

The All-American Five

G. Rabjohn

Which 20th century innovation had the greatest effect on the everyday lives of Canadians? The National Academy of Engineering (an American organization) has compiled what they believe are the 20 most important engineering achievements of the 20th century. They list “Electrification” as the greatest achievement, followed by the automobile, air travel, and water supply and distribution. Even before I had seen the list, I strongly believed that radio and radio broadcasting belong somewhere near the top, and indeed electronics, and radio and TV broadcast occupy #5 and #6 on this list.

Radio made instant communications possible across vast distances and was embraced quickly for nautical applications. By the 1920's, broadcast radio brought radio to the home, and after early adopters helped bring the price down, it was affordable even for families of modest means. This made it an extremely popular form of entertainment during the depression, and its role as a propaganda machine during WW2 (on both sides) was unprecedented. It was available everywhere, even when there were no roads, no electrical mains, and low population density. The seeds of modern media and advertising, instant communication, and the information age were sewn with the humble broadcast radio.

Many great technological advances have a pinnacle, a point where it could be confidently said that they have become a mass-market phenomenon. The automobile industry had the Ford model “T”. The telecommunications industry had the model 302 and later model 500 telephone set. I believe that the zenith (so to speak) of commercial broadcast radio in the home is the much-maligned All-American Five (AA5) radio, the subject of this piece. I'll define it better later, but essentially the quintessential AA5 is a 5-tube AC-DC (can operate from 115V AC or 115V DC. The term “AC-DC” started not with the radio, but rather with the universal wound motor) superheterodyne radio of standard design, produced by essentially every radio manufacturer from the 30's to well into the 60's.

In 1939, there were 1223502 private radio reception licenses issued in Canada. There is not an accurate count of dwellings in Canada for 1939, but interpolating from earlier data, there would be about 2170000 dwellings in Canada in 1939, so a licensed radio was present in about 58% of Canadian households. (ref: Canada Year Book, 1936 and 1940) I suspect that the number of unlicensed radios increased this number significantly. In 1935, the cheapest electric radio in the Eaton's catalogue was a \$34 Philco 5-tube transformer-based set. In 1939, the year the AC-DC set was introduced in Canada, Eaton's offered a “Viking” AC-DC set for \$12.98. Radios like this were available in Canada for the next 30 years at the \$10-\$25 price point.

Everyone reading this article probably has a radio that they consider an AA5. Much has been written about these radios, both good and bad. Detractors will say that they were cheap, performed poorly, were energy inefficient, were unreliable, were shock hazards, and cause cancer in lab rats when ground into a fine powder and mixed in with their rat

food. However, I believe the universality of this design is admirable and unique in the world of electronics. Hundreds of millions of radios based on essentially the same bill of materials were produced in the golden years of radio. Given the technology of the day, their design was more than adequate to meet the needs of the vast majority of North Americans looking for a first or second radio. The efficiency of the design brought the cost down so that everyone could afford one, and this increased the power of radio as a medium.

The beautiful thing about the AA5 was the flexibility and robustness of the design. They could be made cheaply, yet the design could offer excellent performance: with sensitivity limited by man made noise, not by limitations of the radio itself; without needing an external antenna in most locations; with selectivity that could separate stations 40kHz apart; adequate volume; frequency response as good as the quality of components used in it, and as wide as the programming sent to it; and ease of use: 2 knobs did it all. The components used in this design became very standard, therefore cheap, and available from multiple sources. Furthermore, the uniformity of the resulting radios made them easy, or at least routine, to service. If you've seen one, you've seen 'em all. This radio design was built in mass quantities from the 1930's (more on that later), until tube radios were eclipsed by transistor radios. The Beitman service bulletin for the 1967-1969 model year included schematics for AA5 radios, not very different than the Viking radio Eaton's sold in 1939.

So, when was the first AA5 radio designed? To answer this question, the term AA5 needs to be defined. What is an "All American Five"? To me, the archetypal "All American Five" is an inexpensive, AC-DC, AM-only, superheterodyne, 5-tube radio that uses a 12SA7, 12SK7, 12SQ7, 50L6GT (or 35L6GT), and a 35Z5GT. However, every aspect of the definition I offer can be debated. Though many AA5's were inexpensive, some were mounted in expensive cabinets. Most would define the AA5 as an AC-DC set, however there were many 5-tube AC only sets that differ only by the rectifier tube, the tube filament ratings and the power transformer. Though slightly more expensive, can we truly say that a set using a 5Y4G rectifier instead of a 35Z5GT is not essentially an AA5? And what about the versions using miniature tubes, or loctal tubes, or even the more modern line-up that use tubes with 100mA filaments? Most AA5's were single band radios, but some had one or more short-wave bands added. In my mind all of these are AA5's. Even the "Five" can be debated. There were six tube sets that used an additional stage of RF amplification, IF amplification, or a push-pull output. There were sets with even more tubes. There were also sets with only 4 tubes, with the IF amplifier eliminated. However, the 5-tube version is by far the most popular and practical.

The AA5 was largely a product of RCA's tube division. RCA developed tubes that were optimized to make these radios simple and cheap, and these tubes were made by multiple manufacturers. The pentagrid converter, (an RCA invention, first one being the 2A7 in 1933 (ref: Stokes)), combined the local oscillator with a mixer, and offered some variable gain to boot. The variable-mu pentode IF amplifier (actually a Boonton invention, first introduced by several manufacturers as the 35 and 51 in 1931 (ref: Stokes)) allowed the control of IF gain directly from the AGC (Automatic Gain Control) voltage generated by

the detector. The dual-diode-triode detector/first audio stage was designed for zero bias operation. The dual diode could provide delayed AGC operation, though it was usually used just as a detector with “regular” AGC. The beam power audio output tube was optimized for a B+ of 150 volts that could be generated from the half-wave direct-from-line rectifier. The rectifier tube included a heater tap that allowed a pilot lamp or dial lamp to be added “for free”. The heater string was designed to add up to the line voltage. These 5 tubes were highly optimized for one particular application: the AA5 radio. The first sets using the 150mA heater current tubes: 12SA7, 12SK7, 12SQ7, 50L6GT, 35Z5GT, were introduced in 1939.

There were many different AC-DC tube line-ups, the most common listed in the table below.

Converter	IF Amp.	Det/First Audio	Audio Output	Rectifier
6A8	6K7	6Q7	43	25Z4/5/6
12A8	12K7	12Q7	50L6GT/35L6GT	35Z4GT
12SA7	12SK7	12SQ7	50L6GT/35L6GT	35Z5GT
14B8/14Q7/7A8	14A7/7B7	14B6/7C6	35A5/50A5	35Y4/35Z3
12BE6	12BA6	12AT6/12AV6	50B5/50C5	35W4

Note that AC-DC sets were not officially permitted in Canada until 1939, perhaps underlining the use of the term “American” in AA5. This design was mainly relegated to countries with 120-volt line voltage. Series string radios were not nearly as popular in Europe, probably because typical tube filaments did not add up well to a 220V line. (The “U” series of tubes, with 100mA filaments were used for AC-DC sets, but even then they needed dropping resistors)

I started this article by asking myself who made the first AA5. The answer is not clear, and comes back to the definition of the AA5. The strictest definition of an AA5 uses octal 150mA (filament current) tubes that added up nicely to the full line voltage. These tubes were introduced in 1939, so there were many sets introduced by many manufacturers that year. The version based on miniature tubes came out after the war. However, there were earlier AC-DC sets that used 300mA (filament current) tubes. These tubes required a dropping resistor, which was often incorporated into the line cord. The 6-V octal “metal” tubes were introduced in 1935, and formed the basis for many transformer-based sets, but there were many 5-tube radios based on “Standard” tubes prior to that. Probably the earliest radios that could be considered forbearers to the AA5 came out in the early 1930’s. For example, Atwater-Kent model 155 is a 1933, series-string, 5 tube, AC-DC superheterodyne radio, using 300mA tubes, and no power transformer (Ref: Riders). It used a 77 pentode as a self-oscillating mixer, as the 6A7 was not yet available. Grigsby-Grunow model 140 is a similar radio from 1932. The picture shows a Sparton (Sparks-Withington, Jackson, Michigan) model 50 (?) AC-DC set from approximately 1933 that is part of my collection. It uses tubes 78, 78, 75, 43, and 25Z5, along with a line-cord resistor (that would need to dissipate about 15 watts!). American Mohawk (and others) offered a number of sets for DC-only operation, for cities employing DC mains, and these had to use series string tubes out of necessity (transformers do not work at DC). Under

the “Worst of both worlds” category, the Rogers 15/53 chassis (and several other radios in that series) features a high voltage transformer, but a series string heater. (Ref: RCC schematics)

These radios have been part of my life since I was about 8 years old. One of my first radios was an RCA AA5 that had a melted red plastic cabinet. Canadian and American AA5's are still widely available if you look for them; they often sell for a few dollars at our auctions. The wide variety of cabinetry available makes them an interesting theme to base a collection around. There are many unique and recognizable Canadian AA5 radios, such as the Northern Electric Rainbow radios (Baby Champs), and the Addison Catalin plastic radios. As time moves on, the AA5 will be regarded less as basic utilitarian radio, and more as an example of industrial design from the era when radio was the king of the electronic media.

References:

<http://www.greatachievements.org/default.aspx>

Stokes: 70 years of radio tubes and valves.

Canada Year Book, 1936, 1940

Eaton's catalogue, 1934-1935, 1939-1940, 1948-1949

RCC radio schematics

Beitman radio schematics

Riders radio schematics

Some interesting sites:

<http://pw2.netcom.com/~wa2ise/radios/aa5h.html>

<http://www.angelfire.com/electronic/funwithtubes/AA5-1.html>

http://en.wikipedia.org/wiki/All_American_Five

