BCTM PROCEEDINGS

PROCEEDINGS
OF THE 1998 BIPOLAR/BiCMOS CIRCUITS AND TECHNOLOGY MEETING

1998

Minneapolis, Minnesota
September 27-29, 1998

Sponsored by IEEE

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SPONSORED BY
IEEE ELECTRON DEVICES SOCIETY

in cooperation with
IEEE SOLID-STATE CIRCUITS SOCIETY

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Welcome from the Chairmen

Welcome to the IEEE Bipolar/BiCMOS Circuits and Technology Meeting.

An examination of the content of this year's conference reveals that 1998 is another strong year for both the BCTM and bipolar/BiCMOS circuits and technology. High-speed communications, RF circuits and technology, mixed-signal applications and power devices are all areas that continue to benefit from advances in bipolar circuits, devices, and technology. The 1998 edition of the BCTM promises to be an exciting conference!

The BCTM continues with the theme of recent years, emphasizing the convergence of the fields of Computers and Communications as we edge towards the 21st century. Integrated circuits combining telecommunication and computer applications, using high-speed analog and mixed signal digital circuitry will be a central element of future progress in the electronics industry.

This year's short course is entitled "Tools and Techniques for High-Speed Communications." Three well-known experts will provide overviews of topics for people designing, modeling, or developing circuits and technology for high-speed communications: Dr. Colin McAndrew of Motorola Semiconductor Products will discuss the VBIC BJT circuit simulation model. Mr. Richard Walker of Hewlett-Packard Labs will focus on timing recovery and data regeneration. Finally, Dr. Kenneth Kundert of Cadence Design Systems will discuss analog and mixed-signal circuit simulation.

The keynote speech, which will be given by Dr. Tetsushi Sakai of NTT Electronics Corporation, is entitled "Prospects of Bipolar and BiCMOS Technologies and Its Applications." As attendees at last year's BCTM will recall, Dr. Sakai was one of the guests honored for his contributions to the development of bipolar technology at our celebration of the 50th anniversary of the invention of the bipolar transistor. We are pleased that such a distinguished speaker will be delivering the keynote speech this year to get the next 50 years of the bipolar transistor off to a strong start.

The luncheon speech, which will be delivered by Professor Adel S. Sedra, Vice-president and Provost at the University of Toronto, is entitled "The Role of Engineers in Society." This talk will focus on the roles and responsibilities of engineers in society at large, in the face of the very rapid advance of technology. Professional and ethical responsibilities will be discussed and the evolution of engineering as a career will be described.

There are 12 technical sessions, with five invited and 40 regular session papers covering a broad range of topics. The international flavor of the BCTM is underscored by the fact that over 50% of the papers at this year's conference will be delivered by authors representing universities and companies outside of the United States. In support of our policy of encouraging student participation in BCTM, the conference participants will once again be asked to vote for the best student paper award, which will be awarded at next year's conference. There are two panel discussions Monday night. The first panel, entitled "Will the Best Candidate for Power Amplifiers Please Stand Up!", will assess a number of technologies competing for dominance as power amplifiers in the wireless and cellular markets. The second panel is called "Do PhD's Make Better Engineers?" and makes an effort to address the somewhat sensitive issue of whether extended graduate education is necessarily better than on-the-job training and experience.

Finally, the 1998 BCTM is featuring an enhanced vendor exhibition including several new exhibitors, which is highlighted by a reception at lunch-time Tuesday. We express our great appreciation to the 1998 BCTM committee members for their diligence in putting together an exciting program. It is our great pleasure to extend a hearty welcome to the 1998 IEEE Bipolar/BiCMOS Circuits and Technology Meeting in Minneapolis, Minnesota.

FOR YOUR CONVENIENCE ...

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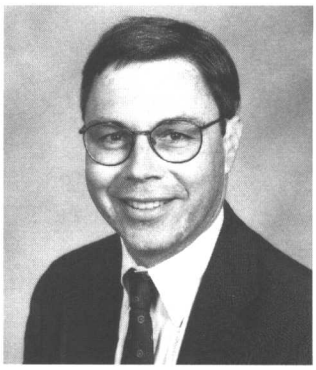
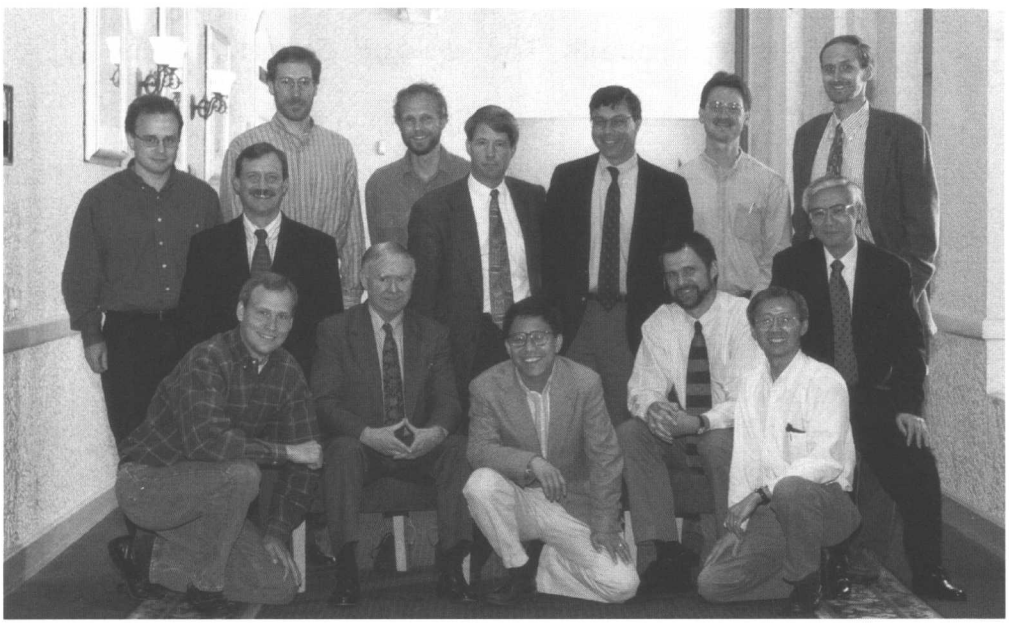
General Chair BCTM 1998



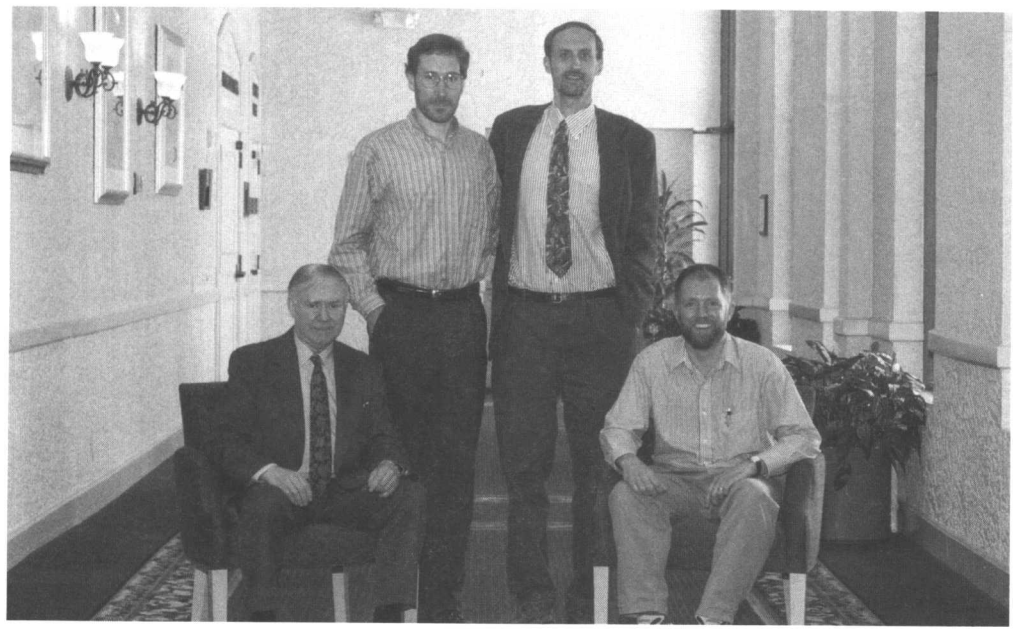
John Shott
Program Chair BCTM 1998

BCTM 1998 Executive Committee



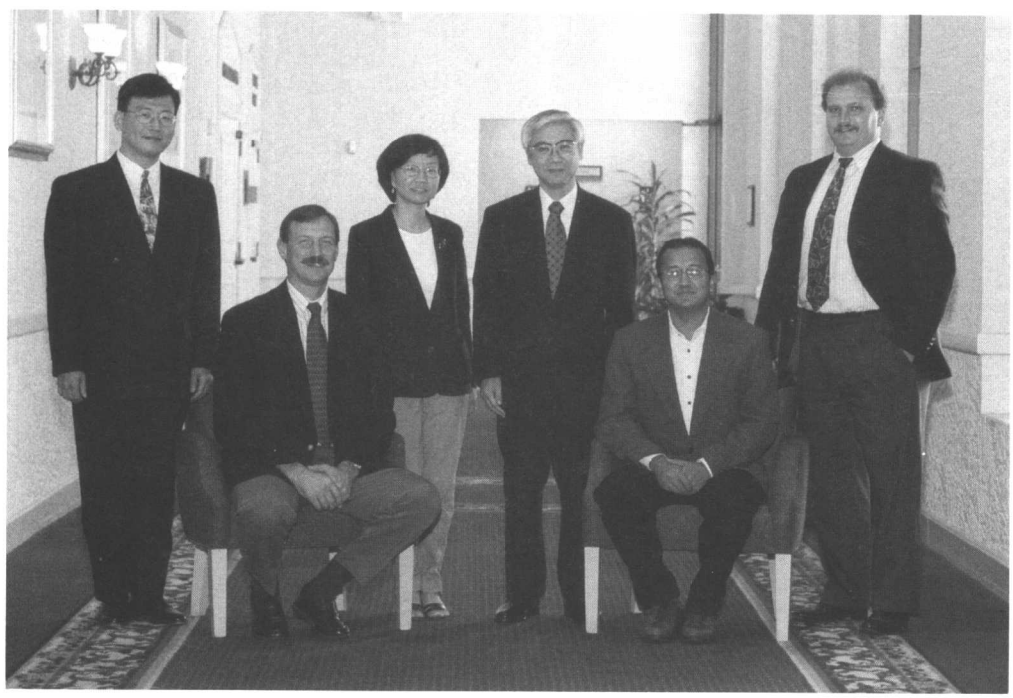
Front row, left to right: Ross Teggatz, Barrie Gilbert, Kenneth O, Joachim Burghartz, Paul Tsui
Seated: Brad Scharf, Hiroshi Iwai
Standing: Marco Corsi, John Long, Michael Schröter, Jim Hayden,
John Shott, John Cressler, Larry Larson

BCTM 1998 RF Design Subcommittee



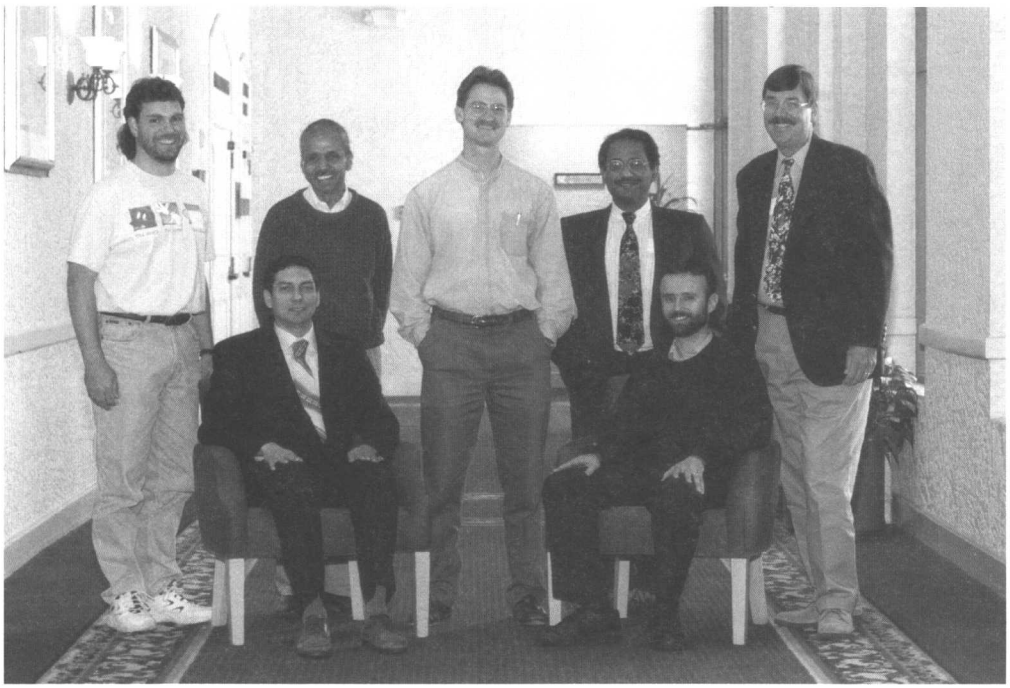
Left to right: Barrie Gilbert, John Long, Larry Larson, John Nisbet

BCTM 1998 Process Technology Subcommittee



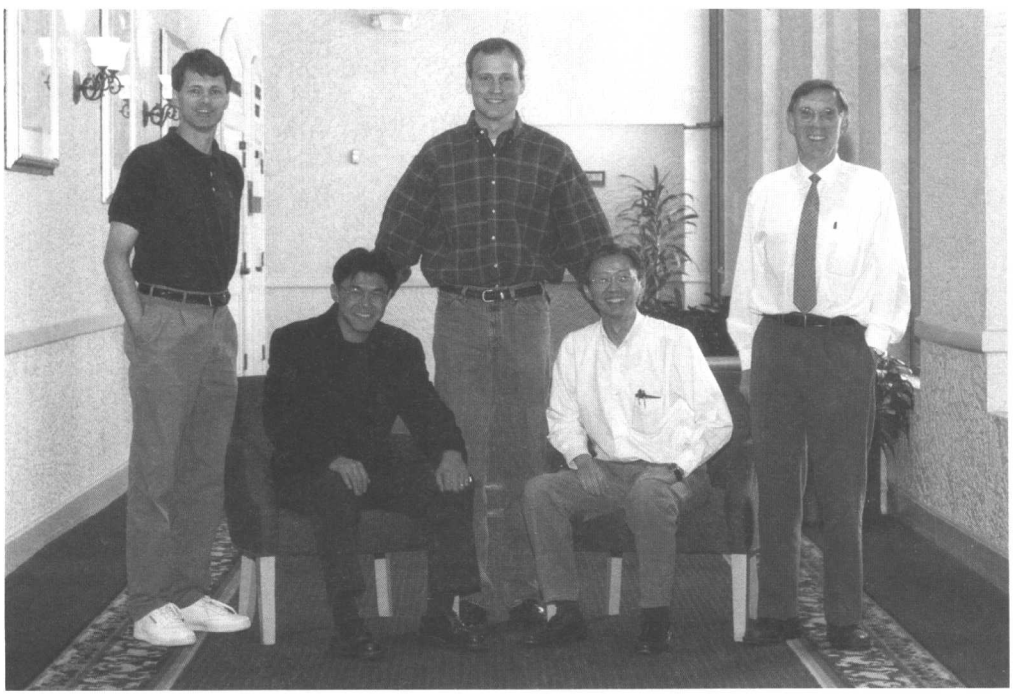
Left to right: Yih-Feng Chyan, Brad Scharf, W. Margaret Huang, Hiroshi Iwai
Rashid Bashir, John Erdeljac

BCTM 1998 Device Physics Subcommittee



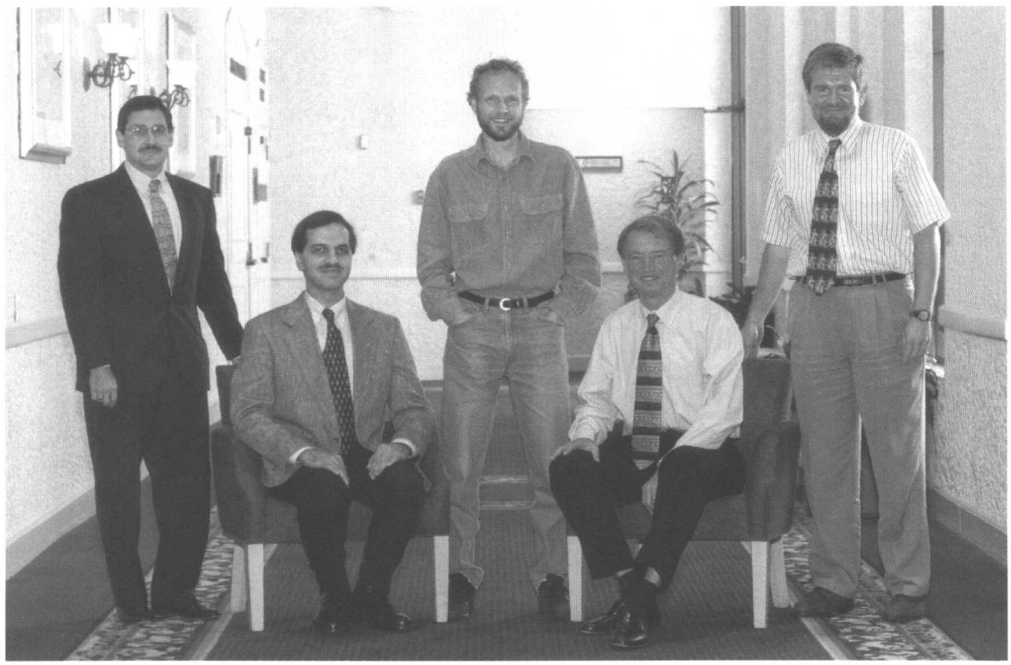
Seated, left to right: Seshu Subbanna, John Hamel
Standing, left to right: Peter Zampardi, S. J. Prasad. John Cressler, Alvin Joseph, Robert Fox

BCTM 1998 Power Devices Subcommittee



Seated, left to right: Clifford Ma, Paul Tsui
Standing, left to right: Garrett Neaves, Ross Teggatz, Pierre Rossel

BCTM 1998 CAD/Modeling Subcommittee

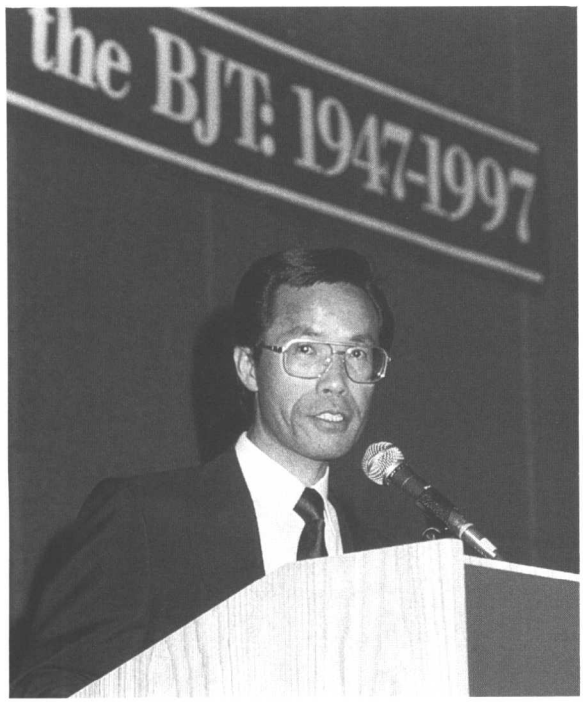


Seated, left to right: Shahriar Moinian, Stephan Cserveny
Standing, left to right: Rick Jerome, Michael Schröter, Colin McAndrew

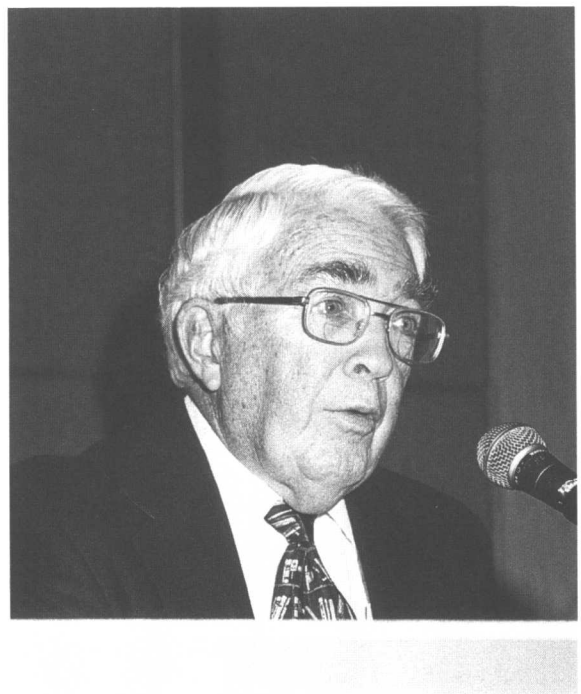
BCTM 1998 Analog/Digital Design Subcommittee

Left to right: Masao Hotta, Tajinder Manku
Standing, left to right: Farhood Moraveji, Marco Corsi

Highlights from the BCTM '97 Celebration of the 50th Anniversary of the BJT

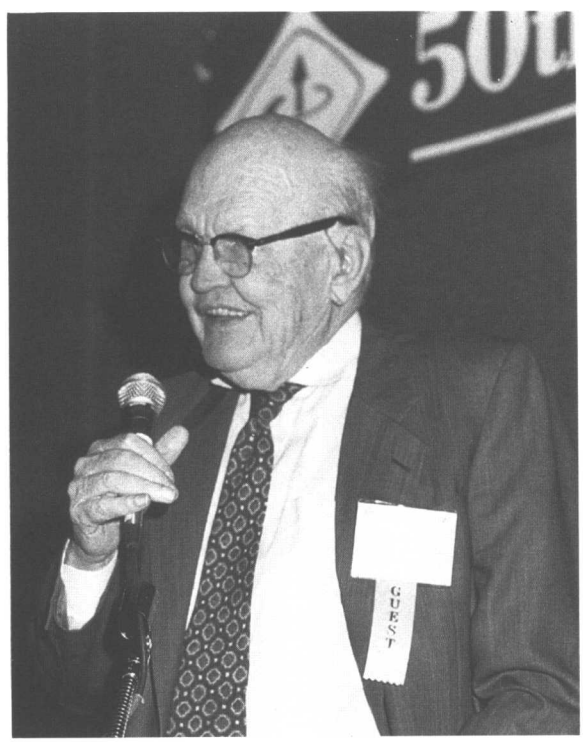


Tad Yamaguchi, BCTM '97 General Chair



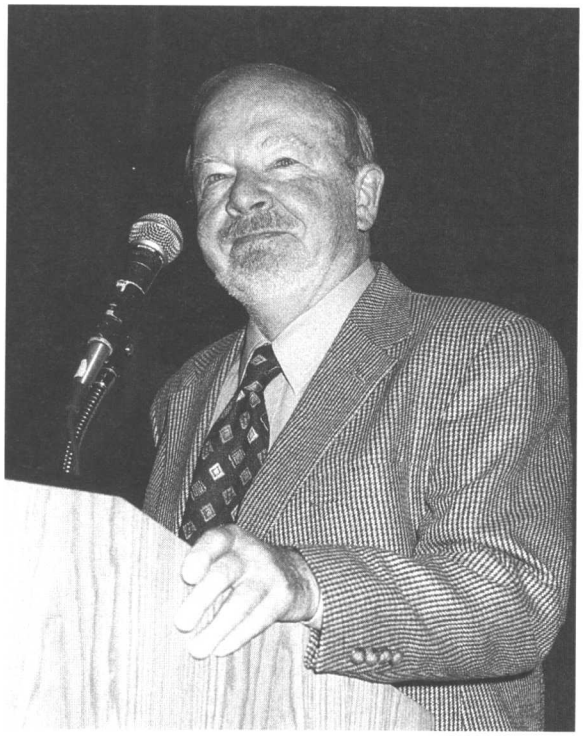
Jim Early, Special Guest and Luncheon Speaker

John Shier, Special Guest and Master of Ceremonies

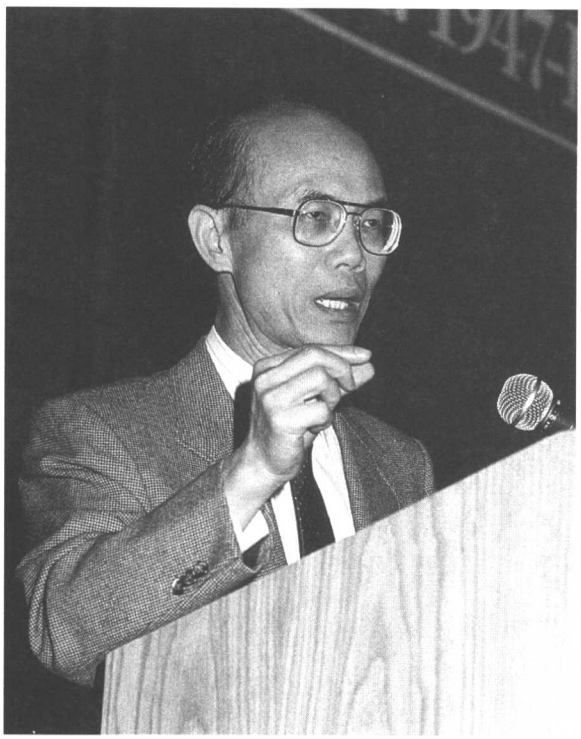


Jack Kilby, Special Guest

John Moll, Special Guest



Ray Warner, Special Guest



Tak Ning, Special Guest

Tetsushi Sakai, Special Guest

1998 BCTM
SCHEDULE AT A GLANCE

Sunday — September 27		
8:45 AM — 5:15 PM	**SHORT COURSE** Tools and Techniques for High-Speed Communications	
7:00 PM	Registration/Reception	
Monday — September 28 Registration open from 7:30 AM in Ballroom Atrium		
8:30 AM	Opening Remarks and Announcements	
8:45 AM	KEYNOTE SPEAKER: Tetsushi Sakai "Prospects for Bipolar and BiCMOS Technologies and Its Applications." Ballrooms 1 and 2	
9:30 AM	Coffee and Cookies in Ballroom Atrium*	
9:50 AM	ESD and Radiation Effects Ballroom 3	Analog Design Ballroom 4
11:45 AM	LUNCHEON SPEAKER: A. S. Sedra "The Role of Engineers in Today's Society" Ballrooms 1 and 2	
1:45 PM	Power Devices I Ballroom 3	Modeling & Simulations Ballroom 4
3:25 PM	Coffee and Cookies in Ballroom Atrium*	
3:40 PM	SiGe Process Technology Ballroom 3	RF Circuits and Technology Ballroom 4
Author Interviews Immediately After Sessions		
Dinner Break		
7:45 PM	Complimentary Refreshments in Ballroom Atrium	
8:00 PM	Will the Best Candidate for Power Amps Please Stand Up! Ballroom 3	Do Ph.D's Make Better Engineers? Ballroom 4
Tuesday — September 29		
8:30 AM	Process Tech. for RF Applications Ballroom 3	Communication Circuits Ballroom 4
10:10 AM	Coffee Break in Ballroom Atrium*	
10:30 AM	Adv. Silicon Bipolar Process Technology Ballroom 3	Distortion, Noise, & Transient Effects in BJT's Ballroom 4
Lunch / Exhibitor Reception		
2:00 PM	Power Devices II Ballroom 3	Modeling & Parameter Extract. Ballroom 4
Author Interviews Immediately After Sessions		

* The Coffee and Cookie Breaks are sponsored by Nortel Semiconductors.

PANEL DISCUSSION A

Monday 8:00-10:00 PM — Ballroom 3
Organizer: Seshu Subbanna (IBM) and M. Huang (Motorola)

Will the Best Candidate for Power Amplifiers Please Stand Up!

The wireless and cellular market continues to expand rapidly, and various technologies are competing to serve this market, specially for the power amplifiers. There are stringent requirements on system linearity, power output, and efficiency, which vary depending on the type of protocol and frequency e.g. AMPS, GSM, CDMA, etc., or 900/ 1800 MHz. Of course low cost is of the essence in these volume markets. This panel will focus on the strengths and weaknesses of various technologies & circuits, as well as the design tradeoffs, to achieve economical system performance requirements. Technologies to be covered include Silicon Bipolar and MOS, LDMOS, Silicon-Germanium, Gallium Arsenide HBTs, MESFETs, and HEMTs.

PANELISTS:

David Harame	IBM, moderator
Bob Bayruns	Anadigics
Wayne Burger	Motorola
Masao Hotta	Hitachi
Pieter Lok	Philips Nijmegen
Jim Moniz	IBM
Stewart Taylor	Triquint Semiconductor
Ken Weller	Rockwell

PANEL DISCUSSION B

Monday 8:00-10:00 PM — Ballroom 4
Organizer: M. Corsi (TI)

Do Ph.D's Make Better Engineers?

The purpose of this panel is to give us the opportunity to discuss the pros and cons of further education. The question is: Do PhD's make better engineers? Our immediate gut reaction is not the only one we are looking for. We are also looking for facts that support that belief. The following questions are meant to clarify by offering some clues to the truth-Whatever that is-.

1. Do Ph.D.'s (in your opinion) make better engineers?

2. Are Ph.D.'s more knowledgeable when they first graduate than a Masters' graduate? If yes do they remain more knowledgeable over the years?

3. Some people are flexible and some are rigid in their thoughts, (right or wrong) identify the most flexible and the degree they hold, and identify the most rigid and what degree do they hold? (Do this within your own cost center or department)

PANELISTS:

Marco Corsi	TI, Moderator
Ming Chiang	TI
Dr. William S. Hortos	Harris & Florida Inst. of Tech.
Dr. Larry Larson	Univ. of California at San Diego
Dr. John Shier	VTC, Inc.

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PANEL DISCUSSION B p. 14

I. ESD AND RADIATION EFFECTS

Monday AM — Ballroom 3
Session chair: Seshu Subbanna
Co-chair: Peter Zampardi

(1.1) 9:50-10:40 AM — **The State of the Art of Electrostatic Discharge Protection: Physics, Technology, Circuits, Design, Simulation and Scaling (Invited Paper)** p. 19
S. H. Voldman (IBM)

(1.2) 10:40-11:05 AM — **Analysis of a Zener-Triggered Bipolar ESD Structure in a BiCMOS Technology** p. 31
D. Coffing, R. Ida (Motorola, Inc.)

(1.3) 11:15-11:30 AM — **The Effects of Emitter-Tied Field Plates on Lateral PNP Ionizing Radiation Response** p. 35
H. J. Barnaby, R. D. Schrimpf (Vanderbilt University), D. M. Fleetwood (Sandia National Laboratories), S. L. Kosier (VTC Inc.)

II. ANALOG DESIGN

Monday AM — Ballroom 4
Session chair: Tom Skaar
Co-chair: Masao Hotta

(2.1) 9:50-10:40 AM — **Design Aspects of 32.7-GHz Bandwidth AGC Amplifier IC with Wide Dynamic-Range Implemented in SiGe HBT** p. 39
K. Ohhata, T. Masuda, E. Ohue, K. Washio (Hitachi, Ltd., Japan)

(2.2) 10:40-11:05 AM — **A 12-bit, 65 MSPS BiCMOS ADC for Cellular Base-station Applications** p. 43
D. Birdsall, A. Kuckreja (National Semiconductor)

(2.3) 11:05-11:30 AM — **High Frequency Low Voltage Current Mode Analog Integratable Filters (Invited Paper)** p. 47
N. Fujii (Tokyo Institute of Technology, Japan)
Author Interviews: Immediately after the Session.

III. POWER DEVICES I

Monday PM — Ballroom 3
Session chair: Cliff Ma
Co-chair: Florin Udrea

(3.1) 1:45-2:10 PM — **Turn-Off Performance Comparison of Self-Firing MOS-Thyristor Devices for ZVS Applications (Student Paper)** p. 53
M. Breil, J-L. Sanchez, P. Austin, J-P. Laur (CNRS, France)

(3.2) 2:10-2:35 PM — **DC Substrate Coupling between LDMOS and CMOS Devices in Hyperintegration I Technology** p. 57
V. Venkatesan, Q. Nguyen, A. Bose, P. Parris (Motorola Inc.)

(3.3) 2:35-3:25 PM — **Advanced Power Bipolar Devices (Invited Paper)** p. 61
A. A. Jaecklin (ABB Corporate Research Ltd., Switzerland)

IV. MODELING AND SIMULATION

Monday PM — Ballroom 4
Session chair: Michael Schröter (Rockwell)
Co-chair: Shahriar Moinian (Lucent/Bell Labs.)

(4.1) 1:45-2:35 PM — **Introduction to RF Simulation and Its Application (Invited Paper)** p. 67
K. Kundert (Cadence Design Systems)

(4.2) 2:35-3:00 PM — **A Simulation-Free Systematic Approach for Analysis of Noise in Emitter-Coupled Pair Bipolar Mixers (Student Paper)** p. 79
Y. Hu, K. Mayaram (Washington State University)