

2023 29th International Workshop on Thermal Investigations of ICs and Systems (THERMINIC 2023)

**Budapest, Hungary
27-29 September 2023**



**IEEE Catalog Number: CFP23TII-POD
ISBN: 979-8-3503-1863-0**

**Copyright © 2023 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP23TII-POD
ISBN (Print-On-Demand):	979-8-3503-1863-0
ISBN (Online):	979-8-3503-1862-3
ISSN:	2474-1515

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

SESSION 1.1: TESTING AND COOLING SOLUTIONS FOR POWER ELECTRONICS

Thermal Transient Tests with Programmed Powering on Wide Bandgap Power Devices of Non-Monotonous and Time-Variant Characteristics.....	1
<i>Sandor Ress, Zoltan Sarkany, Marta Rencz, Gabor Farkas</i>	
Applicability of JESD51-14 to Clip-bonded, Discrete Power Devices	9
<i>Szilárd Szoke, Henrik Sebok</i>	
Modular Design of Coldplate for Cooling Power Module - Application to LV100 Packaging Module Silicon Carbide -	17
<i>M. Vahier, Y. Moison, M. Pektova, W. Cherief, J. Giolat</i>	
An Advanced Integrated Cooling Solution for High Voltage and Power Density Modules	24
<i>Amin Al-Hinaai, Till Huesgen, Cyril Buttay, Eric Vagnon, Ildiko Ettinger, Besar Asllani, Céline Combettes</i>	

SESSION 1.2: THERMAL MANAGEMENT AND COOLING SOLUTIONS

Enabling Short-Term Over-current Capability of SiC Devices Using Microchannel Cooling	30
<i>Shubhangi Bhadoria, Soundhariya G S, Hans-Peter Nee</i>	
Optimization of Hollow Hybrid Fin Heat Sinks Under Natural Convection.....	36
<i>Wooheon Noh, Kyoung Joon Kim</i>	
Experimental Investigation of Pumped Two-Phase Flow Boiling Using Different Finned and Pin Finned Structures on Interchangeable Heater Modules	40
<i>Ralph Schacht, Tobias Gruen, Torsten Nowak, Jörg Arnold, Daniel May, Bernhard Wunderle</i>	
Observer Based Junction Temperature Estimation : 3D Simulations and Experimentations	46
<i>Tychique Nzalalemba Kabwangala, Jean-Pierre Fradin, Yassine Ariba, Alexandre Marie, Frédéric Gouaisbaut</i>	

SESSION 1.3: COUPLED FIELD MODELLING & SIMULATION

A Simple Electrothermal Compact Model for SiC MPS Diodes Including the Snapback Mechanism	52
<i>Vincenzo D'Alessandro, Vincenzo Terracciano, Alessandro Borghese, Marco Boccarossa, Andrea Irace</i>	
Improving the Thermal Ruggedness of GaAs HBTs Through Nonuniform Base Ballasting Optimization.....	57
<i>Antonio Pio Catalano, Ciro Scognamillo, Peter J. Zampardi, Lorenzo Codecasa, Vincenzo D'Alessandro</i>	
Improved Nonlinear Electrothermal Simulation of Bipolar Transistors: Application to InP/InGaAs DHBTs.....	62
<i>Ciro Scognamillo, Antonio Pio Catalano, Giuseppe Della Ragione, Markus Müller, Michael Schröter, Lorenzo Codecasa, Vincenzo D'Alessandro</i>	

A Fast and Reliable Simulator for the Evaluation of Losses in Power Devices Based on a Mixed Analytical and Empirical Model.....	66
<i>Lorenzo Giraudi, Maurizio Tranchero, Claudio Romano, Paolo Santero</i>	

Performance Analysis of Stacked Photovoltaic-Thermoelectric Generator Using Mathematical Thermal-Electrical Model	72
<i>Ahmed Issa Alnahhal, Balázs Plesz</i>	

SESSION 2.1: ADVANCES IN DATA PROCESSING OF THERMAL TRANSIENTS AND COMPACT MODELLING

Tridiagonal Approaches for Network Identification by Deconvolution	77
<i>Nils J. Ziegeler, Peter W. Nolte, Stefan Schweizer</i>	

Structure Curve Representation of Dynamic Thermal Multi-Ports	83
<i>Lorenzo Codecasa, Vincenzo D'Alessandro, Antonio Pio Catalano, Ciro Scognamillo, Dario D'Amore</i>	

Accuracy Comparison of T3ster-Master and Optimization-based Network Identification	90
<i>Nils J. Ziegeler, Peter W. Nolte, Stefan Schweizer</i>	

Boundary Condition Independent Compact Thermal Models Enhanced by Contour Elements.....	96
<i>Lorenzo Codecasa, Vincenzo D'Alessandro, Antonio Pio Catalano, Ciro Scognamillo, Dario D'Amore</i>	

SESSION 2.2: THERMAL MANAGEMENT AND COOLING SOLUTIONS 2

Effect of Leading Edge Geometry on the Performance of Plate Fin Heat Sinks in Forced Convection at Transitional Reynolds Numbers	103
<i>Gearóid Farrell, Rajesh Nimmagadda, Shailesh N. Joshi, Danny J. Lohan, Tim Persoons</i>	

To Bend Or Not to Bend: Impact on Heat Pipe Performance	109
<i>Wessel W. Wits, Rick Groot, Davoud Jafari</i>	

Definition of a Common Parameter Set for Heterogeneous Heat Sink Shapes	115
<i>Ine Vandebek, Sarah Da Silva Andrade, Yogesh Sovani, Lieven Vervecken</i>	

Experimental Investigation of an Ultra-Thin Vapor Chamber with Water and Pure 2-propanol as Working Fluids	119
<i>Arunjoy Baruah, John Mathew, Shankar Krishnan</i>	

SESSION 2.3: OPTIMIZATION, NUMERICAL ANALYSIS, MACHINE LEARNING

Optimising Impinging Microjet Arrays for Varying Heat Source Size in Liquid Cooled Coldplates.....	125
<i>J. W. Elliot, G. Byrne, A. J. Robinson</i>	

Topology Optimization for the CFD Design of Heat Sinks Coupled with Phase Change Materials.....	131
<i>Leonardo Abate, Nicola Bianco, Andrea Fragnito, Marcello Iasiello, Gerardo Maria Mauro</i>	

A Machine Learning Model for the Detection of Solder Voids with Adjacent Sensors.....	137
<i>Nils Jahn, Patrick Sina, Martin Pfof</i>	

SESSION 2.4: NEW CONCEPTS FOR DATA CENTER COOLING

Reduced-Order Model for Predicting Aerodynamic Performance of Dual Impeller Fans in Data Centre Cooling Systems	143
<i>Wenguang Zhao, Sahan Wasala, Tim Persoons</i>	
Thermal Robust Design Considerations for a Forced Convection Immersion Tank	149
<i>Wendy Luiten</i>	
AI-Assisted Characterization of Cooling Patterns in a Water-Cooled ICT Room.....	156
<i>Vlatko Milic, Linus Kåge, Maria Andersson, Jim Enkel, Bahram Moshfegh</i>	

SESSION 3.1: AI-TWILIGHT 1: THERMAL, OPTICAL AND POWERCYCLING TESTING AND MODELLING OF LED PACKAGES

Design of Power Cycling for Reliability Testing of LED Systems: Numerical and Analytical Approach	161
<i>Lisa Mitterhuber, Julien Magnien, Elke Kraker</i>	
Automated Peak Detection for Analysis of Error Propagations and Validation of Structure Functions in Reliability Tests of LED Systems	167
<i>Sandra Fischer, Julien Magnien, Heiko Röthl, Lisa Mitterhuber, Elke Kraker</i>	
On the Importance of Fast and Accurate LED Optical and Thermal Characterization: from Visible Use Cases to UV Technologies.....	174
<i>Nicola Trivellin, Nicola Roccato, Francesco Piva, Matteo Buffolo, Carlo De Santi, Claudio Narduzzi, Riccardo Fraccaroli, Alessandro Caria, Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini</i>	

SESSION 3.2: AI-TWILIGHT 2: MODELLING OF LEDES

An Automated Method for Creating Compact Dynamic Thermal Models for In-Situ Prognostics of Power Electronics and Power LED Packages	179
<i>András Poppe, Gusztáv Hantos, János Hegedüs, Ferenc Ender</i>	
The Minimal Set of IVL Measurements to Characterize Power LED Chips.....	186
<i>Márton Németh, Gusztáv Hantos, János Hegedüs</i>	
Bayesian Experimental Design for LEDs Using Gaussian Processes	192
<i>Peter Förster, Sebastian Schöps, Wil Schilders, Stephan Böckhorst, Maximilian Mevenkamp</i>	

SESSION 3.3: THERMAL INVESTIGATION OF LEDES AND PV CELLS

Transient Thermal Analysis for VCSEL Diodes.....	198
<i>Maximilian Schmid, Marcel Mombert, Marcel Kettelgerdes, Gordon Elger</i>	
Impact of LED Temperature on the Performance of LiFi Optical Wireless Communication Links.....	204
<i>Diego R. Vargas Romero, Jean-Paul M. G. Linnartz, Jacobus L. M. Van Mechelen</i>	
Thermal Behavior of Crystalline Silicon Bottom Cell in a Monolithic Perovskite/Si Tandem Solar Cells.....	210
<i>Ahmad Halal, Balázs Plesz</i>	

SESSION 3.4: THERMAL & RELIABILITY TESTING

Thermographic, Electric, and Spectral Measurements for Analysis of High-Power LEDs.....	216
<i>Simon H. Anke, Nils J. Ziegeler, Peter W. Nolte, Stefan Schweizer</i>	
Thermal Test Vehicle for HPC – System Level Approach for Investigation of the Thermal Heat Path Signature with the Property of Spatial Resolution.....	221
<i>Maik Sternberg, Daniel May, Kaushal Arun Pareek, Volker Bader, Karl-Friedrich Becker, Bernhard Wunderle, Mohamad Abo Ras</i>	
Reliability Tests of the Surface-Mounted Power MOSFETs Soldered Using SAC0307-TiO ₂ Composite Solder Paste.....	228
<i>Pawel Górecki, Adrian Pietruszka, Agata Skwarek, Balázs Illés</i>	

POSTER SESSION

A Study on Optimizing Cooling Design for a Power Transformer.....	233
<i>Seong Eon Kim, Jae Seop Ryu</i>	
Development and Evaluation of a Belt Drive Fatigue Tester for Accelerated Thermo-Mechanical Stress Testing of Thin Metallic Films on Flexible Substrates.....	240
<i>David Walther, Nathanael Jöhrmann, Jörg Arnold, Bernhard Wunderle</i>	
HexMG: A Circuit-Model Based Finite Multi-Domain Simulator.....	244
<i>László Pohl</i>	
Thermal Reduced Order Modelling of Multiple Power Modules on a Forced Air Heat Sink.....	250
<i>Kajol Kulkarni, Pietro Botazzoli</i>	
Discrete Packaged Power Diode's Electro-Thermal Behaviour Modelling Method in a Standard CAD Environment.....	254
<i>Lilas Montaner, Achraf Kaïd, Fabrice Roqueta, Luc Hébrard, Jean-Baptiste Kammerer</i>	
Analysis of Innovative 3D-Printed Direct Coolers for Modular Power Devices.....	259
<i>Nicola Delmonte, Paolo Cova, Davide Spaggiari, Danilo Santoro, Corrado Sciancalepore, Roberto Menozzi</i>	
Analysis of the Performance of Different Packaging Technologies of SiC Power Modules During Power Cycling Test.....	263
<i>Bhanu Pratap Singh, Khaled Redwan Choudhury, Staffan Norrga, Konstantin Kostov, Hans- Peter Nee</i>	
A Simple and Effective Power Derating Strategy Based on Junction Temperature Estimation Improving Both Performance and Reliability.....	269
<i>Andrea Lamanuzzi, Maurizio Tranchero, Andrea Pastore, Claudio Romano, Paolo Santero</i>	
Thermal and Acoustics Investigation of a Combined Porous Media – Piezoelectric Fan System.....	273
<i>Rutuja Bilaskar, Sripriya Ramamoorthy, Shankar Krishnan</i>	
A Simple Self-Exciting Vibration High Cycle Fatigue Tester for Accelerated Stress Testing of Thin Films.....	277
<i>Arash Mohammadi, Majid Tavakolibasti, Jörg Arnold, Bernhard Wunderle</i>	
Antigravity Heat Pipe with Multi-Section Powder Wick.....	281
<i>Victor Maziuk, Valery Aliakhnovich, Aliaxandar Ilyushchanka, Pawel Ancheuski</i>	

Effects of Conductive Particle Networks on the Effective Thermal Conductivity of a Thermal Interface Material	287
<i>J. L. Mayer, A. Griesinger, N. Willenbacher</i>	
The Impact of Additively Fabricated Lattice Geometry on Liquid-Cooling Heat Sink Performance for Railway Applications	291
<i>Ahmad Batikh, Jean-Pierre Fradin, Antonio Castro Moreno</i>	
Investigation of Thermal Design Issues of a Bimaterial MEMS	296
<i>E. Dávid Deák, Balázs Plesz, Péter G. Szabó</i>	
CFD Modelling of the Heat Transfer of Photovoltaic Modules	300
<i>Péter Pálovics, Márton Németh</i>	
3D Finite Element Modelling of Heat Transfer in Continuous Flow Two-Phase Droplet Microfluidic Systems Using On-chip Thermal Control.....	307
<i>Zsombor Szomor, Eszter L. Tóth, Péter Fürjes</i>	
Comparison of Thermal Behaviour of Commercial Packages for Power Devices	311
<i>Lorenzo Giraudi, Maurizio Tranchero, Claudio Romano, Paolo Santero</i>	
SPICE Modeling of Insulator-Metal Transition Devices with Hysteresis	315
<i>Mahmoud Darwish, László Pohl</i>	

Author Index