Foreword
Thermal Investigations of ICs and Systems (THERMINIC)

THERMAL investigations of ICs and systems (THERMINIC) Microelectronics thermal experts from four continents gathered in the Fall of 1999 at the Fifth THERMINIC Workshop, Rome, Italy. THERMINIC is sponsored by the IEEE Computer Society Test Technology Technical Council and TIMA Laboratory in co-operation with the IEEE Components, Packaging, and Manufacturing Technology Society, the DETERMIN Project supported by the European Commission and the European Test Technology Technical Committee. Previous THERMINIC workshops have been held in Grenoble (1995), Budapest (1996), and Cannes (1997 and 1998).

More than 80 submissions were received this year (the highest number since the workshop started). From these, the Program Committee selected 42 contributions for oral presentation and 28 for poster presentation. The workshop also had the highest attendance, with 111 participants from 20 countries. A formal workshop Proceedings is not published, but it is now a tradition that the most valuable papers of the workshop appear in special issues or special sections of leading, international journals. Because of the nature and scope of the workshop, two journals were chosen in which to have papers published, the *Microelectronics Journal* and the IEEE TRANSACTIONS ON COMPONENTS AND PACKAGING TECHNOLOGIES.

The topics of the THERMINIC Workshops involve all of the thermal aspects from die to system level. A traditional topic is microelectromechanical systems (MEMS), and the materials used in them including measurement, modeling, simulation, and application of thermal and electro-thermal effects. In 1999, many papers discussed thermal simulation and measurement, as well as advanced cooling methods and electro-thermal topics. From this rich choice, the papers that follow in this special section were selected for their value and interest to the IEEE TRANSACTIONS ON COMPONENTS AND PACKAGING TECHNOLOGIES. The papers published here represent only a small portion of the total number of papers presented at the THERMINIC Workshop. Of the many within the scope of the IEEE TRANSACTIONS ON COMPONENTS AND PACKAGING TECHNOLOGIES, these are felt to be the best.

The first paper by Kruusing *et al.* discusses heat transfer enhancement by means of a vibrating piezoelectric beam, or alternatively, a rotating magnetic rod. Reported results show a decrease in temperature from 90 to 45 °C in water, and from 110 to 100 °C in air. Numerical simulations are supported by experiments.

Van Dooren *et al.* report on the parameterization of DELPHI-style compact models of Flip Chip assemblies. Parametric compact models offer great benefits to the designer. It is shown that excellent results can be obtained using a star-model. It should be noted, however, that the results conflict with the conclusions from older work, in which it was stated not only that parameterization was very difficult, but also that star-models have limited accuracy. Closer examination of the assembly studied in this paper reveals that the heat transfer is predominantly 1D, which explains the observed discrepancy between the two studies. Heat transfer in microchannels is treated by Nabry, focussing mainly on the deviations with respect to ‘”normally-sized” ’ channels. The author comments critically on the published explanations for the observed deviations, and proposes a new hypothesis based on an increased role of the surface roughness.

The paper by Eveloy *et al.* concentrates on the prediction accuracy of CFD analysis for printed circuit board heat transfer. The paper brings together a number of previously published analyses and covers a lot of interesting material for the designer. It was concluded that, on the average, a good level of predictive accuracy can be obtained. Also, a novel paint film evaporation technique was developed to illustrate the impact of flow phenomena on the distribution of heat transfer from a surface.

A related paper by Lohan *et al.* discusses the influence of board layout on the component’s temperature in a natural convection driven environment. Again, many interesting experiments are demonstrated. An important part deals with a comparison between existing methods to evaluate the effective thermal conductivity of boards. It was concluded that all these methods fail in some respects, therefore the authors propose a new modeling strategy.

In the last paper, Szekely and Rencz present their view on the time-constant spectrum representation of the dynamic thermal behavior of packages. The paper makes clear that studying the thermal response in the frequency domain can retrieve a wealth of information. The authors show also several examples of the implementation of the method in existing software.

Publisher Item Identifier S 1521-3331(00)09287-4.

We hope that you enjoy these contributions as much as we did.

BERNARD COURTOIS, *Guest Editor*
Philips Research Laboratories
Eindhoven, The Netherlands
bernard.courtois@imag.fr

CLEMENS LASANCE, *Guest Editor*
Philips Research Laboratories
Eindhoven, The Netherlands
clemens.lasance@philips.com

Bernard Courtois (M'97) was born in Paris, France, in 1948. He received the Engineer degree from the Ecole Nationale Supérieure d'Informatique et Mathématiques Appliquées de Grenoble, Grenoble, France, in 1973 and the Dr.Ing. and Dr.Sci. degrees from the Institut National Polytechnique de Grenoble.

He is currently Director of the Laboratory of Techniques of Informatics and Microelectronics, Computer Architecture (TIMA), where researches inclued CAD architecture and testing of integrated circuits and systems. He is also the Director of CMP Service that is servicing universities and companies from about 40 countries for ICs, MCMs and MEMs prototyping and small volume production.

Dr. Courtois is a member of ACM, ASME, and IMAPS. He is a IEEE Computer Society's Golden Core member and he is Doctor Honoris Causa of the Technical University of Budapest. He has been General Chair or Program Chair of various international conferences and workshops, including EDAC-ETC-EUROASIC, electron and optical beam testing, EUROCHIP, mixed-signal testing, rapid system prototyping, THERMINIC and design, test, and microfabrication of MEMS/MOEMS.

Clemens Lasance received the M.S. degree in physics from the Eindhoven Technical University, Eindhoven, The Netherlands, in 1969.

He joined Philips Semiconductors in 1969. From 1971 to 1973, he worked on ultrasonic welding at the Centre of Manufacturing Technology (CFT). In 1973, he switched to the Product Division Passive Components Department, and was involved in several activities related to fabrication technologies. In 1980, he took up a post within the Heat Transfer Group, CFT. From 1984 onwards, his main focus has been the thermal management of electronic systems. In 1996, he moved to the Research Department, engaged with a long-term research program in the field of fluid dynamics and heat transfer with a special focus on electronic parts and systems. Amongst his more important R&D activities, he contributed significantly to the success of the ESPRIT project DELPHI. Currently, he leads a ten-partner consortium in another EU-funded project called PROFIT. He lectured at the NATO Advanced Study Institute. He presented invited lectures at several occasions, and authored and co-authored more than 30 papers and chapters on various subjects of electronics cooling. He is an Associate Editor of *Electronics Cooling Magazine*.

Mr. Lasance was the Program Chairman of the First Eurotherm Conference on Thermal Management and Vice-Chairman of the second. For the last couple of years, he acted as the co-program chair of THERMINIC. He is the European Liaison for the SEMITHERM and ITHERM conferences and a Panel Member of *Future Circuits International*.