

# BJT Topologies – Basic Bias

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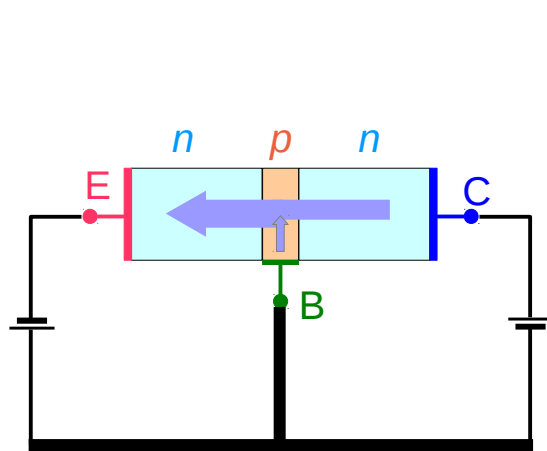
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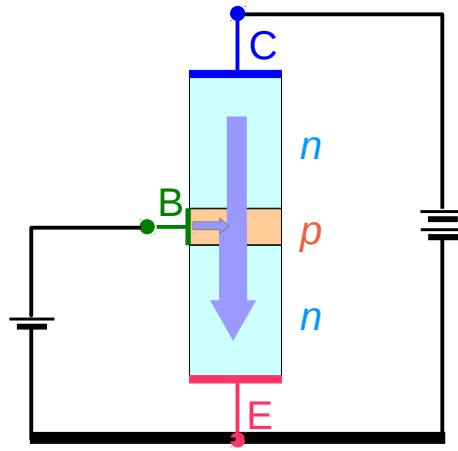
Please send corrections (or suggestions) to [youngwlim@hotmail.com](mailto:youngwlim@hotmail.com).

This document was produced by using OpenOffice and Octave.

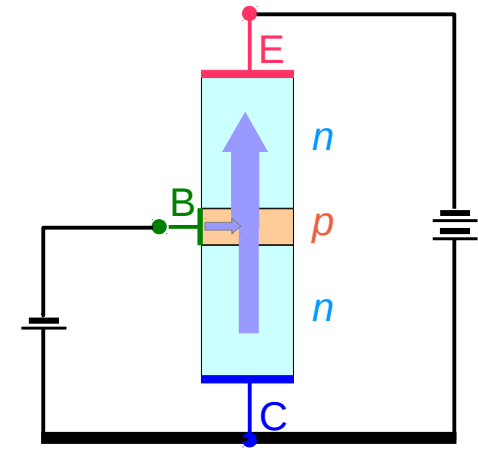
# BJT Amplifier Topologies



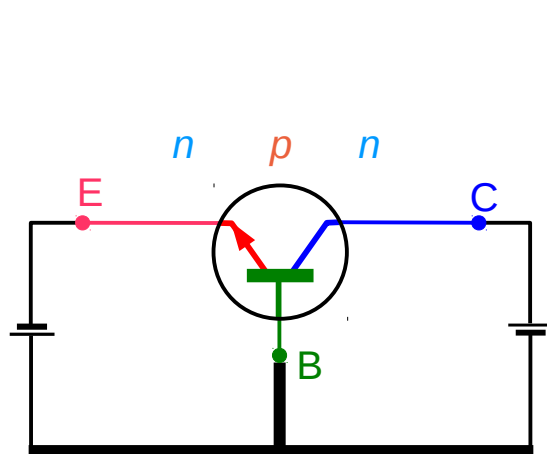
Common Base



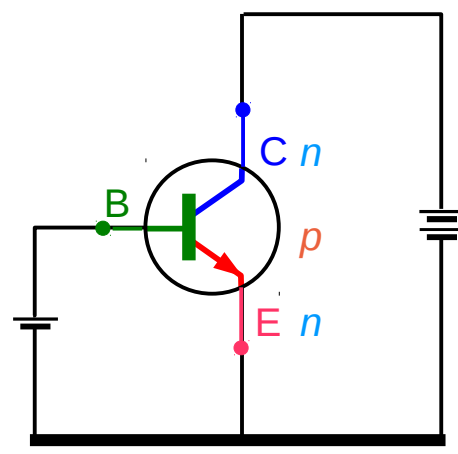
Common Emitter



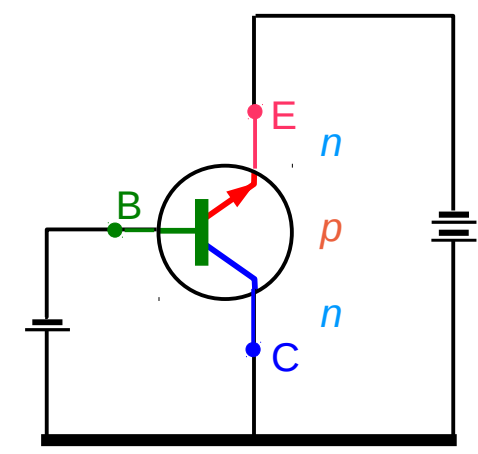
Common Collector



Common Base

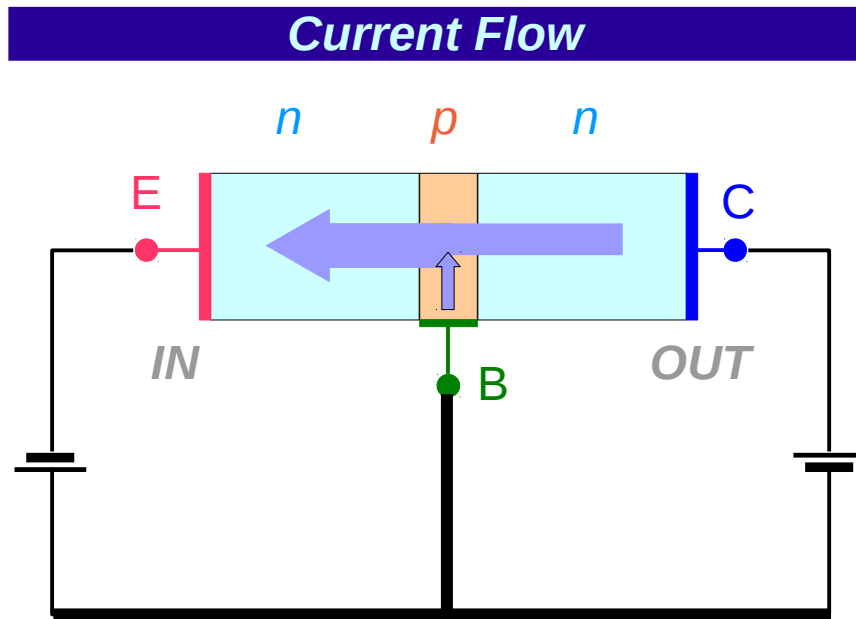


Common Emitter

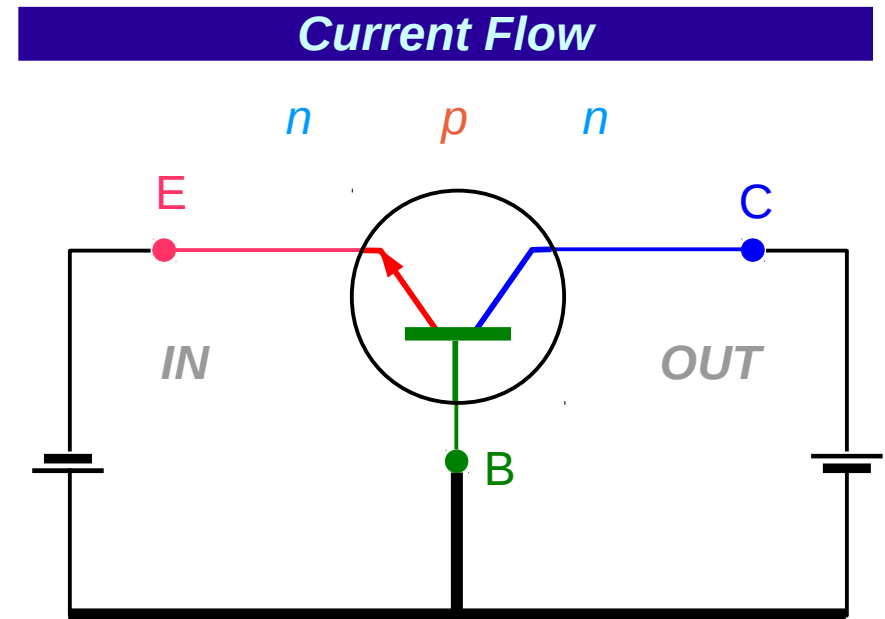


Common Collector

# Common Base Topology



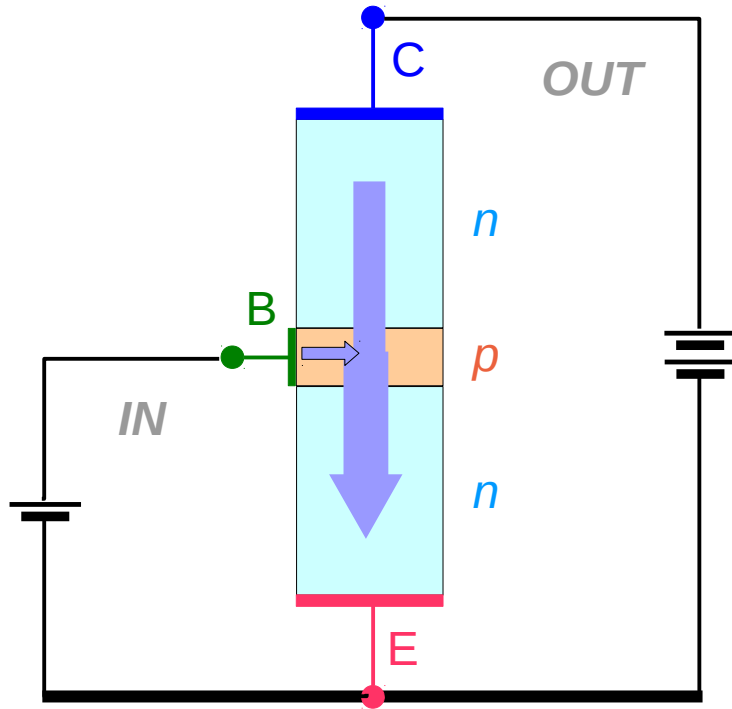
**Common Base**



**Common Base**

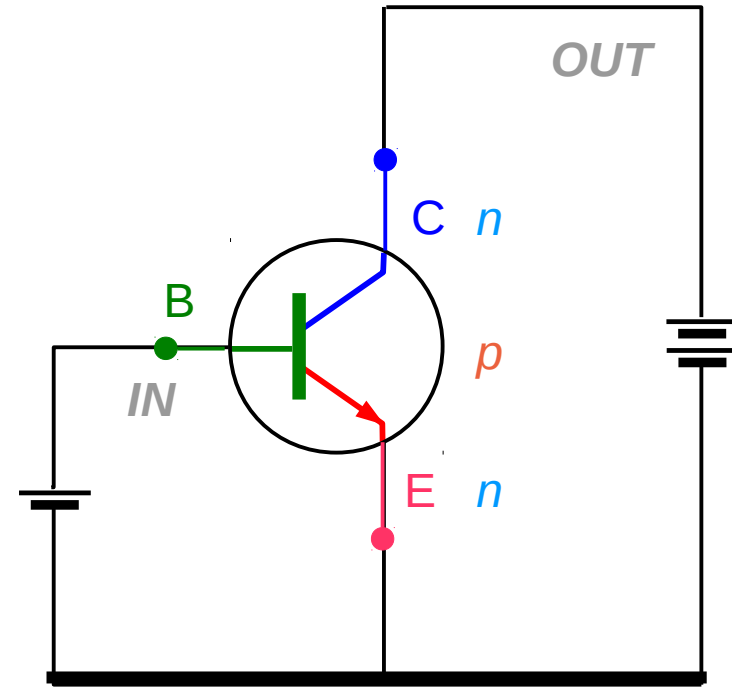
# Common Emitter Topology

*Current Flow*



*Common Emitter*

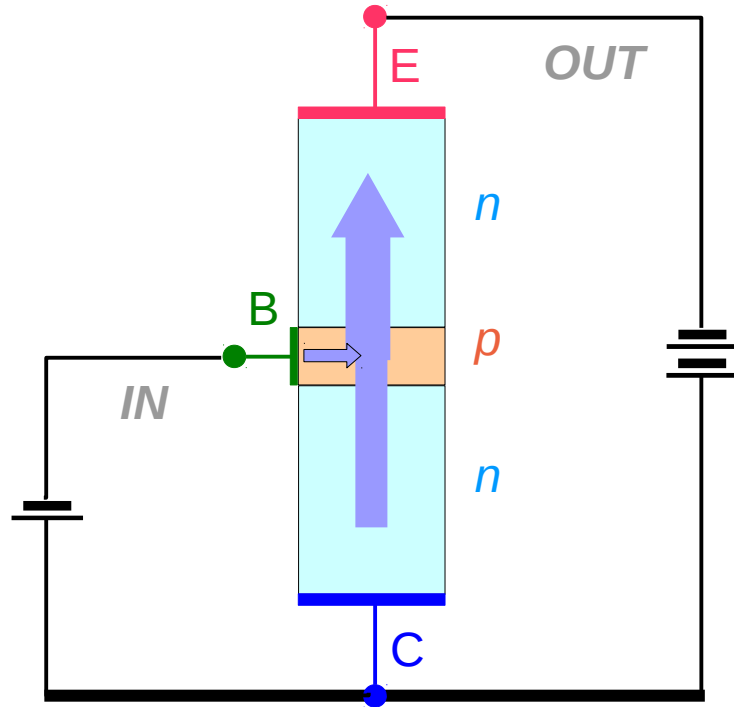
*Current Flow*



*Common Emitter*

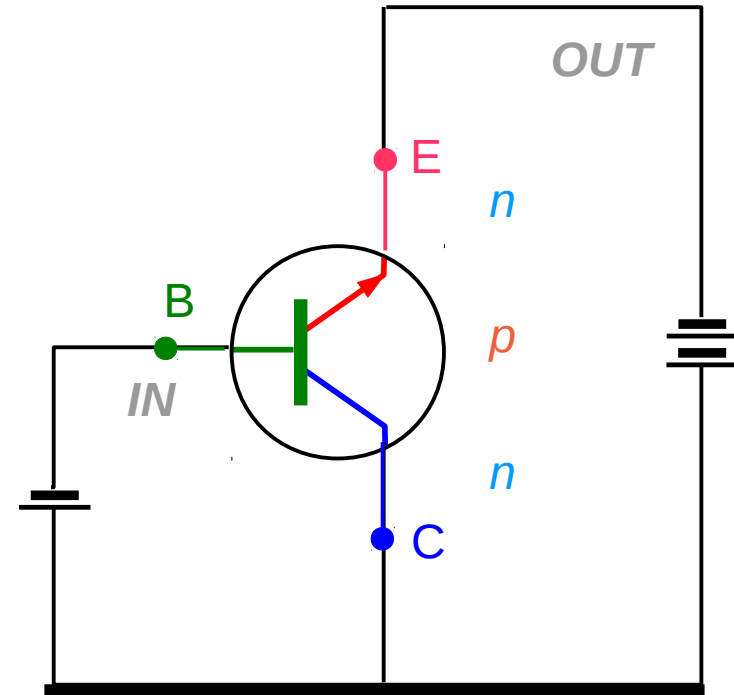
# Common Collector Topology

*Current Flow*



*Common Collector*

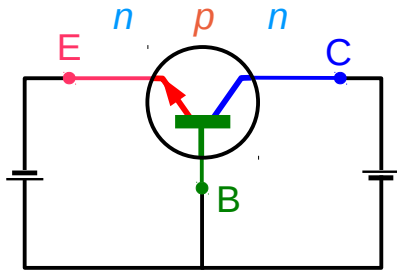
*Current Flow*



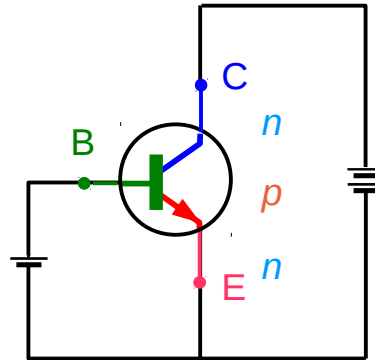
*Common Collector*

# Forward bias (BE) & Reverse bias (CB)

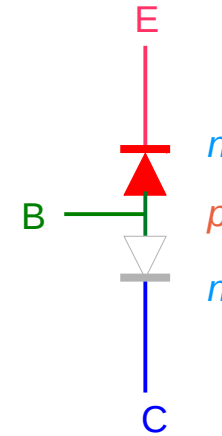
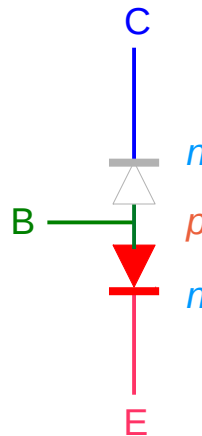
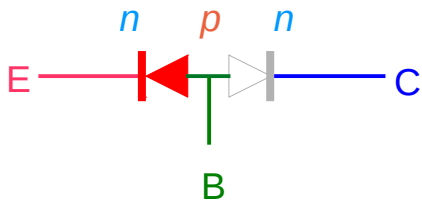
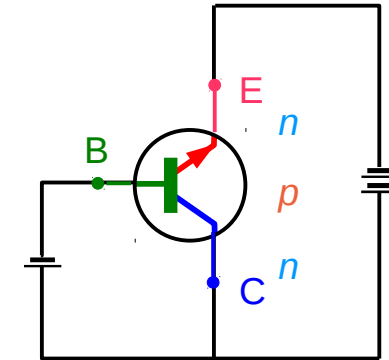
**Common Base**



**Common Emitter**



**Common Collector**



$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

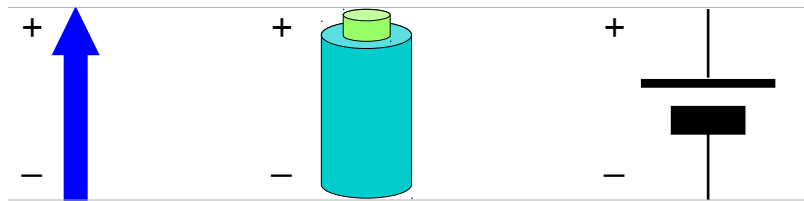
==

$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

==

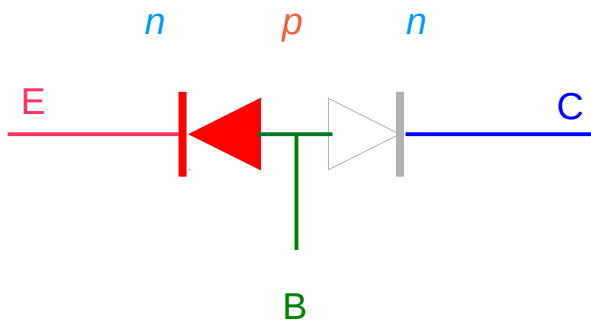
$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

# Bias for the Active Region





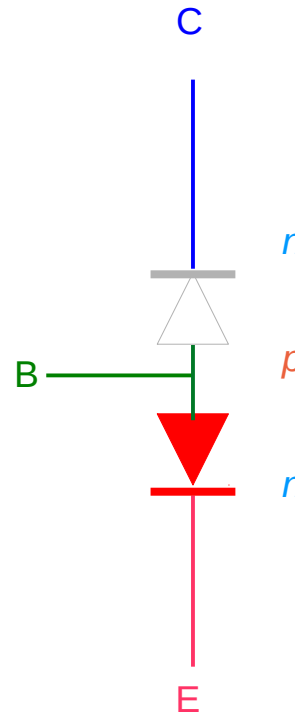
## Common Base



$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

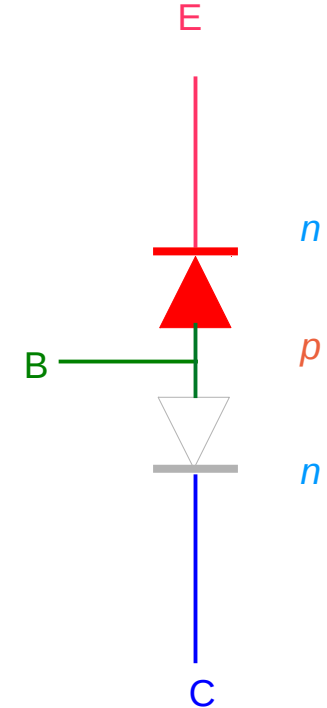
## Common Emitter



$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

## Common Collector



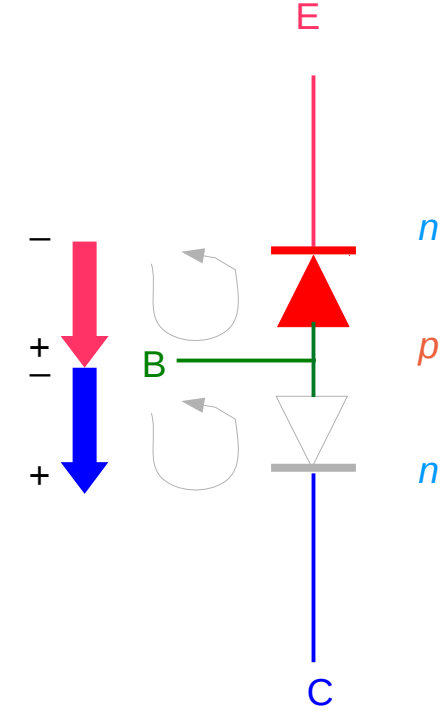
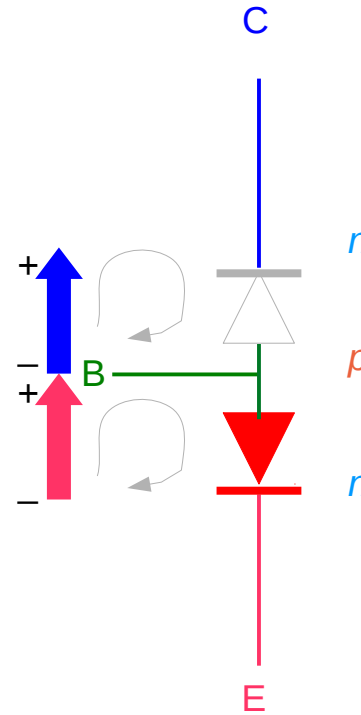
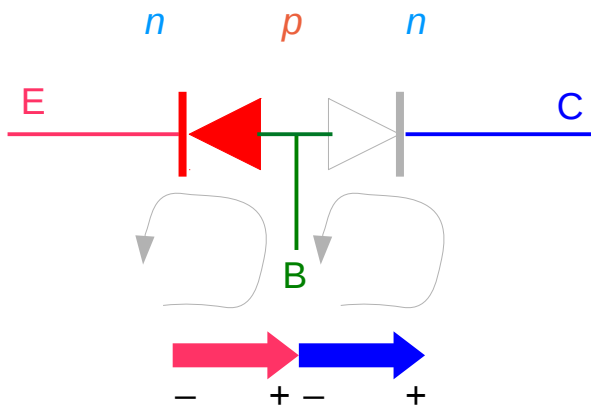
$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

## Common Base

## Common Emitter

## Common Collector



$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

==

$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

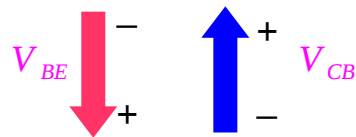
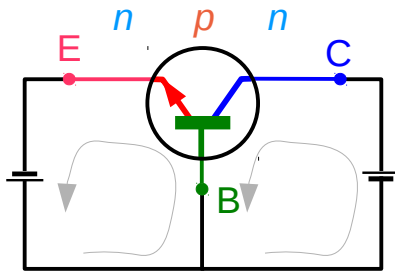
**Active region**

==

$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

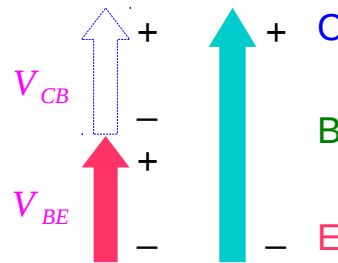
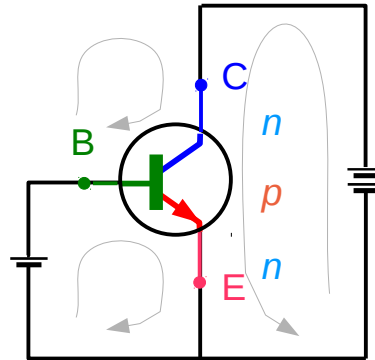
### Common Base



$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

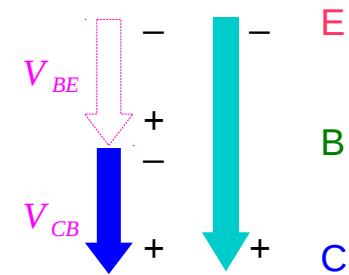
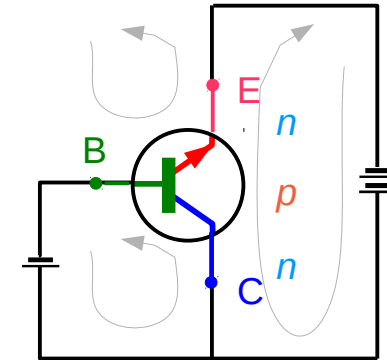
### Common Emitter



$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

### Common Collector



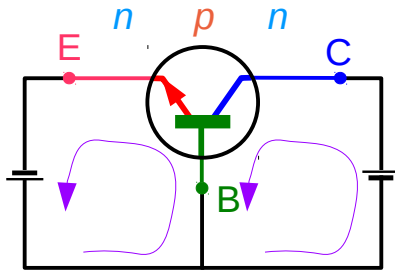
$V_{BE}$  forward bias  
 $V_{CB}$  reverse bias

**Active region**

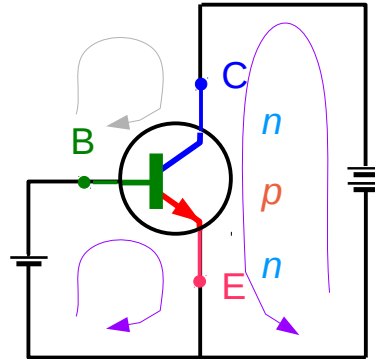
# Two voltage supplies Bias

# Active Region

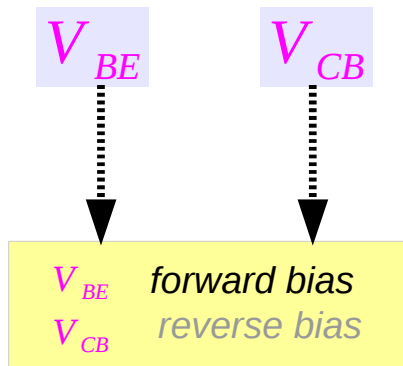
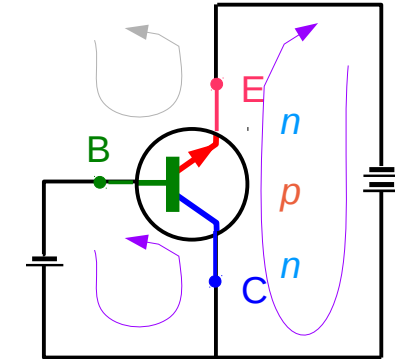
### Common Base



### Common Emitter

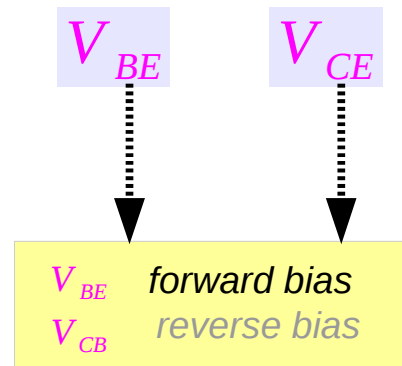


### Common Collector



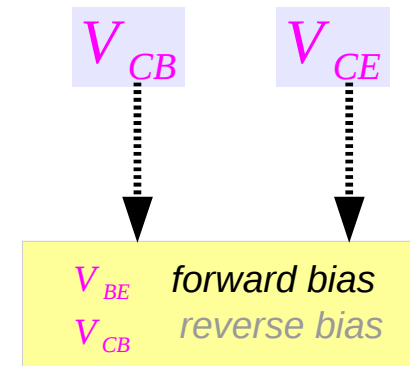
**Active region**

=



**Active region**

=

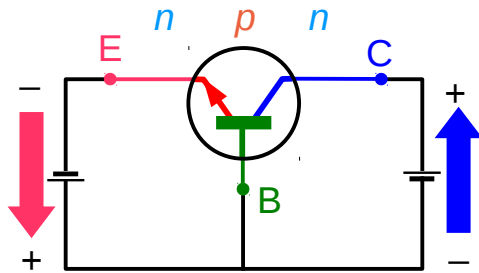


**Active region**

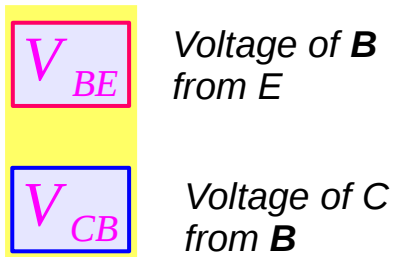
# Controlling $V_{BE}$ & $V_{CB}$

## Active Region

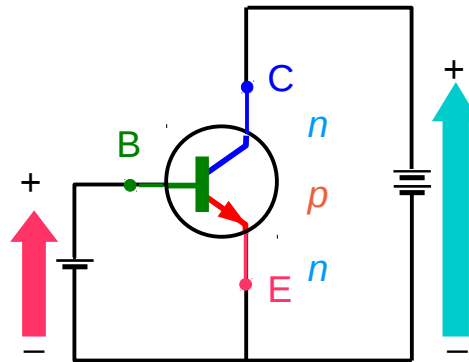
Common Base



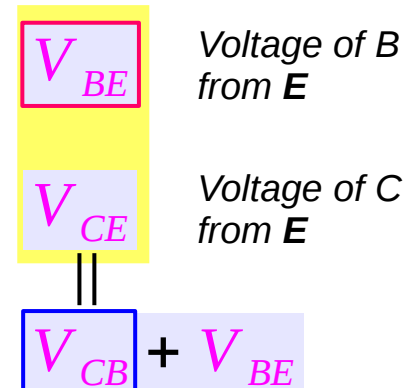
Direct Control



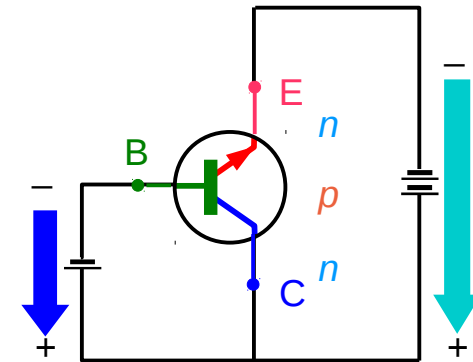
Common Emitter



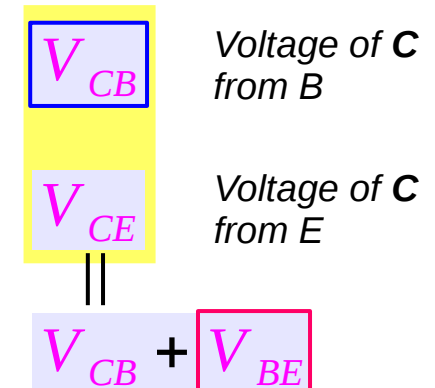
Indirect Control



Common Collector

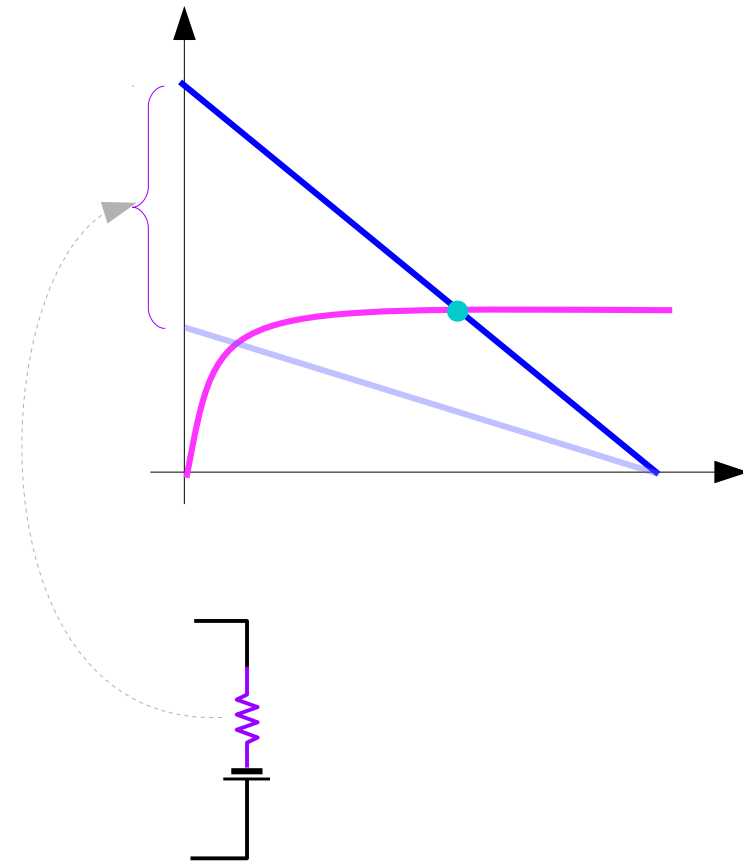
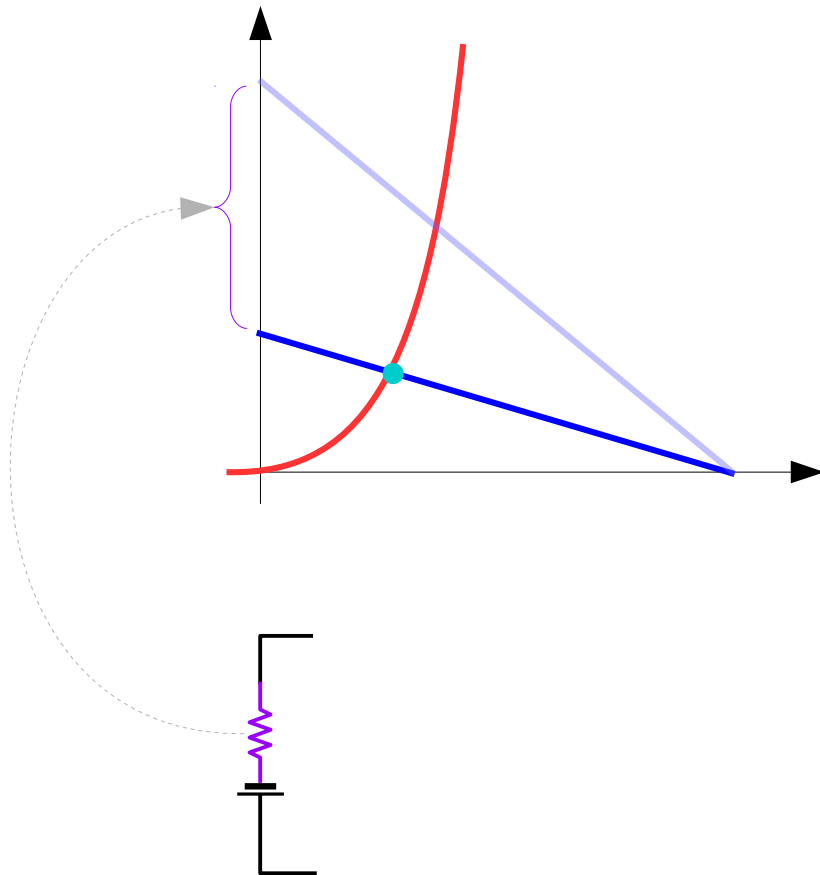


Indirect Control



### Input Characteristics

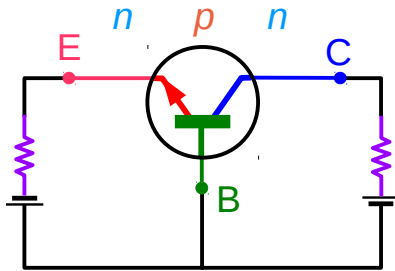
### Output Characteristics



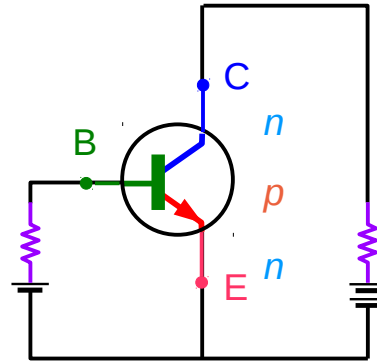
# Two Voltage Sources

# Active Region

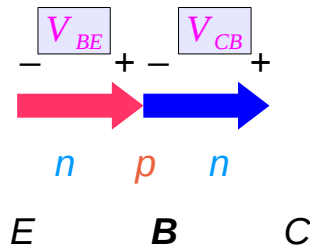
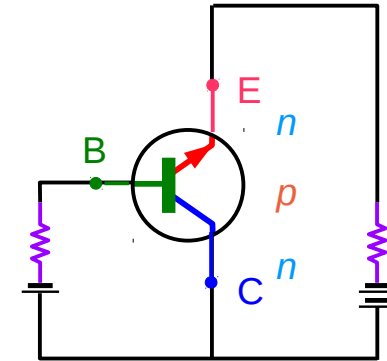
**Common Base**



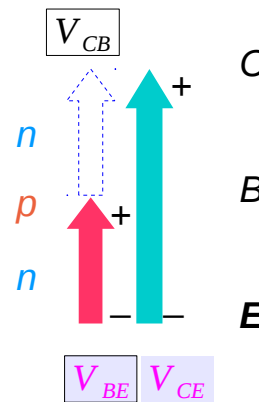
**Common Emitter**



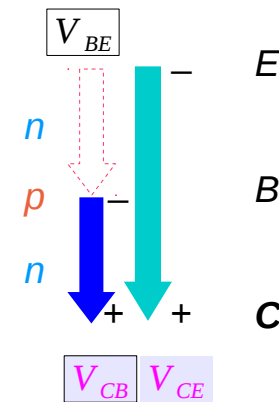
**Common Collector**



**Active region**

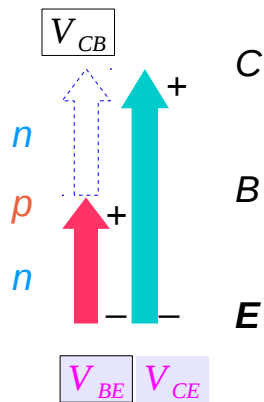
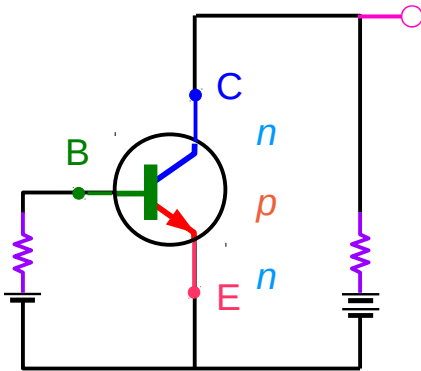


**Active region**



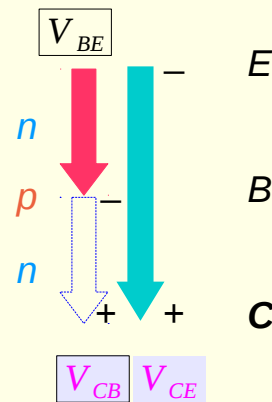
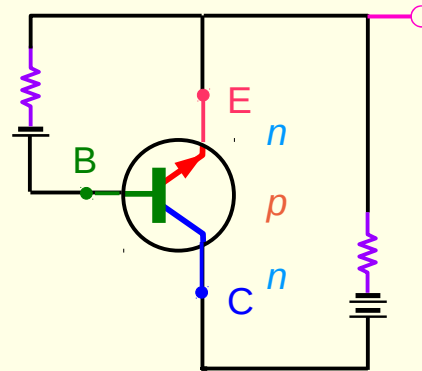
**Active region**

**Common Emitter**



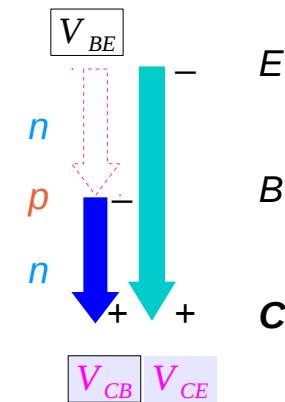
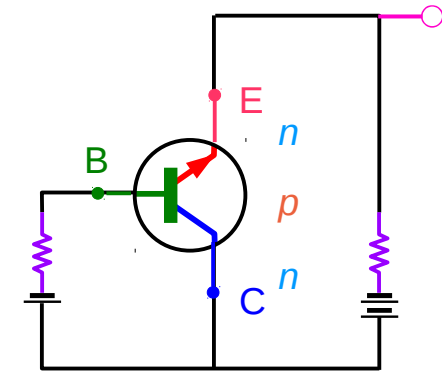
**Active region**

**Common Collector 2**



**Active region**

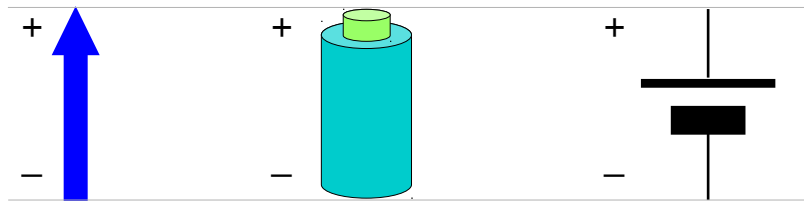
**Common Collector**



**Active region**

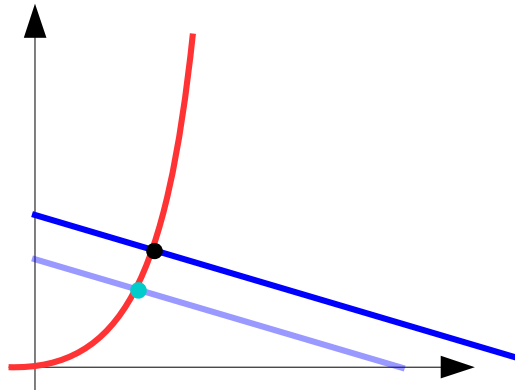


# Bias for the Saturation Region

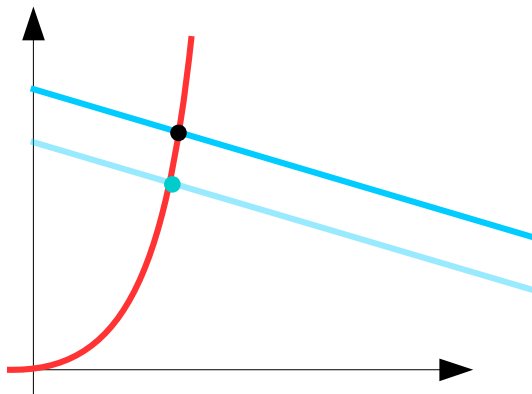


Input Characteristics

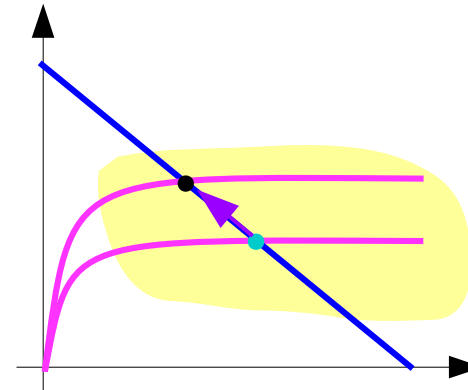
active



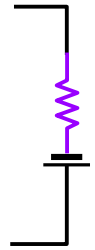
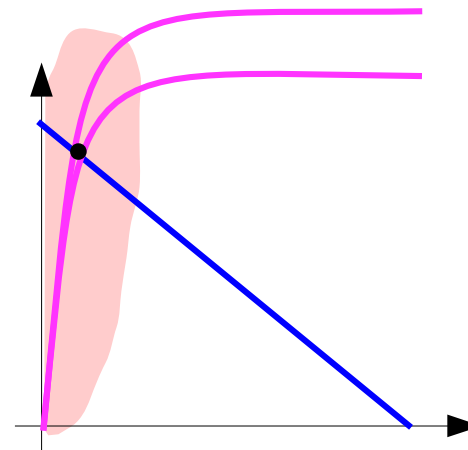
saturation



Output Characteristics



Saturated Current  $I_C$



Large  $V_{BB}$



Large  $I_C$

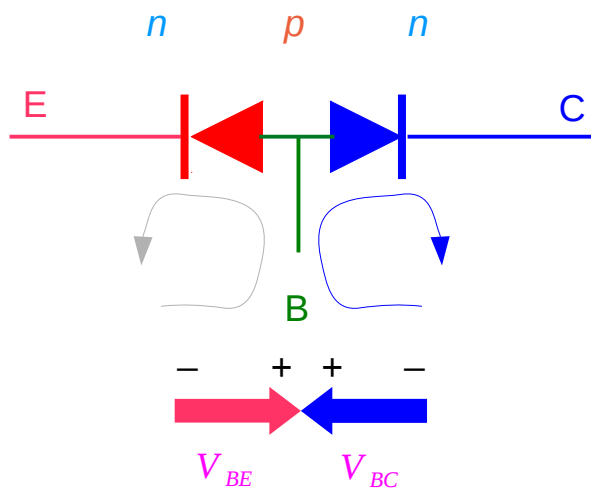


Large Voltage Drop across  $R$



Small  $V_{CE}$

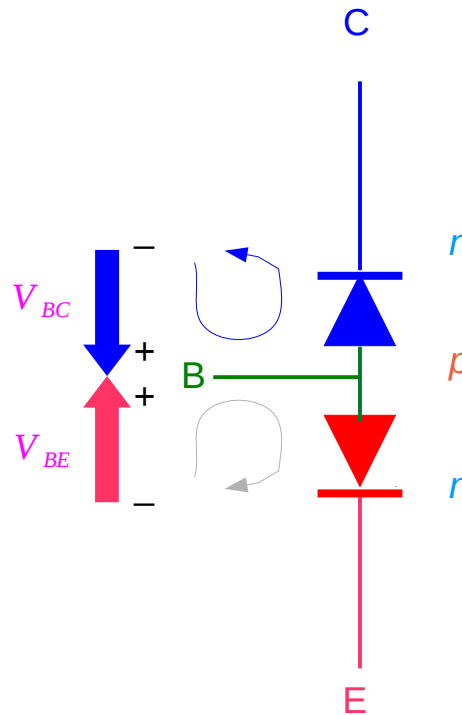
## Common Base



$V_{BE}$  forward bias  
 $V_{BC}$  forward bias

**saturation**

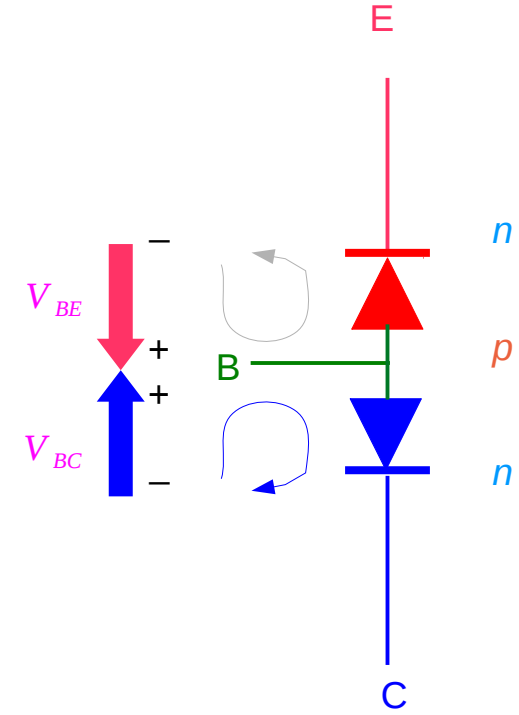
## Common Emitter



$V_{BE}$  forward bias  
 $V_{BC}$  forward bias

**saturation**

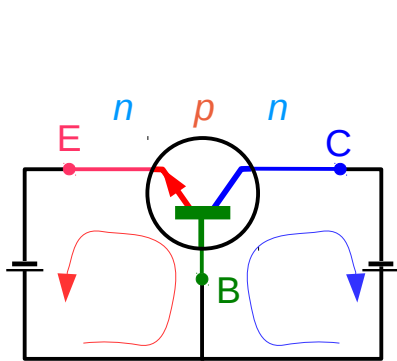
## Common Collector



$V_{BE}$  forward bias  
 $V_{BC}$  forward bias

**saturation**

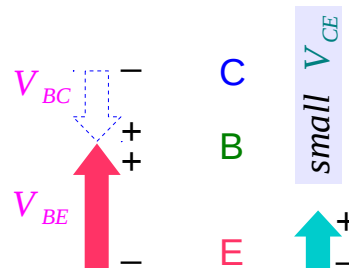
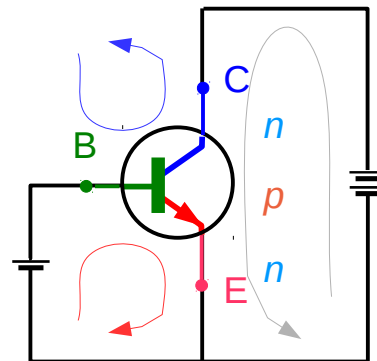
## Common Base



$V_{BE}$  forward bias  
 $V_{BC}$  forward bias

**saturation**

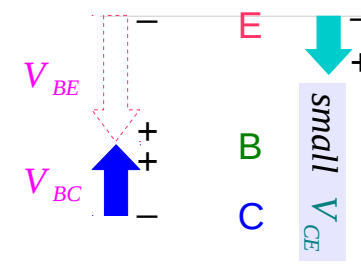
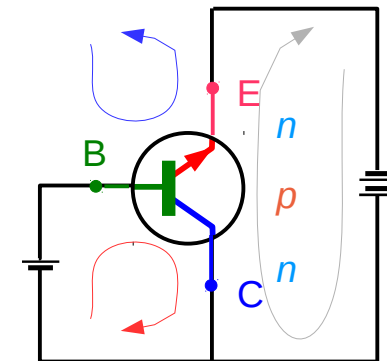
## Common Emitter



$V_{BE}$  forward bias  
 $V_{BC}$  forward bias

**saturation**

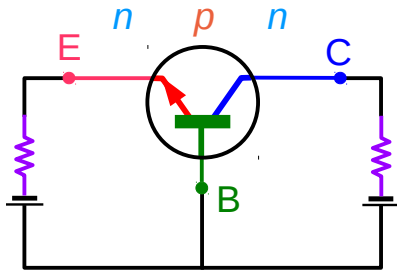
## Common Collector



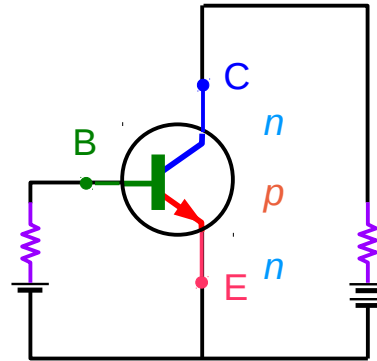
$V_{BE}$  forward bias  
 $V_{BC}$  forward bias

**saturation**

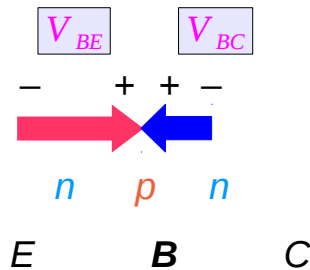
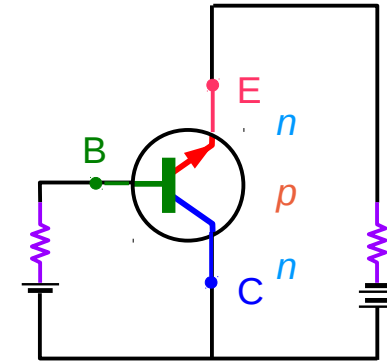
**Common Base**



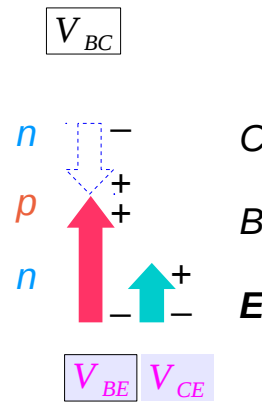
**Common Emitter**



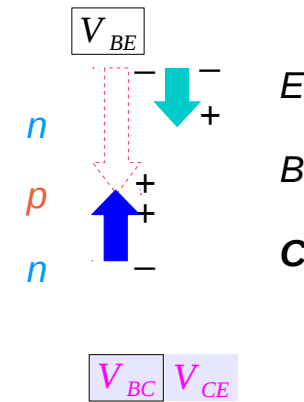
**Common Collector**



**saturation**

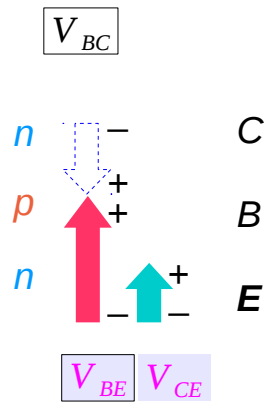
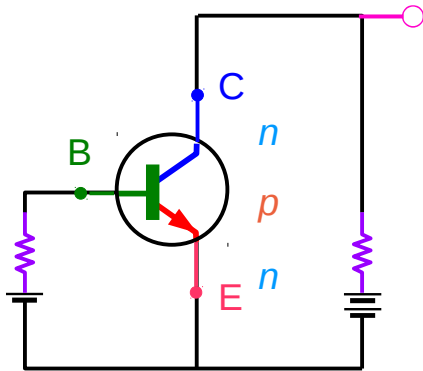


**saturation**



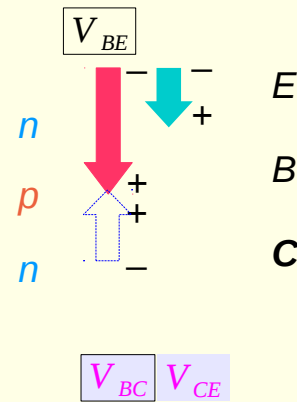
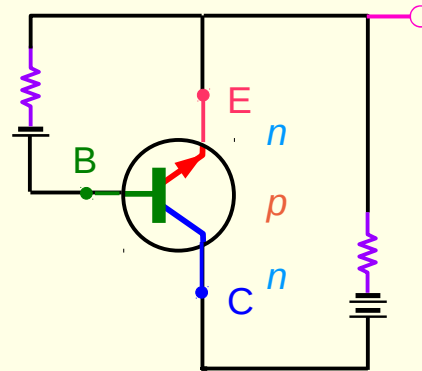
**saturation**

**Common Emitter**



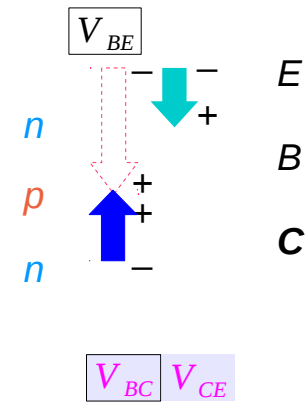
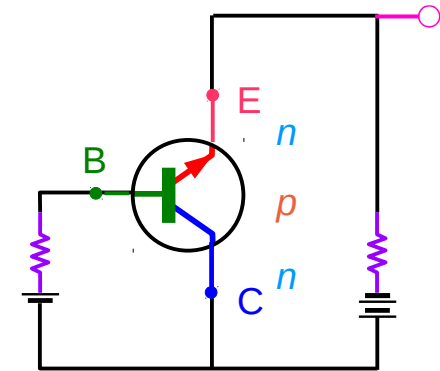
**saturation**

**Common Collector 2**



**saturation**

**Common Collector**

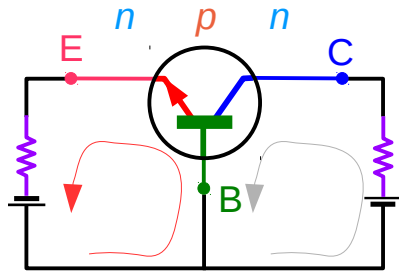


**saturation**



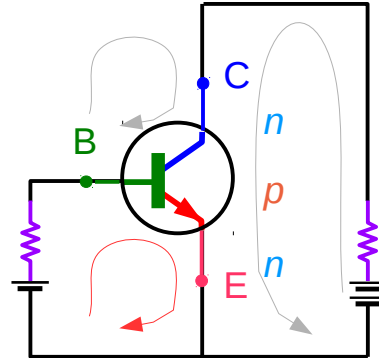
# Active and Saturation Regions (1)

**Common Base**



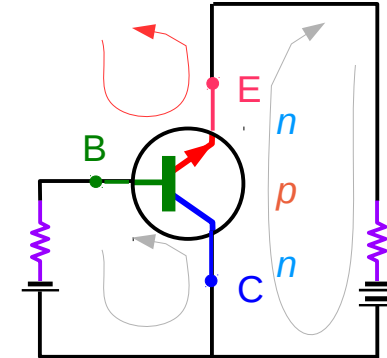
**active**

**Common Emitter**

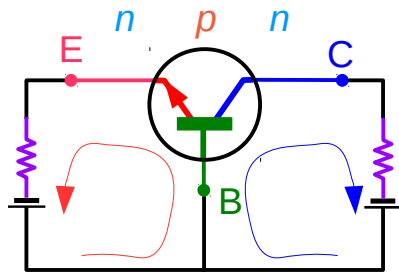


**active**

**Common Collector**

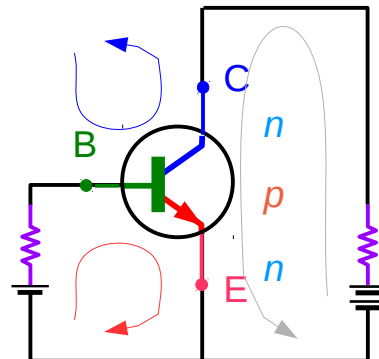


**active**



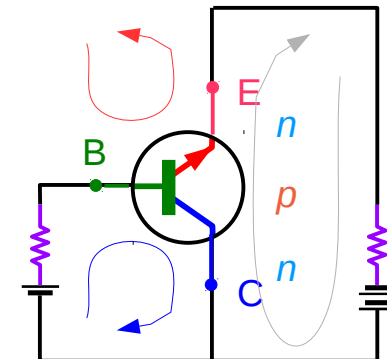
Large  $V_{BB}$ , Small  $V_{CE}$

**saturation**



Large  $V_{BB}$ , Small  $V_{CE}$

**saturation**



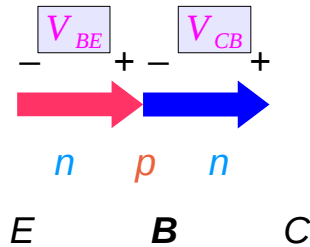
Large  $V_{BB}$ , Small  $V_{CE}$

**saturation**

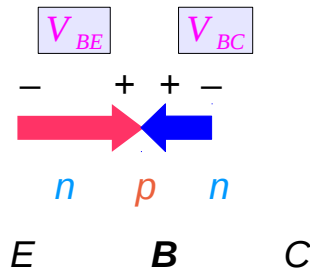


# Active and Saturation Regions (2)

## Common Base

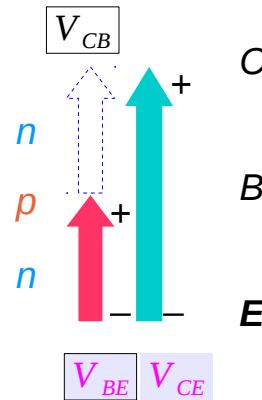


**active**

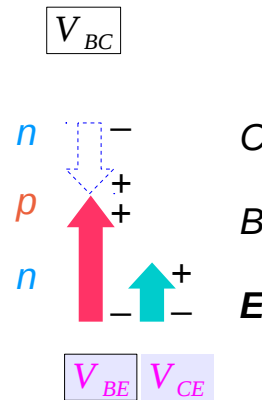


**saturation**

## Common Emitter

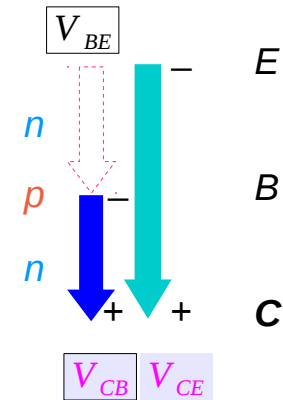


**active**

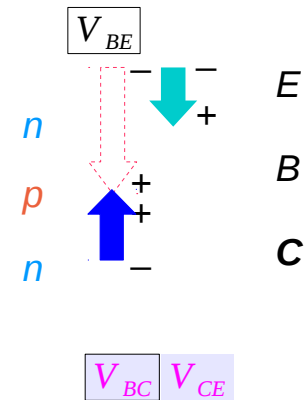


**saturation**

## Common Collector



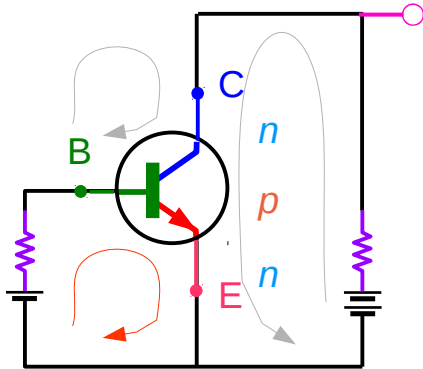
**active**



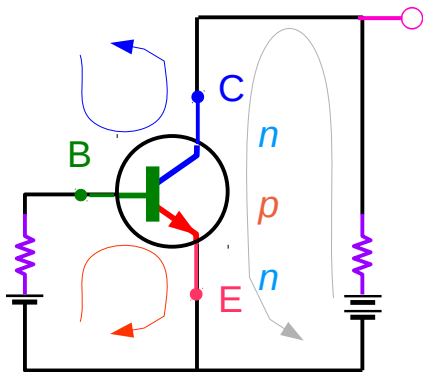
**saturation**

# Active and Saturation Regions (3)

*Common Emitter*

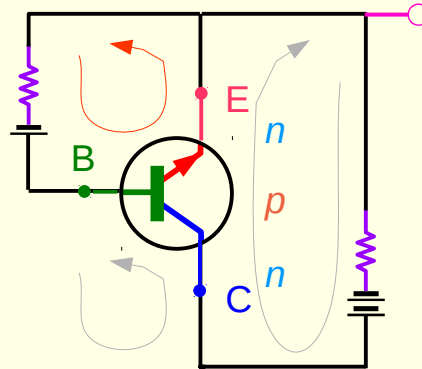


*active*

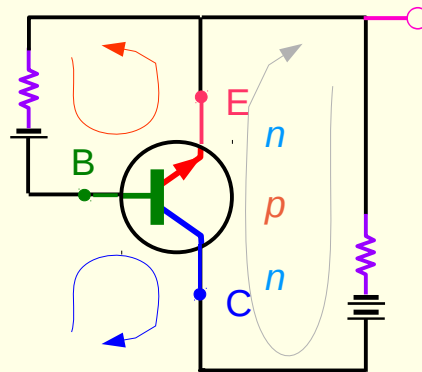


*saturation*

*Common Collector 2*

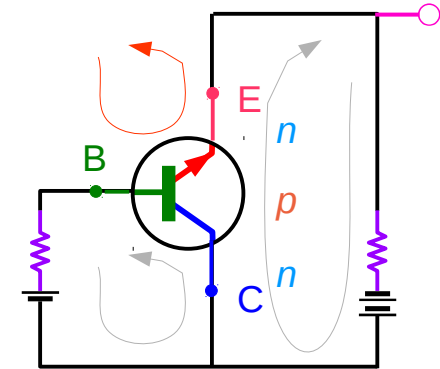


*active*

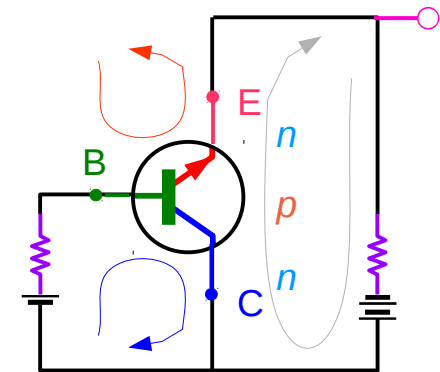


*saturation*

*Common Collector*



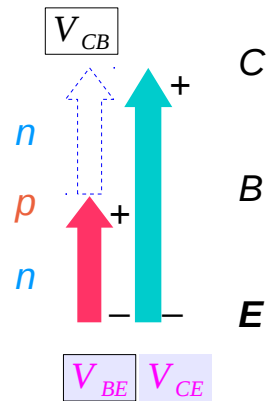
*active*



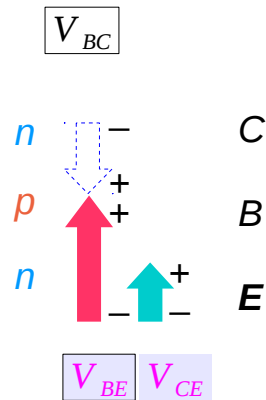
*saturation*

# Active and Saturation Regions (4)

## Common Emitter

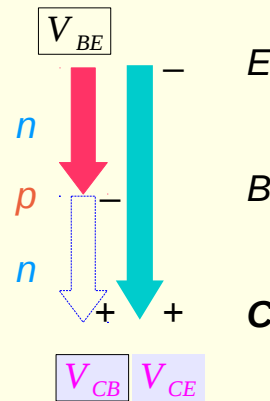


**active**

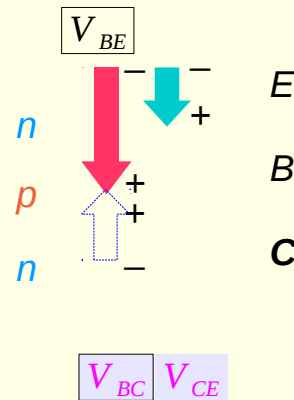


**saturation**

## Common Collector 2

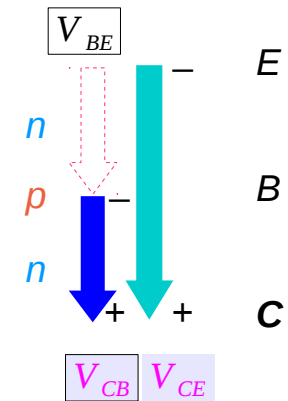


**active**

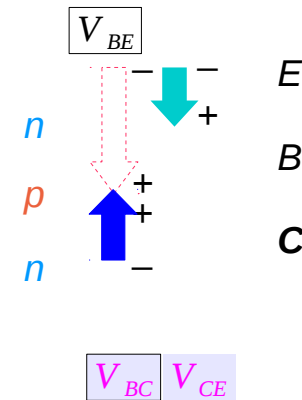


**saturation**

## Common Collector



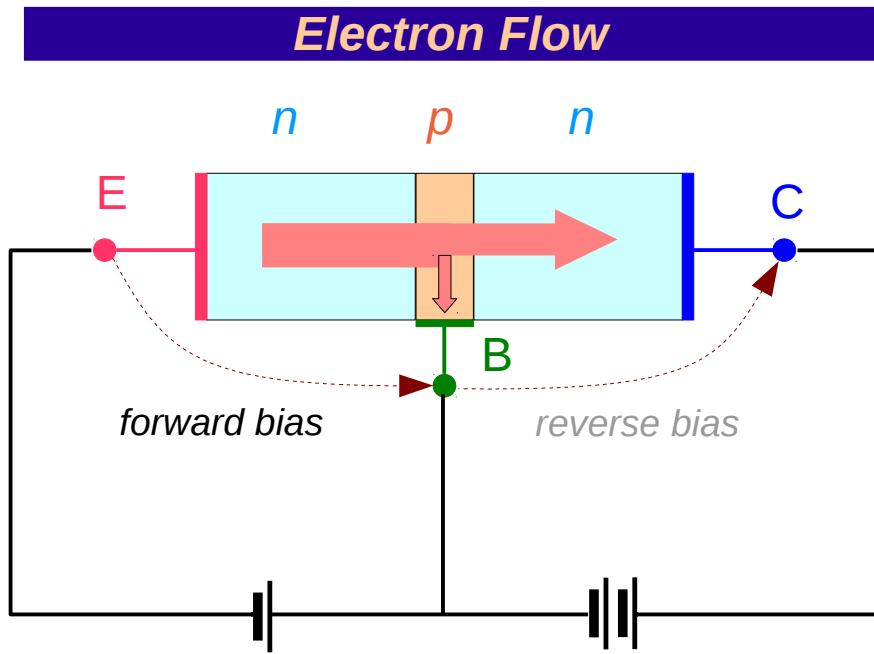
**active**



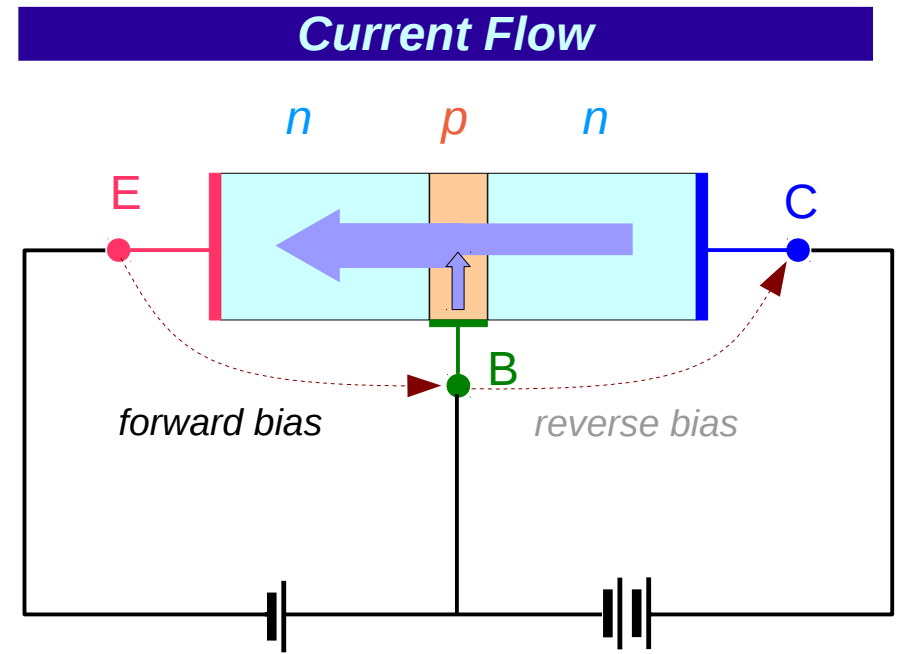
**saturation**



# Common Base (1)



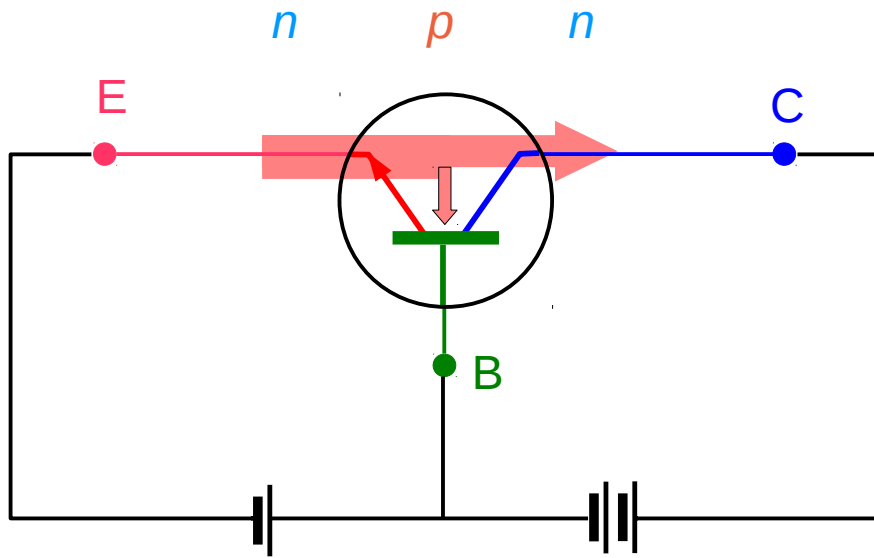
**Common Base**



**Common Base**

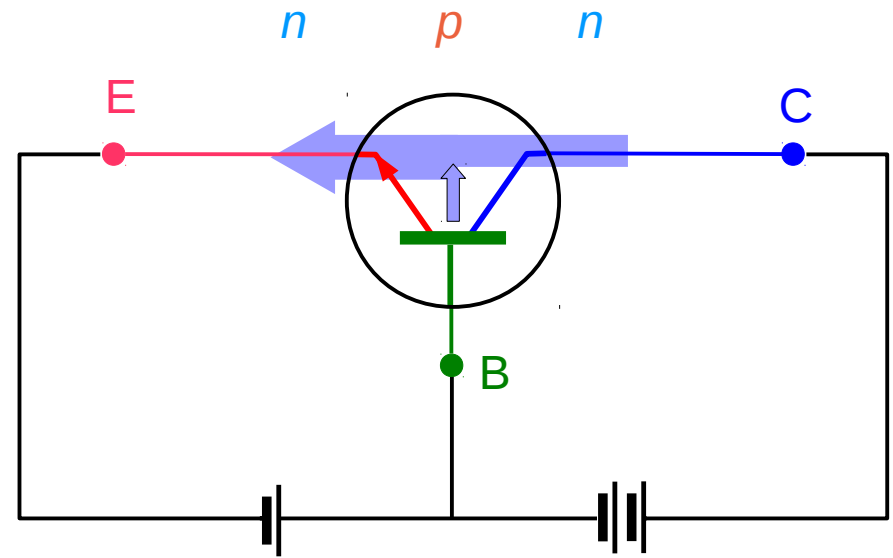
# Common Base (2)

*Electron Flow*

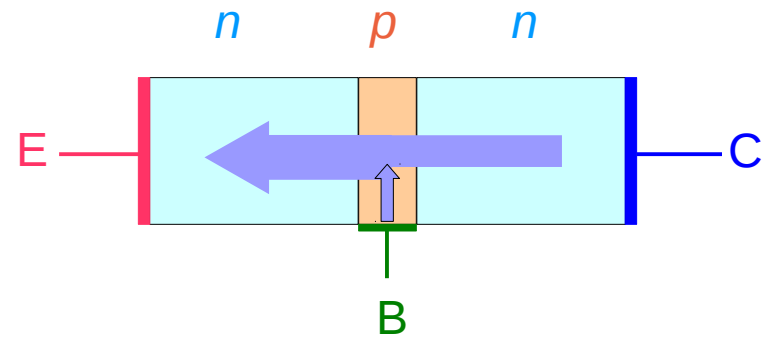
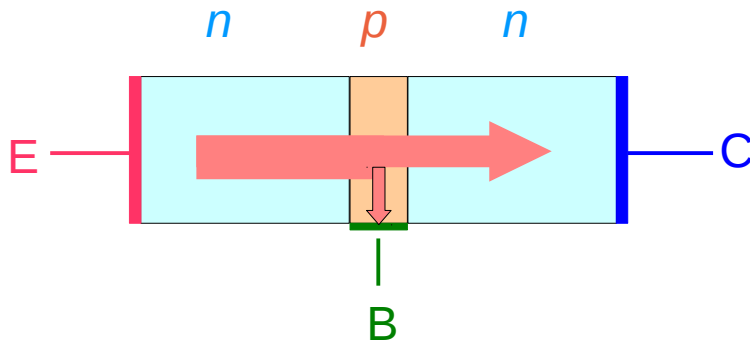


*Common Base*

*Current Flow*

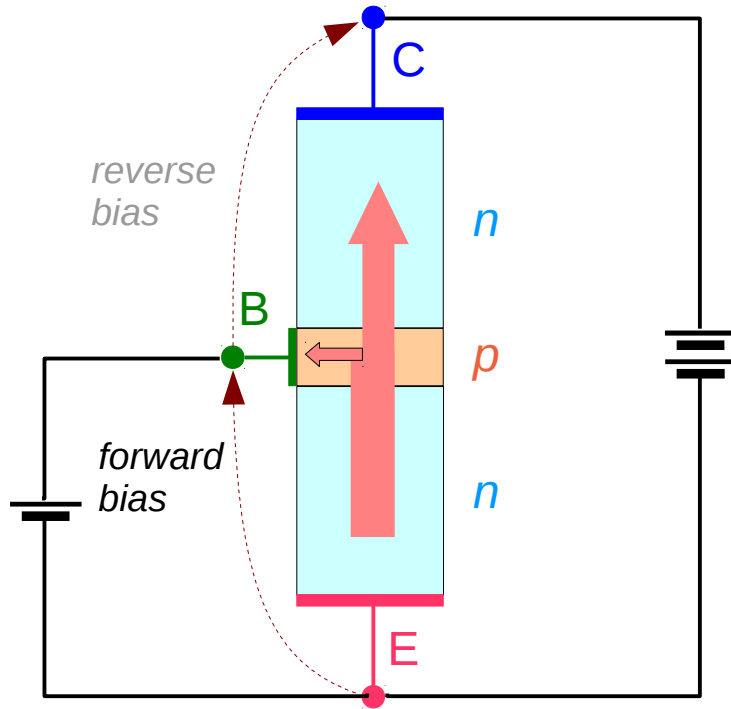


*Common Base*



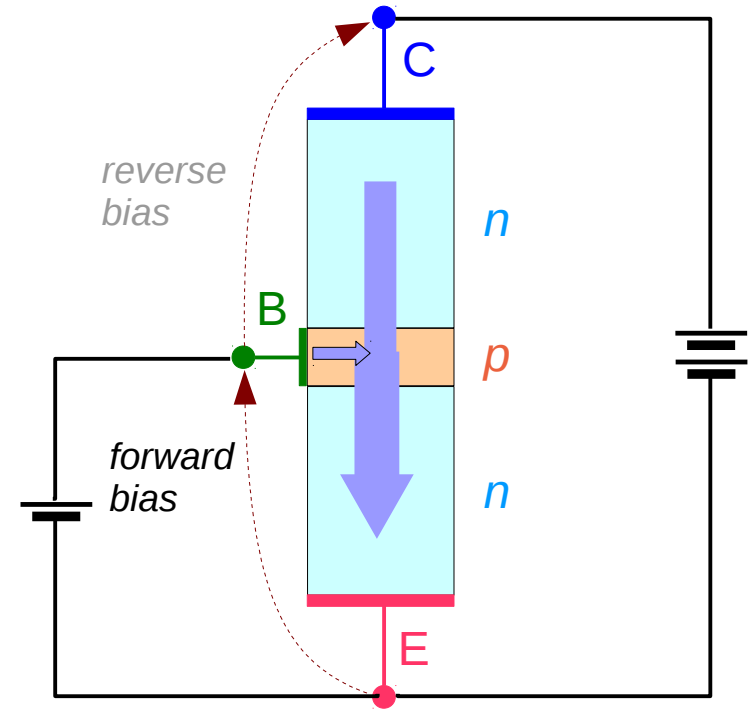
# Common Emitter (1)

## Electron Flow



Common Emitter

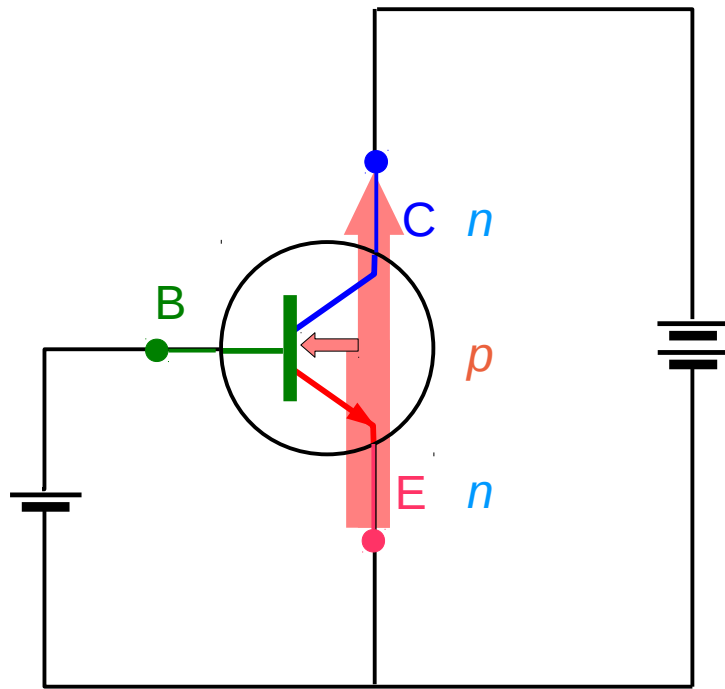
## Current Flow



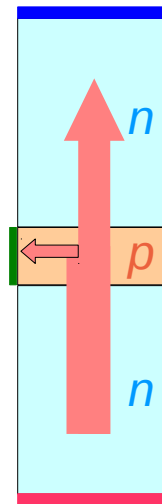
Common Emitter

# Common Emitter (2)

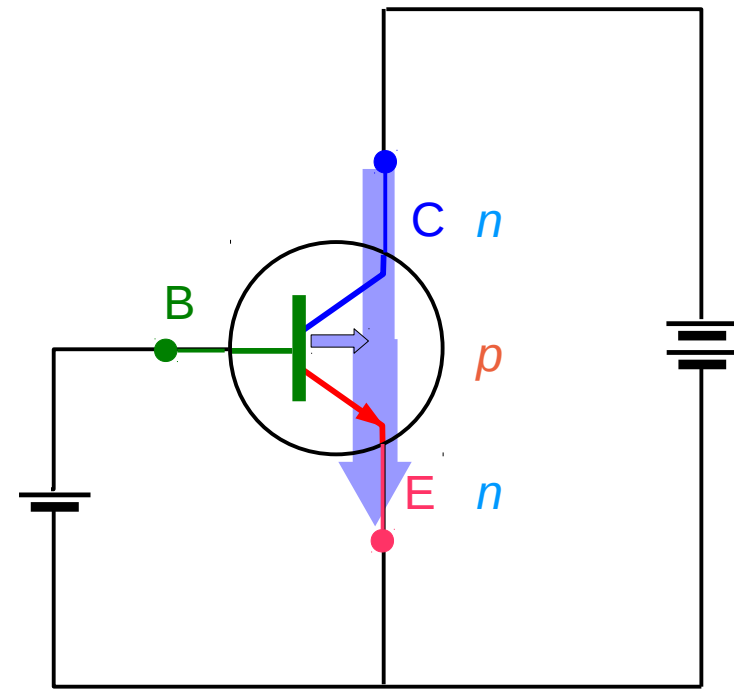
## Electron Flow



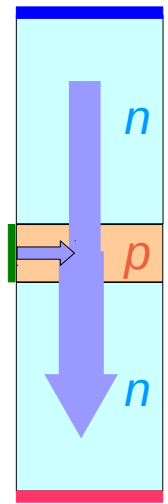
Common Emitter



## Current Flow



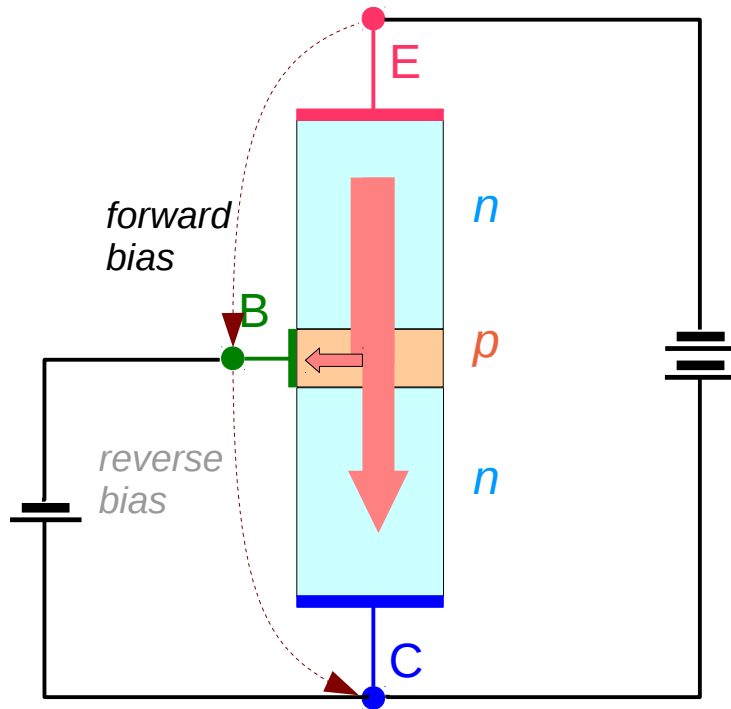
Common Emitter





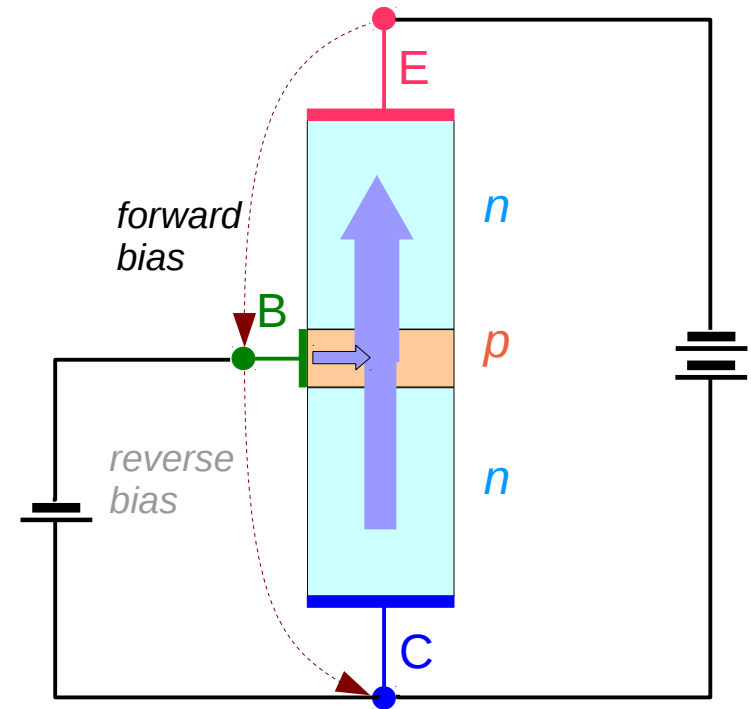
# Common Collector (1)

## Electron Flow



Common Collector

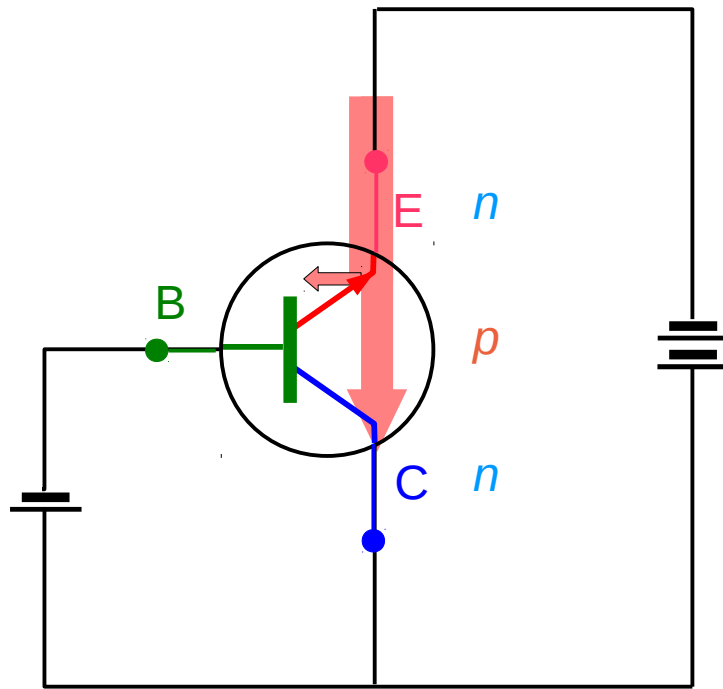
## Current Flow



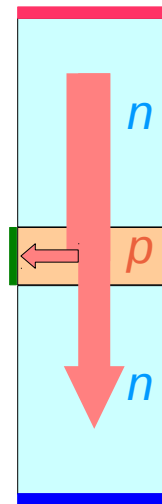
Common Collector

# Common Collector (2)

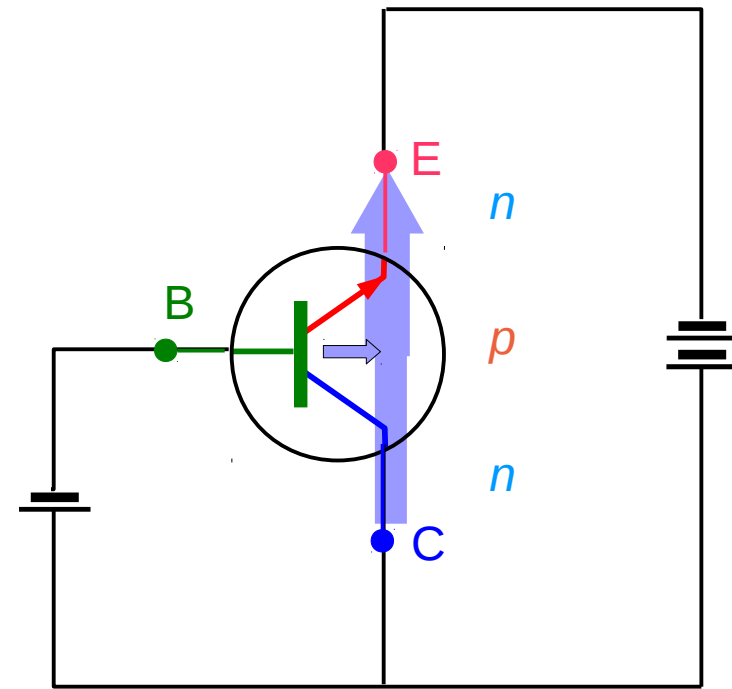
## Electron Flow



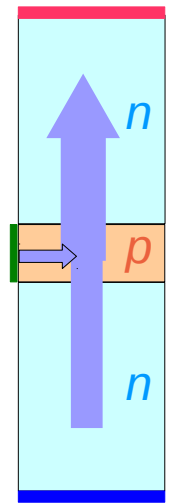
Common Collector



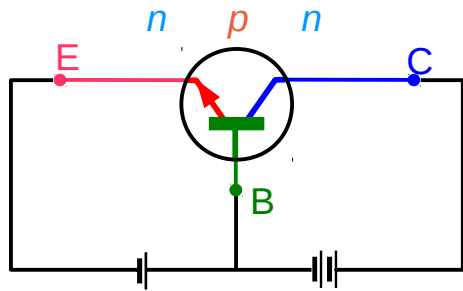
## Current Flow



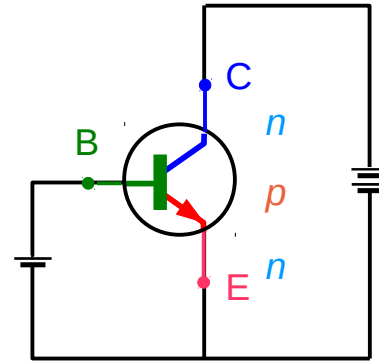
Common Collector



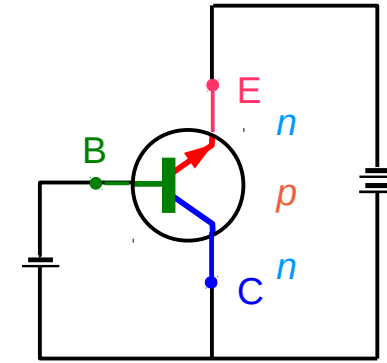
# BJT Bias



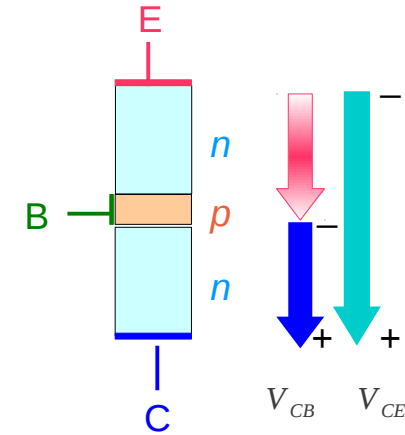
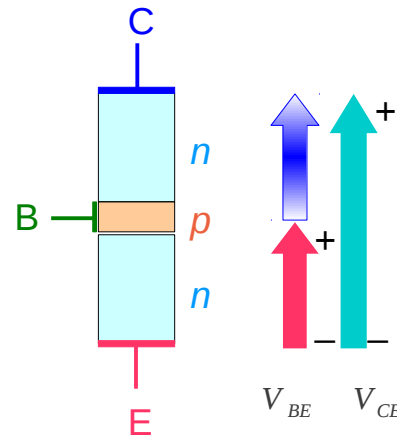
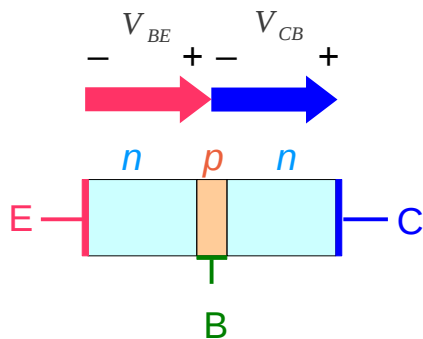
**Common Base**



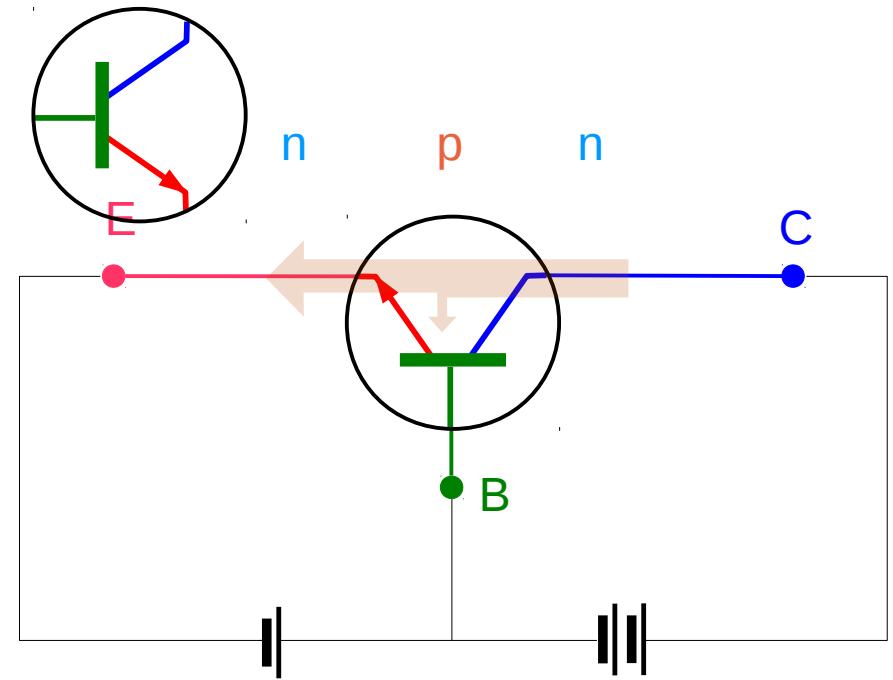
**Common Emitter**



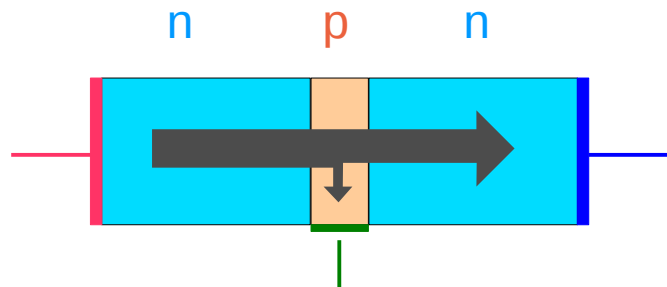
**Common Collector**



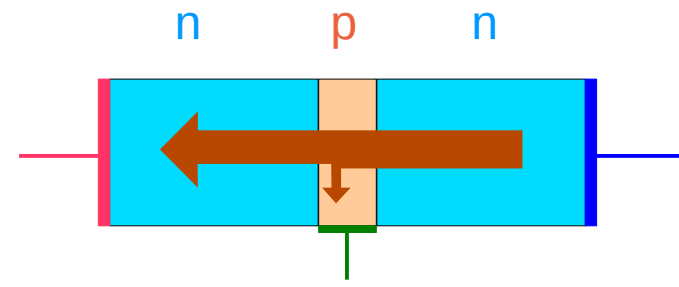
# Common Emitter (2)



*Electron Flow*



*Current Flow*



## References

- [1] <http://en.wikipedia.org/>
- [2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003