

Motherboard and its Function

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What is a computer?

A computer is an electronic device that:

- Accepts raw data
- Processes the data
- Provides an output

Motherboard

The motherboard is a key component found in all electronic devices, including:

- Tablets
- Smartphones
- PCs

The size of the motherboard varies according to the device.

What is a Motherboard?

The motherboard is also known by various terms, including:

1. MB (Mainboard)
2. Mobo, Mboard, Mobd
3. Backplane board, Base board
4. Main circuit board, Planar board
5. System board, Logic board (on Apple computers)

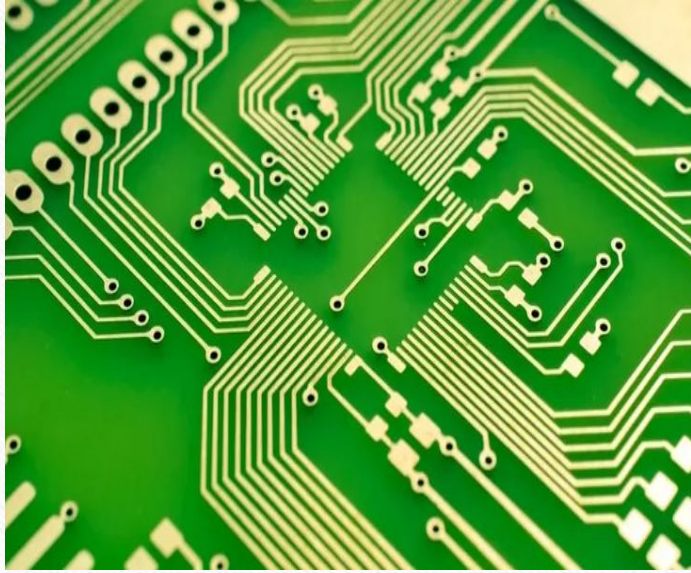
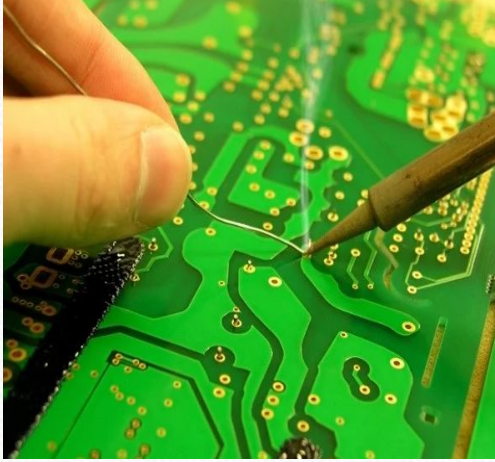
What is a Motherboard?

The motherboard is:

- A printed circuit board (PCB)
- The largest board in a computer chassis

Functions of the motherboard:

- Allocates power to components
- Facilitates communication between the CPU (Central Processing Unit), RAM (Random-Access Memory), and other hardware components.



Motherboard overview

A motherboard provides connectivity between various hardware components of a computer, such as:

- Processor (CPU)
- Memory (RAM)
- Hard drive
- Video card

Motherboard overview

Types of motherboards:

- Multiple types designed to fit different sizes and types of computers.

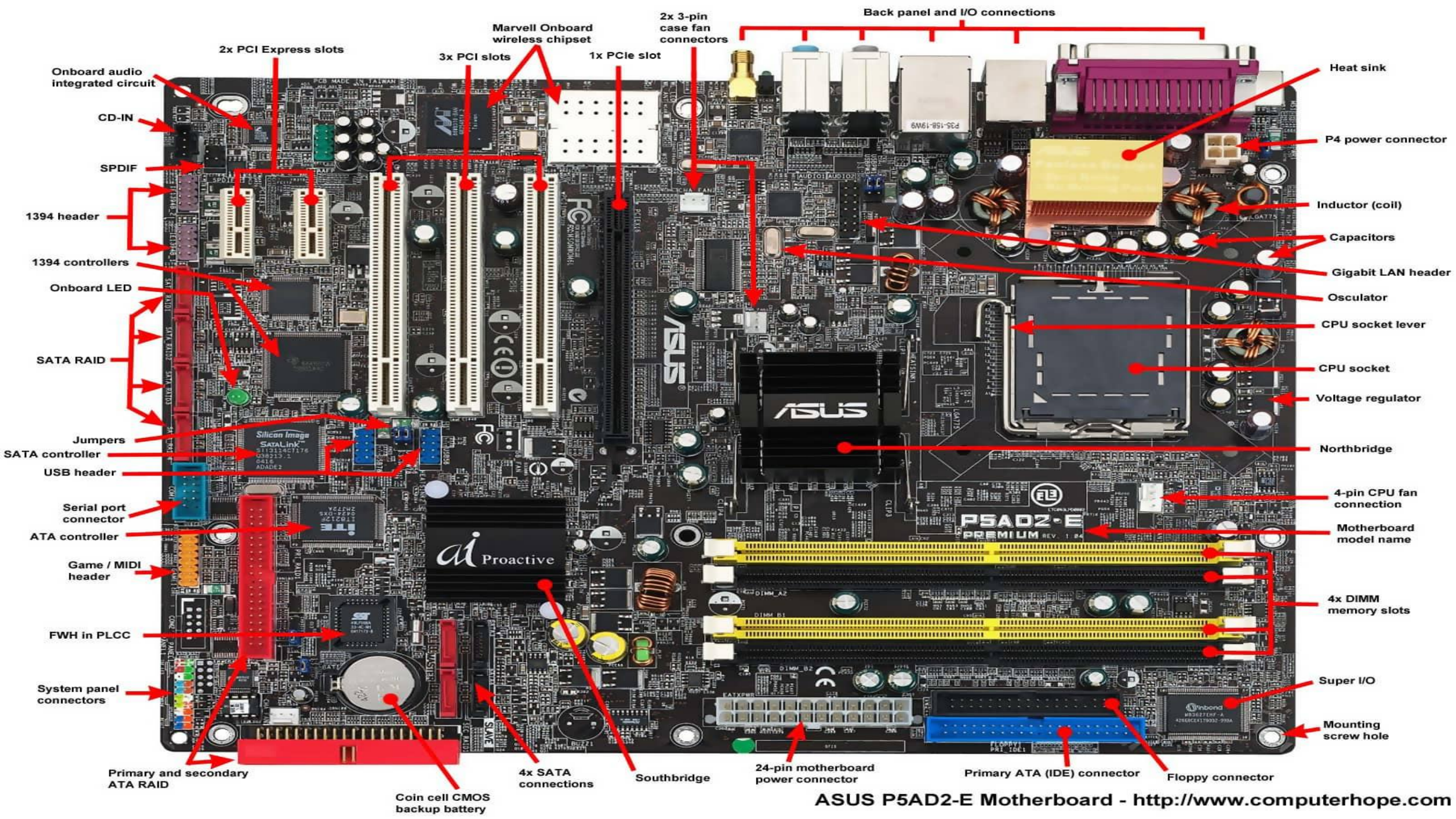
Compatibility:

- Each type of motherboard is designed to work with specific processors and memory types.
- Motherboards are not universally compatible with all processors and types of memory.

Motherboard overview

Hard drive compatibility:

- Hard drives are generally universal and can work with most motherboards, regardless of type or brand.



Where is the motherboard located?

The computer motherboard is located inside the computer case. It is the central hub where most parts and peripherals connect.

In tower computers:

- The motherboard is located on the left or right side of the tower.
- It is the largest circuit board inside the computer case.

Motherboard components

The components are listed in clockwise order starting from the top-left corner of the image.

1. Expansion slots (PCI Express, PCI, and AGP (accelerated graphics port))
2. 3-pin case fan connectors
3. Back pane connectors
4. Heat sink
5. 4-pin (P4) power connector
6. Inductor
7. Capacitor
8. CPU socket
9. Northbridge
10. Screw hole

Motherboard components.....ctd

- | | |
|---|---|
| 11. Memory slot | 16. Coin cell battery (CMOS backup battery) |
| 12. Super I/O | |
| 13. ATA/IDE disk drive primary connection | 17. RAID (redundant array of independent disks) interface |
| 14. 24-pin ATX power supply connector | 18. System panel connectors |
| 15. Serial ATA connections | 19. FWH (firmware hub) |
| | 20. Southbridge |

Motherboard components.....ctd

- | | |
|--|--|
| 21. Serial port connector | 26. S/PDIF (Sony and Phillips Digital Interconnect Format) |
| 22. USB (universal serial bus) headers | 27. CD-IN |
| 23. Jumpers | |
| 24. Integrated circuit | |
| 25. 1394 headers | |

Expansion slots (PCI Express, PCI, and AGP (accelerated graphics port))

An **expansion slot** is also known as:

1. Bus slot
2. Expansion port

It is a connection or port inside a computer, located on the motherboard or riser card.

Expansion slots (PCI Express, PCI, and AGP (accelerated graphics port))

Purpose of expansion slots:

- Provides an installation point for hardware expansion cards.

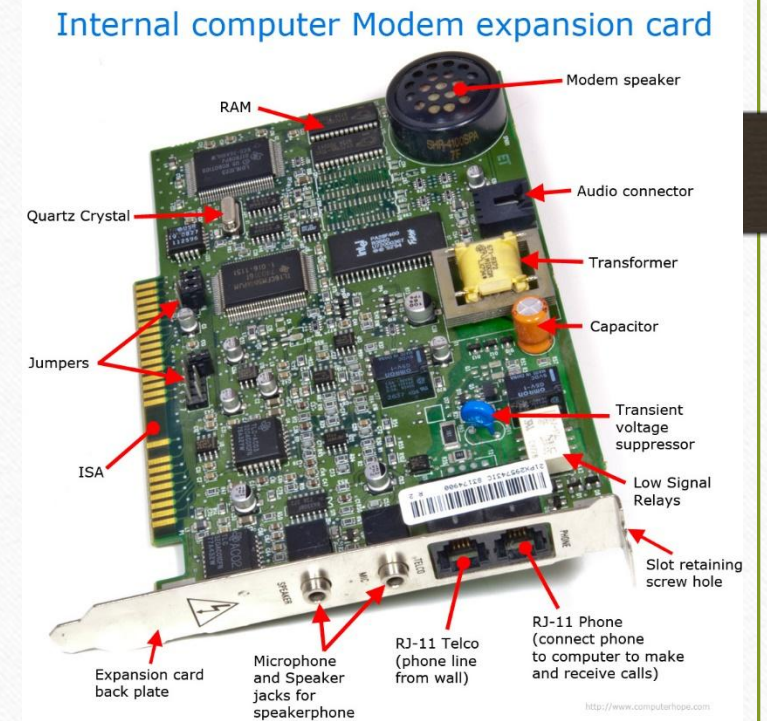
Example:

- To install a new video card, you would purchase a video expansion card and insert it into the compatible expansion slot.

Expansion card

An **expansion card** is also known by various terms:

1. Adapter card
2. Add-on card
3. Expansion board
4. Internal card
5. Interface adapter
6. Card



Expansion card

An expansion card is a PCB (Printed Circuit Board) that fits into an expansion slot on the motherboard.

Purpose of an expansion card:

1. Adds additional capabilities to the computer.
2. Example: Provides enhanced video performance via a graphics card.

Case fan

A case fan is also known as a:

- System fan

Location of the case fan:

- Positioned inside the computer, attached to the front or back of the case.



Case fan

Function of the case fan:

- Helps bring cool air into the case.
- Blows hot air out of the case.

Case fan sizes:

Available in various sizes, with common ones being:

1. 80mm
2. 92mm
3. 120mm (12cm)

Typical width: 25mm

Back pane connectors

A **connection** is a link between:

- A plug or connector
- A port or jack

Example of connections:

- Your monitor, mouse, and keyboard must connect to the computer before they function.



Heat sink

A **heat sink** is a device used to reduce the temperature of a hardware component (e.g., processor).

Types of heat sinks:

- **Active** heat sink: Includes a fan or other mechanisms to enhance cooling.
- **Passive** heat sink: Relies on natural heat dissipation without a fan.

The picture shows a heat sink with both active and passive cooling mechanisms.



4-pin (P4) power connector

- The P4 connector is a 12V power supply cable used with motherboards that have an Intel Pentium 4 or later processor.
- Today, the P4 connector is a standard power connector, used with both Intel and AMD motherboards.



4-pin (P4) power connector

Features of the P4 cable:

- Two black wires serve as ground.
- Two yellow wires provide **+12VDC**.

The P4 connector attaches to a **four-pin connection** on the motherboard.

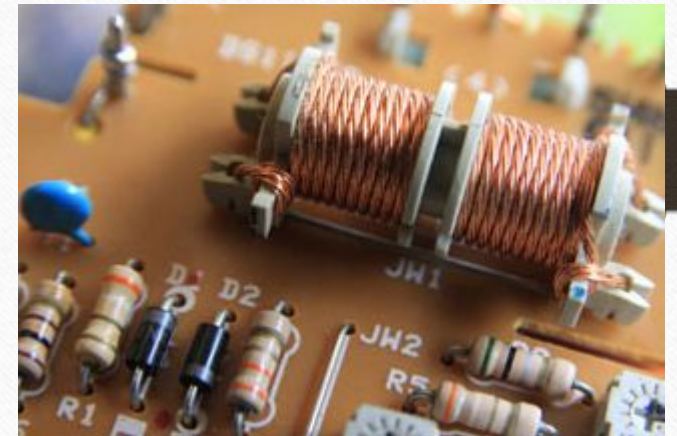
P4 is an abbreviation for **Intel Pentium 4** processor.

Inductor (Coil)

A **coil** (short for electromagnetic coil) is a conducting wire, typically copper, shaped in a helical form around an iron core.

Function of a coil:

1. Creates an **inductor** or **electromagnet** to store magnetic energy.
2. Removes power spikes and dips from power supply.



A coil can also refer to a **spring**

Capacitor

A **capacitor** is a component made of:

- Two conductive plates (or sets of plates)
- A thin insulator between the plates
- Wrapped in a ceramic and plastic container



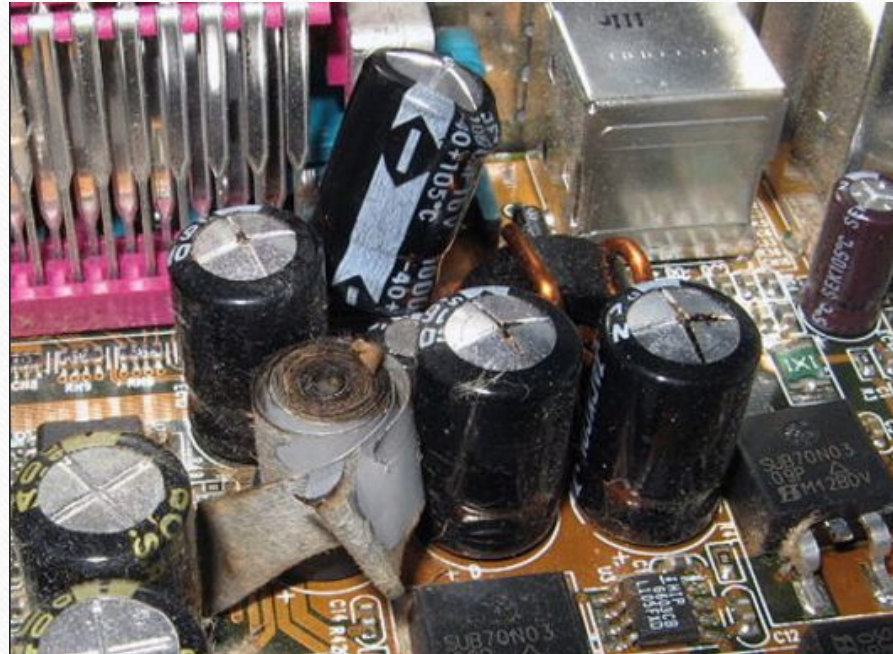
Capacitor

Function of a capacitor:

1. When receiving **DC (direct current)**, a **positive charge** builds up on one plate, while a **negative charge** builds up on the other.
2. The charge, measured in **microfarads**, remains in the capacitor until it is discharged.



Capacitor



The image shows an example of a **capacitor** on a computer motherboard.

Socket

A **CPU socket** (or processor socket) is a connection that allows a computer processor to connect to the motherboard.

Example:

- **Socket 370** is one such processor socket.

The image shows an example of what a **CPU socket** looks like on a motherboard.



Socket

- While some computers use **slot processors**, most computers today and in the past have used **socket processors**.

Why would I need to know the socket on my motherboard?

- The processor socket helps determine what computer processors your computer motherboard can accept. For example, a Socket 1 processor is incompatible with a Socket 370 because of the pin layout and technology differences in each socket.

Northbridge

The **Northbridge**, also known as **PAC (PCI/AGP Controller)** or **nb**, is an integrated circuit responsible for communication between the following components:

1. CPU (Central Processing Unit)
2. AGP (Accelerated Graphics Port)
3. Memory (RAM)

Northbridge

1. Unlike the southbridge, the northbridge is directly connected to the CPU, RAM, and graphics controller.
2. The northbridge acts as a bridge to allow the southbridge chip to communicate with the CPU, RAM, and graphics controller.
3. Modern northbridges are a single chip located north of the PCI bus. However, early computers may have had up to three separate chips making up the northbridge.

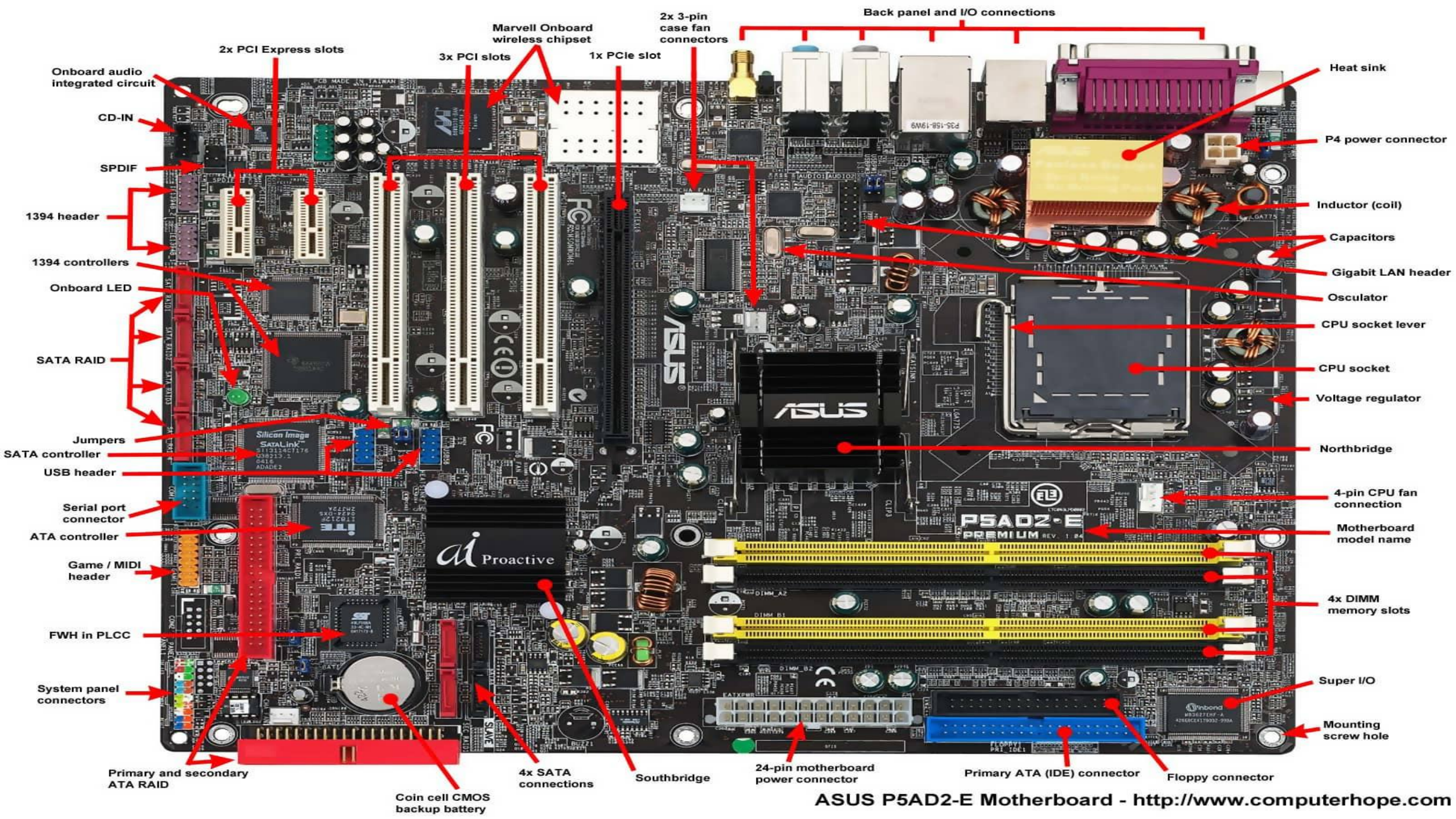
Northbridge

In the **ASUS P5AD2-E motherboard** illustration:

1. The **northbridge** and **southbridge** often have dedicated heat sinks.
2. The northbridge is typically **larger** and positioned **closer to the CPU and memory**

Northbridge

1. When the CPU needs data from RAM, a request is sent to the northbridge memory controller.
2. The northbridge responds by determining how long the processor must wait to read memory over the front-side bus.
3. Some newer motherboards have replaced the northbridge and southbridge with IHA (Intel Hub Architecture).



My motherboard doesn't have a Northbridge

To improve performance and reduce costs, manufacturers are moving functions of the **Northbridge** chip to other CPU components, including the **Southbridge**.

Starting with the **AMD64 AMD** and **Intel Nehalem** processors:

- The **memory controller** was moved from the Northbridge to the **processor die**.

Later, the **Intel "Sandy Bridge"** and **AMD Accelerated Processing Unit** processors:

- Placed all **northbridge functions** onto the **CPU**.

Memory slot

A memory slot, memory socket, or RAM slot allows RAM (Random-Access Memory) to be inserted into the computer.

Most motherboards have two to four memory slots, which determine the type of RAM used.

Common RAM types:

- **SDRAM** (Synchronous Dynamic Random-Access Memory) and **DDR** (Double Data Rate) for desktop computers.
- **SO-DIMM** (Small Outline Dual In-line Memory Module) for laptop computers.

Memory slot

Each RAM type has various types and speeds.

The picture shows what memory slots may look like inside a desktop computer:

Three open slots available for memory sticks.



Why are the memory slots different colors?

Colored memory slots on a motherboard indicate dual-channel memory configuration.

Pairs of memory should be installed in the same channel (same color slots).

- Example: A motherboard with **two yellow** and **two black** memory slots.
 1. Yellow slots indicate **Channel A**.
 2. Black slots indicate **Channel B**.
- For optimal performance, when installing **two memory sticks**, install them both in **Channel A** (yellow slots).

SIO

- Super I/O (SIO) stands for Super Input/Output, and is an integrated circuit on a computer motherboard.
- SIO handles slower and less prominent input/output devices.

History of Super I/O:

- Initially, it was found on an expansion card in the late 1980s.
- Later, it was embedded into the motherboard and communicated over the ISA (Industry Standard Architecture) bus.



SIO

- As ISA became obsolete, SIO began communicating over the PCI (Peripheral Component Interconnect) bus.
- Today, Super I/O communicates through the Southbridge and is still used to support older legacy devices.

Computer devices handled by the Super I/O:

1. Floppy disk controller
2. Game port
3. Infrared
4. Intrusion detection
5. Keyboard and mouse (non-USB)
6. Parallel port
7. RTC (Real-Time Clock)
8. Serial port UART (Universal Asynchronous Receiver-Transmitter)
9. Temperature sensor and fan speed

Note

1. Some newer chipsets combine the Southbridge and Super I/O chips into a single chip, referred to as the Super Southbridge chip.
2. Manufacturers like NVIDIA and SiS have combined the Northbridge, Southbridge, and Super I/O into a single chip.

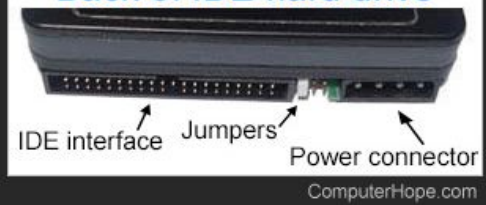
How do I know which integrated circuit is the super I/O on my motherboard?

- Identifying the super I/O on your motherboard is easy if you look for an integrated circuit labeled with a company's name that manufactures super I/O chips. Some common super I/O manufacturers are Fintek, ITE, National Semiconductor, Nuvoton, SMSC, VIA, and Winbond.

IDE

- Short for **Integrated Drive Electronics**, **IDE** is commonly known as ATA or **PATA** (**Parallel AT Attachment**). It is a standard interface for IBM computers that was created by Western Digital and Compaq in 1986 for compatible hard drives and CD (Compact Disc) or DVD (Digital Versatile Disc) drives. IDE is different than SCSI (Small Computer System Interface) and ESDI (Enhanced Small Disk Interface) because its controllers are on each drive, meaning the drive can connect directly to the motherboard or controller. IDE and its updated successor, EIDE (Enhanced Integrated Drive Electronics), are common drive interfaces found in IBM compatible computers. Below is a picture of the IDE connector on a hard drive, IDE cable, and the IDE channels on the motherboard.

Back of IDE hard drive

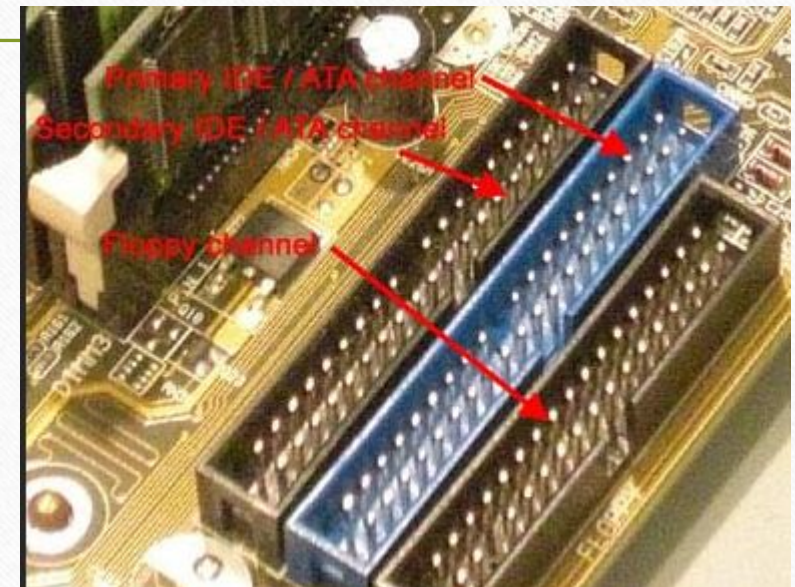


40-pin IDE IDC connector and cable



NOTE:

- The location of the 1 pin (first pin) on an IDE cable is usually designated by the red stripe on one side of the cable. In the example picture above, the 1 pin is on the right side of the cable.



How many drives can each IDE channel support?

- Each IDE channel can support two drives. A single IDE ribbon cable has three connection. One connection connects to the motherboard and the other two connections are available for the two drives.

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- Alternatively called **IDLE**, **IDE** is short for **integrated development environment**, and are visual tools that allow programmers to develop programs more efficiently. Commonly, an IDE may have a compiler, debugger, text editor, and other integrated tools. Smalltalk was the first programming language to have a first true IDE.

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- Below lists some popular IDE programs used by developers today.

- Code::Blocks

- [Cursor](#)

- [IDLE](#) (Integrated Development and Learning Environment)

- [Eclipse](#)

- Komodo

- [Microsoft Visual Studio](#)

- NetBeans

- PyCharm

- RubyMine

- [Xcode](#)

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- Short for **integrated desktop environment**, **IDE** is another name for a desktop environment and described early desktop environments like GlobalView.

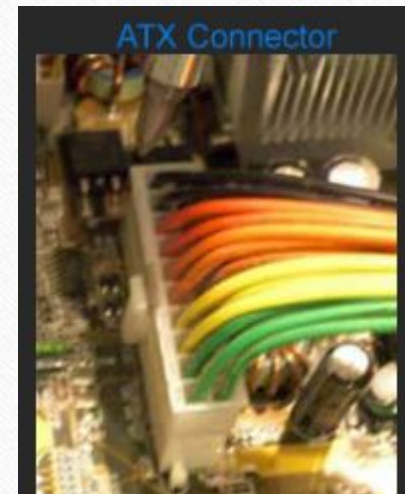
ATX-style connector

- An **ATX-style connector** is a replacement for the older P8 and P9 AT-style connector. It is one of the largest connectors inside a computer. It connects a power supply to an ATX-style motherboard. As shown in the picture, the 20-pin cable is a multi-color cable and may be labeled as **P1**.
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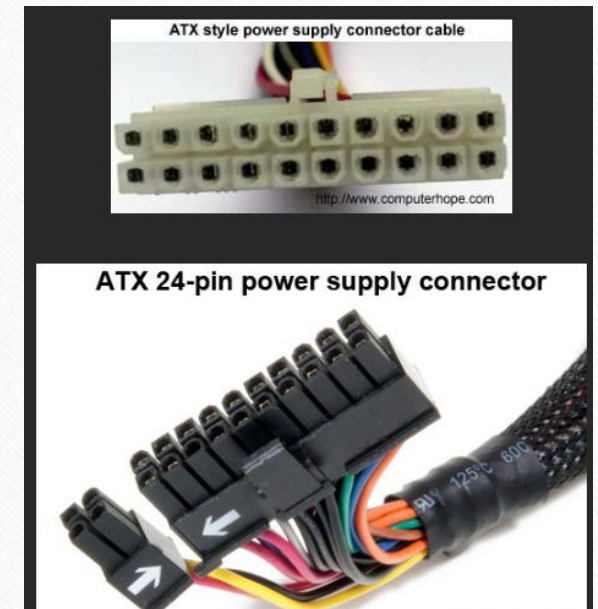
NOTE:

With the introduction of **ATX-2**, this cable is now a 24-pin cable and no longer a 20-pin cable.

- In the pictures, the ATX (Advanced Technology eXtended) cable connector has a small clip on the top, which snaps and holds the cable in place. This cable is also keyed, meaning it only connects in one direction.



- A power supply with a 24-pin connector can be used on a motherboard with a 20-pin connector by leaving the four additional pins disconnected. However, if you have a 24-pin connection on your motherboard all 24-pins need to be connected. If you are using a power supply without a 24-pin connector, you must purchase a new power supply.



Warning

- When using a connector like that shown above, note the arrows pointing to each other. For the cable to be correctly inserted, the arrows must point to each other.

SATA

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- Short for **Serial ATA** or **Serial AT Attachment**, **SATA** 1.0 was released in August 2001 and is a replacement for the parallel ATA interface used in IBM compatible computers. SerialATA can deliver 1.5 Gbps (approximately 187 MBps) of performance to each drive within a disk array. It is backward-compatible with ATA and ATAPI (AT Attachment Packet Interface) devices, and offers a thin, small cable solution, as seen in the "SATA Data Cable" picture. This cable helps makes cable routing easier and offers better airflow in the computer compared to the earlier ribbon cables used with ATA drives.

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- SATA also supports external drives through **External SATA** is called **eSATA**. eSATA offers many more advantages compared to other solutions. For example, it is hot-swappable, supports faster transfer speeds with no bottleneck issues like USB (Universal Serial Bus) and FireWire, and supports disk drive technologies (e.g., S.M.A.R.T.).
 - However, eSATA does have some disadvantages, such as not distributing power through the cable like USB, which means drives require an external power source. The eSATA cable also supports a maximum length of up to 2 meters. Because of these disadvantages don't plan on eSATA becoming the only external solution for computers.

SATA Power Cable



SATA Data Cable



SATA MB Connection



CMOS

- Alternatively known as an **RTC (real-time clock)**, **NVRAM (non-volatile random-access memory)**, or **CMOS RAM**, **CMOS** is short for **complementary metal-oxide semiconductor**. CMOS is an onboard, battery-powered semiconductor chip inside computers that stores information. This information ranges from the system time and date to your computer's hardware settings. The picture shows an example of the most common CMOS coin cell battery (Panasonic CR2032 3V) used to power the CMOS memory.



Which devices use CMOS?

- Digital logic circuits
- SRAM (static random-access memory)
- Microprocessors
- Microcontrollers

How would I know if my CMOS battery is failing?

- If the CMOS battery fails, the computer cannot maintain the correct time or date on the computer after it's turned off. For example, after turning your computer on, you may notice the time changed to 12:00 P.M., and the date is reset to January 1, 1990. This error indicates the CMOS battery has failed.
- Another indication of CMOS battery failure is if one of the following messages are shown as the computer boots.
- **CMOS Read Error**
- **CMOS Checksum Error**
- **CMOS Battery Failure**
- **System battery voltage is low**

How do you pronounce CMOS?

- CMOS is pronounced as one word that sounds like *see-moss*.
- 2. With a camera, see our CMOS sensor definition.
- 3. **CMOS** is an abbreviation for *The Chicago Manual of Style* style guide.

RAID

- Short for **redundant array of independent disks**, **RAID** is an assortment of hard drives connected and set up in ways to help protect or speed up the performance of a computer's disk storage. RAID is commonly used on servers and high-performance computers. The picture of the Drobo is a good example of a device using RAID technology. RAID uses several techniques used in RAID, as explained below.



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- RAID helps protect your data. However, RAID should not be used as a substitute for a backup. If a file is deleted or overwritten, it cannot be restored using RAID.

System panel connector

- Alternatively called the **fpanel** or **front panel connector**, the **system panel connector** or **system panel header** controls a computer power button, reset button, and LED's (light-emitting diode). The System panel cables, as shown in the picture are two wire cables that are color-coded to help identify where they connect to the motherboard system panel connector. The black or white wire is the GND (ground) wire and the colored wire is the powered wire. The cables, colors, and connections vary depending on the computer case and motherboard you have, however, generally include the cables mentioned below.

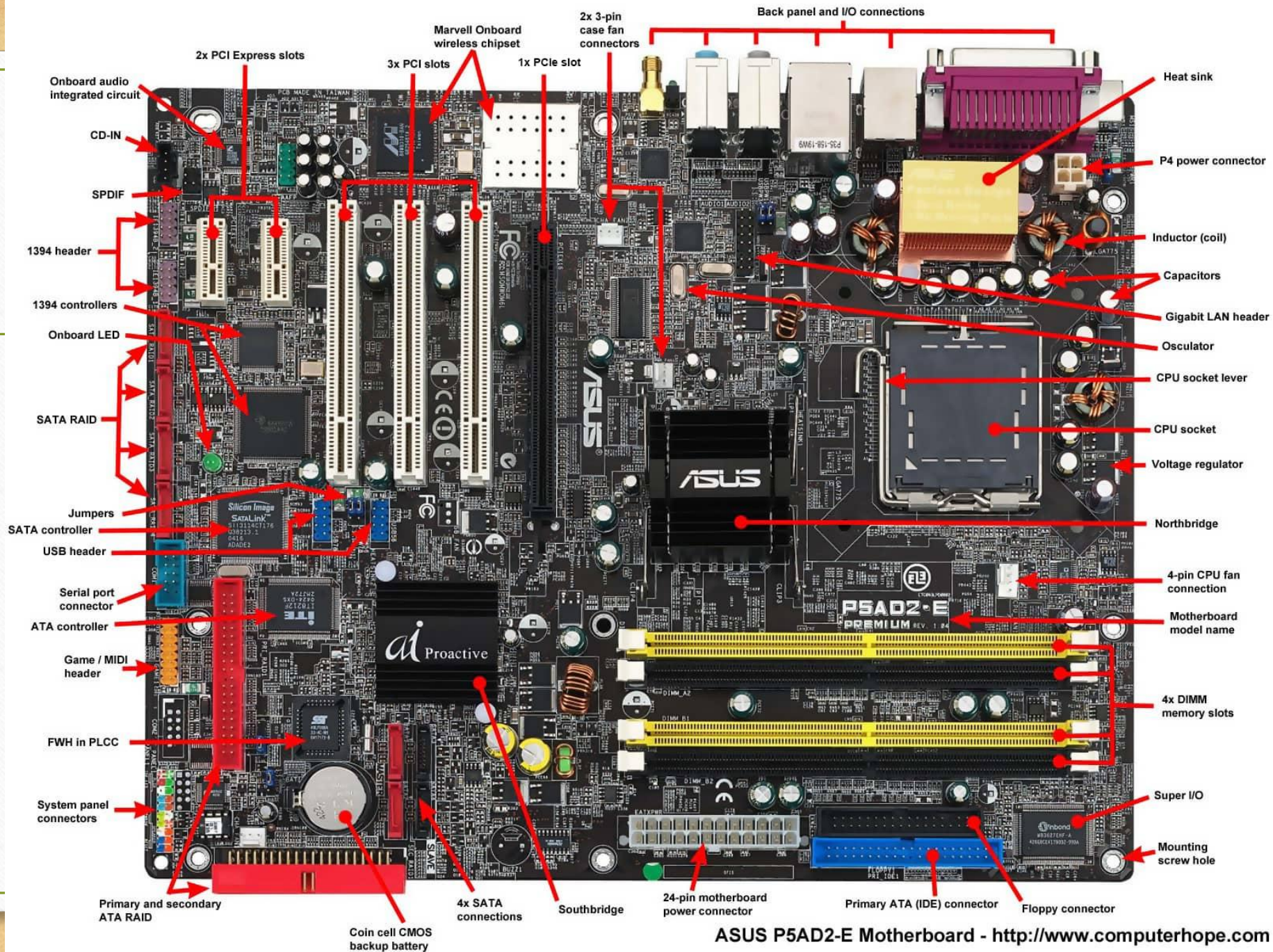
FWH

- Short for **firmware hub**, **FWH** is part of the Intel Accelerated Hub Architecture containing both the system BIOS (Basic Input/Output System) and integrated video BIOS on one component. The firmware hub connects directly to the ICH (I/O Controller Hub) without requiring an ISA (Industry Standard Architecture) bus. The picture shows an example of an FWH chip in a PLCC (Plastic Leaded Chip Carrier).



Southbridge

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- The **southbridge** is an IC (integrated circuit) 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 (universal serial bus), PCI, ISA (Industry Standard Architecture), IDE (integrated drive electronics), BIOS (basic input/output system), and Ethernet.
 - The southbridge gets its name for commonly being South of the PCI (peripheral component interconnect) bus. Below is a graphic illustration of the ASUS P5AD2-E motherboard with explanations of each of the major components including the southbridge. It is common for the northbridge and southbridge to have a heat sink. Also, the northbridge is usually slightly larger than the southbridge.



ASUS P5AD2-E Motherboard - <http://www.computerhope.com>

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- Although the southbridge handles most of the I/O devices, less prominent input/output devices, such as a serial port, keyboard, and non-USB mouse are handled by the SIO (super input/output).

Note



Some newer chipsets are combining the Southbridge and Super I/O chips into a single chip and referring to this chip as the **Super Southbridge chip**. Some manufacturers such as NVIDIA and SiS have even combined the Northbridge, Southbridge, and Super I/O into a single chip.

Note

- New motherboards are replacing the northbridge and the southbridge with IHA (Intel Hub Architecture).

Serial port

- An asynchronous port on the computer used to connect a serial device to the computer that transmits one bit at a time. **Serial ports** are usually identified on IBM-compatible computers as COM (communications) ports. For example, a mouse might connect to COM1 and a modem to COM2. The picture shows the **DB9** serial connector on a cable.



Note

- With the introduction of USB (universal serial bus), FireWire, and other faster solutions, serial ports are rarely used compared to how often they've been used in the past. Also, many new computers and laptops no longer have a serial port.

What is the serial port used for?

- Below is a listing of various hardware components that can be purchased and used with your serial port.
- Mouse - One of the most commonly used devices for serial ports, usually used with computers with no PS/2 or USB ports and specialty mice.
- Modem - Another commonly used device for serial ports. Used commonly with older computers, however, is also commonly used for its ease of use.
- Network - One of the original uses of the serial port, which allowed two computers to connect together and allow large files to be transferred between the two.
- Printer - Today, this not a commonly used device for serial ports. However, was frequently used with older printers and plotters.

Serial port pin information

- Below is a listing of each of the pins on the DB9 connector, their purpose, and signal name.
- **Note:** With many computers, the serial port is labeled as "10101" which are ones and zeros to represent binary. A user may also interpret the number "1" as the letter "I" and the zeros as the letter "O" and call it the "IOIOI" port.



1394 header and USB header

- The **1394 header** and **USB header** is a pin connection found on a computer motherboard that allow additional 1394 and USB (universal serial bus) connections to be added to the computer. For example, a USB add-on could be installed in one of the drive bays and connected to the USB header to add additional USB ports. The picture shows an example of what the 1394 and USB headers look like on a computer motherboard.
- In the picture, both the 1394 and USB headers have nine pins and closely resemble each other. Every motherboard is different, the 1394 or USB header on your motherboard may only have four or five pins.

1394 Headers



USB Headers

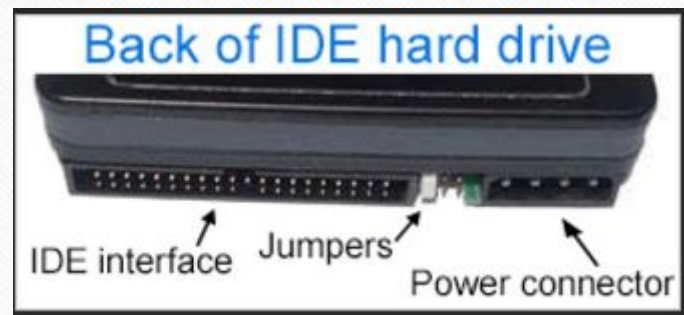


Jumper

- **Jumpers** allow the computer to close an electrical circuit, allowing the electricity to flow on a circuit board and perform a function. Jumpers consist of small pins that can be covered with a small plastic box (**jumper block**), as shown in the illustration. Below the illustration is a picture of what jumpers may look like on your [motherboard](#). In this example, the jumper is the white block covering two of the three gold pins. Next to the pins is a silkscreen description of each pin setting. The picture shows pins 1-2 jumped for Normal mode, 2-3 for config mode, and when open (no jumper), the computer is in recovery mode.

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- **Tip:** A jumper may also be called a **jumper shunt** or **shunt**.

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- Jumpers manually configure computer peripherals, such as the motherboard, hard drives, modems, sound cards, and other components. For example, if your motherboard supports intrusion detection, a jumper can be set to turn this feature on or off.
 - Before plug and play, jumpers were used to adjust device resources, such as changing what IRQ (Interrupt ReQuest) the device uses. Today, most users don't need to adjust jumpers on their motherboard or expansion cards. Usually, you are most likely to encounter jumpers when installing a new drive, such as a hard drive. As shown in the picture, ATA (Advanced Technology Attachment) hard drives have jumpers with three sets of two pins. Moving a jumper between two pins changes the drive from primary drive, secondary drive, or cable select.



How many jumpers are on a motherboard?

- Every computer motherboard is different, so there is no way to know how many jumpers are on a motherboard unless you know the motherboard's manufacturer and model number. Once this information is known, this question can be answered by consulting the motherboard's documentation.

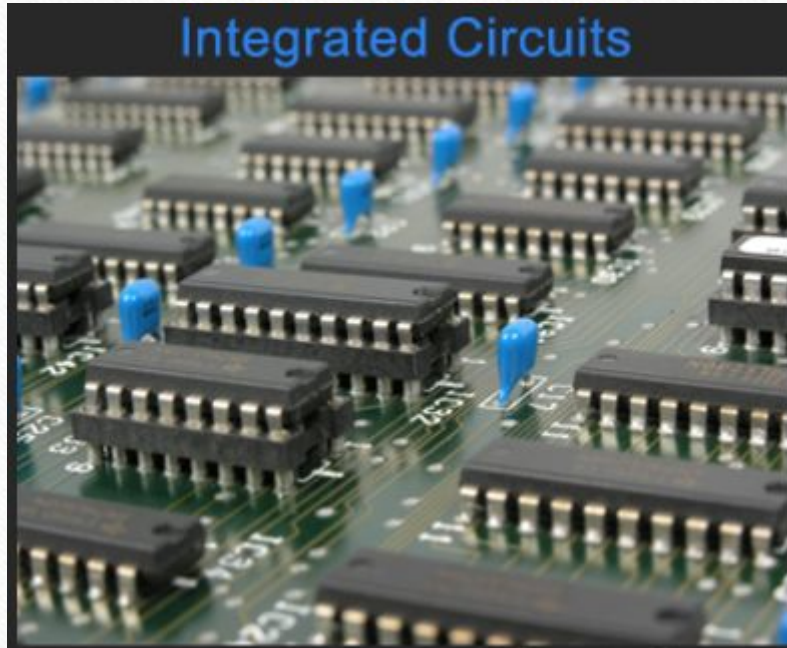
What if my jumper doesn't have a jumper block?

- If you're building a computer, most manufacturers include extra wires, screws, and jumper blocks in the motherboard box. If you cannot find an extra jumper block but see another jumper on the motherboard that's only on one pin, it can be used. Alternatively, if you have other spare hardware with a jumper block, it can be borrowed from any other device.

IC

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- Alternatively known as a **bare chip**, **monolithic integrated circuit**, or **microchip**, **IC** is short for **Integrated Circuit** or **Integrated Chip**. The IC is a package containing silicon with many circuits, logic gates, pathways, transistors, and other components working together to perform a specific function or series of functions. Integrated circuits are the building blocks of computer hardware.
 - The picture shows an example of several integrated circuits. Because the IC is fragile, it's often encased in a plastic package with metal pins extending to connect to a circuit board. An IC may be packaged as SIP (single in-line package), DIP (dual in-line package), PLCC (plastic leaded chip carrier), or another type.

Integrated Circuits



When was the IC first created?

- The integrated circuit was first a concept and invention by British radar engineer Geoffrey Dummer on May 7, 1952. Jack Kilby and Robert Noyce later created IC technology and successfully demonstrated it on September 12, 1958.

Where are chips placed?

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- Chips are placed (installed) onto a PCB (printed circuit board). For example, chips are on the motherboard and expansion cards inside a computer.

Integrated circuit generations

- Since their creation, many generations of integrated circuits have increased the number of transistors and logic gates per chip. Below are early IC generations and the approximate capacity of each chip.
- SSI (small-scale integration) - 1 to 10 transistors and 1 to 12 logic gates.
- MSI (medium-scale integration) - 10 to 500 transistors and 13 to 99 logic gates.
- LSI (large-scale integration) - 500 to 20,000 transistors and 100 to 9,999 logic gates.
- VLSI (very-large-scale integration) - 20,000 to 1,000,000 transistors and 10,000 to 99,999 logic gates.
- ULSI (Ultra Large Scale Integration) - over 1,000,000 transistors and 100,000 logic gates.

What devices use ICs today?

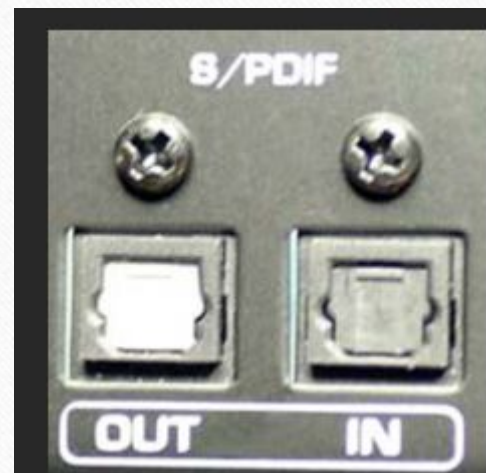
- Because integrated circuits are so versatile, they are incorporated in most electronic devices today, including:
- Computers and peripherals, like keyboards and mice.
- Headphones, speakers, and microphones.
- Smartphones and tablets.
- Wearables, like smartwatches.
- Smart speakers, like Amazon Echo or Google Home.
- Digital photo and video cameras.
- Video game consoles and controllers.
- Infotainment systems in vehicles.
- Smart home LED (light-emitting diode) lights or wall outlets.

S/PDIF

- Short for **Sony and Phillips Digital Interconnect Format**, the **S/PDIF** or **SPDIF** interface transmits digital audio in a compressed form between audio equipment and home theater systems. The S/PDIF interface can utilize a coaxial cable or a fiber optic cable to transmit the audio. Common equipment to use this interface are DVD (digital versatile disc) players and CD (compact disc) players, connecting to a home theater system for Dolby Digital or DTS (Digital Theater Sound) surround sound. High-quality sound cards and laptops also have this connector. The first picture shows what the SPDIF connector may look like on your computer motherboard.



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- The audio transmitted through the S/PDIF interface is defined by the IEC (International Electrotechnical Commission) 61937 standard. The common formats transmitted are the 48 kHz sample rate, which is used in DAT (Digital Audio Tape), and the 44.1 kHz sample rate (used in CD audio). The second picture shows a fiber optic connection on the back of audio equipment.



CD-IN

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- Alternatively called the **optical drive audio connector**, the **CD-IN** is a four-pin connector found on a computer's motherboard or sound card that connects an optical drive's audio. The picture shows a black four-pin connector and an example of what this connector looks like on a computer motherboard.
 - For example, CD-IN could connect the four-pin cable on the back of a CD-ROM (Compact Disc Read-Only Memory) drive to the corresponding audio connection on the motherboard, permitting direct playing of CD (Compact Disc) audio.

Optical Drive CD-IN
(audio connector)



Motherboard form factors and types

- As computers advanced, so have motherboards. Below are various motherboard form factors and additional information about each, including ATX, which is the most common.
- AT (advanced technology)
- ATX (advanced technology extended)
- Baby AT
- BTX (balanced technology extended)
- DTX
- LPX (low profile extension)
- Full AT
- Full ATX
- microATX
- NLX (new low profile extended)

Why are the slots and connections different colors?

- The slots, ports, and connections on a motherboard may be color-coded to help identify the type of slot, port, or connector. For example, with our motherboard picture, the IDE (integrated drive electronics) connectors are different colors to help identify the primary and secondary connectors. When the memory slots are different colors, it indicates the memory slots are dual-channel, and pairs of memory should be installed on the same channel (color). For example, in our picture, the yellow memory slots are Channel A, and Channel B are the black slots. If you were only installing two memory sticks, you'd want to install both of them in Channel A (yellow slots) for optimal performance.

What was the first motherboard?

- The first motherboard is considered to be one used in the IBM Personal Computer, released in 1981. At the time, IBM called it a "planar" instead of a motherboard. The IBM Personal Computer and the motherboard inside it would set the standard for IBM-compatible computer hardware going forward.

Are Dell, HP, and other OEM motherboards different?

- Yes, OEM (original equipment manufacturer) motherboards from manufacturers like Dell and HP (Hewlett-Packard) are slightly different than other motherboards you'd find from a retailer. An OEM designs their motherboard for their needs for each model of computer. Some OEMs may even make drastic changes that go beyond the typical motherboard form factor. However, although an OEM motherboard may have its differences, visually they often look similar. Also, if there hasn't been too many changes, it may be possible to replace the OEM motherboard with a retail motherboard. For OEM computers with differences, you'll need a replacement from the OEM or through a third-party that sells parts from used computers.

Is there a motherboard in a laptop, smartphone, and tablet?

- Yes, although the board is often called a "logic board" and not a motherboard. The logic board is similar to a motherboard and operates the same way. However, because of size requirements with most logic boards, components like the processor and RAM (in tablets and smartphones) are soldered onto the board. Also, because many of these devices have no upgrade options, there are no slots or sockets like a traditional computer motherboard.