DO IT D·I·Y Yourself

The Podzuma

It's summertime, the weather is nice, and with the recent craze in portable audio devices, what better time to build a DIY portable speaker system? But since we're talking DIY here, there's no need to conform to industry expectations; forget the ultra-miniature, micro-sized speakers and boom-boxes that don't play very loud and feel like they cost about three dollars to build. I want a speaker that is portable and that plays loud enough and long enough to be used outdoors at a family reunion, ball practice, or the pool.

I will warn readers in advance—due to the amplification and electronics aspects of this project; it is somewhat more involved to construct than it may look. Not that the wiring of the amplifier and battery system is overly complicated, but it does add some complexity. Also, the extra sub-enclosure for the battery and amplifier, as well as the input and output dish construction does require a bit of attention to detail.

1 Design Goals

Embarking on this project, four main goals influenced my design decisions: overall portability, quality of sound, quantity of sound, and battery runtime. Based on my personal preferences, I decided to weight the quantity of sound and runtime the highest, followed by sound quality, and lastly portability. If you have a different set of priorities, then the design can by all means be modified or adjusted to suit your own individual needs. There are practically an infinite number of variations of this design that could be built which are bigger, smaller, lighter, louder, longer-lasting, and so on.

2 Amplifier/Driver Selection

From an electronics and amplification standpoint, the Sonic Impact T-amp was a natural choice thanks to its high efficiency and relatively healthy output power. The high efficiency design of the amplifier allows us to use either a smaller battery, or to achieve longer runtimes. From an amplifier power standpoint, while 10 or 12 watts per channel doesn't seem like much, many other small boom-box type devices only utilize 2-5 watt amplifiers.

So, that leads us into the speaker design portion, where the goal was to achieve a high sensitivity but also good overall fidelity. Since I wanted this to be a reasonably-sized system, I immediately knew that any 8" or larger speakers were out of the question. Also, I knew that to get the most power out of the T-amp, I wanted each channel to have a 4 ohm nominal impedance. After looking at many 5-1/4" and 6-1/2" drivers in the pro-sound, automotive, and home audio categories, I found the Dayton PA130-8. I liked this driver because of its overall sensitivity, lack of excessive X_{MAX} that I wouldn't need, 8 ohm nominal impedance, and parameters that can achieve decent bass extension in small enclosures.

Tweeter selection was not an easy task, as I knew that I needed to have a real-world sensitivity of around 93-94 dB @ 2.83V, and that the tweeter couldn't be overly large. Since 94 dB is higher than what can be found on most standard dome-type tweeters, I had to look into pro-sound oriented tweeters that utilized waveguides or compression to achieve higher sensitivities. So, I grabbed a handful of bullet and horn tweeters of different sizes and price ranges for some quick testing. Much to my surprise, the Pyle Pro PDBT18 1" bullet horn tweeter pair offered the best combination of flat frequency response, medium-sensitivity, and low cost. Admittedly it does have a bit of a zing to it, but compared to other compression tweeters the remarkably flat frequency response more than makes up for it.

3 Enclosure Design

Guided by my selection of the Dayton PA130-8, I knew that I wanted to use two drivers per channel in a ported alignment. Based on my desired overall cabinet size and the enclosure space that would need to be devoted to the electronics, I had about .30 cu. ft. of available space per driver pair. This works out to be a very nice volume, and the pair can achieve a respectable F3 of approximately 80 Hz in this enclosure. To accomplish the bass tuning, I installed a 1-1/2" flared port tube that was cut to 2-1/2" long for a tuning of 75 Hz.

4 Enclosure Construction & Assembly

Since this system was designed to be portable, I figured that it would be subject to a decent amount of wear-and-tear and the occasional water sprinkling. As such, I didn't want to use MDF due to its soft corners and water-absorbing characteristics. Instead, I used a ¾" 11-ply hardwood plywood; luckily this cabinet is just small enough that all of the external walls can be built from a single 2 ft. x 4 ft. pre-cut panel. However, I did need to use a few scraps of ¾" material that I had leftover in the workshop for some of the internal bracing and partitioning. More detailed info and drawings of the enclosure can be found within this project write-up on the website.

Assembly was done with air brad nails, glue, and a few biscuits. The four side joints were mitered to 45 degrees, biscuited, and then a 1" x 1" reinforcing stringer was nailed and glued from the inside. The stringer was dual-purpose in that it was used for bracing and to create the proper seating depth for the front and rear panels. The electronics sub-enclosure was installed and fastened, and then the front and rear panels were set into place and secured. All seams were sealed and reinforced with polyurethane glue.

As far as achieving the aesthetic look I was going for, it was actually a simple process, though admittedly a bit time

For more information on this project go to parts-express.com

Look for These Products

Tweeter #272-110

Driver #295-010

Amplifier #300-952

*Turn to page 18 for more information on items featured in this article.

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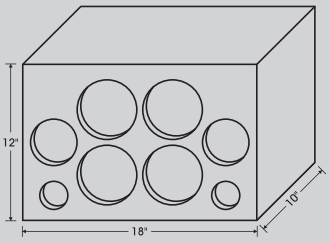
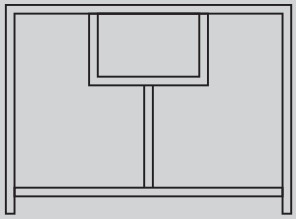
Parts List

Part #	Description	Qty.
004-4	Dayton 4 ohm non-inductive resistor	2
017-20	20 ohm 20 watt wire wound resistor	1
027-421	Dayton 4.0 uF polypropylene capacitor	2
027-429	Dayton 7.5 uF polypropylene capacitor	2
070-008	Ultra-bright 5 mm blue LED	1
070-065	12V super bright red LED	1
080-540	10-pack LED mounting bezels	1
090-317	3.5 mm stereo audio jack	1
090-488	2.1mm panel mount DC jack	1
091-1154	Dayton DESL-18G dual ended binding post pairs	2
100-220	Dayton microphone cable 1 ft.	1
129-330	12VDC 800 mA adapter	1
140-460	12V 5Ah sealed lead-acid battery	1
255-224	Jantzen .40 mH 18 ga air core inductor	2
260-334	Grill cloth yard white	1
260-402	1-1/2" x 4" flared port tube	2
260-525	1" sonic barrier dampening material	1
260-777	1-1/2" x 3/8" rubber foot	4
261-805	Black/white/silver vintage guitar amp grill cloth	1
262-018	5" x 7" vertical louvered dish black	1
262-040	5" x 7" blank metal dish black	1
262-312	Extra wide strap handle nickel	1
262-328	3-1/2" x 5-1/8" blank metal dish black	1
265-274	Marine grade cigarette lighter socket	1
272-110	Pyle Pro PDBT18 bullet tweeter pair	1
295-010	Dayton PA130-8 5" driver	4
300-952	Sonic Impact T-Amp	1
6A-1KV	6A rectifier diode	1

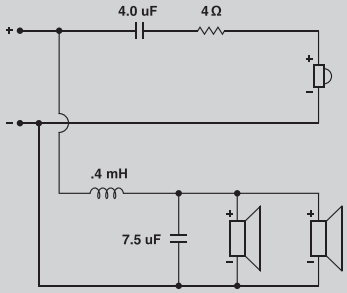
Overall Dimensions



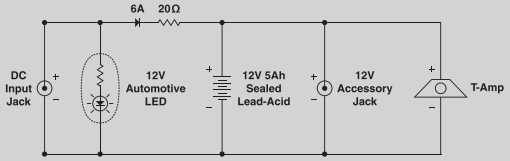
Top View Cutaway



Crossover Schematic



Battery/Charging Schematic



Listeners' Comments

Mike: Clean, clear, and LOUD! The speaker's ability to project coherent sound outdoors was truly impressive–it would put many battery-powered PAs to shame.

Jarrod: Performed excellent in the out-of-doors, especially when compared to brand name "boomboxes". If you've been looking for a portable outdoor party or tailgating system for your iPod or any other mp3 player, well then...

Donna: This system is perfect for camping, fishing, picnics or anywhere outside you want to take it. The sound is a lot louder and crisper than the average iPod speaker. The downside is that it is a little bulky and the interface isn't quite as good as with an iPod-specific product.

consuming. First, I used a 3/8" roundover bit to ease all of the edges to give the softer look I was going for. Then, I used automotive body filler on all of the cracks and voids, and rubbed a thin layer onto all exposed end grain and sanded smooth with medium grit sandpaper. After this, I applied several coats of a filler/primer spray paint out of a can and sanded smooth with fine grit sandpaper. Next was a first color coat of Rust-Oleum gloss white spray enamel which I let dry for a day or two and then gave a quick once-over with very fine sandpaper. A final coat of the gloss white spray-can Rust-Oleum, and I was in business with a finish that looks very rich and is quite durable.

5 Crossover Design

Because the crossover design of this project is only a small part of this project, I'm not going to go into quite as much detail this time around. I will say that despite the simple-looking crossover, the response is actually quite flat and gets about the most out of these drivers as possible. The tweeter is the limiting factor and cannot play much below 5 kHz; luckily the woofer has a smooth response up to about 6 or 7 kHz. The high 5 kHz crossover point does make the speaker more directional than what is found in a typical home speaker, but for an outdoor speaker this works very well.

6 Amplifier & Battery Hookup

To use the Sonic Impact T-amp in self-powered speaker designs, the first step is to remove the amplifier board itself from the overall plastic housing. First, remove the plastic volume knob by sticking a knife or other flat object under the edge and prying the knob forward. Remove the screws under the knob that hold the volume control assembly onto the top portion of the plastic case. Then, to get both halves of the case apart, remove the four screws concealed under the rubber feet and two small screws inside the battery compartment. At this point there are just two plastic rivets and some glue that hold the board into the enclosure. The glue doesn't seem to adhere enough to cause difficulty removing the board, so you only need to carefully snip or trim off the rivets with a small pair of side cutters or a razor knife. Cut off the wires going to the battery compartment and the speaker terminals, and the amp should be ready to go. I would suggest using as much of the existing wire leads and input jacks as possible, as the small size of the board and components makes it difficult to modify.

For my project, the only modifications I did to the amplifier module were changing the power indicator LED to blue, and removing the PC-mount 3.5 mm jack. The LED swap was accomplished by cutting off the stock LED and soldering on wires going to the new blue LED. I removed the PC-mount 3.5 mm jack with desoldering braid, and then soldered the three conductors of the microphone cable in its place. The other end of the microphone cable was soldered to a panel-mount 3.5 mm jack as the main input. The rest of the wires and connections were used as-is, and only needed to be extended in length for easier installation.

7 Comments & Conclusions

As I've said before, at the end of the day, the only real test as to whether a speaker project is successful or not is if it meets the initial goals set forth. In this case, the answer is a resounding yes! The speaker has the ability to play quite loudly, and even at maximum volume will run for about 4 hours off one charge, depending on the type of music. At more casual and reasonable listening levels, the power consumption goes down exponentially and the system will play for well over 8 hours.

The fidelity is very good, and this speaker does a good job at projecting and maintaining clarity at long distances. The bass is respectable—it doesn't play extremely low, but the bass that is there is very solid and punchy. If placed near a wall boundary, the bass performance can be downright impressive. At a barbecue, the park, or the pool, I don't think it can be beat by any other product available on the market!

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!"