



Awesome Audio

Build a better set of speakers than you'd want to pay for in a store

By William Schneider

Who says that you can't build a set of loudspeakers that can sound better than those you can buy? You'll discover that most commercial loudspeaker manufacturers take steps to lower the cost of manufacturing and shipping their products. Two places where corners are cut are cabinet quality and in the electronic assemblies inside. These impact sound quality. Working in

your own shop you can make stout cabinets that won't resonate when the piano hits middle C. Inside, a well-designed crossover will blend low through high tones smoothly.

While you may be comfortable tackling the cabinets, you might feel uneasy about the electrical tasks. But don't worry. With kits like the Overnight Sensations from Meniscus Audio (see Buyer's Guide, p. 64), the difficult electrical

design work is already done. All you have to do is assemble the parts per instructions. The kit featured here contains everything you need except for the wood.

Even though the kit requires soldering electrical components together, supplied stick-on templates show where each item goes. If you can't solder, already assembled crossovers are available.

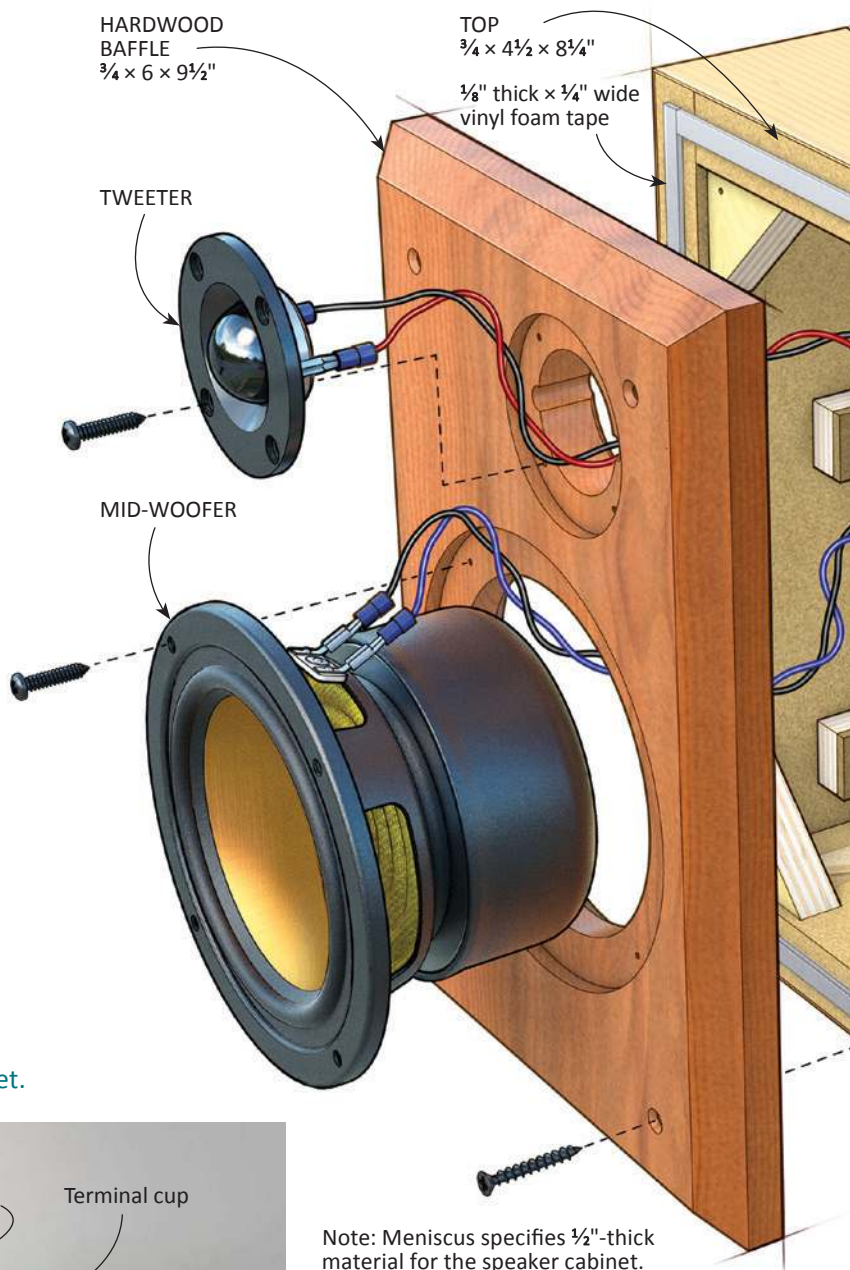
Speaker anatomy: Basic box, beautiful baffle, balanced

Audio expertise isn't required to build first-class speakers, thanks to the balanced components that come in the kit shown below. (But the "Audio 101" vocabulary on the facing page will give you some useful basic knowledge.)

These bookshelf-size speakers are sized to house the components, but you can apply the same construction techniques to build larger speakers as well. MDF makes excellent speaker cabinet material because its dense, uniform composition helps minimize unwanted vibration. Because MDF has poor screw-holding capability, I glued plywood corner brackets to the box interior to hold the four baffle installation screws. Invest in some nice-looking veneer to cover the MDF, and select some attractive hardwood to make your baffles.

Construction sequence

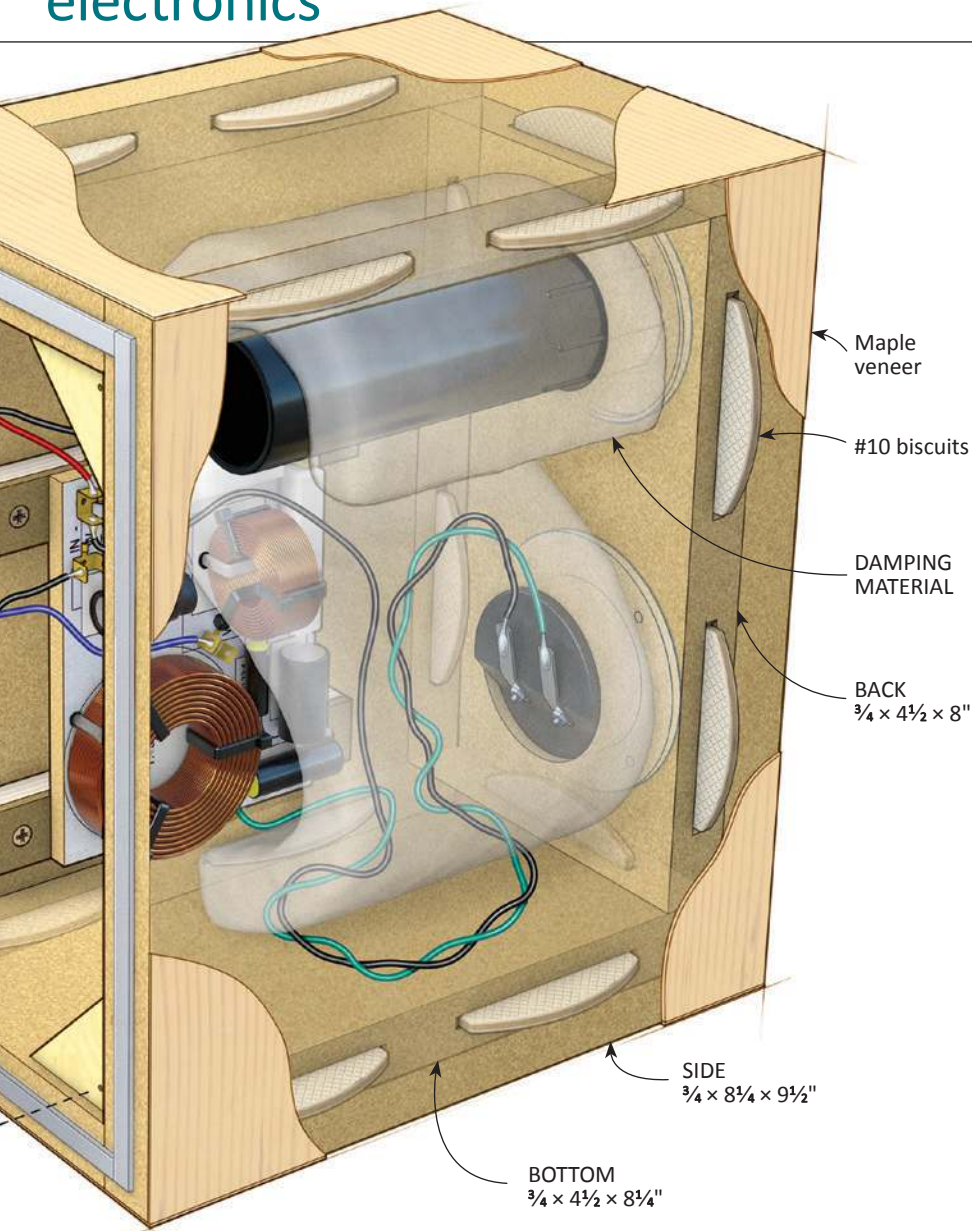
- Mount electronics on crossover board.
- Make the baffle and build the MDF box, then veneer the box.
- Apply finish to baffle and box.
- Install speaker components.
- Screw baffle to box to complete speaker cabinet.



Note: Meniscus specifies 1/2"-thick material for the speaker cabinet. I adjusted cabinet dimensions so that 3/4"-thick stock can be used.

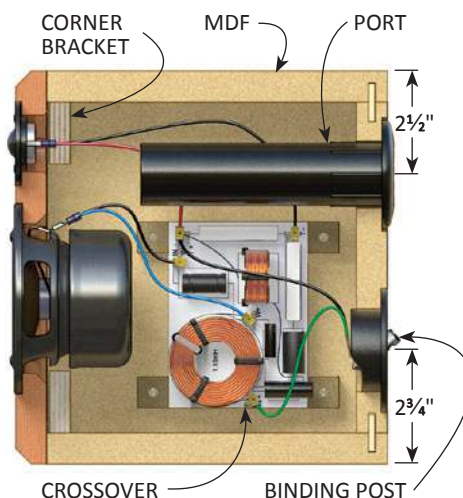
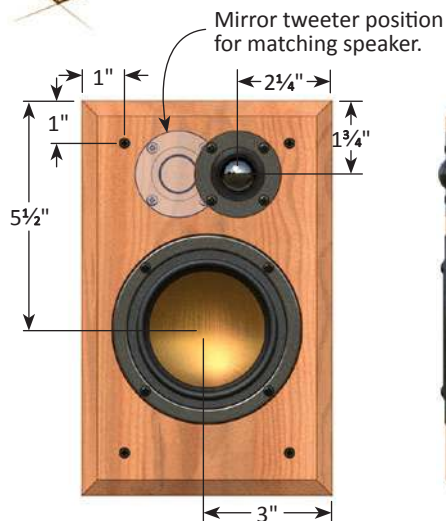


Just add wood. At \$130, the Overnight Sensations speaker kit is a good choice for someone wanting to try speaker building. The kit contains everything you need for two speakers: electronic components, damping material, crossover boards with templates, screws—and candy. You supply the wood and adhesive-backed foam tape (weather stripping).



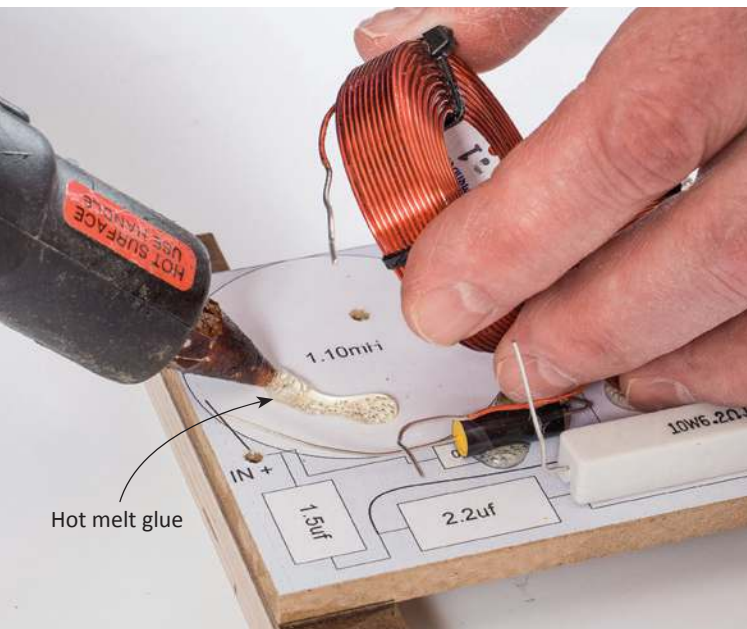
Audio 101

- **Port** - A tube inserted into the cabinet that allows deeper bass. Its size works together with cabinet volume.
- **Baffle** - Holds drivers in position. Baffle width, tweeter position, and driver spacing must be maintained or sound will be affected. Chamfers or round-overs on edges can aid sound.
- **Drivers** - The components that actually produce sound. Small drivers for high frequency notes are called "tweeters." The largest drivers for handling bass are called "woofers." This kit has medium-sized drivers called mid-woofers.
- **Crossover** - Circuitry that splits the electrical signal into high and low bands and sends them to the appropriate drivers. Crossovers include coils, capacitors, and resistors (see below).
- **Coil** - This crossover component passes low frequencies and blocks higher frequencies in the signal.
- **Capacitor** - Blocks lower frequencies and passes higher frequencies
- **Resistor** - Impedes the flow of electrical current.
- **Damping material** - Placed inside the speaker cabinet, this material blocks internal sound waves that adversely affect sound quality.
- **Binding posts** - Color-coded connectors for amplifier wires.

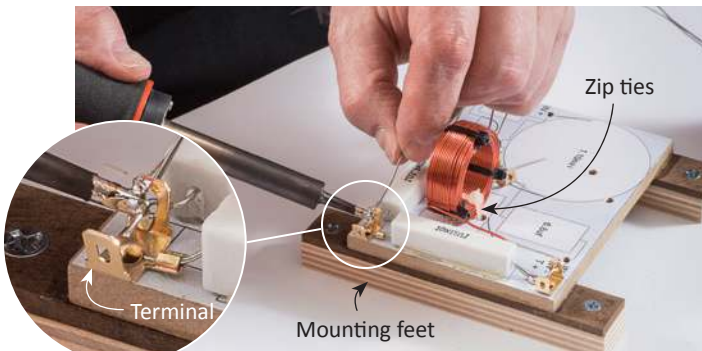




Skin the coat. Coil wire is coated with enamel that interferes with soldering. Use a knife to scrape the coating from wire that needs to be soldered.



Follow the template. Glue the kit's template to the crossover board, then use hot melt glue to adhere the parts. Add zip ties to secure heavy coils. Fit the leads into their terminal openings before soldering.



Solder a connection. Touch the iron's tip to a connection for a couple of seconds. Without lifting the tip, feed solder between tip and connection, melting the solder. Maintain heat for a second after sufficient solder has flowed, then pull the iron's tip away. Allow several seconds for solder to solidify.

Mount & wire the electronics

Some soldering is required to connect the speaker's electronic components. If you feel uncomfortable soldering, you can order pre-assembled crossovers from Meniscus for an extra charge.

Mounting components and soldering connections are simplified, thanks to included templates you can glue to crossover boards, as shown in these photos.

Plan how to mount the crossovers inside the speaker cabinet. I cut $\frac{3}{4} \times 5$ " strips of hardboard and plywood to use as feet for the crossovers. The plywood feet are glued to a cabinet wall, but the hardboard strips (which are glued to the crossover board and screwed to the feet) can be removed.

Soldering 101

To solder electrical components, you'll need a soldering iron and electrical solder. Pencil irons begin at \$15, but I use a \$50 Weller adjustable heat soldering station. Use 60/40 rosin core, 0.031"-diameter solder.

To solder, touch the hot tip to the joint for a few seconds, and feed solder between tip and joint until it melts and flows into the joint. Move solder to coat other parts in the joint. I spend about 5 to 8 seconds per joint. A good joint should be shiny like chrome, not grainy. Occasionally wipe the soldering iron tip clean on a damp sponge.

Once you learn to solder, projects like floor lamps, table lamps, and power tool repair all become possible.



The baffle is tricky; the box is easy.

Assemble, then trim

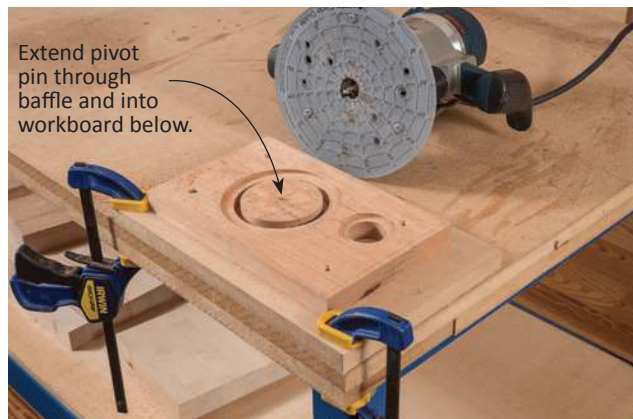
Speaker cabinets require good-fitting parts to minimize unwanted vibration, so cut parts and rout holes precisely. I start with the baffle, cutting it about $\frac{3}{16}$ " over its finished size. Each baffle requires a large, round, rabbeted hole for the mid-woofer and a smaller rabbeted hole for the tweeter. I rout the holes in the baffle and the back with a Jasper circle-cutting jig attached to the base of my router and a $\frac{1}{4}$ " straight bit. If you haven't routed circles with a Jasper jig before, you might want to make some practice cuts on scrap stock.

Rout the rabbeted section of each baffle hole first, then rout the hole by making a series of successively deeper cuts.

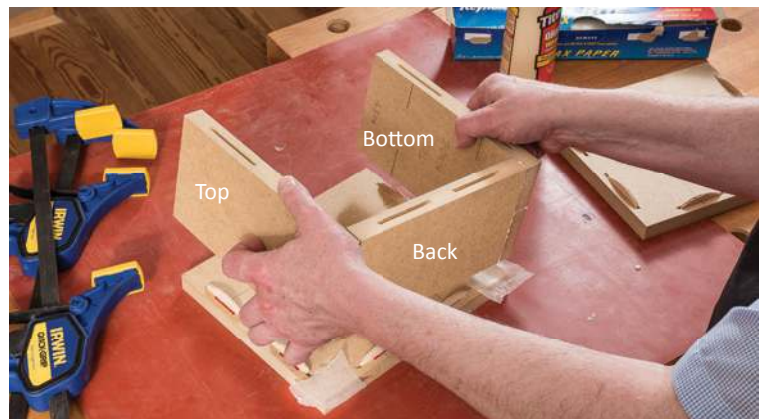
Put the baffle aside after holes are routed, and turn to making the MDF box. I assemble the box with biscuit joints and glue. My biscuit joiner workstation (p. 50) helps me cut slots quickly. When the box is together, temporarily attach the baffle so it can be flush-cut with a flush-trim bit.



Lay out each baffle. Locate each hole carefully. Use the compass to mark the opening and the rabbet to hold each driver's flange.



Rout holes for drivers. Attached to the base of your router, a Jasper jig is ideal for speaker construction. It enables you to rout circular recesses and holes from 1" to 7 $\frac{1}{2}$ " in diameter in $\frac{1}{16}$ " increments. Use a $\frac{1}{4}$ " spiral upcut bit, and take passes about $\frac{1}{8}$ " deep.



Glue up the box in stages. Cut slots for #10 biscuits in box sides, back, top, and bottom. Then glue the back, top, and bottom together. Place a side on the workbench as I'm doing here, to use as a positioning guide before clamping up this subassembly. Wax paper keeps your glue-up from sticking to the positioning guide.



Install corner blocks. Cut corner blocks to hold the screws for the baffle. Mount them about $\frac{1}{16}$ " below flush.



Flush-trim the baffle. Doing this before veneering the box prevents router bearing tracks in the veneer. Tape some cardboard (about 0.030" thick) to approximate the veneer thickness.



Map out your veneer. Make cardboard patterns $\frac{1}{2}$ " oversize and position them on the veneer as shown. Allow at least $\frac{1}{4}$ " between the pieces.



Cut it out. Using scissors or a knife, cut groups of tracings from the roll, leaving a little extra margin all around.



Spread glue on veneer and cabinet. Tape the edges of veneer to a table, then use a sponge paint roller to apply glue. Let the glue dry.

Iron on some veneer for an easy appearance upgrade

While MDF takes paint well after a couple rounds of shellac and sanding, it's even easier to veneer. The iron-on method, using paper-backed veneers and an ordinary clothes iron, is straightforward and simple. Coat both the cabinet and the veneer with Titebond Original, let the glue dry, and iron on the veneer. Once dried, the glue will still reactivate for up to seven days.

The veneer doesn't stick until you apply heat, so it's fairly easy to position each piece precisely. Veneer the back first, then the bottom, sides, and top. After ironing on a piece of veneer, trim the overhanging edges flush with a flush-trim bit. Then move to the next side.

Once all sides are complete, use the wood finish of your choice. I wiped on several coats of General Finishes Arm-R-Seal satin.



Iron on the veneer. Position the veneer as desired. Place cotton cloth (t-shirt material works well) over it. Using an ordinary clothes iron on the cotton setting, press firmly and work slowly to adhere the veneer.

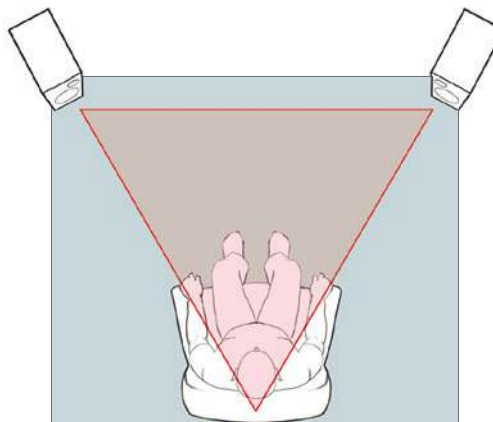


Flush-trim veneer overhang. Use a flush-trim bit in a router or router table to quickly remove the excess veneer from the edges. Tape reduces bearing tracks on already-veneered sides.

Mount the crossover board, install the baffle, then Rock Out

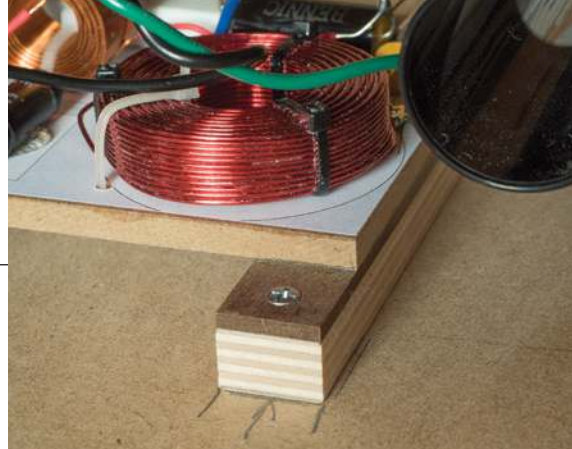
After applying a finish, it's time to install the crossovers and ports, mount the wires, and attach the drivers. First, mark and drill pilot holes for all mounting screws. Glue the crossover assemblies onto an interior side wall. Once secured, run the wires for the binding posts out the back opening, and use the push-on connectors to connect the crossovers to the binding posts. Using the kit screws, attach the binding post to the cabinet. Press the port into place, and then secure with glue. If the port flanges are oversize, file them to fit.

Insert the damping material, and screw the baffle into position. Run the wires through the driver openings, and attach to the terminals. Pay close attention to the wiring polarity given in the instructions! Screw the drivers into position. Time to play music!



Sweet Spot Setup

Viewed from above, speakers and the listener should form an equilateral triangle. Most speakers sound best placed at least a yard from large surfaces like walls or large TVs. The listening seat should also be in the open. While real-world compromises are often involved, you owe it to yourself to listen to these speakers at least once in the ideal configuration before tucking them against the wall.



Mount assembled crossover boards.

Find a location on a side wall where nothing will interfere with the crossover. Spread wood glue on the bottom of the crossover feet, and press them into place for a minute or two. Set aside to dry.



Insert damping material. Cut to size and insert, but be careful not to block the port.



Attach leads to drivers.

Each driver has a "+" and a "-" terminal (plus is sometimes coded red). It's important to use correct polarity per kit instructions. To attach wires, either use the included push-on connectors or solder the wires directly to the driver terminals. Be sure the driver gaskets are in position before attaching leads.

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