

The 1988 MTT-S International Microwave Symposium

CHARLES BUNTSCHUH, MEMBER, IEEE

MAY 1988 marked the first time since May 1964 that the International Microwave Symposium was held in New York. It was indeed a pleasure to host the Symposium again, after so many years, in the most exciting and fascinating city on earth. Judging from the compliments we have received, it was thoroughly enjoyed and appreciated by the worldwide microwave community.

The 1964 Symposium was the first International Microwave Symposium. It met in the International Hotel at the JFK International Airport. A total of 657 people attended, including 24 from Canada and abroad; 45 papers were presented in five sessions over three days. In 1988, the 25th International Microwave Symposium was held in conjunction with the 7th Monolithic Circuits Symposium, the 31st Automatic RF Techniques Conference, and the Industry Exhibition. Over 8000 people participated in the technical programs and exhibitions, which took place in the Marriott Marquis and New York Penta Hotels and the Jacob Javits Convention Center. Collectively, in the three meetings 258 papers in 51 sessions, plus eight full-day workshops and five lunchtime panel sessions were presented over the five-day period which has become known as Microwave Week.

Very roughly, this represents a twelvefold growth, or an average of 10 percent per year, over a quarter century.

MICROWAVES—PAST, PRESENT, AND FUTURE

The theme of the 1988 International Microwave Symposium celebrated the Hertz Centennial, recognized the advances of today, and looked ahead to the challenges of tomorrow.

MICROWAVES—PAST

In the spring of 1888, Heinrich Hertz published the fifth and sixth papers of a series begun in 1886 on his experiments demonstrating the validity of Maxwell's theory. These papers, on the velocity of propagation and reflection properties of the waves, were the first to attract international attention and stimulate duplication of the work by others. It was thus particularly appropriate that we celebrated Hertz's accomplishments and the birth of microwave science at the 1988 Symposium.

To honor the occasion, we were especially fortunate in having an exhibit of replicas of Hertz's experimental apparatus, on loan from the Science Museum of London. This exhibit was the brainchild of Dr. John H. Bryant, who made the initial arrangements for the loan and the refurbishment of the pieces. John also wrote a commemorative guidebook, *Heinrich Hertz—The Beginning of Microwaves*,



Chairman Chuck Buntschuh declaring the 1988 International Microwave Symposium open for business.

to accompany the exhibit, summarizing Hertz's life and work and explaining the artifacts.

This extraordinary exhibition was made possible by the generous contributions of the MTT Society, the IEEE Life Fellows, and 28 microwave companies, as well as by the organizational efforts of John Putnum, Ted Saad, and Mario Maury, Jr.

The Hertz Centennial also included two special technical sessions, with five invited papers on Hertz and the history of electromagnetics. Prof. Robert S. Elliot, UCLA, presented "The History of Electromagnetics as Hertz Would Have Known It," and Prof. Charles Susskind, UC Berkeley, "Heinrich Hertz: A Short Life." Prof. H. V. Friedburg, Karlsruhe, talked about "Heinrich Hertz's Work in Karlsruhe," and Prof. J. D. Kraus, Ohio State, "Heinrich Hertz—Theorist and Experimentor." Prof. James Brittain, Georgia Tech, followed up with "The Legacy of Hertz: Some Highlights of Microwave History from 1889 to 1945." These sessions, also organized by John Bryant, were videotaped. The tapes will be available for loan through the IEEE Service Center.



TPC Co-Chairman Jesse Taub reviewing the Symposium's Technical Program at the opening ceremony.

Bridging the gap from Hertz to the present was the MTT-S Historical Exhibit of the Society's own collection. This collection is under the new curatorship of the Historical Electronics Museum at Westinghouse and the Historical Collection Committee of the Baltimore MTT Chapter, chaired by Ted Nelson. It was completely refurbished by the Electronics Museum for this Symposium, and had a bright new appearance.

Together, these two exhibits created the most comprehensive view of microwave and RF history ever assembled in one place.

MICROWAVES—PRESENT

The microwave exhibition and most of the technical program symbolized "Microwaves—Present" by providing a report on the latest developments in technology and new product offerings.

ATTENDANCE

A record total of 8081 people attended the Symposium, up significantly from the approximately 6600 of the past two years. Of these, 2330 registered for the technical programs, just slightly more than the 2237 and 2240 in 1986 and 1987. The MTT-S Symposium drew 1951, the Monolithic Symposium 800, and the ARFTG conference 82 attendants; 350 were visitors from 26 foreign countries. The individual conference registrations were comparable to those of the last two years, consonant with the relatively flat business level of our industry over the same period. Workshop participation, on the other hand, was up smartly: 948 attended eight workshops, compared to 767 in Las Vegas.

OPENING CEREMONY

The 1988 International Microwave Symposium was officially opened on Wednesday morning, following two days of workshops and Monolithic Symposium and ARFTG Conference meetings. Chairman Chuck Buntschuh and Technical Program Co-Chairman Jesse Taub welcomed the



IEEE President Russell Drew addressing the Symposium at the Opening Ceremony.

symposiaists assembled and gave an overview of the program.

IEEE President, Dr. Russell Drew, shared some of his thoughts on the role of the IEEE in the information age. He likened the IEEE to an information utility, fueled by ideas, generating information by the authors, and distributing it via conferences and publications. He described current efforts by the IEEE to do this more efficiently and economically.

MTT Society President, Dr. Barry Spielman, also addressed the group, reflecting on the growth and increasing complexity of the Symposium.

Ms. Alair Townsend, Deputy Mayor of New York City, welcomed the Symposium to New York with unparalleled sparkle and panache. She also described several high-tech projects of the city and invited us not to wait another 24 years before returning to New York.

The keynote address, as well as several events on the technical program dealt with the future, so we'll come back to those in their proper place.

TECHNICAL PROGRAM

From 394 papers submitted, the Technical Program Committee selected 100 regular length, 65 short length, and 49 open forum papers. In addition, 12 papers in the Monolithic Symposium were presented in joint sessions with the MTT Symposium, and 26 invited papers were read, for a total of 240, 100 of which were from 17 foreign countries.

The program consisted of 43 regular plus two open forum sessions. For the first time the Technical Program was expanded to four parallel sessions to accommodate the

larger number of papers and to hold the open forums to a comfortable 25 papers each.

There were several special sessions and invited papers besides those commemorating Hertz and those with a "future" flavor. A session on European activities and a paper on microwaves in Brazil provided excellent overviews on the international scene. A special session paid tribute to Professor Arthur Oliner, with three papers chronicling his contributions.

Monolithic circuits activity continues to expand. There were 35 papers in the Monolithic Circuits Symposium, including the 12 given in joint sessions. Moreover, there were three additional MMIC sessions in the MTT Symposium, including one invited paper, indicating this area has grown well beyond the bounds of its topical conference.

The 31st ARFTG Conference had nine papers and one panel session on the topic *Innovations in Microwave Time-Domain Measurements*, covering automated measurement techniques and applications.

The MTT Symposium sessions, topics, and chairman were as follows:

<i>Session A:</i>	Producibility and Applications Steve Temple, Raytheon Company Sanjay Moghe, Pacific Monolithics	<i>Session M:</i>	Monolithic Amplifiers B. E. Spielman, Washington University
<i>Session B:</i>	Acoustics and Ferrites Bruce McAvoy, Westinghouse R&D Center	<i>Session N:</i>	Filters and Multiplexers I Jerry Fiedziuszko, Ford Aerospace
<i>Session C:</i>	Special Session in Honor of Prof. A. A. Oliner S. T. Peng, New York Institute of Technology	<i>Session O:</i>	High Frequency Superconductivity R. L. Camisa, David Sarnoff Research Center
<i>Session D:</i>	Biological Effects and Medical Applications Aryre Rosen, David Sarnoff Research Center	<i>Session P:</i>	Millimeter Wave Integrated Circuits and Technology J. Wiltse, Georgia Tech
<i>Session E:</i>	Power Amplifiers J. G. Tenedorio, Harris Microwave D. E. Dawson, Westinghouse	<i>Session Q:</i>	Monolithics—Components L. D. Cohen, Eaton Corp.
<i>Session F:</i>	Heinrich Hertz Centennial Special Session I John H. Bryant, University at Michigan	<i>Session R:</i>	Filters and Multiplexers II C. Kudsia, COMDEV, Ltd., Canada
<i>Session G:</i>	Guided Wave Effects T. Itoh, University of Texas at Austin	<i>Session S:</i>	Solid State Devices Peter Staecker, M/A-Com, Inc.
<i>Session H:</i>	Measurements I R. D. Pollard, University of Leeds, UK	<i>Session T:</i>	Microwave Integrated Circuits Natalino Carnilleri, Texas Instruments
<i>Session I:</i>	MMIC Low-Noise Amplifiers H. C. Huang, COMSAT Laboratories Z. Lemnios, Ford Microelectronics, Inc.	<i>Session U:</i>	Monolithics—Systems Bernard Bossard, Horizon House, Inc.
<i>Session J:</i>	Heinrich Hertz Centennial Special Session II John H. Bryant, University of Michigan	<i>Session V:</i>	Passive Networks I H. C. Bell, Wavecom, Inc.
<i>Session K:</i>	High Power Microwaves J. Goel, TRW	<i>Session W:</i>	Dielectric Resonator Oscillators Joseph F. White, J. F. White Consulting
<i>Session L:</i>	Measurements II R. E. Ham, Clemson University	<i>Session X:</i>	New Methods for Planar Circuits N. G. Alexopoulos, UCLA
<i>Session OF-1:</i>	Open Forum I J. Levy, Eaton Corp.	<i>Session Y:</i>	An Overview of European Activities R. Sparks, Raytheon Co.
		<i>Session Z:</i>	Passive Networks II R. V. Snyder, RS Microwave
		<i>Session AA:</i>	New Developments in Oscillator and Mixer Technology M. Dydyk, Motorola, Inc.
		<i>Session BB:</i>	Microstrip and Finline Discontinuities Arvind K. Sharma, TRW
		<i>Session OF-2:</i>	Open Forum II J. Levy, Eaton Corp.
		<i>Session CC:</i>	Fiber Optic Links and Transmission Systems I N. R. Dietrich, AT&T Bell Labs



Just a small part of the three acres of the Microwave Exhibition in the Jacob Javits Convention Center.

<i>Session DD:</i>	FET Power Amplifiers Douglas Maki, Tachonics Corporation
<i>Session EE:</i>	High Speed Digital Transmission I. Mack, NRL
<i>Session FF:</i>	Microwave and MM Wave Ferrites J. M. Owens, Santa Clara University
<i>Session GG:</i>	Fiber-Optic Links and Transmission Systems II H-W. Yen, Hughes Research Lab
<i>Session HH:</i>	FET Amplifiers W. Kennan, Microwave Technology, Inc.
<i>Session II:</i>	Communications Systems P. G. Petrelis, TRW
<i>Session JJ:</i>	Phased and Active Array Techniques H. G. Oltman, Jr., Tecom Ind., Inc.
<i>Session KK:</i>	High-Speed Fiber-Optic Links Paul J. Stabile, David Sarnoff Research Center
<i>Session LL:</i>	Signal Distribution FET Applications Mahesh Kumar, MSC, Inc.
<i>Session MM:</i>	Systems Applications K. K. Agarwal, E-Systems, Garland Div. D. N. McQuiddy, Texas Instruments, Inc.
<i>Session NN:</i>	Computer-Aided Design; Large Signal Analysis Stephen E. Sussman-Fort, State University of New York
<i>Session OO:</i>	High-Speed Optical Techniques and Components P. Wahi, TASC
<i>Session PP:</i>	Nonlinear FET Applications E. C. Niehenke, Westinghouse Electric Co.
<i>Session QQ:</i>	Computer-Aided Design, Analysis, and Modeling Barry S. Perlman, David Sarnoff Research Center

WORKSHOPS AND PANEL SESSIONS

The eight workshops were held on Monday and Tuesday, before the Symposium, in the Marriott Hotel. The topics and attendance were:

M-1:	Superconductivity and Microwaves. (179)
M-2:	MIC and MMIC FET High-Power Amplifier Design Techniques. (192)
M-3:	Designing MMICs Through Foundries. (82)
M-4:	Packaging Hybrid and Monolithic Microwave and Millimeter Wave Components. (102)
T-1:	FET Structures and Their Modeling. (135)
T-2:	CAD Oriented Modeling of Discontinuities in Microwave and Millimeter Wave Transmission Structures. (157)

T-3:	High Volume Microwave Applications. (62)
T-4:	Developments in Linearizers for Microwave Power Amplifiers. (39)

There were five panel sessions on Wednesday through Friday. The lunchtime was lengthened to two hours to give them more time for discussion. Attendance at each session was estimated to be in the 120–170 range.

P-1:	U.S. Competitiveness—Some Views.
P-2:	The Business of Microwaves: The Better Mouse-trap is No Longer Enough.
P-3:	Heterojunction Bipolar Transistor Circuits.
P-4:	Noise and its Measurement.
P-5:	Ferrites at Millimeter Frequencies.

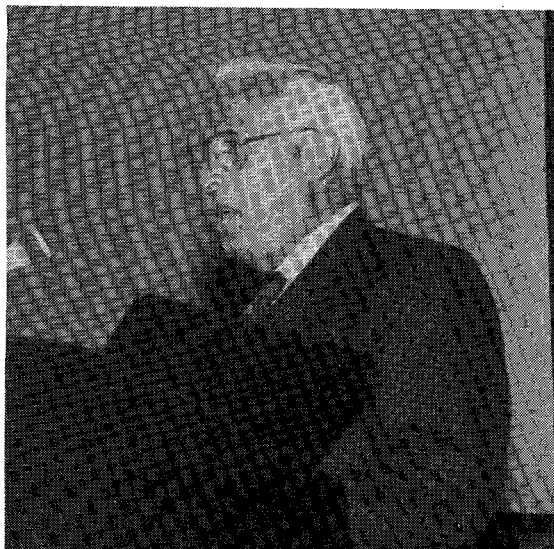
TECHNICAL PROGRAM COMMITTEE

The contributed papers were reviewed and selected by the 107 member Technical Program Committee under the superb leadership of Co-Chairmen Jesse Taub and Jim Whelehan.

Additionally, Joe Levy organized the open forums, Don Neuf oversaw the invited papers efforts, John Pierro coordinated the workshops and panel sessions, and Paul Meier provided liaison with the MMIC and ARFTG conference committees. We can credit the overall success of the technical program to this team's outstanding work.

The Committee members were:

S Adam	H. Howe	A Oliner
M Afsar	T. Itoh	H. Oltman
K. Agarwal	F. Ivanek	J. Owens
N. Alexopoulos	G. Jerinic	B. Perlman
A Atia	R. Kagiwada	S. Peng
H. Bell	W. Kennan	D. Peterson
E. Belohoubek	R. Kihm	P. Petrilis
B. Berson	M. Kim	S. Petty
C. Boyd	R. Knerr	R. Pollard
K. Button	J. Knorr	R. Pucel
J. Calviello	C. Krowne	J. Rautio
N. Camilleri	C. Kudsia	U. Rohde
R. Camisa	M. Kumar	A. Rosen
A. Cardiasmenos	R. Laton	F. Rosenbaum
W. Chang	P. LaTourrette	C. Rucker
W. Childs	C. Lee	R. Rudish
M. Ciminera	R. Levy	J. Schellenberg
E. Cohen	J. Lin	A. Sharma
L. Cohen	T. Lukaszek	R. Snyder
M. Cohn	I. Mack	R. Sparks
W. Cox	D. Maki	P. Stabile
J. Crescenzi	R. Malbon	P. Staecker
H. Cronson	S. March	S. Stutzer
N. Dietrich	D. Masse	S. Sussman-Fort
M. Dydyk	G. Matthaei	R. Van Wagoner
H. Fetterman	M. Maury	G. Vendelin
J. Fiedziuszko	B. McAvoy	P. Wahi
B. Geller	D. McQuiddy	D. Webb
J. Goel	P. Meier	R. Weck
E. Gregory	J. Mink	J. White
P. Greiling	T. Nelson	A. Williams
K. Gupta	D. Neuf	H. Willing
R. Ham	K. Niclas	J. Wiltse
G. Heiter	E. Niehenke	K. Yano
W. Hord	J. Oakes	K. Yen
J. Horton	H. Ogawa	



Frank Brand delivering the Keynote Address, "Tomorrow's Microwave Technology."

MICROWAVE EXHIBITION

This year, an even 300 companies staffed 482 booth spaces with 3824 people, covering about three acres of the Jacob Javits Convention Center. For the first time in many years the exhibition was located immediately adjacent to the technical meeting rooms, making it especially convenient to visit whenever one had a few minutes to spare. Also, this was the 12th year that Howard Ellowitz, of Horizon House—Microwave, Inc., has magnificently organized and managed the show.

MICROWAVES—FUTURE

What's ahead for our microwave profession? We asked Dr. Frank Brand, VP and Chief Technical Officer of M/A-Com, Inc., to give us his view of the future of microwaves in the keynote address, "Tomorrow's Microwave Technology," delivered at the Opening Ceremony. Frank's basic message was that we must seek to find a balance between the states of the industry and the technology. He used the MMIC developments to illustrate how far and fast technology has progressed: industrial developments, however, are not keeping pace. He stressed that industry must be innovative in the way it conducts its business—we must seek more collaborative efforts and move beyond the destructive competitiveness in which no one wins.

Several events on the technical program pointed toward our future. Superconductivity at microwave frequencies was the subject of an all-day workshop on Monday and a regular Symposium session, which included an invited overview paper. The interest here is certainly sparked by the recent developments in high-temperature superconductivity, but the presentations also included the conventional cryogenic regime.

Lightwave technology is rapidly gaining ground as a microwave engineering discipline, as lightwave modulation rates reach into the gigahertz region. Two MTT Sympo-



Anthony Cappello conducting high school students through the MTT-S Historical Exhibit.

sium focused sessions, with eight invited papers, principally described applications in communications, radar, and military systems, and some of the associated microwave componentry. Also eight papers in a regular session and the Open Forum reported on various aspects of optical techniques and components, while one session of the Monolithic Symposium was also devoted to fiber-optic applications of MMIC's.

Looking ahead in yet another way, the 1988 Symposium initiated a novel program this year to introduce high school students to microwave engineering and its applications. About 50 top students from New York City and Long Island were selected by their schools for their academic achievement and interest in engineering. There were talks on microwaves and engineering by high school teachers and by Tony Cappello, a practicing microwave engineer from Eaton-AIL. Barry Spielman addressed them at lunch and presented awards for an essay contest; John Bryant conducted them on a tour of the Hertz Exhibit, and a number of college students were their guides through the Industry Exhibition and MTT Historical Exhibit.

As it turned out, this was a rather difficult program to produce, involving solicitations and inputs from several hundred high schools. We thank S. T. Peng for chairing the effort, and Naomi Taub and Frances Peng for their able assistance.

MICROWAVES—AFTER HOURS

Microwave Week was not all work and no play. The official social program began on Monday evening with the Monolithic Symposium's cocktail reception in the Astor Ballroom of the Marriott Marquis. On Tuesday evening over 1000 people attended the *Microwave Journal* reception in the Roseland Ballroom, which featured music from the 40s and 50's, the heyday of Roseland. The ARFTG Conference reception and banquet also took place on Tuesday, in the N.Y. Penta.

Of course, the highlights of the social program are always the Industry-Hosted Cocktail Reception and the annual Awards Banquet. Both events were held in the Marriott. The reception, compliments of the exhibitors, was attended by well over 1000, and 494 participated in the gala banquet.



Barry Perlman, Bert Berson, Doug Maki, and Bill Hord discuss the past, the present, and the future.



Dr. Leo Young receives the Microwave Career Award from MTT Society President Barry Spielman.

The MTT Society's foremost award, the Microwave Career Award, was presented to Dr. Leo Young "for a career of meritorious achievement and outstanding technical contributions in the field of microwave theory and techniques." Dr. Fred Rosenbaum received the MTT's Distinguished Service Award for his many years of dedicated service to the Society.

Dr. Masumi Fukuta and Mr. Louis Napoli were given the Microwave Application award for their "recognition and demonstration of the potential of GaAs field effect transistors for power applications," and Drs. Kazuhiko Honjo and Mohammad Madihian were awarded the Microwave Prize for their June 1986 MTT TRANSACTIONS paper on "GaAs-Monolithic IC's for an X-Band PLL-Stabilized Local Source." Distinguished Microwave Lecturer awards went to Mr. David Barton and Dr. Rolf Jansen.

Dr. Russell Drew, President of the IEEE, was on hand to present this year's IEEE fellow awards to those who chose to receive them at the Symposium. They were: Mr. Joseph Calviello, Dr. S. T. Peng, Prof. Saul Rosenthal, Mr. James Whelehan, Jr., Prof. Berthold Bosch, Dr. Walter Curtice, Dr. Kuldip Gupta, and Prof. Ingo Wolff. I also note with pride that the first four of these new fellows are members of the NY/LI Chapter of the MTT, and served on the Symposium Steering Committee.

Dr. David McQuiddy, Jr., received the MTT past presidents pin, and Certificates of Recognition were presented to H. George Oltman, Jr., for Meritorious Service, Steven March, Chairman of the 1987 Symposium, and Dr. Reynold Kagiwada, 1987 Symposium TPC Chairman.

The Hertz Centennial was a major undertaking. Dr. John Bryant was presented with a surprise award for conceiving and spearheading this unique event. Also, four of the major corporate financial contributors—Andrew Corp, Hewlett-Packard Co., Maury Microwave Corp, and Texas Instruments, Inc.—were recongized for their leadership role.

This was the second year that the MTT has presented Graduate Fellowship Awards. This year's recipients were



Fred Rosenbaum expressing thanks for the MTT-S Distinguished Service Award.



IEEE President Russell Drew presents the IEEE Fellow Award to Prof. Saul Rosenthal.



Russell Drew congratulating Prof. Ingo Wolff on becoming an IEEE Fellow.



Barry Spielman reading the citation on the MTT Award for Meritorious Service to the recipient and MTT Past President George Oltman.



John Bryant receiving the special surprise award for conceiving and spearheading the Heinrich Hertz Centennial from Barry Spielman.



MTT-S President Barry Spielman congratulating West Germany's Chapter Chairman, Peter Russer, on that chapter's exceptional membership development.

Messrs William Shillue, Leonard Hayden, Mark Sletten, and Patrick Heron.

The festivities concluded with "A Bite of the Apple," a delightful Broadway revue with popular show tunes from the turn of the century to the present.

New York offers a mind-boggling array of attractions and activities for the visitor. The Guest Program, organized by John and Laurie Mruz and Dick and Jo Kamin-sky, offered six tours providing introductory and behind-the-scenes views of the Big Apple. The guests also made good use of the Hospitality Suite, where a continental breakfast was served and tourist information and assistance were provided by the N.Y. Convention Bureau.

1988 SYMPOSIUM STEERING COMMITTEE

In the text above I mentioned the names of only a few of the many Committee members whose hard work and dedicated efforts made the 1988 International Microwave Symposium such an unqualified success. It has indeed been a privilege and a pleasure to work with all of these wonderful friends:

Technical Program Committee:

<i>Co-Chairman</i>	Jesse Taub	Eaton-AIL
	Jim Whelehan	Eaton-AIL
<i>Special Sessions</i>	John Pierro	Eaton-AIL
<i>Open Forum</i>	Joe Levy	Eaton-AIL
<i>Invited Papers</i>	Don Neuf	Anzac-RHG

Local Arrangements Committee:

<i>Chairman</i>	John Coppola	Narda Microwave
<i>Operations</i>	Matt Jacobs	Narda Microwave
	Pari Boloori	Narda Microwave
	Bill Reich	Narda Microwave
<i>Catering</i>	Bob Koelzer	Narda Microwave
	Sid Wolin	Anzac-RHG
<i>Local Transportation</i>	Joe Calviello	Eaton-AIL
<i>Airlines</i>	Jerry Hausner	R&D Associates
<i>Finance Chairman</i>	Al Kelly	Satellite Transmission Sys.

*Publicity Committee:**Chairman*

Bert Aaron

Bertram

D. Aaron & Co.

*Chairman Emeritus and**Historical Exhibits Liaison:*

Saul Rosenthal Polytechnic Univ.

Paul Meier Eaton-AIL

Advance Program

Gerry Katz

Eaton-AIL

MMIC/ARFTG Liaison

S. T. Peng N.Y. Inst. Tech.

Publications Chairman

Ray Viola

Unisys

Student Program Chairman

Hank Paczkowski Eaton-AIL

*Registration Committee:**Chairman*

Klaus Breuer

Eaton-AIL

Exhibits Manager

Howard Ellowitz Horizon House

Assistant

Pete McVeigh

Eaton-AIL

Conference Management

Larry & Margaret LRW Associates

*Awards Banquet Committee:**Chairman*

Joe Schindler

General Microwave

Hertz Exhibit Manager

John Putman M/A-Com.

Assistant

Georgette Baker

General Microwave

Recording Secretary

Naomi Taub

*Guest Program Committee:**Co-Chairpersons*

Dick & Jo

Frequency

Kaminsky

Electronics

John & Laurie

Micronics

Mruz

Technology

I can't thank them enough for the extraordinary job they did. And we're all looking forward to seeing you next June in Long Beach.