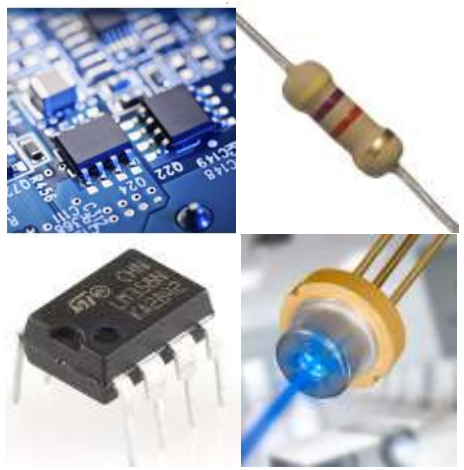
uc3m | Universidad Carlos III de Madrid
Departamento de Tecnología Electrónica

ELECTRONIC SYSTEMS

Review of Fundamental Concepts



Grado Ingeniería Telemática/Sonido e Imagen/Comunicaciones Móviles y Espaciales/Tecnologías de Telecomunicación

Concepts to Review

Amplification
Stages of Basic Amplification
Biasing and Small Signal
Load Effects
Frequency Response
RC Circuits
Transfer Functions

Self-test Questions

- What mathematical function corresponds to a signal amplifier? Consider a sinusoidal voltage signal with a peak-to-peak amplitude of 1V, a mean value of 3V, and a frequency of 3kHz. Model this signal as the function x(t). Can you model the output y(t) if the voltage gain is 2?

- Draw an electrical model of a voltage amplifier with a gain of 2V/V, and input/output resistances of 1MΩ and 1kΩ, respectively.

- Calculate the gain symbolically when a voltage generator with a 50Ω output resistance is connected to the amplifier's input, and a resistive load of 10kΩ is connected to its output.

- We will now review the basic amplification stages using MOSFETs and resistors. Match the elements in the table.

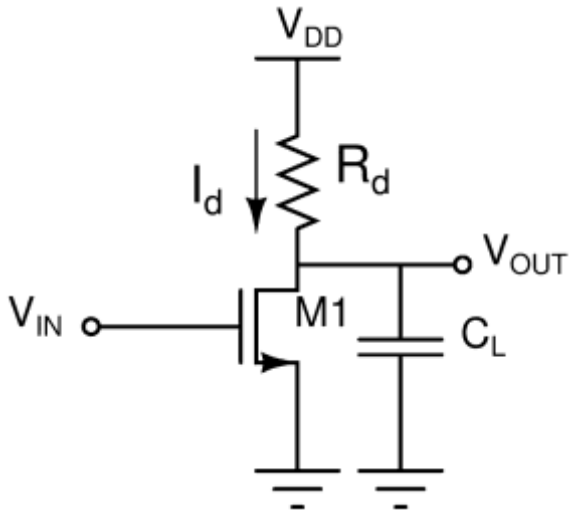
• CS or Common Source	# voltage buffer
• SF or Source Follower	# voltage amplifier
• CG or Common Gate	# current buffer

- What is the advantage of using an active load in a CMOS amplifier instead of a resistive load?

- What is a virtual short in an operational amplifier?

Small-signal Circuit Model

- **Exercise 1: Given the following circuit, model the circuit in small signal. Determine the voltage gain as a function of the transistor parameters (gm, ro). Assume all transistors are the same size. How is the operating point of this amplifier determined? How would this circuit behave with an active load? We will verify through simulation.**

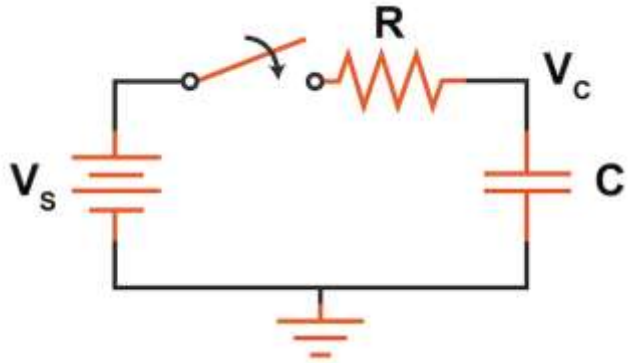


Questions about amplifiers

- What is a differential pair, what is it used for, and how is it modeled?
- What does the principle of virtual short in an operational amplifier mean?
- What distinguishes an operational amplifier from a typical voltage amplifier?
- What is the difference between a transimpedance amplifier and a current amplifier?
- What is the typical frequency response of any amplifier?
- Do you know what the transfer function of a circuit is? What about the sinusoidal steady-state? And the step response?"

RC circuit

- **Exercise 1: Given a series RC circuit, calculate its time constant and draw the response to a 1V step input. How does this response change with a 5V step input? What conditions must a circuit meet for its time constant not to depend on the amplitude of the step input?**



- **Exercise 2: Calculate its cutoff frequency and frequency response.**

Homework

- **Simulate the first exercise in LTSpice and analyze the frequency response.**