

KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING
Electronic Circuits II – EE303

Experiment # 6
Feedback and Nonlinear Distortion

OBJECTIVE

The major objective of this experiment is to illustrate how negative feedback can reduce nonlinear distortion.

INTRODUCTION

Consider the operational amplifier circuit shown in Figure 1. Because the output resistance of the op-amp is about 50Ω then it is expected that the power delivered to the loudspeaker will not be the maximum power. Thus if you listen to the output from the speaker using an input of around 0.5V p-p then you will not hear a loud sound. A possible solution for this problem is to connect an output stage between the op-amp output and the speaker, as shown in Figure 2. If you connect such a circuit you will notice that the sound is now more loud. However, it will be distorted. There are two sources for this distortion. The first as you know is the crossover distortion is to connect the two diodes D1 and D2 as shown in Figure 3. Now it is expected that the crossover distortion will disappear. Unfortunately it will not disappear completely unless the two transistors are identical and also the two diodes are identical and that all the transistors and diodes easily satisfied if you are using discrete elements. So what is the solution? The solution is simply apply negative feedback across the whole circuit as shown in Figure 4.

PRELAB WORK

Students must perform the following calculations and PSPICE before coming to the lab.

1. Using simple hand calculation try to sketch the voltage across the speaker in all cases.
2. Using SPICE simulate the circuits of Figures 1 to 4 and in each case obtain an output file including the output voltage across the speaker. Assume default values for the transistors and diodes. Also assume that the input voltage is a pure sine wave with frequency 1kHz and amplitude around 0.25V.

You must have your SPICE output file with your hand calculations ready before you come to the lab.

EXPERIMENTAL WORK

1. Construct the circuit in Figure 1 to 4 one by one and in each observe the output on the oscilloscope and listen to it from the speaker. Sketch your output.
2. Compare the calculated, simulated and measured results.
3. Now rather than obtaining the input from a function generator, obtain it from the output of a microphone. You may need to change the 10k resistance and make it 1k, this because the output of the microphone is usually small so we need more amplification from the op-amp. Observe the output on the oscilloscope and listen to it, in the four cases of Figure 1 to 4. In each case try to sense how clear and loud your output is. Comment on your results.
4. Try to write a conclusion to illustrate the usefulness of negative feedback as a powerful mean for reducing nonlinear distortion. Are there any advantages for negative feedback?

Table I: Summary of hand calculations, SPICE simulation and experiment

	Output Waveforms			Sound Level Hi or Lo
	Hand Calculation	SPICE	Experiment	
Figure 1				
Figure 2				
Figure 3				
Figure 4				

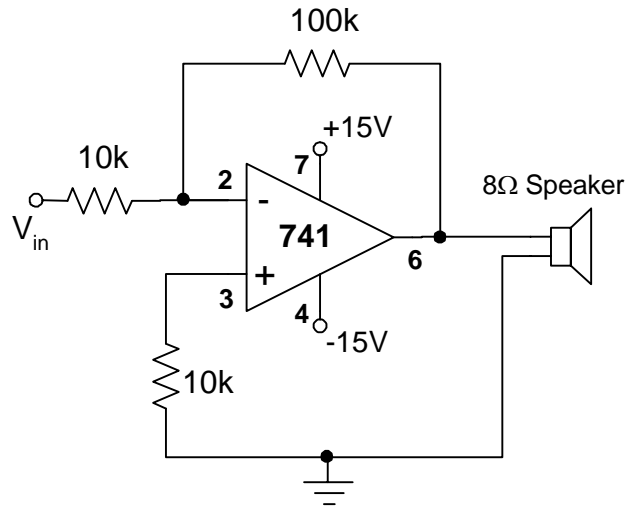


Figure 1

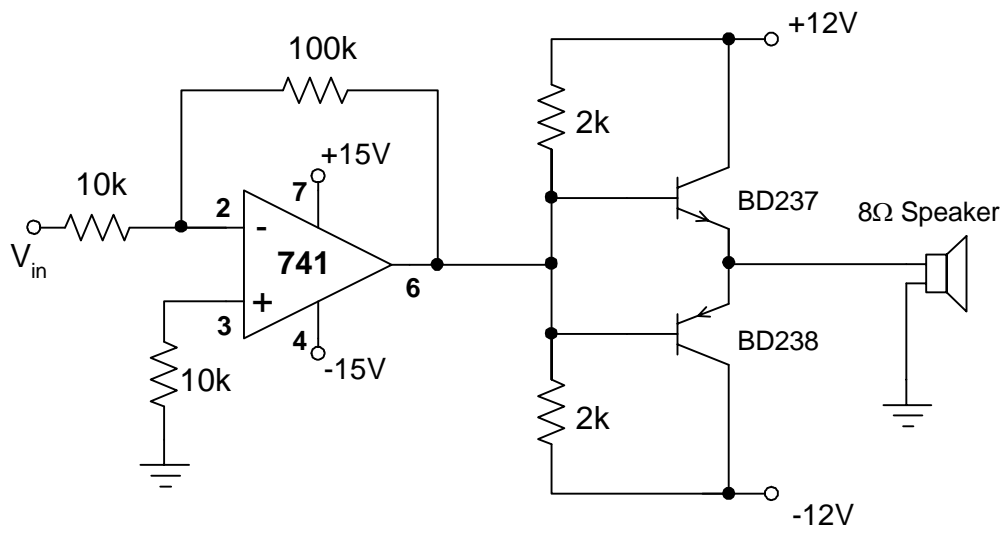


Figure 2

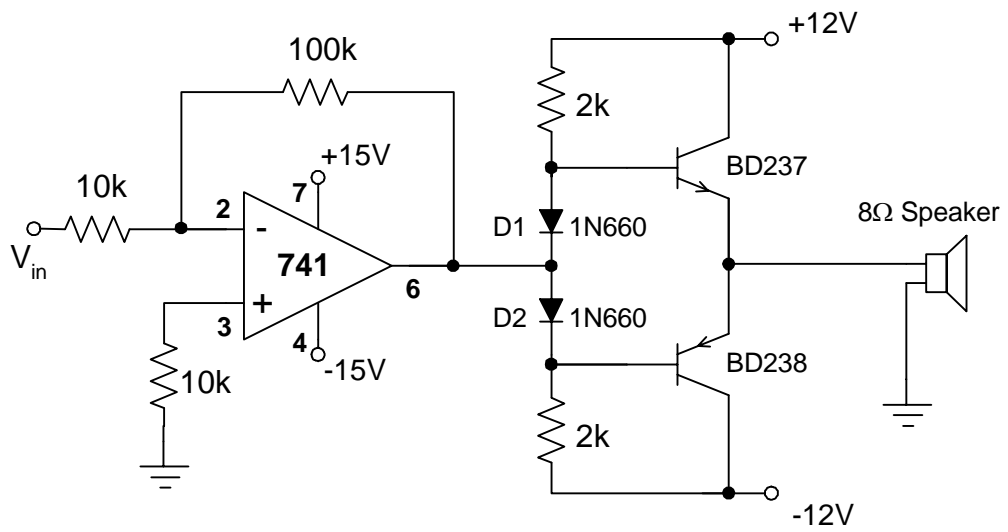


Figure 3

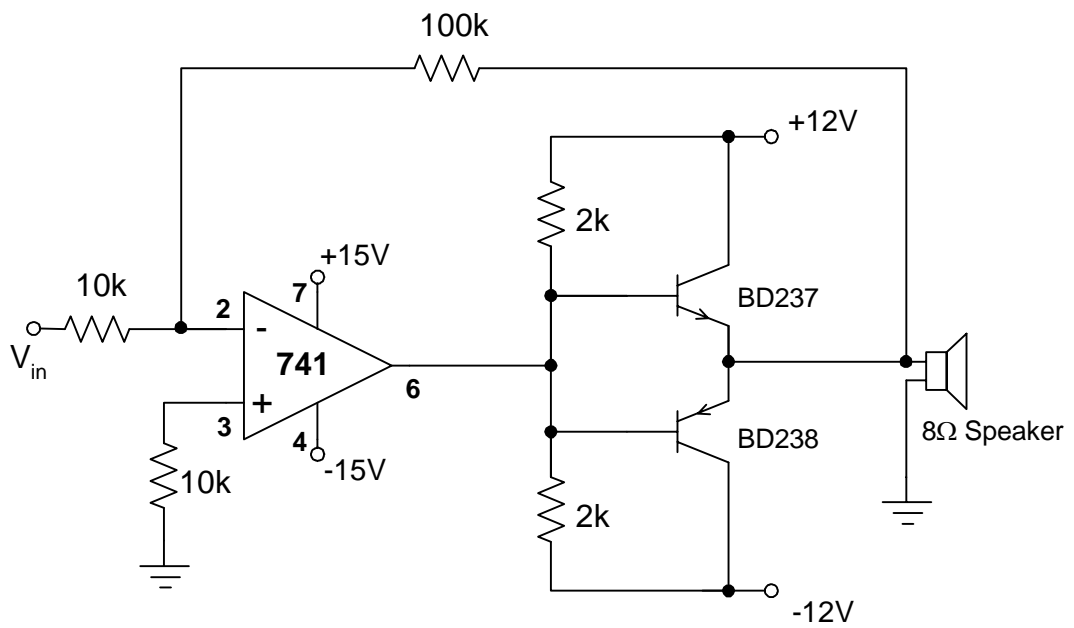


Figure 4