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Session 25
Analysis of practical circuits with OA – Exercises

Electronic Components and Circuits

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Analysis of practical circuits with Operational Amplifiers

OBJECTIVES

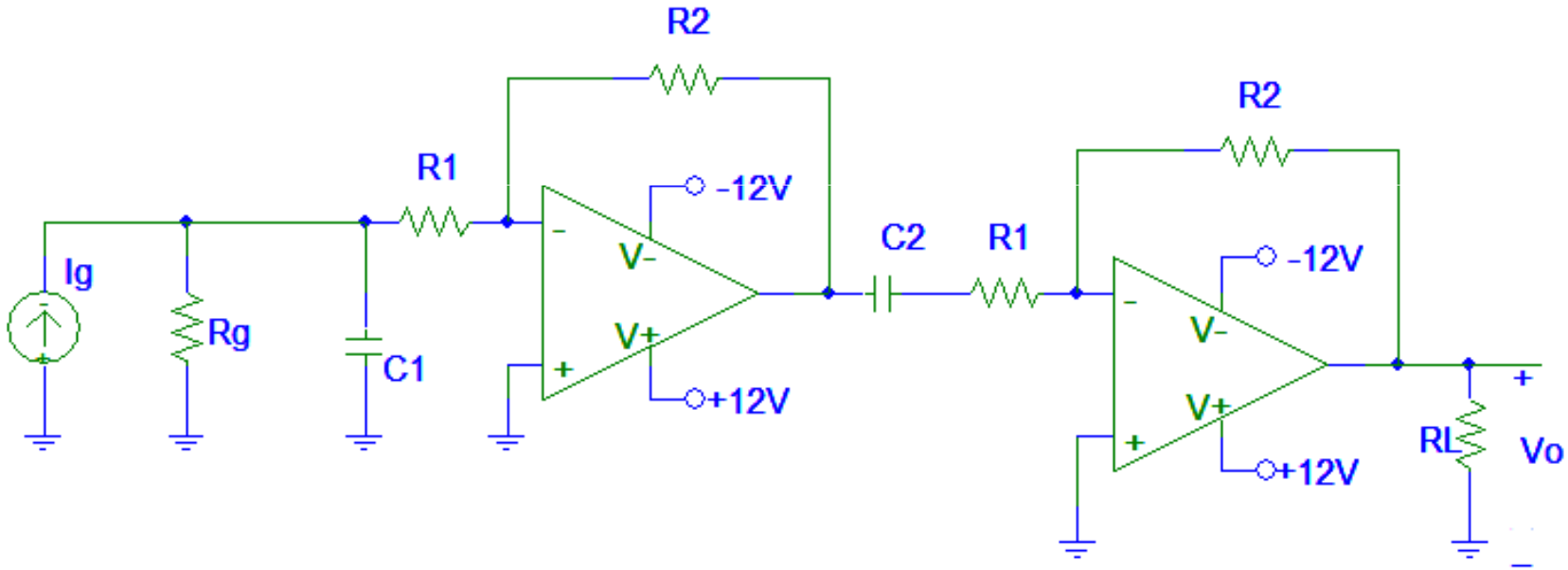
- To analyze linear circuits with operational amplifiers and several input signals
- To analyze the frequency response of linear circuits with operational amplifiers
- To complete a survey of applications of OA
- To analyze comparator circuits with operational amplifiers and obtain the transfer function

Analysis of circuits with Operational Amplifiers

METHODOLOGY

1. ¿Negative feed-back?.
   a) First approach with ideal operational amplifier
   b) Obtain the characteristics of gain, impedances and dynamic range
   c) Consider the frequency response
2. ¿Nonlinear application: comparator, rectifier, etc.?
   a) First approach working as comparator (saturated output) and two cases / ideal diode and two cases (on, off)
   b) Obtain the transfer function

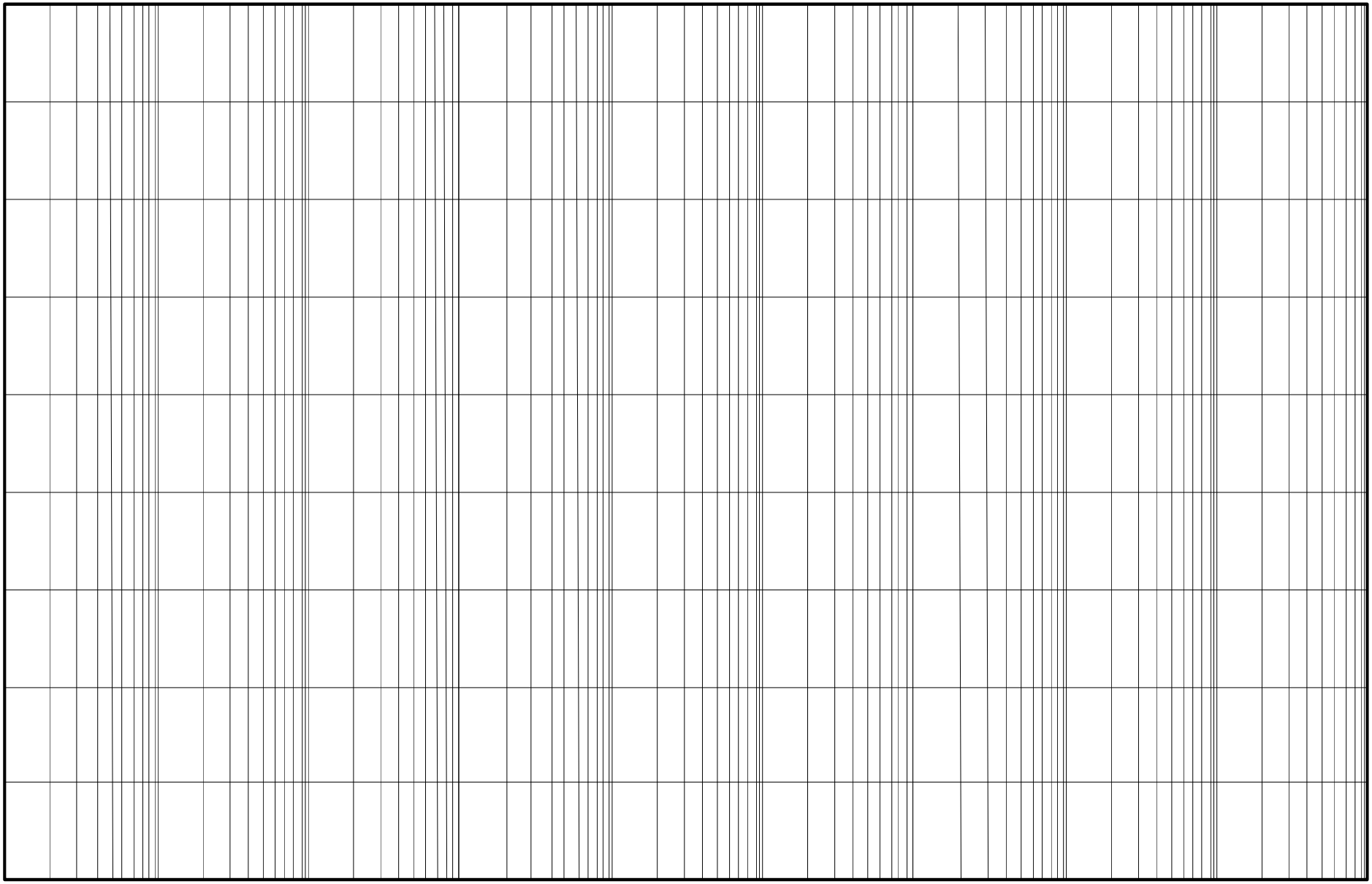
Example: AC coupled multi-stage trasimpedancia amplifier



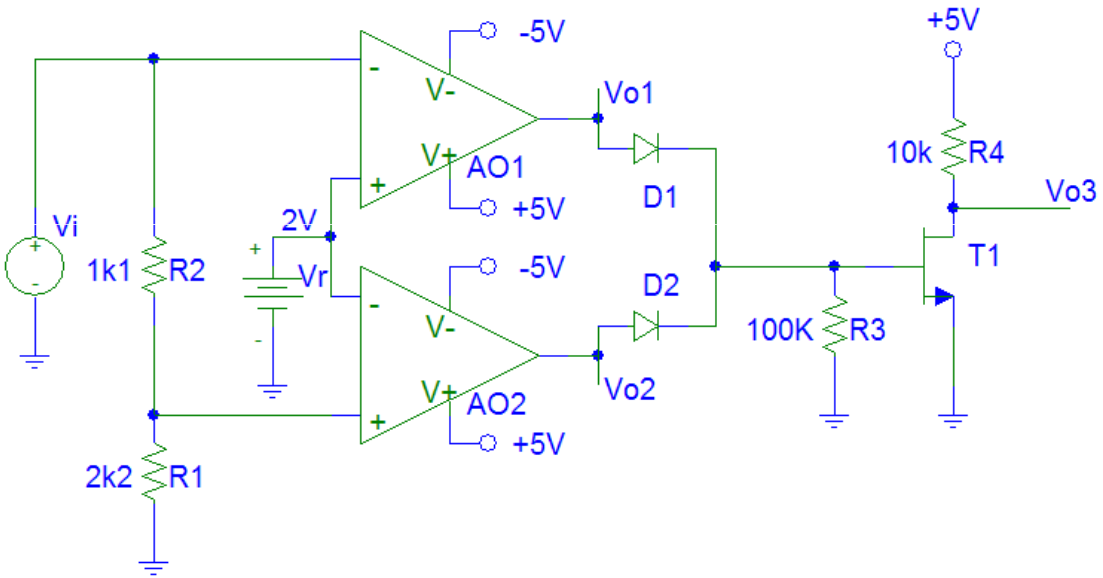
DATA: Rg = 99KΩ, R1 = 1KΩ, R2 = 100KΩ, RL = 100Ω, C1 = 100pF

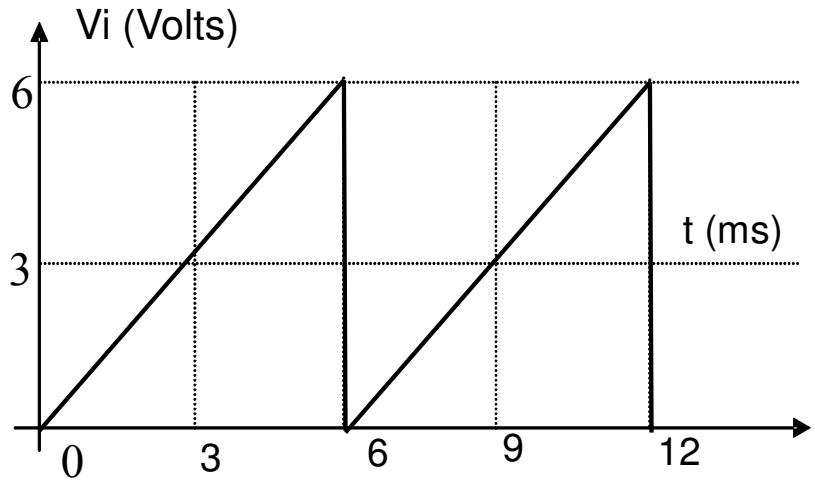
- Obtain the upper cut-off frequency. Recalculate it if GxBW=1.5 in each amplifier.
- Obtain the value of C2 that fixes 1 kHz lower cut-off frequency.
- Obtain the gain of the multi-stage amplifier Vo/Ig for 50 kHz sigal.
- Plot the voltage Vo if the input current Ig is composed of 100µA DC and 10nA rms AC signal (sine, 1kHz).
- Plot the asintotic Bode diagram.

Bode diagram



Exercise: window comparator

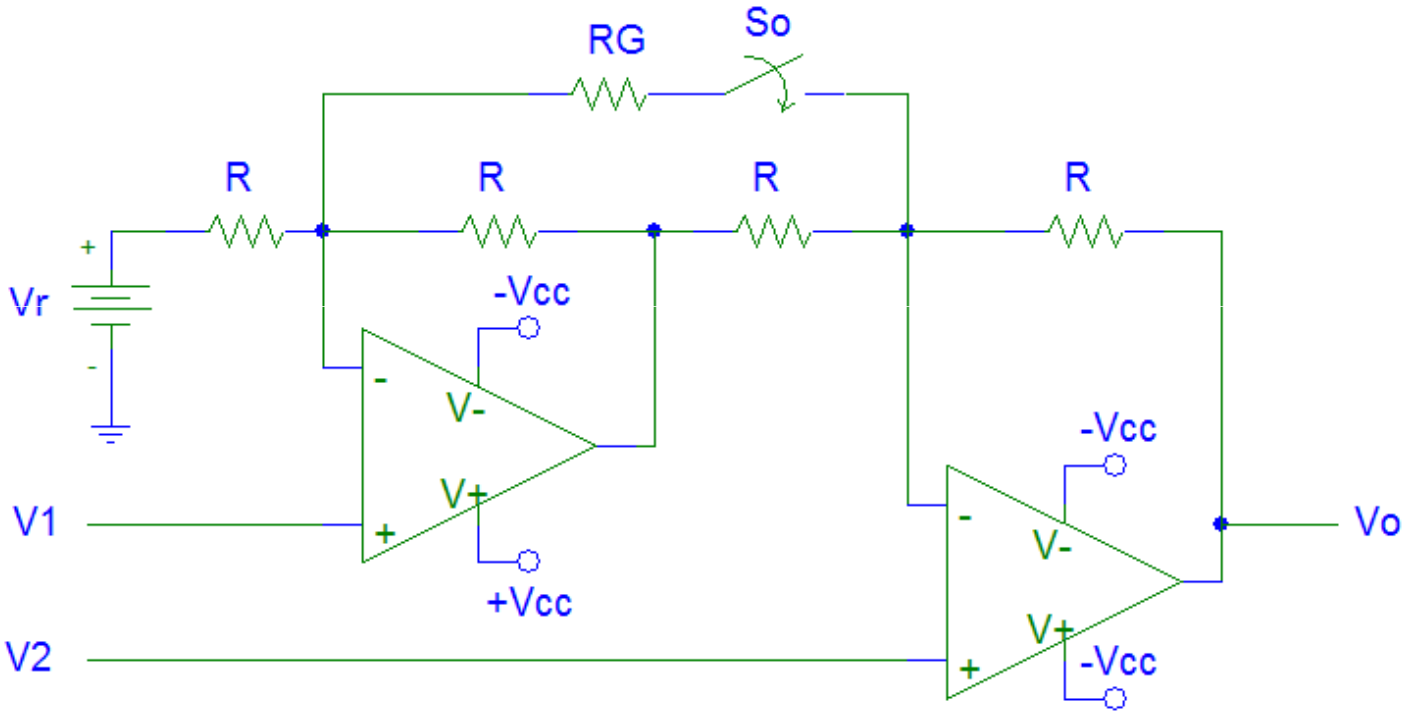




DATA: ±Vcc = ±5V Vr = 2V R1 = 1,1KΩ R2 = 2,2KΩ
R3 = 100KΩ R4 = 10KΩ $V_{D\text{-}ON}$ = 0,7 V $V_{GS\text{-}ON}$ =1 V

- Plot the output voltages Vo1 and Vo2.
- Obtain the value of the voltage Vo3 from each and all combinations of Vo1 and Vo2 values. Indicate which operating region is the MOSFET T1.
- Plot the voltage Vo3, especifying precies time and amplitude values.

Proposed exercise



DATA:

± Vcc = ± 12 V

R = 51 KΩ

Assume that the switch So is open (RG disconnected):

- In the case Vr = 0V, obtain the expression of the output Vo as a function of V1-V2.
- In the case V1 = V2, calculate the value of Vr to make Vo = 6V.
- Plot the signal Vo if the following voltages are applied simultaneously:
  - Vr previously calculated (if not obtained, use Vr = 0V)
  - V1 20V DC and 1V peak (sine, 1kHz) and
  - V2 20V DC

Assume that the switch So is closed (RG connected):

In the case Vr = 0V, V1 = 0V, obtain the value of RG to obtain a gain Vo/V2 = 100.