

# AkAbak®

AkAbak is a professional simulation program for electro-mechano-acoustical networks running under Windows (TM). The simulation is carried out on lumped elements and one-dimensional waveguide components.

It is especially intended for the investigation and design of loudspeaker systems. AkAbak simulates a complete system: from the voltage source through to any listening point - including all filters, networks, radiation elements and the nearby radiation environment.

The philosophy behind the program is to provide a simple, easy-to-use framework, even for complicated and extensive systems. It assists in development work according to the "top down" principle, i.e. from the abstract concept through to technical implementation; this ensures high productivity and efficient design.

A modular principle is used to describe the system to be simulated. The structures that are to be analyzed can be custom-built from standard elements, or for a speedy and efficient simulation, compact modules can be used. There are unlimited possibilities for interconnecting the individual modules, so that even exotic designs can be simulated.

The program as a whole is designed to emulate the principles of loudspeaker design as closely as possible. One consequence of this is that all the parameters required by the models simulating the structures are easy to obtain or to

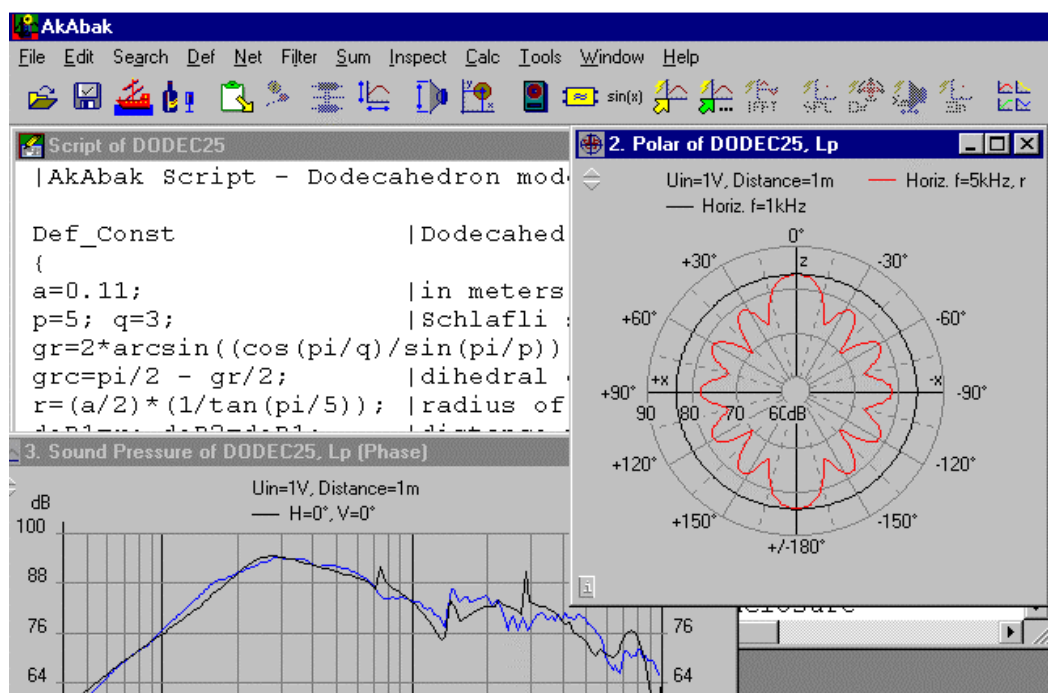
measure. Computation is very fast, so that it is possible to use a trial-and-error method, or to investigate the effects of component tolerances. The superb accuracy of the simulation provides a sound basis for testing out design ideas or for dimensioning and matching the components of an electrical, acoustic or electroacoustic design.

The program usually outputs the results of the simulation as a diagram. AkAbak runs under Windows. This has the advantage that you can compare the results of any number of simulations in different windows. A number of inbuilt user-friendly functions that are always to hand make the program easy to use.

Apart from its simulation functions, AkAbak also includes a range of CAD tools, such as synthesis of passive networks with dissipative coils, tools for bass speaker design, filter design, etc.

The classical simulation method of lumped elements is one of the most powerful and approved tools in designing and investigating electro-acoustic devices. AkAbak makes the application most convenient and efficient. Thanks to the co-operation with our customers the program ripened to its high degree of usability.

It took a long time to develop AkAbak but it will take even more time to implement all the interesting features planned to be part of the program. We hope you will enjoy our simulator as much as we enjoy the developing of it!



# Features of AkAbak v2.1

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## Network

Electrical, mechanical and acoustical domain  
Filter (abstract, transfer functions)  
Any node numbers  
Max. number of nodes = 56  
Max. number of networks = 10  
Max. number of components = 500

## Components

### Electrical

Resistor, Capacitor, Coil  
Operational amplifier (transition frequency, resistances)  
Transistor, FET, Valve (transition frequency, hybrid parameter)  
Transformer

### Mechanical

Passive diaphragm  
Resistance, Compliance, Mass

### Acoustical

Resistance, Compliance, Mass  
Enclosure  
Vented enclosure  
Vented enclosure rectangular, long, deep  
Closed enclosure rectangular  
Duct incl. damping  
Waveguide with variable cross section (conical, expo, hypex)  
Horn with spherical radiation (conical, expo, hypex)  
Radiation impedance with radiation

### Transducer

Dynamical four-pole with one voice coil  
Dynamical six-pole with two voice coils  
Dynamical two-pole with radiation  
Dynamical two-pole with enclosure and radiation  
Piezo four-pole  
Measured two-pole with radiation (SPL and impedance)

### Other

Coupler (eg. for mechano-acoustical couplings)  
Impedance with any complex formula system (eg.  $1/(1 + j\omega/\omega_0)$ )  
Gyrator (eg. for electro-mechanical couplings)  
User defined element (DLL)

### Filter

Rational transfer function up to 30th order  
Any complex function system  
Filter network  
Connectable with flow network

## Radiation

### Positioning

Position (x,y,z)  
Rotation (vertical, horizontal)

### Reflection

Wall  
Room edge  
Room corner  
Mutual coupling of radiation impedance  
Absorption

### Diffraction

Far field  
Mutual coupling of radiation impedance  
Circular and rectangular baffles  
Displacement effects

### Diaphragm radiation

Numerical integration across diaphragm form  
Piston, cone, dome (concave, convex)  
Circular, rectangular, ring radiator  
Displacement  
Mass and area reduction at high frequencies  
Radiation impedance depends on form

### Horn radiation

Modeling of wavefront by finite radiation elements

## Simulations

### Components of response

Amplitude, level, phase, real + imaginary

### Summated parameter

Sound pressure of free radiation  
Directivity of free radiation (cart., polar)  
Acoustical power level of free radiation (numerical integration)  
Directivity factor  
Beamwidth  
Input current, power, impedance of all systems  
Extreme values (list)  
Power density (list)

### Network parameter

Voltage  
Current  
Power  
Force  
Excursion  
Velocity  
Acceleration  
Pressure  
Volume velocity  
Impedance at any node

## Processing

### On simulation output or import data

Frequency to time domain: impulse, step, ETC  
Time to frequency domain  
Minimum phase  
Group delay

### Calculation with graphs

## Tools

### Calculator with complex arithmetics

### Create transducer with radiation from measured curves

From magnitude curves (Hilbert-transformation)  
From vector curves (eg. magnitude and phase)

### Dyn. transducer parameter determination (least square error method)

From magnitude curves  
From vector curves

### Piezo transducer parameter determination (least square error method)

### Determination of vibrating mass or compliance

### Impedance compensation (least square error method)

### Filter Dialog

Max. order = 30  
Creating transfer functions: Butterworth, Bessel, Bessel allpass, Chebychev, Linkwitz-Riley, BU-LR Compromise, BU-Thomson  
Transformation: lowpass - highpass, highpass - lowpass, lowpass - bandpass, lowpass - allpass  
Scaling  
Interactive display in diagram

### Synthesis with passive components

Max. order = 30  
Lowpass, Highpass, Bandpass incl. coil losses  
Allpass lattice, transformer

### Synthesis with active components

First and second order blocks  
Lowpass, bandpass, highpass, allpass  
Sallen+Key-, KHN-types

### Decomposing transfer functions

To first and second order blocks

### Multiplying out transfer functions

### Poles and zeros of transfer functions

### Bass loudspeaker design tool

Closed enclosure  
Vented enclosure  
Closed enclosure with 2nd order highpass filter  
Vented enclosure with 2nd order highpass filter  
Alignment tables (all from 2nd ... 6th order):  
Butterworth (BU), Bessel (BE), Chebychev (CH),  
Sub-Chebychev (SC), Quasi-Butterworth (QB),  
Butterworth-Thomson (BT)  
Interactive display in diagram (sound power, excursion)

Calculation of performance parameter

## Input

Script driven input system

Usual multi document word processor

Additional input dialogs for each component

Comments

Common units and sub-units supported (eg. kHz, L, cm, in,...)

Easy assignment of formulae

Printing

## Output

Any number of diagrams

Calculation of three curves simultaneously

Copy, paste, cut of curves

Zooming, Maximize

Marker

Copy diagram to clipboard (bitmap, metafile)

Printing

Save, load of diagrams

## Import

Import from any source in ASCII format

Display in diagram

Scalar and vector data

Free configuration of interface

From file or clipboard

Formula system to modify import data

Generation of abscissa

## Export

ASCII format

To file or to clipboard

Free configuration of interface

Density of points adjustable

log/lin

## Settings

Sound velocity, medium density

Color of diagrams on CRT and printout

Desktop save, load (for different projects)

Multiple ini-files

## Help system

Program control

Context sensitive detailed explanation

## Documentation

On paper approx. 300 A4 pages

Introduction to electroacoustics

Detailed component description

## Exercises

### Introduction: Construction of a simple two-way loudspeaker system

#### Design of Bass-Speaker Enclosure

Loudspeaker parameter

Using alignments catalog

Analyzing temperature-dependent voice coil resistance

Determining dyn. driver parameter

#### Driver - Enclosure - Radiator

Driver, Enclosure and Radiator elements

Adding a second woofer in the same enclosure

#### Three-Way Speaker with Passive Crossover Network

Crossover for bass range and mid-range

Passive synthesis of the bass-channel filter

Passive synthesis of the mid-range-filter

Inserting a generator resistance

#### Synthesis with active components

Generating and decomposing the transfer function

Using the Active Filter Synthesis tool

Using the formula parser

Implementation with transistors

#### Compression Driver

Determining the equivalent circuit parameter

Compression driver with discrete elements

#### Multiple Driver Modeling

Paper of 102nd AES Convention Munich 1997: 'Multiple Driver Modeling with a Modern Lumped Element Simulation Program'; Jörg W. Panzer, and Richard H. Campbell

# Computer system

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## Computer

PC with Intel 80386 processor or better. A numerical coprocessor is highly recommended. Memory: 4 MBytes. Disk space: 5 MBytes. Monitor: VGA or better. Printer: Any conventional A4-paper size printer.

## Operating system

Microsoft® Windows™ 3.1, 95 or NT.

## Installation

A 3½ inch HD diskette drive is required for the installation.

# Demo-Version

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All the program functions are available, only the numerical range of the input parameter is restricted to decimals of powers of 1, 2 and 5.

A brief, simple exercise guides you through the program.

The Demo-Version can be down-loaded from our Internet site or ordered from one of the contact-addresses.

# Contact Addresses

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<http://www.AkAbak.com>

<http://www.nxtsound.com>

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