Midterm Exam April 13th, 2011

Wednesday 14:40 – 16:40

14.03.2011

©

1N 4001 DIODE Datasheet

Logarithmic

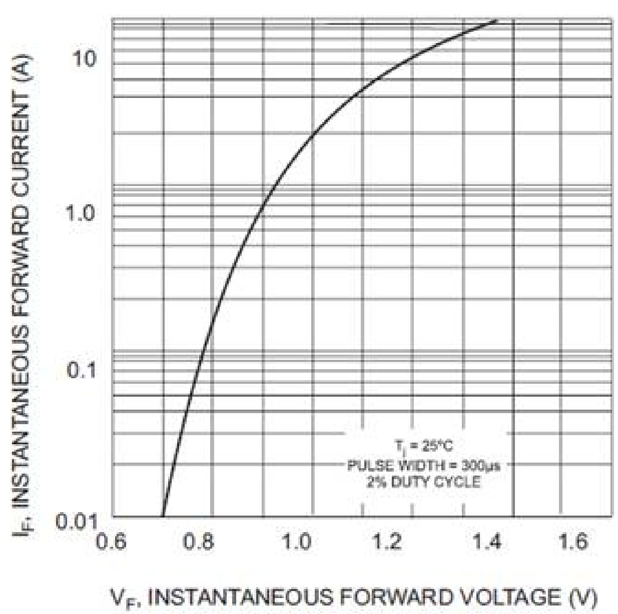
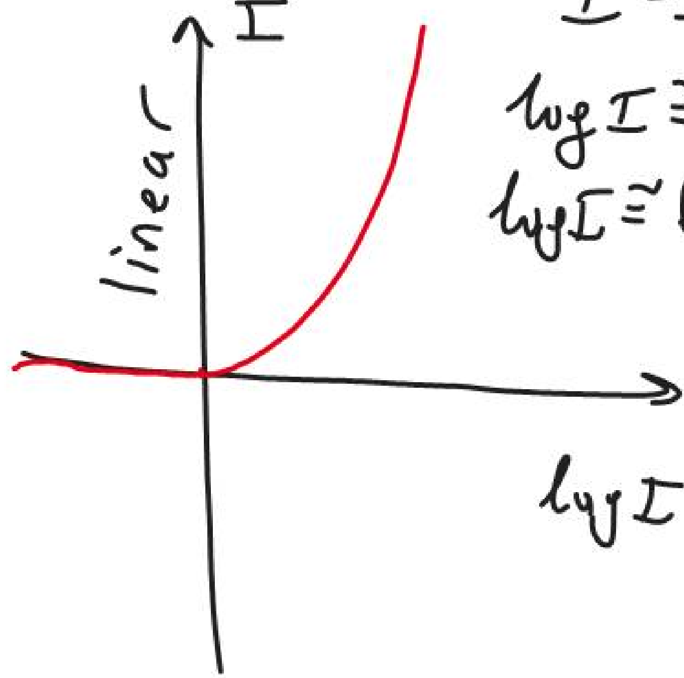


Fig. 2 Typical Forward Characteristics



$$I = I_0 \left(e^{V/V_T} - 1 \right)$$

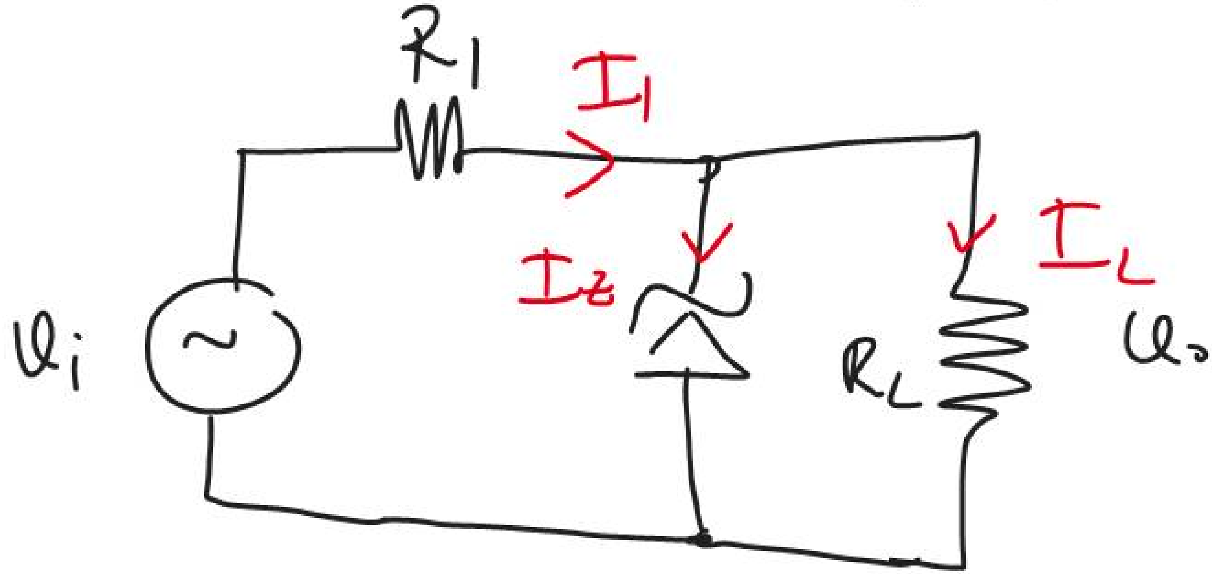
$$\log I \cong \log I_0 + \log e^{V/V_T}$$

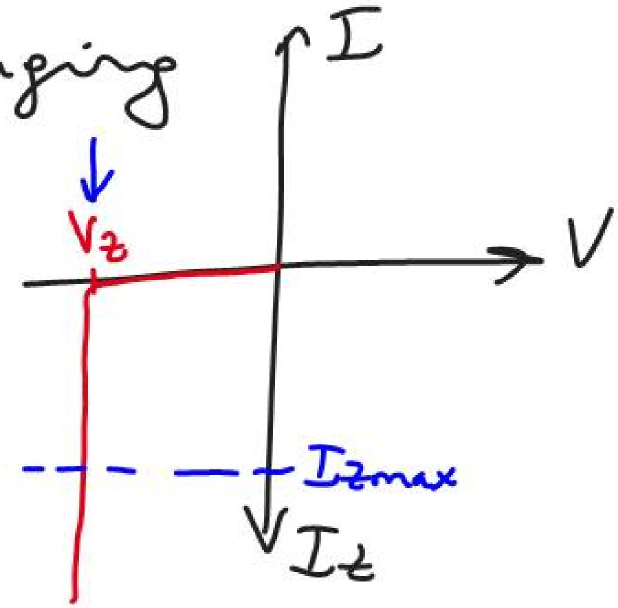
$$\log I \cong \log I_0 + \frac{V}{V_T}$$

$\Downarrow$

1) Line Regulation with Zener

R_L constant, V_i changing





For the Zener to fire: The voltage across the zener diode $\geq V_z$

$$\frac{V_i}{R_1+R_L}\cdot R_L \geq V_z$$ *

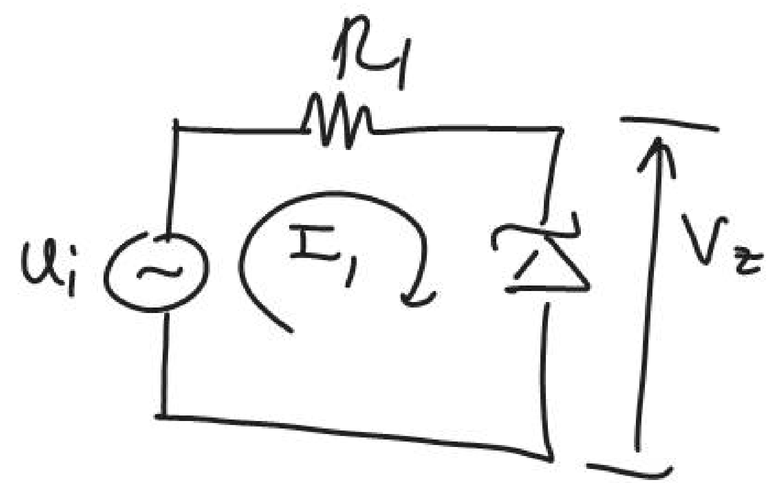
$\Longrightarrow$ This gives the min value of the input signal.

$$V_{i\,min} = V_z \cdot \frac{R_L+R_1}{R_L}$$

$$I_1 = I_Z + I_L$$

I_Z should not exceed $\underline{I_{Zmax}}$

$$I_{1max} = I_{Zmax} + I_L$$



$$I_1 = \frac{V_i - V_Z}{R_1}$$

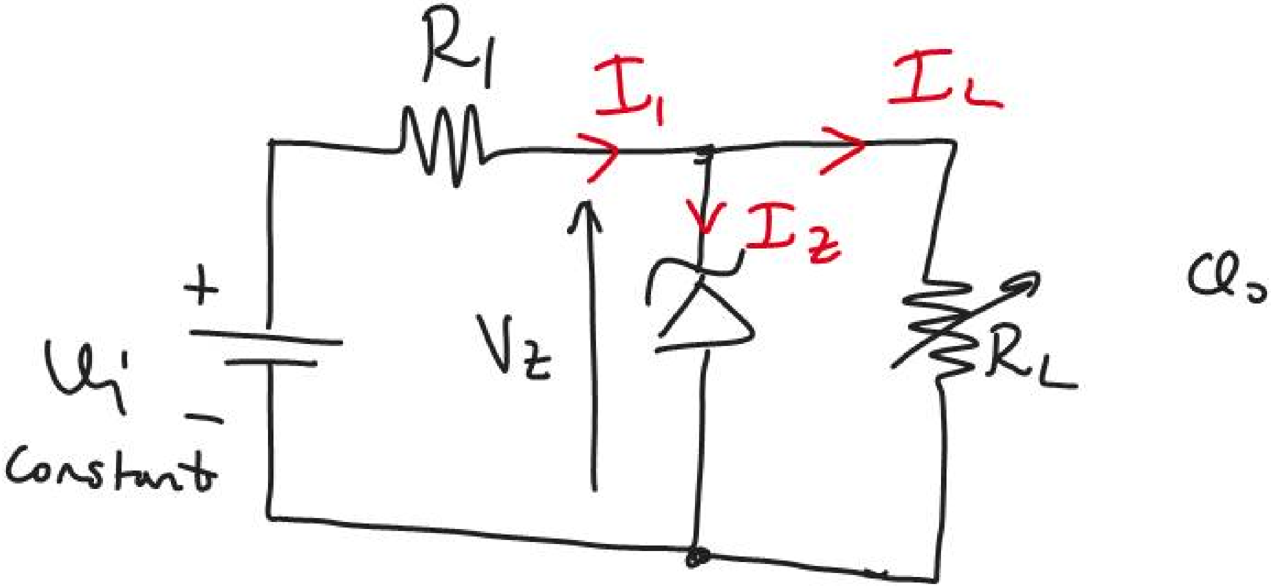
$$I_{1max} = \frac{V_{imax} - V_Z}{R_1}$$

$$\boxed{V_{imax} = I_{1max} * R_1 + V_Z}$$

$$V_{imin} < u_i < V_{imax}$$

② Load Regulation

v_i is constant, R_L is changing



$$I_1 = I_Z + I_L$$

as $R_L \uparrow$ $\quad I_L \downarrow$ $\qquad v_o = V_Z = I_L \cdot R_L \qquad I_L = \frac{V_Z}{R_L}$

since $I_1 = \frac{V_i - V_Z}{R_1} = \text{constant} \qquad I_1 = I_Z \uparrow + I_L \downarrow$

I_Z should not exceed $I_{Z\,max}$

$$\frac{V_1 - V_z}{R_1} = I_{zmax} + I_{Lmin}$$

$$\boxed{I_{Lmin} = \frac{V_i - V_z}{R_1} - I_{zmax}} \Longrightarrow R_{Lmax} = \frac{V_z}{I_{Lmin}}$$

when I_L increases ⇒ due to the decrease in R_L

$$\frac{V_{in}}{R_1 + R_L} \cdot R_L \geq V_z \quad \text{determines } R_{Lmin}$$

$$V_{in} \cdot R_{Lmin} = V_z (R_1 + R_{Lmin})$$

$$R_{Lmin} (V_{in} - V_z) = V_z \cdot R_1$$

$$\boxed{R_{Lmin} = \frac{V_z \cdot R_1}{V_i - V_z}}$$

$$R_{L\,min} \leq R_L \leq R_{L\,max}$$