BIPOLAR JUNCTION TRANSISTOR

INTRODUCTION

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TOPIC OUTLINE

Transistor Construction

Transistor Configurations

Regions of Operation

TRANSISTOR CONSTRUCTION

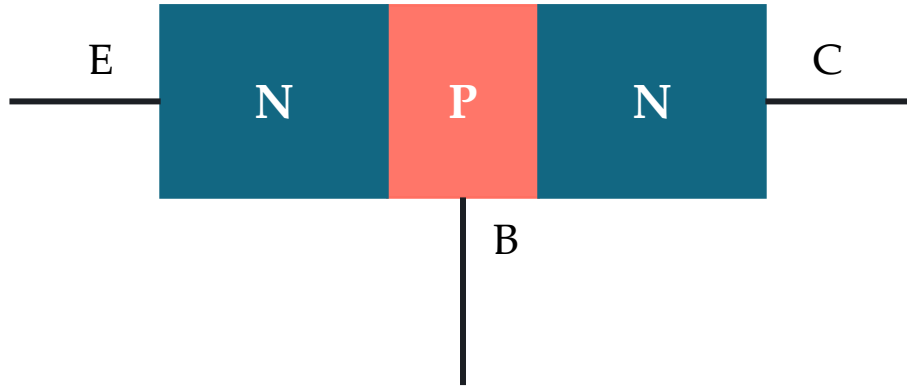# THE FIRST TRANSISTOR

December 23,1947

The invention of the transistor, which revolutionized modern electronics was the result of collaborative work by three brilliant scientists:

- **Dr. John Bardeen**

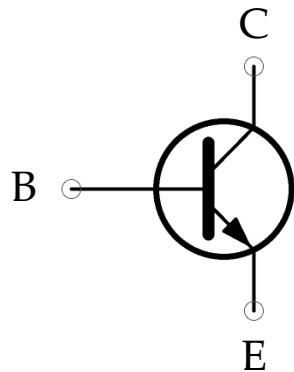- **Dr. Walter Brattain**

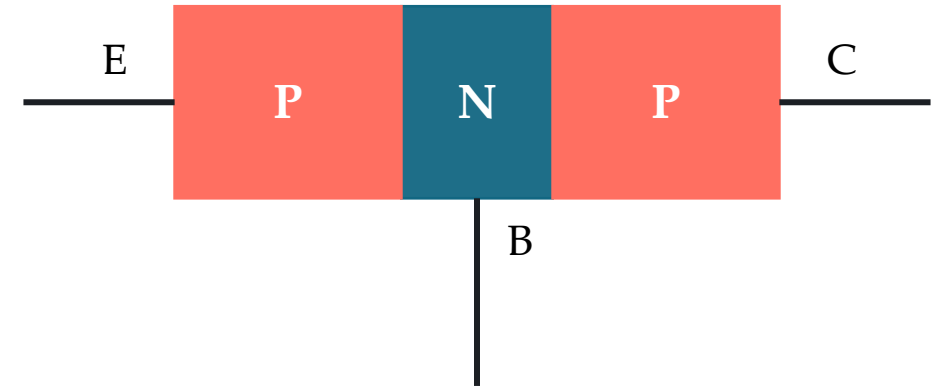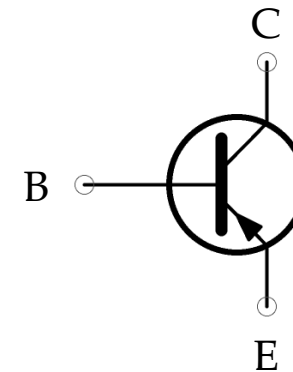- **Dr. William Shockley**

TRANSISTOR CONSTRUCTION
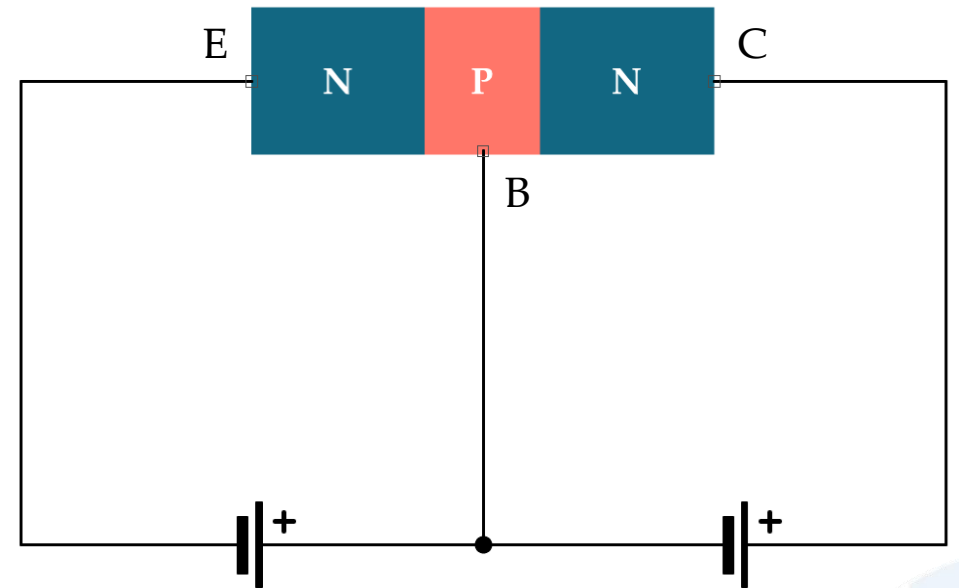
NPN

PNP

Schematic Symbol

Schematic Symbol

BIPOLAR JUNCTION TRANSISTOR

A **Bipolar Junction Transistor** (**BJT**) is a three-terminal semiconductor device that uses both free **electrons** and **holes** as charge carriers for its operation.
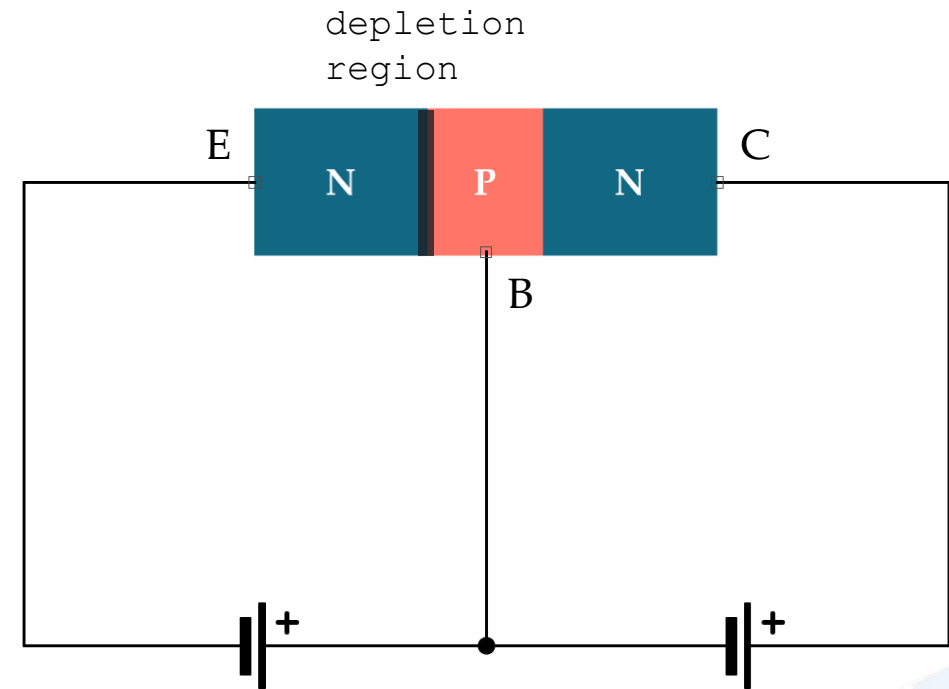
The term "bipolar" means two polarities.

EMITTER-BASE DIODE

The **emitter-based** diode in a BJT is **forward-biased** during normal operation.

The **emitter** is **heavily** doped while **base** is **lightly** doped to ensure most carriers reach the collector.

depletion region

E   C

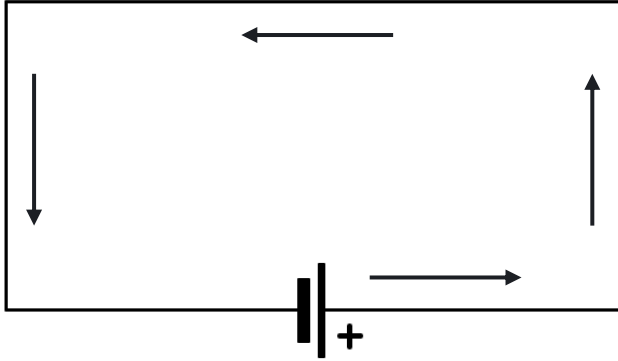N   P   N

B

COLLECTOR-BASE DIODE

The **collector-based** diode in a BJT is typically **reverse-biased**.

The **collector** is doped at **intermediate** level – between the lightly doped base and heavily doped emitter.
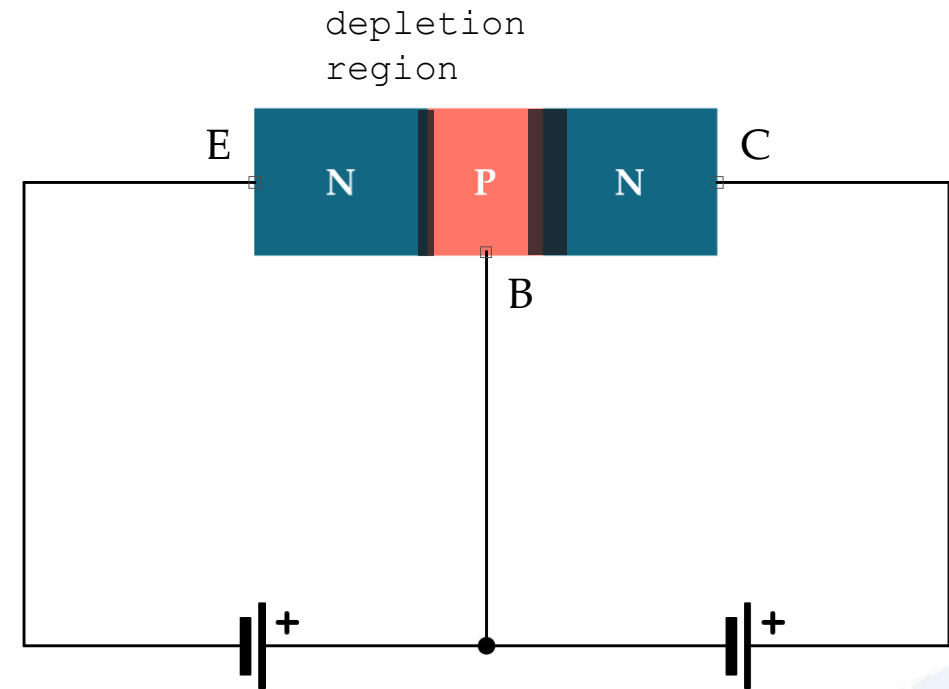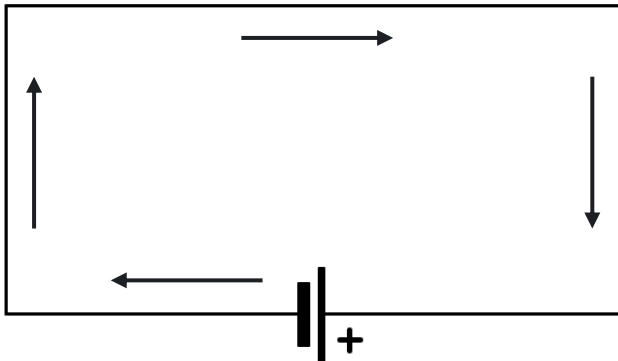
CURRENT FLOW NOTATION
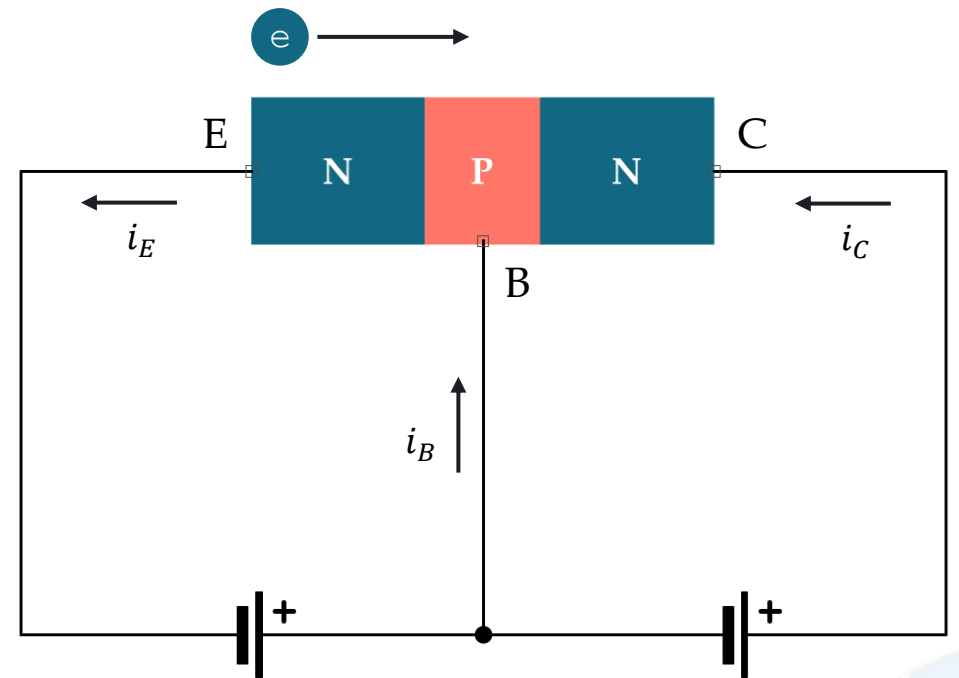
Conventional Flow Notation

Used in mathematical calculations
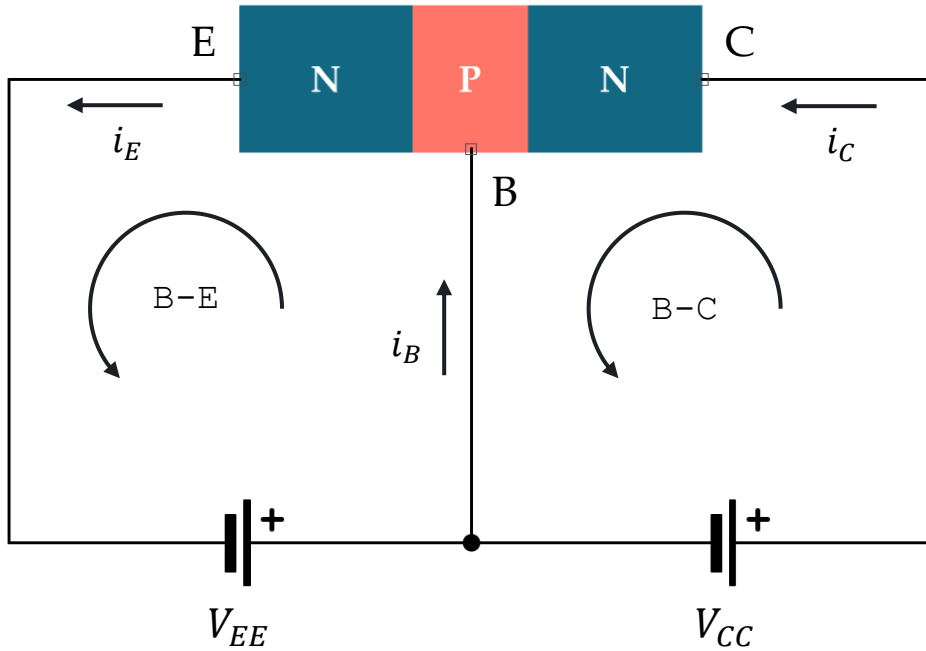
Electron Flow Notation
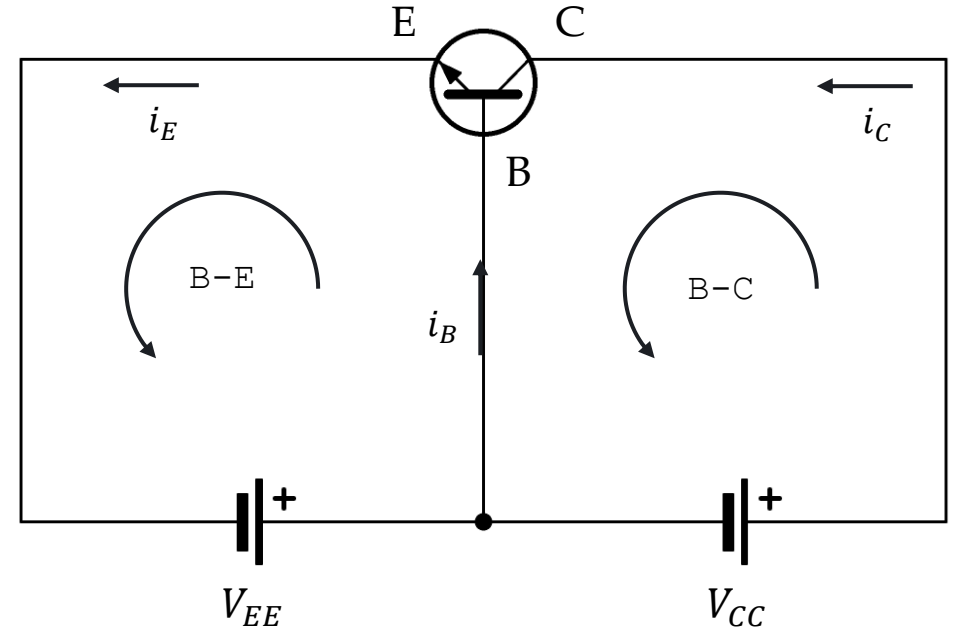
Actual movement of electrons

TRANSISTOR CONFIGURATIONS
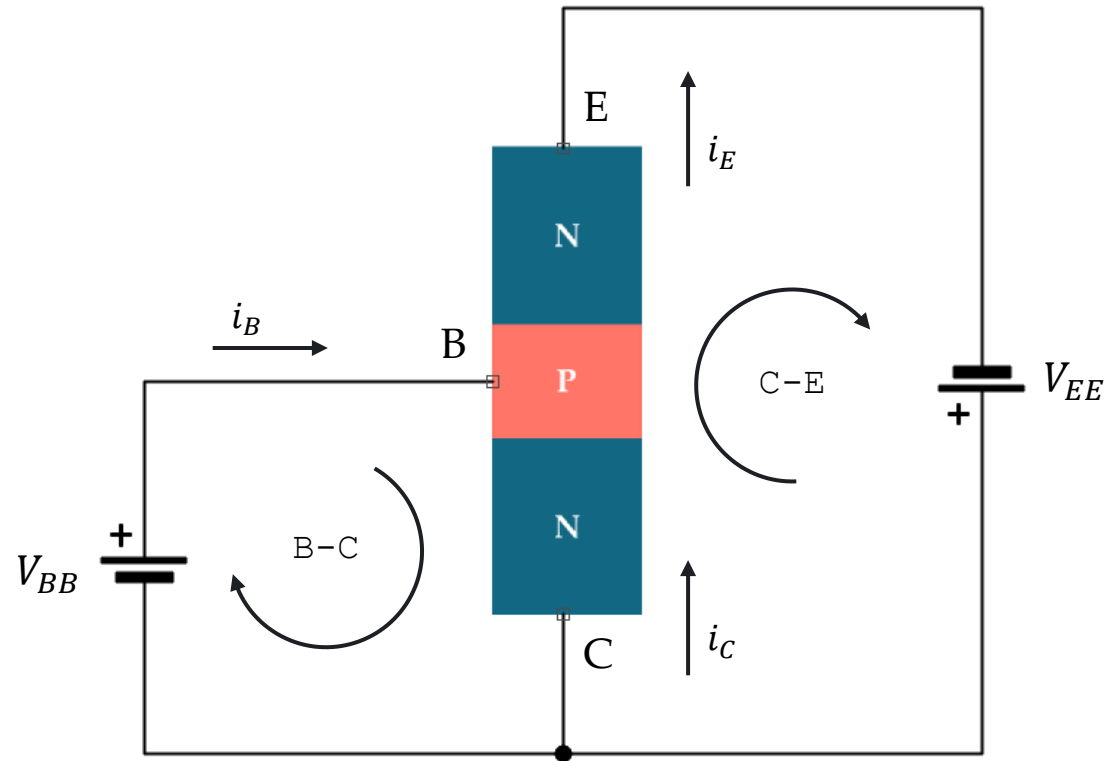
COMMON-BASE

Common-Base Configuration

Circuit Equivalent

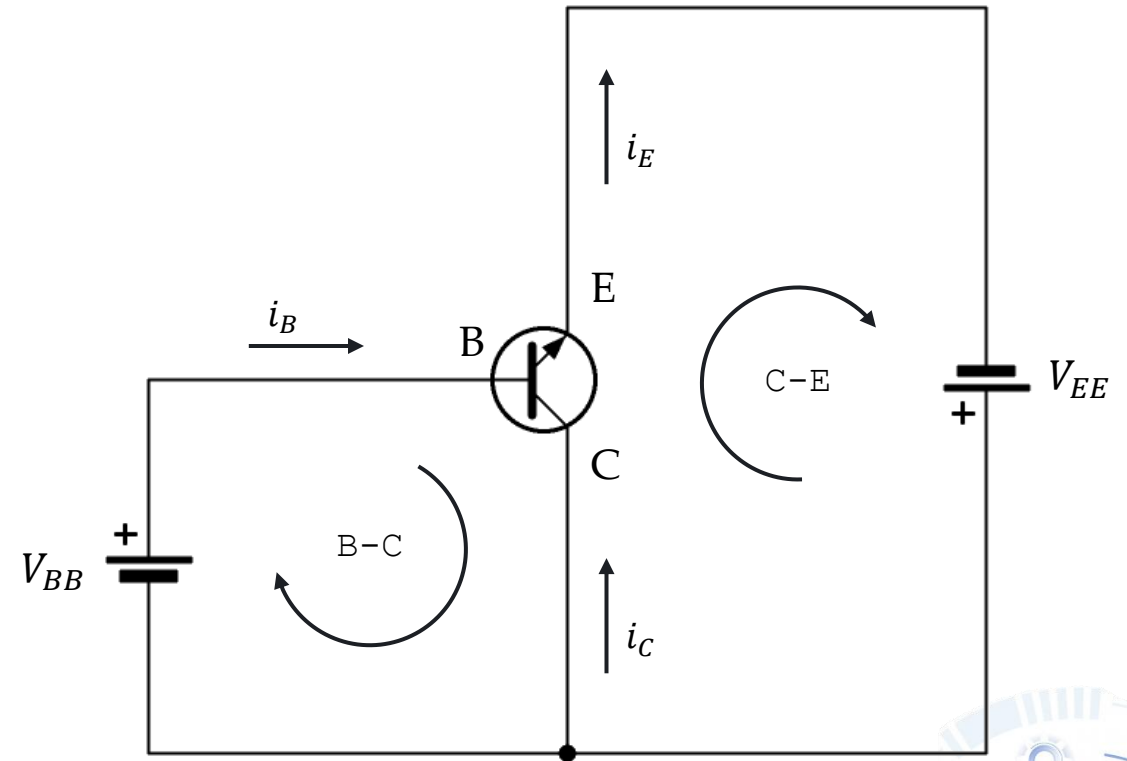Base is common to both input and output loop.

COMMON-COLLECTOR

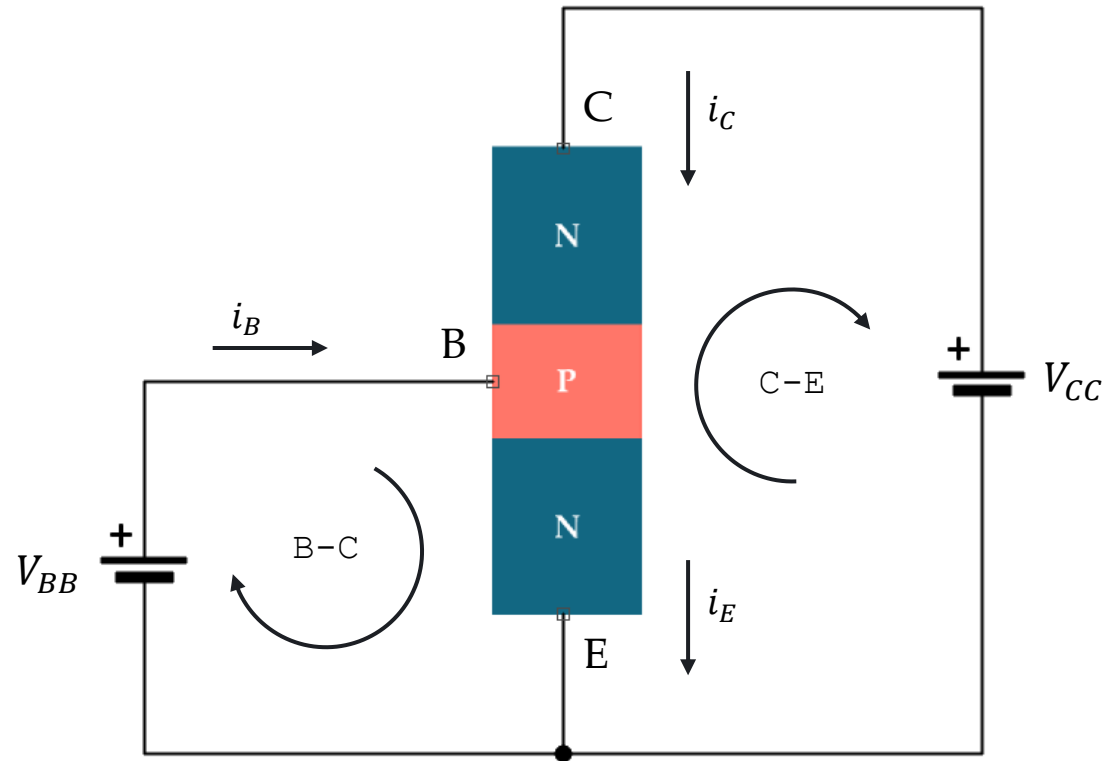Common-Collector Configuration

Circuit Equivalent

Collector is common to both input and output loop.

COMMON-EMITTER

Common-Emitter Configuration

Circuit Equivalent

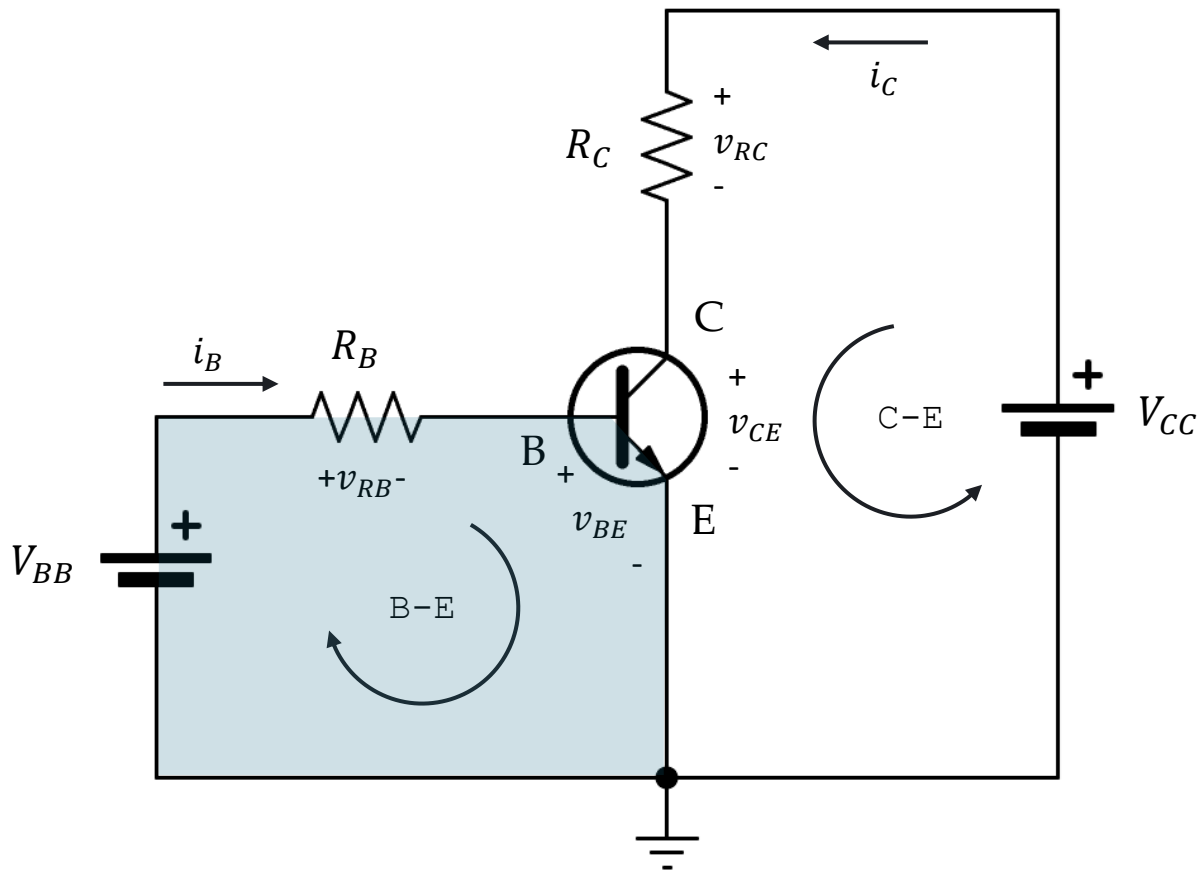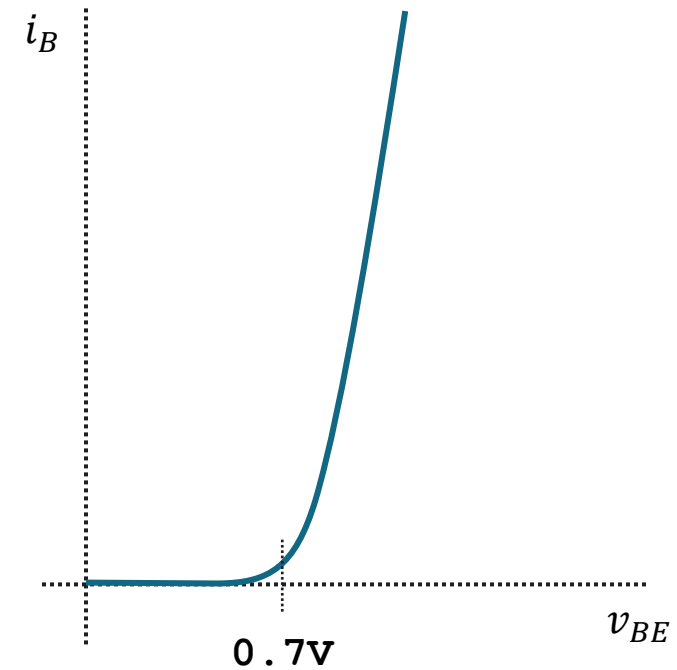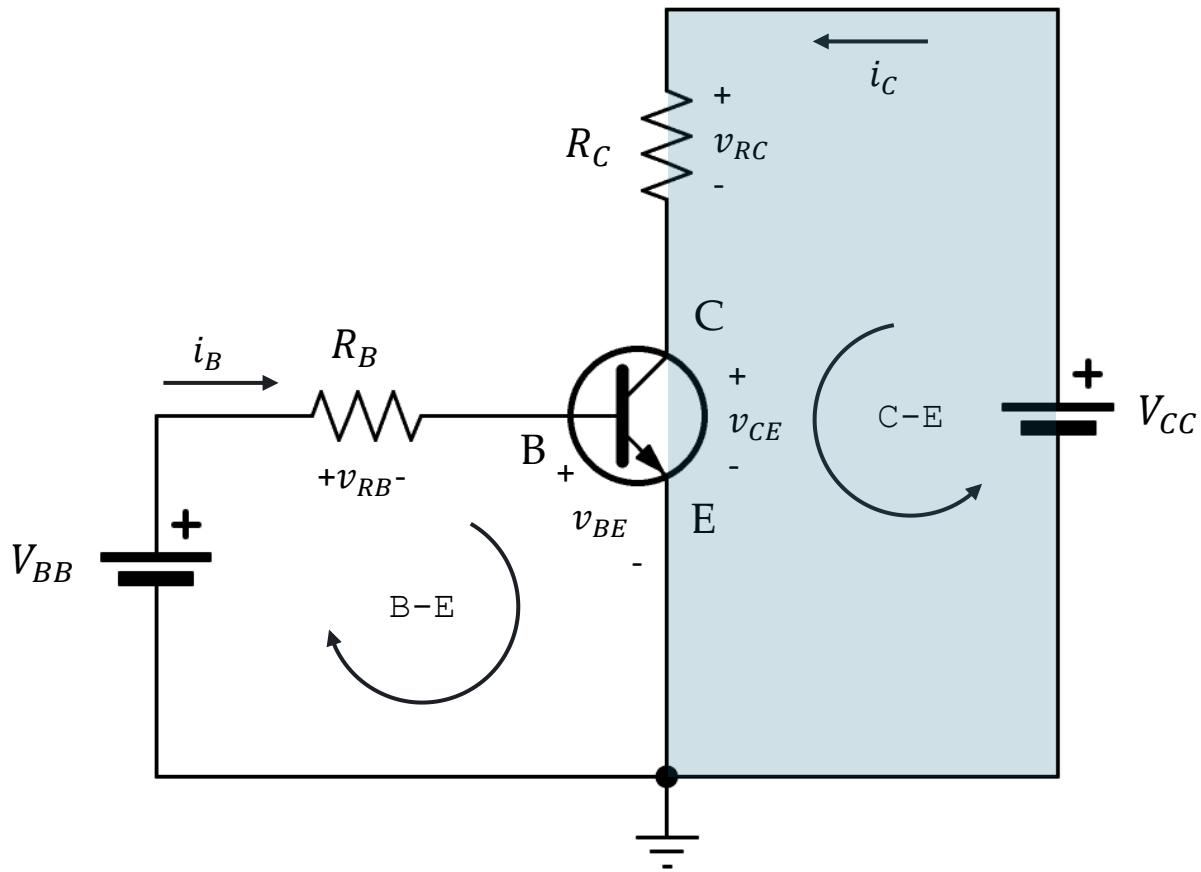Emitter is common to both input and output loop.
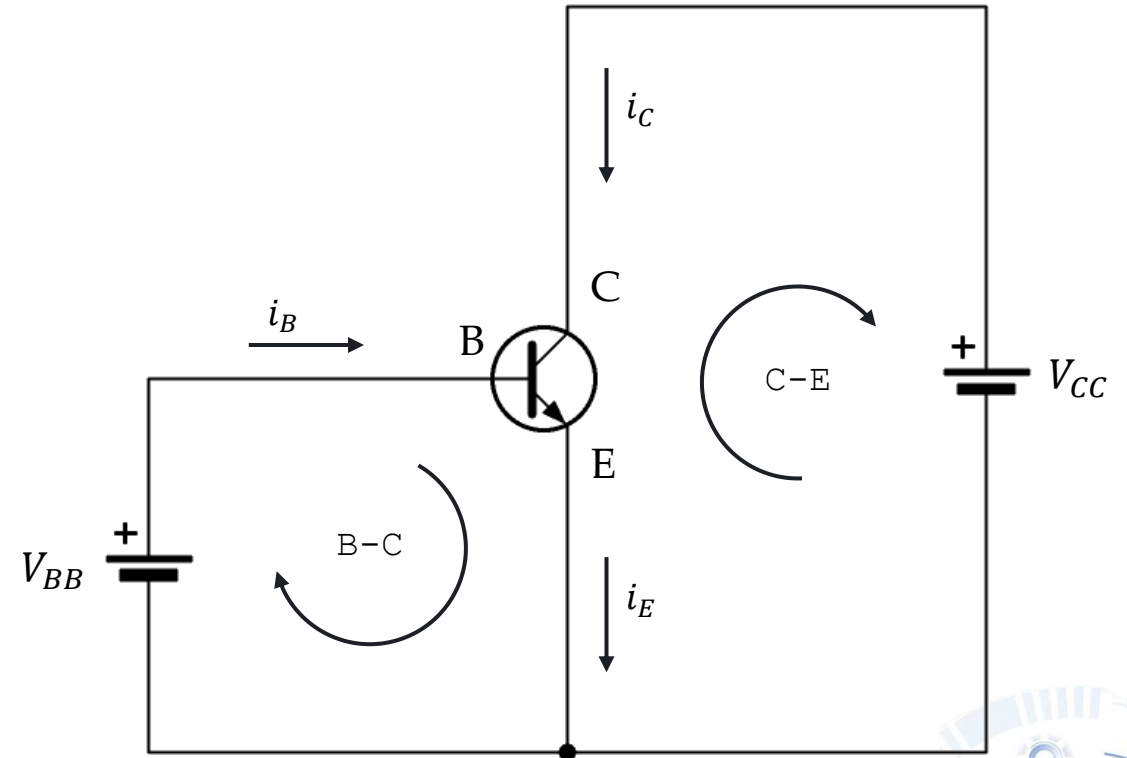
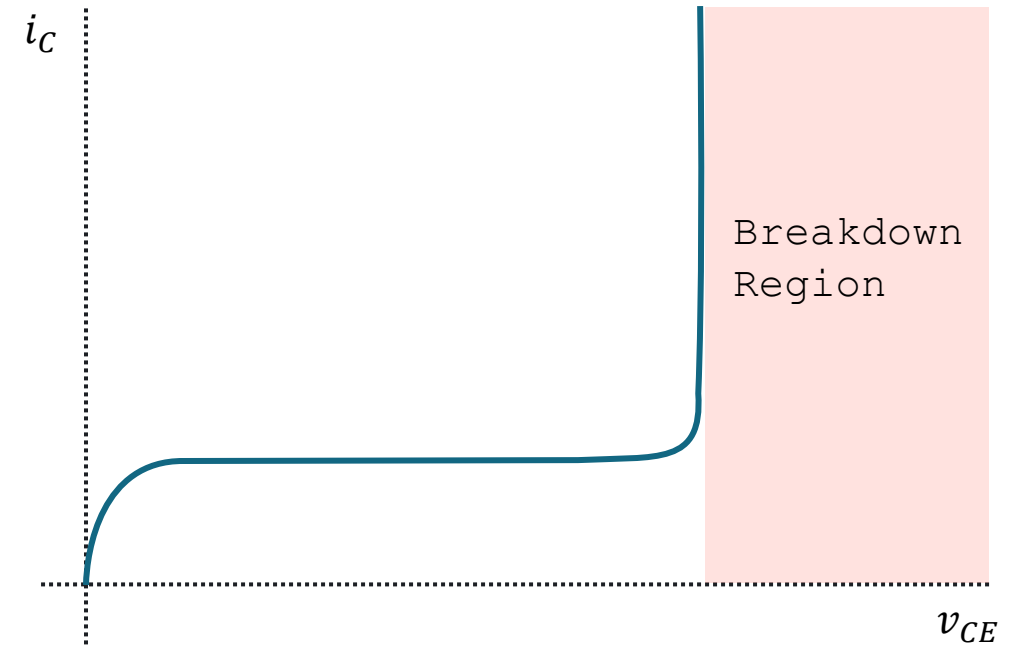# REGIONS OF OPERATION

THE BASE CURVE

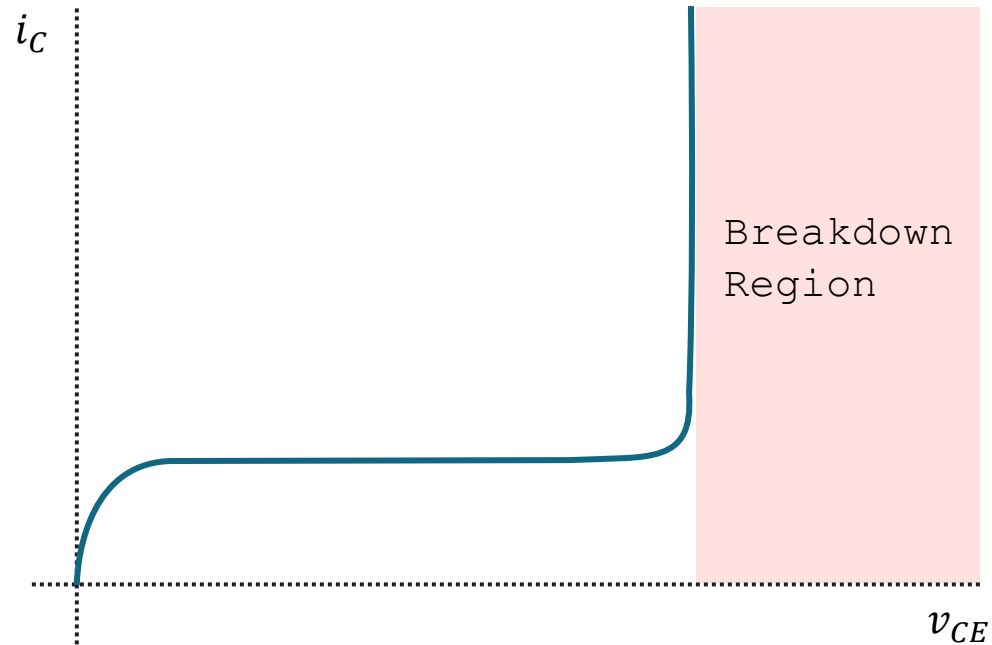The Base Curve

THE COLLECTOR CURVE

The Collector Curve

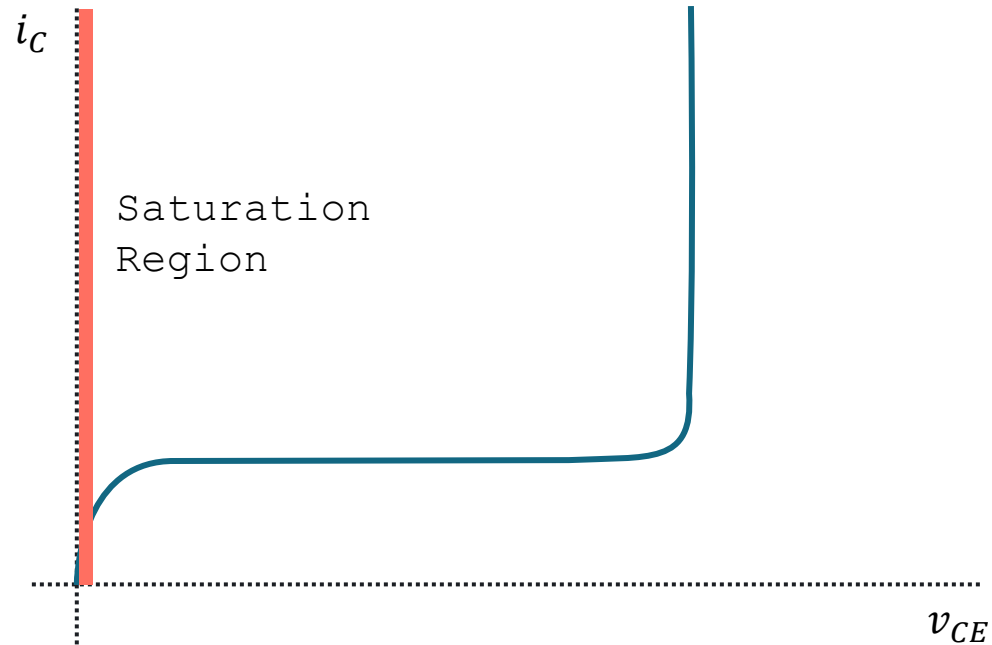# BREADOWN REGION

Collector Curve

The **breakdown region** is the operating state where the voltage across the transistor's junctions exceeds safe limits, causing a large, uncontrolled current that can **destroy** the device.

A transistor should **never operate** in this region.

SATURATION REGION
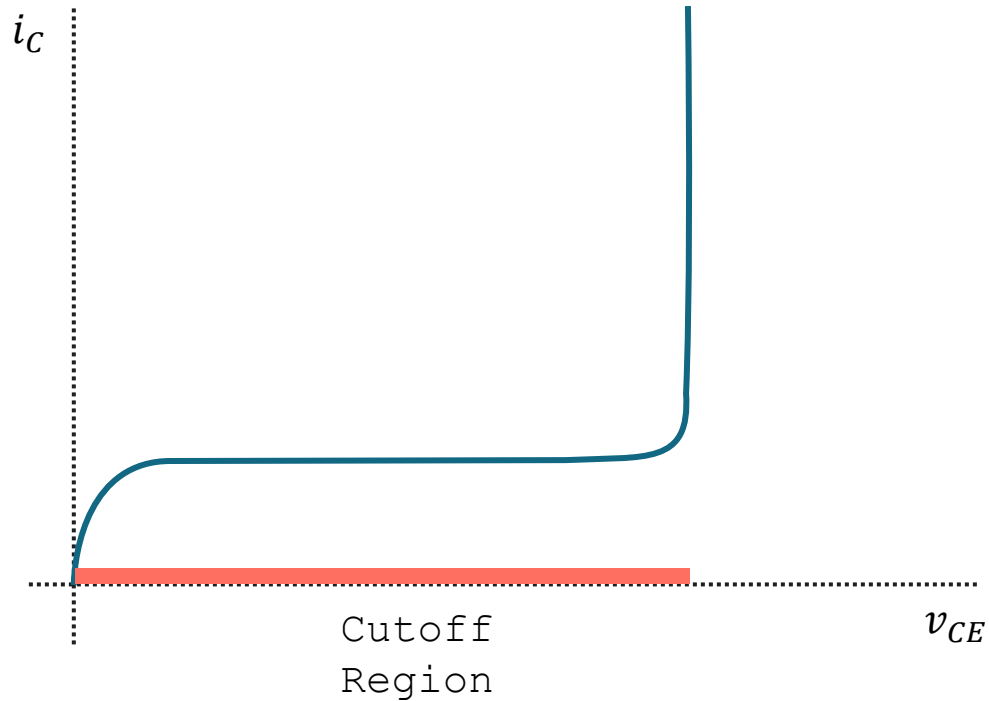
Collector Curve

The **saturation region** is the operating state **maximum curren**t flows from collector to emitter, and very low collector-emitter voltage ($v_{CE} \approx 0$).

In this region, the transistor acts like a **closed switch**.
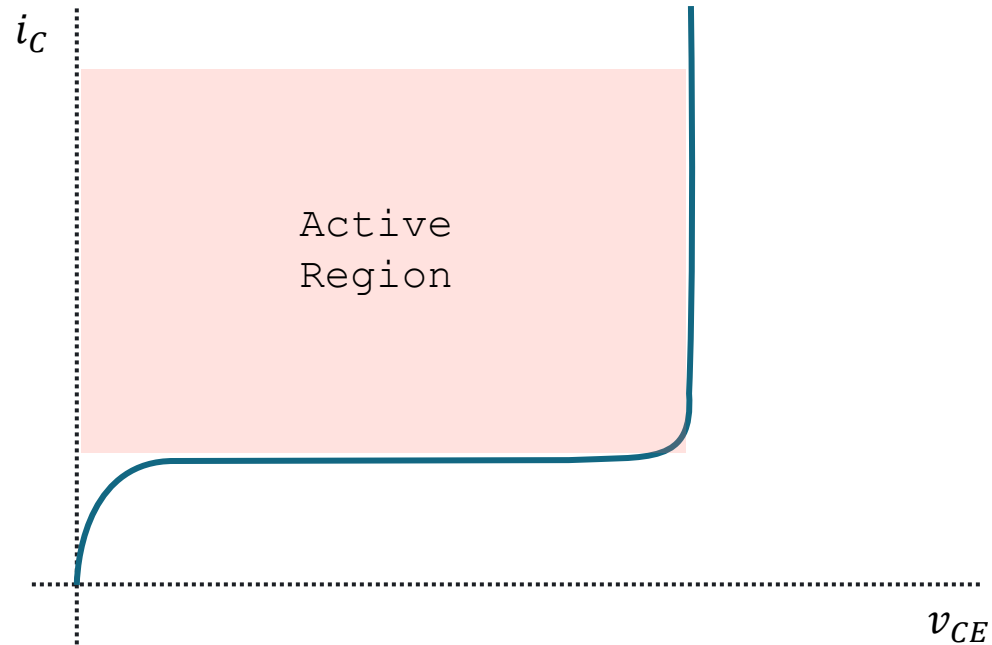
CUTOFF REGION

Collector Curve

The **cutoff region** is the operating state of a transistor where the base current is nearly zero ($i_B \approx 0$), resulting in **no collector current** flow ($i_C \approx 0$).

In this region, the transistor acts like an **open switch**.

ACTIVE REGION

Collector Curve

The **active region** is the operating state of a transistor where the collector current is **constant**.

In this region the transistor functions as an **amplifier**.

LABORATORY