

WORKSHOP

BROADBAND MATCHING AND DESIGN OF MICROWAVE AMPLIFIERS

MONDAY, 30 MAY 1983
8:30 AM - 5:30 PM
COMMONWEALTH ROOM

ORGANIZERS: H. J. Carlin
Cornell University, Ithaca, NY

B. S. Yarman
RCA-David Sarnoff Research Center, Princeton, NJ

With the development of new active devices, broadband matching in the microwave frequency range has assumed renewed importance. This full-day workshop will focus on tutorial presentations directed toward the fundamentals of gain-bandwidth techniques as well as CAD procedures for efficiently implementing broadband equalizer circuit design and design of broadband microwave amplifiers. The schedule is as follows.

Morning Session

(Invited Presentations)

ANALYTIC GAIN-BANDWIDTH THEORY AND ITS APPLICATION
R. Levy
Microwave Development Labs., Inc.
Natick, MA

ABSTRACT

This presentation will concentrate on the most basic, fundamental, and simplest aspects of broad-band matching theory, with examples. In order to further understanding of the subject, actual proofs of various well-known formulas will be given, rather than having to accept them for granted. These include the fundamental gain-bandwidth integral limitations of Bode, and the specific formulas for the element values in low pass prototype networks. At the same time physical reasoning will be stressed, so that a good foundation should be established for proceeding to more advanced material.

**RECENT ADVANCES IN BROADBAND MATCHING THEORY WITH APPLICATIONS TO
GaAs FET MIC AND MMIC AMPLIFIERS***
Walter H. Ku
Cornell University
Ithaca, NY

ABSTRACT

Recent advances in broadband matching theory for lumped, distributed, and mixed lumped/distributed networks are reviewed. New results to be presented include synthesis of lossy matching networks, odd-order bandpass networks and a class of lumped/distributed matching networks suitable for monolithic realizations. These results are applied to the design of broadband GaAs FET MIC and MMIC amplifiers. Computer-aided synthesis computer programs recently developed will also be presented.

*This research was supported by the U.S. Air Force, Rome Air Development Center (RADC) and the Joint Services Electronics Program (JSEP).

WORKSHOP

COMMERCIALLY AVAILABLE CAD SYNTHESIS TECHNIQUES

C. Holmes, CGIS/a COMSAT Company
Palo Alto, CA

ABSTRACT

Capabilities of commercially available CAD synthesis programs including both lumped and distributed synthesis (1)-(3) are reviewed and compared. The versatility and power of these techniques when combined with optimization is illustrated by means of design examples.

1. "AMPSYNTM: Synthesis of Matching Networks," Version 1.2 User Manual, Jun 1980.
2. "CADSYNTM: Computer-Aided Distributed Synthesis Program," Version 1.0 User Manual; Apr 1979.
3. "SUPER-COMPACTTM", Version 1.6 User Manual; Jan 1983.

CHARACTERIZATION OF POWER FETs AND DESIGN OF POWER AMPLIFIERS

F. Sechi RCA-David Sarnoff Research Center
Princeton, NJ

ABSTRACT

An important aspect in the design of broadband amplifiers is the characterization of active devices. For power amplifiers a large-signal characterization, using load-pull or equivalent techniques, is necessary. The tuning circuits are designed using modern network analysis and synthesis procedures and are implemented in distributed or lumped-element form. A new technology - the Miniature Beryllia Circuits - has added a new dimension to the field of possible circuit implementations and is expected to play a major role in the development of broadband low-cost power amplifiers.

NEW APPROACHES TO GAIN BANDWIDTH PROBLEMS

B. S. Yarman
RCA/David Sarnoff Research Center
Princeton, NJ

ABSTRACT

In the previous publications (1), (2) new CAD techniques, called "real frequency" techniques for designing broadband matching networks were introduced. Unlike the other CAD techniques, the new design procedures utilize the measured data obtained from the physical devices to be matched and require no knowledge of the algebraic form of the transfer function or circuit topology. These techniques were also extended to design multi-stage microwave amplifiers using a sequential procedure. In this presentation, real frequency techniques are reviewed. Then a new dynamic design procedure for designing microwave amplifiers is presented. The effectiveness of the real frequency techniques is clearly demonstrated by several examples. It is also known that the laboratory results are in good agreement with the theoretical predictions.

- (1) H. J. Carlin, "A new approach to gain-bandwidth problems," IEEE Trans. Circuit Syst., CAS-Vol. 23, pp. 170-175, April 1975.
- (2) B. S. Yarman and H. J. Carlin, "A simplified "real frequency" technique applied to broadband multi-stage microwave and amplifiers," Trans. MTT, Vol. 30, No. 12, pp. 2216-2222, Dec 1982.

WORKSHOP

PROPERTIES AND LIMITATIONS OF PASSIVE COMPONENTS FOR BROADBAND MONOLITHIC CIRCUIT APPLICATIONS

R. A. Pucel
Raytheon Co.
Lexington, MA

ABSTRACT

An assessment will be made of the performance and design limitations of some commonly used passive components for monolithic circuit applications. Particular emphasis will be placed on the frequency limitations of these components as imposed by their monolithic implementation. Although the discussion will be based, in large measure, on theoretical analyses, some experimental evidence will be presented. Examples of components to be considered include thin film resistors and capacitors, spiral inductors, and couplers, among others.

LUNCH

Afternoon Session (Invited Short Presentations and Discussion)

A SYSTEMATIC THEORY OF WORST CASE OPTIMIZATION IN THE FREQUENCY DOMAIN; HIGH FREQUENCY AMPLIFIERS

J. William Helton
University of California, San Diego
La Jolla, CA

ABSTRACT

This talk illustrates how a new method for broadbanding applies to the conventional design of high frequency amplifiers. A major virtue of the technique is that one can take the conventional philosophy for design at a fixed frequency and convert it immediately to broadband situations using the two mathematical theorems described in the presentation. These mathematical theorems are now close to being implemented on the computer.

PRACTICAL WIDEBAND AMPLIFIER DEVELOPMENTS ON GaAs REAL ESTATE

Eric W. Strid
Texas Instruments, Inc.
Dallas, TX

ABSTRACT

In this presentation various wideband amplifier topologies, including conjugate matching, feedback, active matching, distributed amplifiers, and f_T doublers are compared for their applicability to MMIC's. Several implementations of these, with experimental results, are discussed. Practical problems with analysis of parasitics and measurement of MMIC elements and stages are investigated.

WORKSHOP

THE DESIGN OF BROADBAND POWER FET AMPLIFIERS EMPLOYING NON-LINEAR DEVICE ANALYSIS, NETWORK SYNTHESIS, AND MATCHED EQUALIZATION TECHNIQUES

By

A. M. Pavio and S. D. McCarter
Texas Instruments, Inc.
Dallas, Texas

ABSTRACT

The design of power FET amplifiers encompasses a variety of engineering disciplines ranging from filter synthesis to non-linear analysis. During the last several years computer-aided circuit techniques have become quite sophisticated allowing the designer the ability to develop power amplifiers with optimum gain and power output characteristics. The design philosophy of several FET power amplifiers, including the application of the primary numerical analytical techniques used in the development will be presented.

The discussion will be concentrated in three main areas: large signal device modeling and impedance calculation, input/output network design and performance considerations, and experimental results.

FEES

Workshop registration may be made during the symposium at \$45 for IEEE members and \$50 for non-members. The fee includes lunch and coffee breaks at the workshop.

HYPERTHERMIA FOR CANCER THERAPY

SPOONSORED BY MTT-10 TECHNICAL COMMITTEE ON BIOLOGICAL EFFECTS AND MEDICAL APPLICATIONS.

TUESDAY, 31 MAY 1983
8:30 AM - 5:30 PM
FAIRFAX ROOM

ORGANIZERS: Prof. Padmakar Lele
MIT, Cambridge, MA

Dr. Fred Sterzer
RCA David Sarnoff Research Center, Princeton, NJ

The enthusiasm generated by pre-clinical and early clinical results of the use of hyperthermia in treatment of cancer indicates that the near future its clinical application/evaluation will undergo substantial growth in the U.S. and abroad. This intensive one-day workshop is especially designed to impart the fundamental as well as the state-of-the-art information on various facets on this exciting field. The agenda for the day is as follows:

CLINICAL NEEDS AND BIOLOGICAL RATIONALE (8:30 AM)

Dr. Richard Cumberlin (National Cancer Institute) "Overview on Prospective Hyperthermia Research and Support"

Dr. Emil Frei (Dana Farber Cancer Institute) "Clinical Needs in Hyperthermia in Medical Oncology"

Dr. Herman Suit (MGH and Harvard Medical School) "Clinical Needs for Hyperthermia in Radiotherapy"

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Dr. Leo Gerweck (MGH Harvard Medical School) "Cell Biological Basis for Hyperthermia in Cancer Therapy"

Dr. Muneyasu Urano (MGH) "Tumor Biology Perspective for Hyperthermia"

INDUCTION AND MEASUREMENT OF HYPERTHERMIA (10:30 AM)

Dr. Frederick Bowman (Northeastern, MIT) "Heat Transfer Considerations in Local/Regional Hyperthermia"

Dr. Fred Sterzer (RCA Princeton Research Laboratory) "Heat Generation by Various Modalities"

Dr. Padmakar Lele (MIT) "Ultrasonic Techniques"

Prof. Carl Durney (University of Utah) "Non-Invasive Electromagnetic Techniques"

Prof. Evan Douple (Dartmouth Medical School) "Invasive Electromagnetic Techniques"

Dr. Edward Sternick (New England Medical Center) "Electromagnetic Techniques in Whole Body Hyperthermia"

LUNCHEON (12:30 PM - 1:30 PM)

Prof. Douglas Christensen (University of Utah) "Thermometry: Invasive Techniques"

Mr. Ken Carr (MA/COM) "Thermometry: Non-Invasive Techniques"

CLINICAL EXPERIENCE (2:30 PM)

Dr. Esther Friedenthal (Montefiore Hospital) "Microwave Hyperthermia"

Dr. Jae Ho Kim (Sloan Kettering Institute) "RF Hyperthermia"

Dr. F. Kristian Storm (UCLA) "Magnetrode Experience"

Dr. Frederick Gibbs (University of Utah Medical Center) "BSD Annular Phased Array"

Dr. Padmakar Lele (MIT) "Ultrasound"

Dr. Evan Douple (Dartmouth Medical School) "Interstitial Hyperthermia"
Regulatory Aspects of Medical Devices (5:15)

REGULATORY ASPECTS, OF MEDICAL DEVICES (5:15 PM)

Mr. Raymond Coakley (FDA) "Regulation of Medical Devices"

FEES

Workshop registration may be made during the Symposium registration at \$45 for IEEE members and \$50 for non-members. The fee includes lunch and coffee breaks at the workshop.

WORKSHOP

MODERN MIXER TECHNOLOGY

SPONSORED BY MTT-6: TECHNICAL COMMITTEE ON MICROWAVE AND
MILLIMETER WAVE INTEGRATED CIRCUITS

TUESDAY, 31 MAY 1983

8:30 AM - 5:30 PM

COMMONWEALTH ROOM

ORGANIZER: C. Buntschuh
The Narda Microwave Corp., Hauppauge, NY

The purpose of this workshop is to bring together a "mix" of microwave and millimeter wave mixer people, including circuit designers, theorists, device designers, and mixer users - to review recent developments in the art, and project its future course.

Three invited speakers will present tutorial overviews on circuit, theory, and device developments:

PROGRESS IN MICROWAVE MIXER CIRCUITRY

C. Buntschuh
The Narda Microwave Corp.
Hauppauge, NY

ABSTRACT

Recent mixer developments include a variety of circuit media and non-linear devices. This talk will review the results reported on several new circuit technologies, including MIC, MMIC, E-plane, and quasi-optical. It will also cover mixers using FETs, Gunns, and BARITT diodes, as well as the conventional Schottky barrier diodes. The talk will be applications oriented, concentrating on hardware and performance aspects.

MIXER THEORY, ANALYSIS & OPTIMIZATION

A. R. Kerr
NASA/Goddard Institute for Space Studies

ABSTRACT

The design of high performance microwave and millimeter wave mixers must be based on accurate models for noise and frequency conversion. This talk will describe methods of mixer analysis, starting with the response of the nonlinear device to the large local oscillator wave, and followed by the small-signal and noise analysis. The focus will be on Schottky diode mixers -- single ended, balanced and subharmonically pumped. Examples of the use of the publicly available mixer analysis program GISSMIX, will be given.

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ADVANCES IN MIXER DEVICE TECHNOLOGY

Erik Kollberg
Chalmers University of Technology
Goteborg, Sweden

ABSTRACT

RF and DC properties of metal-semiconductor microjunctions ("Schottky-barrier" - diodes) will be discussed in view of some new results concerning the carrier transport through the junction. The significance, particularly for the design of cooled mm-wave mixers, will be stressed and some results on the optimization of the RF and IF circuits will be given. Finally a short overview of some recent European work on Schottky mixers and superconducting mixers will be presented.

Following each talk there will be a discussion period. Afterwards the workshop will break up into small groups for in-depth discussions of selected topics. Each participant is encouraged to contribute to the discussions by sharing from his own work.

FEES

Workshop registration may be made during the Symposium at \$45 for IEEE members and \$50 for non-members. The fee includes lunch and coffee breaks at the workshop.

AUTOMATED RF TECHNIQUES

SPONSORED BY THE AUTOMATIC RF TECHNIQUES GROUP IN AFFILIATION WITH MTT-12

MONDAY AND TUESDAY, 6, 7, JUNE 1983
8:30 AM - 5:30 PM

HOLIDAY INN*
Wheeler Rd. at Middlesex Turnpike
Burlington, MA

ABSTRACT

The Conference's main topic will be Automated Spectrum Analysis. Papers will be given on recent hardware and software developments in the main topic and other computer-aided RF design and testing topics. Technical exchange will be accomplished by informal twenty-minute talks.

A portion of the sessions is reserved for manufacturers to discuss and/or demonstrate new equipment that has been specifically designed for use in computer-aided RF design and test. The second day of the workshop will include a tour of automated RF test facilities.

FEES

Workshop registration may be made during the Symposium at \$85 for IEEE members and \$95 for non-members. The fee includes lunches and the ARFTG Banquet which will be Monday evenings, June 6. Spouses of preregistered delegates are invited to the banquet at no additional cost.

*A special weekend rate of \$38 (double) per night is available for the Friday and Saturday between the Symposium and the Workshop. The rate will be \$60 single and \$65 double Sunday through Tuesday. Holiday Inn reservations must be made directly through this number: (800) 238-8000.