

# RF Amplifiers! QRO >> QRP



# Let's Do The Math

- Comparing 100 watts to 1500 watts:
- $10 \log (1500/100) = 11.75$  dB more power
- One "S-Unit" = 6 dB, therefore 1500 watts is about 2 S-Units (12 dB) higher than 100 watts

# Types of HF Amps

- **New Solid-state amps:**
  - Easiest to operate
  - Broadband—no tuning up time required
  - Smart interfacing with your computer or rig:
    - Band info—automatically switching bands with you
    - Power control based on SSB/CW/Data modes used
  - Can be very touchy about SWR
  - Don't warm up the room like tube amps do
  - Best overall choice if it fits your budget

Full 1200 watts = \$3,300



600 watts = \$2,000



# Elecraft KPA500K (simple kit)

500 watts = \$2100



400-500 watts = \$980

Mobile or base with 13.8v 75a pwr sup



# Types of Amps

- **New Tube amplifiers:**

- Costs start at \$850 for 600 watts (Ameritron AL-811)
- For full legal limit, wide cost range \$2K-6K
- Must re-tune with each band change (except \$\$ amps)
- Lots of slow tune-ups very hard on tube life
- Tube filaments on all the time—give off heat (150w)
- Lethal high voltages inside
- On lower end, more cost-effective than solid-state amps

AL-811: 600w \$849  
AL-811H: 800w \$999



# AL-80B 1 KW \$1549



# Is Buying Used a Good Idea?

- Caveat Emptor: is the seller honest? Anonymous?
- CB and “golden screwdriver” mods ruin lots of amps
- Best case: Buy from a friend or a local store
- Quite a few for sale, see <https://swap.qth.com>
- I suspect quite a few “like new” purchases turn into repair projects.
- Fixing or upgrading an amp is not impossible, but try to have an experienced ham on speed dial

# Buying Used Amps & Fixing Them

- Transistors or tubes no longer in production & no subs
- Ex: Heathkit SB-230's 8873 tube is super-unobtainium
- Tubes can be expensive or hard to find (3-500z, 8877)
- For tube amps, working with high voltages is both art and science—wrong move WILL kill you
- On the other hand, some real bargains exist every day
- My examples you see here tonight:
- Heathkit SB-220 \$450 + \$330 parts = better than new
- AL-500M \$450 + \$300 parts = better than new
- AL-811H \$550 with one small mod, just like new

# Is There an Amp in My Future?

- Why isn't everyone running high power?
- Amps can cause new and wondrous noises in telephones, TV's, computers and other appliances
- Can cause Wi-Fi routers, cable TV boxes to reboot, quit, malfunction or work intermittently
- "Shooting fish in a barrel" and "Everyone's calling me from down in the noise today" feelings (remedy: run QRP for a while!)
- Almost everyone that has run high power has seen smoke coming out of something at one time or another. Baluns are popular smokers, but so are antennas, tuners, and even AC outlets.
- RF exposure health concerns?

# Heathkit SB-220 “2 KW” Linear

- Made in 1970's to early 80's, about 2000 sold
- Good, conservative heavy-duty design
- Many got “CB” modified—usually with disastrous results
- New matched pair of 3-500z tubes: \$420 (just a backup)
- New power supply capacitors: \$100
- New design rectifier and metering pc board: \$100
- Soft key low-voltage PTT modification & new fan: \$80
- Clean relay contacts and arc flash on bandswitch & caps: \$0
- Misc mods—HV fuse, grounding tube grids: \$50
- “Bonus” Peter Dahl hyperSil transformer: \$450
- Total actual cost: \$1,200 + 20 hours = 1800+ watts output
- 600w Heathkit SB-200's are still out there, relatively easy to fix

# Ameritron AL-500M 500w mobile

- “Early” and “late” models quite different
- I bought “early” model for \$450 from an honest guy
- Then I bought \$250 module from Ameritron to convert to newest remote-controllable design
- \$100 for remote control head
- \$50 to convert open-frame relay to QSK sealed relay
- Fixed minor soldering problem in power wires
- Total investment: \$850 + 10 hours labor
- For non-mobile use, 75 amp power supply: \$250
- Ran this in my Camry with a Lil’ Tarheel HP (500w) screwdriver antenna and Yaesu FT-857—very happy!











K7DAA FT-857 AUTO-TUNE CONTROL  
FOR SCREWDRIVER ANTENNA SYSTEMS

Antenna motor

Antenna motor

TO FT-857 Brown LowPwr input

TO FT-857 ACC Jack

Ground

13.8 VDC

TUNE in progress

# Adding a Linear to Your Station

- All linear amps have RCA female jack on the rear for PTT keying input
- You can build a simple amp PTT cable for your rig, or buy from rig manufacturer or eBay for \$20-30
- There will likely be a setting in your transceiver menu to activate a relay that keys the amp when you key your rig
- Or you can use a manual switch or foot pedal—just close to ground to activate amp
- You can safely ignore the ALC control from the linear in most cases, unless you have a 200 watt transceiver (such as Kenwood TS-480H)
- Going from 100w to 1000w requires upgrades & changes:
  - Antenna Tuner
  - Power meter
  - Antenna and balun
  - AC Power to your shack—some tube amps like to see 240 v for full output
  - Dealing with fun new RFI problems in your and neighbors' homes
  - Must do RF exposure calculations for you AND neighbors

# How to Tune Up Most Tube Linears

- Switch your linear's antenna output to a full-power rated **dummy load**. Tuning up live for many minutes on the air is considered to be classic **LID** behavior.
- Set your exciter (transceiver) to CW or FM mode using power of 20-30 watts or so
- Check your exciter and linear band switch: Both on the same band, correct?
- Pre-set linear amp's **Load** and **Plate** (or **Tune**) knobs
- Don't key down for more than about 5-10 seconds at a time. Unkey, take a breath.
- Key PTT and rotate **Plate** knob for a dip in plate current (or increase in power out)
- Rotate **Load** knob for higher plate current
- Re-dip your **Plate** or peak your power output
- Increase exciter power output to 50-70 watts or so
- Again dip **Plate**, again increase **Load**, then dip **Plate** and increase driving power until you've reached your rated maximum **CW** power output, not **SSB P.E.P.** value
- All during tune-up, as well as while operating, watch your meters for your plate and grid currents carefully. Make sure you are not exceeding your tubes' ratings
- If you increase your exciter power by 10 watts, and **linear** doesn't also increase by 50-100 watts, you've reached your max! Back off a bit to avoid over-driving amp.
- Switch to your intended antenna and re-peak your output with **both knobs**.

# A Note about Full Break-in CW (QSK)

- The following is not needed if you use SSB or normal CW only:
- New and old amp open-frame relays can take 40 ms to activate
- At 30 wpm CW, leading “Dit” = 40 ms long
- LNA and PTT keying sequencers are common in satellite work
- Solution is to add full break-in or “QSK” mod to the amp
- Jennings vacuum relays activate in < 2 ms
  - Can be bought used for \$50 or so. 2 are required
- QSK sequencer kits from Harbach for \$80 and others
- Best sources for all tube amplifier mods:
- [www.rfparts.com](http://www.rfparts.com) for tubes, transistors, vacuum relays
- [www.harbachelectronics.com](http://www.harbachelectronics.com) for amp mods, QSK, fans, caps

# Thanks, and Have Fun!

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