



Basic Tools, Test Gear and Skills for the Shack



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- Please stay muted to avoid interruptions unless you have a question
- Feel free to ASK questions at any time using the Chat tool or voice!
- We will discuss mostly BASIC gear, but also have a quick look at a few more advanced items
- Not enough time to really cover skills in detail eg soldering, making coax connectors. Perhaps those will be covered in other sessions.
- But again, ASK if you have questions about things I'm not covering
- Will do 40-45 minutes on this topic, then a Q & A session
- Followed by a 5 minute break & on to Introduction to Kit Building



Common Hand Tools

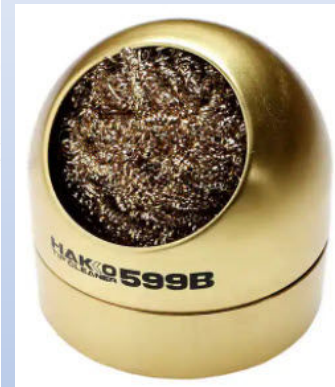
- Several sizes of Philips, flat blade, Robertson screwdrivers
- Wrenches – couple sizes crescent, socket wrench & sockets
- Wire cutters – small flush-cut type and larger for cables
- Pliers – small & larger needle nose type, couple sizes of slip-joint pliers
- Wire strippers –with multiple teeth for various wire sizes
- Nut drivers – small handheld type
- Allen wrenches – metric & imperial
- Jeweler’s screwdrivers – flat and Philips blades
- Crimpers for connector pins & coaxial connectors
- Small drill with good quality smaller bits
- Small Vise and/or “Helping Hands”
- Old toothbrush for cleaning grime out of knobs, corners etc
- Tweezers for handling tiny items

Make sure you have GOOD lighting and a clear space to work in!

Common Shack Tools



Common Tools - Soldering Equipment



Solder “sucker”
(solder wick often
more useful)

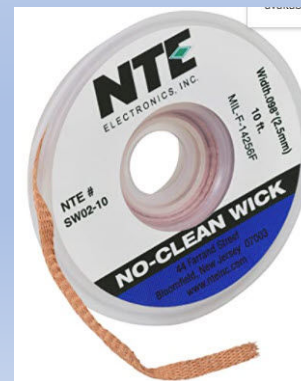


- Buy a GOOD quality unit, with replaceable tips
- Fine point for small components, larger chisel tip holds heat better for larger components
- Adjustable temperature helps with eg small delicate parts, or big heavy items
- Grounded tip helps avoid static discharge damage
- Get a stand & sponge too! (or brass wool “sponge”)
- For heavy work ONLY, a soldering gun can be used



Shop Supplies for the Ham's Workbench

- Rosin-core solder, 63/37 or 60/40 SN/PB (tin/lead) eg 22 ga or smaller
- Soldering iron tip cleaning flux
- Good quality electrical tape eg 3M
- “Vulcanizing” rubber tape for sealing outdoor connections
- Isopropyl alcohol, container & brush for cleaning rosin flux off circuit boards
- Canned air for blowing dust & dirt out
- Contact cleaner such as DeOxit D5 (use sparingly!)
- Solder wick in 2-3 sizes





Basic Test Equipment – Digital Meters



- Good quality leads & probes
- Wide variety of functions eg:
- Auto-ranging
- Volts, Ohms, diode test
- Milliamps & amps
- Continuity beeper
- True RMS AC volts for audio and power line measurement
- Capacitance test nice to have
- Some include frequency counter, but not up to RF
- Some have temperature, but I've never needed that
- For a first meter, handheld is nice and less \$\$ than bench
- Some nice sub-\$100 models

Basic Test Equipment – Analog Meters

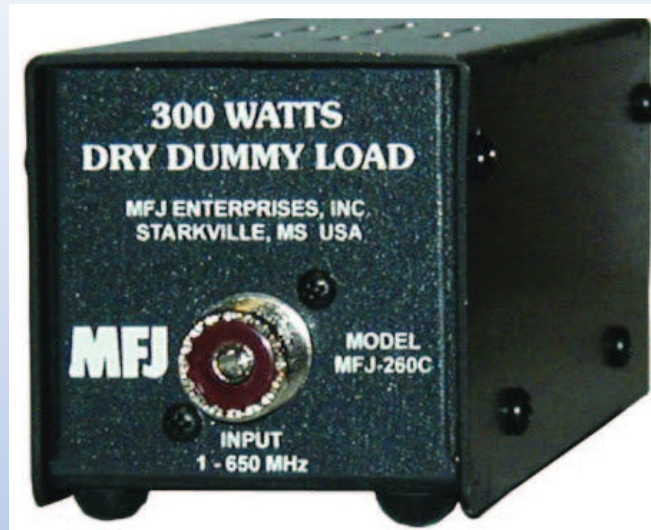


- Meters with analog displays can help sometimes
- Easy to see a slight change with a quick glance
- With a digital meter you'd have to be watching carefully
- Not as great for resolution or accuracy, but those are often not necessary
- Can sometimes find a decent older model quite cheaply





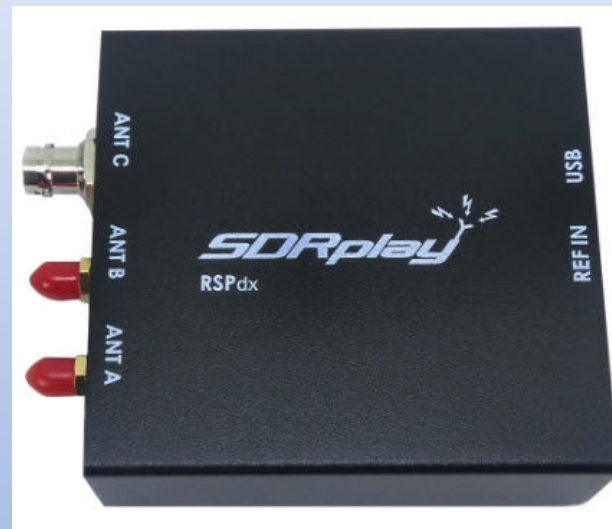
Basic Test Equipment – SWR & Watt Meters



- SWR meter & wattmeter often are combined into one
- A cross-needle meter like the Diamond SX-40 is nice for direct SWR readings
- Some meters just cover one small range eg VHF or HF
- Others like SX-600 cover wider range. It has two selectable sensors but \$\$
- When testing power output might want to Tx into a dummy load to avoid causing interference to others
- Many hams have an antenna switch to select a dummy load instead of antenna for testing purposes



Basic Test Equipment – Other Stuff



- A frequency counter can be used to quickly check your radio Tx
- Or for older rigs without a digital display, can verify you are on the frequency you think you are
- You might have an SDR in the shack already – why NOT??
- Can be used to monitor your transmitted signal quality
- Or if calibrated (eg compared to WWV) can be a fairly good check of frequency
- For more advanced use, can use a scope probe and the SDR's spectrum analyzer capabilities



Basic Test Equipment – Power



- A multi-output power supply can be very useful for...
- Powering 2 or 3 parts of a circuit you're playing with all at once
- Providing an unusual voltage for some oddball device
- Testing something without blowing a fuse, thanks to current limiting
- Or just for everyday use to power various shack accessories
- A clamp-on ammeter can help verify power consumed by a device you can't unplug
- Clamps around one lead of cable
- Not as accurate as inline meter, but often more convenient
- Can handle more current ~40 amps



Helpful Skills for Hams

Soldering demo's:
(many more!)
<https://www.youtube.com/watch?v=Qps9woUGkvl>
<https://www.youtube.com/watch?v=6rmErwU5E-k>
<https://aaroncake.net/electronics/solder.htm>

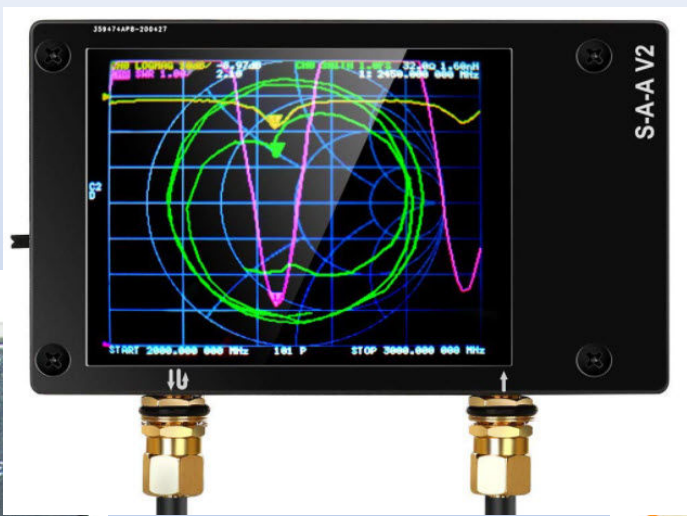
PL259 Installation:
<https://www.youtube.com/watch?v=lnBNyWI1-Ys>
<https://www.youtube.com/watch?v=9akTPqZaYNo>
<https://www.youtube.com/watch?v=uJKRcxKQlyM>

PowerPole Demo's:
<https://www.youtube.com/watch?v=QzLvdR6X81k>
<https://www.youtube.com/watch?v=kmxS8fltUeM>
(some fast-forwarding required on this one!)

NOTE: There are about a thousand ways to do each of these! Give these a try, but feel free to talk with a mentor if you're having any trouble.

Advanced Test Equipment

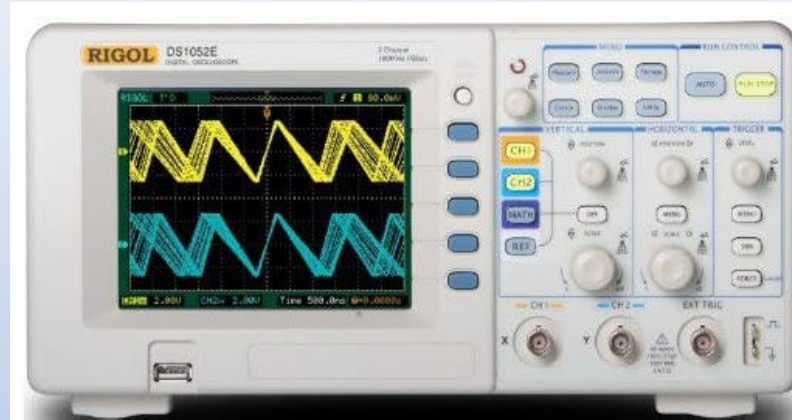
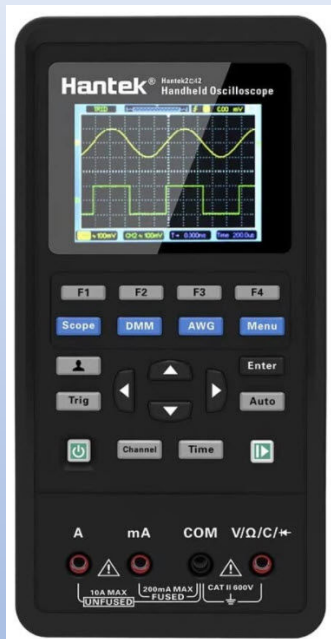
– Antenna Analyzers



- Antenna testers can speed antenna design and adjustment
- An SWR meter can help do basic adjustments, but for “roll your own” antennas especially these can provide lots of detail
- Wide variety available these days, also wide price range!
- RigExpert very professional, HF+6m version price not bad
- MFJ has a few models, some as expensive as RigExpert HF model
- NanoVNA is very popular and cheap. Small and may be awkward for some to use unless you connect to PC

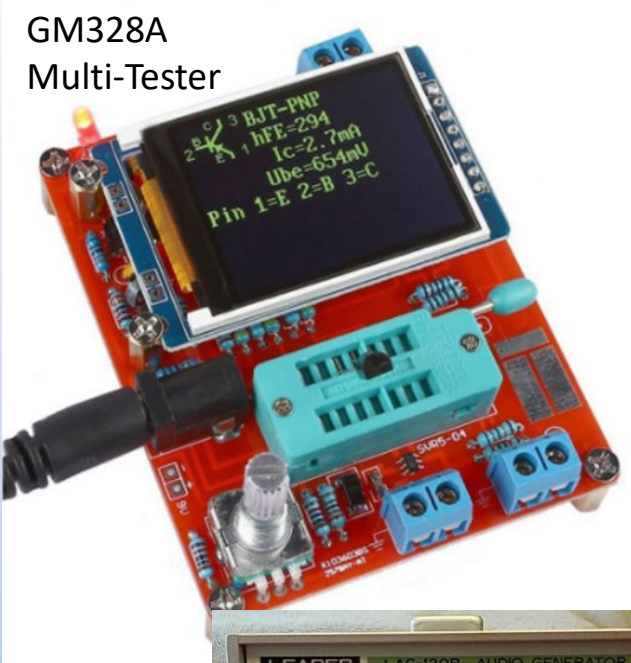


Advanced Test Equipment - Oscilloscopes



- Many older “analog” scopes available cheap or free
- Maybe not designing circuits at this point, but might want to try some repairs
- Or maybe just start learning about how circuits work
- Scopes give you a view into the waveforms flying around inside
- New bench scopes (like Rigol DS1052) can be had under \$400
- Or a small handheld scope such as Hantek for about \$200
- Even cheaper models on eBay and Amazon, but bandwidth limited, not for RF circuits

Advanced Test Equipment



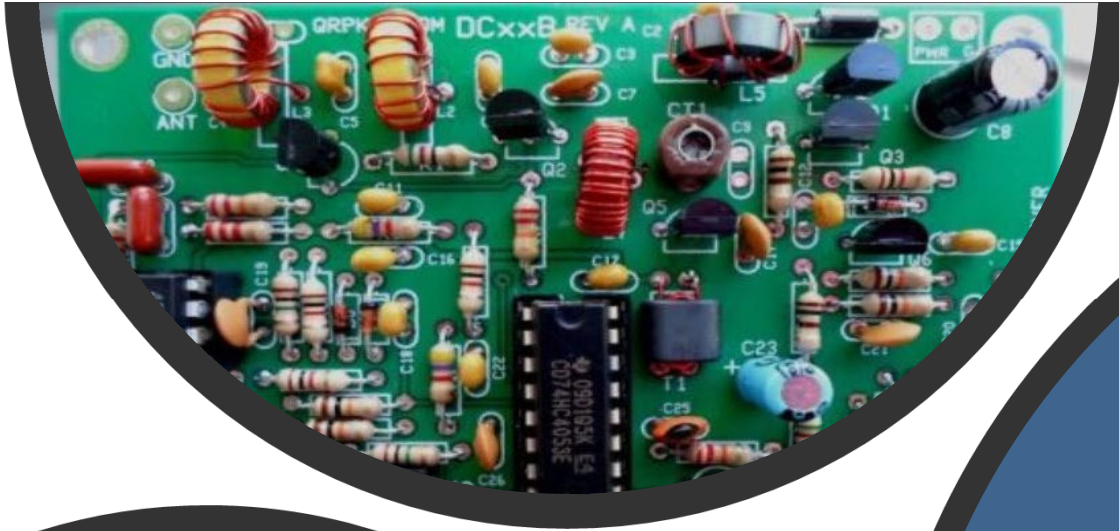
Audio Generator

Two Tone Generator



Questions? (Maybe some answers!)





Introduction to Kit Building



Introduction to Kit Building

- Please stay muted to avoid interruptions unless you have a question
- Feel free to ASK questions at any time, using the Chat tool or voice!
- We will cover many aspects of kit building
- But again, ASK if you have questions about anything I haven't covered
- Will do about 45 minutes on this topic, then a Q & A session
- Lots to talk about, so let's get to it !



Introduction to Kit Building

Remember the Amateur Radio Service regulations!

- RIC-3 (Radiocommunication Information Circular) “Information Regarding Amateur Radio Service” contains regulations that govern ham radio
- RBR-4 (Standards) also applies to hams, but that’s for another day...
- Section 4.4.1 of RIC-3 states (among other items): “The following privileges and restrictions are applicable to the Basic Qualification:
 - **Build and operate all station equipment, except for “home-made transmitters”**
- A footnote adds clarity: “**Build** in the context of the Basic Certificate is limited to the assembly of commercially available transmitter kits of professional design.”
- This means no “home-brew” transmitters until you pass the Advanced exam
- Non-transmitting kits are not affected by this rule



What type of Kits do you want to try?

As many kits out there as hams, it seems...

- Transceiver kits – QRP or QRO? Multi-band or single? SDR or older tech?
- Receiver kits - multi-band, single band, direct conversion, SDR
- Test equipment – Signal generators, SWR meters, step attenuators
- Gadgets not directly related to ham radio, just for fun! (or to practice soldering)
- Complex kits including surface mount components – test your soldering!
- Through-hole only kits, or surface mount parts already installed
- As always, what's your budget? Kits from \$3 to \$3000 (or more) out there!



The Heathkit Experience

What the heck are all those old guys talking about?



- Heathkit as we know it released their first kit, a scope, shortly after WWII
- Over the next few years, they developed a reputation for excellent assembly manuals, great support, and innovative products
- Not just ham kits – HiFi gear, clocks, organs, metal detectors, test gear, computers, robots, generators, even a wood splitter and motorbike!
- A few competitors such as Allied, Knight, Lafayette, Eico, but none quite so well loved or respected.
- A few modern kits include the Heathkit type assembly instructions, but many aren't so careful, expecting high knowledge level.
- HINT: Find a Heathkit manual online – most are full of good tips on kit building, identifying components etc



Challenges with Kit Building

Where are some of the stumbling blocks?

- Building a kit takes time and a bit of patience
- Interpreting assembly instructions that can sometimes be cryptic
- Identifying components, especially the tiny ones
- Soldering surface mount components (eg tiny IC chips) can be tricky (some kit mfrs will pre-install SMT components before selling boards)
- Toroids (small donut-shaped coils or transformers) can be a pain to wind
- Finding components can be a challenge for partial kits
- Alignment of completed kits which require test equipment
- Learning how to fix your kit if it doesn't work right away



Kit Building Guidance

- Set up a workbench where you won't be disturbed, and where little components won't disappear if the dog wags his tail!
- Make sure you have good lighting to reduce eye strain
- Have magnifying goggles or glasses to check solder joints & tiny part values
- Most kit instructions recommend this, but make sure you inventory the parts to make sure you're not missing anything. (& to familiarize yourself)
- Read the instructions carefully, checking each step a couple of times before you start cutting or soldering. (measure twice, cut once, right?!)
- Verify each component carefully before installing. Learn the resistor color code. Measure values with your meter if you're not sure.
- Take breaks – avoid working too long & getting fatigued. That's when most mistakes happen!



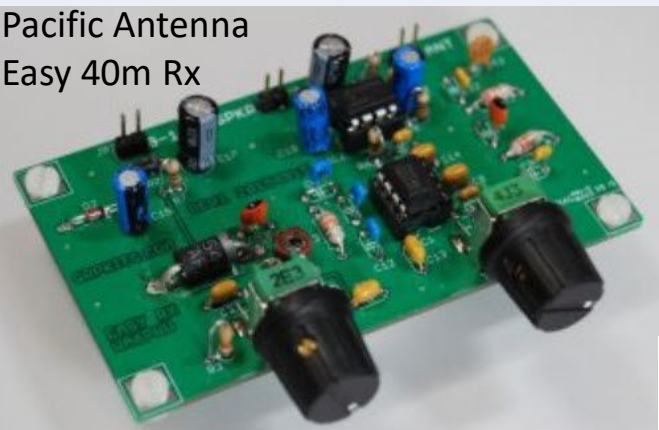
Kit Building Guidance

- Trim component leads carefully. They can fly quite a distance!
- As you finish each small section of the circuit, stop and check your work
- Look for cold solder joints, solder bridges, missed connections regularly
- Clean the remaining flux off the bottom of the board, with isopropyl alcohol & a small stiff brush. (other cleaning methods exist)
- After cleaning, look again for mistakes on the bottom and top of the board
- When first applying power to a new kit, verify supply voltage and polarity
- Use a current-limiting power supply and a fuse of the correct rating. If a short circuit exists due to a mistake, these could save your day!

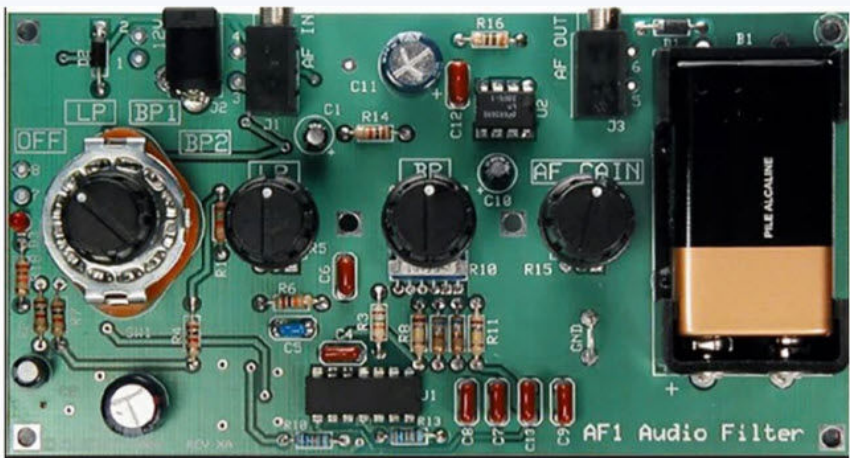


A few decent First Kits...

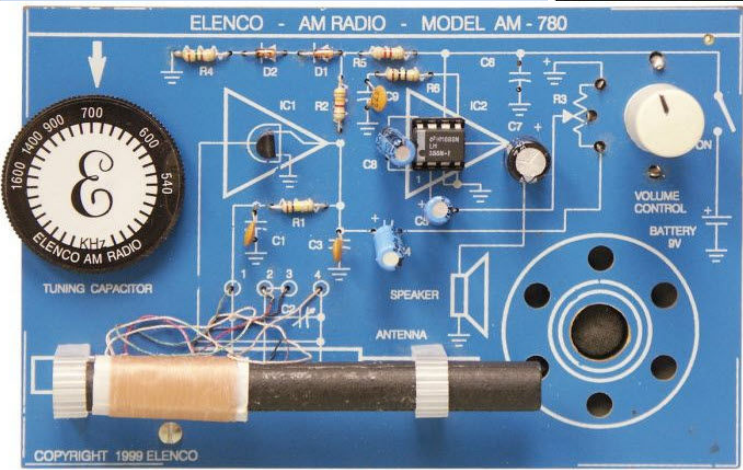
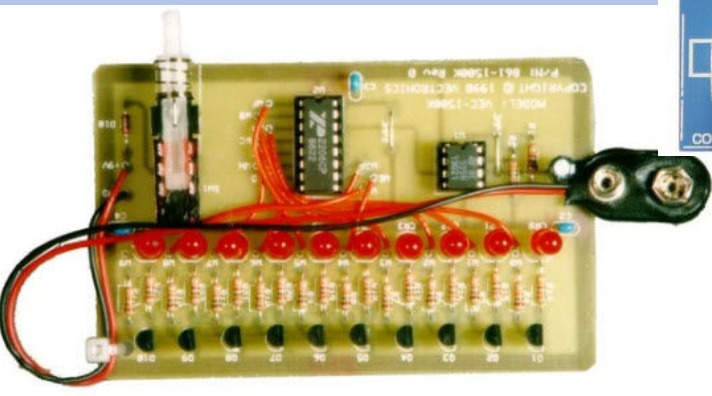
Pacific Antenna
Easy 40m Rx



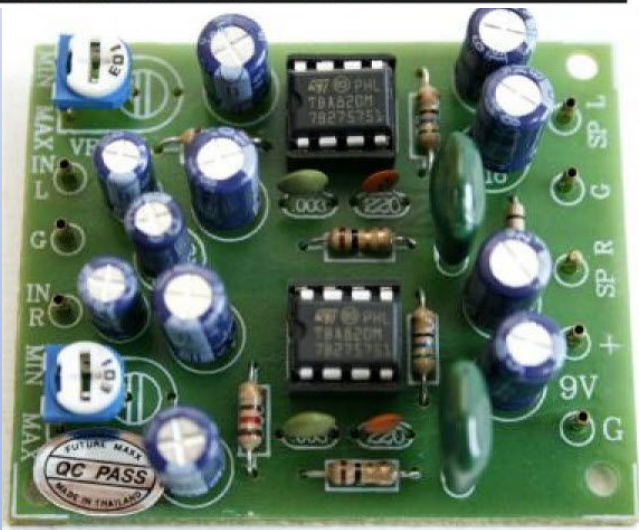
Elecraft AF1
Audio Filter



Vectronics Learn
to Solder Kit



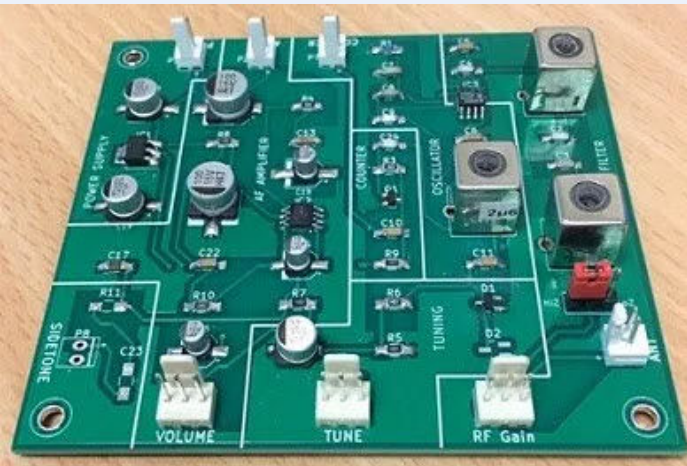
ELENCO AM
Receiver



Velleman Mini
Stereo Amp



Some more Advanced Kits...



Kanga 40m SMD
40m Receiver

Elecraft QRP
Auto Tuner



Pacific Antenna
40m "Simple" Rx

QRP Labs QCX+
QRP CW Xcvr



Useful Websites:

- eHam.net/reviews eg “Ham radio kits” and “QRP” pages
- QRZ.com forums eg “Homebrew and Kit Projects”, “QRP Corner”
- Groups.io – many ham-related groups! Search for your radio
- Facebook groups eg “Canadian Amateur Radio Operators”
- Several sites provide component identification guides – Google is your friend!
- Lots of tutorials on Youtube, on many topics.
- As always: SASTAR !! Check out the Resources & Links pages

Some Component Vendors:

- B&E Industrial Electronics (Calgary)
- Solarbotics (Calgary)
- Digikey.ca
- Mouser.ca



Sample of Kit Manufacturers & Vendors:

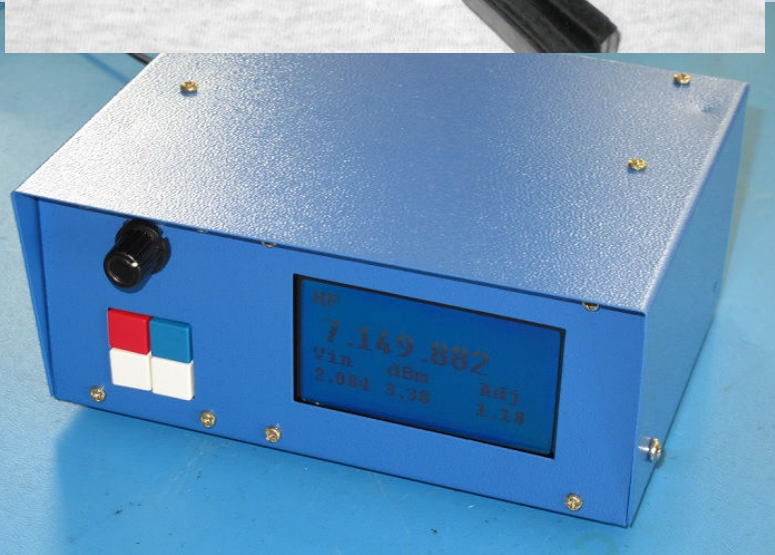
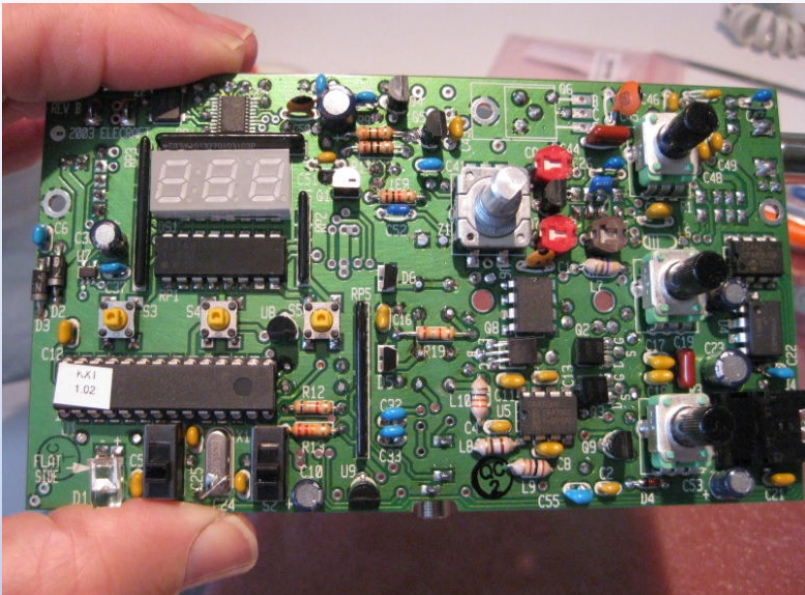
- | | |
|----------------------|--|
| • Elecraft | elecraft.com |
| • BitX | hfsignals.com |
| • Carl's Electronics | electronickits.com |
| • Pacific Antenna | qrpkits.com |
| • K1EL kits | k1elsystems.com |
| • Kanga | kc9on.com/product-category/kanga-uk-kits/ |
| • QRP Labs | qrp-labs.com |
| • Vectronics | mfjenterprises.com/collections/vectronics/type_kit |
| • Velleman (QKits) | store.qkits.com/electronic-kits/velleman-kits.html |
| • Jameco | jameco.com/c/Electronic-Kits-Projects.html |
| • Universal-Solder | universal-solder.ca |
| • QRP Ham Radio Kits | qrphamradiokits.com |
| • ELENCO | shop.elenco.com |



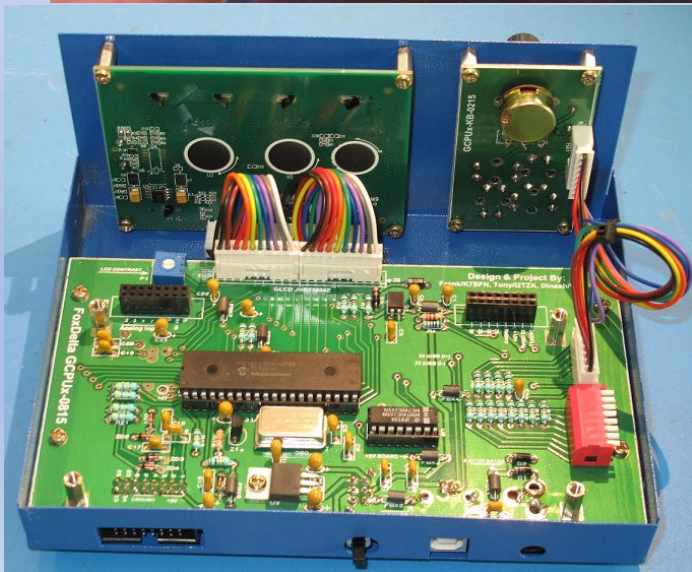
A few Kits I've Built



Elecraft KX1
CW QRP Rig



Fox Delta
Counter



A few Kits I've Built



Softrock QRP
SDR Transceiver



40m two tube
Regen Receiver

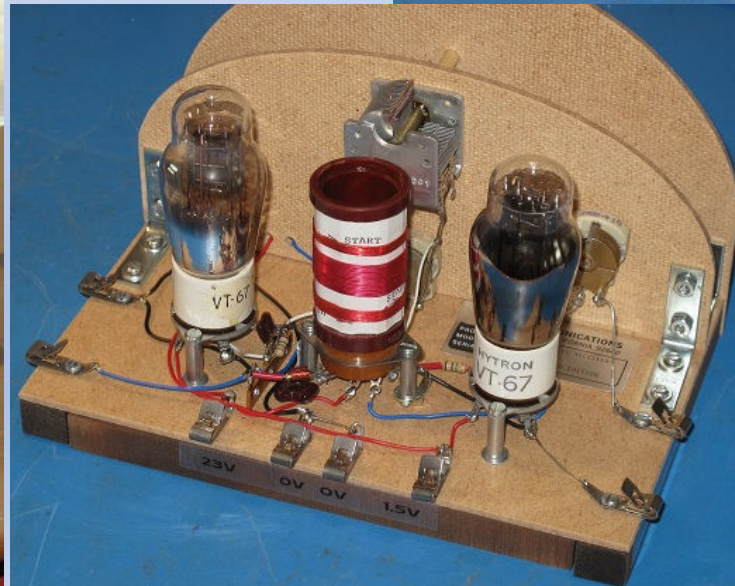


A few Kits I've Built

PAK-i11 Tube
Stereo Amplifier



Yeary MBRT1
Regenerative
Tube Receiver



Questions? (Maybe some answers!)

