UL40-S2 with Auto-Bias and modified Ig2 compensation

This document describes implementation of the Tentlabs/Vanderveen Auto-Bias unit in the UL40-S2 valve amplifier modified with Ig2 compensation to achieve lower 2nd harmonic distortion, after ‘Vanderveen Trans Tube Amplifiers, figure 7-4, page 58’.

Introduction:

The Tentlabs/Vanderveen Auto-Bias unit is aimed at keeping I\textsubscript{cathode} constant and identical for both output tubes. The toroidal output transformers however require that I\textsubscript{a} is identical for both tubes to achieve lowest distortion. Since Ig2 is part of I\textsubscript{cathode} (for pentode, UL and Super-triode configurations), and can vary from one valve to the next, I\textsubscript{a} = (I\textsubscript{cathode} − Ig2) could vary too.

Menno van der Veen describes a neat solution to correct for this current difference in his book Trans Tube Amplifiers for his Trans-30 amplifier. Why not modify the UL40-S2 the same way? Below is shown what is needed, and further on the results are presented.

Schematics:

![Schematic diagram of UL40-S2 Auto-Bias circuit with Ig2 compensation](image)

**Fig. 1: UL40-S2 Auto-Bias circuit with Ig2 compensation**

The following components are added:

- P4 = 1k trim pot
- R17 = 270R
The runner of P4 is mounted to the original connection of C6 (positive side). Wire the two legs of P4 to the corresponding cathodes of B2 and B3.

R17 (originally the cathode resistor) is enlarged to 270 Ω.

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Fig. 2: PCB layout

- The runner of P4 is mounted to the original connection of C6 (positive side). Wire the two legs of P4 to the corresponding cathodes of B2 and B3.
- R17 (originally the cathode resistor) is enlarged to 270 Ω.

Fig. 3: UL40-S2 with Auto-Bias unit

Fig. 4: Detail of P4 and R17 placement
Results:

Fig. 5: AB test with 70 Hz test signal +9 dBV (= 1 W in 8 Ω)
With P4 in its mid position, no adjustment is made for differences in \(I_{g2}\).

\[2^{nd}\text{ harmonic} = -60 \text{ dB} = 0.1\%\]

Fig. 6: AB test with 70 Hz signal +9 dBV (= 1 W in 8 Ω)
P4 is adjusted to minimize the \(2^{nd}\) harmonic component.

\[2^{nd}\text{ harmonic now is } -76 \text{ dB} = 0.016\%\]
Conclusion:

The above shows the benefit of implementing an extra trim pot to optimize the $I_{g2}$ balance with the use of the Tentlabs/Vanderveen Auto-Bias unit. As a result, the 2nd harmonic distortion at 70Hz was reduced from 0.1 % to 0.016 %.

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Literature:


Fig. 7: UL40-S2 Valve Amplifier