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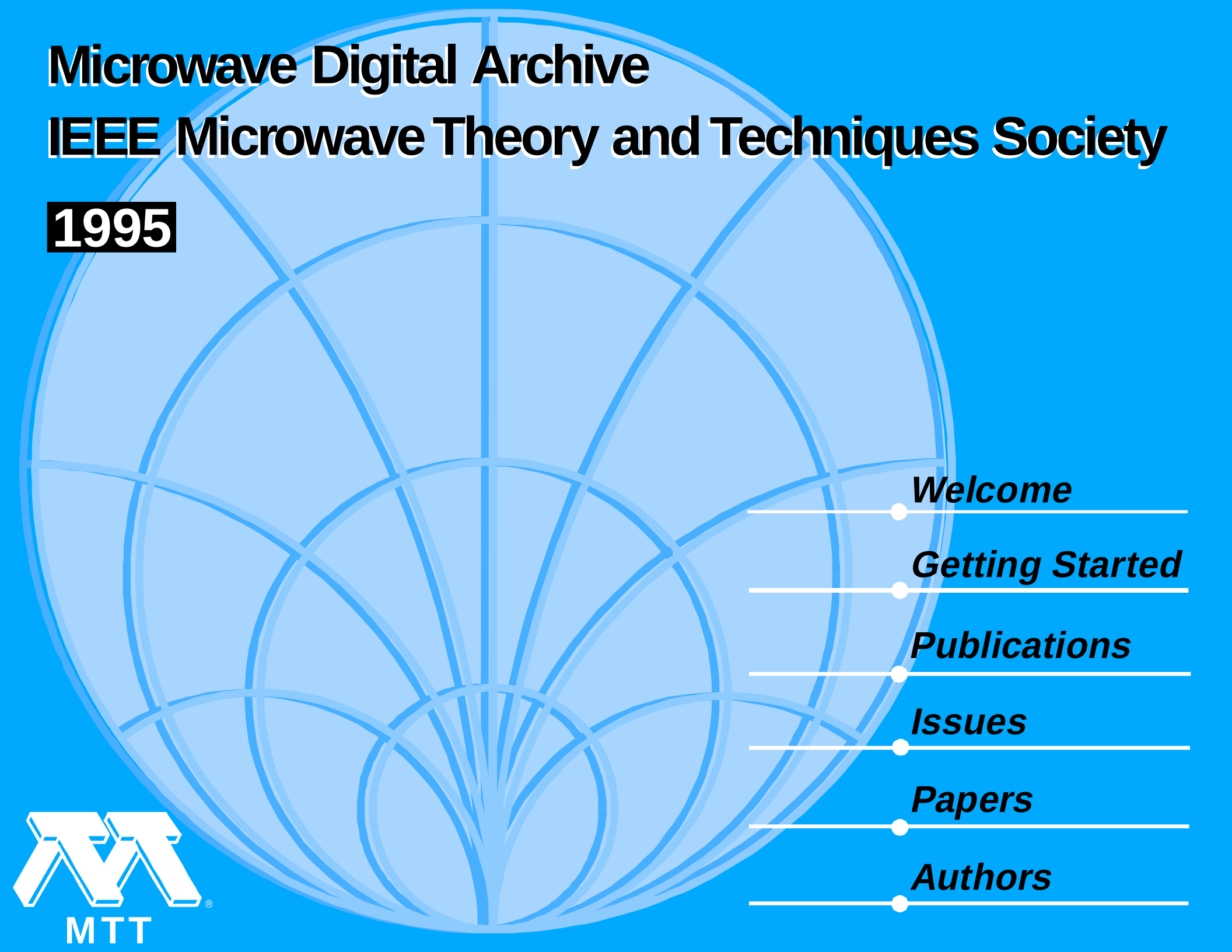
IEEE Microwave Theory and Techniques Society

1995



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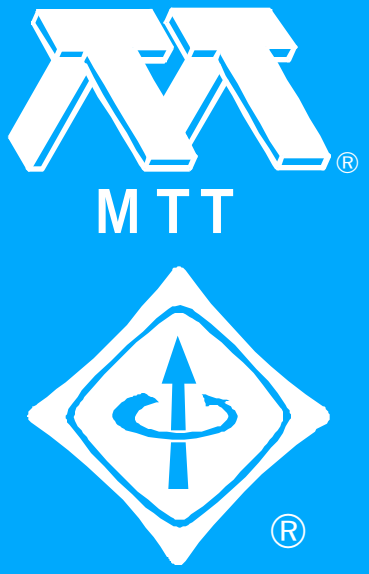

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ACKNOWLEDGMENTS

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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ISBN: 0-7803-9906-4

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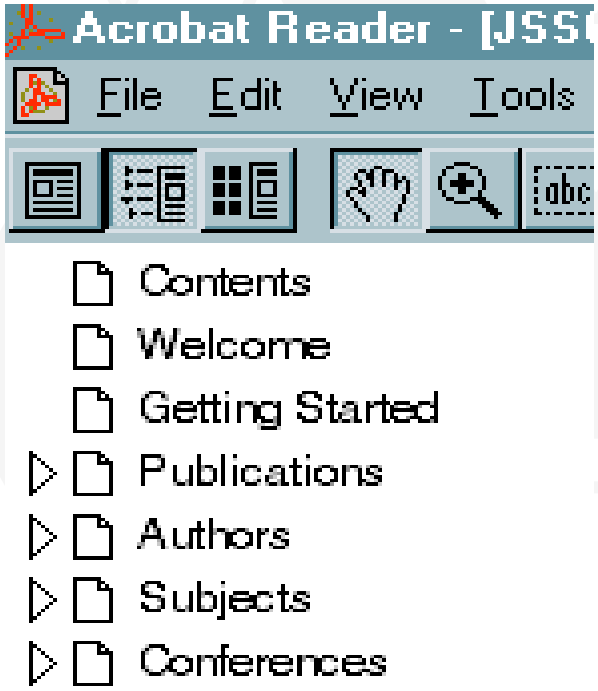

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This Guide contains a variety of navigational aids to help you easily explore the contents.

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The Electronic Guide is constructed in sections: e.g. Sessions, Authors, Getting Started. The current section is shown at the top of each page. The “path” to this section is shown at the right. Clicking these text buttons moves you to the start of that section.

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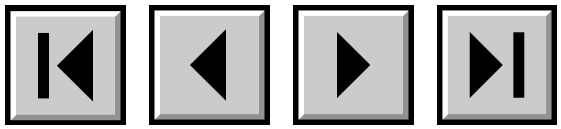

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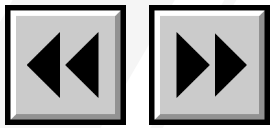

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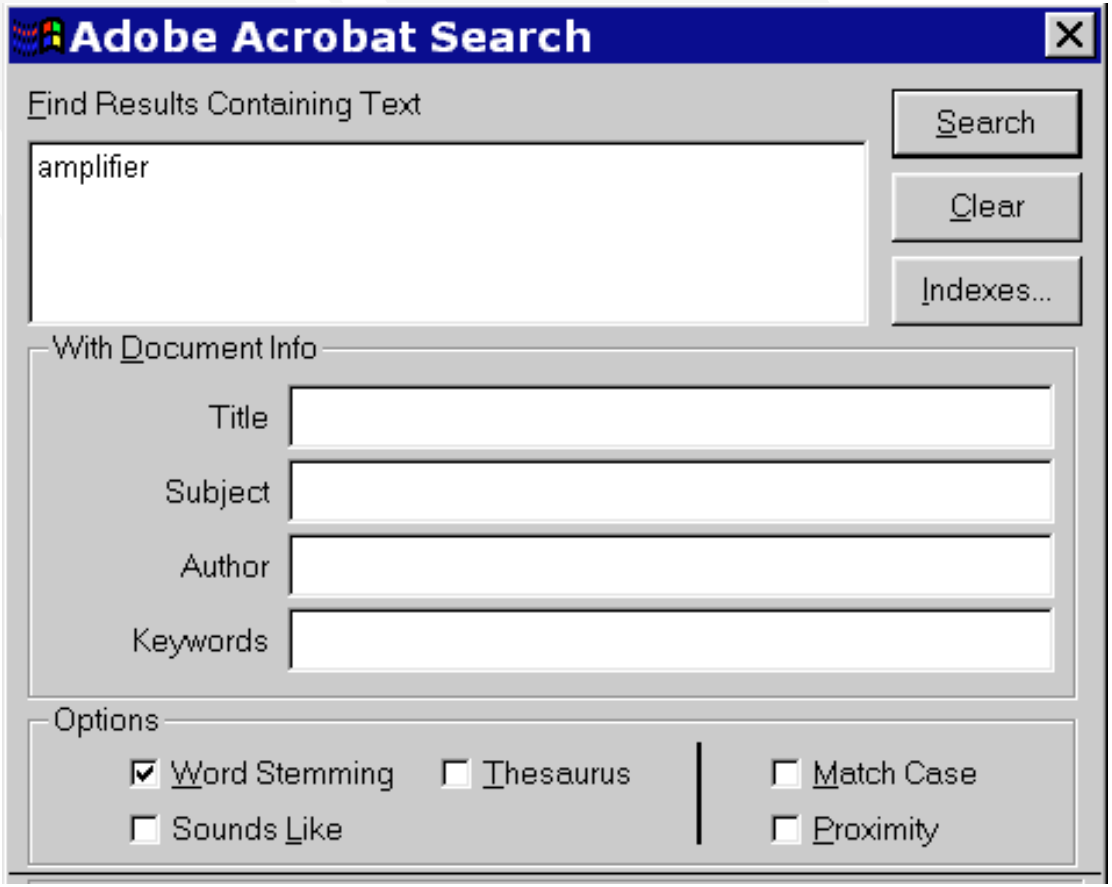

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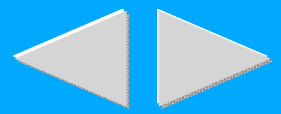

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Some Fundamental and Practical Limits on Broadband Matching to Capacitive Devices, and the Implications for SIS Mixer Design

A.R. Kerr. "Some Fundamental and Practical Limits on Broadband Matching to Capacitive Devices, and the Implications for SIS Mixer Design." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 2-13.

In a given frequency band, the achievable match between a capacitive microwave or millimeter-wave device and a resistive source is limited by the capacitance of the device and its series inductance. The fundamental limit on the match bandwidth is examined for three circuits: 1) parallel RC, 2) parallel RC with series L, and 3) parallel RCL with series L. The broadband matching theories of Bode (1945) and Fano (1950) are used, the latter modified to avoid the standard low-pass to band-pass mapping in case 2) because the terminals of the capacitance are not generally accessible for connection of the requisite parallel inductor. The results are fundamental to the design of broadband mixers, multipliers, switches, and detectors using Schottky diodes or SIS junctions. Practical limitations imposed by the minimum realizable dimensions of millimeter-wave integrated circuits fabricated by standard photolithography are discussed in the context of SIS mixers with series arrays of junctions, and an example of a coplanar SIS mixer design is given. For a series array of IV devices with a given total resistance, it is shown that there is an upper limit to N, below which the theoretical match bandwidth depends only on the RC product of the devices and not on the series inductance of the array.

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Abstracts

Traveling-Wave Microwave Power Divider Composed of Reflectionless Dividing Units

A. Sanada, K. Fukui, S. Nogi and M. Sanagi. "Traveling-Wave Microwave Power Divider Composed of Reflectionless Dividing Units." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 14-20.

We propose a new waveguide type traveling-wave microwave power divider that is adequate for high power applications. The divider is composed of multiple stages of reflectionless dividing units, each having two output ports. Design formulas for reflectionless equal-power dividing are first derived. Structural parameters for wideband design of two- to six-stage dividers are then obtained by means of numerical analyses based on an equivalent circuit. Comparison of experiments at X-band shows good qualitative agreement with the analyses. Typical measured bandwidth for relative divided powers deviation of less than ±0.5 dB was 2.7 GHz, and that for -20 dB return loss was more than 3.2 GHz for the four-stage (eight-way) divider. The divider presented here has excellent features; the bandwidth for equal-power dividing decreases very little and the bandwidth for low return loss increases with increasing number of the dividing stages. It also has advantages of low insertion loss and flexibility over the number of the dividing stages.

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Analysis, Synthesis, and Experimental Validation of a New Type of Microstrip Transition

F. Masot, F. Medina and M. Horno. "Analysis, Synthesis, and Experimental Validation of a New Type of Microstrip Transition." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 21-25.

This paper presents the theoretical analysis, synthesis, and experimental validation of a wideband transition between a conventional microstrip line and a microstrip line printed on a double-layer substrate. This transition is useful to link conventional microstrip circuits to certain special configurations fabricated on double-layer substrates. A particular case of generic interest is the transition between microstrip and suspended microstrip technologies. The analysis is carried out by using an enhanced version of the spectral domain analysis (SDA) that leads to computer codes quick enough to be used in an optimization design program.

Abstracts

Dual FET Active Patch Elements for Spatial Power Combiners

X.D. Wu and K. Chang. "Dual FET Active Patch Elements for Spatial Power Combiners." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 26-30.

A novel dual-FET active patch antenna element and arrays for quasi-optical power combining are described. The circuit uses two FET's that symmetrically load a split patch antenna. The configuration of the devices decreases H-plane cross-polarization dramatically. The power combining was achieved by injection locking through mutual coupling. An equivalent isotropic radiation power of 0.88 W for a 2-element dual-FET patch antenna array has been obtained. For a 2 x 2 array, an equivalent isotropic radiated power of 2.99 W was achieved. The circuit is planar and amenable to monolithic circuits.

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A Corrugated Waveguide Phase Shifter and its Use in HPM Dual-Reflector Antenna Arrays

L.F. Libelo and C.M. Knop. "A Corrugated Waveguide Phase Shifter and its Use in HPM Dual-Reflector Antenna Arrays." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 31-35.

An analysis, with computations and experimental verification, is given which shows that an axially compressible or extendable thin-wall corrugated metallic cylinder can be used as a phase shifter to achieve ±180° phase control. Employment of such a device in an array of HPM dual-reflector antennas to achieve maximum in-phase array radiation is then briefly outlined.

Abstracts

A Novel Technique for Tuning Dielectric Resonators

K.V. Buer and E.-B. El-Sharawy. "A Novel Technique for Tuning Dielectric Resonators." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 36-41.

This paper presents a novel technique for the tuuing of high dielectric resonators at microwave and millimeter wave frequencies. The resonator is tuned by coupling it to a section of non-resonant microstrip line. An experimental band-reject filter with a Q of 550 was tuned using this technique. The resulting tuning range of the filter was over 18 times its bandwidth. This technique makes it cost effective to tune dielectric resonators over a relatively broad range while maintaining a high Q characteristic.

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On the Coupling Between a Quasiperiodic Structure and an Asymmetric Output Arm

L. Schachter and J.A. Nation. "On the Coupling Between a Quasiperiodic Structure and an Asymmetric Output Arm." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 42-47.

We present the analysis of the electromagnetic coupling between a quasi-periodic disk loaded structure and an asymmetric radial arm. The field is excited by a current distribution which models the spatial growth of a space-charge wave in a traveling wave structure. The output power is controlled by a stub tuner. Maximum power does not occur for minimum reflection. The condition for this regime is presented.

Abstracts

Multilevel Methods Applied to the Design of Resonant Cavities

S. Costiner, F. Manolache and S. Ta'asan. "Multilevel Methods Applied to the Design of Resonant Cavities." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 48-55.

An application of multilevel (ML) methods to compute the modes and eigenvalues of resonant cavities is presented. The involved methods include an ML eigenvalue solver, an ML mode separation technique, a boundary treatment method, and a subspace continuation technique (SCT) for sequences of problems. In the presented numerical experiments, an asymptotic convergence factor of order 0.1 is obtained for ML cycles on all fine levels, while performing only a few relaxations per cycle. This factor is obtained for a rectangular cavity as well as for cavities having reentrant corners, holes and narrow regions, and presenting clusters of close and equal eigenvalues. A second order scheme is obtained for the computed eigenvalues and modes with an amount of work of order O (qN) for q modes of size N on the finest level. The SCT is illustrated on a moving boundary problem, where solutions change fast at a small boundary change. Such computations are applied to the design of new microwave selective devices.

Abstracts

S Matrix of a Broad Wall Coupler Between Dissimilar Rectangular Waveguides

A. Datta, A.M. Rajeek, A. Chakrabarty and B.N. Das. "S Matrix of a Broad Wall Coupler Between Dissimilar Rectangular Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 56-62.

The paper describes a method of moment analysis of a four-port juuction between two dissimilar rectangular waveguides coupled through either a longitudinal slot or a transverse slot on the common broad wall. The Green's function approach has been used to obtain the scattered field inside the primary and the secondary waveguide for both cases. The coupled integro-differential equations, arising from the continuity of the tangential component of the magnetic field at both the interfaces of the slot, are transformed into matrix equation using entire domain sinusoidal basis functions in conjunction with global Galerkin's technique. The results obtained using the present method have been compared with the results available in the literature. The theoretical results on the magnitude and phase of the scattering parameters have been compared with the experimental results for the case of a longitudinal slot coupler with moderate offset from the centerline. The use of global sinusoidal basis functions gives a much faster rate of convergence compared to the use of subsectional basis functions. The equivalent loading of a single slot derived in the paper can be effectively utilized to design a multiaperture coupler.

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Wideband Characterization of a Typical Bonding Wire for Microwave and Millimeter-Wave Integrated Circuits

H.-Y. Lee. "Wideband Characterization of a Typical Bonding Wire for Microwave and Millimeter-Wave Integrated Circuits." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 63-68.

A typical grounded bonding wire with a minimum total length of 480 µm for MMIC's and OEIC's is characterized using the Method of Moments with the incorporation of the ohmic loss as well as the radiation loss over a wide range of frequencies. The distributed ohmic resistance is calculated by an application of the Phenomenological Loss Equivalence Method. The simulated results show the wire resistance and the inductance are greatly increasing to frequencies above 30 GHz due to the high radiation effect enhanced by the slow-wave effect of the ohmic loss. The bonding wire is Klghly inductive in most of the frequency range and the maximum quality factor is mostly limited by the ohmic resistance. The results also show the simple static modeling of computer-aided design software that considers only the free-space wire inductance and the skin-effect resistance, overestimates the wire inductance at low frequencies, and is inappropriate at high frequencies due to the high radiation effect. This approach can be applied to many arbitrarily shaped interconnection wires for wideband design and characterization of high-frequency integrated circuits.

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Electromagnetic Field and Transmission Characteristics of a Parallel Two-Wire Line Covered with a Three-Layer Media

Y. Kuboyama, T. Shibuya and R. Sato. "Electromagnetic Field and Transmission Characteristics of a Parallel Two-Wire Line Covered with a Three-Layer Media." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 69-77.

Electromagnetic field and transmission characteristics of a parallel two-wire line (PTWL) covered with a three-layer media were analyzed. It becomes clear that the PTWL mode will strongly couple to the natural HE/sub 1m/ or EH/sub 1m/ modes. At the resonance frequencies, most of the electromagnetic energy is stored in medium II region, while propagation takes place in both medium II and III. Off resonance, most of the energy is concentrated close to the PTWL. Numerical results are in good agreement with experimental results. Such a line could possibly be used as a dielectric tube antenna or, alternatively, as a band elimination filter and so on.

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A Spherical Slot Array Applicator for Medical Applications

M. Krairiksh, T. Wakabayashi and W. Kiranon. "A Spherical Slot Array Applicator for Medical Applications." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 78-86.

A new type of microwave hyperthermia applicator is proposed and analyzed. A cavity, consists of concentric conducting partial spheres which are enclosed by a part of a conducting cone, is employed to excite an array of slots coherently. From numerical results that we obtained, it is possible to focus the electric field radiated from the slots to the center of the sphere where a tumor is assumed to be located. Furthermore, SAR distributions of some applicators are obtained by using computer, and these applicators have been designed. From the measured results of electric field distributions at 2450 MHz, it is found that the focusing characteristics are achievable. Thermographic studies show that the heating volume can be varied by using different number of slots and the maximum heating depth is 3 cm.

Abstracts

Consistent Small-Signal and Large-Signal Extraction Techniques for Heterojunction FET's

P. Jansen, D. Schreurs, W. De Raedt, B. Nauwelaers and M. Van Rossum. "Consistent Small-Signal and Large-Signal Extraction Techniques for Heterojunction FET's." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 87-93.

A new method is reported to extract large-signal current and charge sources from the small-signal S-parameters of pseudomorphic heterojunction field effect transistors (PHFET's). This method produces a new intrinsic small-signal equivalent circuit topology with less constraints concerning the extraction of the large-signal current and charge sources. The main advantage of this new topology is charge conservation. The S-parameter measurements of a 0.2-µm PHFET agrees well with the small-signal S-parameter data, obtained after evaluation of the new large-signal model at different bias points.

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Optimal Signal Processing of Frequency-Stepped CW Radar Data

G.A. Ybarra, S.M. Wu, G.L. Bilbro, S.H. Ardalan, C.P. Hearn and R.T. Neece. "Optimal Signal Processing of Frequency-Stepped CW Radar Data." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 94-105.

An optimal signal processing algorithm is derived for estimating the time delay and amplitude of each scatterer reflection using a frequency-stepped CW system. The channel is assumed to be composed of abrupt changes in the reflection coefficient profile. The optimization technique is intended to maximize the target range resolution achievable from any set of frequency-stepped CW radar measurements made in such an environment. The algorithm is composed of an iterative two-step procedure. First, the amplitudes of the echoes are optimized by solving an overdetermined least squares set of equations. Then, a nonlinear objective function is scanned iu an organized fashion to find its global minimum. The result is a set of echo strengths and time delay estimates. Although this paper addresses the specific problem of resolving the time delay between the first two echoes, the derivation is general in the number of echoes. Performance of the optimization approach is illustrated using measured data obtained from an HP-8510 network analyzer. It is demonstrated that the optimization approach offers a significant resolution enhancement over the standard processing approach that employs an IFFT. Degradation in the performance of the algorithm due to suboptimal model order selection and the effects of additive white Gaussion noise are addressed.

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Spectral Dependence of Light-Induced Microwave Reflection Coefficient from Optoelectronic Waveguide Gratings

W. Platte. "Spectral Dependence of Light-Induced Microwave Reflection Coefficient from Optoelectronic Waveguide Gratings." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 106-111.

After a short description of the method of operation of optoelectronic microwave filters, a detailed analysis of the spectral dependence of light-induced microwave reflection coefficient from an optoelectronically generated distributed Bragg reflection waveguide grating is reported. The theory is based on an improved stepped-impedance model utilizing a diffusion-controlled abrupt-profile approach of photoconductivity along with a conformal mapping technique for the quasi-static evaluation of the spectral performance of photoinduced wave attenuation. The validity of theory is clarified and the calculated results are compared with experimental results. As a useful result for future applications, an optimum excitation wavelength of about 825 nm for a fiber-optically controlled lab-tested 50Omega full-substrate silicon coplanar waveguide has been obtained.

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A Theoretical Study of an Integrated Quantum-Well Resonant Tunneling Oscillator Initiated by an IMPATT Diode

C.C. Yang and D.-S. Pan. "A Theoretical Study of an Integrated Quantum-Well Resonant Tunneling Oscillator Initiated by an IMPATT Diode." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 112-118.

A novel initiation scheme, utilizing the new pulsed IMPATT to generate millimeter-wave oscillations in a series-integrated quantum-well resonant tunneling diode (RTD), is proposed and theoretically investigated for the first time. To facilitate transient analysis, a generalized impedance is defined and adopted in this work. The detailed investigation of a two-RTD oscillator is carried out at 100 GHz. The maximum oscillator output power versus the minimum initial input power required of initiation is about 50%. The duration of only a few RF cycles is needed for such initiation.

Abstracts

A WH/GSMT-Based Full-Wave Analysis for Planar Transmission Lines Embedded in Multilayered Dielectric Substrates

L.-M. Chou, R.G. Rojas and P.H. Pathak. "A WH/GSMT-Based Full-Wave Analysis for Planar Transmission Lines Embedded in Multilayered Dielectric Substrates." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 119-130.

A new full-wave analysis method, referred to as the WH/GSMT, is developed to solve multilayered planar transmission line problems. First, the scattering of an obliquely incident parallel plate mode (PPM) by a PEC half plane embedded in a multilayered isotropic dielectric substrate within a PEC parallel plate region is analyzed via the Wiener-Hopf (WH) technique. The solution is then incorporated into the generalized scattering matrix technique (GSMT) to find the (complex) propagation constant and characteristic impedance of the planar transmission lines. The lateral power leakage is taken into account rigorously in the WH/GSMT. Numerical results including the microstrip line, conductor-backed slotline, coupled microstrip lines, and antipodal finlines are presented along with a discussion of the advantages/disadvantages of this method.

Abstracts

Full Wave Analysis of Microstrip Floating Line Structures by Wavelet Expansion Method

G. Wang and G.-W. Pan. "Full Wave Analysis of Microstrip Floating Line Structures by Wavelet Expansion Method." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 131-142.

A full wave analysis of microstrip floating line structures by wavelet expansion method is presented. The surface iutegral equation developed from a dyadic Green's function is solved by Galerkin's method, with the integral kernel and the unknown current expanded in terms of orthogonal wavelets. Using the orthonormal wavelets (and scaling functions) with compact support as basis functions and weighting functions, the integral equation is converted into a set of linear algebraic equations, with the matrices nearly diagonal or block-diagonal due to the localization, orthogonality, and cancellation properties of the orthogonal wavelets. Limitations inherited in the traditional orthogonal basis systems are released: The problem-dependent normal modes have been replaced by the problem-independent wavelets, preserving the orthogonality; the trade-off between orthogonality and continuity (e.g. subsectional basis functions including pulse functions, roof-top functions, piecewise sinusoidal functions, etc.) is well balanced by the orthogonal wavelets. Numerical results are compared with measurements and previous published data with good agreement.

Abstracts

Multilayer Microstrip Structure Analysis with Matched Load Simulation

E.K.L. Yeung, J.C. Beal and Y.M.M. Antar. "Multilayer Microstrip Structure Analysis with Matched Load Simulation." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 143-149.

This paper presents a generalized approach to the full-wave analysis of multilayer microstrip structures. One of the structures studied is a new kind of microstrip bandpass filter realized in a double-layer dielectric substrate configuration. This filter demonstrates the use of the third (vertical) dimension in the design of microstrip devices. The approach involves the mixed potential integral equation technique, the Method of Moments, and an S-parameter extraction technique based on a simple form of Matched Load Simulation. Simulated and measured results for various microstrip structures are presented and show good agreement. The approach is demonstrated in detail for 2-port structures, with an outline of how it can readily be extended to the 2-port case.

Abstracts

A Numerical Absorbing Boundary Condition for Finite Difference and Finite Element Analysis of Open Periodic Structures

A. Boag and R. Mittra. "A Numerical Absorbing Boundary Condition for Finite Difference and Finite Element Analysis of Open Periodic Structures." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 150-154.

In this paper we present a novel approach to deriving local boundary conditions, that can be employed in conjunction with the Finite Difference/Finite Element Methods (FD/FEM) to solve electromagnetic scattering and radiation problems involving periodic structures. The key step in this approach is to derive linear relationships that link the value of the field at a boundary grid point to those at the neighboring points. These linear relationships are identically satisfied not only by all of the propagating Floquet modes but by a few of the leading evanescent ones as well. They can thus be used in lieu of absorbing boundary conditions (ABCs) in place of the usual FD/FEM equations for the boundary points. Guidelines for selecting the orders of the evanescent Floquet modes to be absorbed are given in the paper. The present approach not only provides a simple way to derive an accurate boundary condition for mesh truncation, but also preserves the banded structure of the FD/FEM matrices. The accuracy of the proposed method is verified by using an internal check and by comparing the numerical results with the analytic solution for perfectly conducting strip gratings.

Abstracts

Scattering from a Sphere of Small Radius Embedded Into a Dielectric One

J.A. Roumeliotis, N.B. Kakogiannos and J.D. Kanellopoulos. "Scattering from a Sphere of Small Radius Embedded Into a Dielectric One." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 155-168.

In this paper, the scattering of a plane electromagnetic wave from a metallic or dielectric sphere of electrically small radius, embedded into a dielectric one, is considered. The classical method of separation of variables is used, combined with translational addition theorems for spherical vector wave functions. Analytical expressions are obtained for the scattered field and the various scattering cross-sections, in the case of an inner sphere with electrically small radius. Numerical results are given for various values of the parameters and for metallic and dielectric inner sphere. Some remarks are made about the possibility of detection or identification of inhomogeneities or nonsymmetries.

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Quasi-Static Image Method Applied to Bi-Isotropic Microstrip Geometry

P.K. Koivisto and J.C.-E. Sten. "Quasi-Static Image Method Applied to Bi-Isotropic Microstrip Geometry." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 169-175.

A generalization of the partial image method, applicable for static planar-layered problems, is used to form Green's functions for the layered structure involving bi-isotropic medium. The results are applied for the analysis of a microstrip transmission line assumed to support the quasi-TEM mode. The capacitance and inductance per unit length are calculated to determine the propagation factor and impedance for the structure composed of a conducting strip attached to a bi-isotropic slab with conducting backing.

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Surface Integral Formulation for Calculating Conductor and Dielectric Losses of Various Transmission Structures

T. Roy, T.K. Sarkar and M. Swaminathan. "Surface Integral Formulation for Calculating Conductor and Dielectric Losses of Various Transmission Structures." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 176-185.

The power-loss method, along with a surface integral formulation, has been used to compute the attenuation constant in microstrip and coplanar structures. This method can be used for the analysis of both open and closed structures. Using the surface equivalence principle, the waveguide walls are replaced by equivalent electric surface currents and dielectric surfaces are replaced by equivalent electric and magnetic surface currents. Enforcing the appropriate boundary condition, and E-field integral equation (EFIE) is developed for these currents. Method of moments with pulse expansion and point matching testing procedure is used to transform the integral equation into a matrix one. The relationship between the propagation constant and frequency is found from the minimum eigenvalue of the moment matrix. The eigenvector pertaining to the minimum eigenvalue gives the unknown electric and magnetic surface currents.

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Modal Characteristics of Ferromagnetic Tridisk-Coupled Resonator

T. Nagao, Z. Tanaka, H. Morishita and I. Makita. "Modal Characteristics of Ferromagnetic Tridisk-Coupled Resonator." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 186-193.

The Elgenvalue characteristics of a ferromagnetic tridisk-coupled (TDC) resonator are described first. A TDC resonator is made of three AIYIG ferrite disks partially scraped and mutually attached on a center conductor. The EM field is treated with a consistent theory. The eigenvalue characteristics computed with stress on the mode of v=1 are represented by the Z/sub 10/ versus Z/sub 0/ and Z/sub 1/ versus K/µ relationships, where Z/sub 10/ is a degenerate eigenvalue, Z/sub 0/ is a wavenumber-eccentric radius product, and Z/sub 1/ is a continuously varying eigenvalue dependent on K/µ, with a given value of Z/sub 0/. Z/sub 10/ is distinguished by either a single- or double-value region as a function of Z/sub 0/. The computed Z/sub 1/ versus K/µ graph belonging to the double-value region demonstrates a contradiction to the physical reality, which is resolved by introducing an equivalent circular resonant mode. The equivalent resonant mode is definitely identified by a degenerate eigenvalue and its modal curve with large modal separation. Experiments were carried out with various center conductors. The experimental results support the equivalent resonant mode. Finally, discussions are presented.

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Penetration of Electromagnetic Fields through an Elliptical Hole in a Wall of Finite Thickness

B. Radak and R.L. Gluckstern. "Penetration of Electromagnetic Fields through an Elliptical Hole in a Wall of Finite Thickness." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 194-204.

The penetration of electromagnetic fields through an elliptical hole of variable eccentricity in a wall of finite thickness is analyzed. Six cases are considered: p /spl ap/ 0, 0.2, 0.4, 0.6, 0.8, 1., where p = (a - b)/(a + b), a and b being semimajor and semiminor axes of the ellipse. Polarizabilities and susceptibilities are calculated. Results for zero-thickness wall are compared to known analytical expressions.

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Guided Modes on Open Chirowaveguides

S.F. Mahmoud. "Guided Modes on Open Chirowaveguides." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 205-209.

Surface wave modes on an open chiral rod and a planar chiral slab are studied. It is shown that the effect of chirality is to split each mode in the nonchiral case to a pair of modes, the cutoff frequencies of which are above and below that of the nonchiral case. The mode with the lower cutoff freqnency is dominantly right circularly polarized (RCP) mode while the mode with the higher cutoff frequency is dominantly left circularly polarized (LCP) mode near their respective cutoff frequencies. At sufficiently higher frequencies, all modes tend to become RCP (assuming a right handed chiral medium). Closed form expressions for modal cutoff frequencies on the planar chiral slab and chiral circular rod are derived. The surface wave modes are classified as HE and EH modes and a suitable definition for these mode types, that reduces to well known definitions in the nonchiral case, is proposed.

Abstracts

GaAs TUNNETT Diodes on Diamond Heat Sinks for 100 GHz and Above (Short Papers)

H. Eisele and G.I. Haddad. "GaAs TUNNETT Diodes on Diamond Heat Sinks for 100 GHz and Above (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 210-213.

Single-drift GaAs TUNNETT diodes were mounted on diamond heat sinks for improved thermal resistance and evaluated around 100 GHz in a radial line full height waveguide cavity. The diodes were fabricated from MBE-grown material originally designed for diodes that operate in CW mode around 100 GHz on integral heat sinks. An RF output power of more than 70 mW with a corresponding dc to RF conversion efficiency of 4.9% was obtained at 105.4 GHz. This is the first successful demonstration of GaAs TUNNETT diodes mounted on diamond heat sinks. To the authors' knowledge, these dc to RF conversion efficiencies and RF power levels are the highest reported to date from TUNNETT diodes and exceed those of any single discrete device made of group III-V materials (GaAs, InP, etc.) at this frequency. Free-running TUNNETT diode oscillators exhibit clean spectra with an excellent phase noise of less than -94 dBc/Hz, measured at a frequency off-carrier of 500 kHz and an RF output power of 40 mW.

Abstracts

Modelling Drain and Gate Dependence of HEMT 1-50 GHz, Small-Signal S-Parameters, and D.C. Drain Current (Short Papers)

S.J. Mahon and D.J. Skellern. "Modelling Drain and Gate Dependence of HEMT 1-50 GHz, Small-Signal S-Parameters, and D.C. Drain Current (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 213-216.

We present refinements to a previously validated HEMT model that improves the model's accuracy as a function of drain bias for simulating d.c. drain current and 1-50 GHz, small-signal S-parameters. By comparing simulation data with experimental data for a 0.4-µm-gate pseudomorphic HEMT, we have been able to establish the accuracy of the refined model, which predicts the device's d.c. current and S-parameters as a function of the appfied drain and gate biases to within an accuracy of ~5%. The core of the model and, in particular, its bias dependence, are directly dependent on the HEMT wafer structure and the physical gate length.

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Nonlinear Mixer Gain Calculations for Josephson Junctions (Short Papers)

H. How, T.-M. Fang, C. Vittoria and A. Widom. "Nonlinear Mixer Gain Calculations for Josephson Junctions (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 216-218.

We have numerically solved the steady-state solutions of the initial value problem associated with a current-driven Josephson weak-link junction shunted by an Ohmic resistance. The nonlinear mixing action of the junction leads to Shapiro steps in the dc response with step height in units of the mixing frequency. Mixer gains have been calculated with a wide range of parameter values and intrinsic chaos are observed whenever Shapiro steps are prevalent.

Abstracts

New Technique to Measure Transmission Line Attenuation (Short Papers)

J. Carroll, M. Li and K. Chang. "New Technique to Measure Transmission Line Attenuation (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 219-222.

A new technique using a quarter-wave open stub resonator was developed to measure a transmission line's attenuation coefficient. Transmission line attenuation was extracted from the Q-factor measurement of the open stub resonator. Equations were derived that relate the stub's two port S-parameters to transmission line attenuation. The new method's benefits include higher accuracy over other methods of attenuation measurement, less area required for the test structure, and easier test structure design. Applications include simple and accurate determination of the transmission line's loss characteristics and effective dielectric constant at very high frequencies.

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Waveguide and Resonator Perturbation Techniques Measuring Chirality and Nonreciprocity Parameters Biisotropic Materials (Short Papers)

S.A. Tretyakov and A.J. Viitanen. "Waveguide and Resonator Perturbation Techniques Measuring Chirality and Nonreciprocity Parameters Biisotropic Materials (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 222-225.

Waveguide and resonator perturbation techniques are considered for determining electromagnetic parameters of general biisotropic, or nonreciprocal chiral, materials. The biisotropic materials are the most general linear isotropic media, whose constitutive relations are governed by four complex material parameters. The material parameters of biisotropic media can be obtained through measuring the change in the propagation constant of waveguide modes or measuring the shift in the resonant frequency for resonators with perturbation techniques. To measure these parameters a method utilizing waveguides or cavity resonators with two degenerate modes is proposed.

Abstracts

An Efficient Method for Computing the Capacitance Matrix of Multiconductor Interconnects in Very High-Speed Integrated Circuit Systems (Short Papers)

S.-P. Luo and Z.-F. Li. "An Efficient Method for Computing the Capacitance Matrix of Multiconductor Interconnects in Very High-Speed Integrated Circuit Systems (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 225-227.

A new method for computing the capacitance matrix of multiconductor interconnects with firnite metallization thickness is developed. Converting the vertical wall of the rectangular conductors into the equivalent horizontal strips allows the Green's function in the spectral domain and the FFT algorithm to be used, which makes the method more effective for computing capacitance matrix of the interconnects.

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Eigenmode Sequence for an Elliptical Waveguide with Arbitrary Ellipticity (Short Papers)

S.-j. Zhang and Y.-c. Shen. "Eigenmode Sequence for an Elliptical Waveguide with Arbitrary Ellipticity (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 227-230.

Eigenmode sequence for an elliptical waveguide with arbitrary ellipticity is studied by directly calculating the parametric zeros of the modified Mathieu functions of the first kind and their derivatives. The normalized cutoff wavelength of the lowest 100 successive modes are presented, and the curvefitting expressions for the determination of the cutoff wavelength of the lowest 10 order modes are given, which are valid for the ellipticities ranging from 0.0 to 0.99.

Abstracts

A New Electric Field Integral Equation for Heterogeneous Dielectric Bodies of Revolution (Short Papers)

M.S. Viola. "A New Electric Field Integral Equation for Heterogeneous Dielectric Bodies of Revolution (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 230-233.

In this paper, a novel electric field integral equation (EFIE) is developed for rotationally-symmetric heterogeneous dielectric bodies. This EFIE has several attractive features. Firstly, the azimuthal field component has been eliminated in this formulation thereby reducing the number of scalar unknowns from three to two. Secondly, it is a pure-integral equation in which there are no terms involving derivatives of the field components. Finally, this description is devoid of any highly singular kernel which would require a principal-value evaluation of the associated integral. These attributes render this formulation advantageous for both computational and theoretical pursuits.

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Computation of Proper and Improper Modes in Multilayered Bianisotropic Waveguides (Short Papers)

F. Mesa and M. Horno. "Computation of Proper and Improper Modes in Multilayered Bianisotropic Waveguides (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 233-235.

An efficient numerical method is presented to determine the loci of both the proper and complex improper modes of a multilayered bianisotropic planar waveguide. The propagation constants of the waveguide modes are expressed in terms of the zeros of a specific analytic function. The use of appropriate integration zero-searching methods is proposed since information about the possible number of complex improper modes cannot be previously extracted. The general formulation presented here has been applied to the study of the complex improper modes of single and two-layer structures containing magnetized ferrites. It has been found that the transition from physical proper to complex improper modes is made throughout a nonphysical real improper mode.

Abstracts

A Note on the Mode Characteristics of a Ferrite Slab (Short Papers)

H.-Y. Yang. "A Note on the Mode Characteristics of a Ferrite Slab (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 235-238.

Properties of guided-wave modes of a ferrite slab propagating in the direction transverse to the bias field are reexamined. Analytic results for the frequencies where magnetostatic and dynamic modes exist simultaneously are found. The method of eliminating the dynamic modes in the magnetostatic-wave operation is described. The formulas for the distinction of oscillatory and surface-wave modes are also derived.

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Analysis and Design of a Circular Disc 3-dB Coupler (Comments)

M.D. Abouzahra. "Analysis and Design of a Circular Disc 3-dB Coupler (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 239-239.

In a recent paper, Bialkowski and Jellett discussed the design of a broadband 3-dB quadrature hybrid. This hybrid is comprised of 4-port microstrip disc. It appears that the authors were able to increase the operational bandwidth of the circular disc 3-dB quadrature coupler to about 20%. Open and short-circuited stubs were introduced to the periphery of the coupler in order to realize a broader bandwidth. This technique was applied previously by Riblet and Ohta on planar components and broader operational bandwidth were realized. In addition to listing few corrections, I would like to respond to some inaccurate statements made in [1] by offering the following comments.

Abstracts

Analysis and Design of a Circular Disc 3-dB Coupler (Reply to Comments)

M.E. Bialkowski and S.T. Jellett. "Analysis and Design of a Circular Disc 3-dB Coupler (Reply to Comments)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 239-240.

As mentioned by M. D. Abouzahra, our work presented in [1] concerned the analysis and design of a 3-dB quadrature hybrid in the form of a circular disc that has increased operational bandwidth. Because our investigations primarily involved a 3-dB quadrature circular disc hybrid, we did not attempt to provide a full list of references on disc hybrids (these generally include 180° hybrids, 90° hybrids, and other useful hybrids in the form of 4-ports, 5-ports, etc). In comparison with the material presented in [1], Abouzahra in his comments provides a more thorough listing of references on this broad topic, which we will now comment on.

Abstracts

Analysis of Wide Inclined Slot Coupled Narrow Wall Coupler Between Dissimilar Rectangular Waveguides (Comments and Authors' Reply)

S.R. Rengarajan. "Analysis of Wide Inclined Slot Coupled Narrow Wall Coupler Between Dissimilar Rectangular Waveguides (Comments and Authors' Reply)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 240-241.

We wish to comment on a recent publication in the IEEE Transactions on Microwave Theory and Techniques. The authors claim that our paper has not considered the contribution of TE/sub 00/ mode in the scattered fields in the waveguide region and imply that the Green's function employed in our paper is incomplete. It was recognized as far back as in 1973 that the eigenfunction expansion of the dyadic Green's functions in terms of the waveguide modes is incomplete in the source region and that there is an additional singular term. The source region singularity of the dyadic Green's functions in waveguides and cavities was a topic of discussion in several papers in seventies, and it is well understood now by the electromagnetic community. The singular term was interpreted as TE/sub 00/ mode contribution by Vu Khac and Carson. In our paper, the Green's functions in the waveguide region do indeed include the source region singularity. The correct form of wavegtride Green's functions are found in many papers in the literature, and hence for brevity they were not reproduced in our paper. We wonder how a reader could conclude that the singular terms are not treated in our paper since there is a discussion on the singular contribution with a mathematical expression containing the appropriate Dirac delta function. It is also obvious that the specific terms of the cavity Green's functions that treat the waveguide wall thickness in our analysis do not have such a singular contribution present. Therefore, Green's functions employed in our paper are complete and rigorous.

Abstracts

Analysis of Wide Inclined Slot Coupled Narrow Wall Coupler Between Dissimilar Rectangular Waveguides (Reply to Comments)

D. Satyanarayana and A. Chakrabarty. "Analysis of Wide Inclined Slot Coupled Narrow Wall Coupler Between Dissimilar Rectangular Waveguides (Reply to Comments)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 241-242.

The authors wish to thank Sembiam R. Rengarajan for his comments on our recent publication. In replying to the comments, we wish to stress the following points.

Abstracts

Criterion of Leakage from Printed Circuit Transmission Lines (Comments)

R. Marques, F. Mesa and N.K. Das. "Criterion of Leakage from Printed Circuit Transmission Lines (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 242-243.

Leakage of power in printed transmission lines can be due to the excitation of both volume and surface waves. Depending on the frequency of operation several surface waves can be excited in the background waveguide, contributing to the transversal leakage of power. A crucial point in the analysis is to determine how many of these surface modes contribute to the leakage.

Abstracts

TE-Mode Scattering from Two Junctions in H-Plane Waveguide (Corrections)

H.J. Eom. "TE-Mode Scattering from Two Junctions in H-Plane Waveguide (Corrections)." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 243-243.

In the above paper, there are serious printing errors that need to be corrected. The corrections are as follows: In (9) and (14), j should be replaced by i. In (35), 'when d = a and alpha 0' should be replaced by 'when b/sub m/ = a/sub n/ and alpha = 0'.

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IEEE Copyright Form (Jan. 1995 [T-MTT])

"IEEE Copyright Form (Jan. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 244-245.

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Introducing the 1995 IEEE All-Society Periodicals Package (Advertisement) (Jan. 1995 [T-MTT])

"Introducing the 1995 IEEE All-Society Periodicals Package (Advertisement) (Jan. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 246-246.

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IEEE Financial Advantage Program (Advertisement) (Jan. 1995 [T-MTT])

"IEEE Financial Advantage Program (Advertisement) (Jan. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 247-247.

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The Institute of Electrical and Electronics Engineers (Advertisement) (Jan. 1995 [T-MTT])

"The Institute of Electrical and Electronics Engineers (Advertisement) (Jan. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.1 (Jan. 1995 [T-MTT]): 248-248.

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Editorial (Feb. 1995 [T-MTT])

D. Masse. "Editorial (Feb. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 249-249.

On March 1, 1995 my three-year term as Editor of the IEEE Transactions on Microwave Theory and Techniques will come to an end.

Abstracts

Monolithic 2-18 GHz Low Loss, On-Chip Biased PIN Diode Switches

J.-L. Lee, D. Zych, E. Reese and D.M. Drury. "Monolithic 2-18 GHz Low Loss, On-Chip Biased PIN Diode Switches." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 250-256.

Two state-of-the-art monolithic GaAs PIN diode switches have been designed, fabricated and tested. These single-pole double-throw (SPDT) switches exhibit insertion losses of 1.15 ± 0.15 dB over a 2-18 GHz band, which is an unprecedented performance in loss and flatness for monolithic wideband switches incorporating on-chip bias networks. Isolation and return loss are greater than 43 dB and 12 dB, respectively, and the input port power handling is 23 dBm at 1-dB insertion loss compression. These performance characteristics were measured at a nominal bias setting of -8 V, which corresponds to 3.7 mA of series diode bias current and a total dc power consumption of 55mW. The input power at the third-order interception is 40 dBm. The switches can handle up to 31 dBm (1.25 W) at a higher bias of -18 V and 9.3 mA.

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Pseudomorphic HEMT Manufacturing Technology for Multifunctional Ka-Band MMIC Applications

C.S. Wu, C.K. Pao, W. Yau, H. Kanber, M. Hu, S.X. Bar, A. Kurdoghlian, Z. Bardai, D. Bosch, C. Seashore and M. Gawronski. "Pseudomorphic HEMT Manufacturing Technology for Multifunctional Ka-Band MMIC Applications." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 257-266.

We have demonstrated very good performance, high yield Ka-Band multifunctional MMIC results using our recently developed 0.25-µm gate length pseudomorphic HEMT (PHEMT) manufacturing technology. Four types of MMIC transceiver components--low noise amplifiers, power amplifiers, mixers, and voltage controlled oscillators--were processed on the same PHEMT wafer, and all were fabricated using a common gate recess process. High performance and high producibility for all four MMIC components was achieved through the optimization of the device epitaxial structure, a process with wide margins for critical process steps and circuit designs that allow for anticipated process variations, resulting in significant performance margins. We obtained excellent results for the Ka-band power amplifier: greater than 26 dBm output power at center frequency with 4.0% standard deviation over the 3-in. wafer, 2-GHz bandwidth, greater than 20 percent power-added efficiency, over 8 dB associated gain, and over 10 dB linear gain. The best performance for the Ka-band LNA was over 17 dB gain and 3.5 dB noise figure at Ka-band. In this paper, we report our device, process, and circuit approach to achieve the state-of-the-art performance and producibility of our MMIC chips.

Abstracts

Experiments of Device Failures in a Spatial Power-Combining Array

J. Lin and T. Itoh. "Experiments of Device Failures in a Spatial Power-Combining Array." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 267-271.

The performance of a spatial power-combining array with device failure is investigated. Experimental results show that the array still combines the power in the broadside direction when the DC open-circuit failure occurs. Analysis of measured radiation patterns indicated that the power radiated from the patch antenna attached to the failed device is much smaller than the power radiated from other patch antennas. The effects of the chip resistor and the RF impedance of failed device are discussed.

Abstracts

An Approach to Distributed Amplifier Based on a Design-Oriented FET Model

C. Paoloni and S. D'Agostino. "An Approach to Distributed Amplifier Based on a Design-Oriented FET Model." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 272-277.

A Design-Oriented FET model in conjunction with an appropriate design procedure for distributed amplifiers is presented. The advantage of including the effects caused by FET parasitic in a newly defined simple unilateral FET circuit to be utilized in the conventional distributed amplifier design procedure allows an accurate prediction of the low-frequency gain and the 3-dB cutoff frequency. The simplicity of this formulation and a set of generalized design charts provide an interesting opportunity to designers. Comparisons among different experimental data from literature and the results obtained by this theory confirm the validity of the Design-Oriented FET model and the effectiveness of the given graphical design method.

Abstracts

Noise Calculations and Experimental Results of Varactor Tunable Oscillators with Significantly Reduced Phase Noise

V. Gungerich, F. Zinkler, W. Anzill and P. Russer. "Noise Calculations and Experimental Results of Varactor Tunable Oscillators with Significantly Reduced Phase Noise." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 278-285.

The single-sideband phase noise of varactor tunable GaAs MESFET oscillators is investigated. Two oscillator circuits with different microstrip resonator circuits were designed and fabricated. Using a resonator consisting of coupled microstrip lines instead of a single microstrip line, which is a planar monolithically integrable structure, phase noise is reduced significantly because the quality factor is higher for the coupled resonator. The phase noise is calculated using a nonlinear time domain method, which solves the Langevin equations, describing the deterministic and stochastic behavior of an oscillator by perturbation methods. Calculated and measured phase noise agree within the accuracy of measurements. The very low phase noise of 95 dBc/Hz at 100 kHz offset frequency is achieved.

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Electric Field Enhancement and Power Absorption in Microwave TR-Switches

V. Semenov, M. Lisak and D. Anderson. "Electric Field Enhancement and Power Absorption in Microwave TR-Switches." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 286-292.

An analytical and numerical investigation is made of electric field enhancement due to scattering of an incident plane wave by a biconical conductor. An application to microwave transmit-receive switches (TR) shows that field enhancement factors of the order of 20 to 40 are to be expected in the region close to the keep-alive contacts. An analysis of the microwave absorption by a small plasma sphere located in the vertex of the biconical conductor is also presented, showing that the plasma sphere absorbs a significant fraction of the incident power independently of the plasma size. This explains the observed absorption properties during the turn-on phase of TR switches.

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Small-Signal and Noise Model Extraction Technique for Heterojunction Bipolar Transistor at Microwave Frequencies

J.P. Roux, L. Escotte, R. Plana, J. Graffeuil, S.L. Delage and H. Blanck. "Small-Signal and Noise Model Extraction Technique for Heterojunction Bipolar Transistor at Microwave Frequencies." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 293-298.

The increasing use of Heterjunction Bipolar Transistors (HBT's) in microwave analog circuits requires a valid description of these devices by means of an equivalent circuit including noise sources in an extended bias and frequency range. This paper describes a technique to extract the elements of the equivalent circuit from simultaneous noise and S-parameter measurements. Additionally, the conventional high frequency bipolar junction transistor (BJT) noise model is shown to work well with HBT's. Recent results obtained from GaInP/GaAs HBT's are reported.

Abstracts

Electromagnetic Paper Drying

J.C. Monzon. "Electromagnetic Paper Drying." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 299-305.

A solution to the nonlinear problem of drying of a sheet material is presented, which combines basic thermodynamic properties with the field equations. Some results are given in a numerical simulation.

Abstracts

The Coplanar Resonator Technique for Determining the Surface Impedance of YBa/sub 2/Cu/sub 3/O/sub 7-delta/ Thin Films

A. Porch, M.J. Lancaster and R.G. Humphreys. "The Coplanar Resonator Technique for Determining the Surface Impedance of YBa/sub 2/Cu/sub 3/O/sub 7-delta/ Thin Films." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 306-314.

We describe how coplanar microwave resonators fabricated from patterned thin films of YBa/sub 2/Cu/sub 3/O/sub 7-delta/ (YBCO) can be used to measure the ab-plane microwave surface impedance Z/sub s/ = R/sub s/ + jX/sub s/ of the films, in particular the absolute value and temperature dependence of the magnetic penetration depth lamda. The current distribution of the resonator is calculated by modelling the resonator as a network of coupled transmission lines of rectangular cross-sections; this is then used to estimate the ab-plane lambda(T) from the measurements of resonators of different geometries patterned onto the same film. We obtain values of lambda(0) in the range 150-220 nm. The unloaded quality factors of the linear resonators at 7.95 GHz are around 45000 at 15 K and around 6500 at 77 K. We estimate the corresponding values of the intrinsic R/sub s/ at 7.95 GHz to be 23 µOmega and 110 µOmega at 15 K and 77 K, respectively. These values are comparable with those of other high quality unpatterned YBCO films reported in the literature. Z/sub s/ for the best optimised films appears to be insensitive to the effects of patterning.

Abstracts

Causal-Convolution--A New Method for the Transient Analysis of Linear Systems at Microwave Frequencies

T.J. Brazil. "Causal-Convolution--A New Method for the Transient Analysis of Linear Systems at Microwave Frequencies." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 315-323.

A new convolution-type method is presented for the transient analysis of causal linear systems described in the frequency-domain. The central novelty lies in the proposed method of determining impulse responses in the time-domain, which are interpreted as truly discrete functions corresponding to periodically-extended system functions in the frequency-domain. Such impulse responses may be computed with high numerical efficiency, while having excellent interpolation properties with respect to the original system function. The convolution operations which result are also naturally in the form of a sum-of-products calculation. The method is capable of handling arbitrary excitation signals, and may in principle be readily extended to more general nonlinear analysis. Several examples of the technique are given, including comparisons and validation both using existing methods, analytical results and experimental measurements.

Abstracts

Circular Groove Guide for Short Millimeter and Submillimeter Waves

H.-S. Yang, J. Ma and Z.-Z. Lu. "Circular Groove Guide for Short Millimeter and Submillimeter Waves." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 324-330.

A new type of groove guide, circular groove guide, has been designed for use as a low losses, high power handling, low dispersion and single mode transmission medium in the short millimetric and submillimetric waves ranges. The characteristic equations of TE modes and TM modes have been developed and the propagation characteristics of the fundamental mode have been discussed. Experimental measurements are in good agreement with theoretical results.

Abstracts

Port Reflection Coefficient Method for Solving Multi-Port Microwave Network Problems

Z. Ma and E. Yamashita. "Port Reflection Coefficient Method for Solving Multi-Port Microwave Network Problems." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 331-337.

The port reflection coefficient method (PRCM) is proposed for the treatment of multi-port microwave network systems. The theory is meaningful because in combination with other available numerical techniques, it can provide several possible ways for simplifying and solving complicated multi-port problems. The PRCM also suggests an approach for the measurement of scattering parameters, since it requires only the measurement of reflection coefficients at partial ports of the system. The efficiency and versatility of the method are verified through various numerical examples, including waveguide H-plane right angle bend, E-plane T-junctions, and multi-port power dividers. A special case of this method yields the well-known transverse resonance approach.

Abstracts

The Definition and Computation of Modal Characteristic Impedance in Quasi-TEM Coupled Transmission Lines

G.G. Gentili and M. Salazar-Palma. "The Definition and Computation of Modal Characteristic Impedance in Quasi-TEM Coupled Transmission Lines." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 338-343.

The quasi-TEM analysis of systems of lossless coupled transmission lines in an inhomogeneous medium is reviewed. Starting from the generalized telegrapher's equations, the characteristic impedance of the normal modes is defined and computed according to the three usual definitions for the single-line case: power-current, power-voltage and voltage-current. Unlike the quasi-TEM single-line case, it is shown that the three definitions lead in general to different modal characteristic impedance values. Theoretical results are then confirmed by some numerical examples on two and three coupled-lines systems.

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Analysis of a Coaxial-to-Waveguide Adaptor Including a Discended Probe and a Tuning Post

M.E. Bialkowski. "Analysis of a Coaxial-to-Waveguide Adaptor Including a Discended Probe and a Tuning Post." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 344-349.

A field matching analysis of a coaxial-to-waveguide adaptor incorporating a disc-ended probe and a tuning post is presented. In this analysis, the tuning post is considered as a short-circuited second probe. A computer algorithm for calculating the input impedance of this structure is developed. This algorithm is used to investigate and improve the operation of a commercially available coaxial-to-waveguide adaptor.

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FDTD Analysis of Magnetized Ferrites: Application to the Calculation of Dispersion Characteristics of Ferrite-Loaded Waveguides

J.A. Pereda, L.A. Vielva, M.A. Solano, A. Vegas and A. Prieto. "FDTD Analysis of Magnetized Ferrites: Application to the Calculation of Dispersion Characteristics of Ferrite-Loaded Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 350-357.

The finite-difference time-domain (FDTD) method is extended to include magnetized ferrites. The treatment of the ferrite material is based on the equation of motion of the magnetization vector. Magnetic losses are also included in the equation of motion by means of Gilbert's approximation of the phenomenological Landau-Lifschitz damping term. The discretization scheme is based on central finite-differences and linear interpolation. This scheme allows the fully explicit nature of the FDTD method to be maintained. This extension of the FDTD method to magnetized ferrites is applied to the full-wave analysis of ferrite-loaded waveguides. The dispersion curves are calculated by using a recently proposed 2D-FDTD formulation for dispersion analysis which has been adapted to the present problem. The results for both the phase and attenuation constants of various transversely and longitudinally magnetized ferrite-loaded waveguides are compared with the exact values and with those obtained by means of Schelknnoff's method.

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Three Dimensional Finite-Difference Time-Domain Slotline Analysis on a Limited Memory Personal Computer

Q. Chen and V.F. Fusco. "Three Dimensional Finite-Difference Time-Domain Slotline Analysis on a Limited Memory Personal Computer." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 358-362.

In order to reduce computer memory and computational time required by three dimensional Finite-Difference Time-Domain (FDTD) microwave passive component analysis, two strategies are developed in this paper. First, the recently reported dispersive boundary condition (DBC) is modified thereby enabling the absorbing boundary to be located near to the main field area; second, an exact source plane field distribution itself produced by the FDTD algorithm is adopted to improve numerical accuracy. This leads to a reduction in computer memory requirements. As an example, a full-wave 3d FDTD analysis of a slotline is performed on a 33MHz PC486. The dispersion characteristic of the slotline is presented up to 1000 GHz this agrees well with that of closed form formula. When compared with previous slotline solutions, frequency range results are extended by an octave and less than 9 percent of the computer memory previously required is demanded by this paper. The unique and highly efficient combination of the two strategies presented here could be applied to other microwave waveguide component analyses.

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Analytic Determination of the Capacitance Matrix of Planar or Cylindrical Multiconductor Lines on Multilayered Substrates

D. Homentcovschi, G. Ghione, C. Naldi and R. Oprea. "Analytic Determination of the Capacitance Matrix of Planar or Cylindrical Multiconductor Lines on Multilayered Substrates." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 363-373.

An exact analytical expression for the Maxwell capacitance matrix of a multilayer, multistrip planar or cylindrical line is derived by solving the dual series equation system of the problem by means of a Volterra boundary-value problem. The solution is expressed in terms of some infinite matrices with very good convergence properties. Numerical examples show that the method yields accurate results and is also computationally effective for lines having a large number of conductors.

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Analysis of Metallic Waveguides with Rectangular Boundaries by Using the Finite-Difference Method and the Simultaneous Iteration with the Chebyshev Acceleration

J.-M. Guan and C.-C. Su. "Analysis of Metallic Waveguides with Rectangular Boundaries by Using the Finite-Difference Method and the Simultaneous Iteration with the Chebyshev Acceleration." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 374-382.

A numerical procedure based on the finite-difference method and simultaneous iteration of the power method in conjunction with the Chebyshev acceleration technique is utilized to analyze the metallic waveguides. Due to the efficiency of the present sparse matrix eigenproblem solver, lots of unknowns can be used in the domains of the waveguide cross-sections. Therefore, accurate cutoff wavenumbers or frequencies can be obtained by using the simple finite-difference method for the commonly used metallic waveguides such as the L-shaped, single-ridged, double-ridged, and rectangular coaxial waveguides. Some discrepancies with the numerical results in the recent literature are found and detailed discussions are provided to verify the correctness of the present results.

Abstracts

Analysis of Transmission Lines of Finite Thickness Above a Periodically Perforated Ground Plane at Oblique Orientations

G. Pan, X. Zhu and B.K. Gilbert. "Analysis of Transmission Lines of Finite Thickness Above a Periodically Perforated Ground Plane at Oblique Orientations." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 383-393.

A general method is formulated for the analysis of signal lines of finite thickness in the presence of a periodically perforated ground plane. Utilizing the dyadic Green's functions, a set of electric and magnetic field integral equations (EFIE, MFIE) is established, which are then transformed into the spectral domain by the Fourier transform. Galerkin's method is used to solve the combined integral equations. The B-spline functions are chosen as basis functions to achieve a higher order of convergence. The dispersive characteristics of the transmission lines are studied and the characteristic impedance of the signal lines are evaluated by both the voltage-current definition and the power-current definition, with good consistency. The effect of signal locations versus apertures in the ground plane is discussed. Finally, measurements are conducted, and the results agreed very well with the theory.

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Numerically Efficient Analysis of Planar Microstrip Configurations Using Closed-Form Green's Functions

I. Park, R. Mittra and M.I. Aksun. "Numerically Efficient Analysis of Planar Microstrip Configurations Using Closed-Form Green's Functions." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 394-400.

An efficient technique for the analysis of a general class of microstrip structures with a substrate and a superstrata is investigated in this paper using newly-derived closed-form spatial domain Green's functions employed in conjunction with the Method of Moments (MoM). The computed current distributions on the microstrip structure are used to determine the scattering parameters of microstrip discontinuities and the input impedances of microstrip patch antennas. It is shown that the use of the closed-form Green's functions in the context of the MoM provides a computational advantage in terms of the CPU time by almost two orders of magnitude over the conventional spectral domain approach employing the transformed version of the Green's functions.

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Abstracts

Rigorous, Full-Vectorial Source-Type Integral Equation Analysis of Circularly Curved Channel Waveguides

H.J.M. Bastiaansen, J.M. van der Keur and H. Blok. "Rigorous, Full-Vectorial Source-Type Integral Equation Analysis of Circularly Curved Channel Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 401-409.

A source-type integral equation method is presented to determine the propagation constants, the radiation losses, and the electromagnetic field distributions of the discrete ("guided") modes in circularly curved, integrated optical channel waveguides embedded in a homogeneous background. The method can be extended to the case of a multilayered background, e.g. a ridge waveguide. The source-type integral equation forms an eigenvalue problem, where the electric field strength represents the eigenvector. This problem is solved numerically by applying the method of moments. Numerical results are presented for various rectangular channel waveguides situated in a homogeneous embedding and compared with those of other modeling methods.

Abstracts

An Efficient FEM Formulation for Rotationally Symmetric Coaxial Waveguides

N.Y. Zhu and F.M. Landstorfer. "An Efficient FEM Formulation for Rotationally Symmetric Coaxial Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 410-415.

In this paper, an efficient finite element method formulation (FEM) is applied to rotationally symmetric coaxial waveguides, in which the dependence of the dominant TEM mode on the radius of the cylindrical coordinate system is explicitly taken into account in the basis functions. In this way, a physically appropriate approximation of the unknown field distribution is achieved. After scaling, the resulting sparse matrix equation is solved iteratively by using the biconjugate gradient method (BCG). The numerical results show excellent agreement with results of the mode matching technique (MMT). Compared with the conventional FEM formulation, this method yields a significant improvement in accuracy within the frequency range where the TEM mode dominates.

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Abstracts

Analysis of Rectangular Waveguide Discontinuities by the Method of Lines

W. Pascher and R. Pregla. "Analysis of Rectangular Waveguide Discontinuities by the Method of Lines." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 416-420.

An efficient analysis of discontinuities in the rectangular waveguide is presented using the method of lines with one-dimensional discretization. As the line numbers in the incoming and outgoing waveguides are automatically correctly chosen in the method of lines, relative convergence is avoided. Scattering parameters for the E-plane step discontinuity are determined and an equivalent circuit for the diaphragm, the displacement, and a step with diaphragm is presented.

Abstracts

An A Posteriori Error Reduction Scheme for the Three-Dimensional Finite Element Solution of Maxwell's Equations

U. Pekel and R. Lee. "An A Posteriori Error Reduction Scheme for the Three-Dimensional Finite Element Solution of Maxwell's Equations." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 421-427.

The accuracy of the finite element method (FEM) depends on the properties of the mesh which covers the problem geometry. The accuracy can usually be improved by increasing the element density in the mesh or the order of the shape functions in the elements at the expense of a significant increase in computation time. Instead, in this paper an a posterior error reduction scheme is applied to improve the accuracy in the solution of three-dimensional electromagnetic boundary value problems. In this scheme, first the FEM solution is generated by the use of lower-order shape functions. Then the numerical error is expressed in terms of higher-order shape functions and calculated on an element-by-element basis from information derived from the FEM solution. Finally, this error is added to the FEM solution to improve its accuracy. The degree of error reduction which is achieved with the application of this scheme is demonstrated by means of several simple electromagnetic boundary value problems.

Abstracts

A Numerical Solution to Full-Vector Electromagnetic Scattering by Three-Dimensional Nonlinear Bounded Dielectrics

S. Caorsi, A. Massa and M. Pastorino. "A Numerical Solution to Full-Vector Electromagnetic Scattering by Three-Dimensional Nonlinear Bounded Dielectrics." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 428-436.

This paper deals with electromagnetic scattering by nonlinear dielectric objects. In particular, a numerical approach is developed that is aimed at determining the distributions of the electromagnetic field vector inside a three-dimensional nonlinear, inhomogeneous, isotropic scatterer illuminated by a time-periodic incident electric field vector. An integral-equation formulation for the full-vector scattering problem is considered, and the nonlinear effect is taken into account by introducing equivalent sources and a Fourier-series representation. A system of integral equations (for each harmonic vector components and for the static term) is obtained that includes the internal electric field distribution as the unknown. After discretization, the solution is reduced to solving an algebraic system of nonlinear equations. Some preliminary numerical results are reported concerning scatterers that exhibit a specific (quadratic) dependence of the dielectric permittivity on the total electric field. The harmonic components of the scattered electric field outside the objects are also computed.

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A Fourth-Order in Space and Second-Order in Time TLM Model

N.R.S. Simons and A. Sebak. "A Fourth-Order in Space and Second-Order in Time TLM Model." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 437-444.

In this paper a new TLM model is presented for solving two-dimensional electromagnetic field problems. The new model possesses the same dispersion relation as a fourth-order in space and second-order in time central-finite-difference algorithm. The stability criterion of the TLM model (given in terms of permissible values for the admittance of the permittivity stub) is provided. Investigation of the propagation characteristics indicates the benefits of fourth-order spatial discretization, especially for modelling dielectric media. The improved dispersive properties of the fourth-order models make them attractive candidates for the analysis of electrically large (and inhomogeneous) problems. The scattering and transfer events for the new model are presented as well as results from numerical experiments. The improved computational efficiency of the new fourth-order accurate model in terms of both memory storage and computation time (as compared to the original second-order TLM algorithm) is demonstrated.

Abstracts

Nonreciprocity of Phase Constants, Characteristic Impedances, and Conductor Losses in Planar Transmission Lines with Layered Anisotropic Media

T. Kitazawa. "Nonreciprocity of Phase Constants, Characteristic Impedances, and Conductor Losses in Planar Transmission Lines with Layered Anisotropic Media." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 445-451.

The nonreciprocal characteristics of the planar transmission lines with the layered structures, including the magnetized ferrite, are analyzed based on the versatile hybrid-mode formulation that is applicable to various types of shielded and open structures. Accurate and efficient numerical procedure presents the frequency-dependent nonreciprocal values of the phase constants, characteristic impedances, and attenuation constants, taking the finite metallization thickness into consideration. Numerical results show that the nonreciprocal and metallization thickness effects are dominant parameters on the propagation characteristics, and these effects are different, depending on the types of the planar transmission lines.

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Abstracts

Dispersion Analysis for a TLM Mesh of Symmetrical Condensed Nodes with Stubs

J.A. Morente, G. Gimenez, J.A. Porti and M. Khalladi. "Dispersion Analysis for a TLM Mesh of Symmetrical Condensed Nodes with Stubs." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 452-456.

In this paper, the dispersion characteristics of a TLM mesh formed by interconnected symmetrical condensed nodes with stubs are calculated using two different formulations. The dispersion relation derived is an implicit function of the wave number, frequency, dielectric permittivity, and magnetic permeability. Group and phase velocities are obtained for the three fundamental directions and different values of the relative permittivity. The study demonstrates that an increase in the modeled-medium permittivity leads to a decrease in the cutoff frequency for TLM numerical results.

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Abstracts

X-Band Doubly Balanced Resistive FET Mixer with Very Low Intermodulation (Short Papers)

F. De Flaviis and S.A. Maas. "X-Band Doubly Balanced Resistive FET Mixer with Very Low Intermodulation (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 457-460.

This paper describes a practical realization of a mixer that achieves low intermodulation distortion by using the channel resistance of a GaAs MESFET to provide mixing and achieves even-order spurious response rejection through the use of a doubly balanced structure. Very good results were achieved in terms of second- and third-harmonic levels of -67 and -45 dBC, respectively, at +10 dBm input level. The band-center conversion loss was 11 dB. The circuit was realized in microstrip on an alumina substrate, with a monolithic FET "quad."

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Analysis of an Array of Four Microstrip Patch Resonators Printed on an Anisotropic Substrate (Short Papers)

Y. Chen and B. Beker. "Analysis of an Array of Four Microstrip Patch Resonators Printed on an Anisotropic Substrate (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 460-463.

The spectral-domain approach is applied to the analysis of four microstrip patch resonator array that is printed on anisotropic substrate. Basis functions are carefully chosen to accurately represent the current distribution on each patch, corresponding to every symmetry the structure. Ample numerical results are presented which show the effects of geometrical and anisotropic medium parameters on dominant resonant frequencies of the microstrip patch array.

Abstracts

A Technique for Minimizing Intermodulation Distortion of GaAs FET's

H. Koizumi, S. Nagata and K. Kanazawa. "A Technique for Minimizing Intermodulation Distortion of GaAs FET's." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 463-466.

This paper describes the theory to minimize the intermodulation distortion under certain current bias condition for GaAs FET's. A device-parametric study has been done to obtain the general equation that provides the lowest distortion condition as a function of an operating current. Based on the present theory, FET parameters have been designed practically.

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Abstracts

LRM Probe-Tip Calibrations Using Nonideal Standards

D.F. Williams and R.B. Marks. "LRM Probe-Tip Calibrations Using Nonideal Standards." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 466-469.

The line-reflect-match calibration is enhanced to accommodate imperfect match standards and lossy lines typical of monolithic microwave integrated circuits. We characterize the match and line standards using an additional line standard of moderate length. The new method provides a practical means of obtaining accurate, wideband calibrations with compact standard sets. Without the enhancement, calibration errors due to imperfections in typical standards can be severe.

Abstracts

Call for Papers - Space and Other Applications of High Temperature Superconducting Microwave Technology (Feb. 1995 [T-MTT])

"Call for Papers - Space and Other Applications of High Temperature Superconducting Microwave Technology (Feb. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.2 (Feb. 1995 [T-MTT]): 470-470.

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Broadband Single- and Double-Balanced Resistive HEMT Monolithic Mixers

T.H. Chen, K.W. Chang, S.B.T. Bui, L.C.T. Liu, G.S. Dow and S. Pak. "Broadband Single- and Double-Balanced Resistive HEMT Monolithic Mixers." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 477-484.

A double-balanced (DB) 3-18 GHz and a single-balanced (SB) 2-16 GHz resistive HEMT monolithic mixer have been successfully developed. The DB mixer consists of a AlGaAs/InGaAs HEMT quad, an active LO balun, and two passive baluns for RF and IF. At 16 dBm LO power, this mixer achieves the conversion losses of 7.5-9 dB for 4-13 GHz RF and 7.5-11 dB for 3-18 GHz RF. The SB mixer consists of a pair of AlGaAs/InGaAs HEMT's, an active LO balun, a passive IF balun and a passive RF power divider. At 16 dBm LO power, this mixer achieves the conversion losses of 8-10 dB for 4-15 GHz RF and 8-11 dB for 2-16 GHz RF. The simulated conversion losses of both mixers are very much in agreement with the measured results. Also, the DB mixer achieves a third-order input intercept (IP/sub 3/) of +19.5 to +27.5 dBm for a 7-18 GHz RF and 1 GHz IF at a LO drive of 16 dBm while the SB mixer achieves an input IP/sub 3/ of +20 to +28.5 dBm for 2 to 16 GHz RF and 1 GHz IF at a 16 dBm LO power. The bandwidth of the RF and LO frequencies are approximately 6:1 for the DB mixer and 8:1 for the SB mixer. The DB mixer of this work is believed to be the first reported DB resistive HEMT MMIC mixer covering such a broad bandwidth.

Abstracts

Small-Sized MMIC Amplifiers Using Thin Dielectric Layers

S. Banba and H. Ogawa. "Small-Sized MMIC Amplifiers Using Thin Dielectric Layers." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 485-492.

Miniaturized MMIC amplifiers utilizing a multilayer structure composed of thin film transmission lines are presented. The fundamental characteristics of the thin film transmission lines for use in microwave active circuits are discussed through calculations by numerical analysis. A two-stage low-noise amplifier, a single-stage wideband amplifier, and a balanced amplifier are designed within very small areas, while good performance is maintained. The results include that a Ka-band single-stage amplifier is fabricated in a 0.8 mm x 0.6 mm areas with a gain of 8.0-9.5 dB in the frequency range of 16-26.5 GHz and input/output return losses of better than 8 dB at 26.5 GHz. The proposed amplifier configurations can be applied to high density integration of one-chip MMIC modules.

Abstracts

Analytical Parameter Extraction of the HBT Equivalent Circuit with T-Like Topology from Measured S-Parameters

U. Schaper and B. Holzapfl. "Analytical Parameter Extraction of the HBT Equivalent Circuit with T-Like Topology from Measured S-Parameters." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 493-498.

A pure analytical method for extraction of the small-signal equivalent circuit parameters from measured data is presented and successfully applied to heterojunction bipolar transistors (HBT's). The T-like equivalent circuit is cut into three shells accounting for the connection, and the extrinsic and intrinsic parts of the transistor. The equivalent circuit elements are evaluated in a straightforward manner from impedance and admittance representation of the measured S-parameters. The measured data are stripped during the extraction process yielding, step by step, a full set of circuit elements without using fit methods. No additional knowledge of the transistor is needed to start the extraction process with its self-consistent iteration loop for the connection shell. The extrinsic and intrinsic equivalent circuit elements are evaluated using their bias and frequency dependencies. This method yields a deviation of less then 4% between measured and modeled S-parameters.

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An Approach to Determining an Equivalent Circuit for HEMT's

K. Shirakawa, H. Oikawa, T. Shimura, Y. Kawasaki, Y. Ohashi, T. Saito and Y. Daido. "An Approach to Determining an Equivalent Circuit for HEMT's." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 499-503.

A simple way to determine a small-signal equivalent circuit of High Electron Mobility Transistors (HEMT's) is proposed. Intrinsic elements determined by a conventional analytical parameter transformation technique are described as functions of extrinsic elements. Assuming that the equivalent circuit composed of lumped elements is valid over the whole frequency range of the measurements, the extrinsic elements are iteratively determined using the variance of the intrinsic elements as an optimization criterion. Measurements of S-parameters up to 62.5 GHz at more than 100 different bias points confirmed that the HEMT equivalent circuit is consistent for all bias points.

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A New Method to Determine the Source Resistance of FET from Measured S-Parameters Under Active-Bias Conditions

V. Sommer. "A New Method to Determine the Source Resistance of FET from Measured S-Parameters Under Active-Bias Conditions." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 504-510.

A new method is proposed to evaluate the source resistance R/sub S/ directly from the S-parameters of a field-effect transistor biased in the active region. The method is based on the fact that the real part of the feedback admittance is mainly caused by the source and the gate resistance. This enables the analytical calculation of R/sub S/ at any measured frequency with high accuracy. Taking the ratio of R/sub G/ with regard to R/sub S/ as the only optimizing parameter, it is possible to calculate quickly an equivalent circuit the elements of which do not depend on starting values. The equivalent circuit fits the measured S-parameters very well and allows a physical interpretation of the calculated elements. By application of the new method in accordance with theoretical considerations one can observe for the first time from rf-measurements a bias-dependence of the source resistance that has been assumed to be constant up to now.

Abstracts

Negative Photoresponse in Modulation Doped Field Effect Transistors (MODFET's): Theory and Experiment

M.A. Romero and P.R. Herczfeld. "Negative Photoresponse in Modulation Doped Field Effect Transistors (MODFET's): Theory and Experiment." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 511-517.

A model for the mechanism of negative photoresponse, namely, the decrease of drain current under illumination, in AlGaAs/GaAs MODFET's is presented. Also, a comprehensive experimental study discussing the dependence of this phenomena on gate and drain to source bias voltages and optical power, as well as a comparison with devices that show the usual positive photoresponse, are reported. The negative photoresponse is attributed to trapping of photogenerated carriers in the GaAs buffer layer, causing a change in the potential profile and consequent reduction in the number of carriers in the 2-DEG channel. The above theory is supported by numerical solution of Poisson's and electron continuity equation, using the finite-elements method. Finally, the implications of the negative photoresponse on the high-speed photodetection properties of MODFET's devices are discussed.

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MMIC Compatible Lightwave-Microwave Mixing Technique (Mar. 1995 [T-MTT])

A. Paolella, S. Malone, T. Berceli and P.R. Herczfeld. "MMIC Compatible Lightwave-Microwave Mixing Technique (Mar. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 518-522.

The work presented here concerns the mixing of a microwave signal with a modulated optical signal in a MESFET. A brief theoretical analysis of the mixing mechanism is given in terms of the input signal parameters and device characteristics. Experimental results for the IF response of the MESFET as a function of RF frequency, incident optical power, optical modulation depth and gate bias voltage are shown. The IF response and the noise figure of the MESFET below 700 MHz were smaller than those of a p-i-n detector/Schottky mixer combination.

Abstracts

Optimum Design of Coplanar Waveguide for LiNbO/sub 3/ Optical Modulator

X. Zhang and T. Miyoshi. "Optimum Design of Coplanar Waveguide for LiNbO/sub 3/ Optical Modulator." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 523-528.

In this paper, we first present a novel finite element method combined with the conformal mapping (FEM-CM) for a quasi-static analysis of coplanar waveguides (CPW). Using this approach, the optimum CPW structures for the use in the Ti:LiNbO/sub 3/ optical modulator are discussed in detail to realize optical-microwave phase velocity match and electrode-source characteristic impedance match. Our numerical results reveal that both conditions can be satisfied simultaneously by introducing a SiO/sub 2/ buffer layer and thicker electrodes. The modulator efficiency with respect to the voltage-length product is also evaluated for the optimized structures. Finally, the design guidelines to the optimum CPW structure are presented.

Abstracts

A Quasi-Optical Mode Converter with a Bifocal Mirror

C.T. Iatrou. "A Quasi-Optical Mode Converter with a Bifocal Mirror." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 529-533.

This paper presents the design procedure of a quasi-optical mode converter to transform any kind of TE/sub mn/ mode into a Gaussian wave beam and experimental results obtained in the particular case of the TE/sub 64/ mode at 110 GHz. The quasi-optical system consists of a helical-cut launcher and a bifocal mirror, which is designed, using the techniques of geometric optics, to focus the radiation of the launcher into a Gaussian focal spot. Such a system was fabricated and tested for the transformation of the TE/sub 64/mode. The experimental results showed that about 80% of the power incident in the focal plane is focused into a small Gaussian-like spot of less than 20 mm diameter, while the 97% of the power is contained into the main TE/sub 64/ lobe.

Abstracts

High Performance Microshield Line Components

T.M. Weller, L.P.B. Katehi and G.M. Rebeiz. "High Performance Microshield Line Components." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 534-543.

Several millimeter-wave passive components have been fabricated using the microshield transmission line geometry, and their performance is presented herein. Microshield is a quasi-planar, half-shielded design which uses a thin dielectric membrane (1.5 µm) to support the conducting lines. This approach provides a nearly homogeneous, air-filled environment and thus allows extremely broad-band TEM operation. This paper examines the conductor loss and effective dielectric constant of microshield lines and presents results on transitions to conventional coplanar waveguide, right-angle bends, different stub configurations, and lowpass and bandpass filters. Experimental data is provided along with numerical results derived from an integral equation method. The microshield line is shown to be very suitable for high performance millimeter- and submillimeter-wave applications.

Abstracts

Microwave Measurement of Surface Resistance by the Parallel-Plate Dielectric Resonator Method

A.P. Mourachkine and A.R.F. Barel. "Microwave Measurement of Surface Resistance by the Parallel-Plate Dielectric Resonator Method." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 544-551.

Analysis and experimental results are presented for a parallel-plate dielectric resonator method to measure the surface resistance of conducting or superconducting plates. In the present paper, three main questions are considered in detail: the influence of the relative sizes of the conducting or superconducting plates on the measured value of the surface resistance R/sub s/, the influence of the shape of the plates on the R/sub s/ measurement, and how to interpret obtained results. Measurements were made at resonant frequencies of 14.1-14.5 GHz in a temperature range between 77 and 300 K.

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Nonlinear Mixed Analysis/Optimization Algorithm for Microwave Power Amplifier Design

F. Giannini, G. Leuzzi, E. Limiti, J.S. Mroz and L. Scucchia. "Nonlinear Mixed Analysis/Optimization Algorithm for Microwave Power Amplifier Design." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 552-558.

A nonlinear mixed analysis/optimization algorithm for the design of microwave power amplifiers is presented. Matching conditions for optimum power and efficiency performance are imposed together with the balancing equations of the nonlinear analysis in a consistent way. The analysis/preoptimization of the power stage requires a computation time comparable to or smaller than a single conventional harmonic balance analysis. The algorithm forms the basis of a design procedure for the fulfillment of design specifications in terms of output power, power-added efficiency, and gain. Comparisons to the results of commercial CAD nonlinear analysis programs are presented.

Abstracts

Scattering Optimization Method for the Design of Compact Mode Converters for Waveguides

T. ul Haq, K.J. Webb and N.C. Gallagher. "Scattering Optimization Method for the Design of Compact Mode Converters for Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 559-565.

A method for the design of compact and efficient mode converters for waveguides is presented. The required mode converter is modeled in the form of a scatterer placed in the waveguide and then its surface profile is optimized for maximum excitation of power in the required mode. Design examples are provided which show that such converters can achieve efficiencies of above 98%, while keeping the length of the converter less than that of the conventional mode converters.

Abstracts

A Hybrid Phase Shifter Circuit Based on TlCaBaCuO Superconducting Thin Films

G. Subramanyam, V.J. Kapoor and K.B. Bhasin. "A Hybrid Phase Shifter Circuit Based on TlCaBaCuO Superconducting Thin Films." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 566-572.

A superconductor-semiconductor hybrid reflection-type phase shifter circuit has been designed, fabricated, and characterized for 180° phase bit with center frequency of 4 GHz and bandwidth of 0.5 GHz for operation at 77 K. All of the passive components of the phase shifter circuit such as input/output feed lines, 3 dB Lange coupler, impedence matching networks, and transmission lines consisted of thallium based superconducting TlCaBaCuO thin films of 4000 A angstrom thickness on lanthanum aluminate substrate. Metal-Schottky field-effect-transistors (MESFET's) on GaAs semiconductor were used as active devices for switching action (on-state and off-state) in the phase shifter circuit. The phase shift and insertion losses were investigated as a function of frequency from 3.6 to 4.6 GHz at 77 K. The circuit exhibited a fairly flat response of 180° phase shift with a maximum deviation of less than 2° and a maximum insertion loss of 2 dB for on-state and 2.2 dB for off-state conditions over 0.5 GHz bandwidth at 4 GHz. The insertion losses were also fairly flat within the bandwidth. The insertion losses were constant between 50 and 80 K, giving the circuit a large range of operation at or below 77 K. The performance of this circuit as compared to a gold microstrip-semiconductor circuit designed identically was superior by a factor of 1.5, and may be due to lower conductor losses and lower surface resistance in the superconducting microstrips.

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Synthesis of Octave-Band Quarter-Wave Coupled Semi-Tracking Stripline Junction Circulators

J. Helszajn. "Synthesis of Octave-Band Quarter-Wave Coupled Semi-Tracking Stripline Junction Circulators." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 573-581.

The complex gyrator circuit of stripline circulators using tracking junctions which satisfy the physical and magnetic variables of the Wu and Rosenbaum boundary conditions, is a nearly frequency independent octave-band resistive network. Such a junction may exhibit two minimas in its reflection coefficient when matched by a two section impedance transformer. However, a third minima may be realised by utilizing a complex rather than a real gyrator circuit. This paper summarises this class of semi-tracking solution in a simple way as a preamble to the design of a degree-3 quarter wave coupled circulator. The overall frequency behaviour of this class of junction has been separately evaluated by combining the electromagnetic and network problems (in conjunction with a two step impedance matching network).

Abstracts

Mode Coupling in Coaxial Waveguides with Varying-Radius Center and Outer Conductors

J. Shafii and R.J. Vernon. "Mode Coupling in Coaxial Waveguides with Varying-Radius Center and Outer Conductors." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 582-591.

The mode conversion process in a coaxial waveguide with varying-radius center and outer conductors is shown to be described by a system of first-order differential equations--the coupled mode equations. The nondiagonal coefficients of this system are called the coupling coefficients. In this paper, we derive the explicit expressions for the coupling coefficients in a varying-radius coaxial waveguide and discuss some of their important features. These coefficients can be used in determining model conversion in a coaxial cavity with slowly varying walls or designing and analyzing coaxial waveguide tapers and mode converters. Some experimental results of the coupling coefficients for the case of azimuthally symmetric modes, TE/sub 0n/ modes, are also given.

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Analysis and Correction of Echo Due to Mode Conversion in WC-281 Waveguide

R. Walker. "Analysis and Correction of Echo Due to Mode Conversion in WC-281 Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 592-600.

Testing of the antenna/waveguide systems of a long-haul, high-capacity microwave radio route showed unexpected high levels of group delay ripple. Initial analysis of these measurement results incorrectly indicated echo levels as high as 35 dB below wanted direct signal, as interpreted using a simplistic analysis technique which was later shown to be as much as 10-15 dB too pessimistic. Application of special Fourier analysis techniques to the test results subsequently showed that many of the cases of concern were in fact well within established system requirements. In other cases, it was found that installation of TE/sub 21/ filters could readily be used to absorb the echo energy. The performance of the QAM radio used in this application was also characterized in terms of the residual BER tolerance to multiple echoes. The source of the echoes was isolated to TE/sub 21/ mode generation within the WC-281 waveguide. To ensure the quality of new installations without the need for the application of filters, a method of pre-installation testing of waveguide sections to determine their individual moding levels was also established.

Abstracts

Analog Reflection Topology Building Blocks for Adaptive Microwave Signal Processing Applications

S. Lucyszyn and I.D. Robertson. "Analog Reflection Topology Building Blocks for Adaptive Microwave Signal Processing Applications." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 601-611.

The synthesis and realization of an analog--phase shifter, delay line, attenuator, and group delay synthesizer-are presented. These variable control devices are all implemented using the same generic single stage reflection topology. The optimum conditions of operation have been determined and the corresponding group delay behaviors have been investigated to produce simple design equations. As proof-of-concepts, monolithic technology has been used to realize an X-band, phase shifter, delay line, and attenuator. Hybrid technology has been used to realize an L-band, group-delay synthesizer. Because of the high levels of performance measured, these control devices are ideally suited for use as general building blocks in adaptive signal processing applications, including large phased array applications.

Abstracts

Broadside Coupled Strip Inset Dielectric Guide and its Directional Coupler Application

Z. Fan and S.R. Pennock. "Broadside Coupled Strip Inset Dielectric Guide and its Directional Coupler Application." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 612-619.

A theoretical and numerical method is presented for the analysis of broadside-coupled strip inset dielectric guide. The method of analysis is based on an integral equation formulation and Galerkin's procedure. Besides propagation constants for two fundamental and higher order modes, the characteristic impedances for the two fundamental modes are calculated using the total propagating power and the longitudinal strip currents. The propagation characteristics of the two fundamental modes are then used to compute 4-port circuit parameters that are essential for accurate analysis and design of coupled line circuits. The effects of various structural parameters on the S-parameters are investigated and it is found that this broadside coupled strip IDG structure is useful for the realization of the directional couplers. Examples of strong and weak directional couplers are given. Furthermore, the propagation constants and S-parameters of coaxially excited coupled strips are measured, and are in good agreement with the theoretical analysis.

Abstracts

On the Electromagnetic Field in a Cavity Fed by a Tangential Electric Field in an Aperture in its Wall

J.R. Mautz. "On the Electromagnetic Field in a Cavity Fed by a Tangential Electric Field in an Aperture in its Wall." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 620-626.

Heretofore, the electromagnetic field produced by a specified tangential electric field in an aperture in the wall of an arbitrarily shaped cavity has most often been expanded in terms of cavity modes. An alternative approach that of the electric field integral equation is presented. In this approach, the cavity field is expressed as the field of a surface density of tangential electric current, or a surface density of tangential magnetic current or a combination of surface densities of tangential electric and magnetic currents on the boundary of the cavity. Each surface density is characterized by a single tangential vector function which is determined by the integral equation requiring that the part of the electric field tangent to the boundary of the cavity must reduce to the specified tangential electric field in the aperture and zero elsewhere on the boundary of the cavity. The electric field integral equation method is specialized to more easily determine the field inside an arbitrary cylindrical cavity excited by a tangential electric field in an aperture in its lateral wall. The method is further specialized to a circular cavity.

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Abstracts

Geometric Phases in Magnetooptic Channel Waveguide Devices

M.C. Nistal, J. Linares and D. Baldomir. "Geometric Phases in Magnetooptic Channel Waveguide Devices." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 627-631.

Geometric phases, generated by a coupling process between TE and TM polarizations through anisotropic chiral media--magnetooptic channel waveguides--are determined. In fact, many of the conventional phase and frequency shifters are based on this geometrical effect, nevertheless, the physical origin of these phase factors (spatial and temporal ones) has never been explained. In this work a physical interpretation, based on the topological phases theory, is given. Likewise, an integrated interferometer is proposed for both generating and checking these phases by changing the characteristics of the channel waveguides. The relationship between geometric factors and phase and frequency shifters is shown along the work.

Abstracts

On the Use of Regularization Techniques in Numerical Inverse-Scattering Solutions for Microwave Imaging Applications

S. Caorsi, S. Ciaramella, G.L. Gragnani and M. Pastorino. "On the Use of Regularization Techniques in Numerical Inverse-Scattering Solutions for Microwave Imaging Applications." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 632-640.

This paper deals with integral-equation-based numerical methods for microwave imaging using regularization procedures to overcome ill-conditioning problems. The strong dependence of reconstruction quality on "a priori" information is discussed. Such information is required to select a suitable number of independent columns when using truncated pseudoinversions (or other regularization parameters, in different cases) for accurate dielectric reconstructions. Moreover, a criterion for the choice of the optimal number of independent columns is proposed, and the possibility of making this choice less critical by using a multiview version of the method is explored. Finally, a modified procedure is presented that further increases the range from which to choose the number of independent columns that allows one to achieve acceptable reconstructions.

Abstracts

On the Summation of Double Infinite Series Field Computations Inside Rectangular Cavities

S. Hashemi-Yeganeh. "On the Summation of Double Infinite Series Field Computations Inside Rectangular Cavities." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 641-646.

An accurate and efficient computational technique for the full-wave analysis of passive microstrip lines inside rectangular cavities is described. The unique feature of the technique is the transformation of the double infinite series expansion of the method of moments solution into a few single summations of fast converging series using the residue theorem and the contour-integration method. The technique offers improved convergence especially when the field and source points coincide. Examples of the field computations inside the cavity are presented to verify the technique and its usefulness.

Abstracts

Efficient Solution of the Differential Form of Maxwell's Equations in Rectangular Regions

L.E. Garcia-Castillo, M. Salazar-Palma, T.K. Sarkar and R.S. Adve. "Efficient Solution of the Differential Form of Maxwell's Equations in Rectangular Regions." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 647-654.

One of the problems of the finite element and the finite difference method is that as the dimension of the problem increases, the condition number of the system matrix increases as Theta(1/h²) (of the order of h², where h is the subsection length). Through the use of a suitable basis function tailored for rectangular regions, it is shown that the growth of the condition number can be checked while still retaining the sparsity of the system matrix. This is achieved through a proper choice of entire domain basis functions. Numerical examples have been presented for efficient solution of waveguide problems with rectangular regions utilizing this approach.

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An Application of Fast Integral Wavelet Transform to Waveguide Mode Identification

J.C. Goswami, A.K. Chan and C.K. Chui. "An Application of Fast Integral Wavelet Transform to Waveguide Mode Identification." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 655-663.

We introduce a very efficient method for computing the integral wavelet transform, with any compactly supported spline-wavelet as the analyzing wavelet, on a dense set of the time-scale domain. While the mathematical analysis of this algorithm will be presented elsewhere, the objective of this paper is to describe the computational scheme along with its computer implementation, and to demonstrate its effectiveness in the identification of mode propagation in a rectangular waveguide.

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A Hybrid Wavelet Expansion and Boundary Element Analysis for Multiconductor Transmission Lines in Multilayered Dielectric Media

G. Wang, G. Pan and B.K. Gilbert. "A Hybrid Wavelet Expansion and Boundary Element Analysis for Multiconductor Transmission Lines in Multilayered Dielectric Media." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 664-675.

In this paper the wavelet expansion method, in conjunction with the boundary element method (BEM), is applied for the evaluation of the capacitance and inductance matrices of multiconductor transmission lines in multilayered dielectric media. The integral equations obtained by using a Green's function above a ground plane are solved by Galerkin's method, with the unknown total charge expanded in terms of orthogonal wavelets in L^2 ([0, 1]). The difficulty of using wavelets on the real line to expand unknown functions defined in finite intervals is overcome by the utilization of wavelets in L^2 ([0, 1]). The adoption of the geometric representation of the BEM converts the two-dimensional problem into a one-dimensional problem, and provides a versatile and accurate treatment of curved conductor surfaces and dielectric interfaces. A sparse matrix equation is developed from the set of integral equations, which is extremely valuable, in particular when a large system of equations must be solved. Finally, we compare our numerical results with previously published data, and demonstrate good agreement between the two sets of results.

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Nonlinear FDTD Formulations Using Z Transforms

D.M. Sullivan. "Nonlinear FDTD Formulations Using Z Transforms." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 676-682.

An implementation of the FDTD method for nonlinear optical simulation is described. This method draws on ideas from digital filtering theory by formulating the nordinearities using Z transforms. This provides a means of directly calculating the nonlinear polarizations in a straightforward manner. Further, an analytic expression for the reflection coefficient from a nonlinear dielectric is described and used to confirm the accuracy of the nonlinear FDTD formulation. Finally, a one-dimensional nonlinear FDTD simulation is used to calculate soliton propagation in nonlinear media.

Abstracts

A New Active Array Module for Spatial Power Combiners and Active Antennas (Short Papers)

Y. Shen, C. Laperle, N. Sangary and J. Litva. "A New Active Array Module for Spatial Power Combiners and Active Antennas (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 683-685.

We present the design and performance of a new module of spatial power combiners, which consists of four symmetrical slot coupled patch radiators and four MESFET negative resistance elements, based on a single active antenna design. These circuits are suitable for use in millimeter-wave systems as well as at microwave frequencies. Tests carried out with a prototype circuit showed a radiated power of 20.44 mW with about 16% dc-to-RF efficiency at 8.7 GHz. Feed networks for linear polarization and circular polarization are discussed. Design procedures for dual-frequency application are also addressed.

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A Single Barrier Varactor Quintupler at 170 GHz (Short Papers)

A.V. Raisanen, T.J. Tolmunen, M. Natzic, M.A. Frerking, E. Brown, H. Gronqvist and S.M. Nilsen. "A Single Barrier Varactor Quintupler at 170 GHz (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 685-688.

InGaAs/InAlAs single-barrier varactor (SBV) diodes are tested as frequency quintuples. The diodes were tested in a crossed-waveguide structure and provided output frequencies between 148 and 187 GHz. The highest observed flange-to-flange efficiency was 0.78% at an output frequency of 172 GHz. This is nearly four times greater than the best quintuple efficiency obtained for previous SBV varactors made from the GaAs/AlGaAs materials system.

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A New Method for Measurement of Complex Permittivity of Liquids Using the Phase Information of Standing Waves (Short Papers)

H. Jiang, M. Sun and W. Chen. "A New Method for Measurement of Complex Permittivity of Liquids Using the Phase Information of Standing Waves (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 688-690.

A new approach to determine the propagation constant, gamma=alpha+jBeta, of waves on a transmission line from phase measurements is proposed in this paper. This new method is very snitable for determining small alpha. Its distinctive feature is that the attenuation constant alpha of waves on the transmission line is the slope of a linear function of the displacement of a detector. Thus the attenuation constant alpha can be determined accurately even if it is very small.

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Linearity Condition Between a Cavity's Q-Factor and its Input Resonant Resistance (Short Papers)

B. Tian and W.R. Tinga. "Linearity Condition Between a Cavity's Q-Factor and its Input Resonant Resistance (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 691-692.

This paper proves that a linear relationship between a cavity's Q-factor and its input resonant resistance holds rigorously true provided the Q variation is caused only by power loss in the cavity.

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Transient Analysis of Lossy Coupled Transmission Lines in a Lossy Medium Using the Waveform Relaxation Method (Short Papers)

F.C.M. Lau and E.M. Deeley. "Transient Analysis of Lossy Coupled Transmission Lines in a Lossy Medium Using the Waveform Relaxation Method (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 692-697.

The waveform relaxation method has been shown to be both efficient and accurate when apptied to coupled transmission lines with conductor losses. In this paper, the method is generalized to include the dielectric loss surrounding the transmission lines. The distributed loss model assumes that the conductance matrix is approximately diagonal and its product with the resistive matrix is a scalar matrix. Computational results using the model is presented and compared with HSPICE solutions.

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A Useful Theorem for a Lossless Multiport Network (Short Papers)

X. Shi, C. Liang and Y. Han. "A Useful Theorem for a Lossless Multiport Network (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 697-699.

A useful theorem is obtained for a lossless multiport network from the unitary condition of scattering matrix, and is proven to equivalent to the unitary condition. Some illustrations are given to show how to apply the theorem to the analysis of the properties of a lossless n-port network.

Abstracts

On the Eigenfunction Expansion of Electromagnetic Dyadic Green's Functions in Rectangular Cavities and Waveguides (Short Papers)

L.W. Li, P.S. Kooi, M.S. Leong, T.S. Yeo and S.L. Ho. "On the Eigenfunction Expansion of Electromagnetic Dyadic Green's Functions in Rectangular Cavities and Waveguides (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 700-702.

The electric dyadic Green's functions of both the first and the second kinds due to the presence of electric and equivalent magnetic sources in rectangular cavities are obtained. A method for directly reducing the dyadic Green's functions for a rectangular cavity to those for a semi-infinite and an infinite rectangular waveguides is presented. The Green dyads of the second kind for an infinite and a semi-infinite rectangular waveguides, and a rectangular cavity are obtained.

Abstracts

Call for Papers - 1995 IEEE GaAs IC Symposium (Mar. 1995 [T-MTT])

"Call for Papers - 1995 IEEE GaAs IC Symposium (Mar. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 703-703.

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Membership Application (Mar. 1995 [T-MTT])

"Membership Application (Mar. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.3 (Mar. 1995 [T-MTT]): 704-704.

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Front Cover (Apr. 1995, Part I [T-MTT])

"Front Cover (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): f1-f2.

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Si/SiGe MMIC's

J.-F. Luy, K.M. Strohm, H.-E. Sasse, A. Schuppen, J. Buechler, M. Wollitzer, A. Gruhle, F. Schaffler, U. Guettich and A. Klaassen. "Si/SiGe MMIC's." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 705-714.

Silicon-based millimeter-wave integrated circuits (SIMMWIC's) can provide new solutions for near range sensor and communication applications in the frequency range above 50 GHz. This paper gives a survey on the state-of-the-art performance of this technology and on first applications. The key devices are IMPATT diodes for mm-wave power generation and detection in the self-oscillating mixer mode, p-i-n diodes for use in switches and phase shifters, and Schottky diodes in detector and mixer circuits. The silicon/silicon germanium heterobipolar transistor (SiGe HBT) with f/sub max/ values of more than 90 GHz is now used for low-noise oscillators at Ka-band frequencies. First system applications are discussed.

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Methods for Measuring the Power Linearity of Microwave Detectors for Radiometric Applications (Apr. 1995, Part I [T-MTT])

V.S. Reinhardt, Y.C. Shih, P.A. Toth, S.C. Reynolds and A.L. Berman. "Methods for Measuring the Power Linearity of Microwave Detectors for Radiometric Applications (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 715-720.

A microwave radiometer relies on the power linearity of its microwave receivers to accurately measure the temperature of remote microwave noise sources. This paper considers linearity issues in the design and characterization of such receivers. Analysis is presented relating the radiometer temperature interpolation error to a second order power nonlinearity coefficient for the receiver. Formulas are also developed specifying the temperature error in terms of individual receiver component parameters. It is shown that the key parameter for the RF detector in the receiver is A/sub 4/, a fourth order RF distortion coefficient, and the key parameter for the RF amplifiers in the receiver is IPs, the third order intercept. This paper also discusses experimental methods for measuring the power linearity of RF detectors to the levels required for radiometric applications. Three methods are discussed: the two-tone method, the amplitude modulation method, and the constant ratio method. The theory of determining the coefficients that characterize the nonlinearity of the detector from experimental data is presented. Experimental results are presented showing that the two-tone method and the constant ratio method agree to within experimental error. The sensitivity for measuring nonlinearities and the difficulties encountered in implementing each of these methods are also discussed.

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Millimeter-Wave On-Wafer Waveform and Network Measurements Using Active Probes

R.Y. Yu, M. Reddy, J. Pusl, S.T. Allen, M. Case and M.J.W. Rodwell. "Millimeter-Wave On-Wafer Waveform and Network Measurements Using Active Probes." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 721-729.

We have fabricated active probes for on-wafer wave-form and network measurements. The probes incorporate GaAs nonlinear transmission line (NLTL) based network analyzer (NWA) integrated circuits and low-loss quartz coplanar-waveguide probe tips. The active probes show step response falltimes of 2.7 ps when excited by a 0.7-ps falltime input. Using these active probes, we demonstrate both waveform measurements with 2.7-ps risetime and network measurements to 200 GHz. We discuss the probe tip and NWA IC design, the hybrid assembly and mechanical design, and system design considerations. On-wafer waveform and S-parameter measurements of monolithic millimeter-wave integrated circuits are demonstrated.

Abstracts

Planar Microwave and Millimeter-Wave Lumped Elements and Coupled-Line Filters Using Micro-Machining Techniques

C.-Y. Chi and G.M. Rebeiz. "Planar Microwave and Millimeter-Wave Lumped Elements and Coupled-Line Filters Using Micro-Machining Techniques." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 730-738.

Planar microwave and millimeter-wave inductors and capacitors have been fabricated on high-resistivity silicon substrates using micro-machining techniques. The inductors and capacitors are suspended on a thin dielectric membrane to reduce the parasitic capacitance to ground. The resonant frequencies of a 1.2 nH and a 1.7-nH inductor have been increased from 22 GHz and 17 GHz to around 70 GHz and 50 GHz, respectively. We also report on the design and measurement of a new class of stripline filters suspended on a thin dielectric membrane. Interdigitated filters with 43% and 5% bandwidth have been fabricated and exhibit a port-to-port 0.7 dB and 2.0 dB loss, respectively, at 14-15 GHz. The micro-machining fabrication technique can be used with Silicon and GaAs substrates in microstrip or coplanar-waveguide configurations to result in planar low-loss lumped elements and filters suitable for monolithic integration or surface mount devices up to 100 GHz.

Abstracts

Design of Microwave Filters by Inverse Scattering

P.P. Roberts and G.E. Town. "Design of Microwave Filters by Inverse Scattering." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 739-743.

A new design method for planar microwave filters based on the theory of inverse scattering is presented. The method results in filters with a continuously changing profile, for example a nonuniform microstrip line with continuously varying width. Filters designed by this method are shown to possess some distinct advantages in realization and performance over other common techniques. The design method is presented in detail, and efficient numerical algorithms to solve the design equations that arise are discussed. A wideband 4 pole Chebyshev bandpass filter was designed, constructed, and tested, to prove the design method. This is the first demonstration of a microwave filter designed using inverse scattering.

Abstracts

Full-Wave Design of Spurious Free D.R. TE Mode Band Pass Filters

A. Abdelmonem, J.-F. Liang, H.-W. Yao and K.A. Zaki. "Full-Wave Design of Spurious Free D.R. TE Mode Band Pass Filters." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 744-752.

Analytic full-wave analysis and design of direct-coupled dielectric loaded bandpass filters in rectangular waveguide configuration using the TE/sub 10/ mode with a spurious-free response up to twice the operating frequency is described. The filter has no tuning screws and is small in size. Theoretical design of the filter is supported by the experimental results. Superiority of the filter over the inductive window-coupled filter is presented. Practical issues faced while building the filter are discussed. An alternative folded configuration of the filter that allows the implementation of both the canonical elliptic function as well as the Chebychev response is also presented.

Abstracts

A Non-Contact Interconnection through an Electrically Thick Ground Plate Common to Two Microstrip Lines

M. Davidovitz, R.A. Sainati and S.J. Fraasch. "A Non-Contact Interconnection through an Electrically Thick Ground Plate Common to Two Microstrip Lines." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 753-759.

Coupling rectangular slot in a between two microstrip lines through a common, electrically thick ground plate is analyzed. The results are applied to examine the properties of a vertical, noncontact line-to-line transition. An efficient and accurate design model is constructed. The model allows insight into the coupling characteristics of the device with minimal computational effort. Measured results are used to verify the efficacy of the solution. Analytical or highly convergent forms of the model parameters are derived whenever possible.

Abstracts

The Radiometric Characterization of AMSU-B

R.W. Saunders, T.J. Hewison, S.J. Stringer and N.C. Atkinson. "The Radiometric Characterization of AMSU-B." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 760-771.

The Advanced Microwave Sounding Unit, AMSU, is being developed to fly on the new generation of NOAA polar orbiters due to be launched in the latter half of the 1990's. The U.K. Meteorological Office (UKMO) are procuring the high frequency component of AMSU (AMSU-B) with five channels in the range 88-191 GHz. In order to determine the radiometric performance and verify the method for calibration of AMSU-B an extensive series of tests have been performed by the UKMO on the engineering and three flight models. The instruments were placed in a 3 m thermal-vacuum chamber where their temperature could be controlled over the full range expected in orbit and an Earth target and a space target could be viewed. For the first flight model the measured Ne Delta T values were all <1.1 K at the nominal instrument temperature using a 300 K target. Absolute calibration accuracy and linearity in response were measured to be well within the specification of 1 and 0.3 K, respectively. A small variation in the gain with scan angle was found and an empirical factor was derived to modify the inferred radiances to remove this effect. Measurements of the gain stability for each channel were also measured for simulated in-orbit conditions.

Abstracts

CAD Models for Shielded Multilayered CPW

S. Gevorgian, L.J.P. Linner and E.L. Kollberg. "CAD Models for Shielded Multilayered CPW." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 772-779.

Conformal mapping technique is used to obtain CAD oriented closed form analytical expressions for characteristic impedance per unit length capacitance and relative effective dielectric permittivity of top and bottom shielded multilayered coplanar waveguides. Analytical expressions are deduced for a wide verity of CPW structures.

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Novel Concepts for Improved Nonlinear Transmission Line Performance

H. Shi, W.-M. Zhang, C.W. Domier, N.C. Luhmann, Jr., L.B. Sjogren and H.-X.L. Liu. "Novel Concepts for Improved Nonlinear Transmission Line Performance." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 780-789.

Three new device concepts have been investigated to improve the performance of nonlinear transmission lines (NLTL's). These devices, the Multi-Quantum Barrier Varactor, the Schottky Quantum Barrier Varactor, and the Schottky Superlattice Quantum Barrier Varactor, are predicted to offer significant advantages over the conventional Schottky varactor because of their stronger C-V nonlinearities, symmetric C-V characteristics, high cutoff frequency and increased breakdown voltages. The wave evolution on an NLTL has been numerically investigated using an improved model in which the effects of skin losses, line parasitic and device leakage current have been included. Combining a new transmission line layout design, which permits one to double and even triple the voltage handling capability of the NLTL (dependent upon the minimum pulse duration requirements), with a back-to-back device configuration, enables both positive and negative voltage waveforms to be efficiently compressed. These new devices are shown to be useful in high power harmonic generation applications as well.

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Propagation Characteristics of TE-Waves Guided by Thin Films Bounded by Nonlinear Media (Apr. 1995, Part I [T-MTT])

J.-G. Ma and I. Wolff. "Propagation Characteristics of TE-Waves Guided by Thin Films Bounded by Nonlinear Media (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 790-795.

The behavior of nonlinear TE-waves guided by a-symmetrical dielectric slab waveguides, having a generalized nonlinear substrate with a permittivity of the form epsilon~|arrow over E|/sup delta/, is analyzed. Using an analytical solution for the electromagnetic fields in this nonlinear media, the dispersion relations, electric field profiles, and cutoff frequencies are illustrated and discussed.

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Rigorous Analysis of Arbitrarily Shaped H- and E-Plane Discontinuities in Rectangular Waveguides by a Full-Wave Boundary Contour Mode-Matching Method

J.M. Reiter and F. Arndt. "Rigorous Analysis of Arbitrarily Shaped H- and E-Plane Discontinuities in Rectangular Waveguides by a Full-Wave Boundary Contour Mode-Matching Method." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 796-801.

A rigorous boundary contour mode-matching (BCMM) method is presented for the efficient calculation of the modal scattering matrix of arbitrarily shaped H- and E-plane discontinuities, junctions, and or obstacles in rectangular waveguides. For the inhomogeneous waveguide region with general contour, the field is expanded in the complete set of cylindrical wave functions. The full-wave expansion allows the immediate rigorous inclusion of cascaded structures such as combined H- and E-plane bends. The efficiency of the method is demonstrated at the rigorous design of useful waveguide components which could not be modeled by mode-matching techniques so far: cylindrical post-compensated H-plane T-junction, mitered H-plane and E-plane bends of arbitrary angle, cascaded H-/E-plane bends, circular post-coupled filter, E-plane filter with rounded corners, 180° rat race structure, and side-coupled dual TE/sub 311//TE/su113 -mode filter. The theory is verified by measurements.

Abstracts

Analysis of a Wide Compound Slot-Coupled Parallel Waveguide Coupler and Radiator

A.M. Rajeek and A. Chakraborty. "Analysis of a Wide Compound Slot-Coupled Parallel Waveguide Coupler and Radiator." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 802-809.

An analysis of a parallel waveguide coupler coupled through a wide compound slot, offset from center line and inclined with respect to the longitudinal axis of a rectangular waveguide, is presented. The Galerkin method of moments with sinusoidal basis functions is used to solve the slot aperture electric field integral equations, taking into account finite wall thickness. The highly complicated moment matrices are analytically evaluated using a modified geometry of the slot. Compound slot parallel coupler characteristics are then deduced, including resonant length, dominant mode scattering, and the equivalent network. The theoretical results of both the magnitude and phase of the S parameters are compared with the experimental results. The analysis is extended to study a compound slot radiator, and the results are compared with the results available in the literature. Quantitative data on the aperture electric field phase variability of 360° with slot offset and tilt are given for a compound slot radiator. The equivalent circuit of a compound slot radiator, which turns out to be an antisymmetric T network, is also found.

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Abstracts

Modeling Sources in the FDTD Formulation and Their Use in Quantifying Source and Boundary Condition Errors

D.N. Buechler, D.H. Roper, C.H. Durney and D.A. Christensen. "Modeling Sources in the FDTD Formulation and Their Use in Quantifying Source and Boundary Condition Errors." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 810-814.

The modeling of voltage and current sources as either added or replaced sources in FDTD simulations is described and their differences discussed in terms of a transmission line analogy. An infinitesimal current element (ICE) is used to illustrate the validation of added source modeling and to study the errors involved with modeling an infinitesimal element within the finite-sized FDTD grid. This model is also used to illustrate the behavior of radiation boundary conditions as their near-field position with respect to the source is varied. We characterize the errors due to modeling and boundary conditions and give guidelines for obtaining acceptable accuracy in simulations.

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Abstracts

Analysis of the Electromagnetic Waves in an Overmoded Finite Length Slow Wave Structure

M.R. Amin, K. Ogura, H. Kitamura, K. Minami, T. Watanabe, Y. Carmel, W. Main, J. Weaver, W.W. Destler and V.L. Granatstein. "Analysis of the Electromagnetic Waves in an Overmoded Finite Length Slow Wave Structure." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 815-822.

The electromagnetic fields of the higher order axial resonant modes in a slow wave structure are analyzed and found to have considerably different characteristics from those of the conventional fundamental mode. Here, the reflections at both ends produce axial resonant modes corresponding to axisymmetric transverse magnetic (TM) modes. The period of field modulation of some of the higher order axial modes is shorter than that of the usual mode in a cylindrical waveguide, which could be of practical interest for higher power, higher frequency operation of backward wave oscillators. A perturbation technique is used to ascertain the field distribution inside the resonant cavity, and the numerical results thus obtained are compared to some experimental data.

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Abstracts

Modeling the Electromagnetic Field in Lossy Dielectrics Using Finite Elements and Vector Absorbing Boundary Conditions

V.N. Kanellopoulos and J.P. Webb. "Modeling the Electromagnetic Field in Lossy Dielectrics Using Finite Elements and Vector Absorbing Boundary Conditions." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 823-827.

A new functional for the finite element method is described for the distribution of high-frequency electromagnetic fields in arbitrarily shaped, lossy dielectrics in 3D. The method uses a brick-shaped edge element (covariant-projection element) and a second-order, symmetric, vector absorbing boundary condition. Analytic solutions are available for the case of a plane wave incident on a lossy sphere, and these are used to show that the new method is capable of predicting the fields in and around the sphere to an average accuracy of 1-2%, even when the outer, absorbing boundary is no more than a third of a wavelength from the sphere.

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Abstracts

Integral Representation of Spatial Green's Function and Spectral Domain Analysis of Leaky Covered Strip-Like Lines

F. Mesa and R. Marques. "Integral Representation of Spatial Green's Function and Spectral Domain Analysis of Leaky Covered Strip-Like Lines." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 828-837.

This paper studies the possible integral representations of the Spatial Dyadic Green's Function of a laterally open but covered multilayered planar waveguide with translation symmetry. Among all of integral representations, we especially focus on that unique representation which comprises only out-going waves (energy transferred from the source to infinity in case lateral radiation was present). We propose this specific integral representation as the most appropriate in the Spectral Domain Analysis of strip-like structures when these are assumed to be guiding/leaky systems with translation symmetry. This integral representation directly provides the integration contour to be used in the definition of the inverse Fourier transform. Some aspects concerning the use of the nonconventional Fourier transform are discussed in connection with the application of the Method of Moments. It is also highlighted that the dispersion relation of the strip-like configuration is expressed in terms of the zeros of a multivalued complex function. This fact becomes relevant when searching for zeros out of the spectral sheet (i.e., zeros associated with leaky modes). Finally, some numerical results are presented. These computed values show good agreement when compared with some previously published data. The influence of different definitions of the inverse integration contour on the propagation characteristics of a pair of coplanar coupled strips is also investigated. Computed data will show the leakage characteristics of a pair of noncoplanar strips.

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Abstracts

A Finite-Difference Frequency-Domain Method that Introduces Condensed Nodes and Image Principle

M.M. Afande, K. Wu, M. Giroux and R.G. Bosisio. "A Finite-Difference Frequency-Domain Method that Introduces Condensed Nodes and Image Principle." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 838-846.

A new finite-difference frequency-domain formulation is derived from the integral form of Maxwell's equations. Condensed cubic cell and 3D node are proposed thereby eliminating field discontinuity in the discrete space domain. Deterministic solutions using a reduced 2D condensed node are also presented for standard eigenvalue problems. This method is free from spurious modes by reinforcing electric and magnetic flux conservation among neighboring cells. An image concept is introduced to model field boundaries. Numerical results are presented for the complex propagation constant to demonstrate convergence behavior and accuracy of the proposed approach. Modal field profiles of various guided modes are shown for dielectric waveguides.

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Abstracts

Effects of Conductor Edge Profile on Transmission Properties of Conductor-Backed Coplanar Waveguides

L. Zhu and E. Yamashita. "Effects of Conductor Edge Profile on Transmission Properties of Conductor-Backed Coplanar Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 847-853.

A boundary integral equation method is applied to the full-wave analysis of conductor-backed coplanar waveguides with a rectangular or trapezoidal conductor cross-section. One to a particular choice of Green's functions for each subregion defined in a given cross-section, electromagnetic fields in each subregion are analytically expressed in terms of equivalent magnetic currents on apertures and resulting integration contours are defined only on aperture surfaces. Consequently, this approach can overcome relative convergence problems even in the case of largely different aperture widths among subregions. Numerical data show that this approach has a stable convergence property and requires a short computation time. Numerical results obtained with this approach are in excellent agreement with other available theoretical data. A series of calculated data for some rectangular and trapezoidal conductor configurations are provided to show the effects of conductor edge profile on transmission properties of conductor-backed coplanar waveguides.

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Abstracts

Efficient TLM Diakoptics for Separable Structures (Apr. 1995, Part I [T-MTT])

M. Righi, W.J.R. Hoefer, M. Mongiardo and R. Sorrentino. "Efficient TLM Diakoptics for Separable Structures (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 854-859.

An efficient yet rigorous application of diakoptics to TLM simulation of discontinuities in homogeneously filled waveguides is proposed. The method, based on the expansion of the time-domain Green's function into frequency independent eigen-functions, leads to a dramatic reduction of the numerical effort when compared to the standard Johns Matrix approach. Numerical results show that this new approach provides wide band absorbing boundaries for waveguide problems where several modes (whether propagating or evanescent) are present. In this way, the computational domain is also reduced to just a small region around the discontinuity, with the absorbing boundaries placed just a few cells away.

Abstracts

Spatially Looped Algorithms for Time-Domain Analysis of Periodic Structures

M. Celuch-Marcysiak and W.K. Gwarek. "Spatially Looped Algorithms for Time-Domain Analysis of Periodic Structures." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 860-865.

A class of spatially looped time-domain algorithms is developed. These algorithms prove to be effective tools for the analysis of microwave periodic structures. They use the FDTD or TLM simulation of only one spatial period, with a new type of boundary condition modeling its behavior in the entire structure. Applications to a sinusoidally corrugated slow wave structure and to a four-wall corrugated waveguide are presented. The paper includes a tutorial part, discussing the physical nature of solutions produced by the spatially looped algorithms. This explains the meaning of complex notation in the time domain, and the possibility of reducing the calculations of uniform and periodic guiding structures to real numbers.

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Abstracts

Systematic Computation of the Modal Spectrum of Boxed Microstrip, Finline, and Coplanar Waveguides via an Efficient SDA

G. Cano, F. Mesa, F. Medina and M. Horno. "Systematic Computation of the Modal Spectrum of Boxed Microstrip, Finline, and Coplanar Waveguides via an Efficient SDA." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 866-872.

This work reports an efficient and systematic procedure to obtain the complete modal spectrum of multilayer boxed planar lines. The complex propagation constants are obtained by computing the zeros of a properly built analytic complex function. This function is the product of two factors. One of them is the determinant function provided by the spectral domain-Galerkln analysis (SDA). The other factor is a function which cancels out the poles of the former factor without introducing additional poles nor zeros. The elimination of the poles overcomes numerical difficulties usually found in the zero searching process. In addition, powerful zero--searching integral techniques can be applied without problems. The numerical aspects involved in the computation of the spectral series are considered to speed up the computations. The features of an arbitrary number of propagating, evanescent, backward or complex modes of three important boxed structures (microstrip, finline, and coplanar waveguide) can be systematically studied with our method.

Abstracts

An Efficient Method for Study of General Bi-Anisotropic Waveguides

Y. Xu and R.G. Bosisio. "An Efficient Method for Study of General Bi-Anisotropic Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 873-879.

In this paper, coupled-mode equations for general bianisotropic waveguides with perfect electrically conducting (PEC) walls are studied and a set of rigorous expressions is obtained. The features of these equations are discussed and applications to circular/rectangular Faraday chiral and chiral waveguides are demonstrated. Comparisons between Faraday chiral, chiral, and ferrite-filled waveguides are also given.

Abstracts

An Accurate Field Matching Analysis of Waveguides of Complex Cross-Sectional Geometry Loaded with Magnetized Ferrite Rods

M. Okoniewski and J. Mazur. "An Accurate Field Matching Analysis of Waveguides of Complex Cross-Sectional Geometry Loaded with Magnetized Ferrite Rods." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 880-886.

Many structures, such as ferrite phase shifters and rectangular waveguides loaded with ferrite or dielectric rods of circular cross-section are difficult to analyze. We have developed a field-matching technique capable of analysis of waveguides of complex cross-sectional geometry comprising longitudinally magnetized ferrite rods. The method has been implemented on a PC computer equipped with a Microwave i860 board. Computations of inner products by FFT resulted in three-fold increase in computational speed and two-fold reduction of computer memory required. The method provides results with high accuracy and within a reasonable computing time. Convergence properties, numerical and experimental results are presented.

Abstracts

An Improved Finite Element Method Formulation for the Analysis of Nonlinear Anisotropic Dielectric Waveguides

S. Selleri and M. Zoboli. "An Improved Finite Element Method Formulation for the Analysis of Nonlinear Anisotropic Dielectric Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 887-892.

An efficient and accurate vectorial finite element formulation is presented for the analysis of dielectric waveguides with arbitrary cross-sections, nonlinear behaviors, and anisotropic materials. Remarkable improvements in solution precision and computational effort have been obtained by evaluating new coefficients used in the matrix assembling procedure of the method. The influence of the mesh division is discussed and comparison with a scalar finite element approach is reported.

Click on title for a complete paper.

Abstracts

Niobium Microbolometers for Far-Infrared Detection (Short Papers)

M.E. MacDonald and E.N. Grossman. "Niobium Microbolometers for Far-Infrared Detection (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 893-896.

Microbolometers have been fabricated using a thin niobium film as the detector element. These detectors operate at room temperature, are impedance matched to planar antennas, and are suitable for broad-band use at far-infrared wavelengths. We have achieved responsivities of up to 21 V/W at a bias of 6.4 mA, and electrical noise equivalent powers (NEP) of as low as 1.1 x 10/sup-10/ W/radic HZ at 1 kHz at a bias of 3.6 mA. At this bias, the detectors are 1/f -noise limited below 1 kHz and are Johnson noise limited above 10 kHz. The 1/f noise in nV/radic Hz increases approximately linearly with bias with a typical level of 0.39 I(mA) over radic f(kHz) This level of 1/f noise is approximately a factor of 7 below the best reported for bismuth microbolometers.

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Abstracts

A Planar Quasi-Optical Mixer Using a Folded-Slot Antenna (Short Papers)

S.V. Robertson, L.P.B. Katehi and G.M. Rebeiz. "A Planar Quasi-Optical Mixer Using a Folded-Slot Antenna (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 896-898.

A quasioptical mixer using only planar structures such as co-planar wave guide and slotline is presented. The mixer, which can be scaled for millimeter-wave applications and placed on a substrate lens, uses orthogonal modes in a folded-slot antenna to achieve intrinsic RF/LO isolation without RF filtering or subharmonic pumping. The folded-slot balanced mixer was fabricated on RT/Duriod and obtained a minimum isotropic conversion loss of 1.2 dB at 11.6 GHz. Numerical integration of full two-dimensional antenna patterns yielded an antenna directivity of 7 dB, corresponding to a single side-band (SSB) mixer conversion loss of 8.2dB. The mixer demonstrated -18 dB RF/IF isolation and -30dB LO/IF isolation.

Abstracts

Measurement-Based Model Parameters for Quasi-Optical Electron Device Arrays (Short Papers)

L.B. Sjogren, H.-X.L. Liu, X.-H. Qin, C.W. Domier and N.C. Luhmann, Jr.. "Measurement-Based Model Parameters for Quasi-Optical Electron Device Arrays (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 899-901.

Impedance element values for a Schottky beam control diode array are obtained by curve-fitting quasioptical reflection coefficient measurements to a series RLC array model. The model provides a good representation of the array behavior. Parameters of Schottky varactor arrays tested to-date are summarized. The technique should be applicable to other quasioptical arrays, as well.

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Abstracts

MIM Capacitor Modeling: A Planar Approach (Short Papers)

G. Bartolucci, F. Giannini, E. Limiti and S.P. Marsh. "MIM Capacitor Modeling: A Planar Approach (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 901-903.

On the basis of a planar approach, an equivalent circuit model of MMIC overlay capacitors with feeding lines in generic position has been derived. Closed expressions for the equivalent circuit elements are presented. The validity of the proposed circuit has been successfully tested with experimental data. Its simplicity and flexibility makes it attractive for implementation in CAD packages.

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Abstracts

A Recursive Algorithm for Analysis of Planar Multiple Lines on Composite Substrates for M(H)MIC's and High-Speed Interconnects (Short Papers)

Y. Xu, K. Wu and R.G. Bosisio. "A Recursive Algorithm for Analysis of Planar Multiple Lines on Composite Substrates for M(H)MIC's and High-Speed Interconnects (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 904-907.

A simple recursive algorithm is presented based on the method of fines for the analysis of multilayered multiple microstrip lines or slots. Our previously proposed scheme of vertical multi-subregion space discretization is used to enhance the numerical accuracy. The recursive formulation is extended to model composite substrates which is aimed at reducing the unwanted coupling among different lines in M(H)MIC's and high-speed interconnects. Numerical results are shown for both quasistatic and hybrid-mode analyses. Results of multiple strips on a composite uniaxial anisotropic substrate are also presented.

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Abstracts

The Propagation Constant of a Lossy Coaxial Line with a Thick Outer Conductor (Short Papers)

W.C. Daywitt. "The Propagation Constant of a Lossy Coaxial Line with a Thick Outer Conductor (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 907-911.

The microwave approximation for the propagation constant of a coaxial line becomes inaccurate below 1 MHz. An approximation is presented that is accurate over the entire operating frequency range of the line.

Abstracts

On the Application of Complex Resistive Boundary Conditions to Model Transmission Lines Consisting of Very Thin Superconductors (Comments)

S. Amari. "On the Application of Complex Resistive Boundary Conditions to Model Transmission Lines Consisting of Very Thin Superconductors (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 912-912.

In the above paper, the authors present an elegant method to account for metallic losses in thin superconductors. The extensive numerical effort, which would otherwise be necessary to exactly solve the boundary-value problem, is considerably reduced by using the concept of complex resistive boundary conditions. This idea seems to have been originally introduced by Senior as the authors point out.

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Abstracts

On the Application of Complex Resistive Boundary Conditions to Model Transmission Lines Consisting of Very Thin Superconductors (Reply to Comments)

J.M. Pond and C.M. Krowne. "On the Application of Complex Resistive Boundary Conditions to Model Transmission Lines Consisting of Very Thin Superconductors (Reply to Comments)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 912-914.

The comments indicate a misunderstanding of several issues that are central to the above paper. This response will address all three of those issues in the same sequence as they were raised. The first question concerns the resistive boundary condition. The remaining two issues concern the use of the spectral domain approach with the resistive boundary condition to calculate the propagation constant and loss of transmission line structures.

Abstracts

Conversions Between S, Z, Y, h, ABCD, and T Parameters Which are Valid for Complex Source and Load Impedances (Comments)

R.B. Marks and D.F. Williams. "Conversions Between S, Z, Y, h, ABCD, and T Parameters Which are Valid for Complex Source and Load Impedances (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 914-915.

In his recent paper, Frickey presents formulas for conversions between various network matrices. Four of these matrices (Z, Y, h, and ABCD) relate voltages and currents at the ports; the other two (S and T) relate wave quantities. These relationships depend on the definitions of the waves themselves in terms of voltage and current. Frickey's results are based on an unconventional definition of the waves, whose resulting properties are unfamiliar to most microwave engineers. As a result, application of his formulas can easily lead to catastrophic errors.

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Conversions Between S, Z, Y, h, ABCD, and T Parameters Which are Valid for Complex Source and Load Impedances (Reply to Comments)

D.A. Frickey. "Conversions Between S, Z, Y, h, ABCD, and T Parameters Which are Valid for Complex Source and Load Impedances (Reply to Comments)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 915-915.

I would like to thank Mr. Marks and Mr. Williams for pointing out the error in using the definition of a/sub j/ and b/sub j/ in the above paper as I was unaware of the implications involved. Also, I would like to thank the authors for bringing to my attention their work in [1].

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Abstracts

An Equivalent Transformation for the Mixed Lumped Lossless Two-Port and Distributed Transmission Line (Comments)

R. Finkler and R. Unbehauen. "An Equivalent Transformation for the Mixed Lumped Lossless Two-Port and Distributed Transmission Line (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 915-916.

Stimulated by previous articles by the authors of the above paper, we have done related research. In doing so, we have found additional results and synthesis applications that we would like to communicate here briefly.

Abstracts

TE and TM Modes in Circularly Shielded Slot Waveguides (Correction)

J.L. Tsalamengas, I.O. Vardiambasis and J.G. Fikioris. "TE and TM Modes in Circularly Shielded Slot Waveguides (Correction)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 916-916.

In the above paper, the following misprints should be corrected:

Abstracts

Experimental Proof-of-Principle Results on a Mode-Selective Input Coupler (Correction)

J.P. Tate. "Experimental Proof-of-Principle Results on a Mode-Selective Input Coupler (Correction)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 916-917.

Upon careful review of the above paper, two errors were found. The cutoff frequency for the TE/sub01/ coaxial mode was incorrectly shown as 13.81 GHz in Fig. 4. The results in Fig. 9(a) and 9(b), which compare theory and experiment, are also incorrect. The new figures that should replace them are shown below as Fig. 1(a) and 1(b). The figure captions used for Fig. 9(a) and 9(b) are unchanged. These new graphs correctly illustrate the effect discussed in the text.

Abstracts

Theoretical Study of Variation of Propagation Constant in a Cylindrical Waveguide Due to Chirality: Chiro-Phase-Shifting (Correction)

M.M.I. Saadoun and N. Engheta. "Theoretical Study of Variation of Propagation Constant in a Cylindrical Waveguide Due to Chirality: Chiro-Phase-Shifting (Correction)." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 917-917.

Owing to the delay in sending the proofread galley of our paper to the IEEE Transactions/Journals Department, several typographical misprints, which were made during the typesetting of our manuscript, appeared in the print. These are corrected below.

Abstracts

Call for Papers - Electrical Performance of Electronic Packaging (Apr. 1995, Part I [T-MTT])

"Call for Papers - Electrical Performance of Electronic Packaging (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 918-918.

Abstracts

Call for Papers - Wireless Trends in 21st Century (Apr. 1995, Part I [T-MTT])

"Call for Papers - Wireless Trends in 21st Century (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 919-919.

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IEEE Home Page (Advertisement) (Apr. 1995, Part I [T-MTT])

"IEEE Home Page (Advertisement) (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): 920-920.

Abstracts

Back Cover (Apr. 1995, Part I [T-MTT])

"Back Cover (Apr. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part I [T-MTT]): b1-b2.

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Front Cover (Apr. 1995, Part II [T-MTT])

"Front Cover (Apr. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): f1-f2.

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Special Issue on Space Terahertz Technology (Apr. 1995, Part II [T-MTT])

M.J. Wengler and G.M. Rebeiz. "Special Issue on Space Terahertz Technology (Apr. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 921-921.

The papers in this special issue arise from results reported at the Fifth International Symposium on Space Terahertz Technology, held in May 1994 at the University of Michigan, Ann Arbor. The conference is sponsored by the NASA Office of Advanced Concepts and Technology (OACT), with cooperative sponsorship by the IEEE Microwave Theory and Techniques Society. The emphasis of the conference is on the sensitive detection of terahertz radiation and on the generation of solid-state local oscillator sources at terahertz frequencies. The conference reflects NASA's interest in terahertz sensors appropriate for spaceborne application for use in earth remote-sensing, atmospheric remote-sensing and radio-astronomy. The conference was organized by The University of Michigan's NASA-Center for Space Terahertz Technology.

Abstracts

On the Modeling and Optimization of Schottky Varactor Frequency Multipliers at Submillimeter Wavelengths

J.T. Louhi and A.V. Raisanen. "On the Modeling and Optimization of Schottky Varactor Frequency Multipliers at Submillimeter Wavelengths." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 922-926.

Schottky varactor frequency multipliers are used to generate local oscillator power at millimeter and submillimeter wavelengths. The equivalent circuit of the Schottky varactor contains a junction capacitance, a junction conductance, a series resistance and a model for electron velocity saturation. At millimeter wavelengths the equivalent circuit is affected by the edge effects, which are due to the small-area circular anode. The correction factors due to the edge effect for the junction capacitance and for the series resistance are available in the literature. In this work the electron velocity saturation is modeled by limiting the velocity of the transition front between the depleted and undepleted layer. By using this model the maximum current of the diode is given by the actual area of the transition front between depleted and undepleted layers, and is therefore related to the capacitance correction factor. The new model has been tested by analyzing a two diode balanced doubler for 160 GHz presented earlier in the literature. The agreement between the theoretical results and the measurements is excellent. The new diode model is useful in optimization of varactors for high millimeter and submillimeter wave frequencies.

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Abstracts

155- and 213-GHz AlInAs/GaInAs/InP HEMT MMIC Oscillators

S.E. Rosenbaum, B.K. Kormanyos, L.M. Jelloian, M. Matloubian, A.S. Brown, L.E. Larson, L.D. Nguyen, M.A. Thompson, L.P.B. Katehi and G.M. Rebeiz. "155- and 213-GHz AlInAs/GaInAs/InP HEMT MMIC Oscillators." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 927-932.

We report on the design and measurement of monolithic 155- and 213-GHz quasi-optical oscillators using AlInAs/GaInAs/InP HEMT's. These results are believed to be the highest frequency three-terminal oscillators reported to date. The iridium concentration in the channel was 80% for high sheet charge and mobility. The HEMT gates were fabricated with self-aligned sub-tenth-micrometer electron-beam techniques to achieve gate lengths on the order of 50 nm and drain-source spacing of 0.25 µm. Planar antennas were integrated into the fabrication process resulting in a compact and efficient quasi-optical Monolithic Millimeter-wave Integrated Circuit (MMIC) oscillator.

Abstracts

A Wideband Fixed-Tuned SIS Receiver for 200-GHz Operation

R. Blundell, C.-Y.E. Tong, D.C. Papa, R.L. Leombruno, X. Zhang, S. Paine, J.A. Stern, H.G. LeDuc and B. Bumble. "A Wideband Fixed-Tuned SIS Receiver for 200-GHz Operation." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 933-937.

We report on the design and development of a heterodyne receiver, designed to cover the frequency range 176-256 GHz. This receiver incorporates a niobium superconductor-insulator-superconductor (SIS) tunnel junction mixer, which, chiefly for reasons of reliability and ease of operation, is a fixed-tuned waveguide design. On-chip tuning is provided to resonate out the junction's geometric capacitance and produce a good match to the waveguide circuit. Laboratory measurements on the first test receiver indicate that the required input bandwidth (about 40%) is achieved with an average receiver noise temperature of below 50 K. Mixer conversion gain is observed at some frequencies, and the lowest measured receiver noise is less than 30 K. Furthermore, the SIS mixer used in this receiver is of simple construction, is easy to assemble and is therefore a good candidate for duplication.

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Conversion Gain and Noise of Niobium Superconducting Hot-Electron-Mixers

H. Ekstrom, B.S. Karasik, E.L. Kollberg and K.S. Yngvesson. "Conversion Gain and Noise of Niobium Superconducting Hot-Electron-Mixers." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 938-947.

A study has been done of microwave mixing at 20 GHz using the nonlinear (power dependent) resistance of thin niobium strips in the resistive state. Our experiments give evidence that electron-heating is the main cause of the nonlinear phenomenon. Also a detailed phenomenological theory for the determination of conversion properties is presented. This theory is capable of predicting the frequency-conversion loss rather accurately for arbitrary bias by examining the I--V-characteristic. Knowing the electron temperature relaxation time, and using parameters derived from the I--V-characteristic also allows us to predict the -3-dB IF bandwidth. Experimental results are in excellent agreement with the theoretical predictions. The requirements on the mode of operation and on the film parameters for minimizing the conversion loss (and even achieving conversion gain) are discussed in some detail. Our measurements demonstrate an intrinsic conversion loss as low as 1 dB. The maximum IF frequency defined for -3-dB drop in conversion gain, is about 80 MHz. Noise measurements indicate a device output noise temperature of about 50 K and SSB mixer noise temperature below 250 K. This type of mixer is considered very promising for use in low-noise heterodyne receivers at THz frequencies.

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Integrated Back to Back Barrier-N-N/sup +/ Varactor Diode Tripler Using a Split-Waveguide Block

D. Choudhury, P.H. Siegel, R.P. Smith, A.V. Raisanen, S.C. Martin and M.A. Frerking. "Integrated Back to Back Barrier-N-N/sup +/ Varactor Diode Tripler Using a Split-Waveguide Block." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 948-954.

The back-to-back barrier-N-N+ (bbBNN) varactor is a nonlinear device being developed for frequency multiplier applications above 100 GHz. Its symmetrical C-V characteristic, low series resistance, freedom from external bias and suitability to planarization make it an ideal choice for high frequency, low power, odd harmonic generation. In this paper, the performance of a 220-GHz waveguide tripler using, for the first time, a planar GaAs bbBNN device integrated on a quartz microstrip circuit is presented. A new split-waveguide block design has been employed to provide the proper embedding impedances to the device at the input and third harmonic output frequencies. A flange-to-flange tripling efficiency of 7% has been obtained at 220 GHz with an output power in excess of 700 µW. This is believed to be the highest conversion efficiency yet reported for a tripler with an integrated device at this frequency. Theoretical calculations indicate that substantial improvement is possible with modest changes to the device and circuit parameters.

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Simulation of 100-300 GHz Solid-State Harmonic Sources

M.F. Zybura, J.R. Jones, S.H. Jones and G.B. Tait. "Simulation of 100-300 GHz Solid-State Harmonic Sources." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 955-961.

Accurate and efficient simulations of the large-signal time-dependent characteristics of second-harmonic Transferred Electron Oscillators (TEO's) and Heterostructure Barrier Varactor (HBV) frequency triplers have been obtained. This is accomplished by using a novel and efficient harmonic-balance circuit analysis technique which facilitates the integration of physics-based hydrodynamic device simulators. The integrated hydrodynamic device/harmonic-balance circuit simulators allow TEO and HBV circuits to be co-designed from both a device and a circuit point of view. Comparisons have been made with published experimental data for both TEO's and HBV's. For TEO's, excellent correlation has been obtained at 140 GHz and 188 GHz in second-harmonic operation. Excellent correlation has also been obtained for HBV frequency triplers operating near 200 GHz. For HBV's, both a lumped quasi-static equivalent circuit model and the hydrodynamic device simulator have been linked to the harmonic-balance circuit simulator. This comparison illustrates the importance of representing active devices with physics-based numerical device models rather than analytical device models.

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Analysis of a 170-GHz Frequency Doubler with an Array of Planar Diodes

J. Tuovinen and N.R. Erickson. "Analysis of a 170-GHz Frequency Doubler with an Array of Planar Diodes." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 962-968.

Analysis of a planar diode multiplier from 85-170 GHz is described. The doubler uses a waveguide mount with two series pairs of diodes in a balanced structure. Because of the difficulties in conventional scale model measurements, numerical electromagnetic simulation based on the finite element method was chosen for the analysis, using a commercial program. To optimize the diode design, the de-embedded diode terminal impedance was studied, as well as the power balance between the diodes. The analysis showed that the matching of the diode impedance to that of the waveguide is quite sensitive to the diode substrate thickness. Thicknesses from 25-100 µm in GaAs were studied as well as 100-µm-thick quartz. The accuracy of the theoretical analysis was verified by careful measurements using a slotted line to determine the diode terminal impedance under large signal pump, for frequencies between 80 and 90 GHz. Good agreement between the measured and simulated diode terminal impedance was observed, although full agreement requires the addition of an empirical loss term. Several options are considered for the source of this loss.

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Fundamental and Subharmonic Excitation for an Oscillator with Several Tunneling Diodes in Series

O. Boric-Lubecke, D.-S. Pan and T. Itoh. "Fundamental and Subharmonic Excitation for an Oscillator with Several Tunneling Diodes in Series." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 969-976.

Connecting several tunneling diodes in series shows promise as a method for increasing the output power of these devices as millimeter-wave oscillators. However, due to the negative differential resistance (NDR) region in the dc I-V curve of a single tunneling diode, a circuit using several devices connected in series, and biased simultaneously in the NDR region, is dc unstable. Because of this instability, an oscillator with several tunneling diodes in series has a demanding excitation condition. Excitation using an externally applied RF signal is one approach to solving this problem. This is experimentally demonstrated using an RF source, both with frequency close to as well as with frequency considerably lower than the oscillation frequency. Excitation by an RF source with a frequency as low as one sixth of the oscillation frequency was demonstrated in a proof-of-principle experiment at 2 GHz, for an oscillator with two tunnel diodes connected in series. Strong harmonics of the oscillation signal were generated as a result of the highly nonlinear dc I-V curve of the tunnel diode and a large signal oscillator design. Third harmonic output power comparable to that of the fundamental was observed in one oscillator circuit. If submillimeter wave resonant-tunneling diodes (RTD's) are used instead of tunnel diodes, this harmonic output may be useful for generating signals at frequencies well into the terahertz range.

Abstracts

Measurements of Noise in Josephson-Effect Mixers

R.J. Schoelkopf, J. Zmuidzinas, T.G. Phillips, H.G. LeDuc and J.A. Stern. "Measurements of Noise in Josephson-Effect Mixers." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 977-983.

We present new heterodyne receiver results obtained at 100 GHz using resistively-shunted Nb and NbN tunnel junctions. In addition, we have carried out accurate measurements of the available noise power of these devices at the L-band (1.5 GHz) IF frequency. Both the heterodyne and the output noise measurements show that the noise of these devices can be a factor of five or more higher than that predicted by the simple current-biased RSJ model. The noise approaches the appropriate thermal or thermal and shot noise limits for bias voltages where the nonlinearity is not strong (i.e., V > I/sub C/R/sub N/), but as expected from the RSJ model, can be significantly higher at the low voltages where the mixers are typically biased. The bias voltage dependence of the noise shows structure which is associated with resonances in the RF embeddhg circuit. Surprisingly, we find that changes in the high-frequency (100 GHz) impedance presented to the junction can dramatically affect the magnitude and voltage dependence of the low-frequency (1.5 GHz) noise. This emphasizes the necessity of very closely matching the junction to free space over a wide frequency range.

Abstracts

190-GHz Radiation from a Quasioptical Josephson Junction Array

M.J. Wengler, B. Guan and E.K. Track. "190-GHz Radiation from a Quasioptical Josephson Junction Array." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 984-988.

At 190 GHz, 0.36 µW has been detected from an 11x 58 array of niobium Josephson junctions. The power is radiated directly into free space above the surface of the two-dimensional array of junctions. Detection is made by a commercial bolometer outside the array cryostat. The junctions in the array are closely spaced in the y-dimension, but spaced by more than one-half wavelength in the x-direction. This asymmetry results in mutual phase-locking between adjacent junctions suitable for the production of y-polarized radiation. The resonance and asymmetry also result in a reasonable impedance match between the Josephson junctions and the free-space radiation mode.

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A Low-Cost 20-22 GHz MIC Active Receiver/Radiometer

S. Mollenkopf, L.P.B. Katehi and G.M. Rebeiz. "A Low-Cost 20-22 GHz MIC Active Receiver/Radiometer." 1995 Transactions on Microwave Theory and Techniques 43.4 (Apr. 1995, Part II [T-MTT] (Special Issue on Space Terahertz Technology)): 989-993.

A microwave integrated circuit active receiver is built and tested at 19-25 GHz. The receiver consists of a planar CPW-fed double folded-slot antenna coupled to a six-stage MESFET amplifier and followed by a planar Schottky-diode detector. The folded-slot antenna on a GaAs half-space results in a wide frequency bandwidth suitable for MMIC amplifiers. The measured system performance show a video responsivity close to 1 GV/W at 20 GHz with a 3-dB bandwidth of 1500 MHz. A novel method which uses the planar video detector after the amplifier stages as an RF mixer is used to measure the noise-figure of the direct detection radiometer. The system noise figure is 4.8 dB at 22 GHz. The radiometer sensitivity to a hot/cold load is 3.8 µV/K. The measured antenna patterns show a 90% Gaussicity at 20-22 GHz. The active MIC receiver can be integrated monolithically for low-cost applications and is well suited for millimeter-wave linear imaging arrays.

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A Low-Voltage, High-Power T/R-Switch MMIC Using LC Resonators

T. Tokumitsu, I. Toyoda and M. Aikawa. "A Low-Voltage, High-Power T/R-Switch MMIC Using LC Resonators." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 997-1003.

A novel T/R switch is proposed for high-power/low-distortion operation at a low control voltage. LC-resonant switches composed of inductors, capacitors, and switch FET's are incorporated in TX and RX arms to provide a reverse control scheme that removes the rf-voltage limitation in the transmit mode. A 1.9-GHz LC-resonant T/R switch MMIC with a total FET periphery of 3.36 mm exhibits 3rd IMR less than -40 dB for an input power up to 31 dBm when controlled at 0 V/-2 V. This MMIC occupies an area as small as less than 2x2 mm. This will make it possible to implement advanced T/R-switches at PCS and ISM frequencies below 5 GHz.

Abstracts

A Novel Monolithic HBT-p-i-n-HEMT Integrated Circuit with HBT Active Feedback and p-i-n Diode Variable Gain Control

K.W. Kobayashi, D.C. Streit, D.K. Umemoto and A.K. Oki. "A Novel Monolithic HBT-p-i-n-HEMT Integrated Circuit with HBT Active Feedback and p-i-n Diode Variable Gain Control." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1004-1009.

We report the world's first functional MMIC circuit integrating HBT's, HEMT's, and vertical p-i-n diodes on a single III-V substrate. The 1-10 GHz variable gain amplifier monolithically integrates HEMT, HBT, and vertical p-i-n diode devices has been fabricated using selective MBE and a merged processing technology. The VGA offers low-noise figure, wideband gain performance, and good gain flatness over a wide gain control range. A noise figure below 4 dB was achieved using a HEMT transistor for the amplifier stage and a wide bandwidth of 10 GHz. A nominal gain of 10 dB was achieved by incorporating HBT active feedback techniques and 12 dB of gain control range was obtained using a vertical p-i-n diode as a varistor, all integrated into a compact 1.5 x 0.76 mm² MMIC. The capability of monolithically integrating HBT's, HEMT's, and p-i-n's in a merged process will stimulate the development of new monolithic circuit techniques for achieving optimal performance as well as provide a foundation for high performance mixed-mode multi-functional MMIC chips.

Abstracts

A W-Band Source Module Using MMIC's

H. Wang, K.W. Chang, D. Smith, G.S. Dow, K.L. Tan, A.K. Oki and B.R. Allen. "A W-Band Source Module Using MMIC's." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1010-1016.

A W-band source module providing 4-GHz tuning bandwidth (92.5-96.5 GHz) has been developed. This module consists of three MMIC chips: a 23.5 GHz HBT VCO, a 23.5-94 GHz HEMT frequency quadruple and a W-band three-stage HEMT output amplifier, all fabricated in TRW production lines. It exhibits a measured output power of 3 dBm at 94-95 GHz and a 3-dB tuning bandwidth greater than 3 GHz, with a phase noise of -92 dBc/Hz at 1 MHz offset. This work demonstrates a new and efficient way to implement high performance W-band source. Its wide tuning bandwidth with good phase noise performance, as well as design simplicity, makes this approach attractive for many W-band system applications.

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Ferrite Phase Shifters Using Stress-Insensitive Garnet Materials (May 1995 [T-MTT])

J.T. Vaughn, P.R. Cox, G.P. Rodrigue and G.R. Harrison. "Ferrite Phase Shifters Using Stress-Insensitive Garnet Materials (May 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1017-1022.

Stable hysteresis characteristics of ferrimagnetic materials are critical to the RF performance of microwave ferrite toroidal phasers. Particularly troublesome are the magnetostrictive characteristics where the hysteresis properties are altered by stress. This paper presents the results of a study addressing MN/sup +3/ substitutions in garnets to improve the resultant magnetostrictive characteristics in order to achieve stress-insensitive performance in waveguide toroidal phasers.

Abstracts

Analysis and Design of a Novel Noncontacting Waveguide Backshort

T.M. Weller, L.P.B. Katehi and W.R. McGrath. "Analysis and Design of a Novel Noncontacting Waveguide Backshort." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1023-1030.

A new noncontacting waveguide backshort has recently been developed for millimeter- and submillimeter-wave frequencies. The design consists of a metal bar with rectangular holes cut into it, which is covered with a dielectric layer to form a snug fit with the broadwalls of a waveguide. It is mechanically rugged and can be readily fabricated for frequencies from 1-1000 GHz. This paper presents a technique for the theoretical characterization of the backshort, using an approach that combines the mode-matching method and a set of coupled space-domain integral equations. The convergence characteristics of the analysis are included, along with a set of general design guidelines.

Abstracts

MMIC-Calibrated Probing by CW Electrooptic Modulation

D. Le Quang, D. Erasme and B. Huyart. "MMIC-Calibrated Probing by CW Electrooptic Modulation." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1031-1036.

This paper describes an electrooptic probing technique using a cw semiconductor-laser beam associated with a fast photodetector. Besides its simplicity, this technique presents some advantages over the sampling one thanks to the presence of a Fabry-Perot effect, namely an enhancement of the electrooptic interaction and a simple solution to the calibration problem. The good validity of the calibration method allows the application of this technique to S-parameter measurements. The S-parameter determination, in modulus and in phase, of an industrial MMIC by the electrooptic method is reported and compared with direct network analyzer measurements.

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Nonlinear Models for the Intermodulation Analysis of FET Mixers

S. Peng, P.J. McCleer and G.I. Haddad. "Nonlinear Models for the Intermodulation Analysis of FET Mixers." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1037-1045.

An accurate, detailed analysis program has been developed for intermodulation distortion (IMD) simulation of FET mixers. This program is very efficient at calculating the IMD from multiple RF inputs. We have proposed a simplified nonlinear model for IMD analysis of FET gate mixers. The accuracy of the simplified model has been verified experimentally using two different MESFET mixers and one HEMT mixer at X band. All the tests show good agreement between measured results and the calculated results for second- and third-order IMD. The simplified model is based on modeling the derivative of the device transconductance by a sum of a Gaussian function and a linear function of the gate voltage. Drain bias dependence is ignored. The advantage of this model is that it can be used for both MESFET and HEMT mixers, and its fitting parameters can be easily determined from a nonlinear characterization of the devices at low frequencies.

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Validation of a Nonlinear Transistor Model by Power Spectrum Characteristics of HEMT's and MESFET's

I. Angelov, H. Zirath and N. Rorsman. "Validation of a Nonlinear Transistor Model by Power Spectrum Characteristics of HEMT's and MESFET's." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1046-1052.

The bias dependence of the power output spectrum and the generation of intermodulation products from different HEMT's and MESFET's at large signal excitation is studied and compared with simulated values. An extended HEMT/FET model suitable for small and and negative V/sub ds/ (with a drain voltage dependence of the peak transconductance in the unsaturated drain current region, and at negative drain voltage), is also proposed. Good agreement between simulated and measured power spectrum up to at least the fourth harmonic is demonstrated for HEMT and MESFET devices from different manufacturers. Measured and simulated intermodulation products are also in good agreement, which confirm the validity of the model.

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Modeling the Microwave Properties of Superconductors

J.-G. Ma and I. Wolff. "Modeling the Microwave Properties of Superconductors." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1053-1059.

In this paper a macroscopic phenomenological model for the microwave properties of superconductors is presented. The model is based on the idea that there are two kinds of current carriers, and instead of the first London's equation a new equation is derived. This model can be applied to both low- and high-temperature superconductors. Using this model, an expression for the microwave surface resistance is derived and the surface resistance versus frequency is calculated. The results show that the relation between resistance and frequency is not R/sub s/ ~omega² as indicated by both BCS theory and London model, but R/sub s/~omega/sup a/, where a is between 1 and 2 (e.g. a = 1.35) for thin film high-T/sub c/ superconductors YBa/sub 2/Cu/sub 3/O/sub 7-delta/. The temperature dependence of R/sub s/ is simulated using the given model. These relations and the values of the surface resistance agree well with experimental results. A residual resistance may be interpreted from this model.

Abstracts

A Generic Approach for Permittivity Measurement of Dielectric Materials Using a Discontinuity in a Rectangular Waveguide or a Microstrip Line

J. Abdulnour, C. Akyel and K. Wu. "A Generic Approach for Permittivity Measurement of Dielectric Materials Using a Discontinuity in a Rectangular Waveguide or a Microstrip Line." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1060-1066.

A generic approach is proposed to accurately measure microwave and millimeter-wave properties of dielectric materials. This novel technique first determines the scattering parameters of a discontinuity containing a material having a wide range of complex dielectric permittivity epsilon that is known a priori (the direct problem). The discontinuity is embedded in a rectangular waveguide or a microstrip line. A unified theory, which is essentially based on a combination of the boundary integral equation technique with a modal expansion approach, is presented to tackle the direct problem. A class of generic diagrams are obtained for interrelating the dielectric permittivity epsilon to its S-parameters, and a simple analytical expression is deduced to solve the inverse problem. The proposed analytical formulation is easy to use and much more rapid than its iterative counterparts. It demonstrates a completely new and efficient strategy for accurate complex dielectric measurements.

Abstracts

Non-Leaky Coplanar (NLC) Waveguides with Conductor Backing

Y. Liu, K. Cha and T. Itoh. "Non-Leaky Coplanar (NLC) Waveguides with Conductor Backing." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1067-1072.

In this paper, we present a structure called a non-leaky coplanar (NLC) waveguide with conductor backing. It is a multilayered structure with two possible configurations. The spectral domain approach with a complex root searching procedure is used to investigate leakage phenomena. The simulation results confirm that the leakage in conductor-backed coplanar waveguide (CBCPW) occurs in the form of wave in the parallel plate waveguide with infinite width. The results show that the leakage in the multilayered structure can be removed if the geometrical and material parameters of the structure are chosen appropriately. Experiments were carried out to investigate the transmission of these structures. It was found that the resonance in the transmission of finite-width conductor-backed coplanar wavegnide (FW-CBCPW) is caused by the energy leakage from the dominant CPW mode. The resonance is eliminated in the NLC waveguides. These NLC waveguides are feasible and practical in the uniplanar MMIC design due to their planar nature.

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Full-Wave Characterization of a through Hole via in Multi-Layered Packaging

S.-G. Hsu and R.-B. Wu. "Full-Wave Characterization of a through Hole via in Multi-Layered Packaging." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1073-1081.

A full-wave analysis is presented for the propagation characteristics of a through hole via connecting two semi-infinitely long transmission lines in multi-layered packaging environment. The current distribution on the via and a section of transmission line is solved under the thin wire approximation by the moment method and the scattering parameters are extracted by the matrix pencil method. The Green's function in multilayer packaging environment is derived by applying the image theory and evaluated by the help of the Poisson summation formula. Numerical results are included to investigate the frequency-dependent propagation characteristics for via structures with various geometrical parameters, e.g., the via height, wire diameter, and distance between two ground planes. The excitation of the radial waves due to the current distribution on the via is also discussed in detail.

Abstracts

Shielding Effect of a Diaphragm in a Packaged Microstrip Circuit

H.-H. Chen and S.-J. Chung. "Shielding Effect of a Diaphragm in a Packaged Microstrip Circuit." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1082-1086.

The scattering of a diaphragm in a packaged microstrip line is investigated using the mode-matching method together with the method of lines. Instead of analyzing the discontinuity in the microstrip, this paper tackles the variation of the waveguide housing. The influences of the thickness and the depth of the diaphragm on the scattering of the dominant mode and higher-order modes are analyzed based on a comparison of the modal power distributions. Finally, the shielding effect of a pair of closely spaced diaphragms is investigated.

Abstracts

Microwave Circuit Analysis and Design by a Massively Distributed Computing Network

M. Vai and S. Prasad. "Microwave Circuit Analysis and Design by a Massively Distributed Computing Network." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1087-1094.

The advances in microelectronic engineering have rendered massively distributed computing networks practical and affordable. This paper describes one application of this distributed computing paradigm to the analysis and design of microwave circuits. A distributed computing network, constructed in the form of a neural network, is developed to automate the operations typically performed on a normalized Smith chart. Examples showing the use of this computing network for impedance matching and stabilizing are provided.

Abstracts

Transposing Conductors in Signal Buses to Reduce Nearest-Neighbor Crosstalk

R.H. Voelker. "Transposing Conductors in Signal Buses to Reduce Nearest-Neighbor Crosstalk." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1095-1099.

A conductor layout technique is described that reduces nearest-neighbor crosstalk for multiconductor signal buses with applications in high-speed digital and microwave pulse integrated circuits. Periodic transposition of conductors in a bus increases the average spacing of formerly nearest neighbors and thus decreases their capacitive and inductive coupling compared with ordinary parallel conductors. A conductor transposition pattern is evaluated for crosstalk, propagation delay, and chip area. SPICE simulations demonstrate that conductor transposition reduces, in certain situations, near- and far-end nearest-neighbor crosstalk by roughly 40% compared with parallel conductors. Quantitative guidelines are developed for reducing nearest-neighbor crosstalk in a transposed five-conductor bus, including effects of signal rise time, source resistance, load capacitance, and bus length.

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The Effects of Covering on Complex Wave Propagation in Gyromagnetic Slotlines

K.-F. Fuh and C.-K.C. Tzuang. "The Effects of Covering on Complex Wave Propagation in Gyromagnetic Slotlines." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1100-1105.

The evolution of complex leaky waves in partially open gyromagnetic slotlines into complex modes in a shielded slotline is presented. Given a particular stratified gyromagnetic slotline with two sidewalls present, four types (Types I-IV) of guided structures are defined and investigated, depending upon the four possible combinations of top and bottom covers. The behavior of the complex solutions is discussed for the partially open gyromagnetic slotlines. Initially, the slotline of Type I, which lacks both top and bottom covers, shows that no coupling exists among various pairs of leaky waves. By adding only a top cover into Type I, the resultant slotline of Type II exhibits certain coupling between different sets of leaky waves. Similarly, by adding only a bottom cover into Type I, the resultant slotline of Type III shows that certain strong leaky waves of Types I and II now become weak leaky waves. From these numerical experiments, we deduce that the complex modes supported by Type IV, which is completely shielded, can be the result of the mode coupling of the two previously found leaky waves in Types II and III waveguides, respectively. Therefore, the formation of complex modes in shielded slotline is related to the effects of covering on mode coupling of the various leaky waves of the partially open slotlines.

Abstracts

Effects of Various Suspended Mounting Schemes on Mode Characteristics of Coupled Slotlines Considering Conductor Thickness for Wideband MIC Applications

T. Wang and K. Wu. "Effects of Various Suspended Mounting Schemes on Mode Characteristics of Coupled Slotlines Considering Conductor Thickness for Wideband MIC Applications." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1106-1114.

Propagation characteristics of fundamental and higher-order modes are determined in coupled slotlines with three suspended mounting schemes (pedestal, groove, inverse pedestal) for wideband applications of microwave and millimeter-wave integrated circuits. The analysis is based on a novel enhanced spectral domain approach (ESDA) that combines essentially the conventional spectral domain technique with the power conservation theorem. Numerical results, considering also the influence of finite conductor thickness, are presented for propagation constants and characteristic impedance of the fundamental modes. Effects of different suspended mounting schemes on cutoff frequencies of first higher-order even and odd modes are discussed in detail. Field profiles of the fundamental modes in coupled slotlines with and without pedestals are shown. The inherent mechanism of mode transition is explained with respect to different pedestal sizes, indicating that the monomode bandwidth can be extended by appropriately choosing the dimension of pedestal in coupled slotlines.

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Abstracts

Generalized Coupled Interconnect Transfer Function and High-Speed Signal Simulations

Y. Eo and W.R. Eisenstadt. "Generalized Coupled Interconnect Transfer Function and High-Speed Signal Simulations." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1115-1121.

A new expression for the coupled interconnect system transfer function has been derived under general linear generator and uncoupled load conditions, i.e., without any restrictions in circuit load impedance. High-speed signals on coupled interconnects have been simulated using this transfer function. The simulation uses generalized interconnect circuit model parameters in which all line parameters are frequency dependent. The validity of the interconnect circuit parameters was confirmed previously usings-parameter measurements. High-speed signal simulation using this novel interconnect transfer function has been verified with time-domain measurements using an HP54121T high-speed sampling oscilloscope. This work accurately predicts coupled interconnect circuit responses. With this transfer function, signal integrity problems of high-performance VLSI circuits can be predicted in the design stage.

Abstracts

Microwave Interactions in Semiconductor Multiple-Quantum-Well Heterostructures Utilizing a Coplanar-Strip Geometry Device

S.W. Kirchoefer. "Microwave Interactions in Semiconductor Multiple-Quantum-Well Heterostructures Utilizing a Coplanar-Strip Geometry Device." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1122-1127.

A novel device design utilizing a multiple-quantum-well heterostructure conduction channel with an oxide-isolated overlying coplanar-strip transmission line has been constructed. These devices exhibit negative differential conductance in their dc characteristics for current transport in the plane of the quantum-well layers, originating from the change in mobility of the heated electrons within the quantum-well structure. This device design has permitted the observation of nonlinear conduction properties using these multiple-quantum-well heterostructures at microwave frequencies.

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Dispersion and Attenuation Characteristics of Coplanar Waveguides with Finite Metallization Thickness and Conductivity

J.-Y. Ke and C.H. Chen. "Dispersion and Attenuation Characteristics of Coplanar Waveguides with Finite Metallization Thickness and Conductivity." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1128-1135.

A new approach of modifying the conventional spectral domain approach is proposed for an analysis of the coplanar waveguide whose signal strip and ground planes have finite thickness and conductivity. By introducing suitable equivalent sources in the slot and signal strip regions, the problem can be significantly simplified by reducing the two-dimensional numerical integration into the one-dimensional one, thus it can be treated as easily as the conventional spectral-domain approach. By this modified approach, both the phase constant and attenuation constant can be determined simultaneously without using the assumption that the metallization thickness is much larger or smatler than the skin depth. In this work, comparison with published theoretical and experimental results is presented to check the accuracy of the new approach's results. In particular, the effective dielectric constant epsilon /sub eff/ and attenuation constant alpha of a coplanar waveguide with finite metallization thickness and finite conductivity are discussed in detail, together with the current distributions along the signal strip and ground planes.

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Abstracts

An Efficient Approach to Modeling of Quasi-Planar Structures Using the Formulation of Power Conservation in Spectral Domain

T. Wang and K. Wu. "An Efficient Approach to Modeling of Quasi-Planar Structures Using the Formulation of Power Conservation in Spectral Domain." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1136-1143.

An enhanced spectral domain approach (SDA) is developed for analysis of complex quasi-planar transmission lines. The method is based on a combination of spectral domain formulation and power conservation theorem. The relationship between electric and magnetic fields is established inside dielectric layers by using the conventional SDA while characteristic equation related to interface conditions is derived throngh the power conservation theorem. Maintaining the inherent advantages of the SDA, this technique is able to easily handle more complex quasi-planar structures. Generalized power formulation is also presented to calculate characteristic impedance. Convergence behavior is discussed considering the nature of power conservation. Various finlines with finite thickness of conductors are analyzed to demonstrate its applications.

Abstracts

Static Capacitance of Some Multilayered Microstrip Capacitors

A.K. Verma and Z. Rostamy. "Static Capacitance of Some Multilayered Microstrip Capacitors." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1144-1152.

A new unified model, the modified Wolff model (MWM) is presented to determine the lumped capacitance of rectangular, circular, hexagonal and triangular patches on the single layer substrate and under the multilayer condition. Effect of the top shield on the lumped capacitance has also been determined. The MWM is the combination of Wolff-Knoppick model, TTL technique and single layer reduction (SLR) technique. The results of MWM have been compared against the results of SDA, FEM, dual integral method and other forms of the variational methods with accuracy between 0.5-5% for the most of shapes under various conditions. The present model has accuracy of SDA and other rigorous formulations. No single method has been used in the literature to determine the lumped capacitance of patches of several shapes under the multilayer and shielded condition. The MWM is fast even on the desktop computer. Thus, the model is suitable for a unified CAD for the MMIC applications.

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Abstracts

Partial-Boundary Element Method for Analysis of Striplines with Arbitrary Cross-Sectional Dielectric in Multi-Layered Media

K. Atsuki and K. Li. "Partial-Boundary Element Method for Analysis of Striplines with Arbitrary Cross-Sectional Dielectric in Multi-Layered Media." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1153-1161.

A new method of analysis called the partial-boundary element method (p-BEM) is proposed for the analysis of striplines with arbitrary cross-sectional dielectric in multi-layered media. By using a Green's function that satisfies the boundary conditions of a relevant structure with multi-layered media and introducing a concept of the equivalent charge density, the p-BEM formulates a potential integral and boundary integral equations only on partial-boundaries such as the surface of the arbitrary cross-sectional dielectric. The number of the equations needed to be formulated is much less than in the conventional BEM. Numerical results of analysis are presented for two kinds of striplines: 1) with a rectangular dielectric ridge and 2) with an embedded rectangular dielectric in three-layered media.

Abstracts

Mixed Potential Integral Equation Technique for Hybrid Microstrip-Slotline Multilayered Circuits Using a Mixed Rectangular-Triangular Mesh

J. Sercu, N. Fache, F. Libbrecht and P. Lagasse. "Mixed Potential Integral Equation Technique for Hybrid Microstrip-Slotline Multilayered Circuits Using a Mixed Rectangular-Triangular Mesh." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1162-1172.

In this paper, a mixed potential integral equation (MPIE) formulation for hybrid microstrip-slotline multilayered circuits is presented. This integral equation is solved with the method of moments (MoM) in combination with Galerkin's method. The vector-valued rooftop functions defined over a mixed rectangular-triangular mesh are used to model the electric and magnetic currents on the microstrip and slotline structures. An efficient calculation technique for the quadruple interaction integrals between two cells in the system matrix equation is presented. Two examples of hybrid microstrip-slotline circuits are discussed. The first example compares the simulation results for a microstrip-slotline transition with measured data. The second example illustrates the use of the simulation technique in the design process of a broadband slot-coupled microstrip line transition.

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A Comprehensive Study of Numerical Anisotropy and Dispersion in 3-D TLM Meshes

P. Berini and K. Wu. "A Comprehensive Study of Numerical Anisotropy and Dispersion in 3-D TLM Meshes." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1173-1181.

This paper presents a comprehensive analysis of the numerical anisotropy and dispersion of 3-D TLM meshes constructed using several generalized symmetrical condensed TLM nodes. The dispersion analysis is performed in isotropic lossless, isotropic lossy and anisotropic lossless media and yields a comparison of the simulation accuracy for the different TLM nodes. The effect of mesh grading on the numerical dispersion is also determined. The results compare meshes constructed with Johns' symmetrical condensed node (SCN), two hybrid symmetrical condensed nodes (HSCN) and two frequency domain symmetrical condensed nodes (FDSCN). It has been found that under certain circumstances, the time domain nodes may introduce numerical anisotropy when modelling isotropic media.

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Abstracts

Complex Power and Mode Coupling in Circular Chirowaveguides

G. Busse and A.F. Jacob. "Complex Power and Mode Coupling in Circular Chirowaveguides." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1182-1186.

The total power carried by two (or more) modes of lossless circular chirowaveguides is shown to be complex in general, both above and below cutoff. This is explained by the coupling between modes which, in turn, proves the lack of orthogonality, at least in the power sense.

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Rigorous and Numerically Efficient Computation of the Irrotational Electric and Magnetic Eigenfunctions of Complex Gyrotron Cavities (May 1995 [T-MTT])

A. Jostingmeier, C. Rieckmann and A.S. Omar. "Rigorous and Numerically Efficient Computation of the Irrotational Electric and Magnetic Eigenfunctions of Complex Gyrotron Cavities (May 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1187-1195.

For the modal analysis of complex gyrotron cavities, complete sets of eigenfunctions of the corresponding completely shielded cavity are required. In this contribution, it is shown that the generalized scattering matrix method which is well-known for the computation of the resonance modes can also be applied to the calculation of the irrotational electric and magnetic eigenfunctions. The irrotational eigenfunctions are computed for some circularly symmetrical structures. The validity of the method is checked by investigating a spherical cavity for which the analytical solution is known. Furthermore, a special subdivision of tapered cavity sections is preseuted which considerably improves the numerical efficiency of the method. For a standard gyrotron cavity, the field in the source region is computed with and without making use of irrotational electric eigenfunctions. It is demonstrated that the accuracy and the numerical efficiency of the modal expansion of the cavity field in the source region is improved if these eigenfunctions are included in the analysis.

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Abstracts

A Periodic Spatial Power Combining MESFET Oscillator (Short Papers)

A. Balasubramaniyan, J. Heinbockel, A. Mortazawi and T. Itoh. "A Periodic Spatial Power Combining MESFET Oscillator (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1196-1197.

A planar periodic MESFET based spatial power combiner was designed and fabricated for X-band operation. In this combiner four MESFET devices driving a linear microstrip antenna array are periodically connected to a microstrip transmission line. A large-signal analysis of this combiner and experimental results thereon are presented. An effective radiated power of 484 mW was achieved for this structure at an oscillation frequency of 10.02 GHz with a power combining efficiency of 87%.

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Abstracts

Proviso on the Unconditional Stability Criteria for Linear Twoport (Short Papers)

M. Ohtomo. "Proviso on the Unconditional Stability Criteria for Linear Twoport (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1197-1200.

The proviso imposed by Rollett on the well-known stability criteria for linear twoports is examined and redefined as the requirement that at least one set of immittance parameters must have no RHP (right-half plane) poles. It is shown that the proviso can be interpreted as the extreme cases of a newly introduced proviso that requires that the S-parameters defined for at least one pair of arbitrary positive reference impedances have no RHP poles. The new proviso means that the twoport must be stable for at least one pair of arbitrary positive resistance terminations. Since S-parameters are much easier to measure than immittance parameters at microwaves and their direct measurability is an indication of the absence of RHP poles, the new proviso allows us to apply the stability criteria to measured circuits less consciously of the proviso.

Abstracts

Improvements in the Waveform Relaxation Method Applied to Transmission Lines (Short Papers)

F.C.M. Lau and E.M. Deeley. "Improvements in the Waveform Relaxation Method Applied to Transmission Lines (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1201-1203.

The waveform relaxation method has been shown by Chang to have substantial advantages in computation terms when applied to transmission line problems. It is shown in the present paper that the algorithm can break down if d.c. components are present in the signal, and an improved algorithm is presented. Computational results are presented and compared with the HSPICE solution.

Abstracts

Closed-Form Expressions for the Current Density on the Ground Plane of a Microstrip Line, with Application to Ground Plane Loss (Short Papers)

C.L. Holloway and E.F. Kuester. "Closed-Form Expressions for the Current Density on the Ground Plane of a Microstrip Line, with Application to Ground Plane Loss (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1204-1207.

In this paper closed-form expressions for the current density on the ground plane of a microstrip line are derived. The derivation is based on a quasistatic Green's function approach. These expressions are compared to both experimental and numerical values, and excellent agreement is demonstrated. The loss on a ground plane for a microstrip structure is calculated rising these expressions, and comparisons with results from Wheeler's incremental inductance rule are made.

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Determination of the Eigenfrequencies of a Ferrite-Filled Cylindrical Cavity Resonator Using the Finite Element Method (Short Papers)

G.C. Chinn, L.W. Epp and G.M. Wilkins. "Determination of the Eigenfrequencies of a Ferrite-Filled Cylindrical Cavity Resonator Using the Finite Element Method (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1207-1209.

A formulation of the Finite Element Method (FEM) particular to axisymmetric problems containing anisotropic media is compared to an analytic solution. In particular, the resonant frequencies of a longitudinally biased ferrite-filled cylindrical cavity are examined. For comparison, a solution of the characteristic equation for the lossless, ferrite-filled cylindrical waveguide was modified to give the resonant frequencies of the cylindrical cavity. This analytical solution was then used to examine the error in the FEM formulation for the anisotropic case. It is noted that the FEM formulation for anisotropic material presented, based on both node and edge-based elements, is found to be free of spurious solutions.

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Call for Papers - Electrical Performance of Electronic Packaging (May 1995 [T-MTT])

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Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (May 1995 [T-MTT])

"Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (May 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1211-1211.

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IEEE All-Society Periodicals Package (Advertisement) (May 1995 [T-MTT])

"IEEE All-Society Periodicals Package (Advertisement) (May 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.5 (May 1995 [T-MTT]): 1212-1212.

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Elected Honorary Life Member (Jun. 1995 [T-MTT])

A.A. Oliner. "Elected Honorary Life Member (Jun. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1213-1215.

Professor Tatsuo Itoh (born in Tokyo, Japan, in 1940), who is a widely known and highly respected member of the international microwave community, has just been elected an Honorary Life Member of the Microwave Theory and Techniques Society by its Administrative Committee. He becomes the 7th living member of this distinguished group, and the 11th member to be elected over the 42-year existence of the MTT Society. The last person in this group was elected in 1982, a dozen years ago.

Abstracts

Determination of InP HEMT Noise Parameters and S-Parameters to 60 GHz

R.T. Webster, A.J. Slobodnik, Jr. and G.A. Roberts. "Determination of InP HEMT Noise Parameters and S-Parameters to 60 GHz." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1216-1225.

A millimeterwave experimental technique is described for directly determining the noise parameters and scattering parameters of V-band InP HEMT's. The parameters are suitable for the design of monolithic millimeterwave integrated circuits since they represent the InP HEMT as it would appear in the monolithic environment. The method relies on careful characterization of the measurement system and the lnP HEMT packages or test fixtures. Results are provided for an lnP HEMT with 1.37 dB minimum noise figure and a maximum stuble gain of 12.74 dB at 57 GHz. In addition, it is shown that noise parameters measured between 2 GHz and 26 GHz can be extrapolated to 60 GHz, and that consistent S-parameters can be obtained for InP HEMT's in precision packages and test fixtures.

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Abstracts

HEMT for Low-Noise Microwaves: CAD-Oriented Performance Evaluation

G. Capponi, B. Di Maio and P. Livreri. "HEMT for Low-Noise Microwaves: CAD-Oriented Performance Evaluation." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1226-1229.

This paper shows how a graphic processing of low-noise HEMT's small signal parameters, allows evaluating and comparing the actual performance obtainable in front-end applications. HEMT's tradeoff charts which solve tradeoffs among the basic low-noise amplifier performance are reported. Figures of merit for microwave low-noise HEMT which represent a fast way of evaluating HEMT in actual working conditions and of selecting the proper transistor, are defined. As an example, the tradeoff charts and the figures of merit of two HEMT's (Fujitsu FHR02FH, Sony 2SK677) and a pseudomorphic-HEMT (Celeritek CFB001-03) are reported and compared with the data sheets.

Abstracts

An MMIC Local Oscillator for 16-QAM Digital Microwave Radio Systems

H. Suwaki, T. Nakagawa and T. Ohira. "An MMIC Local Oscillator for 16-QAM Digital Microwave Radio Systems." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1230-1235.

The first MMIC local oscillator for 16-QAM digital microwave systems is presented. The key advance is achieving the very low phase noise required by such systems. Low phase noise is realized with a low phase noise VCO (voltage-controlled oscillator) that is installed into a new PLL (phase-locked loop). Although the developed local oscillator is 90% smaller than the existing Dielectric Resonator-based local oscillators, it achieves comparable receiver performance.

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The Determination of Diode Resistance from the Transmission Using a Waveguide/Coaxial Line Tee Junction

J.R.G. Twisleton. "The Determination of Diode Resistance from the Transmission Using a Waveguide/Coaxial Line Tee Junction." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1236-1240.

A method of finding the resistance and conductance of a diode terminating the coaxial arm of a tee junction from the minimum transmission obtained by adjusting the position of the diode, from the effect of an incremental change in this position, or from the frequency bandwidth of the transmission characteristic, is described. The method avoids the direct measurement of high reflection encountered at the extremes of bias with diode terminations. The parameters of the junction needed in the derivation are found experimentally. Allowing for loss in the coaxial line, the resistance of diodes determined at 9.4 GHz was in good agreement with the results of coaxial line measurements at 500 MHz and 3 GHz. The effect of the reactance of the diode capsule, not allowed for in the determination, is considered briefly.

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A Comparison of Planar Doped Barrier Diode Performance Versus Schottky Diode Performance in a Single Balanced, MIC Mixer with Low LO Drive

J.N. Poelker and R.S. Robertson. "A Comparison of Planar Doped Barrier Diode Performance Versus Schottky Diode Performance in a Single Balanced, MIC Mixer with Low LO Drive." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1241-1246.

This paper demonstrates that an unbiased GaAs planar doped barrier (PDB) diode, single balanced, Ku-band mixer achieves conversion loss performance comparable to a bias-optimized GaAs Schottky design at low local oscillator (LO) power levels for identical RF circuits. An experimental, side-by-side, performance comparison as a function of LO power is presented along with a harmonic balance (HB) simulation. The PDB diode is of interest for its zero-bias requirement and the high pulsed peak power handling potential for low-cost radars.

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Abstracts

CAD Models for Suspended and Inverted Microstrip

J.M. Schellenberg. "CAD Models for Suspended and Inverted Microstrip." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1247-1252.

The accuracies of CAD models for suspended and inverted microstrip are examined, and new models are proposed. The models are compared over the range of 0.1 <= w/h <= 10 and for epsilon /sub r/ values of 3.78 and 12.9. Of the three models examined, the Tomar and Bhartia (T&B) model is shown to be the most accurate. For epsilon/sub r/ = 12.9 (the worst case), the T&B model shows maximum and average errors of 2.94 and 1.28% respectively over its valid range. New CAD models are presented which demonstrate significantly improved accuracy and range of convergence. For suspended and inverted microstrip, the new models demonstrate worst case errors of 0.65 and 1.02%, respectively, and average errors of 0.23 and 0.27%, respectively. Further, the new models are valid for the full 0.1<= w/h <= 10 range, and unlike the other models, converge for the limiting cases of either complete substrate filling or a zero thickness substrate.

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Application of the Planar Model to the Analysis and Design of the Y-Junction Strip-Line Circulator

S.A. Ivanov. "Application of the Planar Model to the Analysis and Design of the Y-Junction Strip-Line Circulator." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1253-1263.

The constituent ferrite resonator and matching transformers of the Y-junction stripline circulator are replaced with their planar equivalents. In this way the fringing fields are taken into consideration and more adequate formulae for circulator design are obtained. Then, the frequency behavior of the resonator input impedance is analyzed in detail for selection of the most appropriate matching procedure. The results are in good agreement with experimental data for S-band.

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Correction Technique for On-Chip Modulation Response Measurements of Optoelectronic Devices

P. Debie and L. Martens. "Correction Technique for On-Chip Modulation Response Measurements of Optoelectronic Devices." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1264-1269.

A new and accurate error correction technique for on-chip intensity modulation response measurements of high-frequency optoelectronic devices is presented. Mathematical expressions for the different sources of errors that exist in the measurement system are derived. The new correction technique applied to the modulation response measurement of a strained quantum well laser diode shows excellent agreement with the theoretically expected result. Simulation results for a small-signal circuit model of the laser diode show excellent agreement with the measured input reflection coefficient (S/sub 11/ and the modulation response S/sub 21/. With the corrected modulation response measurement, more accurate parameters for this model are extracted.

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Multilayer MMIC Directional Couplers Using Thin Dielectric Layers

S. Banba and H. Ogawa. "Multilayer MMIC Directional Couplers Using Thin Dielectric Layers." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1270-1275.

Low-loss and small-sized MMIC directional couplers utilizing a multilayer structure composed of coupled thin-film transmission lines on a GaAs wafer surface are newly proposed. The fundamental characteristics of the couplers are discussed through calculations by numerical analysis, and the performance of the couplers and an application to reverse-phase hybrid ring are demonstrated. The results show that a 3 dB coupler can be designed within a 0.8 mm x 0.8 mm area for a center frequency of 20 GHz. Coupling losses of 3.7 dB ± 0.2 dB over a 4-GHz bandwidth and isolation of better than 26 dB in the frequency range of 0-30 GHz are achieved. The proposed coupler configurations can be applied to the high-density and multifunction integration of MMIC's.

Abstracts

The Incremental Inductance Rule in Quasi-TEM Coupled Transmission Lines

G.G. Gentili and A. Melloni. "The Incremental Inductance Rule in Quasi-TEM Coupled Transmission Lines." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1276-1280.

The application of the incremental inductance rule is described for the computation of losses in quasi-TEM coupled transmission lines. It is shown that the well-known formula valid for the single-line case can be extended to the case of normal modes traveling in general coupled structures providing one uses the power-current modal characteristic impedance definition. Numerical results are shown for several coupled lines systems.

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Real-Time Linear Time-Domain Network Analysis Using Picosecond Photoconductive Mixer and Samplers

S.-L.L. Huang, C.H. Lee and H.-L.A. Hung. "Real-Time Linear Time-Domain Network Analysis Using Picosecond Photoconductive Mixer and Samplers." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1281-1289.

Ion-implanted GaAs photoconductive (PC) switches have been used as an optical-microwave frequency mixer and electrical waveform samplers in a real-time sampling system. This high fidelity system has a bandwidth of 100-GHz, time resolution of 4-ps and a measurement sensitivity of 5-µV//spl radic/Hz. Because of this high sensitivity capability, the magnitude of the testing signal can be maintained sufficiently small to allow network analysis of a device or circuit in the linear mode without signal distortion. In this paper, a linear time-domain network analysis of a broadband monolithic microwave integrated circuit (MMIC) amplifier has been demonstrated in real-time by the optoelectronic technique. A measurement time of less than 40 µs is used to acquire waveform data. The dynamic range of the system can be further improved to 40 dB by reducing the repetition rate of the step recovery diode. Since the PC switches are fabricated with processes compatible to MMIC manufacturing, this real-time system is well-suited for on-wafer MMIC characterization.

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Full-Wave Design and Realization of Multicoupled Dual-Mode Circular Waveguide Filters

J.R. Montejo-Garai and J. Zapata. "Full-Wave Design and Realization of Multicoupled Dual-Mode Circular Waveguide Filters." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1290-1297.

A new full-wave method for the design and realization of dual-mode circular waveguide filters is presented. The rigorous CAD is a combination of the mode-matching and the finite-element techniques, which permits obtaining the Generalized Scattering Matrix for all the blocks that compose the structure (rectangular slots, cross-irises, and screws). The finite thickness of the irises, the higher order mode interaction, as well as the coupling and tuning screws are rigorously taken into account. A systematic design process for the different elements will be described. A full prediction of resonant out-of-band spurious is accomplished prior to the filter construction. Special attention is devoted to the circuital model in order to save a great deal of computational effort in the final adjustment. A four-pole elliptic circular waveguide cavity filter has been designed and constructed. The experimental filter results show excellent agreement with theory.

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Abstracts

Symmetrical N-Port Waveguide Junction Loaded with Dielectric Sleeve and Metallic Post

S.P. Yeo, L. Qiao and M. Cheng. "Symmetrical N-Port Waveguide Junction Loaded with Dielectric Sleeve and Metallic Post." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1298-1302.

The present paper describes the development of a computer model that is able to predict the characteristics of the symmetrical N-port waveguide junction, which has a dielectric sleeve and metallic post inserted concentrically into its central cavity. Computational and experimental test results demonstrate that the resultant software package (which is compact enough to be run on an IBM 486 PC) can yield accuracies of ±0.5% for the scattering parameters of the junction.

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Electromagnetic Scattering from a Coaxial Dielectric Circular Cylinder Loading a Semicircular Gap in a Ground Plane

H.A. Ragheb. "Electromagnetic Scattering from a Coaxial Dielectric Circular Cylinder Loading a Semicircular Gap in a Ground Plane." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1303-1309.

An exact dual series solution of a plane wave incident on a coaxial dielectric circular cylinder imbedded in a semicircular gap of a ground plane is presented. Both TM and TE cases are considered here. The scattered field is represented in terms of an infinite series of cylindrical waves with unknown coefficients. By applying the boundary conditions and employing the partial orthogonality of the trigonometric functions the scattering coefficients are obtained. The resulting infinite series is then truncated to a finite number of terms to produce numerical results. For the sake of comparison with the published data some special cases are introduced first. The comparisons showed excellent agreement in all cases.

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Abstracts

Simulation Diagnostics of Multiple Discontinuities in a Microwave Coaxial Transmission Line

T.Y. Otoshi. "Simulation Diagnostics of Multiple Discontinuities in a Microwave Coaxial Transmission Line." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1310-1314.

Multiple discontinuities in microwave transmission lines can cause unusual reflection and transmission loss characteristics as functions of frequency. This article presents a method for developing models that simulate return loss and insertion loss data measured over a broad band of frequencies. The overall cable is modeled as a coaxial transmission line consisting of shunt susceptance discontinuities separated by line lengths. A nonlinear least-squares fit is then performed between theoretical data (from the model) and experimental data. When this method was applied to modeling discontinuities in a slightly damaged S-band antenna cable, excellent agreement between theory and experiment was obtained over a frequency range of 1.70-2.85 GHz.

Abstracts

Reconstruction of the Constitutive Parameters for an Omega Material in a Rectangular Waveguide

M. Norgren and S. He. "Reconstruction of the Constitutive Parameters for an Omega Material in a Rectangular Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1315-1321.

The inverse problem of determining the constitutive parameters of an Omega material is considered. The dispersive bianisotropic Omega sample is placed in a rectangular waveguide. All the constitutive parameters except one are reconstructed using the reflection and transmission data for some TE/sub m0/ and TE/sub 0n/ modes. The remaining one can be obtained, e.g., from reflection of normally incident plane waves. Numerical results for the reconstruction are presented.

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Abstracts

Efficient Full-Wave Analysis of Stratified Planar Structures and Unbiased TW-FET's

M. Farina, G. Gerini and T. Rozzi. "Efficient Full-Wave Analysis of Stratified Planar Structures and Unbiased TW-FET's." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1322-1329.

We have developed a rigorous full-wave analysis technique capable of characterizing quasiplanar traveling wave structures, constituted of multilayer dielectrics and conductors of finite thickness, also taking into account dielectric and conductor losses. We have studied boxed embedded microstrips and another complex passive structure, namely the T-gate TW-FET, devoting particular attention to the distribution of current inside the metallization. All structures considered were simulated by means of a desktop computer. We have tested our program by comparing our results with experimental data of embedded microstrips and employed it for the characterization of planar and T-type gates of the FET's without bias.

Abstracts

Transient Analysis of Lossy Parabolic Transmission Lines with Nonlinear Loads

P. Bouchard and R.R.J. Gagne. "Transient Analysis of Lossy Parabolic Transmission Lines with Nonlinear Loads." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1330-1334.

The exact analytical expressions of the time-domain step response matrix parameters for the lossy parabolic transmission line are developed, therefore extending the range of problems where Allen's method can be applied for the transient analysis of networks consisting of interconnections of linear distributed elements, lumped linear and/or nonlinear elements, and arbitrary sources. For completeness, similar expressions are derived for the lossless parabolic line. In order to demonstrate the versatility of the techniques presented in this paper, we study the transient response of a lossy parabolic line subjected to the following sets of boundary conditions: 1) a unit step input and a linear load, and 2) a trapezoidal pulse generator and a nonlinear load.

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Abstracts

Transverse Electromagnetic Fields in a Detuned X-Band Accelerating Structure

S.A. Kheifets, S.A. Heifets and B. Woo. "Transverse Electromagnetic Fields in a Detuned X-Band Accelerating Structure." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1335-1341.

Results are presented of a study of the dipole electromagnetic fields in a detuned accelerating section which are excited by a pointlike bunch. The field-matching technique is used for the field calculations. The transverse coupling impedance, the kick factors, and the point wake function are found.

Abstracts

Theory of the Symmetrical Super-Condensed Node for the TLM Method

V. Trenkic, C. Christopoulos and T.M. Benson. "Theory of the Symmetrical Super-Condensed Node for the TLM Method." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1342-1348.

This paper describes a novel time-domain node for the TLM method. It has the unique feature of modeling arbitrary inhomogeneous media on a generally graded rectangular TLM mesh without using stubs. Variations in material properties and arbitrary aspect ratios of mesh cells are modeled by allowing different characteristic impedances in a cell, maintaining impulse synchronism throughout the mesh. The complete theory of the new node is given and its implementation on a general TLM mesh is discussed. Numerical results for a canonical resonator loaded with dielectric layers are presented for different grading cases. Substantial savings in computer storage and run-time as well as improved accuracy compared to the uniform mesh are achieved when an appropriate nonuniform grading of the TLM mesh is used.

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Abstracts

A Neural Network Modeling Approach to Circuit Optimization and Statistical Design

A.H. Zaabab, Q.-J. Zhang and M. Nakhla. "A Neural Network Modeling Approach to Circuit Optimization and Statistical Design." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1349-1358.

The trend of using accurate models such as physics-based FET models, coupled with the demand for yield optimization results in a computationally challenging task. This paper presents a new approach to microwave circuit optimization and statistical design featuring neural network models at either device or circuit levels. At the device level, the neural network represents a physics-oriented FET model yet without the need to solve device physics equations repeatedly during optimization. At the circuit level, the neural network speeds up optimization by replacing repeated circuit simulations. This method is faster than direct optimization of original device and circuit models. Compared to existing polynomial or table look-up models used in analysis and optimization, the proposed approach has the capability to handle high-dimensional and highly nonlinear problems.

Abstracts

Integral Equation Formulation for Inhomogeneous Anisotropic Media Green's Dyad with Application to Microstrip Transmission Line Propagation and Leakage

G.W. Hanson. "Integral Equation Formulation for Inhomogeneous Anisotropic Media Green's Dyad with Application to Microstrip Transmission Line Propagation and Leakage." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1359-1363.

A straightforward numerical technique based on the equivalence principle is presented to determine the complete spectral Green's dyad for inhomogeneous anisotropic media. This method is relevant to guided-wave problems where propagation characteristics are desired in the axial transform domain. Spectral Green's components are determined from a one-dimensional polarization-type integral equation. This method is very simple and versatile, and can be used to model continuously varying or stratified dielectric media with permittivity dyads of the most general form. As an application, a microstrip transmission line residing on a generally orientated uniaxial and biaxial substrate is considered, and new results for higher-order mode leakage are presented.

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Abstracts

Radiation Modes of Open Microstrip with Applications

T. Rozzi and G. Cerri. "Radiation Modes of Open Microstrip with Applications." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1364-1370.

The well known bound modes of open microstrip do not constitute a complete spectrum, for, continuous radiation and localized (reactive) modes are excited at discontinuities in microstrip circuits and antennas. This part of the spectrum has not been investigated before so that, up to date, radiation problems in microstrip are being investigated by nonmodal methods, such as the moment method. We derive here for the first time the complete spectrum of open microstrip, including one or more bound modes and a continuum, and demonstrate its straightforward application to a practical problem such as the excitation by a cylindrical probe of finite radius. Application of Lorentz's reciprocity principle is now possible in complete analogy to the problem of excitation of a close waveguide by a probe. Mode patterns, the equivalent circuit of a via-hole and its radiation pattern are characterized as a practical application of the foregoing theory.

Abstracts

A Novel Synthesis Technique for Conducting Scatterers Using TLM Time Reversal

M. Forest and W.J.R. Hoefer. "A Novel Synthesis Technique for Conducting Scatterers Using TLM Time Reversal." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1371-1378.

This paper presents a novel numerical synthesis technique based on the reversal of the TLM process in time. It allows the designer to generate the geometry of a passive structure from its desired frequency response using alternate forward and backward time domain simulations. The essential steps of the procedure are explained and validated using, as an example, the synthesis of an inductive obstacle in a waveguide. If fully developed, it promises to become an advantageous alternative to the traditional techniques using frequency domain numerical methods.

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Abstracts

Measurement of High Pulsed Microwave Power in Free Space (Short Papers)

M. Dagys, Z. Kancleris, V. Orsevskij, R. Simniskis, M. Backstrom, U. Thibblin and B. Wahlgren. "Measurement of High Pulsed Microwave Power in Free Space (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1379-1380.

Resistive power heads connected to horn antennas are used to measure high pulsed microwave power density in free space. With such a unit, pulsed power densities up to 3 MW/m² have been measured in the S- and X-bands.

Abstracts

Microwave Absorption by Conductor-Loaded Dielectrics (Short Papers)

P.S. Neelakanta and J.C. Park. "Microwave Absorption by Conductor-Loaded Dielectrics (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1381-1383.

A theoretical model to predict the microwave absorption by a conductor-loaded dielectric is developed. The microwave power transmission coefficient of the test material is derived in terms of the effective conductivity and permittivity parameters (of the composite material) as a function of volume fraction of the conductor loading. The absorption transmission characteristics of the test material versus volume fraction of metal loading are described by three distinct regimes having low-loss, lossy, and metal-like characteristics. Theoretical predictions are comparable with the measured data pertinent to an iron-plus-dielectric material.

Abstracts

Geometrical Effects in Gyrotron Coaxial Cavities: Application to Mode Selection (Short Papers)

J.J. Barroso, P.J. Castro and R.A. Correa. "Geometrical Effects in Gyrotron Coaxial Cavities: Application to Mode Selection (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1384-1386.

A study of the electrodynamical properties of gyrotron coaxial cavities using a conical inner rod has been conducted and compared with cold-test measurements on TE modes over the frequency range 11-14 GHz. On the basis of a geometrical design criterion for resonance of the normal modes, it has been demonstrated that the mode spectrum associated with a purpose-built test coaxial cavity is significantly less dense than that for the empty cavity without the coaxial insert.

Abstracts

Condition for Distortionless Transmission Line with a Nonuniform Characteristic Impedance (Short Papers)

J. Lundstedt. "Condition for Distortionless Transmission Line with a Nonuniform Characteristic Impedance (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1386-1389.

The well-known condition for distortionless signal propagation on a dissipative transmission line with constant impedance is generalized to the case of nonuniform impedance. The result is based on a time-domain wave-splitting formulation of the Telegraphist's equations. It is shown that an appropriate choice of the resistance and the conductance can eliminate the distortion caused by the varying characteristic impedance. A nonuniform transmission line that satisfies the given condition is distortionless in both directions, but reflectionless for signals propagating in one direction only.

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New Model of Coupled Transmission Lines (Short Papers)

A. Abramowicz. "New Model of Coupled Transmission Lines (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1389-1392.

The paper shows that an existing description of coupled transmission lines is inconsistent and proposes a new model based truly on the mutual coupling concept. In the existing formulation a series electric coupling and parallel magnetic coupling are combined. In the new formulation the parallel electric and magnetic couplings as well as series electric and magnetic couplings are used. Obtained model of coupled lines has physical background related to the odd and even type of propagation and agrees with the practical results.

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Fast Computation of Multiport Parameters of Multiconductor Coupled Microstrip Lines (Short Papers)

Z. Chen. "Fast Computation of Multiport Parameters of Multiconductor Coupled Microstrip Lines (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1393-1395.

A fast approximate analysis method is presented for computing multiport parameters of uniform and nonuniform multiconductor coupled ndcrostrip lines based on physical parameters considering dispersion and loss. A method for transient voltage analysis based on multiport S-parameters is also presented. The method is adequate for microwave and high-speed integrated circuit CAD software. Computed results for both S-parameters and transient voltages waveforms show good agreement with those by other methods or by measurement.

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Analysis of Superconducting Microstrip Lines and Resonators Using the Complex Resistive Boundary Conditions and the Variational Principle (Short Papers)

R.C. Qiu and I.-T. Lu. "Analysis of Superconducting Microstrip Lines and Resonators Using the Complex Resistive Boundary Conditions and the Variational Principle (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1396-1398.

A full wave characterization of high-temperature superconducting (HTS) microstrip lines and resonators is formulated based on the complex resistive boundary conditions (CRBC) of HTS. A variational approach is used to extend the applicable parameter range of the CRBC.

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Characterization of Off-Slot Discontinuity in Unilateral Fin Line (Short Papers)

A.K. Gupta and A. Biswas. "Characterization of Off-Slot Discontinuity in Unilateral Fin Line (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1398-1400.

A new type of fin line discontinuity, which consists of a rectangular conducting strip placed transversely on the back side of the air dielectric interface containing the slot, is characterized in this work. Modeling of the fin line cavity containing the discontinuity is carried out using hybrid mode analysis, and then the Transverse Resonance Technique is used to extract equivalent circuit parameters of the discontinuity. Suitable sets of basis functions are chosen for accurately representing the field in the slot and the current on the strip. Calculated results are compared with the measured results for a sample discontinuity to validate the choice of the basis functions.

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Abstracts

Analysis of Spherical Radar Cross-Section Enhancers (Short Papers)

J.R. Sanford. "Analysis of Spherical Radar Cross-Section Enhancers (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1400-1403.

A method for determining the plane wave scattering by a spherical radar cross section enhancer is described. In the two-step process, the desired field representation is expressed as a superposition of vector spherical wave functions. This allows the plane wave scattering from a spherically stratified object to be determined. Love's equivalence principle is then employed to account for the metallic portions of the spherical reflector. The analysis utilizes the expansions of a plane wave, an electric current element, and a magnetic current element in terms of spherical wave functions. Measured results show fairly good agreement with predicted results.

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Abstracts

Simultaneous Load-Pull of Intermodulation and Output Power Under Two-Tone Excitation for Accurate SSPA's Design (Correction)

F.M. Ghannouchi, GX. Zhau and F. Beauregard. "Simultaneous Load-Pull of Intermodulation and Output Power Under Two-Tone Excitation for Accurate SSPA's Design (Correction)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1404-1404.

In the above paper, printing errors occurred in Table I, which should have read as shown at the bottom of this page.

Abstracts

High Gain Monolithic W-Band Low-Noise Amplifiers Based on Pseudomorphic High Electron Mobility Transistors (Correction)

D.-W. Tu, S.W. Duncan, A. Eskandarian, B. Golja, B.C. Kane, S.P. Svensson, S. Weinreb and N.E. Byer. "High Gain Monolithic W-Band Low-Noise Amplifiers Based on Pseudomorphic High Electron Mobility Transistors (Correction)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1404-1404.

In the above paper, Fig. 3. was printed upside down.

Abstracts

A New Electric Field Integral Equation for Heterogeneous Dielectric Bodies of Revolution (Corrections)

M.S. Viola. "A New Electric Field Integral Equation for Heterogeneous Dielectric Bodies of Revolution (Corrections)." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1404-1404.

In the above paper, there are several typographical errors. Corrections to these misprints are delineated in that which follows.

Abstracts

Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Jun. 1995 [T-MTT])

"Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Jun. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1405-1405.

Abstracts

IEEE Home Page (Advertisement) (Jun. 1995 [T-MTT])

"IEEE Home Page (Advertisement) (Jun. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1406-1406.

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Frequently Asked Questions and Answers (Advertisement) (Jun. 1995 [T-MTT])

"Frequently Asked Questions and Answers (Advertisement) (Jun. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1407-1407.

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IEEE All-Society Periodicals Package (Advertisement) (Jun. 1995 [T-MTT])

"IEEE All-Society Periodicals Package (Advertisement) (Jun. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): 1408-1408.

Abstracts

Back Cover (Jun. 1995 [T-MTT])

"Back Cover (Jun. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.6 (Jun. 1995 [T-MTT]): b1-b2.

Abstracts

Front Cover (Jul. 1995, Part I [T-MTT])

"Front Cover (Jul. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): f1-f2.

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Rigorous Quasi-TEM Analysis of Multiconductor Transmission Lines in Bi-Isotropic Media -- Part I: Theoretical Analysis for General Inhomogeneous Media and Generalization to Bianisotropic Media

F. Olyslager, E. Laermans and D. De Zutter. "Rigorous Quasi-TEM Analysis of Multiconductor Transmission Lines in Bi-Isotropic Media -- Part I: Theoretical Analysis for General Inhomogeneous Media and Generalization to Bianisotropic Media." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1409-1415.

The quasi-TEM approximation for multiconductor lines embedded in inhomogeneous bi-isotropic media is developed. It is shown that in the quasi-TEM limit a multiconductor line in bi-isotropic media can be represented by a coupled set of nonreciprocal and nonsymmetric circuit transmission lines. The effect on the circuit parameters of absence of losses, reciprocity and symmetry properties of the geometry and of the equations is investigated. Finally, the generalization to full bianisotropic materials is studied.

Abstracts

Rigorous Quasi-TEM Analysis of Multiconductor Transmission Lines in Bi-Isotropic Media -- Part II: Numerical Solution for Layered Media

F. Olyslager, E. Laermans and D. De Zutter. "Rigorous Quasi-TEM Analysis of Multiconductor Transmission Lines in Bi-Isotropic Media -- Part II: Numerical Solution for Layered Media." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1416-1423.

An integral equation technique is used to determine the circuit parameters of the nonreciprocal and nonsymmetrical set of transmission lines that describe a multiconductor line in a layered bi-isotropic background in the quasi-TEM approximation. The integral equation is solved with the method of moments and pointmatching technique. The integrations arising in the problem are handled carefully to allow a fast and accurate implementation. The conductors have an arbitrary cross-section consisting of straight and circularly curved segments. At the edges of the conductors the singular behavior of the surface charge density and surface current density is explicitly taken into account.

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Abstracts

Wide-Locking Bandwidth Optically Injection-Locked Oscillators: S-Parameter Design and Modulation Effects

D. Sommer and N.J. Gomes. "Wide-Locking Bandwidth Optically Injection-Locked Oscillators: S-Parameter Design and Modulation Effects." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1424-1432.

An S-parameter design approach for optically injection-locked microwave oscillators is presented. The approach is verified through the design of a 2.1-GHz microstrip MESFET oscillator that is locked by the detected signal from an edge-coupled heterojunction phototransistor. Relative locking bandwidths (B/f/sub 0/) of over 10% have been measured. The effects of modulated locking signals on such wide locking bandwidth oscillators are also considered, and it is shown that they may be used as FM transmitters and as AM-to-PM converters.

Abstracts

A New Large-Signal AlGaAs/GaAs HBT Model Including Self-Heating Effects, with Corresponding Parameter-Extraction Procedure

K. Lu, P.A. Perry and T.J. Brazil. "A New Large-Signal AlGaAs/GaAs HBT Model Including Self-Heating Effects, with Corresponding Parameter-Extraction Procedure." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1433-1445.

Accurate modelling of the microwave large-signal characteristics of AlGaAs/GaAs Heterojunction Bipolar Transistors (HBT's) is extremely useful for microwave power applications of the device. This paper presents a new type of HBT large-signal model which is valid for dc, small-signal and large-signal ac modes of operation. The model may be used over a wide range of operating conditions and includes allowance for self-heating effects which are very important for HBT's. Through the use of several novel features, the proposed approach is differentiated from the traditional Ebers-Moll or Gummel-Poon BJT representations. The new model is accompanied by a very simple parameter extraction process requiring only a series of conventional dc and multi-bias point small-signal S-parameter measurements. Finally, the model is validated by independent power sweep measurements on HBT's from two different manufacturers.

Abstracts

Dielectric Resonator-Microstrip Interactive Circuit Analysis and Design Using Integral Equation Techniques

M. Yousefi and S.K. Chaudhuri. "Dielectric Resonator-Microstrip Interactive Circuit Analysis and Design Using Integral Equation Techniques." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1446-1452.

Dielectric resonators (DR's) are widely used in microwave/millimeter-wave technologies. In this paper, the coupling between a dielectric resonator and a microstrip circuit is studied. To analyze this problem, an integral equation is developed for the current distribution on the microstrip circuit. The Green's function used in this integral equation is the Green's function of the field in a layered medium modified by adding a term corresponding to the DR-scattered field. This field is produced by equivalent electric and magnetic sources assumed to be on the DR's surface. An efficient numerical method is applied which gives an approximation of the field near the resonant frequency of the DR. The results clearly show the effect of the DR on the microstrip circuit's current distribution and provides a thorough insight into the coupling mechanism. The coupling parameters can be estimated from the current distribution. The efficiency of the method as well as its flexibility in dealing with a general configuration of the DR and microstrip circuit makes it promising for CAD applications.

Abstracts

FET Model Taking Into Account Wave Characteristics of the Active Region and Input Circuits

V.I. Bosy, Y.G. Rapoport and V.V. Senchenko. "FET Model Taking Into Account Wave Characteristics of the Active Region and Input Circuits." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1453-1460.

The new wave model for the field effect transistor (FET) is suggested. Each element of FET layout, including input circuits, is associated with element of equivalent circuit. FET input region includes two parts: variable cross-section microstrip and coplanar lines and a T-junction. Detailed investigation of the influence of input circuits on FET characteristics has been performed. Approximation of transfer characteristics of input region by these of idealized T-junction results in substantial distortion of FET transfer coefficient |(S/sub N/)21|. Feedback region between gate input line and FET output is responsible for noticeable decrease in maximum available gain (MAG) value for gate width W < 60 μm and for appearance of gentle maximum in dependence MAG(W) for the W/2 values of about several dozens microns. It has been shown that dependencies of MAG on gate width and frequency change qualitatively when the gate resistance per unit length passes a certain value. This value is estimated. The loads at the ends of gate and drain electrodes can affect resonantly the value of MAG for submicrometer gate FET.

Abstracts

The Role of Baseband Noise and its Upconversion in HBT Oscillator Phase Noise

M.N. Tutt, D. Pavlidis, A. Khatibzadeh and B. Bayraktaroglu. "The Role of Baseband Noise and its Upconversion in HBT Oscillator Phase Noise." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1461-1471.

The phase noise spectral density (/spl Pound/(f/sub m)) of an 11.02-GHz heterojunction bipolar transistor (HBT) dielectric resonator oscillator (DRO) has been investigated in terms of the HBT's low frequency noise and the oscillator's upconversion coefficient. Experimental studies have been used for this purpose and the measured /spl Pound/(f/sub m/) ranged from -89 dBc/Hz to -101 dBc/Hz at a 10kHz offset frequency (best phase noise spectral density performance was -124 dBc/Hz at 100 kHz). It was shown that in most test cases, /spl Pound/(f/sub m/) can be described by the upconversion of the HBT's baseband noise. As a result the frequency dependence, of /spl Pound/(f/sub m/), is dictated by the low frequency noise spectrum rather than the upconversion itself. Deviation from pure 1/f frequency dependence found for the HBT's baseband noise at frequencies above 100 Hz resulted in d/spl Pound/(f/sub m/)/d(f/sub m/) deviating from about -30-dB/decade rate. Reduced oscillator phase noise at high collector current is attributed to reduced upconversion in the oscillator.

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Abstracts

On the Theory of Discrete TLM Green's Functions in Three-Dimensional TLM

M. Krumpholz, B. Bader and P. Russer. "On the Theory of Discrete TLM Green's Functions in Three-Dimensional TLM." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1472-1483.

The response to a wave pulse incident on the boundary of a certain spatial domain may be represented by discrete TLM Green's functions. On the other hand, the response to a localized electromagnetic excitation at the boundary of a certain spatial domain may be calculated directly from Maxwell's equations and be represented by analytic TLM Green's functions. For low frequencies and small wave numbers, the analytic TLM Green's functions coincide with the discrete TLM Green's functions. Applying the analytic TLM Green's functions in the absorbing boundary condition at the boundary to the open half-space reduces the computational effort considerably when compared with the application of the discrete TLM Green's functions.

Abstracts

Eigenvalue Matrix Analysis of Segmented Stripline Junction Disk Circulator

K.M. Gaukel and E.-B. El-Sharawy. "Eigenvalue Matrix Analysis of Segmented Stripline Junction Disk Circulator." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1484-1493.

An accurate and numerically efficient analysis technique for tightly coupled three-port stripline circulators is discussed. By using the three-way symmetry of the network, the port-only segmentation analysis is reduced to generating and solving three smaller "eigenvalue matrices." In addition, accuracy enhancement is shown by weighting the subport characteristic impedances and subport angles to more accurately reflect the current distribution of the ports.

Abstracts

A Novel Analytic Method for the Broadband Determination of Electromagnetic Impedances and Material Parameters

R. Pelster. "A Novel Analytic Method for the Broadband Determination of Electromagnetic Impedances and Material Parameters." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1494-1501.

A simple analytic technique is described that allows the determination of complex impedances from quasistatic frequencies (some Hz) up to 2 GHz with one setup and a single sweep. Samples are placed in a shielded capacitor-like measurement cell that is inserted into a transmission line. The transmission coefficient of the setup is measured for one signal direction, i.e., only two receiver channels are needed. A complete calibration is achieved with only two standards. Dielectric and, with restrictions in the frequency range, magnetic material parameters can be determined via these impedance measurements. Temperature-dependent calibration and measurement are possible and even low losses down to tan delta = 5 · 10/sup -4/ and small impedances Z >= 0.05 Omega can be determined. The applicability of the method is experimentally verified over a frequency range of nearly nine decades from 5 Hz to 2 GHz.

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Abstracts

Numerical Analysis of Printed Strip Dipole Hyperthermia Applicators

S.L. Dvorak and D.J. Aziz. "Numerical Analysis of Printed Strip Dipole Hyperthermia Applicators." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1502-1507.

The performance of a planar printed strip dipole hyperthermia applicator is simulated using a computer. The applicator is modeled using an exact integral equation formulation, and Galerkin's method is used to obtain the approximate current distribution on the dipole antenna. These currents are then used to compute the input impedance and heating pattern for the applicator. The computer model is used to investigate, and eliminate, the problem of "hot-spots" in the fat layer.

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Abstracts

A New Adaptive Double Envelope Feedback (ADEF) Linearizer for Solid State Power Amplifiers

J.-S. Cardinal and F.M. Ghannouchi. "A New Adaptive Double Envelope Feedback (ADEF) Linearizer for Solid State Power Amplifiers." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1508-1515.

A new adaptive double envelope feedback (ADEF) linearize using a voltage-controlled phase-shifter for predistortion purpose and a dynamic gate bias for gain stabilization purpose has been developed and implemented on a two-watt MESFET amplifier. A two-tone test around 1.6 GHz shows average in-band intermodulation product below -40 dBc up to saturation with a power-added efficiency of 40% at the 1-dB compression point. Validation of the adaptive features of the ADEF technique is carried out with respect to carrier frequency, temperature, two-tone amplitude offset and spacing. In addition, a new formula, which directly relates the third order intermodulation level to the AM/AM and AM/PM distortion coefficients of solid state nonlinear amplifiers is proposed and its accuracy is assessed using both simulation and experimental results.

Abstracts

Novel Techniques for Millimeter-Wave Packages

M.I. Herman, K.A. Lee, E.A. Kolawa, L.E. Lowry and A.N. Tulintseff. "Novel Techniques for Millimeter-Wave Packages." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1516-1523.

A new millimeter-wave package architecture with supporting electrical, mechanical and material science experiment and analysis is presented. This package is well suited for discrete devices, monolithic microwave integrated circuits (MMIC's) and multichip module (MCM) applications. It has low-loss wide-band RF transitions which are necessary to overcome manufacturing tolerances leading to lower per unit cost. Potential applications of this new packaging architecture which go beyond the standard requirements of device protection include integration of antennas, compatibility to photonic networks and direct transitions to waveguide systems. Techniques for electromagnetic analysis, thermal control and hermetic sealing were explored. Three dimensional electromagnetic analysis was performed using a finite-difference time-domain (FDTD) algorithm and experimentally verified for millimeter-wave package input and output transitions. New multi-material system concepts (AIN, Cu, and diamond thin films) which allow excellent surface finishes to be achieved with enhanced thermal management have been investigated. A new approach utilizing block copolymer coatings was employed to hermetically seal packages which met MIL STD-883.

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Abstracts

Accurate Study of Q-Factor of Resonator by a Finite-Difference Time-Domain Method

C. Wang, B.-Q. Gao and C.-P. Deng. "Accurate Study of Q-Factor of Resonator by a Finite-Difference Time-Domain Method." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1524-1529.

This paper describes the application of the finite-difference time-domain method to find the resonators' Q-factors. There are some techniques which can be used to reach it. One way is to directly compute the power loss using the surface impedance boundary condition (SIBC). The other is to incorporate the perturbation techniques to calculate the Q-value. The rectangular and cylindrical cavities have been studied by these method. A number of super conductor-sapphire microwave resonators with extra high Q-values have been studied. The results are very good in accuracy.

Abstracts

Combined Differential and Common-Mode Scattering Parameters: Theory and Simulation

D.E. Bockelman and W.R. Eisenstadt. "Combined Differential and Common-Mode Scattering Parameters: Theory and Simulation." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1530-1539.

A theory for combined differential and common-mode normalized power waves is developed in terms of even and odd mode impedances and propagation constants for a microwave coupled line system. These are related to even and odd-mode terminal currents and voltages. Generalized s-parameters of a two-port are developed for waves propagating in several coupled modes. The two-port s-parameters form a 4-by-4 matrix containing deferential-mode, common-mode, and cross-mode s-parameters. A special case of the theory allows the use of uncoupled transmission lines to measure the coupled-mode waves. Simulations verify the concept of these mixed-mode s-parameters, and demonstrate conversion from mode to mode for asymmetric microwave structures.

Abstracts

New Explicit Expressions for the Coupling Matrix Elements Related to Scattering from a Planar Periodic Single-Strip Grating

D.N. Filipovic. "New Explicit Expressions for the Coupling Matrix Elements Related to Scattering from a Planar Periodic Single-Strip Grating." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1540-1544.

This paper presents an alternative approach for finding elements of the coupling matrix in the multimode equivalent network that describes plane-wave scattering from a planar periodic single-strip grating at a dielectric interface. After solving a Fredholm integral equation of the first kind whose kernel has a logarithmic singularity, the coupling matrix elements are obtained in an explicit analytical form, thus avoiding numerical integration. Numerical computations are carried out and the results are compared to some of the existing ones.

Abstracts

Closed-Form Green's Functions for General Sources and Stratified Media

G. Dural and M.I. Aksun. "Closed-Form Green's Functions for General Sources and Stratified Media." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1545-1552.

The closed-form Green's functions of the vector and scalar potentials in the spatial domain are presented for the sources of horizontal electric, magnetic, and vertical electric, magnetic dipoles embedded in general, multilayer, planar media. First, the spectral domain Green's functions in an arbitrary layer are derived analytically from the Green's functions in the source layer by using a recursive algorithm. Then, the spatial domain Green's functions are obtained by adding the contributions of the direct terms, surface waves, and complex images approximated by the Generalized Pencil of Functions Method (GPOF). In the derivations, the main emphasis is to put these closed-form representations in a suitable form for the solution of the mixed potential integral equation (MPIE) by the method of moments in a general three-dimensional geometry. The contributions of this paper are: 1) providing the complete set of closed-form Green's functions in spectral and spatial domains for general stratified media; 2) using the GPOF method, which is more robust and less noise sensitive, in the derivation of the closed-form spatial domain Green's functions; and 3) casting the closed-form Green's functions in a form to provide efficient applications of the method of moments.

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Abstracts

Quasi-TEM Surface Impedance Approaches for the Analysis of MIC and MMIC Transmission Lines, Including Both Conductor and Substrate Losses

J. Aguilera, R. Marques and M. Horno. "Quasi-TEM Surface Impedance Approaches for the Analysis of MIC and MMIC Transmission Lines, Including Both Conductor and Substrate Losses." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1553-1558.

The surface impedance approach is applied to the quasi-TEM spectral domain analysis of MIC and MMIC lines with lossy metallizations in both the weak skin effect and the strong skin effect regimes. The use of the spectral domain technique makes it possible the analysis of lines with multilayer isoianisotropic substrates, including semiconductor and/or magnetic Iayers. PC computer codes have been developed following the proposed technique. Computation times within a few seconds are achieved.

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Input Impedance of a Probe-Excited Semi-Infinite Rectangular Waveguide with Arbitrary Multilayered Loads: Part I--Dyadic Green's Functions

L.-W. Li, P.-S. Kooi, M.-S. Leong, T.-S. Yeo and S.-L. Ho. "Input Impedance of a Probe-Excited Semi-Infinite Rectangular Waveguide with Arbitrary Multilayered Loads: Part I--Dyadic Green's Functions." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1559-1566.

Part I of this paper presents both the electric and the magnetic types of dyadic Green's functions defined for electromagnetic fields due to electric and magnetic current sources in a semi-infinite rectangular waveguide filled with arbitrary multi-layered media. Applying the principle of scattering superposition, the dyadic Green's functions in each of the multiple loads are constructed in general for such EM current sources located in an arbitrary layer of the waveguide. Analytical expressions of the scattering dyadic Green's functions' coefficients are obtained in terms of transmission matrices. To demonstrate how the method presented is used and how the results are obtained for some special cases, a semi-infinite rectangular waveguide with one load is considered. The dyadic Green's functions and their coefficients in such a case are derived in closed form by reducing the general formulae of the dyadic Green's functions for the arbitrary multiple case to those for the special case concerned. Further comparison of the dyadic Green's functions obtained here with previous publications shows good agreement, demonstrating the applicability of the results presented here. Part II of this paper will present a full-wave numerical analysis of a probe with both electric and magnetic current distributions.

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Abstracts

A Deterministic Approach for Designing Conditionally Stable Amplifiers

M.L. Edwards, S. Cheng and J.H. Sinsky. "A Deterministic Approach for Designing Conditionally Stable Amplifiers." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1567-1575.

Microwave devices with the Rollet parameter (k) less than one can always be made stable by resistive loading, In cases where noise figure or output power is at a premium, the performance of an amplifier can often be enhanced by using a design where k is less than unity thereby avoiding resistive loading. While a simultaneous conjugate match is impossible for such conditionally stable designs, single-sided matching can be achieved. Low-noise and power designs are examples where single-sided matching considerations naturally occur. With single-sided matching and 0 < k < 1, a design method is presented that results in device impedances on both the matched and unmatched sides that are always inside the Unit Smith Chart. This condition is referred to as jointly (input/output) stable. Gains resulting from jointly stable terminating impedances are shown to be bounded, the upper bound being given by 2 ·k· maximum stable gain. The design on an output-matched, conditionally stable amplifier is illustrated.

Abstracts

FDTD Analysis of the Radiometric Temperature Measurement of a Bilayered Biological Tissue Using a Body-Contacting Waveguide Probe

L.-K. Wu and W.K. Nieh. "FDTD Analysis of the Radiometric Temperature Measurement of a Bilayered Biological Tissue Using a Body-Contacting Waveguide Probe." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1576-1583.

Radiometric signal received by an open-ended rectangular waveguide probe in direct contact with a bilayered biological tissue is analyzed by the FDTD method. Two-layer tissue model consists of an outer thin skin layer over a semi-infinite fat layer is analyzed for a X-band total power radiometer. A spherical tumor with same permittivity as, but slightly higher temperature than, the surrounding normal fat tissue is assumed to exist inside the fat tissue. Active probe characteristics are analyzed first using the FDTD method for a propagating, sinusoidally time-varying, TE/sub 10/ type of excitation source. For the same waveguide probe operated as the radiometer antenna, radiometric weighting factors associated with individual tissue cells are then derived from the FDTD calculated field values. Near field radiating characteristics of the probe and radiometric signals determined for tumors of various size and depth are discussed. Presence of the skin is found to result in lower power transmission coefficient across the probe aperture and significantly lower absorbed powers by fat; both of these contribute to much lower radiometric signals observed.

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Abstracts

Simultaneous AM-AM/AM-PM Distortion Measurements of Microwave Transistors Using Active Load-Pull and Six-Port Techniques

F.M. Ghannouchi, G. Zhao and F. Beauregard. "Simultaneous AM-AM/AM-PM Distortion Measurements of Microwave Transistors Using Active Load-Pull and Six-Port Techniques." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1584-1588.

A programmable active load-pull measurement system using two six-port reflectometers and three passive two-port standards has been developed to obtain load-pull contours of the transistor's input-output phase shift variations over a wide dynamic range of the input power. The output power, gain, power-added efficiency, and phase shift are measured simultaneously at the transistor's input and output reference planes. The phase distortion versus input power, Phi ~ P/sub in/, and the AM-PM conversion coefficient at various power levels, k ~ P/sub in/, are obtained for different load impedances by post-measurement calculations. A NE8001 MESFET is tested at f = 1.7 GHz for the class A operation. The experimental results are also given.

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Abstracts

Coplanar Waveguide Bandpass Filter--A Ribbon-of-Brick-Wall Design

F.-L. Lin, C.-W. Chiu and R.-B. Wu. "Coplanar Waveguide Bandpass Filter--A Ribbon-of-Brick-Wall Design." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1589-1596.

This paper proposes a novel ribbon-of-brick-wall design of the coplanar waveguide bandpass filter which is built from cascading several sections of quarter wavelength open-end series stubs. The design originates from modeling the series stub as a system of two asymmetrically coupled transmission lines, which is then made equivalent to a basic filter element of admittance inverter. The relationship between the parameters of the coupled transmission lines and the admittance inverter is derived and the design charts are provided for the convenience of the designers. Systematic procedure is established to design the Chebyshev filter, which is also fabricated and measured. In addition, the quasistatic equivalent lumped circuit models of the discontinuities formed between two sections are evaluated and incorporated into the circuit simulation to get better prediction for the filter performance. The good agreement between simulation results and experimental data justifies the design procedure and validates the present analysis approach.

Abstracts

Source-Type Integral Equation Analysis of Circularly Curved Channel Waveguides in a Multilayered Background

H.J.M. Bastiaansen, H.E. Craye and H. Blok. "Source-Type Integral Equation Analysis of Circularly Curved Channel Waveguides in a Multilayered Background." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1597-1604.

The source-type integral equation method has proven to be a powerful modeling tool for straight ridge waveguides. This method is full-vectorial and mathematically rigorous. In a previous publication the source-type integral equation method has also been successfully applied to circularly curved channel waveguides in a homogeneous background. In the present paper this approach is extended to circularly curved channel waveguides embedded in a multilayered background. These are the type of waveguide structures that are usually encountered in integrated-optical and optoelectronic devices.

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Abstracts

Analysis of Complementary Unilateral Slot and Strip Resonators Printed on Anisotropic Substrates (Short Papers)

Y. Chen and B. Beker. "Analysis of Complementary Unilateral Slot and Strip Resonators Printed on Anisotropic Substrates (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1605-1607.

A systematic method, based on the two-dimensional spectral domain method, for analyzing complementary unilateral slot and strip resonators is presented. The resonators are printed on anisotropic substrates with tensor permittivity and permeability, including the off-diagonal terms and ferrite properties. Numerical data are presented to illustrate the response of resonators to changes in material properties of the substrate.

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Abstracts

Characterization of Cylindrical Microstriplines Mounted Inside a Ground Cylindrical Surface (Short Papers)

R.-B. Tsai and K.-L. Wong. "Characterization of Cylindrical Microstriplines Mounted Inside a Ground Cylindrical Surface (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1607-1610.

A full-wave analysis for the frequency-dependent characteristics of a cylindrical microstripline mounted inside a ground cylindrical surface is presented. Numerical results of the effective dielectric constant and characteristic impedance for various microstripline parameters are calculated and analyzed. Strong dispersive behavior is observed for such cylindrical microstriplines.

Abstracts

Attenuation of the Parasitic Modes in a Shielded Microstrip Line by Coating Resistive Films on the Substrate (Short Papers)

Y.-H. Chou and S.-J. Chung. "Attenuation of the Parasitic Modes in a Shielded Microstrip Line by Coating Resistive Films on the Substrate (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1610-1613.

In this paper, propagation characteristics of even-symmetric hybrid modes in a waveguide-shielded microstrip line with the presence of the resistive films affixed to the two sides of the center strip is investigated. The method of lines with modifications concerning the inhomogeneity of the surface between the air and substrate layers is used for analysis. After a validity check of the analysis by considering two special structures, i.e., a microstrip line (R/sub m/ = /spl infin/) and a coplanar waveguide (R/sub m/ = 0), the resistance R/sub m/ and the width W/sub m/ of the film are varied to see the influence on the propagation and attenuation constants of the dominant mode as well as the higher-order (parasitic) modes. Optimal combinations of the resistance and the width are found so that the resistive film has the largest attenuating effect on the higher-order modes but has no interference with the dominant one.

Abstracts

Toward Standard Figures-of-Merit for Spatial and Quasi-Optical Power-Combined Arrays (Short Papers)

M. Gouker. "Toward Standard Figures-of-Merit for Spatial and Quasi-Optical Power-Combined Arrays (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1614-1617.

A consistent set of figures-of-merit is proposed for the standard characterization of spatial and quasioptical power-combined arrays. A new figure-of-merit, the effective transmitter power, is presented along with slightly modified definitions of standard figures-of-merit. The definitions of these figures-of-merit have been chosen to more directly compare the performance of spatial and quasioptical power-combined arrays with one another and with conventional circuit power-combined transmitters and amplifiers.

Abstracts

General Formulas for the Method of Lines in Cylindrical Coordinates (Short Papers)

R. Pregla. "General Formulas for the Method of Lines in Cylindrical Coordinates (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1617-1620.

General formulas are given for the method of lines in cylindrical coordinates and angular discretization. They describe the transfer of the fields from one boundary of a cylindrical layer to another in a multilayered structure. With these formulas, programming can be accomplished without performing additional analysis.

Abstracts

Magnetic Frequency-Tunable Millimeter-Wave Filter Design Using Metallic Thin Films (Short Papers)

H. How, T.-M. Fang and C. Vittoria. "Magnetic Frequency-Tunable Millimeter-Wave Filter Design Using Metallic Thin Films (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1620-1623.

Frequency tunable millimeter wave filters are considered to be fabricated using metallic ferromagnetic thin films. Whereas conventional filters which include insulating ferrite materials utilize the phenomenon of ferromagnetic resonance (FMR), our design incorporates the phenomenon of ferromagnetic anti-resonance (FMAR). Our calculations indicate that in comparing the characteristics of the two types of filters the filter utilizing magnetic metal films is superior in terms of insertion loss and integrability with other planar millimeter wave devices. Design of band-pass filter can be realized in which the transmission frequency occurs at FMAR frequency with a frequency bandwidth equal to the FMAR linewidth.

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Abstracts

Quick Computation of [C], [L], [G], and [R] Matrices of Multiconductor and Multilayered Transmission Systems (Short Papers)

G. Plaza, F. Mesa and M. Horno. "Quick Computation of [C], [L], [G], and [R] Matrices of Multiconductor and Multilayered Transmission Systems (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1623-1626.

This paper presents a general scheme to compute the four characteristic matrices, [C], [G], [L] and [R], of a multilayered and multiconductor transmission tine with arbitrary cross section conductors under quasi-TEM approach and strong skin effect regime. The conductors are modeled as a set of infinitesimally thin strips following the M-strip model. An spectral domain approach (SDA) has been employed, paying special attention to the efficient computation of the spectral tails. Conductor losses are considered via the incremental inductance rule extended to the multiconductor case.

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Abstracts

A Numerical Method of Evaluating Electromagnetic Fields in a Generalized Anisotropic Medium (Short Papers)

H.-Y. Yang. "A Numerical Method of Evaluating Electromagnetic Fields in a Generalized Anisotropic Medium (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1626-1628.

A transition matrix method is commonly used to deal with the problems of either plane-wave scattering from or the Green's function of a generalized anisotropic medium. This method, although rigorous analytically, introduces numerical breakdown, when the layers are electrically thick and the waves are evanescent. A variable transformation method is developed to deal with the exponentially-growing terms associated with exponential-matrix method. The proposed scheme is suitable for the numerical analysis of generalized anisotropic layers including ferrites, magneto-plasmas, chiral layers, and bianistropic layers.

Abstracts

A Field Theoretical Derivation of TLM (Comments and Authors' Reply)

S. Hein, M. Krumpholtz and P. Russer. "A Field Theoretical Derivation of TLM (Comments and Authors' Reply)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1629-1629.

Contrary to what is claimed in the above cited paper, former mathematical derivations of the TLM method directly from Maxwell's equations (meeting all requirements of rigor, but less complicated than the paper) have been given and can be found, e.g., in [1] and [2].

Abstracts

Coaxial Probe Modeling in Waveguides and Cavities (Comments)

L.W. Li, S.L. Ho, M.S. Leong, P.S. Kooi and T.S. Yeo. "Coaxial Probe Modeling in Waveguides and Cavities (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1629-1630.

In the above paper, Liang et al. presented an excellent analysis of a coaxial probe in waveguides and cavities. The compact dyadic Green's function technique was applied there to calculate the electric field. However, there are some typographical errors of the dyadic Green's function components in that paper which will mislead further investigations. These errors found during the procedure of reproducing their results are listed below as corrections.

Abstracts

Call for Papers - Revolutionary Developments in Phased Arrays (Jul. 1995, Part I [T-MTT])

"Call for Papers - Revolutionary Developments in Phased Arrays (Jul. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1631-1631.

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Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Jul. 1995, Part I [T-MTT])

"Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Jul. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): 1632-1632.

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Back Cover (Jul. 1995, Part I [T-MTT])

"Back Cover (Jul. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part I [T-MTT]): b1-b2.

Abstracts

Front Cover (Jul. 1995, Part II [T-MTT])

"Front Cover (Jul. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): f1-f2.

Abstracts

Introduction to Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications

F. Ali and J.B. Horton. "Introduction to Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1633-1638.

Welcome to the exciting new world of commercial and consumer applications of RF, microwave, and millimeter-wave circuits and systems. The re-birth of "wireless" communication has given a new meaning and a pupose for the traditionally defense-oriented microwave and millimeter-wave technologies. This explosive growth of emerging applications is taking place primarily in the following areas (see Fig. 1).

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Abstracts

Commercial Applications of Millimeterwaves History, Present Status, and Future Trends

H.H. Meinel. "Commercial Applications of Millimeterwaves History, Present Status, and Future Trends." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1639-1653.

The possibility to apply millimeterwaves for various applications in the commercial arena has a long history, as the advantages being offered by such systems have been known for more than three decades. Within the last five years the necessity of turning their attention away from the military sector towards commercial products has caused more and more companies to look at millimeterwave communications and automotive radar. By chance, this was accompanied by the advent of low-cost integration procedures, i.e., hybrid- and monolithic-integration techniques, respectively. Thus, the necessary technology is mature and available now, opening a wide field of deployment areas. Millimeterwave systems have found an ever increasing interest, due to their specific advantages, as well as the lack of frequencies for new services. While the military market is decreasing, commercial applications in the area of microwave tags, radio communication, and traffic control are increasing rapidly. The two most important application areas right now are 38 GHz short-haul transmission links for PCN installations, an already valuable niche market, and 77 GHz automotive radar sensors-simple collision warning devices and intelligent cruise control sensors as well-which have the largest market potential for the very near future.

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Abstracts

A Monolithic Integrated Millimeter Wave Transmitter for Automotive Applications

A. Stiller, E.M. Biebl, J.-F. Luy, K.M. Strohm and J. Buechler. "A Monolithic Integrated Millimeter Wave Transmitter for Automotive Applications." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1654-1658.

An integrated transmitter at 80 GHz is presented. This device finds many applications in civil sensor and communication systems, and is employed in automotive applications. The device consists of an IMPATT diode and a slotted patch resonator. The resonator acts simultaneously as an antenna. The resonator impedance seen by the IMPATT diode is calculated by means of a full wave analysis and the matching of the IMPATT diode is investigated using a large signal analysis. The transmitter devices have been fabricated employing a SIMMWIC (silicon millimeter wave integrated circuit) fabrication process and deliver a radiated power of up to 1 mW at 79 GHz. An excellent carrier-to-noise ratio of 81.7 dBc/Hz at an offset of 100 kHz has been achieved. The deviation of the measured values from the theoretically predicted values of frequency and power is -5.9% and -1.5 dB, respectively.

Abstracts

Forward-Looking Automotive Radar Using a W-Band Single-Chip Transceiver

K.W. Chang, H. Wang, G. Shreve, J.G. Harrison, M. Core, A. Paxton, M. Yu, C.H. Chen and G.S. Dow. "Forward-Looking Automotive Radar Using a W-Band Single-Chip Transceiver." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1659-1668.

A prototype W-band all-weather automotive radar based on a single-chip 0.1-µm AlGaAs/InGaAs/GaAs HEMT transceiver has been developed. This radar has the features of simple architecture and small size, with adequate performance. Owing to the maturity of HEMT MMIC technology, this radar is potentially low cost to implement in personal vehicles. The prototype radar used for autonomous intelligent cruise control in a passenger car is presented in this paper. The MMIC development, together with the radar system design, is also addressed.

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A Uniplanar 90-GHz Schottky-Diode Millimeter-Wave Receiver

G.P. Gauthier, W.Y. Ali-Ahmad, T.P. Budka, D.F. Filipovic and G.M. Rebeiz. "A Uniplanar 90-GHz Schottky-Diode Millimeter-Wave Receiver." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1669-1672.

A 90-GHz Schottky-diode receiver based on a double-slot antenna fed by a coplanar-waveguide (CPW) transmission line is presented. The double-slot antenna is placed on an extended hemispherical high-resistivity silicon substrate lens, The uniplanar receiver results in a 9.3 ± 0.3 dB measured SSB conversion loss at 88-90 GHz including antenna and IF circuit losses and a 1-dB loss due to the use of a nonoptimal matching cap layer at the silicon lens-air interface. The calculated conversion loss agrees very well with the RF measurements. The uniplanar double-slot antenna receiver is very small, less than 1.1 x 4 mm including the RF/IF filter, and is compatible with monolithic two-and three-terminal devices on GaAs substrates. The application areas are in millimeter-wave receivers for automotive systems, communication systems, and radiometric linear imaging arrays.

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A Microwave Noncontact Identification Transponder Using Subharmonic Interrogation

C.W. Pobanz and T. Itoh. "A Microwave Noncontact Identification Transponder Using Subharmonic Interrogation." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1673-1679.

This paper presents the design and analysis of a novel microwave radio (RF/ID) transponder that has been developed for remote identification of personnel and articles, such as in "wireless key" entry systems. Based on a subharmonically pumped quasi-optical mixer, the transponder is activated by a C-band interrogation beam to upconvert and radiate a digitally modulated identification tone at two X-band frequencies. These response signals are nonharmonically related to the interrogation signal. The frequency conversion process is analyzed using a Volterra series model that includes the effects of self-bias current, coupled with a scattering metric that is directly useful in radio link calculations.

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What's Behind DBS Services: MMIC Technology and MPEG Digital Video Compression

P.M. Bacon and E. Filtzer. "What's Behind DBS Services: MMIC Technology and MPEG Digital Video Compression." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1680-1685.

This paper discusses recent developments in Direct-Broadcast Satellite (DBS) television systems, and specifically how these developments are implemented using today's MMIC technology. A brief review of Raytheon's experience in supplying low cost GaAs devices to the commercial DBS market place included. A description of a dual-channel downconverter is provided as an example of applying GaAs MMIC technology to the advanced technical needs of the DBS market. A discussion of the MPEG-2 digital compression standard and its relationship to DBS is also included.

Abstracts

New MMIC's for Tuners in Multichannel Video Distribution Systems Using Optical Fiber Networks

T. Nakagawa, T. Hirota, T. Ohira, M. Aikawa, K.-I. Suto and E. Yoneda. "New MMIC's for Tuners in Multichannel Video Distribution Systems Using Optical Fiber Networks." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1686-1691.

New MMIC's have been developed for an ultra-broadband FM video tuner in a multi-channel video distribution system using optical fiber networks. The MMIC's provide both frequency synthesis and up-conversion. They are integrated on two GaAs MMIC chips and one Si LSI chip. The chips are mounted in a flat package to form a tunable block-up converter. By combining the MMIC's with currently available consumer product type components, a low cost FM video tuner with a 2 GHz tuning bandwidth was achieved in hardware. Successful tuning performance is obtained over the whole tuning frequency range.

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Packet Communication Ultra-Small Aperture Terminal System for the Hokkaido Integrated Telecommunication Network

T. Hatsuda. "Packet Communication Ultra-Small Aperture Terminal System for the Hokkaido Integrated Telecommunication Network." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1692-1698.

Three aspects of a new minimum cost, high reliability system strategy for the Hokkaido Integrated Telecommunication (HIT) network, in which real time operation is not demanded, examined. These are: 1) a packet communication ultra-small aperture terminal (PC-USAT) system, which contains a method overcoming the satellite links rain attenuation discontinuities; an optimum rain margin technique and the 14/12-GHz band rain, snow attenuation, and site diversity (SD) experiments; and a low-bit-rate medical information and still-picture simultaneous transmission system.

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MMIC Transmitter for a Commercial Search and Rescue Radar Transponder

J.B. Vincent and D.G. van der Merwe. "MMIC Transmitter for a Commercial Search and Rescue Radar Transponder." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1699-1702.

This paper reports the design and use of MMIC's in the transmitter of a commercial Search and Rescue Transponder (SART). The SART is a maritime unit operating in the frequency band 9.2-9.5 GHz. The microwave unit is integrated on a single thick film hybrid, using an optimum combination of MMIC's and discrete components. This has resulted in a highly reliable, cost-effective product. There are two MMIC's, namely the VCO and the power amplifier. The VCO MMIC has a typical linearity of better than 5-MHz deviation over a 300-MHz sweep. The power amplifier MMIC has a minimum power output of 27-dBm over the band.

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High Yield X-Band GaAs Power MMIC Insertion Into the 160-W MODAR Wind Shear Detection/Weather System

R.G. Freitag, H.G. Henry, E.K. Lee, M. Pingor and H.L. Salvo, Jr.. "High Yield X-Band GaAs Power MMIC Insertion Into the 160-W MODAR Wind Shear Detection/Weather System." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1703-1709.

This paper describes the successful insertion of a high yield 4-W GaAs X-band power MMIC into the solid-state transmitter of the MODular Avionics Radar (MODAR) weather system. To date, over 15000 4-W MMIC's have been delivered with a combined dc/RF test yield averaging 39%. The design and fabrication of the MMIC's are presented along with statistical test data on over 46000 MMIC's. The integration of the MMIC's into a higher level 12-W hybrid assembly and an 85-W power module are also discussed. Two 85-W modules are combined in the transmitter to achieve a nominal power output of 160 W. Statistical test data on these higher level assemblies is presented. This work demonstrates the viability of inserting GaAs power MMIC's into commercial systems.

Abstracts

Low-Power X-Band Radar for Indoor Burglar Alarms

S. Battiboia, A. Caliumi, S. Catena, E. Marazzi and L. Masini. "Low-Power X-Band Radar for Indoor Burglar Alarms." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1710-1714.

Design and realization of a hybrid microwave integrated circuit (HMIC) for a low-power X-band Doppler effect radar system is presented. The radar operates within the range 9.9 ÷ 10.5 GHz. The system is able to detect the frequency shift between the transmitted and the target reflected signal, providing an IF signal output that can be used for different types of post-processing. The design of the different units composing the system is detailed. Application of this system to indoor intrusion alarms is also fully described.

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Modulation/Microwave Integrated Digital Wireless Developments

K. Feher and H. Mehdi. "Modulation/Microwave Integrated Digital Wireless Developments." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1715-1732.

Simultaneous study and joint optimization of digital modulation techniques and of microwave components, presented in this paper, lead to spectrally efficient, high capacity, fast transmission, and throughput rate wireless systems. The choice of a particular modulation/demodulation (modem) technique has a major impact on the overall microwave system design, transceiver architecture and on the choice of all intermediate frequency (IF) as well as radio frequency (RF) component specifications. The performances of the most frequently used digital modulation techniques, including pi/4-DQPSK, conventional BPSK, DQPSK, GMSK, GFSK, 4FSK, and FQPSK systems are compared. Study of crosscorrelated quadrature modulated GMSK systems used in GSM, PCS-1900, and other standards indicate that the subject technologies applied to GMSK improve the performance of these systems. We demonstrate that with the patented family of digitally modulated Feher's FQPSK systems, the power efficiency of conventional QPSK systems, which require linear microwave amplifiers, can be increased by about 300%, and the spectral efficiency of standardized nonlinearly amplified microwave integrated circuit GMSK systems can be increased by 60-200 %. Similar advantages are obtained with our new FBPSK over BPSK modulated systems.

Abstracts

A 1.9-GHz GaAs Chip Set for the Personal Handyphone System

F. McGrath, K. Jackson, E. Heaney, A. Douglas, W. Fahey, R.G. Pratt and T. Begnoche. "A 1.9-GHz GaAs Chip Set for the Personal Handyphone System." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1733-1744.

The Japanese Personal Handyphone System (PHS) is representative of the latest generation of digital portable communications systems currently being deployed. Enabling technologies for these systems include high performance Radio Frequency Integrated Circuit (RFIC) chip sets. These chip sets allow all the RF transceiver functions to be included in low cost surface mount plastic packages. With the addition of filters and bypassing capacitors, the RF portion of the phone shares the same printed circuit board (PCB) as the DSP, CODEC, and Logic IC's. The availability of such highly integrated 1.9-GHz RFIC's requires the solution of many complex design, manufacturing, and test problems. This paper explains the critical issues relating to the air interface of the PHS system and how it affects the RFIC design. The chip partition, design, and performance of each subfunction is discussed relative to the requirements imposed by the air interface. The result is a highly integrated, cost effective solution that occupies the minimum board area.

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An L-Band Ultra-Low-Power-Consumption Monolithic Low-Noise Amplifier

M. Nakatsugawa, Y. Yamaguchi and M. Muraguchi. "An L-Band Ultra-Low-Power-Consumption Monolithic Low-Noise Amplifier." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1745-1750.

A low-power-consumption variable-gain low-noise amplifier (LNA) is demonstrated. To achieve low noise, low distortion, and low power consumption simultaneously, a cascode connection between an enhancement-mode GaAs MESFET (EFET) and a depletion-mode GaAs MESFET (DFET) is employed. The EFET is superior to the DEFT in its gain and noise figure performance while the DFET offers good intermodulation distortion performance. The advantages of both types of FET's are combined in the developed LNA. It shows excellent performance with an NF of 2.0 dB, a gain of 12.2 dB, and an IP/sub 3/ of 5.1 dBm at 1.9 GHz. The demonstrated performance satisfies the specifications of the Japanese Personal Handy phone System even at the ultra-low power consumption of 2.0 mW.

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Miniature Microwave Filters for Communication Systems

I.C. Hunter, S.R. Chandler, D. Young and A. Kennerley. "Miniature Microwave Filters for Communication Systems." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1751-1757.

This paper will present new developments in miniature integrated microwave filters suitable for application in mobile communication handsets, wireless LAN's and microwave fixed links. Recent measured results for active microwave filters will be presented with emphasis on their nonlinear behavior. The use of high permittivity ceramic substrates in parallel plate TEM mode stripline filters is described and recent measured results will be presented for a prototype 2-GHz filter occupying a volume of 0.5-cubic centimeters. E-Plane filters for millimeter wave applications will be discussed and measured results will be presented for a novel E-Plane filter with asymmetric frequency response which was realized in a planar structure. Finally, a new type of ceramic loaded E-Plane filter will be proposed.

Abstracts

Wide Band Microstrip Phased Array for Mobile Satellite Communications

R. Telikepalli, P.C. Strickland, K.R. McKay and J.S. Wight. "Wide Band Microstrip Phased Array for Mobile Satellite Communications." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1758-1763.

A low profile, dual frequency, microstrip phased array has been designed and developed for INMARSAT (International Maritime Satellite organization) land mobile satellite communications. The purpose of the array was to provide a wide band coverage, right-hand circular polarization with a high gain and minimum sidelobe levels in the principal planes. The developed array has a measured frequency bandwidth of 10% with a VSWR of 1.5, a minimum gain of 12 dBic, a gain to noise temperature ratio of -8.98 dB/K, sidelobe levels 13 dB below the beam peak in both the principal planes. The size of the array was 47 cm in diameter and 1.3 cm thick including a flush mounted light weight radome with the elements and the feed lines on the same layer.

Abstracts

Call for Papers - Revolutionary Developments in Phased Arrays (Jul. 1995, Part. II [T-MTT])

"Call for Papers - Revolutionary Developments in Phased Arrays (Jul. 1995, Part. II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.7 (Jul. 1995, Part II [T-MTT] (Special Issue on Emerging Commercial and Consumer Circuits, Systems, and Their Applications)): 1764-1764.

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"Front Cover (Aug. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): f1-f2.

Abstracts

Variational Propagation Constant Expressions for Lossy Inhomogeneous Anisotropic Waveguides

Y. Liu and K.J. Webb. "Variational Propagation Constant Expressions for Lossy Inhomogeneous Anisotropic Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1765-1772.

Based on reciprocal relationships for the adjoint operator, we derive a variational formulation for the propagation constant satisfying the divergence-free condition in lossy inhomogeneous anisotropic waveguides whose media tensors have all nine components. In addition, with some advantages over previous representations, two variational formulations have been derived for waveguides with the transverse part of the media tensors decoupled from the longitudinal part. However, to obtain a variational formulation for a general lossy reciprocal problem the waveguide must be bidirectional. Each of the variational expressions results in a standard generalized eigenvalue equation with the propagation constant appearing explicitly as the desired eigenvalue. The stationarity of the formulations is shown. It is also shown that for a general lossy nonreciprocal problem the variational functional exists only if the original and adjoint waveguide are mutually bi-directional.

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Inverse Scattering Method for One-Dimensional Inhomogeneous Lossy Medium by Using a Microwave Networking Technique

T.J. Cui and C.H. Liang. "Inverse Scattering Method for One-Dimensional Inhomogeneous Lossy Medium by Using a Microwave Networking Technique." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1773-1781.

The formulation of reflection coefficients from an inhomogeneous lossy medium illuminated by TE and TM waves is approximately derived, in closed form, by using a microwave network method. From the formulation, a novel inverse scattering scheme to reconstruct simultaneously the permittivity and conductivity profiles, is proposed. This scheme is suitable for both continuous and discontinuous profiles, under both the weak scattering and strong scattering conditions. It has also been shown that when the conductivity of the medium equals zero, the reconstructed result of this scheme will reduce to the one in [14]. Numerical and closed-form reconstruction examples show the validity of the scheme.

Abstracts

Ridge Waveguide Polarizer with Finite and Stepped-Thickness Septum

J. Bornemann and V.A. Labay. "Ridge Waveguide Polarizer with Finite and Stepped-Thickness Septum." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1782-1787.

This contribution presents new design dimensions for the ridge waveguide septum polarizer. Emphasis is placed first, on including the finite septum thickness in the analysis; second, demonstrating its influence on the polarizer performance; third, including a stepped approach for extremely thick septa; fourth, optimizing components without the need for additional phase-adjusting structures; and fifth, providing the application engineer with some design guidelines. Examples for varying septum thickness and/or number of sections are given for C-, X-, R120-, Ku- and K-band applications. The analysis is based on an efficient mode-matching technique. Evolution-strategy methods are used for optimization. Both algorithms are translated into PC-operational software. Results are compared with previously published theoretical/experimental polarizer data and with a finite-element analysis, and are found to be in good agreement.

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Abstracts

Radiation Loss of Y-Junctions in Rib Waveguide

L. Cascio, T. Rozzi and L. Zappelli. "Radiation Loss of Y-Junctions in Rib Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1788-1797.

In this paper we analyze the effects of radiation in Y-junctions in rib waveguide by combining the effective dielectric constant method and the concept of local modes of a five-layer slab guide. The evaluation of the fields of the junction is performed together with the analysis of the radiation effects at the end of the transition; various kinds of junctions are examined and discussed, in both LSE and LSM polarizations.

Abstracts

Experimental 6-GHz Frozen Wave Generator with Fiber-Optic Feed

J.B. Thaxter and R.E. Bell. "Experimental 6-GHz Frozen Wave Generator with Fiber-Optic Feed." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1798-1804.

Experimental results from an optically activated 6 GHz frozen wave generator (FWG) test device are presented. The several system components needed to produce a low-cost monolithic pulsed power source suitable for large phased arrays are demonstrated. Static electric energy stored in 50 ohm microstrip transmission lines is released by fast GaAs photoconductive (PC) switches activated by 50 picosecond laser pulses distributed over fiber-optics. The present device is of hybrid construction, using commercial fiber-optic pigtailed integrated optic couplers and semi-insulating (SI) GaAs metal-semiconductor-metal (MSM) photoconductive switch chips bonded into microstrip. However, exclusive of the laser, the design lends itself to monolithic microwave and integrated optic techniques especially at high frequencies. Experimental test results compare well with circuit simulation predictions, showing that hybrid techniques introduce negligible parasitic at the design frequency. Lower resistance PC switches are needed to fully demonstrate the high power performance capabilities of this type of device.

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Abstracts

Modeling of Active Antenna Array Coupling Effects--A Load Variation Method

S. Sancheti and V.F. Fusco. "Modeling of Active Antenna Array Coupling Effects--A Load Variation Method." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1805-1808.

This paper presents a simple method for the calculation of the frequency and power variation of an active antenna operated in the presence of a reflecting surface. The situation modeled accounts for interdependent amplitude and phase dynamics and also allows for the extraction of active antenna array coupling coefficients. Analytical and experimental results are presented for both frequency and power variations of an individual element when operated in a strongly coupled imaged array environment. Here the nearest neighbor coupling is shown to be the dominant coupling mechanism.

Abstracts

New Multilayer Planar Transmission Lines for Microwave and Millimeter-Wave Integrated Circuits

P.-C. Hsu and C. Nguyen. "New Multilayer Planar Transmission Lines for Microwave and Millimeter-Wave Integrated Circuits." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1809-1813.

New types of planar transmission lines employing multilayer structures are proposed for possible applications in microwave and millimeter-wave integrated circuits. Detailed investigations are presented through numerical results calculated using the spectral domain technique. The newly proposed transmission lines have many attractive features such as a large impedance range, flexibility and ability to realize complicated, densely packed integrated circuits, as well as miniaturization through the use of thin dielectric layers. Additionally, they possess all of the inherent advantages of the CPW and microstrip line. Their use in microwave circuits is exemplified through a low-pass filter realized using the new slot-coplanar lines with less than 0.5-dB insertion loss and better than 20-dB return loss. The filter's measured and calculated performances also agree well.

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Abstracts

Chirosolitons: Unique Spatial Solitons in Chiral Media

K. Hayata and M. Koshiba. "Chirosolitons: Unique Spatial Solitons in Chiral Media." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1814-1818.

We show analytically that unique spatial solitons (chirosolitons) can propagate in chiral media that exhibit Kerr-type nonlinearities. In contrast to the solitons in achiral media, unique features of the chirosolitons can be seen in their elliptically polarized nature, the bisoliton state, and the possibility of superluminous phase propagation. Conditions for supporting the bright- and dark-type chirosolitons are discussed.

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Abstracts

Active Antenna Array Behavior

D.E.J. Humphrey, V.F. Fusco and S. Drew. "Active Antenna Array Behavior." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1819-1825.

It has been recently demonstrated that arrays of coupled active antenna oscillating elements can be locked together by mutual radiation in order to form spatial power combining and beam steered arrays. In this paper a nonlinear coupled oscillator theory is developed which accounts for both the amplitude and phase behavior of an array of distributed coupled active antenna oscillators. In its canonical form the theory can be used to describe the behavior of any number of spatially displaced coupled elements placed in a chain. These elements can have unequal spacing and they can have arbitrary free-running oscillation frequencies. Unequal free-running amplitudes are also permitted. Experimental validation of the theory is presented for some basic cases in terms of frequency and amplitude variation under mutual injection locked conditions. In its particular form the theory developed is suited for use with recently reported active antenna imaging methods.

Abstracts

High-Frequency Reciprocity-Based Circuit Model for the Incidence of Electromagnetic Waves on General Waveguide Structures

D. De Zutter and F. Olyslager. "High-Frequency Reciprocity-Based Circuit Model for the Incidence of Electromagnetic Waves on General Waveguide Structures." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1826-1833.

In the present contribution we construct a high-frequency circuit model for the excitation of eigenmodes in general waveguides due to externally impinging electromagnetic waves. The circuit model, consisting of distributed sources in a transmission line model, is based on Lorentz's reciprocity theorem. The classical quasi-TEM solution of this problem is found as a special case from the full-wave model. The theory is illustrated with numerical examples of electric dipoles radiating above thick coupled lossy microstrip lines.

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Abstracts

Analysis of Compact E-Plane Diplexers in Rectangular Waveguide

A. Morini and T. Rozzi. "Analysis of Compact E-Plane Diplexers in Rectangular Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1834-1839.

Photolithographic techniques permit the realization of complex circuits totally confined to the E-plane of millimetric rectangular guides with high precision and low cost. This work contains a detailed analysis of an E-plane diplexer configuration recently introduced. Its main feature is the matching section of the three port junction, a simple abrupt E-plane one tuned by means of an inductive post realized on the same mask as the branching filters. On the basis of this analysis, we also demonstrate the application of a recently developed diplexer synthesis technique. Many prototypes, in K/sub a/-band were designed and tested, showing good performances and good agreement between theory and experiment.

Abstracts

Design of a Multicoupled Loop-Gap Resonator Used for Pulsed Electron Paramagnetic Resonance Measurements

Y. Sakamoto, H. Hirata and M. Ono. "Design of a Multicoupled Loop-Gap Resonator Used for Pulsed Electron Paramagnetic Resonance Measurements." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1840-1847.

The purpose of the present paper is to estabtish a method of design for a multicoupled loop-gap resonator used for pulsed electron paramagnetic resonance measurements. For the design of resonator characteristics, the method has an advantage of a systematic approach without iterative calculations. In this design, the number of loop-gap resonators used is first determined from the pass band required as the specifications of the resonator. To satisfy the specifications, electrical parameters of an equivalent circuit and the dimensions of the resonator are estimated. By the proposed method, a prototype resonator which has the operation frequency of 1.3 GHz is designed and fabricated. For the proto-type resonator, the characteristics of the return loss agree with the required ones. As a result, the validity of the design method is experimentally confirmed.

Abstracts

A New Boundary Integral Approach to the Determination of the Resonant Modes of Arbitrarily Shaped Cavities

P. Arcioni, M. Bressan and L. Perregrini. "A New Boundary Integral Approach to the Determination of the Resonant Modes of Arbitrarily Shaped Cavities." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1848-1856.

We present an efficient algorithm to determine the resonant frequencies and the normalized modal fields of arbitrarily shaped cavity resonators filled with a lossless, isotropic, and homogeneous medium. The algorithm is based on the boundary integral method (BIM). The unknown current flowing on the cavity wall is considered inside a spherical resonator, rather than in free-space, as it is usual in the standard BIM. The electric field is expressed using the Green's function of the spherical resonator, approximated by a real rational function of the frequency. Consequently, the discretized problem can be cast into the form of a real matrix linear eigenvalue problem, whose eigenvalues and eigenvectors yield the resonant frequencies and the associated modal currents. Since the algorithm does not require any frequency-by-frequency recalculation of the system matrices, computing time is much shorter than in the standard BIM, especially when many resonances must be found.

Abstracts

Gaussian Beam Optical Systems with High Gain or High Loss Media

A.A. Tovar and L.W. Casperson. "Gaussian Beam Optical Systems with High Gain or High Loss Media." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1857-1862.

Coherent electromagnetic wave amplifiers with non-negligible gain per wavelength are included in the Gaussian beam matrix formalism and a procedure is developed for propagating Gaussian beams in optical systems that may include unsaturated amplifiers and similar absorbers. Standard formulas for beam spotsize and radius of curvature in a uniform medium are generalized in a new way to include gain or loss. An asymmetric focal shift and a potentially infinite spotsize are predicted. These dramatic effects are interpreted physically.

Abstracts

Extraction Techniques for FET Switch Modeling

A. Ehoud, L.P. Dunleavy, S.C. Lazar and R.E. Branson. "Extraction Techniques for FET Switch Modeling." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1863-1868.

A new simple method for extracting equivalent circuit parameters for series and shunt GaAs FET switches is presented. The circuit elements are extracted from one set of S-parameter measurements for each switch state, and scale linearly with gate width. Extracted Equivalent Circuit Parameters (ECP's) are insensitive to frequency across the measured bandwidth. Good agreement has been obtained between simulated and model results for a 0.5 µm gate length series and shunt GaAs FET switches of varying gate widths, across the 0.45-26.5 GHz band.

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Control of Mode-Switching in an Active Antenna Using MESFET

M. Minegishi, J. Lin, T. Itoh and S. Kawasaki. "Control of Mode-Switching in an Active Antenna Using MESFET." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1869-1874.

New techniques of realizing mode-switching in an active antenna by using MESFET are presented. Two types of control circuits are discussed. One is the control circuit using the reactance variation of MESFET and the other is the control circuit using the resistance variation of MESFET. The design of these two control circuits is discussed and the beam-switching phenomena of the antenna using these control circuits are compared. Important characteristics such as antenna patterns, operating frequencies and the insertion loss of the control circuits are also compared and discussed.

Abstracts

Simplified Mode-Matching Techniques for the Analysis of Coaxial-Cavity-Coupled Radial E-Plane Power Dividers

M.E. Bialkowski, J. Bornemann, V.P. Waris and P.W. Davis. "Simplified Mode-Matching Techniques for the Analysis of Coaxial-Cavity-Coupled Radial E-Plane Power Dividers." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1875-1880.

Two simplified mode-matching techniques for the numerical analysis of nonsymmetric waveguide E-plane radial N-ports are presented. The first model, which utilizes cartesian and cylindrical coordinate systems for interfacing rectangular waveguides to a coaxial cavity, shows excellent agreement between measurements and computer-intensive finite-element calculations. The second technique, which is based on rectangular coordinates only and thereby neglects the curvature of the coaxial cavity, achieves agreement only for transmission coefficients if the inner radius of the coaxial cavity is sufficiently large. The software for both models are operational on personal computers and require only seconds for a complete analysis. Examples are presented for a Ku-band E-plane six-port and a W-band E-plane ratrace ring. Some additional investigations on the ratrace configuration demonstrate the applicability of the models with respect to reliable component design.

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Abstracts

Accurate Quasi-TEM Spectral Domain Analysis of Single and Multiple Coupled Microstrip Lines of Arbitrary Metallization Thickness

J.-T. Kuo. "Accurate Quasi-TEM Spectral Domain Analysis of Single and Multiple Coupled Microstrip Lines of Arbitrary Metallization Thickness." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1881-1888.

The quasi-TEM spectral domain approach (SDA) is extended to rigorously and efficiently analyze single and multiple coupled microstrip lines of arbitrary metallization thickness. The charge distributions on both the horizontal and vertical conductor surfaces are modeled by global basis functions. This results in a relatively small matrix for accurate determination of the line parameters of coupled thick microstrips. A convergence study is performed for the results of a pair of coupled lines with crucial structural parameters to explore the conditions for obtaining reliable solutions using the technique. Results for thick microstrips are validated through comparison with those from available measurements and another theoretical technique. The soundness of the technique is further demonstrated by looking into the trend of the results obtained by a simplified model in which the structural parameters are pushed, step by step, to the numerical extremities. Variations of circuit parameters of a four-line coupled microstrip structure due to the change of finite metallization thickness are presented and discussed.

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An X-Band Acousto-Optic Variable Delay Line for Radar Target Simulation

M.C. Zari, C.S. Anderson and W.D. Caraway, III. "An X-Band Acousto-Optic Variable Delay Line for Radar Target Simulation." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1889-1894.

The design and characterization of a 54-µs, continuously-variable, acousto-optic (AO) delay line developed for radar testing applications is presented. Design goals for the delay line include over 10 MHz of instantaneous bandwidth, 1.2 GHz of tunable bandwidth operating at X-band, 45 dB of dynamic range, and electronically-controllable delay selection to simulate dynamic radar targets with radial range rates up to 500 m/s. In addition, the device was designed to have phase noise and spurious signal levels compatible with high performance radars. To achieve these goals, a 33-MHz center frequency variable delay line was constructed and coherent frequency translation was used to provide operation at X-band. Operating principles for this new intermediate frequency (IF) delay line are presented, and key component issues are discussed. A computer design and analysis tool is described that predicts delay line performance. Experimental results are presented at both the IF and at X-band.

Abstracts

Full-Wave Analysis and Design of a New Double-Sided Branch-Line Coupler and its Complementary Structure

C.-Y. Lee and T. Itoh. "Full-Wave Analysis and Design of a New Double-Sided Branch-Line Coupler and its Complementary Structure." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1895-1901.

A new double-sided branch-line coupler using microstrip lines as input/output lines and slotlines as branches is analyzed and designed. The even-odd mode theory is first used to analyze the ideally simplified circuit model and to find out the preliminary circuit dimensions. Based on these dimensions, the full-wave spectral domain approach (SDA) is employed to accurately simulate the circuit performance. By the formulation of the exact Green's function in the spectral domain, the effects of surface wave and radiation phenomena are accurately accounted for. Experimental data agree very well with the SDA simulation results. It is found that the even-odd mode theory which neglects discontinuities between lines is not enough to design a coupler. The SDA code can then be used to accurately simulate and optimize the circuit performance. The complementary structure with slotlines as input/output lines and microstrip lines as branches is also investigated both theoretically and experimentally. It is noticed that the radiation and leakage from the two double-ended branches for all structures will deteriorate the circuit performance.

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On the Dispersion Errors Related to (FD)²TD Type Schemes

J.L. Young, A. Kittichartphayak, Y.M. Kwok and D. Sullivan. "On the Dispersion Errors Related to (FD)²TD Type Schemes." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1902-1910.

The dispersion errors associated with various frequency-dependent FDTD methods are considered herein. Particularly, we provide a rigorous error analysis of both direct integration and recursive type schemes for two media models: The one-pole Debye and the two-pole Lorentz. The error equations are cast in terms of a dispersion relation that shows explicitly the errors associated with numerically induced dispersion and dissipation. From the dispersion relation, plots are provided that typify the errors of each method. In general, all methods have about the same propagation characteristics; the differences, however, are seen in the attenuation plots. To validate the claims herein, data obtained from FDTD scattering simulations (both 1-D and 3-D geometries) are also given.

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Implementing Transmission Zeros in Inductive-Window Bandpass Filters

M. Guglielmi, F. Montauti, L. Pellegrini and P. Arcioni. "Implementing Transmission Zeros in Inductive-Window Bandpass Filters." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1911-1915.

Transmission zeros are usually implemented in microwave filters as extracted poles, or with cross couplings between nonadjacent cavities. Recent work, however, indicates that, for inductive band-pass filters, higher order-mode excitation can be usefully exploited for the purpose of creating transmission zeros. In this paper we describe a new cavity configuration that can be used to introduce transmission zeros in the electrical performance of microwave filters based on thick inductive windows in rectangular waveguides using the higher order-mode interactions. One transmission zero per filter cavity can be introduced and its frequency location can be easily controlled adjusting suitable geometrical parameters. The basic principle is discussed in detail and a computer aided design procedure is also presented. Finally, several application examples are included indicating how the new cavity design can indeed be used to improve the performance of this class of filters.

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Abstracts

Compact 10-Gbit/s Optical Transmitter and Receiver Circuit Packs

Y. Kobayashi, Y. Akatsu, K. Nakagawa, H. Kikuchi and Y. Imai. "Compact 10-Gbit/s Optical Transmitter and Receiver Circuit Packs." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1916-1922.

Compact wideband 10-Gbit/s optical transmitter and receiver circuit packs are realized using high speed analog and digital GaAs IC's as well as a highly thermally conductive board and appropriately designed small function block modules that employ multichip packaging and resonant cavity mode damping. To achieve a compact receiver, the receiver circuit employs a clamp and peak-detector IC in the high speed analog equalizer amplifier to obtain a constant output direct current level for any mark density imbalance in the number of ones and zeros in the signal and a variable phase-shifter IC in the timing circuit. Realized circuit pack size is 200 x 280 x 15.24 mm and the power consumption of each pack is about 25W.

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Abstracts

Dispersion in Anisotropic Media Modeled by Three-Dimensional TLM

C. Huber, M. Krumpholz and P. Russer. "Dispersion in Anisotropic Media Modeled by Three-Dimensional TLM." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1923-1934.

The dispersion in anisotropic media modeled by three-dimensional TLM is investigated. Two nodes, the symmetrical condensed node with stubs and the symmetrical super-condensed node are considered. Simple closed-form expressions for the dispersion relations do not exist in general, therefore the investigations are restricted to wave propagation in isotropic media and to wave propagation along the mesh axes and the mesh diagonals. The dispersion analysis for the symmetrical super-condensed node yields a direct relationship between the relative permittivity and relative permeability and the parameters of the scattering matrix.

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A Field Theoretical Comparison of FDTD and TLM

M. Krumpholz, C. Huber and P. Russer. "A Field Theoretical Comparison of FDTD and TLM." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1935-1950.

A field theoretical derivation of the three-dimensional TLM method with expanded node and of the three-dimensional TLM method with asymmetrical condensed node is given. In the derivation, the Method of Moments is applied to Maxwell's equations. The wave amplitudes are related to the tangential field components at the boundaries of the TLM cell. The same approach is applied to derive the FDTD method from Maxwell's equations. A complete dispersion analysis is given for the two TLM methods as well as for the FDTD method.

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Device Considerations and Modeling for the Design of an InP-Based MODFET Millimeter-Wave Resistive Mixer with Superior Conversion Efficiency

E.W. Lin and W.H. Ku. "Device Considerations and Modeling for the Design of an InP-Based MODFET Millimeter-Wave Resistive Mixer with Superior Conversion Efficiency." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1951-1959.

We report on the device considerations for resistive FET mixer applications and discuss the design and fabrication of an optimized InP-based 0.1 µm gate length planar-doped pseudomorphic In/sub 0.42/Al/sub 0.58/As/In/sub 0.65/Ga/sub 0.35/As modulation-doped FET (MODFET) well-suited for resistive mixer applications. In addition, we present a general large-signal model suitable for describing the FET in its passive mode of operation to assist in the design and simulation of such mixers. Finally, we discuss the theoretical design of a novel W-band, image-reject resistive mixer based on a large-signal model of our optimized device. The predicted performance of the mixer under +8 dBm of LO drive indicates a minimum conversion loss of 9 dB at 94 GHz, a significant improvement of over 3 dB in comparison to similar GaAs-based mixers, suggesting the potential of InP-based resistive mixer technology to achieve superior conversion loss performance.

Abstracts

Hybrid Wave Propagation in Circularly Shielded Microslot Lines

I.O. Vardiambasis, J.L. Tsalamengas and J.G. Fikioris. "Hybrid Wave Propagation in Circularly Shielded Microslot Lines." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1960-1966.

Hybrid wave propagation in circularly shielded, single or coupled microslot lines is studied by combining singular integral equation (SIE) with Green's function techniques. Discretization of these SIE's by recently developed algorithms leads to linear algebraic systems whose matrix elements assume exponentially converging, numerically very stable analytical expressions. Dispersion characteristics, modal currents, and cut-off frequencies are presented for several cases. The algorithm converges rapidly requiring a few expansion functions per wave-length.

Abstracts

A Wiener-Hopf-Type Analysis of Microstrips Printed on Uniaxial Substrates: Effects of the Substrate Thickness

G.A. Kyriacou and J.N. Sahalos. "A Wiener-Hopf-Type Analysis of Microstrips Printed on Uniaxial Substrates: Effects of the Substrate Thickness." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1967-1977.

A Wiener-Hopf-type analysis of the canonical problem of a TEM wave obliquely incident at the edge of the truncated upper conductor of a parallel plate waveguide loaded with a uniaxial anisotropic dielectric is presented. A numerical integration scheme as well as a thin substrate approximation for the reflection coefficient is given. The influence of the dielectric anisotropy and the slab thickness on the reelection coefficient and the edge admittance are investigated. Numerical results show the importance of the dielectric anisotropy and the expected effects in microstrip applications.

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Abstracts

A New Scalar Transition Finite Element for Accurate Analysis of Waveguides with Field Singularities

J.M. Gil and J. Zapata. "A New Scalar Transition Finite Element for Accurate Analysis of Waveguides with Field Singularities." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1978-1982.

When the scalar Helmholtz equation is solved by Finite Element Method, a slow rate of convergence and inaccurate results can be found if waveguides containing field singularities are analyzed. By using singular elements around the singularity, an important improvement is attained, but when the size of the singular elements is too small, the correct modeling of the fields is lost. In this paper we introduce a new family of transition finite elements that represents a behavior of the axial field component of the form O (r/sup lambda/), with any 0 < lambda < 1, for singular points placed outside the element. By employing these transition elements adjacent to singular elements, the loss of the singular modeling of the fields is avoided.

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Unloaded Q Measurement--The Critical-Points Method (Short Papers)

E.-Y. Sun and S.-H. Chao. "Unloaded Q Measurement--The Critical-Points Method (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1983-1986.

The unloaded quality factor of resonators whether coupled magnetically or electrically, with loss or without loss, is estimated by the critical points (i.e., extreme-reactance/susceptance points) method. The critical-points method derived from this paper is a fast and accurate method for unloaded Q measurement and is suitable for general external coupting environment.

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Further Analysis of Open-Ended Dielectric Sensors (Short Papers)

M. Okoniewski, J. Anderson, E. Okoniewska, K. Caputa and S.S. Stuchly. "Further Analysis of Open-Ended Dielectric Sensors (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1986-1989.

The effect on the input reflection coefficient of the dimensions of open-ended coaxial lines is investigated. Using a standard FDTD technique, the effects of variations in the flange and conductor dimensions on the reflection coefficient of a 3.6 mm coaxial line immersed in water or methanol are simulated. Simulation results are compared with measurements and previous moment method calculations. It is found that the presence or absence of a flange affects the input reflection coefficient substantially in some cases. The results also show that inversion formulas developed for lines with infinite flanges are not valid for flanges with finite radii.

Abstracts

Analysis of Anisotropic High Temperature Superconductor Planar Structures on Sapphire Anisotropic Substrates (Short Papers)

M.A. Megahed and S.M. El-Ghazaly. "Analysis of Anisotropic High Temperature Superconductor Planar Structures on Sapphire Anisotropic Substrates (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1989-1992.

A full-wave finite-difference time-domain technique is used to study the anisotropy associated with high temperature superconductor (HTS) planar structures. The analysis is performed on anistropic YBCO film deposited on anisotropic sapphire substrate. The solution incorporates all the physical aspects of the HTS materials. The finite thickness of the anisotropic strip is rigorously modeled using a graded non uniform mesh generator. The propagation characteristics of HTS microstrip tine are evaluated. The current distributions inside the HTS are calculated for both the normal and the super fluids. It is shown that the 90° r-cut sapphire substrate structure has lower loss and lower effective dielectric constant than the 0° r-cut substrate. Interesting, aspects, concerning the anisotropy of HTS microwave structures, are presented.

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Quasi-TEM Analysis of V-Shaped Conductor-Backed Coplanar Waveguide

K.-K.M. Cheng and I.D. Robertson. "Quasi-TEM Analysis of V-Shaped Conductor-Backed Coplanar Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1992-1994.

In this paper, a new type of V-shaped conductor-backed coplanar waveguide (VGCPW) is proposed. The characteristic impedance of the new line is obtained analytically using conformal mapping method under the assumption of pure-TEM propagation and zero dispersion. Direct solutions for the quasistatic normal electric field components and cumulative electric flux distribution across conductor surfaces are also presented. The numerical results show how the total electric flux terminating on the conductor surfaces varies in terms of the CPW's geometry and substrate parameters.

Abstracts

Analysis of Wide Inclined Slot Coupled Narrow Wall Coupler Between Dissimilar Rectangular Waveguides (Comments)

S.R. Rengarajan. "Analysis of Wide Inclined Slot Coupled Narrow Wall Coupler Between Dissimilar Rectangular Waveguides (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1995-1996.

The reply to our recent comments on the above paper has not addressed the main issue raised in [2]. D. Satyanarayana and A. Chakrabarty apparently do not understand the significance of the incompleteness of the eigenfunction expansions for the dyadic Green's functions in the source region of waveguides, and the relationship between the source region singularity. and the 'TE/sub 00/ mode'. This conclusion is based on 1) their statement, "Also, it is no way connected with the singularity as pointed out in the comments", and 2) by the fact that they do not understand the discussions on the singularity term containing delta(z - z') in our original paper and still they seem to be not clear whether our Green's functions are complete. Therefore additional discussions, are warranted.

Abstracts

Call for Papers - Revolutionary Developments in Phased Arrays (Aug. 1995 [T-MTT])

"Call for Papers - Revolutionary Developments in Phased Arrays (Aug. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1997-1997.

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Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Aug. 1995 [T-MTT])

"Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Aug. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 1998-1998.

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Frequently Asked Questions and Answers (Advertisement) (Aug. 1995 [T-MTT])

"Frequently Asked Questions and Answers (Advertisement) (Aug. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.8 (Aug. 1995 [T-MTT]): 2000-2000.

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"Front Cover (Sep. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): f1-f2.

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TE Modes of an Axially Multiple-Grooved Rectangular Waveguide

K.P. Ericksen and A.M. Ferendeci. "TE Modes of an Axially Multiple-Grooved Rectangular Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2001-2006.

A method is developed to calculate the TE mode fields and cut-off frequencies of an axially multiple-grooved rectangular (AGR) waveguide. A low frequency AGR waveguide is used as a part of a microwave cavity and the cut-off frequencies are measured in order to verify the analytically derived results. Excellent agreement between the measured and calculated values provide the basis for the design of waveguides for millimeter wave applications. The method has also been extended to a waveguide with multiple grooves cut into two of its broad wall parallel surfaces.

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High Frequency Performance of Multilayer Capacitors

A.T. Murphy and F.J. Young. "High Frequency Performance of Multilayer Capacitors." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2007-2015.

The high frequency performance of capacitors is related to their geometry and material properties, By considering multilayer capacitors (MLC) as distributed electrical systems, computer-aided multi-conductor transmission line analyses is applied to study resonant frequencies, equivalent circuits of capacitors, and the influence of ground planes, test fixtures, and type of connection topology. The methods established are applied to well-documented capacitors described in the literature and good agreement between experimental results and analyses is obtained.

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Coplanar Waveguides and Microwave Inductors on Silicon Substrates

A.C. Reyes, S.M. El-Ghazaly, S.J. Dorn, M. Dydyk, D.K. Schroder and H. Patterson. "Coplanar Waveguides and Microwave Inductors on Silicon Substrates." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2016-2022.

Silicon has many advantages as a microwave substrate material including low cost and a mature technology. The aim of this paper is to evaluate the potential of using high-resistivity silicon as a low-cost low-loss microwave substrate through an experimental comparative study. Coplanar waveguides fabricated on Si, GaAs, and quartz substrates are tested and their characteristics are compared. Microwave spiral inductors and meander lines are also fabricated on various substrates, and their performance is also analyzed. The results demonstrate that the losses of a coplanar transmission line (CPW) realized on high-resistivity (3 k to 7 k Omega-cm) silicon substrates are comparable to the losses of a CPW realized on a GaAs substrate covered with insulators. Furthermore, measured unloaded Q's of microwave inductive structures on high-resistivity silicon substrates are comparable to the measured unloaded Q's of the same structures on GaAs and on quartz. This paper demonstrates that hlgh-resistivity Si can be used as a microwave substrate.

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Method of Moments Analysis of Anisotropic Artificial Media Composed of Dielectric Wire Objects

M.E. Peters and E.H. Newman. "Method of Moments Analysis of Anisotropic Artificial Media Composed of Dielectric Wire Objects." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2023-2027.

The paper considers the periodic method of moments (PMM) analysis of anisotropic artificial media composed of a 3D periodic array of identical scatterers. The method is based upon finding the complex wavenumber(s), and the eigenfunction currents and fields, for a plane wave propagating in the artificial medium. From these quantities, the effective tensor constitutive parameters are determined. It is shown that for a given direction of propagation through an artificial medium, there are two distinct modes of plane wave propagation, which may change with the direction of propagation. Examples are shown for the case where the periodic scatterers are thin dielectric wire structures.

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Contour Integral Method with Fringe Complex Images for the Rapid Solution of Patch Resonators of Arbitrary Shape

A.A. Omar, Y.L. Chow and M.G. Stubbs. "Contour Integral Method with Fringe Complex Images for the Rapid Solution of Patch Resonators of Arbitrary Shape." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2028-2034.

An accurate and computationally efficient method is presented for solving patch resonators of arbitrary shape. This method improves on Okoshi's 2-D contour integral (CI) method by including the fringe fields and radiation, through use of the 3D complex images. The presented method may be called contour integral with fringe (CIF). Experiments are conducted to verify the accuracy of the CIF method and show very good agreement with the theoretical predictions.

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Direct Extraction of Equivalent Circuit Parameters for Heterojunction Bipolar Transistors

C.-J. Wei and J.C.M. Hwang. "Direct Extraction of Equivalent Circuit Parameters for Heterojunction Bipolar Transistors." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2035-2040.

A new method is presented for the direct extraction of hybrid-T equivalent circuits for heterojunction bipolar transistors. The method differs from previous ones by extracting the equivalent circuit without using test structures or numerical optimization techniques. Instead, all equivalent circuit parameters are calculated analytically from small-signal S-parameters measured under different bias conditions. The analysis includes the distributed nature of the HBT base. The calculated parameters are essentially frequency-independent and they exhibit systematic bias dependence over the typical operating range of the transistor. Thus, the present method ensures unique and physically meaningful parameters for transistor design improvement and large-signal circuit simulation. In addition, the present method is much faster than the numerical optimization method.

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Scattering at the Junction of a Rectangular Waveguide and a Larger Circular Waveguide

R.H. MacPhie and K.-L. Wu. "Scattering at the Junction of a Rectangular Waveguide and a Larger Circular Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2041-2045.

A full wave, formally exact solution is obtained for the problem of scattering at the junction of a rectangular waveguide and a larger circular waveguide. The general case of an arbitrary offset of the wavegnide axes is considered. E-field mode matching over the rectangular aperture of the smaller guide is facilitated by a transformation of the circular cylindrical Bessel-Fourier modal fields of the circular guide into a finite series of exponential plane wave functions in rectangular coordinates. This permits an analytical finite series solution for each of the elements of the E-field mode matching matrix [M] from which the scattering matrix [S] of the junction is easily obtained. Numerical evaluation of the S-parameters for the dominant TE/sub 10/ (rectangular) and TE/sub 11/ (circular) modes in the cases of junctions with no offset and with offset is presented. Moreover, the practical case of a circular cavity resonator with smaller input and output rectangular guides is considered and excellent agreement is found between the calculated and measured S-parameters.

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A Fullwave CAD Tool for Waveguide Components Using a High Speed Direct Optimizer

F. Alessandri, M. Diomgi and R. Sorrentino. "A Fullwave CAD Tool for Waveguide Components Using a High Speed Direct Optimizer." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2046-2052.

An extremely efficient optimization tool, where the fullwave mode matching simulator is driven by a quasi-Newton optimizer using the adjoint network method, has been developed for the CAD of a class of rectangular waveguide components. This includes filters, phase shifters, branch guide couplers, etc., with step in either the E- or H-plane. With respect to the conventional finite difference computation of the derivatives, a speedup factor of more than 10 times is easily achieved.

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A High Accuracy FDTD Algorithm to Solve Microwave Propagation and Scattering Problems on a Coarse Grid

J.B. Cole. "A High Accuracy FDTD Algorithm to Solve Microwave Propagation and Scattering Problems on a Coarse Grid." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2053-2058.

If the spatial variation of electric permittivity and magnetic permeability is "small" Maxwell's equations can be approximated by the scalar wave equation in each field component. We introduce a new high-accuracy second order finite-difference time-domain (FDTD) algorithm to solve the scalar wave equation on a coarse grid with a solution error less than 10/sup--4/ that of the conventional one. The computational load at each grid point is greater, but it is more than offset by a large reduction in the number of grid points needed, as well as by a reduction in the number of iterations. Also boundaries can be more accurately characterized at the subgrid level. Although optimum performance is achieved at a fixed frequency, the accuracy is still much higher than that of a conventional FDTD algorithm over "moderate" bandwidths.

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Inverted Stripline Antennas Integrated with Passive and Active Solid-State Devices

J.A. Navarro and K. Chang. "Inverted Stripline Antennas Integrated with Passive and Active Solid-State Devices." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2059-2065.

Integrated antennas can reduce the size, weight, and cost of many microwave systems by incorporating component functions directly at the antenna terminals. Their use in many commercial system applications can produce compact, low-cost products. Currently, active integrated antennas are used for distributed oscillators in spatial and quasi-optical power combining. The inverted stripline antenna configuration was developed to easily integrate with solid-state diodes or transistor devices for switching, tuning, modulation, amplification, and oscillating functions. This antenna configuration offers good performance, beam sharpening flexibility, and nondestructive optimization. Good switching, tuning, and oscillating performances have been demonstrated.

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Mode Conversion and Leaky-Wave Excitation at Open-End Coupled-Microstrip Discontinuities (Sep. 1995, Part I [T-MTT])

J.L. Cina and L. Carin. "Mode Conversion and Leaky-Wave Excitation at Open-End Coupled-Microstrip Discontinuities (Sep. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2066-2072.

The method of moments (MoM) is used to study mode conversion and leaky-wave excitation at an asymmetric coupled-microstrip discontinuity. The results show that significant mode conversion can occur at such discontinuities and that dominant leaky-wave modes can be excited strongly. Numerical issues with regard to the MoM analysis of such discontinuities are addressed as well, and for some examples it is shown that inclusion of a complete-domain basis function for the leaky mode improves numerical stability dramatically.

Abstracts

Development of Self-Packaged High Frequency Circuits Using Micromachining Techniques

R.F. Drayton and L.P.B. Katehi. "Development of Self-Packaged High Frequency Circuits Using Micromachining Techniques." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2073-2080.

A new concept for packaging high frequency monolithic circuits is presented. It consists of developing miniaturized housings to shield individual passive components (e.g., CPW based), active elements, or combinations of them by employing silicon micromachining technology. At high frequencies, self-packaged configurations that are fabricated in this manner provide reduction in the overall size and weight of a circuit and provide increased isolation between neighboring circuits. Therefore, the resulting characteristics make these micropackaged components appropriate for high density, multilevel interconnect circuits. This paper will describe the fabrication procedures used to develop self-packaged components. Performance curves for typical high frequency circuit geometries that are implemented in this configuration are shown for measured and theoretical results.

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Abstracts

Generalized TLM Algorithms with Controlled Stability Margin and Their Equivalence with Finite-Difference Formulations for Modified Grids

M. Celuch-Marcysiak and W.K. Gwarek. "Generalized TLM Algorithms with Controlled Stability Margin and Their Equivalence with Finite-Difference Formulations for Modified Grids." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2081-2089.

Generalized TLM formulations based on modified grids of 2-D shunt nodes or 3-D expanded nodes are proposed. Generalization consists of permitting flexible control of the numerical stability margin (and thus a time-step for a particular discretization), and of introducing enhanced models for curved boundaries. Formal equivalence between generalized TLM and FDTD algorithms based on the same grids is proved. Simple rules for transforming circuit models (from TLM to FDTD and vice versa) and for their equivalent excitation are given. It is demonstrated that the application of the generalized algorithm reduces computer resources required for the TLM analysis of a circular waveguide by an order of magnitude.

Abstracts

Examination, Clarification, and Simplification of Modal Decoupling Method for Multiconductor Transmission Lines

G.-T. Lei, G.-W. Pan and B.K. Gilbert. "Examination, Clarification, and Simplification of Modal Decoupling Method for Multiconductor Transmission Lines." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2090-2100.

In the application of the modal decoupling method, questions arise as to why the nonnormal matrices LC and CL are diagonalizable. Is the definition of the characteristic impedance matrix Z/sub c/ unique? Is it possible to normalize current and voltage eigenvectors simultaneously, yet assure the correct construction of the Z/sub c/ matrix? Under what conditions do M/sup t over i M/sub v/ = I and Z/sub c/ = M/sub v/M/sub i//sup -1/? In this paper, these questions are thoroughly addressed. We will prove the diagonalizability of matrices LC and CL for lossless transmission lines (though the diagonalizability of their complex analogues, ZY and YZ matrices, is not guaranteed for lossy lines), and will demonstrate the properties of their eigenvalues. We have developed an algorithm to decouple one type of matrix differential equation, and to construct the characteristic impedance matrix Z/sub c/ explicitly and efficiently. Based on this work, the congruence and similarity transformations, which have caused considerable confusion and not a few errors in the decoupling and solution of the matrix telegrapher's equations, will be analyzed and summarized. In addition, we will also demonstrate that under certain conditions, the diagonalization of two or more matrices by means of the congruence or similarity transformations may lead to coordinate system "mismatch" and introduce erroneous results.

Abstracts

Dispersion Analysis of the Linear Vane-Type Waveguide Using the Generalized Scattering Matrix

W.S. Best, R.J. Riegert and L.C. Goodrich. "Dispersion Analysis of the Linear Vane-Type Waveguide Using the Generalized Scattering Matrix." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2101-2108.

The dispersion characteristics for the linear vane-type waveguide are determined using the generalized scattering matrix (GSM) formed with the mode matching algorithm. This dispersion analysis technique includes determining the eigenvalues (cutoff frequencies) for the various waveguide modes that can propagate on the circuit, as well as forming a determinantal equation for a single period of the circuit from which the system normal mode dispersion characteristics are determined. The resulting GSM is easily manipulated for determining eigenvalues for single or multiple periods of a periodic circuit using either a perfect electrical conductor (PEC) or a Re-entrant boundary condition. This boundary condition formulation using the GSM provides a generalized eigenvalue technique for 2-D and 3-D structures. Similarly, the GSM is easily manipulated to yield a new analytic expression for a determinantal equation to predict the dispersion of the system normal modes for the periodic circuit. The accuracy of the GSM eigenvalue and dispersion solution techniques are limited by the frequency resolution of the simulation and the relative convergence (RC) criterion.

Abstracts

Mode-Matching Analysis of TE/sub 011/-Mode Waveguide Bandpass Filters

A. Melloni, M. Politi and G.G. Gentili. "Mode-Matching Analysis of TE/sub 011/-Mode Waveguide Bandpass Filters." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2109-2116.

A mode-matching technique for the analysis of waveguide bandpass filters employing circular TE/sub 011/ resonators, coupled by rectangular apertures, is presented. Such a technique takes rigorously into account thickness and angular offset of the two coupling irises, and higher modes interactions between resonators, while overcoming the typical limitations of the available approximate models. We show, through an optimization procedure, that it is possible to design filters with a desired frequency response, without needing any further empiric adjustments. Spurious responses can be controlled too.

Abstracts

Investigation of Active Antenna Arrays at 60 GHz

A. Rosen, R. Amantea, P.J. Stabile, A.E. Fathy, D.B. Gilbert, D.W. Bechtle, W.M. Jantom, F.J. McGinty, J.K. Butler and G.A. Evans. "Investigation of Active Antenna Arrays at 60 GHz." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2117-2125.

There has been a significant effort to develop millimeter-wave active-array antennas for communications and radar applications. A dielectric waveguide is a promising medium for this application. However, the integration of active devices, transmission media, and antennas has been difficult to achieve. This paper presents the first successful demonstration of a phase locked array of millimeter wave grating surface emitters (MMWGSE). We discuss three aspects of MMWGSE: 1) The achievement of an optically steered millimeter wave grating surface emitter. 2) The demonstration of a frequency locked array of millimeter wave grating surface emitters. 3) Rigorous analytical studies of efficiently coupling power from a millimeter wave semiconductor device, to a waveguide which incorporates grating surface emitters. This work leads to a full monolithic array using pseudomorphic high electron mobility transistor (PHEMT)-devices.

Abstracts

Improved Analysis and Design of Coupled-Line Phase Shifters

C.E. Free and C.S. Aitchison. "Improved Analysis and Design of Coupled-Line Phase Shifters." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2126-2131.

An analysis of coupled-line microstrip phase shifters is presented which shows that significant differences in theoretical performance are obtained by using an exact analysis in terms of odd and even mode propagation velocities rather than the approach in which the velocities are averaged. Measured data are presented and compared with theory over the frequency range 8-12 GHz and the agreement with theory is good.

Abstracts

High Accuracy Formulas for Calculation of the Characteristic Impedance of Microstrip Lines

D. Homentcovschi. "High Accuracy Formulas for Calculation of the Characteristic Impedance of Microstrip Lines." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2132-2137.

An analytical formula for determination of the characteristic impedance of a microstrip line assuming the quasi-TEM mode of propagation is presented. The new form of the final formulas contains only integrals which can be numerically performed by means of the Gauss-Laguerre quadrature. The method can be applied to multilayer lines and also to the case of anistropic dielectrics. By using some suitable conformal mappings the formulas obtained can be used to determine the characteristic impedance of some cylindrical microstrip lines. We have compared the results given by the proposed formulas with the finite analytical solution available in a particular case and also with results obtained by the substrip method. All the performed tests indicate that the proposed formulas are highly accurate and efficient relations for determining the characteristic impedance of microstrip lines.

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Abstracts

One- and Two-Stage Spatial Amplifiers

T. Ivanov, A. Balasubramaniyan and A. Mortazawi. "One- and Two-Stage Spatial Amplifiers." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2138-2143.

This paper reports the design of nine HEMT, one-and two-stage spatial amplifiers which employ a common ground plane for receiving and transmitting port isolation and for heat sinking. By placing the spatial amplifier array in the near-field of the transmitting and receiving horns, a net gain of 8 dB was obtained. This paper also reports the first demonstration of a two-stage spatial amplifier constructed by employing near-field coupling of two single stage spatial amplifiers in free space.

Abstracts

Short-Pulse Propagation in a Hollow Waveguide: Analysis, Optoelectronic Measurement, and Signal Processing

D. Kralj, L. Mei, T.-T. Hsu and L. Carin. "Short-Pulse Propagation in a Hollow Waveguide: Analysis, Optoelectronic Measurement, and Signal Processing." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2144-2150.

An asymptotic analysis is performed for short-pulse propagation in a hollow waveguide. It is demonstrated that each time-domain mode supported by the guide is characterized by a time-dependent frequency which, as time proceeds, approaches the modal cutoff frequency. This phenomenon is demonstrated experimentally by performing short-pulse optoelectronic measurements for the case of rectangular waveguide. In these measurements a short-pulse laser is used to switch planar antennas photoconductively, generating freely propagating waveforms with instantaneous bandwidth from 15-75 GHz. Time-frequency signal processing is performed on the measured data, the results of which are in close agreement with the predictions of the asymptotic analysis.

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Interconnect Characterization Using Time-Domain Reflectometry

S.D. Corey and A.T. Yang. "Interconnect Characterization Using Time-Domain Reflectometry." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2151-2156.

An approach is presented for modeling board-level, package-level, and multichip module substrate-level interconnect circuitry based on measured time-domain reflectometry data. The scattering poles and residues of a multiport system are extracted and used as a model that can be evaluated in linear time by recursive convolution in a SPICE-based simulator. This allows any linear or nonlinear circuits to be connected to the model ports, and the entire circuit may be simulated in a SPICE-based simulator. Two-port and four-port example microstrip circuits are characterized, and the simulation results are compared with measured data. Delay, reflection, transmission, and crosstalk are shown to be accurately modeled in each case.

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A Convolution-Based Approach to the Steady-State Analysis of Nonlinear Microwave Circuits Using Spice (Short Paper)

P. Halloran and T.J. Brazil. "A Convolution-Based Approach to the Steady-State Analysis of Nonlinear Microwave Circuits Using Spice (Short Paper)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2157-2160.

A convolution-based, black-box approach is proposed to incorporate linear circuit blocks into a nonlinear time-domain analysis program (SPICE) for the purposes of obtaining steady-state results. The technique used is straightforward and offers an effective method for incorporating linear circuits described in the frequency domain into a nonlinear simulation. The technique allows SPICE-users to couple the flexibility and accuracy of general-purpose linear microwave simulators together with SPICE nonlinear device models, and thereby obtain steady-state results which are comparable in accuracy to popular alternative methods such as harmonic balance.

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Are Nonreciprocal Bi-Isotropic Media Forbidden Indeed? (Short Papers)

A.H. Sihvola. "Are Nonreciprocal Bi-Isotropic Media Forbidden Indeed? (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2160-2162.

Doubt is cast in this article on the universality of the conclusion that linear bi-isotropic media have to be reciprocal, which claim has recently been set forth by Lakhtakia and Weiglhofer.

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Fourier-Transform Analysis for Rectangular Groove Guide (Short Papers)

B.-T. Lee, J.W. Lee, H.J. Eom and S.-Y. Shin. "Fourier-Transform Analysis for Rectangular Groove Guide (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2162-2165.

The rectangular groove guide is analyzed using the Fourier transform and the mode-matching technique. The enforcement of the boundary conditions at the groove apertures yields the simultaneous equations for the field coefficient inside the grooves. The simultaneous equations are solved to represent a dispersion relation in analytic series form. The numerical computation is performed to illustrate the behavior of the guided wave in terms of frequency and groove sizes. The presented series solution is exact and rapidly-convergent so that it is efficient for numerical computation. A simple dispersion relation based on the dominant-mode analysis is obtained and is shown to be very accurate for most practical applications.

Abstracts

Phasor Diagram Analysis of Millimeter-Wave HEMT Mixers (Short Papers)

Y. Kwon and D. Pavlidis. "Phasor Diagram Analysis of Millimeter-Wave HEMT Mixers (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2165-2167.

A phasor diagram method is developed based on an analytic approach for conversion gaht evaluation in HEMT mixers. The analytical expressions derived in this work take into account the mixing terms of nonlinear elements and provide a simple method to evaluate the conversion gain. The phasor diagram analysis offers physical insight into the mixing mechanisms and identifies the role of each harmonic of the nonlinear elements of HEMT's on the conversion gain. The method is validated with the experimental data of W-band monolithic InP-based HEMT mixers.

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The Importance of the Surface Divergence Term in the Finite Element-Vector Absorbing Boundary Condition Method (Short Papers)

V.N. Kanellopoulos and J.P. Webb. "The Importance of the Surface Divergence Term in the Finite Element-Vector Absorbing Boundary Condition Method (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2168-2170.

The vector absorbing boundary condition (ABC) is an effective way of truncating the infinite domain of a 3-D scattering problem, and thereby permitting its solution with a finite element method. One of the terms of the ABC is a surface divergence term. It is shown that due to its presence, the normal continuity of the field must be enforced on the surface where the ABC is applied. Numerical analysis of scattering by a conducting sphere demonstrates that if normal continuity is not enforced, the maximum error in the near field may more than double. A similar error occurs if the surface divergence term is omitted from the formulation.

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Abstracts

Coupling of the Pisces Device Modeler to a 3-D Maxwell FDTD Solver (Short Papers)

V.A. Thomas, M.E. Jones and R.J. Mason. "Coupling of the Pisces Device Modeler to a 3-D Maxwell FDTD Solver (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2170-2172.

We show how PISCES-like semiconductor models can be joined non-invasively to finite difference time domain models for the calculation of coupled external electromagnetic, The method involves "tricking" the standard current boundary condition for the device model into accepting an effective parallel external capacitance. For nearly steady state device conditions we show the results for a transmission line-coupled PISCES diode to agree well with those for an ideal diode.

Abstracts

On the Time Step in Hybrid Symmetrical Condensed TLM Nodes

V. Trenkic, C. Christopoulos and T.M. Benson. "On the Time Step in Hybrid Symmetrical Condensed TLM Nodes." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2172-2174.

New formulas for the maximum permissible time step in TLM hybrid nodes modeling anisotropic media are introduced and analyzed. It is shown that the value of the time step in most cases can be higher than that suggested by the miuimum node dimension. The chosen value of the time step has significant impact on the dispersion characteristics of the hybrid symmetrical condensed node.

Abstracts

High Isolation and Low Insertionion Loss Switch IC Using GaAs (Short Papers)

Y. Ota, M. Sakakura, K. Fujimoto, S. Yamamoto and H. Fujimoto. "High Isolation and Low Insertionion Loss Switch IC Using GaAs (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2175-2177.

A novel RF switch IC using GaAs MESFET's has been developed for digital communication systems. The new IC is composed of a three-stage SPST switch and a thin film termination resistor, which realizes a high isolation and a low return loss. In addition, a high power handling capability and a low insertion loss are simultaneously realized with two kinds of pinch-off voltages using the orientation effect of GaAs MESFET's. According to these technologies, the (excellent performance is achieved as follows: the isolation of 60 dB, the return loss of 20 dB, the 1 dB power compression of 27 dBm and the insertion loss of 1.6 dB at a frequency of 1.9 GHz with control voltages of 0/--5 V. The new switch IC contributes to a variety of communication system using high-quality digital modulation.

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Abstracts

Microwave Filters of Parallel-Cascade Structure (Comments)

R. Finkler and R. Unbehauen. "Microwave Filters of Parallel-Cascade Structure (Comments)." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2178-2178.

In the above paper, Osipenkov and Vesnin show how a parallel connection of two four-poles (incorrectly termed four-port networks by them) can be used to implement a (microwave) filter. They start from the assertion that the chain matrix [A] of the parallel connection can be calculated from the chain matrices [A'] and [A''] of the single four-poles by means of (2) of [1]. This assertion is equivalent to the statement that the admittance matrix of the parallel connection is the sum of the admittance matrices of the single four-poles.

Abstracts

Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Sep. 1995, Part I [T-MTT])

"Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Sep. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2179-2179.

Abstracts

Call for Papers - 1996 IEEE-MTT-S International Microwave Symposium (Sep. 1995, Part I [T-MTT])

"Call for Papers - 1996 IEEE-MTT-S International Microwave Symposium (Sep. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): 2180-2180.

Abstracts

Back Cover (Sep. 1995, Part I [T-MTT])

"Back Cover (Sep. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part I [T-MTT]): b1-b2.

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"Front Cover (Sep. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): f1-f2.

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Introduction to Special Issue on Microwave and Millimeter Wave Photonics

P.R. Herczfeld, H. Ogawa, A.A.A. de Salles, A. Seeds and R.S. Tucker. "Introduction to Special Issue on Microwave and Millimeter Wave Photonics." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2181-2183.

The Rapid evolution of photonics and microwave and millimeter wave electronics and their related technologies is resulting in new device developments and novel system configurations. The interface between microwaves and millimeter waves on the one hand and lightwaves on the other is an area of growing interest with a broad range of emerging applications. This Special Joint Issue of the IEEE Transactions on Microwave Theory and Techniques and the Journal of Lightwave Technology is devoted to Microwave and Millimeter Wave Photonics.

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Abstracts

Distortion in Linearized Electrooptic Modulators

W.B. Bridges and J.H. Schaffner. "Distortion in Linearized Electrooptic Modulators." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2184-2197.

Intermodulation and harmonic distortion are calculated for a simple fiber-optic link with a representative set of link parameters and a variety of electrooptic modulators: simple Mach-Zehnder, linearized dual and triple Mach-Zehnder, simple directional coupler (two operating points), and linearized directional coupler with one and two dc electrodes. The resulting dynamic ranges, gains, and noise figures are compared for these modulators. A new definition of dynamic range is proposed to accommodate the more complicated variation of intermodulation with input power exhibited by linearized modulators. The effects of noise bandwidth, preamplifier distortion, and errors in modulator operating conditions are described.

Abstracts

Seventeen-GHz Directional Coupler Optical Modulator

M. Yu and A. Gopinath. "Seventeen-GHz Directional Coupler Optical Modulator." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2198-2202.

The design of our high-speed directional coupler modulators at 0.83 µm used a semi-vectorial finite difference solver to obtain the odd and even mode optical propagation constants in the AlGaAs waveguide structure and a quasistatic finite difference code to obtain the RF characteristics of the electrode structure, which was an asymmetric coplanar waveguide modified capacitance loading. The measured drive voltage of the modulators, for 10-90 % response, varied between 22 and 27 V, compared with the theoretical value of 25 V. The 3 dB bandwidth of 17 GHz was obtained for this capacitive-loaded design, with 2500 mm interaction length, and is in good agreement with the predicted result.

Abstracts

Design of Ultra-Broad-Band LiNbO/sub 3/ Optical Modulators with Ridge Structure

O. Mitomi, K. Noguchi and H. Miyazawa. "Design of Ultra-Broad-Band LiNbO/sub 3/ Optical Modulators with Ridge Structure." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2203-2207.

This paper describes novel coplanar waveguide (CPW) electrode and asymmetric coplanar strip line (A-CPS) electrode structures, introducing ridged LiNbO/sub 3/ substrates and thicker electrodes, for ultra-broad-band LiNbO/sub 3/ optical modulators. The structures are designed here with quasistatic analysis using the finite-element method. Ridged-structures with CPW and A-CPS electrodes are shown to be able to reduce the driving-voltage below that of the conventional planar-type electrodes and are suitable for modulation of exceeding 100 GHz and driving voltage of far less than 4 V under an optical wavelength of 1.55 µm and 50 Omega characteristic-impedance system. The ridge-type CPW can provide a broader bandwidth characteristic with a relatively thinner buffer layer and thinner electrode than the ridge-type A-CPS and is easier to fabricate. The ridge-type LiNbO/sub 3/ modulators are consequently candidate devices for future ultra-high-speed optical fiber transmission systems.

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Abstracts

Passive Elimination of Polarization Sensitivity of Fiber-Optic Microwave Modulators

R.D. Esman and M.J. Marrone. "Passive Elimination of Polarization Sensitivity of Fiber-Optic Microwave Modulators." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2208-2213.

The polarization sensitivity of a bidirectional fiber-optic modulator is passively eliminated by incorporating the modulator in an orthoconjugate loop mirror or in an in-line fiber loop. We describe and analyze these fiber loop configurations which allow remote interrogation of polarization-sensitive devices with either one or two conventional singlemode fibers. For bulk single-drive modulators, the polarization sensitivity is reduced to ±0.15 dB out to 2 GHz. By utilizing a balanced, dual-drive feed to a bidirectional traveling-wave modulator, residual polarization sensitivity of ±2 dB is demonstrated for ultrawideband operation to 25 GHz and ±0.3 dB for narrowbands.

Abstracts

Optical Data Synchronization Using Tunable Transmitters and Nonzero Dispersion Links

P. Blixt, J.E. Bowers, E. Bodtker, O. Sahlen and R.S. Smith. "Optical Data Synchronization Using Tunable Transmitters and Nonzero Dispersion Links." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2214-2221.

A new digital feedback loop for synchronizing optical data with a clock at an arbitrary point in a fiber-optic link has been experimentally demonstrated and its physical limitations have been analyzed. The feedback loop consists of a tunable transmitter, a nonzero dispersion link, and standard microwave and digital electronics. The feedback loop was able to suppress thermal fluctuations with an accuracy better than 1 ps using either a temperature tuned DFB laser diode or a current tuned DBR laser diode. No bit-error rate penalty was measured during closed loop operation compared to back-to-back transmission. The physical limitations of the loop stem from noise in the receiver and the actuator increment. Thermally induced phase fluctuations in the fiber at frequencies above the loop bandwidth were found negligible. The maximum experimental delay time for stable operation was 0.86 s, indicating the possibility of closed loop operation for very long fiber links. The feasibility of packet synchronization is discussed. Moreover, a new scheme is proposed to circumvent wavelength reset when the system approaches the operating boundaries.

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Requirements for Radio-Wave Photonic Devices from the Viewpoint of Future Mobile Radio Systems

S. Komaki, K. Tsukamoto and M. Okada. "Requirements for Radio-Wave Photonic Devices from the Viewpoint of Future Mobile Radio Systems." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2222-2228.

Air interfaces of mobile communication are spreading widely because of diversified service demands, technology trends, and radio propagation conditions. This paper proposes the Radio Highway Network, which universally supports any mobile services and any mobile radio air-interface. As one example of the network, we analyze the optical TDMA signals for radio and show some requirements for radio-wave photonic devices.

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Optical Transmission of Narrowband Millimeter-Wave Signals

J.B. Georges, D.M. Cutrer, O. Solgaard and K.Y. Lau. "Optical Transmission of Narrowband Millimeter-Wave Signals." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2229-2240.

We describe experimentally and theoretically three techniques used to transmit narrowband millimeter-wave (mm-wave) analog signals over optical fiber: 1) narrowband mm-wave optical transmitters based on resonant modulation of monolithic semiconductor lasers, 2) feedforward optical modulation, and 3) a passively mode-locked laser operating in an optoelectronic phase-locked loop. The resonant modulation response at the cavity round-trip frequency is fully characterized for multiple-contact lasers under various bias conditions. Issues such as modulation efficiency, passband bandwidth, noise, and intermodulation distortion are addressed. A system implementation of resonant modulation is presented in which two simultaneous 2.5-Mb/s BPSK channels centered at a subcarrier frequency of 41 GHz is transmitted over 400 m of single-mode fiber. Simple microstrip matching circuits are fabricated at 41 GHz to couple the mm-wave signals into the laser. Resonant modulation of single-contact lasers is also reported. Next, implementation of a tunable mm-wave (30-300 GHz) optical transmitter based on feedforward optical modulation is presented, and the fundamental performance of this technique investigated in terms of noise and dynamic range. Feedforward modulation is used to transmit 300-Mb/s data at 39 GHz over 2.2 km of single-mode fiber. Finally, a passively mode-locked monolithic semiconductor laser operating in an optoelectronic phase-locked loop is implemented as a narrowband mm-wave optical transmitter at 46 GHz. The phase-locked loop bandwidth, mm-wave tracking capability, and fundamental limit to the stability of the mm-wave subcarrier is established. The relative merits of the three techniques are discussed and compared. The mm-wave subcarrier transmission results presented here represent the highest reported to date.

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Abstracts

Coherent Fiber-Optic Microcellular Radio Communication System Using a Novel RF-to-Optic Conversion Scheme

Y. Ishii, K. Tsukamoto, S. Komaki and N. Morinaga. "Coherent Fiber-Optic Microcellular Radio Communication System Using a Novel RF-to-Optic Conversion Scheme." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2241-2248.

This paper proposes a new coherent fiber-optic microcellular radio communication system using a novel RF-to-Optic conversion scheme. In this system a radio signal is converted into an optical signal with the same modulation format coherently transmitted through a wide-band optical fiber without any baseband demodulation and modulation. The theoretical analysis and computer simulation of transmission performances of radio QPSK and QAM signals clarify that the proposed system is superior to the fiber-optic radio commnmication system using conventional coherent analog optical links.

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Abstracts

Modeling Optically Prefiltered AM Subcarrier Multiplexed Systems

J. Marti and J. Capmany. "Modeling Optically Prefiltered AM Subcarrier Multiplexed Systems." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2249-2256.

We provide the theoretical modeling of optically pre-filtered AM subcarrier multiplexed systems, taking into account the coherence of the optical source. This model provides an useful tool to calculate the crosstalk impairment that appears in the subcarrier systems with optical prefiltering. Simulation carried on using realistic parameters is also presented that validates the results from the theoretical analysis.

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Signal Generation Using Pulsed Semiconductor Lasers for Application in Millimeter-Wave Wireless Links

D. Novak, Z. Ahmed, R.B. Waterhouse and R.S. Tucker. "Signal Generation Using Pulsed Semiconductor Lasers for Application in Millimeter-Wave Wireless Links." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2257-2262.

We investigate the generation of signals using pulsed semiconductor lasers for application in millimeter-wave (mm-wave) wireless links. The generation of mm-wave harmonic frequencies in both mode-locked and gain-switched lasers is considered and a method to generate mm-wave modulated optical signals with modulation depths approaching 100 % is implemented. The technique uses optical filtering to select only two optical modes in the pulsed laser spectrum that beat together in a high-speed photodiode. The application of this method to the feeding of mm-wave wireless links incorporating microstrip patch antennas is demonstrated. These optically fed links have application in indoor wireless LAN's and optical fiber microcellular systems.

Abstracts

Dispersion Effects in Optical Millimeter-Wave Systems Using Self-Heterodyne Method for Transport and Generation

R. Hofstetter, H. Schmuck and R. Heidemann. "Dispersion Effects in Optical Millimeter-Wave Systems Using Self-Heterodyne Method for Transport and Generation." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2263-2269.

This paper describes the detrimental effects of chromatic and polarization mode dispersion (PMD) on systems using single-laser-based optical self-heterodyning for generation and transport of millimeter (mm) -wave signals. The decrease of the generated mm-wave power due to chromatic dispersion in conjunction with nonnegligible laser phase noise is calculated and experimentally verified. Considering statistical properties of the PMD an analytical expression for the cumulative probability distribution of the power penalty is found and used to determine the required system margin for a given system outage rate. Furthermore, two system experiments using ASK and DPSK modulation scheme, respectively, are presented showing no limitation due to the dispersion effects.

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Optical Generation of Millimeter-Wave Signals for Fiber-Radio Systems Using a Dual-Mode DFB Semiconductor Laser

D. Wake, C.R. Lima and P.A. Davies. "Optical Generation of Millimeter-Wave Signals for Fiber-Radio Systems Using a Dual-Mode DFB Semiconductor Laser." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2270-2276.

This paper presents a new approach to the optical generation of millimeter-wave signals using a dual-mode multisection distributed feedback semiconductor laser. This simple device is capable of generating high power signals between 40 and 60 GHz with extremely high spectral purity and stability. The two optical modes produced by this laser are heterodyned on an ultrafast photodiode to give a beat signal at the mode difference frequency. The phase noise of the beat signal is greatly reduced by phase-locking the modes using an electrical drive signal applied to the laser at a subharmonic of the beat frequency. Millimeter-wave signals are obtained with a linewidth of less than 10 Hz, a phase noise of less than - 85 dBc/Hz at 100 kHz offset, and a locklng range of about 500 MHz. Millimeter-wave fiber-radio systems are seen as a major application area for these new compact optical sources.

Abstracts

Experimental Study on Close-In to Microwave Carrier Phase Noise of Laser Diode with External Feedback

T.-D. Ni, X. Zhang and A.S. Daryoush. "Experimental Study on Close-In to Microwave Carrier Phase Noise of Laser Diode with External Feedback." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2277-2283.

The residual phase noise at close-in to carrier offset frequency is studied for optical links using a laser diode with an external optical feedback. Since the measured FM noise degradation of the modulating signal was found to be insignificantly higher than the expected 20 log (n) in dB, the residual phase noise of the laser diode was measured to quantify the expected carrier signal FM noise floor level. The measured residual phase noise of a InGaAsP laser diode at 1 KHz offset carrier signal of 5.08 GHz is measured to be -100 and -90 dBc/Hz for with and without a 3-cm-long free-space external cavity, respectively, The close-in to carrier phase noise results of this laser at the external cavity resonance frequency of /spl ap/5 GHz is explained for the first time in terms of laser diode nonlinearity and FM noise theory of injection locked microwave oscillators. A good match between the predicted and measured results was observed.

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Microwave Generation Using Laser Heterodyne Technique with Independent Controllability in Frequency and Phase

N. Kishi, M. Aga and E. Yamashita. "Microwave Generation Using Laser Heterodyne Technique with Independent Controllability in Frequency and Phase." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2284-2287.

This paper describes the theoretical and experimental investigation of a scheme for microwave generation laser heterodyne. The frequency of the generated controlled by changing the frequency difference temperature-controlled semiconductor laser diodes difference between the two microwaves is controlled the difference between the two states of polarization laser beams. An attractive feature of this scheme independent controllability in frequency and phase.

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Millimeter-Wave Diffraction by a Photo-Induced Plasma Grating

V.A. Manasson, L.S. Sadovnik, A. Moussessian and D.B. Rutledge. "Millimeter-Wave Diffraction by a Photo-Induced Plasma Grating." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2288-2290.

Optical gratings are used extensively for beamsteering in the visible and IR range of the spectrum. Change in the dielectric permittivity of a semiconductor medium resulting from the excitation of a nonequilibrium electron-hole plasma makes it possible to extend this technique to MMW frequencies. A photo-induced plasma grating (PIPG) can be easily rewritten by changing the illumination pattern, so this technique can be used in an optically controllable MMW antennas. Initial experimental work studied the diffraction of MMW propagating along a dielectric waveguide containing a PIPG. This paper reports on the diffraction of MMW propagating in free space, steered by the PIPG.

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Traveling-Wave Photodetectors for High-Power, Large-Bandwidth Applications

V.M. Hietala, G.A. Vawter, T.M. Brennan and B.E. Hammons. "Traveling-Wave Photodetectors for High-Power, Large-Bandwidth Applications." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2291-2298.

The traveling-wave photodetectors (TWPD) discussed here offer theoretical quantum efficiencies approaching 100% while maintaining a very large electrical bandwidth. Additionally, they are capable of dissipating the high-power levels required for large dynamic range applications. In this paper, the power dissipation limit of the TWPD is explored. A small-signal steady-state model is developed that includes the effects of electrical propagation losses along the detector. Fabrication details are presented and experimental data shows a 3 x 1250 μm^2 detector with a 4.8-GHz bandwidth.

Abstracts

Optically Transparent ITO Emitter Contacts in the Fabrication of InP/InGaAs HPT's

S.A. Bashar and A.A. Rezazadeh. "Optically Transparent ITO Emitter Contacts in the Fabrication of InP/InGaAs HPT's." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2299-2303.

An optically transparent emitter InP/InGaAs heterojunction phototransistor (HPT) fabricated using Iridium Tin Oxide (ITO) as the ohmic contact is presented for the first time; these devices show similar electrical characteristics to their opaque emitter counterparts and enhanced optical responsivities (5.4 A/W at 780 nm wavelength). Measured spectral response suggests responsivities of up to 30 A/W and 22 A/W at lambda = 1310 nm and 1550 nm respectively.

Abstracts

Modeling of Waveguide PIN Photodetectors Under Very High Optical Power

J. Harari, F. Journet, O. Rabii, G. Jin, J.P. Vilcot and D. Decoster. "Modeling of Waveguide PIN Photodetectors Under Very High Optical Power." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2304-2310.

In this paper, the behavior under very high optical power of waveguide PIN photodetectors grown on InP substrate is simulated. The problem is solved using a pseudo-bidimensional Drift-Diffusion model which describes the electrical behavior of the device including the effects of the external circuit. The optical behavior of the device is analysed using FD 2D and 3D Beam Propagation Method. First, we present the optical behavior of the device when the illumination conditions change. Influence of device structure, spot width, spot position and injection angle on the quantum efficiency of the photodetector is so studied. Second, the whole modeling is validated using experimental results given in the literature. Three typical multimode structures which allow a high cut-off frequency as well as a good responsivity are then modeled and compared. The smaller one has a cut-off frequency of 75 GHz in small signal conditions and the main effect decreasing the microwave output signal when the optical input power increases is the carrier effect in the depletion region of the photodetector. The maximum microwave power of each photodetector is calculated in typical conditions of use.

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Photonic Mixers for Wide Bandwidth RF Receiver Applications

A.C. Lindsay, G.A. Knight and S.T. Winnall. "Photonic Mixers for Wide Bandwidth RF Receiver Applications." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2311-2317.

Optoelectronic mixers can exhibit a very wide band-width of operation with significantly reduced third-order intermodulation products. A 20-GHz bandwidth optoelectronic mixer has been constructed and characterized. The third order intermodulation terms were demonstrated to be more than 70 dB below the I.F. output. The mixer was then incorporated into a simple superheterodyne receiver architecture, which was shown to have a tangential sensitivity of -66 dBm and a compressive dynamic range of 44 dB. System limitations and possible improvements are discussed.

Abstracts

A Low-Loss Downconverting Analog Fiber-Optic Link

G.K. Gopalakrishnan, R.P. Moeller, M.M. Howerton, W.K. Burns, K.J. Williams and R.D. Esman. "A Low-Loss Downconverting Analog Fiber-Optic Link." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2318-2323.

An analog fiber-optic link for concurrent detection and downconversion of microwave signals is reported. Optical amplification is employed in conjunction with electrical power combining of photodetectors to demonstrate link losses of 19.6 and 22.9 dB at RF carrier frequencies of 9 and 16 GHz, respectively. Analytic expressions validating the experimental observations are also developed. The link may be employed to detect phase sensitive or phase-modulated microwave signals and shows excellent potential for application in sensor systems involving remoting of an antenna element.

Abstracts

Optical Demultiplexing for Subcarrier Multiplexed Systems

A.P. Foord, P.A. Davies and P.A. Greenhalgh. "Optical Demultiplexing for Subcarrier Multiplexed Systems." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2324-2329.

Subcarrier multiplexing (SCM) is an attractively simple technique for establishing multiple independent channels over a single fiber. At the receiver, electrical mixing converts a selected channel to baseband. The photodiode, oscillator, mixer, and preamplifier must, however, operate up to the highest subcarrier frequency. The use of an optical filter for channel selection allows any subcarrier to be accessed with only baseband electronics. To obtain the best performance with this approach, sub-subcarrier modulation is needed. In this paper we propose a method suitable for externally modulated CATV systems and show that the sensitivity is comparable to the best conventional receivers.

Abstracts

Dynamic Properties of Optical-Microwave Mixing Processes Utilizing FET Devices

T. Berceli. "Dynamic Properties of Optical-Microwave Mixing Processes Utilizing FET Devices." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2330-2333.

The dynamic behavior of the optical-microwave mixing process is investigated in detail. First, the dynamic properties of mixing and detection are compared. With increasing optical modulation frequency a more remarkable decay is obtained in the mixing product than in the detected signal. Based on the investigations there is a further reason for the decay in the mixing product beside the time constant exhibited by the barrier depletion region: the optically induced substrate current which doesn't contribute to the mixing effect. To describe the operation of combined optical-microwave mixing effects a new approach, the parametric method is introduced which provides a better description for these processes.

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Abstracts

High Sensitivity InP-Based Monolithically Integrated Pin-HEMT Receiver-OEIC's for 10 Gb/s

W. Kuebart, J.-H. Reemtsma, D. Kaiser, H. Grosskopf, F. Besca, G. Luz, W. Korber and I. Gyuro. "High Sensitivity InP-Based Monolithically Integrated Pin-HEMT Receiver-OEIC's for 10 Gb/s." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2334-2341.

InP-based pin-HEMT receiver-OEIC's with different circuit layouts for bit rates up to 10 Gb/s are simulated, realized and characterized. The circuits under investigation are a high impedance amplifier, a common-gate circuit, and a transimpedance-cascode circuit. The high frequency behavior of all circuits is compared by means of on wafer-characterization. All circuits show a bandwidth of more than 5 GHz, the transimpedance circuit has the highest responsivity (12.9 dB A/W) and a very low average noise current of 11.5 pA/spl radic/HZ when assembled in a module. The receiver sensitivity of the transimpedance circuit in the module is measured to be as high as -19.2 dBm.

Abstracts

Signal-to-Noise Performance of the Optical Receiver Using a Distributed Amplifier and P-I-N Photodiode Combination

J.Y. Liang and C.S. Aitchison. "Signal-to-Noise Performance of the Optical Receiver Using a Distributed Amplifier and P-I-N Photodiode Combination." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2342-2350.

The signal to noise performance of grounded source amplifier and distributed amplifier optical receiver configurations has been theoretically investigated. This predicts that an improvement of signal to noise ratio up to 12.7 dB is achievable for the distributed amplifier configuration compared with the grounded source in a bandwidth of 40 GHz. Our preliminary experimental results support the theoretical analysis. An optical receiver with 3 dB bandwidth of 20 GHz was fabricated by embedding the p-i-n photodiode into a T-network at the gate line in the distributed amplifier and an average equivalent input noise of 20 pA/Hz/sup ½/ was achieved over a bandwidth of 2-18 GHz.

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Monolithically Integrated High-Gain and High-Sensitive Photoreceivers with Tunable Filtering Functions for Subcarrier Multiplexed Optical/Microwave Systems

H. Kamitsuna. "Monolithically Integrated High-Gain and High-Sensitive Photoreceivers with Tunable Filtering Functions for Subcarrier Multiplexed Optical/Microwave Systems." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2351-2356.

This paper proposes monolithically integrated photoreceivers with tunable filtering functions using HBT-compatible HPT's for band-limited microwave subcarrier multiplexed transmission and optical/microwave signal processing systems. The filter photoreceiver, which consists of the HPT with a positive feedback LC resonance circuit and a Q-damping resistor, realizes the high quality factor (Q-factor) of 37.7 with the photo-response peak frequency of 13.6 GHz. Furthermore, it yields not only 24.1 dB and 16.2 dB higher gain but also over 7.5 dB and 3.5 dB improvement in sensitivity at 13.6 GHz without any spurious oscillation, in comparison with a standard photodiode and a discrete HPT, respectively. The tuner photoreceiver is constructed based on the filter photoreceiver. By adapting the HBT-compatible varactor diode in the resonance circuit, we realize tunable filtering functions, i.e., a very-wide photo-response peak frequency tuning range of 11.0-14.6 GHz with a Q-factor of over 20.2. The chip size is as small as 1.0 mm x 0.75 mm. The developed photoreceivers promise to realize compact, cost-effective hardware for subcarrier multiplexed optical/microwave or /miltimeter-wave systems.

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Experimental Investigation of Fiber Optic Microwave Link with Monolithic Integrated Optoelectronic Mixing Receiver

Q.Z. Liu, R. Davies and R.I. MacDonald. "Experimental Investigation of Fiber Optic Microwave Link with Monolithic Integrated Optoelectronic Mixing Receiver." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2357-2360.

A fiber optic microwave link with a monolithic integrated optoelectronic mixing receiver (OEM) is demonstrated experimentally. The OEM consists of a GaAs metal semiconductor metal photodetector (MSM-PD) mixer and a MESFET transimpedance preamplifier. By modulating the bias of the MSM-PD with an electrical local oscillator, the information signals on an optical carrier are detected and converted to a desired electrical frequency simultaneously. Experimental results of a fiber optic microwave link with the OEM as a frequency upconverter are shown and the potential application of the OEM in fiber optic millimeter wave links is discussed.

Abstracts

An All-Fiber RF Modulation Technique: Frequency Response Calibration of Optical Detectors

J.L. Cruz, J. Marzal and M.V. Andres. "An All-Fiber RF Modulation Technique: Frequency Response Calibration of Optical Detectors." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2361-2363.

Two all-fiber Mach-Zender interferometers have been designed to generate RF modulated light at 633 nm and 830 nm. The interferometers are scanned with a piezoelectric tube driven at its fundamental frequency of resonance. The actual experimental arrangement covers the frequency range 1 kHz to 1 GHz. The technique combines several interesting features as the simplicity, the stability and reliability of all-fiber systems and the use of low-frequency electronics to control and generate the RF modulated light.

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Optically Controlled Quasi-Optical Local Oscillator Injection for a 100 GHz SIS Imaging Receiver

G.F. Delgado. "Optically Controlled Quasi-Optical Local Oscillator Injection for a 100 GHz SIS Imaging Receiver." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2364-2369.

We present a novel approach to the problem of quasi-optical LO injection in a 100 GHz SIS imaging receiver. The use of a specially engineered molecular beam epitaxy material as an all-optical millimeter wave modulator is presented. This optically controlled modulator, used together with a kinoform to generate and control an array of Gaussian beams, is an efficient, completely solid-state, rugged and physically small solution. The working principle of the optically controlled modulator lies in the fact that the conductivity of a semiconductor can be changed by the generation of free carriers under photonic excitation, thus changing its refractive index.

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Application of Radar Technology to Aerial LIDAR Systems for Enhancement of Shallow Underwater Target Detection

L.J. Mullen, A.J.C. Vieira, P.R. Herczfeld and V.M. Contarino. "Application of Radar Technology to Aerial LIDAR Systems for Enhancement of Shallow Underwater Target Detection." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2370-2377.

Since microwaves do not penetrate water, RADAR, the principal tool for remote sensing of the earth and atmosphere, cannot be used directly for the detection of underwater objects. Currently, aerial light detecting and ranging (LIDAR) systems are therefore preferred for the detection and ranging of objects submerged in the sea. LIDAR provides for large area coverage at high speed, but it lacks coherent detection capability, a short-coming that severely limits system sensitivity and underwater target contrast. In response to this problem, this paper details the merging of RADAR and LIDAR technologies in the constitution of a hybrid LIDAR-RADAR detection scheme. This new sensor configuration has reduced incoherent backscatter clutter by 17 dB in laboratory experiments and related computer simulations.

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Optically Generated True-Time Delay In Phased-Array Antennas

I. Frigyes and A.J. Seeds. "Optically Generated True-Time Delay In Phased-Array Antennas." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2378-2386.

This tutorial review paper deals with various methods for solving a basic problem of wideband phased arrays, i.e. beam squinting, using optical technologies. The problem of beam squinting in phased arrays is analyzed and the concept of true-time delay is introduced. The advantages of realizing variable delay lines by optical rather than by microwave means are reviewed, together with principles of operation. Among the techniques described are switched-path length delay lines, fiber stretchers, tunable lasers with highly dispersive fiber, and coherent techniques incorporating dispersive delay. Recent experimental results are discussed in the light of practical system requirements.

Abstracts

True Time-Delay Fiber-Optic Control of an Ultrawideband Array Transmitter/Receiver with Multibeam Capability

M.Y. Frankel and R.D. Esman. "True Time-Delay Fiber-Optic Control of an Ultrawideband Array Transmitter/Receiver with Multibeam Capability." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2387-2394.

A true time-delay beamformer based on a fiber-optic dispersive prism is developed and characterized. The beam-former is used to control an ultrawideband time-steered array antenna, which is a significant improvement over inherently narrowband phased-array antennas. The time-steered transmitter antenna consists of eight broadband spiral elements in a sparsely-populated array. In transmit mode the bandwidth is microwave-component limited to 2-18 GHz. The transmitter shows an unprecedented performance with >100° azimuth steering and no observed squint over the full frequency range. We also extend the beamformer functionality and demonstrate, we believe for the first time, fully-independent duall-beam dual-frequency ultrawideband antenna transmitter operation. Furthermore, the beamformer is shown to be capable of controlling the transmitter under pulsed operation with microwave pulse-widths as short as 75 ps. In the phase-steered receive mode, the antenna is component-limited to two elements and a frequency range of 6-16 GHz. However, we can still demonstrate squint-free receiver steering over >70° azimuth over the full available frequency range.

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Self-Heterodyning Optical Waveguide Beam Forming and Steering Network Integrated on Lithium Niobate Substrate

K. Horikawa, Y. Nakasuga and H. Ogawa. "Self-Heterodyning Optical Waveguide Beam Forming and Steering Network Integrated on Lithium Niobate Substrate." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2395-2401.

A novel self-heterodyning optical waveguide beam forming and steering network (BFN) integrated on a Lithium Niobate (LN) substrate is introduced to reallize optically controlled active phased array antennas. This integrated LN-BFN can simultaneously control eight array elements and is demonstrated for the first time. The key component in the self-heterodyning system, an optical frequency shifter (OFS), is composed of phase and amplitude-balanced four parallel optical phase modulators. An optical signal processing circuit equipped with a weighted electrode structure simplifies the beam steering operation. A fully integrated LN-BFN connected by optical fibers can steer beam direction with the sensitivity of 1.5 degrees per volt.

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Electric Field Distribution Measurement of Microstrip Antennas and Arrays Using Electro-Optic Sampling

Y. Imaizumi, M. Shinagawa and H. Ogawa. "Electric Field Distribution Measurement of Microstrip Antennas and Arrays Using Electro-Optic Sampling." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2402-2407.

This paper proposes an electric field distribution measurement method for microwave integrated circuit arrays that uses Electro-optic sampling (EOS). The electric fields of a microstrip patch antenna are measured by EOS and compared with the theoretical results calculated by the spectral domain approach. Good agreement between measurement and theory is found. An array antenna composed of two microstrip patches is also assessed by the EOS method and the expected results are experimentally verified. The EOS proposed in this paper is promising to evaluate the electric field distribution of individual antenna elements in large scaled integrated array antennas.

Abstracts

Optically Controlled Coplanar Transmission Lines for Microwave Signal Processing

R. Kremer, S. Redlich, L. Brings and D. Jager. "Optically Controlled Coplanar Transmission Lines for Microwave Signal Processing." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2408-2413.

This paper reviews optically controlled wave propagation effects in coplanar transmission lines on semiconducting substrate. Special emphasis is laid upon distributed Schottky photodiodes where a depletion layer is formed below the center conductor. The cross section is that of a InAlAs/InGaAs/InP heterostructure, where the thin InGaAs layer is optimized with respect to optical absorption leading to an optical control of phase velocity, time delay or attenuation. Experimentally, phase shifts as high as 110 deg/mm at 9 GHz using an optical power of merely 50 pW are obtained for an MBE grown sample with a suitable doping profile and for backside illumination through the transparent InP-substrate. The theoretical treatment is based upon an equivalent circuit including the optoelectronic properties under different illumination conditions. It is further shown that periodic structures can sucessfully be used as efficient phase, shifters or attenuators with optical control. This leads to interesting applications as optical MMIC's for microwave signal processing.

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Optical Control of Microwave-Integrated Circuits Using High-Speed GaAs and Si Photoconductive Switches

S.E. Saddow and C.H. Lee. "Optical Control of Microwave-Integrated Circuits Using High-Speed GaAs and Si Photoconductive Switches." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2414-2420.

An optoelectronic attenuator suitable for the optical control of microwave-integrated circuits is presented. High-speed photoconductive switches are embedded in planar microwave transmission lines fabricated on both semi-insulating GaAs and high-resistivity silicon substrates, and a fiber pigtailed semi-conductor laser diode is used to control the microwave signal level on these high-speed lines. Forty-five dB of microwave attenuation was demonstrated with a silicon coplanar waveguide-photoconductive switch, while up to 8.5 dB of attenuation was achieved with a GaAs device. In addition, the optically induced phase delay through the silicon device was observed to be as large as 180°. The microwave performance of these photoconductive devices has been fully characterized and their suitability for various optical control applications compared. So that one can optimize the laser diode/GaAs photoconductive device interaction, the GaAs device has been characterized as a function of laser photon energy, switch temperature, and applied dc electric field, and the optimum operating point has been determined through experiment.

Abstracts

Microwave Photonic Multichip Modules Packaged on a Glass-Silicon Substrate

S. Iezekiel, E.A. Soshea, M.F. O'Keefe and C.M. Snowden. "Microwave Photonic Multichip Modules Packaged on a Glass-Silicon Substrate." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2421-2427.

A hybrid microwave photonic integration technology known as optoelectronic glass microwave integrated circuit (opto-GMIC) has been developed. It is a multichip module approach that rises a glass substrate on a silicon carrier to interconnect both discrete and monolithic microwave and optoelectronic devices. The glass substrate can support both lumped and distributed elements, thus reducing the number of parts in assembly. In addition, a wide variety of microwave photonic multichip module designs can be produced from the same production line. This has been demonstrated by the fabrication of prototype fiber-optic repeaters, transmitters, and receivers designed for synchronous optical network applications at a bit rate of 622.08 Mb/s and a wavelength of 1.3 µm.

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All-Optical Networks As Microwave and Millimeter-Wave Circuits

S. Tedjini, A. Ho-Quoc and D.A.M. Khalil. "All-Optical Networks As Microwave and Millimeter-Wave Circuits." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2428-2434.

In this work we study the use of optical fiber networks to perform microwave processing functions. Theoretical and experimental results are presented in the case of a Mach-Zehnder interferometer network, a Fabry-Perot network, and a combination of the two previous networks. All of these networks are realized with single-mode fiber elements. The use of optical scattering parameters and the graphical representation technique was introduced in our model, which greatly simplified the analysis. A good agreement between modeling and experiment as well as good performances from the microwave point of view are observed.

Abstracts

Leaky Wave Radiation from a Periodically Photoexcited Semiconductor Slab Waveguide

A. Alphones and M. Tsutsumi. "Leaky Wave Radiation from a Periodically Photoexcited Semiconductor Slab Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2435-2441.

This paper presents investigations on leaky wave antenna that are modeled by periodical illumination of light on a grounded semiconductor slab waveguide using an asymptotic method of singular perturbation procedure based on multiple scales. Analytical results clearly show that the periodical illumination strongly affects the radiation characteristics such as efficiency and the radiation angle. The dominant effects are studied quantitatively and are outlined in the performance diagrams as a function of optically induced plasma density and the grating period. Initial experimental results at Q band using silicon slab guide under an array of 820-nm LED CW excitation are also reported and are in relatively good agreement with the theory.

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"Call for Papers - 1996 IEEE-MTT-S International Microwave Symposium (Sep. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2442-2442.

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Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Sep. 1995, Part II [T-MTT])

"Call for Papers - Medical Applications and Biological Effects of RF/Microwaves (Sep. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2443-2443.

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Call for Papers - Revolutionary Developments in Phased Arrays (Sep. 1995, Part II [T-MTT])

"Call for Papers - Revolutionary Developments in Phased Arrays (Sep. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.9 (Sep. 1995, Part II [T-MTT] (Special Issue on Microwave and Millimeter Wave Photonics)): 2444-2444.

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Abstracts

FDTD Analysis of High Frequency Electronic Interconnection Effects

P.C. Cherry and M.F. Iskander. "FDTD Analysis of High Frequency Electronic Interconnection Effects." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2445-2451.

A full-wave analysis of coupled high-frequency interconnect discontinuities is presented using the finite-difference time-domain (FDTD) method. The electromagnetic effects of two via holes on microstrip lines in close proximity to one another are examined and equivalent circuits are presented. The effects of two adjacent lines with bond wires, used, for example, to connect a die to the leadframe of an integrated circuit (IC) package are also analyzed. Frequency domain results are presented by using the discrete Fourier transform of the time-domain results. Guidelines regarding the effective use of the FDTD code including the use a priori calculated electric field distribution in the excitation plane, and the use of a weighted epsilon/sub r, eff/ to minimize reflections at the absorbing boundaries are described. The obtained FDTD results and the developed equivalent circuit models show the importance of radiation effects at frequencies beyond 20-30 GHz, the possibilities of reducing the inductive effect of bond wires by using two parallel bond wires instead of one, and the importance of including mutual inductance elements in the equivalent circuit model to account for the crosstalk between parallel vias across a ground plane.

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Efficient Finite Element Analysis of Waveguides with Lossy Inhomogeneous Anisotropic Materials Characterized by Arbitrary Permittivity and Permeability Tensors

L. Valor and J. Zapata. "Efficient Finite Element Analysis of Waveguides with Lossy Inhomogeneous Anisotropic Materials Characterized by Arbitrary Permittivity and Permeability Tensors." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2452-2459.

This paper presents a new finite element formulation for solving arbitrarily shaped waveguides including lossy inhomogeneous anisotropic media. The materials are characterized by simultaneous [epsilon] and [μ] full tensors. Complex-mode computation, spurious-mode suppression and the possibility of specifying the frequency as an input parameter are also achieved. The formulation leads to a quadratic eigenvalue problem of dimension N which is transformed into an efficient 2N-dimensional generalized eigensystem with sparse complex matrices. This eigensystem is solved by the subspace method, taking full advantage of the sparsity of the matrices. Permittivity and permeability tensors with some null terms allow an additional reduction from the N-dimensional quadratic eigenvalue problem to a N-dimensional sparse complex generalized eigensystem. The proposed method has been validated by analyzing different lossy, inhomogeneous and anisotropic waveguides. Results show good agreement with previously published data.

Abstracts

Analysis of Curved and Angled Surfaces on a Cartesian Mesh Using a Novel Finite-Difference Time-Domain Algorithm

I.J. Craddock and C.J. Railton. "Analysis of Curved and Angled Surfaces on a Cartesian Mesh Using a Novel Finite-Difference Time-Domain Algorithm." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2460-2465.

The widely accepted finite-difference time-domain algorithm, based on a Cartesian mesh, is unable to rigorously model the curved surfaces which arise in many engineering applications, while more rigorous solution algorithms are inevitably considerably more computationally intensive. A nonintensive, but still rigorous, alternative to this approach has been to incorporate a priori knowledge of the behavior of the fields (their asymptotic static field solutions) into the FDTD algorithm. Unfortunately, until now, this method has often resulted in instability. In this contribution an algorithm (denoted 'SFDTD' for second-order finite difference time domain) is presented which uses the static field solution technique to accurately characterize curved and angled metallic boundaries. A hitherto unpublished stability theory for this algorithm, relying on principles of energy conservation, is described and it is found that for the first time a priori knowledge of the field distribution can be incorporated into the algorithm with no possibility of instability. The accuracy of the SFDTD algorithm is compared to that of the standard FDTD method by means of two test structures for which analytic results are available.

Analysis of Lossy Planar Transmission Lines by Using a Vector Finite Element Method

M.S. Alam, M. Koshiba, K. Hirayama and Y. Hayashi. "Analysis of Lossy Planar Transmission Lines by Using a Vector Finite Element Method." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2466-2471.

The vector finite element method with hybrid edge/nodal triangular elements is extended for the analysis of lossy planar transmission lines. In order to handle lossy conductor transmission lines, the present approach includes the effect of finite conductivity of a lossy area, and the dissipations in metallic conductors and dielectrics are calculated directly by considering a complex permittivity for the lossy region of interest. Propagation constant formulation is used in the FEM, which avoids spurious solutions absolutely and can handle sharp metal edges in inhomogeneous electromagnetic waveguides. Numerical examples are computed for microstrip lines, finlines, and triplate strip lines. The results obtained agree well with the earlier theoretical and experimental results, and thus show the validity of the method. Also, the current distributions on the lossy microstrip lines with finite strip thickness and isotropic substrates are presented.

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A Unified TLM Model for Wave Propagation of Electrical and Optical Structures Considering Permittivity and Permeability Tensors

J. Huang and K. Wu. "A Unified TLM Model for Wave Propagation of Electrical and Optical Structures Considering Permittivity and Permeability Tensors." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2472-2477.

A generalized transmission line matrix (TLM) formalism is proposed for unified simulation of wave propagation problems. The present modeling is made possible with a new TLM node that is derived to account for simultaneously the electromagnetic effects of permittivity and permeability tensors of material. It is shown, through numerical examples, that the new node-based TLM algorithm in the frequency domain can be used to solve a large class of complex electromagnetic problems ranging from microwave circuits to optical devices. A dynamic solution for the r-cut sapphire-based microstrip is presented that highlights its application to high-temperature superconducting microwave circuits.

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Considerations and Simulations of Subfrequency Excitation of Series Integrated Resonant Tunneling Diodes Oscillator

R. Sun, O. Boric-Lubecke, D.-S. Pan and T. Itoh. "Considerations and Simulations of Subfrequency Excitation of Series Integrated Resonant Tunneling Diodes Oscillator." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2478-2485.

A subfrequency pulse initiation of an oscillator of two series-integrated RTD's is considered and simulated. A voltage-dependent current source is adopted to separate the input and output power to represent a circulator in simulations. Simulations show, for example, a 100 GHz integrated RTD oscillator can be excited by a 50 GHz pulse with about 1 ns decay time (a characteristic decay time of 0.2 ns) without the dc instability problem, while a voltage ramp of 1ns rise or fall time is far too slow to initiate such an oscillator. The mechanism that RTD's are driven by subfrequency into the negative differential resistance (NDR) from the positive differential resistance (PDR) is analyzed in detail. A preliminary analysis of the transition from 50-100 GHz oscillation is also presented.

Abstracts

Wave Spreading Evaluation of Interconnect Systems

H. Liao and W.W.-M. Dai. "Wave Spreading Evaluation of Interconnect Systems." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2486-2491.

This paper derives general multiport interconnect constraints and presents a new approach, wave spreading evaluation (WSE), which uses S-parameter based network techniques to analyze coupled, multiconductor interconnect systems for high speed analog and digital integrated circuits. WSE is based on the spreading process of voltage waves with initial spreading waves created by the sources. The spreading process is independent of input sources, and every step of wave spreading meets the constrains of KCL and KVL. The continual spreading of voltage waves will create accurate results. Since the spreading voltage waves is the process of energy attenuation, the WSE method is always convergent for passive networks.

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Analysis of Planar Structures by an Integral Approach Using Entire Domain Trial Functions (Short Papers)

M. Nadarassin, H. Aubert and H. Baudrand. "Analysis of Planar Structures by an Integral Approach Using Entire Domain Trial Functions (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2492-2495.

In this paper, a method based on an integral formulation with an excitation term is presented. The particularities of this approach lie in the utilization of entire domain trial functions and in the characterization of the coupling effect due to the excitation mechanism. The trial functions are taken as the TE-TM modes of a waveguide whose cross section corresponds to the shape of the discontinuity. The trial functions are computed and stored in the memory, then the study of complex planar structures becomes easy. A complete study is proposed, including the analysis of the coupling mechanism due to the source interaction and the characterization of higher order modes influence. This work is followed by two applications: a multiaxial discontinuity (bend discontinuity) in microstrip and in CPW. The computed results have been compared with data furnished by the literature. A good accuracy has been obtained.

Abstracts

On the Utilization of Periodic Wavelet Expansions in the Moment Methods (Short Papers)

G. Wang. "On the Utilization of Periodic Wavelet Expansions in the Moment Methods (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2495-2498.

In this short paper, a new wavelet approach that makes use of periodic wavelet expansions in the moment methods is presented. The unknown field or response is expanded in terms of the periodic wavelet functions. As a wavelet expansion method, the moment-method matrix is rendered sparsely populated after applying a threshold procedure. Moreover, this approach circumvents the difficulties in the application of the conventional wavelet expansions on the real line to finite interval problems. Numerical study shows that this approach gives better accuracy than the use of the conventional wavelet expansions on the whole real line.

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Analytical Expressions for Simplifying the Design of Broadband Low Noise Microwave Transistor Amplifiers (Short Papers)

G.N. Link and V.S.R. Gudimetla. "Analytical Expressions for Simplifying the Design of Broadband Low Noise Microwave Transistor Amplifiers (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2498-2501.

An analytical expression for the minimum achievable noise figure for a specified gain at a given frequency is derived for a microwave amplifier. The minimum noise figure is given in terms of the specified gain, the amplifier noise parameters, and the S parameters. Similarly, another expression for the maximum gain at a specified noise figure is derived in terms of the noise figure, the noise parameters, and the S parameters. It is shown that these expressions simplify the tradeoff considerations for broadband low noise amplifier design by avoiding the need to draw several constant noise and gain circles at each frequency of interest.

Abstracts

Simple and Explicit Formulas for the Design and Analysis of Asymmetrical V-Shaped Mlcroshield Line (Short Papers)

K.-K.M. Cheng and I.D. Robertson. "Simple and Explicit Formulas for the Design and Analysis of Asymmetrical V-Shaped Mlcroshield Line (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2501-2504.

This paper presents some simple, explicit and practical formulas for the evaluation of the quasi-TEM characteristic parameters of asymmetrical V-shaped microshield line, based on a conformal mapping procedure. These formulas give very accurate results in terms of elementary functions rather than the exact solution in terms of difficult functions. Two sets of expressions are described using first and second order approximations. These equations are easy to implement, thus making it an excellent choice for use in computer aided design, analysis and optimization of V-shaped microshield structures.

Abstracts

Nonlinear Yield Analysis and Optimization of Monolithic Microwave Integrated Circuits (Short Papers)

S. D'Agostino and C. Paoloni. "Nonlinear Yield Analysis and Optimization of Monolithic Microwave Integrated Circuits (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2504-2507.

In this paper, a discussion about nonlinear yield evaluation and nonlinear yield optimization of MMIC circuits using a physics-based nonlinear lumped-element MESFET model is presented. The lumped elements of the MESFET model are directly calculated by closed expressions related to process parameters. One of the main features of the model is the easy and effective implementation in commercial CAD tools. It allows the use of nonlinear yield algorithms assuming, as statistical variables, the parameters of the technological process, such as: doping density, gate channel length, etc., maintaining at the same time, the advantages of lumped-element MESFET model, in particular fast computation and reduction of convergence problems in harmonic balance for complex circuit topologies.

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28 GHz Onmi-Directional Quasi-Optical Transmitter Array (Short Papers)

M.J. Vaughan and R.C. Compton. "28 GHz Onmi-Directional Quasi-Optical Transmitter Array (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2507-2509.

Omni-directional base stations are needed in many emerging wireless communication systems. This paper presents the first adaptation of a quasi-optical oscillator array for this purpose. A 28 GHz active oscillator element containing a modified Vivaldi endfire antenna is utilized as the unit cell. Twelve of these are incorporated into the circular array, which is powered from a single dc power supply. The array has a high combining efficiency and remains frequency-locked over a span of 600 MHz.

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Finite-Difference Time-Domain Analysis of Microwave Circuit Devices on High Performance Vector/Parallel Computers (Short Papers)

S.D. Gedney. "Finite-Difference Time-Domain Analysis of Microwave Circuit Devices on High Performance Vector/Parallel Computers (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2510-2514.

In this paper, an efficient finite-difference time-domain algorithm for high performance distributed memory vector/parallel computers is presented. The algorithm is developed in a manner which requires only one interprocessor communication per time step. Illustrated examples based on the analysis of microwave circuit devices are presented demonstrating the efficiency and scalability of the finite-difference time-domain algorithm.

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Scattering from a Circular Dielectric Post Embedded in a Grounded Dielectric Sheet Waveguide (Short Papers)

E. Sawado, K. Ishibashi and K. Hatakeyama. "Scattering from a Circular Dielectric Post Embedded in a Grounded Dielectric Sheet Waveguide (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): 2514-2516.

A systematic method for obtaining the scattered electric field in a grounded dielectric sheet waveguide is presented. It is shown that point-matching method can be used for an explicit calculation of the integral equation to estimate the scattering from a circular dielectric post embedded in the grounded sheet. Magnitude of the reflection coefficient as a function of dielectric constant is given.

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"Back Cover (Oct. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.10 (Oct. 1995 [T-MTT]): b1-b2.

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A Multisection Broadband Impedance Transforming Branch-line Hybrid

S. Kumar, C. Tannous and T. Danshin. "A Multisection Broadband Impedance Transforming Branch-line Hybrid." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2517-2523.

Measurements and design equations for a two-section impedance transforming hybrid suitable for MMIC applications and a new method of synthesis for multisection branch-line hybrids are reported. The synthesis method allows the response to be specified either of Butterworth or Chebyshev type. Both symmetric (with equal input and output impedances) and nonsymmetric (impedance transforming) designs are feasible. Starting from a given number of sections, type of response, and impedance transformation ratio and for a specified midband coupling, power division ratio, isolation or directivity ripple bandwidth, the set of constants needed for the evaluation of the reflection coefficient response is first calculated. The latter is used to define a driving point impedance of the circuit, synthesize it and obtain the branch line immittances with the use of the concept of double length unit elements (DLUE). The experimental results obtained with microstrip hybrids constructed to test the validity of the brute force optimization and the synthesized designs show very close agreement with the computed responses.

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Adjustment of Okada Resonator Using Composite Chambers

J. Helszajn, R. Guixa, J. Girones, E. Hoyos and J. Garcia-Taheno. "Adjustment of Okada Resonator Using Composite Chambers." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2524-2531.

An important high power gyromagnetic resonator is the Okada one consisting of stacked circular metal disks between top and bottom plates on either side of which are mounted thin ferrite disks separated by a free space or dielectric region. The purpose of this paper is to describe some design features entering into the description of the quality factor of this type of junction. The quality factor of one experimental UHF Okada resonator biased above the main Kittel resonance consisting of five inner symmetrical chambers and two outer asymmetrical ones each partially filled with an inner region of ferrite tiles and an outer one of dielectric tiles is given separately.

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Full-Wave Characterization of the Mode Conversion in a Coplanar Waveguide Right-Angled Bend

M.-D. Wu, S.-M. Deng, R.-B. Wu and P. Hsu. "Full-Wave Characterization of the Mode Conversion in a Coplanar Waveguide Right-Angled Bend." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2532-2538.

A full-wave algorithm is proposed to analyze thoroughly a 90° bend of coplanar waveguide (CPW). Based on the mixed potential integral equation (MPIE) formulation, the equivalent magnetic current distribution on the apertures is solved by the moment method using overlapping rooftop basis functions and the Galerkin weighting procedure. The matrix pencil approach is then utilized to do the de-embedding procedure and extract both the coplanar and slotline modes scattering off the asymmetric discontinuity. Experiments are performed to measure the scattering parameters and the results verify the accuracy of the present algorithm. The full 4x4 scattering matrix between these two modes is presented and from which, the occurrence of the mode conversion is investigated. The mode conversion is noticed to become almost complete at certain frequencies, which may be useful in the design of CPW to coupled slotline transition.

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A GaAs MCM Power Amplifier of 3.6 V Operation with High Efficiency of 49% for 0.9 GHz Digital Cellular Phone Systems

K. Tateoka, A. Sugimura, H. Furukawa, N. Yoshikawa and K. Kanazawa. "A GaAs MCM Power Amplifier of 3.6 V Operation with High Efficiency of 49% for 0.9 GHz Digital Cellular Phone Systems." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2539-2542.

An Extremely small GaAs PA (power amplifier) has been implemented using AIN multilayer MCM for 0.9 GHz digital cellular phones. The present PA exhibited high efficiency of 49% with drain supply voltage as low as 3.6V. This PA was designed to provide matching circuits with the maximum gain at the input side and the minimum intermodulation distortion at the output side. Nonlinear simulation result verifies that this matching condition provides the lowest pi/4-shift QPSK distortion and indicates that the phase shift of the amplifier is mainly caused by source-drain resistance.

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ASUR-An Airborne SIS Receiver for Atmospheric Measurements of Trace Gases at 625 to 760 GHz

J. Mees, S. Crewell, H. Nett, G. de Lange, H. Van De Stadt, J.J. Kuipers and R.A. Panhuyzen. "ASUR-An Airborne SIS Receiver for Atmospheric Measurements of Trace Gases at 625 to 760 GHz." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2543-2548.

A heterodyne receiver making use of a SIS waveguide mixer with integrated horn and single backshort tuner has been built. It has been used for a series of airborne measurements of atmospheric trace gases, such as HCI and CIO, above northern Europe during the winter of 1993 and 1994. The receiver is suitable for measurements in the range of 625-760 GHz and shows stable operation in the airplane together with high sensitivity. Best achieved noise temperatures are T/sub DSB/ = 310 K at 708 GHz in the laboratory and T/sub SSB/ = 1500 K at 625 GHz for the complete system in the airplane.

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Leakage of the Dominant Mode on Stripline with a Small Air Gap

D. Nghiem, J.T. Williams, D.R. Jackson and A.A. Oliner. "Leakage of the Dominant Mode on Stripline with a Small Air Gap." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2549-2556.

In addition to the expected bound (proper) dominant mode, an independent leaky (improper) dominant mode has been found to exist on a conventional stripline that has a small air gap above the conducting strip. Such an air gap often occurs during the fabrication process, and has in the past been suspected as the cause of spurious performance. This newly discovered leaky dominant mode leaks into the fundamental TM/sub 0/ parallel-plate mode of the background structure, which is a parallel-plate guide with an air gap. Furthermore, it is found that the leaky dominant mode, not the bound dominant mode, is the continuation of the stripline TEM mode that exists with no air gap. Hence, it is the leaky mode that is excited predominantly by a conventional feed for the small air-gap structure. The general properties of both the bound and leaky dominant modes are obtained by using a full-wave spectral-domain approach. The primary purposes of this paper are to discuss the nature of the leaky dominant mode, and to show that its presence is indeed responsible for spurious transmission-line performance, such as unexpected loss and crosstalk, and interference between the bound and leaky dominant modes. These conclusions are verified experimentally.

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Quasi-Linear Amplification Using Self Phase Distortion Compensation Technique

H. Hayashi, M. Nakatsugawa and M. Muraguchi. "Quasi-Linear Amplification Using Self Phase Distortion Compensation Technique." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2557-2564.

This paper demonstrates a self phase distortion compensation technique to realize linear power amplifiers, in which the positive phase deviation from a common-source FET and the negative phase deviation from a common-gate FET cancel each other. It is confirmed both theoretically and experimentally that increasing the drain-to-source conductance, G/sub d/, causes the self phase distortion compensation effect. An experimental power amplifier for L-band personal communications systems, which employs the cascode connection, shows good phase deviation performance. More than 20-dB gain, 21-dBm output power, and 50% power added efficiency are obtained along with the adjacent channel interference of -52 dBc in 192-kHz bands at 600-kHz offset frquency from 1.9 GHz at the operating voltage of only 3 V. The demonstrated performances satisfy the specifications for the 1.9-GHz Japanese Personal Handy-phone System (PHS) utilizing the pi/4-shift QPSK modulation scheme. The proposed technique is suitable for MMIC design, and allows the design of handsets that are small, lightweight, and have long operating times.

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Experimental Validation of a Combined Electromagnetic and Thermal FDTD Model of a Microwave Heating Process

L. Ma, D.-L. Paul, N. Pothecary, C. Railton, J. Bows, L. Barratt, J. Mullin and D. Simons. "Experimental Validation of a Combined Electromagnetic and Thermal FDTD Model of a Microwave Heating Process." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2565-2572.

Microwave cooking, tempering, and pasteurizing of foods involves several complex and interacting physical phenomena. Although such processes are widely used, the interactions between the food product, packaging, and the microwave oven itself are particularly complicated, are not well understood, and applicable simulation tools are lacking. In this contribution we describe a combined finite difference time domain model for the electromagnetic and the heat transfer processes which include temperature dependence of the electrical and thermal properties of the food product. This model is validated by comparison to experiment.

Abstracts

Transient Analysis of Tapered Transmission Lines Used as Transformers for Short Pulses

Y.P. Tang, Z. Li and S.Y. Tang. "Transient Analysis of Tapered Transmission Lines Used as Transformers for Short Pulses." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2573-2578.

The transient behavior of tapered transmission lines is studied in detail by investigating their step responses by an improved method of characteristics. We take interest in the first arriving wave and following dropping process at the load end which play important roles in determining the response waveform and power coupling efficiency under short pulse excitation. Numerical results show that, for given load and source impedances and propagation delay, the magnitude of the first arriving wave is invariable for any tapered line under both ends are well matched, and the slowest dropping is reached as the characteristic impedance distribution satisfies some condition. The concept of instantaneous dropping speed is used in further theoretical analysis and the numerical results are verified by theoretical formulas. Finally, we show the relation between the instantaneous dropping speed and frequency-domain characteristics.

Abstracts

Extension of the MoM Laplacian Solution to the General Hehmholtz Equation

J. Rejeb, T. Sarkar and E. Arvas. "Extension of the MoM Laplacian Solution to the General Hehmholtz Equation." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2579-2584.

A new boundary integral method for solving the general Helmholtz equation has been developed. The new formulation is based on the method of moments Laplacian solution. The main feature of this new formulation is that the boundary conditions are satisfied independent of the region node discretizations. The numerical solution of the present method are compared with finite difference and finite element solutions.

Abstracts

An Effective Approach for Study of Multiple Discontinuities of Transmission Lines

Y. Xu and R.G. Bosisio. "An Effective Approach for Study of Multiple Discontinuities of Transmission Lines." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2585-2589.

In this paper, a novel approach for calculation of discontinuities of transmission lines is presented. This approach is flexible, simple and effective. For calculation of multiple discontinuities or taking into account the thickness of the obstacles, it is only necessary to transfer the relationship between the electric and magnetic field components from one discontinuity to another and match them on the last one. The method of transfer may be arbitrary, it may also be realized by using the well-known method of lines or others methods. Both single and multiple waveguide discontinuities are calculated and the computed results are in good agreement with the literature. Examples of finite thickness waveguide discontinuities are also given. The proposed method may be readily used to calculate microstrip discontinuities. Extension to discontinuities of other types of transmission lines can also be performed.

Abstracts

Nonlinear Analysis of Microwave Superconductor Devices Using Full-Wave Electromagnetic Model

M.A. Megahed and S.M. El-Ghazaly. "Nonlinear Analysis of Microwave Superconductor Devices Using Full-Wave Electromagnetic Model." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2590-2599.

This paper presents a full electromagnetic wave analysis for modeling the nonlinearity in high temperature superconductor (HTS) microwave and millimeter-wave devices. The HTS nonlinear model is based on the Ginzburg-Landau theory. The electromagnetic fields associated with the currents on the superconducting structure are obtained using a three-dimensional full wave solution of Maxwell's equations. A three-dimensional finite-difference time-domain algorithm simultaneously solves the resulting equations. The entire solution is performed in time domain, which is a must for this type of nonlinearity analysis. The macroscopic parameters of the HTS, the super fluid penetration depth and the normal fluid conductivity, are calculated as functions of the applied magnetic field. The nonlinear propagation characteristics for HTS transmission line, including the effective dielectric constant and the attenuation constant, are calculated. As the power on the transmission line increases, the phase velocity decreases and the line losses increase. The nonlinearity effects on the current distributions inside the HTS, the electromagnetic field distributions, and the frequency spectrum are also analyzed.

Abstracts

A New Edge Element Analysis of Dispersive Waveguiding Structures

J. Tan and G. Pan. "A New Edge Element Analysis of Dispersive Waveguiding Structures." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2600-2607.

A new functional is rigorously selected for the edge element method to solve the 2 - D 1/2 guided wave problems. The variational formulation is derived from the vector wave equation without any assumption or simplifications, and therefore the formulation is the full-wave analysis. Moderate to heavy ohmic loss and dielectric loss are taken into account in a natural and consistent manner. As a result, finite cross-section of arbitrary shape and finite conductivity can be handled without imposing the impedance boundary condition (IBC). The IBC may no longer be held for high-speed microelectronics applications, where the cross-section dimension may have been in the same order of the skin depths of some frequency components. The propagation modes are obtained by solving the large scale generalized eigenvalue and eigenvector equations employing the subspace iteration method. The spurious modes are totally suppressed in the whole frequency range of interest. Numerical examples of dielectric waveguide, microstrip transmission lines with finite conductivity are conducted and compared with previous publications with good agreement.

Abstracts

Propagation Characteristics of Microstrip Transmission Line on an Anisotropic Material Ridge

G.W. Hanson. "Propagation Characteristics of Microstrip Transmission Line on an Anisotropic Material Ridge." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2608-2613.

A microstrip transmission line residing on an electrically anisotropic material ridge embedded in a multilayered environment is studied using a coupled set of integral equations (IE's). The full-wave IE formulation easily accommodates arbitrary material anisotropy and inhomogeneity in the finite ridge region using equivalent polarization currents residing in a multilayered isotropic background. New results are presented for uniaxially anisotropic ridge structures which show that the transmission line propagation constant is sensitive to anisotropy for certain ridge structures and insensitive for others, compared to the conventional line on an infinite substrate. Results are also presented for a transmission line printed on a nonreciprocal solid-state magnetoplasma ridge. The current distribution associated with the dominant microstrip mode is investigated, where it is found that the transverse component of current is much larger for the ridge geometry than for the infinite substrate case, although the transverse component is still small compared to the longitudinal component.

Abstracts

The Relationship Between Dual Mode Cavity Cross-Coupling and Waveguide Polarizers

R. Levy. "The Relationship Between Dual Mode Cavity Cross-Coupling and Waveguide Polarizers." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2614-2620.

Cross-coupling in dual-mode cavity filters may be obtained by introducing an asymmetry within the cavity cross section at an angle of 45° to the two orthogonal modes. This paper presents a novel formula relating the resulting cross coupling coefficient between the orthogonal resonances to the polarization of a waveguide polarizer. Previous theories for such polarizers may then be applied directly to the dual mode filter situation. Formulas enabling the dimensions of the asymmetries for required coupling coefficients are presented for square and circular waveguide cross sections.

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Multimode Network Analysis of Planar Transmission Lines

M. Guglielmi and A.A. Melcon. "Multimode Network Analysis of Planar Transmission Lines." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2621-2626.

An alternative approach for the full wave analysis of single or coupled planar transmission lines is presented. Following the proposed approach, a multiple (or single) transmission line structure is viewed as series of staked (or single) transverse discontinuities in a parallel plate waveguide. As a consequence, both top and side coupled structures can be studied. Each individual discontinuity is described in terms of a multimode equivalent network representation. The complete cross section of the planar transmission line structure is then described in terms of a transverse equivalent network and a simple transverse resonance technique is then used to obtain the dispersion behavior, the modal field of the structure, and the characteristic impedances. The multimode equivalent network representations of the individual discontinuities used in this paper have been derived elsewhere and are given in terms of impedance or admittance matrices that are essentially independent from frequency. As a result, they need to be computed only once for each given geometry thus leading to codes that are computationally very efficient.

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Combined Differential and Common-Mode Analysis of Power Splitters and Combiners

D.E. Bockelman and W.R. Eisenstadt. "Combined Differential and Common-Mode Analysis of Power Splitters and Combiners." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2627-2632.

Power splitter/combiner phase and magnitude imbalance is analyzed in terms of simultaneous orthogonal modes of propagation. These simultaneous modes are defined as differential and common-mode. A new measure of splitter imbalance is suggested in the common-mode rejection ratio (CMRR). Measured response of 180° hybrid splitter is represented in terms of the differential and common-mode responses, and the CMRR is calculated. Combiner imbalance is also analyzed in terms of differential and common-mode responses, and response metrics are suggested. Analytical expressions for CMRR of several common splitters is given as functions of phase and magnitude imbalance.

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Abstracts

Extended Cavity Perturbation Technique to Determine the Complex Permittivity of Dielectric Materials (Short Papers)

B. Meng, J. Booske and R. Cooper. "Extended Cavity Perturbation Technique to Determine the Complex Permittivity of Dielectric Materials (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2633-2636.

An improved measurement technique to determine the complex dielectric properties of materials has been developed that extends the validity of the conventional cavity perturbation technique for circular cylindrical rod-shaped samples in circular cylindrical cavities resonating in TM/sub 0n0/ modes. The method is particularly useful for the dielectric characterization of fragile, low-loss materials that are difficult to machine to typically required thin dimensions. The method further allows for multi-frequency measurements using higher-order radial modes and somewhat alleviates the very small cavity dimensions typically required by the conventional perturbation technique at higher microwave frequencies. A validity criterion for the extended method is given. Measurements of the complex permittivity of NaCl single crystals are presented, showing excellent agreement with theory.

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Characterization of Microstrip Discontinuities Using Conformal Mapping and the Finite-Difference Time-Domain Method (Short Papers)

S. Kapoor and J.B. Schneider. "Characterization of Microstrip Discontinuities Using Conformal Mapping and the Finite-Difference Time-Domain Method (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2636-2639.

Microstrip discontinuities are analyzed using Wheeler's waveguide model and the finite-difference time-domain (FDTD) method. Wheeler's model employs a conformal transformation to convert a microstrip into an enclosed waveguide structure. This permits the mapping of a discontinuous microstrip into a discontinuous, but enclosed, waveguide. The enclosed waveguide eliminates the difficulties usually associated with analysis of an open domain geometry. The FDTD technique is then used to calculate the scattering coefficients of the discontinuous waveguide. The features of this approach are: 1) it yields a smaller computational domain than that required to analyze the untransformed geometry; 2) it yields results over a band of frequencies; and 3) it is simple to implement. Results obtained using this scheme show good agreement with previously published results.

Abstracts

Scattering by a Thick Off-Centered Circular Iris in Circular Waveguide (Short Papers)

Z. Shen and R.H. MacPhie. "Scattering by a Thick Off-Centered Circular Iris in Circular Waveguide (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2639-2642.

A formally exact solution is described for the problems of scattering at a junction between two circular waveguides with their axes offset and at a thick off-centered iris in circular waveguide. The analysis method uses Graf's addition theorem for cylindrical functions and the conservation of complex power technique (CCPT). Sample numerical results are presented and compared with available data in the literature.

Abstracts

Modellization of Losses in TE/sub 011/-Mode Waveguide Bandpass Filters

A. Melloni and G.G. Gentili. "Modellization of Losses in TE/sub 011/-Mode Waveguide Bandpass Filters." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2642-2644.

A mode-matching technique for the analysis of TE/sub 011/ mode waveguide cylindrical bandpass filters including losses is presented, The modes of a lossy radial waveguide are derived and the generalized scattering matrix of the lossy cavity coupled by two rectangular apertures is computed enforcing an impedance boundary condition on the cavity sidewall. Cavity sidewall losses as well as top and bottom wall losses are therefore taken accurately into account. Numerical and experimental results are given for a four cavity filter in K/sub a/ band.

Abstracts

Call for Papers - Bridging the Spectrum (Nov. 1995 [T-MTT])

"Call for Papers - Bridging the Spectrum (Nov. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2645-2645.

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Call for Papers - Revolutionary Developments in Phased Arrays (Nov. 1995 [T-MTT])

"Call for Papers - Revolutionary Developments in Phased Arrays (Nov. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2646-2646.

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We're on the Web (Advertisement) (Nov. 1995 [T-MTT])

"We're on the Web (Advertisement) (Nov. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2647-2647.

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Frequently Asked Questions and Answers (Advertisement) (Nov. 1995 [T-MTT])

"Frequently Asked Questions and Answers (Advertisement) (Nov. 1995 [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.11 (Nov. 1995 [T-MTT]): 2648-2648.

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"Front Cover (Dec. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): f1-f2.

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Analysis of Rectangular Waveguide Junctions by the Method of Lines

W. Pascher and R. Pregla. "Analysis of Rectangular Waveguide Junctions by the Method of Lines." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2649-2653.

A novel discretization on two crossed line systems is introduced in the method of lines to analyze junctions in rectangular waveguides. This discretization is one-dimensional and replaces the two-dimensional discretization otherwise necessary for such structures. Hence the matrices encountered are small compared with other approaches. Equivalent circuits for the right-angle E-plane corner and scattering parameters for the asymmetric T-junction are presented, which agree very well with literature.

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Measuring the Permittivity and Permeability of a Sample at K/sub a/ Band Using a Partially Filled Waveguide

J.M. Jarem, J.B. Johnson, Jr. and W.S. Albritton. "Measuring the Permittivity and Permeability of a Sample at K/sub a/ Band Using a Partially Filled Waveguide." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2654-2667.

A novel method of measuring the relative complex permittivity (epsilon = epsilon' - j epsilon") and relative complex permeability (μ = μ' - jμ") of a material at K/sub a/ Band (26.5-40 GHz) using a partially filled waveguide (PFW) (rectangular) and a vector network analyzer (VNA) is presented. The method is based on 1) placing a material sample of length L, width a (waveguide width), and height d <= b (b is the waveguide height) in a rectangular waveguide, 2) measuring the S-parameters of the sample using the VNA, and 3) inferring the epsilon', epsilon", μ', and μ" parameters by comparing the experimental S-parameters with numerically generated S-parameters. The paper presents a method of moments analysis and also a variational formulation of the scattering that occurs from a finite length sample that partially fills a waveguide. Formulas to calculate the complex Poynting power and energy in the waveguide are derived to check the degree to which the numerical solutions obey the conservation of complex power. Numerical methods to extract the material parameters from the S-parameter data are proposed. The experimental PFW S-parameters of a radar absorbing material are measured and its dielectric material parameters are inferred.

Abstracts

Generators of Magnetic Groups of Symmetry and Commutation Relations

V.A. Dmitriyev. "Generators of Magnetic Groups of Symmetry and Commutation Relations." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2668-2675.

A general procedure is given for determining the matrices [S], [Z]. and [Y] of linear symmetrical multiports with gyromagnetic media. To obtain relations between the elements of the matrices, the color groups, the Curie principle, and the concept of gyrotropic symmetry (GS) and gyrotropic antisymmetry (GA) are used. Symmetries of the dc magnetic field are also considered. General properties of the multiports with GS and GA are discussed. Applications of the symmetry analysis are illustrated by two 3-D structures and some existent devices.

Abstracts

Numerical Implementation and Performance of Perfectly Matched Layer Boundary Condition for Waveguide Structures

Z. Wu and J. Fang. "Numerical Implementation and Performance of Perfectly Matched Layer Boundary Condition for Waveguide Structures." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2676-2683.

This paper presents some numerical implementation issues and the performance of Berenger's perfectly matched layer (PML) boundary condition for modeling wave propagation in waveguide structures by the finite-difference time-domain (FDTD) method, The relation between the thickness and the conductivity profile of the perfectly matched layer is studied and a guideline for the selection of PML parameters is given. It is shown that the standard Yee's time-marching scheme results in virtually the same numerical solution as the exponential time-marching scheme. Numerical tests are provided for parallel-plate and rectangular waveguides and microstrip lines. It is found that PML is very effective in absorbing TEM and quasi-TEM waves, as well as nonTEM waves somewhat above cutoff frequencies, but ineffective in absorbing evanescent waves and nonTEM waves near cutoff frequencies. The reason for the ineffectiveness of PML for absorbing evanescent waves is explained. Comparative study of PML and Higdon's boundary condition shows that high-order Higdon's boundary condition can reach the same performance of 16-cell PML and can be adjusted for absorbing evanescent waves, but PML is in general more robust to implement. Performance of the boundary condition obtained by combining PML and Higdon's boundary condition is evaluated.

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Graphite Millimeter-Wave Waveguide and Mirror for High Temperature Environments

P.P. Woskov and C.H. Titus. "Graphite Millimeter-Wave Waveguide and Mirror for High Temperature Environments." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2684-2688.

A graphite helix corrugated waveguide with a miter mirror has been fabricated and used for 135 GHz pyrometer measurements on a high temperature plasma arc furnace. The guide has an internal diameter of 3.81 cm, a length of 123 cm, and a corrugation of 32 grooves/inch. One end of the guide was sealed with a Teflon window having moth eye surfaces to reduce reflections. The room temperature insertion loss of this guide assembly for HE/sub 11/ mode propagation and launch was measured to be 0.5 ± 0.1 dB. It was used successfully in a high temperature environment where the miter mirror end reached incandescent temperatures in access of 1200° C. High temperature graphite surface corrosion typically increased the insertion loss to 1.2 ± 0.2 dB but did not significantly affect the beam divergence.

Abstracts

Quasi-TEM Study of Microshield Lines with Practical Cavity Sidewall Profiles

K.-K.M. Cheng and I.D. Robertson. "Quasi-TEM Study of Microshield Lines with Practical Cavity Sidewall Profiles." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2689-2694.

This paper presents the quasi-TEM characteristics of microshield lines with practical cavity sidewall profiles. A conformal mapping method is used for the derivation of the electrical parameters of the structures. In this study, numerical results for the characteristic impedances of air-suspended microshield lines with both positive and negative sidewall slopes are presented. Simple and explicit CAD-oriented expressions are proposed for the design and analysis of rectangular-shaped microshield line. Comparisons are made between the results obtained by these formulas and by a standard numerical technique. Furthermore, the sensitivities of the electrical parameters of a rectangular-shaped microshield line to an imperfect sidewall etching process, leading to nonvertical sidewall profiles, are also examined.

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A Quasi-Closed Form Expression for the Conductor Loss of CPW Lines, with an Investigation of Edge Shape Effects

C.L. Holloway and E.F. Kuester. "A Quasi-Closed Form Expression for the Conductor Loss of CPW Lines, with an Investigation of Edge Shape Effects." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2695-2701.

In previous work, we used a matched asymptotic technique to investigate the fields near an edge of a finitely conducting strip with nonzero thickness. It was demonstrated that with this asymptotic solution of the fields, the power loss in the region local to the edge could be determined accurately. In this paper, we will show how the accurate representation of the power loss can be used to obtain a closed form expression for the attenuation constant due to conductor loss of coplanar waveguide (CPW) structures. This expression is valid for an arbitrarily shaped edge and any conductor thickness. Results obtained with this expression are compared to and closely agree with both experimental results and other techniques found in the literature. We also investigated conductors with different edge shapes (45° and 90° edges) to explore their effect on the attenuation constant (or loss) of CPW structures.

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Multilayer Asymmetric Aperture-Coupled Broadside Microstrip Lines and Their Quasi-Static and Dynamic Analyses

S. Kunasani and C. Nguyen. "Multilayer Asymmetric Aperture-Coupled Broadside Microstrip Lines and Their Quasi-Static and Dynamic Analyses." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2702-2707.

This paper describes new multilayer aperture-coupled broadside microstrip lines suitable for miniaturized microwave and millimeter-wave integrated circuits. Spectral-domain method is used for detailed investigations of these structures, and both quasi-static and dynamic results are presented to illustrate the need of a full-wave analysis for accurate circuit designs at high frequencies. The new transmission lines possess many desirable features, such as flexibility in circuit design and ability to optimize various transmission lines' characteristics, as well as miniaturization by using thin dielectric layers. Besides having the inherent properties of large ratios for the mode characteristic impedances and effective dielectric constants found in broadside-coupled structures, we also found that the studied coupled transmission lines can have equal mode effective dielectric constants for certain values of the structural parameters.

Abstracts

Investigation of Periodic Structures in a Fin Line: A Space-Spectral Domain Approach (Short Papers)

N. Gupta and M. Singh. "Investigation of Periodic Structures in a Fin Line: A Space-Spectral Domain Approach (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2708-2710.

The space-spectral domain approach (SSDA) is for the analysis of the unilateral fin line with periodically utilized varying slot patterns. Two new type of structures in a unilateral fin line with sinusoidally and triangularly varying slot patterns are investigated using this approach.

Abstracts

Complex Solitons in a Superconductive Medium (Short Papers)

K. Hayata and M. Koshiba. "Complex Solitons in a Superconductive Medium (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2710-2713.

We show analytically that a type-II superconductor may support short-range electromagnetic spatial solitons with a complex propagation constant. A theoretical model based on the Ginzburg-Landau theory is used. Analytical results for the complex solitons predict unique features that cannot be found in conventional solitons in normal (superconductive) media.

Abstracts

On the Computation of Complex Modes in Lossless Shielded Asymmetric Coplanar Waveguides (Short Papers)

K.M. Rahman and C. Nguyen. "On the Computation of Complex Modes in Lossless Shielded Asymmetric Coplanar Waveguides (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2713-2716.

We compute complex modes in lossless shielded asymmetric coplanar waveguides (CPW's) using the spectral domain technique. The slot asymmetry is found to significantly affect the existence of the complex modes. These modes are found to exist at low microwave frequencies even when using materials with a low permittivity. We found that waveguide modes degenerate into complex modes more frequently than CPW (pi) and slotline (c) modes. When the structures are highly asymmetrical and when the dielectric substrates are thick or have a high permittivity, the degeneration of lower-order c-modes into complex modes is detected. Other forms of mode conversion, where a waveguide mode is converted to a c-mode, are also observed, especially in highly asymmetric structures and when using dielectric materials of a high permittivity or of a large thickness. Numerical convergence of the complex modes' propagation constants is also examined.

Abstracts

Simple and Accurate Solutions of the Scattering Coefficients of E-Plane Junctions in Rectangular Waveguides (Short Papers)

A. Widarta, S. Kuwauo and K. Kokubun. "Simple and Accurate Solutions of the Scattering Coefficients of E-Plane Junctions in Rectangular Waveguides (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2716-2718.

Simple and accurate solution of the scattering coefficients of the E-plane right-angle bend in rectangular waveguide is presented. The solution is obtained by the mode-matching method in which the electromagnetic fields in waveguides are matched with those in junction section formed by a sectoral region. In the same procedure, the solutions of the scattering coefficients of the E-plane T-junction and the cross junction can be also obtained easily. By using the numerical results, the scattering properties of the dominant modes and higher-order modes in the E-plane right-angle bend are examined in detail.

Abstracts

An Improved Modal Expansion Method for Two Cascaded Junctions and its Application to Waveguide Filters (Short Papers)

Z. Shen and R.H. MacPhie. "An Improved Modal Expansion Method for Two Cascaded Junctions and its Application to Waveguide Filters (Short Papers)." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2719-2722.

An improved modal expansion method is described for the scattering matrix of a cascaded network which consists of an enlargement junction combined with a reduction junction. The new method can significantly reduce computation time and requirement of computer memory. Application to iris coupled waveguide cavity filters is demonstrated. Numerical results for a rectangular waveguide cavity filter are given.

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Abstracts

Are Nonreciprocal Bi-Isotropic Media Forbidden Indeed? (Comments and Authors' Reply)

A. Lakhtakia and W.S. Weiglhofer. "Are Nonreciprocal Bi-Isotropic Media Forbidden Indeed? (Comments and Authors' Reply)." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): 2722-2724.

In a recent paper, Sihvola has cast doubt on our claim that all bi-isotropic media must be reciprocal. We show that Sihvola's doubt has no rational basis.

Abstracts

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"Back Cover (Dec. 1995, Part I [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part I [T-MTT]): b1-b2.

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Guest Editors' Overview (Dec. 1995, Part II [T-MTT])

A. Mortazawi and V. Nair. "Guest Editors' Overview (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2725-2727.

This Special Issue of the Transactions contains expanded versions of a selected number of papers that were presented at the 1995 International Microwave Symposium (IMS) and the Millimeter-Wave Monolithic Circuits Symposium (MMWMCS) held in Orlando, FL. This year out of a record number of expanded IMS submissions totaling 130 papers and 9 MMWMCS papers-40 IMS and 4 MMWMCS papers, respectively, were selected for publication in this Special Symposium Issue. The acceptance rate for the submitted papers was largely dictated by the page allocation set for this issue. It may be of interest to note that the number of papers submitted for the IMS issue has been increasing since 1991 (from 74 in 1991 to 130 in 1995), while the page limitations set for this special issue have not changed during this period.

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The 1995 IEEE MTT-S International Microwave Symposium: "Microwaves on the Move!" (Dec. 1995, Part II [T-MTT])

G.K. Huddleston and R.E. Henning. "The 1995 IEEE MTT-S International Microwave Symposium: "Microwaves on the Move!" (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2727-2730.

We are delighted to report the success of the 1995 IEEE International Microwave Symposium (IMS '95), held in Orlando May 14-19. The Orange County Convention Center did their part in hosting 6,482 attendees during Microwave Week, including 1,634 MTT-S attendees and 489 total exhibits. The Orlando Housing Bureau reserved 12,594 hotel room nights, and our 11 hotels reported 9,251 room nights actually used. Gray Line of Orlando provided convenient transportation to and from all events. We expect the financial outcome to reflect the success that was so evident at the meeting.

Abstracts

1995 MTT-S Awards (Dec. 1995, Part II [T-MTT])

"1995 MTT-S Awards (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2731-2739.

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1995 IMS Technical Program Presentation Recognitions

M. Tanenhaus and L. Brockman. "1995 IMS Technical Program Presentation Recognitions." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2740-2741.

This year's Symposium contained three types of presentation competitions. The first was the Student Paper Competition which followed an established format. The second resulted in a "Technical Program Chairman's Honor Roll" which recognizes the quality of the technical presentations. The third, and a new competition this year, resulted in a "Technical Program Chairman's Session Honor Roll" which recognizes the quality of sessions made up of a majority of quality papers.

Abstracts

The Ring-Network Circulator for Integrated Circuits: Theory and Experiments

J.A. Weiss, G.F. Dionne and D.H. Temme. "The Ring-Network Circulator for Integrated Circuits: Theory and Experiments." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2742-2747.

The theoretical model of a ring network junction circulator introduced in 1965 is reexamined and further elaborated, in view of its prospects for compatibility with accomplished and anticipated advances in microcircuit technology. Following a brief review of the theory, solutions are presented to illustrate the potential for novel, efficient designs with options including miniature, self-magnetized, reversible, broadband superconducting, or other advantageous characteristics. New experimental models are showing good conformance to theoretical predictions for this promising alternative circulator design concept.

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Abstracts

Wide-Band Reduced-Size Uniplanar Magic-T, Hybrid-Ring, and de Ronde's CPW-Slot Couplers

L. Fan, C.-H. Ho, S. Kanamaluru and K. Chang. "Wide-Band Reduced-Size Uniplanar Magic-T, Hybrid-Ring, and de Ronde's CPW-Slot Couplers." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2748-2757.

New reduced-size uniplanar magic-T and hybrid-ring coupler suitable for MIC's and MMIC's have been developed using a CPW-slotline ring that is 20% smaller than comparable designs. These circuits provide good amplitude and phase characteristics over a broad bandwidth. Experimental results show that the hybrid-ring coupler has a 1.3 octave bandwidth centered at 4 GHz and the magic-T has a bandwidth of 1.6 octave from 2-6 GHz. Both have a maximum power dividing imbalance of 0.4 dB and a 2.5° maximum phase imbalance. Also a new uniplanar de Ronde's CPW-slot directional coupler was developed with good performance. The even-odd mode analysis of four-port networks with double symmetry was used to analyze this coupler. A de Ronde's coupler with 5 dB coupling was designed and demonstrated over the frequency range of 2.4-3.4 GHz. The measurement results agree with the theoretical design.

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The Effects of the Coupled Slotline Mode and Air-Bridges on CPW and NLC Waveguide Discontinuities

C.-Y. Lee, Y. Liu and T. Itoh. "The Effects of the Coupled Slotline Mode and Air-Bridges on CPW and NLC Waveguide Discontinuities." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2758-2764.

The extended spectral domain analysis is applied to analyze symmetrical and asymmetrical coplanar and non-leaky coplanar waveguide discontinuities. The three-dimensional dyadic Green's function is derived first to calculate the contributions of horizontal (vertical) magnetic (electrical) currents. No air-bridges are needed if the discontinuity is symmetrical. It is shown that the coupled slotline (CSL) mode excited by asymmetrical discontinuities drastically affects the CPW circuit performance. The effect of air-bridges used to suppress the unwanted CSL mode is studied. Experimental data agree very well with numerical results for CPW discontinuities. In addition, the discontinuities of a novel conductor-backed CPW structure, the nonleaky coplanar (NLC) waveguide, are also investigated. From experiment, it is found that the SMA-to-NLC transition causes power leakage. Except for the small leakage, theoretical and experimental results agree well.

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Abstracts

Computer and Measurement Simulation of a New Digital Receiver Operating Directly at Millimeter-Wave Frequencies

J. Li, R.G. Bosisio and K. Wu. "Computer and Measurement Simulation of a New Digital Receiver Operating Directly at Millimeter-Wave Frequencies." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2765-2771.

A novel digital millimetric receiver (DMR) scheme is introduced. Using a six-port phase/frequency discriminator (SPD) in conjunction; with a digital signal processor (DSP), the receiver performs various PSK and QAM demodulations directly at microwave and millimeter-wave frequencies. An important feature of the new DMR is that hardware imperfections such as phase/amplitude imbalance are readily eliminated by a simple calibration procedure. The concept is proved through computer simulation and measurements at 26.5 GHz. This receiver scheme is proposed for small/medium capacity digital terminals typical found in various wireless communication networks.

Abstracts

A Monolithic AlGaAs/InGaAs Upconverter IC for K-Band Wireless Networks

M. Madihian, L. Desclos, K. Maruhashi, K. Onda and M. Kuzuhara. "A Monolithic AlGaAs/InGaAs Upconverter IC for K-Band Wireless Networks." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2772-2777.

This paper concerns with the design consideration, fabrication process, and performance of a CPW heterojunction FET (HJFET) upconverter MMIC for K-band wireless system applications. To realize a mixer featuring a simple structure with inherently isolated ports, and yet permitting independent port matching and low LO power operation, a "source injection" concept is introduced by treating the FET as a three-port device in which the IF and LO signals are, respectively, applied to the gate and source terminals, and RF signal is extracted from the drain terminal. The upconverter chip incorporates an HJFET as a mixing element, an IF matching network, an LO matching network, an RF matching network, and an output filter. The upconverter can operate with an LO power level as low as -16 dBm for IF signals in 1.5-2.5 GHz band, and LO signals in 20-23 GHz band. Including a 3 dB pass-band insertion loss of the filter, the upconverter exhibits a maximum conversion gain of -6 dB for an IF power of -5 dBm at 1.9 GHz, and an LO power of 10 dBm at 21.5 GHz. LO suppression at IF and RF ports, respectively, is better than 22 dB and 20 dB, and IF suppression at RF port is better than 35 dB.

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Millimeter-Wave Fresnel-Zone Plate Lens and Antenna (Dec. 1995, Part II [T-MTT])

H.D. Hristov and M.H.A.J. Herben. "Millimeter-Wave Fresnel-Zone Plate Lens and Antenna (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2778-2784.

A new variety of millimeter-wave Fresnel-zone plate lens with enhanced focusing quality is described. Each full-wave zone of the lens is divided into four quarter-wave subzones, which are covered by dielectric rings having equal thickness but different permittivities. More practical equations are derived for the radii of the zones, and for the thickness of the lens by taking into account the angle of incidence of the electromagnetic wave. A Fresnel-zone plate antenna (FZPA) consisting of a quarter-wave lens and a scalar feed is developed and analysed theoretically. Equations for the aperture field and far field are derived using multiple ray tracing through dielectric plates and vectorial Kirchhoff diffraction theory, respectively. It is demonstrated that the proposed transmissive-type FZPA has an aperture efficiency of more than 50% in the 60 GHz frequency band. This computed efficiency agree with the measured overall efficiency reported by other researchers for an X-band quarter-wave reflector-type FZPA.

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Comparison Between Beryllium-Copper and Tungsten High Frequency Air Coplanar Probes (Dec. 1995, Part II [T-MTT])

J.-L. Carbonero, G. Morin and B. Cabon. "Comparison Between Beryllium-Copper and Tungsten High Frequency Air Coplanar Probes (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2785-2792.

High frequency air coplanar probes using tungsten tips are now available for silicon wafer probing with aluminum pads. A comparative study of the beryllium-copper and tungsten behavior is presented in terms of contact resistance values, stability and reproducibility. The contact theory is summarized for practical purposes and probe cleaning methods are exposed. Finally, tungsten is demonstrated to be the best material for breaking the aluminum oxide over the pad to enable accurate high frequency probing.

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Abstracts

An Accurate and Efficient Entire-Domain Basis Galerkin's Method for the Integral Equation Analysis of Integrated Rectangular Dielectric Waveguides

G. Athanasoulias and N.K. Uzunoglu. "An Accurate and Efficient Entire-Domain Basis Galerkin's Method for the Integral Equation Analysis of Integrated Rectangular Dielectric Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2793-2803.

The propagation characteristics of multiple coupled rectangular dielectric waveguides are investigated through an integral equation analysis. In contrast with the widely used subdomain-basis Galerkin's method, in this work a novel set of entire-domain basis functions is introduced. This set consists of plane wave functions that satisfy Maxwell's equations in each guiding region, therefore representing a proper expansion system. The simple form of the basis functions employed enables the accurate numerical evaluation of the spectral integrals, by means of an efficient asymptotic extraction technique. It is found that the computed dispersion curves presented for various single and coupled waveguides compare very favorably to published results of other methods. Finally, leakage effects in lossy waveguides are numerically treated for the first time, in view of mode transitions from leaky to bound regime. The technique presented in this paper is accurate, though conceptually simple, and can deal with a wide variety of integrated circuits and multilayered substrate configurations. It is also demonstrated that its main advantage is superior computational efficiency, since very satisfactory results are obtained with only a few expansion terms.

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Abstracts

Modeling of Generalized Coaxial Probes in Rectangular Waveguides

H.-W. Yao and K.A. Zaki. "Modeling of Generalized Coaxial Probes in Rectangular Waveguides." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2804-2810.

A rigorous approach combining the orthogonal expansion method for modeling cylindrical posts in rectangular waveguides and the extension of the three short plane technique is introduced to obtain the S-matrix for a general coaxial probe in a rectangular waveguide. A cascading procedure is applied to solve the problem of a probe near a waveguide discontinuity and to obtain the response of a probe-excited band pass filter. The computed results are in excellent agreement with the measured results showing the usefulness of this method.

Abstracts

An MMIC Low-Distortion Variable-Gain Amplifier Using Active Feedback (Dec. 1995, Part II [T-MTT])

K. Nishikawa and T. Tokumitsu. "An MMIC Low-Distortion Variable-Gain Amplifier Using Active Feedback (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2811-2815.

A new low-distortion variable-gain amplifier (VGA) is proposed and analyzed. The VGA's gain is controlled through changing the transconductance of a common-drain FET (CDF) in the negative feedback path. The analysis and prototype results indicate that the third-order intermodulation-distortion ratio is greatly improved at high input-power levels due to a drastic reduction in the VGA's input impedance and the CDF's unilateral characteristic. The gain in a wide temperature range maintains stability due to the combination effect of the transconductances of the CDF and the amplifying FET. This CDF feedback VGA is very useful for developing a wide-dynamic range front-end MMIC. The noise and thermal performances were also measured.

Abstracts

Mixed Modes Cylindrical Planar Dielectric Resonator Filters with Rectangular Enclosure (Dec. 1995, Part II [T-MTT])

C. Wang, H.-W. Yao, K.A. Zaki and R.R. Mansour. "Mixed Modes Cylindrical Planar Dielectric Resonator Filters with Rectangular Enclosure (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2816-2822.

A compact mixed modes cylindrical planar dielectric resonator filter in a rectangular enclosure is presented. Space coupling between the resonators excited in different modes and iris coupling between the identical resonators are realized in the filter. All the couplings and resonant frequencies of the DR cavities are computed by a rigorous full wave mode matching method and a cascading procedure using generalized scattering matrices. A 6-pole elliptic function filter is designed and constructed, and the measured filter frequency responses verify the theory.

Abstracts

Full Wave Modeling of Conducting Posts in Rectangular Waveguides and its Applications to Slot Coupled Combline Filters

H.-W. Yao, K.A. Zaki, A.E. Atia and R. Hershtig. "Full Wave Modeling of Conducting Posts in Rectangular Waveguides and its Applications to Slot Coupled Combline Filters." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2823-2829.

A full wave model of conducting posts in rectangular waveguides yielding their generalized S-matrix is presented. By cascading the generalized scattering matrices of the posts and waveguide discontinuities, slot couplings between two combline resonators are obtained. The validation and accuracy of the method are confirmed by comparing the numerical results with measured data. It is shown that both electric and magnetic couplings can be obtained by changing the slot positions, and the electric coupling is more sensitive to the tuning screw than magnetic coupling, A 6-pole slot coupled combline filter with asymmetrical transmission zeros is designed and built. Excellent filter responses are obtained.

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The Effect of Substrate Anisotropy on the Dominant-Mode Leakage from Stripline with an Air Gap (Dec. 1995, Part II [T-MTT])

D. Nghiem, J.T. Williams, D.R. Jackson and A.A. Oliner. "The Effect of Substrate Anisotropy on the Dominant-Mode Leakage from Stripline with an Air Gap (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2830-2837.

The fundamental properties of dominant leaky modes that exist on stripline structures having a small air gap above the conducting strip and uniaxial anisotropic substrates are investigated. These dominant leaky modes are modes that have a quasi-TEM strip current and are often strongly excited by conventional stripline feeds. The leakage occurs into the TM/sub 0/ parallel-plate mode of the background structure and results in undesirable crosstalk and spurious stripline performance. The properties of the leaky modes are examined for substrates that are either positive or negative uniaxial, and new physical effects introduced by the substrate anisotropy are discussed. The effects of replacing the air gap above the strip with an isotropic or uniaxial anisotropic bonding film are also discussed, and it is shown that the leakage may be eliminated by a proper choice of bonding film material, depending on the type of substrate anisotropy.

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A GaAs Power Amplifier for 3.3 V CDMA/AMPS Dual-Mode Cellular Phones

S.-J. Maeng, S.-S. Chun, J.-L. Lee, C.-S. Lee, K.-J. Youn and H.-M. Park. "A GaAs Power Amplifier for 3.3 V CDMA/AMPS Dual-Mode Cellular Phones." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2838-2843.

For CDMA/AMPS dual-mode cellular phones, a power amplifier operating at 3.3 V has been developed for the first time. It consists of linear GaAs power MESFET's and an output matching circuit which reduces the second and the third harmonics. The amplifier shows an output power of 31.5 dBm and a power-added efficiency of 61% for AMPS mode. The third-order intermodulation distortion and the fifth-order one are measured to be -32 dBc and -45 dBc at an output power of 26 dBm for CDMA mode.

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Three-Dimensional Passive Circuit Technology for Ultra-Compact MMIC's (Dec. 1995, Part II [T-MTT])

M. Hirano, K. Nishikawa, I. Toyoda, S. Aoyama, S. Sugitani and K. Yamasaki. "Three-Dimensional Passive Circuit Technology for Ultra-Compact MMIC's (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2844-2849.

A novel passive circuit technology of a three-dimensional (3-D) metal-insulator structure is developed for ultra-compact MMIC's. By combining vertical passive elements, such as a wall-like microwire for shielding or coupling, and a pillar-like via connection with multilayer passive circuits, a 3-D passive circuit structure is formed to implement highly dense and more functional MMIC's. O/sub 2//He RIE for forming trenches and holes in a thick polyimide insulator, low-current electroplating for foming gold metal sidewalls in the trenches or holes, and ion-milling with a WSiN stopper layer for patterning the gold metal are used to produce such a structure. The complete 3-D structure provides miniature microstrip lines effectively shielded with a vertical metal-wall, a miniature balun with low-loss vertical wall-like microwires, and inverted microstrip lines jointed with pillar-like vias through a thick polyimide layer. This technology stages next-generation ultra-compact MMIC's by producing various functional passive circuits in a very small area.

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Abstracts

Direct-Synthesis Design Technique for Nonlinear Microwave Circuits

P. Colantonio, F. Giannini, G. Leuzzi and E. Limiti. "Direct-Synthesis Design Technique for Nonlinear Microwave Circuits." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2850-2854.

A novel design technique for the direct synthesis of large-signal microwave circuits is presented. It is based on an equivalent linear representation of the nonlinear circuit directly derived from an exact nonlinear analysis method, e.g., of the harmonic balance type. Linear, direct synthesis methods are then applied to this equivalent network. The drawbacks of nonlinear optimization are so avoided, while keeping the advantages of exact nonlinear analysis and accurate nonlinear models.

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Abstracts

Generation and Detection of Picosecond Electric Pulses with Freely Positionable Photoconductive Probes

T. Pfeifer, H.-M. Heiliger, H.G. Roskos and H. Kurz. "Generation and Detection of Picosecond Electric Pulses with Freely Positionable Photoconductive Probes." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2855-2861.

Two different kinds of external photoconductive probes are investigated in detail. Their dual character in application as generators or detectors of picosecond electric transients is demonstrated. The probes are manufactured on transparent silicon-on-sapphire substrates suitable for on-wafer testing of integrated circuits. A detailed analysis of the freely positionable probes is performed in time domain with respect to linearity, sensitivity, time resolution and invasiveness.

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Novel Single Device Balanced Resistive HEMT Mixers

K. Yhland, N. Rorsman and H.H.G. Zirath. "Novel Single Device Balanced Resistive HEMT Mixers." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2862-2866.

A family of novel single device balanced resistive HEMT mixers has been designed and characterized. The RF is fed through a 180° balun. The IF is extracted either by a 180° balun or single ended. The main advantages of this type of mixer are that no device pairing is necessary, since only one HEMT is used and that no RF and LO grounding is necessary. These advantages make the described topology particularly suitable for microstrip MIC's, MMIC's, crossbar, fin-line and quasi optical mixers. The mixers are designed for RF 17.5-20 GHz, the LO is wideband and the IF is 1-2 GHz. Measurements show a conversion loss of 6 to 8 dB and an LO to RF isolation of up to 37 dB (typically 20 dB).

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New Uniplanar Transitions for Circuit and Antenna Applications

N.I. Dib, R.N. Simons and L.P.B. Katehi. "New Uniplanar Transitions for Circuit and Antenna Applications." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2867-2872.

New uniplanar microstrip-to-slotline, microstrip-to-coplanar strips (CPS) and microstrip-to-coplanar waveguide (CPW) transitions for MIC/MMIC and slotline antennas for phased array applications are described. Such transitions are compact and suitable to be used in an open environment or inside a package or a multichip module. The transitions share the concept of using a balun which consists of two microstrip lines connected to a slotline through a pair of coupled microstrips. In this paper, the transitions are studied theoretically using the Finite Difference Time Domain (FDTD) technique and measured experimentally using an HP8510C Network Analyzer. For a back-to-back microstrip-to-slotline transition, an insertion loss of less than 1.3 dB per transition is achieved over a 49% bandwidth with a minimum of 0.6 dB around the design frequency.

Abstracts

Electromagnetic Optimization Exploiting Aggressive Space Mapping

J.W. Bandler, R.M. Biernacki, S.H. Chen, R.H. Hemmers and K. Madsen. "Electromagnetic Optimization Exploiting Aggressive Space Mapping." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2873-2881.

We propose a significantly improved space mapping (SM) strategy for electromagnetic (EM) optimization. Instead of waiting for upfront EM analyses at several base points, our new approach aggressively exploits every available EM analysis, producing dramatic results right from the first step. We establish a relationship between the novel SM optimization and the quasi-Newton iteration for solving a system of nonlinear equations. Approximations to the matrix of first-order derivatives are updated by the classic Broyden formula. A high-temperature superconducting microstrip filter design solution emerges after only six EM simulations with sparse frequency sweeps. Furthermore, less CPU effort is required to optimize the filter than is required by one single detailed frequency sweep. We also extend the SM concept to the parameter extraction phase, overcoming severely misaligned responses induced by inadequate empirical models. This novel concept should have a significant impact on parameter extraction of devices.

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A Stretched Coordinate Technique for Numerical Absorption of Evanescent and Propagating Waves in Planar Waveguiding Structures (Dec. 1995, Part II [T-MTT])

M.A. Gribbons, W.P. Pinello and A.C. Cangellaris. "A Stretched Coordinate Technique for Numerical Absorption of Evanescent and Propagating Waves in Planar Waveguiding Structures (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2882-2888.

Berenger's PML technique is modified to allow for the absorption of evanescent and propagating waves in FDTD modeling of wave propagation in planar waveguiding structures. Analytic results illustrate the validity and capability of the proposed modification. Numerical studies explain the numerical implementation of the modified PML in the FDTD and in the compact 2D-FDTD algorithms. Guidelines for the proper selection of the various parameters that govern the performance of the modified PML are presented. The results from simulations indicate that the proposed modified PML grid truncation can be used efficiently for highly accurate numerical analysis of planar waveguiding structures.

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Stability Analysis for Large Signal Design of a Microwave Frequency Doubler

S. Basu, S.A. Maas and T. Itoh. "Stability Analysis for Large Signal Design of a Microwave Frequency Doubler." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2889-2897.

Microwave circuits such as frequency doublers are notorious for instabilities under parametric variation. The instabilities manifested in the doubler are due to the minority carrier lifetime of the pn junction diode. They are calculated using a simpler stability formulation. A global stability chart is computed using a novel techuique called the piecewise stability analysis (PSA) method and found to be in close agreement with the experimental values. These instabilities are characterized by secondary Hopf bifurcations and their eventual breakdown to chaos has been observed. The onset of Hopf bifurcation has been verified both experimentally and numerically.

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Waveform-Based Modeling and Characterization of Microwave Power Heterojunction Bipolar Transistors

C.-J. Wei, Y.E. Lan, J.C.M. Hwang, W.-J. Ho and J.A. Higgins. "Waveform-Based Modeling and Characterization of Microwave Power Heterojunction Bipolar Transistors." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2898-2902.

A waveform measurement technique has been successfully used to extract the large-signal nonlinear characteristics of microwave power heterojunction bipolar transistors. The extracted model parameters were compared to those extracted from dc and small-signal parameters in a conventional manner. It was found that, for high input drive conditions, the present model predicts a much longer collector transit time than the conventional model. Therefore, the present model is more consistent with the physical structure of the transistors and more suitable for evaluating future design improvement.

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Abstracts

Cascaded Active and Passive Quasi-Optical Grids

W.A. Shiroma, S.C. Bundy, S. Hollung, B.D. Bauernfeind and Z.B. Popovic. "Cascaded Active and Passive Quasi-Optical Grids." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2903-2908.

A general method for analyzing systems of cascaded grids is presented. The analysis is based on a full-wave theory for arbitrary periodic metal gratings printed on dielectrics and loaded with active and/or passive lumped devices. Each quasi-optical component is characterized as a multiport network, in which two of the ports represent the free-space regions on the two sides of the grid surface, and the remaining ports are connected to the devices. This approach allows cascading of quasi-optical components using transmission-line theory. Several examples are presented which demonstrate the theory: free-space filters containing lumped capacitors and resistors; an X-band transmission-mode linear-to-circular polarization converter; an S-band voltage-controlled frequency-selective surface; and a C-band mode-selective grid oscillator.

Abstracts

Modeling of Cascaded Coplanar Waveguide Discontinuities by the Mode-Matching Approach

R. Schmidt and P. Russer. "Modeling of Cascaded Coplanar Waveguide Discontinuities by the Mode-Matching Approach." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2909-2916.

Cascaded coplanar waveguide discontinuities with transverse dimensions in the order of some micrometers are analyzed by the mode-matching and generalized scattering matrix method. This approach permits a full-wave analysis of the electromagnetic field also in the metallic regions. Compared with full-wave analysis assuming perfect conductors and a subsequent loss computation based on the surface impedance model the accuracy is considerably enhanced. The mode-matching method is revisited in the context of a network representation of discontinuities. The implications of Tellegen's general network theorem on the mode-matching method, particularly on the testing functions, are investigated. Furthermore, the mode-matching method is related to the equivalence principle applied to discontinuites and to the continuity condtion of voltage and current of quasi-TEM waves in the static approximation.

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GaAs FET's Gate Current Behavior and its Effects on RF Performance and Reliability in SSPA's

N. Constantin and F.M. Ghannouchi. "GaAs FET's Gate Current Behavior and its Effects on RF Performance and Reliability in SSPA's." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2917-2924.

This paper presents a detailed experimental investigation of gate current limitation effects on power GaAs FET's rf performances. This limitation is accomplished entirely by dynamic compensation of the gate bias voltage. Effects of this current limitation on power added efficiency and output power performances have been examined through an extensive experimental investigation using active second-harmonic loading over the entire Smith chart. Comprehensive results are given and enable the determination of the optimal gate resistor value needed in the dc path for gate current limitation. Thermal runaway problem is also considered when selecting the gate resistor. The current limitation mechanism is analyzed in the case where the gate voltage is controlled in a feedback loop for linearization purposes. Measurements performed on a feedback linearized amplifier are presented and show the behavior of the gate current and its effects on intermodulation product levels.

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MMIC Active Bandpass Filters Using Varactor-Tuned Negative Resistance Elements

U. Karacaoglu and I.D. Robertson. "MMIC Active Bandpass Filters Using Varactor-Tuned Negative Resistance Elements." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2925-2931.

This paper describes techniques for realizing microwave active filters using single transistor active resonators in a negative resistance configuration. The negative resistance topologies for both bipolar (AIGaAs/GaAs HBT) and FET (MESFET or HEMT) devices are studied and compared. The essence of the technique is that the input reactance of the transistor circuit resonates with an external capacitor or inductor, whilst the negative resistance is used to compensate for the losses in the resonator. It is shown that the FET device is ideally suited for this application as it can have a varactor-controlled negative resistance component. Three-stage and two-stage monolithic varactor-tuned bandpass filters have been demonstrated using this technique. The measured response of the three-stage filter exhibits a 120 MHz 3 dB-bandwidth centered on 2.3 GHz, 0dB insertion loss with only ±0.1 dB ripple in the pass-band, up to 100 dB of stop-band attenuation at low frequencies, and over 50 dB of rejection up to 6 GHz. The two-stage filter exhibits a 400 MHz 3 dB-bandwidth centered on 4.7 GHz, with tunable insertion gain and only ±0.1 dB ripple in the pass-band.

Abstracts

Development of Miniature Filters for Wireless Applications (Dec. 1995, Part II [T-MTT])

K.M. Lakin, G.R. Kline and K.T. McCarron. "Development of Miniature Filters for Wireless Applications (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2932-2938.

Miniature filters have been under development for wireless applications from 500 MHz to over 6 GHz using thin piezoelectric films on common substrates. This paper discusses recent results in the development of miniature filters using a solidly mounted resonator (SMR) concept wherein the acoustic resonator is isolated from the substrate with a sequence of quarter wavelength thick layers that form a reflector. The SMR concept is discussed in detail and applications to filters is presented. Ladder filters have been demonstrated with insertion losses in the 3 dB range using aluminum nitride films for the piezoelectric and appropriate substrates such as silicon, sapphire, and glass. The ladder filters reported consist of interconnected series and shunt resonators forming a monolithic structure on a single die of comparable size to an integrated circuit.

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Direct Synthesis of Cascaded Quadruplet (CQ) Filters (Dec. 1995, Part II [T-MTT])

R. Levy. "Direct Synthesis of Cascaded Quadruplet (CQ) Filters (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2939-2944.

Previous designs for CQ filters have required matrix rotation operations on the coupling matrix of the canonic form of the cross-coupled filters. This is a rather awkward and not entirely satisfactory process since the theory is not general, requiring the application of equations specific to each order of filter, and in fact has been developed only as far as even order 10. A new direct CQ synthesis has now been discovered having no such limitations. It is shown how the synthesis may be carried out by applying a new equivalent circuit identity to transform a lumped element filter into a cross-coupled CQ filter.

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Novel Design Topology for Ultra Low Power Down Converters with Broadband on Chip Matching Network (Dec. 1995, Part II [T-MTT])

M.L. Schmatz, U. Lott, W. Baumberger and W. Baechtold. "Novel Design Topology for Ultra Low Power Down Converters with Broadband on Chip Matching Network (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2945-2950.

A novel design topology for ultra low power receivers and down converters has been developed. Using this topology, a monolithic L-band down converter consisting of an input amplifier and a double balanced mixer has been implemented with a standard 0.7 µm GaAs-MESFET process. The circuit has a single ended 50 Omega input and differential outputs offering totally more than 40 dB voltage conversion gain at 1 GHz and 30 dB at 2 GHz. It is supplied by a single lithium cell and has a dc power consumption of less than 2.0 mW at 2.7 V. Through a more exact modeling of the parasitic capacitance of n-implanted resistors an improved agreement between measurement and simulation was achieved. Finally, the determination of the noise figure at a high impedance output from a 50 Omega measurement is presented.

Abstracts

Source Second-Harmonic Control for High Efficiency Power Amplifiers

M. Maeda, H. Masato, H. Takehara, M. Nakamura, S. Morimoto, H. Fujimoto, Y. Ota and O. Ishikawa. "Source Second-Harmonic Control for High Efficiency Power Amplifiers." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2951-2957.

A novel technology that drastically improves output power and efficiency of amplifiers has been developed, where source and load second-harmonic impedances, as well as the fundamental impedances, are optimally terminated in the input and output matching circuits. A record high 74% power-added efficiency (PAE) with 31.4 dBm (1.4 W) output power at a frequency of 930 MHz has been achieved as a single-stage saturated amplifier using an ion-implanted GaAs MESFET under the low supply voltage of 3.5 V. As a single-stage linear amplifier, an excellent PAE of 59% with 31.5 dBm output power has been realized at V/sub d/ = 4.7 V and f = 948 MHz. Saturated and linear two-stage power modules operating at 900 MHz band with 31 dBm (1.25 W) output power have been demonstrated for analog and digital cellular applications respectively, the volume of which is as small as 0.4 cc. The saturated power module has achieved a PAE of 66% at V/sub d/ = 3.5 V, and the linear one has realized a PAE of 50% at V/sub d/ = 4.7 V.

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Abstracts

Spectral-Domain Analysis of Radiating Cylindrical Dielectric Resonator for Wireless Communications

T. Wang, H. An, K. Wu, J.-J. Laurin and R.G. Bosisio. "Spectral-Domain Analysis of Radiating Cylindrical Dielectric Resonator for Wireless Communications." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2958-2963.

A novel class of leaky-mode cylindrical dielectric resonators including mounting holder and radial-step has been recently proposed as a feed structure for omnidirectional antennas that are suitable for wireless communication systems. In this work, a spectral-domain modeling is developed and used for analysis of these composite cylindrical dielectric resonators considering single and double radiating slots. The dielectric resonators are bounded between two parallel conducting plates so that leaky-wave propagation takes place under some electrical and geometricrd conditions. Results and discussion are focused on the properties of low-order leaky TM-modes. Influences of various structural parameters on resonant frequency and quality factor of leaky dielectric resonators are presented in detail, A set of experiments are made to verify the proposed theoretical approach.

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Abstracts

Analysis and Design of Full-Band Matched Waveguide Bends

M. Mongiardo, A. Morini and T. Rozzi. "Analysis and Design of Full-Band Matched Waveguide Bends." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2964-2970.

Compact waveguide bends with low return loss over the full waveguide band width are realized by placing properly selected discontinuities inside the curve. The component is designed by using an extremely efficient computer code which employs the local modes approach to analyze curved sections, while discontinuities are rigorously accounted for by considering their multimode equivalent circuit. A simple technique to select the appropriate matching elements is described and examples of full-band matched bends are provided.

Abstracts

Empirical Modeling of Low-Frequency Dispersive Effects Due to Traps and Thermal Phenomena in III-V FET's (Dec. 1995, Part II [T-MTT])

F. Filicori, G. Vannini, A. Santarelli, A.M. Sanchez, A. Tazon and Y. Newport. "Empirical Modeling of Low-Frequency Dispersive Effects Due to Traps and Thermal Phenomena in III-V FET's (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2971-2980.

The modeling of low-frequency dispersive effects due to surface state densities, deep level traps and thermal phenomena plays an important role in the large-signal performance prediction of III-V FET's. This paper describes an empirical modeling approach to accurately predict deviations between static and dynamic drain current characteristics caused by dispersive effects in III-V devices operating at microwave frequencies. It is based on reasonable assumptions and can easily be embedded in nonlinear FET models to be used in Harmonic-Balance tools for circuit analysis and design. Experimental and simulated results, for HEMT's and GaAs MESFET's of different manufacturers, that confirm the validity of the new approach, are presented and discussed together with the characterization procedures required.

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Full-Wave Modal Analysis of Arbitrarily-Shaped Dielectric Waveguides through an Efficient Boundary-Element-Method Formulation (Dec. 1995, Part II [T-MTT])

C. Di Nallo, F. Frezza and A. Galli. "Full-Wave Modal Analysis of Arbitrarily-Shaped Dielectric Waveguides through an Efficient Boundary-Element-Method Formulation (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2981-2989.

In this work an original procedure, based on the boundary element method (BEM), is carried out for the full-wave modal analysis of dielectric waveguiding structures with arbitrary cross section. A novel integral-equation formulation is developed after a careful analysis of the discontinuities in the dyadic kernel. Numerical solutions are then achieved and tested for both conventional and the new algorithms. Results for several important practical structures are obtained and compared to data from other numerical approaches and from measurements, to emphasize the accuracy, efficiency, and versatility of the new implementation.

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Abstracts

Normal-Mode Analysis of Ferrite-Coupled Lines Using Microstrips or Slotlines

C.S. Teoh and L.E. Davis. "Normal-Mode Analysis of Ferrite-Coupled Lines Using Microstrips or Slotlines." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2990-2997.

A normal-mode analysis of a pair of axially-magnetized ferrite-coupled lines (FCL) is presented for the first time. This normal-mode method, as opposed to the coupled-mode method, will permit optimization of propagation characteristics and impedance-matching. Also, the finite element solution of the normal modes can be used to obtain the field distribution to assist suitable placement of ferrite for device applications. Potential applications include a novel 4-port distributed microstrip circulator which may have advantages over junction devices at millimetric wavelengths. Optimum normal-mode conditions for the use of the FCL as a component in the distributed circulator are derived, and the design procedure for microstrip FCL is presented for the first time.

Abstracts

Calibrated Measurements and Nonlinearity Compensation of Narrowband Amplifiers

T. Van den Broeck. "Calibrated Measurements and Nonlinearity Compensation of Narrowband Amplifiers." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 2998-3005.

A vectorial nonlinear-network analyzer (VNNA) is absolutely calibrated in amplitude and phase for narrowband measurements of nonlinearities. Calibration is performed with a reference generator, characterized with a calibrated sampling oscilloscope. The reference signal, consisting of an unconverted baseband signal, is optimized for high signal-to-noise ratio measurements. Using the calibrated VNNA, narrowband amplifiers can be measured, enabling compensation of intermodulation and crossmodulation.

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Simultaneous Propagation of Bound and Leaky Dominant Modes on Printed-Circuit Lines: A New General Effect (Dec. 1995, Part II [T-MTT])

H. Shigesawa, M. Tsuji and A.A. Oliner. "Simultaneous Propagation of Bound and Leaky Dominant Modes on Printed-Circuit Lines: A New General Effect (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3006-3018.

We were the first to report that both the bound and leaky dominant modes can propagate simultaneously on conductor-backed coplanar strips over a frequency range. We have recently studied this interesting and initially unexpected effect in more detail, and we have made two important discoveries: First, the simultaneous-propagation effect can actually occur on most, if not all, printed-circuit transmission lines (its presence depending on the relative line dimensions), so that, contrary to earlier belief, the effect is rather general. Second, we have discovered the surprising presence of a new improper (or nonspectral) real solution, which is nonphysical but whose evolution as a function of dimensional change serves to explain how the simultaneous-propagation effect can occur. The new solution, and its behavior in a completely nonphysical region, thus governs otherwise-mysterious large changes in the physical, measurable solutions.

Abstracts

High-Power HTS Microstrip Filters for Wireless Communication (Dec. 1995, Part II [T-MTT])

G.-C. Liang, D. Zhang, C.-F. Shih, M.E. Johansson, R.S. Withers, D.E. Oates, A.C. Anderson, P. Polakos, P. Mankiewich, E. De Obaldia and R.E. Miller. "High-Power HTS Microstrip Filters for Wireless Communication (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3019-3028.

The performance of narrowband microstrip filters with low insertion loss and high power-handling capabilities made from YBa/sub 2/Cu/sub 3/O/sub 7-delta/ (YBCO) high-temperature superconducting (HTS) thin films is presented. Results are shown for two different designs that were chosen to optimize the power-handling capability. Both filters have a 2-GHz center frequency and 5 poles that incorporate coupled resonators with 10-Omega internal impedances. They were made on 5-cm-diameter LaAIO/sub 3/ substrates. Both designs use parallel-coupled feed lines to avoid current crowding. The first design includes backward- and forward-coupled filters, has 1% bandwidth, and has handled over 25 watts of input power at 10 K with less than 0.25 dB compression. The second design has 1.2% bandwidth and uses only forward-coupled resonators. The dissipation loss is less than 0.2 dB at 45 K and it has a third-order intercept of 62 dBm. Another similar filter handled 36 watts of power at 45 K with less than 0.15 dB compression across the passband. We have developed a technique to visualize the power dissipation of the filter by observing the bubbles created by the filter when submerged in liquid helium, showing areas with local defects or where the current distribution is at its peak valne. We also discuss several planar high-power filter issues, including material selection and fabrication, device configuration trade-offs, filter structure optimization, and design approaches to maximize power-handling capacity.

Abstracts

Narrowband Lumped-Element Microstrip Filters Using Capacitively-Loaded Inductors (Dec. 1995, Part II [T-MTT])

D. Zhang, G.-C. Liang, C.-F. Shih, M.E. Johansson and R.S. Withers. "Narrowband Lumped-Element Microstrip Filters Using Capacitively-Loaded Inductors (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3029-3035.

Coupling between microstrip resonators decreases very slowly as a function of the resonator separation. Therefore, it is difficult to realize narrowband filters (e.g. <0.1% fractional bandwidth) in reasonably sized microstrip form due to the very weak coupling values required. In this paper, we report a class of lumped-element filters that uses capacitively-loaded inductors to give frequency-dependent inductance values. A novel frequency-transformation technique is used in the design process. Using this approach, filter bandwidth is determined by the inductance slope of frequency-dependent inductors, dL over d omega. Large coupling capacitance, thus small coupling element separations, can still be used in narrowband microstrip filters to keep the filter layout compact. We present a 5-pole, 0.27% bandwidth YBa/sub 2/ Cu/sub 3/O/sub 7/ high-temperature superconducting thin film microstrip prototype filter at 900 MHz, which has 1.2 dB insertion loss and 20 dB return loss. It was designed with the coupling capacitors of a 1% bandwidth filter, and then transformed to a 0.27% fractional bandwidth using an appropriate inductance slope parameter, dL over d omega. Measurement showed good agreement with theory.

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Abstracts

Internal-Node Waveform Analysis of MMIC Power Amplifiers

C.-J. Wei, Y.A. Tkachenko, J.C.M. Hwang, K.R. Smith and A.H. Peake. "Internal-Node Waveform Analysis of MMIC Power Amplifiers." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3036-3041.

A novel internal-node waveform probing technique has been demonstrated on a C-band monolithic microwave integrated circuit (MMIC) power amplifier. The error of the measurement and its perturbance to circuit operation was estimated and verified to be within ±10%. Valuable insight was obtained from the variation of waveforms as a function of frequency, drive and location. The potential impact of this technique includes MMIC design verification, in-situ device model extraction, process diagnosis, and reliability assessment.

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Abstracts

Low Power HFET Down Converter MMIC's for Wireless Communication Applications

V. Nair, S. Tehrani, R.L. Vaitkus and D.G. Scheitlin. "Low Power HFET Down Converter MMIC's for Wireless Communication Applications." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3042-3046.

An ultra low power GaAs HFET (heterojunction FET) amplifier/mixer MMIC was designed and characterized for portable communication applications in the 900 MHz band. A completely monolithic LNA (80 mil x 42 mil) achieved 10 dB gain, 2.5 dB NF and -4 dBm input IP3 at an operating cur-rent of 0.5 mA @ 1.0 V. Receiver sensitivity of a front-end circuit consisting of the LNA and a dual gate FET mixer was characterized using the 12 dB SINAD method. The IC achieved -117 dBm receiver sensitivity in the 900 MHz cellular band. The total power consumption of this miniature down converter was about 2 mW. The HFET down converter IC achieved the same receiver sensitivity as a MESFET down converter at 1/5th of the power. The extremely low power dissipation, high third order intercept point, high level of integration, and very good RF performance of this monolithic IC make it an ideal candidate for wireless applications.

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Reliability of InP-Based HBT IC Technology for High-Speed, Low-Power Applications (Dec. 1995, Part II [T-MTT])

M. Hafizi, W.E. Stanchina, F. Williams, Jr. and J.F. Jensen. "Reliability of InP-Based HBT IC Technology for High-Speed, Low-Power Applications (Dec. 1995, Part II [T-MTT])." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3047-3053.

We report on the reliability of an InP-based AIInAs/ GaInAs heterojunction bipolar transistor technology which has applications in very high-speed and low power integrated circuits. We have performed extensive accelerated lifetest experiments under different dc bias conditions and different ambient temperatures. For high-performance devices we predict mean-time-to-failures in excess of 10/sup 7/ hours at 125° C junction temperatures. We have also investigated the effects of hydrogen on HBT device characteristics which is particularly important for integrated circuits in hermetically sealed packages, We show that the transistor performance is not sensitive to a 4% hydrogen ambient. For integrated circuits requiring precision thin-film resistors we performed lifetest experiments on tantalum-nitride resistors used in our IC process. We show that these thin-film resistors are very stable and exhibit mean-time-to-failures exceeding that of discrete transistors.

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Abstracts

Ultra-Low dc Power GaAs HBT S- and C-Band Low Noise Amplifiers for Portable Wireless Applications

K.W. Kobayashi, A.K. Oki, L.T. Tran and D.C. Streit. "Ultra-Low dc Power GaAs HBT S- and C-Band Low Noise Amplifiers for Portable Wireless Applications." 1995 Transactions on Microwave Theory and Techniques 43.12 (Dec. 1995, Part II [T-MTT] (1995 Symposium Issue)): 3054-3060.

We report on a 2.1 mW low dc power GaAs HBT LNA with 2.0 dB noise figure and 8.9 dB gain at 2 GHz. This amplifier achieves a Gain/NF · P/sub pc/ ratio figure of merit of 2.10 (1/mW) which is the highest reported at S-band. Under low dc power bias of 2 V and 0.46 mA (0.92 mW), the amplifier achieves 5.2 dB gain, 3.01 dB noise figure and a Gain/P/sub dc/ figure of merit of 5.65 (dB/mW) which is also the highest reported in this frequency band. In addition, a 2-stage self-biased C-band LNA which achieves a minimum noise figure of 2.4 dB at 5 GHz, 16.2 dB gain, with only 72 mW of dc power was also demonstrated. This is believed to be the lowest noise figure performance so far reported for an HBT amplifier above 3 GHz. Both HBT LNA's are fabricated using a relaxed 3 µm emitter width low cost GaAs production foundry process. The high performance obtained from HBT's at very low dc bias makes them attractive for portable wireless applications in the Industrial-Scientific-Medical (ISM) frequency bands.

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Abstracts

Message from the General Chairman (1995 Vol. I [MWSYM])

E. Strid. "Message from the General Chairman (1995 Vol. I [MWSYM])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): iii-iii.

Welcome to the 1995 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium (MMWMC). This symposium kicks off Microwave Week with the latest news on IC'S for wireless, satellite, military, automotive, optical communication, and other applications. The technical program is complemented by social activities to relax, meet old friends, and have informal discussions.

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MMWMC Technical Program Committee (1995 Vol. I [MWSYM])

"MMWMC Technical Program Committee (1995 Vol. I [MWSYM])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): iv-iv.

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Message from the Technical Program Chairman (1995 [MCS])

M. Kumar. "Message from the Technical Program Chairman (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): v-v.

On behalf of the Technical Program Committee, welcome to Orlando and the 1995 IEEE Microwave and Millimeter-Wave Monolithic Circuits (MMWMC) Symposium.

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MMWMC Steering Committee (1995 [MCS])

"MMWMC Steering Committee (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): vi-vii.

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Session I -- Challenges Microwave for RF and Microwave Monolithics

"Session I -- Challenges Microwave for RF and Microwave Monolithics." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 1-1.

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Intelligent Transportation Systems

W.G. Fink. "Intelligent Transportation Systems." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 3-3.

Intelligent Transportation Systems (ITS) represent an expanding international market, "Intelligent" is synonymous with the application of technology to the movement of goods and people. The market is maturing--we are in the early phases of ITS deployment. The current market emphasizes infrastructure -- traffic management systems for congestion reduction, interrnodal systems for the efficient movement of goods, and a rapidly expanding traveler information systems market.

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GaAs MMIC Technology: Past, Present and Future

R.W. Bierig. "GaAs MMIC Technology: Past, Present and Future." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 5-5.

MMIC technology has been an extremely active area of research and development for about 20 years. During the most recent six or so years, FIMIC technology has matured to a level wherein literally hundreds of production parts are available from more than 30 vendor companies, worldwide. For most of this period, the dominant "market" for MMIC based products has been military end use. It has been recognized for a number of years that military markets alone will not provide sales opportunities sufficient to support the full body of MMIC vendor companies. Commercial markets for GaAs based products have been, and remain, the "hope for our future". This presentation will examine some of the decisions that dictated technological choices which underlie current MMIC design and production capability. A brief history of MMIC sales will be provided. Important aspects of GaAs MMIC materials history, progress in fabrication technology, the status, past and present, of design capability and demonstrated MMIC performance trends will be discussed. The presentation concludes with some brief personal speculations on what the future might be for our industry.

Abstracts

Low-Cost High-Volume RF Products: Dream, Anticipation, or Reality?

A.M. Pavio. "Low-Cost High-Volume RF Products: Dream, Anticipation, or Reality?." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 7-10.

The analysis of several important high-volume RF product markets, such as the TVRO business, the more mature cable TV industry, and the cellular communications industry will be the focus of this work. A look at the volumes and costs of these products, as well as the RF modules comprising them, will help illustrate market demands. The role of various integrated technologies in these and future products, such as wireless cable, direct digital TV and, set-top converters will also be discussed. In addition, detailed cost discussions will focus on the "trade-offs" between hybrid and monolithic circuits, and Si versus GaAs technology. The remainder of the analysis will concentrate on the aspects of designing for low cost production and the prediction of future trends.

Abstracts

Lightwave Communication ICs Beyond 10 Gb/s - Design and Measurement Challenges

T. Otsuji, Y. Imai and E. Sano. "Lightwave Communication ICs Beyond 10 Gb/s - Design and Measurement Challenges." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 11-14.

Recently emerging lightwave communications technologies have resulted from the remarkable progress in electronic and photonic device technologies as well as in fiber-optic technology and coherent-transmission technology. This paper discusses the state-of-the-art design and measurement technologies for high-speed lightwave communication ICs.

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Session II -- MMIC Power Amplifiers

"Session II -- MMIC Power Amplifiers." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 15-15.

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5 Watt High Efficiency Wideband 7 to 11 GHz HBT MMIC Power Amplifier

J.J. Komiak and L.W. Yang. "5 Watt High Efficiency Wideband 7 to 11 GHz HBT MMIC Power Amplifier." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 17-20.

A fully monolithic HBT power amplifier that has established new benchmarks for bandwidth and efficiency at X-band is reported. Power-added efficiencies of 56 % max/38 % min/44.4 % average across 7 to 11 GHz are the highest X-band efficiencies and widest bandwidth reported for MMIC HPA's. These amplifiers have demonstrated high power levels (up to 7.3 Watts) with high gain (11 to 14.1 dB) under thermally challenging long pulse (500 µsec) high duty cycle (25%) conditions. The amplifiers were fabricated using an advanced re-aligned AIGaAs/GaAs power HBT process with a plated bathtub heat sink.

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The IRIDIUM® K-Band MMIC Chip Set

B.T. Agar, Jr., D.S. Bowser, K.V. Buer, D.W. Corman and C.D. Grondahl. "The IRIDIUM® K-Band MMIC Chip Set." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 21-24.

A set of 16 K-band MMIC chips has been developed for the satellites in the IRIDIUM® communications program. Both high power and low noise 0.25 µm PHEMT technologies were used to develop this MMIC chip set. The MMICs consist of a broad band frequency doubler, up and down converters, high power amplifiers, variable gain amplifiers, low noise amplifiers, and an IF amplifier. A noise figure of less than 3.3 dB at 29 GHz and output power of over 4 watts at 23.3 GHz were achieved with no RF tuning. This paper describes statistical device characterization, design details, measured results, and integration of these MMIC chips into a high density multi-chip module (MCM). downlink frequency of 19.5 GHz. The satellite to satellite link was designed to transmit and receive at a frequency of 23.3 GHz. Each link had an IF frequency of 750 MHz. Two LNA MMICS were designed with greater than 12 dB of gain to establish the front-end noise figure of less than 3.4 dB at 23.3 GHz and 29.2 GHz. The 23.3 GHz LNA includes an input blanking switch to protect the LNA from high power reflections off the antenna during transmit mode.

Abstracts

W-Band 0.3W PHEMT MMIC Power Amplifier Module

S. Weinreb, E. Fischer, B. Kane, N. Byer and M. Zimmerman. "W-Band 0.3W PHEMT MMIC Power Amplifier Module." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 25-28.

A compact (1.8 by 3.0 by 3.8cm) WR-10 waveguide amplifier module providing 310-mW power output, 20-dB gain, and 5 GHz of 1-dB bandwidth at a center frequency of 96 GHz is described. The module is comprised of 22 identical pHEMT chips, 4-way microstrip power combiners and dividers, and a 4-way waveguide power combiner.

Abstracts

Session III -- Transceiver Technology

"Session III -- Transceiver Technology." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 29-29.

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GaAs Monolithic Single-Chip Transceiver

A. Boveda and F. Ortigoso. "GaAs Monolithic Single-Chip Transceiver." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 31-34.

A single-chip transmite/receiver MMIC operating from 1.25 to 3 Ghz and incorporating most of the RF functions of a modern communication system is presented. The device incorporates: a direct vector modulator with the neccesary phase shifter circuits, an output amplifier for the transmitter, a low-noise amplifier and a down-converter with image rejection. The circuit has 60 MESFET and more than 250 passive components in a 5.0 x 2.4 mm chip and has been manufactured using 0.5 micron GaAs MESFET process.

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Low Cost Miniaturized EHF SATCOM Transceiver Featuring HEMT MMICs and LTCC Multilayer Packaging

J.A. Lester, M. Ahmadi, S. Peratoner, J. Hathaway, D. Garske and P.D. Chow. "Low Cost Miniaturized EHF SATCOM Transceiver Featuring HEMT MMICs and LTCC Multilayer Packaging." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 35-38.

Presented is a 20 GHz downconverter and a 44 GHz upconverter for a low cost miniaturized transceiver for EHF SATCOM terminal applications. The hardware features a set of passivated pseudomorphic lnGaAs HEMT MMICs including a 20 GHz balanced low noise amplifier and a 44 GHz 100 mW driver amplifier. The upconverter input and the LO input of the downconverter feature built-in-test (BIT) with on-chip detectors. The downconverter is packaged in a low temperature co-fired ceramic (LTCC) substrate, with integrated RF and DC interconnects, printed resistors, and a buried stripline IF filter.

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A Novel Monolithic HEMT Harmonic Mixer at Q-Band

R. Katz, S. Maas, A. Sharma and D. Smith. "A Novel Monolithic HEMT Harmonic Mixer at Q-Band." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 39-42.

A novel Q-band monolithic harmonic mixer has been designed and fabricated using the 0.15 µm pseudomorphic lnGaAs/GaAs HEMT process for the first time. This high performance mixer is capable of downconverting a Q-Band RF signal with the 12th, 14th or 16th harmonic of a S-band LO signal to produce a signal suitable for a phase lock loop. This compact mixer consists of antiparallel HEMT Schottky diodes with a lumped element IF and LO diplexer and a RF band-pass filter. Measured data shows agreement between simulations and measurements. Total chip Size is 1.0 mm x 2.5 mm.

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Session IV -- Millimeter-Wave ICs

"Session IV -- Millimeter-Wave ICs." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 43-43.

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A High Performance Transceiver Chipset for Millimeter-Wave Commercial Digital Communication Systems

A.K. Sharma, D.M. Smith, M.V. Aust, R.H. Katz, J. Yonaki, R.B. Womack and M.D. Biedenbender. "A High Performance Transceiver Chipset for Millimeter-Wave Commercial Digital Communication Systems." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 45-48.

A high performance Q-band monolithic HEMT transceiver chipset has been developed for millimeter-wave commercial digital radio systems. This highly compact transceiver chipset consists of low noise amplifier, power amplifier with detector, voltage controlled oscillator with buffer amplifier, mixer and harmonic mixer. The chipset has demonstrated high yield making it suitable for high volume commercial applications.

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Millimetre Wave Phase Locked Oscillator for Mobile Communication Systems

I. Telliez, M. Camiade, P. Savary and P. Bourne-Yaonaba. "Millimetre Wave Phase Locked Oscillator for Mobile Communication Systems." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 49-52.

A 56.8GHz phase locked oscillator has been developed for broadband pico-cell networks in the 62 to 63 and 65 to 66 GHz bands. A set of millimetre wave MMICS has been produced using a 0.25µm HEMT low noise process. A 10 MHz reference is used to stabilise the loop with the help of a low frequency synthesiser at 200 MHz and a sampler at 14.2 GHz. Within the temperature range 0 to 50°C, the output signals delivered at 56.8 GHz are higher than the specified 6.5 dBm + 1.5 dB. The phase noise is better than -100 dBc/Hz at 1 MHz from carrier and lower than -70 dBc/Hz at 10 kHz from carrier. A 9 mm² multifunction chip incorporating three basic functions at 56.8 GHz has been implemented. This approach avoids critical connections and demonstrates the capability and maturity of our monolithic technology.

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Ka-Band MMIC-Based Transceiver for Battlefield Combat Identification System

G. Nesbit, T. Dere, D. English, V. Purdy and B. Parrish. "Ka-Band MMIC-Based Transceiver for Battlefield Combat Identification System." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 53-57.

This paper describes how the MMIC technology is utilized to meet the U.S. Army's need for near term solution in minimizing fratricide in the future engagement. One of the key assembly in the Battlefield Combat Identification System (BCIS) equipment set is the Ka-band MMIC transceiver unit. The MMIC transceiver is used to transmit and receive spread spectrum signal at 38 GHz. The design, integration and test of 13 GaAs MMIC chips in a single hermetically sealed housing (2.5 x 2.3 x 0.4 inches) is presented.

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High-Sensitivity W-Band MMIC Radiometer Modules

B. Kane, S. Weinreb, E. Fischer and N. Byer. "High-Sensitivity W-Band MMIC Radiometer Modules." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 59-62.

Multichip monolithic-integrated circuit modules that provide low-noise amplification, bandpass filtering, square-law detection, and DC amplification of a broadband millimeter-wave signal are described. The module is compact (4.50 cm^3) and lightweight (37 g), has low power consumption (80 - 130 mW), and is well-suited for use in focal-plane arrays to provide passive imaging of millimeter-wave thermal radiation. The theoretical gain requirement, radiometer construction, and measured results are reported.

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A Fully Passivated Ultra Low Noise W-Band Monolithic InGaAs/lnAlAs/lnP HEMT Amplifier

G.I. Ng, R. Lai, Y. Hwang, H. Wang, D.C.W. Lo, T. Block, K. Tan, D.C. Streit, R.M. Dia, A. Freudenthal, P.D. Chow and J. Berenz. "A Fully Passivated Ultra Low Noise W-Band Monolithic InGaAs/lnAlAs/lnP HEMT Amplifier." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 63-66.

A W-band 3-stage monolithic low noise amplifier has been developed based on lnGaAs/lnAlAs/lnP HEMT MMIC technology. Both wafer passivation and stabilization bakes have been introduced for the first time to the MMIC process to make it more suitable for production. A minimum noise figure of 3.3 dB and 20 dB associated gain has been achieved at 94 GHz and represents the best reported performance to date for any passivated multi-stage MMIC LNA's operating at W-band.

Abstracts

Session V -- Wireless Applications

"Session V -- Wireless Applications." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 67-67.

Abstracts

Production DC Screening for RF Performance of a 900 MHz Monolithic Low Noise Amplifier

S.-G. Lee and R.D. Schultz. "Production DC Screening for RF Performance of a 900 MHz Monolithic Low Noise Amplifier." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 69-72.

Novel approaches for production DC screening of a 900 MHz monolithic silicon bipolar low noise amplifier for noise figure and power gain are presented. The proposed techniques can be used in screening the performance of any RFIC by setting limits on the AC performance of the active devices used.

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Ultra-Low dc Power GaAs HBT S-Band Low Noise Amplifiers

K.W. Kobayashi, A.K. Oki, L.T. Tran and D.C. Streit. "Ultra-Low dc Power GaAs HBT S-Band Low Noise Amplifiers." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 73-76.

We report on a 2.1 mW low dc power GaAs HBT LNA with 2.0 dB noise figure and 8.9 dB gain at 2 GHz. This amplifier achieves a Gain/N F·P/sub dc/ ratio figure of merit of 2.10 (1/mW) which is the highest reported at S-band. Under low dc power bias of 2V and 0.46 mA (0.92 mW), the amplifier achieves 5.2 dB gain, 3.01 dB noise figure and a Gain/P/sub dc/ figure of merit of 5.65 (dB/mW) which is also the highest reported in this frequency band. The HBT LNA consumes an area of 1.05x0.82 mm² and is fabricated using a relaxed 3 µm emitter width low cost GaAs production foundry process. The high performance obtained from HBTs at very low dc bias makes them attractive for portable wireless consumer applications.

Abstracts

A GaAs Single Balanced Mixer MMIC with Built-In Active Balun for Personal Communication Systems

H. Koizumi, S. Nagata, K. Tateoka, K. Kanazawa and D. Ueda. "A GaAs Single Balanced Mixer MMIC with Built-In Active Balun for Personal Communication Systems." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 77-80.

A GaAs single balanced mixer IC with built-in active baluns for IF and LO inputs has been developed. The present mixer achieved the conversion gain of 16dB and the LO signal suppression over 30dBc at the LO input power of OdBm. Owing to a novel BST (Barium Strontium Titanate) capacitor technology, the implemented mixer IC was packaged in the small 6pin outline with the extremely small chip size of 0.6 x 0.65mm². The IC can eliminate the LO filter of the up-conversion system for a variety of handyphone-sets in L-band.

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Ultra Low Power HFET Down Converter for Wireless Communication Applications

V. Nair, S. Tehrani, R. Vaitkus and D. Scheitlin. "Ultra Low Power HFET Down Converter for Wireless Communication Applications." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 81-84.

An ultra low power GaAs HFET (heterojunction FET) amplifier/mixer MMIC was designed and characterized for portable communication applications in the 900 MHz band. A completely monolithic LNA (80 mil X 42 mil) achieved 10 dB gain, 2.5 dB NF and -4 dBm input IP3 at an operating current of 0.5mA @ 1.0 V. A down converter, consisting of the LNA and a dual gate FET mixer achieved -117 dBm receiver sensitivity in the 900 MHz cellular band. The total power consumption of this miniature down converter was about 2 mW. The HFET down converter IC achieved the same receiver sensitivity as a MESFET down converter at l/5th of the power. The extremely low power dissipation, high third order intercept point, high level of integration, and very good RF performance of this monolithic IC make it an ideal candidate for wireless applications.

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A Highly Miniaturized Receiver Front-End Hybrid IC Using On-Chip High-Dielectric Constant Capacitors for Mobile Communication Equipment

T. Nakatsuka, J. Itoh, S. Yamamoto, T. Yoshida, M. Nishitsuji, T. Uda, K. Nishii and O. Ishikawa. "A Highly Miniaturized Receiver Front-End Hybrid IC Using On-Chip High-Dielectric Constant Capacitors for Mobile Communication Equipment." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 85-88.

A highly miniaturized and low power consumption receiver front-end hybrid IC(HIC) including input matching circuits for 880MHz bands using on-chip high-dielectric constant (epsilon/sub r/) capacitors has been newly developed. The HIC is composed of a GaAs IC chip and a ceramic substrate with spiral inductors on its surface. The HIC showed conversion gain of 20.2dB and noise figure of 4.2dB at supply voltage of 2.7V and dissipation current of 3.7mA. The HIC measures only 5.0mm x 5.0mm x 1.0mm.

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Session VI -- Signal Control and Processing Circuits

"Session VI -- Signal Control and Processing Circuits." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 89-89.

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C-Band Analog Monolithic Vector Modulator

G. Burnsed, D. Kalcik and J. Sherman. "C-Band Analog Monolithic Vector Modulator." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 91-94.

A novel circuit structure for a MMIC C-Band analog vector modulator is described. It provides full 360 degree phase coverage with 50 dB amplitude range over an octave band. The MMIC die size is 70 x 70 mil.

Abstracts

CFET - A New High Quality MMIC Control Device

D.J. Seymour, R.P. Coats, R.E. Lehmann and J. Helvey. "CFET - A New High Quality MMIC Control Device." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 95-96.

A new gallium arsenide (GaAs) device developed for use in microwave monolithic control circuitry has been demonstrated. Known as a CFET, for Control Field Effect Transistor, this device eliminates the need for a conventionrd submicron gate by achieving control by use of a gate located behind the source-drain channel. The resulting capacitance is smaller than a conventional MESFET, resulting in a figure of merit of 800 GHz as compared to 250 GHz for a conventional MESFET. The device capabilities are demonstrated by measured performance of a SPDT switch providing 0.35-dB insertion loss and 20-dB isolation over the dc - 10.0-GHz frequency band.

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X-Band MMIC Switch with 70 dB Isolation and 0.5 dB Insertion Loss

D.A. Blackwell, D.E. Dawson and D.C. Buck. "X-Band MMIC Switch with 70 dB Isolation and 0.5 dB Insertion Loss." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 97-100.

A single-pole, single-throw reflective MMIC switch with 0.5 dB insertion loss and 70 dB isolation over X-band has been demonstrated. A fabrication process that was optimized to achieve the best performance for switch FETs produced this exceptional device. The FET OFF capacitance was reduced by a factor of 1.6 by selectively recessing into the backside of the wafer underneath the FETs to within 1 µm of the top surface. The FET ON resistance remained the same. The reduced FET OFF capacitance allowed the use of larger periphery FETs to obtain the improved performance. The Ron-Coff product of this device is 30% lower than previously reported results.

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Monolithic VCO and Mixer for Q-Band Transceiver Using InP-Based HBT Process

L. Tran, J. Cowles, T. Block, H. Wang, J. Yonaki, D. Lo, S. Dow, B. Allen, D. Streit, A. Oki and S. Loughran. "Monolithic VCO and Mixer for Q-Band Transceiver Using InP-Based HBT Process." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 101-104.

Monolithic VCOs and mixers have been developed for Q-band FMCW transceiver applications using an InP-based HBT process. Tuning range, output power, and phase noise have been characterized for the HBT VCOs, while conversion loss and noise figure were measured for the Schottky diode mixers. The VCO shows 10-dB better phase noise performance over a similar design based on a GaAs HBT process. Measured at very low IF, the InP-based Schottky diode mixer demonstrates more than 1 dB noise figure improvement over the same design based on GaAs Schottky process. The InP mixer also requires a very low LO power at only 1 dBm for a 8dB conversion loss.

Abstracts

Microwave Tunable Active Filter Design in MMIC Technology Using Recursive Concepts

M. Delmond, L. Billonnet, B. Jarry and P. Guillon. "Microwave Tunable Active Filter Design in MMIC Technology Using Recursive Concepts." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 105-108.

In this article, two active filters in the X-band, using low frequency transversal and recursive principles are presented. Previously implemented in hybrid technology, those two structures are developed here using MMIC technology. In a first step, studies of the different functional blocks leading to the design of such original structures are described. Then we validate our approach with the measured results for these two filters.

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Session VII -- Reliability and Diagnostics

"Session VII -- Reliability and Diagnostics." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 109-109.

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Reliability of InP-Based HBT IC Technology for High-Speed, Low-Power Applications (1995 [MCS])

M. Hafizi, W.E. Stanchina, F. Williams, Jr. and J.F. Jensen. "Reliability of InP-Based HBT IC Technology for High-Speed, Low-Power Applications (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 111-114.

We report on the reliability of an InP-based heterojunction bipolar transistor IC technology for very high-speed and low power applications. We have performed extensive accelerated lifetest experiments under bias and temperature stress and found mean-time-to failures (MTTF) in excess of 10/sup 7/ hours at 125 °C junction temperatures. We have also exposed our devices to a hydrogen ambient, particularly important for integrated circuits in hermetically sealed packages. We did not observe any difference in the characteristics of devices with or without exposure to hydrogen ambient. In addition we have performed extensive lifetest experiments on tantalum-nitride (TaN) thin-film resistors (TFR) used in our IC process. Our TFR reliability performance exceeded the active device reliability, as required in a reliable IC process.

Abstracts

Hot-Electron-Induced Degradation of Pseudomorphic High-Electron Mobility Transistors

Y.A. Tkachenko, C.J. Wei, J.C.M. Hwang, T.D. Harris, R.D. Grober, D.M. Hwang, L. Aucoin and S. Shanfield. "Hot-Electron-Induced Degradation of Pseudomorphic High-Electron Mobility Transistors." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 115-118.

Pseudomorphic high-electron mobility transistors have been found to undergo hot-electron-induced degradation. Due to the negative temperature dependence of hot-electron effects, it will be necessary to conduct electrical and temperature stress tests separately, in order to ascertain the reliability of these transistors under normal operating conditions.

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Hydrogen Degradation of GaAs MMICs and Hydrogen Evolution in the Hermetic Package

Y. Saito, R. Griese, J. Kessler, R. Kono and J. Fang. "Hydrogen Degradation of GaAs MMICs and Hydrogen Evolution in the Hermetic Package." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 119-122.

An investigation of hydrogen degradation of GaAs MMICS (MESFET, PHEMT and HBT) was conducted to determine the threshold hydrogen concentration for spacecraft application. The maximum hydrogen in the hermetic package is found to be 0.6 torr (based on 10 year mission at ambient temperature of 125°C). Hydrogen evolution in hermetic package is also studied to determine the source of hydrogen and to minimize its level in the package. Both studies demonstrate the high reliability of hermetic A40 (Al/Si) and Kovar (Fe/Ni/Co) packages for spacecraft applications.

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Coplanar Waveguide Based, Dielectric Coated Flip Chip Monolithic Microwave Integrated Circuit, a Paradigm Shift in MMIC Technology

C.P. Wen, W.D. Wong, C.K. Pao, J.L. Snopkowski and D.L. Ingram. "Coplanar Waveguide Based, Dielectric Coated Flip Chip Monolithic Microwave Integrated Circuit, a Paradigm Shift in MMIC Technology." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 123-126.

The status of a coplanar waveguide based, novel dielectric coated, mechanically rugged, flip-chip, monolithic microwave integrated circuit (MMIC) technology will be described. This technology is ideal for low-cost, multi-chip transmit/receive (T/R) module applications. Equivalent circuit and thermal models, and the fabrication procedure of flip-chip MMICs featuring T-shaped plated silver thermal bumps will be presented along with test results obtained on components designed using these circuit element models. * The work is partially supported by a cooperative grant from the Advanced Technology Program (ATP) Office of the National Institute of Standards and Technology (NIST).

Abstracts

Internal-Node Waveform Probing of MMIC Power Amplifiers

C.J. Wei, Y.A. Tkachenko, J.C.M. Hwang, K.E. Smith and A.H. Peake. "Internal-Node Waveform Probing of MMIC Power Amplifiers." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 127-130.

A novel internal-node waveform probing technique has been demonstrated on a MMIC. The error of the measurement and its perturbance to circuit operation was estimated and verified to be less than 20%. Valuable insight was obtained from the variation of waveforms as a function of frequency, drive and location.

Abstracts

Session VIII -- Systems Applications

"Session VIII -- Systems Applications." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 131-131.

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A Family of Low Cost High Performance HEMT MMICs for Commercial DBS Applications (1995 [MCS])

K. Hubbard, K. MacGowan, C. Kau, D. Smith and S. Maas. "A Family of Low Cost High Performance HEMT MMICs for Commercial DBS Applications (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 133-136.

A family of GaAs HEMT MMICS have been developed for use in Direct Broadcast Satellite TV (DBS) US, Japanese, and European markets. These designs are very compact, high performance, and self-biased. They are meant as building blocks for low noise block (LNB) downconverters. Described in this paper are the receiver chip, low noise amplifier, and self-biased single HEMT device (should a MIC LNA be preferred), The key design is the receiver chip with a nominal gain of 38 dB and NF of less than 3 dB for the US band. This paper presents a description of each design, a performance summary, as well as information describing their actual use in an LNB design.

Abstracts

K-Band T/R-Converter Modules for the IRIDIUM® Satellite Program (1995 [MCS])

D.W. Corman, B.T. Agar, K.V. Buer and D.L. Cook. "K-Band T/R-Converter Modules for the IRIDIUM® Satellite Program (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 137-140.

The paper describes two K-band multi-chip modules developed for the satellites on the IRIDIUM® communication program. The modules employ a wide range of low noise and power 0.25 µm PHEMT MMICS to provide all K-band transmit/receive functions aboard the spacecraft. The modules include over 500 active and passive components including LNAs, power amplifiers, mixers, frequency doublers, and associated support circuitry. Descriptions are provided of the MMIC and module development programs, module producibility features, and the associated MMIC reliability test program. Also described is a novel K-band interface method which eliminates RF alignment.

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Performance of a 6 to 18 GHz Frequency Translator Utilizing GaAs MMIC 5-Bit Digital Phase Shifter (1995 [MCS])

S.R. Mazumder and C.M. Isham. "Performance of a 6 to 18 GHz Frequency Translator Utilizing GaAs MMIC 5-Bit Digital Phase Shifter (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 141-144.

More than 22 dB of carrier and spurious suppression over 6 to 18 GHz has been achieved for a translator employing MMIC phase shifter. Trade-off of maximum allowed amplitude and phase errors versus number of bits are analyzed. For spurious levels <-29.8 dBc, the amplitude and phase errors must be <±0.83 dB and <±5.65 degrees respectively.

Abstracts

A 1.9 GHz-Band Ultra Low Power Consumption Amplifier Chip Set for Personal Communications (1995 [MCS])

M. Muraguchi, M. Nakatsugawa, H. Hayashi and M. Aikawa. "A 1.9 GHz-Band Ultra Low Power Consumption Amplifier Chip Set for Personal Communications (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 145-148.

An ultra low power consumption amplifier chip set for the 1.9 GHz Japanese Personal Handy-phone System (PHS) is presented. The chip set includes a linear power amplifier, a driver amplifier, and an LO switch amplifier. These amplifiers use Cascode FETs that provide low phase distortion, high gain, and low current operation. The power amplifier uses a new concept of a self-phase distortion compensation to achieve a record performance of 45 % power added efficiency with sufficient linearity. The driver amplifier has a gain of 13.5 dB with a low power consumption of 3mW (1mA, 3V). The LO switch amplifier is a new MMIC that has both switch and buffer amplifier functions. The switch amplifier has an output power of 3 dBm, a forward gain of 15 dB, and a reverse isolation of 35 dB with a low power consumption of 6mW (2mA, 3V).

Abstracts

Miniature GPS Translator Module (1995 [MCS])

J. Smuk, P. Katzin, V. Aparin and M. Shifrin. "Miniature GPS Translator Module (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 149-152.

A GaAs MMIC gain/frequency conversion chip set and its integration into a module which frequency translates the C/A-coded L1 GPS signals to the 2200-2290 MHz telemetry band for use in tracking artillery projectiles is demonstrated. The custom downconverter, upconverter and power amplifier MMICs which form the transmission chain as well as the 36 cm^3 module which provides over 125dB of gain with 3dB noise figure, survives firing shock of over 8,000G and operates from 0°C to 70°C are detailed.

Abstracts

Session IX -- Mixers and Related Components

"Session IX -- Mixers and Related Components." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 153-153.

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A Monolithic Broadband Doubly Balanced EHF HBT Star Mixer with Novel Microstrip Baluns (1995 [MCS])

Y.I. Ryu, K.W. Kobayashi and A.K. Oki. "A Monolithic Broadband Doubly Balanced EHF HBT Star Mixer with Novel Microstrip Baluns (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 155-158.

This paper describes a planar MMIC HBT Schottky diode mixer utilizing novel baluns fabricated on a 4 mil thick GaAs substrate. The balun is based on the Marchand balun structure and is implemented in a microstrip environment. The balun structure consists of 7 closely coupled microstrip lines and backside vias. Four 10x lO μm² HBT Schottky diodes in a star configuration provide the mixing function. The HBT diodes have cut-off frequencies in excess of 750 GHz. The mixer achieves 8- 10 dB conversion loss and very low spurious responses over a 26-40 GHz RF and LO bandwidth and DC - 11 GHz IF. This IF bandwidth is broader than a previously demonstrated CPW star mixer using InGaAs HEMT technology, and easier to integrate into an assembly due to its microstrip implementation.

Abstracts

A PMHFET Based MMIC Gate Mixer for Ka-Band Applications (1995 [MCS])

M. Matthes, J.-M. Dieudonne, W. Stiebler and L. Klapproth. "A PMHFET Based MMIC Gate Mixer for Ka-Band Applications (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 159-162.

A multipurpose MMIC gate mixer has been designed, fabricated and measured. The mixer exhibits a maximum conversion gain of about 0 dB in the frequency range of 32 GHz - 38 GHz with an intermediate frequency (IF) of 100 MHz and an IF load of 50 Omega. With an external IF matching network a conversion gain up to 5 dB can be achieved. The mixer which consists of one pseudomorphic HFET represents state of the art performance.

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A K-Band Monolithic CPW Upconverter Utilizing a Source Mixing Concept (1995 [MCS])

M. Madihian, L. Desclos, K. Maruhashi, K. Onda and M. Kuzuhara. "A K-Band Monolithic CPW Upconverter Utilizing a Source Mixing Concept (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 163-166.

This paper concerns with the design consideration and performance of a CPW upconverter MMIC for K-band wireless system applications. The upconverter consists of an FET as a "3-port" mixing element, IF, LO, and RF matching networks, and an output filter. Including a 3dB pass-band insertion loss of the filter, the upconverter exhibits a maximum conversion gain of -6dB with a port-to-port isolation better than 20dB.

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Monolithic Mixers with MESFETs Technology to Up and Down Convert Between C and V Band (1995 [MCS])

J.P. Torres, F. Fortes, M.J. Rosario, J.M. Dieudonne and J.C. Freire. "Monolithic Mixers with MESFETs Technology to Up and Down Convert Between C and V Band (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 167-170.

In this paper the design of singly balanced mixers to convert C to V band signals are presented. A step by step design technique is described, based on harmonic balance simulations. The mixer devices are Schotky diodes compatible with a GaAs MESFET technology. The mixer was optimised for minimum conversion losses on the widest possible bandwidth when used as an up or downconverter in order to be used on a large number of applications. The experiments show a minimum conversion losses on the range of 6 to 8dB for both applications (up and downconverter) and a 3dB bandwidth larger then 6GHz.

Abstracts

MMIC Active Bandpass Filter Using Negative Resistance Elements (1995 [MCS])

U. Karacaoglu and I.D. Robertson. "MMIC Active Bandpass Filter Using Negative Resistance Elements (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 171-174.

This paper describes a monolithic bandpass filter using lumped L-C resonators with single transistor negative resistance elements. The measured response of the filter exhibits a 400 MHz 3dB-bandwidth centered on 4.7 GHz, and has 0 dB insertion loss with only ±0.1dB ripple in the pass-band.

Abstracts

Capacitive-Division Traveling-Wave Amplifier with 340 GHz Gain-Bandwidth Product (1995 [MCS])

J. Pusl, B. Agarwal, R. Pullela, L.D. Nguyen, M.V. Le, M.J.W. Rodwell, L. Larson, J.F. Jensen, R.Y. Yu and M.G. Case. "Capacitive-Division Traveling-Wave Amplifier with 340 GHz Gain-Bandwidth Product (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 175-178.

We report capacitive-division traveling-wave amplifiers having measured rnidband gains of 8 dB with a 1-98 GHz 3-dB-bandwidth, and 11 dB gain with a 1-96 GHz bandwidth. The capacitive-division topology raises the input Q of each cell, giving the amplifier increased bandwidth over conventional designs with the same active device technology; using 0.15 µm gate length InGaAs/InAIAs HEMTs, bandwidths exceeding 150 GHz are feasible.

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Session X -- Monolithic Receiver Components

"Session X -- Monolithic Receiver Components." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 179-179.

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A Novel Baseband-1.5 GHz Monolithic HBT Variable Gain Amplifier with PIN Diode Gain Control (1995 [MCS])

K.W. Kobayashi, A.K. Oki, L. Tran and D.C. Streit. "A Novel Baseband-1.5 GHz Monolithic HBT Variable Gain Amplifier with PIN Diode Gain Control (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 181-184.

This paper reports on a GaAs HBT Variable Gain Amplifier (VGA) which monolithically integrates a GaAs PIN diode as a variable resistor to achieve wide gain control. The PIN diode is made from the intrinsic MBE layers of the HBT collector-base junction which consists of a 7000A thick i-region. The novel VGA topology employs active feedback and output buffering to obtain high IP3 performance and is the first PIN-HBT VGA reported of its kind. The VGA obtains 10 dB gain and over 25 dB of gain control range at 1 GHz. The output IP3 is 15.1 dBm and the noise figure is 9.3 dB at maximum gain. The corresponding input IP3 is +5.1 dBm and remains constant over gain control which is an attractive feature of the HBT-PIN VGA. The PIN diode VGA design is realized in a miniature 0.8x0.4 mm² area. Integrated with a previously developed HBT LNA, the resultant low noise VGA MMIC demonstrates 2.1 dB noise figure, >35 dB gain, +13.5 dBm OIP3, and over 25 dB of gain control at 1 GHz.

Abstracts

A 9-16 GHz Monolithic HEMT Low Noise Amplifier with Embedded Limiters (1995 [MCS])

P. Huang, W.L. Jones, A. Oki, D. Streit, W. Yamasaki, P. Liu, S. Bui and B. Nelson. "A 9-16 GHz Monolithic HEMT Low Noise Amplifier with Embedded Limiters (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 185-186.

A novel 9-16 GHz monolithic HEMT low noise amplifier with on-chip limiters has been designed, fabricated, and measured. This paper presents the design topology, the new fabrication technology, and the on-wafer measurements of this circuit. The limiter consists of one PIN diode and one Schottky diode. The low noise amplifier itself is a single stage balanced amplifier with one limiter embedded in each single-ended amplifier.

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A W-Band Monolithic Low Noise AlGaAs/InGaAs Pseudomorphic HEMT Amplifier Mounted on a Small Hermetically-Sealed Package with Waveguide Interface

Y. Itoh, M. Nakayama, K. Nakahara, T. Takagi, T. Sakura, N. Yoshida, T. Katoh, T. Kashiwa and Y. Ito. "A W-Band Monolithic Low Noise AlGaAs/InGaAs Pseudomorphic HEMT Amplifier Mounted on a Small Hermetically-Sealed Package with Waveguide Interface." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 187-190.

A W-band monolithic low noise AlGaAs/InGaAs/ GaAs pseudomorphic HEMT amplifier mounted on a small hermetically-sealed package has been developed for use in Advanced Microwave Scanning Radiometer. A six-stage amplifier cascading three two-stage MMIC amplifier chips is assembled on a small hermetically-sealed package with waveguide interface and has achieved a noise figure of 4.3 dB with a gain of 28.1 dB at 91 GHz. The overall amplifier measures 12 x 32.8 x 5.4 mm^3. This is the first W-band multi-stage monolithic low noise amplifier mounted on a hermetically-sealed package.

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A Monolithic Integrated HEMT Frontend in CPW Technology from 10-50 GHz for Measurement Systems or Broadband Receivers

R. Heilig, D. Hollmann and G. Baumann. "A Monolithic Integrated HEMT Frontend in CPW Technology from 10-50 GHz for Measurement Systems or Broadband Receivers." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 191-194.

In this paper the design, performance and fabrication of a broadband frontend is shown. The frontend consists of a broad-band matrix distributed amplifier with a gain of about 10 dB and a noise figure of 6.5 dB, a four stages distributed amplifier with 5 dB gain and an output power of 12 dBm, and a distributed mixer with a conversion gain of 0 dB with a LO-power of 0 dBm including the LO buffer amplifier. The active devices are 0.2 µm recessed gate AlGaAs-HEMTs and the coplanar waveguide is used as the propagation medium. The devices have been simulated by using own models for the active device and the passive coplanar elements. For the mixer design a nonlinear HEMT model was used. The total size of the frontend is 6 mm x 6 mm including bias networks and block capacitors.

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A 2-32 GHz Coplanar Waveguide InAlAs/lnGaAs-lnP HBT Cascode Distributed Amplifier

K.W. Kobayashi, J. Cowles, L. Tran, T. Block, A.K. Oki and D.C. Streit. "A 2-32 GHz Coplanar Waveguide InAlAs/lnGaAs-lnP HBT Cascode Distributed Amplifier." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 195-198.

A 2-32 GHz lnAIAs/lnGaAs-lnP HBT CPW distributed amplifier (DA) has been demonstrated which benchmarks the highest bandwidth reported for an HBT DA. The DA combines a 100 GHz f/sub max/ and 60 GHz f/sub max/ HBT technology with a cascode coplanar waveguide DA topology to achieve this record bandwidth. The cascode CPW DA demonstrates both design techniques and technology capability which can be applied to more complex circuit functions such as active baluns for mixers, active combiners/dividers, and low dc power-broadband amplification at millimeter-wave frequencies.

Abstracts

A Distributed Optical Receiver Preamplifier with Unequal Gate/Drain Impedances

I. Darwazeh, P. Moreira, A. Borjak and J. O'Reilly. "A Distributed Optical Receiver Preamplifier with Unequal Gate/Drain Impedances." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 199-202.

A near dc to 16.4 GHz wide band distributed amplifier, constructed using a 20 GHz MMIC GaAs process and optimised to operate as an optical receiver front end preamplifier, has been designed, realised and tested at 10 Gbit/s. The design uses a 75 Omega gate line impedance to maximise the overall transimpedance gain without introducing severe bandwidth restriction.

Abstracts

Session XI -- Open Forum (1995 [MCS])

"Session XI -- Open Forum (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 203-203.

Abstracts

Novel Architecture and MMICs for an Integrated Front End of a Spectrum Analyzer (1995 [MCS])

T. Takenaka, A. Miyazaki and H. Matsuura. "Novel Architecture and MMICs for an Integrated Front End of a Spectrum Analyzer (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 205-208.

This paper proposes a novel architecture and MMICs for an integrated front end of a 2-32 GHz spectrum analyzer. The architecture achieves miniaturization by eliminating the YIG tracking filter. The MMICs achieve ultra-wideband performances as well as chip-size reduction by utilizing novel FET cells for the basic circuit functions.

Abstracts

A New Technique for Obtaining High Isolations in Microwave Mixers Based on the Concepts of Distributed Mixing and Transversal Filtering (1995 [MCS])

A.H. Baree and I.D. Robertson. "A New Technique for Obtaining High Isolations in Microwave Mixers Based on the Concepts of Distributed Mixing and Transversal Filtering (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 209-212.

A new technique for obtaining high RF/LO to IF isolations in microwave mixers is reported. The technique is derived from the concepts of transversal filtering and distributed mixing. An MMIC prototype has been developed which measures only 1.4mm x 1.3mm. Over 30dB of RF/LO to IF isolations have been achieved at X-band and Ku-band.

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Broadband and Tunable Negative Monolithic Circuits for Microwave Active Filters Compensation (1995 [MCS])

A. Brucher, P. Meunier, C. Cenac, B. Jarry and P. Guillon. "Broadband and Tunable Negative Monolithic Circuits for Microwave Active Filters Compensation (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 213-216.

In this article, GaAs MMIC negative resistance chips are presented. These devices are used to improve the performances of planar microstrip resonators structures. The broadband capabilities of these negative resistance circuits are illustrated with their use to compensate for the losses of two 4-pole bandpass microstrip half wave filters designed with alumina substrate and centered respectively at 1.5 GHz and 4 GHz. Finally, experimental results of bandstop active filters built on lossy high permittivity dielectric substrate (epsilon/sub r/=36) and also compensated for with these monolithic circuits confirm their great interest.

Abstracts

Analysis and Design of Multi-Octave MMIC Active Baluns Using a Distributed Amplifier Gate Line Termination Technique (1995 [MCS])

A.H. Baree and I.D. Robertson. "Analysis and Design of Multi-Octave MMIC Active Baluns Using a Distributed Amplifier Gate Line Termination Technique (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 217-220.

The analysis and design of a multi-octave MMIC active balun is described in this paper. The technique employed uses the gate-line 'termination' of a distributed amplifier topology as a non-inverting output. Closed-form expressions for the two output signals have been derived. The MMIC prototype has achieved balun operation over 0.5 to 20 GHz with a 10° maximum phase error.

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MMIC SSB Frequency Translators with Image-Rejection for Satellite Transponder Applications (1995 [MCS])

A.H. Baree, I.D. Robertson and J.S. Bharj. "MMIC SSB Frequency Translators with Image-Rejection for Satellite Transponder Applications (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 221-224.

A highly integrated design for advanced monolithic single side-band frequency translators are presented in this paper. Two monolithic chips have been realised which exhibit between 18-45dB of upper side-band rejection over C, X, and Ku-band. The chips are designed for small band-to-band frequency translations (such as uplink to downlink) in satellite communications transponders. Since the chips exhibit a wide-band response, image-rejection is also obtained for both chips.

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A Single-Chip W-Band Transceiver with Front-End Switching Receiver for FMCW Radar Applications (1995 [MCS])

D.C.W. Lo, K.W. Chang, R. Lin, E.W. Lin, H. Wang, M. Biedenbender, G.S. Dow and B.R. Allen. "A Single-Chip W-Band Transceiver with Front-End Switching Receiver for FMCW Radar Applications (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 225-228.

We have demonstrated the first monolithic W-band transceiver with front-end switching receiver for FMCW radar application. The switching receiver utilizes a novel balanced switching low noise amplifier for switching function and has achieved a conversion gain of 5.4 dB and 10 dB isolation. By operating the MMIC as a heterodyne receiver, we achieved a noise figure at 1MHz IF of 8 dB which is lower than that of the previous reported single-chip W-band homodyne transceivers.

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New Types of MMIC Circulators (1995 [MCS])

D. Kother, B. Hopf, T. Sporkmann, I. Wolff and S. Kosslowski. "New Types of MMIC Circulators (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 229-232.

Circulators can be used to separate transmit/ receive (T/R) signals and for two-port tuners. Conventional ferrite devices are not applicable for MMICs. Two new types of electronical circulators are presented in this paper covering the frequency range from 1.8GHz up to 80GHz.

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Index of Authors (1995 [MCS])

"Index of Authors (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 233-234.

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"Floor Plan, Clarion Plaza Hotel (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): 235-235.

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"Back Cover (1995 [MCS])." 1995 Microwave and Millimeter-Wave Monolithic Circuits Symposium Digest 95.1 (1995 [MCS]): b1-b2.

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