

DIY PC Subwoofer

Welcome! Today we are going to design and build a subwoofer to go with a computer's sound system. While I wasn't entirely displeased with the speakers I had before, my system never quite had the bass response and overall liveliness that I wanted. So I decided to do a little research and come up with a solution and get it done.

First, let's look at the system overview and what goes into a quality system. Most people can hear sounds in the frequency ranges of 20-20,000Hz. Many game designers are incorporating more sound details into the action, and I'm sure that there must be one or two people out there with a couple of MP3's! So, with that in mind, I wanted a system that would be of reasonable power, reasonable size, reasonable cost, and reasonable sound. I knew that for my needs, I simply didn't need a truly high end audiophile system and the accompanying costs - even some basic quality subwoofer systems can sell for \$500-800. I also wanted a system that would be easy to build for our readers if anyone out there wanted to recreate the same project. I'll provide in this article directions to follow, material lists and sources, and end results.

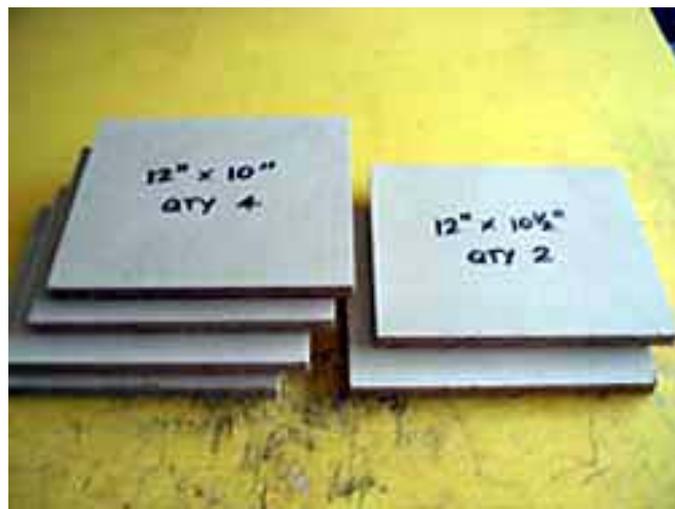
I felt that I could design a total system of subwoofer and two satellites for less than \$200 and get great sound - so that was my initial design criteria. Second, you have to design the system box around the components, so the first item to do was to secure the main parts of amplifier, subwoofer, midrange drivers, and tweeters. After doing a little research on the internet, one name kept reoccurring for components of solid quality at a reasonable cost - Apex Jr. In this business, after dealing with as many vendors as we do at Monster - Hardware, we have really come to appreciate personal service and Steve (the owner) did a good job answering questions and making suggestions. Based on my specifications, he recommended an [Apex Junior Amp](#) and [Vifa 8" subwoofer](#). The amps are custom manufactured to Steve's specifications and are his "signature" product. The Vifas are the OEM drivers used in Mackie and many other high-end studio monitors. I was highly impressed by the quality of construction, finish, and reasonable cost of both of these items.



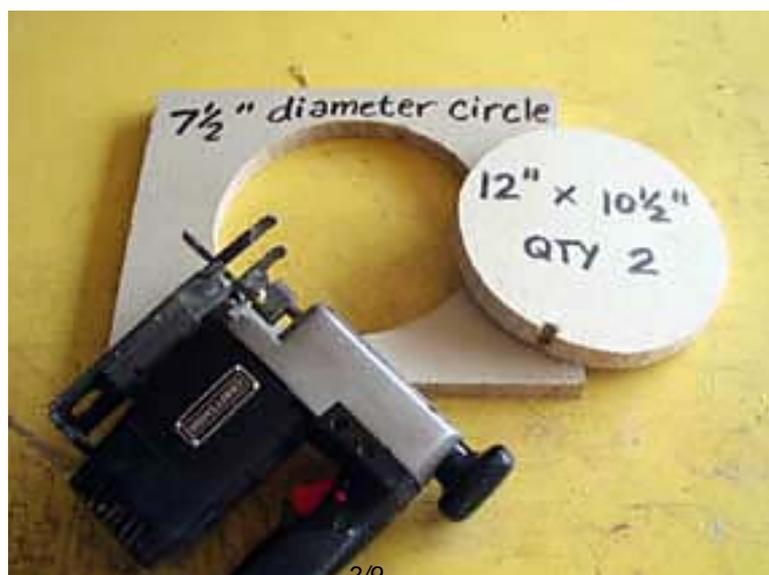
This shows the relative size of the amp against the woofer. The Vifa had a cast magnesium frame and filled polycone, features you wouldn't expect at the [Apex Jr](#) price point. In general, the specs for the amp are as follows: 100w @ 8 ohms, 130w @ 4 ohms, frequency response from 20-150Hz, variable crossover from 60-120Hz, power supply integrated. The Vifa woofers have the technical specs posted at the link listed above (it is beyond the scope of this article to go TOO in depth regarding design parameters - let's just say I've done the work for you...).

Secondly, I wanted to use a box material that was readily available and would provide the least amount of work. Therefore, I wanted to keep as many of the dimensions of the box at standard measurements that are commonly used, 12" if possible. I used the WinISD speaker box program and all of the provided specs to design a sealed subwoofer box. I decided on a sealed box versus a ported box for several reasons: 1) a ported box is more complex to build, 2) a ported box will typically need to be of larger size than a sealed box - requiring more material, 3) a sealed box has better low power and more predictable handling characteristics, and 4) while a ported box can provide lower overall responses, a sealed system sounds "tighter" and cleaner to me.

When I calculated the design specs of the box, the volume required was almost exactly .5 cubic feet. One nice feature of the [WinISD](#) program is that you can specify the thickness of the material you will be using, and it will give you the optimal cut sizes of the box sides. I did modify this to somewhat larger to account for the volume of the amplifier that would be inside the box and also to economize on the material cuts.



Basically, the box ended up being designed as a rectangular cubic shape. I was able to design in so that there were a minimum of cuts; the 12" wide shelving particleboard or MDF from a supply retailer like Lowe's or Home Depot is readily available and they will cut the material for you for free or only a few cents per cut. Plywood would also be an acceptable choice if void-free and of dense material. The box needed to have the overall dimensions of 10" x 12" x 13-1/2", and this configuration can be made with four pieces of 12" x 10" x 3/4" material and two pieces of 12" x 10-1/2" x 3/4". After I cut out the parts, I needed to make measurements from the speaker and amp to make the cutout on the appropriate sides. Note: there is some design variation here. Since low frequency sound is basically omni-directional, you can make the speaker to fire from the side or bottom with good results. If you fire it down, you will need additional "tall feet" to get the subwoofer cabinet off the floor. Offset one of the cutouts if necessary in order to ensure internal clearance between the speaker magnet and amp casing.



After you have made the cutouts, you can begin assembly. Use wood glue for strength and sealing. I made the initial assembly with some 4d finish nails and then came back with 1-5/8" drywall screws for indestructibility. If you use enough glue and just a couple of screws per edge, you will almost be unable to destroy this box once finished - strong is good! Wipe any excess glue from the outer edges to save a lot of work later when you do your final sanding. Important - predrill and countersink the screws or almost any material suitable for this project WILL split.



After the box assembly is complete, you need to ensure that every corner is completely sealed. You can either run another bead of glue, use some hot melt glue if you have it, or similar. I used some blue silicone gasket maker (partially because that's what I had sitting on the shelf, partially because it would show up well in the pictures). A low odor silicone or "siliconized" acrylic latex caulk from Lowe's or Home Depot for about \$1.19 would be perfect. Make no mistake, the subwoofer itself will move a LOT of air, and any escaping in normal operation could create a whistle or unwanted sound. Use a bit of wood putty or filler stick to fill any nail or screw holes.



After the glue is dry, the screws are in place, and the box assembly is complete, it is time to make a frame for the grille. I used some 3/4" pine scraps ripped to appx 1/2" wide. Once again, use a bit of glue and a couple of 4d finish nails. Use a small piece of medium or fine sandpaper to round off any rough edges. Additionally, it would be a good idea to pre-fit the subwoofer and make sure the grille frame will fit correctly. Because I

decided to place the speaker on the narrowest face of the box, I had to use my Dremel tool to relieve a couple of spots to clear the speaker rim; the finished grille cloth must be able to clear the speaker foam surround without touching. At this point, you should do your final surface sanding on the box. If you have access to the tools, use a medium grit belt on a belt sander and follow up with an orbital or vibrating sander. If you want to make it look really nice, you can cover this box with laminate or veneer. Once again, use some sandpaper by hand to ease the sharp corner edges off if you plan on painting.



The box and grille frame are now ready to be painted. I used one can of black to do both the box and the grille frame; I recommend some primer first if you can get some. It will help give an initial sealer coat so that your finish coat will not be soaked into the wood as bad, and it will help ensure a better looking finish. I personally used one coat of primer and a couple of top coats of semi-gloss black, but probably should have used a flat black. Don't take a shortcut and forget to paint the grille frame as the light colors will show up under the cloth. Obviously, if you opt for a down-firing subwoofer, you will not need a grille at all.



After the paint is dry, you will need to install some cloth over the grille frame. I used some inexpensive black woven material with a loose weave that my wife picked up at Wal-Mart. Almost any thin, loosely woven cloth will work. If you remember the double knit cloth from the disco leisure suits - *that* material would be perfect but almost anything will do if it is of medium or light weight... a little stretchiness is also good. You can buy professional grille cloth at Radio Shack if you like, but you can get enough to cover the grilles for the

subwoofer and satellites for less than a buck in almost any fabric store.



Use a heavy duty staple gun (mine is electric but a manual one will work fine) to staple one edge. Trim with scissors, then staple the opposite side. Stretch the material tightly as you work along the edge. Fold the corners like you would make the sheets on a bed corner and staple as well. Lastly, when the cabinet was finally assembled, I used a few 4d finish nails to attach the grille frame knowing I could pry them off later very easily. If you like, Radio Shack and others will have speaker knob "push-ins" that you can install on the grille frames; a socket will be set into the subwoofer body. If you use these, you will need to provide a fitting area in the grille frame corners with a small triangular block of wood.



Next, you will need to install the amp and speaker. Install the amp first using #6 x $\frac{3}{4}$ " pan head screws (black if you can find them). Then, you will need to stuff the box with fiberfill material. You should be able to find a 20-24 oz. Bag at WalMart or a craft store, this material is commonly used to make homemade pillows. Adding fiberfill helps to keep speakers from sounding "boomy" and keeps the sound cleaner. Note the rubber feet I mounted on the bottom of the subwoofer cabinet - stolen from an old scrap AT computer case.



Next, install the speaker, making sure to get the wiring polarity correct and using the same #6 x 3/4" panhead screws to install the speaker. Finally, install the grille - I used some finish nails as I mentioned above and used a black magic marker to touch up the nail heads. They will be virtually invisible from more than three feet away. Here's a look at the final subwoofer on the bench.



Now, for a word about hooking up the amp. The Apex Junior amp has the flexibility to be hooked up in one of two configurations where the input signal may be either at the line or preamp level, or already powered by an amp or receiver. The Apex Junior uses the internal crossover to separate the low frequency input signal and amplifies it to the subwoofer; the high frequency remainder is "passed through" to any satellites you might hook up. If you use a receiver (I feed my sound card line out into the CD-input on the receiver) you will want to use the amp's powered inputs unless your receiver or amp has a specific subwoofer line out. If you use the signal directly from your computer, you will need to feed the preamp inputs and then the passed through signal will be used as the inputs for your existing powered satellites. No subwoofer amp that I know of will take a preamp signal and give you powered outputs for satellites, i.e., mixing the output types. Also, this is an unshielded subwoofer and the 30 oz. magnet on the driver is quite strong. It would not be appropriate to place within a couple of feet near any equipment or materials that could potentially be harmed by magnetic fields.

I was quite pleased with the sound. I got out my sound level meter and mini tripod and actually measured the output levels by using the NCH tone generator. The subwoofer sounded clean and tight, with the bottom end roll-off point at about 35-38Hz. This was predictable due to the natural characteristics of the Vifa 8" driver. I set the subwoofer amp at the maximum crossover point of 120Hz and the upper end began a slow falloff at about 140Hz or so. I personally felt that the sound output was usable up to slightly beyond 200Hz - I will provide a response plot with the satellite article. The VOLUME of low frequency sound is immense. I may have developed cracks in my office's concrete slab!!!! (Side note: I recommend the new Audioslave single, "Cochise" and P.O.D.'s "Satellite", they rock...) Basically, you will set the volume level on the amp one time and use your input volume control from there on out as the primary volume control one you get the system tweaked to your environment.



Here's a list of what you will need to complete this project:

Tools: Saw (or cut at the store), jigsaw or Dremel for holes, drill and drill bits, screwdriver, hammer, staplegun.

Materials: Apex Junior Amp (\$90), Vifa 8" driver (\$28), fiberfill (\$3), paint (\$3), hardware nails and screws (\$5), wire for hookup (\$5), 12" wide x ¾" x 48" shelving (two at \$4 each = \$8), black cloth for grille (\$1)

TOTAL: \$143, just under my goal of \$150. Even less if you have some wood scraps or already have some of the materials laying around. I had tentatively allotted \$150 for the subwoofer and \$50 for the satellites, so this fit into the budget well. Once I had the materials gathered and the design work done, I was able to complete the entire project in less than four hours! I can't stress how easy this was to make and am stunned by the output of the subwoofer for such a simple project. Please understand that a standard cheap subwoofer system advertised for computers at \$29 simply isn't in the same league as a professional larger system like this. Most computer "subwoofers" have 4" or 5" drivers that are physically not capable of producing an adequate low frequency response. You WILL be pleased with the difference.

Finally, I would like to thank Steve at [Apex Jr.](#) for his help and suggestions. Go check his site out for components and other supplies as well. (EDITORS NOTE: Steve at Apex Jr. told us that he would bundle the Apex Junior Amp and Vifa 8" Driver together in a package deal; if anyone orders this, you will need to mention Monster-Hardware to save a few bucks) And, be on the lookout for the companion satellite speaker article, where I build a matching pair of speakers for my desktop - coming in a few days. Good luck on your next project!

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