THE DRAKE R-7/R-7A RECEIVER:

An Outline of Major Features, Modifications and Accessories

David Clark with Jon Williams

Figure 1: The Drake R-7 (Model 1240) Receiver

INTRODUCTION

A general review of features, operating characteristics and performance of the Drake R-7 by Jerry Strawman appeared in *Proceedings 1988* (Strawman, 1988). This paper is not intended to supersede but rather to complement that original article and other earlier reviews which appeared in both the commercial and the hobby press (some of which are cited herein). Larry Magne's comprehensive reviews of the R-7 and its successor R-7A appeared in the pages of the 1980 and 1982 *WRTH* respectively. (Magne, 1980 & Magne, 1982) In a follow-up article in the 1984 *WRTH*, Magne discusses external devices that can really improve the operating characteristics of the R-7A. (Magne, 1984)

In 1984 the R.L. Drake Company ceased production of the R-7A receiver, as well as the other products in its amateur radio line in order to concentrate its energies on the rapidly emerging satellite television market. Drake fans, including the present authors, were of course very pleased when Drake reentered the HF hobby market in 1991 with the launch of the R8 receiver (see Elton Byington's comprehensive review in *Proceedings 1992-93*). Currently, serious broadcast listeners and DXers are blessed with a variety of "high-end" general coverage receivers to choose from, all of which are fully synthesized and offer many operating conveniences by taking advantage of microcomputer technology. In addition to the Drake R8 offering at $980, these include the Japan Radio NRD-535D at $1689 (reviewed by Robert Evans in *Proceedings 1992-93* and compared to the R8 by John Bryant in this edition), and the Lowe HF-225 Europa at $899 (reviewed by Chuck Mitchell in this edition). Finally, we have the latest "professional-grade" DSP marvel, the Watkins Johnson HF-1000 at $3799, which is also the subject of a "first impressions" review in this edition of *Proceedings*.

So why, a decade after it went out of production and given the excellent equipment currently on the market, we are taking another retrospective look at the R-7A? We offer several responses which reflect the objectives of this article. Apart from the aforementioned, somewhat cursory review in *Proceedings 1988*, virtually nothing has been printed in the hobby press concerning the R-7A since 1984. This is understandable but unfortunate, since many new hobbyists have joined our ranks in the last ten years and it seems likely that most would not have more than a passing acquaintance with this high performance, semiprofessional receiver. For those in the market for a cost-effective used but very capable communications receiver, a solid state model like the R-7A is going to be more reliable and easier to maintain than the earlier tube-type receivers.

Second, many longer term DXers who haven't had extensive "hands-on" experience with the R-7A may not have a full appreciation of some of the important features, capabilities and configuration possibilities offered by this unique receiver. Furthermore, a number of useful modifications and adjustments are possible that have not been widely publicized.

This paper is intended to assemble most of this important information together in one place. Notwithstanding the generally excellent performance and operating convenience of the current crop of top-end receivers, consider what Larry Magne wrote in 1982:

Is this the time to buy? Technically, for serious DXing there may not be another receiver available soon, if ever, to surpass the performance of the Drake R-7A. What progress that is taking place is largely in the realm of more fully-automated operation via greater use of internal microprocessors. The Drake R-7A, which requires above-average skill to operate to its full potential, is unsurpassed by any receiver tested in the ability to successfully flush out tough shortwave, mediumwave and longwave DX or SWL signals. (Magne, 1982) **For the most part, we think this statement remains relevant, even in 1994.** In a major user review of the Drake R8 that was published in *DX Ontario*, there is a table comparing the important performance characteristics of the R-7A, the R8 and the NRD-535D. (Clark, 1991)

Although it was certainly expensive and in some respects ahead of its time in today's dollar terms this receiver could easily cost $2500 or more. In 1979, the basic R-7 with only one standard eight-pole crystal filter for SSB, but including the DR-7 digital readout option, listed at $1295. The price increased to $1449 as of June, 1980 and then to $1549 by March, 1981. When the upgraded R-7A was released in late 1981, a second eight-pole crystal filter for CW was included, together with stock provision of a very wide AM bandwidth, the DR-7 digital readout/general coverage capability was incorporated and finally, the previously optional noise blanker was included in the standard offering. This also brought the base price up another one hundred dollars to $1649. A full configuration of five crystal filters with certain other necessary wiring modifications could be purchased for a package price of slightly less than $1800 until the R-7A was discontinued in 1984.

Back in mid-1980, Drake was also publicizing a forthcoming commercial/marine version of the R-7 which was to be called the MR-3. (Magne, 1980) It was to be a digitally-tuned (in 10 Hz increments) version of the R-7 utilizing an optical encoder, probably akin to the synthesized mechanism in the Japan Radio NRD-515. Unfortunately we have no further information about the fate of this model which had a targeted price-tag of $2200. What we do know is that the "professional-grade" model R4245 receiver (perhaps superseding the planned MR-3?) became available in 1981 at a list price of $3800. Despite the different physical design which catered to rack mounting, all the important features corresponded to those of the R-7A but for the distinction that it was fully-synthesized.

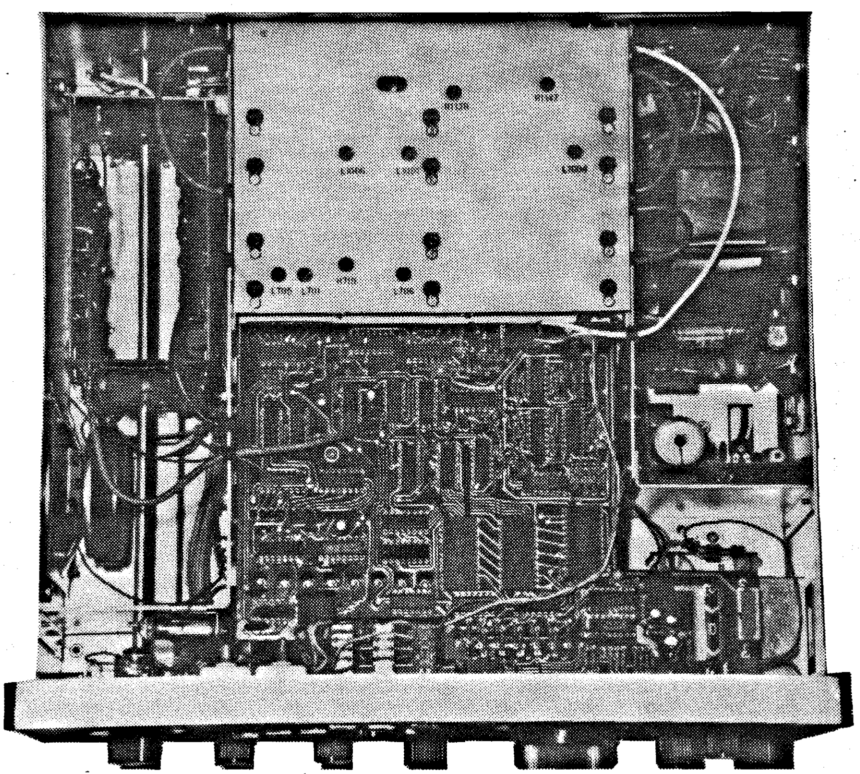

Figure 2: R-7A Top View (with cover removed)

Although they are not plentiful, sometimes an R-7 or R-7A with a full complement of IF filters, and possibly other options, shows up on the used market or at a hamfest in the $700 to $800 price range. **The R-7A is certainly not everyone's cup of tea. But as active DXers who still very much enjoy using this receiver, we think the price-to-performance value remains hard to beat. This is especially so for dedicated DXers who relish "working" all the twenty-five front panel controls the receiver places at their disposal to aid in that constant search for new and rare DX catches.** Guy Atkins concurs. He writes: *I am very much a "hands-on" DXer and I like to constantly fiddle with the controls to try and improve things. I enjoy the R-7 immensely in this regard.*

This is an appropriate point to extend a special thanks to Guy Atkins for his input and encouragement and to James Goodwin for his editorial assistance. Thanks also to Harold Sellers for his cooperation in digging out many of the older source references from the ODXA archives!

SERVICE MANUAL/DRAKE SERVICE DEPARTMENT

In the course of preparing this article, we found that a thorough reading of the Service Manual was useful. Apart from the usual full documentation of the receiver operation and alignment procedures, certain adjustments are described to maintain or improve particular performance and operating characteristics. The manual is also essential if user modifications are to be undertaken. The original R-7 Service Manual sold for $30 and for the R-7A the price was $35. Unfortunately the manuals are no longer in stock at the company. *If a used receiver can be purchased with the Service Manual as well as the standard Operating Manual, that is a bonus. When Guy Atkins and I visited the Drake Service Department in August, 1994, we learned that consideration had been given to reprinting the manuals but at today's prices, the cost would have been prohibitive. (DC)*

The good news, however, is that the Drake Service Department continues to provide expert alignment, parts and service support for the R-7A. *On the occasion of our visit, Guy and I spent the better part of an hour talking with John Andrews who is the man to deal with when it comes to the R-7A. We found him to be very knowledgeable and helpful. At this time, I turned over both of my R-7's to John for a complete overhaul and alignment which was estimated to require three hours each for labor. At the current hourly rate of $74, plus parts, one can expect to have Drake bring an R-7A receiver up to peak operating performance for about $250. I consider this to be an excellent long term investment. (DC)*

Drake has relocated from Miamisburg to nearby Franklin, Ohio but the direct line to the Service Department remains the same: 513-866-3211.

Figure 2 shows a topside view of the internals of Jon Williams' R-7A. The center-rear plate covers the IF Selectivity Board, Passband Tuning/Reference Oscillator Board and the 2nd & 3rd IF/AGC Board. Although the design features modular construction with discrete functions on separate printed circuit boards for easy servicing and alignment, notice also that there is still extensive use of point-to-point wiring.

DR-7 DIGITAL READOUT/GENERAL COVERAGE BOARD

The R-7 was first released in the Fall of 1979, modelled after but improving upon the receiver section of the TR-7 transceiver which came on the market one year earlier. Features such as a switchable preamp, a notch filter and "synchro-phase" AM detection upgraded the R-7 compared to its TR-7 sibling. In its stock form, the original R-7 listed at $1100 but did not provide full general coverage reception capability. The tuning range was limited to .01-5.5 MHz (excluding 2.0-2.5 and 4.0-5.0 MHz) and additional 500 kHz HF segments covering the 40, 20, 15 and 10 meter ham bands. It was necessary to add the $195 accessory DR-7 module to obtain full frequency coverage from .01-30 MHz. The DR-7 also included a counter circuit to provide digital frequency readout to the nearest 100 Hz in a 7-character LED display.

The original version of the receiver equipped with the optional DR-7 module was known as the R-7/DR-7 (and then briefly as Model 1240). While we don't have exact knowledge of the situation, we suspect that very few of the stock R-7 version were sold, even to hams, and it was probably discontinued rather quickly. Before long, the distinction between analog and digital versions disappeared and the latter became known simply as the R-7. Most R-7's (and all R-7A's dating from late 1981) which are to be found on the used market are fitted with the DR-7 module and many hobbyists may not even realize the original distinction. So, for the purpose of this article, generic references to either or both (i.e.. R-7A) models are deemed to include the DR-7 digital readout/general coverage board.

A rear panel connector controlled by a front panel switch is provided which also allows the digital readout to serve alternately as an outboard 150 MHz frequency counter. In *Proceedings 1989*, Cedric Marshall described a simple procedure whereby an insulated wire can be wrapped around the oscillator coils of a tube-type receiver to act as an inductive pickup loop. It is then fed by coaxial cable to the counter input using a phono plug. The R-7A digital display then shows the operating frequency of the tube receiver, incremented by its IF (e.g.. 455 kHz or 3035 kHz in the case of a Hammarlund HQ-180/A, depending on the band selected). (Marshall, 1989)

THE AUX-7 AUXILIARY PROGRAM BOARD

Complementing the general coverage provided by the DR-7, the AUX-7 Range Program/Fixed Frequency Board Model 1536 allows specific selection of up to 8 different frequency ranges of about 750 kHz (nominally 500 kHz) each. This is similar in function to the additional crystal-controlled ranges on the Drake R-4 series receivers. The AUX-7 makes for much greater operating convenience because it can be programmed to cover the SWBC or other HF band segments tuned most often by the DXer or SWL. Normal VFO operation or range selection is provided by the Auxiliary Program switch and a Setband status LED indicates the need to set the Band switch to the proper range when using the AUX-7.

This highly desirable accessory alleviates the need to use the cumbersome 'Up/Down' pushbuttons to step in 500 kHz increments from one of the eleven preset ranges to reach the desired frequency band. As we have noted, except for longwave, medium-wave and the 90 meter Tropical Band, most of the other preset ranges cater to the HF ham bands between 160 and 10 meters. Without the AUX-7 installed, the worst case scenario for SWL's is the necessity to set the Band switch at 21 MHz and to depress the 'Down' button no less than twelve times to reach the 19 meter SWBC band. Just imagine the tuning gymnastics required if trying to check parallels on different bands! It seems surprising how many R-7A's were apparently sold without being fitted with the AUX-7.

There is also provision for a fixed frequency crystal to be used within each AUX-7 range. This feature was probably provided with amateur radio net operations or certain commercial applications in mind. Selection of VFO or AUX-7/fixed frequency operation is controlled by a front panel switch.

The AUX-7 originally sold for $45, and can sometimes be found separately but usually without the appropriate RRM-7 frequency range modules. The modules originally cost $8.50 each, but Drake has not carried them for some time. They are, however, easily made for the desired frequency ranges by purchasing 14-pin headers and IN4148 diodes from an electronics supplier. Headers with brass pins which extend above the top surface of the header are best. The modules are made by soldering diodes to the pins in various combinations corresponding to the desired frequency range. A copy of Drake's module chart is necessary to determine these locations. This home-brew project requires time, patience and careful micro-soldering, but the added band-switching convenience makes it well worth it for serious DXers and SWL's alike.

ANTENNA SELECTOR/SPLITTER CONFIGURATIONS

A unique feature of the R-7A is the rear panel provision for up to three separate and well-isolated antenna inputs. The six-position, front panel Antenna switch allows two antennas to be used in any combination with the R-7A and another receiver. The built-in splitter allows the R-7A and another receiver to operate concurrently off the same antenna. One antenna input/switch position labelled "Converter" is for the R-7A only and renders 75 dB of isolation to guard against unwanted interaction with the other antenna positions. So, this is the position one would use with a dedicated BCB or Tropical Band loop antenna when DXing with the R-7A.

In a user review written for the National Radio Club, Craig Healy points out that by connecting one antenna to 'Main', another antenna to 'Ext Rcvr' and by setting the selector switch to the 'Main/Main' position, the antenna splitter works as a combiner. This enables the use of two phased longwires or a longwire in combination with a loop. (Healy, 1982) This capability will be of particular interest to BCB DXers.

The layout for connections on the rear panel is awkward and one has to take care when making various connections. There are eight, closely-spaced RCA phono jacks for various inputs and outputs, including the three antenna inputs and the output for an external receiver. Typically this requires extensive use of RCA jack/SO-239 adaptors. Guy Atkins has a better idea. He suggests homebrewing a junction box that could be attached to the rear panel with provision of appropriate SO-239 inputs. Another approach Guy suggests is to make up a wiring harness consisting of short (say six inch) lengths of coax terminated with gold-plated RCA plugs and sheathed SO-239's. This would mean the RCA plugs could remain "permanently" connected to the receiver to eliminate wear and tear to the inputs and would make for more convenient changes to antenna/external receiver connections when desired.

FULL ELECTRONIC PBT

One of the great features of the legendary Drake R-4 series that was provided in an improved form with the introduction of the R-7 was what Drake called "full electronic passband tuning" that was operative in all detection modes. The R-4B rendered full passband tuning mechanically, while the R-4C introduced electronic passband tuning but it was inoperative in AM mode. (Williams, 1989) **The version of PBT in the R-7A offers the best of all possible worlds.**

The PBT control is connected to a 13.695 MHz voltage-controlled crystal oscillator and varies the frequency of the oscillator within a range of approximately +/- 4.5 kHz (nominally +/- 3 kHz). Since the oscillator is used to generate both the 5.645 MHz 2nd IF and 50 kHz 3rd IF injection signals, the operating frequency of the receiver remains constant when the frequency of the oscillator is varied by the PBT control. Thus the 2nd IF can be positioned anywhere within a +/- 4.5 kHz range with respect to the filter passband while the receiver remains tuned to the operating frequency.

Unlike the provision for 'Passband Tuning' or 'Passband Shift' in certain other "modern" receivers, the R-7A PBT operates in AM mode thanks to the synchro-phase detection scheme. It has sufficient range to make it continuously variable either side of the "12 o'clock" position between the upper and lower sideband components of an AM signal, or for positioning the 2nd IF filter skirts anywhere within the IF passband for optimum reception of a signal being detected in SSB/ECSS or CW mode. Front panel markings indicate nominal USB/LSB settings for each mode.

Depending on the degree of adjacent interference, one should select the widest possible filter for optimizing the audio response which still allowing an unwanted interfering signal to be positioned outside the receiver passband. Any remaining closely-spaced heterodynes can then be nulled with the tunable notch filter. **When complemented with a full array of IF crystal filters, combined with judicious use of the notch filter), the flexible PBT arrangement of the R-7A is both convenient for SWLing and virtually unbeatable for "tough signal" DXing!** We should perhaps add a future caveat. If full, all-mode passband tuning is properly implemented with a software upgrade, the new Watkins-Johnson HF-1000 has the potential to set the new standard of performance. The DSP filtering capability already provided in the HF-1000 is an incredible technical advance...at a price, of course.

By way of comparison, the Passband Shift in the Japan Radio NRD-535D only allows the center frequency of the selected IF filter to be adjusted +/- 1 kHz without changing its overall bandwidth and it does not work well in ECSS mode. Furthermore, the 535's notch filter is not effective in AM or ECSS mode. (Evans, 1992) To a certain extent, these "sins" are compensated-for by JRC's improved, all-mode Variable Bandwidth Control.

In the case of the Drake R8, the Service Manual outlines the circuitry to provide the passband tuning function (now called Passband Offset) that is essentially the same in design as outlined above for the R-7A. The Passband Offset control is operative in AM or AM Sync modes and has sufficient range (nominally +/- 3 kHz) to cover both the upper and lower sidebands without detuning the operating frequency. Unfortunately it does not work quite so well when tuning broadcast signals in the ECSS mode.

Perhaps due to a design idiosyncrasy or an alignment procedure that may vary slightly from one unit to another, the positioning of the passband offset seems to be "unbalanced" in the sense that it is not possible to shift into the lower sideband if the mode selected is USB. By selecting LSB, however, I have found it is possible to recover most of the upper sideband component by adjusting the Passband Offset control between the "3 o'clock" and "5 o'clock" positions. I always keep the R8 in LSB mode for ECSS DXing so I can readily shift between upper and lower sideband without the inconvenience of scrolling from one mode to the other. The R8's audio notch is operative in all modes too, but it is more tricky to use and somewhat less effective than the IF notch of the R-7A. (DC)

IF FILTER CONFIGURATIONS

The standard R-7 came equipped with only a 2.3 kHz SSB/ECSS eight-pole crystal lattice filter in the 2nd IF. This filter has an excellent shape factor rated at 1.8:1. It is installed on the 2nd & 3rd IF/AGC board. A separate IF filter board provides for up to four additional accessory crystal filter positions in the 2nd IF. It is worthy of note that any IF selectivity position can be utilized independent of mode. This flexibility is a big improvement over Drake's predecessor R-4 series and SPR-4 model. The optional eight-pole crystal filters with 2:1 shape factors available from Drake (originally costing $52 each; $60 by 1982) were 6 or 4 kHz intended for AM, 1.8 kHz for narrow SSB/ECSS, and 500 or 300 Hz for CW. The original R-7 Operator's Manual (printed in 1979) did not contain an illustration of the IF Selectivity Board but an updated version of the manual (dated 5-80) does contain a half-page illustration showing the proper installation sequence of the optional filters on the board.

Soon after the R-7 came on the market, Sherwood Engineering offered a high quality eight-pole crystal lattice filter with a 3 kHz bandwidth and a 1.8:1 shape factor. Eventually, Sherwood offered a full range of filters (costing $80 each) for the R-7A. The other bandwidths were 6, 4, 1.6, .5 and .2 kHz. All of the Drake or Sherwood filters featured excellent deep-skirt selectivity characteristics, thus rendering ultimate selectivity of better than 100 dB.

The R-7 manual contains instructions whereby the user can install a 150 ohm, 1/2 watt resistor jumper in the 4 kHz selectivity position. In the absence of the optional 4 (or 6) kHz filter in this position, that modification rendered very wideband AM selectivity of 8-10 kHz derived solely from the four-pole monolithic, crystal bandpass filter in the 1st (48.05 MHz) IF stage.

As explained in the manual, *the [primary] purpose of this filter is to attenuate signals removed more than +/- 4 kHz from 48.05 MHz, thus protecting the remaining stages of the receiver from strong interfering signals. In this manner, optimum receiver dynamic range is preserved while providing excellent sensitivity.* Drake advertising hailed the special front-end circuitry employing a high-level double balanced mixer and 48 MHz "up-converted" 1st IF as a significant advance in both image rejection (rated > 80 dB) and strong signal-handling characteristics. **Excellent sensitivity and selectivity, combined with superior dynamic range, are hallmark characteristics of the R-7A. Taken together, they are very important to DXers seeking to pull in weak signals through other stronger, closely-spaced signals on medium wave, as well as on the Tropical and HF SWBC bands.**

The rated Third Order Intercept Point (above 1.8 MHz) is an outstanding figure of +20 dBm with preamp off. When the 10 dB RF preamplifier is switched in, the figure is still a very good +10 dBm. These values are based on 100 kHz signal spacing. A review in *QST* magazine reported **worst-case** dynamic range performance was found to be on 80 meters where the Third Order Intercept Point tested out at +17 dBm with preamp off and -2.5 dBm with the preamp on. (DeMaw, 1980) The figures for preamp on/off were transposed in the original review article but corrected in an editorial note in the subsequent monthly issue of the magazine.

With the R-7A, the standard selectivity configuration was upgraded to include both the 2.3 kHz and the 500 Hz crystal filters, as well as factory-installed provision for the 8-10 kHz wideband AM position. On the assumption that the purchaser might take advantage of all five potential selectivity positions, the R-7A front panel Selectivity control positions are labelled (clockwise) as 4, 2.3, 1.8, .5 and .3 kHz.

Many shortwave broadcast DXers and SWL's, however, were not concerned with CW reception capability. They purchased their R-7 or R-7A from suppliers such as Gilfer Shortwave which offered a modified version, fully configured with five voice bandwidths. Perhaps the ideal combination of Drake/Sherwood filters rendered a bandwidth selection of 6, 4, 3, 2.3 and 1.8 kHz. Proper sequencing of the filter selection via the Selectivity switch necessitates several internal modifications. In this configuration, the 2.3 kHz filter has to be rewired onto the IF selectivity board and the 4 kHz filter is installed in its place. In addition, with the R-7A, the stock 500 Hz CW filter has to be removed. Then, an audio filtering circuit automatically invoked when the Selectivity switch is placed in the original 500 or 300 Hz positions should be disabled. This circuit is intended to optimize CW reception quality by lowering the overall high frequency response. To compensate for greater insertion loss when the narrow CW filter positions are selected, additional gain (about 5 dB) is automatically applied in the 2nd IF stage. In this modified configuration, placement of the 2.3 and 1.8 kHz filters in the designated CW positions on the filter board means that this additional amplification partially offsets the insertion loss at these narrow voice bandwidths.

It is clear that the asking price for an R-7A is going to be governed by the auxiliary filters already installed. **We think any prospective purchaser would be well-advised to pay the "premium" that will be dictated by a full array of filters, especially if the Drake 4 kHz and/or the highly-prized Sherwood 3 kHz filter are included.** The 4 kHz Drake filter is ideal for selectable sideband reception utilizing the synchro-phase AM detector. This form of AM demodulation is superior to the more usual diode detection method for AM signals, rendering less distortion and as noted above, allowing the electronic PBT to be utilized in AM mode. Conventional (double sideband) AM detection renders only about 2 kHz of audio bandwidth through a 4 kHz filter. The synchro-phase detection scheme allows more like 3 kHz of audio bandwidth through the sideband least subject to interference, thus rendering greater intelligibility . This is essentially the same effect that is realized when using the product detector to tune in the more complex ECSS mode.

The 3 kHz Sherwood filter bridges the gap nicely between the Drake bandwidths of 2.3 and 4 kHz. We have found this filter to be optimal for ECSS tuning under nearly all reception conditions except when "close-in" interference is extreme. *Some years ago I was fortunate enough to walk into Universal Radio, Reynoldsburg, Ohio the very day that an R-7 had been taken in on trade for what was then a spanking new NRD-525. This particular R-7 had been serviced and modified by Dr. J.R. 'Doc' Sheller, KN8Z of Design Electronics in Ohio. His firm was well known for its expertise with Drake gear. The filter configuration was quite unique. The provision for wideband (8-10 kHz) AM was retained, while the other filters were the Drake 4 and rewired 2.3 kHz, complemented with the Sherwood 3 and 1.6 kHz values. The hastily assigned resale pricetag of $600 did not properly reflect the inherent value of the auxiliary filters (especially with the inclusion of the Sherwood 3 kHz!) and I knew it. To his credit, Universal's Fred Osterman graciously allowed me to purchase the receiver on the spot for the "bargain" price as marked. It would still have been a very fair deal at $750. I DX in the ECSS mode almost exclusively and the bandwidth filter switch rarely moves from the 3 kHz position. That Sherwood filter is a gem! (DC)*

The 1.8 (and possibly the 6) kHz filter is still available from Drake but the most desirable 4 kHz Drake filter and 3 kHz Sherwood filter are no longer available from the original sources. Drake's 6, 4 and 1.8 kHz filters occasionally appear in the Ham Trader Yellow Sheets or at flea markets, but we have never heard of the 3 kHz Sherwood filter being offered separate from one of the relatively few receivers in which it is installed. Substitute filters from other sources are not readily available either because the R-7A uses an unusual 2nd IF of 5.645 MHz.

I finally gave up looking for the Sherwood 3 and ordered a comparable, custom-built 8-pole from International Crystal and Radio in Florida at a premium cost of about $180. It took about four months to arrive from Japan but the investment and the wait were worth it. The performance is comparable to Sherwood's version and believe me, it is the only filter for ECSS DXing. I use it about 80 to 90% of the time, even for casual listening. (JW)

Like David, Guy Atkins uses both the Drake R-7 and the R8 for serious DXing and he compares their selectivity capabilities as follows: *The receivers are used here in head-to-head DXing situations for both difficult shortwave Tropical Band and trans-Pacific mediumwave DX. I prefer the R-7's IF filters. They have better ultimate rejection which I've proved to myself time and again while mediumwave DXing faint T-P stations between the domestic channels. I want to emphasize, however, that unless you are seeking extremely difficult DX, the R8's L-C filtering is very good, especially in conjunction with the passband offset and notch controls. The R8's filters do contribute to its very good audio because of the low distortion inherent in well-designed L-C filters.*

Note that for voice bandwidths less than 3 kHz, some audio distortion is experienced with the R-7A in AM mode. Since audio response is optimized for SSB detection in any event, tuning in ECSS mode is preferred for best intelligibility, especially if a narrow bandwidth filter is being used. Most reviewers subjectively rate audio reproduction in AM mode as adequate (albeit much-improved over that of the predecessor R-4 series and SPR-4); good at 4 kHz or wider bandwidths. There is almost universal agreement that audio in SSB/ECSS mode (at 3 kHz or less) is excellent.

RIT TUNING RATE MODIFICATION

The tuning rate of the stock receiver incremental tuning control (RIT) is quite coarse, at about the same rate as the main tuning knob, across its analog range of +/- 3 kHz. This makes ECSS tuning "touchy" and quite cumbersome with the small concentric RIT tuning knob. Steven Lare brought to our attention a modification that originated with Malcolm Chisholm and was published in David Newkirk's 'Radio Equipment Forum' column in *Review of International Broadcasting*. (Chisholm, 1984)

The idea is to connect a resistor of an appropriate value across the two poles of the RIT control circuit which can be accessed easily from the bottom side of the main circuit board. As Chisholm described it, look for three solder points and a conductor strip labelled 'PTO' and '37' at top-center of the board. An inch to the left and an inch below that group there is a series of coloured wires which are soldered from the control panel to the main board. Looking from right to left, the first two wires (green and grey) are the outside terminals of the RIT control and a resistor can easily be soldered across them.

This modification changes the RIT tuning range to a value in Hertz which is approximately equal to the value of the resistor employed. John installed a 470 ohm resistor and this renders an RIT range of about 470 Hz (+/- 235 Hz). James Goodwin modified both of David's R-7's using a 1/2 watt resistor of about 220 ohms in each case. This is quite sufficient to enable easy and precise ECSS tuning, provided the signal is initially tuned to the nearest 100 Hertz increment with the main tuning dial. Except for the change in range, normal operation of the RIT is maintained so that a change in frequency (to the nearest 100 Hz) will continue to be shown on the digital frequency display.

James found that this modification may necessitate a circuit realignment so that, with the RIT tuning knob set at its mid-range point, switching the RIT on and off does not cause a change in the frequency displayed. Specifically, switch on the RIT and set the RIT tuning knob to the center of its range (indicator straight up). With both SSB/CW mode and the 25 kHz Calibrate function switched on, tune in and zero beat a calibration signal. Then switch off the RIT and adjust potentiometer R24 for zero beat. The slotted adjustment for this pot is accessible through a hole in the bottom side of the main board near where the strapping resistor was soldered. The provision to adjust the RIT center position is not mentioned in the Operator's Manual but is cited in the Service Manual.

A slightly more complicated modification to accomplish the same effect is described by Vincent J. Pinto in his article 'Receiver Notes #1' in *The LOWDOWN*. (Pinto, 1984) Pinto's approach required connecting two like resistors from each end terminal of the RIT pot to the center wiper of the pot. Using resistors having a value of 4000 to 5000 ohms for example, would reduce the RIT tuning range to about one-third of its stock range. A re-alignment of the RIT centering is then required as outlined above.

The RIT tuning range modification is highly desirable for the DXer, unless one enjoys the luxury of a Drake RV75 External VFO (discussed in a following section), because it makes SSB/ECSS zero-beating far easier - comparable in result to the familiar Bournes pot modification of the Delta Tune (RIT) control on the Japan Radio NRD-515.

NOTCH FILTER OPERATION AND ADJUSTMENT

The general consensus among R-7A users who also have experience with the predecessor Drake R-4 series or some of the older Collins and Hammarlund tube-type equipment is that the tunable IF notch is quite effective but not quite up to the same level of notching capability of those older receivers, or indeed, Drake's SPR-4. As noted, however, the R-7A notch is easier to tune and exhibits a greater notch depth than the AF notch on the Drake R8.

The notch filter circuitry functions in the 50 kHz 3rd IF and is capable of eliminating or at least significantly attenuating a single interfering heterodyne within +/- 4 kHz either side of a signal being received. Its operation to position the null within the passband is described in the Operator's Manual: *Merely tune for minimum interference from the unwanted signal by listening for the audio null and observing the S-meter dip. The knob rotation sense is such that when the PBT control is clockwise of center, the notch control is clockwise of center and vice versa. Although the S-meter dip indicates only 20 dB notch depth, the actual audio null can be adjusted to approximately 40 dB depth.*

By reference to the Service Manual we find that two adjustments are possible on the 2nd IF board. The coil of variable can inductor L1104 can be adjusted to center the front panel notch control pointer when the 3rd IF is properly aligned at 50 kHz. The pot of variable resistor R1147 adjusts the circuit gain to provide maximum signal null at any resonant notch frequency.

Even in the absence of an interfering heterodyne, adjustment of the notch filter, in conjunction with the passband tuning control, can be very useful in shaping the audio response for optimum readability, especially when a narrower bandwidth is required. (DC)

AGC CONFIGURATIONS

The R-7A features four AGC positions: 'Fast' (75 milliseconds), 'Medium' (400 milliseconds), and 'Slow' (2 seconds) time constants, as well as 'Off'. Selection is determined by the "in" or "out" positions of two front panel switches in combinations which are not intuitively obvious. For example, with both switches in the "out" position, AGC response is 'Slow'; with both switches in the "in" position, the AGC is 'Off' and subject to manual control with the RF gain.

The two AGC pushbuttons must be handled very carefully. If an incorrect setting is used the receiver will either deliver distorted audio or produce no output at all. On the other hand, this AGC circuit can eliminate most flutter and fading phenomena when used sensibly. The S-meter is very accurate and its characteristics are geared to the AGC circuit. (Lichte, 1985) The sparse operating instructions in the manual do not give any guidance as to which time constant should be used for different modes/reception conditions. Most users agree that either Slow or Medium works well for AM or SSB/ECSS reception. AM and stronger SSB signals suffer distortion in Fast mode unless the RF gain is backed off (counterclockwise) to at least the "3 o'clock" position. Craig Healy was advised by Drake that the Fast mode is intended mainly for reception of CW transmissions with full break-in. (Healy, 1982) For very weak signal reception, especially under difficult noise conditions, sometimes it pays to switch to the Off position, set RF gain between "11 o'clock" and "1 o'clock", and then vary the signal level with the AF gain control.

NB7A NOISE BLANKER / EXTERNAL BLANKER ENHANCEMENT

The noise blanker was a $90 extra cost option for the R-7 but was incorporated as standard equipment with the R-7A. According to the manual, it mutes the receiver for the duration of a noise pulse and between pulses, full receiver gain is restored so that the AGC is affected only by the desired signal and not by the noise. The blanker is claimed to be most effective on strong, periodic noise pulses such as automobile ignition noise.

In his evaluation, Craig Healy reported no evidence of audio distortion (Healy, 1982), although most other reviewers acknowledge and we also find there is a tolerable degree of distortion when the blanker is used, especially in AM mode. There is no provision for varying the threshold level as is common in more recent receivers. Healy also reports finding no evidence of spurs or intermodulation noise in the presence of strong signals as he experienced with another (unspecified) maker's blanker (Healy, 1982)

In his article 'A Synchronous Power Line Noise Blanker', Vincent Pinto outlines the construction details of a homebrew, external synchronous noise blanker which drives the internal IF blanker of the R-7A. He explains that there are two reasons why even good built-in blankers, including the NB7A, will typically remove only 3 to 12 dB of power line (or light dimmer) 120 Hz noise pulses. *Noise blankers look for a sharp short pulse with a fast rise time. Power line noise, on the average, exhibits a broad pulse with a relatively slow rise time...Secondly, noise blankers generally create a short duration blanking pulse, much shorter than the pulses frequently encountered in power noise signatures.*

The external blanker is highly effective because it derives its blanking pulse directly from the power line frequency. Provisions are made to adjust the phase (ie. delay) of the 120 Hz pulses to coincide with the noise pulses, and to adjust the blanking pulse width and level. The author reports spectacular results: *The addition of the synchronous blanker has worked a miracle. Although there still are a few times I can't get rid of all the noise, it usually is completely effective.* (Pinto, 1983)

The only problem with this article is that the "accompanying schematic" was not printed. The article was subsequently reprinted in *Monitoring Times* (Pinto, 1985) and includes the essential schematic.

MEDIUM-WAVE PERFORMANCE AND SENSITIVITY ADJUSTMENT

The superlative capabilities of the R-7A for DXing on the Tropical Band and the HF SWBC bands are well known and scarcely need further comment. But this is also a much better receiver for medium-wave DXing, including foreign "splits", than perhaps has been generally recognized. The 10 dB RF preamp is not operative below 1500 kHz (see Enabling RF Preamp in next section), and yet sensitivity in the 500 to 1500 kHz range is specified as less than 4 microvolts for a 10 dB S+N/N ratio in AM mode and less than 1 microvolt in SSB mode. These are excellent values.

Apparently the R-7A is capable of delivering even better medium-wave sensitivity than specified, based on the way in which it was delivered from the factory. The Operator's Manual explains: *For AM reception within the 0.5 to 1.5 MHz range the following applies. Because of the wide variation in antennas used on this range, an attenuator pot (R1502), located on the input filter module, is provided to allow the R-7A to be optimized for the particular antenna in use. This adjustment is factory preset to the middle of its range, and as such, reduces the sensitivity within this band. To increase or decrease the sensitivity simply adjust the pot (accessible from the top of the radio after removing the wraparound cabinet) while observing the S-meter reading. The location of the R1502 adjustment is shown on the top view (covers removed) illustration in the manual.*

Weak-signal reception capability is complemented of course by outstanding selectivity and the receiver's superior dynamic range. Even in strong signal environments it is virtually immune to overload and spurious signals on the HF bands, and medium-wave performance is almost as good. In this *1980 WRTH* review, Larry Magne enthused that the R-7's medium-wave dynamic range not only comfortably exceeded any other solid state receiver of the day but also *equals that of many of the best tube-type receivers tested in years past.* (Magne, 1980) Strong testimony indeed!

Craig Healy does point out, however, that the prescribed 500 kHz ranges in combination with the front-end bandpass filter configuration cause degraded sensitivity towards the upper limit of the BCB. (Healy, 1982) The arrangement of the bandpass filter module is not cited in the Operator's Manual but is outlined in the Service Manual. A lowpass filter is used for Band 1 longwave (10-500 kHz) and another lowpass filter is used for medium wave Bands 2 and 3 (500-1000 kHz and 1000-1500 kHz). The low frequency cutoff point for this filter is 1650 kHz, so signals up to about 1545 kHz (the limit of frequency overtravel on Band 3) are received well. For Band 4 (1500-2000 kHz) and the HF spectrum ranges up to 30 MHz, hi/lowpass filters are used.

In the particular case of Band 4, the low cutoff frequency is 1750 kHz, right in the middle of the prescribed tuning range. The Service Manual explains: *This is necessary to provide sufficient rejection to strong AM broadcast signals which can create interfering intermodulation products in the 160 meter amateur band. As a result, sensitivity may be degraded below 1.75 MHz in this bandswitch position.* Healy found that a local station on 1540 kHz could be received at 10 dB over S-9 on Band 3, whereas on Band 4 the signal was reduced to S-8, even with the preamp switched on.

Obviously an unmodified R-7A is not the best of receivers for DXing the top 150 kHz of the medium-wave band which is now extended domestically up to 1700 kHz. I certainly experienced its limitations in this range when DXing the 500 watt Australian print-handicapped services that used to occupy 1620 and 1629 kHz. Before they reverted to "conventional" channels below 1600 kHz, these stations were heard with quite readable audio on a number of occasions in the early 1990's from my Newmarket, Ontario DX site. The receiver was a Japan Radio NRD-515. Comparatively, only moderate strength carriers could be detected on an R-7 using the same antenna. (DC)

Apart from the sensitivity limitation at the top end of the band, Healy rated the BCB performance of his R-7A as *at least as good as the [Collins] R-390A.* He noted that longwave performance was quite good as well. (Healy, 1982) His comments suggest he did not have one of the very early production units.

The initial production versions of the R-7 suffered from power line "birdies" and spurious responses on longwave and to a much lesser extent on medium-wave. These gremlins were largely corrected in later production runs. In a courteous letter dated November 21, 1979 to Larry Brookwell, Neil LeSaint, the Drake Project Engineer, confirmed two production modifications. In receivers with serial numbers above 200, a capacitor (1000 mF) was added to the power supply board to reduce internally generated signals in the 500 kHz to 1600 kHz range to typical levels of less than a 0.4 microvolt equivalent. It was also acknowledged that spurious signals +/- 22 kHz either side of the receiver frequency could arise due to conducted energy from the power supply converter. In receivers with serial number above approximately 150, a choke and capacitor were added to the parent board to improve the typical rejection characteristic to 80-90 dB or greater. (LeSaint, 1979) True to form, Drake accepted returns of the deficient sets and rectified the problems. *When I visited the Service Department in August, 1994 I learned that Drake can still retrofit early models with the newer power supply board (part #2100418), if required. (DC)*

The Specifications section in the manual indicates that the nominal 50 ohm antenna impedance is automatically switched to 200 ohms in the 10-500 kHz longwave tuning range. In his original *1980 WRTH* review of the R-7, Larry Magne states that the shift to the higher impedance occurs when the receiver is tuned below 1500 kHz (Magne, 1980) which would seem more logical. Unfortunately the Service Manual is silent on the point so we are uncertain what the antenna input impedance actually is within the 500 to 1500 KHz tuning ranges.

ENABLING RF PREAMP BELOW 1500 KHZ

Vincent Pinto also describes the modifications necessary to enable the preamp to operate on Bands 1, 2 and 3, and to extend the low frequency range of the preamp down to the 160-190 kHz longwave band for DXing low power beacons. He writes: *The RF preamp is normally disabled below 1600 kHz by removing the d.c. return path for the amplifier transistor when the bandpass filters for bands 1, 2 and 3 are switch selected. To re-enable the d.c. path, I added a small 47 mh RF choke in series with a small 250 uh RF choke from the switch side of R1303 (near Q1301, the preamp transistor in the bandpass filter module) to ground. The RF chokes should not have excessive d.c. resistance, although it's not critical to have a very low resistance. A total resistance of a few hundred ohms or less from R1303 to ground is okay. Now the preamp will be enabled on any band when you hit the preamp "on" switch.*

Now we must lower the low frequency range of the preamp circuit so it has some decent gain at 170 kHz. This is very simple. You'll need two .02 mfd disc ceramic or mylar capacitors. Add a .02 disc ceramic capacitor in parallel with C1305 and one in parallel with C1307. Both capacitors are on the bandpass module/preamp board. They are on page 12-80 of the R-7A technical manual. You're done. The useful gain range of the preamp will now extend down to at least 130 kHz.

Pinto concludes: *My "new" preamp works perfectly well on longwave...I was a bit concerned about noise floor figure, but day to day use has shown no discernible change in the receiver noise floor with the preamp enabled on low frequencies...the Drake is dramatically improved in extremely weak signal CW work by the use of this preamp.* (Pinto, 1984)

PTO STABILIZATION MEASURES

While the R-7A uses a frequency synthesizer for control of the operating frequency, it is properly classified as a semi-synthesized receiver because it uses a Permeability-Tuned Oscillator (PTO) or VFO for signal injection to the synthesizer circuitry. The PTO frequency is varied linearly within any 500 kHz range by the main tuning knob. Although the PTO is temperature-compensated and calibrated at the factory, frequency stability cannot compare, especially during the warm-up period, with that of the fully-synthesized receivers that are now commonplace.

The R-7A does not have the greatest reputation for frequency stability. It is fair to say this problem is confined mostly to the first hour or so of operation from a cold start. Nevertheless, drift of 100 Hz or more is a definite nuisance, especially for DXers using the ECSS mode. The ideal solution would be the Drake RV75 outboard synthesizer or the Sherwood SE-4 stabilizer (described in following sections), but neither of these are likely to be available to the majority of receiver owners.

A partial remedy to the stability problem is to leave the receiver powered on at all times. In that case, operation from a DC power source (as below) ought to be considered to prolong component life since the receiver tends to run quite "hot" on AC power. Ben Hester suggests that some internal heat can be reduced by removing the 14 volt analog dial pilot light. It is placed quite close to the PTO and thus could contribute to the instability problem. Visual readout of the analog dial is not really required given the digital readout.

In his *1980 WRTH* review of the R-7, Larry Magne provides two tips to help ensure maximum PTO stability. He says to *check whether the VFO's worm gear is lubricated. If not, carefully work into its threads a very thin film of good machine oil or comparable lubricant. Too, the VFO shaft spring's tension can be increased by mounting the eye hook on the opposite side of the sliding vertical shaft. These two small measures are useful in order to maintain optimum stability.* (Magne, 1980) *Lubrication of the worm gear is not addressed in the Service Manual but I mentioned this point to John Andrews at Drake and he certainly knew what I was talking about.* (DC)

Then in his *1982 WRTH* review of the R-7A, Magne further advises that *active users may also find that occasional tightening of the PTO torque helps to maintain stability.* (Magne, 1982) The somewhat complicated disassembly procedure to gain access to the PTO adjustment hole is outlined in the Service Manual. A long, 3/32" Allen wrench is required to adjust, for the required tuning torque, the internal set screw which serves as the shaft bearing. Care must be taken, however, to avoid overtightening of the set screw to prevent bearing damage.

After taking steps to minimize frequency drift, it is aggravating if the tuned frequency readout is not quite accurate. The alignment procedures in the Service Manual include a simple method of correcting the readout derived from the 40 MHz Reference Oscillator, using WWV instead of a frequency counter. *Place the radio in AM mode, and wait until WWV is transmitting an unmodulated carrier. Enable the calibrator and carefully adjust L1001 for exact zero beat with WWV. This method requires that WWV be of comparable signal strength with the calibrator. As such, it may be necessary to select the proper time of day as well as frequency for your area to achieve the desired results.* Inductor L1001 adjustment is performed on the PBT/Reference Board which is accessible by removing the top cover.

DC OPERATION

The R-7A comes equipped to operate on standard 110-120 volts AC with the resulting high heat output from the power supply. A 2-pin receptacle on the rear panel provides up to .25 amps at 13.8 volts DC for powering external devices when the receiver itself is operated from the AC line. This receptacle, when mated with the appropriate adaptor (Drake part #3291052 for less than $5, or equivalent available from Universal Radio), can then be used to bring power into the receiver from an external DC source. This could include operating on a DXpedition with a deep cycle marine battery or from an AC converter for fixed operation.

The power requirement is stated as 3 amps at 11-16 volts DC (13.8 VDC nominal). Ben Hester advises that experimentation with a variable DC power supply should reveal that only about 12.5 volts is actually required for normal operation of the R-7A. If the voltage is reduced too low, the PTO will suddenly cease to operate; if the voltage supplied is more than required, the additional current draw is simply dissipated in undesirable extra heat which can contribute to instability of the PTO.

It is highly recommended that you obtain a 12 volt DC power supply from an electronics supplier and use it to power not only the R-7A but also any other solid state 12 VDC equipment in the shack. The benefits include appreciably less heat (barely warm on the cover of the R-7), potentially improved stability and avoidance of power surges when the gear is turned on. This can contribute to prolonged equipment life and, in some cases, quieter operation. One approach is to purchase an MFJ Model 1116 Deluxe Multiple DC Power 6-Outlet Box, wire it to the AC power supply, provide individual DC plugs for the R-7A and other equipment and plug them into the outlet box, making sure to observe correct polarity. *I also run a Kenwood R-5000 in this manner and the result is much cooler and quieter receiver operation. (JW)*

The wiring for DC operation of the R-7A combined with the RV75 is tricky and interested readers are invited to send a SASE to either of the authors for two variations on this modification.

THE RV75 EXTERNAL VFO

The RV75 is an external VFO introduced by Drake in 1982 for the purpose of making available crystal-controlled frequency stability for all '5' and '7' line transceivers and receivers. The RV75 features the fully synthesized VFO from Drake's professional model R4245 receiver, provision for variable tuning rates, two fixed frequencies, a dial lock, and an RIT control for very fine vernier tuning. The key feature of the RV75 is the frequency stability it provides to the

Figure 3: Front Panel Close-up of RV75 Remote VFO

R-7A. *Mated with the RV75, my own R-7 drifts only 10-15 Hertz during the first half-hour from a cold start, thus essentially resolving the annoying PTO drift problem (typically 100+ Hz) inherent to the R-7A, especially during the first hour or two of operation from a cold start. (JW)*

Figure 3 shows the front panel operating controls of Jon William's RV75. Note that R4245 knobs have been substituted for the Function and RIT controls.

The free-turning, flywheel-weighted main tuning knob tunes the RV75 in 10 Hz increments. The Variable Rate Tuning Oscillator (VRTO) tunes as slowly as 2 Hz per revolution to as much as 25-30 kHz, depending on the rate of rotation of the knob. Two push buttons for fixed frequency 'A' or 'B' allow access to two previously selected external frequencies such as for WWV or a favorite station. The dial lock (similar to that on the Japan Radio NRD-515) permits use of the receiver passband tuning and notch filter controls while preventing an unintended change of frequency if the main tuning dial is accidentally jarred. Finally, the RIT will tune within a range as fine as 500 Hz and will also change the R-7 frequency readout (to the nearest 100 Hz) in all detection modes.

Since the RV75 connects to the R-7A with an 8-pin Jones plug, an accessory called the RV75/R7 Model 1544 Adaptor is necessary. This consists basically of an anodized metal box (3" X 2" X 1" thick) which plugs into the R-7 with a 12-pin plug. In 1982, the RV75 sold for $250 and the 1544 adaptor was a further $30.

Today, because the RV75 is scarce and in high demand, it is very difficult to find and sells in the used market for between $350 and $400. When considering a purchase, one should ensure that it includes the Model 1544 adaptor box so that it will work with the R-7A. The adaptor is no longer available from Drake so the only alternative would be to build one by hand.

I do not use my R-7A without the RV75, even dragging it along when the R-7A goes on a DXpedition. The combination of the aforementioned features together with its great stability transform the already outstanding R-7A into a superb DX receiver. The performance at least equals, if not exceeds, that of the Drake R4245. The R4245 may not be as stable as the RV75 because the receiver VFO is located near the heat-generating power supply, whereas the RV75 provides complete heat isolation for the VFO of the R-7A receiver. (JW)

SHERWOOD OUTBOARD ACCESSORIES

In 1982, Sherwood Engineering introduced its Model SE-3 phase-locked AM product detector. This $300 unit was fed by the 50 kHz 3rd IF output of the R-7A. It was intended to improve the receiver's synchro-phase AM detection by perfectly matching (phase-locking) the carrier of the receiver BFO with the transmitted carrier of a desired signal. The intended effect was improved low distortion ECSS reception with reduced variability from the effects of selective fading. Another benefit was that the receiver PBT and notch filter facilities could still be used to shape the audio before it was processed by the SE-3's superior audio output circuitry. The limiting factor, however, was that the SE-3 would lose lock with the transmitted signal carrier if the receiver drifted by more than about 25 Hz, thus necessitating periodic retuning.

By 1983, Sherwood had introduced another outboard device to deal specifically with the instability problem of the R-7A, thereby enhancing its performance potential with the SE-3. The Model SE-4 was a $150 external stabilizer which interacted with the RIT circuit to compensate for drift of both the analog PTO and the synthesizer reference oscillator. To that extent it could be regarded as a lower-cost alternative to the RV75 external VFO.

We have no personal experience with either the SE-3 or the SE-4. The features and performance of the SE-3 were outlined by Gene Pearson in *Proceedings 1989.* (Pearson, 1989) We also refer to Larry Magne's discussion and review article titled 'Shortwave's Best Fidelity Receiving System...For a Price' in the *1984 WRTH.* He reports: *In our tests, the system worked well, even with an elder R-7 having an unusually wandering PTO. After an initial warmup of sixty seconds, the R-7A, aided by the SE-4, maintained lock with the SE-3 at all times.* (Magne, 1984)

We would concur with Magne's conclusion that the SE-3 would probably be of greater interest to SWL's seeking improved audio fidelity for program listening. The SE-4, however, would seem to be a useful alternative to the RV75 for stabilizing the R-7A. Either accessory, combined with appropriate IF filters and the RIT tuning rate modification, ought to make for highly effective DXing in the preferred ECSS mode.

R4245 KNOB SUBSTITUTIONS

The standard concentric knobs for the RIT/PBT and AF/RF gain functions on the R-7A are small and made of cheap plastic. They are rather uncomfortable to use because of the deep knurls on their outer surface, while the prominent position indicators protrude too much and have an awkward feel. In his review article in the *1982 WRTH*, Larry Magne cites this shortcoming. (Magne, 1982) Rainer Lichte made the same observation in his 1985 review in *Radio Receiver -- Chance or Choice.* (Lichte, 1985)

Both reviewers suggest substitution of the larger and more substantial metal knobs with finer knurls, used on the R4245 receiver. Two sets of part #345-0452B (knob bottoms) and part #345-0452T (knob tops) can still be ordered from Drake at a cost of $2.89 per knob. For a more consistent front panel "look", substitution of the other four knobs (excluding bandswitch and main tuning) can be made if desired. For these, order four of the R4245 part #345-0504 which the company can still supply too at a cost of $2.51 each. Unfortunately, the knobs Drake provides now are apparently plastic replicas of the original metal knobs and they do not have any white line down the knurling "groove" as on the original knobs. Guy Atkins has installed these replacement knobs on his R-7. Although plastic, the knobs still have a quality appearance. He suggests that for easier visual positioning of the antenna and selectivity switches, filling of the appropriate knurled groove with white paint is in order.

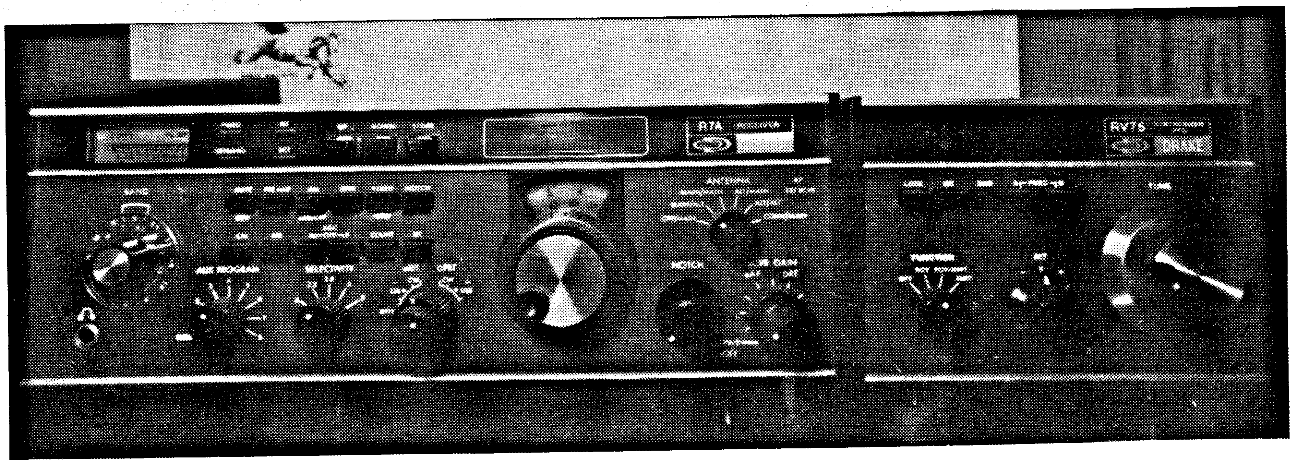

Figure 4: R-7A paired with RV75

Figure 4 shows Jon Williams' R-7A and RV75 at the desktop operating position. Jon has substituted R4245 knobs on both units.

Non-metric Allen wrenches are required for installation of the replacement knobs. Guy also cautions that *for the concentric knob sets, the tightening of the outer knobs is very "fiddly". You have to be careful to not overtighten the set screws or else the inner knob will turn in concert with the outer one! If this happens, just keep backing off slightly on the torque of the outer knob until they operate properly.*

The substitution of even the plastic 4245 knobs is definitely recommended as they have a much better "feel" and make use of the controls much easier, especially during extended operating sessions with the R-7A. The larger 4245 pointer knob is also recommended for the RIT control on the RV75.

EXTERNAL SPEAKER PROVISIONS

The R-7A comes equipped with a small, internal side-firing speaker which is inconvenient for many installations and certainly doesn't do justice to the audio capabilities of the receiver. When the R-7 was first released in 1979, it was offered with the option of either a small, newly-designed matching MS-7 speaker ($36 in 1979; $49 by 1982) or the larger MS-4 external speaker for $33. The MS-4 was designed for and carried over from the earlier '4' line receivers, and is valued by many DXers for its sound qualities in the voice frequency range. Either the MS-4 or just about any other quality 3.2 or 4 ohm speaker rated at 2.5 watts or more will provide far crisper and cleaner audio than the poorly designed MS-7. The MS-4 is often available through the Ham Trader Yellow Sheets or at hamfests for about $25. A 1/4 inch phone jack for connection of an external speaker is provided on the rear panel. The internal speaker is muted if an external speaker is connected.

Esthetically, I think the "unmatched" MS-4 looks quite fine placed beside the R-7A. Personally, however, I prefer to use the large, 12" X 10.5" Hammarlund (model S-200, I believe) 3.2 ohm speaker with both the Drake R-7 and the newer R8, as well as with my other hollow state gear having low impedance speaker outputs. If it cannot be found from the usual sources, this speaker is available from Associated Radio in Overland Park, Kansas for a rather pricey $40 but it does provide rich, full-bodied audio response. (DC)

HEADPHONE OUTPUT

Many owners are probably not aware that the output impedance for the front panel, 1/4 inch headphone jack is a rather unusual 220 ohms. Low impedance phones can be used without any problem. With 600 ohm phones such as the popular Japan Radio ST-3, a higher volume control setting is required in the absence of any form of impedance matching. The headphone outlet is always 'hot', regardless of whether the internal or an external speaker is switched in or out.

FRONT PANEL LIGHTING MODIFICATION

For some DXers, the blue lighting on the analog dial and S-meter may be too bright for extended nighttime operation. Unlike a number of more recent receivers, the R-7A does not provide a switch for dimming the pilot lights.

The suggested solution is to order a second set of the blue plastic sheets which fit in front of the panel lights. Drake can still supply the dial insert (part #446-4000) at a cost of only .30 cents, while the S-meter insert (part #446-4001) costs $1. Install the additional set of sheets between the dial window and the original blue sheets. The resulting effect is a deeper blue and more subdued dial lighting.

Every R-7A owner would be well-advised to buy a spare set of the plastic sheets while they are still available. The background pilot lights tend to cause the blue tint to "wash out" over the years. A replacement set of sheets will come in handy to help keep your receiver looking like new.

CONCLUSION

We hope this paper will serve to augment our readers' appreciation of the R-7A and for some of the ways in which its already outstanding performance capabilities can be exploited, and even improved. Certainly it lacks present-day conveniences like memories and scanning capabilities that are important to some hobbyists. But as a "pure performance" alternative at a fraction of its original cost ten years ago, we love it.

The Drake R-7A was, **and perhaps still is**, the *piece de resistance* among other fine DXing receivers.

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COMPARING SPECIFICATIONS: R-7/R-7A, R8 AND NRD-535D

R-7/A Comparisons	DRAKE R-7/A	DRAKE R8	JRC NRD-535D
$US Price	$700-850 (used)	$980 (new)	$1689 (new)
Antenna Inputs	3 @ 50 ohms (splitter)	2 @ 50 / 500 ohms	2 @ 50 / 600 ohms
Sensitivity AM	< 4 uV .01-1.5 MHz < 1.2 uV 1.8-30 MHz	< 3 uV .1-1.8 MHz < .8 uV 1.8-30 MHz	16 dBu .5-1.6 MHz 6 dBu 1.6-30 MHz
SSB	< 1 uV .01-1.8 MHz < .2 uV 1.8-30 MHz	<1 uV .1-1.8 MHz <.25 uV 1.8-30 MHz	6 dBu .5-1.6 MHz -10 dBu 1.6-30 MHz
Selectivity (kHz @ -6dB)	8-pole Crystal B/W's: 6, 4, 3, 2.3, 1.8 kHz (MW+SWBC DX config)	L/C Bandwidths: 6, 4, 2.3, 1.8, .5 kHz	* Ceramic: 5.5 kHz * Mechanical: 2 kHz Crystal: 1 kHz * + Variable BWC
Shape Factors (@ -60dB)	1.8:1 @ 3 / 2.3 kHz Others: 2:1	1.9:1 at 2.3 kHz Other-Voice: 2.1:1 kHz	2.5:1 Ceramic 3:1 Crystal/Mech
Ultimate Selectivity	> 100 dB	> 95 dB	?
Passband Tuning	+/- 3Hz or more (AM & SSB/ECSS)	+/- 3 kHz or more (AM & SSB/ECSS)	+/- 1 kHz (AM & SSB)
Dynamic Range (1.8-30 MHz)	99 dB @ 100 kHz 95 dB (preamp on)	> 90 dB @ 20 kHz	106 dB @ 300 Hz
3rd Order Intercept Point (1.8-30 MHz)	+ 20 dBm (preamp on) + 10 dBm (preamp on)	> +5 dBm @ 20 kHz > -20 dBm @ 5 kHz	?
Image/IF Rejection	> 80 dB	> 80 dB (1.8-30 MHz) > 60 dB (.1-1.8 MHz)	> 70 dB (1.6-30 MHz)
Notch	IF: 40 dB (AM & SSB/ECSS)	AF: 40 dB (AM & SSB/ECSS)	IF: 40 dB (SSB only)
Stability	< 100 Hz	< +/- 10 ppm	< +/- 2 ppm
Synchronous AM	No (Synchro-phase)	Yes	Yes
VFO's	1	2	1
Memories	No (11 preset + 8 Aux 500 kHz Ranges)	100 (non-tunable)	200 (tunable)
AGC Provisions	Fast/Med/Slow/Off	Fast/Slow/Off	Fast/Slow/Off
Min. Tuning Steps / Freq Display	Analog+RIT / 100 Hz (also 150 MHz Counter)	10 Hz Digital / 10 Hz	1 Hz Digital / 10 Hz
Noise Blanker	Fixed Width	Wide / Narrow	Wide / Narrow
DC Operation	Yes	Yes	Yes
Clock / Timer	No / No	Dual 24 hr / Yes	24 hr / Yes
Audio / Record	2.5W @ 4 ohms / Yes	2.5W @ 4 ohms / Yes	1W @ 4 ohms / Yes
RS-232C Interface	No	Yes	Yes

Model 1240

R7

Synthesized General Coverage Receiver

Full general coverage reception, 0-30 MHz, with no gaps or range crystals required.

Continuous tuning all the way from vlf thru hf. Superb state-of-the-art performance on a-m, ssb, RTTY, and cw—and it transceives with Drake TR7.

- **100% solid state broadband design,** fully synthesized with a permeability tuned oscillator (PTO) for smooth, continous tuning.
- **Covers the complete range 0 to 30 MHz** with no gaps in frequency coverage. Both digital and analog frequency readout.
- **Special front-end circuitry** employing the high level double balanced mixer and 48 MHz "up-converted" 1st i-f for superior general coverage, image rejection and strong signal handling performance.
- **Complete front-end bandpass filters** are included that operate from hf thru vlf. External vlf preselectors are not required.
- **10 dB pushbutton-controlled broadband preamp** can be activated on all ranges above 1.5 MHz. Low noise design.
- **Various optional selectivity filters** for cw, RTTY and a-m are switch-selected from the front panel. Ssb filter standard.
- **Special new low distortion "synchro-phase" a-m detector** provides superior international shortwave broadcast reception. This new technique permits 3 kHz a-m sideband response with the use of a 4 kHz filter for better interference rejection.
- **Tunable i-f notch filter** effectively reduces heterodyne interference from nearby stations.
- **The famous Drake full electronic passband tuning system** is employed, permitting the passband position to be adjusted for any selectivity filter. This is a great aid in interference rejection.
- **Three agc time constants** plus "Off" are switch-selected from the front panel.
- **Complete transceive/separate functions** when used with the Drake TR7 transceiver are included, along with separate R7 R.I.T. control.
- **Special multi-function antenna selector/50 ohm splitter** is switch-selected from the front panel, and provides simultaneous dual receive with the TR7. This makes possible the reception of two different frequencies at the same time. Main and alternate antennas and vhf/uhf converters may also be selected with this switching network.
- **The digital readout** of the R7 may be used as a 150 MHz counter, and is switched from the front panel. Access thru rear panel connector.
- **The built-in power supply** operates from 100, 120, 200, 240 V-ac, 50/60 Hz, or nominal 13.8 V-dc.
- **The R7 includes a built-in speaker,** or an external Drake MS7 speaker may be used.
- **Built-in 25 kHz calibrator** for calibration of analog dial.
- **Low level audio output** for tape recorder.
- **Up to eight crystal controlled fixed channels** can be selected. (With Drake Aux7 installed.)
- **Optional Drake NB7A Noise Blanker** available. Provides true impulse type noise blanking performance.

R7

Accessories available

Model 1531	Drake MS7 Speaker
Model 7021	Drake SL-300 Cw Filter, 300 Hz
Model 7022	Drake SL-500 Cw Filter, 500 Hz
Model 7023	Drake SL-1800 Ssb/RTTY Filter, 1800 Hz
Model 7024	Drake SL-6000 A-m Filter, 6.0 kHz
Model 7026	Drake SL-4000 A-m Filter. 4.0 kHz
Model 1532	Drake NB7A Noise Blanker
Model 1536	Drake Aux7 Range Program/Fixed-Frequency Board
Model 1548	Drake R7/TR7 Interface Cable Kit
Model 385-0005	Drake R7 Service/Schematic Book
Model 3506	Drake RP700 Receiver Protector
Model 1230	Drake LA7 Line Amplifier

R7 SPECIFICATIONS

Frequency Coverage, continuous tuning 0.01 to 30.0 MHz

Plus any eight additional 500 kHz segments between 0 and 30 MHz when programmed into Aux7 Board.

Crystal Controlled Fixed Frequencies: Up to eight crystal-controlled fixed frequencies within the 0-30 MHz range with Aux7 Accessory Board. Proper 500 kHz range for desired fixed frequency is also programmed into Aux7.

Frequency Stability: Less than 1 kHz first hour. Less than 150 Hz per hour after 1 hour warm up. Less than 100 Hz for ± 10% line voltage change.

Digital Readout Accuracy: (DR-7 installed) 15 PPM ± 100 Hz

Analog Dial Accuracy: Better than ±1 kHz when calibrated to nearest calibrator marker.

Modes of Operation: Ssb, cw, RTTY, SSTV, a-m.

Sensitivity (ssb): 1.8-30 MHz Less than .20μV for 10dB (S+N)/N with preamp on (typically .15μV) (Noise floor typically −134 dBm) Less than .50μV for 10 dB (S+N)/N without preamp (typically .30μV) (Noise floor typically −128dBm). .01-1.5MHz Less than 1.0μV for 10 dB (S+N)/N

Sensitivity (a-m): 1.8-30MHz Less than 1.2μV for 10dB (S+N)/N @ 30% modulation, preamp on. Less than 2.0μV for 10 dB (S+N)/N @ 30% modulation, preamp off. .01-1.5 MHz Less than 4.0μV for 10 dB (S+N)/N @ 30% modulation.

Selectivity (2.3 kHz filter supplied): 2.3 kHz at −6 dB, 4.4 kHz at −60 dB (1.8:1) shape factor. Optional 300 Hz, 500 Hz, 1800 Hz, 4 kHz, and 6 kHz filters are available as follows:

Accessory Crystal Filters

SL-300 cw filter: 300 Hz @ 6 dB, 700 Hz @ 60 dB
SL-500 cw, RTTY Filter: 500 Hz @ 6 dB, 1100 Hz @ 60 dB
SL-1800 ssb/RTTY Filter: 1800 Hz @ 6 dB, 3600 Hz @ 60 dB
SL-4000 a-m Filter: 4 kHz @ 6 dB, 8 kHz @ 60 dB
SL-6000 a-m Filter: 6 kHz @ 6 dB, 12 kHz @ 60 dB

Ultimate Selectivity: Greater than 100 dB

Intermodulation:

Two-tone dynamic range: 99 dB * Third order intercept point: +20 dBm	1.8-30 MHz preamp off
Two-tone dynamic range: 95 dB * Third order intercept point: +10 dBm	1.8-30 MHz preamp on
Blocking: >145 dB above noise floor	

** (at tone spacings of 100 kHz and greater)*

I-f and Image Rejection: Greater than 80 dB (48.05 MHz 1st i-f) (5.645 MHz 2nd i-f) (50 kHz 3rd i-f)

Agc Performance; Less than 4 dB audio output variation for 100 dB input signal change above agc threshold. Agc threshold is typical .8μV with preamp off and .25μV with preamp on.

Attack time: 1 millisecond. Three selectable release times: Slow—2 seconds; Med—400 m sec; Fast—75 m sec. Also, "Off" position is provided.

Antenna Input Impedance: Nominal 50 ohms

Audio Output: 2.5 watts with less than 10% T.H.D. into nominal 4 ohm load.

Power Requirements: 100/120/200/240 V-ac ±10%, 50/60 Hz, 60 watts or 11.0 to 16.0 V-dc (13.8 V-dc nominal), 3 amps

External Counter Mode (DR-7 installed): Readout: to 100 Hz. Accuracy: 15 PPM ±100 Hz. Maximum input frequency: 150 MHz. Input level range: 50 mV to 2 V rms.

Dimensions/Weight:

Depth—13.0 in (33.0 cm) excluding knobs and connectors.
Width— 13.6 in (34.6 cm)
Height— 4.6 in (11.6 cm) excluding feet
Weight— 18.4 lbs (8.34 kg)

Specifications, availability and prices subject to change without notice or obligation.

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