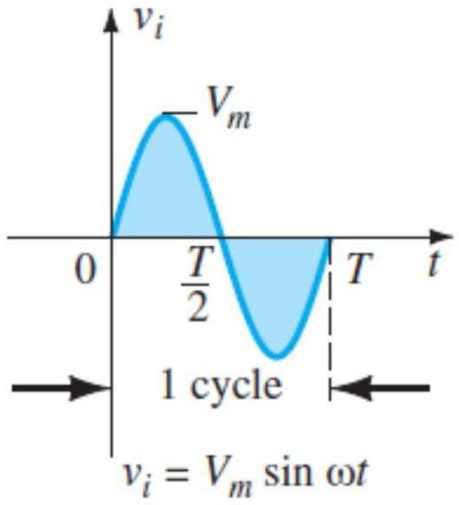
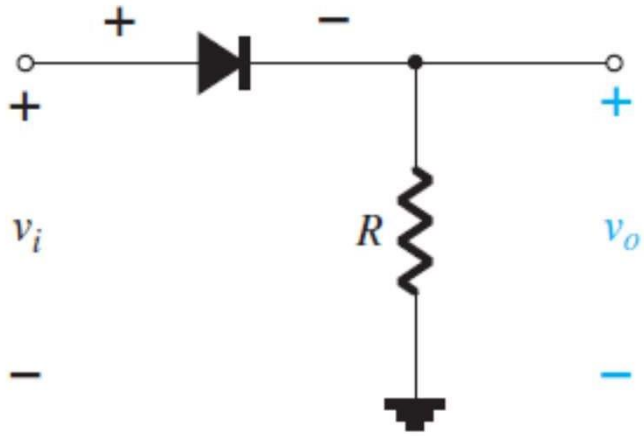
BASIC ELECTRONIC CIRCUITS

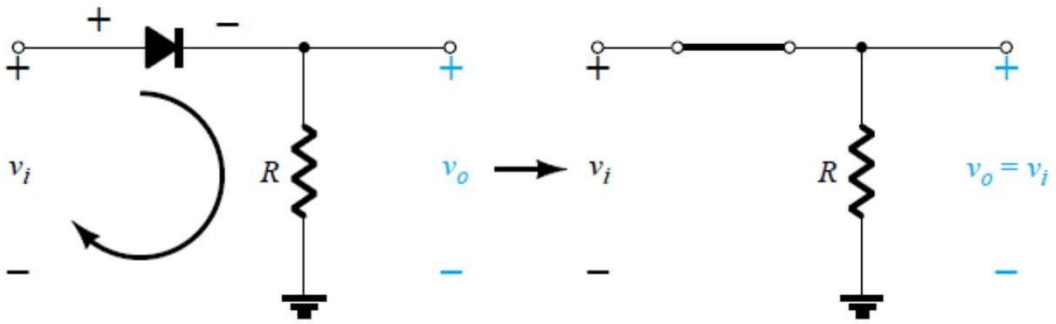
INSTITUTE CORE

The half-wave rectifier

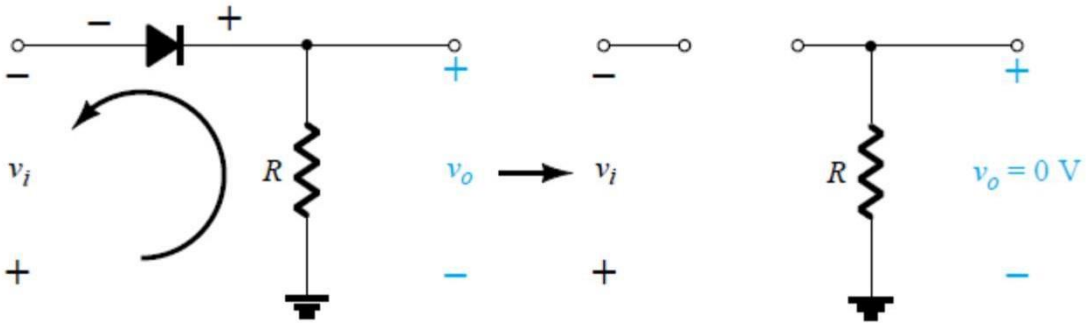


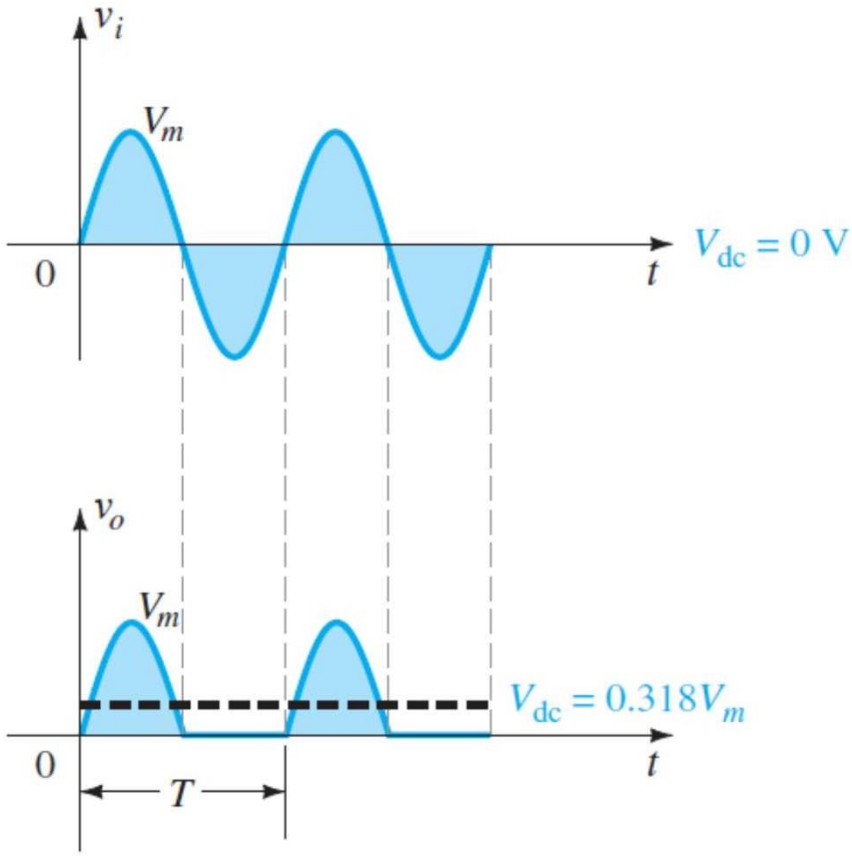


For the +ve half cycle: 0 to T/2

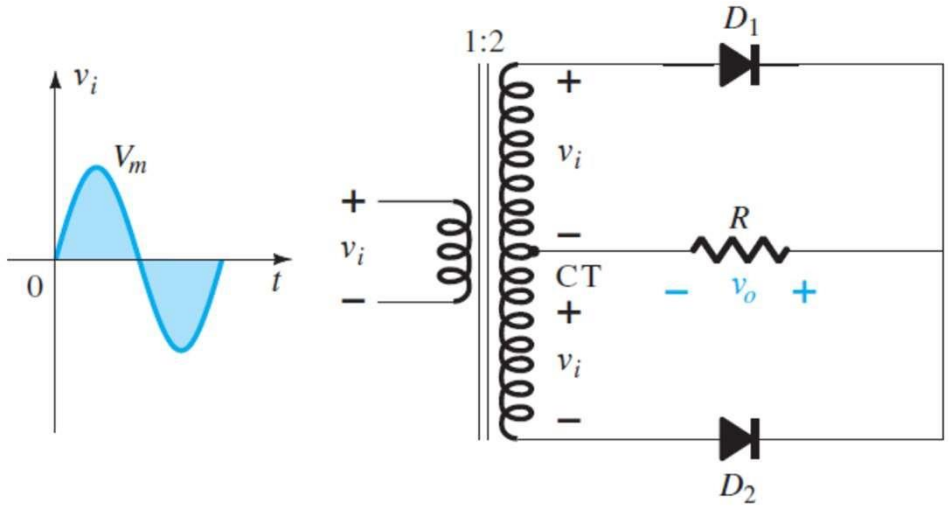


For the -ve half cycle: T/2 to T



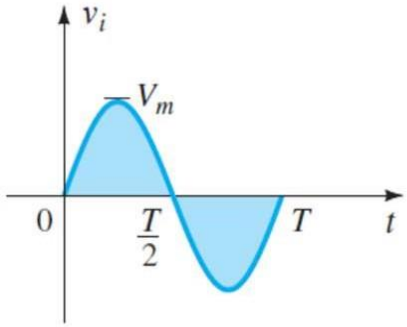


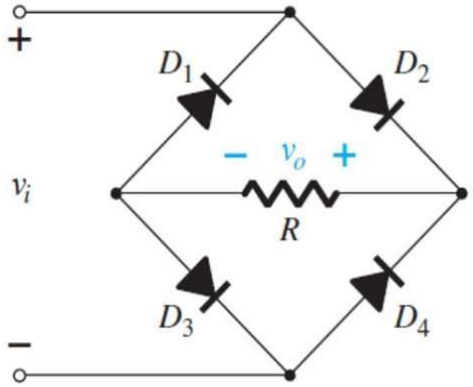
The full-wave rectifier

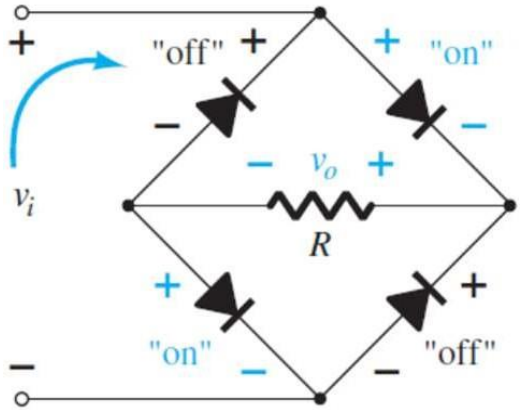


- The transformer was center-tapped to provide two equal voltages V_i, across the two halves of the secondary winding.
- During the positive half cycle only D_1 will conduct and D_2 will be off.

Full wave rectification: The bridge rectifier







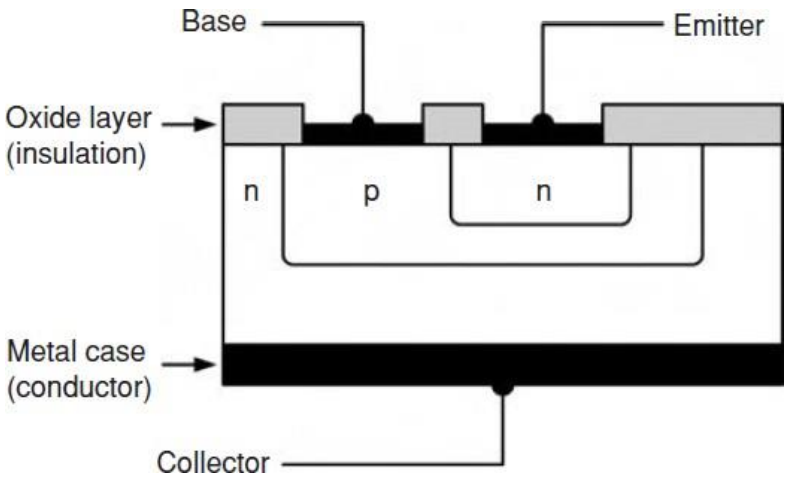
- Utilizes both halves of the input sinusoid, to provide unipolar output.
- Inverts the negative halves of the sine wave.
- During the positive half-cycles, current is conducted through D_2, R, and D_3.
- Since two diodes are ideal, the load voltage Vo = V_i .
- During the negative half-cycle current is conducted through D_4, R, and D_1.
- During both half-cycles, current flows through R in the same direction and thus Vo will always be +ve.

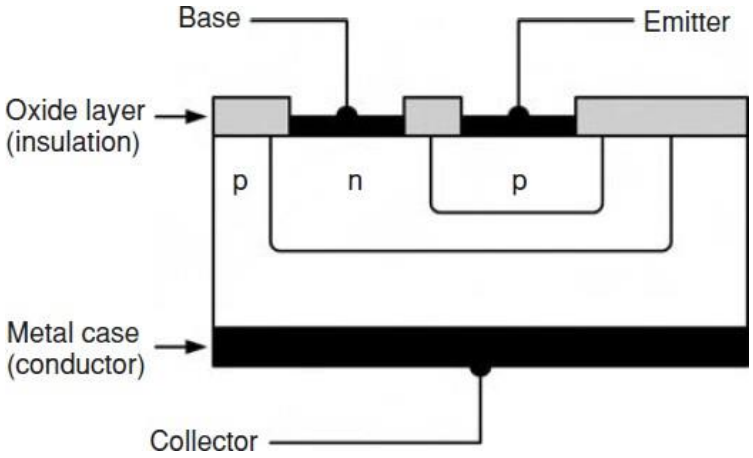
Contents

- Types of Transistors: Bipolar and field effect.
- Physical construction
- Modes of Operation
- Types of Configurations
- Input/output characteristics
- Application as an Amplifier

Bipolar Junction Transistors

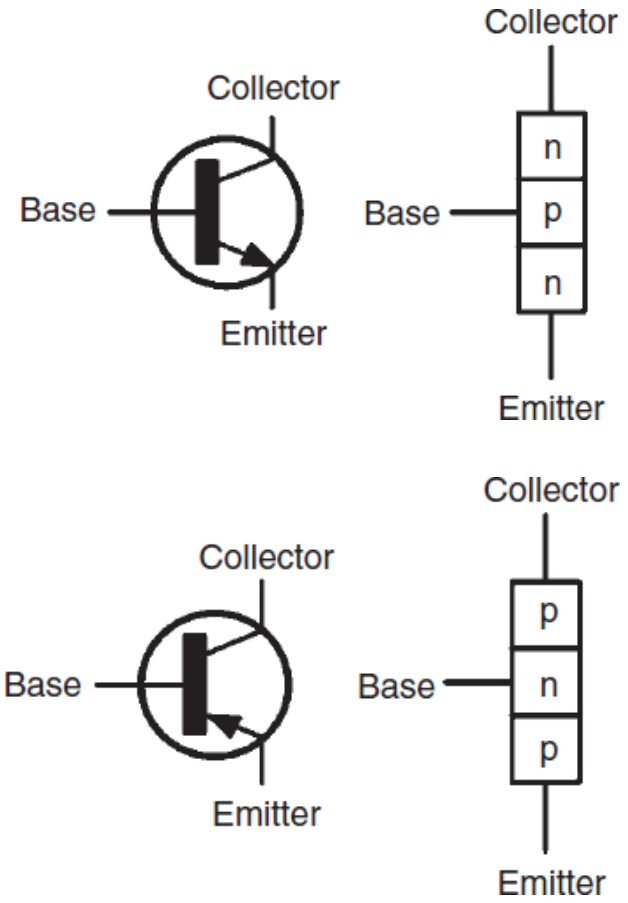
- Physical Construction





BJT: Symbols and junction models

- Emitter – Medium sized and heavily doped, to inject majority carriers to collector through Base.
- Collector – Thick and lightly doped, designed to collect the majority carriers from emitter.
- Base – Thin and medium doped, control the flow of current between Emitter and Collector.



Three-terminal devices are more useful than two-terminal ones, such as the diodes, because they can be used in a multitude of applications:

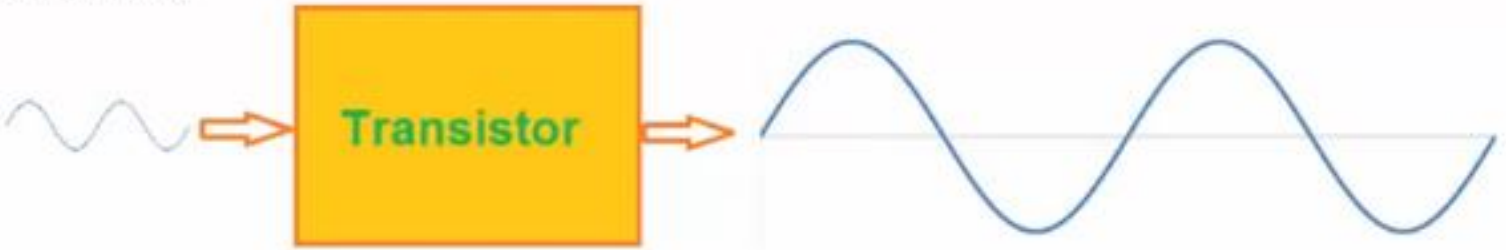
1. signal amplification
2. design of digital logic and memory circuits.

The basic principle is the use of the voltage between two terminals to control the current flowing in the third terminal.

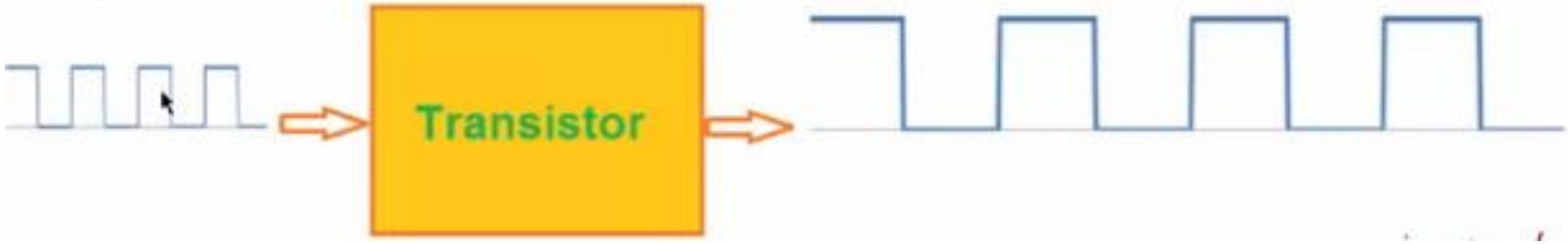
In this way, a three-terminal device can be used to realize a controlled source.

What are functions of transistor?

1. Amplifying



2. Switching



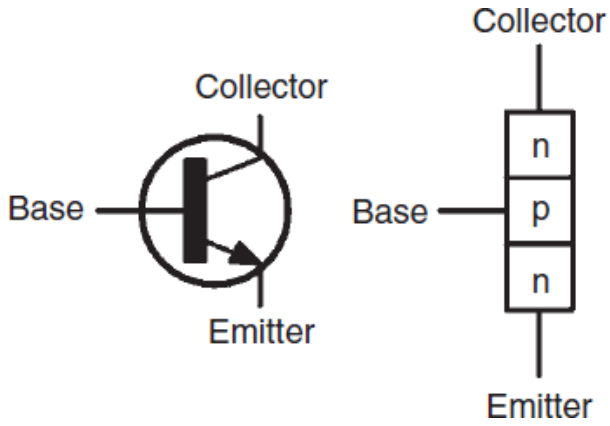
Device Structure and Physical Operation

simplified structure of BJT.

Consists of three semiconductor regions:

- **emitter** region (*n*-type)
- **base** region (*p*-type)
- **collector** region (*n*-type)

Type described above is referred to as *npn*.



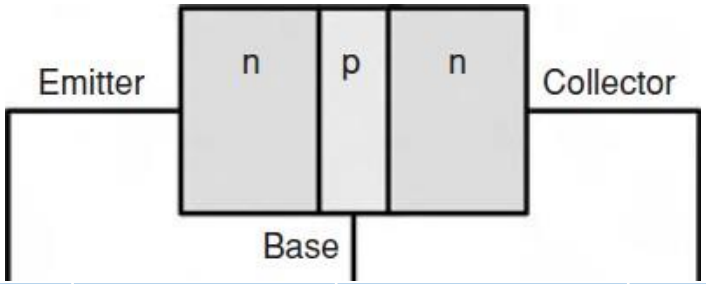
Transistor consists of two *pn*-junctions:

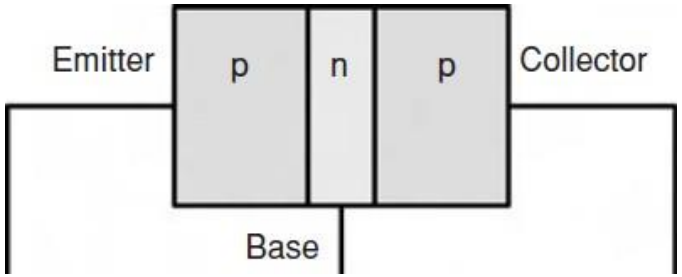
- **emitter-base** junction (EBJ)
- **collector-base** junction (CBJ)

Operating mode depends on biasing.

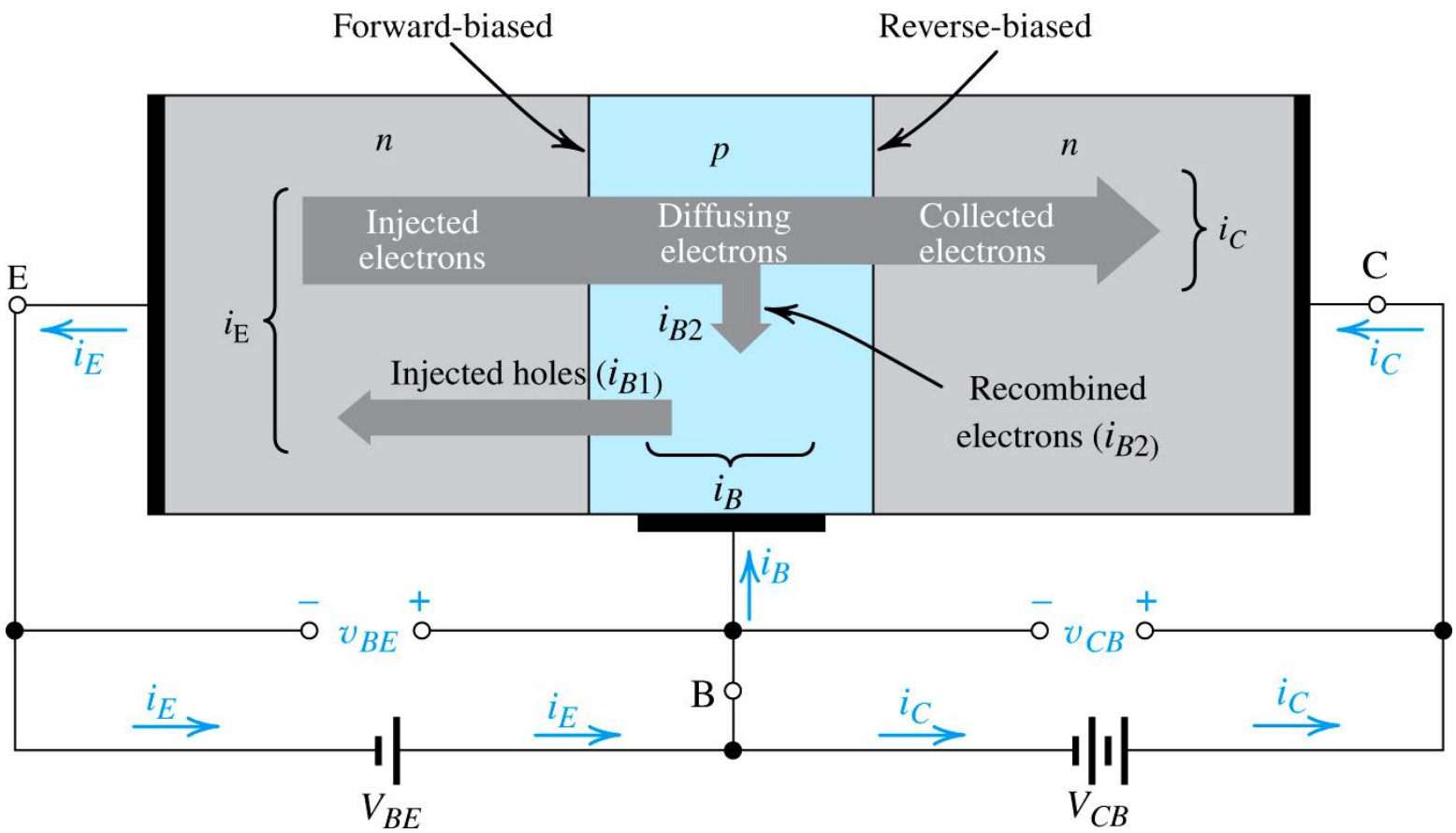
- **active** mode – used for amplification
- **cutoff** and **saturation** modes – used for switching.

BJT: Modes of Operation

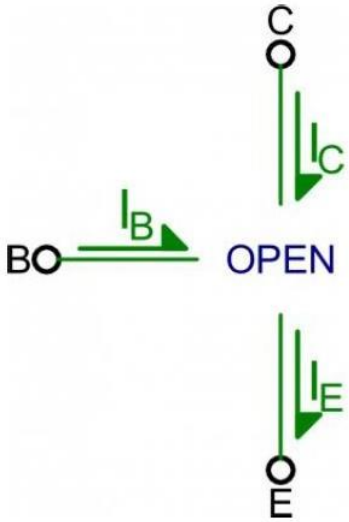


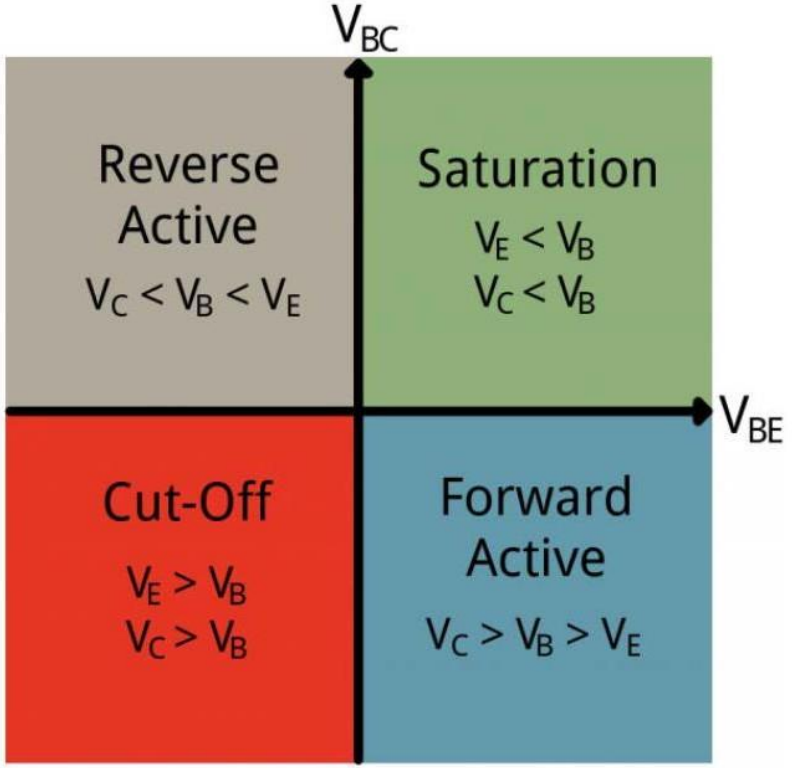


S. No.	Mode	Emitter - Base Junction	Collector Base Junction	Action	Application
1	Cut-off	Reverse	Reverse	Open	Switch
2	Saturation	forward	forward	Short	
3	Active	Forward	Reverse		Amplifier
4	Reverse active	Reverse	Forward		

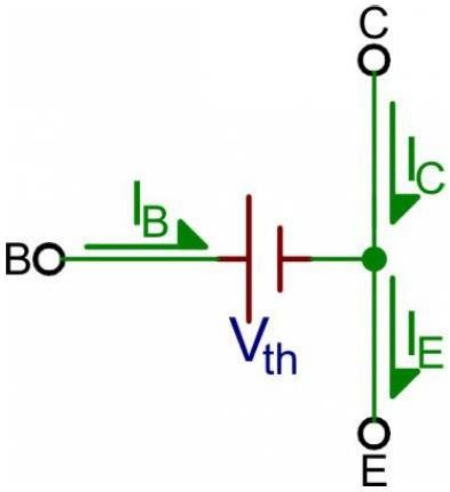

Forward-biased
Reverse-biased
n
p
n
Injected electrons
Diffusing electrons
Collected electrons
i_C
E
C
i_E
i_{B2}
Injected holes (i_{B1})
Recombined electrons (i_{B2})
i_B
i_B
v_{BE}
v_{CB}
B
i_E
i_E
i_C
i_C
V_{BE}
V_{CB}

- Cut-off Mode:
- No collector current and no emitter current.
- Very much like a open circuit





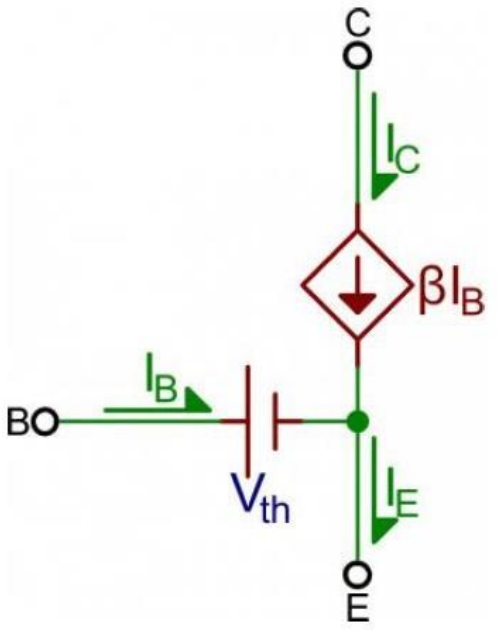
- Saturation mode: on state
- Acts like a short circuit between the collector and emitter.
- Both the junctions are forward biased, V_B must be at higher potential than V_C and V_E.
- V_C must be slightly greater than V_E.
- V_{CE} = 0.2 V.



- Active Mode:
- V_{BE} must be positive and V_{CB} must be negative. $V_C > V_B > V_E$.
- Gain (amplification factor) – β
- Common base current gain - α

$$I_C = \beta I_B \qquad \beta = \frac{\alpha}{(1-\alpha)}$$

$$I_C = \alpha I_E \qquad \alpha = \frac{\beta}{\beta+1}$$



Thank You