

Semiconductor vs microchip vs integrated circuit: What's the difference?

The terms semiconductor, microchip, and integrated circuit are often used interchangeably.

Although there are many similarities between the three, which means that using them interchangeably is generally fine in the context of high-level discussions surrounding them, there's no ignoring the fact that they are quite different on a technical level.

Let's look at all three of these in isolation and explore how they differ from one another.

What is a semiconductor?

A semiconductor is a material with conductivity that is between a conductor and an insulator and room temperature, whose conductivity can be controlled within this range. As its name implies, a semiconductor is a material that conducts current only partly.

Semiconductors are ubiquitous in electronics because of these properties and can be found in everything from electronic calculators to mobile phones and gaming consoles to personal computers. Most semiconductors are crystals made of certain materials, and the most common one used in electronic applications is silicon.



Silicon crystals are the most common semiconducting materials used in microelectronics. Image credit: images-of-elements.com

However, pure silicon alone isn't very useful for the applications we need it for. Small amounts of other elements, such as phosphorus or boron, are typically introduced to a silicon crystal via a process known as 'doping' to improve the silicon crystal's conductivity and improve its utility to create either an N-type (phosphorus) or P-type (boron) semiconductor.

When voltage is applied to either an N-type or P-type semiconductor, current flows because the negative side of the voltage pushes electrons, and the positive side pulls them. This creates a measurable electric current.

Semiconductors are the fundamental materials in both microchips and integrated circuits.

What is a microchip?

A microchip, also known as a computer chip, is a set of electronic circuits printed onto a small flat piece of silicon. Transistors act as miniature electrical switches on the chip that can turn a current on or off. The pattern of tiny switches is created on the silicon wafer by adding and removing materials to form a multi-layered latticework of interconnected shapes.

The true power of microchips is staggering. On a microchip no bigger than the average human fingernail, billions of transistors are present. Things take place on such a microscopic scale, in fact, that chip features are measured in nanometers—or one billionth of a meter (or a millionth of a millimeter).

As chip fabrication processes become more advanced, microchips are getting smaller each year while their performance continues to improve. In 2022, 10nm is the standard transistor length but leading companies such as TSMC are producing 5nm and 7nm chips, with an ambition to make them even smaller still.



TSMC's 'Fab 18' is the company's main 5nm production facility. Image credit: [TSMC](#)

Indeed, it's this progress that has been behind the massive increase in computing power that has enabled technology to advance to where it's at today.

What is an integrated circuit?

An integrated circuit (IC) is a microchip, or computer chip. They are fundamentally the same thing. On an IC, transistors, resistors, capacitors, inductors, and other components and wiring are all interconnected into a circuit, hence the name.

There are many different types of IC, including:

Memory chips

Memory chips store data and programs on computers and data storage devices. Random-access memory (RAM) chips provide temporary workspaces, whereas flash memory chips hold information permanently unless it's erased. Read-only memory (ROM) and programmable read-only memory (PROM) chips cannot be modified.

Graphic Processing Units

A Graphics Processing Unit (GPU) is a type of microprocessor that renders graphics for display on electronic devices. The GPU was introduced in the late 1990s and is known for its applications in modern video games. Prior to the GPU being introduced, graphic rendering was a task handled by the Central Processing Unit (CPU).

Microprocessors

A microprocessor is an integrated circuit, but not all integrated circuits are microprocessors. Unlike other ICs, a microprocessor functions as a computing brain and can process logical and arithmetic instructions that are programmed into it. Most consumers associate microprocessors with CPUs.

Analog chips

An analog chip typically includes a transistor along with passive elements such as an inductor, capacitors, and resistors. Analog chips are more prone to noise, or small variations in voltage, which can cause errors. As a result, they've been almost entirely replaced by digital chips. Some applications such as power supplies, however, still use analog chips, and they're still widely used in sensors.

The bottom line

Although the three terms are used interchangeably, they generally refer to the same thing at a high level. Just remember that it's semiconductors that are the fundamental materials found in both microchips and ICs that enable most technologies we take for granted today.