ONCE A GOOD RECEIVER, ALWAYS A GOOD RECEIVER

THE DRAKE R7 COMMUNICATIONS RECEIVER REVISITED

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The Drake R7 Receiver became widely available in late 1979. In many ways, this receiver was a perpetuation of a line of receivers designed for the radio amateur. The first receiver appeared in 1959. The following table traces the lineage of the Drake R7:

Drake 1-A c. 1959	Drake SW-4A c. 1967
2-A c. 1960	R-4B c. 1968
2-B c. 1962	SPR-4 c. 1970
R-4 c. 1965	DSR-1 c. 1971
R-4A c. 1967	R-4C c. 73-74
2-C c. 1967	DSR-2 c. 75-76

Not included in this list is the Drake SSR-1 of the late 1970's. Drake made a mistake in having the receiver produced for them in the Far East. The receiver was regarded as a disaster. In recent years I have observed examples of all of these Drake receivers, with the exception of the DSR models, offered for sale at Amateur gatherings, equipment sales listings, and hobby publications. The continued interest on the part of radio enthusiasts points to the quality and utility of these fine receivers.

The Drake R7 originally was produced with an analog dial, and like most of its predecessors, provided coverage of the amateur bands only. Several months later, Drake offered a R7/DR7 version, which had a digital dial and 0-30 mHz coverage. The R7/DR7 became to be known simply as the R7, and was priced in the $1200-$1300 range. It was offered with one crystal lattice filter measuring 2.3 kHz at the 6 dB point. Optional accessories included an MS7 speaker, 300, 500, 1800, 4000, and 6000 Hz filters, the NB7A noise blanker, Aux7 Range Program/Fixed-Frequency Board, the R7 Service/Schematic Manual, RP700 receiver protector, and a LA7 Line Amplifier. In the months when it was last offered new, shortwave hobby havens such as Radio West and Gilfer Shortwave sold the receiver for $1650 to $1700 with the buyer's choice of four filters. These dealers made available filters from Drake and from Sherwood Engineering of Denver, Colorado.

Today, the R7 is available in used condition, but do not seem to to be in plentiful supply. Whether the supply of R7's has been set by their ceasing to exist, or they continue to remain in the hands of hobbyists, is not known to me. The current price one can expect to pay, is in the range of $600 to $900US, depending on condition and the number of installed accessories. Because the cost of an R7 approximates the current price for currently available receivers, one must ask whether it is worth the asking price, when a new receiver can be had for a similar price.

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 *	1.8-30 MHz
Third order intercept point: +20 dBm	preamp off
Two-tone dynamic range: 95 dB *	1.8-30 MHz
Third order intercept point: +10 dBm	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)

The R.L.Drake Company, in its advertising, listed receiver specifications which are shown to the left. In the early 1980's Robert Sherwood, owner of Sherwood Engineering, Denver Colorado conducted extensive tests on receivers and transceivers of that time. The results of the testing that involved the Drake R7 showed that the receiver noise floor was -135dBm while the AGC threshold[the point below which audio falls off linearly with the signal] was measured at 0.4 uV. Due to the AGC action, the drop in audio-output level, as compared to a 5 mV signal, was 3 dB. Receiver blocking was found to be 145 dB. Receiver sensitivity was calculated at 0.28 uV without the preamplifier and 0.15 uV when the preamp was employed. Local oscillator noise was 114 dBc at 2 kHz spacing. Mr. Sherwood went on to grade receiver front end selectivity. Radios with a tracking preselector were assigned an A+ grade, while those that had no input selectivity were graded an F. He gave a B grade to the Drake R7. Filter ultimate rejection was shown to be 85 dB. An ultimate rejection of 120 dB would not show leakage until S9+60 dB. Wide dynamic range at a spacing of 100 kHz was 97 dB, while close dynamic range at 2 kHz was 75 dB.

What about receiver features? R.L. Drake literature summarizes the notable features of the R7 in a table at the right.

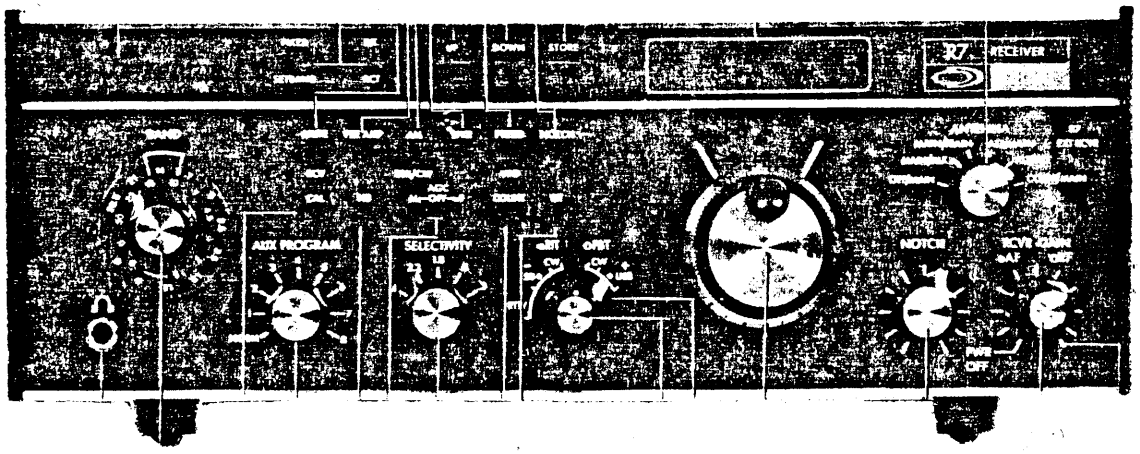
R7

Synthesized General Coverage Receiver

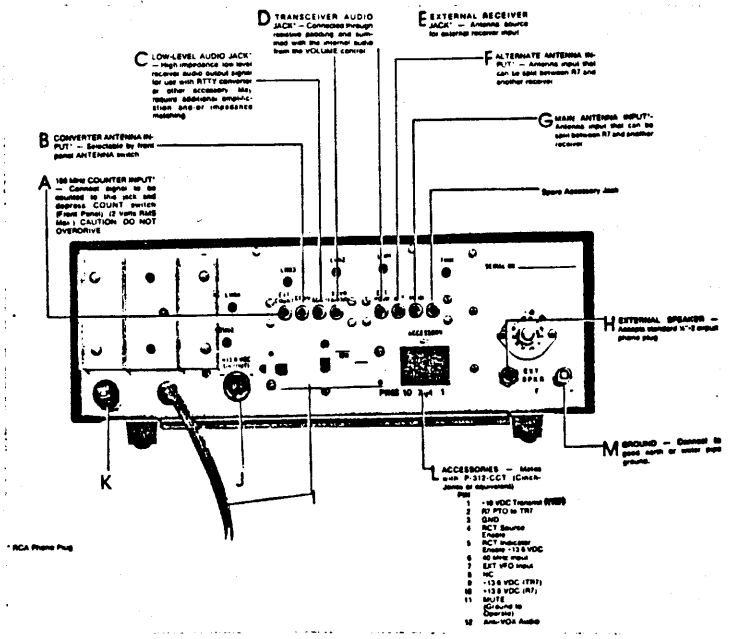
Full general coverage reception, 0-30 MHz, with no gaps or range crystals required.

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/seperate 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.



The illustrations above and below, depict the various controls, control placement, and the various input and output connections.



So how does the Drake R7 play in the real world? My personal experience allows me to make some comparisons between the R7 and the Icom R70 receivers. Both receivers offer a cumbersome tuning arrangement. The Drake receiver divides the spectrum into 500 kHz sections, with some frequency "overtravel" at each end. The Icom unit has thirty 1 mHz segments in its coverage. In the case of the R70, there is a ham/general coverage switch. When the switch is placed in the ham mode, tuning is confined to within all current and planned ham bands. When in the general coverage mode, normal 0-30 mHz coverage is available. When ascending in frequency from xxxx9.9, continuing to rotate the tuning knob causes the display to change to xx00.0. When descending, the reverse holds true. Both receivers require the operator to use up and down push buttons to increment away to the next desired frequency, if not within the same frequency segment.

The Drake R7 did offer one way to improve upon this arrangement. The use of up to eight RRM-7 modules and a crystal installed adjacent to each module, allowed the operator to further select any specific frequency within the 500 kHz segment, as programmed by the RRM-7 module. These modules are encased diode arrays and are no longer available from Drake. I have never seen any offered for sale, and only heard of a few receivers with them installed.

Overall, the tuning system of the R7 is slower than those employed by the Kenwood R-1000 or JRC NRD 515, for example. The system makes rapid checks of parallel station frequencies difficult. Another idiosyncracy of the receiver occurs with the frequency display when the radio is turned on. Regardless of the bandswitch setting, the display comes up only at a predetermined point within an amateur radio band. Despite these quirks, I, a confirmed knob twiddler, found that the tuning procedures required became second nature.

Several contemporary receivers offer selectable tuning rates, while the Drake R7 does not. The Icom R70, for example allows selection of 1, 10, or 100 kHz per tuning knob revolution. The R7 tuning rate is fixed at about 12.7 kHz per revolution. I find this rate is a comprimise; a bit slow for shortwave tuning, and a bit fast in tunig SSB signals. For precise tuning, the receiver incremental tuning control makes possible excursions to either side of the signal frequency. The frequency change is displayed on the digital frequency readout.

Another operating characteristic that is important to receiver users is frequency stability. While the R70, for example, is fully synthesized, and employs a phased-locked-loop for its local oscillator, the Drake R7 is partially synthesized and features a permeability tuned VFO. Simply, the Drake receiver is a bit less stable than current semi-professional and professional radios. I found that the R7 drifted slowly for the first hour, at which time it was stable. The frequency drift was 250 Hz maximum, and at no time was a problem in reception of AM or SSB signals.

Two additional circuits employed in the Drake R7 were found to be similar in effectiveness, when compared to the Icom R70 and to other receivers I have owned and operated. The notch filter, while not so deep as certain older Drake and Collins receivers, will significantly reduce, if not eliminate, all but enormous heterodynes. The NB7A noise blanker, optional with the R7, and a standard feature for the subsequent R7A, is effective against Loran-type interference and against ignition pulse noise, such as produced by automobiles and lawn mowers. Its ability to reduce or eliminate the "Russian Woodpecker" was variable. Its effectiveness seemed to be determined by existing propagation conditions. One day it could be very effective, and less so the following day.

The R7 signal level meter is regarded as accurate, and is calibrated in "S" units and dB above S9. Steve Bohac reports that the meter action, in strong signal situations can be seen to jump in concert with modulation peaks, at BCB frequencies. He says that this results from variations in the AGC line not being obscured by rapid fading, as experienced at shortwave frequencies.

Two additional receiver features that are seldom encountered are: 1] An onboard 150 mHz frequency counter; 2] A three-way antenna selector and splitter control on the front panel. In addition to the separate antenna inputs, any two of the antenna choices may be switched over to a second receiver, or shared with the R7 and a second receiver. The assembly possesses an unusual degree of electrical isolation between the various inputs.

Perhaps the the most acclaimed function found in the Drake R7 receiver is the full electronic passband tuning system. Drake's system allows the operator to tune from one sideband, through the signal carrier to the outer edge of the other sideband. The importance of this capability lies in the ability to place the chosen "selectivity window" anywhere upon the radio signal. In a typical listening situation, Radio Marti, via the VOA, on 9590 kHz is much stronger than the Nihon Shortwave BC station on 9595 kHz, at 1345 UTC. The employment of the Exhalted Carrier Selectable Sideband tuning technique(tuning the signal as if it was a SSB signal) offers some improvement. Modulation splatter interference is still noticeably present. By utilizing the PBT control, the "selectivity window" is moved into the NSB upper sideband, leaving a clear, although weak, signal.

Application of the same tuning procedures in exploring tropical band signals often yields a usable signal from a jumbled mess. R. Reloj, 4832 kHz, can be extracted from interference caused by R. Tachira, 4830, and by interference from 4835 kHz. The CW interference adjacent to R. Sutatenza, 5095, the annoying pulsing interference plauging Unjung Pandang, 4719, the FEMA CW station that affects Bamako, Mali from 3 kHz away, and the enormous utility station that wipes out half of the La Voz de Nahuala signal on 3360 kHz, are all examples of interference that is easily controlled with the flexible PBT system. Allied with the choice of up to five bandwidth filtersand the variable notch filter, the R7 operator is able to confidently challenge any situation, including those with multiple sources of interference.

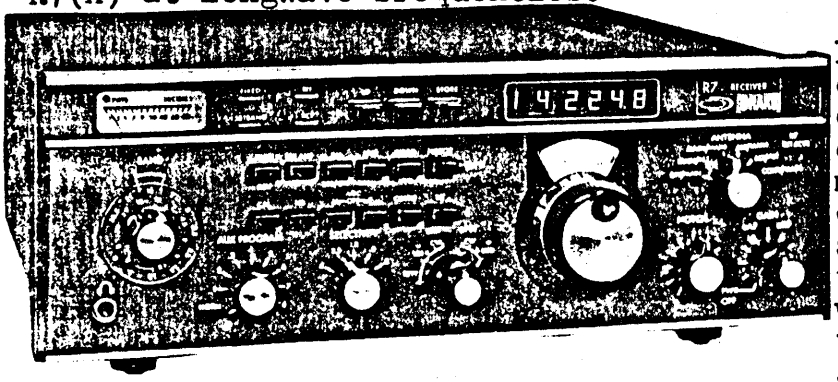
In designing the R7 receiver R.L. Drake engineers had the foresight to allow for the use of up to five crystal lattice filters, independant of mode. Drake supplied quality Japanese-made filters. Others employed equally fine Sherwood filters that were manufactured in the United States.

One point of contention with the R7 and its predecessors has existed for years. I am referring to its reputation for less

than pleasant audio quality. The use of the front panel speaker does justify, this complaint. After properly positioning the desired signal carrier in the passband, I found that the Drake 6 kHz filter allowed for pleasant, wideband audio; this is especially true when use is made of the Drake MS4 speaker. Those looking for a good-sounding external speaker might seriously consider the MS4. Audio quality is of course, a subjective opinion. Steve Bohac, a Drake receiver owner, who is well-acquainted with R7 design and operation, reports that "the Drake R7 begins to roll-off low frequency response at 500 Hz. The Drake's audio is tailored by the manufacturer for 300 Hz highpass audio —optimum for SSB reception, in keeping with the Drake R7's major use as a ham radio receiver. The audio reproduction is not optimum, nor user-adjustable for best audio reproduction in the AM mode."

R.L. Drake used high-quality components in assembling the R7. Despite the use of printed circuit boards, there is point-to-point wiring still evident. Most boards are removable, should service be necessary. Those unable to do such work, will find that the R.L. Drake Company has a well-respected service department. The company may be contacted at 540 Richard Street, Miamisburg, Ohio 45342. Those considering the acquisition of an R7 should be aware that the earliest version(c. 1979) had only fair spurious signal rejection. Some suffered from power supply-generated birdies. Drake offered a correction for the elimination of these unwanted signals.

Those wishing to read more about the Drake R7 receiver should consult articles in the IRCA Technical Manual or the NRC Receiver Reference Manual, volume two. Larry Magne included a thorough discussion of the receiver in the 1982 WRTH. Although I do not have the specific issue date, I am certain that QST Magazine would have featured the R7 in the monthly Product Review column. Finally, Vincent J. Pinto contributed an article describing the construction and use of a synchronous power line noise blanker, in the June, 1983 issue of The Lowdown, a publication of the Longwave Club of America. Mr. Pinto, in the November, 1984 Lowdown, offers his thoughts regarding the use of the R7(A) at longwave frequencies.



R.L. DRAKE COMPANY DRAKE

If one can forego the obvious shortcomings of the R7(A), it will offer solid performance within its coverage of the radio spectrum. The prospective owner must decide whether the R7(A) features meet the desired standards and needs.