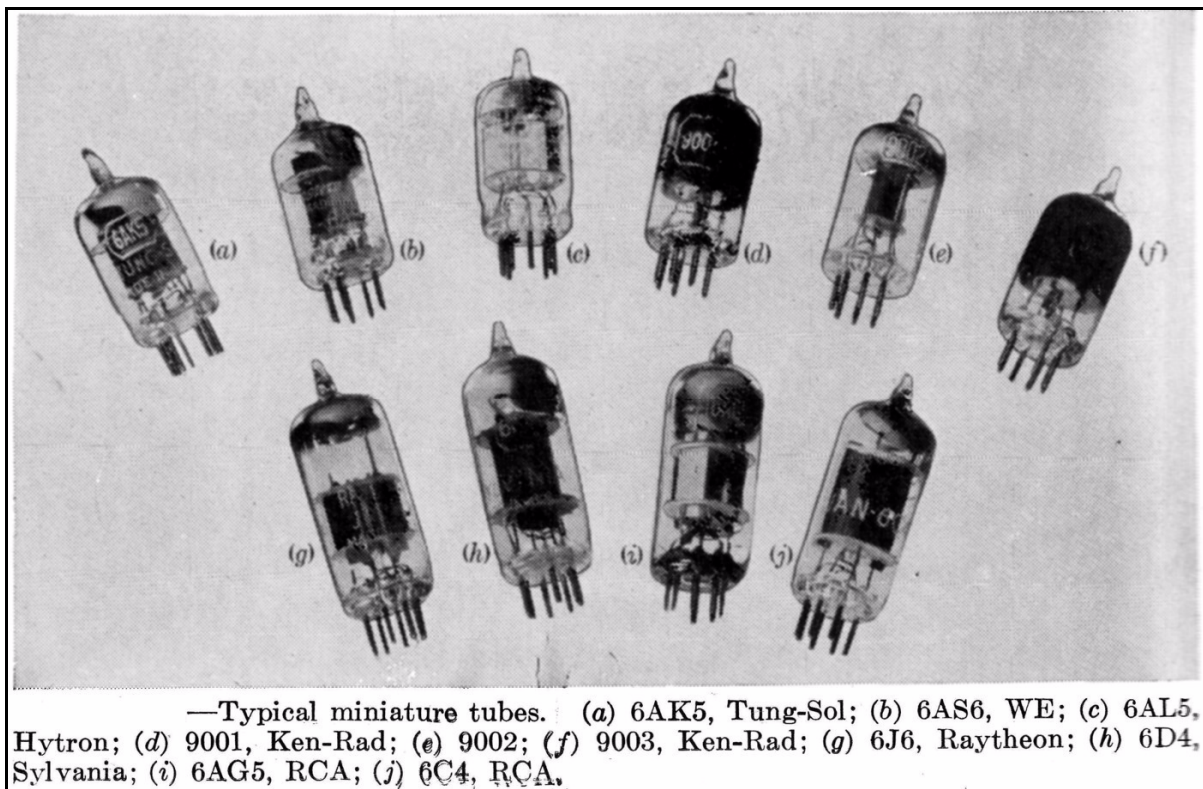


## 12AU7: the true history of the first noval tube

RCA introduced its first line of all-glass 7-pin miniature tubes in November 1939. The family was intended for battery operated portable radios. It included four types, the 1R5 converter, the 1T4 RF/IF amplifier, the 1S5 diode-pentode and the 1S4 power output pentode. A complete description of the new family was given in April 1940 in the article '[Development and production of the new miniature battery tubes](#)'. The new tubes only took up twenty percent of the space previously required by octal GT types and therefore they were very attractive for miniaturized and portable equipment, pocket receivers, hearing aids, meteorological probes and any other application where small size was required. Small electrodes and short connections dramatically reduced the parasitic parameters, so contributing to improve efficiency and high frequency behavior.

The use of miniature tubes quickly spread during the war. Several new types appeared, including some with filamentary cathodes for battery powered sets and other types indirectly heated, mainly high frequency amplifiers and oscillators. Among them we find several future commodities, as 6AK5, 6AK6, 6C4 or 6J6. Other types were introduced for power supply or control applications, as the miniature gas thyatron 2D21 or gaseous voltage stabilizers, 0A2 or 0B2. A survey of relevant all-glass miniature tubes introduced through the war is in the image below. A complete list is given in the MIT Rad. Lab. series volume 17, 'Components Handbook' by Blackburn.



In the two years before the end of the war over 50 million pieces of miniature tubes were produced for military applications, with everyday increasing quantities. Over than 3,500,000 pieces were delivered in May 1945 alone. A very significant experience had therefore been gained and at the end of the war the vacuum tube manufacturers did not hesitate to propose new types of miniature valves intended for the consumer market, mainly radio and TV sets.

RCA for instance since October 1945 introduced a family of tubes for home radio, including the 6BA6/12BA6 RF/IF amplifier, the 6BE6/12BE6 converter, the 6AT6/12AT6 detector-preamplifier, the 50B5 audio power amplifier and the 35W4 rectifier. Also the 6AU6 RF/IF pentode appeared in the same days. More information about the 7-pin miniature tubes can be found in the RCA

publication dated June 1947 '[Miniature tubes in war and peace](#)'. Unfortunately miniature tubes had evidenced two drawbacks in the few available pins and in their quite poor heat dissipation capability. Their direct competitors, octal and loctal types, could dissipate even more than 20 W and could accept multiple electrode systems, such as in the 6SN7 and 6SL7 double triodes.

In the second half of 1945, RCA decided to introduce a slightly larger bulb size with nine pins, the noval base, instead of seven. Probably the decision of using nine pins was taken in order to renew in the new bulb even octal types with extra connection from the top cap. In origin no connection from the head was deemed possible because of the presence of the exhaust pip, previously positioned in the center of the base. The choice of the nine-pin bulb proved successful over time. In the same days in Europe Philips was developing its own design, which led in the second half of 1946 to the release of eight-pin rimlock tubes. The [Philips Technical Review](#) in October 1946 gave the photos of several rimlock types, the entire family for home radio sets including UCH41, UF41, UAF41, UL41 and UY41, plus other types still under development. This solution, although elegant and technically superior for some aspects, was never successful outside Europe. Early in the 1950s Philips had to switch to the noval base, although for a short while passing for its [intermediate 'innovals'](#), noval tubes assembled in the rimlock lines and retaining low-temperature glazing techniques, quietly experienced in the remote Australia.

Back to RCA, on November 27, 1945 the program had been launched for the development of an all-glass dual triode in a T6-1/2 bulb with nine-pin or noval base. The RCA internal code for the new tube was A4498. On April 3, 1946 the development had been completed and then the program for launching the new tube on the market was accelerated. While asking RMA to reserve a type number for the tube, RCA planned all the necessary actions to have 300 engineering samples ready within 1 August and to have its production lines ready for delivering up to 10.000 units per month from September. Estimated sales were at 40.000 tubes in the first year and 80.000 units in the second year. On April 17, 1946 TCA reserved the commercial code 12AU7 to the tube. The announcement scheduled for early September was delayed, while waiting for the RMA registration to be completed. **On October 8, 1947, supposedly as soon as anticipations of the registration arrived, RCA sent a press release to its customers, giving notice of the new 12AU7.** Details of the program are contained in the [documents from the RCA-Harrison archive](#), preserved by Brother Patrick Dowd and scanned by Tube Collectors Association.

The new all-glass tube, supplementing the existing line of seven-pin types, was immediately accepted with great interest. As early as 25 November 1946 Western Electric registered its noval VHF dual triode 2C51. On January 28, 1947 both 12AU7 and 2C51 had been added to the '[Preferred List of Army-Navy Electron Tubes](#)'. Certainly from January 12AU7 could be purchased from the 1947 catalog of [Allied Radio](#), one of the largest American distributors. Also in 1947 we find more noval tubes: 12AX7 was registered to RCA, 6T8 and 19T8 were registered to [General Electric](#), who also second sourced the 12AU7, proposing it for multi-vibrators and for special services in TV receivers and in industrial-control panels. Actually 1947 seems to be a year of ferment for the diffusion of noval valves and also of ancillary products. At the beginning of 1947 we cannot find in the Allied catalog a single noval socket and not even a single tube tester accepting the new tubes. We only know from the Dowd's archives that RCA had 9-pin sockets since February 1946. The estimated budget for the equipment needed to produce the A4498 listed the procurement of 500 nine-pin sockets: RCA had certainly then activated at least one supplier, giving him the drawings of the noval base. Probably, after the official announcement, its salesmen had to sample for a while the 12AU7 complete with its precious noval socket to top customers.

Anyway we know that about from mid-1947 noval sockets and also suitable tube testers became to be regularly advertised in the pages of Electronics.

A NEW TUBE..... AN IMPROVED TUBE..... SPECIAL INFORMATION

# RCA<sup>®</sup> electron tube ANNOUNCEMENT

RADIO CORPORATION OF AMERICA  
RCA VICTOR DIVISION  
HARRISON, NEW JERSEY



October 8, 1946

TUBE DEPARTMENT

Gentlemen:

The new 12AU7--a companion tube to RCA's Miniature Tube Family-- is a small, twin-triode amplifier having characteristics which are very similar to those of the larger types 6SN7-GT and 12SN7-GT.

It utilizes a new button base with 9 pins on a circle a little larger than that of the regular miniature 7-pin button base in order to provide the required additional base-pin terminals, and a glass bulb (T-6-1/2) only slightly larger than that (T-5-1/2) used on the regular miniatures. The 12AU7, therefore, is suitable to include in miniature tube complements whenever equipment design so requires.

Like the larger 6SN7-GT and 12SN7-GT, the 12AU7 is useful in many diversified applications including mixers, oscillators, multi-vibrators, synchronizing amplifiers, and numerous industrial control devices.

In such equipment, the 12AU7 can be employed to advantage because of its compact size, its separate terminals for each cathode, its mid-tapped heater to permit operation from either a 6.3- or a 12.6-volt supply, and its economical consumption of heater power.

The attached bulletin will give you additional technical information on the RCA-12AU7.

If you desire further information on this new tube, we invite your inquiry.

Very truly yours,

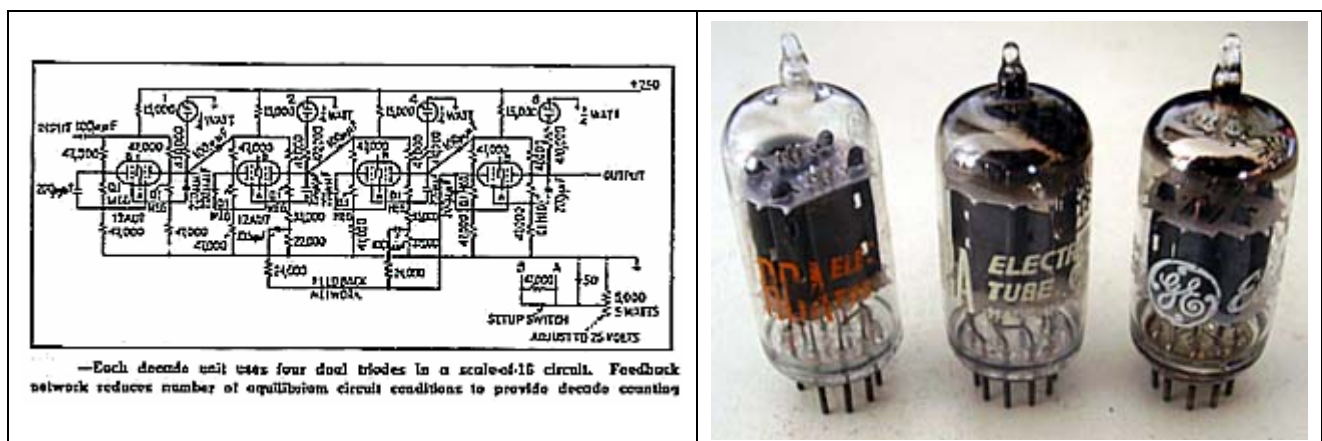
Manager,  
Equipment Sales

LSThees:JS

- The official announcement of the 12AU7, double triode in the new all-glass bulb with noval base, was given as soon as early news of the RMA registration arrived. (RCA-Dowds archives)



The 12AU7 was designed with center-tapped heater, in order to operate at both 6.3 and 12.6 volts and replace the octal types 6SN7 and 12SN7. It was a general purpose double triode, proposed among the other applications as AC/DC amplifier in control systems, as oscillator/mixer or as multivibrator. Obviously we can assume that at the beginning it was accepted with some hesitation in power sets or in any case where most of the tubes were still of the octal type. There weren't many advantages in replacing just a single 6SN7 in a power amplifier or anyway in a set full of many larger tubes. Referring to TV sets, it was necessary to wait for the appearance of more novel tubes, which took at least a couple of years. Certainly at the beginning the 12AU7 was accepted more quickly in the design of innovative airborne equipment, where the reduced size was a priority, in some types of instrumentation, for example single tube VTVMs, and in sequencers or numerical counters full of bistable multivibrators. In February 1948 Electronics published an article on an [industrial counter](#) extensively using these tubes in counting modules, in the control sequencer and in the pulse former. Basing upon the average latency time to have an article printed in Electronics, we must assume that the design was completed not later than October 1947. This kind of counters was not new, since similar sets using octal tubes were currently advertised by other firms, as Potter. It is anyway quite interesting, since counting modules based upon four 12AU7s appeared later in Beckman and HP digital counters/frequency meters, as the marvelous HP 524B, in which designers specified the computer-rated version 5963. And obviously computer-rated types were widely used in the myriad rows of racks full of flip-flops into the big mainframe computers of the '950s.



Left, in 1948 Electronics gave the description of a digital counter using four 12AU7s for each decade. Right, samples of RCA and General Electric 12AU7 tubes.

#### Bibliography and documents

- [Allied Radio catalog, 1947](#)
- [Electronics, February 1948, Predetermined Counter for Process Control](#)
- [General Electric ad, from Electronics, November 1947](#)
- HP 524B Technical Manual
- MIT Rad. Lab. Series volume 17, 'Components Handbook' by Blackburn
- [Philips Australia, 1949 booklet on 'Innoval tubes'](#)
- [Philips Technical Review, October 1946 on Rimlock tubes](#)
- [Preferred list of Army-Navy electron tubes, 28 January 1947](#)
- [RCA Harrison - Dowd archives, scanned by TCA](#)
- [RCA Review, April 1940 - ... New Miniature Battery Tubes](#)
- [RCA Review, June 1947 - Miniature Tubes in War and in Peace](#)
- [RMA registration release no. 529](#)