



Comparison of Ultra-capacitor Electric Circuit Models

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Editorial

An integrated circuit is also called as monolithic integrated circuit, chip, microchip, and IC can be defined as a set of electronic circuits with millions of resistors, capacitors, transistors, and other components are integrated on a semiconductor wafer or small plate of semiconductor material, generally silicon. Typically, every electrical and electronic gadget we use in our day-to-day life is an application of integrate circuits. Even though ICs consist of several billion transistors and other components but still they are smaller in size, very compact. With the advancement in IC technology the width of conducting line in an integrated circuit is reduced to tens of nanometers.

There are different types of ICs; primarily ICs are classified into two types such as analog integrated circuits and digital integrated circuits. In this article as a special case we discuss about analog integrated circuits design and applications.

Analog Integrated Circuits (Analog IC): Analog integrated circuits were primarily designed using hand calculations and process kit parts before the invention of microprocessors and other software dependent design tools. Analog integrated circuit design is used for designing operational amplifiers, linear regulators, oscillators, active filters, and phase locked loops. The semiconductor parameters such as power dissipation, gain, and resistance are more concerned in the designing of analog integrated circuit.

Analog Integrated Circuit Design: Analog IC design process includes system design, circuit design, component design, circuit simulations, system simulations, integrated circuit layout design, interconnect, verification, fabrication, device debug, circuit debug, system debug. Digital IC design can be automated but analog integrated circuit design is very difficult, challenging, and cannot be automated.

Block Level System: Primarily the ideas are implemented for designing block level design for the desired analog integrated circuit. Different blocks are designed and connected to obtain a complete block level system.

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Component Level Circuit: Based on the block level system, different suitable components are used and connected such that to form a component level circuit. Using this circuit as the basic circuit for analog IC design, it is used for simulation.

Verifying Component Level Circuit: The component level circuit is used for verification. This circuit design is simulated and the based on the simulations results, the component level circuit of the analog integrated circuit is verified.

Integrated Circuit Layout: After the verification of component level circuit of analog integrated circuit using simulations. Analog integrated circuit layout is designed using the physical translation. Thus, an analog integrated circuit layout is designed.

Fabrication of IC: Fabrication of analog integrated circuits involves several steps such as creating semiconductor wafer using semiconductor material (or directly semiconductor wafer can be used). Integrating different electrical and electronics components such as resistors, transistors, etc. on the wafer and packing the chip to form package IC.

Testing and Debugging IC: The analog integrated circuit is then tested and debugged for any checking the results with the estimated results. Then IC prototype is designed and used for characterizing the integrated circuit and evaluation board is used for evaluating the analog integrated circuit.

Operational Amplifier Analog Integrated Circuit Design: The component-level circuit diagram of an analog integrated circuit design of IC 741 operational amplifier is shown in the figure below. It consists of resistors and transistors integrated on a chip.

Component Level Diagram of Analog IC 741 Op-Amp Internal Circuit: The colored boxes represents: outlined blue-differential amplifier, outlined magenta-voltage amplifier, (outlined cyan-output stage, and outlined green-voltage level shifter) outlined cyan and green-output amplifier, outlined red-current mirror.

Applications of Analog Integrated Circuit: There are different examples for analog integrated circuit designs such as power management circuits, operational amplifiers, and sensors that are used with continuous signals for performing the functions such as active filtering, power distributing for components with in chip, mixing, and so on.

Application of Analog IC for Active Filtering: Analog integrated circuit design is used for active filtering. Active filter or analog electronic filter utilizes active electronics components like amplifiers used for improving performance and predictability of a filter by avoiding the bulky and expensive inductor.

Application of Analog IC for Power Management Circuit: In analog integrated circuit design (or any integrated circuits), all the electrical and electronics components that are used and integrated to design the integrated circuit requires power. This required electrical power is distributed to the on chip components using a network of conductors designed on chip. Power management circuit includes analysis and design of these types of networks (network of conductors) that are used for distributing power within the circuit.