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 I_{g2} compensation to achieve lower 2nd harmonic distortion, after 'Vanderveen Trans Tube Amplifiers, figure 7-4, page 58'[1].

Introduction:

The Tentlabs/Vanderveen Auto-Bias unit is aimed at keeping $I_{cathode}$ constant and identical for both output tubes. The toroidal output transformers however require that I_a is identical for both tubes to achieve lowest distortion. Since I_{g2} is part of $I_{cathode}$ (for pentode, UL and Super-triode configurations), and can vary from one valve to the next, $I_a = (I_{cathode} - I_{g2})$ 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:

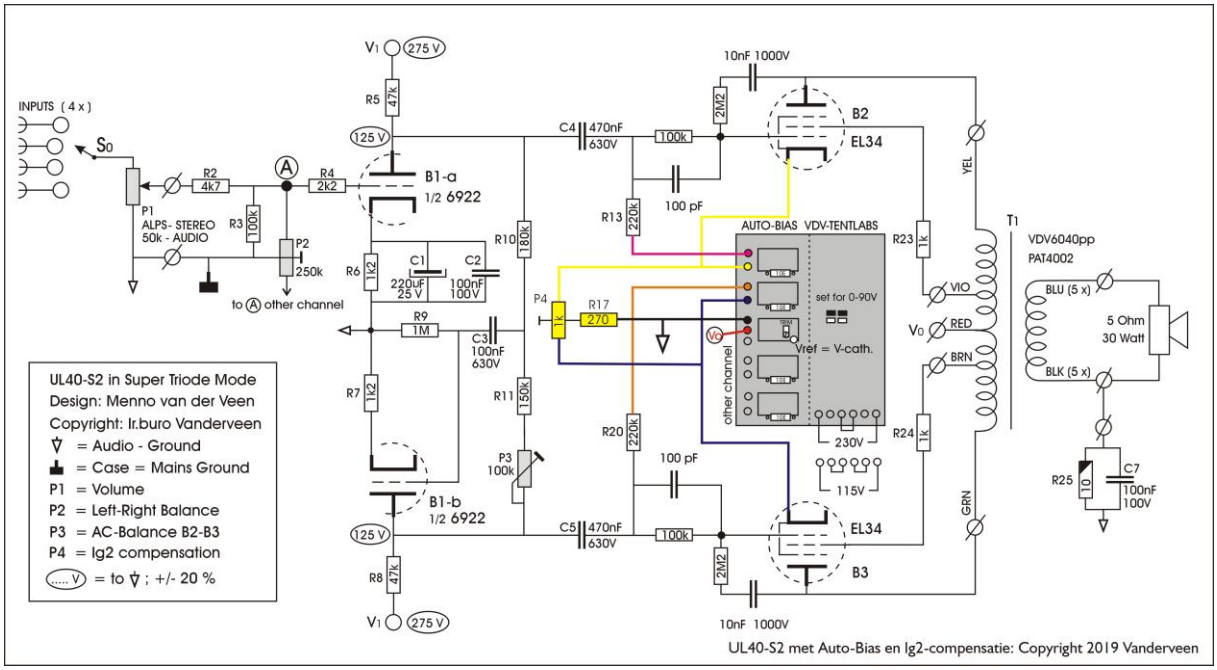

Fig. 1: UL40-S2 Auto-Bias circuit with I_{g2} compensation

The following components are added:

- P4 = 1k trim pot
- R17 = 270R

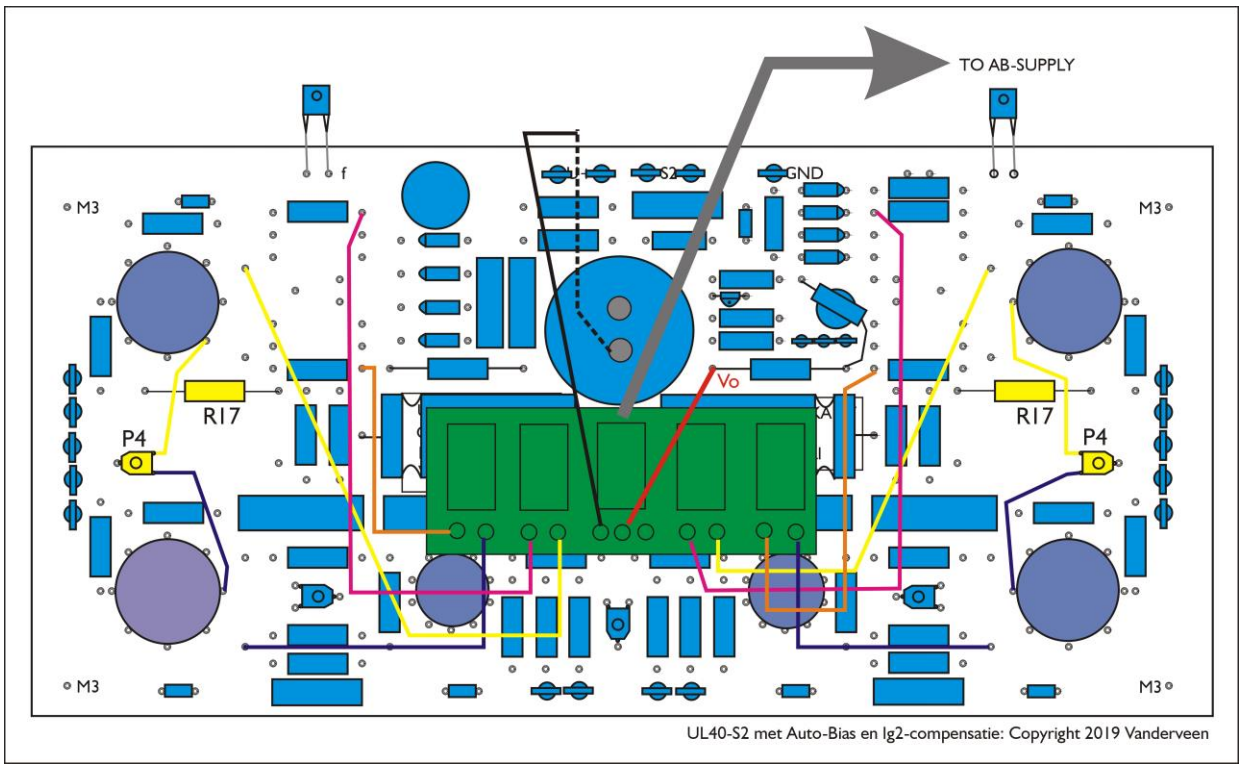

Fig. 2: PCB layout

- 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.

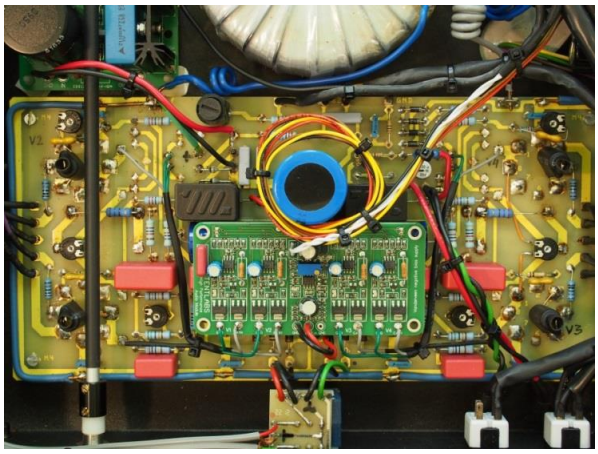

Fig. 3: UL40-S2 with Auto-Bias unit

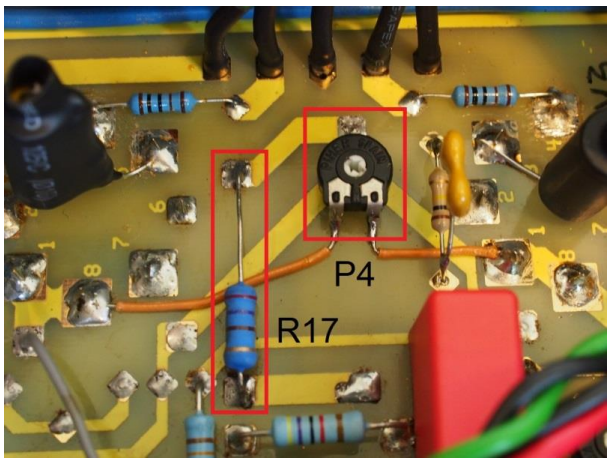

Fig. 4: Detail of P4 and R17 placement

Results:

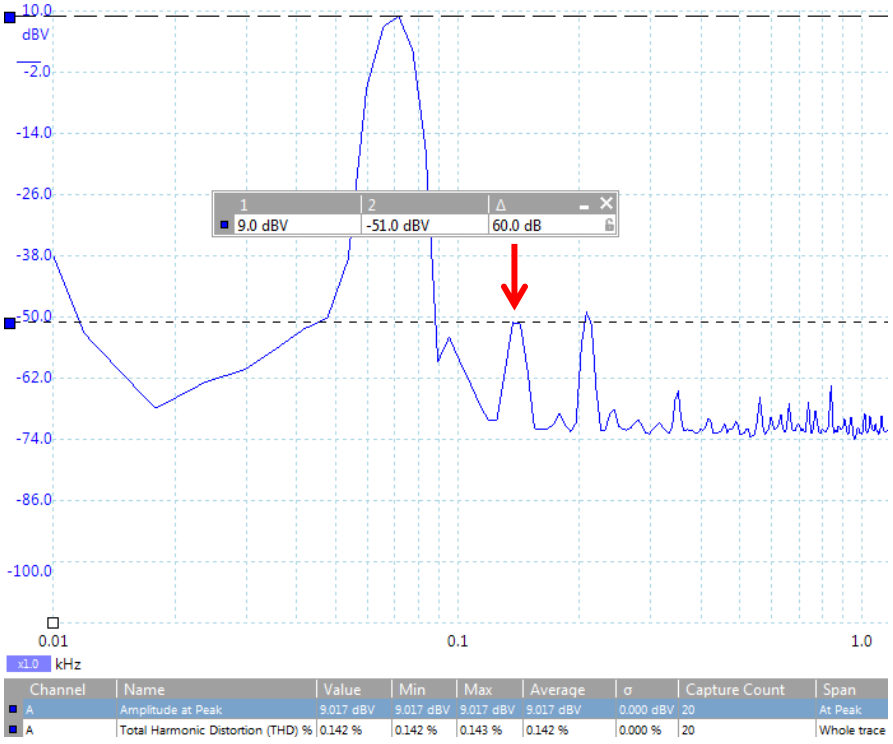

Fig. 5: AB test with 70 Hz test signal +9 dBV (= 1 W in 8 Ω)

With P4 in its mid position, no adjustment is made for differences in I_{g2}.

2nd harmonic = -60 dB = 0,1 %

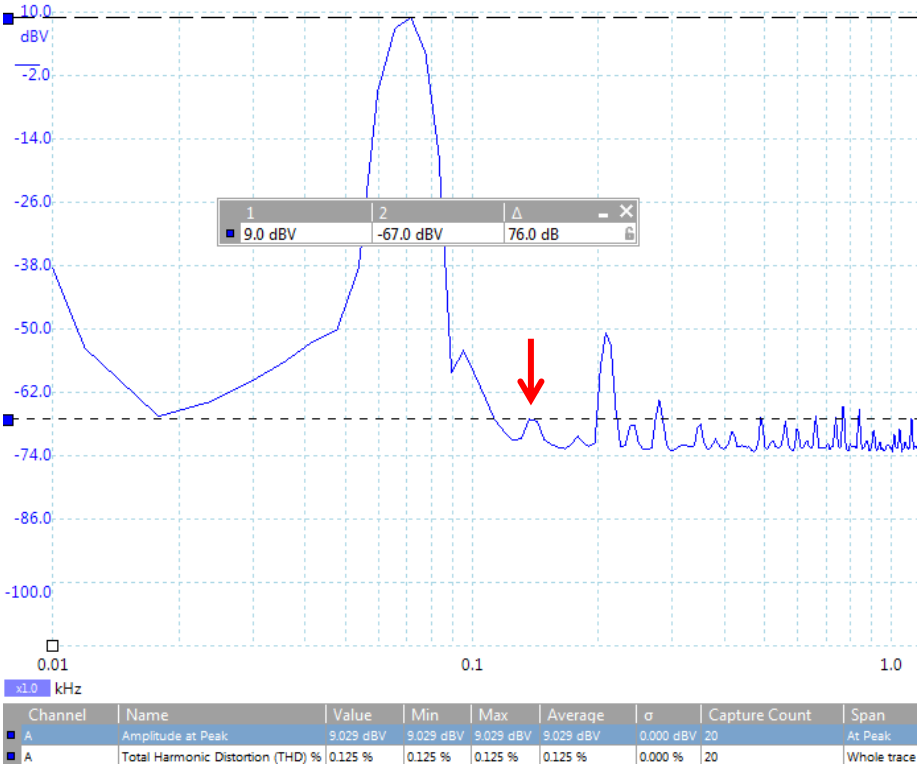

Fig. 6: AB test with 70 Hz signal +9 dBV (= 1 W in 8 Ω)

P4 is adjusted to minimize the 2nd harmonic component.

2nd harmonic now is -76 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:

1: Menno van der Veen: "Vanderveen Trans Tube Amplifiers"; ISBN 978 1907 9203 49; www.elektor.com available as e-book

Fig. 7: UL40-S2 Valve Amplifier