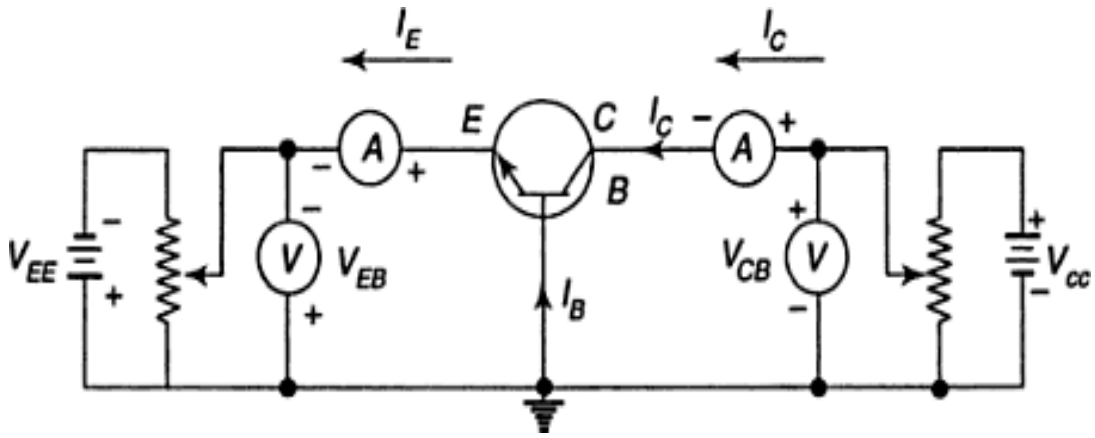
CB CONFIGURATION

In common base configuration circuit is shown in figure. Here base is grounded and it is used as the common terminal for both input and output. It is also called as grounded base configuration. Emitter is used as a input terminal where as collector is the output terminal.



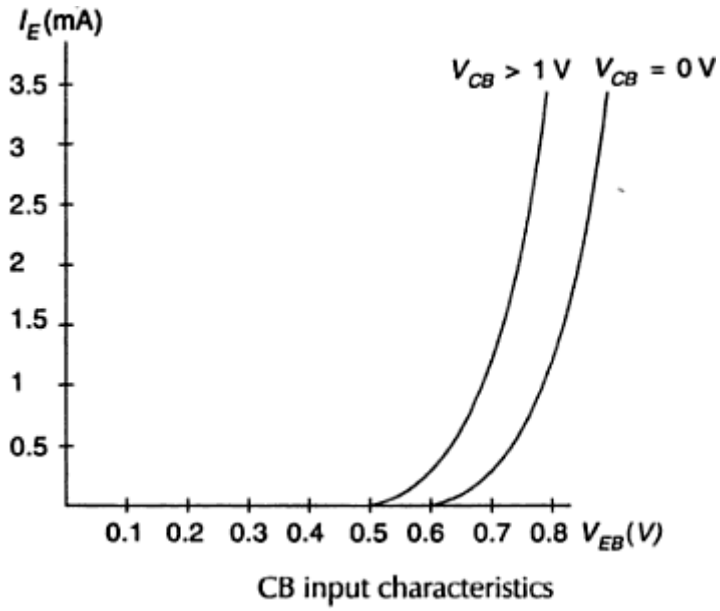
Input Characteristics

It is defined as the characteristic curve drawn between input voltage to input current whereas output voltage is constant.

To determine input characteristics, the collector base voltage V_{CB} is kept constant at zero and emitter current I_E is increased from zero by increasing V_{EB}.

This is repeated for higher fixed values of V_{CB}.

A curve is drawn between emitter current and emitter base voltage at constant collector base voltage is shown in figure.



CB input characteristics

When V_{CB} is zero EB junction is forward biased. So it behaves as a diode so that emitter current increases rapidly.

Output Characteristics

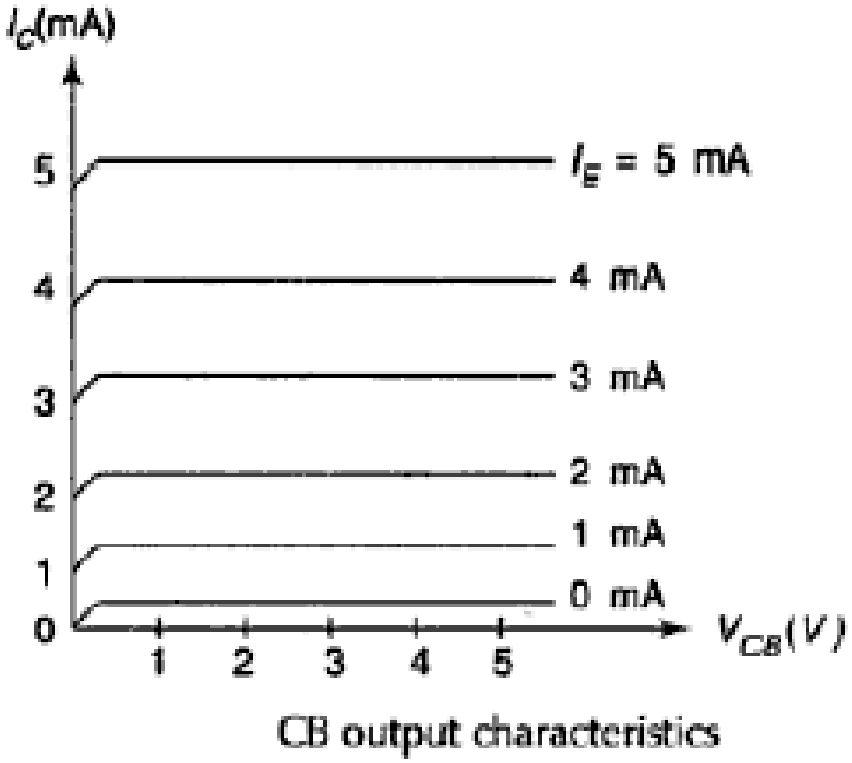
It is defined as the characteristic curve drawn between output voltage to output current whereas input current is constant.

To determine output characteristics, the emitter current I_E is kept constant at zero and collector current Ic is increased from zero by increasing V_{CB}.

This is repeated for higher fixed values of I_E.

From the characteristic it is seen that for a constant value of I_E, Ic is independent of V_{CB} and the curves are parallel to the axis of V_{CB}.

As the emitter base junction is forward biased the majority carriers that is electrons from the emitter region are injected into the base region.



CB output characteristics

In CB configuration a variation of the base-collector voltage results in a variation of the quasi-neutral width in the base. The gradient of the minority-carrier density in the base therefore changes, yielding an increased collector current as the collector-base current is increased. This effect is referred to as the Early effect.

Transistor parameters in CB configuration

The slope of CB characteristics will give the following four transistor parameters. It is known as base hybrid parameters.

I. Input impedance (h_{ib}): It is defined as the ratio of change in input voltage (emitter voltage) to change in input current (emitter current) with the output voltage (collector voltage) is kept constant.

$$h_{ib} = \frac{\Delta V_{EB}}{\Delta I_E}, \; V_{CB} \text{ constant}$$

This ranges from 20ohms to 50ohms.

II. Output admittance (h_{ob}): It is defined as the ratio of change in output current (collector current) to change in output voltage (collector voltage) with the input current (emitter current) is kept constant.

$$h_{ob} = \frac{\Delta I_C}{\Delta V_{CB}}, \; I_E \text{ constant}$$

This ranges from 0.1 to 10μ mhos.

III. Forward current gain (h_{fb}): It is defined as the ratio of change in output current (collector current) to change in input current (emitter current) with the output voltage (collector voltage) is kept constant.

$$h_{fb} = \frac{\Delta I_C}{\Delta I_E}, \; V_{CB} \text{ constant.}$$

This ranges from 0.9 to 1.0.

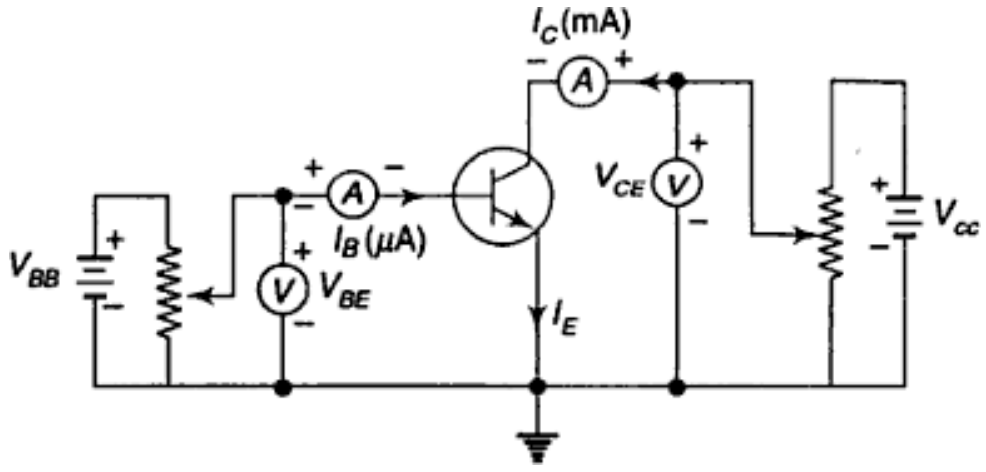
IV. Reverse voltage gain (h_{rb}): It is defined as the ratio of change in input voltage (emitter voltage) to change in output voltage (collector voltage) with the input current (emitter current) is kept constant.

$$h_{rb} = \frac{\Delta V_{EB}}{\Delta V_{CB}}, \; I_E \text{ constant}$$

This ranges from 10^{-5} to 10^{-4}.

CE CONFIGURATION

In common emitter configuration circuit is shown in figure. Here emitter is grounded and it is used as the common terminal for both input and output. It is also called as grounded emitter configuration. Base is used as a input terminal whereas collector is the output terminal.



Input Characteristics

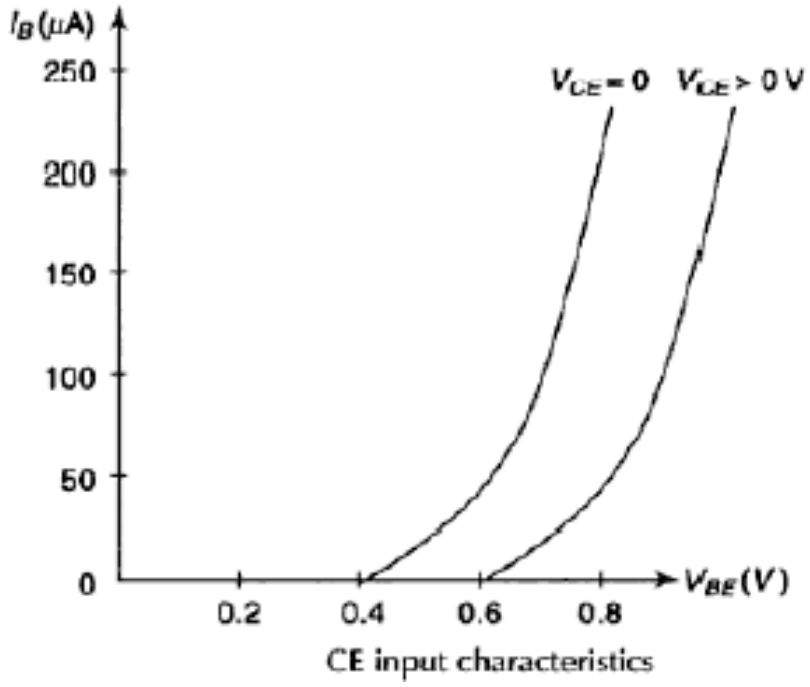
It is defined as the characteristic curve drawn between input voltage to input current whereas output voltage is constant.

To determine input characteristics, the collector base voltage V_{CB} is kept constant at zero and base current I_B is increased from zero by increasing V_{BE}.

This is repeated for higher fixed values of V_{CE}.

A curve is drawn between base current and base emitter voltage at constant collector base voltage is shown in figure.

.



CE input characteristics

Here the base width decreases. So curve moves right as V_{CE} increases.

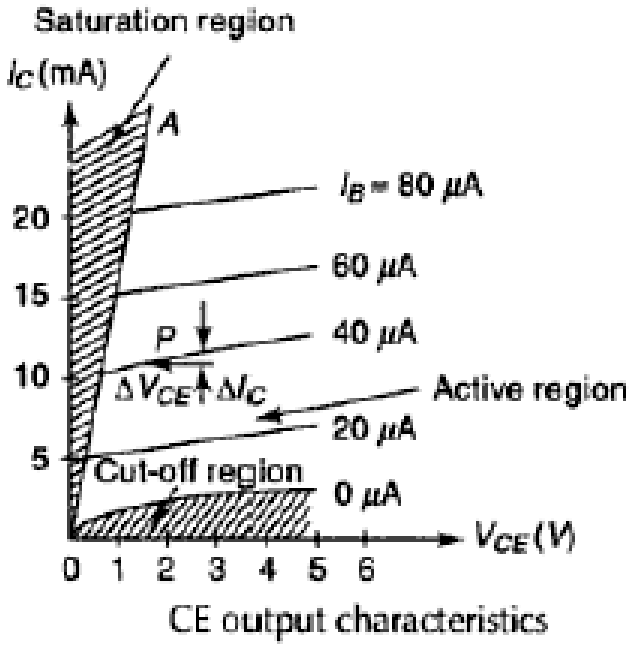
Output Characteristics

It is defined as the characteristic curve drawn between output voltage to output current whereas input current is constant.

To determine output characteristics, the base current I_B is kept constant at zero and collector current Ic is increased from zero by increasing V_{CE}.

This is repeated for higher fixed values of $I_{B..}$

From the characteristic it is seen that for a constant value of I_B, Ic is independent of V_{CB} and the curves are parallel to the axis of V_{CE}.



CE output characteristics

The output characteristic has 3 basic regions:

- Active region –defined by the biasing arrangements

- Cutoff region – region where the collector current is 0A

- Saturation region- region of the characteristics to the left of VCB = 0V

Active region	Saturation region	Cut-off region
•I_E increased, Ic increased •BE junction forward bias and CB junction reverse bias •Refer to the graf, Ic ≈ I_E •Ic not depends on V_{CB} •Suitable region for the transistor working as amplifier	• BE and CB junction is forward bias • Small changes in V_{CB} will cause big different to Ic • The allocation for this region is to the left of V_{CB}= 0 V.	• Region below the line of I_E=0 A • BE and CB is reverse bias • no current flow at collector, only leakage current

Transistor parameters in CE configuration

The slope of CE characteristics will give the following four transistor parameters. It is known as emitter hybrid parameters.

I. Input impedance (h_{ie}): It is defined as the ratio of change in input voltage (base voltage) to change in input current (base current) with the output voltage (collector voltage) is kept constant.

$$h_{ie} = \frac{\Delta V_{BE}}{\Delta I_B}, \; V_{CE} \text{ constant}$$

This ranges from 500ohms to 2000ohms.

II. Output admittance (h_{oe}): It is defined as the ratio of change in output current (collector current) to change in output voltage (collector voltage) with the input current (base current) is kept constant.

$$h_{oe} = \frac{\Delta I_C}{\Delta V_{CE}}, \; I_B \text{ constant}$$

This ranges from 0.1 to 10μ mhos.

III. Forward current gain (h_{fe}): It is defined as the ratio of change in output current (collector current) to change in input current (base current) with the output voltage (collector voltage) is kept constant.

$$h_{fe} = \frac{\Delta I_C}{\Delta I_B}, \; V_{CE} \text{ constant}$$

This ranges from 20 to 200.

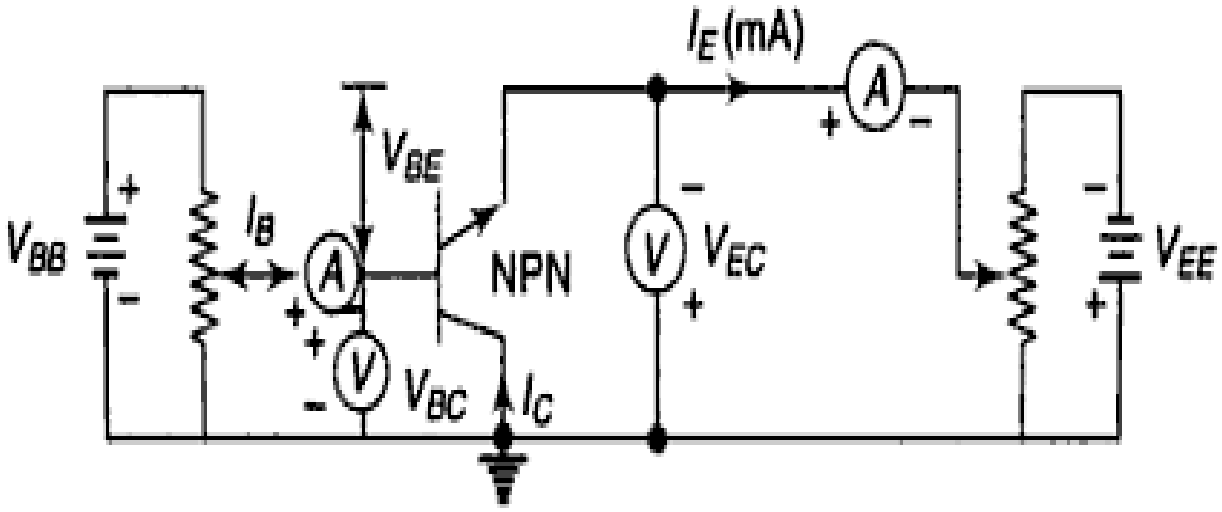
IV. Reverse voltage gain (h_{re}): It is defined as the ratio of change in input voltage (base voltage) to change in output voltage (collector voltage) with the input current (base current) is kept constant.

$$h_{re} = \frac{\Delta V_{BE}}{\Delta V_{CE}}, \; I_B \text{ constant}$$

This ranges from 10^{-5} to 10^{-4}.

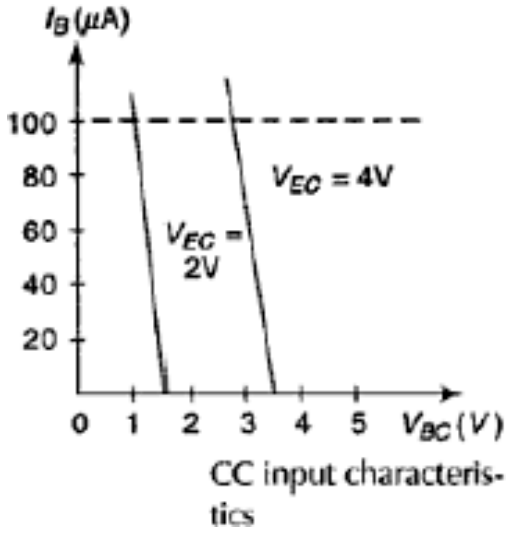
CC CONFIGURATION

In common collector configuration circuit is shown in figure. Here collector is grounded and it is used as the common terminal for both input and output. It is also called as grounded collector configuration. Base is used as a input terminal whereas emitter is the output terminal.



Input Characteristics

It is defined as the characteristic curve drawn between input voltage to input current whereas output voltage is constant.



CC input characteristics

To determine input characteristics, the emitter base voltage V_{EB} is kept constant at zero and base current I_B is increased from zero by increasing V_{BC}.

This is repeated for higher fixed values of V_{CE}.

A curve is drawn between base current and base emitter voltage at constant collector base voltage is shown in above figure.

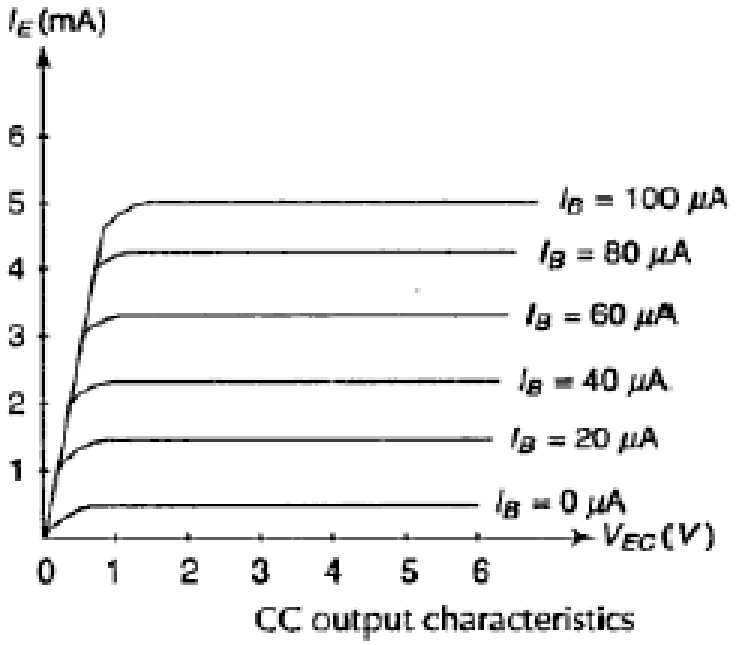
Output Characteristics

It is defined as the characteristic curve drawn between output voltage to output current whereas input current is constant.

To determine output characteristics, the base current I_B is kept constant at zero and emitter current I_E is increased from zero by increasing V_{EC}.

This is repeated for higher fixed values of I_B.

From the characteristic it is seen that for a constant value of I_B, I_E is independent of V_{EB} and the curves are parallel to the axis of V_{EC}.



CC output characteristics

Transistor parameters in CC configuration

The slope of CC characteristics will give the following four transistor parameters. It is known as base hybrid parameters.

I. Input impedance (h_{ic}): It is defined as the ratio of change in input voltage (base voltage) to change in input current (base current) with the output voltage (emitter voltage) is kept constant.

$$h_{ic} = \frac{\Delta V_{BC}}{\Delta I_B}, \; V_{EC} \text{ constant}$$

II. Output admittance (h_{oc}): It is defined as the ratio of change in output current (emitter current) to change in output voltage (emitter voltage) with the input current (base current) is kept constant.

$$h_{oc} = \frac{\Delta I_E}{\Delta V_{EC}}, \; I_B \text{ constant}$$

III. Forward current gain (h_{fc}): It is defined as the ratio of change in output current (emitter current) to change in input current (base current) with the output voltage (emitter voltage) is kept constant.

$$h_{fc} = \frac{\Delta I_E}{\Delta I_B}, \; V_{EC} \text{ constant}$$

IV. Reverse voltage gain (h_{rc}): It is defined as the ratio of change in input voltage (base voltage) to change in output voltage (emitter voltage) with the input current (base current) is kept constant.

$$h_{rc} = \frac{\Delta V_{BC}}{\Delta V_{EC}}, \; I_B \text{ constant}$$

A comparison of CB, CE and CC Configurations

Property	*CB*	*CE*	*CC*
Input resistance	Low (about 100 Ω)	Moderate (about 750 Ω)	High (about 750 kΩ)
Output resistance	High (about 450 kΩ)	Moderate (about 45 kΩ)	Low (about 25 Ω)
Current gain	1	High	High
Voltage gain	About 150	About 500	Less than 1
Phase shift between input & output voltages	0 or 360°	180°	0 or 360°
Applications	for high frequency circuits	for audio frequency circuits	for impedance matching