# The Sound of Silence

Burkhard Vogel

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## Lowest-Noise RIAA Phono-Amps: Designer's Guide

2nd Edition

Springer

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*To Beate*

# Preface Second Edition

It happens always the same way! You have finished writing a book, the editors undertake everything to bring it on the markets in due time, but a simple question by a friend: "did you also tackle this or that issue" immediately rings the alarm bell that something was really forgotten to mention in the first edition. I hope it will not be the case with this second edition and it will satisfyingly answer all questions concerning e.g. the measurement of electronically produced hum as well as it will bring more clearness on basic reference and calibration levels of vinyl records. The complete reworking of all chapters, a new numbering of the chapters, the correction of printing errors and a broad range of add-ons to existing chapters should accompany the below given concentration of the very new themes integrated into this new edition. These themes look as follows:

- A new chapter (3) on "Modern Vinyl Record Reference Levels" shall clear things between prospectus data and reference level requirements. It also includes a description of the different cutting/modulation possibilities to cut vinyl records.
- A new Chapter (12) that offers many MCD Worksheets on the Noise Basics part of the book.
- A very enlarged Chap. 7 on the theory of electronic noise produced by triode driven phono-amps.
- A new Chap. 17 on the handling of electronic noise and the practice of triode driven phono-amps.
- A new Chap. 24 on the qualification of hum in linear amplifiers. The Hum Figure is a new development that could set a standard approach for a method to measure the hum content of the output noise of linear amplifiers.
- A new Chap. 25 on a new development that could lead to a standard approach for a method to measure the Hum Figure of phono-amps.
- A new Chap. 26 that offers many MCD Worksheets on the Noise and Measurement System part of the book.
- The comparative discussion on various noise measurement methods leads to suitable measurement handlings of hum-infected amplifiers.

- A detailed survey on FFT measurement methods throws light upon its misuse in test magazines.
- A broad analysis on the most common noise measurement methods allows creating special tables and figures for measurement result reconciliations from one method to another.
- The discussion on the use of the equivalent noise bandwidth leads to a special band-pass filter allowing a general wyciwym approach (what you've calculated is what you measure).
- A discussion on the theory of the optimal source resistance for BJTs and Op-Amps leads to different looking practical solutions.
- The Module 3 phono-amp section works well now and it shows an excellent and record-signalling noise behaviour for low-impedance (<5 Ω) MC cartridges with rather low output levels.
- Not to forget: the amount of Mathcad 11 Worksheets increased by 160%. However, they will still be available for free on the www.springer.com web site. In addition, because of the world-wide economic troubles we had during the past years there might be superscripts in the text leading to web sites with changed content that will no longer offer the information used in this book (e.g. data sheets, application papers, etc.). In theses cases readers should ask for advice from the author via Springer Editors and e-mail.

Two commercial companies were most helpful with hardware. Without big discussion JJ Electronics[1] from Cadca, Slovak Republic, did support my studies by sending me a range of low-noise selected and non-selected double-triodes and the many meters of Mogami 2549 cable came from F. E. G. Future Equipment Service[2] from Hamburg, Germany.

I guess that nearly 100% of the preface of the first edition is still worth reading. Therefore, I have decided to leave it like it is.

Stuttgart, Germany Burkhard Vogel
January 2011

[1] www.jj-electronic.com
[2] www.feg-online.de

# Preface First Edition

It is still a challenge to develop a low-noise amplifier – despite the fact that nowadays (2007) nearly every solution of an electronic question of the consumer world can be solved by digital means. There is a wide field of tasks left that can satisfyingly only be attacked with the help of old-fashioned analog technology: sensors that are coupled to the existing and living world around us are always confronted with analog signals. Those – in most cases – tiny signals have to be amplified and treated with unbelievably high electronic care. Therefore, frustration on noisy devices should always be turned around into motivation for the search of nearly noiseless solutions!

As producer of such tiny analog signals, the vinyl record (33 1/3 LP and 45 Single/Maxi) is a typical representative of our yesterday – twentieth centuries – life. Despite the nearly 100% digitization of the consumer world it is still alive – with growing sales revenues around the world. One should expect that all secrets of the amplifier chain that transfers the signals out of the record's grooves to our ears are well known. Yes and no! Much is written about distortion, overload matters, noise, phase angles, frequency response, etc[3]. Most technical aspects of amplifiers and sensors were well described.

Nevertheless, simple questions like e.g.: "my moving-magnet cartridge – how much noise does it produce?" or "what's the signal-to-noise-ratio (SN) of my phono-amp after A-weighting?" are still not that easy to answer today.

Worldwide, mathematics is the only language that can be understood by nearly every-body, assumed that there is a certain talent for it, and, not to forget, the right software for calculations. In this book, calculations were all carried out with Mathcad[4]. An easy to get for free simulation software would help as well, e.g. MicroSim v8.0[5] but, not to increase the necessity for the use of various softwares,

[3]Inter alia: "Self on Audio", Douglas Self 2000, see Appendix 6.

[4]MathSoft Inc., USA.

[5]MicroSim Corp., USA.

this simulation software is not essential to understand and follow the mathematical courses.

Therefore, for mathematics-refusal-free and ambitious amateurs and/or students who want to design their own amplifier for specific cartridges this book will find answers to such simple questions and many others concerning RIAA phono-amps! It is also a collection of articles that were published in a more condensed form in the British magazine ELECTRONICS WORLD (EW, formerly called "Electronics World and Wireless World (EW+WW)" or "Wireless World (WW)").

As a consequence, the content of this book will lead to affordable amplifier design approaches which will end up in lowest-noise solutions not far away from the edge of physical boundaries set by room temperature and given cartridges – thus, fully compatible with very expensive so called "high-end" or "state-of-the-art" offers on today markets - and, from a noise point of view in most cases outperforming them!

With easy to follow mathematical treatment it will be demonstrated as well that theory is not far away from reality. Measured SNs will be found within 1 dB off the calculated ones and deviations from the exact amplifier transfer will not cross the ±0.1 dB tolerance lines. Additionally, measurement set-ups and results will be presented and comparisons with measurement results of test magazine will soon become easier to perform.

Last remark: the presented electronic circuits do not contain extra made or extremely expensive components. They all can be found at component dealers worldwide.

Very last remark: I guess that creativity does not mean to reinvent the wheel again, or to find out new things. In many cases, it is nothing else but simply rearranging well-known parts. Therefore, when I started developing the many circuit schemes presented in this book Okham's Razor[6] and one main goal ranked very high: to combine and to re-arrange well known different circuit designs to promising new solutions.

[6]"If you have to choose from some number of competing theories, choose the simplest one because it's most likely to be true", Sharon Kay, www.royalinstitutephilosophy.org/think/

# Overview

**Part IV Noise and Hum Measurement System**



**Part V The RIAA Phono-Amp Engine**



**Part VI Appendices**

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## Part IV Noise and Hum Measurement System