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Lab Notes

IEEE CNSV

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Electroacoustics & Audio

- *Consulting*
- *Design / Testing*
- *Training*

Inside this issue:

Training Services

CJS Labs offers customized in-house training. Our design experience, proven processes, and measurement expertise will make your product development more efficient. Learn how to optimize both your designs and test routines. Having a thorough understanding of fundamentals, correct terminology, and proper techniques will also enable you to make more informed decisions and communicate more effectively with your customers and vendors as well as within your own organization. Understand why certain failure modes are problematic, even if they are not obvious or audible. Sample course outlines and details are available on our website:

http://www.cjs-labs.com/training_seminars.html

Contact us to schedule a training course for your organization.

ASA 178th Meeting—San Diego, CA

The 178th Meeting of the Acoustical Society of America was held 2-6 December 2019 at the historic Hotel del Coronado in San Diego, CA. The ASA Committee on Standards met on Tuesday morning, 3 December. The meeting also featured numerous sessions and technical presentations. ASA will meet again 11-15 May 2020 in Chicago, IL. More information at:

https://acousticalsociety.org/asa-meetings/

News and Upcoming Events

ANSI/ASA S1.42-2019

ANSI Working Group S1-24, which I chair, has completed its revision of S1.42 “Design Response of Weighting Networks for Acoustical Measurement”. The draft has balloted and passed and is awaiting final ANSI approval. This new revision also includes a set of Matlab m-file scripts for designing analogue and digital A-, B-, C-, D-, E, G- , and U-weighting filters. It should appear in the ASA Standards store in early 2020.

IEC TC-29—Warsaw

IEC TC-29 will meet in Warsaw 23-27 March 2020 in Warsaw, Poland. Delegates and accredited experts from around the world will attend. I will head the US Delegation and participate in 4 working group meetings: WG5 on Microphones; WG13 on Hearing Aids; WG21 on Ear simulators; and WG on Modular Instrumentation. I am also Convenor of MT25, however, the revision of IEC 60263 was completed in October is awaiting translated and final CDV ballot, which is expected this spring. I will also be giving a guest lecture at Gdańsk Polyteknik the following week.

Please contact us and let us know how we can be of service to you and your organization.

Happy Holidays!

Christopher J. Struck

CEO & Chief Scientist

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CJS Labs is a consulting firm based in San Francisco, CA. We specialize in audio and electroacoustics applications. With over 30 years of industry experience in engineering and technology management, our areas of expertise include transducers, acoustics, system design, instrumentation, measurement and analysis techniques, hearing science, speech intelligibility, telephonometry, and perceptual coding. We also offer project management, technology strategy, patent & IP evaluation, and training services

Back issues of Lab Notes are available on our website at:
http://www.cjs-labs.com/lab_notes_links.html

Improved Zobel Network

Passive crossover filter networks for multi-way loudspeakers generally require a resistive termination for optimum performance. The driver itself presents, at best, a semi-inductive load. Recall the inductive rise with frequency of the loudspeaker electrical impedance. The L2/R2 impedance model depicted in Fig. 1 represents the electrical impedance as seen by the amplifier output:

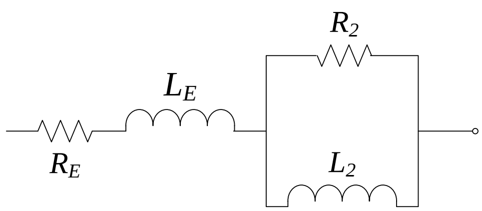

Fig. 1 L2/R2 loudspeaker electrical impedance model.

The typical Zobel network used to make the driver impedance appear closer to an ideal resistive load is a simple series resistor and capacitor shunted across the driver terminals.

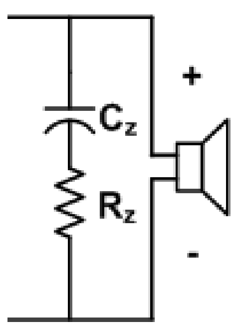

Fig. 2 Typical Zobel impedance compensation network.

The component values are calculated as

$$R_Z \approx 1.25\, R_E\,,\quad C_Z = \frac{L_E}{R_Z^2}\,,\ \text{with}\quad P_R = \frac{V_{MAX}^2}{R_Z}$$

The resistor value is approximate and may need to be adjusted for more extreme voice coil impedances. The resistor should be power rated as shown to handle the current to the loudspeaker.

The flatness of the compensated impedance magnitude is typically limited when using this simplified compensation network. An improved compensation network can be realized by using the analogous circuit ‘dual’ of the L2/R2 model, assuming the values for the driver impedance model are known. Recall that a circuit ‘dual’ replaces series impedances with shunt impedances and vice versa. Capacitors become inductors and inductors become capacitors. Resistors remain resistors. Applying these principles to the network of Fig. 1 results in the following network:

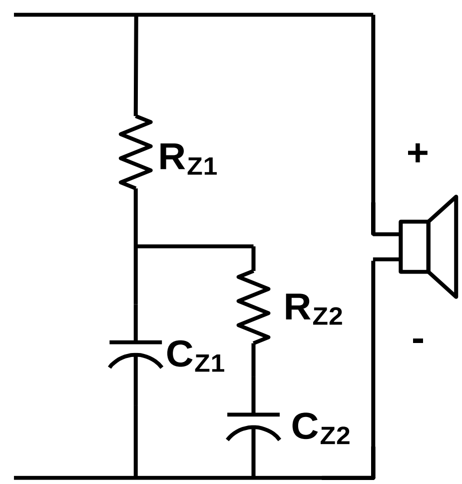

Fig. 3 Improved Zobel compensation network realized as the circuit ‘dual’ of the L2/R2 impedance model.

The component values for this network are calculated as

$$R_{Z1} = R_E\,,\quad R_{Z2} = R_2\,,\quad C_{Z1} = \frac{L_E}{R_Z^2}\,,\ \text{and}\quad C_{Z2} = \frac{L_2}{R_2^2}$$

This represents a dramatic improvement to the basic 2-component Zobel network, and compensates for the non-ideal semi-inductive behaviour of the loudspeaker driver across the entire frequency band. The component values are easily found if the L2/R2 impedance model values are known. The cost, however, is increased size, complexity, and component count.

Please contact us for more information.