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IEEE Microwave Theory and Techniques Society

1988-1989

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ACKNOWLEDGMENTS

This CD- ROM was assembled from the electronic files provided to us by Adam Philippidis at IEEE headquarters and from scanned originals provided by Ted Saad. Many people have contributed to the entire CD-ROM Archival effort. Most notably, Ted Saad provided nearly all the hard copy material, and sacrificed his entire collection of journals for the project. He also wrote a number of the original articles. Another notable contributor, Roger Pollard convinced the Society that this was a worthwhile project. The team at Sony Electronic Publishing Services, and Adam Philippidis, at the IEEE Headquarters, have also provided substantial amounts of help in completing this archival project.

REFERENCES

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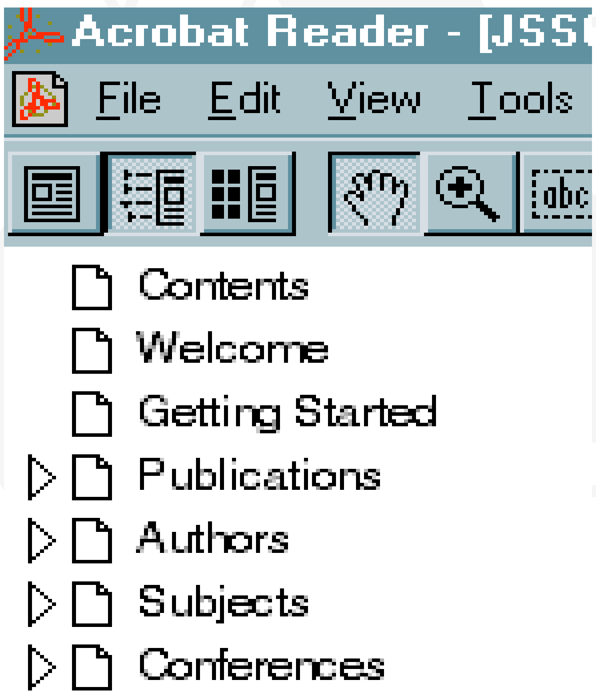

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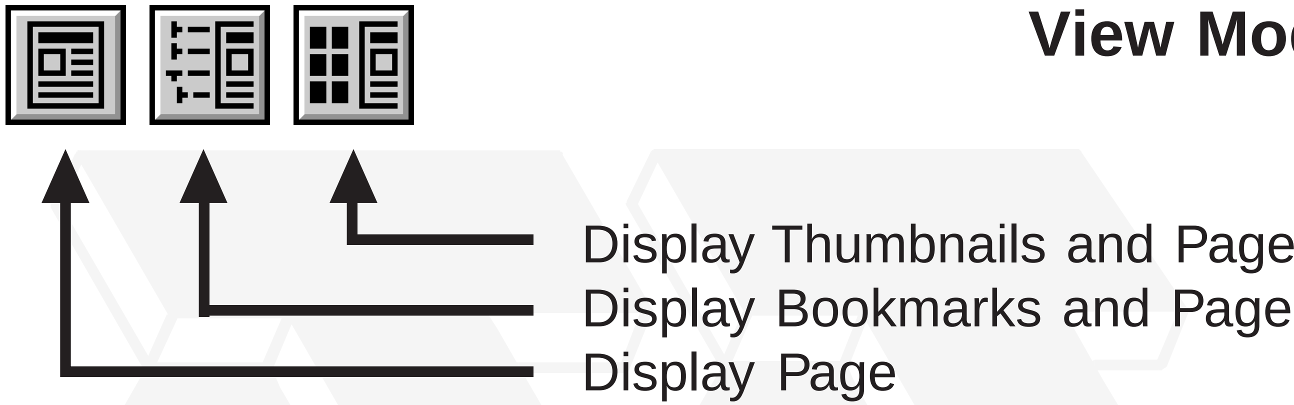

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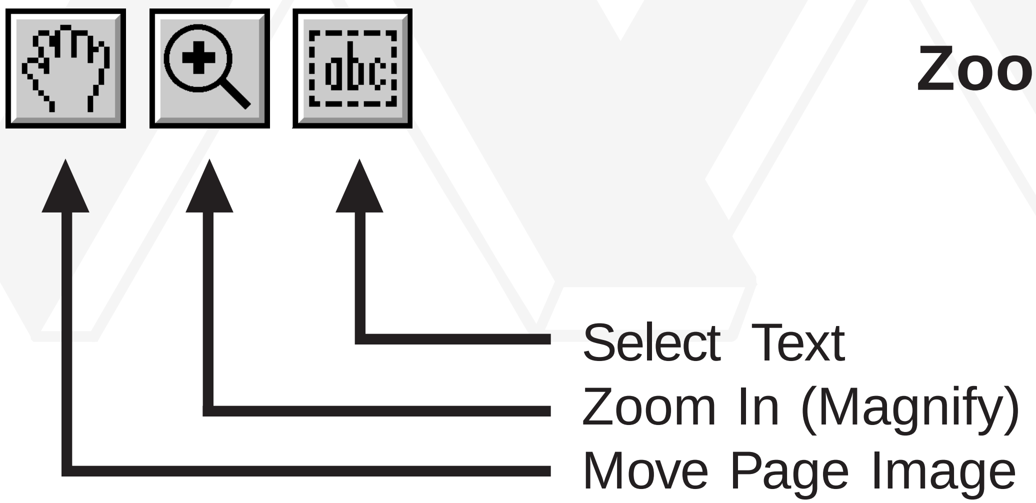

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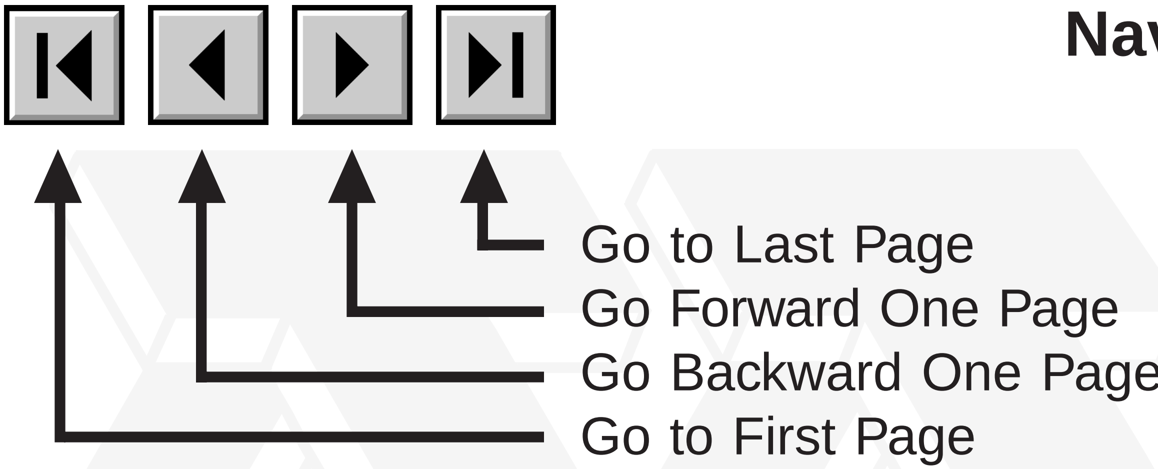

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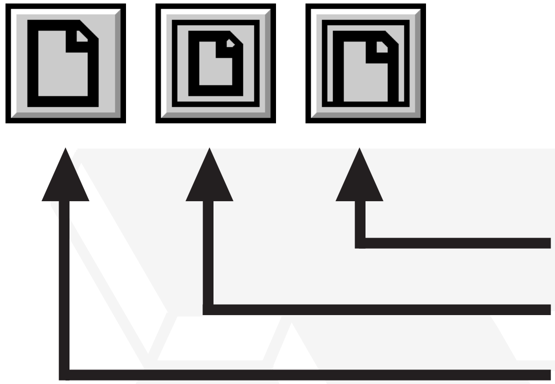

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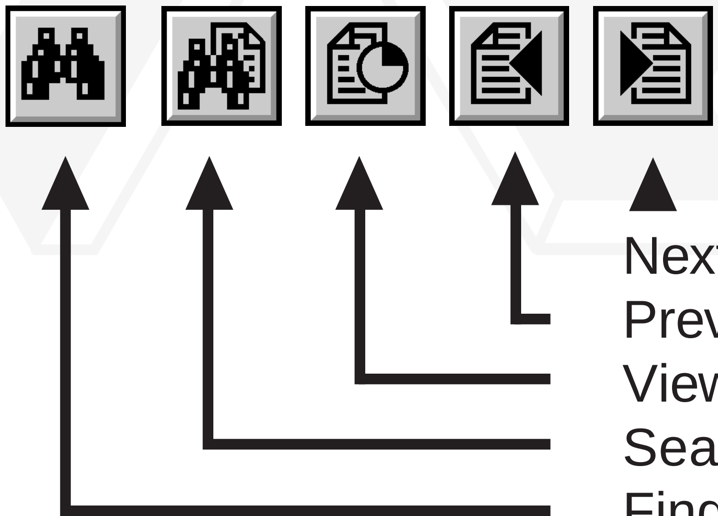

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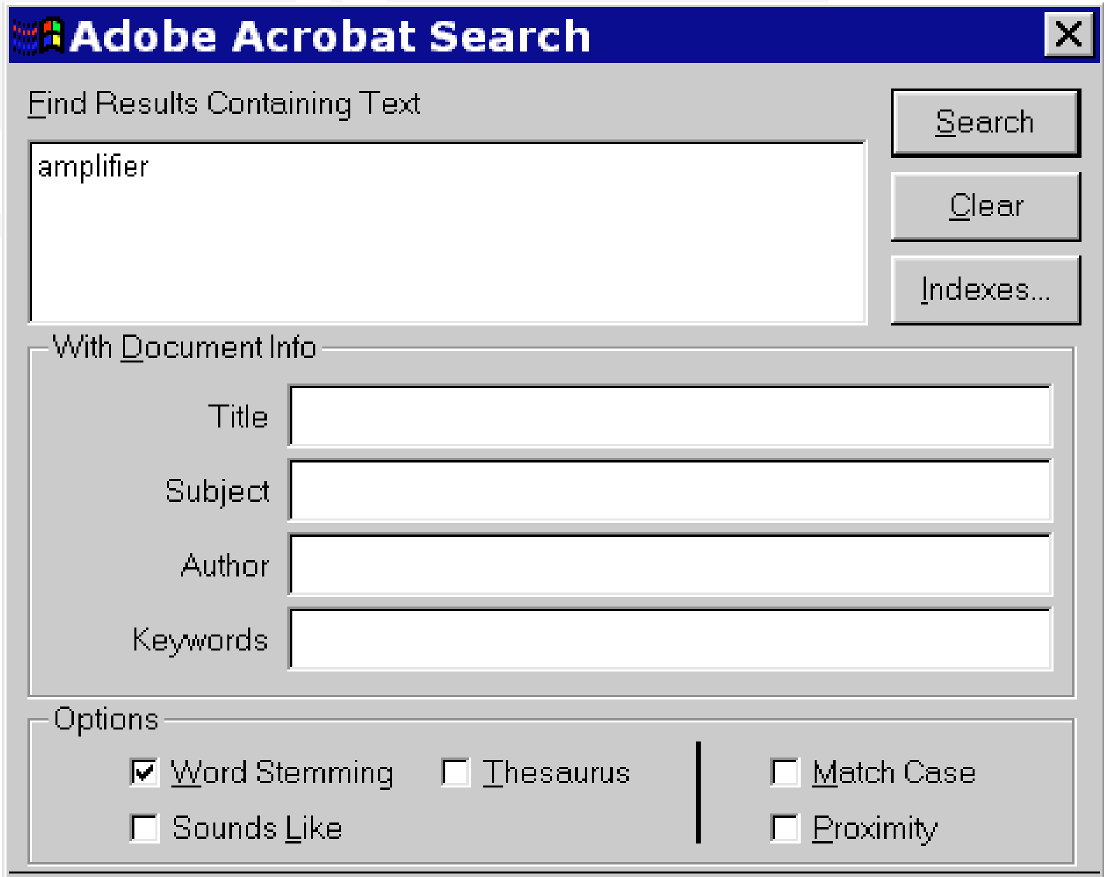

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- Theoretical and Experimental Investigation of Novel Varactor-Tuned Switchable Microstrip Ring Resonator Circuits

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- Large-Signal Time-Domain Simulation of HEMT Mixers (Short Papers)

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- Analysis and Synthesis Equations for Edge-Coupled Suspended Substrate Microstrip Line

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- Design Optimization of Microwave Power Heterojunction Bipolar Transistor Cells

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Wang, T.-H.

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- Confirmation of Slow Waves in a Crosstie Overlay Coplanar Waveguide and its Applications to Band-Reject Gratings and Reflectors
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- A Spectral-Domain Analysis of Periodically Nonuniform Coupled Microstrip Lines
- A Spectral-Domain Analysis of Periodically Nonuniform Microstrip Lines (Comments and Reply)
- CAD Models of Lumped Elements on GaAs up to 18 GHz
- Considering Some Undesired Effects Due to Dense Packing in Supported Coplanar Waveguide MMICs by Using Combined Methods
- Extending the Use of the Conformal Mapping Technique for the Calculation of the Quasi-TEM Parameters of Several Cylindrical and Wraped Transmission
- The Application of the Point Matching Method to the Analysis of Microstrip Lines with Finite Metallization Thickness

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- Exploiting Structure Periodicity and Symmetry in Capacitance Calculations for Three-Dimensional Multiconductor Systems

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Yagita, H.

- Direct Measurement of the Optimum Source Impedance for Minimum Noise Figure

Yam, M.

- A True Off-Set Self-Aligned Process for High Efficiency Ku-Band Power FETs

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Yip, G.L.

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- Synthesis Equations for Shielded Suspended Substrate Microstrip Line and Broadside-Coupled Stripline

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- Modeling Discontinuities in Dielectric-Loaded Waveguides
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- Modeling of MODFET's

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- A Monolithic Ka-Band HEMT Low-Noise Amplifier (Dec. 1988 [T-MTT])

Abstracts

Front Cover (Jan. 1988 [T-MTT])

"Front Cover (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): f1-f2.

Noise Modeling and Measurement Techniques

A. Cappy. "Noise Modeling and Measurement Techniques." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 1-10.

The HEMT noise behavior is presented from theoretical and experimental points of view. The general method used in the high-frequency noise analysis is described and the different approximations commonly used in the derivation of the noise parameter expressions are discussed. A comparison between the noise performance of both MESFET's and HEMT's is carried out. The measurement techniques providing the noise figure and the other noise parameters are then described and compared.

Noise in Two-Tier Matrix Amplifiers

K.B. Niclas and A.P. Chang. "Noise in Two-Tier Matrix Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 11-20.

A noise theory for the two-tier matrix amplifier has been developed that permits the computation of the amplifier's noise figure as a function of the active device and circuit parameters. The computed results based on the noise parameters of a GaAs MESFET with the gate dimensions 0.25x200 µm are discussed. In addition, a comparative study is done on the performance data of a 2x4 matrix amplifier and its equivalent two-stage distributed amplifier. Finally, the noise characteristics of two 2x4 matrix amplifiers incorporating GaAs MESFET's processed on either ion-implanted or VPE substrate material are compared with those measured on actual amplifiers.

Abstracts

Characterization of Via Connections in Silicon Circuit Boards

J.P. Quine, H.F. Webster, H.H. Glascock, II and R.O. Carlson. "Characterization of Via Connections in Silicon Circuit Boards." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 21-27.

Conducting vias isolated by silicon dioxide from a bulk silicon wafer and used to interconnect stripline transmission lines on opposite surfaces of the wafer are analyzed. The net VSWR and insertion loss for a single via and the crosstalk or coupling between two nearby vias are determined as a function of geometry, frequency, and silicon resistivity. For reasonable dimensions (geometries as mils and frequency to 1 GHz), the analysis predicts low VSWR and low insertion loss, provided the silicon resistivity is greater than about 100 Omega·cm. It is shown that crosstalk can be small, and is mostly due to inductive coupling.

Electromagnetic Waves in a Cylindrical Waveguide with Infinite or Semi-Infinite Wall Corrugations

S.L.G. Lundqvist. "Electromagnetic Waves in a Cylindrical Waveguide with Infinite or Semi-Infinite Wall Corrugations." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 28-33.

The electromagnetic waves inside a circular waveguide having a periodically varying radius with corrugations of infinite or semi-infinite extent are considered. The infinitely corrugated waveguide is investigated by use of the null field approach, and some plots of the axial wavenumbers are presented. For a junction between a straight and a corrugated waveguide, the reflection and transmission coefficients are determined by mode matching, and some computations of these reflection coefficients are also given.

Abstracts

Transient Analysis of Microstrip Line on Anisotropic Substrate in Three-Dimensional Space

S. Koike, N. Yoshida and I. Fukai. "Transient Analysis of Microstrip Line on Anisotropic Substrate in Three-Dimensional Space." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 34-43.

The recent development of MIC demands considerable attention to the anisotropy of substrates such as sapphire in order to both utilize its characteristics and eliminate its undesirable features. Anisotropic materials usually have a three-dimensional structure, and yield complex characteristics in wave propagation. Hence the analysis requires an exact three-dimensional treatment using all electromagnetic field components. Also, progress in high-speed pulse techniques demands analysis in the time domain. This paper describes how the anisotropy, with the permittivity tensor involving off-diagonal elements, may be generally formulated by Bergeron's method. The formulation is discussed in the case of the propagation characteristics for single and parallel strip lines on a sapphire substrate with tilted optical axis. Furthermore, to show the distinctive influence of anisotropy on the coupling property between lines, a parallel-line-type directional coupler on such a substrate is analyzed.

Electromagnetic Coupling between Two Half-Space Regions Separated by Two Slot-Perforated Parallel Conducting Screens

Y. Leviatan. "Electromagnetic Coupling between Two Half-Space Regions Separated by Two Slot-Perforated Parallel Conducting Screens." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 44-52.

The problem of electromagnetic coupling between two half-space regions separated by two slot-perforated parallel conducting planes is investigated. A general moment solution for the problem is obtained. This moment solution is then specialized to the case of narrow slots and to a TE (transverse electric to the slot axis) excitation. Attention is given to the power transmitted from one half-space to the other through the slots and to its functional dependence on various problem parameters involved.

Mutual Impedance between Probes in a Waveguide

B. Wang. "Mutual Impedance between Probes in a Waveguide." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 53-60.

The general formulas of mutual impedance between two probes arbitrarily located in a rectangular waveguide are given by means of dyadic Green's function (DGF), field transformation, and reaction concept. The waveguide is semi-fininite. The reflection coefficient at the terminal plane (z = 0) is Gamma. Lengths, feeding points, and orientations of the two probes in the waveguide are all arbitrary. As examples, expressions of mutual impedance for eight specific cases are given and discussed.

Abstracts

A Fully Analytical AC Large-Signal Model of the GaAs MESFET for Nonlinear Network Analysis and Design

A. Madjar. "A Fully Analytical AC Large-Signal Model of the GaAs MESFET for Nonlinear Network Analysis and Design." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 61-67.

In recent years much attention has been focused on nonlinear microwave circuit analysis. Several research groups have published new ideas and new approaches to more efficient computational schemes. To be able to apply these methods it is essential to have an accurate and efficient large-signal model for the device. In previous work the author has developed such a model for the GaAs MESFET. To further increase computational speed and to permit use of the model by other workers, a fully analytical approximation of the model was developed and is presented here. The accuracy of the model is demonstrated, and it is presented in a form that can be easily used and implemented by the reader.

Finite Curvature and Corrugations in Dielectric Ridge Waveguides

T. Rozzi, G. Cerri, F. Chiaraluce, R. De Leo and R.F. Ormondroyd. "Finite Curvature and Corrugations in Dielectric Ridge Waveguides." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 68-79.

Dielectric ridge waveguide is now widely used in passive and active integrated optics and it could find use in millimeter-wave circuits. Families of devices such as ring lasers and couplers require structures with bends of finite length and relatively high curvature. The paper presents a technique, based on the concept of local modes, which also takes into account the corrugations due to fabrication. Results are in good qualitative agreement with experimental values reported in the literature.

Abstracts

Quasi-Optical Integrated Antenna and Receiver Front End

V.D. Hwang, T. Uwano and T. Itoh. "Quasi-Optical Integrated Antenna and Receiver Front End." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 80-85.

A quasi-optical receiver front end applicable to both microwave and millimeter-wave receiver arrays is presented. Two planar MIC quasi-optical receiver circuit designs that integrate a coupled slot antenna, a Schottky diode balanced mixer, and a local oscillator on the same substrate are described. The even-mode/odd-mode characteristics of the coupled slotlines are used to achieve intrinsic RF/LO and RF/IF isolation. To demonstrate circuit feasibility, X-band scaled models of the circuit using a Gunn diode oscillator on an Epsilam-10 substrate, and a MESFET local oscillator on a R/T duroid substrate were built and tested. Results of these tests are included.

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Currents and Conduction Losses in Unilateral Finline

C. Olley and T. Rozzi. "Currents and Conduction Losses in Unilateral Finline." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 86-95.

This paper presents a rigorous calculation of currents, conduction losses, and Q factors of the fundamental and higher order modes of unilateral finline. The latter, in particular, are important in estimating the loss for practical components. The approach is based on a Ritz Galerkin variational development of, first, the field in the fin gap in terms of functions which intrinsically satisfy the edge condition and, second, the currents in the fin also satisfying the same properties. Results show losses to be higher than previously estimated, in very good agreement with experiment.

Analysis of MMIC Structures Using an Efficient Iterative Approach

C.H. Chan and R. Mittra. "Analysis of MMIC Structures Using an Efficient Iterative Approach." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 96-105.

In this paper a class of two- and three-dimensional monolithic microwave integrated circuit (MMIC) structures is theoretically analyzed using an efficient iterative technique. The transfer-matrix approach to constructing the spectral Green's functions of multilayered structures is adopted. Discretization of the continuous functions and exploitation of the periodicity of the MMIC structures enclosed by side walls lead to a discrete convolution operation, which can be carried out numerically efficiently using the FFT algorithm. The spectral Green's functions are modified for both the periodic and aperiodic structures to improve the numerical efficiency of the iterative algorithm. Numerical results are presented and compared with available data.

Galerkin Solution for the Thin Circular Iris in a TE/sub 11/-Mode Circular Waveguide

R.W. Scharstein and A.T. Adams. "Galerkin Solution for the Thin Circular Iris in a TE/sub 11/-Mode Circular Waveguide." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 106-113.

An integral equation for the transverse electric field in the aperture of a concentric circular iris in a transverse plane of a circular waveguide is approximately solved by Galerkin's method. The aperture field is represented by a finite sum of normal TE and TM circular waveguide modes that fit the circular aperture. The numerical convergence of the Galerkin solution is demonstrated via resultant aperture field distributions and equivalent shunt susceptance for the case of dominant TE/sub 11/-mode excitation. The resultant aperture electric field distribution closely resembles that of the TE/sub 11/ aperture mode alone, except for edge condition behavior at the edge of the iris. A resonant or capacitive iris is possible over a restricted range of frequencies.

Transient Analysis of Ferrite in Three-Dimensional Space

N. Kukutsu, N. Yoshida and I. Fukai. "Transient Analysis of Ferrite in Three-Dimensional Space." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 114-125.

The anisotropic medium has been applied to realize the nonreciprocal devices. The characteristics of these devices have become more advanced through the appearance of various materials and the miniaturization of the circuit created by the integration of circuits in MIC. In particular for microwave and millimeter-wave circuits, ferrite is a typical gyroanisotropic medium. So a significant amount of research and many analyses have been carried out to develop nonreciprocal devices using ferrite. To obtain more exact determinations of the properties of these devices, it is necessary to analyze three-dimensional space due to their complicated structures and the medium conditions. And recently, high-speed digital technology has been developed, so that it is important to analyze the electromagnetic field with time domain. This paper presents Bergeron's formulation of vector analysis for magnetized ferrite in a three-dimensional space and time domain. Results are provided for two cases with respect to the relative angle between the directions of the dc magnetic field and wave propagation. For both cases, the results are compared with analytical ones, and the validity of the formulation is verified.

Power Deposition of a Microstrip Applicator Radiating Into a Layered Biological Structure

L. Beyne and D. De Zutter. "Power Deposition of a Microstrip Applicator Radiating Into a Layered Biological Structure." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 126-131.

The power deposited by a microstrip antenna into a layered biological structure is investigated. The solution is based on an integral equation for the surface current density on the antenna and on an electric Green's dyadic for the fields inside a planar stratified medium. The integral equation is solved using the method of moments in conjunction with the point-matching technique. The modeling of the surface current takes the edge conditions into account. Special attention is devoted to a correct modeling of the excitation of the antenna by a coaxial feed. The numerical results focus on the power deposition as a function of depth.

Insertion Loss of Magnetostatic Surface Wave Delay Lines

S.N. Bajpai, R.L. Carter and J.M. Owens. "Insertion Loss of Magnetostatic Surface Wave Delay Lines." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 132-136.

This paper presents an experimental and theoretical study of the insertion loss of magnetostatic surface wave delay line. The magnetostatic surface waves are excited by single microstrip transducer and propagate in a delay line consisting of conductor-dielectric-YIG-GGG. The effect of nonuniformity in microstrip current and the effect of finite width of YIG film are included in the theory. It is seen that an undesired notch seen in the insertion loss response of the surface wave delay line in the low-frequency region of the band can be explained by the present theory, which includes the finite width of the YIG film. Magnetostatic wave delay lines have potential applications in microwave signal processing and phased array antennas in the 1-20 GHz frequency range.

Abstracts

Scattering by a Lossy Dielectric Cylinder in a Rectangular Waveguide

R. Gesche and N. Lochel. "Scattering by a Lossy Dielectric Cylinder in a Rectangular Waveguide." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 137-144.

Electromagnetic fields in a rectangular waveguide containing a lossy dielectric cylinder are investigated by means of the orthogonal expansion method. The calculated results are proved by measurement. Resonance effects become visible by frequency responses of the scattering parameters and understandable by patterns of magnetic fields and Poynting vectors. The lowest resonance is nonsymmetric and can be used to realize tunable bandstop filters with a relative 3-dB bandwidth of about 0.04 and an attenuation of more than 40 dB.

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A Method for Evaluating the Noise Temperature of Microwave Thermal Noise Sources by Introducing an Auxiliary Transmission Line (Short Papers)

Y. Kato, K. Komiyama and I. Yokoshima. "A Method for Evaluating the Noise Temperature of Microwave Thermal Noise Sources by Introducing an Auxiliary Transmission Line (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 145-147.

A new method is proposed to evaluate the noise temperature of a microwave thermal noise source. The noise temperature correction dominated by the transmission line between the termination and the output is expressed in terms of directly measurable parameters. It can be determined by introducing an auxiliary transmission line composed of two lines connected back-to-back, each of which is identical to that of the unknown source.

Abstracts

Optimization of Helical Coil Applicators for Hyperthermia (Short Papers)

M.J. Hagmann. "Optimization of Helical Coil Applicators for Hyperthermia (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 148-150.

Numerical solutions have been used to optimize helical coil applicators in order to maximize the ratio of axial to surface heating within coaxial muscle cylinders. It is shown that this optimization requires significantly larger values of pitch angle and frequency than those which have been specified thus far for experimental applicators. The maximum ratio of axial to surface heating is obtained with a linear helix, which is a limiting form of the helix, defined to have a pitch angle of 90°. Calculated ratios of axial/surface heating with a linear helix are as large as 2.54 (at 352 MHz) for a muscle cylinder with a radius of 4 cm, and 1.26 (at 82 MHz) for one with a radius of 8 cm. The relationship of the linear helix to the annular phased array and the resonant cylindrical cavity applicator is discussed.

Nonlinear Optimization of the Shape Functions in the Finite Element Method When Determining Cutoff Frequencies of Waveguides of Arbitrary Cross Section (Short Papers)

J.C. Utjes, G.S. Sarmiento and P.A.A. Laura. "Nonlinear Optimization of the Shape Functions in the Finite Element Method When Determining Cutoff Frequencies of Waveguides of Arbitrary Cross Section (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 151-152.

The present paper deals with a review of the recently developed k optimization process of the finite element method when solving eigenvalue problems. The methodology is then applied to the determination of the fundamental cutoff frequency of a hollow-piped waveguide of cardioidal cross section. It is shown that a considerable reduction in computer memory and/or CPU time is achieved.

SPICE Implementation of Lossy Transmission Line and Schottky Diode Models (Short Papers)

S.E. Sussman-Fort and J.C. Hantgan. "SPICE Implementation of Lossy Transmission Line and Schottky Diode Models (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 153-155.

Models for the lossy transmission line and the Schottky diode have been incorporated into the source code of the circuit simulation program SPICE (version 2G.6). This work is a continuation of our recent SPICE modeling efforts involving enhancement- and depletion-mode GaAs FET's. As before, the line-by-line modifications to SPICE to include the new models will be made available to interested researchers.

Abstracts

Propagation Losses in Dielectric Image Guides (Short Papers)

J. Xia, S.W. McKnight and C. Vittoria. "Propagation Losses in Dielectric Image Guides (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 155-158.

To evaluate low-loss transmission lines for integrated circuits operating at millimeter wavelengths, we have calculated the propagation losses of a dielectric image guide using the effective dielectric constant (EDC) method to a higher order of approximation than previously reported work. Our results differ significantly from other EDC calculations close to the waveguide cutoff frequency. In this region, we find that there is a minimum in the waveguide attenuation that has not been alluded to in the literature, and also a peak in the imaginary parts of the transverse propagation constants related to dimensional resonances within the waveguide. These results imply that the propagation losses will be lowered and the fields will be more effectively confined within the waveguide at frequencies close to the cutoff. Thus, it may be advantageous when using dielectric image guides for low-loss transmission line applications to operate near cutoff where the corrections included in our calculations are critical.

A 4.5-GHz GaAs Dual-Modulus Prescaler IC (Short Papers)

M. Ohhata, T. Takada, M. Ino, N. Kato and M. Ida. "A 4.5-GHz GaAs Dual-Modulus Prescaler IC (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 158-160.

A 4.5-GHz 100-mW GaAs divide-by-256/258 dual-modulus prescaler with a reset function has been developed. The operating frequency obtained for this modulus prescaler is the highest to date, while the power dissipation is comparable to others that have been reported. The supply voltage is as low as 3 V. A low-power, source coupled FET logic (LSCFL) using novel level shift circuits and 0.5-µm-gate buried P-Layer SAINT (BP-SAINT) FET's have been used to achieve this high performance.

GaAs on Si as a Substrate for Microwave and Millimeter-Wave Monolithic Integration (Short Papers)

M.I. Aksun and H. Morkoc. "GaAs on Si as a Substrate for Microwave and Millimeter-Wave Monolithic Integration (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 160-162.

Recent advances in GaAs growth on Si have resulted in high-quality and high-performance GaAs electronic and optoelectronic devices on Si substrates. One therefore must consider this composite structure as a substrate material for microwave and millimeter-wave monolithic integrated circuits. In order for GaAs on Si to be practical for this purpose, the dielectric loss must be small. We have calculated the dielectric losses of GaAs/Si composite in a transmission line configuration and compared them with those of other possible substrates, such as GaAs and Si alone, in the frequency range of 10-100 GHz. Depending upon the thickness, results show that high-resistivity GaAs epitaxial layers on Si substrates having moderate resistivities reduce the dielectric loss.

Complex Modes in Lossless Shielded Microstrip Lines (Short Papers)

W.-X. Huang and T. Itoh. "Complex Modes in Lossless Shielded Microstrip Lines (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 163-165.

Possible existence of complex modes is investigated in lossless shielded microstrip lines. The analysis is based on the singular integral equation approach which provides good convergence properties. Accurate numerical results are obtained by using a 10x10 matrix equation.

Comparison of the FFT Conjugate Gradient Method and the Finite-Difference Time Domain Method for the 2-D Absorption Problem (Comments)

T.K. Sarkar. "Comparison of the FFT Conjugate Gradient Method and the Finite-Difference Time Domain Method for the 2-D Absorption Problem (Comments)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 166-170.

The objective of this letter is to point out certain wrong assumptions that the authors have made about the FFT conjugate gradient method. Based on these erroneous assumptions, they made certain statements which are quite meaningless. Perhaps the statements made come from lack of acquaintance with recent publications on the conjugate gradient method (CGM). There are four specific comments.

Abstracts

A Method for Measurement of Losses in the Noise-Matching Microwave Network While Measuring Transistor Noise Parameters (Comments and Authors' Reply)

M.W. Pospieszalski, G. Martines and M. Sannino. "A Method for Measurement of Losses in the Noise-Matching Microwave Network While Measuring Transistor Noise Parameters (Comments and Authors' Reply)." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 170-172.

In the above paper, expressions (1), (2), and (3) appear to be correct only if the physical temperature T/sub a/ of the tuner is equal to the standard temperature T/sub 0/ = 290 K. The expression for T/sub a/ NOT= T/sub 0/ = 290 K should read…

Patent Abstracts (Jan. 1988 [T-MTT])

"Patent Abstracts (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 173-177.

Asian Abstracts (Jan. 1988 [T-MTT])

"Asian Abstracts (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 178-200.

Abstracts

IEEE Copyright Form (Jan. 1988 [T-MTT])

"IEEE Copyright Form (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 201-202.

IEEE on Microfilm (Advertisement) (Jan. 1988 [T-MTT])

"IEEE on Microfilm (Advertisement) (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 203-203.

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IEEE Press Books (Advertisement) (Jan. 1988 [T-MTT])

"IEEE Press Books (Advertisement) (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): 204-204.

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Back Cover (Jan. 1988 [T-MTT])

"Back Cover (Jan. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.1 (Jan. 1988 [T-MTT]): b1-b2.

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Front Cover (Feb. 1988 [T-MTT])

"Front Cover (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): f1-f2.

Guest Editorial - Microwave Computer-Aided Design (Feb. 1988 [T-MTT])

K.C. Gupta and T. Itoh. "Guest Editorial - Microwave Computer-Aided Design (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 205-207.

The increasing complexities of modern microwave and millimeter-wave components, circuits, and systems, particularly in monolithic integrated circuit form, have made the use of computer-aided design tools necessary for microwave and millimeter-wave engineers. Some of the CAD programs for microwave circuits have been around for almost two decades, and have reached a certain level of maturity. Most of the earlier CAD tools were developed primarily for the design of hybrid MIC's and have been used extensively for that purpose. However, a recent spurt of interest in monolithic microwave integrated circuits has brought out the need for a new generation of more accurate CAD tools.

A Comprehensive CAD Approach to the Design of MMIC's up to MM-Wave Frequencies

R.H. Jansen, R.G. Arnold and I.G. Eddison. "A Comprehensive CAD Approach to the Design of MMIC's up to MM-Wave Frequencies." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 208-219.

This paper is an extended and updated contribution based on an unpublished presentation given at the 1986 MTT-S Microwave Symposium, Workshop on Trends in Microwave CAD. The paper discusses the main requirements for the computer-aided design of MMIC's, emphasizing in detail the various physical effects, which are important in the development of monolithic circuit designs. Based on these considerations, a comprehensive CAD approach has been developed, which forms the core of a layout-orientated, process-independent simulator for an MMIC design engineering workstation (EWS). The CAD solutions developed and in progress for this EWS are described. The solutions include a new field-theory-based, high-resolution generator which produces the modal characteristics of complex MMIC microstrip structures. Another portion used as a support tool is a three-dimensional, hybrid-mode-based analysis package for discontinuities, nonelementary rectangular conductor patterns, and the analysis of coupling problems. Thus, the layout-oriented analysis and optimization scheme developed can handle interdigitated and spiral components as well as complex coupling situations. The sophistication and simulation accuracy of the approach described are illustrated by a variety of component examples and a four-stage monolithic traveling wave amplifier.

GaAs MESFET Modeling and Nonlinear CAD

W.R. Curtice. "GaAs MESFET Modeling and Nonlinear CAD." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 220-230.

Equivalent circuit modeling techniques are described for both small-signal and large-signal models of GaAs MESFET's. The use of the large-signal model in an interactive program for amplifier analysis is shown. The computed load-pull results and IMD predictions are shown to be in good agreement with measured data at 10 GHz.

A Large-Signal, Analytic Model for the GaAs MESFET

M.A. Khatibzadeh and R.J. Trew. "A Large-Signal, Analytic Model for the GaAs MESFET." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 231-238.

An analytic, large-signal model for the GaAs MESFET is presented. The new device model is physics based and describes the conduction and displacement currents of the FET as a function of instantaneous terminal voltages and their time derivatives. The model allows arbitrary doping profiles in the channel and is thus suitable for the optimization, of ion-implanted and buried-channel FET's. It also accounts for charge accumulation in the conducting channel at high electric fields and the associated capacitance in a self-consistent manner. Theoretical predictions of the model are correlated with experimental data on X-band power FET's, and excellent agreement is obtained.

The Influence of Device Physical Parameters on HEMT Large-Signal Characteristics

M. Weiss and D. Pavlidis. "The Influence of Device Physical Parameters on HEMT Large-Signal Characteristics." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 239-249.

The small- and large-signal high-frequency characteristics of submicron HEMT's are analyzed by taking into account parasitic effects such as parallel conduction, fringing capacitances, and substrate leakage. The dependence of large-signal properties on device physical parameters is reported. This includes device gate length, donor layer thickness and doping, and spacer thickness. Satisfactory agreement is shown to exist between theoretically and experimentally obtained device characteristics.

Physical Equivalent Circuit Model for Planar Schottky Varactor Diode

P. Philippe, W. El-Kamali and V. Pauker. "Physical Equivalent Circuit Model for Planar Schottky Varactor Diode." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 250-255.

A physical equivalent circuit model for the planar GaAs Schottky varactor diode is presented. The model takes into account the distributed resistance and capacitance of the active layer, the side-wall capacitance, and the parasitic resistances and accurately accounts for the high series resistance observed near the pinch-off voltage. The dependence of the maximum series resistance on varactor size, frequency, and doping profile has been theoretically investigated and the results agree well with experimental data. The proposed model can be easily used for optimization of planar Schottky varactor diodes with regard to broad-band monolithic VCO constraints.

Equivalent Circuit Modeling of Losses and Dispersion in Single and Coupled Lines for Microwave and Millimeter-Wave Integrated Circuits

V.K. Tripathi and A. Hill. "Equivalent Circuit Modeling of Losses and Dispersion in Single and Coupled Lines for Microwave and Millimeter-Wave Integrated Circuits." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 256-262.

Losses and dispersion in open inhomogeneous guided wave structures such as microstrips and other planar structures at microwave and millimeter-wave frequencies and in MMIC's have been modeled with circuits consisting of ideal lumped elements and lossless TEM lines. It is shown that, given a propagation structure for which numerical techniques to compute the propagation characteristics are available, an equivalent circuit whose terminal frequency and time-domain properties are the same as the structure can be synthesized. This is accomplished by equating the network functions of the given single or coupled line multiport with that of the model and extracting all the parameters of the equivalent circuit model by using standard parameter identification procedures. This equivalent circuit is valid over a desired frequency range and represents a circuit model which can be used to help design both analog and digital circuits consisting of these structures and other active and passive elements by utilizing standard CAD programs such as SPICE. In order to validate the accuracy and usefulness of the models, results for a mismatched 50-Omega line in alumina and a high-impedance MMIC line stub are included. In addition, for the case of coupled lines the results for a nominal 50-Omega, 10 dB coupler on alumina obtained by using the circuit model on SPICE are compared with rigorously computed values of the scattering parameters for the lossy dispersive system.

Calculations of the Dispersive Characteristics of Microstrips by the Time-Domain Finite Difference Method

X. Zhang, J. Fang, K.K. Mei and Y. Liu. "Calculations of the Dispersive Characteristics of Microstrips by the Time-Domain Finite Difference Method." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 263-267.

The dispersive characteristics of microstrips have been investigated by many authors using various numerical and empirical methods. Those results showed a lack of agreement with each other, and the true dispersive characteristics of microstrips still need to be identified. In this paper, a direct time-domain finite difference method is used to recharacterize the microstrip. Maxwell's equations are discretized both in time and space and a Gaussian pulse is used to excite the microstrip. The frequency-domain design data are obtained from the Fourier transform of the calculated time-domain field values. Since this method is completely independent of all the above-mentioned investigations, the new results can be considered as an impartial verification of the published results. The comparison of the time-domain results and those from the frequency-domain methods has shown the integrity of the time-domain computations. Since this method is very general and can be applied to model many other microwave components, its success in the microstrip problem is an important step toward its general application.

Finite-Element Formulation for Lossy Waveguides

K. Hayata, K. Miura and M. Koshiba. "Finite-Element Formulation for Lossy Waveguides." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 268-276.

An efficient computer-aided solution procedure based on the finite-element method is developed for solving general waveguiding structures composed of lossy materials. In this procedure, a formulation in terms of transverse magnetic-field component is adopted and the eigenvalue of the final matrix equation corresponds to the propagation constant itself. Thus, one can avoid the unnecessary iteration using complex frequencies. To demonstrate the strength of the present method, numerical results for a rectangular waveguide filled with lossy dielectric are presented and compared with exact solutions. As more advanced applications of the present method, a shielded image line composed of a lossy anisotropic material and a lossy dielectric-loaded waveguide with impedance walls are analyzed and evaluated.

Propagation Model for Ultrafast Signals on Superconducting Dispersive Striplines

J.F. Whitaker, R. Sobolewski, D.R. Dykaar, T.Y. Hsiang and G.A. Mourou. "Propagation Model for Ultrafast Signals on Superconducting Dispersive Striplines." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 277-285.

An algorithm suitable for the computer-aided design of transmission lines is used to model the propagation of picosecond and subpicosecond electrical signals on superconducting planar transmission lines. Included in the computation of a complex propagation factor are geometry-dependent modal dispersion and the frequency-dependent attenuation and phase velocity which arise as a result of the presence of a superconductor in the structure. The results of calculations are presented along with a comparison to experimental data. The effects of modal dispersion and the complex surface conductivity of the superconductor are demonstrated, with the conclusion that it is necessary to incorporate both phenomena for accurate modeling of transient propagation in strip transmission lines.

Abstracts

A Dynamic Model for Microstrip-Slotline Transition and Related Structures (Feb. 1988 [T-MTT])

H.-Y. Yang and N.G. Alexopoulos. "A Dynamic Model for Microstrip-Slotline Transition and Related Structures (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 286-293.

An analysis of microstrip to slotline transition is presented. The method of moments is applied to the coupled integral equations. In the formulation, the Green's function for the grounded dielectric substrate, which takes into account all the radiation, surface wave, substrate effects, is used. Meanwhile, all the mutual coupling effects are included in the method of moments solution. Certain related structures, such as slotline, microstrip discontinuities, a slot fed by a microstrip line, and a printed strip dipole fed by a slotline, can also be solved with this analysis. The present approach may find applications to other related transitions in MIC design.

CAD Models of Lumped Elements on GaAs up to 18 GHz

E. Pettenpaul, H. Kapusta, A. Weisgerber, H. Mampe, J. Luginsland and I. Wolff. "CAD Models of Lumped Elements on GaAs up to 18 GHz." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 294-304.

Improved models for integrable lumped-element straight-line single-loop, and spiral inductors, as well as for interdigitated and MIM capacitors, have been derived using numerical solutions of the inductance integral, basic microstrip theory, and network analysis. The broad experimental verification shows good agreement between models and experiments, with deviations of 5 to 10 percent up to 18 GHz. Besides the useful value and frequency range, losses of the lumped elements are presented.

CAD-Oriented Lossy Models for Radial Stubs

F. Giannini, C. Paoloni and M. Ruggieri. "CAD-Oriented Lossy Models for Radial Stubs." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 305-313.

A lumped equivalent circuit model for both series and double-shunt (butterfly) connected radial stub has been developed. The model -- simple and effective -- not only includes conductor and dielectric losses but also radiation ones, which play an important role in microstrip circuit elements. Experiments widely demonstrate its suitability for implementation in available CAD programs. Furthermore, a synthesis procedure for using radial stubs in circuit design is described. An application of the above design procedure and simulation tools in the development of very broad-band nongrounded terminations is also presented.

Arbitrarily Shaped Microstrip Structures and Their Analysis with a Mixed Potential Integral Equation

J.R. Mosig. "Arbitrarily Shaped Microstrip Structures and Their Analysis with a Mixed Potential Integral Equation." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 314-323.

This paper gives a comprehensive description of the mixed potential integral equation (MPIE) as applied to microstrip structures. This technique uses Green's functions associated with the scalar and vector potential which are calculated by using stratified media theory and are expressed as Sommerfeld integrals. Several methods of moments allowing the study of irregular shapes are described. It is shown that the MPIE includes previously published static and quasi-static integral equations. Hence, it can be used at any frequency ranging from dc to higher order resonances. Several practical examples including an L-shaped patch have been numerically analyzed and the results are found to be in good agreement with measurements.

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Accurate Analysis of Arbitrarily Shaped Patch Resonators on Thin Substrates

T.M. Martinson and E.F. Kuester. "Accurate Analysis of Arbitrarily Shaped Patch Resonators on Thin Substrates." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 324-331.

Based on a generalized edge boundary condition (GEBC), an accurate analysis method for arbitrarily shaped microstrip patch resonators is developed. The edge of the patch and its feeding line are first discretized as a series of connected segments. Next, an equivalent voltage and an equivalent current are defined on each segment. This boundary of the patch and the feeding line can be viewed as an interface between two networks. The first takes into account the coupling under the patch. The second represents the dynamical edge effects and the coupling over the top side of the patch. This general and computer-efficient approach is then successfully applied to determine the input impedance of some commonly used probe-fed and strip-fed patch resonators.

Computer-Aided Analysis and Design of Circular Waveguide Tapers

H. Flugel and E. Kuhn. "Computer-Aided Analysis and Design of Circular Waveguide Tapers." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 332-336.

Two different methods for the accurate numerical analysis of circular waveguide tapers are compared and applied to examine the usefulness of existing design methods. A modified Dolph-Chebychev taper turned out to give the best performance with respect to both minimum spurious mode excitation and taper length.

Computer-Aided Analysis of Arbitrarily Shaped Coaxial Discontinuities

W.K. Gwarek. "Computer-Aided Analysis of Arbitrarily Shaped Coaxial Discontinuities." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 337-342.

This paper proposes a method of analyzing a coaxial discontinuity arbitrarily shaped in two dimensions (radial and longitudinal) but maintaining its axial symmetry. It is shown that under such assumptions the equations to be solved correspond to the equations describing an equivalent planar circuit filled with anonuniform medium. These equations are solved by a version of the finite-difference time-domain method. The method produces a universal computer algorithm capable of solving a wide range of practical problems with no analytical preprocessing. The examples presented show that the method can be effectively used in engineering applications.

State of the Art and Present Trends in Nonlinear Microwave CAD Techniques

V. Rizzoli and A. Neri. "State of the Art and Present Trends in Nonlinear Microwave CAD Techniques." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 343-365.

The paper presents a survey of modern nonlinear CAD techniques as applied to the specific field of microwave circuits. A number of fundamental aspects of the nonlinear CAD problem, including simulation, optimization, intermodulation, frequency conversion, stability, and noise, are addressed and developed. For each one it is shown that either well-established CAD solutions are available, or at least a solution approach suitable for implementation in a general-purpose CAD environment can be outlined. Also, the discussion shows that the various subjects are not just separate items, but rather can be chained in a strictly logical sequence. Finally an elementary treatment of vector processing is given, to show that supercomputers can handle the involved large-size numerical problems in a most efficient way.

Abstracts

Applying Harmonic Balance to Almost-Periodic Circuits

K.S. Kundert, G.B. Sorkin and A. Sangiovanni-Vincentelli. "Applying Harmonic Balance to Almost-Periodic Circuits." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 366-378.

Harmonic balance is a powerful technique for the simulation of nonlinear microwave circuits. It solves directly for the steady-state response of a circuit in the frequency domain, and so is often considerably more efficient than traditional time-domain methods when circuits exhibit widely separated time constants and mildly nonlinear behavior. With harmonic balance the linear component models are evaluated in the frequency domain, which for distributed devices results in easier model development and reduced computational complexity. Harmonic balance has had limited application for simulating circuits, such as mixers, that have a steady-state response that contains almost-periodic signals. The reason is that to model a nonlinear device, whose behavior is more conveniently computed in the time domain, harmonic balance requires the transformation of signals from the frequency domain into the time domain and vice versa. For circuits that have a periodic response, the discrete Fourier transform (DFT) is used. Previously, no satisfactory transform existed for almost-periodic signals. In this article, a new Fourier transform algorithm for almost-periodic functions (the APFT) is developed. It is both efficient and accurate. Unlike previous attempts to solve this problem, the new algorithm does not constrain the input frequencies and uses the theoretical minimum number of time points. Also presented is a particularly simple derivation of harmonic Newton (the algorithm that results when Newton's method is applied to solve the harmonic balance equations) using the APFT this derivation uses the same matrix representation used in the derivation of the APFT. Since the APFT includes the DFT as a special case, all results are applicable to both the periodic and almost-periodic forms of harmonic Newton. The simple derivation of harmonic Newton, combined with the rigorous definition of terms and the careful exploration of the error mechanisms of the APFT, makes this article a good base for future research.

Frequency-Domain Nonlinear Circuit Analysis Using Generalized Power Series

G.W. Rhyne, M.B. Steer and B.D. Bates. "Frequency-Domain Nonlinear Circuit Analysis Using Generalized Power Series." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 379-387.

This paper presents for the first time details of the generalized power series technique for the analysis of analog nonlinear circuits. The method uses generalized power series descriptions of the nonlinear elements and a spectral balance technique to operate entirely in the frequency domain. It is therefore suited to the analysis of analog nonlinear circuits with large-signal multifrequency excitation of arbitrary frequency separation. The analysis of a low-frequency mixer is used here as a vehicle to illustrate the concepts of large-signal frequency-domain analysis and the generalized power series analysis technique.

Nonlinear Design Procedures for Single-Frequency and Broad-Band GaAs MESFET Power Amplifiers

T.J. Brazil and S.O. Scanlan. "Nonlinear Design Procedures for Single-Frequency and Broad-Band GaAs MESFET Power Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 388-393.

The design and optimization of MESFET power amplifiers are investigated using an intermediate-level or "functional" device modeling approach. The approximations involved are discussed, together with considerations of required circuit terminations at harmonic frequencies. Three variations of the approach, based on large-signal admittance, scattering, and hybrid parameters, are compared in the design of a single-frequency amplifier, and the method is extended to broad-band power amplifier design. In all cases, results are validated by comparison with a full time-domain large-signal amplifier analysis, involving realistic, distributed external circuits.

Admittance Matrix Formulation of Waveguide Discontinuity Problems: Computer-Aided Design of Branch Guide Directional Couplers

F. Alessandri, G. Bartolucci and R. Sorrentino. "Admittance Matrix Formulation of Waveguide Discontinuity Problems: Computer-Aided Design of Branch Guide Directional Couplers." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 394-403.

A computational scheme is proposed which can be applied to the analysis of cascaded waveguide discontinuities of alternating boundary-enlargement and boundary-reduction type. Based on the mode-matching technique, the proposed procedure makes use of the admittance matrix characterization of waveguide stubs. With respect to the conventional S-matrix formulation, it leads to a notable reduction of the computational effort, particularly for lossless structures. At the same time, the criterion for avoiding relative convergence problems can be satisfied. The procedure has been used to setup a very accurate and efficient computer-aided design tool of branch guide couplers (BGC's) These are key elements of beam forming networks for multicontoured beam satellite antennas and have to be designed with very high accuracy so as to eliminate the necessity for tuning the components realized. Design accuracies better than 0.1 dB in Ku-band are demonstrated by experimental results.

Computer-Aided Design of Evanescent-Mode Waveguide Filter with Nontouching E-Plane Fins

Q. Zhang and T. Itoh. "Computer-Aided Design of Evanescent-Mode Waveguide Filter with Nontouching E-Plane Fins." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 404-412.

This paper presents a computer-aided design algorithm for the analysis and design of an evanescent-mode bandpass filter with non-touching E-plane fins. The theoretical analysis is based on the generalized scattering matrix technique in conjunction with the spectral-domain approach and mode-matching method. The technique used in this paper takes into account the dominant as well as the higher order effects. The measured filter responses in the Ka-band are in good agreement with those obtained by this analysis.

Abstracts

A Sensitivity Figure for Yield Improvement

J.E. Purviance and M.D. Meehan. "A Sensitivity Figure for Yield Improvement." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 413-417.

A new network sensitivity figure for use in gradient-type optimizers which accounts for random parameter variations encountered during manufacturing is presented. The difference between conventional sensitivity descriptions and the new sensitivity figure is analyzed and explained. Two examples are presented where yield improvement is obtained using the new sensitivity figure in a gradient-type optimizer.

Click on title for a complete paper.

Identification of Cascaded Microwave Circuits with Moderate Reflections Using Reflection and Transmission Measurements

T.V. Veijola and M.E. Valtonen. "Identification of Cascaded Microwave Circuits with Moderate Reflections Using Reflection and Transmission Measurements." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 418-423.

A method for identifying the component values of a cascaded microwave circuit with the aid of the time-domain reflection and transmission coefficients is presented. The model proposed is composed of commensurate nondispersive transmission lines separated by either lumped series or shunt resistances. The line delays are equal to the sampling interval. The algorithm takes into account the third-order multiple reflections, thus allowing identification of circuits with moderate internal reflections (reflection coefficient smaller than about 0.2). The method can be applied to the modelling of connectors, discontinuities, transitions, jigs, and even impedance transformers. A numerical example is given to demonstrate the ability of the algorithm.

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Circuit Optimization: The State of the Art

J.W. Bandler and S.H. Chen. "Circuit Optimization: The State of the Art." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 424-443.

This paper reviews the current state of the art in circuit optimization, emphasizing techniques suitable for modern microwave CAD. It is directed at the solution of realistic design and modeling problems, addressing such concepts as physical tolerances and model uncertainties. A unified hierarchical treatment of circuit models forms the basis of the presentation. It exposes tolerance phenomena at different parameter/response levels. The concepts of design centering, tolerance assignment, and postproduction tuning in relation to yield enhancement and cost reduction suitable for integrated circuits are discussed. Suitable techniques for optimization oriented worst-case and statistical design are reviewed. A generalized l/sub p/ centering algorithm is proposed and discussed. Multicircuit optimization directed at both CAD and robust device modeling is formalized. Tuning is addressed in some detail, both at the design stage and for production alignment. State-of-the-art gradient-based nonlinear optimization methods are reviewed, with emphasis given to recent, but well-tested, advances in minimax, l/sub 1/, and l/sub 2/ optimization. Illustrative examples as well as a comprehensive bibliography are provided.

Efficient Optimization with Integrated Gradient Approximations

J.W. Bandler, S.H. Chen, S. Daijavad and K. Madsen. "Efficient Optimization with Integrated Gradient Approximations." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 444-455.

A flexible and effective algorithm is proposed for efficient optimization with integrated gradient approximations. It combines the techniques of perturbations, the Broyden update, and the special iterations of Powell. Perturbations are used to provide an initial approximation as well as regular corrections. The approximate gradient is updated using Broyden's formula in conjunction with the special iterations of Powell. A modification to the Broyden update is introduced to exploit possible sparsity of the Jacobian. Utilizing this algorithm, powerful gradient-based nonlinear optimization tools for circuit CAD can be employed without the effort of calculating exact derivatives. Applications of practical significance are demonstrated. The examples include robust small-signal FET modeling using the l/sub 1/ techniques and simultaneous processing of multiple circuits, worst-case design of a microwave amplifier, and minimax optimization of a five-channel manifold multiplexer. Computational efficiency is greatly improved as compared to estimating derivatives entirely by perturbations.

Description and Development of a SAW Filter CAD System

S.M. Richie, B.P. Abbott and D.C. Malocha. "Description and Development of a SAW Filter CAD System." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 456-466.

This paper will present a description of the appropriate device models, design methods, and analysis techniques for a real-time surface acoustic wave (SAW) computer-aided design (CAD) system. The approaches presented have been successfully implemented in the creation of a fully integrated SAW filter CAD system for the design of bidirectional and three-phase unidirectional filters on a DEC VAX 11/750 system and for the design of bidirectional filters on an IBM PC-AT computer, which acts as an independent workstation. The focus of this paper will be on bidirectional transducer design and analysis using the PC-based computer system. CAD analysis of a SAW bidirectional filter will be compared to measured parameters.

Abstracts

Patent Abstracts (Feb. 1988 [T-MTT])

"Patent Abstracts (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 467-470.

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1986 Index to IEEE Publications (Advertisement) (Feb. 1988 [T-MTT])

"1986 Index to IEEE Publications (Advertisement) (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 471-471.

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IEEE Press Books (Advertisement) (Feb. 1988 [T-MTT])

"IEEE Press Books (Advertisement) (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): 472-472.

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Back Cover (Feb. 1988 [T-MTT])

"Back Cover (Feb. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.2 (Feb. 1988 [T-MTT] (Special Issue on Computer-Aided Design)): b1-b2.

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Front Cover (Mar. 1988 [T-MTT])

"Front Cover (Mar. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): f1-f2.

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Abstracts

Partial Variational Principle for Electromagnetic Field Problems: Theory and Applications

S.-J. Chung and C.H. Chen. "Partial Variational Principle for Electromagnetic Field Problems: Theory and Applications." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 473-479.

A partial variation concept is proposed to clarify and extend the ideas and techniques used in variational electromagnetic (VEM) and variational reaction theory (VRT) of recent papers. Based on this concept, a partial variational principle (PVP) is established for handling a general linear time-harmonic interior and\or exterior electromagnetic field problem. This principle is then applied to attack the problem of waves incident on a dielectric discontinuity in a parallel-plate guide. Also included are numerical results and discussions about such waveguide discontinuity problems for illustrating the use of the proposed technique.

Abstracts

A Method of Analysis of TE/sub 11/-to-HE/sub 11/ Mode Converters

L.C. da Silva. "A Method of Analysis of TE/sub 11/-to-HE/sub 11/ Mode Converters." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 480-488.

An efficient method for the determination of the scattering matrix of TE/sub 11/-to-HE/sub 11/ corrugated cylindrical waveguide mode converters has been developed based on the representation of the fields inside the corrugations by a small number of radial waveguide modes. Numerical results show that the method, when compared to the usual mode-matching techniques, reduces the computation time, without loss of accuracy.

Click on title for a complete paper.

Abstracts

Frequency-Swept Microwave Imaging of Dielectric Objects

T.-H. Chu and N.H. Farhat. "Frequency-Swept Microwave Imaging of Dielectric Objects." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 489-493.

In this paper, analytical and experimental studies of frequency-swept microwave imaging of a nondispersive dielectric object satisfying the Born approximation are presented. The retrieved images shown from experimental data measured in the frequency range 6-17 GHz are free of the speckle noise that plagues conventional coherent imaging system. The results demonstrate that the microwave imaging system described here has potential as a cost-effective tool in nondestructive evaluation of dielectric objects.

An Alternative Explicit Six-Port Matrix Calibration Formalism Using Five Standards

F.M. Ghannouchi and R.G. Bosisio. "An Alternative Explicit Six-Port Matrix Calibration Formalism Using Five Standards." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 494-498.

A new explicit six-port calibration method using five standards based on matrix formalism is developed. The new method has a number of advantages: There is no limitation on the measurements and in the six-port design to include a specific reference port for setting the power level during calibration and testing. The computation method is an explicit one and there is no need to use iterative procedures.

Click on title for a complete paper.

Analysis and Design of Microwave Linearized Amplifiers Using Active Feedback

E. Ballesteros, F. Perez and J. Perez. "Analysis and Design of Microwave Linearized Amplifiers Using Active Feedback." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 499-504.

Intermodulation distortion of active feedback amplifier systems has been analyzed using a simple method. Starting from the amplitude characteristic of both amplifiers -- the main and the auxiliary -- it is possible to calculate the intermodulation distortion of the complete system. Analytical results show that third-order intermodulation products can be considerably reduced when an active feedback with correct amplitude and phase is employed. Experimental measurements have been made on a one-stage bipolar transistor amplifier that confirm the theoretical analysis.

Network Modeling of an Aperture Coupling Between Microstrip Line and Patch Antenna for Active Array Applications

X. Gao and K. Chang. "Network Modeling of an Aperture Coupling Between Microstrip Line and Patch Antenna for Active Array Applications." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 505-513.

An analytical method based upon the aperture coupling theory and the derivation of S-parameter matrix has been developed for modeling a microstrip line coupled to a microstrip patch antenna using a circular coupling aperture. Closed-form solutions were derived for scattering parameters of the coupling circuit. Input impedance and matching condition can be calculated from the equivalent six-port network. The theoretical results agree well with the measurements. The analysis should have many applications in active array and spatial power combining systems.

Abstracts

Narrow-Band Microstrip Bandpass Filters with Low Radiation Losses for Millimeter-Wave Applications

P.K. Ikalainen and G.L. Matthaei. "Narrow-Band Microstrip Bandpass Filters with Low Radiation Losses for Millimeter-Wave Applications." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 514-521.

Microstrip lines are attractive for the lower millimeter-wave ranges, but use of relatively thick substrates would be desirable in order to minimize losses. On such substrates the usual types of microstrip narrow-band bandpass filters (formed from, e.g., coupled line segments with open ends) tend to radiate strongly, giving very poor performance. It has been found that a grating technique initially developed for use with dielectric waveguide can be adapted for microstrip to obtain narrow-band millimeter-wave microstrip filters with little radiation and strong filter characteristics. The stopbands are broad, the second passband occurring at three times the frequency of the first passband. These filters use parallel-coupled gratings with a single grating in cascade at each end. In this paper, we detail the modifications to the dielectric waveguide filter theory which are necessary for use with microstrip. We also present experimental results from microstrip realizations which demonstrate their potential for mm-wave microstrip applications.

Click on title for a complete paper.

Abstracts

A Spectral-Domain Analysis of Periodically Nonuniform Coupled Microstrip Lines

F.-J. Glandorf and I. Wolff. "A Spectral-Domain Analysis of Periodically Nonuniform Coupled Microstrip Lines." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 522-528.

Periodically nonuniform coupled microstrip lines on the basis of a numerical field calculation. As in the case nonuniform microstrip line described in an earlier paper by Floquet's theorem is used to express all field quantities in terms of their spatial harmonics. The boundary value problem is formulated in a rigorous way, then solved using Galerkin's method in the Fourier-transform domain. Numerical and experimental results are presented.

Abstracts

Scattering Parameter Transient Analysis of Transmission Lines Loaded with Nonlinear Terminations

J.E. Schutt-Aine and R. Mittra. "Scattering Parameter Transient Analysis of Transmission Lines Loaded with Nonlinear Terminations." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 529-536.

This work presents a new approach for the time-domain simulation of transients on a dispersive and lossy transmission line terminated with active devices. The method combines the scattering matrix of an arbitrary line and the nonlinear causal impedance functions at the loads to derive expressions for the signals at the near and far ends. The problems of line losses, dispersion, and nonlinearities are first investigated. A time-domain formulation is then proposed using the scattering matrix representation. The algorithm assumes that dispersion and loss models for the transmission lines are available and that the frequency dependence is known. Large-signal equivalent circuits for the terminations are assumed to be given. Experimental and computer-simulated results are compared for the lossless dispersionless case, and the effects of losses and dispersion are predicted.

7.3-GHz Dynamic Frequency Dividers Monolithically Integrated in a Standard Bipolar Technology

R.H. Derksen and H.-M. Rein. "7.3-GHz Dynamic Frequency Dividers Monolithically Integrated in a Standard Bipolar Technology." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 537-541.

Monolithic integrated microwave 1/2 and 1/8 frequency dividers were developed and fabricated in standard 2-µm bipolar technology. The circuits which operate from about 2 to 7.3 GHz are based on the principle of "regenerative frequency division." Assuming that the same technology is used, this principle makes it possible to double the upper frequency limit, compared to the most popular static master-slave D-flip-flop dividers. Furthermore, power consumption can be considerably reduced.

Abstracts

Mode Completeness, Normalization, and Green's Function of the Inset Dielectric Guide

T. Rozzi and L. Ma. "Mode Completeness, Normalization, and Green's Function of the Inset Dielectric Guide." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 542-551.

The inset dielectric guide (IDG) is an easy-to-fabricate alternative to image line that is also less sensitive to loss by radiation at unwanted discontinuities. The discrete spectrum of the IDG was recently analyzed by the transverse resonance diffraction (TRD) method. In this paper we complete the characterization of the spectrum to include the continuum. We also address from a fundamental viewpoint the question of its orthonormalization, and determine the Green's function of the guide, which is an essential prerequisite to the analysis of IDG components and of IDG antenna feeds. An application is given to the scattering by a dipole on the air-dielectric interface.

FET's and HEMT's at Cryogenic Temperatures - Their Properties and Use in Low-Noise Amplifiers (Mar. 1988 [T-MTT])

M.W. Pospieszalski, S. Weinreb, R.D. Norrod and R. Harris. "FET's and HEMT's at Cryogenic Temperatures - Their Properties and Use in Low-Noise Amplifiers (Mar. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 552-560.

This paper reviews the performance of a number of FET's and HEMT's at cryogenic temperatures. Typical dc characteristics and X-band noise parameters are presented and qualitatively correlated wherever possible with other technological or experimental data. While certain general trends can be identified, further work is needed to explain a number of observed phenomena. A design technique for cryogenically cooled amplifiers is briefly discussed, and examples of realizations of L-, C-, X-, and K-band amplifiers are described. The noise temperature of amplifiers with HEMT's in input stages is usually less than half of that for all-FET realizations, setting new records of performance for cryogenically cooled, multistage amplifiers.

Analysis of Microstrip Line to Waveguide End Launchers

T.Q. Ho and Y.-C. Shih. "Analysis of Microstrip Line to Waveguide End Launchers." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 561-567.

An analysis of a microstrip line to waveguide end launcher is presented. The expression for input impedance is derived through the self-reaction concept with the assumption of a sinusoidal current distribution existing in the conductor loop. Three different cases of end launchers are computed for their corresponding input impedances. Comparison between calculated and measured input return loss of an end launcher shows good agreement between theory and experiment at Ka-band frequencies.

Characteristics of Millimeter-Wave Radiation in a Corrugated Ferrite Slab Structure

S. Erkin, N.S. Chang, H. Maheri and M. Tsutsumi. "Characteristics of Millimeter-Wave Radiation in a Corrugated Ferrite Slab Structure." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 568-575.

The characteristics of millimeter-wave radiation in a corrugated ferrite slab supported by a grounded dielectric slab are investigated both theoretically and experimentally. Theoretical analysis is performed by the perturbation theory combined with multiple space scales for the transverse electric mode. A pair of amplitude transport equations are derived, and the characteristics of the leaky wave are explained in terms of the radiation angle and the radiation efficiency. Experiments are carried out by using the layered structure composed of a corrugated polycrystalline yttrium iron garnet slab and a Teflon slab in the frequency range from 40 to 50 GHz. The experimental results are compared with the theory.

A Full-Wave Analysis of Microstrip Lines by Variational Conformal Mapping Technique

C. Shih, R.-B. Wu, S.-K. Jeng and C.H. Chen. "A Full-Wave Analysis of Microstrip Lines by Variational Conformal Mapping Technique." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 576-581.

A novel full-wave analysis of microstrip lines is presented. Wheeler's mapping, which is useful in the quasi-TEM analysis of microstrip lines, is combined with the full-wave variational formulation to facilitate a finite element solution. This desirable mapping not only transforms the problem domain into a finite region, but also overcomes the field singularity on the strip edge. Compared with other known techniques, the present method makes fewer assumptions, and is more rigorous as long as the strip thickness is negligible. Numerical results for the frequency dependence of effective dielectric constant, the characteristic impedance, and both longitudinal and transverse current distributions on the strip are also included.

Optimum Design of Waveguide E-Plane Stub-Loaded Phase Shifters

J. Dittloff, F. Arndt and D. Grauerholz. "Optimum Design of Waveguide E-Plane Stub-Loaded Phase Shifters." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 582-587.

Novel broad-band low-insertion-loss E-plane stub-loaded rectangular waveguide phase shifters are designed with the method of field expansion into normalized eigenmodes, which includes higher order mode interaction between the step discontinuities. Computer-optimized three-stub prototypes of 90° differential phase shift with reference to an empty waveguide of appropriate length, designed for R140-band (12.4-18 GHz) and R320-band (26.5-40 GHz) waveguides, achieve typically ± 0.5° phase shift deviation within about 20 percent bandwidth. For two-stub designs, the corresponding values are about + 2.5°/ -1° and 17 percent. Both designs achieve minimum return loss of 30 dB. The theory is verified by measurements at a compact R120-band (10-15 GHz) waveguide phase shifter design example milled from a solid block, showing measured insertion loss of about 0.1 dB and about + 2.5°/ -0.5° phase error between 10.7 and 12.7 GHz.

Longitudinal and Transverse Current Distributions on Coupled Microstrip Lines

M. Kobayashi and H. Momoi. "Longitudinal and Transverse Current Distributions on Coupled Microstrip Lines." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 588-593.

The normalized longitudinal and transverse current distributions on coupled microstrip lines are obtained for even and odd modes by using the charge conservation formula and the charge distributions calculated by a Green's function technique. Their dependence on the shape ratios w/h and s/h and on the relative permittivity epsilon* of the substrate is shown.

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Propagation Characteristics of Dielectric-Rod-Loaded Waveguides

E.J. Rothwell and L.L. Frasch. "Propagation Characteristics of Dielectric-Rod-Loaded Waveguides." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 594-600.

A general technique is presented for calculating the propagation characteristics of a waveguide with arbitrary cross-sectional shape loaded with a circular dielectric rod. The waveguide fields, which are represented as a sum of functions satisfying the homogeneous Helmholtz equation and the boundary conditions at the rod surface, are point-matched at the surface of the waveguide. Numerical examples of a rod centered in a square guide and off center in a circular guide are given, and results for a rod centered in a rectangular cavity are compared with measured data.

An Efficient Algorithm for Finding Zeros of a Real Function of Two Variables (Short Papers)

M. Mrozowski. "An Efficient Algorithm for Finding Zeros of a Real Function of Two Variables (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 601-604.

A new fast algorithm is described for finding the roots of a real function of two variables. The procedure searches the interval in which a function changes sign and then automatically locks to a curve f(lambda, p)=0, following it inside a given rectangular region. The method ensures that at each step a new pair of points with different function signs is generated, and in effect it minimizes the number of function evaluations. Complementary algorithms opening up opportunities for the further automation of the search process are also presented in outline. An example of the application of the new procedure is included. The proposed algorithm is particularly suitable for solving the electromagnetic problems Ieading to transcendent equations.

Analysis of Coplanar E-H Plane T-Junction Using Dissimilar Rectangular Waveguides (Short Papers)

B.N. Das, G.S.N. Raju and A. Chakraborty. "Analysis of Coplanar E-H Plane T-Junction Using Dissimilar Rectangular Waveguides (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 604-606.

An analysis of a T-junction which differs from conventional H-plane T-junctions in that the T arm is rotated by 90° and coupling takes place through an inclined slot is presented. Since use of standard X-band waveguides result in such a T-junction operating above 11.7 GHz, non-standard waveguide dimensions have been considered to bring down the operating frequency to 9.375 GHz. The effect of a change of the broad dimension of the primary feed waveguide on the resonant conductance is evaluated. The variations of resonant length with the angle of inclination of the slot, and coupling with frequency, are presented.

L- and S-band Low-Noise Cryogenic GaAs FET Amplifiers (Short Papers)

S. De Panfilis and J. Rogers. "L- and S-band Low-Noise Cryogenic GaAs FET Amplifiers (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 607-610.

We present the results of the construction and testing of three cryogenic low-noise GaAs FET amplifiers, based on a National Radio Astronomy Observatory design, to be used in a detector for the axion, a hypothetical particle. The amplifiers are centered on 1.1 GHz, 1.1 GHz, and 2.4 GHz, have a gain of approximately 30 dB in bandwidths of 300 MHz, 225 MHz, and 310 MHz, and have minimum noise temperatures of 7.8 K, 8 K, and 15 K, respectively.

Abstracts

Unusual Identities for Special Functions from Waveguide Propagation Analyses (Short Papers)

J.A. Cochran. "Unusual Identities for Special Functions from Waveguide Propagation Analyses (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 611-614.

The analysis of electromagentic wave propagation in "cylindrical" waveguides with step discontinuities leads naturally to sets of unusual identities for various special functions. In this paper we concentrate on those expressions associated with classical rectangular and circular cross-sectional geometry. From a mathematical point of view it turns out, as expected, that the identities are related to bilinear expansions for Green's functions affiliated with familiar Sturm-Liouville boundary-value problems.

Self-Consistent Finite/Infinite Element Scheme for Unbounded Guided Wave Problems (Short Papers)

K. Hayata, M. Eguchi and M. Koshiba. "Self-Consistent Finite/Infinite Element Scheme for Unbounded Guided Wave Problems (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 614-616.

An efficient finite-element approach for the eigenmode analysis of unbounded guided wave problems is described using decay-type infinite elements. To determine an optimum set of decay parameters, two algorithms based on successive approximation are presented and their validity is checked via the application to an optical fiber problem.

Analysis of Coupled Microslab™ Lines (Short Papers)

B. Young and T. Itoh. "Analysis of Coupled Microslab™ Lines (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 616-619.

Symmetrically coupled Microslab lines are analyzed with a mode-matching method to build design charts for the propagation constant and characteristic impedance. Results are provided for GaAs/alumina Microslab implementations.

Tests of Microstrip Dispersion Formulas (Short Papers)

H.A. Atwater. "Tests of Microstrip Dispersion Formulas (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 619-621.

A set of published formulas for the frequency dependence of the microstrip effective relative dielectric constant epsilon/sub re/(f) is tested relative to an assemblage of measured data values for this quantity chosen from the literature. The r.m.s. deviation of the predicted from the measured values ranged from 2.3 percent to 4.1 percent of the seven formulas for epsilon/sub re/(f) tested. A formula due to Kirschning and Jansen showed the lowest average deviation from measured values, although the differences between the predictions of their formula and others tested are of the order of the error limits of the comparison process. It is concluded that the results indicate the suitability of relatively simple analytical expressions for the computation for microstrip dispersion.

Abstracts

A Coordinate-Free Approach to Wave Reflection from a Uniaxially Anisotropic Medium (Comments and Reply)

F.I. Fedorov and H.C. Chen. "A Coordinate-Free Approach to Wave Reflection from a Uniaxially Anisotropic Medium (Comments and Reply)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 622-624.

I would like to point out that part of the contents of this paper appear similar to sections 6, 17, 21, and 26 of [1], with some variation of notation. Section III of the above paper gives formulas which represent particular cases of general relations given in sections 19 and 23 of [1].

Abstracts

A Spectral-Domain Analysis of Periodically Nonuniform Microstrip Lines (Comments and Reply)

L.J. Rademacher, F.J. Glandorf and I. Wolff. "A Spectral-Domain Analysis of Periodically Nonuniform Microstrip Lines (Comments and Reply)." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 622-622.

Section 26 of Floquet's paper has become known as Floquet's theorem.

Abstracts

Patent Abstracts (Mar. 1988 [T-MTT])

"Patent Abstracts (Mar. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): 625-628.

Abstracts

Back Cover (Mar. 1988 [T-MTT])

"Back Cover (Mar. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.3 (Mar. 1988 [T-MTT]): b1-b2.

Click on title for a complete paper.

Front Cover (Apr. 1988 [T-MTT])

"Front Cover (Apr. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): f1-f2.

Design of Transformerless Quasi-Broad-Band Matching Networks for Lumped Complex Loads Using Nonuniform Transmission Lines

I. Endo, Y. Nemoto and R. Sato. "Design of Transformerless Quasi-Broad-Band Matching Networks for Lumped Complex Loads Using Nonuniform Transmission Lines." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 629-634.

A simple design method for transformerless and lossless quasi-broad-band matching of a lumped RC load is presented by use of a parabolic nonuniform transmission line. The key idea in removing an ideal transformer from the matching network is based on impedance transformation of the nonuniform transmission line, whose mixed lumped and distributed equivalent circuit contains an ideal transformer. Also, illustrative examples and some design curves are presented.

Equivalent Transformations for the Mixed Lumped Richards Section and Distributed Transmission Line

Y. Nemoto, M. Satake, K. Kobayashi and R. Sato. "Equivalent Transformations for the Mixed Lumped Richards Section and Distributed Transmission Line." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 635-641.

Introducing a new analysis method for the nonuniform transmission line, this paper shows equivalent transformations between a circuit consisting of a cascade connection of a lumped Richards section, an ideal transformer, and a distributed transmission line and one consisting of a cascade connection of a class of a nonuniform transmission line, a lumped Richards section, and an ideal transformer. Characteristic impedance distributions of these nonuniform transmission lines are expressed as hyperbolic or trigonometric functions. It is quite difficult to find the exact network functions of nonuniform transmission lines from the telegraph equation, but by using the equivalent transformation described it becomes possible to obtain exact network functions of a class of nonuniform transmission lines.

The Influence of Ion-Implanted Profiles on the Performance of GaAs MESFET's and MMIC Amplifiers

D. Pavlidis, J.-L. Cazaux and J. Graffeuil. "The Influence of Ion-Implanted Profiles on the Performance of GaAs MESFET's and MMIC Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 642-652.

The RF small-signal performance of GaAs MESFET's and MMIC amplifiers as a function of various ion-implanted profiles is theoretically and experimentally investigated. Implantation energy, dose, and recess depth influence are theoretically analyzed with the help of a specially developed device simulator. The performance of MMIC amplifiers processed with various energies, doses, recess depths, and bias conditions is discussed and compared to experimental characteristics. Some criteria are finally proposed for the choice of implantation conditions and process in order to optimize the characteristics of ion-implanted FET's and to realize process-tolerant MMIC amplifiers.

One-Chip GaAs Monolithic Frequency Converter Operable to 4 GHz

M. Shigaki, S. Yokogawa, T. Takano and K. Yamada. "One-Chip GaAs Monolithic Frequency Converter Operable to 4 GHz." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 653-658.

A GaAs monolithic frequency converter integrated circuit that operates at frequencies up to 4 GHz has been developed. It combines a feedback amplifier, a differential amplifier, a double-balanced mixer, a voltage-controlled oscillator, and an IF amplifier on a 1-mm² GaAs chip. The FET circuits were matched by digital IC design rather than by the distributed element network technique, to use the substrate more effectively. Self-aligned WSi/Au gates 1.5 µm long were used, and the resistance in conventional WSi gates was reduced to enhance microwave characteristics. At 4 GHz, the conversion gain is 18 dB, the DSB noise is 11.8 dB, and the output power is 5.6 dBm.

Exact Solutions for Rectangularly Shielded Lines by the Carleman-Vekua Method

J.G. Fikioris and J.L. Tsalamengas. "Exact Solutions for Rectangularly Shielded Lines by the Carleman-Vekua Method." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 659-675.

Exact solutions for the field of the TEM mode of rectangularly shielded round or strip conductors are obtained by solving linear, singular integral equations. There are no limitations on the dimensions or the proximity of the conductors to the shield. Here only round conductors are considered; printed microstrip conductors are analyzed in further publications. The kernel of the integral equation in such problems is the Green's function G of a line source inside the shield, possessing a logarithmic singularity near the source point. In a series of recent papers the authors have developed new expansions for G, in which the singular and certain other terms are extracted in closed form out of G and the remaining, nonsingular part is then reexpanded into series converging uniformly everywhere and very rapidly (exponentially) near the source point. These new expansions for G are particularly suited for the exact solution of the singular integral equation of round shielded conductors by the Carleman-Vekua method, otherwise known as the method of regularization by solving the dominant equation. This leads to strongly convergent solutions for the field of the mode even when the conductors are large or very near the shield. Questions of integrability of nonuniformly convergent series do not arise. Characteristic values of the shielded lines, evaluated by summing a few terms, have been checked against existing approximate results and field plots are shown in the case of close proximity. Due to the exponential convergence of the kernel expansion it is possible to provide useful, closed-form expressions for the characteristic impedance of the line. The accuracy of such formulas is shown to be amply adequate for most practical situations.

Click on title for a complete paper.

A Multiloop Concentric Hyperthermia Applicator with Enhanced Penetration Depth

P.G. Cottis, N.K. Uzunoglu and G.E. Chatzarakis. "A Multiloop Concentric Hyperthermia Applicator with Enhanced Penetration Depth." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 676-681.

The electromagnetic field deposition into a three-layer cylindrical human body model by a multiloop concentric hyperthermia applicator is investigated analytically. The multiloop radiator axis is taken to be coincident with the cylinder axis. A technique based on the method of separation of variables is employed to determine the axisymmetric field in every point. In order to compute the imposed specific absorption rate in the tissues, a numerical integration technique is utilized. Numerical results are presented for several loop geometries at a 13 MHz operation frequency. The possibility of obtaining improved in-depth heating in comparison with conventional single magnetic loop applicators is investigated. It is shown that significant enhancement of the penetration depth cars be obtained by using a simple phased magnetic loop system.

Abstracts

Three-Dimensional Finite, Boundary, and Hybrid Element Solutions of the Maxwell Equations for Lossy Dielectric Media

K.D. Paulsen, D.R. Lynch and J.W. Strohbehn. "Three-Dimensional Finite, Boundary, and Hybrid Element Solutions of the Maxwell Equations for Lossy Dielectric Media." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 682-693.

Finite, boundary, and hybrid element approaches are presented as numerical methods for computing electromagnetic (EM) fields inside Iossy dielectric objects. These techniques are implemented as computer algorithms for solving the Maxwell equations in heterogeneous media in three dimensions. Algorithm verification takes the form of comparisons of test cases with analytic solutions. Computed results for each technique are in good agreement with exact solutions, especially in the light of the coarse computational grid resolutions used. Implementation was in Fortran on a moderate-sized computer (MicroVax II). The basic problem formulation is quite general however, it has direct application in hyperthermia as a cancer therapy where the EM fields produced inside the patient by external sources are of interest. An example of the application of these numerical methods in a three-dimensional clinical setting is shown.

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A Dual-Frequency 183/380 GHz Receiver for Airborne Applications

P.D. Batelaan, M.A. Frerking, T.B.H. Kuiper, H.M. Pickett, M.M. Schaefer, P. Zimmermann and N.C. Luhmann, Jr.. "A Dual-Frequency 183/380 GHz Receiver for Airborne Applications." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 694-700.

A complete dual-frequency cryogenic heterodyne receiver operating at 183 and 380 GHz is described. The cooled mixers are whisker-contacted GaAs Schottky diodes mounted in reduced height fundamental-mode waveguide. The local oscillators are Gunn-oscillator-driven multipliers using GaAs varactor diodes as the harmonic generators. Quasi-optical techniques are used extensively for coupling the remote and local oscillator signals into the mixers. The overall system temperature is 320 K DSB for the 183 GHz receiver and 650 K for the 380 GHz receiver.

Analysis of Two-Tone, Third-Order Distortion in Cascaded Two-Ports

N.G. Kanaglekar, R.E. McIntosh and W.E. Bryant. "Analysis of Two-Tone, Third-Order Distortion in Cascaded Two-Ports." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 701-705.

We consider the third-order intermodulation of a system composed of a number of cascaded two-port two-tone, third-order intercept point (IP) is highly dependent angles of the IMD signals, which are usually unknown designer. Consequently, worst-case design strategies are these situations. In this paper, we develop general bound formulas for the intercept point that include the effects of mismatches between component networks. We also obtain expressions for the expected value and variance of the intercept point of two cascaded two-port networks. A comparison of these results with measurements indicates that worst-case design strategies are overly conservative in many situations.

Propagation Constant Determination in Microwave Fixture De-Embedding Procedure

J.P. Mondal and T.-H. Chen. "Propagation Constant Determination in Microwave Fixture De-Embedding Procedure." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 706-714.

An improper choice of dimensions for the standards used in the microwave de-embedding procedure will cause errors in the determination of the propagation constant. This leads to unrealistic values for the attenuation constant, which in turn causes errors in the de-embedded results. Proper selection of dimensions is made to minimize such errors. Physically realistic values are obtained with this selection.

Theoretical and Experimental Characteristics of Single V-Groove Guide for X-Band and 100 GHz Operation

Y.M. Choi, D.J. Harris and K.-F. Tsang. "Theoretical and Experimental Characteristics of Single V-Groove Guide for X-Band and 100 GHz Operation." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 715-723.

A conformal mapping technique for single-groove guide has been discussed and applied to grooves of V-shaped cross section. Experimental measurements at X-band and 100 GHz confirm the theoretical predictions. The characteristic equation and scale factor of the fundamental mode have been developed, and its propagation characteristics are given graphically for several normalized groove dimensions.

A Monte Carlo Method for the Dirichlet Problem of Dielectric Wedges

R. Schlott. "A Monte Carlo Method for the Dirichlet Problem of Dielectric Wedges." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 724-730.

The Monte Carlo method considered here can be used to numerically compute electrostatic potentials inside a closed surface where a) the potential on the surface is known and b) the dielectric constant inside the surface changes only on boundaries. In this paper a modification is proposed to previously employed Monte Carlo methods, to overcome problems presented by dielectric wedges. In addition it is shown how it can be easily determined whether or not a point is inside a given domain. The connection between this topological problem and the Monte Carlo technique is explained.

Rigorous Full-Wave Space-Domain Solution for Dispersive Microstrip Lines

N. Fache and D. De Zutter. "Rigorous Full-Wave Space-Domain Solution for Dispersive Microstrip Lines." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 731-737.

The eigenmode problem for the open microstrip line is analyzed in the space domain starting from the calculation of a dyadic Green's function in the spectral domain. The transverse and the longitudinal current are discretized using the method of moments. A point-matching technique is used to impose the boundary condition, i.e., zero tangential electric field, on the strip. The edge conditions at the end points of the strip are explicitly incorporated and special care is taken to accurately retain the static behavior of the fields on and near the strip. Special attention is devoted to the variation of the current distribution as a function of frequency.

Abstracts

Analysis of Arbitrarily Shaped Two-Dimensional Microwave Circuits by Finite-Difference Time-Domain Method

W.K. Gwarek. "Analysis of Arbitrarily Shaped Two-Dimensional Microwave Circuits by Finite-Difference Time-Domain Method." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 738-744.

The paper presents a version of the finite-difference time-domain method adapted to the needs of S matrix calculations of microwave two-dimensional circuits. The analysis is conducted by simulating the wave propagation in the circuit terminated by matched loads and excited by a matched pulse source. Various aspects of the method's accuracy are investigated. Practical computer implementation of the method is discussed and an example of its application to an arbitrarily shaped microstrip circuit is presented. It is shown that the method in the proposed form is an effective tool of circuit analysis in engineering applications. The method is compared to two other methods used for a similar purpose, namely the contour integral method and the transmission-line matrix method.

Click on title for a complete paper.

Microwave Noise Characterization of GaAs MESFET's: Determination of Extrinsic Noise Parameters

M.S. Gupta and P.T. Greiling. "Microwave Noise Characterization of GaAs MESFET's: Determination of Extrinsic Noise Parameters." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 745-751.

The noise equivalent circuit model for a GaAs MESFET proposed previously is supplemented with a model for device parasitics, in order to calculate the noise parameters of a mounted GaAs MESFET. The calculated parameters are in good agreement with measured noise parameters from 2 to 18 GHz. The model is thus established as a valid representation of the noise properties of the device. The utility of the model lies in the fact that, compared with the measured and tabulated noise parameters, its elements are easier to obtain, and it serves as a simpler, more compact description of the noise characteristics of the MESFET.

Modal Analysis of the "Gap Effect" in Waveguide Dielectric Measurements (Short Papers)

S.B. Wilson. "Modal Analysis of the "Gap Effect" in Waveguide Dielectric Measurements (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 752-756.

In waveguide measurements on dielectric slabs, small air gaps between the guide walls and the dielectric sample are found to be capable of radically altering the complex reflection and transmission coefficients of the excitation mode. The modal-analysis representation is used to compute these coefficients for low- and high-loss samples with air gaps. The "gap effect" is explained qualitatively by considering the influence of the dominant "slab mode," which focuses its energy into the dielectric slab, and the dominant "gap mode," which focuses its energy into the air gap. An experimental approach, which consists of filling the air gap with conducting paste, is shown to essentially correct the problem altogether.

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Large-Signal Time-Domain Simulation of HEMT Mixers (Short Papers)

G.-W. Wang, I. Ichitsubo, W.H. Ku, Y.-K. Chen and L.F. Eastman. "Large-Signal Time-Domain Simulation of HEMT Mixers (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 756-759.

A large-signal HEMT model and a time-domain nonlinear circuit analysis program have been developed. In this work a systematic method to simulate HEMT mixers and design them for maximum conversion gain is presented. The transconductance-compression effect reduces the mixer's conversion gain at high frequencies. Simulation results from mixers designed to operate at 10, 20, and 40 GHz show that a reduction in parasitic conduction in the AlGaAs layer significantly increases the conversion gain.

Design of Combline and Interdigital Filters with Tapped-Line Input (Short Papers)

S. Caspi and J. Adelman. "Design of Combline and Interdigital Filters with Tapped-Line Input (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 759-763.

Explicit design-equations for combline and interdigital filters with tapped-line inputs are presented. The equations are based upon a new equivalent circuit for a tapped-line input filter, derived from the open-wireline equivalent circuit given by Cristal. Using the new equivalent circuit, explicit expressions are given for all parameters of the circuit. The derivation of the design equations from the equivalent circuit is similar to that described by Matthaei et al. The design equations are checked by an analysis program. The results are compared to the data given by Dishal and Cristal.

On the Realizability of the Impedance Matrix for Lossy Dielectric Posts in a Rectangular Waveguide (Short Papers)

C.G. Hsu and H.A. Auda. "On the Realizability of the Impedance Matrix for Lossy Dielectric Posts in a Rectangular Waveguide (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 763-765.

The equivalent T network for some lossy dielectric posts in a rectangular waveguide is found to have a negative resistance in the parallel arm although the realizability conditions for the impedance matrix are strictly satisfied. Furthermore, the reactive part of the same impedance is found to be a monotonically decreasing function of frequency. These difficulties are overcome in the case of symmetrical post structures by using lattice networks. A simplified lattice network of lumped elements is developed to approximately realize the impedance matrix for resonant lossy post structures in the bandwidth.

Attenuation Distortion of Transient Signals in Microstrip (Short Papers)

T. Leung and C.A. Balanis. "Attenuation Distortion of Transient Signals in Microstrip (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 765-769.

Attenuation distortion, and combinations of dispersion and attenuation distortions, of transient signals in microstrip lines are investigated. Conduction losses are considered for the general case where the strip conductor resistivity is different from that of the ground plane. Dielectric losses are examined for commonly used isotropic substrates. Attenuation and dispersion distortions of short pulses are shown to vary as microstrip and pulse parameters are changed.

A Spectral Iterative Technique with Gram-Schmidt Orthogonalization (Short Papers)

P.M. van den Berg and W.J. Ghijsen. "A Spectral Iterative Technique with Gram-Schmidt Orthogonalization (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 769-772.

Iterative schemes based on the minimization of the integrated square error are discussed. In each iteration a basis function is generated in such a way that it is linearly related to the residual error of the previous iteration. A complete orthogonalization of all of these basis functions leads to an optimal convergent scheme for some choices of the basis functions. In order to reduce the computer storage needed to store all of the basis functions, we present an incomplete orthogonalization scheme that still yields an efficient computational method. In this scheme a limited number of basis functions has to be stored. Some numerical results with respect to some representative field problems illustrate the performance of the various versions of the iterative schemes suggested here.

High-Speed GaAs Dynamic Frequency Divider Using a Double-Loop Structure and Differential Amplifiers (Short Papers)

M. Shigaki, T. Saito, H. Kusakawa and H. Kurihara. "High-Speed GaAs Dynamic Frequency Divider Using a Double-Loop Structure and Differential Amplifiers (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 772-774.

New GaAs 2.0-8.0 GHz and 6.0-10.5 GHz dynamic frequency dividers have been developed. These dynamic dividers have a double-loop structure using a differential amplifier for high-speed and stable operation despite supply voltage fluctuations. This structure operates from one voltage supply. An advanced WSi self-aligned gate process technology (1.0 µm long gate) was used to improve the high-frequency characteristics of the FET.

Properties of Shielded Cylindrical Quasi-TE/sub 0nm/-Mode Dielectric Resonators (Short Papers)

J. Krupka. "Properties of Shielded Cylindrical Quasi-TE/sub 0nm/-Mode Dielectric Resonators (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 774-779.

Comparison of the Rayleigh-Ritz method and the mode-matching method for computations of quasi-TE/sub 0nm/-mode frequencies and unloaded Q factors of shielded dielectric resonators is presented. Rigorous bounds for the true quasi-TE/sub 0nm/-mode frequencies are assessed. Influence of various parameters on the resonant frequencies, unloaded Q factors, and the temperature coefficients of the resonant frequency is demonstrated for many shielded dielectric resonator structures. Different approaches to unloaded Q factor computations are discussed and numerically compared.

Composite Inductive Posts in Waveguide--A Multifilament Analysis (Short Papers)

G.S. Sheaffer and Y. Leviatan. "Composite Inductive Posts in Waveguide--A Multifilament Analysis (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 779-783.

A multifilament moment solution for the analysis of composite dielectric posts in rectangular waveguide is presented. This method permits the analysis of inductive posts composed of disparate regions, each with its own homogeneous complex permittivity. The solution uses the fields generated by sets of fixed-amplitude current filaments to simulate both the field scattered by the posts and the field inside every homogeneous region comprising the posts. Point matching the electric and magnetic fields on the boundaries between regions of different permittivity yields the as yet, unknown amplitudes for the current filaments. These currents can in turn be used to calculate field-related parameters of interest such as the scattering matrix and the equivalent circuit parameters. Inductive posts of any shape, composition, size, location, and number can be handled by this method accurately and with very good numerical efficiency. The results obtained are in good agreement with the few cases for which data are available. They also behave well in the limiting cases studied. The solution is further applied to other situations for which no experimental or calculated results are known.

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TE-TM Mode Conversion of an Optical Beam Wave in Thin-Film Optical Waveguides (Short Papers)

K. Hano. "TE-TM Mode Conversion of an Optical Beam Wave in Thin-Film Optical Waveguides (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 783-785.

This paper describes the TE-TM mode conversion efficiency when a Gaussian beam wave propagates in thin-film optical waveguides. For film thicknesses at which strong coupling between the TE and TM modes is obtained, two hybrid modes have oppositely rotating circular polarizations, or linear polarizations perpendicular to each other with equal magnitude of TE and TM wave components. In the former (i.e., circular polarization), complete TE-TM mode conversion is impossible. In the latter (i.e., linear polarization) complete TE-TM mode conversion is available. These claims are based on the fact that the direction of power flow of the hybrid modes depends on the polarization.

Two-Layer Dielectric Microstrip Line Structure: SiO/sub 2/ on Si and GaAs on Si: Modeling and Measurement. (Short Papers)

R.A. Lawton and W.T. Anderson. "Two-Layer Dielectric Microstrip Line Structure: SiO/sub 2/ on Si and GaAs on Si: Modeling and Measurement. (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 785-789.

Further development is reported of the modeling of the two-layer dielectric microstrip line structure by computing the scattering parameter S/sub 21/ derived from the model and comparing the computed value with the measured value over the frequency range from 90 MHz to 18 GHz. The sensitivity of the phase of S/sub 21/ and the magnitude of the characteristic impedance to various parameters of the equivalent circuit is also discussed. Examples are given of the measurement and modeling of the SiO/sub 2/ on silicon system to 18 GHz and the modeling of the GaAs on silicon system to 100 GHz.

p-i-n Diode Attenuator with Small Phase Shift (Short Papers)

R.J. Baeten, T.K. Ishii and J.S. Hyde. "p-i-n Diode Attenuator with Small Phase Shift (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 789-791.

A computer-aided design technique for minimizing spurious phase shift in microstrip p-i-n diode attenuators is presented. At 9 GHz, a spurious phase shift of 0.17°/dB attenuation has been realized at 15 dB attenuation. This is better than the previous reported value of 1°/dB attenuation at comparable operating frequencies and attenuations. The diode mounting location and the dc blocking chip capacitors on microstrip are important, among other parameters, to minimize the spurious phase shift.

Beam Propagation Method Applied to a Step Discontinuity in Dielectric Planar Waveguides (Short Papers)

L.R. Gomaa. "Beam Propagation Method Applied to a Step Discontinuity in Dielectric Planar Waveguides (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 791-792.

The power transmission and loss at an abrupt discontinuity in planar guides are calculated numerically using the beam propagation method (BPM) for the TE modes. Discontinuities include changes in core thickness and refractive index. Symmetric and asymmetric waveguides are considered. Comparison of results with those obtained by other techniques shows a general agreement.

Low-Phase-Noise Gunn Diode Oscillator Design (Short Papers)

R.A. Strangeway, T.K. Ishii and J.S. Hyde. "Low-Phase-Noise Gunn Diode Oscillator Design (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 792-794.

Low-phase-noise Gunn diode oscillators with an operating frequency of 35 GHz and an output power of 100 mW are designed, fabricated, and tested. The phase noise is -132 dBc/Hz to -125 dBc/Hz at 100 kHz offset from the center frequency. This low phase noise is obtained by closely coupling the stabilizing transmission cavity resonator and the Gunn diode oscillator coaxial line while loosely coupling the transmission cavity to the output waveguide following van der Heyden's approach.

Analysis of Nonreciprocal Coupled Image Lines (Comments and Reply)

C. Schieblich. "Analysis of Nonreciprocal Coupled Image Lines (Comments and Reply)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 795-795.

In the paper in question, nonreciprocal effects are predicated to a homogeneous waveguiding structure containing a gyromagnetic medium biased in the direction of propagation. In [1], the thesis was derived that any longitudinally biased structure showing reflection symmetry with respect to its midplane is reciprocal. The structure in the paper in question falls into this category, because a homogeneous structure is symmetrical with respect to any plane perpendicular to the direction of propagation.

A Study of Electric-Field Breakdown in E-Plane Lines at Centimeter and Millimeter Wavelengths (Corrections)

M.M. Ney, S.R. Valluri, W. Yue, G.I. Costache and W.J.R. Hoefer. "A Study of Electric-Field Breakdown in E-Plane Lines at Centimeter and Millimeter Wavelengths (Corrections)." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 795-796.

In the above paper, the sentence on p. 507, right column, "Diagrams of Fig. 8 were established..." should read: "Diagrams of Fig. 7 were established...." In addition, the next sentence: "Corrections due to the geometry and the frequency have been made by using... " should read: "Then, corrections due to the geometry and the frequency have been made by using...." Also, values in Table II and curves in Fig. 7 are not appropriate. The modified figures and table are given here.

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Patent Abstracts (Apr. 1988 [T-MTT])

"Patent Abstracts (Apr. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): 797-800.

Back Cover (Apr. 1988 [T-MTT])

"Back Cover (Apr. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.4 (Apr. 1988 [T-MTT]): b1-b2.

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Front Cover (May 1988 [T-MTT])

"Front Cover (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): f1-f2.

Editorial (May 1988 [T-MTT])

R. Levy. "Editorial (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 801-801.

This year the Microwave Theory and Techniques Society of the IEEE is organizing several activities marking the Centennial of the historic experiments of Heinrich Hertz which proved the validity of Maxwell's equations. Maxwell's theory appeared in 1864, but experimental proof eluded the best physicists and engineers of the time for over 20 years until Hertz's series of experiments, using remarkably modern microwave techniques, proved the existence of such key Maxwellian concepts as the displacement current in dielectrics.

Heinrich Hertz: A Short Life (May 1988 [T-MTT])

C. Susskind. "Heinrich Hertz: A Short Life (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 802-805.

Heinrich Rudolf Hertz was born in Hamburg on 22 February 1857, the 125th anniversary of the birth of George Washington. His grandfather, Heinrich David Hertz (1797-1863), was a scion of a wealthy Jewish family that had been resident in Hamburg since the 1780's; his grandmother, Betty Auguste Oppenheim (1802-1872), was a daughter of the estimable Cologne banking family. In 1834, when their oldest child, Gustav Ferdinand Hertz (1827-1914), was not quite seven, they were all converted to the Lutheran faith. Heinrich David Hertz was there-upon admitted to the full rights of a Halmburg citizen and presently became one of the city-state's 192 burgesses. His son Gustav (the physicist's father) later received the same honor, was elected to Hamburg's senate, and ultimately became head of its judicature (in effect, minister of justice). He was the first of his clan to attend a university, at Gottingen; in 1856 he married a classmate's sister, Anna Elisabeth Pfefferkorn (1835-1910), the daughter of a Prussian army surgeon and descendant of a long line of Frankfurt burghers. They had five children, of whom Heinrich Hertz was the oldest.

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The History of Electromagnetics as Hertz Would Have Known It (May 1988 [T-MTT])

R.S. Elliott. "The History of Electromagnetics as Hertz Would Have Known It (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 806-823.

Highlights of the separate developments of the sciences of electrostatics and magnetostatics are traced through the end of the 18th century, climaxed by the work of Coulomb and Poisson. The linkage of these two sciences due to the discoveries of Oersted, Ampere, Biot and Savart, and Faraday are described, followed by the theoretical culmination embodied in the work of Maxwell. His prediction of the existence of electromagnetic waves is seen to set the stage for the epochal experiments of Hertz.

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Heinrich Hertz--Theorist and Experimenter (May 1988 [T-MTT])

J.D. Kraus. "Heinrich Hertz--Theorist and Experimenter (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 824-829.

When Heinrich Hertz was appointed professor of physics at Karlsruhe in 1885 he was uniquely prepared for his historic experiments that opened the radio spectrum. He made the first antennas and transmitter receiver radio system. He conducted a series of experiments which established in a brilliant way that radio waves are one with light except for their much greater length. His description of the radiation phenomenon remains the best ever written, revealing his tremendous depth of understanding of the subject. Hertz's training, studies, and experiments are recounted and measurements with a replica of his apparatus are described.

Click on title for a complete paper.

The First Century of Microwaves - 1886 to 1986

J.H. Bryant. "The First Century of Microwaves - 1886 to 1986." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 830-858.

The first century of microwaves began with the historic experiments of Heinrich Hertz, between 1886 and 1889, using what are now called microwave circuits and techniques. His remarkably thorough investigations validated the Faraday-Maxwell theory of electromagnetism, opened up the electromagnetic spectrum between dc and light for scientific and practical uses, and opened up a new line of investigation in the ultraviolet. Even so, his was a step-by-step learning process, alternating between experiments and analytical work. Although Hertz's papers are a model of excellence in technical writing, they are extensive and are difficult to understand, due in part to the hazards of being a pioneer. Nomenclature and ideas that had meaning to him can create unforgiving pitfalls. Hertz's work and his outlook were that of pure scientific inquiry. He never considered patents or products, yet the results of his work form the basis for a wide range of products and services represented in diverse industries and institutions today. Hertz's immediate successors in at least nine different countries made advances in techniques and technology, scaling their apparatus to shorter (millimeter) wavelengths in scientific investigations. The first practical use of Hertz's work in electromagnetic was the wireless telegraphy system. The high-power pulses of RF energy from the Hertzian oscillator could quite readily be formed into dots and dashes of Morse code for the transmitted signal in Marconi's wireless telegraph system (1896). With the need for transmitting increasing amounts of data and information to distant places not accessible to wire or cable, wireless telegraphy experienced rapid growth. The advent of the triode electron tube, the DeForest audion (1906), led to continuous wave (CW) sources, amplifiers, and detectors by about 1914. This made voice communications possible and, equally important, far better use of the RF spectrum. Radio broadcasting started to replace wireless telegraphy. Early microwave system applications, centered in communications and early radar experiments, were stimulated by the advent of CW microwave signal sources in the 1920's. Examples of some of the ensuing advances described in this article are drawn from a search of historical records and from personal correspondence and interviews with some pioneers in microwave devices and applications. This paper is in two parts. Two of the objectives of Part I

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are (1) to identify, and establish a uniform nomenclature for, the apparatus used by Hertz in his experiments, and (2) to serve as a guide to the understanding of the work of Hertz in electromagnetic, especially his experiments. Part II covers succeeding work to the early 1940's in outline, with some detail.

A New Six-Port Microwave Network: Six-Port Magic Junction

I. Ohta. "A New Six-Port Microwave Network: Six-Port Magic Junction." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 859-864.

A new six-port junction, which consists of an H-plane symmetrical waveguide Y junction with a coaxial line on one side of its axis and a circular waveguide on its other, is proposed. The scattering matrix of the junction in an ideal case is derived using the symmetry properties of the structure. If both the coaxial and the circular waveguide arm are matched without destroying the symmetry, the arms of the junction are automatically matched and isolated as well, similar to the side arms of a conventional magic T. Therefore, it is called a six-port magic junction. These properties are confirmed by experiment in X-band. Lastly, some interesting applications based on the properties of the six-port junction are discussed.

Complex Modes in Boxed Microstrip

C.J. Railton and T. Rozzi. "Complex Modes in Boxed Microstrip." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 865-874.

Previously published results for the higher order modes of microstrip have been restricted to a few modes, whereas for the analysis of discontinuities as many as a hundred modes must be taken into account. A method of obtaining the propagation coefficients and field patterns of a large number of modes with a minimum of computational effort is described. This includes the "complex modes" recently reported in microstrip. In addition the characteristic impedance of microstrip is efficiently calculated.

Green's Function for Layered Lossy Media with Special Application to Microstrip Antennas

L. Beyne and D. De Zutter. "Green's Function for Layered Lossy Media with Special Application to Microstrip Antennas." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 875-881.

Suitable Green's dyadics for the fields generated by a surface current density in a plane parallel to the interface of a layered isotropic structure are determined. Special care is taken to ensure that the Green's function can still be calculated in the source region by circumventing the numerical problems by analytical procedures. As it is our purpose to use the obtained Green's function in order to calculate the power deposition from a microstrip antenna inside a layered biological tissue, the media involved can be highly lossy. An analytical method is developed to avoid numerical problems arising from the exponential decay of the fields due to these losses.

Flexible Dielectric Waveguides with Powder Cores

W.M. Bruno and W.B. Bridges. "Flexible Dielectric Waveguides with Powder Cores." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 882-890.

Flexible dielectric waveguides have been demonstrated at 10 GHz and 94 GHz using thin-wall polymer tubing filled with low-loss, high-dielectric-constant powders. Absorptive losses of the order of 10 dB/meter were measured at 94 GHz with nickel-aluminum titanate and barium tetratitanate powder in polytetrafluoroethylene (PTFE) lightweight electrical spaghetti. Bending losses at 94 GHz were negligible for curvature radii greater than 4 cm. Kuhn's theory of three-region cylindrical dielectric waveguide was used to calculate dispersion curves for the lower order modes for several combinations of dimensions and dielectric constants. Good agreement was obtained between experimental and theoretical values of guide wavelength. A scheme is proposed for classifying hybrid modes of three-region guides based on |E/sub z//H/sub z/|. For two-region guides, it reduces to Snitzer's familiar scheme.

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Oscillator Priming and Preoscillation Noise in a Gyrotron

A.H. McCurdy and C.M. Armstrong. "Oscillator Priming and Preoscillation Noise in a Gyrotron." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 891-901.

Phase control is achieved in a pulsed gyrotron oscillator both by applying an external priming signal directly to the oscillator and by applying the signal to a prebunching cavity. A pulse-to-pulse phase jitter of <2.5° is achieved in the gyrotron at drive-to-oscillator power ratios of -36.6 dB (drive signal-to-noise power ratio of 36 dB) in the direct injection case and -71 dB (drive signal-to-noise power ratio of 22 dB) in the prebunched case. A lumped element theory is compared to the experimental results. The theoretical description seems valid when the drive frequency is within about 5 MHz of that of the oscillator. Preoscillation noise in the gyrotron is ~1.0 µW, larger than expected from either shot noise or thermal noise but in the vicinity of spontaneous cyclotron emission. Convective RF noise growth is investigated. No evidence of the electrostatic cyclotron instability is seen. All growth observed can be attributed to the gyroklystron amplification mechanism. However the noise growth per unit length is not as large as that of a narrow-band drive signal. Thus a prebuncing system is advantageous for achieving control over the oscillation buildup in a pulsed gyrotron.

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Millimeter-Wave Diode-Grid Phase Shifters

W.W. Lam, C.F. Jou, H.Z. Chen, K.S. Stolt, N.C. Luhmann, Jr. and D.B. Rutledge. "Millimeter-Wave Diode-Grid Phase Shifters." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 902-907.

Monolithic diode grids have been fabricated on 2 cm square gallium-arsenide wafers with 1600 Schottky-barrier varactor diodes. Shorted diodes are detected with a liquid-crystal technique, and the bad diodes are removed with an ultrasonic probe. A small-aperture reflectometer that uses wavefront division interference was developed to measure the reflection coefficient of the grids. A phase shift of 70° with a 7 dB loss was obtained at 93 GHz when the bias on the diode grid was changed from -3 V to 1 V. A simple transmission-line grid model, together with the measured low-frequency parameters for the diodes, was shown to predict the measured performance over the entire capacitive bias range of the diodes, as well as over the complete reactive tuning range provided by a reflector behind the grid, and over a wide range of frequencies from 33 GHz to 141 GHz. This shows that the transmission-line model and the measured low-frequency diode parameters can be used to design an electronic beam-steering array and to predict its performance. An electronic beam-steering array made of a pair of grids using state-of-the-art diodes with 5 Omega series resistances would have a loss of 1.4 dB at 90 GHz.

Comparison of Power Deposition by In-Phase 433 MHz and Phase-Modulated 915 MHz Interstitial Antenna Array Hyperthermia Systems

B.S. Trembly, A.H. Wilson, J.M. Havard, K. Sabatakakis and J.W. Strohbehn. "Comparison of Power Deposition by In-Phase 433 MHz and Phase-Modulated 915 MHz Interstitial Antenna Array Hyperthermia Systems." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 908-916.

The interstitial microwave antenna array hyperthermia (IMAAH) system produces a pattern of specific absorption rate (SAR) that is nonuniform within a 2 cm square array when driven in phase at 915 MHz. Phase modulation makes the time-averaged SAR pattern significantly more uniform in planes perpendicular to the antennas. To drive antennas in phase at 433 MHz similarly improves SAR uniformity when the antennas are of resonance length.

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Characteristic Impedance of a Coaxial System Consisting of Circular and Noncircular Conductors (Short Papers)

S.-G. Pan. "Characteristic Impedance of a Coaxial System Consisting of Circular and Noncircular Conductors (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 917-921.

A family of transmission lines is based on a circular conductor and a noncircular conductor. Two new types of equivalent eccentric coaxial lines, which give smooth transition between extremes of a small wire and a wire near contact, are presented. The results obtained are very simple analytical expressions which will be useful for fast computation or for the CAD of coaxial components. The accuracy of the expressions is confirmed by comparison with accurate numerical data.

Mode Stability of Radiation-Coupled Interinjection-Locked Oscillators for Integrated Phased Arrays (Short Papers)

K.D. Stephan and S.-L. Young. "Mode Stability of Radiation-Coupled Interinjection-Locked Oscillators for Integrated Phased Arrays (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 921-924.

An array of coupled oscillators can synthesize the microwave phase relationships needed for phased arrays by means of a technique known as interinjection locking. The mode required must be stable, and a general approach for evaluating mode stability and predicting frequency and phase relationships is applied to an experimental two-element 10 GHz array. Radiation coupling between the two oscillators leads to coherent operation, and the simple theory developed successfully predicts the system's behavior over a wide range of interoscillator distances.

Patent Abstracts (May 1988 [T-MTT])

"Patent Abstracts (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): 925-928.

Back Cover (May 1988 [T-MTT])

"Back Cover (May 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.5 (May 1988 [T-MTT] (Special Issue Commemorating the Centennial of Heinrich Hertz)): b1-b2.

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"Front Cover (Jun. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): f1-f2.

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A Rigorous Method for Computation of Ferrite Toroidal Phase Shifters

Y. Xu and G. Zhang. "A Rigorous Method for Computation of Ferrite Toroidal Phase Shifters." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 929-933.

In this paper, coupled wave theory is used to compute ferrite toroidal phase shifters. Computation results show that this method is very effective, rather simple, and easy to handle. As an example, a computation is carried out to analyze the twin toroidal model, which can be readily produced with considerably larger phase shift than the commonly used single toroidal model. Experimental results are in good agreement with theoretical analysis. Our research work shows that coupled wave theory is a powerful method for treating electromagnetic problems of waveguides loaded with magnetized ferrites.

Investigation of the Saturation Properties of Gyroamplifiers

D. Golomb, Y. Goren, A. Ron and J.L. Hirshfield. "Investigation of the Saturation Properties of Gyroamplifiers." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 934-938.

The saturation properties of a TE/sub 0n/ gyroamplifier are investigated using a particle in cell numerical code. The effect of beam velocity spread is analyzed. It is found that for velocity spread <= 5 percent the reduction in efficiency can be compensated by extending the interaction length. A numerical optimization of efficiency enhancement rising a tapered magnetic field is demonstrated. A change in the saturation mechanism from phase trapping to thermalization using the suggested tapering is observed.

Generalized Microstrip on a Dielectric Sheet

A.L. Holloway. "Generalized Microstrip on a Dielectric Sheet." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 939-951.

This paper describes a procedure for arriving at a close approximation to the capacitance between symmetrically placed conducting strips, possibly of different widths, on opposite sides of a dielectric sheet. The procedure is based on static methods, following Black and Higgins for total capacitance of the structure with vacuum dielectric everywhere, and employing Wheeler's method for determining the series component of dielectric capacitance. Dielectric polarization is included. Refraction at the vacuum/dielectric boundary is ignored in the derived method, but its effect is subsequently shown to be small. The derived equations are valid for all finite impedance, all values of relative dielectric constant, and all conductor widths. The maximum absolute error is estimated to be 0 (0.001·Z'), where Z' is the impedance of generalized microstrip on a dielectric sheet. The methods described have general application to open transmission lines on a dielectric sheet, for which the appropriate conformal transformations can be found.

A New Development of an Equivalent Circuit Model for Magnetostatic Forward Volume Wave Transducers

K. Yashiro and S. Ohkawa. "A New Development of an Equivalent Circuit Model for Magnetostatic Forward Volume Wave Transducers." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 952-960.

A new three-port equivalent circuit model of microstip transducers for the generation and detection of magnetostatic forward volume waves (MSFVW) is presented explicitly from fundamental physical considerations. In this circuit model, each microstrip of MSFVW transducers is expressed by a three-port circuit incorporating a series reactance, a lossless transformer, and a lossy transmission line. Circuit parameters are determined in closed forms by the use of solutions of pertinent boundary value problems. Hence, by virtue of the powerful and well-established methods of circuit theory, the three-port circuit can be directly applied to multibar microstrip transducers, of which configurations are of parallel bar, multibar pi, meander, etc. Furthermore, the effects of parasitic, for example, capacities of bonding pads, are also easily taken into account. Some typical configurations of transducers are analyzed numerically and compared with experimental results.

Accurate Characterization and Modeling of Transmission Lines for GaAs MMIC's

H.J. Finlay, R.H. Jansen, J.A. Jenkins and I.G. Eddison. "Accurate Characterization and Modeling of Transmission Lines for GaAs MMIC's." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 961-967.

The benefit of the spectral-domain hybrid mode approach in the design of multidielectric-media transmission lines is described. Using GaAs ring resonator techniques covering 2 to 24 GHz, accuracies in effective dielectric constant and loss of 1 percent and 15 percent respectively, are presented. By combining theoretical and experimental techniques, a generalized MMIC microstrip design data base is outlined.

The Propagation Characteristics of Signal Lines Embedded in a Multilayered Structure in the Presence of a Periodically Perforated Ground Plane

C.H. Chan and R. Mittra. "The Propagation Characteristics of Signal Lines Embedded in a Multilayered Structure in the Presence of a Periodically Perforated Ground Plane." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 968-975.

The propagation characteristics of waves along a periodic array of parallel signal lines in a multilayered structure in the presence of a periodically perforated ground plane are studied in this paper. The surface current density on the conductors is expressed in terms of a set of rooftop subdomain basis functions, and Galerkin's procedure is applied to derive a matrix eigenvalue equation for the propagation constant in a numerically efficient manner. The dispersion characteristics of these signal lines are studied for both the balanced and unbalanced excitations with the relative permittivities of the various layers as parameters. Numerical results are presented and compared with available data. Extension of the present method to treat conductors with finite sheet resistances is also included.

Frequency-Dependent Analysis of a Shielded Microstrip Step Discontinuity Using an Efficient Mode-Matching Technique

N.K. Uzunoglu, C.N. Capsalis and C.P. Chronopoulos. "Frequency-Dependent Analysis of a Shielded Microstrip Step Discontinuity Using an Efficient Mode-Matching Technique." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 976-984.

The frequency-dependent characteristics of microstrip step discontinuities are analyzed by employing a mode-matching technique. The fields on both sides of a discontinuity are expanded in terms of the normal hybrid modes of the shielded microstrip line. The properties of these hybrid modes are determined by applying a previously developed analytical approach using singular integral equation techniques. In addition to propagating modes, higher order modes are also taken into account. The higher order modes are evanescent-type waves. The propagation constants of the evanescent waves in general are found to be complex numbers. A mode-matching procedure is developed to determine the reflection and transmission coefficients of the discontinuity. The use of two types of products to treat the boundary conditions for the continuity of the tangential electric and magnetic fields results in a highly efficient and numerically stable solution. Numerical results are computed for several step discontinuities and the results are compared with previously published data.

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Multiway Uniform Combline Directional Couplers for Microwave Frequencies

S. Islam. "Multiway Uniform Combline Directional Couplers for Microwave Frequencies." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 985-993.

An improved optimization technique for multiway uniform forward directional couplers is presented using a previously published matrix theory of coupled transmission lines. With the help of the computer optimization method, microwave mode-interference combline directional couplers having an arbitrary number of lines can be designed for arbitrary power distribution. Theoretical designs ranging from two-way to nine-way couplers have been tested with success. The observed behavior of some of these couplers is briefly discussed. Typically these couplers exhibited octave bandwidth. A five-way design example of an equal power splitting combline coupler has been fabricated using an open microstripline configuration for operation within 1.6-3.2 GHz. The measured characteristics show good agreement with the computed values.

Design and Performance of a 215 GHz Pulsed Radar System

R.E. McIntosh, R.M. Narayanan, J.B. Mead and D.H. Schaubert. "Design and Performance of a 215 GHz Pulsed Radar System." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 994-1001.

The advent of high-power extended interaction oscillators and low-noise receivers in the 215 GHz frequency window has made it possible to design and operate radar systems at these wavelengths. This paper describes a high-power 215 GHz pulsed radar system developed for remote sensing applications that is capable of making backscatter measurements from terrain targets at ranges of several kilometers under normal atmospheric conditions. The paper also discusses system performance and calibration, together with measurements of snow backscatter coefficients made during early 1987.

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An Analytical Solution for the Coupled Stripline-Like Microstrip Line Problem

D. Homentcovschi, A. Manolescu, A.M. Manolescu and L. Kreindler. "An Analytical Solution for the Coupled Stripline-Like Microstrip Line Problem." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1002-1007.

An analytical method for determining the Maxwell's capacitance matrix of multiconductor coupled stripline-like microstrip lines in an inhomogeneous medium is presented. The method is based on conformal mapping and the theory of singular integral equations.

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Quasi-Static Analysis of a Microstrip Via Through a Hole in a Ground Plane

T. Wang, R.F. Harrington and J.R. Mautz. "Quasi-Static Analysis of a Microstrip Via Through a Hole in a Ground Plane." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1008-1013.

The equivalent circuit of a via which connects two semi-infinitely long transmission lines through a circular hole in a ground plane is considered. The pi-type equivalent circuit consists of two excess capacitances and an excess inductance. They are quasi-static quantities and thus are computed statically by the method of moments from the integral equations. The integral equations are established by introducing a sheet of magnetic current in the electrostatic case and a layer of magnetic charge in the magnetostatic case. Parametric plots of the excess capacitances, the excess inductance, and the characteristic admittance of the via are given for reference.

Magnetically Tunable Rectangular Waveguide E-Plane Integrated Circuit Filters

J. Uher, J. Bornemann and F. Arndt. "Magnetically Tunable Rectangular Waveguide E-Plane Integrated Circuit Filters." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1014-1022.

A rigorous field theory method is described for the computer-aided design of magnetically tunable E-plane metal insert filters, where the waveguide sections are symmetrically loaded with ferrite slabs, and for large-gap finline filters on a ferrite substrate. The design method is based on field expansion in suitably normalized eigenmodes which yields directly the modal scattering matrix of all discontinuities. The theory includes both higher order mode interaction and finite thickness of the metal inserts. Optimized data are given for magnetically tunable Ku-band metal insert and finline filter examples. The metal insert type achieves a tuning range of its operating midband from about 14.1 to 15.7 GHz. The theory is verified by measurements.

A Low-Distortion K-Band GaAs Power FET

T.S. Tan, K. Kotzebue, D.M. Braun, J. Centanni and D. McQuate. "A Low-Distortion K-Band GaAs Power FET." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1023-1032.

A K-band low-distortion GaAs power MESFET has been developed by incorporating a pulse-type channel doping profile using molecular beam epitaxial technology and a novel 0.3 µm T-shaped gate. The low-distortion FET's offer about 10 to 15 dBc improvement in second-harmonic distortion compared to devices fabricated on a uniformly doped active layer. Significantly larger power load-pull contours are obtained with the low-distortion devices, indicating the improved linearity of these devices. In an 8-20 GHz single-stage broad-band amplifier up to 10 dBc improvement in harmonic performance has been achieved using the low-distortion device. This low-distortion device exhibits very linear transconductance (G/sub m/) as a function of the gate bias (V/sub g/). A typical 750 µm gate width device is capable of 26 dBm of output power with 6 dB of gain, and power-added efficiency in excess of 35 percent when measured at 18 GHz. At 25 GHz the device is capable of 24 dBm of output power with 5 dB associated gain.

Low-Loss Twists in Oversized Rectangular Waveguide

J.L. Doane. "Low-Loss Twists in Oversized Rectangular Waveguide." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1033-1042.

Twists may be required in oversized rectangular waveguide used for low-loss transmission at the higher microwave and millimeter-wave frequencies. The unwanted mode conversion in such twists is calculated here from numerical integration of the coupled mode equations, considering simultaneous coupling of the five lowest order modes coupled in a twist. Twists with tapered or linearly varying rates of twist are shown to be superior in medium- or broad-band applications to those with uniform twist rate, such as those normally made commercially for single-mode waveguide. Some recent applications and designs for oversized rectangular waveguides are presented in [1]. Measurements consistent with these theoretical calculations are discussed for uniform twists in WR90 (0.9x0.4 in.) at 60 GHz and for an electroformed twist having a linearly tapered rate of twist in WR187 (1.872x0.872 in.) from 15.7 to 17.7 GHz. The coupling coefficients needed in the calculations are derived in an appendix and are compared with the results of other work, including a modal expansion of the dominant mode in twisted waveguide. A second appendix considers the transmission through an oversized waveguide with a mode converter generating a trapped unwanted mode, and derives the result for the dependence of the resonance depth on the mode conversion and the attenuation of the trapped mode.

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A Triple-Through Method for Characterizing Test Fixtures

R.P. Meys. "A Triple-Through Method for Characterizing Test Fixtures." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1043-1046.

Test fixtures for evaluating microwave components such as transistors or MMIC's consist of two "unmeasurable" sections, each having, for example, one coax and one microstrip terminal. A method is proposed for evaluating the S parameters of these sections through three conventional reflection/transmission measurements. It rests on the use of an auxiliary 2-port. No microstrip standard is needed, except for a load that is necessary if the SWR of the auxiliary 2-port is not low enough.

Abstracts

Miniature SAW Antenna Duplexer for 800-MHz Portable Telephone Used in Cellular Radio Systems

M. Hikita, Y. Ishida, T. Tabuchi and K. Kurosawa. "Miniature SAW Antenna Duplexer for 800-MHz Portable Telephone Used in Cellular Radio Systems." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1047-1056.

A new low-loss, high-power SAW filter has been developed for an antenna duplexer used in an 800-MHz portable telephone transceiver. The new ladder-type configuration uses SAW resonators and capacitors between electrode fingers and the earth. It is fabricated on a 2-mm-square LiTaO/sub 3/ chip. This configuration provides insertion loss as low as 1.0~1.2 dB and output power up to 2 W at 800 MHz. Experimental results of a miniature antenna duplexer module using this filter as a transmitter filter and the previously published high-performance SAW filters as receiver filters are also presented. This module also includes a receiver low-noise amplifier, yet its size is under 8 ml.

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A Directional Coupler of a Vertically Installed Planar Circuit Structure

Y. Konishi, I. Awai, Y. Fukuoka and M. Nakajima. "A Directional Coupler of a Vertically Installed Planar Circuit Structure." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1057-1063.

A new type of directional coupler is fabricated installing a second printed circuit board on a main board. Experimental results agree well with a numerical calculation based on the boundary element method. Compact and low-cost couplers can be created with a wide range of design parameters.

Analysis of Microstrip Circuits Using Three-Dimensional Full-Wave Electromagnetic Field Analysis in the Time Domain

T. Shibata, T. Hayashi and T. Kimura. "Analysis of Microstrip Circuits Using Three-Dimensional Full-Wave Electromagnetic Field Analysis in the Time Domain." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1064-1070.

Calculation of the frequency characteristics for microstrip circuits based on a three-dimensional full-wave electromagnetic field analysis in the time domain is proposed. In this method, the circuit is excited by a pulse which includes broadened frequency components. The frequency characteristics are then computed at once from the Fourier transform of the output transient responses. To evaluate the validity and capability of the method, a side-coupled microstrip filter is analyzed and the frequency characteristics are calculated. A quasi-static analysis of this filter is also presented and the results compared with measurements. The frequency characteristics calculated with the full-wave analysis in the time domain show excellent agreement with the measured values, thus demonstrating the validity and the power of the analytical method.

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Coplanar Waveguide and Slot Line on Magnetic Substrates: Analysis and Experiment

E.-B. El-Sharawy and R.W. Jackson. "Coplanar Waveguide and Slot Line on Magnetic Substrates: Analysis and Experiment." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1071-1079.

A full-wave analysis is presented for coplanar waveguide and slot line phase shifters on magnetic substrates. The analysis is based on a Green's function which is formulated using a transmission matrix approach. Different configurations are investigated with respect to their nonreciprocal phase shift properties. Measurements are presented for a coplanar waveguide etched on the surface of a rectangular ferrite toroid. Calculated and measured results are in good agreement.

The Propagation of Signals Along a Three-Layered Region: Microstrip

R.W.P. King. "The Propagation of Signals Along a Three-Layered Region: Microstrip." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1080-1086.

The tangential components of the electric field on the air- substrate surface of a three-layered region such as microstrip are determined when the source is a unit electric dipole on that surface. This is done by integrating the rigorous Hankel transforms subject to the condition k²/sub 0/ < |k²/sub 1/| << |k²/sub 2/|, where k/sub 0/ is the wavenumber of air, k/sub 1/ of the substrate, and k/sub 2/ of the conductor. It is found that the field consists of lateral-wave terms and direct-wave terms with different wavenumbers and phase velocities. The significance of these characteristics is discussed with reference to dispersion and coupling.

New Equivalent Circuits for Inhomogeneous Coupled Lines with Synthesis Applications

R. Levy. "New Equivalent Circuits for Inhomogeneous Coupled Lines with Synthesis Applications." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1087-1094.

Previously published equivalent circuit representations of parallel-coupled lines in an inhomogeneous medium by Zysman and Johnson are very complicated, and quite unsuitable for application in distributed filter synthesis. This defect was remedied in a previous (1984) conference paper by resynthesizing the circuits in a new and physically meaningful form. The theory is now extended to give an approximate but highly accurate synthesis of a 3:1 bandwidth inhomogeneous distributed high-pass filter realized in suspended substrate stripline. The new procedure is almost purely analytic, and computer-aided design is required only for fine tuning adjustments. Theoretical feasibility of designing such filters for upper pass bandwidths of greater than 8:1 is demonstrated.

Microwave Ferrite Toroidal Phase Shifter in Grooved Waveguide with Reduced Sizes (Short Papers)

Y. Xu. "Microwave Ferrite Toroidal Phase Shifter in Grooved Waveguide with Reduced Sizes (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1095-1097.

In this paper, ferrite toroidal phase shifters in grooved waveguide with reduced sizes are studied both theoretically and experimentally. The influences of the parameters of this model on the performance of the phase shifter are calculated and discussed. Theoretical analysis shows that, with proper choice of the dimensions of the waveguide and the toroid, the phase shifter may be made very broad band and the loss of the phase shifter may be reduced by 16 percent in relation to the case of the rectangular waveguides. Experimental results are in good agreement with theoretical.

Network Analyzer Calibration Using Offset Shorts (Short Papers)

G.J. Scalzi, A.J. Slobodnik, Jr. and G.A. Roberts. "Network Analyzer Calibration Using Offset Shorts (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1097-1100.

Microwave network analyzer accuracy enhancement by offset shorts is investigated. Usable calibration bandwidth and accuracy limitations are determined by applying a previously published model to the case of a reference short and two offset shorts. Data necessary to emulate the HP 8510 are derived and used in the model to provide realistic projections. A technique is presented for precise characterization of offset short standards.

On the Scalar Approximation in Fiber Optics (Short Papers)

C.-C. Su. "On the Scalar Approximation in Fiber Optics (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1100-1103.

It is widely accepted that the scalar approximation is valid when the gradient of the pemittivity distribution /spl nabla/ epsilon/epsilon is small enough. Such a condition is rather demanding, however, since it precludes a rapidly varying permittivity distribution, which is usually the case in a practical optical fiber, due to some kind of fluctuation in a fabrication process. In this investigation, we derive the scalar approximation from the electric field integral equation. From the result it is seen that the applicability of the scalar approximation does not depend on the roughness in the permittivity distribution so long as the permittivity in the core is close to that in the cladding.

Saturation of the SIS Mixer by Out-of-Band Signals (Short Papers)

L.R. D'Addario. "Saturation of the SIS Mixer by Out-of-Band Signals (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1103-1105.

The tendency of SIS mixers to saturate at low input signal levels is shown to depend on the total signal voltage across the junction, including frequency components outside the band of interest. If large dynamic range is to be achieved, mixers should be designed with embedding networks that present low impedances to the junction at out-of-band frequencies.

Variational Bound Analysis of a Discontinuity in Nonradiative Dielectric Waveguide (Short Papers)

J.C. Olivier and J.A.G. Malherbe. "Variational Bound Analysis of a Discontinuity in Nonradiative Dielectric Waveguide (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1105-1107.

This paper describes the application of the variational bound method to nonradiative dielectric waveguide for the analysis of scattering by a dielectric obstacle, in this case a rectangular, air-filled discontinuity in the dielectric center strip. Closed-form equations are obtained that can be used directly in the design of networks using reactive components, such as filters. Measured data agree well with the theoretical calculations.

Frequency Normalization of Constant Power Contours for MESFET's (Short Papers)

J.P. Mondal. "Frequency Normalization of Constant Power Contours for MESFET's (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1107-1110.

The constant power contours have been measured on MESFET's with different doping profiles over the frequency range 8-16 GHz for a fixed input power level at different bias points. At each frequency, the contours are normalized with respect to the load for maximum power output; within experimental accuracy, the normalization holds fairly well independent of frequency under certain limits.

GaAs Dual-Gate FET for Operation Up to K-Band (Comments)

H.-O. Vickes. "GaAs Dual-Gate FET for Operation Up to K-Band (Comments)." 1988 Transactions on Microwave Theory and Techniques 36.6 (Jun. 1988 [T-MTT]): 1111-1111.

In the above paper, the authors have discussed some fundamental properties of dual-gate FET's valid from X-band up to K-band.

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Power-Bandwidth Considerations in the Design of MESFET Distributed Amplifiers

S.N. Prasad, J.B. Beyer and I.-S. Chang. "Power-Bandwidth Considerations in the Design of MESFET Distributed Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1117-1123.

Quantitative procedures are given for the design of MESFET distributed amplifiers using series capacitors in the device gate circuits. It is shown that the choice of series capacitors allows the designer to trade gain for bandwidth while maintaining a given gain-bandwidth product. It is also shown that the input power capability can be increased by the use of series capacitors when the device pinch-off is the power limiting factor. Furthermore, this paper also shows how the addition of series capacitors enables one to increase the gate periphery of an amplifier, which results in an increase in power-bandwidth product.

Modeling of MODFET's

G. Salmer, J. Zimmermann and R. Fauquembergue. "Modeling of MODFET's." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1124-1140.

Accurate modeling of MODFET's and of certain novel structures recently proposed requires that a number of physical phenomena occurring in these devices be considered. Among these, some specific electron dynamic properties of the two-dimensional gas, the influence of deep levels of the doped AlGaAs layers, and the influence of the source parasitic access impedance are reviewed and discussed. The presently available models can roughly be sorted into three classes: the particle or Monte Carlo models, the two-dimensional solving methods of semiconductor equations, and the simpler one-dimensional or analytical models. After a brief review of the physical bases on which the models rely, their main capabilities and ranges of applicability are compared and discussed. Some conclusions are drawn as to the effort which must be developed in the near future in order to improve MODFET modeling. It is recommended that simulations of new devices such as SISFET's, multichannel structures, and pseudomorphic AlGaAs/InGaAs transistors be undertaken.

Simple Approximations for the Longitudinal Magnetic Polarizabilities of Some Small Apertures

N.A. McDonald. "Simple Approximations for the Longitudinal Magnetic Polarizabilities of Some Small Apertures." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1141-1144.

Simple approximations are given for the longitudinal magnetic polarizabilities of some small apertures of various shapes, as functions of the aperture width to length ratios. The shapes considered are the rectangle, diamond, rounded end slot, and ellipse, of which only the last has an exact solution.

Microwave Detection Using the Resonant Tunneling Diode

J.M. Gering, T.J. Rudnick and P.D. Coleman. "Microwave Detection Using the Resonant Tunneling Diode." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1145-1150.

A detailed experimental and theoretical study in the use of a resonant tunneling diode (RTD) as a microwave detector based upon its small-signal equivalent circuit model is presented. It is shown that the rectified current from the diode can be accurately predicted and that the diode can he operated as a reactive microwave detector which absorbs no microwave power. For this detection mode, a matching network which maximizes the applied ac voltage can be used.

A New Method for Determining the FET Small-Signal Equivalent Circuit

G. Dambrine, A. Cappy, F. Heliodore and E. Playez. "A New Method for Determining the FET Small-Signal Equivalent Circuit." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1151-1159.

A new method to determine the small-signal equivalent circuit of FET's is proposed. This method consists in a direct determination of both the extrinsic and intrinsic small-signal parameters in a low-frequency band. This method is fast and accurate, and the determined equivalent circuit fits the S-parameters very well up to 26.5 GHz.

Attenuation Measurement of Very Low Loss Dielectric Waveguides by the Cavity Resonator Method Applicable in the Millimeter/Submillimeter Wavelength Range

F.I. Shimabukuro and C. Yeh. "Attenuation Measurement of Very Low Loss Dielectric Waveguides by the Cavity Resonator Method Applicable in the Millimeter/Submillimeter Wavelength Range." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1160-1166.

A dielectric waveguide shorted at both ends is constructed as a cavity resonator. By measuring the Q of this cavity, one can determine the attenuation constant of the guided mode on this dielectric structure. The complex permittivity of the dielectric waveguide material can also be derived from the measurements. Measurements were made at Ka-band for dielectric waveguides constricted of nonpolar, low-loss polymers such as Teflon, polypropylene, polyethylene, polystyrene, and rexolite.

Abstracts

Modal Attenuation in Multilayered Coated Waveguides

R.-C. Chou and S.-W. Lee. "Modal Attenuation in Multilayered Coated Waveguides." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1167-1176.

Propagation and attenuation constants of low-order normal modes in a circular waveguide lined with lossy coating layers are calculated using a generalized dispersion equation. It is found that the use of multilayered coating can significantly enhance modal attenuations over a broader frequency range compared to that for a single-layer coated structure. For a cylinder with radius a = 2 lambda, the attenuation constants for the dominant modes are shown to increase by 20 dB per a by adding a lossless padding layer to a lossy magnetic coating. Application of this result in radar cross section (RCS) reduction is also discussed.

Abstracts

The Rigorous Analysis of Cascaded Step Discontinuities in Microstrip

C.J. Railton and T. Rozzi. "The Rigorous Analysis of Cascaded Step Discontinuities in Microstrip." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1177-1185.

A rigorous analysis of boxed microstrip single step discontinuities and cascades of strongly coupled discontinuities is presented. Use is made of a variational formulation involving the expansion of the transverse E field at the step in terms of suitable basis functions. Strongly coupled steps are analyzed using the concept of "localized" and "accessible" modes and making use of a network model. The method is applied to a five-section low-pass filter.

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Design Procedure for Inhomogeneous Coupled Line Sections

I.E. Losch and J.A.G. Malherbe. "Design Procedure for Inhomogeneous Coupled Line Sections." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1186-1190.

This paper presents design formulas and a procedure for the design of inhomogeneous coupled line sections as an approximation to a series open circuited stub for application in the realization of microwave pseudo high-pass filters. The accuracy of the design equations is evaluated through the design and test of a seventh-order filter and it is found that the formulation predicts the performance of the section well beyond the quarter-wave frequency.

Abstracts

Via Hole Studies on a Monolithic 2-20 GHz Distributed Amplifier

C. Yuen, S.G. Bandy, S. Salimian, C.B. Cooper, III, M. Day and G.A. Zdasiuk. "Via Hole Studies on a Monolithic 2-20 GHz Distributed Amplifier." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1191-1195.

The role of source inductance on the performance of a distributed amplifier is investigated. A simple theoretical analysis shows that optimum performance is obtained with as low a source inductance as possible (as would be intuitively expected), and that the flattest gain and minimum gate line attenuation occur with the inductance common to the whole amplifier rather than parceled out to each FET individually, as would occur for a MIC distributed amplifier. A novel through-the-wafer via hole process has been developed for a low-inductance contact on monolithic circuits. A 2-20 GHz variable-gate-width monolithic distributed amplifier fabricated with this via-hole grounding technique has demonstrated a 2 dB gain improvement as well as a flatter gain profile compared to that without via grounding. Evidence is presented that indicates that MMIC designs may not be as ideal as expected with regard to being typified by the common inductance case.

Noise Parameters of SIS Mixers

L.R. D'Addario. "Noise Parameters of SIS Mixers." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1196-1206.

It has been shown that very low noise receivers can be constructed at millimeter wavelengths by using mixers containing super-conducting tunnel junctions as the nonlinear elements. This is possible because of both the low intrinsic noise of these devices and their potential for high conversion gain. In this paper the quantum theory of mixing is used to derive the full noise parameters and small-signal parameters of sinusoidally pumped SIS junctions. These are then put into a form that allows the extensive theory of two-port linear networks to be brought to bear, allowing calculation of such useful parameters as minimum noise temperature, optimum source impedance, available (or exchangeable) gain at minimum noise, and stability factor. These quantities are properties of the pumped junction that do not depend on the source or load impedance, but do depend on the terminations at the image and harmonic sideband frequencies. The harmonic sidebands are taken to be shorted, and the image termination dependence is studied in detail. Numerical results are presented for both ideal (BCS theory) and practical (measured current-voltage characteristic) junctions. The noise parameters of the cascade connection of an SIS mixer and a (noisy) IF amplifier are considered, leading to a specification of the optimum coupling network between the two. Finally, it is noted that the SIS mixer is usually not unconditionally stable, but that oscillation can be avoided by careful design of the IF coupling network.

Finite-Element Formalism for Nonlinear Slab-Guided Waves

K. Hayata, M. Nagai and M. Koshiba. "Finite-Element Formalism for Nonlinear Slab-Guided Waves." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1207-1215.

A unified computer-aided numerical approach based on the finite-element method is developed for analyzing optical waves guided by dielectric stab waveguiding structures with arbitrary nonlinear media. In the formulations, both TE and TM polarizations are considered. For the TM case, the biaxial nature of nonlinear refractive index is considered without any approximation. Numerical results are presented for nonlinear TE and TM waves propagating in symmetric slab waveguides. The dependence of dispersion relations on the refractive-index profile of the film is also examined.

Expansions for the Capacitance of the Bowman Squares (Short Papers)

H.J. Riblet. "Expansions for the Capacitance of the Bowman Squares (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1216-1219.

Expansions are given for the capacitance per unit length for the geometry in which two infinite, square cylinders are placed concentric with each other and rotated so that the edges of the inner square are closest to the sides of the outer square.

A Coplanar Probe to Microstrip Transition (Short Papers)

D.F. Williams and T.H. Miers. "A Coplanar Probe to Microstrip Transition (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1219-1223.

A transition between a coplanar probe and a microstrip transmission line is reported. The transition is significant in that it does not require substrate via holes. A set of microstrip impedance standards were developed for the purpose of de-embedding the transition. The transition is suitable for measuring the S parameters of a number of low-cost monolithic microwave integrated circuits with coplanar probes.

Abstracts

Pulse Dispersion Distortion in Open and Shielded Microstrips Using the Spectral-Domain Method (Short Papers)

T. Leung and C.A. Balanis. "Pulse Dispersion Distortion in Open and Shielded Microstrips Using the Spectral-Domain Method (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1223-1226.

The spectral domain method is used to compute the effective dielectric constant [epsilon/sub r/sub eff//(f)] of open and shielded microstrip lines to analyze the dispersion distortion of short electrical pulses. Precise expressions for the longitudinal and transverse current distributions allow a high level of accuracy for epsilon/sub r/sub eff//(f). It is determined that computation time can be minimized for the open microstrip calculations by using the shielded microstrip formulation provided large dimensions for the conducting walls are taken.

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"Patent Abstracts (Jul. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1227-1231.

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Engineering Excellence (Advertisement) (Jul. 1988 [T-MTT])

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Accurate Characterization of an Inductive Strip in Finline

A. Biswas and B. Bhat. "Accurate Characterization of an Inductive Strip in Finline." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1233-1238.

The problem of an inductive strip in a finline cavity is solved by applying the transverse resonance technique. The choice of accurate basis functions for the slot field distributions has made possible an accurate determination of inductive strip discontinuity parameters. The computed results are shown to match well with the experiments and also with the experimental data available in the literature.

Volume Integral Equations for Analysis of Dielectric Branching Waveguides

K. Tanaka and M. Kojima. "Volume Integral Equations for Analysis of Dielectric Branching Waveguides." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1239-1245.

New forms of volume integral equations are developed for the exact treatment of wave propagation in two-dimensional dielectric branching waveguides. The new integral equations can be obtained by considering the condition at a point far away from the junction section. An approximate solution by the Born approximation and a numberical solution by the moment method established the validity of the new volume integral equations. The numerical results are discussed from the viewpoint of energy conservation and reciprocity. The solution is exact if sufficiently large computer memory and computational time are employed.

A Dispersion Formula Satisfying Recent Requirements in Microstrip CAD

M. Kobayashi. "A Dispersion Formula Satisfying Recent Requirements in Microstrip CAD." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1246-1250.

A dispersion formula, epsilon*/sub eff/(f) = epsilon* - {epsilon* - epsilon*/sub eff/(0)}/{1+ (f/f/sub 50/)/sup m/}, for the effective relative permittivity epsilon*/sub eff/(f) of an open microstrip line is derived satisfying recent CAD requirements. Closed-form computations with error less than 1 percent compared with numerical solutions are obtained. The frequency f/sub 50/ at which epsilon*/sub eff/(f/sub 50/) = {epsilon* + epsilon*/sub eff/(0)}/2 (the 50 percent dispersion point) is used as a normalizing frequency in the proposed formula, and an expression for f/sub 50/ is derived. In order to obtain the best fit of epsilon*/sub eff/(f) to the theoretical numerical model, the power m of the normalized frequency in the proposed formula is expressed as a function of w/h for w/h >= 0.7 and as a function of w/h, f/sub 50/, and f for w/h <= 0.7. The present formula has a high degree of accuracy, better than 0.6 percent in the range 0.1< w/h <= 10, 1< epsilon* <= 128, and any h/lambda/sub 0/.

Intermodulation Distortion Analysis Using a Frequency-Domain Harmonic Balance Technique

J.H. Haywood and Y.L. Chow. "Intermodulation Distortion Analysis Using a Frequency-Domain Harmonic Balance Technique." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1251-1257.

A simple approach to the technique of harmonic balance for nonlinear circuit analysis is presented. The algorithm operates solely in the frequency domain to simplify the resolution of the intermodulation products of two input tones with narrow frequency spacing. A description of the technique and its implementation is given. The harmonic and intermodulation products of a single FET amplifier are calculated and the results compared with a Volterra series analysis and experimentally measured values. A second single FET amplifier is analyzed to show the accuracy of the prediction of gain compression with this technique. The accuracy of this technique is shown to equal that of the Volterra series analysis used in the comparison. The ability of the frequency-domain technique to routinely analyze arbitrary circuit topologies, however, provides a definite advantage over the Volterra series method.

Basic Blocks for High-Frequency Interconnects: Theory and Experiment

H.-Y. Yang and N.G. Alexopoulos. "Basic Blocks for High-Frequency Interconnects: Theory and Experiment." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1258-1264.

Proximity-coupled open-end microstrip interconnects (transitions) in double-layer planar structures are investigated through the method of moments solution of integral equations. Two types of EMC (electromagnetically coupled) microstrip lines are considered, collinear lines and transverse lines. It is found that these interconnects are broad-band and provide wide range of coupling coefficient. The theoretical model for the transverse microstrip transition is in good agreement with measurements.

The Application of the Point Matching Method to the Analysis of Microstrip Lines with Finite Metallization Thickness

S. Kosslowski, F. Bogelsack and I. Wolff. "The Application of the Point Matching Method to the Analysis of Microstrip Lines with Finite Metallization Thickness." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1265-1271.

This paper presents an attempt to calculate the characteristics of a shielded microstrip line with finite metallization thickness by the point matching method (PMM). Numerical results are presented in order to assert the validity of this approach in cases of large values of strip width to thickness ratio. It is found that an increase in the strip thickness is always associated with difficulties in convergence. This can be easily recognized if the field distribution is taken into account.

Microstrip/Slotline Transitions: Modeling and Experimental Investigation

B. Schuppert. "Microstrip/Slotline Transitions: Modeling and Experimental Investigation." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1272-1282.

In this paper an analysis of microstrip/slotline transitions is given using a network description through transmission-line models. Different transitions, such as transitions containing uniform and nonuniform lines as well as soldered and virtually shorted microstrip lines, will be treated. The validity of the modeling results is verified experimentally by measuring the transmission coefficient of a cascade of two transitions separated by a slotline in the frequency range from 1 to 16 GHz. For practical applications, design curves are given for 0.635-mm-thick alumina substrates.

A Simplified Field Analysis of a Distributed IMPATT Diode Using Multiple Uniform Layer Approximation (Short Papers)

M. Matsumoto, M. Tsutsumi and N. Kumagai. "A Simplified Field Analysis of a Distributed IMPATT Diode Using Multiple Uniform Layer Approximation (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1283-1285.

A small-signal field analysis of a distributed IMPATT diode is presented. The active region of the diode is assumed to consist of a uniform avalanche layer and avalanche-free drift layers. The propagation constant and field distributions are obtained without numerical solution of differential equations, which is necessary in the analysis described in [9]. Some numerical results are given which show the dependence of the amplification characteristics on the thickness of the avalanche and drift layers.

The Effects of a Dielectric Capacitor Layer and Metallization on the Propagation Parameters of Coplanar Waveguide for MMIC (Short Papers)

R. Delrue, C. Seguinot, P. Pribetich and P. Kennis. "The Effects of a Dielectric Capacitor Layer and Metallization on the Propagation Parameters of Coplanar Waveguide for MMIC (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1285-1288.

The study of coupling phenomena between lines laid on semiconductor substrates in MMIC technologies and the determination of propagation effects on power FET require the characterization lines with micron transversal widths. For such lines, the influence of metallization thickness and dielectric cap layer on propagation properties can no longer be neglected. The purpose of this paper is to characterize these effects for the case of coplanar lines laid on semiconductor substrates.

An Observation on the Sommerfeld-Integral Representation of the Electric Dyadic Green's Function for Layered Media (Short Papers)

M.S. Viola and D.P. Nyquist. "An Observation on the Sommerfeld-Integral Representation of the Electric Dyadic Green's Function for Layered Media (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1289-1292.

The electric dyadic Green's function for layered dielectrics is discussed. It is well known that for the free-space electric dyadic Green's function /doublebar G//sub 0/ evaluation of the electric field at observation points within the source region requires specification of a "principal volume" along with the corresponding depolarizing dyad /doublebar L/. Special considerations are invoked for layered background media which are appropriate for the electromagnetics of integrated electronics. It is shown that use of the Sommerfeld-integral representation of the electric dyadic Green's function leads to an innate choice for the depolarizing dyad. A corresponding principal volume is subsequently identified; it is demonstrated that there exists an alternative choice for this excluding region which leads to the same depolarizing dyad.

The Inductance Matrix of a Multiconductor Transmission Line in Multiple Magnetic Media (Short Papers)

J.R. Mautz, R.F. Harrington and C.G. Hsu. "The Inductance Matrix of a Multiconductor Transmission Line in Multiple Magnetic Media (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1293-1295.

Consider a multiconductor transmission line consisting of N/sub c/ conducting cylinders in inhomogeneous media consisting of N/sub d/ homogeneous regions with permeabilities µ/sub i/, and permittivities epsilon/sub i/. The inductance matrix [L] for the line is obtained by solving the magnetostatic problem of N/sub c/ conductors in N/sub d/ regions with permeabilities µ/sub i/. The capacitance matrix [C] for the line is obtained by solving the electrostatic problem of N/sub c/ conductors in N/sub d/ regions with permittivities epsilon/sub i/. It is shown that [L] = µ/sub 0/epsilon/sub 0/[C']/sup -1/, where [C'] is the capacitance matrix of an auxiliary electrostatic problem of N/sub c/ conductors in N/sub d/ regions with relative permittivities set equal to the reciprocals of the relative permeabllities of the magnetostatic problem, i.e., epsilon'/sub i//epsilon/sub 0/ = µ/sub 0//µ/sub i/.

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"Patent Abstracts (Aug. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.8 (Aug. 1988 [T-MTT]): 1296-1300.

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"Front Cover (Sep. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): f1-f2.

Analysis of Coupled Cylindrical Striplines Filled with Multilayered Dielectrics

C.J. Reddy and M.D. Deshpande. "Analysis of Coupled Cylindrical Striplines Filled with Multilayered Dielectrics." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1301-1310.

A method of analysis for coupled cylindrical striplines filled with multilayered dielectrics is presented using a variational technique in the space domain. Coupled mode analysis is presented for the case of a pair of coupled circular arc strips arbitrarily located between cylindrical ground planes filled with multilayered dielectrics. An even- and odd-mode approach is used for the analysis of shielded cylindrically curved edge-coupled pairs of broad-side parallel strips (broad-side, edge-coupled cylindrical striplines). The effect of environmental changes on an otherwise planar structure is also studied by extending the present analysis to cylindrically warped coupled striplines.

Exploiting Structure Periodicity and Symmetry in Capacitance Calculations for Three-Dimensional Multiconductor Systems

R.-B. Wu and L.L. Wu. "Exploiting Structure Periodicity and Symmetry in Capacitance Calculations for Three-Dimensional Multiconductor Systems." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1311-1318.

The structure periodicity and symmetry usually encountered in the design and packaging of integrated circuits are utilized to dramatically alleviate the computation cost in the capacitance calculations for three-dimensional multiconductor systems by the integral equation method. For periodic structures, the region of unknowns is reduced to the base period by employing a modified Green's function which circumvents the periodicity singularity. For the structures with s orthogonal planes of symmetry, where s=1, 2, or 3, the region of unknowns is reduced to 1/2/sup s/ of the original whole space by the help of even- and odd-mode decomposition techniques. Both algorithms are embedded into a general three-dimensional capacitance calculation program by which a numerical calculation for the via capacitance in a multilayer ceramic environment is presented and compared with the experimental measurements.

Microstrip Circuit Applications of High-Q Open Microwave Resonators

K.D. Stephan, S.-L. Young and S.-C. Wong. "Microstrip Circuit Applications of High-Q Open Microwave Resonators." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1319-1327.

The problem of achieving a high circuit Q in hybrid and monolithic microwave integrated circuits becomes acute in the millimeter-wave range. An open microwave resonator can be formed above a planar microstrip substrate by suspending a spherical reflector above it. We develop a theory to account for the coupling between an open resonator mode and a microstrip line. The open resonator is shown to have useful circuit properties similar to a dielectric resonator, but with the potential of efficient operation well into the millimeter wave range. Experimental confirmation of the theory is demonstrated by a scale model of a microstrip-based single-pole bandpass filter, which shows a loaded Q of 860 and a minimum loss of 0.8 dB ±0.4 dB at 10 GHz.

On the Use of the Coulomb Gauge in Solving Source-Excited Boundary Value Problems of Electromagnetics

K.A. Michalski and R.D. Nevels. "On the Use of the Coulomb Gauge in Solving Source-Excited Boundary Value Problems of Electromagnetics." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1328-1333.

The advantages and difficulties associated with the use of the Coulomb gauge in solving source-excited boundary value problems of electromagnetic are examined. The correct dyadic Green's function for the Coulomb vector potential in a rectangular waveguide is derived to elucidate the discussion. A flaw in the usage of the Coulomb gauge in Smythe's Static and Dynamic Electricity is uncovered.

A Hybrid Representation of the Green's Function in an Overmoded Rectangular Cavity

D.I. Wu and D.C. Chang. "A Hybrid Representation of the Green's Function in an Overmoded Rectangular Cavity." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1334-1342.

A hybrid ray-mode representation of the Green's function in a rectangular cavity is developed using the finite Poisson summation formula. In order to obtain a numerically efficient scheme for computing the field generated by a point source in a large rectangular cavity, the conventional modal representation of the Green's function is modified in such a way that all the modes near resonance are retained while the truncated remainder of the mode series is expressed in terms of a weighted contribution of rays. For an electrically large cavity, the contribution of rays from distant images becomes small; therefore the ray sum can be approximated by one or two dominant terms without a loss of numerical accuracy. To illustrate the accuracy and the computational simplification of this ray-mode representation, numerical examples are included with the conventional mode series (summed at the expense of long computation time) serving as a reference.

Numerical Analysis of H-Plane Waveguide Junctions by Combination of Finite and Boundary Elements

K. Ise and M. Koshiba. "Numerical Analysis of H-Plane Waveguide Junctions by Combination of Finite and Boundary Elements." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1343-1351.

A new numerical method is formulated for the analysis of H-plane waveguide junctions with arbitrary cross sections. The junctions are loaded with arbitrarily shaped dielectric or ferrite. The method is a combination of the finite-element method and the boundary-element method where the finite-element method and the boundary-element method are applied to the regions with and without dielectric or ferrite, respectively. To show the validity and usefulness of the method, a lossy dielectric post and a ferrite slab in a rectangular waveguide are investigated in detail, and the computed results are compared with earlier theoretical and experimental results.

Analysis of Irregularities in a Planar Dielectric Waveguide

S.-J. Chung and C.H. Chen. "Analysis of Irregularities in a Planar Dielectric Waveguide." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1352-1358.

A numerical method based on the partial variational principle (PVP) is proposed to solve discontinuity problems due to arbitrary irregularities in a planar dielectric waveguide. In this study, a variational equation is established and solved by the finite element method along with the Green's function technique. The integral variable of the Green's function is changed so that numerical calculations can easily be performed. Owing to the accuracy of the present method, the radiation fields can be obtained with no difficulty. Several numerical results, including the reflection and transmission coefficients as well as the radiation losses and patterns, are calculated and compared.

Matched Windows in Circular Waveguide (Short Papers)

L. Carin, K.J. Webb and S. Weinreb. "Matched Windows in Circular Waveguide (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1359-1362.

Design curves are presented for the matching of a dielectric window in circular waveguide propagating the dominant TE/sub 11/ mode. The matching is accomplished by thick or thin inductive irises which are in contact with the window on both sides. This configuration gives wide bandwidth and is mechanically convenient, but requires consideration of coupling of the higher order modes generated by the closely spaced discontinuities. Mode matching and the generalized scattering matrix are utilized.

A New Lock Indicator Circuit for Microwave and Millimeter-Wave Phase Locked Loops (Short Papers)

J.B. Sau. "A New Lock Indicator Circuit for Microwave and Millimeter-Wave Phase Locked Loops (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1362-1366.

A new circuit useful as a lock detector in microwave PLL systems has been developed. This circuit avoids the quadrature phase detector or coherent amplitude detector commonly used as a lock indicator in PLL's, thereby reducing the microwave circuitry and components. It is based on the properties of the phase error signal coming from the phase detector; a frequency-voltage conversion is performed on it in a low-frequency (secondary) PLL, the input to which is the output of the phase detector in the main (microwave) PLL. The secondary VCO control signal gives, after a comparison, a logic level related to the lock condition in the main (microwave) PLL.

Abstracts

Polarization Effects on Microwave Imaging of Dielectric Cylinder (Short Papers)

T.-H. Chu. "Polarization Effects on Microwave Imaging of Dielectric Cylinder (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.9 (Sep. 1988 [T-MTT]): 1366-1369.

In this paper, theoretical and experimental studies of frequency-swept microwave imaging of an infinitely long lossless homogeneous dielectric cylinder illuminated by a right-hand circularly polarized (RHCP) plane wave are presented. The reconstructed polarization-dependent microwave image can be seen as embodying contributions from specular, axial, glory, and stationary ray components of the scattered field of the selected receiving polarization state. An automated microwave imaging system employing frequency and polarization diversity techniques is utilized to verify the theoretical and numerical results.

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Oliver Heaviside: Sage in Solitude (Advertisement) (Sep. 1988 [T-MTT])

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Engineering Excellence (Advertisement) (Sep. 1988 [T-MTT])

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Front Cover (Oct. 1988 [T-MTT])

"Front Cover (Oct. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): f1-f2.

A 3.2 GHz, 26 dB Wide-Band Monolithic Matched GaAs MESFET Feedback Amplifier Using Cascodes

W.T. Colleran and A.A. Abidi. "A 3.2 GHz, 26 dB Wide-Band Monolithic Matched GaAs MESFET Feedback Amplifier Using Cascodes." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1377-1385.

Feedback around cascode stages is demonstrated to be a useful means of making matched direct coupled amplifiers with higher bandwidths than afforded by conventional common source topologies. Design techniques are described for an amplifier which is capable of operation to dc and which exhibits a measured gain of 26 dB, a 3.2 GHz bandwidth, and a 2.5:1 VSWR in a 1 µm GaAs MESFET process. A novel adjustment scheme is introduced whereby the amplifier's frequency response can be modified via a dc bias voltage to ensure stable circuit operation in spite of MESFET modeling inaccuracies and GaAs processing variations.

Abstracts

Strongly Convergent Green's Function Expansions for Rectangularly Shielded Microstrip Lines

J.G. Fikioris, J.L. Tsalamengas and G.J. Fikioris. "Strongly Convergent Green's Function Expansions for Rectangularly Shielded Microstrip Lines." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1386-1396.

The exact analytical treatment of the quasi-TEM mode in various cross-sectional configurations of microstrip lines may be based on Carleman-type singular integral equations (SIE's). Their kernel is a Laplacian Green's function G with source point limited on the interface separating the dielectric media. Strongly convergent expansions for G, particularly suited for the subsequent solution of the SIE and for exact field-point evaluations in rectangularly shielded microstrip configurations, are developed. Extraction of the singular logarithmic term leads to rapidly converging series expansions for the nonsingular part. The convergence of certain of these series is further improved when the field point lies also on the interface or when the source point approaches the shielding boundaries. In the first case, occurring typically in the kernel of integral equations, the Watson transformation provides alternative and exponentially convergent expansions for series converging slowly in the original G expression; in the second case, image source terms are further extracted out of G, leading to improved expansions for its remaining part. Numerical evaluations and comparisons illuminating these points are included.

High-Frequency Periodic Time-Domain Waveform Measurement System

M. Sipila, K. Lehtinen and V. Porra. "High-Frequency Periodic Time-Domain Waveform Measurement System." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1397-1405.

A system is presented for the accurate measurement of high-frequency periodic time-domain voltage and current waveforms of a nonlinear microwave device. The measurements are performed in the time domain using a high-speed sampling oscilloscope. The results are Fourier transformed into the frequency domain for error correction and then back into the time domain. An error correction algorithm is presented enabling one to obtain accurate waveforms in spite of nonideal system components. Practical difficulties in measurement system characterization are also discussed. An accurate circuit model for the measurement fixture is developed and its element values are determined. Measurement results are given showing the waveforms in a microwave transistor operated in the nonlinear region. The errors caused by signal processing are discussed.

Normalized Transverse Current Distributions of Microstrip Lines on Anisotropic Substrates

M. Kobayashi and H. Momoi. "Normalized Transverse Current Distributions of Microstrip Lines on Anisotropic Substrates." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1406-1410.

The normalized transverse current distributions are obtained for microstrip lines on anisotropic substrates and their dependence on epsilon*/sub y/, w/h, and the anisotropy ratio AR is explained. These distributions are classified into five cases. There are the cases in which the normalized transverse current distribution can be approximated by that obtained already for the cases of isotropic substrate.

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Modeling of the Transverse Delays in GaAs MESFET's

A.K. Goel and C.R. Westgate. "Modeling of the Transverse Delays in GaAs MESFET's." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1411-1417.

When a signal is applied to the gate electrode in a MESFET, the depletion layer under the gate is not formed instantaneously, resulting in additional propagation delays. We have developed a comprehensive model of these delays in the GaAs MESFET's. The MESFET has been modeled as two lossy transmission lines coupled to each other via the gate-drain capacitances. In addition to the intrinsic MESFET elements, e.g. the internal capacitances and the internal resistances, the model also includes the gate and drain metallization resistances, source and drain contact resistances, and the electrode parasitic capacitances in the MESFET. The electrode capacitances were determined by using the method of moments in conjunction with a Green's function appropriate for the geometry of the MESFET. The model has been used to study the dependence of the delay time and the rise time on the gate length, device width, and resistivity of the gate material. Results can be used for the optimization of high-speed circuits, in particular, picosecond circuits.

Microwave-Induced Auditory Effect in a Dielectric Sphere

N.K. Uzunoglu and S.I. Polychronopoulos. "Microwave-Induced Auditory Effect in a Dielectric Sphere." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1418-1425.

The acoustic pressure wave generation inside an electromagnetically lossy dielectric sphere from an incident microwave pulse is analyzed rigorously. The pressure wave equation, derived by using the first-order approximation of a thorough formulation on microwave-induced thermoacoustic effect in dielectrics, is employed. The inhomogeneous hyperbolic type pressure wave differential equation is solved by employing a Green's function theory approach. The inhomogeneous term of this equation is proportional to the time derivative of the absorbed power (P) per unit volume inside the sphere. The boundary conditions on the dielectric sphere-air interface are taken into account. The power P is computed by applying the exact Mie theory solution for the dielectric sphere. Two types of acoustic waves are derived inside the sphere: a) a transient burst type pressure wave, corresponding to the free-space contribution of Green's function, and b) an infinite set of damped oscillations related to the normal acoustic modes of the spherical resonator. Numerical results are computed and presented for several cases.

A New Algorithm for the Wide-Band Analysis of Arbitrarily Shaped Planar Circuits

P. Arcioni, M. Bressan and G. Conciauro. "A New Algorithm for the Wide-Band Analysis of Arbitrarily Shaped Planar Circuits." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1426-1437.

A new algorithm for the wide-band analysis of the two-dimensional model of a planar circuit is described. The planar circuit is considered to be enclosed in a regularly shaped (rectangular or circular) resonator, and the electric and magnetic fields are derived from the Green's functions of this resonator by integrating over the periphery of the circuit not coinciding with the regular shape. The special form used for the Green's fuuctions makes it possible to derive the Z parameters in a special form, similar to Foster's series, but converging much more rapidly. The calculation requires the determination of a reduced number of resonances of the planar circuit, which are obtained by an integral equation approach leading to a linear eigenvalue problem. The algorithm was implemented in an efficient CAD routine, named ANAPLAN, which is briefly described.

The Determination of the Electromagnetic Field and SAR Pattern of an Interstitial Applicator in a Dissipative Dielectric Medium

Y. Zhang, N.V. Dubal, R. Takemoto-Hambleton and W.T. Joines. "The Determination of the Electromagnetic Field and SAR Pattern of an Interstitial Applicator in a Dissipative Dielectric Medium." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1438-1444.

The spatial distribution of microwave energy absorbed per unit mass (the specific absorption rate, or SAR) in biological tissue is calculated for a class of interstitial antennas. The insulated interstitial applicator is simulated as an asymmetrically driven antenna. An expression for the electric field intensity near the antenna is derived and calculated by direct numerical evaluation of a surface integral over the insulation. The predicted SAR patterns obtained using the calculated electric field intensity and the tissue conductivity agree very well with the measured SAR distributions around three different applicators in muscle-equivalent phantoms.

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Distributed Equivalent Sources for the Analysis of Multiconductor Transmission Lines Excited by an Electromagnetic Field (Short Papers)

A.C. Cangellaris. "Distributed Equivalent Sources for the Analysis of Multiconductor Transmission Lines Excited by an Electromagnetic Field (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1445-1448.

The interaction of multiconductor lines with electromagnetic radiation is commonly studied in terms of field-induced voltage and current sources distributed along the line. This paper presents the relationships between these sources and the incident fields for the general case of a transmission line with its conductors embedded in different dielectric volumes of arbitrary shape. It is shown that the sources can be expressed directly in terms of the incident fields and some vector parameters which are determined from the solution of a series of electrostatic problems with appropriate boundary conditions independent of the incident electric fields.

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Abstracts

Experimental Studies of the Peak Power-Handling Capacity of Finlines at Centimeter and Millimeter Wavelengths (Short Papers)

M.M. Ney, W. Yue and W.J.R. Hoefer. "Experimental Studies of the Peak Power-Handling Capacity of Finlines at Centimeter and Millimeter Wavelengths (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1448-1451.

The microwave and millimeter-wave field breakdown in various unilateral finlines is investigated experimentally. First, experiments in the X- and Ku-band are described to study the breakdown phenomenon and its effects on the structure. Then, experimental values of the maximum transmissible peak power are compared with the theoretical predictions. Experimental results confirm the validity of the theoretical model, within a reasonable limit, when the uncertainties produced by the various parameters pertaining to the electric breakdown phenomenon are taken into account.

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An Evanescent-Mode Tester for Ceramic Dielectric Substrates (Short Papers)

G. Kent. "An Evanescent-Mode Tester for Ceramic Dielectric Substrates (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1451-1454.

The TE/sub 01/ mode in a cylindrical waveguide at a frequency below cutoff is used to probe a ceramic dielectric substrate located on the central plane between input and output coupling loops. Maximum transmission occurs at a frequency determined by the waveguide radius, the substrate thickness, and the dielectric constant, The dielectric constant and loss tangent are obtained from the resonant frequency and the absorption bandwidth. The measurement is insensitive to the position of the substrate in the gap between waveguide sections, and no intimate contact is required.

Resonant Frequencies of Dielectric Resonators Containing Guided Complex Modes (Short Papers)

C. Chen and K.A. Zaki. "Resonant Frequencies of Dielectric Resonators Containing Guided Complex Modes (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1455-1457.

It is shown that unless complex modes are included in the mode matching analysis to determine the resonant frequencies of dielectric-loaded resonators, some resonant frequencies could be missed. Field distributions, mode charts, and mode coefficients of dielelectric-loaded resonators in which complex modes exist are presented. Experimental measurements for the verification of the computed results are presented and show good agreement with theory.

Sidelobe Suppression in Low and High Time-Bandwidth Products of Linear FM Pulse Compression Filters (Comments)

M.K. Roy. "Sidelobe Suppression in Low and High Time-Bandwidth Products of Linear FM Pulse Compression Filters (Comments)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1458-1458.

In the above paper, the authors have computed sidelobe suppression of linear FM pulse compression filters using Hamming weighting functions. They claim to have extended previous results of some other authors from a time-bandwidth (TB) product of 50 to 720. Although they refer to surface acoustic wave (SAW) chirp filters, the calculations do not explicitly show any SAW device parameters.

Abstracts

Three-Dimensional Finite, Boundary, and Hybrid Element Solutions of the Maxwell Equations for Lossy Dielectric Media (Comments and Reply)

C.W. Crowley, P.P. Silvester and D.R. Lynch. "Three-Dimensional Finite, Boundary, and Hybrid Element Solutions of the Maxwell Equations for Lossy Dielectric Media (Comments and Reply)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1459-1459.

We would like to offer art observation on the interesting paper by Paulsen, Lynch, and Strohbehn. Specifically, we would like to point out a potential source of error with the finite element analysis of the vector wave equation. The difficulty is perhaps better known in the context of vector eigenvalue problems, rather than in externally driven problems such as those considered by the authors.

Properties of Shielded Cylindrical Quasi-TE/sub 0nm/-Mode Dielectric Resonators (Corrections)

J. Krupka. "Properties of Shielded Cylindrical Quasi-TE/sub 0nm/-Mode Dielectric Resonators (Corrections)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1459-1459.

In the above paper formula (6) should read:

Design of Ferrite-Impregnated Plastics (PVC) as Microwave Absorbers (Corrections)

V.K. Varadan, V.V. Varadan, Y. Ma and W.F. Hall. "Design of Ferrite-Impregnated Plastics (PVC) as Microwave Absorbers (Corrections)." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1460-1460.

In the above paper, eq. (19) should be correctly written as...

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"Patent Abstracts (Oct. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1461-1464.

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Call for Papers - FET Structures and Their Circuit Applications (Oct. 1988 [T-MTT])

"Call for Papers - FET Structures and Their Circuit Applications (Oct. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1465-1465.

Call for Papers - 1989 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium (Oct. 1988 [T-MTT])

"Call for Papers - 1989 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium (Oct. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1466-1466.

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"LEOS '88 Annual Meeting (Advertisement) (Oct. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1467-1467.

1987 Index to IEEE Publications (Advertisement) (Oct. 1988 [T-MTT])

"1987 Index to IEEE Publications (Advertisement) (Oct. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.10 (Oct. 1988 [T-MTT]): 1468-1468.

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Front Cover (Nov. 1988 [T-MTT])

"Front Cover (Nov. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): f1-f2.

Temperature Variable Noise and Electrical Characteristics of Au-GaAs Schottky Barrier Millimeter-Wave Mixer Diodes

H.H.G. Zirath, S.M. Nilsen, H. Hjelmgren, L.P. Ramberg and E.L. Kollberg. "Temperature Variable Noise and Electrical Characteristics of Au-GaAs Schottky Barrier Millimeter-Wave Mixer Diodes." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1469-1475.

Gold-gallium arsenide Schottky barrier diodes on MBE-grown epitaxial gallium arsenide intended for cryogenic mm-wave mixer applications have been fabricated and characterized. The Schottky barriers were formed either by pulse plating or by in situ evaporation in the MBE system after the epitaxial growth. The equivalent temperature theta as derived from the current-voltage characteristic (equal to the ideality factor eta times the physical temperature T/sub 0/), important for low noise, is considerably lower at high current densities and cryogenic temperature as compared with the more commonly used Pt-GaAs Schottky diode. Noise generation mechanisms are investigated as a function of forward bias and temperature. At cryogenic temperature we obtained at best an equivalent noise temperature of 22 K at 4 GHz for dc-biased diode, which to our knowledge is the lowest reported for GaAs diodes. Results from mixer measurements at millimeter wavelengths and cryogenic temperature are presented and discussed.

Computer-Aided Design Models for Broadside-Coupled Striplines and Millimeter-Wave Suspended Substrate Microstrip Lines

P. Bhartia and P. Pramanick. "Computer-Aided Design Models for Broadside-Coupled Striplines and Millimeter-Wave Suspended Substrate Microstrip Lines." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1476-1481.

The paper presents computer-aided design models for broadside-coupled striplines and suspended substrate microstrip lines. The models have been obtained from the results of conformal transformation on homogeneous stripline, the equivalence of the odd-mode with the quasi-TEM mode of covered microstrip line, and logarithmic regression of spectral-domain results. The models can take the effects of finite strip thickness into account. The present models will be vital to the CAD of microwave and millimeter-wave filters, couplers, dc blocks, and various other circuits.

Computer-Aided Design of Microstrip Filters by Iterated Analysis

G.T. Roan and K.A. Zaki. "Computer-Aided Design of Microstrip Filters by Iterated Analysis." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1482-1487.

An iterative method for the design of microstrip low-pass elliptic function filters is described. The method, which is a direct extension of [1], determines the microstrip line parameters that produce the same locations of the frequencies of transmission zeros and reflection zeros of an equivalent lumped-element prototype. Effects of the discontinuities at the junctions are easily accounted for in the iteration. A design example is included, and an experimental seventh-order filter designed and constructed using the procedure gives measured results which agree closely with theory.

Reflection and Transmission Operators for Strips or Disks Embedded in Homogeneous and Layered Media

W.C. Chew and L. Gurel. "Reflection and Transmission Operators for Strips or Disks Embedded in Homogeneous and Layered Media." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1488-1497.

In this paper, we introduce a new notation to simplify the solution of scattering by strips or disks. We make use of vector Fourier transforms and introduce a double dot product for inner products in an uncountably infinite dimensional linear vector space. We characterize the scattering by a strip or a disk with a reflection operator and a transmission operator that relate the continuum of scattered waves to a continuum of incident waves. After the reflection operator for a single strip or disk is derived, we show how the reflection operator for a strip or disk in the presence of another reflecting medium, e.g., a layered medium, can be derived. The scattering by N strips or disks in a homogeneous medium is also discussed. Next, we derive the reflection operator for an embedded strip or disk in a layered medium. The method can be generalized to N strips or disks embedded in a layered medium and to a slot or an aperture. These operators have applications in a number of scattering, guidance, and resonance problems. In the paper that follows this one, we shall show how such concepts can be used to formulate the guidance and resonance problems involving N strips or disks whose reflection operator is known.

Guidance or Resonance Conditions for Strips or Disks Embedded in Homogeneous and Layered Media

L. Gurel and W.C. Chew. "Guidance or Resonance Conditions for Strips or Disks Embedded in Homogeneous and Layered Media." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1498-1506.

We illustrate how the guidance or resonance conditions of strips or disks embedded in layered media can be formulated easily rising a new notation we developed. We show that once we know the reflection operator of a reflecting medium, we can find the guidance or resonance conditions of this structure quite easily. We can also find the guidance or resonance conditions when the reflecting medium is interacting with another strip or disk. We illustrate this with the calculations of the guidance of a microstrip line with an infinite ground plane and with a finite ground plane. Our results for the infinite ground plane case agree very well with previous calculations on these problems, while the results for the finite ground plane case are new.

Millimeter-Wave Diode-Grid Frequency Doubler

C.F. Jou, W.W. Lam, H.Z. Chen, K.S. Stolt, N.C. Luhmann, Jr. and D.B. Rutledge. "Millimeter-Wave Diode-Grid Frequency Doubler." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1507-1514.

Monolithic diode grids have been fabricated on 2-cm square gallium-arsenide wafers in a proof-of-principle test of a quasi-optical varactor millimeter wave frequency multiplier array concept. An equivalent circuit model based on a transmission-line analysis of plane wave illumination was applied to predict the array performance. The doubler experiments were performed under far-field illumination conditions. This approach facilitates detailed comparison between theory and experiment. A second harmonic conversion efficiency of 9.5 percent and output powers of 0.5 W were achieved at 66 GHz when the diode grid was pumped with a pulsed source at 33 GHz. This grid had 760 Schottky barrier varactor diodes. The average series resistance was 27 omagas, the minimum capacitance was 18 fF at a reverse breakdown voltage of -3 V. The measurements indicate that the diode grid is a feasible device for generating watt-level powers at millimeter frequencies, and that substantial improvement is possible by improving the diode breakdown voltage. The excellent agreement between experiment and the predictions of the theoretical model provide confidence in predictions of achievable CW output power levels of 2.5 W at a frequency of 188 GHz with an edge-cooled grid containing 1000 diodes.

Interperiod Capacitance Calculations for Three-Dimensional Multiconductor Systems

R.-B. Wu. "Interperiod Capacitance Calculations for Three-Dimensional Multiconductor Systems." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1515-1520.

A novel approach is proposed to facilitate the capacitance calculations for periodic three-dimensional multiconductor systems. Based on the Fourier transform technique, the approach requires only the conductors inside one period and solves the charge distribution in the spectial domain by the integral equation method. The resultant spectral capacitances are then inverse transformed to give the capacitances between any two conductors, which may even be inside different periods. The approach is finally applied to the capacitance analysis for connector pins in a packaging board design.

A Broad-Band Microwave Superconducting Thin-Film Transformer

D.P. McGinnis and J.B. Beyer. "A Broad-Band Microwave Superconducting Thin-Film Transformer." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1521-1525.

The design, construction, and testing of a broad-band superconducting transformer based on a Dolph-Chebyshev distribution is described. The transformer is completely compatible with thin-film circuit topologies and allows access to 50 Omega coaxial launchers. The transformer is a taper that utilizes only one side of the substrate and features a coplanar waveguide to microstrip transition without the use of via holes. The taper provides a characteristic impedance transformation from 50 Omega to 2 Omega over a frequency range from 5 to 15 GHz. The taper provides a much larger bandwidth than a linear taper with the same length and impedance transformation.

Design and Fabrication of a Nonradiative Dielectric Waveguide Circulator Mode Ferrite (Short Papers)

H. Yoshinaga and T. Yoneyama. "Design and Fabrication of a Nonradiative Dielectric Waveguide Circulator Mode Ferrite (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1526-1529.

A technique for constructing a high-performance nonradiative dielectric waveguide (NRD guide) circulator for use at 50 GHz has been developed. A novel type of mode suppressor, which serves to reduce unwanted modes to a negligible level, has been devised and used to improve circulator performance significantly. A half-wavelength step transformer was installed at each port of the circulator to increase the operational bandwidth. The insertion loss of this fabricated circulator is less than 0.3 dB, and the 20 dB isolation bandwidth is about 2.6 GHz. Characteristics of the NRD guide circulator are analyzed based on an equivalent circuit representation. This analysis considerably facilitates the design procedure of the circulator.

Thick Circular Iris in a TE/sub 11/ Mode Circular Waveguide (Short Papers)

R.W. Scharstein and A.T. Adams. "Thick Circular Iris in a TE/sub 11/ Mode Circular Waveguide (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1529-1531.

The TE/sub 11/ mode excitation of a concentric circular iris of finite thickness in a circular waveguide is analyzed by Galerkin's method with even and odd excitation. Agreement between calculated and measured dominant mode scattering parameters is generally within experimental accuracy.

A Novel Type of Waveguide Polarizer with Large Cross-Polar Bandwidth (Short Papers)

E. Lier and T. Schaug-Pettersen. "A Novel Type of Waveguide Polarizer with Large Cross-Polar Bandwidth (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1531-1534.

In this paper a new wide-band quarter-wave polarizer is presented having a rectangular cross section, where all four walls are loaded with a dielectric or artificial dielectric. A much larger bandwidth compared to existing polarizers can be obtained without increasing the insertion loss. A polarizer has been measured with differential phase shift within 90°± 0.7° corresponding to 44 dB isolation, insertion loss below 0.06 dB, and return loss below -24 dB (VSWR <1.13) over the frequency band 10.95 to 14.50 GHz.

Simulation of Optically Injection-Locked Microwave Oscillators Using a Novel Spice Model (Short Papers)

D. Warren, J.M. Golio and E. Johnson. "Simulation of Optically Injection-Locked Microwave Oscillators Using a Novel Spice Model (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1535-1539.

Optical injection locking of GaAs FET microwave oscillators has been examined experimentally as well as by using two different optical interaction models. A novel first-order interaction model which utilizes a standard version of SPICE has been developed which produces predictions of injection locking range in excellent agreement with measured results.

p-i-n Diode Attenuator with Small Phase Shift (Comments)

K.W. Lo and T.B. Vu. "p-i-n Diode Attenuator with Small Phase Shift (Comments)." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1540-1540.

The experimental result of the paper in question showed that the spurious phase shift of a 9 GHz microstrip p-i-n diode attenuator could be reduced to 0.75°/dB attenuation at 20 dB attenuation or 0.17°/dB attenuation if the maximum attenuation was limited to 15 dB. The authors concluded that the result was better than that of previously published p-i-n diode attenuators.

Abstracts

Patent Abstracts (Nov. 1988 [T-MTT])

"Patent Abstracts (Nov. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1541-1545.

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Call for Papers - FET Structures and Their Circuit Applications (Nov. 1988 [T-MTT])

"Call for Papers - FET Structures and Their Circuit Applications (Nov. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1546-1546.

Call for Papers - 1989 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium (Nov. 1988 [T-MTT])

"Call for Papers - 1989 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium (Nov. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1547-1547.

Principles of Computerized Tomographic Imaging (Advertisement) (Nov. 1988 [T-MTT])

"Principles of Computerized Tomographic Imaging (Advertisement) (Nov. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): 1548-1548.

Back Cover (Nov. 1988 [T-MTT])

"Back Cover (Nov. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.11 (Nov. 1988 [T-MTT]): b1-b2.

Front Cover (Dec. 1988 [T-MTT])

"Front Cover (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): f1-f2.

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Table of Contents (Dec. 1988 [T-MTT])

"Table of Contents (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1549-1550.

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Editor's Overview (Dec. 1988 [T-MTT])

H.C. Paczkowski. "Editor's Overview (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1551-1551.

The 1988 IEEE MTT-S International Microwave Symposium, held in New York City, was highly successful, as exemplified by the technical quality of the papers that were presented during the three days of the Symposium. A record number of papers had been presented, as indicated by Chuck Buntschuh's review article on Microwaves - Past, Present, and Future appearing in this issue. In addition, a total of 82 expanded manuscripts were submitted for possible inclusion in this Special Issue of the Transactions. Critical culling by the Review Committee resulted in the 41 technical papers published in this journal. Several papers required revisions which could not be completed in time to be included in this issue, and some of these should appear in future regular issues of the Transactions.

Abstracts

Reviewers for This Special Issue (Dec. 1988 [T-MTT])

"Reviewers for This Special Issue (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1552-1552.

The 1988 MTT-S International Microwave Symposium (Dec. 1988 [T-MTT])

C. Buntschuh. "The 1988 MTT-S International Microwave Symposium (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1553-1560.

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.

1988 MTT-S Awards (Dec. 1988 [T-MTT])

"1988 MTT-S Awards (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1561-1566.

1988 IEEE MTT-S International Microwave Symposium Keynote Address

F.A. Brand. "1988 IEEE MTT-S International Microwave Symposium Keynote Address." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1567-1577.

Good morning, friends. I am both pleased and honored to be here with you today and to have an opportunity to share some of my thoughts, opinions, and prejudices about our industry as we look ahead to the future.

Special Session in Honor of Professor Arthur A. Oliner (Dec. 1988 [T-MTT])

S.-T. Peng. "Special Session in Honor of Professor Arthur A. Oliner (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1578-1581.

A special retrospective session in honor of Professor Arthur A. Oliner of Polytechnic University was held at the 1988 IEEE MTT-S International Microwave Symposium on Wednesday morning, May 25, 1988, at which many of Prof. Oliner's basic contributions to microwave theory and techniques were summarized in the context of their relevance to present-day needs. This was the first time a session of this type was held at a Microwave Symposium.

1988 MTT-S and Monolithic Circuits Symposia (Table of Contents) (Dec. 1988 [T-MTT])

"1988 MTT-S and Monolithic Circuits Symposia (Table of Contents) (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1582-1592.

Nonlinear GaAs MESFET Modeling Using Pulsed Gate Measurements (Dec. 1988 [T-MTT])

M. Paggi, P.H. Williams and J.M. Borrego. "Nonlinear GaAs MESFET Modeling Using Pulsed Gate Measurements (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1593-1597.

The effects of traps in GaAs MESFET's are studied using a pulsed gate measurement system. The devices are pulsed into the active region for a short period (typically 1 µs) and are held in the cutoff region for the rest of a 1 ms period. While the devices are on, the drain current is sampled and a series of "pulsed gate" I-V curves are obtained. The drain current obtained under the pulsed gate conditions for a given V/sub gs/ and V/sub ds/ gives a better representation of the instantaneous current for a corresponding V/sub gs/ and V/sub ds/ in the microwave cycle because of the effects of traps. The static and pulsed gate curves were used in a nonlinear time-domain model to predict harmonic current. The results showed that analysis using pulsed gate curves yielded better predictions of harmonic distortion than analysis based on conventional static I-V curves under large-signal conditions.

High-Performance Ka-Band and V-Band HEMT Low-Noise Amplifiers

K.H.G. Duh, P.-C. Chao, P.M. Smith, L.F. Lester, B.R. Lee, J.M. Ballingall and M.-Y. Kao. "High-Performance Ka-Band and V-Band HEMT Low-Noise Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1598-1603.

Quarter-micron-gate-length high electron mobility transistors (HEMT's) developed in our laboratory have exhibited state-of-the-art low-noise performance at millimeter-wave frequencies, with minimum noise figures of 1.2 dB at 32 GHz and 1.8 dB at 60 GHz. At Ku-band, two-stage and three-stage HEMT low noise amplifiers have demonstrated noise figures of 1.7 and 1.9 dB, respectively, with associated gains of 17.0 and 24.0 dB at 32 GHz. At V-band, two-stage and three-stage HEMT amplifiers yielded noise figures of 3.2 and 3.6 dB, respectively, with associated gains of 12.7 and 20.0 dB at 60 GHz. The 1 dB gain compression point of all the amplifiers is greater than +6 dBm. These results clearly show the potential of short-gate-length HEMT's for high-performance millimeter-wave receiver applications.

DC-20 GHz N x M Passive Switches (Dec. 1988 [T-MTT])

M.J. Schindler, M.E. Miller and K.M. Simon. "DC-20 GHz N x M Passive Switches (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1604-1613.

High-order, bidirectional, dc-20 GHz switch networks have been developed. Single-chip 1x2, 1x4, and 2x2 switch MMIC's have been demonstrated. Multiple chips have been used to demonstrate 4x4 and 1x16 switches. The switches all use a combination of series and shunt passive FET switching elements. The 1x4 switch is made of a single stage of switching elements, rather than the usual two stages of 1x2 switches. The 2x2 switch is comprised of two stages of 1x2 switches. The multiple-chip 4x4 switch is made of four stages of 1x2 switches (using the 2x2 switch MMIC's). Two stages of 1x4 switches are used to make the 1x16 switch.

Real Frequency Technique Applied to the Synthesis of Lumped Broad-Band Matching Networks with Arbitrary Nonuniform Losses for MMIC's (Dec. 1988 [T-MTT])

L. Zhu, B. Wu and C. Sheng. "Real Frequency Technique Applied to the Synthesis of Lumped Broad-Band Matching Networks with Arbitrary Nonuniform Losses for MMIC's (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1614-1620.

A new computer-aided synthesis technique is presented in this paper for treating the synthesis of lumped matching networks with arbitrary nonuniform losses. It is especially applicable to the design of the broad-band amplifiers in MMIC's. A new, useful theorem and two corollaries are developed for the transformation between lossy or lossless networks and lossless ones, so that the design of the lossy matching networks is considerably simplified relative to [1] and can yield any complex models of the lumped elements with arbitrary nonuniform losses. An example is given to show the general applications of the new method in monolithic broadband amplifier design.

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High-Yield Narrow-Band Matching Structures

D.H. Monteith and J.E. Purviance. "High-Yield Narrow-Band Matching Structures." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1621-1628.

Circuit yield is evaluated for commonly used narrow-band (bandwidth less than 5 percent) lumped and distributed parameter matching structures. It is found that yield is a function not only of the matching structure but also of the load impedance. The lumped structure yields are analytically determined using an elliptic approximation technique which gives a closed-form solution to the high-yield structure choice problem. Sensitivity issues are discussed. A simple design chart is developed which helps the designer choose a high-yield matching structure for a given load impedance. Two examples illustrate its use. Structure choice in one example changes the yield from 61 percent to 84 percent.

Integrated Model Parameter Extraction Using Large-Scale Optimization Concepts

J.W. Bandler, S.H. Chen, S. Ye and Q.-J. Zhang. "Integrated Model Parameter Extraction Using Large-Scale Optimization Concepts." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1629-1638.

This paper presents a robust approach to model parameter extraction. The approach not only attempts to match dc and ac measurements under different bias conditions simultaneously, but also employs the dc characteristics of the device as constraints on bias-dependent parameters, hence improving the uniqueness and reliability of the solution. The approach is an expansion of the hierarchical modeling techniques recently proposed by Bandler and Chen. Based on Bandler and Zhang's automatic decomposition concepts for large-scale optimization, a sequential model building method is proposed which combined with powerful l/sub /1 optimization techniques, can be used to establish a model with simple topology and sufficient accuracy. Practical FET models proposed by Materka and Kacprzak and by Curtice and Ettenberg are used to illustrate our formulation. A detailed numerical example based on the Materka and Kacprzak model is presented which has up to 28 optimization variables and 414 nonlinear error functions. The results show that a unique solution can be reached even after perturbing the original starting point (initial model parameter values) by 20 to 200 percent. The results also demonstrate the effectiveness of applying the sequential model building method to the FET modeling problem.

The Transfinite Element Method for Modeling MMIC Devices (Dec. 1988 [T-MTT])

Z.J. Cendes and J.-F. Lee. "The Transfinite Element Method for Modeling MMIC Devices (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1639-1649.

A new numerical procedure called the transfinite element method is employed in conjunction with the planar waveguide model to analyze MMIC devices. By using analytic basis functions together with finite element approximation functions in a variational technique, the transfinite element method is able to determine the fields and scattering parameters for a wide variety of stripline and microstrip devices. With minor modification, the transfinite element method can also be applied to waveguide junctions. We show that the transfinite element method can be used to treat singular points in waveguide junctions very efficiently. Examples that have been calculated by this method are a rectangular waveguide two-slot-20 dB coupler, stripline band-elimination filter, and several microstrip discontinuity problems. Good agreement of the numerical results with published values demonstrates the validity of the proposed procedure.

General-Purpose Harmonic Balance Analysis of Nonlinear Microwave Circuits Under Multitone Excitation

V. Rizzoli, C. Cecchetti, A. Lipparini and F. Mastri. "General-Purpose Harmonic Balance Analysis of Nonlinear Microwave Circuits Under Multitone Excitation." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1650-1660.

This paper describes a powerful software tool for the simulation of nonlinear microwave circuits under single- or multiple-frequency excitation. The program operates in a truly general-purpose fashion, both circuit topology and active devices equivalent circuits being arbitrarily established by the user at the data entry level. Built-in facilities based on the multidimensional Fourier transform allow a straightforward and unrestricted treatment of mixer and intermodulation problems. Application capabilities are illustrated by a number of practical examples.

A Unified Theory for Frequency-Domain Simulation and Sensitivity Analysis of Linear and Nonlinear Circuits

J.W. Bandler, Q.-J. Zhang and R.M. Biernacki. "A Unified Theory for Frequency-Domain Simulation and Sensitivity Analysis of Linear and Nonlinear Circuits." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1661-1669.

In this paper, a unified theory for frequency-domain simulation and sensitivity analysis of linear and nonlinear circuits is presented. An elegant derivation expands the harmonic balance technique from non-linear simulation to nonlinear adjoint sensitivity analysis. This provides an efficient tool for the otherwise expensive but essential gradient calculations in design optimization. The hierarchical approach, widely used for circuit simulation, is generalized to sensitivity analysis and to computing responses in any subnetwork at any level of the hierarchy. Therefore, important aspects of frequency-domain circuit CAD such as simulation and sensitivity analysis, linear and nonlinear circuits, hierarchical and nonhierarchical approaches, voltage and current excitations, or open- and short-circuit terminations are unified in this general framework. Our theory provides a key for the coming generation of microwave CAD software. It will take advantage of the many existing and mature techniques such as the syntax-oriented hierarchical analysis, optimization, and yield driven design to handle nonlinear as well as linear circuits. Our novel sensitivity analysis approach has been verified by a MESFET mixer example exhibiting a 90 percent saving of CPU time over the prevailing perturbation method.

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Monolithic Millimeter-Wave IMPATT Oscillator and Active Antenna (Dec. 1988 [T-MTT])

N. Camilleri and B. Bayraktaroglu. "Monolithic Millimeter-Wave IMPATT Oscillator and Active Antenna (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1670-1676.

GaAs IMPATT diodes were monolithically integrated with a microstrip resonator and a loop antenna to produce a single-chip millimeter-wave transmitter module. Devices operating at 43.3 GHz produced 27 mW CW output power with 7.2 percent conversion efficiency. Linear arrays of such radiating elements were produced and radiation patterns were determined as a function of intereIement spacing and element numbers. This monolithic oscillator chip was also directly coupled to and power combined in waveguides, producing an inexpensive millimeter-wave source.

A 2 GHz Surface Transverse Wave Oscillator with Low Phase Noise (Dec. 1988 [T-MTT])

L. Eichinger, B. Fleischmann, P. Russer and R. Weigel. "A 2 GHz Surface Transverse Wave Oscillator with Low Phase Noise (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1677-1684.

A hybrid oscillator at 1.9805 GHz has been developed rising acoustic surface transverse wave (STW) delay lines operating at the third harmonic as the frequency controlling element. The STW delay lines were fabricated on 37.5° rotated Y-cut quartz substrates with a photolithographic technique. A very thin metallization (25 nm) was used to obtain low insertion loss. A split isolated electrode design was used for the transducers. The Q value and the untuned insertion loss of the STW filter were 3400 and 21 dB, respectively. The phase noise and temperature stability of the oscillator were characterized. At a power output of 6.5 dBm a single-sideband phase noise to carrier ratio of -100 dBc/Hz at 1 kHz was attained.

Abstracts

U-Band Shield Suspended-Stripline Gunn DRO and VCO (Dec. 1988 [T-MTT])

Z.-Q. Huang and Q.-R. Yang. "U-Band Shield Suspended-Stripline Gunn DRO and VCO (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1685-1694.

A new millimeter-wave IC DRO is proposed. Equations are derived that give the resonant frequency of the DR in suspended stripline (SSL). A U-band voltage-controlled oscillator (VCO) with varactor tuning also has been developed. The Gunn diode and varactor used in both of the oscillators are commercially available packaged devices. Restrictions on the performance of the oscillators impnsed by packaged and mounted networks and the self-characteristic of the solid-state devices have been analyzed. An electronic tuning range greater than 1000 MHz with an output power exceeding 15 dBm across the bandwidth in the 53 GHz region for the SSL VCO has been realized. The SSL DRO with an output power of more than 17 dBm and a mechanical tuning range of 1.5 GHz in the 54 GHz region has been measured.

Millimeter-Wave InP Lateral Transferred-Electron Oscillators

S.C. Binari, R.E. Neidert, H.L. Grubin and K.E. Meissner. "Millimeter-Wave InP Lateral Transferred-Electron Oscillators." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1695-1700.

We have investigated a lateral InP transferred-electron device (TED) designed with a high-resistivity notch adjacent to the cathode contact and demonstrated its application to millimeter-wave monolithic integrated circuits (MMIC's). At 29.9 GHz, a CW power output of 29.1 mW with a conversion efficiency of 6.7 percent has been obtained from cavity-tuned discrete devices. This result represents the highest power output and efficiency of a lateral TED in this frequency range. The lateral devices also had a CW power output of 0.4 mW at 98.5 GHz and 0.9 mW at 75.2 GHz. In addition, a monolithic oscillator incorporating the lateral TED has been demonstrated at 79.9 GHz. Experimental and theoretical results are presented which further the understanding of the lateral device operation.

Abstracts

Quasi-Optical HEMT and MESFET Self-Oscillating Mixers

V.D. Hwang and T. Itoh. "Quasi-Optical HEMT and MESFET Self-Oscillating Mixers." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1701-1705.

Planar quasi-optical receivers that compactly integrate a coupled slot antenna and a HEMT or MESFET balanced self-oscillating mixer on the same substrate are developed for applications in microwave and millimeter-wave receiver arrays. Both the HEMT and the MESFET circuit are designed and demonstrated at X-band. The HEMT circuit exhibits an isotropic conversion gain of 4.5 dB and a noise figure of 6.5 dB at X-band. The isotropic conversion gain of the HEMT circuit is 7.5 dB higher than the mixer diode circuit previously reported.

Abstracts

Fabrication, RF Performance, and Yield of a Combined Limiting Amplifier and Dual-Modulus Prescaler GaAs IC Chip

A.E. Geissberger, R.A. Sadler, H.P. Singh, G.K. Lewis, I.J. Bahl, M.L. Balzan, E.L. Griffin and M.J. Drinkwine. "Fabrication, RF Performance, and Yield of a Combined Limiting Amplifier and Dual-Modulus Prescaler GaAs IC Chip." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1706-1713.

We present production technology details, RF performance, and yield results for an ECL-compatible, L-band, limiting dual-modulus (/spl divide/10/11) prescaler. This multifunction self-aligned gate (MSAG) process for monolithic integration of analog and digital circuit functions rises refractory self-aligned gate FET technology. When tested with -22 dBm input signal power, one lot of six wafers had a total RF chip yield of 19 percent, with a best-wafer yield of 43 percent. The average operating frequency was 1.45 GHz (SD=51 MHz) with an average power dissipation of 696 mW (SD=23 mW).

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High-Speed QPSK Modulator and Demodulator with Subharmonic Pumping (Dec. 1988 [T-MTT])

R. Trambarulo, M.V. Schneider and M.J. Gans. "High-Speed QPSK Modulator and Demodulator with Subharmonic Pumping (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1714-1719.

High-speed modulators and demodulators which operate at gigabit transmission rates are essential components in many high-capacity communication links. We describe a subharmonically pumped QPSK modulator and demodulator using pairs of beam-leaded Schottky diodes and appropriate high-pass and low-pass filters on dielectric substrates. A modulator and a demodulator were operated in cascade at a carrier frequency of 13 GHz with a common pump at 6.5 GHz. This circuit showed clean eye diagrams of the recovered data trains up to 1.5 Gbit/s with corresponding error rates of less than 10/sup -11/. The circuits can be readily scaled to higher frequencies with a proportional increase of the information rate.

A Broad-Band Low-Noise SIS Receiver for Submillimeter Astronomy (Dec. 1988 [T-MTT])

T.H. Buttgenbach, R.E. Miller, M.J. Wengler, D.M. Watson and T.G. Phillips. "A Broad-Band Low-Noise SIS Receiver for Submillimeter Astronomy (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1720-1726.

A quasi-optical heterodyne receiver using a Pb alloy superconductor-insulator-superconductor (SIS) tunnel junction as the detector and a planar logarithmic spiral antenna for the RF coupling is described, and its performance compared with a theoretical model. Noise measurements were made in the laboratory at frequencies between 115 GHz and 761 GHz, yielding double sideband (DSB) noise temperatures ranging from 33 K to 1100 K. The receiver has also been used for astronomical spectroscopy on the Caltech Submillimeter Observatory (Mauna Kea, Hawaii) at 115, 230, 345, and 492 GHz.

A Low-Loss Bandpass Filter Using Electrically Coupled High-Q TM/sub 01delta/ Dielectric Rod Resonators

Y. Kobayashi and M. Minegishi. "A Low-Loss Bandpass Filter Using Electrically Coupled High-Q TM/sub 01delta/ Dielectric Rod Resonators." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1727-1732.

For a TM/sub 01delta/ mode dielectric rod resonator placed coaxially in a TM/sub 01/ cutoff circular waveguide, the resonant characteristics such as the resonant frequency, its temperature coefficient, the unloaded Q, and the other resonances, are discussed on the basis of results calculated accurately by the mode-matching method. The results show that this resonator compares favorably to a conventional TE/sub 01delta/ mode dielectric resonator, particularly for realization of a high unloaded Q. Analytical results also verify that interresonator coupling between these two resonators can be expressed equivalently by a capacitively coupled LC resonant circuit. A four-stage Chebyshev filter having a ripple of 0.035 dB and an equiripple bandwidth of 27 MHz at a center frequency of 11.958 GHz is fabricated using these resonators. Low loss and good spurious characteristics are realized for this filter; i.e., the insertion loss is 0.5 dB, which corresponds to an unloaded Q of 17000, and no spurious response appears in the frequency range below 17 GHz.

Theoretical and Experimental Investigation of Novel Varactor-Tuned Switchable Microstrip Ring Resonator Circuits

T.S. Martin, F. Wang and K. Chang. "Theoretical and Experimental Investigation of Novel Varactor-Tuned Switchable Microstrip Ring Resonator Circuits." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1733-1739.

A novel microstrip ring resonator circuit loaded with two p-i-n diodes has been developed as a switcbable filter. By replacing one p-i-n diode with a varactor diode, the switchable filter can be made electronically tunable. Isolation exceeding 20 dB with 9 percent tuning bandwidth was demonstrated. An analysis based on transmission line theory was used to model both circuits. The analysis includes the effects of diode parasitic, coupling gaps, dispersion, and mounting gap capacitance. The experimental results agree very well with the theoretical calculation.

A Circuit Model of Probes in Dual-Mode Cavities

K.A. Zaki, C. Chen and A.E. Atia. "A Circuit Model of Probes in Dual-Mode Cavities." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1740-1746.

An accurate model of coaxial probes used as input and output ports in dual-mode cavities (either air-filled or dielectric-loaded) is presented. The model precisely predicts such empirically observed phenomena as limited out-of-band isolation, generation of extra transmission zeros, and asymmetric responses. The model parameters can be determined from simple measured data. It is shown how the model can be used in the analysis and synthesis of canonical dual-mode filters. Experimental verification of the model for several configurations showed excellent agreement with theory.

Multiport Power Divider-Combiner Circuits Using Circular-Sector-Shaped Planar Components

M.D. Abouzahra and K.C. Gupta. "Multiport Power Divider-Combiner Circuits Using Circular-Sector-Shaped Planar Components." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1747-1751.

A novel sector-shaped circuit configuration is proposed for designing planar power dividers-combiners that are compatible with microstrip circuits. This configuration is analyzed by using the two-dimensional planar circuit approach. Expressions for impedance matrix parameters of multiport sectorial planar circuits are given. Theoretical and experimental results reported for 90° and 180° power dividers are in good agreement.

Slot-Coupled Directional Couplers Between Double-Sided Substrate Microstrip Lines and Their Applications

T. Tanaka, K. Tsunoda and M. Aikawa. "Slot-Coupled Directional Couplers Between Double-Sided Substrate Microstrip Lines and Their Applications." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1752-1757.

This paper describes a slot-coupled microstrip directional coupler and its application to a planar multiport directional coupler (MDC). This slot-coupled microstrip directional coupler can be easily applied to tight coupling, such as 3 dB. A 4-port planar MDC fabricated by combining these couplers is described. Slot-coupled MDC's have many useful applications, such as beam-forming networks and multiport amplifiers.

A Generalized Method for Analyzing Shielded Thin Microstrip Discontinuities

L.P. Dunleavy and P.B. Katehi. "A Generalized Method for Analyzing Shielded Thin Microstrip Discontinuities." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1758-1766.

A new integral equation method is described for the accurate full-wave analysis of shielded thin microstrip discontinuities. The integral equation is derived by applying the reciprocity theorem, then solved by the method of moments. In this derivation, a coaxial aperture is modeled with an equivalent magnetic current and is used as the excitation mechanism for generating the microstrip currents. Computational aspects of the method have been explored extensively. A summary of some of the more interesting conclusions is included.

Click on title for a complete paper.

Abstracts

Shielding Effects in Microstrip Discontinuities

L.P. Dunleavy and P.B. Katehi. "Shielding Effects in Microstrip Discontinuities." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1767-1774.

As an application of the theoretical method described in a companion paper, numerical and measured results are presented for open-end and series gap discontinuities and a coupled line filter. Comparisons are also made to commercially available CAD package predictions. The results verify the accuracy of the new theoretical method and demonstrate the effects of shielding on discontinuity behavior. The experimental techniques used, which involve the through-short-delay de-embedding approach, are also explained.

Time-Domain Finite Difference Approach to the Calculation of the Frequency-Dependent Characteristics of Microstrip Discontinuities

X. Zhang and K.K. Mei. "Time-Domain Finite Difference Approach to the Calculation of the Frequency-Dependent Characteristics of Microstrip Discontinuities." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1775-1787.

The frequency-dependent characteristics of the microstrip discontinuities have previously been analyzed rising several full-wave approaches. The time-domain finite different (TD-FD) method presented in this paper is another independent approach and is relatively new in its application for obtaining the frequency-domain results for microwave components. The purpose of this paper is to establish the validity of the TD-FD method in modeling circuit components for MMIC CAD applications.

Skin Effects in Narrow Copper Microstrip at 77 K

U.S. Ghoshal and L.N. Smith. "Skin Effects in Narrow Copper Microstrip at 77 K." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1788-1795.

We have performed finite element and circuit simulations to analyze the performance of copper polyimide wafer scale interconnects at 77 K as a function of line width, dielectric thickness, and line length. The copper line width was generally kept equal to the dielectric thickness; this is a realistic geometry which gives a characteristic impedance of about 60 Omega, but one which is difficult to analyze using analytical techniques. The finite element simulations were used to extract the frequency-dependent complex impedance which arises from the normal skin effect. This was then fitted to obtain an equivalent circuit which could be used in SPICE simulations. Anomalous skin effect was determined to be unimportant for frequencies below 20 GHz and was not included in the detailed finite element models. We have used these results to analyze the performance of these lines for digital interconnects and to identify possible applications that would benefit from still lower resistance, such as might be obtainable from the high temperature oxide superconductors. Skin effects were determined to be important for predicting the response for times less than 1.2 times the time of flight delay, while for larger instants the dc resistance corresponding to the cross section of the signal line is adequate.

Modeling of Some Coplanar Waveguide Discontinuities (Dec. 1988 [T-MTT])

R.N. Simons and G.E. Ponchak. "Modeling of Some Coplanar Waveguide Discontinuities (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1796-1803.

The paper presents lumped equivalent circuit models for several coplanar waveguide (CPW), discontinuities such as an open circuit, a series gap in the center conductor, and a symmetric step in the center conductor and gives their element values as a function of the discontinuity physical dimensions. The model element values are de-embedded from measured S parameters. In addition, the effects of the center conductor width and the substrate thickness on the equivalent circuit element values are presented. The characteristics of a CPW right angle bend employing a novel compensation technique is also presented. The frequency dependence of the effective dielectric constant is measured and compared to computed values.

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Modeling Discontinuities in Dielectric-Loaded Waveguides

K.A. Zaki, S.-W. Chen and C. Chen. "Modeling Discontinuities in Dielectric-Loaded Waveguides." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1804-1810.

The mode-matching technique is applied to model step discontinuities in dielectric-loaded cylindrical waveguide excited by hybrid modes. It is shown that the solution for the fields obtained by mode matching does not converge unless complex modes are included in the field expansion, If the structure parameters and operating frequency allow for the existence of complex modes, then the purely propagating and evanescent mode fields do not form a complete set, unless complemented by the complex mode fields. Numerical results are presented that clearly illustrate the role of the complex mode fields in the modeling of step discontinuities. Examples are included illustrating the representation of the step discontinuities by a multiport scattering matrix.

Confirmation of Slow Waves in a Crosstie Overlay Coplanar Waveguide and its Applications to Band-Reject Gratings and Reflectors

T.-H. Wang and T. Itoh. "Confirmation of Slow Waves in a Crosstie Overlay Coplanar Waveguide and its Applications to Band-Reject Gratings and Reflectors." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1811-1818.

The slow-wave propagation along a new crosstie overlay slow-wave coplanar waveguide has been investigated both theoretically and experimentally. A slow-wave factor observed agrees reasonably well with the theoretical prediction. This structure is used for constriction of frequency-selective distributed Bragg reflectors (DBR's) of compact size. The effect of conductor loss is considered. A doubly periodic band-reject grating has been created from the DBR's and the band-reject phenomenon was observed as predicted. To improve passband characteristics of the grating, a monolithic slow-wave Chebyshev reflector was designed and fabricated. Agreement between theory and preliminary experiment has been confirmed. Based on this theory, a new slow-wave reflector with improved characteristics is proposed and examined. A respectable slow-wave factor and a drastic reduction of conductor loss have been predicted.

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Finite Element Analysis of Dispersion in Waveguides with Sharp Metal Edges

J.P. Webb. "Finite Element Analysis of Dispersion in Waveguides with Sharp Metal Edges." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1819-1824.

The dispersion characteristics of arbitrarily shaped waveguides with sharp metal edges are found by a finite element method in which the usual polynomials are supplemented by singular trial functions. As in recent approaches, the method solves for the three components of the magnetic field and can thereby avoid spurious modes. Results are presented for a rectangular waveguide with two double ridges and for shielded microstrip on isotropic and anisotropic substrates.

Simplified Description of the Field Distribution in Finlines and Ridge Waveguides and its Application to the Analysis of E-Plane Discontinuities (Dec. 1988 [T-MTT])

R.R. Mansour, R.S.K. Tong and R.H. MacPhie. "Simplified Description of the Field Distribution in Finlines and Ridge Waveguides and its Application to the Analysis of E-Plane Discontinuities (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1825-1832.

Using closed-form equations for the field distribution of the eigenmodes in ridge waveguides, this paper presents a simplified analysis for ridge waveguide E-plane discontinuities. The accuracy of the calculated results is checked by comparison with experimental results. Closed-form equations are also presented for the field distribution of the dominant hybrid mode in unilateral and bilateral finlines. The usefulness of these equations in calculating the characteristic impedance and in determining the plane of the circularly polarized magnetic field in unilateral finlines is demonstrated.

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Computer-Aided Design of Slit-Coupled H-Plane T-Junction Diplexers with E-Plane Metal-Insert Filters

J. Dittloff and F. Arndt. "Computer-Aided Design of Slit-Coupled H-Plane T-Junction Diplexers with E-Plane Metal-Insert Filters." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1833-1840.

A rigorous field theory design of a class of rectangular waveguide slit-coupled H-plane T-junction diplexers is described utilizing E-plane metal-insert filters. The filter elements allow low-cost manufacturing by accurate and inexpensive metal-etching techniques. The design method is based on field expansion in suitably normalized eigenmodes which yield the modal scattering matrix of three appropriate key building block structures to be combined, the E-plane metal-insert section, the H-plane iris discontinuity, and the H-plane T. The theory includes the finite thickness of the diaphragms as well as the higher order mode interaction of all discontinuities within the complete diplexer structure. Computer-optimized design data are given for diplexer examples in Ku-band (12-18 GHz) and E-band (60-90 GHz), designed for more than 23 dB common port return losses. The theory is verified by measured results for a five-resonator Ku-band diplexer.

Computer-Aided Design and Improved Performance of Tunable Ferrite-Loaded E-Plane Integrated Circuit Filters for Millimeter-Wave Applications

J. Uher, F. Arndt and J. Bornemann. "Computer-Aided Design and Improved Performance of Tunable Ferrite-Loaded E-Plane Integrated Circuit Filters for Millimeter-Wave Applications." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1841-1849.

The modal scattering matrix method is applied for the rigorous computer-aided design of low-insertion-loss magnetically tunable E -plane metal insert filters with improved characteristic, where only the resonator sections are loaded with ferrite slabs, and large-gap finline filters on a ferrite substrate of moderate width, for millimeter wave applications. The design method is based on field expansion in suitably normalized eigenmodes which yields directly the modal scattering matrix of key building block discontinuities, which are then appropriately combined for modeling the complete filter structure. The theory includes both the higher order mode interaction of all discontinuities involved and the finite thickness of the metal inserts, or metallization, respectively. Optimized data are given for magnetically tunable Ku-band (12- 18 GHz), Ka-band (26-40 GHz), and V-band (50-75 GHz) metal insert and finline filter examples. The theory is verified by measurements of Ku-band metal insert and finline filters, utilizing ferrite TTI-2800 and TTVG 1200 materials.

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Slot and Microstrip Guiding Structures Using Magnetoplasmons for Nonreciprocal Millimeter-Wave Propagation

C.M. Krowne, A.A. Mostafa and K.A. Zaki. "Slot and Microstrip Guiding Structures Using Magnetoplasmons for Nonreciprocal Millimeter-Wave Propagation." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1850-1860.

A full-wave spectral-domain approach for general anisotropy is used to determine the nonreciprocal phase and attenuation properties of slot and microstrip line structures. Dominant mode dispersive behavior is controlled by the semiconductor substrate characteristics, geometric dimensions, and magnetic field bias magnitude and angle in the Voigt configuration. Numerical results are presented to establish the nonreciprocal properties up to 85 GHz.

A Simple Coupled-Mode Analysis Method for Multiple-Core Optical Fiber and Coupled Dielectric Waveguide Structures (Dec. 1988 [T-MTT])

N. Kishi and E. Yamashita. "A Simple Coupled-Mode Analysis Method for Multiple-Core Optical Fiber and Coupled Dielectric Waveguide Structures (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1861-1868.

A simple method is proposed for the coupled-mode analysis of multiple-core optical fiber structures and coupled dielectric waveguide structures. The coupling coefficients between two adjacent cores are first estimated based on the point matching of boundary conditions on the surface of the two cores. The coupled-mode fields of the multiple-core structures are then approximated by using the fields of the two adjacent cores. Parameters calculated with this procedure are compared with those obtained from a more rigorous analysis.

Microwave Performances of n-p-n and p-n-p AlGaAs/GaAs Heterojunction Bipolar Transistors (Short Papers)

B. Bayraktaroglu, N. Camilleri and S.A. Lambert. "Microwave Performances of n-p-n and p-n-p AlGaAs/GaAs Heterojunction Bipolar Transistors (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1869-1873.

The performances of MOCVD-grown n-p-n and p-n-p AlGaAs/GaAs HBT's were compared at microwave frequencies to identify relative merits of each type of device. The f/sub t/ and f/sub max/ values of devices with 100-nm-thick bases were 22 and 40 GHz for n-p-n transistors and 19 and 25 GHz for p-n-p transistors, respectively. An accurate device model was developed using the measured S parameter data. The base resistance of the p-n-p transistors, as determined from the model, was about six times lower than identical size n-p-n devices. Output power and power-added-efficiencies of p-n-p devices were found to be half those obtained with n-p-n devices at 10 GHz.

GaAs Power MESFET Performance Sensitivity to Profile and Process Parameter Variations (Short Papers)

R.J. Trew, J.B. Yan and D.E. Stoneking. "GaAs Power MESFET Performance Sensitivity to Profile and Process Parameter Variations (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1873-1876.

Large-signal performance sensitivities are calculated and compared for power GaAs MESFET's fabricated with uniform, ion-implanted, and lo-hi-lo conducting channel doping profiles. The large-signal sensitivities of the RF power and power-added efficiency are determined for the device designs as a function of variations in various process-dependent parameters. It is demonstrated that the channel doping profile design and breakdown voltage have the most significant influence upon large-signal RF performance.

Click on title for a complete paper.

De-Embedding Coplanar Probes with Planar Distributed Standards (Short Papers)

D.F. Williams and T.H. Miers. "De-Embedding Coplanar Probes with Planar Distributed Standards (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1876-1880.

Two methods are used to de-embed coplanar probes using offset coplanar waveguide shorts and transmission lines. The accuracy of the de-embedded measurements is verified. The S parameters of lumped standards provided by the manufacturer of the probes are measured and found to be suitable for purposes of calibration up to 26 GHz.

Millimeter-Wave Components for Use in a Variable State Four-Port Network Analyzer (Short Papers)

J.V. Bellantoni, G.C. Dalman, C.A. Lee and R.C. Compton. "Millimeter-Wave Components for Use in a Variable State Four-Port Network Analyzer (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1880-1885.

Components developed for use with a new type of network analyzer are presented. The analyzer contains a phase shifter which varies the state of the network, thus allowing accurate measurements to be made with approximately half the hardware required by conventional six-port analyzers. The phase shift is obtained using either a p-i-n diode reflection phase shifter or a mechanically positioned sliding short. Reflection measurements from two such waveguide analyzers will be presented one operates in the 27 to 40 GHz Ku-band, the other in the 75 to 110 GHz W-band. Waveguide-to-microstrip transitions have been developed for these analyzers, to characterize millimeter-wave planar circuits. A back-to-back Ka-band transition was built with a maximum VSWR of 1.9. A second back-to-back transition displayed a maximum VSWR of 1.45 over the W-band.

A 13 GHz YIG Film Tuned Oscillator for VSAT Applications (Short Papers)

Y. Mizunuma, Y. Murakami, H. Nakano, T. Ohgihara and T. Okamoto. "A 13 GHz YIG Film Tuned Oscillator for VSAT Applications (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1885-1889.

A 13 GHz tunable oscillator using YIG film grown by LPE has been developed. A very low phase noise of - 93 dBc/Hz at 10 kHz from the carrier and an output power of 11 dBm have been achieved over the entire tuning range of 500 MHz. With excellent linear tuning characteristics, this oscillator is ideal for use as a frequency-agile synthesized local oscillator in a very small aperture terminal system.

Full-Wave Analysis of Coupled Finline Discontinuities (Short Papers)

G. Schiavon, P. Tognolatti and R. Sorrentino. "Full-Wave Analysis of Coupled Finline Discontinuities (Short Papers)." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1889-1894.

The general discontinuity problem of coupled finline sections is considered. Coupling may occur either along the sides of the slots (parallel coupled finlines) or through their ends (end-coupled finlines). A particular case is the inductive strip discontinuity already addressed in the literature. The analysis is carried out expanding the fields in terms of TE and TM modes in the transverse direction, according to the generalized transverse resonance method. End effects in coupled finline sections are pointed out. Computed results are in good agreement with both data from the literature and first experiments.

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Foreword (Dec. 1988 [T-MTT])

R.S. Kagiwada. "Foreword (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1895-1895.

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Uniplanar MMIC's and Their Applications (Dec. 1988 [T-MTT])

M. Muraguchi, T. Hirota, A. Minakawa, K. Ohwada and T. Sugeta. "Uniplanar MMIC's and Their Applications (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1896-1901.

A new "Uniplanar" MMIC configuration is proposed. The uniplanar MMIC consists of coplanar waveguides, slotlines, air bridges, and lumped circuit elements (GaAs FET's, capacitors, inductors, resistors, etc.), which are integrated on a single side of the GaAs substrate. The uniplanar MMIC has no via holes and no thin polished substrates. As an application of the uniplanar MMIC configuration, key monolithic circuits for a 26 GHz full MMIC receiver are designed and fabricated. The developed uniplanar MMIC's, i.e., a 26 GHz low-noise amplifier, a 26 GHz medium-power amplifier, a 6.5 GHz dual-output voltage-controlled oscillator, 6.5/13 GHz and 13/26 GHz fre-quency doublers, and a 26 GHz/ 1 GHz FET mixer, provide improved RF performance with a simplified fabrication process.

A K/Ka-Band Distributed Power Amplifier with Capacitive Drain Coupling (Dec. 1988 [T-MTT])

M.J. Schindler, J.P. Wendler, M.P. Zaitlin, M.E. Miller and J.R. Dormail. "A K/Ka-Band Distributed Power Amplifier with Capacitive Drain Coupling (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1902-1907.

A 14 to 37 GHz GaAs MMIC distributed power amplifier has been demonstrated. The amplifier has three FET's of varying periphery, all capacitively coupled to the gate line. A new circuit concept has been used to increase output power: the drain of the FET nearest the output is capacitively coupled to the drain line. A gain of 4 to 5 dB has been achieved from 14 to 37 GHz. Output power of 20 dBm or greater has been demonstrated at frequencies up to 33 GHz at 1 dB gain compression. A maximum 1 dB gain-compressed output power of 23.5 dBm (220 mW) has been measured at 26 GHz. The circuit is completely monolithic, with all bias and matching circuitry included on the chip.

A 15 GHz Single-Stage GaAs Dual-Gate FET Monolithic Analog Frequency Divider with Reduced Input Threshold Power (Dec. 1988 [T-MTT])

K. Kanazawa, M. Hagio, M. Kazumura and G. Kano. "A 15 GHz Single-Stage GaAs Dual-Gate FET Monolithic Analog Frequency Divider with Reduced Input Threshold Power (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1908-1912.

A 15 GHz single-stage GaAs dual-gate FET monolithic analog frequency divider with a reduced input threshold power has been designed and fabricated. Use of the dual-gate structure for the FET mixer contributed to a simplified circuit configuration. Introduction of the rejection filter at the output port resulted in a reduction of the input threshold power to 1.4 dBm.

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A 9.5 GHz Commercially Available 1/4 GaAs Dynamic Prescaler

M. Takahashi, H. Itoh, K. Ueda and R. Yamamoto. "A 9.5 GHz Commercially Available 1/4 GaAs Dynamic Prescaler." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1913-1919.

A mass-producible 1/4 GaAs monolithic dynamic prescaler operating with a single clock input of 9.5 GHz and a power dissipation of 480 mW has been successfully realized. In addition, the phase noise performance was -100 dBc/Hz and -120 dBc/Hz at 100 Hz and 10 kHz offsets, respectively, for a 6.725 GHz input, which is considered to be low enough for practical use.

Broad-Band Monolithic Microwave Active Inductor and its Application to Miniaturized Wide-Band Amplifiers

S. Hara, T. Tokumitsu, T. Tanaka and M. Aikawa. "Broad-Band Monolithic Microwave Active Inductor and its Application to Miniaturized Wide-Band Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1920-1924.

A broad-band monolithic microwave active inductor is proposed and its characteristics are discussed. This active inductor consists of a cascode FET with a feedback resistor, and operates in a much higher frequency range than a spiral inductor. The size is independent of the inductance value. Miniaturized wide-band amplifiers in two frequency bands are also realized by utilizing the active inductors.

Monolithic 60 GHz GaAs CW IMPATT Oscillators (Dec. 1988 [T-MTT])

B. Bayraktaroglu. "Monolithic 60 GHz GaAs CW IMPATT Oscillators (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1925-1929.

A monolithic circuit design was developed for GaAs IMPATT diodes to enable their operation under CW conditions at V-band frequencies. All active and passive circuit components were fabricated on the top surface of the GaAs substrate. Good heat dissipation was achieved by distributing the device active area over a large surface area while maintaining a lumped mode of operation. More than 100 mW CW output power was obtained in the 58-65 GHz frequency range, with up to 14.5 percent conversion efficiency. In an alternative design, varactor diodes were integrated with the IMPATT circuits to produce the first monolithic VCO's operating under CW conditions. A tuning bandwidth greater than 3.5 GHz was obtained at a center frequency of 70 GHz, with a maximum CW output power of 40 mW.

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A Monolithic Ka-Band HEMT Low-Noise Amplifier (Dec. 1988 [T-MTT])

C. Yuen, C.K. Nishimoto, M.W. Glenn, Y.-C. Pao, R.A. LaRue, R. Norton, M. Day, I. Zubeck, S.G. Bandy and G.A. Zdasiuk. "A Monolithic Ka-Band HEMT Low-Noise Amplifier (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1930-1937.

A monolithic, single-stage HEMT low-noise amplifier has been, developed for the 20-40 GHz band. This amplifier includes a single 0.25-µm-gate-length HEMT active device with on-chip matching and biasing circuits. A gain of approximately 6 dB from 20 to 38 GHz and a noise figure of approximately 5 dB from 26.5 to 40 GHz were measured. Replacing the triangular gate profile by a mushroom gate profile in the amplifier increased the measured gain to 8 dB from 20 to 37 GHz and reduced the measured noise figure to 4 dB from 26 to 40 GHz. These are the best reported results for a MMIC amplifier over this bandwidth. The chip size is 2.2 mm x 1.1 mm. The same amplifier was fabricated on pseudomorphic HEMT material with a triangular gate profile and has achieved 7.5 dB gain across the 20-35 GHz bandwidth and a 6.0 dB noise figure from 26.5 to 40 GHz. The measured 1 dB compression powers at 30 GHz for the conventional and pseudomorphic HEMT amplifiers are 10 dBm and 11.5 dBm, respectively, when biased for maximum power.

A Dual-Varactor Analog Phase Shifter Operating at 6 to 18 GHz (Dec. 1988 [T-MTT])

D.M. Krafcsik, S.A. Imhoff, D.E. Dawson and A.L. Conti. "A Dual-Varactor Analog Phase Shifter Operating at 6 to 18 GHz (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1938-1941.

An MMIC analog reflection phase shifter achieves 120° of phase shift from 6 to 18 GHz using a dual-varactor reflection circuit which allows varactors with a 3:1 capacitance ratio to achieve the performance that normally requires 10:1 diodes. The varactor diode is a surface-oriented structure with a hyperabrupt doping profile selectively ion implanted to a depth of 0.70 µm.

Click on title for a complete paper.

Millimeter-Wave Monolithic GaAs IMPATT VCO (Dec. 1988 [T-MTT])

N.-L. Wang, W. Stacey, R.C. Brooks, K. Donegan and W.E. Hoke. "Millimeter-Wave Monolithic GaAs IMPATT VCO (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1942-1947.

A monolithic voltage-controlled oscillator (VCO) has been constructed using a GaAs double-drift Read IMPATT as the active element and a similar diode biased below breakdown as the varactor. The chip produced 120 mW peak power over an electronically controlled tuning range between 47 and 48 GHz. A computer analysis based on characterized circuit parameters has been used to predict the performance of the chip.

Double Balanced Mixers Using Active and Passive Techniques

A.M. Pavio, R.H. Halladay, S.D. Bingham and C.A. Sapashe. "Double Balanced Mixers Using Active and Passive Techniques." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1948-1957.

A variety of double balanced mixers, employing dual-gate FET's or diodes as the mixing nonlinearities, have been fabricated using planar monolithic circuit technology. The mixer topologies, which use active balancing methods, eliminate the need for large suspended substrate structures, thus minimizing circuit area and facilitating integration. These unique approaches also eliminate IF extraction problems and combine the best performance characteristics of FET's and diodes.

High-Performance GaAs Heterojunction Bipolar Transistor Monolithic Logarithmic IF Amplifiers

A.K. Oki, M.E. Kim, G.M. Gorman and J.B. Camou. "High-Performance GaAs Heterojunction Bipolar Transistor Monolithic Logarithmic IF Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1958-1965.

The GaAs/AIGaAs heterojunction bipolar transistor (HBT) technology is used to demonstrate high-performance monolithic logarithmic intermediate frequency (IF) amplifiers. These log IF amplifiers, believed to be the first using the HBT technology, implement both "true" and "successive-detection" designs. Monolithically cascaded log gain stages are used to achieve piecewise-approximated logarithmic functions for the compression of wide-dynamic-range signals. An HBT IC fabrication process, based on a 3 µm emitter, self-aligned base ohmic metal transistor employing both molecular-beam epitaxy (MBE) and metal-organic chemical vapor deposition (MOCVD) growth structures, is used to advance the state of the art in monolithic log IF amplifier technology. The true log amp integrates four dual-gain (limiting and unity gain) stages without on-chip video detection. Its performance includes dc-3 GHz IF/video bandwidth, 400 ps rise time, <±1 dB log error over /spl ap/40 dB dynamic range at 3 GHz, and a tangential signal sensitivity (noise) of -60 dBm (test set limited). The successive-detection log amp, designed for lower frequency and dynamic range, employs three limiting gain stages and four detector stages to achieve a 550 MHz bandwidth and <± 0.34 dB log error over a 27 dB dynamic range. It is able to process 13 ns pulses with 5.0 ns and 5.2 ns rise and fall times, respectively.

V-Band GaAs MMIC Low-Noise and Power Amplifiers

H.-L.A. Hung, G.M. Hegazi, T.T. Lee, F.R. Phelleps, J.L. Singer and H.C. Huang. "V-Band GaAs MMIC Low-Noise and Power Amplifiers." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1966-1975.

GaAs monolithic amplifiers based on MESFET technology have been developed at V-band for low-noise and power applications. These MMIC's, which have on-chip dc-blocking and bias networks, were fabricated from both VPE and MBE materials and then evaluated. The low-noise designs resulted in a single-stage MMIC LNA achieving a 6.5 dB noise figure and a 4.1 dB gain at 59 GHz, as well as a cascaded six-stage amplifier exhibiting an 8 dB minimum noise figure and a 30 dB gain from 56.2 to 60 GHz. The single-stage power amplifier provided over 4.5 dB of gain from 57 to 60.5 GHz, with a maximum output power of 95 mW and a corresponding power-added efficiency of 11 percent at 58 GHz. Maximum power-added efficiency of 15.3 percent at 73 mW was also obtained. A cascaded four-stage amplifier demonstrated stable operation, achieving 17 dB of gain and 85 mW of output power. In addition, a two-stage balanced amplifier provided 136 mW of output power and 7.5 dB of linear gain from 56.5 to 61.5 GHz. These results demonstrate that excellent low-noise performance and power/gain performance are achievable with MESFET MMIC's, in the 60 GHz band.

Abstracts

Segmented and Dual-Gate MESFET's for Variable Gain Power Amplifiers in GaAs MMIC

K.H. Snow, J.J. Komiak and D.A. Bates. "Segmented and Dual-Gate MESFET's for Variable Gain Power Amplifiers in GaAs MMIC." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1976-1985.

The design and performance of C-, X-, and K/sub u/-band GaAs MMIC variable gain and variable power amplifier circuits using an improved segmented dual-gate MESFET device with binary scaled gate width ratios are reported. The demonstrated 35 dB control range, flat octave band gain response, and small incidental phase variation are significantly superior to conventional analog controlled devices. First pass performance of these digitally controlled circuits demonstrates the maturation of MMIC technology.

Click on title for a complete paper.

A 0.5 to 4 GHz True Logarithmic Amplifier Utilizing Monolithic GaAs MESFET Technology

M.A. Smith. "A 0.5 to 4 GHz True Logarithmic Amplifier Utilizing Monolithic GaAs MESFET Technology." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1986-1990.

The design of the true logarithmic amplifier is reviewed, and the sensitivity of the circuit's performance to design or process errors is investigated. Following this is a description of a GaAs monolithic dual-gain amplifier stage which has been developed for 0.5 to 4 GHz true logarithmic amplifier applications. This bandwidth is significantly greater than that of previously reported true logarithmic amplifier stages. A cascade of six of these stages has resulted in a logarithmic amplifier with a 70 dB dynamic range.

Patent Abstracts (Dec. 1988 [T-MTT])

"Patent Abstracts (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1991-1994.

Call for Papers - 1989 IEEE MTT-S International Microwave Symposium (Dec. 1988 [T-MTT])

"Call for Papers - 1989 IEEE MTT-S International Microwave Symposium (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1995-1995.

Abstracts

Index, IEEE [T-MTT] 1988, Volume 36, and MTT-S Sponsored Conferences

"Index, IEEE [T-MTT] 1988, Volume 36, and MTT-S Sponsored Conferences." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): i1-i60.

Back Cover (Dec. 1988 [T-MTT])

"Back Cover (Dec. 1988 [T-MTT])." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): b1-b2.

Abstracts

Front Cover (1988 Vol. I [MWSYM])

"Front Cover (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): f1-f1.

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Copyright (1988 Vol. I [MWSYM])

"Copyright (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): i-ii.

Welcome from the Chairman (1988 Vol. I [MWSYM])

C. Buntschuh. "Welcome from the Chairman (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): iii-iv.

The Steering Committee wishes you all a hearty welcome to the 1988 MTT-S International Microwave Symposium. We know you will find the outstanding technical program, industry exhibits and social events of Microwave Week a rewarding and memorable experience. Also be sure to find time to sample and enjoy some of the excitement of New York City.

Table of Contents (1988 Vol. I [MWSYM])

"Table of Contents (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): v-v.

Cover Page - Committees, Awards, Panel Sessions and Workshops (1988 Vol. I [MWSYM])

"Cover Page - Committees, Awards, Panel Sessions and Workshops (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 1-1.

Committees (1988 Vol. I [MWSYM])

"Committees (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 2-12.

Awards (1988 Vol. I [MWSYM])

"Awards (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 13-19.

Panel Sessions (1988 Vol. I [MWSYM])

"Panel Sessions (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 20-32.

Symposium Schedule (1988 Vol. I [MWSYM])

"Symposium Schedule (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 31-31.

MTT-S International Symposium Future Locations (1988 Vol. I [MWSYM])

"MTT-S International Symposium Future Locations (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 32-32.

Table of Contents, Papers by Sessions (1988 Vol. I [MWSYM])

"Table of Contents, Papers by Sessions (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 33-89.

Abstracts

Session A -- Producibility and Applications

"Session A -- Producibility and Applications." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 91-91.

Commercial Applications of GaAs ICs (1988 Vol. I [MWSYM])

J. Gladstone. "Commercial Applications of GaAs ICs (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 93-97.

Applications for GaAs ICs in the commercial marketplace first emerged three years ago. Today they are part of many test and measurement instrumentation systems and essential elements in fiber optic communication systems. These applications as well as potential applications for the near future are reviewed in this paper. A simple market model is developed for categorizing commercial applications and some projections on the size of the market are presented.

Abstracts

GaAs Monolithic Circuit for FMCW Radars (1988 Vol. I [MWSYM])

R. LeBlanc, M.-I. Rudelle, V. Pauker, P. Talbot, A. Collet and J. Bellaiche. "GaAs Monolithic Circuit for FMCW Radars (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 99-101.

A GaAs monolithic transmitter-receiver to be used in a radar system has been fabricated. It operates between 4 and 6 GHz with a 200 to 400 MHz tuning range. The excellent Voltage Controlled Oscillator tuning linearity, the very high external quality factor, the low 1/F noise at the 5 kHz to 10 MHz output port, combined with a reduced size show that the GaAs monolithic ICs are suitable for this type of Radar systems.

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Laser Chip Separation Method for GaAs MMIC Wafers (1988 Vol. I [MWSYM])

E.H. Wong, R.B. Wylie and D.R. Johnson. "Laser Chip Separation Method for GaAs MMIC Wafers (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 103-106.

A chip separation process using a Nd-YAG laser with the wafer mounted on stretchable tape for machine sort and load has been developed for the GaAs MMIC wafers. This method is especially suitable for prototype masks with multiple chip design. One of the major advantages of this technique is that the laser can be programmed to cut any pattern desired such that the different circuits need not be laid out in a straight grid pattern as required for sawing. One hundred percent (100%) chip separation yield with no chipping or cracking has been demonstrated. The complete laser chip separation process will be described.

Broad Band Monolithic Microwave Active Inductor and Application to a Miniaturized Wide Band Amplifier (1988 Vol. I [MWSYM])

S. Hara, T. Tokumitsu, T. Tanaka and M. Aikawa. "Broad Band Monolithic Microwave Active Inductor and Application to a Miniaturized Wide Band Amplifier (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 107-110.

A broad band monolithic microwave active inductor is proposed. This active inductor operates in a much higher frequency range than a spiral inductor and its size is independent of the inductance value. A 0.1 - 10GHz miniaturized wide band amplifier is also realized by utilizing the active inductors.

Session B -- Acoustics & Ferrites

"Session B -- Acoustics & Ferrites." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 111-111.

Abstracts

A 2 GHz Surface Transverse Wave Oscillator with Low Phase Noise (1988 Vol. I [MWSYM])

L. Eichinger, B. Fleischmann, P. Russer and R. Weigel. "A 2 GHz Surface Transverse Wave Oscillator with Low Phase Noise (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 113-116.

A hybrid oscillator at 1.9805 GHz was developed using acoustic surface transverse wave (STW) delay lines as the frequency controlling element. The STW delay lines were fabricated on 37.5° rotated Y-cut quartz substrates with a photolithographic technique. A very thin metallization of 25 nm was used to obtain low insertion loss. A split--isolated electrode design was employed for the transducers. The Q value and the untuned insertion loss of the STW filter were 3400 and 21 dB respectively. The phase noise and temperature stability of the oscillator were characterized. At a high power output of 6.5 dBm a single side band phase noise to carrier ratio of -100 dBc/Hz at 1 kHz was attained.

Abstracts

Clock Recovery in the Gigabit Region Using Dielectric Resonators as an Alternative to Surface Acoustic Wave Filters

P. Baum. "Clock Recovery in the Gigabit Region Using Dielectric Resonators as an Alternative to Surface Acoustic Wave Filters." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 117-119.

The characteristics of coaxial dielectric resonators pertinent to clock recovery are evaluated and shown to compare favorably with surface acoustic wave fiiters. A practical circuit implementation of a dielectric resonator-based clock recovery system at 1.152 Gb/s demonstrates the potential of this technology for gigabit fiber optic transmission systems.

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Millimeter Wave Ferromagnetic Resonance in Cubic and Hexagonal Ferrites

M.N. Afsar and K.J. Button. "Millimeter Wave Ferromagnetic Resonance in Cubic and Hexagonal Ferrites." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 121-124.

Natural ferromagnetic resonance (in the absence of an externally applied DC magnetic field) has been observed for the first time at frequencies as high as 240 GHz in a powdered magnetoplumbite suspended in a thin layer of paint. "Induced" ferromagnetic resonance has been observed at many millimeter wave frequencies in the presence of an externally applied magnetic field according to the rule: f = gamma H. The specimen was placed at the center of a "Bitter" solenoid high intensity magnet in a dispersive Fourier transform spectrometric configuration to provide reliable broadband continuous data, for the first time, for magnetic permeability and dielectric permittivity in the entire millimeter wave frequency range.

Abstracts

Low-Cost Method of the Measurement of Microwave Ferrite Parameters

J. Modelski, K. Derzakowski and A. Abramowicz. "Low-Cost Method of the Measurement of Microwave Ferrite Parameters." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 125-126.

Theory and experimental results are presented to show the possibility of using a ferrite cylindrical specimen coupled to the microstrip line for measuring properties of magnetic materials at microwave frequencies. The complex permittivity and initial scalar permeability of ferrite are calculated on the base of the measured resonant frequencies and Q-factors of the structure with TE/sub 01delta/ mode. The measurements are made, without saturation of tested material, for two (or more) different distances between ferrite sample and upper mobile metal plate of the holder. The measurement accuracies of real parts of permittivity and permeability are better than 0.2 percent, and measurement error of total loss tangent is less than 2 percent.

Click on title for a complete paper.

Abstracts

Quasi-Optical Ferrite Rotator for Millimeter Waves

G.F. Dionne, J.A. Weiss, G.A. Allen and W.D. Fitzgerald. "Quasi-Optical Ferrite Rotator for Millimeter Waves." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 127-130.

A nonreciprocal 45-degree Faraday rotator has been developed for use in optical beams at 35 GHz. In laboratory demonstrations, an effective isolation greater than 40dB and an insertion loss considerably less than 0.1 dB over a frequency band from 32 to 39 GHz (~ 20 %) have been measured.

Session C -- Special Session in Honor of Prof. A. A. Oliner

"Session C -- Special Session in Honor of Prof. A. A. Oliner." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 131-131.

Abstracts

Perspectives on Guided Wave Phenomena

T. Itoh. "Perspectives on Guided Wave Phenomena." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 133-136.

This talk summarizes the work carried out by Professor A. A. Oliner on guided waves throughout his long productive career. As repeatedly pointed out by Prof. Oliner, physically correct guided wave phenomena in certain structures may be hard to find due to hidden factors; ignorance of them will lead to incorrect judgement and unexpected results. This paper reviews several such examples that demonstrate the need for such investigations. Discussion will include applications to contemporary problems.

Click on title for a complete paper.

Radiation from Open Waveguides and Leaky Wave Phenomena

F.K. Schwering. "Radiation from Open Waveguides and Leaky Wave Phenomena." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 137-140.

Professor Oliner's work in the area of microwaves and millimeter waves has resulted in important contributions to the theory of open waveguides; to phased array theory; to the recognition and interpretation of new leaky wave phenomena; and, in recent years, to the design and analysis of a class of novel antennas derived from open mm-waveguides. A review of this work will be presented. The first part of the presentation will be concerned with Dr. Oliner's theoretical research, which was often complemented by careful experiments. The subject of the second part will be the applications resulting from this work as exemplified by the new class of open-waveguide leaky-wave antennas.

Integrated Circuit Discontinuities and Radiation

N.G. Alexopoulos. "Integrated Circuit Discontinuities and Radiation." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 141-143.

A review of the status of integrated circuit discontinuities is presented in the context of Professor A. A. Oliner's contributions. The physical principles involved and the methods of deriving equivalent circuits will be discussed, including radiation effects. In addition, the evolution of Professor Oliner's work to the present modeling methods of discontinuities in a variety of waveguiding structures such as microstrip will be emphasized.

Session D -- Biological Effects and Medical Applications (1988 Vol. I [MWSYM)

"Session D -- Biological Effects and Medical Applications (1988 Vol. I [MWSYM)." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 145-145.

Experimental Determination of Absorbed Power Distribution in a Phantom Irradiated with a Microwave Applicator

D. Van Den Berge, S. Denayer, R. Van Loon, A. Barel and G. Storme. "Experimental Determination of Absorbed Power Distribution in a Phantom Irradiated with a Microwave Applicator." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 147-150.

An original method is described for automatic acquisition of SAR-patterns of applicators used in hyperthermia therapy of cancer. The SAR is determined by processing adequately the time impulse response of the temperature signal in a glass bulb scanned through a liquid phantom above the applicator. The whole process is controlled by a Macintosh PC.

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Design Optimization of Interstitial Antennas for Microwave Hyperthermia

M.F. Iskander and A.M. Tumeh. "Design Optimization of Interstitial Antennas for Microwave Hyperthermia." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 151-153.

Theoretical and experimental results illustrating the design optimization of interstitial antennas for microwave hyperthermia are presented. New numerical models which calculate current distribution and the radiation characteristics of multisection insulated antennas in conductive tissue are developed. Numerical predictions are verified experimentally by making heating patterns measurements and by mapping the various near- and far-field components.

Click on title for a complete paper.

Abstracts

Microwave Correlation Thermography for the Imaging of Hot Spots in Lossy Materials

G. Schaller. "Microwave Correlation Thermography for the Imaging of Hot Spots in Lossy Materials." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 155-156.

The imaging of hot spots in homogeneous, lossy materials using a microwave correlation radiometer is investigated. The system utilizes a circular synthetic aperture and a correlation radiometer with an adjustable time delay. Numerical results for various system configurations are presented graphically.

Microwave Imaging at 3 GHz for the Exploration of Tumors of the Breast

Giaux, J. Delannoy, D. Delvalee, Y. Leroy, A. Mamouni and J.C. van de Velde. "Microwave Imaging at 3 GHz for the Exploration of Tumors of the Breast." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 157-160.

We have used a microwave imaging system worked out by the "Centre Hyperfrequences et Semi-conducteurs" of LILLE. First, we have appraised the method by measurements of 53 large tumors to optimize it. After, we essentially used this device for the determination of the benignity or the malignancy of small breast tumors: 9 non palpable tumors with a mammographic aberration; 9 tumors of small volume. These tumors could not be punctured for a cytologic examination. The microwave radiometry enabled us to determine definitely the malignancy or the benignity of these lesions, which was confirmed by a histologic examination, after surgery. These first results are promising.

Modelisation of Microstrip-Microslot Applicator by Extension of Transmission Line Model

R. Ledee, P. Pribetich, P. Kennis and M. Chive. "Modelisation of Microstrip-Microslot Applicator by Extension of Transmission Line Model." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 161-164.

In this paper we present a model which allows to characterize a microstrip-slot radiator used in biomedical applications. The approach used is based on the transmission line model of radiating antennas. This usual model is improved by using S.D.A. in order to calculate the microwave parameters of the microstrip line with tuning septums which constitutes the transmission line. The validity of our approach is confirmed by comparison with experimental results.

In Vivo Experiment for the Analysis of Multi-Frequency Microwave Radiometric Data

F. Bardati, M. Mongiardo, D. Solimini and B. Paolone. "In Vivo Experiment for the Analysis of Multi-Frequency Microwave Radiometric Data." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 165-168.

Numerical simulations and laboratory experiments suggested the feasibility of reconstructing temperature distributions inside biological structures from multi-frequency radiometric data. This contribution discusses experimental data in real situations, where the variable geometry and dielectric Inhomogeneities in the human body strongly affect the radiometric measurements.

Abstracts

Session E -- Power Amplifiers

"Session E -- Power Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 169-169.

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A 3-Watt X-Band Monolithic Variable Gain Amplifier (1988 Vol. I [MWSYM])

R.B. Culbertson and D.C. Zimmermann. "A 3-Watt X-Band Monolithic Variable Gain Amplifier (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 171-174.

The design and performance of a monolithic dual-gate GaAs FET 3-watt X-Band amplifier are discussed. The two-stage amplifier demonstrates 13 dB gain and over 20 percent power-added efficiency. Both large-signal and small-signal gain can be varied 20 dB while exhibiting less than +/- 6 degrees insertion phase variation.

Stability and Improved Circuit Modeling Considerations for High Power MMIC Amplifiers (1988 Vol. I [MWSYM])

R.G. Freitag, S.H. Lee, D.M. Krafcsik, D.E. Dawson and J.E. Degenford. "Stability and Improved Circuit Modeling Considerations for High Power MMIC Amplifiers (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 175-178.

The cluster matching approach for large periphery power FETs brings with it certain problems including more complex circuitry and new modes of possible oscillations. This paper offers some solutions to these problems including an analysis of the modes along with methods of suppression and improved circuit modeling. These solutions were implemented in the design of a two-stage, 1.6 W monolithic power amplifier which will also be discussed.

Ka-Band Monolithic GaAs FET Power Amplifier Modules (1988 Vol. I [MWSYM])

N. Camilleri, B. Kim, H.Q. Tserng and H.D. Shih. "Ka-Band Monolithic GaAs FET Power Amplifier Modules (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 179-182.

Monolithic GaAs FET power amplifiers consisting of several power combined devices have been fabricated and evaluated. The baseline monolithic chip design consists of a single stage 400μm FET amplifier and a six-way travelling-wave power divider/combiner with a single stage amplifier in each of the six arms. Several chip combinations were used to make a 1 W amplifier with 5 dB gain and a 0.55 W amplifier with 27 dB gain at 34 GHz.

Abstracts

Wideband Variable Gain Amplifiers in GaAs MMIC (1988 Vol. I [MWSYM])

K.H. Snow, J.J. Komiak and D.A. Bates. "Wideband Variable Gain Amplifiers in GaAs MMIC (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 183-187.

The design and performance of C, X, and K/sub u/-band GaAs MMIC variable gain and variable power amplifier circuits using an improved segmented dual gate MESFET device with binary scaled gate width ratios is reported. The demonstrated 35 dB control range, flat octave band gain response, and less than 10 degrees incidental phase variation as a function of gain/attenuation state over a 20 dB control range, is significantly superior to conventional analog-controlled devices. First pass performance of these digitally-controlled circuits demonstrates the maturation of MMIC technology.

Session F -- Heinrich Hertz Centennial Special Session I

"Session F -- Heinrich Hertz Centennial Special Session I." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 189-189.

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The History of Electromagnetics as Hertz Would Have Known It (1988 Vol. I [MWSYM])

R.S. Elliott. "The History of Electromagnetics as Hertz Would Have Known It (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 191-191.

Highlights of the separate developments of the sciences of electrostatics and magnetostatics are traced through the end of the seventeenth century. These include Gilbert's cataloging of materials which, when rubbed, attracted light bodies, a phenomenon he labeled electric; Peregrinus' discovery that a lodestone, shaped to be spherical, behaved as though it possessed north and south magnetic poles, which prompted Gilbert to appreciate that the earth itself is a giant spherical magnet; and Kirchner's demonstration that the two poles of a magnet have equal strength.

Heinrich Hertz: A Short Life (1988 Vol. I [MWSYM])

C. Susskind. "Heinrich Hertz: A Short Life (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 193-194.

In Berlin he came to the attention of Hermann Helmholtz, whose research student he became while still an undergraduate. Hertz did so well that he was allowed to graduate after three semesters in Berlin (that is, a total of six, instead of the prescribed eight), and then became Helmholtz's postgraduate assistant. He stayed for three years, helping with teaching and working on a variety of topics. One was elasticity, a subject to which he made a lasting contribution by developing the theoretical basis for the measurement of hardness; this work underlies the theory of contact stress analysis to the present day. Then he went as Privatdozent (instructor) to the University of Kiel, where he remained for two years.

Session G -- Guided Wave Effects

"Session G -- Guided Wave Effects." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 195-195.

The Importance of Skin-Effect in Microstrip Lines at High Frequencies

A.C. Cangellaris. "The Importance of Skin-Effect in Microstrip Lines at High Frequencies." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 197-198.

The higher speeds and the larger device densities in modern integrated circuits demand better characterization of the electrical parameters which can influence their performance. In this paper, the importance of the skin-effect is examined, and an integral equation approach is introduced for the calculation of the ac resistance and reactance.

Conductor-Backed Slot Line and Coplanar Waveguide: Dangers and Full-Wave Analyses

H. Shigesawa, M. Tsuji and A.A. Oliner. "Conductor-Backed Slot Line and Coplanar Waveguide: Dangers and Full-Wave Analyses." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 199-202.

Despite the many attractive features of conductor-backed slot line and coplanar waveguide, there are dangers or potential surprises in their use. We have developed two theoretical approaches, one purely numerical and the other in network form and analytical in nature, that agree well with each other and with measurements in a special case. They provide, for the first time, a quantitative description of these potential surprises when the line conductors are either infinite or finite in width.

Mode Conversion Due to Discontinuities in Modified Grounded Coplanar Waveguide

R.W. Jackson. "Mode Conversion Due to Discontinuities in Modified Grounded Coplanar Waveguide." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 203-206.

Modified grounded coplanar waveguide is the same as conventional grounded coplanar waveguide except that the side planes are not of infinite extent. This structure is overmoded, but is still used in monolithic circuits since it does not require via holes. In this paper, conversion from the desired CPW mode to an undesirable microstrip-like mode is calculated using a full wave analysis. Results indicate that this conversion can be made small for reasonable structural dimensions.

Abstracts

Role of Complex Modes in Modeling Discontinuities of Dielectric Loaded Wave Guides

S.-W. Chen, C. Chen and K.A. Zaki. "Role of Complex Modes in Modeling Discontinuities of Dielectric Loaded Wave Guides." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 207-210.

It is shown that modeling of step discontinuities in cylindrical dielectric loaded waveguides excited in hybrid modes, using mode matching cannot converge unless complex modes are included in the field expansions. If the parameters of the structure and operating frequency allow the existence of complex modes, then the purely propagating and purely evanescent mode fields are not a complete set, unless complemented by the complex mode fields. Numerical results are presented that clearly illustrate the role of the complex mode fields in step discontinuity modeling.

Abstracts

Nonreciprocal Millimeter Wave Propagation in Slot Guiding Structures Using Magnetoplasmons

C.M. Krowne, A.A. Mostafa and K.A. Zaki. "Nonreciprocal Millimeter Wave Propagation in Slot Guiding Structures Using Magnetoplasmons." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 211-214.

A full wave spectral domain approach for general anisotropy is used to determine the nonreciprocal phase and attenuation properties of slot line structures. Dominant mode dispersive behavior is controlled by the semiconductor substrate characteristics, geometric dimensions, and magnetic field bias magnitude and angle in the Voigt configuration. Numerical results are presented to establish the nonreciprocal properties up to 85 GHz.

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Investigation of Tapered Multiple Microstrip Lines for VLSI Circuits (1988 Vol. I [MWSYM])

M.A. Mehalic, C.H. Chan and R. Mittra. "Investigation of Tapered Multiple Microstrip Lines for VLSI Circuits (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 215-218.

The S-parameters of coupled, tapered microstrip etches are calculated as a function of frequency using an iteration-perturbation technique. The propagation constants and impedance matrices are computed using a perturbation-iteration approach. Representative results are obtained to illustrate the application of the method.

Session H -- Measurements I

"Session H -- Measurements I." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 219-219.

Constant Intermooulation Loci Measure for Power Devices Using H.P. 8510 Network Analyzer

L. Ricco, G.P. Locatelli and F. Calzavara. "Constant Intermooulation Loci Measure for Power Devices Using H.P. 8510 Network Analyzer." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 221-224.

A method of characterization for the IMD behaviour of power FET is presented. Curves with constant IMD and constant gain lie on the Gamma/sub L/ locus have been obtained in order to select the appropriate load for the FET and to maximize the device linearity. Examples to correlate the validity of this approach referred to the other one for the designing of amplifier chains are presented too.

A Method for Measuring Magnitude and Phase of Harmonics Generated in Nonlinear Microwave Two-Ports

U. Lott. "A Method for Measuring Magnitude and Phase of Harmonics Generated in Nonlinear Microwave Two-Ports." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 225-228.

A new method for simultaneously measuring magnitude and phase of the harmonics generated by a microwave two-port is described. The measurement system has a dynamic range superior to time-domain measurements due to its reduced noise bandwidth. Sample measurements on a GaAs MESFET under large-signal operation are presented.

Nonlinear GaAs MESFET Modeling Using Pulsed Gate Measurements (1988 Vol. I [MWSYM])

M. Paggi, P.H. Williams and J.M. Borrego. "Nonlinear GaAs MESFET Modeling Using Pulsed Gate Measurements (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 229-231.

The effects of traps in GaAs MESFETs are studied using a pulsed gate measurement system. The devices are pulsed into the active region for 1µs and are held in the cut-off region for the rest of a 1ms period. While the devices are on, the drain current is sampled and a series of "pulsed gate" I-V curves are obtained and compared to conventional static I-V curves. The static and pulsed gate curves were used in a nonlinear time domain analysis model to predict harmonic content. The results showed that models which used the pulsed gate I-V curves to represent the nonlinear drain current yielded better predictions of harmonic distortion than models which used conventional I-V curves.

Two-Port S-Parameter Characterization of High Electron Mobility Transistors at Millimeter Wave and Microwave Frequencies

J.H. Schaffner, F.K. Oshita, H.R. Fetterman, J.J. Berenz, K. Nakano and H.C. Yen. "Two-Port S-Parameter Characterization of High Electron Mobility Transistors at Millimeter Wave and Microwave Frequencies." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 233-236.

Although millimeter wave amplifiers and oscillators using high electron mobility transistors (HEMTs) have been reported up to 94 GHz, to date no direct characterization of these devices has been reported. This paper presents the two-port S-parameters of sub-micron gate length HEMTs at W-band (75 to 110 GHz) using a specially constructed six-port network analyzer. In addition, for comparison to the millimeter wave measurements, the HEMTs were characterized at microwave frequencies, at room and cryogenic temperatures.

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On-Wafer Characterization of Monolithic Millimeter-Wave Integrated Circuits by a Picosecond Optical Electronic Technique

P. Polak-Dingels, H.-L.A. Hung, T. Smith, H.C. Huang, K.J. Webb and C.H. Lee. "On-Wafer Characterization of Monolithic Millimeter-Wave Integrated Circuits by a Picosecond Optical Electronic Technique." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 237-240.

A new picosecond optical electronic sampling technique for the characterization of monolithic microwave integrated circuits (MMICs) has been developed. The measured time domain response allows the spectral transfer function of the MMIC to be obtained. This technique was applied to characterize the frequency response of a two-stage Ka-band MMIC amplifier. The broadband results agree well with those obtained by conventional network analyzer measurements.

Abstracts

A Technique for Improving the Accuracy of Wafer Probe Measurements

M.A. Magerko and E.W. Strid. "A Technique for Improving the Accuracy of Wafer Probe Measurements." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 241-244.

A technique has been developed to increase the accuracy of wafer probe measurements by identifying the calibration standards as "imperfect." Parasitic effects associated with each standard change their expected characteristics and can cause errors in the calibration data. A computer program is used with a network analyzer to determine the parasitic terms and minimize the measurement error.

Session I -- MMIC Low Noise Amplifiers

"Session I -- MMIC Low Noise Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 245-245.

Abstracts

A Monolithic Ka-Band HEMT Low-Noise Amplifier (1988 Vol. I [MWSYM])

C. Yuen, C. Nishimoto, M. Glenn, Y.C. Pao, S. Bandy and G. Zdasiuk. "A Monolithic Ka-Band HEMT Low-Noise Amplifier (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 247-250.

A monolithic, single-stage HEMT low-noise amplifier has been developed for the 20-40 GHz band. This amplifier includes a single 0.25-µm gate-length HEMT active device with on-chip matching and biasing circuits. A gain of approximately 6 dB from 20 to 38 GHz and a noise figure of approximately 5 dB from 26.5 to 38 GHz were measured. These are the best reported results for a millimeter-wave amplifier over this bandwidth. The chip size is 2.2 mm x 1.1 mm.

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A High Electron Mobility Transistor with a Mushroom Gate Fabricated by Focused Ion Beam Lithography (1988 Vol. I [MWSYM])

Y. Sasaki, K. Nagahama, K. Hosono, T. Katoh and M. Komaru. "A High Electron Mobility Transistor with a Mushroom Gate Fabricated by Focused Ion Beam Lithography (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 251-254.

A super low noise HEMT with a mushroom-shaped quarter micron gate was fabricated by using focused ion beam lithography. The mixed exposure of Be/sup ++/ and Si/sup ++/ focused ion beams was used to form T-shaped resist profiles. This method has the advantages of a high reproducibility and controllability of resist profiles. The gate resistance was extremely reduced by mushroom-shaped gate. As a result, the fabricated HEMT showed a minimum noise figure (NFmin) of 0.68dB with an associated gain (Ga) of 9.7dB at 12GHz. This device also showed an NFmin of 0.83dB with a Ga of 7.7dB at 18GHz.

X-Band and Ka-Band Monolithic GaAs PIN Diode Variable Attenuation Limiters (1988 Vol. I [MWSYM])

D.J. Seymour, D.D. Heston and R.E. Lehmann. "X-Band and Ka-Band Monolithic GaAs PIN Diode Variable Attenuation Limiters (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 255-258.

Monolithic GaAs PIN diode limiter circuits have demonstrated 20 dB of variable attenuation at X- and Ka-bands while maintaining under 1.5:1 input VSWR. Insertion loss is 0.5 dB at 10 GHz and 1.4 dB at 36.5 GHz in the 0-mA bias condition. Passive limiting provides 7 dB of isolation at RF powers up to 1.5 watts (30-percent duty cycle). This paper reports this first use of monolithic GaAs PIN diode circuits in radar receivers.

A 35 GHz Monolithic MESFET LNA (1988 Vol. I [MWSYM])

S. Bandla, G. Dawe, C. Bedard, R. Tayrani, D. Shaw, L. Raffaelli and R. Goldwasser. "A 35 GHz Monolithic MESFET LNA (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 259-263.

This paper describes the design and fabrication of a state of the art 35 GHz Monolithic Amplifier. The amplifier with 6.5 dB gain, 4 dB noise figure and 10 dBm power output at 1 dB gain compression is based on a .25x200 micron MBE grown MESFET. Device, circuit design, fabrication details and test results are presented.

Session J -- Heinrich Hertz Centennial Special Session II

"Session J -- Heinrich Hertz Centennial Special Session II." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 265-265.

Heinrich Hertz at Work in Karlsruhe

H.V. Friedburg. "Heinrich Hertz at Work in Karlsruhe." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 267-270.

The confirmation of Maxwell's electrodynamical theory by Heinrich Hertz in the years 1887/8 was not a straight-on work. The generation and handling of oscillations of very high frequency had to be developed and misleading results to be interpreted. After preliminary experiments a powerful oscillator and transmitter was invented, exited by a spark. The radiated field was detected by secondary sparks in a wire-loop, which was tuned to resonance, also a new invention at that time. The finite velocity of the propagation of electromagnetic action was definitively proved by the detection of standing waves. Further experiments showed the similar nature of electromagnetic waves and light very clearly. Later Hertz verified the theoretically predicted skin-effect.

Heinrich Hertz - Theorist and Experimenter (1988 Vol. I [MWSYM])

J.D. Kraus. "Heinrich Hertz - Theorist and Experimenter (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 271-272.

Heinrich Hertz made the first antennas and transmitter-receiver radio system and conducted a series of experiments which established in a brilliant way that radio waves are one with light except for their much greater length. His description of the radiation phenomenon remains the best ever written, revealing his tremendous depth of understanding of the subject. Hertz's training, studies and experiments are recounted and measurements with a replica of his apparatus are described.

Abstracts

Session K -- High Power Microwaves (Focused Session)

"Session K -- High Power Microwaves (Focused Session)." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 273-273.

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PIN Diode Limiter Spike Leakage, Recovery Time, and Damage

R.J. Tan, A.L. Ward, R.V. Garver and H. Brisker. "PIN Diode Limiter Spike Leakage, Recovery Time, and Damage." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 275-278.

A predominantly experimental study was performed on PIN diode-limiter spike leakage, and some preliminary recovery time and damage level results are discussed. Dependencies on the thickness of the intrinsic region (0.5 to 10 µm) and input power at X-band are given.

A Comprehensive Design Technique for the Radial Wave Power Combiner

G.W. Swift and D.I. Stones. "A Comprehensive Design Technique for the Radial Wave Power Combiner." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 279-281.

A novel structure based upon the radial wave power combiner has been developed, incorporating a radially periodic internal structure which permits its design to be accomplished using techniques similar to those used for distributed element filter design. This paper discusses the development of a radial combiner structure providing less than 0.3 dB insertion loss and operating over greater than one octave bandwidth.

Click on title for a complete paper.

A Microwave Powered High Altitude Platform

J.J. Schlesak, A. Alden and T. Ohno. "A Microwave Powered High Altitude Platform." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 283-286.

Recently the world's first flight of a fuelless airplane powered by microwave energy transmitted from the ground took place. A high-power transmitter at 2.45 GHz was used to beam energy to the aircraft circling overhead. A custom printed-circuit array of dipole antennas with associated rectifying diodes coating the underside of the plane converted the microwave energy to direct current to power the electric motor. This is the prototype of a much larger beamed microwave power transmission system that will have an unmanned airplane circle at high altitudes continuously for many months, and thereby be used as a platform for radio communications and surveillance applications.

Microwave Sintering of Ceramics

M.E. Brodwin and D.L. Johnson. "Microwave Sintering of Ceramics." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 287-288.

An overview of microwave sintering is presented and the basic theory for the design of impedance applicators is derived. Examples of applicators for ribbon materials and rods are developed and sintering results are presented. The problems imposed by radiation loss and plasma breakdown are examined and their solution by use of thermally reflecting high pressure cavities are described. A basic system for sintering with feedback control of surface temperature is presented.

Abstracts

Single-Pulse RF Damage of GaAs FET Amplifiers

J.H. McAdoo, W.M. Bollen and R.V. Garver. "Single-Pulse RF Damage of GaAs FET Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 289-292.

Several GaAs MMIC (microwave monolithic integrated circuits) amplifiers have been tested for damage from single pulses of microwave power applied to the circuit input terminals. Damage characteristics are described and modeled.

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Session L -- Measurements II

"Session L -- Measurements II." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 293-293.

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A Second Generation Dual Six-Port Network Analyser

S.K. Judah and A.S. Wright. "A Second Generation Dual Six-Port Network Analyser." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 295-296.

A new technique in dual six-port reflectometry is proposed. This new technique is known as Biphase-Bimodulation and eliminates mechanically precise phase shifters and attenuators; a requirement of current designs. Calibration is simple, requiring only five standards in a Thru-Delay and Match technique. This new reflectometer system promises measurement performance approaching that of heterodyne analysers though at a much reduced hardware cost.

Modeling of Some Coplanar Waveguide Discontinuities (1988 Vol. I [MWSYM])

R.N. Simons and G.E. Ponchak. "Modeling of Some Coplanar Waveguide Discontinuities (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 297-300.

The paper presents lumped equivalent circuit models for several coplanar waveguide discontinuities such as an open circuit, a series gap, and a symmetric step, and their element values as a function of the discontinuity physical dimensions. The model element values are de-embedded from measured S-parameters. The frequency dependence of the effective dielectric constant was measured and compared to computed values.

Electrooptic Sampling Slot Line and Coplanar Measurement of Dispersion Characteristics of Waveguide (Coupled Slot Line) Even and Odd Modes

R. Majidi-Ahy, K.J. Weingarten, M. Riaziat, D.M. Bloom and B.A. Auld. "Electrooptic Sampling Slot Line and Coplanar Measurement of Dispersion Characteristics of Waveguide (Coupled Slot Line) Even and Odd Modes." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 301-303.

The application of the electrooptic sampling technique for the characterization of propagating modes of uniplanar guiding structures on GaAs is described. The characteristics of slot line and even and odd modes of coplanar waveguide on semi-insulating GaAs substrate are investigated. The potential distribution over the cross section of each was measured. Also the guide wavelength for each guide was directly obtained from standing wave measurements by electrooptic sampling and the dispersion characteristics of CPW modes and slot line were measured from 15 to 40 GHz.

Session OF-1 -- Open Forum I

"Session OF-1 -- Open Forum I." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 305-305.

Optimal Excitation of Multiapplicator Systems for Deep Regional Hyperthermia

A. Boag and Y. Leviatan. "Optimal Excitation of Multiapplicator Systems for Deep Regional Hyperthermia." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 307-310.

A method is proposed for determining the excitation amplitudes and phases of the elements of electromagnetic multiapplicator systems for forming a hot zone around a deep-seated tumor. The general principle is applied to a two-dimensional problem of a piecewise homogeneous cylinder heated by an array of electric current filaments placed outside the cylinder. Numerical simulations are performed to check the effectiveness of the approach. The results demonstrate that using this optimization method, an improved specific absorption rate (SAR) distributions can be achieved.

Click on title for a complete paper.

A General-Purpose Computer Program for the Volterra-Series Analysis of Nonlinear Microwave Circuits

S.A. Maas. "A General-Purpose Computer Program for the Volterra-Series Analysis of Nonlinear Microwave Circuits." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 311-314.

This paper describes a computer program that performs a Volterra-series analysis of a weakly nonlinear microwave circuit having an arbitrary topology. It uses the method of nonlinear currents and a nodal formulation. When special algorithms are used to evaluate only the minimum necessary set of mixing products, the computational efficiency is very great.

FET Model Statistics and Their Effects on Prediction for Microwave Design Centering and Yield Amplifiers

J. Purviance, D. Criss and D. Monteith. "FET Model Statistics and Their Effects on Prediction for Microwave Design Centering and Yield Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 315-318.

The first and second order statistics for the model parameters of a TriQuint 0.5 µm GaAs FET are determined and then tested in a statistical circuit design and yield simulation. The purpose is to identify what statistical FET data is needed to statistically design a high yield MMIC amplifier. An example is used to identify which aspects of statistical circuit design are sensitive to the proper FET model statistics. It is shown that the design values are insensitive and the yield estimates are sensitive. The important issues in statistical circuit design are summarized and a discussion of the needed future works is given.

Robust Model Parameter Extraction Using Large-Scale Optimization Concepts

J.W. Bandler, S.H. Chen, S. Ye and Q.J. Zhang. "Robust Model Parameter Extraction Using Large-Scale Optimization Concepts." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 319-322.

A robust approach to model parameter extraction is presented. This approach utilizes multi-bias measurements and dc device characteristics. Novel automatic decomposition concepts for large-scale optimization are used to detect possible model topology deficiencies. Powerful l/sub 1/ optimization is employed with adjoint analyses for both dc and ac sensitivities.

CAD Synthesis of Interstate Networks for Multi-Stage Amplifiers with a Wide Range of Topologies

D.J. Mellor. "CAD Synthesis of Interstate Networks for Multi-Stage Amplifiers with a Wide Range of Topologies." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 323-326.

This paper reviews the techniques and capabilities of CAD Synthesis algorithms which have the capability of designing interstage networks with expanded topology selections. This enables the CAD synthesis of multi-stage amplifiers and increases the opportunity to find an optimum design solution. design problem. Specific ultra-wideband amplifier design examples are given which illustrate the effectiveness of the CAD Synthesis algorithms and design techniques.

Distributed Analysis of Submicron-MESFET Noise-Properties

W. Heinrich. "Distributed Analysis of Submicron-MESFET Noise-Properties." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 327-330.

A distributed MESFET noise-analysis is presented. Its results are used to determine the validity range of common lumped-element models. We found that in well-designed submicron LN-MESFETs distributed effects may be neglected. Practical gate-width design-values are given.

Synthesis Equations for Shielded Suspended Substrate Microstrip Line and Broadside-Coupled Stripline

W. Yunyi, G. Kaijun and S. Yonghui. "Synthesis Equations for Shielded Suspended Substrate Microstrip Line and Broadside-Coupled Stripline." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 331-334.

Simple and explicit equations for synthesis of shielded suspended substrate microstrip line (SSL) and broadside-coupled stripline (BSCL) are presented, valid over a practical application range of structural parameters and dielectric constants of substrate in common use. By comparison of the results obtained using developed synthesis equations with those obtained using SUPER COMPACT (for SSL) and finite-difference method (for BSCL), the accuracy is found to be within ±3% and ±3.5%, respectively.

CAD of E-Plane Circuits with Field-Theory Based Lookup Tables and Discontinuity Models

P. So, W.J.R. Hoefer and P. Saguet. "CAD of E-Plane Circuits with Field-Theory Based Lookup Tables and Discontinuity Models." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 335-338.

In this paper, a novel CAD procedure for E-plane circuits is presented. The CAD method uses field-theory based lookup tables, discontinuity models and an innovative interpolation technique based on physically realistic functions. Several finline circuit components were designed and measured. The CAD results are in good agreement with the experimental results.

Click on title for a complete paper.

Abstracts

Optimizing the Power-Added Efficiency of a Class B GaAs FET Amplifier

S.R. Lesage, J.A. Detra and J.B. Beyer. "Optimizing the Power-Added Efficiency of a Class B GaAs FET Amplifier." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 339-342.

The paper reports on a design routine which optimizes the power-added efficiency of a Class B microwave amplifier stage. Experimental results at 4.4 GHz are reported which support the procedure and show efficiency increases of 15% when low impedance loading at even harmonic frequencies are provided.

GaAs Power MESFET Performance Sensitivity to Profile and Process Parameter Variations

J.B. Yan, R.J. Trew and D.E. Stoneking. "GaAs Power MESFET Performance Sensitivity to Profile and Process Parameter Variations." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 343-346.

Large signal performance sensitivities are calculated and compared for power GaAs MESFETs fabricated with uniform, ion-implanted, and lo-hi-lo doping profiles. Variations in RF power, power-added efficiency, gain, and device linearity are determined for the various devices as a function of process dependent parameters. It is demonstrated that the channel doping profile design and breakdown voltage have the most significant influence upon large-signal RF performance.

GaAs HEMT Lossy Match Amplifiers

Y. Ito and A. Takeda. "GaAs HEMT Lossy Match Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 347-350.

A novel design approach of hybrid lossy match amplifiers for the 1 to 13 GHz and 1 to 20 GHz bands using 0.3 micron gate length GaAs HEMT's is described. Two types of the two stage lossy match amplifier have been realized. One amplifier, using 0.3 x 280 micron GaAs HEMT's, exhibits 14.0±0.4 dB gain, better than 10 dB return loss, and less than 7.8 dB noise figure over the 1 to 13 GHz band. The other amplifier, using 0.3 x 200 micron GaAs HEMT's, shows 9.5±0.4 dB gain, better than 10 dB return loss, and less than 7.5 dB noise figure across the 1 to 20 GHz band. These are the unprecedented lossy match amplifiers to achieve high gain-bandwidth product.

Lumped and Distributed Scaling of MESFETs

J.P. Mondal. "Lumped and Distributed Scaling of MESFETs." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 351-354.

The paper describes a proper way of scaling up large MESFETs starting from elementary cell measurements. The distributed scaling is emphasized and compared with lumped scaling. Experimental results are shown. All the manifold distribution and parasitic effects are accounted for.

Frequency-Dependent Characteristics of Gap Discontinuities in Suspended Striplines for Millimeter Wave Applications

A. Rong and S. Li. "Frequency-Dependent Characteristics of Gap Discontinuities in Suspended Striplines for Millimeter Wave Applications." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 355-358.

In this paper, a full-wave analysis of equivalent circuit parameters of gap discontinuities in suspended striplines is investigated rigorously by resonance method and variational technique. A set of charts of the parameters at W- and Ka-band are evaluated. A Ka-band prototype bandpass filter has been designed and realized to demonstrate the feasibility of the present analysis. The mesured results agree well with the theoretical prediction.

Abstracts

Scattering from 3-Dimensional Discontinuities in Microwave Transmission Lines

R. Sachs and F.J. Rosenbaum. "Scattering from 3-Dimensional Discontinuities in Microwave Transmission Lines." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 359-361.

A material body whose constitutive parameters are µ=µ'-jµ'', epsilon=epsilon'-jepsilon'' located in a stripline, partially filling it, represents a 3D scattering problem. This problem is solved by the Reaction Method yielding the configuration's scattering parameters. An iterative procedure then enables the determination of µ, epsilon from the measured values of the S-parameters.

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Time-Domain Finite Difference Approach for the Calculation of Microstrip Open-Circuit End Effect

X. Zhang and K.K. Mei. "Time-Domain Finite Difference Approach for the Calculation of Microstrip Open-Circuit End Effect." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 363-366.

The frequency-dependant characteristics of the microstrip open-end has been analysed using several full-wave approaches. The time-domain finite difference (TD-FD) method presented in this paper is another independent approach, which is relatively new in its application to obtain the frequency domain results. The purpose of this paper is to establish the validity of the TD-FD method in modeIing circuit components for MMIC-CAD applications.

Application of the Theory of Linear Operators to the Waveguide Discontinuity Problems

S.M. Mahmoud, M.M. Ibrahim and A.S. Omar. "Application of the Theory of Linear Operators to the Waveguide Discontinuity Problems." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 367-370.

A new technique, based on the matrix representation of linear operators, is presented to solve the inverse problem of finding out a linear operator of known eigenvalues and eigenvectors. The technique solves the discontinuity of a junction between a rectangular waveguide and and a shielded microstrip. Experimental measurements achieved are in good agreement with the theoretical results.

A Monolithic Reduced-Size Ku-Band SPDT FET Switch

D.T. Bryant. "A Monolithic Reduced-Size Ku-Band SPDT FET Switch." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 371-374.

A GaAs Ku-band monolithic single-pole double-throw (SPDT) FET switch has been designed and demonstrated. Small-signal insertion loss is less than 1.4 dB over a 14 GHz to 18 GHz bandwidth with a VSWR less than 1.5:1. The common terminal to off-channel isolation exceeds 18 dB. The switching is achieved with a -4.5 volt signal on the gate of the on-channel FET with the other gate at 0 volts. The switching current requirement is only the reverse bias gate leakage current (typically 3 uA). Large-signal performance is similar with a -10 volt control signal. The small chip size, 1.3 mm X 1.3 mm X 0.15 mm, permits more than 2300 monolithic switches to be fabricated on a single 3-inch GaAs wafer.

Matching Structures for High Yield Amplifier Design

J. Purviance, W. Brakensiek, D. Monteith and T. Ferguson. "Matching Structures for High Yield Amplifier Design." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 375-378.

Circuit yield is evaluated for the commonly used narrowband lumped and distributed parameter matching structures. It is shown that each structure has highest yield for load impedances in a given region on the Smith Chart. A simple design chart is developed which gives the designer a high yield matching structure for any given load impedance. Two examples illustrate its use.

Optimization of Distributed Monolithic GaAs Amplifiers Using an Analytical/Graphical Technique

M. Ross and R.G. Harrison. "Optimization of Distributed Monolithic GaAs Amplifiers Using an Analytical/Graphical Technique." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 379-382.

An analytical/graphical procedure provides a close approximation to the optimum design of a distributed monolithic GaAs amplifier, given specific gain and 1-dB bandwidth requirements. The technique gives the optimum number of stages, the FET dimensions and the values of the lumped inductors used to realize the artifical transmission lines.

Experimental Confirmation of Slow-Waves in a Crosstie Overlay Coplanar Waveguide and its Application to Band-Reject Gratings

T.H. Wang, T.M. Wang and T. Itoh. "Experimental Confirmation of Slow-Waves in a Crosstie Overlay Coplanar Waveguide and its Application to Band-Reject Gratings." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 383-386.

The slow-wave propagation along a new crosstie overlay slow-wave coplanar waveguide has been investigated both theoretically, experimentally. A slow-wave factor observed agrees reasonably well with the theoretical prediction. Based on this structure, a doubly-periodic band-reject grating was created. The band rejection phenomenon was observed as predicted.

New Dispersion Models for Open Suspended Substrate Microstrips

R.S. Tomar and P. Bhartia. "New Dispersion Models for Open Suspended Substrate Microstrips." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 387-389.

New dispersion dielectric constant suspended substrate models for the effective and impedance of open microstrips are presented. For frequencies above 20 GHz, the accuracy of these models (in reproducing the exact fullwave data) is better than 1 percent for the effective dielectric constant and mostly better than 2.5 percent for the impedance.

Finite Element Analysis of Dispersion with Sharp Metal Edges in Waveguides

J.P. Webb. "Finite Element Analysis of Dispersion with Sharp Metal Edges in Waveguides." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 391-394.

The dispersion characteristics of arbitrarily-shaped waveguides with sharp metal edges are found by a finite element method in which the usual polynomials are supplemented by singular trial functions. As in recent approaches, the method solves for the three components of magnetic field and can thereby avoid spurious modes.

Equivalent Coaxial Transmission Lines

S.-G. Pan. "Equivalent Coaxial Transmission Lines." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 395-398.

A family of transmission lines is based on a circular conductor and a noncircular conductor. Two new types of equivalent eccentric coaxial lines, which give smooth transition between extremes of a small wire and a wire near contact, are presented. The results obtained are very simple analytical expressions which will be useful for fast computation or for the CAD of coaxial components. The accuracy of the expressions is confirmed by comparing with accurate numerical data.

A Method for Obtaining Dispersion Characteristics of Shielded Microstrip Lines

Q. Lanfen and G. Changqing. "A Method for Obtaining Dispersion Characteristics of Shielded Microstrip Lines." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 399-402.

The properties of shielded microstrip lines are analyzed by the method of equivalent network, which properly takes into account the hybrid nature of the guided waves. The effective dielectric constants and characteristic impedances of microstrip lines are obtained to illustrate the effects of the size of the waveguide crosssection. Numerical results obtained are shown to be in good agreement with available data in the literature.

Session M -- Monolithic Amplifiers

"Session M -- Monolithic Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 403-403.

Millimeter-Wave Monolithic Integrated Circuits

B.E. Spielman. "Millimeter-Wave Monolithic Integrated Circuits." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 405-408.

This paper summarizes the progress, trends, and technical issues associated with monolithic millimeter-wave effort. Presented first is background information intended to set forth: a description of the opportunities which spur this effort; and a summary of some of the important technical challenges. Next, a discussion is provided of recent performance for semiconductor device types and circuit media which serve as building blocks for this technology. Then a description is provided of salient monolithic programs which benchmark the status of current effort. The paper concludes with a summary of technical issues and thrusts.

V-Band Monolithic Power MESFET Amplifiers

G. Hegazi, H.-L. Hung, F. Phelleps, L. Holdeman, A. Cornfeld, T. Smith, J. Allison and H. Huang. "V-Band Monolithic Power MESFET Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 409-412.

Monolithic GaAs power amplifiers have been developed at V-band. A single-stage amplifier provided over 4-dB gain from 50 to 56 GHz, with output power of 95 mW and a power-added efficiency of 11 percent at 55 GHz. A cascaded amplifier achieved 16.2-dB gain and output power of 85 mW. These results may represent the highest power/gain yet reported from V-band power monolithic microwave integrated circuits (MMICs).

Ka-Band 1 Watt Power GaAs MMICs (1988 Vol. I [MWSYM])

Y. Oda, S. Arai, T. Yoshida, H. Nakamura, S. Yanagawa, S. Hori and K. Kamei. "Ka-Band 1 Watt Power GaAs MMICs (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 413-416.

High-power and high-gain Ka-band GaAs MMICs have been developed using a Be co-implantation technique. At 29.5 GHz, an output power of 1 W with 4.2 dB gain has been obtained with gate width of 4.8 mm MMIC. This power gain is the highest value reported to date on Ka-band FETs providing an output power of 1 W. The intercept point of +42 dBm has been obtained from the 3rd order intermodulation distortion measurements.

Abstracts

A 16 W Pulsed X-Band Solid-State Transmitter

C. Peignet, Y. Mancuso, G. Le Meur, L. Remiro, A. Bert, J.F. Jouen and P. Savary. "A 16 W Pulsed X-Band Solid-State Transmitter." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 417-420.

An X-Band control gain amplifier providing more than 41 dBm CW with 60 dB associated gain and 10 % bandwidth has been developed. The power added efficiency is 15%. The length of the device is about 100 mm. The transverse dimension is 15 mm, corresponding to a quarter wavelength, compatible with an active X-Band phased array. At each power level the most appropriate microwave technology has been selected: MMICs, MHMICs (Miniature Hybrid Microwave Circuits) or high dielectric constant circuits.

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Session N -- Filters and Multiplexers I

"Session N -- Filters and Multiplexers I." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 421-421.

Commensurate-Line, Microstrip, Band-Pass Filters

M. Gat. "Commensurate-Line, Microstrip, Band-Pass Filters." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 423-426.

The commensurate-line, microstrip bandpass filter is a practical topology which yields realizable impedance values for wide-bandwidth filters. Kuroda's network transformations are used to synthesize bandwidth-dependent structures. The distribution of the grounded stub impedances, which is also bandwidth dependent, is discussed in detail for the 40-160% range. The realization of tee-junctions and the method used to ground the stubs are key to this topology. Test results for N=11 filters show excellent correlation between test and simulated data. Sensitivity, phase and temperature stability, rejection of second harmonic and microstrip models are also discussed.

High Performance Parallel Coupled Microstrip Filters

A. Riddle. "High Performance Parallel Coupled Microstrip Filters." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 427-430.

A new construction technique allows microstrip parallel coupled filters to have greater passband symmetry and largely removes the parasitic passband at twice the center frequency. This technique brings microstrip filters closer to stripline filter performance. Advanced computer aided design tools and a high precision thin film process make these filters predictable and repeatable.

Rigorous Design of Septate E-Plane Multiplexer with Printed Circuit Elements

J. Dittloff and F. Arndt. "Rigorous Design of Septate E-Plane Multiplexer with Printed Circuit Elements." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 431-434.

A new design of compact, low-cost and low-insertion loss millimeter wave multiplexer is introduced utilizing metallic E-plane filters integrated in the septate waveguide sections of wide-band E-plane n-furcated power dividers. A rigorous simulation technique, which is based on the modal scattering matrix method, comprises the complete component including the E-plane transformer, the septum as well as the filter sections, and takes the influences of the higher-order mode interaction at all discontinuities into account. Computer optimized data are given for Ku- and E-band di- and triplexer design examples with five-, or seven- resonator metal-insert filters, respectively.

Abstracts

Computer-Aided Design of Parallel-Connected Millimeter-Wave Diplexers/Multiplexers

R. Vahldieck and B. Varailhon de la Filolie. "Computer-Aided Design of Parallel-Connected Millimeter-Wave Diplexers/Multiplexers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 435-438.

This paper describes the analysis and design of a novel integrated millimeter wave diplexer. The structure is simple and can easily be extended to a multiplexer configuration. The diplexer is composed of ladder-shaped E-plane metal insert filters which are fabricated on a single metallic sheet and embedded in a split block housing. The theoretical design procedure is based on the generalized scattering matrix method which includes mutual parasitic loading effects between the filters as well as higher order mode interaction. Thus, no physical fine tuning of the component is necessary.

Electronically Tunable Band-Stop Filter

D. Auffray and J.L. LaCombe. "Electronically Tunable Band-Stop Filter." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 439-442.

The design procedures for an electronically tuned band-stop filter are presented. A novel technique for realizing tunable band-stop filter with coupled lines is described. The physical design and electrical performance of a five sections band-stop filter tunable from 6.5 GHz to 10 GHz, with a constant bandwith, is given. The circuit required to drive the band-stop filter and the calibration procedures are described.

Abstracts

Session O -- High Frequency Superconductivity

"Session O -- High Frequency Superconductivity." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 443-443.

Microwave Characteristics of Bulk High-Tc Superconductors

E. Belohoubek, A. Fathy and D. Kalokitis. "Microwave Characteristics of Bulk High-Tc Superconductors." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 445-448.

Currently most available high-T/sub c/ bulk material is in disk form that does not lend itself readily to microwave loss measurements. This paper describes a resonant measurement technique using low impedance disk resonators. The configuration enhances the influence of conductor losses on the resonator Q and thereby permits the evaluation of disks as a function of temperature in a relatively simple test configuration with good accuracy. Measurements on bulk Y Ba/sub 2/ Cu/sub 3/ 0/sub 6+x/ material will be described with conductivities at X-band ranging up to 10 times that of Au at 65°K.

Abstracts

Slow-Wave Properties of Superconducting Microstrip Transmission Lines

J.M. Pond and C.M. Krowne. "Slow-Wave Properties of Superconducting Microstrip Transmission Lines." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 449-452.

A complex resistive boundary condition is used to accurately model very thin superconducting films used in microstrip transmission lines. The imaginary part of the conductivity is a measure of the energy stored in the superconductor which contributes to the slow-wave propagation behavior of these transmission lines. Numerical solutions of superconducting microstrip have been obtained and the dependence of the complex propagation constant on the microstrip geometry and the superconducting thin film properties was investigated.

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Loss Reduction in Superconducting Microstrip-Like Transmission Lines

B. Young and T. Itoh. "Loss Reduction in Superconducting Microstrip-Like Transmission Lines." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 453-456.

A mode-matching analysis is applied to microstrip-like transmission lines to determine the dielectric and conductor loss. In microstrip using normal metals and typical low-loss dielectrics, the conductor loss dominates the dielectric loss. For microstrip employing superconductors, the dielectric loss is shown to be dominant. Further reductions in overall loss must come in the dielectric loss. Superconducting suspended substrate and ridged microstrip are analyzed to determine the dielectric loss reduction available and the effect of the reductions on the conductor loss.

A Superconducting-Dielectric Resonator at W-Band

C.-S. Pao, Y. Li and S.-P. Chou. "A Superconducting-Dielectric Resonator at W-Band." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 457-458.

This paper describes the electromagnetic properties of a superconducting-dielectric resonator (SDR) at W-band. We report that a fairly high factor (in excess of 10/sup 5/-10/sup 6/ at cryogenic temperature) for a resonator based on a sapphire tube loaded with two plates of Y-Ba-Cu oxides (its chemical composition is Y, Ba/sub 2/Cu/sub 5/O/sub 7/, zero resistance at T/sub c/>~80°K). Resonators of this type have potentially valuable application such as ultrahigh stability low phase noise oscillators, descrimininators.

Abstracts

Session P -- Millimeter Wave Integrated Circuits and Technology

"Session P -- Millimeter Wave Integrated Circuits and Technology." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 459-459.

Abstracts

A 43 GHz-Band Balanced Low-Noise Amplifier

M. Ishizaki, T. Hamabe, Y. Oohashi, S. Asai, T. Kasuga and K. Miyazawa. "A 43 GHz-Band Balanced Low-Noise Amplifier." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 461-464.

We have developed a 43 GHz-band balanced low-noise amplifier using HEMTs with a gate length of 0.25 µm. To reduce the loss, a 3-dB hybrid circuit formed by waveguide branch lines was used for the input/output sections of the amplifier. The amplifier has a gain of 9 dB, a noise figure of 5 dB or less, and an input/output VSWR of 1.5 or less from 40 to 45.5 GHz. It has a gain of 10 dB and a noise figure of 4.3 dB or less at -30°C (ambient temperature).

An SIS Mixer for 85-116 GHz Using Inductively Shunted Edge-Junctions

S.-K. Pan, A.R. Kerr, M.J. Feldman, A.W. Kleinsasser, J. Stasiak, R.L. Sandstrom and W.J. Gallagher. "An SIS Mixer for 85-116 GHz Using Inductively Shunted Edge-Junctions." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 465-468.

For the most part, SIS receivers have failed by a wide margin to achieve the sensitivity promised by theory. One of the main reasons for this is the difficulty of providing appropriate embedding impedances at the signal and image frequencies as well as the higher harmonic sidebands. We describe an SIS mixer with a broadband integrated tuning structure. The mixer is tunable from 85-116 GHz, and at midband has a noise temperature of 6 ± 6 K DSB and unity DSB conversion gain. Referred to the mixer input flange, the receiver noise temperature is 9 ± 6 K at midband.

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A Broadband Low Noise SIS Receiver for Submillimeter Astronomy (1988 Vol. I [MWSYM])

T.H. Buttgenbach, R.E. Miller, M.J. Wengler, D.M. Watson and T.G. Phillips. "A Broadband Low Noise SIS Receiver for Submillimeter Astronomy (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 469-472.

A quasioptical heterodyne receiver using a Pb alloy superconductor-insulator-superconductor (SIS) tunnel junction as the detector and a planar logarithmic spiral antenna for the RF coupling is described. Noise measurements were made at frequencies between 115 GHz and 761 GHz, yielding noise temperatures (DSB) ranging from 33 K to 1100 K.

Waveguide-to-Microstrip Transitions for Millimeter-Wave Applications

Y.-C. Shih, T.-N. Ton and L.Q. Bui. "Waveguide-to-Microstrip Transitions for Millimeter-Wave Applications." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 473-475.

Design data are presented for waveguide-to-microstrip probe transitions that cover millimeter-wave frequencies from 26 to 110 GHz. Experimental results show that the transitions have full waveguide-band performance with low insertion loss. They are useful for the device and circuit characterization of millimeter-wave MICs and MMICs.

Experimental Modeling for Millimeter-Wave Monolithic Integrated Circuit Components

W. Lam, A.K. Sharma, K. Nakano, K. Ip, C. Yang, L. Liu and H.C. Yen. "Experimental Modeling for Millimeter-Wave Monolithic Integrated Circuit Components." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 477-480.

An accurate distributed model of monolithic metal-insulator-metal (MIM) capacitors has been developed for computer-aided design of millimeter-wave monolithic integrated circuits at V-band. It is based on experimental measurements on microstrip ring resonators with and without the air-bridges and capacitors. The model takes into account the effects due to the air-bridge discontinuity, as well as dielectric and ohmic losses. The calculated resonant frequencies are in good agreement with the experiments. This capacitor model reduces discrepancy in the resonant frequency by more than 30% compared with that used in commercially available programs. It provides better correlation with the measured results of a monolithic two-stage low noise HEMT amplifier at V-band.

A 94 GHz Low Noise GaAs FET Oscillator Using Whispering-Gallery Dielectric Resonator Modes and a New Push-Push Configuration Reducing 1/f Converted Noise

L.A. Bermudez, P. Guillon, J. Obregon and A. Bert. "A 94 GHz Low Noise GaAs FET Oscillator Using Whispering-Gallery Dielectric Resonator Modes and a New Push-Push Configuration Reducing 1/f Converted Noise." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 481-484.

In this work we present results obtained in the design of a 47-94 GHz GaAs MESFET oscillator-doubler using a dielectric resonator. A new push-push configuration was used for the generation of fundamental frequency at 47 GHz in the drain at the output. This new topology allows build noiseless oscillators-doublers. As a resonant circuit at fundamental frequency we use, in a first version, the conventional TE/sub 01delta/ mode of cylindrical dielectric resonator and in a second version we use a whispering-gallery mode of a planar dielectric resonator. The results obtained show the potential utilization of: GaAs MESFET and whispering-gallery mode of dielectric resonator for the conception of millimeter-wave sources with low-noise and low-power requirements.

Abstracts

Session Q -- Monolithics-Components

"Session Q -- Monolithics-Components." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 485-485.

Abstracts

Optimized X & Ku Band GaAs MMIC Varactor Tuned FET Oscillators

E. Reese, Jr. and J.M. Beall. "Optimized X & Ku Band GaAs MMIC Varactor Tuned FET Oscillators." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 487-490.

Continuous tuning operation has been achieved in X- and Ku-band monolithic VCOS which operate over an extended temperature range with as much as one octave bandwidth. The use of nonlinear circuit analysis has lead to circuit improvements, including a novel lateral varactor structure realizing better Q.

2.5 - 6.0 GHz Broadband GaAs MMIC VCO

J.E. Andrews, T.J. Holden, K.W. Lee and A.F. Podell. "2.5 - 6.0 GHz Broadband GaAs MMIC VCO." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 491-494.

This paper describes the design, analysis, and experimental results of a GaAs MMIC VCO which continuously tunes from 2.5 to 6.0 GHz.

A Miniature Integrated Monolithic VCO Module

K.J. Anderson and D.L. Allen. "A Miniature Integrated Monolithic VCO Module." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 495-498.

A miniature voltage-controlled oscillator module implementing a novel oscillator/attenuator/buffer amplifier MMIC has been developed for use at 7 GHz. The module provides regulated bias supply for the chip and has been designed for low-cost high-volume automated assembly. Measured performance exceeds goals set forth and matches modeled predictions well.

DC-50GHz MMIC Variable Attenuator with a 30dB Dynamic Range

H. Kondoh. "DC-50GHz MMIC Variable Attenuator with a 30dB Dynamic Range." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 499-502.

A newly developed MMIC FET variable attenuator has demonstrated a 30dB dynamic range of attenuation over a DC-50GHz frequency band with a minimum insertion loss of 1.8dB at 26.5GHz and 2.6dB at 40GHz. The maximum attenuation increases with frequency from 32dB at DC to 42dB at 50GHz.

A Distributed Broadband Monolithic Frequency Multiplier

A.M. Pavio, S.D. Bingham, R.H. Halladay and C.A. Sapashe. "A Distributed Broadband Monolithic Frequency Multiplier." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 503-504.

A broadband frequency doubler, which employs distributed amplifier techniques, has been designed to operate over several octaves of bandwidth. The new circuit design suppresses the fundamental frequency energy present at the output port while maximizing the second harmonic signal. The design can be realized using monolithic or conventional microwave circuit techniques for use in local oscillator chains.

Session R -- Filters and Multiplexers II

"Session R -- Filters and Multiplexers II." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 505-505.

A Bandpass Filter Using Electrically Coupled TM/sub 01delta/ Dielctric Rod Resonators

Y. Kobayashi and M. Minegishi. "A Bandpass Filter Using Electrically Coupled TM/sub 01delta/ Dielctric Rod Resonators." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 507-510.

A compact bandpass filter having Chebyshev, low-loss and good spurious response is constructed by placing high-Q TM/sub 01delta/ dielectric rod resonators coaxially in a TM/sub 01/ cutoff circular waveguide. A precise design of the high-Q resonators and interresonator coupling is performed by the mode matching technique. The interresonator coupling is equivalently expressed by a capacitively coupled LC resonant circuit.

A TE Triple-Mode Filter

R.R. Bonetti and A.E. Williams. "A TE Triple-Mode Filter." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 511-514.

A novel realization of triple-mode filters using only TE mode degeneracies is presented. This approach compares favorably with previous designs that employ mixed TE-TM modes. Experimental results obtained with a prototype six-pole, 11.9-GHz, quasi-elliptic, 30-MHz bandpass filter designed at the degeneracy of the TE/sub 114/ and TE/sub 312/ modes are shown to agree well with theory.

Modeling of Coupling by Probes in Dual Mode Cavities

K.A. Zaki, C. Chen and A.E. Atia. "Modeling of Coupling by Probes in Dual Mode Cavities." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 515-518.

An accurate model of coaxial probes used as input and output ports in dual mode cavities (either air filled or dielectric loaded) is presented. The model precisely predicts such empirically observed phenomena as limited out-of-band isolation, generation of extra transmission zeros and asymmetric responses. The model parameters can be determined from simple measured data. Experimental verification of the model for several configurations showed excellent agreement with theory.

800MHz Band High-Power Bandpass Filter Using TM/sub 110/ Mode Dielectric Resonators for Cellular Base Stations

T. Nishikawa, K. Wakino, T. Hiratsuka and Y. Ishikawa. "800MHz Band High-Power Bandpass Filter Using TM/sub 110/ Mode Dielectric Resonators for Cellular Base Stations." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 519-522.

An 800 MHz band high-power filter using new type TM/sub 110/ mode dielectric resonators has been developed. This filter has a low dissipation characteristics and excellent temperature stability. Under high-power operation, the changes of the filter characteristics are negligible. The size of the filter is 200x140x60mm (1700cc), about one fifth the volume of conventional high-power filters.

Abstracts

Session S -- Solid State Devices

"Session S -- Solid State Devices." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 523-523.

Abstracts

22 GHz Performance of the Permeable Base Transistor

L.J. Kushner, M.A. Hollis, R.H. Mathews, K.B. Nichols and C.O. Bozler. "22 GHz Performance of the Permeable Base Transistor." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 525-528.

Small-signal and power performance of GaAs permeable base transistors (PBTs) at 22 GHz is reported. A small-signal gain of 14.5 dB was demonstrated over a 1 GHz bandwidth from a device having a 3200-Å-periodicity base grating and an 8 x 20 μm^2 active area. A similar device, biased for Class AB operation, achieved 45% power-added efficiency with an output power of 83 mW, and an associated gain of 5.7 dB. We believe this to be the highest reported efficiency of any device operating at this frequency and power level. An output power of 210 mW with 4.7 dB of gain and 37% efficiency were obtained from a larger device having an 8 x 40 μm^2 active area. A pair of these large devices in parallel delivered 370 mW with 3.7 dB gain and 33% efficiency, and 410 mW with 3.1 dB gain and 31% efficiency.

Microwave Performances of npn and pnp AlGaAs/GaAs Heterojunction Bipolar Transistors

B. Bayraktaroglu and N. Camilleri. "Microwave Performances of npn and pnp AlGaAs/GaAs Heterojunction Bipolar Transistors." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 529-532.

The performances of MOCVD grown npn and pnp AlGaAs/GaAs HBTs were compared at microwave frequencies to identify relative merits of each type of device. F/sub t/ and f/sub max/ values of devices with 100 nm thick bases were 22 and 40 GHz for npn transistors and 19 and 25 GHz for pnp transistors, respectively. An accurate device model was developed using the measured S-parameter data. The base resistance of the pnp transistors, as determined from the model, was about five times lower than identical size npn device. A theoretical comparison of the two types indicated that similar performances may be obtained from both if the base layer thickness of pnp transistor is half that of the npn device. Large signal characterization was carried out at 10 GHz.

Watt-Level Millimeter-Wave Monolithic Diode-Grid Frequency Multipliers

R.J. Hwu, C.F. Jou, W.W. Lam, U. Lieneweg, D.C. Streit, N.C. Luhmann, Jr., J. Maserjian and D.B. Rutledge. "Watt-Level Millimeter-Wave Monolithic Diode-Grid Frequency Multipliers." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 533-536.

Monolithic planar arrays containing in excess of 1000 Schottky diodes have produced watt level output at 66 GHz in a doubler configuration in excellent agreement with large signal predictions of the frequency multiplication. Current efforts are concentrated on fabricating and developing arrays of novel barrier-intrinsic-N/sup +/ (BIN) diode which promise increased performance in tripler and quintuple configurations.

Silicon Permeable Base Transistors for Low-Phase-Noise Oscillator Applications Up to 20 GHz

D.D. Rathman and W.K. Niblack. "Silicon Permeable Base Transistors for Low-Phase-Noise Oscillator Applications Up to 20 GHz." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): 537-540.

Silicon permeable base transistors have been fabricated that exhibit a small-signal short-circuit current gain frequency exceeding 20 GHz and a maximum frequency of oscillation near 30 GHz. This transistor has been used to realize voltage-controlled oscillators at C, X, and Ku band that have provided low phase noise.

Back Cover (1988 Vol. I [MWSYM])

"Back Cover (1988 Vol. I [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.1 (1988 Vol. I [MWSYM]): b1-b1.

Abstracts

Front Cover (1988 Vol. II [MWSYM])

"Front Cover (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): f1-f1.

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"Copyright (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): i-ii.

Session T -- Microwave Integrated Circuits

"Session T -- Microwave Integrated Circuits." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 541-541.

Optimised Synthesis of Microstrip Branch-Line Couplers Taking Dispersion, Attenuation Loss and T-Junction Into Account

A. Angelucci and R. Burocco. "Optimised Synthesis of Microstrip Branch-Line Couplers Taking Dispersion, Attenuation Loss and T-Junction Into Account." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 543-546.

Directional couplers are fundamental components for MIC's up to millimeter-wave range. The paper presents an optimised synthesis technique of the microstrip branch-line type, that takes microstrip dispersion, conductor loss and T-junction discontinuity effects into account. The good agreement between measured and computed S parameters of two experimental 3-branch couplers proves the complete model reliability up to 20 GHz. Finally a brief analysis of sensitivity versus geometrical dimensions of the coupler is made.

Thin-Film Millimeter Wave Subassemblies

C. Bueb and D. Murrow. "Thin-Film Millimeter Wave Subassemblies." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 547-550.

Thin film millimeter subassemblies, a 35 GHz low noise downconverter and an 18 to 40 GHz dual channel downconverter are described. The hermetic portion of the 35 GHz downconverter subassembly performs four different circuit functions in a package 1.90" by 0.75" by 0.32". The 18 to 40 GHz dual-channel downconverter subassembly employs three hermetic packages interfaced with small rigid coaxial interconnections. Collectively these three hermetic packages perform five different circuit functions in a total volume of 1.08 cubic inches. These downconverter subassemblies are built out of thin-film circuits which offer reduced system size and low interconnection losses.

Click on title for a complete paper.

Microstrip Disk Cavities Filter Using Gap Capacitances Coupling

L. Zhuang, L. Yu-Quan and G. Zhong-Min. "Microstrip Disk Cavities Filter Using Gap Capacitances Coupling." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 551-553.

In this paper a microstrip disk cavities bandpass filter using gap capacitances coupling is proposed and tested. The advantages of this filter are its excellent electrical performance, small size and its convenience for planar integration. Here a theoretical evaluation of the main capacitances and gap capacitances in a shielded microstrip multi-conductors system is accomplished. Thus the foundation for analysis and synthesis of this filter is established.

Abstracts

Real Frequency Technique Applied to Synthesis of Lumped Broadband Matching Networks with Arbitrary Nonuniform Losses for MMIC's (1988 Vol. II [MWSYM])

L. Zhu, B. Wu and C. Sheng. "Real Frequency Technique Applied to Synthesis of Lumped Broadband Matching Networks with Arbitrary Nonuniform Losses for MMIC's (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 555-558.

A new computer-aided synthesis technique is presented in this paper for treating the synthesis of lumped matching networks with arbitrary nonuniform losses. It is especially applicable to the design of the broadband amplifiers in MMIC's. A new useful theorem and corollary are developed for the transformation between lossy or lossless network and lossless one, so that the design of the lossy matching networks is quite simplified and it can yield any complex models of the lumped elements with arbitrary nonuniform losses than that of Ref. (1). An example is given to show the general applications of the new method in the monolithic broadband amplifier design.

Abstracts

Session U -- Monolithic Systems

"Session U -- Monolithic Systems." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 559-559.

A 32 Tap Digitally Controlled Programmable Transversal Filter Using LSI GaAs ICs

J.W. Culver, D.E. Zimmerman and C.M. Panasik. "A 32 Tap Digitally Controlled Programmable Transversal Filter Using LSI GaAs ICs." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 561-564.

A Digitally Controlled Programmable Transversal Filter (DCPTF) is described that employs a LiNbO/sub 3/ SAW delay line and two LSI GaAs ICs to digitally control magnitude and sign of the 32 tap weights. The DCPTF constitutes a significant reduction in size over the previously reported PTF with little sacrifice in performance. The DCPTF is completely programmable and is constrained only by the bandwidth (100 MHz centered at 300 MHz) and the number of taps.

A 30 GHz-Band Full-MMIC Receiver for Satellite Transponders

H. Kato, T. Ohira, F. Ishitsuka and N. Imai. "A 30 GHz-Band Full-MMIC Receiver for Satellite Transponders." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 565-568.

30GHz-band MMIC modules (low noise amplifier, frequency converters and local oscillator) needed to construct a Ka-band full-MMIC satellite transponder have been developed. A receiver bread-board model has been assembled using MMIC modules and total performances have been evaluated. Test results indicate successful performance as a satellite receiver system.

A Monolithic L-Band Limiting Amplifier and Dual-Modulus Prescaler GaAs Integrated Circuit

A.E. Geissberger, R.A. Sadler, H.P. Singh, G.K. Lewis, I.J. Bahl and M.L. Balzan. "A Monolithic L-Band Limiting Amplifier and Dual-Modulus Prescaler GaAs Integrated Circuit." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 569-572.

We present fabrication details, RF-yield results, and RF performance vs. temperature for an ECL-compatible, L-band, limiting dual-modulus (÷10/11) prescaler. This new process for monolithic integration of analog and digital circuit functions uses refractory self-aligned gate FET technology. When tested with -22 dBm input signal power, one lot of six wafers had a total RF chip yield of 19%, with a best-wafer yield of 43%. The average operating frequency was 1.45 GHz (SD = 51 MHz) with an average power dissipation of 696 mW (SD = 23 mW).

A Monolithic Channelized Preselector for EW Receiver Applications

R.H. Halladay, A.M. Pavio, S.D. Bingham and A. Kikel. "A Monolithic Channelized Preselector for EW Receiver Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 573-576.

A switched preselector, consisting of monolithic bandpass filters, multi-throw switches and broadband amplifiers has demonstrated excellent selectivity and low loss characteristics in considerably less volume than conventional microstrip designs. The switches employ series and shunt FETs in 1P4T and 1P2T configurations, while the filters were designed using semi-lumped element techniques.

Session V -- Passive Networks I

"Session V -- Passive Networks I." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 577-577.

New Slot-Coupled Directional Couplers Between Double-Sided Substrate Microstrip Lines, and Their Applications

T. Tanaka, K. Tsunoda and M. Aikawa. "New Slot-Coupled Directional Couplers Between Double-Sided Substrate Microstrip Lines, and Their Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 579-582.

This paper describes a newly developed slot-coupled directional coupler between two microstrip lines coupling through a rectangular slot in the common ground plane, and its application to a planar multiport directional coupler (MDC). An effective slot-coupled MDC is easily fabricated, and has many useful applications such as beam-forming networks and multiport amplifiers.

Computer Aided Modelling of a Multidielectric Structure and its Application to the Design of Overlay Couplers

J. Gallimore. "Computer Aided Modelling of a Multidielectric Structure and its Application to the Design of Overlay Couplers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 583-586.

A computer model of a multi-dielectric multi-conductor system has been developed. The solution of the field equations of the system has yielded a powerful computer aided design tool suitable for use in the design of microstrip based overlay couplers. The method of analysis of the system is presented together with theoretical predictions of the performance of overlay couplers. Encouraging comparisons have been made between a set of previously measured results and the theoretical performance predicted using this method.

Abstracts

Synthesis and Design of Wideband Symmetrical Nonuniform Directional Couplers for MIC Applications

S. Uysal and A.H. Aghvami. "Synthesis and Design of Wideband Symmetrical Nonuniform Directional Couplers for MIC Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 587-590.

A computer aided synthesis design procedure for wideband symmetrical nonuniform directional couplers in inhomogeneous media is presented. Solutions for the potential problems inherent to these couplers are given. Results for a 2-18 GHz 5-section, -3 dB nonuniform tandem directional coupler designed and built on alumina substrate are presented.

Ideal W.G. to Coax Transitions Using a F.B.M. Monopole

F.C. de Ronde. "Ideal W.G. to Coax Transitions Using a F.B.M. Monopole." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 591-594.

A w.g.- coax probe transition is in fact a monopole in a waveguide. We can match this, without tuning screws, over the full w.g. band for all types of w.g.: radial circular TM/sub 01/, rectangular, single or double ridge and trough guide. Ideal rect. w.g. to coax transitions, right angle-, as well as end launch ones, have been realised: V.S.W.R. <=1.02 for X-band with beadless coax connectors.

Ultra-Broadband High-Directivity Directional Coupler Design

J.D. Bickford and G.R. Branner. "Ultra-Broadband High-Directivity Directional Coupler Design." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 595-598.

This paper discusses the theory and design of ultra-broadband high-directivity tapered line directional couplers. Causes of imperfect directivity are examined from both a theoretical and experimental standpoint. This includes the effects of non-unity VSWR terminations and internal connections, unequal even and odd mode velocities, and unequal even and odd mode attenuation constants. Practical considerations in the modem design of asymmetrical tapered couplers are discussed. Such information is significant in the choice of structure, layout, and tolerances to achieve maximum directivity. An example design is presented which displays a bandwidth that is believed to be approximately 1.7 octaves greater than any other coupler of comparable directivity.

Session W -- Dielectric Resonator Oscillators

"Session W -- Dielectric Resonator Oscillators." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 599-599.

Abstracts

A Fast-Locking X-Band Transmission Injection-Locked DRO

A.P.S. Khanna and E. Gane. "A Fast-Locking X-Band Transmission Injection-Locked DRO." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 601-604.

A novel wideband configuration for a transmission injection-locked DRO is presented. An example of a 9.5 GHz ILDRO with a locking time of less than 100 ns for the final frequency to be within ±1 ppm of the reference frequency is described.

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Dielectric Split-Ring Resonators and Their Application to Filters and Oscillators

M. Sagawa, I. Ishigaki, M. Makimoto and T. Naruse. "Dielectric Split-Ring Resonators and Their Application to Filters and Oscillators." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 605-608.

Dielectric split-ring resonators (DSRs) having excellent properties, such as small size, low loss and good temperature stability, have been developed. The experimental studies carried out to obtain design charts for applications, and the trial filters and oscillators fabricated, have shown that the DSRs have many attractive features above the UHF band.

A Broadband VCO Using Dielectric Resonators

P.C. Kandpal and C. Ho. "A Broadband VCO Using Dielectric Resonators." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 609-612.

A novel approach for obtaining broadband negative resistance in designing 1-port oscillators is described. The circuit uses a varactor in the feedback path to obtain a variable reactance for maximizing the negative resistance. The concept is demonstrated by designing and fabricating a circuit that oscillates in the 3.5-to 6.5-GHz band by only replacing the dielectric resonator. The technique will be useful in building broadband sources and also in MMIC technology as a tool for electrically tweaking the circuits.

Oscillator Applications of Double Dielectric Resonator

S.J. Fiedziuszko. "Oscillator Applications of Double Dielectric Resonator." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 613-616.

Oscillator configurations are presented which are based on utilization of a double dielectric resonator. Major advantage of this particular approach is wide, Iinear tuning of the oscillators. Q-factor degradation associated with metal tuning arrangements is prevented and additional temperature compensation and linearization is possible. The principle of operation and experimental results are shown.

Session X -- New Methods for Planar Circuit Discontinuities

"Session X -- New Methods for Planar Circuit Discontinuities." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 617-617.

Numerical Methods for Passive Components

R. Sorrentino. "Numerical Methods for Passive Components." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 619-622.

Because of recent advances in microwave technology, such as monolithic integrated circuits, and the use of the millimetre-wave spectrum, highly sophisticated numerical techniques are required for the analysis and design of microwave circuits and components. This paper will describe a number of numerical methods which have been developed for the characterization, modelling and design of microwave and millimetre-wave passive structures, with emphasis on planar and quasi-planar structures. Specific advantages and disadvantages in terms of versatility, accuracy, computer discussed. Typical structures representative examples of the time, memory, will be will be illustrated as methods described.

The Transfinite Element Method for Modeling MMIC Devices (1988 Vol. II [MWSYM])

Z.J. Cendes and J.-F. Lee. "The Transfinite Element Method for Modeling MMIC Devices (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 623-626.

A new numerical procedure called the transfinite element method is employed in conjunction with the planar waveguide model to analyze MMIC devices. By using analytic basis functions together with finite element approximation functions in a variational technique, the transfinite element method is able to determine the fields and scattering parameters for a wide variety of stripline and microstrip devices.

Time-Domain Method of Lines Applied to a Partially Filled Waveguide

S. Nam, S. El-Ghazaly, H. Ling and T. Itoh. "Time-Domain Method of Lines Applied to a Partially Filled Waveguide." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 627-630.

A new time-domain method for the analysis of guided wave propagation and scattering is developed in which an analytical process is incorporated along one of the three dimensions in space, so that the problem is effectively reduced to a two-dimensional one. A simple numerical example is presented as a demonstration of the new method.

Dispersion Characteristics of Transient Signals in Microstrip Step Discontinuity

K.S. Chen, G.W. Zheng and S.T. Peng. "Dispersion Characteristics of Transient Signals in Microstrip Step Discontinuity." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 631-634.

We present an analysis of the transmission of electromagnetic pulse through a step discontinuity between two microstrip lines of different width. The step discontinuity is first characterized by a two-port network for which the frequency dependence of the scattering parameters are determined by the method of line. By means of the Fourier transform technique, transient responses of the step discontinuity to various pulses are then investigated for different ratios of strip widths and substrate materials. It is found that the distortion of pulses propagating through the step discontinuity can be quite substantial, particularly for the case of large width ratio and substrate of high dielectric constant. Thus, the results so obtained will provide valuable information for the design of microwave integrated circuits.

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Challenge to 3-D Discontinuous Dielectric Waveguide Circuit Analysis

M. Tsuji and H. Shigesawa. "Challenge to 3-D Discontinuous Dielectric Waveguide Circuit Analysis." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 635-638.

An accurate theoretical approach for discontinuity problems in dielectric 3-D (rectangular) waveguides of open type is presented. This approach takes account of the behavior of both surface wave modes and continuous spectral waves, and is successfully applied to design image-guide grating filters. Experiments proves the effectiveness of our approach.

Session Y -- An Overview of European Activities

"Session Y -- An Overview of European Activities." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 639-639.

GaAs Device Activities in Europe

W. Baechtold. "GaAs Device Activities in Europe." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 641-644.

An overview on the current activities in Europe on GaAs and related devices is presented. The highlights include: high performance GaAs FET devices, opto-electronic circults, GaInAs FETs and theoretical investigations on MESFET performance.

European MMIC Activities (1988 Vol. II [MWSYM])

J. Magarshack. "European MMIC Activities (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 645-648.

This paper reviews the principal activities of Europe in the field of MMIC's. 7 companies are included, two in each of England, France and Germany and one in Italy. An emphasis is made on original contributions from the different groups. These include specific MMIC components designs, architectures, mm applications, modelling, libraries and packaging. A summary of the European approach for applications where this new technology will have a major impact will be given.

Millimeter-Wave Systems and Applications in Europe

H.H. Meinel. "Millimeter-Wave Systems and Applications in Europe." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 649-653.

Two major types of applications have to be distinguished in the millimeter-wave range: communication and radio-location. Millimeter-wave communication systems are used for railroad traffic control or telephone network enlargements, cellular radio is under investigation in the commercial area, while covert (LPI) communication has been developed for military purposes. The widest spread tasks are found in radar. The contact free measurement of velocity or distance for traffic control or industrial use are commercial applications, while intelligent seeker systems for terminal-guidance or 'smart'-weapons are military employments.

Session Z -- Passive Networks II

"Session Z -- Passive Networks II." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 655-655.

Broadbanding Techniques for TEM N-Way Power Dividers

A. Shor. "Broadbanding Techniques for TEM N-Way Power Dividers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 657-659.

Broadband TEM power dividers have traditionally involved multisection or taper designs. However, compensation techniques may be used to achieve broadband designs with a single or fewer sections. The compensating elements may be either lumped or distributed. The suggested techniques involve the transmission lines, the isolation resistors. These principles will be implemented for several practical designs, including broadband lumped-element power dividers.

Use of Circular Sector Shaped Planar Circuits for Multiport Power Divider-Combiner Circuits

M.D. Abouzahra, K.C. Gupta and A. Dumanian. "Use of Circular Sector Shaped Planar Circuits for Multiport Power Divider-Combiner Circuits." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 661-664.

A novel sector shaped circuit configuration is proposed for designing planar power dividers-combiners that are compatible with microstrip circuits. Interesting experimental results on 2, 3, 4, and 5-way power divider circuits are presented. Impedance matrix expressions for annular sectors have been derived and used in the two-dimensional analysis of these circuits.

A Compact Seven-Way Power Divider for Satellite Beam Forming Networks

S.C. Holme, V.E. Dunn and V. Jamnejad. "A Compact Seven-Way Power Divider for Satellite Beam Forming Networks." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 665-668.

A new seven-way power divider/combiner is described. This divider meets the physical and performance requirements needed to implement a novel beam forming network for a communication satellite. Theory, fabrication, and experimental results on two different realizations are presented.

Polarization Adaptor

C.S. Kim and N. Moldovan. "Polarization Adaptor." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 669-671.

This paper describes the performance a polarization adaptor. The polarization changes two orthogonally polarized signals two co-pol signals. With this device commercially available RxTx units performing two way orthogonal polarization modes can be applied to two way co-pol satellite communication systems.

Broadband Phase Invariant Attenuator

D. Adler and P. Maritato. "Broadband Phase Invariant Attenuator." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 673-676.

A 6-18 GHz variable attenuator has been realized, with less then 5° phase error over 32 dB attenuation range. The approach utilizes the bi-phase nature of a reflection from a resistive load. Using quadrature couplers, it is shown that the first order errors are reduced to fourth order terms, resulting in significant phase error improvement.

Session AA -- New Developments in Oscillator and Mixer Technology

"Session AA -- New Developments in Oscillator and Mixer Technology." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 677-677.

A Low-Noise Ku-Band AlGaAs/GaAs HBT Oscillator

N. Hayama, S.R. Lesage, M. Madihian and K. Honjo. "A Low-Noise Ku-Band AlGaAs/GaAs HBT Oscillator." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 679-682.

This paper describes design consideration, fabrication and performance for the first low phase noise Ku-band oscillator implemented using a fully self-aligned AIGaAs/GaAs heterojunction bipolar transistor (HBT). The transistor has a measured collector current 1/f noise power density of 10/sup -19/A²Hz at f=400Hz for a collector current of 1.2mA. On the other hand, the developed free-running oscillator represents an output power of 6dBm at 15.5GHz with a SSB FM noise of -65dBc/Hz at 10kHz off-carrier. The noise level is 24dB lower than that for a GaAs FET oscillator, and 2dB lower than that for a Si VCO, respectively. These experimental results give an indication of the low noise, high frequency oscillator performance available with HBTs.

Monolithic and Discrete MM-Wave InP Lateral Transferred-Electron Oscillators

S.C. Binari, R.E. Neidert and K.E. Meissner. "Monolithic and Discrete MM-Wave InP Lateral Transferred-Electron Oscillators." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 683-686.

We have investigated a lateral InP transferred-electron device structure and demonstrated its application to mm-wave monolithic integrated circuits (MMICs). From cavity-tuned discrete devices, the highest CW power output (29.1 mW) and conversion efficiency (6.7%) of any lateral transferred-electron device has been obtained at 29.9 GHz. These devices also had a CW power output of 0.4 mW at 98.5 GHz and a CW power output of 0.9 mW at 75.2 GHz. In addition, the first monolithic oscillator incorporating a lateral transferred-electron device has been demonstrated at 79.9 GHz.

V-Band Monolithic IMPATT VCO

B. Bayraktaroglu. "V-Band Monolithic IMPATT VCO." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 687-690.

Integration of a GaAs IMPATT oscillator and a varactor diode was achieved on a single chip. The IMPATT oscillator was in the form of a half-wavelength microstrip resonator exited on both ends symmetrically by a pair of diodes. A third diode was placed close to one end of the resonator and used to control the oscillation frequency of the oscillator through a coupling capacitor. Depending on the value of the coupling capacitor, tuning ranges of up to 1.5 GHz could be obtained at a center frequency of 55 GHz. Typical output powers were in the 100 to 400 mW range.

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A Uni-Planar Double-Balanced Mixer Using a New Miniature Beam Lead Crossover Quad

J. Izadian, K. Irwin, R. Curby, R. Forse and K. Van Buren. "A Uni-Planar Double-Balanced Mixer Using a New Miniature Beam Lead Crossover Quad." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 691-694.

A unique silicon beam lead Schottky diode quad having a crossover configuration and very small size is presented. This rugged, high performance device permits the design of new miniature single-sided double-balanced mixer circuits. They require no backside metal patterning and provide for simple component mounting. The mixers are readily manufacturable and therefore low cost. The uni-planar design has 6.3+-0.5 dB conversion loss over the 8-18 GHz band with a 2 GHz IF.

4 to 40 GHz Even Harmonic Schottky Mixer

J.L. Merenda, D. Neuf and P. Piro. "4 to 40 GHz Even Harmonic Schottky Mixer." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 695-698.

Second harmonic mixing from 4 to 40 GHz with a 2 to 20 GHz LO has been obtained using an eight diode antiparallel bridge in a balanced microstrip circuit. The development and testing of this mixer, which includes a lumped element diplexer, was expedited by a 10X scale model at 4 GHz.

Abstracts

Session BB -- Microstrip and Fin-Line Discontinuities

"Session BB -- Microstrip and Fin-Line Discontinuities." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 699-699.

A New Method for Discontinuity Analysis in Shielded Microstrip

L.P. Dunleavy and P.B. Katehi. "A New Method for Discontinuity Analysis in Shielded Microstrip." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 701-704.

A new integral equation method is described for the accurate full-wave analysis of shielded microstrip discontinuities. The integral equation is derived by an application of reciprocity theorem, then solved by the method of moments. Numerical and experimental results are presented for open-end and series gap discontinuities, and a coupled line filter.

Analysis of Microstrip Open-End and Gap Discontinuities in a Substrate-Superstrate Configuration

H.-Y. Yang, N.G. Alexopoulos and D.R. Jackson. "Analysis of Microstrip Open-End and Gap Discontinuities in a Substrate-Superstrate Configuration." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 705-708.

A study of microstrip open-end and gap discontinuities in a two-layer structure is presented. The analysis is based on the method of moments solution of a full wave integral equation. A combination of semi-infinite modes and subdomain modes is used. The transverse dependence of the expansion functions is obtained through a two dimensional infinite analysis. A parametric study of the material effects on the radiation and surface wave losses, and the fringing fields at the discontinuities is also performed. The analysis has been checked with good agreement in the limiting case with the quasi-static method.

Spectral Iterative Techniques for the Full-Wave 3d Analysis of (M)MIC Structures

W. Wertgen and R.H. Jansen. "Spectral Iterative Techniques for the Full-Wave 3d Analysis of (M)MIC Structures." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 709-712.

As an alternative to conventional moment methods, spectral iterative techniques (SITs) are introduced for the fullwave 3d analysis of (M)MIC structures. A spectral domain integral operator formulation is used in analogy to standard scattering problems. The employed iterative computational techniques avoid the handling of large matrix equations otherwise required in the treatment of complex geometries. Hence, computation time is reduced considerably and the capability of analyzing irregular microstrip structures is obtained for problems exceeding the scope of moment methods.

Simplified Description of the Field Distribution in Finlines and Ridge Waveguides and its Application to the Analysis of E-Plane Discontinuities (1988 Vol. II [MWSYM])

R.R. Mansour, R.S.K. Tong and R.H. MacPhie. "Simplified Description of the Field Distribution in Finlines and Ridge Waveguides and its Application to the Analysis of E-Plane Discontinuities (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 713-716.

Using closed-form equations for the field distribution of the eigenmodes in ridge waveguides, this paper presents a simplified analysis for ridge waveguide E-plane discontinuities. The accuracy of the calculated results is checked by comparison with experimental results. Closed-form equations are also presented for the field distribution of the dominant hybrid mode in unilateral finlines.

Non-Uniform Finlines on Anisotropic Substrates

A. Beyer, D. Kother and W.J.R. Hoefer. "Non-Uniform Finlines on Anisotropic Substrates." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 717-720.

Serious errors occur in the analysis of quasi-planar circuits, particulary at millimeter wavelengths, if the anisotropy of the substrates is neglected. This paper addresses the problem of non-uniform finlines (tapered sections) on anisotropic substrates. A solution of the generalized telegraphist's equation is described which takes into account the second - order effects such as dielectric and magnetic losses, finite metallization thickness and substrate mounting grooves. Numerical and experimental data are presented and compared.

Analysis and Optimization of E-Plane Directional Couplers

S. Labonte and W.J.R. Hoefer. "Analysis and Optimization of E-Plane Directional Couplers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 721-724.

A procedure for the simulation of E-plane coupled hybrids is proposed. The component is divided into cascade of uniformly coupled subsections which are individually analyzed with a spectral domain program.The validity of the approach is confirmed by measurements several couplers.

Abstracts

Fullwave Analysis of Coupled-Finline Discontinuities

G. Schiavon, P. Tognolatti and R. Sorrentino. "Fullwave Analysis of Coupled-Finline Discontinuities." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 725-728.

The coupling between transmission line sections or resonators is used in a number of components, such as filters, couplers, etc. The general discontinuity problem of coupled-finline sections is considered. Depending on the arrangement, coupling may occur both at the ends or at the sides of the finlines. A particular case is the inductive strip discontinuity. The analysis is carried out expanding the fields in terms of hybrid modes in the transverse direction, according to the generalized transverse resonance method. Computed results are in good agreement with available data.

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Abstracts

Session OF-2 -- Open Forum 2

"Session OF-2 -- Open Forum 2." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 729-729.

Click on title for a complete paper.

Finite Difference Analysis of Integrated Optical Channel Waveguides with Arbitrarily Graded Index Profile

N. Schulz, K.-H. Bierwirth and F. Arndt. "Finite Difference Analysis of Integrated Optical Channel Waveguides with Arbitrarily Graded Index Profile." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 731-733.

A new finite-difference formulation is described for analyzing diffused dielectric channel waveguides with arbitrarily varying two-dimensional index profiles and arbitrary index difference levels. The method allows the calculation of the complete set of hybrid modes, without the nonphysical, spurious solutions. Hybrid mode dispersion curves of integrated optical channel waveguides with graded index profiles of practical interest are presented.

A High Frequency GaAIAs Traveling Wave Electro-Optic Modulator at 0.82µm

C.M. Chorey, A. Ferendici and K. Bhasin. "A High Frequency GaAIAs Traveling Wave Electro-Optic Modulator at 0.82µm." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 735-738.

Experimental GaAIAs modulators operating at 0.82µm using a Mach-Zehnder interferometer configuration were designed and fabricated. Coplanar 50 Omega traveling wave microwave electrodes were used to obtain a bandwidth-length product of 11.95 GHz-cm. The design, fabrication and DC performance of the GaAIAs traveling wave modulator is presented.

A Simple Coupled-Mode Analysis Method for Multiple-Core Optical Fiber and Coupled Dielectric Waveguide Structures (1988 Vol. II [MWSYM])

N. Kishi and E. Yamashita. "A Simple Coupled-Mode Analysis Method for Multiple-Core Optical Fiber and Coupled Dielectric Waveguide Structures (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 739-742.

A simple method is proposed for the coupled-mode analysis of multiple-core optical fiber and coupled dielectric waveguide structures. Total coupled-mode fields are approximately evaluated by using the field of two adjacent cores. The results of numerical calculation are compared with those of a rigorous analysis.

Abstracts

An Alternative Broadband Method for Automatic Measurement of the Complex Permeability and Permittivity of Materials at Microwave Frequencies

B.B. Szendrenyi, K. Kazi and I. Mojzes. "An Alternative Broadband Method for Automatic Measurement of the Complex Permeability and Permittivity of Materials at Microwave Frequencies." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 743-746.

An alternative broadband method for the simultaneous measurement of the complex permeability and permittivity of lossy microwave solid materials or liquids by automatic network analyzer technique is reported. Both theoretical and practical aspects will be presented in details. Calibration parts, samples with sample holders correlated to measured data will be demonstrated.

A Millimeter-Wave Vector Network Analyzer

J.V. Bellantoni, G.C. Dalman and R.C. Compton. "A Millimeter-Wave Vector Network Analyzer." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 747-750.

A network analyzer for making accurate measurements in the 75-110 GHz band will be presented. The analyzer design is a novel variation on the six-port principle, and can be implemented at relatively low-cost. A 27-40 GHz prototype operating as a reflectometer will be demonstrated. Calibrations and measurements are performed interactively with the aid a Macintosh II equipped with a high resolution color display.

A New Method for Measuring the Properties of Dielectric Substrate

G. Kent. "A New Method for Measuring the Properties of Dielectric Substrate." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 751-754.

The TE/sub 01/ mode in a cylindrical waveguide at a frequency below cutoff is used to probe a ceramic dielectric substrate located on the central plane between input and output coupling loops. Maximum transmission occurs at a frequency determined by the waveguide radius, the substrate thickness and the dielectric constant. The dielectric constant and loss tangent are obtained from the resonant frequency and the absorption bandwidth. The measurement is insensitive to the position of the subtrate in the gap between waveguide sections, and no intimate contact is required.

Q-Band Computerized Slotted Line System

A. Tongyi, M. Jiaheng, M. Qingxiang, Y. Hua and F. Jinlin. "Q-Band Computerized Slotted Line System." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 755-756.

A new auto-test system for measuring network parameters at Q-band is developed. The system is based on the conventional slotted line system and controled by the APPLE II microcomputer. It has all the functions which the manual one has and performs much better than the latter in accuracy, reliability, speed and automatic. The principles, constructions and features of the system are introduced. The typical results for complex reflection coefficient voltage standing wave ratio, impedance, attenuation and S-parameters are given. The system may be valuable in developing test system at short millimeter wave band and seems to make a new life of the slotted line system.

Lumped-Element Circulator Optimization

E. Schloemann. "Lumped-Element Circulator Optimization." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 757-759.

A detailed theoretical model for lumped-element circulalors is used as the basis for a synthesis procedure, in which the various circuit parameters are determined such that the lossless 3-port junction is a perfect circulator at the desired design frequency and that it has maximum bandwidth for given size of the ferrite disc.

Considerations on the Frequency Dependence of Wavegude Modes in Premagnetized Ferrites Near Resonance

D. Kother and A. Beyer. "Considerations on the Frequency Dependence of Wavegude Modes in Premagnetized Ferrites Near Resonance." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 761-764.

Difficult problems occur in the design of nonreciprocal elements at millimeter wavelengths, if the dielectric and magnetic losses of ferrites are neglected. Especially near the gyromagnetic resonance the losses become large and the anisotropic behaviour of the ferrite results significant changes in the behaviour of the waveguide modes. This paper describes the solution for these waveguide modes in premagnetized ferrites and it takes into account the losses. The knowledge and better understanding of the field distribution can be used for the improvement of design procedures of high quality nonreciprocal elements. Several examples are presented and discussed to illustrate these facilities.

The Analysis of Magnetostatic Waves in a Waveguide Using the Integral Equation Method

M. Radmanesh, C.M. Chu and G.I. Haddad. "The Analysis of Magnetostatic Waves in a Waveguide Using the Integral Equation Method." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 765-768.

Magnetostatic wave (MSW) propagation in a finite-width ferrite slab placed inside and along a rectangular waveguide is investigated theoretically and numerically. Using the integral equation method, the general solution to the problem of wave propagation has been derived for the first time here in this paper. The thin-slab approximation made the derived solution more tractable and provided the dispersion relations in terms of an infinite determinant. From the presented results, it can be concluded that in order to obtain high values of group time delay over a large bandwidth, thin, narrow slabs placed in the center of the guide must be used. On the other hand, to maximize the device bandwidth, thin slabs placed at the top or bottom of the guide are most appropriate.

A 20 GHz FET Amplifier in an Integrated Finline/Microstrip Configuration

J. Ruxton, R. Vahldieck and W.J.R. Hoefer. "A 20 GHz FET Amplifier in an Integrated Finline/Microstrip Configuration." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 769-772.

This paper describes the design and fabrication of a 20 GHz FET amplifier which uses an integrated combination of finline and microstrip. A broadband finline-to-microstrip transition is presented. The transition incorporates a novel biasing network to provide unconditional stability. The single-stage amplifier including transitions provides better than 6 dB gain over a 1.25 GHz bandwidth.

Finite Element Analysis of Skin Effect in Copper Interconnects at 77K and 300K

U. Ghoshal and L.N. Smith. "Finite Element Analysis of Skin Effect in Copper Interconnects at 77K and 300K." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 773-776.

We present the methodology for calculating normal skin effect in complex geometries using finite elements. We have used these results to analyze the performance of copper interconnects at 77K and 300K for both digital and microwave applications. This includes attenuation per unit length, phase velocity and characteristic impedance as a function of frequency from d.c. to 10 GHz. For digital signal propagation, skin effects are important for predicting rise time degradation for times less than 1.2 times the time of flight delay, while for larger times the d.c. resistance corresponding to the cross section of the signal line is adequate for explaining the lossy characteristics.

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A Single MESFET Down-Converter for TVRO Application

J.L. Caceres and J. Perez. "A Single MESFET Down-Converter for TVRO Application." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 777-780.

In this paper a compact down-converter for use in TVRO receivers is presented. It consists of an image rejection filter and Self-Oscillating Mixer performing as a block which converts RF into IF signal. Its features are fully comparable to those of conventional structures, with the additional advantage that only one MESFET is required, leading to a more compact and reliable design. Average results on a band of 800 MHz (10.95-11.75 GHz with f/sub LO/=10 GHz) give a conversion gain of 4.5 dB, 8 dB SSB noise figure and more than 40 dB image rejection.

Abstracts

Quasioptical Patch Mixers at 35 and 94 GHz

C.M. Jackson, J.A. Lester, M.A. Yu and Y.C. Ngan. "Quasioptical Patch Mixers at 35 and 94 GHz." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 781-784.

An innovative subharmonically pumped quasioptical mixer has been developed with a 4 GHz bandwidth at 35 GHz, nearly twice the bandwidth reported earlier. The design has been scaled to 94 GHz, and it is possible to scale the design to higher frequencies. Quasioptical mixers are an important component for low cost applications combining the best aspects of microwave and optical technology at millimeter frequencies and beyond. Earlier work has developed low noise patch antenna quasioptical mixers at 35 GHz. This work doubles the earlier 35 GHz bandwidth and extends the operating frequency to 94 GHz.

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Design of a Rugged Millimeter-Wave Doubler Using a Series Varactor Configuration

E. Boch. "Design of a Rugged Millimeter-Wave Doubler Using a Series Varactor Configuration." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 785-787.

An efficient planar employing a novel has been developed. microstrip doubler to 48 GHz series varactor configuration. The nominal conversion loss of the multiplier is 8 dB when driven by 200 mW. Measured performance over -60 to +100° C shows ±1 dB variation in the output power. Several units have been thoroughly tested under vibration with 100% survivability. This design represents a very cost effective and simple planar doubler realization application in future advanced EW systems.

A 32-GHz Reflected-Wave Maser Amplifier with Wide Instantaneous Bandwidth

J. Shell and D. Neff. "A 32-GHz Reflected-Wave Maser Amplifier with Wide Instantaneous Bandwidth." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 789-792.

An eight-stage 32-GHz reflected-wave ruby maser has been built. The maser operates in a 3-watt closed-cycle refrigerator (CCR) at 4.5 kelvin and is capable of 21-dB net gain with an instantaneous bandwidth of 400 MHz. The input noise temperature referred to the room temperature flange is approximately 21 kelvin.

Hybrid HEM/sub 11 p/ -Mode Dielectric Resonators for Filter Applications at Short Millimeter Wavelengths

W. Holpp. "Hybrid HEM/sub 11 p/ -Mode Dielectric Resonators for Filter Applications at Short Millimeter Wavelengths." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 793-796.

This paper describes the measurement of permittivity and dielectric losses of recently available ceramic materials in the frequency range of 80 to 100 GHz. Design criteria for cylindrical dielectric resonators are given and, subsequently to measuring their characteristic absorption curves, unloaded Q factors are calculated for resonators of different materials and aspect ratios. A short description of a 96 GHz bandpass filter gives an example for a typical application.

New Compact Broadband High-Efficiency Mode Converters for High Power Microwave Tubes with TE/sub 0n/ or TM/sub 0n/ Mode Outputs

M.J. Buckley, G.H. Luo and R.J. Vernon. "New Compact Broadband High-Efficiency Mode Converters for High Power Microwave Tubes with TE/sub 0n/ or TM/sub 0n/ Mode Outputs." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 797-800.

New shorter, broader bandwidth designs are discussed for TE/sub 03/-TE/sub 02/ and TE/sub 02/-TE/sub 01/ varying-radius mode converters and TE/sub 01/-TE/sub 11/ serpentine mode converters for a 2.779 cm diameter circular waveguide for 60 and 140 GHz gyrotrons. Designs combining TE/sub 0n/-TE/sub 0n-1/ converters with a 6.35-2.779 cm diameter taper are presented. A TM/sub 01/-TE/sub 11/ serpentine mode converter design for a frequency of 8.6 GHz in a 4.76 cm circular waveguide is also discussed. Measured results are presented.

Abstracts

Impedance of GaAs P-I-N Diodes

A. Gopinath. "Impedance of GaAs P-I-N Diodes." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 801-802.

A computer model of GaAs p-i-n diodes shows that when the i-layer thickness is greater than about four times the diffusion length, diode forward resistance may be high. Comparison with measured I-V characteristics suggest that diodes now have i-layers with lifetimes of about 10-/sup 7/s.

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Electronically Tunable and Switchable Filters Using Microstrip Ring Resonator Circuits

T.S. Martin, F. Wang and K. Chang. "Electronically Tunable and Switchable Filters Using Microstrip Ring Resonator Circuits." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 803-806.

A novel microstrip ring resonator loaded with two PIN diodes has been developed as a switchable filter. By replacing one PIN diode with a varactor diode, the switchable filter can be made electronically tunable. Over 20 dB isolation with 9 percent tuning bandwidth was demonstrated. The experimental results agree very well with the theoretical calculation.

Abstracts

U-Band Shield Suspended-Stripline (SSL) Gunn DRO and VCO (1988 Vol. II [MWSYM])

H. Zhen-Qi. "U-Band Shield Suspended-Stripline (SSL) Gunn DRO and VCO (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 807-810.

The first mm-wave IC Dielectric Resonator Oscillator (DRO) in SSL has been developed. The DRO in a unique configuration with output power of more than 17dBm and the mechanical tuning range of 1.5GHz at 54GHz has been obtained. A Varactor-Controled Oscillator (VCO) with output power over 15dBm across the 1000 MHz electronic tuning bandwidth at 53 GHz also has been developed.

Microwave-Induced Arcing in Filters

S.L. Kaplan, A.A. Cuneo and R.V. Garver. "Microwave-Induced Arcing in Filters." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 811-814.

In a study of the high-power response (particularly arcing) of microwave/RF filters to microwave energy, experiments were performed with a network analyzer and with two 1-MW pulsed sources (S- and X-band). Computer modeling was used to obtain wideband information for parallel coupled-stripline filters during breakdown.

An Integrated 18.75/37.5 GHz FET Frequency Doubler

S. Meszaros, C.J. Verver, R.J.P. Douville and W.J.R. Hoefer. "An Integrated 18.75/37.5 GHz FET Frequency Doubler." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 815-818.

The design and performance of an 18.75/37.5 GHz FET frequency doubler is presented. The doubler is implemented in a combination of antipodal finline and suspended microstrip, permitting the entire unit to be integrated on a single substrate. The resulting circuit is a particularly simple and cost-effective component for low and medium power applications such as local oscillators. The doubler was built using a NEC673 FET and has a conversion loss of 5.8 dB over a 350 MHz input bandwidth.

Session CC -- Fiber Optic Links and Transmission Systems I (Focused Session)

"Session CC -- Fiber Optic Links and Transmission Systems I (Focused Session)." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 819-819.

Lightwave Applications in Communications -- An Overview

R.H. Knerr. "Lightwave Applications in Communications -- An Overview." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 821-822.

Lightwave applications now range from Kbps to Gbps systems. They include both local-data services and longhaul transmission in terrestrial and submarine applications. LAN and subscriber loop applications start to build up enough volume to allow lightwave products to be manufactured at low cost.

Fibre Optic Systems in UK and Europe

T.R. Rowbotham. "Fibre Optic Systems in UK and Europe." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 823-826.

This paper highlights the major differences in approach taken by European administrations to the application of fibre optic systems. The emergence of a comprehensive European undersea system network based on optical fibres is identified and reviewed. Although optical fibre is becoming the preferred medium for long haul network growth, no consensus of opinion has yet emerged about the optimum local access topology.

Fiber-Optic Transmission Systems in Japan

S. Shimada and T. Matsumoto. "Fiber-Optic Transmission Systems in Japan." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 827-830.

This paper describes the main systems that have been developed to date, and some of the technologies for future systems that are now being researched by NTT.

Wide-Band Semiconductor Lasers and Optical Modulators for Communications

R.S. Tucker. "Wide-Band Semiconductor Lasers and Optical Modulators for Communications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 831-832.

The emergence of wide-band semiconductor lasers and optical modulators has opened up exciting new possibilities in the Iightwave transmission of microwave analog signals and multi-gigabit per second digital data. This paper reviews recent progress in wide-band semiconductor lasers and optical modulators. Opto-electronic charactistics, bandwidth limitations, and microwave circuit considerations are described.

Abstracts

Session DD -- FET Power Amplifiers

"Session DD -- FET Power Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 833-833.

Quasi-Monolithic 4-GHz Power Amplifiers with 65-Percent Power-Added Efficiency

B.D. Geller and P.E. Goettle. "Quasi-Monolithic 4-GHz Power Amplifiers with 65-Percent Power-Added Efficiency." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 835-838.

A highly miniaturized C-band 1-W GaAs FET amplifier, part of a three stage power amplifier for communications satellite applications, has been designed, fabricated, and tested. It achieves a maximum power-added efficiency of 65 percent, and occupies an area of 0.20 x 0.36 in. The circuit employs a low-reactance termination at the second harmonic and low-loss quasi-monolithic circuitry. These results were obtained on the first fabrication run and with no circuit tuning.

High-Efficiency 5-Watt Power Amplifier with Harmonic Tuning

B. Kopp and D.D. Heston. "High-Efficiency 5-Watt Power Amplifier with Harmonic Tuning." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 839-842.

An X-band power amplifier using harmonic tuning has demonstrated 36 percent power-added efficiency with 5 watts output power and 6.0-dB gain at 10 GHz. The key to this design is determining and matching the optimum load impedance for power-added efficiency at the first two harmonics.

Abstracts

High Efficiency Small Size 6W Class AB X-Band Power Amplifier Module Using a Novel MBE GaAs FET

M. Avasarala, D.S. Day, S. Chan, P. Gregory and J.R. Basset. "High Efficiency Small Size 6W Class AB X-Band Power Amplifier Module Using a Novel MBE GaAs FET." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 843-846.

A high efficiency 7.2 mm GaAs power FET using a novel doping profile grown by MBE was developed. This FET has achieved greater than 7 dB gain and 35.3 dBm power operating in class AB mode with a power-add efficiency (P.A.E.) of 40% at 10.2 GHz. Extremely compact single and 2-stage balanced amplifier modules were developed achieving power, gain and P.A.E.'s of 37.7 dBm, 6.7 dB, and 34.8% for the single stage and 37.7 dBm, 15.1 dB, and 33.1% for the double stage amplifier modules at 1 and 2 dB gain compression points, respectively, across the 9.2-10.2 GHz band with good gain flatness and output return loss. The total 2-stage amplifier was realized on a carrier measuring only .700"x.280" by using high dielectric constant substrates for all the matching circuits. The values for the P.A.E. remained relatively constant with flange temperatures up to 75°C.

X and Ku Band High Power GaAs FETs

Y. Yamada, H. Kuroda, H. Izumi, T. Soezima, H. Wakamatsu and S. Hori. "X and Ku Band High Power GaAs FETs." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 847-850.

Internally matched GaAs FETs, with output powers of more than 10W, have been developed for the 10.7-11.7 and 14.0-14.5 GHz bands. These devices, with a total gate width of 32mm, consist of two chips that are fabricated by direct ion implantation and chemical dry etching. At 14.25 GHz, the Ku band device has achieved an output power of 41dBm, a power gain of 5 dB and a power added efficiency of 21%. At 11.2 GHz, the X band device has delivered 41.2 dBm, 5.8 dB and 25% respectively at the 1 dB gain compression point.

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Abstracts

Session EE -- High Speed Digital Transmission

"Session EE -- High Speed Digital Transmission." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 851-851.

Signal Processing at 4.5 Gbit/s with Si - ICs for Optical Transmission Systems

G. Hanke. "Signal Processing at 4.5 Gbit/s with Si - ICs for Optical Transmission Systems." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 853-856.

In the trunk network of Deutsche Bundes-post optical transmission systems working at 2.4 Gbit/s will be implemented in the near future. This bitrate can be processed with commercial monolithic integrated GaAs-circuits. For higher bitrates, such as 4.5 Gbit/s, monolithic integrated Si - ICs must be used at the time being. In this paper it is shown that with only a few different types of ICs all the components for a transmission system can be built up using a sophisticated circuitry.

High-Speed QPSK Modulator and Demodulator with Subharmonic Pumping (1988 Vol. II [MWSYM])

R. Trambarulo, M.V. Schneider and M.J. Gans. "High-Speed QPSK Modulator and Demodulator with Subharmonic Pumping (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 857-859.

A high-speed QPSK modulator and demodulator are described. Both units are pumped with a common 6.5 GHz local oscillator giving a modulated carrier at 13 GHz. Data can be transmitted and recovered at speeds up to a total information rate of 3.6 Gbit/s with errors less than 10/sub -11/.

Abstracts

Digital Radio Link Synthesized with a Direct-Division PLL at 22 GHz

P. Dorta, J. Perez and I. Rodriguez. "Digital Radio Link Synthesized with a Direct-Division PLL at 22 GHz." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 861-864.

An innovative 22 GHz digital multi channel has been prototype to be used in urban areas where the communication link between computers, PABX, etc..., is essential. Low costs have been achieved by integration of the RF head into a single microstrip assembly. High stability oscillators through a direct-division phase-lock loop at 22 GHz, is the most outstanding feature of our prototype.

Session FF -- Microwave and MM Wave Ferrites

"Session FF -- Microwave and MM Wave Ferrites." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 865-865.

Abstracts

Ferrite Tuned Millimeter Wave Bandpass Filters with High Off Resonance Isolation

D. Nicholson. "Ferrite Tuned Millimeter Wave Bandpass Filters with High Off Resonance Isolation." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 867-870.

By combining four hexagonal ferrite spheres under the same magnet structure, magnetically tuneable bandpass filters may be built in waveguide yielding increased off resonance isolation, while keeping insertion loss to a reasonable value. Examples of these filters in A, Q, U, and V bands are presented with typical O.R.I. >70 dB and I.L. <13 dB for full band tuning.

Ferrite Tunable Millimeter Wave Printed Circuit Filters

J. Uher, J. Bornemann and F. Arndt. "Ferrite Tunable Millimeter Wave Printed Circuit Filters." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 871-874.

New designs of millimeter wave magnetically tunable E-plane integrated circuit filters are described. The filters combine the advantages of printed circuit technology with those of the high power capability of ferrite-slab loaded waveguides. Computer optimized design data based on the rigorous modal S-matrix method are given for Ka-band tunable metallic and finline type filters. The theory is verified by measured results in Ku-band.

A Microwave Circuit Model for a Magnetostatic Wave Filter

S.N. Stitzer. "A Microwave Circuit Model for a Magnetostatic Wave Filter." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 875-878.

A new circuit model for a magnetostatic forward volume wave filter element is described. The model accurately predicts bandpass shape and triple transit ripple. Computed results are in good agreement with measured performance in an experimental device.

Abstracts

A 13-Channel Magnetostatic Wave Filterbank

J.D. Adam, M.R. Daniel and S.H. Talisa. "A 13-Channel Magnetostatic Wave Filterbank." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 879-882.

The magnetostatic wave filterbank shows particular promise as a key component in high dynamic range channelized receivers for future electronic warfare systems. It consists of an array of narrowband magnetostatic wave delay lines which have a common microstrip input transducer and separate output transducers. The center frequency of each channel is determined by a magnetic bias field supplied by a permanent magnet with a linear field gradient. This paper describes the construction and performance of an improved version of a 13-channel filterbank operating at S-band with a 24 MHz (3dB) channel bandwidth and a 50 dB dynamic range. A comparison of present and projected performance data is given.

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Abstracts

Analysis of Microwave Ferrite Devices by the Transfinite Element Method

J.-F. Lee and Z.J. Cendes. "Analysis of Microwave Ferrite Devices by the Transfinite Element Method." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 883-886.

The transfinite element method is used to model microwave ferrite devices. It is shown that this procedure is both easy to set up and inexpensive to solve. A computer implementation is described that gives the fields and scattering parameters in microwave ferrite devices of arbitrary two-dimensional geometry.

A Magnetostatic Forward Volume Wave Directional Coupler with a Guiding Slot Structure

M. Kaneta, K. Yashiro and S. Ohkawa. "A Magnetostatic Forward Volume Wave Directional Coupler with a Guiding Slot Structure." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 887-890.

A new configuration of a magnetostatic forward volume wave (MSFVW) directional coupler has been proposed. It should be noticed that a slot line structure is adopted. The propagation of MSFVW along the structure has been confirmed experimentally except around the lower limit of MSFVW band. A directional coupler with adjacent guiding slots has been fabricated on an epitaxial yttrium iron garnet (YIG) grown on a gadolinium gallium garnet (GGG) substrate. A nearly 100 % power transfer from one slot line to the other has been demonstrated. The directivity was measured to be above 20 dB except around the lower frequency limit.

Abstracts

Session GG -- Fiber Optic Links and Transmission Systems II (Focused Session)

"Session GG -- Fiber Optic Links and Transmission Systems II (Focused Session)." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 891-891.

Military and Aerospace Applications of Lightwave Technology

A.E. Popa. "Military and Aerospace Applications of Lightwave Technology." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 893-896.

Examples of the use of lightwave circuits to partition aerospaceborne systems are presented. The role of lightwave technology in future radar, communication, and electronic warfare system architectures is discussed. Finally, the status of microwave bandwidth lightwave transmitter and receiver circuits operating between 1 to 20 GHz is summarized.

Devices and Components for Lightwave Transmission Systems

M. Nakamura and N. Chinone. "Devices and Components for Lightwave Transmission Systems." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 897-900.

Device and component developments for future broadband networks are reviewed. High speed (~10Gb/s) operation is pursued both for optical and electrical devices. Wavelength control and narrow-spectrum operation are the key issues for coherent systems. High-reliability low-cost devices are also developed for subscriber systems.

Abstracts

Microwave Multiplexing Techniques for Wideband Lightwave Distribution Networks

R. Olshansky, V. Lanzisera and P. Hill. "Microwave Multiplexing Techniques for Wideband Lightwave Distribution Networks." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 901-903.

The use of microwave subcarriers is a promising new approach for providing wideband services in the subscriber network. Optical communications systems that carry 60 FM video channels in the 2.7 to 5.2 GHz band and 20 100 Mb/S FSK video channels in the 2 to 6 GHz band will be described. A hybrid system which carries a 140 Mb/s baseband singal plus 60 FM video channels will also be described.

Abstracts

New Developments in Optical Control Techniques for Phased Array Radar

A.J. Seeds, I.D. Blanchflower, N.J. Gomes, G. King and S.J. Flynn. "New Developments in Optical Control Techniques for Phased Array Radar." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 905-908.

Recent work on optical signal distribution and control techniques for phased array radar is described. Experimental results for millimetre-wave reference signal generation by heterodyning the outputs of two semiconductor lasers are presented. Novel mixers in which the local oscillator input is an intensity modulated optical signal are described. The use of these developments, together with other optically controlled devices, in new phased array element architectures is discussed.

Abstracts

Session HH -- FET Amplifiers

"Session HH -- FET Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 909-909.

Abstracts

The Dual-Fed Distributed Amplifier

C.S. Aitchison, N. Bukhar, C. Law and N. Nazoa-Ruiz. "The Dual-Fed Distributed Amplifier." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 911-914.

This paper describes a novel microwave distributed amplifier technique which results in a significant improvement in gain and reduction of noise figure in comparison with the conventional distributed amplifier, provided that the novel amplifier uses a small number of MESFETs. Both theory and practice are described.

The STACKFET: An Improved Implementation of the Dual Gate FET

W.W. Hoppin, S.C. Cripps and J.R. Anderson. "The STACKFET: An Improved Implementation of the Dual Gate FET." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 915-918.

A new method of directly coupling two GaAs FET devices in series has been developed. This structure, the STACKFET, exhibits significantly improved gain performance over previous configurations and was used to design a balanced amplifier module giving 22.5 dB of gain over the 2-8 GHz band.

Noise and Small-Signal Distributed Model of Millimeter-Wave FETs

L. Escotte, J.C. Mollier and M. Lecreff. "Noise and Small-Signal Distributed Model of Millimeter-Wave FETs." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 919-922.

This paper presents a distributed FET model for millimeter-wave frequencies and compares experimental S-parameters with distributed and lumped model. In contrast with other circuit models which take distributed effects into account, this new one allows to predict the four noise parameters up to 40 GHz. An example is given, that shows good agreement between theoretical data and S-parameters and noise figure measurements up to 26 GHz.

Abstracts

Millimeter-Wave Low-Noise HEMT Amplifiers

K.H.G. Duh, P.C. Chao, P.M. Smith, L.F. Lester, B.R. Lee, J.M. Ballingall and M.Y. Kao. "Millimeter-Wave Low-Noise HEMT Amplifiers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 923-926.

Short-gate-length high electron mobility transistors (HEMTs) developed in our laboratory have exhibited state-of-the-art low noise performance at millimeter-wave frequencies: minimum noise figure of 1.2 dB at 32 GHz and 1.8 dB at 60 GHz from 0.25µm HEMTs. At Ka-band, a two-stage low noise amplifier has demonstrated an average noise figure of 2 dB from 26.5 GHz to 37 GHz with a gain of 17 dB at 32 GHz. At V-band, a two-stage amplifier yielded noise figure of 3.2 dB at 61 GHz with flat gain 12.7 ± 0.5 dB from 59 GHz to 65 GHz. The results clearly show the potential of the short-gate-length HEMTs for high performance millimeter-wave receiver applications.

InGaAs Pseudomorphic HEMTs for Millimeter Wave Power Applications

P.M. Smith, P.C. Chao, L.F. Lester, R.P. Smith, B.R. Lee, D.W. Ferguson, A.A. Jabra, J.M. Ballingall and K.H.G. Duh. "InGaAs Pseudomorphic HEMTs for Millimeter Wave Power Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 927-930.

We report the development of InGaAs pseudomorphic high electron mobility transistors with state-of-the-art power performance at millimeter-wave frequencies. Results include maximum power-added efficiencies of 44% at 35 GHz and 36% at 44 GHz, output power of 100 mW with 22% efficiency and 3 dB gain at 60 GHz, and output power of 9 mW at 94 GHz. Preliminary reliability data is presented, and prospects for further improvement in performance--the realization of multi-finger HEMTs capable of higher output power and reduction of gate length to 0.1µm--are discussed.

Session II -- Communication Systems

"Session II -- Communication Systems." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 931-931.

Fiber Optic Links for Millimeter Wave Communication Satellites

A.S. Daryoush, A.P.S. Khanna, K. Bhasin and R. Kunath. "Fiber Optic Links for Millimeter Wave Communication Satellites." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 933-936.

Large aperture phased array antennas operating at millimeter wave frequencies are designed for space-based communications and imaging. Array elements are comprised of active transmit/receive (T/R) modules which are linked to the central processing unit through a high-speed fiberoptic network. This paper demonstrates optical control of active modules for satellite communication at 24GHz. An approach called T/R level data mixing, which utilizes fiberoptic transmission of data signal individual T/R modules to be unconverted by an optically synchronized local oscillator, is demonstrated at 24GHz. In study free-running HEMT oscillator, used as local oscillator 24GHz, is synchronized using indirect subharmonic optical injection locking over a locking range of 14MHz. Results of link performance over 500-1000MHz is also reported in terms of gain-bandwidth, linearity and third order intercept, sensitivity, and dynamic range.

Abstracts

A Broadband Down Converter for 4- and 6-GHz Radio Systems

C. Ho and P.C. Kandpal. "A Broadband Down Converter for 4- and 6-GHz Radio Systems." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 937-940.

This paper describes the design of a broadband down-converter to cover both 4- and 6-GHz common carrier bands. The broadband down-converter was tested as a replacement for the down-converter in both the MDR-2204 and MDR-2306 4- and 6-GHz radio systems. Excellent results have been observed in both 4- and 6-GHz radio systems. In threshold bit error rate tests, the broadband down-converter has 1.2-dB better performance than both 4-GHz (MDR-2204) and 6-GHz (MDR-2306) standard radio systems. In overload bit error rate tests, the broadband down-converter has 0.5-dB better performance.

Abstracts

Balanced FET Up-Converter for 6 GHz, 64-QAM Radio

P. Bura and D. Gelerman. "Balanced FET Up-Converter for 6 GHz, 64-QAM Radio." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 941-943.

70 MHz to 6 GHz balanced FET up-converter is described. Third order intercept point of 26 dBm, conversion gain of 3 dB and 33 dB LO suppression were measured. Its highly linear performance makes it suitable for 64-QAM radio. Bit error rates lower than 10/sub -27/ were measured at 2.7 dBm RMS (64-QAM) output level.

Click on title for a complete paper.

Abstracts

Cryogenic, HEMT, Low-Noise Receivers for 1.3 to 43 GHz Range

S. Weinreb, M.W. Pospieszalski and R. Norrod. "Cryogenic, HEMT, Low-Noise Receivers for 1.3 to 43 GHz Range." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 945-948.

This paper describes the construction and performance of a number of receivers built for radio astronomy applications using very low-noise, high-electronmobility transistor (HEMT) amplifiers and small, closed-cycle 13 K refrigerators. The noise temperatures of receivers, measured at the room temperature circular waveguide input, are the best ever reported for receivers built with semiconductor devices (for example, 10.5 K at 8.4 GHz) and are only slightly inferior to that of solid-state maser receivers.

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Session JJ -- Phased and Active Array Techniques

"Session JJ -- Phased and Active Array Techniques." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 949-949.

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A C-Band Low-Noise MMIC Phased Array Receive Module

F. Ali, S. Mitchell, S. Moghe, P. Ho and A. Podell. "A C-Band Low-Noise MMIC Phased Array Receive Module." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 951-954.

The development of a GaAs monolithic C-Band low noise phased array receive module is presented. This low cost, high yield module contains five monolithic ICs: two gain stages, two active baluns, and a two-bit phase shifter with on-chip active isolator. Also included are logic decoders, level shift circuitry and two MIC LNAs. The receive module attains 50 dB gain and 2 dB noise figure across the 4-6 GHz band and is realized in a small housing (2.2" x 1.1" x 0.6").

Monolithic Millimeter-Wave IMPATT Oscillator and Active Antenna (1988 Vol. II [MWSYM])

N. Camilleri and B. Bayraktaroglu. "Monolithic Millimeter-Wave IMPATT Oscillator and Active Antenna (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 955-958.

GaAs IMPATT diodes were monolithically integrated with a microstrip resonator and a loop antenna to produce a single-chip millimeter-wave oscillator module. Devices operating at 43.3 GHz produced 27 mW cw output power with 7.2% conversion efficiency. Linear arrays of such radiating elements were produced and radiation patterns were determined as a function of inter-element spacings and element numbers. This monolithic oscillator chip was also directly coupled to waveguide producing an inexpensive millimeter-wave source.

Optical Control of a GaAs MMIC Transmitt/Receive Module

A. Paolella and P.R. Herczfeld. "Optical Control of a GaAs MMIC Transmitt/Receive Module." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 959-962.

This paper reports on experimental results of an optical gain control and optical pulse code modulation of a GaAs Microwave Monolithic Integrated Circuit (MMIC) distributed amplifier. The control signal was generated by a low cost LED and a MultiFinder MESFET was utilized as a photodetector. The amplifier gain was varied by 15 dB as a function of the optical intensity over the frequency range of 5 to 8 GHz. Pulse code modulation was obtained using a semiconductor laser. The work has relevance to reconfigurable phased array antennas.

Microstrip Active Antennas and Arrays

K.A. Hummer and K. Chang. "Microstrip Active Antennas and Arrays." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 963-966.

Microstrip active antennas and arrays have been designed at X-band using patch antennas and Gunn diodes. Injection locking experiments were carried out to achieve frequency coherency and to calculate the circuit Q-factor. Over 9 percent electronic tuning range has been achieved for the single active patch element. The power outputs from two elements have been successfully combined in free space. The advantages of low cost and wide bandwidth should offer many applications.

A Space-Fed Local Oscillator for Spaceborne Phased Arrays

G.M. Shaw and R.B. Dybdal. "A Space-Fed Local Oscillator for Spaceborne Phased Arrays." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 967-970.

Lightweight, spaceborne phased arrays require both local oscillator signal distribution and compensation for mechanical deformations that dynamically occur in orbit. These array deformations are expressed by a sum of the time and amplitude weighted characteristic mechanical nodes of the array structure, and their effects on the array pattern differ from the effects of random phase perturbations assumed in classical antenna tolerance theory. A space-fed local oscillator concept can partially compensate the effects of array deformations to reduce array pattern degradation. This concept also offers potential weight reduction of the array design and reduced deployment complexity. This concept uses a local oscillator radiator on the back side of the array along with a series of local oscillator pickup elements connected to the array elements.

Session KK -- High Speed Fiber Optic Links

"Session KK -- High Speed Fiber Optic Links." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 971-971.

0.83- and 1.3-Micron Microwave (2-18 GHz) Fiber-Optic Links Using Directly Modulated Laser Sources

R.D. Esman, L. Goldberg and J.F. Weller. "0.83- and 1.3-Micron Microwave (2-18 GHz) Fiber-Optic Links Using Directly Modulated Laser Sources." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 973-976.

Loss and noise characteristics of 0.83-µm and 1.3-µm directly modulated laser fiber optic links were measured from 2 to 18 GHz. The 1.3-µm system exhibited lower loss (46 dB at 18 GHz) and noise figure (64 dB at 18 GHz) than the 0.83-µm version for frequencies above 10 GHz. Deleterious feedback induced effects were observed in the 0.83-µm link, including sporadic 45 dB RF signal dropouts.

21 GHz Wideband Fiber Optic Link

J.J. Pan. "21 GHz Wideband Fiber Optic Link." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 977-978.

1.3 µm, 1 Km wideband 21 GHz fiber optic link was demonstrated using the RF enhanced, phase-reverse velocities matched LiNbO/sub 3/ electro-optic modulator. System signal-to-noise ratio of 102 dB/Hz was achieved with minimum intermodulation products distortion.

High Signal to Noise Operation of Fiber Optic Links to 18 GHz

H. Blanvelt and K. Lau. "High Signal to Noise Operation of Fiber Optic Links to 18 GHz." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 979-981.

Very high signal to noise ratio transmission through a fiber optic link has been demonstrated for frequencies up to 18 GHz. To achieve this required good laser and photodiode frequency response, high laser and photodiode efficiency, low optical reflections, and a laser with good low frequency noise characteristics.

Abstracts

High Speed Fiber Optic Links for Short-Haul Microwave Applications

I. Koffman, P.R. Herczfeld and A.S. Daryoush. "High Speed Fiber Optic Links for Short-Haul Microwave Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 983-986.

An experimental and analytical comparison between the fiberoptic (FO) and the conventional coaxial interconnects are made. Experiments were conducted for two different fiber optic links, namely reactively matched and resistively matched. An approach based on the use of reactively matched optical transmit/receive modules in conjunction with an advanced fiber optic link architecture leads to a substantial improvement in the system performance of high speed FO links.

Radar Applications of X-Band Fiber Optic Links

I.L. Newberg, C.M. Gee, G.D. Thurmond and H.W. Yen. "Radar Applications of X-Band Fiber Optic Links." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 987-990.

High-speed fiber optic delay lines for unique application in radar phase noise and repeater test sets are described. FM and AM signal-to-noise performance measurements of the X-band-modulated fiber optic links for these applications are presented.

Frequency-Dependent and Frequency-Independent Nonlinear Characteristics of a High-Speed Laser Diode

W.I. Way. "Frequency-Dependent and Frequency-Independent Nonlinear Characteristics of a High-Speed Laser Diode." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 991-993.

This paper experimentally demonstrates if a laser diode can be treated as a memoryless nonlinear device. It was found that for an operating condition with modulation depth below about 60%, the relative time delay (which ranges from zero to several hundred pico-seconds) caused by increased modulation depth has strong effect on the frequency-dependent intermodulation products. In this case, the RF bandwidth over which the laser diode can be considered to be effectively memoryless has to be smaller than the inverse of the measured time delay by two orders of magnitude. Increased optical reflections from fiber connectors were observed to cause significant fluctuations of the measured time delay as a function of frequency, and thus cause more pronounced frequency-dependent nonlinear behavior.

Session LL -- Signal Distribution FET Applications

"Session LL -- Signal Distribution FET Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 995-995.

GaAs Semi-Insulated-Gate FETs (SIGFETs) as High Power MMIC Control Devices

Y. Yong-Hoon and R.J. Gutmann. "GaAs Semi-Insulated-Gate FETs (SIGFETs) as High Power MMIC Control Devices." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 997-1000.

GaAs planar Semi-Insulated-Gate FETs (SIG-FETs) have been fabricated with higher CW power handling capability than, and similar switching frequency figure-of-merit as, comparable GaAs recess-gate MESFETs. Initially developed SIGFET devices demonstrated 3dB to 5dB increase in power handling capability with a switching frequency figure-of-merit of 362GHz. This improved power performance is due chiefly to the semi-insulated layer under the gate metal, which allows higher gate-breakdown voltage as well as higher drain saturation current.

DC-20 GHz N X M Passive Switches (1988 Vol. II [MWSYM])

M.J. Schindler, M.E. Miller and K.M. Simon. "DC-20 GHz N X M Passive Switches (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1001-1005.

MMIC switch networks with complexities up to 4 x 4 have been demonstrated using multiple chips, and up to 2 x 2 and 1 x 4 have been demonstrated using single chips. The switches all use a combination of series and shunt passive FET switching elements. A 1 x 2 switch and a 1 x 4 switch are comprised of a single switching stage. A 2 x 2 switch is comprised of two stages of 1 x 2 switches. A 4 x 4 switch is made of four stages of 1 x 2 switches. All the switches are passive and bidirectional, and all operate from dc to 20 GHz.

Abstracts

High Efficiency Microwave Harmonic Reaction Amplifier

T. Nojima and S. Nishiki. "High Efficiency Microwave Harmonic Reaction Amplifier." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1007-1010.

The operation mechanism of the novel high efficiency Harmonic Reaction Amplifier (HRA) is clarified. The HRA is basically constructed with a pair of power FETs. The technical originality lies in a provision of an interconnecting circuit concerning a second-harmonic output component between FETs. This additional circuit realizes an efficient and stable switching-mode operation required for the attainment of highly efficient microwave power amplification. Theoretical analysis results indicate that a drain efficiency of 86% is available with an ideal HRA construction of purely class-B biased operation. Experiments on a miniaturized 2-GHz 5-W HRA module are conducted to verify analysis results. A power-added efficiency of over 70% is achieved confirming that the HRA can be practically applied to microwave power amplifiers. Moreover, an HRA capability of high efficiency as a linear amplifier under a class-AB biased condition is shown in the experiments as well.

Abstracts

The Design of a 6-Port Active Circulator

I.J. Bahl. "The Design of a 6-Port Active Circulator." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1011-1014.

Design of a fully monolithically integrable active circulator without any externally added circuit components is described in this paper. The circuit is capable of providing 0 dB loss, and return loss and isolation better than 16 dB and 23 dB, respectively over an octave or higher bandwidth.

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GaAs Monolithic Implementation of Active Circulators

M.A. Smith. "GaAs Monolithic Implementation of Active Circulators." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1015-1016.

A GaAs monolithic three-transistor signal circulator for 0.2 to 2 GHz applications has been developed and tested. The three-terminal device demonstrates 6 dB insertion loss and 18 dB directivity over this frequency range.

Session MM -- System Applications

"Session MM -- System Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1017-1017.

Microwaves in Brazil: Significant Research and Development Activities

A.A. de Salles. "Microwaves in Brazil: Significant Research and Development Activities." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1019-1022.

Recent microwave research and development activities in Brazil will be described in this paper. These include several programs in universities, research centers and a few in industry, in the areas of microwaves, antennas, propagation and optical communications. Some considerations about the present situation will be presented and the prospective for the next years will be discussed. Also some areas where international cooperation may be stimulated will be highlighted.

A 50-GHz Compact Communication System for Video Link Fabricated in MIC

K. Ogawa, T. Ishizaki, K. Hashimoto, M. Sakakura and T. Uwano. "A 50-GHz Compact Communication System for Video Link Fabricated in MIC." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1023-1026.

A 50 GHz transmitter and a receiver for video and voice communication from 1 to 10 miles have been developed. The RF assemblies of the system consist of a 25 GHz DRO, a 25 GHz FM modulator, and 25/50 GHz frequency doublers. Those are fabricated in MIC using chip form GaAs FET's. The transmitting power of 10 dBm and the receiver noise figure of 13 dB were obtained.

A Noncoherent W-Band Transceiver

R.S. Robertson, R.T. Kihm, E.L. Holzman, J. Poelker and R.L. Bowen. "A Noncoherent W-Band Transceiver." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1027-1030.

This paper discuses the design, configuration, and performance of a W-band transceiver with a volume of 1 in 3. The transceiver employs a noncoherent chirped waveform for a pulse compression radar application. Other topics include a design procedure for the local oscillator, which employs a theoretical circuit model of the oscillator geometry, and the use of preheat bias control as a means to temperature compensate the chirp spectrum of pulsed IMPATT diode transmitters.

35-GHz-Dopplerradar for Law Enforcement Agencies in Europe

R. Westphal and A. Kessler. "35-GHz-Dopplerradar for Law Enforcement Agencies in Europe." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1031-1033.

The accuracy of stationary Ka-band-dopplerradars for law-enforcement agencies is discussed as a function of numerous parameters. The experimental setup for the studies comprises a dual channel 35-GHz-CW-dopplerradar with selectable transmit polarization, direction of motion sensing capability and a signal recording system. The results of the experiments provide basic data to design law-enforcement radars at Ka-Band. The dominant scatterers and their location on the vehicle will be determined.

Hidden Electronics Detection

M.K. Ferrand. "Hidden Electronics Detection." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1035-1038.

The recent bugging of the U.S. embassy in Moscow has caused widespread attention to be focused on eavesdropping as a modern security threat. A brief history of electronic eavesdropping is given, and techniques used by persons wishing to gain confidential information are described. Various methods of detecting RF transmitting devices are explained and the limitations of conventional means for locating them. A device capable of transmitting an extremely pure fundamental signal and "listening" to harmonic signal reflected by semiconductor devices will be explained and demonstrated. The theory of operation is described and description of the electrical circuits will be given.

Abstracts

Session NN -- Computer Aided Design: Large-Signal Analysis

"Session NN -- Computer Aided Design: Large-Signal Analysis." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1039-1039.

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A Unified Framework for Harmonic Balance Simulation and Sensitivity Analysis

J.W. Bandler, Q.J. Zhang and R.M. Biernacki. "A Unified Framework for Harmonic Balance Simulation and Sensitivity Analysis." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1041-1044.

In this paper, a novel theory for exact sensitivity analysis of nonlinear circuits based on harmonic balance simulation is derived. A framework unifying many existing concepts of the frequency domain simulation and sensitivity analysis of linear/nonlinear circuits is established. The proposed sensitivity analysis is verified by a MESFET mixer example exhibiting 98% saving of CPU time over the prevailing perturbation method.

Abstracts

Large-Signal MESFET Characterization Using Harmonic Balance

B.R. Epstein, S.M. Perlow, D.L. Rhodes, J.L. Schepps, M.M. Ettenberg and R. Barton. "Large-Signal MESFET Characterization Using Harmonic Balance." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1045-1048.

A method is described that combines large-signal load tuning (i.e., load-pull) measurements with harmonic balance and optimization techniques to characterize GaAs MESFET devices. An important advantage of the method is that device model parameters are obtained at the frequencies at which the device will operate in circuits. Consequently, ambiguities regarding any frequency dependencies of the parameters are eliminated, thereby improving the accuracy of the device model and simulation. The method is best suited as a supplement to previously reported DC and small signal parameter extraction methods.

Optimized C.A.D. of Power Amplifiers, for Maximum Added Power or Minimum Third Order Intermodulation, Using an Optimization Software Coupled to a Single Tone Source and Load-Pull Set-Up

J.M. Nebus, J.P. Villotte, J.F. Vidalou, L. Hagerman, H. Jallageas and M.C. Albuquerque. "Optimized C.A.D. of Power Amplifiers, for Maximum Added Power or Minimum Third Order Intermodulation, Using an Optimization Software Coupled to a Single Tone Source and Load-Pull Set-Up." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1049-1052.

An automatic symmetrical source and load pull single tone set up is described. It allows the definition of optimum parameters such as input power, impedances to be presented at each port of the F.E.T., so as to obtain maximum added power. After suitable processing of the date file it is possible to optimize the same parameters in order to minimize the third order intermodulation products.

A GaAs MESFET Large-Signal Circuit Model for Nonlinear Analysis

M. Sango, O. Pitzalis, L. Lerner, C. McGuire, P. Wang and W. Childs. "A GaAs MESFET Large-Signal Circuit Model for Nonlinear Analysis." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1053-1056.

A large-signal GaAs MESFET model for performing nonlinear microwave simulations with SPICE or Microwave SPICE™ and Libra™ programs is described. The model includes accurate analytic representation of the dependence of gm, C/sub gs/, C/sub gd/, R/sub j/, and R/sub ds/ upon operating voltages V/sub gs/ and V/sub ds/. The model also functions as a master linear model that accurately replicates measured microwave s-parameters at arbitrarily chosen bias points within the transistor's useful operating I-V range. Microwave SPICE harmonic distortion simulations with the model compare favorably with measurements for an NEC NE71000. The model is useful in the analysis of a broad range of circuits including amplifiers, mixers, and oscillators.

Load Pull Characteristics of GaAs MESFETs Calculated Using an Analytic, Physics Based Large Signal Device Model

D.E. Stoneking, R.J. Trew and J.B. Yan. "Load Pull Characteristics of GaAs MESFETs Calculated Using an Analytic, Physics Based Large Signal Device Model." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1057-1060.

The large signal nonlinear load pull characteristics of power GaAs MESFETs fabricated with uniform, ion-implanted, and lo-hi-lo doping profiles are calculated theoretically and compared. The calculation is performed using a load pull simulator in conjunction with a new physics based, analytic device model. The device and circuit models are interfaced using a harmonic balance routine.

Session OO -- High Speed Optical Techniques and Components

"Session OO -- High Speed Optical Techniques and Components." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1061-1061.

A 100-KHz - 22-GHz Instrumentation Photoreceiver

D.J. Derickson, C.M. Miller and R.L. Van Tuyl. "A 100-KHz - 22-GHz Instrumentation Photoreceiver." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1063-1066.

A photoreceiver consisting of a high speed PIN photodetector, and a 100-kHz to 22-GHz distributed amplifier is described. Photoreceiver calibration is accomplished by optical heterodyne techniques. The photoreceiver is used with a microwave spectrum analyzer to achieve -65-dBm (optical) sensitivity at 1300-nm and 1550-nm wavelengths.

Calibration of Optical Receivers and Modulators Using an Optical Heterodyne Technique

T.S. Tan, R.L. Jungerman and S.S. Elliott. "Calibration of Optical Receivers and Modulators Using an Optical Heterodyne Technique." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1067-1070.

The frequency response of optical receivers are accurately calibrated by measuring a heterodyne signal generated by mixing two Nd:YAG ring lasers. This heterodyne system offers more than 50 dB of dynamic range. Calibration of optical phase and amplitude modulators is achieved by downconverting a sideband of the modulated optical carrier to a fixed IF frequency with another laser. This technique eliminates the need for a high speed receiver.

High Power RF Generation with Optically Activated Bulk GaAs Devices

A. Kim, M. Weiner, R. Youmans, P. Herczfeld and A. Rosen. "High Power RF Generation with Optically Activated Bulk GaAs Devices." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1071-1074.

Utilizing sections of charged transmission line cables and optically activated semiconductor switches, the direct generation of high power RF was demonstrated. A Nd:YAG laser was used to switch an array of GaAs semiconductors, biased at 2 KV DC, resulting in a peak RF output of 7.0 KW at VHF.

Abstracts

Pulsed Operation of an Optoelectronic Finline Switch

K. Uhde and J. Muller. "Pulsed Operation of an Optoelectronic Finline Switch." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1075-1078.

Three finline structures on different semiconductor substrates are presented. By illuminating the slot region on with a pulsed laser diode, the propagation properties of a mm-wave passing through the excited region are changed. The insertion loss without illumination and the attenuation caused by it are measured and experimental results are given.

Characteristics of Coplanar Waveguides with Metal Coating on Multilayer Substrate: Application to Broadband LiNb03:Ti Traveling Wave Light Modulators/Switch

D. Bourreau and P. Guillon. "Characteristics of Coplanar Waveguides with Metal Coating on Multilayer Substrate: Application to Broadband LiNb03:Ti Traveling Wave Light Modulators/Switch." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1079-1082.

We propose in this paper the design of non symetric electrodes for broadband electrooptic modulator with low drive voltage. Traveling wave electrodes lateraly shifted to reverse the direction of the applied electric field, are used to obtain a more constant phase variation. The finite elements method is used to compute the electrodes characteristics taking into account both the electrodes and the buffer layer thickness. Numerical results are given for LiNb03:Ti substrate at 1.52 µm wavelength.

A 13-GHz YIG-Film Tuned Oscillator for VSAT Applications

Y. Mizunuma, T. Ohgiharar, H. Nakano, T. Okamoto and Y. Murakami. "A 13-GHz YIG-Film Tuned Oscillator for VSAT Applications." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1085-1088.

A 13 GHz tunable oscillator using YIG film grown by LPE has been developed. A very low phase noise of -90 dBc/Hz at 10 KHz from the carrier has been achieved over the entire tuning range of 500 MHz. With the excellent linear tuning characteristic, this oscillator is ideal for use as a frequency agile synthesized local oscillator in VSAT.

Abstracts

FET Upconverter Design Using Load Dependent Mixing Transconductance

J.L.M. Lord and J.L. Fikart. "FET Upconverter Design Using Load Dependent Mixing Transconductance." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1089-1092.

A novel FET upconverter design procedure using load dependent mixing transconductance in the FET equivalent circuit has been developed. It optimizes the drain network for acceptable match at the selected sideband and desired LO rejection while avoiding impedance values in the LO frequency range which would otherwise cause severe degradation in conversion loss.

A Quasi-Optical HEMT Self-Oscillating Mixer

V.D. Hwang and T. Itoh. "A Quasi-Optical HEMT Self-Oscillating Mixer." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1093-1096.

A Planar quasi-optical receiver circuit that compactly integrates a coupled slot antenna, and a HEMT self-oscillating mixer on the same substrate is developed for applications in microwave and MMW receiver arrays. The circuit exhibits an isotropic conversion gain of 4.5dB which is 7.5dB higher than the diode circuit previously reported.

2 to 8 GHz Double Balanced MESFET Mixer with +30 DBM Input 3rd Order Intercept

S. Weiner, D. Neuf and S. Spohrer. "2 to 8 GHz Double Balanced MESFET Mixer with +30 DBM Input 3rd Order Intercept." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1097-1100.

Typical third order input intercept (IP3) of +30 dBm was achieved from 2 to 8 GHz using a double balanced MESFET mixer operating in the unbiased or passive mode with +23 dBm LO input power. A quality factor is defined to show the efficiency of third order intercept to available LO power. Also, a single balanced MESFET mixer from 4 to 18 GHz with IP3 greater than +25 dBm is discussed.

Abstracts

Session QQ -- Computer-Aided Design, Analysis and Modeling

"Session QQ -- Computer-Aided Design, Analysis and Modeling." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1101-1101.

Numerical Analysis of Intermodulation Distortion in Microwave Mixers

V. Rizzoli, C. Cecchetti and A. Lipparini. "Numerical Analysis of Intermodulation Distortion in Microwave Mixers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1103-1106.

The paper introduces a general-purpose program for intermodulation distortion analysis in microwave mixers. The program can perform full nonlinear simulations of arbitrarily defined circuits simultaneously excited by three independent sinusoidal sources. The analysis relies upon a three-dimensional sampling waveforms coupled with a triple Fourier transform.

A Mixer Computer-Aided Design Tool Based in the Time Domain

P. Estabrook and B.B. Lusignan. "A Mixer Computer-Aided Design Tool Based in the Time Domain." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1107-1110.

A time domain based technique for computer-aided mixer analysis and design is presented. The design tool uses SPICE (13) to arrive at the steady state solution for the network equations in the mixer circuit. These non-sinusoidal waveforms are studied to understand the interaction of diode, circuit and drive conditions. Graphically derived criteria are developed to optimize mixer performance. Circuit characteristics such as conversion loss, input and output impedances at every small-signal frequencies are rapidly calculated by using a Fast Hartley Transform (FHT) to generate the Fourier transform of the required waveforms. This technique can be used to analyze mixers that can be described in terms of transmission lines, lumped components or any other element blocks available with SPICE. As MMIC's are frequently designed with lumped components, it is envisaged that this tool could be applied to their design.

Non-Linear Modelling and Design of Microwave Mixers

M.I. Sobhy and F. Bassirat. "Non-Linear Modelling and Design of Microwave Mixers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1111-1114.

A non-linear model of a Schottky diode has been developed which is suitable for application in microwave mixer circuits. The entire mixer circuit was analysed using a general non linear simulation computer program. The results of the measurements prove the validity of the diode model and the accuracy of the non-linear simulation.

Abstracts

Optimal CAD of MESFETs Frequency Multipliers with and without Feedback

C. Guo, E. Ngoya, R. Quere, M. Camiade and J. Obregon. "Optimal CAD of MESFETs Frequency Multipliers with and without Feedback." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1115-1118.

In this paper, we propose a method to derive the optimal operating-conditions of a given MESFET to obtain an optimum frequency multiplier. The key point of this approach is that no topology of the embedding network is to be chosen "a priori". The optimum bias voltages and the optimum load impedances (including possible feedback circuit) are found as results of the method. This new method allows to know the ultimate performances that can be achieved by a given device working as frequency multiplier.

A Novel Approach for the Large Signal Analysis and Optimisation of Microwave Frequency Doublers

S. El-Rabaie, J.A.C. Stewart, V.F. Fusco and J.J. McKeown. "A Novel Approach for the Large Signal Analysis and Optimisation of Microwave Frequency Doublers." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1119-1122.

This paper describes a novel approach for the large signal analysis and optimization of microwave frequency doublers. A large signal lumped element model is used for an NE 71000 chip MESFET and a two level Harmonic Balance program employed in order to analyse and then optimize a target 'ideal' doubler. A practical circuit is then built in order to synthesize the 'ideal' doubler requirement. Agreement between experiment and theory is seen to be excellent.

The Use of Parametric Modeling in Microwave Circuit Design

M. Eron and D.L. Rhodes. "The Use of Parametric Modeling in Microwave Circuit Design." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1123-1125.

The increasing level of complexity of MIC and MMIC circuits has increased reliance on computer aided design tools. Economical concerns and demand for faster design cycles has translated into the need for more accurate and sophisticated component models for these CAD systems. In this paper we describe the use of parametric, frequency dependent models for more accurate and realistic active and passive component model development. Two examples are presented to demonstrate the power of this method for the design of analog circuits.

Noise in High Speed Digital Systems (Late Paper)

M.S. Gupta. "Noise in High Speed Digital Systems (Late Paper)." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1127-1130.

This paper surveys the characterization and sources of noise in digital systems. The principal methods of characterizing noise in digital systems, including jitter and bit-error rate specifications, are explained, and the manner in which these are produced is described. The verious sources of noise generated within, and coupled into, digital circuits are briefly reviewed. Design guidelines for minimizing effects of noise are thus developed.

Index of Authors (1988 Vol. II [MWSYM])

"Index of Authors (1988 Vol. II [MWSYM])." 1988 MTT-S International Microwave Symposium Digest 88.2 (1988 Vol. II [MWSYM]): 1131-1134.

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Welcome to the 1989 International Microwave Symposium (1989 Vol. I [MWSYM])

C. Swift. "Welcome to the 1989 International Microwave Symposium (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): iii-iv.

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Committees, Awards, Historical and Space Exhibits, Panel Sessions, Workshops (1989 Vol. I [MWSYM])

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Panel Sessions (1989 Vol. I [MWSYM])

"Panel Sessions (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 20-24.

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Workshops (1989 Vol. I [MWSYM])

"Workshops (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 25-31.

Symposium Schedule (1989 Vol. I [MWSYM])

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MTT-S International Microwave Symposia Future Locations (1989 Vol. I [MWSYM])

"MTT-S International Microwave Symposia Future Locations (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 33-33.

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Session A -- Receivers and Mixers

"Session A -- Receivers and Mixers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 93-93.

A 3 Chip GaAs Double Conversion TV Tuner System with 70 dB Image Rejection (1989 Vol. I [MWSYM])

T. Ducourant, P. Philippe, P. Dautriche, V. Pauker, C. Villalon, M. Pertus and J.-P. Damour. "A 3 Chip GaAs Double Conversion TV Tuner System with 70 dB Image Rejection (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 95-98.

A 3 chip VHF-UHF TV tuner system has been implemented with a 0.7 µm MESFET GaAs technology. The system based on the double frequency conversion method consists in an up-converter (IF/sub 1/ = 1.9 GHz), a smooth filter and an image rejection down-converter (IF/sub 2/ = 35 MHz); it exhibits 30 dB of conversion gain and 70 dB of image frequency rejection throughout VHF-UHF band.

A Monolithic 60 GHz Diode Mixer in FET Compatible Technology (1989 Vol. I [MWSYM])

B. Adelseck, A. Colquhoun, J.M. Dieudonne, G. Ebert, J. Selders, K.E. Schmegner and W. Schwab. "A Monolithic 60 GHz Diode Mixer in FET Compatible Technology (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 99-102.

A technology has been developed with which MeSFETs with an f/sub max of 70 GHz and Schottky diodes with f/sub T//spl ap/=2300 GHz can be fabricated on the same chip. This allows the production of mm wave mixers with integrated LO and IF amplifier. A 60 GHz mixer chip has been designed and fabricated using this technology and shows a conversion loss of 6.0 dB and a noise figure (DSB) of 3.3 dB.

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A W-Band Channelized Monolithic Receiver (1989 Vol. I [MWSYM])

G.L. Lan, J.C. Chen, C.K. Pao, M.I. Herman and R.E. Neidert. "A W-Band Channelized Monolithic Receiver (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 103-107.

Several monolithic integrated circuits with state-of-the-art performances have been successfully developed for a W-band (75 to 110 GHz) channelized monolithic receiver. The receiver comprises one four-channel multiplexer, four balanced mixers, four IF amplifiers, and four local oscillators. All will be monolithically integrated into only three chips. This paper reports on the design, fabrication, and performance of each monolithic component and describes the complete W-band four-channel receiver integration.

Silicon Bipolar Fixed and Variable Gain Amplifier MMICs for Microwave and Lightwave Applications Up to 6 GHz (1989 Vol. I [MWSYM])

I. Kipnis, J.F. Kukielka, J. Wholey and C.P. Snapp. "Silicon Bipolar Fixed and Variable Gain Amplifier MMICs for Microwave and Lightwave Applications Up to 6 GHz (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 109-112.

A variety of fixed and variable gain amplifier MMICS for applications up to 6 GHz are presented. The circuits are fabricated using an f/sub T/ = 10 GHz, f/sub max/ = 20 GHz, non-polysilicon-emitter silicon bipolar process. Three amplifier topologies and their performance will be reported: a fixed-gain wideband amplifier, a high-gain low-noise amplifier that can also be effectively used as a transimpedance amplifier and a variable gain amplifier.

Abstracts

Session B -- Phased and Active Array Techniques

"Session B -- Phased and Active Array Techniques." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 113-113.

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6 to 18 GHz Transmit/Receive Modules for Multifunction Phased Arrays

D.E. Meharry, J.L. Bugeau, W.J. Coughlin and M.A. Priolo. "6 to 18 GHz Transmit/Receive Modules for Multifunction Phased Arrays." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 115-118.

A full 6 to 18 GHz Transmit/Receive module is demonstrated for multifunction phased array applications utilizing a family of high performance MMICs. Featured are output powers reaching over 1.0 W, a 4:1 bandwidth 5-bit digital phase shifter, a low loss, high isolation switch, and a high dynamic range design incorporating all required system functions.

Abstracts

Quasi-Optical Planar FET Transceiver Modules

J. Birkeland and T. Itoh. "Quasi-Optical Planar FET Transceiver Modules." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 119-122.

We present the design and performance of quasi-optical planar transceiver modules suitable for communication and Doppler radar. The designs incorporate microstrip antennas which function as resonant loads for FET oscillators. The FETs operate as oscillators and self-oscillating mixers for down-conversion of the received signal. The circuits are simple and inexpensive, and are suitable for incorporation as elements of an active transceiver array. X-band prototype circuits are reported and their use for Doppler motion detection is demonstrated.

A Waveguide Switched-Susceptance (Diode-Patch) Phase Shifter

K.L. Virga, A.F. Seaton and L.R. Walker. "A Waveguide Switched-Susceptance (Diode-Patch) Phase Shifter." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 123-126.

A new digital PIN-diode phase shifter that operates in double-ridge waveguide is described. The phase shifter consists of several split conductive patches etched on a dielectric strip which is inserted in the longitudinal direction in the waveguide. The upper and lower half of each split patch are electrically connected by a diode that is switched between forward and reverse bias to shift the phase in the waveguide. An optimization design approach and experimental test results are presented.

MMIC Phase Shifters and Amplifiers for Millimeter-Wavelength Active Arrays

V.E. Dunn, N.E. Hodges, O.A. Sy and W. Alyassini. "MMIC Phase Shifters and Amplifiers for Millimeter-Wavelength Active Arrays." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 127-130.

The development of MMIC phase shifters and amplifiers at 20 and 44 GHz for application in space based active antenna arrays is described. RF probing to characterize the active elements at these frequencies is shown to provide a good basis for the MMIC design.

A MMIC Based Injection Locked Oscillator for Optically Fed Phased Array Antennas

T. Berceli, A.S. Daryoush, P.R. Herczfeld, W.D. Jemison and A. Paolella. "A MMIC Based Injection Locked Oscillator for Optically Fed Phased Array Antennas." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 131-134.

In an optically fed phased array antenna system, the microwave carrier signal is transmitted via a modulated lightwave to each active T/R/transmit/receive) module where it must be converted back to the microwave domain. Currently, efficient optical to microwave conversion is extremely difficult as the detected microwave signal is weak and noisy. A novel circuit, containing a high gain-low noise microwave injection locked oscillator, has been developed to improve the interface between the optical and microwave components. The circuit utilizes two FET's and a dielectric resonator which serves as a frequency dependent feedback element. The circuit provides significant amplitude and phase noise suppression and is designed to operate around 10GHz. In addition the circuit realization is fully compatible with MMIC technology.

Microwave Broadband Phased Array Element: Design and Perfomance (Microstrip Horn Opened by Conducting Flaps)

A.C. Garcia, V. Such, J.L. Cruz and B. Gimeno. "Microwave Broadband Phased Array Element: Design and Perfomance (Microstrip Horn Opened by Conducting Flaps)." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 135-138.

In this paper the design and performance of a broadband phased array element with adecuate angular coverage is presented. It was also desirable that this element were easily adaptable to microstrip technology as an alternative to notch or Vivaldi antennas. Radiation field calculation, design parameters study, design process as well as pattern and reflection coefficient measures of a prototipe are included.

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Session C -- Ferrite Applications

"Session C -- Ferrite Applications." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 139-139.

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W-Band Ferrite - Dielectric Image-Line Field Displacement Isolators

J.M. Owens, J.Y. Guo, W.A. Davis and R.L. Carter. "W-Band Ferrite - Dielectric Image-Line Field Displacement Isolators." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 141-144.

This paper describes the results of theoretical and experimental studies of image line field displacement isolators operating at W band (90-100 GHz). Isolators were fabricated using gadolinium gallium garnet, and GaAs as the dielectric and Trans-Tech TT2-111 Nickel-Zinc Ferrite and Epitaxial Yttrium Iron Garnet as the non-reciprocal medium. Isolators with S/sub 21/-S/sub 12/ ratios of greater than 20db have been designed, fabricated and tested.

New Uniaxial-Ferrite Millimeter-Wave Junction Circulators

J.A. Weiss, N.G. Watson and G.F. Dionne. "New Uniaxial-Ferrite Millimeter-Wave Junction Circulators." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 145-148.

Progress is reported in the development of millimeter-wave microstrip and waveguide junction circulators for the band near 31 GHz. By exploiting the properties of high-anisotropy magnetic materials, external magnet requirements are eliminated. Favorable isolation and insertion loss performance, with good temperature stability, are achieved. Design tradeoffs involve device structure and magnetic material parameters.

Magnetostatic Wave Resonators of Microstrip Type

M. Tsutsumi and T. Takeda. "Magnetostatic Wave Resonators of Microstrip Type." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 149-152.

We propose a new type of magnetostatic wave resonator using the Yttrium Iron Garnet (YIG) film with circular metal strips. Assuming the magnetic wall at a edge of strip, a simple dispersion relation is derived and estimated numerically to get the resonant frequency and quality factor as a function of resonator dimensions. Next more practical model of resonator is assumed and analyzed using mode matching technique. The best resonator characteristic is designed with the high concentration of magnetostatic wave energy within a circular strip. Finally resonant characteristic is demonstrated experimentally.

A Low-Loss Magnetostatic Wave Filter Using Parallel Strip Transducer

T. Nishikawa, K. Wakino, H. Tanaka, S. Shinmura and Y. Ishikawa. "A Low-Loss Magnetostatic Wave Filter Using Parallel Strip Transducer." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 153-156.

A new configuration for magnetostatic forward volume wave (MSFVW) filter has been proposed. Parallel strip transducers and metal disks on yttrium iron garnet (YIG) film were adopted. Expressions developed for the radiation impedance of transducers makes the design of these medium band-width filters possible. Insertion loss of 6 dB was achieved in the 0.7-5.2 GHz band, and 4 dB in the 2.8-3.9 GHz band.

A 3.8 - 30.0 GHz YIG Oscillator - Theory and Design

M. Odyniec. "A 3.8 - 30.0 GHz YIG Oscillator - Theory and Design." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 157-160.

A YIG oscillator tunable over 3.8-30.GHz band has been developed. The aim of the paper is to analyze the oscillator and to discuss those of its properties which are critical for wide-band and high frequency performance. The paper consists of two parts: in the first one the methods of small signal analysis are used for wide-band design, the second part is focused on nonlinear properties of the oscillations.

X- and Ku-Band YIG-Film Tuned Low Noise Oscillators

Y. Mizunuma, T. Ohgihara, H. Nakano, T. Okamoto, M. Kubota and Y. Murakami. "X- and Ku-Band YIG-Film Tuned Low Noise Oscillators." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 161-164.

X and Ku-band YIG film tuned oscillators (YTOs) with phase noise below -95 dBc/Hz 10 kHz from the carrier and a high output power of more than +10 dBm without the use of buffer amplifier have been developed. This paper will describe the design criteria used to realize these high performance YTOs. The features of the YTOs are excellent linear tuning, low-phase noise over a relatively wide band, and small frequency drift with temperature. These oscillators are ideal for data and video transmission systems utilizing surface microwave links as well as satellites.

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Session D -- Biological Effects and Medical Applications (1989 Vol. I [MWSYM])

"Session D -- Biological Effects and Medical Applications (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 165-166.

Percutaneous Transluminal Microwave Angioplasty Catheter

A. Rosen, F. Walinsky, D. Smith, Y. Shi, Z. Kosman, A. Martinez, H. Rosen, F. Sterzer, D. Mawhinney, A. Presser, J.-S. Chou, P. Goth and G. Lowery. "Percutaneous Transluminal Microwave Angioplasty Catheter." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 167-170.

Microwave balloon angioplasty (MBA) combines traditional angioplasty techniques with microwave heating as an ancillary modality to help open narrowed arteries and reduce the occurence of restenosis. MBA was used in anesthetized rabbits to induce tissue modification in the endothelium and media. Results of initial in-vitro and in-vivo experiments are presented, and the potential advantages of adding microwave heating to balloon angioplasty are discussed.

A Method of Solution for a Class of Inverse Problems Involving Measurement Errors and its Application to Medical Microwave Radiometry

S. Mizushina, Y. Hamamamura, M. Matsuda and T. Sugiura. "A Method of Solution for a Class of Inverse Problems Involving Measurement Errors and its Application to Medical Microwave Radiometry." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 171-174.

Retrieval of temperature-versus-depth profiles in a biological tissue structure from multi-frequency microwave radiometric measurement data constitutes a typical inverse problem in which the data involve relatively large measurement errors. Meaningful solutions to such a problem ought to include effects of the statistical fluctuation in the measured data. We have developed a method of solution for a class of problems of this type. The method gives solutions in terms of the confidence interval and level. It also has a built-in capability of assessing the degree of fit of solutions to unknown actual source distributions. An agar phantom experiment and computer simulation based on a five-band (1-4 GHz) radiometry were made to test the method and the results are presented.

Electromagnetic Coupling of Microstrip Lines and Coplanar Waveguides to Multilayer Lossy Media

M.F. Iskander and T.S. Lind. "Electromagnetic Coupling of Microstrip Lines and Coplanar Waveguides to Multilayer Lossy Media." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 175-178.

In medical-diagnostic and geophysical applications of electromagnetic (EM) techniques, it is of critical importance to use radiating systems that couple the EM energy efficiently and with minimum external leakage. Experimentally, a family of printed circuit elements including coplanar waveguides has proven to be an ideal surface-wave type coupling system for such applications. To date, no work has been done to describe the coupling characteristics of these structures. In this paper, the spectral domain method is used to provide a detailed analysis of the coupling characteristics of coplanar waveguides to multi-layered lossy dielectric media. The role of a superstrata layer of lossless dielectric in setting up and controlling the surface-wave type coupling to the lossy media is examined. Results for the dispersion characteristics and the various components of the coupled electric field in the lossy medium are presented.

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Analysis of Microstrip Resonator with a Dielectric Protective Layer Radiating into Human Body

J. Pribetich, P. Kennis and P. Pribetich. "Analysis of Microstrip Resonator with a Dielectric Protective Layer Radiating into Human Body." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 179-182.

The originality of this communication is that previous modelization does not obtain the resonant frequencies of the rectangular microstrip resonator with a dielectric protective layer radiating into human body (that's to say the resonant frequency and the Q factor). This analysis is based on the two dimensional Spectral Domain Approach (S.D.A.). The comparison with experiment shows that the method improves the previous one dimensional modelization.

Computation of EM Effects on Large Biological Bodies by an Iterative Moment Method

J.J.H. Wang and J.R. Dubberley. "Computation of EM Effects on Large Biological Bodies by an Iterative Moment Method." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 183-186.

A new iterative moment method algorithm using a conjugate gradient method is developed for a three-dimensional arbitrarily-shaped dielectric or biological body. The algorithm has a restart feature which allows the operator to pause at a preset stage and then resume the iteration in a continuous way, thus making the computation of large bodies a controlled and measured process with minimum cost and time for a desired accuracy.

Sensing Dielectric Properties of Arbitrarily Shaped Biological Objects with a Microwave Resonator

A.W. Kraszeweki, S.O. Nelson and T.S. You. "Sensing Dielectric Properties of Arbitrarily Shaped Biological Objects with a Microwave Resonator." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 187-190.

A rectangular waveguide resonator operating in the H/sub 107/ mode at 6 GHz was used in determining the change in resonant frequency and the Q-factor of the cavity when loaded with single soybean seeds or corn kernels of various shapes and dimensions. By measuring those variables for a kernel oriented in two positions differing by 90 degrees with respect to the maximum E-field vector, the average values of Delta F and Delta T were found to be virtually shape-independent. The ratio Delta F/ Delta T is a size-independent and well-defined function of the material properties (epsilon' - 1)/epsilon' ', and as such it can be related to the material density, moisture content, or other characteristic when all other properties remain unchanged.

Session E -- Millimeter-Wave Amplifiers

"Session E -- Millimeter-Wave Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 191-191.

Monolithic HEMT LNAs for Radar, EW, and COMM (1989 Vol. I [MWSYM])

M.A.G. Upton, K.H. Snow, D.I. Goldstick, W.M. Kong, M.-Y. Kao, W.F. Kopp, P. Ho, G.J. Tessmer, B.R. Lee, K.A. Wypych and A.A. Jabra. "Monolithic HEMT LNAs for Radar, EW, and COMM (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 193-197.

Several monolithic HEMT low noise amplifiers (LNAs), designed for 7-11 GHz airborne radar, 2-18 GHz electronic warfare, and 20 GHz military satellite communications applications have demonstrated outstanding performance. Two-stage MMICs achieve as low as 1.2 dB noise figure at 10 GHz with 15 dB gain, and typically less than 1.8 dB noise figure from 7-11 GHz. A distributed amplifier demonstrates 3.0-5.2 dB noise figure with around 11 dB gain from 2-18 GHz. Finally, a three-stage MMIC achieves less than 2.0 dB noise figure from 18-23 GHz with 29 dB associated gain, representing the highest level of performance yet reported for a low-noise MMIC.

Monolithic V-band Pseudomorphic-MODFET Low-Noise Amplifiers (1989 Vol. I [MWSYM])

G. Metze, A. Cornfeld, J. Singer, H. Carlson, E. Chang, T. Kirkendall, G. Dahrooge, J. Bass, H.-L. Hung and T. Lee. "Monolithic V-band Pseudomorphic-MODFET Low-Noise Amplifiers (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 199-204.

V-band, low-noise MMICs based on pseudomorphic modulation-doped FET's (P-MODFETs) have been developed for the first time and have yielded noise figures that are believed to be the lowest reported for any millimeter--wave MMIC. Single stage low-noise amplifiers with P-MODFETs as active elements (gate dimensions 0.35 x 60 µm) exhibited minimum noise figures of 3.9 dB at 58 GHz, with an associated gain of 3.5 dB. Dual-stage MMICs had minimum noise figures of 5.3 dB at 58 GHz, with an associated gain of 8.2 dB, and maximum gain of 10.4 dB at 59.5 GHz. Further, a cascaded four-stage amplifier (two dual-stage MMIC modules) exhibited a 5.8.dB minimum noise figure at 58 GHz, with an associated gain of 18.3 dB, and 21.1 dB of maximum gain. Device processing uniformity, as well as DC and RF reliability data, are also presented.

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A Monolithic 40-GHz HEMT Low-Noise Amplifier (1989 Vol. I [MWSYM])

C. Yuen, C. Nishimoto, S. Bandy and G. Zdasiuk. "A Monolithic 40-GHz HEMT Low-Noise Amplifier (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 205-208.

A monolithic, single-stage HEMT low-noise amplifier has been developed at 40 GHz. This amplifier includes a single 0.25-µm gate-length HEMT active device with on-chip matching and biasing circuits. A gain of 6.5 dB and a noise figure of 5 dB were measured from 38 to 44 GHz. By replacing the triangular gate profile with a mushroom gate profile, the amplifier achieved 8dB gain and 4-dB noise figure from 36 to 42 GHz. The chip size is 1.1 x 1.1 mm.

GaAs Molecular Beam Epitaxy Monolithic Power Amplifiers at U-Band (1989 Vol. I [MWSYM])

G. Hegazi, H.-L.A. Hung, J.L. Singer, F.R. Phelleps, A.B. Cornfeld, T. Smith, J.F. Bass, H.E. Carlson and H.C. Huang. "GaAs Molecular Beam Epitaxy Monolithic Power Amplifiers at U-Band (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 209-213.

The design, fabrication, and measurements for 44-GHz band molecular beam epitaxy (MBE) monolithic power amplifiers are described. A five-stage balanced amplifier provided a linear gain of 15.1 dB and maximum output power of 500 mW at 42.5 GHz. These results may represent the highest power and gain achieved from a MIMIC in the 44-GHz band.

Session F -- Optical Interaction with Microwave Circuits--I (Focused Session)

"Session F -- Optical Interaction with Microwave Circuits--I (Focused Session)." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 215-215.

Abstracts

A Time-Domain Network Analyzer Which Uses Optoelectronic Techniques

K.J. Webb, E.A. Chauchard, P. Polak-Dingels, C.H. Lee, H.-L. Hung and T. Smith. "A Time-Domain Network Analyzer Which Uses Optoelectronic Techniques." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 217-220.

The performance of characterization measurements using time domain optoelectronic techniques offers many advantages and is especially suited for the on-wafer probing of GaAs integrated circuits. A single measurement can provide broadband scattering parameters. Signal generation is achieved by the illumination of a biased picosecond photoconductor with a short optical pulse and sampling by either a photoconductive or electro-optic technique. A comparison of results using both optical sampling techniques and frequency domain measurements is made.

External Electro-Optic Probing of Millimeter-Wave Integrated Circuits

J.F. Whitaker, J.A. Valdmanis, T.A. Jackson, K.B. Bhasin, R. Romanofsky and G.A. Mourou. "External Electro-Optic Probing of Millimeter-Wave Integrated Circuits." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 221-224.

An external, non-contact electro-optic measurement system, designed to operate at the wafer level with conventional wafer probing equipment and without any special circuit preparation, has been developed. Measurements have demonstrated the system's ability to probe continuous and pulsed signals on microwave integrated circuits on arbitrary substrates with excellent spatial resolution. Experimental measurements on a variety of digital and analog circuits, including a GaAs selectively-doped heterostructure transistor prescaler, an NMOS silicon multiplexer, and a GaAs power amplifier MMIC are reported.

An Optically Excited Microwave Ring Resonator on a Gallium Arsenide Substrate

D.S. McGregor, C.S. Park, M.H. Weichold and H.F. Taylor. "An Optically Excited Microwave Ring Resonator on a Gallium Arsenide Substrate." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 225-228.

An optically excited ring resonator has been fabricated on a GaAs substrate. An optical signal, supplied by a laser diode modulated at microwave frequencies, was focused into a voltage biased resonator coupling gap to generate carriers from photoconductivity. Results from measurements of the optically generated microwave signal out of the ring resonator revealed resonant peaks at 3.48 GHz, 6.94 GHz, and 10.3 GHz with Q values of 53.5, 75.4, and 103.0, respectively.

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Session G -- Passive Components--I

"Session G -- Passive Components--I." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 229-229.

An Accurate Characterization of Open Microstrip Discontinuities Including Radiation Losses

W.P. Harokopus, Jr. and P.B. Katehi. "An Accurate Characterization of Open Microstrip Discontinuities Including Radiation Losses." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 231-234.

An accurate full-wave analysis of a variety of open rnicrostrip discontinuities and circuit elements has been performed. The technique has been employed to characterize microstrip corners, steps, and matching sections. A two-dimensional application of Method of Moments is utilized to solve Pocklington's Integral equation in the space domain. The analysis accurately accounts for dispersion, space wave, and surface wave radiation. Scattering parameters are obtained for the circuit element or discontinuity by using transmission line theory.

Abstracts

Rectangular Disk 3 dB Hybrids

I. Ohta, H. Kinoshita, T. Kaneko and K. Fujiwara. "Rectangular Disk 3 dB Hybrids." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 235-238.

Four novel types of rectangular disk 3 dB hybrids have been obtained through the constituting principle on the basis of field distribution of two dipole modes, (1,0) and (0,1) modes. Their hybrid properties, however, actually are spoilt by the impairing influence of the higher order modes with increasing of center frequency. Therefore, some methods of improvement on them to a practicable level also have been described. Experimental results verify the improvement methodology.

A Compact Planar Microstrip-Slotline Symmetrical Junction Comparator Circuit

G.P. Riblet. "A Compact Planar Microstrip-Slotline Symmetrical Junction Comparator Circuit." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 239-242.

In this paper it is shown that the common 8 port comparator circuit may be constructed as a fully symmetrical junction device. As an example a planar symmetrical comparator circuit which makes use of microstrip and slotline transmission lines is described. Its diameter may be a wavelength or less at mid-band.

A New 6-18GHz, -3dB Multisection Hybrid Coupler Using Asymmetric Broadside, and Edge Coupled Lines

J.S. Izadian. "A New 6-18GHz, -3dB Multisection Hybrid Coupler Using Asymmetric Broadside, and Edge Coupled Lines." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 243-246.

Traditionally, the design of broad band couplers on microstrip has been accomplished by the well known Lange coupler. This paper will present a new asymmetric broadside coupler which could potentially replace the Lange coupler and is shown to have superior performance. An asymmetric broadside coupled line is used as the middle section of a 3-sectlon coupler, the two outside sections being realized by symmetric edge coupled lines. This new configuration utilizes a thin polyimide layer separating the two broadside coupled lines which offers additional design freedom and requires no tuning, or bonding, thus providing higher yield and lower manufacturing cost. The performance of two couplers one using a Lange section and another using the new asymmetric broadside section are presented and compared. An accurate numerical model for the asymmetric broadside coupled section was developed and used to design the present coupler. Calculated and measured results, which exhibit excellent agreement, will be presented. The development of the numerical model for this coupler will be reported in the future.

A Microstrip Planar Disk 3dB Quadrature Hybrid

M.J. Page and S.R. Judah. "A Microstrip Planar Disk 3dB Quadrature Hybrid." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 247-250.

A 3dB quadrature hybrid in the form of a four-port microstrip planar disk circuit is presented. Experimental results verifying the junction design are given.

Enhanced Model for Interacting Step-Discontinuities

F. Giannini, G. Bartolucci and M. Ruggieri. "Enhanced Model for Interacting Step-Discontinuities." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 251-254.

The increase in working frequency and the advent of monolithic technology stress the need of better accuracy in the characterization of passive components. With this respect, a new lumped equivalent circuit is proposed and tested, able to characterize both the interacting and the non-interacting cascaded step-discontinuities in microstrip. The model is based on a dynamic approach, utilizes practically frequency-independent lumped elements, is very broadband and easy to be implemented in the presently available commercial packages.

Abstracts

Session H -- Trends in Microwave Acoustics (Focused Session)

"Session H -- Trends in Microwave Acoustics (Focused Session)." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 255-255.

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Compact Sounding System Using Microwaves and Ultrasound

M. Daas and R. Knochel. "Compact Sounding System Using Microwaves and Ultrasound." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 257-260.

A compact sounding system is described that uses the radar return from a transmitted pulse of ultrasound (22 kHz) for temperature determination and for range measurement of targets. The targets may be nonreflective for ultrasound or microwaves or may show reflections, which can not be used in conventional radars. Technical details are given and experimental results are described for temperature profiling and range determination.

Abstracts

Low Noise Microwave Signal Generation: Resonator/Oscillator Comparisons

M.M. Driscoll. "Low Noise Microwave Signal Generation: Resonator/Oscillator Comparisons." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 261-264.

This paper will compare existing and projected microwave signal spectral performance obtainable using various types of acoustic and non-acoustic high Q resonators. Included will be a discussion of recent progress in resonator technology such as recent improvements in conventional dielectric resonator and quartz crystal resonator performance, development of composite, UHF resonators such as the high overtone bulk acoustic resonator (HBAR) exhibiting tenfold increase in Q and decrease in vibration and sensitivity (compared to quartz), and superconducting cavity type resonators exhibiting ultrahigh Q directly at microwave frequency.

A 9 GHz Oscillator Stabilized with a STW Delay Line

R. Hugli and U. Lott. "A 9 GHz Oscillator Stabilized with a STW Delay Line." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 265-268.

This paper presents a STW-stabilized X-band oscillator. The main feedback oscillator circuit consists of a third harmonic STW delay line at 2.25 GHz, a two stage amplifier and a diplexing network. The second stage of the amplifier in the oscillator loop doubles the frequency from 2.25 GHz to 4.5 GHz. An additional 4.5 GHz to 9 GHz MESFET doubler is integrated on the same substrate. The oscillator delivers 5 mW of output power. Phase noise is at least -90 dBc/Hz down at 20 kHz from the carrier.

Wide-Band Nonlinear Chirp Transducers for Planar Acoustooptic Deflectors

K. Anemogiannis, P. Russer and R. Weigel. "Wide-Band Nonlinear Chirp Transducers for Planar Acoustooptic Deflectors." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 269-272.

Design, fabrication and performance characteristics of LiNb0/sub 3/ based wide-band nonlinear interdigital chirp transducers are reported. A 54 % bandwidth centered at 720 MHz has been obtained for a collinear deflector on a YX substrate. A 66 % bandwidth at a midband frequency of 600 MHz has been designed for a Bragg deflector on a YZ substrate with electrodes tilted to satisfy the Bragg condition. Both tranducers are down-chirp designs. The chirp waveform has been optimized using an accurate model of analysis. The transducers have been fabricated using 10:1 reduction projection printing and liftoff technique. Good agreement has been found between theory and measurement. No severe bulk wave generation has been observed.

Abstracts

Session I -- Broadband ICs

"Session I -- Broadband ICs." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 273-273.

Abstracts

An Ultra Wide Bandwidth Power Divider on MMIC Operating 4 to 1.0 GHz (1989 Vol. I [MWSYM])

J. Staudinger. "An Ultra Wide Bandwidth Power Divider on MMIC Operating 4 to 1.0 GHz (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 275-278.

A circuit topology has been developed to realize power dividers with bandwidths of 2.5:1 or greater on MMIC. A three-way divider has been fabricated which achieved 5.8 dB nominal insertion loss and 18 dB isolation from 4 to 10 GHz. This topology consists of lumped element interconnected networks and is thus ideally suited for MMIC technology.

Silicon Bipolar Double Balanced Active Mixer MMIC's for RF and Microwave Applications Up to 6 GHz (1989 Vol. I [MWSYM])

J. Wholey, I. Kipnis and C. Snapp. "Silicon Bipolar Double Balanced Active Mixer MMIC's for RF and Microwave Applications Up to 6 GHz (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 281-285.

A monolithic silicon bipolar technology based on transistors with f /sub T/'s of 10 GHz and f/sub MAX/'s of 20 GHz has been used to develop double balanced active mixers. These circuits are based on Gilbert cell multipliers and exhibit conversion gain for RF and LO bandwidths to 6 GHz and IF bandwidths to 2 GHz. This paper presents an overview of the bipolar technology used. It discusses the basic mixer circuit design and presents a novel technique for modeling its noise figure. Finally RF measurements for two representative designs are summarized.

Design and Performance of a 2-18 GHz Monolithic Matrix Amplifier (1989 Vol. I [MWSYM])

A.P. Chang, K.B. Niclas, B.D. Cantos and W.A. Strifler. "Design and Performance of a 2-18 GHz Monolithic Matrix Amplifier (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 287-289.

The paper discusses the design and the performance of the first monolithic matrix amplifier. A gain of 15.5 ± 0.9 dB at a worst return loss of -12 dB, a maximum noise figure of 7 dB, and a minimum output power of P/sub 1 dB/ = 15.5 dBm were obtained in the two-tier module across the 2-18 GHz frequency band.

A Novel 4-18 GHz Monolithic Matrix Distributed Amplifier (1989 Vol. I [MWSYM])

S.L.G. Chu, Y. Tajima, J.B. Cole, A. Platzker and M.J. Schindler. "A Novel 4-18 GHz Monolithic Matrix Distributed Amplifier (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 291-295.

This paper describes the design, fabrication, and performance of a 4 to 18 GHz matrix distributed amplifier. This amplifier incorporates a novel biasing scheme which enables the stages to be connected in cascade at RF frequencies and in cascode for dc biasing, thus conserving current. This is the first MMIC amplifier of its kind. The amplifier has shown greater than 13 dB gain across the frequency band.

Abstracts

Session J -- Optical Interaction and Microwave Circuits--II (Focused Session)

"Session J -- Optical Interaction and Microwave Circuits--II (Focused Session)." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 297-297.

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100 GHz On-Wafer S-Parameter Measurements by Electrooptic Sampling

R. Majidi-Ahy, B.A. Auld and D.M. Bloom. "100 GHz On-Wafer S-Parameter Measurements by Electrooptic Sampling." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 299-302.

We describe the electrooptic sampling system at Stanford configured for millimeter-wave measurements. An active wafer probe frequency-multiplier, developed for supplying the stimulus signal for these measurements is also described. 100 GHz on-wafer S-parameter measurements of linear circuits, time waveforms of nonlinear circuits and propagation characteristics of uniplanar waveguides on GaAs are discussed.

Magnetostatic Waves-Based Integrated Optic Device Modules and Applications to Communications and Signal Processsings

C.S. Tsai, D. Young, T.Q. Vu and C.L. Wang. "Magnetostatic Waves-Based Integrated Optic Device Modules and Applications to Communications and Signal Processsings." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 303-306.

In this paper an up-to-date progress report on wideband magnetooptic interactions between guided-optical waves and magnetostatic waves, the resulting device modules, and applications to communications and signal processing is given. First, the technique for realization of GHz bandwidth magnetooptic Bragg cells with electronically tunable center frequency and their applications to wideband light beam scanning and switching, and RF spectral analysis are described. The design, fabrication, and performance characteristics of ion-milled waveguide lenses and the resulting magnetostatic waves-based integrated optic device modules are then presented.

An Optically Controlled Coplanar Waveguide Phase-Shifter

P. Cheung, D.P. Neikirk and T. Itoh. "An Optically Controlled Coplanar Waveguide Phase-Shifter." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 307-309.

Phase-shift measurements of an optically controlled coplanar waveguide phase shifter are presented. This device is based on the interaction between the guided wave on a coplanar waveguide (CPW) and an optically induced electron-hole plasma in the semiconductor substrate. A prototype device consisting of a CPW on a heterojunction substrate of AlGaAs/GaAs/AlGaAs was fabricated and tested. The measured phase-shift obtained with the total illuminating optical power in the -20 dBm range was as large as 50° for a 1cm long line at 10 GHz.

Abstracts

Session K -- Passive Components--II

"Session K -- Passive Components--II." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 311-311.

Abstracts

Time-Domain Calculation of Microstrip Components and the Curve-Fitting of Numerical Results

X. Zhang and K.K. Mei. "Time-Domain Calculation of Microstrip Components and the Curve-Fitting of Numerical Results." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 313-316.

The Time-Domain Finite Difference method combined with Fourier transform techniques has recently been shown to be a very effective approach in modeling the dispersive characteristics of microstrip components. The present research further investigate the problems associated with the generation of design data over a larger substrate and line parameter range and the curve-fitting of the numerical results for CAD purpose.

Multiport Branch-Waveguide Couplers with Arbitrary Power Splitting

P. Carle. "Multiport Branch-Waveguide Couplers with Arbitrary Power Splitting." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 317-320.

An optimised synthesis method to design multi-port branch-waveguide couplers with arbitrary output power distributions is presented. This component offers the potential to reduce complexity, mass and size of beam forming networks of multiple or contoured satellite antennas. Besides, the power distributions obtained, feeding separately any input port, are orthogonal and that gives this device suitable for "multi-mode" antenna applications. The design of a six-port coupler in WR75 wave-guide is outlined in detail. Comparing the experimental results with the computed performance shows that the synthesis procedure is verified very satisfactorily. Moreover, the theoretical and measured results obtained on an eight-port coupler prototype will be available at the time of the symposium.

Multi-Way Unequal Power Divider Circuits Using Sector-Shaped Planar Components

M.D. Abouzahra and K.C. Gupta. "Multi-Way Unequal Power Divider Circuits Using Sector-Shaped Planar Components." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 321-324.

In this paper the design of a sector shaped unequal power divider is presented. The design and the method of analysis are extensions of those previously presented for the sector shaped multi-way equal power divider. The initial experimental results for a 4-way power divider show that the power distribution among the output ports can be controlled by suitably locating shorting pins along the radial edges of the sector. Designs with bandwidths greater than 40% (for S/sub 11/ better than -14 dB) have been realized experimentally for a four-way divider with power output at two ports being 4 dB lower than that at the other two ports. The experimental results are in agreement with the theoretically computed values.

The AC Resistance of a Microstripline and its Ground Plane

R. Faraji-Dana and Y.L. Chow. "The AC Resistance of a Microstripline and its Ground Plane." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 325-327.

It is found that the RF resistance of a microstripline is substantially higher than the theoretical value from the skin effect of the strip alone. Based on rigorous analyses, this paper finds that the extra resistance is caused mainly by (i) The concentration of grounded plane current under a wide microstrip, and (ii) the concentration of the strip current towards the ground.

Analysis and Design of Ideal Non Symmetrical Coupled Microstrip Directional Couplers

T. Emery, Y. Chin, H. Lee and V.K. Tripathi. "Analysis and Design of Ideal Non Symmetrical Coupled Microstrip Directional Couplers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 329-332.

Ideal directional couplers consisting of coupled asymmetric lines in an inhomogeneous medium have been realized by equalizing the inductive and capacitive coefficients of coupling. Analysis, design procedure and examples of such high directivity asymmetric couplers consisting of various planar and layered strictures are presented together with the experimental results for 6 dB couplers on Alumina.

Abstracts

Asymmetric Lumped Element Power Splitters

B. Kopp. "Asymmetric Lumped Element Power Splitters." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 333-336.

A new type of asymmetric power divider is described, which utilizes lumped elements to reduce circuit size and realize high impedance levels not possible in microstrip. A new method is also presented to realize asymmetric splitters with a reduced number of transformers. The paper concludes with a presentation of measured data for a 2 to 6 GHz two-way asymmetrical divider.

Session L -- Open Forum

"Session L -- Open Forum." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 337-337.

Simple CAD Formulas of Edge Compensated Microstrip Lines

E. Yamashita, H. Ohashi and K. Atsuki. "Simple CAD Formulas of Edge Compensated Microstrip Lines." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 339-342.

The proximity effects of microstrip lines near a substrate edge are estimated by using the rectangular boundary division method for effectively designing high-packing-density MMIC's. Simple CAD formulas of edge-compensated microstrip lines (ECM lines) are introduced which can be applied to circumvent the proximity effects on the characteristic impedance.

A General Planar Circuit Simulator Based on Two-Dimensional TLM Method

P.P.M. So and W.J.R. Hoefer. "A General Planar Circuit Simulator Based on Two-Dimensional TLM Method." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 343-346.

A two-dimensional circuit simulator based on the TLM method (2D-TLM) has been developed. It can analyze two-dimensional circuits of arbitrary geometry containing both linear and nonlinear media. The circuit geometry is input graphically. Both time-domain and frequency-domain responses can be computed and visualized. As examples, a microstrip lowpass filter, a microstrip varactor multiplier, and a waveguide post-coupled filter have be analyzed and compared with other methods.

A Large Signal Nonlinear MODFET Model from Small Signal S-Parameters

J.M. O'Callaghan and J.B. Beyer. "A Large Signal Nonlinear MODFET Model from Small Signal S-Parameters." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 347-350.

A general technique for predicting the FET large signal performance has been developed. The technique is based entirely on experimental data (small signal S-parameters at different bias points) and therefore is independent of the structure of the FET. Large signal measurements confirm the validity of the model.

A Novel Analytical Approach for the Nonlinear Microwave Circuits and Experimental Characterisation of the Nonlinear Behaviour of a New MESFET Device Structure

V. Krozer, K. Fricke and H.L. Hartnagel. "A Novel Analytical Approach for the Nonlinear Microwave Circuits and Experimental Characterisation of the Nonlinear Behaviour of a New MESFET Device Structure." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 351-354.

A novel analytical technique is described based on generalised Volterra series to analyse non-linear microwave and millimeter-wave circuits and devices. In contrast to previous publications the new method is especially efficient for general-purpose CAD applications and can be easily incorporated into existing CAD programs. The capabilities of the technique has been demonstrated on especially fabricated new MESFET structures, designed to reduce the losses due to the high resistance of the gate electrode. Power and intermodulation distortion measurements has been carried out and good agreement with calculated values has been observed.

Abstracts

Control of Aliasing in the Harmonic Balance Simulation of Nonlinear Microwave Circuits

P.L. Heron, C.-R. Chang and M.B. Steer. "Control of Aliasing in the Harmonic Balance Simulation of Nonlinear Microwave Circuits." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 355-358.

The simulation of nonlinear microwave circuits using harmonic balance requires Fourier transformation to interface the frequency domain analysis of the linear subcircuits with the time domain analysis of the nonlinear subcircuits. Subsequent aliasing can unacceptably reduce the accuracy of harmonic balance simulation. Simulation error can be reduced by selecting a large set of frequencies for use in the circuit analysis. Unfortunately, such analyses require extended simulation time. A dual frequency set analysis scheme is proposed which reduces aliasing without requiring excessive simulation time.

Abstracts

A CAD Program and Equations for System Phase and Amplitude Noise Analysis

A. Riddle. "A CAD Program and Equations for System Phase and Amplitude Noise Analysis." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 359-362.

A novel method for calculating the amplitude and phase noise of component chains is described. The equations for oscillator, amplifier, multiplier, and bandpass filters are discussed. These equations include the upconversion of 1/f noise. A user friendly CAD program is described. This work is important for the calculation of amplifier chain noise, fiber optic receiver jitter, and general system noise analysis.

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Practical, High Speed Gradient Computation for Harmonic Balance Simulators

J.W. Bandler, Q.J. Zhang and R.M. Biernacki. "Practical, High Speed Gradient Computation for Harmonic Balance Simulators." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 363-366.

We introduce a powerful computational concept which we name the future adjoint sensitivity technique (FAST). FAST combines the efficiency of the exact adjoint sensitivity technique with the simplicity of the conventional perturbation technique. The same concept carries over to a practically implementable Jacobian for fast harmonic balance simulation. Our result promises high speed gradient evaluation essential for yield optimization of nonlinear MMIC circuits by general purpose software.

Wideband Conductor Loss Calculation of Planar Quasi-TEM Transmission Lines with Thin Conductors Using a Phenomenological Loss Equivalence Method

H.-Y. Lee and T. Itoh. "Wideband Conductor Loss Calculation of Planar Quasi-TEM Transmission Lines with Thin Conductors Using a Phenomenological Loss Equivalence Method." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 367-369.

Conductor loss calculation based on the incremental inductance rule is not valid if conductor thickness becomes very thin and on the order of the skin depth, such as in monolithic microwave integrated circuits. In this paper, conductor loss of a planar quasi-TEM transmission line with thin conductors is calculated over a broad frequency range using an approach to be called a phenomenological loss equivalence method. The calculated conductor losses of microstrip lines agree well with those calculated using the finite element method. Because of its simplicity, this method should be very useful for computer-aided design of monolithic microwave circuits. In addition, this method can also be applied to very thin and narrow superconductive lines using the complex conductivity based on the two-fluid model.

Abstracts

Modeling and Analysis of GaAs MESFETs Considering the Wave Propagation Effect

R.L. Chang, T.J. Shieh, W.A. Davis and R.L. Carter. "Modeling and Analysis of GaAs MESFETs Considering the Wave Propagation Effect." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 371-374.

The effect of wave propagation along the electrodes of a GaAs MESFET is studied using distributed circuit analysis technique. Each distributed device element is considered as a combination of two pair of coupled coplanar strips and a conventional GaAs MESFET. The distributed equivalent circuit is then analyzed using SUPER-COMPACT. The maximum available power gain (MAG) or the maximum stable power gain (MSG) of the device is calculated as a function of device width. The results show, for single gate MESFETs over 100 µm wide, the transmission line properties of the electrodes have a significant effect on the transistor performance. The power gain also depends on where the input signal is fed and where the output signal is extracted.

An Efficient Linear Statistical FET Model

M. Petzold, J. Purviance and C. Potratz. "An Efficient Linear Statistical FET Model." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 375-378.

The commonly used FET model is examined and found to be at best a difficult structure for modeling a FET's perfomance statistics. A simpler linear statistical model based on Principal Component Analysis is proposed which results in uncorrelated model parameters. An example using actual measured GaAs FET data uses just 13 uncorrelated random variables to model the FET's performance statistics from 1 to 11 GHz.

Abstracts

Ultra-Broadband Lossy Match Amplifiers

Y. Ito, M. Nakajima, M. Kimishima and M. Asa. "Ultra-Broadband Lossy Match Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 379-383.

This paper describes the design, fabrication, and performance of the three stage lossy match amplifier with a gain of 8.0±0.6 dB and return loss of better than 9 dB over the 2 to 32 GHz band. This amplifier uses a novel m-derived low-pass network, and thus shows the widest bandwidth ever reported for a lossy match amplifier.

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Modeling of Noise Parameters of MESFET's and MODFET's and Their Frequency and Temperature Dependence (1989 Vol. I [MWSYM])

M.W. Pospieszalski. "Modeling of Noise Parameters of MESFET's and MODFET's and Their Frequency and Temperature Dependence (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 385-388.

A simple wideband noise model of microwave MESFET (MODFET, HEMT, etc.) is described and verified at room and cryogenic temperatures. Closed form expressions for T/sub min/ - minimum noise temperature, Z/sub gopt/ - optimum generator impedance, g/sub n/ - noise conductance are given in terms of frequency, the elements of FET equivalent circuits, and the equivalent temperatures of intrinsic gate resistance and drain conductance. The model allows prediction of the noise parameters for a broad frequency range from a single frequency measurement of noise parameters.

A New GaAs Power-MESFET with Large Unit Gate Width

K. Fricke, V. Krozer and H.L. Hartnagel. "A New GaAs Power-MESFET with Large Unit Gate Width." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 389-392.

A new GaAs-power-FET is proposed which uses an additional transmission line feeder parallel to the gate. With a suitable termination at the end of this transmission line and a unit gate width of 2mm the fabricated device shows excellent power handling capabilities and an increased output resistance at 4 GHz. It is demonstrated that this approach leads to higher output power and easier matching of GaAs-power-FET.

Abstracts

Class-A GaAs FET Power Amplifier Design for Optimizing Intermodulation Product

Y. Daido, M. Minowa and N. Okubo. "Class-A GaAs FET Power Amplifier Design for Optimizing Intermodulation Product." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 393-396.

Since optimizations of amplifier gain and cutoff frequency f of FET are important to minimize nonlinear distortion, intermodulation products of Class-A GaAs FET amplifier is extensively estimated. output back-off and power added efficiency at any specified D/U ratio are determined under various matching condition using FET's with different f/sub T/. For optimum design of the amplifier, new charts are given which show the back-off and efficiency at the specified D/U ratio as functions of small-signal gain and ratio of operating frequency to f/sub T/.

The Design and Performance of Large Signal Distributed Microwave Amplifiers

M.I. Sobhy and A.J. Castelino. "The Design and Performance of Large Signal Distributed Microwave Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 397-400.

Large signal models of microwave power MESFETs have been developed. The models match closely measured D.C. and R.F. characteristics of the device. The complete distributed microwave amplifier was simulated using a non-linear simulation program. Three circuits were built and results show good agreement with predicted performances. Power outputs up to 0.7 Watt were obtained over the range 2-6 GHz using 3 MESFETs per circuit. The non-linear simulation was able to predict the dynamic range, the power gain, fundamental and harmonic power outputs to a reasonable degree of accuracy.

CAD and Performance of the Ultrawide - Band GaAs FET Amplifiers

S. Shiying, H. Bin, W. Chucheng and Z. Xiaohung. "CAD and Performance of the Ultrawide - Band GaAs FET Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 401-404.

In this paper the effect of feedback elements on noise figure is discussed. The numerical analysis shows clearly the contribution of each sensitive element to noise figure and to other performance. A circuit analysis method concerned with tree-structured circuits is proposed. This method allows it possible to analyse such microwave two-port circuit which contains feedback networks (serial, parallel) and T branches more quickly and efficiently. As an example, three experimental amplifier modules have been developed that cover the frequency band 1.4-11.7 GHz, 2-10 GHz and 1.5-6.25 GHz.

Design Techniques for GaAs MESFET Switches

G.J. Gardiner, M.W. Geen and D.C. Smith. "Design Techniques for GaAs MESFET Switches." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 405-408.

A three port bias dependent model for a switch FET is presented. The importance of a three port model is highlighted. Large signal behaviour of a MESFET switch in its ON and OFF states is discussed. The effect of gate bias resistor and bias potential is illustrated. Simple equations and techniques are presented which enable estimates of power performance of complex switches to be made prior to detailed non-linear analysis.

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A 2-20 GHz Dual Channel Receiver with 2-6 GHz IF

S.S. Bharj, S.P. Tan, J. Gluck and B. Thompson. "A 2-20 GHz Dual Channel Receiver with 2-6 GHz IF." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 409-412.

A dual channel 2-20 GHz receiver with a 2-6 GHz IF has been designed and developed to give conversion gain and good LO and RF rejections at intermediate frequencies. It utilizes nine MMIC chips and has an 8 to 12 GHz MESFET voltage controlled oscillator. Applications of this receiver are intended for future electronic warfare systems. The receiver uses a unique planar balun for the double balanced mixer.

Characterization of Active and Passive Millimeter-Wave Monolithic Elements by On-Wafer Probing

G. Dawe and L. Raffaelli. "Characterization of Active and Passive Millimeter-Wave Monolithic Elements by On-Wafer Probing." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 413-415.

A Technique for modeling active and passive monolithic elements in a microstrip environment at millimeter wave frequencies using on-wafer probing is developed. This procedure involves accurately characterizing the coplanar waveguide to microstrip transition used in making on-wafer measurements. Once the transition is characterized, the models for various elements can be determined.

Click on title for a complete paper.

Nonlinear Charge Control DC and Transmission Line Models for GaAs MODFET's

D.-H. Huang and H.C. Lin. "Nonlinear Charge Control DC and Transmission Line Models for GaAs MODFET's." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 417-420.

A new simple analytical nonlinear charge control model is developed for two-dimensional electron gas density of GaAs MODFET and included in the d.c. model. MODFET is modeled as a lossy transmission line for microwave frequency analysis. The model predictions show a good agreement with experimental results of 0.3µm GaAs MODFET for both d.c. characteristics and 1-26 GHz frequency range.

A 0.3 to 3 GHz Monolithic Vector Modulator for Adaptive Array Systems

A. Truitt, J. Cerney and J.S. Mason. "A 0.3 to 3 GHz Monolithic Vector Modulator for Adaptive Array Systems." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 421-422.

A monolithic vector modulator element has been demonstrated that combines the bi-phase modulation and gain control functions on a single chip covering the 0.3 to 3 GHz frequency band. Over 50 dB of gain control is provided.

Super Low Noise AlGaAs/GaAs HEMT with One Tenth Micron Gate

H. Kawasaki, T. Shino, M. Kawano and K. Kamei. "Super Low Noise AlGaAs/GaAs HEMT with One Tenth Micron Gate." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 423-425.

Low noise AIGaAs/GaAs HEMT with 0.1 µm gate length have been successfully developed. A state-of-the-art low noise figure of 0.51 dB and 1.9 dB are obtained at 18 GHz and 40 GHz at room temperature, with an associated gain of 10.8dB and 5.3dB, respectively. The performance has been achieved by shortening the gate length to 0.1 µm and also by lowering the gate resistance drastically with a T shaped gate structure.

Abstracts

A Highly Directive, Broadband, Bidirectional Distributed Amplifier

J.W. Byrne and J.B. Beyer. "A Highly Directive, Broadband, Bidirectional Distributed Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 427-430.

Design considerations for developing a highly directive broadband bidirectional distributed amplifier are discussed. Directivities on the order of -25 to -35 dB over as much as an octave in frequency are demonstrated using computer simulation with measured s-parameter data for an NEC 9000 transistor.

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High Yield Matching Structures for 20% Bandwidth Microwave Amplifiers

W. Brakensiek, J. Purviance and T. Ferguson. "High Yield Matching Structures for 20% Bandwidth Microwave Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 431-434.

Circuit yield is used as a criterion to choose among possible input-output, lumped, lossless, two and three element matching structures, considering a bandwidth constraint on the match of 10% and 20%. A new design chart is presented. An amplifier design example shows the use of the design chart and shows yield variations from 0% to 69% as a function of structure choice.

State-Preserving Intermittently-Locked Loop (SPILL) Frequency Synthesizer for Portable Radio (1989 Vol. I [MWSYM])

S. Saito, Y. Tarusawa, H. Suzuki and S. Yuki. "State-Preserving Intermittently-Locked Loop (SPILL) Frequency Synthesizer for Portable Radio (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 435-438.

A novel PLL concept, SPILL, suitable for intermittent-operation frequency synthesizers used in UHF portable radio sets is proposed. The SPILL employs digital circuit techniques which preserve frequency and phase during power-off periods, in order to perform fast acquisition at the beginning of power-on period. Both theoretical analysis and experiments confirm acceptable acquisition performance. A 1.6 GHz SPILL frequency synthesizer achieves two order magnitude improvement on acquisition time. Application of the SPILL to high frequency synthesizer are especially effective for reducing power consumption in the portable radio communication set.

High Dynamic Range Airborne Tracking and Fire Control Radar Subsystems

A.M. Madni, P.T. McDonald, R.K. Hansen and L.A. Wan. "High Dynamic Range Airborne Tracking and Fire Control Radar Subsystems." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 439-442.

Two high dynamic range receiver sub-systems for use in airborne radar fire control and tracking applications are described. A high performance X-band monopulse tracking receiver and a doppler fire control receiver are presented with performance data and design considerations to achieve high dynamic range.

A Superconducting Single Film Device Oscillator Made of High Tc and Low Tc Materials

J.S. Martens, J.B. Beyer, J.E. Nordman, G.K.G. Hohenwarter and D.S. Ginley. "A Superconducting Single Film Device Oscillator Made of High Tc and Low Tc Materials." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 443-446.

We have constructed a superconducting oscillator made with single film devices. Circuits made of the high T/sub c/ superconductor TlCaBaCuO as well as those made with the low T/sub c/ material Nb oscillated in the range 700 MHz to 3.3 GHz.

Observation of Microwave Comb Generation with a Josephson Junction Array

G.K.G. Hohenwarter, D.P. McGinnis, J.B. Beyer and J.E. Nordman. "Observation of Microwave Comb Generation with a Josephson Junction Array." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 447-450.

We report high harmonic content sideband generation with a Josephson junction array as center conductor of a 50 Ohm coplanar line. The line was fed with a low level microwave signal and an ac bias current with a dc offset. Over 100 harmonics of the ac signal were observed in the mixing spectrum at rf frequencies up to 20 GHz. The shape of the spectrum changed with magnetic field and dc bias point.

Propagation Characteristics of Inductively-Coupled Superconducting Microstrip

J.M. Pond, P. Weaver and I. Kaufman. "Propagation Characteristics of Inductively-Coupled Superconducting Microstrip." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 451-454.

The propagation properties of two inductively coupled superconducting transmission lines have been studied. An expression for the attenuation of the coupled-line modes was derived for the case of low loss. It was found that, for transmission line geometries of practical interest, the low loss expression agrees well with the more general numerical solution. The numerical solution was used to determine the dispersion characteristics of inductively coupled lines as a function of the superconductor thicknesses and the operating temperature. A lumped-element equivalent circuit, with the same dispersion equation, is presented along with the relationship between the lumped-element values and the physical parameters of the line. Prototype circuit elements such as 20 dB couplers have been designed.

Magnetic Bremsstrahlung Radiation Sources Using The Meissner Effect

A.F. Boden and H.R. Fetterman. "Magnetic Bremsstrahlung Radiation Sources Using The Meissner Effect." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 455-458.

Given the recent interest in high T/sub c/ superconductors, development of a radiation source that could exploit the novel properties of these materials has been suggested. One approach would be to use the Meissner magnetic field rejection phenomenon to create a high-field gradient region that could function as a source of magnetic bremsstrahlung. Physical structures containing superconducting component could serve as the basis for such magnetic bremeetrahlung devices as a Free Electron Laser. A preliminary discussion of the merits and liabilitee of the use of Meissner effect magnetic field manipulation in radiation eource application is presented. There are a number of reasons to believe that the Meissner effect will lead to an exciting new class of devices.

Theory of Regenerative Frequency Dividers Using Double-Balanced Mixers

R.G. Harrison. "Theory of Regenerative Frequency Dividers Using Double-Balanced Mixers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 459-462.

Regenerative frequency halvers using double-balanced mixers are analysed in terms of modified Bessel functions. Closed-form solutions predict the threshold of turn on, the steady-state input-output amplitude relationship, and the operational bandwidth.

An Accurate and Simple Large Signal Model of HEMT

Q.Z. Liu. "An Accurate and Simple Large Signal Model of HEMT." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 463-466.

A large signal model of discrete HEMTs has been developed. It is simple and suitable to SPICE simulation of hybrid digital ICs. The model parameters are extracted by using computer programs and data provided by the manufacturer. Based on the model, a hybrid pulse inverter with rise and fall times of 20 ps and 29 ps at 5 Gbit/s, respectively, has been built. The accuracy of the model has been verified by obtaining good agreement between the measured and simulated waveform of the inverter.

Planar Doped Barrier Mixer and Detector Diodes as Alternatives to Schottky Diodes for Both Microwave and Millimetre Wave Applications

I. Dale, A. Condie, S. Neylon and M.J. Kearney. "Planar Doped Barrier Mixer and Detector Diodes as Alternatives to Schottky Diodes for Both Microwave and Millimetre Wave Applications." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 467-470.

Planar Doped Barrier diodes with extremely low barrier heights and highly asymmetric I-V characteristics have been developed using MBE grown GaAs material. This paper reports upon the RF performance of these devices and discusses the significant advantages offered by PDB devices over conventional Schottky diodes for mixer and detector applications at both microwave and millimetre wave frequencies.

Microwave Characteristics of MBE Grown Resonant Tunneling Devices

J.M. Owens, D.J. Halchin, K.L. Lear, W.S. Lee and J.S. Harris, Jr.. "Microwave Characteristics of MBE Grown Resonant Tunneling Devices." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 471-474.

Resonant tunnel beam epitaxy experimentally devices grown by molecular have been measured using network analysis techniques from 130 MHz - 20 GHz. A circuit model for the devices has been extracted for two different InGaAs well structures at a fixed bias point, which fits the measured data well and is useful for circuit design. Additionally, the device impedance has been measured as a function of bias at a fixed frequency point. Complicated capacitance characteristics were observed for the devices with large indium content wells.

Trends in Mixer Damage

C.M. Glenn and R.V. Garver. "Trends in Mixer Damage." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 475-477.

The dynamic damage properties of 74 pairs of 1N23 X-band mixer diodes have been measured using a train of 30 short pulses at a 1-pps repetition rate. A first 30-uJ pulse caused a 3-dB degradation of conversion loss. The damage of successive 16-uJ pulses asymptotically approached 3-dB.

Abstracts

Study of Fundamental Wave Injection Locking of MM-Wave Gunn Harmonic Oscillator Using Large Signal Model of Gunn Device

C. Ning, S. Zhong-Liang and L. Si-Fan. "Study of Fundamental Wave Injection Locking of MM-Wave Gunn Harmonic Oscillator Using Large Signal Model of Gunn Device." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 479-482.

A new large signal mathematical model of Gunn device at the state of harmonic operation is presented. The locking characteristic of fundamental wave injection locking of mm-wave Gunn harmonic oscillator is analyzed theoretically by using this model. The theoretical results have good agreement with experiment.

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Performances of Laser-Processed HEMTs with AIAs-nGaAs Superlattice Donor Layers

J.M. Dumas, A. Christou, A. Belhadj, G. Kiriakidis, Z. Hatzopoulos, P. Audren, H. Thomas and J. Goostray. "Performances of Laser-Processed HEMTs with AIAs-nGaAs Superlattice Donor Layers." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 483-486.

In-site laser resorption of GaAs semi-insulating substrate surfaces prior to MBE growth and laser processing of ohmic contacts have been used for the fabrication of X-band HEMTs with superlattice donor layers. The improvements made lead to high performance devices.

Microwave and Millimeter Wave QWITT Diode Oscillator

V.P. Kesan, A. Mortazawi, D.P. Neikirk and T. Itoh. "Microwave and Millimeter Wave QWITT Diode Oscillator." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 487-490.

We present dc, microwave, and millimeter wave characteristics of different quantum well injection transit time (QWITT) diodes.Small-signal and large-signal device models are used to provide physical device design parameters to maximize output power density. A peak output power of 1 mW in the frequency range of 5-8 GHz has been obtained from a planar QWITT oscillator. This is the highest output power obtained from any quantum well oscillator at any frequency. This result also represents the first planar circuit implementation of a quantum well oscillator. Millimeter wave oscillations at 28-31GHz in a full-height waveguide circuit with an output power of 30 µW have been obtained. In addition, we present results on improving device efficiency by optimizing the design of the drift region through the use of a doping spike. By optimizing the doping concentration and width of the doping spike, an increase in efficiency from 2% to 5% is obtained, without compromising on output power at X-band.

Investigations of Complex Modes in a Generalized Bilateral Finline with Mounting Grooves and Finite Conductor Thickness (1989 Vol. I [MWSYM])

W.-K. Wang, C.-K.C. Tzuang, C.-Y. Shih and T.-H. Wang. "Investigations of Complex Modes in a Generalized Bilateral Finline with Mounting Grooves and Finite Conductor Thickness (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 491-494.

A generalized bilateral finline with mounting grooves and finite conductor thickness is analyzed by full-wave mode-matching method. The final nonstandard eigenvalue equation is derived from unknown coefficients in two slot regions. Both relative and absolute convergence analyses of complex modes are performed. The field patterns along the metallized strips are investigated for relative converence studies. Once the optimal ratios of the numbers of expansion terms among different regions are decided, the absolute convergence study is initiated to obtain the minimal number of total modal expansion terms to save computer time. The validity of this approach is confirmed by checking the available complex mode data. Finally, the dispersion characteristics of fundamental, higher order, evanescent, and complex modes are presented for an asymmetric bilateral finline.

Complex Modes in Shielded Planar Microstrip Lines

C.-K.C. Tzuang, J.-T. Kuo, C.-C. Tien, J.-S. Jang and T.-H. Wang. "Complex Modes in Shielded Planar Microstrip Lines." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 495-498.

This paper analyzes the existence of complex modes, which have important effects on the properties of planar transmission line discontinuities, in electrically shielded microstrip lines. A rigorous full-wave spectral domain approach (SDA) with a newly proposed and tested set of basis functions can efficiently and accurately determine the complex modes of a class of general planar transmission line problems if the complex modes exist. Under the case studies of this paper, it shows that the complex modes may exist in every shielded microstrip lines. Both convergence study and the cross-sectional field patterns, which guarantee the correct boundary conditions being satisfied, confirm the validity of the solutions for complex modes. Theoretical results for fundamental, higher order, evanescent, and complex modes are presented for symmetric coupled microstrip lines.

Abstracts

An Investigation of NRD Waveguide Grating

Y. Ping and M. Jingfeng. "An Investigation of NRD Waveguide Grating." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 499-502.

The filter characteristic of NRD waveguide grating is investigated rigorously by combining network approach with mode matching theory. Numerical examples are shown and compared with experiment results.

On the Analysis of Quasi-Planar Transmission Lines in Circular/Elliptical Waveguides Using the Method of Lines

K. Wu and R. Vahldieck. "On the Analysis of Quasi-Planar Transmission Lines in Circular/Elliptical Waveguides Using the Method of Lines." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 503-506.

The analysis of a class of quasi-planar transmission lines in circular/elliptical waveguides is introduced. Data will be presented to characterize wave propagation in microstrip and slotlines in closed and semi-open circular metallic enclosures. The method of lines has been modified for this problem to treat curved and open boundary value problems in this type of transmission lines.

Self Adaptive Mesh Scheme for the Finite Element Analysis of Anisotropic Multiconductor Transmission-Lines

M. Salazar-Palma and F. Hernandez-Gil. "Self Adaptive Mesh Scheme for the Finite Element Analysis of Anisotropic Multiconductor Transmission-Lines." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 507-510.

A self adaptive mesh algorithm for transmission-lines Finite Element analysis is presented: it leads to an easy-to-use automatic FEM program in which the mesh corresponding to the domain discretization necessary for the FEM application- is automatically well adapted to the structure under study, taking into account not only its geometry and materials, but field behavior and singularities. The method is based on the calculation of the error of the gradient conjugate solution of the structure FEM approach with a given coarse mesh. The error analysis gives information about the need of refining the grid, and which elements must be subdivided. Method application to the quasi-static approach of several anisotropic substrates microstrip-line structures is shown.

Analysis of Waveguides with Metal Inserts

A.S. Omar and K. Schunemann. "Analysis of Waveguides with Metal Inserts." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 511-514.

A systematic analysis of waveguides with metal inserts is presented. The method is based on a field expansion in terms of the normal modes of the corresponding hollow waveguide without metal inserts. The analysis leads to two main formulations: the matrix formulation and the moment method formulation, The matrix formulation is suitable for structures with smooth metal inserts, which are free from sharp edges, while the moment method is more suitable for metal sheets (e.g. strips and fins) or metal inserts with sharp edges (e.g. ridges). The method is applied to the analysis of ridged waveguides and finlines, and leads to a generalization of the widely used spectral domain technique with respect that ridges, fins, and strips with finite thickness can now equally be analyzed. Any existing routine for the analysis of planar structures, which is based on the spectral domain technique, can slightly be modified in order to take the metallization thickness into account.

Microwave Quenchable Oscillators - A New Class

A.P.S. Khanna, R.T. Oyafuso, R. Soohoo and J. Huynh. "Microwave Quenchable Oscillators - A New Class." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 515-518.

A new class of fast-switching oscillators is presented, in which the oscillations are switched on and off without affecting the device bias conditions by quenching the negative resistance with a PIN diode. The quenching technique, applicable to all types of oscillators, makes possible the realization of fast-switching, fast-settling, spurious-free wideband multi-oscillator assemblies. The speed of operation is demonstrated by a Ku-band VCO which settles within 1 MHz of its final frequency and a Ku-band DRO which settles within 100 kHz of its final frequency within 1 µs after the output is switched on using the PIN-diode quenching technique. The same PIN-diode control can be used in a "partial quenching" mode for control of output power level, and for harmonic reduction.

State-of-the-Art Performance Millimetre Wave Gallium Arsenide Gunn Diodes Using Ballistically Hot Electron Injectors

S. Neylon, I. Dale, H. Spooner, D. Worley, N. Couch, D. Knight and J. Ondria. "State-of-the-Art Performance Millimetre Wave Gallium Arsenide Gunn Diodes Using Ballistically Hot Electron Injectors." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 519-522.

Ballistically hot electron injectors have been designed using a graded gap GaAs/AlGaAs structure and incorporated into the cathode side of a GaAs Gunn diode drift region. Epitaxial material has been grown using MBE techniques and diodes fabricated. RF assessment at 94GHz has resulted in efficiencies over 2.3%, above 50mW output power, combined with low sideband noise performance and much improved temperature stability.

Abstracts

Convention and Hotel Maps (1989 Vol. I [MWSYM])

"Convention and Hotel Maps (1989 Vol. I [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.1 (1989 Vol. I [MWSYM]): 523-523.

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Monolithic Millimeter Wave CPW Circuits

M. Riaziat, E. Par, G. Zdasiuk, S. Bandy and M. Glenn. "Monolithic Millimeter Wave CPW Circuits." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 525-528.

Three monolithic circuits were designed and fabricated on GaAs substrates using CPW transmission lines. These circuits consist of two amplifiers and a frequency doubler, and demonstrate the application of CPW in the Ka band. The active device used in these circuits is a 0.25µm gate AlGaAs HEMT defined by E-beam lithography. Transmission line and substrate dimensions are chosen to avoid interaction with extraneous modes.

A Monolithic Variable Gain Ku-Band LNA

R.D. Eppich and D.D. Heston. "A Monolithic Variable Gain Ku-Band LNA." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 529-532.

A monolithic four-stage low noise amplifier (LNA) has demonstrated over 25 dB gain with gain control exceeding 30 dB and less than 3.5 dB noise figure from 14 GHz to 17 GHz. Single-gate FETs (SGFETs) provide minimum noise figure in the two input stages while dual-gate FETs (DGFETs) In the output stages contribute enhanced gain with gain control. Gain control is achieved without degradation in either input or output VSWR.

Ka-Band Monolithic Broadband LNA Modules

N. Camilleri and P. Chye. "Ka-Band Monolithic Broadband LNA Modules." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 533-536.

A set of broadband monolithic GaAs MESFET low noise amplifiers (LNAs) have been developed. These Ka-band amplifiers make use of state of the art sub .25 µm MESFET devices. Typical performance for a single stage LNA using a 75µm device is about 5 dB of gain with an average noise figure of 4.5 dB across the 26.5 to 40 GHz band. A two stage monolithic chip has 10 dB of gain with an average noise figure of 6 dB across the Ka-band.

A GaAs HBT Monolithic Logarithmic IF (0.5 to 1.5 GHz) Amplifier with 60 dB Dynamic Range and 400 mW Power Consumption

G.M. Gorman, A.K. Oki, E.M. Mrozek, J.B. Camou, D.K. Umemoto and M.E. Kim. "A GaAs HBT Monolithic Logarithmic IF (0.5 to 1.5 GHz) Amplifier with 60 dB Dynamic Range and 400 mW Power Consumption." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 537-540.

A GaAs/AlGaAs HBT monolithic successive-detection logarithmic IF amplifier (SDLA) is described which demonstrates significant reduction in size and power consumption over state-of-the art Si bipolar and GaAs MESFET log amps with comparable dynamic range and IF bandwidth. This work was motivated by electronic warfare channelized receiver applications in which size, power, and cost are key drivers. The GaAs HBT SDLA log amp achieves single-chip (1.2x2.4 mm²) dynamic range >60 dB (-55 to +5 dBm) with <±1dB error over 1 GHz IF bandwidth at temperatures up to 125°C while consuming less than 400 mW of power.

An L-Band Temperature Compensated Ultra Low Power Successive Detection Logarithmic Amplifier

R. Michels, N. Scheinberg and J. Gluck. "An L-Band Temperature Compensated Ultra Low Power Successive Detection Logarithmic Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 541-544.

This paper describes a temperature compensated L-band GaAs MMIC successive detection logarithmic amplifier (SDLA) featuring ultra low power consumption. Log-linearity of ±2.5 dB and a dynamic range of 60 dB was achieved over a 100 degree temperature range. This device shows no sacrifice of performance over larger, labor intensive hybrid MIC approaches.

Session N -- Microwave Properties of Superconductors (Focused Session)

"Session N -- Microwave Properties of Superconductors (Focused Session)." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 545-545.

New Experimental Results for Microwave Conductivity of High-TC Superconductors and Consequences for Applications to Linear Devices

H. Chaloupka, G. Muller, U. Klein and H. Piel. "New Experimental Results for Microwave Conductivity of High-TC Superconductors and Consequences for Applications to Linear Devices." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 547-550.

Experimental results for the surface impedance of the oxide superconductor YBa/sub 2/Cu/sub 3/O/sub 7/ in the frequency range from 3 to 90 GHz and the temperature range from 4.2 to 300 K are presented for single-crystalline and polycrystalline layers. Today the best results were achieved with a film grown epitaxially on SrTiO/sub 3/ by pulsed laser ablation leading to a surface resistance of less than 8 m Omega at 86.7 GHz and 77 K. Therefore applications to microwave and millimeterwave components which require a much higher quality factor as realizable with normal conductors or which have to be miniaturized by some orders of magnitude can be envisaged. Furthermore "inductive films" with "electronically tunable" properties may be realized.

Surface Impedance of High T/sub c/ Superconductors

L. Drabeck, J. Carini, G. Gruner, T.L. Hylton, A. Kapitulnik and M.R. Beasley. "Surface Impedance of High T/sub c/ Superconductors." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 551-554.

The surface impedance of various high temperature superconductors has been examined in the millimeter wave spectral range. The ceramic, thin film and single crystal samples are characterized by a residual surface resistance R/sub s/(T--> O) and a temperature dependent contribution R/sub s/(T). R/sub s/(T--> O) is accounted for by a model of Josephson coupled grains. The surface resistance exceeds the Mattis-Bardeen limit in both ceramic and thin film specimens.

Abstracts

Dielectric Resonator Used as a Probe for High Tc Superconductor Measurements

S.J. Fiedziuszko and P.D. Heidmann. "Dielectric Resonator Used as a Probe for High Tc Superconductor Measurements." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 555-558.

A novel probe for high Tc superconductor measurements based on the post dielectric resonator is described. Advantages of the device and the method of measurements include high sensitivity, simplicity, ability to measure small superconductor samples and nondestructive measurements of selected areas of larger samples including thin film superconductors. The technique and selected results are presented.

Microwave Surface Resistance Measurement Technique for Cylindrical High-Tc Superconductor

K. Aida and T. Ono. "Microwave Surface Resistance Measurement Technique for Cylindrical High-Tc Superconductor." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 559-562.

A surface resistance measurement method is investigated using an open-circuit terminated cavity constructed from a shielded pair comprising two cylindrical conductors as a specimen. The accuracy is confirmed by measuring copper specimens. High-Tc YBaCuO superconductor surface resistances are evaluated from 1 to 8 GHz.

Abstracts

Session O -- Computer-Aided Modeling and Design of Active Circuits

"Session O -- Computer-Aided Modeling and Design of Active Circuits." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 563-563.

Computer-Aided Design of MESFET Distributed Amplifier

M.-K. Vai and S. Prasad. "Computer-Aided Design of MESFET Distributed Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 565-568.

An automatic CAD procedure for the design of a MESFET distributed amplifier is described. This procedure is based on a novel design method called design-by-simulation. A combinatorial optimization process called simulated annealing is applied in this design procedure to provide information about the number of stages, the MESFET model parameters, and the characteristics of microstrips used for matching networks in an amplifier which matches the desired frequency response. This procedure is fully automatic and the only input needed is the desired gain and the 1-dB point.

Abstracts

FET Power Performance Prediction Using a Linearized Device Model

H. Kondoh. "FET Power Performance Prediction Using a Linearized Device Model." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 569-572.

A new model has been developed which, based on a linearized device model, describes the power output at 1 dB gain compression, optimum load impedance and load-pull contours of a FET explicitly in terms of device parameters. Applications of the model to practical devices including commercial MESFET's and a 0.25um-gate MODFET showed agreement with measurements to 40GHz.

A Large Signal Physical MESFET Model for CAD and its Applications

R.R. Pantoja, M.J. Howes, J.R. Richardson and C.M. Snowden. "A Large Signal Physical MESFET Model for CAD and its Applications." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 573-576.

A quasi-static, large-signal MESFET circuit model has been developed. It is based on a comprehensive quasi-two-dimensional semi-classical device physical simulation where its unique formulation and efficiency makes it suitable for the CAD of nonlinear MESFET subsystems. A single/two-tone harmonic balance analysis procedure which employs the describing frequency concept has also been developed and combined with the MESFET model. Numerical load-pull contours, as well as intermodulation distortion contours, have been simulated and comparing these with measured results substantiates the approach taken.

Efficient Large-Signal FET Parameter Extraction Using Harmonics (1989 Vol. II [MWSYM])

J.W. Bandler, Q.J. Zhang, S. Ye and S.H. Chen. "Efficient Large-Signal FET Parameter Extraction Using Harmonics (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 577-580.

We present a novel approach to large-signal nonlinear parameter extraction of GaAs MESFET devices measured under harmonic conditions. Powerful nonlinear adjoint-based optimization simultaneously processes multi-bias, multi-power-input, multi-fundamental-frequency excitations and multi-harmonic measurements to uniquely reveal the parameters of the intrinsic FET. One test successfully processed 111 error functions of 20 model parameters. The technique has been implemented in a new program called HarPE.

Waveform-Balance Method for Nonlinear MESFET Amplifier Simulation

V.D. Hwang and T. Itoh. "Waveform-Balance Method for Nonlinear MESFET Amplifier Simulation." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 581-584.

A new algorithm for the analysis of a nonlinear MESFET amplifier is presented. The algorithm is a hybrid method which uses both time and frequency domain analysis. However, unlike the Harmonic Balance method, the solution is optimized in the time domain where the EXACT error gradient matrix is calculated. The new method is shown to have excellent convergence speed and accuracy.

Computer-Aided Design of Class-C Microwave Transistor Amplifiers by Direct Numerical Optimization

V. Rizzoli, C. Cecchetti and A. Costanzo. "Computer-Aided Design of Class-C Microwave Transistor Amplifiers by Direct Numerical Optimization." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 585-588.

In this paper we outline a straightforward procedure for microwave class-C amplifier design. We first discuss an empirical bipolar junction transistor model of an enhanced Ebers-Moll type, allowing an accurate simulation of the device performance in the power saturation region. We then describe the use of this model in conjunction with a general-purpose harmonic-balance simulator, to provide a direct numerical optimization capability for the class-C amplifier. Finally, as an illustrative example, we report on the simulation of a practical MIC amplifier built on teflon-fiberglass substrate.

Session P -- Advanced Filter Technology

"Session P -- Advanced Filter Technology." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 589-589.

Dielectric Receiving Filter with Sharp Stop Band Using Active Feedback Resonator Method for Cellular Base Stations (1989 Vol. II [MWSYM])

Y. Ishikawa, T. Nishikawa, J. Hattori and K. Wakino. "Dielectric Receiving Filter with Sharp Stop Band Using Active Feedback Resonator Method for Cellular Base Stations (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 591-594.

800MHz band dielectric receiving filter with sharp stopband has been developed. By using the active feedback resonator method, unloaded Q of resonator having 1500 was raised to over 50000. And small size active bandstop filter with high rejection was obtained. Center frequency is 845.75MHz stopband width is 1.0MHz, and attenuation is 30dB. Physical size is 55x180x25mm.

Notch Filters with Variable Center Frequency and Attenuation

S. Toyoda. "Notch Filters with Variable Center Frequency and Attenuation." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 595-598.

This paper describes notch filters whose center frequencies and the maximum attenuation are variable. Three different types of the filters using varactor diodes and GaAs FETs are proposed and tested at 2 - 4 GHz bands. The tunability over 2.2 - 4 GHz is obtained by changing the junction capacitances of varactor diodes, and the maximum attenuation over 15 - 60 dB is obtained by changing the inner resistances of FETs.

A New Class of E-Plane Integrated Millimeter-Wave Filters

J. Bornemann. "A New Class of E-Plane Integrated Millimeter-Wave Filters." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 599-602.

A new class of E-plane integrated circuit millimeter-wave bandpass filters is introduced which provide high skirt selectivity by comprising inductively coupled stop-band sections. The structure is simple, fully compatible with the E-plane manufacturing process, and does not require fine tuning elements. The design procedure is based on an efficient but rigorous modal S-matrix method including higher-order mode interactions and finite metallization thicknesses. Optimized design data are presented for 33 and 94 GHz in Ka- and W-band, respectively.

Rigorous Design of Evanescent-Mode E-Plane Finned Waveguide Bandpass Filters

J. Bornemann and F. Arndt. "Rigorous Design of Evanescent-Mode E-Plane Finned Waveguide Bandpass Filters." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 603-606.

This paper presents a new design of compact, low-cost and low-insertion loss evanescent-mode waveguide bandpass filters with bilateral metallic E-plane fins. Based on the modal scattering matrix method, the rigorous design takes into account the influences of both, the finite fin thickness and the higher-order mode interaction at all discontinuities. Computer optimized design data are given for filters with passbands in the X- and the E-band with wide stopbands. The theory is verified by measurements.

Session Q -- European Microwave Session

"Session Q -- European Microwave Session." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 607-607.

Recent European Developments in Active Microwave Imaging

J.C. Bolomey. "Recent European Developments in Active Microwave Imaging." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 609-612.

At the beginning of the 80's, research programs devoted to short range active microwave imaging have been initiated in Europe. Since that time, a permanent research effort has been organized and oriented toward the development of microwave imaging equipments for industrial and medical applications. This effort has been conducted within the frame of national or european cooperation programs. This paper presents some representative results which have been obtained during the last decade and the general trends concerning their continuation and extension in the next few years. Whithout underestimating theoretical aspects and their importance for further evolutions of microwave imaging techniques, a special emphasis has been given to equipments which provide the real measure of the impact of the recently developed microwave imaging technologies in a growing field of applications.

Modeling of Microwave and Millimeter Wave Passive Components in Europe

R. Sorrentino. "Modeling of Microwave and Millimeter Wave Passive Components in Europe." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 613-616.

This paper reviews some of the most significant contributions of European research groups to the modeling of passive microwave and millimeter wave components. Rather than to the components themselves, the attention is focused on the methodologies for modeling the various types of components, including hybrid and monolithic integrated circuits as well as conventional structures.

Click on title for a complete paper.

Solid-State Local Oscillator Sources for Millimeter and Submillimeter Waves in Europa

A.V. Raisanen. "Solid-State Local Oscillator Sources for Millimeter and Submillimeter Waves in Europa." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 617-620.

This paper gives an overview of the European activities in developing solid-state local oscillator sources for high millimeter and submillimeter frequencies. Radio astronomy with ground based telescopes has conventionally been the driving force in this area. Projects funded by the European Space Agency and national space agencies aiming to spaceborne radio astronomy and remote sensing of the atmosphere have recently given more impetus for this research.

Abstracts

Session R -- Microwave Applications of Superconductors (Focused Session)

"Session R -- Microwave Applications of Superconductors (Focused Session)." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 621-621.

Experiments with a 31-cm High-T/sub c/ Superconducting Thin Film Transmission Line

L.A. Hornak, M. Hatamian, S.K. Tewksbury, E.G. Burkhardt, R.E. Howard, P.M. Mankiewich, B.L. Straughn and C.D. Brandle. "Experiments with a 31-cm High-T/sub c/ Superconducting Thin Film Transmission Line." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 623-626.

Electrical time domain measurements and transmission response measurements were made using a 31 cm long, YBaCuO superconducting thin film microstrip line and a YBaCuO ground plane, each on separate 1 cm LaGa0/sub 3/ substrates, with a 125 µm sapphire substrate serving as the dielectric insulator. Degradation of the performance of the line for currents up to the critical current density and for magnetic fields moderately above the lower critical magnetic field H/sub C1/ were evaluated in a variety of simple measurements.

Superconducting Stripline Resonators and High-T/sub c/ Materials

D.E. Oates, A.C. Anderson and B.S. Shih. "Superconducting Stripline Resonators and High-T/sub c/ Materials." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 627-630.

The use of high-transition-temperature (T/sub c/) superconducting resonators to stabilize oscillators operating between 1 and 10 GHz is discussed. Measurements of surface resistance are presented and related to resonator quality factor (Q). Projections of resonator Q and oscillator phase noise are discussed. Improved materials should offer greater than 20 dB reduction in noise over competing technology. The implications of flicker noise in reaching this level of performance are discussed, and preliminary measurements of flicker noise in the high-T/sub c/ materials are reported.

A 77 K Computer Controlled mm Wave Spectral Josephson Detector Using Microstrip Technique, Preliminary Results

M. Daginnus and J.H. Hinken. "A 77 K Computer Controlled mm Wave Spectral Josephson Detector Using Microstrip Technique, Preliminary Results." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 631-634.

Superconducting granular bridges of Y-Ba-Cu-O show the ac Josephson effect. A spectral detector is built up with a granular bridge as the sensor, which is coupled to a microstrip line. The device is operated in the millimeter wave range (Ka-band) in liquid nitrogen at a temperature of 77 Kelvin.

Abstracts

Microwave Detectors Based on Granular High-Tc Thin Films (1989 Vol. II [MWSYM])

J. Konopka, R. Sobolewski, G. Jung, W. Kula, A. Konopka, P. Gierlowski and S.J. Lewandowski. "Microwave Detectors Based on Granular High-Tc Thin Films (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 635-638.

Detecting and mixing properties of superconducting YBCO and BCSCO granular thin film structures have been investigated. The microstrips were deposited on various substrates by two different techniques. Device performance has been tested in 25, 55 and 110 GHz bands and temperature range from 50 to 80K. Detectors response was bias and temperature dependent. The mixing experiments were performed in 25 GHz frequency band. The i.f. frequency was varied from 50 MHz to 5 GHz without any decrease in the mixer output up to 3 GHz. YBCO and BCSCO thin film devices are operational in temperature range from T = Tc-10K to about 50K. The lower limit is imposed by quantum effects which render erratic the output signal. Although the mechanism responsible for the detecting and mixing properties have not been positively identified, the auxiliary emission measurements performed at 12 GHz and down to 4.2K revealed that low temperature performance limit is associated with Josephson radiation from weak-link clusters composed of multi-loop quantum interferometers.

Superconducting Frequency Tunable SAW Filter and Dispersion Line

H.-P. Baum, B.K. Sarma and M. Levy. "Superconducting Frequency Tunable SAW Filter and Dispersion Line." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 639-641.

The superconducting transition of a thin film with a high sheet resistivity can change the attenuation of surface acoustic waves (SAW) by as much as 30 dB/cm at 700 MHz. This effect could be used to produce variable bandwidth SAW filters, RAC (Reflective Array Compressors) dispersion lines, and switches in SAW delay lines.

Session S -- CAD Methods

"Session S -- CAD Methods." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 643-643.

Parallel Processing Application to Non-Linear Microwave Network Design (1989 Vol. II [MWSYM])

M.I. Sobhy and Y.A.R. El-Sawy. "Parallel Processing Application to Non-Linear Microwave Network Design (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 645-648.

One of the objectives of this paper is to introduce microwave network designers to an important new development in computer-aided design techniques. The paper describes how parallel processing is applied to the CAD of non-linear microwave circuits. The advantage of parallel processing is the significant reduction in computational time such that optimisation becomes feasible even on a desk-top computer. The developed programs run on an AT desk-top with a transputer board capable of concurrent processing speeds of over 40 MIPS. A new representation of microwave and non-linear circuits has been developed to suit the required parallelism. Applications to the analysis of non-linear amplifiers, frequency multipliers and microwave mixers are described.

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Yield Optimization of Nonlinear Circuits with Statistically Characterized Devices

J.W. Bandler, Q.J. Zhang, J. Song and R.M. Biernacki. "Yield Optimization of Nonlinear Circuits with Statistically Characterized Devices." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 649-652.

A comprehensive treatment of yield optimization of nonlinear microwave circuits with statistically characterized devices is proposed. We fully exploit advanced techniques of one-sided l/sub 1/ circuit centering with gradient approximations, and efficient harmonic balance simulation with exact Jacobians. Multidimensional statistical distributions of the intrinsic and parasitic parameters of FETs are fully handled. Yield is driven from 25% to 61% for a frequency doubler design having 34 statistically toleranced parameters. Yield of a small-signal amplifier is increased from 36% to 68%.

The Generalized Method of Characteristics for Waveform Relaxation Analysis of Lossy Coupled Transmission Lines (1989 Vol. II [MWSYM])

F.-Y. Chang. "The Generalized Method of Characteristics for Waveform Relaxation Analysis of Lossy Coupled Transmission Lines (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 653-656.

Transient response of lossy coupled transmission lines is simulated by iterative waveform relaxation analyses of equivalent disjoint networks constructed with congruence transformers, FFT waveform generators and characteristic impedances synthesized by the Pade approximation. A phenomenal two order reduction of CPU time and one order savings in computer memory have been achieved. A lossy directional coupler is simulated for illustration.

Considering Some Undesired Effects Due to Dense Packing in Supported Coplanar Waveguide MMICs by Using Combined Methods

I. Wolff, D. Kiefer and S.S. Bedair. "Considering Some Undesired Effects Due to Dense Packing in Supported Coplanar Waveguide MMICs by Using Combined Methods." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 657-660.

Combined methods are used to predict some undesired effects due to dense packing in supported coplanar waveguide monolithic microwave integrated circuits (MMICs). These include, the effects due to the presence of an adjacent grounded side wall or the presence of another adjacent line. The presented information can either be used to consider these effects during the design stage or to help in designing MMICs in which these effects can be ignored. Numerical results are also presented in order to demonstrate these effects.

Computer Aided Design of Square Spiral Transformers and Inductors

E. Frlan, S. Meszaros, M. Cuhaci and J.S. Wight. "Computer Aided Design of Square Spiral Transformers and Inductors." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 661-664.

A simple, yet accurate, lumped element model for four-port planar rectangular spiral structures has been developed. Closed form expressions were used to generate frequency dependent parameter values, resulting in an equivalent circuit which is easily incorporated into existing analysis packages. The technique has been applied to standard and centre-tapped transformer configurations, and has also been modified to accurately analyze spiral inductors to 20 GHz. Comparison with measured results has shown good agreement up to the first resonant frequency of the structures.

Abstracts

Session T -- Filter Applications

"Session T -- Filter Applications." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 665-665.

Click on title for a complete paper.

Miniaturized Hair-Pin Resonator Filters and Their Applications to Receiver Front-End MICs (1989 Vol. II [MWSYM])

K. Takahashi, M. Sagawa and M. Makimoto. "Miniaturized Hair-Pin Resonator Filters and Their Applications to Receiver Front-End MICs (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 667-670.

This paper describes the newly-developed miniaturized hair-pin resonator filters suitable for microwave integrated circuits (MICs). The size of the experimental filters has been reduced to one-half of the conventional hair-pin resonater filter, without increasing insertion losses. Trial receiver front-end MICs using these filters have also been developed and shown good characteristics, such as low noise and high image suppression ratio.

Thin-Film Lumped-Element Microwave Filters

D. Swanson. "Thin-Film Lumped-Element Microwave Filters." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 671-674.

A method for the design and construction of thin-film lumped-element microwave filters is presented. The resulting filters exhibit broad spurious-free stopbands, small physical size, excellent amplitude and phase match, and high reliability due to their thin film construction. The necessary models for inductors and capacitors are discussed.

Logarithmic-Periodic Contiguous-Channel Microwave Multiplexers

C. Rauscher. "Logarithmic-Periodic Contiguous-Channel Microwave Multiplexers." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 675-678.

The issue pursued in this study is the applicability of logarithmic-periodic principles to the design of microwave multi-port networks. It is demonstrated, in particular, how such principles can be put to use in solving microwave multiplexing problems. Practicability of the approach is illustrated with the help of two five-channel contiguous-band multiplexer designs and an experimental realization of one of these circuits covering most of C- and X-band. The experimental circuit is believed to represent the first successfully implemented and reported logarithmic-periodic microwave multi-port circuit.

Click on title for a complete paper.

Capacitively Compensated High Performance Parallel Coupled Microstrip Filters

I.J. Bahl. "Capacitively Compensated High Performance Parallel Coupled Microstrip Filters." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 679-682.

A capacitive compensation technique is described for the design of microstrip parallel coupled filters with improved passband symmetry and very low spurious response up to 2.5 times the center frequency. The technique is useful for the design of filters on alumina as well as GaAs substrates.

Satellite L-Band Output Multiplexer Utilizing Single and Dual Mode Dielectric Resonators

S.J. Fiedziuszko, D. Doust and S. Holme. "Satellite L-Band Output Multiplexer Utilizing Single and Dual Mode Dielectric Resonators." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 683-686.

A four-channel, contiguous band output multiplexer for L-band satellite applications is described. The filters feature single and dual mode dielectric resonators and operate at power levels up to 13 Watts in vacuum. The design of the multiplexer was optimized to meet different requirements for each of the filters. Excellent electrical performance in a relatively small package was obtained by use of high performance dielectric resonators and a coaxial line combiner.

Abstracts

Session U -- Lightwave Links

"Session U -- Lightwave Links." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 687-687.

Click on title for a complete paper.

A Theoretical and Experimental Comparison of Directly and Externally Modulated Fiber-Optic Links

C.H. Cox, III, L.M. Johnson and G.E. Betts. "A Theoretical and Experimental Comparison of Directly and Externally Modulated Fiber-Optic Links." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 689-692.

Analytic models of directly and externally modulated fiber-optic links have been derived and experimentally confirmed. The models have been employed to optimize the operating parameters of fiber-optic links. Experimental measurements on these optimized links indicated net incremental link power gains of +3 dB for direct modulation and +11 dB for external modulation. The implications of these optimization on other measures of link performance, such as bandwidth and noise figure, are also presented.

Long Microwave Delay Fiber Optic Link for Radar Testing

I.L. Newberg, C.M. Gee, G.D. Thurmond and H.W. Yen. "Long Microwave Delay Fiber Optic Link for Radar Testing." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 693-696.

A unique application of a long fiber optic delay line as a radar repeater to improve radar testing capabilities is described. Using a 31.6 kilometer long experimental externally modulated fiber optic link with a DFB laser, we demonstrated the first known generation of 152 microsecond delayed ideal target at X-band (10 GHz) frequencies having the phase stability and signal-to-noise ratio (SNR) needed for testing modern high resolution Doppler radars.

Multi-Gigabit Fiber-Optic Video Distribution Network Using BPSK Microwave Subcarriers

D.D. Tang. "Multi-Gigabit Fiber-Optic Video Distribution Network Using BPSK Microwave Subcarriers." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 697-700.

This paper describes the design and performance of a field deployable fiber optic video distribution system using bi-phase-shift-keyed (BPSK) microwave subcarrier multiplexing (SCM) techniques to provide each subscriber with twenty 107 Mb/s digitized video signals and one 2.04 Mb/s voice/data signal, giving a total transport capacity of 2.144 Gb/s. The microwave subcarrier frequency covers the range from 1.9 GHz to 5.9 GHz. The 21 microwave subcarriers are multiplexed together to intensity modulate a high speed 1.3 µm single-mode laser dedicated to each subscriber. Each subscriber station is equipped with a high frequency PIN diode detector followed by microwave receivers. A bit-error rate of 10/sup -9/ is achieved at a laser modulation depth of 5% and a received optical power of -12 dBm.

Abstracts

Integrated Fiber Optic Transmission of FM HDTV and 622Mb/S Data

C.N. Lo and L.S. Smoot. "Integrated Fiber Optic Transmission of FM HDTV and 622Mb/S Data." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 703-704.

We report the integrated transmission of a 622 Mb/s (SONET STS-12 rate) data signal with three frequency-modulated (FM) component HDTV signals over 2 km of single-mode fiber. At -10 dBm received optical power a BER <10/sup -9/ was measured on the data channel while simultaneously, the unweighed signal/noise ratio (SNR) was over 38 dB for the HDTV signals.

Session V -- Analysis Methods for Guiding Structures

"Session V -- Analysis Methods for Guiding Structures." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 705-705.

Multiport Network Model for Evaluating Radiation Loss and Spurious Coupling Between Discontinuities in Microstrip Circuits

A. Sabban and K.C. Gupta. "Multiport Network Model for Evaluating Radiation Loss and Spurious Coupling Between Discontinuities in Microstrip Circuits." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 707-710.

This paper presents a convenient method for evaluating radiation from microstrip discontinuities. The multiport network model is used to find voltage distribution around discontinuity edges and an equivalent magnetic current model is used to compute the external fields produced. As an example, the results show that for a 90° bend in 50 Omega line on 10 mil thick substrate with epsilon/sub r/ = 2.2, the radiation loss is 0.1 dB at 30 GHz. Electromagnetic coupling between two discontinuities is evaluated by finding the currents induced by the fields of one of the discontinuities at the location of the second discontinuity.

Abstracts

A New Hybrid Mode Boundary Integral Method for Analysis of MMIC Waveguides with Complicated Crossection

W. Schroeder and I. Wolff. "A New Hybrid Mode Boundary Integral Method for Analysis of MMIC Waveguides with Complicated Crossection." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 711-714.

A boundary integral formulation for quasistatic, TE, TM and hybrid wave analysis of open or shielded waveguides with arbitrary multiregion crossection is presented. A special form of boundary integral equation is derived first to make possible the numerical treatment of cornered geometries. Subsequently operator equations including source terms are given for analysis of arbitrary 2-D structures. The numerical method is described shortly, including as example the quasistatic analysis of coplanar waveguide with non-rectangular conductor shape.

Click on title for a complete paper.

A Mixed Spectral Domain Method Applied to the Analysis of Generalized Dielectric-Loaded Ridged Waveguides

K.T. Ng and C.H. Chan. "A Mixed Spectral Domain Method Applied to the Analysis of Generalized Dielectric-Loaded Ridged Waveguides." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 715-717.

A new mixed spectral domain method is applied for the analysis of generalized dielectric-loaded ridged waveguides. Auxillary structures are constructed for formulating the spectral Green's functions and applying the spectral immittance method. Magnetic surface currents at apertures are identified as unknowns. Mixing different spectral domains existing on the two sides of an aperture in a spectral Galerkin approach leads to the characteristic equations required for the dispersion analysis. Representative results are obtained to illustrate the application of the method.

Characterization of Coupled Asymmetric Suspended Strip Lines Having Three Thick-Strip Conductors and Side-Wall Grooves

M. Nakajima and E. Yamashita. "Characterization of Coupled Asymmetric Suspended Strip Lines Having Three Thick-Strip Conductors and Side-Wall Grooves." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 719-722.

Coupled asymmetric suspended strip lines having three thick-strip conductors and side wall-grooves are characterized with the use of the rectangular boundary division method. An offset broad-side coupling device and a control device of edge coupling with the use of the third strip conductor are discussed as important applications.

Session W -- Millimeter-Wave Source Technology

"Session W -- Millimeter-Wave Source Technology." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 723-723.

25-42 GHz GaAs Heterojunction Bipolar Transistor Low Phase Noise Push-Push VCOs

D.M. Smith, J.C. Canyon and D.L. Tait. "25-42 GHz GaAs Heterojunction Bipolar Transistor Low Phase Noise Push-Push VCOs." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 725-728.

Two Push-push thin-film VCOs utilizing GaAs/AIGaAs Heterojunction Bipolar Transistors (HBT) that cover the 25 - 42 GHz frequency range are presented. Key features of the designs are: Greater than 33% continuous tuning bandwidth, SSB phase noise less than -70 dBc/Hz at 100 kHz offset, and better than -90 dBc fundamental spur suppression.

MMIC-Compatible 55 mW InP and GaAs 30 - 40 GHz Field Controlled TE-Oscillators

K. Lubke, H. Scheiber, D. Grutzmacher, C. Diskus and H. Thim. "MMIC-Compatible 55 mW InP and GaAs 30 - 40 GHz Field Controlled TE-Oscillators." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 729-730.

55 mW 34 GHz InP, 56 mW 29 GHz GaAs and 39 mW 37 GHz GaAs lateral MMIC-compatible transferred electron oscillators with MESFET injection contacts have been fabricated exhibiting 2.9%, 5.3% and 4.9% efficiencies, respectively. CW power levels are somewhat lower (30 mW). The achieved power levels are the highest ever obtained with lateral TEOs and FET-oscillators.

Design and Performance of a 94 GHz HEMT Mixer

P.D. Chow, D. Garske, J. Velebir, E. Hsieh, Y.C. Ngan and H.C. Yen. "Design and Performance of a 94 GHz HEMT Mixer." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 731-734.

A 94 GHz HEMT mixer was designed and fabricated using 0.1 µm gate HEMT device and hybrid MIC circuit. The mixer downconverts the 92-96 GHz RF to a 8-12 GHz IF. At 4-dBm LO drive, the mixer showed 5.8 dB conversion loss, 12.4 dB noise figure, and -3.2 dBm input power at the 1-dB gain compression point.

Theory of Subharmonic Synchronization of Nonlinear Oscillators

A.S. Daryoush, T. Berceli, R. Saedi, P.R. Herczfeld and A. Rosen. "Theory of Subharmonic Synchronization of Nonlinear Oscillators." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 735-738.

Synchronization is an important technique to provide frequency coherency of remotely located independent oscillators to the same frequency reference. To extend this technique to the millimeter wave frequencies of interest, subharmonic injection locking is used as a viable technique. This attractive method primarily relies on nonlinear characteristics of microwave devices, such as FET, to extend injection locking of millimeter wave oscillators to large subharmonic numbers. Important figure of merit of injection locked oscillators is locking range, and goal of this paper is to present analytical method to express locking range of the subharmonically locked oscillators in terms of nonlinear current voltage relationship. Experimental results of a subharmonically injection locked FET oscillator at 18GHz are also presented.

Abstracts

Monolithic IMPATT Millimeter-Wave Oscillator Stabilized by Open-Cavity Resonator

W.P. Shillue, S.-C. Wong and K.D. Stephan. "Monolithic IMPATT Millimeter-Wave Oscillator Stabilized by Open-Cavity Resonator." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 739-740.

A monolithic IMPATT oscillator operating in the 50 GHz region has been controlled in frequency in an open microwave resonator. Also, the noise spectrum of the oscillator in a closed quasi-optical cavity showed substantial improvement when compared to oscillation in free-space. These results show that monolithic circuits are compatible with open resonator techniques, and can lead to improved monolithic oscillator stability.

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Session X -- Special Session in Honor of Dr. Seymour B. Cohn

"Session X -- Special Session in Honor of Dr. Seymour B. Cohn." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 741-741.

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An Admirable Microwave Engineer

K. Tomiyasu. "An Admirable Microwave Engineer." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 743-748.

In 1944 while taking a course on electromagnetics taught by Professor Ronold W. P. King at Harvard University, I barely noticed a quiet, unassuming, serious student. Later, I learned that his name was Seymour B. Cohn, a part-time student who was employed at the Radio Research Laboratory (RRL) in Cambridge, MA under the directorship of Dr. Frederick E. Terman. In 1948 Seymour received the PhD degree from Harvard and his dissertation dealt with ridge waveguide. This topic was important to RRL because of its application to wideband countermeasures.

Abstracts

The Rantec Years - Dr. Seymour B. Cohn (1960 to 1967)

W.H. Harrison. "The Rantec Years - Dr. Seymour B. Cohn (1960 to 1967)." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 749-751.

Dr. Cohn's research efforts have resulted in major contributions to the microwave community. The broad scope of his work includes design concepts for numerous types of filters, couplers, multiplexers, and even test equipment used to more accurately measure the devices he designed. His papers on these subjects are always outstanding because they provide detailed practical information easily used by design engineers, i.e., well defined concepts and methods. This paper describes a small part of his activities as Vice President and Technical Director during the Rantec period (1960-1967) as reported by this engineer and friend. His equally successful family life is also mentioned.

Novel Contributions to Microwave Circuit Design

J.K. Hunton. "Novel Contributions to Microwave Circuit Design." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 753-755.

Dr. S. B. Cohn's work in two areas is described. One is slot line which he introduced in 1968. The other is circuit design by equal ripple optimization which appeared in a 1974 paper.

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S.B. Cohn Reference List (1989 Vol. II [MWSYM])

"S.B. Cohn Reference List (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 757-758.

Abstracts

Session Y -- Manufacturing Microwave Components and Subsystems

"Session Y -- Manufacturing Microwave Components and Subsystems." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 759-759.

Excellent Reliability with High Throughput Techniques and Materials for Alloy Attachment

J.S. Pavio. "Excellent Reliability with High Throughput Techniques and Materials for Alloy Attachment." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 761-764.

Although device alloy attachment has received considerable study in recent years due to increasing requirements for high power performance, secondary and tertiary levels of attachment have received scant attention. Yet, their reliability is key to the performance of each microwave module, and critical to the reliability of the solder system as a whole. An evaluation is presented which comprehensively examines alloys which can be utilized for secondary attachment in microwave modules. After reflow, the evaluation cycle encompassed a 168 hour bake operation, thermal cycling and mechanical vibration and shock. The samples were x-rayed, examined visually for wetting anomalies, and microsectioned to analyze intermetallic formation. All alloys tested were reflowed without flux in a reducing atmosphere reflow furnace, a high throughput process clearly amenable to high volume production.

Abstracts

An Automated Technique for Post Production Tuning of Microwave Circuits

E.C. Gomiuho. "An Automated Technique for Post Production Tuning of Microwave Circuits." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 765-767.

Tuning, in the form of physical adjustments to microstrip matching networks, is needed for most microwave circuits to meet today's state of the art performance requirements. This is because there is only so much that can be done in the design phase to account for the effects of tolerance variations and parasitics in the components that make up the circuit, and manufacturing variations in assembly and etching of the circuiy itself. Presently circuit adjustments are performed manually by highly skilled technicians who must probe the circuit, measure its resulting response and determine how to modify the circuit elements for best overall performance. This iterative process is empirical in nature and consequently highly dependent on the experience level of the technician and his learning skills. It is for most circuits a very time-consuming and therefore costly part of the production cycle.The tuning technique presented in this paper removes the empirical element from the production cycle and, through automation, expedites and standardizes the circuit alteration process. It therefore provides for reduced tuning time and improved repeatability and producibility of microwave circuits. This technique can be used in a semi-automated mode, with a computer instructing the technician on how to modify the circuit for optimum performance, or as a fully automated workstation with a laser and a robot working per instructions from the said computer. A description of the technique as well as application data are included in this paper. Data is provided for a single stage L band power amplifier tuned in the automated workstation and for a four stage X band amplifier tuned using the computer-aided approach.

High Volume Manufacturing of a High-Efficiency X-Band Power Module for Phased Array Applications

J.L. Vorhaus. "High Volume Manufacturing of a High-Efficiency X-Band Power Module for Phased Array Applications." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 769-772.

This paper describes the production of a state-of-the-art microwave power module for use in active aperture phased-array radar transmit/receive (T/R) modules. More than 2000 modules have been manufactured to date at rates exceeding 100 modules per week. The production process will be described in detail with particular attention given to the issues relating to large volume manufacturing of microwave power circuits.

Abstracts

Microwave Amplifier Manufacturing with Advanced Thin-Film MIC and Elementary MMIC Technology

E.J. Crescenzi, Jr., S.E. Beam, R.L. Fenton, T.R. Kritzer and T.A. Maddox. "Microwave Amplifier Manufacturing with Advanced Thin-Film MIC and Elementary MMIC Technology." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 773-776.

New thin-film MIC processes, a coined carrier, and elementary MMIC devices are applied to construct amplifier modules with only five parts. Costs are significantly reduced while maintaining performance and insertion equivalence with conventional circuits. The approach offers an attractive alternative to classic MIC and pure MMIC realizations.

Session Z -- Leakage and Package-Mode Effects in Millimeter-Wave IC's

"Session Z -- Leakage and Package-Mode Effects in Millimeter-Wave IC's." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 777-777.

Full-Wave Theory Based Development of mm-Wave Circuit Models for Microstrip Open End, Gap, Step, Bend and Tee

R.H. Jansen and L. Wiemer. "Full-Wave Theory Based Development of mm-Wave Circuit Models for Microstrip Open End, Gap, Step, Bend and Tee." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 779-782.

Millimeter-wave discontinuity circuit models have been developed on the base of systematic full-wave data generated by a rigorous numerical approach. The applied physics - related and topology - sensitive modeling concept is new and extends previous quasi-static descriptions into dynamic ones including parasitic wave coupling and package resonances.

Printed-Circuit Waveguides with Anisotropic Substrates: A New Leakage Effect

M. Tsuji, H. Shigesawa and A.A. Oliner. "Printed-Circuit Waveguides with Anisotropic Substrates: A New Leakage Effect." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 783-786.

A new class of power leakage effects has been found for the dominant mode on uniform printed-circuit waveguides when anisotropic dielectric materials are used as substrates. We demonstrate both from physical reasoning and by accurate quantitative calculations that above a certain critical frequency the dominant mode on uniform printed-circuit waveguides, such as microstrip line, slot line or coplanar waveguide (whether of finite or infinite width), on suitable anisotropic substrates will leak power into surface waves on the substrate, and that the maximum leakage rate can be rather large. This power leakage is a qualitatively new effect, reported here for the first time, and is entirely distinct from the leakage or radiation into surface waves that occurs at junctions or discontinuities on the line.

Rigorous Analysis of Open Microstrip Lines of Arbitrary Cross-Section in Bound and Leaky Regimes (1989 Vol. II [MWSYM])

K.A. Michalski and D. Zheng. "Rigorous Analysis of Open Microstrip Lines of Arbitrary Cross-Section in Bound and Leaky Regimes (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 787-790.

The problem of a microstrip line of arbitrary cross-section is solved by an integral equation technique in conjunction with the method of moments. The approach is general and can handle as special cases multiple strips and strips of finite or infinitesimal thickness. It applies to both the fundamental and higher-order modes, whether in the bound or leaky regime. Computed dispersion curves and modal current distributions are presented for several cases of interest and, where possible, are compared with published data.

Analysis of Radiating End Effects of Symmetric and Asymmetric Coplanar Waveguide Using Integral Equations Technique

M. Drissi, V.F. Hanna and J. Citerne. "Analysis of Radiating End Effects of Symmetric and Asymmetric Coplanar Waveguide Using Integral Equations Technique." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 791-794.

An integral equation technique solved by the moment method associated with the single one-port model is used to analyse radiating end effects of symmetric and asymmetric coplanar waveguides (CPW). Theoretical results obtained on a short circuit end of CPW are compared with those obtained experimentally using series-gap-coupled straight CPW resonators.

Abstracts

Theoretically Zero-Loss Design of Planar Dielectric Waveguide Y-Branch: Amazing Effect of Surpentine-Shaped Taper

H. Shigesawa, M. Tsuji and O. Tanaka. "Theoretically Zero-Loss Design of Planar Dielectric Waveguide Y-Branch: Amazing Effect of Surpentine-Shaped Taper." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 795-798.

A new methodology is proposed for designing planar dielectric-waveguide Y-branch with theoretical zero-loss due to radiation, which designs its taper section so as to control intentionally the intensive power conversion and reconversion between the surface-wave mode and the radiation wave, thereby transforming the input surface-wave mode only into the desired surface-wave mode on the output waveguide, while suppressing the undesired reflection at the input end. The effectiveness of our idea is confirmed by comparing numerical results with those of usual type of Y-branches and also with some measurements that we took.

Session AA -- Millimeter-Wave Amplifier Technology

"Session AA -- Millimeter-Wave Amplifier Technology." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 799-799.

Abstracts

High Performance V-Band Low Noise Amplifiers

S. Vaughn, K. White, U.K. Mishra, M.J. Delaney, P. Greiling and S. Rosenbaum. "High Performance V-Band Low Noise Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 801-804.

Significant advances in high frequency, low noise amplifier (LNA) performance have been achieved. Noise figures under 2.0 dB have been demonstrated with several single stage amplifiers incorporating devices from different wafers. These amplifiers utilized an Al/sub 0.48/In/sub 0.52/As-Ga/sub 0.47/In/0.53/sub/0.53/As lattice matched InP HEMT device with a gate periphery of 50 µm x .2 µm. Typical f/sub t/ of these devices are in excess of 120 GHz, with an extrinsic g/sub m/ of more than 900 mS/mm. The best results obtained by a single stage LNA was .8 dB, with an associated gain of 8.7 dB at 63.5 GHz. A 3-stage V-band amplifier produced a minimum noise figure of 2.6 dB, with 19.5 dB of gain at 61.0 GHz.

Abstracts

High-Performance InP-Based HEMT Millimeter-Wave Low-Noise Amplifiers

K.H.G. Duh, P.C. Chao, P. Ho, M.Y. Kao, P.M. Smith, J.M. Ballingall and A.A. Jabra. "High-Performance InP-Based HEMT Millimeter-Wave Low-Noise Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 805-808.

Quarter-micron InAlAs/InGaAs planar-doped HEMTs lattice-matched to InP developed in our laboratory have exhibited state-of-the-art noise and gain performance at frequencies up to 94 GHz. Minimum noise figures of 0.5, 1.2, and 2.1 dB have been measured at 18, 60, and 94 GHz, respectively. Small signal gains as high as 15.4 and 12.0 dB have also been obtained at 63 and 95 GHz, respectively. Using 0.25 µm InP-based HEMTs, a V-Band three-stage amplifier yields an average noise figure of 3.0 dB with a gain of 22.0 ± 0.2 dB from 60 to 65 GHz. At W-Band, a two-stage amplifier exhibits a noise figure of 4.5 dB with a gain of 10.2 dB at 90.4 GHz and a three-stage amplifier shows a noise figure of 4.8 dB with a gain of 15.0 dB at 90.4 GHz. These results clearly show the great potential of InP-based HEMTs for high performance millimeter-wave low noise receiver applications.

Q-Band Coplanar Waveguide Amplifier

G.S. Dow, T.N. Ton and K. Nakano. "Q-Band Coplanar Waveguide Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 809-812.

Q-band monolithic amplifiers using CPW (coplanar waveguide), GCPW (grounded coplanar waveguide), and MS (microstrip) structures were designed and RF evaluated. At 44 GHz, the CPW amplifier exhibited a gain of 7.5 dB and for the GCPW amplifier, the gain is 7.0 dB. These compare very favorably with the MS amplifier which has a gain of about 7.5 dB. This represents the first reported Q-band monolithic amplifier using CPW structure. These results are encouraging and show great promise of Millimeter-wave MMIC implementation using this structure.

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Millimeter-Wave Noise Parameters of High Performance HEMT's at 300 K and 17 K

S. Weinreb, R. Harris and M. Rothman. "Millimeter-Wave Noise Parameters of High Performance HEMT's at 300 K and 17 K." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 813-816.

Measurements at 43 GHz of the four noise parameters of very low-noise HEMT's fabricated at several laboratories are reported. The measurements are facilitated by tunable waveguide-to-microstrip transitions which present known, variable generator and load impedances to the device under test and are operable over a wide range of temperature.

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Possibility of Silicon Monolithic Millimeterwave Integrated Circuits

S.A. Campbell and A. Gopinath. "Possibility of Silicon Monolithic Millimeterwave Integrated Circuits." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 817-819.

Previous work on high resistivity silicon suggests that microstrip line dielectric losses cease to be significant above 30 GHz. Silicon-Germanium Heterojunction Bipolar Transistors now provide a well behaved three-terminal device capable of operating at microwave frequencies. The tradeoffs available to operate this device at millimeterwave frequencies are discussed, making the fabrication of Silicon Monolithic Millimeterwave Integrated Circuits a genuine possibility.

Abstracts

Session BB -- Microwave Integrated Circuit Measurements

"Session BB -- Microwave Integrated Circuit Measurements." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 821-821.

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A Non-Contacting Probe for Measurements on High-Frequency Planar Circuits

S.S. Osofsky and S.E. Schwarz. "A Non-Contacting Probe for Measurements on High-Frequency Planar Circuits." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 823-825.

A novel probe for internal measurements on high-frequency planar circuits has been designed and tested. It requires no electrical contact with the circuit and has little or no effect on the circuit under test. Amplitudes and phases of currents at arbitrary positions can be measured. Using microfabrication techniques, working probes have been constructed for measurements in the 26.5-40 GHz band. Performance characteristics and typical measurements will be described. Direct measurements obtained with these probes provide new information on internal circuit operation: The technique can also be applied to rapid production testing.

Accuracy Factors in Microwave Noise Parameter Measurements

A. Davidson, B. Leake and E. Strid. "Accuracy Factors in Microwave Noise Parameter Measurements." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 827-830.

Factors contributing to microwave noise parameter measurement accuracy are examined theoretically and experimentally. It is shown that the test source impedances needn't be grouped around the impedance for minimum noise. Calibration and DUT S-parameter accuracy is shown to be important to the noise parameter accuracy. A new algorithm has been implemented which corrects for different noise source "on" and "off" impedances.

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On-Wafer Large Signal Pulsed Measurements

J.F. Vidalou, F. Grossier, M. Camiade and J. Obregon. "On-Wafer Large Signal Pulsed Measurements." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 831-834.

Sophisticated design tools are now available for non-linear microwave circuit design. Many simulators have been developed and give reliable results. However, sometimes, predicted results differ from the experimental ones; the difference is generally due to a bad modeling of the active devices used.

Large-Signal Characterization of Millimeter-Wave Transistors Using an Active Load-Pull Measurement System

R. Actis, R.A. McMorran, R.A. Murphy, M.A. Hollis, R.W. Chick, C.O. Bozler and K.B. Nichols. "Large-Signal Characterization of Millimeter-Wave Transistors Using an Active Load-Pull Measurement System." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 835-838.

An automated measurement system is described for obtaining the load-pull characteristics of high speed transistors at millimeter-wave frequencies. The method uses "active tuning" to electronically vary the transistor output load impedance. The large-signal characteristics of an 8-by-20-µm permeable base transistor (PBT) have been measured with this method and applied to the design of a 27-mW PBT amplifier at 40.1 GHz.

Maps (1989 Vol. II [MWSYM])

"Maps (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): 839-839.

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Back Cover (1989 Vol. II [MWSYM])

"Back Cover (1989 Vol. II [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.2 (1989 Vol. II [MWSYM]): b1-b2.

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Front Cover (1989 Vol. III [MWSYM])

"Front Cover (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): f1-f1.

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"Copyright (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): i-ii.

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Panel Sessions (1989 Vol. III [MWSYM])

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Abstracts

Session CC -- Advances in FET Amplifiers

"Session CC -- Advances in FET Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 839-839.

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Abstracts

Performance of a 2-18 GHz Ultra Low-Noise Amplifier Module

K.B. Niclas and R.R. Pereira. "Performance of a 2-18 GHz Ultra Low-Noise Amplifier Module." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 841-844.

The performance of two-tier matrix amplifiers optimized for best noise figure across the 2-18 GHz band will be discussed. An average noise figure of NF = 2.95 dB with an associated average gain of G = 19.2 dB has been measured in a single-stage module using MESFET's.

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A Balanced Cascade 26-40GHz Amplifier

D.M.F. McCann. "A Balanced Cascade 26-40GHz Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 845-848.

This paper described the design, fabrication and performance of a balanced cascade 26-40GHz amplifier. The circuit is fabricated using an advanced multilayer thin film technology on a glass ceramic substrate material. Details and results for the quadrature coupler design, termination approach and amplifier technique will be presented.

A 1 to 40 GHz MESFET Hybrid Distributed Amplifier

H. Brouzes, G. Deredec and Y.W. Bender. "A 1 to 40 GHz MESFET Hybrid Distributed Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 849-852.

A 1 - 40 GHz hybrid amplifier with 10 dB minimum gain up 40 GHz and using 0.3 micron MESFETs is presented. Gain ripple is +/- 1dB in the 1 to 26.5 GHz range. Maximum noise figure is 7.5 dB in the 2 - 18 GHz range and output power at one dB gain compression is 11 dBm. The circuit includes a 1-40 GHz biasing system. Device S parameters were measured in the 1-20 GHz band and static measurements used to derive an equivalent circuit of the FET loading to very good agreement between simulations and measurements up to 40 GHz.

A Cryogenic 43-GHz-Band Low-Noise Amplifier for Radio Astronomy

T. Saito, Y. Oohashi, H. Kurihara, Y. Hirachi, T. Kasuga and K. Miyazawa. "A Cryogenic 43-GHz-Band Low-Noise Amplifier for Radio Astronomy." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 853-856.

This paper describes the first development of a cryogenic millimeter-wave-band HEMT low-noise amplifier for radio astronomy application. To ensure stable operation, the amplifier was designed using S-parameters measured at a cryogenic temperature of 30 K. Very low noise temperature is obtained over wide frequency range from 41.3 to 44.5 GHz by adopting a balanced amplifier configuration with a waveguide-type 3 dB hybrid. Minimum and maximum noise temperatures within the frequency range are 65 and 95 K, at an ambient temperature of 30 K and amplifier gain of 11.5 dB.

High Efficiency Power Amplification for Microwave and Millimeter Frequencies

W.S. Kopp and S.D. Pritchett. "High Efficiency Power Amplification for Microwave and Millimeter Frequencies." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 857-858.

A novel technique for realizing high efficiency operation of power amplifiers at microwave frequencies is demonstrated. This appoach features third harmonic peaking Class-F amplifier operation. Modeled data indicates this Class-F circuit provides an 8% improvement over the conventional Class-B approach at X-band.

Session DD -- High Power Microwave (Focused Session)

"Session DD -- High Power Microwave (Focused Session)." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 859-859.

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Operation of Solid State Power Amplifiers at Cryogenic Temperatures

J.H. Johnson and P.E. D'Anna. "Operation of Solid State Power Amplifiers at Cryogenic Temperatures." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 861-862.

A novel approach is presented to the cooling of lightweight transistor amplifier modules for high power operation. 1800 Watts (C.W.) at 425 MHz was obtained from a four transistor amplifier that weighed a mere 13 ounces.

Abstracts

Power Amplifier Linearization Using IF Feedback

K.G. Voyce and J.H. McCandless. "Power Amplifier Linearization Using IF Feedback." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 863-866.

A narrowband feedback technique for linearizing power amplifiers is presented. The technique uses frequency conversions, thus allowing loop compensation and added loop gain to be implemented at the intermediate frequency (IF). An analysis is presented which allows assessment of the applicability of the technique and which shows the performance advantages of using a two pole loop compensation filter. When applied to a 450MHz power amplifier with a delay of 70nS, the technique suppressed intermodulation products at ±500 KHz by 12dB with the amplifier driven to within 5dB of its 1dB impression point.

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A Production 30-kW, L-Band Solid-State Transmitter

S. Bird and M. Reinhart. "A Production 30-kW, L-Band Solid-State Transmitter." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 867-870.

A 30-kW, L-Band Solid-State Transmitter has been designed for the look-down radar used on a tethered aerostat system deployed to combat drug smugglers. This transmitter replaces a tube transmitter previously used in this type radar which results in significantly improved reliability, maintainability, availability, and a 30 percent decrease in overall transmitter weight.

The Sophisticated Properties of the Microwave Oven Magnetron

W.C. Brown. "The Sophisticated Properties of the Microwave Oven Magnetron." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 871-874.

The magnetron commonly used in the microwave oven has unusually low noise and long life resulting from an internal feedback process that limits the emission from the cathode to optimum values for these properties. Without compromising these properties the magnetron can be combined with external circuitry to lock the output phase to the input phase and simultaneously provide 30 dB of gain. Together with its low cost and universal availability, these properties make it an attractive option for a number of applications.

High-Power Microwave Diagnostic System Based on Compact, Single-Unit, Radiate-and-Receive Devices

T.A. Treado, R.S. Smith, III, W.O. Doggett and D.J. Jenkins. "High-Power Microwave Diagnostic System Based on Compact, Single-Unit, Radiate-and-Receive Devices." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 875-878.

Two unique S- and C- band waveguide radiate-and-receive systems were developed as multioctave diagnostics and vacuum loads for high power microwave bursts (> 150 MW) emitted from relativistic magnetrons. The compact devices (< 1 m^3) did not require an anechoic chamber. The complete HPM diagnostic system is described.

Abstracts

Microstrip Plasma Limiter

S.D. Patel, L. Dubrowsky, S.E. Saddow, R. Kaul and R.V. Garver. "Microstrip Plasma Limiter." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 879-882.

An operational microstrip plasma limiter was developed for DC to 18-GHz operation. The limiter threshold is 65 W for a 1-µs microwave pulse. Spike leakages of less than 20 µJ and flat leakage of less than 1 W were achieved from S- to X-band. Device power handling capacity is 50 kW peak.

Abstracts

Session EE -- Microwave Measurements

"Session EE -- Microwave Measurements." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 883-883.

Abstracts

Measurement of Memory Effects in Predistortion Linearizers

W. Boesch and G. Gatti. "Measurement of Memory Effects in Predistortion Linearizers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 885-888.

A typical method for designing a predistortion linearizer is to realize a circuit that creates an AM/AM and AM/PM characteristic inverse to that of the power amplifier to be linearized. This strategy is correct only if the predistortion circuit maintains this characteristic also at signal envelope frequencies. This is often not true due to the time constants present in the linearizer circuits that limit its effectiveness. We refer to these effects as memory effects. This problem is not limited to linearization techniques but affects the operation of non-linear systems in general. The purpose of this paper is to review the major consequences of memory effects and to present efficient techniques to measure them.

Picosecond Optoelectronic Characterization of a Heterojunction Bipolar Transistor

M. Matloubian, H. Fetterman, M. Kim, A. Oki, J. Camou, S. Moss, D. Smith and J. Knudsen. "Picosecond Optoelectronic Characterization of a Heterojunction Bipolar Transistor." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 889-892.

A time domain network analyzer with a bandwidth greater than 100 GHz was constructed using picosecond optoelectronic techniques. The S-parameters of a heterojunction bipolar transistor with an f/sub max/ of 35 GHz was measured using this system. The measured S-parameters agree with those obtained using a conventional automatic network analyzer over the range of frequency overlap.

Noise Characterization Uncertainty of Microwave Devices Under Low Current Operation

R. Lucero, C. Moyer, R. Vaitkus and M. Dydyk. "Noise Characterization Uncertainty of Microwave Devices Under Low Current Operation." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 893-895.

An automated source reflection coefficient synthesizer combined with mechanical output tuner was used in conjunction with gage capability studies for the noise parameters of GaAs MESFETs and planar-doped psuedomorphic MODFETs operating at low currents (Ids <1 mA). The net repeatability and reproducibility (99% confidence interval for the test) of the measurement system was established at ±0.2 dB and ±1.4 dB for the minimum noise figure and associated gain, respectively.

A Parameter Extraction Technique for Heterojunction Bipolar Transistors

R.J. Trew, U.K. Mishra, W.L. Pribble and J.F. Jensen. "A Parameter Extraction Technique for Heterojunction Bipolar Transistors." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 897-900.

A technique useful for parameter extraction of heterojunction bipolar transistors is presented. The technique makes use of a 'tee' equivalent circuit based upon the physical operation of the device. The technique uses the device f/sub T/, determined by extrapolation of the device h parameters, to establish the total emitter-to-collector delay time from the experimental data. This information is used to establish an equation that is used to constrain the circuit elements, thereby facilitating the parameter extraction procedure. The technique is easily implemented using commercially available computer software.

Advances in NIST Dielectric Measurement Capability Using a Mode-Filtered Cylindrical Cavity

E.J. Vanzura and W.A. Kissick. "Advances in NIST Dielectric Measurement Capability Using a Mode-Filtered Cylindrical Cavity." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 901-904.

A 60-mm diameter cylindrical cavity resonator has been constructed for performing high-accuracy permittivity measurements on low-loss materials at microwave frequencies. The cavity's design and evaluation are described. Estimated errors in seven parameters result in approximately 0.2% uncertainty in permittivity and 6% uncertainty in loss tangent for a fused silica measurement.

Microstrip Noncontacting Thickness Monitor

R.B. Hurley, I. Kaufman and R.P. Roy. "Microstrip Noncontacting Thickness Monitor." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 905-908.

A microwave technique for measurement of the height of a material on a metallic surface using a planar microstrip transmission line structure is presented. A device was designed to monitor the height of a film of water up to about 1 mm. The method produced consistant results and may be adapted for use without microwave frequency measurement devices.

Session FF -- Losses in Guided-Wave Structures

"Session FF -- Losses in Guided-Wave Structures." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 909-909.

Full-Wave Analysis of Conductor Losses on MMIC Transmission Lines (1989 Vol. III [MWSYM])

W. Heinrich. "Full-Wave Analysis of Conductor Losses on MMIC Transmission Lines (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 911-914.

A mode-matching analysis of lossy planar transmission lines is presented. In contrast to the usual perturbation methods it includes metallic loss by a self-consistent description without any skin-effect approximation. The approach is validated by comparison to previous work. First results on microstrip and slot line are given.

Channelized Coplanar Waveguide: Discontinuities, Junctions, and Propagation Characteristics

R.N. Simons, G.E. Ponchak, K.S. Martzaklis and R.R. Romanofsky. "Channelized Coplanar Waveguide: Discontinuities, Junctions, and Propagation Characteristics." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 915-918.

A new variant of CPW which has been termed channelized CPW, CCPW, is presented. Measured and computed propagation characteristics are presented. Lumped equivalent circuit element values for a CCPW open circuit and right angle bend have been obtained. CCPW power divider junctions and a coax-to-CCPW in-phase, radial power divider are also presented.

Abstracts

High Frequency Conductor and Dielectric Losses in Shielded Microstrip

T.E. van Deventer, P.B. Katehi and A.C. Cangellaris. "High Frequency Conductor and Dielectric Losses in Shielded Microstrip." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 919-922.

An integral equation method is developed to calculate the dispersion of non-perfectly conducting microstrip lines. Both dielectric losses in the substrate and conductor losses in the strips and ground plane are considered. Multiple conductors on several layers can be studied using an impedance boundary formulation for the derivation of the Green's function. The microstrip losses are evaluated by using a frequency-dependent surface impedance which is derived by solving the fields in the conductors. This surface impedance replaces the conducting strip and takes into account the thickness and skin effect of the strip at high frequencies. Good agreement with available literature data is shown.

Analysis of the "Microstrip-Loaded Inset Dielectric Waveguide"

T. Rozzi, R. De Leo and A. Morini. "Analysis of the "Microstrip-Loaded Inset Dielectric Waveguide"." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 923-926.

Strip-loaded inset dielectric guide antennas have shown considerable potential in the millimeter wave range. For the purpose of signal feeding and processing, it would be useful to employ microstrip-type circuitry. In this contribution we describe the properties of microstrip-loaded inset guide and its application to a strip-loaded antenna with horizontal polarization.

Complex Guidance Properties of the Slitted Asymmetric Ridge Waveguide

F. Frezza, M. Guglielmi and P. Lampariello. "Complex Guidance Properties of the Slitted Asymmetric Ridge Waveguide." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 927-930.

A new open waveguide for millimeter-wave applications, namely the slitted asymmetric ridge waveguide, is proposed and analyzed that is at the same time simple to fabricate and flexible in terms of electrical characteristics. The analysis is based on the development of an accurate transverse equivalent network and on the derivation of a dispersion relation which gives the complex longitudinal propagation costant in terms of the structural parameters. A detailed parametric analysis is then carried out showing how the real and imaginary parts of the complex propagation constant can be controlled with a good degree of independence from each other.

Session GG -- Power FET Amplifiers

"Session GG -- Power FET Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 931-931.

A 12 Watt 20 GHz FET Power Amplifier

F.S. Auricchio, Jr., R.A. Rhodes and D.S. Day. "A 12 Watt 20 GHz FET Power Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 933-936.

A state of the art 20 GHz GaAs FET power amplifier with a maximum output of 12 watts and 15.5% power added efficiency has been developed. The amplifier utilizes a novel 2.0 watt power FET design that incorporates partial input impedance matching circuitry on the FET die to improve bandwidth performance and repeatability. Single ended and balanced power modules were combined with low loss waveguide hybrids in a planar amplifier designed to be compatible with integration into satellite systems.

Broadband Power Amplifiers Based on a New Monolithic Ceramic Technology

F.N. Sechi and M. Bujatti. "Broadband Power Amplifiers Based on a New Monolithic Ceramic Technology." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 937-940.

A new monolithic ceramic technology especially developed for high power applications is proposed. Broadband power amplifiers based on this technology have demonstrated output powers in the range of one to two watts over the 6-18 GHz frequency band, with good efficiency and high reproducibility.

Abstracts

Design Technique for High Power, High Efficiency, Broadband Distributed Amplifiers

J.B. Cole and A. Platzker. "Design Technique for High Power, High Efficiency, Broadband Distributed Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 941-944.

Distributed amplifiers, while having uniform gain over a broad frequency range, typically have nonuniform power performance. The Computer Aided Design technique described here was applied to an MMIC distributed power amplifier design with the result that improved efficiency (10-13%) and constant output power (> 25 dBm) was achieved over the 6-18 GHz band, while the conventionally designed circuits show 4-6 dB power degradation.

Monolithic High-Voltage FET Power Amplifiers

K.E. Peterson, H.-L. Hung, F.R. Phelleps, T.F. Noble and H.C. Huang. "Monolithic High-Voltage FET Power Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 945-948.

High-voltage field-effect transistor (HVFET) power amplifiers offer improved system efficiency through reduced DC power distribution loss and more efficient DC power conditioning. Results are presented for the first such monolithic microwave integrated circuit (MMIC) amplifiers and four-cell amplifiers at X-band. Drain bias voltages up to 40 V with such amplifiers have been achieved.

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A Technique for the Maintenance of FET Power Amplifier Efficiency Under Backoff

B.D. Geller, F.T. Assal, R.K. Gupta and P.K. Cline. "A Technique for the Maintenance of FET Power Amplifier Efficiency Under Backoff." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 949-952.

An operational technique for FET power amplifiers, which allows the maintenance of high efficiency as the amplifier is backed off from its rated output power level, is described. Using this technique, an experimental, single-stage, 1-W, C-band amplifier, capable of 65 percent power-added efficiency at its rated output power, maintains a minimum efficiency of 55 percent for a 10-dB output backoff range. Comparable amplifiers operating under conventional Class B or Class A demonstrate efficiencies of about 18 and 4 percent, respectively. An analytic basis for the technique is given. Experimental results are also presented for a three-stage, 2-W, C-band amplifier.

Session HH -- Microwave Integrated Circuits--I

"Session HH -- Microwave Integrated Circuits--I." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 953-953.

Lossless, Broadband Monolithic Microwave Active Inductors (1989 Vol. III [MWSYM])

S. Hara, T. Tokumitsu and M. Aikawa. "Lossless, Broadband Monolithic Microwave Active Inductors (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 955-958.

Lossless, broadband microwave active inductors are proposed for general purpose use in microwave circuits. These active inductors operate in a wide frequency range with very low series resistance. Furthermore, the inductance value can be controlled by the external control voltage.

A 2-18 GHz 180 Degree Phase Splitter Network

S.S. Bharj, S.P. Tan and B. Thompson. "A 2-18 GHz 180 Degree Phase Splitter Network." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 959-962.

A 2-18 GHz phase splitter network has been designed and developed to provide two outputs 180° out-of-phase, with a low insertion loss. The network consists of an active 2-20 GHz in-phase power divider, implemented in MMIC, the two outputs of which feed band pass filter networks, which have identical amplitude response but are 180° out-of-phase. The filter network has been modified in a novel fashion to make it MMIC compatible. The network has applications in double balanced mixers, class AB power amplifiers, push-pull amplifiers, etc.

Very Small, Ultra-Wideband MMIC Magic-T and Applications to Combiners and Dividers

T. Tokumitsu, S. Hara and M. Aikawa. "Very Small, Ultra-Wideband MMIC Magic-T and Applications to Combiners and Dividers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 963-966.

An FET-size, 1-18GHz MMIC magic-T (180° hybrid) which unifies two different dividers, electrically isolated from each other, in a novel GaAs FET electrode configuration based on the "LUFET" concept is proposed. Applications of this module to miniaturized RF signal processing modules such as dividers, combiners, and switches are also described.

A New Coplanar Waveguide/Slotline Double-Balanced Mixer

D. Cahana. "A New Coplanar Waveguide/Slotline Double-Balanced Mixer." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 967-968.

A new double-balanced MIC mixer design is presented. Through the use of a diode crossover quad and coplanar waveguide/slotline baluns, the need for via holes and back metalization has been eliminated. A sample mixer with 6-18 GHz RF and 1GHz IF demonstrates a 5.0 to 8.5 dB conversion loss.

Recrystallized Silicon-on-Alumina as a Monolithic Circuit Technology

T.J. Letavic, S. Wu, E.W. Maby and R.J. Gutmann. "Recrystallized Silicon-on-Alumina as a Monolithic Circuit Technology." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 969-972.

A new microwave monolithic technology based upon zone-melt recrystallization (ZMR) of silicon films on alumina substrates using a phosphosilicate glass (PSG) buffer layer is described. While initial recrystallization results confirm the difficulty of obtaining device-quality films with a thermally mismatched substrate, the planarity and viscoelastic strain relief introduced by the PSG indicates that the technology should be feasible. A surface-oriented PIN diode device structure has been developed which is compatible with the recrystallized silicon films. Results obtained with this process using single-crystal substrates demonstrate the feasibility of the device structure. The potential for high-power monolithic control circuits is discussed.

Session II -- HEMT Technology

"Session II -- HEMT Technology." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 973-973.

Ultra-Low-Noise Millimeter-Wave Pseudomorphic HEMT's (1989 Vol. III [MWSYM])

R.E. Lee, R.S. Beaubien, R.H. Norton and J.W. Bacon. "Ultra-Low-Noise Millimeter-Wave Pseudomorphic HEMT's (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 975-978.

Tenth-micrometer gate length devices based on AlGaAs/InGaAs/GaAs pseudomorphic HEMT's have produced record low-noise performance at 43 GHz. The room temperature device noise figure is measured to be 1.32 dB (noise temperature =103 K) with 6.7 dB associated gain and at 17 K physical temperature, the noise figure is 0.36 dB (noise temperature =25 K) with 6.9 dB associated gain. This is the lowest noise figure yet reported for any GaAs based device at 43 GHz.

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Low-Noise InGaAs HEMT Using the New Off-Set Recess Gate Process

O. Ishikawa, K. Nishii, T. Matsuno, C. Azuma, Y. Ikeda, S. Nanbu and K. Inoue. "Low-Noise InGaAs HEMT Using the New Off-Set Recess Gate Process." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 979-982.

Low noise InGaAs HEMT (high electron mobility transistor) with noise figure of 0.68 dB at 12 GHz has been developed using the new off-set recess gate process. The pseudomorphic n-AlGaAs / InGaAs HEMT structure was grown on the semi-insulating GaAs substrate by MBE. The new off-set recess gate process make it possible to decrease the source and gate resistance. The breakdown voltage between gate and drain became higher than 6V. Gm of 510mS/mm at minimum noise bias point has been obtained in a 0.2µm gate InGaAs HEMT. The minimum noise figure and associated gain of the device are 0.68dB and 10.4dB at Vds=2V, Ids=16mA and f=12GHz, respectively. Three stage amplifier using the new HEMT at the head has showed the minimum noise figure of 1.2dB and the maximum gain of 31dB.

Abstracts

A 0.15µm Gate-Length Pseudomorphic HEMT

P.M. Smith, M.Y. Kao, P. Ho, P.C. Chao, K.H.G. Duh, A.A. Jabra, R.P. Smith and J.M. Ballingall. "A 0.15µm Gate-Length Pseudomorphic HEMT." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 983-986.

0.15µm gate-length double heterojunction pseudomorphic HEMTs that simultaneously exhibit state-of-the-art power and noise performance are reported. Power results include record power-added efficiencies of 51%, 41%, and 23% at 35, 60 and 94 GHz, respectively, and output powers of 139mW at 60 GHz and 57mW at 94 GHz. Measured minimum noise figures of 0 55dB at 18GHz and 1.8dB at 60 GHz are the lowest ever reported for passivated transistors. Based on its demonstrated performance and continued rapid rate of improvement, the pseudomorphic HEMT should be the preferred transistor for a number of millimeter wave applications, used either as a discrete device in high performance hybrid amplifiers or integrated into GaAs-based MMICs.

44 GHz Hybrid HEMT Power Amplifiers

D.W. Ferguson, P.M. Smith, P.C. Chao, L.F. Lester, R.P. Smith, P. Ho, A. Jabra and J.M. Ballingall. "44 GHz Hybrid HEMT Power Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 987-990.

Doped Channel 0.25µm gate length InGaAs Pseudomorphic HEMTs developed in our laboratory have exhibited state-of-the-art power performance at millimeter wave frequencies, including output power density of 0.93 W/mm and power added efficiency of 41% at 44 GHz. Using these devices, two Q-Band hybrid power amplifiers have been developed. A two-stage design has produced 108 mW output power gain with 9.5dB and 26.5% power added efficiency. A three-stage design produced 251 mW output power with 13.6dB of gain and 26.8% power added efficiency. The peak efficiency of the three stage amplifier was 31.3% when biased differently. The linear gain of these amplifiers was 12 and 20 dB respectively, These results clearly show the potential of these devices for millimeter wave transmitters.

Theoretical Comparison of 0.35µm Gate Length GaAs and GaInAs HEMTs

D.H. Park and K.F. Brennan. "Theoretical Comparison of 0.35µm Gate Length GaAs and GaInAs HEMTs." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 991-994.

We present a theoretical study of the performance of nearly identical 0.35 µm gate length HEMTs made from three different materials systems, GaAs/Al/sub 0.32/Ga/sub 0.68/As, In/sub 0.15/Ga/sub 0.85/As/Al/sub 0.15/Ga/sub 0.85/As, and Ga/sub 0.47/In/sub 0.53/As/Al/sub 0.48/In /sub 0.52/As. The calculations are made using an ensemble Monte Carlo simulation which includes the full details of real space transfer, the transport properties of the two-dimensional electron gas, nonstationary transport, and the two-dimensional electric field profile through the self-consistent solution of the Poisson equation. The performance of each device type, measured in terms of the current-voltage characteristic, transconductance, and cutoff frequency is compared. In this way, the effects of the material parameters on the device performance can be completely isolated and as such independently ascertained. It is found that the InGaAs-based devices well outperform the "conventional" GaAs/AlGaAs device, consistent with recent experimental measurements. Of the three devices, the GaInAs/AlInAs structure provides the highest frequency performance and delivers the greatest current.

Session JJ -- The Time Domain and Electromagnetics

"Session JJ -- The Time Domain and Electromagnetics." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 995-995.

Time-Domain Method of Lines Applied to the Uniform Microstrip Line and its Step Discontinuity

S. Nam, H. Ling and T. Itoh. "Time-Domain Method of Lines Applied to the Uniform Microstrip Line and its Step Discontinuity." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 997-1000.

The general formulation and the procedure of the time-domain method of lines for the analysis of wave scattering and propagation properties in planar circuit are described. The results of the time-domain data and the derived frequency domain characteristics for the uniform microstrip line and its step discontinuity are presented.

Abstracts

Distortion of Transient Signals on Multilayer Coupled Symmetric Microstrip Transmission Lines

J.P. Gilb and C.A. Balanis. "Distortion of Transient Signals on Multilayer Coupled Symmetric Microstrip Transmission Lines." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1001-1004.

Pulse distortion on symmetric coupled microstrips is investigated for multilayer structures using a simplified Spectral-Domain Approach (SDA). Results for pulse distortion on multi-layer coupled microstrips are shown. Control of the electrical properties of the substrate layers to reduce coupling and cross-talk between adjacent lines is discussed and results are presented.

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Analysis of Coplanar Waveguide by the Time-Domain Finite-Difference Method

G.-C. Liang, Y.W. Liu and K.K. Mei. "Analysis of Coplanar Waveguide by the Time-Domain Finite-Difference Method." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1005-1008.

An analysis of coplanar waveguides (CPW) by the Time-Domain Finite Difference (TD-FD) method is discussed. The propagating waveforms along a coplanar waveguide, which is excited by a Gaussian pulse, are found in the time-domain. After the time-domain computation is done, the frequency domain parameters, such as the effective dielectric constant and the complex characteristic impedance, are calculated by Fourier transformations. The results agree well with the available theoretical and experimental data over a wide frequency range.

Analysis of Microstrip Discontinuities Using the Finite Difference Time Domain Technique

C.J. Railton and J.P. McGeehan. "Analysis of Microstrip Discontinuities Using the Finite Difference Time Domain Technique." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1009-1012.

This contribution demonstrates the potential of the Finite Difference Time Domain technique to analyse MMIC structures of arbitrary complexity with moderate computational effort and to meet the requirement for CAD tools capable of treating high density MMIC's. Results are presented for uniform microstrip, the abrupt termination and the microstrip right angle bend.

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Accurate Calculation of the Capacitance Matrix of a Multiconductor Transmissionline in a Multilayered Dielectric Medium

W. Delbare and D. De Zutter. "Accurate Calculation of the Capacitance Matrix of a Multiconductor Transmissionline in a Multilayered Dielectric Medium." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1013-1016.

An integral equation method for the calculation of capacitance and inductance matrices is presented. The method is suited for multiconductor transmission lines embedded in a multilayered dielectric medium on top of a ground plane. Conductors of arbitrary polygonal cross-section can be handled, as well as infinitely thin conductors. The method is new in two respects. The kernel of the integral equation is the space domain Green's function of the layered medium. The accuracy of the solution is improved by using basis functions which exactly model the singular behaviour of the charge density in the neighborhood of a conductor edge. Numerical examples show the accuracy of the calculations and the complexity of the configurations that can be treated.

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Session KK -- FET Devices and Applications

"Session KK -- FET Devices and Applications." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1017-1017.

The Effects of P Co-Implants Upon the RF Performance of Ion-Implanted GaAs Power FETs

T.A. Winslow and R.J. Trew. "The Effects of P Co-Implants Upon the RF Performance of Ion-Implanted GaAs Power FETs." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1019-1022.

The use of P-type co-implants to improve GaAs MESFET performance has been examined by use of a physically based, analytic large-signal device model. The P dopants are shown to affect RF performance by altering both the shape and conduction characteristics of the channel. The P dopants improve channel charge confinement, but reduce the electron transport characteristics. RF performance degradation due to the reduced mobility and saturation velocity can be compensated by increasing the drain bias, since BV/sub gd/ is increased. The net result is that improved RF performance is obtained compared to similar devices fabricated without the P co-implants. The model is verified by comparison with measured RF data of an X-band ITT-GTC MSAG MESFET.

A True Off-Set Self-Aligned Process for High Efficiency Ku-Band Power FETs

K. Wakamoto, K. Imura, M. Yamamoto, S. Shimoyama, T. Kameyama, M. Isomae, Y. Okubo, M. Ohoka, T. Nagashima, D.A. Figueredo, L.H. McCarty, C.Y. Su, M. Yam and S. Kakihana. "A True Off-Set Self-Aligned Process for High Efficiency Ku-Band Power FETs." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1023-1026.

A new off-set self-aligned process has been used to fabricate a 2 x 3000 µm gate width internally matched power FET which at 14 GHz has produced 34.4 dBm output power, 6 dB gain and 32% added efficiency at the -1 dB gain compression point with a power combining efficiency of = 96%. The high combining efficiency is attributed to the close parameter match of the self-aligned power FETs.

Abstracts

Zero Bias GaInAs MISFET Mixers

K.W. Chang, B.R. Epstein, E.J. Denlinger and P.D. Gardner. "Zero Bias GaInAs MISFET Mixers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1027-1030.

This paper reports the experimental results of a passive, switch-type single-ended mixer using a metal-insulator-semiconductor field effect transistor (MISFET) that was fabricated from Ga/sub 0.47In/sub 0.53/As (GaInAs). The device operated without any applied DC drain or gate bias. A third order input intercept point as high as +30 dBm was obtained with +20 dBm LO input power. Also presented are harmonic balance simulations of the mixer circuit.

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A Practical Distributed FET Mixer for MMIC Applications

I.D. Robertson and A.H. Aghvami. "A Practical Distributed FET Mixer for MMIC Applications." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1031-1032.

A novel distributed FET mixer configuration suitable for MMIC realisation has been demonstrated in hybrid form. The mixer has achieved 3dB conversion gain over 2 to 12GHz and the single-sideband noise figure is 11dB. There is still considerable scope for improving the results of this prototype, using either MMIC or hybrid techniques.

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An Easy-to-Use FET DRO Design Procedure Suited to Most CAD Programs

P.G. Wilson and R.D. Carver. "An Easy-to-Use FET DRO Design Procedure Suited to Most CAD Programs." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1033-1036.

A design procedure for a reflection stabilised dielectric resonator oscillator (DRO) is given that takes advantage of the facilities available from most linear microwave CAD programs, hence streamlining and simplifying the task. 27.61GHz MESFET hybrid DROs were designed using this method. These DROs gave an average output power of +3dBm, with +/-2MHz stability from -20 to +40° C and -75dBc/Hz phase noise at 10 kHz from carrier.

Session LL -- Microwave Integrated Circuits--II

"Session LL -- Microwave Integrated Circuits--II." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1037-1037.

Taper and Forward-Feed in GaAs MMIC Distributed Amplifiers

M. Ross, R.G. Harrison and R.K. Surridge. "Taper and Forward-Feed in GaAs MMIC Distributed Amplifiers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1039-1042.

An improved distributed-amplifier (DA) architecture uses simultaneous inductance tapering and signal forward feeding to obtain additional degrees of freedom for optimization. The approach is illustrated by the design and fabrication of a DA with a predicted gain of 6.9 ± 0.7 dB over a band-width of 1-12 GHz.

MTT

IEEE

Active Broadband Impedance Transformations Using Distributed Techniques

K.R. Cioffi. "Active Broadband Impedance Transformations Using Distributed Techniques." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1043-1046.

A circuit concept is derived which allows impedance transformations to be performed over extremely broad bandwidths. The transformation is obtained by coupling two or more identical distributed amplifier circuits in parallel by the use of a common input or output line. The circuit technique can be used where broadband impedance matching is important such as laser diode drivers or antenna matching in broadband receivers and transmitters. The circuit technique is demonstrated for a 1:2 impedance transformation over a 2 to 20GHz bandwidth by results presented for a fabricated amplifier.

A Ku-Band MMIC PLL Frequency Synthesizer

T. Ohira, M. Muraguchi, T. Hirota, K. Osafune and M. Ino. "A Ku-Band MMIC PLL Frequency Synthesizer." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1047-1050.

A Ku-band PLL frequency synthesizer has been developed in a very compact configuration, incorporating two novel monolithic chips of GaAs MMIC and LSI. The MMIC includes a Ku-band VCO, a dual-output buffer amplifier, a balun and a dynamic/static prescaler. A very small chip size has been realized by the uni-planar MMIC configuration. The LSI includes a dual-modulus prescaler, programmable counters, and a PFC. The proposed synthesizer exhibits a tuning range broader than 1 GHz and a phase noise of about -70 dBc/Hz at 1 kHz offset from the carrier.

Abstracts

An Octave Band GaAs Analog Phase Shifter

S.T. Salvage, R.J. Hash and B.E. Petted. "An Octave Band GaAs Analog Phase Shifter." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1051-1054.

A GaAs variable gain analog phase shifter, which operates with high phase and amplitude resolution over an octave band has been demonstrated. The phase shifter, which consists of three GaAs MMIC chips in a hybrid package, exhibits greater than 10db gain and 100mW output power from 400MHz to 1400 MHz, with a phase/amplitude settling time of less than 100 nS. This paper addresses the design of the three MMIC chips contained in the module, and the performance of the module itself.

Session MM -- Solid-State Devices and Circuits

"Session MM -- Solid-State Devices and Circuits." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1055-1055.

2.5 W CW X-Band Heterojunction Bipolar Transistor

B. Bayraktaroglu, R.D. Hudgens, M.A. Khatibzadeh and H.Q. Tserng. "2.5 W CW X-Band Heterojunction Bipolar Transistor." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1057-1060.

2.43 W CW output power was obtained with AlGaAs/ GaAs heterojunction bipolar transistors at 10 GHz with 5.8 dB gain and 30% power-added-efficiency using 2 µm minimum geometry devices. The device design and fabrication techniques were improved to maintain the high power density (> 3 W/mm of emitter length) operation as the device size is increased. Accurate device models were developed both for common-emitter and common-base devices to aid in this size scaling.

Design Optimization of Microwave Power Heterojunction Bipolar Transistor Cells

G.W. Wang, L.W. Yang, R.W. Laird, D.A. Williams, J.P. Sadowski and P.D. Wright. "Design Optimization of Microwave Power Heterojunction Bipolar Transistor Cells." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1061-1064.

Results of a design optimization study of power heterojunction bipolar transistor cells are presented. AlGaAs/GaAs HBTs have been fabricated using a simple heterostructure design grown by molecular beam epitaxy and a novel self-aligned fabrication process which offers relatively low parasitics. The influence of power transistor cell design on device performance is emphasized. The design optimization study involved simultaneous fabrication of transistor cells with a relatively wide range of geometries. Transistors with a wide range of emitter finger sizes and number of emitter fingers, but with the same number of collector contacts and the same basic cell design approach, have been fabricated and characterized by DC and microwave testing. The results of this study provide a basis for obtaining further improvements in microwave power HBT performance.

A 20GHz Silicon Microwave Monolithic Integrated Circuits Process and a 7.4GHz Frequency Divider

S. Miyazaki, C. Takai, K. Eguchi and T. Nakata. "A 20GHz Silicon Microwave Monolithic Integrated Circuits Process and a 7.4GHz Frequency Divider." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1065-1068.

A Silicon Microwave Monolithic Integrated Circuits process named "DNP-III" has been developed without self-alignment technique. By using "DNP-III" process. NPN transistors with 0.6µm width and 0.1µm depth emitter achieved f/sub T/ of 20 GHz. Maximum dividing frequency (Fmax) of 7.4GHz at Vcc=6V was also achieved for 1/2 prescaler with master slave T-type flip-flop.

Quasi-Optical Watt-Level Millimeter-Wave Monolithic Solid-State Diode-Grid Frequency Multipliers

R.J. Hwu, L.P. Sadwick, N.C. Luhmann, Jr., D.B. Rutledge, M. Sokolich and B. Hancock. "Quasi-Optical Watt-Level Millimeter-Wave Monolithic Solid-State Diode-Grid Frequency Multipliers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1069-1072.

A monolithic planar array containing thousands of GaAs Barrier-Intrinsic-N/sup +/ (BIN) diodes have produced one watt output power at 100 GHz in a tripler configuration in excellent agreement with the predictions from large-signal nonlinear circuit analysis of frequency multiplication. Significant improvement is expected with realizable diode parameters and optimized pumping condition.

Distortion in Microwave and RF Switches by Reverse Biased PIN Diodes

R.H. Caverly and G. Hiller. "Distortion in Microwave and RF Switches by Reverse Biased PIN Diodes." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1073-1076.

Distortion caused by PIN diode switches can significantly compromise microwave and RF communication system performance. This paper presents an original analytical and experimental study of distortion generated by reverse biased PIN diodes. Concise distortion relationships are presented and compared with the authors' previously published work on forward biased PIN diode distortion. The results indicate that reverse bias distortion can be worse than forward bias distortion, with further degradation as the frequency increases.

Session NN -- Microwave Systems Applications

"Session NN -- Microwave Systems Applications." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1077-1077.

Performance of Five 30 GHz Satellite Receivers

R.J. Kerczewski, G.E. Ponchak and R.R. Romanofsky. "Performance of Five 30 GHz Satellite Receivers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1079-1082.

Technology development contracts funded by NASA have resulted in five 30 GHz satellite receivers of various design. This paper presents and discusses the results of tests performed at NASA Lewis Research Center to determine the operating characteristics of the receivers and their ability to perform in a digital satellite link.

Millimeter-Wave Transmitter and Receiver Using the Nonradiative Dielectric Waveguide

T. Yoneyama. "Millimeter-Wave Transmitter and Receiver Using the Nonradiative Dielectric Waveguide." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1083-1086.

Transmitter and receiver front ends have been fabricated in an integrated manner at 35 GHz based on the nonradiative dielectric waveguide (NRD-guide). Structures and characteristics of various key components are described. Transmission testing over a ten month period using the fabricated front ends has proved that the NRD-guide integrated circuits are reliable in performance, moderate in size, hence promising at millimeter-wavelengths.

A 4-Device Powercombiner Used as a Lossless High Power Switch at 94GHz

H. Barth. "A 4-Device Powercombiner Used as a Lossless High Power Switch at 94GHz." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1087-1090.

In the millimeter wave range PIN-diode switches are rather lossy (ca. 2dB at 94 GHz). Additionally, the power handling capability of beam-lead diodes is limited to some 100 mW average power. To overcome switching problems in high power applications, i.g. for a pulse radar, the injection power for a symmetrical four coupler power combiner is switched from on of its two input ports to the other. Hence, the combined power alternately appears at one of the both output ports. If power and phase of the combined oscillators are balanced within .5dB and ±10°, the power level at the difference port is more than 25dB below the power level at the sum port. In this manner, the insertion loss of the lossy single port, double throw PIN-diode switch reduces only the low level injection power while the combined power of the four devices is switched lossless between the two output ports of the combiner network. In our application, this performance is used to switch the radar transmit power from left to right hand circular polarization.

94 GHz 3D-Imaging Radar for Sensorbased Locomotion

M. Lange and J. Detlefsen. "94 GHz 3D-Imaging Radar for Sensorbased Locomotion." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1091-1094.

For obstacle detection, navigation and route planning acquisition of 3D sensor information in real-time is essential for autonomous vehicles operating in partially predetermined, dense environments like production plants. Featuring direct access to range information and doppler signal processing, this radar sensor, suited for autonomous locomotion is an alternative to video sensors, due to it's real-time capability. This paper reports on system design and imaging results of an agile 94 GHz pulse doppler radar with 25 cm radial and 1.5° angular resolution. Test environment is a laboratory, representing a structured, stationary indoor scene, which is comparable to those expected in future applications. Results are discussed with respect to the visibility of typical mm-wave scattering phenomena as well as to the potential identification of object contours and zones free of obstacles.

MM-Wave Direct-to-Home Multichannel TV Delivery System

M. Pilgrim and R.P. Searle. "MM-Wave Direct-to-Home Multichannel TV Delivery System." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1095-1098.

Millimetre-wave Multichannel Multipoint Video Distribution Service, known as M³VDS, is a new means of delivering multichannel TV to the home. This contribution describes the concept, outlines the technology, and reports on the Demonstrator system operating at Saxmundham in England. Distribution by mm-waves has the potential to make a substantial impact on the TV market in some countries. Also it could be one of the first high-volume civil applications for GaAs monolithic circuits at mm-waves.

Millimetre-Wave Downconverter Using Monolithic Technology for High Volume Application

P.G. Wilson and B.C. Barnes. "Millimetre-Wave Downconverter Using Monolithic Technology for High Volume Application." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1099-1102.

Ten receiver downconverters have been produced, tested and deployed for TV distribution at 29GHz. GaAs monolithic technology has been chosen in order to make the imminent production version an affordable product. Conversion gains and noise figures are 30 to 38dB and 12 to 16dB, respectively. DRO stability is +/-2 MHz over -20°C to +40°C.

Session OO -- Monolithic Integrated Circuits

"Session OO -- Monolithic Integrated Circuits." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1103-1103.

Ka-Band 2 Watt Power GaAs MMIC (1989 Vol. III [MWSYM])

S. Arai, T. Yoshida, K. Kai, S. Takatsuka, Y. Oda and S. Yanagawa. "Ka-Band 2 Watt Power GaAs MMIC (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1105-1108.

High-power Ka-band power GaAs MMICs have been developed using distributed-element impedance transforming technique. At 30 GHz, an output power of 2 W with 3.3 dB gain and a saturation output power of 3 W have been obtained from 9.6 mm gate width power GaAs FET MMIC. These output powers are the highest values reported to date on Ka-band FETs.

A Monolithic 2-20 GHz GaAs PIN Diode SP16T Switch

S.D. Pritchett and D. Seymour. "A Monolithic 2-20 GHz GaAs PIN Diode SP16T Switch." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1109-1112.

A Broadband Monolithic Single-Pole Sixteen-Throw (SP16T) Switch has been fabricated using GaAs Vertical PIN Diodes. The SP16T switch features < 4.5 dB Insertion Loss with >35 dB isolatlon across the 2-20 GHz band. A novel de-embedding scheme used for switch characterization is also introduced.

Abstracts

Voltage-Tolerant Monolithic L-Band GaAs SPDT Switch

S.W. Cooper and G.A. Truitt. "Voltage-Tolerant Monolithic L-Band GaAs SPDT Switch." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1113-1114.

A monolithic GaAs L-band single-pole double-throw nonreflective (SPDTNR) FET switch has been developed. The switch has shown to be significantly less sensitive to DC ripple when compared to conventional FET switches. Also, the switch has the advantage of operating with either positive or negative control voltages. Small-signal insertion loss is less than 1.3 dB over a 1 to 2 GHz bandwidth with less than 1.3:1 VSWR in all states. Isolation exceeds 35 dB, with a switching current requirement of less than 10 uA. The chip size is 0.97 mm x 1.75 mm x 0.15 mm which permits more than 2100 monolithic switches to be fabricated on a 3-inch GaAs wafer.

Click on title for a complete paper.

An RLC Matching Network and Application in 1-20 GHz Monolithic Amplifier

P.K. Ikalainen. "An RLC Matching Network and Application in 1-20 GHz Monolithic Amplifier." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1115-1118.

New design equations are derived for an RLC matching network. These equations can be applied in lossy-match MESFET amplifiers to give flat gain and low SWR over wide bandwidths. Experimental results are presented from a monolithic 1-20 GHz amplifier. The theory is useful, in general, for design of wideband, resistive matching network for capacitive loads with a small series resistance.

Broadband High-Efficiency MMIC Power Amplifiers Using Ion-Implanted MESFET Technology

Y.C. Shih, K. Tan, K. Kasel, K.K. Yu and S.K. Wang. "Broadband High-Efficiency MMIC Power Amplifiers Using Ion-Implanted MESFET Technology." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1119-1120.

Broadband high-efficiency MMIC amplifiers had been designed and fabricated using ion-implanted MESFET technology. In the 7.5 to 18 GHz bandwidth, the amplifier has demonstrated a power-added efficiency of 15 to 34 percent, averaging greater than 20 percent. The output power is about 24 dBm at 1-dB compression and 26 dBm at 2-dB compression.

Abstracts

Session PP -- Open Forum

"Session PP -- Open Forum." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1121-1121.

Analysis and Synthesis Equations for Edge-Coupled Suspended Substrate Microstrip Line

Y.Y. Wang, G.L. Wang and Y.H. Shu. "Analysis and Synthesis Equations for Edge-Coupled Suspended Substrate Microstrip Line." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1123-1126.

The dispersion characteristics of edge-coupled suspended substrate microstrip line is analyzed by using method of lines. Based on the numerical results obtained from this method, a set of closed-form analysis and synthesis equations are presented, valid over a practical application range of structural parameters and substrate dielectric constant. Compared with the data obtained from SUPER COMPACT, the accuracy is found to be within 3.5% for analysis and 5% for synthesis.

Click on title for a complete paper.

Abstracts

Extending the Use of the Conformal Mapping Technique for the Calculation of the Quasi-TEM Parameters of Several Cylindrical and Wraped Transmission

S.S. Bedair and I. Wolff. "Extending the Use of the Conformal Mapping Technique for the Calculation of the Quasi-TEM Parameters of Several Cylindrical and Wraped Transmission." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1127-1130.

An approach will be outlined in order to extend the use of the conformal mapping for the calculation of the quasi-TEM parameters of several cylindrical transmission lines. The approach leads, in most cases, to analytic closed form expressions. Some of the structures which will be analyzed, have been already analyzed by using the conformal mapping, some have also been analyzed but not with the use of the conformal mapping technique, others will be analyzed here for the first time. In all cases numerical results are presented for the aid of comparisons for the previously analyzed lines or to investigate some of the properties of the new ones.

MTT

IEEE

Analysis and Design of Slow-Wave Structures Using an Integral Equation Approach

T.G. Livernois and P.B. Katehi. "Analysis and Design of Slow-Wave Structures Using an Integral Equation Approach." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1131-1134.

An integral equation formulation which yields dispersion characteristics for planar transmission lines on layered, lossy substrates is presented. Galerkin's procedure in the space domain is used and roots of the resulting characteristic equation provide the desired phase and attenuation constants. Numerical results are compared to those found in the literature for the MIS slow-wave structure.

Click on title for a complete paper.

Formulation of Mode Coupling Equations at Step Discontinuity Based on the Planar Circuit Theory

J.-P. Hsu, T. Anada, A.A. Oliner and S.T. Peng. "Formulation of Mode Coupling Equations at Step Discontinuity Based on the Planar Circuit Theory." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1135-1138.

Surface-wave planar circuits are frequently used at microwave, millimetric and optical waves. In order to construct a practical surface-wave planar circuit as shown in Fig.1, side-wall is needed to reflect or confine the surface-wave laterally. Usually two kinds of side-wall, i.e. metal wall or total power reflection wall above the critical angle (effected by step discontinuity as shown in Fig. 2) are utilized. The former is free from mode conversion, and conveniently used at microwaves, but not so at optical and millimetric waves because of the Ohmic loss. On the other hand the latter is useful at optical and millimetric waves because it is free from the Ohmic loss.

Modeling of High Frequency MMIC Passive Components

A. Nakatani, S.A. Maas and J. Castaneda. "Modeling of High Frequency MMIC Passive Components." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1139-1142.

The fullwave Green's function and Method of Moments approach is recognized as the most general and accurate solution method to the problem of high frequency modeling of MMIC passive circuit components. However, the computer codes derived on the basis of that method are usually computationally intensive. Several numerical techniques that significantly improve both the accuracy and efficiency of the method are presented. The numerical procedures do not reduce the generality of the method. The numerical technique is described as it has been applied to the problem of the enclosed or boxed microstrip structure. Results for the closed structure open-end and step discontinuities are presented.

Abstracts

Analysis and Modelng of Coupled Right Angle Microstrip Bend Discontinuities

A. Hill and V.K. Tripathi. "Analysis and Modelng of Coupled Right Angle Microstrip Bend Discontinuities." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1143-1146.

Various coupled right angle microstrip bends encountered in microwave integrated circuits can be modeled in terms of four port networks consisting of equivalent excess discontinuity self and mutual inductances and capacitances associated with the coupled bends. Coupling parameters of two frequently encountered microstrip right angle bend configurations are computed by employing an iterative technique in a moment method formulation. The simulation of a rectangular spiral inductor is included to demonstrate the coupling effect of the investigated discontinuities.

Abstracts

Equivalent Circuits of Microstrip Discontinuities Including Radiation Effects

A. Skrivervik and J.R. Mosig. "Equivalent Circuits of Microstrip Discontinuities Including Radiation Effects." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1147-1150.

An efficient theoretical method for the full-wave analysis of microstrip circuit elements has been developed, taking into account effects due to surface waves and radiation. A new de-embedding process allows the derivation of equivalent circuits independent of the feed model used. Results for bends and slots are in good agreement with measurements and reduce to quasistatic predictions in the low frequency range.

Abstracts

Three Dimensional Finite Element Method Applied to Dielectric Resonator Devices

S. Verdeyme, P. Auxemery, M. Aubourg and P. Guillon. "Three Dimensional Finite Element Method Applied to Dielectric Resonator Devices." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1151-1154.

Three dimensional finite element method (F.E.M.) is applied to evaluate electromagnetic and electrical parameters of the TE/sub 01delta/ cylindrical dielectric resonator (D.R.) mode housed into a parallelipipedic metallic enclosure. Numerical results concerning both frequencies, field vectors and coupling coefficients between adjacent D.R. are presented.

MTT

IEEE

Abstracts

New Possibilities of Cavity-Filter Design by a Novel TE-TM- Mode Iris-Coupling

U. Rosenberg and D. Wolk. "New Possibilities of Cavity-Filter Design by a Novel TE-TM-Mode Iris-Coupling." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1155-1158.

TE-TM resonances, being located in adjacent (physical) cavities are coupled by an iris. This new method is shown to provide realization of advantageous new coupling structures in dual-triple- mode cavity filter design. First experimental results obtained by a 7- pole filter (dual-/triple- mode cavities) are presented.

Computer Aided Design of Evanescent Mode Waveguide Bandpass Filter with Non-Touching E-Plane Fins

K.S. Kong and T. Itoh. "Computer Aided Design of Evanescent Mode Waveguide Bandpass Filter with Non-Touching E-Plane Fins." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1159-1162.

This paper presents an efficient computer aided design procedure for the evanescent mode waveguide bandpass filter with non-touching E-plane fins. The design procedure systematically utilizes a look-up table containing the scattering parameters of E-plane fins. In addition, this design procedure incorporates the correlations between each filter parameter and each characteristic of the filter into its algorithm.

Microwave Characteristics of GaAs MMIC Integratable Optical Detectors

P.C. Claspy, S.M. Hill and K.B. Bhasin. "Microwave Characteristics of GaAs MMIC Integratable Optical Detectors." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1163-1166.

Interdigitated photoconductive detectors have been fabricated on microwave device structures, making them easily integratable with MMIC's. Detector responsivity as high as 2.5 A/W and an external quantum efficiency of 3.81 were measured. Response speed was nearly independent of electrode geometry, and all detectors had usable response at frequencies to 6 GHz. A small signal model of the detectors based on microwave measurements is also developed.

Distortion Characteristics in Directly Modulated Laser Diodes by Microwave Signals

M.L. Majewski and L.A. Coldren. "Distortion Characteristics in Directly Modulated Laser Diodes by Microwave Signals." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1167-1170.

A simple method for harmonic and intermodulation distortion determination of a laser diode under direct modulation by microwave analog signals is presented and experimentally verified. The method makes use of small-signal perturbation analysis of the rate equations to obtain analytical expressions for laser diode distortion. Experimental verification of the method presented has been done using DFB laser diodes operated at 1.3 and 1.5µm wavelengths with modulation frequencies up to 6 GHz.

Microwave Characteristics of Planar Electrooptic Modulator

R. Delrue, E. Paleczny, J.F. Legier, P. Pribetich and P. Kennis. "Microwave Characteristics of Planar Electrooptic Modulator." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1171-1174.

We present in this communication an attempt to modelize new traveling wave optical modulators in the microwave frequency range by two methods: a desktop computer one based on the effective complex dielectric constant and a more rigourous method: the mode matching technique.

Dispersion Studies of a Single-Mode Triangular-Core Fiber with a Trench by the Vector Mode Analysis

G.L. Yip and J.W. Jiang. "Dispersion Studies of a Single-Mode Triangular-Core Fiber with a Trench by the Vector Mode Analysis." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1175-1178.

A Runge-Kutta procedure is used for investigating the dispersion characteristics of triangular-core fibers with a trench in the cladding. Numerical results on the total dispersion are presented, revealing some special features due to the trench. The presence of a trench has not been investigated previously.

An 8mm FM and AM Noise Measuring Equipment

D. Minren and X. Dezhong. "An 8mm FM and AM Noise Measuring Equipment." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1179-1181.

A FM/AM noise measurement equipment, in which a resonator cavity has been used as a discriminator to measure the FM/AM noise of a single oscillator, has been introduced in this paper, the threshold for FM noise measurement is -120dBc/Hz (f=50kHz) and for AM noise measurement is -158dBc/Hz (f=50kHz).

Direct Measurement of the Optimum Source Impedance for Minimum Noise Figure

O. Ishikawa, H. Yagita, T. Tanbo and T. Onuma. "Direct Measurement of the Optimum Source Impedance for Minimum Noise Figure." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1183-1186.

A new measurement system and method measuring the optimum source impedance for the minimum noise figure of the transistor on the wafer has been developed by using the microwave wafer prober system. The new measurement system is constructed from four blocks: 1) network analyzer 2) noise meter 3) microwave wafer probers 4) coaxial switches that connect the 1) - 3) blocks. After tuning to the minimum noise point by connecting the noise meter and microwave probers, these probers are turned to the network analyzer by coaxial switches, and then source (or load) impedance is measured continuously. The optimum source impedance is measured by two different methods: ("REAL-TIME method" and "50-SHORT-OPEN method"). Two measurement methods showed a little phase difference. Using this system and methods, we have designed the low noise MMIC amplifier operating at 12GHz and evaluated. It showed the the minimum noise figure without another tuning.

Establishing the Complex Measurement Ability of a Homodyne Network Analyzer via Self-Calibration

H.-J. Eul. "Establishing the Complex Measurement Ability of a Homodyne Network Analyzer via Self-Calibration." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1187-1190.

A homodyne phase shifter controlled double-reflectometer is presented. The ability for complex measurement, i.e. the knowledge of the phase shifter characteristics, is established with fully unknown standards by only exploiting reciprocity. If a system error correction is performed the data needed for error correction contain enough information to determine the phase shifter behavior. Therefore no additional standards are needed.

Theoretical and Experimental Characterization of Radial-Resonator Waveguide Mounting Structures

A. Ko and B.D. Bates. "Theoretical and Experimental Characterization of Radial-Resonator Waveguide Mounting Structures." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1191-1194.

Further development of millimeter wave computer-aided design methods requires accurate analysis and measurement techniques. This paper provides a useful source of experimental data for verification of a systematic computer-based analysis for a radial-resonator diode-mounting structure. The measurements are processed through an accurate de-embedding technique for this radial-waveguide device.

Vector Measurements of Microwave Devices at Cryogenic Temperatures

J.W. Smuk, M.G. Stubbs and J.S. Wight. "Vector Measurements of Microwave Devices at Cryogenic Temperatures." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1195-1198.

A real-time method to de-embed S-parameter measurements of MIC devices operated at 77°K is presented. Measurements of both an interdigitated capacitor and a GaAs MESFET cooled in a liquid nitroqen bath are shown for frequencies from 2.5 GHz to 20 GHz.

A Multipath Fading Microwave Simulator for Studying Space Diversity Systems

J.C. Guillard and X. Le Polozec. "A Multipath Fading Microwave Simulator for Studying Space Diversity Systems." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1199-1202.

This article describes the microwave structure of a multipath fading simulator for studying space diversity systems. This simulator has two independent channels and is controlled in real time by a PC (or compatible). It is used for developing control software for space diversity and the automatic registering of signatures.

Abstracts

A New W-Band Coplanar Waveguide Test Fixture

J.V. Bellantoni, R.C. Compton and H.M. Levy. "A New W-Band Coplanar Waveguide Test Fixture." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1203-1204.

A new type of coplanar waveguide (CPW) test fixture suitable for transistor measurements in the 75-110 GHz band will be presented. The fixture employs finline tapers to transition from waveguide to CPW, and air-bridges to tie the opposing ground planes to the same potential. A simple computer model has been developed to aid in the design of the waveguide to CPW transitions. A prototype fabricated on low dielectric substrate has 4 dB loss from 85-95 GHz.

Varactor-Tuned Planar W-Band Oscillator

J. Buechler, J.F. Luy and K.M. Strohm. "Varactor-Tuned Planar W-Band Oscillator." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1205-1206.

A planar integrated VCO for the W-Band on high resistivity silicon substrate was fabricated. For that purpose an oscillator circuit for fixed frequency CW operation was extended. Frequency variation is obtained by coupling a radial line sector to a disc resonator via a varactor diode. As the active device a Si-MBE (molecular beam epitaxy) made Quasi Read Double Drift IMPATT diode is used. A hyperabrupt doping profile is used in the varactor diode. The hybrid integrated VCO is fabricated on a 10000 Omega · cm silicon substrate. The chip size is 6 · 4.5 mm². A tuning range of 380 MHz around 80.2 GHz with an output power of 18 mW is obtained.

Abstracts

High Performance Millimeter-Wave Local Oscillator Module for EW Applications

E. Boch and T. Stajcer. "High Performance Millimeter-Wave Local Oscillator Module for EW Applications." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1207-1210.

A miniature high stability local oscillator module has been developed for EW applications. The module consists of a dielectrically stabilized FET oscillator, buffer amplifier and a planar varactor multiplier which are integrated to form a minature planar circuit. The module exhibits excellent phase noise, high efficiency, high frequency stability and good power stability (over temperature). The module has also been successfully tested over extremes of temperature and vibration environments encountered for military environments without degradation of the LO performance.

A Novel W-Band Suspended Substrate Microstripline Second Harmonic GaAs Gunn Oscillator

Y. Shu and Y. Wang. "A Novel W-Band Suspended Substrate Microstripline Second Harmonic GaAs Gunn Oscillator." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1211-1214.

A novel w-band suspended substrate microstripline second harmonic GaAs Gunn oscillator has been developed. The output power of 4 mW at 94 GHz, 5.8 mW at 88.3 GHz and 15 mW at 75 GHz has been achieved with different Gunn devices and circuit parameters, respectively.

A W Band Dielectric Resonator Power Combiner

D. Cros, P. Auxemery, X.H. Jiao, B. Jarry and P. Guillon. "A W Band Dielectric Resonator Power Combiner." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1215-1218.

This article presents the utilization of planar millimeter wavelength whispering gallery (W.G.) dielectric resonators modes for the realization of power combiners. A theoretical model of whispering Gallery dielectric resonator mode coupled with two transmissions lines and experimental results of power combination obtained in both X band (8-12.4 GHz) and W band (75-110 GHz) are given.

Theoretical and Experimental Characterization of Nonsymmetrically Shielded Coplanar Waveguides for Millimeter Wave Circuits (1989 Vol. III [MWSYM])

F. Alessandri, U. Goebel, F. Melai and R. Sorrentino. "Theoretical and Experimental Characterization of Nonsymmetrically Shielded Coplanar Waveguides for Millimeter Wave Circuits (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1219-1222.

The nonsymmetrically shielded coplanar waveguide (NSCPW) is proposed as a quasi-TEM transmission line with advantageous characteristics for mm-wave circuit applications. The structure combines properties of the finline and the suspended stripline. In addition to a full wave theoretical analysis, an experimental technique has been developed which enables the evaluation of the transmission line spectrum in a wide frequency band (15:1) with a single transmission measurement. Results are shown to be in excellent agreement with theoretical predictions. Design curves are also presented.

Abstracts

Higher Order Frequency Multipliers -- A Solution for mm- and Submm-Wave Local Oscillator Signal Generation

T. Tolmunen, A. Raisanen and M. Sironen. "Higher Order Frequency Multipliers -- A Solution for mm- and Submm-Wave Local Oscillator Signal Generation." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1223-1226.

A frequency quadrupler for 140 GHz and frequency doublers for 183 GHz and 230 GHz have been analyzed both theoretically and experimentally. A theoretical comparison of generation of 345 GHz signal using a doubler, tripler, quadrupler or two cascaded doublers, and generation of 460 GHz signal using a doubler, quadrupler or two cascaded doublers has also been carried out.

A Tunable, Temperature Compensated Hybrid Mode Dielectric Resonators

S.-W. Chen, K.A. Zaki and R.G. West. "A Tunable, Temperature Compensated Hybrid Mode Dielectric Resonators." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1227-1230.

A thermal and an electromagnetic model of a tunable hybrid mode dielectric double resonator is introduced, and analyzed by the mode matching technique. Results of the analysis shows the temperature sensitivity of the structure as a function of the spacing between the double resonators as well as the other resonator parameters. A simple optimization procedure is described, which enables the design of the resonator to simultaneously have wide tunability range and good thermal stability of the resonant frequency.

Unloaded Q's of Axially Asymmetric Modes of Dielect of Resonators

H.-C. Chang and K.A. Zaki. "Unloaded Q's of Axially Asymmetric Modes of Dielect of Resonators." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1231-1234.

Resonant frequencies and unloaded Q's of hybrid modes on cylindrical, dielectric resonators in conducting enclosures are studied. The formulation uses the mode matching technique, and includes axially symmetric (TE/sub 0m/ and/or TM/sub 0m/), as well as axially non-symmetric hybrid (HE/sub nm/) modes which could exist in dielectric loaded waveguides. The structures analyzed can simulate resonators on microstrip substrates. The losses in both the conducting walls and the dielectric material, and stored energy in the general resonator are obtained. Mode amplitudes determined from the solution of the boundary value problem by mode matching, are used to rigorously compute the unloaded Q's of the resonators. Numerical results in the millimeter wave range are presented for the unloaded Q's of various modes, as a function of the resonator parameters. From these results effect of losses on the resonator wall are discussed, and methods of improving the unloaded Q's are explored. Experimental results are presented which verify the accuracy of the model used and the numerical computations.

Numerical Analysis of the Tubular Dielectric Resonator with a Dielectric Tuning Rod

D. Kajfez and J. Lebaric. "Numerical Analysis of the Tubular Dielectric Resonator with a Dielectric Tuning Rod." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1235-1238.

This paper presents the results of the numerical analysis of a resonant cavity containing a tubular dielectric resonator and a dielectric tuning rod. For the given set of dimensions, the analysis indicates that the resonant mode TM/sub 01/ can be tuned over 14% of the frequency range. Higher-order modes, which could interfere with the desired TM/sub 01/ mode, are also evaluated.

Frequency and Low-Temperature Characteristics of High-Q Dielectric Resonators

Y. Kobayashi, Y. Kabe, Y. Kogami and T. Yamagishi. "Frequency and Low-Temperature Characteristics of High-Q Dielectric Resonators." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1239-1242.

Accurate calculations of unloaded Q are described for the TE/sub 01delta/, TM/sub 01delta/, EH/sub 11delta, and HE/sub 11delta/ modes in a dielectric rod resonator placed in a conductor cavity. These calculated results are verified experimentally. Mode designation is investigated from a viewpoint of field distribution. In particular, for high-Q TE/sub 01delta/-mode dielectric resonators, the frequency and temperature characteristics are discussed. A typical result measured at 4 GHz shows the unloaded Q values of 45,000 at 20°C and of 140,000 at -180°C with the temperature coefficient of frequency of 1.5 ppm/°C.

Abstracts

180° Lumped Element Hybrid

S.J. Parisi. "180° Lumped Element Hybrid." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1243-1246.

At frequencies below 18 GHz, distributed element hybrids consume too much valuable GaAs real estate to be cost-effective. An appreciable reduction in surface area without a degradation in electrical performance can be realized with the use of lumped element hybrids. This paper describes the design methodology employed in the development of a 180-degree lumped element hybrid. This technique is also applicable to other distributed devices such as the 90-degree branch line hybrid and the Wilkinson power divider.

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Unilateral Microstrip Balanced and Doubly Balanced Mixers

R. Knochel, B. Mayer and U. Goebel. "Unilateral Microstrip Balanced and Doubly Balanced Mixers." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1247-1250.

Possibilities for the uniplanar realisation of balanced and doubly-balanced microstrip mixers are discussed. Several novel mixer designs are presented, which can be used for miniaturization or for broadbanding the performance, using simple and noncritical branchlike structures. The feasibility of the structures is verified experimentally. Relative bandwidths up to approximately 45% are reached easily.

The Power Transfer Mechanism of MMIC Spiral Transformers and Adjacent Spiral Inductors

G.E. Howard, J. Dai, Y.L. Chow and M.G. Stubbs. "The Power Transfer Mechanism of MMIC Spiral Transformers and Adjacent Spiral Inductors." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1251-1254.

With its accuracy verified by many tests, the software WATMIC-EMsim is now used to analyze the coupling between (I) the two coils of an MMIC transformer and (II) two adjacent MMIC square spiral inductors. It is found that: (I) for the transformer, the simple magnetic coupling in power transfer between the two coils only occurs at the low frequency end of the microwave frequency, and (II) for the adjacent inductors, the coupling S/sub 21/ is very small. It begins at -26 dB when the two spirals nearly touch and rapidly drops as a function of (1/d)/sup 7/ where d is the center to center separation between the two spirals.

Focusing Mirrors for Gaussian Beams

M. Boheim. "Focusing Mirrors for Gaussian Beams." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1255-1258.

A new procedure is presented, that calculates the shape of focusing mirrors by controlling the phase distribution of Gaussian beams. The angle of incidence and three of the four beam parameters (beam waist radii and focal lengths of the incident and reflected beam) can be choosen arbitrarily.

Parasitic Effects Induced by Power Strips Current Switching in Full Wafer Package

J. Chilo and G. Angenieux. "Parasitic Effects Induced by Power Strips Current Switching in Full Wafer Package." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1259-1262.

Parasitic effects induced by current switching in power lines for full wafer packages (monolithic or hybrid) are analyzed in the time domain. Theoretical results allow to give simple relations in order to easily predict: * the dynamic drop voltage on the power line, * the parasitic voltages on signal lines, induced by coupling with power line. Experimental measurements on typical devices validate these formula.

Abstracts

Suppression of Resonant Modes in Microwave Packages

D.F. Williams and D.W. Paananen. "Suppression of Resonant Modes in Microwave Packages." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1263-1265.

Undesirable resonant cavity modes of a metal package are shown to be effectively damped by placing a dielectric substrate coated with a resistive film in the cavity. Theoretical predictions are confirmed experimentally. The application of the technique is demonstrated for a practical packaging problem.

Lossy Model of Diode Packages: An Alternative Method for Exact Evaluation of Active Chip Parameters

K. Kazi, B.B. Szendrenyi and I. Mojzes. "Lossy Model of Diode Packages: An Alternative Method for Exact Evaluation of Active Chip Parameters." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1267-1270.

A systematic method of obtaining accurate models of microwave active device packages is reported. Using a set of offset shorts as coaxial line extensions the effect of the lossy elements of the package can be determined with high accuracy. In the next step encapsulated varactor diode chips are investigated. The Q factor of the encapsulated device calculated by applying the model to experimental measurements shows a high degradation depending on the ratio of the package parasitic to the device parameters. Experimental results compared with calculated model show good agreement up to 20 GHz on S4 type packages.

Dispersion in Anisotropic NRD Waveguide

A.C. Cesar and R.F. Souza. "Dispersion in Anisotropic NRD Waveguide." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1271-1272.

NRD waveguide is a proposed structure for millimeter wave applications. In this paper, the isotropic dielectric of this structure is replaced by a longitudinally magnetized ferrite, allowing the implementation of NRD non-reciprocal devices. Numerical results for the dispersion of the first few propagation modes in this structure is presented.

Abstracts

Analysis and Tuning Efficiency Optimization of Magnetically Tuned Printed E-Plane Circuit Filters

J. Uher and W.J.R. Hoefer. "Analysis and Tuning Efficiency Optimization of Magnetically Tuned Printed E-Plane Circuit Filters." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1273-1276.

The tuning efficiency of metal insert filter loaded with ferrite slabs is defined and analysed. Three parameters which dominate the filter tunability (ferrite slab thickness, distance to narrow waveguide wall and ferrite saturation magnetization) are discussed. An optimum combination of these parameters has been found and new filter design based on modal scattering method is presented. The improved filters can be tuned over 60-70% of a standard waveguide band with an insertion loss between 1 and 3 dB, depending on frequency.

Design and Low-Power Testing of a Microwave Vlasov Mode Convertor

B.G. Ruth, R.K. Daldstrom, C.D. Schlesiger and L.F. Libelo. "Design and Low-Power Testing of a Microwave Vlasov Mode Convertor." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1277-1280.

A circular waveguide with a shaped open end forms the launcher component of a Vlasov mode convertor. This paper compares the gain pattern obtained for an open end with a step cut with that for a beveled cut. Determination of the gain pattern is the first step in the design of a high-power mode convertor intended for X-band (8 to 12 GHz).

50W Class Multi-Port Amplifier for Multi-Beam Satellite Communications

K. Yamamoto and M. Tanaka. "50W Class Multi-Port Amplifier for Multi-Beam Satellite Communications." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1281-1284.

A Multi-port Amplifier (MPA), composed of an array of high power amplifiers (HPAs), a power divider and a power combiner, is suitable for on-board transponder in a multi-beam mobile satellite communications system. A 50W class experimental MPA composed of 8 HPAs has been developed based on a design method which takes account of the nonuniformity of HPA characteristics. It has exhibited excellent performance.

Session QQ -- Solid State Circuits

"Session QQ -- Solid State Circuits." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1285-1285.

Millimeter-Wave, Lumped-Element, Gunn VCO's with Ultrawideband (20 GHz) Tuning

L.D. Cohen and E. Sard. "Millimeter-Wave, Lumped-Element, Gunn VCO's with Ultrawideband (20 GHz) Tuning." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1287-1290.

A new millimeter-wave Gunn VCO with ultrawideband tuning has been developed and modeled. The VCO is tuned at its reactively terminated fundamental frequency and output is obtained from the in-situ generated Gunn diode second harmonic. Measured state-of-the-art performance includes continuous tuning from 46 to 66 GHz, a 20-GHz tuning range, with a maximum power output of +6 dBm.

Abstracts

Second-Harmonic Reflector Type High-Gain FET Frequency Doubler Operating in K-Band

Y. Iyama, A. Iida, T. Takagi and S. Urasaki. "Second-Harmonic Reflector Type High-Gain FET Frequency Doubler Operating in K-Band." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1291-1294.

High gain FET frequency doubler with second harmonic reflector in input circuit has been developed. The reflector position which gives maximum multiplication gain depends on line loss. The relation between multiplication gain and the reflector position is varying with line loss. K-band frequency doubler designed by this theory was fabricated. Good coincidence was obtained with high gain of 6dB.

A Monolithic DC-1.6GHz Digital Attenuator

J. Bayruns, P. Wallace and N. Scheinberg. "A Monolithic DC-1.6GHz Digital Attenuator." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1295-1298.

A 5-bit digital attenuator with integral TTL compatible switch drivers is described. The unit has a 15.5dB attenuation range in 0.5dB increments, 3dB insertion loss, operating frequency range from DC to 1.6GHz, and 1.4:1 input/output VSWR over that frequency range. The unit employs the use of GaAs MESFET integrated circuit technology.

A Balanced 11 GHz HEMT Up-Converter

P. Bura and B. Vassilakis. "A Balanced 11 GHz HEMT Up-Converter." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1299-1302.

A 70 MHz to 11 GHz balanced up-converter circuit is described. HEMTs were found to be very suitable for this application due to their high gain at 11 GHz. The measured results show 7 dBm 1 dB gain compression point, 15 dBm third order intercept point, 3 dB conversion gain and 35 dB LO suppression.

Transient Response of PIN Limiter Diodes

R.J. Tan, A.L. Ward and R. Kaul. "Transient Response of PIN Limiter Diodes." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1303-1306.

Results of experimental and theoretical studies have determined which physical parameters of PIN diode junctions control their dynamic responses as limiters to fast risetime microwave pulses. Both rf and dc dynamic impedance measurements were made and compared, with good agreement, to theoretical calculations which model both the junction and intrinsic regions of the PIN diode.

Abstracts

Maps (1989 Vol. III [MWSYM])

"Maps (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1307-1307.

Abstracts

Index of Authors (1989 Vol. III [MWSYM])

"Index of Authors (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1309-1312.

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Abstracts

Exhibition Guide (1989 Vol. III [MWSYM])

"Exhibition Guide (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): 1313-1327.

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Back Cover (1989 Vol. III [MWSYM])

"Back Cover (1989 Vol. III [MWSYM])." 1989 MTT-S International Microwave Symposium Digest 89.3 (1989 Vol. III [MWSYM]): b1-b2.

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Front Cover (1988 [MCS])

"Front Cover (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): f1-f1.

Copyright (1988 [MCS])

"Copyright (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): i-ii.

Message from the General Chairman (1988 [MCS])

D. Hornbuckle. "Message from the General Chairman (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): iii-iii.

Welcome to the 1988 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium, and to New York City. Thanks to your interest and participation, this, the seventh annual Symposium, is once again expected to set a new record for attendance, and is already the largest ever in terms of number of papers. The two day technical program begins Tuesday, May 24, at the Marriott Marquis Hotel, Times Square, New York. On Wednesday, May 25, the Symposium continues under joint sponsorship of the IEEE Microwave Theory and Techniques International Microwave Symposium, at the Jacob Javits Convention Center.

Committees (1988 [MCS])

"Committees (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): iv-iv.

Message from the Technical Program Chairman (1988 [MCS])

R.S. Kagiwada. "Message from the Technical Program Chairman (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): v-v.

On behalf of the Technical Program Committee, I would like to welcome you to the 1988 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium. Through the hard dedicated work of the Technical Program Committee, we have again prepared an outstanding program. The quality of this symposium is reflected in the rapid growth both in the record number of papers submitted and the large attendance. Last year 950 people attended the Microwave and Millimeter-Wave Monolithic Circuits Symposium.

Abstracts

Steering and Technical Program Committees (1988 [MCS])

"Steering and Technical Program Committees (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): vi-vii.

Table of Contents (1988 [MCS])

"Table of Contents (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): viii-xi.

The MIMIC Program--Key to Affordable MMICs for DoD Systems

E.D. Cohen. "The MIMIC Program--Key to Affordable MMICs for DoD Systems." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 1-4.

The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program is a seven year, $0.5 billion program initiated by the Department of Defense (DoD) in 1986 to provide affordable, available and reliable microwave and millimeter wave circuits for use in military electronic systems. This paper describes the program, its objectives, organization, plans, and current status.

Abstracts

A K/Ka-Band Distributed Power Amplifier with Capacitive Drain Coupling (1988 [MCS])

M.J. Schindler, J.P. Wendler, M.P. Zaitlin, M.E. Miller and J.R. Dormail. "A K/Ka-Band Distributed Power Amplifier with Capacitive Drain Coupling (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 5-8.

A 14 to 37 GHz MMIC distributed power amplifier has been demonstrated. The amplifier has three FETs of varying periphery, all capacitively coupled to the gate line. A new circuit concept has been used to increase output power, the drain of the last FET is capacitively coupled to the drain line. 4 dB gain has been achieved from 14 to 37 GHz. Output power of 20 dBm or greater has been demonstrated at frequencies up to 33 GHz at 1 dB compression. A maximum 1 dB compressed output power of 23.5 dBm (220mw) has been measured at 26 GHz. The circuit is truly monolithic, with all bias and matching circuitry included on the chip.

Application Specific MMIC: A Unique and Affordable Approach to MMIC Development

E. Turner, Z. Lemnios, S. Moghe, A. Podell, C. Korgell, R. Genin and H.-C. Huang. "Application Specific MMIC: A Unique and Affordable Approach to MMIC Development." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 9-14.

The high levels of integration possible with GaAs Microwave Monolithic Integrated Circuits has the potential of tremendous benefits of reduced cost, size, and weight and increased reliability of microwave systems. These benefits have only been realized for systems that can justify the high costs and risk of MMIC development. Application Specific MMIC (ASMMIC) promises to simplify the development process and hence reduce the development cost and risk. Furthermore, ASMMIC can realize volume production savings through a shared production process and through increased production demand. The foundation of the innovative ASMMIC concept is a predesigned footprint building block. This footprint comprises the layers containing FETs, resistors and diodes in an array compatible with a wide range of circuit functions. The chip is completed by applying personalized metalization to the footprint. Wafers of footprints can reproduced in volume, fully characterized, and placed in inventory. The characterized data will be used as accurate parameters of the models contained in the ASMMIC CAD library. The ASMMIC CAD will facilitate the design of the metalization layers which establish the circuit functionality (amplifier, mixer, oscillator, limiter, switch, isolator, attenuator, etc.) and the operating frequency and power range. The design and application of the metalization layers can be accomplished with high confidence and within a time span of a few weeks. This contrasts with a complex "from the ground up" custom design and production process requiring many months and one that inherently has the potential for many design and process errors. ASMMIC offers the possibility of making MMICs accessible, affordable and available for a broad range of systems applications. To ensure accessibility, the ASMMIC technology will be readily transferable to a wide range of users through computer aided engineering tools which are being developed.

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6 to 18 GHz Single-Ended and Push-Pull MMIC Amplifiers for High-Gain Modules

R. Ramachandran, S. Moghe, J. Girimaji and A. Podell. "6 to 18 GHz Single-Ended and Push-Pull MMIC Amplifiers for High-Gain Modules." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 15-18.

Broadband single-ended and push-pull MMIC amplifiers are presented which achieve high gain per mA and demonstrate excellent cascadability. The single-ended 6 to 18 GHz amplifier shows 10±1 dB gain for 25 mA current, which is the highest gain per mA reported for an amplifier in this band. The push-pull amplifier shows 10 dB gain for 50 mA current with a higher output power of 12 dBm at 1 dB gain compression, P(-1 dB). It also has the added features of gain equalization and gain control. A module designed with four push-pull chips shows excellent gain flatness of 34±1 dB. Both of these MMICS are very compact (only 36 x 48 and 48 x 48 mils) and demonstrate high overall yield (>80%) due to the absence of via holes and other yield limiting process steps.

Satellites and Cables in the Future Marketplace and the Role of MMIC

S.J. Campanella and C.E. Mahle. "Satellites and Cables in the Future Marketplace and the Role of MMIC." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 19-26.

Satellite communications began in 1965 with a small, lightweight INTELSAT I satellite called Early Bird, placed in the geostationary orbit at an altitude of 22,300 miles above the equator. Its antenna was a simple dipole that generated a 360° toroidal (doughnut) beam pattern, only 17° of which intercepted the earth yielding only modest performance capabilities; viz. a receive gain-to-noise temperature ratio (G/T) of -20 dB/K and an e.i.r.p. toward the earth of only 11 dBw. It carried only one wideband transponder operating at the C-band frequencies of 6 GHz up, and 4 GHz down. This was sufficient to support 240 voice circuits between large 30-m-diameter aperture antennas with 63-dB gain and a G/T of 39 dB/K. These large earth stations were very expensive, a fact that would ultimately result in a lower bound on the cost of delivery of telephony service.

A GaAs MESFET 7 Gb/s Dynamic Decision Circuit I.C.

R.J. Bayruns, A.D.M. Chen, J. Gilbert, R. Goyal and J. Wang. "A GaAs MESFET 7 Gb/s Dynamic Decision Circuit I.C.." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 27-30.

A dynamic decision circuit uses 0.5 µm gate GaAs MESFET technology and charge canceling techniques to obtain a 7 Gb/s clocking rate. The 0.6Vp-p output data eye is symmetrical and has 70 pS rise and fall times while retiming a noisy data input. The circuit operates from a single -6V supply and dissipates 0.24W of power. The chip size is 0.5 mm².

A 9.5 GHz Commercially Available 1/4 GaAs Dynamic Prescaler with Suppressed Noise Performance

M. Takahashi, H. Itoh, K. Ueda and R. Yamamoto. "A 9.5 GHz Commercially Available 1/4 GaAs Dynamic Prescaler with Suppressed Noise Performance." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 31-36.

A mass-production level 1/4 GaAs monolithic dynamic prescaler operating at a single clock input of 9.5 GHz with a power dissipation of 450 mW has been successfully realized. In addition, the phase noise performances were also investigated to obtain an excellent result and to accomplish the verified level of -100 dBc/Hz and -120 dBc/Hz at 100Hz and 10 KHz offsets for a 6.725 GHz input, which are considered to be low enough for a practical use.

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A GaAs Monolithic True Logarithmic Amplifier for 0.5 to 4 GHz Applications

M.A. Smith. "A GaAs Monolithic True Logarithmic Amplifier for 0.5 to 4 GHz Applications." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 37-40.

A GaAs monolithic dual-gain amplifier stage for 0.5 to 4 GHz logarithmic amplifier applications has been developed and tested. A cascade of six of these stages has resulted in a true logarithmic amplifier with 70 dB dynamic range, operational across this band.

High-Performance GaAs Heterojunction Bipolar Transistor Logarithmic IF Amplifier

A.K. Oki, M.E. Kim, G.M. Gorman and J.B. Camou. "High-Performance GaAs Heterojunction Bipolar Transistor Logarithmic IF Amplifier." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 41-46.

The GaAs/AIGaAs heterojunction bipolar transistor (HBT) has been used to demonstrate a high performance logarithmic amplifier, also believed to be the first using the HBT technology. A "true" logarithmic intermediate frequency (IF) amplifier is implemented, based on a silicon bipolar transistor dual-gain log stage design. The HBT true log IF amplifier monolithically integrates four log stages to achieve a piecewise-linear approximated log function for compression of wide dynamic range signals. An HBT IC fabrication process based on metal-organic chemical vapor deposition (MOCVD) epitaxy and a 3 µm emitter self-aligned base ohmic transistor is used to advance the state-of-the-art log IF amplifier technology in terms of IF frequency and bandwidth, pulse resolution, and monolithic dynamic range and accuracy. The true log IF amp performance includes DC-3 GHz IF/video bandwidth, 400 pS rise time, and <±1 dB log error over/spl ap/ 40 dB dynamic range at 3 GHz.

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A 15 GHz Single Stage GaAs Dual-Gate FET Monolithic Analog Frequency Divider with Reduced Input Threshold Power (1988 [MCS])

K. Kanazawa, M. Kazumura and G. Kano. "A 15 GHz Single Stage GaAs Dual-Gate FET Monolithic Analog Frequency Divider with Reduced Input Threshold Power (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 47-50.

A 15 GHz single stage GaAs dual-gate FET monolithic analog frequency divider with the reduced input threshold power has been designed and fabricated. Use of the dual-gate structure for the FET mixer contributed to simplifying the circuit configuration. Introduction of the rejection filter at the output port resulted in reducing the input threshold power down to 1.4dBm.

GaAs MMIC Slotline/CPW Quadrature IF Upconverter

G.K. Lewis, I.J. Bahl, A.E. Geissberger and E.R. Schineller. "GaAs MMIC Slotline/CPW Quadrature IF Upconverter." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 51-54.

A unique GaAs monolithic Slotline/Coplanar Waveguide (SL/CPW) quadrature IF upconverter IC has been developed. The IC is a single-sideband suppressed carrier upconverter and consists of LO and RF power splitters, two IF/RF diplexers, and two SL/CPW single balanced mixers. The IC is unique because it has circuitry on both sides of the chip which required a few additional processing steps to fabricate. With a 7.0 GHz LO, and a 1 MHz to 1000 MHz quadrature IF input signal, the typical upconverter performance was 40dB LO port to RF port isolation, 25 dB carrier suppression, 20 dB sideband suppression, and 14 dB conversion loss in the 6-8 GHz RF output band.

Monolithic Ka-Band VCOs

R. Goldwasser, D. Donoghue, G. Dawe, S. Nash, C. Fingerman, I. Crossley, C. Mason, L. Rafaelli and R. Tayrani. "Monolithic Ka-Band VCOs." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 55-58.

Two distinct monolithic GaAs Voltage Controlled Oscillators have been developed: a Gunn diode based circuit and a FET based circuit. The Gunn VCO design incorporates 14 Gunn diodes, a varactor diode, power combiner, matching network and bias on a single integrated chip. The Gunn oscillator has delivered 125 mW at 32 GHz and 70 mW at 40 GHz. This is considerably above power levels reported for Ka-band Monolithic Oscillators to date. The FET circuit utilizes a 1/4 µm x 200 µm GaAs MESFET; it has produced up to 20 mW output power. This is the first publication of a millimeter wave, monolithic MESFET VCO to our knowledge.

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Millimeter-Wave Monolithic GaAs IMPATT VCO (1988 [MCS])

N.L. Wang, W. Stacey, R. Brooks, K. Donegan and W. Hoke. "Millimeter-Wave Monolithic GaAs IMPATT VCO (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 59-62.

A monolithic voltage controlled oscillator (VCO) has been constructed using a GaAs double-drift Read IMPATT as the active element and a similar diode biased below breakdown as the varactor. The chip produced 120 mW peak power over an electronically controlled tuning range between 47 to 48 GHz. A computer analysis based on characterized circuit parameters has been used to predict the performance of the chip.

Monolithic 60 GHz GaAs CW IMPATT Oscillator (1988 [MCS])

B. Bayraktaroglu. "Monolithic 60 GHz GaAs CW IMPATT Oscillator (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 63-66.

A monolithic circuit design was developed for GaAs IMPATT diodes to enable their operation under CW conditions at V-band ferquencies. All impedance matching circuits were fabricated on the top surface of the GaAs substrate. At 61.5 GHz 100 mw CW output power was obtained with 13.5% conversion efficiency. In an alternative design, varactor diodes were integrated with the IMPATT circuits to produce the first monolithic VCOs operating under CW conditions. Over 3.5 GHz tuning bandwidth was obtained at a center frequency of 70 GHz with a CW output power of 15 mW.

Silicon Millimeter-Wave Circuits for Receivers and Transmitters

J. Buechler, E. Kasper, J.F. Luy, P. Russer and K.M. Strohm. "Silicon Millimeter-Wave Circuits for Receivers and Transmitters." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 67-70.

For the 90 GHz band we have fabricated a monolithic integrated Schottky diode receiver on a highly insulating silicon substrate. The receiver consists of the monolithic Schottky diode and a planar antenna structure on one silicon chip. The receiver sensitivity is 65 µWcm/sup -2/. The receiver antenna half-power beamwidth is 23° and the side lobe attenuation is 12 dB. Also new results on planar W-band oscillators hybrid integrated on highly insulating silicon substrates with double drift region IMPATT diodes are presented. The CW oscillator output power is greater than 20 mW and the efficiency is more than 1 percent.

Broadband Monolithic Single and Double Ring Active/Passive Mixers

A.M. Pavio, R.H. Halladay, S.D. Bingham and C.A. Sapashe. "Broadband Monolithic Single and Double Ring Active/Passive Mixers." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 71-74.

Several double balanced multi-octave bandwidth mixers, comprised of active center tapped baluns and diode rings have been fabricated using planar monolithic circuit technology. The unique approach eliminates IF extraction problems and combines the best performance characteristics of FETs and diodes.

Uniplanar MMICs and Their Applications (1988 [MCS])

M. Muraguchi, T. Hirota, A. Minakawa, K. Ohwada and T. Sugeta. "Uniplanar MMICs and Their Applications (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 75-78.

Key uniplanar MMICs for a 26GHz full MMIC receiver have been designed and fabricated using 0.3µm-gate ion implanted GaAs IC processes. They consist of coplanar waveguides, slotlines, and lumped circuit elements (GaAs FETs, capacitors, etc.), which employ only one side of GaAs substrate and have no via holes and no polished thin substrates. The developed uniplanar MMICs yield improved RF performance, chip size reduction, and fabrication process simplification.

X-Band Monolithic Variable Gain Series Feedback LNA

D.D. Heston and R.E. Lehmann. "X-Band Monolithic Variable Gain Series Feedback LNA." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 79-82.

An X-band monolithic four-stage low-noise amplifier (LNA) employing series feedback has demonstrated a 1.8-dB noise figure with 33.8-dB gain and greater than 40-dB gain control capability. This design features single- and dual-gate FETs (DGFETs) on the same chip. Gain control is achieved without degradation of input or output VSWR. The two input stages use single-gate FETs to achieve minimum noise figure, while the output stages employ DGFETs for gain control capability.

A Dual-Varactor, Analog Phase Shifter Operating 6 to 18 GHz (1988 [MCS])

D.M. Krafcsik, S.A. Imhoff, D.E. Dawson and A.L. Conti. "A Dual-Varactor, Analog Phase Shifter Operating 6 to 18 GHz (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 83-86.

An MMIC analog reflection phase shifter achieves 120 degrees of phase shift from 6 to 18 GHz using a dual-varactor reflection circuit which allows varactors with 3:1 capacitance ratio to achieve the performance that normally requires 10:1 diodes. The varactor diode is a surface-oriented structure with a hyperabrupt doping profile selectively ion implanted to a depth of 0.70 µm.

60-GHz GaAs MMIC Low-Noise Amplifiers

H.-L.A. Hung, T.T. Lee, F.R. Phelleps, J.F. Singer, J.F. Bass, T.F. Noble, H.C. Huang and P. Rainville. "60-GHz GaAs MMIC Low-Noise Amplifiers." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 87-90.

GaAs monolithic MESFET low-noise amplifiers (LNAs) have been developed at V-band. A single-stage MMIC has achieved a 6.4-dB noise figure and 3.5-dB gain at 59 GHz. A cascaded six-stage amplifier exhibited 9.5-dB minimum noise figure and 26-dB gain from 56 to 60 GHz. These data may represent the first reported results of MMIC LNAs in the 60-GHz band with DC-blocking and bias networks.

Abstracts

A Q-Band Monolithic Three-Stage Amplifier

J. Yonaki, M. Aust, K. Nakano, G. Dow, L.C.T Liu, E. Hsieh, R. Dia and H.C. Yen. "A Q-Band Monolithic Three-Stage Amplifier." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 91-94.

A Q-band High Electron Mobility Transistor (HEMT) amplifier has been designed and fabricated. This three stage circuit utilizes 0.2 x 60 micron HEMT devices. The amplifier has a measured gain of over 10 dB from 42 to 47.5 GHz and a peak gain of 16 dB at 44.5 GHz. This result represents the state-of-the-art monolithic HEMT amplifier performance.

Click on title for a complete paper.

Abstracts

A 3 Bit K/Ka Band MMIC Phase Shifter

M.J. Schindler and M.E. Miller. "A 3 Bit K/Ka Band MMIC Phase Shifter." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 95-98.

A K\Ka band 3 bit GaAs MMIC phase shifter has been demonstrated. It uses passive MESFET switching elements and is bi-directional. The phase shifter uses high-pass/low-pass filter circuits in which MESFET off-state capacitances are incorporated as filter elements. This technique allows high performance, broadband phase shifter response to be achieved. The K/Ka band phase shifter uses MESFETs with the same characteristics as those used in amplifiers operating in the same band, for ease of future integration. The phase shifter operates from 18 to 40 GHz.

Click on title for a complete paper.

Abstracts

A High Performance V-Band Monolithic FET Transmit-Receive Switch

G.L. Lan, D.L. Dunn, J.C. Chen, C.K. Pao and D.C. Wang. "A High Performance V-Band Monolithic FET Transmit-Receive Switch." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 99-102.

A state-of-the-art performance has been achieved for a monolithic V-band GaAs FET switch. The insertion loss for the switch-on path is less than 1.5 dB across 2 GHz bandwidth (59 to 61 GHz) and is less than 3.2 dB across 8 GHz bandwidth (56 to 64 GHz). The isolation, switch-off, is greater than 25 dB across 2 GHz bandwidth (59 to 61 GHz) and is greater than 23 dB across 8 GHz bandwidth (56 to 64 GHz). The monolithic FET switch circuit has also demonstrated a switching speed of less than 1 nanosecond and RF power handling capability in excess of 450 mW.

Click on title for a complete paper.

Commercial Applications of GaAs ICs (1988 [MCS])

J. Gladstone. "Commercial Applications of GaAs ICs (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 103-108.

Applications for GaAs ICs in the commercial marketplace first emerged three years ago. Today they are part of many test and measurement instrumentation systems and essential elements in fiber optic communication systems. These applications as well as potential applications for the near future are reviewed in this paper. A simple market model is developed for categorizing commercial applications and some projections on the size of the market are presented.

GaAs Monolithic Circuit for FMCW Radars (1988 [MCS])

R. LeBlanc, M.-I. Rudelle, V. Pauker, P. Talbot, A. Collet and J. Bellaiche. "GaAs Monolithic Circuit for FMCW Radars (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 109-112.

A GaAs monolithic transmitter-receiver to be used in a radar system has been fabricated. It operates between 4 and 6 GHz with a 200 to 400 MHz tuning range. The excellent Voltage Controlled Oscillator tuning linearity, the very high external quality factor, the low l/F noise at the 5 kHz to 10 MHz output port, combined with a reduced size show that the GaAs monolithic ICs are suitable for this type of Radar systems.

Laser Chip Separation Method for GaAs MMIC Wafers (1988 [MCS])

E.H. Wong, R.B. Wylie and D.R. Johnson. "Laser Chip Separation Method for GaAs MMIC Wafers (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 113-116.

A chip separation process using a Nd-YAG laser with the wafer mounted on stretchable tape for machine sort and load has been developed for the GaAs MMIC wafers. This method is especially suitable for prototype masks with multiple chip design. One of the major advantages of this technique is that the laser can be programmed to cut any pattern desired such that the different circuits need not be laid out in a straight grid pattern as required for sawing. One hundred percent (100%) chip separation yield with no chipping or cracking has been demonstrated. The complete laser chip separation process will be described.

Broad Band Monolithic Microwave Active Inductor and Application to a Miniaturized Wide Band Amplifier (1988 [MCS])

S. Hara, T. Tokumitsu, T. Tanaka and M. Aikawa. "Broad Band Monolithic Microwave Active Inductor and Application to a Miniaturized Wide Band Amplifier (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 117-120.

A broad band monolithic microwave active inductor is proposed. This active inductor operates in a much higher frequency range than a spiral inductor and its size is independent of the inductance value. A 0.1-10GHz miniaturized wide band amplifier is also realized by utilizing the active inductors.

A 3-Watt X-Band Monolithic Variable Gain Amplifier (1988 [MCS])

R.B. Culbertson and D.C. Zimmermann. "A 3-Watt X-Band Monolithic Variable Gain Amplifier (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 121-124.

The design and performance of a monolithic dual-gate GaAs FET 3-watt X-Band amplifier are discussed. The two-stage amplifier demonstrates 13 dB gain and over 20 percent power-added efficiency. Both large-signal and small-signal gain can be varied 20 dB while exhibiting less than +/-6 degrees insertion phase variation.

Stability and Improved Circuit Modeling Considerations for High Power MMIC Amplifiers (1988 [MCS])

R.G. Freitag, S.H. Lee, D.M. Krafcsik, D.E. Dawson and J.E. Degenford. "Stability and Improved Circuit Modeling Considerations for High Power MMIC Amplifiers (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 125-128.

The cluster matching approach for large periphery power FETs brings with it certain problems including more complex circuitry and new modes of possible oscillations. This paper offers some solutions to these problems including an analysis of the modes along with methods of suppression and improved circuit modeling. These solutions were implemented the design of a two-stage, 1.6 W monolithic power amplifier which will also be discussed.

Ka-Band Monolithic GaAs FET Power Amplifier Modules (1988 [MCS])

N. Camilleri, B. Kim, H.Q. Tserng and H.D. Shih. "Ka-Band Monolithic GaAs FET Power Amplifier Modules (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 129-132.

Monolithic GaAs FET power amplifiers consisting of several power combined devices have been fabricated and evaluated. The baseline monolithic chip design consists of a single stage 400 µm FET amplifier and a six-way travelling-wave power divider/combiner with a single stage amplifier in each of the six arms. Several chip combinations were used to make a 1 W amplifier with 5 dB gain and a 0.55 W amplifier with 27 dB gain at 34 GHz.

Wideband Variable Gain Amplifiers in GaAs MMIC (1988 [MCS])

K.H. Snow, J.J. Komiak and D.A. Bates. "Wideband Variable Gain Amplifiers in GaAs MMIC (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 133-138.

The design and performance of C, X, and K/sub u/-band GaAs MMIC variable gain and variable power amplifier circuits using an improved segmented dual gate MESFET device with binary scaled gate width ratios is reported. The demonstrated 35 dB control range, flat octave band gain response, and less than 10 degrees incidental phase variation as a function of gain/attenuation state over a 20 dB control range, is significantly superior to conventional analog-controlled devices. First pass performance of these digitally-controlled circuits demonstrates the maturation of MMIC technology.

A Monolithic Ka-Band HEMT Low-Noise Amplifier (1988 [MCS])

C. Yuen, C. Nishimoto, M. Glenn, Y.C. Pao, S. Bandy and G. Zdasiuk. "A Monolithic Ka-Band HEMT Low-Noise Amplifier (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 139-142.

A monolithic, single-stage HEMT low-noise amplifier has been developed for the 20-40 GHz band. This amplifier includes a single 0.25-µm gate-length HEMT active device with on-chip matching and biasing circuits. A gain of approximately 6 dB from 20 to 38 GHz and a noise figure of approximately 5 dB from 26.5 to 38 GHz were measured. These are the best reported results for a millimeter-wave amplifier over this bandwidth. The chip size is 2.2 mm x 1.1 mm.

A High Electron Mobility Transistor with a Mushroom Gate Fabricated by Focused Ion Beam Lithography (1988 [MCS])

Y. Sasaki, K. Nagahama, K. Hosono, T. Katoh and M. Komaru. "A High Electron Mobility Transistor with a Mushroom Gate Fabricated by Focused Ion Beam Lithography (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 143-146.

A super low noise HEMT with a mushroom-shaped quarter micron gate was fabricated by using focused ion beam lithography. The mixed exposure of Be/sup ++/ and Si/sup ++/ focused ion beams was used to form T-shaped resist profiles. This method has the advantages of a high reproducibility and controllability of resist profiles. The gate resistance was extremely reduced by mushroom-shaped gate. As a result, the fabricated HEMT showed a minimum noise figure (NFmin) of 0.68dB with an associated gain (Ga) of 9.7dB at 12GHz. This device also showed an NFmin of 0.83dB with a Ga of 7.7dB at 18GHz.

X-Band and Ka-Band Monolithic GaAs PIN Diode Variable Attenuation Limiters (1988 [MCS])

D.J. Seymour, D.D. Heston and R.E. Lehmann. "X-Band and Ka-Band Monolithic GaAs PIN Diode Variable Attenuation Limiters (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 147-150.

Monolithic GaAs PIN diode limiter circuits have demonstrated 20 dB of variable attenuation at X- and Ka-bands while maintaining under 1.5:1 input VSWR. Insertion loss is 0.5 dB at 10 GHz and 1.4 dB at 36.5 GHz in the 0-mA bias condition. Passive limiting provides 7 dB of isolation at RF powers up to 1.5 watts (30-percent duty cycle). This paper reports this first use of monolithic GaAs PIN diode circuits in radar receivers.

A 35 GHz Monolithic MESFET LNA (1988 [MCS])

S. Bandla, G. Dawe, C. Bedard, R. Tayrani, D. Shaw, L. Raffaelli and R. Goldwasser. "A 35 GHz Monolithic MESFET LNA (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 151-155.

This paper describes the design and fabrication of a state of the art 35 GHz Monolithic Amplifier. The amplifier with 6.5 dB gain, 4 dB noise figure and 10 dBm power output at 1 dB gain compression is based on a .25x200 micron MBE grown MESFET. Device circuit design, fabrication details and test results are presented.

Index of Authors (1988 [MCS])

"Index of Authors (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): 156-156.

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Back Cover (1988 [MCS])

"Back Cover (1988 [MCS])." 1988 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 88.1 (1988 [MCS]): b1-b1.

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Front Cover (1989 [MCS])

"Front Cover (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): f1-f1.

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Copyright (1989 [MCS])

"Copyright (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): i-ii.

Message from the General Chairman (1989 [MCS])

R. Kagiwada. "Message from the General Chairman (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): iii-iii.

Welcome to the 1989 IEEE Microwave and Millimeter-Wave Circuits Symposium, and to Long Beach. Thank you for your interest and participation in the Eighth Annual Symposium. Because of the large number of people working in microwaves and millimeter-waves in this area, we expect a record breaking attendance. The two day technical program begins Monday, June 12, at the Long Beach Convention and Entertainment Center in Long Beach, California. The Monday evening panel sessions will be held at the Long Beach Hyatt Regency. On Tuesday, June 13, the Symposium continues under joint sponsorship with the IEEE Microwave Theory and Techniques Society International Microwave Symposium, again at the Long Beach Convention and Entertainment Center.

Committees (1989 [MCS])

"Committees (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): iv-iv.

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Message from the Technical Program Chairman (1989 [MCS])

A. Chu. "Message from the Technical Program Chairman (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): v-v.

On behalf of the Technical Program Committee I would like to welcome you to the 1989 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium. This year our program is comprised of one invited paper, thirty-two contributing papers and three panel discussions.

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Steering Committee (1989 [MCS])

"Steering Committee (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): vi-vi.

Table of Contents (1989 [MCS])

"Table of Contents (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): vii-x.

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Panel Sessions (1989 [MCS])

"Panel Sessions (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): xi-xiii.

This includes Panel Sessions I, II, III

Abstracts

MMIC Progress in Japan

M. Aikawa, H. Ogawa and T. Sugeta. "MMIC Progress in Japan." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 1-6.

In recent years, GaAs monolithic microwave integrated circuits (MMICs) are being actively developed in Japan, and the technology and performance levels are improving at a rapid pace. This article provides an overview of present technological trends in the development of practical GaAs MMICs in Japan.

A 12 GHz-Band Super Low-Noise Amplifier Using a Self-Aligned Gate MESFET

N. Ayaki, T. Shimura, K. Hosogi, T. Kato, Y. Nakajima, M. Sakai, Y. Kohno, H. Nakano and N. Tanino. "A 12 GHz-Band Super Low-Noise Amplifier Using a Self-Aligned Gate MESFET." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 7-10.

A 12 GHz-band 4-stage monolithic super low-noise amplifier has been designed and fabricated using self-aligned multi-layer gate FETs. A 0.3µm-gate FET used in the amplifier has achieved a typical noise figure of 1.07dB with an associated gain of 9.0dB at 12GHz. The amplifier gives a minimum noise figure of 1.58dB with a gain of 29dB at 12GHz and the noise figure is less than 1.76dB with an associated gain as high as 28.0dB in the frequency range from 11.7 to 12.7GHz. It is the lowest noise figure ever reported for MESFET monolithic amplifiers in the 12GHz-band.

A Broadband Low Noise Dual Gate FET Distributed Amplifier

W.J. Thompson. "A Broadband Low Noise Dual Gate FET Distributed Amplifier." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 11-13.

A 2 to 18 GHz monolithic GaAs low noise distributed amplifier has been developed with 10 dB nominal gain. The noise figure is less than 5.7 dB over the 2 to 18 GHz band and less than 4.0 dB from 3 to 13 GHz. The DGFET amplifier provides gain control capability and has low power requirements of 60 mA at 5 volts. This state of the art performance is achieved with a 0.5 µM ion implanted process.

Abstracts

A Family of 2-20GHz Broadband Low Noise AlGaAs HEMT MMIC Amplifiers

R. Dixit, B. Nelson, W. Jones and J. Carillo. "A Family of 2-20GHz Broadband Low Noise AlGaAs HEMT MMIC Amplifiers." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 15-19.

Rapid advances in AlGaAs High Electron Mobility Transistor (HEMT) processing technology have made HEMT MMIC technology possible. This paper presents design and development information on a family of broadband, low noise amplifiers. Amplifiers covering the 2-20 GHz frequency band have been developed, and achieve noise figures comparable to their counterpart in hybrid HEMT technology. The amplifiers are configured in a cascadable design, with simultaneous low input and output VSWR, and flat gain response. Performance results include measured and modeled data for a 2-7 GHz LNA with 2.5 dB noise figure, a 2-20 GHz distributed amplifier with 9.5 dB flat gain, less than 3.5 dB noise figure, and a 5-11 GHz balanced LNA with 10dB gain, less than 2.5dB noise figure (6-11 GHz). Other octave band balanced amplifier designs are currently being fabricated (2-7GHz, 9-19GHz) and performance results are expected January '89. A preliminary temperature step-stress reliability evaluation on the discrete process HEMT device is also presented.

Click on title for a complete paper.

C-Band 10 Watt MMIC Amplifier Manufactured Using Refractory SAG Process

I.J. Bahl, R. Wang, A. Geissberger, E. Griffin and C. Andricos. "C-Band 10 Watt MMIC Amplifier Manufactured Using Refractory SAG Process." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 21-24.

The design and performance of a C-Band single chip GaAs MMIC Amplifier manufactured using the refractory self-aligned gate process is described. The amplifier demonstrates 10 watts power output at 5.5 GHz with associated gain of 5 dB and power added efficiency of 36%. The functional yield of the IC on the best wafer was 70%. To our knowledge, these results exceed the best published results for C-Band power MMIC amplifiers.

Abstracts

A 2.5-Watt High Efficiency X-Band Power MMIC

M. Avasarala, D.S. Day, S. Chan, C. Hua and J.R. Basset. "A 2.5-Watt High Efficiency X-Band Power MMIC." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 25-28.

The design and performance of a 2-stage MBE monolithic power amplifier chip are presented. The MBE monolithic chip contains full interstate matching, partial matching at the input, and no match at the output. When matched to 50 ohms at input and output using off-chip circuitry, the MMIC demonstrated best overall performance of 34dBm (0.436W/mm), 36%, and 14.5dB of power, power-added-efficiency (PAE), and associated gain respectively, across the band of 9.0-10.0 GHz. The PAE was as high as 38% in parts of the band. The average performance considering 26 devices from at least 12 wafers from 5 different runs was 33.6dBm (.4W/mm), 32%, and 14dB, respectively. The chip size was very compact at 0.081"x0. 070"x003.3" (2.06x1.78 mm²).

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Monolithic Ku-Band GaAs 1-Watt Constant Phase Variable Power Amplifier

S.D. Pritchett. "Monolithic Ku-Band GaAs 1-Watt Constant Phase Variable Power Amplifier." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 29-32.

A GaAs monolithic 1.0 Watt constant phase variable power amplifier has been demonstrated for the first time at Ku-band. Compressed gain of this amplifier is greater than 14 dB with >1 Watt output power over the 13.5 to 15. 5 GHz band. This amplifier features dual gate FETs which achieve greater than 30 dB of gain control with less than ±10° of phase variation over the entire band.

Click on title for a complete paper.

Abstracts

Ka-Band Monolithic GaAs Two-Stage Power Amplifier

Y. Oda, T. Yoshida, K. Kai, S. Arai and S. Yanagawa. "Ka-Band Monolithic GaAs Two-Stage Power Amplifier." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 33-36.

A Ka-band monolithic GaAs two-stage power amplifier with 3.6 mm total gate width has been developed. It has delivered an output power at 1 dB gain compression point of 0.56 W with 7.2 dB gain and 15 % power-added efficiency at 28 GHz. The performance obtained may be the highest power/gain yet reported on Ka-band monolithic GaAs amplifiers.

Abstracts

Accurate Nonlinear Modeling and Verification of MMIC Amplifier

V.D. Hwang, Y.-C. Shih and H.M. Le. "Accurate Nonlinear Modeling and Verification of MMIC Amplifier." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 37-41.

An accurate MESFET nonlinear model and a reliable model verification approach which uses the on-wafer RF probing method are presented. The nonlinear model is based on small signal S-parameter characterization of the MESFET at a wide range of bias voltages. Simulation results of an MMIC amplifier at various frequencies, bias voltages, and power levels agree well with the measurement data.

Click on title for a complete paper.

High Isolation 1-20 GHz MMIC Switches with On-Chip Drivers

J.A. Eisenberg, T.B. Chamberlain and L.R. Sloan. "High Isolation 1-20 GHz MMIC Switches with On-Chip Drivers." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 41-45.

MMIC SPST and SPDT reflective GaAs MESFET switches with on-chip TTL compatible drivers have achieved 50 dB isolation over the 1-20 GHz range. This is the highest isolation yet reported for MMIC switches covering this bandwidth. Insertion loss was less than 2.5 dB for the SPST switch and less than 2.7 dB for the SPDT switch. The MMIC switches were designed for convenient use and require only a single +12 volt power supply and external dc blocking capacitors. Switching time for either device was less than 15 nanoseconds. Good agreement was obtained between measured and simulated results.

A Monolithic High Power Ka Band PIN Switch

J.V. Bellantoni, D.C. Bartle, D. Payne, G. McDermott, S. Bandla, R. Tayrani and L. Raffaelli. "A Monolithic High Power Ka Band PIN Switch." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 47-50.

A high power Ka Band SPDT switch using monolithic GaAs epitaxial PIN diode technology is presented. Insertion loss is 0.7 dB at 35 GHz, and isolation is better than 32 dB from 30 to 40 GHz. The power handling capability is at least +38 dBm pulsed and +35 dBm CW. Switching speed rise and fall times are 2 ns.

High Power Control Components Using a New Monolithic FET Structure

M. Shifrin, P. Katzin and Y. Ayasli. "High Power Control Components Using a New Monolithic FET Structure." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 51-56.

A new monolithic switch FET (MFET) control device has been developed that can be integrated with other monolithic functions or used as a discrete component in a MMIC structure. This device increases the power handling capability of the conventional switch FET (SFET) by an order of magnitude. It does this by overcoming the breakdown voltage limitation of the SFET device. The design, fabrication, and performance of two high power control components using MFET devices are described as examples of the implementation of this technology (an L-Band terminated single pole single throw (SPST) switch, and an L-Band limiter).

Abstracts

A Novel MMIC Active Filter with Lumped and Transversal Elements

M.J. Schindler and Y. Tajima. "A Novel MMIC Active Filter with Lumped and Transversal Elements." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 57-60.

A novel active filter structure has been developed and demonstrated as an MMIC. This filter structure makes use of both lumped elements and active transversal elements. The combination of lumped and transversal elements provides performance superior to a filter made of lumped elements alone, and is much smaller than a filter made of transversal elements alone. This miniature MMIC filter has a passband of 9.8-11.1 GHz with 2 dB loss, and better than 30 dB rejection 1.1 GHz from either passband edge. This level of performance could not have been achieved on a conventional 4 mil thick GaAs MMIC with only passive lumped elements.

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Abstracts

An Ultra-High Speed DCFL Dynamic Frequency Divider

T. Ichioka, K. Tanaka, T. Saito, S. Nishi and M. Akiyama. "An Ultra-High Speed DCFL Dynamic Frequency Divider." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 61-64.

A new circuit of a DCFL (Direct Coupled FET Logic) dynamic frequency divider has been developed using 0.25µm gate inverted HEMTs. The divider is operated with a single signal input in a very wide frequency range from 1.8 GHz to 15 GHz with low power dissipation of 62mW. The maximum operating frequency of 26.5 GHz is obtained.

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Abstracts

K/sub a/-Band MMIC Beam Steered Transmitter Array

A.L. Riley, D. Rascoe, V. Lubecke, J. Huang and L. Duffy. "K/sub a/-Band MMIC Beam Steered Transmitter Array." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 65-68.

A 32 GHz six element linear transmitter array utilizing state-of-the-art MMIC phase shifters and power amplifiers has been developed and tested as part of the development of a spacecraft array feed for NASA deep space communications applications. Measurements of the performance of a number of MMIC phase shifter and power amplifier was carried out and electronic beam steering was demonstrated.

4:1 Bandwidth Digital Five Bit MMIC Phase Shifters

D.C. Boire, G.S. Onge, C. Barratt, G.B. Norris and A. Moysenko. "4:1 Bandwidth Digital Five Bit MMIC Phase Shifters." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 69-73.

Five bit MMIC phase shifters that cover over two octaves of bandwidth have been demonstrated. The phase shifters maintain low phase error, insertion loss, insertion loss variation with phase state, and VSWR, over their entire operational bandwidths.

Abstracts

A Multioctave Active MMIC Quadrature Phase Shifter

P. Coget, P. Philippe, V. Pauker, P. Dautriche and P. Jean. "A Multioctave Active MMIC Quadrature Phase Shifter." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 75-77.

This paper describes a 0.1 - 4.5 GHz GaAs monolithic quadrature phase shifter with very small phase error based upon a phase locked loop system. Such a wide band capability has been achieved by using FETs as voltage controlled resistors in a R-C all-pass phase shifter. This circuit, integrated in a broadband receiver produced an image rejection of at least 30 dB over the frequency band.

A DC-18GHz GaAs MESFET Monolithic Variable Slope Gain-Equalizer IC

H.J. Sun and B.C. Morley. "A DC-18GHz GaAs MESFET Monolithic Variable Slope Gain-Equalizer IC." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 79-82.

A broadband GaAs MESFET gain-equalizer with variable linear slope control has been developed, to be reported of the first time for this type of circuit. The IC uses a modified bridged-T configuration. It provides an attenuation slope of -0.67dB/GHz at the maximum linear slope state with a minimum insertion loss of 2.7dB at 18 GHz, and a deviation of linearity less than 0.25dB from DC to 18GHz. The slope is electrically variable from -0.67dB/GHz to 0.0dB/GHz and, upward to +0.22dB/GHz. The input and output VSWRs are less than 2:1 over the entire frequency and control range.

A GaAs HBT Monolithic Microwave Switched-Gain Amplifier with +31 Db to -31 Db Gain in 2 dB Increments

A.K. Oki, G.M. Gorman, J.B. Camou, D.K. Umemoto and M.E. Kim. "A GaAs HBT Monolithic Microwave Switched-Gain Amplifier with +31 Db to -31 Db Gain in 2 dB Increments." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 83-86.

A GaAs/AlGaAs heterojunction bipolar transistor (HBT) monolithic 5-bit digital gain control amplifier has been developed for application to electronic warfare receivers. The switched-gain/attenuator amplifier performance includes monotonic gain control in 2 dB increments from +31 dB to -31 dB from DC to 2.25 GHz with less than 1.6 dB RMS gain error across the band. The chip size is 1.2x2.2 mm^2 and consumes 1.3 watts. The circuit is the first reported monolithic microwave HBT gain control circuit for signal processing applications as well as one of the first three chips (all HBTs) demonstrated on the DARPA Microwave/Millimeter Wave Monolithic Integrated Circuit (MIMIC) Phase 1 Program.

A 3 Chip GaAs Double Conversion TV Tuner System with 70 dB Image Rejection (1989 [MCS])

T. Ducourant, P. Philippe, P. Dautriche, V. Pauker, C. Villalon, M. Pertus and J.-P. Damour. "A 3 Chip GaAs Double Conversion TV Tuner System with 70 dB Image Rejection (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 87-90.

A 3 chip VHF-UHF TV tuner system has been implemented with a 0.7 µm MESFET GaAs technology. The system based on the double frequency conversion method consists in an up-converter (IF/sub 1/ = 1.9 GHz), a smooth filter and an image rejection down-converter (IF/sub 2/ = 35 MHz); it exhibits 30 dB of conversion gain and 70 dB of image frequency rejection throughout the VHF-UHF band.

A Monolithic 60 GHz Diode Mixer in FET Compatible Technology (1989 [MCS])

B. Adelseck, A. Colquhoun, J.M. Dieudonne, G. Ebert, J. Selders, K.E. Schmegner and W. Schwab. "A Monolithic 60 GHz Diode Mixer in FET Compatible Technology (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 91-94.

A technology has been developed with which MESFETs with an f/sub max/ of 70 GHz and Schottky diodes with f/sub T//spl ap/ 2300 GHz can be fabricated on the same chip. This allows the production of mm wave mixers with integrated LO and IF amplifier. A 60 GHz mixer chip has been designed and fabricated using this technology and shows a conversion loss of 6.0 dB and a noise figure (DSB) of 3.3 dB.

Abstracts

A W-Band Channelized Monolithic Receiver (1989 [MCS])

G.L. Lan, J.C. Chen, C.K. Pao, M.I. Herman and R.E. Neidert. "A W-Band Channelized Monolithic Receiver (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 95-99.

Several monolithic integrated circuits with state-of-the-art performances have been successfully developed for a W-band (75 to 110 GHz) channelized monolithic receiver. The receiver comprises one four-channel multiplexer, four balanced mixers, four IF amplifiers, and four local oscillators. All will be monolithically integrated into only three chips. This paper reports on the design, fabrication, and performance of each monolithic component and describes the complete W-band four-channel receiver integration.

Silicon Bipolar Fixed and Variable Gain Amplifier MMICs for Microwave and Lightwave Applications Up to 6 GHz (1989 [MCS])

I. Kipnis, J.F. Kukielka, J. Wholey and C.P. Snapp. "Silicon Bipolar Fixed and Variable Gain Amplifier MMICs for Microwave and Lightwave Applications Up to 6 GHz (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 101-104.

A variety of fixed and variable gain amplifier MMICs for applications up to 6 GHz are presented. The circuits are fabricated using an f/sub T/ = 10 GHz, f/sub max/ = 20 GHz, non-polysilicon-emitter silicon bipolar process. Three amplifier topologies and their performance will be reported: a fixed-gain wideband amplifier, a high-gain low-noise amplifier that can also be effectively used as a transimpedance amplifier and a variable gain amplifier.

Monolithic HEMT LNAs for Radar, EW, and COMM (1989 [MCS])

M.A.G. Upton, K.H. Snow, D.I. Goldstick, W.M. Kong, M.-Y. Kao, W.F. Kopp, P. Ho, G.J. Tessmer, B.R. Lee, K.A. Wypych and A.A. Jabra. "Monolithic HEMT LNAs for Radar, EW, and COMM (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 105-109.

Several monolithic HEMT low noise amplifiers (LNAs), designed for 7-11 GHz airborne radar, 2-18 GHz electronic warfare, and 20 GHz military satellite communications applications have demonstrated outstanding performance. Two-stage MMICs achieve as low as 1.2 dB noise figure at 10 GHz with 15 dB gain, and typically less than 1.8 dB noise figure from 7-11 GHz. A distributed amplifier demonstrates 3.0-5.2 dB noise figure with around 11 dB gain from 2-18 GHz. Finally, a three-stage MMIC achieves less than 2.0 dB noise figure from 18-23 GHz with 29 dB associated gain, representing the highest level of performance yet reported for a low-noise MMIC.

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Monolithic V-Band Pseudomorphic-MODFET Low-Noise Amplifiers (1989 [MCS])

G. Metze, A. Cornfeld, J. Singer, H. Carlson, E. Chang, T. Kirkendall, G. Dahrooge, J. Bass, H.-L. Hung and T. Lee. "Monolithic V-Band Pseudomorphic-MODFET Low-Noise Amplifiers (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 111-116.

V-band, low-noise MMICs based on pseudomorphic modulation-doped FETs (P-MODFETs) have been developed for the first time and have yielded noise figures that are believed to be the lowest reported for any millimeter-wave MMIC. Single-stage low-noise amplifiers with P-MODFETs as active elements (gate dimensions 0.35 x 60 W) exhibited minimum noise figures of 3.9 dB at 58 GHz, with an associated gain of 3.5 dB. Dual-stage MMICS had minimum noise figures of 5.3 dB at 58 GHz, with an associated gain of 8.2 dB, and maximum gain of 10.4 dB at 59.5 GHz. Further, a cascaded four-stage amplifier (two dual-stage MMIC modules) exhibited a 5.8-dB minimum noise figure at 58 GHz, with an associated gain of 18.3 dB, and 21.1 dB of maximum gain. Device processing uniformity, as well as DC and RF reliability data, are also presented.

A Monolithic 40-GHz HEMT Low-Noise Amplifier (1989 [MCS])

C. Yuen, C. Nishimoto, S. Bandy and G. Zdasiuk. "A Monolithic 40-GHz HEMT Low-Noise Amplifier (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 117-120.

A monolithic, single-stage HEMT low-noise amplifier has been developed at 40 GHz. This amplifier includes a single 0.25-µm gate-length HEMT active device with on-chip matching and biasing circuits. A gain of 6.5 dB and a noise figure of 5 dB were measured from 38 to 44 GHz. By replacing the triangular gate profile with a mushroom gate profile, the amplifier achieved 8dB gain and 4-dB noise figure from 36 to 42 GHz. The chip size is 1.1 x 1.1 mm.

GaAs Molecular Beam Epitaxy Monolithic Power Amplifiers at U-Band (1989 [MCS])

G. Hegazi, H.-L.A. Hung, J.L. Singer, F.R. Phelleps, A.B. Cornfeld, T. Smith, J.F. Bass, H.E. Carlson and H.C. Huang. "GaAs Molecular Beam Epitaxy Monolithic Power Amplifiers at U-Band (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 121-125.

The design, fabrication. and measurements for 44-GHz band molecular beam epitaxy (MBE) monolithic power amplifiers are described. A five-stage balanced amplifier provided a linear gain of 15.1 dB and maximum output power of 500 mW at 42.5 GHz. These results may represent the highest power and gain achieved from a MIMIC in the 44-GHz band.

An Ultra Wide Bandwidth Power Divider on MMIC Operating 4 to 10 GHz (1989 [MCS])

J. Staudinger. "An Ultra Wide Bandwidth Power Divider on MMIC Operating 4 to 10 GHz (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 127-131.

A circuit topology has been developed to realize power dividers with bandwidths of 2.5:1 or greater on MMIC. A three-way divider has been fabricated which achieved 5.8 dB nominal insertion loss and 18 dB isolation from 4 to 10 GHz. This topology consists of lumped element interconnected networks and is thus ideally suited for MMIC technology.

Silicon Bipolar Double Balanced Active Mixer MMICs for RF and Microwave Applications Up to 6 GHz (1989 [MCS])

J. Wholey, I. Kipnis and C. Snapp. "Silicon Bipolar Double Balanced Active Mixer MMICs for RF and Microwave Applications Up to 6 GHz (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 133-137.

A monolithic silicon bipolar technology based on transistors with f/sub T's/ of 10 GHz and f/sub MAX/'s of 20 GHz has seen used to develop double balanced active mixers. These circuits are based on Gilbert cell. multipliers and exhibit conversion gain for RF and LO bandwidths to 6 GHz and IF bandwidths to 2 GHz. This paper presents an overview of the bipolar technology used. It discusses the basic mixer circuit design and presents a novel. technique for modeling its noise figure. Finally RF measurements for two representative designs are summarized.

Design and Performance of a 2-18 GHz Monolithic Matrix Amplifier (1989 [MCS])

A.P. Chang, K.B. Niclas, B.D. Cantos and W.A. Strifler. "Design and Performance of a 2-18 GHz Monolithic Matrix Amplifier (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 139-141.

The paper discusses the design and the performance of the first monolithic matrix amplifier. A gain of 15.5 ± 0.9 dB at a worst return loss of -12 dB, a maximum noise figure of 7 dB, and a minimum output power of P/sub 1dB/ = 15.5 dBm were obtained in the two-tier module across the 2-18 GHz frequency band.

A Novel 4-18 GHz Monolithic Matrix Distributed Amplifier (1989 [MCS])

S.L.G. Chu, Y. Tajima, J.B. Cole, A. Platzker and M.J. Schindler. "A Novel 4-18 GHz Monolithic Matrix Distributed Amplifier (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 143-147.

This paper describes the design, fabrication, and performance of a 4 to 18 GHz matrix distributed amplifier. This amplifier incorporates a novel biasing scheme which enables the stages to be connected in cascade at RF frequencies and in cascode for dc biasing, thus conserving current. This is the first MMIC amplifier of its kind. The amplifier has shown greater than 13 dB gain across the frequency band.

Index of Authors (1989 [MCS])

"Index of Authors (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): 148-148.

Back Cover (1989 [MCS])

"Back Cover (1989 [MCS])." 1989 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 89.1 (1989 [MCS]): b1-b1.