Transitional Characteristics of the Loudspeaker Systems

Ekaterinoslav S. Sirakov[1], Atanaska A. Angelova[2]and Georgi K. Evstatiev[3]

Abstract – **In the work, a block scheme of a digital system for researching pulse characteristics of an electrodynamic loudspeaker with a direct radiating is considered. The given measuring the system, she displays for demonstrating: the frequency response, the pulse reverberation, the time of increment, the time of fading. These characteristics are particularly important for the audio (the sound) quality of the loudspeaker.**

Keywords – **Audio, Loudspeaker, Pulse (transitional) characteristics, Cumulative spectral decay.**

I. Introduction

The dynamic transitional characteristic of the spectrum of the sound pressure created by a loudspeaker or a Loudspeaker system with a pulse signal, enables us to read the so-called impediment of the resonances (delayed).

In fact, this can not be read by the conventional frequency characteristics (response) and curve the phase. These resonances are a result of the own resonances of the tweeters, midrange and woofer; of the own resonance frequency of the box size; of the box corners; of the special location of the driver in the box; of the influence of the separating filters and the correcting chains, etc.

According to many experts these results correlate with the subjective perception of the spatial characteristic of the sound.

The pulse $g(\tau)$ is measured in order to directly evaluate the bendings in the transitory area of the signals of a radiating loudspeaker.

The pulse characteristic is the response of the system under the influence of a signal – delta a function (unit function) with zero initial conditions.

II. Block Diagram

Through power amplifier 2, the pulse generator 1 or the PC (See Fig. 1) apply to the measured loudspeaker/loudspeaker system 3 a series of rectangular pulses with the width of 2÷200 μs, repetition period less than 10 Hz and amplitude of 10÷100 V (See Fig. 2 and 3).

The signal from the microphone or the microphone preamplifier 6 is applied to the sound card 5 and across the analogue to digital converter it is applied to the personal computer 9 (See Fig. 1). The 16÷24 bits, ADC (analogue to digital converter) must be used to provide dynamic range of up to 86÷120 dB.

When Qts is greater than 0.5 [1], the response is oscillatory with increasing values of Qts contributing increasing amplitude and decay time. That's why the value of Qts=0.5 is critically-damped alignment.

The input voltage V(Vad:+)/1.3 MegV is rectangular volt-

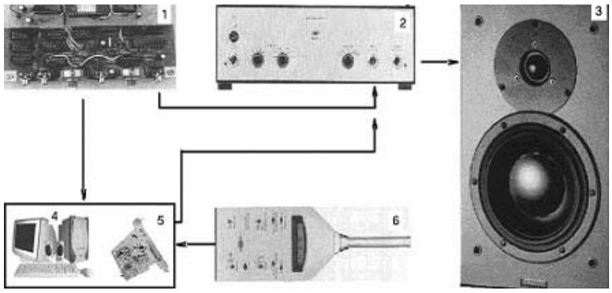

Fig. 1. Block diagram of a system for measuring the characteristics of the Loudspeaker systems.

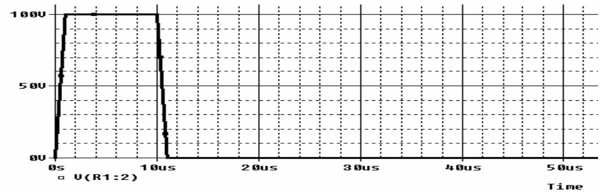

Fig. 2. Rectangular pulse with a width of 10 μs, a time of increment and fading 1 μs, maximum amplitude 100 V.

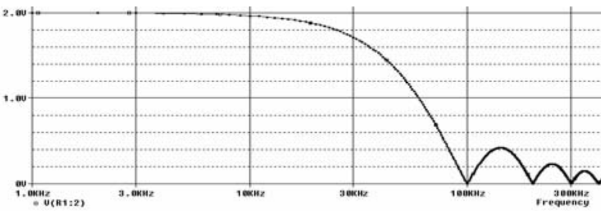

Fig. 3. Spectrum of the rectangular pulse with a width of 10 μs.

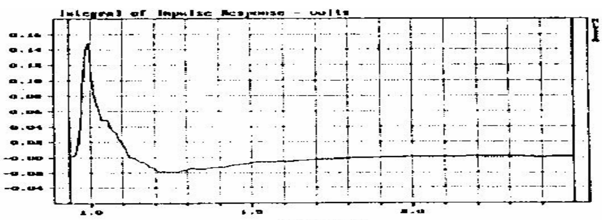

Fig. 4. Transitional characteristic of a loudspeaker D-28AF. (the response is made available by the producer DYNAudio)

[1]Ekaterinoslav S. Sirakov is with the Department of Radio engineering, Faculty of Electronics, Technical University-Varna, Studentska Street 1, Varna 9010, Bulgaria, E-mail: katio@mail.bg

[2]Atanaska A. Angelova is with the Department of Radio engineering, Faculty of Electronics, Technical University-Varna, Studentska Street 1,Varna 9010, Bulgaria, E-mail: lz4hi@yahoo.com

[3]Georgi K. Evstatiev is with the Department of Radio engineering, Faculty of Electronics, Technical University-Varna Studentska Street 1, Varna 9010, Bulgaria, E-mail: evstatg@mail.bg

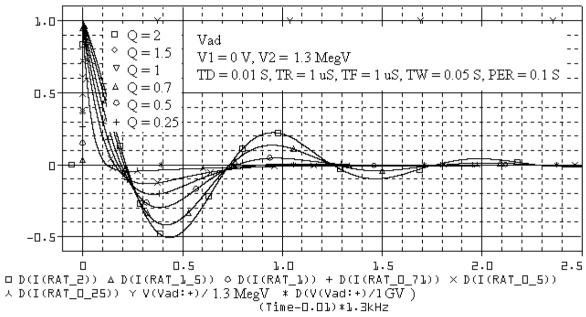

Fig. 5. Normalized transitional characteristic of the loudspeaker D-21AF for parameter Q.

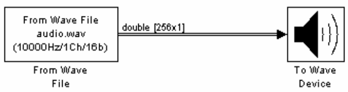

Fig. 6. Pulse Generator in SimuLink.

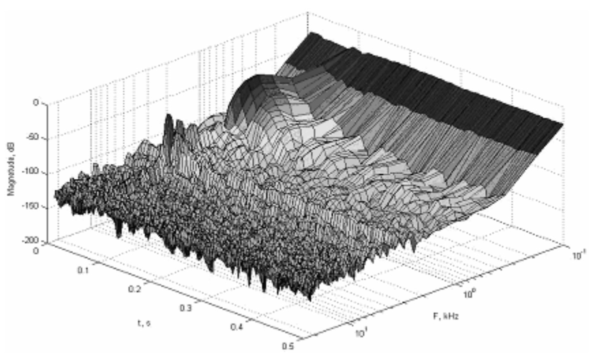

Fig. 7. Dynamic transitional characteristic of the spectrum of the sound pressure, created by the Loudspeakers system with a pulse signal. (Commutative spectral decay).

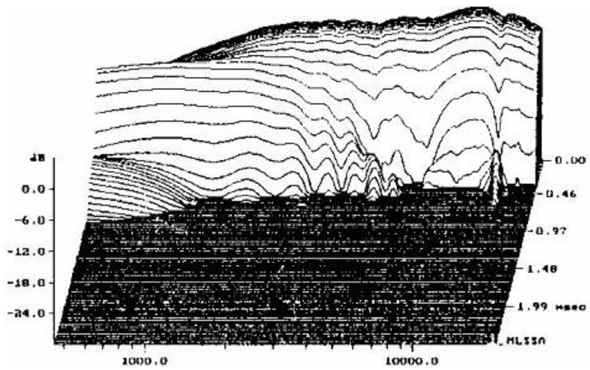

Fig. 8. Dynamic transitional characteristic of the spectrum of create by the loudspeaker D-28AF sound pressure with a pulse signal. (the response is made available by the producer DYNAudio)

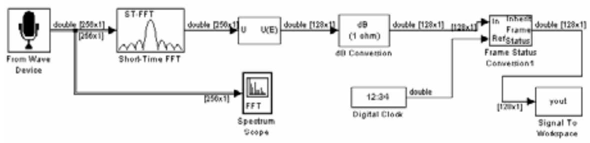

Fig. 9. Measure the transitional characteristic the loudspeakers with the program SimuLink.

age with a time of fading (these definitions are for the simulations in the program PSpice) TR=TF=1 uS, its derivative D(V(Vad:+)/1G) is delta a function (unit function) [2].

III. Block Diagram in Sumulink and Real Concrete Measured Results

All values in the spectrum are formed in a three - dimensional array. All data from the array are processed and displayed for demonstrating with the help of a suitable algorithm.

On the three axises is: the time in seconds, the frequency in kHz and the level of the sound pressure in dB.

```
out=[];
t=[];
out(:,:)=yout(:,1,:);
t=tout(:,:)';
surf(t,y,out);
set(gca,'YDir','reverse') set(get(gca,'XLabel'),'String','t, s')
set(get(gca,'YLabel'),'String','F, kHz')
set(get(gca,'ZLabel'),'String','Magnetude, dB')
set(gca,'YScale','Log')
```

IV. Conclusion

The block diagram offered successfully demonstrates the transitional characteristics of the sound system, and the software doesn't require a concrete SoundBlaster; it is only limited concerning the SoundBlaster used.

In future the test rectangular pulse could be generated by an external device, while a DSP (Data Signal Processor) would be able to digitally process the results, thus replacing the SoundBlaster partially or completely. The increase of the signal to noise ratio is achieved by a series of pulses with accumulation and processing of the results. (An example: in case the pulses are 64, the signal to noise ratio can be increased with 18 dB)

References

[1] R. H. Small, "Closed-Box Loudspeaker Systems Part I: Analysis," J. Audio Eng. Soc.,, vol. 20, Number 10, 1972 Dec.

[2] Allan V. Oppenheim, Al. S. Uilski and J. . Jang, "Signals and Systems", "Tehnika", Sofia, 1993.

[3] D. Campbell, "MLSSA vs. sine testing: a tutorial on methodology" Speaker Builder, Volume13, Number 2, 1992.

[4] Irina A. Aldishina, A. G. Voishcilo, "High-Fidelity loudspeaker systems and loudspeakers", Moscow, Radio and svias, 1985.

[5] Jim Moriyasu, "A Study of Midrange Enclosures" Speaker Builder, the Loudspeaker Journal, Volume 21, Number 8, December 2000

[6] Heinz Scbmitt "ATB-Precision, das Profisystem mit intutiver Bedienbarkeit", Klang+Ton, Februar/Marz, 2, 2002.

[7] Rob Baum, "SLAB Technology Flat Diagrams Loudspeakers", Voice Coil, Volume 15, Issue 3, January 2002.

[8] http: //www.microsim.com/, /www.pspice.com/

[9] http://www.mathworks.com/products/dspblockset/

[10] Brochures issued by DynAudio, Morel, Fokal Audax