Introduction to Interface Electronics

- Lumped Circuit Elements
- General Amplifiers
- Operational Amplifiers

📖 Reading: Senturia, Chapter 14, p.353-395

Lumped Circuit Elements

- Linear 1-port (2-terminal) passive devices
  - Resistor: energy dissipation
  - Capacitor: energy storage
  - Inductor: energy storage

Parameter	*Basic Relation-ship*	*Voltage-Current Relationships*		*Energy*
R $G = \frac{1}{R}$	$v = Ri$	$v_R = Ri_R$	$i_R = Gv_R$	$w_R = \int_{-\infty}^{t} v_R i_R \, dt$
L (or M)	$\psi = Li$	$v_L = L\frac{di_L}{dt}$	$i_L = \frac{1}{L}\int_{-\infty}^{t} v_L \, dt$	$w_L = \frac{1}{2}Li^2$
C $D = \frac{1}{C}$	$q = Cv$	$v_C = \frac{1}{C}\int_{-\infty}^{t} i_C \, dt$	$i_C = C\frac{dv_C}{dt}$	$w_C = \frac{1}{2}Cv^2$

Lumped Circuit Elements

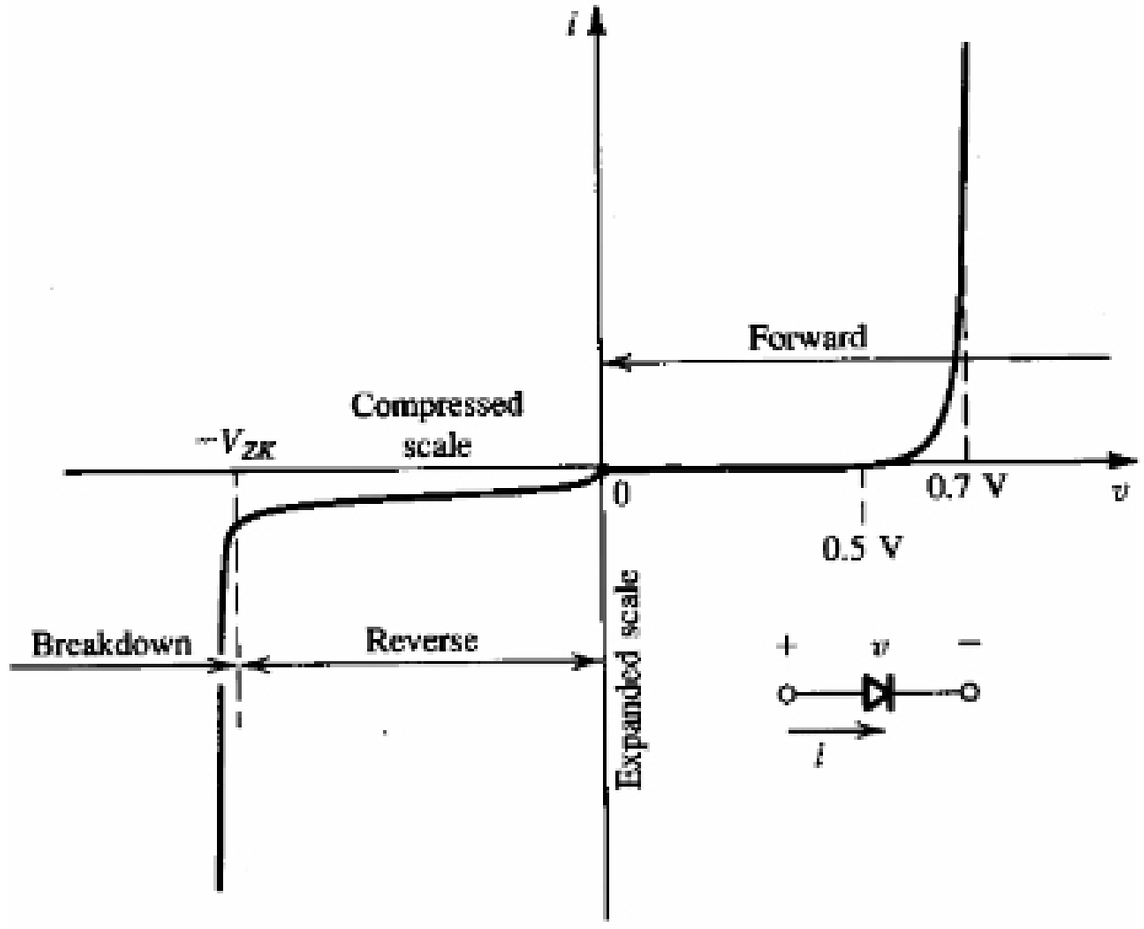
- Non-linear 1-port (2-terminal) passive devices
  - P/N junction diode
  - Nonlinear I-V characteristic

$$i_D = I_S\left(e^{\frac{qv_D}{kT}} - 1\right)$$

Note: Diode voltage, $v_D = V_D + v_d$

$$DC: \quad I_D = I_S\left(e^{\frac{qV_D}{kT}} - 1\right)$$

$$Small-signal: \quad \mathrm{i_d} = \left(\frac{qI_D}{kT}\right)v_d = \frac{1}{r_d}v_d$$



Ref. Sedra and Smith, Microelectronic Circuits, p. 132.