



Analog electronics

Fifth lecture

Common collector & Common Base circuits

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Third stage

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2022- 2023

Outline

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2. Common Base Circuit
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5.1 Common collector circuits

The **Common Collector Amplifier** is another type of bipolar junction transistor, (BJT) configuration where the input signal is applied to the base terminal and the output signal taken from the emitter terminal. Thus the collector terminal is common to both the input and output circuits. This type of configuration is called Common Collector, (CC) because the collector terminal is effectively “grounded” or “earthed” through the power supply.

The common collector or grounded collector configuration is generally used where a high resistance input source needs to be connected to a low resistance output load requiring a high current gain.

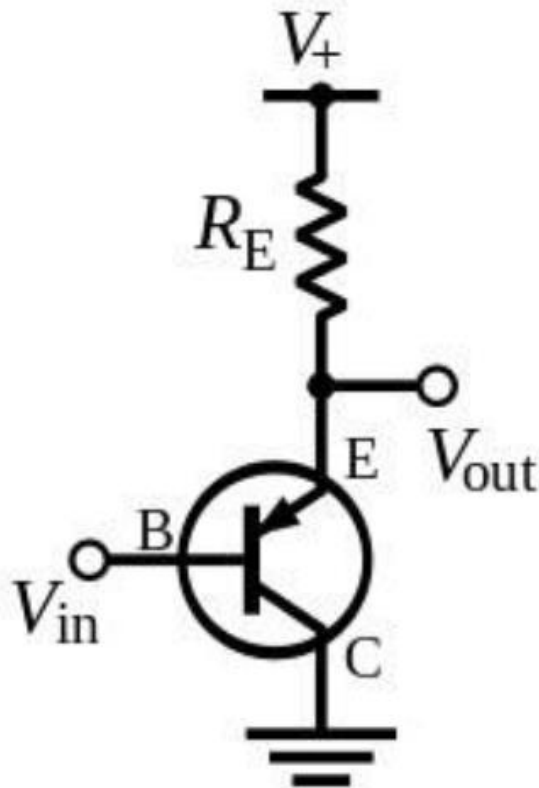


Figure 1: Common Collector Circuit.

As the base-emitter pn-junction is forward biased, base current flows through the junction to the emitter encouraging transistor action causing a much larger collector current, I_C to flow. Thus the emitter current is a combination of base current and collector current as: $I_E = I_B + I_C$. However, as the base current is extremely small compared to the collector current, the emitter current is therefore approximately equal to the collector current. Thus $I_E \approx I_C$.

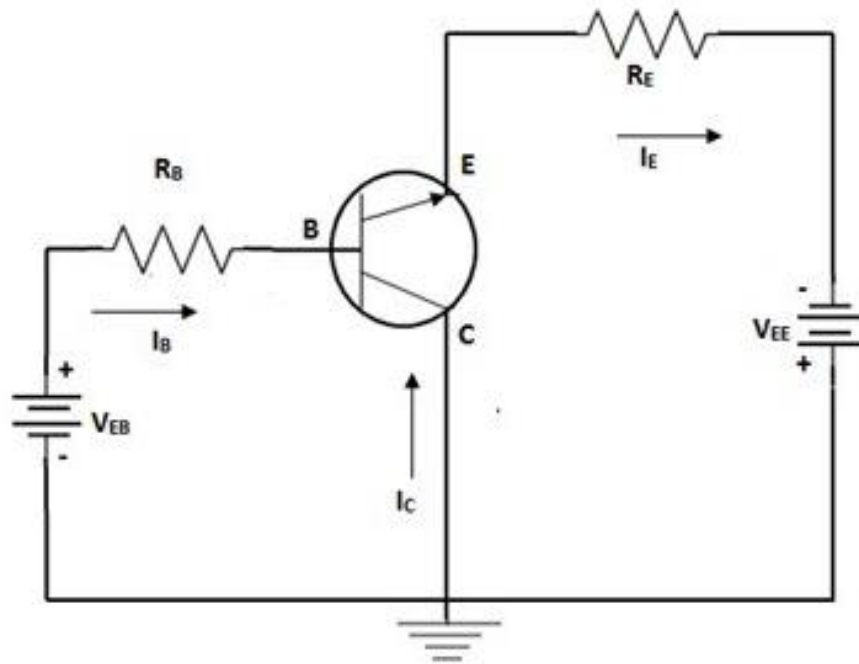


Figure 2: Common Collector Circuit

Characteristics of Common Collector Amplifier

The load resistor in the common collector amplifier being placed in series with the emitter circuit receives both the base current and collector currents. Since the emitter of a transistor is the sum of the base and collector currents.

Parameters	Characteristics
Voltage gain	Zero
Current gain	High
Power gain	Medium
Input or output phase relationship	Zero degree
Input resistance	High
Output resistance	Low

Advantages of Common Collector amplifier

- ✓ It has current gain
- ✓ The Voltage gain is at best slightly less than 1.
- ✓ It has the lowest output resistance compare to other type amplifier.
- ✓ When used like this it is sometimes called a isolation amplifier.
- ✓ When placed between the two stages it prevents the stage with the low input resistance from overloading the stage with the high output resistance.

Applications of Common Collector amplifier

- ❖ This amplifier is used as an impedance matching circuit.
- ❖ It is used as a switching circuit.
- ❖ The high current gain combined with near-unity voltage gain makes this circuit a great voltage barrier.
- ❖ It is also used for circuit isolation.

5.2 Common Base Circuit

The Common Base Amplifier is a type of BJT configuration or bipolar junction transistor, in which the input and output signals share the base terminal of the transistor, hence the name common base (CB). Furthermore, the CB configuration is not commonly in use as an amplifier in comparison to the more prevalent common collector (CC) and common emitter (CE) configurations.

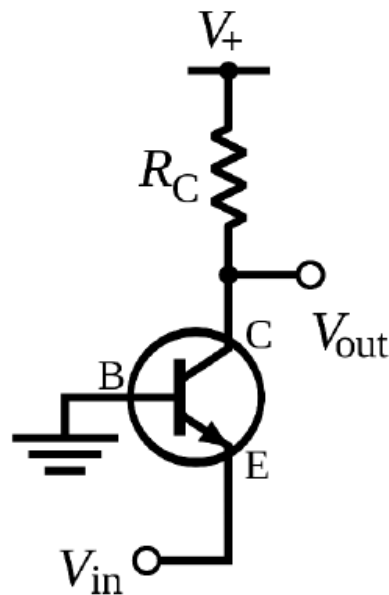


Figure 3: Common Base Circuit Symbol.

To facilitate amplifier functionality with the common base configuration, we need to supply the input signal to the emitter terminal, while extracting the output from the collector terminal. Therefore, in this instance, the input current is also the emitter current. This also means that the output current is indeed the collector current. However, since the transistor is both a three-layer device and a two PN-junction device, it needs to be correctly biased for it to work as a common base amplifier. This means that its base-emitter junction will need to be forward-biased.

Additionally, because I_E is also the input current, there will be a subsequent change in I_C whenever there is a change to the input current. In general, with common base amplifier configurations, the current gain is defined as $I_{out} \div I_{in}$ or the formula $I_C \div I_E$.

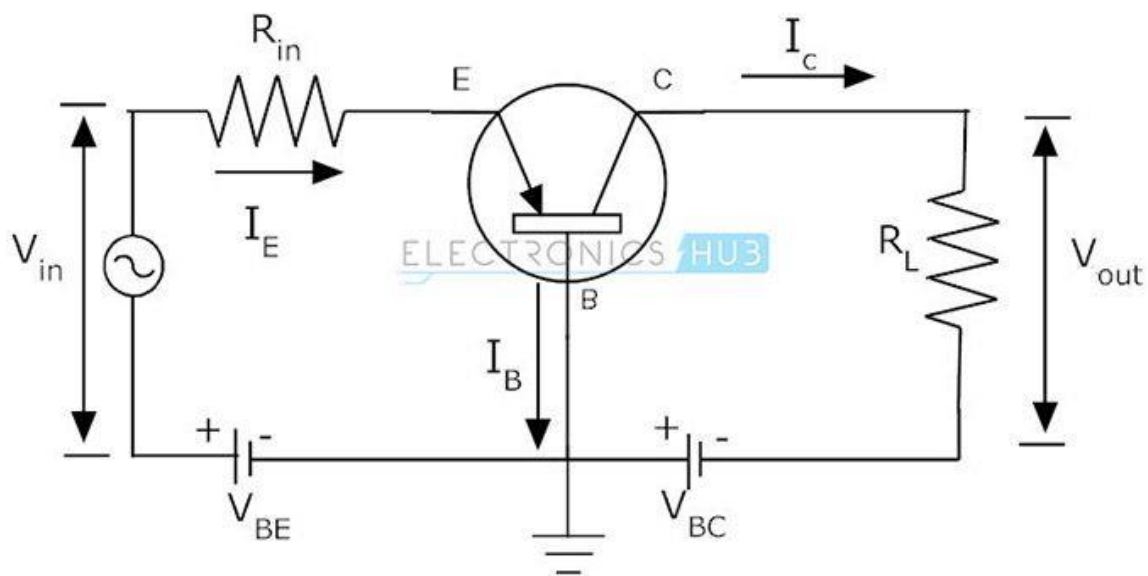


Figure 4: Common base Circuit

Characteristics of Common Base Amplifier

- ✓ It has very high output resistance.
- ✓ It has low input resistance.
- ✓ Its voltage gain is of the order of 1500.
- ✓ Its current gain is less than unity.
- ✓ Its power gain is of the order of 30 dB.
- ✓ Its input and output signals are in the same phase.

Parameters	Characteristics
Voltage gain	High
Current gain	Low
Power gain	Low
Input or output phase relationship	Zero degree
Input resistance	Low
Output resistance	High

Applications of Common Base Amplifier

- ✓ It is mainly used at high frequencies where low source resistance.
- ✓ It is used for resistance matching in circuits with very low output resistances to those with a high input resistance.
- ✓ It is used in moving coil microphones Preamplifiers.

3.4 References

Electronics principles (fourth edition) by Malvino.