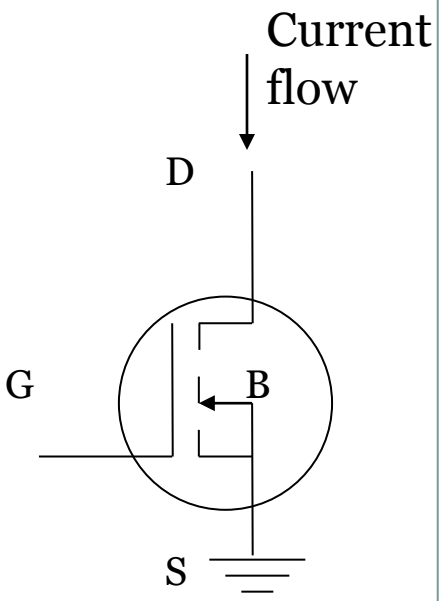
BJT transistors

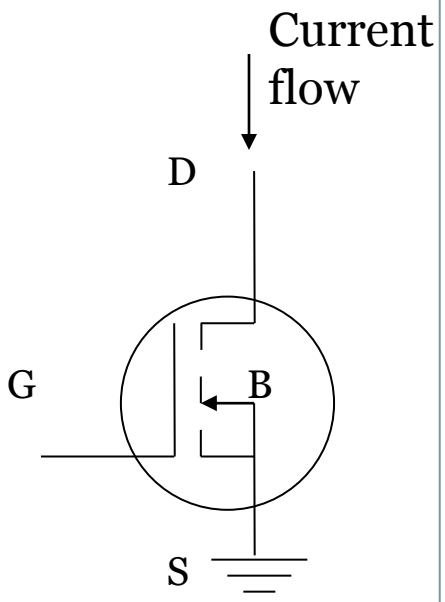
FET Transistors – Regions

Region	Criteria	Effect on Current
Cut-off	$V_{GS} < V_{th}$	$I_{DS}=0$
Linear	$V_{GS} > V_{th}$ And $V_{DS} < V_{GS}-V_{th}$	Transistor acts like a variable resistor, controlled by V_{gs}
Saturation	$V_{GS} > V_{th}$ And $V_{DS} > V_{GS}-V_{th}$	Essentially constant current



JFET vs MOSFET Transistors

MOSFET	**JFET**
High switching speed	Will operate at $V_G<0$
Can have very low R_{DS}	Better suited for low signal amplification
Susceptible to ESD	
More commonly used as a power transistor	



Power Transistors

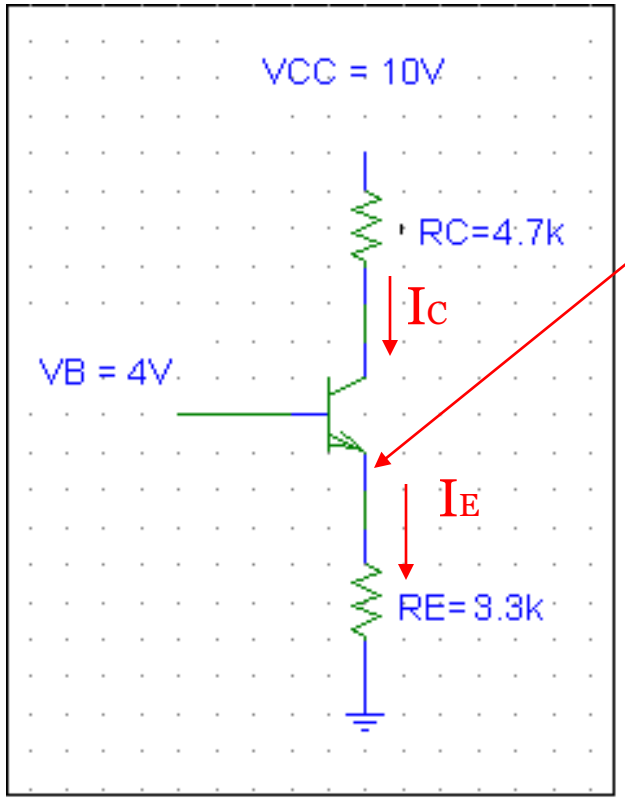
- Additional material for current handling and heat dissipation
- Can handle high current and voltage
- Functionally the same as normal transistors

Transistor Uses

- Switching
- Amplification
- Variable Resistor

Analysis of transistor circuits at DC

For all circuits: assume transistor operates in linear region
write B-E voltage loop
write C-E voltage loop



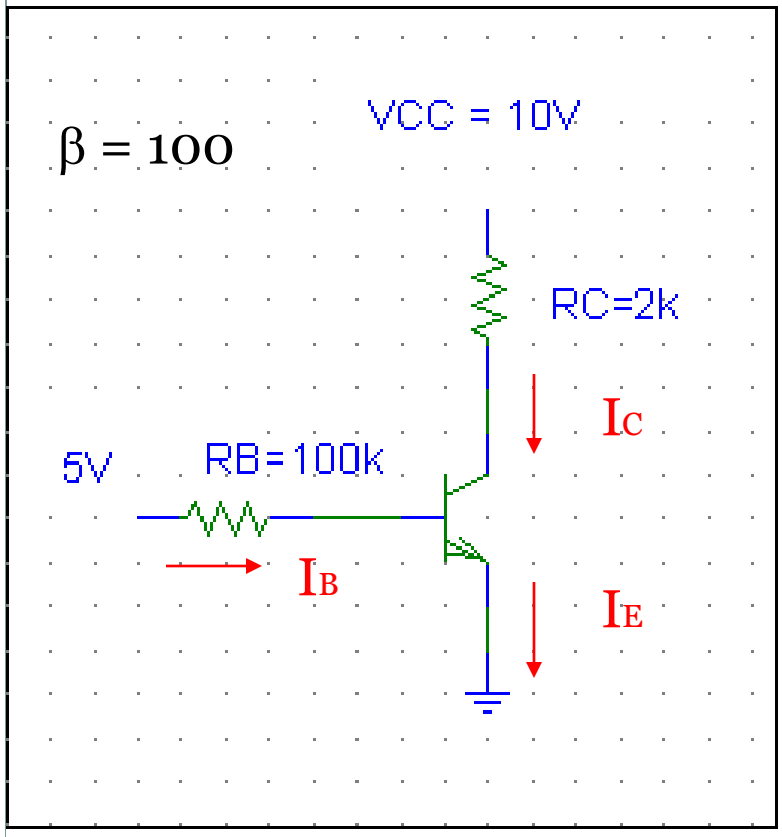
B-E junction acts like a diode

$V_E = V_B - V_{BE} = 4V - 0.7V = 3.3V$

$I_E = (V_E - 0)/R_E = 3.3/3.3K = 1mA$

$I_C \approx I_E = 1mA$

$V_C = 10 - I_C R_C = 10 - 1(4.7) = 5.3V$



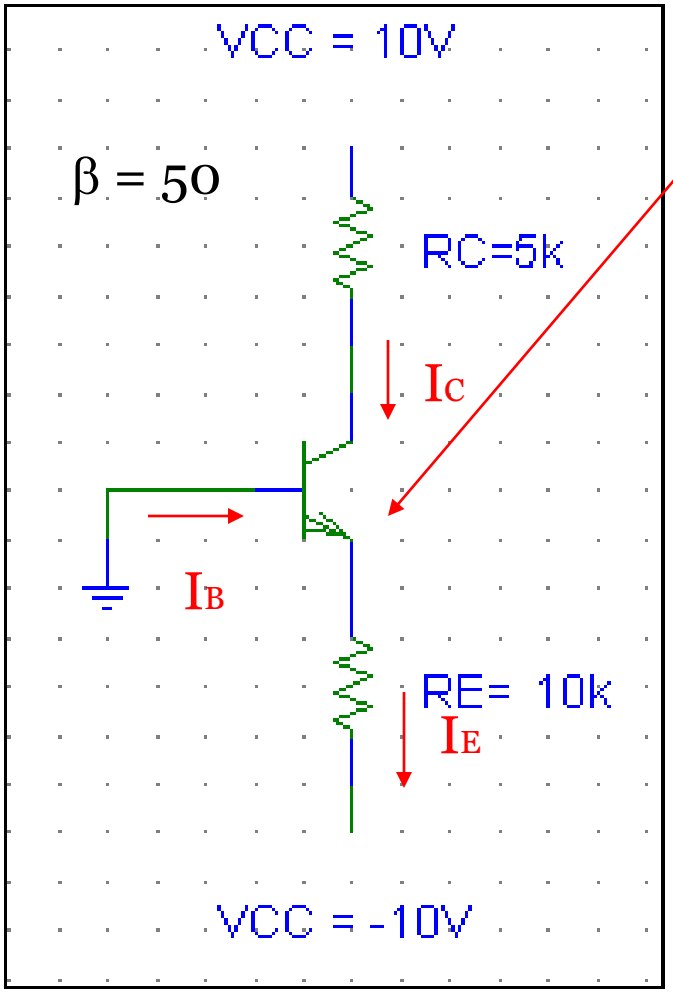
B-E Voltage loop

$5 = I_B R_B + V_{BE}$, solve for I_B

$I_B = (5 - V_{BE})/R_B = (5-.7)/100k =$ 0.043mA

$I_C = \beta I_B = (100)0.043mA =$ 4.3mA

$V_C = 10 - I_C R_C = 10 - 4.3(2) =$ 1.4V



$V_E = 0 - .7 = -0.7V$

$I_E = (V_E - -10)/R_E = (-.7 + 10)/10K =$ 0.93mA

$I_C \approx I_E =$ 0.93mA

$I_B = I_B/\beta = .93mA/50 =$ 18.6μA

$V_C = 10 - I_C R_C = 10 - .93(5) =$ 5.35V