Fundamental of Integrated Circuit

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***Abstract*— Over the past 60 years, silicon-based semiconductor technology has developed very speedily. It forms the pillar of a major part of economic, and scientific activity. The first part of the talk shows from a historical perspective the development from basic transistors to highly complex integrated circuits. With the invention of the transistor by Shockley, Bardeen and Brattain a revolution in electronic circuits started which led to the first integrated circuits built by Kilby and Noyce. Integrated circuits have grown exponentially in complexity and performance. The goal is to give a basic understanding of the functioning and manufacturing of integrated circuits. Therefore, the basics of digital logic and chip design as well as fabrication methods such as lithography. To conclude the talk refers to possible future developments in integrated circuit technology.**

I. INTRODUCTION

Integrated circuit (IC) is the most significant technological development of the 21st century if I may say. It has forever transformed the world of electronics. It has reduced the size of electronics from a refrigerator size to palm size electronics or even less. Disparate vacuum tubes used in early electronics, ICs dissipates less heat and as consumes less energy compared to vacuum tubes. Its reliability is not to be compared with that of vacuum tubes, it is very reliable. ICs have changed the destiny of electronics. It's also changed the design of electronics from the use of separate electronic components to hybrid solid-state devices which combine discrete components with ICs. ICs are so small that you cannot see the connections between them unless with the help of a microscope. Thus, ICs are immensely in use in our electronics and almost all control devices. An IC consists of interconnected transistors, capacitors, resistors, diodes etc. These components are interconnected with an external connecting terminal contained in a small package.

II. DEFINITION

An integrated circuit (IC) is a small semiconductor-based electronic device consisting of fabricated transistors, resistors and capacitors. Integrated circuits are the building blocks of most electronic devices and equipment.

"An integrated circuit is also known as a chip or microchip."

III. CLASSIFICATION OF ICS

SSI: Small scale integration. 3 – 30 gates per chip.

MSI: Medium scale integration. 30 – 300 gates per chip.

LSI: Large scale integration. 300 – 3,000 gates per chip.

VLSI: Very large-scale integration. More than 3,000 gates per chip.

IV. TYPES OF ICS (INTEGRATED CIRCUITS)

Based on the method or techniques used in manufacturing them, types of ICs can be divided into three classes:

- Thin and thick film ICs
- Monolithic ICs
- Hybrid or multichip ICs

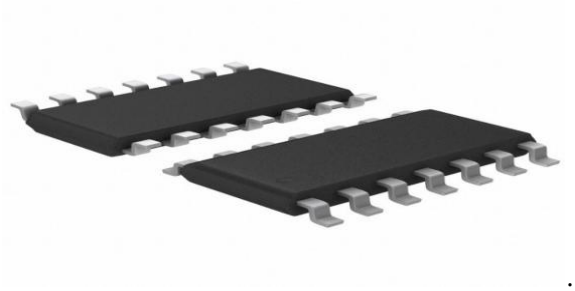
V. CHARACTERISTICS OF INTEGRATED CIRCUITS

The integrated circuit (IC) is one of the most complex things ever made. They consist of small squares of silicon, imprinted with microscopic patterns. The patterns may contain hundreds of millions of transistors, resistors and other electronic parts. Inexpensive and ubiquitous, the power our PCs, cell phones, and music players. They make everything from toaster ovens to cars more efficient. As chip designers continue to improve the state of the art, they squeeze more functionality into ever-smaller packages.

VI. LINEAR INTEGRATED CIRCUITS

Linear integrated circuit referred to as analog ICs due to the fact their input and output can take on a Continuous range of values and the output are Generally proportional to the input. Linear Integrated Circuits use less as compare to digital integrated Circuits. LICs are quickly displacing their discrete circuit counterparts in many applications as their cost become competitive. They also possess much higher reliability because so many external connections are eliminated. LICs Find wide use in military and industrial application as well as in consumer products. They are frequently used in

1. microwave amplifiers
2. Multipliers
3. voltage comparators
4. Voltage regulators
5. Operational amplifiers
6. Small –signal amplifiers
7. Power amplifiers
8. RF and IF amplifiers



VII. Digital Integrated Circuit

Digital Integrated Circuits About 80 per cent of the IC market has been captured by digital ICs which are mostly utilize By the computer industry. Digital IC lend themselves easily to monolithic integration because a Computer uses a large number of identical circuits. Moreover, such circuits employ relatively few Capacitors and values of resistances, voltages and currents are low. Digital ICs contain circuits whose input whose input and output voltages are limited to two possible Level-low or high. It is so because digital signals are usually binary. Sometimes, digital circuits are referred to as switching circuits. Digital ICs include circuits such as

- Logic gates
- Flip-flops
- Counters
- Clock chips
- Calculator chip
- Memory chip

Figure 1

VIII. Integrated Circuit Packaging

In electronics manufacturing, integrated circuit packaging is the final stage of semiconductor device fabrication, in which the tiny block of semiconducting material is encapsulated in a supporting case that prevents physical damage and corrosion. The case, known as a "package", supports the electrical contacts which connect the device to a circuit board.

Electrical

The current-carrying traces that run out of the die, through the package, and into the printed circuit board (PCB) have very different electrical properties compared to on-chip signals. They require special design techniques and need much more electric power than signals confined to the chip itself. Therefore, it is important that the materials used as electrical contacts exhibit characteristics like low resistance, low capacitance and low inductance.[1] Both the structure and materials must prioritize signal transmission properties, while minimizing any parasitic elements that could negatively affect the signal.

Mechanical and Thermal

The integrated circuit package is responsible for keeping the chip safe from all sorts of potential damage. The package must resist physical breakage, provide an airtight seal to keep out moisture, and also provide effective heat dissipation away from the chip. At the same time, it must have effective means of connecting to a PCB, which can change drastically depending on the package type.[1] The materials used for the body of the package are typically either plastic (thermoset or thermoplastic) or ceramic. They both can offer a high thermal conductivity and decent mechanical strength. Ceramic generally has more preferable characteristics, but is more expensive.[2]

Economic

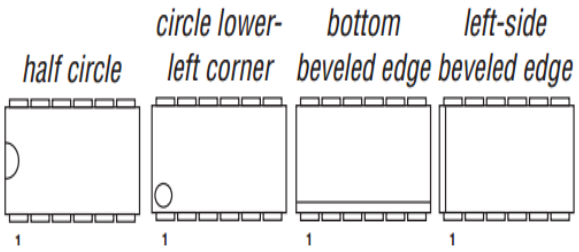
Cost is a major limiting factor for many designs. Choices such as package material and level of precision must be balanced by the economic viability of the end product. Depending on the needs of the system, opting for lower-cost materials is often an acceptable solution to economic constraints. Typically, an inexpensive plastic package can dissipate heat up to 2W, which is sufficient for many simple applications, though a similar ceramic package can dissipate up to 50W in the same scenario.[1] As the chips inside the package get smaller and faster, they also tend to get hotter. As the subsequent need for more effective heat dissipation increases, the cost of packaging rises along with it. Generally, the smaller and more complex the package needs to be, the more expensive it is to manufacture.[2]

IX. Identifying Pin

"If the IC/Chip has got no markings then hold it horizontally so that the writing is from left to right and now the pin no 1 is the one on the bottom left."

Here are a few images which might help you in identifying the pin no 1 in a chip/integrated circuit.

The image shown below is applicable for two sided chips like DIP, SIP, SO, SOIC



X. CONCLUSIONS

IC technique is well suited for the implementation of LV CTFs, since the voltage swings become almost negligible with respect to the supply voltage required to properly bias the circuit. It also offers a high current efficiency since the design is based on the nonlinear device characteristics and therefore no additional linearization scheme is required. The IC technique seems therefore very promising for the Realization of continuous-time filters that have to operate at low-voltage and consume as little power as possible while maintaining reasonable dynamic range. However, the design of integrated circuits is better Linder stand the limitations in order to fully exploit this new technique and clearly demonstrate its advantage over the more classical approaches.

REFERENCES

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