

عنوان البحث

........................................................................................................................................................................

|  |  |
| --- | --- |
| كلـــــــــــــــية | : الهندسة الالكترونية بمنوف |
| القســم/الشعبة | :عام |
| الفرقـة/المستوي | :الأولى |
| اســــم المقـــرر | : Electronics (2) |
| كــــود المقــــرر | :ECE 123 |
| اســـــم الطالب | :عبدالرحمن عمادالدين محمد الشافعي |
| الرقـــم القومي | :30004301700253 |
| البريد الأكاديمي | :ab.al.shafei@el-eng.menofia.edu.eg |
| اشـــــــــــــراف | : أ.د./ عبدالمجيد شرشر  : أ.د./ أحمد نبية راشد |

**Abstract**

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal.

**Introduction**

The Bipolar Junction Transistor usually called BJT is a semiconductor device which can be used for switching or amplification. If we join two diodes back-to-back, this will give us two PN-junctions sharing a common P or N terminal. The fusion of these two diodes produces a three-layer, two junction, three-terminal device forming the basis of a Bipolar Junction Transistor. The three terminals are labelled as the Emitter (E), the Base (B) and the Collector (C) respectively. Transistors are made from different semiconductor materials that can act as either an insulator or a conductor by the application of a small signal voltage. The transistor’s ability to change between these two states enables it to have two basic functions: “switching” (digital) or “amplification” (analog). Thus, BJTs can operate within three different regions:

* **Active Region**: the transistor operates as an amplifier,
* **Saturation**: the transistor is operating as On-switch

Figure 2- A typical bipolar transistor

* **Cut-off**: the transistor is operating as Off-switch,

There are basically three possible ways to connect the BJT within an electronic circuit with one terminal being common to both the input and output.

* **Common Base Configuration** – has Voltage Gain but no Current Gain.
* **Common Emitter Configuration** – has both Current and Voltage Gain.
* **Common Collector Configuration** – has Current Gain but no Voltage Gain.

**Research Project Contents**

**The Common Base (CB) Configuration:**

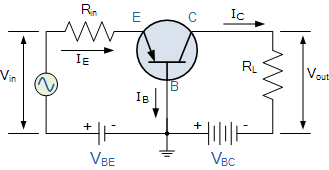


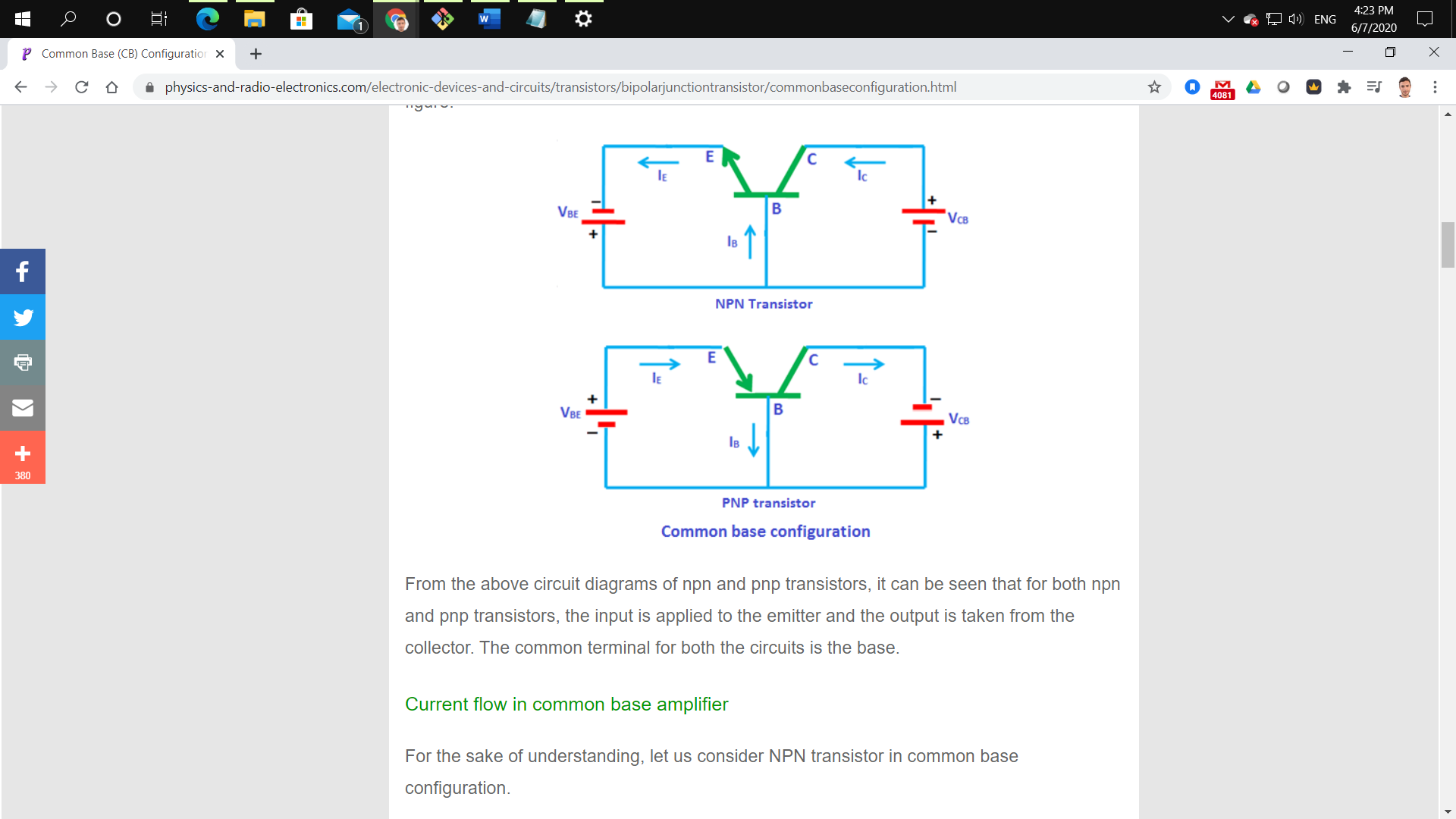
Figure 2-Common Base Transistor Circuit

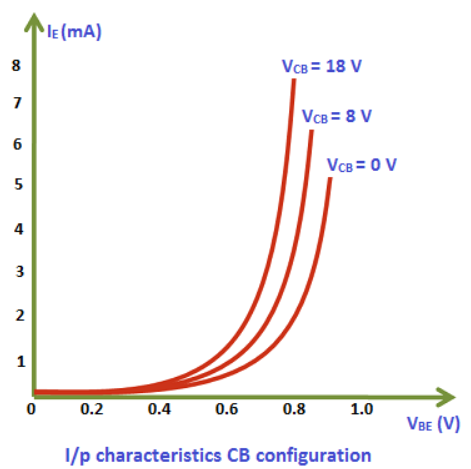
As its name suggests, in the Common Base or grounded base configuration, the **base** **connection** is common to both the input signal AND the output signal. The input signal is applied between the transistors base and the emitter terminals, while the corresponding output signal is taken from between the base and the collector terminals as shown. The base terminal is grounded or can be connected to some fixed reference voltage point.

The input current flowing into the emitter is quite large as its the sum of both the base current and collector current respectively therefore, the collector current output is less than the emitter current input resulting in a current gain for this type of circuit of “1” (unity) or less, in other words the common base configuration “attenuates” the input signal.

**The Common Base Transistor Circuit**

This type of amplifier configuration is a non-inverting voltage amplifier circuit, in that the signal voltages and are “in-phase”. This type of transistor arrangement is not very common due to its unusually high voltage gain characteristics. Its input characteristics represent that of a forward biased diode while the output characteristics represent that of an illuminated photodiode.



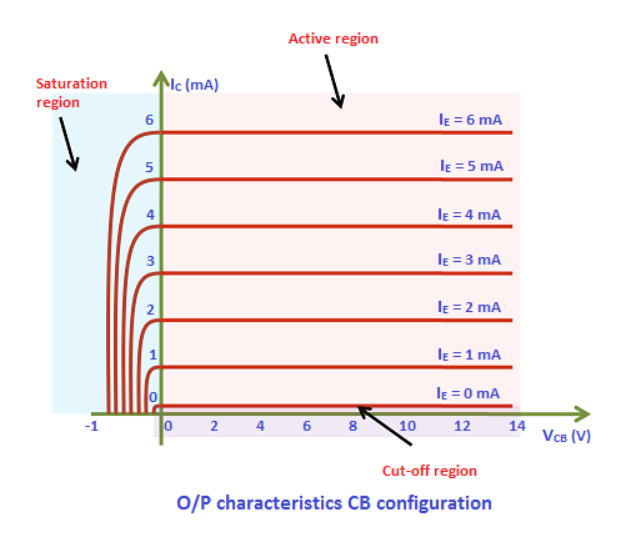
**The input characteristics** describe the relationship between input current () and the input voltage (). The input current or emitter current () is taken along the y-axis (vertical line) and the input voltage () is taken along the x-axis (horizontal line).

To determine the input characteristics, the output voltage (collector-base voltage) is kept constant at zero volts and the input voltage is increased from zero volts to different voltage levels. For each voltage level of the input voltage (), the input current () is recorded on a paper or in any other form. A curve is then drawn between input current and input voltage at constant output voltage (0 volts).

To determine the input characteristics, the output voltage (collector-base voltage) is kept constant at zero volts and the input voltage is increased from zero volts to different voltage levels. Next, the output voltage () is increased from zero volts to a certain voltage level (8 volts) and kept constant at 8 volts. While increasing the output voltage (), the input voltage () is kept constant at zero volts. After we kept the output voltage () constant at 8 volts, the input voltage is increased from zero volts to different voltage levels. For each voltage level of the input voltage (), the input current () is recorded on a paper or in any other form. A curve is then drawn between input current and input voltage at constant output voltage (8 volts).

This is repeated for higher fixed values of the output voltage (). When output voltage () is at zero volts and emitter-base junction JE is forward biased by the input voltage (), the emitter-base junction acts like a normal p-n junction diode. So, the input characteristics are same as the forward characteristics of a normal pn junction diode.

The cut in voltage of a silicon transistor is 0.7 volts and germanium transistor is 0.3 volts. In our case, it is a silicon transistor. So, from the above graph, we can see that after 0.7 volts, a small increase in input voltage () will rapidly increase the input current (). When the output voltage () is increased from zero volts to a certain voltage level (8 volts), the emitter current flow will be increased which in turn reduces the depletion region width at emitter-base junction. As a result, the cut in voltage will be reduced. Therefore, the curves shifted towards the left side for higher values of output voltage .

**The output characteristics** describe the relationship between output current (IC) and the output voltage (VCB). The output current or collector current (IC) is taken along the y-axis (vertical line) and the output voltage (VCB) is taken along the x-axis (horizontal line).

To determine the output characteristics, the input current or emitter current is kept constant at zero mA and the output voltage is increased from zero volts to different voltage levels. For each voltage level of the output voltage , the output current () is recorded. A curve is then drawn between output current and output voltage at constant input current (0 mA).

When the emitter current or input current is equal to 0 mA, the transistor operates in the cut-off region. The output characteristics describes the relationship between output current () and the output voltage (). Next, the input current () is increased from 0 mA to 1 mA by adjusting the input voltage and the input current is kept constant at 1 mA. While increasing the input current , the output voltage is kept constant.

After we kept the input current () constant at 1 mA, the output voltage () is increased from zero volts to different voltage levels. For each voltage level of the output voltage (), the output current () is recorded. A curve is then drawn between output current and output voltage at constant input current (1 mA). This region is known as the active region of a transistor. This is repeated for higher fixed values of input current (I.e. 2 mA, 3 mA, 4 mA and so on). From the above characteristics, we can see that for a constant input current , when the output voltage is increased, the output current remains constant. At saturation region, both emitter-base junction and collector-base junction are forward biased. From the above graph, we can see that a sudden increase in the collector current when the output voltage makes the collector-base junction forward biased.

**Early effect**

Due to forward bias, the base-emitter junction JE acts as a forward biased diode and due to reverse bias, the collector-base junction JC acts as a reverse biased diode.

**References**

Write the references of the research project in this part.

1. Reference 1.
2. Reference 2.
3. Reference 3.
4. Reference 4.
5. Reference 5.

المراجع: يكتب فيها أسماء المراجع المرتبطة بالمشروع البحثي بشرط لا تقل عن 5 مراجع وان يكون معظمها من بنك المعرفة المصري.