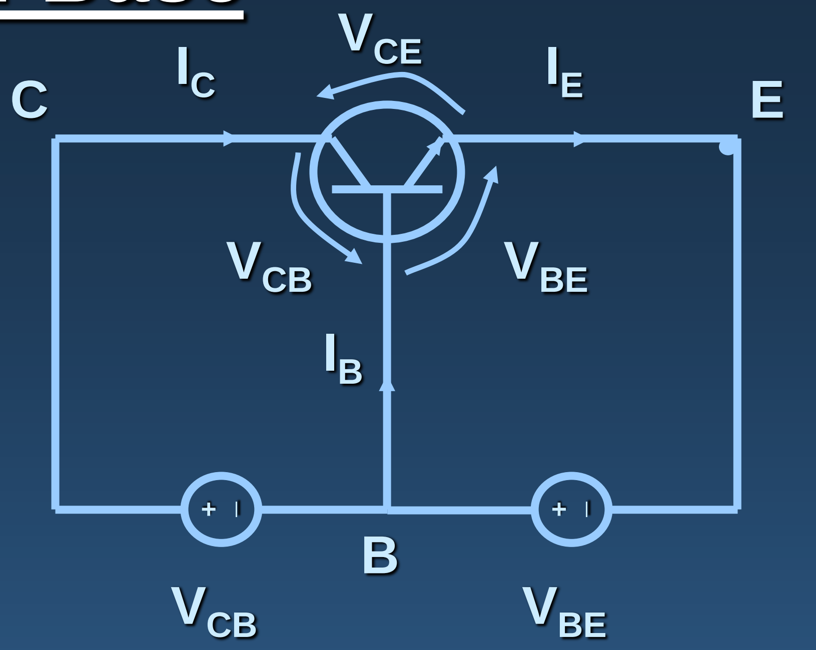
Common-Base

Circuit Diagram: NPN Transistor



The Table Below lists assumptions that can be made for the attributes of the common-base biased circuit in the different regions of operation. Given for a Silicon NPN transistor.

Region of Operation	I_C	V_{CE}	V_{BE}	V_{CB}	C-B Bias	E-B Bias
Active	βI_B	$=V_{BE}+V_{CE}$	~0.7V	❍ 0V	Rev.	Fwd.
Saturation	Max	~0V	~0.7V	$-0.7V<V_{CE}<0$	Fwd.	Fwd.
Cutoff	~0	$=V_{BE}+V_{CE}$	☯ 0V	❍ 0V	Rev.	None /Rev.

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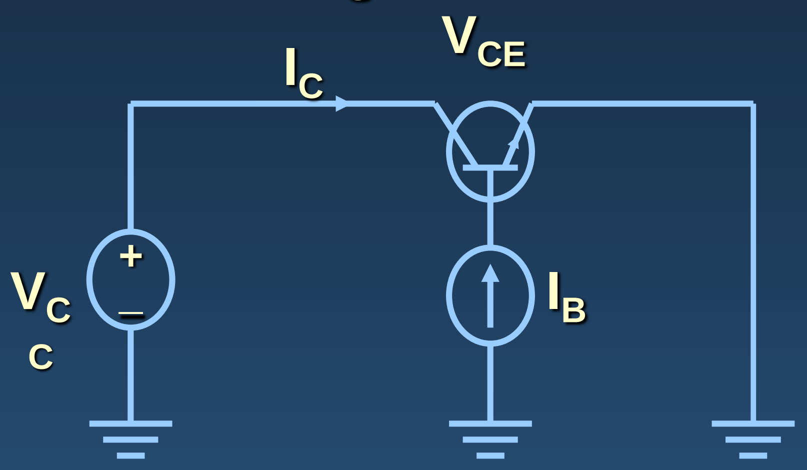
Spring 2002

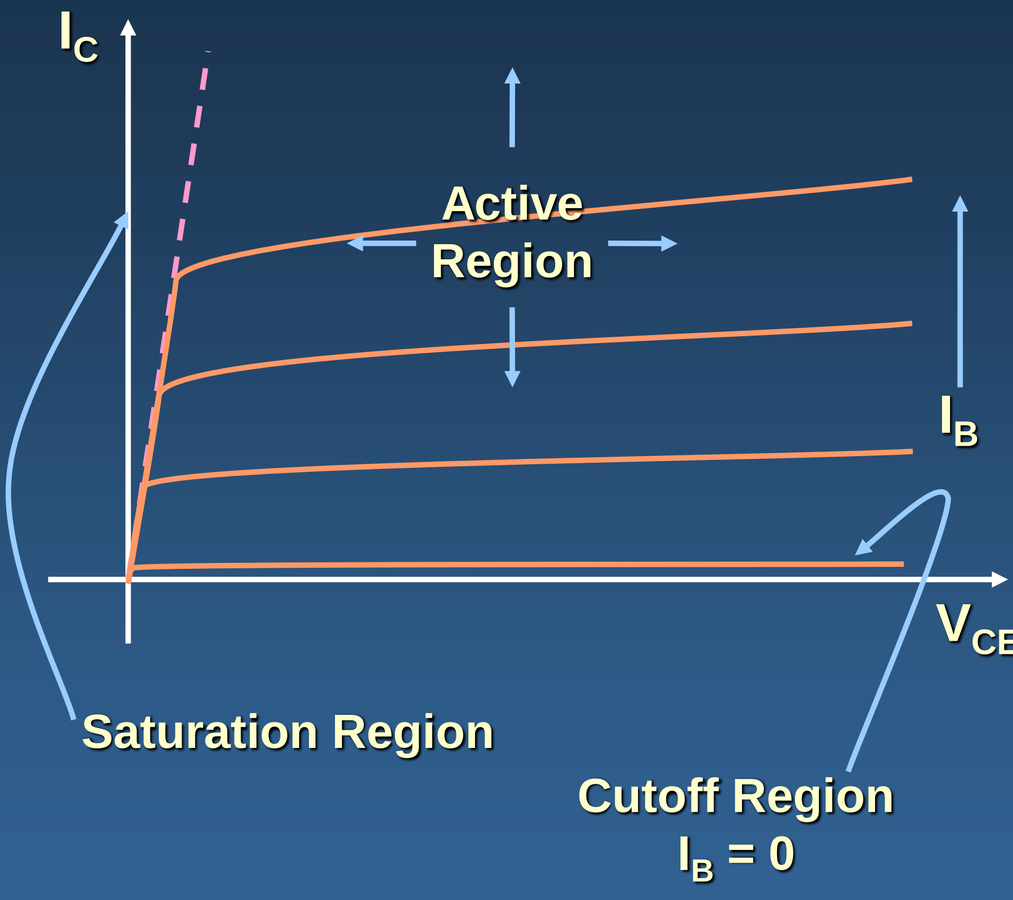
Common-Emitter

Circuit Diagram



Region of Operation	Description
Active	Small base current controls a large collector current
Saturation	$V_{CE(sat)} \sim 0.2V$, V_{CE} increases with I_C
Cutoff	Achieved by reducing I_B to 0, Ideally, I_C will also equal 0.

Collector-Current Curves



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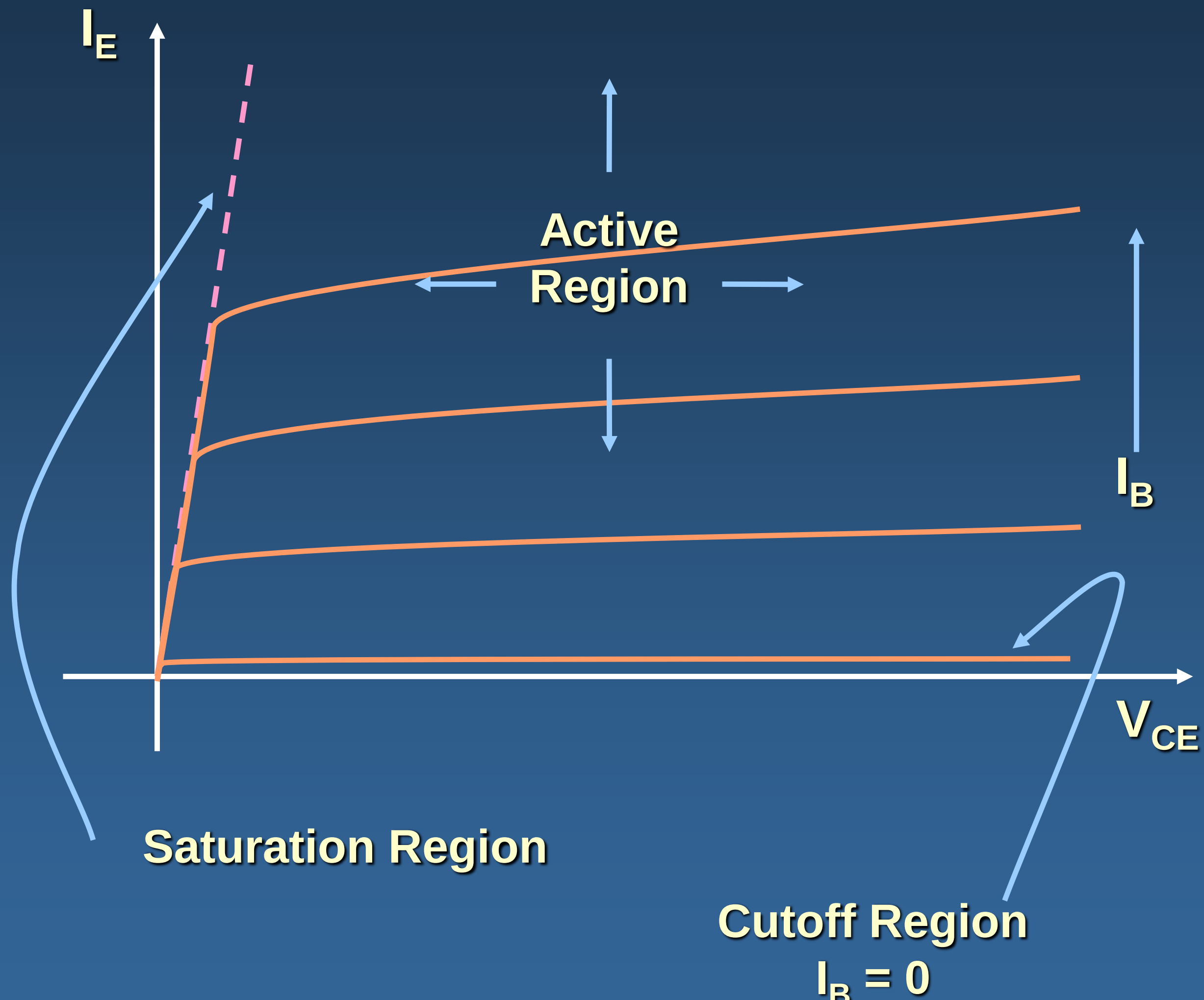
Common-Collector

The Common-Collector biasing circuit is basically equivalent to the common-emitter biased circuit except instead of looking at I_C as a function of V_{CE} and I_B we are looking at I_E.

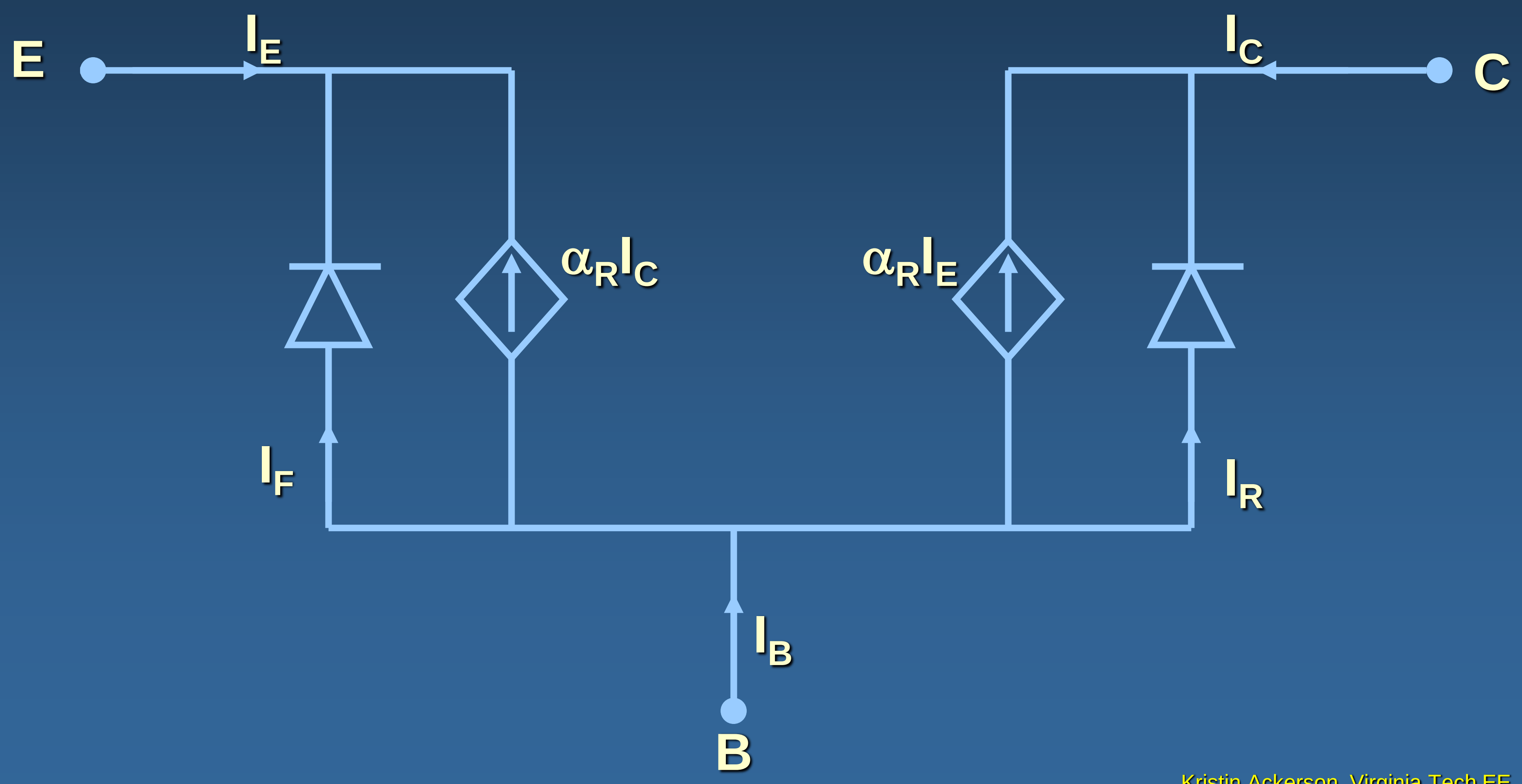
Also, since $\alpha \sim 1$, and $\alpha = I_C/I_E$ that means $I_C \sim I_E$

Emitter-Current Curves



Eber-Moll BJT Model

The Eber-Moll Model for BJTs is fairly complex, but it is valid in all regions of BJT operation. The circuit diagram below shows all the components of the Eber-Moll Model:



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Eber-Moll BJT Model

α_R = Common-base current gain (in forward active mode)

α_F = Common-base current gain (in inverse active mode)

I_{ES} = Reverse-Saturation Current of B-E Junction

I_{CS} = Reverse-Saturation Current of B-C Junction

$I_C = \alpha_F I_F – I_R$ $\qquad$ $I_B = I_E - I_C$

$I_E = I_F - \alpha_R I_R$

$I_F = I_{ES}$ [exp(qV_{BE}/kT) – 1] $\qquad$ $I_R = I_C$ [exp(qV_{BC}/kT) – 1]

- If I_{ES} & I_{CS} are not given, they can be determined using various BJT parameters.

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