

Circuit Basics

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Circuit Basics

- Kirchhoff's Laws

- Current Law: $\sum \text{currents}_{\text{entering a node}} = 0$

- Voltage Law: $\sum \text{voltages}_{\text{around a loop}} = 0$

- Resistance

- $V = IR$

- Series Resistors: $R_{\text{series}} = \sum_{n=1}^m R_n$

- Parallel Resistors: $1/R_{\text{parallel}} = \sum_{n=1}^m 1/R_n$

Circuit Basics

- Capacitance

- $Q = CV$

- $i = C \frac{dv}{dt}$

- Parallel Capacitors: $C_{series} = \sum_{n=1}^m C_n$

- Series Capacitors: $1/C_{parallel} = \sum_{n=1}^m 1/C_n$

- Inductance

- $\Phi_m = LI$

- $v = L \frac{di}{dt}$

- Series Inductors: $L_{series} = \sum_{n=1}^m L_n$

- Parallel Inductors: $1/L_{parallel} = \sum_{n=1}^m 1/L_n$

Circuit Basics

- RC transients
 - R
 - Output impedance of a circuit (gate)
 - Wire (trace) resistance
 - C
 - Input capacitance of a circuit (gate)
 - Wire (trace) capacitance
 - τ
 - RC time constant
 - Units is seconds

Circuit Basics

- RC transients

- Rising (charging) transient*

- $v(t) = v_{final} (1 - e^{-t/\tau})$

- * assuming $v_{initial} = 0v$

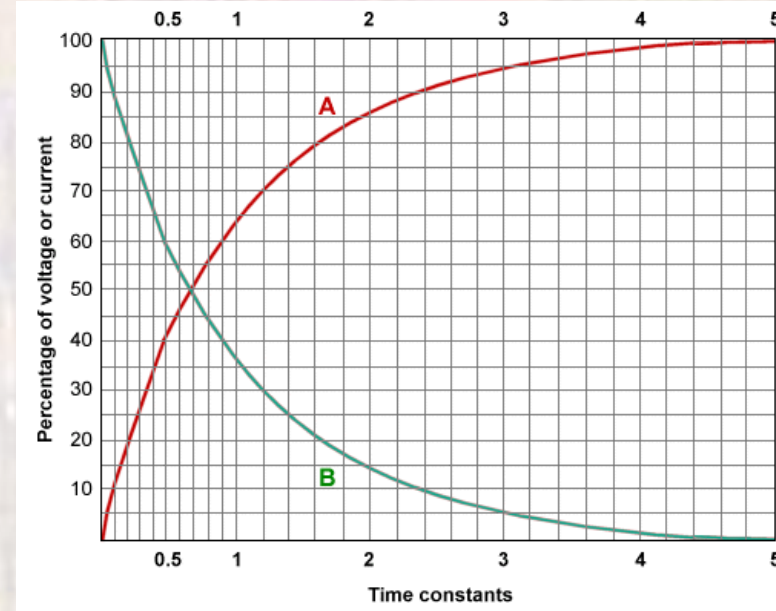
- Falling (discharging) transient*

- $v(t) = v_{initial} e^{-t/\tau}$

- * assuming $v_{final} = 0v$

- General transient

- $v(t) = v_{final} + (v_{initial} - v_{final}) e^{-t/\tau}$

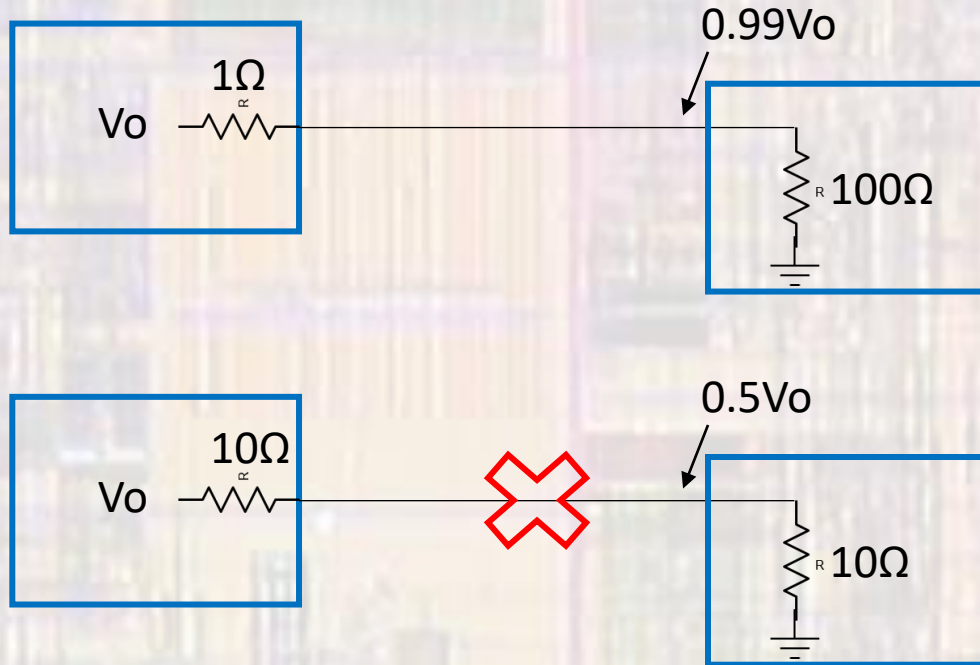


50% - 0.693τ

98% - 4τ

Circuit Basics

- Input / Output Impedance
 - Want low output impedance driving high input impedance



Circuit Basics

- Common Symbols

