**System Bus**

**Definition - What does *System Bus* mean?**

The system bus is a pathway composed of cables and connectors used to carry data between a computer microprocessor and the main memory. The bus provides a communication path for the data and control signals moving between the major components of the computer system. The system bus works by combining the functions of the three main buses: namely, the data, address and control buses. Each of the three buses has its separate characteristics and responsibilities.

The system bus model is a [computer organization](https://gerardnico.com/computer/organization) based on the [Von Neumann architecture](https://gerardnico.com/computer/von_neumann). It deviates from the von Neumann model by combining:

* the [arithmetic logic unit (ALU)](https://gerardnico.com/computer/cpu/alu)
* and the [central processing unit (CPU)](https://gerardnico.com/computer/cpu/cpu)

into a single unit.



***System Bus***

The system bus connects the CPU with the main memory and, in some systems, with the level 2 (L2) cache. Other buses, such as the IO buses, branch off from the system bus to provide a communication channel between the CPU and the other peripherals.

The system bus combines the functions of the three main buses, which are as follows:

* The control bus carries the control, timing and coordination signals to manage the various functions across the system.

* The address bus is used to specify memory locations for the data being transferred.

* The data bus, which is a bidirectional path, carries the actual data between the processor, the memory and the peripherals.

The design of the system bus varies from system to system and can be specific to a particular computer design or may be based on an industry standard. One advantage of using the industry standard is the ease of upgrading the computer using standard components such as the memory and IO devices from independent manufacturers.

System bus characteristics are dependent on the needs of the processor, the speed, and the word length of the data and instructions. The size of a bus, also known as its width, determines how much data can be transferred at a time and indicates the number of available wires. A 32-bit bus, for example, refers to 32 parallel wires or connectors that can simultaneously transmit 32 bits.

The design and dimensions of the system bus are based on the specific processor technology of the motherboard. This, in effect, affects the speed of the motherboard, with faster system buses requiring that the other components on the system be equally fast for the best performance.

**Input Devices**

An **input device** is a piece of hardware used to provide data to a computer used for interaction and control.  It allows input of raw data to the computer for processing.
Here’s a list of some input devices used in computers and other computing devices:

* **Keyboard** – one of the primary input devices used to input data and commands. It has function keys, control keys, arrow keys, keypad and the keyboard itself with the letters, numbers and commands.  Keyboards are connected to the computer through USB or Bluetooth.  A laptop keyboard is more compact than a desktop keyboard to make the laptop smaller and lighter.  Smartphones and tablets use on-screen keyboard to input messages and select commands.
* **Mouse** – an input device used to control the cursor and coordinates. It can be wired or wireless.  It allows the user to do the following:
	+ Move the mouse cursor
	+ Select
	+ Scroll
	+ Open or execute a program
	+ Drag-and-drop
	+ Hover
	+ Perform other functions with the use of additional buttons
	+ A laptop uses a touchpad as the mouse.  A smartphone and tablet use a touchscreen as primary input device and the user’s finger is used as the mouse.
* **Microphone** – an input device that allows users to input audio into their computers. Here are some uses of the microphone:
	+ Audio for video
	+ Computer gaming
	+ Online chatting
	+ Recording musical instruments
	+ Recording voice for dictation, singing and podcasts
	+ Voice recorder
	+ Voice recognition
	+ VoIP – Voice over Internet Protocol
* **Digital Camera** – is an input device that takes pictures digitally. Images are stored as data on memory cards.  It has an LCD screen that allows users to preview and review images.  Digital cameras have become popular over film cameras because of the following features:
	+ LCD screen – allows users to view the photos and videos immediately
	+ Storage – can store thousands of pictures
	+ Picture development – allows users to choose and pick which pictures to develop
	+ Size – takes up less space and can be easily carried
* **Scanner** – is an input device that reads an image and converts it into a digital file. A scanner is connected to a computer through USB.  There are different types of scanners:
	+ Flatbed scanner – uses a flat surface to scan documents
	+ Sheetfed scanner – like a laser printer where paper is fed into the scanner
	+ Handheld scanner – the scanner is dragged over the page to be scanned
	+ Card scanner – for scanning business card
* **Touchscreen** – is an input device that allows users to interact with a computer using their fingers. It is used widely in laptop monitors, smartphones, tablets, cash registers and information kiosks.  Most common functions of touchscreens are as follows:
	+ Tap
	+ Double-tap
	+ Touch and hold
	+ Drag
	+ Swipe
	+ Pinch
* **Barcode Reader** – also known as barcode scanner or point of sale (POS) scanner, is an input device capable of reading barcodes.
* **Webcam** – is an input device connected to the computer and the internet that captures still picture or motion video.
* **Biometric devices** – is an input device used to input biometric data into a computer. Here are the types of biometric devices:
	+ Face scanner
	+ Hand scanner
	+ Finger scanner
	+ Voice scanner
* **Stylus** – is a pen-shaped input device used to write or draw on the screen of a graphic tablet or device. Initially it was just used for graphic tablets and PDAs, but now, it has become popular on mobile devices as a replacement for the user’s fingers.  It’s used for more accurate navigation and to keep oils from user’s fingers off the device screen.

**Output Devices:**

[**107**](https://turbofuture.com/computers/Computer-Basics-10-Examples-of-Output-Devices)

**What is an Output Device?**

An output device is a piece of computer hardware that receives data or instructions from a computer. Essentially, the computer interacts with the output device in some way. The most common output devices are the monitor and printer, but there are many others. The key distinction between an input device and an output device is that the former **sends** data to the computer, whereas the latter **receives** data from the computer. Input and output devices that provide computers with additional functionality are also called peripheral, or auxiliary devices.

**Examples of Output Devices**

1. Monitor
2. Printer
3. Audio Speakers
4. Headphones
5. Projector
6. GPS
7. Sound Card
8. Video Card
9. Braille Reader
10. Plotter

**1. Monitor**

The most common output device used with computers is the monitor, which displays video images and text. A monitor essentially consists of a screen, circuitry, a power supply, buttons to adjust screen settings, and a casing that contains all of these components. The first monitors used the same technology as early televisions, relying on a cathode ray tube and fluorescent screen, but nowadays they incorporate flat panel display technology. VDT(video display terminal) and VDU(video display unit) are alternative names for monitors.

**2. Printer**

Printers are another common output device found in homes in offices. In computing terms, they take electronic data stored on a computer and generates a hard copy of it. Usually that means printing images and text onto paper. There are numerous different types of printer, with Inkjet and laser printers being two of the most common. Modern printers usually connect to a computer with a USB cable or via Wi-Fi.

**3. Computer Speakers**

Computer speakers are hardware devices that transform the signal from the computer's sound card into audio. Speakers are essential if you want a louder sound, surround sound, fuller bass, or just a better quality of audio. External computer speakers began to appear in stores in the early 1990's when computer gaming, digital music, and other forms of media became popular. Some computer speakers are wireless nowadays, connecting to the computer via Bluetooth.

**4. Headphones**

Also known as earphones, headphones allow you to listen to audio without disrupting other people in the vicinity. They connect via the computer line out, or to the speakers. The first headphones were invented in 1910 for U.S. Navy use. Nowadays, headphones come in all sorts of shapes and sizes, from basic earbuds to the more traditional style with padding around the earpieces and a connecting band that fits over the user's head.

**5. Projector**

As its name suggests, this output device "projects" computer images onto a wall or screen. Projectors are typically used for presentations, watching movies, or as a teaching aid, as they enable an entire roomful of people to see images generated by a single computer. Modern projectors usually connect to the computer via an HDMI cable or VGA.

**6. GPS**

GPS (Global Positioning System) uses a network of satellites to provide information, which can then be used to calculate the location of a specific device. It is often used with other digital technology, such as mapping apps. GPS can produce very accurate results, it was originally developed for the U.S. military, but following the downing of a civilian airlines flight by Soviet jets in 1983, the system was made available for commercial use.

**7. Sound Card**

The sound card controls the output of sound signals, enabling devices like speakers and headphones to work. The sound card is known as an expansion card, which means it can be added to the motherboard. Although a sound card is not essential to a computer's basic functionality, you need one if you wish to play games, watch movies, listen to music, and use audio and video conferencing.

**8. Video Card**

As with the sound card, the video card is an expansion card that slots into the motherboard. The video card processes images and video, enabling visuals to be seen on a display. Most computers have basic video and graphics capabilities built into the computer's motherboard, but for faster, more detailed graphics, a video card is required.

**9. Braille Reader**

A braille reader is a peripheral device that enables a blind person to read text displayed on a computer monitor. The text is sent by the computer to the device, where it translated into a braille format and made readable by pushing rounded pins up through a flat surface. Braille readers are also called braille displays and come in various sizes.

**10. Plotter**

A plotter is a similar type of hardware device to a printer. Unlike a printer, however, plotters use writing tools, such as pen, pencil, marker, to draw lines. Designed to use vector graphics, plotters were once commonly employed for computer-aided design, but have now been largely replaced by wide-format printers.

**Central processing unit:**

Alternately referred to as a **processor**, **central processor**, or **microprocessor**, the **CPU** (pronounced sea-pea-you) is the **central processing unit** of the computer. A computer's CPU handles all [instructions](https://www.computerhope.com/jargon/c/compinst.htm) it receives from [hardware](https://www.computerhope.com/jargon/h/hardware.htm) and [software](https://www.computerhope.com/jargon/s/software.htm) running on the computer.

**Tip**

The CPU is often referred to as the **brain** of the computer. However, it is more appropriate to refer to software as the brain and the CPU as a very efficient [calculator](https://www.computerhope.com/jargon/c/calc.htm). A CPU is really good with numbers, but if it wasn't for the software it wouldn't know how to do anything else.

**Note**

Many new computer users may improperly call their [computer](https://www.computerhope.com/jargon/c/computer.htm) and sometimes their [monitor](https://www.computerhope.com/jargon/m/monitor.htm) the CPU. When referring to your computer or monitor, it's proper to refer to them as either the "computer" or "monitor" and not a CPU. The CPU is a chip inside the computer.

**What does the CPU do?**

The CPU's main function is to take input from a [peripheral](https://www.computerhope.com/jargon/p/peripher.htm) (keyboard, mouse, printer, etc) or computer program, and interpret what it needs. The CPU then either outputs information to your monitor or performs the peripheral's requested task.

**CPU history**

The CPU was first developed at [Intel](https://www.computerhope.com/comp/intel.htm) with the help of [Ted Hoff](https://www.computerhope.com/people/marcian_hoff.htm) and others in the early 1970s. The first processor released by Intel was the [4004](https://www.computerhope.com/jargon/num/4004.htm) processor, shown in the picture.

**Components of the CPU**

In the CPU, there are two primary components.

1. [ALU](https://www.computerhope.com/jargon/a/alu.htm) (arithmetic logic unit) - performs mathematical, logical, and decision operations.
2. [CU](https://www.computerhope.com/jargon/c/contunit.htm) (control unit) - directs all the processors operations.



Over the history of computer processors, the speed ([clock speed](https://www.computerhope.com/jargon/c/clockspe.htm)) and capabilities of the processor have dramatically improved. For example, the first microprocessor was the Intel [4004](https://www.computerhope.com/jargon/num/4004.htm) that was released on November 15, [1971](https://www.computerhope.com/history/1971.htm), and had 2,300 [transistors](https://www.computerhope.com/jargon/t/transist.htm) and performed 60,000 operations per second. The Intel Pentium processor has 3,300,000 transistors and performs around 188,000,000 instructions per second.

**Types of CPUs**

In the past, computer processors used numbers to identify the processor and help identify faster processors. For example, the Intel [80486 (486)](https://www.computerhope.com/jargon/num/80486.htm) processor is faster than the [80386 (386)](https://www.computerhope.com/jargon/num/80386.htm) processor. After the introduction of the Intel Pentium processor (which would technically be the 80586), all computer processors started using names like Athlon, Duron, Pentium, and Celeron.

Today, in addition to the different names of computer processors, there are different architectures ([32-bit](https://www.computerhope.com/jargon/num/32bit.htm) and [64-bit](https://www.computerhope.com/jargon/num/64bit.htm)), speeds, and capabilities. Below is a list of the more common types of CPUs for home or business computers.

**Note**

There are multiple versions for some of these CPU types.

The CPU is the heart and brain of a computer. It receives data input, executes instructions, and processes information. It communicates with input/output (I/O) devices, which send and receive data to and from the CPU. Additionally, the CPU has an internal bus for communication with the internal cache memory, called the backside bus. The main bus for data transfer to and from the CPU, memory, chipset, and AGP socket is called the front-side bus.

The CPU contains internal memory units, which are called registers. These registers contain data, instructions, counters and addresses used in the ALU's information processing.

Some computers utilize two or more processors. These consist of separate physical CPUs located side by side on the same board or on separate boards. Each CPU has an independent interface, separate cache, and individual paths to the system front-side bus. Multiple processors are ideal for intensive parallel tasks requiring multitasking. Multicore CPUs are also common, in which a single chip contains multiple CPUs.

# Memory Units

Memory units are used to measure and represent data. Some of the commonly used memory units are:

1) **Bit:** The computer memory units start from bit. A bit is the smallest memory unit to measure data stored in main memory and storage devices. A bit can have only one binary value out of 0 and 1.

2) **Byte:** It is the fundamental unit to measure data. It contains 8 bits or is equal to 8 bits. Thus a byte can represent 2\*8 or 256 values.

3) **Kilobyte:** A kilobyte contains 1024 bytes.

4) **Megabyte:** A megabyte contains 1024 kilobytes.

5) **Gigabyte:** A gigabyte contains 1024 megabyte.

6) **Terabyte:** A terabyte contains 1024 gigabytes.