

Natural Radio

News, Comments and Letters About Natural Radio

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Natural Radio Receiver Prototyping System - My current Natural Radio Receiver that I designed and built a few years ago is showing a bit of wear. Several years of use has also made me aware of its shortcomings in performance so I've been thinking about a few ideas for a new design. Part of the motivation comes from the great ongoing discussions on the VLF_Group about the finer points of receiver design and what FETs and Op-Amps are best and so on. In fact, probably half or more of the discussions in that group relate to receiver design. Most dyed-in-the-wool Natural Radio listeners are listening with a home built receiver as their primary receiver even though they might own one or two commercial units. Building a receiver is an important component of this hobby. I would assume that part of the lure is that construction is not complex, the parts are readily available and it is easy to get performance matching or exceeding commercial units -- not to mention having a unit built expressly for your particular needs.

So as my thoughts wandered to the construction of a new receiver, I thought back a few years to the prototyping of my current unit. Building a circuit on the bench is one thing, but the fact remains that it must be taken outside for testing. The image in my memory was clear -- standing out in the cold at the end of my driveway with a prototyping board in hand, 9 volt battery dangling, ear-phone connector dangling; simultaneously trying to keep the ground wire attached to my hand, the antenna up and attached to the board, everything else attached together, but yet avoiding the ear-shattering feedback that would occur if the earphone wiring got too close to the antenna. Meanwhile my cat circled me rubbing against my leg generating a whole new and strange set of sferics.

Well, the cat is long gone, but what could I do about the rest of the chaos? I began to think about a prototyping system that would be portable and solve the above-mentioned problems.

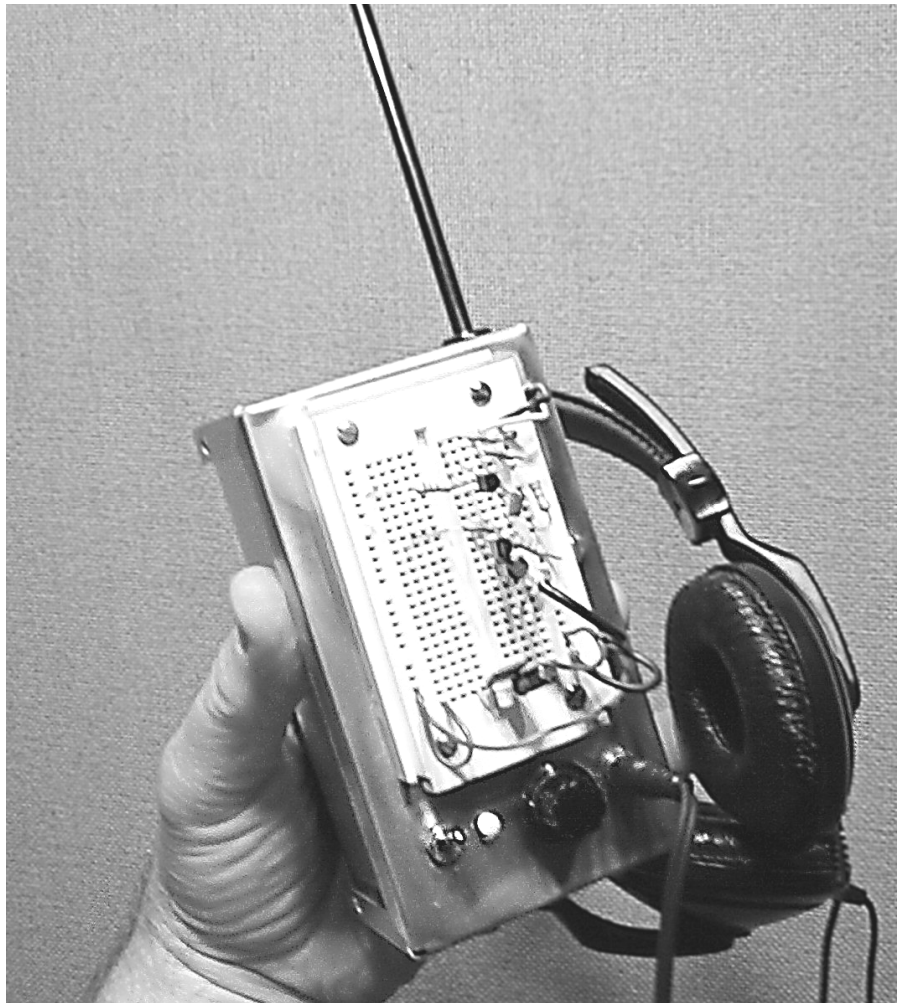


Figure 1. The completed unit ready to go.

Here's what I wanted from this device:

- Metal construction or ground plane for shielding & easy grounding.
- Integral antenna
- Internal switched power source
- Headphone amplifier, jack, & volume control
- Manageable in one hand

I went through several designs in my head, and it did not take long to come up with one that would serve my needs. After a quick trip to Radio Shack, I was able to complete the project in one evening.

I'm not going to give all the details of construction here, but I'll throw out ideas for possible modifications as I describe each section. This just a starting point for your own design. Use whatever junk box components you have on hand and adapt the design to your own needs. As a point of reference, if I had purchased all parts new this device could probably be built for about \$30.

Basic Design As you can see in Figure 2, the basic design of the prototyping system is a Radio Shack prototyping board mounted to the front of a project box. The battery and headphone amp are mounted inside the box, and an antenna protrudes from the top.

At this point you should consider the amount of circuitry that you will be prototyping and how large of a prototype board you will need. This will determine the size of the project box. Consider all the features that you want and then do a layout and make sure all pieces fit comfortably in the box. You may want to lay the pieces in place just to double check the fit before you begin drilling holes.

Allow for the fact that the box cover fits inside the main chassis so make sure there is enough clearance from components once you insert it. Then you can begin the marking and drilling operation.

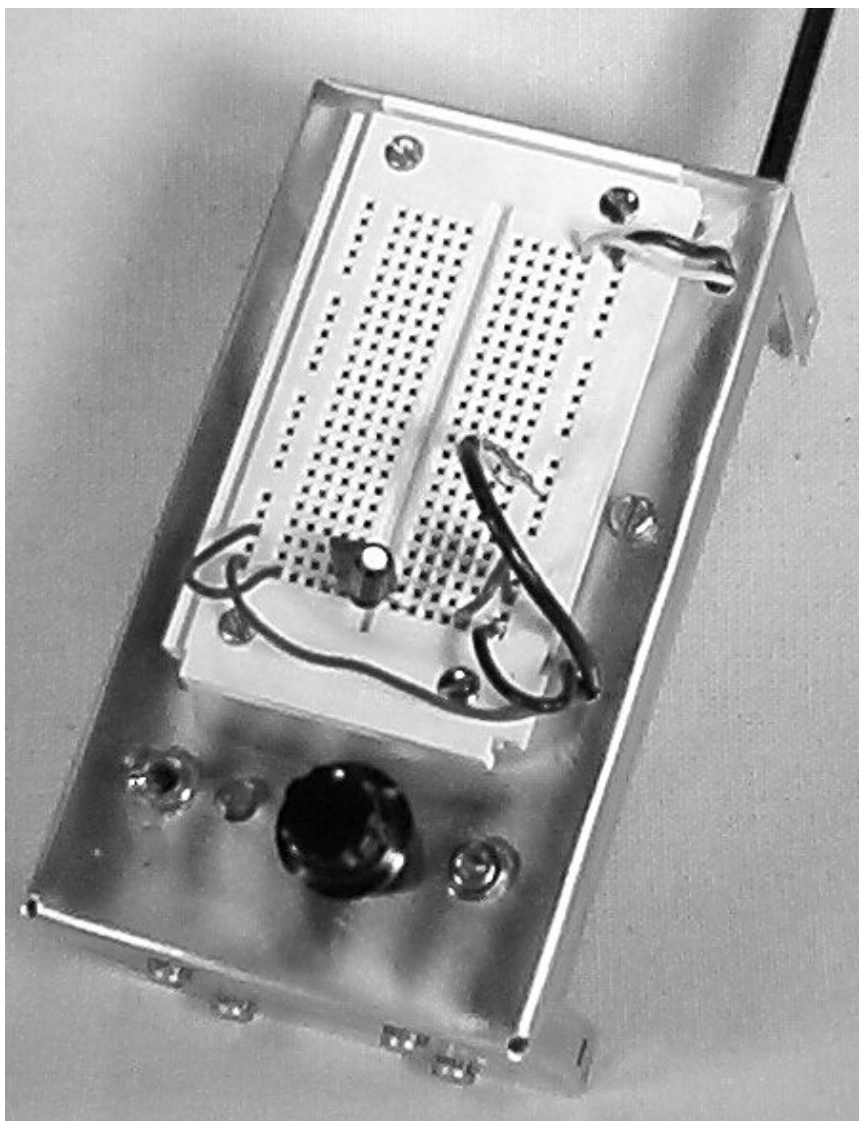


Figure 2 - Front view of the prototyping unit.

Power Supply The nine volt battery is housed inside the unit and held in place by a Radio Shack battery clip, as shown in Figure 3. If you design your circuits with plus and minus supplies or higher voltages, allow for the extra batteries. The power switch is on the front along with a LED. There is nothing worse than trying to troubleshoot a circuit to find a broken connection, when your real problem was a dead battery. Using a LED power on indicator will save you this trouble.

The battery is bypassed with 10 μ fd. electrolytic and .1 μ f. monolithic capacitors on the head-phone amplifier circuit board. I would recommend that you repeat that same bypassing as your first addition to the prototyping board at the point where the power leads come up from the inside of the box.

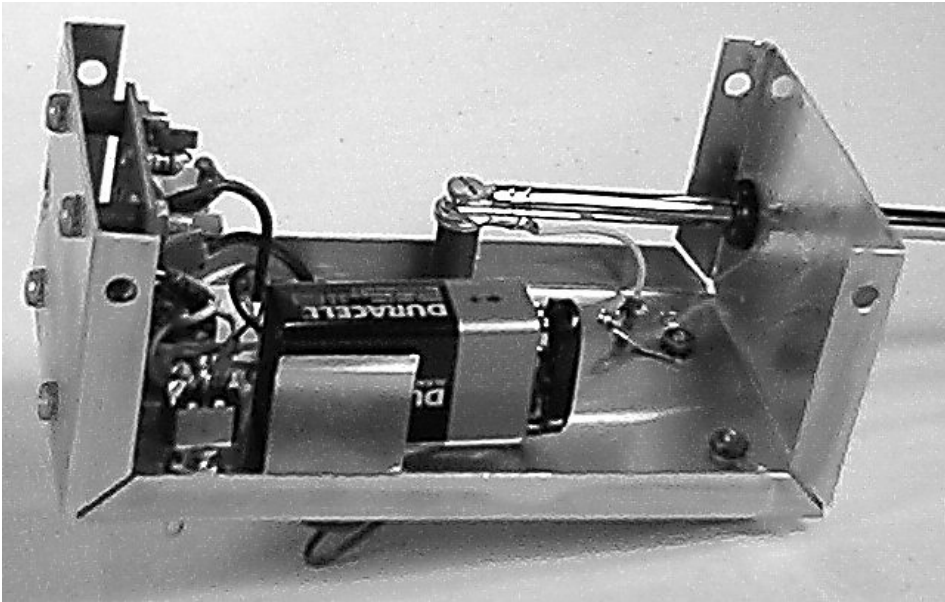


Figure 3 - Inside of unit showing battery, clip and antenna mounting

Antenna The antenna passes through a grommet on the top of the box and fastens to an insulated standoff inside. A wire from a lug attached at this point passes up to the prototyping board. Make sure the antenna or the connecting lug doesn't touch the box cover when it is inserted. Also keep the antenna and its connection positioned well away from the headphone amplifier and its associated output wiring.

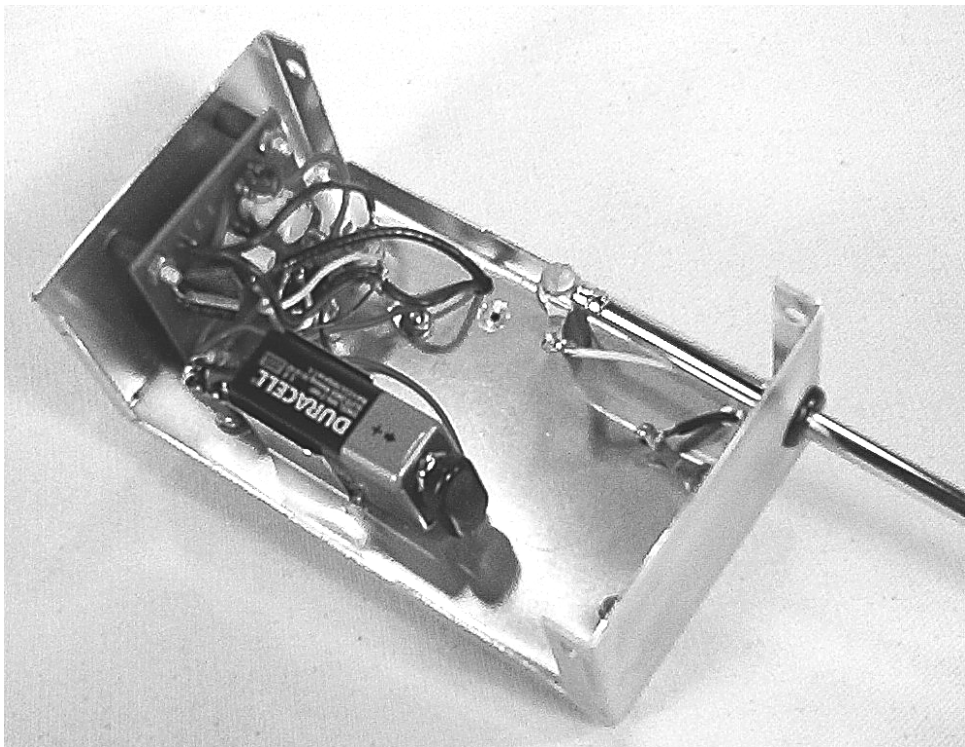


Figure 4 - Inside view showing battery, amplifier board, and antenna mounting.

As an alternative method of antenna mounting, you could install a chassis mount BNC connector on the top of the project box to allow the connection of a variety of antennas.

Headphone Amplifier and Controls I chose to add a LM386 based headphone amp inside the box, because this seems to be a proven circuit that I probably will not change. My amplifier is set for a voltage gain of 20. Placing the appropriate

components between pins 7 and 8 on the chip will allow you to change the gain if desired or add a switch to set several levels of gain.. Remember to add the appropriate stereo or mono jack that matches the type of headphones that you plan to use.

If you are going to be designing different headphone amplifiers, you can eliminate the internal amplifier, but you will probably want a volume control and headphone jack mounted in the unit with leads coming up to the prototyping board.

I attached two ground lugs to the mounting screws for the prototyping board on the inside of the cabinet, one at either end. The one near the amplifier has the circuit board and battery ground attached to it as well as a wire that goes up to the prototyping board. The lug at the antenna end has a wire going up to the prototyping board. Using this second ground at the front end might help eliminate feedback and interference.

Table 1 includes the Radio Shack part numbers for some of the unique components, but again, there aren't any critical components so use what you have on hand if possible.

Table 1 – Unique Parts & RS Part Numbers	
Telescoping Antenna	270-1403
Prototyping Board	276-175
Project box 5 ¼ x 3 x 2 1/8	270-238
Battery Holder Clip	270-326
Battery Connector	270-324
Circuit Board (for Amplifier)	276-159
Power Switch	275-612
Knob	274-416
Potentiometer 10K	271-1715
Led Assy	276-069
Insulated Standoffs	276-1381

Using It I am looking forward to using this device because it will make it easier to do experimentation when there is just a little time available. Even if I have only an hour or half hour before I stumble off to bed, this unit is convenient enough to use that I can accomplish something within that time frame. This makes this hobby more enjoyable because I don't have to hunt for a big chunk of time to do a little design work. I am looking forward to playing with some new receiver and filter ideas.

Listening to Missiles - Many thanks to Bill Wyckoff, KA1JHZ for answering my plea from a few months back and sending me copies of several old articles from *Popular Electronics* relating to whistlers.

One of the articles, *Build the Black Box that Hears Missiles*, talked about using a loop antenna connected to a high gain amplifier to listen for rocket launches. Apparently, missiles generate ionization noise on their way up that produces signals in the frequency range of Natural Radio signals.

Has anyone heard signals from a rocket launch, or tried to? It might be an interesting project for you guys in California and Florida.

INSPIRE Reinstates Coordinated Observations – According to the April Issue of the INSPIRE Journal, Coordinated Observation has been resumed and will permanently be on the first weekend of October and the last weekend of April. Details are included in the April Issue.