ICMTS 99 CONFERENCE INFORMATION

March 15-18, 1999
Sheraton Göteborg Hotel & Towers
Göteborg, Sweden

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ICMTS 1999
CHAIRMAN'S LETTER

Dear Colleague,

On behalf of the committee, I would like to invite you to the 1999 International Conference on Microelectronic Test Structures (ICMTS 1999) in Sweden. The conference is sponsored by IEEE Electron Device Society and will bring together designers and users of test structures from all over the world to discuss the most recent developments and future directions. This is the 12th time for ICMTS as an international conference and the first ICMTS to be held in Sweden. Starting up many years ago as a workshop, the conference has been able to maintain its friendliness by providing ample social activities to ensure that participants get the chance to meet others in their field and to learn from each others experiences.

The purpose of the conference is to bring together researchers and engineers for discussing microelectronic test structures and their applications for parameter extraction and characterization of device matching, critical dimensions, yield, reliability, interconnects, etc.

The technical program consists of 10 sessions containing 44 contributed papers, including 8 posters. Authors of the poster session will present a five minute oral summary of their poster to the general audience. Following immediately after the poster presentation each of the exhibitors are given an opportunity to present their latest products to the general audience. Following these presentations a combined poster session and measurement equipment exhibition is arranged. All the details will be found in the programme booklet.

On Monday March 16, the conference is preceded by a one-day tutorial short course to overview the main topics comprising the field of microelectronics test structures. The tutorial course will be the best place for young researchers to learn fundamentals on microelectronic test structures so as to catch up advanced topics in this field. A wine and cheese get-together will be held following the tutorial. On Wedneysday evening the conference banquet will be held during which the 1998 ICMTS Best Paper Award will be presented.

The conference will be held at Sheraton Göteborg Hotel and Towers, just a block away from the city center. Göteborg is the second largest city of Sweden, located on the west coast in the southern parts of the country. The city was founded in 1621 and has the largest port in Sweden with 20% of its export coming through this harbour. Well-known companies in the region are Volvo, manufacturing a major part of their trucks and family cars here, and Ericsson, having most of their microwave activities here. Göteborg has also a national symphony orcestra and the new opera house has already become a new landmark of the city.

I am sure that ICMTS 1999 in Göteborg will provide an excellent site for a very rewarding technical experience. We are looking forward to seeing you in Göteborg!

Sincerely,
Kjell O. Jeppson
General Chairman

GENERAL INFORMATION

The 1999 IEEE ICMTS will be held at the Sheraton Göteborg Hotel & Towers. The conference headquarters hotel will provide guest accomodations as well as meeting facilities for all attendees. The technical program will be held March 16 through 18. The technical program consists of 10 sessions containing 44 contributed papers, including 8 posters. A one-day Tutorial Short Course on Microelectronic Test Structures will be offered on March 15.

About the conference

The International Conference on Microelectronic Test Structures is sponsored by the IEEE Electron Devices Society. The purpose of the conference is to bring together designers and users of test structures to discuss recent developments and future directions. Thereby, the conference will serve as a forum for discussions between test chip engineers in industry and researchers in academia. Original papers will be presented that address new developments in test structures for both silicon and GaAs technologies as well as for microelectro-mechanical systems (MEMS). The emphasis of the meeting is on test structure research, implementation and application as well as on test structures aimed at material and device characterization.

The use of test structures for new process, device and circuit developments has become more and more important as feature size have been scaled down into the deep sub-micron regime. Furthermore, it is widely recognized that test structures pay a key role in the rapid transfer of new VLSI technologies from R&D into mass production as well as for yield improvement. The conference builds upon this by presenting the latest developments on measurement techniques and related device layouts that can be used to characterise the process and help identify process issues.

ICMTS is held on a three year rotation scheme between the US, Asia and Europe. Following the last conferences in Monterrey, CA, and Kanazawa, Japan, the conference will for the first time be held in Scandinavia. The conference is guided by an international steering committee and a technical committee with members from all over the world. However, the conference is arranged by a local committee giving each ICMTS conference a unique flavor of its host country.

Conference registration

Pre-registration is encouraged. To pre-register, use the tear-out registration form in the program booklet or the registration form available from this home page. Please fill out all spaces completely. Note that fees are higher for registration forms received after February 15, 1999. You may mail your registration form together with an international cheque maid payable to the conference secretariat at Technoconsult, or pay by postal giro or credit card. To e-mail your registration you must send a fax with your signature authorizing Technoconsult to charge your credit card for the registration fee. Eurocard, Master Card and Visa are accepted. Payment for fees at the conference must be in Swedish kronor (SEK).

Mail your conference registration form and remittance to:

Technoconsult
Dorteavej 7
DK-2400 Copenhagen NV
Denmark

Phone: +45 38 88 06 00
Fax: +45 38 88 06 11

Call the above number for *registration information only*. Telephone registrations will not be accepted. Registrations should be mailded no later than February, 15, 1999, or registrations should be made to hand carry fees to on-site registration.

Early Registration: (Postmarked by February 15, 1999)

	IEEE Member*	Non IEEE Member*	Student** IEEE Member*	Student** Non IEEE Member*
Tutorial Short Course	1,600 SEK	2,000 SEK	1,000 SEK	1,400 SEK
Technical Sessions	3,000 SEK	3,400 SEK	2,000 SEK	2,200 SEK

Late and on-site Registration: (Registered after February 15, 1999)

Tutorial Short Course	2,000 SEK	2,400 SEK	1,400 SEK	1,800 SEK
Technical Sessions	3,400 SEK	3,800 SEK	2,400 SEK	2,600 SEK

* Must be a member of the IEEE (or IEICE or JSAP). ** To qualify for reduced student rates, you must be a Student Member, full-time student, not be self-employed, nor working part or full time at a facility or corporation.

Registration fee includes admittance to the technical sessions, registration reception on Monday at 19.00-21.00, banquet at Sheraton on Wednesday at 19.00, lunches on Tuesday and Wednesday at 12.30, one copy of the proceedings, and admittance to the exhibits.

On-site registration hours

On-site registration for the conference will be conducted in the Lobby (1st floor) of the Sheraton Göteborg Hotel & Towers as follows:

Monday,	March 15	8:00 - 13:00 19.00-21.00
Tuesday,	March 16	8:00 - 17:00
Wednesday,	March 17	8:00 - 17:00
Thursday,	March 18	8:00 - 12:30

Cancellation

Due to advance financial commitments, refunds of registration fees requested after March 1, 1999, cannot be guaranteed. A SEK 200 processing fee will be withheld from all refunds. Requests for refunds of registrations canceled after March 1 will be considered after the conference.

Hotel information

Hotel reservations can be made by completing the tear-out form in the centre of the programme booklet or by using the reservation form available from this home page. Fill out the appropriate section of this form and mail it to Sheraton Göteborg Hotel & Towers. Hotel reservations can also be made by calling the hotel (phone: +46 31 80 6000) or by faxing your reservation form (fax: +46 31 15 98 88).

The hotel cut-off date for ICMTS group reservations is February 15, 1999. After that date hotel accomodations will be available on a space.available basis only, at the regular higher rate. March is a busy month in Göteborg - therefore you are urged to to make reservations as soon as possible. The group rate is SEK 1170 per night.

Parking is available in a nearby parking house across the street.

The Sheraton Göteborg Hotel & Towers is conveniently located close to the railway station and the Nils Ericsson bus terminal where the airport bus stops (just across the Drottningtorget).

The conference participants can easily slip out from the modern meeting place into the old part of the city where old fortifications still can be seen, and modern shopping centers, pubs and restaurants are nearby. For those who prefer to stay indoors, the hotel has both a beautiful indoor winter garden and a well-equipped fitness center.

Transportation

Travelling to and from Goteborg is easy and the modern airport has non-stop connections to many big cities in Europe, like Stockholm, Copenhagen, London, Paris, Brussels, Amsterdam, Frankfurt and Zurich. This means that Göteborg can be reached from many places in the US and Japan with only one-stop airflights.

From the airport the city center can be reached by the airport bus which leaves the airport at least every 30 minutes (rush hours every 15 minutes). The ticket price is 45 SEK and the trip takes about 30 minutes. Taxi cabs are also available at the airport, most of them offering a fixed price (~230 SEK) to down-town Göteborg.

Rental Cars

The following rental car agencies are located at Göteborg-Landvetter airport: Avis, Hertz, Budget, and Eurocar.

Messages

Messages can be left for attendees during registration hours and will be posted on the message board. Call the hotel direct (phone: +46 31 80 6000) and ask for the ICMTS registration desk. Messages for attendees who are hotel guests can also be left for the individual in their rooom, or you may fax to a hotel guest at the guest fax number (fax: +46 31 15 98 88).

Tutorial Short Course on Monday, March 15, 1999.

An Introduction to the Design, Measurement, and Analysis of Microelectronic Test Structures

The ICMTS Tutorial is a one-day short course that is intended to provide the non-expert with the fundamentals associated with microelectronic test structures. The course strive to provide good design, test, and analysis guidelines so that superior test-structure practice will be followed, thus paving the way for improved process control, higher yield product, and rapid product introduction. The course instructors, chosen by Dr. Anthony Walton for this year's tutorial, are distinguished speakers from academia and industry having many years of experience in the field of test structures. The format of the tutorial short course will be interactive with emphasis on the practical use of microelectronic test structures.

The topics of the Tutorial Short-Course include

- **Introduction - Fundamentals of Microelectronic Test Structures**
- **Electrical Linewidth and Overlay Structures**
- **DC-type Transistor Model Parameter Extraction**
- **High Frequency Parameter Extraction**
- **Noise Measurements and Modeling**
- **Characterising CMOS Technologies for ESD Robustness**
- **Extraction of Statistically Valid Model Parameters for IC Design**
- **Matching**

TUTORIAL OUTLINE

08:00 Registration

09:00   Introduction - Anthony Walton

09:05 1. Fundamentals of Microelectronic Test Structures - Anthony J. Walton,
        University of Edinburgh, Scotland, UK

    o **Tutorial Overiew**
    o **Probe pad design**
    o **The 2xN probe pad array**
    o **Four-terminal Kelvin measurement technique**
    o **Bridge/cross resistors for sheet and linewidth measurements**
    o **Design curves for linewidth measurements**
    o **Three-terminal capacitor measurements**
    o **Matrixed test structures**

09:45 2. Electrical Linewidth and Overlay - Loren W. Linholm,
        NIST, Gaithersburg, Maryland, USA

    Introduction/background
    o **Optical structures**
    o **Electrical structures**
    o **Metrology comparisons**
    o **Recent advances**

10.30 COFFEE BREAK

11.00 3. DC-type Transistor Model Parameter Extraction - Colin McAndrew,
        Motorola, Tempe, Arizona

    o **Compact modelling foundation: Process and geometry dependence**
    o **BJT modelling review (VBIC emphasis)**
    o **MOS modelling review (Tsividis charge sheet model emphasis)**
    o **Common MOS modelling problems, their consequences, and how to detect them**
    o **Model parameters versus "physical" parameters**
    o **Direct extraction versus optimization**
    o **The importance of using the right target data and residual metric**
    o **Extraction tricks and targets for BJT characterization, the substrate current goldmine**
    o **Generic iterative optimization strategy for MOS characterization**

11.45 4. High Frequency Parameter Extraction - Franz Sischka
        Hewlett Packard, Germany

    o **Basics of S-Parameters**
    o **High Frequency Measurement Techniques**
      - **Network Analyzer Calibration**
      - **Probes and Device Layout**
    o **Introduction to De-Embedding (off-stripping) of parasitic components**
    o **HF Transistor Parameter Extractions**
      - **Large Signal Model**
      - **Small Signal Model**
    o **Introduction to Package Modelling**

12:30 HOSTED LUNCH

13.45 5. High Frequency Noise Measurements and Modelling - Jamal Deen,
      Simon Fraser University, Vancouver, Canada

     o Test structures for HF measurements
     o Scattering and Noise Parameter Measuremnents
       - entire system setup
       - system settings
       - system calibration
     o Noise in Semiconductor Devices
     o Review of Noise Models of MOSFETs
     o Noise Modeling and Experiments
       - Theory of Noisy Two-Ports
       - Noise Parameter De-Embedding and Pad Modeling
       - Modeling and Experimental Results

14.30 6. Characterising CMOS Technologies for ESD Robustness - Robert Ashton,
      Bell Labs, Lucent Technologies, - , USA

     o Introduction to ElectroStatic Discharge (ESD)
     o ESD testing of Integrated Circuits (HBM,MM,CDM)
     o Basics of ESD Protection Circuitry
      -Circuit Elements to be protected
      -Circuit Elements used for protection
     o Understanding Circuit Elements outside of Normal Operation
      -Transmission Line Pulse Measurement (TLP)
      -Test Structures for ESD Characterization
      -SEMATECH Structures for ESD Robustness

15.15 COFFEE BREAK

15.45 7. Extraction of Statistically Valid Model Parameters for IC Design - Kevin McCarthy,
     NMRC, Cork, Ireland

     o Introduction - the need for statistical methods in parameter extraction.
     o Literature Review - a brief look at some methods used in the past.
     o Multivariate Statistical Methods - especially Principal Component Analysis which is widely used at present.
     o Design of Experiments - factorial design techniques which can be used to explore the boundaries of the parameter distributions.
     o Some Examples

16.30 8. Matching - Hans Tuinhout,
     Philips Research Laboratories, Eindhoven, The Netherlands

     o Introduction and motivation
     o Mismatch effects
     o Measurement methods
     o Test structures
      - Rules
      - Examples
     o Modeling and matching numbers

17.15 WRAP-UP and CONCLUSION

19.00-21.00 RECEPTION

INSTRUCTORS

Anthony J. Walton, Univ. of Edinburgh, Scotland, UK

Anthony J. Walton has been a member of the Electrical Engineering Department at the University of Edinburgh for the past 15 years. During that time he has been involved with the microelectronics industry in a number of areas which include silicon processing, yield improvement, Design for Manufacturability (DFM), Technology Computer Aided Design (TCAD) and microelectronic test structures. His present interests also include the optimisation of semiconductor processes through the integration of experimental design and TCAD simulation tools. He has published widely and in 1990 won the best paper award for the IEEE Transactions on Semiconductor Manufacturing.

Loren W. Linholm, NIST, Gaithersburg, Maryland, USA

Loren Linholm received the B.S. in Electrical Engineering from the University of California, Berkeley in 1968 and the M.S. In Electrical Engineering from the University of Maryland, College Park in 1973. Loren has been employed by the Naval Missile Center, Point Mugu, CA, the Department of Defence, Ft. Meade, MD, and since 1978, by the Semiconductor Electronics Division at the National Institute of Standards and Technology, Gaithersburg, MD. Loren currently heads the Integrated Circuits Technology Group which is responsible for designing,

developing, and evaluating measurement methods for silicon integrated circuits with emphasis on test structures, associated data analysis techniques, novel sensors, and advanced microelectromechanical systems. Loren is a member of the IEEE Electron Devices Society and co-founder of the International Conference on Microelectronic Test Structures.

Colin McAndrew, Motorola, Tempe, Arizona

Colin McAndrew received the Ph.D. and M.A.Sc. degrees in Systems Design Engineering from the University of Waterloo, Waterloo, Ontario, Canada, in 1984 and 1982 respectively, and the B.E. degree in Electrical Engineering from Monash University, Melbourne, Victoria, Australia, in 1978. Since 1995 he has been with Motorola, Tempe AZ, and is at present the Manager of the Modeling Technology Laboratory. From 1987 to 1995 he was at AT&T Bell Laboratories, Allentown PA. His work is primarily on compact and statistical modelling and characterization for circuit simulation.

Franz Sischka, Hewlett Packard, Germany

Franz Sischka studied communications engineering at the University of Stuttgart, Germany, where he also received his M.S. (Diplom-Ingenieur) and the Ph.D. degrees in 1979 and 1984. After joining Hewlett-Packard in Germany, he worked for 5 years in R&D in the fiber optics group at HP Boeblingen and was co-developer of HP's first optical time domain reflectometer (OTDR) for glass fiber characterization. Since 1989, he has been a consultant for HP's device modelling software IC-CAP and author of the IC-CAP modelling handbook. His work is specially focusing on high frequency device modelling and model parameter extraction strategies.

Jamal Deen, Simon Fraser University, Vancouver, Canada

Dr. M. Jamal Deen is professor of Engineering Science at Simon Fraser University, Vancouver, British Columbia, Canada. Previously, he was with the CNRS Laboratory of Physics of Semiconductors Devices (LPCS), Grenoble (summer 1998), Faculty of Electrical Engineering (ECTM Lab), Delft University of Technology (Visiting Professor, summer 1997); Herzberg Institute of Astrophysics, National Research Council, Ottawa (Visiting Scientist, summer 1986); and Lehigh University, Bethlehem, Pennsylvania (Assistant Professor, 1985-86). His industrial experience includes a one-year visiting scientist position (1992-93) with the Device Technology Group, Northern Telecom, Ottawa, and several years of consulting and joint research with Mitel, Northern Telecom, Bell Northern Research, Nanowave Technology, National Semiconductor and Rockwell Semiconductor Systems. His present research interests are in silicon device physics and modelling, high frequency devices, optical detectors and novel semiconductor materials.

Robert Ashton, Bell Labs, Lucent Technologies, - , USA

Robert Ashton received his B.S. and Ph.D. degrees in Physics from the University of Rhode Island in 1971 and 1977. After doing post doctoral positions in low temperature physics at Rutgers University and Ohio State University he joined AT&T Bell Laboratories in 1980. At AT&T Bell Labs and now at Bell Labs, Lucent Technologies, which spun off from AT&T in 1996, he has been a Member of Technical Staff in the VLSI Technology Laboratory. He has been involved in technology integration for core CMOS technologies, test structure design for technology development, and the technology issues of ElectroStatic Discharge (ESD). He is a member of the IEEE Electron Device Society, the ESD Association and the SEMATECH ESD Working Group. He has been a member of the ICMTS Technical Committee since 1990 and served as Technical Chairman in 1994 and as General Chairman in 1997.

Kevin McCarthy, NMRC, Cork, Ireland

Kevin McCarthy received the B.E., M.Eng.Sc.and Ph.D. degrees from University College Cork, Ireland in 1982, 1986 and 1992 respectively. From 1982 to 1984 and again from 1990 to 1993 he worked with Analog Devices, Limerick, Ireland in the Product Engineering and CAD departments. He has been with the National Microelectronics Research Centre, Ireland since 1993 where he is now a Senior Research Scientist. His research interests are in compact device modelling for CMOS and bipolar devices and the use of these models for statistical analysis. He has participated in the simulation aspects of European Union technology development projects such as JLP, ADEQUAT and ACE and is a member of the IEEE Electron Devices Society.

Hans Tuinhout, Philips Research Laboratories, Eindhoven, The Netherlands

Hans Tuinhout received his MSEE degree from the University of Technology of Delft (NL), in 1980. Since then Hans worked at Philips Research Laboratories in Eindhoven (NL), interrupted by a sabbatical year at the ECE Department of Carnegie-Mellon University, Pittsburgh, Pennsylvania. During his professional career, Hans has always been involved with device characterization for CMOS and BiCMOS processes. Currently Hans works as Senior Scientist in the Semiconductor Device Architectures group at Philips Research. His research activities are focused on very accurate DC device measurements for matching characterization. Hans is a member of the IEEE Electron Devices Society and member of the ICMTS Technical Program Committee. He served as Technical Program Chairman for the ICMTS 1989. Hans is a part-time instructor for the Philips Centre for Technical Training where he teaches IC-technology and Bipolar and MOS device characterization.

Technical Session Information

The technical session will be held in the conference hall "Västerhavet" on the ground floor.

The official language of the conference is English and it will be used for all presentations, printed materials, slides and OHP transparencies. A overhead projector and 35mm slide projector for 50mm x 50mm mount will be available for use at the presentation. All speakers are requested to report to the speaker's registration desk located in front of the conference room to arrange their slides in the carousels and preview them.

One of the papers presented at the conference will be selected for the Best Paper Award. The award will be presented at the award ceremony during ICMTS 2000.

The IEEE ICMTS 1999 will publish a proceedings. One copy of the proceedings is included in the registration fee. Additional copies will be available during the conference for 600 SEK per copy, or from the IEEE after the conference.

Poster presentation, Vendor presentation and Equipment Exhibition

A poster session will be held Tuesday at 15.40 at which time authors will give a brief 5-minute summary of their work. Posters will be displayed from Tuesday at 13.00 until Wedneysday at 19.00. Following the poster presentation a 5-minut oral presentation will be given by the exhibitors on Tuesday at 16.30.

Following these presentations a combined poster session and measurement equipment exhibition is arranged. The equipment exhibition will display equipment closely paralleling the nature of this meeting. This permit one-on-one discussions between exhibitors and conference attendees on the latest test equipment.

Equipment exhibition hours

Tuesday	March 16	12:00 - 20.00
Wedneysday	March 17	09:00 - 18.00
Thursday	March 18	09:00 - 12:00

Food and Beverages Functions

Registration welcome reception

A wine and cheese get-together reception will be held on Monday at 19-21 in the Sheraton lobby.

Lunch

Lunch will be served on Monday (for those attending the tutorial short course), Tuesday and Wedneysday at the Sheraton Hotel.

Banquet

The Conference Banquet will be held Wedneysday March 17, at the Sheraton Hotel. One banquet ticket is included with the technical session registration. Additional guest tickets are available at the cost of SEK 450.

Göteborg Information

The city of Göteborg is located on the west-coast of southern Sweden. Göteborg is the second largest city of Sweden with a population of almost 500,000. The city was founded in 1621 by king Gustav II Adolf, the king who also built the big battle-ship Vasa, the world´s oldest battle ship from 1628 which can be seen in at the Vasa museum in Stockholm. Göteborg has the largest port in Sweden with 20% of all Swedish export and import going through this harbor. Göteborg is also the home town of Volvo, with a major part of their family cars and trucks being manufactured here. Other well-known companies in the region are Ericsson who has its microwave activities here and Hasselblad, the well-known camera manufacturer. Göteborg is also a university city, hosting both the University of Göteborg and Chalmers Technical University. Göteborg has also a national Symphony Orchestra and the new opera house has become a new landmark of the city.

Climate and Clothing

The weather in Göteborg during the conference period is often unpredictable. March is often associated with noon-day thaw: we are leaving winter behind, days are getting longer and spring is not faraway. Most winters there is not much snow at all in Göteborg, close as it is to the sea, and if there is most of it is usually gone by March.

The temperature will range between -5°C (23°F) and +5°C (41°F), usually with a few plus degrees during the day and a few minus degrees during the night. Warm clothing is recommended. Bring your longjohns if you want to make long outdoor walks. Walks or jogging in the Skatås/Delsjön forest park is strongly recommended.

Hotels and buildings are fully heated and air-conditioned.

Excursion - BOAT TRIP with "ÄRTOR & PUNSCH"

What a perfect conclusion of the conference! At 13.00 we leave the Lilla Bommen ferry terminal with Älvsnabben, a commuter ferry regularly cruising the Göteborg Harbor. After an exciting trip through the wintry harbor, where big ferries and speedy catamarans regularly leave for Denmark, we arrive at the Eriksberg docklands (a former shipyard). At the exclusive restaurant of Westra Piren we will have ärtor and punsch (Swedish pea-soup with warm Swedish punch) and Swedish pancakes for dessert. An old Swedish tradition, only available on Thursdays! An excellent choice on a chilly day!

CONFERENCE OFFICIALS

ICMTS 1999 Conference Committee

General Chairman:
Kjell O. Jeppson
Chalmers University of Technology

Dept. of Solid-State Electronics
S-41296 Göteborg, Sweden
Phone: +46-31-772 1856, Fax: +46-31-772 3622
e-mail: kjell.jeppson@ic.chalmers.se

Technical Chairman:
Alan Mathewson
NMRC
University College
Lee Maltings, Prospect Row
Cork, Ireland
Phone: +353-21-904 142, Fax: +353-21-904 204
e-mail: amathews@nmrc.ucc.ie

Tutorial Chairman:
Anthony J. Walton
Electrical Engineering Department
University of Edinburgh
Kings Bldg. , Edinburgh, EH9 3JL, UK
Phone: +44-131-650-5620, Fax: +44-131-650-6554
e-mail: Anthony.Walton@ee.ed.ac.uk

Tutorial Co-chairman:
Hans Tuinhout
Philips Research Laboratories
Semiconductor Device Architecture Group
Prof. Holstlaan 4 (WAG 11)
5656 AA Eindhoven, The Netherlands
Phone: +31-40-274 2214
Fax +31-40-274 3390
e-mail: tuinhout@natlab.research.philips.com

Equipment Exhibit Chairman:
Gerard Ghibaudo
LPCS/ENSERG
23 Avenue des martyrs, BP 257
38016 Grenoble Cedex-FRANCE
Phone: +33-(0)4-7685-6058, Fax:+33-(0)4-7685-6070
e-mail: ghibaudo@enserg.fr

USA Representative:
Loren W. Linholm
National Inst. of Standards & Technology
B-360 Tech. Bldg.
Gaithersburg, MD 20899, USA
Phone: +1-301-975-2052, Fax: +1-301-948-4081
e-mail: linholm@piper.eeel.nist.gov

Asian Representative:
Takashi Ohzone
Toyama Prefectural University
Kurokawa, Kosugi-Machi
Imizu-Gun,Toyama 939-03, Japan
Phone: +81-776-56-7500 Ext. 501, Fax: +81-766-56-6172
e-mail: ohzone@pu-toyama.ac.jp

ICMTS 1999 Conference Secretariat:
Ivan Ring Nielsen
Technoconsult
Dortheavej 7
DK-2400 Copenhagen NV, Denmark
Phone: +45-38-880 600, Fax: +45-38-880 611
e-mail: technoconsult@technodata.dk

Steering Committee

| Anthony J. Walton | University of Edinburgh | UK |

Technical Committee

Charles N. Alcorn	Lockheed-Martin	USA
Kunihiro Asada	University of Tokyo	Japan
Robert Ashton	Bell Laboratiories, Lucent Technologies	USA
Lawrence Bair	Compaq Computer Corporation	USA
Michael W. Cresswell	NIST	USA
Harold Davis	SEMATECH	USA
Gerard Ghibaudo	LPCS/ENSERG	France
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Alfred C. Ipri	David Sarnoff Research Center	USA
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Naoki Kasai	Nippon Eelectric Corporation	Japan
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Loren W. Linholm	NIST	USA
Emilio Lora-Tamayo	CNM	Spain
Alan Mathewson	NMRC	Ireland
Takashi Ohzone	Toyama Prefectural University	Japan
Alexander Rahm	Siemens AG	Germany
Willy Sansen	Katholieke Universiteit Leuven	Belgium
Nobuo Sasaki	Fujitsu Laboratories	Japan
Akella Satya	Level One Communications	USA
Dieter Schroder	Arizona State University	USA
Masakazu Shimaya	NTT	Japan
Johnny K. O. Sin	The Hong Kong University	Hong Kong
Giovanni Soncini	IRST	Italy
Yoichi Tamaki	Hitachi Ltd	Japan
Hans P. Tuinhout	Philips Research Laboratories	The Netherlands
Timothy E. Turner	Keithley Instruments	USA
William Verzi	Hewlett Packard	USA
Anthony J. Walton	University of Edinburgh	UK
Toshiharu Watanabe	Toshiba Corporation	Japan