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| **Engineering Technology, CSULB** |
| **Experiment 16 – Transistor Operating Regions** |
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**Transistor Operating Regions**

This lab focused on transistor regions, which are categorized by being either; cutoff, saturation, or active. We evaluate this by checking if we have a base current as well as a collector current. In theory, in order to have a base current, you must have a complete path in place, with a voltage applied somewhere in the path. This theory is similar for the collector current. When there is no base current the transistor goes into **“cutoff**”. On the other hand, when there *is* a base current, where VBE is about 0.7 V, the transistor may operate in any three regions. In short, a small-signal transistor is in the **active region** when the collector-emitter voltage (VCE) is greater than 1V but less than VCC. **Saturation** occurs somewhere *below* 1V, depending on the transistor. Typically, a small-signal transistor, VCE(Sat) is between 0.1 V to 0.2 V.

 For this lab, we had to build 4 different circuits. The first two, in series with 2 resistors (varying between 470 kΩ, 10 kΩ, and 1kΩ) and a small-signal transistor, one circuit with a cut off base current, and the last circuit with a resistor in place of the cutoff region from the third circuit. Our measured values for the following are shown in the table below:

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| --- | --- | --- | --- | --- |
|  | **1st circuit** | **2nd circuit** | **3rd circuit** | **4th circuit** |
| **VBE** | 0.65 V | 0.7 V | 0.2 V | 0 V |
| **VCE** | 6.56 V | 48 mV | 9.98 V | 10.22 V |
| **Region** | Active | Saturated | Cutoff | Active |









**Questions for Experiment 16**

1. The base current in Fig. 16-1 is closest to:

 (b) 20 µA

2. The collector current in Fig. 16-2 is closest to:

 (d) 10mA

3. The collector current in Fig. 16-3 is closest to:

 (a) 0

4. The collector voltage in Fig. 16-4 is closest to:

 (d) 10V

5. In Fig. 16-5, Q1 operates in which region?

 (b) saturation

6. In Fig. 16-5, Q4 operates in which region?

 (a) active

7. When the collector resistor of Fig. 16-1 is shorted, VCE equals:

 (d) 10V

8. When the collector resistor of Fig. 16-1 is open, VCE is closest to:

 (a) 0

9. You are troubleshooting a circuit like Fig. 16-1 and have measured the collector-emitter voltage.

 How can you tell which of the regions the transistor is operating in?

 If the region is active, the VCE is greater than 1V but less than VCC .