

INTEGRATED CIRCUIT – CLASSIFICATION

All the IC's have interconnected discrete devices inside the chip and the corresponding external connecting terminals outside. Each pin may have each function and may vary according to the manufacturer's design. In order to make the circuit fully operative, the pins in the IC must be used for supply voltage, input and output connections, and also some external components according to the needs of the manufacturer.

ICs can be classified on the basis of their chip size as given below:

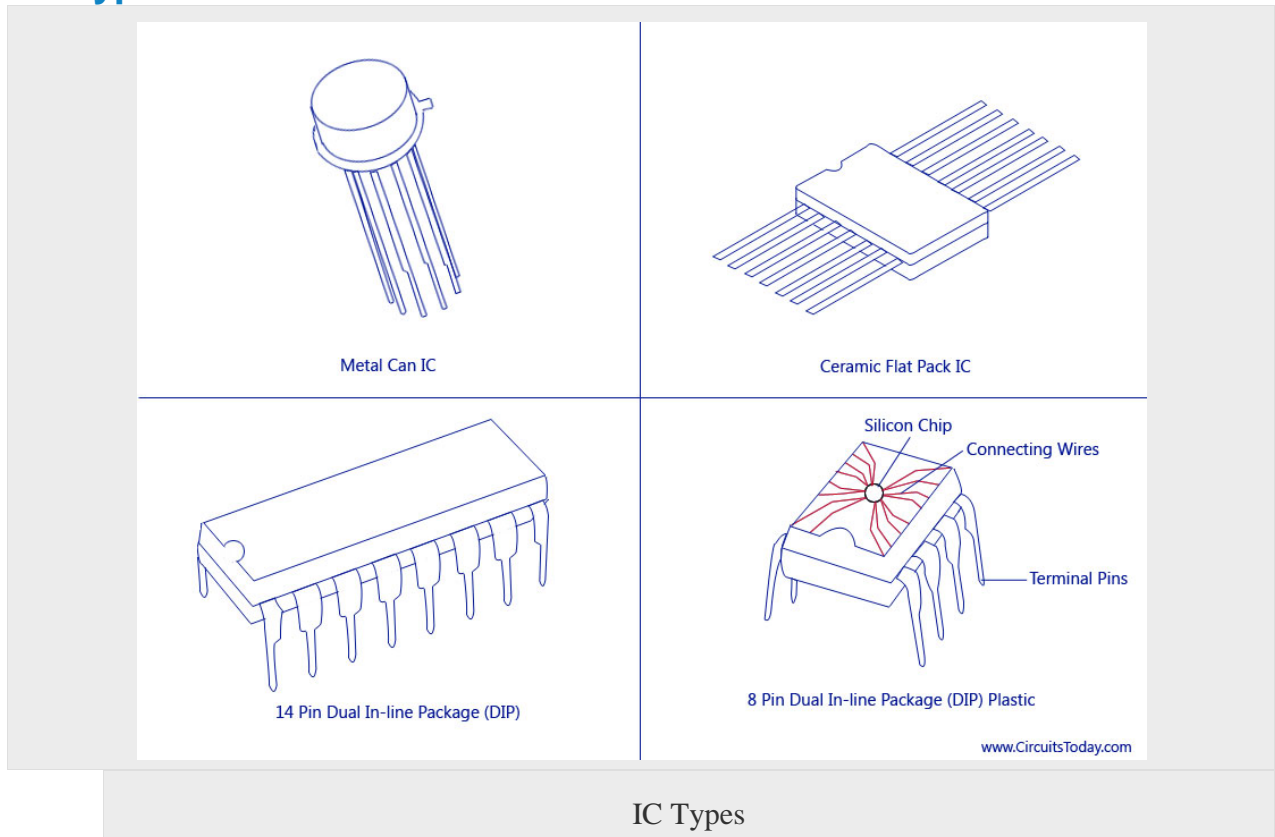
Small scale integration (SSI)—3 to 30 gates/chip.

Medium scale integration (MSI)—30 to 300 gates/chip.

Large scale integration (LSI)—300 to 3,000 gates/chip.

Very large scale integration (VLSI)—more than 3,000 gates/chip.

IC Types



On the basis of applications ICs are of two types namely: Linear Integrated Circuits and Digital Integrated Circuits.

Linear IC's are used in cases when the relationship between the input and output of a circuit is linear. An important application of linear IC is the operational amplifier commonly referred to as op-amp.

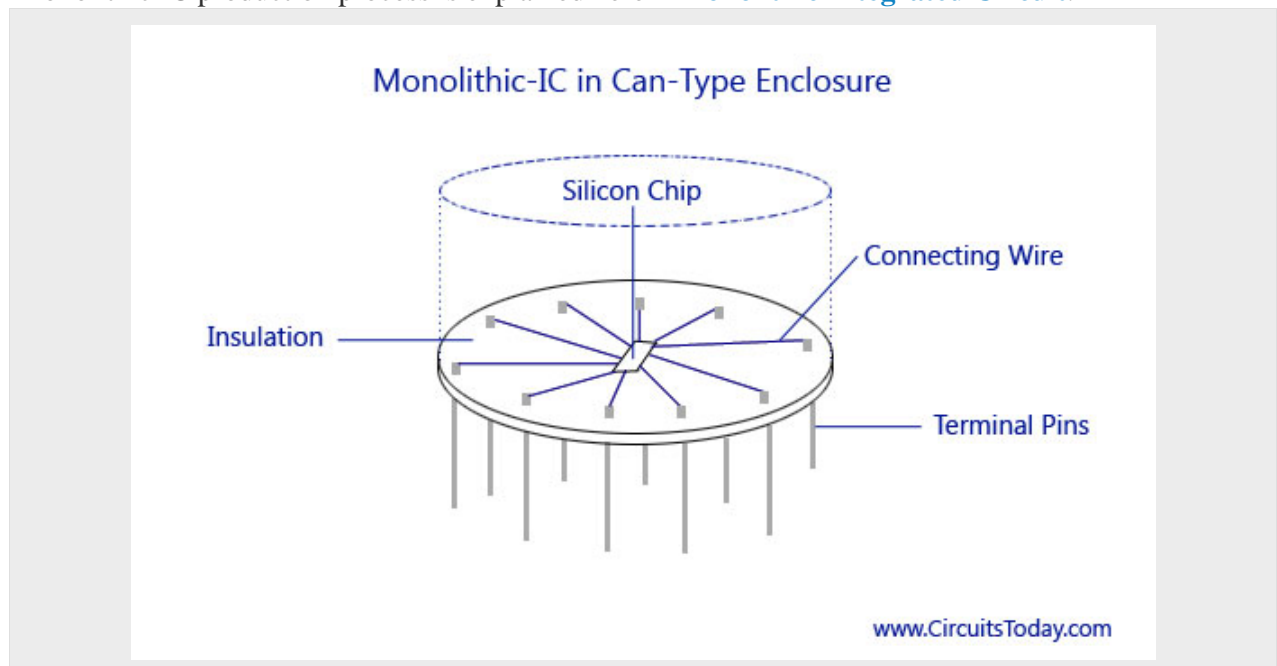
When the circuit is either in on-state or off-state and not in between the two, the circuit is called a digital circuit. IC's used in such circuits are called digital IC's. They find wide applications in computers and logic circuits.

Here are some further classification of integrated circuits based on the fabrication techniques used.

1. Monolithic Integrated Circuits

The word 'monolithic' comes from the Greek words 'monos' and 'lithos' which means 'single' and 'stone'. As the name suggests, monolithic IC's refer to a single stone or a single crystal. The single crystal refers to a single chip of silicon as the semiconductor material, on top of which all the active and passive components needed are interconnected. This is the best mode of manufacturing IC' as they can be made identical, and produces high reliability. The cost factor is also low and can be manufactured in bulk in very less time. They have been found applicable for C's used for AM receivers, TV circuits, computer circuits, voltage regulators, amplifiers and so on.

A detailed article explaining the concept and fabrication process of different components and monolithic IC production process is explained here – [Monolithic Integrated Circuit](#).



Monolithic IC – Can Type

Being as it is, monolithic IC's have some limitations as well.

1. Monolithic IC's have low power rating. They cannot be used for low power applications as they cannot have a power rating of more than 1 watt.
2. The isolation between the components inside the IC is poor.

3. Components like inductor cannot be fabricated to the IC.
4. The passive components that are fabricated inside the IC will be of small value. For higher values they have to be connected externally to the IC pins.
5. It is difficult to make a circuit flexible for any kind of variation; a new set of masks is required.

2. Thin and Thick Film Integrated Circuit

Thick and thin film IC's are comparatively larger than monolithic IC's and smaller than discrete circuits. They find their use in high power applications. Though it is a little large in size, these IC's cannot be integrated with transistors and diodes. Such devices have to be externally connected on to its corresponding pins. Passive components like resistors and capacitors can be integrated.

Both thick and thin film IC's are explained in detail below. Though both the IC's have similar appearance, properties, and general characteristics, the main difference between the two of them is the manner in which the film is deposited on to the IC.

Thin Film Integrated Circuits

This IC is fabricated by depositing films of conducting material on the surface of a glass or ceramic base. The resistors are fabricated by controlling the width and thickness of the films and by using different materials selected for their resistivity. For capacitors, a film of insulating oxide is sandwiched between two conducting films. A spiral form of film is deposited onto the IC to create an inductor.

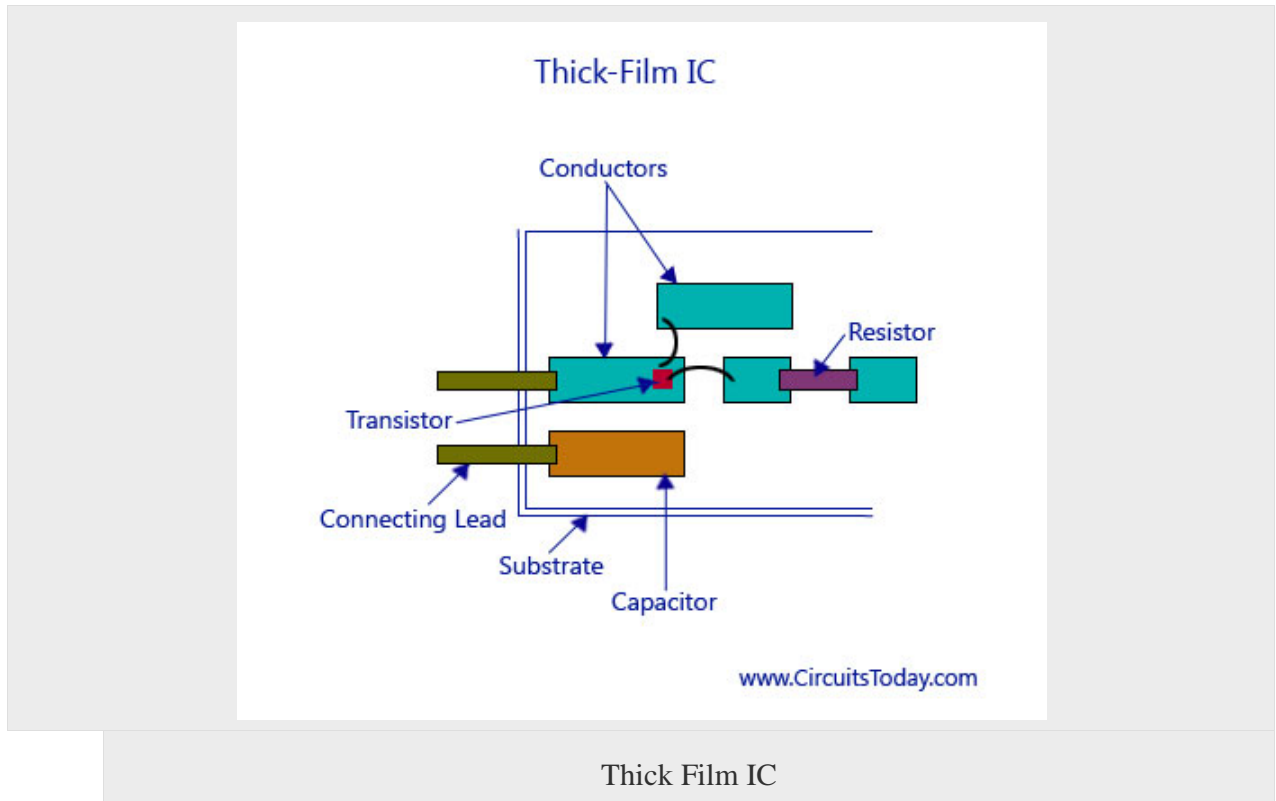
Mainly two methods are used for producing thin films. One method, called vacuum evaporation is used in which vaporized material is deposited on a substrate contained in a vacuum. The other method is called cathode sputtering in which atoms from a cathode made of the desired film material are deposited on a substrate located between a cathode and an anode.

Thick Film Integrated Circuits

They are also commonly called as printed thin film circuits. The desired circuit pattern is obtained on a ceramic substance by using a manufacturing process called silk-screen printing technique.

The inks used for printing are usually materials that have resistive, conductive, or dielectric properties. They are selected accordingly by the manufacturer. The screens are actually made of fine stainless steel wire mesh. The films are fused to the substrate after printing by placing them in hot high temperature furnaces.

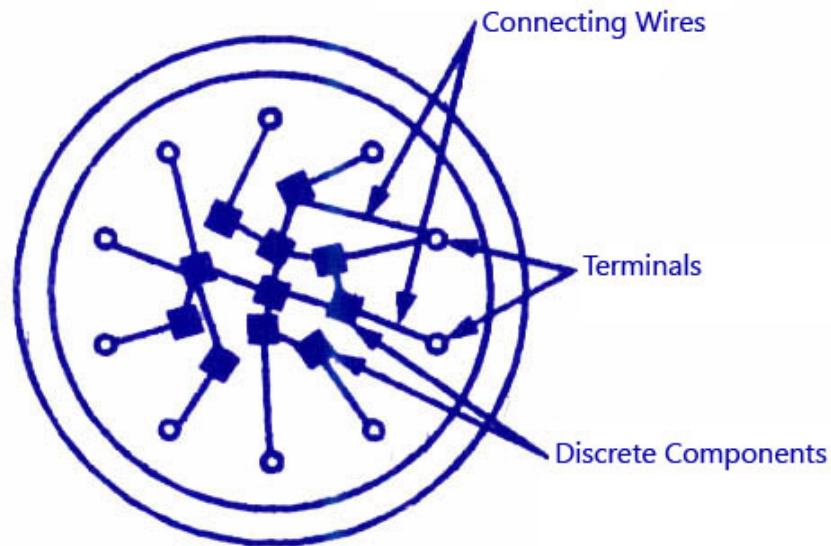
The fabrication techniques used for thin film passive components are adopted for thick films as well. As with thin-film circuits, active components are added as separate devices. A portion of thick-film circuit is given in the figure below.



When compared to monolithic IC's, thick and thin film IC's do have some advantages. They have the advantage of better tolerance, better isolation between components, and greater flexibility in circuit design that further helps in providing high frequency performance. But, these are the only factors that must be considered for the application of such IC's as they are costly in making, and has higher dimensions than monolithic IC's. They also cannot be used to fabricate active components which further increase the size.

3. Hybrid or Multi-chip Integrated Circuits

As the name suggests, the circuit is fabricated by interconnecting a number of individual chips. Hybrids ICs are mostly used for high power audio amplifier applications from 5 Watts to more than 50 Watts. The active components are diffused transistors or diodes. The passive components may be group of diffused resistors or capacitors on a single chip, or they may be thin-film components. Interconnection between the individual chips is made by wiring process or a metallized pattern.



Hybrid or Multichip IC

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Hybrid IC

The diagram of a hybrid or multi-chip IC is shown in the figure above. Hybrid IC's are also known to provide a better performance than monolithic IC's. Although the process is too expensive for mass production, multi-chip techniques are quite economical for small quantity production and are more often used as prototypes for monolithic ICs.

Based upon the active devices employed the ICs can be classified as bipolar ICs using bipolar active devices (BJT) and unipolar IC's using unipolar active devices like FET.

Source : <http://www.circuitstoday.com/integrated-circuits#ic-classification>