

# TECHNICAL PROGRAM

## 1966 G-MTT INTERNATIONAL SYMPOSIUM

MAY 16 - 19, 1966

CABANA MOTOR HOTEL, PALO ALTO, CALIFORNIA

### INTRODUCTORY SESSION 9:00 A.M. Monday May 16

#### WELCOMING REMARKS

P. D. Lacy, Chairman, Steering Committee, 1966 International G-MTT  
Microwave Symposium

E. N. Torgow, Chairman, G-MTT National Administrative Committee

### SESSION I SOLID-STATE DESIGN Monday A.M. May 16

Chairman: L. Lewin

Standard Telecommunication Laboratories, Harlow, England

- |       |  |    |
|-------|--|----|
| I-1   | GaAs POST-THRESHOLD MICROWAVE AMPLIFIER, MIXER, AND OSCIL-           |    |
| 9:20  | LATOR, Basil W. Hakki, Bell Telephone Laboratories                   | 1  |
| I-2   | QUANTITATIVE COMPARISON OF SOLID-STATE MICROWAVE DETECTORS,          |    |
| 9:40  | A.M. Cowley and H. O. Sorensen, hp Associates                        | 7  |
| I-3   | ULTIMATE NOISE FIGURE AND CONVERSION LOSS OF THE SCHOTTKY            |    |
| 10:00 | BARRIER MIXER DIODE, M. R. Barber and R. M. Ryder, Bell Telephone    |    |
|       | Laboratories   | 13 |
| I-4   | SOME SELECTED TOPICS IN BRITISH SOLID-STATE RESEARCH, L. Lewin,      |    |
| 10:50 | Standard Telecommunication Laboratories (Invited)                    | 18 |
| 10:20 | COFFEE BREAK   |    |
| I-5   | IMPROVED INTERMODULATION REJECTION IN MIXERS, J. H. Lepoff and       |    |
| 11:20 | A.M. Cowley, hp Associates   | 19 |
| I-6   | PERFORMANCE CHARACTERISTICS OF CW SILICON AND GaAs AVALANCHE         |    |
| 11:40 | DIODE OSCILLATORS, F. A. Brand, V. J. Higgins, and J. J. Baranowski, |    |
|       | Electronic Components Laboratory, U.S. Army Electronics Command      | 23 |

### SYMPOSIUM LUNCHEON 12:15 - 1:45 P.M.

#### KEYNOTE ADDRESS

Dr. Hubert Heffner, Associate Provost for Research, Stanford University

## SESSION II

Monday P.M. May 16

### AMPLIFIERS, MULTIPLIERS, AND CONVERTERS

Chairman: Carl Blake  
Lincoln Laboratories, Lexington, Mass.

II-1	MICROWAVE SOLID-STATE SOURCES, B. C. De Loach, Bell Telephone Laboratories (Invited)	28
II-2	INSTABILITIES IN VARACTOR MULTIPLIERS, D. B. Leeson, Applied Technology, Inc.	30
II-3	THEORY AND MEASUREMENTS OF NOISE IN VARACTOR HARMONIC GENERATOR SOURCES, M. E. Hines and J. G. Ondria, Microwave Associates	35
3:25	COFFEE BREAK	
II-4	PRACTICAL APPLICATION OF A POSITIVE RESISTANCE UP-CONVERTER FOR ULTRA-LOW-NOISE AMPLIFICATION, E. Sard, B. Peyton, and S. Okwit, Airborne Instruments Laboratory	41
II-5	A 1200 MEGABITS/SEC, GRAY CODE, ANALOG TO DIGITAL CONVERTER, R. E. Fisher, Bell Telephone Laboratories	46
II-6	BROADBAND FREQUENCY TRANSLATORS, F. S. Coale, H. M. Weil, and P. M. La Tourrette, Melabs	52
II-7	INJECTION-LOCKED OSCILLATORS AS AMPLIFIERS FOR ANGLE-MODULATED SIGNALS, H. L. Stover and R. C. Shaw, Bell Telephone Labs	60

## SESSION III

Monday Evening May 16

### LINEAR PARTICLE ACCELERATORS

Chairman: W. K. H. Panofsky  
Stanford Linear Accelerator Center

III-1	THE RF DRIVE SYSTEM FOR THE STANFORD TWO-MILE LINEAR ACCELERATOR, G. A. Loew, Stanford Linear Accelerator Center (Invited)	67
III-2	MICROWAVE APPLICATIONS OF SUPERCONDUCTIVITY, Perry B. Wilson, Hansen Laboratories, Stanford University (Invited)	69
III-3	ACCURATE PHASE LENGTH MEASUREMENTS OF LARGE MICROWAVE NETWORKS, J. N. Weaver and R. Alvarez, Stanford Linear Accelerator	76

## SESSION IV

Tuesday A.M. May 17

### FILTERS AND COUPLERS

Chairman: S. B. Cohn  
Rantec Corp., Calabasas, California

- IV-1 SYNTHESIS OF DISTRIBUTED ELLIPTIC-FUNCTION FILTERS FROM  
9:00 LUMPED-CONSTANT PROTOTYPES, R. Levy and I. Whiteley, Leeds 83  
University (Invited)
- IV-2 THE FIELD DISPLACEMENT FILTER -- A NEW FAMILY OF DISSIPATIVE  
9:45 WAVEGUIDE FILTERS, Nikolai Eberhardt, Lehigh University 90
- IV-3 THEORETICAL AND PRACTICAL APPLICATIONS OF CAPACITANCE  
10:05 MATRIX TRANSFORMATIONS TO TEM NETWORK DESIGN, R.J. Wenzel,  
Bendix Research Laboratories 94
- 10:25 COFFEE BREAK
- IV-4 OPTIMAL DESIGN OF MATCHING NETWORKS FOR MICROWAVE TRANS-  
10:55 ISTOR AMPLIFIERS, F.E. Emery, M.O'Hagen, and S.D. Nolte, Texas  
Instruments 101
- IV-5 FILTER REQUIREMENTS FOR NANOSECOND DIODE SWITCHING,  
11:15 R.V. Garver and T.H. Mak, Harry Diamond Laboratories 108
- IV-6 COUPLED-TRANSMISSION-LINE DIRECTIONAL COUPLERS WITH COUPLED  
11:35 LINES OF UNEQUAL CHARACTERISTIC IMPEDANCES, E.G. Cristal, 114  
Stanford Research Institute
- IV-7 THE DESIGN AND CONSTRUCTION OF BROADBAND, HIGH-DIRECTIVITY  
11:55 90° COUPLERS USING NON-UNIFORM LINE TECHNIQUES, C.P. Tresselt,  
Bendix Research Laboratories 120

## SESSION V

Tuesday P.M. May 17

### INTEGRATED CIRCUITS

Chairman: I. H. Solt  
Fairchild Semiconductor, Mountain View, California

- V-1 SURVEY OF INTEGRATED CIRCUITS WITH IMPLICATIONS FOR MICRO-  
2:00 WAVES, R. L. Pritchard, Stanford University (Invited) 126
- V-2 CERAMIC MICROSTRIP FOR MICROWAVE HYBRID INTEGRATED  
2:45 CIRCUITRY, B.T. Vincent, Jr., Texas Instruments 128
- V-3 INTEGRATED MICROWAVE TUNNEL DIODE DEVICE, H. C. Okean,  
3:00 Bell Telephone Laboratories 135
- 3:15 COFFEE BREAK

V-4 3:45	INTEGRATED MICROWAVE CONTROL DEVICES, W.J.Moroney and A. Botka, Microwave Associates, Inc.	142
V-5 4:00	A LOW-LOSS 1-NANOSECOND 1-WATT X-BAND SWITCH, R.W.Dawson and B.C.De Loach, Bell Telephone Laboratories	146
V-6 4:15	INTEGRATED BALANCED MIXERS FOR S- AND X-BAND, C.M.Howell, Microwave Associates, Inc.	151

## SESSION VI

**Tuesday Evening May 17**

### MICROWAVES ABROAD

Chairman: W. W. Mumford  
Bell Telephone Laboratories, Whippany, New Jersey

VI-1 7:00	GUIDED-WAVE RESEARCH IN BRITISH UNIVERSITIES, P. J. B. Clarri- coats, Leeds University, England (Invited)	156
VI-2 7:45	MICROWAVES AT JAPANESE UNIVERSITIES, Nobuaki Kumagai, Osaka University, Japan (Invited)	157
8:30	COFFEE BREAK	
VI-3 8:45	DELAY SPECTRA OF SINGLE CRYSTAL FERRIMAGNETICS WHEN LOADED BY POLYCRYSTALLINE FERRITES, J. H. Collins and B. Yazgan, Glasgow University, Scotland (Invited)	158
VI-4 9:15	A SELECTIVE SURVEY OF MICROWAVES IN SCANDINAVIA AND WESTERN EUROPE, M.M.Brady, Aksjeselskapet NERA, Norway (Invited)	162

## SESSION VII

**Wednesday A.M. May 18**

### ULTRAMICROWAVE AND OPTICAL TECHNIQUES

Chairman: A. Gardner Fox  
Bell Telephone Laboratories, Holmdel, New Jersey

VII-1 9:00	OPTICAL TRANSMISSION MEDIA, E. A. J. Marcatili, Bell Telephone Laboratories (Invited)	163
VII-2 9:45	DEVELOPMENT TOWARDS PRACTICAL APPLICATIONS OF TE <sub>01</sub> -MODE CIRCULAR WAVEGUIDES, LEAKY WAVEGUIDES, AND BEAM WAVE- GUIDES, T. Nakahara, Sumitomo Electric Ind., Japan (Invited)	164
10:30	COFFEE BREAK	

VII-3	CONFOCAL RESONATOR BANDPASS FILTERS, J. Cohen and J. J. Taub,	
11:00	Airborne Instruments Laboratory	170
VII-4	SUBMILLIMETER BROADBAND POWER-MEASURING DETECTOR,	
11:15	M. Wang and F. Arams, Airborne Instruments Laboratory	176
VII-5	PERTURBATION OF OPTICAL RESONATOR CHARACTERISTICS BY AN	
11:30	INHOMOGENEOUS FOCUSING MEDIUM, S.A. Harrison and W.K. Kahn,	
	Polytechnic Institute of Brooklyn	179
VII-6	A LIGHT BEAM WAVEGUIDE USING HYPERBOLIC-TYPE GAS LENS,	
11:45	Y. Suematsu, K. Iga, and S. Ito, Tokyo Institute of Technology, Japan	184

## SESSION VIII

Wednesday P.M. May 18

### MICROWAVE TECHNIQUES

Chairman: R. W. Beatty  
National Bureau of Standards, Boulder, Colorado

VIII-1	ELECTROMAGNETIC MOMENTUM AS A TOOL IN MICROWAVE	
2:00	ANALYSIS, John Brown, University College, London (Invited)	190
VIII-2	SAMPLING FOR OSCILLOSCOPES AND OTHER RF SYSTEMS: DC	
2:30	THROUGH X-BAND, Wayne Grove, hp Associates	191
VIII-3	A POWER REFLECTION TECHNIQUE FOR CHARACTERIZATION OF	
2:45	HIGH QUALITY VARACTOR DIODES, G.D. Vendelin and S. A. Robinson,	
	Texas Instruments	197
VIII-4	APPLICATION OF A MICROWAVE TECHNIQUE TO THE MEASUREMENT	
3:00	OF ELECTRON DENSITY AND RELAXATION TIME, S. Lederman and	
	E. F. Dawson, Polytechnic Institute of Brooklyn	202
3:15	COFFEE BREAK	
VIII-5	FULL-BAND MATCHING OF WAVEGUIDE DISCONTINUITIES,	
3:45	F. C. De Ronde, Philips Research Laboratories (Invited)	208
VIII-6	MICROWAVE BREAKDOWN TECHNIQUE FOR MEASURING IONIZATION	
4:30	RATE OF HIGH TEMPERATURE GASES IN A SHOCK TUBE, J.B. Chown,	
	W.C. Taylor, and T. Morita, Stanford Research Institute	210
VIII-7	CHARACTERISTICS OF A PERIODIC TYPE OF MICROWAVE SAMPLING	
4:45	CAVITY, R. E. Post and A. G. Potter, Iowa State University	214

## **SYMPOSIUM BANQUET**

**Wednesday Evening May 18**

**7:00 - 10:00 P.M.**

1965 IEEE G-MTT MICROWAVE PRIZE

Hendrik Bosma

Philips Research Laboratories, Eindhoven, Netherlands

BANQUET SPEAKER

Prof. John Brown, University College, London, England

"Technical Education in Developing Countries"

## **SESSION IX**

**Thursday A.M. May 19**

### **FERRITE PHASE SHIFTERS**

Chairman: Max Weiss

Aerospace Corporation, El Segundo, California

- |       |  |     |
|-------|--|-----|
|       |  | 219 |
| IX-1  | A FAST FERRITE MILLIMETER LATCHING SWITCH, R. A. Stern and   |     |
| 9:00  | J. P. Agrios, Electronic Components Lab, U.S. Army Electronics Command                               |     |
| IX-2  | CIRCULARLY POLARIZED PHASE SHIFTER FOR USE IN PHASED ARRAY   |     |
| 9:15  | ANTENNAS, M. C. Mohr and S. Monaghan, Raytheon Company   | 224 |
| IX-3  | A SLOW WAVE DIGITAL FERRITE STRIP TRANSMISSION LINE PHASE  |     |
| 9:30  | SHIFTER, R. R. Jones, Westinghouse   | 230 |
| IX-4  | A MINIATURIZED C-BAND DIGITAL LATCHING PHASE SHIFTER,  |     |
| 9:45  | J. K. Parks, B. R. Savage, L. J. Lavedan, and J. Brown, Jr., Sperry Microwave<br>Electronics Company | 235 |
| IX-5  | A RECIPROCAL TEM LATCHING FERRITE PHASE SHIFTER, J. W. Simon,  |     |
| 10:00 | W. K. Alverson, and J. E. Pippin, Scientific-Atlanta, Inc.   | 241 |
| 10:15 | COFFEE BREAK   |     |
| IX-6  | MICROWAVE FERRITES FOR PHASE SHIFTING APPLICATIONS,  |     |
| 10:45 | J. J. Green, Raytheon Research Division (Invited)  | 248 |
| IX-7  | A COUPLED-MODE DESCRIPTION OF THE REGGIA-SPENCER PHASE   |     |
| 11:30 | SHIFTER, C. R. Boyd, Rantec Corp.  | 250 |
| IX-8  | RECIPROCAL LATCHING FERRITE PHASE SHIFTER, E. Schlomann,   |     |
| 11:45 | M. Harris, and J. J. Green, Raytheon Research Division   | 256 |

## FERRITE CIRCULATORS AND SWITCHES

Chairman: Perry Vartanian  
Melabs, Palo Alto, California

- X-1. THEORETICAL ASPECTS OF 3-PORT JUNCTION CIRCULATORS,  
2:00 H. Bosma, Philips Research Laboratories (Invited) 261
- X-2 PHASED-ARRAY DIGITAL TIME DELAY PHASER USING LATCHING  
2:45 FERRITE SWITCHES, P. C. Goodman, Bendix Research Laboratory 264
- X-3 A 35 GHZ LATCHING SWITCH, W. C. Passaro and J. W. McManus,  
3:00 Sperry Microwave Electronics Company 270
- 3:15 COFFEE BREAK
- X-4 A SWITCHING CIRCULATOR: S-BAND; STRIPLINE; REMANENT; 10 KW;  
3:45 10 MICROSECOND; TEMPERATURE-STABLE, F. Betts, D. H. Temme,  
and J. A. Weiss, M.I.T. Lincoln Laboratories 275
- X-5 THEORETICAL DESIGN OF STATIC AND LATCHING FERRITE 3-PORT  
4:00 AND 4-PORT SYMMETRICAL WAVEGUIDE CIRCULATORS, L. E. Davis,  
Rice University 281
- X-6 THE FOUR-PORT SINGLE JUNCTION CIRCULATOR IN STRIP LINE,  
4:15 C. E. Fay and W. A. Dean, Bell Telephone Laboratories 286
- X-7 ANALYSIS OF A GROUNDED JUNCTION CIRCULATOR, M. Omori,  
4:30 Bell Telephone Laboratories 291

The Steering Committee of the 1966 G-MTT International Symposium and the Administrative Committee of the G-MTT wish to express their sincere appreciation to the U. S. Army Research Office and to the Office of Naval Research for funding travel expenses of several of the invited speakers from universities abroad, and thus contributing greatly to the success of the Symposium. They are also grateful to those agencies and companies in other countries who have provided generous financial assistance that has enabled other invited speakers to participate in the Symposium.