Dear Audio Enthusiast:

Thank you for taking the time to read my article in the May '96 Audio magazine and thank you for requesting the information on building your own HVCD woofer. The enclosed package has a license agreement printed on the outside. By opening the package you agree to all of the fine print describing the license agreement. If you violate the agreement you will be hearing from my partner George.

Inside the package you will find two 3.5" floppy disks and hard copy print-outs of some of the files. I apologize, in advance, if you find these models a little difficult to use. The spreadsheet models are condensed from even less user-friendly MathCad models. In addition, I'm assuming that anyone using these models has a good working knowledge of loudspeaker design already.

On the first disk you will find several versions of the two working files in spreadsheet form, HVCD.xxx and PWRPORT.xxx . HVCD is used for calculating the band-pass box and driver parameters while PWRPORT is used for calculating the power port dimensions to match the results from HVCD. Instructions are included in each file. The file formats are as follows:

HVCD.WB2	Quattro Pro 6.0
HVCD.WB1	Quattro Pro for Windows ver 4.0 and 5.0
HVCD.XLS	Microsoft Excel 7.0
HVCD.WK1	Lotus 123 ver 2.x, no format file (Untested, Goodluck!)

The Quattro Pro and Excel versions support both the embedded drawings and floating graphs. The Lotus version is untested and does not support the drawings or graphs. (However, a graph can be created in Lotus using the data table at the end of the HVCD file.)

The other disk contains some example files optimized for Polk DB subwoofer drivers. These files are all in .WB2 format for Quattro Pro 6.0 . Open the DBxxHVCD.WB2 files first and read the introduction. These drivers may be purchased from Polk Audio Car dealers. If you don't know where the nearest Polk Car dealer is located or if you're not near one at all, call 1-800-377-7655 and we'll help you out.

Below are some very helpful tips for using these models. I strongly recommend that you read them. If you have more questions call Chet Pelkowski in Customer Service at the number above.

There is one final condition attached to using this technology which is not contained in the licensing agreement. If you succeed in building a really outrageous subwoofer using these techniques, I would really like to hear about it. Thanks again for your interest and goodluck!

Sincerely
Polk Audio, Inc.

Lworks

Matthew S. Polk

1. The box volumes are calculated without any volume damping. Use of volume damping materials such as dacron or fiberglass makes the cabinet act larger than its actual size. Typically, the sealed chamber can be about 30% full of loose (uncompressed) volume damping material. This will make the sealed chamber behave about 17% larger than its physical dimensions. The vented chamber should use less, only about 15% loose fill placed well away from the internal port opening. This will give about a 10% effective increase in its volume. Adjust your cabinet dimensions to account for this effect.

2. Speaking of adjustments to cabinet volume, remember to allow enough volume in the vented chamber for the port. The volume occupied by the conventional port is calculated in the HVCD file. The volume occupied by an equivalent power port is calculated in the PWRPORT file. Add this to the vented chamber volume when figuring your box dimensions. (Note: the adjustment for volume damping applies only to the net chamber volume not to the volume occupied by the port.)

3. The final adjustment to cabinet volume is for the volume occupied by the driver(s). Since HVCD cabinets can be quite small this can be significant. In a band-pass there are three things to include in your adjustments: Total volume occupied by the driver, volume inside the cone on the other side and volume gained in the mounting cutout. The way these affect your cabinet volumes depends on which chamber the driver faces and which side of the baffle it's mounted from. Here are some typical numbers for a ¾" thick baffle:

Driver Size	Volume Occupied cu. ft.	Volume of Cut Out, cu. ft.	Volume inside Cone, cu. ft.
8"	.022	.017	.006
10"	.042	.028	.013
12"	.062	.038	.028

4. Multiple driver combinations can produce some very interesting results (see KILRHVCD.WB2). However a couple of rules must be followed to get the driver parameters right. The model uses the parameters for the combined total of all drivers in the system. Always use identical drivers.

BL product - stays the same as one driver for parallel connection, doubles for a series connection. Eg. 4 drivers in parallel have the same BL as one driver. The same 4 drivers wired series/parallel have twice the BL. Compound mounting has no effect on this rule. If you've created a model which requires a very high BL product driver, for example 30 weber/m, you could achieve this by wiring two drivers, each with BL=15 weber/m, in series.

Compliance (Cms) - Take the compliance for a single driver and divide by the total number of drivers regardless of wiring or mounting. It takes more force to displace two drivers than one. Therefore two drivers are less compliant than one, right.

Cone Area (Sd) - simply multiply by the number of drivers you are using. However, if you're using a compound mounting (ie. 2 drivers face-to-face) the cone area for the pair is the same as for a single driver.
Moving Mass (Mmd) - sometimes Mms is quoted. This is almost the same as Mmd and close enough for our purposes. For multiple drivers multiply the mass for one by the number of drivers used regardless of the mounting or wiring. Once again, compound mounting can help to achieve a requirement for high moving mass without also increasing cone area.
Voice Coil Resistance (Re) - for all parallel connections divide the resistance for one driver by the number of drivers used. For series connections, multiply by the number of drivers used. For series/parallel an even number of drivers must be used, usually four. Four drivers connected in series parallel have the same resistance as a single driver.
Mechanical Losses (Rms) - multiply the loss for a single driver by the number of drivers used regardless of mounting or connections.

5. If you have Quattro Pro you can use the optimizer to find an HVCD design for a particular driver. Simply enter the parameters as per the instructions including the center frequency and tilt. Then open the optimizer dialog box. In the constraints box, point to the calculated cells for driver moving mass and BL product. Set these two constraints equal to the values for the driver you want to use. In the variable cells box, establish the entered values for Qtp, Qtc and Qmc as the variables. Then hit solve.

6. The ports required for HVCD woofers can be very large, sometimes bigger than the box itself. Using a power port reduces the size but sometimes not enough. Two tricks can be used to help. First, nothing says that the port has to be entirely inside the cabinet. In fact everything but the internal disk could be outside the cabinet. Second, if you are careful with your dimensions, the power port will extend exactly from one side of the cabinet to the other. In this case the opposite inside wall of the cabinet acts as the internal disk. Only a suitable sized flange on the inside end of the port tube is required. The distance from this flange to the cabinet wall is the same as the baffle to disk spacing, d.