

Georgia Institute of Technology
School of Electrical and Computer Engineering
ECE 4435 Op Amp Design Laboratory Fall 2004
Design Project 1, Preliminaries
A White Noise and Pink Noise Generator

Introduction

Loudspeaker systems in professional audio applications are normally set up by equalizing their frequency response with graphic and/or parametric equalizers. The equalization requires a test signal that is called pink noise. Pink noise is generated from white noise by filtering it with a filter that has a frequency response that varies inversely with the square root of the frequency over the audio frequency band. White noise is noise which has a flat spectral density. That is, it has equal voltage per unit frequency. In contrast, pink noise has equal voltage per octave or per any fraction of an octave. The object of this design project is to design a white noise source and a filter which will convert the white noise output into pink noise.

Preliminary Procedure

The first step in the lab is to assemble a white noise source. The circuit shown in Fig. 1 is suggested. There is no theoretical way to design this circuit. It must be optimized experimentally. The transistor can be either a 2N4401 or 2N3904. The circuit shows the base connected to the collector. The circuit may generate more noise if the base is grounded and the collector is open circuited. Alternately, more noise may be generated with the collector grounded and the base open circuited. You are to decide the optimum connection in the lab. For the power supply voltages, use +15 V and -15 V. The transistor is operated in the reverse breakdown region of its base-emitter junction, so that it resembles a zener diode. The noise it generates will vary with the dc current through it. This current is set by the resistor R_1 . This resistor must be experimentally determined to obtain the maximum noise and noise bandwidth. A suggested starting value is $R_1 = 100 \text{ k}\Omega$. For C_1 , a suggested value is $10 \mu\text{F}$. For R_2 and R_3 , respectively, suggested values are $R_2 = 10 \text{ k}\Omega$ and $R_3 = 100 \text{ k}\Omega$.

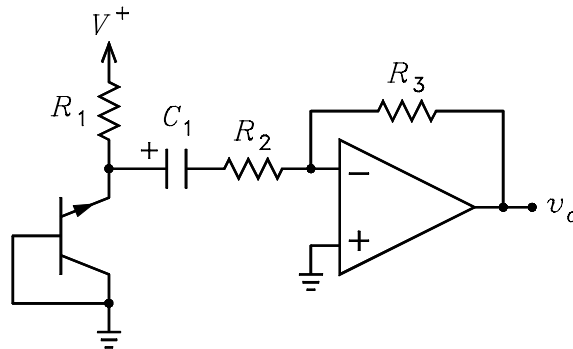


Figure 1: Suggested white noise generator.

After the optimum value of R_1 is determined, R_3 should be adjusted so that the observed noise waveform on the oscilloscope has peak values that are approximately in the range of 120 mV to 180 mV. For a noise signal, the rms value is approximately 1/4 to 1/3 of the observed peak values. Thus the rms value of v_o should be in the range from 30 mV to about 60 mV. You should turn on

the 20 MHz bandwidth limit on the oscilloscope to measure the noise. With Dr. Brewer's reluctant assistance, the noise spectrum of your noise generator can be measured and documented.

This is only the first part of this experiment. Further details will be posted. In particular a suggested circuit for converting the white noise into pink noise will be given with its design formulas.