

Basement Teehie

Issue #2 – Spring, 2013



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Finding Parts & Stuff

Welcome to the second issue of Basement Techie. I received a lot of feedback from the first issue, and would now like to thank everyone who took the time to let me know what you thought about our first issue. From the feedback I received, there were two things that were on the mind of most of you who wrote in. They were contributing to the magazine, and finding parts for your projects.

I am always looking for contributions to Basement Techie. I'm mostly an RF guy, so the majority of the articles are going to have that slant until some contributions come in. I'm interested in any DIY techie-type stuff: electronics, robotics, electronic security, computer hardware and software (programming), Arduino, Raspberry Pi, SDRs, or whatever! Send it in!!! While I can't as of yet compensate anyone monetarily for their contribution, you'll get a few free issues or some advertising space if you have a business or product you'd like to sell.

The best place I've found stuff for my basement techie experiments has been hamfests and surplus stores. Wildflower, on the other hand, has good luck dumpster diving, curbside scrounging, and checking out the local Goodwill stores. Both of us do well finding assorted random bits at the Dollar and Odd-Lot/Job-Lot stores, and Harbor Freight has been good to my friends and I. Look around your area, and you'll find stuff!



Listening Post

I would have hoped that by now you have done some research on sites like EHam, found some older equipment models with favorable reviews, and acquired gear. There is a lot of good stuff out there, and to mention it all would be impossible. As a rule of thumb, if most of the reviewers thought favorably of an item then it's OK. Likewise if everyone had panned the item then you want to steer clear. Mixed reviews probably mean it's OK, but caveat emptor. I don't put much credence in online reviews because I don't know the background or agenda of the reviewer. I don't put much credence in magazine reviews because magazines sell advertising to the companies whose equipment they review. I ask the fellow interceptors I know personally, and get their take on a particular toy I might be interested in because I respect their opinions and they don't have any agenda. Then I try to play with one for a bit before making a decision. I like receivers made by Icom, AOR, Yaesu, WJ/CEI, GRE, and Sangean. Never did much with Kenwood, Bearcat/Uniden, Sony, or Grundig, but a few guys I know have had good

experiences with the gear. Every manufacturer has put out a real piece of shit at least once.

I have previously mentioned the Radio Shack PRO-2006. This was the latest model in a series of GRE manufactured, Radio Shack branded scanner receivers from the so-called "Golden Age" of VHF/UHF communications monitoring. Previous models included the PRO-2004 and PRO-2005. This series was immortalized by the late Bill Cheek, aka "Dr. Rigormortis", who published a series of books detailing various scanner modifications that were focused around the PRO-2004/5/6 series. After the PRO-2006, Radio Shack marketed the PRO-2035 and PRO-2042. These scanners were also made by GRE, and Cheek thought them to be the next generation '2006. There is some mention of the PRO-2035 and PRO-2042 in The Ultimate Scanner (Cheek 3) and in later issues of World Scanner Report. I've seen these models sell for anywhere from \$75-\$150 on Epay, and offered for a slightly lower amount at local hamfests. For general-purpose VHF/UHF monitoring they are all good units.

Many times receiver selection is determined by what you find cheap at a hamfest. One example is a Radio Shack PRO-38 that cost something like \$10. Before you Google it thinking I've disclosed some hidden gem kept secret by professional interceptors, it's just a 10-channel hand-held with basic VHF-low, VHF-high, and UHF bands coverage. Why buy it then? The price was right and it works fine for keeping a close eye on a

couple local frequencies. A similar purchase was made by one of our Southwestern brethren who found a Bearcat BC-155 at a yard sale for 7 bucks. A \$40 (talked down from \$70) Hallicrafters S-77 is more than good enough for AM and Shortwave broadcasts. It also adds a little class to the listening post. A curbside (read: free) Lafayette HE-51 is fine for watching that one VHF-low band frequency you have an interest in. Our esteemed editor found a surplus VHF-high band spook receiver system that sported a nice Marantz cassette recorder. It had apparently escaped the interest of all the other hamfest attendees during the course of the morning. The entire rig is built inside a Pelican case. If you keep your eyes and mind open, you will find neat shit like that.

One type of receiver we look for when cruising the swap meets is the surplus mil-spec surveillance or "spook" receiver used in SIGINT applications. The most famous brands are CEI and Watkins Johnson. Other noteworthy brands are Nems Clarke, Reggco, Racal, Astro, and Norlin. We also look for adjunct equipment such as demodulators, digital frequency readouts, spectrum display units (panadapters), and tuners. If the price is reasonable we grab anything of this type we find at the swap meets, even non-working "parts" units. For the most part this equipment is overlooked by all but a select few monitoring "hobbyists". This gear is top of the line, and originally cost orders of magnitude more than the standard asking price at the hamfests. It also has certain features that you don't find

in the consumer-grade scanners and shortwave receivers. We will discuss "premium receivers", as they are known in hobbyist parlance, in future issues of Basement Techie.

The VHF/UHF antenna of choice for many interceptors is the discone. Radio Shack sells one, although the preferred model is the Diamond D130. The cost however may be prohibitive to some budgets. Radio Shack sells their Cat#20-176 ground-plane antenna for \$30 that works from 108-1300 MHz., optimized for 152-470 MHz. Many interceptors have started out with one of these. It works well enough, but I found it to be lacking on the VHF-low band due to its small size in relation to the wavelength involved. Many interceptors elect to build their own antennas. Indeed, a simple 1/4 wave groundplane antenna can be made out of coat-hanger wire and a SO-239 connector for a few bucks. Radio Shack sells chassis-mount SO-239s for \$4, and you can likely find better-quality ones elsewhere for less than that. Just about any chassis-mount female RF connector can be used to make this antenna. Many interceptors eschew the SO-239 in favor of a BNC or N-type connector. Some even just forgo the connector entirely and solder the elements directly to coax.

Ideally, you want to get your antenna outside, but in some instances that may not be possible. In that case a simple vertical dipole made out of a length of coaxial cable with the appropriate RF connector on one end will do an adequate job. If you are making either an indoor coax dipole or a quarter-wave ground

plane antenna out of coat-hanger wire, you will need to determine the length of the antenna elements. Use the following formula: $L=2808/F$ Where L = Length in Inches, and F = Frequency in MHz.

To make a coax dipole, strip off the cable jacket to the length you determined from using the formula. For example 155 MHz. would be $2808/155=18.1$ inches. 18 inches would be close enough. Take a small flat-blade screwdriver, make a hole in the braid where the jacket ends, and pull the center conductor through. You now have a dipole antenna that is $18 \times 2=36$ inches. That is a half-wave length for 155 MHz. and the proper dipole length for that frequency. For the ground-plane antenna you would solder an 18 inch length of stiff wire (coathanger) to the center conductor as your vertical element, and four 18 inch lengths at 90 degree intervals to the braid. A SO-239 or similar chassis connector is perfect for this as you have a center solder connection and four chassis mount holes for the ground-wires. If you can find a metal pan or pie tin that has a circumference equal to or greater than a 1/4 wave length at your frequency of interest, you can attach a chassis-mount connector to it, and use the pan as your ground-plane. Many interceptors use that arrangement with mag-mount antennas inside.

For HF (shortwave), most interceptors I know use either whatever HF ham antennas they already have installed, or go with the traditional inexpensive longwire antenna as long and as high as they can get it. In limited space

situations, I've done pretty well with Hamstick-type mobile antennas attached to a counterpoise. While these antennas are designed for use on a specific amateur band, they also work well enough for Rx on frequencies adjacent to their particular ham band. One particularly good antenna I've used is the Barker & Williamson AP-10 apartment dweller antenna. The AP-10 has been discontinued, but MFJ has their MFJ-1622 that is an equivalent.

Your coaxial cable can make or break your antenna installation. Do not use cheap hi-loss coax! For short runs at UHF and short to medium runs at VHF use nothing less than RG-8X or preferably RG-213. Hardline would be better, but then you are getting into a higher cost. There is a decent low-cost alternative. Many savvy interceptors use RG-6 type coax used in CATV and satellite TV installations. The stuff is fairly low-loss at frequencies up to 1 GHz., and the mismatch of 75 Ohms versus the usual 50 Ohms in comm gear is minimal. Some hams have even used it for transmitting and reported no issues. For receiving setups it'll work just fine. I picked up a 100-foot spool of it from a local odd-lot/job lot store for only \$10. It comes with F-type connectors on it, but adapters are readily available for PL-259, BNC, and other common types. You can also take advantage of the inexpensive splitters and antenna switches available via common retail channels.



Scrounge-Tek

I try to remember how as kids my buddies and I used to build almost anything from material scrounged and adapted from scrap and nature, and how in the '60s we furnished our apartments with tables made from old cable spools and bookshelves made from milk crates or cinderblocks and scrap boards. The true survivalist is not a purist. You know the type, "It's gotta be authentic Special Forces Issue... It's gotta be authentic mountain man era gear... Ya gotta make it with stone tools and yer bare hands... Etc." Use any and everything available!!!
- Injun Jessie,
Cybertek Issue #17

Every Basement Techie I know keeps a collection of scrounged piece parts. The size and composition varies depending on the amount of space available and what they're currently into experimenting with. Sometimes we find something dirt-cheap at a tag sale, flea market, surplus store, or hamfest that looks interesting or potentially useful. The preferred means of acquisition is free via dumpster-diving or curb-side scrounging. At one previous job, the route to the dumpster was via the back of my service truck and I managed to score a decent collection of "obsolete" working and semi-working radio gear that was either put into ham use, traded to fellow techies for other neat stuff, or stripped for useful

parts. When storage started getting a little tight, items that were considered excess to needs were just given away. The stuff didn't cost you anything in the first place, and your buddies would reciprocate kind when they found something they knew you'd be interested in. That last part was always useful when you were running a little tight on cash or scrounging resources.

Whenever I start getting into a project, I take a trip down into basement and go through the boxes that hold my scrounge stock. Sure enough I found two items that I needed for some of the projects in Voice Of the Crystal and Impoverished Radio Experimenter. Some copper tubing I salvaged from an old propane stove installation had a fitting on it that after a little clean-up will make a perfect crystal holder for a home-built detector. Flare nuts aren't too expensive, only about 2 and a half bucks each. Still though the small parts add up in cost. The other item was an 8-pin octal relay socket from a box of assorted parts I rescued from previous job's dumpster. Actually was two of them in there. Those start getting a little more pricey at anywhere from \$3 to \$17 each depending on where you buy them from. My local source has them for about four and a half bucks. These three items would have been around \$12, which is a quarter tank of gas for the car in these parts. Thanks to a little scrounging, they didn't cost me a dime.

Using mostly scrounged parts, I put together a working crystal radio set for AM Broadcast Band. How I did that is the subject of my next article...



A (Mostly) Scrounged Crystal Detector

A lot of crystal radio enthusiasts prefer the “soft” sound that comes from a mineral detector. The most common minerals used are Galena and Pyrite. After having compared my Galena detector to a 1N34 Germanium diode, I agree that the former does sound better.

Depending on where you live, you may be able to go mineral prospecting and find some Galena or Pyrite for free. I've seen both at various mineral shops costing anywhere from \$1 to \$7 for a small to medium-sized piece suitable for use as a detector. Being the middle of winter with likely prospecting locations under snow, I visited Nature's Art in Oakdale, CT. So far I have found them to have the best rock prices, and was able to pick up some small pieces of Galena and Pyrite for a couple Dollars each.

The holder for the crystal is a brass flare nut used in natural gas and plumbing fixtures. I drilled and tapped it for three 6-32 machine screws used to hold the crystal in place. The holder was then soldered to a piece of flat Brass stock.

The cats-whisker assembly is made from a piece of thin music wire. It is held to a piece of copper-plated pipe strap by way of two nuts and a machine screw that I cut a slot in with a Dremel Tool and cutting wheel. Another piece of flat Brass stock attaches the assembly to the base.

The base is a small Lego box that my wife got me for Christmas. She says she found it at thinkgeek.com. Some machine screws and nuts hold the two assemblies to the base. I then removed most of one side of the lower box half (it slides into the upper) to make room for the two terminal posts that I attached to the upper half.

Finally, some 22ga hook-up wire was used to attach the terminal posts to the two assemblies at the top of the box.

The flare nut assembly is great for trying different minerals as a detector. The cats-whisker assembly works, but I'm not too happy with it. I'll try something different in the next version.

Useful Books To Have:

Voice Of the Crystal:

<http://www.hpfriedrichs.com/bks-votc.htm>

Impoverished Radio Experimenter:

<http://www.youoldtimebookstore.com/category-s/2033.htm>

A Trip To Goodwill

Goodwill stores get a lot of mention as a good source of materials. Some basement techies seem to have better luck at finding things than others, but like any other used merchandise source it's hit or miss. The general consensus is that the more frequently you visit, the better your "luck" is in finding stuff.

A couple weeks ago, I visited a local Goodwill store on a weekday, as opposed to my usual weekend schedule. My budget was a nominal \$10, and I wanted to see what I could find that could be used for my experimentation. This particular Goodwill has been about average in yield for me. Many times I've left empty-handed, but when I have found something it was an above-average find.



My first find was this Radio Shack 200 channel police scanner, a PRO-2018, for \$4. It came with its wall-wart power supply and was 100% functional. Right now it's scanning VHF aircraft band frequencies, and you can see in the photo that it was stopped on one of my local ARTCC enroute frequencies. There is still

enough analog VHF/UHF traffic around here to warrant grabbing another inexpensive police scanner, and they also make good test receivers for various projects, especially considering what I found next.

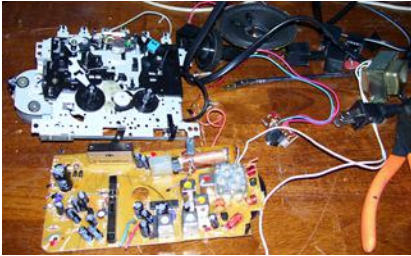


This \$3 1970s vintage walkie-talkie is unique in that in addition to being a 49 MHz. band license-free transceiver, also receives the 27 MHz. CB channels. I just grabbed it to add to my radio collection, although it could be used for monitoring the 11 Meter band, or as the transmitter in a one-way telemetry link on 49 MHz. The police scanner I purchased along with this unit would serve well as the receiver. While this one was in working condition, even if not 100% functional the telescoping antenna alone would have been worth the \$3.

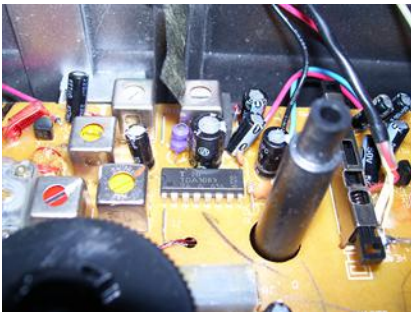


This small portable AM/FM cassette stereo cost \$5 and was 100% functional. It is to be dismantled in order

to show you what useful experimenter parts are inside electronic gear of this type. When buying stuff for deconstruction, ideally you want the cost of the item to be less than that of the individual components. For recent-vintage solid state gear like this, \$5 is a good target price.



As you can see, I definitely got my money's worth out of it. I salvaged an AC power cord, 6V transformer, telescoping whip antenna, a cassette deck with motors, gears, and other mechanical bits, and a circuit board with some useful RF parts including an AM loopstick antenna, tuning capacitor, and some inductors.



Here is a closeup of the receiver circuit board showing a TDA1083 integrated circuit. The TDA1083 is a One

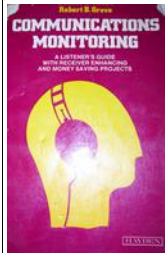
Chip AM/FM Radio with Audio Power Amplifier. Many hobbyists have successfully used this chip to make nice LF/MF receivers, and with some basic modifications, a standard AM radio could be slid up or down in frequency for a coverage of 300 KHz. To 3 MHz. Similar mods can be done on the FM side for coverage above the standard FM broadcast band where interesting things have been known to transmit.

If I had need for an inexpensive receiver covering those frequency ranges, I probably would have left the radio intact, and modified the RF components on the receiver board to slide the frequency coverage into the desired range. This trick can be done on most solid-state AM/FM receivers of recent vintage by spreading or compressing the coils alongside the tuning capacitor unit (the white/clear square plastic component). Determining which coil to adjust is as simple as tuning to a station located at the edge of the band of interest and touching the coils with your finger to see which one de-tunes the radio when it's touched. You then squeeze or expand the coil to lower or raise the frequency coverage and "walk" the station up or down the dial.

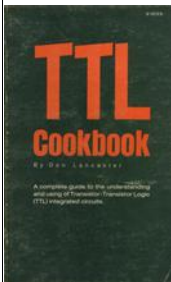
A very excellent set of directions on how to do this with an AM transistor radio to receive shortwave broadcasts is available in **Cybertek** Issue #9, "Doing a Radio". You can download from:

http://servv89pn0aj.sn.sourcedns.com/~gbpprorg/2600/TAP/cybertek/Cybertek_09.pdf

Another good reference to have is **Communications Monitoring**, by Robert B. Grove, ISBN 0-8104-0894-0.



You can find copies on Amazon for only a few bucks. This is one of the first books I bought when I started this hobby. Among the other useful information it contains is a set of instructions on how to tweak consumer AM/FM portable radios to go out of band, and several simple electronics projects to enhance your monitoring activities.



While on the subject of books, although I did not find anything interesting on this last trip, I have often found useful electronics and engineering books in my local Goodwill and Savers stores. The best stores for books are the ones in college towns. It was one such store where I found this copy of the classic **TTL Cookbook** by Don Lancaster.¹

Used equipment sources are hit or miss, and you need to frequent them on a regular basis to find the good stuff. While you find neat stuff, most of what you'll come across is common stuff you can buy cheap and kit-bash for your particular purposes, much like I did to that portable stereo.



Old-School Wireless Networking

I was surfing a Yahoo Group on survival communications, and came across a post by a member who found an old PC PDA, and was wondering about its usefulness for packet radio. The poster came across this link:

<http://www.qsl.net/o/oe9fww/packet.html>

A good discussion followed afterward, and I was surprised how many old-school Guerrilla-Net RF hackers were still out there.

Back in the days way before the Internet, ham radio operators were doing data communications over the air. When I first got my ticket, it was just straight up Baudot and ASCII RTTY at speeds from 45.45 to 300 baud. Most of the activity was on the HF bands, with occasional activity on VHF. One of my elmers was a hardcore RTTY enthusiast, but when I went down to Varick St. in 1984 and passed my Technician Class license exam the latest thing in digital ham communications was 1200 baud AX.25 Packet Radio on the 2-meter band. Shortly after I got my first rig, I bought a used TNC and started surfing the AX.25 networks. Hams had a VHF/UHF wireless digital network on the East Coast

¹ <http://www.tinaja.com/>

extending from Maine to Florida, and inland as far as the Mississippi River. Portions of that network are still active to this this day as Eastnet:

<http://www.eastnetpacket.net/eastnet.html>

The biggest use of AX.25 these days is a system on 144.390 MHz. called APRS: Automatic Packet Reporting System. The APRS website is <http://www.aprs.org/>. According to the website, APRS is *“a two-way tactical real-time digital communications system between all assets in a network sharing information about everything going on in the local area.”*

Besides APRS and the occasional AX.25 network such as EastNet, the frequencies² used for Packet Radio are pretty quiet. Used TNC³s are commonly and cheaply available at hamfests, as well older 2-meter radios to hook them up to. This means plenty of equipment and space for groups of technological experimenters to set up their own long-distance wireless networks. **The bands are out there waiting to be used.**

Besides 2-meters, there are other underutilized ham bands that you can use for Packet Radio. Two of the other popular bands are 6-Meters (50-54 MHz.) and 1.25-Meters (222-225 MHz.). The 1.25-Meter band is used heavily for point-to-

point network links, where 6-Meters seems to enjoy a lot of long-haul work.

If you were doing Packet Radio with a few friends over a bit of distance, and wanted an alternagtive to 2-Meters, then the 6-Meter band might be the place for you.



I found this 6-Meter Band data radio at a recent hamfest. While not as extensive as 2-Meters, there is still some activity there. The Kentucky Packet Network at <http://kypn.wordpress.com/> has a lot of good information on it. However the neatest thing I've found for 6-Meter Packet is an application for an APRS Meteor Scatter Email System. See <http://www.aprs.org/meteors.html>.

Those of you who would like to experiment with TCP/IP over the air are also in luck. Check the following links:

Getting Started With TCP/IP On Packet Radio -

<http://www.febo.com/hamdocs/intronos.html>

Linux AX.25 Configuration -

<http://www.febo.com/packet/linux-ax25/index.html>

There is a lot of good & cheap used/surplus equipment out there, the frequencies are mostly dead, and the test is easy to pass. Why not give it a try?

2 145.01, 145.03, 145.05, 145.07, and 145.09 MHz.

3 TNC – Terminal Node Controller

