Computational Modeling of External Impact on Electronic Devices

Alexander Shalumov
Dr., Prof., General Director of Research institute "ASONIKA" (Russia, Skolkovo resident)
e-mail: shalumov@asonika.com
Dr. Alexander Shalumov is the General Director of the research institute “ASONIKA”. Dr. Shalumov has received several prestigious national awards in science technology and is recognized as a leader in the field of information technology and automated systems in Russia. He has more than 300 publications, including 10 books. During the last 10 years he was the supervisor of 20 PhD works.
What is ASONIKA?

ASONIKA is an automated software system for simulation of electronic devices for harmonic and random vibrations, single and multiple impacts, linear acceleration and acoustic noise, and stationary and non-stationary thermal effects. The program calculates the number of cycles to failure under mechanical loads, as well as, under cyclic thermal effects.
System ASONIKA structure

**Scheme**
- Scheme calculation: PSpice, Mentor Graphics, OrCAD, Altium Designere
- Characteristics
- Scheme file

**Data control at modelling ASONIKA-UM**
- Placing, trace: PCAD, Mentor Graphics, OrCAD, Altium Designere
- PDIF, IDF

**Creation of drawings:**
- ProEngineer, SolidWorks, Inventor
- IGES, SAT

**Formation of cards of operating conditions of electronic components:**
- ASONIKA-R

**Analysis of fatigue durability of designs of printed-circuit boards and electronic components at mechanical influences**
- ASONIKA-UST

**Analysis of indicators of reliability:**
- ASONIKA-B

**Integrated database of electronic components:**
- ASONIKA-BD

**Analysis of mechanical durability of cases, blocks:**
- ASONIKA-M, ASONIKA-V

**Analysis of electromagnetic compatibility:**
- ASONIKA-EMC

**Analysis of thermal characteristics of cases, blocks:**
- ASONIKA-T

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Why ASONIKA is unique?

1. ASONIKA has reliable physical models and databases of the required properties of all materials and components.
2. ASONIKA has simple intuitive interfaces that are easy to use by designers for rapid modeling.
3. ASONIKA considers features of properties of the materials applied in electronics, for example, their nonlinear properties.
4. ASONIKA is compatible with popular CAD systems and formats: PCAD, Mentor Graphics, OrCAD, Altium Designer.
5. ASONIKA has been used by Russian companies and universities for more than 35 years.
Transient thermal + fatigue analysis in ASONIKA

Run automatic FE mesh generation procedure

Specify the end time of the analysis, the time integration step and the number of thermal cycles contained in the solution interval.
Two arbitrary nodes were selected. Temperature vs time curves for two nodes.
Two arbitrary nodes were selected

Stress vs time curves for two nodes
Fatigue plot

Plot shows minimum fatigue life (451.9 thermal cycles) in solder balls

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ASONIKA-M

Subsystem of the analysis of volumetric constructions of electronic equipment on mechanical influences

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POWER SOURCE

Subsystem of the analysis of thermal processes
Subsystem of the analysis and maintenance of stability to mechanical influences of electronic equipment, established on vibration isolators
Subsystem of the analysis of constructions of printed-circuit boards on thermal and mechanical influences
ASONIKA - UST
Analysis of fatigue durability of designs of printed-circuit boards and electronic components at mechanical influences
Example of use ASONIKA-EMC

This is an electronic device, which is a hollow rectangular box, consist two halves separated by dielectric gasket. Need to find the effectiveness of shielding of the electric field in the frequency range from 1000 to 3000 MHz.

Excitation: Incident Plane Wave (Eo = 20 V/m) propagating along the gasket. Enclosure dimensions: 200x180x130 mm, gasket height 2 mm wall thickness 2 mm, wall material - aluminum.

Solution results (Electric Field)

Shielding Effectiveness

The dependence of the shielding effectiveness of the frequency

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### ASONIKA-B

Subsystem of the analysis of parameters of reliability taking into account actual operational modes

<table>
<thead>
<tr>
<th>Component properties</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of non-failure operation</td>
<td>0.989946838347252</td>
</tr>
<tr>
<td>Average probability of non-failure operation</td>
<td>0.989946838347252</td>
</tr>
<tr>
<td>Average operating time to the full (resource), [h]</td>
<td>49844774.830894</td>
</tr>
<tr>
<td>Average time of non-failure operation, [h]</td>
<td>49844774.830894</td>
</tr>
<tr>
<td>Operational failure rate, [1/4]</td>
<td>2.02083572639823E-03</td>
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<tr>
<td>Residual resource, [h]</td>
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<tr>
<td>Probability of refusal</td>
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<tr>
<td>Factor of influence of the raised temperature</td>
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<tr>
<td>Transition temperature, [°C]</td>
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<tr>
<td>Acceptance</td>
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<tr>
<td>Other factor</td>
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<tr>
<td>Other factor</td>
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<tr>
<td>Energy of activation</td>
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<td>Other factor</td>
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<tr>
<td>Other factor</td>
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<tr>
<td>Base failure rate, [1/4]</td>
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<tr>
<td>Operation factor</td>
<td>0.5</td>
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<tr>
<td>Constant of model of factor of a mode</td>
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<tr>
<td>Actual capacity of factor of a mode</td>
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<tr>
<td>Degree of quality</td>
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</tr>
<tr>
<td>Actual temperature heated, [°C]</td>
<td></td>
</tr>
</tbody>
</table>
Integrated database
of electronic components: ASONIKA-BD
ASONIKA - UM
Subsystem of modeling management during engineering
Ведущие ученые научной школы «АСОНИКА»

Колесов Олег Николаевич — доктор, профессор, д.ф.н.
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Яковлев Сергей Яковлевич — доктор, профессор, д.ф.н.
Малеев Николай Васильевич — доктор, профессор, д.ф.н.

АВТОМАТИЗИРОВАННАЯ СИСТЕМА

АСОНИКА

для моделирования физических процессов в радиоэлектронных средствах с учетом внешних воздействий

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Prof. Dr. Alexander Shalumov is the Director General of the research institute "ASONIKA" (Russia) and the Chair of the Information Technologies Department at the Russian Presidential Academy of National Economy and Public Administration. Dr. Shalumov has received several prestigious awards in science technology and is recognized as a leader in the field of information technology and automated systems in Russia. He has more than 300 publications, including 9 books. During the last 10 years he was the supervisor of 17 PhD works.

Ph. D. Evgeny Pershin is the research assistant of the research institute "ASONIKA" (Russia) and the developer of system ASONIKA.
Thank you for attention!

Contact Information

www.asonika.com

E-mail: shalumov@asonika.com