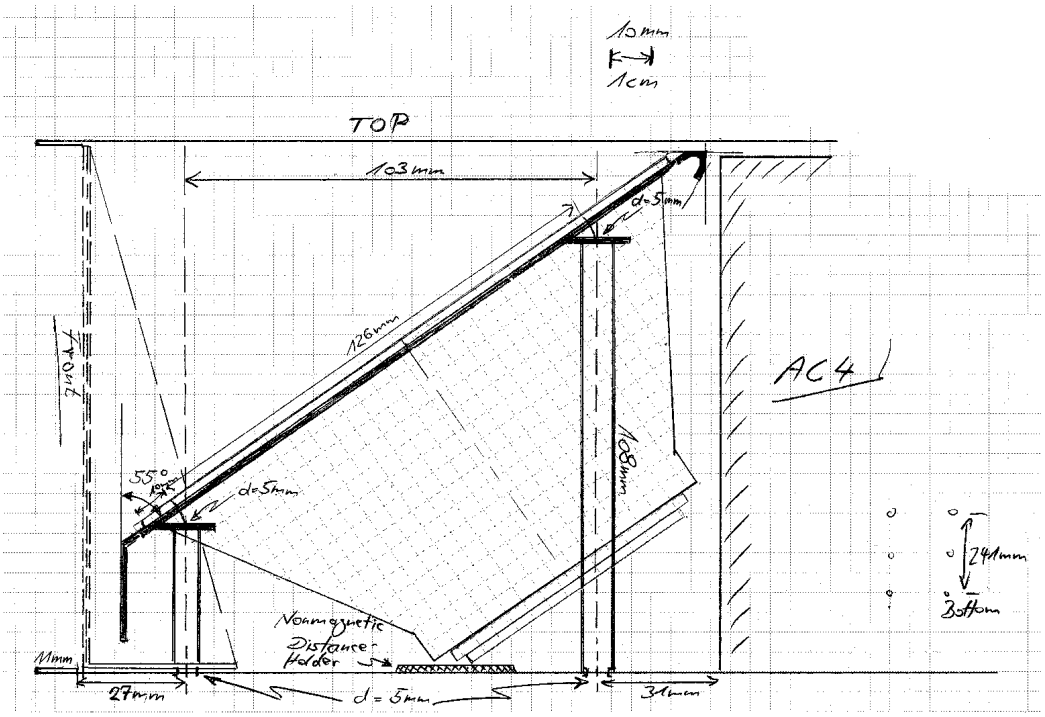
Repair of a Drake Speaker MS-4

My MS-4 had a bad sound, getting worse with the time. Removing the speaker´s chassis and testing it showed a severe sensitivity against mechanical stress and tension. Depending upon which one of the four mounting screws was fixed harder or softer, the sound got better or worse. This effect was much bigger than it could be expected from such a speaker.

So i decided to exchange the speaker – but couldn´t find any with similar dimensions. Additionally, i wanted to have a lower resonance frequency (f_c) of the new speaker, because i measured actually app. 125Hz - with the speaker´s chassis out of the MS-4´s case.
See addendum for the measurement of a speaker´s f_c !

But speakers with a lower f_c are bigger and won´t fit into the existing case. There was a problem to solve.
I´ve chosen a woover (30Hz to 7kHz) with an outer diameter of app. 160mm and f_c = 45Hz.

First step was to make a drawing of the case including AC4 and the speaker (picture 1).
The speaker is mounted with an angle of app. 55 degrees!

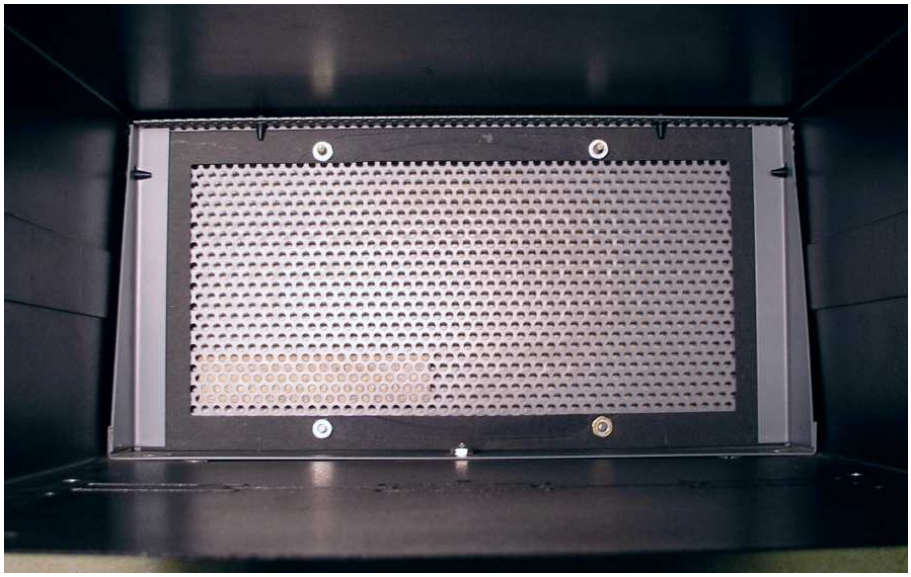


Picture 1: Drawing of the MS-4 (inside view)

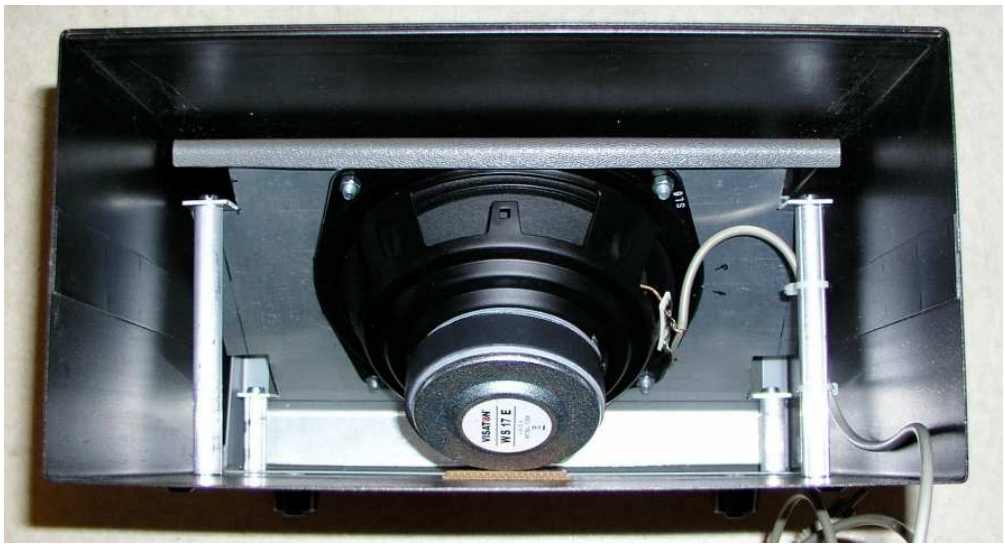
Based on this drawing all dimensions can be exactly defined. The existing holes in the bottom of the case can be used, but they had to be bored up to 5,5mm for a metric M5-screw.
A plate (aluminum) was cut, drilled and bent according to this drawing.
Four bolts (aluminum, 10mm diameter) were cut and screw-threads (metric M5) bored at both ends, see pictures 2 to 5.

Picture 2 – 5: Views of the speaker´s plate

The inside front-cover, made from hard paper, was cut rectangular and the speaker mounted – see pictures 6 and 7.



Picture 6: Front –inside view



Picture 7: Inside view with speaker

Important!

Damping material for HiFi-boxes was used to avoid mechanical resonances inside the case (pictures 8 and 9). This was necessary, because i had bad resonances without damping.
A small piece of an experimental board is used to avoid mechanical contact between the woovers magnet and the bottom of the case („distance holder“ - see pictures 1 and 7).

All screws have to be fixed firmly to avoid unwanted vibrations.

Picture 8 and 9: Damping material

A rear cover was made from a double coated pcb with one M5-nut soldered at the right point to fix it at the bottom of the case – see pictures 10 and 11.

Please note:

It´s important to have in mind that the AC4-supply should be installed later; therefore all relevant distances and dimensions have to be considered (picture 1).

Picture 10: Rear Cover

Picture 11: Rear cover installed

Result:

My new MS-4 has a big sound.
The measured resonance frequency (f_c) with the AC4 installed is 66,5 Hz and can only be felt but not heard.

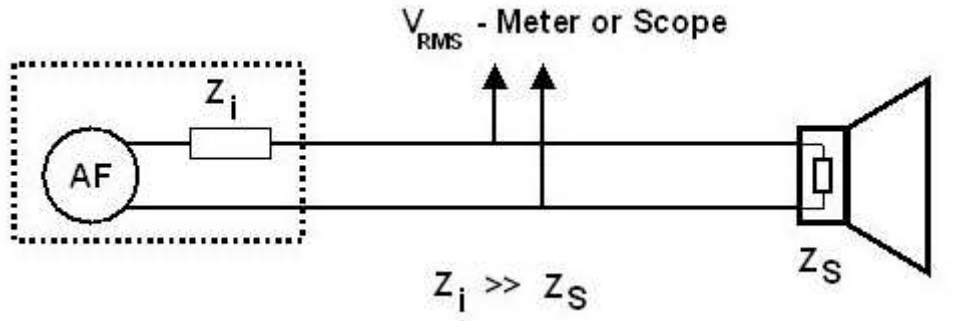
Without damping material, the MS-4 had three resonance frequencies: 77,2Hz; 52,7Hz and 49,0Hz !!!

Addendum

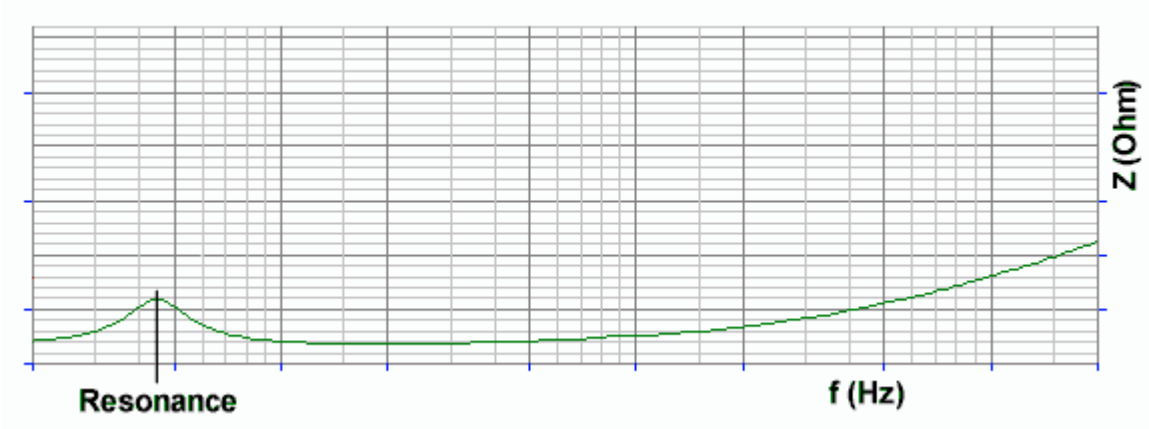
How to measure the resonance-frequency (f_c) of a speaker

Principle: At the resonance frequency (= mechanical resonance), the speaker´s coil moves easier, has less losses and therefore a higher impedance.

1. Connect a levelled(!) audiogenerator (at least 10Hz to 10kHz) to the speaker
2. Z_i of the generator should be much bigger than 4 Ohms, proposed are 50 Ohm
3. Connect a RMS-voltmeter or a scope parallel to the speaker
4. Set the generators outputlevel for a convenient acoustic level at 1kHz
5. Tune the generator´s frequency without(!) changing the output-level



6. You will get a curve like this:



7. f_c can be seen as the local maximum of the impedance (= voltage) at a low frequency, typ. 30 to 100Hz. Several f_c ´s are possible if the case is not sufficiently damped.
   The increase of the impedance at higher frequencies is due to the coil´s inductivity.

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