This can include allowing applications on the computer to play music, programs which edit videos or audio, presentation software, games equipment and any other type of program which plays audio.

- The ability to play sound is often integrated into the motherboard of the computer, however this is not necessarily the best way to achieve high-quality sound.

- Sound expansion cards convert digital sound data into analog format, which is then relayed to an external device capable of playing sound such as headphones or a speaker.

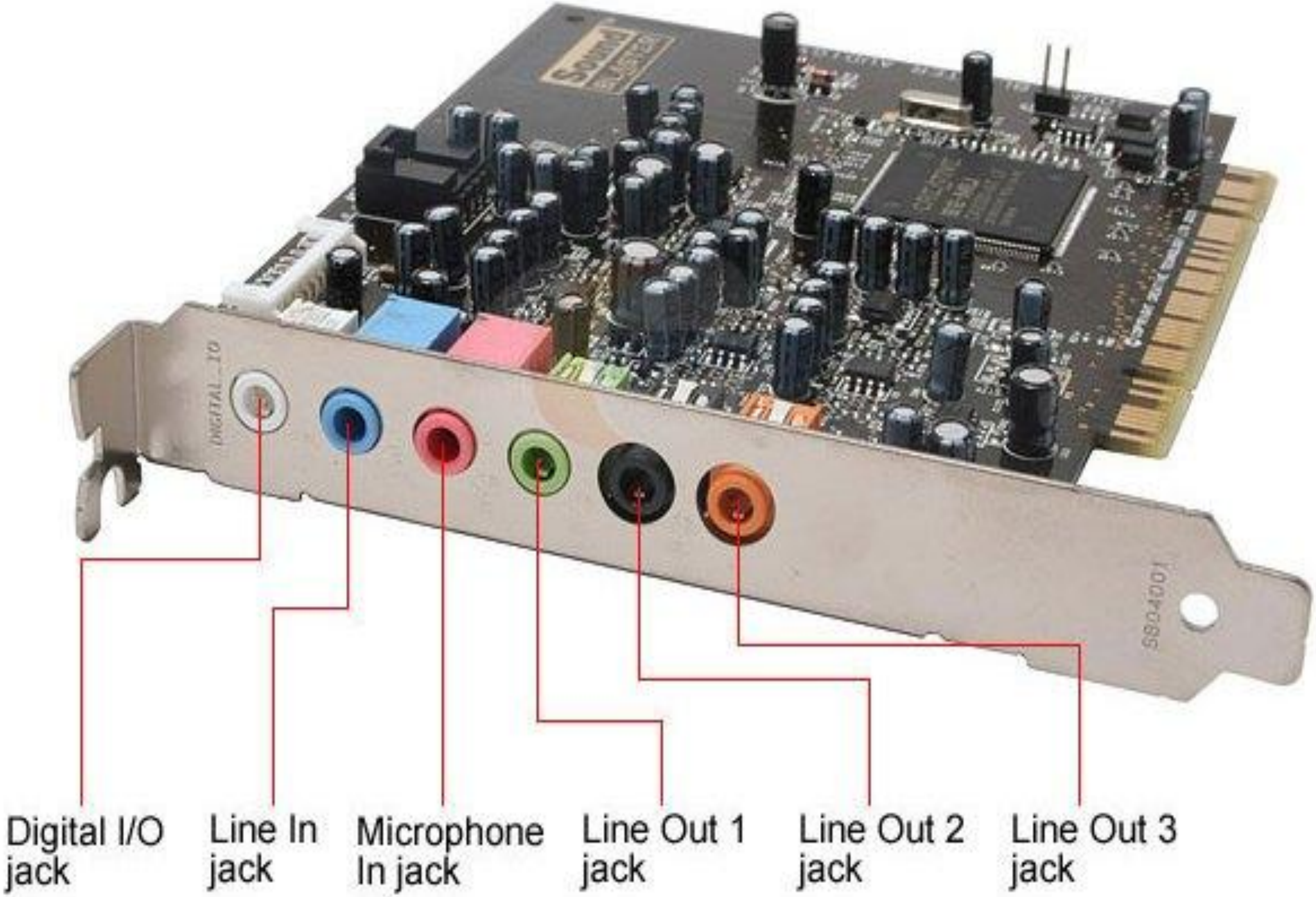
- Sound cards also need to be capable of processing multiple sounds at the same time, splitting them up into audio channels.

- This allows different sound configurations to be produced, such as surround sound and stereo sound.

- Modern sound cards providing advanced sound mixing such as this are sometimes referred to as Hardware Audio Accelerators and can provide features such as positional audio and 3D sound.

- To set up surround sound on your computer, you need two things: a set of surround-sound speakers and a sound card that is Dolby Digital compatible. There are many formats to choose from such as Dolby Digital EX, Dolby Digital Plus, and Dolby TrueHD.

Sound Cards


Digital I/O jack
Line In jack
Microphone In jack
Line Out 1 jack
Line Out 2 jack
Line Out 3 jack

Network Card

- A Network Interface Card (NIC), also called a network card, network adapter, orLAN Adapter is a piece of computer hardware designed to allow computers to communicate over a computer network.

- Used for remote communication via cable.Data is transmitted over a cable network.

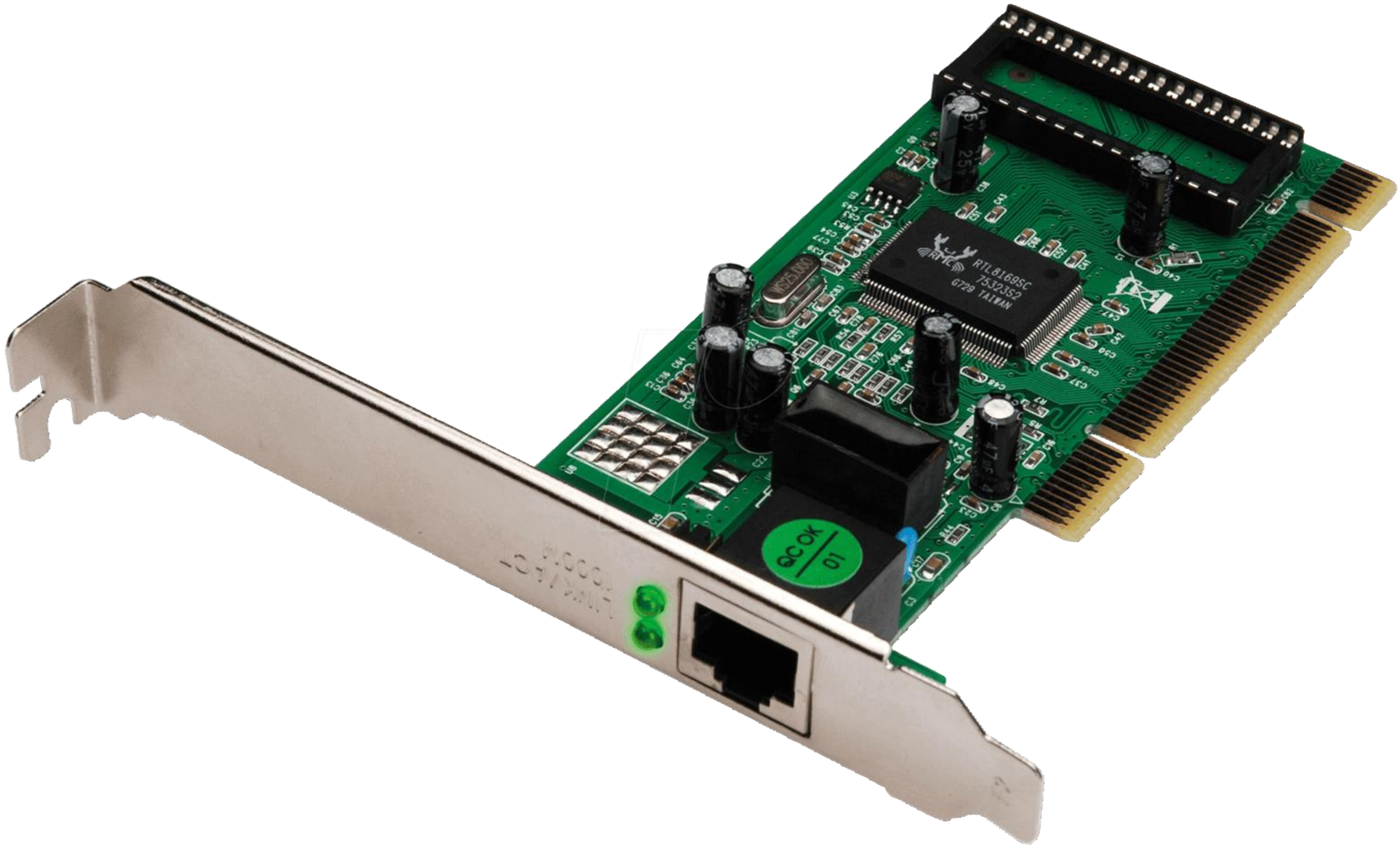
- The NIC connects computers to the Internet and other devices, such as printers.

- Many modern motherboards have NICs built in by default.

- This type of expansion card was most popular in early models of computers, in more modern machines almost all computers have a network interface built directly into the motherboard. But a different network card can be added if required.

- Network cards can offer wired or wireless connection. They can fit into a PCI slot on the motherboard or even connect to a USB socket.

Network Card



Serial and Parallel cards

- Serial and Parallel expansion cards are used to provide additional connection ports to a computer, specifically to provide either parallel or serial port connections.

- A parallel port is only able to transmit data one way to a secondary device, commonly a printer or similar, using a dual data transmission system.

- This type of one-way transmission was also used for older external storage devices. Serial ports are able to process data in a two-way direction, and are often slightly slower than parallel ports due to the more accurate transmission of data they send.

- Both serial ports and parallel ports have been mostly superseded by the faster and more efficient USB port in modern computers.

Serial and Parallel cards

USB Card

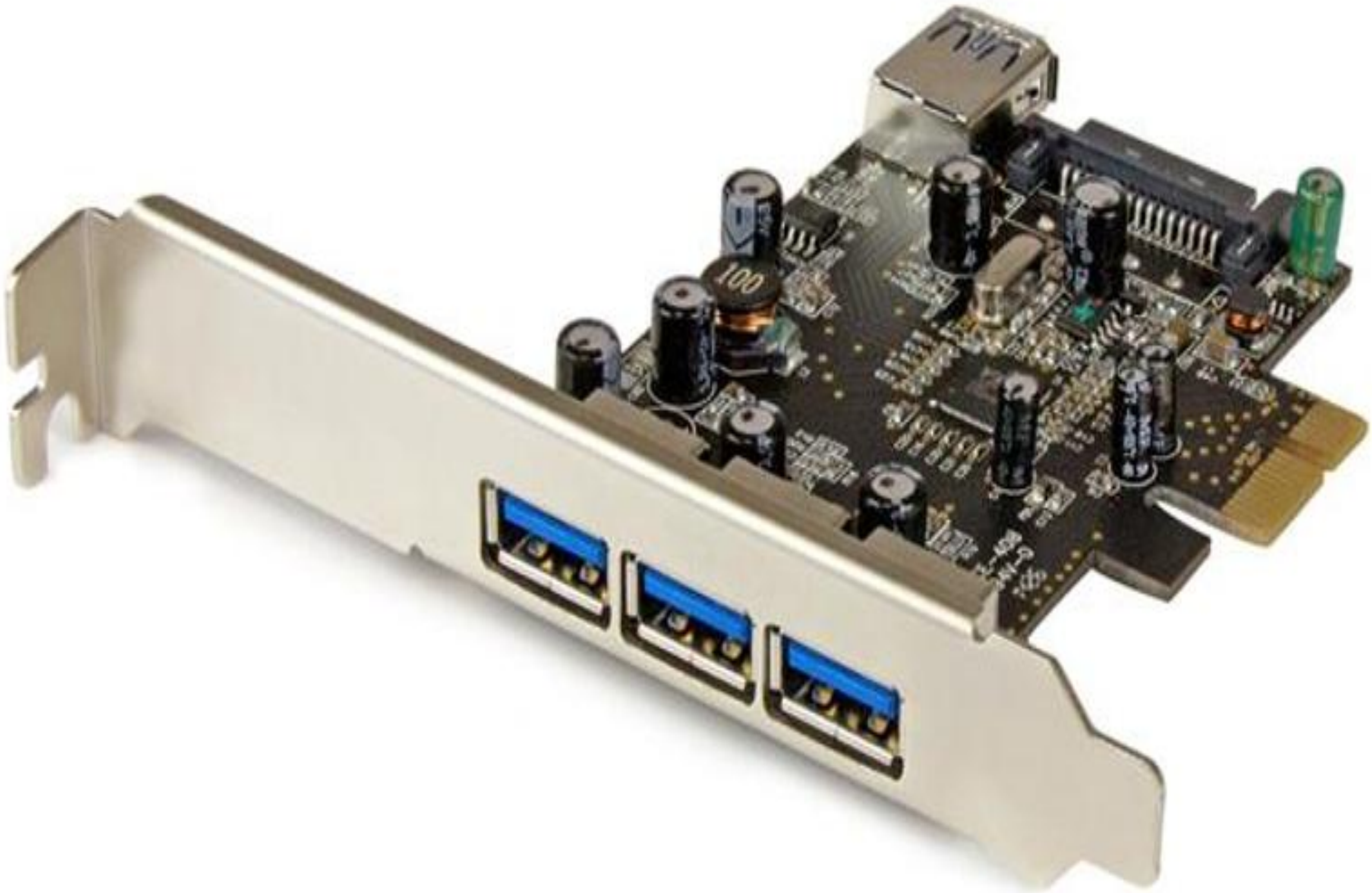
- A USB expansion card is used to provide additional connection ports to a computer by connecting the card to the motherboard.

- USB is short for Universal Serial Bus, and is the most common type of port found in modern computers. Peripherals such as printers, keyboards, printers, removable flash drives and mice can be attached to the computer.

- USB cards are necessary if a computer does not already have this capability, or to add additional ports for more use of external devices at once.

- USB connections are faster at transmitting data and quickly became a general industry standard for cross-platform communication.

USB Card



Fire Wire card (IEEE-1394)

- A firewire card is used to provide computers with an IEEE 1394 interface connection, also known as a firewire.

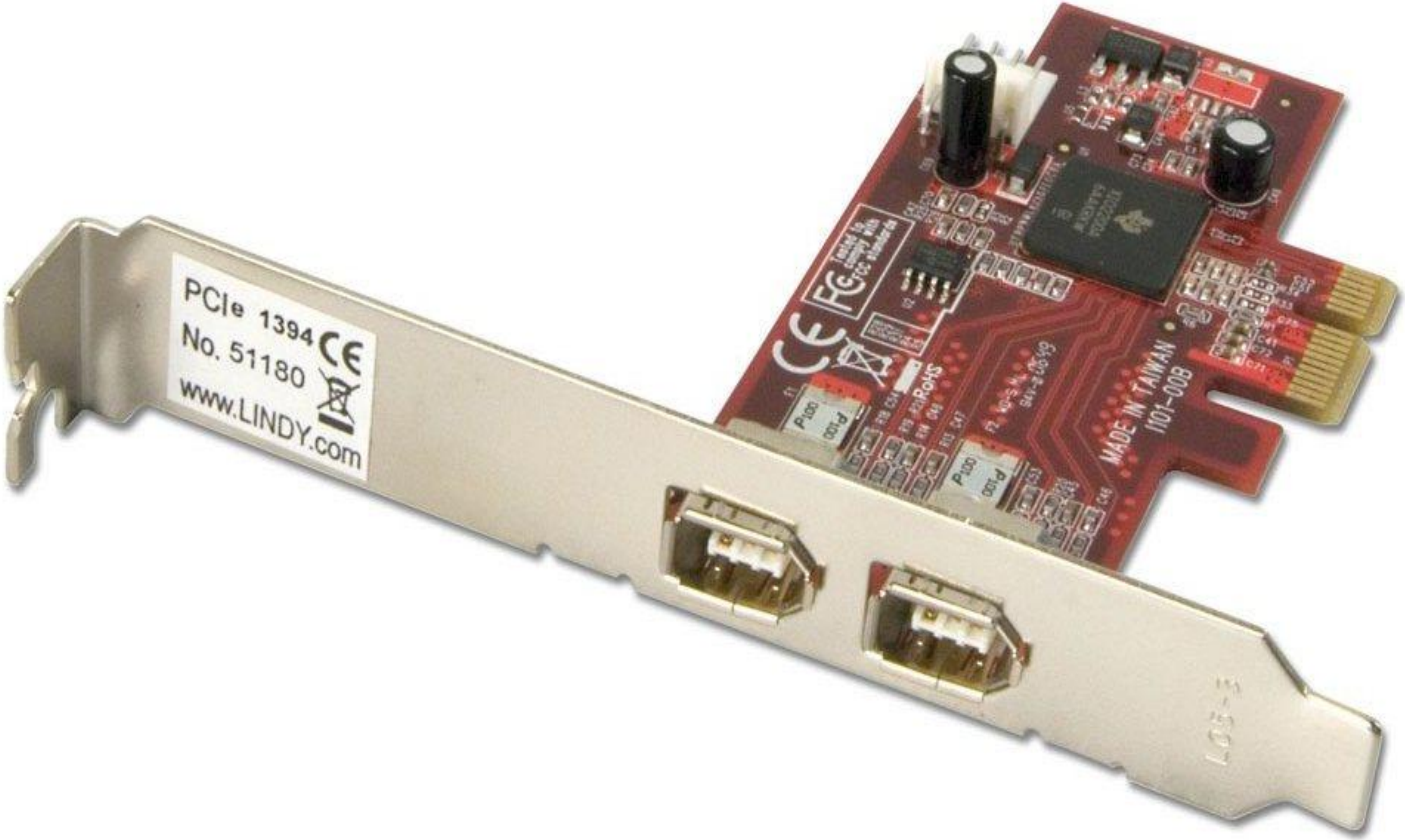
- The term was coined by Apple in the early 1990s, and the ports themselves have been included on most apple computers since the year 2000.

- Recently Apple has begun replacing this port with the Thunderbolt interface on all modern Mac computers.

- The port itself is very similar to a USB connection, although USB is much more popular across a range of cross-platform devices and the two are not interchangeable.

- Fire wire is another popular connector for adding peripherals to your computer. Fire wire is most often used to connect digital camcorders, external hard drives, and other devices that can benefit from the high transfer rates (up to 480 Mbps) supported by the Fire wire connection.

Fire Wire card (IEEE-1394)



Modem Card

- A modem card allows a computer to send an analog carrier signal carrying digital information, and decodes the reverse of this signal in return to reproduce the original digital data.

- The most common way of doing this in the past was by using electrical signals transmitted over telephone lines, although more modern systems such as satellite, WiFi, mobile phones and mobile broadband modems also use this type of communication.

- Wireless modems can be embedded inside of a device or be external to it, and can be locked to only receive certain types of frequency signals, for example only those from one particular network provider.

Modem Card

TV tuner card

- A Television Tuner card is a card which is inserted into a computer to allow a device to receive television signals that would not otherwise be suited to picking them up.

- Cards are usually either PCI, mini PCI or PCIe, or sometimes as an external USB device.

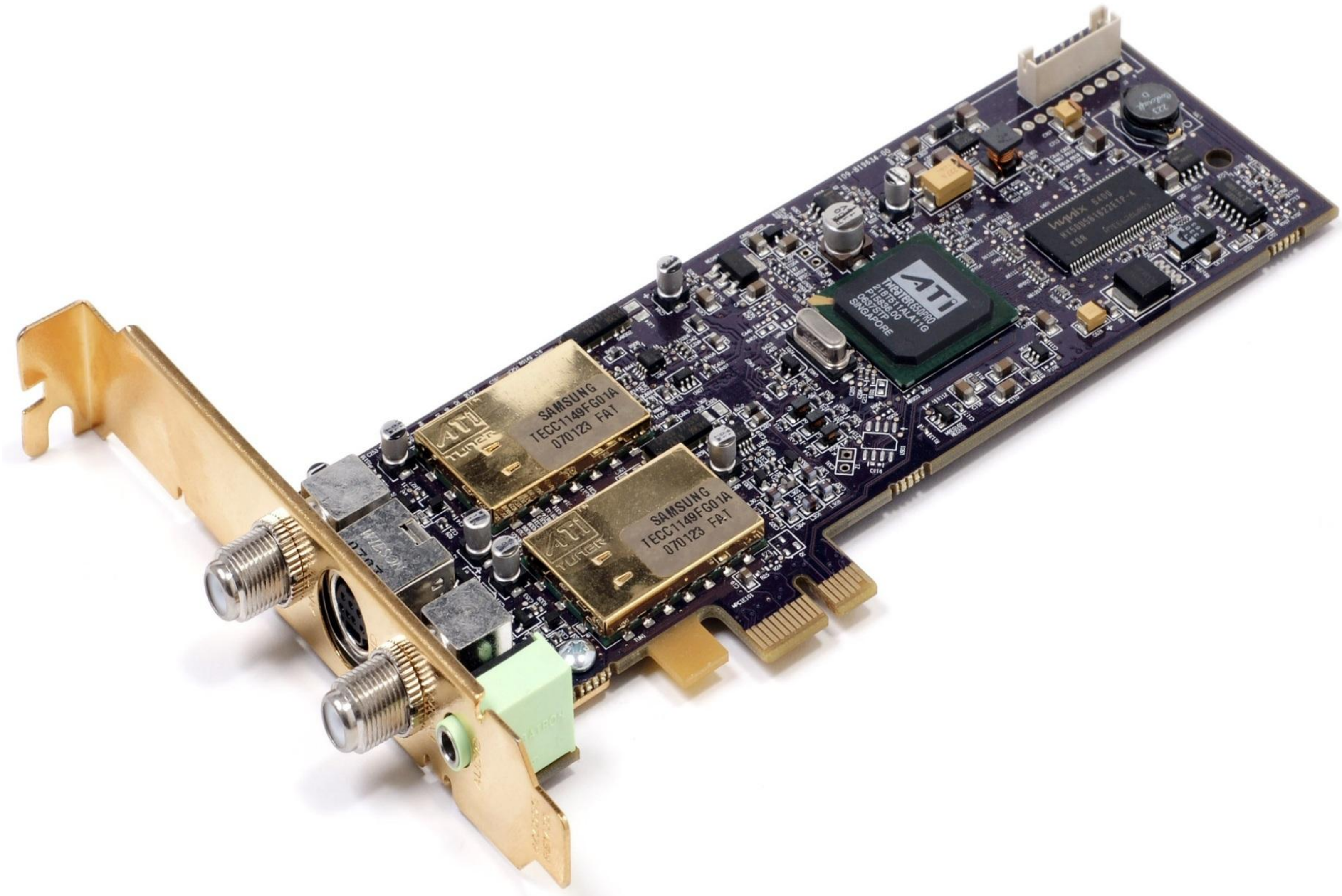
- Most cards have an inbuilt processor to free up space from the system's CPU and ease the pressure on the computer.

- Cards can be either analog or digital depending on which type of television the user wishes to view, and many hybrid tuners exist which are able to switch between the two types.

- High-end tuner cards often include a special chip to encode and decode the data being transmitted, however smaller and cheaper cards are less likely to have this capability due to the high power it takes to run them.

- Many TV tuner cards also include a form of flash memory which allows them to store several different types of decoding software, meaning the tuner card can be used in many different countries and with different video formats without reformatting the system to recognize the new data.

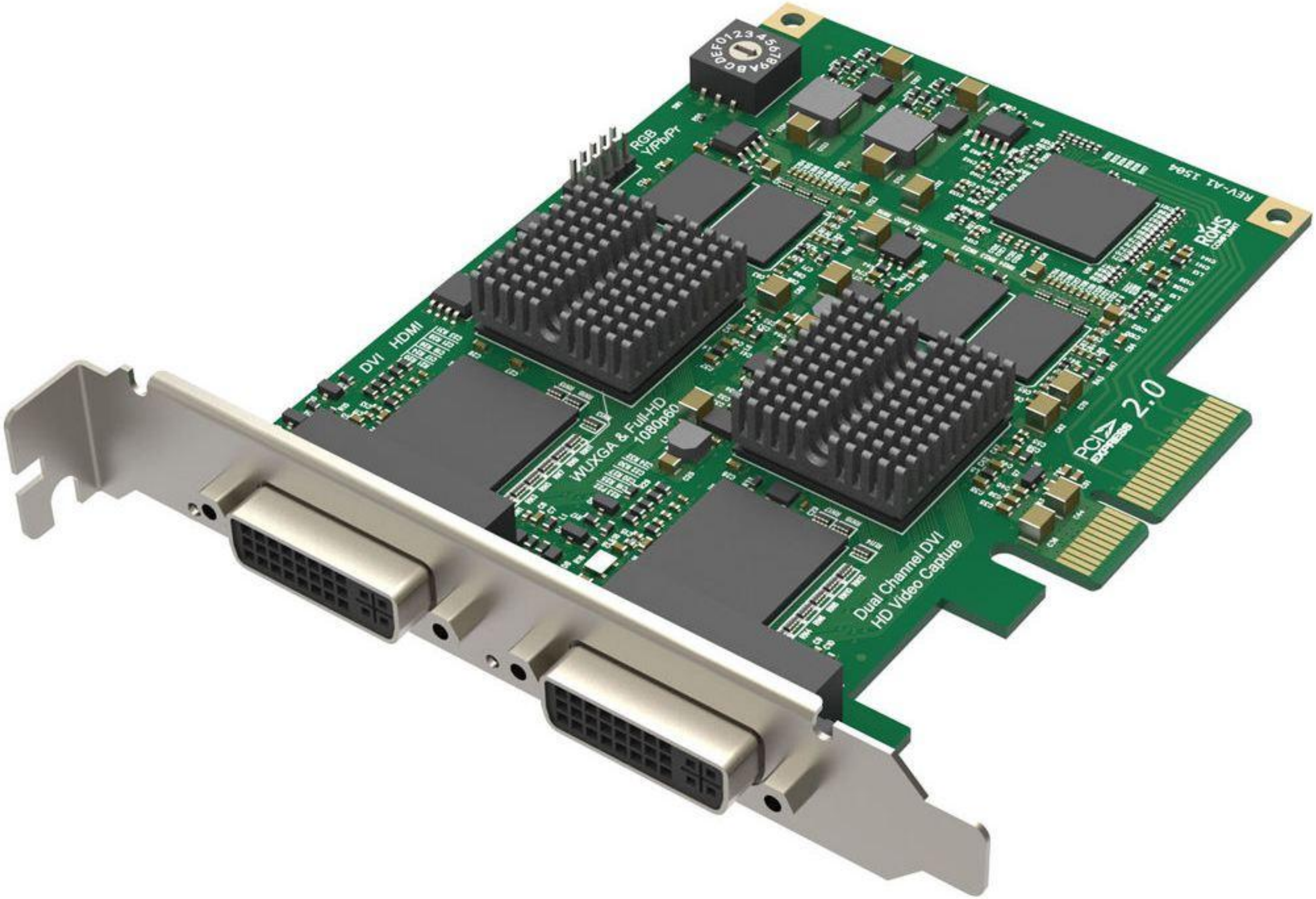
TV tuner card



Video Capture Card

- A video capture card is used to allow a computer to convert an analog video signal into a digital video data form.
- Many TV tuner cards double up as video capture cards, allowing the user to record TV transmissions as they are being broadcast and viewed.
- The inclusion of a dedicated video card is important in a system as the circuitry required to convert analog video to digital video is quite specialised and high-performance.
- Data must be digitised and modified to account for colour differences and encoded to a completely different format, as well as separating the different aspects of composite video if this is captured.

Video Capture Card



SCSI- Card

- Short for **Small Computer System Interface**, **SCSI** is pronounced as *"**Scuzzy**"* and is one of the most commonly used interface for disk drives that was first completed in1982.

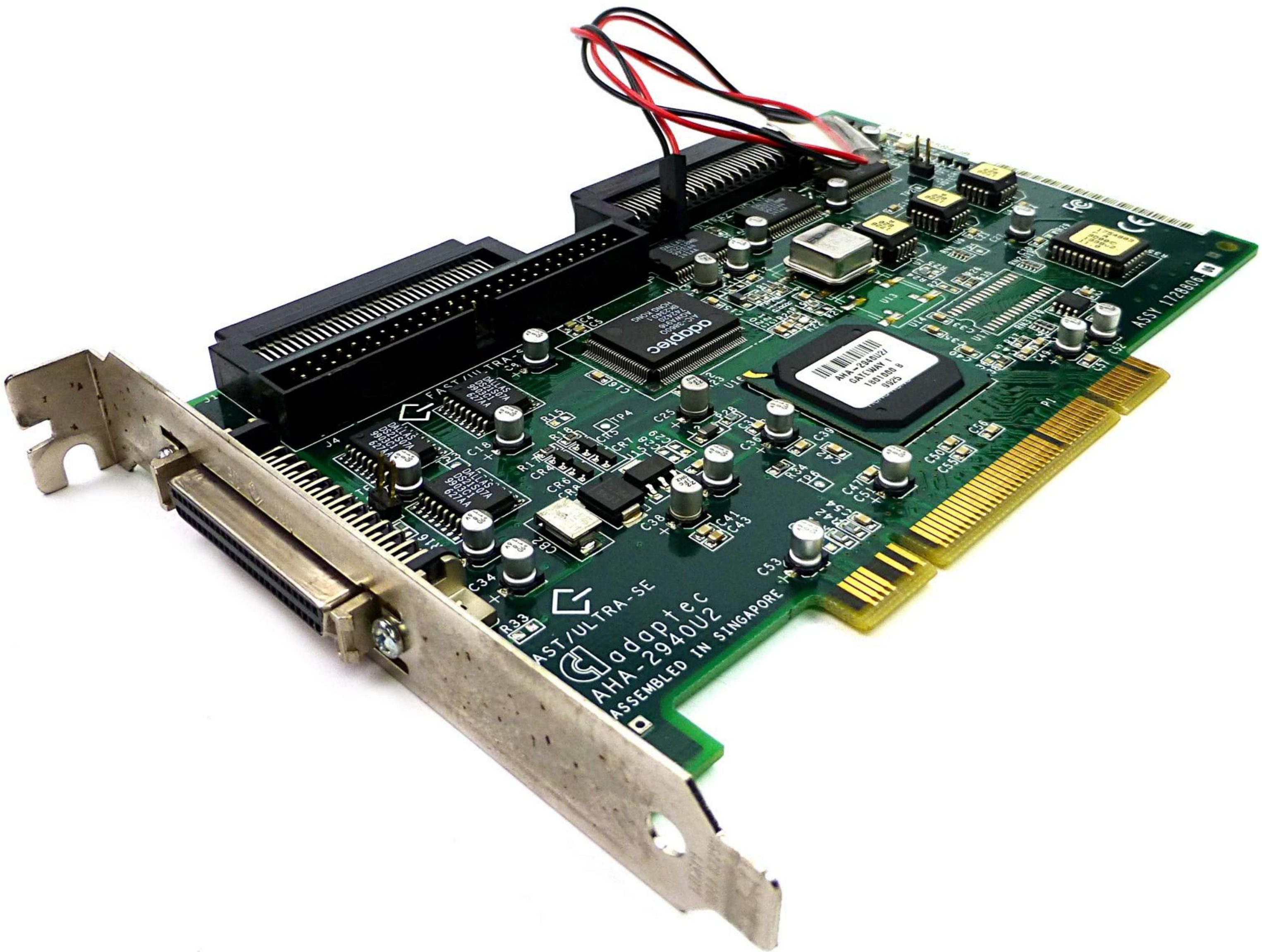
- Unlike competing standards, SCSI is capable of supporting eight devices, or sixteen devices with Wide SCSI. However, with the SCSI host adapter located on ID number 07 and boots from the ID 00.

- This leaves the availability of six device connections. In the picture below, is an example of a SCSI adapter expansion card with an internal and external connection.

- Once installed in the computer, this adapter would allow multiple SCSI devices to be installed in the computer. More advanced motherboard may also have available SCSI connections on the motherboard.

- SCSI is a standard for parallel interfaces that transfers information at a rate of eight bits per second and faster, which is faster than the average parallel interface. SCSI-2 and above supports up to seven peripheral devices, such as a Hard Drive, CD-ROM, and Scanner, that can attach to a single SCSI port on a system's bus.

SCSI- Card



Graphics Processor Unit-GPU

Graphics Processing Unit (GPU)

A Graphics Processing Unit (GPU) is a single-chip processor primarily used to manage and boost the performance of video and graphics.

GPU features include:

- 2-D or 3-D graphics
- Digital output to flat panel display monitors
- Texture mapping
- Application support for high-intensity graphics software such as AutoCAD
- Rendering polygons
- Support for YUV color space
- Hardware overlays
- MPEG decoding

- These features are designed to lessen the work of the CPU and produce faster video and graphics.

- A GPU is not only used in a PC on a video card or motherboard; it is also used in mobile phones, display adapters, workstations and game consoles. This term is also known as a visual processing unit (VPU).

- This GPU model could process 10 million polygons per second and had more than 22 million transistors. The GeForce 256 was a single-chip processor with integrated transform, drawing and BitBLT support, lighting effects, triangle setup/clipping and rendering engines.

- GPUs became more popular as the demand for graphic applications increased. Eventually, they became not just an enhancement but a necessity for optimum performance of a PC. Specialized logic chips now allow fast graphic and video implementations.

- Generally the GPU is connected to the CPU and is completely separate from the motherboard. The random access memory (RAM) is connected through the accelerated graphics port (AGP) or the peripheral component interconnect express (PCI-Express) bus.

- Some GPUs are integrated into the northbridge on the motherboard and use the main memory as a digital storage area, but these GPUs are slower and have poorer performance.

- Most GPUs use their transistors for 3-D computer graphics. However, some have accelerated memory for mapping vertices, such as geographic information system (GIS) applications. Some of the more modern GPU technology supports programmable shaders implementing textures, mathematical vertices and accurate color formats.

- Applications such as computer-aided design (CAD) can process over 200 billion operations per second and deliver up to 17 million polygons per second. Many scientists and engineers use GPUs for more in-depth calculated studies utilizing vector and matrix features.

- GPU computing is the use of a GPU (graphics processing unit) as a co-processor to accelerate CPUs for general-purpose scientific and engineering computing.

- The GPU accelerates applications running on the CPU by offloading some of the compute-intensive and time consuming portions of the code. The rest of the application still runs on the CPU. From a user's perspective, the application runs faster because it's using the massively parallel processing power of the GPU to boost performance. This is known as "heterogeneous" or "hybrid" computing.

- A CPU consists of four to eight CPU cores, while the GPU consists of hundreds of smaller cores. Together, they operate to crunch through the data in the application. This massively parallel architecture is what gives the GPU its high compute performance. There are a number of GPU-accelerated applications that provide an easy way to access high-performance computing (HPC).

- While GPUs excel at rendering graphics, the raw power of a GPU can also be used for other purposes. Many operating systems and software programs now support GPGPU, or general-purpose computation on graphics processing units. Technologies like Open CL and CUDA allow developers to utilize the GPU to assist the CPU in non-graphics computations. This can improve the overall performance of a computer or other electronic device.

Architectural Difference of CPU and GPU

- The CPU and GPU are essential devices of the embedded and electronic systems but both work for different purposes.
- The CPU is a microprocessor used for executing the instructions given by a program according to the operations (such as arithmetic, logic, control and input-output).
- Conversely, the GPU is initially devised to render images in computer games. The CPU emphasis on low-latency while in GPU the importance is given to the high throughputs.

Key Differences Between CPU and GPU

- In CPU's the priority is given to the low-latency whereas the GPU is optimized for throughput where the number of calculation performed in a time interval must be high or as much as possible.
- The CPU provides more effective results when processing of serial instructions is involved. On the other hand, the GPU process parallel instructions in a more effective way.
- A CPU is comprised of less number of powerful cores. In contrast, the GPU is constructed through a large number of weak cores.
- The GPU can achieve a high speed comparative to the CPU because of its immense parallel processing.
- The CPU requires more memory for processing while comparatively, GPU needs less memory.

Comparison of CPU and GPU

Basis for comparison	CPU	GPU
Stands for	Central Processing Unit	Graphics Processing Unit
Focuses on	Low-latency	High throughput
Good at	Processing serial instructions	Processing parallel instructions
Contains	Fewer powerful cores	A lot of weaker cores
Feature	Control logic for out-of-order and speculative executions.	Architecture is tolerant of memory latency.
Speed	Effective	Can be higher than the CPU's.
Memory consumption	High	Low

NVidia RTX2080 Ti

Power Supply Unit-SMPS

Power Supply Unit (PSU) - SMPS

- Short for **switched-mode power supply**, **SMPS** is a power supply that uses a switching regulator to control and stabilize the output voltage by switching the load current on and off. These power supplies offer a greater power conversion and reduce the overall power loss.

- Every PC power supply has connectors that attach to the motherboard, providing power to the motherboard, processor, memory, chipset, integrated components (such as video, LAN, universal serial bus [USB], and FireWire), and any cards plugged into bus slots.

- These connectors are important; not only are these the main conduit through which power flows to your system, but attaching these connectors improperly can have a devastating effect on your PC, including burning up both your power supply and motherboard.

- Just as with the mechanical shape of the power supply, these connectors are usually designed to conform to one of several industry-standard specifications, which dictate the types of connectors used as well as the pinouts of the individual wires and terminals.

- The power supply is not only one of the most important parts in a PC. **The** the power supply is the foundation of the system and am willing to spend a little extra to get a more robust and reliable unit.

- The power supply is critical because it supplies electrical power to every other component in the system.

- The power supply is also one of the most failure-prone components in any computer system.

- A malfunctioning power supply not only can cause other components in the system to malfunction, but it also can damage the other components in your computer by delivering improper or erratic voltages.

- The basic function of the power supply is to convert the electrical power available at the wall socket to that which the computer circuitry can use.

- The power supply in a conventional desktop system is designed to convert either 120 V (nominal) 60 Hz AC (alternating current) or 240 V (nominal) 50 Hz AC power into +3.3 V, +5 V, and +12 V DC (direct current) power.

- Some power supplies require you to switch between the two input ranges, whereas others auto-switch.

- **Constant voltage** means the power supply puts out the same voltage to the computer's internal components, no matter the voltage of AC current running it or the capacity (wattage) of the power supply.

- **Switching** refers to the design and power regulation technique that most suppliers use. Compared to other types of power supplies, this design provides an efficient and inexpensive power source and generates a minimum amount of heat. It also maintains a small size and low price.

- All electronic systems and equipment regardless of their size or function have one thing in common: they all need a power supply unit (PSU) that converts input voltage into a voltage or voltages suitable for their circuits.

- The most common type of today's PSU is the switch mode power supply (**SMPS**). There is a wide variety of SMPS topologies and their practical implementations used by PSU manufacturers.

- However they all use the same basic concepts. This page explains the principals of operation of a switching mode power supply and reviews its main parts and functions.

- The computer's *power supply unit* (PSU) converts the domestic *alternating current* (ac) mains supply voltage (220-240 volts in Europe) into various regulated, low voltage *direct current* (dc) outputs required by the components that make up the computer system.

- The PSU usually takes the form of a metal box 150mm wide x 86mm high x (typically) 140mm deep.

- It is mounted inside the system case using four screws in a standard location such that the on/off switch and power cord socket mounted on the back of the PSU are accessible via an aperture in the rear of the case.

- The same aperture also allows air to flow into the PSU's cooling fan.

- In some cases, there may be a voltage selector switch to allow the user to select a voltage according to their geographical location .

- Inside the case, a bundle of cables emerges from the front of the PSU. The cables are often grouped and colour-coded according to the type of device they will be connected to.

- ATX PSUs are designed to work specifically with the ATX family of motherboards and fit into an ATX system case, and can be turned on or off (or placed into standby mode) using signals generated by the motherboard.

- The maximum rated power output of a PSU can range from around 250 watts up to as high as 2 kilowatts, depending on the type of system they are intended for.

- Small form factor computer systems tend to have low power supply requirements in the order of 300 watts or less.
- Systems used for gaming have much higher power requirements (typically 450 to 800 watts), mainly because they employ high-end graphics adapters which consume large amounts of power.
- The highest power consumption is found in commercial network servers or high-performance personal computers featuring multiple processors, a number of disk drives, and multiple graphics cards.
- The amount of power required by a particular computer system will depend on the power requirements of the motherboard, processor and RAM, and on the number of add-on cards and peripheral devices drawing power from the PSU. In reality, few personal computers currently need more than about 350 watts.
- Even so, care should be taken when selecting a power supply unit, since the rated maximum power output claimed by some manufacturers does not always reflect the actual power output that can be achieved under various load conditions.

- As a result, manufacturers and vendors of PC systems and system components (especially high-end graphics cards) have a tendency to over-specify the minimum power requirements when it comes to recommending a power supply rating for PSUs to be used with their products.

- Whilst it is true that an inadequate power supply can fail if it becomes overloaded, it is not a good idea to use a high-output power supply regardless of the actual power requirements.

- On the contrary, you should select a PSU with a power output that reflects the power requirements of the system. Energy efficiency is at its highest when the load on the power supply is between 50% and 75% of the maximum output. This means that the PSU dissipates less power as heat.

- If the PSU fan speed is being regulated by the motherboard, as is often the case, the system will run more quietly because less airflow is required to cool the PSU.

- At low loads (less than 20% of capacity), energy efficiency drops significantly and more power will be dissipated as heat than would be the case in a more appropriately rated PSU.

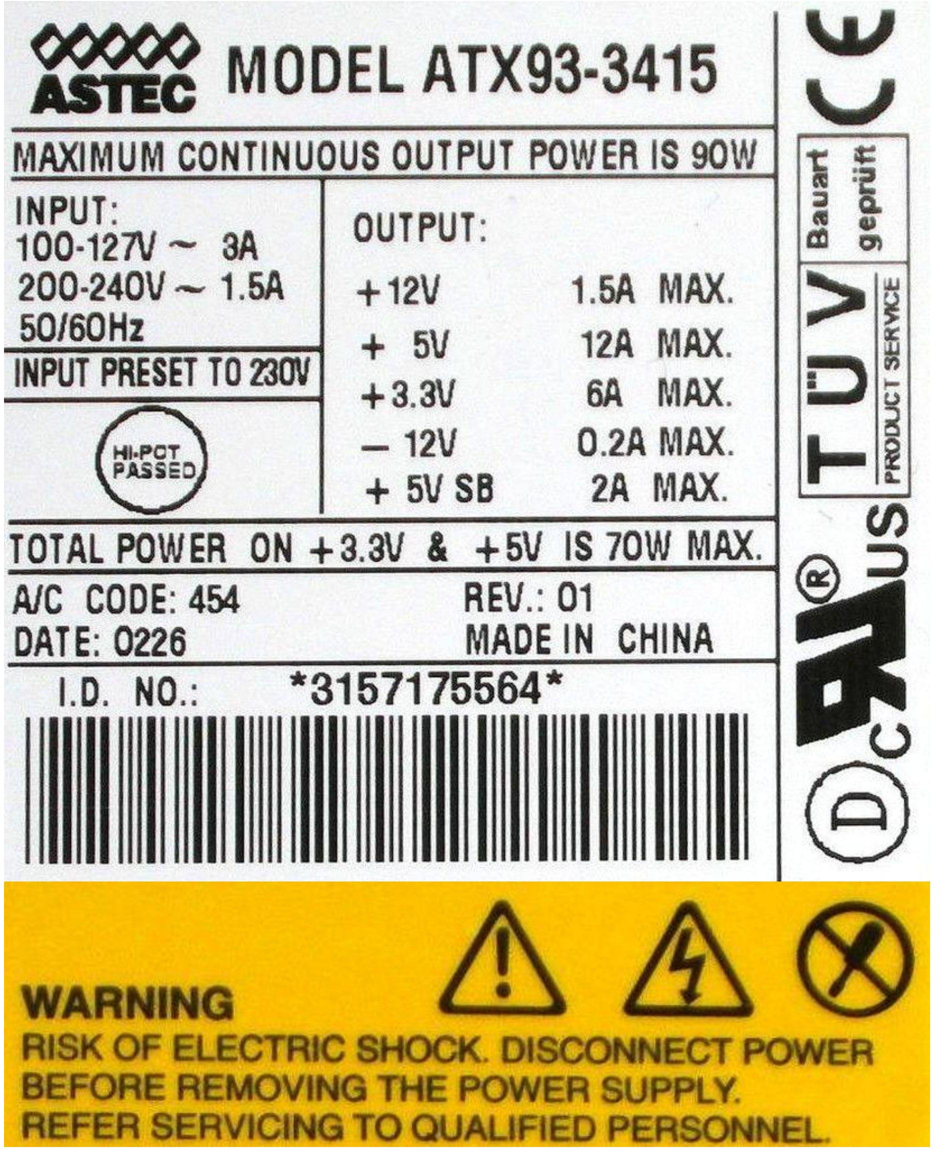
- Even worse, if the load drops below 15% of capacity the PSU may not function properly, and there is a good chance that it will shut down altogether.

- The information supplied on the label or plate attached to the power supply provides technical information about the power supply which will include the ac mains supply voltages, currents and frequencies that the unit can be used with, the maximum total power output in watts, and the various dc voltage and current outputs available.

- It will also display hazard warnings and the required safety certification information (in Europe, this is the CE mark).


AC 230V

A typical PSU label



Type	Description	Illustration
P1	A 20-pin or 24-pin connector that provides power to the motherboard. On some PSUs, the P1 is split into one 20-pin connector and one 4-pin connector which can be combined if required (see illustration) to form a 24-pin connector.	
ATX12V (or P4)	A 4-pin power connector that goes to the motherboard in addition to a 20-pin P1 to supply power to the processor.	
Molex	A 4-pin peripheral power connector that supplies power to IDE disk drives and CD- ROM/DVD drives.	
Berg (or Mini-Molex)	A 4-pin power connector that supplies power to the floppy disk drive (it can also be used as an auxiliary connector for AGP video cards).	
Serial ATA	This is a 15-pin power connector mainly used for SATA hard drives.	
PCI Express	A 6-pin or (more recently) 8-pin power connector used for PCI Express graphics cards. Some 8-pin connections allow for either a 6-pin or an 8-pin card to be connected by using two separate connectors on the same cable (one with 6 pins and another with 2 pins).	

Standard Output Voltages

- The positive output voltages produced by a power supply unit are +3.3V, +5V and +12V. Negative voltages of -5V and -12V are also provided, together with a +5V *standby voltage*. Different voltages (sometimes referred to as *rails*) are used to power different components, and a summary of which voltages and (and currents) are used for what purpose is given below.

- For those unfamiliar with the concept of negative voltages in dc circuits, this simply means that the potential difference is measured from ground to the signal rather than the other way round (ground is commonly used as a reference point for measuring voltage). The current requirements of the various system components are significant, because power is the product of voltage and current. The total power requirements of the system thus depend on the voltage and current requirements of its individual components.

Voltage	Purpose
-12V	Used on some older types of serial port amplifier circuits. Generally unused on newer systems. Current is usually limited to 1A.
-5V	Used on some early personal computers for floppy disk controllers and some ISA add-on cards. Generally unused on newer systems. Current is usually limited to 1A.
0V	The zero volt ground (also called common or earth) and reference point for other system voltages.
+3.3V	Used to supply power for the processor, some types of memory, some AGP video cards, and other digital circuits (most of these components required a +5V supply in older systems).
+5V	Still used to supply the motherboard and some of the components on the motherboard. Note that there is also a 5V standby voltage present when the system is powered down which can be grounded (e.g. by the user pressing the power switch on the front of the case) to restore power to the system.
+12V	Primarily used for devices such as disk drives and cooling fans which have motors of one sort or another. These devices have their own power connectors that come directly from the power supply unit.

How the power supply unit works

- The type of power supply unit found in a modern PC is referred to as a *switched mode power supply unit* (SMPSU). What this means in essence us that the ac mains voltage coming into the PSU is rectified to produce a dc voltage without using a mains transformer (these are usually rather heavy due to the need for a coil with a ferrite core).

- The voltage thus obtained is then switched on and off at very high speeds using electronic switching circuitry, effectively producing a high-frequency square wave voltage (effectively, a series of dc pulses). A light and relatively inexpensive high-frequency transformer can then be used to produce the required dc output.

- The dc output voltage and current are *regulated* (kept constant) using a feedback controller that increases or decreases power output in accordance with variations in load current. It does this by increasing or decreasing the *duty cycle* (essentially, this means increasing or decreasing the number of voltage pulses produced by the switching circuitry in a given time frame).

- Note that most PSUs can shut themselves down if load current exceeds a certain threshold, reducing the possibility of damage to the computer system (or its user) in the event of an electrical fault such as a short circuit. The same principle applies to the absence of a load current (or a very low load current), since the PSU cannot operate correctly below a certain power output level and will shut down if insufficient load current is detected.

- When first turned on, it can take half a second or so for the power supply to stabilise and start generating the correct dc voltages required by the computer. The power supply therefore sends a signal to the motherboard called the *Power Good* signal, once it has carried out its internal tests and is satisfied that the power outputs are all as they should be. The motherboard must wait for this signal before powering up the system.

- A power surge or momentary power failure will sometimes cause a short interruption in the Power Good signal, which will cause the system to reboot when it is resumed. Note also that for practical reasons the different voltages produced by a power supply unit are actually produced by several different switched-mode supplies that are linked together within the PSU, each of which varies its output according to component power requirements.

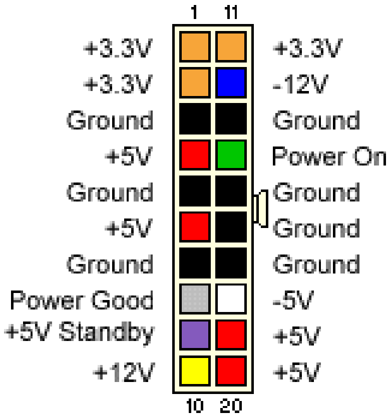
- One recent trend in PSU design has been the concept of a *modular power supply*, in which cables can be attached to the PSU via connectors *at the power supply end*, allowing the user to install only the cables they actually need.

- The idea is that the omission of cables that are not required will reduce clutter inside the case and improve airflow. It also provides more choice in the type of power cable the user can install (e.g. Serial ATA or Molex for hard drives).

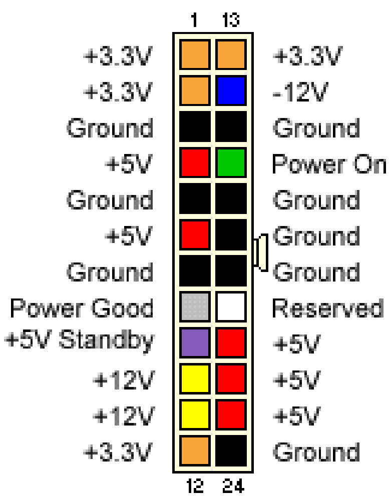
- Critics of this development have pointed out that electrical resistance will be increased due to the greater number of electrical connections. Proponents point out that the increase in resistance is very small.

- In practical terms however, problems are only likely to occur if the connectors are old and worn (in which case the connection may be a loose one) or the connection has not been made correctly during installation. The obvious answer is to replace old cables and check all connections prior to first use.

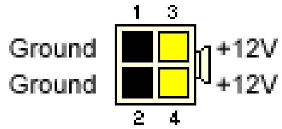
Connectors and Pin Outputs



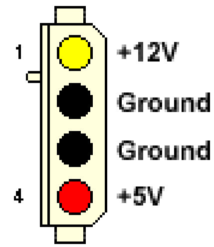
ATX 20-pin
power connector



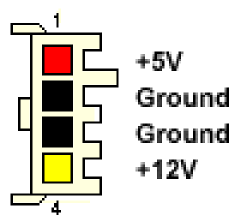
ATX 24-pin
power connector



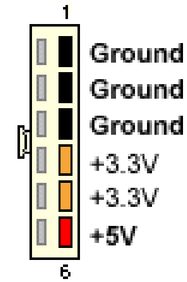
ATX 4-pin 12V
power connector



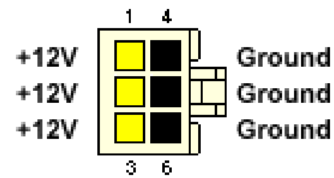
Molex 4-pin
peripheral connector



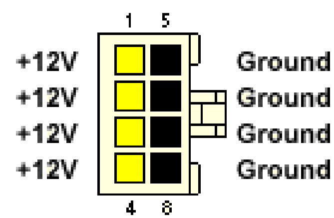
Berg 4-pin
peripheral connector



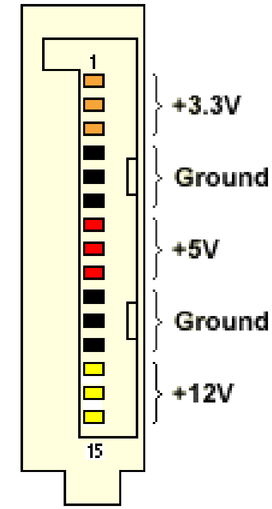
6-pin
auxilliary connector



6-pin PCI Express
power connector



8-pin PCI Express
power connector



Serial ATA
power connector

- Power supply failure will invariably require the replacement of the PSU, since the computer will obviously not function without it. Such failures often result from overheating due to the breakdown of the cooling fan. The system subsequently powers itself off and cannot be rebooted or, as sometimes happens, repeatedly reboots itself at apparently random intervals.

- In critical computer systems such as network servers, it is not uncommon to find redundant power supplies acting as a backup for the main power supply. The backup unit takes over in the event of a failure in the primary power supply, which can then be replaced during a scheduled maintenance period.

- At the other end of the scale, portable computers such as laptops and netbooks require far less power (200 watts or less) enabling them to be powered by a removable rechargeable battery which can easily be replaced if necessary. An external power supply is used to charge the battery, and can supply power to the system while it is connected. This external power supply unit typically supplies 19.5V direct current.

- The facility to power the computer's power supply on or off by grounding the +5V standby voltage means that the system can be powered on or off by a signal generated by the motherboard in response to a *software interrupt* (or *system call* - a signal generated by the operating system) or a *hardware interrupt* (a signal generated by a hardware component on the system).

- The ability to control power using a system call means that the user can power down the system by clicking on an icon or menu item rather than having to physically switch off the system using the power switch. It also means that power management software can be configured to power down the computer in the absence of user input for a given period of time. The system can be set to power on again in the event of some predetermined occurrence, such as the user pressing a key on the keyboard or the activation of a network connection.

Computer Case/Cabinet

Desktop Computer Case Sizes

Most computer cases come in four distinct sizes: small form factor (SFF), mini tower, mid tower and full tower. The image below shows the distinct difference between PC case sizes:

Computer Case Size Comparison

	SFF	Mini Tower	Mid Tower	Full Tower
Motherboards	Mini-ITX	Mini-ITX MicroATX	Mini-ITX MicroATX ATX	Mini-ITX MicroATX ATX EATX
5.25" Drive Bays	1	1 to 2	2 to 5	3 to 6
3.5" Drive Bays	1 to 3	4 to 6	6 to 8	6 to 13
2.5" Drive Bays	0 to 4	0 to 4	0 to 10	0 to 11
Expansion Slots	2	4	7 to 8	7 to 10
Graphics Cards	1	1 to 2	2 to 3	3 to 4
Case Fans	1 to 3	2 to 4	3 to 9	5 to 10

Small Form Factor (Mini-ITX Case)

- Home Theater PC - A small form factor case is perfect for housing a HTPC. Their small size makes them a great fit for most TV shelves and closets, plus they won't look out of place next to other home theater equipment. And since HTPCs don't demand much computing power, you'll be able to squeeze the required hardware into a nice little case.

- Space-Saving - A Mini-ITX case also makes a lot of sense for basic users with limited space. Whether you're working in a small office or living in a cramped apartment, a SFF case will save you a lot of space... while being much easier and cheaper than laptop to repair and upgrade.

- Semi-Portable - While a shoebox case isn't going to fit into a traveling pouch, it is still light enough to be carried around. A typical small form factor PC weighs around 4 to 7 kg (when fully loaded), making it an appealing choice for people who need to move often and gamers who attend LAN parties.

Mini Tower (MicroATX Case)

- Budget PC - All things equal, mini towers tend to be the cheapest among the different computer case sizes (simpler design and less materials needed). Mini towers also support MicroATX motherboards, which happen to be the most common form factor for budget boards.

- And the savings do not stop there - Despite their size, most mini towers are still able to accept (cheaper) standard sized components. On the other hand, SFF cases sometimes require smaller and more expensive parts such as SFX power supplies and low profile graphics cards.

- Flexible Placement - Not too big, not too small... A mini tower's Godilocks size allows it to be stashed almost anywhere - It works just as well sitting on your desktop or floor. Compare this to a shoebox case which is too short for the floor... or a full tower that is massive enough to devour most table tops.

Mid Tower (ATX Case)

- Gaming - Most mid to high end graphics cards take up two expansion slots each and can stretch up to ~31 cm (12.1 inches) long. Most mid towers are able to support two such cards, packing enough gaming muscle for at least 95% of gamers out there. Some gaming mid towers can even take up to three cards, though we do recommend a full tower for a triple GPU setup.

- And it's not about just squeezing big graphics cards into a case. Graphic cards are the hottest components in a PC, hitting temperatures of up to 90°C under load. Toss in a 60 to 70°C CPU, and we end up with something capable of cooking eggs. A mid tower's roomier interior allows for better air circulation, plus gives you more space for additional case fans and larger heat sinks.

- Cable Management - Power cables, data connectors, case wires... Left unchecked, the insides of a PC case can quickly degenerate into a rat's nest of wires. The extra drive bays, additional cable routing holes and bigger side panel clearance all add up to simpler and better cable management. This goes a long way in improving air flow and reducing dust buildup over time.

Full Tower (EATX Case)

- Servers - In order to accommodate a second CPU and extra RAM slots, server motherboards can get quite massive. Most mid towers can't hold anything larger than a standard ATX motherboard, so you'll need a full tower to house the larger EATX and SSI CEB server boards.

- Overclocking - Pushing the limits of your computer requires a lot of cooling, and proper cooling equipment can take up a lot of space. 230 mm case fans, dual tower heat sinks, triple radiators... only a full tower can contain these monsters with room to spare. What's more, larger computer case size = higher air volume = better ventilation and heat dissipation.
- Hardcore Gaming - For some, playing the latest games with relative smoothness isn't enough - They demand 4K resolution gaming...with ultra settings...on a triple monitor setup. If that sounds like you, then you'll want a full tower capable of transforming into a gaming monster with triple or even quad graphics cards.

Input Devices

Input Devices

- An input device is any device that provides input to a computer.
- Computer cannot understanding our language because it understands only machine language and it can be possible using some devices are called **input devices**
- When we work with computer we need to enter data and instructions to the computer using these devices
- These devices convert data and instructions to a form that can be recognized by the computer
- Any peripheral (piece of computer hardware equipment)used to provide data and control signals to a computer.
- Without any input devices, a computer would only be a display device and not allow users to interact with it
- Six Widely used input devices are the keyboard, mouse, microphone, scanner, digital camera and PC video camera.

Keyboards

- A computer keyboard is a peripheral modelled on the typewriter keyboard. Keyboards are designed for the input of text and characters, and also to control the operation of the computer. Physically, computer keyboards are an arrangement of rectangular or near-rectangular buttons, or keys.

- The most common arrangements in Western countries are based on the QWERTY layout The number of keys on a keyboard generally varies from the standard 101 keys and 104-key Windows keyboards, to as many as 130 keys, with many programmable keys.

- A computer keyboard is effectively an array of switches, each of which sends the PC a unique signal when pressed.

- Two types of switch are commonly used: mechanical and rubber membrane.

- Mechanical switches are simply spring-loaded push to make types, so when pressed down they complete the circuit and then break it again when released. These are the type used in clicky keyboards with plenty of tactile feedback.

- Membranes are composed of three sheets: the first has conductive tracks printed on it, the second is a separator with holes in it and the third is a conductive layer with bumps on it. A rubber mat over this gives the springy feel. When a key is pressed, it pushes the two conductive layers together to complete the circuit. On top is a plastic housing which includes sliders to keep the keys aligned.

- With these a key depression pushes down on a rubber dome sitting beneath the key. A conductive contact on the underside of the dome touches (and hence connects) a pair of conductive lines on the circuit below. This bridges the gap between them and allows current to flow, changing the signal strength. A scanning signal is emitted by the chip along the pairs of lines to all the keys. When the signal in one pair becomes different, the chip generates a make code corresponding to the key connected to that pair of lines.

- The keys are connected up as a matrix, and their row and column signals feed into the keyboard's own microcontroller chip. This is mounted on a circuit board inside the keyboard, and interprets the signals with its built-in firmware program. A particular key press might signal as row 3, column B, so the controller might decode this as an A and send the appropriate code for A back to the PC.

- Increasingly, keyboard firmware is becoming more complex as manufacturers make their keyboards more sophisticated. It is not uncommon for a programmable keyboard, in which some keys have switchable multiple functions, to need 8KB of ROM to store its firmware. Most programmable functions are executed through a driver running on the PC.

- Keyboards are wired or wireless

Mouse

- The first devices were bulky and used two gear wheels perpendicular to each other: the rotation of each wheel was translated into motion along one axis in the plane.

- The ball of an opto-electronic mouse is steel for weight and rubber-coated for grip. When the mouse is moved, the ball rotates, and as it does so it drives two rollers, one each for x and y displacement.

- A third spring-loaded roller holds the ball in place against the other two. These rollers then turn two disks with radial slots cut in them.

- Each disk rotates between a photo-detector cell, and each cell contains two offset light emitting diodes (LEDs) and light sensors.

- As the disk turns, the sensors see the light appear to flash, showing movement, while the offset between the two light sensors shows the direction of movement.

- Also inside the mouse are a switch for each button, and a microcontroller which interpret the signals from the sensors and the switches, using its firmware program to convert them to X and Y velocities and translate them into packets of data which are sent to the PC.

- Serial mice use voltages of 12V and an asynchronous protocol from Microsoft comprised of three bytes per packet to report x and y movement plus button presses. PS/2 mice use 5V and an IBM-developed communications protocol and interface.

Optical Mice

- Early optical mice used an infrared LED to detect the movement the mouse pad, rather relying on the traction between the mouse ball and the rollers.

- While this type of mouse was more accurate than an optical mechanical mouse, and avoided the maintenance problems associated with the moving parts of an optical mechanical mouse, it did have its drawbacks.

- As computing power grew cheaper, it became possible to embed more powerful special-purpose image processing chips in the mouse.

- This advance enabled the mouse to detect relative motion on a wide variety of surfaces, translating the movement of the mouse into the movement of the pointer, eliminating the need for a special mouse pad.

- This advance paved the way for widespread adoption of optical mice.

- In optical mice a LED illuminates the surface underneath the mouse. The light from the LED reflects off microscopic textural features in the area of traverse, a plastic lens collecting the reflected light and forming images on a sensor.

- Optical mice work on nearly any surface, such as wood, paper, and cloth – although they do have some difficulty with reflective surfaces, such as CD jewel cases, mirrors and glass.

Cordless Input Device

- There are two primary frequency bands used in RF cordless devices today: 27MHz and 900MHz. Logitech chose 27MHz as it offers many advantages over 900MHz:

- 27MHz is a frequency not used by other common cordless devices in or around the computer. 900MHz is very commonly used by cordless telephones. As a result, the risk of interference/jamming/cross-talk in a home or office is significant with 900MHz and virtually non-existent with Logitech's 27MHz technology.

- Multiple concurrent device support is possible without jamming effect at low cost with 27MHz. 900MHz requires expensive TDMA or spread spectrum technology to achieve an equal level of performance.

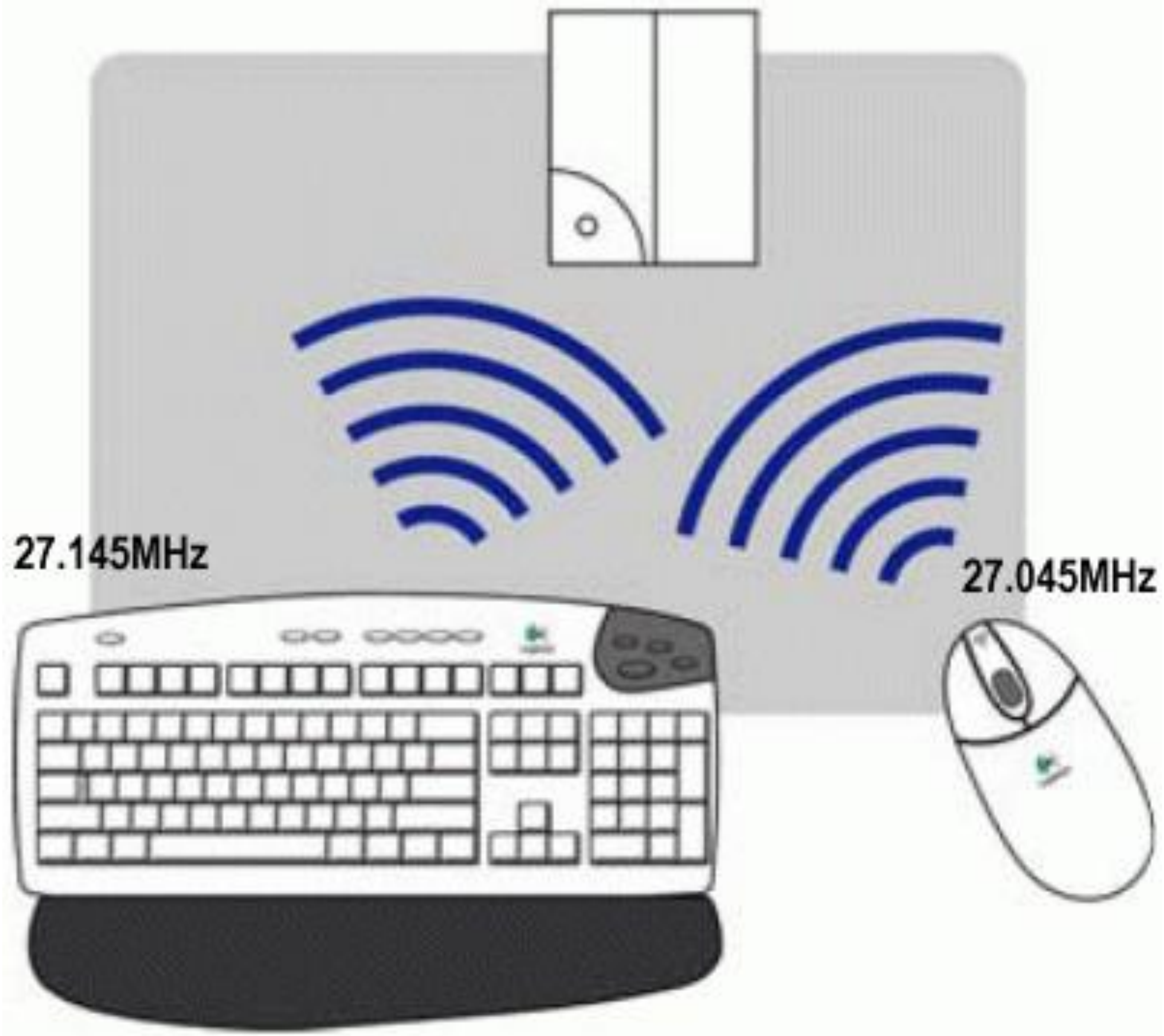
- 27MHz is an approved frequency available worldwide for use in cordless devices for the computer. 900MHz is available only in certain countries.

- A few devices use the same frequency as Logitech products, but none present a risk of interference in a business environment. Devices such as citizen band (CB) radios, remote control cars and short-range RF devices like garage door openers can interfere briefly when intermittently used. None of them will send unintended messages to a PC though.

- With this, a mouse has the capability to switch between four different power modes, depending on the current usage state. When in active use, a mouse uses maximum power. For recent devices this means the LED strobes at a full speed, of up 6000 times a second.

- When a mouse stops moving it will switch to a mode in which the LED strobes at a reduced rate, typically 1000 times a second. After a period of inactivity of a couple of minutes the strobe rate is further reduced, to as little as ten flashes per second.

- A prolonged period of inactivity will result in a mouse switching to its lowest power mode, in which it draws practically no current at all. At any time, regardless of current mode and without any discernible lag, the mouse will return to its full sampling rate at the detection of the slightest motion.


27.145MHz
27.045MHz

Trackball

- A trackball is a pointing device consisting of a ball housed in a socket containing sensors to detect rotation of the ball about two axes – like a mouse lying on its back.
- The cursor is moved about the screen by a user rolling the ball with their thumb, fingers, or the palm of their hand.
- There are usually one to three buttons next to the ball, which are in the same way as mouse buttons.
- The principal advantages of trackballs over mice is that since it is stationary, it requires less space to use, and it can be operated on any type of surface, including the user's lap.
- These attributes make a trackball particularly suitable for use with portable computers, and they were widely used on laptop PCs before the advent of the touchpad.
- A further benefit is that because there is no need to physically move the device around, they offer ergonomic relief from Repetitive Strain Injury (RSI) and Carpal Tunnel Syndrome (CTS).

- Like traditional mice, trackballs can be communicate with a PC through serial or USB connections, or in the case of wireless mice, via infrared or radio frequency.

- When the user rotates the patterned ball of a Marble trackball, an image of the ball, illuminated by a pair of LEDs, passes through a lens focused on the Marble sensor, where it is sampled 1000 times per second.

- The sensor is composed of 93 small cells working independently as a neural network. Each of them can detect a unitary motion by sharing information with its direct neighbours, similar to the way a human eye operates.

- The sensor then computes the average of the displacement returned by all these individual cells for successive samples and passes this information to a microprocessor in the trackball.

- This transmits this information to the host computer, either via a cable or a wireless communications protocol in the case of a cordless device. The trackball driver software then renders the cursor on the screen.

Joystick

- A joystick is a PC peripheral or general control device consisting of a handheld stick that pivots about one end and transmits its angle in two or three dimensions to a computer.

- Most joysticks are two-dimensional, having two axes of movement (similar to a mouse), but three-dimensional joysticks do exist.

- A joystick is generally configured so that moving the stick left or right signals movement along the X axis, and moving it forward (up) or back (down) signals movement along the Y axis.

- In joysticks that are configured for three-dimensional movement, twisting the stick left (counter-clockwise) or right (clockwise) signals movement along the Z axis.These three axis – X Y and Z – are, in relation to an aircraft, roll, pitch, and yaw, respectively.

- Joysticks are often used to control games, and usually have one or more push-buttons whose state can also be read by the computer.

- Commonly used as controllers in first and second generation game consoles, joysticks eventually gave way to the GamePad game controller.

- Analogue joysticks were subsequently to become standard on video game consoles, greatly increasing the freedom of movement any given on-screen object may have.

Scanner

- Digital imaging has come of age. Equipment that was once reserved for the wealthiest bureaux is now commonplace on the desktop.

- At its most basic level, a scanner is just another input device, much like a keyboard or mouse, except that it takes its input in graphical form.

- These images could be photographs for retouching, correction or use in DTP.

- They could be hand-drawn logos required for document letterheads. They could even be pages of text which suitable software could read and save as an editable text file.

- flatbed scanners are the most versatile and popular format. These are capable of capturing color pictures, documents, pages from books and magazines, and, with the right attachments, even scan transparent photographic film.

- The list of scanner applications is almost endless, and has resulted in products evolving to meet specialist requirements:

- High-end drum scanners, capable of scanning both reflective art and transparencies, from 35mm slides to 16-foot x 20in material at high (10,000dpi+) resolutions

- Compact document scanners, designed exclusively for OCR and document management

- Dedicated photo scanners, which work by moving a photo over a stationary light source

- slide/transparency scanners, which work by passing light *through* an image rather than reflecting light off it

- Handheld scanners, for the budget end of the market or for those with little desk space.

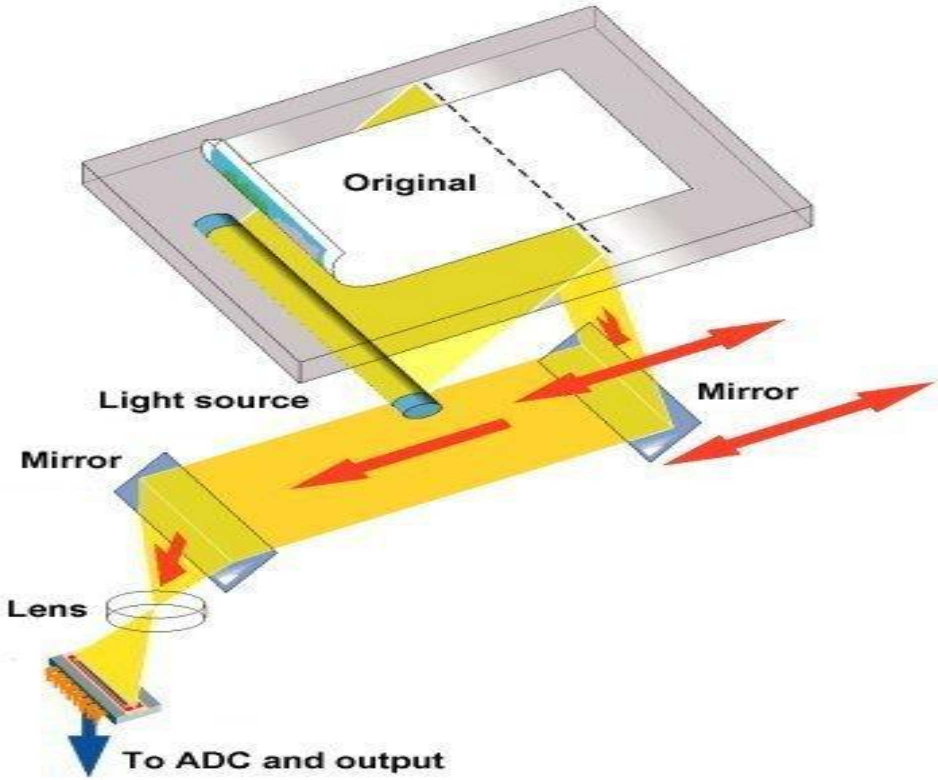
- All scanners work on the same principle of reflectance or transmission. The image is placed before the carriage, consisting of a light source and sensor; in the case of a digital camera, the light source could be the sun or artificial lights.

- When desktop scanners were first introduced, many manufacturers used fluorescent bulbs as light sources. While good enough for many purposes, fluorescent bulbs have two distinct weaknesses: they rarely emit consistent white light for long, and while they're on they emit heat which can distort the other optical components.

- For these reasons, most manufacturers have moved to cold-cathode bulbs. These differ from standard fluorescent bulbs in that they have no filament.
-
- They therefore operate at much lower temperatures and, as a consequence, are more reliable. Standard fluorescent bulbs are now found primarily on low-cost units and older models.

- To direct light from the bulb to the sensors that read light values, CCD scanners use prisms, lenses, and other optical components. Like eyeglasses and magnifying glasses, these items can vary quite a bit in quality.

- A high-quality scanner will use high-quality glass optics that are colour-corrected and coated for minimum diffusion. Lower-end models will typically skimp in this area, using plastic components to reduce costs.



- The amount of light reflected by or transmitted through the image and picked up by the sensor, is then converted to a voltage proportional to the light intensity – the brighter the part of the image, the more light is reflected or transmitted, resulting in a higher voltage.

- This analogue-to-digital conversion (ADC) is a sensitive process, and one that is susceptible to electrical interference and noise in the system. In order to protect against image degradation, the best scanners on the market today use an electrically isolated analogue-to-digital converter that processes data away from the main circuitry of the scanner.

- However, this introduces additional costs to the manufacturing process, so many low-end models include integrated analogue-to-digital converters that are built into the scanner's primary circuit board.

The sensor component itself is implemented using one of three different types of technology:

  - PMT (photomultiplier tube), a technology inherited from the drum scanners of yesteryear
  - CCD (charge-coupled device), the type of sensor used in desktop scanners
  - CIS (contact image sensor), a newer technology which integrates scanning functions into fewer components, allowing scanners to be more compact in size.

Digital Camera /Camcorder

- A camera that stores the pictures or video it takes in electronic format instead of to film.

- Digital cameras have become the camera solution for most users today as the quality of the picture they take has greatly improved and as the price has decreased.

- In principal, a digital camersa is similar to a traditional film-based camera. There's a viewfinder to aim it, a lens to focus the image onto a light-sensitive device, some means by which several images can be stored and removed for later use, and the whole lot is fitted into a box.

- In a conventional camera, light-sensitive film captures images and is used to store them after chemical development. Digital photography uses a combination of advanced image sensor technology and memory storage, which allows images to be captured in a digital format that is available instantly – with no need for a "development" process.

Digital Camera/Camcorder

Audio Input Devices – Microphone (Mic)

- Microphones can accept auditory input. A microphone requires a sound card in the PC.
- A sound card can digitize analog sound signals, and convert digital sound signals to analog form.
- With speech recognition software, you can use your microphone to dictate text, navigate programs, and choose commands.
- Latest technology uses continuous speech recognition where the user does not have to pause between words
- Use a microphone to talk to your computer
    - Add a sound card to your computer
    - Sound card digitizes audio input into 0/1s

Audio Input Devices – Microphone (Mic)

Cordless Microphone

USB Microphone

Output Devices

CRT-Monitor

- Short for **cathode ray tube**, a **CRT** is the electron beams in a monitor that move across your screen either interlaced or non-interlaced, hitting phosphor dots on the inside glass tube.

- In the CRT are three electron guns: red, green, and blue.Each of these guns streams a steady flow of electrons, left to right, for each line of your monitor.

- As the electrons hit the phosphors on the CRT, the phosphor will glow certain intensities. As a new line begins, the guns will then begin at the left and continue right.

- These guns will repeat this process sometimes thousands of times until the screen is completely drawn line by line.

- Once the phosphors on the CRT have been hit with an electron, they only glow for a short period of time. Because of this, the CRT must be refreshed, which means the process will be repeated as explained above.

- If the video card's refresh rate is not set high enough, you may encounter a flicker or a noticeable steady line scrolling from the top to the bottom of your screen.

- Dot pitch
  - Measurement between the same spot in two vertically adjacent dot trios
  - Expressed in millimeters or dots per inch
  - Dot pitch tells “sharpness”
  - Software-pixel placement is limited to hardware’s transistor placement
- Resolution
  - Number of pixels used to draw the screen.
  - Higher resolutions = more information in the same screen area.
  - indicate rows and columns of pixels on screen

Liquid Crystal Display (LCD) Monitor

- A liquid crystal display (LCD) monitor is a computer monitor or display that uses LCD technology to show clear images, and is found mostly in laptop computers and flat panel monitors.

- This technology has replaced the traditional cathode ray tube (CRT) monitors, which were the previous standard and once were considered to have better picture quality than early LCD variants.

- With the introduction of better LCD technology and its continuous improvement, LCD is now the clear leader over CRT, in terms of color and picture quality, not to mention capabilities for large resolutions. LCD monitors may be made much more cheaply than CRT monitors.
- Crystals align themselves with the current when passed through a semi-crystalline liquid. Combining transistors with liquid crystals, pattern formed. Patterns combined to represent numbers or letters. First used in watches, now in monitor, even TV.

- Available in analog (like VGA) :PCs digital signals are converted to analog by video card digital interface: no analog modulation required, generally sharper Backlight makes easier to view

LCD Technologies

In Plane Switching (IPS) Panel Technology: These panels are considered to have the best color accuracy, viewing angles and image quality in LCD technology.

Super Plane to Line Switching (PLS): Developed by Samsung, this LCD panel is very similar to the IPS panel but reportedly, it is 10 percent brighter, has wider viewing angles and is cheaper to produce.

Vertical Alignment (VA) Panel Technology: These panels are considered to be in the middle of TN and IPS technology. Compared to TN panels, they offer wider viewing angles and better color quality but have slower response times. They have higher contrast ratios, compared to the other panels but have a downside, in terms of color shifting, where the brightness display is unevenly distributed throughout the screen.

Twisted Nematic (TN) Panel Technology: These panels are the most commonly used type of panel in LCD technology. They are cheaper and offer faster response times, making them a preferred choice for gamers. The downside is that the viewing angles, contrast ratios and color production are considered the lowest of LCD panel types.


FLATRON
LG

Projector

- Projector is one of the output device
- Condensed video display units with a lighting system that projects the VDU’s image onto a screen
- Interactive whiteboards allow presenters to project an image onto the board as they use virtual markers to electronically draw on the displayed image
- Focusing mechanism is included on the lens

Printers and Characteristics

A printer is an external output device that takes data from a computer and generates output in the form of graphics / text on a paper.

There are two types of printers

- ❑ Impact printers
- ❑ Non Impact printers

Impact printers

- ❑ An impact printer makes contact with the paper. It usually forms the print image by pressing an inked ribbon against the paper using a hammer or pins. Following are some examples of impact printers.

Non-impact printers

- ❑ Non-impact printers do not use a striking device to produce characters on the paper; and because these printers do not hammer against the paper they are much quieter. Following are some non-impacted printers.

- **Color vs Monochrome –** Of course, one of the first things you'll need to know about a printer is whether you have the ability to print in color. If you *don't* need a color printer, then it can be worth looking at a monochrome printer instead.
- **Printing speed –** Although nowadays most home printers have a better printing speed, it doesn't usually match up to office printers which usually have a fast speed out of necessity. Printing speed is measured in pages per minute (PPM).
- **Resolution (dpi) –** Essentially, the resolution is how many dots that can be imprinted per inch of page. This doesn't matter too much for regular printing, but you'll notice there's a big difference with photographs and other images. So, if you see something like 300dpi, this stands for the amount of dots per inch, which higher numbers are necessary for in details imagery.
- **Type quality –** Another way that you might see printer quality measure is by the quality of type, meaning how well the letters are represents on a page. Top printers will have letter quality printing, but lower range printers might not have this.
- **Warm Up –** Printers usually vary drastically in the amount of time that they take to warm up and actually be ready for printing. It's usual for any printer to take some time to warm up, but newer printers generally take a lot less time than older printers, which may have taken a *long* time to warm up in the past.
- **Wireless –** The vast majority of newer printers that are being released will be made for wireless printing with Airprint or with any other kind of wireless printing.

Dot matrix printer

Types of Printers Cont.

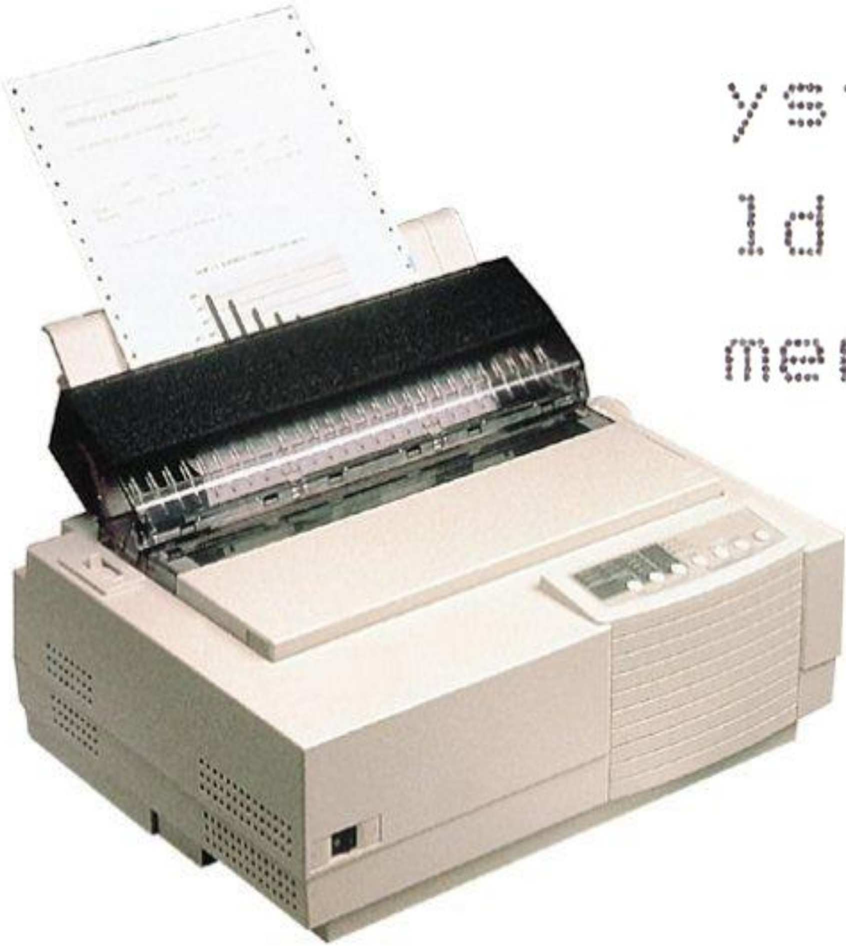
Some of the printers out in the market today include the following:

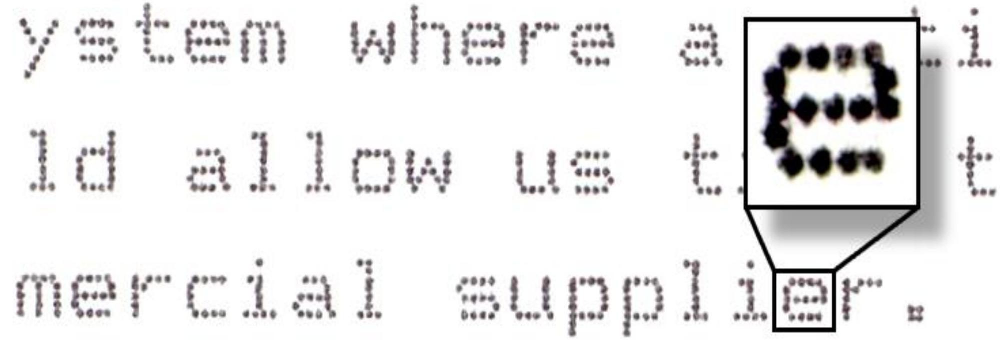
- Dot Matrix Printers
- Ink Jet Printers
- Laser Printers
- Snapshot Printers
- Other High-Quality Printers

Dot matrix printer

- Dot matrix printers are known as impact printers also called as matrix printer.
- They create an image on paper by striking pins against an inked ribbon.
- The ink is transferred to the paper as closely shaped dots that form each character.
- The more pins, the better the print quality. 24-pin dot matrix printers can print at near letter-quality.
- Dot-matrix printers were once very popular, but have been replaced in popularity by ink-jet printers.
- Dot-matrix printers typically use continuous form multipart paper and are commonly used for documents such as sales invoices and purchase orders.
- Inside a dot-matrix printer a print head containing small blunt pins strikes an inked ribbon to stamp images on a page.
- Speed measured in characters per second

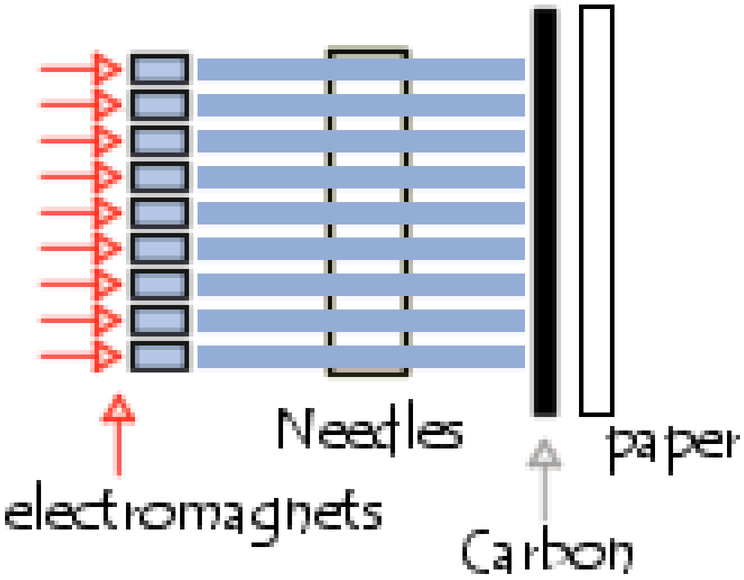
Dot matrix printer



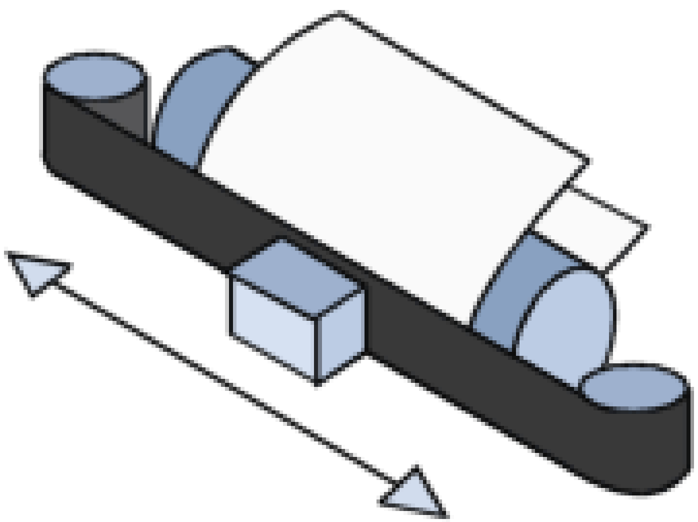


Dot matrix printer

- The **dot-matrix printer** allows you to print documents on paper thanks to the "back and forth" motion of a carriage housing a print head.
- The head is made up of tiny metal pins, driven by electromagnets, which strike a carbon ribbon called an "**inked ribbon**", located between the head and the paper.
- The **print head** of the dot matrix printer consists of a column of **7 small needles**.
- Each needle can move freely.

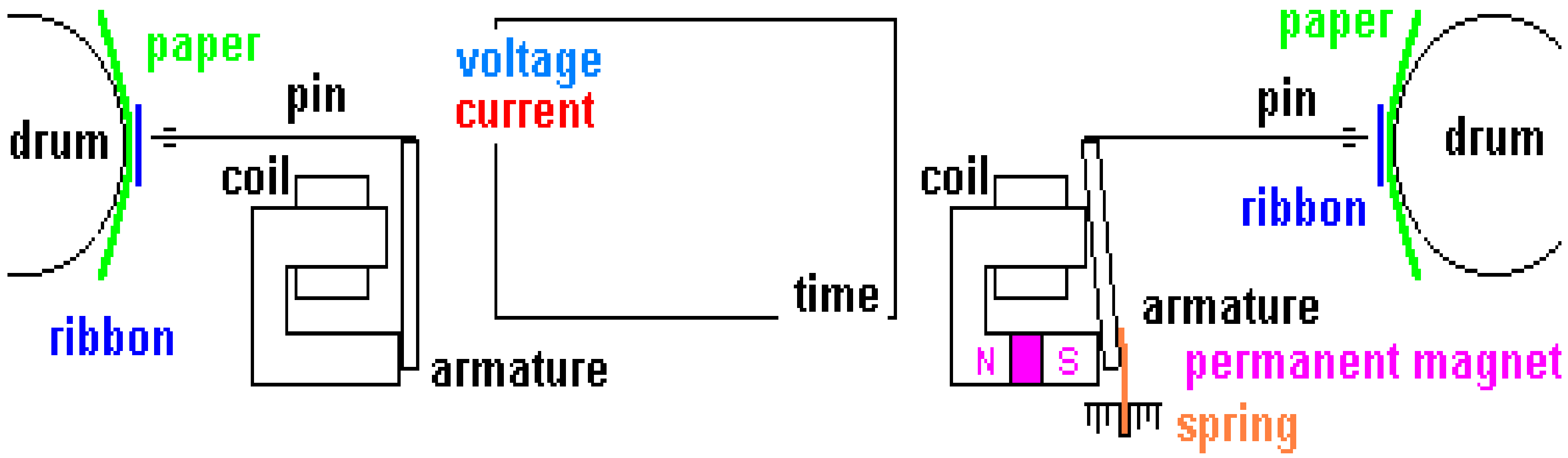


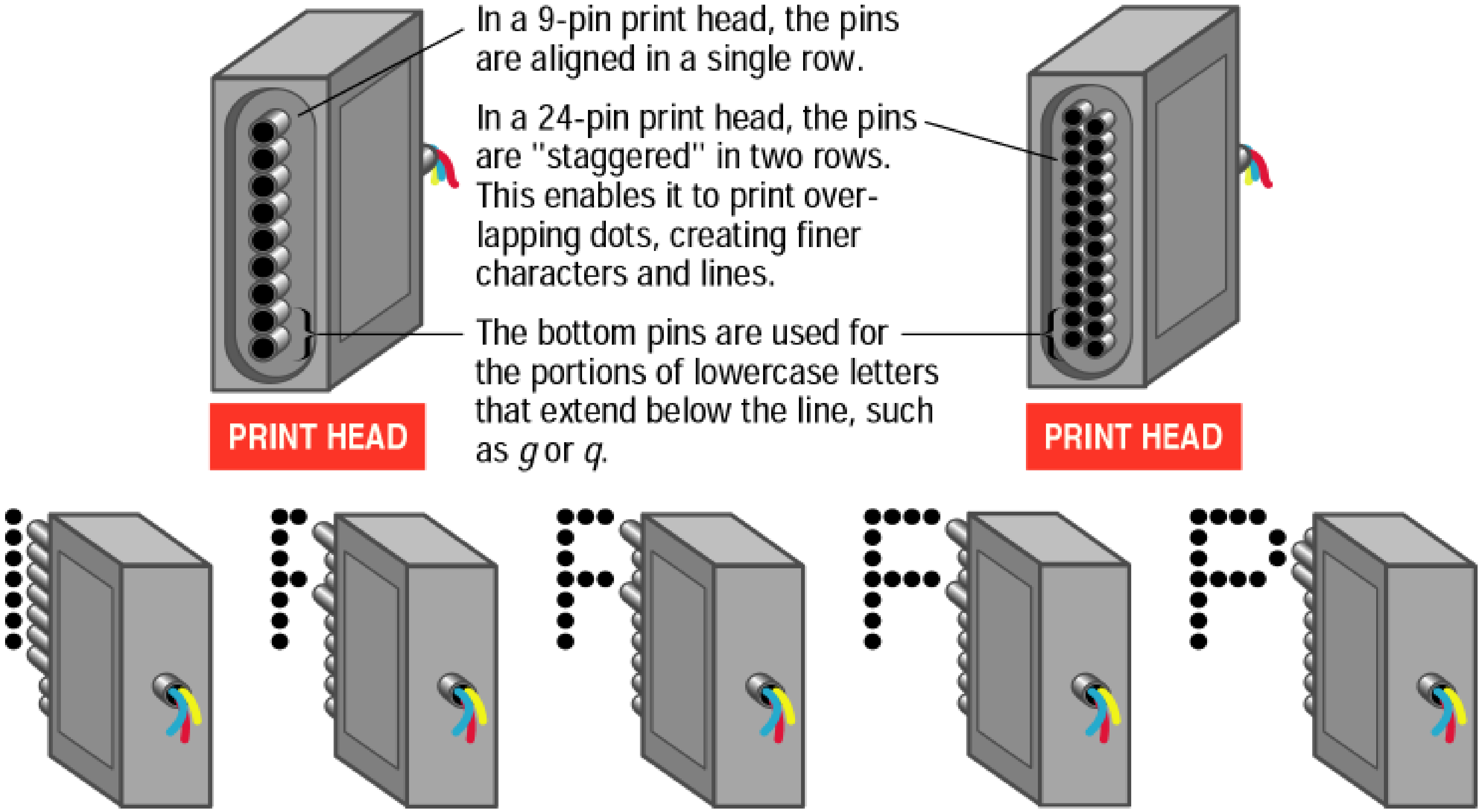
- Each needle can be made to print a dot by means of a **hammer action** that forced the needle to come out and press **the ribbon against the paper**.
- Standard characters are produced in a **5 x 7 dot matrix**. (7 dots high and 5 dots wide).
- The carbon ribbon scrolls by so that there is always ink on it. At the end of each line, a roller makes the sheet advance.
- The most recent dot-matrix printers are equipped with 24-needle printer heads, which allows them to print with a resolution of 216 dpi (*dots per inch*).



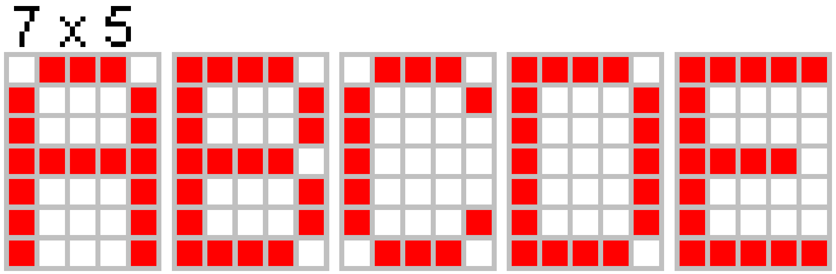
Working principle

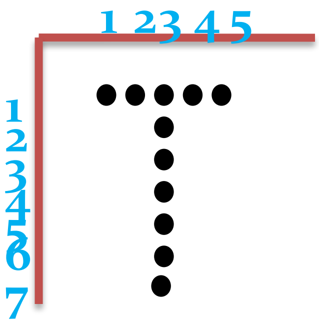
It is widely used to print multipart forms and address labels. Also known as a "serial dot matrix printer," the tractor and sprocket mechanism in these devices handles thicker media better than laser and inkjet printers.




In a 9-pin print head, the pins are aligned in a single row.
In a 24-pin print head, the pins are "staggered" in two rows. This enables it to print over-lapping dots, creating finer characters and lines.
The bottom pins are used for the portions of lowercase letters that extend below the line, such as g or q.
PRINT HEAD
PRINT HEAD

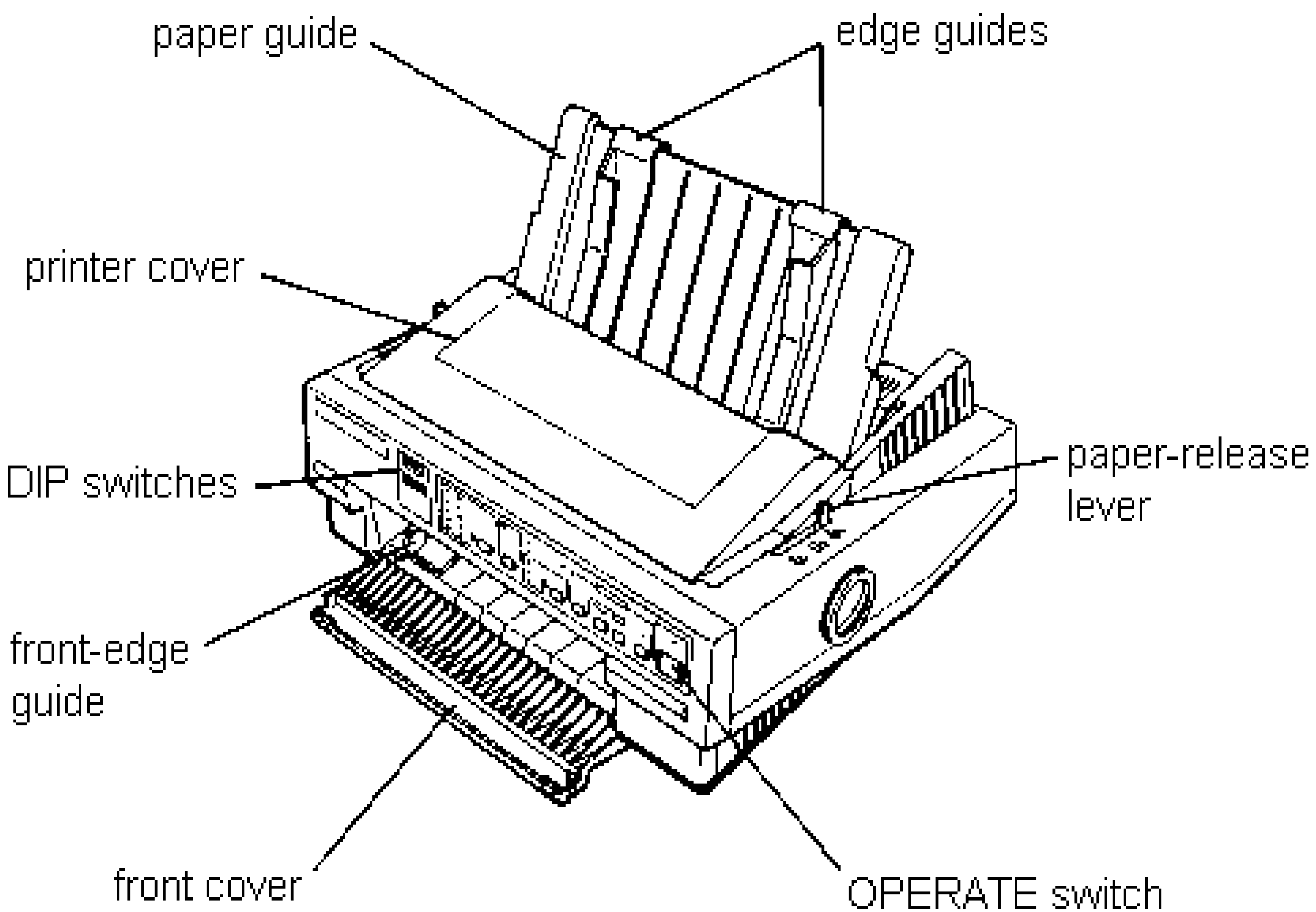
5X7 Dot Matrix



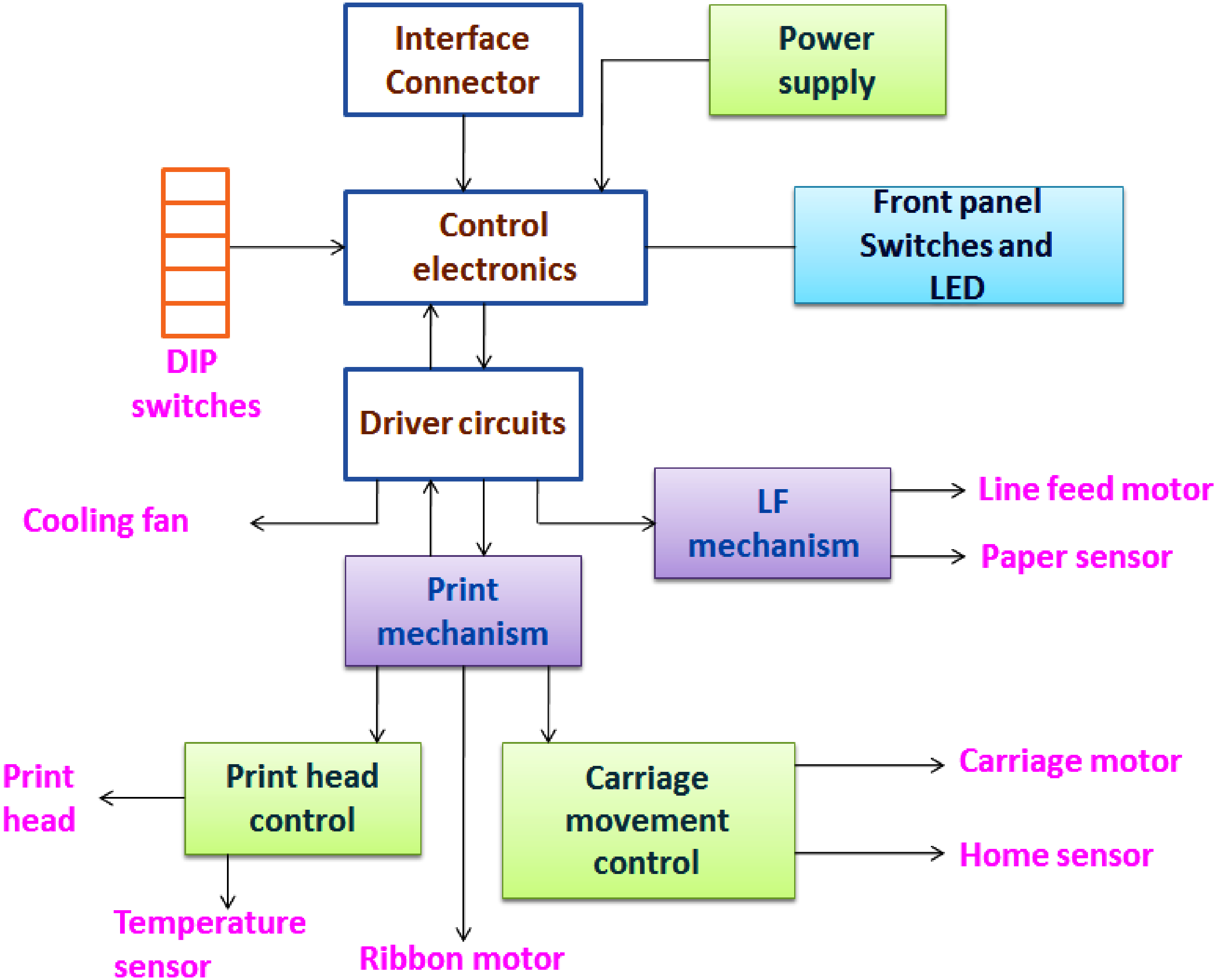


- The characters are printed **column by column** and not all at once.
- For example to print the character **T**, initially pin number **1** is made to contact the ribbon.
- Thus **first column** of the characters is got.
- Then the print head is moved towards right and once again the pin 1 is made to contact the **ribbon**.
- Thus **second column** of the character is got. Then the print head is moved to get the third column and so on.

Parts of a Dot Matrix Printer

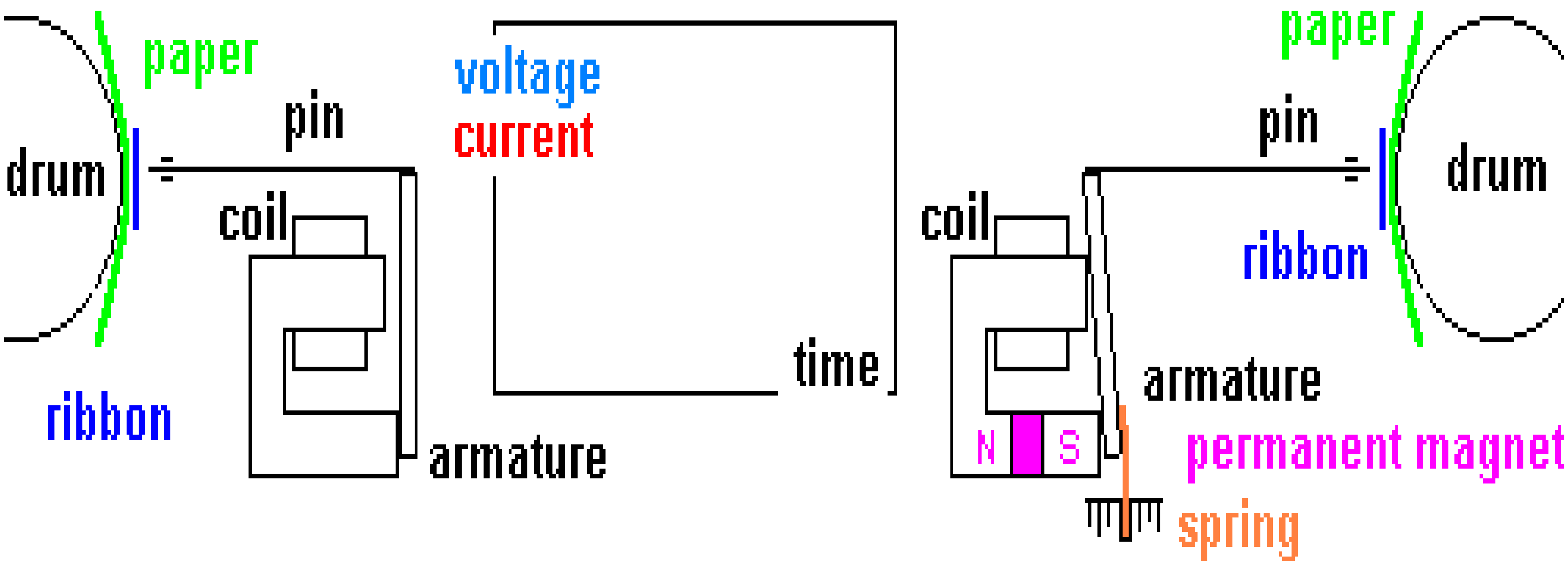


Block diagram of Dot matrix printer



Dot matrix printer head mechanisms in action

Classical print head mechanism is showed from the left side. The permanent magnet printer head mechanism you may see at right.

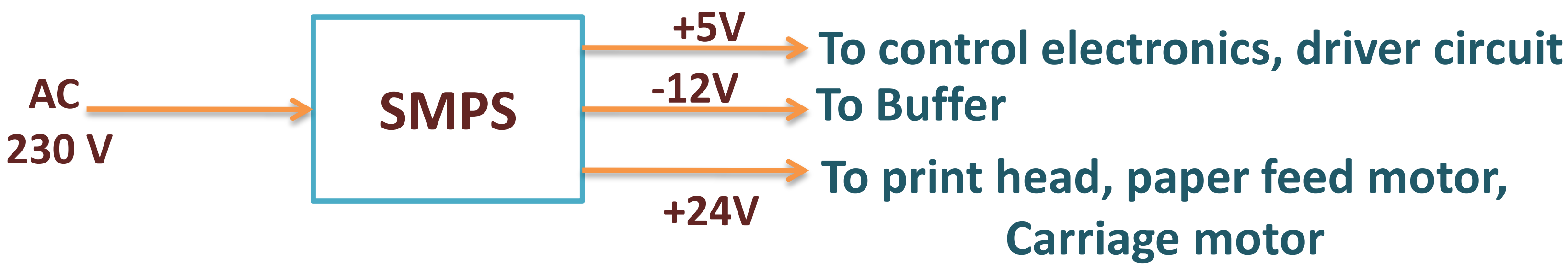


Construction of a Dot matrix printer

Power supply

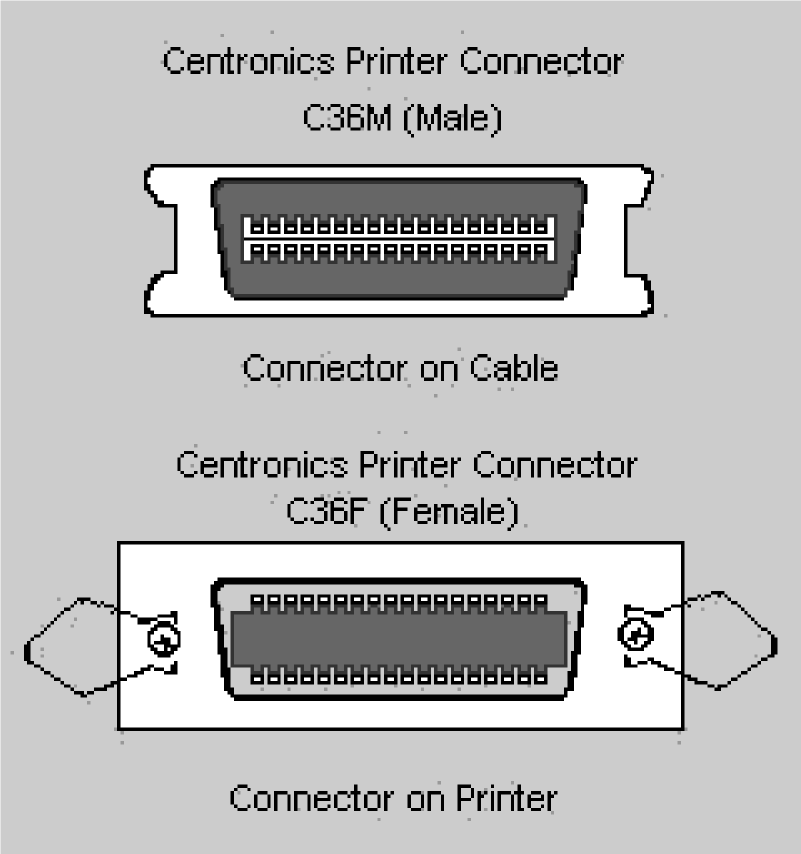
Normally printers consist of **Switch Mode Power Supply (SMPS).**

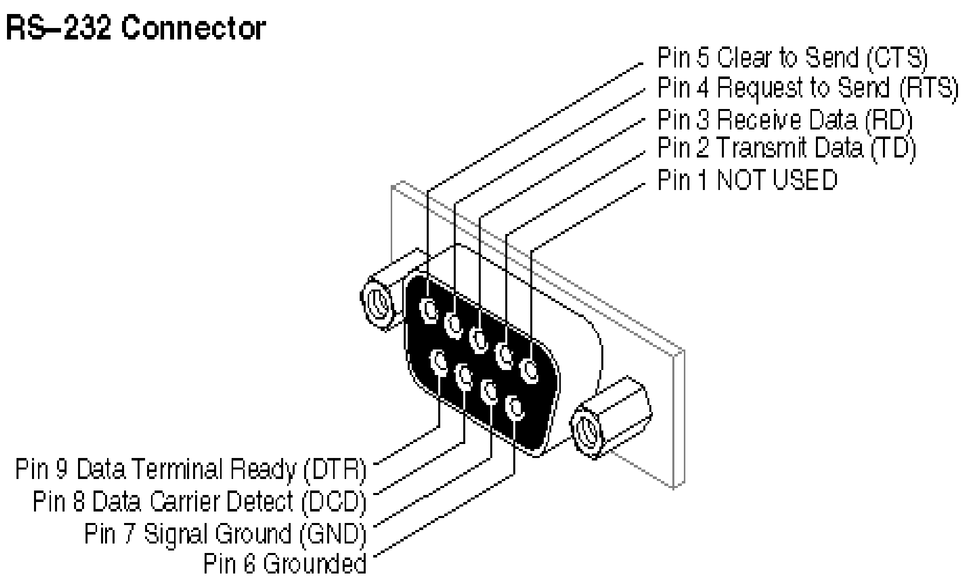
This unit is used to **convert the AC** voltage to **different DC voltage** levels.



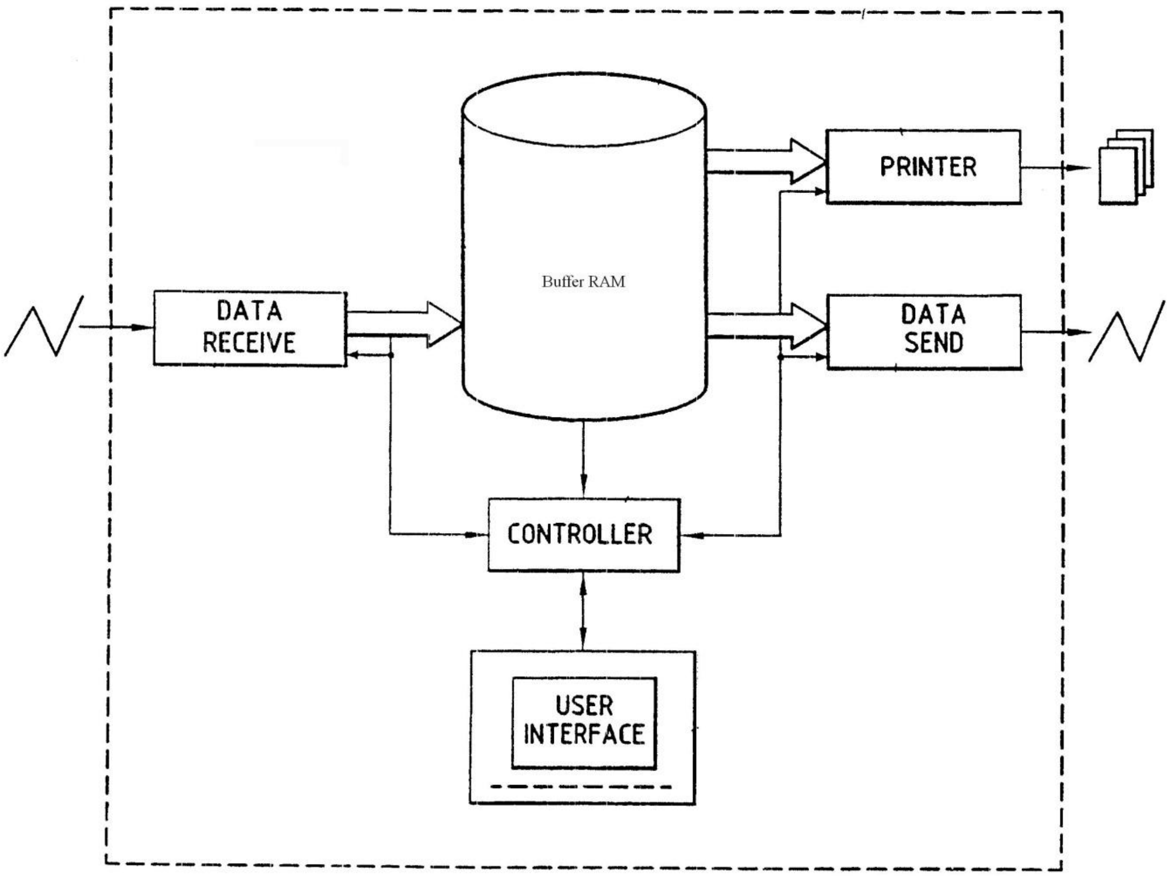
Interface connector – Centronics –RS232

- Printers are connected to the computer through a **36 pin centronics interface cable** or a **9-pin RS 232C** serial interface cable.
- The serial data from the computer is received and stored in the printers **buffer RAM**.



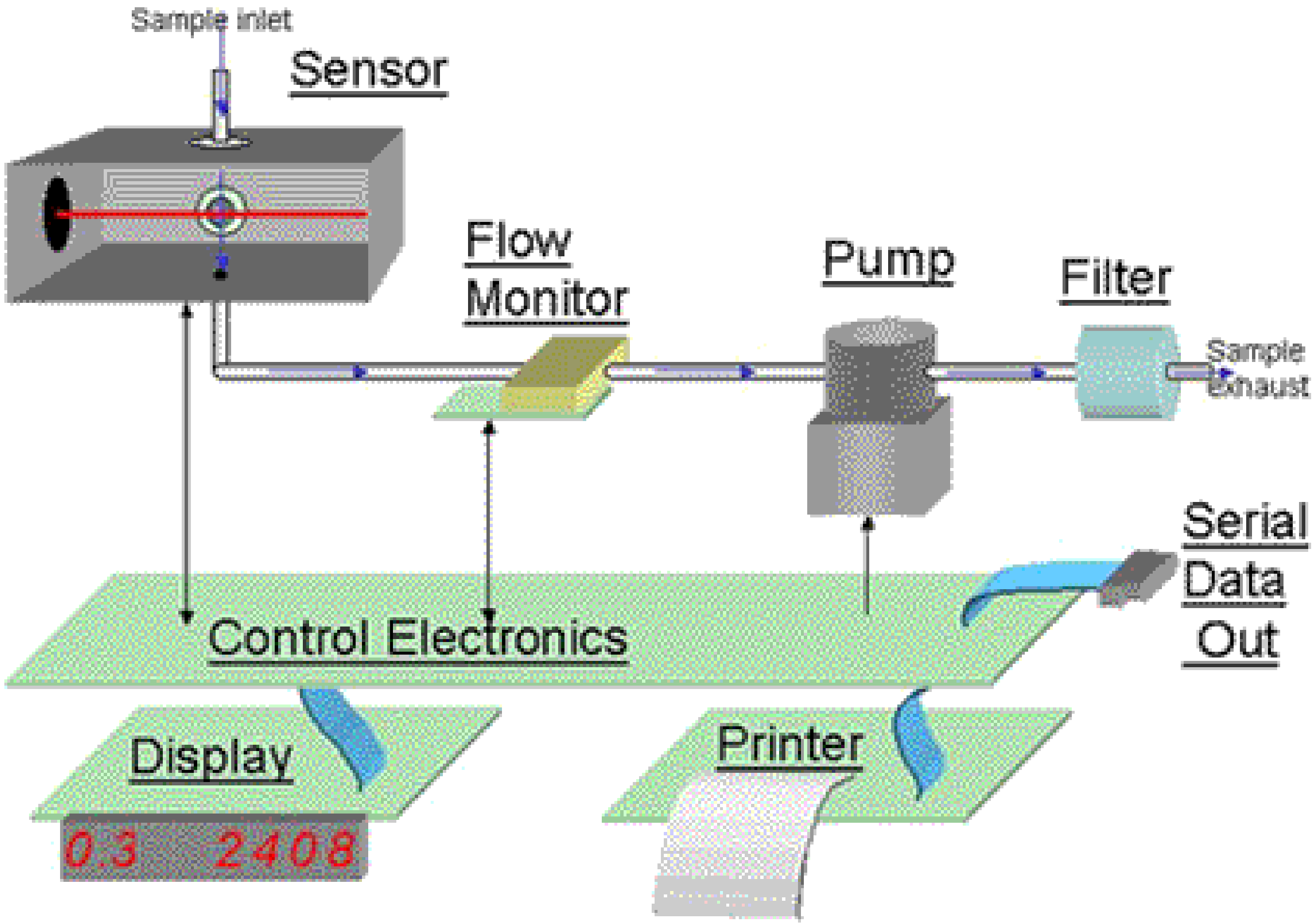


Printer Buffer RAM



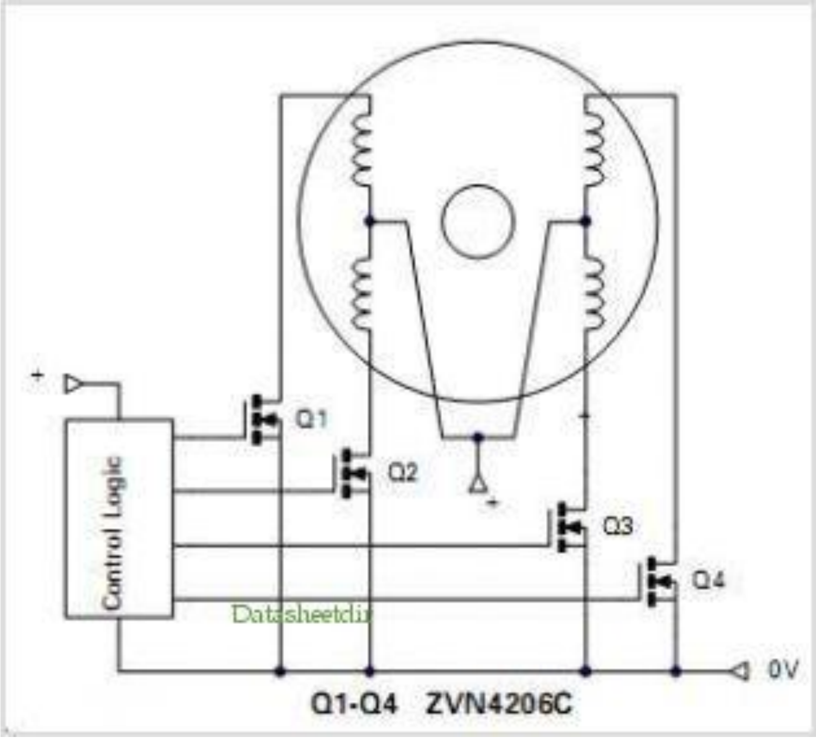
Control electronics

This unit contains an **intelligent processor** for controlling the functions of the printer.



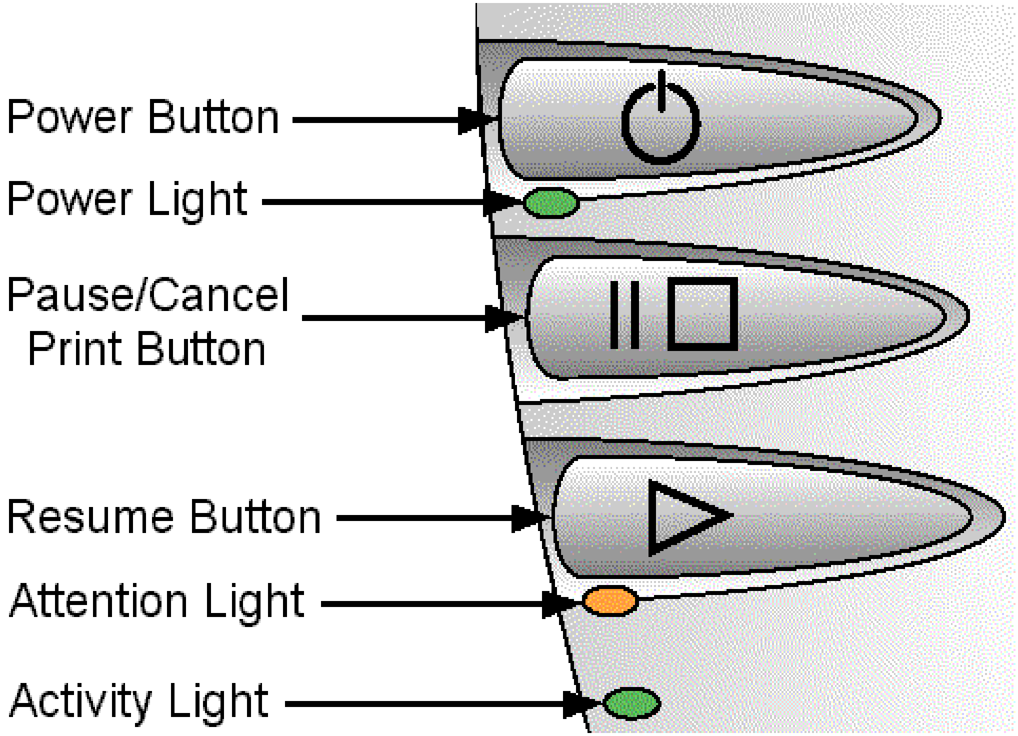
Driver circuit

- This unit is used to control the **line feed mechanism**, **print mechanism** and **ribbon movements**.
- These mechanisms use **stepper motors**.
- This circuit provides **high current** for driving these **stepper motors**.
- Also it sends feed back signals to control electronics for monitoring the speed and displacement of these mechanisms.



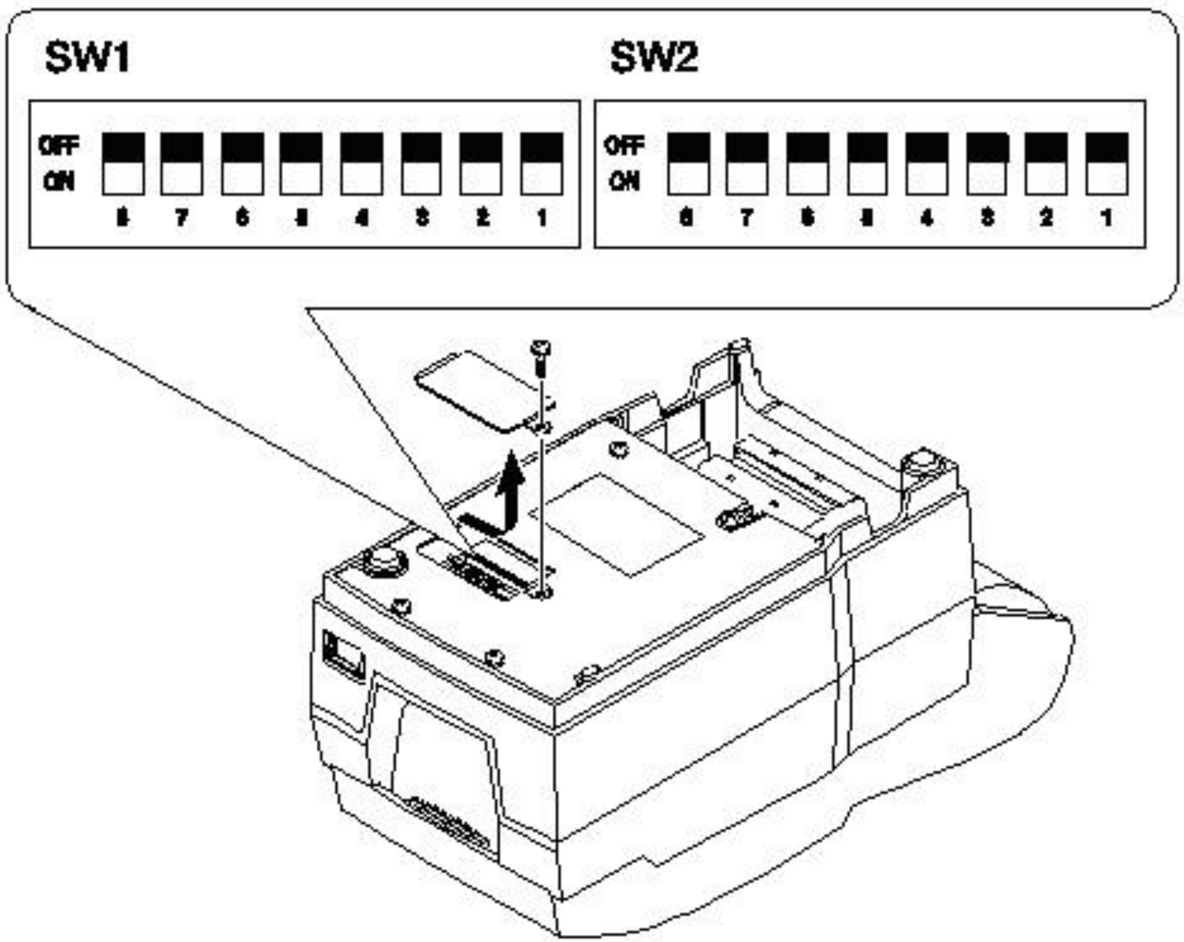
Front panel

- This consists of a minimum **three status lights (LED)** and three **soft touch switches**.
- The lights are used to give information about the status of the printer to the user.
- **Switches** are used to give the control commands.
- For example **font selection**.



DIP switches

- These switches are present in the **interface card** and are used **to change the printer settings**.



Printer setting change

The settings that can be changed are

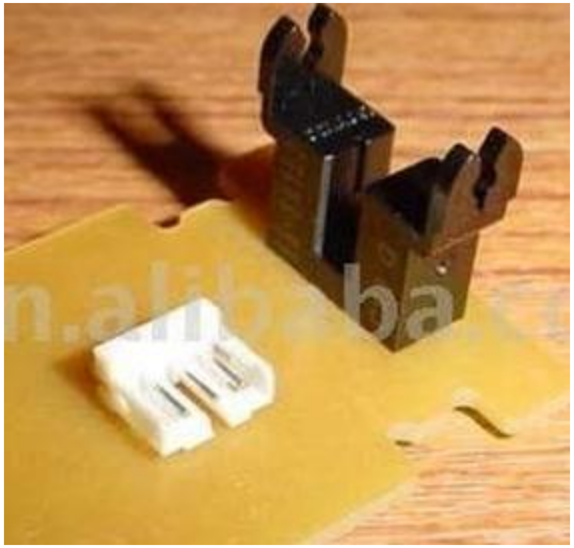
- Printing of graphics and accented characters
- Page length
- Line spacing
- Print quality
- Auto line speed
- Character set for different countries

Printer sensor

Home sensor - This is used to detect whether the head carriage is in the extreme left margin.

Paper empty sensor - This is used to signal when there is no paper in the printer.

Temperature sensor - This is used to detect the abnormal timings used to fire the pins.

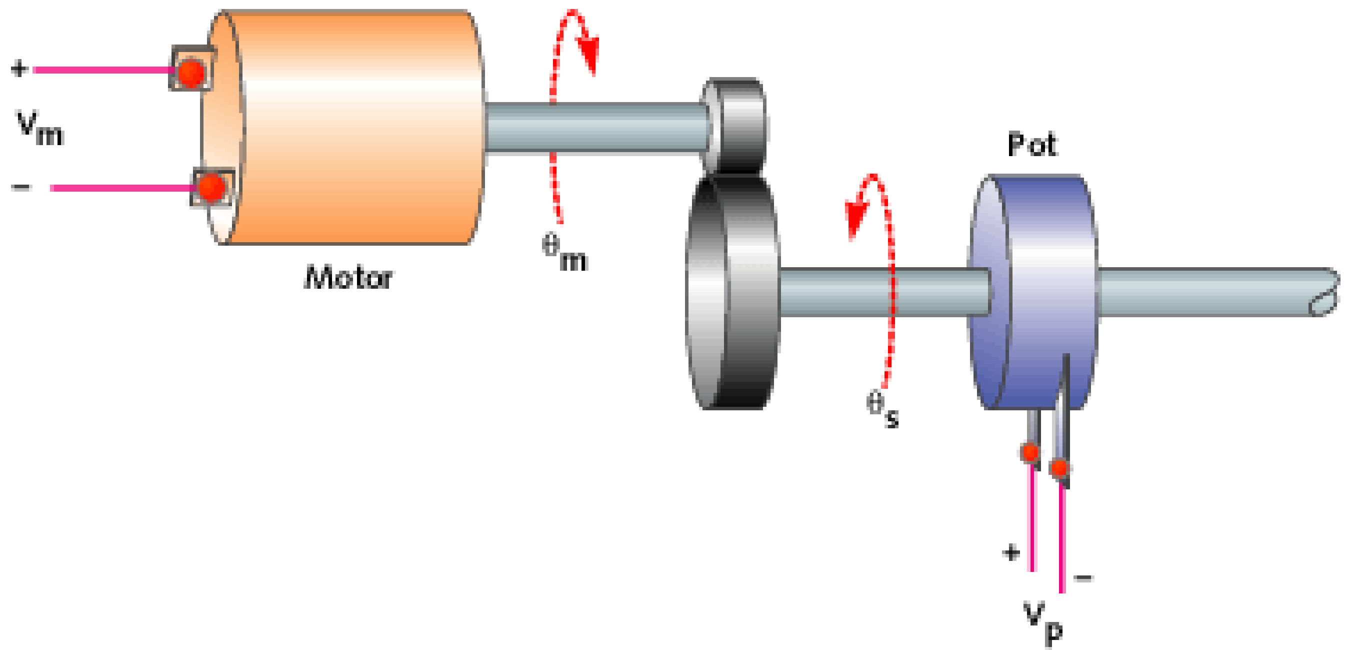


Print mechanism

This contains two subsystems

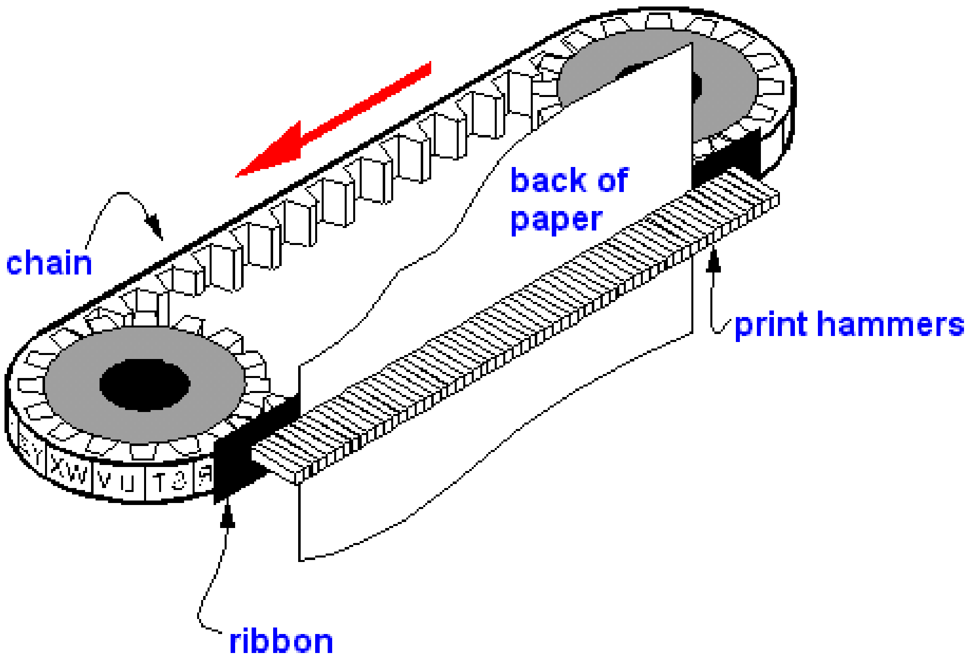
Carriage movement control mechanism

This moves the carriage bidirectionally by means of a stepper motor



Ribbon feed mechanism

- This feeds the ribbon when the print head is printing



Line Dot Matrix Printers

There are several printer technologies used in today's home, office and banking printers.

Dot matrix printers are divided on two main groups:

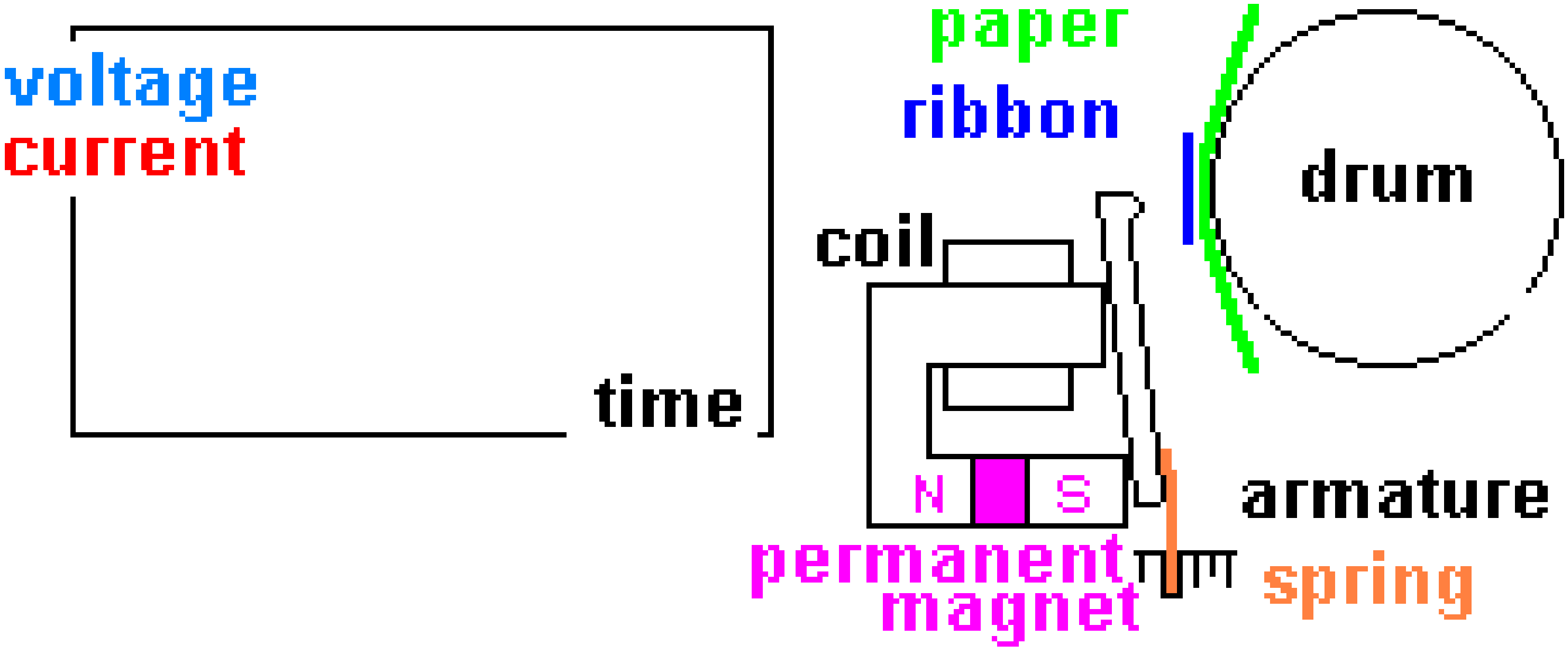
- ❑ serial dot matrix printers
- ❑ line printers (or **line dot matrix printers**).

- ❑ Line printers as well as serial dot matrix printers use pins to strike against the inked **ribbon**, making **dots** on the paper and forming the desired characters.
- ❑ The differences are that line printers use **hammer bank** (or **print-shuttle**) instead of print head, this print-shuttle has **hammers** instead of print wires, and these hammers are arranged in a horizontal row instead in vertical column.
- ❑ The hammer bank uses the same technology as the permanent magnet print head with the small difference that instead of print wires the print-shuttle has hammers.

Printing mechanism

- The **printing mechanism** works as follow. The permanent magnetic field holds the hammer spring in stressed, ready to strike position.
- The driver sends electrical current to hammer coil, which then creates electromagnetic field opposite to the permanent magnetic field.
- When both fields equalize, the energy stored in the spring is released to strike the hammer against the ribbon and prints a dot on the paper.
- The hammer printing mechanism is shown in action at the picture bellow.

The line printer mechanism in action



- During printing process the print-shuttle vibrates in horizontal direction with high speed while the print hammers are fired selectively.
- So each hammer may print a series of dots in horizontal direction for one pass of the shuttle, then paper advances at one step and the shuttle prints the following row of dots

- Line matrix printers are the right solutions for high-volume impact printing and are superior in speed, reliability and quality.
- As price-performance leaders, line printers cost less to service and less to use. The fastest line matrix printers available on the market are [Tally]() T6218 and [Printronix]() P5220, with a claimed print speed between 1800 and 2000 **lines per minute** (**lpm**).

Line dot matrix printer Features:	Specifications
Print Technology:	Line impact dot matrix
Print Speed LPM (lines per minute)	500 - 2000 lpm (draft)
Graphics Resolution	60 - 240 DPI
Copies (Original +)	5 - 9
Workload (Duty cycle) PPM (Pages per month)	60,000 - 600,000 PPM

Characteristics of Dot- matrix printers

Dot-matrix printers vary in two important characteristics:

- **speed:** Given in *characters per second* *(cps),* the speed can vary from about 50 to over 500 cps. Most dot-matrix printers offer different speeds depending on the quality of print desired.

- **print quality:** Determined by the number of pins (the mechanisms that print the dots), it can vary from 9 to 24. The best dot-matrix printers (24 pins) can produce near letter-quality type, although you can still see a difference if you look closely.

- In addition to these characteristics, you should also consider the noise factor. Compared to laser and ink-jet printers, dot-matrix printers are notorious for making a racket.

Advantages of Dot-matrix printers

The advantages are:

- low purchase cost.
- can handle multipart forms.
- cheap to operate, just new ribbons.
- rugged and low repair cost.

Advantages of Dot-matrix printers

The disadvantages are:

- noisy.
- low resolution. You can see the dots making up each character.
- Not all can do colour.
- Colour looks faded and streaky.

Future of dot-matrix printers

- The main use of dot-matrix printers is in areas of intensive transaction-processing systems that churn out quite a lot of printing.

- Many companies who might have started off with dot-matrix printers are not easily convinced to go for printers based on other technologies because of the speed advantage of dot-matrix printers.

Inkjet Printers

Introduction - Inkjet printer and Bubble jet Printer

- Non Impact Printers

- The **inkjet** printer technology was originally invented by Canon. It is based on the principle that a heated fluid produces bubbles.

- The researcher who discovered this had accidentally brought a syringe filled with ink into contact with a soldering iron. This created a bubble in the syringe that made the ink in the syringe shoot out.

- Today's printer heads are made up of several nozzles (up to 256), equivalent to several syringes, which are heated up to between 300 and 400°C several times per second.

- Each nozzle produces a tiny bubble that ejects an extremely fine droplet. The vacuum caused by the decrease in pressure creates a new bubble.

Inkjet printer and Bubble jet Printer

- An ink-jet printer produces high-quality documents at a relatively low price.
- An ink-jet printer sprays ink through small nozzles onto a page to produce images.
- Typically, **inkjet printing** forms images by spraying tiny droplets of liquid ink onto paper.
- Small size and precision placement of the dots of ink produce very near photo-quality images.
- You can use the documents produced by an ink-jet printer in most circumstances, except when only the highest quality is acceptable, such as for important business correspondence.
- Some inkjet printers employ a hybrid dye-sublimation process. The color is contained in cartridges, heated, vaporized, and laid down a strip at a time rather a page at a time creating an effect closer to continuous tone than traditional inkjet technology

Inkjet vs Bubble jet

- Generally, we make a distinction between the two different technologies:
- **Inkjet printers** use nozzles that have their own built-in heating element. Thermal technology is used here.
- **Bubble jet printers** use nozzles that have piezoelectric technology. Each nozzle works with a piezoelectric crystal that changes shape when excited by its resonance frequency and ejects an ink bubble.

Inkjet and Bubble-jet Printers Technology

Inkjet printers technology development starts in the early 1960s. The first inkjet printing device was patented by Siemens in 1951, which led to the introduction of one of the first inkjet chart recorders.

Continuous inkjet printer

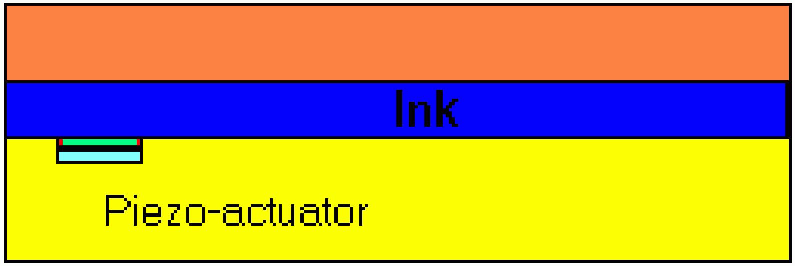
- This technology was developed later by IBM in the 1970s. The continuous inkjet technology basis is to deflect and control a continuous inkjet droplet stream direction onto the printed media or into a gutter for recirculation by applying an electric field to previously charged inkjet droplets.

Drop-on-demand inkjet printer

- This technology was led to the market in 1977 when Siemens introduced the PT-80 serial character printer. The drop-on-demand printer ejects ink droplets only when they are needed to print on the media.

- This method eliminates the complexity of the hardware required for the continuous inkjet printing technology. In these first inkjet printers ink drops are ejected by a pressure wave created by the mechanical motion of the piezoelectric ceramic.

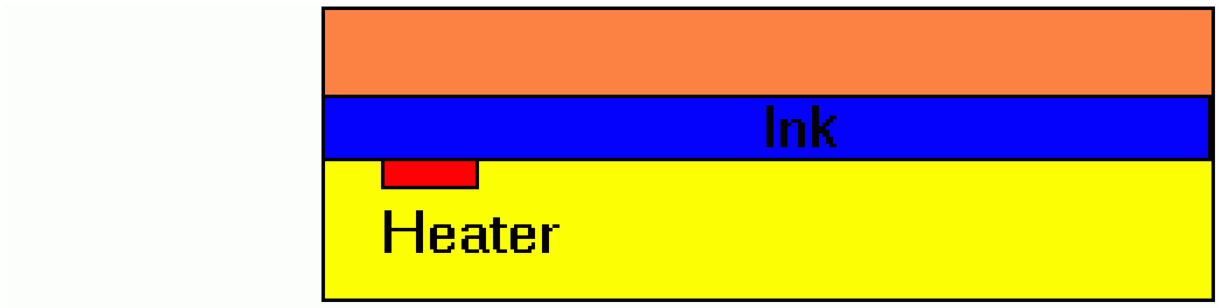
Inkjet printer drop-on-demand technology with piezoelectric actuator



- At the same time Canon developed the **bubble jet printer technology**, a drop-on-demand inkjet printing method where ink drops were ejected from the nozzle by the fast growth of an ink vapor bubble on the top surface of a small heater.

- Shortly thereafter, Hewlett-Packard independently developed a similar inkjet printing technology and named it **thermal inkjet**.

Bubble jet printer drop-on-demand technology



- The most popular inkjet and bubble-jet printers use serial printing process. Similarly to dot matrix printers, serial inkjet printers use print heads with a number of nozzles arranged in vertical columns.

- The printing process is the same as in dot matrix printers.

Serial Inkjet printer

- There are also available inkjet and bubble-jet printers analogous to line dot matrix printers for high speed printing applications.
- The image printing process is similar to that in LED printers.

Line inkjet printer

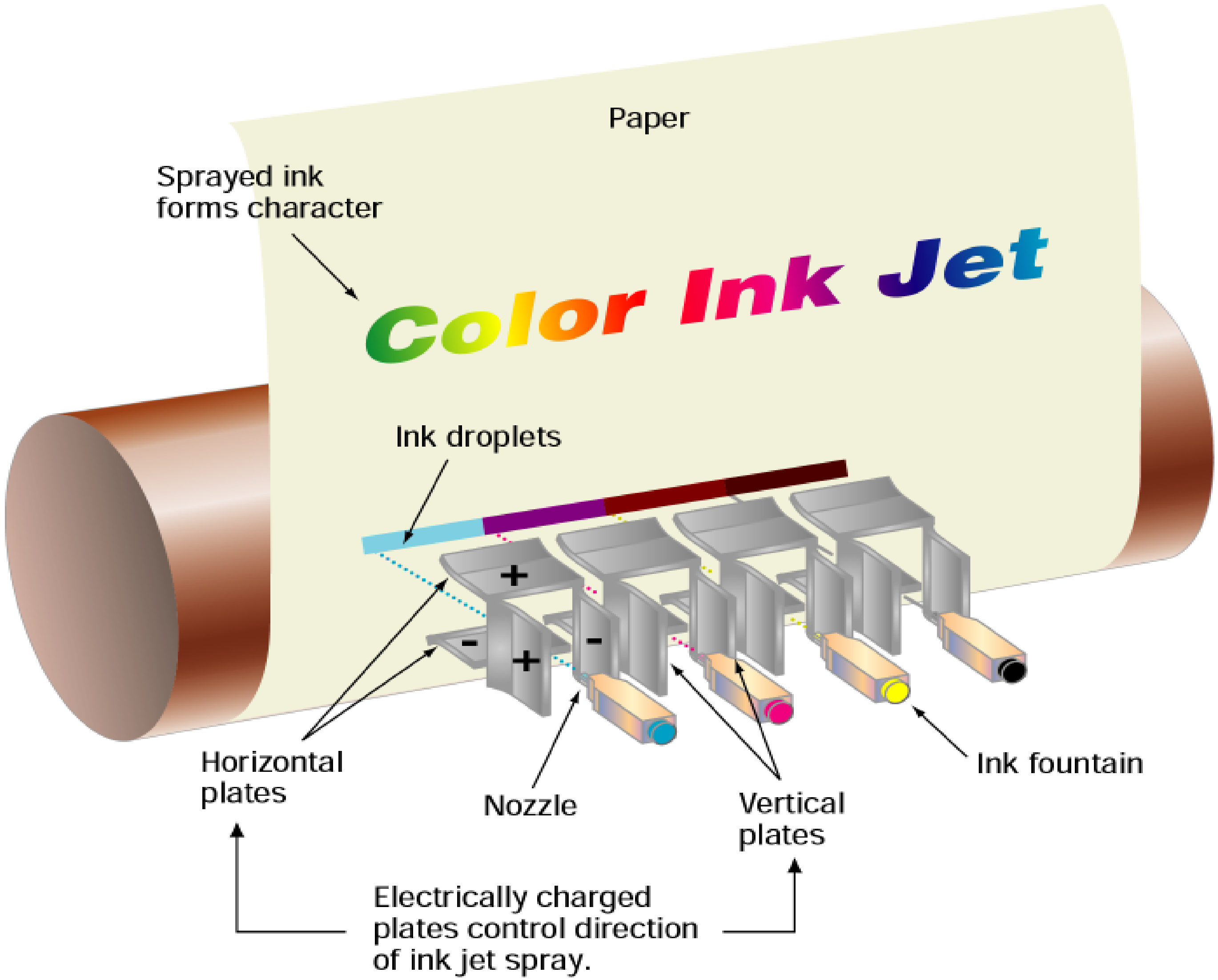
- The greatest advantages of inkjet printers are, quiet operation, capability to produce color images even with photographic quality and the low printer prices.
- The down side is that although inkjet printers are generally cheaper to buy than lasers, they are far more expensive to maintain.
- When it comes to comparing the cost per page, ink jet printers work out many times more expensive than laser printers.
- There are some exceptions of course for some heavy-duty industrial printers.
- From Tally claim the T3016 SprintJet prints at only 1/3 of a cent per page.

Printer Features:	**Specifications**
Print Technology	Inkjet or Bubble-jet
Print Speed PPM (pages per minute)	1 - 20 PPM
Graphics Resolution	300 - 1200 DPI
Copies (Original +)	0
Workload (Duty cycle) PPM (Pages per month)	6,000 - 60,000 PPM

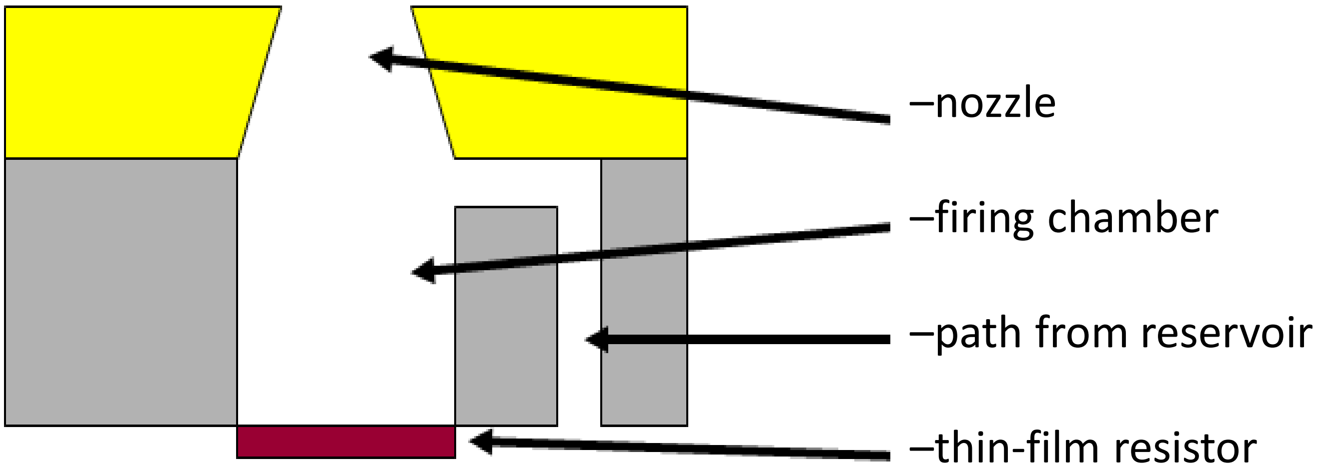
Working principle of Ink-jet printers

- Inkjet printers – let us spray
- Inkjet printers literally spray liquid ink through a miniature nozzle
- similar to your garden hose nozzle. These printers are very quiet and are moderately priced, and the print quality rivals that of a laser printer.
- The printhead contains 4 cartridges of different colored ink: cyan (blue),magenta, yellow and black (CMYK). It moves along a bar from one side of the paper to the other, writing as it goes. The formatting information and data sent to it activates the chambers of the ink cartridges.
- When the designated nozzle is selected, an electrical pulse flows through thin resistors in the ink chambers that form the character to be printed.
- The resistor is heated and used to heat a thin layer of ink in each selected chamber, causing the ink to boil or expand to form a bubble of vapor.
- This expansion causes pressure on the ink, which pushes it through the nozzle onto the paper. Your page is printed.

Printing Mechanism



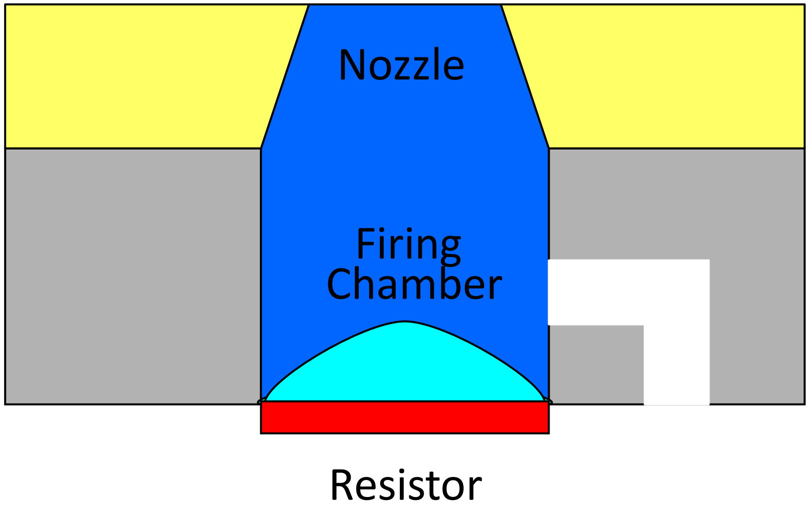
The Ink Cartridge



Cross-section of a nozzle.

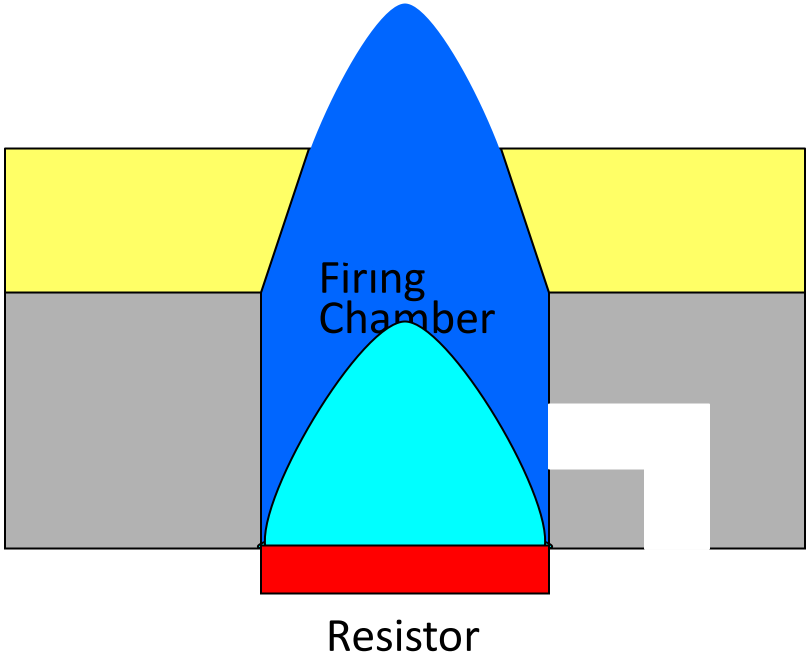
How does the ink get out? One of two ways:
The Thermal method or the Piezo-Electric method.

How the ink gets out: Thermal Method



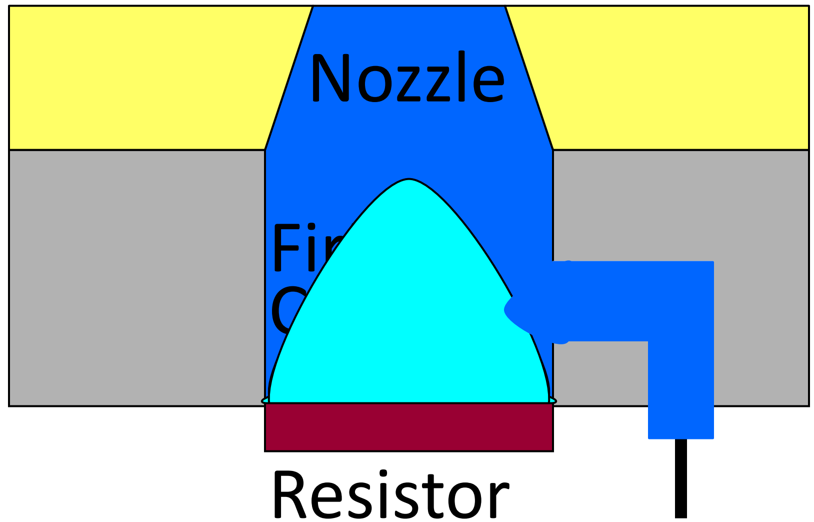
- ❑ Used by Hewlett Packard & Canon
- ❑ A thin-film resistor is heated by electric current.
- ❑ The resistor heats up the ink that is next to it.

How the ink gets out: Thermal Method



- The ink- now gaseous - expands, forming a bubble.
- The bubble pushes out the rest of the ink in the firing chamber.

How the ink gets out: Thermal Method



- The resistor cools, causing the bubble to shrink.
- The shrinking creates a vacuum, which draws new ink from the reservoir.
- The piezo method uses a flexing, swelling crystal instead of heat to push the ink out.

Advantages of Inkjet printers

- The colour is perfect.
- It is faster the dot matrix, daisy wheel and laser printers.
- Most models are relatively light weight and compact so they don't take up too much space on the desk.

Disadvantages of Inkjet printers

- Due to the cost of ink, running an inkjet printer over time is a more expensive than a laser printer.
- Prints emerge from the printer slightly wet and may need time to dry.
- Printing is slower and therefore inkjets aren't designed for high volume printing.

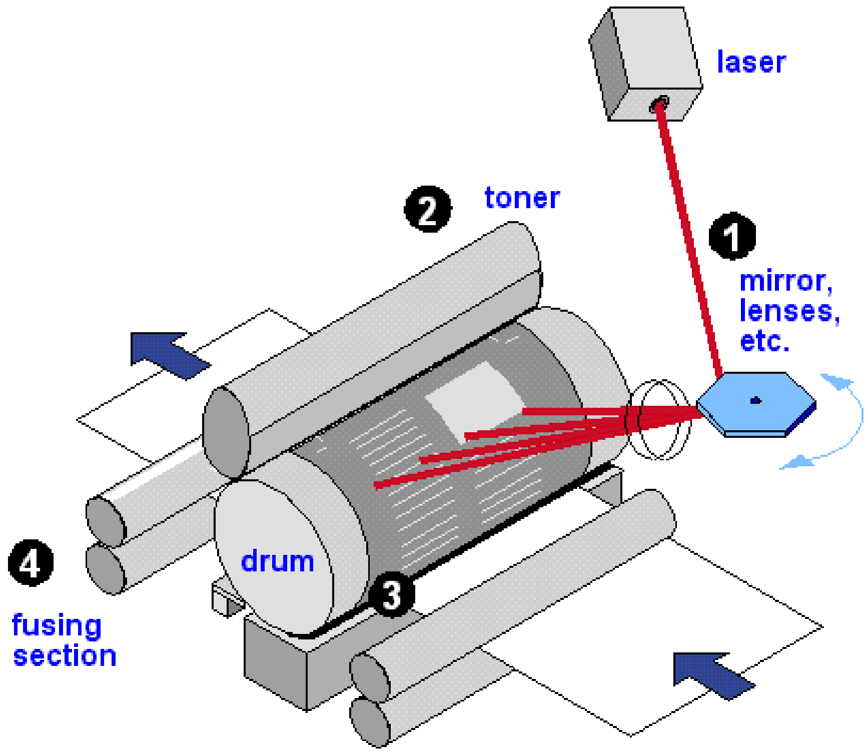
Laser printers

Introduction - Laser printers

- In 1975, IBM introduced the first laser printer, the model 3800. Later, Siemens came out with the ND 2 and Xerox with the 9700. These self-contained printing presses were online to a mainframe or offline, accepting print image data on tape or disk.

- In 1984, HP introduced the LaserJet, the first desktop laser printer, which rapidly became a huge success and a major part of the company's business. Desktop lasers made the clackety daisy wheel printers obsolete, but not dot matrix printers, which are still widely used for labels and multipart forms.

The Laser Mechanism



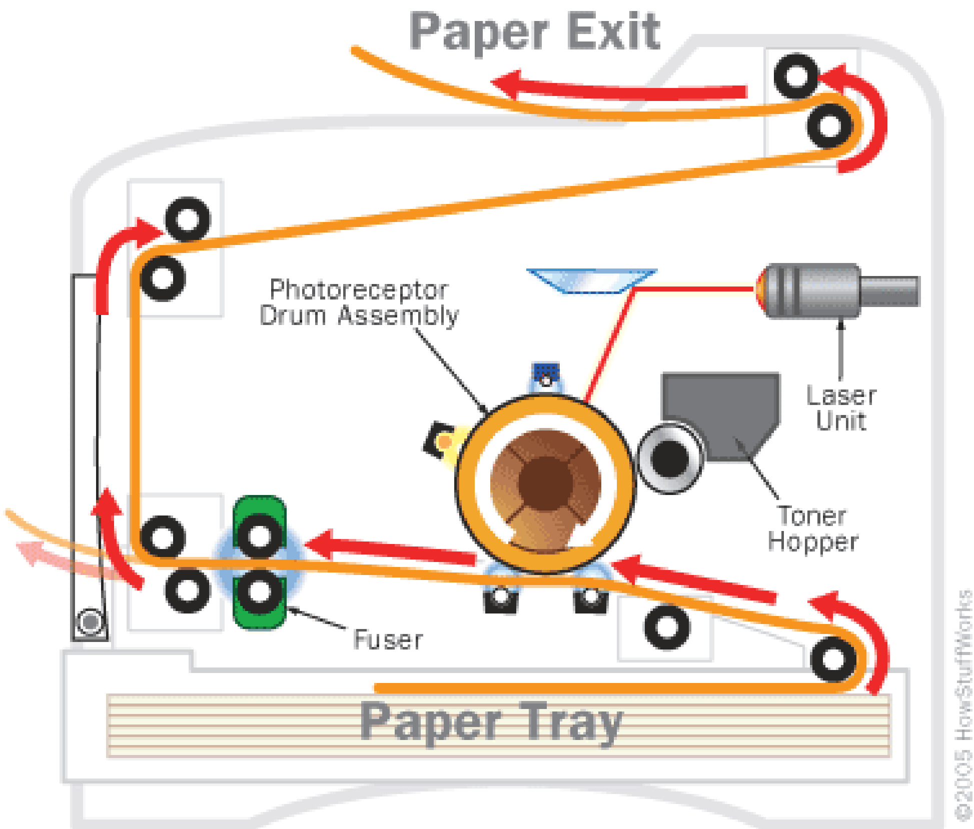
- The laser printer uses electrostatic charges to (1) create an image on the drum, (2) adhere toner to the image, (3) transfer the toned image to the paper, and (4) fuse the toner to the paper. The laser creates the image by "painting" a negative of the page to be printed on the charged drum. Where light falls, the charge is dissipated, leaving a positive image to be printed.

Working principle - Laser printers

The Basics: Static Electricity

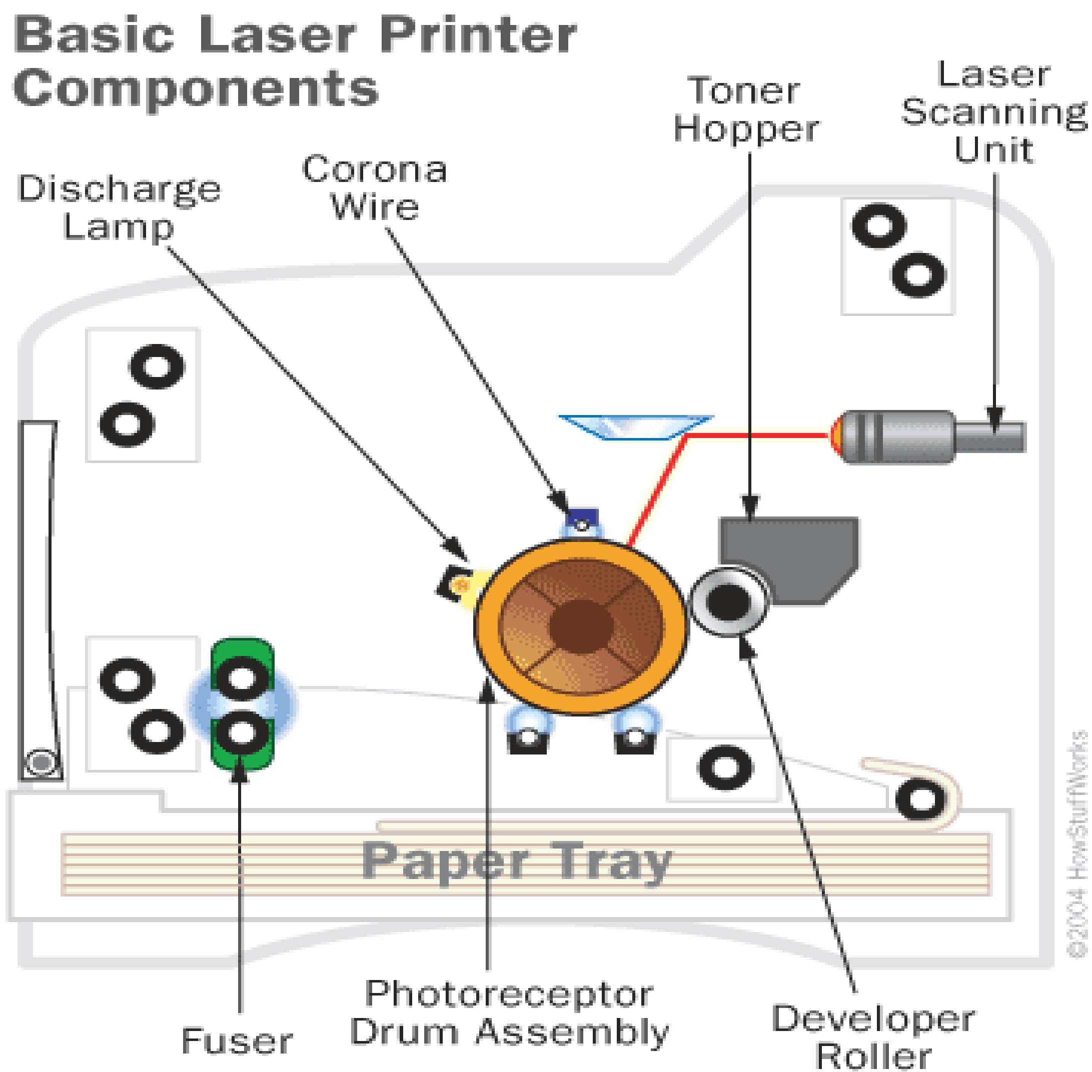
- The primary principle at work in a laser printer is static electricity, the same energy that makes clothes in the dryer stick together or a lightning bolt travel from a thundercloud to the ground.

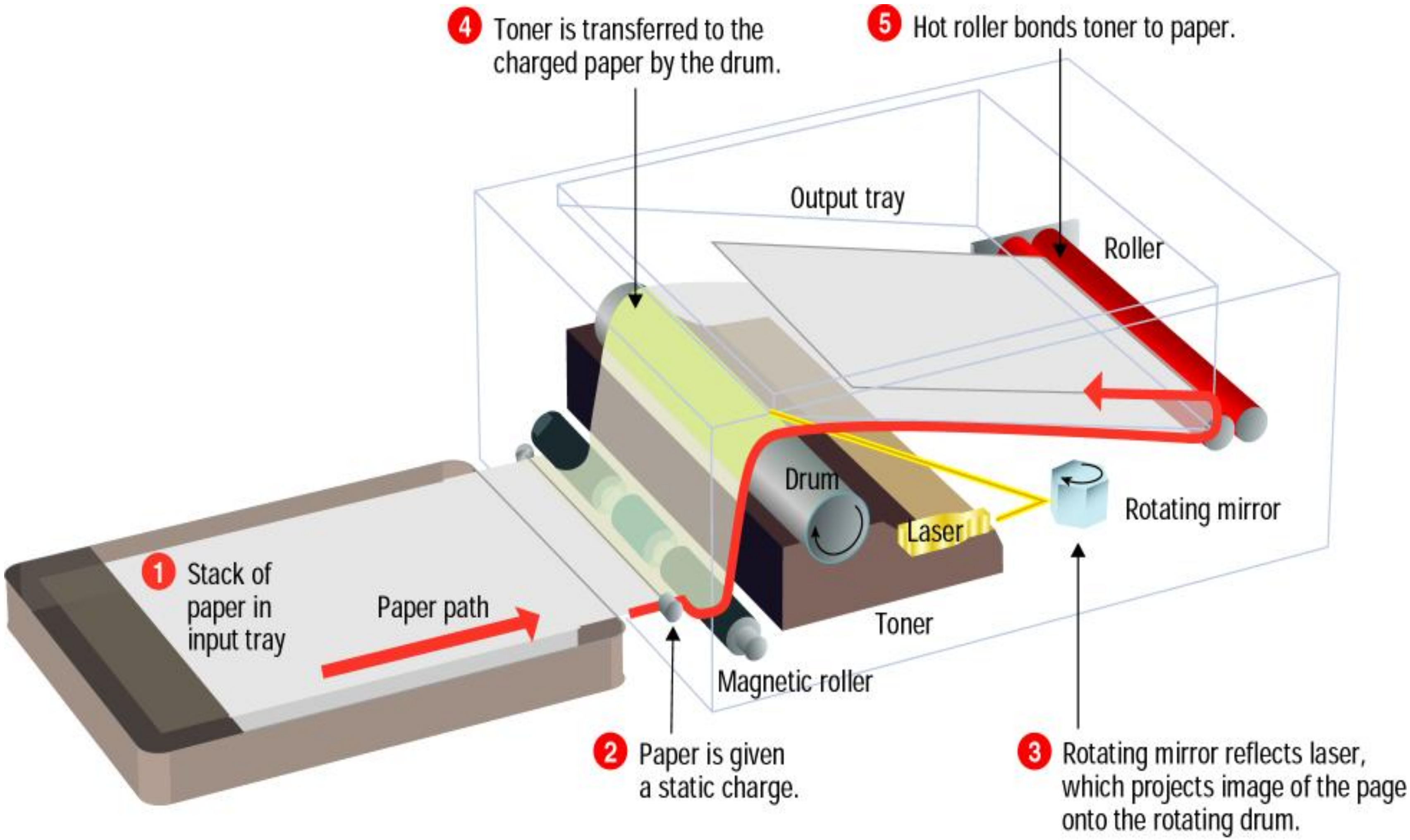
- Static electricity is simply an electrical charge built up on an **insulated object**, such as a balloon or your body. Since oppositely charged atoms are attracted to each other, objects with opposite static electricity fields cling together.



- A laser printer uses this phenomenon as a sort of "temporary glue." The core component of this system is the **photoreceptor**, typically a revolving drum or cylinder.

- This **drum assembly** is made out of highly **photoconductive** material that is discharged by [light photons](#).


Basic Laser Printer Components
Toner Hopper
Laser Scanning Unit
Discharge Lamp
Corona Wire
Paper Tray
©2004 HowStuffWorks
Fuser
Photoreceptor Drum Assembly
Developer Roller

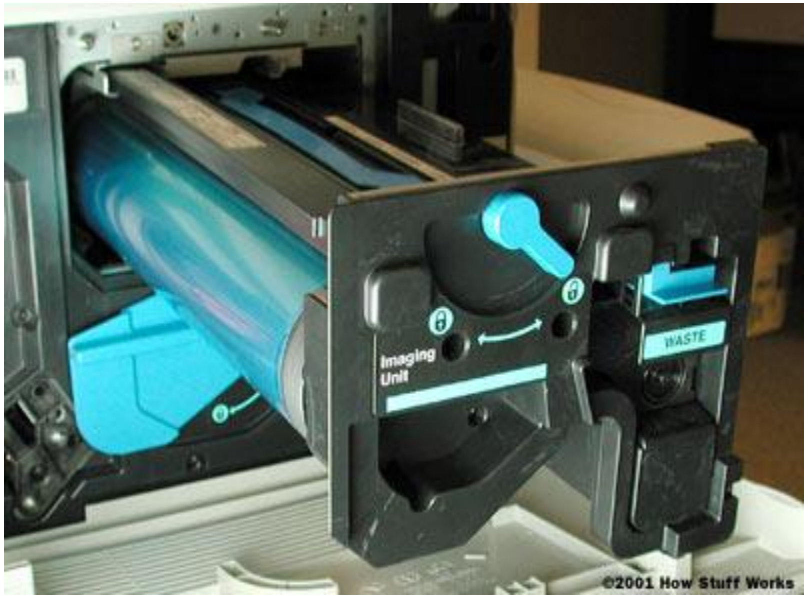

4 Toner is transferred to the charged paper by the drum.
5 Hot roller bonds toner to paper.
Output tray
Roller
Drum
Laser
Rotating mirror
1 Stack of paper in input tray
Paper path
Toner
Magnetic roller
2 Paper is given a static charge.
3 Rotating mirror reflects laser, which projects image of the page onto the rotating drum.

The Basics: Drum

- Initially, the drum is given a total **positive charge** by the **charge corona wire**, a wire with an electrical current running through it. (Some printers use a **charged roller** instead of a corona wire, but the principle is the same.)

- As the drum revolves, the printer shines a tiny laser beam across the surface to discharge certain points. In this way, the laser "draws" the letters and images to be printed as a pattern of electrical charges -- an **electrostatic image**. The system can also work with the charges reversed -- that is, a positive electrostatic image on a negative background

The laser "writes" on a photoconductive revolving drum.

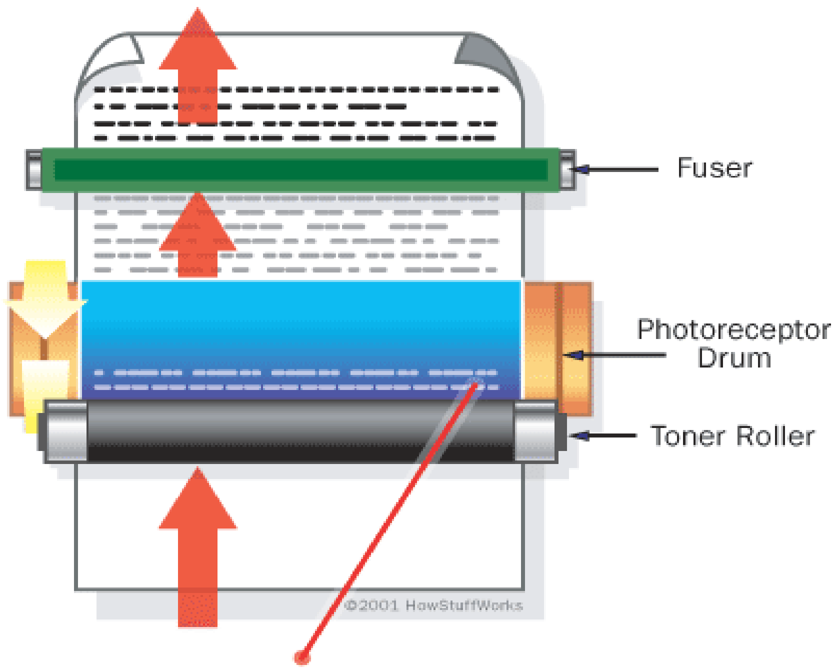


- After the pattern is set, the printer coats the drum with positively charged **toner** -- a fine, black powder. Since it has a positive charge, the toner clings to the negative discharged areas of the drum, but not to the positively charged "background." This is something like writing on a soda can with glue and then rolling it over some flour: The flour only sticks to the glue-coated part of the can, so you end up with a message written in powder.

- With the powder pattern affixed, the drum rolls over a sheet of paper, which is moving along a belt below. Before the paper rolls under the drum, it is given a negative charge by the **transfer corona wire** (charged roller). This charge is stronger than the negative charge of the electrostatic image, so the paper can pull the toner powder away. Since it is moving at the same speed as the drum, the paper picks up the image pattern exactly. To keep the paper from clinging to the drum, it is discharged by the **detac corona wire** immediately after picking up the toner.

The Basics: Fuser

- Finally, the printer passes the paper through the fuser, a pair of heated rollers. As the paper passes through these rollers, the loose toner powder melts, fusing with the fibers in the paper. The fuser rolls the paper to the output tray, and you have your finished page. The fuser also heats up the paper itself, of course, which is why pages are always hot when they come out of a laser printer or photocopier.



- So what keeps the paper from burning up? Mainly, *speed* -- the paper passes through the rollers so quickly that it doesn't get very hot.

- After depositing toner on the paper, the drum surface passes the discharge lamp. This bright light exposes the entire photoreceptor surface, erasing the electrical image. The drum surface then passes the charge corona wire, which reapplies the positive charge.

- Conceptually, this is all there is to it. Of course, actually bringing everything together is a lot more complex. In the following sections, we'll examine the different components in greater detail to see how they produce text and images so quickly and precisely.

The Controller: The Conversation

- Before a laser printer can do anything else, it needs to receive the Page data and figure out how it's going to put everything on the paper. This is the job of the **printer controller**.
- The printer controller is the laser printer's main onboard computer. It talks to the host computer (for example, your PC) through a communications port, such as a parallel port or USB port. At the start of the printing job, the laser printer establishes with the host computer how they will exchange data.
- The controller may have to start and stop the host computer periodically to process the information it has received.

A typical laser printer has a few different types of communications ports.

- In an office, a laser printer will probably be connected to several separate host computers, so multiple users can print documents from their machine. The controller handles each one separately, but may be carrying on many "conversations" concurrently. This ability to handle several jobs at once is one of the reasons why laser printers are so popular.

The Controller: The Language

- For the printer controller and the host computer to communicate, they need to speak the same **page description language**. In earlier printers, the computer sent a special sort of text file and a simple code giving the printer some basic formatting information. Since these early printers had only a few fonts, this was a very straightforward process.

- These days, you might have hundreds of different fonts to choose from, and you wouldn't think twice about printing a complex graphic. To handle all of this diverse information, the printer needs to speak a more advanced language.

- The primary printer languages these days are Hewlett Packard's **Printer Command Language** (PCL) and Adobe's **Postscript**. Both of these languages describe the page in **vector** form -- that is, as mathematical values of geometric shapes, rather than as a series of dots (a **bitmap** image).

- The printer itself takes the vector images and converts them into a bitmap page. With this system, the printer can receive elaborate, complex pages, featuring any sort of font or image. Also, since the printer creates the bitmap image itself, it can use its maximum printer resolution.

- Some printers use a **graphical device interface** (GDI) format instead of a standard PCL. In this system, the host computer creates the dot array itself, so the controller doesn't have to process anything -- it just sends the dot instructions on to the laser.

- But in most laser printers, the controller must organize all of the data it receives from the host computer. This includes all of the commands that tell the printer what to do -- what paper to use, how to format the page, how to handle the font, etc. For the controller to work with this data, it has to get it in the right order.

The Controller: Setting up the Page

- Once the data is structured, the controller begins putting the page together. It sets the text margins, arranges the words and places any graphics. When the page is arranged, the **raster image processor** (RIP) takes the page data, either as a whole or piece by piece, and breaks it down into an array of tiny dots. As we'll see in the next section, the printer needs the page in this form so the laser can write it out on the photoreceptor drum.

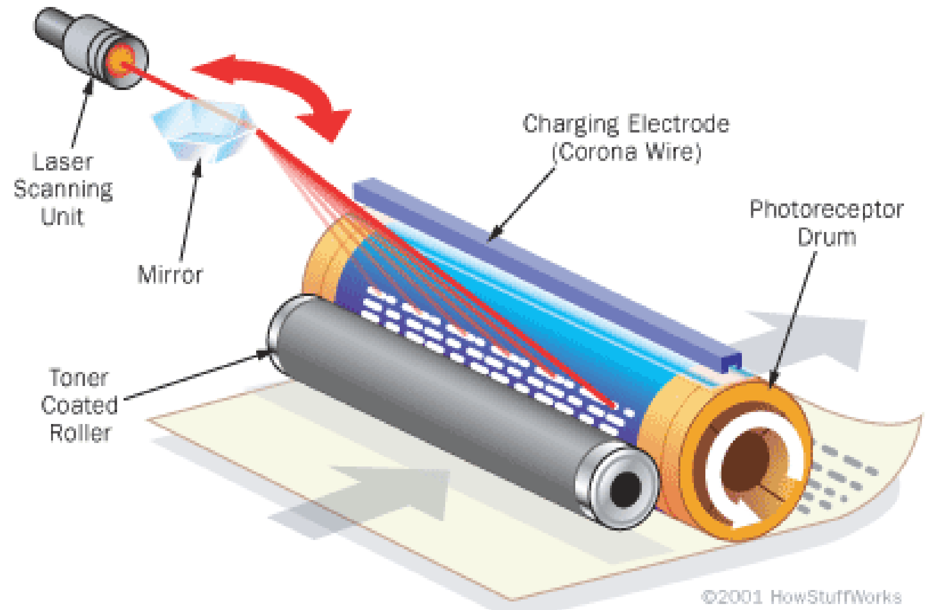
- In most laser printers, the controller saves all print-job data in its own memory. This lets the controller put different printing jobs into a **queue** so it can work through them one at a time. It also saves time when printing multiple copies of a document, since the host computer only has to send the data once.

The Laser Assembly

Since it actually draws the page, the printer's laser system -- or **laser scanning assembly** -- must be incredibly precise. The traditional laser scanning assembly includes:

- A **laser**
- A **movable mirror**
- A **lens**

The laser receives the page data -- the tiny dots that make up the text and images -- one horizontal line at a time. As the beam moves across the drum, the laser emits a pulse of light for every dot to be printed, and no pulse for every dot of empty space.



- The laser doesn't actually move the beam itself. It bounces the beam off a movable **mirror** instead. As the mirror moves, it shines the beam through a series of **lenses**. This system compensates for the image distortion caused by the varying distance between the mirror and points along the drum.

Writing the Page

- The laser assembly moves in only one plane, horizontally. After each horizontal scan, the printer moves the photoreceptor drum up a notch so the laser assembly can draw the next line. A small print-engine computer synchronizes all of this perfectly, even at dizzying speeds.

- Some laser printers use a strip of light emitting diodes (LEDs) to write the page image, instead of a single laser. Each dot position has its own dedicated light, which means the printer has one set print resolution. These systems cost less to manufacture than true laser assemblies, but they produce inferior results. Typically, you'll only find them in less expensive printers.

Toner Basics

- One of the most distinctive things about a laser printer (or photocopier) is the toner. It's such a strange concept for the paper to grab the "ink" rather than the printer applying it. And it's even stranger that the "ink" isn't really ink at all.

- So what is toner? The short answer is: It's an electrically-charged powder with two main ingredients: **pigment** and **plastic**.

- The role of the pigment is fairly obvious -- it provides the coloring (black, in a monochrome printer) that fills in the text and images. This pigment is blended into plastic particles, so the toner will melt when it passes through the heat of the fuser. This quality gives toner a number of advantages over liquid ink. Chiefly, it firmly binds to the fibers in almost any type of paper, which means the text won't smudge or bleed easily.

Applying Toner

- So how does the printer apply this toner to the electrostatic image on the drum? The powder is stored in the **toner hopper**, a small container built into a removable casing. The printer gathers the toner from the hopper with the **developer unit**.

- The "developer" is actually a collection of small, negatively charged magnetic beads. These beads are attached to a rotating metal roller, which moves them through the toner in the toner hopper.

- Because they are negatively charged, the developer beads collect the positive toner particles as they pass through. The roller then brushes the beads past the drum assembly.

- The electrostatic image has a stronger negative charge than the developer beads, so the drum pulls the toner particles away.

In a lot of printers, the toner hopper, developer and drum assembly are combined in one replaceable cartridge.

- The drum then moves over the paper, which has an even stronger charge and so grabs the toner. After collecting the toner, the paper is immediately discharged by the detac corona wire. At this point, the only thing keeping the toner on the page is gravity -- if you were to blow on the page, you would completely lose the image. The page must pass through the fuser to affix the toner.

- The fuser rollers are heated by internal **quartz tube lamps**, so the plastic in the toner melts as it passes through.

- But what keeps the toner from collecting on the fuser rolls, rather than sticking to the page? To keep this from happening, the fuser rolls must be coated with **Teflon**, the same non-stick material that keeps your breakfast from sticking to the bottom of the frying pan.

Color Printers

- Initially, most commercial laser printers were limited to monochrome printing (black writing on white paper). But now, there are lots of color laser printers on the market.

- Essentially, color printers work the same way as monochrome printers, except they go through the entire printing process four times -- one pass each for cyan (blue), magenta (red), yellow and black. By combining these four colors of toner in varying proportions, you can generate the full spectrum of color.

- There are several different ways of doing this. Some models have four toner and developer units on a rotating wheel. The printer lays down the electrostatic image for one color and puts that toner unit into position. It then applies this color to the paper and goes through the process again for the next color. Some printers add all four colors to a plate before placing the image on paper.

- Some more expensive printers actually have a complete printer unit -- a laser assembly, a drum and a toner system -- for each color. The paper simply moves past the different drum heads, collecting all the colors in a sort of assembly line.

Advantages of Laser printers

- ❑ Colour printing is possible
- ❑ Print quality is good
- ❑ Noiseless
- ❑ Printing speed is high
- ❑ Most models are relatively light weight and compact so they don't take up too much space on the desk

Disadvantages of Laser printers

- ❑ Not be the printer of choice for everyone, Due to the cost of ink, running an inkjet printer over time is a more expensive than a laser printer.
- ❑ Prints emerge from the printer slightly wet and may need time to dry.
- ❑ Printing is slower and therefore inkjets aren't designed for high volume printing

Plotter

- A plotter is a computer vector graphic printer that gives a hard copy of the output based on instructions from the system. Plotters are widely used to print designs of things such as cars, ships and buildings on a piece of paper using a pen.

- Plotters are different than a printer in that they are more precise and they are most commonly used in engineering, where precision is mandatory. They are also more expensive than ordinary printers. A plotter is also known as a graph plotter.

- Plotters are widely used in engineering projects because they can produce continuous lines, in contrast to ordinary printers that conventionally drew lines using closely spaced dots.

- Plotters come in various forms. Most plotters use a pen to draw the design onto paper. However, a 3-D plotter (cutting plotter) uses knives to cut out a piece of material based on instructions from the computer.

- The object to be cut is placed on the flat surface in front of the plotter the computer sends cutting dimensions and designs for the plotter to produce a precisely carved design, and potentially repeat the cutting process on hundreds of objects, producing identical copies of the same design.

Plotter Types

Drawing Plotter

- A type of pen plotter that wraps the paper around a drum with a pin feed attachment. The drum turns to produce one direction of the plot, and the pens move to provide the other. The plotter was the first output device to print graphics and large engineering drawings.

Flatbed Plotter

- A graphics plotter that contains a flat surface that the paper is placed on. The size of this surface (bed) determines the maximum size of the drawing.

Electrostatic Plotter

- A plotter that uses an electrostatic method of printing. Liquid toner models use a positively charged toner that is attracted to paper which is negatively charged by passing by a line of electrodes (tiny wires or nibs). Models print in black and white or color, and some handle paper up to six feet wide. Newer electrostatic plotters are really large-format laser printers and focus light onto a charged drum using lasers or LEDs

Plotter- Types

Drum Plotter

Flat bed Plotter

Advantages of plotters

- Plotters can work on very large sheets of paper while maintaining high resolution.
- They can print on a wide variety of flat materials including plywood, aluminum, sheet steel, cardboard, and plastic.
- Plotters allow the same pattern to be drawn thousands of times without any image degradation.

Disadvantages of plotters

- Plotters are quite large when compared to a traditional printer.
- Plotters are also much more expensive than a traditional printer.

Speakers

- Speakers are one of the most common output devices used with computer systems.
- They receive audio input from the computer's sound card and produce audio output in the form of sound waves.
- Some speakers are designed to work specifically with computers, while others can be hooked up to any type of sound system.
- Most computer speakers are active speakers, meaning they have an internal amplifier which allows you to increase the volume, or amplitude, of the sound.
- Speakers usually come in pairs, which allows them to produce stereo sound from two separate audio channels.
- Regardless of their design, the purpose of speakers is to produce audio out that can be heard by the listener.
- Speakers are connected to the green color analog audio out port of the computer

Multimedia - Speakers

Safety Handling

Safety Handling

General Safety

- Safe working conditions help prevent injury to people and damage to computer equipment. A safe workspace is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow the basic safety guidelines to prevent cuts, burns, electrical shock, and damage to eyesight. As a best practice, make sure that a fire extinguisher and first-aid kit are available in case of fire or injury.
- Poorly placed or unsecured cables can cause tripping hazards in a network installation. Cables should be installed in conduit or cable trays to prevent hazards.

This is a partial list of basic safety precautions to use when working on a computer:

- Remove your watch and jewelry and secure loose clothing.
- Turn off the power and unplug equipment before performing service.
- Cover sharp edges inside the computer case with tape.
- Never open a power supply or a CRT Monitor.
- Do not touch areas in printers that are hot or that use high voltage.
- Know where the fire extinguisher is located and how to use it.
- Keep food and drinks out of your workspace.
- Keep your workspace clean and free of clutter.
- Bend your knees when lifting heavy objects to avoid injuring your back.

Electrical Safety

Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace. Power supplies and CRT monitors contain high voltage.

CAUTION

- Do not wear the antistatic wrist strap when repairing power supplies or CRT monitors. Only experienced technicians should attempt to repair power supplies and CRT monitors.
- Some printer parts become hot during use, and other parts might contain high voltage. Check the printer manual for the location of high-voltage components. Some components retain a high voltage even after the printer is turned off. Make sure that the printer has had time to cool before making the repair.
- Electrical devices have certain power requirements. For example, AC adapters are manufactured for specific laptops. Exchanging power cords with a different type of laptop or device may cause damage to both the AC adapter and the laptop.

Fire Safety

- Follow fire safety guidelines to protect lives, structures, and equipment. To avoid an electrical shock and to prevent damage to the computer, turn off and unplug the computer before beginning a repair.

- Fire can spread rapidly and be very costly. Proper use of a fire extinguisher can prevent a small fire from getting out of control. When working with computer components, be aware of the possibility of an accidental fire and know how to react. Be alert for odors emitting from computers and electronic devices. When electronic components overheat or short out, they emit a burning odor. If there is a fire, follow these safety procedures:

  - Never fight a fire that is out of control or not contained.
  - Always have a planned fire escape route before beginning any work.
  - Get out of the building quickly.
  - Contact emergency services for help.
  - Locate and read the instructions on the fire extinguishers in your workplace before you have to use them.

- Be familiar with the types of fire extinguishers used in your country or region. Each type of fire extinguisher has specific chemicals to fight different types of fires:

  - Paper, wood, plastics, cardboard
  - Gasoline, kerosene, organic solvents
  - Electrical equipment
  - Combustible metals

- It is important to know how to use a fire extinguisher. Use the memory aid P-A-S-S to remember the basic rules of fire extinguisher operation:

  - **P:** Pull the pin.
  - **A:** Aim at the base of the fire, not at the flames.
  - **S:** Squeeze the lever.
  - **S:** Sweep the nozzle from side to side.

PC Assembling/Disassembling

PC Assembling

Assembling computers is a large part of a technician’s job. As a technician, you will need to work in a logical, methodical manner when working with computer components. As with any learned trade, your computer assembly skills will improve dramatically with practice.

1.Open the Case

- Computer cases are produced in a variety of form factors. Form factors refer to the size and shape of the case. Prepare the workspace before opening the computer case.

- There should be adequate lighting, good ventilation, and a comfortable room temperature. The workbench or table should be accessible from all sides.

- Avoid cluttering the surface of the workbench or table with tools and computer components. An antistatic mat on the table will help prevent physical and ***electrostatic discharge (ESD)*** damage to equipment.

- Small containers can be used to hold small screws and other parts as they are being removed.

There are different methods for opening cases. Most computer cases are opened in one of the following ways:

- ❑ The computer case cover can be removed as one piece.
- ❑ The top and side panels of the case can be removed.
- ❑ The top of the case may need to be removed before the side panels can be removed.
- ❑ Tool-less entries allow technicians to enter a case without the use of tools.

2.**Install the Power Supply**

- ❑ Most ***power supplies*** can fit into the computer case in only one way.
- ❑ There are usually three or four screws that attach the power supply to the case.
- ❑ Power supplies have fans that can vibrate and loosen screws that are not secured.
- ❑ When installing a power supply, make sure that all of the screws are used and that they are properly tightened.

These are the power supply installation steps:

Step 1. Insert the power supply into the case.
Step 2. Align the holes in the power supply with the holes in the case.
Step 3. Secure the power supply to the case using the proper screws.

3.Attach the Components to the Motherboard and Install the Motherboard

This section details the steps to install components on the ***motherboard*** and then install the motherboard into the computer case.

After completing this section, you will meet these objectives:

- Install a CPU and a heat sink/fan assembly.
- Install the RAM.
- Install the motherboard.

3A.Install a CPU and a Heat Sink/Fan Assembly

The ***central processing unit (CPU)*** and the heat sink/fan assembly may be installed on the motherboard before the motherboard is placed in the computer case.
CPU
The CPU and motherboardare sensitive to electrostatic discharge. When handling a CPU and motherboard, make sure that you place them on a grounded antistatic mat. You should wear an antistatic wriststrap while working with these components.

Key electrostatic-sensitive components include the following:

- CPUs
- Motherboards
- RAM
- Expansion cards
- Hard disk drive electronics

Caution

When handling a CPU, do not touch the CPU contacts at any time.

- The CPU is secured to the socket on the motherboard with a locking assembly.
- The CPU sockets today are ***zero insertion force (ZIF) sockets***.
- You should be familiar with the locking assembly before attempting to install a CPU into the socket on the motherboard.
- Orient the missing pin in the corner of the CPU to the missing hole on the socket.
- ***Thermal compound*** helps to conduct heat away from the CPU.

Caution

- Silver-oxide thermal compound is toxic. Use rubber gloves and wash your hands thoroughly afterward. It does not take very much compound to fill the space between the CPU and heat sink. If you use too much it will leak onto the motherboard. When you are installing a used CPU, clean the CPU and the base of the heat sink with ***isopropyl alcohol***. Doing this removes all traces of old thermal compound. The surfaces are now ready for a new layer of thermal compound. Follow all manufacturer recommendations about applying the thermal compound.

3B.Heat Sink/Fan Assembly

- It is a two-part cooling device. The heat sink draws heat away from the CPU. The fan moves the heat away from the heat sink. The heat sink/fan assembly usually has a 3-pin power connector.

Follow these instructions for CPU and heat sink/fan assembly installation:

Step 1. Align the CPU so that the Connection 1 indicator is lined up with Pin 1 on the CPU socket. Doing this ensures that the orientation notches on the CPU are aligned with the orientation keys on the CPU socket.

Step 2. Place the CPU gently into the socket.

Step 3. Close the CPU load plate and secure it in place by closing the load lever and moving it under the load lever retention tab.

Step 4. Apply a small amount of thermal compound to the CPU and spread it evenly. Follow the application instructions provided by the manufacturer.

Step 5. Align the heat sink/fan assembly retainers with the holes on the motherboard.

Step 6. Place the heat sink/fan assembly onto the CPU socket, being careful not to pinch the CPU fan wires.

Step 7. Tighten the heat sink/fan assembly retainers to secure the assembly in place.

Step 8. Connect the heat sink/fan assembly power cable to the header on the motherboard.

4.Install the RAM

- Like the CPU and the heat sink/fan assembly, ***random-access memory (RAM)*** is installed in the motherboard before the motherboard is secured in the computer case.

- Before you install a memory module, consult the motherboard documentation or website of the manufacturer to ensure that the RAM is compatible with the motherboard.

- RAM provides temporary data storage for the CPU while the computer is operating. RAM is ***volatile memory***, which means that its contents are lost when the computer is shut down.Typically, more RAM will enhance the performance of your computer.

Follow these steps for RAM installation:

Step 1. Align the notches on the RAM module with the keys in the slot and press down until the side tabs click into place.

Step 2. Make sure that the side tabs have locked the RAM module. Visually check for exposed contacts. Repeat these steps for additional RAM modules.

5.Install the Motherboard

- The motherboard is now ready to install in the computer case. Plastic and metal standoffs are used to mount the motherboard and to prevent it from touching the metal portions of the case.

- You should install only the standoffs that align with the holes in the motherboard. Installing any additional standoffs may prevent the motherboard from being seated properly in the computer case.

Follow these steps for motherboard installation:

Step 1. Install standoffs in the computer case.

Step 2. Align the I/O connectors on the back of the motherboard with the openings in the back of the case.

Step 3. Align the screw holes of the motherboard with the standoffs.

Step 4. Insert all of the motherboard screws.

Step 5. Tighten all of the motherboard screws.

6.Install Internal Drives

- Drives that are installed in internal bays are called internal drives. A ***hard disk drive (HDD)*** is an example of an internal drive.

Follow these steps for HDD installation:
Step 1. Position the HDD so that it aligns with the 3.5-inch drive bay.

Step 2. Insert the HDD into the drive bay so that the screw holes in the drive line up with the screw holes in the case.

Step 3. Secure the HDD to the case using the proper screws.

6A.Install Drives in External Bays

- Drives, such as ***optical drives*** and ***floppy disk drives (FDD)***, are installed in drive bays that are accessed from the front of the case. Optical drives and FDD store data on removable media. Drives in external bays allow access to the media without opening the case.

After completing this section, you will meet these objectives:
  - Install the optical drive.
  - Install the floppy drive.

6B.Install the Optical Drive

- An optical drive is a storage device that reads and writes information to CDs and DVDs. A ***Molex power connector*** provides the optical drive with power from the power supply. A PATA cable connects the optical drive to the motherboard. If you use a PATA data connector you might need a berg connector. To provides power to the (FDD), you will need the smaller berg power connector.

Follow these steps for optical drive installation:

Step 1. Position the optical drive so that it aligns with the 5.25-inch drive bay.

Step 2. Insert the optical drive into the drive bay so that the optical drive screw holes align with the screw holes in the case.

Step 3. Secure the optical drive to the case using the proper screws.

Caution

- If you use screws that are too long, you may damage the drive you are mounting.

6C.Install the Floppy Drive

- A floppy disk drive (FDD) is a storage device that reads and writes information to a floppy disk. A ***Berg power connector*** provides the FDD with power from the power supply. A floppy drive data cable connects the FDD to the motherboard.

Follow these steps for FDD installation:

Step 1. Position the FDD so that it aligns with the 3.5-inch drive bay.

Step 2. Insert the FDD into the drive bay so that the FDD screw holes align with the screw holes in the case.

Step 3. Secure the FDD to the case using the proper screws.

7.Install Adapter Cards

- ***Adapter cards*** are installed to add functionality to a computer. Adapter cards must be compatible with the expansion slot.

This section focuses on the installation of three types of adapter cards:

- PCIe x1 NIC
- PCI wireless NIC
- PCIe x16 video adapter card

After completing this section, you will meet these objectives:

- Install the NIC.
- Install the wireless NIC.
- Install the video adapter card.

7A.Install the NIC

- A ***network interface card (NIC)*** enables a computer to connect to a network. NICs use peripheral component interface (PCI) and PCIe expansion slots on the motherboard

Follow these steps for NIC installation:

Step 1. Remove the blank from the case where the new card will be installed so that the port can be accessed.

Step 2. Align the NIC with the appropriate expansion slot on the motherboard.

Step 3. Press down gently on the NIC until the card is fully seated.

Step 4. Secure the NIC PC mounting bracket to the case with the appropriate screw.

7B.Install the Wireless NIC

- A wireless NIC enables a computer to connect to a wireless network. Wireless NICs use PCI and PCIe expansion slots on the motherboard. Some wireless NICs are installed externally with a USB connector.

Follow these steps for wireless NIC installation:

Step 1. Align the wireless NIC with the appropriate expansion slot on the motherboard.

Step 2. Press down gently on the wireless NIC until the card is fully seated.

Step 3. Secure the wireless NIC PC mounting bracket to the case with the appropriate screw.

7C.Install the Video Adapter Card

- A ***video adapter card*** is the interface between a computer and a display monitor. An upgraded video adapter card can provide better graphic capabilities for games and graphic programs.

- Video adapter cards use PCI, advance graphics port (AGP), and PCIe expansion slots on the motherboard. If the BIOS does not automatically sense the new video card and disable the integrated one, you may need to do that manually through BIOS settings.

Follow these steps for video adapter card installation:

Step 1. Remove the expansion slot case blank.

Step 2. Align the video adapter card with the appropriate expansion slot on the motherboard.

Step 3. Press down gently on the video adapter card until the card is fully seated.

Step 4. Secure the video adapter card PC mounting bracket to the case with the appropriate screw.

8.Connect All Internal Cables

- Power cables are used to distribute electricity from the power supply to the motherboard and other components.

- Data cables transmit data between the motherboard and storage devices, such as hard drives.

- Additional cables connect the buttons and link lights on the front of the computer case to the motherboard.

After completing this section, you will meet these objectives:

  - Connect the power cables.
  - Connect the data cables.

9.Connect the Power Cables

- Power cables are brightly colored bundles of wires that branch out from the power supply. As the name suggests, they provide internal devices with electricity. There are several kinds of power connectors.

9A.Motherboard Power Connections

Just like other components, motherboards require power to operate. The ***Advanced Technology Extended (ATX)*** main power connector will have either 20 or 24 pins. The power supply may also have a 4-pin or 6-pin Auxiliary (AUX) power connector that connects to the motherboard. A 20-pin connector will work in a motherboard with a 24-pin socket.

Follow these steps for motherboard power cable installation:

Step 1. Align the 20-pin ATX power connector with the socket on the motherboard.
Step 2. Gently press down on the connector until the clip clicks into place.
Step 3. Align the 4-pin AUX power connector with the socket on the motherboard.
Step 4. Gently press down on the connector until the clip clicks into place.

9B.SATA Power Connectors

SATA power connectors use a 15-pin connector. ***Serial advanced technology attachment (SATA) power connectors*** are used to connect to hard disk drives, optical drives, or any devices that have a SATA power socket.

Molex Power Connectors

Hard disk drives and optical drives that do not have SATA power sockets use a Molex power connector.

Caution

- Do not use a Molex connector and a SATA power connector on the same drive at the same time. It will prevent the drive from working properly.

Berg Power Connectors

The 4-pin Berg power connector supplies power to a floppy drive.

Follow these steps for Berg power connector installation:

Step 1. Plug the SATA power connector into the HDD.

Step 2. Plug the Molex power connector into the optical drive.

Step 3. Plug the 4-pin Berg power connector into the FDD.

Step 4. Connect the 3-pin fan power connector into the appropriate fan header on the motherboard, according to the motherboard manual.

Step 5. Plug the additional cables from the case into the appropriate connectors according to the motherboard manual.

10.Connect the Data Cables

Drives connect to the motherboard using data cables. The drive being connected determines the type of data cable used. The types of data cables are PATA, SATA, and floppy disk.

10A.PATA Data Cables

The ***parallel advanced technology attachment (PATA) data cable*** is sometimes called a ribbon cable because it is wide and flat. The PATA cable can have either 40 or 80 conductors.

A PATA cable usually has three 40-pin connectors. One connector at the end of the cable connects to the motherboard. The other two connectors connect to drives. If multiple hard drives are installed, the master drive connects to the end connector. The slave drive connects to the middle connector.

A stripe on the data cable denotes the location of Pin 1. Plug the PATA cable into the drive with the Pin 1 indicator on the cable aligned with the Pin 1 indicator on the drive connector. The Pin 1 indicator on the drive connector is usually closest to the power connector on the drive. Many motherboards have two PATA drive controllers, providing support for a maximum of four PATA drives.

10B.SATA Data Cables

The ***SATA data cable*** has a 7-pin connector. One end of the cable is connected to the motherboard. The other end is connected to any drive that has a SATA data connector.

10C.Floppy Drive Data Cables

- The floppy drive data cable has a 34-pin connector. Like the PATA data cable, the floppy drive data cable has a stripe to denote the location of Pin 1.
- A floppy drive cable usually has three 34-pin connectors. One connector at the end of the cable connects to the motherboard.
- The other two connectors connect to drives. If multiple floppy drives are installed, the A: drive connects to the end connector. The B: drive connects to the middle connector.
- Plug the floppy drive data cable into the drive with the Pin 1 indicator on the cable aligned with the Pin 1 indicator on the drive connector.
- Motherboards have one floppy drive controller, providing support for a maximum of two floppy drives.

Note

- If Pin 1 on the floppy drive data cable is not aligned with Pin 1 on the drive connector, the floppy drive does not function. This misalignment does not damage the drive, but the drive activity light displays continuously. To fix this problem, turn off the computer and reconnect the data cable so that Pin 1 on the cable and Pin 1 on the connector are aligned. Reboot the computer.

11.Follow these steps for data cable installation:

Step 1. Plug the motherboard end of the PATA cable into the motherboard socket.
Step 2. Plug the connector at the far end of the PATA cable into the optical drive.
Step 3. Plug one end of the SATA cable into the motherboard socket.
Step 4. Plug the other end of the SATA cable into the HDD.
Step 5. Plug the motherboard end of the FDD cable into the motherboard socket.
Step 6. Plug the connector at the far end of the FDD cable into the floppy drive.
Step 7. Double check to make sure all cables are securely connected to the devices and to the motherboard.

Caution

- When attaching cables, never force a connection.

12.Connect all the front panel indicator and switches from the computer case

- Power switch
- Reset switch
- Power LED
- HDD LED
- Front panel Audio
- Front panel USB

13.Reattach the Side Panels to the Case

- Most computer cases have two panels, one on each side. Some computer cases have one three-sided cover that slides down over the case frame.

- When the cover is in place, make sure that it is secured at all screw locations. Some computer cases use screws that are inserted with a screwdriver. Other cases have knob-type screws that can be tightened by hand.

- Tool-less cases simply “click” closed.If you are unsure about how to remove or replace the computer case, refer to the documentation or website of the manufacturer for more information.

Caution

- Handle case parts with care. Some computer case covers have sharp or jagged edges.

Note

- ❑ Plug in the power cable after you have connected all other cables.

14.Connect External Cables to the Computer

- ❑ After the case panels have been reattached, connect the cables to the back of the computer.

Here are some common external cable connections:

- Monitor
- Keyboard
- Mouse
- USB
- Ethernet
- Power

When attaching cables, ensure that they are connected to the correct locations on the computer.

For example, some mouse and keyboard cables use the same type of PS/2 connector.

15.Follow these steps for external cable installation:

Step 1. Attach the monitor cable to the video port.
Step 2. Secure the cable by tightening the screws on the connector.
Step 3. Plug the keyboard cable into the PS/2 keyboard port.
Step 4. Plug the mouse cable into the PS/2 mouse port.
Step 5. Plug the USB cable into a USB port.
Step 6. Plug the network cable into the network port.
Step 7. Connect the wireless antenna to the antenna connector.
Step 8. Plug the power cable into the power supply.

16.Follow these steps for external cable installation:

- Plug the power cable into the AC outlet
- Switch on the system

PC Disassembling

- You can reverse the process of assembly of PC to disassemble it.

Queries ?

Thank You