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## Computational Modeling of External Impact on Electronic Devices

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ASONIKA October 13, 2017





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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.





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# 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.







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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 Designerer.
- 5. ASONIKA has been used by Russian companies and universities for more than 35 years.





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### Transient thermal + fatigue analysis in ASONIKA

### Run automatic FE mesh generation procedure



x ASONIKA Solution parameters Solution variant Transient thermal analysis 600 End time [sec] 50 Time step [sec] Number of thermal cycles 2 in the solution time interval ASONIKA 🖌 Solve 🗙 Cancel

Specify the end time of the analysis, the time integration step and the number of thermal cycles contained in the solution interval

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600.0

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### **Temperature – time curve at nodes**



Two arbitrary nodes were selected

Temperature vs time curves for two nodes

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#### **Stress-time curve**



Two arbitrary nodes were selected

Stress vs time curves for two nodes

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#### **Fatigue plot**



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

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#### 25 nanometer





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#### 25 nanometer



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## **ASONIKA-M**





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## ASONIKA-T wv

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#### Subsystem of the analysis of thermal processes

CONDUCTION CONTACT HEAT EXCHANGE RADIATION DUSTING **CARRY OF HEAT** NATURAL CONVECTION **CONVECTION IN AN AIR** PASSAGE COMPLEX HEAT DISSIPATION THERMAL RESISTANCE **POWER SOURCE** 20,000 18.000 14.000 13.00 12.000

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2013 Workshop on Accelerated Stress Testing and Reliability



#### ASONIKA-V -

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Subsystem of the analysis and maintenance of stability to mechanical influences of electronic equipment, established on vibration isolators



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Subsystem of the analysis of constructions of printed-circuit boards on thermal and mechanical influences







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Г	Depend	dence of a	cceleratic	n on tim	e (shock:	influence	)			-A	COH	MK	J
ſ	160.0	G [g]											:
	140.0												
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#### **ASONIKA - UST**

#### Analysis of fatigue durability of designs of printed-circuit boards and electronic components at mechanical influences



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#### **ASONIKA - EMC Electromagnetic compatibility**

subsystem

#### **Example of use ASONIKA-EMC**

A Shielding effectiveness

100 E E 350 <u>بر</u> 300

> 200 1000

1500

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 = 200 V/m) propagating along the gasket Enclosure dimensions: 200x180x130 mm, gasket height 2 mm wall thickness 2 mm, wall material - aluminum.



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Frequency, MHz H Shelding effectiveness of the electric field in H Shelding effectiveness of the magnetic field

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## **ASONIKA-B** Subsystem of the analysis of parameters of

#### reliability taking into account actual operational modes

🛷 ASONIKA-B - C:\ASONIKA43\ASO	NIKA-B\Projects\prima_English.akp									
Project Edit View Tools Window	Help									
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REE frame	Component properties Failure rate									
⊿ - <mark>20</mark> Unit	Discription, [dimension]	Value								
D2	Probability of non-failure operation	0.999946893847292								
- Henni D3	Average probability of non-failure operation	0.999946893847292								
	Average operating time to the full (resource), [h]	494844774.830894								
<b>1==1</b> , R1	Average time of non-failure operation, [h]	494844774.830894								
THIN VD1	Operational failure rate, [1/h]	2.02083572639872E-9								
Marca VD3	Residual resource, [h]	494818494.830894								
r≓ VT2	Probability of refusal	5.31061527080379E-5								
	Factor of influence of the raised temperature	1.13252262370515								
	Transition temperature, [°C]	80								
	Acceptance	5								
	Other factor	0.00028								
	Other factor	0.0048414595741383								
	Energy of activation	0.4								
	Other factor	1.08								
	Other factor	0.005								
	Base failure rate, [1/h]	1E-6								
	Operation factor	0.5								
	Constant of model of factor of a mode	298								
	Actual capacity of dispersion, [W]	1								
	The Degree of quality	<u>5</u>								
🔒 🗕 🔀	LAmhient temperature (cases) [°C] ∢									
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### Integrated database

### of electronic components: ASONIKA-BD

SONIKA			
SF-1-35			
Set material parametres			
Thickness, [mm] 1.5 Density, [kg/m^3]	1910	Color	-
Description The mechanical The thermal Temperature dependences Admis	sible characteristics		
The elasticity module on axis 0X, [GPa]		16.9	Reliability V
The elasticity module on axis OY, [GPa]		16.9	<b>v</b>
The elasticity module at an angle 45 *, [GPa]		16.9	$\checkmark$
Factor of Puassona on axis 0X, [relat. units]		0.22	<b>v</b>
Factor of Puassona on axis 0Y, [relat. units]		0.22	V
Factor of Puassona at an angle 45°, [relat. units]		0.22	$\checkmark$
Factor of mechanical losses, [relat. units] for vibra	ating influences	0.002637	•
fc	or shock influences	0.002637	
Factor of dependence of factor of mechanical losses from stress, [1/Pa]			
for vibra	ating influences	7.458E-10	<b>v</b>
fo	or shock influences	7.458E-10	
Weariness factor			
ONIKA			
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ASONIKA - UM Subsystem of modeling management

#### during engineering



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### Thank you for attention!

# **Contact Information**

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