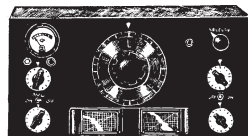


THE COMMUNICATIONS RECEIVER



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The National RDG Panoramic Receiver

As most of the readers know, I am a great fan of the National HRO and its variants. This article is about the most radical variant of the early HRO, the RDG. I saw a picture of an RDG when I was doing research for my 2004 article on the HRO series. That particular one was in very poor condition. A short time ago, one of the members of the National list mentioned seeing pictures of an RDG. I was able to contact the owner and acquire a lightly modified RDG. I thought it would be interesting to document this particular receiver in its current configuration and later to provide information on its restoration.

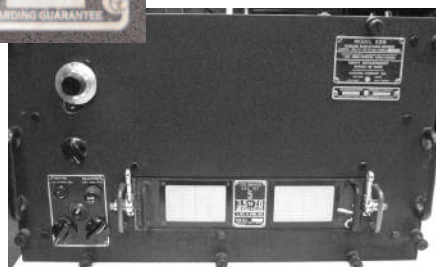
The RDG was designed for use with an oscilloscope to provide visual means for instantaneous monitoring of a relatively wide band of frequencies. This is accomplished by tuning over the full range of coil set frequencies through use of a motor driven main tuning capacitor gang. The receiver output is connected to the oscilloscope, which can be synchronized with the tuning capacitor rotation. The sweep of the oscilloscope will cover the full range of frequencies with any signals showing up as pips on the screen. According to the manual, recording equipment may be connected to the receiver to give a transcribed record of the signals.

This system was developed in 1943/1944 as part of the electronic warfare systems used by the US Navy. In 1943 the German air force had developed two types of guided bombs. These were controlled to the target

using radio signals. The countermeasures included jamming those signals. In order to determine the frequencies used by these bombs, a system to quickly scan the electromagnetic spectrum was required. Two systems were produced, one based on the Hallicrafters S27 receiver, designated RDC, to cover the frequencies between 28 and 140 MHz and one based on the HRO, designated RDG, for coverage of the 500 kHz to 30 MHz range.

The “guided missiles” were the PC-1400-TX and the HS-293. The first was a 1400 Kg high angle armor piercing bomb equipped with a flare in the tail and fins projecting from the tail structure. This was a “Fritz” bomb with the added tail assembly. They were quite expensive and used sparingly for high value targets such as battleships or cruisers. They were dropped from relatively high altitudes and guided by the bombardier using the flare to assist in tracking the bomb.

The second “guided missile” was a rocket-pro-



Front panel of receiver as modified by previous owner. Vernier control at upper left substituted for the original motor.

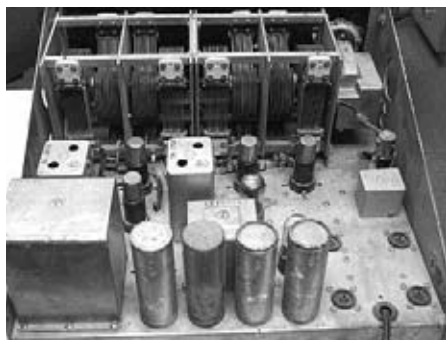
pelled glide bomb of about 800 Kg. It was launched at relatively low altitudes and the rocket motor operated for only 12 to 15 seconds, accelerating the bomb to about 400 MPH. It was also guided from the attacking airplane. These were used more widely, but had a high rate of failure.

The analysis of radio transmissions during bombing attacks led to the conclusion that the frequencies used were in the range of 47.5 to 50 MHz. Effective jamming transmitters were developed and after a relatively short period of success, the guided bombs were rarely used. There is a paper titled *Report on General Instructions for Guided Missile Countermeasure Systems*, which is available on the internet at www.ibiblio.org/hyperwar/USN/ref/RADELEVEN/GCMS/index.html, that gives a great deal of information on the two guided bombs.

Some information indicates that the RDG was used successfully in anti-submarine warfare. Unfortunately information on the success of the system has been difficult to find. I have been unable to find a paper that details the detection of short messages from submarines.

The receiver uses the same coils as the HRO-M receivers, but lacks the frequency-determining graphs. The circuit resembles the HRO with several major changes. The BFO was eliminated, an additional untuned RF stage was added between the antenna and the first tuned RF stage, a power supply was built on the receiver chassis and the four gang tuning capacitor was replaced. There were also several modifications to the circuitry. The modified receiver had two tuned RF stages, mixer and separate high frequency oscillator, two IF stages, a detector, and audio frequency amplifier, like the original HRO.

The tuning capacitor remains a four gang design with the same maximum and minimum capacitance as the HRO. It is, however, of much heavier construction, with ball bearings to allow continuous rotation at 900 RPM. It also has a second set of plates that cover about 90 degrees of rotation. These are used to quickly return the frequency to the lower end of the range. This



Top view as seen from rear. Gearbox at right of tuning capacitor had been rotated so its input shaft could be brought out to front pAnel. Shock mounts for removed motor are at lower right.

capacitor is fitted with a cam operated switch to allow synchronizing the oscilloscope sweep to the capacitor position. On the left end of the main tuning capacitor there is a right angle gearbox and synchronous AC motor.

This design allows the receiver to sweep the full frequency of the inserted coil at 900 times per minute, giving a sweep repetition rate of 15 sweeps per second. Generally the HRO covers about a 2 to 1 frequency range, 30 to 14 MHz for the "A" coil, and so on down to about 500 KHz with coil "F".

The Navy let two contracts for the construction of these receivers; the first contract included two prototypes and 25
(continued on page 54)



Luckily, the original drive motor, along with coupling system and other associated hardware had been retained after conversion.

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 - [6] Robison, Samuel Shelbourne, *Manual of Wireless Telegraphy (Radio) for the Use of Naval Electricians*, 3rd Revised Edition, United States Naval Institute, Annapolis, MD, 1913, p.142.
 - [7] Bucher, Elmer E., *Practical Wireless Telegraphy*, Revised Edition. Wireless Press, New York, 1917.
 - [8] "Queries Answered" Column, *Wireless Age*, Vol. 1, Aug. 1914, p. 942.
 - [9] Bucher, Elmer E., *How to Conduct a Radio Club*, 4th Revised Edition. Wireless Press, Inc., New York, 1917, p. 9.
 - [10] Bucher, Elmer E., "Wartime Wireless Instruction," *Wireless Age*, June, 1918, p. 758.
 - [11] Snyder, Jerome, "The How and the Why of Crystal Detectors," *Wireless Age*, Vol. 10, No. 12, Sept. 1923, pp. 69-71.
 - [12] Simes, William, "Biasing Effects on Diode Performance, Pt. 2," *The Xtal Society Newsletter*, Vol. 8, No.3, May 1, 1988, pp. 4-5.
 - [13] "Queries Answered" column, *Wireless Age*, Vol. 1, Aug. 1914, p. 942.
 - [14] Ibid, Vol. 2, Nov. 1914, p. 155.
 - [15] Ibid, Vol. 4, Nov. 1916, p. 147.

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complete receivers. The second contract was for 150 units. This particular receiver came from the first contract, serial number 10. It is unclear how many of the second contract receivers were actually delivered.

A very fortuitous circumstance preserved this receiver for us. The original owner decided to make a useful shortwave receiver from this RDG and had the ability to perform this task. With his modifications the receiver operates much like any early HRO without the crystal filter (Juniors and some military receivers). The first modification was to remove the drive motor and rotate the gearbox so that the input shaft came out the front panel. He then attached a vernier drive to allow a reasonable manual tuning rate. He then rewired the un-tuned RF amplifier to become a BFO. He added a volume control and changed the impedance of the video/audio amplifier to match an external speaker. Most importantly the owner re-

tained the original motor, coupling, and front panel escutcheons.

Restoration of this receiver will require patching the small shaft hole in the front panel along with a few screw holes, re-seating the drive system and motor, and rewiring the receiver to match the original circuit diagram. I was very fortunate in finding a member of the National mailing list who had an original manual and supplied me with an electronic copy.

The normal display for the RDG was a modified DuMont model 241 "Cathode-Ray Oscillograph." I have been trying to find one of these to go with the restored RDG without very much luck. Hopefully I will be able to find one of these, complete the restoration and have a fully operational system. It will be interesting to see how it performs. I am sure the new SDR units do not have to fear a resurgence of this 150 pound system.