

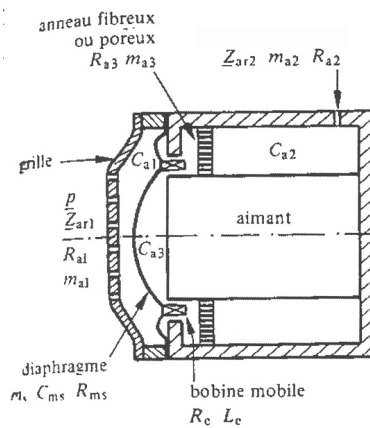
Chapter V - 1. Microphones

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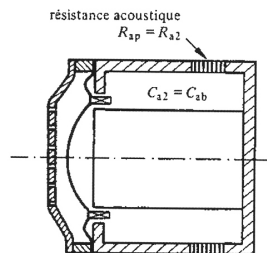
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Exercice 1. Omnidirectional electrodynamic microphone

Let's consider the omnidirectional electrodynamic microphone represented as a cut-view on the following figure :

**Figure 1** – Omnidirectional electrodynamic microphone scheme

1. Justify the directivity of the microphone by examining the scheme of Fig. 1.
2. What is the use of the hole (m_{a2} , R_{a2}) ?
3. Justify the use of the grid (m_{a1} , R_{a1}) and the ring of fibrous material (m_{a3} , R_{a3}).
4. Establish the electro-mechanical scheme of the microphone (including the two-ports).
5. Derive the pressure sensitivity function $\frac{u(f)}{p(f)}$
6. What happens if we modify the acoustic circuit as in Figure 2 ?

**Figure 2** – Modified electrodynamic microphone

Exercice 2. Omnidirectional electrostatic (measurement) microphone

Let's consider the electrostatic microphone which is illustrated on the following figure :

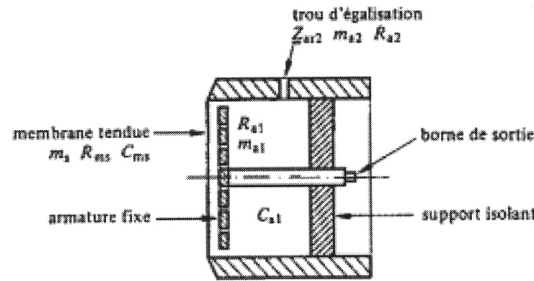


Figure 3 – Omnidirectional electrostatic microphone scheme

1. Establish the electro-mechanical scheme of the microphone (including the two-ports).
2. Derive the sensitivity in pressure $\frac{u(f)}{p(f)}$
3. What happens if we modify the acoustic circuit as in the following figure ?

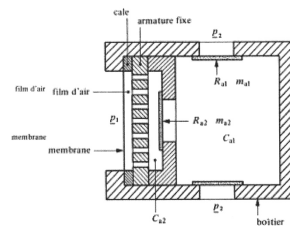


Figure 4 – Alternative electrostatic microphone scheme

4. Draw the electro-mechanical scheme of the modified microphone.

Exercice 3. Microphone sensitivity

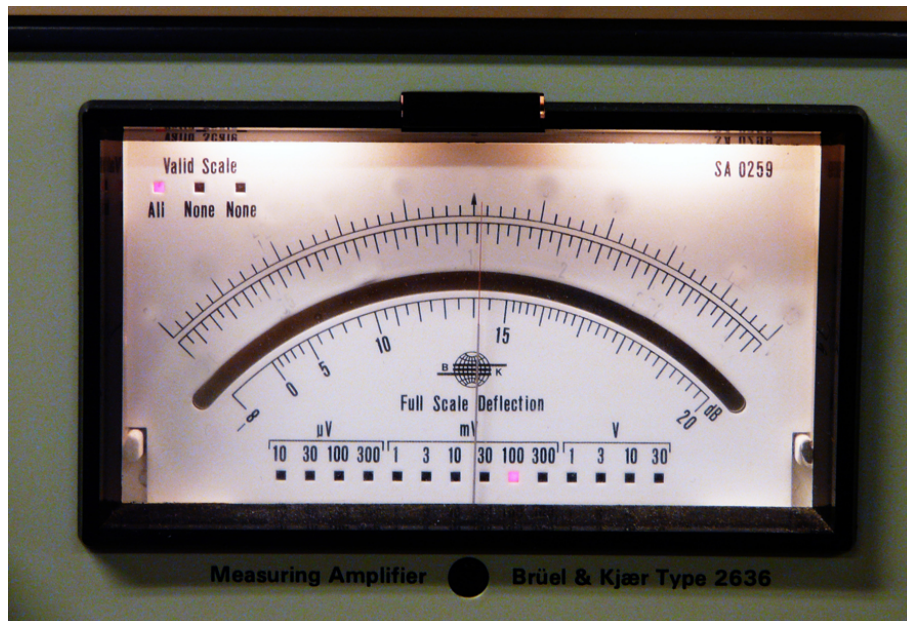
We want to measure a sound pressure rms value $\tilde{p}$ in Pa. You own a measurement microphone of which the only sensitivity level L_M (dB re. 1V/Pa) is specified.

You also own a microphone pre-amplifier, on which the microphone is connected, with a VU-meter displaying a voltage level L_U (dB re. 1 μ V). During the measurement, the VU-meter is set to display $L_{U,max}=100$ dB (re. 1 μ V) on full-scale.

1. What is the maximum rms value of voltage measurable at full-scale with this setting ?
2. Give the expression of :
 - the sound pressure level L_p (in dB re. 20 μ Pa) as a function of the rms value of pressure $\tilde{p}$ and the reference pressure $\tilde{p}_0$
 - the voltage level L_U (in dB re. 1 V) as a function of the voltage U and the reference voltage U_0

- the linear sensitivity M (in V/Pa) as a function of the intensity level L_M and the reference sensitivity M_0

We measure the following value :



- Derive the relationship giving L_p as a function of L_U and L_M . What is the sound pressure level, and then the rms value of pressure measured in this case?

Definition : a microphone sensitivity is defined as the ratio of the output voltage of the microphone over the input sound pressure p .

Numerical application : $L_M = -26.2$ dB (re. 1 V/Pa); $U_0 = 1$ μ V; $p_0 = 20$ μ Pa; $M_0 = 1$ V/Pa.