The Racal RA-17 RC63-1-2

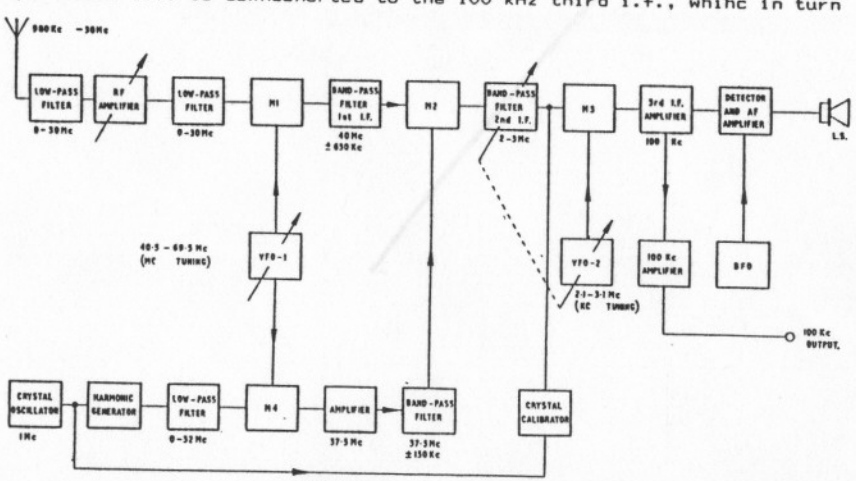
by Bruce Portzer

During the past few years a remarkable receiver has appeared on the surplus electronics market. It's called the Racal RA-17. This receiver was originally designed and built in the 1960's when it had a price tage of a couple thousand dollars - a lot of money even by today's standards. The Racal Company itself is a well-respected British electronics conglomerate, and their communications equipment has long ranked near the top in quality and reputation. The high price, of course, placed the receiver out of reach of most hobbyists back then, but government and commercial users found good use for them. Mine, for example, saw 15-20 years service at the FCC monitoring station in Ferndale, WA, before it was surplussed a few years ago. Around that time, the Canadian government unloaded several RA-17s, which Don Moman bought and resold to Canadian DXers. I'm not sure how many were made, but the manual for mine says it was received 12-15-67 and has serial number 251.

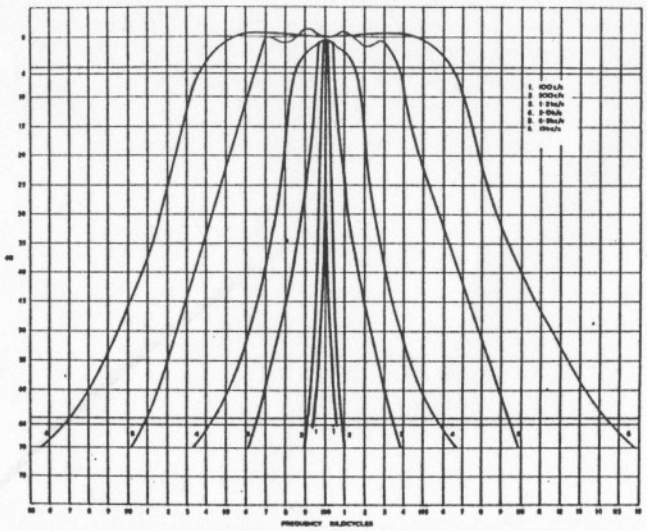
When it first came out, the RA-17 represented the state of the art in receiver design. It was the first receiver to use the Wadley loop circuit. This enabled the set to provide 1 kHz resolution all the way from 500 kHz to 30 MHz, a monstrous improvement over the "slide rule" accuracy of most sets of that era. The results were, and still are pretty impressive. It wasn't until the mid 1970's that the Wadley loop circuit showed up in the Barlow-Wadley XCR-30, the Yaesu FRG-7 and other hobbyist type receivers. Nowadays, frequency synthesizers and digital readout have made the Wadley loop nearly obsolete, but in the 1960s it was a godssend for those who could pay the price. The receiver is also very solidly constructed; it is the only receiver I've seen with a cast aluminum chassis. The internal circuitry is very well shielded, components are securely mounted and appear to have been top quality for their time. Best of all, the kilohertz readout is on several feet of 35 mm film, with 0.6 inches for every 10 kHz and markings every kHz.

How It Works

Figure one is a diagram of the receiver. Basically, the front end is tunable with a 7 position bandswitch and a variable capacitor for tuning the r.f. stage. The output from VFO-1 selects the "megahertz" tuning mixes with incoming signals to up-convert to the 40 MHz first i.f., and a second mixer down-converts the signals to the second i.f. which is tunable from 2 to 3 MHz, and gives you the "kilohertz" portion of the tuning. The crystal calibrator and various filters, etc set up the Wadley loop to provide the necessary tuning accuracy. The output from the second i.f. is downconerted to the 100 kHz third i.f., whihc in turn



BLOCK DIAGRAM OF THE RECEIVER



TYPICAL SELECTIVITY CURVES

is followed by relatively standard detector, amplifier, etc stages. All this is done with 23 tubes. For those interested, Figure 2 is the selectivity curves from the receiver manual. Table 1 is the published performance specifications for the receiver.

The front panel controls include on/off, r.f. range and r.f. tune (for the front end), attenuator (6 position), megahertz and kilohertz tuning knobs and displays, mode (standby, AGC, MGC, calobrate, BFO), af gain, BFO tune, RF/IF gain, AGC long/short, audio level (for driving external amps, recorders, etc.), limiter, speaker with on/off jack, and headphone jack. There is also a meter to display either r.f. or a.f. levels (switch selectable). The rear of the receiver has various audio outputs, antenna input, and various BNC jacks for using an optional longwave converter or monitoring various receiver outputs.

The receiver is quite large. It's designed for 19" rack mounting, and is about 10" high and 18" deep. The weight is about 67 lbs.

How Well Does it Work?

The receiver takes a small amount of getting used to, but no more than more contemporary receivers. First you select the megahertz control and rf range switch to the band you want to listen to, then use the kilohertz knob to select the rest of the frequency (i e. to tune in 1290 kHz, set the MHz control for "1" and the kHz control for "290". Then move the r.f. tune control to peak the signal. It's possible to peak it on the wrong signal if there's a strong station on a nearby frequency, but with some practice and sometimes using the attenuator, you can get the hang of it. The other controls are more of less the same as you'd find on any other receiver.

The following is a series of general impressions and comparisons with my other receivers, a Hammarlund HQ-180A and a Yaesu FRG-7, and my ham transceiver, a Yaesu FT-101E.

Sensitivity: I have no reason to dispute the published sensitivity. It picks up everything my other sets can receive. For some reason, it has a tendancy to load down my 4 foot air core loop, making it very difficult (and sometimes impossible) to peak MW signals. The Radio West loop works well with it, however, as does my longwire.

Selectivity: The Racal has all my other receivers beat. I thought the HQ-180A had good selectivity until I used it side-by-side with the Racal. When listening 10 kHz from strong locals, such as KLSY-1540 and KMPS-1300, the Racal typically has listenable signals with occasional sudio spikes from the local. while the '180 has signals that are being severely trashed. This is true, even when switching back and forth between the same antenna, and even when the HQ-180A selectivity is set for 2kHz with the Racal set at 3 kHz. Unfortunately, the next narrower selectivity setting for the Racal is 1.2 kHz, which is too narrow for useable listening. However, the 3 kHz setting is sharp enough to be more than acceptable.

Audio Quality: It's great for program listening, especially with selectivity set at 6 or 12 kHz. It improves even more when you switch off the receivers 2" speaker and run one of the external audio outputs into a stereo amplifier.

Overloading, spurious signals, etc: The receiver will overload on strong locals if you don't have the rf stage tuned properly. Sometimes I have

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to crank in the attenuator to prevent the loop or the rf tuning control from peaking on the wrong signal. Once the two controls are properly peaked, I don't have a problem. The receiver does not seem to overload significantly on medium wave when I hook up my longwire, and the shortwave bands seem to be clear of spurious signals from local broadcasters. Overall, the Racal is better in this regard than my other receivers.

Readout Accuracy: Wonderful, at least for a receiver of that vintage. You have to adjust the marker on the kHz readout to maintain complete accuracy from one end of the dial to the other. But it's less of a problem than on the FRG-7 or the HQ-180A. It's not as good as a digital readout, but that's the way it goes (maybe I should add an output for a frequency counter!).

Longwave Converter: Mine came with the optional longwave converter, which tunes from 10 to 980 kHz. The converter is designed specifically for use with the RA-17 and one or two other Racal receivers. It requires external DX power and local oscillator from the receiver or another source in order to operate. For reasons I haven't figured out, my LW converter becomes insensitive with a longwire as you tune lower in frequency, unless you use a matching network or a longer longwire. Nick Hall-Patch, however, has the same model converter and hasn't experienced the problem with it. Otherwise, the LW converter works well with little in the way of spurious signals from local AM broadcasters.

I must admit I really enjoy this receiver. It "handles" well, and it's still in good condition after years and years of use by the FCC (on the other hand, the tuning knobs on my FRG-7 and HQ-180A require frequent tightening to keep them from falling off). In some ways, it's not as convenient to operate as a modern synthesized receiver (after all, you have to tweak about four controls). Still it's lots of fun to operate a "classic" receiver....sort of like driving a 1967 Mercedes.

TECHNICAL SPECIFICATIONS

Frequency range:	1 - 30 MHz
Type of reception:	AM, CW, and MCW
Stability:	After warm up, overall drift is less than 50 cps per hour with constant supply voltage and ambient temperature.
Input impedance:	75 ohms unbalanced
Tuning:	Effective scale length of approximately 145 feet, i.e. 6 inches of scale length corresponds to 100 KHz. Frequency increments remain constant over the entire range.
Calibration:	A 100 KHz signal derived from a 1 MHz crystal oscillator having an accuracy of 5 parts in 10^8 provides check points at 100 KHz intervals.
Sensitivity:	A1 reception, bandwidth 3 KHz; 0.5 uV for 18 db signal-to-noise ratio. A2 reception, 30% modulated, bandwidth 3 KHz; 1.5 uV for 18 db signal-to-noise ratio.
Intermodulation:	More than 100 db down for interfering signals at least 10% removed from the wanted signal.
Cross modulation:	For wanted input signal levels between 3 uV and 1 mV, an interfering signal 10 KHz removed and modulated 30% must have a level greater than 50 db above the wanted signal to produce a cross modulation of 3%. The ratio of wanted to unwanted signal is improved up to 10% off tune, at the rate of 2 db for each 1% off tune.
Blocking:	With similar conditions to those for cross modulation, an unwanted signal f2 must be 60 db greater before the audio output of the wanted signal f1 is reduced by 3 db due to blocking.
Selectivity:	Six alternative IF bandwidths are obtained by means of a selector switch. Filter details are:

	-6 db	-66db
(1)	13 KHz	35 KHz
(2)	6.5 KHz	22 KHz
(3)	3.0 KHz	15 KHz
(4)	1.2 KHz	8 KHz
(5)	0.3 KHz	Less than 2 KHz
(6)	0.10 KHz	Less than 1.5 KHz

Bandwidths 5 and 6 are obtained with crystal-lattice filters; differences in center frequencies of these bandwidth settings do not exceed 50 cps.

IF output:	100 KHz at 75 ohms impedance. Level 0.2V approximately with AGC in operation. Two outlets in parallel are provided.
Image and spurious responses:	With wideband or tuned input, external image signals are at least 60 db down. Internally generated spurious responses are less than 2 db above noise level in all cases.
Noise figure:	Better than 7 db throughout entire range.
B.F.O. range:	±8 KHz
B.F.O. stability:	With constant ambient temperature and supply voltage, drift after warm up does not exceed 50 cps. For input level variations from 10 uV to 1 mV, B.F.O. drift is negligible.
Automatic gain control:	An increase in signal level of 20 db above .5uV improves the signal-to-noise ratio by 18 db. An increase in signal level of 100 db above .5uV increases the A.F. output by less than 7 db.
AGC time constants:	Short: Charge - 25 milliseconds Discharge - 200 milliseconds Long: Charge - 200 milliseconds Discharge - 1 second
A.F. response:	With 13 KHz bandwidth, response remains within ±4 db from 250 cps to 6000 cps.
Distortion:	Not greater than 5% at 1W output.
Hum level:	With A.F. GAIN control at maximum, the hum level is never worse than 40 db below rated output (1W).
Noise limiter:	A series noise limiter circuit can be switched into operation to provide limiting at modulation levels exceeding 30%.