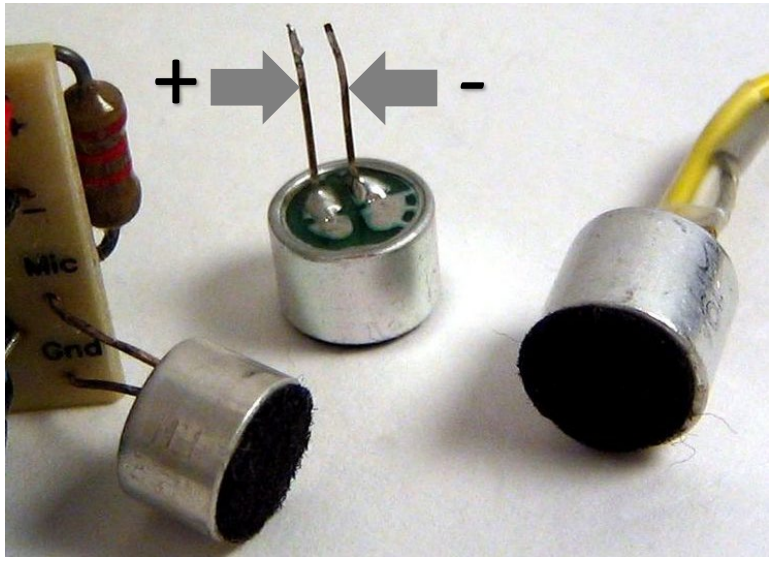
Electret Microphone

Laboratory Outline

An electret microphone with proper biasing (the way you apply voltages to power it and make it operate in a predictable manner) produces a response from ordinary sounds often measured only in the millivolts or tens-of-millivolts range. These voltages are small enough that typical electronic circuits would fail to capitalize on the sound information for typical sound applications like detection (did someone clap?), equalization (pump up the bass!), or even transmission over short distances (tiny signal + tiny noises = significant noise interference). For this reason, the electret microphone's output voltage should be immediately amplified to both preserve the original integrity (lowest noise) version of the signal and allow for additional electronics operations at voltage levels typical of basic electronic devices like diodes and transistors.



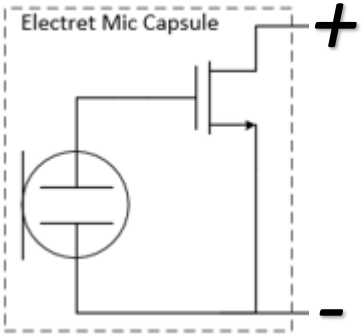


***Figure 1**: A photo and a model of the inner operation of the electret microphone capsule. Close examination of the photo shows the negative lead has metallic connections to the case or "can" of the mic capsule. Photo credit: https://upload.wikimedia.org/wikipedia/commons/5/57/Electret_condenser_microphone_capsules.jpg*

Notes:

Prerequisites

- Recommended module: OpAmp Amplifier with Gain and Offset Control
- Knowing how to construct a breadboard circuit containing an IC.
- Use of an oscilloscope.

Parts Needed

- (1) $1\ k\Omega$ resistor, (1) $1\ k\Omega$ potentiometer, (1) $0.1\ \mu F$ capacitor
- (1) electret microphone capsule,
- A battery with nominal voltage 6-9 volts

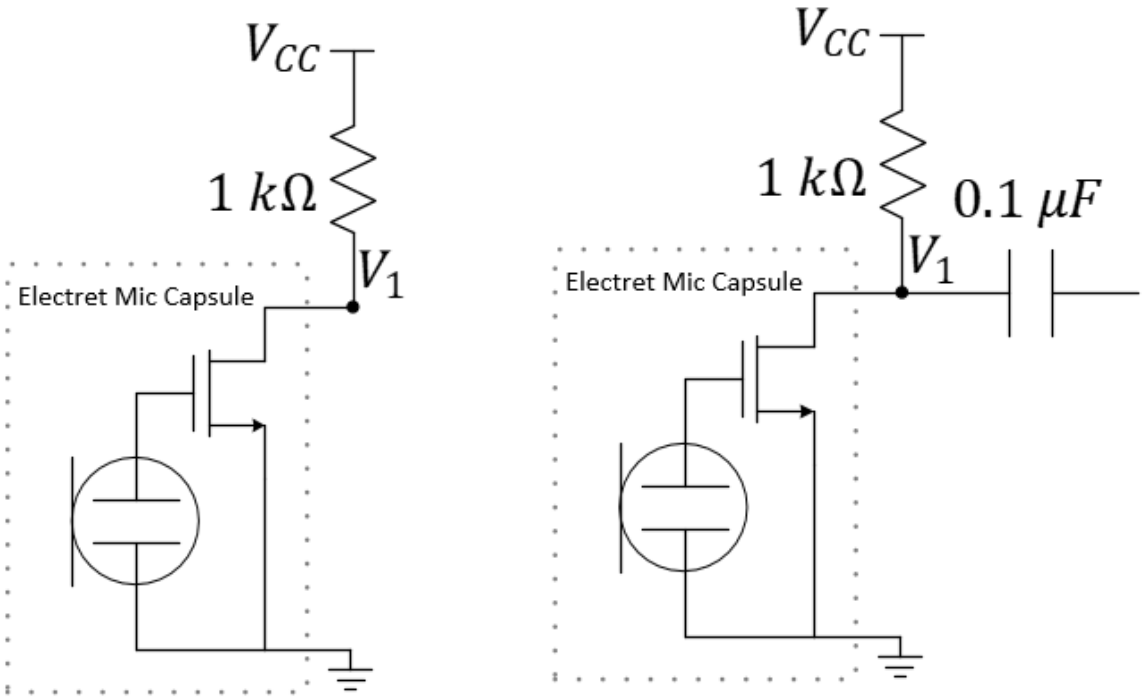
Learning Objectives

- To gain practical experience in circuit building and use of a microphone.
- To improve oscilloscope skills.

Procedure

Part of this construction may be done at home to save lab time for when you need access to the benchtop equipment.

Notes:



(a) (b)

***Figure 2**: (a) A resistor provides bias to the internal MOSFET of the capsule. (b) An AC-coupling capacitor removes the DC component of V_1 before sending the microphone signal to the next component.*

"Bias" the Mic: Please be aware that the microphone is NOT symmetric. The internal MOSFET is a transistor that must be biased properly as discussed in lecture and shown in Figure 2. A close observation of the electret microphone capsule (Figure 1) will allow you to determine which of the two leads should be attached to the negative side of the battery (shown in Figure 2 as ground). Build Figure 2 (b). ***Do not actually attach a battery yet.*** Instead, just make the connections for V_{CC} and ground to the power rails of the breadboard.

Check: You can now connect one channel of your oscilloscope to view the output after the $0.1\ \mu F$ capacitor (relative to ground). If you connect the battery and adjust your oscilloscope settings (horizontal and vertical), you should be able to see a (very-small voltage) sinusoid when you whistle into the mic.

Notes:

Explore Even More!

The voltage level of this simple microphone circuit is too small for most applications. Consider completion of the module **Microphone with Voltage Amplification** which uses an operational amplifier (LM358) to boost the voltage levels.

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To gain credit for this module, you will need to submit a video that states your name and section, shows your circuit, and then demonstrates the response of $\tilde{V}_1$ to a clap and/or whistle. Comment on the voltage level and whether it is high enough to drive, say, a diode-based half-wave rectifier.