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Recommended design guideline for micro speakers

Common Application Design Guidelines

- Back volume
  - … why a closed back volume?
  - … how to connect to the speaker?
  - … mechanical robustness
  - … acoustical influence
- Sound Port
  - … opening size vs. Bandwidth
  - … damping/acoustic load
  - … turbulence/noise

Back volume

... Why a closed back volume?

- ... to have a well defined acoustical environment behind the speaker
  - Well defined acoustical performance

- ... to be able to adjust the resonance frequency of the system
  - Resonance frequency range is the most efficient range of the speaker

- ... to avoid acoustical short circuit
  - Speaker for closed box design needed

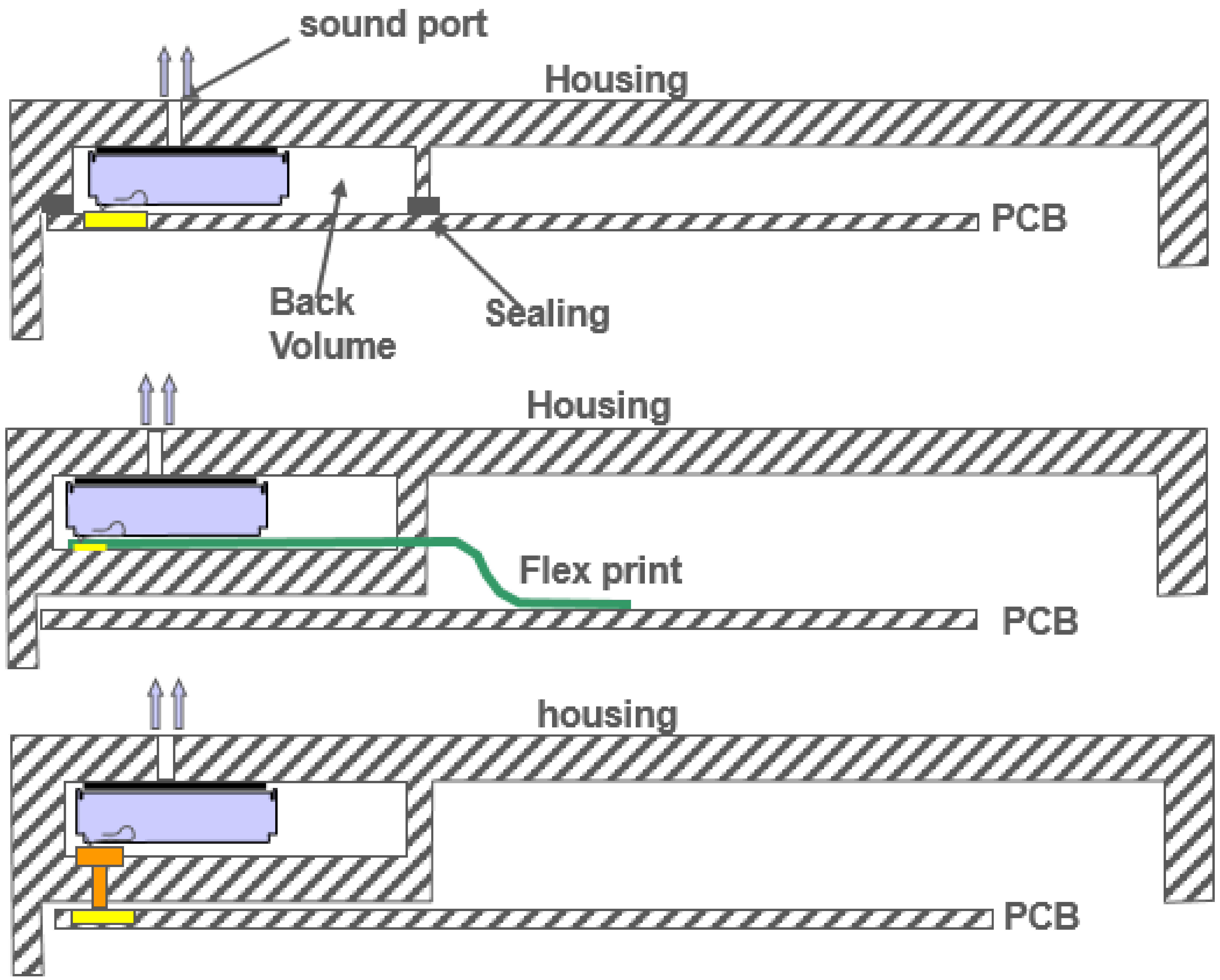
Back volume

… How to connect to the speaker?

- Using PCB as box-cover
- Directly contacting to PCB

- Create closed box
- Contacting with flex-print

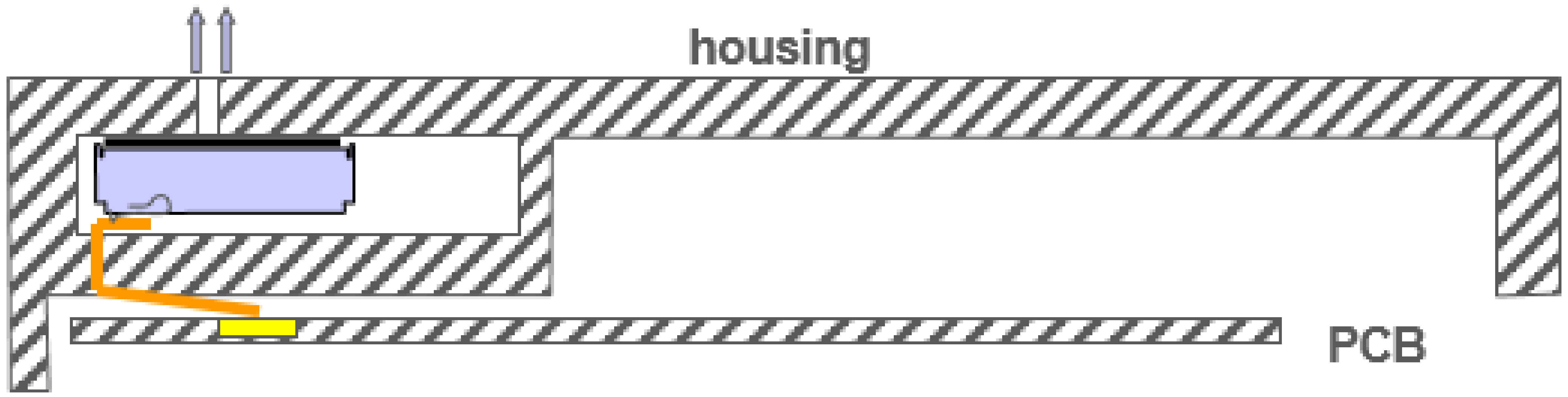
- Create closed box
- Contacting with contact pin



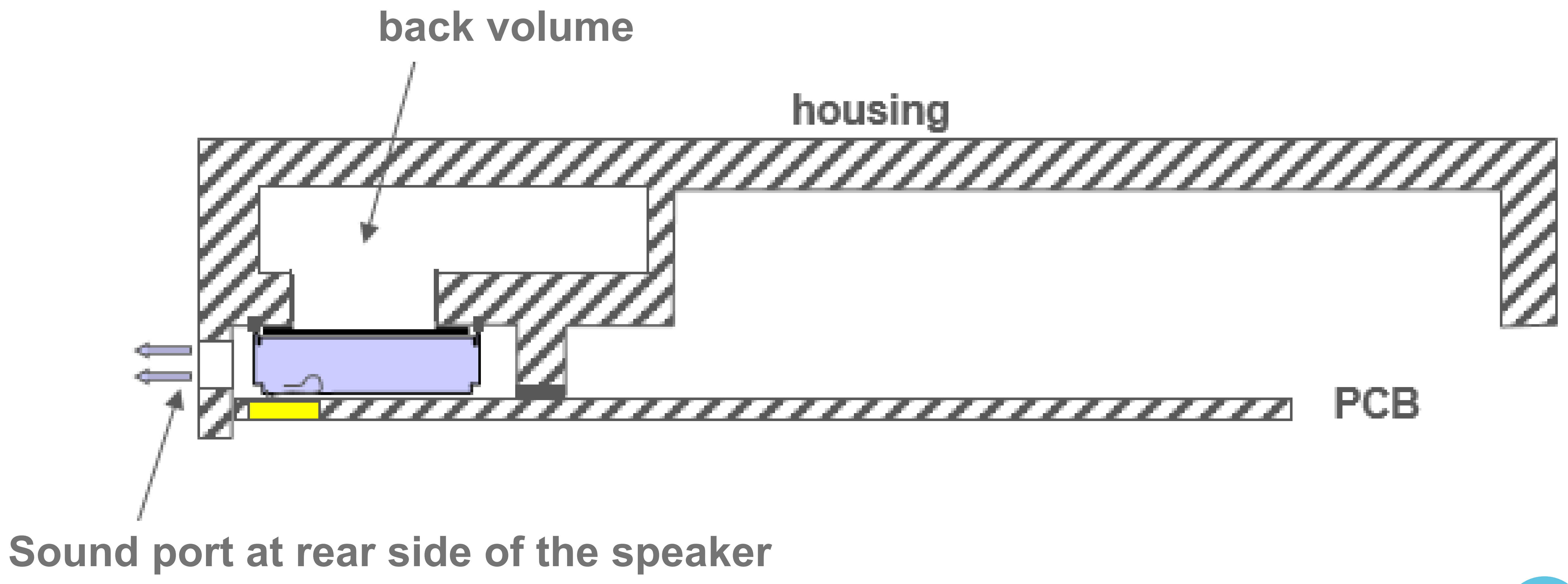
Back volume

… How to connect to the speaker?

- Create closed box
- Contacting with contact spring



- Reverse application
- Directly contacting to PCB



Back volume

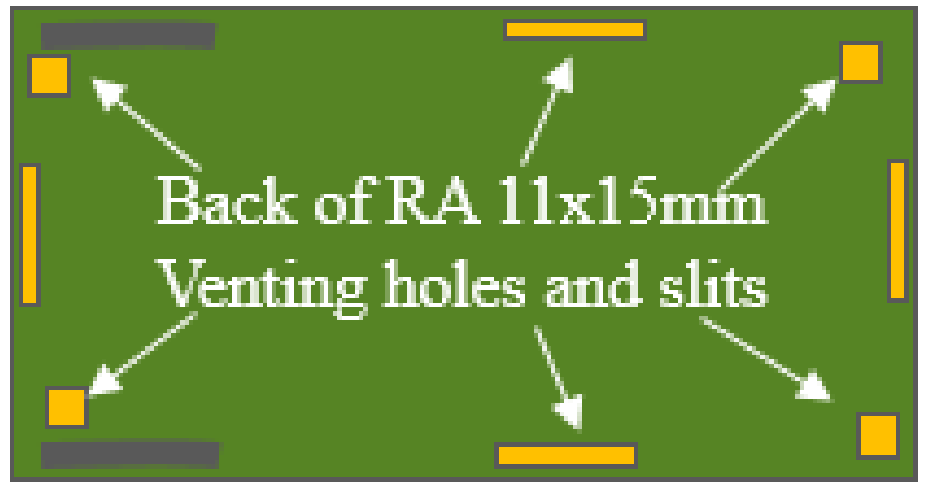
… Mechanical robustness

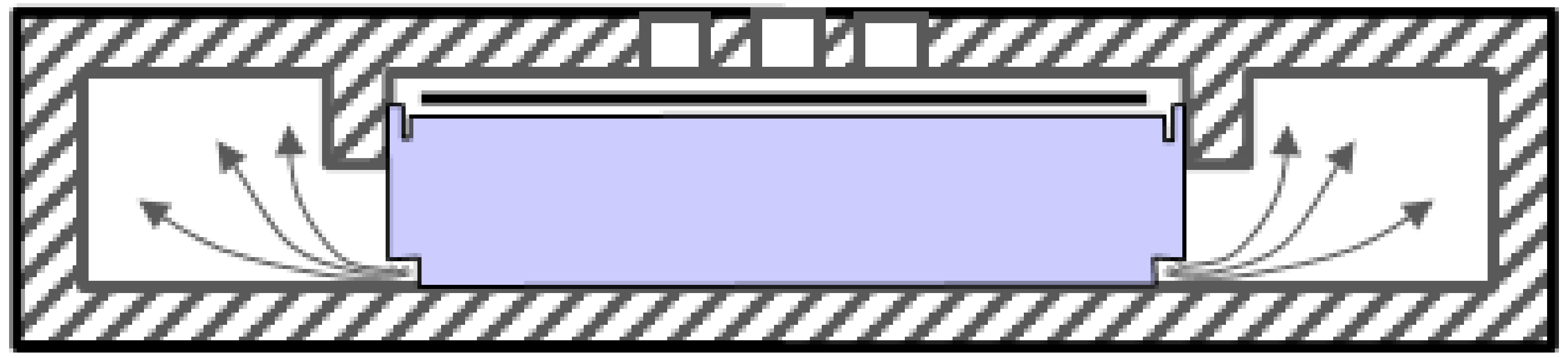
- Min. wall thickness to avoid wall resonating (depends on material)
- Avoid « wall-to-wall-design » (e.g. antenna module)
  - Vibrations can cause rattling noise
- Use « sandwich » for applying the speaker (foam-gasket, speaker, hard support at rear side)
- No heat-radiating components inside the back volume
- Etc.

Back volume

Back venting of RA11x15

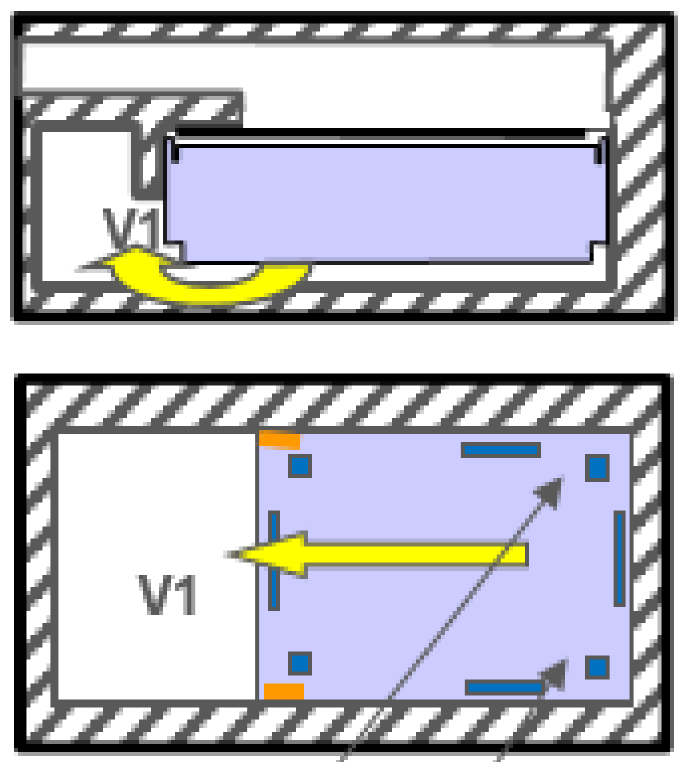
- It is possible to put the RA completely down on a PCB or module housing
- Venting to the back is provided by 4 venting holes and slits
- All 4 holes should lead to a common, closed back volume

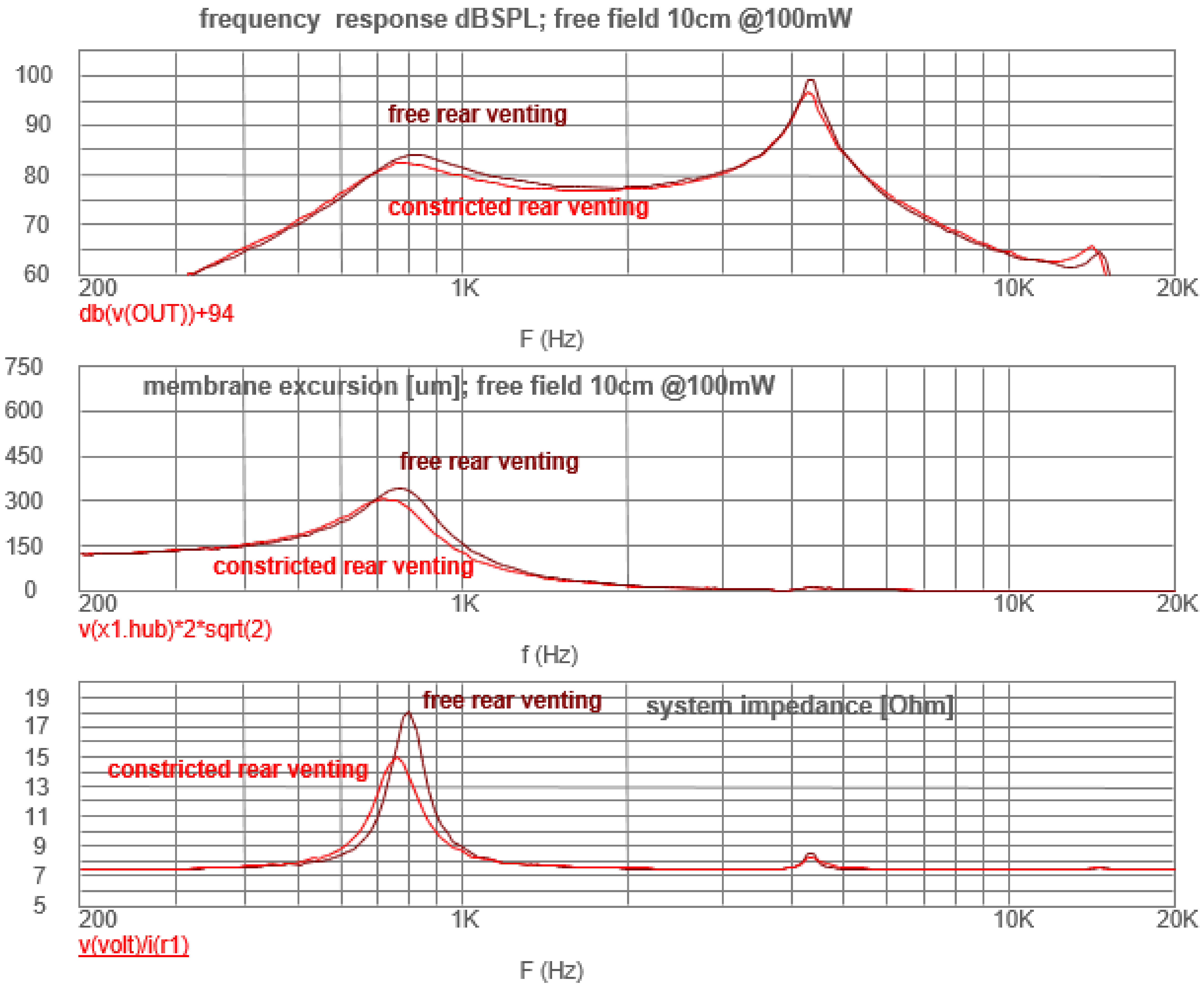




Back volume

Acoustic load at the rear side of speaker





Speaker surounded on three sides by walls will influence resonance frequency and sensitivity.

Additional acoustic load will reduce performance compared to a free scenario

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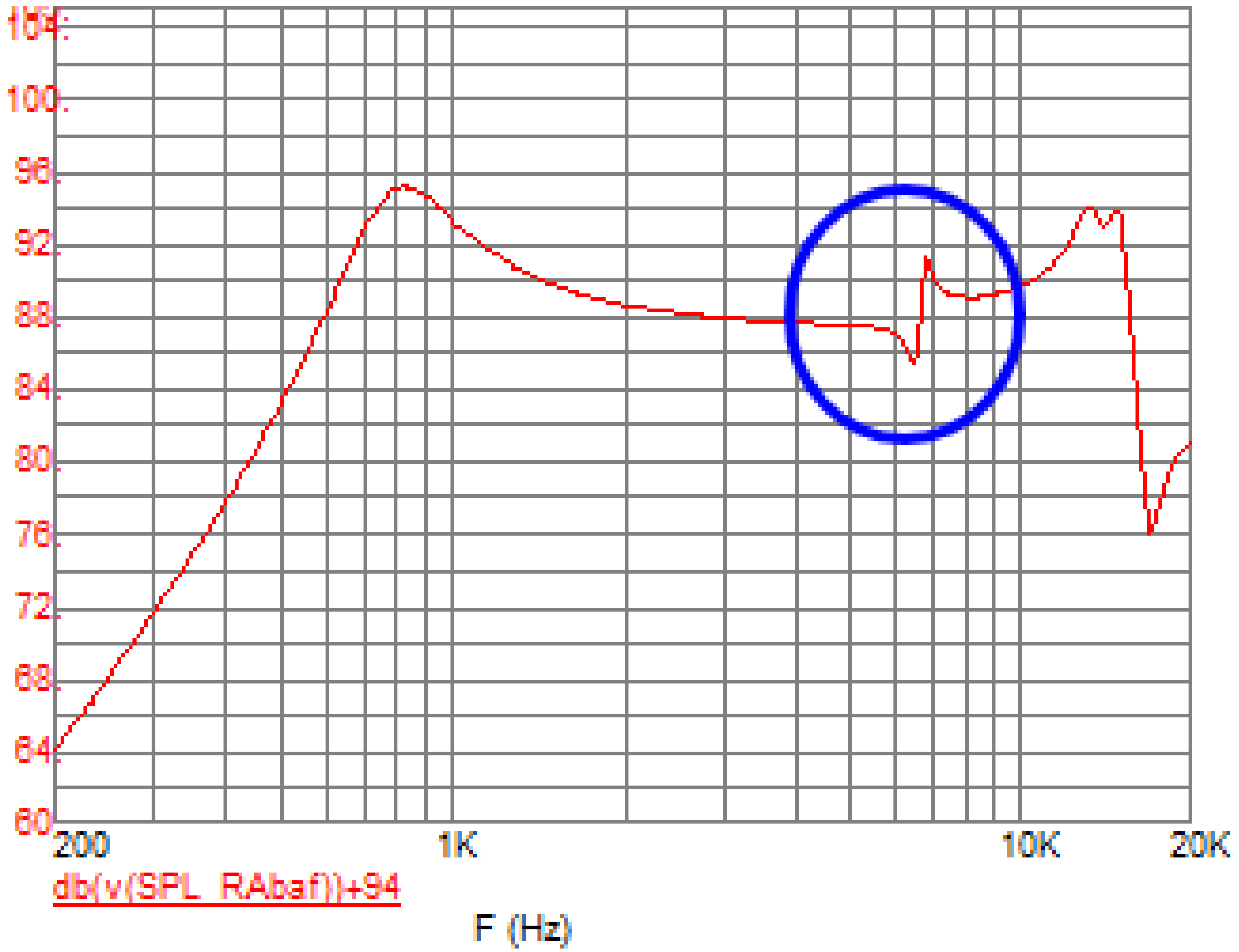
Back volume

Acoustical influence

- Channels connecting parts of the back volume can cause peaks in frequency response
- Shape of volume: high aspect ratio volume spaces do not constitute effective volume

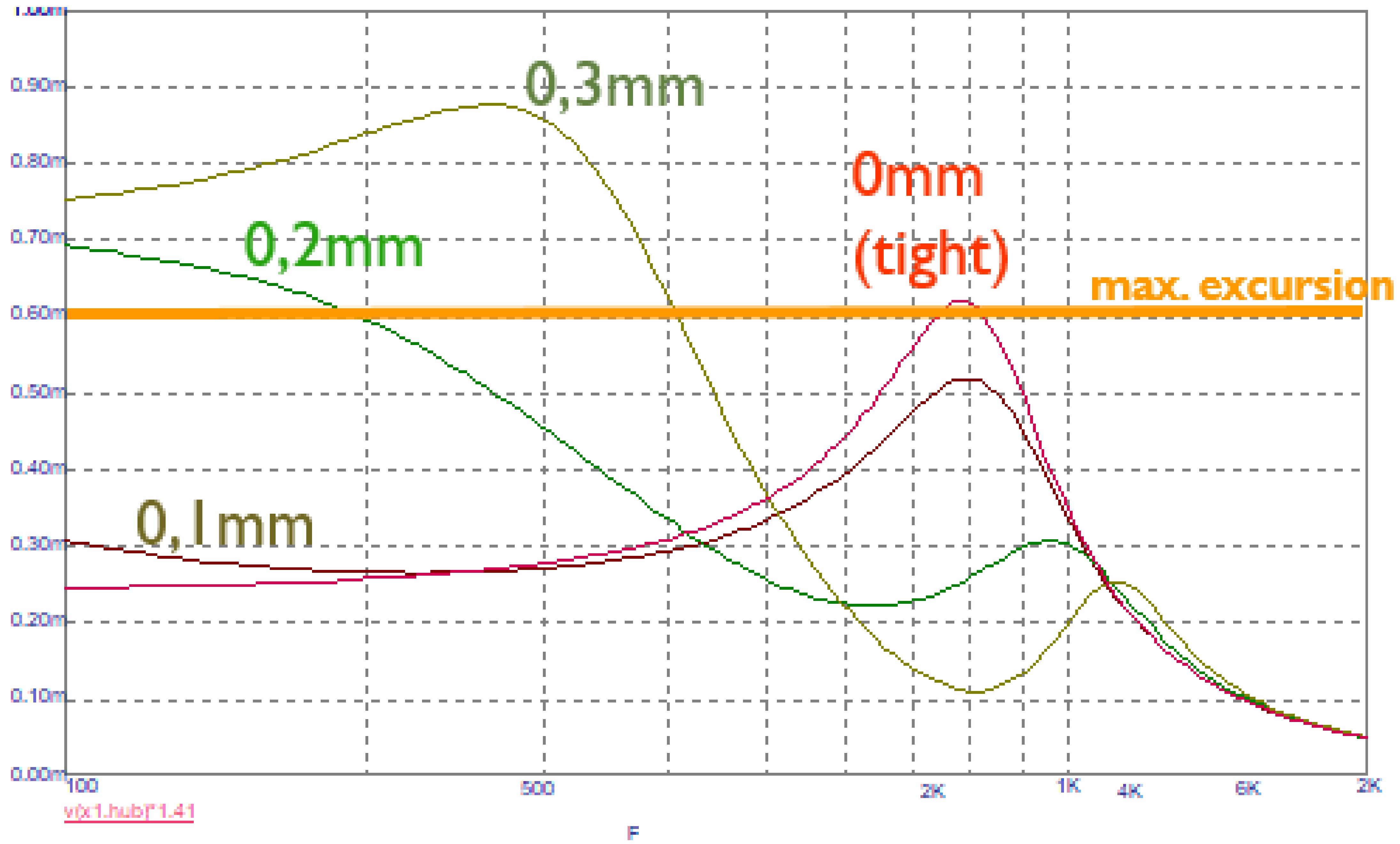


Back volume

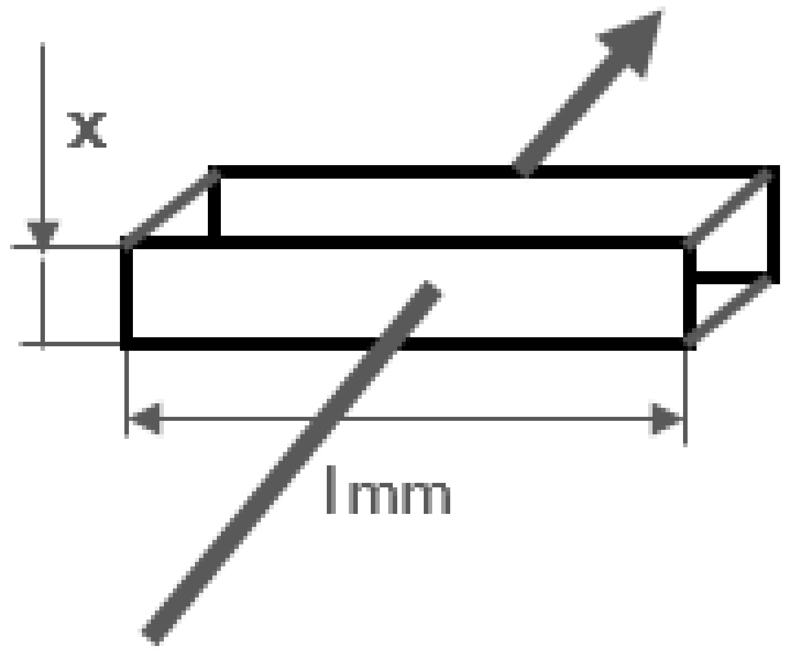
Acoustical influence

- Leaks can cause damage to the speaker by exceeding maximum membrane excursion

Simulation: excursion RA11x15 in 1ccm back volume; P = 350mW (@ 8Ohm)

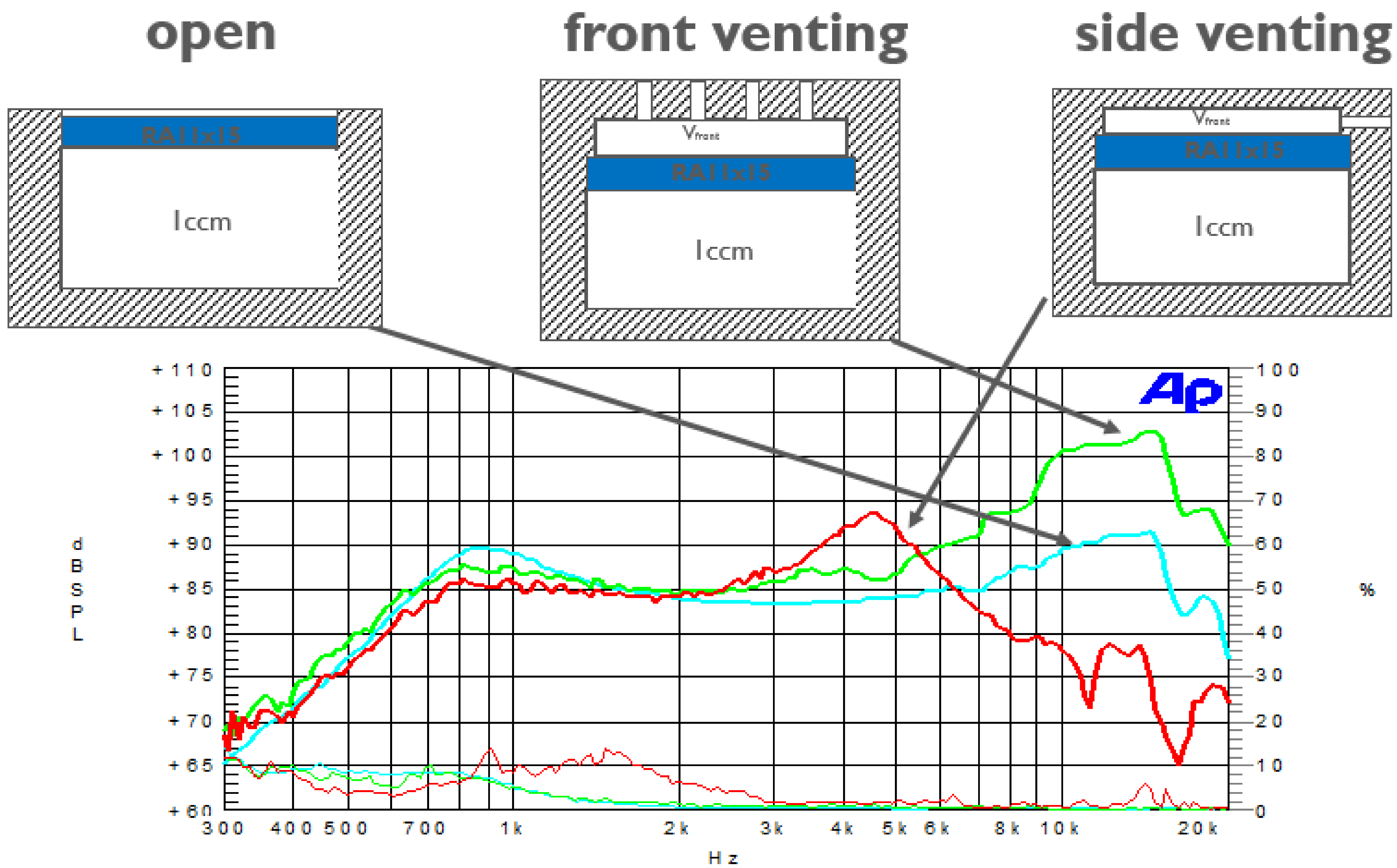


variable slit dimension x



Sound Port

Opening size vs. Bandwidth

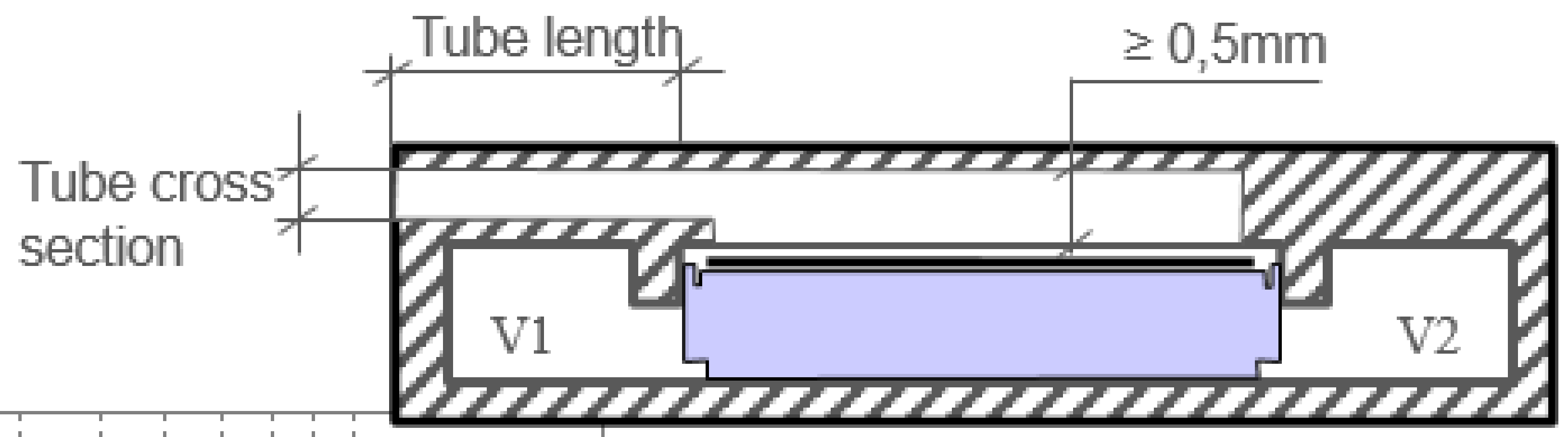


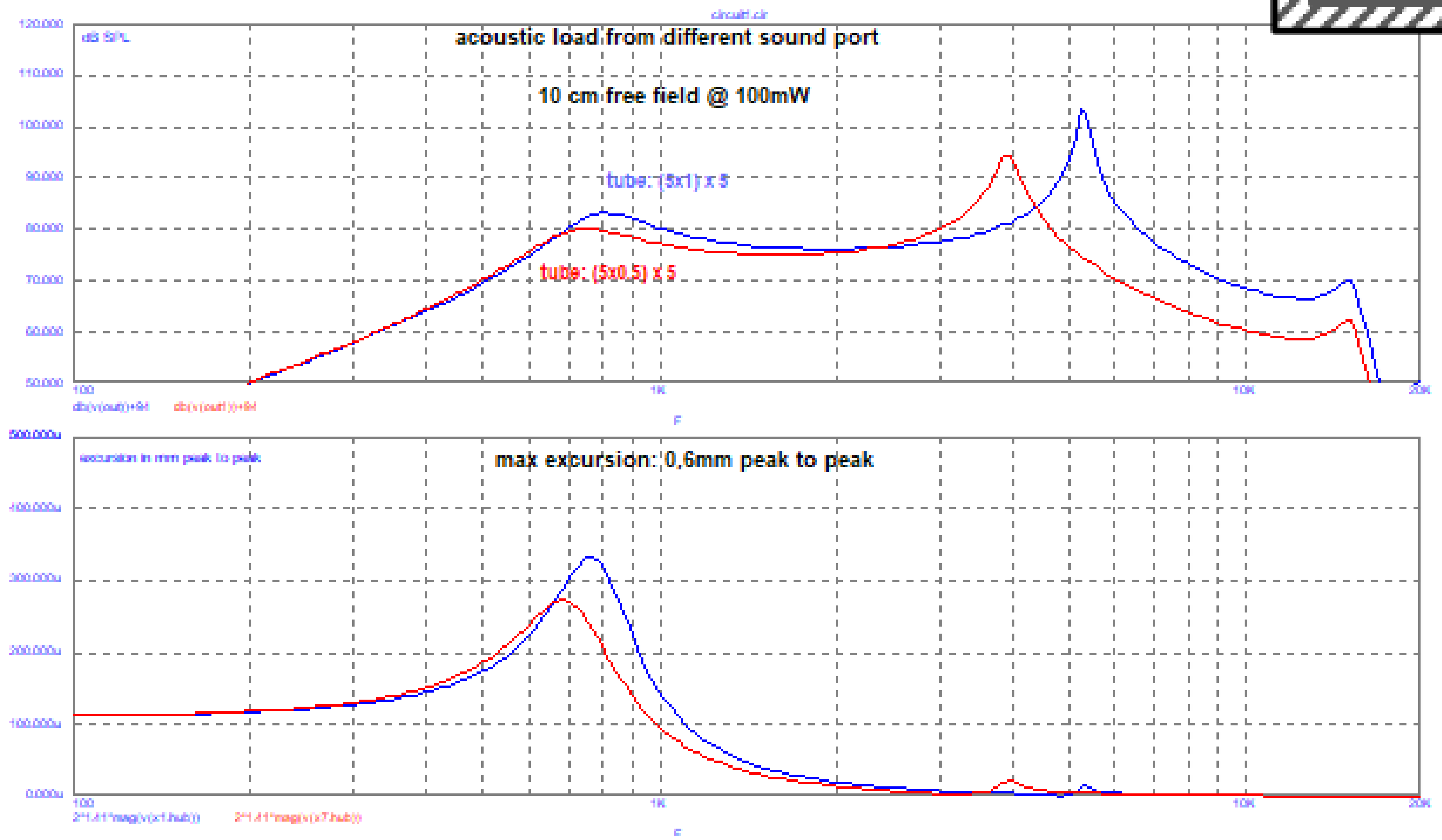
Sound Port

Acoustic load by side venting sound port

Tube dimensions have a dramatic influence on the acoustic performance.

Tube length: avoid sharp edges or corners that could result in audible turbulence.





Distance from top of speaker to housing should be at least 0,5mm to avoid audible turbulence.

Dimensions:

V1 = V2

V1 + V2 = 0,8ccm

Tube 1: (5x1) x 5 mm

Tube 2: (5x0.5) x 5 mm

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Sound Port

Turbulence/noise

Possible reasons:

- Sound port openings too small
- Front volume too small
- Sharp edges in sound port
- Damping mesh on sound port too tight

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THANKS !