Antilog Amplifiers

Integrated Circuits (EC-503)

B. Tech. (Electronics and Communication Engineering)

3rd Year/ 5th Semester

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Antilog or Exponential Amplifier

- Antilog amplifiers are the examples of non-linear application of op-amp.
- Applications
  - Mathematical operations (i.e. log(x), ln(x) and sinh(x) calculation.
  - Direct dB display on digital instruments
  - Multiplication, division, square root calculation etc.
  - Analog computers

Basic Antilog Amplifier

- The complement, or inverse function, of the log amplifier is the antilog, or exponential, amplifier. Since v_1 is at virtual ground.

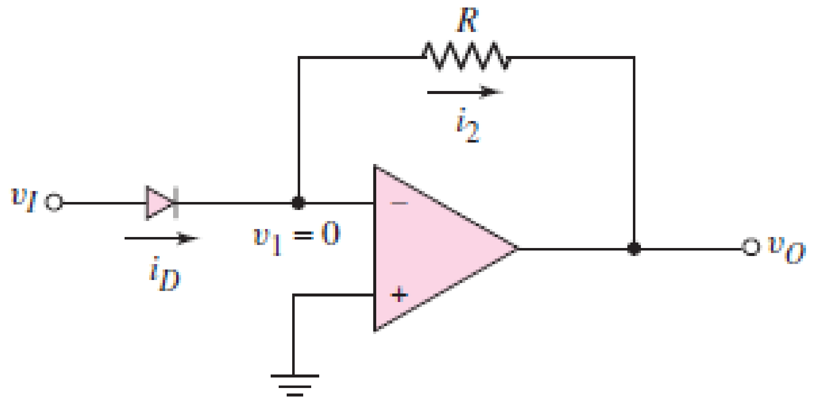
  If $v_I > 0$ than

  $$i_D \cong I_S e^{\frac{v_I}{V_T}}$$

  Thus $v_O = -i_2 R = -i_D R$

  $$v_O = -I_S e^{\frac{v_I}{V_T}} R$$

- The output voltage is an exponential function of the input voltage.



Antilog Amplifier with Temperature Compensation

If Op-Amp A_1 and A_2 are ideal.

$$V_2 = -V_f + V_1$$

$$= -\eta V_T(lnI_f - lnI_0) + \frac{R_1}{R_1 + R_2}V_s$$

Since V_2 is -ve of the voltage across D_2

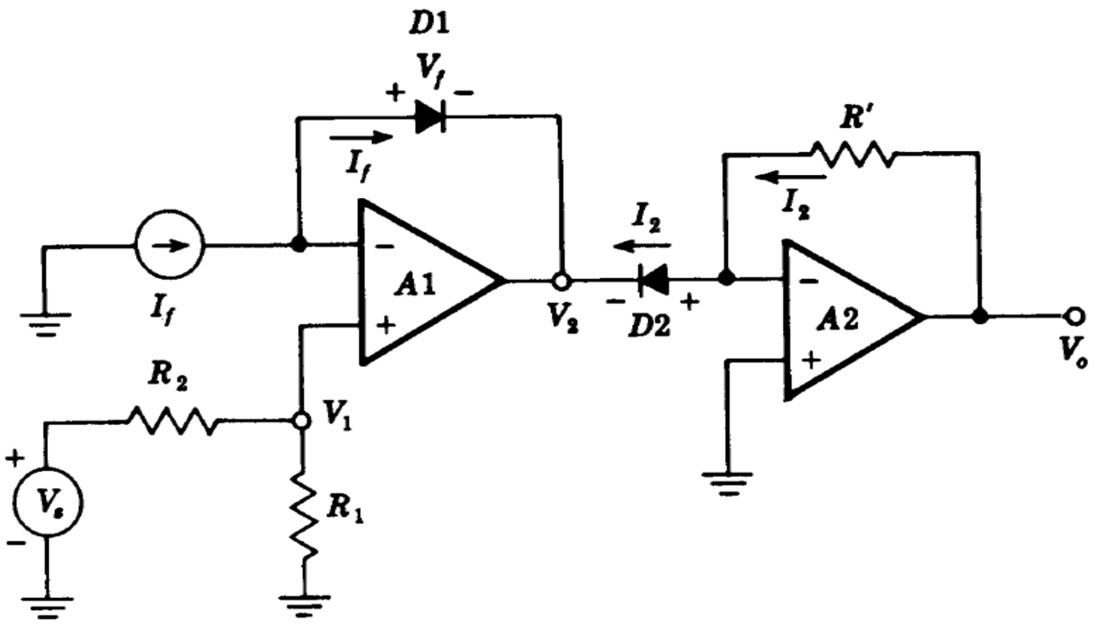
$$V_2 = -\eta V_T(lnI_2 - lnI_0)$$

$$\frac{R_1}{R_1 + R_2}V_s = \eta V_T ln\frac{I_f}{I_2} = \eta V_T ln\frac{I_f R'}{V_0}$$

Because $V_2 = I_2 R'$

$$V_0 = R' I_f ln^{-1}\left[-V_s\left(\frac{R_1}{R_1 + R_2}\frac{1}{\eta V_T}\right)\right]$$

R_2 is made temperature sensitive using thermistor. Thus the effect of change in V_T due to the temperature can be eliminated.



Transistor based Temperature Compensated Antilog Amplifier

Q_1 and Q_2 are matched transistors and V_{ref} is the external voltage.

$V_{BE1} = V_T ln\left(\frac{I_{C1}}{I_S}\right)$ and $V_{BE2} = V_T ln\left(\frac{I_{C2}}{I_S}\right)$

$I_{C1} = \frac{V_O}{R_1}$ and $I_{C2} = \frac{V_{ref}}{R_1}$

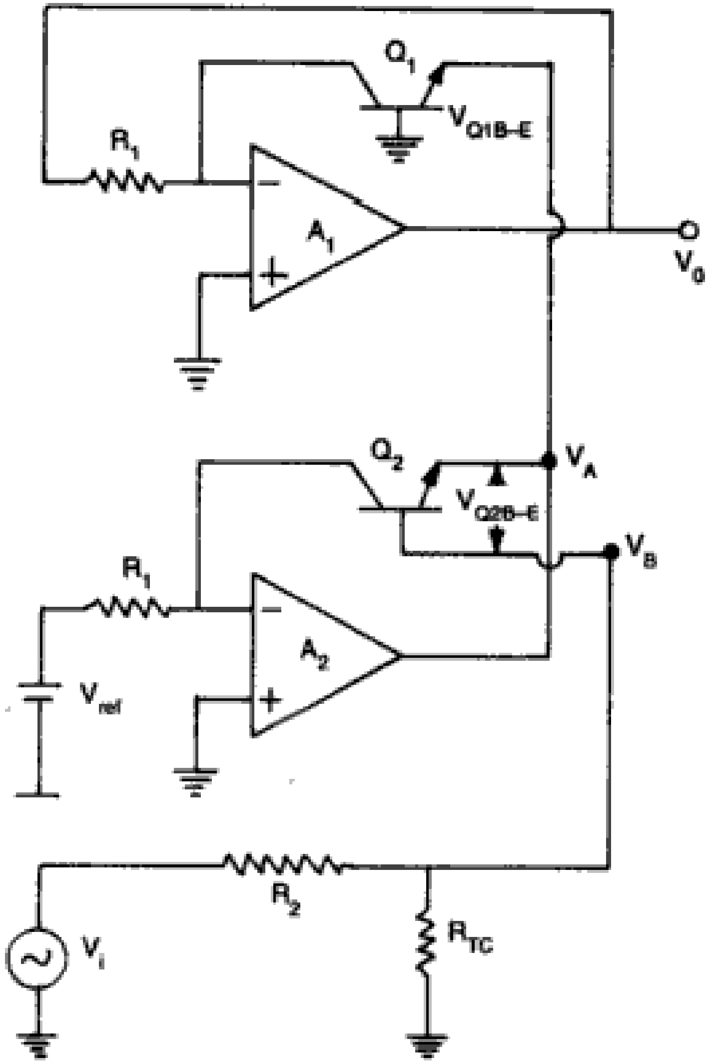
$V_A = -V_{BE1}$ and $V_A = V_{E2}$

$$V_{B2} = \frac{R_{TC}}{R_2 + R_{TC}} V_i$$

$$V_{BE2} = V_{B2} - V_{E2}$$

Substituting the values of VB_{E2}, V_{B2} and V_{E2}.

$$V_O = V_{ref} ln^{-1}\left(\frac{-V_i R_{TC}}{V_T(R_2 + R_{TC})}\right)$$



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Thank you!!!
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