

LEF technology: The new generation of analogue amplifier! Avoiding signal losses instead of correcting signals

Distortions and other sound degradations of amplifiers are due to one main reason: The signal is running through the non-linear characteristic of transistors or tubes. (Other distortion sources, like poor power supply and component parts are avoidable by proper engineering.) Triode tubes, pentode tubes, FETs and transistors have different characteristics, but one common fact: They are all non-linear! If their characteristic would be linear, it would be easy to build good sounding amplifiers.

The common way of reducing measurable distortions is negative feedback (NFB). At the first glimpse this method seems to solve the problem, but only for static test signals, not for “random” music signal – looking good on measurement equipment and paper, but with the usual limitations in sound we all got used to.

As there are no common ways to test short time (transient) distortions, which happen during fast signal changes, most engineers assume they don't exist. Prof. Mati Ojala developed a way to measure TIM – Transient Intermodulation, which is only a small part of the whole story.

Carlos Candeias succeeded in proofing these short time distortions, which origins from NFB limitations. As a consequence the development of amplifiers without negative feedback, as well as very low dynamic and static distortions was initiated. (There are already amplifiers without NFB on the market, but with sound influencing distortions.)

LEF avoids degradations of sound instead of “correcting” it afterwards.

The breakthrough of LEF circuit is: The signal transistor does neither pass through its voltage characteristic V_{ce} nor the current characteristic I_c .

Passing the voltage characteristic is avoidable by using floating cascode circuit. This method is known, but causes losses in efficiency and power when using traditional circuitry.

As the signal transistor in LEF circuit does not handle the current requested by the speaker, loss in efficiency is negligible.

LEF's most significant progress is splitting the handling of the loudspeaker's current request from the music signal voltage output stage!

LEF means “**Load Effect Free**”. This means: The signal transistor is not loaded by the speaker's current request, because he has strong current handling “assistants” – thus no sound degradation effects due to the load happens.

With today's common amplifiers it is easy to hear whether it sounds like an airy ballet dancer or a heavyweight bodybuilder, because the music signal has to pass the more or less “heavyweight” output transistors using NFB correction.

In LEF technology the fast, airy and delicate signal transistor and the heavyweight current assistants work, supporting each other. However, the current assistants are not “allowed” to take part of the signal voltage. This means: The signal transistor does not pass through his current characteristic I_c . The load, usually the speaker, “sees” only the signal transistor, but no “current assistants”. This is due to the signal transistor's very low output impedance, combined with the very high output impedance of the “current assistants”. In case of some small current inaccuracy that may occur, the “current assistants” are safely “overruled” by the signal transistor.

Unlike usual amplifiers the LEF amp sounds like unlimited power, as long as it works within the designated power range; combined with speed, dynamic and colourful elegance.

Leonardo da Vinci and LEF

Let's illustrate LEF:

Imagine: Leonardo da Vinci's task is painting a church in Florence - completely and very detailed. (In this example Leonardo da Vinci is the LEF signal transistor.)

He can easily paint well in front of his chest.

As the church is very high (illustrating transistor's voltage characteristic V_{ce}), he stands on a movable platform, lifting him to optimum height, so he always can paint in front of his chest, without ever stretching himself to the limits. (The platform stands for the floating cascode.)

But during painting he has to carry all his heavy pails full of colors (... for current characteristic I_c) on his arms - Impossible for fine painting! Luckily he has very strong assistants (... current assistants) handling his pails, so that he can easily paint without feeling any weight beside the brush.

If you also imagine, Leonardo paints with both hands, at the same time with small and large paint-brushes, using a large palette of colors, and painting in high speed – then you are close to understand the advantages of LEF.

By the way: Usual amplifiers act like painters always carrying their pails while painting and always using stairs and arm stretching in order to reach the whole painting area.