THE DRAKE R4B AND R4C
Two Receivers From the Past

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●INTRODUCTION

It is not without mixed emotions that one suggests that DXers take a serious look at the Drake R4B/R4C duo of receivers. On the one hand, these receivers pale when compared with the digital readout, excellent selectivity, stability, and memories on the R7A, NRD 515/ 525, and Kenwood R5000. On the other hand, the R4B and R4C were excellent DX receivers in the seventies and are still capable of very good DX when their very effective notch filter and passband tuning features are employed. This article will discuss the two most popular models in Drake's R4 series in the hope that they might meet a need for some DXers looking for a quality receiver. I have used them for twelve years, and have grown to respect them.

I do not suggest that one should forego a new Kenwood or Yaesu and buy a 20 year old Drake, no matter how good it might be. Instead, let the R4B/R4C show that one does not need the latest receiver to hear rare DX.

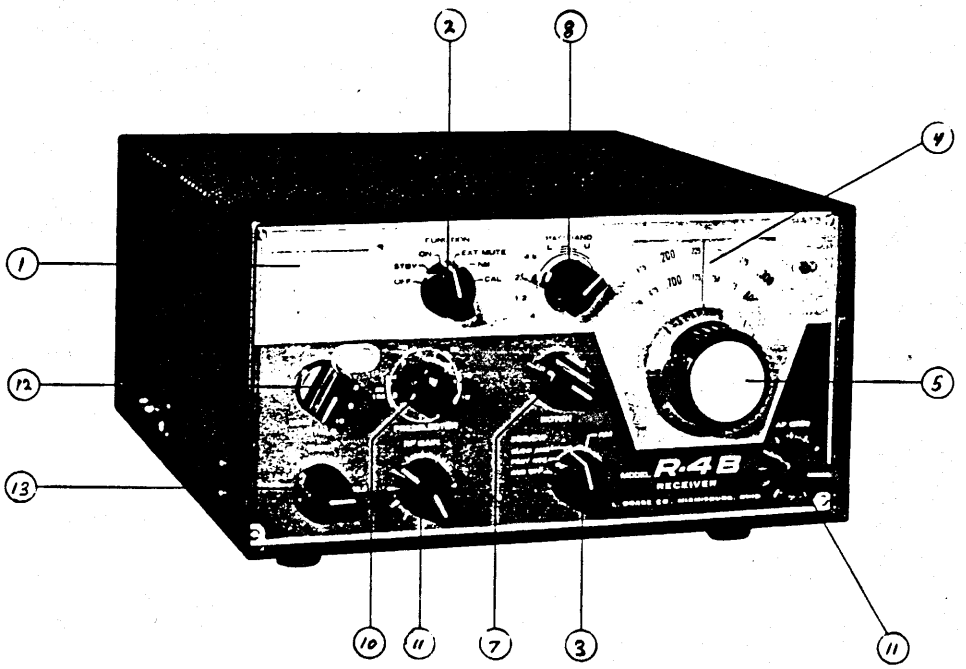
What makes a receiver a DX rig? One standard is that offered by Ace DXer, Al Niblack, who once wrote that a quality DX receiver has "the three S's: selectivity, sensitivity, and stability." These qualities are common in today's solid-state receivers, but at a price. However, a well cared for Drake R4B/R4C offers those three S's at a price well below that of current receivers. The R4B was manufactured by Drake from 1968 to about 1973, and the R4C from 1973 to about 1976. The "B" has ten tubes and the "C" six, and is partly solid state. Both were designed as ham receivers and came equipped with crystals covering the ham bands. With auxiliary crystals, they will cover any ten (fifteen in the "C") additional ranges in 500 kHz segments from 1.5 to 30 mHz (except for the IF hole between the 5-6 mHz). This makes them a natural for those interested in DXing the tropical broadcast bands. For the serious DXer, their strength is in the three "S's" along with the tremendous flexibility afforded by passband tuning, direct frequency readout to one kHz, and notch filter.

●TUNING THE R4 SERIES

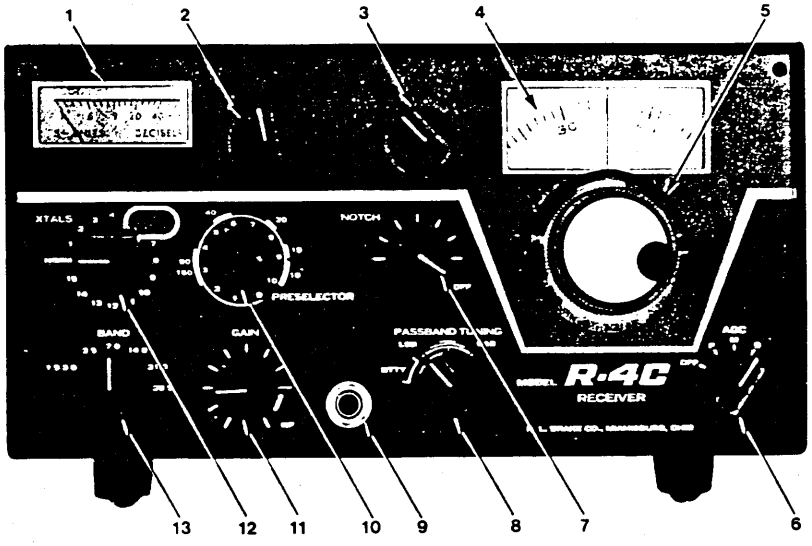
With the exception of a few quirks, tuning the R4 series of receivers is fairly straightforward. Let's take a tour of the front control panels of each receiver, noting the diagram accompanying this article.

The "S" meters (1) on both receivers are in "S" units and decibels, and are very easy to read. They are sensitive and can be calibrated for optimum accuracy. The function switch (2), provides for on/off, standby, noise blanker, and calibrate selections. The noise blanker on the "B" is really a noise limiter, whereas on the "C", it is the more sophisticated IF gate-type blanker which is effective for pulse-type interference such as auto ignition noise. However, I have not found either blanker particularly effective for the electrical hash I encounter. The crystal calibrator emits a signal every 25 kHz for very accurate calibration of the dial (4).

Tuning is accomplished by a permeability-tuned VFO with a range of 500 kHz and 50 kHz overtravel on either end (100 kHz for the "C"). The dial on the "B" is one-piece plastic with marks every 25 kHz. The skirt on the knob (5) is calibrated in one kHz segments and is rotated to the exact calibration point in conjunction with the crystal calibrator marker to achieve precise calibration. The "B" knob, however, lacks a finger detent for fast excursions across the band. The solution is to obtain a "C" knob which has such a detent. The "C" dial consists of two concentrically rotating plastic dials in the same fashion as the SPR4, with readout to one kHz. The skirt on the knob is rotated for calibration by holding the knob



THE MODEL R4-B



THE MODEL R4-C

and rotating the skirt to one of the 25 kHz dial markers on the dial. Linearity of the PTO seems to suffer somewhat with age, as the "B" needs to be recalibrated about every 50 to 75 kHz, whereas the "C" requires it one or two times for the entire 500 kHz range.

Tuning the R4 series of receivers is very similar to tuning the SPR4. The desired non-amateur frequency range is determined by the corresponding 500 kHz crystals installed in the auxiliary crystal bank at the rear of the receiver, the "B" having 10 slots and the "C" fifteen. The auxiliary crystal selection knob (12) has a small window in which can be written the frequency range of each crystal. After selecting the desired crystal, the matching band range must then be selected (13). The band ranges correspond to the amateur bands, so you must select a band which is closest in frequency to your desired range. The preselector (10) is then tuned for maximum signal strength. This is where one of the quirks in Drake receivers appears, including the SPR4. For example, if one desires to use the crystal for the 25 meter band, one would normally choose the 7 mHz band range since it is closer in frequency than 14 mHz, the next position on the band switch. However, sensitivity is much better using the 14 mHz position. A general rule to follow, therefore, is to select that band which allows the preselector to achieve maximum signal strength at the lowest end of the preselector range. In practice, this means the band frequency should be higher than the crystal frequency. I found it helpful to write in the band and preselector positions in the crystal selection window until I became familiar with the proper positions.

Tuning one of the amateur bands is much simpler; set the crystal selection knob to "normal" (no auxiliary crystal selected), choose the amateur band desired, and tune the preselector within the marked amateur band ranges for maximum signal strength. While tuning within a band, it is necessary to peak the preselector occasionally. For one unfamiliar with Drake receivers, this may sound complicated, but is easy to get used to.

Selection of mode (3) with the "B" is rather straightforward; select "AM" or "SSB" in the slow, fast, or off AGC positions. The selection of mode is independent from selectivity. The "C" takes a departure from this approach, as mode is either "AM", "SSB", "CW 1.5", "CW .5", or "CW .25". Thus, on the "C", as with an unmodified SPR4, mode is not independent of selectivity. What is independent is the selection of "off" and three different AGC positions (6).

Having selected the mode for the stations being tuned, AF and RF levels are selected on the "B" with two knobs (11). On the "C", AF level is selected with a knob and RF level with a small metal tab on the same shaft; an inconvenience, as the tab tends to move inadvertently through use, and you suddenly find why your sensitivity is reduced.

Two additional controls contribute to the versatility of these receivers. The first is the IF notch filter (7), the notch depth of which is quite deep (approximately 50 db), operative in all modes, and quite effective if tuned very carefully. The second is passband tuning (8). On the "B", the passband tuning is mechanical and independent of mode, with a metal tab on the same shaft for selecting one of four selectivity positions (4.8, 2.4, 1.2 and .4). This control is extremely effective, especially when tuning in the 2.4 selectivity position either in ECSS or AM. Moreover, any position within the control's range may be selected without retuning the receiver. Passband tuning on the "C" is electronic and is disabled in the "AM" mode.

The "B" has a small red tab to the right of the dial window to move a red vertical dial marker for use in calibration. The headphone jack on the "B" is on the right side of the chassis (inconvenient), the "C"'s on the front panel. Both receivers have external mute for use when tranceiving with a transmitter.

●THE THREE "S's"

In the important criteria of sensitivity, stability, and sensitivity, both receivers perform quite well. Sensitivity is claimed at less than .25 microvolts at a 10db signal-plus-noise to noise ratio on all bands for the "B", and from less than .25 to less than .5 microvolts, depending upon frequency, for the "C". After recent realignments, my "B" measured .21 microvolts, and the "C" better than .2 microvolts. However, I have never found either receiver to be particularly sensitive on 120 meters. I have

also found the "B" to be quieter than the "C", but there is a reason for this as I will discuss later.

Drake claims stability for both receivers to be not more than ± or 100hz drift after warm up. I have found this to be generally true, however, I have heard reports from other owners of varying amounts of drift. Such drift may well be indicative of the condition of the PTO. Thus, it is important to check the PTO's linearity and drift prior to purchase.

The means of achieving selectivity evidences the major difference between these two receivers. The IF system in the "B" is double conversion using a crystal lattice filter in the first IF, and a tuned LC circuit in the 50kHz second IF to achieve each of the four selectivity positions. This results in shape factors ranging from 3.4 to 1 (2.4 kHz filter) to 6.0 to 1 (.4 kHz filter). As result, the 4.8 kHz position is essentially useless (4.8 at 6db and 20 kHz at 60db). For DXing purposes, the 2.4 and 1.2 kHz positions are the only useful ones (2.4 and 1.2 kHz at 6db and 8.2 and 4.8, respectively, at 60db), especially when used in conjunction with passband tuning and the notch filter and ECSS.

The IF system in the "C" is triple conversion, utilizing the same wide crystal lattice filter in the first IF as in the "B". However, the additional IF frequency was employed to accommodate the use of 8 pole crystal filters in the second IF for each of the selectivity values. The result is that one has the factory choice of either a 6 or 4 kHz AM filter with shape factors of less than 2.0 to 1; certainly an improvement over the "B", but unusable with passband tuning. Unfortunately, the excellent 2.4 and 1.5 kHz filters (shape factors of 2.0 to 1 or less) can only be used in ECSS, albeit with passband tuning. Thus, despite the improved selectivity, the "C" is less versatile for DX purposes unless one employs the ECSS means of tuning. One can cut the mode shaft to allow filter selection separate from mode. This was a frequent modification on the SPR4 and presumably would be performed cautiously in the same manner on the "C". However, the passband tuning would still be unusable in the AM mode.

WEAKNESSES AND DISADVANTAGES

There are some disadvantages to owning an R4B or R4C, alleviated in part by accessories and modifications. First and foremost would be the limited frequency coverage which is heir to the PTO method of tuning in combination with the fixed frequency crystals. However, in the sixties, this appeared to be the only cost-effective means of achieving accurate frequency readout. To one whose interest is in tuning the tropical bands, this is not a disadvantage when the necessary crystals for all the desired tropical band and adjacent frequencies are installed, provided however, that one can tolerate the reduced sensitivity on 120 meters. Secondly, the somewhat complex tuning requirements might dampen a prospective purchaser's enthusiasm. Thirdly, because there are a number of tubes, not only do both receivers get quite warm during use, but require periodic alignment and tube replacement. Tubes can be purchased for reasonable prices at hamfests, and an alignment at Drake will cost about $100- plus parts. Finally, the solid state audio in the "C" is quite poor in my judgment. I would characterize it as distorted, muffled, and transparent. The tube-based audio in the "B" is much better, particularly when modified.

ACCESSORIES AND MODIFICATIONS

As neither the "B" nor "C" have built-in speakers (thankfully!), the matching MS4 speaker is a necessary purchase. You do not need to look any further, as it is excellent. Be sure that you can purchase the speaker with the receiver, as it is also the speaker of choice for many R7 owners, so there may not be many stray ones available.

Two notable accessories requiring no modifications, however, were available for these receivers. The first was a digital readout which plugged directly into the injection socket on the rear panel. One unit was made by Torrestronics which read from 100 kHz down to 100 Hz in four digits. Another was the FR-4 made by E-Tek which read the complete frequency down to 100 Hz

in six digits, also serving as a frequency counter. I own the latter, and have been very pleased with it, except for a burned-out nixie tube segment and the high amount of heat the unit generates. Not only does this provide more accurate frequency readout, but with it, recalibration is no longer necessary.

The second accessory is the FS4 frequency synthesizer manufactured by Drake which converted any of the pre-R7 Drake receivers to a general coverage receiver. These are reported to have operated quite well, but very few were made, and when found on the used market, are about as costly as a used "B" or "C" receiver. Ham Radio published an article on how to build one in its August, 1982 issue. Radiokit Company, Pelham, NH offers a kit for $69.95 based on a design featured in May, 1981 QST.

Both receivers, especially the "C", have been the subject of numerous modifications. However, I cannot overemphasize that the modification of any receiver must be carefully evaluated and approached with great caution.

My "B" modifications include the relocation of the headphone jack to the front panel, installation of a "tape-out" jack on the back panel, and improvement of the distorted audio in the "AM" mode by converting the half-wave AM detector to full-wave rectification. For more information and instructions on the latter two modifications, as well as other maintenance and operating tips, see Larry Magne's excellent article in the September 1973 issue of FRENDX. I had one other modification performed on the "B", and that was the replacement of the marginally selective 8 kHz wide 1st IF filter with a more selective 8 pole 5 kHz Sherwood filter. The result is better performance of the four filter positions, including a now usable 4.8 filter with a shape factor similar to the 4.8 kHz filter on the SPR4, but at the expense of the resulting reduction in audio quality that comes with tighter selectivity skirts. In my judgment, the modification was worthwhile.

Modifications to the "C" abound, most of which have resulted from the work of Sherwood Engineering, Inc., Denver, Colorado. These modifications relate to the audio amplifier, product detector, power supply, refeeding of the 6EJ7 third mixer, as well as numerous filter options and the switches to select the various filters. About six years ago, I had the notion that the R4C could be an ultimate DX receiver with the above modifications performed. Thus began a saga fraught with extreme expense, dissatisfaction and frustration, as the modifications were performed, apparently improperly, by an individual recommended by Sherwood. The receiver never operated properly after the modifications, even after being returned to the individual for reworking. The "C" sat in its box for about four years until I met "Doc" Sheller at the 1988 Dayton Hamfest. After discussing the problem with him, I had him check the receiver. He was able to redo the modifications properly. In addition to the circuit modifications mentioned above, the 5 kHz 1st IF filter was installed, as well as an AM 2 kHz filter with switch to supplement the 4 kHz stock AM filter. At this date, the receiver operates quite well, although it is still somewhat noisy in all modes and the audio poor in AM, such that there is very little enjoyment when using it in anything but ECSS. In my judgment, the strength of the modified "C" is on the amateur bands, both on SSB and CW, where its performance and selectivity is outstanding, not as a tropical band DX receiver.

In conclusion, if anyone desires to have any of the Sherwood modifications performed on any Drake receiver, I would strongly urge that they be performed only by either Rob Sherwood, Sherwood Engineering, Inc., 1268 South Ogden Street, Denver, Colorado, or "Doc" Sheller, Design Electronics Ohio, 4925 South Hamilton Road, Groveport, Ohio.

●ON THE AIR WITH THE R4B/R4C

Now let's tune both modified receivers to see how they perform under adverse conditions of interference. As I tune across the 49 meter band with the "B", I note the BBC World Service with a strong signal on 6005. Tuning slightly higher, I note a very weak R. Reloj on 6005.6 with much splatter from the BBC as well as an interfering carrier. By tuning the "B" in ECSS in the 2.4 kHz selectivity position, and then slightly detuning the passband control from the USB position, I am able to get a marginally readable signal from Reloj. However, I still have the interfering carrier from 6005. By tuning the notch filter very carefully, I am able to notch out the carrier, leaving Reloj readable, but with quite a bit of splatter from the BBC.

I then tune the "C" to the same frequency using the 2.4 kHz filter in ECSS, and adjust the passband tuning and notch filter as above. The result is that the splatter is less because of the tighter skirts on the 2.4 kHz filter of the "C", but the readability is less because of the muffled audio.

I compared the "B" and "C" with my NRD 515. My conclusion is that the signal-handling capability of the '515, using the 2.2 kHz filter, is somewhat better than the "B", but not as good as the "C", the '515 suffering from lack of an IF notch filter. The audio quality of the '515 is not as good as the "B", but better than the "C".

The two Drake receivers were also compared with a modified HQ180A with Q Multiplier about which John Bryant wrote in Proceedings 1988. The 180A in the 4 kHz AM selectivity position was the most effective receiver in handling the BBC splatter, provided the Q multiplier was used. The superb slot filter was very effective in eliminating the carrier. However, in my judgment, the audio quality of the 180A lacks crispness and clarity.

My R4B has received much more use than the R4C, and has done an excellent job for my DXing. Using just a 75 foot longwire, I logged Comoros Islands and Fiji Islands in the early seventies. However, the "B" and "C" are now semi-retired, as the '515 is my main DX receiver.

● CONCLUSIONS AND RECOMMENDATIONS

From the foregoing, one can easily see why the R4 series of receivers were popular as DX receivers during the 1970's. In fact, many senior Dxers owned a "B" as a backup receiver to an HQ 180A. Where else could one find a receiver with good selectivity, sensitivity, and stability; passband tuning, a notch filter, and one kHz resolution--all for under $500.00!

At present, used "B's" and "C's" can be found in local trade papers, ham magazines, and radio stores such as Amateur Electronic Supply in Wisconsin. Average prices range anywhere from $135.00 to about $250.00 for a well-equipped "C" in good condition. There were a fair number of these receivers at the 1988 Dayton Hamfest, but very few at Dayton in 1989. A friend of mine purchased a Sherwood-modified "C" in excellent condition with extra tubes and 15 auxiliary crystals for $400.00. He has since purchased an FS-4 for $250-. After you find a receiver in good condition, and after checking it out to make sure it works properly, I recommend that you return it to Drake for a complete alignment to factory specifications for about $100.00 in labor, not including parts.

I have a decided personal preference for the "B". Although it does not have the tight selectivity skirts of the "C", it is more versatile, the audio is much better, and in my judgment, the quality control is better.

Nevertheless, either receiver does a creditable job as a DX receiver, and they are really the last of the tube receivers.