

**Department of Collegiate and
Technical Education**

WEEK 4

SESSION 1

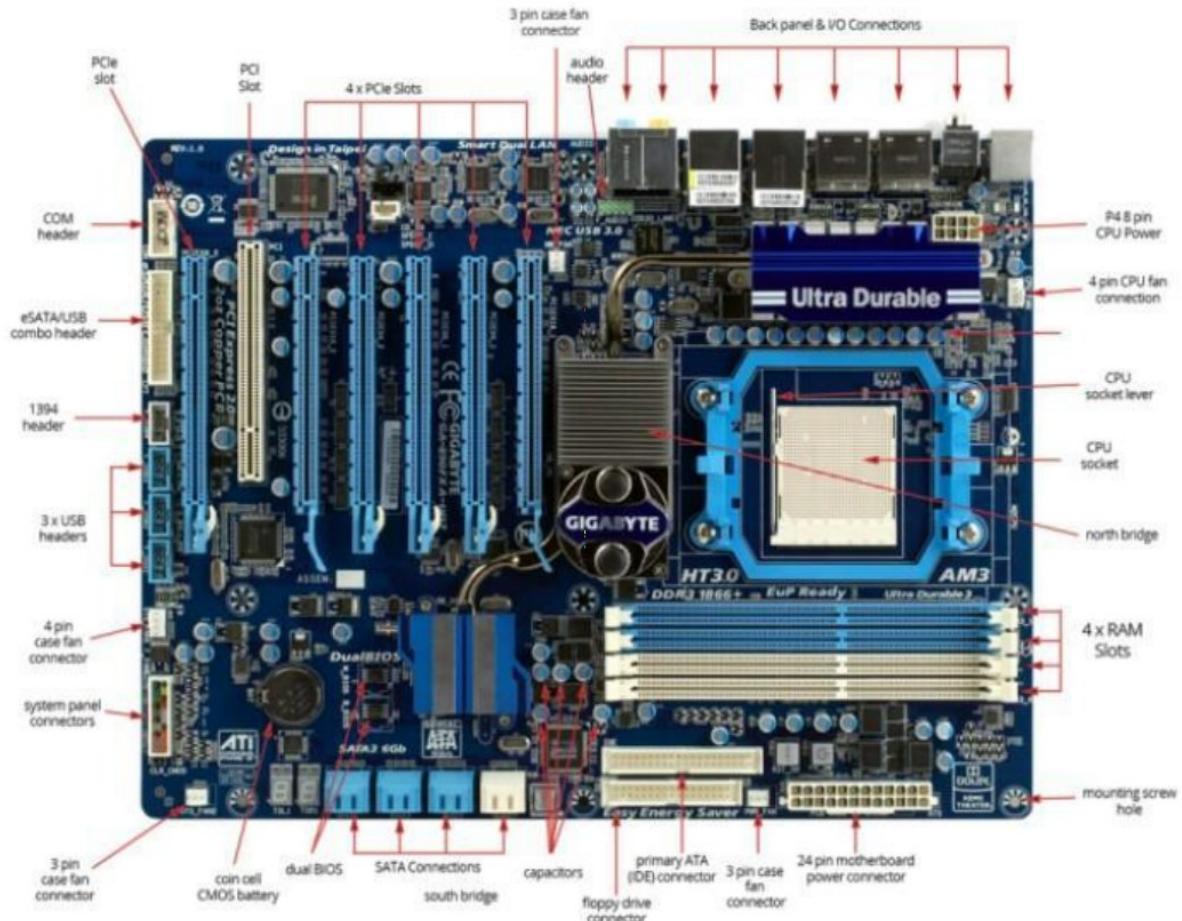
**COMPUTER HARDWARE MAINTAINACE &
ADMINISTRATION – 20CS32P**

MOTHERBOARD

4.1 Introduction

The motherboard is defined as a circuit board for the computer system, also called a logic board or mainboard. In the computer system, the biggest component is the motherboard that controls all the components of the computer system and establishes a link between all components. From the motherboard, different components like ROM, CPU, RAM, PCI slots, USB ports, and other components are connected. The controller device is also attached to the motherboard like DVD, hard drive, mouse, and keyboard. The computer system starts using the motherboard and these components act as the backbone for starting the system.

4.1.1 Components



1. CPU (Central Processing Unit) chip

CPU is the electronic circuitry in a computer that executes instructions that make up a program. It is also known as a central processor or the main processor.

2. RAM (Random Access Memory) slots

RAM is a kind of computer memory that can be read and written. It is mainly used to save data and machine code. A RAM device permits data to be read or written in nearly the same amount of time. Compared to the direct-access storage devices like hard drives, CD/DVD and magnetic tapes, RAM media is much faster for data reading and writing.

3. Northbridge

The north bridge, also known as host bridge or Memory Controller Hub, is connected directly to the CPU via the front-side bus (FSB). It is responsible for tasks requiring the highest

performance. Together with the south bridge, they manage communications between the CPU and other motherboard components.

4. Southbridge

The south bridge is an IC on the motherboard responsible for the hard drive controller, I/O controller and integrated hardware. Integrated hardware can include the sound card and video card if on the motherboard, USB, PCI, ISA, IDE, BIOS, and Ethernet.

5. BIOS (Basic Input / Output System)

BIOS, also called system BIOS, PC BIOS or ROM BIOS, is firmware that is used to perform hardware initialization during the booting process; and to provide runtime services for operating system and programs. The BIOS firmware is the first software to run when powered on; it is re-installed on a PC's system board.

6. I/O port

Input/output ports are the connections between the CPU and peripheral devices on a motherboard.

7. USB (Universal Serial Bus)

USB is an industry standard that creates specifications for connectors, cables and protocols for connection; power supply (interfacing) and communication among computers, computer peripherals as well as other desktops.

8. CPU slot

A CPU slot, also called a CPU socket or Processor socket, contains one or more mechanical components that provide mechanical and electrical connections between the PCB and a microprocessor (CPU).

9. PCI (Peripheral Component Interconnect) slot

Peripheral Component Interconnect is a local computer bus for connecting hardware to a computer. It supports all the functions of a processor bus. PCI is usually called Conventional PCI to distinguish it from its successor PCI Express (PCIe, PCI-e or PCI-E).

10. AGP (Accelerated Graphics Port) slot

AGP was designed as a high-speed point-to-point channel for connecting a video card (graphics card) to a computer system. Primarily, it was used to assist in the acceleration of 3D computer graphics. AGP is originally designed to be a descendant of the PCI series of connections for video cards. Yet, it was replaced by the PCIe slots.

11. Parallel port

A parallel port is a kind of interface for attaching peripherals on desktops. The name of this kind of port is derived from the way the data is sent. That is, the parallel ports send multiple bits of data at the same time.

12. FDC (Floppy-Disk Controller)

FDC is a special-purpose chip and associated disk controller circuitry. It controls and directs reading from and writing to a computer's floppy disk drive (FDD).

13. CMOS (Complementary Metal-oxide-semiconductor) battery

CMOS battery, also called memory battery, clock battery or real-time clock (RTC), is generally a CR2032 lithium coin cell. The lifespan of the CMOS battery is estimated to be three years when the power supply unit (PSU) is unplugged or switched off.

14. Power supply connector

A power supply provides the necessary electrical power to let the computer to work. It takes standard 110-Volt AC (Alternative Current) power to DC (Direct Current) power of 12 Volt, 5 Volt, 3.3 Volt, etc.

15. Heat sink (cooling system)

A heat sink is a passive heat exchanger that transfers the heat generated by parts of the motherboard into a fluid medium like liquid or air. The fluid medium will dissipate away from the device. Thus, the temperature of the device is kept within a tolerable range. On the motherboard, the heat sink is usually used to cool CPU, GPU (graphics processing unit), chipsets and RAM modules.

4.2 Example Motherboards

4.2.1 Motherboard kit socket AM3 with AMD 785G chipset

This motherboard kit has many features to allow users to build a gaming computer from the ground up. Here are the specifications:

It comes with the ATI Radeon HD 4200 Graphics card containing the AMD 785G Chipset. This brings gaming and HD video experience. The ATI Radeon HD 4200 Graphics card can transform your ordinary PC into a powerful digital media PC. It is also backwards compatible with the previous generation of CPUS; it works with the AMD Athlon II and the AMD Phenom II processor.

The kit is definitely for gamers. It has Microsoft DirectX 10.1 for gaming performance, and 3D visual effects. It has ATI Stream Technology. This provides better balanced platformance. It provides ATI Power Play, which reduces system power draw.

4.2.2 Intel SE7501BR2 Server Kit

This kit has a variety of interesting features for a low price under \$60.00. For starters, it has an Intel SE7501BR2 Server with Dual Xeon 2.4GHz CPUs, 1GB RAM, Heat Sinks & Fans. So It comes with the devices necessary to start up your system.

Video provides an integrated video controller using the ATI Rage XL PCI. Moreover, the integrated ATA-100 IDE controllers deliver storage options.

The SSI-EEB 3.0 form factor motherboard also has two network controllers. One is a 10/100 network connection based on the Intel 82550 PM Fast Ethernet controller. The other uses the Intel 82540EM Gigabit Ethernet controller, which provides a 10/100/1000 network connection. It can expand with four 64-bit PCI-X slots, two 32-bit PCI slots and four 184-pin DIMM sockets.

4.2.3 BIOSTAR Kits

Another kit that is good for home users and inexpensive is the Biostar combo system. Here are two examples.

The Biostar Combo 6P1250 has an AMD Sempron LE1250 AM2 and Graphics card from the NVIDIA, GeForce 6150. It uses a Micro ATX form factor. It supports the following CPU types: Phenom II / Phenom / Athlon II / Athlon64 /Sempron. It has 2×240pin memory slots which support the DDR2 533/667/800 memory standard and can support 4 GB of memory

Another Biostar motherboard kit product is the Viotech 3100+ with a VIA C7-D cpu running at 1.6GHz running the Micro ATX. It has 2×240pin memory slots that run the DDR2 667/533 memory standard and comes with 2 GB of Ram.

4.3 Functions Description of Motherboard

The functions of a computer motherboard are as follows:

- The motherboard acts as the central backbone of a computer on which other modular parts are installed such as the CPU, RAM and hard disks.
- The motherboard also acts as the platform on which various expansion slots are available to install other devices / interfaces.
- The motherboard is also responsible to distribute power to the various components of the computer.
- They are also used in the coordination of the various devices in the computer and maintain an interface among them.
- Some of the Sizes in which the motherboards are available are : BTX, ATX, mini-ATX, micro-ATX, LPX, NLX etc..

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SESSION 2

**COMPUTER HARDWARE MAINTAINACE &
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4.4 SPECIFICATION AND VARIATION OF MOTHERBOARDS

Motherboard is perhaps the most important component of a PC that connects all components together. All the computer parts like CPU, RAM, Graphics Card, SSDs, Optical drives, USB drives, monitor, keyboard, mouse connect and communicate via the motherboard. The motherboard is the foundation of your PC and it determines what other components you can install in your PC.

Like with any component the motherboard also has a lot of technical specifications that the end user needs to understand in order to select the right one for his needs.

There is no single metric that indicates the performance of a motherboard. A motherboard actually implements numerous technologies and standards like SATA, PCIE, USB, Ethernet etc, each of which have their own technical specifications. The motherboard determines what CPU you can use and how fast and efficiently all the components shall work.

Some of the most important features and specifications of motherboards. Here is a quick list:

- Form Factor - ATX, MicroATX, Mini-ITX
- CPU Socket - Intel and AMD
- Chipset - Intel and AMD
- USB Ports (2.0, 3.0, 3.2 Gen1, Type C)
- RAM / DIMM Slots - DDR3, DDR4
- Video Connectors - HDMI, DisplayPort, VGA, Dvi
- PCIE Slots - x1, x16 (Gen 3, Gen 4)
- Inbuilt Wifi
- Sata 3 connectors
- M.2 NVME Support
- RGB Headers

4.4.1 Form Factor - Motherboard Size

Motherboards come in 3 popular sizes - ATX, micro-ATX (mATX), and mini-ITX (ITX). The main difference between the three form factors is their sizes and the number of interfaces (like RAM slots, PCIE slots, USB slots) available on them to connect various other hardware components. There is an even larger form factor known as E-ATX or Extended ATX but it is not that popular in the consumer PC market segment.

4.4.2 CPU Socket

The CPU socket and chipset are the most important thing that you should consider when choosing your motherboard. The socket determines what CPU you can install onto the motherboard.

Different processors from different vendors require different sockets. So you need an intel compatible socket for intel processors and AMD socket for AMD processors.

The main sockets for AMD Ryzen series processors include AM3 and AM4. With AMD there are only few socket types to use and they are often backward compatible with previous generation processors. This makes it easy to upgrade your CPU without having to upgrade your motherboard everytime.

The main sockets for Intel processors include LGA775, LGA1151, LGA1200. It should be noted that Intel has far more socket types for its processors. Due to this intel socket based motherboards often run into compatibility with future versions of intel processors. Users have to buy a new motherboard for a new cpu if they wish to upgrade.

4.4.3 Chipset

Besides the socket, the chipset is the next important thing that determines what processor can be installed on a motherboard. Any processor is only compatible with a limited set of chipsets.

The chipset is the main chip on the motherboard that enables the cpu and peripherals to communicate with each other. So the chipset determines how fast and efficiently various components can exchange data.

A chipset that supports PCIE4 will allow for faster communication between the pcie peripherals and cpu for instance.

It should be kept in mind that the choice of chipset also affects the motherboard form factor. For example the X570 chipset is seen mostly on ATX motherboards. Whereas the B550 series of chipset is available in micro-ATX size motherboards.

4.4.4 USB Ports

Motherboards will often have multiple different versions of USB ports available on them. USB ports are present on the backside IO panel and also onboard as header pins. The header pins connect to the front USB ports on the computer case via cables.



Fig 4.1: Motherboard Ports

The USB standard has gone several upgrades all the way from USB 2.0 to USB 3.2 Gen2 with increasing speeds. USB 3.0 offers up to 10 times faster transfer speeds than USB 2.0, so be on the lookout for the number of USB 3.0 and 2.0 ports on your motherboard. The latest version is USB 3.2 Gen 2x2 which offer speeds upto 20 Gigabits/s. Motherboards can have both USB 3.2 Gen 1 and Gen 2 ports depending on form factor and chipset.

Newer motherboards also include USB Type C, which implement 3.2 Gen 2 speed standard. The number of USB ports and the maximum supported speed actually depends on the the CPU and Chipset both. Newer chipsets like X570 have full PCIE 4.0 support and multiple lanes for USB data transfer and can support far more USB ports than other older chipsets. Another important thing that affects the number of USB ports is the motherboard form factor. Compact sized micro-atx motherboards will have fewer USB ports than ATX motherboards.

4.4.5 RAM Slots

RAM Slots (also known as DIMM slots) will determine the type and capacity of RAM your motherboard supports. Motherboards usually support only a specific version of DIMM like DDR3 or DDR4 and then is a maximum upper limit to the amount of RAM that can be installed. RAM nowadays is mostly either DDR3 or DDR4, unless you have a very outdated system. Most newer generation processors only support DDR4, so make sure that the motherboard supports it as well.

The motherboard determines the maximum clock speed the RAM modules can run at. If the motherboard supports overclocking then it can run RAM at much higher clock speeds of upto 4400 Mhz, provided that the RAM module also supports overclocking. Make sure to check up to what RAM speeds the motherboard supports before buying a high-frequency RAM kit. Take some time to think about the number of RAM slots as well as the maximum supported RAM which varies from motherboard to motherboard.

4.4.6 Video Connector Ports

There are several different video ports available on motherboards, such as HDMI, DP, DVI, and VGA. These ports are used to access the on-board graphics of your processor. Most Intel processors have integrated graphics while Ryzen processors with a “G” on their name are the only Ryzen processors that have integrated graphics. AMD processors with integrated graphics are called APUs.

Most modern motherboards have both HDMI and Display Port interfaces together. If you have a monitor that has VGA port then use a convertor adaptor.

1. VGA

The Video Graphics Array or VGA port is one of the oldest video ports, still used in the market today. It makes use of analog signals making it prone to signal degradation, but older devices are guaranteed to work with it. It is slowly being phased out and is not available on newer motherboards.

2. DVI

Digital Visual Interface or DVI provides a better image than VGA and is more versatile due to its capability of both analog and digital signals. However, much like VGA, it is rarely used nowadays.

3. HDMI

High Definition Multimedia Interface or HDMI provides better color and image than the older connectors. It can also support audio, making it one of the mainstream connectors today. Any new device will almost certainly have at least one HDMI port. This is the most popular video connector and is available on all recent motherboards.

4. Display Port

Display Port or DP is a graphics port that is usually found on high refresh rate monitors. The main advantage of DP over HDMI is that it can support up to 8K resolution, multiple video streams, and high refresh rate at high resolutions, that helps eliminate lag and screen tearing.

The higher end motherboards have DisplayPort interface whereas the budget motherboards may only have HDMI.

4.4.7 PCI-E Slots

Most motherboards come with PCI-E Gen 3 slots which offer 32GB/s bandwidth and 8 GT/s transfer speeds. However, the new X570 chipset together with Ryzen 3000 series processors support PCI-E Gen 4 which doubles both the bandwidth and transfer speeds of Gen 3.

The PCI-E slot is where peripherals like graphics cards are plugged into the motherboard. Most motherboards will have atleast 1 x16 PCI-E slot and additional x1 or x16 slots. They allow you plug numerous other peripherals like USB port adapters, Wifi adapters. Capture Cards etc.



Fig 4.2: Motherboard PCIe and M2 Slots

If you plan to use specialised hardware for professional work that requires to be plugged into the PCI-e slot then you should consider ATX motherboards which have 2 or more x16 slots

4.4.8 Onboard Wi-Fi Support

Built-in Wi-Fi is becoming a common feature on desktop motherboards. These motherboards are targeted towards the gaming users who need fast connectivity without having to depend on wires.

Onboard wifi on motherboards are not upgradable like pcie based wifi cards. Sometimes the pcie based wifi cards may offer superior bandwidth and connectivity with better antennas compared to the motherboard's inbuilt wifi.

4.4.9 SATA 3 Ports

Sata 3 Ports allow you to connect SATA devices like hard disks, SSDs, internal optical drives etc. Most motherboards have between 4-6 sata ports.



Fig 4.3: Motherboard SATA Ports

Sata 3 interface allows for speeds upto 6 Gbit/s or 600 MB/s.

For storage drive the M.2 NVME technology far superior to SATA. Though you may use SATA ports to add additional hard drives for more space.

4.4.10 M.2 Nvme Support

M.2 is a different type of SSD that makes use of PCI-E standard to provide support for faster transfer speeds over the traditional 2.5" SSD. M.2 NVMe SSDs can have transfer speeds of up to 1000MB/s for PCI-E Gen 3 and 2000 MB/s for PCI-E Gen 4, way faster than the fastest SATA III which can only support speeds of up to 600 MB/s.

Generally speaking, using faster storage not only allows your PC to boot-up, copy items, and open applications faster, but it also makes your system respond quicker and snappier in general. If you want the best and the fastest, make sure to grab a motherboard with M.2 NVMe support.

4.4.11 RGB Headers

RGB headers on the motherboard is a must for users who like bright and flashy lights in their PC. There are 2 types of RGB headers - the common and typical 12V RGB header, which are the most common ones, and the 5V ARGB header, which can be used to control each RGB led individually.

4.5 What is motherboard form factor?

The form factor is the specification of a motherboard –the dimensions, power supply type, location of mounting holes, number of ports on the back panel, etc. motherboards are produced in a variety of sizes and shape called computer form factor, sum of which are specific to individual computer manufacturers. It most often used to describe the size of the circuit boards, especially the motherboard and expansion cards.

The change in form factors is the slow process, however due to changing demands the boards are required to evolve regularly. In 1995, ATX boards and there standards were introduced. More than a decade later, in 2007, the latest update to the ATX standard was released. These are now currently known as ITX and are based on much smaller form factors and have their own standards. The need for ITX boards came from the shift in the demand for compact PCs as many gamers looked towards a smaller system that they can travel around with.

4.5.1 Does Form Factor Matter?

The most obvious difference between a desktop and laptop computer, it's the form factor. Both of these devices might be using similar parts, but these parts and components are attached or shaped differently.

The most obvious example can be keyboard. Desktop computer keyboards are much larger than those present in a laptop. The same form factor is seen in a motherboard. A slot present in a full ATX board might be present in a different position on a much smaller motherboard.

Form factor is important for the efficient running of components. A mini USB. It caters to that particular technology. Thus, with such advancements within the form factors of these connections and port, the form factor of the boards designed also changes.

These are important because the electronic specifications of these components might need similar amounts of power regardless of whether the board is small or large. To cater to these requirements, as mentioned before, the manufactures ensure that the smaller form- factor board layout and design do not impact the required flow of electricity.

Below is a chart comparing the most popular motherboard form factors.

S	Manufacturer/Date	Dimensions	Applications
Standard-ATX	Intel 1995	12 × 13 in	Workstation/Desktop
Micro-ATX	Intel 1997	9.6 × 9.6 in	Small Form Factor
Mini-ITX	VIA 2001	6.7 × 6.7 in	Small Form Factor
Nano-ITX	VIA 2003	4.7 × 4.7 in	Embedded Systems
Pico-ITX	VIA 2007	3.9 × 2.8 in	Embedded Systems
Mobile-ITX	VIA 2009	2.4 × 2.4 in	Embedded Systems

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SESSION 3

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4.6 Types and features of motherboard form factor -ATX, Micro-ATX , Mini-ITX , Nano-ITX and Pico-ITX.

Micro ATX

It is an evolution of ATX. Its measures are 9.6×9.6 inches. The Micro-ATX supports up to four expansion slots that can combine freely with ISA, PCI, PCI / ISA shared, and AGP. Mounting holes changed from the Standard ATX, since the measurements are different, but they are also compatible with most ATX cabinets.

This type of motherboard form factor supports both Intel and AMD processors. It is commonly used on Small Form Factor Desktop Computers.

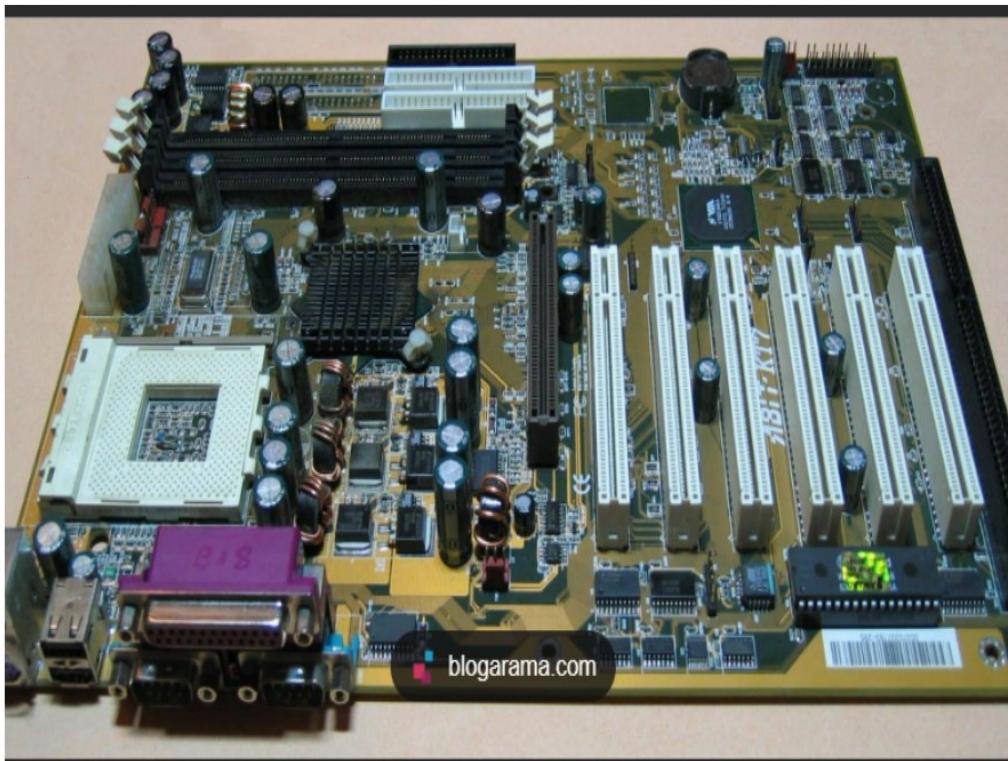


Fig 4.4: Micro ATX

Mini-ITX

Mini ITX is a low-power consumption motherboard format of 6.7×6.7 inches. Its dimensions are the most characteristic factor of this type of form factor. Although this type of motherboard was designed with the aim of empowering teams of low consumption, at present there are no limits and they have grown by giant steps in terms of benefits.

Since the Mini-ITX was introduced they have expanded in all kinds of applications, thanks to their open standard factor. Mini ITX is a standard format for all types of equipment, such as vehicle embedded computers, industrial applications, and IoT. The Mini-ITX is the first standard system of reduced format that is popularized, reaching all types of projects and any equipment where it may be necessary.



Fig 4.5: Mini ATX

Nano-ITX

The Nano-ITX is another type of motherboard form factor, that measures 4.7×4.7 in. Nano-ITX are fully integrated boards designed to consume very low power. This type of motherboard can be used in many applications, but it was specially designed for smart entertainment, like PVRs, media centers, smart TVs, in-vehicle devices, and more.



Fig 4.6: Nano ATX

Pico-ITX

The Pico-ITX is the smallest type of motherboard form factor in this list. Its measurements are 3.9×2.8 in and it is 75% smaller than the Mini-ITX. This motherboard was designed and developed by VIA, to open up innovation for smaller and smarter IoT devices.

The Pico-ITX with an x86-based-platform and low-power consumption board is a great choice for embedded systems applications, such as industrial automation, in-vehicle computers, digital signage, and more.

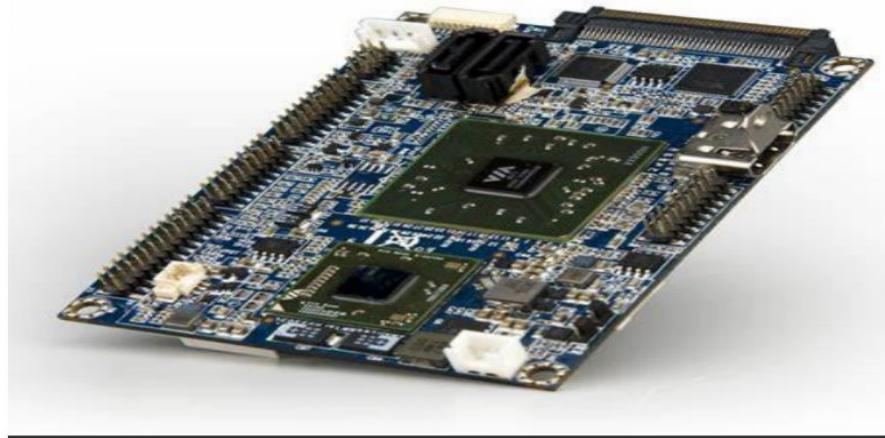


Fig 4.7: Pico ATX

4.7 Functional components of Motherboard.

1.Northbridge

Northbridge is an Intel chipset that communicates with the computer processor and controls interaction with memory, the Peripheral Component Interconnect (PCI) bus, Level 2 cache, and all Accelerated Graphics Port (AGP) activities.

2.USB (Universal serial bus)

USB is the General-purpose connection for PC. You can find USB versions of many different devices, such as mice, keyboards, scanners, cameras, and even printers. a USB connector's distinctive rectangular shape makes it easily recognizable.

3. CMOS Battery:

To provide CMOS with the power when the computer is turned off all motherboards comes with a battery. These batteries mount on the motherboard in one of three ways: the obsolete external battery, the most common onboard battery, and built-in battery.

4.PCI slot

Intel introduced the Peripheral component interconnect bus protocol. The PCI bus is used to connect I/O devices (such as NIC or RAID controllers) to the main logic of the computer. PCI bus has replaced the ISA bus.

5.DIMM

DIMM (dual in-line memory module) is a type of computer memory that is natively 64 bits, enabling fast data transfer. DIMM is a module that contains one or several random access memory (RAM) chips on a small circuit board with pins that connect it to the computer motherboard.

6.South Bridge

Main function of the South Bridge is as Peripheral controller. Most modern computers use two buses: industry standard architecture (ISA) bus for slower peripherals, and for compatibility with older components, and PCI a high-speed 'local bus ' for hard disks, video cards and other high-speed devices.

7. Front Panel

The Front Panel Connectors, also known as the Front Panel Header or F Panel, is a block of connectors on a motherboard that control the power on, power reset, beep code speaker and the LED light indicators on your PC case/chassis.

8.CPU fan connection

A motherboard fan connector is a small three or four-pin connector located on the motherboard. The fan will have one set of cables (bundled together) that will connect into the connector on the motherboard.

9.Socket

CPU socket is used to connect a microprocessor with a printed circuit board (PCB) without soldering, allowing for the CPU to be installed or replaced more easily on the motherboard.

10.SATA

The SATA technology itself is a connector interface primarily used for computer bus connections in storage applications. In this application, the cables are used to connect a mass storage device (e.g. hard disk drives, optical drives, solid-state memory drives) to a host bus adapter such as a motherboard.

4.7.1 Different Types of Motherboard Ports and their Functions

1. RJ-45 (Registered Jack 45) LAN port : This port allows connection to a Local Area Network (LAN) through a network hub using a RJ-45 cable.

2. Analog Audio port : This port connects a tape, CD, DVD player or other audio sources.

3. VGA Port(Video Graphics Array) : VGA cables carry an analog signal as opposed to a digital signal (ones and zeroes). Using higher frequencies, it's possible to reach relatively high range of video resolutions. However, video quality directly responds to cable quality, and doubly so on higher resolutions. Due to this, the quality of a VGA image can variate notable across different makes of cables.

4. USB (Universal Serial Bus) 2.0 Ports: There are usually a couple of these ports located on each motherboard used for connecting pen drives and external hard drives, like I pods or Mp3 players.

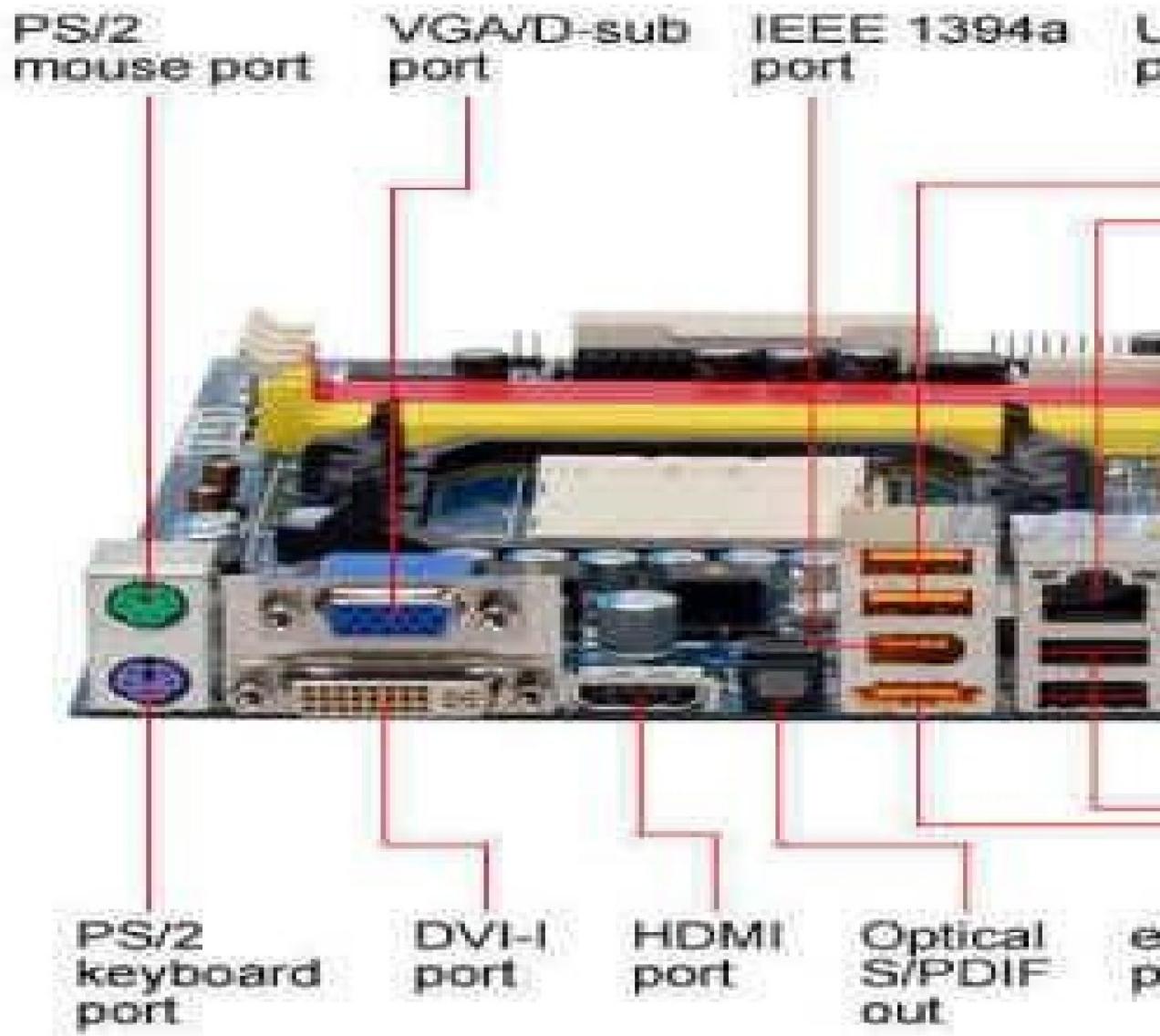


Fig 4.8: Motherboard Ports

5. PS/2 Keyboard Port (purple) :

This port is for a PS/2 keyboard.

6. PS/2 mouse port (green):

This port is for a PS/2 mouse.

7. 1394a Port :

This port is used to connect to any firewire device. FireWire has largely been supplanted by USB. Some professional audio hardware still uses FireWire, though; you may also occasionally find higher-speed IEEE 1394b headers, but they are even rarer.

8. Optical S/PDIF Used for sound connections to home audio receivers or powered PC speakers with optical connections.

9. eSATA port(External Serial Advanced Technology Attachment): It is an external interface for SATA technologies. It competes with FireWire 400 and universal serial bus (USB) 2.0 to provide fast data transfer speeds for external storage devices.

10. HDMI Connector(High-Definition Multimedia Interface): HDMI is a digital interface for transmitting audio and video data in a single cable. It is supported by most HDTVs and related components, such as DVD and Blu-ray players, cable boxes, and video game systems.

11. DVI (Digital Visual Interface) connector : It is used to send digital information from a computer to a digital display, such as a flat-panel LCD monitor.

12. North Bridge : The northbridge typically handles communications among the CPU, in some cases RAM, and PCI Express (or AGP) video cards, and the southbridge. Northbridge is directly connected to AGP video, thus providing higher transfer rates.

13. South Bridge : The southbridge is one of the two chips in the core logic chipset on a personal computer (PC) motherboard, the other being the northbridge. The southbridge typically implements the slower capabilities of the motherboard in a northbridge/southbridge chipset computer architecture. A southbridge chipset handles all of a computer's I/O functions, such as USB, audio, serial, the system BIOS, the ISA bus, the interrupt controller and the IDE channels.

4.8 CPU and CPU Socket-Types of Sockets

CPU -Central Processing Unit

- The computer's central processing unit (CPU) is the portion of a computer that retrieves and executes instructions.
- It consists of an arithmetic and logic unit (ALU), a control unit, and various registers.
- CPU is often simply referred to as processor.

There are two different types of processor architecture or design:

1. 32-bit CPU

1. These are the older processor. 32-bit processor has a structure that can process instructions less efficiently.

2. 32-bit processor can handle less instruction at one time.
3. 32-bit processor can only handle 4GB of memory.
4. Even though it can handle up to 4GB of memory, having that much memory on a 32-bit processor will not make it perform quicker.

2.64-bit CPU

1. 64-bit is larger than 32-bits, that means that a 64-bit processor can handle more instructions in one load.
2. 64-bit processor which can handle up to 16EB(=1 billion GB) of memory or RAM.

4.8.1 Types of CPU

The trending CPU is now available in the form of microprocessor which comprises unit metal-dioxide-semiconductor in the integrated circuits. An integrated chip comprises CPU along with peripheral interfaces, memory chips, microcontrollers, and other systems on the chip.

The leading manufacturers of CPU are AMD and Intel. The various types of processor are built in different architecture like 64 bit and 32 bit with maximum speed and flexible capacity. The major types of CPU are classified as Single -core ,dual-core, Quad-core, Hexa-core,Octa-core, and Deca core processor which is explained below.

1. Single -core CPU :-

It is the oldest type of CPU which is available and employed in most of the personal and official computers. The single-core CPU can execute only one command at a time and it's not efficient in multi-tasking . It signifies that there is a markable declination in performance if more than a single application is executed. If one operation is started , the second process should wait until the first one is finished. But if it is fed with multiple operations , the performance of the computer is drastically reduced . The performance of a single- core CPU is based on its clock speed by measuring its power.

2. Dual-core CPU:-

It is a single CPU that comprises of two strong cores and functions like dual CPU acting like one. Unlike the CPU with a single core, the processor must switch back and forth within a variable array of data streams and if or more thread is executed , the dual-core CPU manages the multitasking effectively . To utilize the dual -core CPU effectively , the running programs and operations system should have a unique code called simultaneous multi - threading technology embedded in it. Dual-core CPU is rapid than a single core but it is not robust as quad-core CPU.

3. Quad-core CPU:-

The quad-core CPU is a refined model of multiple core CPU features and design with four cores on a single CPU. Similar to dual-core CPU, that divides the workload in between the cores, and quad- core enables for effective multitasking .It doesn't signify any single operation which is four times faster rapid than others .Unless the applications and program executed on it by SMT code will fasten the speed and becomes unnoticeable. Such types of CPU are used in people who need to execute multiple different programs at the same time as gamers, series of Supreme commander that is optimized in multiple core CPU.

4. Hexa core processor:-

It is another multiple core processor which is available with six cores and can execute the task which works rapidly than the quad-core and dual-core processors. For users of the personal computer , the processors of Hexa-core is simple and now the Intel is launched with Intel core i7 in 2010 with Hexa-core processor. But here the users of smartphones use only quad-core and dual-core processors. Nowadays, smartphones are available with Hexa-core processors.

5. Octa-core processors :-

The dual- core is built with two cores,four cores are built-in quad-core ,Hexa comes with six cores where the octa processors are developed with eight independent cores to execute an effective task that is efficient and even acts rapidly than quad-core processors. Trending Octa-core processors comprises of a dual set of quad-core processors that divides different activities between the various types. Many times,the minimum powered core sets are employed to produce advanced tasks. If there is any emergency or requirement , the rapid four sets of cores will be kicked in.Inprecise, the Octa-core is perfectly defined with dual-code core and adjust it accordingly to give the effective performance.

6. Deca-core processor:-

Deca -core is available with ten independent systems that are deployed to execute and manage the task that is successful than other processors that are developed until now.Owning a PC , or any device made with a deca-core processor is the best option. It is faster than other processors and very successful in multi-tasking. Deca-core processors are trending with its advanced features. Most of the smartphones are now available with Deca core processors with low-cost and never become outdated.

4.8.2 CPU Socket types

The processor socket (also called a CPU socket) is the connector on the motherboard that houses a CPU and forms the electrical interface and contact with the CPU. Motherboards are subcategorized by the type of processor socket they have.

The types of CPU sockets are as follows:

- 1. LGA Sockets:** The land grid array (LGA) is a type of surface-mount packaging for integrated circuits (ICs) that is notable for having the pins on the socket rather than the

integrated circuit. An LGA can be electrically connected to a printed circuit board (**PCB**) either by the use of a socket or by soldering directly to the board. The below figure shows the LGA socket on a mother board.

Example: LGA 1150

LGA 1150 also called Socket H3, is an Intel microprocessor compatible socket which supports the Intel Haswell microprocessor. It is a replacement for the LGA 1155 (known as Socket H2). All socket 1150 motherboards support varying video outputs (VGA, DVI, HDMI - depending on the model) and Intel Clear Video Technology. Chipset for LGA 1150 is codenamed Lynx Point. Intel Xeon processors for socket LGA 1150 use the Intel C222, C224, and C226 chipsets

Contacts	1150
Processor Dimension	37.55mm x 37.55mm
Predecessor	LGA 1155

The below figure shows the typical LGA 1150:

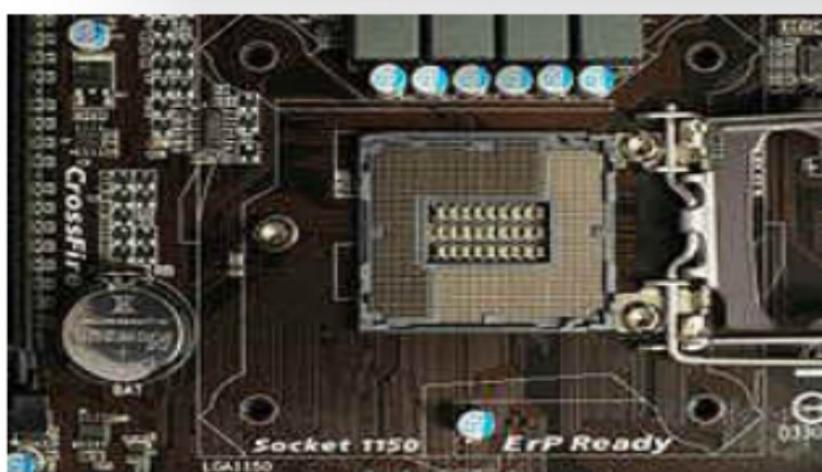


Fig 4.9: LGA 1150

2. ZIF sockets: A zero insertion force (ZIF) socket, designed by Intel and includes a small lever to insert and remove the computer processor. Using the lever allows a user to add and remove a computer processor without any tools.

Example: 40-pin ZIF socket

It high-quality, easy to use 40 pin ZIF socket that is 0.6" wide with gold-plated contacts. Compatible with 0.3" up to 0.6" wide ICs up to 40-pins. Makes for easy connecting or programming to many DIP ICs. High conductivity terminals create solid connections.

Armature makes it easy to open and close socket. The below figure shows the 40-Pin ZIF socket:

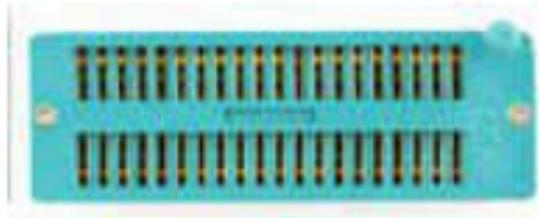


Fig 4.10: ZIF Socket

3. PGA socket : it is a type of integrated circuit packaging. In a PGA, the package is square or rectangular, and the pins are arranged in a regular array on the underside of the package. The pins are commonly spaced 2.54 mm (0.1") apart, and may or may not cover the entire underside of the package.

PGAs are often mounted on printed circuit boards using the through hole method or inserted into a socket. PGAs allow for more pins per integrated circuit than older packages such as dual in-line package (DIP). The below figure shows the pin grid array at the bottom of a XC68020, a prototype of the Motorola 68020 microprocessor.

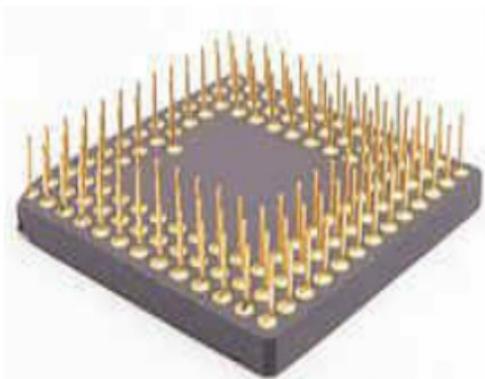


Fig 4.10: PGA Socket

4. BGA sockets : A Ball Grid Array (BGA) is a type of surface-mount packaging used for integrated circuits. BGA packages are used to permanently mount devices such as microprocessors. The BGA is descended from the pin grid array (PGA), which is a package with one face covered (or partly covered) with pins in a grid pattern which, in operation, conduct electrical signals between the integrated circuit and the printed circuit board (PCB) on which it is placed. Soldering of BGA devices requires precise control and is usually done by automated processes. BGA devices are not suitable for socket mounting. A disadvantage of

BGAs is that the solder balls cannot flex in the way that longer leads can, so they are not mechanically compliant.

The example for the BGA is as shown in the below figure:

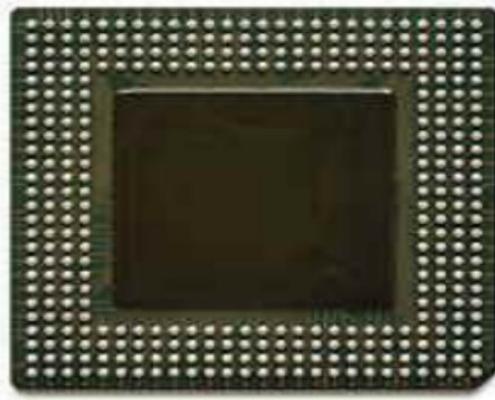


Fig 4.10: BGA Socket

4.9 Overview of Microarchitecture of INTEL and AMD CPU

A microarchitecture (sometimes written as "micro-architec- ture") is the digital logic that allows an instruction set to be executed. It is the combined implementation of registers, memory, arithmetic logic units, multiplexers, and any other digital logicblocks. All of this, together, forms the processor. A microarchitecture combined with an instruction set architecture (ISA) makes up the system's computer architecture as a whole.

INTELCPU

The Intel Core microarchitecture (formerly named Next- Generation Micro-Architecture) is a multi-core processor microarchitecture unveiled by Intel in Q1 2006, It is based on the Yonah processor design and can be considered an iteration of the P6 microarchitecture introduced in 1995 with Pentium Pro List of Intel CPU microarchitectures.

1 x86 microarchitectures

- 16-bit
- 32-bit (IA-32)
- 64-bit (x86-64)
- x86 ULV (Atom)

2 Other microarchitectures

- IA-64 (Itanium)

AMD CPU

Zen is the codename for a family of computer processor microarchitectures from AMD, first launched in February 2017 with the first generation of its Ryzen CPUs. While there have been four generations of Ryzen CPUs. The memory, PCIe, SATA, and USB controllers are incorporated into the same chip(s) as the processor cores. The breakdown of the different AMD Ryzen processor brackets are:

- Ryzen 3 Up to 4-core processors.
- Ryzen 5 Up to 6-core processors.
- Ryzen 7- Up to 8-core processors.
- Ryzen 9- Up to 16-core processors.
- Threadripper - Up to 64-core processors.