Restoring an Eddystone Model S.750

Gary Albach, April 2019, Victoria, Canada

(This article originally appeared as a two-part series in the December 2018 and February 2019 issues of 'Canadian Vintage Radios', the publication of the Canadian Vintage Radio Society.)

I was recently given an Eddystone Model S.750 communications receiver by an old friend who wanted it to have 'a good home'. He didn't know that I had always wanted a classic Eddystone ever since I was a teenager and first spun one of their silky dials. So now I finally had one of my own and was looking forward to enjoying it after doing some routine recapping and cosmetic work. My friend said that the set had been 'worked on' but still needed a little repair. That was an understatement.

This article documents how a simple weekend project expanded into the return of an Eddystone S.750 to its original factory condition, including restoration of the RF stage, the oscillator/mixer stages, the BFO wiring, the dial cord, and cosmetic touch-ups, in addition to the usual leaky capacitor and out-of-tolerance resistor replacements.

Background

Eddystone as a radio brand dates to the mid-1920's in Birmingham, England. It was formed under the ownership of Stratton & Co. Ltd., which in turn traces its history back to the mid-1800's, first as a manufacturer of ladies' hat pins and later, in the business of making flags. Sound familiar? In Canada, Sparks-Withington Co. (Sparton radios) started off making automotive horns, Noblitt-Sparks (Arvin radios) supplied tire pumps, and Dominion Electrohome made furniture and was Canada's largest manufacturer of electric fans. Eddystone earned a reputation during and following WWII as a manufacturer of high-quality communications gear for military, commercial, and amateur radio use.

The Eddystone Model S.750 is truly one of Eddystone's classic receiver designs (see Figures 1 and 2). First introduced in 1950 as a successor to their earlier pre-war models, it sold for an impressive £45 in 1950 ($1,500 Canadian today!). The S.750 was their first true dual-conversion offering and was one of their first to have a modern "sliderule dial", a major change from the earlier half-moon dials popular in the late 1940's.

Figure 1: Eddystone S.750

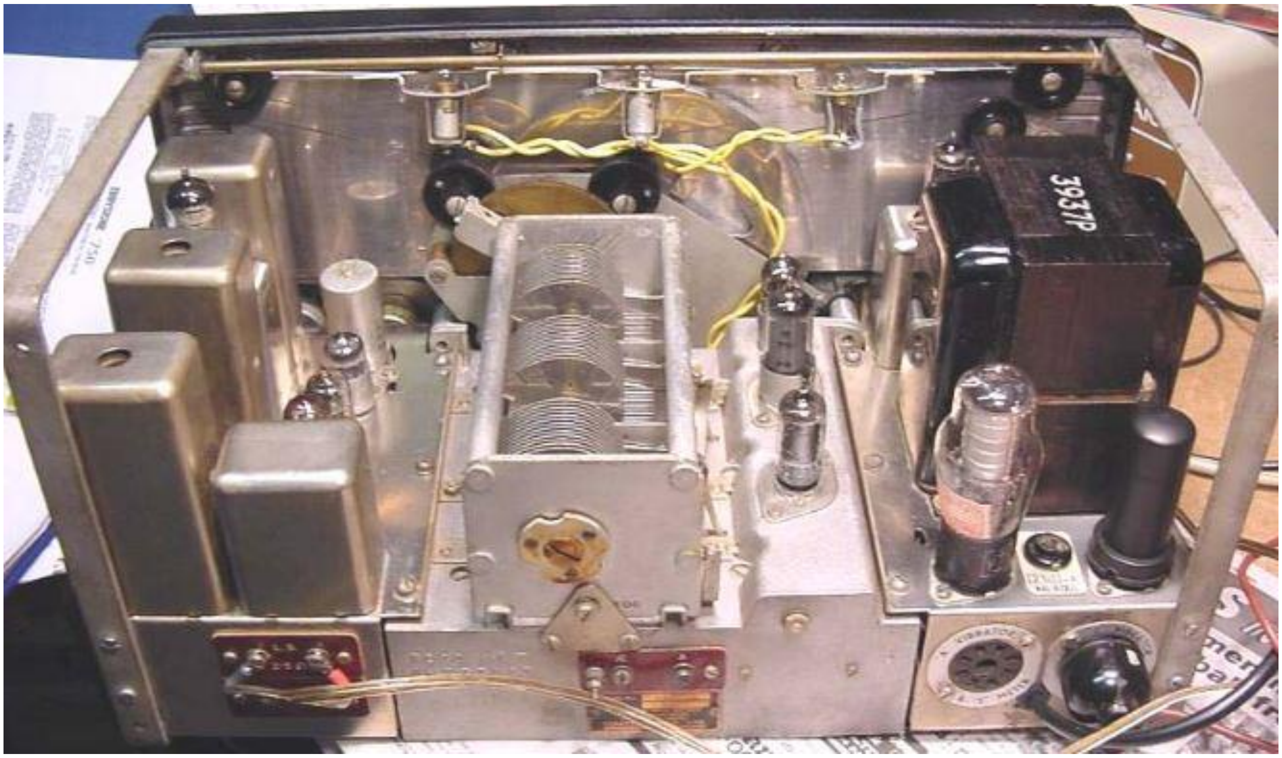

Figure 2: Chassis of Eddystone S.750

The S.750 is an 11-tube, dual-conversion communications receiver tuning 480kHz – 32MHz in four bands (with a gap between 1465 and 1700kHz to avoid the 1535kHz second local oscillator frequency). It incorporates variable selectivity (variable-width IF bandpass), variable RF, IF and AF gain, a noise limiter, balanced heater wiring, and regulated B+ voltages. It was sold with an optional external speaker, and an optional S meter, neither of which came to me with the radio. It is housed in a classic black wrinkle-finish steel cabinet and weighs a hefty 40 pounds.

A conventional pentode RF amplifier is followed by the first mixer stage at 1620kHz and immediately by the second mixer at 85kHz. All the IF amplification is done at 85kHz following the second converter. Both mixers use ECH42 (6CU7) triode-hexode tubes. However, the first converter stage has a separate pentode (8D3/EF91) as the local oscillator and uses the grid of the ECH42 merely as a means of injection. The second converter stage is more conventional, utilizing the triode section of the ECH42 as the oscillator.

Demodulation uses one diode section of the DH77 (6AT6), the other diode being used for the AGC. A 6BA6 is used as a separate BFO oscillator at 85 +/- 3 kHz. AF amplification is conventional, using the triode section of the DH77 followed by an N78 (6BJ5) power pentode. A 5Z4G full wave rectifier provides unregulated B+ at about 235 volts, and a VR150/30 gas regulator tube provides 150 volts regulated B+ to the oscillators.

The N78 audio output tube warrents a comment, given the history of this particular radio. Articles on the website of the Eddystone Users Group (EUG) effuse over its ability to operate from audio frequencies to over 150MHz, describing it as 'comparatively rare - and expensive to replace'.
(See for example: http://eddystoneusergroup.org.uk/wp-content/uploads/2015/03/pw-article-750-July-2003.pdf). A quick on-line search reveals current prices ranging up to $50, so I'm lucky the tube in my receiver is good.

The Dial Cord

The silky-smooth dial mechanism on an Eddystone receiver is a trademark of the brand. When working properly, the dial spins effortlessly from one end to the other, the result of a combination of superb engineering and excellent build quality. The internal mechanism is truly a work of art. In my set the good news was that the complete mechanical gear mechanism was intact, requiring only careful lubrication with a mixture of white lithium grease and light machine oil (as Gerry O'Hara has pointed out in his excellent restoration articles on the EUG website, never use 3-in-One oil for radio parts. It just gums them up). The bad news was that 'only' the dial cord was missing. Normally, this would not be a big deal – many old radios need a new dial cord. But for an Eddystone, a missing dial cord seemed odd, because the 'cord' was originally a stranded metal wire, firmly attached to the dial mechanism at the factory. It would have taken some concentrated work to remove it.

I started my restoration efforts by reading Gerry's article 'Eddystone Dial Drive Mechanism and Gearbox' available on the EUG website:
http://eddystoneusergroup.org.uk/Restoration%20projects/Eddystone%20Dial%20Drive%20Mechanism%20and%20Gearbox.pdf. Gerry reviews in detail how the mechanism works and explains that "The bronze-plated steel dial cord is soldered to metal pins embedded into the spool pulleys and is soldered at its mid-point to the brass slider of the dial pointer (actually, the dial cord in the set featured in my S.750 restoration article is a fabric cord knotted into the spool pulleys and attached to the dial pointer slider with a screw: an example of either a replacement at some stage in the set's life or of a variation in design over the production life of the model)".

My set may have had a fabric cord when it was new, but I was still very thankful for the detailed drawings and photographs in Gerry's restoration article showing how the dial cord is strung. I couldn't locate a suitable "Drennan bronze-coated stainless steel 7 Strand Pike Wire 24lb – 10.9kg, available from fishing tackle shops", so instead I used standard 0.040" non-stretch woven fabric dial cord from Radio Daze: http://www.radiodaze.com/dial-cord/, and it worked just fine.

The tricky part in restringing this cord is getting the length correct in order to obtain the proper tension throughout the mechanism. I used Gerry's 'pre-wound spool' method and much trial and error, tying one end of the cord to one of the pulleys, wrapping it multiple times around the pulley, threading the cord along its path, tying it to the other pulley and then temporarily installing this second pulley to check the tension. The cord tends to slip off the various pulleys along its path when loose, so I found it helpful to temporarily secure it in place with tape as I threaded it through its path. After finding the correct length, I secured both the knots at the ends and the attachment of the pointer with drops of superglue.

The RF Amplifier Stage (V1, 6BA6), 1st Mixer Stage (V2, 6CH7), and 1st Local Oscillator (V3, EF91)

When Field Effect Transistors (FETs) were first introduced commercially back in the 1960's, hobbyist articles were written about how to convert your old tube radios to use the modern transistors. As an example, see 'FETs in the Eddystone 640' available here:
http://eddystoneusergroup.org.uk/Tech%20Information/Pages%20from%20TT-1967%20May%20Eddysone%20640%20FETs.pdf,
and 'MOSFETs for Tubes' available here:
https://www.qsl.net/kh6grt/page4/tubesters/MOSFETs%20for%20Tubes.pdf

The RF amplifier stage in a cheap shortwave tube radio was a prime target for modification: FETs offered the holy grail of lower noise, increased sensitivity, increased selectivity, lower power consumption, and unlimited lifetime. However, Eddystone receivers of the 1950's were not cheap shortwave sets; they were well designed, well built, and excellent performers. It seems unlikely that rebuilding the RF amplifier and/or mixer stages with transistors would offer any great advantage in performance, not to mention destroying the radio's iconic chassis.

In the set that I was given, a previous owner had started a project to replace the RF amplifier and mixer stages with transistors, only to quit after removing much of the original wiring but not getting to the installation of MOSFET circuits. For most of my restoration projects, I aim to recreate as closely as I can the original factory 'look and performance' of the radio, for both the cosmetics of the cabinet, and the components/wiring of the chassis. Hence, most of my work on this radio involved replacing the components that had been removed.

As shown in Figure 3, the wiring of the RF and mixer stages of the S.750 is contained in a machined-aluminum 'coil box' consisting of three compartments located beneath the tube sockets of the respective tubes. In Figure 2, the bottom compartment is the RF amplifier (6BA6), the middle compartment is the first mixer at 1620kHz, and the top compartment is the second mixer at 85kHz. The wiring on the RF tube socket had been cut off from below and most of the components removed, including the custom bypass capacitors which are fabricated in metal cans with threaded studs attached to a custom bracket. As can be seen in the lower red circle in Figure 3, the lower left section of the coil box was empty, with only two white wires dangling into the empty space below the disconnected RF tube socket.

Figure 3: Chassis wiring of Eddystone S.750

A capacitor and bracket assembly were missing, but thanks to Gerry and the folks at the SPARC museum near Vancouver, I was able to obtain these original components from a spare 'parts' set. As a tribute to Eddystone quality, these bypass capacitors along with all the other stud-mounted paper caps proved to have very low leakage. Figure 4 shows the rebuilt lower left section of the coilbox.

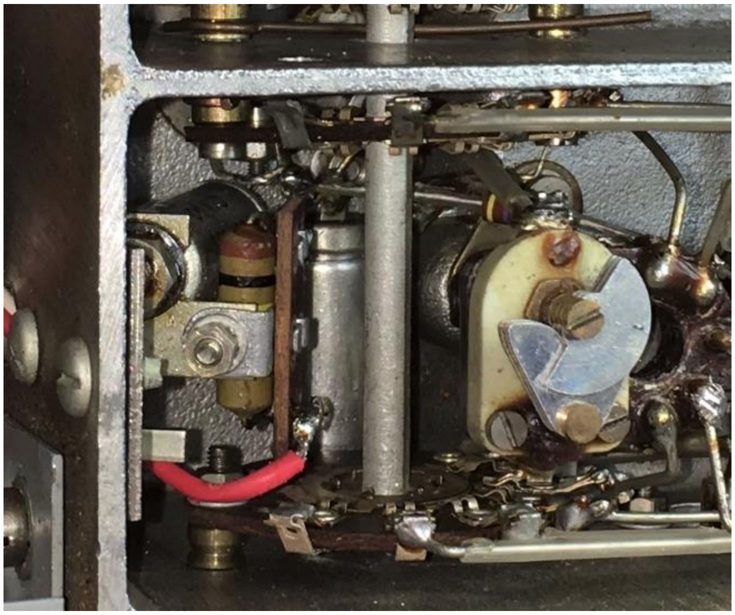

Figure 4: Rebuilt RF Section of Coil Box

Re-installing these original parts and their related components (e.g. the 470kohm resistor in Figure 4) was considerably more difficult than the work a previous owner did to remove them. Short of removing the complete coil box assembly, the only practical way to access the pins on the tube sockets is from the top of the chassis. This can be done by unbolting the sockets and carefully leveraging them up and sideways as much as possible to allow replacement components to be attached. Figure 5 shows how this was done. I used curved hemostats to grip the wires and a long tip on my soldering pencil to reach under the sockets.

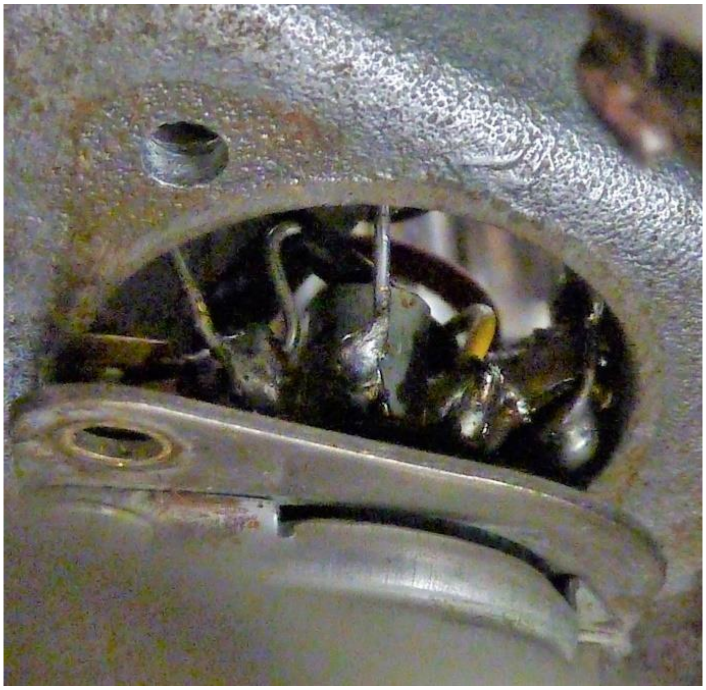

Figure 5: Wiring of Tube Socket

A brief mention of the RF gain control is in order here. RF gain is varied by changing the cathode bias on the 6BA6 RF amplifier tube, and this in turn is done with a variable voltage divider consisting of a 10kohms wirewound potentiometer connected in series with a 100kohms resistor between B+ and ground, (wirewound because it conducts current in the circuit). One end of the pot is grounded, and the wiper is connected to the cathode of the 6BA6 through a small value resistor. You can see that maximum gain will occur when the wiper (cathode) is at the ground end of the rotation, effectively putting minimum positive voltage on the cathode and minimum negative bias on the control grid. A previous owner had replaced the 10kohms wirewound pot with a 2kohms carbon unit and wired it in anticipation that a positive rotation of the shaft would lift the wiper above ground, as is common with an AF gain control. Until I find a replacement 10kohms wirewound logarithmic reverse taper pot, I've left the carbon unit in place with the wrong end grounded and live with the quirk that rotating the RF gain control clockwise actually reduces the gain!

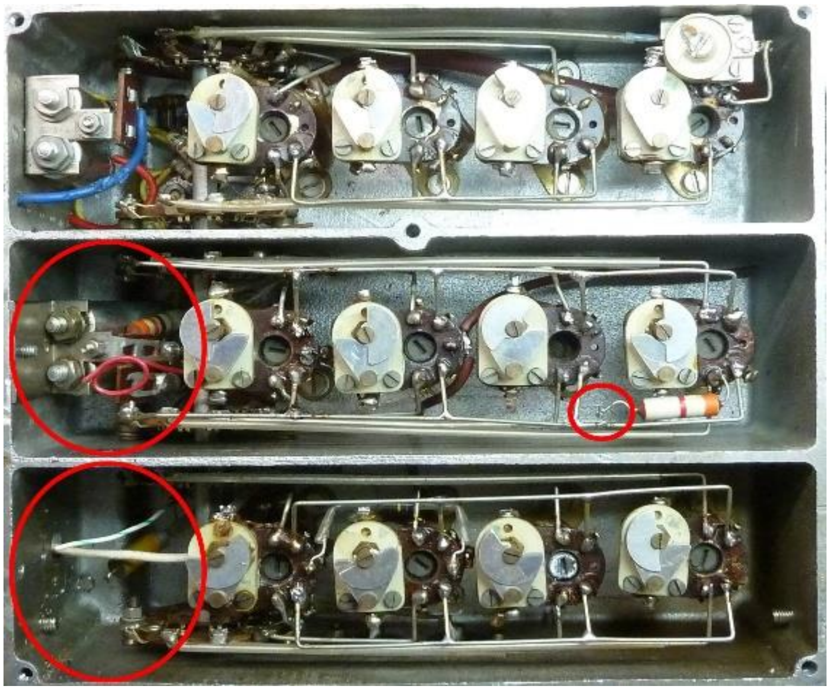

Figure 6: Coilbox showing areas requiring repair.

The coilbox of the S.750, as shown in Figure 6, consists of three (3) sections; the lower section is the RF amplifier, the centre section is the first mixer, and the upper section is the first oscillator

Restoration of the wiring around the RF tube socket, shown by the lower red circle in Figure 6, was dealt with earlier (the broken solder joint towards the right end of the middle section was an easy fix!). It was also necessary to replace parts that had been removed from the first mixer section in the middle. As shown in Figure 6, there was an odd loose wire (red pigtail) emerging from the tube socket at the left end of the centre section, presumably in preparation to adding a MOSFET transistor as a replacement for the ECH42 mixer tube. This wire was removed and all the wiring in this section restored according to the original schematic. Figure 7 shows the final wiring in the RF and mixer sections.

Figure 7: Final rewiring

As with the RF section, this rewiring was done from the top of the chassis by leveraging the tube socket slightly out of the way (Figure 8).

Figure 8: Rewiring tube socket from above

No repairs were required to the first oscillator. Similarly, the second mixer stage was also left intact, although out-of-tolerance resistors had clearly been replaced in the past.

Wiring around the BFO switch took a bit of time to understand because a 10uF electrolytic capacitor had been added to the AGC line (presumably in an attempt to increase the AGC lag time) and wiring to two of the terminals on the switch had been reversed. The capacitor was removed, and the original wiring restored.

The Cabinet and Knobs

The metal black wrinkle-finish cabinet was cleaned with warm soapy water, dried with a heat gun on a low setting, and given a spray of clear wax furniture polish. With the wax coat it looks almost new.

A previous owner had drilled a hole in the dial tuning knob near its circumference, probably for the installation of a crank handle, which would not only have been unnecessary for this beautifully smooth mechanism but would also have unbalanced the knob, impeding its ability to ‘spin’ across the dial. This hole had been partially filled with a waxy substance, which I removed and replaced with a wooden plug. The plugged hole now looks like a pointer on the edge of the knob.

The Power Supply

Apart from having the wrong size fuse installed (a 3-amp fast blow fuse had been substituted for the ¼-amp slow blow specified in the parts list), the power supply was in good condition.

Normally, I re-stuff the cans containing the electrolytic filter capacitors in adherence with my restoration philosophy of ‘factory look and performance’, but in this case I decided to try to reform them. I don’t use this technique very often because I’ve found that any improvement in performance is temporary, the capacitors quickly reverting to high leakage. However, for this radio I decided to try reforming them for two reasons: first, my ESR meter showed that the filter caps were almost within tolerance for their internal resistance (at low voltage), and second, given Eddystone’s reputation for quality, the caps were probably well made. I didn’t test them initially with my high-voltage capacitor tester for fear of creating an internal short.

To reform the filter caps, I temporarily replaced the 5Z4 rectifier with a couple of 1N4007 diodes, removed all the other tubes, and ramped up the line voltage over several hours with the radio plugged into a Variac. It was convenient to monitor the DC current from the bridge rectifier into the filter caps by measuring current across the B+ fuse holder with the fuse removed. As hoped, the current into the filter caps increased with small increases in the Variac voltage, and then settled back to a small value.

After reforming the filters, the radio sat unused for four months and so the capacitors were again tested for leakage before power was applied. The internal resistance of the capacitors remained acceptably high.

Alignment and Use

Alignment on all bands was carried out without incident according to the factory instructions. The receiver had been aligned on an image frequency in Band 3 (1.7 – 4.5 MHz) but this was easily corrected. Listening tests are now being planned to use the antenna array of a local radio amateur.