



Garage Speakers— seldom discussed, but easily recognized. Anyone who has been involved in audio for a length of time is familiar with the situation: you have an old pair of speakers that are too big to use at home, but that still work well, and you hate to throw them out. By process of elimination, these speakers end up in the garage or a workshop, powered by a wood-cased vintage receiver. But not every speaker will make a good garage speaker— which is why I decided to set forth my own garage speaker design!

1 Design Goals

From a frequency-response standpoint, the key requirements of a garage speaker are punchy bass and somewhat extended and slightly exaggerated high frequency response. This extra bit of boom and sizzle will help the speakers project the sound well and be easily heard in a workshop environment where the listening area is large and the noise floor is high. Low-end response below 60 Hz is not critical, as this will be lost in the open environment regardless.

From an expense and functionality standpoint, the primary goal of the garage speaker is simplicity and low-cost. These speakers are not meant to require a large investment of construction time and money, since they are constantly at risk of getting damaged. It isn't unusual for the typical garage speaker to be covered with dust, exposed to paint fumes, used in extreme heat or cold, hit with flying debris, or even rained on. Therefore, it is important that the drivers are inexpensive and easily replaceable, allowing continual maintenance and upkeep if a driver is damaged.

2 Driver Selection

The majority of my driver selection decisions on this project were dictated by my goal to keep the cost as low as possible. In addition, I knew that I needed a relatively large woofer to achieve the desired output levels, aesthetic appeal, and bass requirements. I also kept in mind that I frequently see questions on the Tech Talk discussion board about Goldwood speakers, and the lack of information about them. So, by using them in a project, I hoped to get a better handle on the capabilities and performance of some of their drivers.

The woofer that was chosen for this project is a buyout 12" Goldwood woofer, the GW-1220/8R. I chose this driver primarily for its very low cost, and secondarily for its red foam surround, which would match my retro design theme quite well. An alternative to this woofer would be the Pismo Series 12" woofer, GW-212/8, which will provide slightly stronger bass thanks to its stronger motor and higher sensitivity. The crossover design can remain unchanged for this substitution.

As a midrange, the Goldwood GM-65/8 provided the flattest frequency response of any of the sealed-back midranges I tested, and has a healthy power-handling capability. Since I was using a relatively small midrange, I knew that I did not need a tweeter that played exceptionally low. In keeping with the durability theme, the Goldwood GT-1025 piezo mid/tweeter was chosen for its good top end extension and relatively flat frequency response. Despite being called a mid/tweeter, it has a better top-end extension than many other piezo drivers.

THE GOLDEN BOYS



3 Enclosure Design

Since we are using a woofer that has a very high Q, we are in a situation where there is no "optimum" enclosure per se'. High Q woofers should be used in sealed enclosures, and the larger the enclosure, the lower the system Q will be. But, it will never drop below the Q of the driver in free air, so at some point we have to draw the line on the enclosure volume due to practical size limits. In this case, I decided to use a 2.0 cu. ft internal volume for the woofer, which translates into a 16" tall, 24" wide, and 12" deep cabinet. Even fully stuffed, this enclosure still leaves the system Q very high, so a larger enclosure could be used if desired. The midrange and tweeter are both fully sealed, so they can simply be dropped into cutouts in the baffle.

I want to point out that the horizontal orientation of the speaker is not critical to the design. This speaker could just as easily be oriented vertically with the drivers aligned down the center of the speaker. As a true garage speaker, the horizontal orientation worked better for my application. But, a vertical orientation would place the acoustic centers of the drivers closer together, and may yield slightly better integration between the three.

4 Enclosure Construction & Assembly

Since these are low-cost speakers, and will most likely be used where the looks are not important, I expect that most people will build them with whatever materials they happen

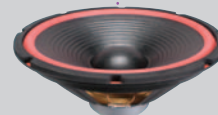
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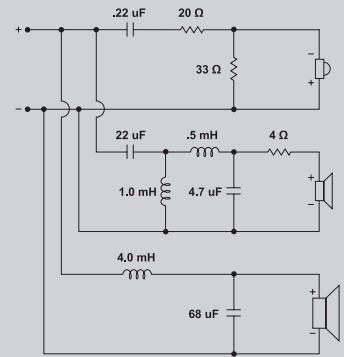
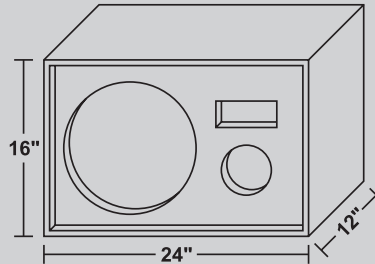
Parts List

External Dimensions

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Crossover Schematic

Part #	Description	Qty.
016-20	20 ohm 10 watt wirewound resistor	2
016-33	33 ohm 10 watt wirewound resistor	2
016-4	4 ohm 10 watt wirewound resistor	2
027-332	4.7 uF non-polar capacitor	2
027-348	22 uF non-polar capacitor	2
027-356	68 uF non-polar capacitor	2
027-402	Dayton .22 uF polypropylene capacitor	2
255-036	Jantzen .50 mH 20 ga air core inductor	2
255-048	Jantzen 1.0 mH 20 ga air core inductor	2
266-562	4.0 mH 18 ga I Core Inductor	2
280-062	Goldwood GT-1025 piezo horn mid/tweeter	2
280-105	Goldwood GM-65/8 5" sealed back midrange	2
299-738	Goldwood GW-1220/8R 12" woofer	2



Listeners' Comments

Mike: These great-looking speakers have a bright, clear sound that will cut through the background noise of an air compressor or party. Crank up the bass and rock the house, or garage!

Jarrod: Just as planned, these would be great for a garage, workshop, or as party speakers. Even though it is against "the rules", bass and treble controls, or even better a loudness button, are a must to get these to really rock.

Donna: I thought the speakers sounded pretty good, but I did not love them. The punchy bass is a plus in my book, but I think that overall a younger crowd would enjoy them more.

to have lying around the workshop. Plywood, MDF, or particleboard would all work equally well. Construction can be done with simple butt joints, glue, screws, staples, or whatever fastening method is most convenient. The cabinets can of course be left unfinished, given a clear-coat, or painted.

The look that I was going for with my rendition of the design was a vintage, retro look. The cabinet main panels are birch-faced plywood; the corners were mitered to eliminate as much end grain as possible. The leading edges of the plywood were covered with birch edge banding to eliminate all end grain and to provide the look of being built from solid wood. The finish is a pecan stain with a gloss polyurethane clear coat. The vintage oxblood with gold stripe grill cloth by itself was too transparent to provide the look that I was going for, so I needed to layer it on top of standard brown grill cloth.

5 Crossover Design

When working with lower-cost drivers, the crossover design is often more difficult than it would be with pricier drivers. Flaws in the drivers must be compensated for, and at the same time an effort must be continuously made to keep the number of components and cost as low as possible. I struggled with the crossover design for quite some time, trying many different topologies to get the desired performance without excess components. In the end, I was able to start with a somewhat more complex crossover, and then carefully eliminate components that were not critical to the design.

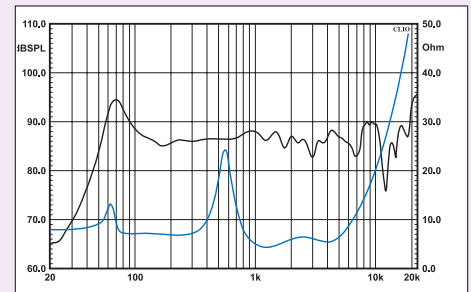
The crossover on the woofer portion is a straightforward second order low-pass filter. Initially I used a conjugate network to contour the upper end response, but found that it was not necessary to the overall design, and could be compensated for by adjusting the shunt capacitor value. The upper-end cutoff of the woofer is at about 500 Hz.

The midrange takes over from 500 Hz through about 6,000 Hz, and uses second order high-pass and low-pass filters. A 4 ohm padding resistor reduces the output by several dB, while propping up the impedance throughout the midrange. The piezo tweeter uses a .22 uF capacitor in addition to a fixed L-pad. In this case, the presence of the two resistors is critical to the functioning of the tweeter crossover; without the shunt resistor the high-pass filter would not function correctly. In true vintage style, a variable L-pad could be substituted in place of the fixed resistors if desired.

6 Comments & Conclusions

Cosmetically, these speakers have a somewhat cool, vintage look; most people that have seen them have been enamored of the style. The size, while somewhat large for a typical living room, is perfect for a garage or workshop.

Frequency Response Chart



Considering the design goal was to keep the cost as low as possible, these speakers perform quite well. The drivers, crossover components, and terminals can be bought for less than \$75.00 for the pair. Add to this about \$20.00 for a 4' x 8' sheet of wood, and you can build a complete pair of speakers for under \$100.00. When you consider that there are many woofers by themselves that cost more than this, it is even more impressive!

Sonically, these speakers deliver the punchy bass and extension that I was looking for. The bass peaks at about 70 Hz, and then output drops off quickly, but this helps protect the woofers from overexcursion and provides great party "thump" without bothering the neighbors. For the best bass response, the speakers will benefit greatly from being placed in a corner or up against a wall or ceiling. The top-end extension of the piezo tweeter is good, and is not excessively shrill or harsh on most musical passages. The speakers do lack the refinement of more costly designs, but they are free from massive midrange peaks and shrill highs that normally plague this type of speaker. All in all, they are very listenable speakers, and with an old high-powered receiver will fill large garages or workshops with plenty of good music.



About the Designer

During the daytime, Darren Kuzma is a mild-mannered product manager, handling the everyday business of making sure Parts Express has the best speaker building offerings and the most in-depth information available. At night, the DIYer in him comes out, and he spends most of his time working on projects, fixing things around the house, cooking, and keeping up with the speaker building community. He's been building speakers for many years, and says "I learned the most by talking to other speaker builders, reading, doing experiments, and by trial-and-error. There's nothing like getting your hands dirty, that's why they call it DIY!"

