



DAVID: The Giant Killer

This author's latest horn box slays the competition with big-time performance in a small package.

By Bill Fitzmaurice

The David loudspeaker (**Photo 1**) is a high-efficiency design that offers a level of performance you once could only obtain with cabinets two times or more its size. The heart of this box is a horn-loaded subwoofer (**Figs. 1 and 2**). Utilizing a long-throw high Bl 8" driver, it achieves low-frequency extension and sensitivity once reserved for large horn-loaded cabinets equipped with fifteens.

As you can see in **Fig. 3**, the response of the subwoofer section almost equals that of the legendary Klipschorn, but from a far smaller and much easier to build package. Note the differences in the corner, wall, and freestanding

placements in the bass; you can adjust the bass response quite a bit just by moving the cabinet.

Trace D shows the response at 30° off-axis. Most experts agree that superior imaging and realism requires no more than a 6dB differential between the on-axis and 30° off-axis response. David's 30° off-axis response averages within 3dB of on-axis. Average sensitivity of 94dB/2.83V/1m allows powering with low wattage tube amplification.

DRIVER SELECTION

You can configure the midbass/tweeter section of the David in a variety of ways. The prototype uses an MTM, but it could also use a single high-efficiency wide range Fostex, Lowther, or Jordan driver, because the woofer horn can keep up with even the most sensitive full-range drivers. You may use high-end audiophile drivers, ribbon tweeters, or even the same inexpensive drivers used in the original—the Pioneer A11EC80-02F midbass and the MCM

PHOTO 1: The completed speaker.



FIGURE 1: 3-D view of cabinet insides from the back.

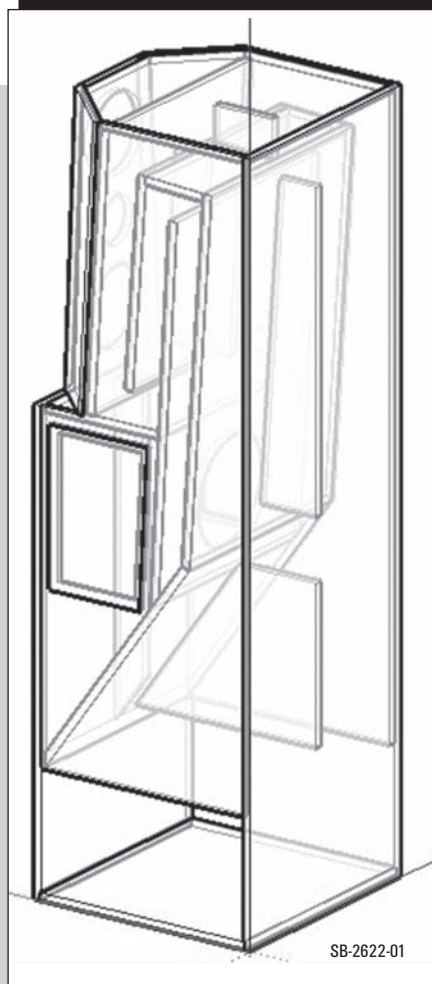
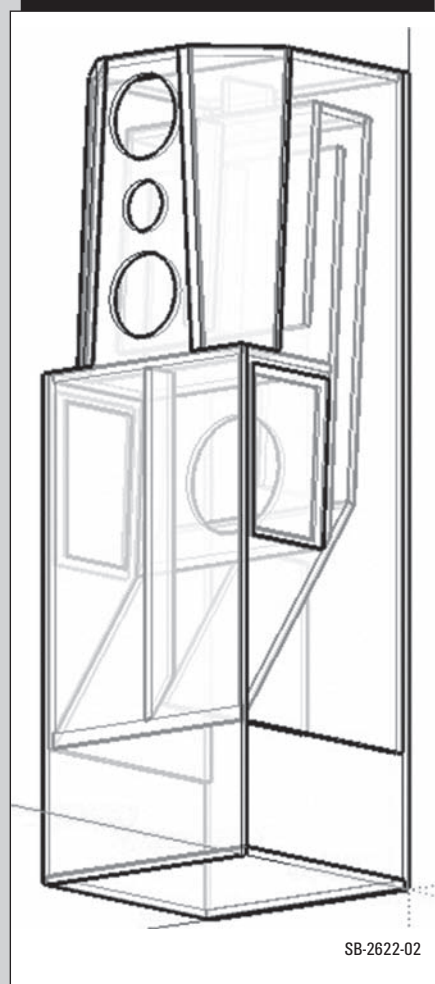


FIGURE 2: Front 3-D view of cabinet.



BK-16 Kit

Madisound is pleased to offer the **BK-16 folded horn kit**.



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We have chosen the **Fostex FF165K 6.5"** full range for use in the BK-16 cabinet. The **FF165K** has a **Kenaf fiber cone**, inverted foam surround and aluminum dust cap.

The **FF165K** is run full range with a frequency response out to 15kHz. The **T90A** super tweeter has been added to cover the upper frequencies. The **T90A** is a top-mount horn tweeter with an **Alnico magnet**. The tweeter is rolled off on the low end with a **Fostex Tin & Copper foil capacitor**. The system frequency response is 55Hz to 35kHz at 95dB.



The **BK-16** cabinet is made from **Baltic Birch** plywood and is sold flat, unassembled, unsanded and unfinished. Cabinet dimensions are 9.75" W x 14.75" D x 29" T.

The kit includes:

- Pair of Cabinets - Flat
- Pair of FF165K - full range
- Pair of T90A - horn tweeter
- Pair of DB-Cup - Input cup
- Pair of Crossovers
- Nordost 2-Flat wire for tweeter
- Instructions

Kit Price: \$635.00 /pair

Parts without cabinets: \$439.00 /pair

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(www.mcmminone.com) 53-325 dome tweeter. The preferred subwoofer drivers are the MCM 55-2421 and the Tang Band W8-740. An alternative is the Dayton Quatro 8 (www.partsexpress.com), which lacks the output capability of the MCM or TB, but is still adequate.

You may run the speaker full range, with a sub amp, or even in tri-amplification. The original's average impedance is 6Ω, with the woofer at 8Ω (the driver is rated at 4Ω, but the high acoustic impedance horn doubles that figure), the mids at 4Ω, and the tweeter at 8Ω (**Fig. 4**). Being as sensitive as it is, this is not a difficult speaker to drive.

CONSTRUCTION

I built the prototype from ½" Baltic birch plywood. You may also use MDF, especially if you plan on a painted or veneered finish. I used all dado joints, cutting grooves into the cabinet sides with a router, but plain butt joints are

OK. With dado construction you can hold the parts together with small nails or trim staples while the adhesive sets, but for butt joints drywall screws—piloted and countersunk—would be better. As for the adhesive, I recommend a caulking gun applied polyurethane base construction adhesive, which expands while curing to fill gaps and ensure airtight joints.

Note that you must determine the final sizes of all parts by dead reckoning, because the actual thickness of the materials used will determine part lengths. Start by rough-cutting your materials. The front and back measure 15" wide x 40" (two pieces). Note that the rest of the parts measure 14" wide, so cut accordingly. With 5 x 5' Baltic birch you'll need two sheets, and you'll have some left over. If you use dado construction, make the interior parts ¼" wider to account for the material that will go into the dados.

FIGURE 3: Subwoofer response.

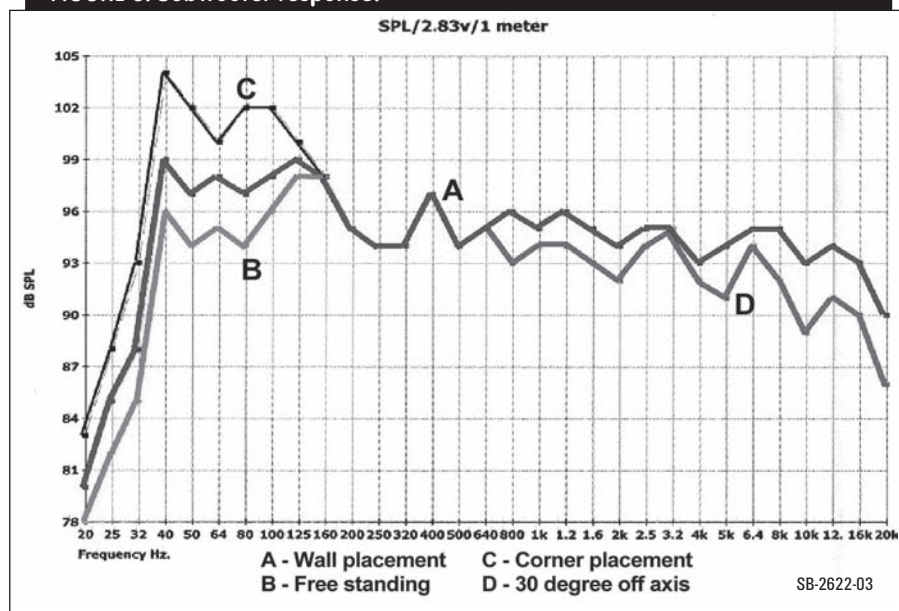
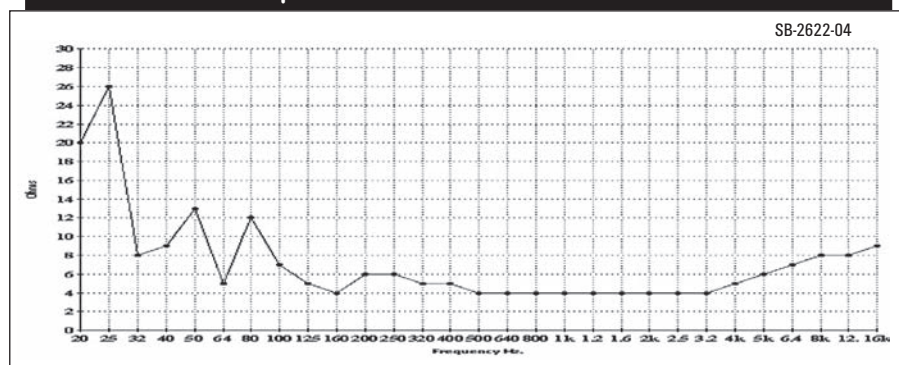


FIGURE 4: Tweeter response.



The next step is to draw the locations of the joints on the cabinet sides per **Fig. 5**. Draw them all on the inside, and also on the outside where plates 1, 2, and 6 form the woofer chamber, keeping in mind that the front and back overlap the sides. The internal clearances are plate-to-plate. Measure them starting at the horn mouth, going backwards through the horn, so that whatever size discrepancy caused by your material thickness will end up altering the volume of the midbass/tweeter chamber, which is not critical.

With dado joints rout a 1/8" deep trough at all the joints with a 1/2" pattern-following router bit. Clamp or screw the sides to the workbench, clamp or screw a straight guideboard on the joint, and rout away. Make sure to fill any holes you make later on with adhesive. When you finish the first side do the other, in mirror image.

FIGURE 5: Internal dimensions.

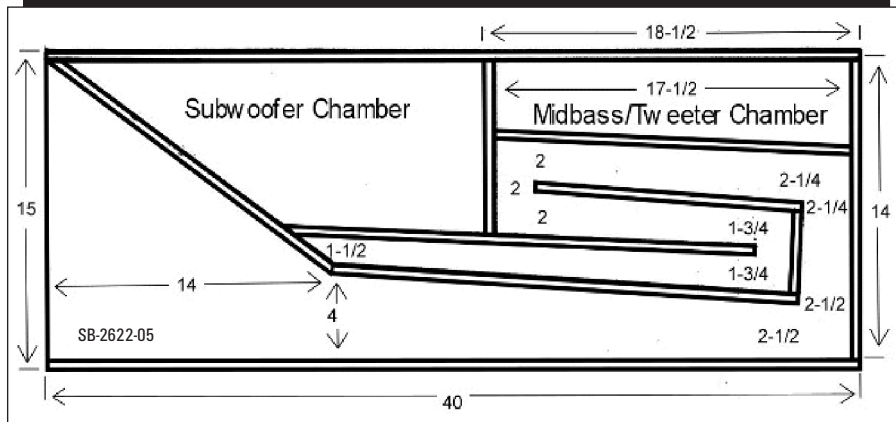


Diagram illustrating the layout of the SB-2622-06 enclosure. The diagram shows a rectangular structure with various internal components labeled with numbers 1 through 8. The components are arranged as follows:

- 1**: A horizontal component located in the lower right section.
- 2**: A vertical component located in the center-right section.
- 3**: A horizontal component located in the upper right section.
- 4**: A horizontal component located in the lower right section, adjacent to component 1.
- 5**: A horizontal component located in the lower right section, adjacent to component 4.
- 6**: A diagonal component located in the upper left section.
- 7**: A horizontal component located in the upper right section, adjacent to component 3.
- 8**: A vertical component located on the far right side.

Additional labels include "Subwoofer Chamber" and "Side Removal Area".

SB-2622-06

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FIGURE 7: Brace locations.

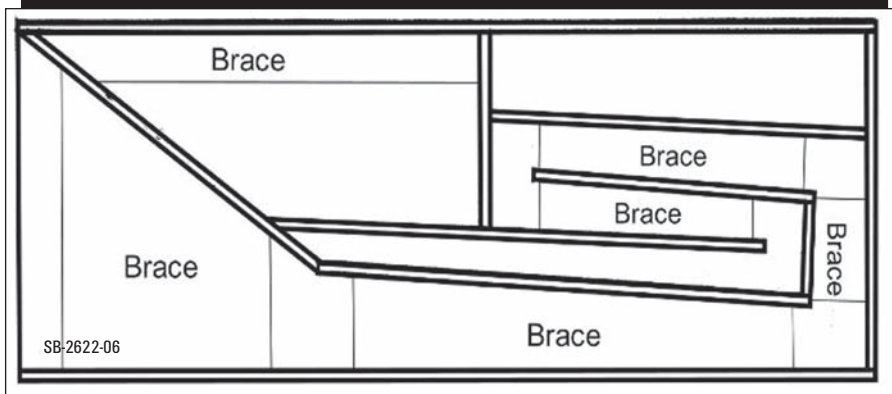


FIGURE 8: Midbass baffle wings.

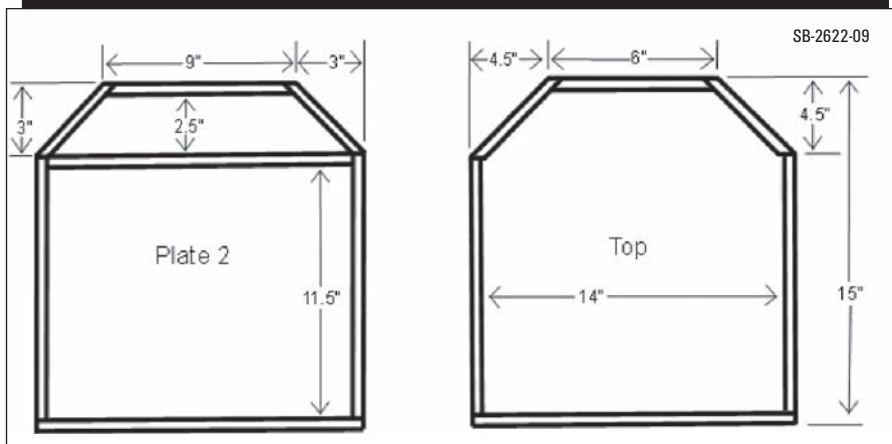


PHOTO 2: Clamping inside panels.



PHOTO 3: Installing the brace for plate 6.



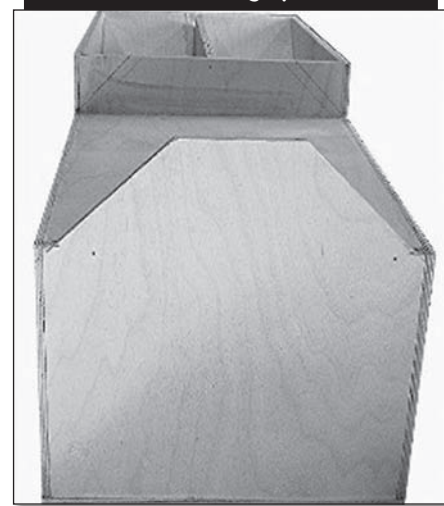
as you install each plate. Either butt- or dado-joint them as you prefer. For dado jointing, again use a $\frac{1}{8}$ " groove $\frac{1}{8}$ " deep; the easiest way to cut these is with the router mounted in a router table with a fence. Determine each plate length, cut it to size, and dado for the brace if you're using dado joints. Note that the angles of the plate ends are small enough that you can cut them square and the expanding urethane adhesive will fill the gaps, except for plate 1 as already noted, and the mating ends of plates 5 and 6, which are cut at 15° .

Install plate 1, then measure, cut, and install plate 2, using a square to align the parts and a clamp to hold them square until fastened (**Photo 2**). Add the other side to the assembly, and attach the brace that runs between plates 1 and 3. Next attach the brace plate 3 that runs between it and plate 7. Then install plates 4 and 5, remembering to first attach their braces, and then plate 6.

Don't cut the end of plate 6 where it meets the cabinet front at an angle, instead cut it long enough to overhang the joint. Attach the brace to plate 6. Apply plenty of adhesive to the plates 5 and 6 joint to fill the gap caused by the angle of the joint. From the inside attach the brace that runs from plate 2 to plate 6. Trim off the extra from plate 6, clamping a board across the cabinet bottom to serve as a platform for a jigsaw.

Use a square to install the brace from plate 2 to plate 6 (**Photo 3**), and use a sander to make it flush. Attach

PHOTO 4: Buttoning up the box.



assembly. Start installing the internal plates per the assembly order in **Fig. 6**. Cut out plate 1, marking on it the joint with plate 2. Cut the end of plate 1 where it meets plate 6 at a 45° angle; it's not perfect, but the adhesive will fill the gap. Cut a 7" hole in plate 1 for the woofer; if you plan on mounting the driver with T-nuts, install them now and trial-fit the driver.

Braces are located midway across the plates (**Fig. 7**); determine their sizes by dead reckoning

plate 7. After the adhesive has set, sand the excess side material for a nice smooth joint. Cut out the top and install

according to **Fig. 7** and **Photo 4**.

Drill a hole through plate 2 for two speaker wires (**Photo 5**), leaving a cou-

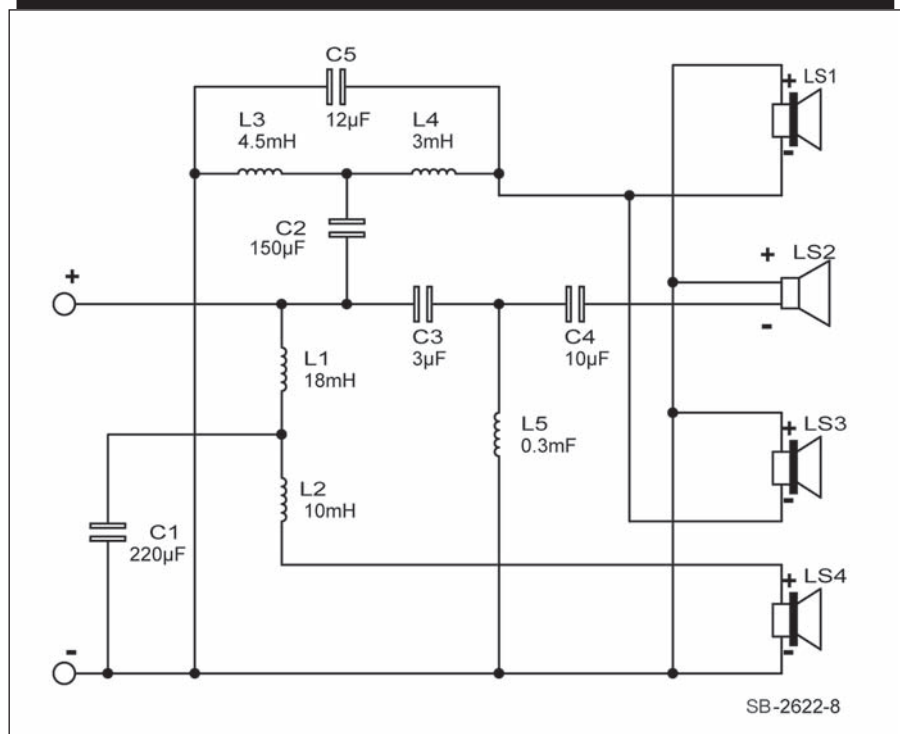
ple of feet hanging on either side, and seal the hole tight with adhesive or hot melt glue. Also note the lines drawn on plate 2. These are where the joints will be with the midbass baffle wings; **Fig. 8** provides more detail. Both here and with the top, don't worry if things aren't quite perfect according to the diagrams, as variations in the thickness of your materials will influence the finished measurements, but not enough to affect performance.

FRONT AND BACK

If you're using dado joints, dado the inside of the front and back panels where they will joint. These panels are 48" long, leaving an 8" overhang at the bottom of the cabinet. Where the front will intersect, the baffle wings cut it at a 45° angle (**Photo 6**).

Rough-cut the baffle wings larger than necessary by about ¼" in each dimension, with the edges that will mate at the cabinet sides cut at a 45° angle. Place these where they will join the cabinet, the 45° edge meeting the side, and trace where the other joints

FIGURE 9: Crossover schematic.



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PHOTO 5: Accommodating speaker wires.

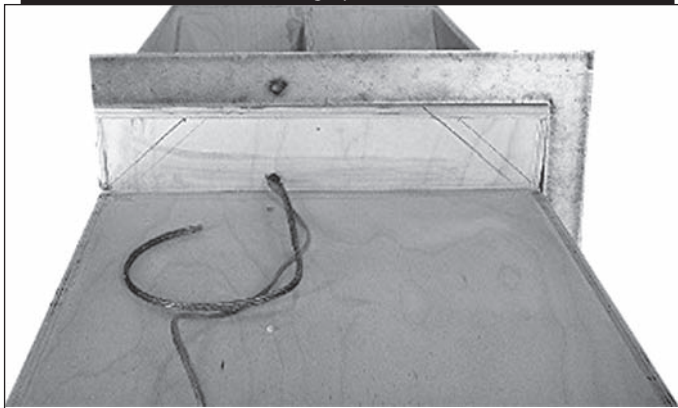


PHOTO 6: Front panel and baffle wings.



will go. Trim it to size but leave 1/8" or so extra; install it and do the same with the other wing (**Photo 7**). When the adhesive has set, sand the joints flush, as well as all the cabinet edges. Depending on how you plan to finish the box, you may

choose to make the edges rounded over or crisp and sharp.

Using the lines previously drawn on the outside of the box, rough-cut a port-hole about 1" from where plates 2, 6, and the front intersect the side, about 10" long (**Photo 8**). Do the same on the other side. With a straight guideboard clamped or screwed to the cabinet, use a router with a trim bit to finish the holes as in **Photo 9**.

Reaching through the opposite port-hole, trace onto plywood the port-hole openings to produce covers for them. Rim the openings with plywood to produce mounting flanges for the covers (**Photo 10**). Be very sure that the sub driver will fit into the cabinet. Then cut and trim the port-hole covers, making sure they fit properly.

Cut the holes for the midbass drivers and the tweeter with a jig-saw or hole-saw. Keep the drivers pretty tight to each other, with the upper midbass driver mounted close to the top of the cabinet. If you prefer to use a router to

cut insets in the baffle for flush mounting the drivers, don't go more than 1/4" deep. Install the bottom. Note how the final mouth of the horn is formed by having the front and back longer than the sides, and the mouth exits to both the left and right.

PHOTO 7: Installing the baffle wings.

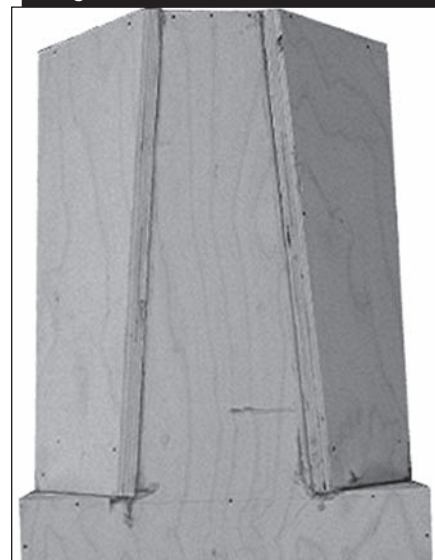


PHOTO 8: Rough cut for the port-hole opening.

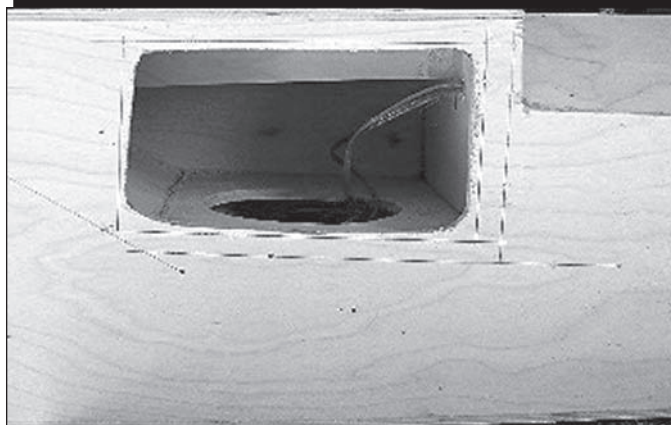


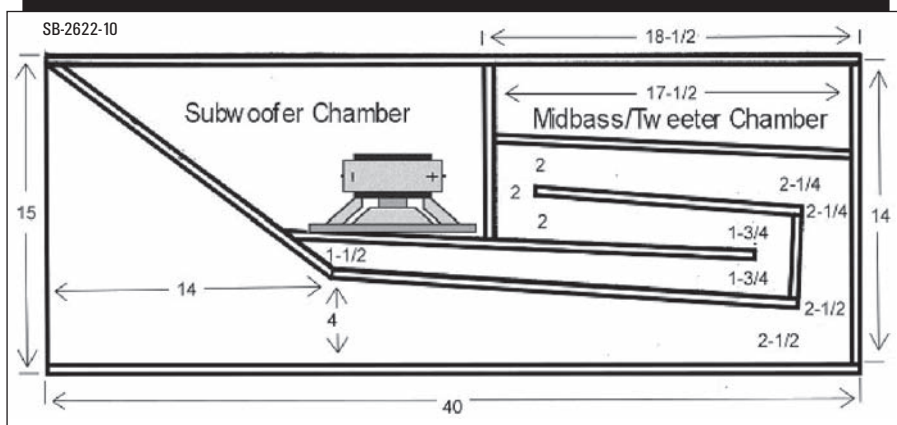
PHOTO 9: Finishing the porthole.



PHOTO 10: Flanges for the cover.



FIGURE 10: Woofer shown attached.



FINISHING TOUCHES

Now is the time to put a finish on the box—whatever you wish, from bare wood to paint to a fine veneer. When that's complete, mount the drivers, connecting the wires to them when you do so, wiring the two midbasses in parallel. Loosely but thoroughly stuff the midbass chamber with polyester pillow stuffing (stuffing is not used in

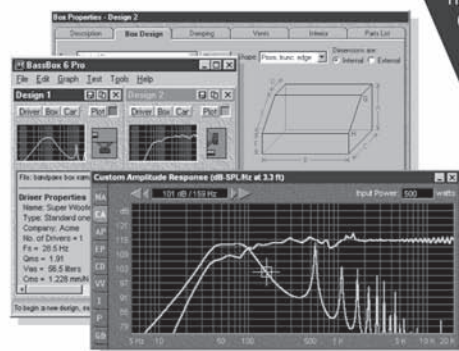
the woofer chamber). Weather-strip one of the porthole flanges and screw the cover in place.

On the cabinet, lower-back mount binding posts—one set if you're going full range, two sets if you're using a separate sub amp, three sets for bi-amping. Drill a hole through plate 6 for the wires to pass through to the woofer chamber. Wire the posts, feed the wire into the woofer chamber, and seal the hole airtight. For a separate sub amp, wire one set of posts directly to the woofer; for tri-amping, wire the three sets of posts to their respective drivers.

The best place to mount the crossover is on the remaining porthole cover. When you wire the binding posts, make sure to have plenty of wire so you can wire to the crossover with the cover off the box. **Figure 9** is a schematic of the crossover for full range use with the suggested drivers, with crossover points at approximately 200Hz and 4kHz. The values of the 3rd-order LP filter on the woofer appear to be those for a far lower crossover point, but that compensates for the rising response of

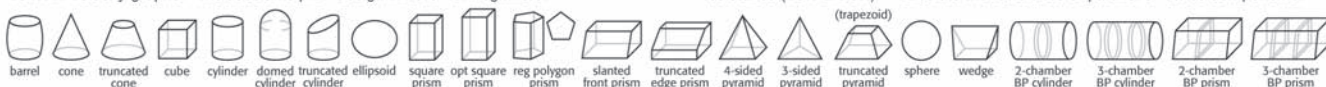
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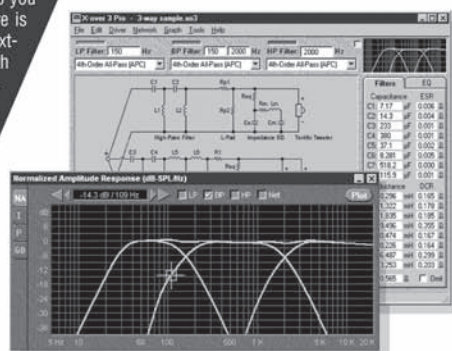
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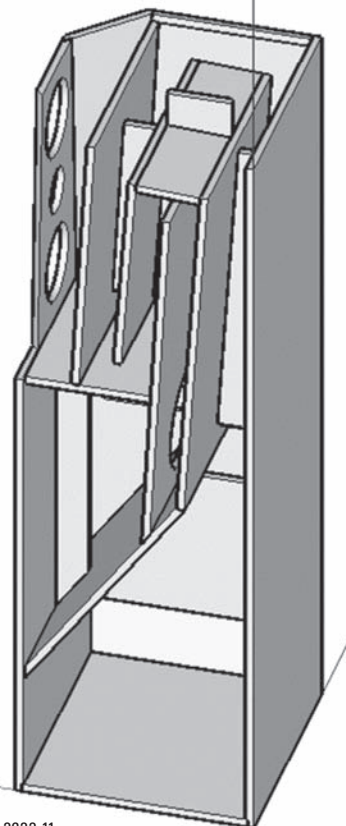
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the woofer horn. The 18mH, 10mH, and 3mH inductors must be iron or ferrite core with low (less than 1Ω) Re values; air core is fine for the 4.5mH and 0.3mH inductors.

The 220μF and 150μF caps are electrolytics, though the 150μF value will work better if you parallel-wire a 140μF electrolytic cap and a 10μF poly cap. All remaining caps must be polys. Securely attach all the crossover components to the porthole cover and wire it up. Note that the midbasses and tweeter are wired with inverse polarity relative to the woofer. With a separate sub amp, use only the components for the midbass/tweeter crossover, also eliminating the 150μF cap and 4.5mH coil midbass high-pass filter.

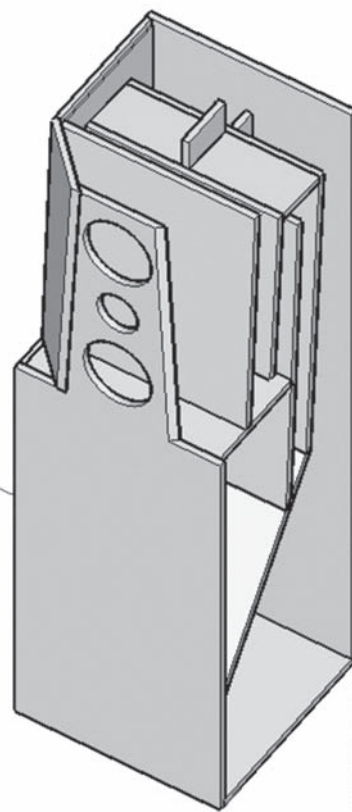
With tri-amping, a crossover is not required, but still use a 10μF DC protection cap in series with the tweeter. When everything is wired, weather-strip the mounting flange and screw the cover in place. Finally, if you wish, add either feet or isolation spikes to the bottom. *aX*

FIGURE 11: Cutaway from side.



SB-2622-11

FIGURE 12: Cutaway from top.



SB-2622-12

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