

# INTEGRATED CIRCUITS

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**Abstract** - ICs can be made very compact, having up to several billion transistors and other electronic components in an area the size of a fingernail. the advantages of Integrated Circuits are Very small size, Lesser weight ,Reduced cost Though every good thing there is a bad thing . In order to maintain the progress for future, every dimension of the integrated circuits has to be shrunk continuously with almost the same ratio. However, the dimensions are now close to their limit of downscaling, and further reduction becomes very difficult. In order to solve the problem, the introduction of new materials and structures are seriously considered. High-*k* gate insulator technology is one of the examples being developed seriously to overcome the problems. In this paper, progress of IC technologies for the past 30 years is described at first. Then, the difficulties of the further downsizing for future are explained in detail. Finally, the efforts to solve difficulties and the possible solutions are described.

**Index Terms**- semiconductor , digital ic's , linear ic's , multiplexers .

## I. INTRODUCTION

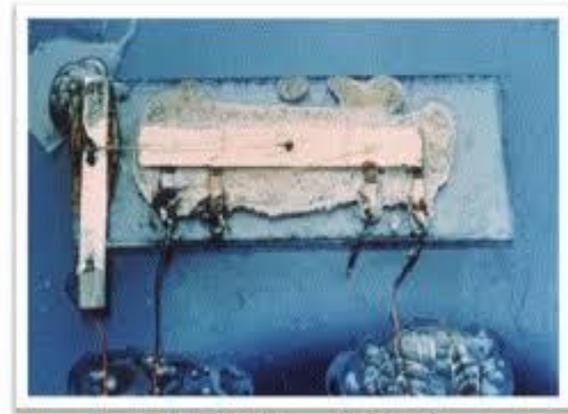
An integrated circuit (ic), sometimes called a chip or microchip, is a semiconductor wafer on which thousands or millions of tiny resistors, capacitors, and transistors are fabricated. i.e. a circuit in which all or some of the circuit elements are inseparably associated and electrically interconnected so that it is considered to be indivisible for the purposes of construction and commerce.



Figure 1: Integrated circuits

## II. HISTORY

Integrated circuits have their origin in the invention of the transistor in 1947 by William B. Shockley and his team at the American Telephone and Telegraph Company's Bell Laboratories. Shockley's team found that negative charge would form a barrier at the surface of certain crystals, and control the flow of electricity through the crystal by manipulating this barrier, which allowed the team to create a device that could perform certain electrical operations, such as signal amplification, that was done by vacuum tubes and named it a transistor, which is a combination of two word transfer and resistor . Solid-state devices proved to be much easier to work with, more reliable, much smaller, and less expensive than vacuum tubes. Using the same principles , engineers soon learned to create other electrical components, such as resistors and capacitors. Now that electrical devices could be made so small, the largest part of a circuit was the awkward wiring between the devices. In 1958 Jack Kilby of Texas Instruments, Inc., and Robert Noyce of Fairchild Semiconductor Corporation independently thought of a way to reduce circuit size further. They laid very thin paths of metal (usually aluminum or copper) directly on the same piece of material as their devices. These small paths acted as wires. With this technique an entire circuit could be "integrated" on a single piece of solid material and an integrated circuit (IC) thus created. ICs can contain hundreds of thousands of individual transistors on a single piece of material the size of a pea. The invention of the integrated circuit made technologies feasible.



*The First Integrated Circuit*

Figure 2: first integrated circuit

### III. CLASSIFICATION OF INTEGRATED CIRCUIT

ICs are basically classified according to their mode of operation.

- Digital
- Linear.

**Digital ICs** are complete functioning logic networks that are equivalent to basic transistor logic circuits and basically they are used to form gates, counters, multiplexers, demultiplexers, shift registers, and others. It usually requires nothing more than a power supply, input, and output because it is a complete pre-design package. There are only two level in digital ICs one is HIGH and another one is LOW. Therefore, accurate control of operating region characteristics is not required in digital circuits, unlike in Linear circuits. And this the only reason because of which digital circuits are easy to design and are produced in large quantities as low cost devices.

**Linear ICs** are equivalent of discrete transistor networks, such as amplifiers, filters, frequency multipliers, and modulators, require additional external components for satisfactory operations. For example, external resistors are necessary to control the voltage gain and frequency response of an op amp. In linear circuits the output electrical signals vary in proportion to the input signals applied or the physical quantities they represent. Since the electrical signals are analogous to the physical quantities, linear circuits are also referred as analog circuits.



Figure 3: Digital IC'S

### IV. ADVANTAGES AND DISADVANTAGE OF USING INTEGRATED CIRCUIT

Since initiation in the 1950s, integrated circuits have had a success. Some of the advantages observed in integrated circuits;

1. Since the soldering joints are not used in integrated circuits, this means that they are more reliable than discrete circuits. This is due to the reduction in number of interconnections between components.
2. Due to fabrication of the various components on the integrated circuits, the components became much smaller. This makes integrated circuits much lighter than discrete circuits. The integrated circuits thus consume much less space than discrete circuits.
3. Integrated circuits are encapsulated with a silicon oxide layer during manufacture. This layer is tough and resistant and thus gives the integrated an ability to operate at extremes of temperatures and other extreme environmental conditions.
4. Integrated circuits are constrained to minimize the number of external connection. This has greatly simplified the layout of these circuits and makes them easier to use.
5. Integrated circuits have been notice to use less power for operations.
6. Integrated circuits have a lower cost of production than that of discrete circuits.

On the other hand integrated circuits have had a flipside too. They have had some limitations. Here are some of the disadvantage occur in integrated circuits;

1. If one component in an integrated fails, that means the whole circuit has to be replaced.
2. Integrated circuits have limited capacitances. This calls for external components if the capacitance needs an extension.
3. It is impossible to fabricate transformers or any

other kind of inductor onto the integrated circuits and again calling for a discrete circuit.

4. Power that integrated circuits can produce is limited and calls for extension.

5. Integrated circuits are not flexible. Their components cannot be modified and neither can the parameters of operation.

## V. USES OF INTEGRATED CIRCUIT

### In Present Time

Integrated Circuits can be found in almost every electronic device today. Anything, from a common wristwatch to a personal computer has Integrated Circuits in it. There are circuits that control almost everything, as simple as a temperature control in a common iron or a clock in a microwave oven. This has made a major difference in how we operate electronic items. Not only does it make electronic items simpler to use, for example, on most microwave ovens now, you have preset controls for different settings. Now you can push a button and it will automatically set the time for defrosting an item or popping popcorn.

### In Future

In the future, Integrated circuits may even be used for medical purposes. For example, Research has been going on since the late 1980s in which they are trying to develop a computer chip that can be attached to the brain to repair different types of brain damage. With this kind of link, they would be able to repair some kinds of blindness or even memory loss from brain damage.

### Impact Of Integrated Circuit

only a half-century after their development was initiated, integrated circuits can be found everywhere. Computers, cellular phones, and other digital appliances are now entangled parts of the structure of modern technological societies. In other words, modern computing, communications, manufacturing, and transport systems, including the Internet, all depend on the existence of integrated circuits. Indeed, many scholars believe that the digital revolution that is based on integrated circuits is one of the most significant developments in the history of mankind.

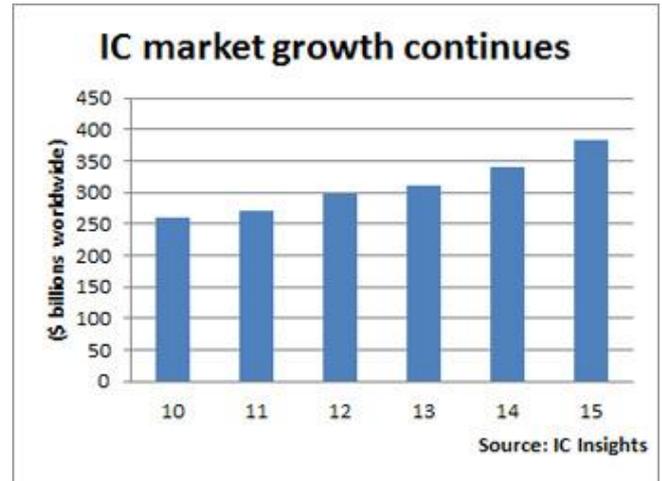


Figure 2: IC market growth

## VI. FUNCTIONS OF INTEGRATED CIRCUITS

The function of an IC (integrated circuit) chip is to replace many separate electronic components which could possibly have been used to build a particular electronic circuit. Most of those separate components are replaced by just one tiny IC chip that has been manufactured ("fabricated" is the correct technical word) to include extremely miniature circuits which imitate the behavior of all those separate components.

There are many reasons why ICs are being used more and more.

- 1.costs of manufacture: using an IC saves the labor of soldering together all the separate components to make the equivalent circuit
- 2.space: using an IC saves the huge amount of space that the circuit would take up if it were built using separate components
- 3.energy: using an IC saves a lot of electrical energy compared to the same circuit built using separate components
- 4.speed: using an IC makes the circuit work much faster than it could ever do if it were built using separate components.

## VII. CONCLUSIONS

Another name for a chip , an integrated circuit (IC) is a small electronic device made out of a semiconductor material. In this paper I have provided a brief sketch of parts of integrated circuits and the segment of the integrated circuits. We've also discussed about the uses of integrated circuits along with their respective functions. The advantages and disadvantages of IC's and the issues related to the IC's have been discussed in the paper.

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