EG-03 Speaker

Introduction

Acoustical experiments need a compact source of sound so that the electrical signals can be heard. The very meaning of the word requires that the sense of hearing is involved. The human ear is an elegant detector of frequency and amplitude of sound waves. The EG-03 Speaker produces the audible sound for the ear to evaluate. The EG-02 Operational Amplifier has enough power to operate one or two EG-03 Speakers. The Speaker can be driven by the EG-50 Audio Driver set to a low amplitude. If the output is turned up, the Speaker may fail due to excessive power.

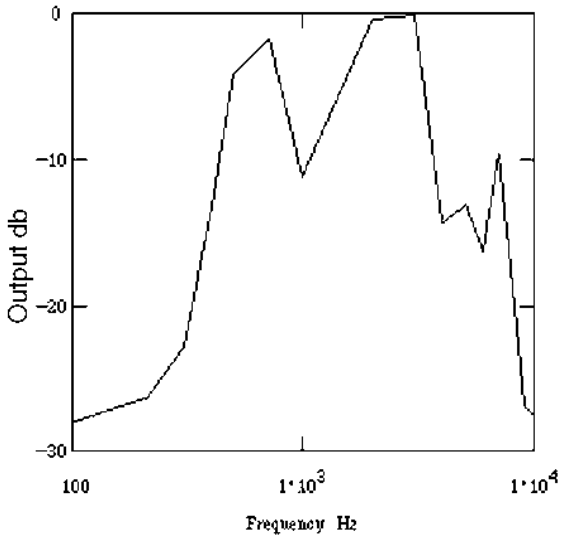

Figure One

The audio output of the EG-03 Speaker extends from 300 Hz to 7 kHz. It has an input impedance of 8 ohms. A typical response curve of a Speaker is shown in Figure One.

Typical Experiment

The output of the EG-03 Speaker can be measured with the EG-04 Microphone. This will not give the absolute response of the microphone and/or the speaker but will indicate the frequency range at which they will work together.

1. Set the Op Amp and microphone on a clear bench top. Set the Speaker 30 cm from the microphone. The microphone and speaker should be taped to the bench so that they will not move during the measurements. The Speaker should be connected to an EG-01 Function Generator or an EG-50 Audio Driver.

2. The microphone's plugs are color-coded. The yellow (*YEL*) is the ac output of the microphone, the black (*BLK*) is ground, and the remaining red plug (*RED*) connects to the dc power supply. Connect these to the Op Amp so that the *BLK* connects to the *BLK* input jack, the *YEL* connects to the red input jack and the *RED* connects to the +6 Vdc supply on the front panel.

3. Connect an ac voltmeter to the output of the Op Amp. If one is available, connect an oscilloscope to the output of the amplifier as well.

4. Adjust the Function Generator to 2.5 kHz. This is near the peak response of the combination. Set the output of the Function Generator so that the Op Amp output signal is 1.5 Vac. This adjustment will prevent the amplifier or microphone from overloading during the measurement.

5. Set the frequency of the Function Generator to 100 Hz and measure the output signal from the amplifier. This frequency is below the band pass of the combination and the signal you will measure represents hum and noise picked up on the leads or from the amplifier. Adjust the frequency in 100 Hz steps and record the output voltage.

6. The sound level becomes quite loud in the 2 to 3 kHz frequency range. This is the resonant peak of the small loudspeaker. The response of the speaker and microphone is useful from 400 Hz to 7 kHz. By 10 kHz there is no response. The band pass is limited more by the small speaker than by the microphone, but when planning experiments try to stay within this frequency range.

This short experiment gives some practice in setting up acoustic measurements. Sound waves reflect easily so that reflections adding to the direct signal are always a problem. When precision acoustic measurements are needed, they are performed in an anechoid chamber. This chamber has interior surfaces that absorb virtually all of the sound that strikes them so those echoes are largely eliminated.

Interference can be observed between coherent sources of sound. In the audible range, the wavelength of sound is quite long; for example the wavelength is 33 cm for a 1 kHz frequency. In order to observe interference between two sources, they have to be fairly far apart so that the interference pattern is big enough to properly measure. This is the reason that many acoustic interference experiments are performed using ultrasonic frequencies i.e. 40 kHz, so that the wavelength is quite short and the interference pattern broad enough to easily measure.

If two EG-03 Speakers are available, a simple demonstration of interference of sound waves can be set up.

1. Connect both speakers in parallel to the output of an EG-50 Audio Driver. Set them on a flat bench top facing an EG-04 Microphone and 60 cm from it.

2. Set the Driver frequency to 7 kHz.

3. Adjust the separation between the speakers to be about 20 cm. Observe the amplitude of the sine wave on the oscilloscope face.

4. Change the separation between the speakers and notice the change in amplitude of the sine wave. I observed a minimum when the separation was 21.5 cm, but your results may be quite different. You should be able to find a maximum and a minimum as the speakers are moved.

The reason that the maximum and minimum are not sharper is the presence of reflection from objects around the bench top and the bench top itself. You may observe that the amplitude changes as you move your arm while making adjustments. This simple experiment demonstrates interference of sound waves even if only partially.