

A Basic Guitar Amplifier Using the Hitachi HA13118

Part 1

This project started as an attempt to build a guitar amplifier that my son could easily store in a high school locker. The amplifier he was using was too big to fit in his locker. Even though the amp was not a high value amp, he did not want to leave it unsecured in his band room. I found several commercial amplifiers that were small and portable but most put out just one measly watt or less. I knew there was a better way.

What follows is a description of how this all came together. It is meant to help guide someone that might want to replicate this project. I included photos to help augment the written guidance. I made the following assumptions before writing.

- You know some very basic things about electronics, what a potentiometer is, what a circuit board is, and the differences in phono-jacks. I do not assume you know how to solder so I provided a reference.
- You know some very basic wood working skills and can operate a circular saw or jig saw without a resulting trip to the emergency room.

The DIY Audio site offered ample information. I wasn't looking to build an engineering work of art or something that kicked out high power at microscopic levels of distortion. Something simple like a single chip amp that would put out maybe 5-10 watts with a 12 volt supply. I wanted to use parts from what I had laying around as much as possible. None of the parts are hard to find. What follows is not only a description of how this was built, but also a tale of the path that led to the final product. There are lessons to be learned in each aspect of the project. There are two goals to this article. One is to offer construction guidance should you want to duplicate this effort. The other is to encourage you to try something like this if you might be hesitant or new to electronic construction. The wonderful world of DIY Audio then awaits.

I first searched the DIY Audio site for a likely design. I found ideas using a TDA 2003. A 10 watt amplifier made for car radios. I got two chips and put them into a bridge configuration circuit that I copied from the manufacturers specification sheets. This would give me higher power using a single rail simple 12 volt power supply. I had originally thought about adding some effects like fuzz or tremolo, or including a three band graphic equalizer circuit, but this would take more time and I could find no circuit boards already printed for such a circuit. There are also many commercial add-on effects boxes that are much more versatile than the simple circuits I was thinking of. So

this was going to be a simple amp with only a volume control, not even passive tone control.

I built the test circuit by soldering the components onto a proto board. The circuit tested fine at first but then broke into oscillation and overheated. I had not mounted the chips to heat sinks thinking I'll just test it with a low signal level. Later I read, I think somewhere on the DIY Audio site, that the TDA 2003 is not really made for bridge configuration. Someone suggested other chips. I found the Hitachi HA13118. This one chip amp has two internal amplifiers in a bridge configuration. The gain is 55dB so no pre-amplifier is needed.

Here are some of the basic specs;

DC supply: 8-18 volts

Power output: 18 watts, 4 ohm load, 18 volt supply

6 watts, 4 ohm load, 12 volt supply

Even better, I found the chip, parts, and pc board available from www.kitsrus.com. The company does not sell directly but the web site lists several suppliers. I bought two kits from Circuit Specialists, one for construction and a spare for possible destruction of the first. I've ordered material from Circuit Specialists before with good results and got the kits 3 days after I placed my order on line. <http://www.circuitspecialists.com/>

The kit includes the board, chip, heat sink, resistors and capacitors. It does not include plugs, jacks, speaker, enclosure, or volume control.

I soldered up the board in about one hour early one Saturday morning, installing small parts first then attached the heat sink securely. If you've never soldered much, check out the how to video on the Curious Inventor web site.

http://store.curiousinventor.com/guides/How_to_Solder/

This is one of the best soldering instructional videos I've seen on line.

For a power supply, I used an old lap top PC power supply brick. These are switching power supplies that are pretty compact, run cool, and put out several amps at 12 to 20 volts depending on the model. Just look at the name plate for the volt and current rating. I bought the one I used in this project for one dollar at a ham radio flea market or hamfest. The hobby of amateur radio or ham radio is alive and well. The old image of pounding out Morse code into a short wave transmitter can still be found but so can digital modes using orbiting satellites put into earth orbit by radio clubs around the world. I've been a ham since my teens and it had a lot to do with my college and career choices. Hamfests take place across the country and usually have a flea market set up

where you can buy all kinds of parts, supplies, and used electronics not limited ham radio gear. I found a guy selling old PCs and under the table was a box of lap top PC power bricks. I rooted through the box until I found a 12 volt unit good for 4 amps. I offered the guy a buck and he thanked me. You can find hamfests near you by checking out this link to the American Radio Relay League web site.

<http://www.arrl.org/hamfests-and-conventions-calendar>

Be careful as you may find ham radio just a short stroll from the world of DIY Audio. Ham radio operators are also great sources of help and learning when it comes to electronics and construction. Chances are there's one near you willing to give advice. Just look for the huge antennas on the house. There is probably a ham radio club in your area. Check out www.arrl.org for more information. You might also find lap top power supplies laying around orphaned collecting dust in a file cabinet somewhere, the parent PC long gone.

After soldering up the board, I connected the amp to a volume control which was a 50 k-ohm audio taper (log taper) potentiometer, along with a speaker, and the power supply. On the power supply I cut off the end plug as I did not have a receptacle to match and connected the wires directly to the amp. These PC power supplies usually have a small cylinder near the plug. These are ferrite filters for noise suppression and should not be cut off. The solid wire is usually positive feed while the stranded wire is usually negative but you should verify this with a voltmeter. I used some alligator clip jumper wires and connected the guitar to the amp. I fired it up and it sounded nice, even better when I turned off a fluorescent desk light and the obnoxious buzz went away.

Now I needed to build the enclosure. I had some particle board shelves left from a cabinet I got rid of a few years ago. These worked nicely. I did not have a spare speaker lying around so I drove down to the big box store and got a pair of Sony XS-GT5726A speakers. They were 5 by 7 inch ovals, 4 ohms rated at 35 watts. I was looking for low cost and that is why I picked these. They are 2 way speakers with a built in cross over network. They sound very nice. I built a 6" by 6" by 12" box to house the speaker. The packing material that came with the speakers had some cardboard with 5 X 7 oval cut outs that I used a template to cut a hole in the board I would use for the front. This let me drop the speaker in from the front and screw it down. Be aware that working with particle board requires a few precautions. Note that when you cut it with a circular saw, there will be rough edges on the bottom side of the cut unless you use the right blade. Despite my best efforts I had some rough edges which I kept to the inside of the box when it was assembled. To prevent the board from splitting from screws, I drilled pilot holes before drilling in screws to hold the pieces together. When I was doubtful about the wood splitting with a certain size screw, I used small spare pieces to test a pilot hole/screw combination to make sure the wood did not split. I placed the front board slightly in so it was not flush with the other boards. This kept the speaker

from protruding and allowed me to place some really ugly looking hardware cloth on the front to protect the speaker from the perils of a high school locker. As I started to attach the hardware cloth, I found it just a bit too ugly so I got some grill cloth on it which looks better. Apparently I've got a fraction of artist in me. I mounted some small wood pieces slightly inside the back of the box to act as lips to attach the back plate. I also wanted the back slightly inset so switches would not protrude and there would be less damage risk. I painted the outside flat black to hide any minor surface defects. I attached an old fence gate handle to the top for carrying.

I mounted the speaker, dropping it in from the front and then began building the back plate where I'd mount the plugs, controls, and amp board.

I used a piece of sheet metal for the back of the enclosure. This did not work too well. All the wood pieces I had laying around were too thick for mounting the jacks and volume control. I thought the metal would work well and I attached the amp board to it using the heat sink screw. The trouble came as I cranked up the volume the metal rattled like a snare drum. I wanted to use stuff I had on hand for this project but I had to breakdown and go to another big box store to get some 1/8 inch peg board without the holes. A 2' by 4' piece cost under \$5.00, so not too bad. I cut out the back plate with a jigsaw. I drilled 5 holes. One for a power switch, a 1/4 inch phono jack to use for the guitar input, and hole for a 1/8 jack that I used for the power supply connection. Make sure you have your polarity correct on the power jack. The nice thing about using a plug for the power supply is that you can use the same plug to connect to a battery back if you want to take it portable. There needs to be two holes for the volume control, one for the center shaft and the second is a smaller one that is for the tab that sticks up on the side of the volume control. The tab goes into the smaller hole and keeps the volume control from spinning when the shaft is turned. Once all the holes were drilled I painted the smooth side of the board silver. When the paint dried, I mounted the components and the amp board. I wired the amp board to the speaker, put it all together then...time to fire it up. The whole thing together sounded better than I expected. I'm not a guitar player but my kid likes it. This is not hi-fi but for a small portable practice amp it fits the bill nicely. I've seen some PC power supplies rated at 20 volts that I'd like to try. The HA13118 is rated at 18 volts for an operating voltage but has a peak rating of 50 volts so I'm not sure how it would do. I will eventually try it as this would put the power around 18 watts. I think the heat sink can handle it but I won't know for sure until I try it.

Pictures in the next parts show some detail of how this all went together. You can also check out how it sounds on You Tube.

<http://www.youtube.com/watch?v=2S5n8oq-BC0>