

TPA3255 And Postfilter Feedback (PFFB)

For some time there seems to be some hype about postfilter-feedback in this forum. When I started evaluating TPA3255 I did my own investigations on that issue resulting in an approach different from TI. Some aspects not covered by TI app note SLA788 reveal additional insights and may change your point of view.

Adding PFFB to the internal prefilter feedback reduces nonlinearity of output filter and improves overall linearity as well. This is achieved by reducing the gain of the power amp and as a result require additional gain for compensation. But with a fixed gain of approximately 21.5dB there not very much you can reduce furthermore. According to TI's appnote SLAA788 a gain reduction of 5.5dB was achieved giving the same amount of negative feedback. To take advantage of less than 6dB lower THD figures the driving op-amp must deliver 6dB more output level – at a very low distortion. It should be mentioned that THD and noise measurements done by TI's labs were performed by feeding the EVM directly with the symmetrical output of the AP signalgenerator. No recommendation is given for a real-world audio-frontend which certainly would further degrade the numbers. So what can we expect? Some 4-5dB lower THD- and noise figures or less at the expense of an exceptional op-amp in the audio frontend. Speaking frankly, for me this is not worth the effort. THD and noise are fine even without PFFB. But there is more to say about PFFB.

Besides the sparse improvements of linearity the PFFB improves frequency response above the audioband by dampening the output LC-filter resonant tank. The resonant peak in the area of 50kHz can be considerable specially with the output unloaded. LC output filters are calculated for critical dampening with 4 or 8 ohms speaker resonance. It should be pointed out that dampening of a 50kHz resonant tank requires a resistor with a real impedance of 4 or 8 ohms **at 50kHz**. There is very little chance to find a real-world loudspeaker with 4 or 8 Ohms real impedance upto 50kHz. Accordingly square response is measured in the testlabs with low inductance dummy loads yielding impressive oscilloscope plots. Certainly it is a fact that the resonant peak is considerably dampened by PFFB as implemented by TI. But being wicked guy I assume a real speaker with its self-inductance provides an open circuit at 50kHz. So testing the **unloaded** output filter resonance with square waves is the real way to investigate overall stability.

Anyway the relevance of these considerations is debatable. With band-limited signal sources like digital audio with sample rates of 44kHz you cannot excite that resonant tank – and you will never encounter any related problem at all. As there is no content above 22kHz in the signal, so why care about a peak of 50kHz?! It is really simple like this. Test your amp with the output of your soundcard with 44kHz sample rate and you will observe no strange behaviour at all. Do we have to consider frequency response of our audio equipment above the audio band? This has been debated for decades, and my opinion is firm: There is no audible relevant need for such improvements.

But for me it is fun to expand the limits of amps beyond personal perception, nothing more nothing less. A close to perfect square wave response always intrigues me. It may be irrelevant to the perceived sound but it gives a feeling of stability and wide bandwidth: The eyes are listening as well!

The screenshot shows a RIGOL oscilloscope interface. At the top, the status bar includes the RIGOL logo, a STOP button, and various settings: H 200us, 250MSa/s, 600k pts, D 0.00000000ps, T 120mV. The main display area shows a square wave signal. The left sidebar contains measurement settings: Period, Freq, Rise Time, Fall Time, +Width, and -Width. The right sidebar shows a label 'Verzög. Kal.' with a value of 0.00 s. The bottom status bar displays the following measurements: Freq=996 Hz, Rise<10.00us, Vpp=19.8 V, Vpp=20.0 V, Vpp=2.00 V.

