A TUBE TYPE HOMEBREW BCB DX RECEIVER

by Michael A. Bittner

This homebrew BCB DX receiver was designed not so much with performance in mind, but rather to see what could be put together with used parts stripped out of junked, tube-type, portable radios, with a few surplus parts thrown in. I collect 1940s through 1960, pre-transistor era portables at flea markets and swap meets. Ones in good working condition sell here for $5 to $15 depending on appearance, but that's a whole other subject. More pertinent here are the smashed or otherwise non-working junkers (good for parts stripping) that go for 50¢ to $3 with the typical price being $1. For your dollar, you get at least a 2-gang tuning capacitor, four tubes, two IF transformers, an audio output transformer, a speaker, an oscillator coil, a loop antenna, and all sorts of miscellaneous useful parts including a few long lengths of hookup wire and maybe a few resistors and ceramic capacitors with long leads. Certain parts should not be saved at all. These are the paper and electrolytic capacitors, and the selenium rectifiers. Usually, failure of one of these items was responsible for the set's being junked in the first place.

What I look for, when picking out a junked portable, is one with slug tuned coils, a 3-gang tuning capacitor, either a ferrite loop antenna or a low impedance, air-core loop with matching transformer, and of course, models with extra longwave or shortwave bands. I then snip out all the parts, being careful to diagram the connections to all coils and transformers so that they can be hooked up properly when later re-used. I also identify the larger parts with stick-on labels for the same reason. A trip to your parts distributor to price a set of Miller coils equivalent to those in my radio will convince you that this whole procedure can be worthwhile. Besides, it's kind of fun and educational insofar as learning how radios are made.

My radio was constructed using tubes from the old style battery portable sets. Two problems common to most tube radios that these sets don't have are: delayed reaction after turn-on, and drift due to warm up. The tubes used in these sets have no cathode to heat up but use the filament itself as the cathode. This filament requires only 1.5 volts, i.e. a flashlight battery, for power. These tubes are on and running as quick as a transistor, and they never become perceptibly warm to the touch, so low is their power consumption. However, they do have the problem of requiring a low current, 90 volt DC power source for plates and screens. I originally planned a 12 volt DC to DC converter to supply both filament and plate/screen voltages, but then I discovered the Radio Shack free battery card! Around my QTH, there is a Radio Shack store on just about every corner of every square mile, so I have no trouble getting enough flashlight and transistor batteries to keep me "on the air". Ten 9-volt batteries make 90 volts, right? So, now my guilty conscience is making me buy stuff at Radio Shack stores that I never intended to buy! (hi)

Before describing the circuit, I will mention a few factors that led to this design. I discovered the hobby of BCB DXing quite by accident while listening to one of my flea market portables, an RCA model 6-BX-63 with TRF stage. I was startled to hear a clear, fade-free station identify as KBOI, Boise, Idaho and I'm in southern California. I dropped everything and began tuning up and down the dial just to hear what was coming in, and logged 75 stations that evening. What I learned during that session with regard to the receiver's capabilities were:

1) The lack of dial calibration and general sloppiness of the string-type dial and tuning knob were the most troublesome aspects of its design.
2) The sensitivity seemed adequate--probably because the idea of foreign DX on BCB had not occurred to me up to that point.
3) The selectivity could be improved, as there was much slop-over from local stations.

The idea of using the built-in loop to null locals hadn't occurred to me either. I used the loop to "peak" DX stations! I decided that in a DX receiver, the most important thing would be a well calibrated, backlash free dial. The next most important thing would be a narrower IF passband, and finally I decided, although mistakenly, that I would design it for use with a longwire antenna.

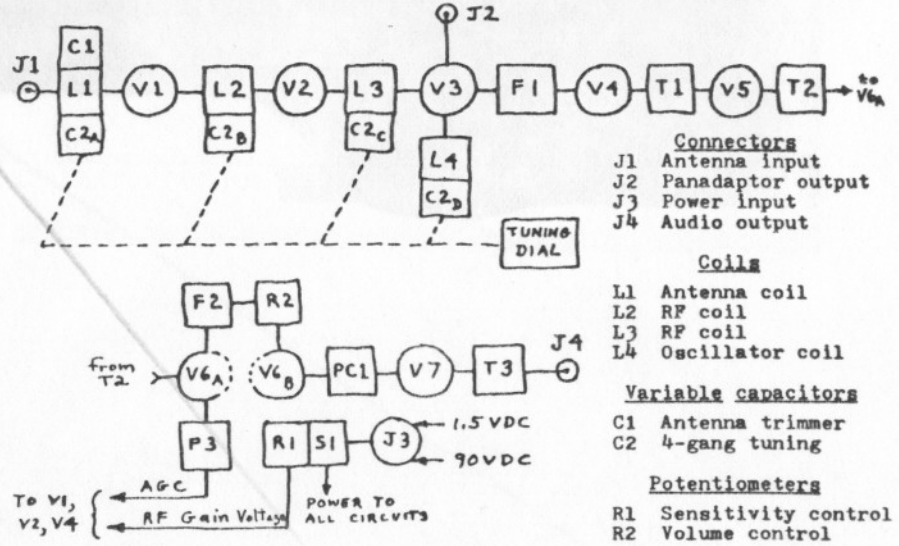
The receiver I built is configured as follows: Referring to the block diagram, the combination L1/C1/C2A form the antenna input tuned circuit. C1 allows peaking this circuit to accomodate different length antennas that might be connected to the set. V1/L2/C2B and V2/L3/C2C are identical TRF amplifier stages. 1T4s were chosen for these stages due to their good AGC characteristics. V3 is a conventional pentagrid converter with L4/C2D forming the local oscillator tuned circuit. This stage feeds the surplus mechanical filter F1 as well as my Heathkit IO-13 panadaptor via J2. V4/T1 and V5/T2 are identical IF amplifier stages. A 1T4 was originally planned for V4, but the high insertion loss of the surplus mechanical filter required that the higher gain 1U4 be used. $V6_A$ is a diode detector feeding filters F2 and F3. F2 feeds detected audio to $V6_B$ via the volume control control R2, while F3 feeds the DC component of the detection process to the control grids of V1, V2 and V4 for automatic gain control. The output of $V6_B$ is fed via the impedance matching network PC1 (a resistor-capacitor network for coupling audio tubes, formerly made by Centralab, #PC-91) to the audio power output stage consisting of V7/T3. I use a pair of series connected 4 ohm speakers connected to J4 for listening. Those free Radio Shack batteries connect to J3, and S1 allows turning the whole thing on and off. R1 controls the screen grid voltage of V1, V2 and V4 for manual RF gain control, allowing local station or DX reception. That's about it. A rather conventional superheterodyne with added RF and IF stages, a couple of extra controls, a good backlash-free dial, and about 90% "user tested" parts in it.

The only new parts are the J.W. Miller MD-5 dial with 9:1 gear ratio (no longer available, though Jackson Bros. still make various dials) and the chassis assembly. A standard, blank 7"x9"x2" aluminum chassis was punched and drilled for sockets, transformers, etc. Front and rear panels were made by cutting down the standard covers for this chassis to 4" height. Due to the dial configuration, the optimum arrangement for the chassis turned out to be upside down with the tubes etc. pointed downward. With regular tubes, this would cause heat problems. However, with 1.5 volt tubes, heat is no problem and this arrangement has the added benefit of keeping dust off the tuning capacitor and other parts.

I have made no side-by-side comparisons of my radio's performance with established, good DX radios. However, it has managed to provide readable copy on many stations that are unreadable on any of my other AM radios. The radio would be very difficult to duplicate, and I'm not sure I'd recommend it. This first effort does have faults that will be corrected in my next receiver if I can ever find the time to build it. Got all the parts, but no time. (I know the feeling...NHP)

All in all, I've found the experience of BCB DXing with a radio I've built myself to be rewarding, and all the more so for having done it with something created out of what would otherwise have been junk.

BLOCK DIAGRAM, 7-TUBE BROADCAST BAND DX RECEIVER



Connectors
J1 Antenna input
J2 Panadaptor output
J3 Power input
J4 Audio output

Coils
L1 Antenna coil
L2 RF coil
L3 RF coil
L4 Oscillator coil

Variable capacitors
C1 Antenna trimmer
C2 4-gang tuning

Potentiometers
R1 Sensitivity control
R2 Volume control

Filters
F1 Mechanical IF, 3.1 kHz bandwidth, 455 kHz center frequency
F2 Pi-network, low-pass audio filter
F3 L-section, low-pass AGC filter

Switch
S1 DPST on/off

Tubes
V1 1T4, first RF amplifier
V2 1T4, second RF amplifier
V3 1R5, converter
V4 1U4, first IF amplifier
V5 1U4, second IF amplifier
$V6_A$ 1U5, diode detector
$V6_B$ 1U5, first AF amplifier
V7 3V4, AF power amplifier

Transformers
T1 455 kHz IF
T2 455 kHz IF
T3 Audio output

Coupling network
PC1 Pentode audio ceramic circuit