

Conclusions of Bruno Putzeys's excellent article "Why there is no such thing as too much feedback", Linear Audio, vol.1, April 2011, contains some kind of "reminder" for engineers and audiophiles, some provisions of which must comment:

Finally, some stuff to remember

- 1) Beware of error sources outside of the feedback loop.
- 2) TIM is not a special type of distortion; it is a method to test for Slew Induced Distortion.
- 3) SID can be eliminated without changing loop gain. Therefore, SID is not caused by negative feedback.

– This is only true half. In fact, these distortions (TIM) arise due to violation of the Dynamic Linearity Criteria, which binds a slew rate V_m , loop cutoff frequency f_{co} (i.e. amplifier's frequency range) and linear region of output voltage U_m (see articles and my book): $V_m \geq 2\pi \times f_{co} \times U_m$. The Criteria can be satisfied either by increasing a slew rate, or by decreasing a loop gain, or by decreasing an output voltage maximum. Bruno suggests rising of a slew rate, although in a classic Lin's topology this leads to decreasing of a loop gain, as a rule. However, with the same success a loop gain can be reduced, i.e. NFB concerns TIM in any case. It should be noted that the maintenance the Criterion would be easily provided by a topology with a parallel high-frequency channel (on which UMVT84 implemented) in which slew rate could be controlled independently of the loop gain (see Danilov A.A. HIGH-POWER DC SCALING AMPLIFIER // Instruments and Experimental Techniques, 1989, T. 31, №6 pt2, pp.1489-1491).

- 4) Improving loop gain improves TIM. There is no horse trading between "ordinary" distortion and TIM.

– If the Criterion violated, increasing of a loop gain leads to increasing of TIM.

- 5) Ojala's work neither implies nor proves that valve amplifiers are better than solid state.
 - 6) DC open loop gain is no measure of how much feedback an amplifier has. Loop gain at 20 kHz is.
 - 7) Slew Rate is a bad predictor of audio performance.
 - 8) Open-loop bandwidth is no measure of how fast an amplifier is. Gain-bandwidth product is.
- The question is whether you will be able to apply the desired NFB to amplifier with that open-loop bandwidth, without breaking its stability.**
- 9) Make sure you have actually heard an amplifier with proven negligible distortion before having opinions re sound vs. measurements.
 - 10) Make sure you have actually heard an amplifier with large loop gains before having opinions re sound vs. feedback.
 - 11) Various proposed alternative error correction schemes are functionally equivalent to feedback.
 - 12) Nested feedback is functionally equivalent to global feedback.
- Here it is necessary to clarify: "if it does not change the loop gain and affect the stability." This is possible only in one case - amplifying stage is the emitter or source follower. In all other cases, there is an expansion in bandwidth and increased phase shift, which leads to problems with stability, and forcing to introduce additional frequency correction, which reduces the loop gain. The overall effect is usually negative, i.e. distortions will increase.**
- 13) Higher order loops make it possible for slower amplifiers to attain top notch audio performance.
 - 14) There are only advantages and no disadvantages to applying stratospheric amounts of negative feedback in an amplifier. The only hard part is figuring out how to do it.
 - 15) The more feedback, the better it sounds provided that it's never less than 30dB at any audio frequency.