

# Electronics

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Electronics refers to the flow of charge (electron) through non-metal conductors (often called semi-conductors), whereas electrical refers to the flow of charge through metal conductors. For example, flow of charge through silicon which is not a metal would come under electronics whereas flow of charge through copper which is a metal would come under electrical. This distinction started around 1908 with the invention by Lee De Forest of the valve (triode). Until 1950 this field was called "Radio technics" because its principal application was the design and theory of radio transmitters and receivers.

Fig:Surface mount electronic components

The study of new semiconductor devices and related technology is considered a branch of physics whereas the design and construction of electronic circuits to solve practical problems comes under electronics engineering. This article focuses on engineering aspects of electronics.

Electronic devices and components

An electronic component is any physical entity in an electronic system whose intention is to affect the electrons or their associated fields in a desired manner consistent with the intended function of the electronic system. Components are generally intended to be in mutual electromechanical contact, usually by being soldered to a printed circuit board (PCB), to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator). Components may be packaged singly or in more complex groups as integrated circuits. Some common electronic components are capacitors, resistors, diodes, transistors etc.

### Types of circuits

#### Analog circuits

Most analog electronic appliances, such as radio receivers, are constructed from combinations of a few types of basic circuits. Analog circuits use a continuous range of voltage as opposed to discrete levels as in digital circuits.

The number of different analog circuits so far devised is huge, especially because a 'circuit' can be defined as anything from a single component, to systems containing thousands of components.

Analog circuits are sometimes called linear circuits although many non-linear effects are used in analog circuits such as mixers, modulators, etc. Good examples of analog circuits include vacuum tube and transistor amplifiers, operational amplifiers and oscillators.

Some analog circuitry these days may use digital or even microprocessor techniques to improve upon the basic performance of the circuit. This type of circuit is usually called "mixed signal."

Sometimes it may be difficult to differentiate between analog and digital circuits as they have elements of both linear and non-linear operation. An example is the comparator which takes in a continuous range of voltage but puts out only one of two levels as in a digital circuit. Similarly, an overdriven transistor amplifier can take on the characteristics of a controlled switch having essentially two levels of output.

#### Digital circuits

Digital circuits are electric circuits based on a number of discrete voltage levels. Digital circuits are the most common physical representation of Boolean algebra and are the basis of all digital computers. To most engineers, the terms "digital circuit", "digital system" and "logic" are interchangeable in the context of digital circuits. In most cases the number of different states of a node is two, represented by two voltage levels labeled "Low"(0) and "High"(1). Often "Low" will be near zero volts and "High" will be at a higher level depending on the supply voltage in use.

Computers, electronic clocks, and programmable logic controllers (used to control industrial processes) are constructed of digital circuits. Digital Signal Processors are another example.

Building–blocks:

- \* Logic gates
- \* Adders
- \* Binary Multipliers
- \* Flip–Flops
- \* Counters
- \* Registers
- \* Multiplexers
- \* Schmitt triggers

Highly integrated devices:

- \* Microprocessors
- \* Microcontrollers
- \* Application–specific integrated circuit (ASIC)
- \* Digital signal processor (DSP)
- \* Field–programmable gate array (FPGA)

Heat dissipation and thermal management

Heat generated by electronic circuitry must be dissipated to prevent immediate failure and improve long term reliability. Techniques for heat dissipation can include heatsinks and fans for air cooling, and other forms of computer cooling such as water cooling. These techniques use convection, conduction, & radiation of heat energy.

Noise

Noise is associated with all electronic circuits. Noise is defined[1] as unwanted disturbances superposed on a useful signal that tend to obscure its information content. Noise is not the same as signal distortion caused by a circuit.

Electronics theory

Mathematical methods are integral to the study of electronics. To become proficient in electronics it is also necessary to become proficient in the mathematics of circuit analysis.

Circuit analysis is the study of methods of solving generally linear systems for unknown variables such as the voltage at a certain node or the current through a certain branch of a network. A common analytical tool for this is the SPICE circuit simulator.

Also important to electronics is the study and understanding of electromagnetic field theory.

### Computer aided design (CAD)

Today's electronics engineers have the ability to design circuits using premanufactured building blocks such as power supplies, semiconductors (such as transistors), and integrated circuits. Electronic design automation software programs include schematic capture programs and printed circuit board design programs. Popular names in the EDA software world are NI Multisim, Cadence (ORCAD), Eagle PCB and Schematic, Mentor (PADS PCB and LOGIC Schematic), Altium (Protel), LabCentre Electronics (Proteus) and many others."

### Construction methods

Many different methods of connecting components have been used over the years. For instance, early electronics often used point to point wiring with components attached to wooden breadboards to construct circuits. Cordwood construction and wire wraps were other methods used. Most modern day electronics now use printed circuit boards (made of FR4), and highly integrated circuits. Health and environmental concerns associated with electronics assembly have gained increased attention in recent years, especially for products destined to the European Union, with its Restriction of Hazardous Substances Directive (RoHS) and Waste Electrical and Electronic Equipment Directive (WEEE), which went into force in July 2006.