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Radio Technology July 2000 Announcement by Shinichi Noro D-NFB (NFB for Distortion Only) Amplifier Reproduction Experiment

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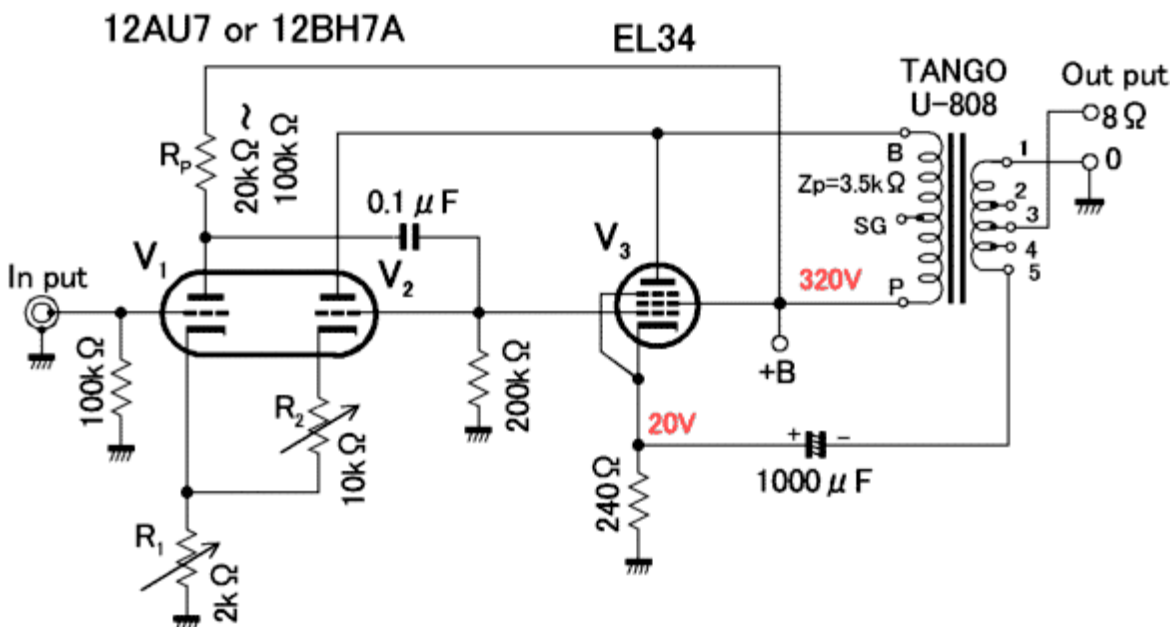
[D-NFB Simulation](#)

The D-NFB (NFB for Distortion Only) 6G-B8 single amplifier presented by Shinichi Noro in the July 2000 issue of Radio Technology is a circuit similar to my ultra-triode connection [Ver.3 KT90 single amplifier](#), but it achieves an extremely low distortion rate and extremely low output impedance by operating principles different from the ultra-triode connection.

For more information, please refer to Radio Technical Magazine.

The following is a report of an attempt at a reproducibility experiment.

Experimental circuit



Since the parts used are different from Mr. Noro's circuit, I would like to say at the beginning that it is not an accurate reproduction experiment.

In the experimental circuit, V_1 is the first stage tube, V_2 is the distortion detection tube, and V_3 is the output tube.

The input signal voltage is applied to the grid of V_1 , and the strain voltage of the

output stage detected by V_2 is applied to the cathode.

If there is no distortion in the output stage, the input signal voltage is amplified by the same amplification of the initial stage and the output stage.

The distortion of the output stage is the component compared to the amplification characteristics of V_2 .

Therefore, this circuit seems to operate so that the amplification characteristics of the output stage are equal to the amplification characteristics of V_2 .

EL34 (6CA7) was used for the output tube, and Tango U-808 was used for the output transformer.

I experimented with the first stage tube and the distortion detection tube by replacing 12AU7 and 12BH7A, but both can be used.

The reason why the cathode NFB is hung on the output tube seems to be to prevent the gain of the output stage from fluctuating greatly depending on the presence or absence of load.

If the cathode NFB is lost, oscillation may occur when the load is removed.

The plate resistance R_P of the first stage tube was replaced from 20 k Ω to 100 k Ω and experimented, but it can operate at any resistance value.

R_2 changes the output impedance.

The output impedance measured the change in output voltage with or without load.

When the output voltage rises from load to no load, the output impedance is positive, the larger the amount of rise, the higher the output impedance, and if the output voltage does not change, it can be judged as 0, and if the output voltage decreases, it can be judged as negative.

Reducing R_2 reduces the output impedance, which can be 0 or even negative, but if it is reduced too much, it will oscillate.

Oscillation causes an overcurrent in the output tube and increases the cathode voltage.

R_1 changes the distortion factor.

A strain meter is required to measure the strain rate.

We could have achieved less than 0.01% at $f=1\text{kHz}$ $P_O=1\text{W}$ $R_L=8\Omega$, but this requires some adjustment.

Because reducing R_1 lowers the plate voltage at V_1 , unfortunately we were unable to reach the point where the distortion factor and the minimum point of the output impedance coincide at this stage.

I still don't understand the theoretical aspects of DNFB in detail, so I may be doing something off the mark.

Or maybe you don't have the right interpretation of this circuit.

My current impression is that although it is a simple circuit, it can be expected to have very high performance, but the adjustment is troublesome.

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I think it is too early to draw conclusions despite not having done enough experiments and analysis, but I would like to write down what I feel now.

Since the output impedance and distortion rate can be changed depending on the tuning (adjustment), it seems that the characteristics can be adapted according to the listener's preference, but since the tuning position is pinpointed, it is expected that it will be a characteristic that you do not like at different frequencies, different load impedances, and different outputs, and I think that there is an aspect that can not cope with the dynamic thing of the speaker.

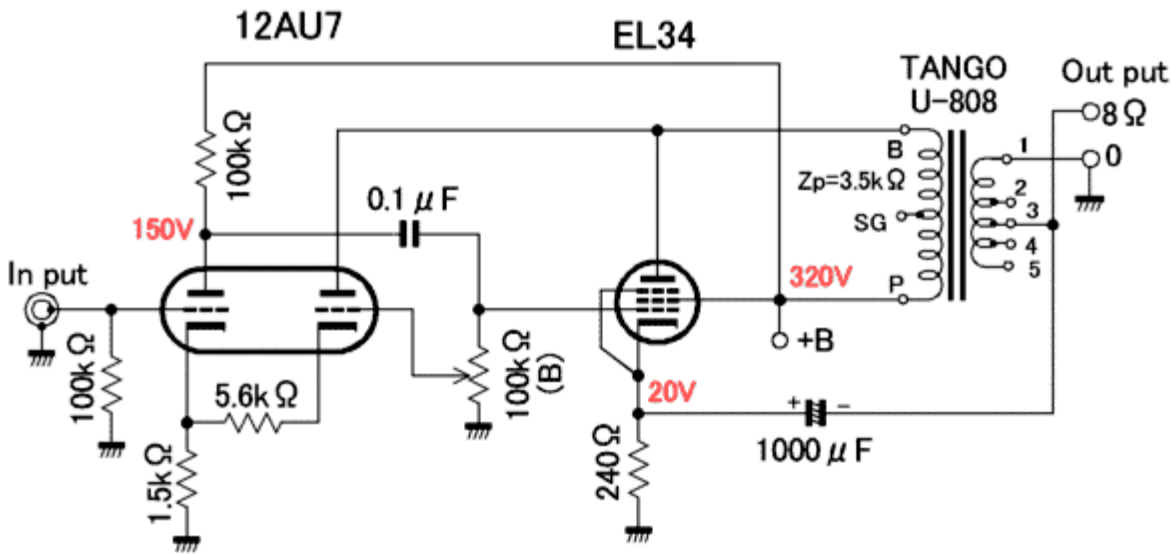
As a normal person, I am not a hobbyist, but I enjoy the characteristics that swing in music, and I have an atmosphere that seems to be received by maniacs (people in bad taste), and if I make a mistake, it will become a dangerous amplifier and I am worried about the future.

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Make adjustments easier

Since the DC operating point moves when adjusting R_1 and R_2 , the circuit is changed as shown in the figure below so that the positive feedback amount can be changed without changing the operating point.



Raising the 100kΩ volume slider from the ground side to the first grid side of the **EL34** increases positive feedback and reduces the output impedance. If the output impedance is set too low, it will oscillate, so it is safer not to make it 1 Ω or less.

By the way, I will introduce a simple measurement method to read the output impedance directly.

When an 8Ω load is connected, the output voltage is aligned to position 8 on the meter scale, then no load, and the output voltage is read on the meter scale, and that is the value of the output impedance.

For example, if the output voltage when an 8Ω load is connected is 0.8V and the output voltage when unloaded is 1V, the output impedance is 1.2Ω because the amount of change on the scale of the meter is 1.2. If the output voltage at no load is 0.7V, the output impedance is -1Ω.

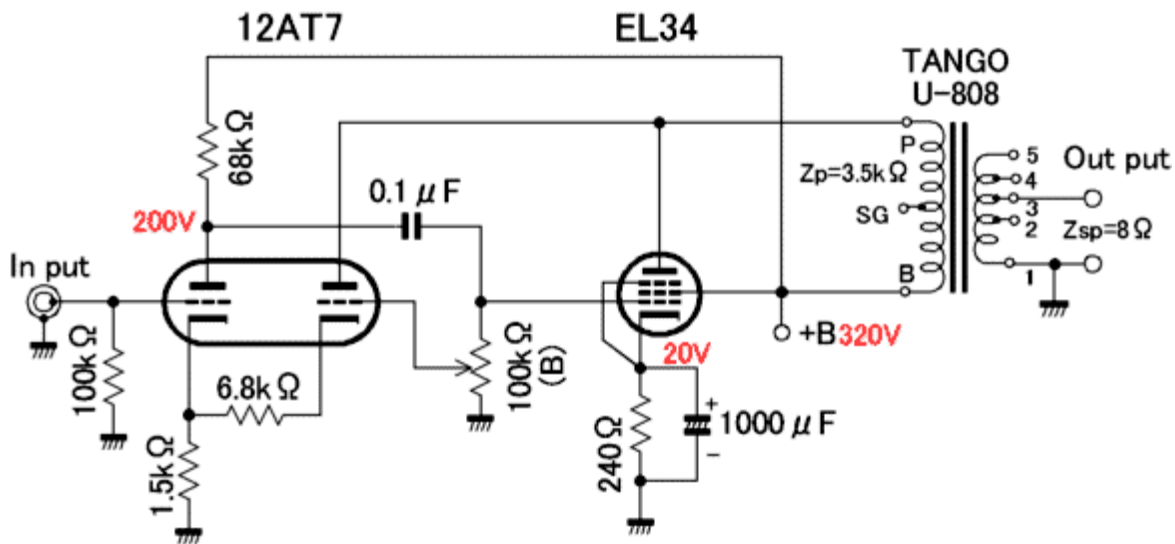
When the output impedance is small, it becomes unstable when unloaded, and when the output voltage waveform is observed with an oscilloscope, it can be confirmed by the waveform oscillating up and down as a whole.

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Increase Gain

At 12AU7, which has a low μ , the input/output gain of the amplifier is only about 5 times, so I replaced it with a 12AT7 with a larger μ .



It seems to be okay without cathode feedback in the output stage.
The characteristics of $R_L = 8 \Omega$ $f = 1 \text{ kHz}$ are

THD=0.023%

$Z_o=0.9\Omega$

$A_v=13$

This is finally an amplifier with practical performance.

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