

Acoustic Resonators, Filters, Microphones and Loudspeakers

EC 522 Acoustics
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Helmholtz Resonator

- ▶ Helmholtz noticed that at a certain frequency, resonance frequency, the pressure inside the cavity is bigger than the input pressure.

- ▶ SPL-gain

$$n_0 = 20 \log Q_0$$

$$= 20 \log \left(\frac{1}{\omega_0 R_A C_A} \right)$$

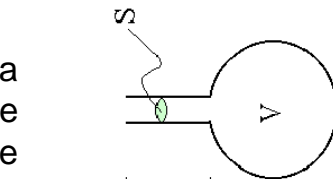
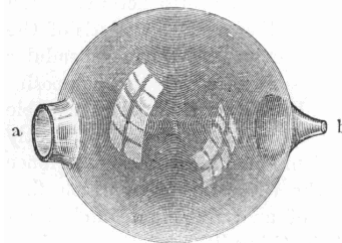


FIG. 16a.

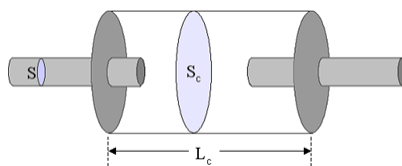


Helmholtz Resonators (cont.)

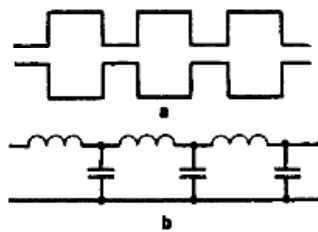
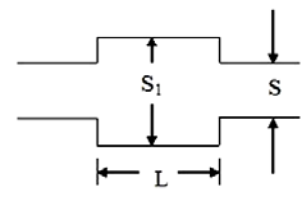
- ▶ Helmholtz theorized that musical and speech vowel sounds are composed of different frequencies, referred to as harmonics.
- ▶ Tonal quality of the sound is determined by the relative intensity of these harmonics.
- ▶ Using the amplifying effect of sympathetic resonance, Helmholtz designed and used these resonators to identify and estimate the relative strengths of the partials present in these sounds.
- ▶ The resonators were designed to have a very precise natural frequency and in general, the larger the resonator the lower the frequency.



Low-Pass Filter

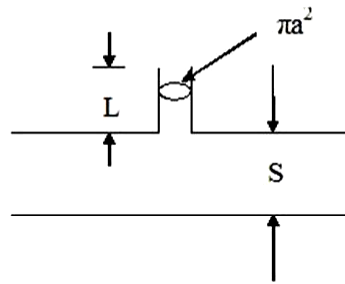


Low-Pass Filter Schematic



High-Pass Filter

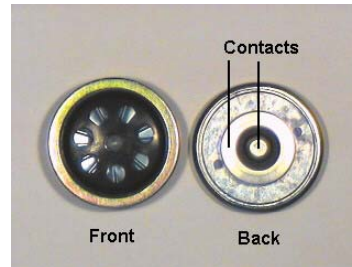
High-Pass Filter Schematic



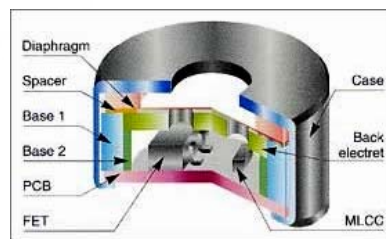
Types of Microphones

- ▶ Compare microphones based on sensitivity and frequency response.
- ▶ There are four key types of microphones:
 - ▶ Carbon
 - ▶ Condenser
 - ▶ Dynamic
 - ▶ Crystal

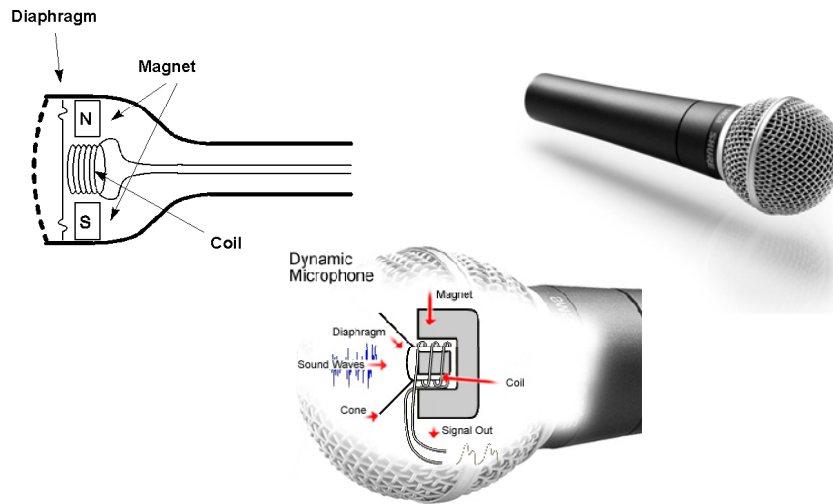
Carbon Microphone



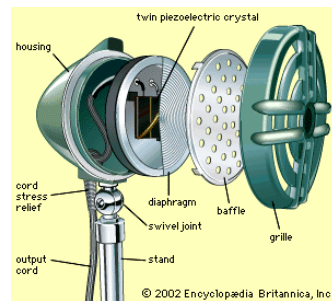
Condenser Microphone



Dynamic Microphone



Crystal Microphone

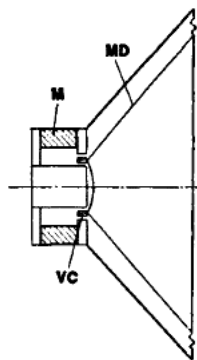


Loudspeakers

- ▶ Direct radiator → efficiency < 10 % ~ 5%
- ▶ Horn loudspeaker → efficiency > 10 % ~ 25%



Direct Radiator Loudspeaker



Horn-Type Loudspeaker

