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# TRANSISTOR REQUIREMENT TO USE AS AN AMPLIFIER

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**Abstract:-**
Transistor has three terminals and can be used for amplification but it can't be used directly for AC and DC Hence some requirements are needed which are enlisted in this paper

**What is a transistor?**
A transistor is a miniature semiconductor that regulates or controls current or voltage flow in addition amplifying and generating these electrical signals and acting as a switch/gate for them. Typically, transistors consist of three layers, or terminals, of a semiconductor material, each of which can carry a current.
When working as an amplifier, a transistor transforms a small input current into a bigger output current. As a switch, it can be in one of two distinct states -- on or off -- to control the flow of electronic signals through an electrical circuit or electronic device.

**Why transistors are important**
On its own, a transistor has only one circuit element. In small quantities, transistors are used to create simple electronic switches. They are the basic elements in integrated circuits (ICs), which consist of a large number of transistors interconnected with circuitry and baked into a single silicon microchip.
In large numbers, transistors are used to create microprocessors where millions of transistors are embedded into a single IC. They also drive computer memory chips and memory storage devices for MP3 players, smartphones, cameras and electronic games. Transistors are deeply embedded in nearly all ICs, which are part of every electronic device.
Transistors are also used for low-frequency, high-power applications, such as power-supply inverters that convert alternating current into direct current. Additionally, transistors are used in high-frequency applications, such as the oscillator circuits used to generate radio signals.


Transistors greatly benefit electronics and computing.

**How transistors revolutionized the tech world**
Invented at Bell Laboratories in 1947, the transistor rapidly replaced the bulky vacuum tube as an electronic signal regulator. Considered one of the most significant developments in the history of the PC, the invention of the transistor fueled the trend toward miniaturization in electronics. Because these solid-state devices were significantly smaller, lighter and consumed significantly less power than vacuum tubes, electronic systems made with transistors were also much smaller, lighter, faster and more efficient. Transistors were also stronger, required significantly less power and, unlike vacuum tubes, didn't require external heaters.
As the size of transistors has exponentially decreased, their cost has fallen, creating many more opportunities to use them. Integrating transistors with resistors and other diodes or electronics components has made ICs smaller. This phenomenon regarding miniaturization relates to Moore's Law, which states that the number of transistors in a small IC would double every two years.

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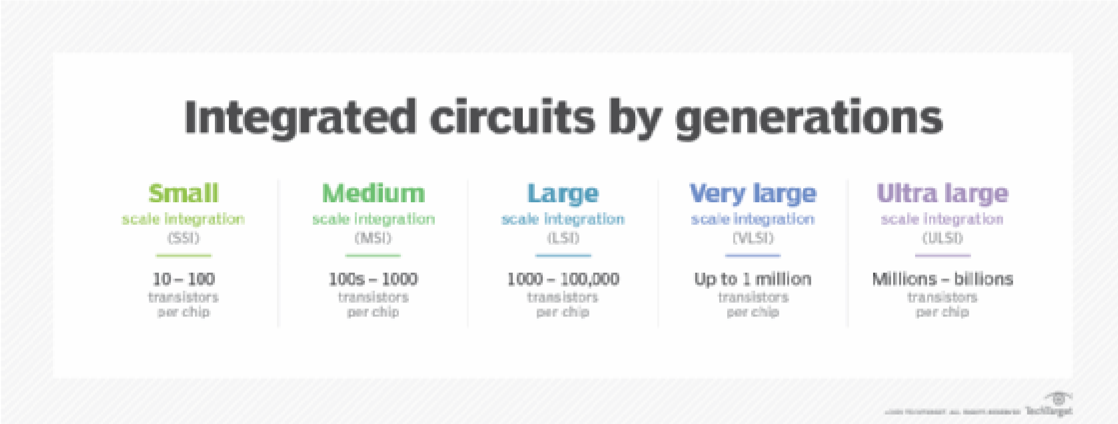



Blending transistors and diodes with resistors, capacitors and other components produces integrated circuits.

**Transistors explained**

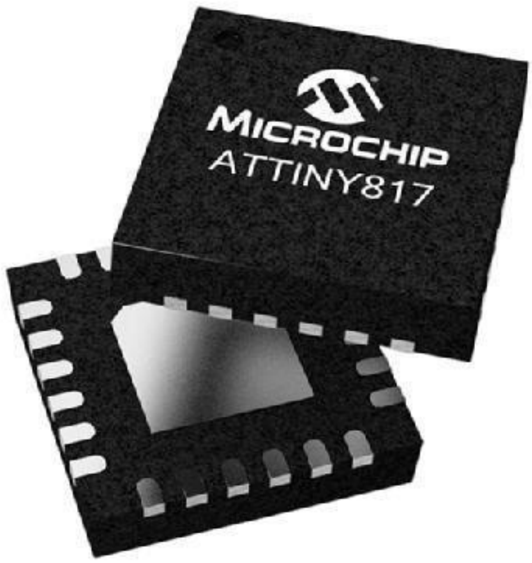
A semiconductor, which conducts electricity in a "semi-enthusiastic" way, falls somewhere between a real conductor like copper and an insulator such as the plastic wrapped around wires). Although most transistors are made from silicon (Si), they can be made from other materials such as germanium and gallium arsenide (GaAs).

Silicon, a chemical element often found in sand, isn't normally a conductor of electricity. A chemical process called doping -- in which impurities are introduced into a semiconductor to modulate electrical, optical and structural properties -- enables silicon to gain free electrons that carry electric current. The silicon can be classified as an n-type semiconductor -- electrons flow out of it -- or a p-type semiconductor -- electrons flow into it. Either way, the semiconductor enables the transistor to function as a switch or amplifier.

A transistor's three-layer structure contains one of the following layers:

- an n-type semiconductor layer between two p-type layers in a positive-negative-positive (PNP) configuration; or
- a p-type layer between two n-type layers in a negative-positive-negative (NPN) configuration

Regardless of its configuration, the inner semiconductor layer acts as the control electrode. A small change in the current or voltage at this layer produces a large, rapid change in the current passing through the entire component, enabling the transistor to function.




Microchip Technology's ATtiny817 is an integrated circuit that controls specific operations in embedded systems. Microchips, which embed transistors, consist of a processor, memory and input/output peripherals on a chip.

**How transistors work**

A transistor can act as a switch or gate for electronic signals, opening and closing an electronic gate many times per second. It ensures the circuit is on if the current is flowing and switched off if it isn't. Transistors are used in complex switching circuits that comprise all modern telecommunications systems. Circuits also offer very high switching speeds, such as hundreds of gigahertz or more than 100 billion on-and-off cycles per second.

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Transistors can be combined to form a logic gate, which compares multiple input currents to provide a different output. Computers with logic gates can make simple decisions using Boolean algebra. These techniques are the foundation of modern-day computing and computer programs.
Transistors also play an important role in amplifying electronic signals. For example, in radio applications, like FM receivers, where the received electrical signal may be weak due to disturbances, amplification is required to provide audible output. Transistors provide this amplification by increasing the signal strength.

**Parts of a transistor**
A transistor is like a set of two diodes with their cathodes or anodes tied together. It has three terminals that carry electrical current and help make a connection to external circuits:

- the emitter, also known as the transistor's negative lead,
- the base, which is the terminal that activates the transistor, and
- the collector, which is the transistor's positive lead.

Let's consider an NPN transistor to understand these terminals. In this configuration, the p-type silicon (base) is sandwiched between two slabs of n-type silicon (the emitter and collector).
The emitter -- indicated by the letter E -- is moderately sized and heavily doped as its primary function is to supply numerous majority carriers to support the flow of electricity. It's called the emitter since it emits electrons.
The base -- indicated by the letter B -- is the center terminal between the emitter and the collector. It is thin and lightly doped. Its main purpose is to pass the carriers from the emitter to the collector.
The collector -- indicated by the letter C -- collects carriers sent by the emitter via the base. It's moderately doped and larger than both the emitter and base.
The emitter, base and collector have the same functions in a PNP circuit. The only difference in this type of transistor is that the n-type base is sandwiched between the p-type emitter and collector, which influences the direction of the arrow on the emitter. This arrow is always part of the emitter-base junction. The arrow points out for an NPN circuit, and points in for a PNP circuit.

**Types of transistors**
Transistors are classified into two major types:

- Bipolar junction transistor (BJT)
- Field-effect transistor (FET)

A BJT is one of the most common types of transistors, and can be either NPN or PNP. This means a BJT consists of three terminals: the emitter, the base and the collector. By joining these three layers, a BJT can amplify an electrical signal or switch the current on or off.
Two kinds of electrical charge -- electrons and holes -- are involved in creating a current flow. In its normal operation, the BJT's base-emitter junction is forward-biased with a very small emitter resistance, while the base-collector junction is reverse-biased with a large resistance.
In a PNP-type BJT, conduction happens through holes or the absence of electrons. The collector current is slightly less than the emitter current. Changes in the latter affect the former. The base controls the current flow from the emitter to the collector. In this case, the emitter emits holes, which are then collected by the collector.
In an NPN-type BJT, electrons pass from the emitter to the base and are collected by the collector. When this happens, conventional current flows from the collector to the emitter. The base controls the number of electrons emitted by the emitter.
A field-effect transistor (FET) also has three terminals -- source, drain and gate -- which are analogous to BJT's emitter, collector and base, respectively. In the FET, the n-type and p-type silicon layers are arranged differently from those of the BJT. They are also coated with layers of metal and oxide to create the metal-oxide semiconductor field effect transistor (MOSFET).
In the FET, *field effect* refers to an effect that enables the flow of current and switches the transistor on. Electrons can't flow from the n-type source to the drain because the p-type gate between them contains holes. But attaching a positive voltage to the gate creates an electric field that enables electrons to flow from the source to the drain. This creates the field effect, which facilitates the flow of current in the FET.
FETs are commonly used in low-noise amplifiers, buffer amplifiers and analog switches. The metal-semiconductor field-effect transistor (MESFET) is commonly used for high-frequency applications, such as microwave circuits.
Other transistor types include the following:

- junction field effect transistor (JFET), a three-terminal semiconductor essential in precision-level, voltage-operated controls in analog electronics;
- thin-film transistor (TFT), a type of FET often used in liquid crystal displays (LCDs);
- Schottky transistor, which combines a transistor and a Schottky diode known for extremely fast switching to keep the transistor from saturating by diverting excessive input current; and
- diffusion transistor, which is a type of BJT formed by the diffusion of dopants onto a substrate.

- **Need as an Amplifier**:- During positive half cylce of AC one diode of transistor conducts but during negative half cycle diode is reverse biased hence no conduction .Hence extra DC voltage is required which is called biasing.

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