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Experiment 12Lab Report
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Experiment #13: Bipolar Transistors and Amplifiers

Bipolar Transistor I-V Characteristics

In finding the Bipolar Transistor I-V characteristics of the 2N2222A transistor, the following curves are observed. *Figure 1* shows this graph. This is expected and the cutoff, active, and saturation regions can be observed.

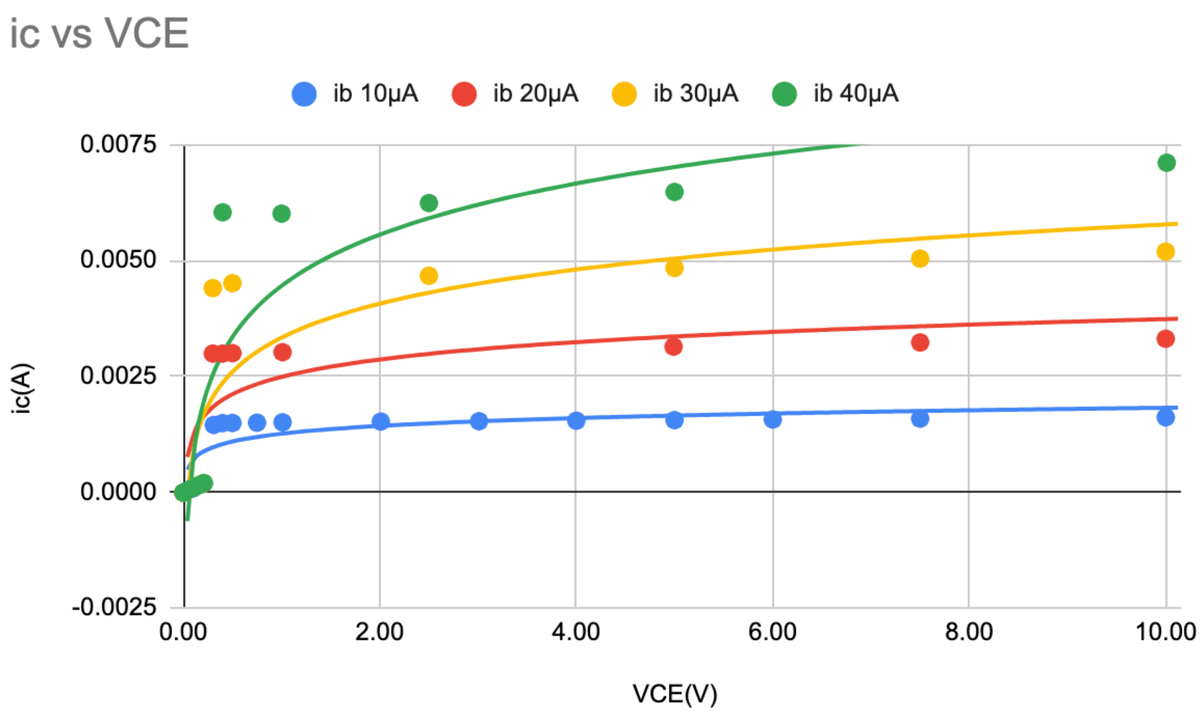

Figure 1: ic vs VCE for 2N2222A transistor at variable base currents, ib.

Further, the respective transistor current gain can be found to be, $\beta_f = \frac{i_c}{i_b}$. Current gains are seen in *Figure 2*. Note that these values vary with temperature.

	βf
ib 10μA	155.30
ib 20μA	157.00
ib 30μA	161.33
ib 40μA	162.00

Figure 2: 2N2222A current gain at 20ºC.

A BJT-Resistor Inverter

While buildinging a BJT-Resistor Inverter, varying voltages across the base, collector, and emitter allow for control of the circuit. A graph of VCE vs VBE is expected to produce a BJT voltage transfer curve which shows high voltage in the cutoff region, low voltage in the saturation region, and a steep, nearly linear curve in the active region.

By varying voltages, the following graph can be observed. *Figure 3* shows the entire curve and *Figure 4* shows a close-up of the active region.

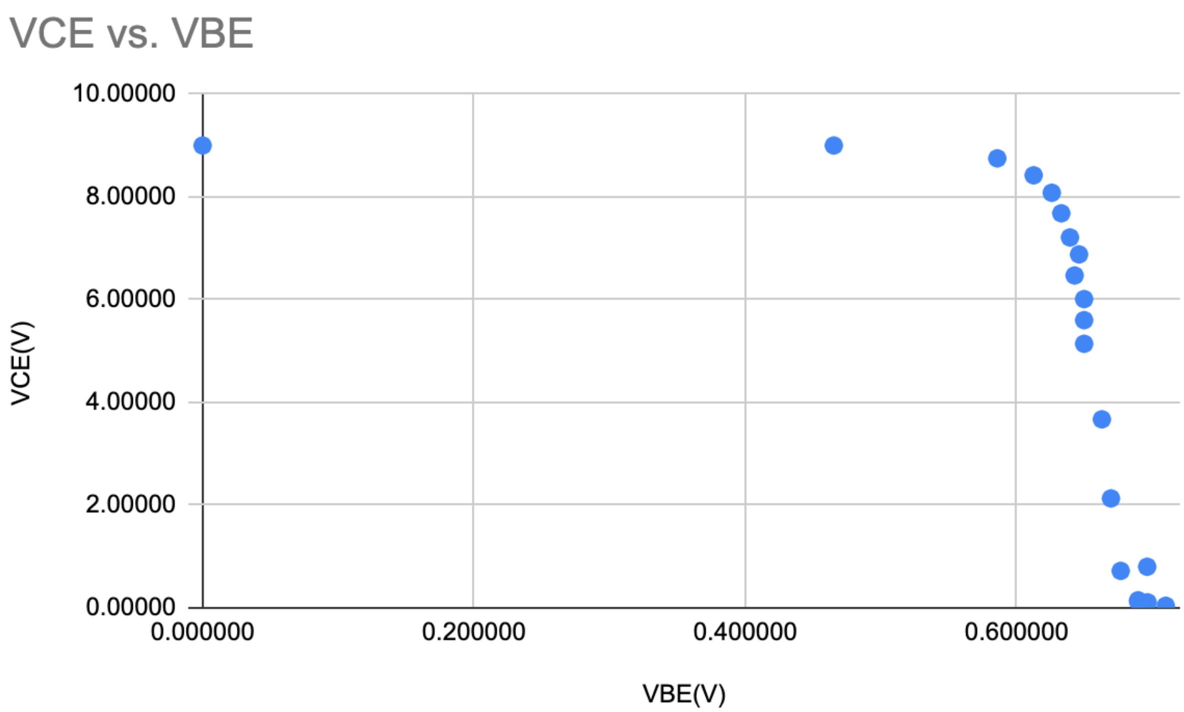

Figure 3: 2N2222A BJT-Resistor inverter graph.

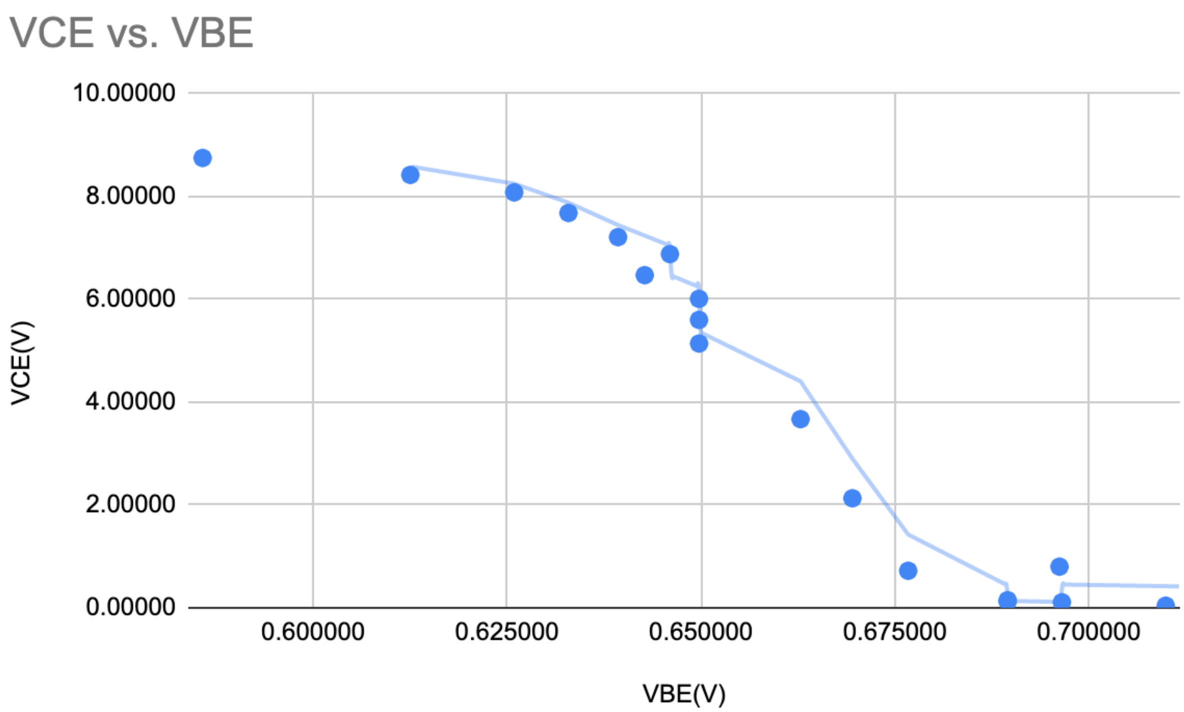

Figure 4: 2N2222A BJT-Resistor inverter graph with moving average trendline.

This curve allows us to determine the amplification of the output of the circuit and to interpolate VCE and VBE at any given point. For example, at the point where VCE is 4.0V, VBE is 0.6599V. Assuming that VBE varies around this point, the slope(gain) seen in the linear region is -112.385V/V. This value is negative, hence the term “inverting” in the name.

Experiment 11: MOSFET Characteristics and Applications

MOSFET I-V Characteristics

Using the CD4007, we can measure the I-V characteristics of the MOSFET. It is expected that the I-V curve grows parabolically while in the triode region, flattening out in the saturation region. The I-V curve found in *Figure 5*, which shows the collected values of ids and Vds, does not produce the expected curves. We believe that this is due to a bad ammeter that produced skewed outputs. We believe that the produced curves should be closer to those seen in *Figure 6*. While it is difficult to estimate with the measured curves, it appears that the saturation voltage is ~1.5V. This would mean that the saturation current for each value of VGS would be as follows: [85.2µA, 5Vgs], [75.8µA, 3Vgs], [72.3µA, 1Vgs].

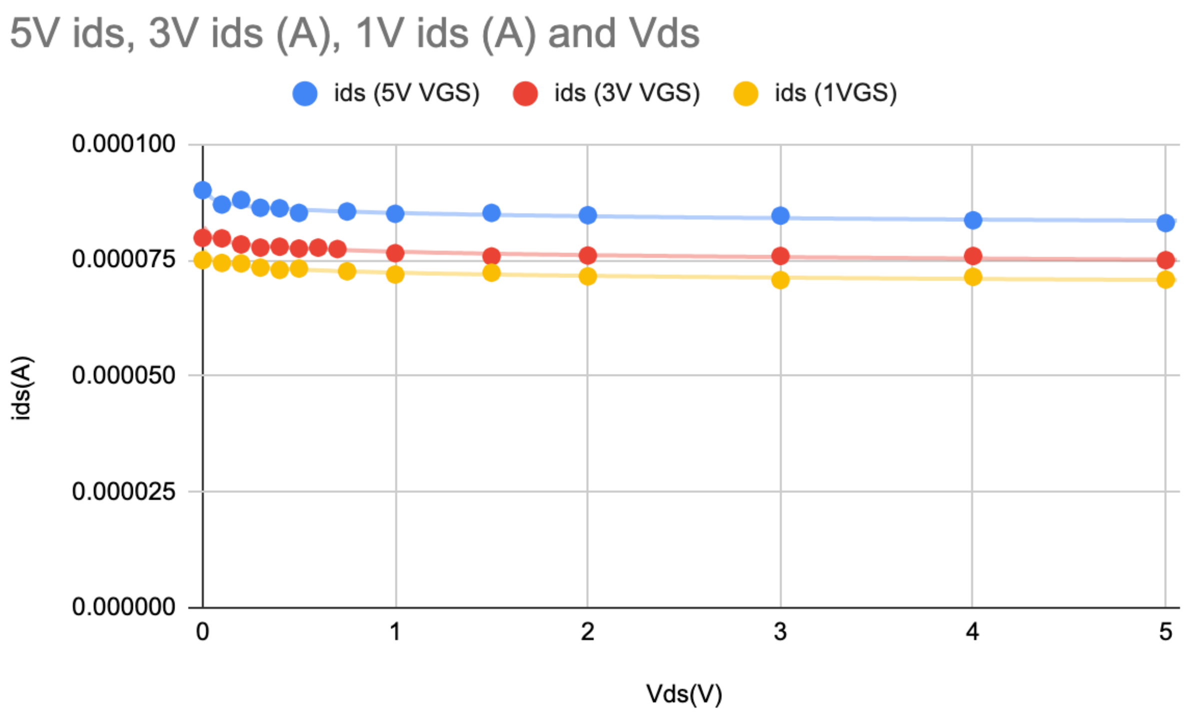

Figure 5: I-V characteristic curve for the CD4007 from recorded values. It is likely that the values recorded are incorrect due to a bad ammeter.

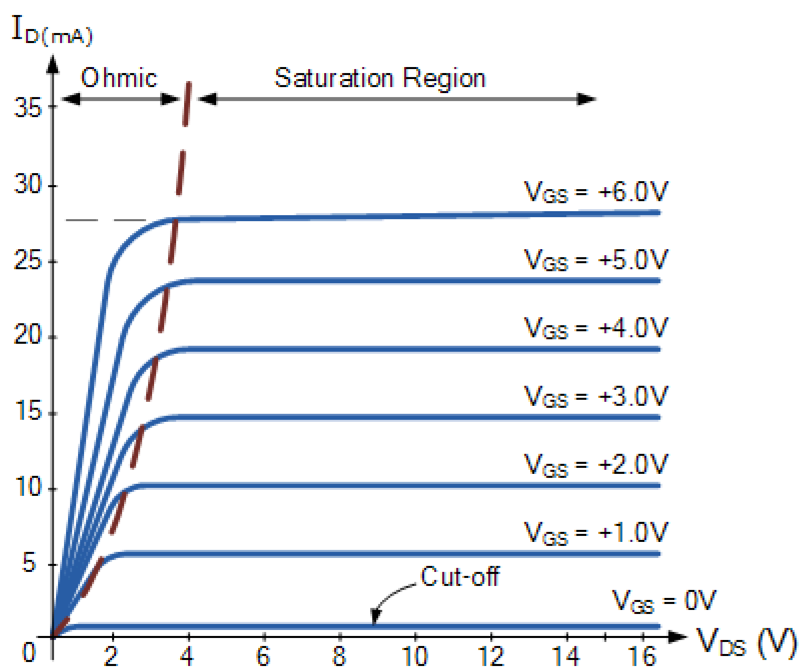

Figure 6: Form of the expected I-V characteristic curve.