speakers

The Tuba 18 Sub

By Bill Fitzmaurice

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This small horn-loaded subwoofer delivers all the bass power you need for home use or in the car.

PHOTO 1: THE TUBA 18 SUB.

After prototyping the Tuba 24 pro-sound sub (April '04 *aX*, p. 34), I was intrigued at the thought of building a diminutive Tuba, one small enough for home or auto-sound use. As my intended outside dimension of approximately 18 in^3 is an unheard-of size for a horn-loaded sub I used the McBean Hornresp.™ simulation program to see whether it was at all feasible. The mouth would need to be very small, so I modeled in ⅛ space for corner loading.

To support loading to 40Hz the horn path would need to be at least 7′ long, and that would result in a very small rear chamber, too small even for a ten. But despite my own misgivings the simulation results indicated that the concept would work. I only needed to find an appropriate driver.

DRIVER SEARCH

I gave up on 6½″ drivers early on, as I could find none at a reasonable price with the requisite Xmax spec, which I figured would need to be at least 5mm. I looked at many eights as well, but understandably there aren't many designed for sub duty which is primarily the domain of twelves and fifteens. But one driver—the MCM #55–2421 8″—had just the specs I needed. This woofer has a claimed Fs of 25Hz, Qts .18, Vas 39 ltr, SPL 87dB, 120W power rating, and, most important, a 16mm Xmax.

My sample turned out to have a measured Fs of 30Hz, which is even better for horn loading, which pushes the effective Fs to a much lower Fs(h).

PHOTO 2: RABBETS CUT INTO ONE SIDE.

FIGURE 2: INTERSECTING PARTS.

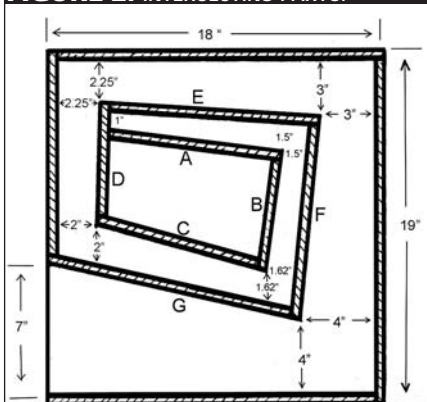


FIGURE 1: TUBA 18 SPL CHART.

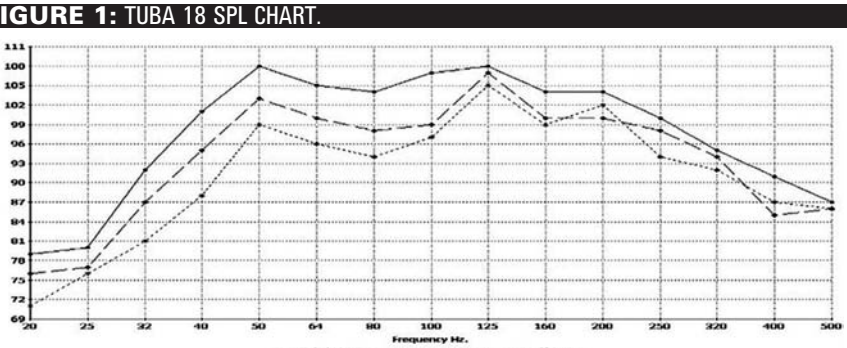
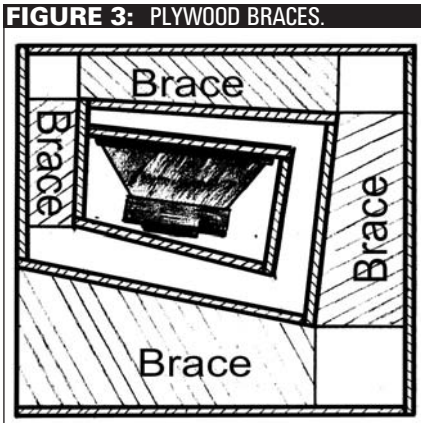


FIGURE 3: PLYWOOD BRACES.



Interestingly, Koonce and Wright considered this driver for their VB sub project (*aX* 5/04 and 6/04), but passed on it due to slightly better measured specs from another driver. I found that for a horn-loaded sub its specs were unsurpassed, and at less than $30, shipping included, the price is an absolute steal.

The lower passband required from a home theater/hi-fi sub, as opposed to the pro-sound Tuba 24 model, required another foot of horn path despite a smaller footprint, which I achieved by using more bends in the horn. The horn mouth ended up far smaller than I would have preferred, but to make it larger would have cost horn length. In the end that turned out to be no problem. As a pro-sound sub, Tuba 24 would more often than not have no available boundary reinforcement; taking that into account, I made its mouth-to-path-length ratio very high for maximum SPL in a freestanding placement.

With Tuba 18 my intent from the beginning was to corner-load, so I made the mouth-to-path-length ratio small. This hurts response in a freestanding location, but since corner placement adds both additional path-length and mouth area, the resulting combination of response and sensitivity (*Fig. 1*) is one not normally associated with either an 8″ driver or a 3.3ft^3 box (*Photo 1*).

CONSTRUCTION

Construction of the Tuba 18 is nearly identical to the Tuba 24. The material is ½″ plywood; if weight is of no concern ½″ MDF or particleboard will work just as well. You can use heavier materials for the outer shell parts, as long as you do not alter the internal clearances. Do not use horn plates thicker than ½″, however, or the driver chamber will end up too small.

While you may opt to simply screw and glue the parts together, I used a different technique with the prototype. I routed ½″ wide by ⅛″ deep rabbets on the sides at all the joints, glued the joints with polyurethane construction adhesive, and slid the parts into place, securing them with 1″ brads while the adhesive cured. This method produces a very strong joint, though the routing process is time consuming.

I did this primarily to see how long it would take to assemble the cabinet from pre-cut pre-routed parts, as would be the case in a factory. You can do it this way yourself if you wish, or stick with simple butt joints. By the way, with pre-cut parts the assembly time was less than an hour.

To start construction, cut out the two sides. Draw the locations of all the intersecting parts (*Fig. 2*) on them, starting with the front, top, back, and bottom, and from there the horn plates, starting at the junction of plate G where it joints to the front. The internal measurements shown are the pathway clearances at each horn bend; the panel dimensions will depend on the actual measured thickness of the material used, as there is no such thing as ½″ plywood that actually measures ½″ thick.

If you are rabbeting the joints, do so now (*Photo 2*) using a guide board clamped or screwed to the side to act as a guide for a pattern following router bit (*Photo 3*). When you cut the rabbets have them run all the way to the cabinet edge so that you can slide each part in turn into place.

ASSEMBLY

Cut enough material for all of the remaining parts at one time, so that the table saw rip fence will not be moved and all parts will be of identical width. Since the cabinet is 18″ wide, the nominal width of all the parts is 17″, but if you use the rabbet joint technique, add another ¼″ to the parts width. Cut the parts to length one by one as each is installed, using dead reckoning to determine their true lengths. Start with plate A, going through plate G, and

PHOTO 3: CUTTING RABBETS WITH A ROUTER ATOP A GUIDEBOARD.

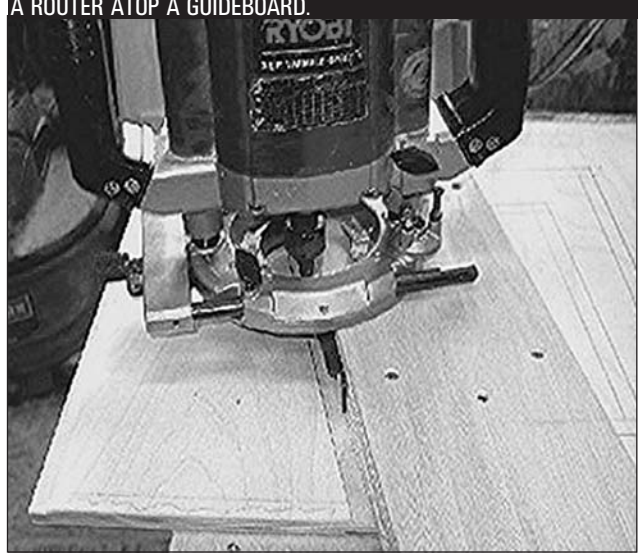


FIGURE 4: TUBA 18 IMPEDANCE CHART.

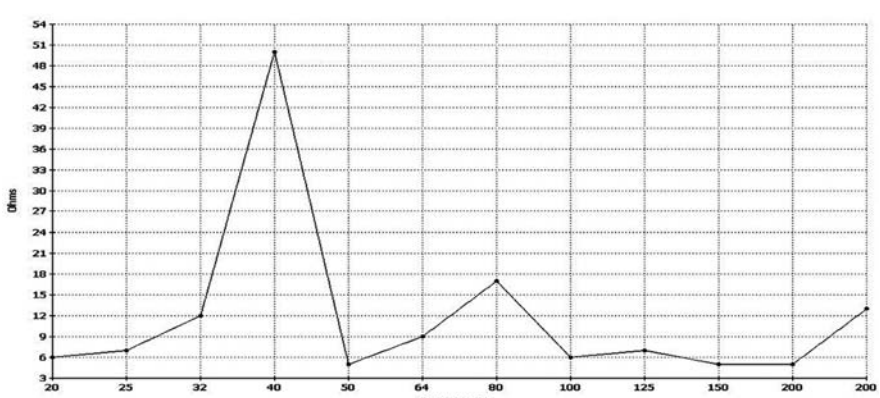


PHOTO 4: ATTACHING PLATE A TO ONE SIDE.

then in turn the front, top, back, and bottom. Plate A also serves as the baffle, through which you cut a hole for the driver.

Install "T"-nuts for driver mounting if you wish, though screws are adequate. The angles where the plates intersect are slight enough so that cutting the plates at an angle is not required; the expanding polyurethane adhesive will fill any voids. The exception is the junction of plate G and the cabinet front, where the angle is severe enough to require cutting to suit. Begin attaching the plates (*Photo 4*). With butt joints, use a straight guide-board and clamps to hold the pieces together in proper alignment while drilling pilots and driving screws. With rabbet joints, keeping things aligned while attaching the first parts is easy if you use another part as a temporary spacer (*Photo 5*).

PHOTO 5: ATTACHING THE SECOND SIDE TO THE ASSEMBLY.

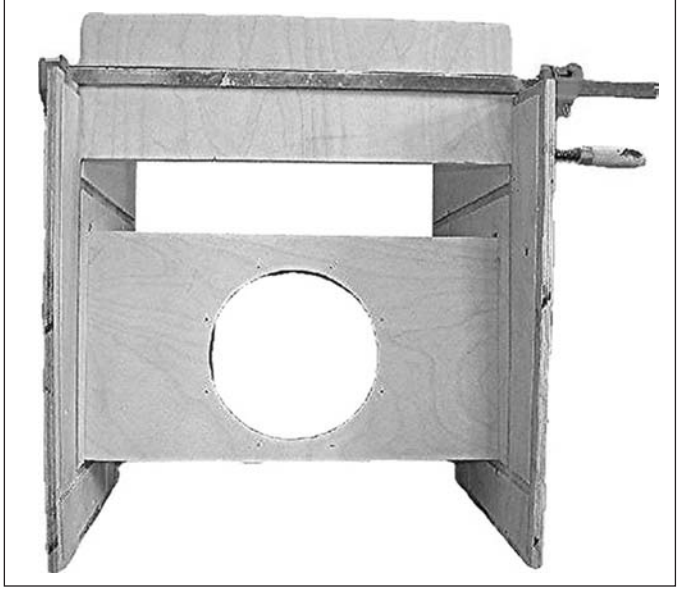
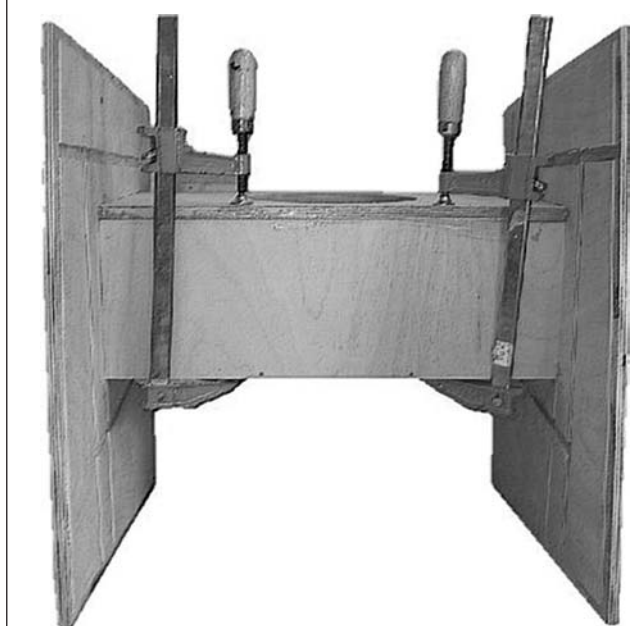


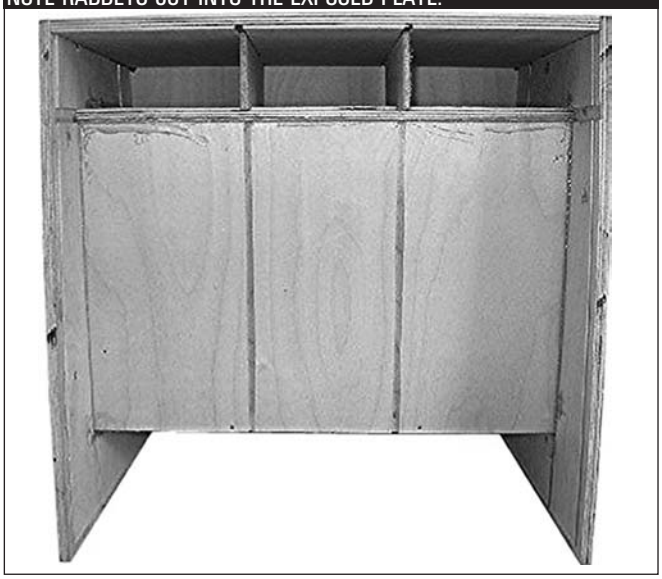
PHOTO 6: CLAMPING PARTS FOR ASSEMBLY.



As you add more parts, use clamps to hold them in alignment until you nail them (*Photo 6*).

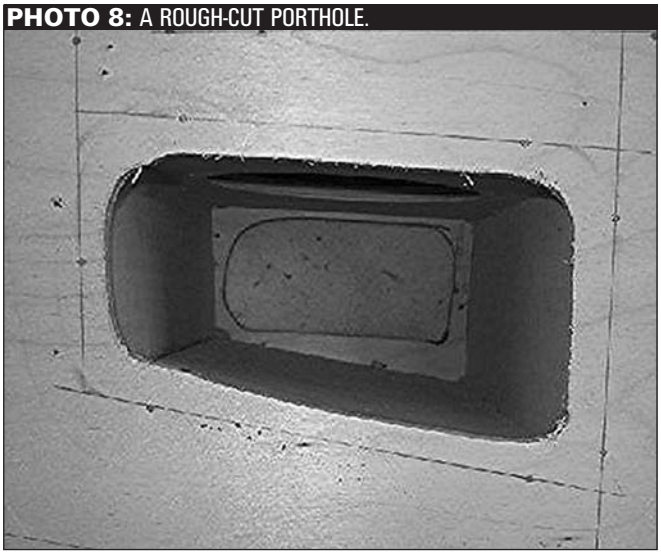
There are ¼″ plywood braces between the outer horn plates and the front, top, back, and bottom (*Fig. 3*), approximately dividing the panels into thirds, their sizes determined by dead reckoning. They slide into ⅛″ deep rabbets cut into their mating parts either on a table saw or a router table. Make sure before you install the braced parts that you cut the necessary rabbets into them (*Photo 7*), and thoroughly glue the rabbets as you install the braces.

PHOTO 7: BRACES IN PLACE; NOTE RABBETS CUT INTO THE EXPOSED PLATE.



The porthole openings are framed by plates A through D. Determine their locations by the nails or screws through the sides going into those plates. Rough-cut the porthole opening (*Photo 8*) with a saber-saw, then use a flush-trimming router bit to final-trim the opening to the plates (*Photo 9*). There are portholes on both sides of the cabinet to provide access to the driver mounting bolts/screws. Speaking of the driver, now's a good time to make sure it fits (*Photo 10*).

PHOTO 8: A ROUGH-CUT PORTHOLE.



From the opposite side of the box, reach through the driver chamber to trace the opposite porthole cover on a piece of plywood, cutting the cover ½″ oversize all around. Use a router to cut a ¼″ deep flange on the porthole covers (*Photo 11*) and also on the cabinet sides (*Photo 12*) so that the portholes fit flush to the cabinet sides. Apply the finish of your choice and then install the driver, wiring it through one of the porthole covers, thoroughly sealing the hole. Weatherstrip the flanges and install the porthole covers.

Note that horn loading the 4Ω driver gives an average impedance over 6Ω (*Fig. 4*), so this is not a difficult box to drive. Also note that the rear chamber is not lined or stuffed. I tested the cabinet with and without stuffing (*Fig. 5*) and found that damping materials actually hurt performance.

The best placement for the box is

PHOTO 10: TIGHT SQUEEZE!

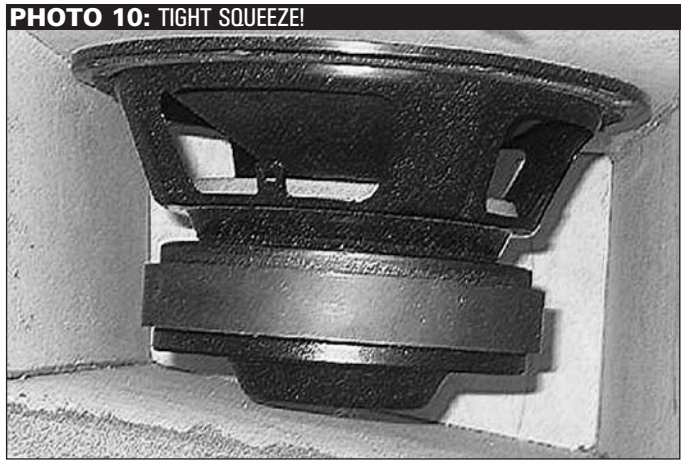


PHOTO 9: A FINISHED PORTHOLE.

PHOTO 11: A FLANGED PORTHOLE COVER.

facing into a room corner, tight to the walls. Alternately, it will work almost as well facing the wall from about 6″ distance in a center of wall placement. If you currently have a non-horn-loaded sub, you'll notice a big difference with Tuba 18. I used mine to replace a pair of $2ft^3$ sealed boxes loaded with twelves, and even after reducing the amp output by some 10dB the Tuba still delivers a low-frequency extension of which the twelves were never capable. You could easily drive this sub with SET power. If you have a variable low-pass filter on your sub amp, a setting of 40 to 50Hz gives the best result in smoothing response.

While intended primarily as a home/auto sub, this box still has the requisite efficiency and power handling required for pro-sound in small venues, or for permanent installations such as churches where very high SPL is not required. It matches well with my DR200 (August '04 *aX*, p. 24) for those of you who want a high-efficiency full-range PA from the smallest possible cabinetry.

As for auto-sound use, I substituted my Tuba 18 for my regular car sub for a couple of days and it was amazingly better in low-frequency extension, sensitivity, and total output. If you want bass power that will leave the local teenagers slack-jawed in disbelief, stick one of these in your trunk. It will deliver the goods. *aX*

PHOTO 12: FLANGING A PORTHOLE WITH A ROUTER AND GUIDEBOARD.

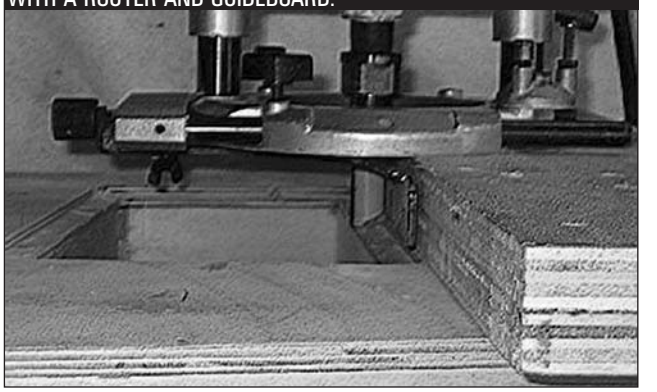


FIGURE 5: TUBA 18 NEAR FIELD RESPONSE CHART.