

**1996 IEEE MTT-S
INTERNATIONAL MICROWAVE
SYMPOSIUM DIGEST**

*Technical Program Contents
Tuesday June 18th*



1996 Microwave Symposium Technical Program Schedule

Session TU1A

(Joint with MMWMC Symposium)

Low Noise Millimeter Wave MMICs

8:00 am–9:50 am Room 135 Tuesday, June 18, 1996

Chair: J. Whelehan, AIL Systems, Inc., Co-chair: E. Rezek, TRW

TU1A-1 8:00 am	(Invited) Status of INP HEMT Technology for Microwave Receiver Applications P.M. Smith	5
TU1A-2 8:20 am	High Performance, High Yield Millimeter-Wave MMIC LNAs Using InP HEMTs L. Tran, R. Isobe, M. Delaney, R. Rhodes, D. Jang, J. Brown, L. Nguyen, M. Le, M. Thompson and T. Liu	9
TU1A-3 8:40 am	A 60 GHz-Band Low Noise HJFET Amplifier Module for Wireless Lan Applications K. Maruhashi, M. Funabashi, T. Inoue, M. Madihian and M. Kuzuhara	13
TU1A-4 8:50 am	A Ka-band GaInP/GaAs HBT Four-stage LNA A.P. Freundorfer, Y. Jamani and C. Falt	17
TU1A-5 9:00 am	Withdrawn	
TU1A-6 9:20 am	A Low Noise Heterodyne 89 GHZ MMIC Module for the Multifrequency Imaging Microwave Radiometer (MIMR) U. Güttich, J.-M. Dieudonné, A. Klaassen, H. Sledzik, K.-E. Schmegner, U. Goebel and M. Boheim	21
TU1A-7 9:40 am	A Technique for Deriving Noise-Parameters of Millimeter-Wave Low-Noise HEMTs and its Application to MMIC LNA Design H. Yoshinaga, Y. Kashiwabara, B. Abe and K. Shibata	25

Session TU1B

(Focused Session)

Automotive Applications of Microwave and mm-Wave Techniques

8:00 am–9:50 am Room 132 Tuesday, June 18, 1996

Chair: F. Ali, Westinghouse, Co-chair: E. Cohen, Palisades Research Institute

TU1B-1 8:00 am	Microwave and Millimeter-Wave Applications in Automotive Electronics R. Dixit	31
TU1B-2 8:20 am	Millimeter-Wave Automotive Radars and Related Technology L. Raffaelli	35
TU1B-3 8:40 am	GaAs MM-Wave Activities for Automotive Sensor Applications H. Dambkes and M. Camiade	*
TU1B-4 9:00 am	MMICS for Automotive Radar Applications N.P. Morenc	39

*Manuscript not available at time of publication



Session TU1C

High Power Sources and Control Components

8:00 am–9:50 am

Room 133

Tuesday, June 18, 1996

Chair: D.W. Reid, AMPARO Corp.

TU1C-1	High Power V-Band Power Amplifier Using PHEMT Technology	45
8:00 am	J. Goel, G. Onak, D.I. Stones, D. Yamauchi, A. Sharma, K. Tan and J. Mancini	
TU1C-2	A High-Efficiency Single-Supply RFIC PHS Linear Power Amplifier with Low Adjacent Channel Power Leakage	49
8:20 am	B. Nelson, S. Cripps, J.S. Kenney and A.F. Podell	
TU1C-3	Millimeter Wave, Solid-State Amplifiers in Radar and Communication Systems	53
8:40 am	M. Russell, A. Marinilli and F. Sullivan	
TU1C-4	Compact, Reliable 70-Watt X-Band Power Module with Greater than 30-Percent PAE	57
8:50 am	J. Sweder, G.A. Truitt, S.R. Nelson and J.S. Mason	
TU1C-5	A New Microwave Power Source and its Application	61
9:10 am	J. Liu, Z. Chen and Y. Zhong	
TU1C-6	New Devices for Processing of Powerful Short-Duration Single Microwave Pulses	65
9:20 am	B.D. Zaitsev, A.V. Ermolenko, V.A. Fedorenko and I.E. Kuznetsova	

Session TU1D

Hybrid MCM Techniques and Applications

8:00 am–9:50 am

Room 134

Tuesday, June 18, 1996

Chair: J. Pierro, AIL Systems, Co-chair: C. Buntschuh, Microwave Engineering Services

TU1D-1	A Novel Microstrip Antenna Using Alumina-ceramic/Polyimide Multilayer Dielectric Substrate	71
8:00 am	K. Kamogawa, T. Tokumitsu and M. Aikawa	
TU1D-2	Characterization of Metal on Elastomer Vertical Interconnections	75
8:20 am	F. Colomb, K. Eastman and J. Roman	
TU1D-3	New Multibeam Beamforming Networks for Phased Array Antennas Using Advanced MMCM Technology	79
8:30 am	F. Coromina, J. Ventura-Traveset, J.L. Corral, Y. Bonnaire and A. Dravet	
TU1D-4	Integration of Various Types of Compensated Dielectric Bridges for mm Coplanar Applications	83
8:40 am	L. Stephan, J. Ph. Coupez, E. Rius, C. Person and S. Toutain	
TU1D-5	Temperature and Bias Effects in High Resistivity Silicon Substrates	87
8:50 am	A.C. Reyes, S.M. El-Ghazaly, S. Dorn and M. Dydyk	
TU1D-6	The Hybrid Integrated Planar/NRD-Guide Technology: A New Concept for Low-Cost Application of Microwave and Millimeter-Wave Circuits	91
9:00 am	K. Wu and L. Han	
TU1D-7	Temperature Stability for Microstrip Delay Lines on High Permittivity Substrates	95
9:20 am	T. Ashour, L. Fan, Z. Ding and K. Chang	
TU1D-8	High Purity Ferroelectric Materials by Sol-Gel Process for Microwave Applications	99
9:30 am	F. De Flaviis, D. Chang, N.G. Alexopoulos and O.M. Stafsudd	
TU1D-9	A New Technology for Si Microwave Power Transistor Manufacturing	103
9:40 am	P. Li and T. Boles	

Session TU1E

Non-Reciprocal Ferrite and Semiconductor Devices

8:00 am–9:50 am

Room 130

Tuesday, June 18, 1996

Chair: D. Webb, NRL, Co-chair: M. Afsar, Tufts University

TU1E-1	Broadband Millimetric Semiconductor Junction Circulators at 77K	109
8:00 am	R. Sloan, C.K. Yong and L.E. Davis	
TU1E-2	K-Band Circulators on Semiconductor Wafers	113
8:20 am	J.D. Adam, H. Buhay, M.R. Daniel, G.W. Eldridge, M.H. Hanes, R.L. Messham and T.J. Smith	
TU1E-3	Optimization of a Lumped Element Circulator Based on Eigen Inductance Evaluation and Structural Improvement	117
8:40 am	T. Miura, M. Kobayashi, H. Nagata and Y. Konishi	
TU1E-4	3D DYADIC Green's Function for Radially Inhomogeneous Circular Ferrite Circulator	121
8:50 am	C.M. Krowne	
TU1E-5	Finite Element Modeling of Ferrite Phase Shifters	125
9:10 am	S.N. Stitzer	
TU1E-6	Full Wave Analysis of Edge-Guided Mode Microstrip Isolator	129
9:20 am	T.F. Elshafiey, J.T. Aberle and E. El-Sharawy	

TU
1E

TU
2A

TU
3A

TU
3B

Session TU2A

(Plenary Session)

10:15 am–12 noon

Rooms 102, 103 and 104

Tuesday, June 18, 1996

Speakers: Reed Hundt, FCC, and Edward Tuck, Endgate

Session TU3A

(Joint with MMWMC Symposium)

Large Signal Generation and Amplification

1:40 pm–3:30 pm

Room 135

Tuesday, June 18, 1996

Chair: N. Camilleri, AMD, Co-chair: Z. Bardai, Hughes

TU3A-1	Monolithic VCO Using a Novel Active Inductor	137
1:40 pm	Y. Cho, S. Hong and Y. Kwon	
TU3A-2	A High-Performance and Miniaturized Dual-Use (Antenna/Local) GaAs SPDT Switch IC	141
2:00 pm	Operating at +3V/0V H. Uda, K. Nogawa, T. Hirai, T. Sawai, T. Higashino and Y. Harada	
TU3A-3	High Efficiency X-Ku Band MMIC Power Amplifiers	145
2:20 pm	M. Cardullo, C. Page, D. Teeter and A. Platzker	
TU3A-4	Fully-Matched, High-Efficiency Q-Band 1 WATT MMIC Solid State Power Amplifier	149
2:40 pm	Y. Hwang, P.D. Chow, J. Lester, J. Chi, D. Garske, M. Biedenbender and R. Lai	
TU3A-5	Highly Efficient Compact Q-Band MMIC Power Amplifier Using 2-MIL Substrate and Partially-Matched Output	153
3:00 pm	J.A. Lester, Y. Hwang, J. Chi, R. Lai, M. Biedenbender and P.D. Chow	
TU3A-6	A Practical MMIC Negative Resistance Structure for X and Ku Band Applications	157
3:10 pm	M.R. Moazzam and M. Darvishzadeh	
TU3A-7	GaAs Monolithic Integrated Microwave Power Sensor in Coplanar Waveguide Technology	161
3:20 pm	A. Dehé, H. Klingbeil, V. Krozer, K. Fricke, K. Beilenhoff and H.L. Hartnagel	

Session TU3B

New Guiding and Radiative Effects on Planar Circuits

1:40 pm–3:30 pm

Room 132

Tuesday, June 18, 1996

Chair: A.S. Omar, Technical Univ. of Hamburg, Co-chair: T.K. Sarkar, Syracuse University

TU3B-1	Utilization of the Matrix Pencil Technique for Determining Modal Propagation Characteristics of Printed Circuits	167
1:40 pm	T.K. Sarker, R.S. Adve, Z.A. Maricevic and M.S. Palma	
TU3B-2	Excitation of Leaky Modes on Multilayer Stripline	171
2:00 pm	C. Di Nallo, F. Mesa and D.R. Jackson	
TU3B-3	A Simple Formulation for Complex Modes of Image Lines	175
2:20 pm	S.T. Peng and J.J. Wu	
TU3B-4	A New Type of the Narrow-Pulse Distortion Caused by the Simultaneous-Propagation Effect of Both Bound and Leaky Modes on Printed-Circuit Transmission Lines	179
2:40 pm	M. Tsuji, H. Takayama and H. Shigesawa	
TU3B-5	Leakage Fields from Planar Semi-Infinite Transmission Lines	183
3:00 pm	F.J. Villegas, D.R. Jackson and J.T. Williams	

Session TU3C

Frequency-Domain Modeling of Microwave Structures

1:40 pm–3:30 pm **Room 133** **Tuesday, June 18, 1996**

Chair: A.C. Cangellaris, University of Arizona, Co-chair: P. Russer, Tech. University of Munich

TU3C-1	Optimum Port Numbering in the Electromagnetic Simulation of Complex Networks	189
1:40 pm	M. Dionigi, A. Esposito, L. Tarricone, R. Sorrentino	
TU3C-2	Discrete Mode Matching for the Full-Wave Analysis of Planar Waveguide Structures	193
2:00 pm	A. Dreher	
TU3C-3	Hybrid Dynamic-Static Finite-Difference Approach for MMIC Design	197
2:20 pm	S. Lindenmeier, P. Russer and W. Heinrich	
TU3C-4	Efficient Implementation of Higher Order Expansion Functions into the Spectral Domain Analysis of Planar Circuits	201
2:40 pm	T. Vaupel and V. Hansen	
TU3C-5	On the Accuracy of Perfectly Matched Layers Using a Finite Element Formulation	205
2:50 pm	M.R. Lyons, A.C. Polycarpou and C.A. Balanis	
TU3C-6	Application and Design Guidelines of the PML Absorber for Finite Element Simulations of Microwave Packages	209
3:00 pm	J. Gong, S. Legault, Y. Botros, J.L. Volakis and P. Petre	

Session TU3D

Historical Perspectives on Microwaves in the San Francisco Bay Area

1:40 pm–3:30 pm **Room 134** **Tuesday, June 18, 1996**

Chair: G.R. Branner, University of California, Davis, Co-chair: C. Holmes, Eagleware

TU3D-1	Microwave Technology and Industry Dynamics from WWII to 1970	215
1:40 pm	D. Watkins	
TU3D-2	Early History of Radar and Countermeasures	215
2:00 pm	B. May	
TU3D-3	Microwave Satellite Communications/Navigation Contributions in the San Francisco Bay Area	215
2:10 pm	J.J. Spilker	
TU3D-4	Microwave Instruments: The Past and the Future	216
2:20 pm	R.W. Anderson	
TU3D-5	Early Contributions to Microwave Components at SRI	216
2:40 pm	S. Cohn	
TU3D-6	Some Early Passive Microwave Circuit Contributions in the Bay Area	216
2:50 pm	G. Matthaei	
TU3D-7	The Bay Area's Solid-state Microwave Device Heritage	216
3:10 pm	J. Barrera	
TU3D-8	Electron Beam Devices	216
3:20 pm	C. Loeb	

TU
3C

TU
3D

TU
3E

TU
4A

Session TU3E

Packaging and Interconnect Technologies

1:40 pm–3:30 pm Room 130 Tuesday, June 18, 1996

Chair: J. Pavio, Motorola, Co-chair: M. Harris, Georgia Tech Research Inst.

TU3E-1	Multichip-on-Flex Plastic Encapsulated MHDI—Low Cost Substrateless Manufacturing for Microwave and Millimeterwave Modules	219
1:40 pm	P.D. Cooper, P.A. Piacente and R.J. Street	
TU3E-2	Experimental and Theoretical Study of Parasitic Leakage/Resonance in a K/KA-Band MMIC Package	223
1:50 pm	J.G. Yook, L.P.B. Katehi, R.N. Simons and K. Shalkhauser	
TU3E-3	Thermally Enhanced Plastic Packages Using Diamond for Microwave Applications	227
2:10 pm	M. Gomes-Casseres and P.M. Fabis	
TU3E-4	Solder Free Interconnects for Mixed Signal (DC/Microwave) Systems	231
2:20 pm	D. Strack, H. Fudem, F. Kuss, W. Marsh and J. Costello	
TU3E-5	Transitions and Interconnects Using Coplanar Waveguide and Other Three Conductor Transmission Lines	235
2:30 pm	R. Sturdivant, C. Quan and J. Wooldridge	
TU3E-6	Investigation of MMIC Flip Chips with Sealants for Improved Reliability Without Hermeticity	239
2:50 pm	R. Sturdivant, C. Quan and J. Wooldridge	
TU3E-7	New Module Structure Using Flip-Chip Technology for High-Speed Optical Communication ICs	243
3:00 pm	S. Yamaguchi, Y. Imai, S. Kimura and H. Tsunetsugu	
TU3E-8	Millimeter-Wave Performance of Chip Interconnections Using Wire Bonding and Flip Chip	247
3:20 pm	T. Krems, W. Haydl, H. Massler and J. Rüdiger	

Session TU4A

(Joint with MMWMC Symposium)

MMIC System Components

4:00 pm–5:50 pm Room 135 Tuesday, June 18, 1996

Chair: S.S. Bharj, Princeton Microwave Technology, Co-chair: H.A. Hung, TRW

TU4A-1	A MMIC Radar Chip for Use in Air-to-Air Missile Fuzing Applications	253
4:00 pm	M.D. Pollman, P. Katzin, B. Bedard, V. Aparin, W. Grammer and R. Orgusaar	
TU4A-2	A Silicon MOS Process for Integrated RF Power Amplifiers	257
4:20 pm	C. Dragon, J. Costa, D. Lamey, D. Ngo, W. Burger, and N. Camilleri	
TU4A-3	Frequency Translation MMICs Using InP HEMT Technology	261
4:40 pm	L. Tran, M. Delaney, R. Isobe, D. Jang and J. Brown	
TU4A-4	A Novel Type of Constant Impedance Traveling Wave Phase Shifter for InP-Based MMICs	265
5:00 pm	R. Kremer, S. Redlich, L. Brings and D. Jäger	
TU4A-5	Active Coplanar Up-Converter for High Gain V-Band Applications	269
5:20 pm	R. Kulke, Th. Sporkmann, I. Wolff, M.J. Rosário and F. Fortes	
TU4A-6	26 GHZ Coplanar SiGe MMICS	273
5:30 pm	C. Rheinfelder, K. Strohm, F. Beißwanger, J. Gerdes, F.J. Schmückle, J.-F. Luy and W. Heinrich	
TU4A-7	MMICs For Sensor Applications	277
5:40 pm	R. Tempel, W. Lütke, J. Herrmann and I. Wolff	

Session TU4B

Wave Interactions with Gyromagnetic and Semiconductor Media

4:00 pm–5:50 pm **Room 132** **Tuesday, June 18, 1996**
 Chair: M. Dydyk, Motorola, Co-chair: S.M. El-Ghazaly, Arizona State University

TU4B-1	Anomalous Propagation, Loss and Radiation Effects in Open Waveguides with Gyrotropic Media	283
4:00 pm	P. Baccarelli, C. Di Nallo, F. Frezza, A. Galli and P. Lampariello	
TU4B-2	Leaky Wave Behaviour in the Silicon H-Guide with Optically Induced Plasma Region	287
4:20 pm	Y. Satomura, S. Sumida and M. Tsutsumi	
TU4B-3	Field Theory Analysis of Slow-Wave Propagation on Silicon Based Coplanar MIS Transmission Lines	291
4:30 pm	S. Chen, R. Vahldieck, J. Huang and M. Kim	
TU4B-4	Analysis of Electromagnetic Wave Propagation on Coplanar Waveguides on Doped Semiconductor Substrates	295
4:50 pm	T.R. LaRocca, A.C. Reyes and S.M. El-Ghazaly	
TU4B-5	Contact Effects on HF Loss of CPW High Resistivity Silicon Lines	299
5:00 pm	Z.R. Hu, V.F. Fusco, Y. Wu, H.G. Gamble, B.M. Armstrong and J.A.C. Stewart	
TU4B-6	Dispersive Effects of a Thin Metal-Insulating Layer in MMIC Structures	303
5:10 pm	A.C. Polycarpou, M.R. Lyons and C.A. Balanis	
TU4B-7	The Analysis and Reduction of Crosstalk on Coupled Microstrip Lines Using Nonuniform FDTD Formulation	307
5:20 pm	S. Dai, A.Z. Elsherbeni and C.E. Smith	
TU4B-8	Low Conductor Loss Microstrip Lines with Side-Grooves	311
5:30 pm	K. Li and K. Atsuki	

Session TU4C

Intelligent Transportation Systems

4:00 pm–5:50 pm **Room 133** **Tuesday, June 18, 1996**
 Chair: R. Henning, University of South Florida

TU4C-1	Automotive Radars-Development Status	317
4:00 pm	R. Dixit	
TU4C-2	W-Band Collision Avoidance Radar for Light Rail Applications	321
4:20 pm	M. Sholley, R. Alvarez, T. Leary, D. Renkowitz, S. Schell, L. Wendel, D. Cisneros, W. Brunner, B. Osgood, C. Gage, J. Alley, T. Cazares and P. Yocum	
TU4C-3	5.8 GHZ Phased Array Antenna for Electronic Toll Collection in Road Traffic Applications	325
4:40 pm	W. Grabow, T. Wixforth and H. Ziegler	
TU4C-4	A Low Cost K-Band Safety Warning Radar Receiver System	329
5:00 pm	M.C. Tsai, C. Autio, M. Batten, M. Gagne, T. Kvenvold, C. Papadopoulos, B. Ricker, S. Sarkar and A. Perlowski	
TU4C-5	A Self-Mixing Active Antenna for Communication and Vehicle Identification Applications	333
5:20 pm	C.M. Montiel, L. Fan and K. Chang	
TU4C-6	Monolithic, W-Band, Voltage-Controlled Oscillator	337
5:40 pm	M.J. Vaughan, R.C. Compton, S. Duncan, D. Tu and S. Weinreb	

TU
4B

TU
4C

TU
4D

TU
4E

Session TU4D

Modern Concepts in Microwave Field Theory

4:00 pm–5:50 pm

Room 134

Tuesday, June 18, 1996

Chair: A. Beyer, Univ. of Duisburg

TU4D-1	Use of Frequency Derivatives in the 3-D Full-Wave Spectral Domain Technique	343
4:00 pm	J. Pekarek and T. Itoh	
TU4D-2	3-D Modeling of Interconnects in MMICS by the Method of Lines	347
4:20 pm	L. Vietzorreck and R. Pregla	
TU4D-3	A Fast Spatial Domain Method for the Suppression of Excitation-Induced Spurious Modes in SCN-TLM	351
4:40 pm	S. Lindenmeier, B. Isele, R. Weigel and P. Russer	
TU4D-4	A New Global Finite Element Analysis of Microwave Circuits Including Lumped Elements	355
5:00 pm	K. Guillouard, M.F. Wong, V. Fouad Hanna and J. Citerne	
TU4D-5	FD-TD/Matrix-Pencil Method for the Efficient Simulation of Waveguide Components Including Structures of More General Shape	359
5:20 pm	J. Ritter and F. Arndt	
TU4D-6	Diakoptics Using Finite Element Analysis	363
5:30 pm	K. Guillouard, M.F. Wong, V. Fouad Hanna and J. Citerne	

Session TU4E

Millimeter and SubMillimeter-Wave Receivers

4:00 pm–5:50 pm

Room 130

Tuesday, June 18, 1996

Chair: J.W. Dees, Georgia Inst. of Technology, Co-chair: M. Frerking, JPL

TU4E-1	Large Scale W-Band Focal Plane Array for Passive Radiometric Imaging	369
4:00 pm	G.S. Dow, D.C.W. Lo, Y. Guo, E.W. Lin, T.T. Chung, M.D. Biedenbender, O. Miromontes, A. Marashi, L. Yujiri, P.S.C. Lee, M.M. Shoucri and B.R. Allen	
TU4E-2	A Millimeter Wave Monolithic Load Switching Twist Reflector for Compact Imaging Cameras	373
4:20 pm	G.R. Huguenin, S. Bandla and E.L. Moore	
TU4E-3	600 GHz Planar-Schottky-Diode Subharmonic Waveguide Mixers	377
4:40 pm	I. Mehdi, T.H. Lee, D.A. Humphrey, S.C. Martin, R.J. Dengler, J.E. Oswald, A. Pease, R.P. Smith and P.H. Siegel	
TU4E-4	Fabrication and Performance of Separately-Biasable Antiparallel-Pair “T-Anode” Mixer Diodes Employing A Compact Multiple-Layer Integrated Bias Circuit at 210 GHz	381
5:00 pm	T.-H. Lee, D.A. Humphrey, R.J. Dengler, I. Mehdi, S.C. Martin, A. Pease, J.E. Oswald, R.P. Smith and P.H. Siegel	
TU4E-5	A 94 GHz Uniplanar Subharmonic Mixer	385
5:10 pm	S. Raman and G.M. Rebeiz	
TU4E-6	A Monolithic W-Band CPW Rat-Race Mixer with HBT IF Amplifier	389
5:30 pm	H. Matsuura, K. Tezuka, I. Aoki, A. Miura, M. Yamanaka, T. Yakihara, S. Kobayashi, S. Oka, T. Fujita and D. Murata	
TU4E-7	Millimeter-Wave Gaussian-Beam Antenna and Integration with Planar Circuits	393
5:40 pm	T. Matsui, M. Kiyokawa and N. Hirose	