Refurbishment of a Drake 2B Ham Bands Receiver – Gerry O'Hara

Background

The Drake company was founded in 1943 by radio design engineer Robert L. Drake as a manufacturer of low pass and high pass filters for the government and amateur radio market, and after WWII, produced several lines of amateur radio transmitters, transceivers, and receivers.

The Drake 1A receiver, introduced in 1957 (photo, right), was the company's first receiver offering aimed directly at radio amateurs. The 1A was revolutionary in several ways: physically, it was much smaller and lighter than most amateur receivers of the period and had a vertical form factor. Electronically, it was designed specifically to include facilities for reception of the then relatively new and increasingly popular single sideband (SSB) mode of voice transmission. Ergonomically, the design focussed on simplicity and ease of operation: altogether, a very powerful package. I have worked on repairing and restoring a couple of these now fairly rare receivers, and an article on one can be found here[1].

In 1959 they followed the 1A with the 2A, an equally compact but more traditional-looking receiver, having a horizonal form factor. The 2A had more features, increased sensitivity and selectivity, and was introduced at the same price as the 1A. It was followed two years later by the 2B (photo, below), very similar in appearance to the 2A, but with improved performance and a new set of controls for adjusting the selectivity (bandwidth) and center frequency of the passband. The Drake chassis of this era are distinguished by their copper plating, giving them an instantly recognizable and 'quality' look. Several accessories were available for the 2B, including a plug-in crystal calibrator, low frequency converter, crystals covering a wide range of 'auxiliary' wavebands, and a combined speaker/Q-Multiplier unit.

[1] The background on my computer monitors is of a photo taken through a Drake 1A chassis with the tubes illuminated – looks so cool!

Drake went on to manufacture some well-respected ham band transceivers through the 1960's, and I used to own a TR4 transceiver. This was a great rig – both on transmit and receive, and it also sported the distinctive copper-plated chassis. My TR4 was sold on as part of my downsizing efforts a few years ago, and the only Drake equipment I currently own is a solid-state MSR-2 that sports a cool amber Nixie tube frequency readout. I keep this receiver as part of my test equipment stack.

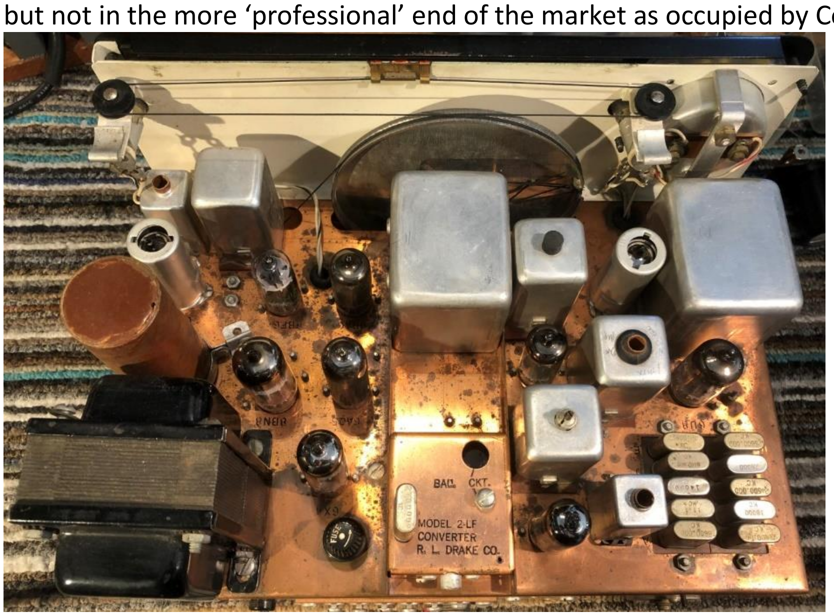
I have worked on a couple of Drake 2B receivers some years ago and was impressed by their performance (I was equally impressed by the Drake 1A), so I was interested when I was contacted by someone with one that needed some TLC – this is the receiver featured in this article.

The Drake 2B Receiver

The Drake 2B is a ten-tube triple-conversion ham band receiver of innovative design. The tube line-up is a 6BZ6 RF amplifier, a 6U8 crystal-controlled first local oscillator/mixer, converting the input signal to 3.5MHz - 4.1MHz on all bands, a 6BE6 VFO (3.955mHz - 4.555MHz)/2nd mixer with an output at 455kHz, a 6BE6 oscillator/3rd mixer with an output frequency of 50kHz, a 6BA6 IF amp. (50KHz), 6BE6 product detector/BFO, 8BN8 1st AF amp./bias rectifier/automatic noise limiter, 6AQ5 AF output, 6BF6 AGC amp./AM detector, and a 6X4 power supply HT rectifier. On the 80m band, the first conversion is not needed, and the pentode section of the 6U8 then acts as a second RF amplifier stage. The receiver is supplied with three pre-set passband widths of 500Hz (CW), 2.1KHz (SSB) and 3.6KHz (AM), plus a facility to allow variable tuning of a signal within the passband, eg. selecting upper or lower sideband. A pre-selector, automatic noise limiter, slow/fast AGC switching and crystal calibrator (option) are also included in the circuit design. The external Q-Multiplier accessory, incorporating a single 12AX7 tube, and operating at the 455KHz IF of the 2B, allows signals to be peaked or unwanted signals and heterodynes to be nulled-out effectively – this is especially useful for weak signal CW reception.

The specification claims a sensitivity of <0.5uV for 10dB S/N, >60dB image rejection, a dial accuracy of 1KHz, and a frequency drift of <100Hz. It requires an external speaker and this was supplied with the outboard Q-Multiplier.

Build quality is, in my opinion, 'middle of the pack' – much better than low-end Hallicrafters offerings, but not in the more 'professional' end of the market as occupied by Collins. Other 'middle of the pack' receivers of the day, eg. those marketed by Hammarlund and National, were generally much larger and heavier physically and this 'boatanchor heft' perhaps gave the impression of better quality. The lighter, innovative and more 'nimbly'-designed 2B was arguably a better performer, especially for SSB reception, and where bench space was at a premium. As noted earlier, the chassis was copper-plated (photo, left), which I think was more for aesthetic appeal than



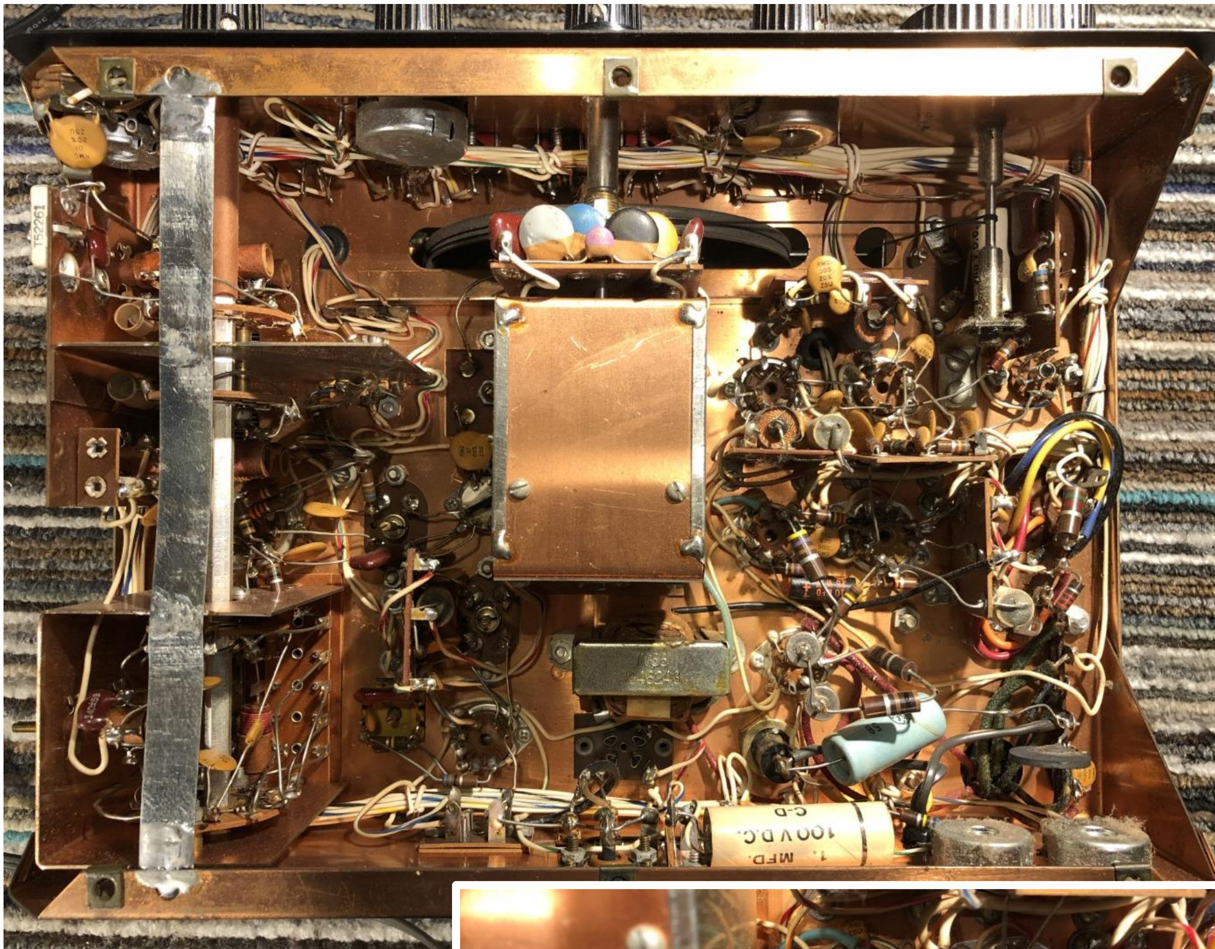
improved electrical contact or screening efficiency, and, when in good condition looks really impressive. Unfortunately, six decades on, the plating is often in poor shape, the protective clear coat having worn away/degraded and the copper oxidized, or, worse, punctured through to the underlying base metal (as in part of this chassis).

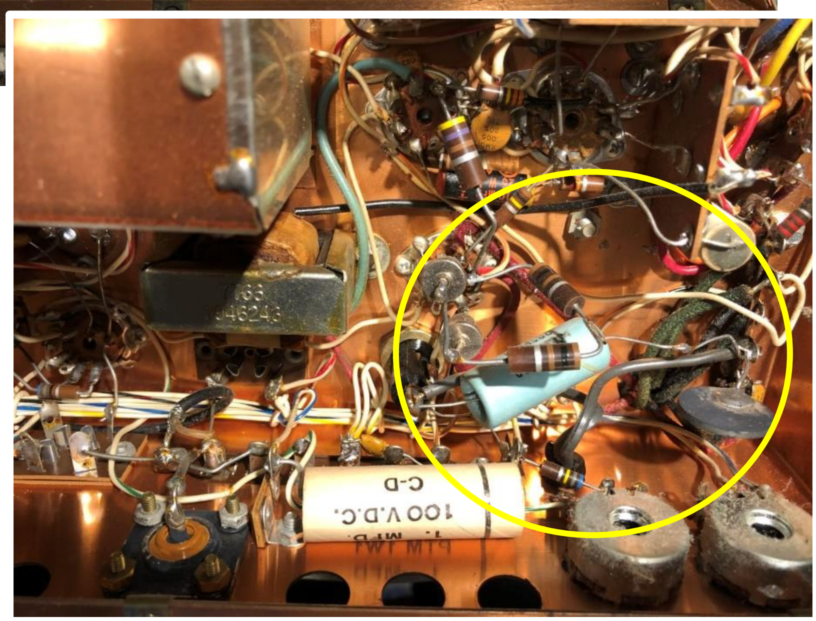
Drake used quality components, and care was taken in construction, including the used of bespoke tagboards for component mounting, resulting in a neat and functional under-chassis appearance and, generally, ease of service. The front panel and sliderule dial arrangement, although working well ergonomically, looks a little 'hammy', but functions well and has stood the test of time.

Initial Inspection and Clean-up

This example was in reasonable shape physically - some minor scratches on the front panel and metal case, and, as is typical for Drake receivers of this period and noted above, the thin copper plating on the upper side of the chassis is discoloured in patches with the underlying steel showing through as tarnished patches, all covered in a layer of dust and fluff – the photos below show the set and its matching speaker/Q-multiplier on arrival.

I vacuumed out the accumulated fluff and dust, cleaned the chassis with lighter fluid and alcohol, wiped the grime off the tubes, and then gave the chassis a preliminary inspection. This revealed some modifications to the power supply: a pair of silicon rectifier diodes and two 100 ohm series resistors had been added to the underside of the 6X4 rectifier socket, and a thermistor included in the power





transformer primary to provide a 'soft start' to reduce the HT voltage on switch-on before the tubes warm up and draw current (photos above and right, with these components circled). Inexplicably though, a 6X4 tube was still installed in the tube socket(!) and the set was even supplied with a spare 6X4 tube(!!). I can only think that someone was unaware of the under-chassis modification to a solid state rectifier and, seeing that the 6X4 tube was missing, popped one in - I suppose the set would work in that condition... (the HT supply would certainly be 'well rectified'!). There was also an added component connected across the line supply where it enters the chassis - likely a capacitor, but it was not marked with a capacitance or voltage rating. The multiple-section electrolytic power supply filter capacitor can had been replaced with a tatty-looking cardboard body part with incorrect capacitance values. The remainder of the chassis looks original and in reasonable shape - there are only four 0.1uF and one 1.0uF tubular paper(?) capacitors and one small electrolytic present that may need replacement, as the majority of capacitors in this model are disc ceramics, which are generally very reliable.

Next steps were to check the power transformer continuity and, if ok (it was), revert the power supply to its original configuration and replace the capacitors noted above thus:

- removed the two silicon rectifiers and the two 100 ohm series resistors from the underside of the 6X4 rectifier socket, as well as the thermistor and capacitor(?) that had been added to the power supply section, and thus reverted to the original line input and 6X4 rectifier wiring per the schematic;

- opened up one of the white cardboard body tubular 0.1uF capacitors and found the dielectric used was plastic film. I re-stuffed the cardboard body with a new plastic film 0.1uF capacitor (photos, right), and decided to leave the other tubular capacitors alone for now as, being of the same type and therefore plastic film, they were likely to be ok;

- removed the scruffy cardboard body multi-section electrolytic from the chassis. I tested each section and they had all failed either low/no capacitance, and all sections had high leakage;

- temporarily jury-rigged 2 x100uF 450vw and 2 x 10uF 450vw electrolytics in its place, and then briefly powered-up the receiver, measuring the peak voltage on each capacitor - the highest voltage reached was 152vDC on one of the 100uF parts (reservoir capacitor), dropping to 150vDC working voltage – this is the 'beauty' of an indirectly-heated rectifier tube such as the 6X4[2] - virtually no cold switch-on voltage surge as all the tubes reach operating temperature almost at the same time. I therefore decided to used 160vw rated parts for all four capacitors - being physically much smaller than the equivalent capacitance 450vw parts, these would easily fit into a new can of the correct size for this chassis;

- found a suitably-sized old aluminum can capacitor, gutted it and stuffed it with 2 x100uF 160vw and 2 x 160vw 10uF 105C rated new electrolytics (photos, left). I recycled the wires off the removed cardboard body

[2] The 6X4 tube sometimes gets a 'bad rap' for premature failure due to internal shorting of tube elements and hence were often replaced by silicon diodes. However, millions of these tubes were used in a variety of equipment for many years without issue. Given that this set will have limited use, for the sake of originality, the silicon diodes and other mods were removed

capacitor onto the new capacitors, and installed the new capacitor assembly onto the chassis with an appropriate clamp removed from a scrap chassis;

- re-stuffed the 10uF 25vw electrolytic cathode bypass capacitor on the output tube. This is a brittle (ceramic?)-bodied part with ceramic(?) ends, and consequently it was difficult to remove the old 'guts', and parts of the sleeve broke off during this process. The damage was repaired with epoxy putty and then coloured black/red/yellow per the original using a permanent marker pens (photo, right) before re-installing into the chassis;

The receiver was then powered on again and a series of voltage checks undertaken at critical circuit nodes - all were ok according to the voltage table in the 2B manual. The receiver was functioning, though all controls were noisy. I therefore spent some time cleaning the controls and band-change switch contacts with De0xit, cleaning and lubricating the two tuning gangs (pre-selector and main tuning) with Deoxit and lithium grease, and then removed the knobs, and then cleaned the front panel, dial and the knobs. One of the knobs had split (its set screw previously over-tightened), so this was repaired with J-B Weld. In addition, I:

- replaced the two dial bulbs (both had failed);

- carried out additional detailed cleaning above and below the chassis;

- cleaned-up and inspected the speaker/Q-Multiplier chassis (it had a lot of fluff accumulation behind the grill! – photo, left). All capacitors on the Q-Multiplier chassis are disc ceramic or silver mica, so none were replaced;

- checked a few critical resistors on the 2B chassis – all were within or close to their marked tolerances; and

- undertook a full set of tube pin voltage checks - all within a reasonable tolerance (10%).

Alignment and Performance Checks

Satisfied that the DC operating conditions were good throughout the chassis, I completed a full re-alignment as per the manual - it was quite close on most counts: the 405KHz local oscillator was a few KHz off spec., but only slight tweaks were needed to the 455KHz IF transformer, BFO, crystal oscillator and preselector to optimize performance. The VFO calibration was checked and found to be accurate. No issues were encountered during the alignment, and all coil/transformer slugs and the sole trimmer capacitor moved freely, allowing the various tuned circuits to be adjusted properly and accurately.

The receiver appeared slightly 'deaf' and a little noisy: the design claims that the noise level from the 6BZ6 front end is such as to be the dominant noise level in the receiver, however, having two 6BE6 tubes in the signal path after the 6U8 first mixer is not the lowest-noise tube configuration in my book… Although the tubes tested ok in my tube testers, I decided to try subbing the RF, converter and IF tubes to see if any improvement could be made. After some effort (and many tubes), I ended up replacing the 6BZ6 RF amp., 6U8 crystal osc./1st mixer, 6BE6 405KHz osc./3rd mixer and 6BA6 455KHz IF amp., where installing NOS tubes noticeably improved gain and/or lowered the noise level. Overall, a 20dB improvement in signal level was obtained without increasing the noise level.

I then adjusted the S-Meter 'zero' - actually this means set to '1' on the scale or the manual states that the S-Meter readings will be "Scotch"(!), and its sensitivity: a 30mV signal should give an S-Meter reading of S9+60dB.

I then connected-up and checked out the Q-multiplier. I found that it worked very well on both peak and notch settings without any adjustment necessary.

I had tried out the '2-LF' low frequency converter unit that came with this set (photo, left) once the receiver was initially functioning, but it was not working. Focussing on optimizing performance of the 2B chassis, I had put it aside, but now decided to try it again. I soon figured out why it was not working when I had tried it previously: the crystal calibrator switch must be set to 'on' as (obviously) the unit derives its power from the calibrator socket (doh!) - however in mitigation, the 2-LF manual does not state that anywhere in its set-up instructions...

This unit actually works reasonably well considering its simplicity. It comprises a single transistor crystal oscillator and aperiodic diode ring mixer that up-converts the low frequency signals to the 10M bands. This 2-LF unit was supplied with both crystals enabling signals from 100KHz to 3.5MHz to be received, allowing coverage of the Broadcast Band and the 160M ham band. Being wide-band, the unit will not have a great cross modulation performance, however, for general reception on the Broadcast Band it is perfectly adequate.

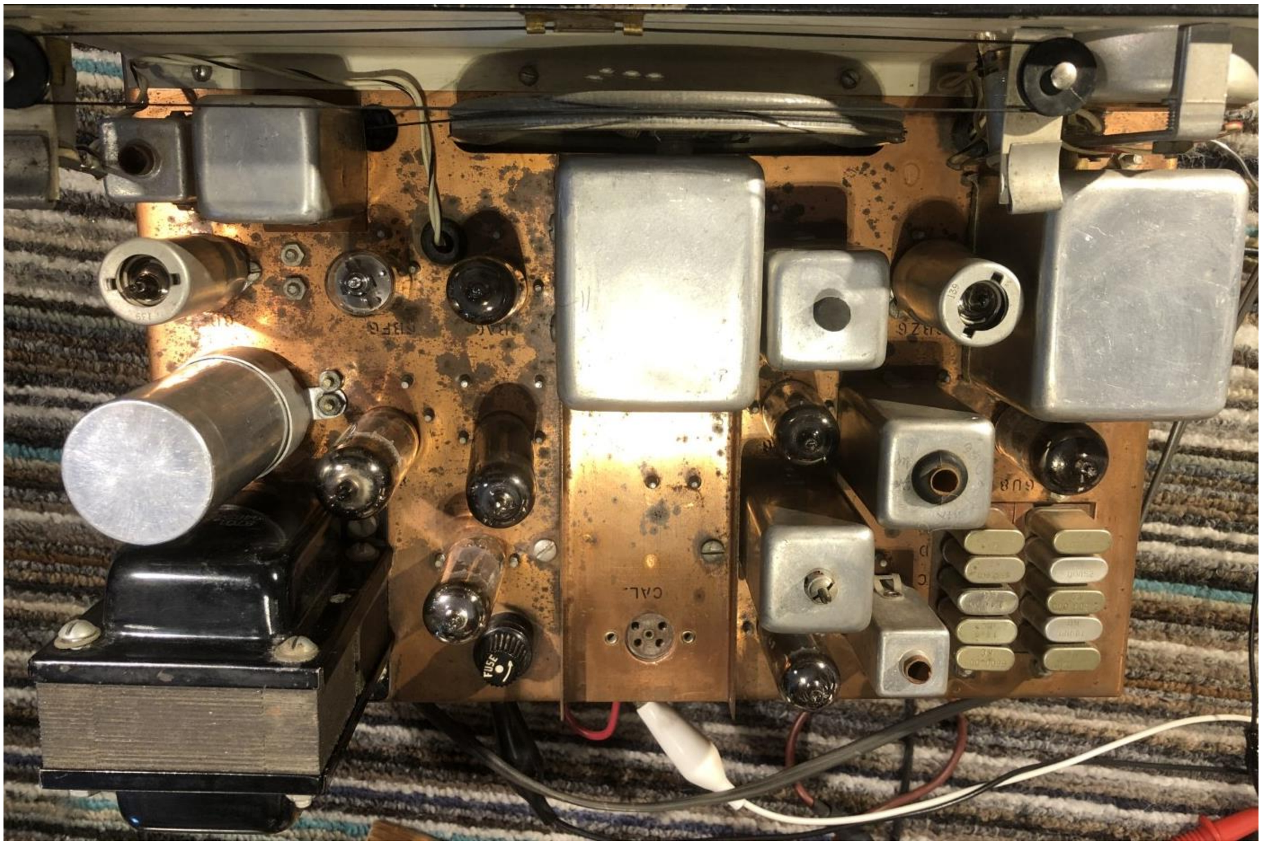
The home-brew crystal calibrator unit (photo, right) was then checked and found to be bang-on frequency (100KHz), with harmonics audible on all bands (this is a copy of the Drake calibrator circuit).

Finishing-up

The receiver chassis was re-installed in its case and soak tested along with the Q-Multiplier. It was easily picking up ham stations on 20m SSB using a mag-loop antenna in the workshop (short video demo here, and with the 2-LF converter, brought in many Broadcast Band stations (short video demo here.

Some minor cosmetic touch-up was carried out on the case using a black permanent marker and it was then given a polish with some Novus #1. For a 60 year-old receiver, it looks (and works) great!

Above left: Q-Multiplier chassis after clean-up. Above right: crystal bank on the 2B chassis - the left-hand row is the standard ham band set of crystals, and the right-hand row is for 'auxiliary' frequency coverage crystals. Below: the 2B front panel after refurbishment, here receiving a station on the Broadcast Band with the 2-LF converter installed (upconverting to one of the 10M bands)



Above: chassis after cleaning and refurbishment – pity about the state of the copper plating. The crystal calibrator /2-LF socket can be seen lower-centre. Below: the replacement (re-stuffed) electrolytic can installed on the chassis – looks much like the original fitment

Above: underside of the Q-multiplier chassis – a simple but very effective circuit. Left: side of chassis showing the preselector adjustment slugs and trimmer. Below: rear apron showing Band E preselector adjustment slug, Q-multiplier socket, antenna and other connections. The two trimmer pots on the left hand side are for S-Meter sensitivity and 'Receiver Sensitivity' (actually AGC 'bias' or delay)


FREQUENCY
BFO
OFF
PROD
DIODE
NL
OFF
S. AVC
F. AVC
STBY
RCV
CAL
OFF
POWER
OFF
PRESELECTOR
AF GAIN
PASSBAND
RF GAIN
BAND
MODEL 2-B COMMUNICATION RECEIVER
R.L. DRAKE CO-MIAMISBURG OHIO
TUNING