

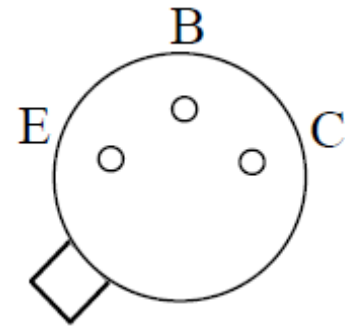
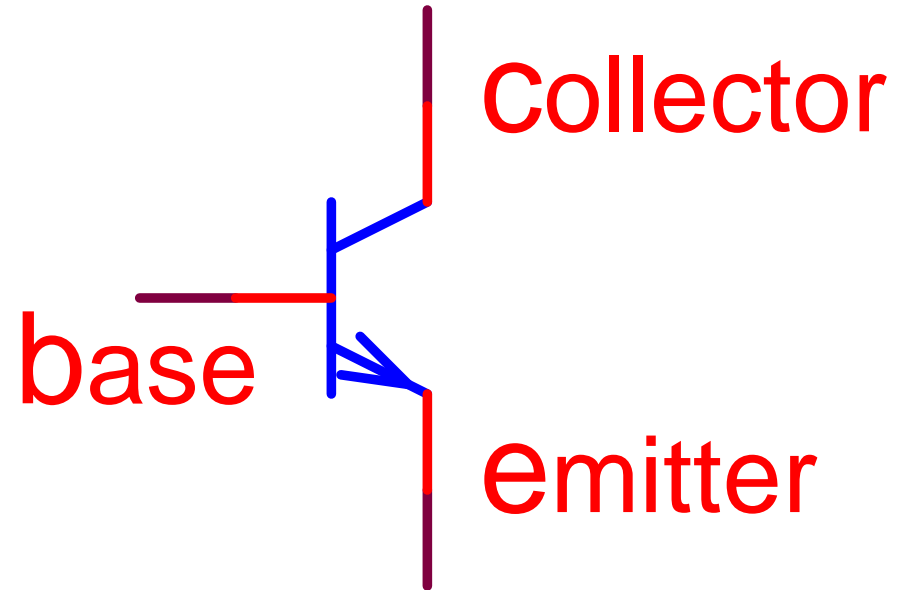
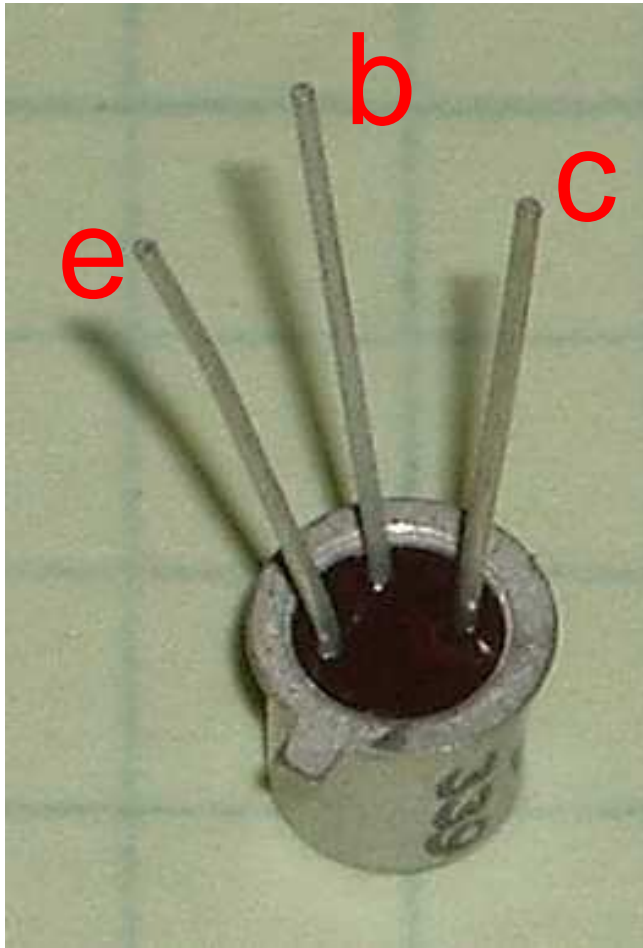
# Lecture 3 Goals:

- . Lab Practical (First Hour of Lab, 70 Pts.)
- Estimation of Thevenin, Norton Parameters
- Constant Current Source
- Thevenin Equivalent of Transistor Dimmer

# Lab Practical Checklist

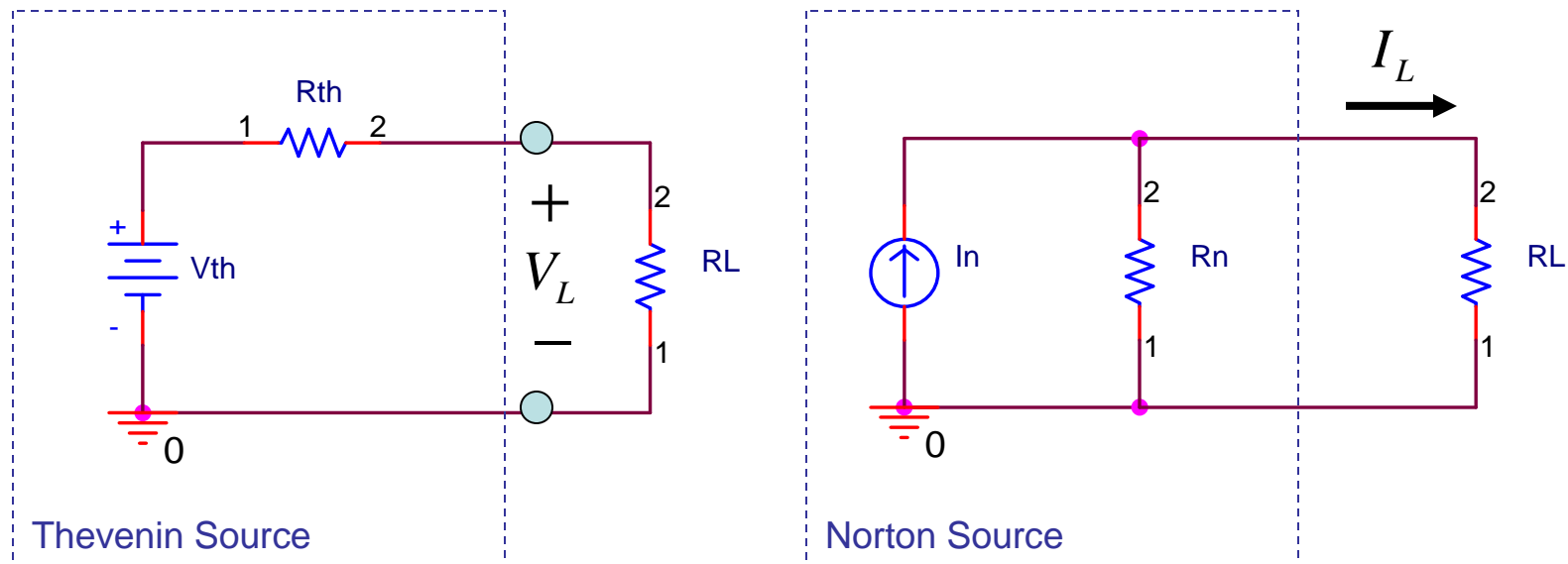
- Breadboard a circuit consisting of resistors, transistors, Op-Amps, and LEDs.
- Measure current and voltage using the DMM.
- Create a sinusoid given specifications of  $V_{PP}$ ,  $V_{RMS}$ , frequency.
- Measure frequency and DC/AC voltages using an oscilloscope.
- Manage your time.

# Transistor Pins



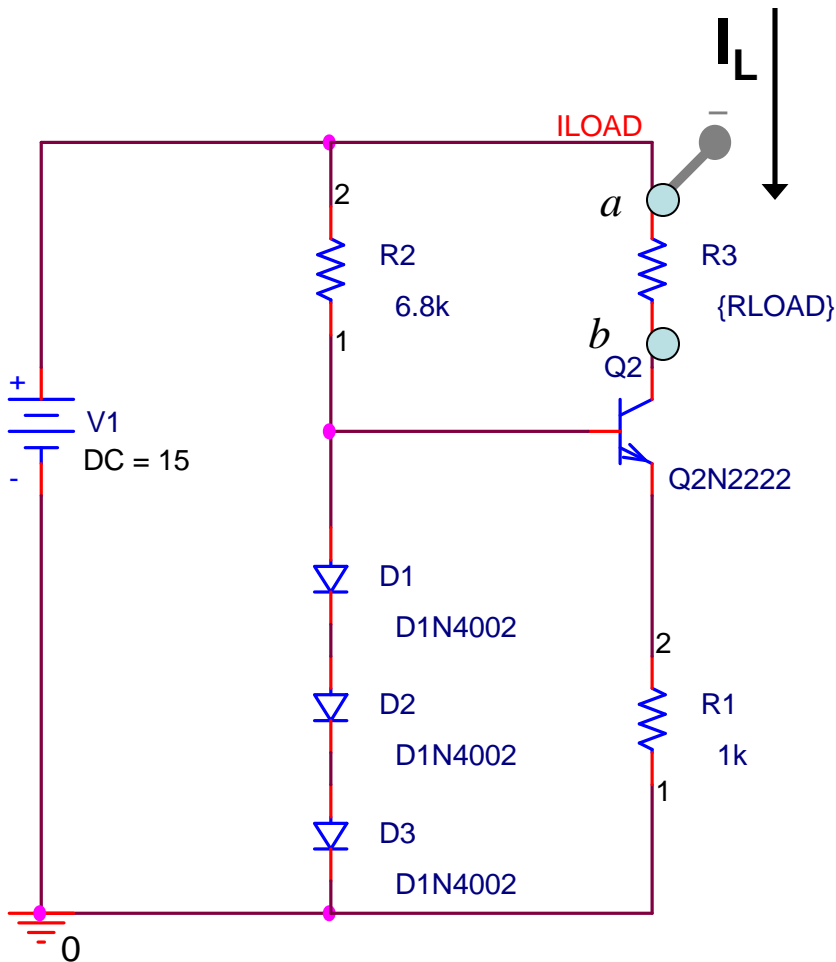
- Transistor in a TO-18 Package.
- SUGGESTION: first identify pins, place transistor in the breadboard, and then build the circuit around transistor.

# PART 1: Estimating $R_{Th}$ and $R_N$ from Load Parameters



- Find  $R_{Th}$  in terms of  $R_L$  and  $V_{Th} / V_L$
- Find an expression for  $I_L$ 
  - Take the derivative of  $I_L$  with respect to  $R_L$   $dI_L/dR_L$
  - Show when  $R_N \gg R_L$ ,  $I_L$  is only a function of  $I_N$  and  $R_N$

# PART 3: Constant Current Source Transistor Circuit



(a) Run a Bias Point with  $R_{LOAD} = 5k$ . Verify that the following quantities agree with the caption of Fig 3:

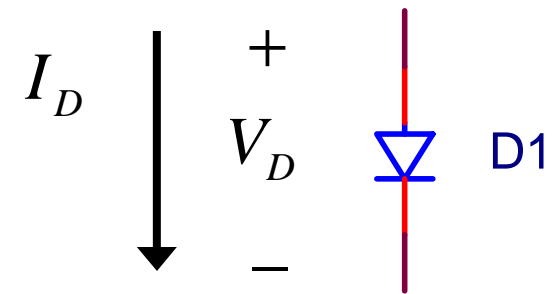
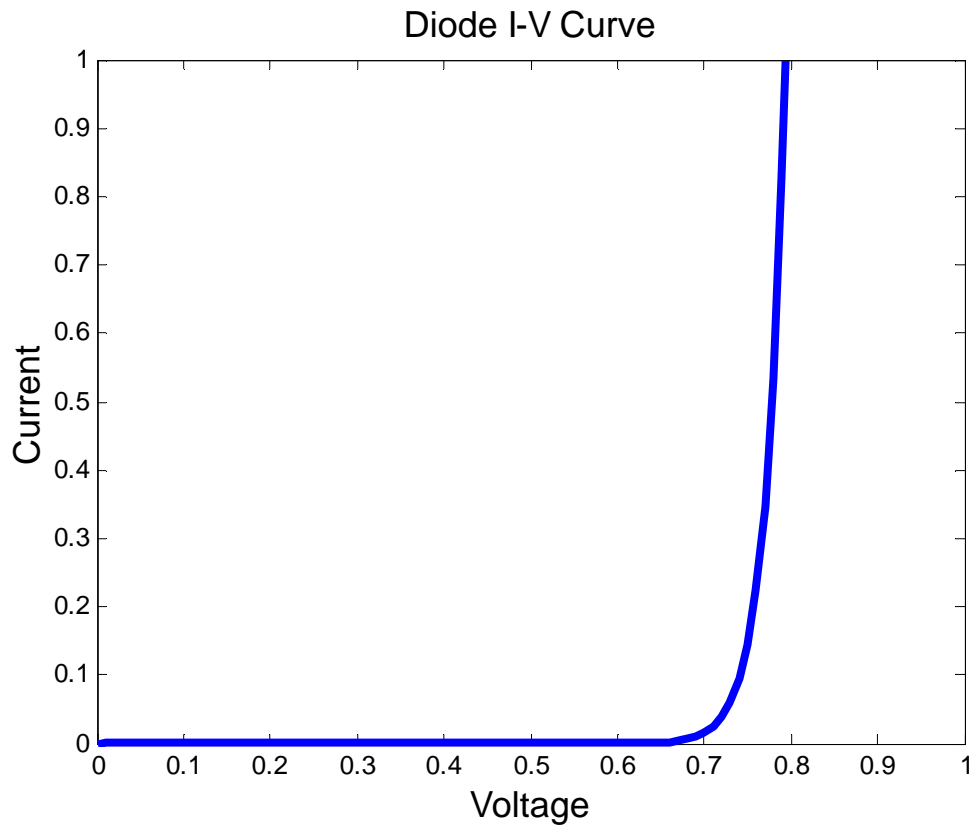
- $V_{DIODE}$
- $V_D$
- $V_{BE}$
- $I_E$
- $I_C$

(b) Run a DC Sweep of  $R_{LOAD}$  from  $1 \Omega$  to  $10k \Omega$ , measuring  $I_{LOAD}$ . Find  $R_N$ ,  $I_N$

(c) What is the value of  $R_N$  For an ideal current source? Compare with this circuit.

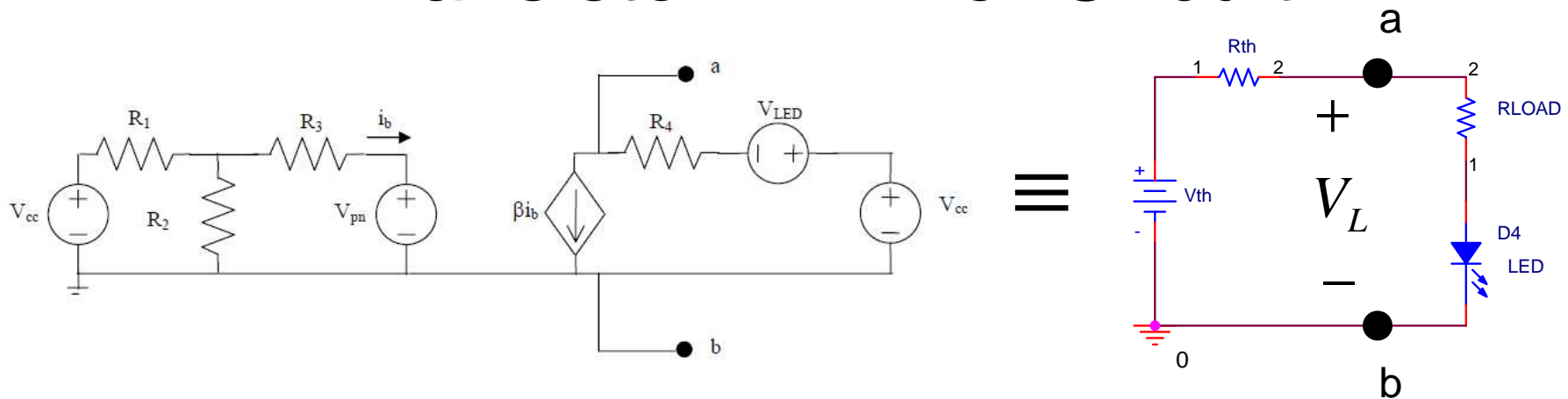
(d) Run a Bias Point with R2 changed from the next standard value above 7.5k, and again with a value below. Using these results explain why the value of the current source is a function of R2.

# I-V Curve for a Diode



- When  $V_D$  approaches about 0.7 V, the diode allows a large amount of current to pass. Also this function is monotonically increasing.

# Part 4: Thevenin Equivalent of Transistor Dimmer Circuit



- Find the Thevenin parameters  $V_{Th}$  and  $R_{Th}$  as seen at the terminals a-b
- Compute the  $V_{Th}$  and  $R_{Th}$  using the given component values
- Calculate  $V_L$  for different values of  $R_{LOAD} = \{300, 470, 680, 910\}$
- Verify your results using PSpice:

$V_{Th}$ : Run a Bias Point and find  $V_{Open\ Ckt}$  across terminals a-b

$R_{Th}$ : Short terminals a-b, and find the current, i.e.  $I_{Short\ Ckt}$

$V_L$ : Attach the load to the transistor dimmer and run a DC SWEEP using a VALUE LIST for specific values of  $R_{LOAD}$