

**BC<sup>TM</sup>**

**PROCEEDINGS**

**PROCEEDINGS  
OF THE 1999  
BIPOLAR/BI-CMOS CIRCUITS AND  
TECHNOLOGY MEETING**

**1999**



**Minneapolis, Minnesota  
September 26-28, 1999**

**Sponsored by**



**IEEE Catalog Number: 99CH37024**

**PROCEEDINGS OF THE 1999  
BIPOLAR/BI-CMOS CIRCUITS AND  
TECHNOLOGY MEETING**

**SPONSORED BY  
IEEE ELECTRON DEVICES SOCIETY  
IN COOPERATION WITH  
IEEE SOLID-STATE CIRCUITS SOCIETY  
IEEE TWIN CITIES SECTION**

**September 26-28, 1999**

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## Welcome from the Chairmen

Welcome to the 1999 IEEE Bipolar/BiCMOS Circuits and Technology Meeting. We believe that we have another exciting technical program that reflects ongoing advances in bipolar circuits and technology.

BCTM will offer a short course on Sunday, September 26, entitled "Bipolar & Interconnect Physics for High-Frequency Circuit Design" that will feature instructors affiliated with academic institutions well-known for their strength in the device physics, modeling, and characterization of advanced bipolar devices. Prof. John Cressler of Auburn University will lead off with a comprehensive overview of SiGe HBT device physics. Prof. Leo de Vreede of Delft University of Technology and Henk de Graaff (who is a consultant both to Delft and the University of Twente) will follow with a discussion of several compact bipolar device models suitable for HF circuits requiring large-signal operation. Finally, Prof. Joseph Tauritz of Delft University of Technology will present a comprehensive strategy for modeling and characterizing RF power devices.

The keynote speech this year will be delivered by Dr. Dennis Buss of Texas Instruments and will be entitled "Prospects for Bipolar and BiCMOS Technologies and Their Applications". As many of you are well aware, Dr. Buss has long been a leading technologist and will bring an extraordinarily broad technological perspective to this year's keynote address.

The luncheon speech is entitled "Trends in Commercial Satellite Communications - Smarter Satellites Via Terrestrial Mainstream Technologies" and will be delivered Dr. Keith Warble from the Satellite Communications Group of Motorola, Inc. As more and more semiconductor products are either used in or depend on satellite communications, this speech should be of great interest to many attendees.

This year there will be a total of 11 technical sessions including 5 invited papers. Once again we feature an excellent mix of both academic and industrial papers from around the world. To encourage student participation in BCTM, conference participants will be asked to vote for the best student paper award that will be awarded at next year's conference.

There will be two panel discussions held on Monday evening. The first is entitled "Process/Device Improvement vs. Circuit Innovations - which is the Road to Nirvana?" will allow device physicists, process technologists, and circuit designers to make their case for providing primary leadership into the future. The second panel, called "The Pros and Cons of Technical Ladders in Corporations/Academic Institutions".

We express our great appreciation to the 1999 BCTM committee members for their diligence in putting together an exciting program. It is our great pleasure to extend a hearty welcome to the 1999 IEEE Bipolar/BiCMOS Circuits and Technology Meeting in Minneapolis.

John Shott - BCTM 1999 General Chair

Joachim Burghartz - BCTM 1999 Program Chair



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Leo de Vreede (Delft Univ. of Tech. ECTM Lab)  
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## BCTM 1999 Executive and Technical Program Committees



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BCTM 1999 General Chair



Joachim Burghartz  
BCTM 1999 Program Chair

### Executive Committee



Front row, seated, left to right: W. Margaret Huang, John Shott, Joachim Burghartz  
Second row, standing, left to right: Kenneth O, Brad Scharf, Tom Skaar,  
Hiroshi Iwai, Priscilla Escobar-Bowser, John Cressler  
Back row, left to right: Larry Larson, Jan Jopke, Ross Teggatz, Michael Schröter



### **RF Subcommittee**



Left to right: John Long, Scott Williams, David Ngo, Larry Larson

### **CAD/Modeling Subcommittee**



Left to right: Colin McAndrew, Michael Schröter, Stefan Cserveny,  
Shahriar Moinian

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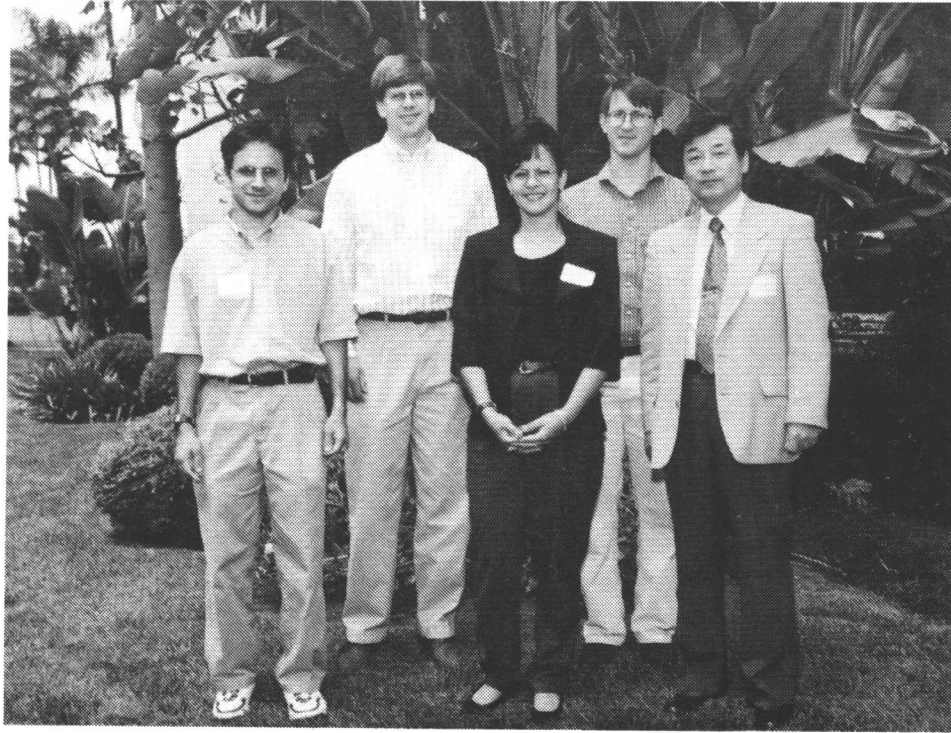
Seated, left to right: Ross Teggatz, Marise Bafleur  
Standing, left to right: Garrett Neaves, Joe Devore, Frank Thiel

### **Process Technology Subcommittee**



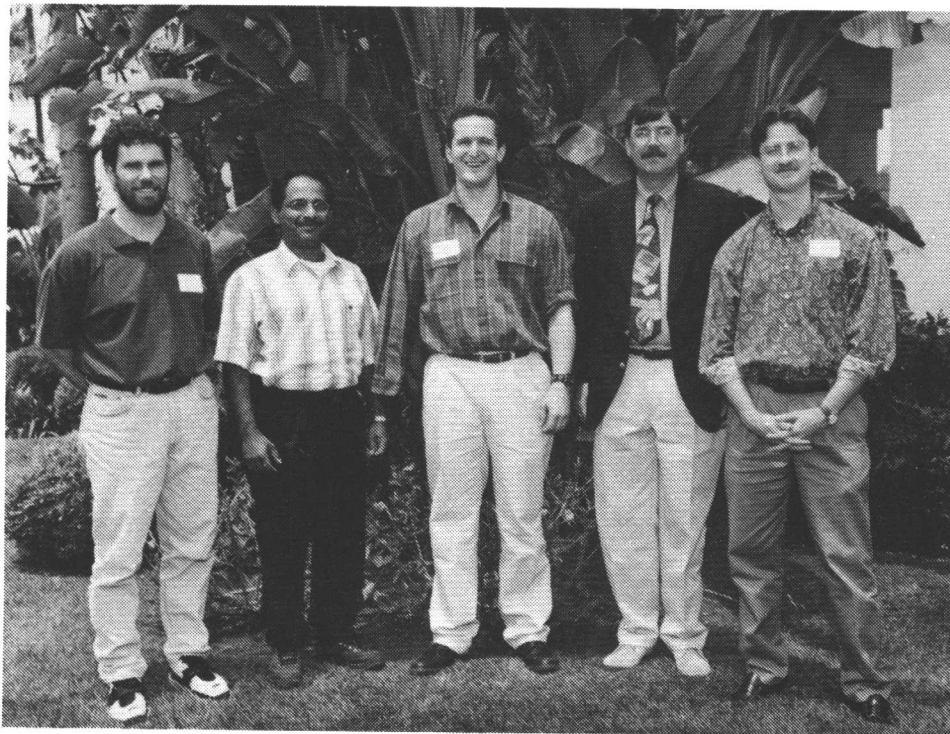
Seated, left to right: Rashid Bashir, W. Margaret Huang  
Standing, left to right: John Erdeljac, Yasuhiro Katsumata, Yih-Feng Chyan

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Left to right: Tajinder Manku, Tom Skaar, Priscilla Escobar-Bowser,  
Dan Mavencamp, Masao Hotta

### **Device Physics Subcommittee**



Peter Zampardi, Alvin Joseph, Clifford King, Rob Fox, John Cressler

1999 BCTM		
SCHEDULE AT A GLANCE		
Sunday — September 26		
8:45 AM - 5:15 PM	SHORT COURSE: Bipolar & Interconnect Physics for High-Frequency Circuit Design	
7:30 PM	Registration/Reception	
Monday — September 27		
Registration open from 7:30 AM in Ballroom Atrium		
8:30 AM	Opening Remarks and Announcements	
8:45 AM	Keynote Speaker: Dennis Buss "Is There Life after CMOS?" Ballrooms 1 and 2	
9:30 AM	Coffee and Cookies in Ballroom Atrium *	
9:50 AM—11:30 AM	Design Ballroom 3	Advanced Analog Circuits Ballroom 4
11:45 AM	Lunch + Luncheon Speaker: Keith Warble "Commercial Satellite Communications - Smarter Satellites Via Terrestrial Mainstream Technologies" Ballrooms 1 and 2	
1:40 PM 3:20 PM	Device Physics Ballroom 3	Wireless Bipolar RF Systems Ballroom 4
3:20 PM	Coffee in Ballroom Atrium	
3:40 PM — 5:45 PM	Power Device Ballroom 3	Modeling and Parameter Extraction Ballroom 4
Author Interviews Immediately After Sessions		
Dinner Break		
7:45 PM	Complimentary Refreshments in Atrium	
8:00 PM	Panel Session A Process/Device Improvements vs. Circuit Innovations Ballroom 3	Panel Session B Pros and Cons of Technical Ladders Ballroom 4
Tuesday — September 28		
8:30 AM - 10:35 AM	SiGe Process Technology Ballrooms 1 and 2	
10:35 AM	Coffee Break in Ballroom Atrium	
10:55 AM — 12:10 PM	RF Device Enhancements Ballroom 3	VCO and Passive RF Technology Ballroom 4
Lunch / Exhibition Reception in Atrium 11:45 AM - 2:00 PM		
2:00 PM 3:40 PM	RF Building Blocks Ballroom 3	Analog Communication Circuits Ballroom 4
Author Interviews Immediately After Sessions		

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## **PANEL DISCUSSIONS**

### **Panel Discussion A**

Monday 8:00-10:00 PM — Ballroom 3

Organizer: Larry Larson (Univ. California San Diego)

#### **Process/Device Improvements vs. Circuit Innovations - which is the Road to Nirvana?**

The relentless upward spiral in integrated circuit performance has always relied on a delicate balancing act between device and process improvements and circuit innovations. The interplay between these two often boils down to the fundamental question of "can this product be made with an improved circuit design, or is an improvement in the process required?" This panel will examine the role that developments in each field play in inspiring and driving innovations in the other.

#### **PANELISTS:**

Larry Larson	(UC San Diego, Moderator)
Paul Davis	(Lucent Technologies)
John Long	(University of Toronto)
Peter Zampardi	(IBM)
Tom Zirkle	(Motorola, Inc.)

### **Panel Discussion B**

Monday 8:00-10:00 PM — Ballroom 4

Organizer: Priscilla Escobar-Bowser (Texas Instruments)

#### **Pros and Cons of Technical Ladders in Corporations/Academic Institutions**

The fundamental goal of technical ladder is to attract, encourage and retain technical personnel by providing a career path for advancement of those individual technical contributors who are not interested in the managerial ladder. The panel will discuss whether and how far the technical ladder has helped the companies/academic organizations and what controversies it produces e.g. "Should it be driven by strictly individual accomplishments or by value added to the company?", "Should you be nominated by your peers/management or yourself?", "How far can/should one be able to be on both ladders", "How to evaluate recently recruited senior technical staff?", etc.

#### **PANELISTS:**

Priscilla Escobar-Bowser	(Texas Instruments, Moderator)
Charles Huang	(ANADIGICS)
Arnokia Nathan	(University of Waterloo)
Joe Heck	(Motorola)
Taylor Effland	(Texas Instruments)
Hiroshi Iwai	(Tokyo Institute of Technology/Toshiba)
Richard Skovholt	(GE/Bell/Honeywell - Embry Riddle Aero. U)

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Co-chair: W. J. Kloosterman	
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<b>(Invited Paper)</b> C. Hull and S. V. Kishore (Silicon Wave, Inc.)	
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Co-chair: Dan Mavencamp	
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Co-chair: David Ngo

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Session chair: Frank Thiel

Co-chair: Joe Devore

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- (5.2) 4:30 - 4:55 PM — Physical Analysis of Current Snap-Back Phenomenon in** p. 80  
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- (6.4) 4:55 - 5:20 PM — Comprehensive Hydrodynamic Simulation of an** p. 105  
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B. Neinhüs, K.H. Bach, A. Schüppen and B. Meinerzhagen (University Bremen, Germany)

## VII. SiGe Process Technology

Tuesday AM — Ballroom 3

Session chair: W. Margaret Huang

Co-chair: Juergen Arndt

- (7.1) 8:30 - 9:20 AM — Carbon Doped SiGe Heterojunction Bipolar Transistors for High Frequency Applications (Invited Paper)** H.J. Osten, D. Knoll, B. Heinemann, H. Rücker, and B. Tillack (Institute for Semiconductor Physics Frankfurt, Germany) p. 109
- (7.2) 9:20 - 9:45 AM — A 0.24  $\mu\text{m}$  SiGe BiCMOS Mixed-Signal RF Production Technology Featuring a 47 GHz f<sub>t</sub> HBT and 0.18  $\mu\text{m}$  L<sub>eff</sub> CMOS** S. A. St. Onge, D. L. Haramé, J. S. Dunn, S. Subbanna, D. C. Ahlgren, G. Freeman, B. Jagannathan, S. J. Jeng, K. Schonenberg, K. Stein, R. Groves, D. Coolbaugh, N. Feilchenfeld, P. Geiss, M. Gordon, P. Gray, D. Hershberger, S. Kilpatrick, R. Johnson, A. Joseph, L. Lanzerotti, J. Malinowski, B. Orner, M. Zierak (IBM) p. 117
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## VIII. RF Device Enhancements

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Session chair: John Erdeljac

Co-chair: Yasuhiro Katsumata

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## IX. VCO and Passive RF Technology

Tuesday AM — Ballroom 4

Session chair: Cynthia Baringer

Co-chair: Scott Williams

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Tuesday PM — Ballroom 3

Session chair: John Nisbet

Co-chair: Leo de Vreede

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**(CDMA/AMPS) Cellular Handset Applications (Student Paper)** P. D. Tseng, L. Y. Zhang

G. B. Gao and M. F. Chang (University of California, Los Angeles, U. S. A.)

**(10.2) 2:25 - 2:50 AM — A Highly Linear Bipolar 1 V Folded Cascode 1.9GHz** p. 157

**Low Noise Amplifier (Student Paper)** B. Ray, T. Manku, R. D. Beards, J. J. Nisbet, and

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**with Center-Tapped Inductor in a SiGe-HBT Technology for 5 GHz Wireless**

**LAN Applications (Student Paper)** G. Grau U. Langmann (Ruhr-University Bochum, Germany),

W. Winkler, D. Knoll, J. Osten, K. Pressel (Institute for Semiconductor Physics)

## **XI. Analog Communication Circuits**

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Session chair: Tom Skaar

Co-chair: Masao Hotta

**(11.1) 2:00 - 2:25 PM — A Fully-Integrated 5-GHz Frequency Synthesizer in** p. 165

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