

TRANSISTOR THEORY OF OPERATION

prepared by:

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GRADING SYSTEM

The background of the slide is a light, textured collage. It features faint, overlapping architectural drawings, including floor plans and cross-sections of a building. On the right side, there is a vertical bar chart with four bars of increasing height, colored in shades of blue and yellow. The overall aesthetic is clean and professional, typical of a technical or academic presentation.

30%

PRELIM

30%

MIDTERM

40%

ENDTERM

50%

WEEKLY

50%

EXAM

100%

LABORTORY

0

ABSENT

3

45-min LATE

7_{max}

15-min LATE

TOPIC OUTLINE

Transistor Construction and Operation

Transistor Configurations

Common Base

Common Collector

Common Emitter

Characteristic Curve

Regions of Operation

Reading Datasheet



TRANSISTOR **CONSTRUCTION AND** **OPERATION**



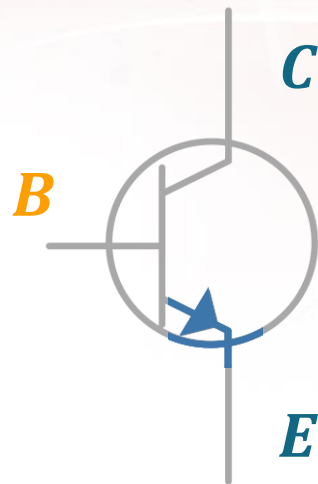
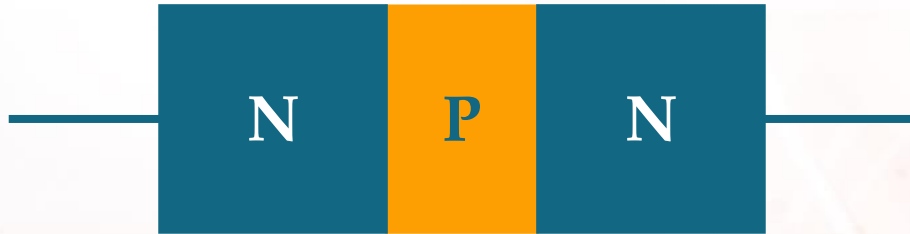
Dr. William Shockley

Dr. John Bardeen

Dr. Walter Brattain

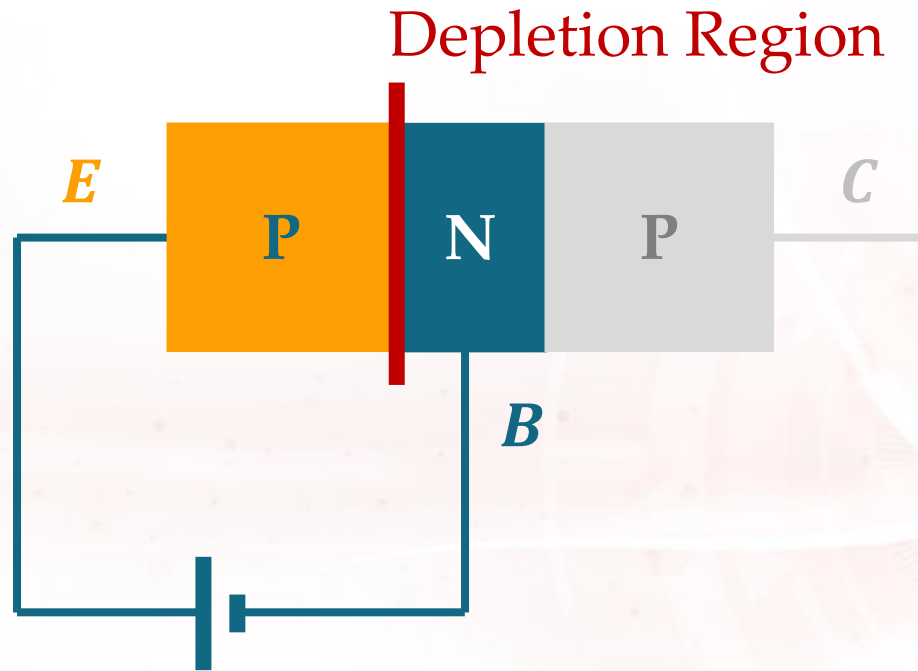
December 23, 1947

NPN



PNP

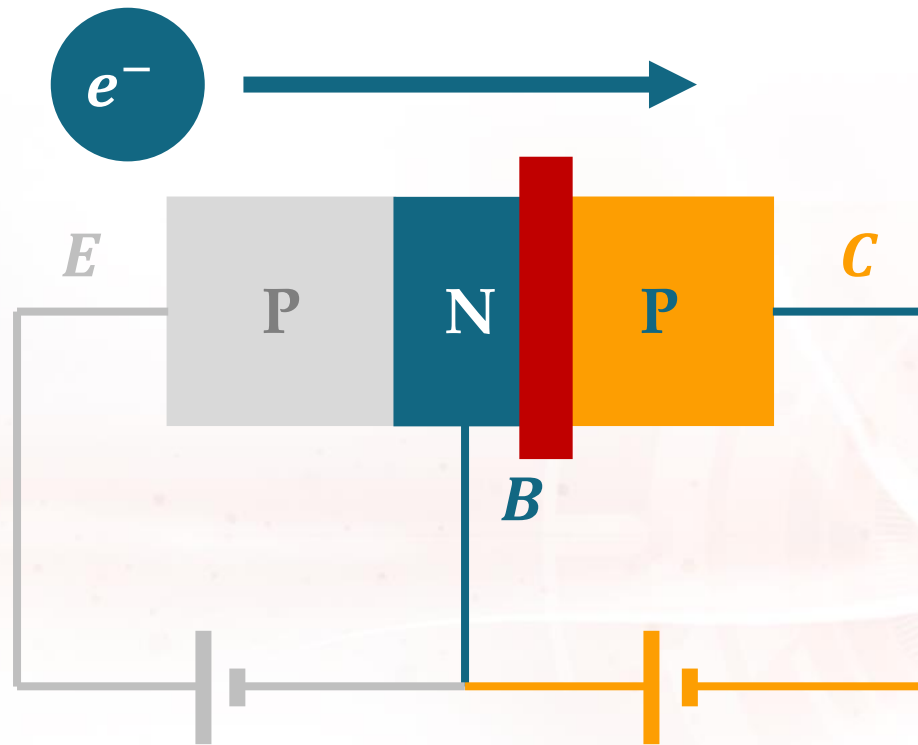




forward-biased

Emitter is heavily doped

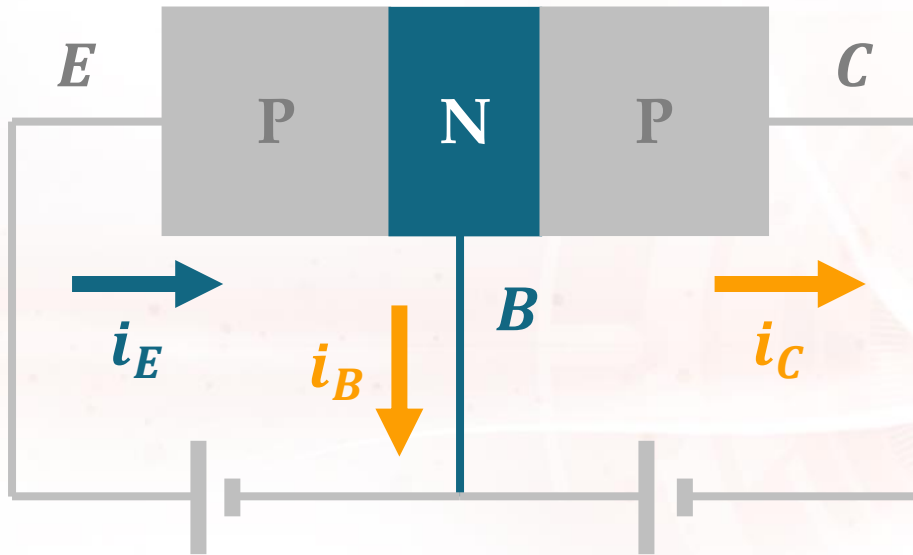
Base is lightly doped



reverse-biased

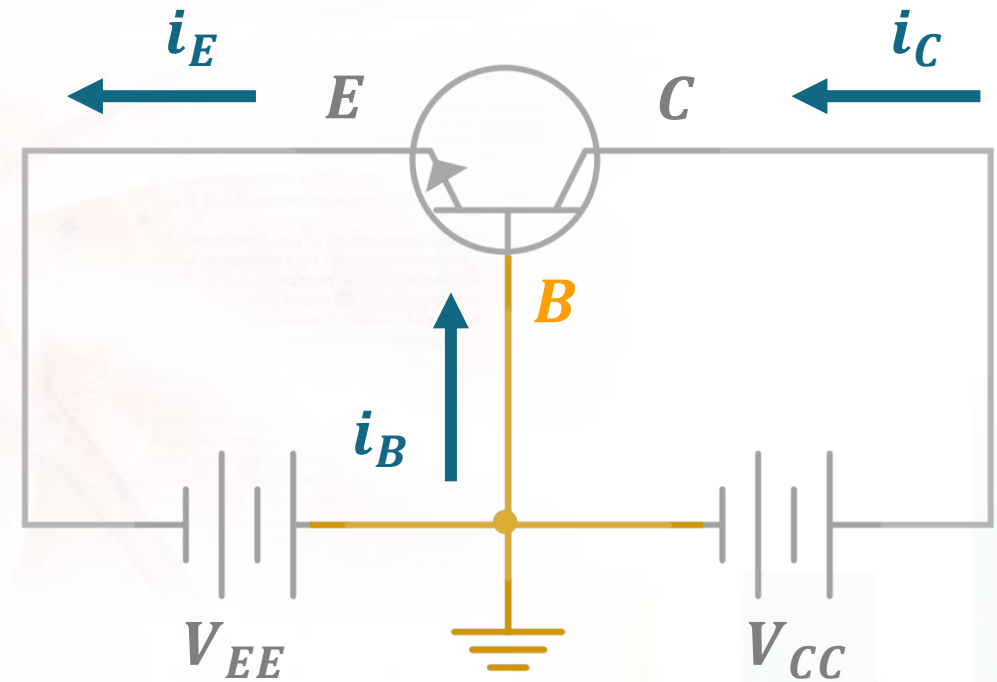
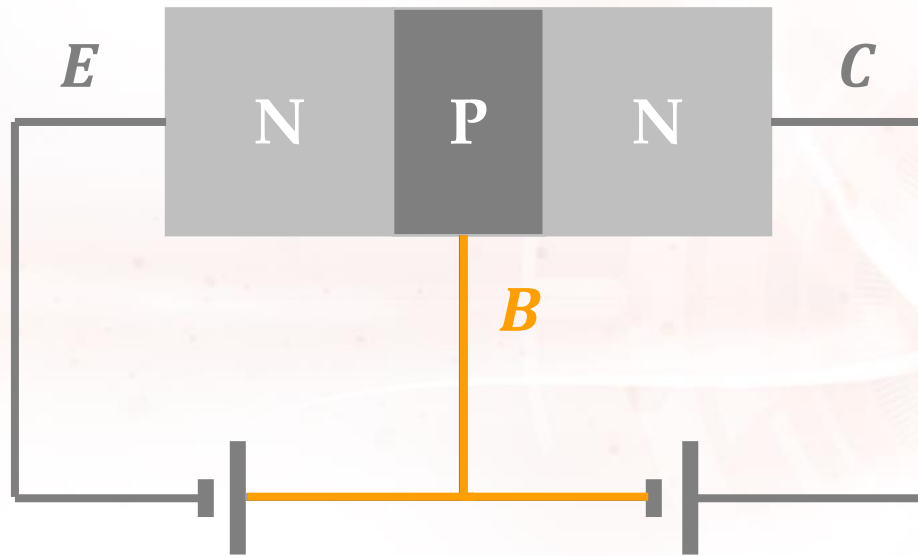
Collector is “intermediate” doped

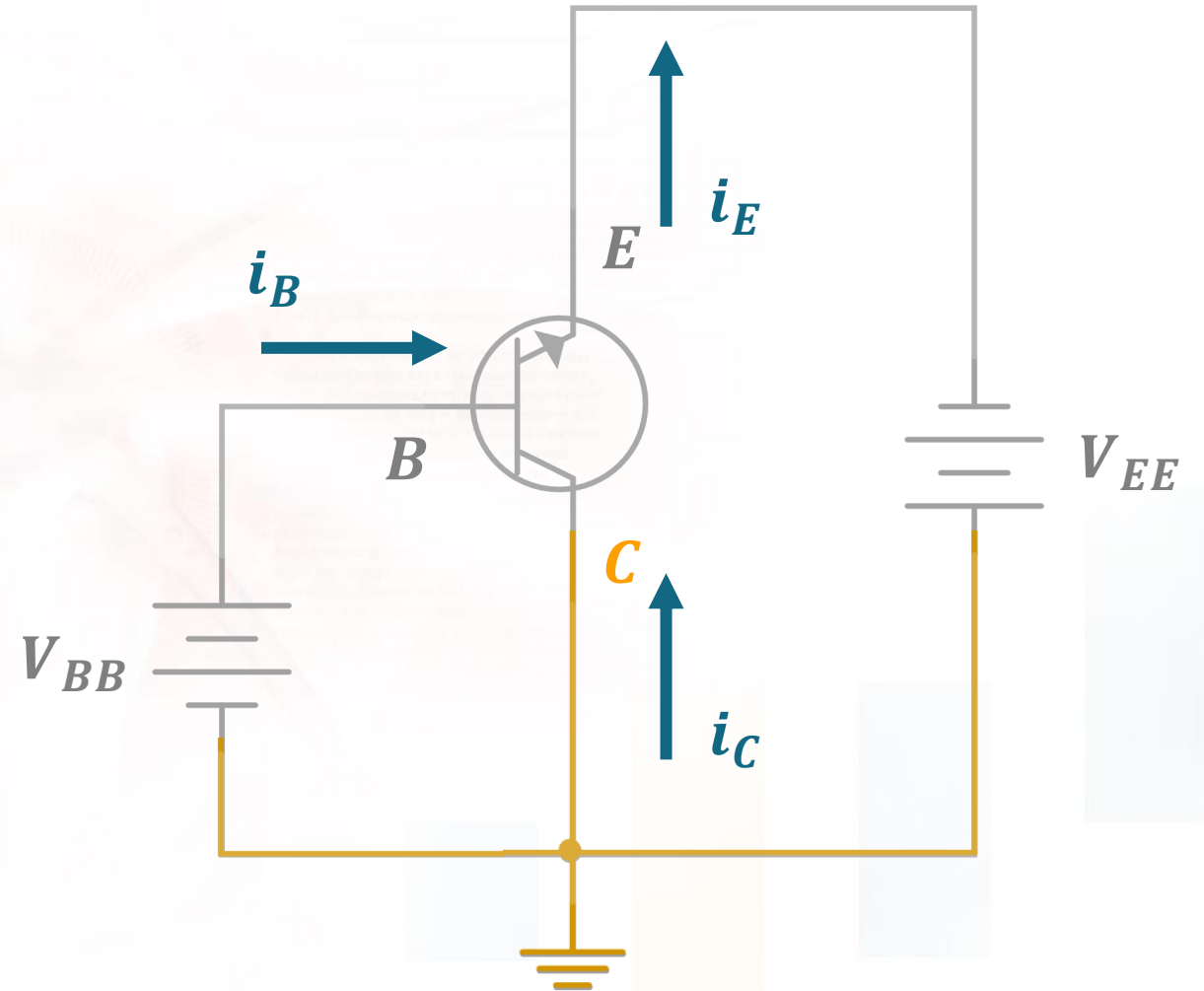
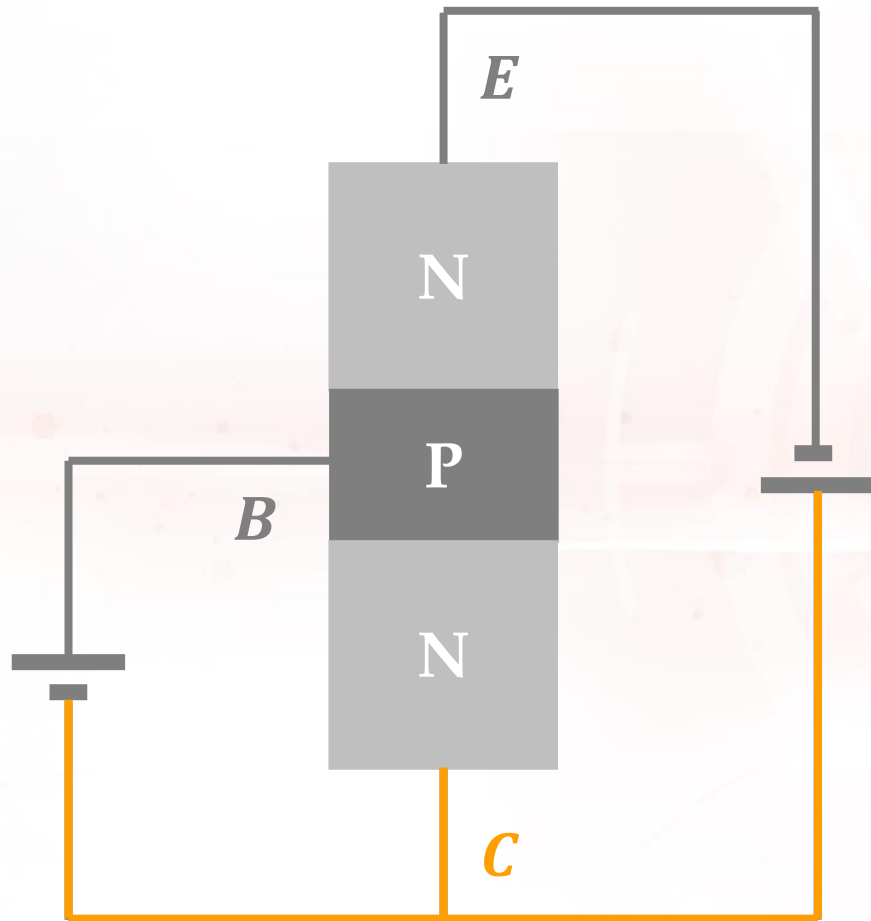
KCL @ B,

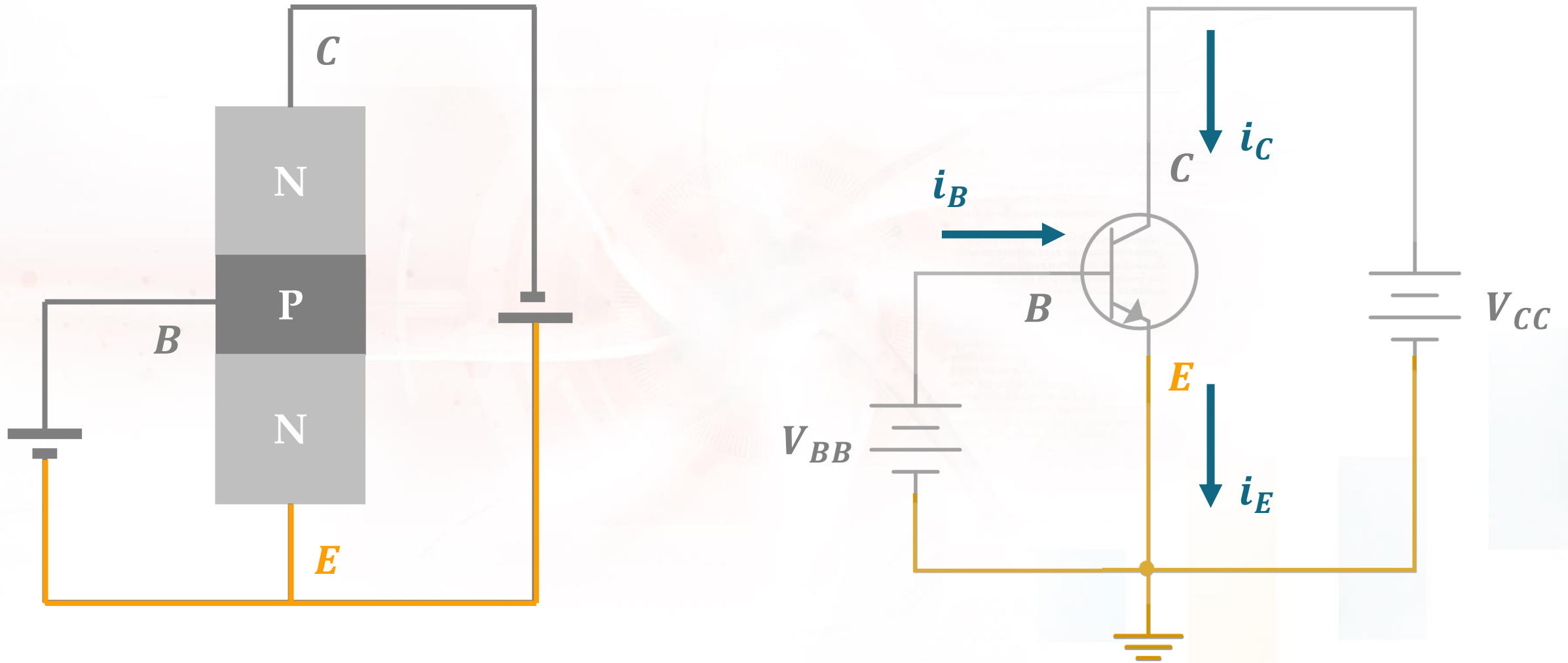


$$i_E = i_C + i_B$$

TRANSISTOR CONFIGURATIONS

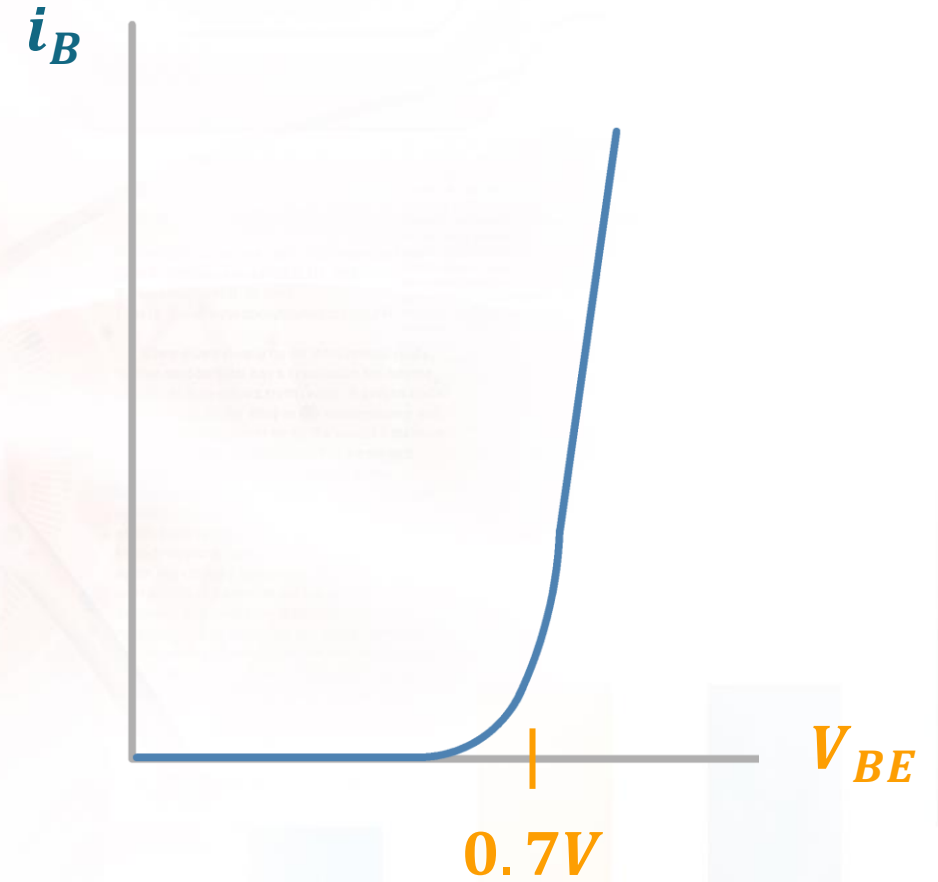
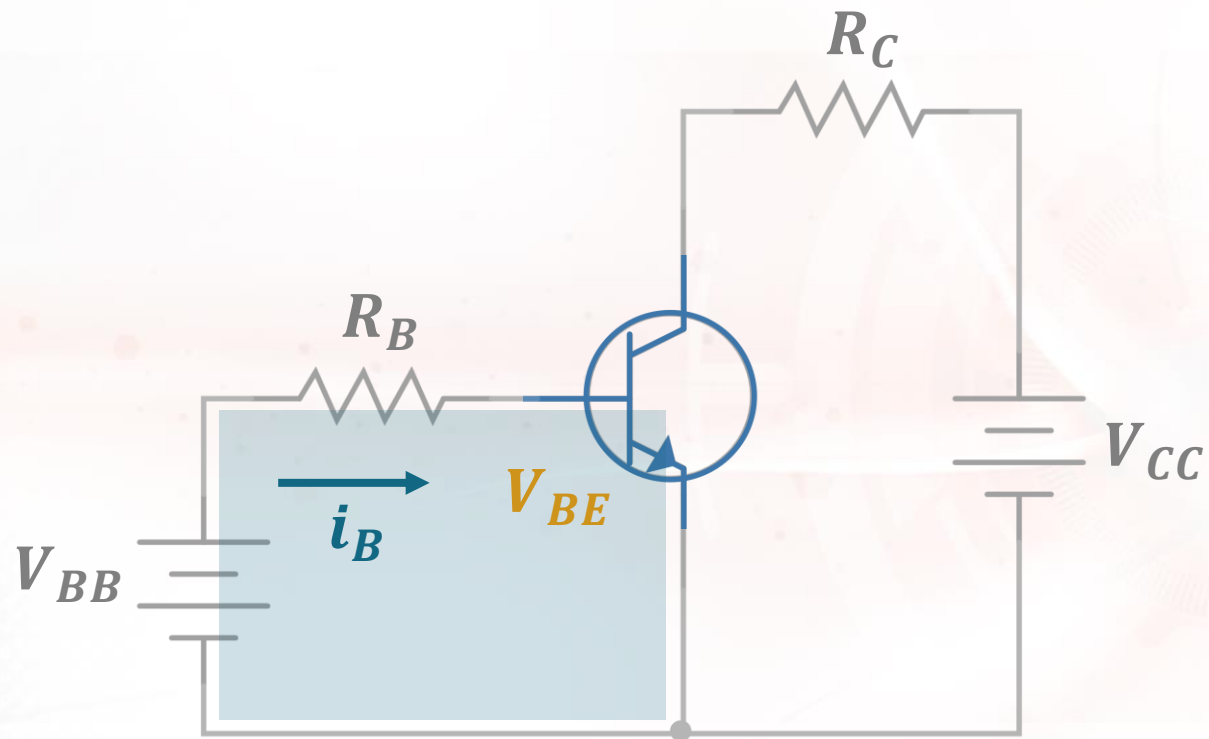




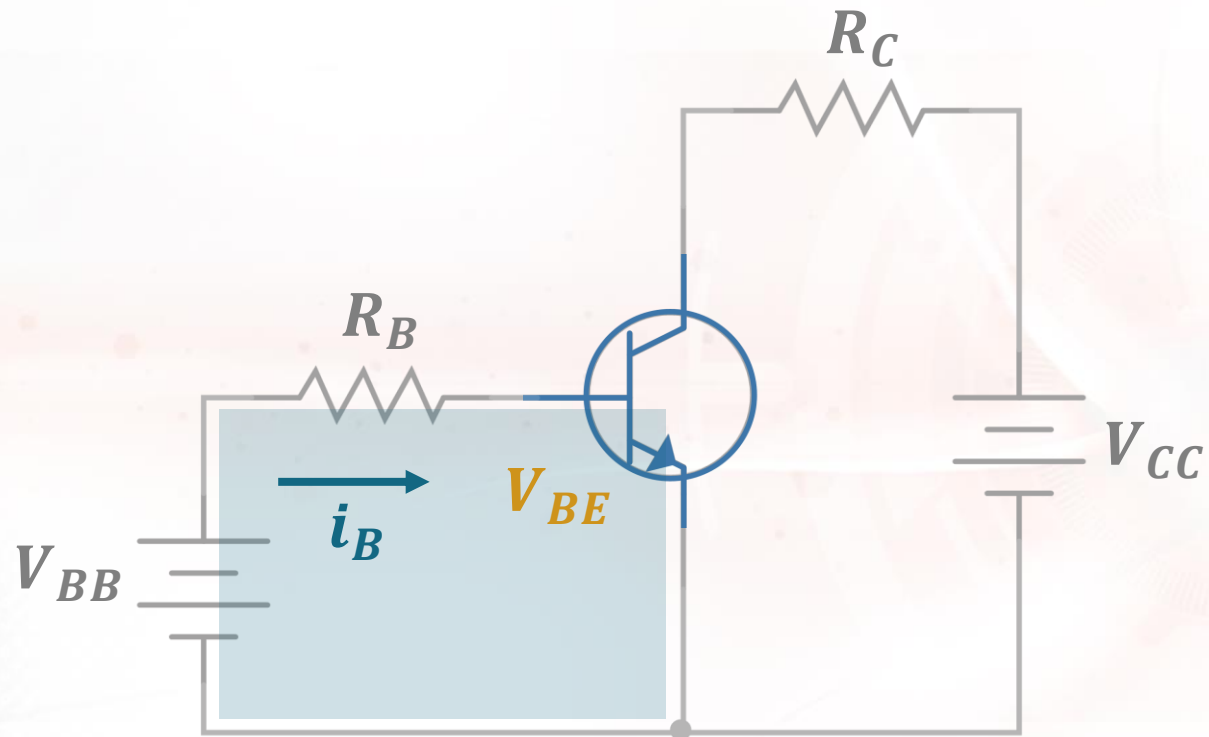


CHARACTERISTIC CURVE

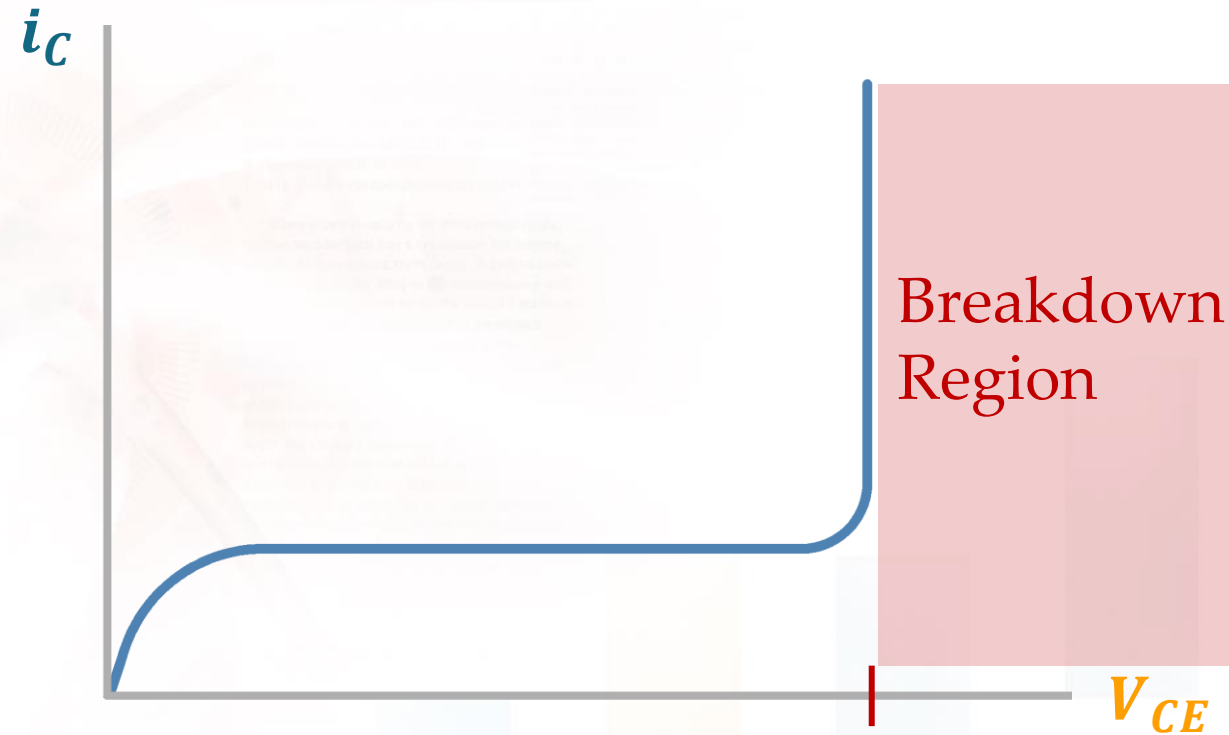
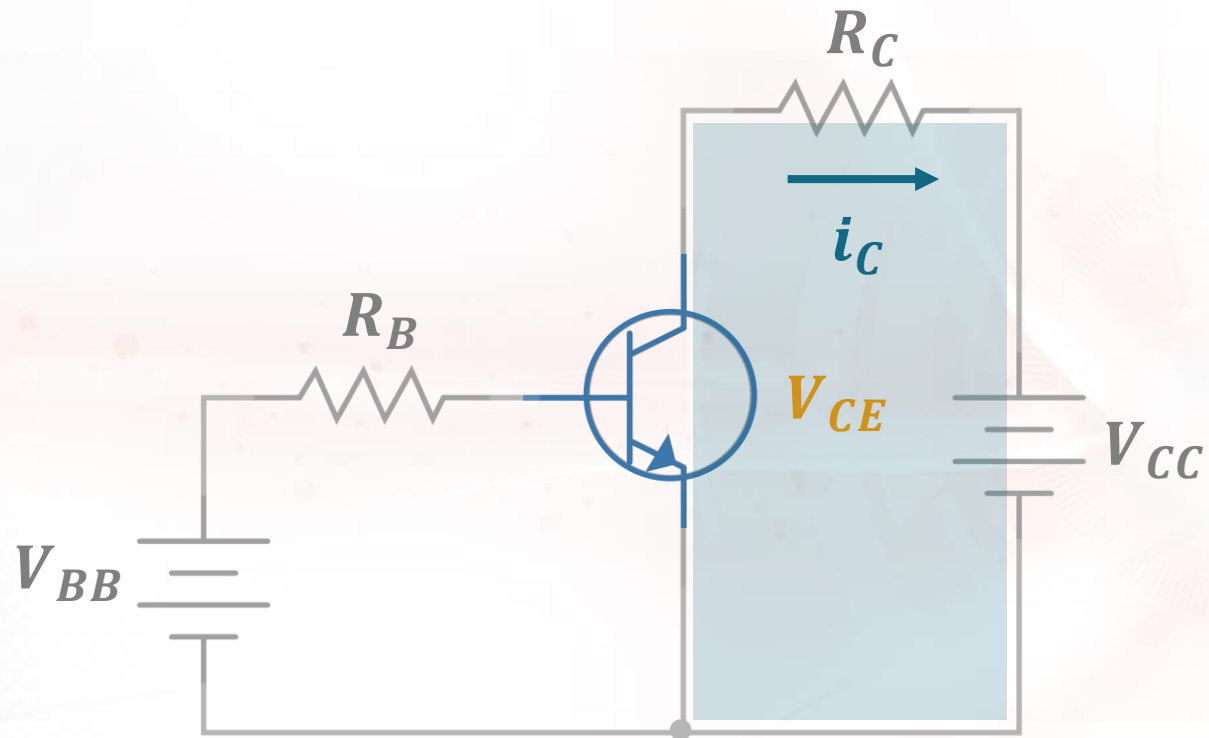




Base-Emitter Loop,

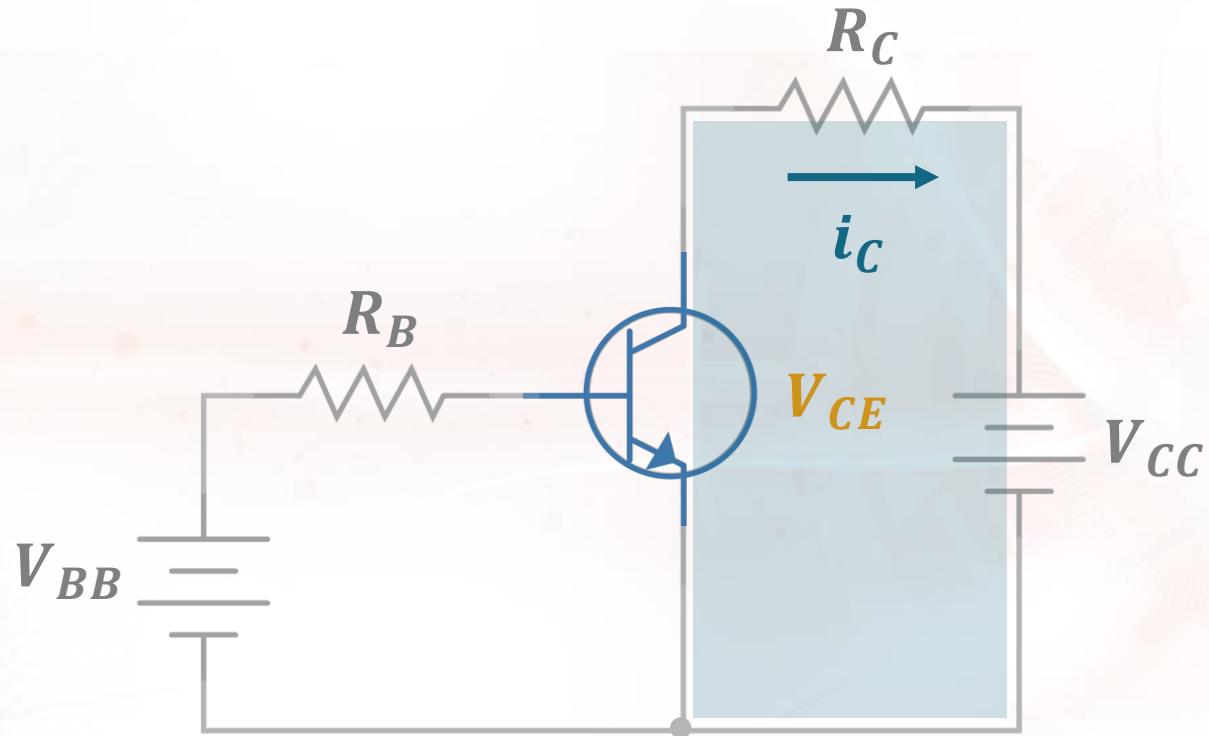


$$i_B = \frac{V_{BB} - V_{BE}}{R_B}$$



COLLECTOR-EMITTER VOLTAGE

Collector-Emitter Loop,



$$V_{CE} = V_{CC} - i_C R_C$$

Alpha,

$$\alpha_{dc} = \frac{i_C}{i_E}$$

Beta,

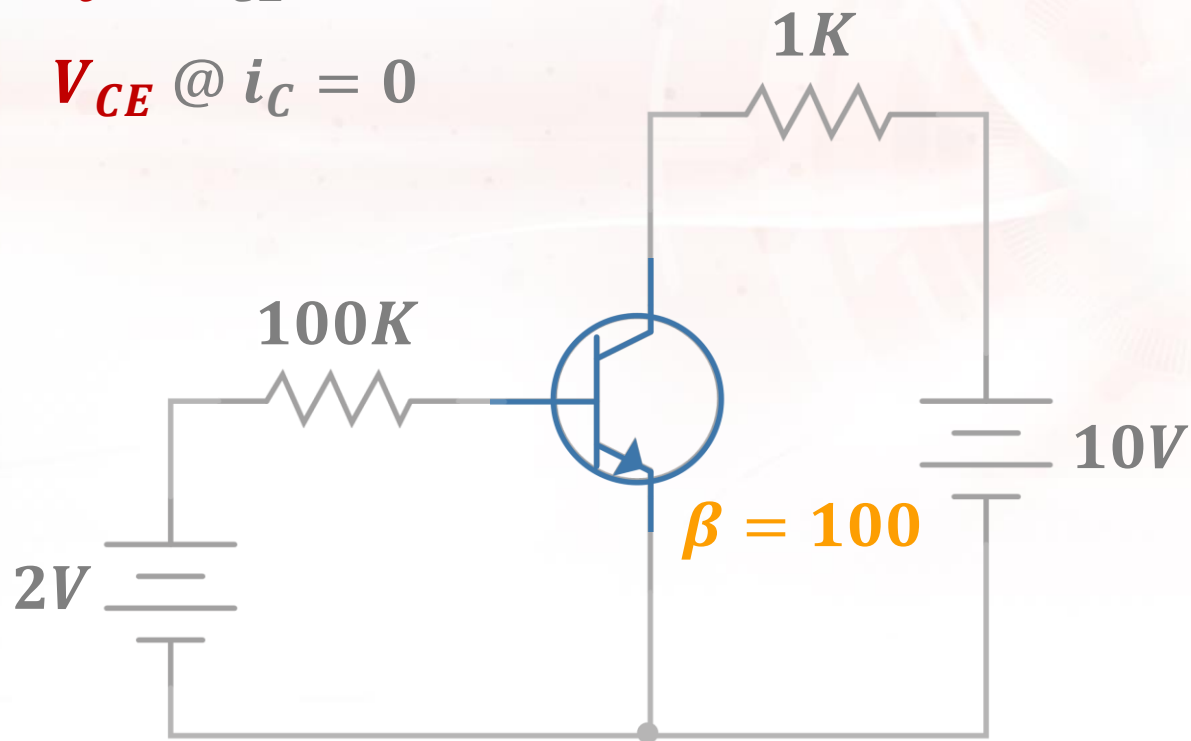
$$\beta_{dc} = \frac{i_C}{i_B}$$

Determine the parameters of the given transistor network.

i_B , i_C , and V_{CE}

$i_C @ V_{CE} = 0$

$V_{CE} @ i_C = 0$

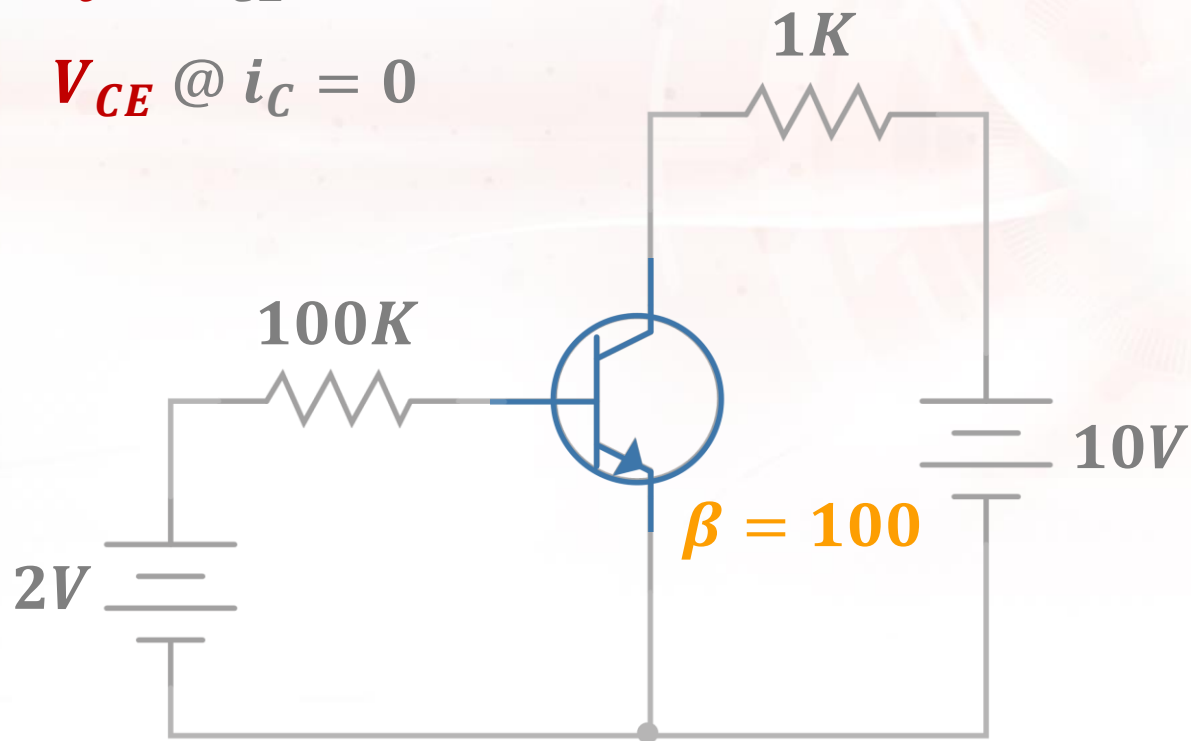


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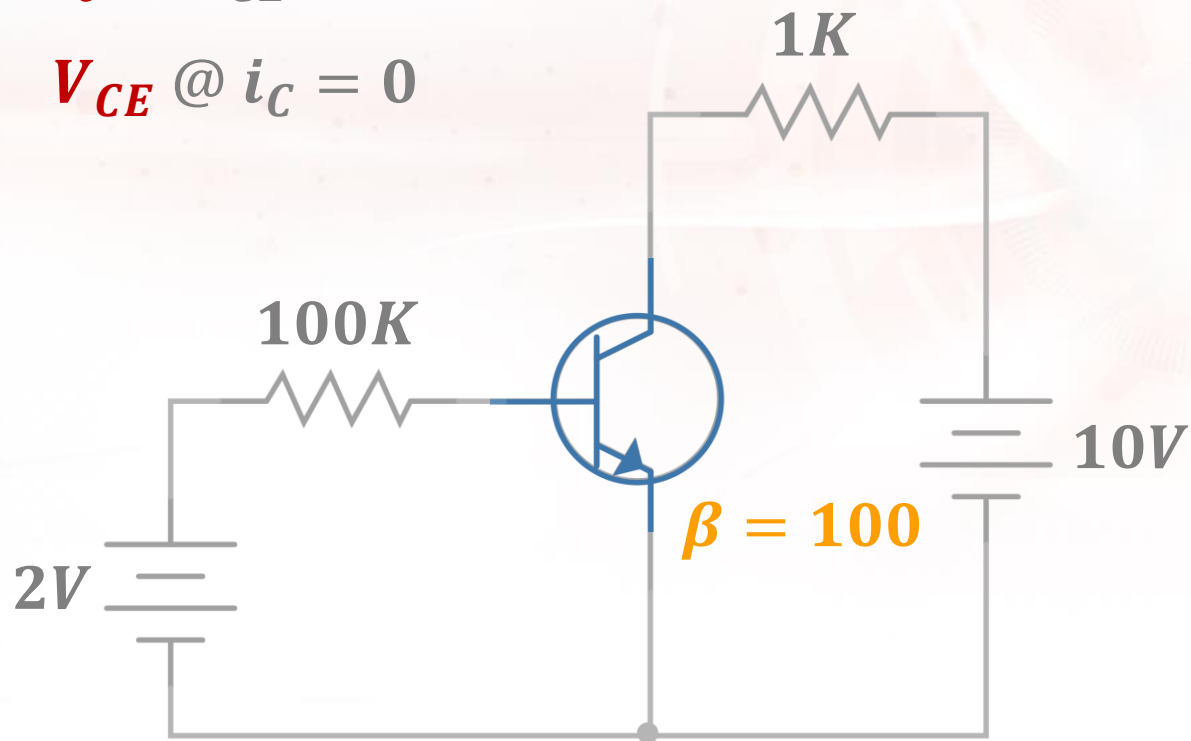


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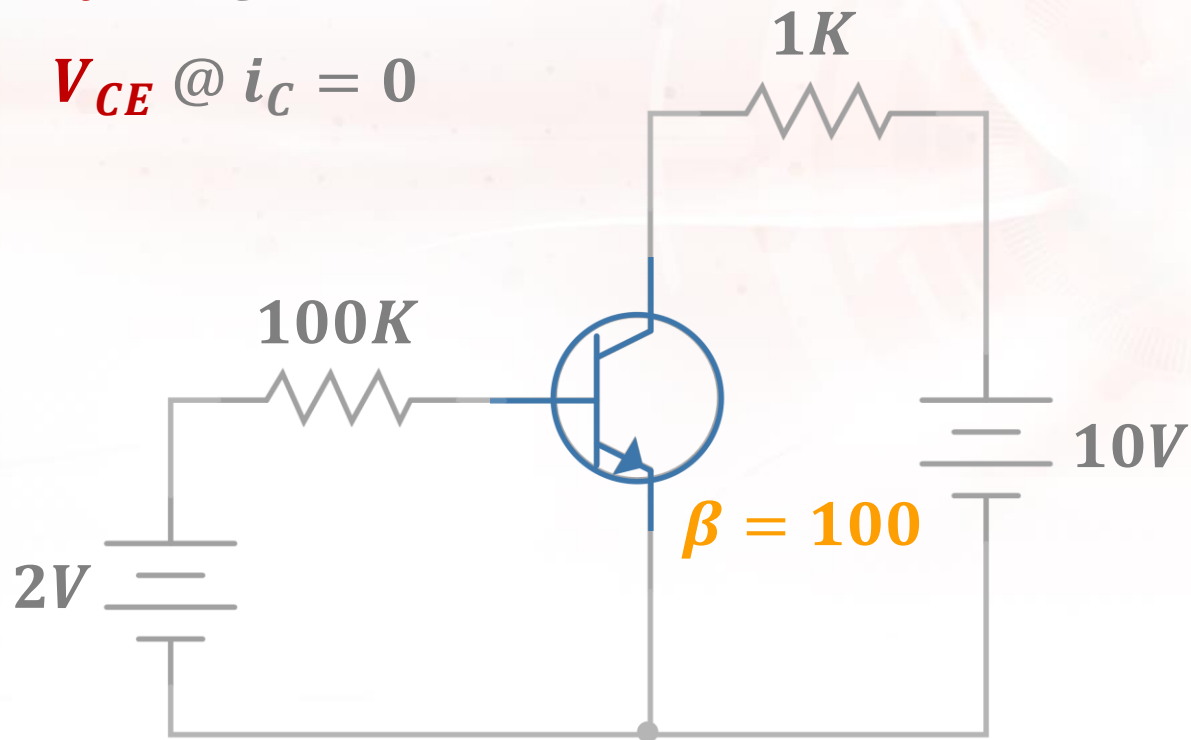


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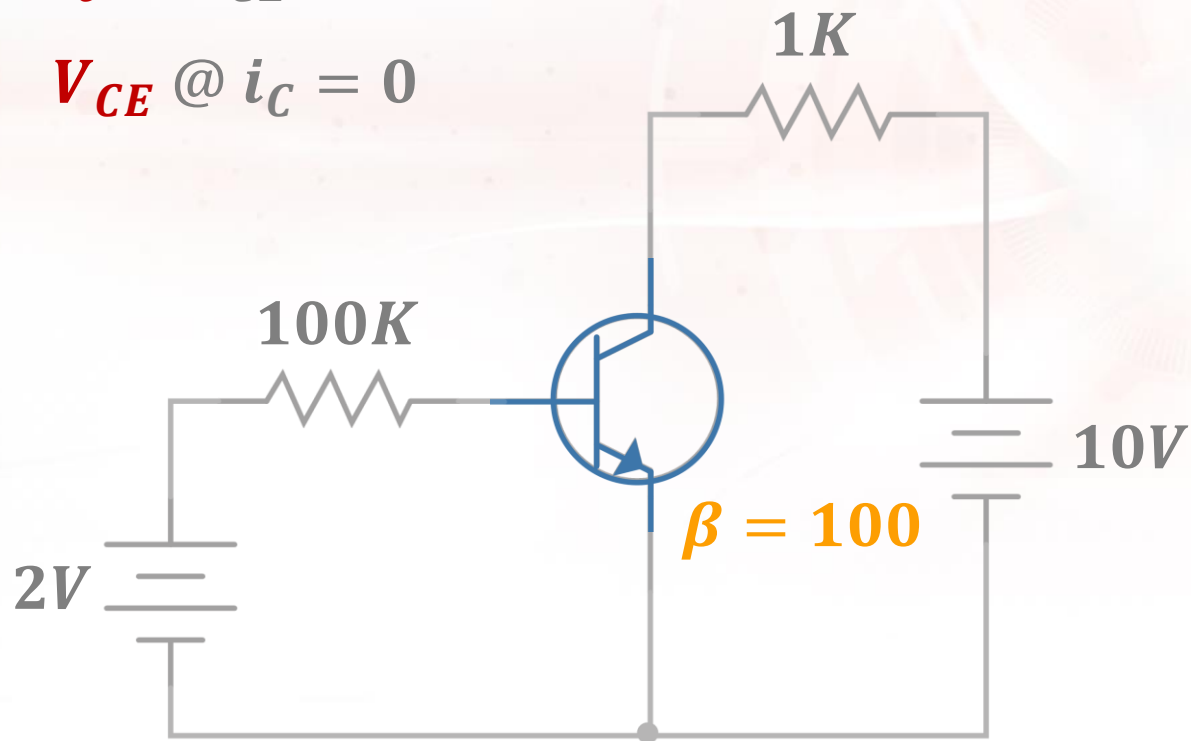


Determine the parameters of the given transistor network.

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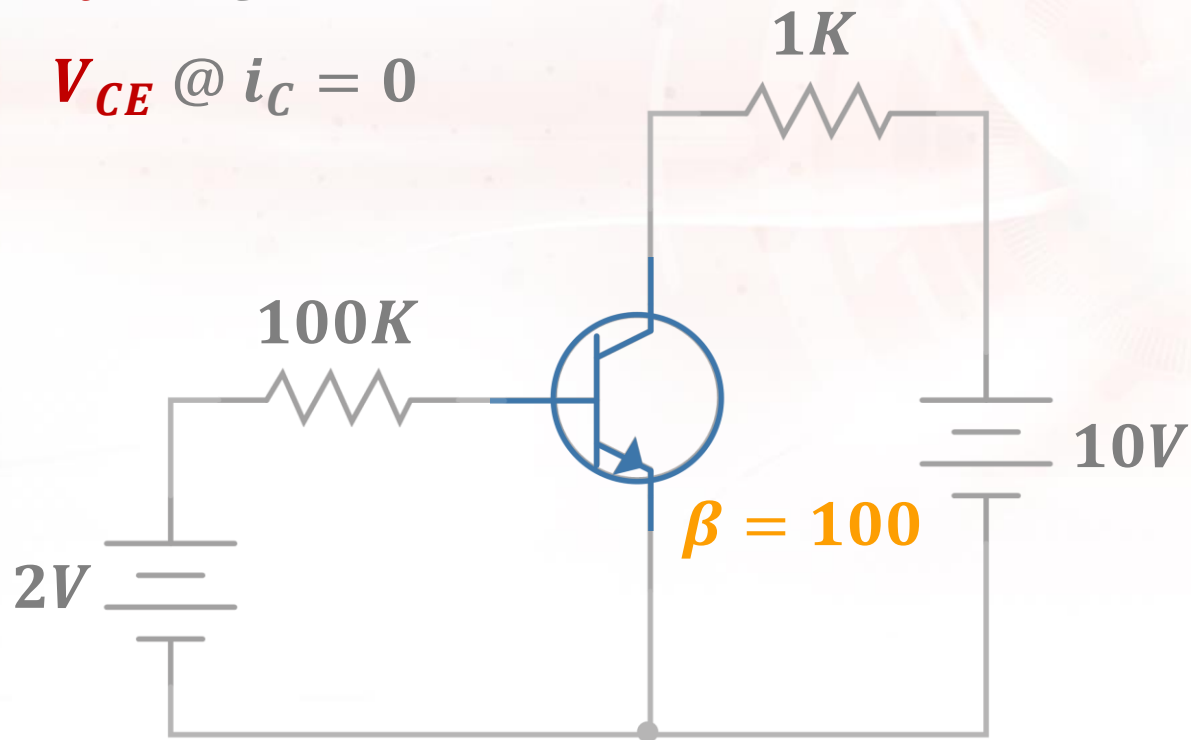


Determine the parameters of the given transistor network.

i_B , i_C , and V_{CE}

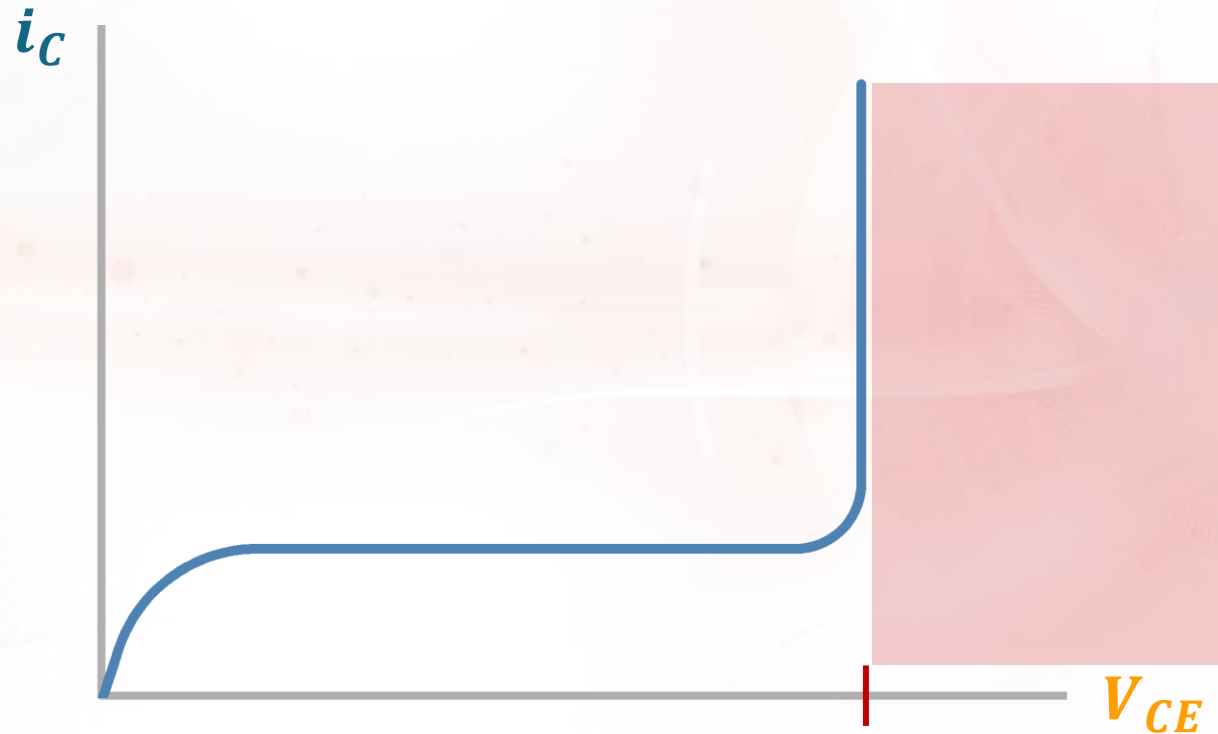
$i_C @ V_{CE} = 0$

$V_{CE} @ i_C = 0$

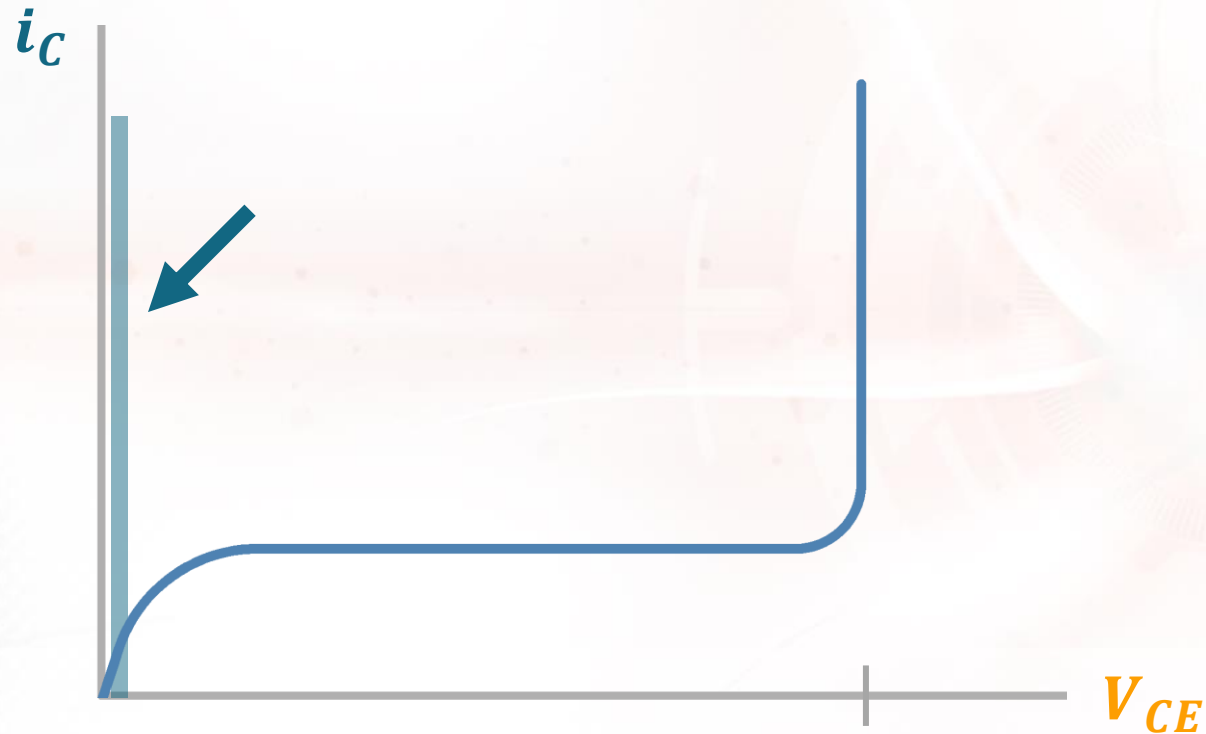




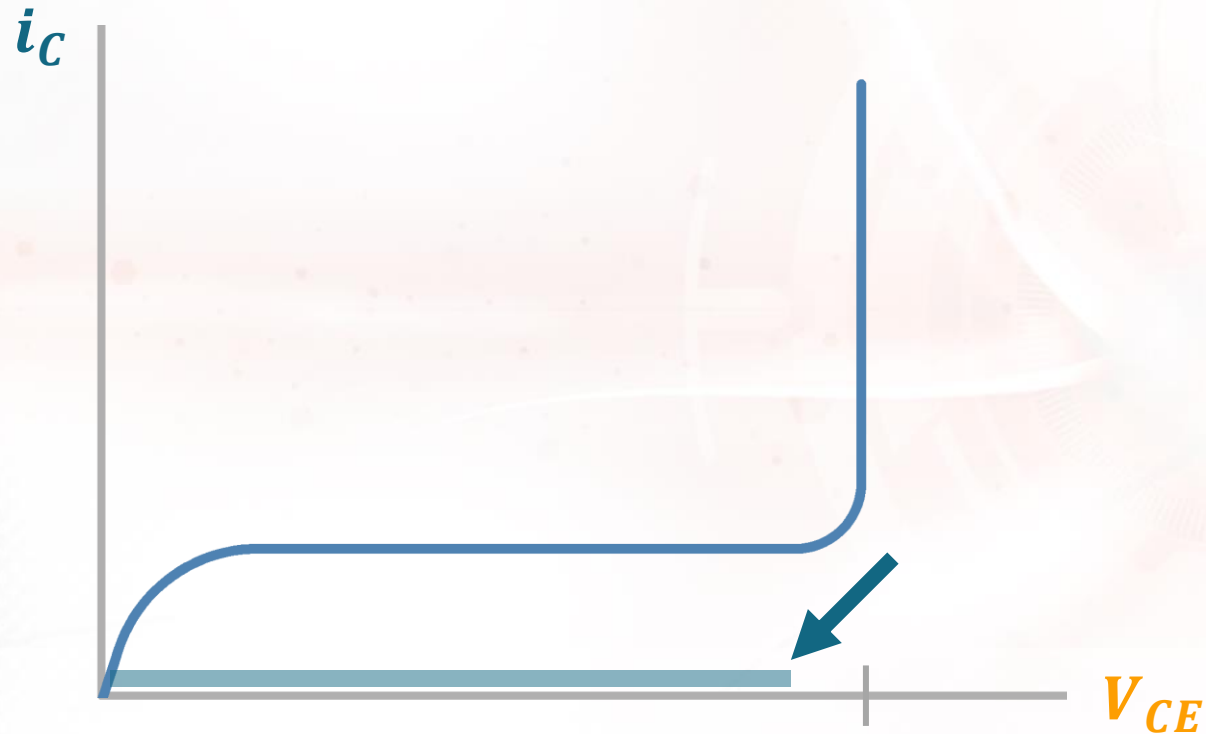
REGIONS OF OPERATION



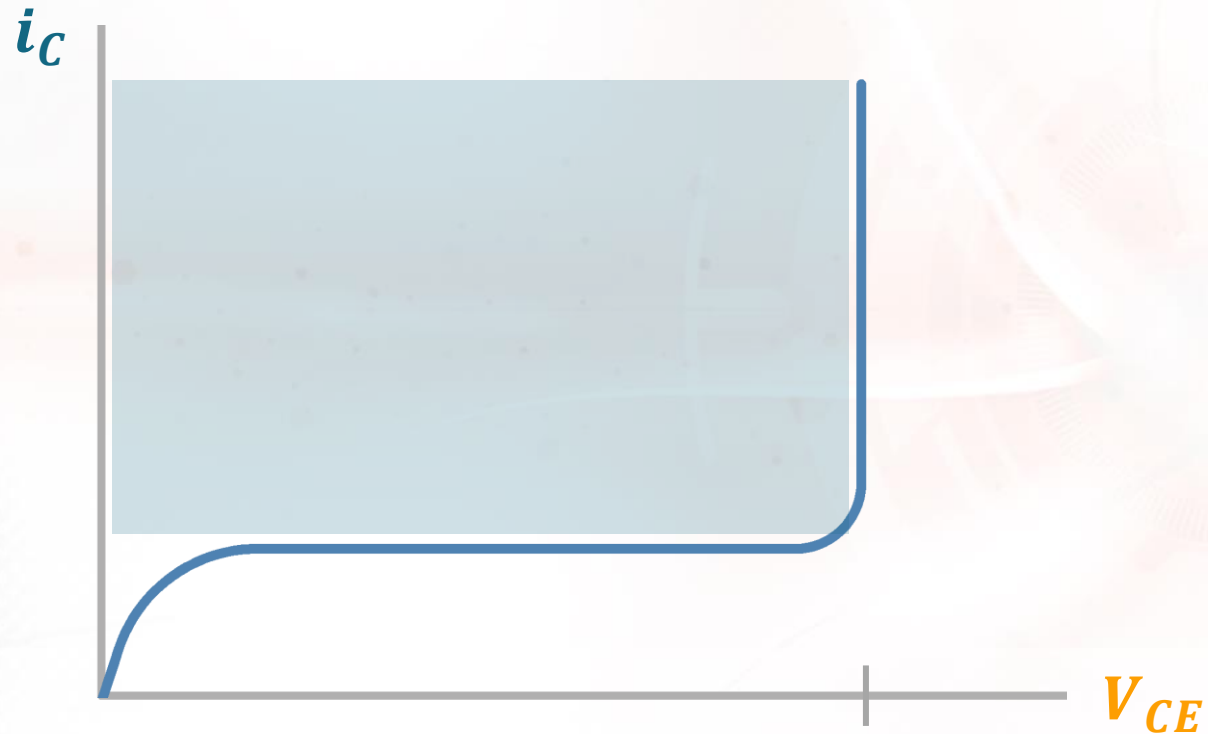
The transistor should never operate in this region because it will be **destroyed**



The early rising part of the curve, where V_{CE} is between **0V** and few tenths of a volt



A **small collector current** when the base current is zero



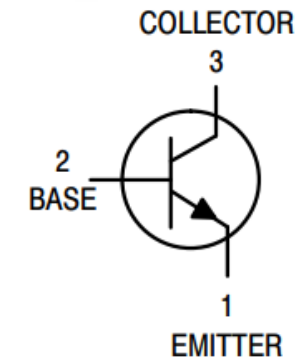
Collector current is **constant** in this region

READING DATASHEET

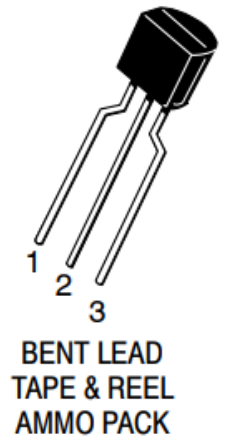
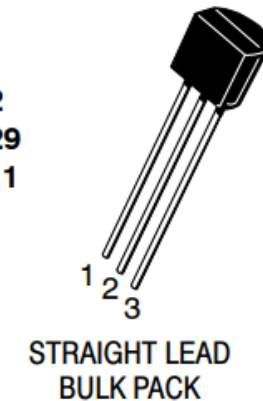
The background of the slide is a light, abstract collage. It features a hand holding a pen, a document with text and a line graph, and a bar chart with four bars of increasing height. The colors are muted, including shades of orange, blue, and yellow.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector – Emitter Voltage	V_{CEO}	40	Vdc
Collector – Base Voltage	V_{CBO}	60	Vdc
Emitter – Base Voltage	V_{EBO}	6.0	Vdc
Collector Current – Continuous	I_C	200	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 12	W mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$



TO-92
CASE 29
STYLE 1



ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS				
DC Current Gain (Note 2) ($I_C = 0.1 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$)	h_{FE}	20	–	–
2N3903		40	–	
2N3904		35	–	
($I_C = 1.0 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$)		70	–	
2N3903		50	150	
($I_C = 10 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$)		100	300	
2N3904		30	–	
($I_C = 50 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$)		60	–	
2N3903	$V_{CE(sat)}$	15	–	Vdc
($I_C = 100 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$)		30	–	
2N3904		–	0.2	
Collector – Emitter Saturation Voltage (Note 2) ($I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$)		–	0.3	
($I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$)				
Base – Emitter Saturation Voltage (Note 2) ($I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$)	$V_{BE(sat)}$	0.65	0.85	Vdc
($I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$)		–	0.95	

LABORATORY

The background is a light-colored collage of various scientific and technical illustrations. On the left, there is a faint image of a DNA double helix. In the center, a microscope is visible. To the right, there is a bar chart with four bars of increasing height, colored in shades of blue and yellow. Above the bar chart, there is a line graph showing a fluctuating trend. The overall aesthetic is clean and professional, with a focus on scientific research.