Subwoofer design with SLAPS passive radiator

4 easy steps to build the perfect subwoofer with SLAPS

SLAPS is a patented system that dramatically increases subwoofer efficiency and capability for ultra low frequency reproduction. SLAPS stands for Symmetrically Loaded Audio Passive System. As the name indicates, SLAPS is built symmetrically which distinguishes it from traditional passive devices. SLAPS integrates identical components in its suspension and design ensuring the unit is moving identically in both directions. The revolutionary efficiency and performance are the result of the pneumatic coupling between SLAPS and the active driver. SLAPS overcomes the limitations known from conventional closed and ported designs that prevent radical excursion and deep response. The unique design allows the active driver compression-free movement resulting in deep, dynamic and hard-hitting bass response.

The only thing a SLAPS has in common with a traditional passive device is that it is passive, besides that few similarities exists. Conventional computer modeling software will not work correctly with SLAPS and will in most cases greatly overestimate the internal volume of the optimal cabinet.

1. Why, how and what do I do?

Why use SLAPS radiator instead of a sealed or ported cabinet?

- SLAPS increases a subwoofer efficiency and capability for ultra low frequency reproduction (very deep Sub-bass) without the drawbacks of traditional designs.
- SLAPS opens up new subwoofer designs where even very small enclosures can be tuned to quite low frequencies. SLAPS can be custom tuned for optimum performance in a wide range of housing sizes and device configurations.

How does SLAPS work?

- A subwoofer design with SLAPS consists of an active sub woofer driver and a cabinet (sealed cabinet) and a SLAPS passive radiator.
- The SLAPS device is controlled by the active device through the alternating pressure and counter-pressure (vacuum) which occurs in a sealed cabinet when the active device plays bass. It gives you much better performance due to the increased surface area and the fact that the particles of air

inside the enclosure and outside the cabinet moves with the same speed and in a near phase relationship.[1]

A traditional bass reflex port design- the system is limited in performance due to the air in the reflex port not being in phase or at the same speed of movement as the air in front of the active driver.

How do I get started with my own design?

- You have to decide on what size bass speaker to use.

2. Initial planning.

- **CHOICE OF WOOFER** You've probably already given some thoughts to what size subwoofer you want to use and you probably also have a rough idea of how large your cabinet should be. Here are a few guidelines that you should follow:
- In principle you can choose what size bass speaker you want to use but it is recommended to use from 10 inch and up to 18 inches. There is in principle no limit to how many woofers or SLAPS devices you can use in the same cabinet. However it is important not to use a SLAPS smaller than the active woofer since it is not an efficient design. Using a larger SLAPS than active woofer is no problem. There can be several smaller SLAPS units, as long as the sum of which at minimum equals the surface area of the active device.
- It is important that the chosen woofer is a "LONG STROKE" or "LONG THROW" ie a woofer designed for Sub-bass.

Dbxi-15D
(long stroke woofer)

Pro-X15-8
(non-long stroke woofer)

- Active woofer unit should preferably have a resonance frequency (FS) of 30Hz or less and not more than 35 HZ. This data can be found in the woofers datasheet. The technical term is called- FS / Fs or F0 but it can also be listed as the resonance frequency or free air resonance or just resonance.
- If the selected woofer unit is of poor quality this will influence performance. Look for a woofer with a large magnet and heavy duty voice coil. It is important that the voice coil has a high winding height and is of large diameter. (Does not apply to

[1] *Phase* means that the active device and SLAP work almost concurrently and simultaneously creates respectively pressure and counter-pressure at the same time.

neodymium[2] magnets which are typically physically smaller)

SELECTION OF CABINET SIZE

- Whichever size woofer you choose will determine the size of the cabinet. It is important that the cabinet is solidly constructed so it does not vibrate or rattle. Typically 16 mm MDF or thicker. Particleboard or plywood are also excellent materials. You can also make the cabinet in acrylic or plexiglass. The most important thing is that the cabinet is completely sealed and does not vibrate.When using SLAPS, it is very important that the chassis is 100% sealed all joints and terminals / devices and SLAPS so no air can get either in or out.

- The following shows the cabinet size should be used with the different sizes of woofers. This covers all long stroke woofers of all brands. It is important that you do not exceed the maximum specified enclosure volume. The air inside the cabinet acts like a spring and the larger the enclosure the lower the linear output. This also introduces distortion.

10 "inch 20 - 45 liters internal volume sealed cabinet

12" inch 30-60 liters internal volume sealed cabinet

15 "inch 35-100 liters internal volume sealed cabinet

18" inch 50-140 liters internal volume sealed cabinet

The Slaps Passive Radiator should not touch the magnet. The minimum distance between woofer and Slaps is 8cm.

The bigger the cabinet, the lower the system resonance will be. If the minimum size cabinet is desired the system resonance can be lowered by adding weight to the SLAPS (see section 4 of this manual).

- Internal damping material should not be used as that lowers the precision of the pneumatic coupling between the active and passive driver.
- Make sure to design your cabinet so that there is room for both the woofer and SLAPS device and the excursion of the SLAPS. If the subwoofer is to have a build in amplifier, then also account for the cabinet space it needs.

[2] *Neodymium* is the strongest magnetic material in existence and is also used for speaker magnets, but very rarely woofer units. A few manufacturers on the market use neodymium. Conventional magnets are made of Strontium Ferrite which is a much cheaper material. Some also use Cobalt or Alnico.

Placement of the SLAPS.

- You can place your SLAPS on either side of the cabinet or the back of the cabinet. If you have room on the front you can also place your SLAPS next to the active woofer. **By placing SLAPS right next to the active woofer so you run the risk that at the acoustic resonance frequency there may be a negative interference which and the can lower the overall sound pressure level of the deepest bass tones. The lower the resonance is set, the less likely it is that there will be an issue.**
- Best results are obtained by placing it on the back or side of the cabinet.
- The SLAPS device can also be mounted on the bottom of the cabinet. Note that when doing so you can not add extra weight to the SLAPS as shown in Step 4 of this manual.
- Now you have both a cabinet with a woofer and a SLAPS mounted and all that remains is to connect the wires to the active woofer.

● 3 Job done - your new subwoofer will now be able to play deep bass.

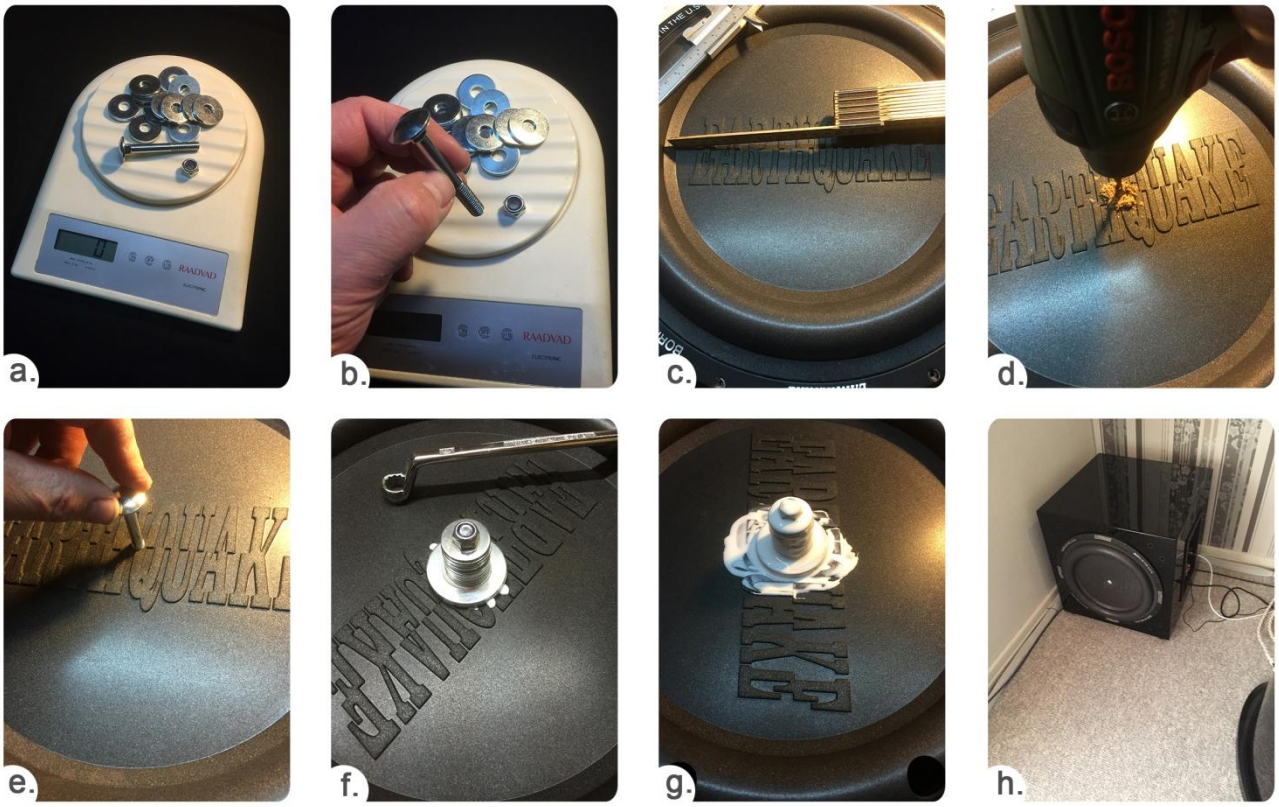
- If you followed the instructions right from the start you now have a finished subwoofer in front of you. You only need to connect it to your bass amp. We are certain that the sound will be superb to any ordinary design.

- Most will be happy now and can sit back and enjoy the music

For those who wish to push the boundaries of optimization please read on.

● 4. Deep bass tuning of your SLAPS subwoofer with the addition of weight to the moving mass.

- Your SLAPS membrane has a given net weight from the factory. This specific weight can be increased and adjusted to the cabinet resulting in a deeper bass. A higher moving mass on the SLAPS lowers overall system resonance and increased membrane inertia is pushing it towards lower frequencies.
- All you need is a drill, a drill bit, a bolt, a few nuts and some washers and a weight (letter scale or similar)



- In the specially designed computer program which can be found at **http://earthquakesound.dk/slaps/index.html**
  Enter the following.

The new system desired resonance of your subwoofer in Hz[3]

The current cabinet volume that you selected in liters

- computer program will tell you how much weight you need to add the membrane.
- IMPORTANT. Note that 25 Hz as the resonance is a very deep bass and 20 Hz, the lowest frequency that can be perceived by the human ear. With SLAPS and a good woofer it will be possible to tune your system down to below 15 Hz which is the subsonic region that can only be felt as pressure waves. You will of course try to tune your own design as far down as possible, but never try to add more extra weight than 350-400 gr as it may harm your speaker design.

Practical example

Here is a practical example of a design with a TremorX- 124 woofer from Earthquake Sound Corporation. It's just an example design and you can choose from many other options.

Proposals may be a cube with inside dimensions of 43 ltr and the goal is the volume as Earthquake Sound recommend to TremorX-124 as a reflex. I leave out, of course, the bass reflex port when it is not needed. I choose the selected cabinet size and check that it is within the physical framework of cabinet volume as

[3] Hz means Hertz which is the technical term for the number of cycles / strokes per minute. second

determined in step 2, and it does. Then you have the ability to reach 21 HZ linearly with SLAPS 12 "inches and a TREMORX-124 without having to add any extra weight. (Shown 9 grams but it is assumed for as little as equal to 0)

CUSTOM MADE TO SLAP 12

Please fill in the following values into the orange cells:						
Desired fb of enclosure in Hz =	**21.0**	Hz				
Actual Vb of enclosure in ft ^ 3 =	**1.50**	ft ^ 3	42.48	L		
Measured Sd of PR in m ^ 2 =	**0.0420**	m ^ 2	419.6	cm ^ 2		
Starting Mass of PR =	**400**	grams	14.11	oz.	0.88	lbs .
Desired Number of PR's	**1**	PR (s)				
Calculated Dp (effective diameter PR) =	9.10	inches	23.11	cm	231.14	mm
Calculated Vb in L (liter) =	42.48	liter				
Total mass required =	408.83	grams	14.4	oz.	0.90	total
lbs.mass required for hvert PR =	408.83	grams	14.4	oz.	0.90	lbs.
Mass som added two hvert PR =	**8.83**	gram	0.3	oz.	0, 02	lbs.

With this hypothetical example, you have the standard components of an extremely efficient subwoofer.