

THE HRO-600
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In the late 60s National gradually slipped from view. First the regular ham articles disappeared. Then the back-page advertisements vanished, and finally all ads for ham gear disappeared. The last ads promoted the HRO-500, which by then was up to over \$1,500 in 1967 dollars. No doubt the reasons for this gradual fadeout will make a fine story but as far as most amateurs were concerned, National was history.

However, in the military market the company was very much alive. In the late '60s and almost up to the current time they produced and supported a line of specialized communications equipment. There was, however, one last HRO: the -600. Needless to say, this HRO was not priced to attract the ham buyer and was not produced in large numbers. Jim Musgrove, K5BZH, noted in a recent article "The Classic HRO and Its Evolution" in *Electric Radio* that the 1979 National brochure listed the price of the '600 at "only" \$5,600. He added that he had never seen one. Such was the case for most HRO enthusiasts; the HRO-600 was almost a myth.

In 1988, I visited Antique Electric Supply in Phoenix and purchased Fred Osterman's Shortwave Receivers Past and Present. This fine publication is an excellent guide to all sorts of exotic shortwave receivers. As I usually do, I scanned the page on National. Only two receivers were listed, the HRO-500 and -600. The listing included pictures of the two receivers. All at once the myth had flesh and became real.

Last summer I was offered a chance to acquire a real live HRO-600. After resisting the acquisitive urge for at least five microseconds, I snapped up the receiver featured in this article.

When I looked at the HRO-600 for the first time, I was strongly reminded of the famous Mark Twain novel A Connecticut Yankee in King

Arthur's Court. In this tale, the hero used 19th Century technology to solve 12th Century problems. Since essential materials had not yet been developed, he used ingenuity instead. The result was 19th Century applications of 12th Century materials.

The HRO-600 looks and operates like a modern Japanese receiver. There is a numeric display, broadband front end, and a variety of crystal filters for selectivity. Housed in a low-profile cabinet, the receiver looks nothing like an HRO. Inside the cabinet it looks more like a mini-computer than a receiver. Most assemblies are modular and plug into a "main frame."

However, the influence of computer technology stops there. Unlike the modern Japanese equivalent, there is no internal processor. Although the first injection-frequency synthesizer is controlled by read-only memory, it is programmed with actual diodes. Display and counter circuits are actual individual IC logic elements and frequency-determining circuits are switched by motor-driven switches.

The -600 also lacks the functional beauty of its HRO-500 predecessor. In the -500, I believe National created one of the best looking communication receivers ever made. Not only is the PW dial good looking but the receiver has a delightful symmetry. The -600 not only lacks the PW dial but is squat and wide.

However, when it comes to operation the -600 blows the -500 away. In the -600 National abandoned the 500-kHz bands of the past. The -600 covers 16 kHz to 30 MHz in 30 one-MHz bands. Also, unlike the -500, no outboard preselector is required to tune frequencies below 500 kHz. The self-contained -600 even has its own little speaker built in.

When it comes to frequency control, the -600 is



in a class by itself. It is basically a frequency standard. The VFO's VCO is locked to an oven-controlled crystal frequency standard. A one-MHz frequency counter reads out the selected VFO frequency on four digital Nixie glow tubes. When the range tuned exceeds the counter range, a + or - symbol is turned on.

The entire VFO assembly, designated the 601 Scanning Unit, is removable. It could be replaced by the 602 Synthesizer (frequencies selected by thumbwheel switches) or the 603 Fixed Channel Unit with twelve crystal-controlled channels. Additional accessories included the 650 FSK Converter and 640 ISB Adapter.

The technical manual included with the receiver was clearly not directed at Joe Ham. While it includes the usual sections on installation, operation theory, and maintenance, whole sections of detail on individual modules are missing. Clearly the HRO-600 was designed for depot, not field, maintenance.

Maintenance also requires special extender boards. These boards are not likely to accompany the HRO-600. If alignment of the front end module or second IF is required, an extender must be obtained.

Fortunately much information about this receiver has survived. DAR Electronics (229 Marginal St., Chelsea, MA 02150) has copies of the original manuals and the detailed bench service manual. Most of the parts on the boards are either generally available ICs or discrete transistors. Even extender boards can be fabricated and the alignment tools required are standard stock items. It is possible to service this radio.

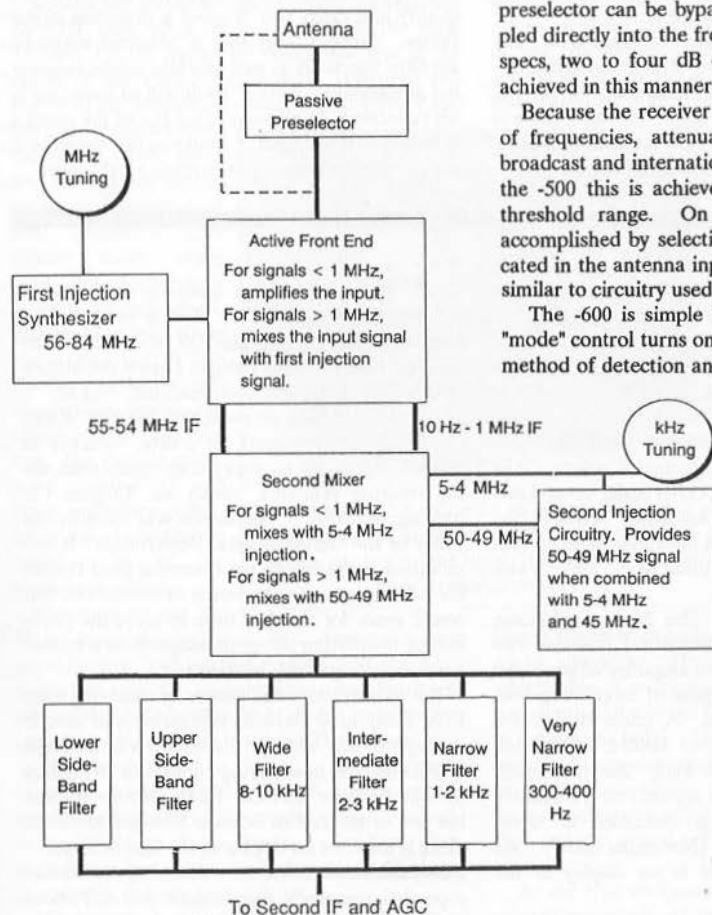
Functionally the -600 is rather simple. Below 1 MHz it is a single-conversion superheterodyne. Above 1 MHz the receiver uses double conversion. The signal path is altered by relays located on the modules affected. Selectivity is obtained from a passive preselector and multiple crystal filters. As the block diagram indicates, the preselector can be bypassed and the signals coupled directly into the front end. According to the specs, two to four dB of additional gain can be achieved in this manner.

Because the receiver covers such a wide range of frequencies, attenuation is required on the broadcast and international shortwave bands. On the -500 this is achieved by adjusting the AGC threshold range. On the -600 attenuation is accomplished by selecting a resistive network located in the antenna input circuit. The process is similar to circuitry used in the Kenwood TS-930.

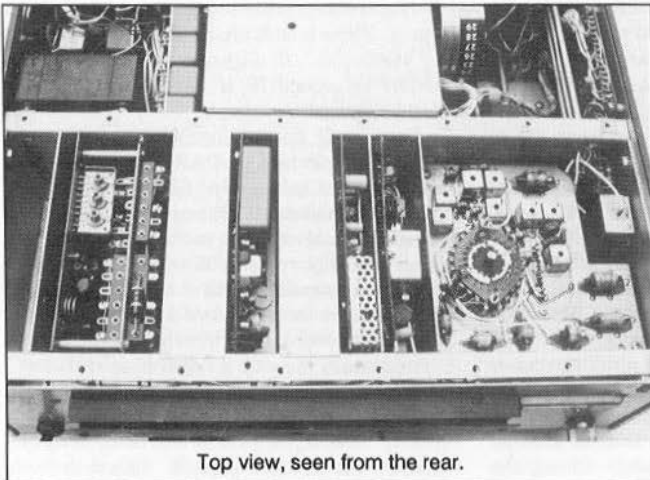
The -600 is simple to operate. Rotating the "mode" control turns on the power and selects the method of detection and selectivity. Selectivity is

fixed at 2.4 kHz for upper and lower side-band and varies from wide (8-10 kHz) to very narrow (300-400 Hz) for AM and CW. Frequency is selected by rotating the MHz knob (just as in the Collins receivers) and selecting the kHz on the VFO knob.

When tuning side-band signals, the BFO is fixed at 5 MHz, the proper upper or lower sideband filter selected and the product detector automatically switched in. While this is common practice with to-day's com-



HRO-600 BLOCK DIAGM



Top view, seen from the rear.

munication receivers, it differs from the -500, where the passband tuning control had to be varied to select the wanted sideband.

Unlike most modern receivers, there is no passband tuning for any mode. Either the crystal filter selected got rid of the interference or you lived with the result. Also, unlike the -500, there is no rejection filter to get rid of interfering heterodynes. However, it all seems to work quite well.

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Delayed QSL: Every now and then one reads of a letter delivered after a delay of many years. I experienced a like situation when I recently received a 54-year-old QSL from W9NN confirming a QSO on 14284 kHz, 4:38 PM, Oct. 3, 1938. My call was then W8ACY.

Lost-Found Fax: For several years I've been searching for a misplaced prewar Finch facsimile machine. It was finally located under several cartons of tubes in the old Museum. AWA is also the owner of a 1939 RCA machine. With current interest in fax, these machines would make a nice historic display.

Mechanical Amplifier. The Multi-Audiphone, the Western Electric mechanical repeater element, and the S. G. Brown amplifier all preceded the vacuum tube as means of amplifying telephone and radio signals. A crude device, the Brown unit was developed before WW I and used in England in the early '20s to amplify broadcast signals from a crystal set. A working model of this device is described in Geoff Arnold's *Radio Bygones* (November issue). An original Brown amplifier is on display in the AWA Museum.

Enigma Machine: Are you interested in spy radios, cipher machines and other secret code de-

In comparison to other receivers in my collection, the -600 fares quite well in the sensitivity and selectivity area but not as well in terms of audio. The tube HRO-60 is superior in that respect. As to how it relates to the modern (well, almost modern!) Kenwood TS-930, there really is no comparison. The TS-930 has controls and features that the -600 cannot match. I also suspect that if I had ordered the -930 with its optional TCXO, it would have equalled the -600 in frequency accuracy and stability.

Of course, utility is not the primary need for a collector. The facts are that quality and rarity will demand a premium in the future. Nobody says that a Marconi magnetic detector functions as well as a late-model receiver but any serious collector would kill to have one in his collection. I believe that the last of the famous HROs is in this league . . . and you can even use it for short wave listening or hamming right now!

vices? If so, look for an article in *Radio News*, January, 1924, page 878. Having read the intriguing book *The Enigma War* by Jozef Garlinski (Scribner's, 1979) I thought I knew the history of this WW II German code machine. Not so.

While thumbing through this issue of *Radio News*, Ed Allison found an article, "Secrecy in Radio" describing an encrypting mechanism using rotating cylinders, called an "Enigma Ciphering Machine." The device was used in the 1920s by the German Postal Department. It was modified in the '30s by the Germans (and Polish) for military use. In the words of the article, "[i]t would seem for the first time to solve the problem of translating secret messages into a cypher which cannot possibly be detected . . ."

The British broke the system by removing a set from a captured German submarine and used it during the war without the enemy's knowledge. Collectors are now paying thousands of dollars for one of these devices. Keith Geddes showed me two in the British Science Museum archives; there is also one on display in the Smithsonian.

European Radio Museums: Planning to visit Europe this summer? Pat Leggatt will tell about both large and small museums in the British Isles and on the Continent in the next OTB.