ELEC-313
Lab 1: Amplifier Models

September 17, 2013

Date Performed: September 11, 2013
Partners: Charles Pittman
Stephen Wilson

1 Objective

The objective is to verify the equivalence of four circuits used to model an amplifier, shown in Figure 3.

2 Schematics

Circuit Tested

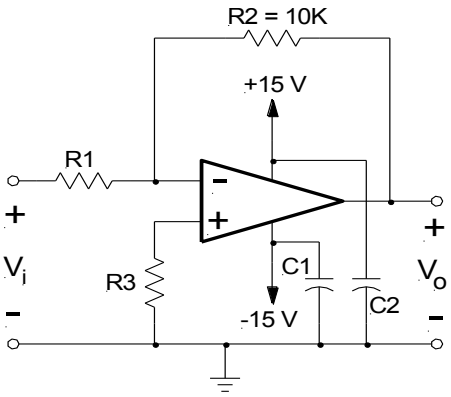

Figure 1: Circuit being tested. $C_1 = C_2 = 1\,\mu\text{F}$

Test Configuration

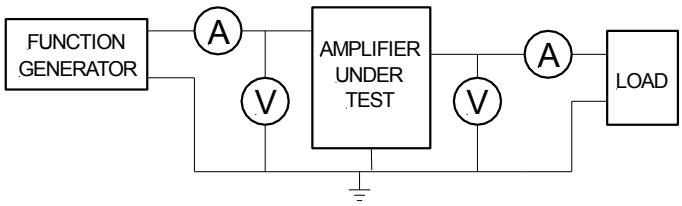

Figure 2: Test Configuration

3 Procedure

First, the resistors that were intended for use in the experiment were measured with a multimeter and recorded in Table 1. Then the circuit in Figure 1 was built on a breadboard. A function generator was programmed to output a sine wave at 1kHz. The test configuration was constructed as shown in Figure 2 using

Fluke multimeters as the ammeters and an oscilloscope as both voltmeters. The function generator was added to the circuit as the voltage input (V_i) and, with the oscilloscope measuring the voltage generator, the amplitude was adjusted to 200V_{rms}. The input voltage, input current, and output voltage were taken and recorded in Table 2 with the open circuit across the load terminals. Finally, the decade box was added to the output terminals (V0 in Figure 1) of the circuit and, set to 200Ω, and the output voltage was measured and recorded in (Table 2).

4 Results

Name	**Nominal** (kΩ)	**Measured** (kΩ)	**% Error**
R_1	1	0.986	1.40
R_2	10	9.88	1.20
R_3	1	0.983	1.70

Table 1: Comparison of labelled and actual resistance.

	Voltage		**Current**		**Gain**	
	V_i (mV_{rms})	V_o (V_{rms})	I_i (mA_{rms})	I_o (mA_{rms})	A_v	A_i
No Load	200	1.98	0.2	nil	9.9	nil
Load	200	1.98	0.2	9.52	9.9	47.6

Table 2: Comparison of electrical characteristics of the amplifier under load.

5 Conclusion

As seen in Table 3, the measured results of the circuit were very close to the calculated values using nominal values of the resistors. This shows that the four amplifier models shown in Figure 3 are closely representative of the operational amplifier circuit seen in Figure 1. The highest % difference when comparing the measured with the nominal theoretical value was only 4.8% (current gain [Ai] Table 3)!

Equations

$$\%_{error} = \frac{|measured - nominal|}{nominal} \times 100\% \tag{1}$$

$$R_o = \frac{V_{noload} - V_{load}}{I_{load}} \tag{2}$$

$$R_i = \frac{V_i}{I_i} \tag{3}$$

$$A_v = \frac{V_o}{V_i} \tag{4}$$

$$A_i = A_v \left(\frac{R_i}{R_o} \right) \tag{5}$$

$$G_m = \frac{A_v}{R_o} \tag{6}$$

$$R_m = A_v R_i \tag{7}$$

6 Appendix

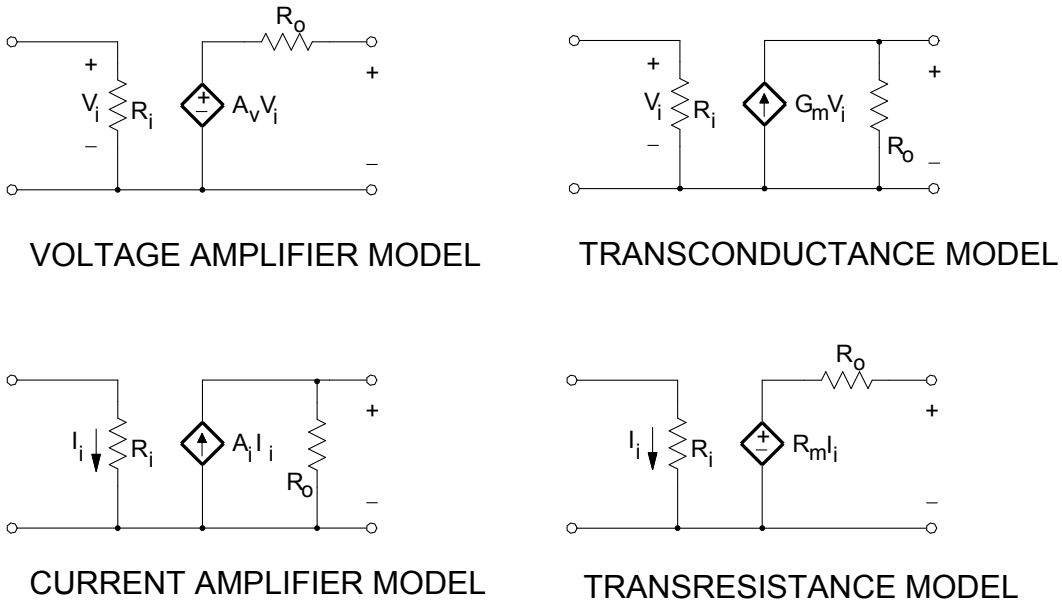

Figure 3: Four equivalent models of an amplifier