Preface to the 2nd Edition

This 2nd edition marks a turning point in my life as analogue audio amplifier enthusiast. In the past as General Manager and/or CEO of several software-producing companies I had to learn to live with the sometimes rather strange looking attitudes towards customers. What I mean is the way of developing and selling software by use of astonishing approaches with eg taking customers by surprise with huge announcement actions, offering of beta versions, steadily shipping of releases to improve incomplete or defective versions, collecting of improvements via 'let the customers do the job demands', continuous and never-ending bug fixing, etc. These software related experiences triggered my mistrust most when it comes to acceptance questions concerning simulation software for audio equipment and their devices. Nevertheless, I had to learn that during the past three decades things changed a lot on the field of software-based simulations of electronic circuits. Very expensive softwares had to go, replaced by free solutions à la LTSpice from Linear Technology.

That's why I'm convinced now that—concerning the low-noise audio equipment I present in the book on hand—this modern simulation software will be able to yield results very close to the calculated and measured ones.

However, the application of such software will work well only if we understand how the simulated DUT treats all kinds of amplifier transfer questions in all parts of its electronic circuit. In most chapters of this book the basic focus is on noise generation of audio pre-amps. It is a very wide field that is eg poorly managed by many Spice models of bipolar junction transistors (BJTs), valves, and transformers. Despite the easy time and cost-saving work with LTSpice I'm also convinced that only a mathematical description of the DUT's circuit will lead to a full understanding of its noise generation.

I think, after many tests, LTSpice offers the right power to produce reasonable results. Therefore, concerning the goals of this 2nd edition the enlarged emphasis lies on the simulation approaches of all presented amplifier and measurement solutions, of course including their traps. Gained results will always be presented in conjunction and comparison with the necessary calculation results. In most cases, measurement results judge the software's usability additionally.

Thus, with regard to the 1st edition (TSOS-E-1) the here presented 2nd edition of "Balanced Phono-Amps" (TSOS-E-2) shows the following improvements and add-ons:

1. A very new 'Part I: Basics—Simulations and Calculations' with nine chapters covers the fundamentals about the noise calculation and simulation alternatives of fully differential amplifiers, based on solid state (BJTs and op-amps) and triode designs. It also includes excess noise calculations and simulations of resistors.
   A new and extensive chapter allows calculating the Spice flicker noise coefficients AF and KF of BJTs. Exclusively, application of these factors will lead to useful and sense-making noise simulations of electronic circuits with BJTs.
   In the professional as well as in the consumer world small-signal triodes still play a major role in audio pre-amplifier circuits (triodes in power amplification are not on the focus of this book). A new chapter about the triode's noise production allows simulating any kind of triode in any kind of small-signal audio configuration.
2. In 'Part II: Example Phono-Amp—The RIAA Phono-Amp Engine II' (formerly Part I and now with 12 chapters) various simulation approaches complete the measurement and calculation results of all shown amplifier stages of the headline's Engine II. Its main focus is on MC cartridge amplification.
3. 'Part III: Knowledge Transfer' (formerly Part II and now with 12 chapters) is still a collection of amplifier designs (also with new and extremely low-noise ones) and useful measurement devices. Additionally and under the light of the balanced or un-balanced question, I add a further discussion on MM amplification including or excluding very sophisticated load synthesis (also called electronic resistor cooling) approaches. This part is rounded-up by an extensive chapter with—partly self-developed—Spice models of all devices used in this book.
4. Very detailed indexes of this book (black) and of the 2nd edition of 'The Sound of Silence' (red) close the book's 'Part IV: Appendices and Indexes'.
5. Readers may be surprised that I do not tackle noise issues of Junction Field Effect Transistors (JFETs) in depth. In fact, compared with BJTs they do not fall into the lowest-noise category of singletons in MC amplification circuits. Like triodes, their singleton place could be found in other than MC input stages; eg in input stages of MM phono-amps or in intermediate amp stages. I guess, the two editions of 'The Sound of Silence' and the here presented Chaps. 22 and 23 do offer enough insight into the matter. Nevertheless, in Chap. 22 I present pre-amp solutions with several paralleled input JFETs and/or extensive paralleled JFETs in long-tailed pair (LTP) configurations, however, not designed by myself.
6. Of course, I tried to find and I took care of all typos, bugs and calculation errors. Additionally, I've changed the temperature and tolerance settings on all Mathcad worksheets: from T := 315 K or 300 K to T := 300.15 K, from default TOL := 10^{-3} to TOL := 10^{-12} or 10^{-14}. Thus, direct comparisons with simulation results are based now on common treatments.

7. On Springer's website of 'Extra Materials' readers will find all Mathcad worksheets presented in this book. They can be downloaded free of charge.
8. Many thanks to:

   8.1 The authors of 'The Art of Electronics', Mr. Hill and Mr. Horowitz, who provided me with important spectra about the noise voltage density of extremely low-noise BJTs.

   8.2 Douglas Self, who convinced me to produce a clearer statement about the advantages and disadvantages of balanced and/or un-balanced input stages of MM phono-amps, of course in conjunction with his special approach of load synthesis.

   8.3 Jan Didden, who did not hesitate to publish short versions of some of the book's chapters in his Linear Audio bookzines, completed by a number of letters to the editor, still available on LA's website free of charge.

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